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COLORADO-BIG THOMPSON PROJECT

SYNOPSIS OF REPORT

ON

COLORADO-BIG THOMPSON PROJECT, PLAN OF DEVELOPMENT AND COST ESTIMATE PREPARED BY THE BUREAU OF RECLAMATION, DEPARTMENT OF THE INTERIOR

PRESENTED BY MR. ADAMS

JUNE 15, 1937—Ordered to be printed without illustrations

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EXHIBIT 33

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LETTER OF TRANSMITTAL

FEBRUARY 3, 1937.

From Senior Engineer Porter J. Preston.
To Chief Engineer.
Subject: Colorado-Big Thompson project.

1. Transmitted herewith is a synopsis of the report of plan of development and cost estimate of the Colorado-Big Thompson project.

2. The plans and designs upon which the estimates are based are shown in the full report to follow this synopsis.

3. The detail estimates have been worked out in the Denver office under the following divisions:

Canals: H. R. McBirney.
Reservoirs: K. B. Keener.
Power: L. N. McClellan.
Hydraulics: E. B. Debler.

4. The field work was done under the supervision of M. E. Bunger.

5. The economic study was carried on by R. L. Parshall, senior irrigation engineer, Bureau of Agricultural Engineering, United States Department of Agriculture. This study is later proposed to be issued as a separate document.

PORTER J. PRESTON.

Revised synopsis of report submitted June 11, 1937.

LETTERS OF SUBMITTAL

Hon. HAROLD L. ICKES, JUNE 11, 1937.
Secretary of the Interior.

MY DEAR MR. SECRETARY: There is attached hereto the portion of the report on the Colorado-Big Thompson project in Colorado covering the principles and stipulations governing the construction and operation of said project for the protection of the rights and interests dependent on the Colorado River in Colorado.

The provisions contained therein have been considered by the Northern Colorado Water Users' Association, representing the irrigation and other interests on the eastern slope in Colorado, and we respectfully submit that they are satisfactory and meet the approval of said association.

We ask that acknowledgment be made of this communication.

Respectfully yours,

NORTHERN COLORADO WATER USERS' ASSOCIATION,
CHAS. HANSEN, *President.*
MOSES E. SMITH, *Vice President.*
THOMAS A. NIXON, *Attorney.*

Hon. HAROLD L. ICKES, JUNE 11, 1937.
Secretary of the Interior.

MY DEAR MR. SECRETARY: There is attached hereto the portion of the report on the Colorado-Big Thompson project in Colorado covering the principles and stipulations governing the construction and operation of said project for the protection of the rights and interests dependent on the Colorado River in Colorado.

The provisions contained therein have been considered by the Western Slope Protective Association, representing the irrigation and other interests on the western slope in Colorado, and we respectfully submit that they are satisfactory and meet the approval of said association.

We ask that acknowledgment be made of this communication.

Respectfully yours,

THE WESTERN SLOPE PROTECTIVE ASSOCIATION,
SILMON SMITH, *Secretary.*
CLIFFORD H. STONE, *Director.*
A. C. SUDAN,
Special Representative of Grand County.

SYNOPSIS OF REPORT, COLORADO-BIG THOMPSON PROJECT

OUTLINE OF CONSTRUCTION AND OPERATING CONDITIONS

The Colorado-Big Thompson project in Colorado contemplates the diversion of surplus waters from the headwaters of the Colorado River on the Pacific or western slope to lands in northeastern Colorado on the Atlantic or eastern slope greatly in need of supplemental irrigation water.

To accomplish this diversion, the following features are required:

ON COLORADO RIVER

(1) Storage on the Blue River in what is called Green Mountain Reservoir located about 16 miles southeast of Kremmling, Colo., where the Blue enters the Colorado River. This reservoir is to be used to replace water diverted to the eastern slope that would be required by prior rights along the Colorado River.

(2) A hydroelectric plant below the Green Mountain Dam to utilize the flow of the Blue River and water stored in the reservoir for the generation of electrical energy.

(3) A storage reservoir located on the Colorado River about 6 miles northeast of Granby, Colo., to be known as Granby Reservoir. This reservoir will store the flow of the Colorado at this point as well as water diverted from Willow Creek, a tributary of the Colorado and Strawberry and Meadow Creeks, tributaries of the Fraser River.

(4) A diversion dam located about one-half mile below the junction of the North Fork and Grand Lake outlet and about 3 miles south of the village of Grand Lake. This dam will create a lake known as Shadow Mountain Lake which will have the same elevation as Grand Lake and will aid in supplying the transmountain diversion tunnel with water pumped from Granby Reservoir. This lake together with Grand Lake is to be kept at nearly constant level.

(5) An electrically driven pumping plant on the shore of Granby Reservoir, where water will be pumped into a canal feeding Shadow Mountain and Grand Lakes. The length of the canal is 4½ miles.

(6) An outlet channel at the east end of Grand Lake connecting the lake with the portal of a transmountain diversion tunnel and provided with control features that will regulate the level of Grand Lake within a fluctuating range of 1 foot.

(7) A transmountain diversion tunnel under the Continental Divide 13.1 miles in length extending from Grand Lake to a point in Wind River about 5 miles southwest of Estes Park village.

ON EASTERN SLOPE

(8) A conduit 5.3 miles in length extending from diversion tunnel outlet to penstock of a power plant on the Big Thompson River just below Estes Park village. This conduit will be made up of buried

pipe, siphons, tunnels, and open canal. It will be entirely concealed through the area authorized to be taken into Rocky Mountain National Park.

(9) The waste rock from the tunnel is to be terraced and landscaped and all structures connected with the tunnel will be constructed to blend into their natural surroundings.

(10) A power plant known as power plant no. 1 constructed along the Big Thompson River just below the village of Estes Park utilizing the western slope water.

(11) Four additional power plants down the Big Thompson Canyon to utilize all available fall and also all water available for power in the Big Thompson River in addition to the western slope water diverted.

(12) A diversion dam on Big Thompson River about 12 miles west of Loveland to divert the water by means of a canal 9 miles in length to a storage reservoir known as Carter Lake.

(13) Carter Lake Reservoir located 8 miles northwest of Berthoud, Colo., to store water brought over during winter months. Water is released from this reservoir through a 4-mile canal into the Big Thompson River and through a 9-mile canal into the St. Vrain River for irrigation purposes.

(14) A siphon across the Big Thompson River, 9 miles west of Loveland, Colo., and a canal 10 miles in length to convey water from the fourth power plant to a storage reservoir, located about 5 miles west of Fort Collins, known as Horsetooth Reservoir.

(15) A canal from Horsetooth Reservoir to the Cache La Poudre River and extended north to a pumping plant which lifts water high enough to serve the North Poudre Canal.

(16) A storage reservoir near the mouth of Buckhorn Creek to be known as Arkins Reservoir, supplied from a canal diverting from the Big Thompson River just below the last power plant. It is to be used to aid in balancing the demands for power and irrigation, also storing excess water available in the Big Thompson River. Water will be released from the reservoir for supplemental irrigation in the South Platte area.

(17) Transmission lines connecting the Valmont steam plant of the Public Service Co. with all the hydroelectric plants contemplated, also connecting with the transmountain tunnel portals and the Granby and North Poudre pumping plants. The line connecting power plant no. 1 and Granby pumping plant will run east, and south of the outside boundaries of the Rocky Mountain National Park, crossing the Continental Divide at Buchanan Pass.

In order to carry out the construction, operation, and maintenance of the project as outlined above, it will be necessary to comply with the following requirements as agreed to by representatives of the eastern and western slopes in Colorado and here made as a part of this report.

MANNER OF OPERATION OF PROJECT FACILITIES AND AUXILIARY FEATURES

The construction and operation of this project will change the regimen of the Colorado River below the Granby Reservoir. The project contemplates the maximum conservation and use of the waters of the Colorado River, and involves all of the construction features

heretofore listed. In addition thereto certain supplemental construction will be necessary. This will be for the primary purpose of preserving insofar as possible the rights and interests dependent on this water, which exist on both slopes of the Continental Divide in Colorado. The project, therefore, must be operated in such a manner as to most nearly effect the following primary purposes:

1. To preserve the vested and future rights in irrigation.

2. To preserve the fishing and recreational facilities and the scenic attractions of Grand Lake, the Colorado River, and the Rocky Mountain National Park.

3. To preserve the present surface elevations of the water in Grand Lake and to prevent a variation in these elevations greater than their normal fluctuation.

4. To so conserve and make use of these waters for irrigation, power, industrial development, and other purposes, as to create the greatest benefits.

5. To maintain conditions of river flow for the benefit of domestic and sanitary uses of this water.

In order to accomplish these purposes the project should be operated by an unprejudiced agency in a fair and efficient manner, equitable to all parties having interests therein, and in conformity with the following particular stipulations:

(*a*) The Green Mountain Reservoir, or similar facilities, shall be constructed and maintained on the Colorado River above the present site of the diversion dam of the Shoshone power plant, above Glenwood Springs, Colo., with a capacity of 152,000 acre-feet of water, with a reasonable expectancy that it will fill annually. Of said capacity, 52,000 acre-feet of water stored therein shall be available as replacement in western Colorado, of the water which would be usable there if not withheld or diverted by said project; 100,000 acre-feet shall be used for power purposes; and all of said stored waters shall be released under the conditions and limitations hereinafter set forth.

(*b*) Whenever the flow in the Colorado River at the present site of said Shoshone diversion dam is less than 1,250 cubic feet per second, there shall, upon demand of the authorized irrigation division engineer or other State authority having charge of the distribution of the waters of this stream, be released from said reservoir as a part of said 52,000 acre-feet, the amount necessary with other waters available, to fill the vested appropriations of water up to the amount concurrently being diverted or withheld from such vested appropriations by the project for diversion to the eastern slope.

(*c*) Said 100,000 acre-feet shall be stored primarily for power purposes, and the water released shall be available, without charge, to supply existing irrigation and domestic appropriations of water, including the Grand Valley reclamation project, to supply all losses chargeable in the delivery of said 52,000 acre-feet of water, and for future use for domestic purposes and in the irrigation of lands thereafter to be brought under cultivation in western Colorado. It shall be released within the period from April 15 to October 15 of each year as required to supply a sufficient quantity to maintain the specified flow of 1,250 cubic feet per second of water at the present site of said Shoshone diversion dam, provided this amount is not supplied from the 52,000 acre-feet heretofore specified. Water not required for the above purposes shall also be available for disposal to agencies for the development of the shale oil or other industries.

(*d*) The cost of construction and perpetual operation and maintenance of said reservoir or reservoirs shall be a charge against the project and shall be paid from revenues collected from this project as may be provided in contracts between the Secretary of the Interior and the beneficiaries of the project in eastern Colorado, and any other contracting parties.

(*e*) In the event said reservoir or reservoirs are not maintained with a capacity of 52,000 acre-feet, the Secretary of the Interior should withhold the diversion of water from the western to the eastern slope of Colorado until such storage capacity is made available.

(*f*) The Secretary of the Interior shall have the option to require the transfer to the United States of any and all rights initiated or acquired by the appropriation or use of water through the works of the project in eastern Colorado, at any time: *Provided, however,* That the title so taken shall be subject to a beneficial use of such water as may be provided in the repayment contract or contracts; and the rights to store water to the extent of said 152,000 acre-feet shall be initiated, acquired, and held by the appropriate authorities for use in western Colorado, for replacement of water diverted to the eastern slope, and for other purposes contemplated for this project.

(*g*) The Secretary of the Interior shall operate this project in accordance with the following stipulations as to priorities of water use as between the parties claiming or using project water and within the limits of his legal authority. Said 52,000 acre-feet of replacement storage in Green Mountain or other reservoirs shall be considered to have a date of priority for the storage and use of replacement water earlier than that of the priorities for the water diverted or stored for delivery to the eastern slope. The 100,000 acre-feet of storage in said reservoir shall be considered to have the same date of priority of appropriation as that for water diverted or stored for transmountain diversion.

(*h*) Said Green Mountain Reservoir, or such other replacement reservoirs as provided in paragraph (*a*) herein, as are planned as a part of the project, shall be constructed at the same time as the other parts of the project and shall be completed before any water is diverted to the eastern slope of the Continental Divide by means of said project.

(*i*) Inasmuch as the State of Colorado has ratified the Colorado River Compact, and inasmuch as the construction of this project is to be undertaken by the United States, the project, its operation, maintenance, and use must be subject to the provisions of said Colorado River Compact of November 24, 1922 (42 Stat. 171), and of section 13 of the Boulder Canyon Project Act, dated December 21, 1928 (45 Stat. 1057–1064). Notwithstanding the relative priorities specified in paragraph (*g*) herein, if an obligation is created under said compact to augment the supply of water from the State of Colorado to satisfy the provisions of said compact, the diversion for the benefit of the eastern slope shall be discontinued in advance of any western slope appropriations.

(*j*) An adequate system, as determined by the Secretary of the Interior, shall be provided for the irrigation of the lands in the vicinity of Kremmling, now irrigated by either natural or artificial means, and the installation made therefor shall be a part of this project. The rights to the use of water for the irrigation of these lands shall be considered to have a date of priority earlier than that of the rights to the use of water to be diverted through the works of this project to the eastern slope. This system shall be designed and built in a manner requiring the least possible continuing annual expense for operation

and maintenance but the cost thereof shall not exceed $300,000; and said system shall be provided and in operation before any water is stored for transmountain diversion. In addition, the Secretary shall protect, add to, or improve the source of supply of domestic waters for the municipalities of Kremmling and Hot Sulphur Springs in the manner and to the extent which he may determine to be necessary to provide a source of supply not less than that now available for these municipalities. The cost of these features shall be included in the total project cost.

(*k*) To compensate Grand County for the loss of taxes through the transfer of property to the United States for the construction of this project, $100,000 shall be paid to said Grand County. This payment shall be made in 10 annual installments of $10,000 each, commencing upon the date when 10 percent of the total property in Grand County required for said project has been removed from taxation.

(*l*) The project and all of its features shall be operated in a manner determined by the Secretary of the Interior as necessary to provide the water to preserve at all times that section of the Colorado River between the reservoir to be constructed near Granby and the mouth of the Fraser River as a live stream, and also to insure an adequate supply for irrigation, for sanitary purposes, for the preservation of scenic attractions, and for the preservation of fish life. The determination of the need for and the amount and times of release of water from Granby Reservoir to accomplish these purposes shall be made by the Secretary of the Interior, whose findings shall be final.

In order to facilitate compliance with the stipulation in paragraphs (*j*), (*k*), and (*l*) hereof a representative may be selected and designated by the interests dependent thereon in Grand County, Colo., and when so designated he will be recognized as the official spokesman of said interests in all matters dealing with project operations affecting Grand County.

The principles and provisions expressed in these stipulations have been approved by the Western Colorado Protective Association, representing interests in western Colorado, and the Northern Colorado Water Users Association as evidenced by the letters hereto attached.

SUMMARY

The Colorado-Big Thompson project comprises 615,000 acres of irrigated lands, out of approximately 800,000 acres lying under the canal systems in the northern and northeastern portions of Colorado.

The water supply for the area is to be derived from a portion of 782 square miles of drainage area above Hot Sulphur Springs lying west of the Continental Divide in Grand County, Colorado, and varying in elevation from 8,050 to 14,000 feet.

HISTORY

The first irrigation in northeastern Colorado occurred about 1860 where the early settlers plowed out small ditches with sufficient grade and length to irrigate a few acres of land in the first bottom—i. e lands not far above the high-water line of the streams and adjacent to them.

The first irrigation of the higher or second bench lands along the Cache La Poudre River was by the Old Union Colony, of Greeley, in

1870. This colony was organized by Horace Greeley, then editor of the New York Tribune, who will be remembered here especially for his advice to eastern young men to "Go west and grow up with the country."

This colony irrigated about 12,000 acres under their first project and it was a success from the start, due in a large measure to the fact that they were people of considerable means and were then able to finance themselves over the period required to bring raw prairie land into profitable cultivation.

This colony was soon followed by others along the Poudre at Fort Collins, on the Big Thompson, at Loveland and the St. Vrain near Longmont.

The difficulties experienced by these colonists in distributing the water between them led to the creation of Colorado's irrigation laws which have been copied by most of the irrigation States of the West.

This irrigated area of six hundred to eight hundred thousand acres was developed by means of individual initiative and by small scale cooperative enterprises. Today there are 6,400 irrigated farms, served by 124 canals and ditches and 60 storage reservoirs.

IRRIGATION USE

In the early days irrigation in this area was confined to growing crops to supply local needs, the lack of transportation contributing to high prices for the home-grown production and prohibiting shipping to distant points. The crops grown were mainly the grains and hay for local consumption, with some vegetables. Such irrigation corresponded with the run-off of the streams.

As mining developed in the State, Denver and other towns grew into cities, and after these cities were connected to the East by railroads the markets demanded a more diversified agriculture to supply their needs. Thus a gradual demand developed for late water which the streams could not supply.

This change created a need for storing the flood waters for late irrigation. From 1890 to 1910 was a period of reservoir construction, during which storage was provided for all the available water supply of the streams over and above the direct irrigation requirements for the area here under discussion. Much of this development took place during a decade of more than normal run-off on the eastern slope and also during a period expanding the agricultural area throughout the West.

Attempts to maintain the area under cultivation with the depleted run-offs during the past 10 years have spread the water supply to such an extent that much acreage has had an insufficient water supply to produce full crops or crops producing the higher values. Attempts have been made to supplement the individual farm water supply by the development of the underground sources by pumping from numerous wells throughout the region. This is lowering the water table and already is affecting the water supply of the lower South Platte Valley which receives its irrigation supply largely from return waters.

NEED OF SUPPLEMENTAL WATER

Under such conditions only the older water rights have any assurance of an adequate water supply, and in the dryer years the owners of junior rights are forced to confine their farming to crops that can

be matured by the early flood flow or that require a minimum amount of water. In years when the supply is not correctly estimated considerable loss results. Ordinarily the crops raised in this and other irrigated areas do not compete with those grown under rainfall conditions, but a shortage of water always leads to the raising of more of the competing crops. Such crops also cut the income of the irrigation farmer below what he can earn with the higher type, noncompetitive crops.

On fully three-fourths of the 615,000 acres in this area the water supply is inadequate, in spite of every effort to conserve, store flood water, or otherwise add to the water supply that has been within the financial ability of the farmer. This inadequacy is due not only to a development probably too large for the period when run-off of the streams was much higher than at present, but to the fact that the last 10 years have seen a very marked decrease in the stream flow. It must be emphasized that the additional water supply here contemplated is to be used for a supplemental supply and not to create a large new additional irrigated acreage.

There has been expended in this area to date for various types of irrigation works, including nearly $750,000 for pumping plants, most of which have been installed in the last 10 years, about $35,000,000 against which there is an outstanding indebtedness of only $1,510,650. These people, however, have about reached their limit as individuals and mutual irrigation companies to provide for themselves a supplemental water supply so badly needed to make their present water supply secure and are obliged to seek Government aid to bring this about.

It has been conceded by a majority of the irrigation interests in this section of the State that the water supply in 1926 was ample for all their present acreage now irrigated. In order, therefore, to determine the normal shortage in acre-feet over a period of years a comparison of the supply in these years with that of 1926 was made and the difference obtained. These differences are set up in the following table:

TABLE 1.—*Showing water districts, acreage irrigated, deficiencies 1925 to 1935 with tentative allocation of total supplemental supply*

Water district no.	Area irrigated	1926 diversion, acre-feet	Average diversion, 1925-35	Difference, 1926, 11-year average required supplementary water in acre-feet	Tentative allocation of supplemental supply			
					Colorado-Big Thompson project water	Moffat and Jones Pass tunnel water return	Present seepage return, acre-feet	Total supplemental supply, acre-feet
(1)	(2)	(3)	(7)	(15)	(16)	(17)	(18)	(19)
3	213,640	530,000	398,000	132,000	104,000	----------	49,500	153,500
4	68,408	235,000	163,000	72,000	44,100	----------	21,000	65,100
5	81,806	113,000	94,000	19,000	38,800	----------	18,500	57,300
1	92,394	663,000	457,000	206,000	81,400	11,000	83,000	175,400
2	37,899	170,000	154,000	16,000	5,000	4,500	5,100	14,600
64	121,289	513,000	383,000	130,000	36,700	14,500	37,400	88,600
Total	615,436	2,224,000	1,649,000	575,000	310,000	30,000	214,500	554,500

It will be noted from column no. 15 that the total average shortage in this project area which comprises water districts 3, 4, 5, 1, 2, and 64 is 575,000 acre-feet. Column no. 16 is a tentative allocation of the proposed supplemental supply to the various districts. Column no. 18 is the estimated usable return flow that would arise from the addition of 310,000 acre-feet of new water to this area. Column no. 19 is the total usable supplemental supply amounting to 554,520 acre-feet, an amount within 5 percent of the 10-year average shortage. The sale or rental of supplemental water, when available, in the Poudre Valley has averaged $4.50 per acre-foot over a period of years. In extreme cases it has sold as high as $9 per acre-foot.

The deficiency in water supply for the period 1925 to 1934, inclusive, reflected a direct economic loss in crop production of approximately $42,355,000.

The following shows the approximate annual loss in value of crops because of inadequate water supply:

Sugar beets	$1,900,000
Alfalfa	948,000
Small grain	470,000
Beans	302,000
Corn	228,000
Potatoes	425,000
All other crops	444,000
Total	4,700,000

This average annual direct crop loss is about 19 percent of the $24,800,000 estimated cost of the Colorado-Big Thompson irrigation project.

The crop loss in 1934, due to shortage of water, as compared to 1926, after variation in price and acreage factors had been accounted for, amounted to $12,400,000, or just one-half the cost of the project.

The losses here given are the farm losses and do not include the losses that are due to processing, transporting, or handling of that quantity of production, which would add several million dollars to the loss of the community as a whole.

The effect of such inadequate water supply for the period 1925–35 is shown graphically on drawing no. 1 following.

SUPPLEMENTAL WATER SUPPLY

In 1929 the State engineers of Colorado, in cooperation with the Platte Valley Water Conservation League, and the United States Army engineers, made a comprehensive study of the water resources of the South Platte Basin in northeastern Colorado. This study included the Cache La Poudre River in water district no. 3, the Big Thompson River in water district no. 4, and the St. Vrain River in district no 5. The investigators determined the excess water available on these streams above present normal demands and also above the normal demands on the South Platte River proper below where these streams enter.

The investigators also determined the location, capacity, and cost of the most feasible reservoir sites for the storage of this excess water.

The results are shown in the following table and have been brought up to date by using the same demands for irrigation as set up in the report and using the water-supply records furnished by the State engineer's office.

Stream	Excess supply available for storage, average, 1918–35	Capacity proposed reservoir by Army engineers	Average annual yields at reservoirs	Total reservoir costs	Cost per acre-foot capacity	Cost per acre-foot yield
	Acre-feet	*Acre-feet*				
Cache La Poudre	30,000	52,000	25,500	$2,747,000	$72	$147
Big Thompson	16,000	32,700	11,300	2,006,000	61	178
St. Vrain	16,000	30,000	14,000	2,186,000	73	156

From the foregoing table it is evident that there is not sufficient excess water available that originates in this area to supply the demands for supplemental water, and the cost of making use of what is available is prohibitive. It will be shown, however, that 16,000 acre-feet of this surplus is available for storage in the Colorado-Big Thompson project reservoirs on the eastern slope with no additional cost.

The water users in northeastern Colorado have now exhausted every possible source of obtaining supplemental water or augmenting their present supply either by storage, transmountain diversion within their individual cooperative means, and by pumping. Fortunately, however, there exists a surplus of water on the headwaters of the Colorado River west of this area and separated from it by the Continental Divide.

In the spring of 1935, $150,000 was allocated to the Bureau of Reclamation to make surveys and prepare plans and cost estimates for bringing water from the headwaters of the Colorado River into the area in northeastern Colorado in need of supplemental water.

In August 1935 the Bureau of Reclamation started surveys for the project and previously there had been started a land classification to determine the irrigated and arable land in the Colorado River Basin in Colorado in order to arrive at the approximate amount of water now used in the area and how much might be used when full development has been made. Both surveys have been completed, insofar as this project is involved, and the following is the result of the land classification.

LAND CLASSIFICATION—COLORADO RIVER AREA

Since the quantity of water available for diversion from the headwaters of Colorado River might be limited now by the water rights of lands already irrigated, or might in the future limit in turn the development of lands in the Colorado Basin within the State, all the land on Colorado River and its tributaries above the Colorado-Utah line, except the Gunnison River area, has been classified to show the location and extent of irrigated lands and of lands capable of irrigation.

This classification was undertaken in all areas covered by former reports, supplemented by local information as to possible projects and by reconnaissance. For localities with no records of water supply it was assumed to exist unless the contrary was obvious, and doubtful areas were included rather than excluded from the classification. The land was measured by plane-table survey except some small isolated areas which were estimated.

Land that had customarily been irrigated was so classed, no matter how inadequate the supply. Land capable of irrigation was

tested according to a set of standards which fairly represent the experience on this area and others as to what constitutes arable land. Where pumping for irrigation was involved land was classified up to 200 feet above the source of supply.

The result of the survey of the irrigated and arable land appears in the following table.

It should be stated, that, as will be shown under the discussion of water supply which follows, the present irrigated area above the Utah State line does not limit the diversion possible at the location chosen. It is also true that the diversion when in operation, and replacing the summer flow of Colorado River in the manner contemplated by the project plan, will not limit the future development of all the arable land on Colorado River and its tributaries above Gunnison River.

Colorado River drainage—Gunnison excepted—Colorado (land classification according to streams)

Stream name	Irrigated	Arable	Total
Colorado River:	*Acres*	*Acres*	*Acres*
1. To Granby Dam	2,600	1,100	3,700
2. Granby Dam to Hot Sulphur Springs	1,300	350	1,650
3. Hot Sulphur Springs to Kremmling	3,200	1,200	4,400
4. Kremmling to Glenwood Springs	1,100	260	1,360
5. Glenwood Springs to Palisade	7,000	2,500	9,500
6. Palisade to State line	70,600	32,800	103,400
Total	85,800	38,210	124,010
Tributaries:			
Willow Creek	860	120	980
Fraser River	7,100	650	7,750
South Fork Colorado River	610	30	640
Small streams [1]	2,300	4,000	6,300
Williams Fork River	3,600	10,900	14,500
Troublesome Creek	4,200	7,200	11,400
Muddy Creek	4,900	5,100	10,000
Blue River	8,400	3,100	11,500
Small streams [2]	610	570	1,180
Sheephorn Creek	1,200	50	1,250
Piney Creek	790	50	840
Egeria Creek	5,700	9,300	15,000
Cabin Creek area	5,700	2,600	8,300
Catamount Creek	1,000	10	1,010
Sweetwater Creek area	1,100	380	1,480
Eagle River	16,400	5,000	21,400
Small streams [3]	939	60	990
Roaring Fork River	33,100	9,400	42,500
Garfield Creek	2,100		2,100
Elk Creek	3,000	130	3,130
Divide and Mam Creeks	13,700	9,100	22,000
Rifle Creek	11,100	3,200	14,300
Parachute Creek	1,700	370	2,070
Roan Creek	5,600	3,300	8,900
Plateau Creek	24,000	7,000	31,600
Small streams [4]	10,200	3,000	13,200
Grand total	258,300	122,330	379,130

[1] Above Hot Sulphur Springs.
[2] Between Hot Sulphur Springs and Kremmling.
[3] Between Kremmling and Glenwood Springs.
[4] Between Glenwood Springs and Palisade.

WATER SUPPLY

The stream flow records at the different stations in the Colorado River Basin show the amount of water passing the stations after all present irrigation has taken place above, so there is no need for any further adjustment of stream flow to take care of water consumed in this irrigation.

It is assumed that all arable lands as shown will be irrigated some time in the future, notwithstanding the fact that quite a percentage

is so located that it would never be feasible to irrigate. It is also further assumed that reservoirs would be built on the tributaries to conserve a portion of the flood flows to make the irrigation of these arable lands possible.

With the above assumptions it has been found that in a year like 1931, with the run-off only 40 percent of the average for a 31-year period, and the lowest year of record, the Colorado-Big Thompson project would only have to supply approximately 53,000 acre-feet to replace water diverted by the proposed project that could have been used by the Colorado River water users for power and irrigation, provided the project was in operation at that time.

The average run-off of the Colorado for the years of record are: Hot Sulphur, 31 years, 523,000 acre-feet; Glenwood Springs, including Roaring Fork, 3,413,000 acre-feet, Fruita, 6,300,000 acre-feet. These amounts are exclusive of supply consumed in present irrigation of Colorado River Basin lands.

The following is the estimated amount of water available for diversion from the drainage area above the Colorado-Big Thompson collection system at 8,260 feet elevation.

YIELD OF GRANBY RESERVOIR

Stream-flow records available on the Colorado River near the Granby Dam site for the years 1908–11 and 1935–36, and on Willow Creek for the years of 1935 and 1936, were supplemented by estimates based on available stream-flow records on the Colorado River at Hot Sulphur Springs and Glenwood Springs to cover the 37-year period, 1900 to 1936, inclusive.

A capacity of 482,000 acre-feet was selected as the best capacity for the Granby Reservoir, considering cost and use. Of this capacity, 20,000 acre-feet were set aside for dead storage to reduce pumping lifts for waters delivered to Shadow Mountain Reservoir. A further objective is to keep to the lowest practicable area the exposure of reservoir bed when storage is exhausted. This leaves an active capacity of 462,000 acre-feet.

Reservoir operating studies are based on the following conditions:

(*a*) Recorded (or estimated) past flows of Colorado River at Shadow Mountain and Granby Dams reduced by 27 percent prior to 1906, and 13 percent thereafter, of the flow of the North Fork at Grand Lake to allow for increasing diversions by the Grand River ditch.

(*b*) Willow Creek diverted to reservoir to the extent of 90 percent of the flow of Willow Creek and other streams intercepted by the diversion canal from May to October, inclusive, of each year.

(*c*) Strawberry, Meadow, and Walden Hollow Creeks also diverted whenever practicable. The flow of these streams, together with some additional waters capturable from Willow Creek at times, are expected to offset evaporation and seepage losses in excess of present losses from the Granby and Shadow Mountain Reservoir sites.

(*d*) No releases from Granby Dam for any reason.

(*e*) Transmountain tunnel to be operated at full capacity from October 1 until March 31 following, with operations thereafter gaged to fit run-off conditions so as to avoid spills and yet concentrate flows in the period of July 15 to September 15, for the purposes of best

distribution in power production and to minimize reregulating storage requirements on the eastern slope. The computations assumed infallible forecasts of run-off.

(*f*) A minimum storage hold-over of 100,000 acre-feet on September 30 of each year to assure dependable power production in winter.

Under these conditions, a yield of 320,000 acre-feet of primary water is secured as follows:

Unit 1,000 acre-feet

Run-off year (October to September)	Inflow to Granby Reservoir		Tunnel diversion	Spills	Shortages
	Colorado River	Willow Creek			
1899–1900	242.8	52.4	320.0		
1900–1901	246.9	53.4	320.0		
1901–2	164.9	34.7	255.1		64.9
1902–3	222.0	48.8	270.8		49.2
1903–4	253.5	51.2	304.7		15.3
1904–5	287.9	54.9	310.2		9.8
1905–6	292.4	58.7	320.0		
1906–7	381.0	78.3	320.0		
1907–8	190.6	25.6	320.0		
1908–9	323.8	91.5	320.0		
1909–10	200.1	32.5	320.0		
1910–11	268.5	53.6	320.0		
1911–12	350.4	79.3	320.0		
1912–13	215.4	40.3	320.0		
1913–14	371.0	85.1	320.0		
1914–15	223.2	43.8	320.0		
1915–16	249.5	47.8	320.0		
1916–17	348.3	79.7	320.0		
1917–18	322.9	81.2	356.4	18.7	
1918–19	189.6	36.4	320.0		
1919–20	361.2	78.4	345.5		
1920–21	347.9	90.7	388.6	70.0	
1921–22	196.8	39.5	320.0		
1922–23	280.3	60.2	320.0		
1923–24	262.2	54.4	320.0		
1924–25	202.6	36.7	320.0		
1925–26	346.4	70.0	320.0		
1926–27	275.0	54.8	320.0		
1927–28	317.5	61.9	338.3		
1928–29	297.1	61.2	358.3		
1929–30	247.4	42.9	320.0		
1930–31	171.5	36.6	320.0		
1931–32	243.9	48.0	320.0		
1932–33	239.5	54.5	320.0		
1933–34	128.9	26.2	320.0		
1934–35	209.2	41.8	252.5		67.5
1935–36	279.7	53.3	310.0		10.0
Average	263.6	55.4	318.7	2.5	5.5

Operating results cannot be expected to result so favorably. The operating conditions enumerated imply superhuman ability to forecast stream flow. Occasional releases will be required from Granby Reservoir although small in amount. Interruptions in tunnel operation cannot always be arranged so as to lose no water.

In view of these conditions, it is concluded that the firm yield of tunnel water from the Granby and Shadow Mountain Reservoirs should be taken as 300,000 acre-feet annually. Shortages of 5 percent may be expected on an average of once every 5 years and shortages of 25 percent may be expected on an average of once every 20 years. Secondary water may be expected to be available in some years in amounts up to 50,000 acre-feet.

EFFECT OF THE PROPOSED TRANSMOUNTAIN DIVERSION ON FUTURE WESTERN SLOPE DEVELOPMENT

Most of the diverted water is derived from the spring floods, when there is an excess of water over all present and future requirements along the Colorado River in the State. To permit full use of the inflow to the Granby Reservoir, Ranch Creek Reservoir may be constructed near Tabernash to store water locally surplus. The waters there conserved would in part be utilized to replace the waters withheld at Granby Dam, but the greater part of the conserved water would be used to augment irrigation supplies down to Hot Sulphur Springs and to maintain a satisfactory stream flow in this locality for recreational purposes.

With the region above Hot Sulphur Springs taken care of by the Ranch Creek Reservoir, the critical points along the Colorado River, from the standpoint of present and future use of water, are at Glenwood Springs, where the Shoshone power plant of the Public Service Co. uses present stream-flows up to 1,250 second-feet, and near Palisades at the head of the Grand Valley, where the Government high-line canal diverts water for irrigation and power purposes. The present irrigated area along the Colorado River between Palisades and the Colorado-Utah State line is 70,600 acres.

The additional arable area in this region, not now irrigated, is as follows:

	Acres
Under constructed canals	13,800
Pumping unit of Grand Valley project, for which canal capacity has been provided	10,000
Lands on Mack Flat, no present provision for water service	9,000
Total	32,800

Maximum irrigation demand at the head of the Grand Valley for the present irrigated area and for the additional area of 23,800 acres for which provision has been made in the constructed canals, is estimated as 1,700 second-feet, and this amount is being demanded in the pending adjudication proceeding.

With maximum irrigation demands there is a full water supply for the Orchard Mesa pumping plant and for the Grand Valley power plant. In the nonirrigation season the controlling requirement is for power with a total demand of 800 second-feet for power and for domestic needs under the higher canals. With the new area of 9,000 acres developed, the future demands are then estimated as 1,800 second-feet in the months of May to August, inclusive, tapering off uniformly to 800 second-feet on April 1 and on November 30.

In determination of the effect of the Colorado-Big Thompson transmountain diversion on the western slope, the past stream flows at Glenwood Springs and at the head of the Grand Valley were first depleted to show the resulting stream flows with the following developments:

(*a*) Full irrigation development of 276,000 acres of irrigated and arable lands along the Colorado River and tributaries above Palisades (the present irrigated area is 186,000 acres).

(*b*) Full development of Moffat Tunnel diversion from Fraser River and tributaries, Jones Pass diversion from Williams River, and Independence Pass diversion from the Roaring Fork, including

replacement storage so that these projects may divert all flows interceptible.

From the reconstructed flows, thus computed, there was subtracted the water estimated to be withheld at the Granby Reservoir site. The reductions in stream flow at Glenwood Springs and at the head of the Grand Valley, during those periods of each year when the resulting stream flows would be less than the future demands above described, then represents the effect of the project on the western slope if no replacement storage were provided. These computations were made for the years 1926 to 1936, inclusive, at Glenwood Springs, and for the entire period of record, 1902 to 1936, inclusive, at the head of the Grand Valley, with the following results:

Year	Shortages at Glenwood Springs (acre-feet)			Shortages at head of Grand Valley (acre-feet)		
	End of flood season, Oct. 31 [1]	Nov. 1 to flood season of following year [2]	Total	Before flood season in spring [3]	After flood season to Oct. 31	Total
1902	(4)	(4)		6,000	39,000	45,000
1903	(4)	(4)		3,000	12,000	15,000
1904	(4)	(4)		None	2,000	2,000
1905	(4)	(4)		None	14,000	14,000
1906	(4)	(4)		None	None	None
1907	(4)	(4)		None	None	None
1908	(4)	(4)		None	6,000	6,000
1909	(4)	(4)		None	None	None
1910	(4)	(4)		None	12,000	12,000
1911	(4)	(4)		None	1,000	1,000
1912	(4)	(4)		None	None	None
1913	(4)	(4)		None	7,000	7,000
1914	(4)	(4)		None	None	None
1915	(4)	(4)		None	9,000	9,000
1916	(4)	(4)		None	None	None
1917	(4)	(4)		None	None	None
1918	(4)	(4)		None	1,000	1,000
1919	(4)	(4)		None	7,000	7,000
1920	(4)	(4)		2,000	None	2,000
1921	(4)	(4)		None	None	None
1922	(4)	(4)		None	None	None
1923	(4)	(4)		None	None	None
1924	(4)	(4)		None	4,000	4,000
1925	(4)	(4)		None	None	None
1926	18,000	19,000	37,000	None	2,000	2,000
1927	7,000	32,000	39,000	None	None	None
1928	10,000	18,000	28,000	None	None	None
1929	None	20,000	20,000	None	None	None
1930	12,000	14,000	26,000	None	None	None
1931	37,000	16,000	53,000	1,000	27,000	28,000
1932	14,000	24,000	38,000	None	3,000	3,000
1933	23,000	21,000	44,000	5,000	15,000	20,000
1934	31,000	17,000	48,000	None	28,000	28,000
1935	20,000	15,000	35,000	2,000	11,000	13,000

[1] Encroachment on irrigation supplies.
[2] Encroachment on winter power waters.
[3] These shortages occur in years of late run-off when irrigation requirements rise faster than stream flow. Winter flows are always adequate Nov. 1 to Apr. 1.
[4] Not computed.

DIVERSION PLAN AND STRUCTURES

REPLACEMENT

In order to protect the water users in the Colorado River Basin against any depletion of their water supply by diversions through the Continental Divide tunnel to northeastern Colorado, a storage reservoir is planned on the Blue River about 16 miles southeast of Kremmling, Colo. This reservoir is to be known as the Green Mountain.

The dam site is located in the E ½ of sec. 15, T. 2 S., R. 80 W., sixth principal meridian, near the head of a box canyon, between Green and Little Green Mountains, caused by the river cutting through a porphyry sill. The foundation bedrock consists of sedimentary rocks, either Dakota sandstone or Morrison shales, and the intrusive porphyry.

The irrigation outlet capacity is 1,000 cubic feet per second, and the power outlet capacity is 1,500 cubic feet per second. The spillway capacity is 25,000 cubic feet per second.

The reservoir will flood 2,100 acres of land and will have a capacity of 152,000 acre-feet.

From the water-supply studies it was found, assuming that full development had taken place in the Colorado River Basin and that the Big Thompson project had been in operation the last 35 years, that in the year 1931, the lowest year of dependable run-off record, the Colorado Basin users above Glenwood Springs would have been shorted 37,000 acre-feet for irrigation use and the Public Service Co. would have been shorted 16,000 acre-feet at their power plant at Shoshone during the nonirrigation season, or a total shortage of 53,000 acre-feet. Accordingly, 50,000 acre-feet of Green Mountain storage have been allocated to replacement purposes for which the water users in northeastern Colorado will pay $1,500,000. The remaining 100,000 acre-feet are allocated to power and will be paid for out of power revenues.

Since the average shortage for both power and irrigation for the last 10 years, the lowest 10 years of run-off record is 36,000 acre-feet. There would be the 16,000 acre-feet difference, and a portion of the 100,000 acre-feet let out for power that could be used by the Colorado Basin users to supply shortages that might occur in their irrigation use in years of extreme low run-off, these shortages not being caused by the transmountain diversion.

The total estimated cost of the dam and reservoir is $3,776,032, $2,276,032 of which will be paid for from power revenues.

GRANBY RESERVOIR AND STORAGE

The storage of Colorado River waters for the project is to be made in what is known as Granby Reservoir which is located in Tps. 2 and 3 N., Rs. 75 and 76 W., sixth principal meridian, in Grand County, Colorado. The reservoir basin occupies the valleys of Stillwater Creek, the south fork or Arapaho Creek, and the main Colorado River.

The damsite is located about 4 miles northeast of the town of Granby, Colo., in the NE¼ of sec. 11, T. 2 N., R. 76 W., in Grand County, Colo. It is located at the head of a short canyon which the river has cut through pre-Cambrian rocks forming a spur of the main Rocky Mountain mass. At the damsite the canyon at river-bottom level is 200 feet wide, while at elevation 8,275 it is 720 feet in width.

The dam is to be a combination earth and rockfill structure with a maximum height of 223 feet. The outlet capacity is 300 cubic feet per second and the spillway capacity is 12,000 cubic feet per second.

With the high-water line at elevation 8,275 feet the reservoir has a capacity of 482,860 acre-feet, and will flood an area of 6,943 acres.

This reservoir will not only intercept the flow of the Colorado at that point, but the flow of Willow Creek will be intercepted near Dexter, Colo., and brought into the reservoir through a canal of 1,000

cubic feet per second capacity. Willow Creek enters the Colorado about 2 miles below Granby Dam.

It is estimated that Willow Creek will supply an average of about 60,000 acre-feet per year, and that the total estimated cost of this diversion is $733,203.

The storage in Granby Reservoir will also be augmented by the flow of Meadow and Strawberry Creeks, tributaries of Fraser River which enters the Colorado about 5 miles below the dam. The canal intercepting these two creeks will have a capacity of 500 cubic feet per second, and it is estimated they will produce an average of 12,000 acre-feet a year. The total estimated cost of this diversion is $133,600.

If water supply records kept in the future show there is sufficient water supply left in the Fraser River below the City of Denver's diversion, a canal could be taken out of it just below the mouth of St. Louis Creek near the town of Fraser, Colo., and extend from there to Granby Reservoir, intercepting Ranch, Meadow, and Strawberry Creeks on the way. A small regulating reservoir should be built on Ranch Creek above where the Canal intercepts it.

NORTH FORK DIVERSION DAM AND SHADOW MOUNTAIN LAKE

In order to divert the water of the North Fork of the Colorado into Grand Lake and thence to the channel extending from it to the west portal of the Continental Divide tunnel, it is planned to construct a concrete overflow dam 35 feet in height, above streamed, across the North Fork about one-half mile below its junction with the Grand Lake outlet.

The dam site proper is located in the NW¼ of sec. 19, T. 3 N., R. 75 W., and is a glacial morain cut through by the river.

The water backed up by this dam will form a lake called Shadow Mountain, the name of a nearby mountain, which will have a surface area of 1,356 acres. The elevation of this lake will be the same as Grand Lake and connected with it by means of the present outlet.

NORTH FORK DIVERSION DAM

The dam proper is a concrete gravity overflow spillway section, 90 feet long, with crest elevation at 8,370. This spillway is designed for maximum discharge of 1,800 cubic feet per second. On each side of the overflow section is a concrete gravity section containing three automatic siphon spillways on each side. The total spillway capacity is 9,400 cubic feet per second.

The total estimated cost is $483,928.

GRANBY PUMPING PLANT

As stated before, the water surface elevation of Granby Reservoir is 8,275 and the water surface of Shadow Mountain and Grand Lakes is 8,369. In order to get the water stored in Granby Reservoir into Shadow Mountain Lake and available for delivery through the Continental Divide tunnel, a pumping plant is located on the north shore of Granby Reservoir about one-half mile above the junction of the South Fork with the Colorado. A granite spur juts out into the reservoir site at that point making it ideal for the intake tunnels and a shaft for the pump.

The proposed pumping plant will contain three motor-driven vertical-shaft pumping units having a total capacity of 900 cubic feet per second with full reservoir and 550 cubic second-feet at low water. At normal water surface the capacity will be 870 cubic feet per second.

Each pump will be driven by a 6,500-horsepower synchronous motor.

Power will be delivered to the plant from a 69,000-volt transmission line extending from power plant no. 1 just below Estes Park, around the Rocky Mountain National Park, and crossing the Continental Divide at Buchanan Pass about 5 miles south of the park boundary.

The water from the pumps empties into a canal of 900 cubic second-feet capacity and runs by gravity into Shadow Mountain Lake. It is planned to operate this canal all winter when temperatures get as low as 40° below zero. The latent heat in the water and the friction heat absorbed from the pumps will prevent this water from freezing and will keep quite an area open after the water reaches Shadow Mountain Lake.

The total estimated cost of the pumping plant is $1,250,000.

The total estimated cost of the pump canal is $417,553.

CONTINENTAL DIVIDE TUNNEL

The west tunnel portal is connected with Grand Lake by means of a channel constructed 67.5 feet in width and 15 feet in depth. At the lake end of this channel a permanent concrete barrier or weir will be placed with a crest elevation at 8,368 which would be the minimum elevation to which the water in Grand Lake could be drawn. Since the barrier is so constructed that it requires the water to be 1 foot in depth over it to supply the normal capacity of the tunnel, the normal elevation of Grand and Shadow Mountain Lakes would be 8,369 feet.

The present maximum fluctuation of Grand Lake is about 4 feet, or from an elevation of 8,368 in winter to 8,372 feet during the peak run-off from melting snow. The automatic control gates at the North Fork Diversion Dam and at tunnel inlet will so control the elevation of the water surface in Grand Lake that it would never fluctuate more than 1 foot.

The Continental Divide tunnel extends from the easterly end of Grand Lake to Wind River, southwest of Estes Park, with an azimuth of 242° 20′ 30″, and length of 69,023 feet. It is to be horseshoe shape 9.5 feet in diameter and lined throughout with a 9-inch concrete lining.

It will be located entirely in pre-Cambrian rock consisting of the Longs Peak and related granites and the gneisses and schists of the Idaho Springs formation. The granites are strong massive rocks. Gneisses predominate over schists and only a small proportion have prominent and continuous cleavage planes. The proportion of granite to gneiss and schist is approximately 4 to 1.

From a detailed geological survey of the tunnel and comparing it with conditions actually encountered in the Moffat Railroad tunnel, which was built under the Continental Divide for the Denver & Salt Lake Railroad, and about 25 miles due south of this one, it was estimated there would be only 400 feet of bad ground and 5,200 feet of ground needing support. However, for purposes of estimate, it was figured there would be 6,900 feet of bad ground and 17,500 feet of ground needing support.

The total estimated cost is $7,271,371.

POWER CONDUIT NO. 1

Power conduit no. 1 extends from the east portal of the Continental Divide tunnel in Wind River to the penstock of power plant no. 1 on the northeast slope of Prospect Mountain.

Both ends of the Continental Divide tunnel are without the national-park boundaries but the area east of the east portal is authorized by Congress to be taken in, through that area. The water will be taken through a closed conduit consisting of a 10-foot reinforced concrete pipe completely buried. The total length of power conduit is 5.36 miles, of which 1.86 miles is closed conduit, 1.19 miles is concrete lined tunnel, 0.98 mile is siphon, and the remainder is open canal.

The total estimated cost of power conduit no. 1 is $1,101,000.

POWER PLANT NO. 1

Power plant no. 1 will be located on the south bank of the Big Thompson River about one-half mile east of Estes Park. It will contain two 15,000 kilovolt-ampere generating units with auxiliaries. Each unit will consist of a vertical-shaft, single-runner, spiral-casing type hydraulic turbine operating under an effective head of 705 feet direct connected to a 15,000 kilovolt-ampere water-wheel type generator. A complete description with cost estimate will be found in Power and Pumping Summary.

Until there has developed a sufficient market for power to justify the construction of power plants nos. 2 and 3, the water will be turned into the Big Thompson at power plant no. 1 and carried by that stream to a diversion dam located in SE¼ sec. 1, T. 5 N., R. 71 W., about midway between the present diversion dam and power plant for the town of Loveland, Colo.

POWER CANAL NO. 4

From this diversion dam the water will be carried in a canal of 750 cubic second-feet capacity on the south side of the stream a distance of 4.93 miles to a point just above the mouth of the Big Thompson Canyon. At this point a portion of the water will drop direct into the Big Thompson River to supply the supplemental water demands of that stream and a portion will be siphoned across to elevation 5,450 to supply the canal going to the Poudre River, which will be described later. Power plants nos. 4 and 4–A will be constructed at this point to take advantage of a fall of 550 feet into the Thompson and 358 feet to the Poudre Canal when the power market justifies.

CARTER LAKE SUPPLY CANAL

About 3.07 miles below the diversion dam mentioned above, a canal of 300 cubic feet per second takes off toward the south and supplies Carter Lake.

This canal is 8.78 miles in length, of which 7,040 feet is tunnel 1,878 feet siphon, and the remainder is open canal.

The estimated cost of this supply canal is $710,629.

CARTER LAKE RESERVOIR

This site is located in Ts. 4 and 5 N., R. 70 W., of sixth principal meridian, about 1 mile north and 7 miles west of Berthoud, Colo.

The reservoir will occupy a valley about 2¾ miles long and from one-half to 1 mile wide. The northern portion of the area is a natural

basin called Carter Lake. This lake dried up during the last 5 drought years, for the first time within the memory of the white settlers.

The proposed maximum water surface in the reservoir is at elevation 5,760 with a capacity of 111,963 acre-feet. The area of high water line is 1,150 acres. For this water surface three dams will be required. Dam no. 1 is located at the natural outlet of the valley and will contain the outlet works for the reservoir; the other two dams will occupy saddles. These dams are earth and rock fill; the main dam is 243 feet high, and the saddles 43 and 48, respectively.

The capacity of the outlet to St. Vrain supply canal is 300 cubic feet per second, the outlet to the Big Thompson has a capacity of 1,000 cubic feet per second.

The total estimated cost of the reservoir is $1,822,202.

ST. VRAIN FEEDER CANAL

A canal of 300 cubic feet per second capacity will extend from the small outlet of Carter Lake to the St. Vrain, reaching the St. Vrain high enough to supply all ditches.

The length of this canal is 9.76 miles with 3,445 feet in tunnel, 1,575 feet of siphons, and the remainder open canal.

The estimated cost of the St. Vrain feeder is $368,951.

BIG THOMPSON FEEDER

About one-half mile below Carter Lal e Dam a canal will be taken out of the draw leading from the dam, and will run into Cottonwood Creek, a tributary of the Big Thompson. This canal will have a capacity of 1,000 cubic feet per second and be 5.37 miles in length.

The cost is estimated at $155,246.

HORSETOOTH SUPPLY CANAL

This canal starts at the end of a siphon across the Big Thompson from power conduit no. 4. This water will pass through power plant no. 4–A when constructed. The canal starts at elevation 5,450 with a capacity of 250 cubic feet per second. The structures, however, are designed for a capacity of 400 cubic feet per second on the theory that some time in the future it might be necessary to increase the capacity of the canal to that amount. The length of this canal is 9.88 miles, of which 12,863 feet is tunnel, 3,296 feet is siphons, and the remainder open canal.

The elevation of 5,450 was chosen because it not only puts the water above all present diversions on the Poudre River, but it afforded the most direct and economical route.

The estimated cost of this feeder is $1,208,391.

HORSETOOTH RESERVOIR

The proposed Horsetooth Reservoir will occupy a valley 6 miles long and from one-quarter to three-quarters miles wide, extending in a north-south direction, formed by the erosion of soft red beds of Lykens formation between harder ridges of Lyons on the west and Dakota sandstone on the east. There are three natural outlets to the east through the Dakota hogback, namely, Soldier, Dixon, and

Spring Canyons, which are the sites of three proposed dams of the same names. The fourth proposed dam, Horsetooth, will cross the valley at the north end on a low saddle separating the valley from drainage to the north into the Poudre River. The outlet will be through the Horsetooth Dam saddle. There are no outlets through the other dams. The proposed water surface is at 5,400 feet in elevation which gives a capacity of 96,756 acre-feet. The area flooded will be 1,513 acres. The outlet capacity was designed for 1,200 cubic feet per second with reservoir full. This large capacity is necessary as the irrigation use requires that the entire amount of supplemental water be delivered at a rate that would supply it in 60 days.

The advantages of a reservoir at this point are: It is high enough to supply all users from the main Cache La Poudre River and is located close to it. It takes the place of 6 miles of canal through rough country and allows a canal of 250 cubic second-feet to be constructed from the Big Thompson instead of one for 1,000 cubic feet per second.

The estimated cost of the reservoir is $3,625,021.

POUDRE FEEDER CANAL

From the outlet of Horsetooth Reservoir a canal of 1,000 cubic second-feet capacity will extend north to Lewstone Creek, a tributary of the Poudre. The water will run down this creek to the Poudre above all the diversions except the Poudre Valley.

POUDRE VALLEY FEEDER CANAL

A canal will extend from Lewstone Creek to the Poudre Valley Canal about 1 mile below its headgate, crossing the Poudre River in a siphon. This canal will have a capacity of 400 cubic feet per second to take care of the supplemental demands of the Poudre Valley Canal and also the demands of the North Poudre irrigation district. The total length of the two canals is 5.48 miles.

The cost of the Poudre Feeder and Poudre Valley Canals is estimated at $632,843.46.

NORTH POUDRE FEEDER CANAL

It is planned to enlarge the Poudre Valley Canal for a distance of 3.58 miles from the point the supply canal enters to the location of the pumping plant for the North Poudre district. This will enlarge the canal from a capacity of 500 to 750 cubic feet per second and the estimated cost is $11,436.

NORTH POUDRE PUMPING PLANT

This pumping plant, constructed on the banks of the Poudre Valley Canal, will consist of two 75 cubic second-feet capacity vertical synchronous motor driven single stage pumps, operating against an effective head of 187 feet.

The estimated cost is $200,000.

NORTH POUDRE FEEDER CANAL

This canal of 150 cubic second-feet capacity extends from the pressure outlets of the pumping plant to the North Poudre Canal, a distance of 9.98 miles.

The estimated cost is $128,889.

ARKINS RESERVOIR

This reservoir is located on Buckhorn Creek, a tributary of the Big Thompson, in Tps. 5 and 6 N. R. 70 W., sixth principal meridian, and about 8 miles northwest of Loveland, Colo. The object of this reservoir is to provide storage for Colorado River waters brought over in the wintertime and to be used to supply supplemental water on the lower South Platte in water districts 1, 2, and 64. It will also serve in connection with the use of the 16,000 acre-feet of floodwater now available on the Big Thompson.

The bringing of more of the supplemental water over in the wintertime aids materially in the production of a maximum amount of power out of the waters of the Big Thompson River. For that reason the entire cost of the inlet to Arkins Reservoir and one-half the cost of the reservoir itself is assessed against power and paid for out of power revenues from plant no. 1.

The capacity of Arkins Reservoir is 50,000 acre-feet with a high water line at 5,275 feet elevation and floods 929 acres of land.

The dam site occupies a notch cut through the Dakota sandstone ridge by Buckhorn Creek.

The main dam is an earth- and rock-fill structure 155 feet in height with an outlet capacity of 650 cubic feet per second and a spillway of 10,000 cubic second feet capacity.

There is a saddle dam, in addition to the main dam of earth- and rock-fill construction, 50 feet maximum height, built across a saddle at the southern extremity of the reservoir.

The total estimated cost of the reservoir and dam is $1,740,737.

The estimated cost of the Arkins Reservoir inlet is $351,488.

This inlet diverts from the Big Thompson River just below the dam of the Handy Canal and follows around the north side of the river a distance of 2.33 miles to Arkins Reservoir.

ROCKY MOUNTAIN NATIONAL PARK

Every effort has been made in the survey and design of this project to not disturb the natural beauties of the Rocky Mountain National Park and its surrounding areas. The Continental Divide tunnel was lengthened 1.6 miles in order that its extremities should fall outside the boundaries of the park. The conduit leading from the east portal of the tunnel to power plant no. 1 is to be buried and the surface landscaped through the area authorized by Congress to be added to the park. The waste from the east portal of the tunnel placed in this area is to be terraced and planted with evergreen trees. The waste from the west portal is to be used to fill up some low areas and render the area suitable for the building of summer homes.

The approach to the Western Gateway of the Rocky Mountain National Park will be along the shores of Shadow Mountain Lake with

its fluctuation of only 1 foot instead of the swampy area that now breeds mosquitoes and exposes mud flats in low water.

The bill authorizing the creation of the Rocky Mountain National Park reserved the right for the Bureau of Reclamation to survey and construct an irrigation project within the boundaries of the park.

OPERATION OF THE SYSTEM

IRRIGATION PROJECT OPERATIONS

The system is planned and it is anticipated that it will be operated in a manner to have the water available in Carter Lake, Horsetooth and Arkins Reservoirs available by July 1, to the full capacity of those reservoirs, 256,000 acre-feet. The usual demand for supplemental water begins July 1 to 15 and extends to September 15 to 30. The outlets of the reservoirs are planned to deliver the water from the reservoirs in 60 to 75 days, including the water that must pass through them for direct delivery that may be in the way of being transferred from the Colorado River Basin to the eastern slope during the period of irrigation application. The balance of the 310,000 acre-feet, or 54-000 acre-feet, will be available for direct irrigation use as brought over during the above period or to some extent may be required prior to July 1.

The run-off of the waters of the Colorado River here contemplated to be used will largely be secured from the melting snows during May, June, and early July and stored in the Granby Reservoir. During the fall of that year, winter and spring of the following year, the water will be transferred from the Granby Reservoir through the Continental Divide tunnel at a uniform rate and restored in the Carter Lake, Horsetooth, and Arkins Reservoirs. This will permit a flow that is well suited to the development of firm power through the five power plants that will eventually be constructed along the Big Thompson as shown on the map of the general layout.

Granby Reservoir will act as a hold-over reservoir to carry the water from years of excessive run-off to years of subnormal flow.

POWER PROJECT OPERATION

Water will be carried through the Continental Divide tunnel at a uniform flow for the generation of power at the several power plants, except that the quantity will be reduced during the summer season when some water from the Big Thompson is available for power purposes in power plants nos. 2, 3, 4, and 4–A. At this period there will be little or no demand for power for pumping at the Granby pumping plant, which will permit the cutting down of the quantity of water to take care of the commercial power load.

It is planned to construct the Granby pumping plant and the Granby pump canal 150 percent of the capacity of the Continental Divide tunnel. This will permit the operation of the pumping plant at full capacity with off-peak power, and reduce the amount of pumping with firm power. The varying discharge of the pump ditch during the 24-hour period will be equalized by the Shadow Mountain and Grand Lakes, so that a uniform discharge will be maintained through the Continental Divide tunnel. The range in height of water surface in Shadow Mountain and Grand Lake to equalize this

flow will not exceed two-tenths of a foot, and will be greatest in the winter and early spring months.

There is an average of 16,000 acre-feet of surplus water on the Big Thompson available for storage in the system mainly in May and June. In order to take this water into the reservoirs it will be necessary to reserve capacity in the three reservoirs on the eastern slope until toward the latter part of June. The snowfall, the main source of this water supply, will be known well in advance so that operations of the several parts of the system, including the production of power at the several power plants, can be adjusted to take care of this water and hold back an equal amount in Granby Reservoir.

TENTATIVE PROJECT FINANCIAL SET-UPS

This proposed development consists of two projects: first, the irrigation project, and second, the power project.

It is planned that those features of the development that are used mainly for irrigation are grouped under the irrigation project set-up, while those used entirely, or are made of a greater capacity because of power development, are grouped in whole or in part in the power project set-up.

IRRIGATION PROJECT

The following major features with their appurtenant structures are given with the estimated field costs including 10 percent for engineering and 15 percent for contingencies. The full capacity of Arkins Reservoir is necessary to develop a larger portion of firm power than would otherwise be possible without it. At the same time, a reservoir of half its capacity or additional capacity in Horsetooth or Carter Lake Reservoirs would be necessary to provide capacity to deliver the irrigation water as needed. It is, therefore, deemed equitable to divide the cost of this reservoir equally between the irrigation and power projects.

The Green Mountain Reservoir, with a capacity of 152,000 acre-feet, is larger than is necessary to furnish replacement for a like amount of water diverted by the project above Granby Dam at a time when it would be required for irrigation, present and future, and to furnish the Shoshone power plant 1,250 second-feet or such lesser amount that they would be entitled to receive if the proposed project was not operating. From studies made, it appears that 50,000 acre-feet will be sufficient to replace all the water that the proposed project will take at a time when required for use lower down in the stream within the State. Therefore 52,000 acre-feet of the Green Mountain Reservoir capacity is allocated for replacement (including evaporation losses) and charged to the irrigation project. The balance of the capacity or 100,000 acre-feet is allocated to the power project and is to be paid for out of power revenues.

The following is a summary of the irrigation project costs:

Estimated cost chargeable to irrigation feature

Willow Creek feeder canal	$733,203
Granby Reservoir	2,813,703
Granby pumping plant	1,250,000
Granby pump canal	417,553
North Fork diversion dam	483,928
Continental Divide tunnel	7,271,371

Estimated cost chargeable to irrigation feature—Continued

Carter Lake supply canal		$710,629
Horsetooth supply canal		1,208,391
St. Vrain feeder canal		368,951
Big Thompson feeder canal		155,246
Poudre feeder canal		632,843
Poudre Valley feeder canal		11,436
North Poudre feeder canal		128,889
North Poudre pumping plant		200,000
Horsetooth Reservoir		3,625,021
Arkins Reservoir		1,859,323
Carter Lake Reservoir		1,925,253
Green Mountain Reservoir (52,000 acre-feet replacement) (100,000 acre-feet for power)		3,776,032
Improvement of Colorado River above Kremmling to maintain fishing and to adjust the present irrigation system to the altered conditions		300,000
		27,871,772
Less the following items tentatively chargeable to power:		
One-half cost of Arkins Reservoir	$929,661	
Portion of cost of Green Mountain Reservoir for 100,000 acre-feet	2,276,032	
		3,205,693
Cost of irrigation features		24,666,079
Say		24,800,000

REPAYMENT

Twenty-four million eight hundred thousand dollars upon 310,000 acre-feet at $80 per acre-foot.

Two dollars per acre-foot on 40-year repayment basis.

In the above repayment is predicated upon the contracts to be made upon a basis of 310,000 acre-feet. Beside the 320,000 acre-feet available from the Colorado River drainage there is an average of 16,000 acre-feet available for storage on the Big Thompson, making 336,000 acre-feet in all, leaving 26,000 acre-feet for losses on the eastern slope and for the uncertain, heretofore mentioned in operations on the western slope.

The power costs are shown under the heading "Power and pumping system."

The construction of power plant no. 1 as shown in the power set-up is a necessary development in order to secure power for pumping purposes at the Granby pumping plant.

POWER AND PUMPING SYSTEMS

The ultimate power and pumping system is proposed to consist of the major pumping plant at Granby, power plant no. 1 near the town of Estes Park, power plant no. 2 near Drake post office, power plant no. 3 at Cedar Cove, power plants nos. 4 and 4–A near the mouth of the Big Thompson Canyon, and power plant no. 5 at the Green Mountain Reservoir. If conditions justify, there may also be a pumping plant on the Poudre River near the point where the proposed Poudre supply canal crosses the river. Power plant no. 5, Granby pumping plant, and power plant no. 1, would be interconnected by a single circuit 69,000-volt transmission line. Power plants nos. 1 to 4–A, inclusive, would be interconnected by two 115,000-volt transmission lines and these same lines would extend to one or more load centers where the power could be disposed of commercially.

The buildings for the power and pumping plants would be of reinforced concrete construction of suitable size to house the machinery and provide space for such facilities as would be required for efficient and economical operation. For scenic reasons, special care would be taken in the architectural design of the buildings to make them blend in with the beauties of the surrounding territory so as to be both as inconspicuous as possible and also as artistic as feasible without undue expenditure. An artist's sketch of one of these buildings is included with the report.

Following is a tabulation covering the essential data for each of the power and pumping plants:

Power plants

Plant designation	Effective head in feet	Turbine capacity in cubic feet per second	Power available in horsepower	Number of units	Size of each unit in horsepower	Installed power in kilowatts
No. 1	704	550	38,800	2	20,000	30,000
No. 2	1,195	550	65,800	2	34,000	50,000
No. 3	328	550	18,000	2	9,000	13,500
No. 4	550	400	22,000	1	22,000	16,000
No. 4-A	381	250	9,500	1	9,500	7,000
No. 5	225	1,500	33,800	2	17,000	26,000
Total installed power in kilowatts						142,500

Pumping plants

Plant designation	Head in feet	Pump capacity in cubic feet per second	Capacity of each pump in cubic feet per second	Number of pumps	Rating of each motor in horsepower	Power required in kilowatts
Granby	130	870	290	3	6,500	15,000
Poudre	187	150	75	2	2,000	3,000
Total installed pumping, kilowatts						18,000

POWER PLANT NO. 1

Power plant no. 1 will be located on the south bank of the Big Thompson River about one-half mile east of the village of Estes Park and will contain two 15,000 kilovolt-ampere generating units with auxiliaries. Each unit will consist of a vertical-shaft, single-runner, spiral casing type hydraulic turbine operating under an effective head of approximately 705 feet and direct connected to a 15,000 kilovolt-ampere water-wheel type generator with direct connected exciter and pilot exciter. Water would be supplied to each turbine through a steel penstock approximately 5,000 feet long, with synchronous bypasses provided so that the flow through the penstock can be discharged either through the turbines or the bypasses into the Big Thompson River. The bypasses will be mechanically connected to the turbine gate operating mechanism so that rapid governing of the units under varying load conditions can be effected without creating excessive water hammer. Trashracks with shut-off gates for

each penstock will be provided in the forebay structure. The headgates will be controlled from the power plant. A spillway will be provided to care for the flow when the headgates are closed and the penstocks inoperative. The plant will be equipped with all necessary auxiliaries, including a traveling crane for handling the large pieces of equipment. A small machine shop will be provided for making minor repairs. An outdoor type substation with self-cooled transformers will be provided for stepping the voltage up to 69,000 for transmission to the Granby pumping plant, and to 115,000 volts for transmission to commercial markets. The substation structure will be of the conventional structural steel type with high voltage oil circuit breakers, lightning arresters and necessary auxiliaries. The control of the oil circuit breakers will be from the main power plant switchboard. Operators' quarters, a warehouse, and a large machine shop for general project repairs will be provided in the vicinity of the power plant.

POWER PLANT NO. 2

Power plant no. 2 will be located about one-half mile northwest of Drake, on the south bank of the north fork of the Thompson River just above its junction with the Big Thompson. The plant will contain two 25,000-kilovolt-ampere generating units of the horizontal shaft type. The net head will be approximately 1,195 feet. Each unit will consist of a double overhung impulse wheel hydraulic turbine with the generator mounted in the center, between the two runners. A direct connected exciter and pilot exciter will be mounted at one end. Water will be delivered to the turbines through two steel penstocks about 4,150 feet long. Each penstock will be provided with two branches to the turbine nozzles and each branch will be provided with a synchronous bypass arranged so that the flow through the penstock can be discharged through either the nozzles of the bypasses to the river. The bypasses will be mechanically connected to the turbine nozzle operating mechanism so that rapid governing can be effected under varying load conditions without excessive water hammer. The head-gate structure will be provided with trash racks and sliding gates at the end of the penstocks and a spillway to care for the flow when the gates are closed. The plant will be complete with all necessary auxiliaries for station service requirements and with a crane for handling the machinery. A structural steel outdoor type substation will be provided with self-cooled transformers for stepping the voltage to 115,000 volts, and with outdoor type oil circuit breakers, lightning arresters, and other necessary auxiliaries. The operation of the substation will be handled from the main switchboard of the power plant. Quarters for the operators will be provided adjacent to the power plant.

POWER PLANT NO. 3

Power plant no. 3 will be located about one-half mile east of the Loveland power-diversion dam on the north bank of the Big Thompson River. The plant will contain two 6,500 kilovolt-ampere generating units, each consisting of a vertical hydraulic turbine direct connected to a generator with main exciter and pilot exciter. The effective head will be approximately 328 feet. Water from the head-gate structure will be delivered to the turbines through steel

pen stocks about 650 feet long. Each pen stock will be provided with a synchronous bypass arranged so that the flow through the pen stock can be discharged either through the turbines or the bypasses to the Big Thompson River, and to allow rapid governing of the units without excessive water-hammer. The head-gate structure will be provided with trash racks and sliding gates at the head of the pen stocks and a spillway to care for the flow when the gates are closed. The plant will be complete with all necessary auxiliaries for station-service operation, and with a crane for handling equipment. The plant will be provided with a structural-steel outdoor-type substation similar to that proposed for plant no. 2.

POWER PLANTS NOS. 4 AND 4–A

Power plant no. 4 will be located about 2 miles east of Cedar Cove on the south bank of the Big Thompson River, while power plant no. 4–A will be located a short distance upstream from plant no. 4, and at an elevation about 175 feet above the river. The capacity of plant no. 4 will be 16,000 kilovolt-amperes and of plant no 4–A, 7,000 kilovolt-amperes. One unit only will be provided at each plant and will consist of a vertical-shaft, single-runner, spiral-casing type turbine direct connected to a vertical water wheel generator with direct connected main and pilot exciters. Plant no. 4 will have an effective head of about 550 feet, and plant no. 4–A, 380 feet. Plant no. 4 will receive its water through a single steel penstock about 1,960 feet long, and plant no. 4–A, through a similar pipe about 1,400 feet long. Each plant will be provided with synchronous bypasses similar to those in plants nos. 1 and 3. Plant no. 4 will discharge directly into the Big Thompson River. Plant no. 4–A will be siphoned under the river through a pressure tunnel to the proposed Poudre supply canal, but will have provisions so that if so desired, the water may be discharged directly into the Big Thompson River. The headgate structure will be provided with trashracks, sliding gates, and spillways similar to those in plants nos. 1, 2, and 3. A single outdoor structural steel type switchyard will be provided for the two plants. The equipment in this substation will be similar to that for plants nos. 1, 2, and 3. Plant no. 4–A will be remotely controlled from plant no. 4, so that the two plants can be operated with one set of operators. The plant will be complete with auxiliaries and cranes similar to that in other plants. Quarters for the operators will be provided in the vicinity of the plants.

POWER PLANT NO. 5

Power plant no. 5 will be located about 12½ miles southeast of Kremmling, on the east bank of the Blue River, immediately downstream from the dam forming the proposed Green Mountain Reservoir. The plant will contain two 13,000 kilovolt-ampere generating units of the vertical hydraulic-turbine driven type, with direct connected generator with main and pilot exciters. The plant will have a varying head depending upon reservoir water surface, but it is expected that the average head will be about 225 feet. The trashrack and intake structure will be located immediately upstream from the dam and a single steel penstock installed in the tunnel will conduct the water to the power plant. Each turbine will be provided with a

pressure regulator or relief valve to limit the water hammer under sudden change of load conditions. The plant will be complete with necessary auxiliaries for station service, a small machine shop for minor repairs, and a crane for handling equipment. An outdoor structural steel substation will be provided complete with equipment for stepping the voltage up to 69,000 volts for transmission and with oil circuit breakers and other necessary auxiliaries for the control and protection of the lines and equipment. The oil circuit breakers will be controlled from the main switchboard of the power plant. Quarters for operators will be constructed in the vicinity of the power plant.

GRANBY PUMPING PLANT

The Granby pumping plant will be located approximately 6 miles south of the village of Grand Lake on the north shore of the proposed Granby Reservoir. The plant will contain three motor-driven vertical-shaft pumping units having a total capacity of 900 second-feet at full reservoir, and 550 second-feet at low water. The total capacity at the normal water surface will be approximately 870 second-feet. The motors will be of the synchronous type and arranged for semi-magnetic operation. That is, the operator will be required only to close the main switch to the unit in order to place it in operation, and to open the same switch to discontinue operation. The motors will be equipped with direct connected exciters. The water from the Granby Reservoir will be delivered to the pumps through tunnels about 155 feet long. A channel in the reservoir will convey the water to the mouth of the intake tunnels in extreme low water. Water from each pump will be discharged through about 175 feet of tunnel, and 165 feet of steel pipe to the canal at elevation approximately 8,381. This canal, which will be approximately 4 miles in length, will discharge into the proposed Shadow Mountain Lake. The center line of each pump and propeller will be at approximately elevation 8,145, with the base of the motor driving the pump 135 feet above, or at elevation 8,280. Vertical shafts in the rock between the underground pump room and the motor room on the surface will accommodate the shafts connecting the pumps to the motors. Each pump will have a capacity of 290 second-feet when operating under a total dynamic head of 130 feet and will be driven by a 6,500-horsepower synchronous motor.

The entrances to the intake tunnels will be provided with trashrack and stop-log structures, and sliding gates will be installed at the intake and discharge of each pump. The intake gates will be located in the gallery adjoining the pump room and will be hydraulically operated. The discharge gates will be located at the head of the canal and will be of a type which will close automatically in the event power service is interrupted, so as to prevent water in the canal from running back down through the pump.

The pumping plant will be complete with auxiliary pumping units for unwatering the intake and discharge tunnels and the drainage sump. It will also be complete with all other necessary station auxiliaries, including a crane for handling the equipment. A small machine shop will be provided for making minor repairs. Quarters for the operators will be provided in the vicinity of the plant.

Power will be delivered to the plant from a 69,000-volt transmission line, through an outdoor structural steel type substation containing self-cooled transformers, together with all necessary protective appa-

ratus and auxiliaries. The operation of the substation will be handled from the main switchboard of the pumping plant.

POUDRE PUMPING PLANT

The Poudre pumping plant will be located on the Poudre Valley Canal at a point about 3 miles below the crossing of the proposed Poudre supply canal. It is proposed to have a capacity of 150 second-feet, composed of two 75-second-foot vertical synchronous-motor-driven single-stage pumps, operating against an effective head of 187 feet. The plant will be complete with all necessary auxiliaries, including a crane for handling the equipment. An outdoor substation will be provided for stepping the voltage down from transmission voltage to motor voltage. Due to the relatively short periods of operation, it is not probable that it will be necessary to construct operator's quarters at this plant.

TRANSMISSION SYSTEM

The transmission system will consist of a single 69,000-volt circuit connecting power plant no. 5 with the Granby pumping plant and power plant no. 1. Power plants nos. 1 to 4–A, inclusive, will be connected by two 115,000-volt lines and two 115,000-volt lines will continue to market. For the purpose of this report only, and to include a sufficient amount in the cost estimates for any probable transmission set-up, this market has been assumed as the valmont steam plant of the Public Service Co. of Colorado. Power plant no. 4 will be connected with the Poudre pumping plant by one 34,500-volt transmission line. The number of lines and mileage involved in each are as shown in the following tabulation:

From—	To—	Number of lines	Number of miles	Voltage
Power plant no. 5	Ka Rose	1	38	69,000
Granby pumping plant	Grand Lake	1	10	69,000
Do	Power plant no. 1	1	36	69,000
Power plant no. 1	Power plant no. 2	2	12	115,000
Power plant no. 2	Power plant no. 3	2	3	115,000
Power plant no. 3	Power plant no. 4	2	4	115,000
Power plant no. 4	Valmont	2	27	115,000
Do	Poudre pumping plant	1	18	34,500

The line to the Poudre pumping plant would be a wood-pole line with pin-type insulators. All other lines would be of the wood-pole, H-frame type, with suspension insulators, and combining all of the most modern features for continuity of service, ease of maintenance, and long life. The line from power plant no. 1 to the Granby pumping plant will probably require special construction to give added strength in the mountainous region near the Continental Divide.

In order to provide power for construction, it is proposed that one of the first features of the project would be to build one of the permanent 115,000-volt circuits from the Valmont plant to plant no. 1, the permanent 69,000-volt lines from plant no. 1 to Granby pumping plant and from Ka Rose to the Green Mountain dam site, and an extension from the Granby Pumping Plant to the west portal of the pro-

posed tunnel. Initially this entire line would be operated at 69,000 volts, and under such operation would be adequate for all contemplated construction activities. In connection with supplying construction power it would also be necessary to install a substation at the Valmont steam plant to step voltage up to 69,000 volts for transmission. Preliminary studies indicate that it would be advisable to make this substation of approximately 5,000 kilovolt-ampere capacity.

The estimated cost of installing the facilities to provide construction power are as indicated in the following tabulation:

From—	To—	Miles	Cost	
			Per mile	Total
Valmont	Power plant no. 2	34	$6,750	$229,500
Power plant no. 2	Power plant no. 1	12	4,100	49,200
Power plant no. 1	Granby pumping plant	36	3,600	129,600
Granby pumping plant	Grand Lake	10	3,200	32,000
Ka Rose	Power plant no. 5	36	3,600	129,600
Total transmission lines		128		569,900
Substation at Valmont				61,300
Total to supply power for construction				631,200

The transmission system as provided to furnish construction power would be adequate for transmission of power to markets from power plant no. 1 or power plant no. 5 if either were built individually, but the additional complete system would probably be constructed when two or more plants are constructed. The additional costs of the lines involved in this construction are shown in the following tabulation:

From—	To—	Miles	Cost	
			Per mile	Total
Power plant no. 1	Power plant no. 2	12	$4,100	$49,200
Power plant no. 2	Valmont	34	6,750	229,500
Power plant no. 4	Poudre pumping plant	18	1,800	32,400
Total additional cost of permanent transmission system		64		311,100

In addition to the transmission lines required for the disposal of power, it may be necessary that the Government also construct a substation at the point of power disposal. As a market survey has not been conducted to establish the points at which this power can be disposed of, or the quantities involved at each point of disposal, it is assumed for the purpose of this report that the substations will average in cost $10 per kilowatt of capacity. Assuming that provision is made to dispose of a peak capacity of 140,000 kilowatts, this will involve an additional expenditure of $1,400,000.

POWER OUTPUT

Water supply studies indicate that with power plant no. 1 only constructed, there is available, above all requirements for pumping purposes, a constant power output at 100 percent load factor of 120,000,000 kilowatt-hours per year. Since the pumping plant capac-

ity proposed is sufficient to allow pumping to be done in 16 hours of each day it will be possible to handle peak commercial power requirements without undue interference. With this in mind, it has been assumed for the purpose of this report that a market can be found which has a load factor such that 60 percent of this power or 72,000,000 kilowatt-hours per year can be absorbed as firm energy. The balance of this energy, or 48,000,000 kilowatt-hours per year, plus about 40,000,000 kilowatt-hours additional, which is available during various parts of the year, is classed as secondary energy.

Since the Valmont steam plant of the Public Service Co. of Colorado has an installed capacity of 75,000 kilowatts, it appears that the 88,000,000 kilowatt-hours of secondary energy could be absorbed as a fuel saving measure if the price does not exceed fuel costs. Allowing 10 percent for line losses, this is equivalent to an average load of about 9,000 kilowatts.

FINANCIAL OPERATION OF POWER SYSTEM

It is contemplated that the initial power development would consist of the construction of power plant no. 1 only, together with such transmission lines and substations as are required to supply power to the Granby pumping plant and to commercial markets. The estimated construction cost of the strictly power features, as well as items which it is expected that power revenues will repay, is given below.

It is assumed that 5 mills per kilowatt-hour can be secured for firm energy and 1.8 mills per kilowatt-hour for secondary energy with delivery at the market. In each case 10 percent loss is allowed for transmission. The following gives the financial set-up for power plant no. 1, operation costs and returns.

While for the purpose of this report the allocation of construction cost to irrigation and power has been made on the basis set out below, it is understood that this allocation is not thereby fixed, and the same may be changed as further information may warrant until such time as the contract for repayment of the cost of the irrigation features has taken final form.

Power plant no. 1 construction costs

Power plant no. 1 near Estes Park	$1,778,000
Conduit from east portal continental divide tunnel to power plant no. 1	1,101,000
Transmission lines connecting power plant no. 1 with Granby pumping plant—with Valmont and line to North Poudre pumping plant	440,000
	300,000
Commercial substation (30,000 kilowatts)	100,000
Headquarters at power plant no. 1 for operation of power system	
Subtotal	3,719,000
Interest during construction, 3 percent	112,000
Total repayable in 50 years with interest	3,831,000
One-half cost of Arkins Reservoir	929,661
Portion of cost Green Mountain Reservoir, for 100,000 acre-feet allocated to power	2,276,032
Payable on 40-year basis without interest	3,205,693
Total cost power plant no. 1 including other items that are required to be accomplished with the initial development	7,036,693

Annual revenues from power plant no. 1

From sale of 65,000,000 kilowatt-hours firm power, at $0.005	$325,000
From sale of 79,000,000 kilowatt-hours secondary power, at $0.0018	142,000
From rental of water for power development to privately owned plants	20,000
Gross annual income	487,000

Annual operation and maintenance plus retirement of principal

Brought forward	$487,000
3.887 percent, on $3,831,000, interest and retirement of investment on basis of 50 years	148,000
Repayment of $3,205,693 on basis of 40 years without interest	80,000
Operation and maintenance of power plant	36,000
Operation and maintenance Granby pumping plant	27,000
Operation and maintenance of transmission lines	13,800
Operation and maintenance conduit, tunnel, and canals	15,000
Depreciation, 1.5 percent, on $3,831,000	57,000
General expense	18,200
Total annual costs	395,000
Annual surplus during 40 years repayment period of the non-interest-bearing obligation	92,000

FULL POWER DEVELOPMENT

The results of this study indicate that the initial installation proposed is sufficient from a financial standpoint to return all necessary costs of operation and repayments.

There are five additional plants that can be developed in the future in a manner that will keep pace with the power requirements of the section that may be served and not have a large unearning investment tied up for some years.

The following is an estimate of the cost of the additional power plants that may be constructed in the future, but are not a part of the initial development.

Power plant no. 5	$1,190,000
Green Mountain-Ka Rose transmission line	130,000
Operators' quarters	60,000
Substation (20,000 kilowatts)	200,000
Subtotal	1,580,000
Interest during construction, 3 percent	47,400
	1,627,400

The above plant, together with plant no. 1, will produce: 113,000,000 kilowatt-hours firm power annually; 92,000,000 kilowatt-hours secondary power annually.

The following are the construction costs of developing power plants nos. 2, 3, 4, and 4–A with appurtenant structures:

Power plant no. 2	$2,325,000
Power plant no. 3	665,000
Power plant no. 4	760,000
Power plant no. 4–A	420,000
Power canal no. 2	2,444,000
Power canal no. 3	493,000
Power canal no. 3–A	113,000
Power canal no. 4	1,194,000
Operators' quarters	150,000

Substations (90,000 kilowatt hours)	$900, 000
Additional transmission lines	311, 000
Subtotal	9, 775, 000
Interest during construction, 3 percent	293, 250
Total repayable in 50 years with interest	10, 068, 250
Arkins Canal feeder, payable in 40 years without interest	351, 000
Total power plants nos. 2, 3, 4, and 4–A	10, 419, 250
Total power plant no. 5	1, 627, 400
Total second-stage development	12, 046, 650
Primary development plant no. 1	7, 036, 693
Cost of full power development	19, 083, 243

The total salable output of the full development is estimated as follows, exclusive of that used for pumping:

	Kilowatt-hours
Firm power, annually	360, 000, 000
Secondary power, annually	[1] 200, 000, 000

[1] Out of an available production of 387,000,000 kilowatt-hours secondary power.

CONCLUSIONS

(1) There is a large area (615,000 acres) of irrigated land in northeastern Colorado, the major portion of which has an inadequate water supply.

(2) The feasible storage possibilities with the available water supply in the drainage area has been exhausted.

(3) There is at least an available water supply of 310,000 acre-feet on the upper drainage area of the Colorado River that can be diverted to supplement the present water supply on the eastern slope.

(4) That the diversion of this quantity of water from the Colorado River watershed will not interfere with or encroach upon the present or future irrigation along the Colorado River and tributaries within the State, with the protection provided in the Green Mountain Reservoir.

(5) That the plan for the project here laid out appears entirely feasible from a construction point of view.

(6) That the cost of construction estimated at $2 per acre-foot per annum over the repayment period of 40 years is less than storage water is now commanding and that it will increase the crop values five or more times this annual cost, showing its economic worth.

(7) That the power developments that may be made in the six power plants will produce a large quantity of cheap hydroelectric power that will materially benefit Colorado.

(8) That the revenues from the commercial power generated at power plant no. 1 will pay for the power features as set up under the initial power development, in addition to the power required for pumping at Granby pumping plant, and in lieu of the irrigation features used in power development, the operation of the system to a point where the water leaves the tailrace of the lower power plants can be taken care of by the power development.

(9) That the cost of the irrigation feature of the project is within the ability of the water users to pay.

7.72.2.2.3

In Reply Refer To:
S-601

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COPY

South Platte River District
Building 50, Denver Federal Center
Denver, Colorado

January 8, 1954

Mr. Martin J. Harrington, Attorney
Grand Lake Water Level Committee
Suite 728, University Building
Denver 2, Colorado

Dear Mr. Harrington:

This is in reply to your letter of December 1, 1953, requesting further explanations on certain phases of operations relative to water surface elevations and the presence of algae in Grand Lake.

During the past summer season, the water level in Grand Lake was maintained between 8366 and 8367 feet which was in accordance with the information in my open letter and in conformance with Senate Document No. 80. As previously explained, the water level must be maintained at an elevation of 8366.3 to obtain full tunnel capacity. The water level was maintained slightly in excess of 8366.3. It was necessary to maintain this level so that required diversions could be maintained while the pumps were idle during the day.

I am sure if you or your committee care to investigate our pumping records which are available at the Granby Pumping Plant, you will find that pumping was done with power from "off peak" production. Our records will also show that we pumped 1 hour 53 minutes in May, 2 hours 42 minutes in June, 618 hours in July, 584 hours in August, and 680 hours in September. Two pumps were operated at various times and none were operated continuously.

To maintain a live stream between Shadow Mountain and Granby Reservoirs, releases from Shadow Mountain Reservoir were made in conformance with an agreement between the Fish and Wildlife Service and the Bureau of Reclamation. This agreement provides for a release of 25 cfs from October through May and 50 cfs from June through September. Examination of our records will show that we complied with this agreement. During the "runoff" from May 20 to June 25, releases, of course, were in excess of this amount.

Late in the summer of 1952, the City of Loveland reported to the Bureau the presence of algae in the municipal water supply and requested that we do something about it. The matter was discussed with

EXHIBIT 34

2009.73.2.a4

our Regional Counsel and he advised me that this situation should be classified under the term "consequential damages," i.e., natural results, and, therefore, the Bureau had no legal responsibility.

Through the efforts of the City Engineer of Loveland, representatives from the following agencies: Colorado Department of Public Health, Colorado Game and Fish Department, Northern Colorado Water Conservancy District, City of Greeley, City of Fort Collins, City of Loveland and the Bureau of Reclamation, met July 30, 1953, at Loveland to discuss the algae problems in the Big Thompson River and all the waters of the Colorado-Big Thompson Project. At the end of the discussion, the Colorado State Board of Health was requested to investigate the source or sources of algae and, if necessary, enlist the aid of the U. S. Public Health Service in an attempt to find a solution to the problem. During the late summer, samples of water for testing were sent to the Colorado Department of Public Health by the City of Loveland, State Game and Fish Department, and the Bureau. The U. S. Public Health Service was also contacted but, because of lack of personnel, was unable to assist during the period of algae infestation. The City Engineer of Loveland has advised me informally that the algae condition this past season was so much less severe that little special treatment of the domestic water supply was required.

Mr. William Gahr, State Sanitary Engineer, informs me that the City Engineer of Loveland is planning another meeting of this group sometime this spring to work out a program for the coming season. It is suggested that residents of the Grand Lake area join this group to assist in working out a solution of the problem.

In your letter, you also informed me that a survey was being made of the possible claims for damages by various property owners around Grand Lake. If property owners desire to file claims, it is proper for them to do so. When claims are filed, they will be considered on their merits.

If I can be of any further assistance to you in the resolution of these problems, please so advise me; or, I will be glad to discuss these matters with you at any time convenient for you.

Very truly yours,

s/ J. H. Knights

J. H. Knights
District Manager

February 8, 1954.

Dear Friends:

On December 2 we mailed you a copy of a letter written to Mr. Knights at the Reclamation Bureau. We also gave you a brief report of your committee's activities.

In January we received a letter of reply from Mr. Knights. A copy of Mr. Knights' reply is attached.

After we had received Mr. Knights' letter and had studied it, we thought it best that we get our committee together and arrange a conference with Mr. Knights at the Bureau of Reclamation offices.

On Tuesday afternoon, January 12th, at 2:00 p.m. part of your committee met with Mr Knights and two of his engineers. The committee members present were Donald Campbell, Henry Rhone, Dick Cadell, and Clarence Beaglehole, with Martin Harrington as Counsel.

We might say that our meeting was on a very friendly basis; and even though at times the discussion could easily have gotten rather heated, the entire conference was held at a very high level.

Our discussion on the water level was rather brief. Mr. Knights again told us that the project was set so as to operate the lake between 8366 and 8367 feet. During most of the summer the lake was held at around 8366.78 to 8366.80 feet. The lake is now frozen at about this level. We asked Mr. Knights if they might not operate the lake at around 8366.5 feet, and that if in an emergency they did need it then they could go to even the 8367 feet. He promised that he would check this with the engineering department and that he would let us know.

We did spend a great deal of time on the algae problem. You will note from the attached letter that as far as the folks in the Loveland area are concerned, the Bureau does not accept any of the responsibility for the algae. Martin Harrington asked Mr. Knights if he would get an opinion from their legal department as to whether or not the Bureau would accept the responsibility for the algae as far as Grand Lake is concerned. This Mr. Knights promised he would do.

2004.73. [illegible]

February 8, 1954.

Donald Campbell brought up the point that in Senate Document 80 it is very definitely stated that when the project was completed it would retain the natural beauty of Grand Lake and in fact improve it. This is a point on which we feel we have a very definite complaint, and we are sure that you agree on this. We will not give you all the details of our discussion as many important points were brought up but the final decision was this---we are now going to have a meeting with the State Health Department, and the State Health Department, with the cooperation of the Bureau, is going to try and get a member of the Federal Health Department out here so that we may come to some final conclusion. Mr. Knights stated that the Bureau is very anxious to do something on the algae problem but up to this point they are at a loss on what may be done. We suggested that it had been suggested by Fred McLaren that possibly Shadow Mountain Lake might be drained and the algae formation be burned out. Mr. Knights has just phoned Martin Harrington that they are now checking this possibility. This is to keep you informed and to bring you up to date on our activities and, if you have any constructive suggestions your committee will greatly appreciate them.

Donald Campbell
Henry Rhone
Dick Cadell
Clarence Beaglehole

EUGENE D. MILLIKIN, COLO., CHAIRMAN
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ROBERT S. KERR, OKLA.
J. ALLEN FREAR, JR., DEL.
RUSSELL B. LONG, LA.

United States Senate

COMMITTEE ON FINANCE

February 15, 1954

Mr. G. A. Spitzmiller
P.O. Box 128
Grand Lake, Colorado

Dear Mr. Spitzmiller:

Senator Millikin is in Colorado for a few days and in his absence I am taking the liberty of acknowledging your letter of February 10, 1954, concerning conditions at Grand Lake due to algae in the water.

In replying to others who have written him on this subject, Senator Millikin has stated:

> "I have been advised that the problem is a serious one. I have been informed that a committee has been organized which includes representation from the Bureau of Reclamation, State Public Health Department, The Northern Colorado Conservancy District, City of Loveland, and a representative of the Colorado Water Conservation Board. As you may know, a meeting has been called at Loveland for February 18, 1954, for a technical discussion of the possible solutions."

Please be assured your letter will be brought to the Senator's attention at the earliest opportunity, and I know he will appreciate having the benefit of your observations.

Sincerely yours,

Dorothy A. McRae

(Mrs.) Dorothy A. McRae
Administrative Assistant
Senator Eugene D. Millikin

DM:m

Feb. 24, 1954

Dear Friend,

Thank you for the letter that you sent to U.S. Senator Eugene D. Millikin, Washington, D.C., regarding the algae condition in Grand Lake. It is now unmistakably known in Washington that we are all very much perturbed and want action.

To bring you up-to-date, a meeting was held on Thursday, February 18, 1954 in Loveland, Colorado to find a possible solution to the algae infestation of Grand Lake and was attended by representatives from The Bureau of Reclamation, State Public Health Department, State Game and Fish Department, The Northern Colorado Conservancy District, Cities of Loveland, Berthoud, Ft. Collins, Greeley, Longmont and Boulder, U.S. National Parks Department, Grand Lake and other interested individuals. It was recognized and agreed that algae is a very serious and important problem and something must be done now to control it for the summer of 1954.

The meeting took most of the day and to be brief, it was more or less decided that copper-sulphate would be used to treat the lakes after samples of the water were carefully analyzed. This is necessary in order to determine the amount of treatment needed to kill the prevailing type of algae but not injure the fish life. Working committees were chosen from the various groups to make this study and to handle the treatment arrangements.

For your information the following prominent officials in Washington and in the State of Colorado have been clearly informed of our serious situation. We have been assured of their help.

U.S. Senator Eugene D. Millikin of Colorado, U.S. Senate, Washington, D.C.
U.S. Senator Edwin C. Johnson " " " " " "
U.S. Repr. William S. Hill " " Hse. of Reprs. " "
U.S. Repr. Wayne N. Aspinall " " " " " " "
Hon. Douglas McKay, Secretary of Interior, " "
W.A. Dexheimer, Chief of the Bureau of Reclamation, " "
Governor Dan Thornton of Colorado, State Capitol, Denver, Colo.
Colo. Senator E.P. Hazard, Chm. Water & Water Resources, Saguache, "
Colo. Senator Fay DeBerard Kremmling, "
Colo. Repr. Farrington R. Carpenter Hayden, "
Colo. Repr. Mrs. Eleanor Carr, 747 Downing St., Denver, Colorado

It is still not too late to write to any of the above officials about the ruining of Grand Lake; the more complaining letters they receive the hotter the issue will be. In addition, for Grand Lake out-ot-state residents, letters to your own United States Senators would definitely help.

Again we thank you for your cooperation.

With very best regards, I am

Sincerely,
Robert L. Coon,
1757 Bellaire St.,
Denver 7, Colorado

RLC:ds

THIS IS A COPY OF A LETTER SENT TO OUR U.S. CONGRESSMEN. HAVE YOU SENT YOUR LETTER??

Denver, Colorado,
February 27, 1954

U.S. Senator Eugene D. Millikin,
United States Senate,
Washington, D. C.

Dear Senator Millikin:

This is to inform you of the results and our comments of the meeting held February 18, 1954 in Loveland, Colorado regarding the algae infestation of Grand Lake. Representatives from the following organizations were present; The Bureau of Reclamation, State Public Health Department, State Game and Fish Department, The Northern Colorado Conservancy District, Cities of Loveland, Berthoud, Boulder, Ft. Collins, Greeley and Longmont, U.S. National Parks Department, Grand Lake and other interested individuals.

All of the representatives recognized that algae control is a very serious and important problem and something must be done now to curb it for the summer of 1954. It was brought out that it could be controlled by the use of copper-sulphate treatments, however, samples of the water would have to be carefully analyzed to determine the amount of treatment needed to kill the prevailing type of algae but not injure the fish life. Working committees were chosen from the different groups to make this study and to handle the treatment work. There was, of course, no offer by representatives of the Reclamation Bureau to take over this work on a permanent basis and assume their responsibility because of lack of authority.

The treatment arrangements for this summer are only temporary and would not work out satisfactorily on a permanent basis because it will be necessary to continually treat the water pumped into the canal between Granby and Shadow Mountain reservoirs as well as Shadow Mountain Lake itself during the spring, summer and fall months. The Bureau of Reclamation should assume their rightful responsibility in this connection because it is their project, they created it, operate it and are liable under Senate Document No. 80 wherein it is stated that the natural beauty of Grand Lake would definitely be retained, in fact, improved.

The operation of pumping water in the summertime should definitely be discontinued for example; in 1953 the Granby pumping plant, pumped algae infested water from Shadow Mountain reservoir thru Grand Lake as follows: 618 hours in July, 584 hours in August, and 680 hours in September. Their schedule for this summer calls for practically no pumping in these months, which should help. Shadow Mountain reservoir is a natural breeding ground for algae and no water should be run thru Grand Lake during the summer infestation period.

If the Reclamation Bureau would take over their responsibility and set-up the necessary organization and equipment to treat Shadow Mountain Lake waters and the water pumped into it from the Granby reservoir on a continuing basis and discontinue pumping during the summer months, it is possible that the algae might be controlled in Grand Lake which would provide the cities on the eastern slope with good, clear and healthful drinking water.

Very sincerely yours,

Robert L. Coon,
1757 Bellaire Street,
Denver 7, Colorado

RLC:ds

COPIES TO U.S. SENATORS EUGENE D. MILLIKIN AND EDWIN C. JOHNSON, AND TO U.S. REPRS. WILLIAM S. HILL AND WAYNE N. ASPINALL.

Denver, Colorado, March 11, 1954

Mr. H. E. McPhail, Acting Commissioner,
U.S. Department of Interior, Bureau of Reclamation,
Washington 25, D. C.

Dear Mr. McPhail:

Thank you for your letter of March 5, 1954 regarding the algae infestation of Grand Lake, we appreciate your help and only hope that the action planned will result in a solution.

One of our chief concerns is that the action to be taken should be done by a single agency equipped with the necessary material and equipment to do an effective and continuous treatment work that would definitely control the algae and not by a committee (with all due respect to its members) that has to sandwich in this extra work with their regular duties. The practical facts of what we are all up against were brought out in the February 18th meeting by Mr. George J. Turre, Sanitary engineer, Board of Water Commissioners, City of Denver. Mr. Turre is an expert on the control of algae and has written many treatise and given numerous lectures on the subject. In addition, he has the practical knowledge because it is his job to treat and restrain the algae in all of Denver's reservoirs. This, he has done very successfully over the past eleven years. He claims that practically all types of algae can be curbed by the use of copper-sulphate if treated when the first signs of growth appears, usually in the latter part of May each year. Also, he states that in none of Denver's reservoirs did the algae lessen after the minerals (phosphates & nitrates) dissolved out. It is still necessary to treat the water in the reservoirs every year just the same, so we do not want to have Grand Lake ruined while we are hopefully waiting. Further, he brought out the facts, that algae flourishes in shallow and warm water where there is an abundance of sunlight and where there is food to feed upon, such as, the decaying vegetation in the bottom of Shadow Mountain Lake. In former years, we had appreciablely no algae in Grand Lake until last year when it was swept into the lake along with the large volume of water that was transferred to the eastern slope during the months of July, August and September.

Mr. McPhail, please do not think that we are critical of what is being done or the progress so far, it is definitely a step in the right direction, however, we do want a good job of algae control and that is why we would like to have the Bureau of Reclamation take it over, so that the final results will be highly satisfactory to all concerned. We all have a fairly good investment in property around Grand Lake and a stake in its future and only want the lake to be like it used to be. The business men in Grand Lake depend upon the tourists, vacationists from Denver and other Colorado Towns and the summer residents for their livelihood. They will not be able to retain this business if Grand Lake loses its attraction, such as, happened last summer when the lake was completely covered over with a dark green, slimy and odoriferous scum which resulted in many cancelled reservations, other visitors refused to let their children in the unsanitary looking water and many uncomplimentary remarks, for instance, this is the last time we are coming here, etc.

We, therefore, look to the Bureau of Reclamation to preserve the scenic beauty and natural attractions of Grand Lake as agreed and set forth in Senate Document No. 80 of the 75th Congress.

We believe, that if you were in our predicament you would feel the same as we do. We only ask for what is just and fair in this matter and your continued interest and help to eliminate the condition.

Very truly yours,
Robert L. Coon,
1757 Bellaire St., Denver

RLC:ds

Denver, Colorado, March 19, 1954

TO ALL GRAND LAKE PROPERTY OWNERS BUSINESSMEN AND RESIDENTS.

This is a very brief summary of our activity to date regarding the algae problem in Grand Lake. First permit us to thank you for your letters which are creating quite a stir in Washington and have the interested agencies busy. We hope everyone has sent in a letter or will do so right away.

Recently a meeting was held in Loveland, Colorado on the algae subject with representatives and committees from the Grand Lake area, the Colorado State Game & Fish Department, the National Park Service, the Bureau of Reclamation, municipalities of the project area, and the Northern Colorado Conservancy District. It was agreed by all present that the algae infestation is a very serious situation and requires immediate action. We were informed at the meeting by Mr. George J. Turre, Sanitary Engineer, Board of Water Commissioners, City of Denver, that the algae could be controlled by the use of copper-sulphate treatments. A working committee was selected from the different agencies present to take samples of the water in the late spring for analyzing and then to perform the actual treatment work. No provision was made to furnish the committee with the necessary material and equipment, such as, a continuing supply of copper-sulphate, etc. Also, there was no offer by the Bureau of Reclamation representatives to take over this work or in assuming their rightful responsibility. It is, of course, obvious that the Reclamation Bureau is trying to side-step their liability as set forth in Senate Document No. 80 of the 75th Congress, which we quote in part:

> "The project, therefore, must be operated in such a manner as to most nearly effect the following primary purposes:"
>
> 2. "To preserve the fishing and recreational facilities and the scenic attractions of Grand Lake, the Colorado River, and the Rocky Mountain National Park."

We think it is time for all of us to unite in one large organization for the express purpose of maintaining and safeguarding the scenic attractions of Grand Lake and to carry out this algae problem to a definite conclusion. Also, if you all agree perhaps we should request our U.S. Senators to initiate and support a bill to provide the Reclamation Bureau with the necessary funds to have their water transported to the tunnel in some other way than thru Grand Lake. For example, this could be done by taking the water direct from Shadow Mountain reservoir by buried pipe line along the north side of the tunnel road and thence into the Alva Adams tunnel. It would, undoubtedly be a very difficult task to get the Reclamation Bureau to accept this change, however, if it cannot be accomplished we should at least get the other things that we have been after as a compromise, such as, high water and algae control carried out by the Bureau of Reclamation.

As for the organization it could be called "THE GRAND LAKE SCENIC AND PROPERTY PROTECTIVE ASSOCIATION" and would unite all of us together, if necessary, for an all out campaign. We have nothing to lose by the attempt because it is already too late to do anything but make a last ditch stand as it is only a matter of time until Grand Lake will be completely ruined and our properties greatly depreciated or to win out and get Grand Lake back like it used to be. It would be an undertaking that we must all support to the last man. If you are interested in such a plan, this coming summer would be an opportune time to organize it, while we are at the lake.

Sincerely yours,
Robert L. Coon
a Grand Lake property owner
1757 Bellaire Street
Denver 7, Colorado

Mailed to 112
RLC:ds

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In reply refer to:

420

UNITED STATES

DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Washington, D.C.

Mar. 22, 1954

Mr. Robert L. Coon
1757 Bellaire Street
Denver 7, Colorado

My Dear Mr. Coon:

We are pleased to reply to your letter of March 11 in which you stress the importance of the Bureau of Reclamation taking responsibility for solution of the Algae problem on Grand Lake rather than dividing this responsibility with other agencies.

We assure you that we are very much concerned with this problem, and there is no intention on the part of the Bureau of Reclamation to shirk its duties or responsibilities. We will do everything within our authority to remedy the situation. The purpose of calling a committee for consultation was to obtain assistance in formulating the most practicable and effective methods of control of Algae, considering all other uses of the area and water and without serious impact on fishery values.

We note your statement that Mr. George J. Turre, Sanitary Engineer, Board of Water Commissioners, City of Denver, is an expert on the control of Algae. We are therefore requesting officials of the Bureau at Denver to confer with Mr. Turre and obtain any information which he may have which will be helpful in the solution of this problem.

Sincerely yours,

Signed H.F. McPhail

Assistant Commissioner

COPY COPY COPY

Denver, Colorado,
March 29, 1954

Mr. H.F. McPhail, Assistant Commissioner,
U.S. Department of the Interior,
Bureau of Reclamation,
Washington 25, D. C.

Dear Mr. McPhail:

We wish to thank you very much for your letter of March 22, 1954 regarding the Reclamation Bureau's responsibility in correcting the algae infestation of Grand Lake.

We now assume that the Bureau of Reclamation will go ahead with the treatment and control of the algae condition in Grand Lake on a continuing basis as soon as they learn more about the subject. However, we thought with your chemists and biologists it would be an easy matter for you to handle, but perhaps we are wrong. Mr. George J. Turre, Sanitary Engineer, Board of Water Commissioners, City of Denver, says it is a simple procedure to control algae and quite inexpensive. However, it is necessary to treat the condition each year at the time it starts. Copper-sulphate costs about 14¢ a pound and one pound will treat one million gallons of water without injuring the fish life.

In mentioning the fishing values, most of the fish are suckers as evidenced by the Colorado State Game and Fish Department who caught tons of them last summer in their fish traps in Shadow Mountain reservoir in an attempt to clear them out. The reason for the increase in fishing on the three lakes is due to the big increase in outboard motor-boating enthusiasts who fish during their outings to these lakes even though they only catch one or two keepable fish.

Your taking over the control of the algae situation will undoubtedly save the life of the Town of Grand Lake, the livelihood of its residents and maintain the value of all of the property in and around Grand Lake which is considerable.

Again we thank you, may we learn if our assumption as above is correct.

Sincerely yours,

Robert L. Coon
1575 Bellaire St.,
Denver 7, Colorado

RLC:ds

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EUGENE D. MILLIKIN, COLO., CHAIRMAN
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United States Senate

COMMITTEE ON FINANCE

July 28, 1954

Mr. G. A. Spitzmiller
P. O. Box 128
Grand Lake, Colorado

Dear Mr. Spitzmiller:

We are enclosing for your information a letter dated July 26, 1954, from Mr. L. N. McClellan, Acting Commissioner of the Bureau of Reclamation, Department of the Interior, concerning developments in the algae control problems in Grand Lake, Colorado.

With very best regards, we are

Sincerely yours,

Edwin C. Johnson, USS

Eugene D. Millikin, USS

Encl.

COPY

UNITED STATES
DEPARTMENT OF THE INTERIOR
Bureau of Reclamation
Washington 25, D. C.

July 26, 1954

Hon. Eugene D. Millikin
United States Senate
Washington 25, D. C.

My dear Senator Millikin:

In our letter of May 20 we advised you that we would keep you informed concerning developments in the algae control problem in Grand Lake, Colorado.

At the meeting of the Algae Committee on May 21 a Technical Sub-committee was appointed to review the problem and to develop specific plans for treatment. The report of the Sub-committee was reviewed at a meeting held on July 2 and its recommendations were accepted. The report recommends that the water in Grand Lake be treated when the count of certain species of algae reaches a value of 2,000 volumetric standard units per milliliter. The Parent Committee also took the necessary steps to obtain permission from the Governor of Colorado and the Colorado Game and Fish Department to place copper sulphate in the waters of Grand Lake.

The water samples being taken periodically indicated that the 2,000 units probably would be reached about July 9. Further inspection on July 7 showed that the water in Grand Lake was clearer than any time since the initial impoundment of Shadow Mountain Reservoir and that treatment was not yet warranted. This was believed to be due to the diluting effect of the large volume of water passing through Shadow Mountain Reservoir and Grand Lake. Deferment of treatment was concurred in by the Grand Lake representatives of the committee.

The Algae Committee will continue the sampling program and when the count reaches about 2,000 units, treatment will be promptly undertaken with all member agencies cooperating. From discussions with the Grand Lake representatives involved, it is evident that they are pleased with the arrangements which have been made.

Sincerely yours,

(sgd) L. N. McClellan
Acting Commissioner

This is in agreement w/ letter dated 2/27/1954 (Loan to Residents)
stating plan to pump very little water in July, Aug, Sep.

For the past several months, or actually since July 1952, careful investigation of the water level problem at Grand Lake, Colorado, has been made. It was discovered that the basic factors controlling the water level were either not understood or were misconstrued. As a result of this situation efforts have been made to procure for the residents of the Grand Lake region a more factual picture of the Colorado-Big Thompson project as it affects said region.

The enclosed letter prepared by the U. S. Bureau of Reclamation sets forth an accurate description of the operation which it is hoped and believed will promote a better understanding of the situation.

Grand Lake Water Level Committee

GLAHS 2009.73.1 - 01

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
South Platte River District
Building 50, Denver Federal Center
Denver, Colorado

AN OPEN LETTER

To: The Residents of the Grand Lake Area

In answer to your many questions concerning water-surface levels at Grand Lake, I hope, in this letter, to explain our position and responsibility in our operation of the Colorado-Big Thompson Project. That you may have a more complete understanding of the situation, I'd like first to outline briefly a bit of the background history of the Colorado-Big Thompson Project--its origin and its purpose.

Accompanying the rapid development of northern and eastern Colorado in the late 1800's, there developed with equal rapidity the distressing problems created by the drastic and inescapable shortage of water. The situation in eastern Colorado was quite different from that on the water-blessed Western Slope--insufficient precipitation and over-appropriation of streams under irrigation to meet the needs of the rapidly growing population and expanding industry resulted in water shortages, crop failures and the absolute impossibility of utilizing much of this rich, irrigable land for the production of late season crops. To obtain additional water for this area required the diversion of surplus waters from a distant source by means of a complex series of reservoirs, dams, tunnels, canals, penstocks, power and pumping plants.

The idea of transmountain diversion of surplus waters from the upper reaches of the Colorado River on the Western Slope for further benefit and utilization in northern Colorado had been in existence since 1889. But it took several decades of research and survey, and the skill of outstanding engineers to devise the most economical means of achieving such diversion. And it took years of study and negotiation on the part of public-spirited citizens to bring about the accomplishment of the Colorado-Big Thompson Project and to insure the protection of all interests involved--both East Slope and West Slope--in its plan of construction and operation.

These years of investigations, reports, and innumerable meetings culminated June 15, 1937, with the presentation by the late Senator Alva B. Adams to the 75th Congress, 1st Session, Senate Document No. 80--"Synopsis of Report on Colorado-Big Thompson Project, Plan of Development and Cost Estimate Prepared by the Bureau of Reclamation, Department of the Interior." The provisions contained therein governing the construction and operation of the Colorado-Big Thompson Project were approved by the Northern Colorado Water Users' Association, "representing the irrigation and other interests on the Eastern Slope in Colorado," and the Western Slope Protective Association, "representing the irrigation and other interests on the Western Slope in

Colorado." The project, as presented in Senate Document No. 80, was authorized by Congress in August 1937 and approved by the President December 21 of that same year.

The purpose of the Colorado-Big Thompson Project may best be realized by an examination of the attached map. The area shown in green is the area to be benefitted by supplemental irrigation water--consisting of over 707,000 acres of rich, irrigable farm lands. In addition to these irrigation benefits, power plants will take advantage of the water cascading down the Eastern Slope of the Rockies to generate nearly three-fourths billion kilowatt-hours of electric energy annually--enough to meet the normal requirements of a city of 350,000 people. On the map is shown the intricate network of transmission lines supplying low-cost electric power to municipalities, cooperatives, and industries.

The Colorado-Big Thompson Project is self-liquidating, all costs being repaid by the revenues from the sale of water and power. Existing contracts require the repayment of the irrigation investment be accomplished in 40 years. The specific costs allocated to power must be repaid within 50 years with interest at 3 percent.

As you can see, the Colorado-Big Thompson Project is a single project composed of many parts--in fact, over 100 separate engineering features--each of which has been designed and built so that the entire project operates as one unit. Two sketches are attached which show the western entrance of the Alva B. Adams Tunnel and the intake structure from Grand Lake. The elevation of the floor of the tunnel at the entrance is 8356.85 feet and in order to operate at its designed capacity, the minimum surface elevation of Grand Lake must be 8366.3 feet. At the West Portal Intake structure, a permanent barrier with a crest elevation of 8365.0 feet was constructed. The sole purpose of this barrier is to insure compliance with the stipulation in Senate Document No. 80 that we never draw the water-surface elevation of Grand Lake below 8365.0 feet. To lower the barrier would serve only to permit lowering Grand Lake below elevation 8365 and would not change the capacity of the tunnel. In other words, capacity of the tunnel is dependent upon water-surface elevation in Grand Lake and <u>not</u> upon the elevation of this barrier.

Inasmuch as the operation of the Adams Tunnel at its designed capacity requires a water-surface elevation of 8366.3 in Grand Lake and the maintenance of an <u>exact</u> level is an easily understood impossibility, maintaining water-surface elevations between a minimum of 8366.0 and a maximum of 8367.0 feet in Shadow Mountain Reservoir and Grand Lake is an essential requirement. Even with this range, we do not attain full tunnel capacity from 8366.0 to 8366.3.

Water drawn from Grand Lake through the Adams Tunnel is replaced with water pumped from Granby Reservoir by the Granby Pumping Plant. This plant, therefore, provides the principal regulation of Grand Lake water surface as well as being the principal source of water supply to the power plants on the Eastern Slope. With the widespread use of electricity and the dependence of these users on a constant supply, we all realize, of course, that interruptions in that supply can have most serious consequences, even to loss of life.

GLAHS 2009.73.02

Man's works do sometimes fail or require adjustment, however, and it is to insure against such a circumstance resulting in catastrophe that the small flexibility provided by allowable fluctuation in Grand Lake is essential.

As previously stated, the costs of the Colorado-Big Thompson Project are to be repaid to the Federal Treasury (taxpayer) from its operating revenues. To obtain the greatest economy of operation in the Grand Lake area, power used at Granby Pumping Plant for this pumping operation must come principally from "off peak" production (periods of the day when demands for project power are at a minimum), since such power is worth less than half as much as "on peak" power. Flexibility provided by operation of Shadow Mountain Reservoir and Grand Lake between elevations 8366 and 8367 permits this accomplishment, as well as insuring continued project operation for limited periods in case of scheduled or emergency repairs of the Granby Pumping System. Repairs to the Adams Tunnel would have no effect on the level of Grand Lake as, during such times, we can and will maintain Grand Lake within its operating range by use of the gates or stop logs at the West Portal and Shadow Mountain Dam.

A chart is also attached illustrating the fluctuation in water-surface elevations for Grand Lake during 1939 and 1940. Unfortunately, these are the only years for which data are available which are not affected in any way by work on the project. Inflow during these two years was considerably below average, being about 81 percent in 1939 and 75 percent in 1940. Records since 1940 may reflect some artificial control of the water surface because of our construction work on the tunnel and on the connecting channel between Grand Lake and Shadow Mountain Reservoir. It can be seen from this chart that for these particular years, the water surface of Grand Lake fluctuated between elevations 8364.9 and 8368.75. Controlling the operating range between 8366.0 and 8367.0 appears to be an improvement, of considerable benefit to residents and boat owners, over the natural fluctuation.

We maintain an automatic recorder at Grand Lake which registers an accurate, continuous record of water-surface elevations of the lake. If you have any questions as to the elevation at a particular time, this record is available and may be inspected at the Granby Pumping Plant. If desired, we will be glad to furnish weekly bulletins of this information to Grand Lake organizations for more convenient inspection by residents or visitors.

To further assist you in relating the operating elevations of the lake to your existing or proposed structures, we will install a series of bench marks (permanent points of established elevations) around the lake. These will be established at about elevations 8368 to 8370 and will be plainly stamped as to the elevation on the top of the bronze cap of the bench mark. Because of wind action and the normal pile up of water in the lee of the wind, it will not always be possible to accurately check the elevation of the lake surface by reference to these bench marks. However, the automatic recorder does give you this information accurately at any particular moment.

It is our intent and purpose to operate the Colorado-Big Thompson Project within the limits and criteria under which it was conceived, authorized, and designed, which include limitation of fluctuation of Grand Lake between elevations 8366 and 8367 and which will enable the accomplishment of all the

objectives for which it was built, including liquidation of its cost to the general taxpayer.

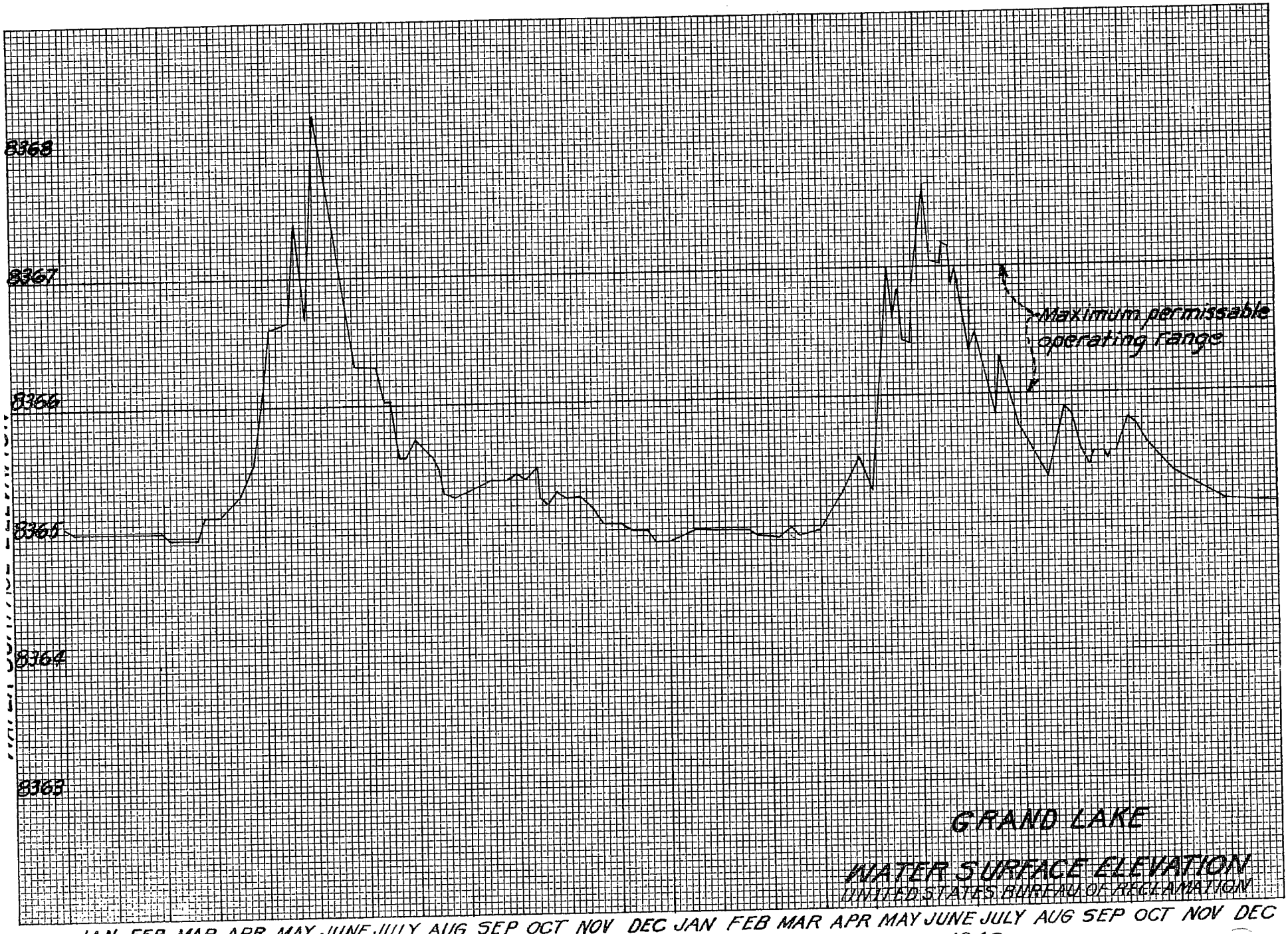
In case of any questions on physical operation of the pumping plant or water-surface elevation in the Grand Lake area, you are invited to contact me at the Denver Federal Center or Mr. E. J. Neilsen, Superintendent, Granby Facilities. Mr. Neilsen has recently established residence in Grand Lake, but can best be contacted during office hours at the pumping plant--telephone Grand Lake 100.

We wish to emphasize our willingness to cooperate in every way possible and to assist you in the resolution of any local problems incident to the Colorado-Big Thompson Project and its operation. You, as a taxpayer, are a stockholder in the Colorado-Big Thompson Project. We of the Bureau of Reclamation (who are also stockholders as well as employees) hope you will visit all or any part of the project. Such visits would result in better understanding of project operation and objectives and, we sincerely believe, result in pride that you <u>are</u> a stockholder in this enterprise.

J. H. Knights
District Manager

Attachments

3 LAKS
1004.73.1.(1)



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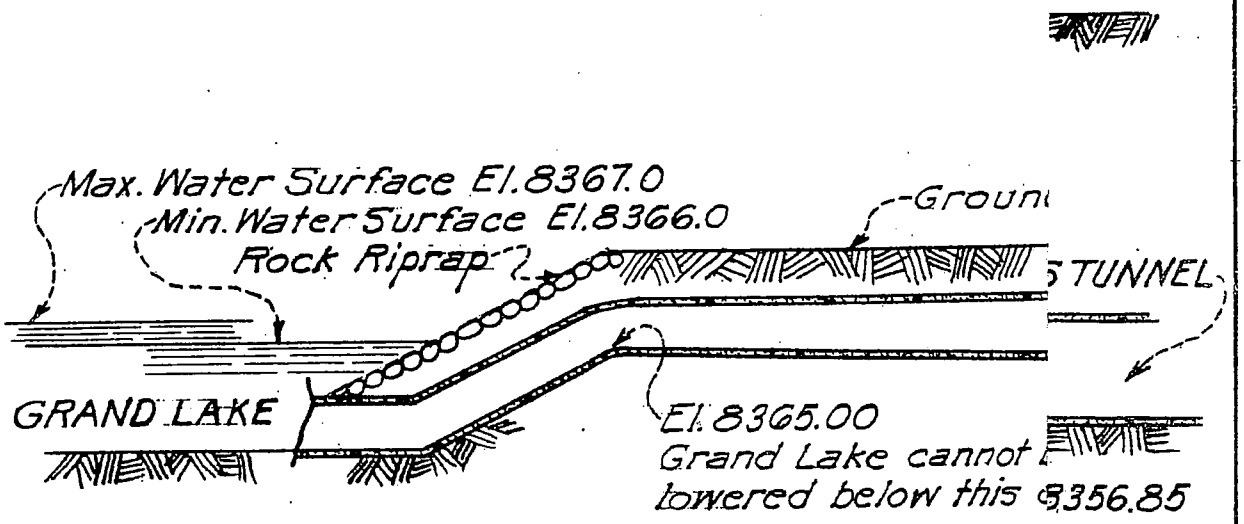

OR

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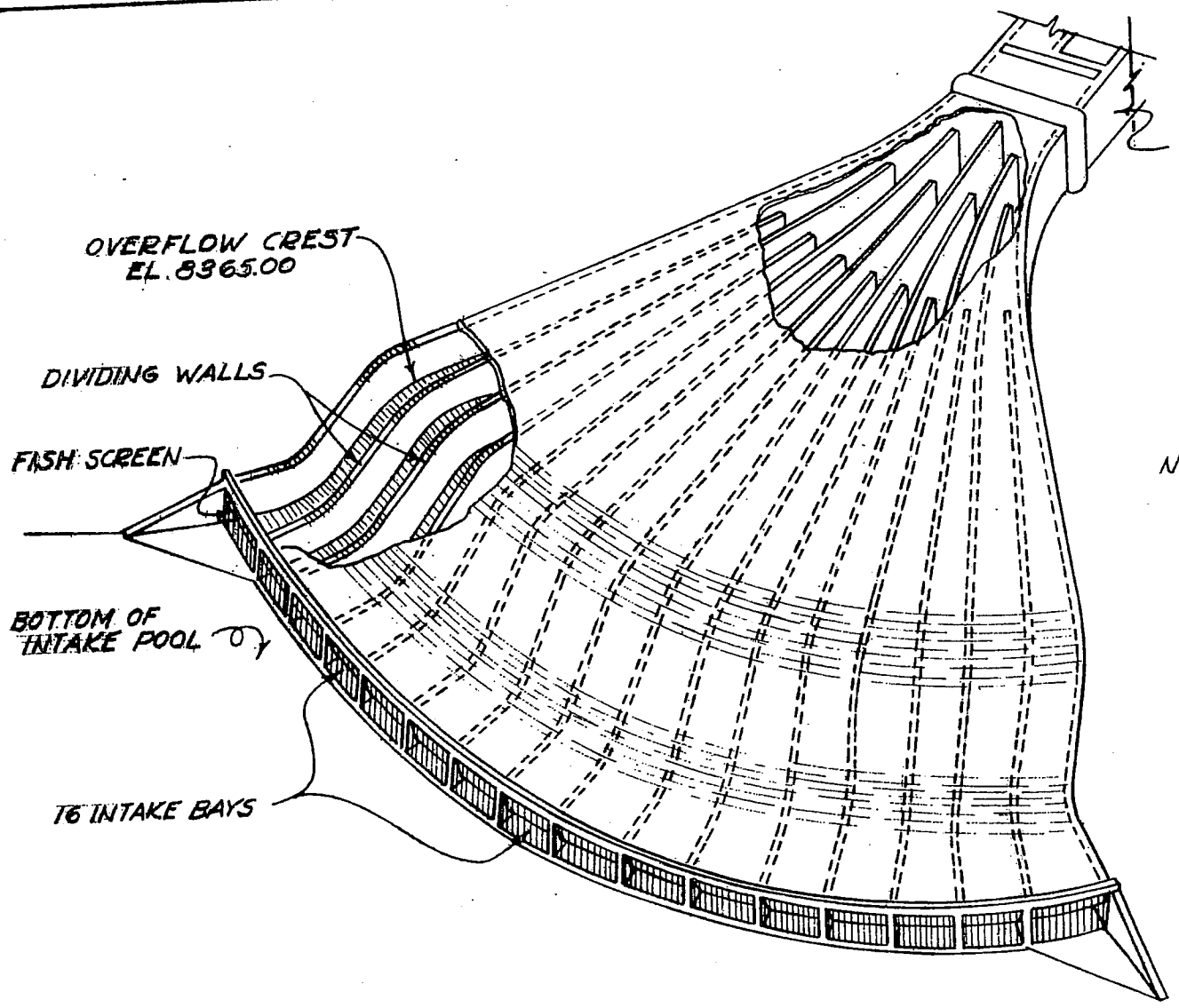
Denver, Colo.

GLANS. 2009.72.1.(3)



NOTE: ENTIRE STRUCTURE REINFORCED CONCRETE

AVERAGE BACKFILL OVER STRUCTURE 5 FEET DEPTH

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLO. BIG THOMPSON PROJECT COLO.

ALVA B. ADAMS TUNNEL
INLET STRUCTURE

Public Law 95-450
95th Congress

An Act

To create the Indian Peaks Wilderness Area and the Arapaho National Recreation Area, to authorize the Secretary of the Interior to study the feasibility of revising the boundaries of the Rocky Mountain National Park, and to add certain lands to the Oregon Islands Wilderness.

Oct. 11, 1978
[H.R. 12026]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Indian Peaks Wilderness Area, the Arapaho National Recreation Area and the Oregon Islands Wilderness Area Act.

SHORT TITLE

SECTION 1. This Act may be cited as the "Indian Peaks Wilderness Area, the Arapaho National Recreation Area and the Oregon Islands Wilderness Area Act".

16 USC 460jj note.

FINDINGS AND PURPOSES

SEC. 2. The Congress finds that it is in the national interest—

16 USC 460jj note.

(1) to include the land within the Arapaho and the Roosevelt National Forests known as the Indian Peaks Area in the National Wilderness Preservation System so as to protect the area's enduring scenic and historic wilderness character and its unique wildlife and to preserve the area's scientific, educational, recreational, and inspirational resources and challenges; and

(2) to create the Arapaho National Recreation Area within the Arapaho and the Roosevelt National Forests and the Colorado Big Thompson project so as to preserve and protect the natural, scenic, historic, pastoral, and wildlife resources of the area and to enhance the recreational opportunities provided.

INDIAN PEAKS WILDERNESS AREA

SEC. 3. (a) An area of land comprising approximately seventy thousand acres located in Boulder and Grand Counties, Colorado, within the Arapaho and the Roosevelt National Forests (as generally depicted as the "Indian Peaks Wilderness Area" on a map entitled "Indian Peaks Wilderness Area and Arapaho National Recreation Area", dated July 1978) is designated for purposes of the Wilderness Act (16 U.S.C. 1131-1136) as a wilderness area and shall be known as the Indian Peaks Wilderness Area.

16 USC 1132 note.

(b) The Indian Peaks Wilderness Area shall be administered by the Secretary of Agriculture (hereafter in this Act referred to as the "Secretary") pursuant to those provisions of the Wilderness Act which govern areas designated by that Act as wilderness areas, except that any reference in such provisions to the effective date of the Wilderness Act shall be deemed to be a reference to the effective date of this Act.

Administration.

ARAPAHO NATIONAL RECREATION AREA

SEC. 4. (a) An area of land comprising approximately thirty-six thousand two hundred thirty-five acres located in Grand County, Colorado, within the Arapaho and the Roosevelt National Forests and the Colorado Big Thompson project (as generally depicted as the

16 USC 460jj.

EXHIBIT 35

ROCKY MOUNTAIN NATIONAL PARK STUDY

SEC. 13. Within one year of the date of enactment of this Act, the Secretary of Agriculture and the Secretary of the Interior shall jointly develop and submit to the Committee on Interior and Insular Affairs of the House of Representatives and the Committee on Energy and Natural Resources of the Senate, a comprehensive report studying and evaluating the suitability of revising the boundaries of Rocky Mountain National Park to include all or part of the Indian Peaks Wilderness Area as established by this Act and examining the possible addition or deletion of other lands designated as "Park Study Area" on a map entitled "Indian Peaks Wilderness Area and Arapaho National Recreation Area" dated July 1978: *Provided*, That regardless of the ultimate administration of the areas to be studied under this section, the seventy thousand-acre Indian Peaks Wilderness Area established by this Act shall remain as a component of the National Wilderness Preservation System.

Report to congressional committees. 16 USC 1132 note.

Approved October 11, 1978.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 95-1460 (Comm. on Interior and Insular Affairs).
CONGRESSIONAL RECORD, Vol. 124 (1978):
Sept. 12, considered and passed House.
Sept. 27, considered and passed Senate.

89-194 O—80—pt. 1——73 · QL3

ROCKY MOUNTAIN NATIONAL PARK STUDY

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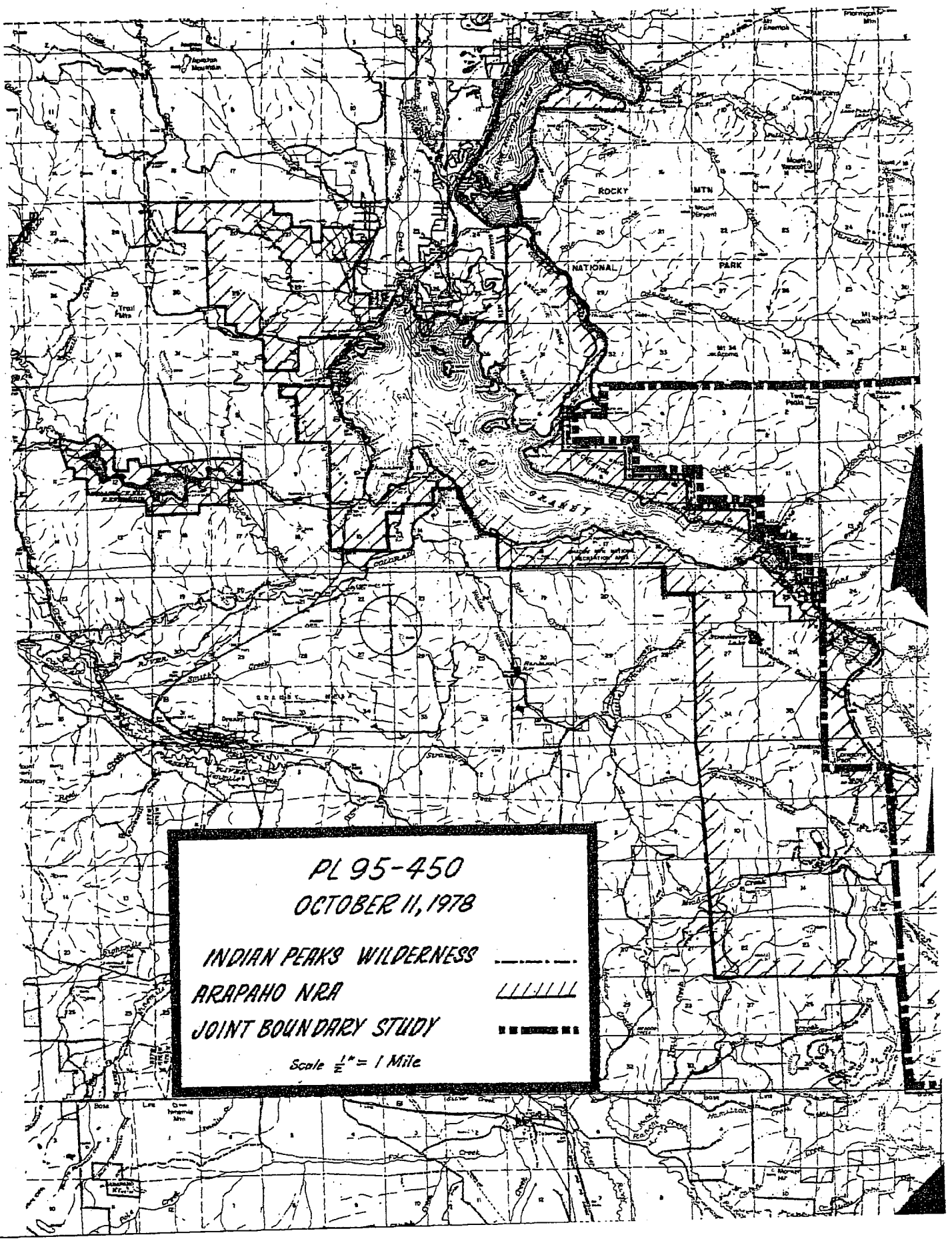
Report to congressional committees. 16 USC 1132 note.

Approved October 11, 1978.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 95-1460 (Comm. on Interior and Insular Affairs).
CONGRESSIONAL RECORD, Vol. 124 (1978):
Sept. 12, considered and passed House.
Sept. 27, considered and passed Senate.

39-194 O—80—pt. 1——73 : QL3


ROCKY
MTN
NATIONAL
PARK
PL 95-450
OCTOBER 11, 1978
INDIAN PEAKS WILDERNESS
ARAPAHO NRA
JOINT BOUNDARY STUDY
Scale 1/2" = 1 Mile

OCT 2 1980

AGREEMENT CONCERNING THE WINDY GAP PROJECT
AND THE AZURE RESERVOIR AND POWER PROJECT

PART I

PARTIES

The following named entities and persons are the Parties to this Agreement:

A. Municipal Subdistrict, Northern Colorado Water Conservancy District, herein designated as "Subdistrict" is a political subdivision of the State of Colorado, created under the provisions of C.R.S. 1973, 37-45-101, et seq., for the purposes stated therein, and by Order of the Weld County District Court, pursuant to said statute, on July 6, 1970.

B. Colorado River Water Conservation District, herein designated as "River District," is a political subdivision of and a body corporate under the laws of Colorado, created by the provisions of C.R.S. 1973, 37-46-101, et seq., for the purposes stated therein. The River District was the only protestant in the hereinafter referred to proceedings in Civil Action No. 1768.

C. Northwest Colorado Council of Governments, herein designated as "NWCCOG," is a regional planning commission organized pursuant to C.R.S. 1973, 30-28-105, and an association of local governments contracting pursuant to Article XIV, Section 18 of the Constitution of Colorado and C.R.S. 1973, 29-1-201 et seq., encompassing the Colorado counties of Grand, Eagle, Summit, Jackson, Routt and Pitkin.

D. Grand County is a county of the State of Colorado created by Article XIV of the Colorado Constitution and C.R.S. 1973, 30-5-128, for the purposes stated therein.

E. Middle Park Water Conservancy District, herein designated as "Middle Park" is a political subdivision of the State of Colorado, created under the provisions of C.R.S. 1973, 37-45-101, et seq. for the purposes stated therein.

EXHIBIT 36

F. Three Lakes Water and Sanitation District, herein designated as "Three Lakes" is a special district created under the provisions of and for the purposes set forth in C.R.S. 1973, 32-10-101, et seq.

G. Ritschard Cattle Co., Inc.; Joseph McElroy; Isabel McElroy; Olga Hill; Clayton Hill; Howard K. Schmuck, Jr.; Richard P. Doucette; Christine O. Doucette; Jacques Ranch I and Jacques Ranch II, Illinois limited partnerships; Gene Ritschard; David Mayhoffer; John H. McElroy; Mary K. McElroy; Edna L. Palmer; Lloyd A. Palmer; Leo Marte; Eunice Marte; Jessie Joyce Thompson; David Howard Thompson; John Sheriff; Ida L. Sheriff; H. Grady Culbreath; J. Gail Culbreath; John L. Kemp; Crockett C. Kemp; William Henry Thompson; Anita Lewis Thompson; Skylark Ranch Company, a Colorado corporation; Charles G. Broady; Phyliss Broady; Blanche Cowperthwaite dba Gore Canyon, Ltd.; Colorado River Land Corporation; Sunset Associates, a partnership; (herein designated as "Ranchers,"), their successors and assigns, are, among others, owners of ranches on the Colorado River below its confluence with the Fraser River and above its confluence with the Blue River, which in some manner may be affected injuriously by the construction of the Subdistrict's Windy Gap Project.

H. The Town of Granby, the Town of Hot Sulphur Springs, Stanley Broome, Richard P. Doucette and Winter Park Water and Sanitation District and several of the Ranchers are objectors or have entered their appearance in Case No. W-4001, Water Division 5.

PART II

DEFINITIONS

A. Windy Gap Project. A water diversion storage and conveyance system commencing at a point on the Colorado River just below its confluence with the Fraser River and

terminating at Lake Granby, which lake is a part of the Colorado - Big Thompson Project.

B. Azure Reservoir and Power Project. A proposed water storage and hydroelectric power project located on the main stem of the Colorado River approximately 8-1/2 miles west of the Town of Kremmling.

C. Una Reservoir. A proposed water storage and hydroelectric project on the mainstem of the Colorado River located in DeBeque Canyon near the Town of DeBeque.

PART III

RECITALS

A. In 1968, Ralph H. Price, as trustee for the cities of Boulder, Longmont, Estes Park, Loveland, Fort Collins, and Greeley filed claims for certain conditional water rights for the Windy Gap Water System, hereinafter termed the "Windy Gap Project" in the District Court for Grand County in a supplemental water adjudication, Civil Action No. 1768, and under the provisions of the 1943 Adjudication Act. The claims were subsequently assigned and deeded to Subdistrict upon its creation.

B. In April, 1972, hearings on the claims were held by Michael D. White, a Referee, appropriately appointed to conduct such hearings. On April 8, 1974, Referee White entered his findings, conclusions of law and recommendations, and subsequently, after several additional hearings before both Charles F. Stewart and George E. Lohr, Water Judges for Water Division 5, Judge Lohr by Order dated February 23, 1978, granted the conditional decrees sought by Subdistrict.

C. Upon the granting of the conditional decrees for Subdistrict's Windy Gap Project, River District appealed Judge Lohr's decision to the Supreme Court of Colorado, Docket No. 28417, where on September 14, 1979, the Supreme Court reversed Judge Lohr's decision and remanded the action

to the Water Court of Water Division 5 for further proceedings. Upon Petition of the Parties, the Supreme Court has now extended the time for filing petitions for rehearing to May 1, 1980.

D. Since the decision of the Supreme Court on September 14, 1979, representatives of Subdistrict, River Distfict, NWCCOG, Grand County, Middle Park, and the Ranchers have met upon numerous occasions to resolve the differences existing between the Parties in an effort to reach an agreement which would permit Subdistrict to construct its Windy Gap Project by devising a plan for the design, construction and operation of the Project which would comply with the provisions of C.R.S. 1973, 37-45-118(1)(b)(IV) and to mitigate any and all adverse impacts thereof.

E. On December 12, 1978, Subdistrict filed an application for water right in the Water Court for Water Division 5 (Case No. W-4001) seeking an enlargement of its conditional decree for the Windy Gap Pump, Pipeline and Canal by 100 cubic feet per second. This application has been objected to or entries of appearance made, by NWCCOG, River District, Middle Park, Town of Granby, Jacques Ranch I and Jacques Ranch II, Richard P. Doucette, Town of Hot Sulphur Springs, Winter Park Water and Sanitation District, Board of Grand County Commissioners for Grand County, Ritschard Cattle Co., Inc. and Stanley Broome. The application is presently pending in Water Division 5.

F. The Parties have reached an agreement as a result of such meetings and discussions referred to above in Part III, paragraph D, and now wish to execute this Agreement specifying the terms and conditions thereof.

THEREFORE, in view of the foregoing, the Parties hereby agree as follows:

PART IV

PURPOSE OF AGREEMENT

1. The purpose of this Agreement is (1) to permit the Subdistrict immediately to commence and complete the construction of its Windy Gap Project, as evidenced by its decrees, and (2) to permit the immediate planning of the Azure Reservoir and its power features, herein designated as the "Azure Reservoir and Power Project," in order that the Project may be under construction within fifteen (15) years from the date hereof or sooner.

2. Implementation of the provisions of this Agreement satisfies and constitutes compliance by Subdistrict of its obligations under C.R.S. 1973, 37-45-118(1)(b)(IV), insofar as the Parties hereto are concerned, and is in compliance with all requirements for obtaining valid conditional water rights for all components of the Windy Gap Project.

3. Implementation of the provisions of this Agreement will constitute compliance with all objections to the Draft Environmental Impact Statement for the Windy Gap Project by any Party hereto, furnishes satisfactory mitigation measures for the development of the Windy Gap Project and following a hearing and decision of the Grand County Commissioners under paragraph 36 (assuming the decision is favorable) will constitute compliance with all valid permitting requirements imposed by any of the Parties.

4. Implementation of the provisions of this Agreement, specifically Part V, paragraph 16, is to insure that Subdistrict will plan, design and construct such facilities as are necessary to allow Ranchers to continue to divert their existing senior decrees at no additional cost other than that which would have occurred had the Windy Gap Project not have been constructed.

5. The Agreement constitutes a desirable and practical method and approach for the financing and construction

of the Azure Reservoir and Power Project for the benefit of the prospective users of Colorado River water for irrigation and other beneficial consumptive uses, and, further implementation of this Agreement by all Parties is a further step in providing continued cooperation of both the East and West Slopes of Colorado in the development of all of Colorado's water resources for the beneficial use of all citizens of the State of Colorado.

PART V

AGREEMENTS OF SUBDISTRICT

6. Subdistrict, as expeditiously as reasonably possible, will use its best efforts to cause the Azure Reservoir and Power Project to be constructed at or near its decreed location on the Colorado River to its maximum feasible capacity at the Subdistrict's sole cost and at no cost to the River District, except as hereinafter provided, or to any citizen or entity of Colorado West of the Continental Divide, including Jackson County. Provided, however, that determination of the maximum feasible capacity of Azure Reservoir (estimated to be 28,000 to 30,000 acre feet) shall include an evaluation of the cost effectiveness of protective works and facilities required to prevent interference with the maintenance and use of the Denver and Rio Grande Railroad. In determining cost effectiveness, if the incremental value (over the life of the Azure Project) of the gain in storage capacity and power production by construction of protective works exceeds the cost of such works, such protective works shall be included as part of the Project. All necessary Federal, State or local permits and licenses required by law shall be obtained by Subdistrict at its sole cost. River District will cooperate and aid, including participation as a joint applicant, Subdistrict in obtaining such permits and licenses. Costs incurred by the River District in cooperating, aiding, or as a joint applicant, in the obtaining of necessary permits or licenses shall be borne by River District.

7. All water released from Azure Reservoir shall, unless impracticable, be released through the power plant, and all power produced from Azure Power Plant shall be marketed upon terms and conditions mutually satisfactory to the Subdistrict and River District by an entity to be selected by the Subdistrict and River District. Revenues produced from the marketing of said power shall be applied in the following order:

First: To payment of all annual operation and maintenance costs associated with Azure Reservoir and Power Project including the maintenance of adequate contingency funds.

Second: To payment of annualized debt service (including therein preconstruction costs and those costs incurred by Subdistrict pursuant to paragraph 16) incurred by the Subdistrict in the construction of Azure Reservoir and Power Plant for the repayment period of any bonds issued to finance the Azure Reservoir and Power Project.

Third: To payment to Middle Park for hydroelectric power produced from Middle Park water released pursuant to paragraph 9, subparagraph First.

Fourth: All sums remaining after the payments contemplated in subparagraphs First, Second and Third (or after retirement of all debt described in subparagraph Second) shall be divided equally between Subdistrict and River District to be utilized as they may individually determine; or, Subdistrict may elect to receive its one half of the revenues in electrical energy or to have its one half of any such revenues applied to the payment of its power costs for the Windy Gap Project.

8. Title to the Azure Reservoir and Power Project facilities or alternate facilities contemplated hereunder will be transferred by Subdistrict to River District upon

repayment of all advance costs incurred by Subdistrict following the date of this Agreement in the development of said Project or as may be provided for or required by any bond covenants entered into by Subdistrict for the financing of the Azure Reservoir and Power Project.

9. The capacity of Azure Reservoir, with due regard being given to Project hydroelectric capabilities, shall be allocated as follows:

First: An amount not to exceed 2000 acre feet of water to Middle Park to be marketed by that entity within the geographic area of Middle Park or as may be authorized by statute. On or before the first day of each water year Middle Park shall notify the entity operating Azure Reservoir and Power Plant, the Subdistrict and the River District, of the quantity of water to be allocated to Middle Park for which Middle Park has or expects contracts for the use thereof in the coming water year. Such quantity of water will be retained to Middle Park's account, to be released as directed by Middle Park. The volume of water, if any, not disposed of by Middle Park up to said 2000 acre feet shall be disposed of pursuant to the provisions of subparagraph Third of this paragraph 9, provided, however, that all power revenues produced from said 2000 acre feet shall be credited to the account of Middle Park pursuant to paragraph 7, subparagraph Third. In the event Middle Park exercises its option upon completion of Azure Reservoir to utilize its additional 1000 acre feet of water in Azure Reservoir as set forth in paragraph 17, then the figure of 2000 acre feet herein shall be changed to 3000 acre feet.

Second: An amount not to exceed 3000 acre feet of water to Subdistrict to be used as replacement for out-of-priority diversions of the Windy Gap Project;

provided, if not so needed on an annual basis on or before October 31 of each year, then such water will be subject to the provisions of subparagraph Third of this paragraph 9. The amount of water herein allocated to Subdistrict may be reduced to 2000 acre feet depending on the election of Middle Park as provided in Paragraph 17.

Third: The balance of the water yield of Azure Reservoir shall be marketed by River District in Colorado for the benefit of western Colorado on terms and conditions to be determined by River District. All revenues derived from the marketing of this water shall be the property of River District. Provided, the allocations herein made shall be subject to the operational priorities established in paragraph 10 hereof. Should a dispute arise between the Parties hereto concerning any conflict between the operating priorities described in paragraph 10 and a specific contract for disposition of Azure water, it shall be resolved by the Water Judge for Water Division 5, subject to appeal as provided by law. The Ranchers to the extent of their interest, if any, shall be represented in any such proceeding by Middle Park and River District pursuant to said District's statutory obligations at no cost to the Ranchers.

10. Azure Reservoir and Power Project shall be operated by an entity to be selected by mutual agreement between Subdistrict and River District. The reservoir shall be operated by the selected entity as nearly as practicable according to the following priorities:

First: To comply with and satisfy the terms and provisions of C.R.S. 1973, 37-45-118(1)(b)(IV).

Second: To satisfy future beneficial consumptive uses of water in Colorado for the benefit of western Colorado and to replace out-of-priority Windy Gap Project diversions as set forth in paragraph 9, subparagraph Second hereof.

Third: To generate hydroelectric power.

Fourth: To the extent compatible with the foregoing primary priorities, for aesthetic, recreational and other nonconsumptive uses, provided, that the operational integrity of the Azure Reservoir and Power Project is maintained and the safety of the public is protected. The governmental entity making use of the Project for these purposes shall assume in a separate agreement with Subdistrict and River District all resulting operational and maintenance costs and all liability of any nature arising from the use of the Project for such public purposes.

11. During preconstruction, design and construction activities, it may be necessary to modify project design or relocate project features. Should such situation arise, decisions related thereto will be made by mutual agreement of Subdistrict and River District with advice of all such changes to Middle Park.

12. At any time during a period of 15 years, or of any extended time mutually agreed upon by Subdistrict and River District, from the date of initiation of construction of the Windy Gap Project, the Subdistrict and the River District may by mutual agreement determine that it is no longer feasible to pursue the construction of Azure Reservoir and Power Project for engineering or other reasons. Should Subdistrict and River District so mutually agree, then likewise by mutual agreement of such parties, an alternate facility shall be selected for construction at the cost of the Subdistrict, which facility shall be located, if practicable, within the geographic area of Middle Park. Said alternate facility shall be comparable to Azure Reservoir in the sense that it can provide substantially similar benefits to the Parties hereto; provided, the hydroelectric features may be omitted if not feasible and the costs and benefits related

thereto likewise may be omitted from the alternate selected. If hydroelectric features are constructed as a part of such alternate facility, the power revenues therefrom shall be distributed and allocated as set forth in paragraph 7. The nonreimbursable costs of construction of such alternate facility shall not exceed, so far as the obligation of Subdistrict is concerned, excluding the costs of compliance with paragraph 16, the sum of $10,000,000 escalated or deescalated from the date of this Agreement in accordance with the ENR (Engineering News Record) "Irrigation and Hydro Cost Index for the West" to the date of award of contract for the construction of the alternate facility. If said alternate facility has included therein hydroelectric features, Subdistrict shall include in said $10,000,000 the previously incurred costs relating to the Azure Reservoir and Power Project and the costs of compliance with paragraph 16.

Should construction of the Azure Reservoir and Power Project not be initiated within 15 years from the date of initiation of construction of the Windy Gap Project, or in the case of an alternate facility, within 20 years of said date, and any extension thereof mutually agreed to by River District and Subdistrict, then the Subdistrict shall have the right to apply to the Water Judge for Water Division 5, subject to the right of appeal, for a determination that under the then extant conditions, the Subdistrict's actions hereunder, other than construction of the Azure Project or the alternate facility, constitute adequate compliance with C.R.S. 1973, 37-45-118(1)(b)(IV) to the end that Subdistrict shall be relieved from any further duty in relation to its Windy Gap Project diversions and said statute.

Should the parties hereto agree to forego additional work toward construction of the Azure Reservoir and Power Project or the alternate facility contemplated hereunder, and/or the Water Court should relieve the Subdistrict from any further duty, the Subdistrict shall forthwith assign to

the River District all permits, licenses, engineering plans, drawings, specifications and other material acquired or produced by the Subdistrict or others in connection with the Azure Project or said alternate facility. River District shall have the right to proceed with said Project(s) free of the obligations of this Agreement with respect thereto. To the extent the failure to initiate construction within the periods herein contemplated for Azure Reservoir and Power Plant, or the alternate facility, is due to reasonably avoidable fault or delay on the part of Subdistrict, the time within which construction was to have been initiated shall be extended a like period. For the purposes of this Agreement, the initiation of construction shall be deemed to have occurred on the date construction contracts are signed which result in physical onsite work on the facilities contemplated hereunder. All lands and rights-of-way, if any, acquired by Subdistrict for said Project may be acquired by River District at cost, plus interest thereon at the rate being paid by Subdistrict thereon, if notice of River District's desire to obtain said lands and rights-of-way is given to Subdistrict in writing within six months after any agreement to forego said additional work.

13. Windy Gap Project diversions will be made strictly under the priority system (including exchanges), thus protecting all conditional and absolute water rights senior in priority, unless specifically subordinated to Windy Gap decrees.

14. Subdistrict will comply with all terms and provisions of Senate Document 80 in the design, construction and operation of the Windy Gap Project.

15. The Parties acknowledge and agree that Subdistrict may initiate immediately the construction of its Windy Gap Project prior to the construction of Azure Reservoir and Power Project, which latter facility is intended to comply with the provisions of C.R.S. 1973, 37-45-118(1)(b)(IV);

provided that no water may be diverted from the western slope of Colorado (from streams west of the Continental Divide) through said Windy Gap Project facilities prior to the initiation of construction of such facilities contemplated in paragraphs 6 and 12 hereof, or it is determined that such facilities will not be constructed pursuant to the provisions of paragraph 12; provided, however, that in the event of actual requirements by any or all of the Windy Gap Project participants for water for initial domestic, municipal or power purposes within the boundaries of the Subdistrict, directly or by exchange, diversions to the extent of such requirements may be made with the prior consent of River District and such consent shall not be unreasonably withheld.

Subdistrict shall have the right to make the maximum diversion necessary or possible, pursuant to paragraph 3(d) of that Carriage Contract, Contract No. 14-06-700-7497, between the Northern Colorado Conservancy District, United States of America and Subdistrict, dated October 3, 1973, in any one year only and when the diversion will not interfere with any beneficial consumptive use of water from the Colorado River and its tributaries in western Colorado.

Diversions by the Windy Gap Project prior to completion of adequate facilities for diversion of water by Ranchers shall not interfere with the delivery into Ranchers' diversion facilities of their presently decreed prior rights to water.

16. Subdistrict within one year after initiation of the construction of the Windy Gap Project is under construction, will advance a sum sufficient for the following purposes: (1) payment of $25,000 to Grand County for salinity studies of the Colorado River (the results thereof to be made available without cost to all other parties hereto), (2) payment to the Town of Hot Sulphur Springs of $150,000 for assistance in improving its water treatment facility and $270,000 for assistance in improving its waste water treatment facility,

and (3) such additional sums as needed for Subdistrict to plan, design and construct facilities needed by the Ranchers for the diversion and delivery of the Ranchers' senior decreed water rights from the Colorado River. Said sums, when paid by the Subdistrict and expended or obligated, shall not be recoverable in the event the Subdistrict voids this Agreement under the terms of paragraph 41 below. Subdistrict shall design and construct such facilities in accordance with specifications approved by the State Engineer. Ranchers agree that the design of any such facility when approved by the State Engineer, constitutes compliance of the design requirements by Subdistrict. Subdistrict agrees to replace and reconstruct such facilities at its own cost if the same prove to be defective at any time within seven (7) years after completion of the Windy Gap Project. If the efficiency or purpose of such facility is rendered ineffective or defective for delivery of existing decreed water to a Rancher because of any action by or operation of Subdistrict, the Subdistrict agrees to correct such defect at its own cost. Subdistrict agrees to process and obtain such permits as necessary to permit construction of Ranchers' facilities.

Individual contracts shall be negotiated with each Rancher in order to meet the requirements of this paragraph, including necessary construction easements, subject, however, to the limitations contained in this Agreement. The contracts for construction of such facilities shall be finalized within 90 days after the Windy Gap Project is under construction, and if not finalized within said period, Subdistrict may proceed to construct said facilities as designed by Subdistrict and approved by the State Engineer.

17. Subdistrict will dedicate and set aside annually, but noncumulatively, the following amounts of water produced from the Windy Gap water supplies to be stored as follows:

(a) Prior to the construction of Azure Reservoir and Power Project, or alternate facility, the Subdistrict will place 3000 acre feet of water in Granby Reservoir for beneficial use, without waste, in Middle Park and will release 2000 acre feet thereof for all beneficial uses, except for instream uses and industrial uses (unless the industrial use is within a municipality and through its municipal water system), and the additional 1000 acre feet of such water for municipal and domestic uses in Middle Park. The release of this 1000 acre feet shall be made only if domestic and municipal uses in Middle Park have not been met adequately from the 2000 acre feet of water previously released.

(b) After the Azure Reservoir and Power Project, or alternate facility, has been constructed, the Subdistrict will place 2000 acre feet of water in Granby Reservoir for beneficial use, without waste, in Middle Park and will release said 2000 acre feet for all beneficial uses, except for instream uses and industrial uses (unless the industrial use is within a municipality and through its municipal water system). Subdistrict will additionally place, at the direction of Middle Park, 1000 acre feet of water in either (1) Azure Reservoir, or the alternate facility, for all beneficial uses in Middle Park and thereby reduce the 3000 acre foot capacity reserved to Subdistrict in paragraphs 9 Second and 29 to 2000 acre feet, or (2) Granby Reservoir for municipal and domestic uses in Middle Park. If said 1000 acre feet is placed in Granby Reservoir, all pumping costs incurred by Subdistrict to store said water in Granby Reservoir shall be reimbursed annually to Subdistrict by Middle Park.

These waters shall be released by Subdistrict, upon request of Middle Park and subject to operational criteria

established by the United States. Any water so stored in Granby Reservoir shall be the last of any Subdistrict water to be spilled from Granby Reservoir, if such spill is required.

18. Subdistrict will not claim the use of Green Mountain Reservoir for replacement purposes for the Windy Gap Project operation.

19. Subdistrict will apply for an NPDES permit for diversion and carriage of water to Granby Reservoir if the same is required by law.

20. Subdistrict will pay its proportionate share of any direct mitigation costs attributable to salinity on the Colorado River which legally may be imposed at a future date by any competent authority and which is proportionately required of all users in Colorado of Colorado River water.

21. Subdistrict agrees to a water classification for Granby Reservoir, Shadow Mountain Reservoir and Grand Lake which will permit all present beneficial uses of these reservoirs or lakes, but reserves its right to contest imposition of water quality regulations on its activities.

22. Subdistrict will not oppose the dredging of Shadow Mountain Reservoir for water quality purposes, provided that such work is scheduled in such a manner as to not interfere with the essential operations of the Colorado-Big Thompson Project and the Windy Gap Project.

23. Subdistrict shall withdraw its opposition to any present River District Water Court proceedings in Water Division 5 and 6. As long as Subdistrict is proceeding diligently in the planning and construction of the Azure Reservoir and Power Project, or its alternate, or the same is constructed, River District agrees not to make a call on Subdistrict water rights for the benefit of any of its present conditional decrees with diversion points on the main stem of the Colorado River above the confluence of the Colorado and Roaring Fork Rivers, nor as to storage below such point on the Colorado

River to the extent the same will probably fill from other sources as determined by mutual agreement between the River District and Subdistrict. In the event of disagreement, such determination shall be made by the Division Engineer, Water Division No. 5. Provided, further, however, that to the extent that vacant capacity in Una Reservoir is created by power releases only, and the water so released not beneficially consumptively used in Colorado, that capacity shall be subordinated to the Windy Gap Project. This Agreement not to call shall become ineffective, except as to the capacity in Una Reservoir created by water releases for power purposes only, in the event of release by the Water Court of Subdistrict's duty to construct Azure Reservoir and Power Project, or its alternate facility. Further, Subdistrict will not oppose any present or future applications of River District in Water Division 5 and 6 unless the same may affect the administration of the Subdistrict's Windy Gap water rights on the main stem of the Colorado River.

24. Subdistrict agrees to bypass at the Windy Gap Reservoir diversion site at all times the lesser of the following: (1) Such amount as may be necessary to satisfy all senior decrees of the Ranchers and to provide such minimum stream flow in that stream segment of the Colorado River below the Windy Gap Project and above the confluence of the Blue River and the Colorado River as may be determined by the Colorado Division of Wildlife and subsequently decreed to the Colorado Water Conservation Board pursuant to C.R.S. 1973, 37-92-102(3), or (2) the natural flow of the river at the Windy Gap Reservoir diversion site if the natural flow is less than (1) hereof. It is the intent of the Parties that the amount of bypass by Subdistrict contemplated herein is based upon valid existing decrees and shall not be increased by future changes in stream regimen caused by changes in point of diversion, changes in type, place or extent of use, or

future junior decrees on this segment of the River, including tributaries thereto. Further, it is not the intent of this provision to preclude Ranchers from exercising their senior rights against any or all junior existing conditional or future rights on the Colorado River or its tributaries or to supersede those rights guaranteed to Ranchers by C.R.S. 1973, 37-86-113.

Further, Subdistrict agrees not to oppose the application for minimum stream flow made by the Colorado Water Conservation Board for this purpose if the same is not in conflict with the provisions hereof, and to assist in supporting the integrity thereof, if necessary.

Subdistrict agrees to the installation, at no cost to Ranchers, of a stream gaging station on the Colorado River in the vicinity of the present diversion structure of the Kinney-Barriger Ditch, and at such other points on the Colorado River as may be necessary as determined by State Engineer and the Colorado Water Conservation Board, to adequately monitor the minimum stream flows as set forth in this paragraph.

25. Subdistrict agrees to subordinate its Windy Gap decrees to all present and future in-basin irrigation, domestic and municipal uses, excluding industrial uses, on the Colorado and Fraser Rivers and their tributaries above the Windy Gap Reservoir site.

26. Subdistrict agrees that no additional water or water supplies will be carried through the Windy Gap facilities unless such conveyance complies with the provisions of C.R.S. 1973, 37-45-118(1)(b)(IV).

27. Subdistrict will cooperate with all parties in permitting public use for recreational purposes of the land owned by Subdistrict at the Windy Gap Reservoir site upstream of the diversion dam, provided that the operational integrity of the Windy Gap Project is maintained and the safety of the public is protected. Grand County, or other responsible

governmental agency, in a separate agreement with Subdistrict shall assume all operation and maintenance costs and all liability of any nature for use of the facility by the public for recreational purposes. Subdistrict will maintain the Windy Gap Reservoir full at all times following the termination of diversions in the fall and prior to the start of diversions in the spring, provided, however, that the reservoir may be temporarily drained during this period for any maintenance or improvements.

28. Three Lakes intends to construct a sewer project that will collect sewage effluent presently discharging into Grand Lake, Shadow Mountain Reservoir and Lake Granby and will carry such effluent to new treatment facilities to be constructed in the Willow Creek drainage. At the request of the Northern Colorado Water Conservancy District, Three Lakes has agreed to construct such ditches and related facilities as are necessary to allow the effluent from its proposed new treatment facilities to flow by gravity to a point on Willow Creek above the headgate of the Bunte Highline Ditch in order to reduce the quantity of water required to be released from Willow Creek Reservoir to meet the call of said ditch. Northern Colorado Water Conservancy District has agreed that the construction of such facilities will satisfy any obligation of Three Lakes that might be asserted to arise because of depletions to Colorado-Big Thompson Project water rights and storage facilities resulting from construction of the Three Lakes project. Except for the costs of the initial construction of the treatment facilities, the ditches and related facilities, and maintenance of them, Subdistrict shall pay any and all costs required to implement the exchange, or incurred as a result of such exchange, of Three Lakes sewage effluent for water that would otherwise be required to be released from Willow Creek Reservoir to meet the call of the Bunte Highline Ditch, including all costs incurred to

obtain any permits or other approvals required by law in order to implement such exchange.

PART VI

AGREEMENTS OF RIVER DISTRICT

29. River District and Middle Park agree to provide for the purpose and subject to the limitation contained in paragraph 9, subparagraph Second, 3,000 acre feet of capacity in Azure Reservoir or substitute facility built pursuant to this Agreement for the use and benefit of the Subdistrict, thereby reducing the entitlement of Middle Park in Azure Reservoir to 2000 acre feet.

30. River District will make satisfactory arrangements to permit joint or other appropriate use by Subdistrict of its pending Federal Energy Regulatory Commission (FERC) application for a preliminary permit for the Azure Reservoir power features or for such other appropriate arrangement as may be agreed upon by River District and Subdistrict.

31. For the purposes of this Agreement the following decrees for Azure Reservoir and Power Plant shall be utilized:

Structure	Water District	Case No.	Adjudicated Date
a. The Azure Reservoir	53	1277	10-19-62
b. First Enlargement of Azure Reservoir	53	1416	9-13-67
c. Azure Reservoir Power Conduit and Power Plant, First Enlargement	Division 5	W-3991	-

d. Such other decrees as may be necessary to operate the Azure Project in accordance with this Agreement.

Appropriation Date	Priority No.	Amt. Decreed
a. 7-21-58	433	25,583.6 a.f.
b. 7-21-58	482	63,803.5 a.f.
c. 9-29-78	-	1,000 c.f.s.

PART VII

MUTUAL AGREEMENTS OF ALL PARTIES

32. Each Party to this Agreement agrees not to object to the Subdistrict obtaining any and all licenses, permits, rights-of-way or other approvals required to permit the immediate construction of the Windy Gap Project. All such Parties agree to withdraw any former opposition to any such licenses, permits, rights-of-way or other approvals and further to not make any further objections or adverse comments concerning the granting thereof.

33. Each Party to this Agreement will cooperate in obtaining all licenses, permits, rights-of-way, or other approvals necessary or required to permit the construction of the Azure Reservoir and Power Project. If any person or entity not a party to this Agreement should oppose the construction of the Azure Reservoir and Power Project in such a manner that said Project cannot be under construction within 15 years, each Party, to the best of its ability, will do everything possible to encourage the withdrawal of any such objections so as to permit the construction of the Azure Reservoir and Power Project as expeditiously as possible.

34. Each Party hereto will not oppose the granting of Subdistrict's 1967 and 1978 appropriation dates for the various features of the Windy Gap Project and for a new appropriation of not to exceed 200 c.f.s. if such enlargement is necessitated by reason of a need for a bypass imposed by virtue of the provisions of paragraph 24 hereof. Subdistrict may divert under its decrees an amount of water not in excess of 90,000 acre feet in any one year, and not to exceed an average of 65,000 acre feet per year in any consecutive ten year period. It is anticipated by the Parties that the long term annual yield of water to the Subdistrict will be approximately 54,000 acre feet.

35. All Parties agree that Subdistrict may proceed immediately to construct the Windy Gap Project upon filing of a final Environmental Impact Statement by the Water and Power Resources Service (formerly United States Bureau of Reclamation) for the Windy Gap Project and after the appropriate 30 day waiting period has expired, and each agrees to not request or require that a draft Environmental Impact Statement simultaneously be prepared for the Azure Reservoir and Power Project as each Project is a separate and distinct Project which is not dependent upon any other Project for construction. The Parties recognize that if Azure Reservoir and Power Project cannot be built for any reason, an appropriate alternative project may then be selected under the terms of this Agreement and it is impossible now to determine which project, if any, will be built. The Subdistrict and River District agree that the Subdistrict will furnish all data and information necessary to enable the appropriate federal entity to comply with NEPA requirements for the Azure Reservoir and Power Project, or alternative thereto, as a separate project. All environmental concerns among the Parties regarding the Windy Gap Project have been resolved by this Agreement regardless of whether none, all or only one facility is constructed and operated.

36. Grand County, NWCCOG, and Subdistrict further agree that this Agreement is an intergovernmental agreement pursuant to Article XIV, Sec. 18 of the Colorado Constitution and Sec. 29-1-201 to 203, inclusive, among all governmental entities hereto and contains all standards upon which Grand County will base any or all decisions for the Windy Gap Project, including 1041, zoning and environmental decisions. Each governmental entity, however, reserves the right to contest any 1041 and zoning regulations or actions which at any later time may be adopted or pursued by Grand County or others if such regulations or actions would in any manner affect the construction or operation of any such facility or

facilities. If the decision of Grand County is not in accord with this Agreement, it is understood and agreed to by all parties hereto that the Subdistrict reserves the right to contest the application of any or all Grand County requirements, including 1041, zoning or environmental application, permit or approval requirements as to Subdistrict activities pursuant to this Agreement.

37. Within the limits and conditions contained herein, Subdistrict may build and operate such facilities as needed to accomplish the purposes of this Agreement.

38. All Parties agree that this Agreement shall not bind Ranchers to any financial commitment for implementation thereof.

39. The Parties agree that upon request of any party to this Agreement they will join with Subdistrict, and other interested parties, in the defense of any litigation against the construction or operation of either the Windy Gap Project or Azure Reservoir and Power Project, or alternative project, by persons or entities who are not parties to this Agreement. However, this provision shall not be construed to require any financial participation of any type from Ranchers or Three Lakes.

40. Within 30 days after the issuance of a 1041 permit and any other necessary Grand County approvals pursuant to paragraph 36, Subdistrict and the Northern Colorado Water Conservancy District will withdraw from Civil Action 79CV173, Denver District Court, and from Civil Action 79CV5133, presently pending in the Denver District Court, Denver, Colorado by stipulation of the Northern Colorado Water Conservancy District and Subdistrict and all parties defendant to these actions, which stipulation shall embody the terms of this Agreement, and agree that the actions and claims represented thereby shall not be refiled except in accordance with the rights reserved to Subdistrict under the terms of this Agreement.

41. The Parties hereto agree that this Agreement shall be either void or extended in certain circumstances. Therefore, unless conditions (a) and (b) are met, this Agreement shall be void:

(a) All signatory parties identified herein have validly executed this Agreement by June 30, 1980 unless the necessity thereof has been specifically waived by Subdistrict.

(b) Approval of Agreement by all six of Subdistrict participants by June 30, 1980.

To the extent that the conditions in the following subparagraphs (c), (d), (e) and (f) delay beyond June 30, 1983 the initiation of construction of the Windy Gap Project and the implementation of this Agreement, all time periods provided for in paragraph 12 herein shall be extended for a time equal to the period of delay.

(c) A determination has been made that NEPA compliance for the Azure Reservoir and Power Project is not required as a condition precedent for NEPA compliance for the Windy Gap Project.

(d) Approval is given by Subdistrict Bond Counsel on the legality and appropriateness of Subdistrict issuing revenue bonds for the construction of the Windy Gap Project and Azure Reservoir and Power Project, all as set forth herein, and if necessary, confirmation of this Agreement by the District Court for Weld County, Colorado, pursuant to C.R.S. 1973, 37-45-143, and enactment of such legislation as may be needed to permit Subdistrict to accomplish the purpose and substance of this Agreement.

(e) A final Environmental Impact Statement and all necessary federal, state and local permits and clearances for the Windy Gap Project are issued, no litigation is pending, and the Subdistrict is able to proceed with completion and operation of the Windy Gap Project in accordance with the terms of this Agreement.

(f) Approval of this Agreement by the Water Judge, Water Division 5, State of Colorado in accord with the terms of this Agreement, and entry of final decrees to Subdistrict for a total of 600 c.f.s. of water for the Windy Gap Project.

42. This Agreement may be filed by any Party hereto in any court or administrative proceedings as a Stipulation of and between the appropriate parties to any such proceedings.

THIS AGREEMENT may be executed in counterparts, each of which must be executed by Subdistrict and River District, and shall inure to and be binding upon the Parties, their personal representatives, successors and assigns, as appropriate.

Dated and signed as of the 30th day of April, 1980.

ATTEST:

Secretary

MUNICIPAL SUBDISTRICT, NORTHERN COLORADO WATER CONSERVANCY DISTRICT

By
President

ATTEST:

Secretary

COLORADO RIVER WATER CONSERVATION DISTRICT

By
President

ATTEST:

Clerk of the Board

BOARD OF COUNTY COMMISSIONERS OF THE COUNTY OF GRAND, COLORADO

By Herbert A. Ritschard
Herbert Ritschard, Chairman

ATTEST:

Tom Isaac,
Secretary/Treasurer

NORTHWEST COLORADO COUNCIL OF GOVERNMENTS

By
Keith Troxel, Chairman

ATTEST:

Secretary

THREE LAKES WATER AND SANITATION DISTRICT

By
President

ATTEST:

Secretary

WINTER PARK WATER AND SANITATION DISTRICT

By
President

ATTEST:

_____
Secretary

MIDDLE PARK WATER CONSERVANCY DISTRI

By_____
President

ATTEST:

_____
Town Clerk

TOWN OF HOT SULPHUR SPRINGS, COLORADO

By_____
Mayor

ATTEST:

_____
Town Clerk

TOWN OF GRANBY, COLORADO

By_____
Mayor

ATTEST:

_____
Secretary

RITSCHARD CATTLE CO., INC.

By_____
President

ATTEST:

_____
Secretary

SKYLARK RANCH COMPANY, a Colorado corporation

By_____
President

ATTEST:

_____
Secretary

GORE CANYON, LTD., a Colorado corporation

By_____
President

ATTEST:

_____
Secretary

COLORADO RIVER LAND CORPORATION

By_____
President

JACQUES RANCH I, a limited partnership

_____
David Mayhoffer

By_____
General Partner

_____
Lloyd A. Palmer

JACQUES RANCH II, a limited partnership

_____
Edna L. Palmer

By_____
General Partner

_____
Leo Marte

_____
Joseph McElroy

_____
Eunice Marte

_____
Isabel McElroy

_____
Jessie Joyce Thompson

_____
John H. McElroy

David Howard Thompson

John Sheriff

Ida L. Sheriff

H. Grady Culbreath

J. Gail Culbreath

John L. Kemp

Crockett C. Kemp

William Henry Thompson

Anita Lewis Thompson

Blanche Cowperthwaite

John Taussig

Mary K. McElroy

Olga Hill

Howard K. Schmuck, Jr.

Richard P. Doucette

Christine O. Doucette

Gene Ritschard

Charles G. Broady

Phyliss Broady

Stanley Broome

SUNSET ASSOCIATES, a partnership

By _____
General Partner

CORRAL CREEK RANCHES, INC.

By _____

RESOLUTION OF THE GRAND COUNTY PERMIT AUTHORITY
PURSUANT TO BOARD OF COUNTY COMMISSIONER RESOLUTION NO. 1978-5-4

RESOLUTION NO. 1980-6-1

A RESOLUTION GRANTING TO THE MUNICIPAL SUBDISTRICT, NORTHERN COLORADO CONSERVANCY DISTRICT, A PERMIT TO ENGAGE IN AN ACTIVITY PREVIOUSLY DESIGNATED AN ACTIVITY OF STATE INTEREST PURSUANT TO THE BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY RESOLUTION NO. 1978-5-4, AS AMENDED.

WHEREAS, The Municipal Subdistrict has filed an Application and Petition with the Grand County Permit Authority and the Board of County Commissioners of Grand County, pursuant to Resolution No. 1978-5-4, to engage in an activity of State interest; namely, to construct a municipal and industrial water project;

AND WHEREAS, public hearing on said Application and Petition was held on June 17, 1980 for final decision by the Permit Authority;

AND WHEREAS, said Permit Authority has considered the Application and Petition of the District, the oral and written material submitted at the public hearing, the recommendation of the Grand County Department of Development and such further and additional matters as it deems appropriate and DOTH FIND AND DETERMINE AS FOLLOWS:

1. That the Application and Petition of the Municipal Subdistrict conforms to the requirements of the regulations adopted by Grand County pursuant to Resolution No. 1978-5-4, as amended.

2. The need for the proposed water project can be substantiated.

3. Assurances of compatibility of the proposed water project with federal, state, regional and County planning policies regarding land use and water resources have been provided.

4. The Municipal and industrial water project shall emphasize the most efficient use of water, including, to the extent permissible under existing law, the recycling and reuse of water. Urban development, population densities, and site layout and design of storm water and sanitation systems shall be accomplished in a manner that will prevent the pullution of aquifer recharge areas.

5. The proposed water project will not contaminate surface water resources.

6. The proposed water project is capable of providing water pursuant to standards of the Colorado Department of Health.

7. The proposed diversion of water from the source development area shall not decrease the quality of peripheral or downstream surface and subsurface water resources in the source development area below that designated by the Colorado Water Quality Control Division on January 15, 1974 and effective June 19, 1974 or below stricter standards subsequently adopted.

8. The proposed development and the potential diversions of water from the source development area will not significantly deteriorate aquatic habitats, marshlands and wetlands, groundwater recharge areas, steeply sloping or unstable terrain, forests and woodlands, critical wildlife habitat, big game migratory routes, calving grounds, migratory ponds, nesting areas and the habitats of rare and endangered species, public outdoor recreational areas, and unique areas of geologic, historic or archaeological importance.

EXHIBIT 37

NOW THEREFORE, BE IT RESOLVED BY THE GRAND COUNTY PERMIT AUTHORITY, PURSUANT TO THE AUTHORITY granted to it by Resolution No. 1978-5-4 of the Board of County Commissioners of Grand County, as follows:

1. That the Municipal Subdistrict, Northern Colorado Water Conservancy District shall be and hereby is granted a Permit to engage in an activity of State interest, said Permit being attached hereto as Exhibit "A" and by this reference incorporated herein and made a part hereof.

2. That the requirements of Resolution No. 1978-5-4 relating to Application fee and financial security shall be and hereby are waived as well as any other requirements not specifically addressed by Applicant pursuant to its Application and Petition except for a $500.00 (five-hundred dollar) processing fee.

3. Water Quality of the Colorado River should be protected during all phases of construction.

4. The Final Environmental Impact Statement should address the concerns of the Colorado Department of Health, Department of Natural Resources, and the Departments of Local Affairs, Agriculture and Wildlife.

5. The applicant should address housing impacts prior to construction and provide all housing in accordance with Grand County Zoning and Building Standards.

6. The visual impact must be fully addressed to include the following:

a. The reservoir level should be maintained to not allow mud flats or dust problems.

b. All structures should be colored to blend with the surrounding natural area.

c. Landscaping should be maximized between the public roadway and the reservoir, dam and associated structures.

d. Natural vegetation should be utilized in conjunction with native stone and ground cover.

e. Utilize existing mature trees and other vegetation to screen the lower side of the dam and spillway.

f. The pipe cut area should be revegetated.

7. This permit is subject to Applicants and County compliance with the provisions of the "Agreement Concerning The Windy Gap Project and the Azure Reservoir and Power Project," dated as of April 30, 1980.

8. That this Permit Authority hereby declares its intent to grant this Permit regardless of any procedural or substantive irregularities which may have occurred in the course of reviewing and granting said Application and Petition and any such irregularities shall be and hereby are waived.

MOVED, SECONDED AND UNANIMOUSLY APPROVED THIS 17TH DAY OF JUNE, 1980.

GRAND COUNTY PERMIT AUTHORITY

BY Herbert A. Ritschard
Herbert A. Ritschard, Chairman

Elwin E. Crabtree
Elwin E. Crabtree, Member

John E. Martling
John E. Martling, Member

PERMIT ISSUED TO CONDUCT
A DESIGNATED ACTIVITY OF STATE INTEREST

OR

TO ENGAGE IN DEVELOPMENT IN A
DESIGNATED AREA OF STATE INTEREST

IN

THE COUNTY OF GRAND, STATE OF COLORADO

Pursuant to Administrative Regulations and Guidelines for Administration heretofore adopted by the Board of County Commissioners of Grand County, said County has received an application from The Municipal Subdistrict Northern Colorado Water Conservancy District (hereinafter called "Applicant") for a permit involving the following matter (s) of State interest:

Design, construction and operation of the Applicant's Windy Gap Project, Reservoir and Pipeline, as proposed.

and has approved that application.

This Permit authorized the Applicant:

1. To design, construct and operate its dam, reservoir and pipeline represented in Applicant's Petition and Application on file with the Permit Authority.

2. On the following described tract of land: As described in the Application.

3. For the following period: For an indefinite period beginning June 17, 1980, but in no event longer than the life of the Project.

4. In accordance with the plans and/or specifications approved by the Permit Authority on the 17th day of June, 1980, as well as the Guidelines for Administration adopted by Grand County for: Municipal and Industrial Water Projects as set forth in Resolution 1978-5-4 as amended by the Permit Authority.

5. On the condition that the Applicant proceeds in conformity with all applicable Federal and State Statutes and Regulations as well as all applicable local land use controls including, but not limited to, master plans, subdivision regulations, zoning ordinance and building code.

This Permit is valid for use only by the Applicant and may not be transferred. In the event that the Applicant fails to take substantial steps to initiate the above development or activity within twelve (12) months from the date of this Permit or, if such steps are taken, in the event the Applicant fails to complete the development or activity with reasonable diligence, this Permit may be revoked by the Permit Authority.

DATED THIS 17th DAY OF June, 19 80.

Herbert A. Ritschard
Chairman
Permit Authority

AGREEMENT

THIS AGREEMENT is entered into as of this 7th day of July, 1980, by and between the Board of County Commissioners of the County of Grand, Colorado (hereinafter, "the County"), and the Middle Park Water Conservancy District (hereinafter, "Middle Park").

W I T N E S S E T H:

WHEREAS, Middle Park is the duly constituted Water Conservancy District comprised of Grand and Summit Counties as set forth in the Water Conservancy District Act;

AND WHEREAS, the County is duly invested with all the powers and authority granted to it by Colorado Statutes as a County and has primary responsibilities for land use planning within the unincorporated areas of the County;

AND WHEREAS, both parties recognize that there is a recognizable connection between water planning and land use planning, and that it would be expeditious to enter into an agreement effectuating coordination between the two Boards;

AND WHEREAS, both parties desire to provide a mechanism for cooperation between the County and Middle Park on matters of mutual concern;

AND WHEREAS, both parties desire to provide for cooperation between Middle Park and the County to ensure the full and complete beneficial use of the 3,000 acre-feet of water allocated to Middle Park and to be placed in Granby Reservoir by the terms of Paragraph 17 of that Agreement entered into as of April 30, 1980, by Grand County, Middle Park, the Colorado River Water Conservation District, and the Municipal Subdistrict of the Northern Colorado Water Conservancy

EXHIBIT 38

District, the Northwest Colorado Council of Governments and others, with respect to the Windy Gap Project and the Azure Reservoir and Power Plant Project in Grand County. A copy of said Agreement is attached hereto as Appendix A and incorporated herein by this reference;

AND WHEREAS, both parties desire to insure that the lawful rights and responsibilities of both the County and Middle Park are protected. The County has a responsibility to plan for and enact land use regulations to control development, all for the protection of the health, safety and welfare of the inhabitants of the County. Middle Park is charged, by statute, with the responsibility to make water available for beneficial use. It is the intent of this Agreement to provide a mechanism whereby both the County and Middle Park may fulfill their responsibilities;

AND WHEREAS, Middle Park and the County each recognize the contribution made by the other party in obtaining an appropriate settlement from the Municipal Subdistrict, Northern Colorado Water Conservancy District for the Windy Gap project; and they agree as much as possible to coordinate their policies to provide that the water obtained from the Municipal Subdistrict, Northern Colorado Water Conservancy District will service the residents of Grand and Summit Counties from a domestic and municipal standpoint for the foreseeable future.

NOW THEREFORE in consideration of premises and mutual covenants and agreements between the parties it is agreed as follows:

(1) This Agreement is entered into pursuant to the authority, inter alia, of the Colorado Constitution, Article XIV, Section 18, C.R.S. (1973) 29-1-201 et seq., 30-10-301 et seq., 30-11-101 et seq., 29-20-101 et seq., and 37-45-101 et seq.

(2) Prior to entering into a contract, or negotiations leading to such contract, (whether short- or long-term) for the sale,

lease and/or disposition of any portion of the 3,000 acre-feet of water referenced at Paragraph 17 of Appendix A hereto, Middle Park will solicit comments from the County.

(3) Prior to entering into a contract, or negotiations leading to such contract, (whether short- or long-term) for the sale, lease and/or disposition of any portion of the 3,000 acre-feet of water referenced at Paragraph 17 of Appendix A hereto, Middle Park will require that any and all County land use plans and regulations and their associated requirements and approvals have been complied with and/or acquired from the County, as appropriate. This obligation shall include, without limitation, applicant compliance with the County zoning, subdivision, and PUD regulations.

(4) Middle Park hereby agrees to reserve an amount of water out of the total 3,000 acre-feet referenced in Appendix A, (but in any event not to exceed 3,000 acre-feet) for long-term, future domestic and municipal purposes within the County. This reservation shall be based upon an engineering projection of such needs conducted by Middle Park in consultation with all Towns within Middle Park and with due regard to individual differences in actual and legal needs.

(5) Middle Park will cooperate and consult with the County regarding the development of rules and regulations governing the immediate use and ultimate disposition of the 3,000 acre-feet of water referenced at Paragraph 17 of Appendix A. In furtherance of this objective, Middle Park will accord the County the opportunity to review and comment upon drafts of such rules and regulations prior to their adoption by Middle Park, as well as the opportunity to appear before the Middle Park Board at the meeting or meetings at which said rules and regulations are considered. Said rules and regulations shall include, but not by way of limitation, inter alia, costs of water, protection of senior rights, and reservations of water within Middle Park for future municipal and domestic needs in the County. Middle Park also agrees and consents to furnish to the County at least

thirty (30) days in advance copies of all the rules and regulations that it intends to enact, as well as notify the County of any meeting at which consideration will be made upon entering into any contract with any petitioning entity. Such notification shall be supplemental to the required publication as set forth in the Statutes.

(6) The County agrees to send to Middle Park Water Conservancy District, Post Office Box 588, Granby, Colorado, or such other place as Middle Park may designate, copies of all water rights and physical water supply information as filed with subdivision plats, and County agrees to designate Middle Park a designated review agency for subdivision and PUD preliminary plats.

(7) The County agrees to provide prompt review and comment upon all proposed sales of water by Middle Park, as such review and comment is guaranteed by the terms of this Agreement.

(8) The County agrees to cooporate with Middle Park to ensure that the 3,000 acre-feet of water referenced at Paragraph 17 of Appendix A is fully utilized for the citizens within the jurisdiction of Middle Park.

(9) The County agrees to notify Middle Park of any proposed amendments to the County master plan, zoning, subdivision, 1041 and/or PUD regulations, and to provide to Middle Park copies of all proposals and adopted amendments.

(10) The provisions of this Agreement are enforceable by both parties.

WHEREFORE, in consideration of the mutual promises and covenants given herein, the parties do execute this Agreement as of the day and year first above written.

ATTEST:

Johnny Lee Pottey
COUNTY CLERK

BOARD OF COUNTY COMMISSIONERS
OF THE COUNTY OF GRAND, COLORADO

BY: Herbert A. Ritschard
Chairman

ATTEST:

MIDDLE PARK WATER CONSERVANCY DISTRICT

BY: Richard Fisher

RECORD OF DECISION
PERMIT APPLICATION NO. 6520

Permit No. 6520 is being issued.

The viable alternatives considered in making this decision are:

1. No Action: No action would consist of continuation of present water supplies for Windy Gap Service Area. Projected water supply shortfall would probably be partially met by conversion of agricultural water rights to municipal and industrial uses. More stringent water use restrictions would be implemented.

2. Windy Gap Project: Project would meet projected water demands for Service Area. Minimum streamflows in the Upper Colorado River would be maintained; recreation opportunities would be developed for about 112 surface acres of reservoir; dependable water supply for Rawhide Powerplant would be provided; and current and prospective West Slope water rights and users of Colorado River water would be compensated for loss of an annual average depletion of 54,000 acre-feet of water.

The No-Action alternatives is the environmentally preferred alternative.

I have reviewed and evaluated, with regard to the overall public interest, the project Environmental Impact Statement prepared by Lower Missouri Region, Water and Power Resources Service and other documents concerning the proposed activity described in Department of the Army Permit Application No. 6520, submitted by Municipal Subdistrict, Northern Colorado Water Conservancy District on 16 January 1978.

The possible natural resource, social, and economic consequences of the proposed activity, as well as other relevant factors, have been studied in accordance with the Department of the Army's responsibilities under 33 CFR 320-329.

After consideration of Corps of Engineers' regulations and Environmental Protection Agency's guidelines with respect to Section 404 of the Clean Water Act, I find that the proposed discharge of dredged or fill material will not have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas, wildlife or recreational areas.

All practicable means to avoid or minimize environmental harm from the project have been adopted. As identified in the EIS, the following mitigation measures will be incorporated to substantially reduce impacts associated with the project:

1. A minimum flow agreement between the Northern Colorado Water Conservancy District and the Division of Wildlife was signed 23 June 1980. The terms of this agreement will lessen the adverse impacts of the project on aquatic life and recreation.

EXHIBIT 39

2. The pipeline route will be revegetated and vegetation will be planted around the reservoir to minimize impacts on vegetation.

3. A plan to mitigate wetlands inundated by the reservoir will be prepared and coordinated with the Environmental Protection Agency.

4. Reservoir operations and architectural controls on structures are being utilized to lessen the impacts on aesthetics.

5. Impacts to cultural resources are being mitigated through controlled surveys and data gathering.

6. Roads will be permanently and temporarily relocated to reduce interference with normal traffic flow.

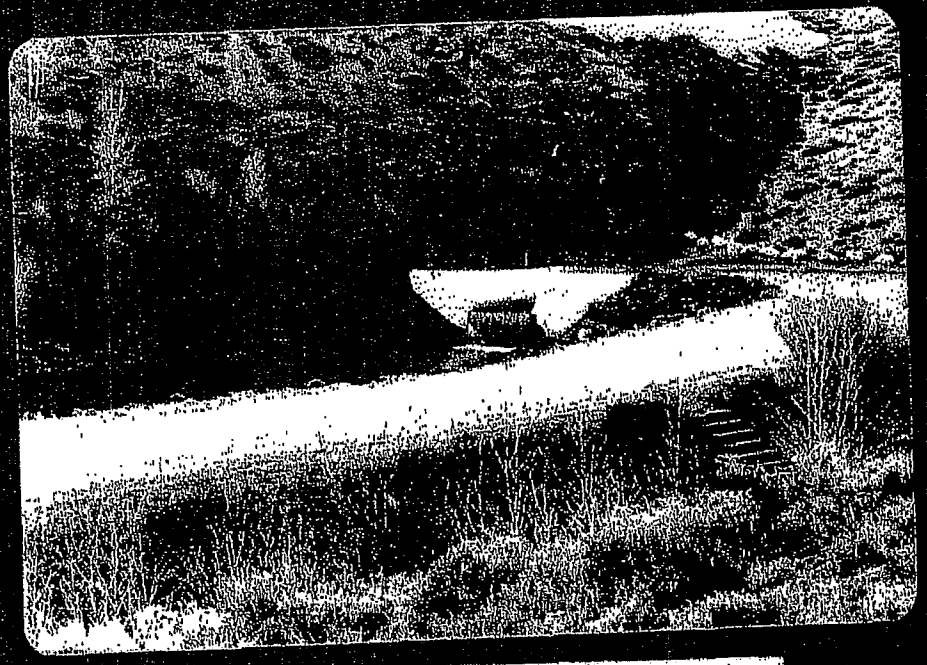
7. Conservation measures to aid recovery of the endangered fishes in the Colorado River will be accomplished.

8. Mitigation associated with salinity increases and reduced flows downstream is being handled by the Colorado River Salinity Control Project.

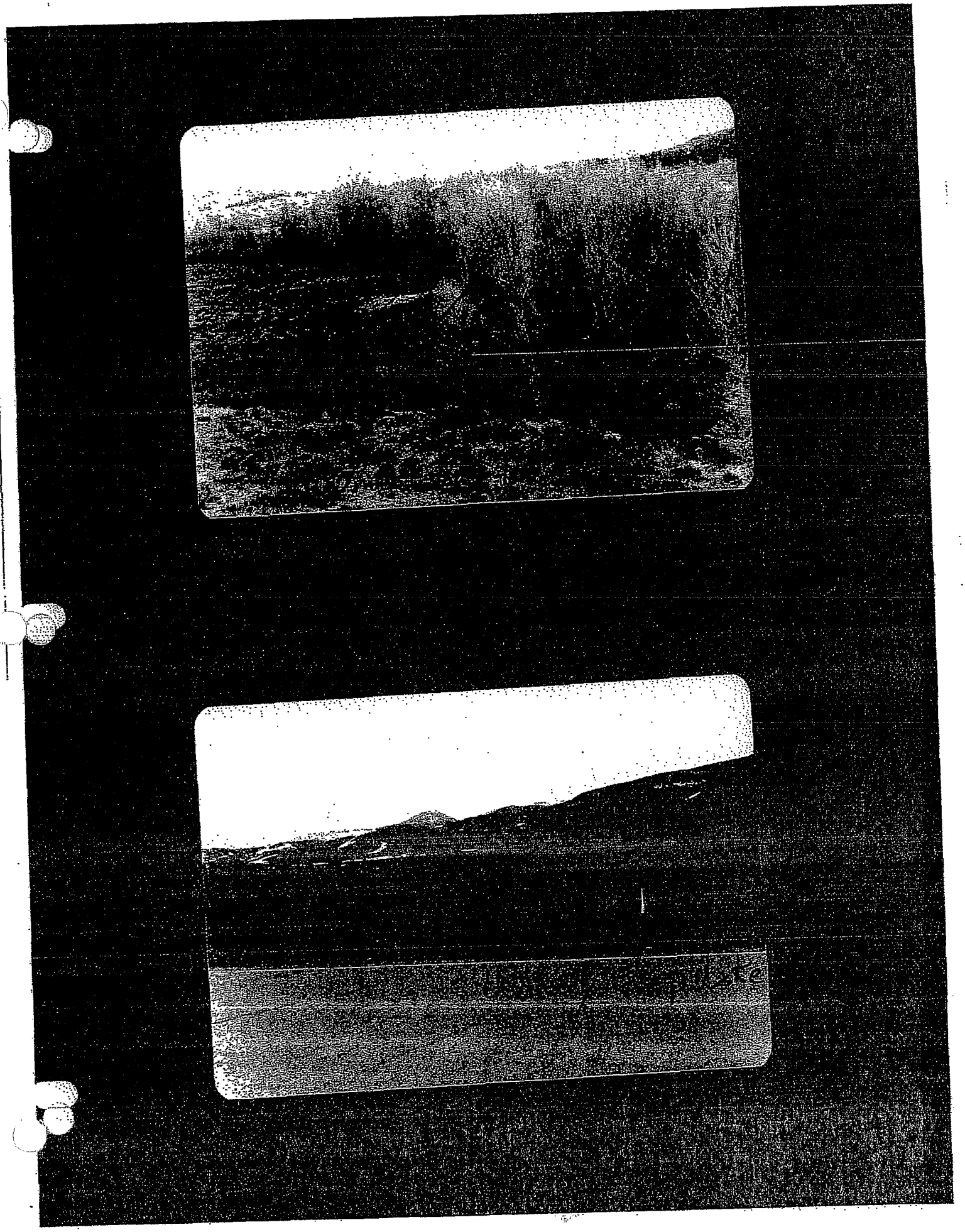
9. Monitoring of pre- and post-project water temperatures will occur to detect and possibly correct any post-project temperature changes.

DATE: 8 Jun 81

GLENN R. MASSARO
Lieutenant Colonel, CE
Deputy Commander and Deputy
District Engineer



25 April 1978-Willow Creek Dam Structure
Water is moved to Granby Lake by gravity
canal & pumps from Willow Cr.Reservoir-
Will meet Windy Gap Water at the Slough-
way into Granby Lake





25 April 1978 Permit 6520
Location of Windy Gap Dam & Lake
on Colorado River





25 April 1978 Granby Lake
Water from Windy Gap Dam will be pumped to Granby Lake



25 April 1978 Granby Dam
Looking Downstream

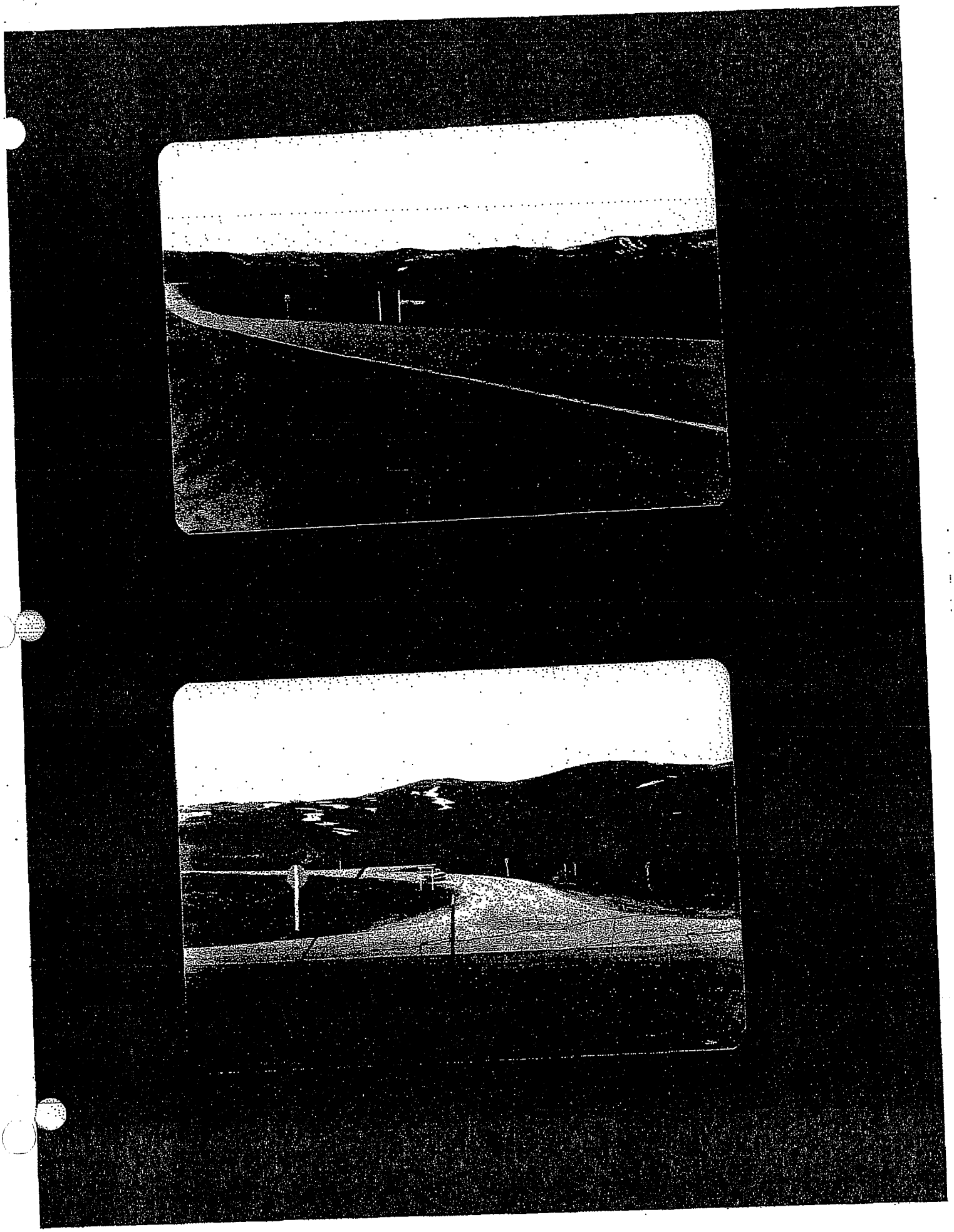
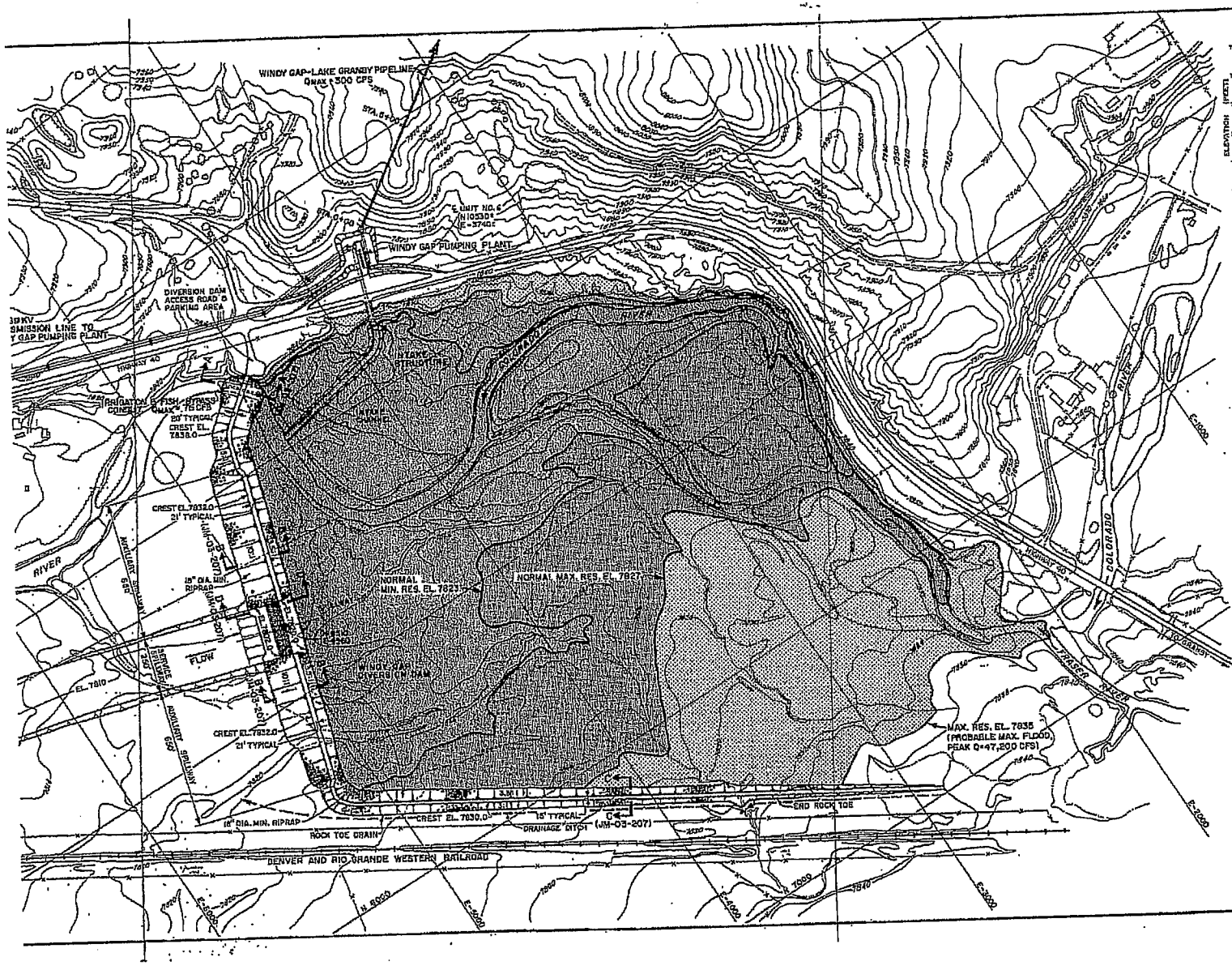
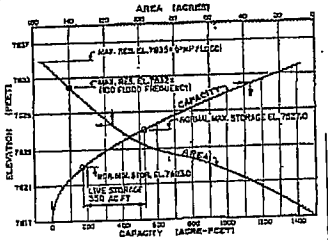


EXHIBIT A-3





WINDY GAP DIVERSION DAM RES.
AREA-CAPACITY CURVES

NOTE:

TOPOGRAPHIC MAPPING PREPARED BY HOGAN AND OLHAUSER ENGINEERS, LOVELAND, COLORADO

REFERENCE DRAWINGS:

WINDY GAP DIVERSION DAM & SPILLWAY - PLAN & SECTION JM-03-207

WINDY GAP PUMPING PLANT - SITE PLAN & PROFILE JM-03-208

WINDY GAP DIVERSION DAM - LOCATION OF BOREHOLES & SEISMIC LINES JM-03-251

SCALE 0 100 200 400 600 800 FEET

MUNICIPAL SUBDISTRICT
NORTHERN COLORADO WATER CONSERVANCY DISTRICT

WINDY GAP PROJECT

WINDY GAP DIVERSION DAM PLAN

INTERNATIONAL ENGINEERING COMPANY, INC.

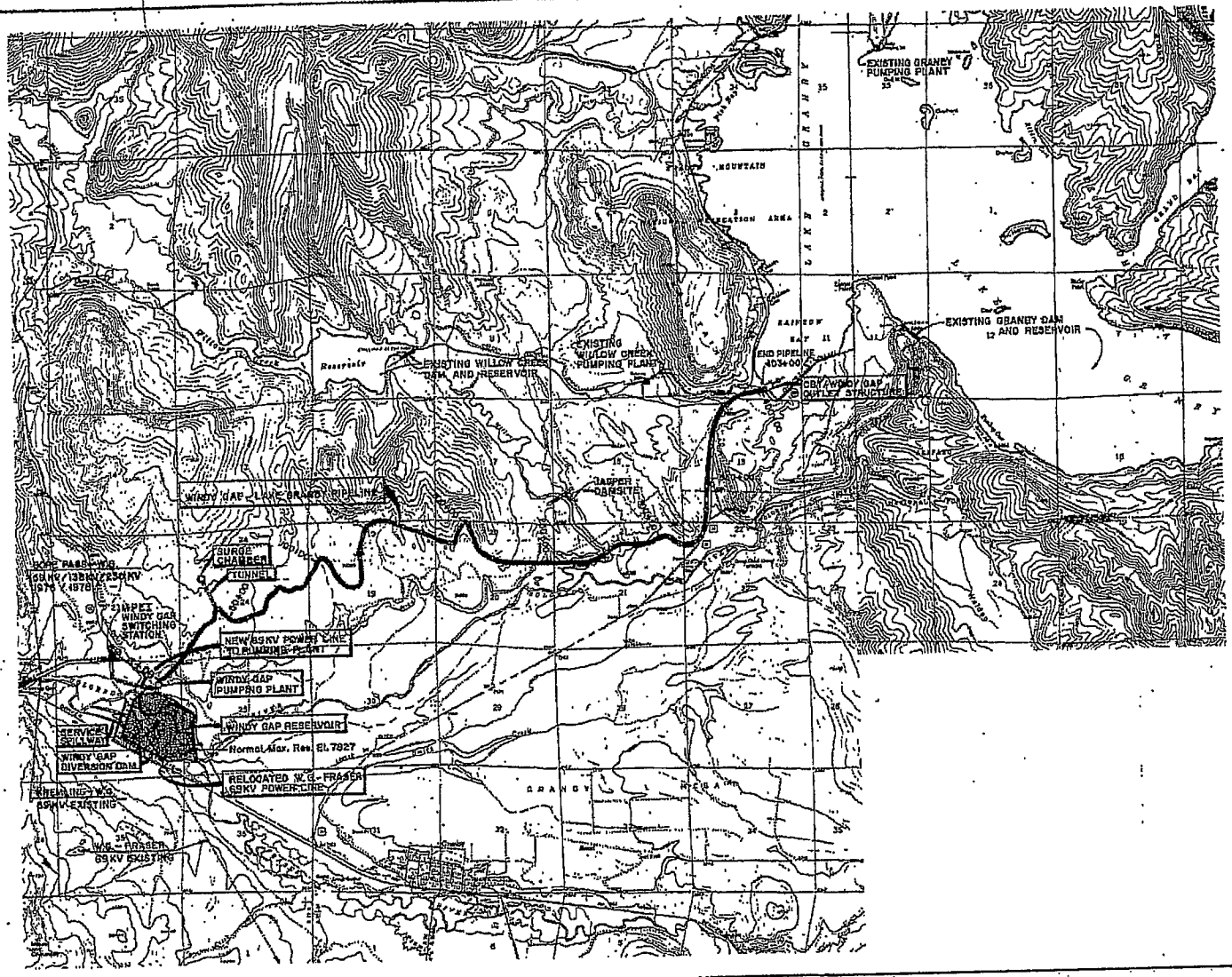
DESIGNED	CHECKED	APPROVED	
DRAWN REB	DATE	RECOMMENDED	
		MAY, FEBRUARY 1978	

IECO
220 MONTGOMERY STREET
SAN FRANCISCO CALIFORNIA 94104

DRAWING NO. JM-03-206

EXHIBT A-

6520



LEGEND

- EXISTING MOUNTAIN PARK ELECTRIC, INC. SWITCHING STATION
- EXISTING 69 KV POWER LINE
- FUTURE EXTENSION LINE
- PROPOSED WINDY GAP PROJECT 69 KV POWER LINE
- PROPOSED PIPELINE
- PROPOSED PUMPING PLANT AND STRUCTURE
- PROPOSED TUNNEL

NOTES:

THE RECOMMENDED DEVELOPMENT PLAN INCLUDES THE FOLLOWING FACILITIES:

1. DIVERSION DAM AND RESERVOIR APPROXIMATELY ONE MILE ABOVE WINDY GAP
2. PUMPING PLANT WITH MAXIMUM DISCHARGE CAPACITY OF 300 c/s
3. A 40,300 FOOT LONG, 7 FOOT DIAMETER PIPELINE FROM WINDY GAP PUMPING PLANT TO LAKE GRANBY.
4. A COMBINED CBT/WINDY GAP PROJECT OUTLET STRUCTURE FOR DISCHARGE BOTH WILLOW CREEK AND WINDY GAP WATER INTO LAKE GRANBY.

APPROXIMATE MEAN DECLINATION, 1957

SCALE,

1000 0 0.5 0 1000 2000 3000 4000 5000 6000 7000 FEET

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL.

Topography has been taken from the U.S.G.S. 7½ minute Quadrangle Sheets of the area.

MUNICIPAL SUBDISTRICT
NORTHERN COLORADO WATER CONSERVANCY DISTRICT

WINDY GAP PROJECT

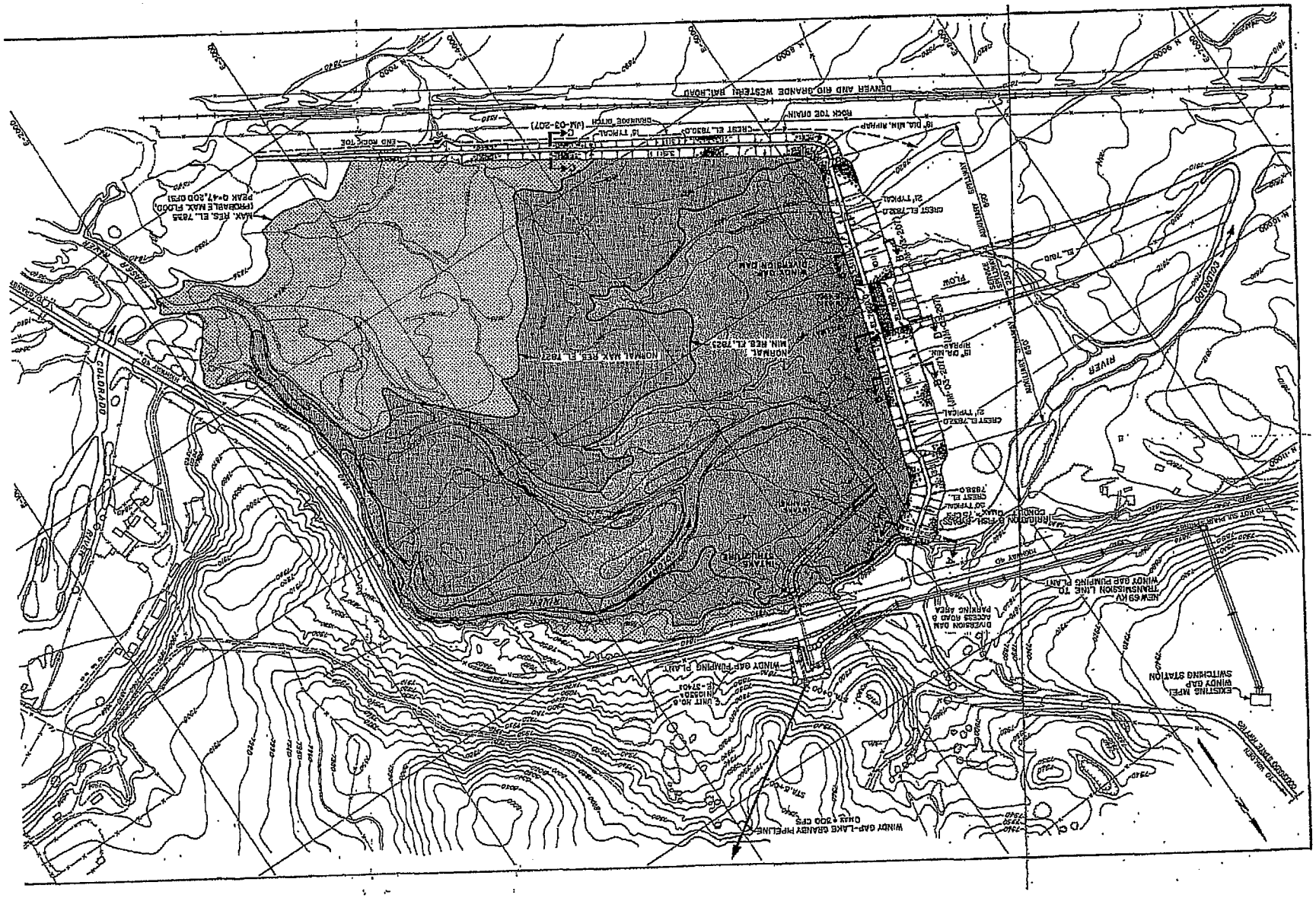
RECOMMENDED DEVELOPMENT PLAN

INTERNATIONAL ENGINEERING COMPANY, INC.

DESIGNED IECO DRAWN BHE COK CHECKED JMC APPROVED RECOMMENDED DATE FEBRUARY 1974

IEC
333 MONTGOMERY STREET
SAN FRANCISCO CALIFORNIA 94104

DRAWING NO. JM-03-205


DENVER AND RIO GRANDE WESTERN RAILROAD
ROCK TOE DRAIN
END ROCK TOE
DRAINAGE DITCH
CREST EL. 7830.0'
15' TYPICAL
(UM-03-207)
MAX. RES. EL. 7835
(PROBABLE MAX. FLOOD)
PEAK Q=47,500 CFS)
NORMAL MAX RES EL 7821
NORMAL
MIN. RES. EL. 7625
WINDY GAP PUMPING PLANT
UNIT NO. 6
EL=5743
WINDY GAP-LAKE GRANBY PIPELINE
QMAX=200 CFS
DIVERSION DAM
ACCESS ROAD & PARKING AREA
NEW 69 KV
TRANSMISSION LINE TO
WINDY GAP PUMPING PLANT
EXISTING MPEI
WINDY GAP
SWITCHING STATION
TO KREMMLING
COLORADO
RIVER
PLOW
CREST EL. 7832.0
21' TYPICAL
CREST EL. 7832.0
21' TYPICAL
CREST EL. 7832.0
20' TYPICAL
CREST EL. 7832.0
20' TYPICAL
EL. 7810
EL. 7810
EL. 7810

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CALIFORNIA 95814-2922

REPLY TO
ATTENTION OF

November 13, 2008

Office of Counsel

SUBJECT: Freedom of Information Act Request No. FA-09-0015; Request for the 1981 Record of Decision and Permit 6520 for the Windy Gap Project West of Granby, Colorado

Mr. Robert Tuchman
1700 Lincoln Street, Suite 4100
Denver, Colorado 80203-4541

Dear Mr. Tuchman:

Enclosed please find a portion of the agency records responding to your Freedom of Information Act request received in this office on October 28, 2008. A copy of the Decision Document for the subject permit action is enclosed. Ms. Barbara Morgan of our Grand Junction Regulatory office has informed me that she also mailed 144 pages of records directly to you.

For the purpose of assessing fees, I have classified you as a commercial requester under 32 C.F.R. § 518.85(b)(2)(i). The charge for providing the requested information is as follows:

Clerical Search and Review; 1/4 hours @ $20.00 per hr	$ 5.00
Photocopies; 146 copies @ $0.15 per page	$21.90
Colored Photocopies; 5 copies @ $1.00 per page	$ 5.00
Microfiche copies; 2 copies @ $0.25 per page	$ .50
TOTAL	**$32.40**

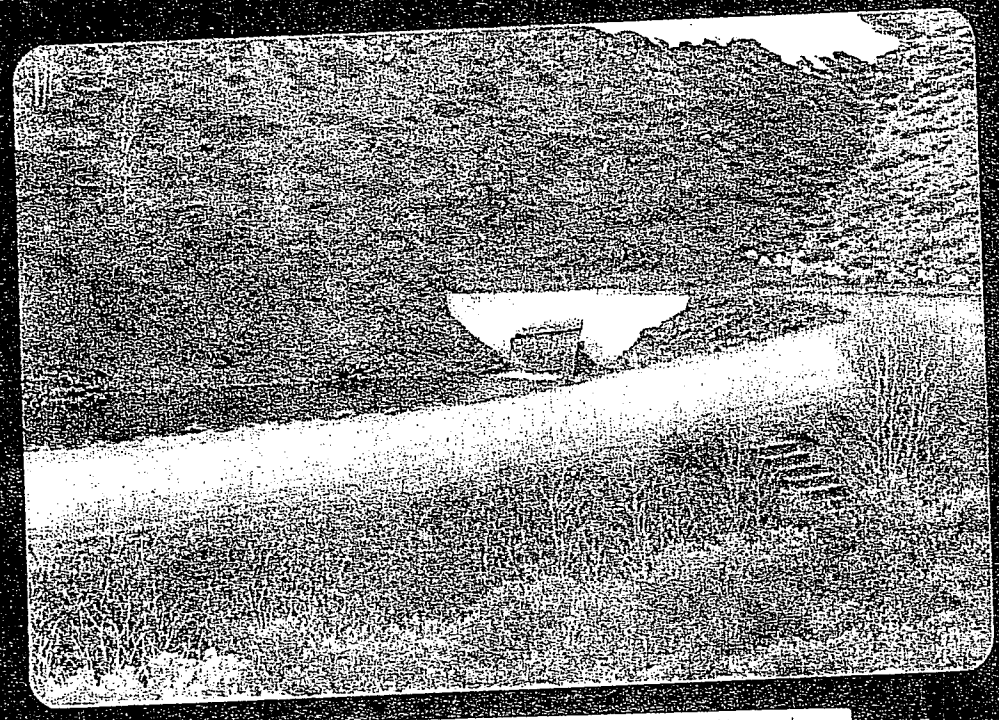
Please remit a check for the above amount within thirty (30) days of receipt of this letter. Your check should be made payable to **F & A O USAED-SACRAMENTO.** Please address the envelope to **OFFICE OF COUNSEL, ATTN: FREEDOM OF INFORMATION ACT OFFICER.**

If you have any question regarding the provided information, please contact me directly at (916) 557-6619 or by e-mail at Sondra.c.sperr@usace.army.mil.

Sincerely,

Sondra C. Sperr
Assistant Freedom of Information Act Officer

Enclosures



25 April 1978-Willow Creek Dam Structure
Water is moved to Granby Lake by gravity
canal & pumps from Willow Cr.Reservoir-
Will meet Windy Gap Water at the Slough-
way into Granby Lake



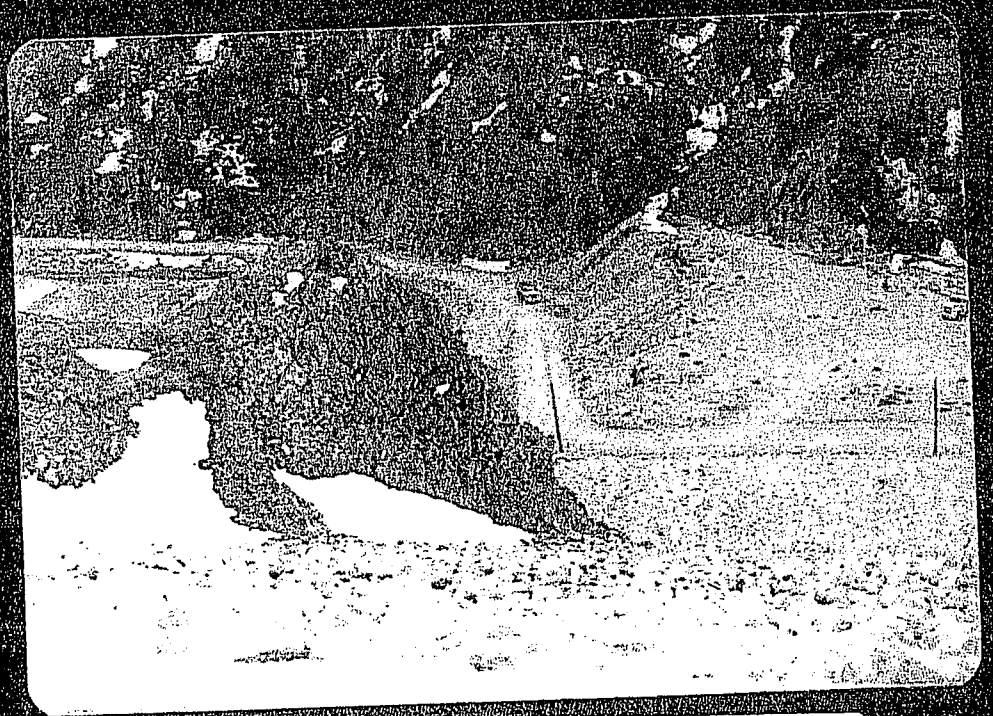


25 April 1978 Permit 6520
Location of Windy Gap Dam & Lake
on Colorado River





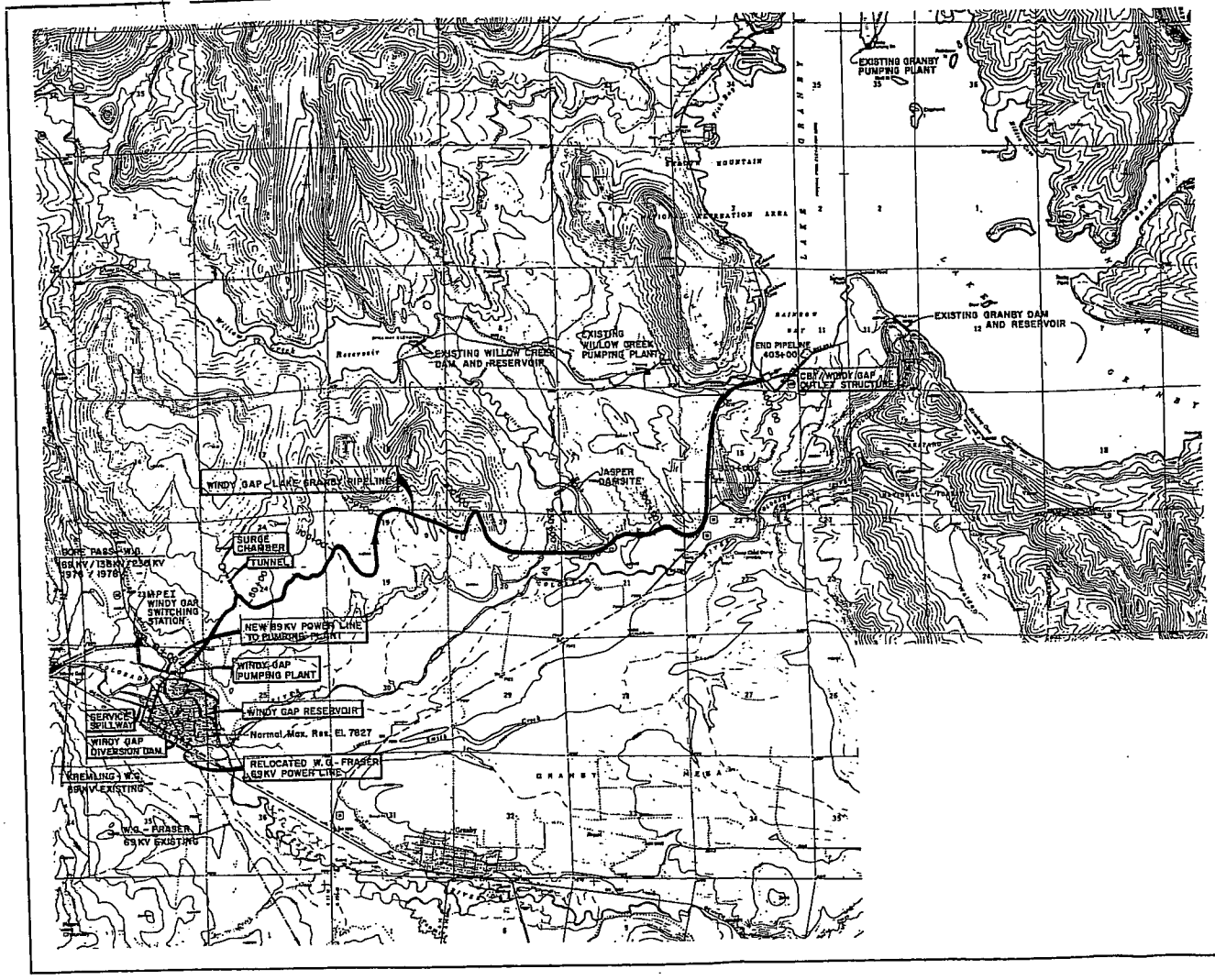
25 April 1978 Granby Lake
Water from Windy Gap Dam will be
pumped to Granby Lake



25 April 1978 Granby Dam
Looking Downstream

EXHIBIT A-2

6520



TRUE NORTH
MAGNETIC NORTH
14½°
APPROXIMATE MEAN DECLINATION, 1957

LEGEND

- EXISTING MOUNTAIN PARK ELECTRIC, INC. SWITCHING STATION
- EXISTING 69 KV POWER LINE
- FUTURE EXTENSION LINE
- PROPOSED WINDY GAP PROJECT 69 KV POWER LINE
- PROPOSED PIPELINE
- PROPOSED PUMPING PLANT AND STRUCTURE
- PROPOSED TUNNEL

NOTES:

THE RECOMENDED DEVELOPMENT PLAN INCLUDES THE FOLLOWING FACILITIES:

1. DIVERSION DAM AND RESERVOIR APPROXIMATELY ONE MILE ABOVE WINDY GAP
2. PUMPING PLANT WITH MAXIMUM DISCHARGE CAPACITY OF 300 cfs
3. A 40,300 FOOT LONG, 7 FOOT DIAMETER PIPELINE FROM WINDY GAP PUMPING PLANT TO LAKE GRANBY.
4. A COMBINED CBT/WINDY GAP PROJECT OUTLET STRUCTURE FOR DISCHARGING BOTH WILLOW CREEK AND WINDY GAP WATER INTO LAKE GRANBY.

SCALE

1 0.5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

Topography has been taken from the U.S.G.S 7½ minute Quadrangle Sheets of the area.

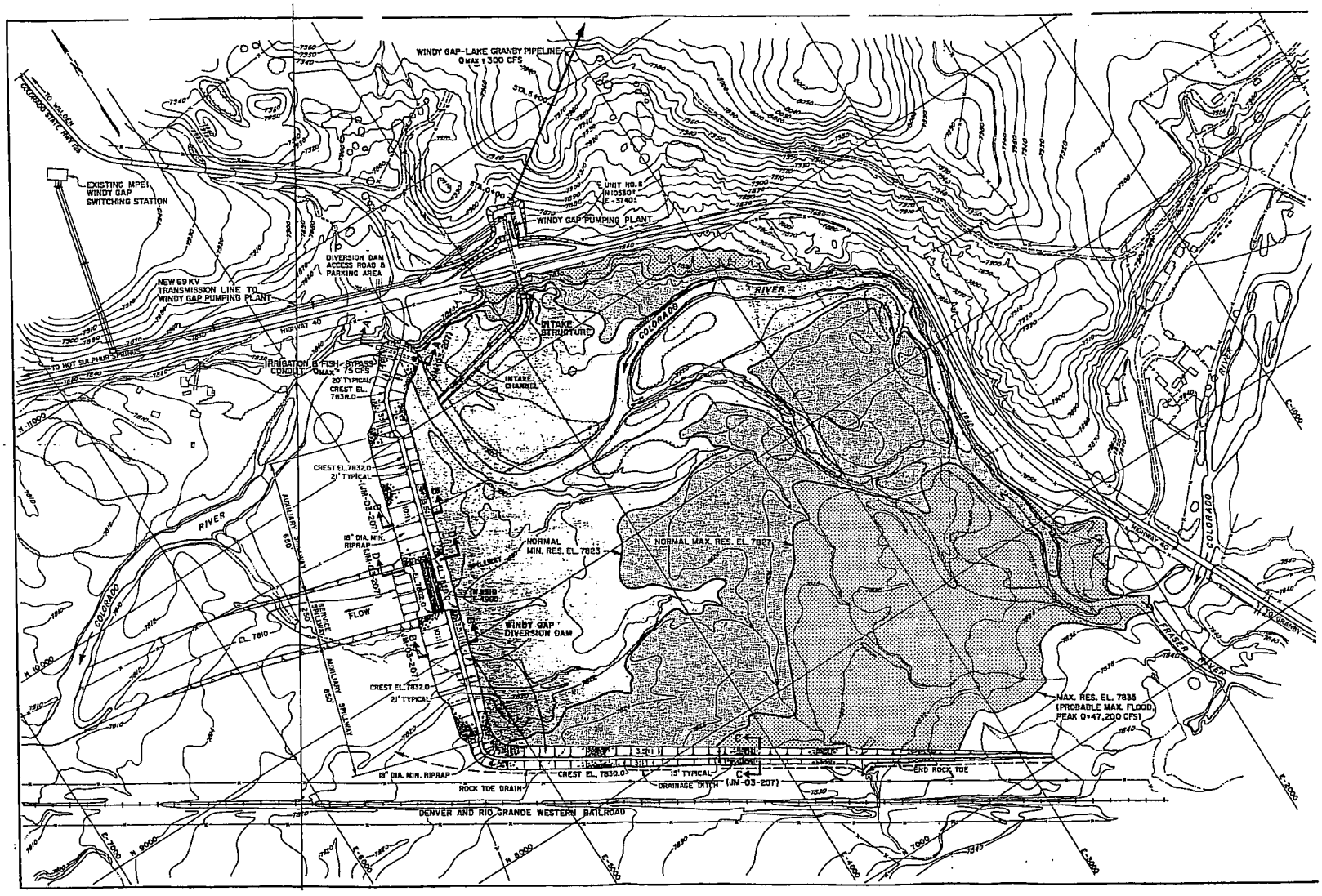
MUNICIPAL SUBDISTRICT
NORTHERN COLORADO WATER CONSERVANCY DISTRICT

WINDY GAP PROJECT

RECOMMENDED DEVELOPMENT PLAN

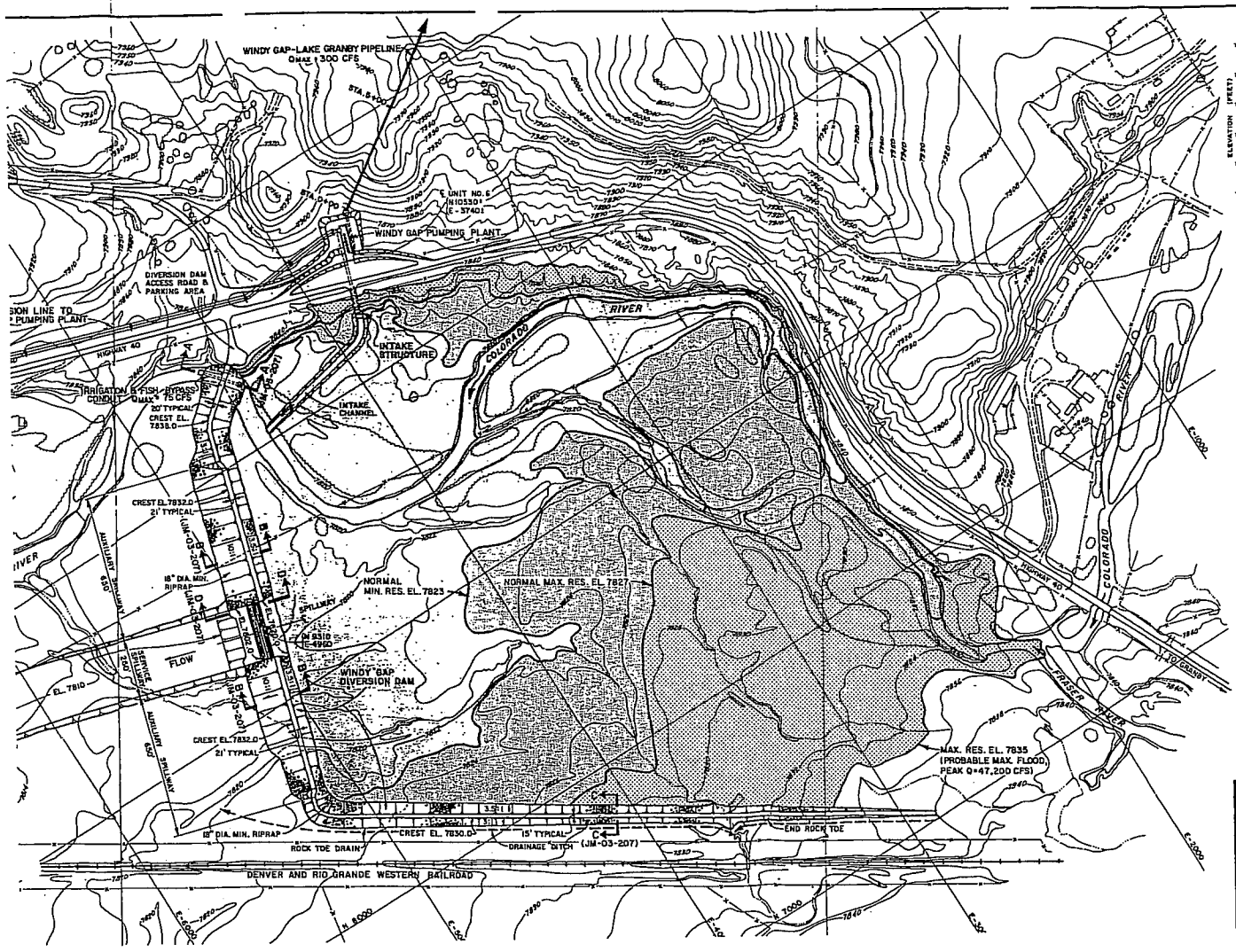
INTERNATIONAL ENGINEERING COMPANY, INC.

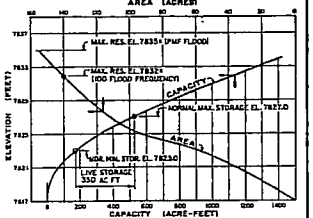
DESIGNED IECO	CHECKED	APPROVED
DRAWN	INSPECT	RECOMMENDED
IECO 220 MONTGOMERY STREET SAN FRANCISCO CALIFORNIA 94104		DATE FEBRUARY 1976
		DRAWING NO. JM-03-205



WINDY GAP-LAKE GRANBY PIPELINE
QMAX = 300 CFS
STA. 5+00
TO WALDEN
COLORADO STATE HWY 125
EXISTING MPEI WINDY GAP SWITCHING STATION
℄ UNIT NO. 6
N 10530±
E - 3740±
WINDY GAP PUMPING PLANT
DIVERSION DAM ACCESS ROAD & PARKING AREA
NEW 69 KV TRANSMISSION LINE TO WINDY GAP PUMPING PLANT
HIGHWAY 40
TO HOT SULPHUR SPRINGS
IRRIGATION & FISH BYPASS CONDUIT QMAX = 75 CFS
20' TYPICAL
CREST EL. 7838.0
INTAKE STRUCTURE
INTAKE CHANNEL
COLORADO
RIVER
CREST EL. 7832.0
21' TYPICAL
(JM-03-207)
18" DIA. MIN. RIPRAP
AUXILIARY SPILLWAY
650'
NORMAL MIN. RES. EL. 7823
NORMAL MAX. RES. EL. 7827
SPILLWAY
FLOW
SERVICE SPILLWAY
250'
EL. 7810
WINDY GAP DIVERSION DAM
CREST EL. 7832.0
21' TYPICAL
MAX. RES. EL. 7835 (PROBABLE MAX. FLOOD, PEAK Q=47,200 CFS)
18" DIA. MIN. RIPRAP
CREST EL. 7830.0
15' TYPICAL
DRAINAGE DITCH
(JM-03-207)
END ROCK TOE
ROCK TOE DRAIN
DENVER AND RIO GRANDE WESTERN RAILROAD
FRASER RIVER
TO GRANBY
N 11000
N 10000
N 9000
N 8000
N 7000
E-7000
E-6000
E-5000
E-4000
E-3000
E-2000
E-1000

EXHIBIT A-3





WINDY GAP DIVERSION DAM RES.
AREA-CAPACITY CURVES

NOTE:

TOPOGRAPHIC MAPPING PREPARED BY HOGAN AND OLHAUSER ENGINEERS, LOVELAND, COLORADO

REFERENCE DRAWINGS:

WINDY GAP DIVERSION DAM & SPILLWAY - PLAN & SECTION JM-03-207

WINDY GAP PUMPING PLANT - SITE PLAN & PROFILE JM-03-208

WINDY GAP DIVERSION DAM - LOCATION OF BOREHOLES & SEISMIC LINES JM-03-231

SCALE 0 100 200 400 600 800 FEET

MUNICIPAL SUBDISTRICT
NORTHERN COLORADO WATER CONSERVANCY DISTRICT

WINDY GAP PROJECT

WINDY GAP DIVERSION DAM PLAN

INTERNATIONAL ENGINEERING COMPANY, INC.

DESIGNED IECO	CHECKED [illegible]	APPROVED [illegible]	
DRAWN NER	AGENCY [illegible]	RECOMMENDED [illegible]	
IECO		DATE FEBRUARY 1978	

Record of Decision

I. Introduction

This document is a concise public record of the Department of the Interior's decision associated with the Windy Gap Project, Colorado, covered in the Colorado-Big Thompson/Windy Gap Projects Final Environmental Statement (FES 81-20).

The decision is whether or not to approve the use of the Colorado-Big Thompson Project carriage facilities to transport Windy Gap Project water in compliance with article 12 of the carriage contract (No. 14-06-700-7497 dated October 3, 1973) among the United States, the Municipal Subdistrict of the Northern Colorado Water Conservancy District (subdistrict), and the Northern Colorado Water Conservancy District.

Article 12 stipulates that environmental impacts must be assessed before Windy Gap Project water (developed and managed by the subdistrict) can be conveyed through the Bureau of Reclamation's Colorado-Big Thompson Project.

II. Description of Alternatives

A. Viable Alternatives

1. No Action (includes continued operation of the Colorado-Big Thompson Project).

No Action would consist of continuation of the present water supplies for the Windy Gap service area (cities of Estes Park, Boulder, Loveland, Longmont, and Greeley; and Platte River Power Authority). The projected water supply annual shortfall of 32,400 acre-feet would probably be partially met by the conversion of water use on approximately 15,000 acres of agricultural lands to municipal and industrial uses. More stringent water use restrictions would be implemented in the service area.

2. Windy Gap Project: Preferred Alternative

The Windy Gap Project would divert a long term annual average of about 56,000 acre-feet from the Upper Colorado River Basin near Granby, Colorado. The diverted water would be pumped from the West Slope through Colorado-Big Thompson Project facilities to the East Slope cities of Estes Park, Boulder, Longmont, Greeley, Loveland, and Platte River Power Authority. The project has been planned and would be constructed and operated by the Municipal Subdistrict of the Northern Colorado Water Conservancy District.

The project consists of a diversion dam 27 feet high, a reservoir with about 122 surface acres, a 600 ft^3/s pumping plant, and a pipeline about 31,000 feet long.

EXHIBIT 40

B. Alternatives Considered But Not Selected

1. Water conservation and management
2. Alternative water supplies
3. Alternative project features

III. Environmentally Preferrable Alternative

The environmentally preferred alternative in this case differs depending upon the affected area. West Slope interests consider No Action the best alternative as opposed to East Slope interests who prefer Windy Gap. Without Windy Gap the West Slope would be spared the water depletions caused by the project and other localized impacts caused by construction of the diversion and appurtenant facilities. On the other hand, the East Slope would experience an accelerated conversion of water use on agricultural lands to municipal and industrial uses and more intense restrictions of existing water use.

IV. Important Factors Which Should Be Considered for Each Alternative

With a No Action alternative the water supply needs of the Windy Gap service area would probably be met by some combination of conversion of agricultural water rights and severe water use restrictions. Up to 15,000 acres of agricultural land in and around the service area would need to be converted in order to partially meet the projected "shortfall" of 32,400 acre-feet annually by the year 2000. It is currently the State of Colorado's policy to avoid agricultural water rights conversion whenever possible, and the cities within the service area already have water conservation programs in effect. None of the environmental impacts summarized in Table II-10 of the FES would occur with a No Action scenario.

With the Windy Gap Project agricultural water right conversion to municipal and industrial use would be slowed considerably and the projected (year 2000) water needs of the service area would be satisfied. An additional net annual average of 88 million kilowatts of energy would be generated by conveying an annual average of 56,000 acre-feet of water through the Colorado-Big Thompson Project. As indicated in Table II-10 of the FES, there would be some residual impacts due to construction and operation of the Windy Gap Project; however, there will be no long-term significant impacts because of substantial mitigation commitments by the subdistrict.

V. Adoption of Mitigation Measures

The Supreme Court of Colorado overruled the Water Court which granted a conditional water right to the subdistrict to divert water for the Windy Gap Project. The Supreme Court found that a conditional water

right could not be granted until the subdistrict defines a plan to adequately mitigate the potential harm to prospective water use within the Upper Colorado River Basin. Subsequently, the subdistrict entered into agreements with various interests to mitigate potential damage from Windy Gap's diversion.

Attachments 1 and 2 of the FES include agreements among the subdistrict and parties affected by the project. These agreements stipulate measures which will substantially reduce the environmental and socioeconomic impacts of the project. Many other commitments are itemized in the applications which the subdistrict has made to the Forest Service, Bureau of Land Management (BLM), and the Corps of Engineers in order to acquire the necessary permits and/or easements to construct and operate project features associated with lands and programs which they administer.

The following major mitigation measures have been agreed to by the subdistrict: (1) about 11,000 acre-feet of the average annual project yield of 56,000 acre-feet will be commited to maintain minimum "instream" flows (2) existing and some future water rights will be protected; (3) disturbed soil and vegetation will be reclaimed; (4) various commitments by the subdistrict to West Slope interests will protect prospective West Slope uses of Colorado River water; and (5) threatened and endangered fish will be protected by resolution of the subdistrict to provide certain conservation measures.

VI. Monitoring and Enforcement of Mitigation Commitments

The Windy Gap Project is not a Federal project. Therefore, control of monitoring and enforcement of Federal concerns associated with Windy Gap must be handled indirectly in most cases.

Federal regulations for which the subdistrict are responsible are the requirements for permits and easements to use BLM and Forest Service lands; a dredge and fill permit issued by the Corps of Engineers; and a contract for water conveyance through Bureau of Reclamation facilities.

In addition, the subdistrict has agreed to mitigation of project water depletions in order to protect West Slope water users, threatened and endangered fish, aquatic biota, and others.

The subdistrict, in cooperation with West Slope interests (e.g., ranchers, local governments, etc.), the BLM, Forest Service, Fish and Wildlife Service, Colorado Division of Wildlife, Corps of Engineers, Bureau of Reclamation, and others have integreated monitoring and enforcement of Federal regulatory requirements and mitigation commitments into contract specifications and operating plans for the project.

The subdistrict's construction inspectors and management personnel will assure enforcement of these specifications and plans.

Compliance with article 12 of the carriage contract has been accomplished, and use of the Colorado-Big Thompson carriage facilities in accordance with contract 14-06-700-7497 is hereby:

Approved: B. E. Martin

Regional Director
Bureau of Reclamation
Lower Missouri Region

Date: JUN 1 8 1981

U S DEPARTMENT OF THE INTERIOR

WATER AND POWER RESOURCES SERVICE

LOWER MISSOURI REGION

FINAL ENVIRONMENTAL STATEMENT

Colorado-Big Thompson Windy Gap Projects

Colorado

EXHIBIT 41

COVER SHEET

1 Responsible and Lead Agency

Lower Missouri Region
Water and Power Resources Service
U S Department of Interior

2 Title and Location of Action

Colorado-Big Thompson/Windy Gap Projects
Boulder, Grand, Larimer, Logan, Morgan, Sedgwick,
Summit, Washington, and Weld Counties, Colorado

3 Contact for Further Information

Richard Eggen
Water and Power Resources Service
Lower Missouri Region
P O Box 25247
Denver, Colorado 80225
Telephone (303) 234-3779

4 Chronology of NEPA Compliance

Documents	Completion Date
Draft Environmental Statement, Colorado-Big Thompson/Windy Gap Projects (INT DES 79-33)	June 18, 1979
Final Environmental Statement, Colorado-Big Thompson/Windy Gap Projects	APR 2 8 1981
Statement Number	FES 81-20

5 Abstract

This final environmental statement discusses the environmental implications associated with meeting the year 2000 projected water needs for the cities of Estes Park, Boulder, Lonamont, Greeley, and Loveland, and Platte River Power Authority The preferred alternative consists of an annual average transmountain diversion of about 54,000 acre-feet of water from the Upper Colorado River Basin to the Service Area The preferred alternative would be constructed and operated by the Municipal Subdistrict of the Northern Colorado Water Conservancy District Existing facilities would be utilized to convey the water from the Subdistrict constructed facilities on the West Slope to the Service Area Mitigation committments of the Subdistrict would substantially reduce environmental impacts

This final environmental statement will be utilized by the Commissioner of Water and Power Resources Service and the Secretary of the Interior in deciding the content and extent of the Federal action

SUMMARY

Purpose and Need

The purpose of the Windy Gap Project is to supply the municipal and industrial water needs of the cities of Estes Park, Boulder, Loveland, Longmont, and Greely, and Platte River Power Authority The Project would supply all of the additional municipal and industrial water needs of the service area projected for the year 2000

The Windy Gap Project is not a Federal project It was planned, and would be constructed and operated by the Municipal Subdistrct of the Northern Colorado Water Conservancy District (Subdistrict) Federal actions include allowing the water to be conveyed through Federal facilities, granting of right-of-way permits and easements, and issuance of a dredge and fill permit

The water need for the service area is projected to be about 32,400 acre-feet by the year 2000

Alternatives

1 Alternatives considered but discarded

a Water conservation and management
b Alternatives water supplies
c Alternative project features

2 Description of Viable Alternatives

a No Action (includes continued operation of Colorado-Big Thompson Project)

No Action would consist of continuation of present water supplies for Windy Gap Service Area Projected water supply shortfall would probably be partially met by conversion of agricultural water rights to municipal and industrial uses More stringent water use restrictions would be implemented

b Windy Gap Project Preferred Alternative

Project would meet projected water demands for Service Area (see Purpose and Need) Minimum streamflows in the Upper Colorado River would be maintained, recreation opportunities would be developed for about 112 surface acres of reservoir, dependable water supply for Rawhide Powerplant would be provided, and current and prospective West Slope water rights and users of Colorado River water would be compensated for loss of an annual average depletion of 54,000 acre-feet of water

Comparison of Impacts of Viable Alternatives

See table II-10 of FES

Unresolved Issues

None

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CHAPTER I PURPOSE AND NEED

Chapter I PURPOSE AND NEED

A Purpose

The purpose of the Windy Gap Project is to supply the municipal and industrial water needs of the cities of Estes Park, Boulder, Loveland, Longmont, and Greely, and Platte River Power Authority The Project would supply all of the additional municipal and industrial water needs of the service area projected for the year 2000

The Windy Gap Project is not a Federal project It was planned, and would be constructed and operated by the Municipal Subdistrict of the Northern Colorado Water Conservancy District (Subdistrict) Federal actions include allowing the water to be conveyed through Federal facilities, granting of right-of-way permits and easements, and issuance of a dredge and fill permit

B Needs

The primary need is to meet projected water demands for the cities of Loveland, Longmont, Greeley, Estes Park, Boulder, and PRPA These entities when referred to collectively will hereafter be known as the Service Area

Tables I-1 and I-2 illustrate the past, present, and projected (year 2000) water demands for the Service Area Table I-1 projects a "short fall" of about 32,400 acre-feet within the Service Area by the year 2000

Table I-1

Summary of Projected Population and Water Use, Firm Yield, and Needs to be Met by Windy Gap Project for year 20..

	Projected Population (Year 2000)	Projected Use Rate (gal/cap/day)	Projected Water Use (Year 2000) (Acre-feet)	Firm Yield[1] (1975 level) (Acre-feet)	Needs to be Met by Project (Acre-feet)
Boulder	135,100	181	27,388	28,792	0
Estes Park	11,600	213	2,768	1,746	1,022
Greeley	115,800	306	39,704	29,994	9,710
Longmont	74,200	272	22,604	17,812	4,792
Loveland	60,900	287	19,576	10,936	8,640
PRPA	--	--	8,200[3]	0	8,200
Total	397,600	250[2]	120,240	89,280	32,364

Source Robinson, 1978 Except where otherwise indicated

1/ Amount of water available from all sources during a minimum water supply year (Dames and Moore, 1977a)

2/ Based on 112,040 acre-feet annual use by population of 397,600 (PRPA requirement excluded)

3/ Platte River Power Authority projections An additional 8,000 acre-feet would also be needed as a back-up supply for Rawhide Powerplant during drought years In non-dry periods this additional water would be sold to local users under temporary contract

Table I-2

Present and Projected Population and Water Supply for Entities of the Municipal Subdistrict

Population Served	Actual 1960[1]	Actual 1970[1]	Actual 1980[2]	Projected[3] 1990	Projected[3] 2000
Boulder	38,000	70,600	98,800	111,200	135,100
Estes Park	2,500	3,500	5,000	8,700	11,600
Greeley	28,000	42,000	63,300	92,800	115,800
Longmont	12,000	24,000	50,000	58,900	74,200
Loveland	11,000	20,000	35,500	43,400	60,900
Total	91,500	160,100	251,600	315,000	397,600
Water Use (Acre-feet)					
Boulder	7,843	13,544	19,500	22,543	27,380
Estes Park	1,406	1,681	1,200[5]	2,082[5]	2,760[5]
Greeley	9,300	13,710	20,300	31,805	39,700
Longmont	4,304	7,022	11,300	17,943	22,600
Loveland	3,100	5,217	9,000	13,951	19,570
PRPA[4]	0	0	0	6,500	8,200
Total	25,953	41,174	53,674	94,824	120,240

1/ Dames and Moore, 1977a

2/ Population estimates for 1980, based on available preliminary census data for municipal boundaries plus estimated service-area population outside of municipal boundaries. Water use is actual delivered or treated water

3/ Robinson, 1978. Population projection from Larimer Weld COG and DRCOG

4/ Platte River Power Authority projection of requirements for Rawhide Powerplant

5/ Reductions in projected and actual reflects impact of water metering program implemented in 1977

C Modifications to the DES

The DES discussed the environmental impacts of three actions (1) Operation and maintenance of the C-BT and alternative operations, (2) construction and operation of the proposed Windy Gap Project (Windy Gap), and (3) construction and operation of PRPA's Rawhide Powerplant (under construction)

The need for an environmental statement was "triggered" because these three actions were considered to be directly related to Federal actions which require an environmental statement pursuant to the National Environmental Policy Act of 1969 (NEPA) The Federal actions are (1) Execution of water carriage contract between Water and Power Resources Service (Water and Power) and the Municipal Subdistrict (Subdistrict) of the Northern Colorado Water Conservancy District (NCWCD), (2) issuance of permits and/or easements by the Bureau of Land Management (BLM) and the Forest Service (FS) allowing a pipeline (Windy Gap to Lake Granby) to be constructed by the Subdistrict on lands administered by the Federal Government, and (3) issuance of a section 404, dredge and fill permit by the Corps of Engineers

Based on comments on the DES it was apparent that the discussion of the existing and alternative C-BT operations and maintenance, and construction and operation of the Rawhide Powerplant was confusing and in some respects may have received erroneous or too extensive coverage

The reasons for addressing the existing and alternative C-BT operations and maintenance was to (1) Establish a base upon which the cumulative impacts of subsequent and associated proposals could be evaluated for impacts, and (2) document the impacts of alternative operational schemes within existing authorization, thereby reducing the need for future NEPA compliance

The need for discussing existing C-BT facilities, operations, and maintenance is still appropriate There must be a base upon which Windy Gap and future associated projects can be assessed for environmental impacts However, many reviewers were confused over what the proposed actions were in the DES, especially in light of the fact that the C-BT is already constructed and operating To reduce this confusion, the C-BT facilities and operations are described as part of the No Action alternative The analysis of the impacts of alternative C-BT operations is no longer needed as a separate section The alternatives discussed in the DES were minor modifications to present operations and maintenance programs These modifications are being pursued under current programs and authorizations when money and manpower become available A brief description of these operational modifications is integrated with the description of C-BT facilities and operations as part of the No Action alternative The impacts are integrated with the No Action alternative

Reviewers of the DES also found redundancy in the descriptions of the existing environment associated with the C-BT and Windy Gap development

and Service Areas To decrease this redundancy, the environments affected by C-BT facilities and operations are described When there is an overlap of environments affected by the Windy Gap Project and C-BT the environments are described by cross reference

The DES treated PRPA's Rawhide Powerplant as an integral and directly related component of the proposed actions discussed in chapter I Detailed impacts associated with Rawhide's construction and operation were presented After review of the comments on the DES, Water and Power decided to treat Rawhide as a potential user of Windy Gap water Rawhide, unlike Windy Gap and C-BT operations lacks direct Federal involvement (no Federal contracts, financing, permits, or easements are required) and is currently being constructed without Windy Gap water PRPA has other water supplies available as discussed under chapter IV, Windy Gap development and Service Area However, PRPA plans to purchase Windy Gap water if the Windy Gap Project is constructed Consequently, this document analyzes and describes the Rawhide Powerplant as a potential user of Windy Gap water Because of the lack of direct Federal involvement and because Rawhide is being constructed without Windy Gap, this document discusses the Rawhide Powerplant in less detail than the DES PRPA completed a detailed environmental assessment (1978) and has received full environmental clearance from Larimer County to start construction PRPA has also acquired an air quality emissions permit from the State

The Supreme Court decision was the result of a suit filed by the Colorado River Water Conservation District protesting the Subdistrict's conditional water right (granted by Water Court No 5) to divert water from the upper Colorado River Basin on the West Slope of the Rocky Mountains to the Windy Gap Service Area located on the East Slope

The Supreme Court overruled the Water Court by finding that the conditional water right could not be granted until the Subdistrict defines a plan to adequately mitigate the potential harm to prospective users within the upper Colorado River Basin This requirement for mitigation is specified in section 37-45-118(1)(b)(IV), CRS, 1973 "However, any works or facilities planned and designed for the exportation of water from the natural basin of the Colorado River and its tributaries in Colorado, by any district created under this article, shall be subject to the provisions of the Colorado River Compact and the Boulder Canyon Project Act Any such works or facilities shall be designed, constructed and operated in such a manner that the present appropriations of water, and in addition thereto prospective uses of water for irrigation and other beneficial consumptive use purposes, including consumptive uses for domestic, mining, and industrial purposes, within the natural basin of the Colorado from which water is exported, will not be impaired nor increased in cost at the expense of the water users within the natural basin The facilities and other means for the accomplishment of said purpose shall be incorporated in and made a part of any project plans for the exportation of water from said natural basin in Colorado " The matter was remanded to the Water Court for further deliberation contingent upon compliance by the Subdistrict with the above statute

CHAPTER II ALTERNATIVES

A GENERAL

B DESCRIPTION OF ALTERNATIVES

C COMPARISON OF ALTERNATIVES

Chapter II ALTERNATIVES

A General

This chapter describes and compares the viable alternatives which would meet the needs discussed in chapter I A short description is also provided for alternatives which were analyzed for meeting the needs discussed in chapter I, but which were found to be non-viable because of economic, environmental, or other reasons These non-viable alternatives are not used in the comparison section of this report The descriptions are based primarily on information provided in the DES and updated material resulting from additional studies which are outlined in chapter I C of this report The comparison of reasonable alternatives is based on the conclusions reached in chapter IV

B Description of Alternatives

1 No Action

a Overview

This alternative consists of the continuation of the existing facilities and operations which supply water to the Service Area (five cities plus PRPA)

Water is currently supplied to the five cities via direct flows, storage, the C-BT, and ditch stock The current and projected water supplies are shown in table I-2 Reservoirs currently owned or leased by Windy Gap participants and their water capacities are shown in table II-1 Figure II-1 illustrates the location of the East Slope storage and exchange facilities which are currently supplying water to the five cities These facilities and operations (except for the C-BT) are not treated in detail herein because they are not directly involved with satisfying the projected water supply shortfall (see chapter I) for the cities A description of these facilities and their operation can be obtained from the Subdistrict

The other major user within the Service Area is PRPA With a No Action alternative PRPA would use about 4,200 acre-feet of secondarily-treated sewage effluent from the city of Fort Collins' Sewage Treatment Plant PRPA, Fort Collins, and the Water Supply and Storage Company have signed an agreement for the use of this effluent The agreement would allow the Water Supply and Storage Company to supply water to Fort Collins Fort Collins would then convey its effluent from Sewage Treatment Plant No 2 to the Rawhide Powerplant site for use as cooling water

PRPA is negotiating agreements with the cities of Fort Collins and Longmont for a short-term backup supply of water that can be used at Rawhide Both cities have a temporary surplus of water that can be made available to PRPA to accelerate the filling of the Rawhide reservoir prior to startup, and to cope with any drought or other emergency Execution of these agreements was completed in 1980

In late 1979, PRPA's Board authorized the acquisition of water rights from the Colorado-Big Thompson Project PRPA's acquisition of approximately 1,000 acre-feet per year of the 230,000 acre-feet per year of Colorado-Big Thompson water, was nearly completed at the end of 1979 This water will give Platte River a usable source of water and a backup supply for future projects When such water is not being used by PRPA it will be made available, under a trust agreement, to the four constituent municipalities for their temporary use

The locations of the above water supply sources for Rawhide Powerplant are shown in figure II-1

TABLE II-1

Reservoirs Presently Owned or Leased
by Windy Gap Participants[1/]

City or Town	Reservoir or Ditch Company Reservoir	Capacity	Reservoir or Ditch Company Reservoir	Capacity (AF)
Greeley	Own		Leased Capacity Presently Utilized	
	Seaman	5,008	Lake Loveland	61
	Hourglass (Big Beaver)	1,693	Seven Lakes	323
	Comanche	2,629	Boyd Lake	4,500
	Twin Lake	301		
	Barnes Meadow	2,349		
	Peterson Lake	1,239		
	Subtotal	13,219	Subtotal	4,884
	TOTAL	18,103		
Fort Collins	Own		Leased Capacity Presently Utilized	
	Joe Wright	6,750	Halligan	1,948
			Claymore Lake	270
			Warren Lake	624
			Chambers Lake	662
			Subtotal	3,504
	TOTAL	10,254		
Estes Park	None			
Loveland	Own			
	Loveland Raw Water Storage	640		
	TOTAL	640		
Longmont	Own		Leased Capacity Presently Utilized	
	Button Rock	15,548	Clover Basin	75
	Blue Bird	990	Oligarchy No 1	293
	Pear Lake	420	Pleasant Valley	395
	Sand Beach	296	Independent	11
	Copeland	75		
	McCall	506		
	Subtotal	17,835	Subtotal	774
	TOTAL	18,609		
Boulder	Own		Leased Capacity Presently Utilized	
	Albion	1,111	Base Line	486
	Goose Lake	1,036	Barker Meadow	6,000
	Silver Lake	3,977		
	Island	333		
	Green Lakes No 1, 2, 3	792		
	Boulder Reservoir	8,300		
	Subtotal	15,549	Subtotal	6,486
	TOTAL	22,035		
	GRAND TOTAL	69,641		

1/ NCWCD

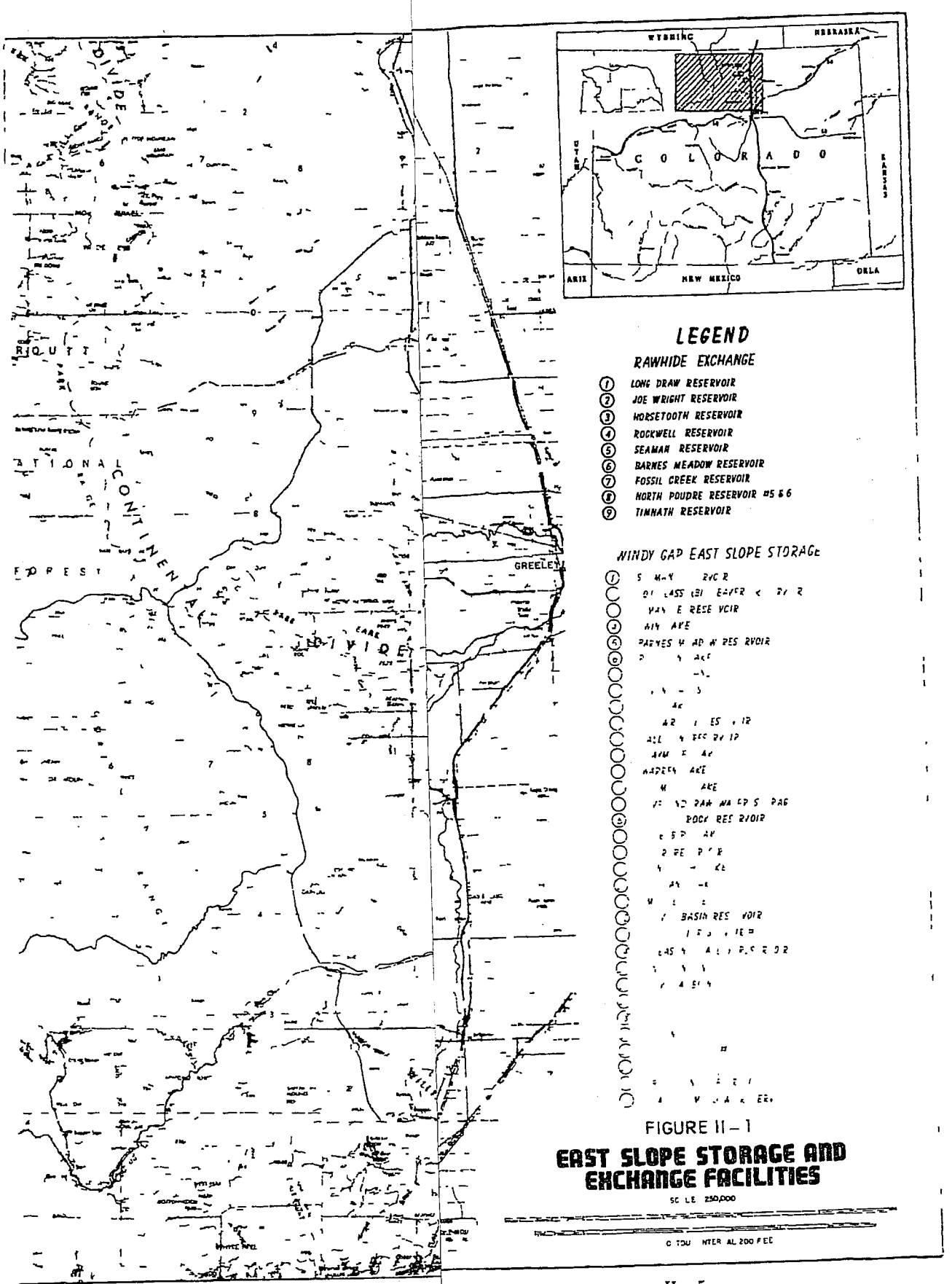


FIGURE II – 1

EAST SLOPE STORAGE AND EXCHANGE FACILITIES

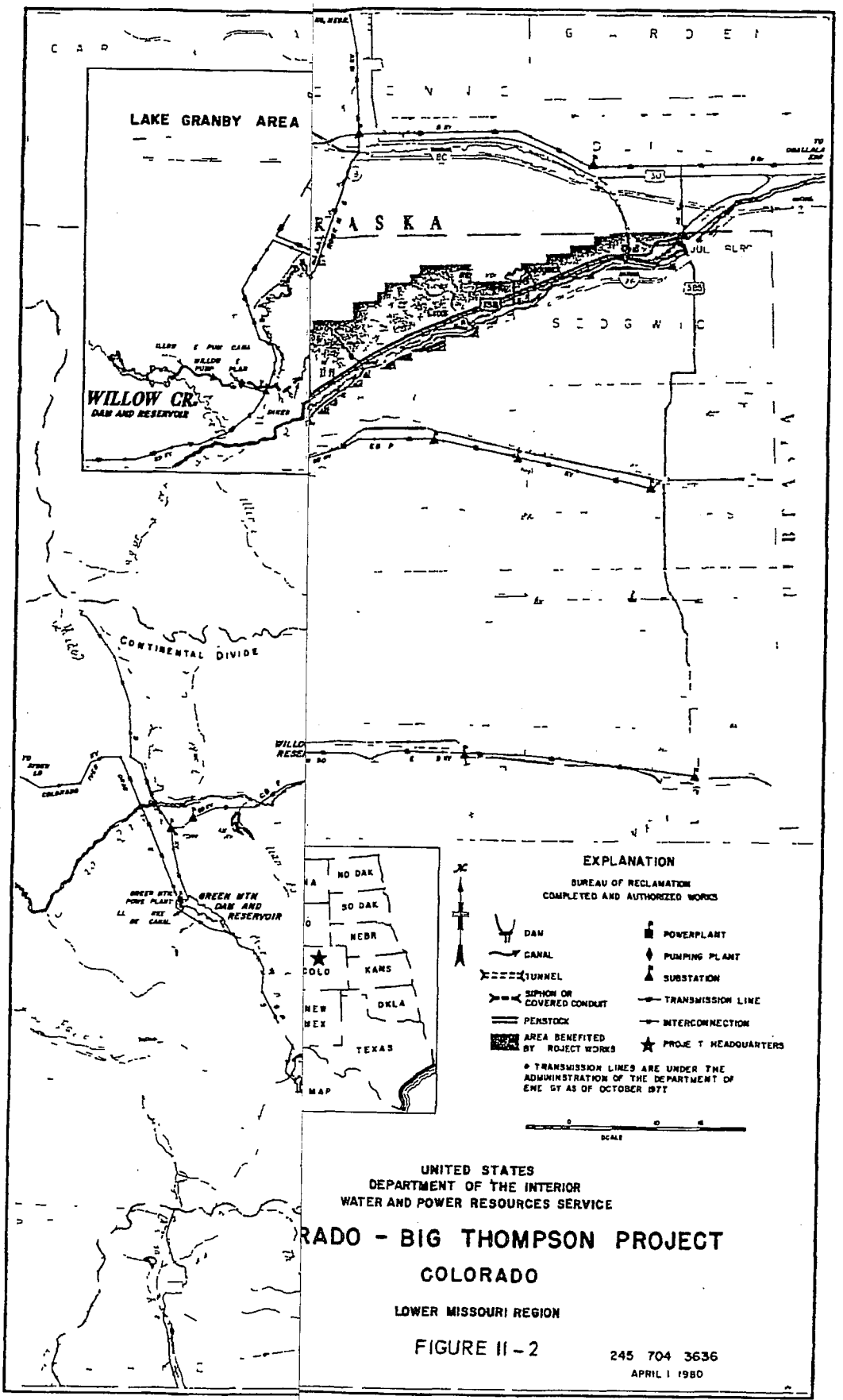

LAKE GRANBY AREA
WILLOW CR.
DAM AND RESERVOIR
CONTINENTAL DIVIDE
GREEN MTN. DAM AND RESERVOIR
EXPLANATION
BUREAU OF RECLAMATION
COMPLETED AND AUTHORIZED WORKS
DAM
CANAL
TUNNEL
SIPHON OR COVERED CONDUIT
PENSTOCK
AREA BENEFITED BY ROJECT WORKS
POWERPLANT
PUMPING PLANT
SUBSTATION
TRANSMISSION LINE
INTERCONNECTION
PROJE T HEADQUARTERS
* TRANSMISSION LINES ARE UNDER THE ADMINISTRATION OF THE DEPARTMENT OF ENE GY AS OF OCTOBER 1977
NO DAK
SO DAK
NEBR
COLO
KANS
OKLA
TEXAS
MAP
UNITED STATES
DEPARTMENT OF THE INTERIOR
WATER AND POWER RESOURCES SERVICE
RADO - BIG THOMPSON PROJECT
COLORADO
LOWER MISSOURI REGION
FIGURE II - 2
245 704 3636
APRIL 1 1980
GPO 855 627

TABLE II-2

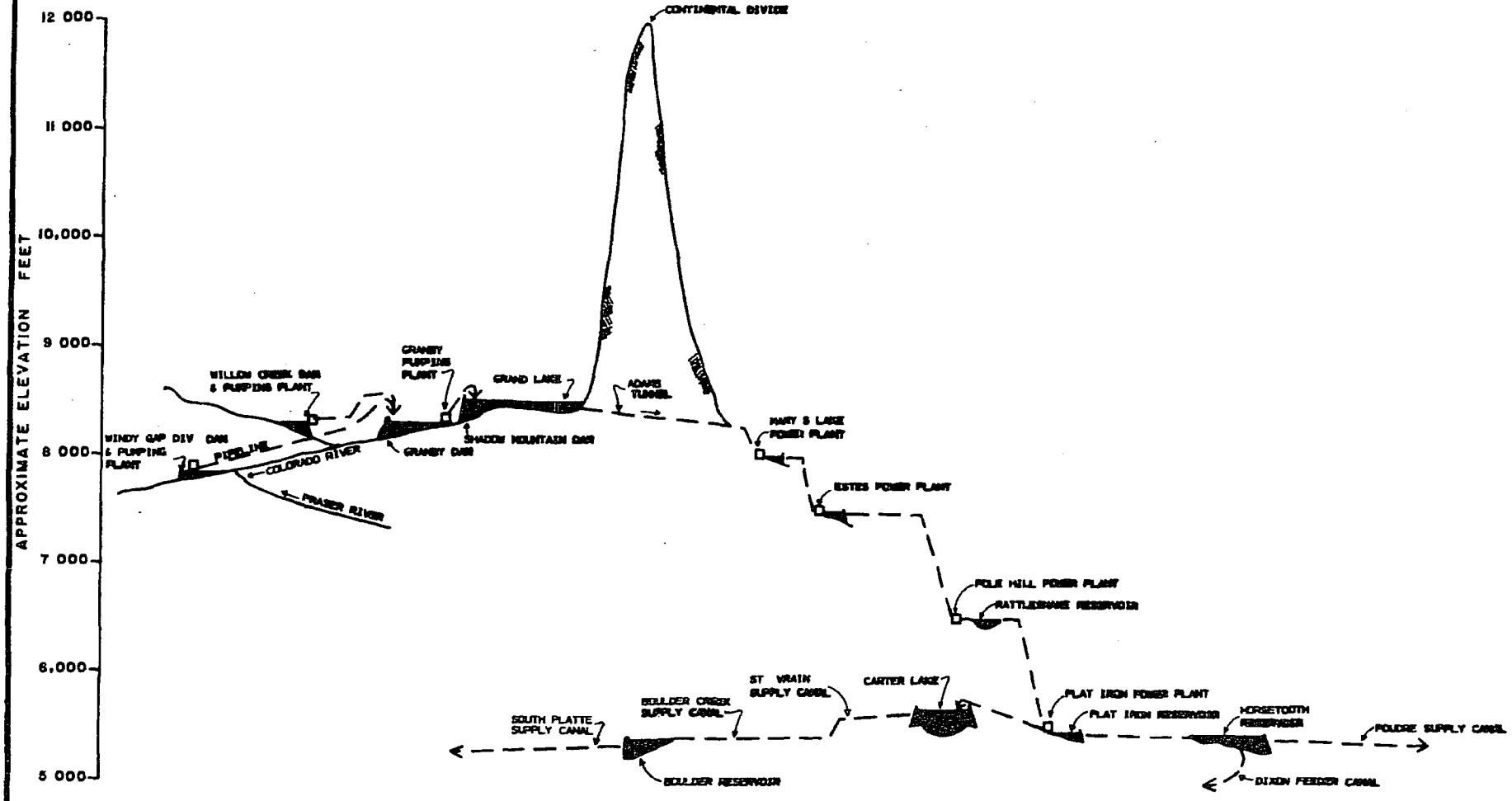
Project Data
Reservoirs and Dams

Reservoir	Shoreline miles	Dam	Structural (height) of dam (feet)	Maximum Reservoir Depth 3/	Crest length (feet)	Reservoir Capacity (acre-feet)	Surface Acres 3/
Green Mountain	19	Green Mountain	309	254	1,150	153,600	2,100
Lake Granby	40	Granby	298	231	861	539,800	7,300
Willow Creek	7	Willow Creek	127	93	1,100	10,600	300
Shadow Mtn Lake	8	Shadow Mountain	63	37	3,077	18,400 2/	1,900
Marys Lake	1	Marys Lake 1/	29	33	820	900	--
Lake Estes	4	Olympus	70	45	1,951	3,100	200
Pinewood	3	Rattlesnake	130	100	1,100	2,180	100
Flatiron	2	Flatiron	86	56	1,725	760	--
Carter Lake	8	Carter Lake 1/	190	180	1,235	112,200	1,100
		Dam No 1	214	180	1,235	112,200	1,100
		Dam No 2	75		1,150		
		Dam No 3	55		1,425		
Horsetooth	25	Horsetooth 1/	155	170	1,840	151,800	1,900
		Soldier Canyon	226		1,438		
		Dixon Canyon	240		1,265		
		Spring Canyon	220		1,120		
Total reservoir capacity and surface acres						994,340 acre-feet	16,000 Surface Acres

1/ Completed reservoir also required dikes

2/ Includes Grand Lake

3/ Top of conservation pool



SCHEMATIC PROFILE OF
PRINCIPAL FEATURES
CBT PROJECT WITH
WINDY GAP PROJECT

Lake Granby is the major C-BT storage reservoir Granby Dam and associated dikes are earthfill structures located on the Colorado River about 4-1/2 miles northeast of Granby The dam is 298 feet high with a crest length of 861 feet In addition to the dam, four dikes were constructed three (nos 1, 2, and 4) close off low areas west of the main dam and one (no 3) fills a saddle about 1 mile southeast of the dam Dikes 1, 2, and 4 are connected to form a single structure 4,430 feet long at the crest and 98 feet high Dike 3 is 2,000 long and 60 feet high

The lake inundates about 7,250 acres and has 539,760 acre-feet of storage capacity The active capacity is 465,600 acre-feet The remainder is inactive and below the pump intake

The dam has a concrete open channel spillway with two 21- by 20-foot radial gates designed to pass 11,500 ft^3/s The crest of the spillway is at elevation 8260 feet Two outlet tubes in the right abutment allow small releases to the Colorado River They can pass a maximum of 380 ft^3/s

Shadow Mountain Dam is an earth and rockfill structure on the Colorado River about 3-1/2 miles south of the town of Grand Lake It is 63 feet high and 3,077 feet long at the crest The reservoir is contiguous with Grand Lake at normal operating elevation 8367 feet The two lakes have about 1,852 surface acres

Grand Lake's fluctuation is limited to 1 foot by legislation This limitation provides 1,839 acre-feet of regulation in both lakes

Shadow Mountain Dam has a concrete-lined spillway with a discharge capacity of 10,000 ft^3/s The lake level is controlled by two 18- by 20-foot radial gates which release into the spillway The river outlet works have a sluicing outlet below the spillway The inlet is controlled by a 2-1/2- by 2-1/2-foot slide gate Maximum capacity is 50 ft^3/s

Willow Creek Dam and Reservoir is 4 miles north of Granby on Willow Creek, a tributary of the Colorado River The dam is an earth and rockfill structure, 127 feet high and 1,100 feet long at a crest elevation of 8140 feet

Total storage capacity is 10,550 acre-feet at normal water surface elevation 8130 feet Active capacity is 9,067 acre-feet The open-channel spillway can release up to 3,200 ft^3/s The outlet works consists of a vertical inlet which allows water to flow from the reservoir through a concrete-lined tunnel in the right abutment to a diversion turnout and stilling basin below the dam

(b) East Slope Storage

The storage reservoirs, in order of decreasing elevation, are Marys, Estes, Pinewood, Flatiron, Carter, and Horsetooth

Marys Lake was a natural basin which was enlarged to provide regulation of flows from Estes Powerplant The reservoir covers 42 surface acres at elevation 8046 It provides 927 acre-feet of active storage including 547 acre-feet of reregulation The lake is impounded by two earth and rockfill dikes at crest elevation 8050 feet Dikes 1 and 2 close depressions on the northeastern and southeastern shorelines, respectively

Dike 1 is 29 feet high and 820 feet long, Dike 2 is 35 feet high and 950 feet long There are no natural inflows and no spillway The outlet works, in Dike 1, serves as an intake to Prospect Mountain Conduit which feeds Estes Powerplant Diversions are controlled by a 12-1/2-foot hydraulically operated fixed-wheel gate

Lake Estes, impounded by Olympus Dam, is on the Big Thompson River near the eastern limits of Estes Park It is an afterbay for Estes Powerplant and has storage space to control outflow The reservoir covers 185 acres with a total capacity of 3,068 acre-feet between water surface elevation 7425 and 7475 feet About 409 acre-feet is below the outlet's lowest intake

The earth and rockfill dam is 70 feet high and 1,950 feet long The right abutment contains two 18-inch river outlets, a spillway, and headworks for Olympus Siphon The spillway can carry up to 21,200 ft^3/s which is controlled by five 20- by 17-foot radial gates Two 2-1/2- by 2-1/2 slide gates regulate the outlets, and the inlet to Olympus Siphon is controlled by two 6-1/2- by 8-foot fixed-wheel gates Siphon headworks and outlets have fish screens

Pinewood Reservoir is on Rattlesnake Creek in Pinewood Park, 12 miles east of Estes Park It acts as a forebay for Flatiron Powerplant and regulates daily peaking power Total capacity is 2,181 acre-feet at elevation 6580 feet, normal capacity is 1,568 acre-feet

The dam (Rattlesnake Dam) is an earth rockfill structure 130 feet high and 1,100 feet long at elevation 6595 feet It has an uncontrolled concrete-lined spillway that can pass up to 10,400 ft^3/s The valve controlled outlet has a capacity of 23 ft^3/s Spillway crest elevation is 6580 feet

Flatiron Dam and Reservoir is on Chimney Hollow Creek, 8 miles southwest of Loveland It acts as afterbay for Flatiron Powerplant, forebay for the No 3 pump-generator, and a common point from which water can be diverted north or south into other facilities It has a capacity of 760 acre-feet and a surface area of 47 acres at elevation 5473 Flow into Horsetooth Feeder Canal can be regulated by 436 acre-feet of capacity within the reservoir

The earth and rockfill dam is 86 feet high and 1,725 feet long It has a concrete-lined spillway that can pass up to 23,600 ft^3/s at water surface elevation 5480

The outlet has a gate controlled headworks for the Charles Hansen Feeder Canal It is designed to release up to 930 ft^3/s at water surface elevation 5464 feet

Water can be pumped from Flatiron to Carter Lake or released back to Horsetooth through the Flatiron No 3 pump-generator The pump is rated at 370 ft^3/s with 240 feet of head

Carter Lake is about 7 miles northwest of Berthoud It occupies a valley about 2-3/4 miles by 1/2 to 1 mile A natural lake existed in the northern section of the valley

The lake is formed by an earth-rockfill dam on a natural drainage and two earth-rockfill dams across saddles The reservoir can hold up to 112,200 acre-feet at water elevation 5759 feet, and covers 1,144 acres Dam 1 on the natural basin outlet is 214 feet high and 1,234 feet long Dams 2 and 3 are north of the main dam No spillway was built Drainage area is small and flood space is provided

The outlet at Dam 1 has a gate-controlled tunnel Water is released into St Vrain Supply Canal Discharge is limited by the 625 ft^3/s canal capacity The outlet has additional capacity Releases can also be made to Flatiron Reservoir and delivered north via Carter Lake Pressure Tunnel and Flatiron Pumping Plant

Horsetooth Reservoir is about 3-1/2 miles west of Fort Collins It is about 6 miles long and 1,500 to 3,000 feet wide and situated between two parallel hogback ridges It is formed by Soldier Canyon, Dixon Canyon, and Spring Canyon Dams which plug natural drainage openings through the hogbacks The northern portion of the reservoir is held by Horsetooth Dam and Satanka Dike Total storage is 151,800 acre-feet at water elevation 5430 feet The drainage area is is about 17 square miles

All dams and the dike are earth-rockfill construction Horsetooth Dam is 155 high and 1,840 long It contains the principal outlet which releases water to Charles Hansen Supply Canal The outlet can pass up to 2,500 ft^3/s at

water elevation 5480 However, maximum discharge is limited to the canal capacity of 1,500 ft^3/s

Satanka Dike is in a saddle about 500 feet west of Horsetooth Dam It is 20 feet high and 348 feet long

Soldier Canyon Dam closes a natural opening in the hogback about 4,000 feet southwest of Horsetooth Dam It is 226 feet high and 1,438 feet long An outlet tunnel through the right abutment passes up to 570 ft^3/s It provides water on demand to Colorado State University, Fort Collins, domestic water districts, and irrigation water through Dixon Feeder Canal

Dixon Canyon Dam closes an opening in a hogback about 2 6 miles south of Soldier Canyon Dam It is 240 feet high and 1,265 feet long Spring Canyon Dam plugs the remaining gap in the east hogback about 1 7 miles south of Dixon Canyon Dam and 5 miles southeast of Horsetooth Dam It is 220 high and 1,120 feet long

(c) Tunnels, Siphons, Conduits, and Canals

Table II-3 summarizes basic characteristics of these facilities The Alva B Adams and Olympus Tunnels are the primary conveyances which deliver water from the West to East Slope

The Alva B Adams Tunnel is a circular concrete pipe, 9-feet 9-inches in diameter, with a capacity of 550 ft^3/s It starts at Grand Lake and extends through the Continental Divide and exits 4 5 miles southwest of Estes Park It is 13 1 miles long The tunnel discharges into East Portal, a small reservoir

Olympus and Pole Hill Tunnels receive water from Lake Estes via Olympus Siphon and connecting flume, and deliver water about 7 2 miles eastward to Pole Hill Canal Olympus and Pole Hill Tunnels are concrete horseshoe-shaped structures 9-feet 9-inches in diameter and 9,537 and 28,567 feet long, respectively They are joined by a buried concrete conduit 178 feet long The structures can carry up to 550 ft^3/s

(d) Pumps and Powerplants

Tables II-4 and II-5 summarize the basic characteristics of the four pumping plants and seven powerplants The Granby Pumping Plant is the most important pumping facility The 94-foot drawdown of Lake Granby dictated that 138 5 feet of the pumping plant be underground and 188 5 feet above The three single-stage, vertical shaft, centrifugal pumps are 107 feet below ground and can pump up to 600 ft^3/s with a dynamic head of 186 feet A 6,000-horsepower synchronous motor drives each unit The remaining three units are of lesser importance and are not discussed

TABLE II-3

Colorado-Big Thompson Project Data
Canals and Conduits

Feature	Location	Total length miles	Design capacity, second-feet
Elliott Creek Feeder Canal	Elliott Creek to Green Mountain Reservoir	1 1	90
Willow Creek Feeder Canal	Willow Creek Reservoir to Granby Reservoir	3 4	400
Granby Pump Canal	Granby Pumping Plant to Shadow Mountain Lake	1 8	1,100
Alva B Adams Tunnel	Grand Lake to Wind River	13 1	550
Aspen Creek Siphon	East Portal Reservoir to Rams Horn Tunnel	1 3	550
Rams Horn Tunnel	Aspen Creek Siphon to Marys Lake penstock	1 3	550
Prospect Mountain Conduit	Marys Lake to Prospect Mountain Tunnel	0 6	1,300
Prospect Mountain Tunnel	Prospect Mountain Conduit to Estes penstocks	1 1	1,300
Olympus Siphon	Lake Estes to Olympus Tunnel	0 8	550
Olympus Tunnel	Olympus Siphon to Pole Hill Tunnel	1 8	550
Pole Hill Tunnel	Olympus Tunnel to Pole Hill Canal	5 4	550
Pole Hill Canal	Pole Hill Tunnel to Pole Hill penstock	0 5	550
Rattlesnake Siphon and Tunnel	Pole Hill Afterbay to Rattlesnake Reservoir	1 7	550
Bald Mountain Tunnel	Pinewood Reservoir to Flatiron penstocks	1 3	960
Flatiron Canal	Flatiron Powerplant to Flatiron Reservoir	0 3	960
Carter Lake Pressure Tunnel and Pressure Conduit	Flatiron Pumping Plant to Carter Lake Reservoir	1 4	550
St Vrain Supply Canal	Carter Lake Reservoir to St Vrain Creek	9 8	625
Boulder Creek Supply Canal	St Vrain Creek to Boulder Creek	15 7	200
South Platte Supply Canal	Boulder Creek to South Platte River	31 3	230
Charles Hansen Feeder Canal			
Flatiron Section	Flatiron Reservoir to Big Thompson turnout	3 8	930
Horsetooth Section	Big Thompson turnout to Horsetooth Reservoir	9 4	550
Horsetooth Supply Section	Big Thompson River to Flatiron Section	1 0	375
Dixon Feeder Canal	Horsetooth Reservoir to Dixon Reservoir	3 0	8
Poudre Supply Canal	Horsetooth Reservoir to Cache La Poudre River	5 1	1,500

TABLE II-4

Colorado-Big Thompson Project Data
Pumping Plants

Plant	Location	Pumping plant rating[1]			
		Number of units	Capacity, second-feet	Lift, feet	Installed horsepower
Granby	On north shore of Granby Reservoir, 7 miles northeast of Granby, Colorado	3	600	186	18,000
Willow Creek	On Willow Creek Feeder Canal, 1 mile west of Granby Reservoir	2	400	175	10,000
Colorado River Improvement[2]	Along Colorado River in vicinity of Kremmling, Colorado	12[2]	2-12	7-1/2-17	7 5-20
Flatiron	At Flatiron Powerplant, 15 miles east of Estes Park, Colorado	1[3]	370	240	13,000

1/ Rating based on horsepower output for specified vertical lift

2/ Packaged units, installed for replacement purposes

3/ Pumping unit may be operated in reverse as generating unit to utilize water released back to Flatiron Reservoir

TABLE II-5

Colorado-Big Thompson Project
Powerplant Data

Powerplant	No of Units	Capacity Each Unit (KW)	Total Installed Capacity (KW)	Operating Limits Head (FT)	Plant Hydraulic Capacity (CFS)	Generation GWH 10-Year Average	Generation GWH WY 1975
Green Mountain	2	10,800	21,600	126 - 261	1,660	61 1	52 7
Marys Lake	1	8,100	8,100	200 - 215	550	38 2	41 0
Estes	3	15,000	45,000	508 - 548	1,300	101 0	109 9
Pole Hill	1	33,250	33,250	810 - 840	550	191 9	219 2
Flatiron	2	31,500	63,000	1,118 - 1,210	960	241 8	274 4
(Flatiron)	1 1/	8,500	8,500	140 - 290	440	0 5	1 1
Big Thompson	1	4,500	4,500	166 - 186	350	14 8	16 1
Total	11		183,950			649 3	714 4

1/ Pumping plant which may be operated in reverse to generate energy

Green Mountain is the only powerplant located on the West Slope Ultimately it can be operated as a peaking or base load facility The East Slope powerplants develop the hydroelectric potential of the 2,800-foot drop from the mountains to the plains Estes and Flatiron Units 1, 2, and 3 generate peaking power Marys Lake and Pole Hill generate base load Flatiron acts as a pump-generating plant Peaking power is produced when water falls 1,108 feet from Pinewood to Flatiron Afterbay Additional peaking power is generated after water is pumped to Carter Lake during low power demand and released when demand is high This pump-generation cycle is accomplished by a single reversible motor-generator coupled to a combination pump turbine The two generators have a total capacity of 63,000 kilowatts The motor-generator has a capacity of 8,500 kilowatts

(e) Transmission Lines, Switchyards, and Substations

Tables II-6, II-7, and II-8 summarize these facilities The 775 miles of transmission lines and the substations were constructed by Water and Power They occupy 101 acres and were transferred to the Department of Energy by Executive Order 19009, September 13, 1977 The switchyards are still managed by Water and Power

(f) Recreation and Fish and Wildlife

C-BT authorization did not provide for construction, operation, and maintenance of recreation facilities However, on July 9, 1966, Public Law 89-72 (Federal Water Project Recreation Act) allowed planning, land acquisition, and development of existing water projects It stipulates that the Federal Government can cost share in development provided that administering agencies pay 100 percent of the operation, maintenance, and replacement costs

In addition, the Land and Water Conservation Fund Act of 1965 (Public Law 88-578) grants funding to Government entities for land acquisition and public recreation development These two laws significantly influenced recreation development and management of C-BT facilities Recreation development is an ongoing process

Lake Granby, Shadow Mountain, and Willow Creek are part of the Arapaho National Recreation Area which is administered by the Forest Service Administering authority was granted by Public Law 95-450 (October 11, 1978)

The Forest Service also administers recreation on Green Mountain Reservoir pursuant to Public Laws 93-575 (December 31, 1974) and 89-72 (July 9, 1956) However, Water and Power retains administration on some areas for operation and maintenance of the C-BT

TABLE II-6

Transmission Lines and Taps Maintained by Colorado-Big Thompson Project
Transmission Line Data[1/]

Transmission Line	Voltage (kV)	Circuit Miles[2/]	Transmission Line	Voltage (kV)	Circuit Miles[2/]
Archer-Weld	230	17 17	Sidney-Beaver Creek	115	58 48
TOTAL 230-kV lines		17 17	Weld-Beaver Creek	115	96 28
			TOTAL 115-kV lines and taps		562 97[3/]
Green Mountain-Hayden	138	18 55			
TOTAL 138-kV lines		18 55	Estes-Granby Pumping Plant	69	28 93[4/]
			Green Mountain-Granby Pumping Plant	69	74 29
Beaver Creek-Limon	115	69 99	Sterling-Holyoke	69	48 25
Beaver Creek-Wray	115	74 51	TOTAL 69-kV lines		151 47
Erie-Beaver Creek	115	91 58			
Estes-Flatiron	115	16 28			
Estes-Marys Lake	115	3 11	Granby-Granby Dam	24 9	1 60
Estes-Pole Hill	115	10 29	TOTAL 13 8-kV lines		1 60
Flatiron-Cheyenne	115	43 10			
Flatiron-Kodak	115	23 86	Flatiron-Big Thompson	13 8	4 32
Flatiron-Pole Hill	115	4 83	Flatiron-Pole Hill	13 8	4 87
Faltiron-Poudre Valley REA Lyons Tap	115	10 83	TOTAL 13 8-kV lines		9 19
Greeley-Rosedale	115	4 61	Troublesome-Colorado River Improvement	12 5	10 00
Green Mountain-Summit	115	28 22	TOTAL 12 5-kV lines		10 00
Kodak-Weld	115	6 10			
Longmont Northeast-Erie	115	17 63			
Poudre Valley REA Lyons Tap-Longmont Northwest	115	3 27	Estes-Marys Lake	6 9	3 42
			TOTAL 6 9-kV lines		3 42
TOTAL					774 97[3/]

1/ As of July 1, 1975
2/ Total, Lines and Taps
3/ Includes 19 58 miles of non-Water and Power Transmission Lines not necessarily maintained by the Water and Power
4/ Includes 13 1 miles of cable circuit through the Alva B Adams Tunnel

TABLE II-7

Colorado-Big Thompson Project
Switchyard Data

Switchyard	Rated Voltage (kV)	Installed Capacity (kVA)	Type Operation
Big Thompson	13 8	4,687	Unattended
Estes	115 0	77,500	Attended
Flatiron	115 0	93,334	Attended
Granby Pumping Plant	66 0	17,250	Attended
Green Mountain	138 0	129,500	Attended
Marys Lake	115 0	9,999	Unattended
Pole Hill	115 0	46,667	Unattended
Willow Creek	67 0	8,500	Unattended

TABLE II-8

Colorado-Big Thompson Project
Substation and Switching Station Data[1/]

Substation	Installed Capacity (kVA)	Type Operation	Substation	Installed Capacity (kVA)	Type Operation
Akron	4,687	Unattended	Limon	10,000	Unattended
Beaver Creek	57,375	Attended	Longmont	12,187	Unattended
Brighton	12,187	Unattended	Loveland	10,000	Unattended
Brush	12,500	Unattended	Nunn	1,500	Unattended
Derby Hills[2/]	8,625	Unattended	Poudre	13,333	Unattended
Erie[2/]	Switching Station	Unattended	Prospect Valley	10,000	Unattended
			Shadow Mountain	1,500	Unattended
Fleming	2,250	Unattended	Sterling	19,123	Unattended
Fort Morgan	18,751	Unattended	Troublesome	1,500	Unattended
Granby	5,000	Unattended	Weld[3/]	Switching Station	Unattended
Greeley	16,500	Unattended			
Haxtun	1,500	Unattended	Wigggins	12,500	Unattended
Holyoke	5,050	Unattended	Windsor	4,687	Unattended
Hoyt	4,687	Unattended	Woodrow	4,687	Unattended
Hygiene	3,999	Unattended	Wray	4,687	Unattended
Kremmling Tap	Switching Station	Unattended	Yuma	16,833	Unattended

1/ The Colorado-Big Thompson Project includes 33 substations with a capacity of 548,711 kVA leased to Pick-Sloan Missouri Basin Program for O&M and shown under Pick-Sloan Missouri Basin Program South Platte area, on Budget Document Project Statistics Sheets Two substations, with a capacity of 25,750 kVA, not leased to Pick-Sloan Missouri Basin Program for O&M, are shown as Colorado-Big Thompson Substations on the Budget Document Project Statistics Sheets The remaining 80,000 kVA are shown in the Project Statistics under Colorado River Storage Project

2/ Not in Colorado-Big Thompson Project total, included in Pick-Sloan Missouri Basin Project

3/ Not in Colorado-Big Thompson Project total, included in Colorado River Storage Project

Recreation facilities on East Portal, Marys Lake, and Lake Estes are administered by the Rocky Mountain Metropolitan Recreation District Larimer County Recreation Board manages Pinewood, Flatiron, Carter, and Horsetooth Reservoirs

There are no wildlife refuges associated with C-BT facilities However, waterfowl use the reservoirs especially during migration

(g) Communications

Three radio systems are used to operate and maintain power systems and for water dispatching The Very High Frequency (VHF) system is used to maintain contact with personnel during remote maintenance and line patrols The power dispatcher also uses VHF during emergencies (i e power failures) and for switching purposes which include load changes and coordination with public and private power companies VHF includes 4 repeaters, 11 base stations, and 64 mobile units

The second system, Ultra-High Frequency (UHF), is used to communicate between remote areas (i e power and pumping plants, substations, and water regulation facilities)

UHF is located at 28 sites, with the receiving and dispatching point at Flatiron Control Center near Loveland Flatiron is the control center for all power and water regulation, and information dispatching within the Western Division of the Pick-Sloan Missouri Basin Project, which includes the C-BT It is also integrated with other Federal, public, and private power grids A computerized control system is being developed for Flatiron This system will automatically meet demands and stay current with changes in power and water operations and procedures

The third system is microwave radio which links Flatiron Control Center and Cheyenne, Wyoming Communication with the rest of the western division is provided by power line carriers and leased telephone circuits from Cheyenne to Yellowtail, Montana, and elsewhere Another line connects with the disaster dispatching station at Watertown, South Dakota, which directs a large portion of power operations for the eastern division of the Pick-Sloan Missouri Basin Program

(2) Operation

(a) Employees

The C-BT is operated by 105 permanent and 20 temporary employees who live near the facilities on both sides of the Continental Divide and in the city of Loveland

(b) Water Allotments

About 85 percent of C-BT water is used for irrigation The rest is for municipal and industrial purposes Table II-9 indicates the municipal and industrial water deliveries and recipients of C-BT water during 1980 Quantities amounted to about 43,500 acre-feet As the urban population increases, irrigation allotments will be transferred for municipal and industrial purposes In May 1937, Congress established a C-BT allotment of 310,000 acre-feet pursuant of the Conservancy District Act The Act provides three classes of allotments B, C, and D Repayment of C-BT facilities is made by taxation and contract

Class "B" allotments are repaid by municipalities which agree to secure payment through property assessments Class "C" allotments are repaid by irrigation districts which rely on assessments on lands within the District Class "D" is a method whereby individual farmers may petition for an allotment for a specific piece of land and agree that the annual charge per acre-foot shall be a tax lien on the land

The District sets the yearly water quota for allottees by analyzing the Soil Conservation Service and Water and Powers' watershed snowpack, water content, and precipitation, and reservoir storage predictions These predictions are summarized in Water and Power's Annual Operating Plan, Western Division, Pick-Sloan Missouri Basin Program (AOP) The AOP not only describes the previous year's operations but also forecasts C-BT operations for the upcoming water year maximum, reasonable minimum and most probable runoff condition It is updated throughout the year as new information arises Flexibility is the guiding principle

Another factor which governs the operations of the C-BT and the water available to each user is water rights According to Colorado water law, a right may be granted to a project for storage and diversion purposes However, this water can only be appropriated on a priority basis If use of water by one right holder infringes on the senior rights of another, the former user must cease that use or provide a replacement supply

(c) Operation Skim

Operation Skim is an informally agreed-upon procedure between Water and Power and the State of Colorado This procedure allows Big Thompson River water in excess of the minimum requirements as determined by the State of Colorado and the Fish and Wildlife Service to be diverted at Lake Estes into the East Slope Foothills System for power generation The amount to be diverted depends on the flow of the Big Thompson River and tributaries above Lake Estes, importations through Alva B Adams Tunnel and the capacity of the

TABLE II-9

Colorado-Big Thompson Project
1980 Water Distribution

Municipal and Industrial Users	Acre-Feet of Water Delivered
Town of Estes Park (*)	452
City of Fort Collins	6,053
City of Greeley (*)	6,167
City of Loveland (*)	5,734
Town of Lyons	58
City of Longmont (*)	4,899
Town of Mead	105
City of Boulder (*)	2,844
Town of Frederick	58
Bald Mountain Water Users' Association	3
Prospect Mountain Water Association	21
Windcliff	70
Fort Collins-Loveland Water District	2,836
East Larimer County Water District	2,096
North Weld County Water District	2,065
Arkins Water Association	100
Sunrise Enterprises	6
Eden Valley Water Company	18
Spring Canyon Water and Sanitation District	76
Little Thompson Water District	2,073
North Carter Lake Water District	22
Central Weld County Water District	2,473
Crystal Water Company	99
Longs Peak Water Users Association	460
Lefthand Water Supply Company	1,156
Newell-Warnock Water Association	7
Great Western Sugar Company	2,518
Ideal Basic Industries	262
Public Service Company	792
Total	43,523

(*) Subdistrict Cities for Windy Gap

power system Water taken from the Big Thompson River at a variable rate on a given day is returned to the river, through the Big Thompson Powerplant at the mouth of the Big Thompson Canyon, at a specified rate on the following day

(d) Operating Criteria for Green Mountain Reservoir

Green Mountain Reservoir was built to replace out of priority diversions from the West to the East Slope via the C-BT Releases are made from Green Mountain to satisfy senior water rights when there are C-BT induced water shortages Paragraph 6 of the stipulation dated October 5, 1955, as amended on October 12, 1955, and filed with the United States District Court for the District of Colorado in Civil Action Nos 2782, 5016, and 5017, calls for the development and submission of operating plans for Green Mountain Reservoir These plans discuss the prior year's operation, and project operation plans for a most probable, reasonable minimum, and reasonable maximum inflow

The October 12, 1955 Stipulation and Decree, the April 16, 1964 Stipulation and Decree, the November 2, 1977 Memorandum Opinion and Order, and the February 9, 1978 Supplemental Judgment and Decree, Consolidated Cases Nos 2782, 5016, and 5017, together with Senate Document No 80, 75th Congress, 1st session, all contain provisions that relate to the operation of Green Mountain Reservoir Such operation will be consistent therewith

The criteria are listed below

(aa) Winter operation (October 16-April 14)

1 Bypass inflow to supply downstream vested rights

2 Replacement of water withheld out of priority by the Colorado-Big Thompson Project, as required

3 Maximum power generation, while maintaining (1) adequate storage to meet the anticipated requirements of Senate Document No 80, and (2) a minimum power head which is consistent with the integrated system power operations

(bb) Operation during snowmelt period (April-July)

1 Bypass inflow as required to supply downstream vested rights

2 Replacement of water withheld out of priority by the Colorado-Big Thompson Project, as required

3 Fill without spilling

4 Maximum power operation consistent with paragraph 1(c)

5 Make releases as outlined in the above-referenced documents[1/]

(cc) Operation after snowmelt period (August 1 - October 15)

1 Bypass inflow as required to supply downstream vested rights

2 Replacement of water withheld by the Colorado-Big Thompson Project, as required

3 Maximum power operation consistent with paragraph (aa) 3

4 Make releases as outlined in the above-referenced documents

(e) Fish and Wildlife

Some facilities are bound by minimum releases for prescriptive water rights and fish and wildlife The Secretary of the Interior (January 19, 1961) established a 20 ft^3/s flow at a point 3 miles below Granby Dam between September 1 and April 30 of each year Several irrigation ditches divert water between the dam and the 3-mile control point, however, there is also tributary inflow and dam seepage

At the control point, 40 ft^3/s is required during September and August and 75 ft^3/s from May through July, except in subnormal water years Flow can be reduced between May and September if forecasted inflow to Shadow Mountain, Grand, and Granby Lakes, and pumped water from Willow Creek Reservoir will be less than or equal to 230,000 acre-feet In addition, the vested rights between the dam and the Fraser River must be met These reductions are based on a forecast made by Water and Power during the last week in April The reductions are adjusted using revised forecasts and actual flows during May, June, and July

1/ By the use of these criteria for current operating purposes, the United States does not intend to imply any definition of rights and obligations, nor is there intended any priority by the order in which these criteria are listed

No releases from Willow Creek Dam are required to maintain Willow Creek, however, 7 ft^3/s or inflow (whichever is less) is required between October 1 and April 30 to augment fish flows in the Colorado River

The Colorado River between Lake Granby and Shadow Mountain Reservoir is augmented by a minimum of 25 ft^3/s fish release from October 1 to May 31 and 50 ft^3/s or inflow (whichever is less) from June 1 to September 30

Flows below Green Mountain Reservoir are adequate for fish and wildlife preservation Releases are controlled by downstream vested water rights and power generation

On the east side of the Continental Divide, minimum fish releases from Lake Estes are 25 ft^3/s from November 1 through April 15, 50 ft^3/s from April 16 through April 30, 100 ft^3/s from May 1 through May 15, 125 ft^3/s from May 16 through August 15, 100 ft^3/s from August 16 through August 31, 75 ft^3/s from September 1 through September 15, and 50 ft^3/s from September 16 through October 31 These flows were recommended by the Colorado Division of Wildlife and the U S Fish and Wildlife Service

Big Thompson River diversions from Lake Estes for power production are generally restricted to the May 15 - September 15 period Runoff during the fall and winter is usually much less than the recommended minimum flows Releases in excess of inflow are not required

(f) Power

Colorado-Big Thompson Project electric transmission facilities are part of the Pick-Sloan Missouri Basin Program, western division, Federal Interconnected Power System The Western Division is an interconnected system of 15 Water and Power powerplants with 391,162 kW of installed capacity The C-BT power system interconnects with the Colorado River Storage Project, Public Service Company of Colorado, Platte River Power Authority, and Tri-State Generation and Transmission Association, Inc

Long-term gross (C-BT) generation averages 760 million kWh annually, of which 70 million kWh are used by project pumps, and 690 million kWh are marketed to 11 cities in Colorado and 9 rural electric cooperatives These serve about 324,000 people in rural areas and small towns

Project power sales annually bring in revenues of $4 8 to $5 million, with a present mill levy of 7 07 percent

(3) Maintenance and Rehabilitation of Facilities

(a) Dams and Reservoirs

Major operational problems include (1) Reduced flows due to debris accumulation at inlets and outlets, (2) leaks in control gate seals, (3) trespass and vandalism, especially where access is uncontrolled, and (4) safety problems associated with keeping people away from unsafe facilities

These problems are alleviated by biannual removal of debris from structures, replacement of seals using water bypass facilities, installation of buoys, fences, and warning signs

(b) Diversion Dams and Canals

Debris are removed from screens on diversion dams monthly during the irrigation season Sediment deposits are extracted by hand once every 2 years Structures are painted and given a safety inspection every 5 years Minor repairs such as replacement of gate seals, motors, and cables are done as needed

On the West Slope there are about 6 miles of canals - 17 percent are concrete-lined and 83 percent are unlined The East Slope has about 93 miles of canals - 27 percent are concrete-lined and 73 percent are unlined Deteriorated sections of both types of canals are replaced annually

Joints are sealed with mastic on a yearly basis Debris is removed as needed Fences are installed along canals to prevent drownings of livestock and people Repairs are made about every 5 years Escape ladders are maintained at all siphons In addition, guard posts protect maintenance people

(c) Recreation and Fish and Wildlife

Recreation areas are managed by non-Water and Power entities pursuant to memoranda of understanding General maintenance is their responsibility while major construction and repairs are cost shared between Water and Power and the managing entity Major repairs are rotated among areas so all are maintained adequately Items which require repair include (1) Boat ramps, (2) buildings, (3) fences, (4) camping and picnic areas, (5) trails, (6) roads, (7) vehicles and equipment, and (8) barrier posts In addition, there are erosion control activities, vandalism prevention, and public awareness programs

The Youth Conservation Corps and Young Adult Conservation Corps help with the above activities

Deer crossings and escape devices are installed and maintained on canals in problem areas

Fish screens are maintained on all outlets

(d) Cultural Resources

At the project level there is no comprehensive program for management of cultural resources If cultural resources are discovered during routine operation and maintenance, work will cease and the Regional Archeologist will be notified

A comprehensive survey of project lands will begin in fiscal year 1981 pursuant to Executive Order 11593 A management program will subsequently be prepared and implemented

(e) Forestry

The small amount of timber on project lands is managed in cooperation with the Colorado State Forest Service This cooperative program includes the removal of diseased trees, thinning, and slash disposal Two project people are assigned to this program

(f) Permits, Easements, and Grants

Water and Power receives requests to use project lands from various utility, oil, gas, water, telephone, power, and sanitation districts, companies, and private citizens Sometimes their proposed uses create management problems because of conflicts with project purposes When uses can be accommodated, Water and Power issues permits, easements, and grants They are subject to environmental standards such as revegetation, landscaping, replacement of and/or repair of facilities such as roads and canals

In addition, Water and Power cooperates with city and county planning departments and developers in planning residential and commercial developments which are served by utilities which cross Water and Power lands

(g) Erosion Control

Erosion control is implemented under the Soil and Moisture Conservation Program (S&MC) which encourages proper management of soil, vegetation, and water resources

Major erosion problems around facilities include (1) Shoreline erosion, (2) improper public use, and (3) erosion of exposed soils such as roadbeds and cut banks Corrective and preventive measures include (1) Maintenance of roads, parking areas, and trails, (2) construction of water bars, retaining walls, and drop chutes, (3) revegetation of disturbed areas, (4) fencing

to prevent overuse by public and livestock, (5) placing rip-rap along shorelines and near drainage facilities, (6) construction of designated trails to regulate use, and (7) cooperation with other agencies such as the Soil Conservation Service to find better ways to prevent erosion

(h) Channel Clearance and Maintenance

Channel maintenance by the removal of debris and phreatophytes is not a significant problem within the C-BT This is due to climatic, topographic factors, off-stream reservoirs, and the limited amount of C-BT lands downstream of reservoirs

(i) Sewage and Solid Waste Disposal

All sewage is connected to existing public sewage facilities or is disposed of through septic tanks and leach fields Vault toilets are emptied by a commercial sewer service and disposed of at designated land fills Vault toilets are located at recreation areas and are the responsibility of the managing agency They are serviced as needed on an average of twice per month during the recreation season

Project wastes, including wastes from recreation areas, are deposited in county sanitary land fills

(j) Control of Undesirable Vegetation

Vegetation interferes with operation, maintenance, access, and poses a fire hazard in and around electrical substations, switchyards, and power poles Consequently, the soil is sterilized once every 3 to 5 years using Aprotal 8P This completely eliminates plant growth

State and Federal laws require the eradication of noxious weeds Accordingly, Water and Power uses Dicamba and 2, 4-D to eliminate field bindweed, Canada thistle, and musk thistle from reservoir and canal rights-of-way Infested areas are treated once a year from mid-May to mid-July Vegetation is also mowed around roads, canals, and service areas to reduce fire hazard

Aquatic vegetation, such as elodea, creates maintenance problems for marina operation and interferes with recreational activities such as boating, fishing, and waterskiing To date, no method of chemical control is acceptable and effective Solutions are under investigation including the possibility of using a mechanical harvester

Another problem is the growth of algae in concrete-lined canals which reduces carrying capacity and causes maintenance problems Growth is controlled by applying copper sulphate

(k) Project Roads and Maintenance of Structures

Some project roads are maintained by Larimer and Grand Counties Others are serviced by Water and Power Gravel and earth roads are bladed and resurfaced about every 2 years Asphalt surfaces are resealed about every 5 years

All roads and parking lots are kept in good condition by rotating the work around the project rather than concentrating in one area

Other road maintenance activities include the installation of gates, cattle guards, culverts, etc

Few, if any, additional roads will be constructed Reasons for new roads would include the expansion of recreation facilities, development of substations and appurtenant facilities, and prevention of land damage due to public abuse

Buildings periodically require maintenance of exterior and interior surfaces New structures are occasionally constructed to store equipment, provide workshops, etc

(l) Oil Spill Prevention

The Clean Water Act of 1977, section 311(c)(2), section 4 of Executive Order 11735, and 40 CFR 1510 require certain oil and gas spill controls on recreation areas These controls apply to the recreation concessions as well as other facets of reservoir area management

All C-BT facilities are complying with Federal regulations by constructing dikes in spill prone locations and by the proper siting of gas dispensers, switchyards, and substations

(m) Power Generation

Generation and transmission facilities are maintained, replaced, and uprated as parts become worn and technology improves Facilities include transformers, transmission towers, generators, turbines, substations, switchyards, and inlet and outlet structures

The current preventive maintenance program consists of rewinding generators every 20 years, replacement of seals, bushings, rings, etc usually every 5 to 10 years, repair and replacement of transmission lines, poles and insulators A mobile substation can be installed during facility maintenance or power outages

(n) Inclusion and Exclusion of Lands

The District occasionally requests that lands be included or excluded from receiving C-BT water These requests must be approved by the Secretary of the Interior according to article 35 of the repayment contract between the District and Water and Power

Approval is normally given if the inclusion or exclusion does not impair the District's ability to repay the Federal Government for project costs

2 Windy Gap Project Preferred Alternative

a Sponsor

The Municipal Subdistrict of the NCWCD is a political subdivision of the State of Colorado It is a body corporate with all the powers of a public or municipal corporation and was organized as a Subdistrict of the NCWCD by decree of the District Court of Weld County, Colorado, on July 6, 1970 The Water Conservancy Act, section 150-5-1 et seq , CRS 1963, since amended and now codified as section 37-45-101 et seq , Colorado Revised Statutes (CRS) 1973, as amended, provides for establishment of the Subdistrict

The Subdistrict was formed under the sponsorship of the six cities of Boulder, Longmont, Loveland, Fort Collins, Greeley, and Estes Park for the purpose of developing a new and independent water supply for the use of those municipalities or their subsequent assignees Since the formation of the Municipal Subdistrict, the city of Fort Collins transferred its share of the Windy Gap water to the Platte River Power Authority (PRPA)

On October 3, 1973, the Subdistrict executed a tripartite contract (Carriage Contract) with the NCWCD and the Bureau of Reclamation (now Water and Power), for the use of any unused capacity in the C-BT system for the carriage of water developed by the Subdistrict on the Western Slope to the participants on the Eastern Slope This contract provides for the use of the facilities and compliance with the National Environmental Policy Act prior to the time any Windy Gap water is introduced into the C-BT system

The Subdistrict applied for water rights on the Colorado River A conditional water right was awarded the Subdistrict by Water Division No 5 over the protest of the Colorado River Water Conservation District (River District) The River District appealed the conditional decree to the Colorado Supreme Court which overruled the lower court and remanded the matter back to the lower court The Supreme Court found that the conditional water right could not be granted until the Subdistrict formulated a plan to adequately mitigate any potential harm to prospective users within the upper Colorado River Basin This requirement is specified in section 37-45-118(1)(b)(IX), CRS 1973

As described in chapter I, two agreements were executed whereby certain mitigation provisions were resolved (attachments 1 and 2)

b Project Concept

Colorado-Big Thompson Project The C-BT was built to provide supplemental water supplies for the irrigated farms, cities, and industries of northeastern Colorado The C-BT accomplished its purpose Today, some 30 years since completion, the irrigation water and the farms to which it is supplied are the economic backbone of the region

The growth of cities within this region of northeastern Colorado since completion of the C-BT Project has been significant Each year a larger percentage of C-BT Project water is used by these cities to meet increasing demands After examination of many possible projects, the cities composing the Subdistrict selected the Windy Gap Project as the most viable and economic alternative to meet these demands

The proposed Windy Gap Project will consist of a diversion dam, a pumping plant and a pipeline The diversion dam will be located on the Colorado River just downstream of its confluence with the Fraser River This will make water available from the Fraser River drainage basin which is not now controlled by the C-BT system During periods of high flows, water will be pumped by the pumping plant from a small reservoir behind the diversion dam through the pipeline to Lake Granby From Lake Granby the water will pass through the existing C-BT system to the East Slope cities

c Feature Descriptions

(1) Diversion Dam

The proposed diversion dam will consist of a zoned earthfill embankment composed of compacted clay, silty sand, gravel and cobbles with a slurry trench cutoff A rock drain will be installed in the downstream toe to control seepage Riprap will be placed on the upstream face of the dam for erosion protection The dam will have a maximum height of 27 feet with a crest elevation 7838 and a total crest length of 5580 feet A plan view of the diversion dam is shown on figure II-4

The alinement of the diversion dam is dictated by the location of an existing Denver and Rio Grande Railroad embankment that runs along the left bank of the Colorado River in the vicinity of the damsite At the damsite, the railroad is located between the river channel and natural high ground that would otherwise serve as the left abutment The top of the railroad embankment is considerably lower than the estimated maximum water surface elevation of the reservoir necessary to pass the project design flood To protect the railroad embankment, the

alinement of the diversion dam will turn upstream and extend about 3300 feet to the point where the crest will intersect the natural ground surface A drainage ditch will be located between this section of the diversion dam and the railroad embankment to convey the present drainage flows and any dam seepage away from the railroad embankment

(2) Diversion Reservoir

The reservoir formed by the diversion dam will have a total live storage capacity of 320 acre-feet between elevation 7823 (normal minimum operating level) and elevation 7827 (normal maximum operating level and service spillway crest elevation)

Dead storage (water stored below elevation 7823) will be 125 acre-feet The live storage capacity will allow considerable flexibility in pumping plant operation during periods of low flow, and especially when low flows have excessive daily and hourly fluctuations The maximum reservoir water surface during flood flows was set at elevation 7836 Backwater from this flood would not affect the normal flood levels at the confluence of the Colorado and Fraser Rivers A plan of the reservoir is shown on figure II-4

The surface area of the reservoir at normal maximum pool will be about 112 acres During the Probable Maximum Flood the reservoir surface area would be 155 acres

(3) Spillway and Stilling Basin

The spillway and stilling basin will be constructed as integral parts of the diversion dam Figure II-4 shows the relationship of the diversion dam and spillway The spillway will be an ungated free overflow concrete gravity type structure The stilling basin will be a submerged roller bucket type, structurally continuous with the spillway The spillway/stilling basin structure will be 685 feet long with a crest at elevation 7827 The maximum discharge will be 32,410 ft^3/s with the reservoir water surface at elevation 7836 This discharge will equal the reservoir inflow computed for approximately one-half the probable maximum flood

(4) Bypass Outlet and Auxiliary Outlet

A low-level bypass structure will be provided at the maximum section of the diversion dam to satisfy downstream fish and irrigation flow requirements The bypass outlet will have a capacity of 93 ft^3/s at normal minimum reservoir operating level (7823) and a capacity of 133 ft^3/s at normal maximum operating level (7827) This structure, which will be located near the present Colorado River channel with the intake in the end bay of the pumping plant, will be comprised of an intake, a 48-inch-diameter, reinforced-concrete conduit, and an outlet for dissipating energy at the downstream toe of the diversion

dam The discharge will be controlled by a 48-inch-diameter butterfly value operated from the pumping plant

An auxiliary outlet facility will be provided at the north end of the concrete spillway structure This will consist of a 4-foot square sluiceway discharging into the spillway roller bucket stilling basin A 48-inch motor operated slide gate will be installed for control at the intake which is constructed integral with the end pier of the spillway structure The auxiliary outlet will be used to supplement the capacity of the bypass outlet if required for downstream releases and flushing flows and would be used in the event the bypass outlet was taken out of service for repair or maintenance The auxiliary outlet will have discharge capacities of about 168 ft^3/s at minimum reservoir operating level (el 7823) and about 229 ft^3/s at maximum reservoir operating level (el 7827)

(5) Pumping Plant

The pumping plant will be located on the right abutment of the diversion dam on the south side of U S Highway 40, near its junction with State Highway 125, as shown on figure II-4 The reservoir will form the forebay to the plant and the intake to each pump will be provided with trashrack facilities and a slide gate

The pumps will be arranged in a line running generally parallel to the direction of river flow One longitudinal side of the pumping plant will accommodate intake facilities while the opposite side will contain the outlet manifold which will transmit flow into the pipeline The centerline of the pumps will be set at elevation 7798, about 15 feet below the present riverbed This will result in a pumping plant which is almost completely underground The pumping plant roof will be at approximately 10 feet above the dam crest

The pumping plant will contain four, vertical-shaft, centrifugal pumps rated at 150 ft^3/s at 514 r/min under a total dynamic head of 526 feet Each pump will be coupled to a synchronous electric motor rated at 12,000 hp at 514 r/min When less than four pumps and motors are operating, the friction losses in the pipeline will be less than those at full capacity The following table shows the relationship between pump capacity and number of pumps operating when the Windy Gap Reservoir is at elevation 7827

Number of Pumps Operating	Discharge per Pump (ft^3/s)	Pumping Plant Discharge (ft^3/s)
1	195	195
2	182 5	365
3	167 7	503
4	150	600

Power for the pump motors will be supplied by Mountain Parks Electric, Inc (MPEI) at 138-kV The transformer, located at the pumping plant roof level, will reduce this voltage to 13 8-kV for use by the motors When operating at full capacity, the four motors will require 40,500 kW of power

An additional small amount of power will be required for station service, pumping plant lights and other non-pumping uses With the station service requirements the peak pumping plant power requirement will be about 41,200 kW

(6) Windy Gap to Lake Granby Pipeline

(a) Alinement

From the pumping plant, the pipeline will proceed in a long curve under U S Highway 40 and then under State Highway 125 The alinement then climbs to the northwest where the surge tank will be located From this point the alinement is nearly straight to Lake Granby with only minor directional changes to avoid problem areas The pipeline alinement and land ownership is shown in plan view on figure II-5

The pipeline will have several local high points and low points along this alinement Automatic vents will be installed at each high point and provisions for draining the pipeline will be provided at each low point At the crossing under Willow Creek, the pipeline will not be gravity drained because it will be below the ground-water table, facilities for pumping out the pipe will be provided at this point

A description of the permanent and temporary alinements of the pipeline, roads, and appurtenant facilities have been submitted to the Forest Service, Bureau of Land Management, and Federal and State transportation agencies in order to acquire the necessary permits and easements

A road will be built along the pipeline alinement for access purposes during construction Most portions of this road will be removed after pipeline construction is complete and the area will be restored to its original condition as much as possible

Permanent access roads will be provided to structures along the pipeline which may need servicing or inspection These roads may follow the pipe alinement where such a road alinement will cause less distrubance than alternative alinements

The combined capacity of the two conduits is 1040 ft^3/s Together the two conduits are 24 feet wide and 10 feet high The conduits are constructed below grade so as to reduce visual impact The total length of the structure is 425 feet with only about 65 feet remaining above water when Lake Granby is full

(7) Storage

The diversion dam will only provide storage for short term variations in river flows With no inflow, the pumping plant will be able to empty the diversion dam reservoir live storage capacity of 320 acre-feet in about 6 5 hours of pumping at maximum capacity or about 20 hours with one pump in operation Thus, diversion dam storage will allow flexibility in pumping plant operation when there are significant daily fluctuations in river flow, however, insufficient capacity will be available for long term storage

The main storage facility to be utilized for Windy Gap water during the period between which it is diverted and delivered will be Lake Granby Under actual operational conditions, Windy Gap water which is pumped to Lake Granby will simultaneously become available for delivery on the Eastern Slope from Carter Lake or Horsetooth Reservoir Once the project is in full operation, delivery from the Eastern Slope reservoirs will occur on a relatively firm basis each year, with little deviation in annual delivered amounts Consequently, during wet years, water will be stored in Granby Reservoir and carried over into the next year to provide a relatively uniform supply of water As is provided for in the Carriage Contract between the Municipal Subdistrict, Northern Colorado Water Conservancy District, and U S Bureau of Reclamation, carry-over storage of Windy Gap in Lake Granby can only be accomplished when capacity is available in that reservoir over and above the needs of the Colorado-Big Thompson Project However, since the entire Colorado-Big Thompson Project was designed and physically built to handle an average of 310,000 acre-feet per year, and yields to date have averaged less than 245,000 acre-feet per year, there should be ample physical capacity in the system, including Lake Granby, to adequately handle both the storage and the transmission of all Windy Gap water to the East Slope

From Lake Granby, Windy Gap water will be pumped through the Granby Pumping Plant into Shadow Mountain Reservoir which has a common level with Grand Lake Shadow Mountain Reservoir and Grand Lake are maintained at essentially a uniform level and, therefore, provide no storage From Grand Lake, Windy Gap water will be released into the Alva B Adams Tunnel which conducts the water to the East Slope A schematic diagram of the C-BT system is shown on figure II-3

On the East Slope, Windy Gap water will flow through the existing system of powerplants, tunnels, siphons, and reservoirs on its way to the two main East Slope storage points, Carter Lake and Horsetooth Reservoir The upper reservoirs such as Marys Lake, Lake Estes and Pinewood Lake are used as afterbays for powerplants and do not provide significant storage

From the Flatiron Powerplant, water will either be pumped to Carter Lake or released to Horsetooth Reservoir for storage Carter Lake provides a storage capacity of 112,000 acre-feet while Horsetooth Reservoir has a capacity of 152,000 acre-feet Water will be released through the existing canal system for delivery to the individual municipal water supply systems and to the Platte River Power Authority via a newly constructed pipeline and diversion structure

d Appurtenances and Relocations

(1) Roads

A road will be built along side the pipeline for access during construction After construction is completed, most portions of this road will be abandoned and the ground graded to its original surface form Permanent access roads will be provided to locations along the pipeline which require periodic inspection or maintenance

A permanent road will be required for access to the pumping plant This road will be very short since the pumping plant is only a few yards from U S Highway 40 Access to all other project facilities will be provided by existing roads

Construction of the pumping plant and pipeline will require the temporary relocation of U S Highway 40 (attachment 3), about 1500 feet of which will be temporarily realined to be approximately 100 feet north at the intersection with Colorado Highway 125 The duration of this temporary realinement will be about 1 year

A section of Colorado Highway 125 (attachment 3) at the intersection with U S Highway 40 will also be relocated from the present alinement About 100 feet of Colorado Highway 125 will be realined to the east to move the intersection to a point opposite the entrance road to the pumping plant, approximately 200 feet east of the present location

Although realinement of U S Highway 40 will be temporary, realinement of Colorado Highway 125 may become permanent, subject to the approval of the Colorado Department of Highways Such a permanent change in the location of the intersection would direct runaway vehicles on Colorado Highway 125 away from the pumping plant whereas the present location of the intersection suggests a possible collision with the pumping plant in

the event a runaway vehicle is unable to stop at the intersection

Temporary relocation (attachment 3) of U S Highway 34 will be required at the pipeline crossing near Lake Granby The road will be shifted east about 80 feet at the crossing point This will involve about 700 feet of U S Highway 34 and should last about 3 weeks Construction will occur within the existing highway right-of-way

(2) Utilities

A 138-kV transmission line will be built from the existing MPEI Windy Gap Substation to the Windy Gap Pumping Plant The alinement of this transmission line is shown on figure II-4 This line will involve 0 6 miles of double-circuit overhead transmission line on wood pole structures The line will terminate at a substation having a stepdown transformer located at the pumping plant A segment of the existing 69-kV transmission line from Windy Gap to Fraser will have to be relocated around the diversion dam and reservoir

Temporary relocation of U S Highway 40 and Colorado Highway 125 will require minor alteration of an existing transmission line along the highway in the area Two or possibly three power poles will require temporary relocation

Provisions for a potable water supply and sewage treatment at the pumping plant will be contained in the pumping plant No external hookups will be required

(3) Offices

Permanent offices and a control room will be located within the pumping plant structure Temporary office space may be rented by the construction contractor and the engineer during construction of the project

e Summary of Physical Data

DIVERSION DAM	
Type	Zoned earth fill
Maximum Height	27 feet
Crest Length	5580 feet
Embankment Volume	331,000 yd^3
Crest Elevation	7838 feet
Slope Protection	Riprap
DIVERSION RESERVOIR	
Normal Maximum Pool Elevation	7827 feet
Normal Minimum Pool Elevation	7823 feet
Maximum Flood Pool Elevation	7836 feet
Live Storage Capacity	320 acre-feet
Water Surface Area at Normal Maximum Pool	112 acres

SPILLWAY AND STILLING BASIN	
Spillway Type	Ungated concrete gravity structure
Stilling Basin Type	Concrete submerged roller bucket
Crest Elevation	7827 feet
Crest Length	345 feet
Capacity at Maximum Flood Pool	32,410 ft^3/s
BYPASS OUTLET WORKS	
Type	48-inch-diameter concrete pipe under embankment
Intake Invert Elevation	7803
Design Capacity	93 ft^3/s at minimum reservoir
Control	48-in^2 Butterfly valve
Pipe Length	245 feet
AUXILIARY OUTLET WORKS	
Type	Sluiceway
Intake Invert Elevation	7816
Design Capacity	168 ft^3/s at minimum reservoir
Control	Motor operated slide gate
PUMPING PLANT	
Type	Underground reinforced concrete
Pump Type	Centrifugal
Number of Pumps	4
Maximum Discharge all Pumps	600 ft^3/s
Power Required at Maximum Discharge	41,200 kW
Motor Horsepower - Each Pump	12,000 hp
PIPELINE	
Type	Underground steel and concrete cylinder pipe or all steel pipe
Capacity	600 ft^3/s
Length	31,000 feet
Nominal Pipe Diameter	9 feet
Pipe Wall Thickness	varies
SURGE LINE	
Type	Underground concrete cylinder pipe or all steel pipe
Nominal Diameter	9 feet
Length	725 feet
LAKE GRANBY OUTLET - WINDY GAP - C-BT WILLOW CREEK CHUTE	
Discharge Capacity	1040 ft^3/s 600 ft^3/s WGP, 440 ft^3/s C-BT
Type	Dual concrete box chutes w/internal baffles
Structure Length	425 feet
Internal Conduit Dimensions	24 feet wide, 10 feet high (both chutes together)

f Operation

The Windy Gap Pumping Plant will be operated in a manner such that the water needs of the Subdistrict allottees are met without infringing on the existing water rights of Western Slope interests The project features have been sized in order to make this possible

In general, the pumping plant will pump as much as possible while maintaining flows below the diversion dam in such an amount as may be necessary to satisfy all senior water rights and to provide minimum stream flows agreed (attachment 2) upon with the Colorado Division of Wildlife in the stream segment of the Colorado River below the diversion dam and above the confluence of the Blue River The diversion amounts at Windy Gap are limited by agreement (Intergovernmental Agreement, attachment 1) to a maximum of 93,300 acre-feet in any 1 year and cannot exceed 683,000 acre-feet in any 10-year period Of the amount which may be diverted, 2,000 acre-feet is pumped to Lake Granby storage under a commitment to Middle Park An additional 1,300 acre-feet for Middle Park may be provided by exchange from a potential future reservoir (Azure or Una)

Minimum stream flows below Windy Gap diversion dam are by agreement as follows

(1) From Windy Gap diversion point to the mouth of the Williams Fork River - 90 ft^3/s

(2) From the mouth of Williams Fork River to the mouth of the Troublesome Creek - 135 ft^3/s

(3) From the mouth of Troublesome Creek to the mouth of the Blue River - 150 ft^3/s

Once every 3 years, if equivalent flows do not otherwise occur past the Windy Gap diversion point, pumping may be curtailed such that a flushing flow of 450 ft^3/s is released past the dam for a period of 50 hours sometime within the months of April, May and June

At times, senior downstream rights may call for the release of more than the agreed minimum Under these circumstances pumping will be curtailed to satisfy senior downstream rights

If the reservoir inflow falls below the amounts required for downstream minimum flow requirements as described above or as decreed by senior downstream water rights, the pumping will cease at Windy Gap and all the inflow released downstream The pumping plant will operate during the months of April through August using these criteria in most years

Under certain circumstances, exceptions will be made to the general operating criteria described above For example, only water for which there is an anticipated demand will be pumped During wet years existing sources may be sufficient to meet demands so pumping plant operation will be less than that which is possible If, after a series of wet years, Lake Granby is at maximum storage capacity, pumping rates will be reduced until Windy Gap water can be accomodated

These general operating criteria will result in heavy pumping during the period of spring runoff, May, June, and July, and little pumping during the period of September through March Pumping during April and August will be variable, depending on the flow during those months Water and Power's simulated the operation of the Windy Gap Project in relation to the C-BT carrying capacity is discussed in chapter IV C 1

In October, 1973, the Subdistrict contracted with Water and Power to utilize C-BT Project facilities to convey Windy Gap Project water from Lake Granby to the East Slope This contract is known as the Carriage Contract Briefly, it provides for an accounting system such that the amount of Windy Gap water in the C-BT system is known at any time The Windy Gap Project is charged a shrinkage and evaporation fee in form of water based on the amount of water pumped into Lake Granby and on the amount which is stored there The contract also provides for payment of pumping and maintenance costs by the Subdistrict In general, it is the Carriage Contract that specifies when and how much Windy Gap water will be transferred to the East Slope from Lake Granby

The amount of Windy Gap water delivered to East Slope users will be about 47,500 acre-feet annually after Carriage Contract deductions This delivery will be relatively uniform from year to year, although the annual amount of water diverted will fluctuate over a wide range When more than 57,000 acre-feet is pumped to Lake Granby, the excess will be stored When less than 57,000 acre-feet is pumped, water will be withdrawn from storage to provide the necessary deliveries

g Rawhide Powerplant

(1) General

The following briefly describes the facilities and operations associated with PRPA'S Rawhide Powerplant The environmental impacts of the powerplant are summarized in chapter IV C of this document More detailed information is presented in PRPA (1978)

(2) Concept

Platte River Power Authority (PRPA) has proposed to construct and operate a 750 megawatt (MW) coal-fired electric generation

plant (Rawhide Powerplant) The facility would utilize lowsulfur, western coal It will be located in Larimer County about 18 miles northeast of Fort Collins, Colorado and will serve Estes Park, Fort Collins, Longmont, and Loveland

Rawhide Powerplant is related to the Windy Gap Project because PRPA plans to contract for about 16,200 acre-feet of the developed water supply Approximately 8,200 acre-feet would ultimately be used for the 750 MW of capacity The remaining 8,000 acre-feet would be used as an emergency back up supply to provide water in drought years

Construction would occur in three 250 MW phases Construction on the first phase began in November 1979, with operations to begin in 1985 The second unit would be needed by 1990 No schedule has been established for the third unit

(3) Need

In the past, the power requirements for the cities have been furnished by Water and Power In 1967, Water and Power notified the cities that in the future, the amount of power provided would be limited to that amount furnished in 1967 This limitation created a need for the development of additional power sources PRPA began studying alternative sources of power In January 1976, an evaluation of alternative power sources was completed None of the alternatives offered a secure, economic source of energy PRPA then examined the environmental and engineering feasibility of constructing its own generating plant The following tabulation shows the projected demands and supplies for the Platte River cities (PRPA, 1978)

	System Peak MW		Energy Requirements GWh	
	Month of September	Average Yearly % Increase Since 1970	12 Months Ended September	Average Yearly % Increase Since 1970
1970	69 2	--	381 5	--
1971	75 7	9 4	409 2	7 3
1972	81 3	8 4	466 5	10 6
1973	88 5	8 5	522 4	11 0
1974	97 5	8 9	553 5	9 8
1975	107 0	9 1	604 1	9 6
1976	115 5	8 9	656 7	9 5
1977	134 1	9 9	733 5	9 8
1978	148 8	10 0	793 8	9 6

(4) Water Supply

Water requirements associated with the project are primarily for powerplant cooling The plant will utilize an open-cycle system in which the cooling water will be circulated between the station condenser and a reservoir A 400-acre reservoir

with a capacity of 13,600 acre-feet will be constructed adjacent to the powerplant

The first unit will use 4,820 acre-feet of water per year 3,600 acre-feet per year will be needed to make up cooling pond losses, i e natural evaporation, forced evaporation, and exfiltration, onsite irrigation will consume 600 acre-feet per year, possibly, releases downstream of up to 100 acre-feet per year may be necessary to hold harmless nearby water users, 240 acre-feet per year will be required for powerplant operation and 280 acre-feet per year will be reserved for contingencies (PRPA, 1978) After taking account of 620 acre-feet of rainfall annually captured in the cooling pond, and rainfall runoff into the cooling pond basin, a net yearly requirement of 4,200 acre-feet remains to be supplied from an off-site source

Water for the first unit will come from 4,200 acre-feet of secondarily treated sewage effluent from the city of Fort Collins' Sewage Treatment Plant, PRPA, the city and the Water Supply and Storage Company, Mutual Ditch Company, signed an agreement for the use of this effluent

What makes the water reuse plan workable is that both Fort Collins and Water Supply have recently imported substantial amounts of new foreign water into the Cache La Poudre River Basin ("Foreign" waters are waters imported into a stream system from an unconnected stream system, waters only recently imported are "new" foreign waters) Colorado law permits an importer of foreign water to use them, to capture their return flows and reuse them, successively, until completely consumed An importer, if it so chooses, may dispose of the return flows by selling them to a third party rather than reusing them itself (PRPA, 1978)

The Water Supply and Storage Company recently enlarged Long Draw Reservoir and rehabilitated the Grand River Ditch The project and the increased water supply that would be developed from the addition-in-basin storage and the increased transmountain diversion from the Colorado River are described in USBR (1973) At the time of the project's inception, all water was to be allocated to agricultural uses The Water Supply and Storage Company recently submitted an application for a change in their water right, the application was submitted jointly with PRPA and the city of Fort Collins to accommodate PRPA's reuse plan The petition is for approval of a plan for augmentation, for reuse of water, for changes in place, character, and type of use, for conditional decrees, for modification of conditional decrees, and for exchanges (PRPA, 1978)

The city of Fort Collins has enlarged the original 800 acre-feet capacity of Joe Wright (Cameron Pass) Reservoir by about 6,360 acre-feet The enlargement will provide storage capacity for additional waters to be diverted by the Michigan Ditch from the North Platte

River Basin and for storage of in-basin flood waters of Joe Wright Creek, a tributary of the Cache La Poudre River (PRPA, 1978)

In this instance, the new foreign water of the Water Supply and Storage Company and those of the city of Fort Collins will, through an exchange, first be used by the city of Fort Collins Then the 4,200 acre-feet of return flows in the form of sewage effluent will be transferred to Platte River at the outlet of the Fort Collins Sewage Treatment Plant No 2 for conveyance to the Rawhide Project site

In exchange for the right to reuse their new foreign water, PRPA will compensate Fort Collins and water supply in one of three ways, depending on Windy Gap's status When Windy Gap is complete, PRPA will compensate the city and water supply on an acre-foot-for-acre-foot basis from its allotment of the Windy Gap Project Prior to the completion of Windy Gap, PRPA will pay a nominal consideration to Fort Collins and water supply for each acre-foot of water delivered by them until Windy Gap is operational If Windy Gap were to be abandoned, then PRPA would be obligated to make a substantial cash payment for each acre-foot of water delivered (PRPA, 1978)

As noted above, PRPA is an allottee of 16,200 acre-feet of the Windy Gap water In a series of dry years, the yield could drop to as low as one-half that amount Power generation requires a firm and dependable supply of water for cooling requirements PRPA is planning for that worst case condition A substantial amount of Windy Gap waters is necessary, therefore, simply to assure that the worst case condition can be weathered and that a series of dry years would not curtail electric generation

The balance of PRPA's Windy Gap allotment would be reserved for future generation projects, including unit number three at Rawhide If PRPA were to conclude that such waters were not needed, the terms of the assignments under which Platte River obtained Windy Gap allotments from Estes Park, Fort Collins, and Loveland require that such water be first offered to each of these cities If these cities had no need of the waters, they would then be offered to Longmont, the fourth municipal member of Platte River Any remaining allotment could then be sold on the open market

If PRPA had no immediate need for the water, but had later need of it for future generation projects, it could lease the water to the cities or on the open market during that interim period If no lessee could be found, the water could be left on the Western Slope for short periods of time until required

h Interrelationships With Other Projects and Proposals

(1) Other West to East Slope Transbasin Diversions

The Grand River Ditch, the Eureka Ditch, the Alva B Adams Tunnel, the Berthoud Pass Ditch and the Moffat Tunnel are the only diversions which are related to the Windy Gap Project All others involve the diversion of water from basins other than the drainage basin above Windy Gap

(2) Directly Related Water Projects

The C-BT Project is the only directly related water project The relationship of the Windy Gap Project to the C-BT Project is described in the preceding paragraphs of this section

(3) Indirectly Related Water Projects

The Grand River Ditch diverts an average of about 20,000 acre-feet annually from the upper Colorado Basin north of Grand Lake to the Cache La Poudre Basin

The Eureka Ditch diverts an average of 200 acre-feet annually from an area within Rocky Mountain National Park into the Big Thompson River Basin

The Berthoud Pass Ditch diverts an average of 1500 acre-feet annually from the upper Fraser River Basin to the Clear Creek Basin on the Eastern Slope The Moffat Tunnel diverts water to the Boulder Creek Basin from a collection system located in the upper Fraser River Basin Of the 58,500 acre-feet average annual flow through the Moffat Tunnel about 54,400 acre-feet are diverted from the upper Fraser River Basin The remainder originates in the upper Williams Fork Basin which is not part of the Fraser River Basin

The recently completed Cabin-Meadow Creek Project, contributes about 6000 acre-feet per year to the flow in the Moffat Tunnel

(4) Power Consumption

The Windy Gap Project operation will cause the consumption of electrical power at two primary locations the Windy Gap Pumping Plant and the Lake Granby Pumping Plant The Windy Gap pumps will require 41,200 kW of power when operating at full capacity Since the pumping rate is variable, the energy required will vary from month to month and from year to year

The Lake Granby Pumping Plant will not require any changes in its pumps in order to pump Windy Gap water, however, the

pumps will have to operate longer This will require an increase in energy consumption This increase is discussed quantitatively in the next section, power generation

The Windy Gap Project will also reduce the amount of water available for hydroelectric power generation on the lower Colorado River

(5) Power Generation

After Windy Gap water flows through the Alva B Adams Tunnel, it will contribute to power generation as it drops several thousand feet to East Slope storage reservoirs

The series of hydroelectric power plants, together with the Lake Granby Pumping Plant, forms part of the Water and Power's Pick-Sloan Missouri River Basin Water and Power system A computer program that simulated operation of this system has been run with and without Windy Gap water (Water and Power, 1981) in order to determine the net effect on the power production of the system This program indicates, for the 20 years of simulated operation, that the net effect of Windy Gap water will be to increase the average annual energy generation of the system by an amount in the order of 95,000,000 kWh

C Description of Non-Viable Alternatives

1 Water Conservation and Management

The primary objective of the water conservation alternative is to reduce total demand for water This can be achieved through providing economic incentives, creating a sense of conservation among users through educational programs, or making certain conservation measures mandatory All of the cities participating in the Windy Gap Project have implemented various forms of the water conservation alternative The city of Boulder has been metering all customers since 1963 As of June 1, 1977, all users in the town of Estes Park were metered The city of Greeley is about 30 percent metered, and all new connections are required to install meters The city of Loveland has required metering of all customers outside the city limits for several years and in late 1980, adopted an ordinance requiring installation of meters on all existing water service connections The city has budgeted $2,700,000 for the purchase and installation of meters on existing service connections All commercial and industrial water users in the city of Longmont and residential users outside the city have been metered since 1960 Meters are required on all new residential customers The city has participated in an educational program and has implemented alternate day restrictions and restrictions on water use during certain hours of the day during high consumption summer months Longmont is in the process of conducting engineering studies to detemine the feasibility of universal metering and other water conservation measures

Projected water demand for municipalities is a function of population growth, indoor and outdoor domestic use, and industrial water use Conservation programs primarily impact one aspect of projected water demand--outdoor domestic use, though indoor domestic use may also be influenced by conservation programs Industrial use is a major component of water demand in Greeley, Longmont and Loveland, and is a significant factor in future projections of average annual use These projections are provided below

City	Projected Average Annual Use Gallons Per Capita Per Day
Boulder	181
Estes Park	213
Greeley	306
Longmont	272
Loveland	287
Weighted Average	250

Results of water conservation programs implemented by Windy Gap Service Area municipalities have been impressive Prior to 1963 when universal metering was implemented, the city of Boulder's average annual consumption was 225 gallons per capita per day Between 1963 and 1977, the average annual consumption was 159 gallons per capita per day Some of the decrease, however, is probably attributable to the fact that a large number of multiple family dwelling units have been constructed in Boulder during the 1963-1977 period The town of Estes Park has reported a significant savings in water use since metering The city of Loveland implemented mandatory every third day and restricted hour of watering restrictions in 1977 along with an extensive educational program Loveland reported a 14 percent decline in water use during the summer months of 1977, compared to the same period in 1976

The expected results of water conservation programs have been factored into the projected average annual water use indicated above The municipalities of the Windy Gap Service Area are firmly committed to water conservation programs for the long term which include, as a minimum, economic incentives for water conservation and continued education programs The cities have indicated their willingness to implement more restrictive and mandatory programs as the need arises

As described above, all of the municipalities participating in the Windy Gap Project have water conservation programs in place Even considering the impacts of conservation programs, the shortfall of 32,364 acre-feet per year is predicted, i e water demand will exceed supplies by that amount If the municipalities were to rely solely on the water conservation and management alternative to meet this shortfall, the following consequences could be anticipated

1 Decline in the quality of life in the individual communities,

2 Water shortages,

3 Potential public health problems,

4 A chronic inability to meet water demands,

5 Inability to support orderly growth in accordance with presently approved land use plans,

6 Inability to plan for the future,

7 Economic instability resulting from loss of jobs, industry, and population

Water conservation and management alternative will continue to play a vital role in the water planning programs of each of the municipalities, however, the municipalities cannot rely on the water conservation alternative alone to meet the significant shortfall of water which will occur by the 2000

2 Alternative Water Supplies

a Ground Water

The ground water necessary to meet the projected needs (32,400 acre-ft/yr) is equivalent to a well field pumping continuously at a rate of 20,096 gpm It is obvious that this quantity of water could only be obtained from an extensive, very permeable aquifer with very high recharge characteristics The ground water would have to be adequate in quality as well as quantity and meet the Colorado water quality standards under the Ground Water Administrative Act of 1969 The aquifers that have the most potential for providing such large quantities of water are the consolidated sedimentary bedrock formations of the Denver Basin and the unconsolidated sand and gravel aquifers of the major streams and rivers flowing eastward from the foothills The crystalline basement rocks of the Front Range contain water of good quality, but the permabilities are very low and well yields are seldom greater than a few gallons per minute

The sedimentary bedrock formations of the Denver Basin contain vast amounts of ground water in storage, however, the amount that can be practically recovered by wells is considerably less than the amount in storage In general, aquifer transmissivities of these formations are low and corresponding well yields are low, usually less than 100 gpm Assuming an average well yield of 100 gpm, a total of 201 wells pumping continually would be needed to provide the necessary water for the project Water levels in these aquifers are declining since current withdrawals are in excess of the natural recharge, and pumping lifts are increasing and well yields are declining These problems would be aggravated by additional withdrawals of large quantities of water In addition, many of these aquifers have poor quality water associated with them In general, it appears that the bedrock formations in the Windy Gap Service Area would not be a viable alternate source for the Service Area

Unconsolidated sand and gravel aquifers in the Service Area are the major source of ground water for irrigation wells during periods of low precipitation These aquifers are directly interconnected and occur along the major streams in the area Several thousand domestic wells tap these aquifers for irrigation, municipal, domestic, and livestock supplies in the north half of the Denver Basin The well yields vary from a few to as much as 2,000 gpm

One negative aspect of this alternative is that the aquifers are charged by surficial waters, and many areas are contaminated with TDS concentrations varying from a few hundred to several thousand parts per million (ppm) In some areas, mineral concentrations exceed Colorado water quality standards Additionally, all of the ground waters from the surficial alluvial-aquifers have to be appropriated by users and administered by the Colorado State

Engineer in accordance with State statutes The surface waters and ground waters within the South Platte River Drainage Basin are heavily appropriated and any new wells tapping these tributary aquifers would be junior to all existing surface-water rights Furthermore, the cost of pumping and transporting so large a quantity of water would probably be economically prohibitive A more detailed discussion of the ground water alternative is included in Dames and Moore (1977a)

b Conversion of Agricultural Water Rights

Next to the Windy Gap development this alternative is probably the most viable

Agricultural rights within the Northern Colorado Water Conservancy District could be purchased by the municipalities and the PRPA The municipalities currently have a policy of purchasing water rights as they become available Based upon 1975 levels, almost 12 percent of the cities' present firm water supply is from unconverted ditch rights and 35 percent is from acquired Colorado-Big Thompson rights A sufficient quantity of agricultural water rights exist on the East Slope to meet the projected needs In order to satisfy these needs, an estimated 13,000 to 15,000 acres of agricultural land would be taken out of production It is likely that the No Action alternative would accelerate the trend toward condemnation and/or conversion of irrigation and storage water rights

Such an acceleration of the removal of water from agriculture would be in direct contradiction of established State policy and would have a profoundly adverse effect on the agricultural economy of this region One of the main reasons that an alternative water supply is needed is to preserve this valuable local and national agricultural resource

3 Alternative Project Features

A conceptual plan for development of the Windy Gap Project established by the Subdistrict served as the basis of this evaluation Discussions with personnel of the Subdistrict, Dames and Moore, and the Water and Power early in the studies led to the selection of two additional schemes for inclusion in the evaluation All three schemes would develop some of the unappropriated water presently passing the Windy Gap diversion damsite, located on the Colorado River below its confluence with the Fraser River The three schemes are described in the following sections

a Scheme I - Windy Gap-Jasper-Granby

This scheme was the conceptual plan proposed by the Subdistrict for initial evaluation In this scheme water diverted at the proposal Windy Gap diversion dam would be pumped to Lake Granby via a new storage reservoir (Jasper Reservoir), located on Willow

Creek about 1 mile upstream from its confluence with the Colorado River

In scheme I the capacity of Jasper Reservoir would be limited by the existence of Willow Creek Dam and facilities a short distance upstream Jasper Reservoir storage capacities of 15,000, 30,000, and 47,000 acre-feet were studied With a storage capacity of 47,000 acre-feet Jasper Reservoir would necessitate modification of the Willow Creek Dam, spillway, outlet works, pump canal and access road With a capacity of 47,000 to 60,000 acre-feet, the reservoir would inundate all of these facilities (except the dam) and Willow Creek Pumping Plant With a capacity of 70,000, it would also inundate the dam

Specifically this alternative included (1) Pumping from Windy Gap Reservoir to Jasper Reservoir via Windy Gap Pumping Plant and a 7-foot-diameter pipeline, and (2) pumping from Jasper Reservoir directly to the combined C-BT-Windy Gap Project outlet into Lake Granby via Jasper Pumping Plant and an 8-foot-diameter pipeline (bypassing Willow Creek Pumping Plant) This alternative was rejected because it is economically unfeasible

b Scheme II - Windy Gap-Willow Creek-Granby

This scheme was similar to a scheme proposed by the Water and Power in its report, Reconnaissance Report on the Western Slope Extension, Colorado-Big Thompson Project, Colorado, December, 1956 In the present scheme, water diverted at the Windy Gap diversion dam would be pumped to Lake Granby via the existing Willow Creek Reservoir, which would be enlarged (by raising Willow Creek Dam) to increase its storage capacity This scheme also required the provision of a new uncontrolled spillway crest and chute and modification of the existing outlet works to Willow Creek and to Willow Creek Pumping Plant With the maximum storage capacity studied (47,000 acre-feet), the maximum water surface level of the enlarged reservoir would be 70 feet higher than that of the present reservoir, and an additional 1,000 acres of rangeland would be flooded

This alternative involved (1) Pumping from the Windy Gap Reservoir to an enlarged Willow Creek Reservoir (with additional storage capacity of 30,000 acre-feet) via Windy Gap Pumping Plant (300 ft^3/s) and a 7-foot-diameter pipeline, (2) delivery of water from Willow Creek Reservoir to Willow Creek forebay through a new pipeline, and (3) pumping of water from Willow Creek forebay to a combined C-BT/Windy Gap Project outlet into Lake Granby via the existing Willow Creek Pumping Plant and pipeline and a new pipeline extension This alternative was rejected because it is economically unfeasible

c Scheme III - Windy Gap-Granby Directly

The basic concept for scheme III is that water diverted at Windy Gap diversion dam would be conveyed to Lake Granby without intermediate storage

This involved pumping from the Windy Gap Reservoir to Lake Granby via Windy Gap Pumping Plant (300 ft^3/s capacity) and a 7-foot-diameter pipeline along a high-level alinement, with discharge near the existing Willow Creek pump canal outlet works into Lake Granby

This alternative is essentially the same as the selected alternative, but with a slightly smaller diversion capacity The major difference would be that diversions would be restricted to 300 ft^3/s At times the flow in the Colorado River would be up to 300 ft^3/s greater under this alternative The diverted water would be more expensive than with the selected alternative

D Comparison of Alternatives

Table II-10 summarizes the environmental impacts of the (1) No Action, and (2) Windy Gap A brief discussion of all the alternatives initially considered is found in chapter II C of this document It was determined that the structural and conservation alternatives initially considered and subsequently judged to be nonviable were more costly from an environmental, economic, and engineering view than the No Action and Windy Gap alternatives

Table II-10 Comparison of Environmental Impacts of Alternatives

Environmental Parameter	No Action	Windy Gap
Colorado River Water Supply	Opportunity to utilize an annual average of 54,000 acre-feet that Colorado is entitled to under Colorado River Compact and subsequent compacts is lost	Deplete river by an annual average of 54,000 acre-feet
Water and Sewage Treatment, and Diversion Facilities	No foreseeable rehabilitation of existing facilities	Facilities rehabilitated and historic minimum flows maintained, thus no impact
Hydrology	No impact	Average annual depletion would be about 54,000 acre-feet At Hot Sulphur Springs average flows would be reduced by 12, 63, 65, and 24 percent during April, May, June, and July
Water Quality water temperature	No impact	Potential increase (few degrees) in water temperature immediately below diversion dam during late summer-early fall Monitoring of pre- and post-project temperatures will occur
sediment	No impact	Sediment Reservoir will trap 100% of bed load and 50% of suspended sediment Current levels would be reduced from an average of 28 mg/l and peak of 40 mg/l to 14 and 20 mg/l, respectively Thus, dam outflow would be a little clearer than inflow There will be no downstream aggradation of degradation
salinity	No impact	1) 0 1% or 1 mg/l increase at Imperial Dam, Az -Calif 2) 0 5% or 3 mg/l increase at Lees Ferry, Az 3) 1 8% or 8 mg/l increase at Cameo, Colorado Could result in economic loss of about $343,000 (1976 dollars) at Imperial Dam
aquatic biota	No impact	1) No significant operational impact Potential impacts mitigated by minimum flow agreement (Attachment 2) 2) Reservoir will replace about 10 acres of permanent stream with a 112 surface acre reservoir About 4,500 pounds of trout would be produced in the reservoir versus about 1,000-1,500 pounds in the inundated stream 3) About 5% of the potential trout productivity of the reservoir would be reduced by diversion into the reservoir pumps 4) Upstream trout migration will be prevented--considered insignificant by DOW

TABLE II-10 (Continued)

Environmental Parameter	No Action	Windy Gap
		5) Worst case analysis indicates about 13 5 acres or 6 percent of the aquatic productivity between Fraser River and Troublesome Creek could be lost for 1 year due to construction activities
Threatened and Endangered Species	No impact	No impact--conditional on mitigation agreed to by Subdistrict (Attachment 2)
Recreation	No impact	No significant impact on recreation is anticipated because of minimum flow agreement (see Attachment 2)
Windy Gap Development and Service Area		
Air Quality	No impact	No significant impact
Physiography and Geology	No impact	No significant impact
Water Quality	No impact	No significant impact
Soils	No impact	Disturbance and displacement of soil, and some erosion of exposed soil due to construction (See Chapter IV C 2 d) Disturbed soil and vegetation will be mitigated by following the Reclamation Plan, Dames and Moore (1978)
Vegetation	No impact	Permanent loss due to Windy Gap Dam riparian = 12 acres pasture = 90 acres Temporary loss due to Windy Gap Pipeline (will be revegetated) sagebrush = 36 acres Rawhide Powerplant will disturb or eliminate about 1,000 acres of short-grass prairie
Wildlife	No impact	About 112 acres of riparian-woodland/ pasture habitat will be lost due to the Windy Gap Dam The wildlife dependent on this habitat will be lost or displaced About 26 species breed in the area Impacts were not quantified No mitigation planned About 36 acres of sagebrush habitat will be temporarily disrupted by pipeline and road construction Sage grouse strutting ground may be disrupted Habitat will be reclaimed No long-term impacts expected
Threatened and Endangered Species	No impact	No impact (see Attachment 2)
Recreation	No impact	Potential recreation opportunities associated with Windy Gap Reservoir No definite plans formulated yet May be some environmental impacts associated with human use if facilities are developed

TABLE II-10 (Continued)

Environmental Parameter	No Action	Windy Gap
Aesthetics	No impact	Some visual intrusion due to reservoir and powerplant Intrusion minimized by reservoir operations and architectural controls on structures Pipeline will be buried
Cultural Resources	No impact	Planning and construction for Windy Gap has resulted in destruction of cultural resources through controlled survey and data gathering Overall beneficial impact because of scientific recovery of data Construction of project with mitigation will result in same effect as above
Land Use	Probable conversion of agricultural water rights to municipal and industrial uses Could convert up to 15,000 acres of agricultural land to other uses	Inundation of about 10 acres of river, 12 acres of riparian and 90 acres of pasture Not expected to cause land use changes in service area due to growth Growth already anticipated and is not contingent upon water Construction of Rawhide Powerplant will convert about 1,000 acres of prairie currently used for cattle grazing to uses associated with powerplant operations
Transportation	No impact	Short-term (up to 2 years) impacts on traffic volumes during construction of Windy Gap Dam and pipeline Roads will be permanently and temporarily relocated to reduce interference with normal traffic flow The least disruptive haul truck route for Rawhide Powerplant will be agreed to between PRPA and Larimer County
Socio-economics	1) If Windy Gap is not constructed there would be economic and social impacts associated with conversion of agricultural water rights to municipal and industrial uses The agricultural base around the service area would be adversely affected Up to 15,000 acres of agricultural lands could be taken out of production to satisfy projected municipal and industrial water demands 2) More stringent water restrictions would be implemented in the service area The Rawhide Powerplant would not have as ready an access to a dependable water supply	1) Construction work force will stabilize at 30 people during construction season Will reach a peak of 259 people 2) School enrollments will not be affected 3) About $357,000 (1975 dollars) in salaries will be spent in Grand County during construction 4) Land acquisition will result in about $15 000 (1975) less taxes to Grand County 5) A portion (about $6 million) of the expenditures for equipment and materials will be spent in Grand County Expect overall positive economic impact on county Availability of Windy Gap water will lessen the growing competition for agricultural water rights in and around the service area Socio-economic impacts of Rawhide Powerplant are expected to be minor

TABLE II-10 (Continued)

Environmental Parameter	No Action	Windy Gap
Colorado-Big Thompson Development and Service Area		
Hydrology	No impact	1) An additional 2,000 acre-feet of water will be released from Lake Granby to satisfy the Middle Park area 2) Lake Granby's average annual water surface will increase by 8 feet or 380 surface acres 3) Water released to Big Thompson River will increase by an annual average of 5,000 acre-feet 4) End-of-year storage contents of Carter and Horsetooth Reservoirs will be reduced by an annual average of 8 000 acre-feet each
Water Quality	No impact	No significant impact on 'conservative chemical constituents " Additional phosphorus to Lake Granby would approximate 3,545 kg per year Does not change trophic status of any of the three lakes
Aquatic Biota	No impact	Minor increase in algal productivity and population levels in the three lakes
Threatened and Endangered Species	No impact	No impact
Recreation, Aesthetics, Land Use, and Socio-economics	No impact	No significant impact
Energy	The C-BT would lose the potential to generate a net average annual 88 million kilowatts of energy	An additional net average annual 88 million kilowatts of energy would be generated by conveying Windy Gap water through the C-BT system

CHAPTER III AFFECTED ENVIRONMENT

A GENERAL

B COLORADO RIVER

C WINDY GAP DEVELOPMENT AND SERVICE AREA

D COLORADO-BIG THOMPSON DEVELOPMENT AND SERVICE AREA

Chapter III AFFECTED ENVIRONMENT

A General

The environments which would be impacted by the alternatives are separated into three areas the Colorado River, C-BT development and Service Area, and Windy Gap development and Service Area This separation is based upon hydrological and geographical differences The hydrologic differences are defined by artificial (C-BT and proposed Windy Gap development and Service Areas) and natural (Colorado and Big Thompson drainages) characteristics The geographic differences are defined by the Continental Divide which separates the development and Service Areas

The components of the environment which are specific to each of the areas are discussed in subsequent sections The more general components associated with all three areas are described below

1 Climate

The area covered by the Colorado-Big Thompson (C-BT) in western Colorado, Windy Gap, and Service Area spans some 245 miles between Kremmling and Julesburg in northeastern Colorado This area is roughly divided into two major climatic zones mountain and high plains

The existing C-BT and proposed Windy Gap water development facilities are located in the mountain zone The Service Areas for both projects are largely located in the high plains zone The C-BT conveyance system spans the transition zone between

The mountain zone's rugged topography dictates large climatic variations over short distances and few generalizations apply to the whole area within which the C-BT water development facilities are located Elevations range from 9000 to 14000 feet Average annual precipitation ranges between 14 15 and 16 07 inches at the major features Average seasonal temperature extremes occur in July (62 2°F) and January (12 7°F) The average number of frost-free days ranges from 4 at Fraser to 95 at Estes Park

The high plains zone is characterized by a "continental" type of climate Characteristics of the climate include "low relative humidity, abundant sunshine, light rainfall, moderate to high wind movement, and a large daily range in temperature" (USDA, 1941)

Average seasonal temperature extremes occur in July (76 4°F) and January (24 1°F) Severe cold waves are common on the eastern plains The average frost-free period for the eight-county area ranges from 4 days at Fraser to 152 days at Boulder (NOAA, 1974) Table III-1 includes a tabular summary of climatic data

In the C-BT and Windy Gap Service Areas, the maximum average monthly precipitation (2 49 to 3 36 inches) occurs in May About

TABLE III-1

Climate of the Colorado-Big Thompson and Windy Gap Project Areas[1/]

Station, County	Av [2/] Temp	Av July Temp	Av January Temp	Frost-free Days	Average[3/] Annual Precip	Month Max Average Precip	Month Min Average Precip
Sterling, Logan	48 9	72 2	24 8	139	14 10	May 2 60	Feb 0 32
Fort Morgan, Morgan	48 9	73 9	24 3	151	12 86	May 2 58	Feb 0 27
Julesburg, Sedgwick	50 9	76 4	27 7	150	16 32	May 2 94	Jan 0 41
Greeley,[5/] Weld	48 3	73 7	24 1	142	11 12	May 2 49	Dec 0 33
Boulder[5/] Boulder	51 8	73 6	32 7	152	18 57	May 3 36	Dec 0 62
Fort Collins,[5/] Larimer	48 1	71 0	26 6	146	14 19	May 2 90	Jan 0 38
Longmont,[5/] Boulder	48 8	71 6	27 0	144	12 03	May 2 66	Dec 0 32
Estes Park,[5/] Larimer	43 0	62 2	26 3	95	16 07	May 2 22	Jan 0 53
Fraser, Grand	33 5	54 8	12 7	4	17 43	April 1 90	Oct 1 03
Grand Lake,[4/] Grand	36 0	57 8	14 3	41	14 15	Aug 1 70	Oct 0 75

1/ National Oceanic and Atmospheric Administration, 1974
2/ All temperatures in degrees fahrenheit
3/ All precipitation in inches
4/ Source Dames and Moore, 1977a
5/ Windy Gap Service Area

70-80 percent of the annual precipitation is received between April and September

The minimum averages of monthly precipitation occur in February (0 27 inch) and December (0 62 inch) Annual precipitation is generally less than 14 inches (PRPA, 1978) Perhaps more important than the average of precipitation is the variability In much of the Great Plains area, one can expect more years of below-average than above-average rainfall (Hildreth and Thomas, 1956)

Relative humidity is frequently below 50 percent in the C-BT Service Area and will occasionally be less than 20 percent Evaporation rates are high Mean annual lake evaporation over the area is about 40 inches With mean annual precipitation of approximately 14 inches, the net evaporation is about 26 inches (PRPA, 1978)

2 Topography

Both mountains and plains topography are included in the project areas The mountainous portion of the area is located in the southern Rocky Mountain physiographic province The parts of this province included in the C-BT and Windy Gap development areas are a rugged mountain portion of the Front Range, an adjoining portion of the Middle Park Basin to the west of the range, and a foothills area characterized by hogback ridges to the east

The plains area of the project is located in the Great Plains physiographic province, primarily in the Colorado Piedmont portion

Collection and distribution features of the C-BT Project are located in parts of two major drainage basins the Colorado on the West Slope and the South Platte on the East Slope of the Continental Divide

In the high alpine areas (above 12,000 feet), glaciers have carved out a serrated skyline of bare rock with cirques and troughs along the mountain ridges, and scooped out broad U-shaped valleys below Only small remnants of these glaciers are now present The highest peak, Long's Peak, has a cirque carved rock face and is surrounded by glacial lakes Below the glaciated portions of the valleys, streams flow through steep narrow canyons

The glaciers deposited large heaps of morainal material in all their valleys during successive advances and retreats Generally, evidence of glaciation is more prominent on the western side of the Divide, where morainal and outwash deposits are extensive Many alpine meadows formed by glacial outwash are present on the western side Those parts of the Front Range below timberline present a rough topography covered by evergreen forests

Elevations in the Windy Gap development area range between 7950 feet and 8600 feet Gradients in the site vicinity range from 20 feet-per-mile to nearly 1500 feet-per-mile along the pipe alinement terminating at Lake Granby

East of the hogbacks, project features are in the Colorado Piedmont trough of the Great Plains physiographic province The eastern plains have a flat rolling surface sloping eastward Relief is minimal

Most of the lands receiving C-BT water have sufficient slope to assure adequate drainage The elevations of the C-BT Service Area range from nearly 5400 at Boulder to nearly 3500 feet at Julesburg Estes Park is an exception having an elevation of 7500 feet

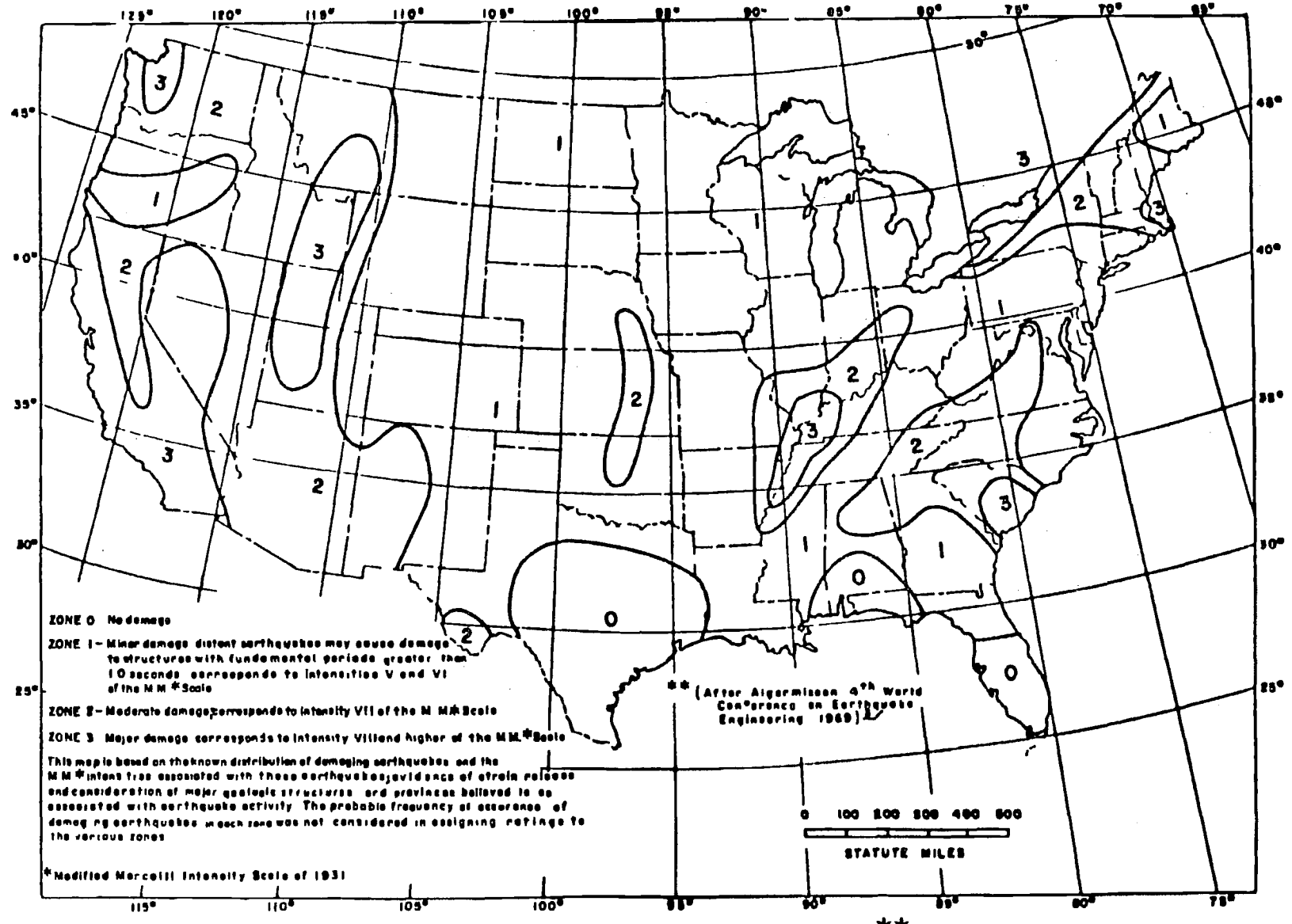
Recent deposition is occurring at much slower rates with great decreases in the volume of sediments being deposited

3 Seismicity

The project areas are in seismically stable portions of Colorado Colorado is considered to be a region of only minor seismicity (figure III-1) No destructive earthquake has occurred in Colorado within recorded history In the 103-year period between 1870 and 1973, only 28 earthquakes with intensities over 3 to a maximum of 4 (Modified Mercalli scale) were recorded (figure III-2)

Hundreds of minor events with intensities of IV or less (Modified Mercalli) occur annually from epicenters around the State None of these epicenters are present in the project areas

Seismic activity usually is associated with faulting Where faults are present, a "credible" possibility of seismic activity exists Seismic criteria used by the Water and Power for evaluation of structures includes not only the historical record of events, but also activity of faults within Quaternary time (10,000-100,000 years) as indicated by geologic evidence The project areas are considered seismically stable Although the presence of major faults in the areas allow a "credible" possibility of seismic activity, no evidence indicates that past Quaternary movement has occurred



Seismic Zone Map of the United States **

FIGURE III – 1

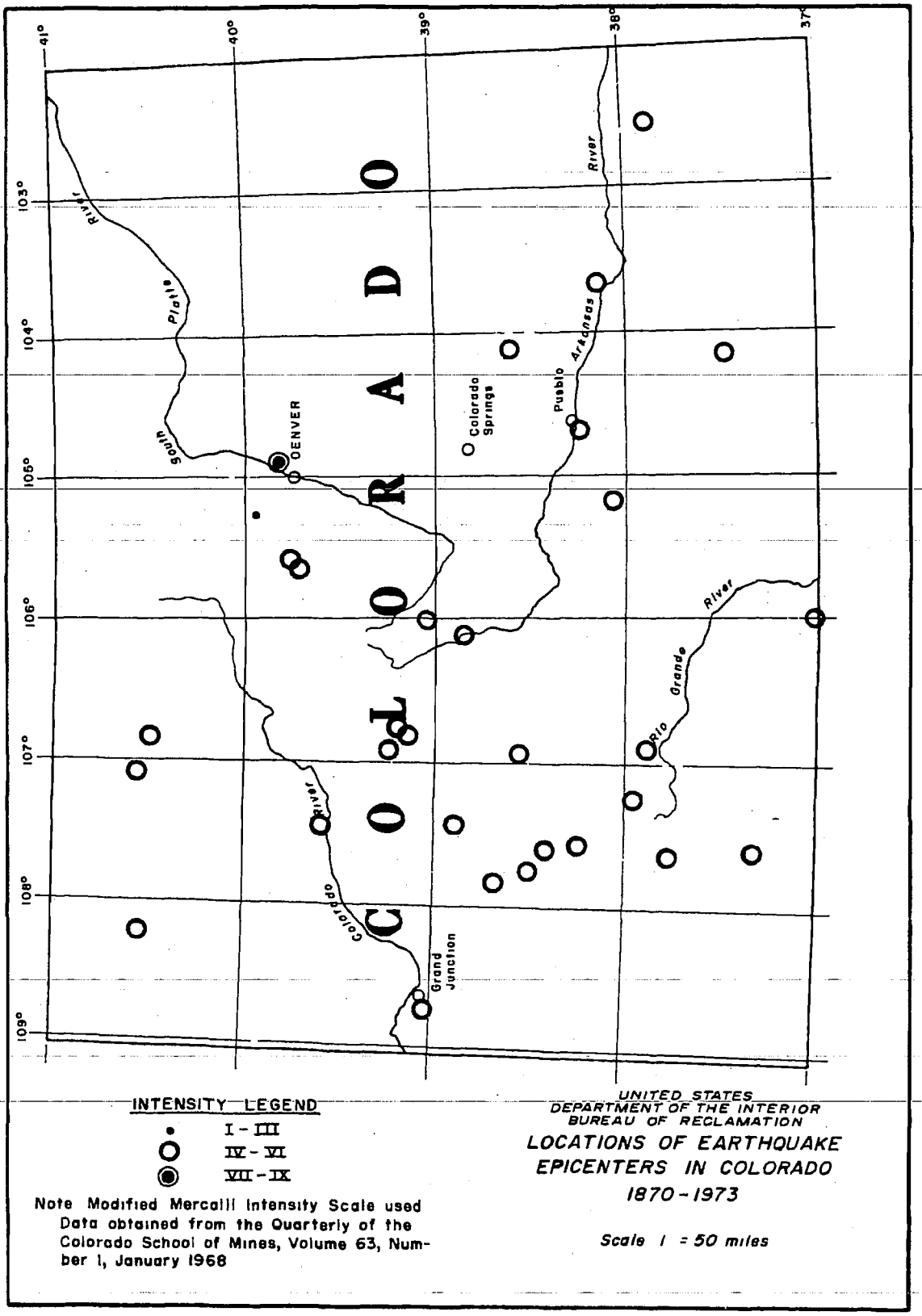

41°
40°
39°
38°
37°
103°
104°
105°
106°
107°
108°
109°
COLORADO
South Platte River
DENVER
Colorado Springs
Pueblo
Arkansas River
Rio Grande River
Colorado River
Grand Junction
INTENSITY LEGEND
I - III
IV - VI
VII - IX
Note Modified Mercalli Intensity Scale used
Data obtained from the Quarterly of the Colorado School of Mines, Volume 63, Number 1, January 1968
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
LOCATIONS OF EARTHQUAKE EPICENTERS IN COLORADO
1870 - 1973
Scale 1 = 50 miles

FIGURE III – 2

B Colorado River

The extent of influence that each alternative would have on the Colorado River depends on whether and how much Colorado River water would be depleted Only two alternatives (1) No Action (continued operations of the Colorado-Big Thompson Project), and (2) the Windy Gap Project would currently deplete water from the Colorado River Basin

Both alternatives are associated with river depletions as far downstream as Imperial Dam

The following section describes those elements of the river environment which would be affected by the Windy Gap Project The pre-Colorado-Big Thompson Project environment is not discussed The C-BT was constructed prior to NEPA, consequently a discussion of its impacts is not required

1 Hydrology

The C-BT and Windy Gap development areas involve the upper reaches of the Colorado River The major river system is shown in figure III-3, and its flows at key points are summarized in table III-2 The water sources for the C-BT and Windy Gap Projects are also illustrated in figure III-3

The nearest established stream gaging station to the Windy Gap diversion dam is at Hot Sulphur Springs about 7 miles downstream The Colorado River at Hot Sulphur Springs averaged 165,900 acre-feet annually during the period 1958-1977 Although the flows vary from year to year, the average volume is distributed monthly as shown in the following tabulation

Colorado River at Hot Sulphur Springs
Average Monthly Flows

Month	Acre-Feet
October	6,200
November	5,300
December	4,600
January	4,300
February	4,100
March	6,200
April	16,600
May	40,300
June	42,300
July	22,300
August	8,700
September	5,000
Total	165,900

TABLE III-2

Summary of Streamflows at Selected Points[1/]
(Rounded Figures)

Station	Drainage area (square mile)	(1958-1977) Annual runoff (acre-feet) Maximum	Average	Minimum	Range of daily discharge (ft^3/) Maximum	Minimum
Colorado River at Hot Sulpher Springs, Colorado	825	356,000	165,900	80,700	2,740	42
Colorado River at[2/] Kremmling, Colorado	2,383	1,210,000	687,200	412,100	6,210	250
Colorado River NR Dotsero, Colorado	4,394	2,317,000	1,415,900	808,600	15,500	460
Colorado River NR Cameo, Colorado	8,050	4,000,900	2,562,550	1,402,000	24,400	800

1/ Water Resources Data for Colorado (United States Geological Survey)

2/ Period of record used (1962-1970, 1972-1977)

Over 70 percent of the annual runoff occurs in the months of April, May, June, and July as a result of melting snow in the mountains The river runoff is not erratic although it may approach flood proportions in the spring and drop steadily until midsummer

2 Water Quality

The quality of water in the Colorado and Fraser Rivers upstream from the point of diversion and in the Colorado River near the diversion is shown in table III-3 Water quality at the three stations is excellent although the dissolved solids concentrations are somewhat higher in the Fraser River The water is also slightly more alkaline The water is of the calcium bicarbonate type Chemical analyses were performed on the water at 11 different stations in the upper Colorado River Basin (Dames and Moore, 1977a) These extended from the diversion to a point upstream from Hot Sulphur Springs The results of the analyses indicates that the water quality at all points is very good, showing little evidence of upstream contamination Bacterial levels were low as shown by total and fecal coliforms ranging from 12 to 100 and from 4 to 35 colonies per 100 ml respectively at the diversion point BOD_5 was also low with a range from 0 5 to 2 1 mg/l However, COD was somewhat higher than expected for the area, extending up to as much as 18 mg/l during July 1976

3 Aquatic Biota

Dames and Moore (1977a) in preparing the environmental assessment for the Windy Gap Project, electrofished the Colorado River and Willow Creek seasonally for a year The sampling yielded four species of each trout and suckers, longnose and speckled face, and the mottled sculpin Trout species included rainbow, brown, brook, and cutthroat, with the latter two species being restricted to the Colorado River Trout made up a maximum of 18 percent of the total fish sampled, but were usually between 10 and 15 percent of the total The Colorado River fishery was dominated by the longnose and bluehead suckers

The Willow Creek sampling indicated that considerable seasonal variability in community composition occurs in the stream At times, brown trout made up about 97 and 84 percent of the total at two stations During the summer this decreased with suckers increasing concurrently During the fall the percentage of brown trout was again observed to increase to former levels This fall increase was attributed to spawning movements of the brown trout The summer decline was attributed to loss of suitable habitat due to flow reduction because of diversions for irrigation The concurrent increase in suckers was apparently due to their spawning activities This was further indicated by the capture of ripe suckers in Willow Creek at the time

Concurrent with the fish sampling, Dames and Moore (1977a) sampled the macrobenthos of the Colorado River Table III-4 presents a

TABLE III-3

Water Quality Data of the Colorado and Fraser Rivers Near the Windy Gap Diversion (Source Dames and Moore, 1977a)

	Fraser River Near Granby for WY 1976 Mean (Min-Max)	Colorado River Upstream From the Fraser River Mean (Min-Max)	Colorado River at the Diversion WY 1976 Mean (Min-Max)
pH (S U)	(6 6-8 6)	(6 9-8 3)	(7 2-8 6)
Total Dissolved Solids (mg/l)	103 (76-125)	86 (64-110)	86 (64-120)
Total Hardness (mg/l as $CaCO_3$)	70 (32-92)	63 (40-76)	56 (40-68)
Total Phosphorus (mg/l)	0 12 (<0 1-0 3)	0 13 (<0 1-0 2)	0 12 (<0 1-0 2)
Total Nitrogen (mg/l)	1 4 (0 2-3 3)	0 95 (<0 3-1 6)	1 2 (0 2-2 7)
Bicarbonate (mg/l)	90 (49-110)	77 (49-92)	78 (55-110)
Chloride (mg/l)	3 9 (<1-20)	3 2 (<1 0-7 0)	1 7 (<1 0-4 3)
Sulfate (mg/l)	4 5 (4 0-10)	4 5 (4 0-10)	4 5 (4 0-10)
Calcium (mg/l)	21 (11-27)	18 (11-23)	17 (11-20)
Magnesium (mg/l)	4 7 (3 2-6 8)	4 5 (1 5-8 2)	3 1 (0 5-6 2)
Sodium (mg/l)	17 (7 0-26)	15 (6 0-20)	14 (7 0-25)
Nitrate (mg/l)	0 34 (<0 1-0 9)	0 5 (<0 1-1 4)	0 5 (<0 1-1 2)

TABLE III-4

Number of Taxa, Average Number and Standing Crop, and Associated Measures of Diversity of Benthic Macroinvertebrates Collected Seasonally at Each Station on the Colorado River During the Study Period (Source Dames and Moore, 1977a)

Location	Total Number (#/m^2) Fall 1975	Spring 1976	Summer 1976	Fall 1976	Standing Crop (mg/m^2) Fall 1975	Spring 1976	Summer 1976	Fall 1976
Colorado River Above Windy Gap	2891	4018	3974	5457	2157 3	6091 1	2207 8	3386 4
Colorado River Below Windy Gap	Not Sampled	2352	1948	3274	Not Sampled	7208 3	2215 3	3800 2

Location	Number of Taxa Fall 1975	Spring 1976	Summer 1976	Fall 1976	Diversity Index Fall 1975	Spring 1976	Summer 1976	Fall 1976
Colorado River Above Windy Gap	18	20	20	20	2 8	2 9	3 0	2 9
Colorado River Below Windy Gap	Not Sampled	20	18	20	Not Sampled	3 4	3 1	3 2

summary of the results of each sampling at two locations The two communities are representative of riffle areas in the Colorado River The two were similar with respect to numbers of taxa and diversity (Shannon-Wiener's $\bar{D}$) during all seasons The diversity indices are, in general, representative of an unpolluted environment However, the upstream station consistently exhibited a greater density, i e numbers per square meter, while the downstream station exhibited the greater biomass (standing crop), although the latter difference was not great In general, the trends with season are those to be expected when a community is dominated by organisms with an annual life cycle, i e maximum biomass with an intermediate number of individuals in the spring, low numbers and biomass in the summer, and maximum numbers with an intermediate biomass in the fall Respectively, these phenomena represent maximum growth of the immature insects after almost a year's predation on the community in the spring, emergence and reproduction in the summer, and a large number of early instar immature forms having had some growth by fall Seasonal patterns of density and biomass at the intermediate station on Willow Creek near the Bunte Highline Canal were similar to those of the Colorado River However, the downstream station exhibited a further downstream decline in the fall rather than the expected increase Several reasons were postulated for this phenomenon, with siltation from irrigation return flows being the most likely cause (Dames and Moore, 1977a) During 1975, the downstream station was apparently the more productive of the two, but was less productive in 1976 Again, siltation was the apparent cause, in that the turbidity levels were greater in 1976

The fauna at the sampling station immediately below the dam was dominated by organisms not found or uncommonly found at the other Willow Creek station and oligochaetes, both of which are common in lakes or pools, and caddisflies These latter feed on algae (Chu, 1949) These organisms would reflect the influence of Willow Creek Reservoir immediately upstream from the sampling site

4 Threatened and Endangered Species

Three endangered fish, the Colorado River squawfish (Ptychocheilus lucius), the humpback chub (Gila cypha) and the bonytail chub (Gila elagans) are known to occur in the Colorado River mainstem below Windy Gap These species could be affected by depletions from the Colorado River as a result of Windy Gap diversions

The Colorado River squawfish, humpback chub, and bonytail chub were once abundant throughout the Colorado River Basin The primary cause for the decline of these fish, and their subsequent listing as endangered species, is alteration and degradation of the river environment Major impoundments and water diversions have depleted water supplies, altered temperatures, turbidity, and stream flows, thus reducing habitat These habitat changes have resulted in environmental conditions more suitable to exotic species such as carp, channel catfish, striped bass and others The introduction and success of these exotics is also thought to be a factor in the decline in native species

Currently, the Colorado River squawfish is limited to the upper mainstem and major tributaries of the Colorado River system (figure III-4) The humpback chub occurs in limited areas within the system in Colorado, Utah, and Arizona (figure III-5) The bonytail chub may be the most endangered of the three fish The only records of the bonytail in the last several years are from the Green River in Utah and two lower basin reservoirs (Lake Havasu and Lake Mohave)

The Colorado River Fisheries Project, a joint Fish and Wildlife Service, Water and Power Resources Service, and Bureau of Land Management study of endangered Colorado River fishes, was begun in 1979 (Miller, 1980) As a result of this study, four locations have been identified in the mainstem Colorado River as important habitat areas for the squawfish or humpback chub The habitat areas are near Potash, Utah, in Blackrocks area of Ruby Canyon, West Water Canyon, and just west of De Beque in Colorado To date, no bonytails chubs have been taken from these areas Thus the probability of bonytails occurring in the area of potential project impact is low

The razorback sucker (Xyrauchen texanus) is listed as threatened by the Colorado Division of Wildlife This species has been collected by Miller (1980) in the mainstem Colorado between De Beque, Colorado, and Moab, Utah Although this fish is not currently protected as a federally listed species, the Fish and Wildlife Service is concerned about its status

The bald eagle (Haliaeetus leucocephalus) is a federally endangered species known to winter along the Colorado River January midwinter bald eagle counts, sponsored by the National Wildlife Federation, indicated there were 51, 65, and 64 bald eagles utilizing the mainstem Colorado River from the Utah border to its head waters and its main tributaries above Glenwood Springs in 1979, 1980, and 1981, respectively

Historical records of bald eagles nesting in Colorado are sparse Only five records are known between 1889 and 1974 (Torres et al , 1978) Increased efforts to inventory the species over the last few years by the Colorado Division of Wildlife and the Bureau of Land Management have resulted in the discovery of four nesting territories along the mainstem Colorado and Roaring Fork Rivers Although eagles have been observed at the nest sites, no young have been produced in the last 5 years (Nancy Green, BLM personal communication)

5 Aesthetics

The upper Colorado River winds its way southwestward from the Continental Divide through mountain meadows ringed by high peaks and forested hillsides The river flows through meadowlands used mostly for cattle ranching and hay production The river merges with the Fraser River near the town of Granby upstream from the proposed Windy Gap diversion Stream side vegetation becomes especially dense and broad at the damsite Between the confluence with the Fraser downstream to Troublesome Creek, the river is wide, shallow, clear, and the streambed is composed of small gravels and cobbles Cottonwood

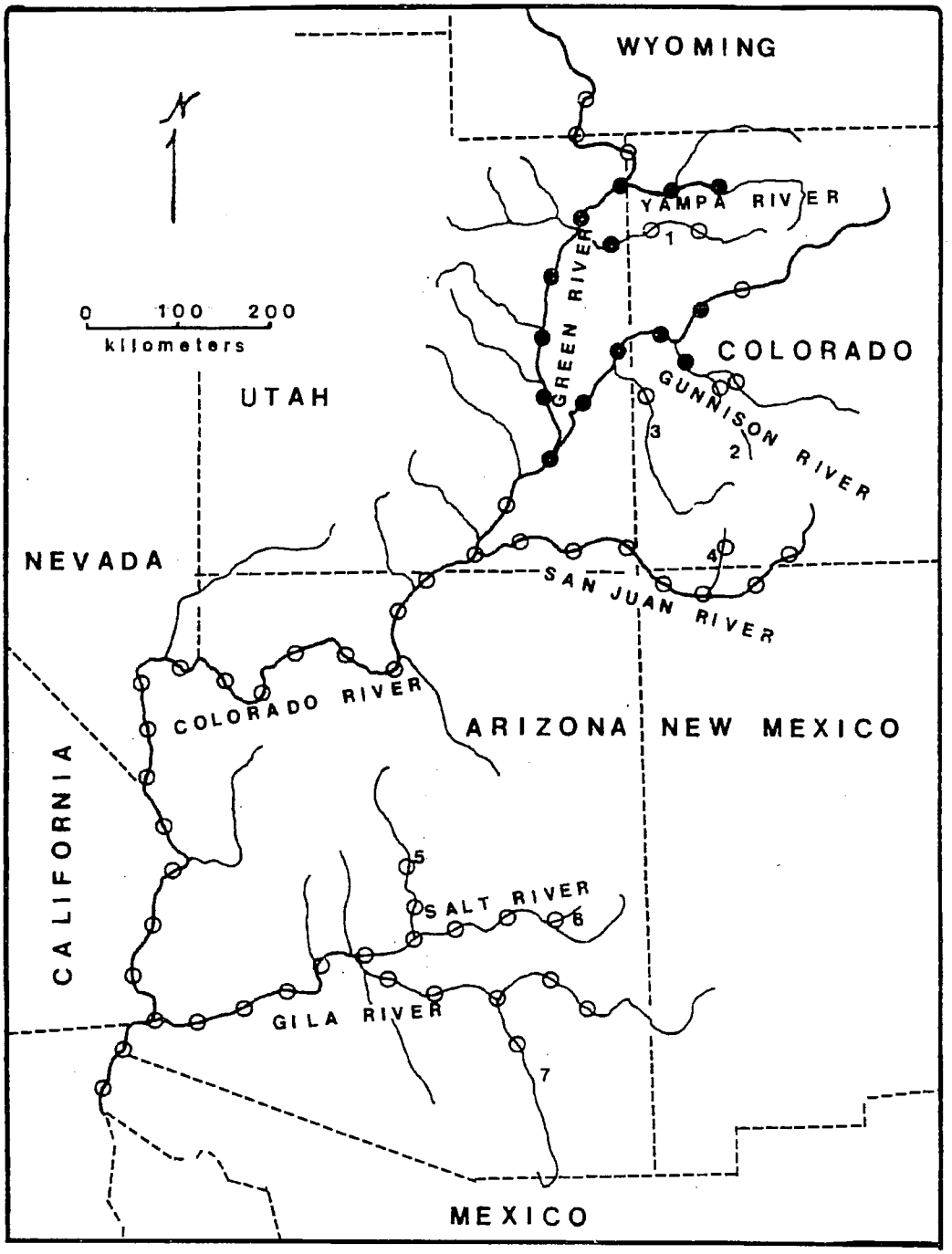


FIGURE III – 4 Historical (all circles) and present (solid circles only) distribution of the Colorado squawfish in the Colorado River basin The numbers refer to the following rivers 1) White River, 2) Uncompahgre River, 3) Dolores River, 4) Animas River, 5) Verde River, 6) White River, 7) San Pedro River (Colorado River Fishes Recovery Team, 1978)

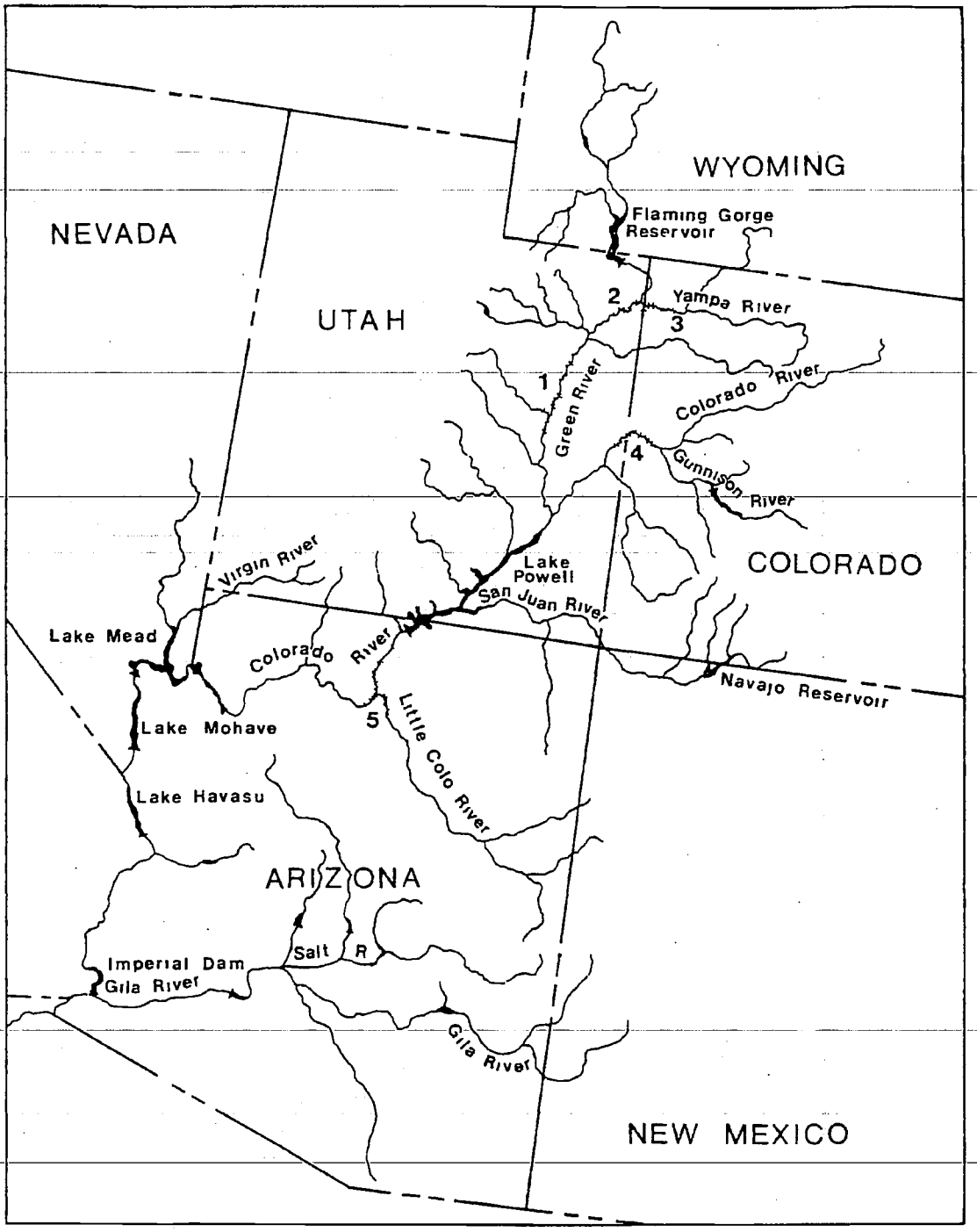


FIGURE III-5 Present distribution of the Humpback chub (Gila cypha) within the Colorado River drainage (Colorado River Fishes Recovery Team, 1979)

and willows form a narrow border along most of this reach As it flows westward, the stream meanders away from U S Highway 40 through privately owned ranchlands

Below Hot Sulphur Springs, high granite cliffs constrict the channel and form Byers Canyon Within the canyon stream velocities increase, riparian vegetation becomes sparse, and larger boulders are scattered along and in the river

As the river exits from Byers Canyon, it regains the characteristics it had before entering and retains these characteristics until it merges with the Troublesome The Troublesome's large sediment load clouds the water and blankets the river bottom This influence is felt down river to the confluence with the Blue River near Kremmling

The Continental Divide can be seen from many points along the river The higher peaks are usually laced with snow in the summer and render a sharp contrast to the green meadows, forested and exposed hillsides, and clear, blue sky

6 Recreation

The 120-mile stretch of the Colorado River between the proposed Windy Gap diversion and the town of Dotsero is popular for fishing and floating According to the Bureau of Land Management (BLM) the heaviest floating use occurs in the 17-mile stretch upstream from State Bridge (BLM personal communication, July 2, 1978)

Water from the Blue River augments the Colorado River flows in this popular floating stretch In 1976, BLM recorded nearly 40,000 visitor-days of use, and in 1977, nearly 35,000 visitor-days occurred There are 25 known commercial outfitters for floating the Colorado River below Gore Canyon

C Windy Gap Development and Service Area

1 Air Quality

The Rawhide Powerplant is the only proposal associated with the Windy Gap Project which has the potential to affect air quality The following briefly describes the air quality which could be affected by the powerplant A more detailed description is presented in PRPA (1978)

Stearns-Rogers (1978) has monitored air quality at the Rawhide Plant site since June 1978 Sulphur oxides (SO_x), nitrogen oxides (NO_x), total suspended particulates (TSP), sulfation rate, dustfall, and trace element content of the particulates have been monitored

The maximum recorded 3-hour concentration of SO_x during the first year (June 1977 - June 1978) was 3 44 ppb, which amounts to 0 7 percent of the National Ambient Air Quality Standard (NAAQS) for the SO_x and is 1 3 percent of the Colorado standard of 270 ppb The maximum 24-hour value was 0 74 ppb or 0 5 percent of the NAAQS of 140 ppb The average annual concentration of SO_x was 0 02 ppb, which is less than 0 1 percent of the annual NAAQS of 30 ppb

The annual NAAQS for NO_x is 50 ppb The average annual NO_x concentration at the Rawhide site was 9 5 ppb or 19 percent of the NAAQS

The NAAQS and State standard for TSP are not to be exceeded more than once per year Therefore, Stearns-Rogers (1978) used the second highest measured TSP concentration as the basis for comparison The second highest TSP concentration was 60 mg/m^3, which is well within the NAAQS of 260 mg/m^3 and the secondary and Colorado standard of 150 mg/m^3 It should be noted that the maximum observed TSP concentration of 105 mg/m^3 is also below all of the above standards

Then annual geometric mean TSP concentration during the year was 23 9 mg/m^3 This is 32 percent of the primary NAAQS of 75 mg/m^3 and 40 percent of the secondary NAAQS of 60 mg/m^3 The arithmetic mean TSP was 28 mg/m^3 or 62 percent of the Colorado annual standard of 45 mg/m^3 for non-designated areas of the State While none of the TSP concentrations violated any standards during the year, it would be expected that the NAAQS and the Colorado standard for 24-hour TSP may be violated at times during protracted dry spells due to fugitive dust emissions from unpaved roads, agricultural activity, and natural windblown dust from sparsely vegetated grasslands

In general, the air quality of the plant site is characteristic of a rural area with no significant local sources of pollutants Threshold concentrations of SO_x usually occur at night under inversion conditions, wherein the SO_x can be transported great distances in the stable layer with little chance for for dilution (Stearns-Rogers, 1978) Threshold NO_x concentrations were associated with southerly winds and it was concluded that the NO_x was automobile-related with the point of origin being the urban corridor between Fort Collins and Denver

2 Physiography and Geology

a Overview

There are three structural units in Middle Park (Tweto, 1957) where the Windy Gap development areas would be located (figure III-6) The western unit contains shales overridden by a major thrust fault The central unit has been up-warped and Precambrian rocks outcrop throughout a thin sedimentary layer The eastern unit, near the Windy Gap site, contains a thick sedimentary unit sharply overlapped against older rocks

Outcropping materials on and near the Windy Gap site include the Upper Cretaceous Pierre Shales, the Tertiary Middle Park Formation, including the Windy Gap volcanic member, the Troublesome Formation, with interbedded basalt, and Quaternary alluvial, terrace, and landslide deposits The Pierre Shale is composed mainly of gray to brown shale, siltstone, claystone, and sandstone The Pierre Shale is overlain by the Windy Gap volcanic member of the Middle Park Formation This member consists of andesite and trachyandesite The remainder of the Middle Park Formation consists of variegated siltstones, sandstones, and conglomerates

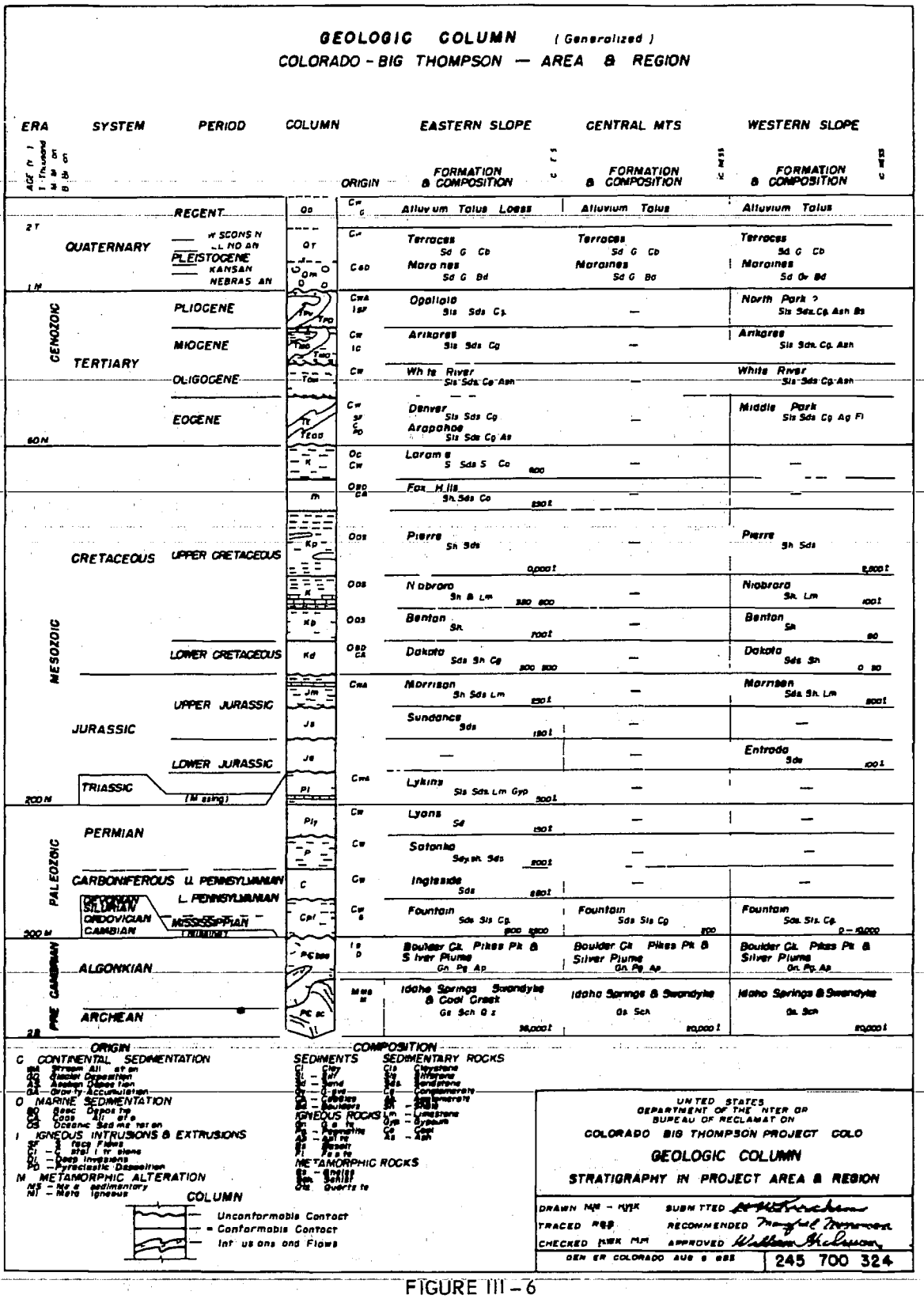
The Troublesome Formation overlies the Middle Park Formation and consists of sandstone, siltstone, and conglomerate with interbedded tuffaceous material The alluvial material consists of poorly sorted clay, silt, sand, and gravel derived mostly from the Troublesome Formation

Drilling at the proposed site of the Windy Gap diversion dam indicates that the bedrock unit is the Pierre Shale The shale is weakly foliated and is more accurately described as a claystone with sandstone interbeds This unit is overlain by up to 25 feet of river gravel deposits The proposed reservoir would be underlain by the previously described Middle Park Formation (Dames and Moore, 1977a)

Bedrock in the Rawhide Powerplant site is also of the Pierre Formation Resting on the Pierre Formation in much of the Rawhide site are Quaternary terrace and pediment gravel deposits consisting of coarse sand, gravels, pebbles, and boulders up to 2 feet in diameter A more detailed description of the geology at the Rawhide site is presented in PRPA (1978)

b Landslides

A minor geologic risk at the Windy Gap diversion site would be due to landslides Landslides were considered a threat to the originally proposed site of the Windy Gap Pumping Plant, but do not threaten the presently proposed site Similar landslide deposits occur along the route of the Windy Gap-Lake Granby pipeline, but are not considered to be a significant threat to any features of the Windy Gap Project (IECO, 1980)


GEOLOGIC COLUMN (Generalized)
COLORADO - BIG THOMPSON — AREA & REGION
ERA
SYSTEM
PERIOD
COLUMN
EASTERN SLOPE
CENTRAL MTS
WESTERN SLOPE
ORIGIN
FORMATION & COMPOSITION
CENOZOIC
MESOZOIC
PALEOZOIC
PRE CAMBRIAN
QUATERNARY
RECENT
PLEISTOCENE
TERTIARY
PLIOCENE
MIOCENE
OLIGOCENE
EOCENE
CRETACEOUS
UPPER CRETACEOUS
LOWER CRETACEOUS
JURASSIC
UPPER JURASSIC
LOWER JURASSIC
TRIASSIC
(Missing)
PERMIAN
CARBONIFEROUS
U. PENNSYLVANIAN
L. PENNSYLVANIAN
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
MISSISSIPPIAN
PRECAMBRIAN
ALGONKIAN
ARCHEAN
Alluvium Talus Loess
Terraces Sd G Cb
Moraines Sd G Bd
Ogallala Sls Sds Cg
Arikaree Sls Sds Cg
White River Sls Sds Cg Ash
Denver Sls Sds Cg
Arapahoe Sls Sds Cg Ag
Laramie S Sds S Co
Fox Hills Sh Sds Co
Pierre Sh Sds
Niobrara Sh & Lm
Benton Sh
Dakota Sds Sh Cg
Morrison Sh Sds Lm
Sundance Sds
Lykins Sls Sds Lm Gyp
Lyons Sd
Satanka Sdy sh Sds
Ingleside Sds
Fountain Sds Sls Cg
Boulder Ck. Plkes Pk & Silver Plume Gn Pg Ap
Idaho Springs Swandyke & Coal Creek Gs Sch Q z
Alluvium Talus
Terraces Sd G Cb
Moraines Sd G Bd
Fountain Sds Sls Cg
Boulder Ck. Plkes Pk & Silver Plume Gn Pg Ap
Idaho Springs & Swandyke Gs Sch
Alluvium Talus
Terraces Sd G Cb
Moraines Sd Gr Bd
North Park ? Sls Sds Cg Ash Bs
Arikaree Sls Sds Cg Ash
White River Sls Sds Cg Ash
Middle Park Sls Sds Cg Ag Fl
Pierre Sh Sds
Niobrara Sh Lm
Benton Sh
Dakota Sds Sh
Morrison Sds Sh Lm
Entrada Sds
Fountain Sds Sls Cg
Boulder Ck. Plkes Pk & Silver Plume Gn Pg Ap
Idaho Springs & Swandyke Gs Sch
ORIGIN
C CONTINENTAL SEDIMENTATION
O MARINE SEDIMENTATION
I IGNEOUS INTRUSIONS & EXTRUSIONS
M METAMORPHIC ALTERATION
COMPOSITION
SEDIMENTS
SEDIMENTARY ROCKS
IGNEOUS ROCKS
METAMORPHIC ROCKS
COLUMN
Unconformable Contact
= Conformable Contact
Intrusions and Flows
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO BIG THOMPSON PROJECT COLO
GEOLOGIC COLUMN
STRATIGRAPHY IN PROJECT AREA & REGION
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DENVER COLORADO AUG 8 1955
245 700 324

FIGURE III – 6

c Economic Geology

The project areas do not include significant metallic mineral deposits since they lie north of the Colorado mineral belt

Nonmetallic mineral production is significant In 1973, Larimer County ranked fourth in production of stone, and fifth in production of sand and gravel in the State Stone, lime, and gypsum are produced in the hogback areas Sand and gravel resources are extensive, particularly in the river valleys in the basins east and west of the Divide where there are extensive terraces and stream channel deposits

An important pegmatite mineral area in Colorado is located across the Big Thompson River Valley from the Alva B Adams Tunnel Although it has not been economically productive, it does constitute an important beryl reserve

No strippable coal resources are present in Larimer County There is one producing oil and gas field in the vicinity of the Rawhide Project area Pierre sandstones near Fort Collins are similar in characteristics to those in the Wattenberg Field, and might produce economic amounts of hydrocarbons at some future date The limited thickness and extent of the Pierre sandstones make the probability of a major discovery very unlikely, and the overall oil and gas potential of the area does not appear to be very large

Arkosic sandstone lenses in the Middle Park and overlying Troublesome Formations have been found to contain radioactive minerals in the vicinity of the Windy Gap development area The firm of Burton Hawkes announced in September 1976, that a potentially economic zone of uranium mineralization had been encountered in an oil well being drilled in T1S, R77W Further drilling and evaluation is planned The potential for locating economic uranium deposits in this area is considered good (Dames and Moore, 1977a)

Uranium is another potential resource also found in the vicinity of the Rawhide development area Recent exploration by several mining companies has proven the existence of low to moderate grade deposits The exact location and grade of these mineralized zones is proprietary information held by the exploration companies Although these resources are still under evaluation, it is anticipated that they will be mined in the future

3 Soils

Soil disturbance would be confined to the diversion dam and pipeline rights-of-way and areas in and around the Windy Gap site Classification of these affected soils and associated properties affected by the diversion dam and pipeline are tabulated in table III-5 The relationship of these soils to the diversion dam and pipeline is illustrated in figure III-7

TABLE III-6

Population Estimates[1/] and Density of Common Rodents Occurring on the Project Development Area

Species	Grid 1 Habitat Sagebrush	2 Conifer Forest	3 Riparian Woodland
Least Chipmunk			
Population estimate	5(1-13)[2/]	30(13-58)	16(9-25)
Density[3/]	2	15	--[3/]
Deer Mouse			
Population estimate	15(6-32)	10(2-31)	29(13-56)
Density	7	5	--
Western Jumping Mouse			
Population estimate	--	--	4(1-15)
Density	--	--	--

1/ Method of estimation after Schnabel (1938), value rounded to the nearest integer

2/ Range based upon 95 percent upper and lower confidence limits

3/ Density is based upon the number of individuals per one hectare Density was not computed for riparian woodland due to variation from the grid configuarion

Only six amphibians and seven reptiles have ranges which include the Windy Gap site (Stebbins, 1966 and Dames and Moore, 1977a) Of these, the boreal chorus frog, and western terrestrial garter snake were observed during the field study In general, these species were confined to riparian habitats, irrigated meadows, or areas immediately adjacent to permanent water

Composite lists of mammals, birds, amphibians, and reptiles of the Windy Gap site are available for inspection at the Lower Missouri Region Office in Denver

The Rawhide Powerplant site was also surveyed for mammals, (PRPA, 1978) the most abundant of which were silky pocket mouse, thirteen-lined ground squirrel, and deer mouse The swift fox was observed on numerous occasions Coyote, badger, and skunk signs were detected, but they are not believed to be numerous in the area White-tailed jackrabbits, cottontail rabbits, and black-tailed prairie dogs were also observed and do appear to be common in the project area The antelope is the only large game mammal of significance in the vicinity of the Rawhide site Larimer County overlaps two antelope management units (DOW, 1976), the combined 1976 annual harvest of which exceeded 250 animals Antelope, however, were not detected in large numbers

6 Recreation

Recreational use of the diversion dam and pipeline development area, exclusive of designated recreation areas, consists primarily of fishing and hunting Sport fishing in the development area is limited Although game fish are abundant, 98 percent of the land is private and no stocking is done by the Colorado Division of Wildlife Because of trespass restrictions, sport-fishing and hunting are generally limited to landowners and their invited guests

Recreational use of the Rawhide site is very limited The entire site and all lands adjacent to it are privately owned Public recreation resources exist south of the project area on Reservoirs 3 and 4 on Boxelder Reservoir 3 The reservoirs are stocked with fish by the State, and basic fisherman-use facilities are maintained Annual visitation for fishing is estimated at 12,500 fisherman-days for the three reservoirs (PRPA, 1978)

7 Threatened and Endangered Species

Wintering bald eagle use of the Windy Gap development area (the Colorado River from Granby Dam to Hot Sulphur Springs) was monitored by Water and Power biologists in conjunction with a program to evaluate endangered species use of Lower Missouri Region lands The results of these studies (table III-7) indicate that bald eagles use of the Colorado River below Lake Granby and at the Windy Gap diversion dam site has been low and sporadic

TABLE III-7

Bald Eagle Observations in the Windy Gap and West Slope C-BT Development Areas[1/] (Adults/Immatures)

Date	Shadow Mountain Reservoir	Lake Granby	Colorado River[2/] Between Reservoirs	Colorado River Granby Dam to Granby	Colorado River Granby to Hot Sulphur	Windy[3/] Gap
11/28/78	--	1/0	1/1	--	--	--
11/29/78	--	--	--	--	--	1/0
12/08/78	--	3/1	1/0	--	--	--
12/15/78	4/1	--	--	--	--	--
01/08/79	--	0/2	1/0	--	--	--
02/04/79	3/0	0/1	3/0	--	--	--
02/16/79	--	--	--	--	0/1	--
02/19/79	1/0	--	3/0	--	--	--
03/08/79	3/2	1/0	3/1	--	--	--
03/17/79	2/2	--	2/2	--	--	--
04/09/79	--	0/1	0/2	--	--	--
04/29/79	0/1	--	--	--	--	--
10/25/79	2/0	--	--	--	--	--
11/02/79	0/1	1/1	--	--	--	1/0
11/08/79	--	--	--	--	1/0	--
11/22/79	--	--	--	--	--	1/0
12/05/79	1/1	--	--	--	--	--
12/14/79	2/1	3/2	1/0	--	--	--
12/26/79	1/0	--	2/0	--	--	--
01/02/80	2/0	--	1/0	--	--	--
02/10/80	1/0	1/0	--	--	--	--
02/17/80	--	--	--	--	1/0	--
03/27/80	1/0	1/0	--	--	--	--
04/06/80	--	--	--	--	0/1	--
04/13/80	1/0	0/1	--	--	--	--
11/15/80	--	--	--	--	--	1/0
11/28/80	--	3/0	4/2	--	--	--
12/05/80	--	--	3/2	2/0	--	--
12/27/80	--	4/2	--	1/1	--	1/0
01/09/81	2/0	3/1	--	--	--	--
01/21/81	1/0	1/0	0/1	--	--	--
02/03/81	1/0	1/0	0/1	--	--	--

1/ Observations from Water and Power Resources aerial and ground surveys of the project area
2/ Colorado River between Shadow Mountain Reservoir and Lake Granby
3/ Colorado River at Windy Gap diversion dam

The American peregrine falcon (Falco peregrinus anatum) is a federally endangered species known to breed in Colorado The Colorado Division of Wildlife has identified essential habitat for this species (Torres, et al , 1978) No essential habitat is located in the vicinity of the Windy Gap development area Potential nesting habitat south and east of the Windy Gap development area was identified (Fisher, 1979, Fisher and Howell, 1979) and rated as low quality due to disturbance factors present in the area Although this bird may fly through the Windy Gap development area, no recent sightings have been reported Patsy Goodman, Colorado Division of Wildlife (personal communication)

The Arctic peregrine falcon (Falco peregrinus tundrius), a federally endangered species, is a rare migrant in Colorado Its occurrence in the Windy Gap development area is unlikely

The river otter (Lutra canadensis) is a State endangered species that once occurred in essentially all the major drainages in Colorado (Torres, et al , 1978) The otter was extirpated within Colorado, but has been reintroduced by the Colorado Division of Wildlife Early introductions were in the South Platte and Gunnison River drainages Seven otters were released in 1978, and three were released in 1980 in the Kawaneeche Valley above Grand Lake The Division of Wildlife is currently monitoring the success of these introductions Otters have been observed in the Windy Gap development area, however, no sightings have yet been reported at the site of the Windy Gap diversion dam (Stevens, 1980)

The Colorado River cutthroat trout (Salmo clarki pleuriticus) is a State threatened species that historically inhabited the Colorado River in the Windy Gap development area (Torres et al , 1978) The species are no longer present in the waters of the project area (Behnke, 1976)

The Osterhout milkvetch (Astragalus osterhoutii) is a plant species that has been recommended for listing as a federally endangered species The plant has a limited distribution and is known to occur in western Grand County A survey of the Windy Gap development area indicated the species is not present (Erickson, 1980)

The Windy Gap Service Area consists of the municipalties of Boulder, Estes Park, Longmont, Greeley, and Loveland No suitable habitat for endangered species are known to occur in these cities

8 Aesthetics

The mountain meadows and neighboring forest borders of the Middle Park Colorado River Valley exemplify the unique physical attractiveness of Colorado's Western Slope According to a recent carrying capacity study by Colorado State University and interpretations by Engineering Science, Inc , most of the Windy Gap development area could be characterized as having high visual aesthetic character

To other observers the dominance of the Grand County landfill, U S Highway 40, and Rio Grande Railroad Corridor tends to diminish aesthetics associated with the natural state of the environment

The dense forests buffer noises from nodal points of construction activity, and railroad trains which pass through the town of Granby about 5 miles from Lake Granby On the reservoirs, one can hear motorboats and their waves wash against the shoreline banks

During winter, the area is cloaked in deep snow which contrasts sharply with the green conifers and frequent blue skies

9 Cultural Resources

The project area elevation ranges between 2384 meters (7820 feet) and 2548 meters (8360 feet) MSL The area contains a gently rolling, prairie-type environment with sagebrush and grasses being the dominant vegetation Pine forest mixed with grasses occur in the northwest section Expected native American occupation at these elevations would have been seasonal and relatively short-term in nature Activities would have centered around hunting/gathering (for foodstuff and nonorganic raw materials), but would have included religion-related activities (vision quests), group migrations, and trade Expected Euro-American activities in this area would have included trapping, mining, ranching, lumbering, and tourism

Affected project lands have been studied in terms of native American (archeological) and Euro-American (historical) occupational history and paleontological (fossil) evidence

Archeologists currently divide the archeological data from this part of the country into four distinct time periods These periods represent change through time in the adaptive responses to the environment as intepreted from the physical evidence left on or in the ground The dates assigned to these periods do not represent sudden cultural changes, but rather approximate times when one lifestyle began to be dominant over another These four periods are outlined in table III-8, for a more extensive discussion of archeological history and other specific cultural research from the project area, see Burney et al , (1979)

Four cultural resource surveys have been conducted on the lands to be affected by the Windy Gap Project The first survey was conducted by Lischka (1976) He investigated the general corridor of the pipeline, however, the actual alinement was not surveyed Lischka's reconnaissance followed the 8200 foot contour Thirteen archeological sites and six isolated finds were located during the survey Chipped stone artifacts were the only cultural materials observed Eleven of the sites are associated with quarrying activities, while activities from two sites could not be defined The second survey was completed by Huse in 1977 (Huse, 1977) She performed a class III archeological survey on the proposed route of the pipeline, the dam, reservoir, and pumphouse areas Thirteen sites were recorded

TABLE III-8
Archeological Periods

Periods	Time Range	Description	Evidence in Middle Park
Paleo - Indians	13000 B C to 5000 B C	Primary dependence upon large game animals (some now extinct) - use of large projectile points attached to spears - nomadic lifestyle	Very little - see Fitting (1978)
Archaic	5500 B C to A D 200	Gradual change in types of food procurred Dependence upon large game decreases (probably due to climatic changes) Increase in use of small game animals and plant foods Introduction of smaller projectile points (probably for atlatl-a spear-throwing device) - stone circles appear-grinding stones for crushing plant fiber and grain appear Period is divided into three sub-periods Early - (5000 B C - 3000 B C) Middle - (3000 B C - 1000 B C) Late - (1000 B C - A D 500) Lifestyle is still nomadic, but plant and animal resources both determine seasonal location of groups	Minimum amount of direct evidence That which exists, indicates occupation during the early and late periods
Late Prehistoric	A D 500 to A D 1800	Groups are still nomadic seasonal occupants of mountain areas Pottery appears as do small projectile points (thought to indicate the use of the bow and arrow) The horse and gun appear toward the end of this period, causing a great amount of culture change	Direct evidence of late prehistoric occupation - Fitting (1978)
Historic (Aboriginal Activities after contact with Euro-Americans	A D 1800 to A D 1900	Continuation of activities during late prehistoric with adoption of Euro American technology Eventual physical break-up of many groups caused by disease, warfare, and relocation Some attempts (mostly unsuccessful) at assimilataion to or assimilation by Euro-American culture	Direct historical reports of summer use of Middle Park for procurement of food resources by Ute, Cheyenne, and Arapahoe Indians Dispite this, only one physical site (Granby Ute Fort) can be attributed to these native Americans

One site 5GA118, was previously recorded by Lischka (1976) All of the sites appear to be associated with prehistoric quarrying activities

In 1978, test excavations and site evaluations were conducted by Western Cultural Resource Management, Inc , (WCRM) (Burney, et al , 1978) Test excavations were conducted at nine sites previously recorded by Lischka and Huse In addition, WCRM completd a survey of new disturbance areas From the results of this survey, six new sites were identified and the site boundaries of three known sites were redefined

The fourth survey was also conducted by Western Cultural Resource Management, Inc , (Ayers, 1981) It was a resurvey of a portion of the pipeline where a Forest Service archeologist had located a site not previously inventoried This survey resulted in the identification of two additional archeological sites

In addition to the four surveys discussed above, a fifth survey is planned for the spring of 1981 This survey will investigate project lands which have been added to the overall project design within the past half year These include 20,190 feet of access road and 5,555 feet of surge tank and blow off valve right-of-way

A literature search (class I survey) conducted prior to completion of the four surveys revealed no cultural resources on or eligible for the National Register of Historic Places

Results of Surveys

The four surveys resulted in the identification of three different types of prehistoric sites (1) Quarry sites, (2) camp sites, and (3) lithic scatters In addition, isoloated finds were identified, but they are not discussed in this document

For the purpose of this FES, a quarry site is defined as an area where raw material (rock) was acquired for the purpose of manufacturing stone tools This includes areas where raw material was extracted by excavation and areas where nodules of raw material are exposed on the ground surface Core reduction (the preparation of the rock for making tools) was the primary activity associated with quarry sites Artifacts found include a relatively high percentage of cores and primary flakes (products of initial core reductions) and a low percentage of tools

Campsites are defined as "Living" areas or places of occupation having some degree of permanence Activities associated with campsites would include tool production and maintenance, food preparation, and shelter construction The remains of housing structures and fire hearths may be present Artifact types would include a relatively high percentages of tools representing many different categories (i e cutting, scraping, piercing, etc) and a lower percentages of primary flakes Most stone debitage would

consist of interior flakes (produced during secondary core reduction and tool maintenance) Cores would be present, sometimes in large quantities, although many would no longer have production potential

Lithic scatters are sites of short term occupation Usually these sites are smaller in size and artifact density than camp sites and contain fewer numbers of tool categories They represent a single activity or a limited range of activities

The sites located by the four surveys are listed below by site number and type

SITE NO	TYPE
5GA118	Lithic Scatter
5GA119	Quarry
5GA120	Lithic Scatter
5GA121	Quarry
5GA122	Quarry
5GA123	Lithic Scatter
5GA124	Lithic Scatter
5GA125	Lithic Scatter
5GA126	Lithic Scatter
5GA127	Lithic Scatter
5GA128	Lithic Scatter
5GA129	Lithic Scatter
5GA130	Lithic Scatter
5GA149	Camp
5GA150	Lithic Scatter
5GA151	Quarry
5GA152	Lithic Scatter
5GA153	Quarry
5GA154	Lithic Scatter
5GA155	Lithic Scatter
5GA156	Lithic Scatter
5GA157	Camp
5GA158	Lithic Scatter
5GA159	Camp
5GA160	Camp
5GA238	Lithic Scatter
5GA239	Lithic Scatter
5GA240	Lithic Scatter
5GA241	Lithic Scatter
5GA243	Lithic Scatter
5GA245	Lithic Scatter
5GA666	Lithic Scatter
5GA668	Lithic Scatter

Nine of the sites found in the course of the first two surveys (Lischka, 1976 and Huse, 1977) were subjected to further investigation by Western Cultural Resource Management, Inc This investigation consisted of a random sample surface collection and subsurface testing These nine sites are listed below

SITE NO	TYPE
5GA118	Lithic Scatter
5GA149	Camp
5GA151	Quarry
5GA153	Quarry
5GA155	Lithic Scatter
5GA156	Lithic Scatter
5GA157	Camp
5GA159	Camp
5GA160	Camp

In addition, further investigation at three sites located during the third survey have been recommended by WCRM This further testing is conditional upon whether or not specific features of the Windy Gap Project will be built This point is discussed in chapter IV - Mitigation

Evidence of historical occupation is evident although no distinct historical sites were found Historical material consisted of trash deposits and isolated scatters located throughout the survey area

A paleontological survey was completed in 1977 as part of Huse's survey (Huse, 1977) Paleontological resources were not observed within the proposed project area, however, it is highly probable that subsurface fossil bearing deposits are present within the Paleocene Age, Middle Park Formation, and the Miocene Age, Troublesome Formation Fossil mammals have been reported from nearby exposures of the Troublesome Formation (Huse, 1977)

An archeological survey of the entire Rawhide site was conducted by Dr Bruce Lutz and a crew from the University of Northern Colorado The survey was conducted in the summer of 1977 and a total of eighteen archeological sites were located Most of these sites consisted of light lithic scatters without diagnostic artifacts

In July of 1978, all of the potential archeological sites identified during the previous summer that would be directly affected by project construction, were test excavated Nothing was found that merited further excavation The other two sites (5LR526 and 5LR525) may be significant The first is on extensive woodland site and the second has yielded some paleo - Indian materials Neither was test excavated

A paleontological survey of the Rawhide site was conducted in the summer 1977 by Dr K Lee Shropshire and R Kumbe Sadler of the University of Northern Colorado They planned to conduct site testing (limited exploratory excavations) if indications of important

buried paleontological materials were encountered during the site survey However, no such indications were found, so no such site testing was conducted Of the fossils found none are unusual or especially significant geologically All occur commonly in northeastern Colorado

10 Land Use

Discussed in chapter III D 12 of this document

11 Socio-economics

a Development Area (Diversion Dam and Pipeline)

(1) Population

The population of Grand County is currently estimated to be between 7,672 and 7,822, and has exhibited an average annual growth rate between 17 and 18 percent for the past 5 years This growth contrasts strikingly with the stable population between 1940 and 1960 (Dames and Moore, 1977a) The official figures on county population are understated due to the large number of visitors in the area throughout the year Seasonal residents have a significant social and economic impact on the county In 1970, it was estimated that temporary residents numbered slightly more than twice the permanent resident population (Grand County Comprehensive Plan)

Grand County population forecasts come from two different sources These are the 1970 Grand County Comprehensive Plan and the State Division of Planning (Dames and Moore, 1977a) It is assumed that Grand County will continue to experience significant tourist activity during the summer and winter recreational seasons

(2) Economic Base

The economic base of Grand County is sustained mainly by recreation, agriculture, and forestry (Dames and Moore, 1977a) Employment estimates for 1974 show a decline in the proportion of county employment attributable to agriculture, nevertheless, the rate is higher for Grand County (8 percent) than the comparable rate for the State (5 percent) The strong seasonal pattern of retail sales is indicative of significant tourist industry, with highest figures recorded during the summer months The four sectors of manufacturing, transportation/communications/public utilities, retail trade, and services reveal the highest receipts in the county Grand County retail sales amounted to 0 23 percent of the State total in 1975, and 0 22 percent in 1974

(3) Employment and Income Trends

Employment in the county is seasonal in nature due to increased activity in both agriculture and recreation during the summer months Per capita income in Grand County is generally lower than the State average, and has increased at a slower pace than that of the State or the Nation In 1969, Grand County per capita income was 81 percent of the State and 77 percent of the National averages respectively By 1973, it had declined to 62 percent of the National average

Unemployment in Grand County is generally lower than that of other parts of the State (Dames and Moore, 1977a)

The agriculture industry in Grand County produces mainly oats and hay In 1973, the county produced 1 9 percent of Colorado's hay, and 0 33 percent of the total crops in the State In 1974, Grand County's agricultural production was 0 2 percent of the State total

Mining operations in Grand County consist of sand and gravel recovery

(4) Tax Base

The county tax base is dominated by commercial activity (Dames and Moore, 1977a)

(5) Land Ownership

A large proportion of Grand County is covered by Rocky Mountain National Park, and Arapaho and Routt National Forests, approximately 69 percent of the county is federally owned Twenty-nine percent of Grand County is farmland, most of which is privately owned Approximately 2 percent of Grand County is developed as urbanized areas or subdivisions under development

(6) Housing

In 1976, the estimated number of housing starts for Grand County was 318 compared to 100 in 1969 These were composed of 160 single units, 4 duplexes, and 154 multiple units As of January 1977, the year-round housing inventory in Grand County was estimated 4,890, of which 790 were mobile homes This figure has more than doubled the 2,301 housing units in April 1970 In 1977, owner-occupied units totaled 4,805, while 875 were rental units

As of January 1977, there were only 11 low-to-moderate priced, federally subsidized housing units constructed in Grand County (Colorado Division of Housing, March 1978) Housing is scarce and quite expensive because of the popularity and desirability of living near Grand Lake, Granby, and Shadow Mountain Reservoirs

(7) Education

There are two school districts in Grand County East Grand (two elementary and 1 junior-senior high) and West Grand (one elementary and 1 junior-senior high) Total fall 1977 enrollment was 1,368 with 796 pupils in elementary schools and a secondary school enrollment of 572 The pupil/teacher ratio for the West Grand School District is 12 9 1, and East Grand 17 9 1 (Colorado Department of Education, Statistics, August 1978)

b Service Area

A brief description of the Windy Gap Service Area is included in chapter III D 12 A more detailed description is included in Dames and Moore (1977a) Socio-economics associated with the Rawhide Powerplant are discussed in PRPA (1978)

D Colorado-Big Thompson Development and Service Areas

1 Physiography and Geology

a Overview

The C-BT Project area includes a wide spectrum of rock types, structures, and land forms

Rock types include an assemblage of metamorphic schists, gneisses, and igneous granites in the central Front Range Sandstones, shales, and limestone occur as hogbacks on both sides of the central uplift Sandstones, shales, and conglomerates occur in the basins east and west of the hogbacks Volcanics, moraines, sediments and alluvium, and surficial and alluvial deposits occur on the eastern plains This geologic progression is shown on figure III-6, Geologic Column

The Front Range is a deeply eroded, broad anticlinal fold formed during the Eocene period The fold is characterized by overturned and thrust faults on the west, and bordered by shear faults on the east The shear faults generally trend northwest The thrust faults on the west trend more northerly and are more pronounced and complex

b Slides and Shoreline Stability

(1) Slides

Three existing landslide areas are present in the C-BT development area where project features have been constructed

Large landslide areas are present in the hogback area of the North Poudre Supply Canal in the vicinity of Tunnel No 4 These are caused by complex geologic structures The tunnel was located to avoid these landslides

Existing landslide areas adjoin Green Mountain Reservoir, one on the north side and two on the south Both are in overburden materials On the south side, old landslide masses are composed of glacial drift overlying the bedrock The drift is composed of rocks of varying sizes from angular to round and soil of varying clay consistencies When saturated, the clay makes the mass unstable The dip of the underlying bedrock is in the direction of the slides and may provide a continuous slide plane Irrigation at the top of the slide apparently provides moisture which aggravates movement

On the north side, a landslide mass on the southeast face of Green Mountain is composed to two types of material The eastern half of the slide is composed of talus fragments The west half is almost entirely in shale The slide has moved to the south, in the opposite direction from the dip

of the underlying bedrock It is about 1/4-mile-long and extends back several hundred feet from the road with a vertical height of about 200 feet

(2) Shoreline Stability

The shorelines of many of the C-BT Project reservoirs are composed of sedimentary sequences, primarily shales, which are easily erodable Wave erosion can cut banks in previously stable slopes, which are then susceptible to slumping with fluctuations in water levels of the reservoirs Where bedding planes slope downward into the reservoir, susceptibility to slumping is further increased In addition, some of the shales may slake and slump upon drying during drawdown periods Resevoirs with such banks include Horsetooth, Carter Lake, Flatiron, Granby, and Willow Creek

2 Hydrology

The hydrology associated with operations of the C-BT is described in chapter II, B 1 and chapter III, B 1 of this document

3 Water Quality

a Surface Water

The C-BT and Windy Gap Project areas encompass the Colorado River and its headwater tributaries on the West Slope of the Continental Divide, and the South Platte River and its mainstem tributaries on the East Slope In general, the quality of water at the point of diversion is excellent It remains so at its terminal storage points (Horsetooth and Carter Reservoirs) on the East Slope However, the C-BT water is subsequently used and reused throughout the South Platte Basin, as are native flows of the South Platte River Consequently, it is continually degraded as it flows downstream to the Colorado-Nebraska State line

Water bodies on the West Slope include Willow Creek Reservoir and Willow Creek, Lake Granby, Shadow Mountain Reservoir, Grand Lake on the Colorado River, and Green Mountain Reservoir on the Blue River Nelson (1971) conducted limnological studies of all project lakes and reservoirs except Willow Creek Reservoir As can be seen in table III-9, the waters are relatively pure with salinity at very low levels Dissolved solids at Green Mountain Reservoir are somewhat higher than the other bodies of water, reflecting the greatest degree of upstream development Table III-9 also indicates that the water is relatively alkaline, especially at Granby However, recent data collected by the Geological Survey indicate that the water tends to become somewhat acidic during the summer (table III-10)

There has been concern on the part of a number of individuals and agencies over the possible eutrophication of the three lakes

TABLE III-9

Chemical Characteristics of Reservoirs and Lakes in the Colorado-Big Thompson Project, 1962-1966 (From Nelson, 1971)

Reservoir or Lake	Date	pH min -max 0-10 m	Total alkalinity mg/1 0 0- 2 m	Total solids mg/1 0-1 m	Dissolved Oxygen mg/1 0 m	mid-depth	max depth	(m)
Green Mountain	7-26-62	7 7	35	--	7 5	7 5	7 2	(40)
	8-01-63	7 8	50	104	7 3	6 3	5 9	(39)
Granby	7-25-62	7 8	20	--	7 8	6 5	5 8	(30)
	7-31-63	7 7	24	44	7 3	4 7	4 3	(41)
	7-28-64	7 6-9 0	24	70	7 6	3 4	3 0	(40)
	7-30-65	7 0-7 9	23	34	6 7	4 7	3 9	(48)
	9-07-66	7 3-7 4	30	34	6 6	2 9	3 1	(29)
Shadow Mountain	7-30-63	7 8	23	45	8 0	---	6 1	(7)
	7-29-64	7 2-7 4	17	39	7 0	---	5 1	(6)
	7-29-65	7 0-7 2	9	18	7 2	6 6	7 0	(5)
	9-07-66	7 3-7 4	26	32	6 2	---	4 8	(6)
Grand Lake	7-30-63	7 7	18	35	8 2	7 1	4 1	(73)
	7-29-64	7 2-7 6	14	33	7 6	6 4	4 4	(73)
	7-29-65	7 0-7 2	6	10	8 0	6 8	3 9	(73)
	9-08-66	7 2-7 5	23	25	7 1	5 6	---	----

TABLE III-10

Water Quality of the Three Lakes During 1975
(USGS, 1975)[1/]

	Grand Lake		Shadow Mountain		Lake Granby	
	Jan	June	Jan	June	Jan	June
	6 9	5 2	6 7	5 6	7 0	5 7
Ammonia (mg/l-N)	0 01	0 00	0 00	0 01	0 04	0 01
Total Nitrogen (mg/l)	0 27	3 5	0 30	3 7	0 40	3 8
Total Phosphorus (mg/l)	0 02	0 01	0 01	0 01	0 02	0 01
Secchi Disk (in)	---	78	---	59	---	78
Dissolved Oxygen (mg/l)	7 2	8 0	8 0	8 6	10 4	8 6

[1/] All samples taken at a depth of 2 feet

system As can be seen in table III-9, there is some oxygen depletion in the deeper water of the lakes Following initial filling of the reservoirs and during the early years of operation, algal blooms were a common occurrence, however, these have abated As a result of these concerns, several studies of the three lakes systems have been conducted These are outlined and summarized in Nelson, Haley, Patterson, and Quirk (1977) and EPA (1978) Although conflicting conclusions have been drawn with respect to the trophic status of the lakes, it seems that the recent concensus is that they are oligotrophic to mesotrophic

Shadow Mountain Reservoir also experiences heavy growths of Elodea canadensis during the summer, particularly in the littoral zone The cause of these is unknown

The quality of water at some of the East Slope facilities of the project is shown in table III-11 The data for the Big Thompson River at Estes Park reflect the quality of the outflow from Lake Estes Carter Lake and Horsetooth Reservoir are the project's terminal storage reservoirs and indicate the quality of water entering the distribution system

Dissolved solids concentrations at the East Slope facilities remain quite low (table III-11) Nutrient levels are still somewhat low in the upper Big Thompson River, although not as low as those previously shown for the West Slope reservoirs Nutrient levels in the two terminal reservoirs, however, are greater than in the tributary river, this is especially true of the total phosphorus concentrations There is also an indication of some oxygen depletion in the reservoirs Although the oxygen depletion is not severe, the oxygen minima fall below the State standards for coldwater fisheries, i e 6 mg/1 Both resevoirs support two-story fisheries, and are also used for primary contact recreation Bacterial levels are well within the State standards for such use The water quality of the surface waters in the C-BT Service Area is shown in table III-12

b Ground Water

One of the major ground-water sources in the basin is from the alluvial aquifer of the South Platte River Prior to the development of the extensive irrigation network on the river flood plain and terraces, there was little ground water available At that time, the South Platte River was a losing stream (Bluestein and Hendricks, 1975) Over the years the water table has been raised to the point that it is now a gaining stream There has been such a large amount of ground-water development in recent years, however, that the trend is beginning to reverse itself The ground water in the alluvial aquifer is, for the most part, harder and more mineralized than the surface water Total dissolved solids concentrations ranged between 450 to 4,060 mg/1 during 1965 (USGS, 1965) Values for hardness ranged up to 1950 mg/1 of total hardness Major constituents in the ground water include calcium,

TABLE III-11

Means (Minima-Maxima) for Various Water Quality Parameters at East Slope Facilities of the C-BT
(Source USGS, 1975 and 1976)

Station-Water Year	pH (S U)	Nitrate plus Nitrite (µg/l)	Ammonia (µg/l)	Total Phosphorus (µg/l)	Dissolved Oxygen (mg/1)	Total Dissolved Solids (mg/1)	Immediate Coliform Bacteria (#/100ml)	Fecal Coliform Bacteria (#/100ml)
Big Thompson River at Estes Park - WY 1974	-- (6 9-7 9)	140 (30-390)	55 (20-120)	54 (10-140)	8 6 (7 4-10 8)	<35[1] --	52 (0-245)	3 (0-9)
WY 1975	-- (6 3-7 9)	140 (80-200)	35 (0-70)	35 (20-50)	8 6 (6 8-9 8)	37 (35-40)	62 (<1-320)	6 (<1-41)
Carter Lake - WY 1974	-- (6 5-7 5)	32 (10-60)	79 (30-200)	279 (10-840)	8 3 (4 5-11 8)	48 (41-56)	26 (0-400)	11 (0-2)
WY 1975	--	60	36	129	8 9	50	ı2	<1[2]
Horsetooth Reservoir - WY 1974	-- (6 3-7 3)	86 (70-130)	76 (40-150)	182 (20-640)	7 9 (4 8-10 6)	43 (37-50)	16 (<1-125)	<1 (</-1)
WY 1975	-- (5 8-7 7)	104 (50-140)	24 (<10-70)	120 (<10-610)	8 4 (5 0-10 4)	50 (46-54)	28 (<1-200)	</1 (<1-2)

1/ All values reported as <35
2/ All values reported as <1

TABLE III-12

Water Quality of Streams in the Project Service Area - Means
(Minima-Maxima)

Stream	St Vrain Creek near Platteville (1971-75)	South Platte River at Henderson (1971-73)	Big Thompson River near La Salle (1971-75)	Cache La Poudre River at Greeley (1971-75)	South Platte River at Julesburg (1971-75)
pH (S U)	--- (6 9-8 4)	--- (6 9-7 7)	--- (7 0-8 2)	--- (6 5-8 0)	--- (6 6-8 8)
TDS (mg/1)	926 (213-1340)	581 (239-823)	1445 (212-2160)	1124 (169-1580)	1416 (508-1720)
Total Hardness (mg/1 as $CaCO_3$)	507 (130-710)	225 (75-300)	835 (130-1100)	662 (110-880)	668 (250-790)
Sodium Absorption Ratio	2 1 (0 9-2 7)	2 8 (1 4-4 0)	2 2 (0 8-3 0)	1 8 (0 6-2 5)	2 8 (1 6-3 2)
Phosphorus (mg/1 as P)	0 33 (0 00-0 80)	3 4 (0 000-8 2)	0 18 (0 30- 78)	0 72 (0 06-1 7)	0 31 (0 01-1 3)
Nitrate and Nitrite (mg/1 as N)	2 44 (0 01-5 0)	2 5 (0 16-10 0)	2 18 (0 30-6 0)	3 83 (0 55-7 0)	3 06 (0 67-8 8)
Bicarbonate (mg/1)	267 (83-403)	224 (95-317)	327 (70-437)	306 (63-432)	281 (155-328)
Chloride (mg/1)	26 (5 9-43)	85 (2-140)	20 1 (3 1-33 0)	37 8 (3 9-100)	71 (29-88)
Sulfate (mg/1)	473 (88-710)	162 (70-230)	826 (100-1300)	564 (65-830)	642 (200-840)
Calcium (mg/1)	93 (27-130)	69 (22-88)	158 (28-220)	147 (25-190)	167 (64-220)
Magnesium (mg/1)	72 (15-93)	15 (4 8-20)	101 (15-150)	71 8 (9 7-99)	56 (21-78)
Sodium (mg/1)	111 (23-160)	100 (34-210)	146 (20-200)	108 (14-160)	163 (58-210)

magnesium, sodium, bicarbonate and sulfate, the latter of which ranged in concentration up to 2,210 mg/l

4 Soils

The area which uses water from the Colorado-Big Thompson as a supplemental irrigation supply includes a large portion of northeastern Colorado and, as a consequence, contains a wide variety of soils

Northeastern Colorado contains some of the most productive irrigated lands on the United States The valleys of the South Platte and Poudre Rivers are generally among the highest quality in the State

The soils along the foothills from Fort Collins to Boulder, and some of the upland areas bordering the river valleys, are equally productive and well suited to agricultural production Irrigation has been practiced to varying degrees for many years within the area (prior to the turn of the century) and existing irrigation distribution systems are often very complex

In addition to the general description of the C-BT Service Area, a rather detailed description of conditions within the Narrows Unit (roughly coincident with the C-BT "secondary" Service Area) is available in the Final Environmental Statement for the Narrows Unit, Colorado (USBR, 1976)

a Project Lands

Lands receiving a supplemental water supply from the Colorado-Big Thompson Project are located in north-central and northeastern Colorado

No detailed land classification survey was made of the area in the initial C-BT Project investigation The investigation took place prior to the certification act and project works were to supply only supplemental water to lands that already had adjudicated water rights and also had demonstrated their ability to sustain a productive irrigated agriculture (for over half a century) Irrigation suitability of these lands had been adequately established, and their productive capability was determined from existing crop records

The following description divides the Service Area into "primary" and "secondary" Service Areas The primary area consists mainly of the lands of the Cache La Poudre, Big Thompson, Little Thompson, Saint Vrain, and upper South Platte River drainages The secondary area consists mainly of lands of the lower South Platte River drainage which receive C-BT water mainly through exchange arrangements or in the return flows in the South Platte River

b Primary Area

The primary area comprises a large, relatively compact body of over 477,000 acres of irrigated land which has produced generally excellent yields of crops for over 75 years About 471,000 acres of the 477,000 acres receive C-BT Project water in any given year Most of the land is highly developed and is capable of continued high production for an indefinite period Table III-13 indicates the approximate acreage under irrigation in the primary area and the principal soil types and their textures

The soils in the primary area are forming on deposits of recent geologic age The texture of the soils varies from sand to heavy clay, with fine sandy loam predominating Because only a negligible amount of sand or heavy clay land is irrigated, the soil textures of importance from the standpoint of receiving supplemental water range from loamy sand to clay loam

Most of the land in this area is only slightly saline and is free from harmful accumulations of sodium The soluble salt content of the water used for irrigation is very low (table III-12), consequently, sodicity and salinity have never constituted a major problem on the irrigated lands

In the western portion of the area, some isolated lands have heavy textured soil with a high salt content Chemical analysis indicates that the principal anion is sulfate

c Secondary Area

The project lands of the secondary area parallel the South Platte River from Kersey, Colorado, to the Nebraska State line (a distance of approximately 160 miles) The width of these lands varies from 1 to 12 miles This area includes 230,000 acres of land which has been irrigated from time to time, depending upon the water supply Approximately 188,000 acres of the 230,000 acres receive C-BT Project water in any given year In more recent years, ground-water development has resulted in a large amount of these lands being irrigated by well water

The soils in the secondary area are formed on deposits of recent age and include alluvial, eolian, and terrace deposits The irrigated land is comprised of soils that are, for the most part, medium to light in texture and deep in profile About one-half of these soils are found on bottom land and terraces, with the remainder on uplands They range widely in texture, with sandy loam predominating Approximate acreages and soil types are shown in table III-14

The greater part of the irrigated lands in the secondary area is free from harmful accumulations of sodium or other salts Soluble salts have concentrated principally on the old flood plain where the permanent water table is high and in a few isolated areas where the soil has a very low permeability

TABLE III-13

Approximate Acres of Principal Soil Types and Textures on Irrigated Land - "Primary" Area

Soil Type	Texture: Loamy Sand	Sandy Loam	Fine Sandy Loam	Fine Sandy Loamy Valley	Loam	Loam Valley	Clay Loam	Total Acres
Berthoud					14,000		8,000	22,000
Cass			25,000	2,000			14,000	41,000
Fort Collins	1,000		5,000		35,000		6,000	47,000
Gilcrest		20,000	11,000		1,000			32,000
Greeley			18,000		1,000		2,000	21,000
Kuner			4,000				5,000	9,000
LaPorte					6,000			6,000
Larimer			6,000	14,000	6,000		4,000	30,000
Neville			6,000		2,000			8,000
Nunn		7,000			16,000		15,000	38,000
Terry	3,000				50,000		23,000	76,000
Weld	1,000		95,000	14,000		12,000	23,000	145,000
Valentine	2,000							2,000
Total Acres	7,000	27,000	170,000	30,000	131,000	12,000	100,000	477,000

TABLE III-14

Approximate Acres of Principal Soil Types on "Secondary" Area Irrigated Land

Soil Type	Acreage
Loamy sand	4,000 acres
Sandy loam	88,000 acres
Fine sandy loam	19,000 acres
Silt loam	18,000 acres
Loam	69,000 acres
Clay loam and light clay	32,000 acres
Total	230,000 acres

5 Vegetation

Elevations within the project area vary from less than 5000 to more the 9000 feet MSL The variation in soil and climatic conditions associated with elevation changes produces a broad spectrum of vegetative categories plains, mountain and plateau, and semi-desert (Costello, 1954)

The plains area was formerly a mixed-grass prairie of wheat grasses, bluestems, blue grama, and buffalo-grasses, except for areas of seepage, sandhills, and along major drainages The drainages supported fringes of trees and shrubs, including cottonwoods, willows, rabbitbrush, snakeweed, saltbush, winterfat, rose, and skunkbrush (Lechleitner, 1969) Most of the plains have been cultivated or extensively grazed These grazed areas now support short grasses consisting mostly of blue grama and buffalograss In many counties of the C-BT Service Area, loose sands have formed dunes that support sagebrush communities The cottonwood-willow communities persist along drainages where grazing and cultivation are limited

The mountain and plateau area of Colorado supports five subcategories of vegetation pinyon-juniper, mountain shrub, Ponderosa pine-Douglas fir, spruce-fir, and alpine (Costello, 1954) The alpine and spruce-fir types are not found in the Windy Gap - Colorado-Big Thompson area

The pinyon-juniper type occurs from about 5000 to 8500 feet and consists of extensive stands of pinyon pine and juniper Grass and forb cover is sparse under these stands The upper edge of this type contacts the mountain shrub type and may show an intermingling of oaks and other shrubs with the conifers (Lechleitner, 1969)

The mountain shrub type consists of shrubs in the transition zone between the grasslands, semi-deserts, and pinyon-juniper woodlands below to the coniferous forests above The dominant shrub is mountain mahogany with rabbitbrush, skunkbrush, chokecherry, plum, serviceberry, and rose also common in this type Intermingled

grasses and forbs are often abundant under the shrub cover during moist seasons

The Ponderosa pine-Douglas fir type occurs above the pinyon-juniper type between 8500 and 9500 feet These two species are often intermixed, but may occur as distinctive stands The open nature of Ponderosa pine allows for a good growth of shrubby vegetation, grasses, and forbs Aspen or lodgepole pine may be present on burned or logged areas (Lechleitner, 1969)

The semi-desert type occurs primarily on alkaline soils of the lower mountain slopes, plateaus, and arid mountain valleys below 7000 feet, but may occur as high as 10000 feet This area supports three subcategories of vegetation greasewood, saltbrush, and sagebrush The greasewood type occurs on highly alkaline soils of arid valleys in western Colorado Rabbitbrush may occur as a border to the greasewood type The saltbrush type occurs on alkaline soils that are dry, well drained, and less alkaline than those supporting greasewood Grasses and forbs tend to occur intermittantly in this subcategory, as well as the greasewood type The sagebrush type also occurs primarily in western Colorado, in the Colorado River drainage The boundary between this and other vegetative types is variable The boundary between sagebrush and mountain shrub is often sharp, but sagebrush may blend diffusely into pinyon-juniper stands or create mosaics with Ponderosa pine and oak mixtures (Lechleitner, 1969)

6 Wildlife

The historic ranges of 82 mammals overlap the C-BT Project area Of this number, 19 species are considered common on the West Slope portion of the project area In general, the West Slope species are characteristic of montane habitats, e g snowshoe hare, yellow-bellied marmot, pine marten, mule deer, red squirrel, and northern pocket gopher The East Slope species include many of the above named group, but also contains those mammals more typical of plains habitats, e g antelope, black-tailed prairie dog, and Nuttall's cottontail rabbit A listing of the fauna of the Colorado-Big Thompson Project area is available for inspection at the Lower Missouri Region Offices in Denver

Bailey and Niedrach (1965) list 420 bird species as occurring in Colorado Due to the broad range of vegetypes in the C-BT area, it can be asssumed that most or all of these 420 species could occur in the project area

The plains would typically support birds such as upland plover, western meadowlark, lark sparrow, horned lark, burrowing owl, long-billed curlew, lark bunting, and Cassin's sparrow (Bailey and Niedrach, 1965)

The mountain and plateau sections typically support such species as blue gray gnatcatcher, plain titmouse, pinyon jay, common bushtit, Bewick's wren, scrub jay, rufous-sided towee, dipper, western bluebird, downy and hairy woodpeckers, gray jay, and brown creeper (Bailey and Niedrach, 1965)

The semi-desert type contains birds such as poor-will, scrubjay, scaled quail, rock wren, rufous-sided towee, brown towee, canyon wren, and violet green swallow (Bailey and Niedrach, 1965)

There are 10 amphibians and 23 reptiles whose historic ranges overlap the C-BT Project area In general the toads inhabit the plains, mountain shrub, and grassy meadow habitats while the frog species are associated with aquatic habitats The most common amphibians include tiger salamander, western toad, chorus frog, and striped chorus frog Both amphibians and reptiles increase in diversity as one proceeds from the higher elevations to the plains This is particularly true for reptiles Lizards are totally absent from the higher elevations, but particularly prominent in the plains Only one species of turtle, the snapping turtle is commonly found at relatively high elevations and this species occurs in aquatic habitats The remaining reptiles that are most frequently observed in the C-BT area are painted turtle, blue racer, bullsnake, western box turtle, western terrestrial garter snake, plains garter snake, and red-sided garter snake

7 Aquatic Biota

Phytoplankton in Granby, Grand Lake, and Shadow Mountain have been studied on a number of occasions The most recent study was conducted by the EPA (1977) Table III-15 shows a summary of the algal community composition and mean and maximum numbers of individuals in the more common genera, as identified in EPA (1977) On the basis of algal communities, Shadow Mountain is the most productive followed by Granby and Grand Lake, respectively Shadow Mountain is the shallowest of the three lakes and is held at a relatively constant water level, the euphotic zone can extend to the reservoir bottom All three factors could contribute to the reservoir's higher level of productivity Although there have been no recently documented problems with algal blooms, Nelson (1971) has cautioned that a potential for undesirable changes in limnological parameters and biological populations exists

Shadow Mountain Reservoir also supports a dense growth of aquatic vegetation This flora is dominated by waterweed, hornwort, and water milfoil Hornwort reportedly favors hard water and is capable of clogging waterways (Palmer and Fowler, 1975) Waterweed is also capable of achieving dense growths, although its ecological requirements are not known Aquatic vegetation in the reservoir interferes with both boating and fishing during the latter part of the summer

Aquatic vegetation is limited in Granby and Grand Lake Granby experiences sufficient annual fluctuation to control such plants Grand Lake is a deep, natural lake, aquatic vegetation is probably limited by the shape of the lake basin

The three lakes provide an important fishery in the State and are a principal focus of the Arapaho National Recreation Area Lake Granby is an important mackinaw fishery and supports an execellent population of kokanee salmon This population is heavily fished

TABLE III-15

Algal Community Composition of the Three Lakes - Partial Listing of Genera (Source EPA, 1977)

Lake or Reservoir	Division Class Genus	Mean Number of Cells per ml (N = 28)	Maximum Number of Cells per ml in any sample
Lake Granby Reservoir	Chrysophyta Bacillariophyceae		
	Nitzschia sp	46	432
	Melosira sp	37	256
	Asterionella sp	35	232
	Stephanodiscus sp	27	240
	Fragilaria sp	16	80
	Chrysophyta Chrysophyceae		
	Dinobryon sp	8	48
	Chyanophyta		
	Anacystics sp	64	496
	Lyngbya sp	9	136
	Chlorophyta		
	Cosmarium sp	6	32
	Dictyosphaerium sp	5	48
	Total (including miscellaneous other genera)	301	
Shadow Mountain Reservoir	Chrysophyta Bacillariophyceae		
	Melosira sp	96	280
	Nitzschia sp	79	200
	Stephanodiscus sp	65	260
	Asterionella sp	45	160
	Synedra sp	24	104
	Navicula sp	17	88
	Fragilaria sp	15	96
	Chrysophta Chrysophyceae		
	Dinobryon sp	18	96
	Cyanophyta		
	Lyngbya sp	11	48
	Anabaena sp	10	104
	Chlorophyta		
	Closterium sp	8	56
	Unidentified (unicellular flagellate)	39	320
	Total (including miscellaneous other genera)	494	

TABLE III-15 (continued)

Lake or Reservoir	Division Class Genus	Mean Number of Cells per ml (N = 28)	Maximum Number of Cells per ml in any sample
Grand Lake	Chrysophyta Bacillariophyceae		
	Stephanodiscus sp	45	192
	Asterionella sp	33	72
	Melosira sp	26	56
	Nitzschia sp	14	72
	Fragilaria sp	6	16
	Chrysophyta Chrysophyceae		
	Dinobryon sp	7	24
	Chyanophyta		
	Anacystis sp	7	32
	Lyngbya sp	6	40
	Chlorophyta		
	Scenedesmus sp	15	56
	Dictyosphaerium sp	7	32
	Unicellular Flagellates	14	56
	Total (including miscellaneous other genera)	220	

during the fall snagging season, as is that of Green Mountain Reservoir The Granby kokanee population is also a primary source of spawn for the Colorado Division of Wildlife, however, during 1977, the spawn-taking had to be supplemented from Green Mountain Reservoir because of the lower-than-usual yield from Granby The three lakes also support other trout species These include rainbow, brown, and brook trout, as well as cutthroat The most abundant fish in the system, however, are suckers White and longnose suckers dominate, but bluehead suckers also occur

On the Eastern Slope of the Continental Divide, typical aquatic biota of the C-BT Project area occurs in Lake Estes, Carter Lake, Horsetooth Reservoir, and some small reservoirs, along with the various tributaries of the South Platte River and its mainstem For the most part, productive fisheries are maintained only in the mountain or coldwater reaches of the streams and in reservoirs On the lower or plains stream reaches, diversions result in rapid fluctuations in flows which can lead to extremely high water temperatures, which sometimes exceed 30° C in the summer In addition, the substrate in most areas is not conducive to the production of food organisms

8 Threatened and Endangered Species

Bald eagles migrate through and overwinter in the C-BT development and Service Area Eagle sightings have been reported at nearly all reservoirs Midwinter surveys (sponsored by the National Wildlife Federation) indicated statewide populations of 316, 595, and 538 bald eagles in January of 1979, 1980, and 1981, respectively The South Platte River and adjacent reservoirs were estimated to overwinter 60 eagles with up to 170 migrant birds (Fitzgerald and La Bonde, 1980), which constitutes one of the largest concentrations of bald eagles in the State Use of East Slope C-BT reservoirs (Estes, Horsetooth, Pinewood, Flatiron, and Carter) is very low and sporadic Audubon Christmas counts from 1963 to 1972, for Horsetooth Reservoir and Carter Lake indicate a total of 15 bald eagle sightings

Wintering eagle use of the C-BT development area on the West Slope has been monitored by Water and Power biologists as part of a program to evaluate endangered species use of Lower Missouri Region lands The results of these efforts (table III-7) indicate that the three lakes complex is consistantly used by wintering bald eagles Wintering eagles begin arriving in October, and the last birds usually depart in April Three to five birds remain in the area throughout the winter with migration peaks of nine or ten birds A communal roost utilized by wintering birds in the area is located in the Columbine Bay area of Lake Granby As can be seen from the data presented above, the three lakes area supports relatively low numbers of migrating and overwintering bald eagles compared to the rest of the State

In 1981, a Forest Service biologist observed courtship and nest building acitivities in the three lakes area (Goodson, personal communication, U S Forest Service) Summer sightings of bald eagles

in this area have been reported consistently in past years and nesting attempts may have occurred Four other known nesting territories in the Colorado River drainage have been occupied during the winter and subsequently deserted (Green, personal communication, Bureau of Land Management)

Arctic and American peregrine falcons may occasionally migrate through the C-BT Project area Historical American peregrine eyries are located on Horsetooth Rock near Horsetooth Reservoir and at Twin Owls near Estes Lake This site was last occupied in the 1960's A discussion of peregrine falcon use of C-BT development areas on the West Slope is included in chapter III C

The greenback cutthroat trout (Salmo clarki stomias) is a federally listed threatened species The historical distribution of this species in Colorado included the upper portions of the South Platte and Arkansas River drainages Permanent habitat for this species did not extend out of the foothills region into the plains The current distribution of this species is restricted to several headwater streams within its historical range (Torres, et al) No greenback cutthroat trout currently occur in C-BT development and Service Area waters (Behnke, 1976) The Colorado River cutthroat trout once inhabited the waters at the C-BT development area on the West Slope This species is no longer present in these waters (Behnke, 1976)

9 Recreation

The 11 reservoirs and Grand Lake are administered for recreation by five separate entities Nearly 17,463 acres of land and 14,446 surface acres of water are available for recreation Table III-16 lists each reservoir and the acreages available for recreation use There are 118 miles of public shoreline access to the reservoirs

The C-BT Project is located in a mountain setting area that is nationally recognized for its tourism It is close to major metropolitan population centers along the Front Range Lake Granby, Shadow Mountain Reservoir, and Grand Lake are intergral parts of the Arapaho National Recreation Area Rocky Mountain National Park is to the north and contiguous to the National Recreation Area Together, they attract millions of visitors every year to the C-BT Project reservoirs

Denver, Boulder, Fort Collins, and Greeley are some of the major population centers (combined total is nearly 2 million people) located within a 2 hour drive of the C-BT reservoirs These population centers contribute a significant portion of the visitation Table III-17 summarizes the visitor-day utilization of the recreation areas by recreation activity

The towns of Estes Park, Grand Lake, and Granby rely heavily on the tourist industry directly associated with the aesthetic qualities and the variety of recreational opportunities

TABLE III-16

Recreation Area, C-BT Project, 1976

Dam, reservoir, or area	Total acres (fee and withdrawn) land	water	Acres available for recreation land	water	Shoreline miles
Carter Lake	910	1,144	910	1,144	8
East Portal Reservoir	70	2	70	2	1
Flatiron Reservoir	248	47	173	47	2
Green Mountain Reservoir	2,108	2,125	1,998	2,125	19
Horsetooth Reservoir	1,978	1,899	1,978	1,899	25
Lake Estes	123	185	118	185	4
Lake Granby	10,381	7,256	10,381	7,256	40
Marys Lake	175	42	138	42	1
Pinewood Lake	142	97	142	97	3
Shadow Mountain Reservoir	1,102	1,346	1,102	1,346	8
Willow Creek Reservoir	665	303	455	303	7

Source Water and Power Resources Service, Water and Land Resource Accomplishments, 1976, Statistical Appendix I, pg 273

TABLE III-17

Utilization of Recreation Areas - 1976[1]
Visitor-Days (12 hours)
Colorado-Big Thompson Project

Area	Sightseeing	Picnicking	Camping	Swimming	Waterskiing	Boating	Fishing	Hunting	Other[3]	Total	Source of Visitor (%) Local	Other
Lake Granby	83,129	426	112,490	36	346	1,183	15,284	44	358	213,296	5	95
Shadow Mountain Lake	[2]	450	77,266	43	331	1,273	7,374	52	--	86,789	5	95
Willow Creek Reservoir	42	116	9,586	8	--	811	2,882	34	--	13,479	20	80
Green Mountain Reservoir	5,500	2,125	54,000	200	350	3,600	20,000	275	--	86,050		
East Portal Reservoir	666	271	9,075	--	--	--	16	13	--	10,041	16	84
Marys Lake	506	1,189	14,375	--	--	--	3,753	--	--	19,623	15	85
Lake Estes	443	4,653	--	--	51	1,947	31,995	--	2,139	41,228	30	70
Pinewood Lake	453	339	10,100	--	--	270	7,200	--	--	18,362	40	60
Flatiron Reservoir	160	800	1,290	--	--	--	1,448	--	--	3,698	40	60
Carter Lake	3,389	7,960	101,970	2,932	10,815	18,025	31,724	--	154	176,969	20	80
Horsetooth Reservoir	6,790	2,425	20,370	3,880	10,731	21,465	4,423	--	1,000	71,084	45	55
Total	101,078	20,754	410,522	7,099	22,624	48,574	126,099	418	3,651	740,819		

1/ Compiled from Recreation and Wildlife Summary Reports submitted by adminstering agencies

2/ Included in Lake Granby visitor-days

3/ Includes off-road vehicle use, snowmobiling and cross-country skiing

a West Slope

Winter Park and Mary Jane ski areas are located approximately 20 miles south of Granby The Forest Service has identified several potential sites for future ski development in addition to Winter Park expansion These include Devil's Thumb Park area, Little Vasquez Creek area, and the Kawuneeche area (Dames and Moore, 1977a) The Arapaho National Forest surrounding the Windy Gap development area provides many opportunities for the activities of hunting, fishing, camping, picnicking, hiking, cross-country skiing, and sightseeing Williams Fork Reservoir, located south of the Windy Gap site, provides fishing opportunities

b East Slope

Hidden Valley Ski Area, located within the boundaries of Rocky Mountain National Park, is under the jurisdiction of the National Park Service

There are several State areas administered by the Division of Parks and Outdoor Recreation These include Lory State Park, Boyd Lake, Barbour Ponds, and Jackson Lake The State has developed facilities for camping, picnicking, hiking, rock climbing, boating, water skiing, and fishing (Dames and Moore, 1977a)

10 Aesthetics

The C-BT water developments are situated in the mountains and valleys Reservoirs provide sharp topographic contrasts because of the broad, flat, open areas of water set against the lofty relief of mountains The reservoirs on windless days cast a mirror image of the adjacent mountains The broad expanses provide a retreat from the cities and a sense of solitude During fall local tourists enjoy the display of color from the aspen

11 Cultural Resources

Most of the Colorado-Big Thompson system has not been surveyed for cultural resources Exceptions are several spot surveys completed by Huse when she surveyed the Windy Gap Project (Huse, 1977) The remainder of the C-BT system will be surveyed under the authority of Executive Order 11593 "Protection and Enhancement of the Cultural Environment " Curent Reclamation plans call for the C-BT system surveys to start in 1983 Until those surveys are completed, no description of the cultural resources of the system can be made

12 Land Use, Transportation, and Utilities

The C-BT and Windy Gap Service Areas are identical in their overall geographical characteristics Therefore, this discussion will address both projects together, and highlight those characteristics that are closely related to the proposed actions

a Land Use

The economy of the C-BT Service Area is based primarily on agricultural and agriculturally-associated industries Most of the land with suitable soils and topography of the South Platte River valley is intensively farmed with irrigation water Primary crops include corn, sugar beets, and alfalfa Sprinkler irrigation is a recent innovation introduced within the last 15 years in this area Much of the corn and alfalfa is harvested to provide grain or silage for use on the farms or for sale to nearby livestock operations, such as the Monfort feedlot near Greeley

The only crop of economic significance grown without irrigation is winter wheat Lands of the river valley which are not well suited for irrigation or dryland farming due to soil deficiencies (very sandy or gravelly), topography (steep terrace breaks, low-lying river bottoms), or drainage (high ground water or lack of surface drainage outlets) are generally left uncultivated and are used for pasture to provide supplemental food for livestock The local livestock industry consists primarily of producing calves on ranches which are sold locally to feeders for finishing and slaughter

The six cities of the subdistrict are cultural focal points for business, entertainment, and living The major businesses near the cities in the plains include Eastman-Kodak, Hewlett-Packard, and International Business Machines Three cities support major universities - University of Colorado in Boulder, Colorado State University in Fort Collins, and the University of Northern Colorado in Greeley Estes Park is primarily a resort-tourist town which includes resorts, restaurants, motels, and souvenir shops

Table III-18 illustrates the land area, income source, and land ownership associated with the Service Area

b Transportation

(1) Railroads

The counties of Larimer, Weld, and Boulder in the C-BT and Windy Gap Service Areas are serviced by the Colorado and Southern, Denver-Rio Grande and Western, Union Pacific, and Burlington-Northern Railroads

The Denver-Rio Grande and Western Railroad is adjacent to the south of the Windy Gap diversion and impoundment in Grand County Both passenger and freight trains use this track regularly for east-west traffic

TABLE III-18

Land Area, Major Income Source, and
Ownership By County
Colorado-Big Thompson Project Service Area

County	County Area (Sq mi)	Major Income Source	Land Ownership			
			Private (Acres)	Federal (Acres)	State (Acres)	County and Municipal (Acres)
Weld	4,004	Agriculture Industry and Education	1,706,573	196,957	168,152	8,973
Boulder	750	Manufacturing, Education and Agriculture	314,610	167,670	3,013	14,194
Larimer	2,614	Agriculture, Manufacturing and Education	1,079,967	777,306	53,099	5,617[1/]
Morgan	1,282	Agriculture	760,816	2,459	54,161	2,750
Logan	1,827	Agriculture	1,011,569	1,612	135,790	768
Washington	2,525	Agriculture	1,493,100	795	106,530	667[1/]
Sedgwick	544	Agriculture	309,751	273	6,108	141[1/]
TOTAL	13,546		6,676,386	1,147 072	526,853	54,887

Source Colorado Interstate Gas Company, 1972, Colorado Marketing Manual

1/ Figures from the source listed could not be used for the County and Municipal category for Larimer, Washington and Sedgwick Corrected figures were obtained from the County Governments

(2) Highways and County Roads

Interstate 25 provides the major north-south route between Cheyenne, Wyoming, and Denver State and U S Highways provide access to the mountains and service to the cities along the Front Range

(3) Airports

Commercial airline services are available in Denver and Cheyenne There are airports in Fort Collins, Greeley, Loveland, Longmont, and Boulder They handle small private aircraft, charter flights and small commercial service

c Utilities

Facilities are presently available in the project area for satisfying the immediate energy needs Private power companies now furnish electrical energy to Greeley and Boulder Fort Collins, Estes Park, Loveland, and Longmont municipal systems have formed the Platte River Power Authority (PRPA) to develop electric power supplies over and above the allocations of Western Division, Pick-Sloan Missouri Basin Program and Colorado River Storage Project power PRPA has an 18 percent interest in the first two units at Craig Powerplant to provide an additional power supply in the future

Private companies serve all the principal towns with natural gas

13 Socio-Economic Characteristics

a Demographics

Table III-19 presents selected demographic characteristics from major cities of the existing C-BT and Windy Gap Service Areas for 1970

The Service Areas exhibited one of the greatest growth rates in the United States This growth rate is not expected to diminish by a large margin in the next decade

County population projections by the Colorado Division of Planning estimate that the area will grow between 64 to 117 percent by the year 2000

b Economic Characteristics

The economic base of the area is widely varied The eastern counties are mainly agricultural, while the western counties have more varied economics Assessed valuations for the area are on file at the Lower Missouri Region Office in Denver These substantiate the above pattern The 1970 employment characteristics shown in table III-20 also verify the economic basis of the counties

TABLE III-19

Selected Demographic Characteristics - 1970
Colorado-Big Thompson Project Service Area

COUNTY CITY	Weld	Greeley	Boulder	Boulder	Longmont	Larimer	Loveland	Estes Park	Fort Collins
Population	89,297	--	131,889	--	--	89,900	--	--	--
Percent change from 1960	23 4%	--	77 6%	--	--	68 5%	--	--	--
Urban population	41,472	38,902	102,602	66,870	23,209	59,557	16,220	1,616	43,337
Percent change from 1960	57 6%	47 8%	82 1%	77 3%	102 0%	71 3%	66 6%	37 5%	73 2%
Rural population	47,825	--	29,287	--	--	30,343	--	--	--
Percent change from 1960	3 9%	--	63 6%	--	--	63 3%	--	--	--
Median age	24 6	23 8	24 3	23 1	27 0	24 5	31 0	40 7	22 1
Percent over 65	8 8%	9 8%	6 9%	6 4%	10 7%	9 6%	16 2%	15 2%	8 2%
Percent under 18	34 5%	28 8%	33 0%	27 6%	36 5%	30 3%	32 8%	28 5%	25 6%
Native of native percentage	75,257	33,349	115,448	58,227	20,594	79,146	13,798	N/A	38,032
SPANISH LANGUAGE/SPANISH SURNAME									
No of SL/SS persons	13,752	4,792	8,292	3,183	2,398	6,017	1,181	N/A	3,416
Median age	18 7	20 1	20 8	21 8	17 6	20 0	18 6	N/A	19 4
Percent of SL/SS of popluation	15 4%	12 3%	6 3%	4 8%	10 3%	6 7%	7 3%	N/A	7 9%

N/A - Data not available

COUNTY CITY	Morgan	Fort Morgan	Brush	Logan	Sterling	Sedgwick	Julesburg	Washington
Population	20,105	--	--	18,852	--	3,405	--	5,550
Percent change from 1960	-5 1%	--	--	-7 1%	--	-19 7%	--	-16 2%
Urban population	10,971	7,594	3,377	10,636	10,636	--	1,578	--
Percent change from 1960	-0 3%	.2 9%	-6 7%	-1 1%	-1 1%	--	-14 2%	--
Rural population	9,134	--	--	8,216	--	3,405	--	5,550
Percent change from 1960	-10,4%	--	--	-14 0%	--	-19 7%	--	-16 2%
Median age	28 7	30 1	31 9	16 8	27 4	35 6	38 3	33 7
Percent over 65	11 5%	13 7%	20 6%	10 7%	13 3%	14 2%	17 6%	13 5%
Percent under 18	37 9%	35 0%	34 0%	35 3%	31 3%	33 8%	32 1%	34 4%
Native of native percentage	16,576	N/A	N/A	15,760	9,250	2,645	N/A	5,033
SPANISH LANGUAGE/SPANISH SURNAME								
No of SL/SS persons	2,225	N/a	N/A	1,344	628	347	N/A	20
Median age	15 6	N/A	N/A	16 4	18 5	N/A	N/A	N/A
Percent of SL/SS of popluation	11 1%	N/A	N/A	7 1%	5 9%	10 2%	N/A	0 4%

N/A - Oata not available

Source U S Bureau of the Census, 1971, U S Census of Popluation, 1970

TABLE III-20

Employment Characteristics - 1970
Colorado-Big Thompson Project Service Area

County	City	Civilian Labor Force		Industry of Employed Persons				Employment by Occupation							
		No	Percent Unemployed	Agriculture, Forestry, Fishing	Mining	Construction	Manufacturing	Professional, Technical, Managerial	Sales	Clerical	Craftsmen, Foremen	Operatives[1]	Except Farm	Farm	Service Workers[2]
Weld		34,807	4 2	4,958	113	2,496	4,837	7,202	2,203	4,960	3,919	4,494	1,630	1,581	4,559
	Greeley	15,829	4 9	507	18	951	1,652	4,491	1,299	2,737	1,564	1,541	678	239	2,500
Boulder		54,880	4 4	978	339	2,923	11,025	19,397	3,610	9,061	5,894	5,317	1,544	349	4,006
	Boulder	28,800	4 7	181	97	980	4,471	9,152	2,054	5,376	2,289	2,087	617	49	1,929
	Longmont	9,351	4 3	135	68	728	2,807	1,777	577	1,342	1,394	1,478	349	50	1,152
Larimer		36,043	5 4	2,167	129	2,450	5,175	10,045	2,371	5,384	4,375	3,752	1,237	729	5,308
	Loveland	6,128	4 4	147	14	523	1,762	871	526	802	1,062	914	250	62	816
	Fort Collins	17,439	6 1	467	42	948	1,500	4,466	1,218	2,965	1,574	1,260	531	164	2,828
Morgan		7,746	3 2	1,668	222	435	634	1,506	459	739	777	1,119	374	1,496	1,027
	Fort Morgan	3,028	4 1	N/A	N/A	197	338	838	226	323	359	485	121	84	469
	Brush	1,262	2 7	N/A	N/A	51	149	271	93	145	128	267	78	43	203
Logan		7,156	1 9	1,094	190	314	536	1,414	562	1,048	729	837	298	1,026	1,103
	Sterling	4,336	2 4	138	130	175	389	948	412	731	454	592	226	114	775
Sedgwick		1,386	2 4	411	12	66	48	281	77	119	128	114	48	374	212
Washington		2,135	4 4	858	19	125	55	347	106	185	168	225	43	807	162

1/ Including transportation

2/ Including household

N/A - Not available

Source U S Bureau of the Census, 1972, U S Census of Population, 1970

CHAPTER IV ENVIRONMENTAL CONSEQUENCES

A GENERAL

B NO ACTION

C WINDY GAP PROJECT PREFERRED ALTERNATIVE

Chapter IV ENVIRONMENT CONSEQUENCES

A General

This section discusses the environmental impacts associated with the viable alternatives The non-viable alternatives are discussed in chapter II and are not analyzed for impacts in this chapter Chapter II discusses why each of these alternatives is non-viable Obviously, it serves no useful purpose to discuss their environmental impacts because they do not meet the need described in chapter I and are either already being pursued by the Subdistrict or would not be pursued because of economic or engineering reasons

The discussion of each environmental parameter, except those related to the Rawhide Powerplant, includes mitigation and indicates the significance of the net impact (the impacts remaining after mitigation) Mitigation for Rawhide's impacts are discussed in PRPA's comment letter (dated August 3, 1979) and is included in chapter VII B , Letters of Comment

B No Action

The following section briefly describes (1) The impacts which would occur if Windy Gap is not constructed, and (2) impacts due to the continued operations of the C-BT The impacts that are due to the continued operations of the C-BT are discussed because of the reasons noted in chapter I Primarily, there must be a base upon which cumulative impacts of future projects associated with the C-BT can be evaluated for impacts

1 Impacts Without Windy Gap

a Colorado River

(1) Water Supply

With a No Action alternative the State of Colorado (specifically the sponsors of the Windy Gap Project) would forego the opportunity to consume an annual average of 54,000 acre-feet of Colorado River water This water is part of the Colorado River water to which Colorado is entitled under the Colorado River Compact and subsequent Upper Colorado River Compact

(2) Water and Sewage Treatment, and Diversion Facilities Within the upper Colorado River Basin

According to the Intergovernmental Agreement, the Subdistrict is obligated to provide $150,000 to Hot Sulphur Springs to assist in improving its water treatment facility, and $270,000 to improve its waste water treatment facility Additional sums, as needed, would be provided by the Subdistrict to plan, design, and construct facilities needed by ranchers' to obtain their senior decreed water rights from the Colorado River With a No Action alternative the above impovements and actions would be some other entities' responsibility and most probably would be delayed indefinitely

b Windy Gap Development and Service Area

With a No Action alternative none of the impacts discussed in chapter IV C would occur However, the following environmental consequences would take place within the Service Area due to the unavailability of Windy Gap water

As discussed chapters II B 2 and II C 1 the cities are already pursuing various kinds and levels of water conservation With a No Action alternative these conservation measures would be intensified and integrated with the conversion of agricultural water rights to municipal and industrial use

It is most likely that stringent water restrictions would have to to be implemented Steps toward limiting or directing population growth by restricting the number of water taps or zoning restrictions could also be pursued

One of the first measures to restrict water use would probably be to forbid low value uses, e g lawn watering, washing of automobiles, horticultural uses, and filling of private swimming pools Rationing mechanisms could also be employed to penalize overuse by prorating prices or fines

Future residential development would probably be geared toward higher densities with minimal landscaping

In addition to these restrictions, agricultural water rights would continue to be converted to municipal and industrial uses The nature and severity of this impact is discussed in chapter II C 1 , Water Conservation and Management

In addition to the cities, PRPA would forego a firm water supply for its Rawhide Powerplant

Although PRPA has other supplies available, they would not provide the quantity of water or dependability that Windy Gap would Currently, there are adequate supplies for cooling the first 250 MW unit at Rawhide However, other supplies will need to be obtained to meet the ultimate capacity of 750 MW These supplies would be obtained by buying agricultural water rights or other future supplies that may be developed on the East Slope

c Colorado-Big Thompson Development and Service Area

Without the Windy Gap Project the C-BT would not generate the additional annual average of 88 million kilowatts of energy

2 Impacts of Continued C-BT Operations

The following discusses the impacts of continued C-BT operations on the Colorado River and C-BT development and Service Areas No impacts on the Windy Gap development and Service Areas are expected

a Climate and Air Quality

There are no adverse impacts anticipated for either climate or air quality as a result of C-BT operation

b Physiography and Geology

(1) Green Mountain Reservoir

Existing landslide masses have been described at Green Mountain Reservoir Both of the Green Mountain slide areas are unstable and present the possibility of continued movement Movement can be triggered by changes in moisture, seismic shocks, or changes in conditions at the base or head of the mass Slides occurred in the major south slide area in 1963, and in another area on the south in 1975 and 1977 Observation is continuing in order to determine causes of movement In 1963, reservoir

drawdown was limited to a recommended level in order to provide data on the relationship of drawdown to movement Irrigation water at the top of the slope appeared to be a major cause

The western half of the slide has continued to creep downwards, necessitating repairs to the county road in 1971 and 1977 Since this occurred at a period of high water in the reservoir, movement is apparently unrelated to reservoir drawdown A possible cause is the weight of the continuing accumulation of the slope make landslides inherently likely, and movement is expected to continue, regardless of reservoir conditions

The 1974 check indicated no major movement had occurred in the south slide area, although hummocky topography and open cracks indicated the instability of the entire area In 1975, movement occurred south of this mass, necessitating reshaping of the road and causing destructon of trees near the waterline The geologic conditions and cause of the slide are similar to the older south slide area, with movement occurring in morainal material and irrigation at the top of the slope supplying aggravating moisture

(2) St Vrain Supply Canal

A significant landslide condition was caused by construction along the St Vrain Supply Canal where the canal traverses the east dip slope of the Dakota hogback Several large rockslides occurred where the canal was cut through a 1/2- to 6-inch clay seam in the sandstone, and the overlying rock slide along the dip slope plane provided by this seam One such landslide required excavation of about 100,000 cubic yards of slide material and the attendant closing of the canal section Other canal sections in similar formations may also experience slides This could result in interruptions in water service and increased maintenance costs

c Hydrology

There are no anticipated adverse impacts on hydrology as a result of C-BT operations

d Water Quality

(1) Surface Water

Grand Lake is a natural lake that receives inflow from Lake Granby via Shadow Mountain Reservoir Prior to the construction of the project, Grand Lake was presumably oligotrophic With the initial operation of the project, there were reports of algal blooms in Grand Lake Nelson (1971) summarizes these early studies and states that in general his results confirm the earlier reports Recent studies, as summarized in EPA (1977), have classified Grand Lake as being either oligotrophic

or mesotrophic Since the system has apparently stabilized, continued operation of the C-BT Project should maintain the existing productivity of Grand Lake

There is a potential for adverse impacts on Grand Lake that would result, at least in part, from the operation of the C-BT Project The three lakes system occupies a very scenic setting As a result, there has been quite a tourist and second home economy established There have been various projections of population growth in the environs of the area There has been some platting of subdivisions EPA (1977) has identified local nonpoint sources as the primary cause of nutrient loadings to Lake Granby and Shadow Mountain Reservoir If these do in fact increase in the future, project operations would subsequently increase loadings to Grand Lake Similarly, additional loadings to Shadow Mountain Reservoir would result from continued pumping from Lake Granby Thus, the pumping operation could increase the potential for algal blooms occurring in the upstream reservoirs Such algal blooms caused considerable concern on the part of area residents and project water users in the early 1950's primarily from an aesthetic viewpoint

Green Mountain Reservoir on the Blue River and Willow Creek Reservoir on Willow Creek are also involved in project operations The water quality of Willow Creek Reservoir will remain essentially the same as at present with continued project operations Green Mountain Reservoir experiences a rather extensive annual drawdown There is a large slide area within the reservoir The fluctuation of the reservoir surface has been implicated in sloughing of the slide area, with consequent sedimentation of the reservoir Continuation of existing operations will maintain the current potential for future sedimentation, causing turbidity and a reduction in the storage capacity of the reservoir

Among the three lakes Shadow Mountain Reservoir is unique in that it experiences heavy growths of rooted aquatics These plants (macrophytes) are large plants rooted in the bottom of the lake which often extend to the surface The occurrence of these plants interferes with fishing and recreational uses of Shadow Mountain Reservoir and has been a persistent problem for several years These plants are not a problem in Lake Granby or Grand Lake

In 1980, the U S Forest Service with support from the Northern Colorado Water Conservancy District initiated a major investigative program to determine the cause of the macrophyte problem in Shadow Mountain Lake The program included an extensive water quality sampling of all tributary inflows, collection of a large number of water quality samples from various locations and various depths in Shadow Mountain Lake, and sampling of the

bottom of the lake to a depth of 6 inches at numerous locations (USFS, 1981) The Forest Service team quantified nutrient loadings from various sources including tributary streams and those pumped in from Lake Granby The Forest Service study showed that introduced nutrients from tributary streams and those puumped in from Lake Granby are an insignificant source of nutrients compared to nutrients available from the bottom materials of Shadow Mountain Lake Shadow Mountain Lake was once the location of alluvial meadows and is rich in nutrients Shadow Mountain Lake is also the shallowest of the three lakes, with a mean depth of approximately 10 feet In comparison, Lake Granby has a mean depth of 74 feet and Grand Lake has a mean depth of approximately 135 feet The depth of sunlight penetration in Shadow Mountain Lake (the depth of the euphotic zone) is estimated at 8 or 9 feet According to the Forest Service Research Team, the combination of available nutrients from the benthic materials as well sunlight penetration practically to the bottom of the lake combines to create a highly productive environment for rooted macrophytes The Forest Service is developing management alternatives and will continue its monitoring and sampling programs The Forest Service study shows that the macrophyte problem is independent of nutrient loading from tributary sources or pumping from Lake Granby As a result, additional pumping associated with the Windy Gap Project will not affect the existing macrophyte problem in Shadow Mountain Lake

Transbasin diversions of high quality water from the headwaters of the Colorado River have been indentified as a contributing factor to the salinity problem in the Lower Basin This is due to the removal of water that would otherwise act as a diluent to saline inflows The operation of the C-BT could account for approximately 2 and 3 percent of the current salinity at Lees Ferry and Imperial Dam, respectively

The water diverted from the West Slope is of approximately the same quality as the native flow of the Big Thompson River when they are mixed at Lake Estes Lake Estes is located near the town of Estes Park in a scenic mountain valley near the entrance to Rocky Mountain National Park The upper Thompson Sanitation District, which includes the suburbs of Estes Park, has recently constructed sewage treatment facilities that include tertiary treatment Nelson (1971) found that although Lake Estes was essentially a flow-through system with a complete exchange of water every 3 days during the summer, an isolated bottom layer with an oxygen deficit could develop He found no evidence of thermal stratification due to the rapid exchange Continuation of this operation will maintain the rapid exchange, and along with the upgraded sewage effluent, minimize the oxygen deficit

Horsetooth Reservoir and Carter Lake are the project's terminal storage reservoirs The other East Slope reservoirs are small and essentially flow-through systems that provide regulation

for power generation These latter have no impacts on water quality

The only water quality problem indentified in either of the terminal storage reservoirs was oxygen depletion in Horsetooth Reservoir and Carter Lake (Nelson, 1971) Horsetooth Reservoir was the most productive reservoir of the C-BT Project over the course of the limnological studies The oxygen depletion occurred during the period of summer stagnation and apparently resulted from the decomposition of algae produced in the reservoir However, Carter Lake also showed some oxygen depletion, even though it was the least productive of the reservoirs during the study The position of the inflow was identified as the cause of the cold hyplimnion (Nelson, 1971) This could similarly account for the low productivity at Carter Lake in that the inflow and consequently the influent nutrients would be conveyed to the reservoir bottom Thus, they would be unavailable to the algae in the overlying strata In such a case, peak productivity would occur in the fall during turnover There was one productivity analysis in Carter Lake during September, but the reservoir was still stratified Since the water supply to Horsetooth Reservoir and Carter Lake comes from a common source and the two reservoirs are morphometrically similar, it would seem that the difference in the position of the inlets is the controlling factor with respect to productivity and consequent oxygen depletion In any case, the continued operation of the project would maintain conditions similar to those that are currently present, assuming that there are no dramatic changes in conditions in the watershed areas

Continued operation of the Colorado-Big Thompson Project will maintain existing water quality on East Slope reservoirs including Lake Estes, Horsetooth Reservoir, and Carter Lake Exisisting quality is considered to be adequate for all beneficial uses of water in the Colorado-Big Thompson system including recreation, fishing, and municipal/industrial water supply Occasional problems with algal blooms have been reported in Horsetooth Reservoir and Carter Lake However, these problems are not considered to be serious and have not interfered with beneficial uses of water in the reservoirs

As was described in the preceding chapter, water of the South Platte River and its mainstem tributaries are subjected to successive use and reuse, primarily for agriculture As a result, the river is continually degraded as it flows downstream The C-BT Project was, in part, constructed to provide supplemental water to agricultural interests in the South Platte Basin In accordance with the Colorado River Compact, all water diverted by the C-BT is consumed within the State of Colorado As a result, approximately 12,500 tons of salts annually are contributed to the South Platte River on the average

Bluestein and Hendricks (1975) have outlined the problem hydrologically They indicate that the annual runoff in the basin is about 1 44 million acre-feet Total depletions due to consumptive use amount to 1 47 million acre-feet Obviously, more water is consumed than originates within the basin Approximately, 336,000 acre-feet of water on the average are imported from the Colorado and North Platte Rivers annually Therefore, the total basin supply would amount to 1 77 million acre-feet per year About 304,000 acre-feet per year flow out of the State into Nebraska These 304,000 acre-feet of water leaving the State carry the majority of the initial salt load downstream As a result, TDS concentrations in excess of 1700 mg/l have been recorded On the average, the initial C-BT diversion would contribute about 2 percent (21 mg/l) of the South Platte River salinity, if the water were 100 percent consumed and all of its salt returned to the river This is on the border of the zone where TDS can have detrimental effects on sensitive crops and that in which careful management must be exercised to prevent adverse effects on most crops, using criteria presented in NAS (1973) However, during the irrigation season, the TDS concentration in the lower South Platte ranges between 1100 and 1800 mg/l, which is well into the above described latter range (1000-2000 mg/l) A difference of 21 mg/l in that range would have no discernible impact one way or the other, especially since the lands in question have been irrigated for over 100 years in most cases

(?) Ground-Water

The C-BT has no impact on ground-water quality in the area encompassing the water collection and conveyance system In the C-BT Service Area, the water going to municipal and industrial uses similarly has no impact on ground-water quality However, in the agricultural Service Area, there are localized areas with ground-water quality problems due to excessive levels of dissolved solids and nitrates The availability of supplemental irrigation water has permitted additional irrigation to occur Although it is virtualy impossible to segregate C-BT water from other water within the various irrigation systems, it is probable that a certain amount of the ground-water degradation is due to the use of C-BT water Continued operation of the C-BT would continue past trends with respect to such degradation of the ground water in the agricultural Service Area In some of these localized areas, the ground water has become unusable for municipal or domestic use

e Soils

No new construction will occur as a result of C-BT operations The impact on soils, therefore, is negligable and confined to minor disturbances caused by maintenance

f Vegetation

The C-BT system has been functioning since 1954, and therefore, any vegetative impacts associated with this facility would be limited to the operations Water level variation in the canals

and reservoirs undoubtedly influences aquatic and shoreline vegetation These fluctuations, however, have occurred for the past 22 years, and the existing vegetation is product of this variation Therefore, water level changes within normal operating limits should have no significant impact upon aquatic or shoreline vegetation

Normal maintenance will cause some minor vegetative impacts While these cannot be predicted in this statement, an example would be the planned construction of deer escape ramps along the Charles Hansen Feeder Canal (See Wildlife section)

g Wildlife

The operation of the C-BT system causes fluctuations in the water levels of the canals and reservoirs within the system The impact to wildlife, therefore, is confined to those species associated with aquatic habitats

Lake Estes, Marys Lake, Shadow Mountain Reservoir, and Flatiron and Pinewood Reservoirs function as regulating reservoirs and as such, their water levels remain relatively constant Green Mountain, Willow Creek, and Horsetooth Reservoirs, plus Lakes Carter and Granby, serve as storage reservoirs and their levels may fluctuate up to 80 percent The regulating reservoirs provide habitat for resident and migratory wildlife (i e geese, ducks, shorebirds, and various mammals) The storage reservoirs provide stop-over habitat for spring migrants, but comparatively little habitat for resident or fall migrant species due to the summer drawdowns If water were retained in the storage reservoirs throughout the year, a significant increase could be expected in resident as well as migrating wildlife

The C-BT Project has an ongoing problem of deer and elk mortality in the systems concrete-lined canals There are approximately 67 9 linear miles of this type of canal in the system The Charles Hansen Feeder Canal is the only lined canal for which deer and elk mortalities have been tabulated in the past The canal is approximately 8 5 miles long and the average deer loss for 12 years (1957 to 1968) is 49 animals per year Efforts have been made to alleviate this problem through the construction of deer bridges, but the mortality has persisted at the 40 to 50 per year level The project is currently experimenting with escape ramps spaced at known deer concentrating points in an effort to reduce losses There has been no concerted effort to evaluate elk mortality, but it has probably been low Two elk were observed in the canal during the winter of 1977-78 One of the animals, a bull, escaped successfully, and the other (cow) was killed passing through a siphon Occasionally smaller mammals and domestic livestock are drowned in the canal, but the overall frequency has been low

h Threatened and Endangered Species

A biological opinion on the C-BT operations was rendered by FWS on January 5, 1981 (attachment 2)

The opinion stated that the operation of the C-BT Project is not likely to jeopordize the continued existence of the bald eagle,

whooping crane, peregrine falcon, Colorado River squawfish, bonytail chub, and humpback chub (see attachment 2) The FWS did not express concern over any other threatened or endangered species associated with the operations of the C-BT Project

1 Aquatic Biota

Present levels of algal biomass and community structure (species composition) reflect the operational impacts of the C-BT Project Continued operation with the present criteria should maintain the status quo However, if there is appreciable development around Lake Granby, as has been predicted by local officials, then nutrient loadings to Lake Granby would increase EPA (1977b) indentified nonpoint sources as being the most significant The proposed enlarged Three Lakes Sanitation District Waste Treatment Plant will discharge either to the Red Top Valley Ditch during the irrigation season or to Willow Creek downstream from the reservoir, thus, the effluent will be diverted from the system (EPA, 1978a) The nonpoint source loadings will be proportional to the amount of additional land developed and will contribute pulse loadings, primarily as urban storm runoff, to Lake Granby These nutrients would be dispersed throughout the project, resulting in an increase in algal biomass and possibly change community structure This change in community structure would be most noticeable if the limiting nutrient became nitrogen, in which case algae that were capable of nitrogen-fixation would be favored, i e certain Anabaena spp

Lake Granby was formerly more productive than it is at present Limited oxygen depletion was also observed in the past (Nelson, 1971) However, no oxygen deficit was reported The increase in productivity would not be expected to cause such a deficit if the former levels of primary production were attained Some of the former oxygen depletion was attributed to the decomposition of inundated terrestrial plant life, which would no longer be a factor It was predicated by Dames and Moore (1977b) that increased productivity may benefit the fishery Since there seems to have been a decline in fish production from what was formerly observed, that assessment may be true

As was indicated above, the increase in nutrients would be dispersed throughout the system Some oxygen depletion has been observed at each of the West Slope reservoirs In no case was it severe In addition, reservoirs tend to trap nutrients As a result, the effects tend to be lessened as the waters pass through a series of reservoirs, at least in the short term Long term impacts of nutrient loadings can result from the recycling of nutrients within a reservoir, such that any future reductions in loading may take a considerable period to manifest their effect

Stream fisheries should experience no impacts due to continued project operation As was described in chapter II, reservoir releases to maintain stream fisheries have been established The project will continue to operate under those criteria and existing fisheries will be maintained

The spawning streams upstream from Lake Granby and Green Mountain Reservoir will continue to be used for spawn taking by the State Releases from Shadow Mountain Reservoir will be made by the project to maintain the runs on the Colorado River Studies have indicated the productivity of the Green Mountain Reservoir fishery is inhibited by the loss of benthic organisms due to the extensive annual drawdown (Finnell, op cit) Given the existing operating criteria, this will continue into the future

Shadow Mountain Reservoir fluctuates very little over the course of a year It also experiences excessive growths of rooted aquatics These growths are probably encouraged by the relatively stable water surface This will probably continue to be a problem in the future Water and Power has agreed to lower the level of Shadow Mountain Reservoir to permit private interests to remove accumulated sediment and aquatic vegetation However, this is likely to be only a temporary solution Recurrence of heavy growths of aquatic vegetation are likely

Nelson (1972) raised concern over the possible eutrophication of Lake Estes, which is a relatively small reservoir In addition, oxygen deficits have been recorded in Lake Estes The reservoir remains isothermal throughout the year due to the short water exchange time The temperature throughout the reservoir remains within the range that is suitable for coldwater fishes Therefore, an oxygen deficit should not result in any loss of fish, since any uninhabitable area can be avoided There is currently no concerns regarding this aspect

As was true of the West Slope streams, operating criteria have been established to provide for minimum releases to the Big Thompson River for fishery maintenance The Big Thompson River provides a valuable coldwater fishery at present Continued operation of the project should maintain the fishery at its present quality

Carter Lake and Horsetooth Reservoir both support two-story fisheries, i e warmwater fishes in the epilimnion and coldwater fishes in the hypolomnion Surveys reported in Nelson (1971) indicate that Carter Lake is the least productive and Horsetooth Reservoir is the most productive reservoir in the C-BT system Both reservoirs have experienced some degree of oxygen depletion in the hypolimnion (Nelson, 1971) However, monthly data have been collected by the GS (USGS, 1975, 1976) These same data indicate that oxygen depletion is not significant in Carter Lake Since Carter Lake may be the least productive of the C-BT reservoirs, an increase in productivity may be beneficial from a fisheries viewpoint Horsetooth Reservoir on the other hand has experienced problems with excessive algal growth This is more of an aesthetic problem, since there is no evidence of any adverse impacts on the fishery

Efficient operation of irrigation projects requires the use of herbicides and algicides to control aquatic vegetation that restricts the flow of water in canals Water and Power has

investigated the effects of vegetation control on nontarget aquatic species in canals receiving C-BT water (Otto, 1974) Results of the study showed few statistically significant differences between treated and untreated canals on the basis of standing crop biomass or taxonomic diversity indices In addition, canal water return flows exhibited very little differences in biological populations from those of the natural streams receiving drainage waters (Otto, 1974) However, the receiving streams included the South Platte River and the lower reaches of its tributaries, all of which are classified as being of little habitat value to aquatic life (Bluestein and Hendricks, 1975) Of the canals receiving herbicide treatments (xylene and copper sulfate), Otto (1974) observed a monthly decline in species diversity with a rapid recovery when treatments were stopped Macroinvertebrate populations were immediately reduced following the application of xylene, but within 1 month they returned to previous levels Diatoms recovered more slowly (Otto, 1974) The results of the study indicate that herbicide applications produce localized, short-term decrease in nontarget organisms

The biota of the plains South Platte and the lower reaches of its tributaries support mostly pollution tolerant life forms (Bluestein and Hendricks, 1975) However, it has been projected that improvements in water quality would not significantly improve the aquatic habitat The aquatic habitat is limited by erratic flows, diurnal and seasonal temperature variations, a substrate consisting of shifting sand, and perhaps by a lack of bank cover (Bluestein and Hendricks, 1975) On the whole the impact of herbicides in agricultural return flows on the aquatic biota is probably not discernible due to the poor physical habitat

J Recreation

There is an acute need for water recreation opportunities for the Denver metropolitan area (BOR, 1967) Nearly two-thirds of the water-oriented recreation demands generated by the Denver metro area are presently unsatisfied by the existing available water surface area The C-BT reservoirs, totaling nearly 16,000 surface acres, provide a significant amount of the existing water-oriented recreation areas used by the major metropolitan areas identified in the report The total visitation at the project's 11 water-oriented recreation areas amounted to 740,819 visitor-days in 1976 This use is anticipated to increase in future years Impacts associated with this use are discussed below

(1) Providing water-oriented recreation opportunities contributes to

(a) Satisfying a significant portion of demand for power-boating, sailing, water skiing, fishing, canoeing, swimming, scuba diving, and related land recreation demands including picnicking, camping, nature study, and sightseeing

(b) Reduced travel distance for metro Denver residents seeking water-oriented recreation opportunities

(2) Recreation utilization within the C-BT development area does the following

(a) Stimulates the economic activity for goods and services in Grand and Larimer Counties This stimulation occurs primarily during the summer

(b) Gives Federal, State, and county outdoor recreation personnel an additional management load because of operation and maintenance of project-developed campgrounds and picnic areas

(3) The most common spinoff effect of storage reservoirs is the development of subdivisions for both primary and secondary houses adjacent to the project-owned lands Impacts related to these subdivisions include

(a) The conversion of agricultural lands to subdivision development

(b) Elimination of wildlife habitat and the displacement of game

(c) Sanitation disposal problems associated primarily with developments that are not on a centralized sewage treatment facility The problems are primarily caused by improper installation of septic tanks and leaching fields and exceeding the capacity of the land to handle sewage This leads to seepage into the ground water, and at times, into the reservoirs Such sewage problems are prevalent at Shadow Mountain Reservoir

(d) The need for additional law and fire protection facilities and personnel which have to be provided by the local governments

(e) The need for additional utilities and their installations Water wells are drilled, power distribution lines brought in, and sources of fuel found and stored for heating purposes

(f) Increased traffic and asociated problems of congestion and pollution

(4) Recreation-related businesses, including marinas, boat and motor stores, restaurants, motels, and fast-food service operations, have been established in the local vicinity of the C-BT reservoirs The spinoff effect of the reservoirs presence contributes to diversifying the local economic base The business mentioned above provide additional job opporunities related to providing services The local job opportunities curtail the outward migration of rural residents to major urban areas

(5) The C-BT reservoirs provide some of northeastern Colorado's needs for off-road vehicle use, hiking trails, open space for bicycling, picnicking, camping, boating, water skiing, stream fishing, and hunting The 1978 Colorado Comprehensive Outdoor Recreation Plan (CDPOR 1976) shows these needs to be significant

(6) The rooted aquatics, primarily Elodea, present a problem at Shadow Mountain Reservoir The increase in density and extent of rooted aquatics have inhibited both boating and fishing in the reservoir and created objectionable odors due to decay (EPA 1977a) These rooted aquatics decrease the quality of the recreation experiences and could decrease realization of the reservoir's full potential for satisfying recreation needs

k Aesthetics

The design and maintenance of some C-BT facilities may be considered incompatible with the surrounding aesthetic qualities For example, the silver colored penstocks above the ground contrast with the green vegetation In fall, the penstocks continue to contrast with the gold, orange, yellow, and green vegetative colors

Fluctuation of water levels in Green Mountain, Willow Creek, Granby, Horsetooth, and Carter Lake Reservoirs exposes a foreshore area that is devoid of vegetation The barren ground contrasts with the surrounding vegetation and is incompatible with the aesthetic qualities

The continual encroachment of development adjacent to reservoir project lands detracts from the natural qualities of the area Urbanization is diminishing the probability of finding solitude on and near the reservoirs

Part of the C-BT water is used for municipal and industrial purposes in cities The availability of this water helps sustain exotic vegetation in the semiarid area The trees, shrubs, flowers, and grass are integral aesthetic qualities of the cities Without the additional water, the city environment would revert to a semiarid type vegetation

l Cultural Resources

Since there has been no comprehensive survey of cultural resources associated with the C-BT system, no assessment of impacts can be made at this time Such an assessment will have to await the completion of surveys under Executive Order 11593

m Land Use

Because the C-BT system has been in full operation for 20 years, no new direct impacts to land are expected in the C-BT Project area

n Transportation

No impacts will be noticed in the transportation patterns of the C-BT Sevice Area The transportation systems are already well developed, and no new construction is currently planned in this area

o Utilities

The operation of the C-BT Project will not impact utilities in the project area beyond that presently occurring The C-BT system provides an average 230,000 acre-feet of water annually to East Slope water users for irrigation and M&I uses A recent trend has been the conversion of agricultural use to M&I through the purchase of C-BT water shares It is not possible to predict the scope or extent of this transition, but the inevitable impact is a loss of agricultural production in the C-BT Service Area

The C-BT system generates an annual average 596 million kilowatts of electricity for sale to preferred customers, primarily as peaking power This power generation is not expected to change as a result of C-BT operation

p Socio-Economics

The C-BT system has been operational since 1957 The preproject and post-project socio-economic impacts have already occurred Operating impacts, however, are still occurring and these are discussed in chapter II B 1

q Energy

The average annual energy consumption for the C-BT Project shown on Power Repayment Studies was slightly over 64,105,000 kWh during the 10-year period from 1967 to 1976 Energy is used at Willow Creek, Granby, and Flatiron pumping plants, Shadow Mountain Dam, Green Mountain Camp, and Flatiron Dispatching Center

The C-BT Project has six powerplants Big Thompson, Estes, Flatiron, Green Mountain, Marys Lake, and Pole Hill The average annual gross generation during the 10-year period from 1967 to 1976 is about 660 million kWh, leaving over 596 million net kWh of marketable generation The revenue received from the marketable generation will pay back nearly 80 percent of the cost to build the C-BT

C Windy Gap Project Preferred Alternative

1 Colorado River

a Hydrology

The Windy Gap Project will divert water primarily during April, May, June, and July when streamflow exceeds 90 ft^3/s Diversions would not occur when stream flow drops below 90 ft^3/s Pursuant to the Agreement Concerning the Windy Gap Project and the Azure Reservoir and Power Project (Intergovernmental Agreement (attachment 1), diversions cannot exceed 93,300 acre-feet in any 1 year, nor 683,000 acre-feet in any consecutive 10-year period Diversions can not exceed the pump rate of 600 ft^3/s

This diversion would deplete the average annual runoff of the upper Colorado River by about 54,000 acre-feet during the study period Table IV-1 illustrates the average diversion during April, May, June, and July for a 20-year simulated period Over 90 percent of the annual depletions would occur in May and June, and about 3 percent and 6 percent would take place in April and July, respectively During the driest year, 1977, no water would have been diverted because the amount of water legally available would have been uneconomical to pump

The net effect of these diversions would be to eliminate most of the peaks of the existing annual hydrographs in low and average water years and substantially reduce the peaks during wet years (see attachment 4) Consequently, the duration of 90 ft^3/s or less would increase for all years On the average, historic flows (1957-1977) would be reduced by 12, 63, 65, and 24 percent during April, May, June, and July at Hot Sulphur Springs Pre- and post project monthly flows at other locations along the Colorado River are shown in table IV-2

The DES presented an analysis of potential low flow in the Colorado River near Hot Sulphur Springs to evaluate the potential impact on the town's water and wastewater treatment facilities (WWTF) That analysis used the historical 7-day, once in 10-year low flow (7-Q-10) as the criterion for impact Since preparation of the DES, several mitigatory measures have been agreed to by the Subdistrict to mitigate those potential impacts These include

(1) increased minimum flows below the diversion point, as stated in attachment 2,

(2) assistance to Hot Sulphur Springs in upgrading their WWTF, as stated in attachment 1, and

(3) upgrading diversion facilities, including the intake to the treatment plant for the municipal water supply, also in attachment 1 The net effect of these measures, particularly number 1, is to maintain flows in the Colorado River at least

TABLE IV-1

Windy Gap Project Yields
(600 ft^3/s capacity)

Years	April	May	June	July	Year Total Yield
1		36,886	35,690		72,576
2		19,114	24,968		44,082
3		34,311	27,178		68,459
4	6,970	15,510	9,159		24,660
5		36,886	35,426		93,300(1)
6	20,988	12,240			12,240
7		25,599	12,850		38,449
8		36,886	35,690	20,724	93,300(1)
9		20,969	180		21,149
10		24,424	30,716	7,360	62,500
11		2,670	35,690		38,360
12		36,886	35,690	5,910	78,486
13		36,886	35,690	5,270	77,846
14	8,120	36,886	35,690	9,580	90,276
15	30	30,267	32,829		63,126
16		36,886	35,690	11,520	84,096
17	320	36,886	35,690	965	73,861(2)
18		18,360	31,658	10,360	60,378
19		15,810	5,560		21,370
20			49		
			0		490
Total Yield	36,428	514,362	496,525	71,689	1,119,004
Average Yield/ Month	1,735	25,718	24,826	3,584	55,950(3)

(1) Diversion in any 1 year is limited to 93,300 acre-feet

(2) Diversions in any consecutive 10-year period cannot exceed 683,000 acre-feet

(3) Total average annual diversion, including Middle Park allotment

TABLE IV-2

Historical, Preproject Streamflows, and Streamflows with the Windy Gap Project - Colorado River (Water Years 1958-1977)

(1000 acre-feet)

Location	Wet Year (1962) Preproject[1]	Wet Year (1962) Post-Project	Average (1958-1977) Preproject[1]	Average (1958-1977) Post-Project	Dry Year (1977) Preproject[1]	Dry Year (1977) Post-Project
Colorado River below Windy Gap Site						
October	14 7	14 7	9 1	9 1	6 4	6 4
March	6 5	6 5	7 5	7 5	5 0	5 0
April	26 9	5 1	10 8	9 1	9 0	9 0
May	68 9	32 0	39 9	14 2	13 7	13 7
June	47 7	12 3	38 1	13 3	8 7	8 2
July	19 3	19 3	12 6	9 0	9 0	9 0
August	5 1	5 1	6 5	6 5	7 1	7 1
September	6 6	6 6	5 4	5 4	4 8	4 8

Location	Wet Year (1962) Preproject[2]	Wet Year (1962) Post-Project	Average (1962-1977) Preproject[2]	Average (1962-1977) Post-Project	Dry Year (1977) Preproject[2]	Dry Year (1977) Post-Project
Colorado River near Kremmling, CO						
October	61 8	61 8	48 1	48 1	40 1	40 1
March	85 7	85 7	40 7	40 7	20 4	20 4
April	196 2	175 2	59 4	57 7	38 0	38 0
May	260 2	223 3	107 8	82 1	29 3	29 3
June	147 1	111 7	100 2	75 4	30 9	30 4
July	141 7	141 7	74 1	70 5	56 7	56 7
August	62 2	62 2	60 4	60 4	63 4	63 4
September	45 4	45 4	48 9	48 9	55 0	55 0

Location	Wet Year (1962) Preproject[2]	Wet Year (1962) Post-Project	Average (1958-1977) Preproject[2]	Average (1958-1977) Post-Project	Dry Year (1977) Preproject[2]	Dry Year (1977) Post-Project
Colorado River near Dotsero, CO						
October	119 7	119 7	80 1	80 1	73 3	73 3
March	120 6	120 6	69 1	69 1	38 7	38 7
April	333 3	312 3	108 6	106 9	66 9	66 9
May	528 8	491 9	274 2	248 5	88 3	88 3
June	431 9	396 5	306 9	282 1	97 0	96 5
July	282 7	282 7	158 2	154 6	80 6	80 6
August	106 8	106 8	96 8	96 8	84 3	84 3
September	70 5	70 5	78 9	78 9	73 3	73 3
Colorado River near Cameo, CO						
October	200 2	200 2	139 6	139 6	138 4	138 4
March	160 5	160 5	115 2	115 2	80 0	80 0
April	512 6	491 6	177 5	175 8	109 5	109 5
May	892 6	855 7	486 1	460 4	156 0	156 0
June	882 4	847 0	620 6	595 8	176 1	175 6
July	544 9	544 9	303 8	300 2	112 4	112 4
August	185 6	185 6	157 2	157 2	108 3	108 3
September	120 9	120 9	132 0	132 0	103 2	103 2

1/ Simulated preproject conditions (CORSIM II)

2/ Historical values presented because it was impossible to accurately simulate preproject conditions at these locations

near the historic minimum for the runoff period when diversions are being made The historic 7-Q-10 occurred during the non-diversion period This will be the case with Windy Gap operating Flows during the diversion season will remain well above the historic 7-Q-10 (45 ft^3/s) as outlined in attachment 2 As a result of the above referenced agreements, there will be no adverse impacts on either the operation of the water treatment facilities or the effluent limitations that the WWTF is required to meet

b Water Quality

The Windy Gap diversion may increase water temperature for a few miles downstream during warmer months and reduce the quantity of larger suspended solids in the river below the diversion dam The depletion of an annual average of 54,000 acre-feet of Colorado River water will increase salinity as far downstream as Imperial Dam These increases are projected to be insignificant Other water quality parameters will not be directly affected because of the short hydraulic retention time of the reservoir The reservoir is small and shallow and its water capacity could be emptied in less than 1 day's pumping

Indirectly, water quality in the Colorado River may change due to the relatively larger influence of the tributaries when Windy Gap is diverting The Williams Fork would have the greatest influence because of its large discharge Its water quality is high, therefore, the influence would not be adverse

The quality of the Colorado River will be affected, particularly during spring runoff, by Troublesome Creek downstream of its confluence with the Colorado Presently there is no data base to evaluate the effect of the Troublesome

The following describes the impacts on water temperature, sediment, and salinity Other factors will not be affected

(1) Water Temperature

It is possible that the reservoir water temperature will exceed incoming water temperatures when air temperatures are high (late summer and early fall) and pumping has ceased Persistent statification will not occur because of the shallow reservoir depth and short retention time As a result downstream water temperatures could increase by a few degrees This increase could be important because the river sometimes (based on records at Hot Sulphur Springs) reaches 24° C, which is near the upper limit for trout The warming effect would be detected only a few miles downstream, but this additional stress could have adverse effects on trout and trout fishing

Thermographs have been installed at three locations on the river These will allow the DOW and Subdistrict to detect and possibly correct any post-project temperature changes

(2) Sediment

The reservoir will trap some sediment, primarily the coarse fraction Consequently, the reservoir bypasses will be somewhat clearer than the inflow Studies by Ward (1981) indicate that the reservoir will trap 100 percent of the bedload and about 50 percent of the suspended sediment based on an analysis of yields for a typical year (1969) However, the bedload of the river is essentially negligible owing to the coarse nature of the river bed Suspended solids were similarly below the carrying capacity of the river with an average of 28 mg/l and a peak of 40 mg/l during the typical year, these would be reduced to 14 and 20 mg/l respectively with Windy Gap operating, if Ward (1981) is correct in his assumptions These primarily involve inflow concentrations, therefore, reductions through the reservoir and concentrations in the discharge would still approximate the percentages given above

Periodic (to be defined by Ward, In prep) dredging of the Windy Gap Reservoir would temporarily increase turbidity and sediment concentration downstream Ward (1981) discusses the rate of filling of the reservoir based upon field measured sediment loads, however, unusual runoff events or increased erosion from upstream development in the Fraser Valley could increase the sediment inflow

Dredged materials will be deposited in a borrow area between the reservoir and U S Highway 40 so that sediment will not drain back into the reservoir

According to Ward (1981), neither aggradation nor degradation downstream from the dam should be a problem Degradation often occurs downstream from dams because of the trapping of sediments in the reservoir Clear water releases then cause scouring of the river bed and consequent channel degradation However, Ward (1981) has shown that the river near the diversion site is consistently below its carrying capacity for sediment Furthermore, large-sized bed armor (median diameter of 3 4 inches [87 mm]) protects the underlying subsurface material from erosion The even larger material, which composes about 10 percent of the surface layer by weight (diameter of 4 3 inches [110 mm]) provides additional protection (Ward, 1981)

The fact that the river is consistently below its carrying capacity for sediment would also minimize any tendency for aggradation The provision of a flushing flow when needed will further inhibit any aggradation downstream from the dam

(3) Salinity

The diversion of high quality water from the upper Colorado River Basin leads to an increase in salinity in the lower basin because of the loss of diluting water The projected increase in salinity attributable to the Windy Gap diversion at three lower basin locations is shown below

Colorado River Salinity Due to Windy Gap Diversions

Total additional diversion = 54,000 acre-feet at 103 mg/l TDS

Salt removed = $\frac{(54,000)(103)}{735\ 29} = \frac{5,562,000}{735\ 29}$ = 7,564 tons/year

(a) Colorado River at Cameo, Colorado

Present Modified Conditions = 438 mg/l TDS (USDI, 1981)
With Windy Gap = $\frac{(1,505,000 - 7,564)(735\ 29)}{(2,525,000 - 54,000)}$ = 446 mg/l

Difference = 446 mg/l - 438 mg/l = 8 mg/l = 1 8 percent increase

(b) Colorado River at Lees Ferry, Arizona

Presented Modified Condition = 620 mg/l TDS (USDI, 1981)
With Windy Gap = $\frac{(8,456,000 - 7,564)(735\ 29)}{(10,030,000 - 54,000)}$ = 623 mg/l

Difference = 623 - 620 = 3 mg/l = 0 5 percent increase

(c) Colorado River at Imperial Dam, AZ-CA

Present Modified Conditions = 875 mg/l TDS (USDI, 1981)

Above Parker Dam $\frac{(9,844,000 - 7,564)}{(9,388,000 - 54,000)}$ = 1 0538 tons/acre-foot

Below Parker Dam (8,678,000 - 54,000)(1 0538) = 9,087,971 tons
(9, 184,000 - 9,087,971) = 96,029 tons

At Imperial Dam $\frac{(9,321,000 - 96,029)(735\ 29)}{(7,815,000 - 54,000)}$ = 874 mg/l

Difference = 875 mg/l - 874 mg/l = 1 mg/l = 0 1 percent increase

The economic impacts due to the above salinity increses can be ascertained from Kleinman and Brown (1980) Using their impact curve, Windy Gap would cause an annual economic impact of about $343,000 (1976 dollars) at Imperial Dam

Mitigation for this impact along with impacts caused by other upper and lower Colorado River Basin depletions is being handled by the Colorado River Salinity Control Project (USDI, 1981)

c Aquatic Biota

This section addresses the effects on fish, aquatic vegetation, and benthos Most of this analysis is concerned with three reaches of the upper Colorado River (1) The proposed Windy Gap diversion dam to the confluence with the Williams Fork, (2) the confluence of the Williams Fork to Troublesome Creek and (3) Troublesome Creek to the town of Kremmling (see figure IV-1) These reaches were defined based on the quantity of tributary inflow, sediment load, and water quality Stream mileages and acreages are illustrated in table IV-3 Aquatic biota was not analyzed below the confluence with the Blue River because it would not be significantly impacted by the Windy Gap Project

The primary causes of impact are (1) Construction of the diversion dam, and (2) operations associated with the removal of water, manipulation of water in the Windy Gap Reservoir, and periodic dredging of the reservoir These activities will affect aquatic habitat by (1) Inundating the riverbed and replacing it with a reservoir, (2) changing the flow volume and flow regime in the Colorado River downstream of the dam with attendant changes in depth, velocity, and percent of wetted riverbed, and (3) potentially adding sediment loads to the river during reservoir dredging

(1) Construction Impacts

Dam and reservoir construction will disturb about 0 92 mile of stream bed Two temporary and one permanent cofferdam would be constructed This 0 92 mile of stream length is about 1 7 percent of the river between Windy Gap and Kremmling or 2 3 percent between the confluence of the Fraser and the confluence with Troublesome Creek

About 0 1 and 0 25 mile of the river channel will be dewatered during the first and second construction season, respectively Most or all of the aquatic productivity in the dewatered area will be temporarily lost Portions of the aquatic productivity of the riverbed downstream will also be temporarily affected because of the increased sediment The worst case condition would be a 100 percent loss of productivity of 9 acres for 1 year and 25 percent loss of productivity for 2 miles downstream of the dam The result would be a loss of 13 5 acres or about 6 percent of the productivity for 1 year between the Fraser River and Troublesome Creek Factors which would lessen the worst case condition would be the drift of disturbed benthic organisms downstream and trout movements up and downstream of the disturbed area It should take about 3 years for

TABLE IV-3

Stream Miles and Acreages Along the Colorado River
From the Mouth of the Fraser to Kremmling

Colorado River Section	Fraser River to Windy Gap Dam	Fraser River to Williams Fork	Williams Fork to Troublesome Creek	Troublesome Creek to Blue River Mouth	Total
Distance in Miles	0 92	14	7 5	8	29 1/2
Approx Average Width of Section	80	80	100	120	
Acres/Stream Mile	9 7	9 7	12 1	14 5	
Acres Total Section	9	136	91	116	343

dewatered areas to regain their preproject productivity, especially for species such as P californica which has a 2-3-year life cycle A stretch of river 50-75 yards downstream of the dam would fall into this category It would be less than 1/2 acre or less than 1/4 percent of the similar habitat between the dam and Troublesome Creek

(2) Operational Impacts

Operational impacts are associated with pumping Colorado River water to Lake Granby Fluctuations in the quantity and pattern of stream flow below the dam is the major variable which would cause environmental impacts These fluctuations are discussed under the hydrology section The impacts on trout migration, aquatic life within the reservoir area, aquatic habitat, aquatic vegetation, benthic life, and fish are described herein

(a) Trout Migration and Movement

The dam will prevent the upstream movement of fish Downstream movements will be facilitated through the bottom release of minimum stream flows or via the spillway when flow is greater than the capacity of the pumps and the river outlet works combined

To ascertain the trout movements, tagging and shocking studies were conducted These studies are not conclusive but do give an indication of movements Only brown trout were tagged because they are the most abundant species in the vicinity of Windy Gap (based on shocking studies done in 1975-1976) There is no direct information on rainbow trout movements in the vicinity of the dam

Based on the 1975-1976 data (Dames and Moore, 1977a) and DOW sampling stations, rainbow trout become dominant from about the mouth of Drowsy Water Creek (3 1 miles downstream of Windy Gap) This dominance continues downstream

Data from tag/recovery studies on Willow Creek indicate that some brown trout could swim from below the dam site and spawn in Willow Creek, however, the numbers would be small based upon recovery data

Despite the apparent lack of hard data on trout movements, especially rainbow trout, the DOW indicates that Windy Gap will not interfere with significant upstream movements This conclusion is based on DOW's experience on the Colorado River and experience with tagging studies of rainbow trout on other rivers in Colorado

Based upon the above, Erickson (1980) concludes that there is likely to be some interference with upstream movements of

brown trout, however, the number of fish affected will be small and will not significantly affect trout populations above the reservoir It is also possible that some of the trout populations which develop in the reservoir may migrate upstream into the Colorado and Fraser Rivers in the fall and spring The extent of this upstream migration is presently unknown However, any sexually mature trout in the reservoir will seek the appropriate current and spawning gravels during the spring and fall and thereby partially or completely replace any fish blocked by the dam

(b) Effects on Aquatic Life Within Reservoir Area

Windy Gap Dam would replace 10 acres of permanent stream with an 112-acre reservoir Full benthic colonization of the reservoir would probably take several years The colonizing species would be slow water, sediment loving organisms as opposed to the faster water, solid substrate forms such as Pteronarcys californica which currently occupy most of the river P californica is an important food source for trout Actual benthic, and consequently trout, productivity would depend upon the degree and rate of water level fluctuation Nehring (1979) estimated that about 150 pounds per acre (probably ranges between 100 to 150 lbs) of trout are produced in the river below the dam Conservatively low post-project trout production would approach 50 pounds per acre if we assume lower benthic productivity in the slower moving water and a larger population of rough fish As a result, about 5,000 pounds of trout would be produced in the reservoir versus about 1,000-1,500 pounds which exists in the inundated stream

This comparison of losses and gains assumes a productive surface area of about 100 to 112 acres Present plans assume a full reservoir for recreation and operational reasons However, it is reasonable to assume that 10 percent of the reservoir bottom will be alternately wet and dry This alteration would reduce productivity of the reservoir by about 10 percent and result in a total reservoir trout production of about 4,500 pounds There would also be some trout drawn into the pumps and transported to Lake Granby The pump intake would be located near the reservoir bottom At maximum pump capacity water will be drawn into the 48-inch intake at 0 8 feet per second A trashrack would be placed over the intake The quantity of organisms diverted has not been ascertained

Drifting benthic life and smaller fish would be most easily diverted This loss of benthic life would be small because the still-water organisms would exhibit little tendency to drift Some small trout would also be diverted Erickson (1980) estimates that about 5 percent of the potential trout productivity of the reservoir would be reduced by entrainment into the pump intake

(c) Aquatic Habitat Downstream of Windy Gap

Aquatic habitat has two essential physical components (1) Hydrology (consisting primarily of flow, depth, and velocity), and (2) substrate The stream banks with their overhanging vegetation are also an important component of the physical and biological habitat for some fish species The following discusses the impacts on the components of aquatic habitat for each of the three river sections

Table IV-2 illustrates river mileages and approximate acreages of the river sections Figures IV-2 to IV-5 show typical sections of the Colorado River between Windy Gap and Kremmling

(aa) Hydrology (Flow, Depth, and Velocity)

When Windy Gap is in full operation, flows would approximate those shown in attachment 4

Physical data were collected at several river locations in order to predict depth, velocities, and wetted perimeters for various flows Examples are discussed in Erickson (1980) Tables IV-4 and IV-5 show changes in average depths, velocities, and wetted perimeters for "critical" riffle areas between Windy Gap and the Williams Fork and from the Troublesome Creek to Kremmling

Generally, depths, velocities, and wetted perimeters would decrease from equivalent historic values during the pumping period The following discusses specific impacts on flow, depth, and velocity in the three study reaches

Windy Gap to the Williams Fork

In this stream section, minimum flows would be 90 ft^3/s or the "run of the river" whenever the discharge falls below 90 ft^3/s as measured at Windy Gap

During low flow years (e g 1964, 1966, 1968, 1976, and 1977) the highest flows below Windy Gap ranged between 400-600 ft^3/s These flows would be reduced to 90 ft^3/s with Windy Gap or natural flow, except for brief periods Average depth, velocity, and wetted perimeters over critical riffles at 90 ft^3/s would be 0 9 foot, 1 2 feet/second, and 73 percent, respectively

Based on predicted values, average velocities would increase about 0 3 foot/second, average depth would increase about 3 inches, and average wetted perimeter would increase about 13 percent, as flow increases from 90 to 160 ft^3/s

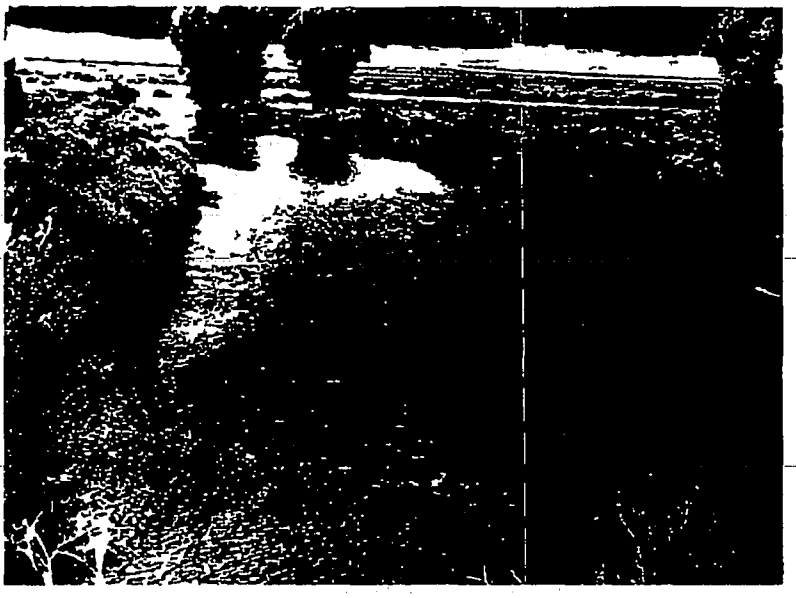

Figure IV-2 Colorado River between Windy Gap and Hot Sulphur Springs



Figure IV-3 Colorado River between Hot Sulphur Springs and Troublesome Creek (Byers Canyon)



Figure IV-4 Colorado River between Hot Sulphur Springs and Troublesome Creek



Figure IV-5 Colorado River between Troublesome Creek to Kremmling

TABLE IV-4

Summary of Changes in Average Velocity, Depth, and Wetted Perimeter of Critical Riffles on the Colorado River Between Windy Gap and the Williams Fork[1/]

Flow	Average Velocity (f/s)	Average Depth (feet)	Percent Wetted Perimeter
60 ft3/s	1 03	0 68	69
75	1 13	0 80	71 7
85	1 16	0 86	72 3
90	1 19	0 88	73
100	1 23	0 93	74
160	1 58	1 14	86

1/ Based on Colorado Division of Wildlife Data at three critical riffles, 1977 and 1979, using the R2-Cross Method

TABLE IV-5

Summary of Changes in Average Velocity, Depth, and Wetted Perimeter of Critical Riffles on the Colorado River Between Troublesome Creek and Kremmling[1/]

Flow	Average Velocity (f/s)	Average Depth (feet)	Percent Wetted Perimeter
90 ft^3/s	0 76	1 07	52
100	0 77	1 20	56
120	0 80	1 20	62
140	0 87	1 34	73
160	0 92	1 4	72
213	1 0	1 6	85

1/ Based on Colorado Division of Wildlife Data at one critical riffle, 1977, using the R2-Cross Method

Williams Fork to Troublesome Creek

Minimum flows in this stream section would be maintained at 135 ft^3/s while Windy Gap is pumping or "run of the river" whenever the dischargs falls below 135 ft^3/s Measurement would be made by gaging station below the Kinney-Barriger Ditch Depths, and velocities at several flows were measured at three transects These measurements are shown in attachment 4 C Additional bypasses may be necessary at the diversion dam to increase the flow to 135 ft^3/s in this reach

The Williams Fork strongly influences flows and other parameters in this reach of the Colorado River This influence is due to the need to satisfy the senior downstream water rights of the Shoshone Powerplant (1,250 ft^3/s and the Grand Valley Ditch (2,000 ft^3/s) The flows of the Williams Fork at the confluence with the Colorado River have ranged from 15-420 ft^3/s Below the mouth of the Williams Fork, the Windy Gap Project would affect flows that exceed 135 ft^3/s under preproject conditions At 135 ft^3/s riffle velocities would range from 1 5 to 3 6 feet/second, maximum depths would range from 0 9 to 1 6 feet in riffles and 1 5 to more than 3 feet in pools and runs

Troublesome Creek to Kremmling

Minimum flow in this reach is 150 ft^3/s or preproject flows -- whichever is less The DOW considers this reach less productive and less important than the upper reaches because of its poorer habitat Only one transect at a "critical" riffle was available to estimate desirable depths and velocities for this reach Consequently, there is less certainty of flow predictions for this reach Estimated velocities and depths are shown in table IV-5

(bb) Substrate

The following discusses the impacts on substrate in the two reaches of the river that have distinctively different substrate characteristics

Windy Gap to Troublesome Creek

Bedload materials would be partially blocked by the dam and finer bed materials could increase below the dam due to decreased flows and velocities Ward (1981) indicates no degradation of the streambed below the dam and no significant increase of fine sediment in riffles The hydrologic analysis indicates that riffle velocities would still be high during minimum flows Velocities

would range from 0 9 to more than 3 feet/second in riffles and 1 to 2 feet/second in much of the river except pools, edges, and backwaters Flows of 400 to 2,100 ft^3/s and attendant higher velocities would occur in 8 out of 16 years In addition, the minimum flow agreement with DOW specifies a 450 ft^3/s release at Windy Gap for 50 hours or its equivalent every 3 years, if normal flows fail to provide such a flow

It is probable that riffles would remain as they are, but there would be some deposition of fines in areas where velocities are marginal in keeping fines suspended Deposition would vary yearly commensurate with discharge

Troublesome Creek to Kremmling

Since much of this lower reach has a sandy bottom, it is possible that sand could deposit further upstream due to lower flows A worst case condition would be the replacement of some gravel and cobble in this reach and consequently poorer physical habitat for benthic life and trout The extent of this possible effect is unknown Factors which would tend to reduce sand accumulation would be (1) Blockage of some fine sediments originating above Windy Gap, and (2) periodic flushing flows due to natural runoff or flows specified in the minimum flow agreement Whether these factors would be sufficient to prevent sand and fine sediment deposition is presently unknown

(d) Aquatic Vegetation

Aquatic vegetation could be affected by (1) A reduction in total available nutrients, but not the concentration of nutrients originating upstream of Windy Gap, and (2) changes in stream hydrology or morphology Nutrient concentrations would not change due to Windy Gap, however, increased development in the Fraser Valley may increase concentrations in the river and thus contribute to vegetative growth

Growth of attached and rooted vegetation could be affected by modifications in stream hydrology The net result of flow changes would be the lessening of scouring of dead and loosened algae during moderate runoff years The sloughing is likely to extend for a longer period than preproject Below the dam there should be no major change in species diversity or abundance A pre- and post-project study has been initiated to determine project impacts

Reservoirs (even small ones) tend to provide a physically stable habitat for algae Consequently, a planktonic algal community will develop in the diversion reservoir Some of these algae will be released to the river with the bypass

flows This source of drift could to some extent enhance the productivity of the downstream reaches of the river

(e) Benthic Life

The factors that affect benthic life are similar to those affecting fish life, however, benthic organisms are more dependent on substrate As mentioned previously, Windy Gap will reduce velocity, depth, and wetted perimeter during a portion of the diversion period Velocity and wetted perimeter are most important to benthic life Depth is not important in riffles as long as the substrate is submerged Velocity helps to maintain a preferred substrate and carries food and oxygen The agreed upon minimum flows would provide adequate velocity for oxygen replacement and food delivery between Windy Gap and Kremmling (Erickson 1980)

Based upon Water Surface Profile predictions, there will only be a minor loss of wetted perimeter as flows are decreased Therefore benthic life will not be significantly affected by this factor

Observations and analysis by Ward (1981) indicates that there will not be a significant aggradation of fine sediment due to reduced spring flows In addition, the minimum flow agreement will provide "flushing flows" and thus reduce any tendency for sediment deposition

Based on the above, benthic life in the upper two study sections should not be significantly affected In particular no significant decline in Pteronarcys californica in the upper two sections are anticipated because

P californica feeds on detritus and vegetation No change in this food base is expected Their preferred habitat is large gravel and cobble Sediment transport studies (Ward, 1981) indicate no major change in existing substrate In addition, ample areas of high velocities at minimum flows will remain

Any significant increase in the present peak water temperature of 24° C could adversely affect P californica in a short stretch below the dam The specific impact on water temperatures has not been ascertained As discussed in the water quality section, water temperatures will be monitored to determine effects

There is the possibility (Ward, 1981) of sands and finer materials in the lower study reach advancing upstream due to reduced flows Whether this will actually happen is unknown, if it does occur in areas covered with gravel-cobble substrate, benthic life would be greatly reduced

(f) Factors Limiting for Fish Life

There would be direct and indirect impacts on fish life due to reduced flows During the months of April-July, there will be direct effects on wetted perimeter, depth, and water velocity Reduced flows will indirectly affect fish food, water quality, and the streambed The magnitude and significance of impacts would depend on the fish species and life stage

In order to determine impacts Erickson (1980) examined Windy Gap's effects on the factors limiting fish populations The potential limiting factors are water quality, food, cover, current, spawning areas, and nursery areas Although some aspects of these factors have been previously discussed they are analyzed herein in more specific terms related to fish life

(aa) Water Quality

Present water quality does not appear to be limiting for any life stage With Windy Gap summer and early fall river temperatures may increase due to reservoir warming The uncertainty and monitoring associated with possible temperature increases has been previously discussed A few degree rise above 24° C could decrease growth rates and cause lethargy Any temperature increase should not be detected more than 2 miles downstream of the dam depending on the duration of warming A worst case would be a 10-day period of poor fish growth or about 5 percent of the growing season Fishing would be poor during this period

(bb) Food Supply

The existing food supply is plentiful based on benthic samples and the excellent condition of fish Currently, food is not limiting and Windy Gap is not likely to affect food production (especially benthic life) in the upper two river sections From Troublesome Creek to Kremmling food may be limiting because of the poor substrate There may be decreased fish growth, if sand and silt deposition increases below Troublesome Creek where cobble and large gravel are lacking This possibility has not been quantitatively estimated

(cc) Cover

Depth and other cover-related factors such as boulders, undercut banks, and low overhanging trees and bushes could be limiting factors, especially for brown trout Such factors in the Colorado River in the Windy Gap to Kremmling reach are not considered ideal, but Erickson (1980) does not believe them to be limiting

Negring (1979) came to the conclusion that the limiting or "critical" factor for both rainbow and brown trout was adult habitat, as defined by the USFWS Instream Flow Group preference curves The densities of trout per acre are not high, however, (100-120/acre Nehring, 1979) Observations by Erickson (1980) led him to conclude that there is adequate cover for greater densities in many areas of the river He postulated that the normal low flows of 50-60 ft^3/s provide the critical limits in terms of cover, particularly of smaller fish that are subject to predation Under conditions of Windy Gap the boulders, undercut banks, and low overhanging trees and bushes will not change nor will cover in terms of depths and velocity at non-pumping times (September to mid-April)

Depths normally experienced during spring and much of the summer will decrease with Windy Gap pumping Based upon the stream transects shown in attachment 4 C (which apply to the Colorado River from Williams Fork to Troublesome Creek) and based on field observations and the assumption that the channel shape and hydraulic values in the upper river section of river is similar for a 90 ft^3/s flow as the mid-section is for 135 ft^3/s, the adult habitat for trout does not appear to be limiting significantly more than it is at present On this basis no significant change in cover was foreseen as long as the recommended bypasses, including flushing flows, are maintained

(dd) Spawning, Incubation, and Nursery Areas

Existing data (Erickson, 1980) indicates that the number of young trout is small compared to the number of large older fish These data would suggest poor spawning, incubation, nursery conditions, or excessive mortality According to Erickson (1980), it appears that spawning areas may be limiting in portions of the river Some spawning areas that would otherwise be available to spring spawning rainbows may be lost because of lower flows However, at 90 ft^3/s there is an average of 11 inches of water over critical riffles and 73 percent of the preproject wetted perimeter Depth and wetted perimeter would increase by 10 percent at 160 ft^3/s The mid-section of the river would average 1 foot depth over the riffles at 135 ft^3s

Brown trout spawning occurs in the fall and therefore, would not be impacted because Windy Gap would not be diverting

Data is lacking on predation of young trout, however, Erickson (1980) does not believe that lowered flows will significantly increase predation

The middle and lower study sections will receive significant volumes of water from the Williams Fork However, the fishery in the lower section is of lesser value than the upper sections There is insufficient data on the lower section to discuss specific impacts to the fishery

(q) Summary of Impacts of Lowered Flows on Trout

The negotiated minimum flows for all three stretches are considered to be adequate to maintain the existing fishery No enhancement will occur

These minimum flows are based upon the analysis of physical data measured at various transects in the study reaches and the comparison of these data at different flows with known requirements of rainbow and brown trout at various life stages The U S Fish and Wildlife Services' Instream Flow Methodology, additional data analysis gathered from R2-Cross transects, and comparisons of physical data to known requirements of trout were used by Erickson (1980) and the DOW to predict weighted usable area for fry, juveniles, and adults and spawning and incubation (see attachment 4 b)

Based upon Water Surface Profile data processed by the Instream Flow Group's Habitat Program, optimum flows for incubation, fry, and juvenile habitat ranged from 75-115 ft^3/s Optimum flow for adult rainbows is 300 ft^3/s and 244 ft^3/s for adult brown trout

The DOW is interested in maintaining the existing fishery with a slight bias for large fish Nehring (1980) in his instream flow analysis of the reach from the Williams Fork to Troublesome Creek stated " it is not possible to fall below 140 ft^3/s in a minimum flow recommendation and still maintain the trout fishery in this section of the Colorado River in its present state "

However, the results of the Habitat analysis for two sets of transects in this stretch are somewhat less restrictive Analysis of the Ritschard/Stewart Ranch (attachment 4 c) transect shows little difference in usable spawning, fry, or juvenile habitat between 80 and 160 ft^3/s of streamflow There is a marked increase of incubation habitat as flow exceeds 80 ft^3/s, however, spawning habitat is less available than incubation area, therefore, spawning area is limiting Adult rainbow trout habitat increases with flow from 80 ft^3/s to 300 ft^3/s (1 33 x 10^4 ft^2 at 80 ft^3/s, 1 57 x 10^4 ft^2 at 135 ft^3/s, and 1 67 x 10^4 ft^2 at 180 ft^3/s)

Analysis of the Hill/Mayhoffer Ranch transect (below the Kinney-Barriger Ditch, attachment 4 c indicates a trend for rainbow trout habitat which is similar to the Ritschard/

Stewart Ranch transect However, adult habitat increases more as flow exceeds 80 ft^3/s From 135 to 180 ft^3/s adult habitat changes from 3 9 x 10^4 ft^2 to 4 3 x 10^4 ft^2 or about 10 percent versus 6 percent for the Ritschard/ Stewart Ranch transect

Brown trout adult and spawning habitat exhibits little change as flow varies from 135 ft^3/s to 180 ft^3/s For the same range fry habitat declines somewhat and incubation area increases sharply Transect data do not indicate much change in average flow, depth, or wetted perimeter between 120 and 140 ft^3/s Trout habitat is not significantly enhanced between 160 and 180 ft^3/s based on an extrapolation from the 120-140 ft^3/s range

If the adult habitat were limiting, a significant portion of the adult population would be forced into less favorable habitat An indicator of this effect would be reduced average size and growth rate DOW data and observation of the condition of fish caught by anglers and during electroshocking indicate that the growth rate of adult fish is good compared to highly productive portions of the South Platte River below Cheesman Reservoir This indicates that adult habitat is not limiting to the existing trout populations in the upper Colorado River

d Threatened and Endangered Species

The section 7 endangered species consultation has been completed on the Windy Gap Project The FWS issued a biological opnion on March 13, 1981 that indicated the project would not jeopardize the continued existence of any endangered species During the consultation process (outlined in chapter V) FWS biologists analyzed the impacts of Windy Gap depletions on the habitat of the Colorado River squawfish and humpback chub The bonytail chub was not considered in this analysis because it is no longer thought to occur in the impact area

The FWS determined that Windy Gap depletions alone would not reduce the likelihood of survival of the squawfish or humpback chub They did determine that project depletions would hinder recovery of the two fish To offset this effect the FWS recommended conservation measures which would aid in recovery of the endangered fishes The measures include funding for habitat modification and monitoring and 3 years of research The Subdistrict has agreed to fund the conservation measures recommended by the FWS For more detailed information on the endangered species analysis, see the biological opinion in attachment 2

The conservation measures proposed by the FWS have been agreed to in principle by the Bureau of Land Management,

Colorado Division of Wildlife, Forest Service, and the Corps of Engineers The details regarding the implementation of the mitigation measures will be worked out by Water and Power, FWS, and the Subdistrict over the next 2 months Any environmental compliance required by the conservation measures will be addressed when the measures are delineated

The razorback sucker occurs in essentially the same area of the Colorado River as the Colorado River squawfish and humpback chub The impact of Windy Gap depletions to flows in this area were shown to be negligable, thus the project, is not expected to significantly affect the razorback sucker It should be noted that the conservation measures recommended to aid the recovery of the squawfish and chub will also provide additional information on the razorback sucker

Fish are thought to be an important source of food for bald eagles wintering on the mainstem Colorado River This is also true for the eagles attempting to nest along the river The project is expected to have little or no effect on fisheries in the mainstem for the following reasons analysis of stage changes in the river with and without Windy Gap depletions indicate negligable effects to aquatic habitat, Windy Gap depletions occur from April through July and diversions are not made during low runoff years, the downstream impact of Windy Gap depletions are lessened by tributary inflow, and existing minimum flows between Windy Gap and Dotsero are controlled by a 1,250 ft^3/s senior water right at the Shoshone Powerplant Thus, neither wintering bald eagles nor those attempting to nest along the river will be significantly impacted by the project

The biological opinion on the Windy Gap Project indicated that the project would not jeopardize the existence of bald eagles

2 Windy Gap Development and Service Area

This section discusses the environmental impacts of the Windy Gap Project on the Windy Gap development and Service Area The impacts on the development area are restricted to areas which would be affected by construction activities, primarily, the diversion dam, pumping plant, and pipeline The impacts on the Service Area are restricted to the areas encompassed by the five cities and PRPA Operational impacts are primarily associated with Colorado River and C-BT development and Service Areas The impacts on these areas are discussed under seperate sections in this chapter The detailed impacts due to PRPA's Rawhide Powerplant are discussed in the DES and PRPA (1978) These detailed impacts are not repeated in this document because the impacts have not been modified from the discussion in the DES and PRPA (1978), the powerplant has received all

necessary environmental clearance from the State and is under construction, and powerplant construction and operation is not contingent upon Federal involvement Therefore, only a brief description of the major environments affected by Rawhide is presented

a Air Quality

The only impacts on air quality anticipated during construction of the Windy Gap facilities are increased local levels of dust and exhaust emissions These impacts will be minor and temporary A fugitive dust permit has been acquired

Once the Windy Gap Project is operational, it is anticipated that there will be no measurable effect on air quality

The evaporation from the reservoir and the evapotranspiration from the vegetation in the Service Area may cause a more humid condition within given micro-climates High evaporation will slightly increase the rapidity of cooling in the evenings Because of the frequency of winds, both in the mountains and on the plains, no significant change in local humidity is expected Based on the same rationale, no significant change in temperature is expected

Stearns-Rogers (1978) performed an air quality impact analysis on the Rawhide Powerplant Based on their dispersion modeling, the Rawhide Powerplant plume will not interact in a measurable way with any other major sources of pollution in the region Ambient air concentrations for SO_2 and NO_x were too low to measure outside of a 4-mile radius of the Rawhide site

b Physiography and Geology

Some Windy Gap site preparation will be required for the proposed diversion dam, reservoir, and pumping plant In addition, trenching and the subsequent burying of the pipeline will be necessary None of these activities will cause significant impacts on the geological characteristics of the Windy Gap development area

Operation of the Windy Gap Project will have no measurable effect on geological characteristics of either the development area or the Service Area The size and expected fluctuations in water levels of the diversion reservoir will be such that it will be generally confined to the existing riverbed and therefore will have very little effect on erosion patterns

c Water Quality

(1) Ground Water

Two-thirds of the Windy Gap water is allocated to municipal users As is the case with the C-BT, municipal use should have no impact on ground-water quality There had been a proposal

to sell Windy Gap water to agricultural interests on an as available basis Given the high cost of Windy Gap water, agricultural use is extremely unlikely If this is true, there should be little impact on ground-water quality due to agricultural use of Windy Gap water

PRPA has assessed the potential for ground-water contamination from the Rawhide Powerplant cooling pond and waste disposal areas The assessment is described in detail in PRPA (1978)

Based on PRPA (1978) the cooling will not have a significant effect on ground-water quality because of (1) The very small water quantities that are expected to exfiltrate, (2) the dilution that will take place as exfiltrated water moves through the soil and mixes with existing ground water, and (3) the low quality of ground water already at the site

Seepage from the coal storage area may contain trace elements such as heavy metals in concentrations that are higher than existing ground water within the site This is not expected to have a significant impact, however, because of the small amount of water that will come into contact with the coal and the small amount of seepage that can take place through the consolidated Pierre Shale that underlies the coal storage area

The bottom ash storage ponds will contain sluice water, bottom ash, and discharges from the water treatment systems These ponds will be excavated in Pierre Shale, a very tight impermeable material Seepage will be slight, and any permeable layers will be treated to reduce seepage No significant effects on ground-water quality are expected from these ponds

Additional potential sources of ground-water contaminants are the ash and flue gas cleaning wastes that will be disposed of in the solid waste disposal area These wastes will also contain heavy metals The stable form of these metals in the ash will be as oxides, which for most metals are completely insoluble in water and can be expected to remain inert in the ash or flue gas cleaning wastes Oxides of other elements, notably barium, boron, fluoride, and vanadium, are partially soluble and can be expected to be dissolved to some extent in any water with which they come in contact

The ash and flue gas cleaning wastes will be landfilled, covered with approximately 2 feet of earth, and then revegetated Berms will be built around this solid waste disposal area to prevent any offsite water (runoff) from entering During the landfilling operations, temporary berms will be built downhill of the immediate working area to catch any rainfall runoff These provisions, together with the low annual rainfall at the site, are expected to result in no significant seepage or leachate from the waste disposal area

No significant additional impacts on ground-water quantity or quality would be expected when the Rawhide Project is expanded to 750 MW

d Soils

Potential impacts of site preparation and construction on the soils of the Windy Gap development area will include disturbance and displacement of soil and subsurface material and temporary erosion from exposed areas This will reduce the productive capability of the soil and cause a loss of vegetation The following tabulation quantifies the extent of soil disturbance

Structure	Area	Estimated Volume	Action
Diversion Reservoir	112 Acres	107,800 yds^3	Removed
Diversion Dam	3 4 Acres[1]/	107,800 yds^3	Placement
Pipeline	34 4 Acres[2]/	55,850 yds^3	Removed
Surgeline	1 7 Acres	2,790 yds^3	Removed
Outlet Structure[3]/			Placement
Highway Widening[3]/			Placement

Materials from the diversion reservoir will be placed on the dam embankment Approximately 50,000 cubic yards will be displaced by the presence of the 9-foot-diameter pipeline This material will be placed in one or more of the following locations

(1) At the downstream end of the line, the waste would be used to reclaim some of the swampy areas near the present sanitary landfill

(2) Used in widening the highway along the reservoir edge (this action has been requested by the Highway Department)

(3) Near Willow Creek immediately northeast of the pipeline crossing

(4) At the outlet end, the old borrow area for embankment material used in Granby Dam

1/ Surface area of downstream face only
2/ Assumes average of 50-foot-wide disturbance area
3/ Areas and volumes of disturbance are not known and will depend upon the amount of excess material displaced by the pipeline

Impacts upon these areas will depend upon the amounts and method of placement and swelling characteristics of the displaced material The erosion control and soil reclamation procedures, outlined in the Reclamation Plan (Dames and Moore, 1978) and in Colorado Mined Land Reclamation Permits required by BLM and USFS, will be used

Construction activities will remove the areas discussed above from agricultural production and grazing for the duration of the disturbance The degree of erosion resulting from construction activities will depend upon timing of operations, duration of construction activities, and weather conditions

The principal impact on soils in the Windy Gap development area from project operation will involve soils affected by the fluctuating reservoir water level Soils on the upper end of the reservoir, where frequent flooding occurs or where the water table rises near the surface, will become waterlogged and not support vegetation

Other minor soil disturbances will occur if operational pipeline maintenance requires reopening the trench and removing the pipe for repair

e Vegetation

The construction of the Windy Gap diversion structure, reservoir, and appurtenant facilities will impact approximately 152 acres One hundred and twelve acres will be inundated by the reservoir Of this number, 10 percent is riparian vegetation, 10 percent is river channel, and the remainder is pasture (Dames and Moore, 1977a) Approximately 36 acres of sagebrush-shrub habitat will receive damage from excavation and construction of the pipeline to Lake Granby This impact will be temporary since the pipeline is to be buried and the disturbed areas revegetated with naturally occuring plant species (Dames and Moore, 1978) Some physical damage to existing flora will also occur as a result of the construction equipment, but this should be short-term and replaced by natural and artificial vegetation (Dames and Moore, 1978) Four acres of sagebrush-shrub habitat and river bed will be permanently covered by the diversion structure

Construction of the Rawhide Powerplant will disturb or eliminate about 1,000 acres of shortgrass prarie Those areas not occupied by structures will be reseeded with grasses (see PRPA, 1978)

f Wildlife

The following analysis was performed by Dames and Moore (1977a) The most significant impact to wildlife would occur to those species normally associated with riparian habitats Approximately 0 7 linear miles of stream habitat would be inundated by the Windy Gap diversion dam, and the least mobile wildlife in this area

would drown Those species able to retreat from the rising water would be forced into already occupied similar habitats where inter- and intra-specific competition for living space would be increased

There would undoubtedly be some resulting loss of wildlife, but the extent is unquantifiable The wildlife groups receiving the greatest impact include fossorial species, ground-nesting birds, and various predator species The nature of the impacts would be direct mortality, loss of nesting and brooding habitat, and reduced prey densities The diversion reservoir would increase the surface area of open water available to wildlife and should result in an increased density of waterfowl, amphibians, and certain mammal species associated with this type of habitat

Site preparation and construction will affect wildlife primarily in terms of habitat destruction Approximately 112 acres of riparian woodland and associated pasture habitat will be eliminated by construction of the Windy Gap diversion dam and reservoir Pipeline and road construction will remove about 36 acres of sagebrush

Baseline data indicates that the riparian woodland habitat supports a more diverse terrestrial vertebrate fauna than either the coniferous forest or sagebrush habitats The sagebrush habitat was shown to have fewer vertebrate species utilizing it for feeding and reproduction

On a per unit area basis, habitat removal in and near the Windy Gap diversion dam and reservoir will have a greater impact than will habitat removal along the pipeline, since more species will be affected For example, 26 bird species were observed as breeding residents in riparian woodland habitat and only seven breeding species were recorded for the sagebrush habitat Both willow shrubs and cottonwood groves grow at the site of the diversion dam and reservoir and nearly all of the 26 breeding species use either of these microhabitats However, these woody species readily reproduce themselves in favorable situations and will probably become established along the perimeter of the reservoir

Pipeline construction may stress and otherwise adversely affect the welfare of the local population of Sage Grouse, including an apparent strutting ground in sagebrush habitat along the route The pipeline will cross the potential strutting ground in the center of section 19, T2N, R77W

Mule Deer were reported to migrate to and from the Colorado River at Windy Gap Construction and site preparation may disrupt normal behavoir and movement, but these activities are not expected to directly cause mortality

Once construction is completed the pipeline ditch will be backfilled and the access road will be scarified and seeded to aid in restoring the disturbed area to the sagebrush habitat Impacts upon the habitat should be short-term and not critical, the vertebrate fauna are not expected to suffer significant long-term reductions in either composition or abundance

Other than revegetation of the pipeline and plantings around the reservoir no wildlife mitigation is proposed for the Windy Gap development area

Construction of Rawhide Powerplant will eliminate or alter about 1,000 acres of shortgrass prairie habitat This may result in the loss of carrying capacity for antelope, small mammals, and raptors There should be no significant impact on prairie dogs See PRPA (1978) for a more detailed explanation of impacts

q Threatened and Endangered Species

In the letter of August 27, 1979, and subsequent telephone conversations, the Fish and Wildlife Service specified that the following federally listed and proposed species associated with the Windy Gap Project should be asessed for impacts

Listed Fauna

American peregrine falcon (Falco peregrinus anatum)
Bald eagle (Haliaeetus leucocephalus)
Colorado River squawfish (Ptychocheilus lucius)
Humpback chub (Gila cypha)
Bonytail chub (Gila elegans)

Proposed Flora

Osterhout milkvetch (Astragalus osterhoutii)

Conversations with biologists with DOW and BLM and surveys conducted by Water and Power between 1978-1980 did not indicate the presence of nesting birds of either of these avian species Wintering bald eagles have been sighted at Granby and Willow Creek Reservoirs, and along the Colorado River These sightings are discussed under the Colorado River and C-BT areas of impacts No sightings of peregrine falcons have been reported in the vicinity of the Windy Gap development and Service Area

The listed and proposed threatened and endangered fish are discussed in IV C 1

The Osterhout milkvetch was not found in the development area in a survey conducted by Western Resource Development Corporation (1980)

The biological opinion (attachment 2) issued by the FWS on March 13, 1981, indicated that the Windy Gap Project will not jeopardize the existence of any of the above listed species

There are no known species of wildlife currently listed as endangered by the State or Federal Governments which would be impacted by construction and operation of the Rawhide Project

h. Recreation

(1) Construction of the Windy Gap diversion dam and pumping station involves the temporary relocation of 1500 and 1000 feet of U S Highway 40 and Colorado Highway 125 respectively near the intersection of the two highways The relocation work will last for about 1 year In addition, about 80 feet of U S Highway 34 will be relocated for no more than 3 weeks during the installation of the pipeline (see attachment 3)

The relocated highways should not impede traffic to the Arapaho National Recreation Area (NRA) and Rocky Mountain National Park

(2) The impact of the project on existing housing and lodging facilities will not be severe and is not expected to result in a loss in recreation based income or an alteration in the major recreation based sectors of the regional economy (Dames and Moore, 1977a) The contractor will be required to provide housing to prevent negative impacts to recreation lodging This is in compliance with Grand County's 1041 permit recommendation

(3) Construction of the 9-foot-diameter pipe to the previously enlarged Willow Creek Chute will traverse NRA lands administered by the USFS A reservoir access and picnic area are within the pipe alinement Tourists will have varied reactions to the construction activity Some recreationists may be annoyed by the presence and commotion associated with the construction activity Others will be more curious about the activity and become construction spectators These spectators need to be kept a safe distance from the construction activity

Although sport-fishing activity in the vicinity of the diversion dam and proposed reservoir will be disrupted, numbers of fishermen affected will be minimal as land is now privately owned and not open to public fishing (Dames and Moore, 1977a)

(4) Hunter use and access in the development area will probably not be altered except for the immediate construction areas which are not in designated recreation areas

The reservoir created by the Windy Gap diversion dam will provide potential flat water recreation opportunities such as

fishing, picnicking, camping, and non-motorized boating At the time this FES was prepared, the Subdistrict had no definite plans for developing and managing this recreation potential, but the Intergovernmental Agreement does provide for Grand County to develop and manage a recreation area at the reservoir, if it chooses to do so Consequently, any evaluation of impacts due to human use of the reservoir will be contingent upon whether Grand County decides to manage the area If Grand County decides to develop and manage recreation facilities, there will be a small increase in economic activity within the local area coupled with some pressure on local services These impacts could be minimized if the development is well planned and managed

The Rawhide Project will have slight impacts on recreation Recreational use of the project site is currently very low, therefore, the project will not eliminate or degrade a significant recreation resource It is probable, however, that construction of the project will result in some reduction of wildlife populations This reduction will be small, but any reduction of species, such as antelope, will diminish recreational opportunities

The cooling pond has the potential for fishing use PRPA may stock warmwater fish and allow public access to the pond if suitable arrangements for the management of fishing activities can be worked out

i Aesthetics

Construction of the Windy Gap diversion dam and related facilities will occasion short-term impacts on the aesthetic features of the Windy Gap development area However, these adverse or undesirable impacts of increased traffic, the operation of heavy duty equipment, and related noise, dust, and turbidity of water will be slight in terms of the numbers of persons affected (Dames and Moore, 1977a)

The Windy Gap diversion dam and reservoir site, while displacing approximately 112 acres of existing meadow land and trees, will not be in stark contrast or represent an intrusion to the aesthetic features of the Windy Gap development area Ancillary project facilities will be of an environmentally conscious and low-profile design, particularly the power lines and switching substation The latter facility will be surfaced with non-glare forest green epoxy and will be situated at the same elevation as the Windy Gap pumping station which will be faced with native stone

j Cultural Resources

Current Impacts

The initial impact on the cultural resources located within the project boundary was the immediate legal and responsibility change which occurred with project authorization All of the resources

came under the authority and protection of Federal cultural resource legislation, especially the 1966 Historic Preservation Act (as ammended) and the National Environmental Policy Act These laws and other pertinent rules, regulations, and legislation provide for the protection, preservation, restoration, and maintenance of sites, districts, buildings, or objects of archeological, historical, or scientific significance In order to meet these legal requirements cultural resource investigations were implemented These have resulted in a beneficial contribution to archeology by affording an opportunity to study the cultural record of this poorly known region

There have been specific onsite impacts to all of the sites inventoried as a result of field investigation These include artifact collection, subsurface test pits, and general human presence The impacts are listed below

Site No	Collection	Subsurface Testing
5GA118	X	X
5GA119	X	
5GA120	X	
5GA121	X	
5GA122	X	
5GA123	X	
5GA124	X	
5GA124	X	
5GA126	X	
5GA127	X	
5GA128	X	
5GA129	X	
5GA130	X	
5GA149	X	X
5GA150	X	
5GA151	X	X
5GA152	X	
5GA153	X	X
5GA154	X	
5GA155	X	X
5GA156	X	X
5GA157	X	X
5GA158	X	
5GA159	X	X
5GA160	X	X
5GA238	X	
5GA239	X	
5GA240	X	
5GA241	X	
5GA242	X	
5GA243	X	
5GA245	X	
5GA666	X	
5GA668	X	

If the project is not built, the above impacts will be the only effect the project will have on cultural resources

Construction Without Mitigation

Because all of the identified cultural resources are not located within the proposed construction zone, only certain sites will be impacted by construction If the non-mitigation plan alternative is used, impacts to those cultural resources will be total and adverse Affected resources which will have direct impacts are

5GA118	5GA150	5GA157	5GA239
5GA122	5GA151	5GA158	5GA243
5GA126	5GA152	5GA159	5GA666
5GA128	5GA153	5GA160	5GA668
5GA149	5GA155	5GA238	

Indirect impacts will occur at the following sites provided that construction stays within prescribed boundaries, otherwise impacts will be direct

5GA119	5GA240
5GA121	5GA241
5GA156	5GA245

The impacts incurred under this plan will be adverse and non-beneficial because the resource will be destroyed without the benefit of additional data gathering

In addition, it is probable that paleontological (fossil) resources will be destroyed through excavation for the pipeline If no mitigation plan is employed for data recovery on these resources, then the impacts will be adverse and non-beneficial due to loss of data

Construction With Mitigation

With a mitigation plan direct and indirect cultural resource impacts will be identical to those described above However, definite research goals will serve as guidelines for the deliberate destruction of resources This approach will be most beneficial because basic archeological and paleontological data will be gathered and added to the data base, information that will be useful for the indentification and prediction of prehistoric human behavoir and a further understanding of the area's fossil record

The mitigation plan for this project will not call for the preservation and protection of cultural resources in their natural environment However, it will call for the complete disturbance of selected significant or potentially significant resources Through the recovery of additional data, resources will be preserved "on paper " The information, which can only be gathered through additional investigation, may be of a nature to assist

other cultural resource programs in Middle Park so that initial project planning may identify significant resources and plan for their protection and preservation at the earliest possible date In this regard, mitigation plans cannot be thought of as project specific programs Rather they must be viewed as contributing to research that will assist and complement future efforts on other projects

The Subdistrict Northern Colorado Water Conservancy District has offered a mitigation plan prepared by WCRM The letter dated March 2, 1981, presents the plan and gives the Subdistrict's commitment for further cultural resource work Additional impacts under this plan will occur at the following archeological sites 5GA151, 5GA153, 5GA238, 5GA239, and 5GA128 only if reinspection indicates that the latter site will be directly affected

Mitigation work will not be necessary at the following sites, if no access road widening occurs

5GA119
5GA121
5GA126
5GA241
5GA245

A plan for mitigation of the paleontological resources has been required by the Bureau of Land Management in conjunction with the Water and Power Resources Service (letter dated August 16, 1979) No specific committment to this plan has been received from the Subdistrict as of this time The Municipal Subdistrict is currently negotiating with the BLM in an effort to develop an adequate plan for monitoring and/or mitigation of paleontological resources

At present there are no known significant archeological resources that will be directly impacted by construction of the Rawhide Powerplant (Lutz, 1977) Two sites (5 LR526 and 5 LR525) may be significant, but they have not been test excavated While both sites will not receive direct impacts from construction, it is likely that they will suffer damage from the influx of personnel into the area, e g accidental vehicular damage and intentional and casual pothunting This will result in a loss of knowledge about past human activities

k Land Use

Site preparation and construction activities for the diversion dam and pumping plant will cause the disturbance of approximately 40 acres of river bottomland and pasture The diversion reservoir will result in the additional loss of about 112 acres of river bottom and pasture This inundation will constitute a long-term impact on agricultural land use in the county However, the productive value of the land involved is low relative to other agricultural land in the county and the State

Drilling and construction activities along the proposed pipeline corridor situated between the pumping plant-damsite and Lake Granby will also result in minor land disturbance However, with the exception of permanent pipeline access and entrance points, impacts due to pipeline construction will be temporary in nature The construction of the required power line and switching station will have minimal impact on existing land use features in the Windy Gap development area The installation of the new Mountain Parks Electric line is anticipated independent of Windy Gap power requirements Operation of the Windy Gap Project is not expected to directly affect land use patterns in the development area

The effect of the Windy Gap Project on land use and population growth patterns in the Service Area is difficult to evaluate There is a popular assumption that the volume of a given municipality's water supply exercises a controlling influence over the absolute level and rate of growth of its population, i e an abundant water supply is viewed as a casual factor or an inducement to population growth, while a shortage of municipal water is seen as a restrictive influence, capable of inhibiting and perhaps interrupting population growth altogether In reality, the determinents of population growth and decline are more complex A number of cities in Colorado, for example, although endowed with an ample water supply, have witnessed declining populations, while the attractions of employment, climate, and unique cultural and service amenities have fostered population growth in cities where the maintenance of a firm supply of water is a continued source of public concern and expense

The five participating cities of the Windy Gap Project are illustrative of this latter case Each city has pursued the project in anticipation of a future population base capable of being generated by a combination of social, economic, and demographic growth factors The availability of Windy Gap water cannot be viewed as a determinent of this expected growth While it might be reasoned that an absolute finite limit on any of the municipalities' water supplies would eventually force a reduction in consumptive use and ultimately establish an upper limit on the size of the Service Area population, in practical terms the likelihood of any city accepting such an imposition is remote

The legal and institutional framework of water resource development in Colorado is unique in the absence of constraints on municipal development and use of the unappropriated waters of the State Indeed, preference for municipal water use (as opposed to agricultural and industrial uses) is a basic constitutional tenet of Colorado water law, and this continues to be a far more decisive factor governing water use in the State than hydrologic limits on supply

Finally, even the most growth-conscious city would probably not judge it desirable to have an absolute finite limit on its water supply, since it would be desirable to provide for an adequate

water supply for the "preferred" or "optimum" population There is in fact a growing recognition among planning professionals, administrators, and elected officials concerned with the management and control of municipal population growth that a responsible and genuine resolution of the complex question of optimum community size and character is best achieved through straightforward policy prescriptions grounded in the zoning and land use powers granted to municipalities by State law (Title 31, Article 23, CRS 73) and not directly through restrictions on the community's raw water supply The public actions and investment decisions which commit the five participating cities to the Windy Gap Project do not in themselves, reflect these municipalities' final conclusion or resolution of the difficult questions of growth management and optimum city size

As noted earlier, it is the Comprehensive Master Plan that is the paramount vehicle for prescriptive standards on a community's future growth and land use policy decisions The primary goals and objectives of each city's Comprehensive Plan are summarized in chapter III together with the activities that will be necessary for their realization It is clear that the enactment of these growth management tools by the respective city governments reflects a public expectation and acceptance of future community growth which assumes the cities' participation in the Windy Gap Project Through public hearings and the constituted legislative process the five cities have established the need and desirability of the project and have affirmed its compatibility with the current and long-term interests of the community The city of Boulder, for example, under Ordinance 4038 of 1975 (published as a bill on May 20, 1975, reviewed in public hearing, passed on June 3, 1975, and recorded on June 22, 1975)" deems it appropriate and in the public interest to secure water to be obtained through the Windy Gap Project and hereby elects to apply for an allotment providing for the beneficial use of 80 units of the Windy Gap Project" and, "in the opinion of the City Council of the city of Boulder, Colorado, the acquisition of said units of water is necessary and essential for the well-being of the community and for the preservation and protection of the public peace, property, health, safety, and welfare " Subsequently, on July 11, 1975, the city of Boulder executed a formal petition and entered into an allotment contract with the Municipal Subdistrict of the Northern Colorado Water Conservancy District, which establishes the city's intent to participate in the project Similar and comparable official public actions on the part of Greeley (Ordinance 41 of 1975, adopted on June 3, 1975), Longmont (Ordinance of 1975, adopted on June 10, 1975), Estes Park (Ordinance 10 of 1975, adopted on May 13, 1975), and Loveland (Ordinance 1443 of 1975, adopted July 15, 1975) affirms the Windy Gap Project to be not only compatible with the long-term public interest of these respective cities, but necessary for their well-being

It can be concluded, therefore, that the compatibility of the Windy Gap Project with the anticipated long-term population growth

and land use expectations of each city has been confirmed through the formal legislative process It must also be recognized, of course, that this compatibility rests on a parallel commitment by these cities to the growth management strategies outlined in their respective Master Plans

The prospects of continued compatibility between these two public policy actions (i e participation in the Windy Gap Project and adherence to the local Master Plan) appeared favorable The recent enactment by Boulder residents of an explicit growth control measure essentially affirms that city's commitment to a land use policy aimed at effecting balanced population growth and distribution and land use patterns

The goals and objectives of Greeley's Comprehensive Plan were supported by both the local governing body and by the legislative action of the Weld County Board of Commissioners which led to the adoption of the Weld County Comprehensive Plan In summary, the Windy Gap Project is not expected to foster any alterations in existing population and land use features in the Windy Gap Service Area that are not already anticipated and acknowledged by the respective local Governments of the cities participating in the project

Development of the Rawhide Project will convert approximately 1,000 acres of land which are currently used for cattle grazing to land uses associated with operation of a powerplant One thousand two hundred and forty additional acres have been acquired by PRPA This land will be used for expansion of the powerplant In addition, between 485 and 558 acres will be occupied by transmission line rights-of-way Of these right-of-way acres, less than 1 acre will be precluded from other uses because of the placement of powerline support structures, while the rest will continue to be available for agricultural activities and other uses Approximately 31 5 acres will be occupied by the rail spur right-of-way

In addition to on-site impacts, the 65 employees required to operate the project will impact existing land use patterns It is also possible that some workers who located within the region during construction will continue to reside within the region after construction is completed The population attracted to the region by development of the project will contribute directly to the on-going conversion of agricultural lands to residential and commercial uses The number of people attracted to the region by development of the project is small, however, in comparison to current projected growth

1 Transportation

The presence of the Windy Gap construction work force will result in short-term increases in traffic volumes during the summer construction months, particularly along U S Highwas 40 and 34

The estimated increases in average daily traffic counts outlined in the following tabulation assumes a two-people per car commuting rate

ESTIMATED INCREASE IN AVERAGE DAILY TRAFFIC VOLUME
U S HIGHWAY 40 BETWEEN GRANBY AND WINDY GAP DAMSITE
Windy Gap Development Area

	First Construction Year	Second Construction Year
April	130	20
May	115	20
June	68	20
July	62	20
August	31	22
September	20	22

Source Dames & Moore (1977a)

The Colorado Department of Highways will make an official determination of the need for new highway crossings, channelized intersections, and additional signing in the project vicinity upon review of traffic conditions presented by the project

The increase in daily traffic volume will constitute a minor negative impact to Grand County residents The road surfaces may require more maintenance due to increased heavy truck traffic bringing construction materials to the site, but this impact will also be minor Cost of this maintenance will be borne by the county and the Municipal Subdistrict Increased daily traffic enforcement will be necessary during certain periods, but it is unlikely that new personnel will need to be hired

After construction is completed, there will be no noticeable increase in traffic volume as a result of the operation and maintenance of the project

Both U S Highway 40 and State Highway 125 will have to be realined during construction activities due to the proximity of their junction to the pumping plant Although realinement of U S Highway 40 will be temporary, realinement of State Highway 125 will be permanent as approved by the Colorado Department of Highways This permanent change in the location of the intersection would direct runaway vehicles on State Highway 125 away from the pumping plant whereas the present

location of the intersection suggests a possible collision with the pumping plant in the event a runaway vehicle is unable to stop at the intersection In an attempt to further reduce the damage of runaway vehicles on State Highway 125, two locations for truck escape ramps are being investigated

The Denver and Rio Grande Railroad parallels the Colorado River at the Windy Gap damsite The alinement of the left side of the diversion dam is dictated by the railroad embankment At the damsite, the railroad lies between the river channel and natural high ground that would otherwise serve as the left abutment The railroad embankment is considerably lower than the estimated maximum water surface elevation of the reservoir In order to protect the railroad embankment, the alinement of the dam will parallel the embankment upstream for approximately 2,800 feet to the point where maximum reservoir elevation will intersect the natural ground surface A drainage ditch will be located between this section of the diversion dam and the railroad embankment to convey present drainage flows and dam seepage away from the railroad embankment

Principal access to the Rawhide site for delivery of construction supplies will be by rail spur or by Interstate 25 and County Road 82 (the Buckeye Road) The Buckeye Interchange on I-25 has sufficient clearance designed into it to allow all ordinary truck traffic to utilize it, including long loads and load heights to 16 feet

The maximum capacity of the Buckeye Interchange on I-25 in terms of vehicles per hour is about 800 according to formulae used by the State Department of Highways This capacity can also be expressed as thirteen vehicles per minute entering the ramp and I-25 If every construction worker drove to and from the site, at the peak of activity, approximately 600 vehicles would have to negotiate the interchange when the day shift let out Carpooling will likely reduce the number of vehicles Assuming about 1 5 occupants per vehicle, 1/ the total number of vehicles drops to about 400 At 13 vehicles per minute moving through the interchange, 30 minutes would be required to allow all vehicles access to I-25 To improve traffic flow and minimize any waiting period, the end-of-shift timing would be staggered, probably with each trade union letting out at 10- to 15-minute intervals

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1/ 1 5 occupants is a figure commonly used for transportation planning in urban situations, the projection has been factored upward to account for the planning period and possible effects of increased fuel costs

Since most of this homeward-bound construction commuter traffic is destined for points along I-25 as far south as Denver, automobile traffic patterns are not expected to alter significantly in most of Northern Larimer County The Waverly Road (State Highway 1 and County Road 15) may experience a small temporary increase in traffic volume of about 30 to 40 vehicles per day since workers who are residents of the Fort Collins area may choose to travel this route More likely, however, County Road 7 traffic will increase, especially when shifts let out and workers attempt to shortcut the slowed traffic at the Buckeye Interchange by using the Owl Canyon Interchange 6 miles to the south

To accommodate the increased traffic, Larimer County officials indicate that the Buckeye Road (County Road 82) will have to be improved beyond its present gravel surface in order to meet minimum standards for truck traffic These standards call for asphalt paving on constructed course base and sub-base, with two travel lanes and a roadway width of 26 to 28 feet An existing bridge over Coal Creek would have to be upgraded in concrete with other road improvments County Road 9 would provide access to the project site north from the Buckeye Road and would also be improved Altenate commuter routes of travel to and from the site, such as County Roads 7 and 15 may require temporary measures to control dust, depending upon the volume of traffic

Local truck traffic will be primarily sand and gravel transport to the concrete batch plant supplying the project site If the supply of Portland cement is local, additional truck traffic can be expected, probably originating at the Ideal Cement Company near LaPorte, Colorado Typically, travel to and from a construction site is the most direct route available over public highways, whether gravel-surfaced or paved Assuming truck transport to be the maximum allowable weight (40-ton maximum gross vehicle weight and 25-ton load capacity), the approximate number of round trips required for delivery of raw materials to the batch plant would be as follows

Portland Cement	230
Sand	440
Aggregate	650
TOTAL	1,320

Most of the concrete work is in the various structural foundations of the facility Foundation work represents about 80 percent of the total concrete requirements of the project, and is scheduled to take place over a year's time Truck traffic carrying materials to the batch plant would be most intense during that year (1981)

Conflicts may evolve out of increased truck traffic along certain routes Gravel-surfaced roads and light-duty asphalt paving will not stand the intensity of the heavy truck traffic anticipated Dust and noise will affect residents along the routes Some

bridges may require upgrading to support increased truck traffic and heavy loads Two alternatives are (1) To improve the direct routes to the batch plant site to minimize conflicts, or (2) to re-route truck traffic and pay the increased mileage costs per ton of raw material delivered

An analysis of probable truck routes to the Rawhide site, based upon quality of the highway and directness of travel, is as follows

(a) Interstate 25 would be the best route to the site to minimize conflicts, but the highway is convenient only to truck traffic originating on the east side of Fort Collins

(b) The Waverly Road (State Highway 1 and County Road 15) provides direct access to the site from northern Fort Collins, but passes through a densely-populated residential area north of Fort Collins and through the small community of Waverly

(c) State Highway 1 encounters the same residential neighborhood and would bring truck traffic through the town of Wellington to reach Interstate 25

(d) From State Highway 1, trucks could continue north on County Road 9 to County Road 70 (Owl Canyon Road) and then gain access to I-25, dodging Wellington, but traversing the residential neighborhood in b and c above

(e) County Road 19, near the foothills, will be paved (light-duty asphalt) north to County Road 70, which intersects County Road 15 and continues on to I-25, an acceptable route could probably be arranged, but 14 miles of road would have to be improved

(f) If none of these routes proved acceptable for truck traffic to the Rawhide site, truck traffic would most likely have to follow State Highway 287 to Riverside Avenue in Fort Collins, thence to State Highway 14 and Interstate 25 This routing is rather roundabout and would cause increased traffic congestion in northern Fort Collins as well as higher costs in haulage

The most feasible and environmentally sound truck route cannot be decided until the sources of materials are finalized by contract However, the above analysis should provide an important first step in setting route priorities at a later date In coordination with Larimer County Road and Bridge Department, PRPA may require truck traffic to follow the most suitable route

m Socio-economic

The construction of the Windy Gap dam, Pumping Plant, pipeline, and related facilities will span an elapsed time period of about

3 years and will contribute to short-term population impacts in Grand County Construction activity will be suspended from November to April and after the first 4 months of each construction phase employment will stabilize at about 30 men per month Construction manpower requirements are outlined in table IV-6 The project work force will reach an estimated peak of 259 persons during the second month of the first year's summer construction period The number of construction personnel will drop sharply after the fourth month of construction and decline to 61 persons by the sixth month Population impacts due to the physical presence of the construction work force in Grand County are thus expected to be short-term in nature and induced employment and population will be minimal School enrollments in the East Grand and West Grand School Districts will not be affected

Wage and salary payments for Windy Gap construction manpower have been noted separately in table IV-7 Gross construction wage and salary payments are expected to total $2,582,900, and it is estimated that about $357,000 of this amount may be expended in Grand County in the form of work force consumption expenditures over the 3-year construction period This estimate has been derived by calculating that portion of monthly new disposable income of the construction work force that is likely to be spent locally The assumed local expenditures rate by the construction work force is 19 percent of net monthly income for rent, food, clothing, transportation, and other retail goods and services Table IV-8 shows a monthly breakdown of estimated local expenditures in Grand County during the 3-year construction period

While local expenditures by the project work force will have a positive effect on local income and public sales tax revenue in Grand County, the acquisition of land for project facilities will have a long-term negative effect on (i e will reduce) the county's existing property tax base The Municipal Subdistrict's (a tax exempt entity) land acquisition will result in a reduction of about $15,000 in the county's total current assessed valuation of $58 million

Expenditures associated with the Windy Gap Project for labor, material, and equipment are expected to total more than $17 million A portion of this total will be expended in Grand County with the balance being committed to out-of-state vendors and contractors Estimates in this regard can only be speculative due to the influence of competitive bidding and variations in design specifications However, table IV-9 presents a projected breakdown and geographical apportionment of major project expenditures that indicates approximately $6 3 million could be expended in Grand County with other in-state and out-of-state expenditures totaling $7 6 million and $3 2 million, respectively

Operation of the Windy Gap Project will have minimal impact in the development area The loss of property tax revenue due to the Municipal Subdistrict's acquisition of land in Grand County as

TABLE IV-6

Approximate Manpower Requirements by Month and by Activity[1/]

	1st Year									2nd Year									3rd Year
	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan
Stripping		9	9																
Common Excavation		7	7	7	7	7	7	7	Shutdown	7	7	7	7	7	7	7	7	7	7
Ripper Excavation		8	8	8	8														
Rock Excavation		14	14	14	14														
Structure Excavation		14	14																
Underground Excavation		39	39	39	39														
Embankment Fill		11	11	11	11	11													
Backfill		6	6	2	2														
Riprap		50	50		50														
Conrete		14	14	14	14	14	14	14	Shutdown	14	14	14	14	14	14	14			
Iron Work		5																	
Pipelines		17	17	17	17	17	17	17	Shutdown	17	17	17	14	14	14				
L S Ironwrok		6	6																
L S Civil Work		11	11	11															
Stilling Basin Anchors		14																	
Access Roads		12	12																
Painting		2																	
Asphalt Paving		8																	
Electrical Installation	12	12	12	12	12	12	12												
Mechanical Equipment Installation														8	8	8	8	8	8
TOTALS	12	259	239	135	124	61	38	38		38	38	38	43	43	43	15	15	8	

1/ IECO, 1976

TABLE IV-7

Manpower and Wage and Salary Estimates
Windy Gap Project Construction

	Rate Per Hour Incl Fringe Benefits	Approximate Total Wage
Crew Foreman	$15	$ 282,000
Equipment Operator	13	590,000
Equipment Oiler	11	105,400
Teamster	12	165,700
Grad Checker	12	33,200
Driller	13	162,500
Driller's Helper	11	41,000
Powerderman	12	17,500
Powerderman Helper	11	16,100
General Laborer	10	486,000
Mechanic	12	128,600
Carpenter	13	127,800
Concrete Finisher	11	53,900
Ironworker	13	22,200
Welder	13	76,900
Electrician	13	149,800
Millwright	13	59,900
Rodman	13	63,900
TOTAL CONSTRUCTION WAGES		$2,582,900

TABLE IV-8

Estimated Constuction Wages Expended Locally in Grand County
(X $1,000)

1	March	April	May	June	July	Aug	Sept	Oct
Total Net Construction Wages	19	418	371	218	220	98	61	61
Local Expenditures	3 6	79 4	70 5	41 4	38 4	18 6	11 6	11 6

TOTAL LOCAL EXPENDITURES YEAR 1 $275,100

2	May	June	July	Aug	Sept	Oct	Nov	Dec
Total Net Construction Wages	61	61	61	70	70	70	24	24
Local Expenditures	11 6	11 6	11 6	13	13	13	4 6	4 6

TOTAL LOCAL EXPENDITURES YEAR 2 $82,000

TOTAL YEARS 1 and 2 LOCAL EXPENDITURES $357,100

TABLE IV-9

Windy Gap Project Construction Cost Estimates (1975 dollars)

	Windy Gap (Grand County) Development Area	Colorado	Out-of-State
Windy Gap Dam - total	$2,097,000	$ 539,500	
Mobilization	150,000		
Diversion Dam Dike	702,600		
Auxiliary Spillway Dike	701,100		
Spillway and Discharge Channel	142,500	367,200	
Outlet Works		21,400	
Care of River	48,700		
Land Acquisition	275,000		
Intake Structure	77,100	150,900	
Pumping Plant - total	$1,017,600	$1,256,200	$3,179,300
Civil Works	442,800	700,200	49,200
Electrical Works			
Motors-excitors	235,200		759,500
Switchgear	136,000		535,700
Switchgear-low voltage	13,500	42,700	
Misc electrical		152,800	
Mechanical Works			
Pumps	152,300		1,239,000
Valves and gates	5,000		419,000
Discharge Manifolds	13,900	326,400	
Miscellaneous	12,800	34,100	176,900
Land Acquisition	6,900		
Pipeline - total	$3,197,400	$5,833,700	
Mobilization	700,000		
Pipeline	1,484,200	5,075,900	
Surge Chamber	480,300	566,300	
C-BT/WGP Outlet Works	457,400	191,500	
Land Acquisition	75,500		
PROJECT TOTALS	$6,312,000	$7,629,400	$3,179,300

described earlier will constitute a minimal long term adverse impact A portion of operation and maintenance expenditures associated with the project will constitute a positive economic impact in the development area

The availability of Windy Gap water will mitigate the growing pressure and competition for agricultural water rights in the Windy Gap Service Area As noted earlier in this report, the conversion of agricultural water rights to municipal and industrial uses will have the effect of structurally altering the agricultural base of the Service Area economy In light of current and projected water consumption rates in the Service Area (and the consumption incentives embodied in and fostered by Colorado Water Law,) such alteration in the agricultural economic base of the region would appear inevitable in the absence of the Windy Gap Project

The Rawhide Project is not expected to significantly affect population growth in Larimer County A principal finding of a study conducted for Platte River by EDAW in association with Dr Evan Vlachos, is that population impacts directly attributable to construction of the powerplant will be relatively minor and that anticipated impacts resulting from the operation phase are virtually nonexistent These findings are based on research which suggests that very few construction workers will be drawn from outside the Colorado Front Range region and the fact that relatively few people are required to operate a powerplant

3 Colorado-Big Thompson Development and Service Area

a Hydrology

The impacts described herein are the results of a Colorado-Big Thompson - Windy Gap Project operations study (table IV-10) performed in November of 1980 by the Water Scheduling Division of the Water and Power Resources Service project office in Loveland, Colorado The study was performed using the computer program for the Western Division system annual operating plan

The first studies done were performed in June of 1978 utilizing a Windy Gap diversion capacity of 400 ft^3/s and historical demands for C-BT Project water As a direct result of negotiations between water interests on the Eastern/Western Slopes, it was mutually agreed in early 1980 that the Windy Gap Pump Plant capacity could be increased to 600 ft^3/s This increased diversion capacity coupled with the need to analyze C-BT operations with ultimate C-BT and Windy Gap water demands were the primary reasons leading to an update of the study In addition to the study assumptions and general criteria used to develop the operation study, it is necessary to briefly describe the assumptions used in establishing ultimate demand patterns for both the C-BT and Windy Gap water supplies

TABLF IV-10

Average Annual Summary of
November 1980 Hydrology Studies
For Windy Gap
Environmental Impact Statement

(20-Year Period)

Item	Base Study (1000 AF)	Base Study Windy Gap Gap Deliveries (1000 AF)	Increase With Windy Gap (1000 AF)
Windy Gap Water Pumped to Granby	-	56 0	56 0
Granby Release to River and Seepage	30 3	30 3	0
Middle Park Demand	-	2 0	2 0
Windy Gap Project Storage in Granby (Avg Sep)	-	34 6	34 6
Windy Gap Project Storage in Granby (Max Mo)	-	85 2	85 2
Granby Storage (Avg Sep)	262 5	302 4	39 9
Granby Storage (Max Mo)	440 2	501 5	61 3
Windy Gap Water in Adams Tunnnel	-	47 5	47 5
Total Adams Tunnel	253 4	300 9	47 5
Release to Big Thompson River below Estes	40 2	45 2	5 0
Release to Big Thompson River below Estes (Max Mo)	29 9	29 9	0
Carter Lake EOM (Avg Sep)	25 6	17 2	-8 4
Horsetooth EOM (Max Mo)	56 8	48 0	-8 8
Total Windy Gap Demand, East Slope	-	48 3	48 3
Total Delivery to Windy Gap, East Slope	-	44 6	44 6
Total Windy Gap Shortage, East Slope	-	3 7	3 7
C-BT East Slope Generation (GWH)	677 3	773 4	96 1
C-BT Pumping Energy (GWH)	72 5	80 9	8 4
C-BT Net Generation (GWH)	604 8	692 5	87 8

Since both of these supplies will be supplemental in terms of demand, it is essential that the quota system used by the District to establish annual C-BT Project water availability be thoroughly understood The primary purpose of the C-BT Project water supply is to make existing base supplies whole, not to provide an independent water supply The District's Board of Directors very early in the development of the project, saw fit to establish a quota system whereby a percentage of this total water supply would be made available each year dependent solely upon the supplemental needs for water within the boundaries of the Conservancy District Since the C-BT Project was designed to yield 310,000 acre-feet of supplemental water annually, this project supply was divided into 310,000 acre-foot units Based on the analysis of watershed snowpack and forecasted streamflow runoff, supplemental needs ranging from 60 percent to 100 percent of the 310,000 acre-foot units are then made available each year In extremely dry years (1976, 1977), it therefore follows, that quotas of 100 percent making available 310,000 acre-feet of supplemental water would be expected Similarly in extremely wet years (1978, 1979), the need for supplmental water is minimal and reflected in quotas of 60 percent providing only 186,000 acre-feet of supplemental water Near normal water years would tend to be reflected by quotas in the 70 percent to 80 percent range

Since the demand for all supplemental water on a monthly basis can be greatly influenced by the quota declared, it can be concluded that the demand for supplemental municipal, domestic, and industrial water both from the C-BT Project and Windy Gap Project should be influenced in a similar manner It was further concluded that the municipal, domestic, and industrial demand patterns for C-BT Project water in 1977 (a dry year) and 1979 (a wet year), would most likely be indicative of the total demands for supplemental water by those classes of service in future years Since this ultimate demand for supplemental water would have to be met from the Windy Gap Project supplies and a portion of the C-BT Project supplies, it was further concluded that because of language in the Carriage Contract, the Windy Gap water supplies would be utlized first Any remaining demand thereafter would be met from C-BT Project water supplies controlled by these classes of service

Based on the Windy Gap participants' ultimate water needs, their present ownership of Windy Gap water and a projection of their C-BT Project allotment acquisitions, monthly demands as a function of quota declaration were determined using quotas which were declared during the past year hydrologic period The demand distribution for both the Windy Gap water and C-BT Project water based on these assumptions is discussed herein It was assumed that all water available for delivery based on the quota declaration for C-BT Project water, was delivered if available, in addition, to a firm demand of 32,500 acre-feet for Windy Gap water

48 300 AF
(Table IV 15)

Based on the criteria outlined above, the following impacts would occur

(1) All water available to the Windy Gap Project is pumped to Granby Reservoir during the study period At no time is water spilled or bypassed at Granby Reservoir in excess of the required fish releases, and bypasses at Willow Creek Reservoir are not increased as a direct result of Windy Gap water being stored in Granby Reservoir

(2) The ultimate/demands used could not be met on four different occasions because of insufficient water supplies in the project system, resulting in a reduction of quota declaration

(3) An additional 2,000 acre-feet of water will be released from Granby Reservoir annually to satisfy the needs of the Middle Park area These releases will most likely be accommodated in the form of increased minimum streamflow releases from Granby and/or Willow Creek Reservoirs

(4) Injection of Windy Gap water supplies into Granby Reservoir will result in an average increased end-of-year water content of approximately 40,000 acre-feet annually This represents an average increase in water surface elevation of approximately 8 feet and about 380 surface acres (figure IV-6) An increase in maximum Granby Reservoir storage will be approximately 61,000 acre-feet, representing an increase in water surface elevation of approximately 9 feet

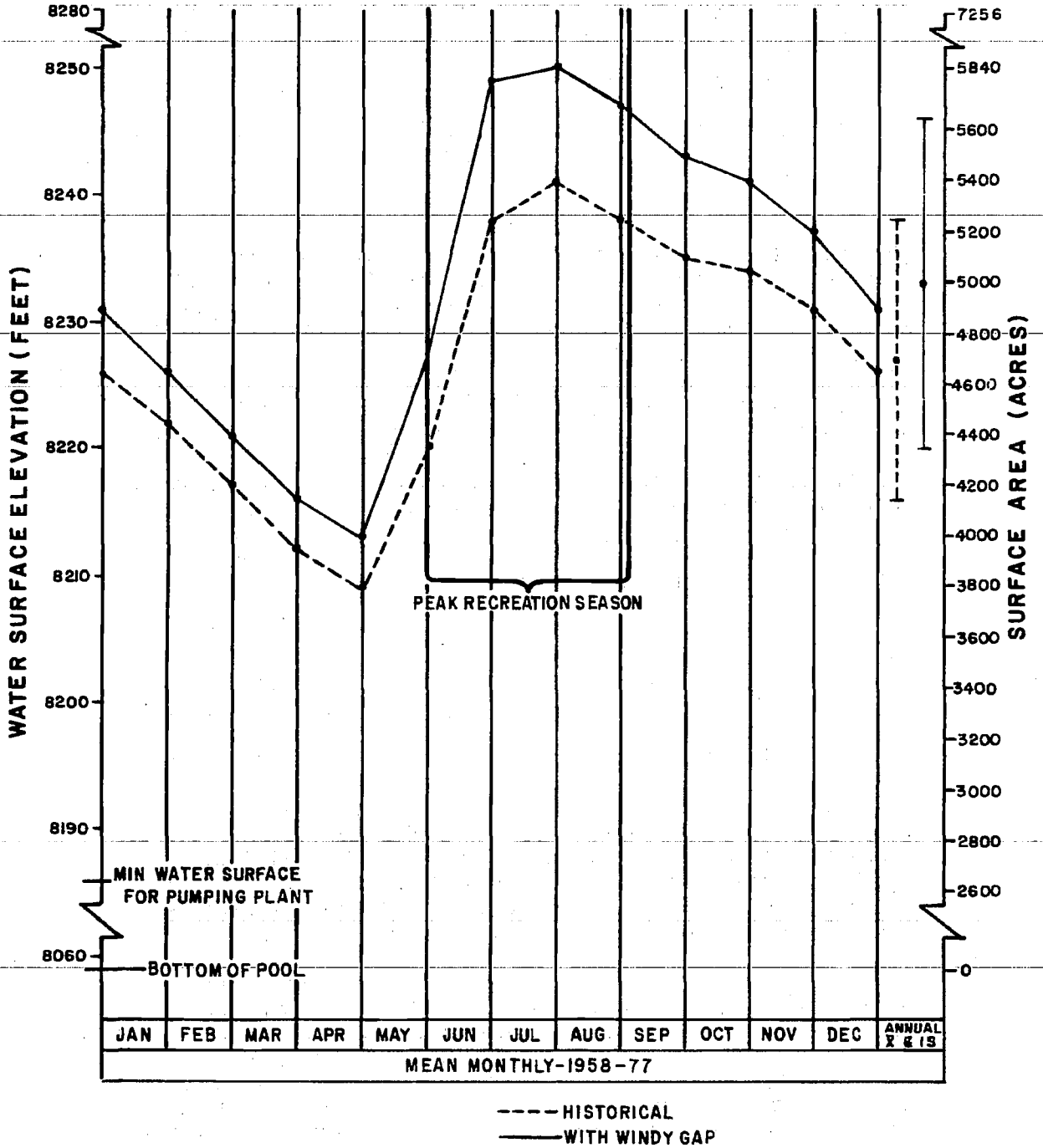
(5) Transportation of Windy Gap water through the C-BT system, on the average, increases Big Thompson River water being annually released from Olympus Dam by approximately 5,000 acre-feet The reason for this increase is because of the C-BT Project's inability to "skim" these flows accommodated previously by unused capacity in the East Slope power system

(6) The study results indicate that to meet a Windy Gap demand of ~~32,500~~ acre-feet annually, Windy Gap participant storage capabilities other than the C-BT Project must be utilized The study indicates that this participant storage capacity should be approximately 90,000 acre-feet as a minimum available for Windy Gap water storage on the Eastern Slope

It is anticipated that this storage requirement could be accommodated either by utilizing available storage in Granby Reservoir for longer periods and/or by utilizing East Slope storage currently owned or leased by the Windy Gap participants Additional East Slope storage can be acquired by the Windy Gap participants through future contractual arrangements with existing reservoir owners on the East Slope Since there is currently over 400,000 acre-feet of privately owned storage within the boundaries of the Conservancy District with only a

FIGURE IV - 6

CHANGES IN MEAN MONTHLY WATER SURFACE ELEVATION AND AREA OF GRANBY RESERVOIR DUE TO WINDY GAP DIVERSIONS



present demand for approximately 30,000 acre-feet, it is logical to assume that the storage requirements for Windy Gap water are at present available without dependence upon new reservoir construction along the Front Range

Although the C-BT Project reservoirs on the Eastern Slope (Horsetooth and Carter Lake) were not considered to be available for Windy Gap storage in the study, it can be determined from the results that Windy Gap participant storage requirements could be reduced from 90,000 acre-feet to approximately 30,000 acre-feet utilizing these two project facilities

(7) Since the study criteria did not allow storage of Windy Gap Project water in Carter Lake or Horsetooth Reservoirs and allowed Windy Gap water to be delivered by exchange, provided Windy Gap water was available in Granby Reservoir, the East Slope project reservoirs end-of-year content as a result of Windy Gap water deliveries will decrease by an average of approximately 8,000 acre-feet annually

b Water Quality

As was previously illustrated (table III-3), the concentrations of most dissolved substances in the Colorado River at the site of the Windy Gap diversion site are rather low Introduction of such water into the C-BT system would have no noticeable effect on the quality of water entering the system from other sources This would be true of the major components such as total dissolved solids, calcium, magnesium, sodium, potassium, sulfate, bicarbonate, chloride, and such characteristics as hardness, alkalinity, and conductivity

The above listing includes primarily "conservative chemical" constituents In other words, they reflect the effects of the hydrologic and geologic influences of the watershed and are little affected by instream biological and/or chemical need etc

The Colorado River at the Windy Gap site has approximately the same nutrient concentration as major tributaries to the Three Lakes system This was previously documented by Dames and Moore (1977b) As was previously discussed in the DES, there is a potential for eutrophication of the three lakes due to additional nutrient loadings from the Windy Gap Project However, since publication of the DES, additional data have been collected Also the operational scheme of the Windy Gap Project has been modified, as described previously Both of these factors have an effect on the estimated nutrient loadings as presented in the DES Consequently, the previous study has been repeated to incorporate the appropriate changes

The revised operations study for the Windy Gap Project shows an average diversion of 56,000 acre-feet per year Based on

the updated water quality information for the Colorado River at the diversion site, the total phosphorus concentration during the diversion period is 46 µg/l, as opposed to the previously used value of 100 µg/l On this basis the additional phosphorus loading to Granby Reservoir attributable to the Windy Gap diversion would be about 3545 kg per year The additional areal phosphorus loading to each of the Three Lakes that would result from the Windy Gap diversion is shown in table IV-11, which also shows the boundary loadings between oligotraphy and mesotrophy and between mesotrophy and eutrophy A complete derivation of these values is included in an updated technical report (Yahnke, 1981) that is available on request

As is also shown in table IV-11, Granby and Shadow Mountain are currently in the mesotrophic range while Grand Lake is well within the oligotrophic range The addition of the Windy Gap phosphorus load does not change the trophic state of any of the Three Lakes However, Granby Reservoir would be shifted from the lower end of the mesotropnic range to approximately the center of the range The biological implications of such a shift are discussed in section IV C 3 e below

Previously, concerns were raised over the possible secondary effects of population growth in the Fraser River Basin, particularly in the Granby Sanitation District This concern was based on the fact that treated sewage is rather high in total phosphorus With the projected population growth in the basin, the Fraser River would receive an increased nutrient load that would in part be diverted to the three lakes In the DES it was indicated that this could cause eutrophication of Granby as early as 1990 if the "high" growth projection for the Granby Sanitation District were realized On the basis of the revised loading estimates and a much lower growth rate than was projected, this now seems highly unlikely

Erickson (1980) recommended that the above be taken into account and that growth effects be reanalyzed He recognized that at some point the nutrient load of the Fraser River was likely to become sufficiently great as to effect the eutrophication of Granby For the most part, the recommendations of Erickson (1980) have been followed

The difference between the eutrophic boundary loading and the projected loading as altered by the Windy Gap diversion is 195 mg P/m^2/yr, which translates to 4400 kg P per year of absolute load, EPA (1975) indicates that treated sewage would be expected to contain 2 5 lbs (1 13 kg)/capita/year of total phosphorus The average duration of diversion is 2 6 months which yields a per capita total phosphorus load of 0 24 kg for the diversion period However, only 57 percent of the flow would be diverted, further increasing the population equivalency On this basis an additional population in the Fraser basin of about 32,000 would be required to generate the additional phosphorus

TABLE IV-11

Boundary Loadings, Estimated Nutrient Loadings, and Projected Trophic State of the Three Lakes Without and With Windy Gap

Lake Reservoir	Windy Gap Present	Boundary Loadings (mg $P/m^2/yr$) Oligotrophic	Eutrophic	Estimated Loading (mg $P/m^2/yr$)	Trophic State
Granby	No	319	638	364	Mesotrophic
	Yes	354	709	561	Mesotrophic
Shadow Mountain	No	903	1860	1609	Mesotrophic
	Yes	1104	2209	2047	Mesotrophic
Grand Lake	No	2381	4762	803	Oligotrophic
	Yes	2738	5476	1506	Oligotrophic

load At the current growth rate it would be well beyond the year 2000 before such a population level would be reached

Erickson (1980) recommended that a program of water quality monitoring be undertaken at the diversion point Currently, additional data are being collected The required load would be attained if the mean annual total phosphorus concentration were 93 g/l at the diversion point, all other things being equal However, it must be recognized that the nutrient load, productivity, and trophic state interrelationships reflect a continuum As one moves up the continuum, there would be an increase in the frequency of problems There would be no sudden change as the phosphorus loading increased from 708 to 709 $mg/m^2/yr$ Since occasional problems are likely to appear well before the actual eutrophic boundary loading is reached, there will be a period of time to implement corrective measures Decisions as to what those measures may be will have to be made at that time

c Vegetation

As shown in figure IV-6, Lake Granbys' water surface elevation will increase an average of 8 feet for the year This additional elevation change will not cause reservoir fluctuations outside the previous operating limits The lake has very little shoreline vegetation due to extensive annual drawdowns Therefore, no significant cumulative impact on vegetation around Lake Granby is expected The same rational and conclusion holds true for Carter and Horsetooth Reservoirs which will have 8,000 acre-feet less end of the year storage with Windy Gap However, instead of a water surface elevation increase, Carter and Horsetooth Reservoirs will decrease This decrease is well within past operational drawdowns and is not expected to have a significant adverse impact on vegetation

d Wildlife

No significant adverse impact on wildlife within the C-BT development and Service Areas is expected as a result of the Windy Gap Project

e Aquatic Biota (C-BT)

The increased nutrient loadings to the Three Lakes will result in an increase in the algal productivity and population levels One measure of potential productivity and, to some extent, algal population levels is the concentration of chlorophyll a extracted from a water sample Vollenweider (1976) derived an empirical relationship between the mean annual chlorophyll a concentration and an index representing the phosphorus loading characteristics of a lake (or reservoir) Under the calculated current phosphorus loading characteristics as shown in table IV- , the predicted mean annual chlorophyll a concentrations with 99 percent

confidence intervals for Granby and Shadow Mountain Reservoirs and Grand Lake are 3 2 ± 1 0 q/l, 5 0 ± 1 2 q/l, and 1 1 ± 0 4 q/l respectively The mean chlorophyll a concentration in Shadow Mountain Reservoir during 1975, as calculated from data presented in EPA (1977) was 5 8 q/l, which is within the predicted range, i e 3 8 - 6 2 q/l The additional nutrient loadings due to Windy Gap would raise the previously presented predicted mean annual chlorophyll a concentrations and confidence intervals to 5 0 ± 1 2 q/l, 5 5 ∓ 1 4 q/l, and 1 8 ± 0 7 q/l respectively for the three lakes To put this in further perspective, the predicted mean annual chlorophyll a concentration at the eutrophic boundary loading for Granby Reservoir is 5 8 ± 1 9 q/l

The above chlorophyll a values represent a prediction of the range within which the mean annual concentration would be expected to fall 99 percent of the time The annual mean will fluctuate from year to year It is also apparent that there is considerable overlap in the ranges, e g , under current conditions, the range for Granby is 2 2 to 4 2 q/l, while at the eutrophic boundary it becomes 3 9 to 7 7 q/l The significance of the increase lies in either of two factors, either a longer duration of large algal populations that presently occur or greater algal populations persisting for the same period However, it may also represent an increase in both persistence and population level

Under the discussion of the boundaries in the earlier section on water quality, the continuum of increasing productivity and nutrient loadings was discussed The increased ranges in mean annual chlorophyll a concentrations represents movement along the continuum Eutrophy represents a combination of factors that include, among others, frequent algal blooms, low dissolved oxygen concentrations in deeper waters, and possible fish kills At some point in time, the characteristics of eutrophy become readily apparent A small, or at least tolerable, increase in productivity may be beneficial, but a continuous increase would ultimately have an adverse effect on the system The magnitude and timing of impacts is a function of actual future nutrient loading rates from a variety of potential sources The relationships among these sources are complex, as are the interactions occurring within the natural systems receiving the nutrient loads Therefore, it is not possible to state with complete certainty that a continuous increase in nutrient loading will occur To guard against adverse impacts, the project sponsor will continue to review the results of on-going water quality monitoring programs to determine impacts on aquatic biota

f Threatened and Endangered Species

The biological opinion (attachment 2) issued by the Fish and Wildlife (FWS) on March 13, 1981, stated that no significant adverse impacts on threatened and endangered species would occur as a result of Windy Gap construction and operation The FWS made

its conclusion contingent upon the Subdistrict implementing certain conservation measures The Subdistrict has resolved (attachment 2) to carry out the suggested conservation measures

g Recreation, Aesthitics, Land Use, Socio-economics

No significant impacts on these resources associated with the C-BT will occur as a result of Windy Gap construction and operation

h Energy

The injection of approximately 56,000 acre-feet of additional water into the C-BT system will result in the generation of approximately 96 million kWh of additional energy annually from the project Approximately 8 million kWh of pump energy will be required to pump this additional water through the system resulting in an additional net total project generation of approximately 88 million kWh annualy

CHAPTER V CONSULTATION AND COORDINATION

CHAPTER V

CONSULTATION AND COORDINATION

A Consultation and Coordination During the Development of the Proposal and During Preparation of the Draft Environmental Statement

1 Colorado-Big Thompson Project Operation

Water and Power prepares an Annual Operating Plan for the ensuing year This plan largely determines how the C-BT Project will be operated A minimum of 150,000 acre-feet of water must be brought to the east slope to operate the hydroelectric powerplants The maximum that can legally be brought to the east slope is 310,000 acre-feet Water and Power consults and coordinates with the C-BT water recipients to determine their needs for water quantities and the delivery times These needs are met to the extent water is available An average of 232,000 acre-feet has been brought to the east slope since the project went into operation

Replacement flows for senior water rights in the Colorado River Basin are met by releases from Green Mountain Reservoir These releases are only made when there is a call for the water by west slope interests

2 Development of the Windy Gap Proposal

a Windy Gap

The Municipal Subdistrict initiated consultation and coordination activities for Windy Gap in August 1971 Table V-1 displays a partial list of contacts with Federal, State, and local government and private entities Three public information meetings were conducted seeking input from Grand County citizens (September 28, 1971, and July 29, 1976) and Fort Collins citizens (June 28, 1977)

In addition, the Six Cities Committee, an official steering Committee acting for and on behalf of the City Councils of the Cities of Greeley, Estes Park, Loveland, Longmont, Boulder, and Fort Collins have met with the Staff of the Municipal Subdistrict at least quarterly to review all aspects of the Windy Gap Project This Committee acts as a liaison to the respective councils and offers advice and recommendations concerning the project Numerous informal meetings with agencies and individuals are not listed and meetings and contacts concerning applications for permits licenses, etc , were also involved but are too numerous for listing

On March 10, 1976, the Subdistrict contracted with Dames and Moore consultants, to prepare an environmental assessment for the water development aspect of Windy Gap

The David Fleming Company and its CORSIM II computer program were used for determining the availability and allocation of water in the Colorado River Basin Bureau personnel and the Company worked with the District to refine the hydrology presented in this the DES

During the week of July 7-11, 1979, personnel from the Bureau of Land Management (BLM), Fish and Wildlife Service, Bureau of Reclamation, and the Colorado Division of Wildlife met with the Municipal Subdistrict representatives for an on-site orientation of the Windy Gap diversion and the conveyance system to Lake Granby After the orientation, the agencies reconvened at the BLM Kremmling office to discuss the agencies' respective concerns, requirements, and mitigatory measures the Subdistrict and the Bureau needed to consider The BLM people explained what requirements had to be met before it would issue a special use permit to cross its land with the Windy Gap conveyance pipe The requirement subjects included wildlife, range conservation, cultural resources, recreation, aesthetics, and lands As a result of the meeting, the Subdistrict's consultant prepared a plan to address some of the requirements including rehabilitation of the pipeline alinement The plan has been submitted to BLM but has not been approved to date

TABLE V-1

Partial List of Contacts Re Windy Gap Project

Aug 17, 1970	Met USBR Projects office re Carriage Contract
Sept 30, 1970	Met USBR Region office re Carriage Contract
July 1, 1971	Met USBR Project office re Carriage Contract
July 28, 1971	Met USBR Region & Project office re Carriage Contract
Sept 17, 1971	Met with USBR re Proposed Carriage Contract
Sept 20, 1971	Reviewed proposed Windy Gap Project with DRCOG Water Advisory Committee
Sept 27, 1971	Met with LWR Planning Commission to review proposed Windy Gap Project
Sept 28, 1971	Informational Public Hearing conducted in County Building, Hot Sulpher Springs to review proposed Windy Gap Project with Citizens of Grand County
Sept 30, 1971	Met with Larimer-Weld Regional Policy Council to review Windy Gap Project
March 13, 1972	Met with Department of HUD to discuss Windy Gap Project Financing
April 3, 1972	Court Hearing regarding Windy Gap Water Rights
May 9, 1972	Met with USBR re Proposed Carriage Contract
May 17, 1972	Met with USBR re Proposed Carriage Contract
June 12, 1972	Met with USBR re Proposed Carriage Contract
July 20, 1972	Met with Chairman of Water Board, City of Fort Collins, re Windy Gap Project
July 27, 1972	Met with representative of City of Boulder re Windy Gap Project
Aug 10, 1972	Met with USBR Projects office re Carriage Contract
Aug 24, 1972	Met with City of Fort Collins re Windy Gap status
Sept 20, 1972	Met with USBR re Proposed Windy Gap Project
Oct 20 1972	Met with USBR re Proposed Carriage Contract
March 2, 1973	Met Longmont Water Board re Windy Gap status
March 8, 1973	Met USBR Region re Environmental Impact Assessment
April 5, 1973	Big Thompson Ditch Association -- Windy Gap Status
April 26, 1973	Met with USBR re Computer Hydrology runs on Windy Gap Operations
April 28, 1973	Fort Collins City Council -- Work Session on Windy Gap
May 15, 1973	Greeley City Council -- Work Session on Windy Gap
May 17, 1973	Estes Park Representatives re Windy Gap status

TABLE V-1 (Continued)

May 29, 1973	Met with City of Loveland to review Windy Gap Project
June 4, 1973	Met with Estes Park City Council to review Windy Gap Project
June 12, 1973	USBR -- FIS
Aug 22, 1973	Estes Town Board re Windy Gap and Allotment Contracts
Sept 25, 1973	USBR Region -- Carriage Contracts
Oct 9, 1973	Met with Mr Webb, Colorado Division of Water Quality, re Windy Gap Project
Oct 10, 1973	USBR Projects -- FIS
Nov 21, 1973	Met with Estes Park Realty Board to review Windy Gap Project
Nov 29, 1973	Presentation to LWRCOG Citizens Advisory Committee on Windy Gap Project
Nov 30, 1973	Met with USBR re Carriage Contract
Jan 29, 1974	Longmont Council and Water Board Windy Gap review
Feb 6, 1974	Estes Park Town Board -- Allotment Contracts and Windy Gap status
Feb 7, 1974	Larimer County Farm Bureau -- Windy Gap review
Feb 26, 1974	Met with City Council of Longmont to review Windy Gap Project
June 11, 1974	Longmont Council -- Allotment Contract
July 18, 1974	PRPA, Fort Collins, Loveland, Estes Park re Allotment Assignments
Aug 5, 1974	Longmont Council Windy Gap review and allotment
Aug 23, 1974	City Attorneys and Managers re Allotment Contracts
Sept 5, 1974	Loveland, Greeley Chamber of Commerce Tour -- Windy Gap and CBT
Sept 16, 1974	Met with Superintendent of Rocky Mountain National Park to review Windy Gap Project
Oct 22, 1974	Took Six City Councils and Water Boards on a tour of Windy Gap Site
March 3, 1975	Met with Board of Three-Lakes Sanitation District to review Windy Gap Project
April 30, 1975	Meeting with USBR Regional Office re F A R for Windy Gap Project
May 9, 1975	Talked to Mr H K Schmuck to review Windy Gap Project
May 13, 1975	Boulder City Council -- Work Session -- Windy Gap and Allotments
May 27, 1975	Longmont City Council -- Work Session -- Windy Gap and Allotments
Aug 6, 1975	Met with Mr Sweale of U S Corps of Engineers re Proposed Windy Gap Project

TABLE V-1 (Continued)

Feb 3, 1976	Met with Colorado River Water Conservancy District to discuss Windy Gap Project
Feb 5, 1976	Met with Estes Park Rotary to review Windy Gap Project
March 31, 1976	Met with Horn Ranches Inc , re Rights-of-way for Windy Gap Project
May 12, 1976	Met with Horn Ranches Inc , re Rights-of-way for Windy Gap Project
May 20, 1976	Met with Mr Wallace BLM, Kremmling to review Windy Gap Project
May 25, 1976	Met with State Engineer's Office re Dam Permit
June 1, 1976	Spoke to Loveland Rotary re Windy Gap Project
June 9, 1976	Met with Mr Eggen USBR re Windy Gap FIS
June 11, 1976	Made presentation to DRCOG reviewing Windy Gap Project
June 23, 1976	Middle Park Water Conservancy District Representatives -- Windy Gap and Azure
June 29, 1976	Tri-State Electric -- Representatives re Windy Gap Power
June 30, 1976	River District and Middle Park Water Conservancy District at Granby -- Windy Gap and Azure
July 29, 1976	Informational Public Hearing to Grand County Commissioners and Citizens of Grand County reviewing Windy Gap Project
Aug 10, 1976	Boulder City Council -- Windy Gap review
Aug 11, 1976	Colorado River Water Conservancy District, Middle Park Water Conservancy District -- Aspen -- Windy Gap and Azure
Sept 23, 1976	Met with USBR Regional Office re EIS and Willow Creek Inlet Chute
Oct 6, 1976	Cultural and Archaeological Reconnaisance survey Windy Gap Project
Nov 8, 1976	Met with Board of Three-Lakes Sanitation District to review Windy Gap Project
Jan 12, 1977	Met with USBR re FIS
Feb 14, 1977	Met with Mountain Parks Electric and Tri-State Generation and Transmission
March 16, 1977	Executive Committee, Board of Directors met with members of Board of Directors, Colorado River Water Conservation District and Middle Park Water Conservancy District
March 17, 1977	USBR, Region -- re Windy Gap Power
March 31, 1977	Met with Staff and Consultants of Colorado River Water Conservation District in San Francisco
April 8, 1977	Presentation to DRCOG re Windy Gap Project

TABLE V-1 (Continued)

April 25, 1977	Met with representatives of Horn Ranches, Inc
April 28, 1977	Greeley Centennial Club -- Windy Gap Program
April 29 1977	Met with Mr Howard K Schmuck and Mrs Riamor M Schmuck
May 2, 1977	USBR, PRPA re Windy Gap/Rawhide
May 26, 1977	Met with Mr Jonez USBR Washington, DC
June 3, 1977	USBR -- Windy Gap EIS Work Session
June 8, 1977	Colorado River Water Conservancy District, IFCO at San Francisco re Windy Gap/Azure
June 28, 1977	Public Hearing, Fort Collins -- Rawhide and Windy Gap
June 30, 1977	Presentation to Annual Meeting Colorado Municipal League on Windy Gap Project
Aug 11, 1977	Meeting of USBR Denver re EIS
Aug 25, 1977	Joint Meeting, City Councils of Greeley, Estes Park, Longmont, Boulder, Loveland, Fort Collins, and Board of Directors PRPA to review status of Windy Gap Project
Nov 16, 1977	USBR, Region re Windy Gap EIS
Dec 6, 1977	USBR, Project's office -- Windy Gap hydrology for EIS
Dec 13, 1977	USBR, Region -- Windy Gap EIS and Willow Creek Chute
Dec 20, 1977	USGS re Water Quality Monitoring for Windy Gap
Jan 11, 1978	USBR, Region -- EIS Draft Comments
Jan 12, 1978	Presentation to Four-States Irrigation Council on Windy Gap Project
Jan 16, 1978	Meeting with USCE on 404 Permit for Windy Gap Project
Jan 25, 1978	Weld County Farm Show -- Presentation on Windy Gap
March 13, 1978	Meeting with Grand County Commissioners, Grand County Attorney, Grand County Manager, and Staff to review Windy Gap Project, Willow Creek Inlet Chute and the relationship between the two projects
April 10, 1978	USBR, Washington, DC -- Specht and Lozier re Windy Gap EIS
April 14, 1978	USBR, Region -- Windy Gap EIS
April 27, 1978	USDI, Parrish and Sanches -- CBT and Windy Gap
June 7, 1978	USBR Region, PRPA, EDAW -- Windy Gap, EIS, Rawhide
June 8, 1978	USBR Region, and Project -- Windy Gap Hydrology for EIS
June 13, 1978	USBR Region and Project -- EIS Socio-Economic
June 15, 1978	Longmont Builders Association -- Program on CBT and Windy Gap

The Municipal Subdistrict submitted an application to the Corps of Engineers, Sacramento District for a Section 404 Permit The Corps circulated Public Notice No 6520 on March 14, 1978 Twenty comment letters were received The majority of the letters requested that the 404 Permit process be held up until NEPA compliance has been completed The Corps has agreed to this

In conjunction with the 404 Permit, the Subdistrict will have to obtain water quality certification from the Colorado Department of Health (CDH) In addition, it may be necessary to obtain a National Pollutant Discharge Elimination System Permit from the Water Quality Control Division, CDH

h Rawhide Powerplant

From the beginning, Platte River has consulted with the Larimer-Weld Regional Council of Governments (COG) in order to identify a site which will be acceptable from a regional standpoint During consideration of the Weld County sites in the fall of 1976, the Larimer-Weld COG held public information sessions in Nunn, Fort Collins, and Greeley to acquaint citizens of the area with Platte River's plans With the new site in Larimer County, additional public meetings were held in Wellington, Windsor, Loveland, and Fort Collins

The COG also organized a Technical Review Team to study the impacts of the project The review team issued a report in May 1977

The following agencies and individuals have been consulted or asked to review the proposed Rawhide Energy Project

Larimer-Weld Council of Governments
201 East 4th Street
Loveland, CO 80537

Larimer County Commissioners
and various County staff
County Courthouse
200 West Oak Street
Fort Collins, CO 80521

U S Environmental Protection Agency
Air Pollution Section
Denver, CO

U S Bureau of Reclamation
Lower Missouri Region
P O Box 25247
Denver Federal Center
Denver, CO 80225

Mr T Carroll Agee
Poudre R-1 School District
Administration Office
2407 Laporte Avenue
Fort Collins, CO 80521

Mr Eyestone, Mayor
Town of Wellington

Burlington Northern Railroad
1405 Curtis
Denver, CO 80202

Director, Pawnee National Grasslands
Roosevelt National Forest
Pawnee Grasslands District
2009 9th Street
Greeley, CO 80631

Director, State Board of Land Commissiners
1845 Sherman Street
Denver, CO 80203

Platte River has contracted with a number of consultants in planning for the project These consultants and their areas of expertise are as follows

Site Selection, Transmission Alinements

FDAW, Inc
Environmental Planning
315 West Oak Street, Suite 700
Fort Collins, CO 80521

Meteorology, Baseline Ecological Studies

Stearns-Roger, Inc
Environmental Sciences Division
925 South Niagara Street
P O Box 5888
Denver, CO 80217

Project Engineering and Geology

Black & Veatch
Consulting Engineers
1500 Meadow Lake Parkway
Kansas City, MO 64114

Archaeology

Dr Bruce Lutz
Office of Public and Contract Archaeology
University of Northern Colorado
Greeley, CO 80631

Paleontology

Dr K Lee Shropshire
Associate Professor of Geology and Paleontology
University of Northern Colorado
Greeley, CO 80631

Socio-Economic Analysis

FDAW, Inc , in association with Dr Evan Vlachos

B Coordination During Review of the Draft Environmental Statement (DES) and Preparation of the Final Environmental Statement (FES)

The DES was distributed to those listed in the Distribution section of the FES The comments and responses associated with this distribution are included in Chapter VIII B of the FES Public hearings were also held in Granby and Loveland, Colorado, on August 2 and 3, 1979 See Chapter VII A for a more detailed explanation of the hearings Subsequent to review of the DES, it was apparent that additional studies and attendent consultation and coordination was required The results of this additional work is discussed in Chapter IV of the FES A list of those consulted is included in Table V-2 The most important result was the consummation of two agreements between West and East Slope interests and various governmental entities and individuals The two agreements are included in Attachments 1 a and 2 a of the FES

Other important consultation and coordination has involved Section 7 consultation with the Fish and Wildlife Service on threatened and endangered species, Section 404 dredge and fill permit coordination with the Corps of Engineers, and right-of-way coordination with the BLM and the Forest Service Most of this coordination was the responsibility of and conducted by the Municipal Subdistrict Water and Power personnel acted as liaisons in some cases A composite list of those consulted, the subject matter, and the date is indicated in Table V-2 These represent the important meetings and contacts Informal discussions are not included A brief description and the results of this coordination and consultation is included below

1 Threatened and Endangered Species

Threatened and endangered species consultation with the Fish and Wildlife Service pursuant to Section 7 of the Endangered Species Act was initiated on November 4, 1980 The Corps of Engineers, BLM, and Forest Service were contacted by letter and they agreed that Water and Power should act as lead agency during the consultation process Three major meetings among the Fish and Wildlife Service, Subdistrict, and Water and Power were held which eventually lead to an acceptable alternative which would not jeopardize the existence of the two species in question the Colorado River squawfish and humpback chub

The Subdistrict's Board of Directors resolved to certain conservation measures (Attachment 2 D) which FWS found acceptable The accepted alternative was concurred in by BLM, FS, and Corps of Engineers on March 10, 1981, and a "nonjeopardy" biological opinion was rendered by the FWS on March 13, 1981 (Attachment 2 B)

2 Dredge and Fill Permit

As indicated in Tables V-1 and V-2 coordination and consultation between the Subdistrict and the Corps of Engineers has been an ongoing process for several years The Corps commented on the DES (see Chapter VII B) and commented on the advance draft of this FES on February 18, 1981 Their concerns have been integrated into the FES If the Corps finds this FES acceptable it intends to issue a Section 404 permit to the Subdistrict after the appropriate comment period on the FES is complete No hearing is anticipated at this time

3 Right-of-Way Coordination with the Bureau of Land Management and Forest Service

As stated in Chapter I, the BLM and Forest Service will be issuing permits and/or easements to the Subdistrict for use of Federal lands The BLM and Forest Service have environmental requirements which must be met in order to issue permits and easements The FES discusses the environments associated with these Federal lands which would be impacted by the Windy Gap project and summarizes or references the mitigation to which the Subdistrict has agreed Throughout project formulation, BLM and the Forest Service have been consulted by the Subdistrict (see Tables V-1 and V-2) The results of this consultation are refelected in the studies conducted by the Subdistrict to meet each agency's permit application requirements

Primarily, the studies are associated with reclamation and mitigation of disturbed soils, vegetation, and cultural resources as a result of pipeline and road construction and operation

Reclamation of soils and vegetation are stipulated in Dames and Moore (1978) which is being updated to reflect project modifications, and the various cultural resource studies performed by cultural resource consultants (see Chapter IV C 2 of the FES)

Commitments by the Subdistrict to carry out mitigation for soils and vegetation will be reflected in the permit applications to the BLM and Forest Service

The State Historic Preservation Office (SHPO) has evaluated the 1979 report prepared by Western Cultural Resources Management Nineteen of the 33 sites located during the four surveys were extensively discussed in that report In a letter dated January 14, 1981, the SHPO found two sites eligible to the National Register of Historic Places These were 5GA-151 and 5GA-153 On April 15, 1981, formal determinations of eligibility on those sites were requested from the National Register of Historic Places On April 17, 1981, the SHPO was requested to comment on (1) the eligibility of the 14 remaining sites, and (2) the mitigation plan as defined by the Subdistrict's commitments and modified by comments solicited from BLM and the Forest Service

When responses have been received from the SHPO and the National Register, Water and Power will forward a preliminary case report to the Advisory Council on Historic Preservation (ACHP) and request a Memorandum of Agreement (MOA) on the mitigation plan This MOA will be among the Advisory Council, Water and Power, and the SHPO Authorization given to the Subdistrict to convey water through C-BT facilities will be contingent upon two factors These are (1) execution of the MOA, and (2) successful negotiation of a paleontological mitigation program among the Municipal Subdistrict, BLM, and Water and Power

The following list of correspondence directly relates to project consultation regarding cultural resources

December 29, 1980 USFS to SHPO transmits WCRM (1979) report for comment and preliminary determinations of eligibility

January 14, 1980 SHPO to USFS states that two sites (5GA-151 and 5GA-153) are apparently eligible Requests more information on 5GA-239

February 13, 1981 Water and Power to Municipal Subdistrict requests specific commitment to mitigation plan as defined in WCRM (1979) report, and commitment to survey additional lands

March 2, 1981 Municipal Subdistrict to Water and Power states commitment as required in February 13 letter and provides support documentation through two letters (February 23 and 25, 1981) from WCRM to Municipal Subdistrict

March 17,1981 Water and Power to BLM and USFS requests comments/concurrence on Municipal Subdistrict's mitigation commitments

April 2 1981 BLM to Water and Power provides comments as requested

April 8, 1981 USFS to Water and Power provides comments as requested

April 15, 1981 Water and Power to Keeper of the National Register requests determinations of eligibility on 5GA-151 and 5GA-153

April 17, 1981 Water and Power to SHPO requests additional determinations and evaluation of mitigation plan

TABLE V-2

Consultation and Coordination by the Subdistrict July 1978 - March 1981

Date	Entity (s)	Subject
July 11, 1978	USBR, BLM, DOW, FWS	Review Windy Gap Plans (tour)
July 12, 1978	BLM (Kremmling)	ROW application
Aug 21, 1978	George Mullin (Crazy U Ranch)	ROW acquisition
Aug 25, 1978	Rodney Wood (Corps)	404 application
Aug 28, 1979	Six cities participants	Progress on Windy Gap
Aug 31, 1978	Mountain Parks Electric and Tri-State	Review power supplies for Windy Gap
Sept 20, 1978	State Engineer	Rancher water rights
Sept 28, 1978	National Park Service (property taken over by Forest Service	ROW pemit
Oct 18, 1978	Bill Thompson (Kremmling)	Ranchers diversions
Nov 2, 1978	Chuck Hughes (Forest Service)	ROW for Windy Gap
Nov 6, 1978	Ranchers	Rancher diversion improvements
Dec 21, 1978	Charles Woodward, Three Lakes Water and Sanitation	Impacts on water quality - Three Lakes
Jan 9, 1979	Gary Morgan (Forest Service)	ROW permit
Jan 9, 1979	District 51 Water Commissioner	Rancher water rights
Jan 22, 1979	Six city participants	Progress on Windy Gap
Feb 16, 1979	Barnie, WCRM	Archeological Studies
Feb 20, 1979	State Engineer	Rancher water rights
March 8, 1979	George Mullin	ROW requirements
April 10, 1979	USBR	DES hearings
April 16, 1979	Representatives of Senator Hart	Progress on Windy Gap
April 24, 1979	USBR	Power supplies for Windy Gap
May 1, 1979	River District	District records re Windy Gap
May 8, 1979	Brian Ross, rep from Senator Hart's Office	DES
May 21, 1979	Six cities participants	Progress on Windy Gap

Date	Entity (s)	Subject
May 23, 1979	George Mullin (Kremmling)	ROW for Windy Gap
May 30, 1979	Hontchen Homes	ROW required across C Lazy U Ranch
May 31,, 1979	Senator Hart	Progress on Windy Gap
July 15, 1979	Bill Thompson	Tour of rancher diversions
July 23, 1979	Six cities participants	Progress on Windy Gap
Aug 2, 1979	Granby DES hearing	DES public hearing
Aug 3, 1979	Loveland DES hearing	DES public hearing
Aug 7, 1979	Representatives of Longmont	Progress on Windy Gap
Aug 31, 1979	Representatives of Jim Johnson	Progress on Windy Gap FES
Sept 21, 1979	USBR	Review comments on DES
Oct 15, 1979	Hollinogen and Bolcomb	Negotiating Windy Gap Settlement
Oct 15, 1979	Six cities	Progress on FES
Oct 18, 1979	Eggen and Nash of USBR	Windy Gap settlement
Nov 5 1979	Higginson, USBR	FES progress
Nov 29, 1979	Boulder	Windy Gap settlement
Nov 30, 1979	Loveland	Windy Gap settlement
Nov 30, 1979	Longmont	Windy Gap settlement
Nov 30, 1979	Estes Park	Windy Gap settlement
Dec 3, 1979	Greeley	Windy Gap settlement
Dec 5, 1979	EPA and USBR	EPA's position on DES
Jan 2, 1980	Colorado River ranchers	Windy Gap settlement
Jan 4, 1980	River District	Windy Gap settlement
Jan 24, 1980	Colorado River ranchers	Windy Gap settlement
Feb 5, 1980	DOW	Minimum streamflows
Feb 7, 1980	River District	Negotiate settlement
Feb 18, 1980	Senator Hart's Office	Windy Gap settlement
Feb 21, 1980	DOW	Minimum streamflows
Feb 21, 1980	Schmuck	Fishing closures below Windy Gap Dam
March 3, 1980	EPA	DES

Date	Entity (s)	Subject
March 7, 1980	DOW	Minimum streamflows
March 17, 1980	DOW	Minimum streamflows
March 24, 1980	Front unlimited and Ouin Front	Minimum streamflows
March 24, 1980	Hontchen Homes	ROW
March 25, 1980	Forest Service, USGS, and USBR	Water quality - Three Lakes
March 27, 1980	Nountain Parks Electric and Tri-State	Power supply for Windy Gap
April 22, 1980	Grand County	Hearing on 1041 permit
April 22, 1980	Front Unlimited (Weaver and Crosby), Colorado Open Space Council, and Ouin Front	Minimum streamflows
April 24, 1980	Northwest COG	Windy Gap settlement
April 25, 1980	River District	Windy Gap settlement
April 28, 1980	Six cities participants	Windy Gap settlement
May 1, 1980	Colorado River ranchers	Windy Gap settlement
May 13, 1980	Three Lakes water and Sanitation District	Windy Gap water quality
May 13, 1980	Greeley	Windy Gap settlement
May 19, 1980	City Council Loveland	Windy Gap settlement
May 20, 1980	City Council Longmont	Windy Gap settlement
May 21, 1980	City Council Estes Park	Windy Gap settlement
May 23, 1980	Six cities	Windy Gap settlement
May 27, 1980	City Council Boulder	Windy Gap settlement
May 29, 1980	PRPA	Windy Gap settlement
June 12, 1980	Tim Ward	Sediment Study
June 16, 1980	Grand County	Hearing on 1041 permit
July 1, 1980	Water and Power	Windy Gap operation studies
July 16, 1980	Mountain Parks Electric and Tri-State	Power supplies and transmission line relocation
July 18, 1980	Corps of Engineers, Sacramento	404 permit
July 25, 1980	Bond Counsel, New York City	Financing of Windy Gap
July 29, 1980	Water and Power, RO	Tour Windy Gap
Aug 14, 1980	Colorado River ranchers	Diversion improvements

Date	Entity (s)	Subject
Aug 14, 1980	IECO	Tour ranch diversions
Aug 15, 1980	IECO	Tour ranch diversions
Sept 9, 1980	Bill Thompson	Pump test
Aug 10, 1980	Bill Thompson	Pump test
Aug 10, 1980	McElroy	Pump test
Aug 11, 1980	Culbreath	Pump test
Aug 11, 1980	McElroy	Pump test
Aug 12, 1980	Culbreath	Pump test
Aug 12, 1980	Mayhoffer	Pump test
Sept 18, 1980	Kemp	Pump test
Sept 23, 1980	FWS, USBR	Endangered species
Sept 23, 1980	Six cities	Endangered species
Sept 25, 1980	Kemp	Ranch diversion improvements
Sept 25, 1980	Kemp	Ranch diversion improvements
Sept 25, 1980	McElroy	Ranch diversion improvements
Sept 25, 1980	McElroy	Ranch diversion improvements
Sept 25, 1980	Thompson	Ranch diversion improvements
Sept 25, 1980	Culbreath	Ranch diversion improvements
Sept 26, 1980	Sheriff	Ranch diversion improvements
Sept 26, 1980	Thompson	Ranch diversion improvements
Sept 26, 1980	Palmer	Ranch diversion improvements
Sept 26, 1980	Ritschard	Ranch diversion improvements
Oct 2, 1980	BLM, Kremmling	ROW permits
Nov 3, 1980	Mountain Parks Electric	ROW permits transmission line relocation
Nov 3 and 4, 1980	Stewart	Ranch diversion improvements
Nov 3 and 4, 1980	Lakey	Ranch diversion improvements
Nov 3 and 4, 1980	Mayoffer	Ranch diversion improvements
Nov 3 and 4, 1980	Marte	Ranch diversion improvements
Nov 3 and 4, 1980	Reynolds	Ranch diversion improvements
Nov 3 and 4, 1980	Brodie	Ranch diversion improvements

Date	Entity (s)	Subject
Nov 3 and 4, 1980	Wall	Ranch diversion improvements
Nov 3 and 4, 1980	Rentor of Dolloff Prop	Ranch diversion improvements
Nov 6, 1980	Jack Horn	ROW permits for borrow area
Nov 17, 1980	River District	Windy Gap settlement
Nov 17, 1980	Clark	Ranch diversion improvements
Nov 17, 1980	Water and Power	Ops Study
Nov 18, 1980	Estes Park	Progress on Windy Gap
Nov 18, 1980	Crosby	Ranch diversion improvements
Nov 19, 1980	Water and Power	Ops Study
Nov 26, 1980	Tri-State	Power line relocation
Dec 3, 1980	Water and Power FWS	Endangered species
Dec 4, 1980	Dorsett	Ranch diversion improvements
Dec 5, 1980	USFS	ROW permit
Dec 11, 1980	River District	Windy Gap settlement
Dec 23, 1980	USFS	ROW permit
Jan 8, 1981	Tom Pitts	Tour for Mined Land Reclamation Permit
Jan 14, 1981	USFS, Fort Collins	Water quality - Three Lakes
Jan 19, 1981	Six cities	Progress on Windy Gap
Jan 22, 1981	River District	Progress on Windy Gap
Jan 28, 1981	FWS and Water and Power	Endangered species
Feb 6, 1981	BLM, Kremmling	ROW permit
Feb 10, 1981	BLM, State Office	ROW permit
March 3, 1981	BLM, District Office	ROW permit
March 10, 1981	Water and Power, FWS, BLM, USFS	Endangered species
March 10, 1981	Six cities	Endangered species
March 17, 1981	Howard Schmuck and Leon Demouth	Migration of impacts on Schmuck property

CHAPTER VI LIST OF PREPARERS

Chapter VI LIST OF PREPARERS

The list of preparers is divided into two categories (1) environmental statement preparation, and (2) primary sources of support information The qualifications and experience of those primarily responsible for preparation of the environmental statement are listed so that their contribution to particular sections of the final environmental statement is apparent

The primary sources of support information are listed by organization Because much of this support information represents joint efforts by many individuals, it is impractical to provide a separate listing of the qualifications and experience of individuals within each organization

A Environmental Statement Preparation

1 Steve Rademacher, Environmental Specialist, Water and Power Resources Service, Lower Missouri Region

Steve Rademacher has a B S in Biological Sciences with graduate work in environmental science, business, and law Mr Rademacher has 10 years of experience in natural resources management and planning, and environmental assessment

2 James Yahnke, Natural Resource Specialist, Water and Power Resources Service, Lower Missouri Region

B S in Biology plus 3 years post-graduate studies in Aquatic Ecology and Aqueous Geochemistry Seven years experience - 1 in NEPA compliance and environmental impact assessment, 6 in water quality research and evaluation

3 William Butler, Jr , Wildlife Biologist, Water and Power Resources Service, Lower Missouri Region

Bill Butler has a B S in Zoology, B S in Wildlife Biology, and M S in Zoology He has 2 years experience as a field biologist and 4 years experience as an Environmental Specialist

4 Jeff L Kenyon, Regional Archeologist, Water and Power Resources Service, Lower Missouri Region

Jeff Kenyon is a cultural resources specialist with a B A in History and an M A and Ph D in American Studies specializing in the archeology of historic sites He has 12 years of experience in the study of archeological, historical, and architectural resources As Regional Archeologist, he is in charge of all cultural resource compliance activities for the Lower Missouri Region

5 Robert Erickson, Environmental Consultant, Longmont, Colorado

Mr Erickson has a B S in Zoology and Masters and Ph D degrees in aquatic ecology and radiation biology He has extensive experience in aquatic ecology and environmental assessment

B Support Information

Provided by personnel representing the following organizations

1 Dames and Moore, environmental consultants, Denver, Colorado

2 Municipal Subdistrict, Northern Colorado Water Conservancy District, water resource planning and management, Loveland, Colorado

3 Water and Power Resources Service, South Platte River Projects Office, water resource management, Loveland, Colorado

4 Platte River Power Authority, electrical utility, Fort Collins, Colorado

CHAPTER VII COMMENTS AND RESPONSES ON DRAFT ENVIRONMENTAL STATEMENT

A PUBLIC HEARING

B LETTERS OF COMMENTS

A. PUBLIC HEARING

Analysis of Public Hearing

This summary analysis of both the oral and written statements represents a digest of the issues presented at the public hearing for the Draft Environmental Statement for Colorado-Big Thompson/Windy Gap Projects Two hearings were held the first was held in Granby, Colorado, on August 2, 1979, the second was held in Loveland, Colorado, on August 3, 1979

These hearings were held in compliance with the National Environmental Policy Act of 1969, the Council on Environmental Quality Guidelines published in the Federal Register and the Bureau of Reclamation (changed to Water and Power Resources Service) Instructions, Part 376 5 9A

The Water and Power Resources Service appreciates the interest shown by those organizations and individuals participating in the public hearing

The primary purpose of the public hearing section is to identify people's concerns and to answer their questions to the extent possible in the preparation of the Final Environmental Statement

The hearing in Granby lasted about 3 hours with 56 people registered Thirteen people gave an oral statement only, three gave oral and written comments, four gave written comments only, and thirty-nine were observers The majority of the attendees came from the area directly impacted by the Windy Gap Project

Of the 13 oral statements presented, seven were given by representatives of West Slope county and city governments, and water and sanitation districts The remaining six statements were presented by concerned citizens of the project development area Most of the observers lived within the Windy Gap development area, especially Grand and Summit Counties

The hearing in Loveland lasted about 2 hours with 28 people registered Seven people gave an oral statement only, one person gave oral and written comments, one person gave written comments only, and 20 people were observers The majority of the attendees came from the area to be served by the Windy Gap Project

Of the seven oral statements, four were given by representatives of the project sponsors or cities within the service area, one from an environmental organization, and two from concerned citizens Most of the observers lived within the Windy Gap service area

The issues presented at the public hearing are responded to in the following sections They are categorized into 22 different subjects and are addressed in the appropriate sections of the Final Environmental Statement

1 Issue Inclusion of Rawhide Powerplant

Raised by

John Martling
Mary Muller
Larry Simpson
Dwight Smith
Albert Hamilton
Jerry Trotter
S R Broome
Gerald Dahl
Roland Fischer

Response The Rawhide Project is being constructed by the Platte River Power Authority and is not dependent on Federal actions The Rawhide Project is being constructed without the Windy Gap Project Treatment of the Rawhide Powerplant in the FES is at a level of detail similar to that given all other participants in the Windy Gap Project, because it may be receiving water to cool future units Detailed environmental impacts have been discussed in PRPA (1978) All necessary State and local permits have been issued and the project is under construction

2 Issue Legality of using Colorado-Big Thompson facilities to convey Windy Gap water

Raised by

Richard Doucette
S R Broome, Grand County Manager
Gerald Dahl

Response The legality of conveying Windy Gap water through the C-BT was purused during negotiation and preparation of the Carriage Contract The only provision which prevents the execution of this contract is environmental impact analysis and documentation Acceptance of this final environmental statement should satisfy this provision

3 Issue Windy Gap Project water rights

Raised by

Gerald Dahl
John Martling
Richard Doucette

Response The background of Windy Gap water rights is summarized in Chapter I A The water right decrees and findings of fact are included in Attachment 1

4 Issue Tradeoffs between East and West Slope uses of Windy Gap water Specifically East Slope growth at the expense of West Slope uses such as agricultural, instream uses, energy, and municipal and industrial

Raised by

Scott Ready
Richard Blodgett
Scott Balcomb
John Kemp
Wendell Funk

Response The Intergovernmental Agreement (Attachment 1) compensates West Slope users for the Windy Gap water depletion See Attachment 1 for a discussion of these mitigation measures and parties to the agreement

5 Issue Better coordination should be made with those affected by the Windy Gap Project, including consideration of water and land use plans, etc

Raised by

John Martling
Gene Ritschard
Joe McElroy
Wendell Funk
Scott Ready
S R Broome

Response Subsequent to review of the draft environmental statement, the Subdistrict went to great lengths to coordinate its project with affected entities and individuals The Intergovernmental Agreement (Attachment 1) indicates the results of this coordination A list of those coordinated with is included in Chapter V of this document

6 Issue Wildlife impacted by Windy Gap

Raised by

Mary Muller
Dwight Smith

Response A description and impact analysis of wildlife associated with the Windy Gap Project is included in Chapters III and IV of this document

7 Issue Windy Gap water demands

Raised by

John Martling
Gerald Dahl
Roland Fischer

Response Windy Gap's water demands are described in Chapter II B 2 Depletions are indicated in Chapter IV C a of this document

8 Issue Preparation of a new draft environmental statement

Raised by

John Martling
Richard Doucette
Gerald Dahl

Response Because of mitigation provided by the various agreements negotiated between the Subdistrict and West Slope and other governmental entities, a redraft would serve no useful purpose All of the significant issues raised concerning the draft environmental statement have been alleviated to a significant degree by these agreements See Attachments 1 and 2 of this document

9 Issue Physical carrying capacity of the Colorado-Big Thompson Project with Windy Gap

Raised by

Scott Ready

Response The physical carrying capacity of the C-BT is described in detail in Chapter II B 1 of this document The original C-BT Project design provided for the diversion of 310,000 acre-feet per year, which included a diversion similar to the Windy Gap Project

10 Issue Operations of Green Mountain Reservoir

Raised by

Scott Balcomb
Stan Cazier
Gerald Dahl
Roland Fischer

Response Current operations of Green Mountain Reservoir are described in Chapter II B 1 of this document Green Mountain Reservoir water will not be used to replace depletions caused by the Windy Gap Project

11 Issue Evaluation of need for Windy Gap Project

Raised by

Dwight Smith
S R Broome

Response A description of the need for the Windy Gap Project is included in Chapter I B of this document

12 Issue The aesthetics of the river should be mentioned Impact on unique features such as Byers Canyon should be expanded

Raised by

Gene Ritschard	H K Schmuck
Stan Cazier	Dr George Warner
John Martling	S R Broome

Response The discussion of aesthetics has been expanded, see the aesthetic sections of Chapters III and IV

13 Issue Minimum stream flows and impacts on existing flows in the Colorado River

Raised by

John Martling	Richard Doucette	Stan Cazier
Scott Balcomb	S R Broome	John Kemp
Mary Muller	Gerald Dahl	Sylvia Hites
Dwight Smith	Scott Ready	

Response A minimum stream flow agreement to protect instream and downstream uses of water is included in Attachment 2 The Intergovernmental Agreement (Attachment 1) provides for further compensation to West Slope interests as a result of Windy Gap water depletions Impacts on hydrology are discussed in Chapter IV of this document

14 Issue Impacts of salinity increases in the Colorado River should be explained Should include impact on river as it leaves Grand County as well as other locations

Raised by

Gene Ritschard	S R Broome
Gerald Dahl	Roland Fischer
John Martling	John Petty
Dwight Smith	

Response Salinity in the Colorado River Basin is being addressed by the Colorado River Salinity Control Program This program is responsible for investigating problems, and proposing and carrying out solutions Several projects are authorized and more are being investigated The purpose of the program is to alleviate the adverse economic and environmental impacts caused by high salinity concentrations

This corrective and preventive program assumes that water allocations between the upper and lower Colorado River Basin states will be exercised according to the Colorado River Compact, Boulder Canyon Project Act, Mexican Treaty of 1944, Upper Colorado River Basin Compact, Arizona vs California suit in the Supreme Court, and the Colorado River Storage Project Act

It is true that some projects are decreasing salinity concentrations while others are increasing concentrations However, the net effect of the Colorado River Salinity Control Program will be to maintain salinity concentrations within acceptable limits at specific locations

15 Issue Water quality (other than salinity) impacts on the Colorado River and three lakes system

Raised by

John Martling
Dwight Smith
Sylvia Hites
John Petty
Dr George Warner
S R Broome
Gerald Dahl

Response Water quality impacts due to Windy Gap are discussed in Chapter IV C 1 b and Chapter IV C 3 b of this document

16 Issue Threatened and endangered species

Raised by

Scott Balcomb
Dwight Smith
Derald Dahl

Response The FWS issued biological opinions on C-BT operations and construction and operations of the Windy Gap Project These opinions are included in Attachment 2 and are summarized in Chapter IV of this document The opinions indicate that no impacts to threatened and endangered species will occur as long as certain mitigation measures are pursued The mitigation measures are described in Attachment 2

17 Issue Recreation impacts

Raised by

John Martling
Richard Blodgett
John Kemp
S R Broome

Response Impacts on recreation are discussed in the recreation sections of Chapter IV of this document

18 Issue Impacts on and compensation to present and prospective West Slope water users as a result of the Windy Gap transmountain diversion, specifically, impacts on and compensation to Grand and Summit Counties, and the Colorado River Water Conservation District

Raised by

John Martling
Scott Ready
Wendell Funk
S R Broome
Gene Ritschard
Stan Cazier
Richard Blodgett
Richard Doucette
Scott Balcomb
Dwight Smith
Gerald Dahl

Response Impacts on and compensation to West Slope interests are discussed in Chapter IV C and the Intergovernmental Agreement (Attachment 1)

19 Issue Alternatives to the Windy Gap Project

Raised by

John Martling	S R Broome
Wendell Funk	John Petty
Richard Doucette	Gerald Dahl

Response Alternatives to the Windy Gap Project are discussed in Chapter II of this document

20 Issue Downstream and Fraser Valley water rights and water uses will be adversely affected by decreased flows due to the Windy Gap Project Especially ranchers who divert water directly by rock diversion structures, towns which divert for municipal and industrial uses, and waste water treatment facilities

Raised by

Gene Ritschard	Joe McElroy	Dr George Warner
Stan Cazier	Richard Blodgett	Wendell Funk
Dennis Ducommun	Richard Doucette	S R Broome
John Martling	H K Schmuck	Harald Dahl

Response The agreements executed among West Slope interests, government entities, and the Subdistrict mitigate or compensate for impacts to West Slope resources Water rights will not be affected pursuant to the Intergovernmental Agreement (Attachment 1)

21 Issue Localized environmental impacts (e g , mud flats, aesthetics, soil disturbance, etc) caused by construction of the Windy Gap diversion dam, pumping plant, and pipeline

Raised by

Stan Cazier

Response Localized impacts and mitigation are discussed in Chapter IV C of this document

22 Issue Aquatic impacts and mitigation associated with Windy Gap flow depletions Includes impacts on and mitigation for aquatic habitat and aquatic biota especially fish

Raised by

Gene Ritschard	Dwight Smith
Stan Cazier	Sylvia Hites
John Kemp	S R Broome
Mary Muller	Gerald Dahl

Response Impacts on and mitigation for flows and aquatics are discussed in Chapter IV C of this document Mitigation is provided by the minimum flow agreement with the Division of Wildlife (Attachment 2)

B. LETTERS OF COMMENTS

FEDERAL AGENCIES

U TED ST TES D RTMEN OF AGR CULTURE
ORE T ER C
11177 West 8th A enue
P O B 25127
Lakewood Col rad 80225

August 2 1979

Joe D Hall Regional Director
Bureau of Reclamation
Lower Missouri Region
P O Box 25247 Bldg 20
Denver Federal Center
Denver Colorado 80225

Dear Mr Hall

Thank you for the opportunity to review the Draft Environmental Statement for the Colorado-Big Thompson/Windy Gap Projects The statement seems to be well written and complete however we have the following comments

1 Figure II-8 It appears that the Bureau of Reclamation may not realize that a portion of the pipeline is on National Forest land (from Lake Granby across the NRA) This should be pointed out to them etc

2 Page II 17, 5th paragraph The Forest Service acquired jurisdiction of project lands at Green Mountain Reservoir by order of the Reclamation Commission effective February 15 1976 pursuant to PL 88-578 not the public laws cited in this paragraph

Further no lands were ~~obtained~~ reta ra by the Bureau in the Arapaho NRA The following is from PL 95-450 which established the NRA

(e) Notwithstanding any other provision of law any Federal land or interests in land located within Arapaho National Recreation Area shall be transferred without consideration to the administrative jurisdiction of the Secretary for use by the Secretary in carrying out this Act Lands within the Arapaho National Recreation Area acquired by the Secretary or transferred to the Secretary s administrative jurisdiction shall become part of that recreation area and of the National Forest within or adjacent to which they are located: Provided that the operation and facilities of the Colorado Big Thompson project shall remain under the jurisdiction of the United States Bureau of Reclamation

2

The following is the opinion of the Regional Attorney regarding status of former Bureau lands within the NRA

Question 6

a Whether the lands which support facilities of the Colorado Big Thompson Project remain under the jurisdiction of the Bureau of Reclamation after the enactment of PL 95-450

b Do such lands have National Forest status as a result of PL 95-450?

Answer 6:

a No

b Yes

The National Forest System lands within the NRA have acquired status and public domain status The public domain lands were withdrawn for reclamation purposes PL 95-450 gave these lands National Forest System status but did not affect the withdrawal Therefore the Bureau of Reclamation will be able to do as they wish across their lands without consent of the Forest Service The acquired lands are not subject to the 1902 Reclamation Act Therefore they are not withdrawn for reclamation purposes Should the Bureau of Reclamation propose to construct any road pipeline or powerline across those acquired lands in the NRA they can do it only with the consent of the Forest Service This consent should be in the form of a Memorandum of Understanding supposedly

3 Figure III-9 Reports certain lands within the NRA as Bureau of Reclamation excluded lands This is not true according to the Regional Attorney s letter cited above

4 Page III-33 The Three Lakes NRA should be changed to the Arapaho NRA

5 Page III-41: Under K 1 second paragraph should read Lake Granby Shadow Mountain Lake Grand Lake and Willow Creek Reservoir are integral parts

3

6 Page IV-28 Paragraph 2 a (3) should be changed to read traverse Arapaho NRA lands administered by the Forest Service U S D A

7 Page IV-29 Suggest adding a paragraph dealing with the impacts of water storage drawdown on recreational values on the reservoirs

Sincerely

CRAIG W RUPP
Regional Forester

UNITED ST ES DE RTM NT OF AGR CULTURE
FOREST SERV CE
11177 West 8th Avenue
P O Box 25127
Lakewood Colorad 80225

1950 3
August 22 1979

Joe D Hall Regional Director
Bureau of Reclamation
Lower Missouri Region
P O Box 25247 Bldg 20
Denver Federal Center
Denver Colorado 80225

Dear Mr Hall

Reference is made to our letter dated August 2 1979 regarding the Windy Gap Projects

Please make the following changes on our August 2 memo

1 Figure II 8 Delete paragraph and replace with Please indicate where the pipeline crosses National Forest land

2 Answer 6 Please delete the paragraph following b Yes It tends to confuse rather than clarify the intent of answer 6

Sincerely

CRAIG W RUPP
Regional Forester

Memorandum

To Files

Subject Response to August 2 1979 Comment Letter from Forest Service on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Please indicate where pipeline crosses USFS lands

Response The location of the pipeline alinement in relation to Forest Service property is indicated on Figure II 5 and has been included in the easement application submitted to the Forest Service by the Subdistrict

2 Comment Green Mountain Reservoir was transferred to the U S Forest Service by order of the Reclamation Commission effective February 16 1976 pursuant to Public Law 88 578 not the public laws cited on page II 17 fifth paragraph

Response The DES cited the correct public laws Green Mountain Reser oir was transferred to the FS on February 16 1976 pursuant to Public Law 89 72 and Public Law 93 575 A notice of this transfer was published in the Federal Register Vol 41 No 25 on February 5 1976

3 Comment No lands were obtained by the Bureau in the Arapaho NRA

Response We believe the comment is based on an out of context interpretation of the language on page II 17 paragraph 7 last sentence of the DES

The sentence states Certain lands and specific exclusion tracts were retained by the Bureau at both of these areas for operation of the C BT Project

This is a correct statement is standard procedure on all Water and Power facilities and does not imply that Water and Power has obtained or intends to obtain any jurisdiction over lands it does not specifically require for project operations

4 Comment Figure III 9 erroneously reports lands within the NRA which are administered by Water and Power

Response See Response No 3

5 Comment The name of the NRA is incorrect

Response Correction made in the FES

6 Comment Willow Creek Reservoir is part of the NRA and should be added to the language on page III 41 K 1 second paragraph

Response Addition is included in the FES

7 Comment Page IV 28 paragraph 2 a (a) Should substitute the U S Fores Service for the National Park Service

Response Correction noted in the FES

8 Comment Should discuss the impacts of reservoir drawdown on recreation values

Response See Chapter II

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO CALIFORNIA 95814

SPKED W 3 Aug 1979

OFFICIAL FILE COPY
AUG 9 1979

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D S r

h e ew d th draft n it nme t l stat ment f r the Colorado - Big Th mpso /k dy C p P j t C l do s it l t t th weste l pe d j di t o l resp sibiliti of Sacr me to Dist i t Corp of E g ers

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h n ti me ts b t pp e i t the pport ity t re i w the d ft i n l m t

Si r ly

GEORGE C WEDDEL
Chi f E gi ee g Di isi

Memorandum

To Files

Subject Response to August 3 1979 Comment Letter from Corps of Engineers Sacramento District on Colorado Big Thompson/ Windy Gap Projects Final Environmental Statement

NO RESPONSE REQUIRED See Chapter V Consultation and Coordination for information on 404

U S DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
R o

August 27 1979

SEP 137

HED 08

Mr Joe D Hall
Regional Director
Bureau of Reclamation
P O Box 25247
Denver Colorado 80225

Dear Mr Hall

Thank you for the opportunity to review the Colorado Big Thompson Windy Gap Transmission Statement

These water/power availability impacts were not found to have significant impact on the ground transportation systems in the region The minor effects to the local highways were adequately identified in the document

Sincerely yours

F S Wilson

Memorandum

To Files

Subject Response to August 27 1979 Comment Letter from Federal Highway Administration Region 8 on Colorado Big Thompson/ Windy Gap Projects Final Environmental Statement

NO RESPONSE REQUIRED

United States Department of the Interior
BUREAU OF MINES
OFFICE OF THE DIRECTOR
WASHINGTON DC

JUL 30 1979

DES 79 33

Memorandum

To Director Office of Environmental Assistance
Through Assistant Secretary Land and Water

AUG 2 1979

From Director Bureau of Mines

Subject Draft Environmental Statement for Colorado Big Thompson/Windy Gap Project Grand and Larimer Counties Colorado

I general the statement adequately covers the principal factors of the environmental impacts of both the Rawhide power plant site in Grand County and the Windy Gap reservoir site in Grand County and gravel deposits of the Windy Gap reservoir

We also agree that final selection of the pipeline route should carefully consider the minerals of the area Any impact on these minerals will be insignificant

We also agree that final selection of transmission lines should be made only after mineral resources and facilities have been analyzed The impacts of Rawhide are not discussed in the FES See Response No 2 to the Geological Survey letter

Thank for the opportunity to review this draft environmental statement

Acting Assistant Director

Memorandum

To Files

Subject Response to July 30 1979 Comment Letter from Bureau of Mines on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment The FES should discuss more fully the sand and gravel resources immediately east of the confluence of the Colorado and Fraser rivers and their tributaries

Response Windy Gap Reservoir will inundate some sand and gravel deposits However the impact of the project on other minerals will be minimal except for that material which is used in the actual construction of the project Selection of the pipeline route carefully considered the minerals of the area Any impact on these minerals will be insignificant

2 Comment Final corridor selection for Rawhide s transmission lines should be made only after mineral resources and facilities have been analyzed

Response The impacts of Rawhide are not discussed in the FES See Response No 2 to the Geological Survey letter

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON VA 22092

OFFICE OF THE DIRECTOR

In Reply Refer To
EGS DES 79/33
Mail Stop 760

27 JUL 1979

Memorandum

To Director Office of Environmental Affairs
Bureau of Reclamation

Through Assistant Secretary Energy and Minerals JUL 30 1979

From Director Geological Survey

Subject Review of draft environmental statement for Colorado Big Thompson/Windy Gap Projects Colorado

We have reviewed the draft statement as requested in your memorandum of June 17

The potential problem of landslides at the site of the proposed diversion dam appears to call for a more thorough discussion of mitigation We recommend further discussion also of proposed measures to control potential pollution of ground water from coal storage areas and ash ponds

These concerns are discussed in the enclosure

J R Balsley
Acting Director

Enclosure

DES 79/33 USGS Comments

Evaluations of geologic hazards particularly of landslide haza ds are generally comprehensive However it is stated that The major geologic risk at the Windy Gap Diversion site would be due to landslides (p III 9 par 1) but little additional information was found on how the anticipated problem would be mitigated For example it is stated without elaboration that Some Windy Gap site preparation will be required for the proposed diversion dam reservoir and pumping plant (p IV 3 par 5) We believe that additional information should be provided on methods of ensur ng safe design and maintenance of the dam as it would evidently be underlain in part by claystone of the Pierre Shale

A comparison of figures II 12a and II 14 suggest that the red symbol for the proposed site ray have been displaced about 1 000 feet to the east putting it erroneously in map unit A whereas it should have been shown in the more favorable map unit B

Information on the typical particle size range for the coal in inactive or active storage would be helpful in assessing both water and air impacts (p II 53)

The statement discusses the use of large trenches in order to prevent air impacts from the inactive coal storage (p II 53) It should also assess the probability of the accumulation of water in the trenches and in the coal and of subsequent leaching to ground water

It is stated that the ash ponds for the Rawhide Project are to have imper vious linings such as asphalt (p II 60) Further discussion indicates reliance on the impermeability of the Pierre Shale and treatment of only permeable layers to reduce seepage and does not mention linings (p IV 17) This apparent discrepancy should be explained it seems especially pert nent because the Pierre of this area appears to contain more than average amounts of sandstone layers (Mather K F Gilluly James and Lusk R G 1928—Geology-and-oil-and-gas-prospects-of-northeastern-Colorado— U S Geological Survey Bulletin 796 p 65 124 Griffitts M O 1949 Zones of Pierre Formation of Colorado Am Assoc Petroleum Geologists Bull vol 14 no 6 p 2024)

Although it is indicated that there will be no direct discharge of waste water from the project (p II 59 item h(1)) the statement would be strengthened by including more specific information on wastewater control measures for the coal supply systems (p II 53 item f par 4 and 5)

ONE HUNDRED YEARS OF EARTH SCIENCE IN THE PUBLIC SERVICE

MEMORANDUM

To Files

Subject Response to Geological Survey Comment Letter on the Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Additional information should be provided on methods of insuring safe design and maintenance of the dam

Response The stability of the Windy Gap Dam and Reservoir sites has been intensively investigated by qualified geologists of the International Engineering Company (IECO) These analyses have been reviewed carefully by the State Engineer with a great deal of emphasis being placed on dam safety and stability The State Engineer has issued a permit for the Windy Gap Dam and Reservoir Any additional information concerning the geology underlying the dam and reservoir and the dam stability is presented in the Windy Gap Dam Specifications and Permit (IECO and State Engineer) and the geology report done by IECO

2 Comment The red symbol on figure II 12a which shows the location of Rawhide powerplant should be moved 1 000 feet to the west

Response As stated in Chapter I of the FES the Rawhide Powerplant discussion is extensively edited from the DES Consequently most of the discussion dealing with the Rawhide Powerplant has been deleted in the FES including figure II 12a

3 Comment Information on typical particle size range from coal should be given

Response See Response No

4 Comment The FES should discuss the accumulation of water in the trenches and coal and resultant leaching to ground water

Response See Response No 2

5 Comment The apparent discrepancy over whether the ash ponds at Rawhide will or will not be lined should be explained

Response See Response No 2

6 Comment The FES should include more specific information on waste water control measures for Rawhide s coal supply systems

Response See Response No 2

FEDERAL ENERGY REGULATORY COMMISSION
W G ON D C 20426

In Reply Refer To

OEPR DRB
Cooperative Studies
Environmental Impact Statement
Colorado Big Thompson Windy Gap Projects Colorado

SEP 6 1979

Mr Al Jonez
Director of Environmental Affairs
Bureau of Reclamation
Washington D C 20240

Dear Mr Jonez

This is in reference to your request for our comments on the draft environmental statement on Colorado Big Thompson Windy Gap Projects Colorado

According to the material furnished the proposal involves three actions (1) a change in the operation of the Bureau of Reclamation s existing Colorado Big Thompson Proj ct (2) construction and operation of a diversion dam on Colorado River a pumping plant and a five mile conduit to Grandby Reservoir and (3) construction and operation of a 750 meg watt (ult mate cap c ty) coal fired powerplant

We ha e revie ed the materials furnished to determine the effects of the p oposal on th Commission s responsibilit es Such responsi bilities relate to the developm t of hydroelectric power und r the Federal Pow r Act and the construction and operation of natural gas pipelin s und r the Natural Gas Act

Our review indicates that as of August 1978 there ar no natural gas pipelines nor any gas or oil exploratory development activity within the vicinity of the proposed Windy Gap Water development project The proposed Rawhide powerplant would lie on the western edge of the Denver structu al basin which has undergo e extens e explo atory activity with 835 ells drilled during the year 1977 However no significant dis coveries were reported in Larimer County where the Rawhide project is planned

Mr Al Jonez 2

The 4 200 acre f et of cooling ater for the first unit of the Rawhide po e plant will come from secondarily treated se age effluent from the City of Fort Collins The tr ated effluent ould be delivered to the Rawhide site via an underground 24 inch diameter 20 mile long steel pipeline This pipeline would ross a 6 inch d ameter natural gas p pel e operated by the Western Slope G s Company an the same r a ty there are three small natural gas pipeli s op rated by th Public Servi e Company of Colorado and by the Rocky Mount in atural Gas Company Inc

The t o 230 kV transmission lines eeded to d str bute power from the propos d Rawhide pl nt would lso be in the area of the natural gas pipelines belonging to three ompan me tio d ib e If any of the transmiss on lines are located alo g the same r ght of ay as a pipeline special prec ut ons must be taken agai st induced electromagnetic alte nating c rrents and fault currents within the pipel n s

It is also recommended that the developer of the Rawhide complex contact the above m ntioned natural gas pipel ne companie and coordinate the propo ed acti ities

The a rage an ual di ersion of 49 000 acre feet of Windy Gap ater passi g through the Colorado Big Thompson Systen ill increase the pow r generation by an ave age of 29 million kilo att hours

We appreciate the opportunity to revie the draft environmental statement and hope our comment will be helpful to you in the prep aration of the final environmental statement

Sincerely

William W Lindsay Director
Office of Electr c Power Regulat on

Memorandum

To Files

Subject Response to Federal Energy Regulatory Commission Comment Letter dated September 6 1979 on the Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

Comment FERC s letter identifies precautions which should be taken to avoid impacts of Rawh de s ater pipeline and transmission lines on e isting gas pipelines

Response PRPA has been forwarded a copy of FERC s comment letter

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

AUG 29 1979

Ref BW EE

Mr Al R Jonez Director
Office of Environmental Affairs
Bureau of Reclamation
Washington D C 20240

Dear Mr Jonez

We are herewith providing you with the EPA comments on the Windy Gap Draft Environmental Impact Statement (DEIS) Our review of the Draft EIS for the Colorado Big Thompson Windy Gap Project finds the document to be deficient in its discussion of a number of water quality issues such as Colorado River flow depletion effects on downstream municipal wastewater treatment systems nutrient re cycling into the Three Lakes System and salinity increases in the Colorado River Basin In addition the EIS fails to adequately assess the impacts to threatened and endangered species or discuss the effects on wetlands in the vicinity of the proposed project

Of particular concern is the fact that the EIS does not relate appropriate State and Federal legal/institutional environmental constraints to the project such as the State Implementation Plan (SIP) for air quality 208 and local planning guides 404 and National Pollution Discharge Elimination System permits (NPDES)

The draft fails to comply with the new CEQ regulations which require a clear and thorough discussion of alternatives to the pro posed project The statement glosses over the possible alternatives at best We believe a combination of water conservation measures water reuse metering local planning efforts and the use of irriga tion water as alternatives to the project should be more thoroughly studied

Mitigation measures for impacts resulting from the project s operation need to be addressed Presently the draft deals only with those measures necessary to mitigate construction impacts

Based on the above concerns as discussed in the attached detailed comments we have assigned this environmental impact statement a Category 3 and are requesting that the draft be re issued We believe

Page 2

that substantial additional information and further analysis of reasonably available alternatives is needed to adequately assess the environmental impacts of the project before a rating of the proposal can be given EPA will be happy to meet with the Bureau to scope out these issues for the new draft

I have personally discussed our concerns briefly with Joe Hall your Regional Director responsible for the EIS on this project and will continue to work with him toward a satisfactory resolution of our concerns

If you have any questions concerning our comments please contact me or Susan Manich of my staff at 837 4831

We appreciate the opportunity to comment

Sincerely yours

Roger L Williams
Regional Administrator

Attachment

cc Joe Hall

DETAILED COMMENTS FOR THE
COLORADO BIG THOMPSON WINDY GAP PROJECTS

Water Quality Impacts

Flow Depletion

The adverse impacts of the 31% flow depletion in the Colorado River must be more thoroughly addressed Among the items which should be evaluated are the impacts of this flow depletion on the aquatic habitat stream morphology water supply and the design effectiveness of wastewater treatment facilities downstream of the depletion

The draft EIS gives a minimum bypass flow of 75 cfs but this figure does not guarantee that minimum streamflows necessary for fishery maintenance will be met after irrigation diversions are satisfied It further states that additional data is needed before a fishery maintenance flow can be recommended This data should be collected and a recommendation should be made before this project is allowed to proceed

We would also like to see a detailed description of the water rights situation between Windy Gap and Hot Sulphur Springs The principal diversion amounts and types of uses of diverted water should be denoted An effort should be made to more clearly explain the reasons for the historic 1971 75 22 cfs diversion versus the 44 cfs entitlement Is this situation one that can be reasonably expected to continue?

Downstream and reservoir water quality changes (i e dissolved oxygen and temperature) for high and low seasonal flows should be evaluated using presently available models Sartoris 1978 Daka and Harleman 1977 Huber and Harleman 1971 Adams 1974

The effects of flow depletion on downstream wastewater treat ment facilities needs to be addressed Water quality for the Colorado River in the vicinity of the Windy Gap diverison is currently classified as effluent limited This classification re quires secondary wastewater treatment capacities for downstream municipalities based on the 7 day once in ten year low flow The draft EIS states that If there is no effect on this flow due to the Windy Gap Project there should be sufficient water remaining in the riv r to assure that the water quality standards will be met The draft needs to further explain and discuss the possibility of there not being sufficient water remaining in the river and what

Page 2

this means in terms of water quality impacts (i e increased nutrient concentrations) and downstream treatment costs Will additional treatment be necessary? If so how will the Bureau of Reclamation or cities sponsoring the Windy Gap project compensate the affected downstream municipalities as proposed in the North West Colorado Council of Governments (NWCCOG) areawide water quality plan? This plan has been certified by the State and is awaiting EPA approval This plan states in part that

> Increased wa tewater treatment necessary to meet water quality standards and determined to be a direct result of flow modifi cations through changes in the transport of nutrients or other pollutants due to the operation of new municipal and industrial water project facilities will be offset by the permittee This may be accomplished either by construction and operation of additional wastewater treatment facilities made necessary by the reduction in flow or the permittee may elect to pay a fee in lieu of those mitigation measures This fee will be based upon the additional costs of wastewater treatment (capital operation and maintenance) and will be payable to the permitting authority for exclusive use in meeting the costs of such additional wastewater treatment

The implication of this and other requirements of the areawide plan and how they affect the Windy Gap Project need to be discussed in the EIS

Nutrient Recycling

In view of the high nutrient concentrations (i e phospho rous and nitrogen) at the point of diversion as noted in the EIS the possibility for accelerated eutrophication of the Three Lakes and Front Range reservoirs (Horsetooth Reservoir and Carter Lake) exists A comparison of the figures in Tables III 6 and III 7 on pages III 18 and 20 reveals that water of lesser quality (from the Colorado River) due to higher nutrient levels will be entering the Three Lakes syston In addition these waters will be recycled back into the Three Lakes without the benefits of advanced waste water treatment Non point sources have already been identified by EPA as contributing to nutrient loading in the Three Lakes and are expected to increase with the area s growing population The EIS has not fully recognized the potential for additional contribu tors of nutrients from the Upper Fraser Valley as well The area between Winter Park and Granby is expanding rapidly and could con tribute both point and non point pollution to the Windy Gap system The Bureau should coordinate with the NWCCOG 208 in assessing these problems and help to develop a plan to mitigate their impacts

Page 3

We find this lack of discussion concerning mitigation measures to be unacceptable and insist that both the responsibilities and opportunities for mitigating this adverse impact be discussed

The EIS should contain the results of estimating the poten tial contribution of nutrients from point source discharges in the Three Lakes Granby and Upper Fraser Valley and non point sources from population growth in these areas at present and by the years 1990 and 2000 The expected amounts of nutrients to be dis charged into Lake Granby during average low and high flow years should be made In stream quality changes could then be modeled using available models cited in the discussion of Flow depletion above

Salinity

The effect of increased salinity levels in the Colorado River Basin due to the Windy Gap project are recognized in the EIS but are not adequately discussed The draft statement should note that the project will increase salinity at Imperial Dam 4 5 mg/l and with an average damage figure of approximately $343 000 per mg/l, this salinity increase would result in damages of $1 372 000 to $1 715 000 per year

The information provided on salinity increases seems to conflict page IV 4 states that the impact on salinity would be an increase of two and three percent of current salinity at Lee s Ferry and Im perial Dam respectively Page IV 15 indicates that for both Lee s Ferry and Imperial Dam the projected increases in salinity are 0 5% The actual increase in salinity measured as mg/l is important not the percent increase It is also important to indicate the monetary cost of the projected increase in salinity Another potential cost to the Colorado River System is the loss of 50 000 acre feet of water available for hydro power The discussion on energy benefits should recognize this loss to Lake Powell need etc and attempt to estimate the cost

Since salinity is an acknowledged problem in the activities of the USBR and since the removal of 49 000 acre feet annually from the Colorado River by the Windy Gap project the lack of discussion concerning mitigation measures in the EIS is surprising EPA believes that a salinity policy should be delineated discussed and en couraged for this project The USBR should consider various means

Page 4

of compensation (perhaps in the form of fees levied for use of the CB T system) to be used for salinity control projects The NWCCOG 208 plan suggests such an approach EPA believes that the USBR should develop some method of offsetting salinity costs and impacts in any case The final EIS should contain a discussion and suggest possible alternatives for alleviating this impact

Big Thompson River

The impact of additional diversions to Big Thompson River should be evaluated For example Table IV 4 indicates that for a wet year the highest historic pre project flows were 20 400 acre feet while the post project flows would be 29 200 acre feet This indicates an increase of over 40 percent which would have significant impact on the river system This increase in streamflow must be addressed in the final environmental impact statement Impacts on aquatic systems flood flows and existing land uses should be considered

Air Quality

This EIS clearly fails to take account of the most significant air quality problems associated with the Windy Gap project amely the condition of air quality in the Front Range cities receiving this project water No mention is made for example of the fact that all of the six cities lie within Air Quality Control Regions considered to be non attainment areas for one or more critical air pollutants

Two non attainment areas are affected by this project the Denver Region (non attainment for carbon monoxide (CO) ozone total suspended particulates (TSP) and nitrogen oxides (NO_x)) and the Larimer Weld Region (non attainment for CO TSP and at present ozone) CO ozone and TSP problems are largely due to mobile source contributions which are in turn related to population growth and lifestyles centering on the automobile

Congress has mandated the manner and direction of cleaning up metropolitan air pollution problems through the Clean Air Act The State of Colorado local and regional agencies are in the process of developing a State Air Implementation Plan (SIP) to carry out the management and control of air pollution sources

Page 5

While we can unde s and he phil sophy outlined on pages IV 36 through IV 38 dissociat ng gro n impac rom water uoply develop ment we cannot concur en rely EPA is aware that population growth in a given area is dependent on many factors particularly economic ones n addi ion to water supply We can also accept the proposi ion that the presence or absence of Windy Gap water to the Six Cities may no e a par icu arly critical deterrent to further growth especially in view o the large amoun s of agricultural water including Big Thomosor Project flows that could be converted to municipal use

Ho e er PA believes that Federal investment decisions and other Federal permitting act vities do play a part in accommodating population g owth We also think tha the Federal agencies have an a firmative role under NEPA and other environmental legislation to articulate and a tempt o mitigate environmental problems they encounter in their ac ivities

Congre has further spelled out the duties of Fede al agencies regarding act v ies ha impinge on air qua i y where State Air Implementation Plans deve opec u der Section 110 of the Clean Air Ac are cor erned cc ion 176( ) of re Ac states

(c) No department agency or instrumentality of the Federal Go ernment shal (1) engage in (2) support in any way or provide f rarc al as sta or ( ) license or permit or (4) approve any activity which doe not cor orm to a plan after it has been approved or prom lgat o under section 110 No met opolitan planning orgnai ation designa ed under section 134 of title 23 United States Code shall give its approval to any project pro gram or plan which does not conform to a plan approved or promulgated under section 110 The assurance of conformity to such a plan shal be an affirmat ve responsibility of the head of su h department agency or instrumentality

EPA is ur ent y developing a formal process for implementing this section of he Act Because it is a very complex issue and has rationwide impl cations it may be some time before the process is develo ed we do think at the USBR should at a minimum follow tre pirit of this sec ic Some attempt shou d be made to define the air quality issues in the Front Range cit es and provide a rough estimate o he vehicle miles traveled (VMT) increases as a result of he popula ion growth accommodated by the project waters EPA would be happy to assist in such evaluations for preparation of the final EIS

Page 6

We do believe that the USBR could do more in the way of proposing mi igating measures in this EIS to ameliorate the air quality problem For example EPA has recognized its own role in fostering growth through wastewater treatment grants In the recently completed Regional EIS for the Denver metropolitan area EPA has adopted a number of policies dealing with air pollution that require local cooperation We have asked communities within the Denver Air Quality Cont ol Region to develop voluntary air pollution control measures considered reasonable for their area as a condition for wastewater treatment grants We think that a similar approach could and should be adopted by the USBR in dealing with the Windy Gap project A copy of the Final Action document on the overview Regional EIS is enclosed for your consideration Appendix C of this document con tains a list of potential local air pollution control measures

The Bureau should also solicit views from the State and local air quality planning agencies on the conformity of the Windy Gap Project with the SIP

Gas Supersaturation

Gas supersaturation levels downstream of the dam should be modeled for worst case conditions using available models Johnson 1978 U S Army Corps of Engineers 1971

Threatened and Endangered Species

The EIS lists a number of endangered species that do not occur in the immediate project area but do inhabit the Colorado River farther downstream The cumulative impacts of large dams and diver sion structures such as Windy Gap have been cited in the EIS as contributing causes of the decline of these species These impacts (such as habitat reduction and temperature changes) and the measures to mitigate them should be discussed The Bureau should cooperate with the U S Fish and Wildlife Service and State Division of Wildlife in determining impacts and mitigative measures

Wetlands

The draft EIS indicates that riparian vegetation will be impacted by the Windy Gap re ervoir but does not provide detail as to the types and quality of wetlands affected Studies to determine the status of wetlands in the area should be undertaken with the assistance of the U S Fish and Wildlife Service and State Division of Wildlife for inclusion in the environmental impact statement

Page 7

NPDES Permit

Be au e of the potential for eutrophication in the Three Lakes system a National Pollutan Discharge Elimination System Permit (NPDES) could be require for the c peline discharge entering Granby Lake from the Windy Gap Proje t his will have to be determined based on he quality o wa er being discharged from the pipeline and whether or not it meets State water quality standards and anti degradation policies This should be discussed in the EIS The State Water Pollution Cor rol Division should be consulted in this regard

404 Permit

It is apparent hat the diversion dam and reservoir site will require a 404 permit but whether or not a permit will be necessary for construction activities at the Willow Creek pipe line crossing is not discussed in the draft statement A more thorough evaluation of the impacts expected at Willow Creek should be detailed and included in the final impact statement

The Bureau of Reclamation hould be aware that special permit condi ions by EPA may include (1) development and approval of a sedimentation control plan (2) minimum streamflow requirements and (3) a specific revegetation plan

Alternatives

Water conservation as an alternative is essentially dismissed in the EIS with the statement it is not possible to accurately evaluate he probable savings and associated impacts attributable to various conservation and management measures We find this approach unacceptable in view of the President s June 1978 national water pol cy directives which emphasize water conservation and the need to place increased attention on environmental quality Boulder by virtue of its low projected per capita use figure demonstrates how effec ive planning and metering can reduce water consumption We beli ve the Windy Gap Project by failing to emphasize water conservation as an alternative removes the need to consider water saving measures for the five municipalities

The EIS also ntends that construction of the Windy Gap Project would reduce the need to convert agricultural water rights to municipal uses We find his to be a weak argument in support of the project since most of the growth to be accommodated by the project will take place on irrigated armlands Since growth in the area appears to be inevitable and urban and agricultural land uses consume similar

Page 8

amounts of water the use of irrigation water in lieu of Windy Gap supplies should be further explored If additional Colorado farmland will be put into irrigation as a result of this project the final EIS should demonstrate where and how these agricultural benefits will occur

Water reuse systems such as those being developed in the cities of Northglenn and Westminster should also be considered as a possible component of municipal water development programs Given the sizeable quantities of agricultural CB T water available some form of first use by municipalities could ideally be combined with successive use by the Northern Colorado Water Conservation District farmlands

In summary a combination of water conservation measures water reuse systems effective local planning and the use of irrigation water should be studied and discussed in the EIS as a possible alternative to direct diversion of Windy Gap water

REFERENCES

Adams D B 1974 A Predictive Mathematical Model for the Behavior of Thermal Stratification and Water Quality of Flaming Gorge Reservoir Utah Wyoming M S Thesis Massachusetts Institute of Technology Cambridge Massachusetts May p 213

Corps of Engineers 1971 A Nitrogen Gas (N_2) Model for the Lower Columbia River Project No 1 350 U S Army Corps of Engineers

Dake J M K and Harleman D R F 1966 An Analytical and Experimental Investigation of Thermal Stratification in Lakes and Ponds M I T Hydrodynamics Laboratory Technical Report No 99 Cambridge Massachusetts September

Huber W C and Harleman D R F 1968 Laboratory and Analytical Studies of the Thermal Stratification of Reservoirs M I T Hydrodynamics Laboratory Technical Report No 112 Cambridge Massachusetts October

Johnson P L 1975 Prediction of Dissolved Gas at Hydraulic Structures GR 8 75 Bureau of Reclamation Denver Colorado

Sartoris J J 1978 The Corps/WRE Reservoir Temperature Simulation Model U S Army Corps of Engineers

Memorandum

To Files

Subject Response to August 29 1979 Comment Letter from Environmental Protection Agency on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

The following responses answer the detailed comment portion of EPA s letter The comments on the first two pages of EPA s letter are a summation of the detailed comments

1 Comment The impacts of flow depletions on various uses must be addressed

Response Impacts of flow depletions have been more thoroughly defined in studies which were performed subsequent to issuance of the DES Impacts have been substantially mitigated pursuant to the Intergovernmental Agreement and minimum flow agreement (FES Attachments 1 and 2 respectively) A discussion of these studies is presented in Chapter I Their results are presented in Chapter IV of the FES

2 Comment There is no guarantee that minimum fishery flows will be met after irrigation diversions are satisfied

Response See Attachment 2 of the FES

3 Comment Would like to see a more detailed description of water rights principal diversion amounts and types of uses should be noted Should explain the reasons for less water being diverted than what is legally available Would this situation continue?

Response A detailed description of water rights quantity and types of diversions and reasons why less water is diverted than legally available is included in Hydro Triad 1980 The FES paraphrases this report It should be noted that Windy Gap Project would not interfere with senior downstream water rights This lack of interference is specified in the Intergovernmental Agreement (Attachment 1)

At this time there is no evidence which suggests that diversions between Windy Gap and Hot Sulphur Springs will differ from historical diversions

4 Comment Downstream and reservoir water quality changes should be evaluated using available models

Response The reservoir is too small to be reasonably evaluated using existing models The reservoir is too small to have an appreciable effect on the river water quality except possibly water temperature in a short section downstream of the dam Pre and post project water temperatures will be monitored as discussed in Chapter IV C Aquatic Biota

5 Comment Effects of flow depletions on downstream wastewater treatment facilities and NWCCOG s areawide water quality plan should be addressed

Response A low flow study conducted by Hydro Triad (1980) indicates no impact to existing wastewater treatment facilities The Intergovernmental Agreement signed by downstream municipalities and the Northwest Colorado Council of Governments protects downstream entities from having to upgrade existing treatment facilities in order to maintain a suitable water quality

The NWCCOG is a party to the Intergovernmental Agreement therefore there is no impact on the areawide water quality plan

6 Comment The DES does not fully recognize the potential for nutrient input from Fraser Valley The Bureau should coordinate with NWCCOG s areawide plan in assessing these problems and help develop a plan to mitigate their impacts

Response The impact of future nutrient inflow from Fraser Valley is analyzed in Chapter IV C Water Quality of the FES The NWCCOG has indicated the insignificance of impacts due to Fraser Valley by signing the Intergovernmental Agreement

7 Comment The effect of increased salinity levels in the Colorado River are not adequately discussed

Response The Colorado Salinity Control Project was authorized to analyze and mitigate for salinity impacts due to upper and lower Colorado River Basin depletions The project is being designed to mitigate in part for the State of Colorado s allocation pursuant to existing compact The Windy Gap Project is part of Colorado s allocated water supply The economic impacts of increased salinity at Imperial Dam is discussed in USDI (1980) and in Chapter IV C of the FES

8 Comment Information on increased salinity levels in the Colorado River presented on pages IV 4 and IV 15 appear to conflict Should estimate the monetary costs of increased salinity

Response Salinity numbers have been corrected to correspond to the results of the calculations presented in Chapter IV C

9 Comment Should estimate the loss to Colorado River power generation due to the Windy Gap Project

Response As discussed on page IV 59 of the DES Windy Gap will not affect power production within the Colorado power area

10 Comment Salinity impacts and mitigation should be discussed in more detail

Response See Response No 7

11 Comment Should discuss the increased stream flow in the Big Thompson River and the resultant impacts on the environment

Response As discussed in Chapter IV C transportation of Windy Gap water through the C BT will increase (annual average) Big Thompson River releases from Olympus Dam by about 5 000 acre feet Releases would increase by 2 200 2 500 and 300 acre feet for June July and August These increases are too small to have significant effect on the existing river environment

12 Comment Water and Power should provide more detailed analysis of the air quality impacts of Windy Gap on the service area An attempt should be made to mitigate impacts Water and Power should work closely with State and local air quality planning agencies concerning the relationships of the Windy Gap Project to the State Implementation Plan (SIP)

Response Growth and attendant air quality impacts will not be encouraged by the Windy Gap Project Growth is occurring along the Front Range because of employment climate recreation and other quality of life opportunities not because of the availability of water

In commenting on the air quality aspects of the Windy Gap DES State and local governments were concerned with the impacts of Rawhide powerplant not with growth induced air quality impacts

13 Comment Gas supersaturation downstream of the dam should be modelled for worst case conditions

Response Gas supersaturation is not a problem with small dams such as Windy Gap which have low head discharges shallow stilling basins and near horizontal spillway outlets See USDI (1974) page 77

14 Comment Water and Power should cooperate with the Fish and Wildlife Service and DOW to determine impacts and mitigation measures associated with threatened and endangered species which inhabit the river downstream

Response See Chapter IV C Threatened and Endangered Species

15 Comment The DES states that riparian vegetation will be impacted but doesn t give detail on the types and quality of wetlands affected Studies should be undertaken in association with Fish and Wildlife Service and DOW

Response A complete vegetation survey and impact analysis of the vegetation affected by the Windy Gap Project was undertaken by Dames and Moore (1977) A summary of Dames and Moo e (1977) is presented in Chapter III and IV of the FES

16 Comment The water quality impacts associated with discharging Windy Gap water into Lake Granby should be discussed including the need for an NPDES permit

Response This information is presented in Chapter IV C of the FES and in a supporting report that has been provided to your office

17 Comment The impacts associated with the Willow Creek pipeline crossing should be discussed in the FES

Response See Chapter IV of the FES

18 Comment Water conservation as an alternative is not given adequate analysis in the DES

Response See Chapter II of the FES

19 Comment The statement in the DES that Windy Gap water would prevent expropriation of agricultural water rights is poor support for the project since most of the growth in the area will occur on irrigated farmlands Conversion of agricultural water rights should be further explored Will Windy Gap put new agricultural lands into production?

19 Response It is the policy of the State of Colorado to prevent conversion of agricultural water rights whenever possible Colorado Department of Agriculture s comments on the DES (July 30 1979) stated in general it appears that there will be a net positive impact to agriculture within the state as a result of this project This is because Front Range communities will have a supply of water for their anticipated growth without having to condemn and purchase agricultural water rights This will result in 13 000 to 15 000 acres of irrigated cropland which will not be lost as a result of water condemnation procedures

Water developed by the Windy Gap Project will be used for municipal and industrial purposes No new agricultural lands will be put into production

20 Comment A combination of water conservation measures water reuse systems effective local planning and the use of irrigatio ate should be studied as an laternative to Windy Gap

Response The water needs specified in Chapter I are needs in addition to those already being met by management of existing supplies Management includes water conservation reuse and local planning As stated in Response No 19 conversion of irrigation water is not considered to be an acceptable alternative

UNITED STATES GOVERNMENT DEPARTMENT OF HEALTH EDUCATION AND WELFARE
REGION VIII

Memorandum

PUBLIC HEALTH SERVICE REGION VIII

JUL 18 979 DATE July 12 1979

TO Joe D Hall Regional Director
United States Department of the Interior
Bureau of Reclamation

FROM Regional Health Administrator

M 150
00 C BT

SUBJECT DES Colorado Big Thompson/Windy Gap Projects

The Draft Environmental Statement (DES) for the Colorado Big Thompson/Windy Gap Projects has been reviewed by the Region VIII Public Health Service staff There were no public health concerns identified in the proposed DES that have not been addressed It was noted that on page IV 56 reference is made to the Colorado Occupational Safety and Health Programs (COSH) This program is no longer a funded State effort and this reference may need to be modified

Hilary H Connor M D

cc EHSD Atlanta Georgia Attn Ms Anderson
ROFEC Region VIII Attn E W McIntire

MEMORANDUM

To Files

Subject Response to the July 12 1979 Department of Health Education and Welfare Comment Letter on the Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Colorado Safety and Health Programs are no longer funded by the State Reference in the draft statement should be deleted

Response Reference is deleted in the final statement

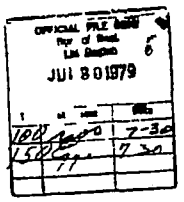
Missouri River Basin Commission

Suite 403 10050 Regency Circle Omaha Nebraska 68114

Mailard W Hall
Chairman
J n E Aco d Monta
Vice-Ch ma

A ss de t pl State Fede al R e B s n Commiss o

J ly 27 1979



Mr Joe D Hall
Regio al Di ector
Lower Missouri Region
Bureau of Reclamation
U S Dep rtment of the Inte ior
B lding 20 Fede l Center
Den e Colorado 80225

Dear Mr Hall

The staff of the Missouri River Basin Commission has reviewed the Draft En ironmental Impact Statement (DEIS) for the Colorado-Big Thompson/Windy Gap Projects Colorado We note that a significant and conscious effort has been made to reduce the bulk of the document without omitting discussion of relevant backgro nd material or major environmental issues This is not an easy task especially when one must integrate several proposed actions as is true in the Windy Gap and Rawhide P ojects b t it has been well done

Below a e specific comments which are provided to assist you in addressing the complex issues associ ted with the proposed water and energy development projects

1 Quantity of water proposed for use for Rawhide Plants No 1 2 and 3 The DEIS on page II 45 indicates that the project will utilize 9 500 a f from th Windy Gap Project; however page II 56 states that the total water req irement of these plants will be 8 200 a f In addition on pag II 54 it states th t the first unit could likely use 4 200 a f of municipal sewage effluent from Fort Collins This effl e t evidently does not originate from Windy Gap water It appea s to us that the total water to be used by the Rawhide p oject is the sum of the Windy Gap and Fort Collins efflue t water (9 500 4 200 a f 13 700 a f) If this is the case we could not find this clearly stated in the DEIS

2 Distrib tion of power from the Rawhide Project The DEIS indicates that the power generated will be utilized to satisfy the energy demands of Fort Collins Loveland Longmont and Estes Park In page II 45 or i othe parts of the DEIS there is no mention however if excess power could be distributed in a regional power network and sold to other tilities

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Mr Joe D Hall
July 27 1979
Page 2

3 Municipal Water Consumption Page II 10 of the DEIS indicates that water consumption of the fi e cities involved in the Windy Gap Project is about 250 gal/cap/day This figure is based on apparent ccurat popul tion nd water se data but represents water consumption wh ch is m ch higher than the 170 gal/cap/day aver ge fo the Unit ed St tes and somewhat higher than the 230 gal/cap/day a erage figure utilized in input-o tput water modeling studies for the Sou h Platte Ri er Basin (see Hendricks et al Water for the South Platte Basin I formation Series No 37 Colorado Water Resources Research Institute) If water consumption in the project area is considerably higher than average the report should document reasons for this higher use including display of water consumption by use sector Cur ent projections co ld be inflated for example if certain high water-demanding industries pla to relocate or will be imposing water conservation measures in orde to meet the water quality goals of P L 92 500 In addition wate conservation potentials can be better determined (i e promotion of water sa ing plumbing devices or promotion of use of semiarid landscaping materials) through display of water use by sector

4 Use of Colorado-Big Thompson facilities to convey Windy Gap Water The 48 900 a f diversion of upper Colorado water or municipal and industrial w ter will utilize a portion of a federally built and maintained system of 310 000 a f capacity which was apparently intended for conveyance of water to supplement and stabilize water supplies for predominately agricultural ers in the South Platte Basin A question is whether the project charges (an assessment of 10 percent of the developed water to allow for wate supply system transmission and evaporative losses) and benefits (29 million kilowatts of power dded to the Federal power supply) will be asple to cover added maintenance and operation costs incurred by the Federal Government in conveyance of Windy Gap project water This should be discussed in more detail in the EIS

5 Integrated or coordinated water quantity/water quality planning The DEIS in page IV 16 notes that use of Windy Gap water will result in additional sewage which will require treatment or disposal and briefly notes that water q lity plans have been developed fo the municipalities sponsoring the Windy Gap project The DEIS does not address whether or not water quality-quantity planning is integr ted at the municipal level and whether or not water conservation techniques could have important spinoffs in terms of savings for water treatment costs Reduction for public works expenditures in both sectors may be possible th ough integrated planning within each municipality

Mr Joe D Hall
J ly 27 1979
Page 3

6 Impacts related to increased salinity in the Colorado River downstream to the diversion Page IV 6 indicates that salinity in the Colorado River downstream at Imperial Dam will increase 0 5 percent or 4 mg/l This effect however is not translated or converted into downstream economic impacts The annual report of the Colorado Water Resources Institute 1978 states that each additional part per million of salt carried in the Colorado River can incu extra costs of 250 to 400 thousand dollars each year to downstream ers of the Colorado A discussion of this possible impact should be added to the EIS

7 Instream flows below the proposed Windy Gap Diversion Dam Page IV 25 indicates that adverse effects to aquatic fauna downstream in the Colorado Rive can be expected due to poor flow conditions and that fish and wildlife studies were limited to a survey of one stream cross-section Modern instream flow assessment methods including availability of computers to process large amounts of data should have provided help in this area Proposed water diversions at a mi imum should provide information to quantify effects on the aquatic resource

We trust the above comments will be helpful to you in relating the nvironmental impacts of the proposed action to the public and to concerned governmental entities Thank you for the opportunity to comment

Sincerely

Millard W Hall
Chairman

MWH/dlp

MEMORANDUM

To Files

Subject Response to the July 27 1979 Missouri River Basin Commission Comment Letter on the Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Page II 45 indicates Rawhide will use 9 500 acre feet of Windy Gap water but page II 56 says 8 200 acre feet

Response The correct figure is 8 200 acre feet Page II 45 has been corrected

2 Comment On page II 54 it states that the first unit would use 4 200 acre feet of sewage effluent from Fort Collins It appears that the sum of Windy Gap and Fort Collins water would be 13 700 acre feet Needs to be clearly stated

Response The 4 200 acre feet of water for the first 250 MW unit will come from Fort Collins Once Windy Gap water is available Fort Collins will be compensated on an acre foot by acre foot basis by exchange Ultimately the three units will require an additional amount of Windy Gap water which will sum up to 8 200 acre feet The wording in the statement has been clarified

3 Comment The DES did not mention if excess power from Rawhide could be distributed in a regional power network and sold to other utilities

Response PRPA will sell temporarily excess energy to other utilities until the four city load grows to a sorb it

The app opriate wording has been included in the FES

4 Comment The DES stated that water consumption in the 5 county area is 250 gal/cap/day This is much higher than the national average of 170 gal/cap/day and the 230 gal/cap/day used in the South Platte River Basin Studies The statement should state why use is higher in the project area In addition water conservation potentials can be displayed better by indicating water use by sector

Response Per capita water consumption varies greatly from area to a ea depending upon the amount and type of industry population density amount of horticulture calculation of consumption and other factors

The 250 gcd is a weighted average for the five cities based on a study done by Robinson (1978) The consumption varies from 181 gcd for Boulder to 306 gcd for Greeley The disparity is based upon the different uses of water Boulder has a higher population density and consequently a larger density of multi dwelling units which results in a lower per capita water consumption Greeley is less densely populated has more irrigation and has the large Eastman Kodak plant which is a heavy water user A more detailed explanation of water use by sector as well as an explanation of per capita water use is presented in Robinson (1978)

5 Comment Will the 10 percent water carriage charge and 29 GW be sufficient to cover the added costs incurred by the C BT? Should be discussed in more detail

Response In addition to the carriage charge and power benefits supplemental charges will be paid to the Federal Government each water year for the carriage storage and release of Windy Gap water These charges are categorized into three components

1 A charge for pumping Windy Gap water through each C BT pumping facility This assessment will equal the product of acre feet pumped times the current energy charge

2 A charge for operation and maintenance (O&M) consisting of a prorata share of the total actual C BT O&M costs calculated on a dollar per acre foot of Windy Gap water transported through the Alva B Adams Tunnel

3 A charge for the C BT construction component computed as the product of $1 75 times the total acre feet of Windy Gap water introduced into the C BT during the water year

The above charges will be adequate to cover costs to the Federal Government for conveyance of Windy Gap water through the C BT

6 Comment The draft statement does not address whether water quality quantity planning is integrated at the municipal level and whether water conservation techniques could save water treatment costs Public works expenditures in both sectors may be reduced by inter municipality planning

Response Page IV 16 of the DES adequately cross references studies and plans which deal with inter municipality sewage treatment and disposal Water conservation is an integral part of these plans and is discussed in the appropriate reference

7 Comment The salinity effects discussed on page IV 6 of the DES are not translated into downstream impacts

Response The downstream economic impacts caused by Windy Gap other diversions is difficult to pinpoint A 1974 study by Wate and Power titled Economic Impacts of Changes in Salinity Levels of : e Colorado River estimated a cost of $230 000 per mg/l pe year This information is considered out of date The results of a newer study by Kleinman and Brown (1980) indicates that the relationship of costs to salinity levels is not linear In the salinity range projected for a post Windy Gap condition damages would be estimated at $343 000 per mg/l increase

8 Comment Page IV 25 indicates that Windy Gap will cause adverse impacts to downstream flows Modern methods should be used in quantifying these impacts

Response The impacts to Colorado River flows due to Windy Gap are discussed in Chapter IV C Hydrology The CORSIM Model was used by Hydro Triad to predict changes in flow regimes under various water conditions The Intergovernmental Agreement (Attachment 1) represen s mitigation for the depletions

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
W h gton D C 20230
(202) 377 3111 4595

Augu t 7 1979

Director Office of
Environmental Affai s
B re u f Reclamatio
L S Departm nt of the Interior
Wa hington D C 20240

Dear Sir

This is in r f r ce to yo r draft environmental impact st tement e titl d Col rado-Big Th mpso Wi dy Gap Projects Colorado The nclosed comme ts from the Envir mental Dat nd Information Servi National Oceanic and Atmospheric Administration (NOAA) ar f rw rded for your conside ation

Thank you for giving us an oppo t ity to provide th comme t which we hope will be of assista ce to you We would appreci te r iving 12 copi s f the final statement

Sinc rely

Sidney R Galler
Dep ty Assistant Secretary
f Envi onmental Affairs

E closure Memo from Douglas M LaConte

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL DATA AND INFORMATION SERVICE
W gton D C 20235

J ly 2 1979 OA/Dx61

TO PP/EC R Lehman

FROM OA/Dx61 Do glas M LeConte

SUBJECT DEIS 7906 22 Colorado-Big Thompson Windy Gap Proj cts C lorado

Page III 1

Th text i q ite corre t in ying that v riability of pre cipitation i perhaps more impo tant than verage precipitation yet no disc ssi n is made of short term rainfall ext mes Any climate d scription of this region hould incl d informatio on eve summer thund rstorm occ ences of the type which caused th devastating Big Thompson flash flood seve l years ago Data on the location freque cy and i te sity of such torms wo ld be app opriate

Rcd PP/EC JUL 2 1979

Memorandum

To Files

Subject Response to August 7 1979 Comment Letter from Department of Commerce on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment The DES does not discuss short term rainfall extremes such as the Big Thompson flood Should include data on location frequency and intensity of such storms

Response Such data was used by the Subdistricts consultants to develop design floods for Windy Gaps diversion dam and spillway The resultant design was approved by the Colorado State Engineer s office This information is available from the Subdistrict

DEPARTMENT OF THE ARMY
OM D C CO O NW N
401 U S POST OF CE D CO RT OUSE
M N S

MROPD A

24 July 1979

Mr Al R Jones Director
Office of Environmental Affairs
U S Department of the Interior
Bureau of Reclamation
C Street NW
Washington DC 20240

Dear Mr Jones

We are responding to your letter of 19 June 1979 in which you requested comments on the Draft Environmental Statement for the Colorado Big Thompson/Windy Gap Projects Colorado

Jurisdiction of the Corps of Engineers over the proposed project stems from Section 404 of the Clean Water Act Section 404 regulates the discharge of dredged or fill material in our Nation s waterways lakes and wetlands Diversion of water within the Omaha District passes through an existing conduit Accordingly a permit pursuant to the above Act will not be required from the Omaha District However the project as proposed appears to involve filling activities within the boundaries of the Sacramento District which District should be contacted pursuant to the above requirements

Thank you for the opportunity to review this project

Sincerely

for Richard L Buse
JOHN E VELEHRADSKY
Chief Planning Division

Memorandum

To Files

Subject Response to July 24 1979 Comment Letter from Corps of Engineers Omaha Nebraska on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment The Sacramento District U S Corps of Engineers should be contacted regarding the requirements for a Section 404 permit

Response Application has been made for these permits and all concerns of the Corps of Engineers will be addressed through that permit process

DEPARTMENT OF HEALTH EDUCATION AND WELFARE
PUBL C HEALTH SERV CE
D E O
N O

July 31 1979

OFFIC AL FILE COPY
Bur of Rec
LM Region
AUG 3 1979

Mr Joe D Hall
Regional Director
U S Departme t of the Inte ior
B au of Reclamation
Denver Federal Center
Room E-2418 B ilding 20
Denver Color do 80225

De r Mr Hall

We ha e completed o r review of the Draft Environmental Impact Statement for the Colorado Big Thompson (C BT)/Windy Gap P ojects in Colorado e are responding on behalf of the P blic Health Service The following comments are off red for yo r se in preparing the Final EIS

Health and Safety

We note that the Bureau shares in the responsibility for major construction and r pair of the existing and proposed recreation facilities Information sh uld be provided on the frequency of accidents and injuries that have oc urred at the C BT lakes as a result of maintenance activities by employees and incidents involving recreationists (boaters swimmers campers etc) This informati n can provide insight as to the design and operational measures that might be implemented to reduce hazards

With reg rd to swimmi g and fishing in the Rawhide Project cooling pond the paragraph on page II 58 of the EIS should state that swimming and fishing will in fact not b llowed until the pidemiological study is completed and determination made that the a es is saf for th e activities Methods to assure public safety at the cooling pond should be ex plained Th comment on page V-2 under Public Safety do not address this cooling pond

Requirements fo safety and health in conformance with the Federal C nstr ction Act of 1969 (P L 91 54) should be included in each construc tion contract d noted on page II 62

Water Quality

According to the EIS the operation of the project could r sult in adv se water quality impacts from increased nutrient loadings because of the expected sec ndary d v lopment The prevalence of sewage problems (i e

improper i stallation of septic tanks and leaching fields) in the Shadow Mountain Lake area reveals the need for careful control and regulation of any addition l watershed development associated with the project Since the c nstructi of a reservoir generally ctr cts new residential develop ment the effectiveness of local building codes and permit procedures to ins re pr perly installed sanitary systems should be assessed in the EIS This information can be obtained in the Larimer-Weld Council of Governments Area Wide Wat r Quality Management Plan Any new reservoir c nstruction should be mad contingent pon the de elopment and implementation of nvironmentally acceptable building codes and permit restrictions for sanitary systems

The EIS i dicates that Shadow Mo ntain Lake currently has a problem with he vy growths of rooted aquatics primarily Elodea It is stated on page IV 12 that i cr sed n trients are probably not the cause Yet on page IV 27 it i indicated that sewage problems with a bsequent reservoir con tami ti ist at Shadow Mountain Lake We believe the cause of the heavy growths sh uld be further cl rified in the EIS It should also be i dic t d if these h avy growths are int rfering with the Lake s designated ses as established by applic ble water quality standards

Mechani l remo al or harv sting of macrophytes may be an acceptable short term sol tion These plants and any nutrients that might be associated with their d cay could be permanently removed from the Lake s ecosystem Consideration should be given to their use as a mulch for sediment control or possibly as animal feed

It appears that n provisions have been made to provide nutrient removal f cilities (p IV 14) as p rt of the proposed expansion of the Grandy W stewater Treatment F cilities (GWWTF) The Windy Gap project will div rt the Fraser River flows that c nt in the GWWTF effluent Without nutrient emoval by this facility estimates presented in the EIS indicate that the 1990 tr phic status of the three lakes (which will receive Windy Gap diver sions) will be eutrophic (assuming a high pop lation scenario) In order to better nderstand the impact of the GWWTF effluent upon downstream w t rs (witho t providing utrient controls) the affect of providing n trient control at the GWWTF pon the trophic status of Windy Gap and the lakes receivi g its diversion should also be evaluated Water quality conditions (such as noxious weeds algal growths and odor problems) ther n c often represe tative of an e trophic lake may be considered violations of applicable water quality standards For this reason the EIS should address the legal requirements and the need to (1) reduce nutrient inflows to Windy Gap and the other C BT lakes and other man-made factors contri buting to their potential eutrophication and (2) prevent noncompliance with w ter quality standards

An explanation should be given o whether the Rawhide Project onsite cooling pond reservoir will have any discharge continuous or periodic The affect

of any discharge upon waters downstream should be discussed I l r ll The descriptions of the onsite reservoir on pag s II 54 and II 6 not consistent and should be corrected The di position f blowdown from the plant should also be explained I addition the final EIS hould describe (1) how cooling pond blowdown would be accomplished if the quality of water in the reservoir became unsuitable fo pl t (p II 59) and (2) the prob bility of reservoir water not being suitable for pls t us

Alternati es

A cost benefit comparison of the pr ject and the various alternative schemes systems should be presented in the EIS

We appreciate the opportunity to review this EIS Please send us one copy of the final EIS when it becomes available

Sincerely yours

Frank S Lisella Ph D
Chief Environmental Affai s Group
Environmental Health Services Division
D rem o of State Services

Memorandum

To Files

Subject Response to July 31 1979 Comment Letter from Department of Health Education and Welfare on Colorado Big Thompson/ Windy Gap Projects Final Environmental Statement

1 Comment Information should be provided on the frequency of accidents and injuries that have occurred at the Colorado Big Thompson lakes as a result of maintenance activities by employees and incidents involving recreationists (boaters swimmers campers etc)

Response The recreation aspects of the Colorado Big Thompson Project are administered by other governmental entities under public law or a memorandum of understanding between the entity and the Water and Power Resources Service Major construction of recreation facilities is not physically done by Water and Power Resources Service work forces but is accomplished through the administering agency either by their own work forces or by a contract Financial assistance is provided by Federal programs administered by Water and Power

All general and routine maintenance of the recreational facilities is done by the administering agency Therefore Water and Power does not maintain accident and injury statistics on construction and maintenance activities of the administering agency However we do maintain statistics on fatalities on our canals and reservoirs There have been 38 fatalities as a result of drowning and 26 by other means such as vehicular accidents or suicide from 1959 through 1979

2 Comment The statement should state that swimming and fishing in the Rawhide cooling pond will not be allowed until an epidemiological study ascertains that the pond is safe The requirements of the Federal Construction Act of 1969 should be included in each construction contract

Response Rawhide is not being constructed with Federal funds nor are Federal permits required See Response 2 to the Geological Survey comment letter

3 Comment The impact of Windy Gap on the trophic status of the three lakes coupled with modifications regulation of sewage should be more carefully addressed

Response The Subdistrict and its consultants have collected additional data on the nutrient levels at the diversion site These data have been incorporated into a revised study which can be provided upon request The esults of this study a e included in the FES In addition the Subdistrict has cooperated with the Forest Service which has through recent legislation acquired the water quality management responsibilities for the three lakes area Ongoing studies are being made to attempt to ascertain a solution to the present aquatic weed problem in the Shadow Mountain Reservoir

4 Comment New reservoir construction should be contingent upon development and implementation of environmentally acceptable controls on sanitary systems

Response See Response 2 to the Geological Survey letter PRPA is responsible for development and implementation of sanitary controls

5 Comment The cause of the Elodea problem and whether it interfers with designated uses should be discussed Mechanical harvesting and use as mulch may be a solution to the problem

Response See Chapter II B 1 b(3)(j)

6 Comment Thr trophic effects on Windy Gap and the three lakes should be evaluated for Granby wastewater treatment facilities with nutrient removal The EIS should address the legal requirements and need to reduce nutrient inflow other man induced factors and prevent noncompliance with water quality standards

Response See Chapter IV E 3 Water Quality

7 Comment Whether Rawhide s cooling pond will have a discharge should be explained

Response See Response 2 to the Geological Survey comment letter

8 Comment Descriptions of the cooling pond on pages II 54 and II 56 are inconsistent

Response See Response 2 to the Geological Survey letter

9 Comment The deposition of blowdown should be explained How will cooling pond blowdown be accomplished if reservoir water becomes unsuitable for plant use? What is the probability of pond water not being suitable for plant use?

Response See Response 2 to the Geological Survey letter

10 Comment A cost benefit of the project and alternatives should be presented

Response The Windy Gap Project is not a Federal action therefore we cannot require a benefit/cost analysis in the final environmental statement

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

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AUG 1 1979

MEMORANDUM

TO Director Office of Environmental Affairs

FROM State Director Colorado

SUBJECT DES 79/33 Colorado Big Thompson/Windy Gap Projects Colorado

We have reviewed this draft environmental impact statement and our consolidated comments are included below

GENERAL COMMENTS

Cultural Resources

A two volume publication entitled An Archeological Study of Aboriginal Sites within the Windy Gap Dam Reservoir and Pipeline Project near Granby, Grand County, Colorado was printed by Western Cultural Resource Management Inc (WCRM) after this DEIS was printed It contains base survey data and recommendations for sites impacted by the Wind Gap Project This information should be included in the final EIS Mitigation for sites on BLM administered lands are similar to those recommended by WCRM Inc Sites on private surface will be identified and disposed of by the private land owners

Land Use

There are a number of possible rights of way and access problems which were not described in the DEIS thus possible stipulations for mitigation of impacts could not be assessed These areas are listed below

1 The existing Grand County sanitary landfill located in the E 1/2 of Section 23 T 2 N R 77 W and of its access road (which is crossed by the proposed pipeline) located in the E 1/2 of Section 23 and the NE 1/4 of Section 26 T 2 N R 77 W

2 The existing communication facility located in the W 1/2 of Section 24 T 2 N R 77 W and its access road (which is crossed by the proposed pipeline) located in the W 1/4 of Section 24 NW 1/4 of Section 25 and NE 1/4 of Section 26 T 2 N R 77 W

3 The powerline and its access road (both of which are crossed by the proposed pipeline) located in the NE 1/4 of Section 19 and the NW 1/4 of Section 20 T 2 N R 76 W

4 The powerline and its access road (which is crossed by the proposed pipeline) located in the NW 1/4 of Section 25 and the NE 1/4 of Section 26 T 2 N R 77 W

5 The powerline and its access roads the telephone line and its access road and the range fence (all of which are affected by the temporary realignment of U S Highway 40) located in the NW 1/4 of Section 25 T 2 N R 77 W

The abandoned Grand County sanitary landfill (which is crossed by the proposed pipeline) located in the NE 1/4 of Section 26 T 2 N R 77 W could also cause pollution problems especially in light of the surface and ground water resources in the E 1/2 of Section 23 W 1/2 of Section 24 NW 1/4 of Section 25 and NE 1/4 of Section 26 2 N P 77 W

Water Quality

The DEIS states that the salinity would increase by 0 3 percent at Imperial Dam There is no analysis on the impacts of this effect This is significant in view of the desalinization programs which are trying to achieve compliance with the treaty with Mexico

SPECIFIC COMMENTS

Chapter 2, page 42, second sentence Should read The alignment then climbs to the northeast

Chapter 3, page 31

a Bald Eagles The DEIS does not adequately address the importance of the Colorado River ecosystem to wintering bald eagles It mentions that bald eagles are frequently observed along the Colorado River drainage when in fact bald eagles have been observed annually along the Colorado River in Grand County for the past 25 winters

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

A statewide multi agency bald eagle winter habitat inventory was initiated December 1978 Participating agencies included the Bureau of Reclamation Bureau of Land Management and Colorado Division of Wildlife Although the inventory is not complete data collected during winter of 1978 79 is available from the participating agencies and should be incorporated into this EIS

b Peregrine Falcons The report of an active peregrine falcon aerie at Phinney Creek is a misunderstanding The active aerie is that of prairie falcons The author should confirm this with the Colorado Division of Wildlife

Page 38, Windy Gap Water Development A table should be prepared to clarify the number of fish sampled A breakdown by weight would be helpful The total fish sampled should include all small cyprinids

Page 44

2 a , second paragraph Grand County sanitary landfill cannot readily be seen from U S Highway 40

Fourth paragraph In most cases transmission lines do dominate the landscape especially if they cross a scenic volcanic structure such as the Windy Gap structure

Chapter 4, page 19, 2 b , second paragraph, Energy Development A statement should be made whether permanent access and maintenance roads will be needed along the pipeline right of way If so where will they be located and will they remain unvegetated?

Page 22, 3 b , Windy Gap The Colorado River area provides habitat fo bald eagles Impacts on the bald eagles and their habitat in the Windy Gap Project should be stated

Page 24, 2 , first paragraph How will the Windy Gap Project impact downstream Colorado River riparian habitat?

Page 30, 3 1 , second paragraph The land area between the maximum reservoir level and minimum level will result in an aesthetic intrusion

Chapter 5, page 4, Cultural Resources Testing has been carried out as recommended by Huse on the Windy Gap Project Sites have been recommended by Western Cultural Resource Management (WCRM) Inc to the National Register of Historic Places (NRHP) for sites on the Windy Gap Project No determination of eligibility to NRHP was sought from State Historic Preservation Officer Advisory Council Secretary of the Interior by WCRM or BLM Mitigations have been recommended to the Northern Colorado Water Conservation District (NCWCD)

Page 10, c(2), Pipeline to Lake Granby It is not stated where along the pipeline the spoil storage sites will be located

Chapter 6, page 3, Aesthetic Values Visual impacts associated with the draw down area between maximum and minimum reservoir level would be long term Also the presence of the pumping plant itself would be a long term impact

Chapter 10, page 1, 2 a , last paragraph Meeting was held in Kremmling on July 7 11 1978

Page 12, first paragraph Cultural resource studies have no covered 3 years Rather over a 3 year period the total time spent was 6 to 8 months including field time and report writing

We appreciate the opportunity to provide comments on this draft environmental impact statement

cc Director (220)
Craig DO

MEMORANDUM

To Files

Subject Response to the August 1 1979 Bureau of Land Management Staff Office Comment Letter on the Colorado Big Thompson/ Windy Gap Projects Final Environmental Statement

1 Comment The archeological publication (by Western Cultural Resources Management Inc) dealing with sites near Granby should be included in the FES

Response The conslusions of the above report are presented in the FES

2 Comment There were a number of right of way problems and attendant mitigation (see letter) which were not described in the DES

Response The problems and mitigation associated with BLM rights of way are discussed in the appropriate sections of the FES These problems and mitigation have been coordinated with BLM s area district and State offices

3 Comment The DES states that salinity would increase by 0 5 percent at Imperial Dam The DES does not analyze the resultant impact

Response The impacts associated with increased salinities due to the Windy Gap Project are being described and mitigated through the Colorado River Salinity Control Project to which the comment also refers

4 Comment Page II 42 should read The alinement then climbs to the northeast

Response Corrected

5 Comment The DES doesn t adequately address the importance of the Colorado River to wintering bald eagles Information from the current multi agency inventory should be included in the FES

Response The latest information (1980) from the inventory is included in the FES

6 Comment The nest sited at Kinney Creek is that of prairie falcon not a peregrine

Response Corrected

7 Comment A table displaying the number of fish sampled and weighed including cyprinids should be prepared

Response The section dealing with fisheries has been revised to reflect the work done by Erickson (1980)

8 Comment Grand County sanitary landfill cannot readily be seen from U S Highway 40

Response Reference to the landfill is deleted in the FES

9 Comment Most transmission lines dominate the landscape especially if they cross the scenic Windy Gap structure

Response The Windy Gap project will not involve the construction of transmission lines close to the Windy Gap structure A distribution line will be constructed from the existing Windy Gap substation along Highway 125 approximately 1 mile to the Windy Gap pumping plant This transmission line will follow the existing line and should not add appreciably to the visual impact of transmission lines within the area

10 Comment Should state whether permanent access roads along the pipeline will be required and if they will remain unvegetated

Response Permanent access and maintenance roads will be required along much of the pipeline right of way of the Windy Gap Project On private land these access roads will closely parallel the pipeline They will be revegetated only where such vegetation would not be destroyed by vehicle travel On Bureau of Land Management property access roads will be kept to a minimum and will follow existing access road systems wherever possible Exact location of these access roads has been submitted to the Bureau of Land Management as part of the license application for the pipeline

11 Comment Impacts on bald eagle habitat should be noted

Response According to the biological opinions rendered by the Fish and Wildlife Service for the Colorado Big Thompson Project and Windy Gap Project bald eagle habitat would not be adversely impacted by either project

12 Comment How will Windy Gap impact Colorado River habitat?

Response The impact on Colorado River habitat is discussed in Chapter IV of this document

13 Comment The land within the water fluctuating zone will be an aesthetic intrusion

Response Windy Gap will be operated so that fluctuations in the reservoir during periods of operation will be held to a minimum During non operational periods Windy Gap Reservoir will normally be held at its maximum operating surface The only time that this will not be true will be during brief and infrequent periods of maintenance The aesthetic intrusion of reservoir fluctuation is normal for reservoir operations and cannot be totally avoided

14 Comment Cultural resource mitigation has been recommended to the Northern Colorado Water Conservation District

Response The Municipal Subdistrict has been cooperating with Bureau of Land Management and cultural and archeological resource consultants to develop recommended mitigation The results of this cooperation are discussed in Chapter IV of the FES It should be emphasized that the license application is from the Muncipal Subdistrict Northern Colorado Water Conservancy District not the Northern Colorado Water Conservation District

15 Comment Pipeline spoil areas are not indicated

Response Spoil from the pipeline will be used for access road fill or as a buffer between Windy Gap diversion dam and U S Highway 40 The exact locations are indicated in the Subdistrict s permit application

16 Comment Impacts of the fluctuating reservoir and the pumping plant will have long term visual impacts

Response See response No 13 The fact that the pumping plant will present a long term visual impact is noted in the FES

17 Comment Page X 1 2 a last paragraph Meeting was held in Kremmling on July 7 11 1978

Response Meeting date has been corrected in the FES

18 Comment Cultural resource studies occurred over a 3 year period They did not take 3 years of total time

Response The FES clarifies this point

United States Department of the Interior

FISH AND WILDLIFE SERVICE
AREA OFFICE COLORADO—UTAH
[illegible] FEDERAL BUILDING
125 SOUTH STATE STREET
SALT LAKE CITY UTAH [illegible]

OFFICIAL FILE COPY
LM Branch
JU - 31979

(ES) July 18 1979

MEMORANDUM

TO Regional Director
Bureau of Reclamation
Lower Missouri Region
Denver Colorado

FROM Area Manager
U S Fish and Wildlife Service
Salt Lake City Utah

SUBJECT Draft Environmental Statement Colorado Big Thompson/Windy Gap Projects Colorado (EC # 79 29)

The Fish and Wildlife Service has reviewed the draft EIS for the Windy Gap Project In general the draft is very well prepared and most biological issues are adequately addressed There are however a few inadequacies Our comments on these are listed below

IV 20 2 The big game winter range loss at the Diversion Dam should be noted

IV 21a para 1 While the prey base may not be the most important factor in determining the size of a raptor population it is one of several equally important factors

IV 21a para 2 The fact that warmed water in the cooling pond would provide a holding area for waterfowl will not assure winter survival nor improved off site waterfowl hunting opportunities Unnaturally warm water can encourage waterfowl to remain in the area beyond the time when they normally would have migrated farther south If other waters freeze the birds are trapped for the winter and if sufficient food is not available serious problems can develop

IV 25 2 para 5 2nd sentence The DOW (1978) stated that a discharge that yielded an average velocity of 1 ft/s an average depth of 1 foot and coverage of 70 percent of the maximum wetted perimeter

We believe the velocity should be given as 1 ft/S rather than 1 ft^3/s

Page 2

It should be noted that C BT operational criteria were established years ago solely for game fishes without any concern for the endemic fishes that are now classed as endangered

Para 2 As no threatened or endangered fish species occur in bodies of water that would be affected by the Windy Gap Project no impacts on such species are expected to occur

Although endangered fish species do not occur in the immediate project area the endangered Colorado squawfish and humpback chub do occur downstream and the project will remove nearly 50 000 acre feet of water annually from their habitat

The Bureau should request a list of threatened and endangered species and species that are being proposed for classification in the area that will be affected by the Colorado-Big Thompson/Windy Gap projects This list should then be used to prepare a biological assessment that addresses the cumulative impact of this and other proposed developments upon the habitat of endangered and threatened species

The opportunity to comment is appreciated

MEMORANDUM

To Files

Subject Response to the July 18 1979 Fish and Wildlife Service Comment Letter on the Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Should note big game winter range that will be lost

Response As noted in Danes and Moore (1977) some deer migrate through the proposed reservoir area In addition elk and deer utilize the area as winter range The Windy Gap Reservoir would permanently inundate about 120 acres of pasture 15 acres of riparian and 15 acres of river channel Big game migration routes will not be permanently lost however animals will be forced to move around the periphery of the reservoir rather than along the river channel

Because of the ample amount of similar habitat proximate to the proposed reservoir and the lack of permanent disruption to migration there would be no significant long term adverse impacts on big game

2 Comment Prey base may not be the most important factor in determining the size of raptor populatioo but t is one of several equally important factors

Response We agree that prey base is an important factor but not equally important This change has been noted in the FES

3 Comment The fact that warmed water in the cooling pond would provide a holding area for waterfowl will not assure winter survival nor improved off site waterfowl hunting opportunities Unnaturally warm water can encourage waterfowl to remain in the area beyond the time when they normally would have migrated farther south If other waters freeze the birds are trapped for the winter and if sufficient food is not available serious problems can develop

Response See Response No 2 to Geological Survey letter

4 Comment Velocity on page IV 25 2 should be 1 ft/s not 1 ft^3/s

Response Error has been corrected

5 Comment Operation criteria were established years ago solely for game fish rather than endangered species

Response This information has been added to the final statement

6 Comment Impact on Colorado squawfish and humpback chub which are endangered species Preparation of a biological assessment

Response Impact on these fish has been analyzed and noted in the endangered species section of the FES Endangered species list was prepared by Fish and Wildlife Service and submitted to Water and Power Resources Service A subsequent biological assessment was submitted to Fish and Wildlife Service on November 4 1980 Chapter IV C Threatened and Endangered Species discusses endangered species in more detail A biological opinion was issued on March 13 1981 Conditional clearance has been granted by your agency

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL/AREA OFFICE
E ECUTIVE TOWER 1405 CURTIS STREET
DENVER COLORADO 80202

REGION VIII

J ly 20 1979

BSOQ

Mr Al R Jonez
Director
Office of Environmental Affairs
United States Department of Interior
Washingt n DC 20240

Dear Mr Jon z

Thank you for tha copy of the draft en ironmental

statement on the Colorado- Big Thompson/Windy Gap

Projects Colorado We have no comments on this

statement

Sincerely

Raymond D McKinley
Director
Program Planni g and Evaluation

AREA OFFICE
Denver Colorado

Memorandum

To Files

Subject Response to July 20 1979 Comment Letter from Department of Housing and Urban Development on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

NO RESPONSE REQUIRED

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

P O Box 17107 Denver CO 80217

July 17, 1979

OFFICE COPY
LM Bazron
JUL 23 1979

Joe D Hall Regional Director
USDI Bureau of Reclamation
Regional Office Lower Missouri Region
Box 25247
Bldg 20 Denver Federal Center
Denver CO 80225

Dear Mr Hall

Thank you for the opportunity to review the Draft Environmental Statement on the Colorado Big Thompson Windy Gap Project The document has been reviewed by our Plant Science and Watershed/River Basin staffs as well as our local field office staff We have the following comments

1 The effect of additional salt loading because of the diversion of Colorado River water is adequately addressed This is one of the known effects that the Colorado River Salinity Control Program (PL 93 320) is designed to offset

2 The problem of sediment due to construction is recognized in the statement but not addressed for reducing impact The statement hould address practical remedies to the increased sediment load

3 The statement addresses complete revegetation of disturbed areas along the pipeline with native species This is a good idea if the seed is available and the planting is successful On some soils however a mixture of introduced species with the native species may give quicker and better protection The installation of waterbars may also be a necessary practice to insure reduced erosion and complete revegetation The local Soil Conservation District may be able to provide specific revegetation information for this project

Sincerely

R G Halstead

Robert G Halstead
State Conservationist

cc R M Davis Administrator SCS Washington DC
Office of the Coordinator of Environmental Quality Activities
Office of the Secretary USDA Washington D C
Director Office of Federal Activities EPA Washington D C (5 copies)
Director Environmental Services Division SCS Washington DC
Portland OR

MEMORANDUM

To Files

Subject Response to the July 17 1979 Department of Agriculture Soil Conservation Service Comment Letter on the Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment The problem of sediment due to construction is recognized in the statement but not addressed for reducing impact

Response Careful consideration has been given to the methods available for reducing sediment in the Colorado River due to construction Ca efully formulated specifications will be followed during construction These specifications have been submitted to the Corps of Engineers as a part of the Section 404 Permit application Construction inspection will assure that contractors comply with these specifications

2 Comment On some soils a mixture of introduced species with the native species may give quicker and better protection than native species only Water bars may also be necessary

Response A detailed reclamation plan has been prepared by a former SCS employee who works for Dames & Moore Inc This plan is subject to approval by the private landowner and the Bureau of Land Management who also owns land on the pipeline right of way Modifications may be required to the revegetation plans in order to meet their respective goals The Municipal Subdistrict will attempt to revegetate in a manner which will restore the preproject condition Water bars and any other erosion control methods will be constructed and will be made a part of the plans for the project

STATE AND LOCAL GOVERNMENT

PITKIN COUNTY

506 E MAIN STREET ASPEN COLORADO

August 3 1979

REGIONAL FILE COPY
Bu. of Rec.
LM Region
AUG 6 1979

Joe D Hall
Regional Director
U S Bureau of Reclamation
Lower Mississippi River Basin
P O Box 25247
Denver Federal Center
Denver CO 80225

Dear Mr Hall

We have heard from the NWCCOG regarding the status and content of the Windy Gap diversion project draft Environmental Statement Since we are vitally interested in maintaining the health of western slope water resources we would like to offer the following comments on the Windy Gap E S

It appears that the Windy Gap E S is inadequate and incomplete in several vital respects Given the crucial importance of water resources to Western Colorado and especially considering the inevitable future demands on these resources we find these deficiencies both frustrating and alarming The document s insensitivity to indirect environmental impacts and its indifference to mitigating measures render it useless and probably illegal under NEPA requirements

We would like to suggest strongly that the Windy Gap Environmental Statement be completely rewritten to include the presently missing or inadequate sections

1) A complete and detailed analysis of a no action alternative The lack of this analysis in the draft statement tends to reinforce the feeling that the Bureau of Reclamation regards diversion projects such as this one as irrevocable without regard for costs vs benefits or possible alternatives such as conservation Such intransigence can only perpetuate mistrust among agencies responsible for allocating and protecting our water resources

2) A detailed discussion of all secondary impacts including impacts on downstream wildlife (with special emphasis on endangered species) recreational uses water treatment facilities and agriculture Increases in downstream pollution from salinity and suspended solids must be thoroughly analyzed The reluctance of the Bureau to address these issues can only reinforce the arguments of those now arguing for the suspension of Colorado Basin water projects pending completion of a comprehensive region-wide E S

3) Detailed outlines of all socio-economic impacts including the costs of improved water treatment facilities for downstream municipalities

4) Expanded analysis of projected stream flows below the diversion points including discussion of the effects of decreed water rights on that flow Recent court rulings guaranteeing minimum stream flows make this a particularly crucial section if the E S is to have any credibility

In conclusion we would like to point out that future energy development in Western Colorado is bound to place heavy demands on existing water supplies making it more and more difficult to justify diversion to the Eastern Slope With this in mind we hope your agency will initiate a shift in emphasis from development to conservation with the aim of distributing this precious resource fairly and equitably

Yours truly

Mark Fuller
Pitkin County Environmental Coordinator

MF/slt

cc Bob Child County Commissioner
Gerald Dahl Regional Counsel NWCCOG
P O Box 739
Frisco CO 80443

Memorandum

To Files

Subject Response to August 3 1979 Comment Letter from Mark Fuller Pitkin County Environmental Coordinator on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Should provide a complete and detailed analysis of a 'no action alternative

Response An analysis of the No Action alternative is presented in the FES and Dames and Moore 1977

2 Comment Should provide a detailed discussion of downstream impacts especially on wildlife endangered species recreation water treatment facilities and agriculture

Response Chapter IV of the FES provides updated information regarding the impacts on the above resources

3 Comment Should provide a detailed discussion of all socio economic impacts including costs of modifying water treatment facilities

Response Socio economic impacts including costs for modifying facilities are discussed in Chapter IV of the FES Mitigation for socio economic impacts are discussed in the Intergovernmental Agreement (Attachment 1)

4 Comment Should expand discussion of downstream flow and impacts on water rights

Response An expanded discussion of impacts on flows and water rights are presented in Chapter IV of the FES

5 Comment Water and Power should shift emphasis from development to conservation

Response The Windy Gap Project is not a Water and Power Resources Service project Water and Power is required to prepare an environmental statement because of the reasons stated in Chapter I of the FES

TOWN OF WALDEN
COUN O JACKSON
WALDEN COLORADO
A gust 2 1979

Mr Joe D Hall
Regional Director
U S Bureau of Reclamation
Lower Missouri River Basin
Post Office Box 25207
Denver Federal Center
Denver Colorado 80225

Dear Mr Hall:

Please find attached the comments of the Town of Walden Board of Trustees of Walden Colorado regarding the draft enviornmental statement for the Windy Gap Project issued J ne 18 1979 by the U S Bureau of Reclamation

Sincerely

TOWN OF WALDEN
BOARD OF TRUSTEES

By _____
Mayor Pro-tem Cecil Lockhart

Cl/mjm

Enclosure File copy

NOTE
If you do not receive a response
Insert your code number

MEMORANDUM

TO U S Bu ea f Recl mation Regional Office

FROM Town of Walden Board f Trustees Walden Colorad

E Comment n Windy Gap Project Draft Envi rnme tal Statement

DATE August 2 1979

Th f llowi g comm nt submitted i respons t th Draft Environmental St tement (ES) prepared f th Windy Gap Project i sued by the U S Burea of Recl mat' J 18 1979

A RAWHIDE POWER PLANT

Th whid powe pl t is incl ded i th ES s the en gy dev lopme t pect f th Windy Gap Pr ject We would submit that the Rawhid pr ject its lf tit t maj fed l tion requiri g th preparati f independent vironment l statement At a mi 'mum the present ES i l gally i sufficient f r t f 'l t id discuss a y easur to mitigat the adver e environmental pact of th R whid roject Th fail t di cuss mitigati measures fo th whid pl nt i pe fect exampl of th bus a f cat tailing"; n enviorn- ment l st t m nt for the wh de project woul l clea ly be legally insufficient with out m h d' cu si nd th present ES i inadeq t fo th same reason

F rth bjection rai ed rel tive t th fact that the ES assumes a annu l growth rata in lectrical demand of 10% That figure i nrealistically high ss it would require th Pl tte Ri Power A thority to doubl its generating capacity every even (7) years physical impo ibility Reas essment would ppea t be in rder Alt rnative t providi ew gen rating capa ity are not adequately ddressed ither and th need fo th project on th cal envisioned is not dequat ly justified

U S Bureau f Reclamation Regional Office
Page (2)

B ALTERNATIVES

The analysis of alternatives t the Windy Gap Pr ject ' t tally inadequat Particul ly dis oncerting i th fact that th no action lternativ was s sum marily dismis ed the 13 lines devoted t that lt rnati i th ES (IX 2) cannot pos ibly onstit t good f ith ff rt t omply with th l w Equally bjection- ble is th fact that no meaning ful naid ration ha bee gi en t th board ra g f alt rnative avail bl t the i (6) City ervic rea uch tringent wat ons r- vation measures incl ding wat tap m ratorium Su h vi bl nd vi rnm ntally pref rabl alt rnati agricult ral reus were t t ll di cussed nd d rv careful consideration in the final statement In s m it i submitted that a great deal more tt ntion will have t be focu ed on th issu f lt rnati if th final tatement is t omport with th l tt nd spirit f the l w

C MITIGATING MEASURES

Bringing to light those steps which ca be tak n t itigat th d ra en- vironmental impact of project is one of the most importa t funct s f a envi n- mental tatement In the c a f Windy Gap th project will ha two (2) s rious en- vironmental impacts s vere flow depletion in the Colorad Ri nd increased l i ity Incredibly mea re re s t out in the ES t mitigat th s impacts Chapter 5 containing nly twelve pages f discu ion n the issu f itigati i th weakest point of the ES It is submitted that great deal m re emphasis must be pla ed in mitigating measures in th final statement i ord t sati fy th re- quirements of NEPA

U S Burea of Recl mati n Regional Offic
Page (3)

D ENVIRONMENTAL IMPACTS

Th ES f ila t dequ t ly nalys the environmental onsequences f depleting th flow of h ppe Colorado River by 48 900 cre-feet per year or 31% of the flow t Hot Sulphu Springs The nalysis of the consequences of increased salinity i th C lorad River i i ila ly shallow and can not possibly provide the basis fo well reasoned admi istrative deci ion oncerning the project It is submitted that a programmati environmental statement is required to determine the cumulative ffects f Bureau of Reclamation project upon depletion and salinity increases on th Colorad Rive System before final decision can be made It is also submitted that nsupported sweepi oncl ion su h e the one that No significant dverse impacts a thetics re nticipated from operation of the Windy Gap Project need t be supported by factual documentation for they are wholly inadequate (VI 3)

E MINIMUM STREAM FLOWS

Th ES ontains beolutely no ju tification for the 75 c f s bypas flow figure recommended from the Windy Gap Dam (IV 5) There is no objective analysis which would ensu both the couracy and the adequacy of the 75 c f figure which is recommended This fl w is compounded by the fact that a total of 42 f of water rights re de reed f th rive mmedi tely below the dam thereby reating the po- tenti l f reducing th stream flow to 33 f s Assurances mu t be given based pon state- f the-art analysi that th bypass flows will be adequate to ensure the p a ervation of the quatic environment a well as ll other esthetic recreational and wilderness valu oci ted with the rivers and streams affected

F SILTATION

In rive with as heavy silt content as the Colorado the lif of a dam is ensured in t rms of th time it will take f r th dam to fill up with silt The pr blem f ilt cumul tion however received sbeolutely no mention in the ES nd mu t c rtainly be addre sed i the final tatement

U S Burea of Reclamation Regional Office
Pag (4)

G WATER QUALITY

The major impact of the salinity increases associ ted with th Windy Gap Project will be felt in the NWCCOG rea NWCCOG pursuant to S208 f the Federal Water Pollution Control Act (FWPCA) has adopted a water quality plan which includes precis standards for the control of salinity Whit the Bureau of Reclamation is clea ly obligated pursuant to S313 of the FWPCA t omply with the terms and onditions set forth in the NWCCOG S208 plan as well as ll ther wats quality regulations promulgated by the Col rad Wats Quality Control Commissions the ES is devoid f ny discussion of the impact f salinity increases pon the NWCCOG area It i sub- mitted that u til all questions related to salinity nd water quality have been compre- hensively addressed in the final statement the environmental nalysis is both incom- plete nd inadequate as matt f law

H LEGAL AUTHORITY FOR COMMENTS

These comments re submitted to the Bureau f Recl mation pursuant to S102 (2) (c) f th National Environmental Pol cy Act 42 U S C S4332; CEQ Regulations for im- plementing NEPA 40 C F R Parts 1500-1508; nd Department of Interior nd Bureau f Reclamatio guidelines on the preparation f environmental impact statements Depart ment of Interior Manual Pa t 516 Chapter 2 nd Bureau of Reclamation Instru tions Part 376 Chapter 5 all of which evidence concern for the rights and interests of local Government in ensuring the procedural integrity and securing the substantive rights provided for by the National Environmental Policy Act

U S Bureau of Reclamation Regional Office
Page (5)

Respectfully submitted

TOWN OF WALDEN
BOARD OF TRUSTEES

By _____
Mayor Pro-tem Cecil Lookhart

Cl/mjm

Memorandum

To Files

Subject Response to August 2 1979 Comment Letter from Town of Walden on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

Comments and responses are the same as the Board of County Commissioners County of Jackson

(916) 445-5656

EDMUND G BROWN JR
GOVERNOR OF
CALIFORNIA

OFFICIAL FILE

LM Region

AUG 9 1979

THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO CALIFORNIA

AUG 7 1979

U S Department of the Interior
Bureau of Reclamation
Lower Missouri Region
P st Office Box 25247
Denver CO 80225

Attention Joe D Hall

The State of California has reviewed the Draft Environmental Statement Colorado-Big Thompson Windy Gap Projects Colorado dated June 18 1978 submitted through the office of Planning and Research in the Governor s Office

We offer the following comments

1 The alternatives to the Windy Gap Project water supply page IX-2 do not include agricultural water conservation (increased efficiency) to make water available for municipal use without curtailing agricultural production

2 On page i the report gives the impact at Imperial Dam from development of Windy Gap as a 0 5 percent increase in salinity Calculation of that valu is presented on page IV 15 However on page VI-4 reference is made to downstream impacts of salinity which are given as a 3 percent increase This discrepancy should be corrected

The State s review which fulfills the requirements of Part II of Office f Management nd Budget Ci cular A 95 was coordinated with the Departments of Conservation Fish and Game Parks and Re reation Water Resources Food and Agriculture and Health Services the Air Resources Solid Waste Management and State Water Resources Control Boards the State Lands Commission and the Colorado River Board of California

We appreciate having been gi en the opportunity to review this report

Sincerely

James W Burns

JAMES W BURNS
Assistant Secretary for Resources

cc Director of Management Systems
State Clearinghouse
Office of Planning and Research
1400 Tenth Street
Sacramento CA 95814
(SCH 79071015A)

Memorandum

To Files

Subject Response to August 7 1979 Comment Letter from The Resources Agency of California on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Agricultural water conservation as an alternative to Windy Gap without curtailing agricultural production should be discussed

Response The water developed by the Windy Gap Project will be used for municipal and industrial uses not agriculture Agricultural water conservation and reuse programs are already in progress

2 Comment There is a contradiction between the salinity concentration presented on pages i and IV 15 and page VI 4

Response The correct concentration range is 1 to 8 mg/l or 0 5 to 1 8 percent The 8 mg/l is at Cameo Colorado and the 1 mg/l is at Imperial Dam The error has been corrected in the FES

CITY OF BOULDER COLORADO 80306

August 15 1979

OFFICIAL FILE COPY
AUG 28 1979

Mr Joe D Hall Regional Director
United States Department of the Interior
Bureau of Reclamation
P O Box 25247 Bldg 20
Denver Federal Center
Denver Colorado 80225

Re LM 150

Dear Mr Hall

The City of Boulder as a member of the Municipal Subdistrict Northern Colorado Water Conservancy District wishes to take this opportunity to comment on the Draft Environmental Impact Statement for the Colorado Big Thompson/Windy Gap Project (INT DES 79 33) The draft EIS considers in great detail the various impacts that must be evaluated for a project such a Windy Gap However we feel that the Bureau of Reclamation must also reevaluate the relationship between Windy Gap and the proposed Platte River Power Authority (PRPA) Rawhide Project

As originally proposed the Windy Gap Project was to deliver water to the six members of the Municipal Subdistrict including Boulder Longmont Estes Park Fort Collins Loveland and Greeley During the course of project development over the last several years Estes Park and Fort Collins elected to sell all or part of their allotments to the Platte River Power Authority (PRPA) to be used in the development of the proposed Rawhide Power Plant Consequently the PRPA Rawhide Energy Development Project became an allottee of the proposed Windy Gap Project

We must express our dismay over the less than acceptable manner in which the Bureau of Reclamation chose to present the relationship between the Windy Gap Project and the proposed Platte River Power Authority (PRPA) Rawhide Energy Development Project Rawhide while an allottee of the proposed Windy Gap Project does not represent an energy aspect of the Windy Gap Project The two projects were conceived independently of each other As was noted in the draft EIS Rawhide has developed an independent water supply for its first 250 megawatt unit It is equally conceivable that PRPA would propose to do the same for any additional units if Windy Gap were not constructed Neither project is dependent on the other and

their relationship is no different than those between Windy Gap and the remaining allottees who will receive water from Windy Gap

We are especially concerned over the tendency to combine the environmental impacts and concern of both the Windy Gap and Rawhide Projects As was noted above the projects were conceived independently of each other and should be considered in that manner The environmental impacts associated with the PRPA energy production including air quality transmission line corridors and water quality would be the result of developing the Rawhide Project and should not be construed as resulting from Windy Gap development To do otherwise could jeopardize the Windy Gap Project

The proposed Windy Gap Project represents an integral part of Boulder s water development program The City recognizes its responsibilities to the future and also realizes that those responsibilities will be met in all likelihood by acquisition of agricultural water rights Windy Gap presents an additional alternative to such an approach with the further opportunity for potential reuse of the water supply

We wish to thank the Bureau of Reclamation for this opportunity and hope that our comments are helpful and constructive

Respectfully

Robert H Westdyke
City Manager

RH/pjf

Memorandum

To Files

Subject Response to August 15 1979 Comment Letter from City of Boulder on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment The Bureau of Reclamation must reevaluate the relationship between Windy Gap and Rawhide Powerplant

Response Most of the discussion in the DES relating to the Rawhide Plant is not included in the FES See Chapter I for a discussion of this modification

ROUTT COUNTY BOARD OF COUNTY COMMISSIONERS

Box 936 Steamboat Springs Colorado 80477 303/879-0108

August 24 1979

OFFICIAL FILE COPY
AUG 29 1979

Mr Joe D Hall Regional Director
U S Bureau of Reclamation
Lower Missouri River Basin
P O Box 25247
Denver Federal Center
Denver Colorado 80225

Dear Mr Hall

Please find attached the public comments of the Routt County Commissioners regarding the draft environmental statement for the Windy Gap Project issued June 18 1979 by the U S Bureau of Reclamation Routt County is part of the Northwest Council of Governments which has adopted water quality standards Although the Windy Gap Project does not directly affect Routt its impact would cause us great concern For purposes of input the Routt County Board of County Commissioners has adopted generally the statement submitted to you by Grand County We heartily support the views expressed by Grand County as indicated in the attached memo We do hope that you will give these statements careful considerate attention

Very truly yours

Daniel S Maus
COUNTY ATTORNEY

Attachments

Insert your code number

ROUTT COUNTY BOARD OF COUNTY COMMISSIONERS
Box 936 Steamboat Springs Colorado 80477 303/879-0108

MEMORANDUM

TO U S Bureau of Reclamation Regional Office

FROM Routt County Colorado

RE Public Comments on Windy Gap Project
Draft Environmental Statement

DATE August 22 1979

The following public comments are submitted in response to the Draft Environmental Statement (ES) prepared for the Windy Gap Project issued by the U S Bureau of Reclamation on June 18 1979

A RAWHIDE POWER PLANT

The Rawhide power plant is included in the ES as the energy development aspect of the Windy Gap Project We would submit that the Rawhide project itself constitutes a major federal action requiring the preparation of an independent environmental statement At a minimum the present ES is legally insufficient for its failure to consider or discuss any measures to mitigate the adverse environmental impacts of the Rawhide project The failure to discuss mitigation measures for the Rawhide plant is a perfect example of the abuses of coat-tailing an environmental statement for the

Rawhide project would clearly be legally insufficient without such a discussion and the present ES is inadequate for the same reason

Further objection is raised relative to the fact that the ES assumes an annual growth rate in electrical demand of 10% That figure is unrealistically high as it would require the Platte River Power Authority to double its generating capacity every seven years a physical impossibility Reassessment would appear to be in order Alternatives to providing new generating capacity are not adequately addressed either and the need for the project on the scale envisioned is not adequately justified

B ALTERNATIVES

The analysis of alternatives to the Windy Gap Project is totally inadequate Particularly disconcerting is the fact that the no action alternative was so summarily dismissed the 13 lines devoted to that alternative in the ES (IX 2) can not possibly constitute a good faith effort to comply with the law Equally objectionable is the fact that no meaningful consideration has been given to the broad range of alternatives available to the 6 City service area such as stringent water conservation measures including a water tap moratorium Such viable and environmentally preferable alternatives as agricultural reuse were not at all discussed and deserve careful consideration in the final

statement In sum it is submitted that a great deal more attention will have to be focused on the issue of alternatives if the final statement is to comport with the letter and spirit of the law

C MITIGATING MEASURES

Bringing to light those steps which can be taken to mitigate the adverse environmental impact of a project is one of the most important functions of an environmental statement In the case of Windy Gap the project will have two serious environmental impacts severe flow depletion in the Colorado River and increased salinity Incredibly no measures are set out in the ES to mitigate those impacts Chapter 5 containing only twelve pages of discussion on the issue of mitigation is the weakest point of the ES It is submitted that a great deal more emphasis must be placed on mitigating measures in the final statement in order to satisfy the requirements of NEPA

D ENVIRONMENTAL IMPACTS

The ES fails to adequately analyze the environmental consequences o depleting the flow of the upper Colorado River by 48 900 acre-feet per year or 31% of the flow at Hot Sulphur Springs The analysis of the consequences of increased salinity in the Colorado River is similarly shallow and can not possibly provide the basis for a well-reasoned administrative decision concerning the project It is submitted that a programmatic

environmental statement is required to determine the cumulative effects of Bureau of Reclamation projects upon depletion and salinity increases on the Colorado River System before a final decision can be made It is also submitted that unsupported sweeping conclusions such as the one that No significant adverse impacts on aesthetics are anticipated from operation of the Windy Gap Project need to be supported by factual documentation or they are wholly inadequate (VI 3)

E MINIMUM STREAM FLOWS

The ES contains absolutely no justification for the 75 c f s bypass flow figure recommended from the Windy Gap Dam (IV 5) There is no objective analysis which would ensure both the accuracy and the adequacy of the 75 c f s figure which is recommended This flaw is compounded by the fact that a total of 42 c f s of water rights are decreed for the river immediately below the dam thereby creating the potential for reducing the stream flow to 33 c f s Assurances must be given based upon state-of-the art analysis that the bypass flows will be adequate to ensure the preservation of the aquatic environment as well as all other aesthetic recreational and wilderness values associated with the rivers and streams affected

F SILTATION

In a river with as heavy a silt content as the Colorado the life of a dam is measured in terms of the time it will take

for the dam to fill up with silt The problem of silt accumulation however received absolutely no mention in the ES and must certainly be addressed on the final statement

G WATER QUALITY

The major impact of the salinity increases associated with the Windy Gap Project will be felt in the NWCCOG area NWCCOG pursuant to § 208 of the Federal Water Pollution Control Act (FWPCA) has adopted a water quality plan which includes precise standards for the control of salinity While the Bureau of Reclamation is clearly obligated pursuant to § 313 of the FWPCA to comply with the terms and conditions set forth in the NWCCOG 208 plan as well as all other water quality regulations promulgated by the Colorado Water Quality Control Commission the ES is devoid of any discussion of the impact of salinity increases upon the NWCCOG area It is submitted that until all questions related to salinity and water quality have been comprehensively addressed in the final statement the environmental analysis is both incomplete and inadequate as a matter of law

H LEGAL AUTHORITY FOR PUBLIC COMMENTS

These public comments are submitted to the Bureau of Reclamation pursuant to § 102(2)(c) of the National Environmental Policy Act 42 U S C § 4332 CEQ Regulations for implementing NEPA 40 C F R Parts 1500 1508, and Department of Interior and Bureau of Reclamation guidelines on the preparation of

environmental impact statements Department of Interior Manual Part 516 Chapter 2 and Bureau of Reclamation Instructions Part 376 Chapter 5 all of which evidence concern for the rights and interests of local government in ensuring the procedural integrity and securing the substantive rights provided for by the National Environmental Policy Act

Memorandum

To Files

Subject Response to August 24 1979 Comment Letter from Routt County Board of County Commissioners on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Rawhide Powerplant constitutes a major Federal action which requires a separate environmental statement

Response The Rawhide Powerplant is not a Federal action nor is its development and operation contingent upon Federal actions Its environmental impacts are covered by an environmental assessment (PRPA 1978) has all the necessary permits and is under construction Its treatment in the FES has been modified considerably See Chapter I of this document

2 Comment The DES is insufficient in that it fails to discuss mitigation for Rawhide

Response See Response No 1

3 Comment PRPA assumes an annual electrical growth of 10 percent This is unrealistically high and should be reassessed

Response See Response No 1

4 Comment The analysi of alternatives to Windy Gap is inadequate and should be redone Agricultural reuse alternatives were ignored

Response The analysis of alternatives has been revised in the FES purusuant to the CEQ guidelines which became effective in 1979

5 Comment The DES doesn t discuss the mitigation for impacts on flow depletion and increased salinity in the Colorado River

Response Mitigation for flow depletions is discussed in Chapter IV C and Attachment 1 of the FES Mitigation for salinity impacts are being addressed under the Colorado River Salinity Control Project

6 Comment The DES doesn t analyze the impacts of flow depletion in the Colorado River

Response See Response No 5

7 Comment The DES inadequately describes the impacts on salinity in the Colorado River

Response See Response No 5

8 Comment A programmatic environmental statement covering flow depletions and salinity is required

Response The environmental impacts associated with salinity are being analyzed and mitigated pursuant to the Colorado River Salinity Control Project Environmental documents are prepared on each unit of the project as they are proposed Programmatic EIS s have been prepared on both Title I and Title II of the project (q v)

9 Comment The statement on page VI 3 of the DES No significant adverse impacts of aesthetics are anticipated needs to be supported by documentation

Response See Chapter IV C Aesthetics

10 Comment The DES doesn t contain justification for the 75 ft^3/s bypass flow

Response Minimum flow releases have been agreed to between the Subdistrict and the DOW Justification for these releases are discussed in Chapter IV C Aquatic Biota and Erickson (1980) and Attachment 2

11 Comment Siltation behind Windy Gap Dam was not discussed in the DES and should be described in the FES

Response See Chapter IV C Water Quality

12 Comment The DES fails to discuss the impacts on water quality within the Northwestern Colorado Council of Government s Section 208 planning area

Response See Chapter IV C Water Quality

GO E NO S D CE D A N NG COO O TION

CARSON C T NE O 8 7 0

SEP : 2 1979

September 7 1979

Joe D Hall
Regional Director
U S Department of the Interior
Bureau of Reclamation
Regional Office Lower Missouri Region
P O Box 25247
Building 20 Denver Federal Center
Denver Colorado 80225

RE SAI NV #80200003 Project Big Thompson Windy Gap

Dear Mr Hall

The State Clearinghouse has processed the S P 424 for the proposed project Based on the information contained therein and the responses of interested parties the proposed project is as of this date found not to be in conflict with the State s plans goals or objectives

Attached are the comments of the State Clearinghouse prepared by the Division of Colorado River Resources

You should now continue with the application process prescribed by the appropriate funding agency

The S P 424 is to be included with your final application and a copy of this letter must also accompany the application to the funding agency

Sincerely

Mike Nolan for
Robert M Hill
State Planning Coordinator

If you have enclosures please insert your code number

RMH/gd

Enclosure

STATE OF NEVADA

DIVISION OF COLORADO RIVER RESOURCES

August 15 1979

MEMORANDUM

To Robert Hill State Planning Coordinator

From Administrator Division of Colorado River Resources

Subject Draft Environmental Statement Colorado-Big Thompson Windy Gap Projects Colorado - SAI NV #80300003

We have reviewed the aforementioned draft statement as requested and have the following commen s

On Page VI-4 reference is made to the downstream impact to water quality on the Colorado River due to the development of Windy Gap resulting in an approximate salinity increase of two and three percent at Lee s Ferry and Imperial Dam respectively Calculated values presented on Page IV-15 show the anticipated increase in salinity at these two locations to be 0 5 percent Additionally Page i of the Summary states that the impact on salinity at Imperial Dam resulting from this development will be 0 5 percent These discrepancies should be corrected

Duane R Sudweeks

cc Mr Noel Clark Director
Department of Energy

Memorandum

To Files

Subject Response to September 7 1979 Comment Letter from the State Clearinghouse of Nevada on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment The discrepancies among salinity numbers presented on pages 1 IV 15 and VI 4 of the DES should be corrected

Response Corrected

COLORADO DEPARTMENT OF NATURAL RESOURCES
1313 Sherman Street
Denver CO 80203
(303) 839 3311

COLORADO DEPARTMENT OF HEALTH
4210 East 11th Avenue
Denver CO 80220
(303) 320 8333

September 20 1979

OCT 5 1979

M Joe D H ll Region l Director
B rea of Reclamation
Lower Missouri Region
P O Box 25247
Denver Federal Center
Denver Co orado 80225

Dear Mr H ll

The State of Colorado has reviewed the Draft Environmental St tement for the Colorado Big Thompson/Windy G p/Rawhide projects This eview was jointly managed by the Colorado Departme t of Natural Resources and the Colorado DePartment of Health and invol ed overy st te agency ha ng a intere t n the overall project Based pon these reviews we have prepared this r sponse to the DES

The Windy Gap/R whid eview addresses two ary s bstantial ct v ties of major St te conc rn The Windy Gap w ter divers o project s one of the last major transmo ntain d v rsions being contempl ted t th s time This p oject w ll divert Color do R ver water to Color do s easter slope via the exist ng Color do-BigThompson f cilities for e by the cities of Bo lder Estes P rk Fort Collins Greeley Longmont and Lo eland Use of W ndy Gap water by the municipalities will relieve municipal p re on gric lt r l waters in the lower Pl tte River b sin In recent year the e g cult al wate have f ced major demands for municipal exp opriatio d e to apid populatio growth in Larimer Weld and Bo lder counties W thout an alternative so rce of municipal water supply these agricult ral waters will face incre sing munic p l use demands d e to continuing growth and development pressures By prov d ng an ltern tive water s pply ource for munic pa use n the rba ed reas of Larime Weld and Bo lder count es the Wi dy G p project is co te t with State policy which seeks to discourage cont n ed l ge c le e propri tion of gricultural w ters for municipal ses in the interests of p eserv ng h gh quality agr cult e in Colorado

The R whid Powerplant to be constructed by the Pl tte R ve Powe A thority will be l rg c le coal fired electricity gener t ng facility wh ch w ll present the f ll complement of nv ronm ntal es inher nt to large coal f ed powerplants The City of Fort Collins has relinquished its Windy G p water allotment to the Pl tte River Powe Author ty in an exch ge greement to fur ish w ter to th proposed Rawh de Powerpla t which w ll be loc ted c th of Fort Collins

I ew of the scale nd ignificance of the Colorado Big Thompson/Windy Gap Raw ide p ojects considerabl att ntion was di ected to the review of the D aft Environmental St tement by State agenc es

I gen a, we belie e that signif cant mpro emc ts re ece sary to the en onmental sse sment and should be made n the proper t on of the Final E v onse t l St t me t This concern was sed by a umbe of e ew ng ge c es wh ch felt that the DES was nadeq ate its presentation of w ll doc me ted b t nti e informat on n the lik ly environmental effects oci ted w th both the W ndy G p d vers o p oject nd the R wh de Powe pl t Con e sely exce i e ttent on i g ven to the ex st ng Color do Big Thompson d s on f cil t e wh ch thomsel es are likely to have little or no d co n ble effect o the env onment desp te the r role n the Windy Gap/ R wh de p oject Ba ed po th i format on pro ided o referenced in the DES lo e t i d ff c lt to rak ny ol d det rm natio of the likely e onmental effects of the complex w t d ve s on and powerpl nt projects It n st be noted howe e th t th does not mean that f lt has been found w th either the W ndy G p or R wh de project themsel es or that ternati es to these p oject wo ld be p ere ble Rather we a e concerned that the e iromn t l s essment pe se of the e projects s inadequate and needs mpro eme t We e conf d nt that the e problems ca be rectified i the p porat on of the fin l document

A pec f c ea of conce n de t fied by many of the reviewing gencies is the l ck of d sc ss o .n the DES of mit gat ng meas res for ad erse envi onmental effect engendored by the W ndy Gap nd Rawhide p ojects Co cer were e p essed eg d ng the effects of the projects o water q l ty qu l ty f sh d w ldlife hab tats m nimum streamflow needs nd other matters for which little or no d sc ssion of mitig tion measures w prov ded

Th follow ng comme t dd e s the majo co cerns de tified in the State ge cies o iew of the Windy G p d R wh de projects These comments dd e f t the Windy G p water diversion project second the Rawhide Powe pl nt nd th d the State s concern with g owth manageme t as they l t to th Windy G p/R wh d propos l In addit on copie of the rev w comme ts f om the p nc pal re ewing genc es were appended in th ent r ty to th lett r

1 Windy G p D e o P oject

Se e l def c ncie ha e been ide tif ed n ssessment of the Windy Gap D or on P oject The re lt t w te q l ty mpl c t ons of this d r o p oject e not cov ed n ffic ent deta l to allow an e al t o of the f ll ffect of thi diversion Of particular concern are the n tr.ant l ol (u o t and e pected build p) in Grand Lake Shadow Mounta Rese o r nd Lake G by The n t e t l vels in these l kes w ll be d rectly affected by the dive sion of the F se River w te which s expected to ece e the wastewater of n creas ng ec eat on o ented pop lation A f more deta led explanation of the w t r q l ty mpl c t ons s needed particul ly for the downstream wate n te ms of po t nd no po nt o ce dischargers s l nity and inc eased sed ment load d r g construction Additional comments on water qu l ty are prov ded the ttachee t from the Department of Health Depa tme t of Ag c lt e nd the D on of Planning

Another area of signific nt concern is the lack of attent on g ven to the wildlife aspects of the diversion project A habitat based e al ation would be most helpful as well s n alysis and qu ti f cation of the impacts of Windy Gap upon those habit ts The ma n habitat of concern s the fisheries in the Colo ado nd Frase R ers Items that concern this habitat re migration and spawn ng h bits wate temperature flow regimes quat c plant growth and di solved oxygen More pecific comments on wildl fe are included in the attach ments f om the Divisio of Wildlife and the Water Conserv t on Bo d

The minimum streamflow below the diversio dam lso raises mpo tant quastions regarding the fisheries n this area There appears to be a discrepancy in the amount of water that can be diverted by senior wate rights and that reported n the DES for the area between the divers on dam nd the confluenc of the Williams Fork River A tab lation of th senior rights nd their respect ve di ersions d ng c itical dry period would resolve th s problem In addi tion analysis and q entif cation of the rrigation ret rn flow on this tretch of the Color do River is needed to determine the actual m n mum streamflow for this area Additional comments are included in the attachments from the Division of Wildlife nd the Water Conservation Board

Oth r important concerns that have not been f lly addressed include land slides and seismic acti ity fluctuating water le els in the Thre Lakes air quality during construction and the i c eased traffic du ing construction Specific comme ts on these items a e included in the ttachme ts from the Colo do Geologic l Su vey Department of Health the Depa tment of Highways and the Division of Pl nning

2 Rawhide Powerplant

A number of deficiencies have been dentified n the assessment of the Rawhide Powerplant From an air quality perspective the information contained in the DES is inadequate except fo a very general determination of the likely air quality impacts The emis ion inventory type(s) of analytical models nd ambient monitoring data used are not identified in sufficient detail to permit ny intelligent agreement or disag eement with the conclusion that the powe plant will have no ignificant dverse effect on ambient air quality This doe not mean that f lt has been found with the air quality aspects of the powerplant b t that the DES review of those aspects is cursory and inadequ te No e specific comments on the a r quality aspects of the proposed Rawh de f cility ere included in the attached comments from the Department of He lth

In respect to the groundwate effects of the proposed powerplant nd to the d spos l of ash produced by the burning of l rge volumes of coal in the Rawhide facility the DES is al o deficie t Concerning ash disposal there ppea s to be confusion or inaccuracies in the DES review of the prod ctio of ash in light of projected coal consumptions given stated assumptions on

sh co t nt of th coal to be sed The whol discussion ho ld be thoro ghly o ewed nd be cl if ed o where nec ssa y corrected Th co c de tion of pote t l g o ndw te se page from ash d sposal p nts is lso deq te No format on on Gro ndwater t the Rawhide s t s p o ded o ny docum ntation p o ided to b tt ess the st ted content o that gro ndw te eep ge from th site w ll be s gn f cant No pecific comments on the g o ndw ter nd ash dis po l aspects e pro ded the att ched comments from the Departme t of Health nd the D vi on of W ldl fe

The p ovi ons nece ry to ccommodate R wh de related traffic at the Buckeye I terch ng on I 25 ho ld be ddressed purs ant to the letter (att ched) from the Depa tme t of H ghw ys to M s I Consulting Engineers In dd t on the DES ho ld recogn ze that the crossing of St te Highways by electrical tran m ss o l e should be coordinated with the Department of Highw ys to ns re th t p oper p oced res are followed

W ldl fe has been g e o ly token ttentio n the DES eview of ths Rawh de element Th document sho ld address n a much more comp e hen e manne the l kely effects of the proposed powerplant on wild life habit ts nd m g tion patterns Al o f ller explanat on of the potenti l e of the cooling pond w ldl fe hab tat and recrea tio fac l ty s ecess ry More specific comments on the wildlife spects of the R wh de facility a e provided in the attached comments f om the Div sion of Wildlife

3 G owth M agement

Th State conc ned with ll projects and ct ities wh ch will affect large cale patte ns of growth nd development in Color do Both the Windy Gap and Rawhide projects h e the potential to affect growth and de elopment patterns most particularly in La me Weld nd Boulde count o nd to le e extent n G and County Whil the St te does not hold the Northe n Colorado W te Con erv ncy District or its municipal ubd st ct nor th Platte R er Powe A thor ty directly esponsible for the management of g owth nd development press e engendered by the two project we do bel eve that the pplicants should be cogn zant of and esponsive to th potent al g owth nd development issues aised by the e p oject Comments f om the Di s on of Pl nning and the Division of Local Go ment wh ch dd ess these co c rns are attached

We ppre. te th opportunity to rev ew thi DES and t st that our comme ts will be of se in mp o ing the assessment and preparing the final docume t

S nce ely

Harr s D Sherman
E ec ti e D ecto
Depa tmo t of N t l Reso ces

Frank A Traylor M.D.
E ecut e Director
Depa tment of Health

HDS/FAT/jl

Attached comments from
- Department of N t r l Resources
  - Di i ion of W te Resources
  - Division of Wildlife
  - W te Conserv t o Board
- Department of Health
- Department of Agric lture
- Department of Loc l Aff irs
  - Division of Planning
  - Divis o of Loc l Government
- St t Historic P ervation Offic r

Colorado Department of Health

[illegible] Telephone No
Executive Director

[illegible]
Denver Colorado 80220
Phone (303) 320 6 [illegible]

AUG 17 1979
DIV OF FI

MEMORANDUM

TO State Clearinghouse

FROM Steve Kelsey Colorado Department of Health

RE Windy Gap/Rawhide Draft EIS DEIS #79 127

DATE August 15 1979

The Water Quality Control Air Quality Control and Radiation and Hazardous Materials Control Divisions of the Office of Health Protection Colorado Department of Health have reviewed the draft environmental statement on the Windy Gap/Rawhide project and have the following comments

I GENERAL

The Department of Health is gravely disappointed in this draft EIS It is entirely inadequate in its coverage of air quality water quality and waste disposal concerns Much of the bulk of the draft EIS is taken up by detailed but rather meaningless descriptions of the existing Colorado-Big Thompson facilities including of such esoterica as the radio communications network However useful substantive information on the probable environmental effects of constructing the proposed Windy Gap water diversion facilities of the new Western Slope-to-Eastern Slope diversion of waters the project would engender and of the Rawhide powerplant are cursory and inadequate Most of what little hard information is presented is poorly documented either directly or by reference Based upon the information provided or referenced in this document alone it would not be possible to make any well-founded determination of the environmental acceptability of the complex water diversion/powerplant project

Fortunately for the Department of Health at the time the draft EIS was being reviewed reviews were concurrently being conducted by the Air Quality Control and Radiation and Hazardous Materials Control Divisions of applications or an air emission permit and a waste disposal permit for the Rawhide generating plant The information contained in the permit applications answered many of the technical questions raised by the proposed water diversion/powerplant projects The Water Quality Control Division will also conduct an in-depth review of necessary water quality permit applications when these are received which may also provide satisfactory answers to technical water quality issues However for those agencies and organizations which do not have access to the detailed technical data provided the Health Department in the permit applications it would be very difficult or impossible to make a meaningful assessment of environmental impacts using only the data contained in the draft EIS

II WINDY GAP DIVERSION PROJECT

A The Water Quality Control Division has identified a number of issues pertaining to the Windy Gap Diversion element of the overall project These are

1 The present trophic state and nutrient loadings of the three lakes (Lake Granby Shadow Mountain Reservoir Grand Lake) need to be analyzed A major concern exists regarding the effects of additional nutrient loadings from the diversion will have on these lakes Nutrient levels in the Fraser River similarly need to be addressed particularly in respect to sewerage treatment plant discharges

2 A far more specific and precise identification of the environmental and economic effects of point source discharges in all waters affected by the project needs to be provided

3 What adverse impacts may occur in respect to down stream sedimentation due to the construction of the proposed dam? This is an important issue which needs to be addressed

4 Why was no apparent consideration given to other diversion alternatives such as routing the diversion pipeline completely around the three lakes? The lack of alternatives in the EIS is a serious deficiency and raises serious questions about whether the proposed project is the best alternative

5 The draft EIS provides apparently conflicting data on likely salinity impacts of the project (compare Table IV-6 with Page VI 4) The discrepency is significant and needs to be resolved Further the economic effects of increased salinity needs to be addressed along with possible mitigation measures

6 The draft EIS fails to address the issue of the combined trophic effects of the diversion project and existing and future subdivision development in the Fraser Valley This is an important issue which needs to be addressed

B In addition to the foregoing comments the Air Quality Control Division voices concern about the EIS s failure to address the effects on air quality of particulate emissions from the construction of the diversion facilities including dam conduits roadways etc A simple statement as to the amount of material to be moved and application of an appropriate emission factor would probably be sufficient to give an idea of the likely impact on ambient airborne particulate levels due to the construction activities This information should be presented along with a discussion of mitigation measures Also if it is anticipated the open burning will be necessary to dispose of brush and slash material the effects of such burning should at least be mentioned The air quality impacts of the water development element are discribed as minor and temporary It is difficult to come to this conclusion from the information presented

III RAWHIDE POWERPLANT PROJECT

A The Air Quality Control Division conducted the principal review of the Rawhide Powerplant aspect of the draft EIS The Division indicates that the EIS is inadequate for any but the most general determination of the effects on air quality of the Rawhide project The emission inventory type(s) of analytical models and ambient monitoring data used are not identified in sufficient detail to permit any intelligent agreement or disagreement with the conclusion that the powerplant will have no significant adverse effect on ambient air quality While the Air Quality Control Division has recently received an application for an emission permit for the Rawhide facility based upon which the air quality impacts should be readily determinable this does not compensate for the inadequacy of the draft EIS in addressing this important issue

The Air Quality Control Division also has the following specific comments

1 The draft EIS states that the sulfur content of the coal to be used is 0 29% This is a very low sulfur content even by western low-sulfur coal standards It has been the Division s experience that the sulfur content of coal even from the same pit is subject to significant variation this variation is all the more problematical since the coal to be used is from a proposed mine rather than an operating mine How will a sulfur content of less than 0 3% be assured? If higher sulfur contents are experienced what if any additional mitigation measures will be taken to control sulfur dioxide (SO_2) emissions What will the effects on ambient air quality of possible higher coal sulfur content be?

2 The potential for air quality impacts on Rocky Mountain National Park a Class I air quality area may exist This is an extremely difficult question which is ignored in the draft EIS While the Division is sympathetic with the problems of analyzing long-range transport of pollutants and assessing impacts on visibility it considers attention to this matter to be important It offers its assistance in addressing the matter

3 No measures for the mitigation of emissions from the powerplant as designed and their effects on air quality are addressed in any way

4 The construction activities associated with the powerplant including truck travel on adjacent paved and unpaved roadways will result in elevated suspended particulate levels The amounts of construction-related particulate emissions their likely effect on ambient air quality and the means to be employed to control these emissions need to be identified

5 The matter of fugitive dust emissions from fly ash haulage equipment and disposal operations are not adequately addressed How will such emissions be prevented or controled?

B The Radiation and Hazardous Materials Control Division is most unhappy with the draft EIS discussion of ash disposal matters In their words the information

pertaining to ash disposal practices is misleading in correct omitted or poorly documented The Radiation and Hazardous Materials Control Division has the following comments

1 The draft states that all solid waste will be disposed of at county landfills There is no indication that arrangements for doing so have been made Disposal of large volumes of construction waste can be barred by landfill operators because of site capacity limitations (Page II-30)

2 The use of asphalt lined ash ponds will entail an intensive maintenance program or periodic relining after dredging This is not discussed Also a program of monitoring for leachate should be included (Page II 60)

3 The statement regarding the necessity for the handling of coal ash from western coal in a dry state appears to be in error This statement should be documented or retracted (Page II 60)

4 There is no groundwater information provided for the Rawhide site This deficiency should be corrected

5 There may be a potential for alluvial seepage from the Rawhide site into Reservoirs No 3 and 4 and Boxelder No 3 which are used for recreation purposes It is impossible to determine whether such a potential actually exists since the distance between these reservoirs and the Rawhide site is not identified (Page III-42)

6 The possible impacts of groundwater seepage from the Rawhide site are dismissed as insignificant There is no discussion or documentation of this assertion Also the stated soil permeabilities and groundwater seepage rates at the site are not documented and seem unrealistic Also a statement is made that groundwater at the Rawhide site had been discussed but no such discussion exists (Pages IV-10 17)

7 No analysis is provided of the null or no action alternative in respect to the Rawhide facility No reason is given for this omission which appears arbitrary (Page IX-14)

8 The discussion on the production of ash is confusing and appears to be incorrect The relationships between stated coal consumption and ash production are not apparent and there appear to be major discrepencies in the stated assumptions concerning coal consumption ash content etc and the actual values stated for ash production The whole section should be thoroughly reviewed and where necessary corrected (Pages II 53 II 59-61)

D The Water Quality Control Division is concerned about the entirely inadequate discussion of the effects on groundwater quality of the Rawhide powerplant operations A number of undocumented assertions are made and many important issues are ignored Given the information provided in the draft EIS no meaningful determination of the implications of the Rawhide facility for ound water quality can be made The entire assessment of groundwater impacts of the Rawhide project needs to be thoroughly refined and expanded

Stephen M Kelsey Program Administrator
Office of Health Protection

SMK ja

cc Frank Traylor M D
Warner Reesor Office of Health Protection
Micki Barnes Office of Health Protection
Ken Webb Water Quality Control Division
Jim Martin Radiation & Hazardous Materials Control Div
Orville Stoddard Radiation & Hazardous Materials Control Div
Dave Ross Air Quality Control Division
Dan Donohoue Air Quality Control Division
John Sternberg Air Quality Control Division

STATE OF COLORADO

COLORADO DEPARTMENT OF AGRICULTURE

MEMORANDUM

TO STATE CLEARINGHOUSE

FROM JIM RUBINGH COLORADO DEPARTMENT OF AGRICULTURE

SUBJECT PRELIMINARY COMMENTS ON COLORADO BIG THOMPSON DRAFT ENVIRONMENTAL IMPACT STATEMENT

In general it appears that there will be a net positive impact to agriculture within the state as a result of this project This is because Front Range communities will have a supply of water for their anticipated growth without having to condemn and purchase agricultural water rights This will result in 13 000 to 15 000 acres of irrigated cropland which will not be lost as a result of water condemnation procedures

There are however some comments which need to be made

1 In the summary and Table IV 6 it states that this action will increase salinity at the Imperial Dam by 0 5 percent Page VI 4 however states that it will be increased by 3 0 percent This discrepancy should be resolved Furthermore the consequences to agricultural production of this increase in salinity should be analyzed

In the Alternatives Chapter alternative C(2) Conversion of Agricultural Water Rights is listed as the most viable alternative What is not explained in any way however are the economic environmental and social cultural consequences of such action should be discussed in greater detail as is possible

Department of Local Affairs
Colorado Division of Planning

MEMORANDUM

TO Lead Agencies

FROM Philip H Schmuck Director

SUBJECT Draft Environmental Statement
Colorado Big Thompson/Windy Gap Project

DATE July 27 1979

The Division of Planning has reviewed the above referenced Environmental Statement resulting in the following findings

1 The Statement is inadequate in its coverage of water quality problems The issue of eutrophication of the Three Lakes is inadequately discussed on page IV 14 The concern is greater than the Granby Wastewater Treatment Facility All upstream facilities including the Upper Fraser facilities would contribute phospherous and nitrates through the stream which would not break down prior to reaching the Windy Gap Reservoir The final Environmental Statement should evaluate (1) all discharges into the Fraser or Colorado rivers above the Windy Gap reservoir (2) the percentages of natural nutrients in the streams and the percentages of discharged nutrients (3) the amount of the total stream nutrients likely to be diverted into the Three Lakes and (4) it should establish mitigation for eutrophication such mitigation being the responsibility of the Windy Gap Project developers

2 The Windy Gap Project will not cause any significant amount of population growth other than the relatively modest construction forces However by increasing the water available to five Eastern Slope communities it will help to determine where growth is accomodated with the primary impact being on the cities of Estes Park Loveland Longmont Greeley and Boulder Growth accomodation in those municipalities is generally consistent with the Human Settlement Policies adopted by this Division and the Department of Local Affairs The growth impacts of the construction force required for the Rawhide Power Plant are large enough to be a socioeconomic problem if not adequately accomodated They would likely overburden the Town of Wellington but should be able to be absorbed by the city of Fort Collins Because of location many of the construction workers would likely commute from front range municipalities rather than relocate to the area of the power plant

520 S Colorado Blvd 1313 Sherman St Denver Colorado 80203 (303) 892 2351

All of the communities to receive water from the Windy Gap Project have adopted a comprehensive plan and have ongoing planning and land use regulation program to guide development Generally those plans provide for compact contiguous development and seek to discourage sprawl and leapfrog development However it should be noted that the City of Boulder has committed to providing water service to some areas that are not considered consistent with desirable land use patterns In view of the Boulder County plan it appears that those developments will be limited to ones already approved and should not create an ongoing problem The City of Greeley has shown unusually good coordination and cooperation with Weld County in seeking to avoid sprawl forces The City of Longmont has not shown similar restraints to sprawl and has recently acted to extend its services north of State Highway 66 Although the City of Fort Collins is currently developing an updated comprehensive plan and has shown sensitivity to issues of compact development patterns its lack of coordination and cooperation with and from Larimer County has resulted in undesirable sprawl to the south and continuing annexations of undeveloped land although forty percent of the municipality remains undeveloped at the present time We would support restraints on land use patterns as a condition of providing the water service proposed from Windy Gap

4 On page IV 37 of the Environmental Statement it is stated that the primary goals and objectives of each city s Comprehensive Plan are summarized in Chapter III together with the activities that will be necessary for their realization We have not been able to find those goals and objectives in Chapter III

5 There appears to be some unresolved questions concerning fluctuations of the water line in the Three Lakes It seems to be the view of local recreation operators in the area that one foot of fluctuation in the water level is not compatible with sound recreation management While we have no expertise in the field of recreation it should be pointed out that recreation is the essential economic base of the Three Lakes area and any change that is detrimental to recreation will have a significant impact on that Grand County community We would strongly encourage that the Bureau of Reclamation mitigate any adverse effect on the recreation in the Three Lakes

Thank you for the opportunity to review this matter

PHS/pgh

STATE OF COLORADO
[illegible]
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE
[illegible]
6060 Broadway
Denver Colorado 80216 (825 1192)

July 24 1979

TO Margie Kaminsky
Colorado Clearinghouse

FROM Chuck Graham Prentiss Senior Wildlife Biologist

SUBJECT Windy Gap EIS #79 127

We have conducted a preliminary review of the Windy Gap DES (#79 127) and have found it to be inadequate in several areas

Under the new Fish and Wildlife Coordination Act a habitat based evaluation must be conducted on all proposed water projects This is to include all project alternatives Although these new Coordination Act regulations do not apply specifically to Windy Gap a habitat based evaluation is still necessary

Outlined below are but a few areas of concern which we feel are in need of further evaluation

1 What fish species are present in the Colorado River Willow Creek and Fraser River? What are their relative populations

2 To what degree and how will Brown and Rainbow Trout spawning runs in the Colorado River and Willow Creek be impacted

3 How will water temperature and flow regimes be affected down stream of Windy Gap How will changes in temperature and flow affect fish growth spawning and population dynamics? What will be the effect on invertebrate production

4 How will aquatic plant growth be affected by changes in water temperature and flow?

DEPARTMENT OF NATURAL RESOURCES Hen Sherman Executive Director WILDLIFE COMMISSION Mrs Th Gibbes Chairman
Mrs Ib Reddy Vice Chairman Sam Caudill Secretary J K T Mumby Vice Chairman Wilson Mumby
James Smith Mumby Don Feder Mumby Richard O Ibbs Mumbe

5 To what degree will heavy metal concentrations increase phosphates salinity and nitrogenous compounds? How will they then affect local fisheries

6 To what degree will dissolved oxygen decrease

7 Will minimum stream flow requirements be met downstream?

8 How will deer and elk migration patterns be disrupted

9 How many acres of wetlands will be inundated?

10 What affect will increased human activity and growth have on present wildlife habitats?

11 To what degree will non point pollution and siltation have on fish and invertebrate productivity in Lake Granby?

12 How will bird migration activities be disrupted by proposed power lines

13 What changes in vegetative patterns will occur when a massive layer of impenetrable material (fly ash) will be stored at the Rawhide plant? What will happen to wildlife populations

14 To what degree will water levels in Windy Gap fluctuate? How will this affect Windy Gap as a potential fishery?

In summary we feel that further analysis of all habitats and the potential impacts upon those habitats and associated wildlife is in order

In addition measures to mitigate those impacts must be addressed Only by addressing necessary mitigative measures can the true value of the project be evaluated

CGP jb
cc

STATE OF COLORADO
[illegible]
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE
[illegible]
6060 Broadway
Denver Colorado 80216 (825 1192)

August 14 1979

TO Steve Norris
Colorado Clearinghouse

FROM C J Graham Prentiss [illegible] 1979
Senior Wildlife Biologist

SUBJECT Windy Gap EIS #79 127

As a result of the several public meetings sponsored by the BOR on Windy Gap we would like to take this opportunity to reiterate our position on the Windy Gap DES

As we have indicated previously we feel that a habitat based evaluation of the Windy Gap project is necessary An analysis and quantification of the impacts of Windy Gap upon those habitats should be addressed We are quite concerned about the possible losses in fish spawning habitat impacts upon fish migration decreased scouring of spawning habitats due to reduced spring flows maintenance of minimum stream flows downstream of Windy Gap increased water temperatures and build up of aquatic vegetation increased salinity and nutrient concentrations and impacts upon our wetlands dispersal and commitment and associated terrestrial wildlife species

In addition we are vitally interested in the possible impacts upon Granby Reservoir What effect will continuous pumping of Windy Gap have upon the stratification of Lake Granby Will the increased silt load and nutrient buildup in Lake Granby have a negative impact upon the fishery If so a tremendous economic and environmental loss could occur

Wildlife has only been given token attention by the Rawhide project In some cases gross misrepresentation of the data was submitted For example on page IV 21a it is stated that habitat for 5 antelope will be lost When you consider that it is 5 antelope per year that will be impacted then you realize that substantial environmental and economic benefits are lost

DEPARTMENT OF NATURAL RESOURCES Hen Sherman Executive Director WILDLIFE COMMISSION Mrs Th Gibbes Chairman
Mrs Ib Reddy Vice Chairman Sam Caudill Secretary J K T Mumby Vice Chairman Wilson Mumby
James Smith Mumby Don Feder Member Richard O Ibbs Mumb

...or ...s
August 14 1979
Pag 2

It is suggest d that the cooling plant at the Rawhide plant will have c rtain ildlife alu s We feel this needs to be explored more fully For example what will be the water temperatu e in he cooling pond Will nut ent and contam nent concentrations increase with e aporation Is this pond n fact su table for wildlife uses We are skeptical of this

No mit gat on measu es have bee addr ssed for either Windy Gap or Rawhid P oject This by ecessity needs to be considered

Also plea e f nd attached list of rema k speeific to the Windy Gap DES

CGP jb
cc Dan Law
Steve Kelsey
Dave Clippinge
Jerry Claassen
NW Region
NE Region
file

S T CF DC
C E I TOR N TURAL R CLE ES
DIVISION OF WILDLIFE
J R C
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JUL 1 1979
F D H

August 14 1979

DOW Comm nts
Windy Gap Project

1 Inc ase in Salin ty
Under summary it states the project w ll cre se the al ty level by one half of one percent at Imperial D m Page VI 4 b l last par states the increase will be two to three percent at Lee s Ferry and Imperial Dam pect vely Ne ther statem t is indicative as the present salinity l vel s not stated List ng salinity ncreases in terms of mg/l or ppm would be more definitive

2 T & E Spec es page III 31
There s a misquote it is a praire falcon not a peregri e nest on Kinney Creek There is also a misspell ng it should read Jerry Claassen not Jay Clausen

3 Stream Flo s IV 15
If flows should be reduced by additional divers ons to 33 cfs below Hot Sulphur Springs both the fishery and the habitat wo ld be damaged

4 Impacts page IV 20
There can also be mpacts on terr strial as well as aquat c wildlife species Roads if not losed could open the area to use by recreation l4 wheel drivel veh cles and sno mob les Harassment of wildlife by snowmobiles duri g the itical inter months should not be permitted There is also some deer and elk mortality in the Granby and Willow Creek canals The st te ment lists only the Charles Hansen Canal

5 Stream F sh r e IV 23
Stream f sheries should experience no impacts due to continu d p oject operation Th s statement is questionab e as the bro n trout spawning runs from the Colorado Ri er up W llow Creek ill probably be impaired The Colorado Rive do nstream i she v may also be adve sely mpacted Fu the discussion of possible impacts is ncluded on page VI 5

DEPART ENT OF NATURAL RESOURCES H Sh m E ecutive Dir ecto WILDLIFE COMMISSION M hael H gbe Ch m
W bur Redd V Ch ma Sam C ud S Sec y J K T el M mbe V no C V ll m mbe
mme Am mber Donald ud Membe R d Dru lb Memb

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6 F sh rm an Le page III 42
Use at the reser oir s te is limited but the downstream use is quite heavy Reproduction and food production may be more important than fisherman use

BE SI D
C D
RED R C f
JO FETC IR
C PUR E U
LO O L GETZ
R C GORMLE
ROBERT A C SON
O V D LE SDORF
ERBERT VANDEMOER

E SP S
D D
Da D

R C RDC L MM

DEPARTMENT OF NATURAL RESOURCES
COLORADO WATER CONSERVATION BOARD
823 STATE CENTENNIAL BUILDING
1313 SHERMAN STREET
DENVER COLORADO 80203

TELEP ONE
303 839 3441

August 30 1979

M E M O R A N D U M

TO Steve Ellis
Colorado Clearinghouse

FROM Daniel L Law
Water Resource Specialist

SUBJECT Comments on the Colorado-Big Thompson/ Windy Gap Project EIS #79 127

The discharge for the probable maximum flood was given as 63-000 cubic feet per second and the flood elevation at the reservoir was given as 7 835 feet A map showing the floodplain with and without the project would be extremely helpful in evaluating the diversion dam s effects on upstream and downstream water levels

Another concern which needs discussion is the impact of floodflows on properties below the spillway particularly at full discharge

DLL/pm

STATE OF COLORADO

COLORADO GEOLOGICAL SURVEY
DEPARTMENT OF NATURAL RESOURCES

July 20 1979

Colorado Division of Planning
Attn Mr Steve Ellis
1313 Sherman St Room 520
Denver CO 80203

Dear Mr Ellis PE EIS #79 127 COLORADO BIG THOMPSON/ WINDY GAP PROJECTS

We have reviewed the Draft Environmental Statement for the proposed Colorado Big Thompson/Windy Gap projects The following comments focus upon the Windy Gap project specifically the proposed construction of the dive sion dam pumping plant and 5 mile conduit to Granby Reservoir

The description of the geology in the area on pages III 5 to III 8 is adequate for general purposes of the rock types structures and landforms throughout the C BT project area Although we do not feel that additional more detailed geologic information is needed for those existing portions of the C BT project such information is needed for the Windy Gap project The Environmental Statement includes some basic information regarding the types of geologic materials in the area (p III 6) but there is no discussion of the engineering properties of these materials nor of their effect upon the construction and operation of the proposed Windy Gap project In addition a current geologic map of the Windy Gap project area should be included in the Final Environmental Statement The proposed locations of the dam and pumping plant and the alignment of the conduit should be clearly delineated on this map

With regard to seismic activity in Colorado the Statement indicates that the maximum intensity recorded from 1870 to 1973 was 4 on the Modified Mercalli Scale (p III 8) However recent studies by our office indicate that intensities of VII have been recorded which would place Colorado in Zone 2 on the Seismic Zone Map of the U S (p III 10) We recommend that the Bureau of Reclamation consult with members of our staff to discuss the available information regarding recent and possible future seismic activity in the Windy Gap area

GEOLOGIST
SO OF E S KE OTE E

Colorado Division of Planning
July 20 1979
Page 2

Existing landslides in the Windy Gap area are also briefly discussed on page III 9 A discussion as to whether these slides are active or inactive should be added as well as an evaluation of their effect upon the proposed project Other slopes in the area especially along the proposed conduit route should be evaluated with regard to the potential for initiation of landslide activity during and following construction

The discussion of economic geology on page III 9 fails to make specific mention of sand and gravel deposits in the proposed reservoir area The presence of 25 feet of river gravel deposits is mentioned on page III 6 and should be included in the section on economic geology

Chapter IV Environmental Impacts (Physiography and Geology pages IV 2 to IV 3) should include discussion of the landslides mentioned on page III 9 as well as a section on economic geology and the loss of sand and gravel in the reservoir area in particular Where mitigation of adverse geologic features or conditions is necessary a discussion of such measures should be included in Chapter V Mitigation Measures and Air and Water Quality Aspects The recommended additions noted above may also necessitate additions to Chapter VI Unavoidable Adverse Impacts

In general we do not foresee any engineering problems or geologic hazards in the Windy Gap project area that can not be adequately mitigated However we do feel that the above recommendations will result in a more complete analysis of the geology and mineral resources in the area If we can be of further assistance at this time please contact our office

Sincerely
James H Price
Engineering Geologist

JHP/ba

COLORADO STATE DEPARTMENT OF HIGHWAYS

July 19 79

Mr Phillip S
Director
Colorado Department of Highways
State Office Building
131 South Street
Denver Colorado 80203

Dear Mr Shoemaker

The Colorado Department of Highways has completed its Draft Environmental Impact Statement for the Windy Gap pumping plant and 5 mile conduit to Granby Reservoir The following comments are offered

The proposed location of the Windy Gap pumping plant and 5 mile conduit to Granby Reservoir will require relocation of US 40 and SH 125 where they cross the proposed conduit route Both highways are important transportation routes in Grand County and the relocations should be designed to meet current standards for safety and capacity

Consideration should be given to the impact of increased traffic volumes on the highway system in the vicinity of the Windy Gap project during construction Particular attention should be given to the effect of construction traffic on the intersection of US 40 and SH 125 in Granby

The Department of Highways District IV office has been contacted by Mr Lloyd Gesell of your staff concerning the proposed conduit crossing of US 40 and SH 125 in Granby

Your cooperation in allowing the Department of Highways the opportunity to review the Draft Environmental Impact Statement is appreciated

Sincerely
Jack Kultgen
Executive Director

By
Harry R Welsh
Director
Division of Transportation Planning

RG
Attachment

4201 EAST ARKANSAS AVENUE DENVER CO 80222 (303) 757-9525

STATE DEPARTMENT OF HIGHWAYS

July 19 79

DOH FILE # 1160

Lloyd Gesell
4 8 1 Centennial Building
4201 South Santa Fe
Fort Collins CO 80521

cc Lloyd

Enclosed are copies of current plans for the Buckeye Interchange as requested by you and Mr Schoemaker at the meeting of April 26 1979 with the County and Platte River Representatives The plans include a Layout Plan of the Interchange and three plan and profile sheets which include the plan and profile for Brockye Road westerly to the C & S Railroad

As discussed with you and Mr Schoemaker at the Interchange site area we request the following be done with the Interchange area

1 Flatten slopes in the areas of the Interchange indicated by A B and C in red on the accompanying plan

2 Delay the Cross Road through the Interchange with 2 inches of Hot Bituminous Pavement Length of area to be paved is approximately 850 feet and width is 30 feet

After these items are accomplished we feel the geometrics are adequate for the volumes projected during construction of the plant which has a height of about 100 feet for storage before backing traffic back to the Interstate main lanes Also there are 100 foot shoulders on the Interstate through these cloverleafs for shoulder widths should be necessary There should be adequate sight distance at the proposed crossroad left turn movements These left turn movements after a stop should be safe and adequate with the proposed sight distance resulting from the curves and slope flattening

We appreciate being informed of the plans for the Rawhide Plant and its effect on the Buckeye Interchange Should you feel at any time that we could attend your period meetings or should any other information become available please let us know

DIGHAM BOWER
DISTRICT ENGINEER

RLF sw
Encls
cc D M Bower
William Campbell Colorado Energy Research Institute
D Fraser Mills
FILE Peters Sims

Ralph L Florence
District Geological Engineer

stream channel and would afford some degree of protection to the Windy Gap Ranch improvements located immediately downstream of the diversion dam near the right abutment It is anticipated that these same flows would once again fill the entire valley flood channel a short distance downstream It is highly probable that flood flows of this magnitude would entirely bypass the Windy Gap Diversion Dam as an upstream control in the form of a railroad bridge would probably divert the majority of the water to the south of the railroad embankment until it reached a point somewhat downstream of the Windy Gap Project where the waters would overflow the railroad and return to the original channel However the Windy Gap Project and Diversion Dam has been designed to handle the entire probable maximum flood if it were to pass through the railroad constriction and enter the diversion reservoir In summary at the probable maximum flood it is doubtful that the concentrating effect of the Windy Gap Spillway on the flows for the short distance downstream of the diversion dam would have any negative effect on property downstream At the flows involved with the probable maximum flood, it is anticipated that the entire area between the railroad embankment on the south and Highway 40 on the north through the Windy Gap area would be inundated

Letter from the Colorado Geological Survey dated July 20 1979

1 Comment Regarding general geologic description and specific detailed geologic description of the Windy Gap Project

Response Under present CEQ guidelines voluminous detail concerning the physical aspects of a project are not appropriate A detailed description and detailed analysis of the geologic structures and materials underlying the Windy Gap Project are presented in Dames and Moore (1978) and IECO A geologic map of the Windy Gap Project area is available for review at the District s office in Loveland

2 Comment Regarding seismic activity in Colorado

Response This comment has been noted and an analysis has been made as to the effect of the reported information on the design and adequacy of the Windy Gap Project

3 Comment Concerning landslides in the Windy Gap area

Response Specific details and design information regarding geologic phenomena such as landslides have been included in the design of the Windy Gap Project and these calculations and analyses are available from International Engineering Company It is not felt that such information is relevant to the environmental impact statement as it is engineering and geologic information used in the design of the project Incipient landslides along Highway 40 adjacent to the proposed Windy Gap Reservoir will be stabilized by fill material placed along Highway 40 The use of the area along Highway 40 for spoil material disposal should assist in the protection of Highway 40 from these landslides

4 Comment Discussion of economic geology

Response Details of economic geology are presented in IECO (1976)

5 Comment Concerning organization of geologic information in the environmental impact statement

Response The final environmental impact statement has been reorganized in an attempt to cover all relevant environmental impacts of the project including those concerning geology

Letter from Colorado State Department of Highways dated August 3 1979

1 Comment Concerning the realinement of U S Highway 40 and State Highway 125 near the Windy Gap Project

Response Close coordination of the design of the temporary relocation of Highway 40 and the permanent relocation of State Highway 125 has been made with the Craig office of the State Department of Highways Detailed plans have been submitted to that office for the necessary permits for realinement

2 Comment Concerning the scheduling and routing of construction traffic

Response Efforts will be made to minimize the interference of construction traffic with traffic on U S and State highways However any routing or scheduling of construction equipment or trucks across or along public roads and highways will be coordinated closely with the State Department of Highways and the Grand County Road Department

3 Comment Regarding the involvement of the Rawhide Project with State Department of Highway jurisdiction

Response All coordination and scheduling and permits involved in the Rawhide Project will be obtained by the Platte River Power Authority

Letter from Division of Water Resources dated August 8 1979

1 Comment Regarding the general impacts of the Windy Gap Project

Response None required

Letter from the Colorado Division of Local Governments dated July 23 1979

1 Comment Regarding overall impacts of the Windy Gap Project on the Grand County area and recommendation that local officials be included in the Windy Gap developmental process

Response The impacts mentioned are in agreement with those anticipated by the Subdistrict in its environmental assessment report See Dames and Moore (1978) and the final environmental statement Close coordination with Grand County has culminated in an agreement between the Subdistrict and Western Slope interests including Grand County and the Northwest Colorado Council of Governments (Attachment 1)

Letter from the Colorado Historical Society dated June 20 1979

1 Comment Regarding adequacy of treatment of cultural and archeological resources

Response None required

BOARD OF COUNTY COMMISSIONERS

Richard B rt

COUNTY OF JACKSON

WALDEN COLORADO 80480

J ly 30 1979

FILE COPY

AUG 1 1979

Mr Joe D Hall
Regi nal Director
U S Bure of Reclamati n
Lower Missouri River Basin
Post Office Box 25247
Denver Fed ral Center
Denve Colorado 80225

Dear Mr Hall

Pl se find attached the comments of the B ard of County Commissioners of Jackson County C l ado regarding th draft environmental tatement for the Windy G p Project iss ed J na 18 1979 by the U S B reau of Reclamation

Since ly

THE BOARD OF COUNTY COMMISSIONERS
JACKSON COUNTY COLORADO

By Howard W Hampton
Howard W Hampton Tempo y Chairman

BCC/dsc

xc file copy

CEQ

MEMORANDUM

TO U S Bu f Re lmma ion Region 1 Offi

FROM B d f C unty Comm(sion f J k on Co ty C l d

RE C mme t Wi dy G p P j D ft Ea i onme 1 St me t

DATE J ly 30 1979

Th f llowi g comme bmitt d i po t h D ft kn i onme t l St m t (ES) p p d f h Wi dy Gap P j t i d by th U S B f Re l ma i ! 18 1979

A RAWHIDE POWER PLANT

Th R whid p w pl i i l d d i th ES as th gy de l pma t asp f h Wi dy G p P j W ld ubmit th t th R whid p j t it if ti m j f d l ti q l i g th p p ti f ind p d t i me l me At mi i m he p ES i l g lly in ffi i t f it f il t id di us y m t mitig t th d se iro me t l imp f h R whid p j t Th f il di mitig ti me f th Ra hid pl i p f r mmpl f th b f t t lli g iron n t ! t t me t f th Rawhid p j t wo ld l ly b l g lly ins ffi i t ith t h di i d th pre t ES i i d q t f th ame F th bj cti i i d l ti t th f t th t th ES assume on l R with i l t i l d ma d f 10% Th fig i un li ti lly high as it wo ld q i h Pl tt Ri Pow A th ity d bl it g ti g p ity rv phy i l impo ibility Re me t would ppe t b i rd Al i p idi g w g ti g p ity d q t ly dd d ith d h d f h p j t h l i i d i t d q t ly justifi d

B ALTERNATIVES

Th lv i f it rn i t th Wi dy Gap P j is t t lly i dequat P i l lv di i g i th f th t th ti lt i w me- n il di i d h l3 li d t d t h t lt rmati i th ES (IX 2) ___ not p ibly tit t g d f ith ff t t mplv with th law Equally bj ction abl i h f t th t me i gf i id ti h b gi t th b ad ang f l rn ti il bl t th 6 Ci y rvi h as i g w t ns l me i l di g t t p mo ium S h i bl d i mme t lly p f bl lt nati g i lt l we t t ll di us d nd d rv f l id ti i h fi l t me t I n i i ubmitt d th t g t d l mo tt ti will h t b f u d on h i ue f lr rmati e if th final t me t i mpo wi h th l tt d pi it f h l w

C MITIGATING MEASURES

B i ni g t lisht th t p whi h h t k mitig t h d i me t l imp t f p j t i f th mo t impo t fun ti f an i t l t t me l th e f Wi dy Gap th p j t will h two i us i nme l i p r flow d pl ti i th C l do Ri nd i d l i ity I dibly me t t i th ES t mitig t th imp t Ch pt 5 t i i g ly t l p g f di us io th i f mitigati is th we k t p i f h ES l i bmitt d th t g t d l mo mphasi must b pl d i itig ti g me i th fi l t t me t i d t tisfy th re q i me t f NEPA

U S Bu f Re lmati Region 1 Offi
Pg 2

D ENVIRONMENTAL IMPACTS

Th ES f ile t d q t ly naly th wi nme t l q f d pl ti g th flow f th ppe Col ad Ri by 48 900 e-f p y 31% f th flow t H t S lph Sp i g Th ly i f th que f i d li i y i th C l d Ri i i il ly h llow and t p ibly p id h b i f well d dmi i t i d i i i g h p j t l i bmitt d th t p g ammati i nme t i t t me t i q i d t d t i h mal ti ff t f B f R lamati p j t p d pl ti d li ity i th Col d Ri Sy t m b f fi i d i i b mad It i l b itt d h un pp t d we pi g l i h th th t N ignifi an d imp t on th i ti ip t d f om p i f th Wi dy G p P j d t b pp t d by f l d ume t ti f th y wh lly i d q (vl 3)

E MINIMUM STREAM FLOWS

Ths ES ont i b l t ly j ifi ti f th 75 f byp flow fig nme d d f m th Wi dy G p Dam (IV 5) Th i bj ti ly i whi h w ld ns both h c y d th d q y f h 75 f fig whi h i ome d d Thi flaw i ompou d d by th f t th t t l f 42 f f t ight d d f th i immedi t ly b low h dam h by ti g th po- te ti l f d i g th t am flow t 33 f As s ume b gi b d pon t t f th rt ly is th t th b p flows will be d quat t th p eservati f the q ti iromme t w ll as ll th th ti tio l and wild rn l s as i t d with th i d t ams ff t d

F SILTATION

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G WATER QUALITY

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H LEGAL AUTHORITY FOR COMMENTS

Th s comme t bmitt d t h B f Re l mati p r ua t t §102(2) ( ) f th N ti l En i nme t l P li y Act 42 U S C §4332 CEQ Regul i f im- pleme ti g NEPA 40 C F R P t 1500-1508 nd Dep me f l t i d B f Re lamati g id li th p p ti f i me t l imp t me Dep me t f I t i Ma 1P t 516 Ch pt 2 and 8 f R lama i I at i P t 376 Ch pt 5 11 f wi h id rn f th ight nd i ter t f l l g rnme t i en i g the p d l i t g ity d i g th b t i ight

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p id d f by th N i l En i me t l P li y Act

R p tf lly bmitt d

THE BOARD OF COUNTY COMMISSIONERS
JACKSON COUNTY COLORADO

By Howard W Hampton
How d W Hamp ton ry Ch irman

BCC/d

CEQ

fil py

RC RDDL M
Gove nor

W Mat T
Acting Se Engineer

DIVISION OF WATER RESOURCES

Department
1 1 Sher m S eets
De C o as 80203
Ad nistrat on 303) 839-3581
G ne Water 303) 839-3587

Augu t 8 1979

I EMORANDUM

TO STEPHEN O EL IS STATE CLEARINGHOUSE

ROM DR JERIS A DANIELSON DEPUTY STATE ENGINEER

BJECT COLORADO BIG THOMPSON/WINDY GAP PROJECTS EIS #79 127

his is to acknowledge eceipt of your request for review of the above referenced port It wo ld appear the Platte Rive Power Authority (PRPA) has sufficient ater to meet its needs in the f ture even without the Windy Gap project since the agreement between PRPA a d Fort Collins allows PRPA to purchase the econdarily treated sewage effluent from Fort Collins if Windy Gap is not con tructed

I addition the water from the project will enable the five cities in olved to meet growth needs through the year 2000 without having to acquire agricultural ater rights along the Front Range of northeastern Colorado

We have o objections to the p oject as long as existing water rights are not i jured during its co struction and it is operated in accordance with the criteria set forth in the Environmental Impact Statement

Jeris A Danielson

JAD/RLS mvf

Colorado Division of Local Government

R dD t Co

C ev e Le gt le gh Director

MEMORANDUM

TO Depar ment of Natural Resources

FROM Di ision of Local Government

SUBJECT Colorado Big Thompson Windy Gap Projects EIS #79 127

DATE July 23 1979

There appears to be th ee levels of impact that communities ill e perie ce as a result of the projects

First impact from construction on communities in the immediate a ea com nit es most directly effected will be Granby hot Sulphur Sprin s and K erriing c the est end and Wellington on the east Because of the size of these comm.nit es the influx of aven a hundred constructio orkers could lead to a boom and ust cycle if financial and technical assistance is not pro ided to help them prepare for the construction per od

A second level of construction impact will be experienced by the commun ies of Grand Lake Tabernash Fraser and Winter Park on the west end Because of distance and competition from e isting rapid g owth occurring as a result of recreation development we would expect few wo kers to locate in this part of the Fraser Valley But the Windy Gap project will contribute to the overall economic activity of the area and therefore exacerbate the problems of rapid change hich they are experiencing Because of the larger population in Fort Collins a d Larimer County the impacts should not be as great but will contribute by a degree to their current rate of development

The third level of impact ill result from the permanent ork fo ce needed o operate the project These numbers are small in relation to both the construc ion force and the resident populations of the areas and ould not appear to create a problem for the communities

In both Grand and Larimer Counties additional planning and ma agement capacity will be required to address this and other concurrent deve'opments in the impacted areas Local officials should be included early on in the planning a d de elop ent process and contacts maintained to communicate any cha ges in the timing phasing work force etc

I pacted areas should e plo e some type of payment i lieu of taxes ith t e Po e A tho ity to a d them in m t gati g the impacts of this de elopment

1313 Sher m S t Room 523 De C l d 80203 (303) 839 2156

COLORADO HISTORICAL SOCIETY

Th Colo d H tag C t 1300 B dw Den e Colo do 80203

June 28 1979

Stephen O Ellis
Principal Planner
Department of Local Affairs
Colorado Division of Planning
520 Centennial Building
Denver Colorado 80203

Dear Mr Ellis

This is to acknowledge receipt of the Draft Environmental Statement on Colorado Big Thompson/Windy Gap Projects Colorado Lower Missouri Region Bureau of Reclamation

We find Cultural Resources have been adequately considered and meet the goals and objectives of the National Historic Preservation Act et alia and those of this Office If the BOR adheres to the management procedures outlined in the document for Cultural Resources

Thank you for the opportunity to comment on the proposed project

If this Office can be of further assistance please do not hesitate to call upon ES Reviewer Betty LeFree (Office of the State Archaeologist) at 839 3391

Sincerely

Arthur C Townsend
State Historic Preservation Officer

cc Dr Bruce Rippeteau State Archaeologist
Mr James Hartmann Coordinator Historic Preservation
Dr Ward Weakley BOR

Memorandum

To Files

Subject Response to September 20 1979 Comment Letter from the Colorado Department of Natural Resources and the Colorado Department of Health on Colo ado Big Thompson/Wi dy Gap Projects Final Envi onmental Statement

Incl ded in this comment letter are the joint comments from

Department of Natural Resources (Division of Water Resou ces Division of Wildlife and Water Conservation Board) Department of Health Department of Agriculture Department of Local Affairs (Division of Planning and Di sio of Local Government) and the State Historic Preservation Officer (See Chapter V Cons ltation and Coordination for a list of State permits a d approvals)

Letter from Colorado Department of Natural Resources and Colorado Department of Health dated Octobe 5 1979

1 Comment The DES is insufficient in several areas and lacks adequate organization including excessive treatment to the existing Colorado Big Thompson Project with a lack of adequate treatment for the Windy Gap Project and the Rawhide Project

Response The FES has been revised to address in more detail the specific impacts and mitigation measures in olving the Windy Gap Project The discussion of the C BT has been deemphasized The FES addresses in its entirety the recent agreement between the Subdistrict Northern Colorado Wate Conservancy District and various Western Slope interests (Attachment I) In this agreement the Subdistrict agrees to various mitigation measures which should substantially alleviate the undesirable impacts of the Windy Gap Project The treatment of the Rawhide Project however is confined to the scope of treatment given all other pa ticipants who will rece e ate from the Windy Gap Project (see Chapter I)

2 Comment The water quality implications of the Windy Gap Project were not co ered in sufficient detail

Response A mo e comprehensi e treatment of wate quality implications of the Windy Gap Project has been i cluded in the FES Detailed references are cited

3 Comment Concerning the habitat evaluation of the fishe ies and minimum streamflows below the di ersion dam

Response Since issuance of the DES additional studies (E ickson 1980) have been done on the aquatic habitat below the Windy Gap di ersion site including extensive work ith the Di ision of Wildlife in the determinatio of adequate st eam flows in the i e

below to maintain viable fishery In this regard the Subdistrict has agreed to honor minimum stream flows as determined by the Division of Wildlife in the amount of 90 ft^3/s below the Windy Gap diversion to the mouth of the Williams Fork River 135 ft^3/s from the Williams Fork River to the mouth of Troublesome Creek and 150 ft^3/s from the mouth of Troublesome Creek to Blue River (Attachment 2) These flows have been agreed on by the Division of Wildlife and the Subdistrict and have been filed for under the aporopriation system of the State of Colorado by the Colorado Water Conservation Board (Intergovernmental Agreement paragraph 24)

4 Comment Various concerns associated with the Windy Gap Project

Response Landslides and seismic activity air quality during construction and traffic during construction are covered under the specific comments by various state agencies

5 Comment Concerning the Rawhide Powerplant and the adequacy of the DES in the coverage of this project

Response The Rawhide Project is being constructed by the Platte River Power Authority and is not dependent on Federal actions The Rawhide Project is being constructed without the Windy Gap Project Treatment of the Rawhide Powerplant in the FES is at a level of detail similar to that given all other participants in the Windy Gap Project because it may be receiving water to cool future units Detailed environmental impacts have been discussed in PRPA (1978) All necessary State and local permits have been issued and the project is under construction

6 Comment Concern with growth control

Response Responses with regard to growth control and development on the Front Range area are included with the specific comments of the Division of Planning and Division of Local Government

Memorandum from Colorado State Department of Health dated August 17 1979

1 Comment General Regarding the inadequacy of the information presented with regard to the Windy Gap Project and its effect on water quality

Response See Response No 2 to Department of Natural Resources letter

2 Comment Regarding trophic studies of nutrient loadings in Three Lakes

Response See Response No 2 to Department of Natural Resources letter A more detailed study has also been provided to your office

3 Comment Regarding point source discharges

Response The Windy Gap Project it elf will not involve point source discharges during construction operation or maintenance of the project

Impacts on point source discharges downstream from the diversion have been mitigated thorugh provisions of the Intergovernmental Agreement (Attachment 1 paragraph V)

4 Comment Regarding adverse effects caused by downstream sedimentation due to the construction of the proposed dam

Response Sedimentation below the dam will be minimized For details of the plan for the control of sedimentation see the Windy Gap construction specifications and drawings In addition the impact of sedimentation on aquatic habitat is discussed in Erickson (1980) and Chapter IV C Aquatic Biota Furthermore the construction will have to be undertaken in accordance with a Corps of Engineers 404 Permit and its supporting Water Quality Certification to be issued by your agency

5 Comment Regarding alternatives

Response The alternative chosen for the Windy Gap Project was selected after extensive engineering and environmental investigations (see Chapter II FES) This selection process involved the use of environmental and engineering consultants For detailed summaries of the results of those studies see Chapter IV of the FES

6 Comment Concerning discrepancies in the salinity impacts of the project

Response The discrepancies were typographical errors These errors have been corrected in the FES

7 Comment Regarding trophic effects of the diversion project

Response See Response No 2 to the Department of Natural Resources letter

8 Comment Regarding fugitive air quality particulate emissions during construction of the Windy Gap Project

Response Dust control measures will be taken during the construction of the project to minimize fugitive particulate emissions These control measures are detailed in the construction contract specifications Open burning will probably not be utilized to dispose of brush or slash material However in the event that the contractor on the project does use this method of disposal he will be required to obtain the necessary air quality permits prior to burning and will conduct his operations in a manner which will comply with State regulations

9 Comment Rawhide Powerplant Project

Response See Response No 1 to the Department of Natural Resources letter

Letter from the Colorado Department of Agriculture dated July 30 1979

1 Comment Regarding salinity on the Colorado River

Response See Response No 2 to the Department of Natural Resources letter

2 Comment Requesting detailed explanation of the conversion of agricultural water rights

Response The conversion of agricultural water rights to alternate uses such as municipal and industrial involves a complex set of interconnected actions and reactions from an economic environmental and socio cultural sense Any treatment of the effects of such conversions must of necessity be quite subjective However it can be surmised that continued conversion of agricultural water rights on lands would result in shifting the base of the economy of northeastern Colorado from that of agriculture to that of light industry and electronics This shift is occurring to a degree anyway but any increase in the rate of removal of water from the agricultural areas and the drying up of crop land will greatly accelerate this process From an economic sense this would tend to decrease the stability of the economy of the entire area and from an environmental sense it would eliminate much of the natural greenbelt which is considered one of the finer amenities of the northeastern Colorado area From a socio cultural sense such a shift and decrease in agricultural economy of the area would result in a modification of the social values and cultural traditions of the area Whether such shifts in socio cultural emphasis would be negative or positive depends to a large degree on the outlook of the observer It should be emphasized however that acceleration of conversion of irrigated crop land to dry land would have a tremendously adverse impact upon northeast Colorado in the eyes of a large percentage of the populace

Letter from the Department of Local Affairs or Division of Planning

1 Comment Concerning eutrophication and nutrient impact on the Three Lakes

Response See Response No 2 to the Department of Natural Resources letter

2 Comment Concerning comprehensive plans of participants

Response The land use planning of the participants is within their legal authorities and their participation in the Windy Gap Project is a result of their elected officials and staffs determination of a need for additional water supply The analyses made by these entities in evaluating their water supply needs are presented in Reports on Water Needs and Conservation (Subdistrict files) Use by any of the participants of the water supplies developed by the Windy Gap Project for the purposes of growth contrul or restraints on land use patterns is strictly a determination which must be made by the legally constituted governing bodies of those participants

3 Comment Regarding statement of primary goals and objectives of each city

Response The FES corrects this oversight

4 Comment Concerning fluctuations in the Three Lakes

Response The Three Lakes are operated in a manner which maximizes their intended use for water supply and hydro electric power generation In the original operational agreements for these lakes it was agreed that Shadow Mountain Lake and Grand Lake would be held to a fluctuation of one foot in an attempt to enhance the recreational management of this region It should be emphasized however that recreational use of these lakes was in no way used to justify the Colorado Big Thompson Project and any such recreational use shall in no way interfere with the priority use of this project and these lakes for water supply purposes Experience over many years since the project was built has shown that the 1 foot fluctuation in Shadow Mountain or Grand Lake has created no problems for the recreational users and in fact has created a very stable recreational base The function of Lake Granby however is that of a storage reservoir for the water supplies of northeastern Colorado Any recreational use of this lake is strictly incidental to its primary use and by necessity its primary use creates major fluctuations in water surface elevation While Lake Granby is operated whenever possible to minimize fluctuations in water surface it should be emphasized that it will continue to fluctuate in response to whatever demands are made of it

Division of Wildlife Letters dated July 24 and August 14 1979

1 Comment Various comments asking for additional information and analysis on fish and wildlife

Response The answers to DOW s questions are addressed in the appropriate sections of the FES Erickson (1980) and the attached agreement (Attachment 2) concerning minimum fishery flows

Letter from Colorado Water Conservation Board dated August 30 1979

1 Comment Concerning delineation of the floodplain for the probable maximum flood with or without the Windy Gap Diversion Dam and the impact on flood flows on property below the spillway at full discharge

Response At the flows indicated [illegible] flood the entire valley floor [illegible] be inundated with or without the Windy Gap [illegible] however with the Windy Gap Project flows below the dam would be directed to the

MEMORANDUM

To Files

Subject Response to July 30 1979 Board of Commissioners for Jackson County Letter on the Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Rawhide is a major Federal action requiring the preparation of an independent environmental statement

Response The Rawhide Project is not a Federal action of any kind receiving Federal funding It will be receiving Windy Gap water through an exchange with Fort Collins The environmental analyses which were completed on Rawhide are cited in the Bibliography

2 Comment The draft statement is legally insufficient because it fails to discuss mitigation for the Rawhide Project

Response Mitigation measures were omitted in the DES It could be argued whether mitigation is legally required because Rawhide is not a direct Federal action Regardless PRPA has gone to great lengths to mitigate environmental effects A summary of these mitigation measures is attached as PRPA s comments on the draft EIS starting on page 15 of their comments

3 Comment The annual electrical growth rate of 10 percent is unrealistically high The rate should be reassessed

Response A table from Appendix 2 to Section 1 3 of Platte River s Environmental Impact Analysis for the Rawhide Project is set forth below It illustrates the historical growth in electrical demand for Platte River s four member municipalities and thus the need for the Rawhide Project

	System Peak MW		Energy Requirements GWh	
	Month of September	Average Yearly % Increase Since 1970	12 Months Ended September	Average Yearly % Increase Since 1970
1970	69 2		381 5	
1971	75 7	9 4%	409 2	7 3
1972	81 3	8 4	466 5	10 6
1973	88 5	8 5	522 4	11 0
1974	97 5	8 9	553 5	9 8
1975	107 0	9 1	604 1	9 6
1976	115 5	8 9	656 7	9 5
1977	134 1	9 9	733 5	9 8
1978	148 8	10 0	793 8	9 6

4 Comment Alternatives to providing new generating capacity are not adequately addressed

Response Alternatives to the present project are discussed on page 9 1 of PRPA's Environmental Assessment for Rawhide

5 Comment The need for the project on the scale envisioned is not justified

Response The need for Rawhide is justified on pages 1 4 and 1 5 of PRPA's Environmental Assessment

6 Comment Analysis of alternatives to Windy Gap are inadquate especially No Action Agricultural reuse was not discussed at all

Response The alternatives to meeting the projected water needs of the service area are described and analyzed in Chapter II of this document The extent of analysis is based upon the reasonableness of each alternative to meet the need stated in Chapter I An agricultural reuse alternative is not discussed because agricultural is already being extensively reused In addition agricultural reuse water could not be used to satisfy municipal needs because of poor water quality

7 Comment Greater emphasis should be placed on mitigation in the FES especially flow depletions and salinity

Response Mitigation for project impacts on flow and salinities are described in the FES

8 Comment The DES inadequately discusses the flow depletion impacts on the Colorado River

Response A more extensive analysis of flow depletions is presented in Chapter IV of the final environmental statement

9 Comment The DES inadequately analyzes the impacts of increased salinity on the Colorado River

Response See Responses 1 and 2 to the San Miguel Soil Conservation District

10 Comment A programmatic environmental statement is required to determine the cumulative effects of Water and Power projects upon depletion and salinity in the Colorado River before a decision is made

Response Cumulative impacts on salinity concentrations in the Colorado River due to the consumptive use of Colorado River water is being addressed by the Colorado River Salinity Control Program

11 Comment Statements such as no significant adverse impacts on aesthetics are anticipated need to be supported by documentation

Response The statement in the DES is in error Reservoir level fluctuations due to normal project operations result in an unaesthetic bath tub ring This is an unavoidable result of project operations

12 Comment The DES does not justify the 75 ft^3/s bypass flow for Windy Gap Dam Assurances must be given that the bypass flow must be adequate to preserve the aquatic environment and the aesthetic recreation and wilderness values of the river

Response The bypass flows to the Colorado River has been modified based on studies performed by Erickson (1980) The conclusions of these studies have been discussed with the Colorado Division of Wildlife (CDOW) and as a result an agreement (Attachment 2) between CDOW and District was executed This agreement specifies flow maintenance for sections of the river which will fully protect the existing fishery

13 Comment Siltation was not mentioned in the DES and should be discussed in the FES

Response Siltation is discussed in Chapter IV of the FES

14 Comment The DES does not discuss the impact on water quality within the Northwest Colorado Council of Government s Section 208 planning area

Response The DES did discuss the impact on water quality within Northwest Colorado Council of Government s planning area The water quality discussion in the FES contains additional information as a result of subsequent investigations NWCOG is also signatory to the Intergovernmental Agreement which documents mitigation measures

PLANNING DIVISION
(STATE CLEARINGHOUSE)

REVIEW CERTIFICATION FORM

STATE PLANNING DIVISION
DEPT OF FINANCE AND ADMINISTRATION
826 DON GASPAR
SANTA FE NEW MEXICO 87503
(505) 827 3570

TO U S Dept of Interior

SUBJECT ____ PRELIMINARY REVIEW
____ FINAL REVIEW
____ STATE AREA PLAN
X EIS

PROJECT TITLE DES Colorado Big Thompson Windy Gap Project

APPLICANT U S Dept of Interior

FEDERAL CATALOG NO 15 502

FEDERAL AGENCY U S Dept of Interior

SAI NUMBER 9 06 11 073

PROPOSED FUNDING (PER 424 FORM)

	AMOUNT
FEDERAL	$
APPLICANT	
STATE	
LOCAL	
OTHER	
TOTAL	

FOR FINAL APPLICATION ONLY

REVIEW RESULTS

X The application is supported
X The application is in conflict with State Area wide or Local plans
____ Comments are attached for submission with this application

You may now submit your application package the form and all review comments to the Federal or State Agency() from whom action is being requested

Please notify the Planning Division (Clearinghouse) of any changes in the project Refer to the SAI number on ALL correspondence pertaining to this project

TECHNICAL ASSISTANCE AND RESEARCH

PLANNING DIVISION

Approved July 1978
Secretary DFA

2 white to applicant for Federal Agency
1 yellow SPD copy

PLANNING DIVISION
(STATE CLEARINGHOUSE)
PROJECT NOTIFICATION AND REVIEW SYSTEM

GENERAL REVIEW AND COMMENT FORM

Review of SAI No 9 06 11 073

TO Review Agency Kat Wick B II
Agency Address 527 Don Gaspar City Santa Fe, NM Zip 87501

FROM Planning Division Department of Finance and Administration
Address 505 Don Gaspar City Santa Fe, NM Zip 87503

SUBJECT (Project Title) DES Colorado-Big Thompson Windy Gap Projects
Because of your possible interest this project has been submitted for you for review and comment Please complete this form and return to Planning Division Dept of Finance and Administration by July 19, 1979
(date)

IT be Completed by the Reviewer!

1 Are you aware of any programs which have similar goals and objectives to the proposed plan? Yes ____ No X
If yes who provides these programs? What populations are being served?

2 In your estimation do these programs preclude the need for the proposed program? Yes ____ No X

3 Is the proposed plan incompatible with existing or planned programs you are aware of? Yes ____ No X If the answer is yes in what way is the proposed program incompatible?

4 Does the proposed program conform with comprehensive plan developed for the area in which it is located?
Yes X No ____

5 In your opinion is the population being served critical need of or large enough warrant the proposed action?
Yes X No ____ If no explain

6 Does the proposed plan conflict with any applicable statute order rule or regulation (federal state local) with which you are familiar? Yes ____ No X If yes has conflicting statute order rule or regulation

7 Describe any suggestions on means of improving or strengthening the proposed program

8 Is the information contained in the application and information forms consistent?
Y

9 On the basis of the above evaluation convey your general conclusion by checking the appropriate statement or statements
X No interest in or comment on this project
____ Proposal is supported
____ Proposal is considered noncompatible with plans planned below
____ Additional information as described as described below
____ Conference desired with applicant

10 Remarks or additional comments

SIGNATURE OF REVIEWER Kat Wick
TITLE Planner IV
DATE July 25, 1979

Approved July 1978
Secretary DFA

white to applicant
yellow SPD copy
pink Review Div copy

KATE WICKES

FEDERAL ASSISTANCE

Application identifier: NO 9 06 11 073
Date Assigned: 79 06 25

Applicant: Department of the Interior
Bureau of Reclamation
P O Box 25247
Denver
Colorado 80225
Joe D Hall

Federal Agency: N/A

Catalog of Federal Domestic Assistance Number: 1 1 5 0 0 2

Title: Irrigation Systems Rehabilitation & Betterment

Descriptive title of applicant's project:
DES COLORADO BIG THOMPSON WINDY GAP PROJECTS
A change in the operation of the Bureau's existing Colorado Big Thompson Project Construction & operation of a diversion dam on the Colorado River a pumping plant & a 5-mile conduit to Granby Reservoir & construction & operation of a 750 megawatt coal fired powerplant

Areas affected by project: Interstate Project

Estimated number of persons benefitting: N/A

Federal grantor agency: Department of Interior

Federal grantor agency to which initial project application will be submitted: N/A

Catalog of Federal Domestic Assistance Number: Technical Assistance & Research

Standard form 24 Page 0-81
Prescribed by GSA Office of Management and Budget October 74

Memorandum

To Files

Subject Response to July 25 1979 Comment Letter from State Clea Inghouse Santa Fe New Mexico on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

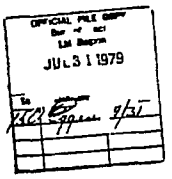
NO RESPONSE REQUIRED

P O BB 7 D O BO 7

Town of Granby

Granby Colorado 80446

July 26 1979



Mr Joe D Hall
Regional Director
United States Department
of Interior
Bureau of Reclamation
Regional Office
Lower Missouri Region
P O Box 25247
Building 20
Denver Federal Center
Denver Colorado 80225

Dear Mr Hall

This letter is submitted to you in response to the Draft Environmental Statement for the Windy Gap Project

As is readily apparent the Town of Granby is the closest town to the proposed project The impact of the 259 persons that are proposed for said project will be tremendous There are presently no available existing houses or trailers in the area and as to the proposal of filling up the motels this will permanently dry up a portion of the year round tourist economy since people are unlikely to return to areas where they cannot find accomodations to begin with Likewise there will be a commensurate call on services particularly law enforcement

Anyone that views the sight unlike it is stated in the Draft Environmental Statement cannot help but being favorably impressed by the beauty of the setting This valley is one of the prettiest in the state with the existance of the willows and particularly the cottonwoods which are almost unique in Northwestern Colorado and obviously cannot be replaced The idea that the setting is not aesthetically pleasing is ridiculous

The Town of Granby has been seeking for many years a light industry to provide a better year round tax base Obviously this project does not provide the same but could defeat the intent of the Town of Granby to attract that type of industry The Town has been able to obtain a Four Corners Grant to lay a sewer line to a likely sight for a light industrial plant but if all the water is in fact preempted and the Town is unable to provide adequate water through its system by virtue of this development it would be extremely difficult to promote light industry being located here

Mr Joe D Hall
July 26 1979
Page Two

The location of a mud flat located down at the Windy Gap project site can have no benefical impact on the Town of Granby Also another point on the water right situation the Town of Granby has requested the ability to negotiate with the Bureau of Reclamation for Green Mountain Storage Water but nothing has happened with apect to this request

Another adverse impact upon Granby and Grand County which likewise affects the industrial problem is that presently the entirety of Grand County is only utilizing 30 thousand megawatts The new power lines were permitted Grand County based upon the representation that they would service the present and future needs of Grand County for the foreseeable future However with one fell swoop one fourth of their capacity will be taken by the Windy Gap project which is a tremendous energy drain especially in light of President Carters new energy conservation goals

Grand County is experiencing a fast rate of growth which is desirable based upon a limited sparse population all of which may be endangered by this particular project which will utilize the remaining available water The state engineer in recently analysing the availability of unappropriated water in the Fraser Valley refused to grant new well permits based upon the conditional decree status of the Windy Gap Project

Also as a particular problem was that in the report it states that there are sixteen species of endangered plants in the vicinity of Windy Gap However since it is impossible for the Town to know what those species are it would be imponsible to determine whether there are in fact some in the area of Windy Gap Also the loss of fisheries between the town of Granby and Kremmling which is a considerable tourist attraction whether on public or private land and the decrease in flow will have a substantial impact on tourism The decreased wintering range for deer and elk since grass not anything else will grow in the vicinity of the reservoir which as pointed out in the Draft Environmental Statement is wintering grounds for the deer and elk will slow down tourism during the hunting season and also effectively force the deer and elk out of the area

In conclusion the Town of Granby feels that the project will have serious detrimental impacts upon the Town of Granby which have not been adequately addressed by the Environmental Statement nor mitigating factors adopted for the same

Very truly yours

Jerry F Woods

MEMORANDUM

To Files

Subject Response to July 26 1979 Town of Granby Comment Letter on the Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Windy Gap construction workers will dry up a portion of the tourist economy by occupying housing that would otherwise be occupied by tourists They will also put additional demands on local governmental services

Response The impact of the construction workers in the long term tourist economy in Grand County is difficult to predict The severity and nature of the impact will depend on the health of the tourist industry and occupancy level of available housing during the construction period In addition some construction workers will temporarily live in personal trailers or commute from surrounding areas These factors cannot be reliably quantified therefore a prediction of impacts would not be meaningful The effects on local government services are discussed in the draft environmental statement Please note that a portion of the funds expended for the construction of Windy Gap will find its way into the local economy and help offset any drain on services

2 Comment The draft doesn t adequately describe the impressive aesthetics of the Windy Gap site

Response Aesthetics is a largely subjective resource and difficult to describe with words The draft indicated on page III 44 that the Windy Gap development site has a high visual aesthetic character We have inserted several photos in the final statement to illustrate present conditions (see Section IV C 1 c)

3 Comment Windy Gap could use water that could otherwise be used for prospective light industries

Response The Inter governmental Agreement (Attachment 1) between the Subdistrict and West Slope interests stipulates that Windy Gap will subordinate its water right to all domestic and agricultural users along the Fraser River In addition up to 3 000 acre feet will be provided in Lake Granby for municipal domestic and agricultural users downstream The city of Granby is signatory to this agreement Therefore it is anticipated that the Windy Gap project will not interfere with the use of Colorado River water by Granby

4 Comment A mud flat at Windy Gap on the benefit Granby

Response The Windy Gap Reservoir will fluctuate minimally during the runoff period When not pumping the reservoir will be maintained at its highest operational level thereby minimizing the possibility of a mud flat

5 Comment Granby has requested the ability to negotiate with Water and Power for Green Mountain Reservoir water nothing has happened in respect to this request

Response We understand that the City of Granby has withdrawn its request because of operational and engineering problems associated with conveying water up hill from Green Mountain Reservoir to the place of use

6 Comment Windy Gap pumping plant will use one fourth of the capacity of the new power lines presently in Grand County This is a tremendous energy drain especially in light of President Carters energy conservation goals

Response The Windy Gap Project should not impact the energy availability the Grand County This conclusion is based on careful analysis of the demands of Windy Gap in relation to the demands of the rest of Grand County and consideration of the newly developed supplies into the area

7 Comment Windy Gap will enable the growth in Grand County by utilizing water which would otherwise be available for Grand County

Response See Response No 3

8 Comment The draft statement does not clearly define whether endangered plants are located within the vicinity of the Windy Gap Project

Response A letter dated August 27 1979 from the Fish and Wildlife Service to the Bureau of Reclamation pursuant to Section 7 consultation of the Endangered Species Act listed one plant species This species is the Osterhout milk etch (Astralagus osterhoutii) and is a proposed species for Federal listing A botanical survey (Western Resource Development Corporation 1980) did not reveal evidence that this species occurs within the reservoir site or surrounding area

9 Comment Loss of fisheries and decrease in stream flows between Granby and Kremmling will adversely affect tourism

Response According to Erickson (1980) fisheries in the upper Colorado River will not be significantly impacted as a result of the proposed Windy Gap Project Attachment 2 of the FES is the agreement between the Subdistrict and DOW This agreement specifies minimum bypasses which will sufficiently protect the present fishery

10 Comment The reservoir will adversely affect big game winter range forcing them out of the area and decreasing tourism during the hunting season

Response Windy Gap Reservoir will inundate about 150 acres of pasture riparian and river habitat This habitat is used by big game as winter range and is located along a deer migration route The impacts to population levels and migration are not considered significant due to the abundance of similar habitat nearby and alternative migration routes around the proposed reservoir

11 Comment Windy Gap will have adverse impacts on City of Granby which will not be mitigated

Response Mitigation provisions for impacts caused by the Windy Gap Project are included in the Intergovernmental Agreement (Attachment 1) to which the City of Granby is a party

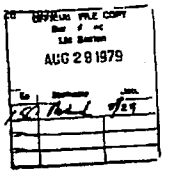
CONSERVATION ENTITIES

COLORADO COUNCIL 1740 High Street Denver Colorado 80218 (303) 391-0218



A g t 20

OFFICIAL FILE COPY
Bur f ec
Lee Barton
AUG 28 1979
To Signature Date
9/29



R gi l Di t
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Je C l d 80225

D Si

Th C i d C il f T t U limit d (CCTU) h iewed th p ti f th D ft E i nm l St t me t th C BT/Wi dy C p P j t hi h l t lmp t ld w gam fi h l Th f li wi g ment f i l si i th p rman t ffi i l p d i a this m tt

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Th litt y f p ibl ilk ly h g th t id i ly dimi i h th bi l gi l it lity f h fi h v i l g

1 L k f fl hi g d i g flow
2 Bl k g f up t am p g f p wni g
3 R d ti d h g f paw i g dd
4 R d d xyg il bilitv f ng
5 W t T mp i
6 I d li ity b l th p i t f g i lt l t
7 D d t am flow
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Th list b is l ompl t b t th it i i di ti f th v y i hi h th Wi dy Gap imp dm t i lik ly t dam g lq d C l d t l fi h y

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A ambi i f th on p j t lt rn ti dis us d i the DES h ld b y l ely tudi d a means f pplyi g e ry wat f th h rn t i p lties

And d ci umst h ld th Wi dy G p p j ct b p t d t di i l l th t p ts l es deq at to ab l t ly p t t th lity f th exi ti g bioti d phy i l dition o th Col ad b l w th p j t whi h ti l t mai t i ing it t bl e thb p t fi h ry

Sin ly

Si B l y
Ex ti Di ect

JB/km

Memorandum

To Files

Subject Response to August 28 1979 Comment Letter from T out Unlimited on Colo ado Big Thompson/Windy Gap P ojects Final En i onmental Statement

1 Comment The Windy Gap di ersion may result in serious damage to the ecology of the upper Colo ado River and lead to eutrophication of Lake Granby

Response See Chapter IV C Aquatic Biota and Chapter IV C Water Quality

2 Comment The nonproject alternatives discussed in the DES should be closely studied

Response See Chapter II

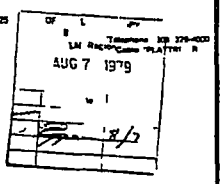
3 Comment Windy Gap should be operated to protect the current blue ribbon fishery

Response See Attachment 2

PLATTE RIVER POWER AUTHORITY

MBERL NE A HORSETOOTH ROADS FORT COLL NS COLORADO 80525

August 3 1979



Mr Joe D Hall Regional Director
U S Department of the Interior
Bureau of Reclamation Lower Missouri Region
Denve Federal Center Building 20
Denver Colorado 80225

Re Colorado Big Thompson Windy Gap Project Draft Environmental Statement

Dear Mr Hall

We have reviewed the Draft Environmental Statement for the Windy Gap Project dated June 18 1979 that was submitted to Platte River for comment We regret to report that we find the draft EIS to be naccurate and misleading Page i of the draft EIS states that the proposal involves three actions including

(3) construction and operation of a 750-megawatt (ultimate capacity) coal-fired power plant

On f rther reading it becomes apparent that the power plant referred to by the EIS is the Rawhide Energy Project (Rawhide) being constructed by the Platte River Power Authority (Platte River)

This is a serious distort on of the relationship between the Windy Gap Project and the Rawhide Energy Project Rawhide is not a part of the proposed Windy Gap Project

Construction and operation of Rawhide is no more a pa t of Windy Gap than is the construction and operation of a new shopping center at Longmont or the construction and operation of an en larged man f cturing facility in Loveland Platte River is con structing the Rawhide P oject as part of its program to supply electricity to the four Colorado municipalities which own Platte River No significant Federal action is required for Rawhide and I m sure you will agree that the Bureau has no control or responsibility for its const uction or operation On many other matte s however we have been and continue to be privileged to work with the Bu eau

PLATTE RIVER POWER AUTHORITY

Mr Joe D Hall Regional Directo
U S Department of the Inte io
August 3 1979
Page 2

Like a shopping center o new subdivision in one of the cities Rawhide is at most an indirect effect of the Windy Gap P oject The Council on Environmental Quality regulations for implementing the National Envi onmental Policy Act define indirect effects as those

> which are caused by the action and are later in time or further removed i distance but are still reasonably foreseeable Indirect effects may include growth inducing effects and other effects elated to induced changes in the pattern of land use population density or growth rate and related effects on air and water and other natural systems inc uding ecosystems

One could argue that Platte River s future energy projects i cluding additional units at Rawhide will be indirect effects since they may potentially and eventually receive Windy Gap water Subsequent units may be constructed at Rawhide when a d if needed and Windy Gap could potentially supply the water re quirements of these units But Platte River envisions no diffi culty in securing an alternative water supply for these units if for any reason the Windy Gap Project is never constructed In view of these facts it may be difficult to characterize a y part of Rawhide as even an indirect effect of Windy Gap

But there is no justification whatever for the Bureau s decision to define and treat the initial Rawhide unit as though it were an integral part of Windy Gap We are aware of the competi ion for water on both sides of the Continental Divide and Platte River is prepared to cope with the consequences of a prolonged controve sy Platte River has therefore secured an alternative s bstitute water supply for the first unit of Rawhide in the form of sewage effluent from the City of Fort Collins Construction and operation of Rawhide One is in no way dependent pon construction of the Windy Gap Project

We would find the inaccurate characterization of Rawhide in your Draft Environmental Impact Statement less discouraging if we had not repeatedly pointed out to the Bureau s staff members respon sible for the preparation of this document the true relationship between Rawhide and Windy Gap and if we had not also coopera- tively supplied detailed background information on Rawhide that is more complete accurate and up to date than that contained in the Draft Statement

PLATTE RIVER POWER AUTHORITY

Mr Joe D Hall Regional Director
U S Department of the Interior
August 3 1979
Page 3

In the interest of securing a correct and accurate final EIS we urge that this misleading draft statement be revised to accurately reflect the true relationship between Rawhide and Windy Gap We are submitting herewith the specific revisions which we believe are necessa y to correct this and other inaccuracies in the draft EIS

Very truly yours

PLATTE RIVER POWER AUTHORITY

Albert J Hamilton
General Manager

/kr

Enclosure

Memorandum

To Files

S bject Respo se to August 3 1979 Comment Letter f om Platte Ri er Power Authority o the Colo ado Big Thompso /Windy Gap Projects Final E vironme tal Statement

1 Comme t There s no justification fo discussing Ra hide as tho gh It is a i teg al part of Windy Gap It is not a Fede al action and ill be built whether Windy Gap is constructed or not Platte River has alternative ate supplies a ilable

Respo se The disc ssion of Rawhide in the FES has been considerably reduced from that in the DES because of the reasons stated in Chapter I Most of the description of Rawhide powerplant and its impacts o the environment have bee deleted in the FES PRPA (1978) adeq ately discusses these impacts and is readily a ilable to the public The FES analyzes Rawh de only in relation to the wate supply de eloped by Wi dy Gap Consequently any of the evisions suggested by PRPA are no longer elevant

PLATTE RIVER POWER AUTHORITY

COMMENTS OF
PLATTE RIVER POWER AUTHORITY
ON DRAFT ENVIRONMENTAL
STATEMENT FOR THE
BIG THOMPSON/WINDY GAP PROJECT

PLATTE RIVER POWER AUTHORITY

August 3 1979

Mr Joe D Hall Regional Director
U S D pa tme t of the Interior
Bu eau of Reclamatio Lower Missouri Region
Denver Federal Cente Building 20
Den er Colorado 80225

Re Colo ado Big Thompso W rdy
Gap Project D aft En iro
mental Statement

Dear Mr Hall

We ha e reviewed the Draft Environmental Statement for the Wi dy Gap Project dated J ne 18 1979 th t was s bmitted to Platte River for comment We regret to report th t we fi d the dr f EIS to be naccurate and misleading Page 1 of the draft EIS states that the proposal involves three actions incl di g

(3) construction and operation of a 750 megawa.t (ultimate capacity) coal fired power plant

On further reading it becomes apparent that the power plant referred to by the EIS is the Rawhide Ene gy Project (Rawh de) b ing co structed by the Platte River Power A thority (Platte River)

This is a seriou distortion of the relatio sh p betwee the Windy Gap Project and the Rawhide Energy Project Rawhide is not a pa t of the proposed Windy Gap Project

Construction nd operation of Rawh de is no mo e a part of Windy Gap than s the construction a d operation of a ew shopp g center at Lo gmont or the co struction a d operatio of an e largod m nufacturing facil ty i Loveland Platte River is con structing the Rawhide P oject as p rt of its progran to n pply elect icity to the fou Colo ado m icipalities which ow Pl tte River No significa t Federal actio is equired for Rawhide and I m sure you will agree that the B reau has no control o responsib lity for its constructio r ope atio On ma y other matters howeve we ha e been and continue to be privileged to work with the Bureau

Like a shopp ng center or new subdivision in one of the cities Rawhide is at most sh indirect effect of the Windy Gap Project The Council on Environmental Quality regulatio s for implementing the National Environmental Policy Act define indi ect effects s those

> which are caused by the action and are later in time or further removed in distance but are still reaso ably foreseeable Indirect effects may includo g owth inducing effects and other effects related to induced changes in the pattern of land use populat o density or growth ata a d related effects on air and water and other nat al systems including ecosystems

One could arg e that Platte River s future energy projects i cluding add tional units at Rawhide will be indirect effects since they may potentially and eventually receive Windy G p water Subsequent units may be constructed at Rawhide when nd if needed and Windy Gap could potentially supply the water re q irements of these units But Platte River envis ons no diffi- culty n s curing an alternative water s pply for these units if for any re son the Windy Gap Project is e er constructed In view of these facts it may be difficult to characterize any part of Rawhide as even an indirect effect of Windy Gap

But there is no justification whatever for the Bureau s decision to define and treat the initial Rawhide unit as though it were an integral part of Windy Gap We are aware of the competition for w ter on both sides of the Continental Divide nd Platte Rive is p epared to cope with the consequences of a prolonged controversy Platte River has therefore secur d an alter ative sub t tute w ter upply for the first unit of Rawhide in the form of sewage efflue t from the City of Fort Collin Const uction and operation of Rawhide D o is n no way dependent upon construction of the Windy G p Project

We wo ld fi d the inaccurate characterization of Rawhide in your Draft Env onmental Impact Stateme t less d scou aging if we had ot repeatedly pointed out to the B rea s staff member espon s ble fo th preparat on of this document the tr e relationship betwee R whide nd W ndy Gap and if we had not also coopera tively supplied detailed background i formation o Rawhide that no o complete ccu ate and p to date than that cont ined in the D aft Statement

In the interest of securing a correct and accurate fi al EIS we rge that this misle ding draft statement be revised to accu ately reflect the true relatio sh p betwee R wh de a d Windy Gap We are submitting herew th the specific revisions wh ch we believe are necess ry to correct this and other inaccuracies n the draft EIS

Very truly yours

PLATTE RIVER POWER AUTHORITY

Albert J Hamilton
General Manager

/kr

Enclosure

REVISIONS SUBMITTED BY
PLATTE RIVER POWER AUTHORITY TO DRAFT
ENVIRONMENTAL STATEMENT
COLORADO BIG THOMPSON/WINDY
GAP PROJECTS COLORADO

Page	Revision
i (Summary)	Strike the paragraph 2 Brief Description of Action in its entirety Insert "2 Brief Description of Action The proposal involves two actions (1) changing the operation of the Bureau's existing Colorado Big Thompson Project (CBT) and (2) construction and operation of a diversion dam on the Colorado River a pumping plant and a 5 mile conduit to Granby Reservoir An annual average of 48 900 acre feet will be diverted from the Colorado River conveyed through the CBT system and utilized by the cities of Estes Park Loveland Longmont Greeley and Boulder and the Platte River Power Authority The construction activities will take place in Grand County The Platte River Power Authority a municipal utility which supplies the generation and transmission needs of Estes Park Fort Collins Longmont and Loveland is one third allottee of Windy Gap waters The Authority plans to utilize its allocation to supply the requirements of future generation projects it may develop While at one time Windy Gap waters were proposed for use at the first 250 megawatt unit of the Rawhide Energy Project a separate alternative supply for that unit has been developed and the Authority has no present project planned that would utilize Windy Gap water Nevertheless the Bureau has determined that the Rawhide Energy Project and its environmental impacts should be discussed in detail in this document This was done for two reasons (1) if Windy Gap is constructed the entities supplying water to Rawhide as first unit may elect to be compensated by receiving Windy Gap water on an acre foot for acre foot basis and (ii) subsequent units at Rawhide (a potential total ultimate capacity of 750 megawatts) though not dependent on Windy Gap for construction may utilize Windy Gap waters if Windy Gap is built Thus the Rawhide Energy Project may be viewed by some as an indirect effect of Windy Gap construction (See CEQ Guidelines Fed Reg Vol 43 No 230 11/29/78) and the Bureau has determined that it should be discussed in that light

2

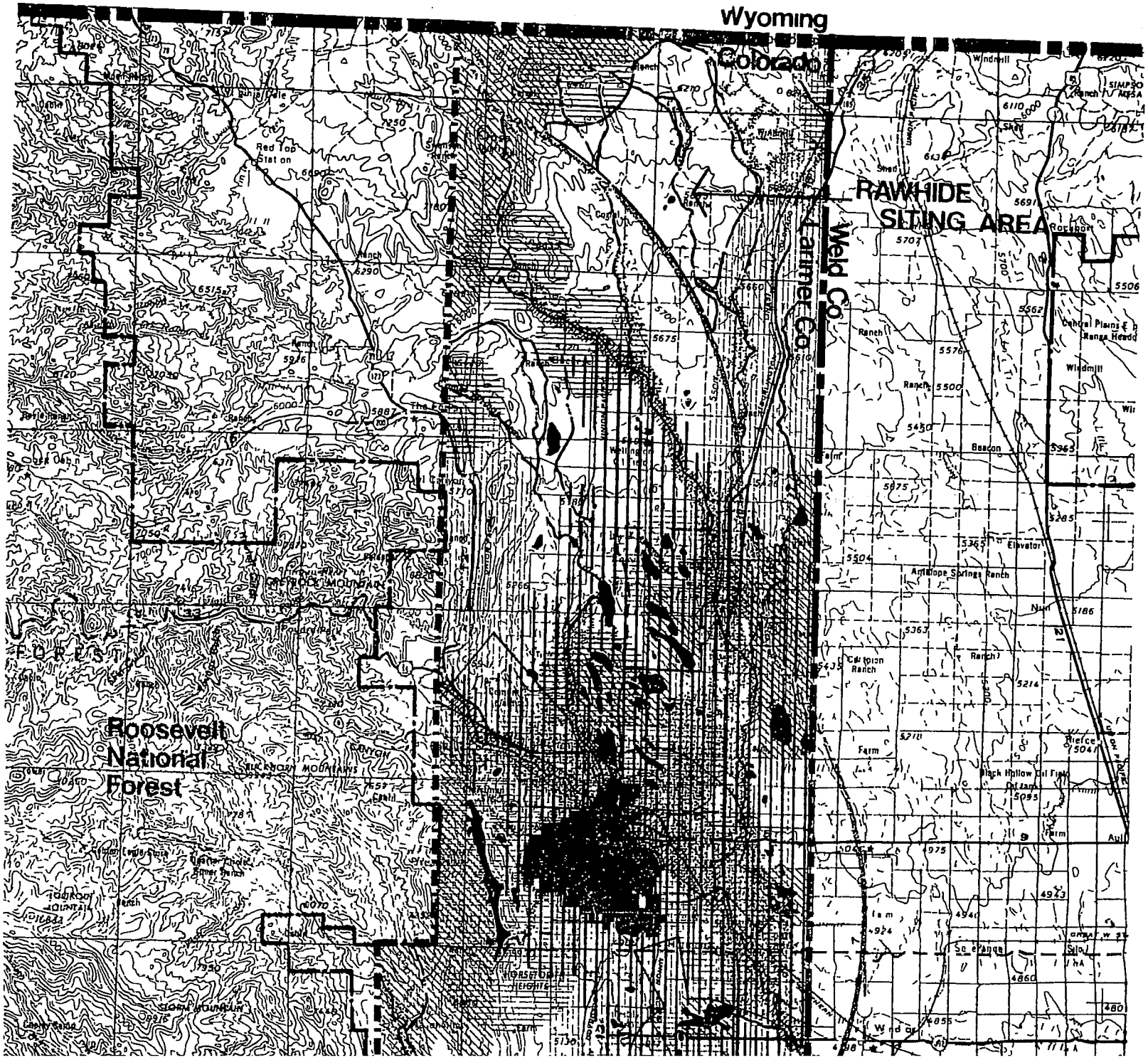
Page	Revision
i (Summary)	Strike the portion of the second sentence of paragraph a of Section 3 which reads for cooling at the proposed Rawhide power plant Insert "by Platte River Power Authority for cooling and other purposes at future electric energy generation projects
i (Summary)	Revise the third sentence of paragraph b Section 3 to read "Indirect economic effects from construction of Rawhide will generate an estimated total income of $7 9 million during the peak year of construction
i (Summary)	Revise paragraph c of Section 3 to read "c Placement of the Windy Gap facilities will eliminate approximately 152 acres of past range Indirect effects include some losses of grazing and agricultural lands due to continued growth of the municipalities receiving the water and the induced conversion to other uses of 993 acres of rangeland by the development of the Rawhide Energy Project
i (Summary)	Revise paragraph d of Section 3 to read "d The Rawhide Project's first unit will require an estimated 33 million tons of coal over its forty year economic life
i (Summary)	Revise the heading of paragraph c of Section 4 to read "c Rawhide Energy Project (alternatives listed are those considered by Platte River Power Authority and are beyond the jurisdiction of the United States Bureau of Reclamation to review since the Rawhide Energy Project is not part of this proposed action)
I 1	Revise the first sentence of the fourth paragraph by substituting the word two for the word three
I 1	Strike the fourth paragraph from the fifth sentence (beginning The third aspect is) to Insert "Development of Windy Gap is not Federal action to its receiving Federal funding for construction or operation However it must meet NEPA compliance

3

Page	Revision
I 1 (cont.)	requirements because Federal facilities will be used to convey Windy Gap water There is no additional new construction for the CBT Project The Rawhide Energy Project as presently conceived (one 250 megawatt unit) is in no way dependent upon Windy Gap for water Nevertheless the project and its environmental impacts are reviewed herein This was done for two reasons ( ) under the water supply plan developed by Platte River water for Rawhide will be supplied from sewage effluent identified with new foreign waters of the City of Fort Collins and the Water Supply & Storage Company those two entities can elect to be compensated for waters they supply to Rawhide's first unit by the receipt of Windy Gap waters on a acre foot for acre foot basis should Windy Gap in fact be constructed and (ii) subsequent units at Rawhide though not dependent on Windy Gap for construction may utilize Windy Gap waters if the project is built Thus the Rawhide Energy Project may be viewed by some as an indirect effect of Windy Gap construction (See Proposed CEQ Guidelines Fed. Register Vol 43 No 112 Part 2 6/6/78 pp 25231 47) and the Bureau has determined that it should be discussed as such
I-1	Strike the fifth and sixth sentences of the fifth paragraph and insert a new sixth paragraph Although the Rawhide Project involves no major Federal action that would trigger NEPA compliance requirements including an Environmental Impact Statement Platte River Power Authority has compiled an analogous document entitled an Environmental Impact Analysis as part of its subsistence to local governmental authorities reviewing the Rawhide Project Reference should be made to that document for inquiries beyond the scope of this statement
II 32	Revise last sentence of the second paragraph of Section B 1 a to read Since the formation of the municipal subdistrict the City of Fort Collins has assigned all of its share and the municipalities of Estes Park and Loveland have assigned half of their shares to Windy Gap waters to the Platte River Power Authority
II 35 (Table II 11)	Strike the words Power Plant in footnote 3 and Insert the words Energy Project

4

Page	Revision
II 40 (Figure II 9a)	The source of specific reference to this figure the text and references to Rawhide are inaccurate and out of place Rockwell Seam and Basalt Meadow have no connection whatsoever with Rawhide and all reference to Rawhide should be struck
II 45 through II 64	These pages should be presented as a new subsection 3 under Section C of Chapter II Interrelationships with Other Projects and Proposals commencing at Phase II 67
II 45	Strike 2 Energy Development Aspects a Sponsor and first two paragraphs Insert under Section C of Chapter II (Interrelationships with Other Projects and Proposals) 3 Indirectly related Energy Projects Rawhide Energy Project a Sponsor Platte River Power Authority is a municipal utility and a political subdivision of the State of Colorado It was formed pursuant to Section 29 1 204 of the Colorado Revised Statutes (1973) by the municipalities of Estes Park Fort Collins Longmont and Loveland to supply their electric generation and transmission needs Platte River is wholly owned by these municipalities and is governed by a Board of Directors consisting of eight members two from each municipality Platte River began revenue producing operations 1 July 1973 its source of bulk energy at the present time is over of U S Bureau of Reclamation projects whose generating output is supplied over transmission lines of the Western Area Power Administration Additional energy generation will be provided in the forthquarter of 1979 from Platte River's 134 MW share of the Yampa Project Load projections indicate that additional generation must be built to meet the four municipalities needs beyond 1984 To meet the growing need of its members municipalities Platte River has proposed to construct and operate a 250 megawatt (MW) coal fired electric generation facility 18 miles north of Fort Collins Colorado The proposed facility will burn low sulfur western coal from the Antelope Mine of Northern Energy Resources Company in Converse County Wyoming While the site has an ultimate capacity of 750 MW only a 250 MW unit is presently planned for construction and additional unit will be built only if needed


Wyoming
Colorado
RAWHIDE
SITING AREA
Larimer Co.
Weld Co.
Roosevelt
National
Forest

5

Page	Revision
II 45 (o t)	Although init al plans were to use Windy Gap water for cooling and other p rposes at Rawhide Platte River has developed an alternative water supply pla and construction and operation of Rawhide Unit One is not dependent in any way upon Windy Gap Nevertheless the Rawhide Project is eviewed in det l s the B reau has determined that it is an indirect effect of the Windy Gap Project as discussed earl er
II 45	St ke the words all th ee in li e four of Section 2 c and insert p to three 250 MW strike the figu e 460 and ert 500 in line six and evise the last se te ce to ead Of the enal ing 1780 acres 25 cres wo ld ccom modate future generating nits (if constructed) and the balance would be managed to suppo t recreational uses to p o ide wildlife habitat and to act as a buffer one to adjacent properties
II 45	Revise first sentence to second paragraph of Section 2 d to e d Delivery of construction supplies will be by both rail spur and truck
II 48 (Figure II 12A)	Strike entire Figure II 12a Insert eplacement attached hereto (The graphic implies that the mapping units A B and C relate to overall power plant site suitability This is inaccurate The figure dep cts geologic suitability only) The placement of the power plant on the figure is i accurate as it is closer to the cooling pond and in Unit B ot in A This figure with corrections should be placed ne r Page III 6 as Figure III 1a where site geology is discussed in detail
II 51	Strike e Powe plant a d following material except last two pa agraph and inse t e Powe Generatio Facilities Rawhide Unit One will be a 250 MW coal fi ed steam electric ge erating station An a tist s ronde i g of the facility is shown in Figure II 15 The site selected is capable of ccommodating n lt mate capacity of 750 MW which if needed would be added in 250 MW unit increments

6

Page	Revision
II 51 (cont)	U it O e s planned for commercial ope atio n Ap l 1984 at n estimated cost of 5298 mill on Current plans are to initiate constr ction i late 1979 Put e generatio n ts at Rawhide may o m y not be dded depe di e upon (1) load growth rates a d (2) eco omic and environmental a alyses of then a ailable alter ative e ergy sources If demand co ti es to g ow at present levels addition l gene ation will be nce sary in 1991 and a decision as to a spec fic p oject n de n 1985 o 1986 The life span of a unit is about 35 to 40 years The powerplant comple will co sist of (1) power plant (2) on site reservoir (cooling pond) (3) coal delivery a d sto age area (4) solid waste d posal area (5) appurte nt f c l ties related to project operation Pulver ed co l w ll be combined w th ir s pplied by for ed d aft fan ignited and bur ed in the furnace Induced dr ft f ns will emove comb tion g ses from the furnace to be e hausted th ough a 500 foot stack
II-53	Revise second sentence of fi st paragraph of Sectio 2 f to read In October 1978 Platte Rive e ecuted a cont ct with the Antelope Coal Corp y a subsidiary of Northern Ene gy Resources Company for sufficie t co l for Raw hide One to be supplied from its proposed Antelope mine in northern Converse County Wyomi g
II-53	Revise the second paragraph of Sect o 2 f to ead "At a ot output of 250 MW the ma imum coal con sumption of Rawhide Unit One w ll be app o mately 155 tons per ho r The a erage an ual consumpt on will be abo t 870 000 tons per year
II 54	Strike the figures 400 and 13 600 in the fourth li e of the first paragraph of Section 2 g (1) and inse t 500 and 15 400
II 54 and II 55	Revise the ca ryover sentence beg nning on page II 54 and the fi t full se tence on page II 55 to read On April 24 1979 the Water Division No 1 Dist ict Cou t gra ted the petitio of the Water S pply and Storage Compa y the City of Fo t Coll ns and the Platte Rive Power Authority for app oval of a plan for

7

Page	Revision
	augmentation fo euse of water for change in place char cter and type of use for conditional decrees for modification of conditional decrees a d for exchanges
II 55	St ike the third fourth and fifth sentences of the last paragr ph on page II 55 a d insert The water supply pumps which will be housed in a small building djacent to the ditch will draw water directly from the ditch Fluctuations in flows will be accommodated through an exchange with Fossil Creek Reservoir via the Fossil Creek Ditch This system will also permit Platte River to divert surplus Poudre River flows thro gh the ditch and pipeline to the Rawhide cooling pond
II 55	Strike the words filed for in last se tence on page and insert obtained
II 56	Add as an introductory paragraph to (3) PRPA s Continuing Need for Windy Gap Water (PRPA, 1978) the following As noted above Rawhide Unit One no longer requires Windy Gap water as its source of cooling water Never theless Platte River has cont nued to participate in the support of the project since it may wish to put the water to use in future generation projects Such projects may include future units at Rawhide or may be located else whe e depending upon economic and environmental analyses to be undertaken when the need for additional generation requires them
II-56	Strike the first sentence of the second paragraph of (3); in the second sentence st ike such and inse t Windy Gap
II 56	Strike 460 in fi st line of section (4) and in ert "500" strike southwest in last line and insert southeast"
II 57	Strike 14 000 in second line on page and insert 15 400 same change in the fifth line of the third full paragraph on page II 57

8

Page	Revision
II 57	Revise second full par graph on page II 57 to read "The irculating water discha ge f om the condenser will be designed so that the heated circulating water coming from the power plant condenser will sp ead over the surface of the cooling pond By discharging the circulating water onto the po d surface in this manner the greatest possible temperatu e difference is main ta ned between the condenser intake a d its discharge flows which will imp ove the performance of the steam condense and the efficiency of the generati g unit The verage monthly reservoir surface temperatures in the summer se son are expected to range between 51° and 73°F During the winter season the surface of the reservoir is not expected to freeze even with only the first Rawhide generating unit in operatio
II 57	Strike 460 i seco d line of third full paragraph insert 500
II 57	Strike either carbon or from the first sentence of the last paragr ph
II 58	Strike the second sentence of the first paragraph and insert "Platte River is conducting ongoing studies of available processes for treating water entering the cooling po d
II 59	Revise last paragr ph of Section 2 h (1) to ead "Wate quality in the cooling pond will be care-fully monitored and managed to assure that it will not become unsuitable for plant use Platte River is committed to developing such a mon to ing nd ma ge me t scheme a d is p esently wo king with water quality experts to do so
II 60	Revise next to l st se te ce of first parag ph to re d "The h ponds will be exc vated nto the F erre Shale formation which has a low permeability Are s within the ponds th t have highe perme bility will be sealed with n impervious materi l
II 60	Revise second pa agraph to read "Materials deposited in the ash po ds w ll be removed after drying nd bu ied in a landfill which will be constructed on the Project site The decanted water will be cycled fo reuse Fly ash a d SO_x clean ing wastes will be pneumatically conveyed from the fabric filter to a storage silo The silo will provide

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Page	Revisio
	fo p to thr e d ys storage at m mum it operatio The silo will be eq ipped with a rotary d stless unloader which mixes water with the waste mate ial as it is transfer ed f om the silo to dump trucks
II 60	Revise table of air quality sta dards as follows

Pollutant	Juri diction	M imum Allowable Emission
S lfur D oxide	Fede al EPA	Best A ailable Co trol Tech ology (BACT) with at least 70% removal equ red
P rtic l te	Federal EPA	03 lb/million Btu and 20% opacity (maximum)
Nit ogc Oxides	Fed al FPA	0 5 lb/m llion Btu

II 61	Strike first pa agraph of Sulfu Dio de Cont ol sec tion a d nsert R whide's sulfu lioxide removal system must meet the Fed ral best available control technology standard The sp ay d y fab c f lter flue g s clea g syste propo ed fo stallatio t Rawh de meets this standard The exact percentage of sulfur dioxide removal (above the 70 percent minimum) will be established by the Env ronmental Protection Agency pursuant to its applicatio eview procedure
II 61	St ive the last sentence of the seco d paragraph of "Sulfur Dioxide Co trol section and inse t "Give the EPA's minimum requireme t of 70 per cent removal Rawhide One emissio s will be reduced to no more tha 0 2 lbs per million Btu
II-61	Rev se third par graph of Sulf r Dio ide Co trol section to re d While the ge of the design coal as received has a typical s lfu content of 0 29 percent and a heat l e of 8500 Btu/lb it also has a maxim m sulf conte t of 0 44% d a mi mum heat al e of 7 934 Btu pe pc d Po thes worst c se parameters SO_2 removal effic ency of 70 percent wo ld result in emissio of 0 33 lbs per millio Bt
II 61	St ik figure 0 1 thi d li e of third p r graph u de Partic late Removal and se t 03 strike the words "about 10 pe cent n fourth l e a d se t less tha 20 perc t

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Page	Rev sio
II 62	U d r (2) Operat o trike the fig e 54 i fi t line and e t "65 t ke 40 in the fi st li e and ins rt "51"
II 63 (Figure II 16)	St ike enti e fig e entitled Alte ative Tran missio Corridors and in ert attached fig re (demoninated Fig 2 14)
II-64	In the first se tence der I terrel t onships with Other P ojects a d P oposals t ke "the Gra d Rive D tch nd the Mich ga Ditch i the second sentence at ike fo r nd inse t a x str ke descript on of Michigan Ditch nd G and Rive Ditch from l Directly Related Water Projects d n ert der Indi ectly Rel ted ater Projects" at page II 67
III-1	Remove all refere ces to the Rawh d P oject the d sc s ion noc A Cl mate Colo ado Big Thomp on a d W ndy G p and discuss climate in two sep rate sect ons e titled 1 Climate Colo ado Big Thomp on a d Windy Gap nd 2 Climate Rawh de Energy Project
III 3	St ke the he di g 1 Windy Gap Ene gy De elopm nt Aspects and replace it with "1 Rawhide E ergy Project It would be easier for the reader if ambie t air qual ty measurements were expressed i the same un ts prefer ably micrograms per cubic mete Th s the seco d a d third parag aphs nde A Qual ty should be changed to read as follows The ma imum recorded 3 hour co cent ation of SO_x during the fi st year (J ne 1977 June 1978) was 7 3 ug/m³ Tho maximum 24 hour val e was 1 6 g/m³ Th average annual co ce tration o SO_x was less the 0 1 g/m³ All of these values are less tha 1% of the National Ambient Air Quality Standards (NAAQS) fo SO The annual NAAQS for NO_x is 100 ug/m³ The average an al NO_x concent tion at the Rawh de site was 14 6 g/m³ or 14 6 pe cent of the NAAQS It is also confusi g to refer to micrograms per c bic meter as mg/m³ partic larly s nce the Glossary of Terms defines mg as milligrams
III 3	T afe ll references to Rawhide f om C Topog aphy Colorado Big Thompson and Windy Gap to a separate sec tion "2 Topography Rawhide E ergy Proj ct
III 5	Change 2 200 cre in the si th pa agraph li e 3 to "2 880 acre

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P ge	Re ision
III 6	Remove ll references to the Rawh de site from D Physiography and Geology Colorado Big Thompson and Windy Gap" and place them i a separate sectio c titled "6 Physiography and Geology Rawhide E ergy Project"
III 9	Remove the eferences to the Rawhide site from 4 Economic Geology a d place them in the sepa te sectio c titled 6 Physiography nd Geology Rawhide Energy Project"
III 13 through III 16	Remove the references to the Rawhide site from E Hydrology Colorado-Big Thompson and Windy Gap and place them in a sepa ate section entitled "3 Hydro logy Rawhide Energy Project It ppears that a discussion of ground water at the Rawhide ite w s omitted from Section III f 2 We suggest inserting the following under 3 Hydrology Rawhide Energy Project "The geohydrology of the Rawhide site was investi- g ted by installing and monitoring 21 piezometers Data from these piezometers indicate that a water table e sts n the Pierre Shale bedrock be e th po tio s of the site and in the surficial deposit in Coal Creek The lim ted extent of the water table indicates it is probably perched in the upper portion of the Pierre Shale The elevation of the water table varies across the Rawhide site with a general gradient to the south southeast The depth to ground water ranges f om 11 to 67 feet with the shallower depths recorded in the cooling pond basin near the site of the proposed dam The vertic l extent of the water table below 5 507 feet MSL is not k own Two inactive windm ll-pumped tock wells exist on the site Their yields quality and source of wate are not know although these are a med to be imilar to those of the piezometers on the site In ge eral only s dsto e members of the Pie re Shale are class fied as quife s However the strata be eath the Rawhide site that contain water can be technically classified as an aquifer because they yield eno gh water for stock tanks There may also exist deeper aquifers in sandstone units of the Pierre Shale but thei existenc and yields of these aquifers beneath the site a e unknown The shallow water table as recorded by the site pie ometers is recharged by direct infiltration from precipitation and runoff Deeper aquife s if they exist beneath the site are p obably recha ged t outcrop distant f om the site

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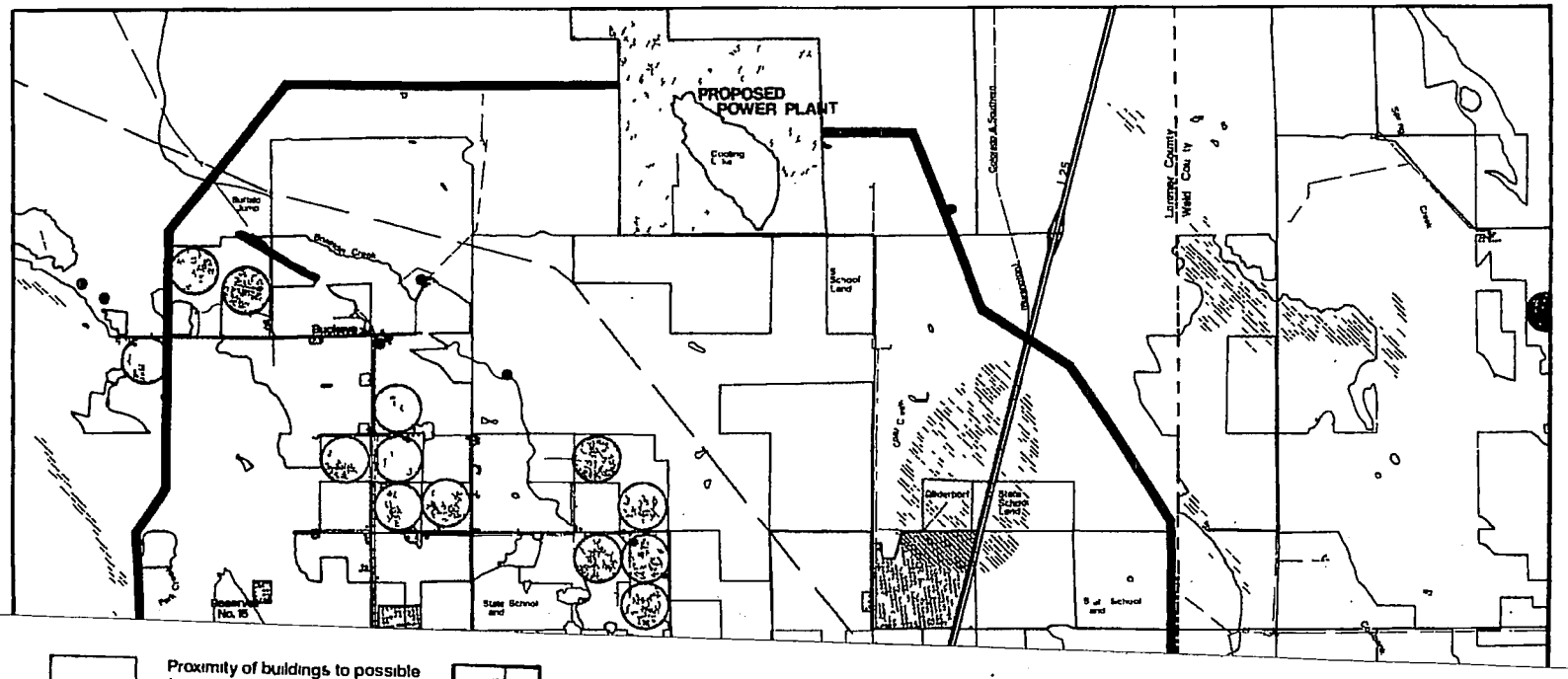
Page	Rev sion
III 15 (Figure III 6)	Revise the legend to read Fort Collin s sig ed its shars of Wi dy Gap wate to the Platte River Power A thority Estes Park a d Loveland assig ed one half of their shares [these cities sho ld be epresented by the symbol ◐] [Is your spelli g mu ciple a matter of principal ?]
III 19	It appears that a discussion of ground water quality t the Rawhide site was omitted from Section III F 2 This omission should be co rected particularly since it is stated on p IV 17 that "the quality of ground water within and near the Rawh de site was described in Section III F 2 We suggest inserting the follow ing under Hydrology Rawh de Energy Project "The quality of ground water at the Rawhide site was determined from analysis of samples of ground water from piezometers at the site G ound water beneath the site is generally poor quality a d exhi- bits high values in specific conductance total dis solved solids alkalinity and hardness
III-26	Change the heading b Energy Developme t Aspects to "3 Rawhide Energy Project" so that the disc ssion of Rawhide energy development is not a part of Windy Gap
III 26	Change the he ding b E e gy Development Aspects to "3 Rawhide Ene gy Project"
III 28	Change the heading 3 Endangered Plants to 3 En dangered Plants Windy Gap and Rawhide Energy Projects
III 30	Change the heading b Energy Developme t Aspects to "3 Rawhide Energy P oject" and renumber subsequent section accordi gly Under this heading add the following sentence Composite lists of mammals birds amphib- ian and reptiles of the Rawhide Energy Project site are available for inspect on at the Lower Missou i Region Office in De ver Species lists we c ncluded in the append of the Rawhide EIA
III 31 and III 32	Change the headi g (2) Energy Developme t Aspects to "c Rawhide Energy Project"
III 44	Change the heading b E e gy Development Aspects to "3 Rawhide E ergy Project"
III 50	Change the heading b Energy Development Aspect to "4 Rawhide E ergy Project"



Proximity of buildings to possible transmission line along roads
- Homes within right-of-way
- Homes within 50-100'
- Homes beyond 100'
- Auxiliary Buildings
- Commercial Building
- Institutions
- Oil Wells
- State Highways
- County Roads
- Railroads
- Streams
- PVREA Distribution Lines
- PSC Distribution Lines
- Transmission Lines
- Substations

- Public and Reserved Lands
- Cultural Resources
- Airspace Zones
- Subdivisions
- Communities
- Rangeland
- Center Pivot Irrigation
- Non-irrigated Cropland
- Irrigated Cropland
- Waterfowl Flight Area
- Seasonal Lakes
- Lakes &/or Reservoirs
- Ridgelines
- Proposed Routes

Preferred Transmission Routes

Rawhide Energy Project
Environmental Impact Analysis

640 Acres

Date: October

0 3000 6000 Feet

N

EDAW inc Environmental Planning

SECTION 6

MITIGATION MEASURES AND MONITORING

6 1 PALEONTOLOGICAL RESOURCES

Although no important fossils were found at the Rawhide site during the course of a thorough paleontological survey there is a distinct possibility that important fossils may exist in the shallow subsurface and might be uncovered during construction Therefore a paleontologist will be on call to evaluate any paleontological materials uncovered during construction and to recommend any action necessary to protect such discoveries

6 2 SOILS

Soils that provide a good medium for plant growth and that will be inundated by the cooling pond or removed during excavation will be stockpiled for later use in revegetation and general landscaping of the site The removal and stockpiling of good soils will be delayed as long as possible to minimize stockpile erosion Stockpiles will be constructed and oriented in a manner that will minimize wind erosion and will be temporarily revegetated as necessary For a more detailed discussion on soils handling see the reclamation report by Ecology Consultants Incorporated (Bibliography No 25)

Soils that are compacted by the operation of heavy equipment during the construction period will be loosened and reseeded as necessary so that they may rebuild their structure and recover their permeability

6 3 HYDROLOGY

The Rawhide project has been designed to have no discharges of waste water to existing streams or water bodies The ash and flue gas cleaning waste storage ponds will be lined or otherwise treated to minimize seepage and potential contamination of ground water The cooling pond drainage will be diverted around the solid waste disposal area to avoid contact with the contaminants contained in the solid wastes

The cooling pond will be treated so that a sufficiently good water quality can be maintained to provide a habitat for fish and other wildlife and to minimize excessive algae growth and potential odors The Rawhide plant will also be managed so that contaminants associated with boiler cleaning waste management

and other activities will not cause water quality problems in the cooling pond In this way potential problems associated with exfiltration from the cooling pond reaching other surface water bodies or ground water and thus degrading water quality can be minimized

6 4 VEGETATION

Areas that are disturbed during construction of the Rawhide project and not occupied by project facilities will be revegetated with native grasses using a seed mixture consisting of species such as western wheatgrass blue grama buffalo grass and others An exception to the exclusive use of native species will be the use of a seed mixture containing crested wheat grass on the steeper cuts and fills along the rail spur where rapid revegetation and stabilization of slopes will be necessary See the ECI report on reclamation (Bibliography No 25) and the LDAW landscape plan for discussions of proposed revegetation

Revegetation efforts at specific locations will be directed toward the establishment of wildlife habitat (See the discussion in Section 6 5 Wildlife)

Native range on those portions of the Rawhide site that are occupied by project facilities will be managed with proper grazing techniques so that productivity and species composition can return to the levels that existed prior to excessive grazing Platte River is working with the U S Soil Conservation Service in this effort to develop a site grazing management plan and will utilize data collected by Stearns Roger Inc

Cactus plants having horticultural value which are present at Rawhide Project locations that will be disturbed during the course of construction will be studied for possible salvage to supply them to civic and public groups that express interest

6 5 WILDLIFE

Development of the Rawhide project will result in the loss of some existing wildlife habitat The primary mitigation to this impact will be the development of habitat for waterfowl small game and non game species around the cooling pond and other areas of the site These efforts will focus on the west and northwest portions of the cooling pond where one or more small islands will be developed to provide nesting sites for waterfowl

Windbreaks consisting of tree and brush plantings will also be established in these areas to reduce wave action and thus allow

the establishment of aquatic vegetation near the shoreline and to provide cover and nesting habitat Aquatic vegetation will be transplanted at appropriate locations along the shoreline to accelerate the development of wetland habitat Platte River will seek guidance from the Colorado Division of Wildlife in the establishment of a wildlife habitat at the site

As stated in Section 6 4 Vegetation disturbed areas will be revegetated and rangelands within the Rawhide site will be managed in such a manner that will allow them to recover productivity that was lost through excessive grazing These actions will benefit most species of wildlife that utilize the site

Water quality within the Rawhide cooling pond will be maintained at a level that will allow the establishment of a warm water fishery Except for the riprap on the face of the dam however the cooling pond will be relatively barren of features that add diversity to the aquatic environment Therefore artificial devices consisting of old railroad ties rock piles or concrete fragments will be placed at appropriate locations within the cooling pond to provide a fish habitat Platte River will consult with the Colorado Division of Wildlife on the establishment of a fishery in the cooling pond

Fencing around the site boundaries will be a type that will not be a barrier to antelope movements The rail spur will be unfenced or if fencing is needed on some segments it will be installed in a manner that will allow pronghorn antelope to cross

6 6 AIR QUALITY

The Rawhide Energy Project Unit 1 will be designed to meet all applicable State and Federal emission and ambient air quality standards This includes the requirement to meet the Class II Prevention of Significant Deterioration (PSD) and the ambient increments established by the Colorado Air Pollution Control Commission

During construction roads on-site will be paved or gravel surfaced and wetted to minimize fugitive dust emissions Water spray vehicles will be used to control dust in areas of site preparation excavation and construction

Pollutant emissions from the combustion process will be controlled with the equipment described in Section 2 The 500 foot stack will ensure adequate dispersion of those emissions Fugitive dust emissions from coal handling facilities will be controlled with fabric filter systems or water sprays A below grade

storage system will be developed for the inactive coal reserve to reduce wind erosion Water sprays compaction and reclamation will be used to control dust emissions from the solid waste disposal area On site roads will be paved to reduce emissions from solid waste disposal activities

In addition to the equipment and procedures used to mitigate air quality impacts from the power plant operations Platte River will actively encourage car pooling in both the construction and operation phases of the Rawhide project A program will be established to provide both construction and operations employees with the names address and telephone numbers of co workers living in the area This type of program should help reduce the number of vehicle miles driven and thus reduce the air quality impact of construction and operations employee traffic

6 7 LAND USE

Development of the project will result in the conversion of grazing lands capable of supporting approximately 13 animal units per year to uses associated with energy production This lost productivity will be mitigated through the implementation of controlled grazing on the remainder of the site Range condition and productivity studies that were conducted on the site indicate that palatable forage is being produced at an annual level of approximately one-third of the potential capacity of the range Through proper management it is probable that carrying capacity can be doubled

Proper management will involve the continued resting of the undisturbed range followed by light grazing (substantially less than 50 percent of annual production of palatable species) Light grazing will be continued until range conditions and productivity levels are achieved that approach those levels associated with similar range sites that are in good condition As stated earlier Platte River is working with the U S Soil Conservation Service to develop a grazing management plan for the Rawhide site Implementation of such a plan will result in long term productivity that exceeds productivity lost through development of the project

In addition Platte River will irrigate and cultivate crops such as alfalfa on the NW¼ of Section 4 This quarter section has been cultivated in the past but has been fallow for the past two years

6 8 CULTURAL RESOURCES

An archaeological survey of the Rawhide site was conducted so that significant sites could be identified and salvaged before construction begins As was stated earlier no significant sites were identified at locations that will be disturbed To provide added assurance that no significant sites are destroyed an archaeologist will be on call to investigate any discoveries uncovered during construction

6 9 RECREATION

The Rawhide site will be open to recreational use by the public Potential recreational uses include observation of waterfowl and other wildlife that are expected to utilize the cooling pond educational tours of the generating station and other areas of the site and fishing Platte River intends to develop a warm water fishery within the cooling pond and public fishing will be allowed if it can be established that no health hazard exists ~~As shown in Figure 2 5~~ Recreational facilities consisting of picnic tables interpretive facilities and a small enclosed herd of buffalo will be developed near the south east shore of the cooling pond

6 10 VISUAL RESOURCES

In order to reduce visual impact it is necessary to affect either the amount of change created the amount of change seen or the viewer s interpretation of what is seen The use of proper colors will minimize the amount of change created by reducing the contrast created between project structures and the surrounding landscape The chimney will be constructed of light colored concrete and except for the top 30 feet will be left unpainted to minimize the contrast of its silhouette against the sky However strobe lights will be mounted on the chimney to comply with FAA safety regulations The power generation buildings will be painted a muted shade of tan to minimize contrast with the surrounding rangelands with the tops of the buildings and chimney trimmed in chestnut brown

The amount of visual change or contrast created by the dominant vertical elements of the Rawhide generating station will be partially reduced by measures that emphasize or reinforce horizontal characteristics Masses of trees extending from the facilities into the landscape will be planted to create a strong horizontal line This will integrate the project with the surrounding topography by making a more gradual transition between the landscape and the vertical structures

The amount of visual change that can be seen is minimized most successfully at the outset through careful site selection This facto was considered in siting the plant and is detailed in a report prepared by EDAW Inc Among other factors the plant was intentionally situated in a low lying sparsely populated area in order to minimize the amount of visual change seen

Mitigation measures will also be directed towards the public s interpretation of the visual changes seen These measures will include a landscape plan that projects an image of the plant unlike that commonly associated with obtrusive industrial complexes EDAW Inc is developing a landscape plan that will achieve an organized and orderly appearance through the arrangement of plant materials and ground forms to articulate spaces control views and facilitate compatible land use relationships

6 11 NOISE

Noise levels within and near plant facilities will be maintained in compliance with OSHA standards Land has been acquired around the plant facilities to provide a buffer zone so that noise levels can be maintained at acceptable levels at the Rawhide site boundaries

6 12 LOCAL GOVERNMENT IMPACT MONITORING

Projections of socio economic impacts resulting from the Rawhide Project indicate that with a few exceptions the impact on local government will be small What impact does occur will be difficult to identify and will most likely be confined to (i) the Fort Collins Wellington area and (ii) the northern part of Larimer County in the immediate vicinity of the Rawhide plant site Most of the work done to date by Platte River s consultants suggests that because of the very small degree of impact that is expected from Rawhide an elaborate or sophisticated monitoring system which went into a multiplicity of detail would not be cost-effective

The kind of monitoring system which would be needed in this situation would be one that (i) carefully establishes baseline data for potentially impacted activities before the Rawhide project construction begins (ii) collects data on expenditures by affected local governments and agencies and (iii) provides pertinent employment and demographic data in the jurisdictional areas of such local governments and agencies including data on Rawhide and the local economies Such a monitoring system does not now exist but can be constructed with justifiable additional effort

Unless other arrangements are made for the reimbursement of local governments for the impact of Rawhide to which Platte River and such governments agree the monitoring system which Platte River would propose would accumulate information from available sources and develop data from new sources in a way which would provide impact identification and suggest the degree of mitigation or reimbursement

The following information would appear to be useful to effectively monitor the experience of local governments before during and after construction of the Rawhide Project and to establish the amount of direct and identifiable impact which can be attributable to that project

1 Annual population and employment data within the jurisdictional area of those local governments and agencies for which impact is reasonably predicted These local governments and agencies probably would include Wellington Larimer County the Poudre R 1 School District and possibly Fort Collins

2 Annual tax levies income and expenditure data from all such local governments and agencies and where such budget data may contribute to an assessment of the problem

3 Monthly demographic data for the employees of the Rawhide Energy Project including family sizes number of school children and other data that would assist impact assessment

4 Data necessary to measure inflation rates on an annual basis for each identified local government and agency subject to impact

5 Road network inventory and evaluation from the standpoint of traffic volumes level of service and capacity for Wellington and northern Larimer County

~~It may be desirable for~~ by mutual agreement, Larimer County and Platte River Power Authority who have responsibilities for keeping track of potential impacts and for reviewing data as the Rawhide Project evolves ~~to~~ to create an ~~informal~~ advisory group that ~~would~~ could fulfill the role of an impact monitoring committee ~~If such a group were formed, it should be appointed jointly by Larimer County and Platte River, although if the impacts from Rawhide turn out to be as small as is now anticipated, such a special group may not be justified. In that event, Larimer County and Platte River would themselves jointly fulfill the roles of reviewing and evaluating concerns that evolved from data gathered by the impact monitoring system.~~

~~If an impact monitoring system is adopted it must be designed to deal with the realties of Rawhide in the best way possible It must be flexible so as to be responsive to changes in program, budget and sources of funds and it must be acceptable to local government decision makers. The impact monitoring system proposed would also be subject to revision as needed to reflect changing circumstances in the pre-construction, construction, and post-construction periods of the Rawhide Energy Project~~

6 13 PLAN FOR FISCAL AND OTHER ASSISTANCE

The plan for fiscal and other assistance to local governments in the vicinity of the Rawhide Project can be broken into two different categories Each will play its part in providing an understanding of any direct and identifiable impact in the area as well as suggesting mitigation activities

The first form of impact mitigation would be to provide services and/or funds to directly mitigate such impacts as are discussed in ~~Section 5 of~~ this report Negotiations between Platte River and affected local governments and agencies will work out the details of how the impact is to be mitigated standards for construction formulas for cost sharing timing of activities etc ~~For example, if it is agreed between Larimer County and Platte River that county roads in the area of the Rawhide site would be impacted by construction vehicles and worker traffic, the two parties would get together and work out the details of the needed improvements The following kinds of details would then need to be resolved (1) what road segments need upgrading and what kind of structural treatment for roads is required, (2) what road engineering and construction standards including grading, drainage and bridges would apply; and (3) what cost sharing formulas would be used.~~ These are part of an integrated agreement between Platte River and Larimer County, a copy of which is attached Each identified and agreed upon impact would follow a similar process. ~~Impacts and corrective measures would be identified and agreed upon first, with the operative details to be worked out later between Platte River and the affected local government. Following agreement implementation of the impact mitigation program would take place.~~

The second form of assistance would be one generally described as education Platte River would make available information gathered in various studies that identify the impact consequences

of other power plant projects in other parts of the state and surrounding states This information would be used to develop an understanding of what should be expected from the Rawhide Project No other single energy project will be exactly like Rawhide but all such project possess certain similarities from which insights can be gained about what might be expected in Rawhide's case

tion information is already available from other power plant projects and additional material will be developed Projects that appear to offer an insight into the impact consequences of power plants and which should provide good background information for affected local governments include (1) Colorado Springs Ray Nixon Power Plant south of Colorado Springs Colorado (2) Public Service Company's Pawnee Plant near Fort Morgan Colorado (3) the Tampa Plant near Craig Colorado and (4) the Missouri River Basin Power Plant at Wheatland Wyoming

[illegible] potential impacts and [illegible] approach recognizes that [illegible] mitigation is a change rather than outright elimination of impacts Platte River will endeavor to develop practicable assistance programs and should take the initiative to work with local officials and the original owner Self help projects that can be developed locally with the assistance of local governments offer the best opportunity for positive forward looking programs that has local community involvement and commitment

6 14 TRANSMISSION LINE MITIGATION MEASURES

The primary mitigation for transmission line impacts is careful route selection A study conducted by IDAW Inc resulted in the careful selection of the proposed Rawhide transmission line routes based upon minimizing impacts on agriculture wildlife habitats residences and other criteria Additional mitigation measures are described in the following sections

6 14 1 Soils

The amount of soil disturbance that occurs during transmission line construction will be minimized by confining equipment movement across undisturbed areas as much as possible Soils that are compacted during construction will be treated so that they may recover lost permeability and on cultivated lands this usually can be accomplished by the use of deep tillage tools Platte River will either furnish these services in affected areas or reimburse the landowner for having it done or doing it himself where soils become severely compacted Additional measures may be

necessary At some locations it may be necessary to seed the compacted area to deep-rooted crops to reduce tillage operations and to provide protective mulches against rain in order to allow the soil to rebuild its structure and recover reasonable permeability If and where such measures are necessary Platte River will assume all costs including those associated with lost productivity while the affected soils recover Similar efforts will be made on compacted range land where necessary

Erosion control measures will also be taken to minimize the amount of soil loss These will include revegetation of disturbed areas and other stabilization measures where necessary

6 14 2 Hydrology

Revegetation and stabilization of disturbed areas will minimize impacts on hydrology The proposed routes were carefully chosen to minimize impacts on aquatic areas

6 14 3 Vegetation

Disturbed rangelands will be reclaimed and revegetated as soon as possible after construction is completed Revegetation plans will be developed on a site specific basis in cooperation with the landowner

6 14 4 Wildlife

A survey of the proposed transmission line routes was conducted so that important wildlife habitats could be identified and avoided The transmission line poles arms and insulators are designed sufficiently visible under all but the most adverse weather to be avoided by migratory and other birds The conductor phases (wires) are sufficiently far apart (17 5 feet) to be beyond the wingspread of any bird and thus virtually precluding hazard from electrocution

6 14 5 Land Use

The proposed transmission line routes were selected to minimize impacts on existing land use Platte River will work with affected landowners to make minor adjustments in the proposed transmission route alignments and carefully spot poles to further minimize land use impacts The proposed transmission line construction period which extends from Fall to Spring was chosen to minimize disruption of agricultural activities

6 14 6 Visual Resources

The proposed transmission line routes were chosen to minimize visual impacts to residents of the area High terrain areas and areas of higher population densities were avoided wherever possible The transmission line support structures (poles) have a more aesthetic design than lattice and some other designs In addition the poles will be treated to have a non glare dull gray finish that will minimize reflections and structure visibility The conductor (wires) will also be treated to minimize reflection and the shimmering effect that can be seen on some transmission lines

6 14 Transmission Line Operations Mitigation

The electrical field generated by transmission lines can cause interference with television and radio reception under some circumstances If television and radio reception are impaired by operation of the transmission lines from the Rawhide Project Platte River will work with the affected individuals to restore good reception Reception problems have not been reported to date by any individuals living near the existing Platte River 115 kV and 230 kV lines in Larimer or Weld Counties

Platte River will make available to individuals who live near the proposed Rawhide transmission lines a brochure that provides a discussion of the potential safety hazards associated with high voltage lines To eliminate the nuisance shocks that are sometimes experienced when an individual touches an ungrounded object Platte River will ground all fences that are located within the proposed rights of way

Any damages that are caused to fence crops or other items by emergency repair of the Rawhide transmission lines will be paid for by Platte River

6 15 WATER PIPELINE MITIGATION MEASURES

Mitigation of construction related impacts for the Rawhide water supply pipeline will include working with affected residents along the path of construction to assure (1) that driveways are not blocked and (2) that special concerns about access to fields or other areas are handled properly One or more field engineering representatives of Platte River will be on the job during working hours or on call after hours to help prevent socio economic or environmental impacts or to assure mitigation of those that cannot be prevented

Traffic control will be an integral part of the water pipeline construction mitigation measures When one lane of traffic must be shut down to install the pipeline flagmen will be posted to assure safe traffic operations with a minimum of disruption In congested areas such as the pipeline crossing at Colorado Highway 14 a tunnel will be bored and the pipeline inserted through this tunnel This will allow uninterrupted traffic flow during construction operations

The pipeline contractor will be restricted to working only during daylight hours to reduce the noise impact of construction machinery on nearby houses The contractor will also be required to use water sprays to reduce fugitive dust emissions from construction activity

Areas along the pipeline route that are disturbed during its construction will be restored as close as possible to their original condition by the pipeline contractor or his subcontractor The field engineering representative on the job will monitor the progress of this reclamation to assure its completion After the Rawhide water pipeline commences operation frequent inspections will be made to assure that water is not leaking from the pipeline

6 16 AIR MONITORING PROGRAMS

An air quality monitoring station will be established by Platte River in order to monitor the ambient air quality impacts of the Rawhide Project following its start up and to assure compliance with State and Federal regulations This monitoring station will be located near the point where the maximum annual average NO_x SO_2 and TSP concentrations are predicted to occur As shown in ~~Appendix 16~~, this point is about 0 8 miles north of the Rawhide power plant chimney near the northern boundary of the site

This monitoring station will contain equipment to measure and record ambient air concentrations of NO_x SO_2 and TSP In addition the existing weather monitoring equipment at the Rawhide site will be used to record meteorologic conditions at the site

Plans for the location of the air quality monitoring station and for the types of monitoring and recording equipment installed will have to be approved by both the Environmental Protection Agency (EPA) and the Colorado Air Pollution Control Division

Monitoring equipment will also be installed to monitor and record the levels of NO_x and SO_2 emitted from the Rawhide plant along with a monitor to measure plume opacity This will provide a

record of the Rawhide Project s compliance with State and Federal emission standards The monitoring equipment will be purchased and operated in a manner to comply with the performance requirements of the EPA and the Colorado Air Pollution Control Division

6 17 WATER MONITORING PROGRAMS

Some systems in the Rawhide plant require a high quality of water which must be provided by special treatment systems The e treatment systems produce wastes which contain treatment additive residues dissolved and suspended solids and other chemicals Other systems in the plant can use lower quality water which requires less treatment with less wastes produced

Water is also used to transport bottom ash to the storage pond It is difficult to predict accurately the amount of pollutants that will be in these waste streams and accordingly wastewater monitoring will be conducted as outlined in Table 6A to provide performance data on waste treatment systems and information on the pollutant content of discharges from the plant

The ~~460~~ 500-acre cooling pond will be filled and supplied with treated effluent from the Fort Collins Sewage Treatment Plant No 2 (STP 2) There is little precedent for forecasting the future water quality conditions and aquatic ecosystem relationships with Rawhide One in operation using sewage effluent for cooling The quality of the treated effluent may vary considerably in the future and unforeseen phenomena may cause major shifts in chemical characteristics or biological activity in the pond The quality of the STP 2 effluent will be monitored on a regular basis to provide information to manage the operation of the cooling pond water treatment system

The quality of the makeup water following treatment at the Rawhide site will be monitored as will the quality of the water in the cooling pond Investigations of the aquatic ecosystems in the pond may be necessary at times and will be arranged as needed The effluent from STP-2 will be regularly analyzed by the Fort Collins Water Department chemist assigned to the laboratory there and the results of such regular monitoring will satisfy the requirement for monitoring the effluent prior to treatment at the site All other water quality testing will be handled by the chemist employed at the Rawhide Project

There are several features of Unit 1 that present a potential for affecting ground water quantity and quality The cooling pond is the most significant with the coal storage and the solid

Table 6A

Rawhide Project Water Quality Monitoring Program

Location	Parameter	Frequency
At STP No 2	As Required by State	Weekly
	Flow C F S	Continuous
Effluent into Cooling Pond (after treatment)	pH	Continuous
	Carbon dioxide	Daily
	Alkalinity	Daily
	Temperature	Continuous
Inlet of Condenser	Temperature	Continuous
	pH	Continuous
	Suspended Solids	Daily
	Dissolved Oxygen	Daily
	Alkalinity	Daily
	Hardness	Daily
	Sulfates	Daily
	5 Day Biological Oxygen Demand	Monthly
	Coliform	Monthly
	Heavy Metals	Twice Yearly
Outlet of Condenser	Chlorine	Continuous
	Temperature	Continuous
Recycle Pond and miscellaneous Discharges to Cooling Pond	Flow C F S	Continuous
	pH	Continuous
	Suspended Solids	Daily
	Total Dissolved Solids	Daily
	Hardness	Daily
	Trace Elements	Twice Yearly
	Heavy Metals	Twice Yearly
Cooling Pond	Level	Daily
	Visual for Algae Color Foam etc	Daily
Monitoring Wells Coal Creek and Seasonal Pond 1/	Total Dissolved Solids	Monthly
	pH	Monthly
	Water Analysis 2/	Twice Yearly
	Trace Elements	Yearly
	Heavy Metals	Yearly
	5 Day Biological Oxygen Demand	Yearly

1/ Coal Creek below Spottlewood Creek seasonal pond east of eastern boundary
2/ See Appendix 5 for water quality parameters to be tested

waste disposal area having less potential for such impacts round water monitoring wells have been installed so that existing ground water characteristics may be ascertained prior to and during plant operation ~~The wells are designated B-3, B-79 and B-35, as shown in Appendix 6~~ Additional on-site monitoring wells will be drilled to the upstream of the solid waste disposal area and downstream of the cooling pond dam Any water leaking out of the cooling pond will discharge into the subsurface but some will surface below the dam along the toe The ground water monitoring locations and the program are summarized in Table 6A and will enable Platte River to conduct regular observations on quality of ground water and to identify changes that may be the result of the operation of Rawhide One

6 18 VEGETATION MONITORING

No damage to vegetation is expected to result from emissions associated with the Rawhide Project This conclusion is based upon predicted levels of emissions from Rawhide that will be several times less than the levels at which damage may occur to plants most susceptible to SO_2 Nevertheless in addition to constantly monitoring air quality near the point predicted to have the highest average annual concentrations of SO_2 ~~(see Section 5.9)~~ Platte River will monitor potential impacts on vegetation by planting susceptible species such as pinto beans and alfalfa in the northwest quarter of Section 4 This area has been previously cultivated and is located near the point where the maximum average annual concentrations of SO_2 are predicted to occur Crops cultivated at this location will be carefully monitored under controlled conditions to detect any changes that may be induced by emissions from the Rawhide Project

6 19 WILDLIFE MONITORING

The Colorado Division of Wildlife monitors antelope populations within the region surrounding the Rawhide site This will continue during the construction and operation phases of the Rawhide Project and will allow a determination to be made of the actual impacts observed in antelope populations in the region surrounding the site Platte River will also monitor wildlife usage of the site either through a cooperative arrangement with the Colorado Division of Wildlife or by contracting with an institution such as Colorado State University

AGREEMENT

This Agreement made and entered into this 21 day of March 1979 by and between the Board of County Commissioners of Larimer County Colorado (County) and the Platte River Power Authority (Platte River) herein collectively called the Parties

WITNESSETH

In consideration of the promises and mutual covenants herein contained and the County s approval of Platte River s application for land rezoning and special review of the Rawhide Energy Project a 230 megawatt (net) coal fired electric energy generating unit and related facilities to be constructed in northern Larimer County (Rawhide) the Parties agree as follows

I GENERAL AGREEMENTS

1 The Parties agree that the conditions and requirements set forth herein together with those set forth in the decision of the County which shall be attached hereto and incorporated herein as Exhibit A are necessary and reasonable to protect promote and enhance the public welfare and comprise all of the conditions and requirements to be imposed by the County in connection with its rezoning and approval by special review of Rawhide This Agreement shall be incorporated in and expressly made a part of the County s zoning resolution approving Rawhide

2 Platte River is an electric energy production and transmission instrumentality that is wholly owned by the municipalities of Estes Park Fort Collins Longmont and Loveland with responsibility for constructing and operating Rawhide

3 The Parties intend by this agreement to establish a procedure that will provide an ongoing comprehensive and responsible review of the environmental aspects of Rawhide all as more specifically set forth in this Agreement

4 Both Parties are governmental entities and this Agreement shall not be construed to limit or supersede the governmental authority of either Party but is intended to clarify the respective governmental obligations of both Parties

II IMPACT MONITORING AND ALLEVIATION REVIEW TEAM

1 The Parties agree that there is hereby established an environmental impact monitoring and alleviation review team (Review Team) for the purpose of examining and making recommendations to the Parties in regard to environmental aspects of Rawhide as hereinafter set forth

2 The membership of the Review Team shall consist of

a A representative designated by the County who shall serve as Chairman of the Review Team

b A member of the Larimer County Planning staff

c A member of the Larimer County Department of Health

d A representative of the Town of Wellington designated by Wellington s Town Council

e A representative of the United States Agricultural Research Service in Larimer County designated by that service

3 The Review Team shall be the forum for hearing citizen or other public comments or other matters arising with respect to the environmental land use or socio-economic aspects of the construction and operation of Rawhide

4 The Review Team shall convene at the call of its Chairman but shall meet at least once per calendar quarter in public session to receive comments and to address other matters pursuant to this Agreement

5 The Review Team shall prepare a quarterly written review to be submitted to the County and to Platte River which shall contain a summary of public comments received a report of the activities and recommendations of the Review Team and a report on the sufficiency of the various corrective actions it has observed in the light of the requirements set forth herein

6 Platte River agrees to pay the County for the out of pocket expenses of the Review Team other than reimbursement for salaries of its members in the actual annual amount thereof not to exceed $10 000 per year through the calendar year 1984 and $5 000 per year thereafter The first such payment shall be made as an advance upon the execution of this Agreement and each subsequent payment shall be made on the first business day of the year to which such payment applies following the receipt of an accounting for funds previously expended

7 Subject to approval by the County the Review Team may expend such funds to assist the Review Team on specific matters covered by this Agreement

8 Platte River shall keep the Review Team advised of the progress of all environmental impact monitoring and alleviation programs undertaken in connection with Rawhide Copies of all environmental studies and reports relating to Rawhide shall be made available to the Review Team for its use in formulating recommendations to the Parties pertaining to the following subjects

a Visual impact of Rawhide

b Impact of Rawhide upon vegetation and wildlife

c Impact of fugitive dust the disposal of solid wastes and the reclamation of land areas disturbed by Rawhide

d Impact of the Rawhide cooling pond on water quality in wells and aquifers affected by the presence of said cooling pond

e Impact within Larimer County of the transportation of coal to and its storage at Rawhide and

f Impact of noise generated at Rawhide

9 Within 30 days after the receipt of a Platte River study or report as to matters specified in Section 8 above the Review Team shall transmit to Platte River any recommendation concerning the environmental land use or socio-economic aspects thereof Platte River shall reply with its written decision and reasons therefor within 30 days after receipt of each Review Team recommendation If Platte River s decision is not satisfactory to the Review Team the Review Team s recommendation may be referred to the County If the County concludes that such recommendation should be reconsidered or that additional time is required for review it shall arrange a meeting with Platte River to discuss it Platte River agrees to use its reasonable best efforts to comply with all reasonable requests by the County in support of the Review Team s recommendations

10 The County shall furnish a meeting place mailing address and shall be the custodian of all correspondence and records of the Review Team

III LAND USE CONSIDERATIONS

1 In order to assure compliance with reasonable land use conditions established by the County and to avoid or minimize delays in the construction of components of Rawhide affecting land use the Parties agree as follows

a Platte River shall provide to the County information plans designs and/or specifications as appropriate and relating to the following features of Rawhide

(i) Site layout

(ii) Water pipeline design and construction

(iii) County road improvements

(iv) Solid waste disposal reclamation and revegetation

(v) Drainage erosion and flood control including plans for the diversion of Coal Creek

(vi) Site landscaping and lighting

(vii) Interior road construction

(viii) Cooling pond construction and water quality control and

(ix) Air and water quality monitoring facilities

b The County shall promptly review such plans designs and/or specifications and shall deliver to Platte River its comments thereon within 30 calendar days

2 Platte River shall also provide copies of such plans designs and/or specifications to the Review Team at the same time they are submitted to the County

3 Platte River shall provide to the Review Team the site plans for improving the visual impact of Rawhide by the planting of trees shrubs and grasses It is understood and agreed that visual impact mitigation measures under this Section will be contained on the Rawhide site and will be undertaken in such a manner as Platte River shall determine to be feasible and practicable in the circumstances

4 Electric transmission lines between Rawhide and the Platte River electric transmission system shall be constructed along routes acceptable to Platte River and approved by the County following a public hearing to be held in April 1979

5 Platte River agrees to use its reasonable best efforts to construct such transmission lines in a manner that minimizes their impact upon areas of residential density and to minimize their impact upon productive agricultural acreage by the location of the transmission line poles

IV CONDITIONS FOR WILDLIFE

Platte River agrees to develop plans for a monitoring system to measure the impact of Rawhide upon wildlife and to provide such plans to the Review Team If adverse impacts upon wildlife are

found to be attributable to Rawhide Platte River shall use its reasonable best efforts to mitigate such impacts and shall provide evidence of the results of such mitigation to the Review Team

V VEGETATION

1 Platte River agrees to provide to the Review Team an air quality and dispersion model relating to the areas physically impacted by contaminants resulting from the products of combustion from Rawhide

2 Platte River agrees to monitor through the use of on site test plots native and cultivated vegetation to determine if injury or damage is occurring to such vegetation as a result of the operation of Rawhide

3 Data from the monitoring of vegetation pursuant to this Section shall be made available to the Review Team at least twice during each growing season If Rawhide has a significant adverse impact upon such vegetation Platte River shall use its reasonable best efforts to mitigate such impact

VI FEDERAL AND STATE PERMITS

Platte River agrees to report to the Review Team on a quarterly basis concerning the status of all applications for Federal and State permits and reviews which are required for Rawhide

VII FUEL STORAGE TRANSPORTATION AND BY PRODUCTS

1 Platte River shall use its reasonable best efforts to

minimize coal dust and other particulate matter dispersal from the coal storage sites at Rawhide

2 Platte River agrees to use its reasonable best efforts to assure that all coal delivery to Rawhide will be handled in a manner to reduce coal dust and other particulate matter employing such methods as are found to be technically and economically feasible

3 Platte River agrees to dispose of fly-ash residue and other solid wastes on the Rawhide site in a manner that will not endanger public health safety or welfare

4 Platte River agrees to conduct a solid waste disposal monitoring program at Rawhide in accordance with the regulations of the Colorado Department of Health and to report the findings of such program to the Review Team

VIII AIR QUALITY

1 Platte River agrees (i) to meet or exceed and comply with all Federal and State air quality standards rules and regulations applicable to the construction and operation of Rawhide and (ii) to install air quality control equipment incorporating the best available control technology at the time such equipment is ordered for initial installation

2 Platte River agrees to establish appropriate air quality monitoring systems in accordance with applicable Federal and State regulations and to report to the Review Team at least quarterly interpreted results from such monitoring systems as to the actual air emissions and ambient air conditions affected by Rawhide

IX WATER SUPPLY AND DELIVERY

1 Platte River agrees to use its reasonable best efforts (i) to encourage and require the other parties to its water reuse agreement namely Fort Collins and Water Supply & Storage Company to comply with their contractual obligations under said agreement (ii) to maximize the quantities of reusable water available under that agreement and (iii) to maximize the operational efficiencies of that agreement s water supply plan

2 Platte River shall inform the Review Team of any modifications of the water reuse agreement s plan for augmentation as are approved by the Water Court

3 If for any reason it appears that water available to Platte River under its water supply plan will not be sufficient to permit operation of Rawhide then Platte River shall provide to the Review Team as soon as practicable its alternative water supply plans for securing sufficient water for such operation

4 Platte River agrees that under no circumstances as a result of future deficiencies or otherwise shall it exercise its power of condemnation or eminent domain to acquire water supplies for Rawhide

5 Platte River agrees that designs and engineering plans for the construction of the water supply pipeline to Rawhide shall be furnished to the County for review pursuant to Article III Section 1 of this Agreement

X WATER QUALITY MONITORING AND COOLING POND DEVELOPMENT

1 Platte River agrees to develop plans for water quality monitoring and provide them to the Review Team Such plans shall include

A n p l t l ce l iro l water mo ito ng p i ts both o d off the Rawl de s te together with description of the mo to ing methods to be employed

b W ter qu lity s mpli i i amote s d mpli g f eq e s t cl mon to ing points and Engi e i e det l wl h d er be the pro posed mo tori g eq ipme t to be used

Pl tt Ri sl ll pply to the R view Team all interpreted d t bta ed f o h s f c l g ound wate monitor g d se its reaso able best effo ts to mit gate y signific t ad erse wate q l ty imp cts

Pl tte River will establish the followi g mo itoring a d po t p og s lating to the Rawhide cooling po d

A b oloj cal s vey of the aquatic resources of pote t lly influenced areas near Coal Creek and Spottlewood Creek to be conducted coordina tio ith represe t t ves of the Colorado Division of W ldlife

b A p og am fo mo itor g water q ality of i coming w te and the Rawhide cooling po d to identify s g ific t problems from a public health a d e re t on st dpo t

A i t t w th the cool g po l s p n y c fo el ctric e erny ge er t on to dete mi e f sl l i ertebrate species suited

11

to the R wh l co l g po l a d its e me t to e ha e the biological p od ctivity l e reatio l val e of th t cooli g po d l to monitor the de elopment f y of f sh g the ei

4 The d ta pro ided by the mo itor i d de lopme t l programs d tak p s t to this A t cle sh ll be s pplied by Platte Ri er to the Rev ew Team q art l, through December 31 1988 and to the County a lly the e fter

XI ROAD IMPROVEMENTS

1 The Parti s agree that the following La mei Co t, o d segme ts will ce l to be e tended graded ejraled re l g ed pa ed d otherwise improved incl di g elated co struction o replacement of r dges culverts nd lr i ge i ciliti s s necess ry in o der to ccommodate the dditional el ic lar traffic resulting from the const ction and operatio of Rawhide

a	County Road 82 Segme t 1	from its i ters ctio with I terstat 25 to ts i tersection with th e ti nce to the R whide site
b	Cou ty Ro d 82 Segme t 2	f om ts tersec io w th th t e to the Rawhi l te to its ters ct o w th Co ty Ro d 15
c	County Ro d 9	f om the o the e d of t e t j v me t o t te c o w th Co ty Ro d 82 n l
d	Co ty R d 15	f om its inte sect o with Co ty R d 82 to ts te ectio w th Co nty Ro d 78

I

2 I d s i c l te l p ct the l improveme t wo k desc bed n Sect o l of this Arti l the County shall retain a f rm of e g eers registe ed Colorado and acceptable to Platte R ve All such o d improveme t work shall be done in accordance w th the Co ty s ro l q eering st dards e cept for County Road 82 Segme t l wl ch hall be regrade l j el a d otherw se impro ed to s ch h gher st d ris s Platte River may specify to accommodate the weight d olume of R whil o str ction traffic

3 S bject to ie mb se ent s provided in S ct o 6 of this A t le the Co ty sl li cquire ll ea eme ts and rights of w y e d d to ccommod te ch road improvement work

4 The road mproveme t work de c bed in Section 1 of this A ticle shall be do e pursuant to co t ct or contracts awarded by the Cou ty to the lowest espons ble b dder based upon cons de ations of the co tra tor s ep tation his available wo k fo ce his abil ty n the Co nty j dgm t to complete the work on schedule his will ns e s a d b l y to b de by Colorado law d the lowest et o t

5 The P t es agree th t co t cts fo said road impro me t work sh ll pec fy complet o d tes so that all ch work may be fi h d by Oc ob 31 1980

6 Platt R er agrees to mb se the Co nty fo ts act l o t of po ket re a d co tr ct cost to ucl oad mp ovem t o k cl l j q j fe l ght of w y ost j d ly tl Co ty ch co t rc ly t m t u to amo t to $1 4 0 000 b t th f q e sh ll ot be co t oll j The Co ty shall Abso b t te l o st t e costs atti b table to ch ro d improve n t work fo wh ch mp ct imb rseme t is pro ided pursu nt to Article XII

I

7 Payment by Pl t Ri fo s l road mpro eme t wo k shall be d will t (10) d ys followi g re ipt of the Co nty s in o ce s pported by the Co ty s certific te of wo k p formed a d by evidence of out of pocket costs i curred

8 I co st ct o of the water p pel c f R de P tte Ri er shall e t e to th o l gi e i q t d rds of th Co t, all segme ts of Cou ty roads wh h e dist rb d by s ch co str ct o Platte Ri er grees to sc its r o ble be ffo t to m n r e the i co ve ie c a sed to esi le ts and fa mini ope at c lo o ch Co nty roads a d to hold the Co nty h mless f om y l b l y arisi g f om such water pipeli e co t ct o ll s mor def nit ely set forth in the ca em nt g e m t the efor to be ent d i to between the Co t a d Pl tte Ri

II FI CAL IMPACT PAYMENTS

1 Fo (i) ll l cet d d rect il t f able ost rp ts of Rawhide po tl Co nty a d tl low of Well gton ot vol i g road impro ement l for (ii) ll services po mits ro d r te ance a d spect o to be pro d d to Pl tt R e by s ch an er mental entities for Rawl de Platte Ri er agrees to pay to the Co ty fo the be ef t of both s ch jo e ent l e t t th total of Two H ndred N nty ix tho sa o Thr H ired Doll rs ($ 96 300) Such sum h ll le p l p t to the ollow sched le

5	o D mb r	31	1979	20	De b	31	1984
5	o D be	31	1980	10% o	D mb	31	198
10	o D embe	31	1981	10% o	D cemb	31	1986
10%	o De embe	31	198	5% o	D emb	31	1987
20	on D embe	3	1983	5% on De ember		31	1988

If either Party can demonstrate a different total fiscal impact occurring before December 31 1988 the Parties agree to negotiate further and if warranted to adjust the payments accordingly

2 For each full calendar year following the effective date of this Agreement Platte River shall make annual payments to the Poudre R 1 School District relating to the school children of employees at Rawhide who reside in the County and attend Poudre R 1 Schools the amount of which shall equal the amount that would be paid as financial assistance to that school district for such year by the Federal government pursuant to Public Law 81 874 Impact Aid (20 U S C 236) the same as if Rawhide were a Federal facility

XIII CONSTRUCTION STANDARDS INSPECTIONS AND SITE RECLAMATION

In order to assure compliance with the building code of the County to minimize impacts upon the County s engineering and inspection personnel and to avoid unnecessary delays in the scheduled construction and completion of Rawhide the Parties further agree as follows

1 To the extent applicable to steam-electric power plant construction Platte River shall adopt specifications for all Rawhide structures which conform to the building codes and construction standards approved by the County for new construction in unincorporated areas

2 Platte River at its sole expense shall retain the services of a firm of professional engineers registered in Colorado and qualified in the fields of civil structural mechanical electrical and sanitary engineering to inspect construction work at Rawhide at least weekly throughout the period of its construction Copies of all such inspection reports shall be furnished to the County promptly following the completion thereof Prior to each weekly inspection Platte River shall give reasonable notice to the County of the schedule and scope thereof and the County may if it chooses send a representative to accompany such construction inspectors

3 Upon request Platte River shall furnish to the County a copy of the designs and specifications for any structure or civil work at Rawhide Upon completion of each such structure or work Platte River shall obtain and furnish to the County a certificate from the engineering firm selected pursuant to Section of this Article that such structure or work has been constructed in accordance with the plans and specifications therefor and where appropriate for steam electric power plants in compliance with the building codes and construction standards of the County

4 A building permit will not be required by the County for the construction of any of the components of Rawhide including facilities on site the water pipeline and the transmission lines

5 If Platte River abandons the Rawhide site as a location for the generation of electric energy Platte River agrees to reclaim or restore such site by the removal of all above ground structures excluding the cooling pond dam and power plant foundations and in accordance with such reasonable specifications and procedures as the Parties shall agree upon at the time of such abandonment

XIV REMEDIES UPON DEFAULT

1 Upon default of this Agreement by either party the nondefaulting party may

a obtain specific performance of this Agreement in a Court of competent jurisdiction

b proceed in any manner authorized by law for a breach of contract including obtaining a judgment for damages or

c pursue any other remedy otherwise available to such non defaulting party in the absence of this Agreement

2 In the event of default the defaulting party agrees to pay all the expenses incurred by the aggrieved party occasioned by said default including but not limited to a reasonable expense for attorneys fees in enforcing the terms and provisions of this Agreement and if the Court determines that the default was willful or intentional liquidated damages in the additional amount of Ten Thousand Dollars ($10 000)

XV SEVERABILITY

1 If any provision of this Agreement is declared to be invalid or unconstitutional by a decision of any Court of competent jurisdiction the Parties agree that

a the effect of such decision shall be limited to that provision or provisions which are expressly stated in the decision to be invalid and

b such decisions shall not affect impair or nullify this Agreement as a whole or any other part thereof but the remainder of this Agreement shall continue in full force and effect

XVI TERM OF AGREEMENT

This Agreement shall become effective when duly approved and executed on behalf of the Parties and shall continue in effect for as long as Rawhide is operable provided that Articles II and XII shall terminate on December 31 1988 and provided further that if any law is enacted by the State of Colorado subjecting Platte River to taxation or requiring it to make in lieu of tax payments the proceeds of which are provided directly or indirectly to local government) Article XII of this Agreement shall be null and void Upon execution of this Agreement together with County approval of the transmission line routes the Intergovernmental Agreement of August 25 1977 between Platte River and the County shall be deemed fully performed and terminated

EXECUTED this 26 day of May 1979

THE BOARD OF COUNTY COMMISSIONERS
LARIMER COUNTY COLORADO

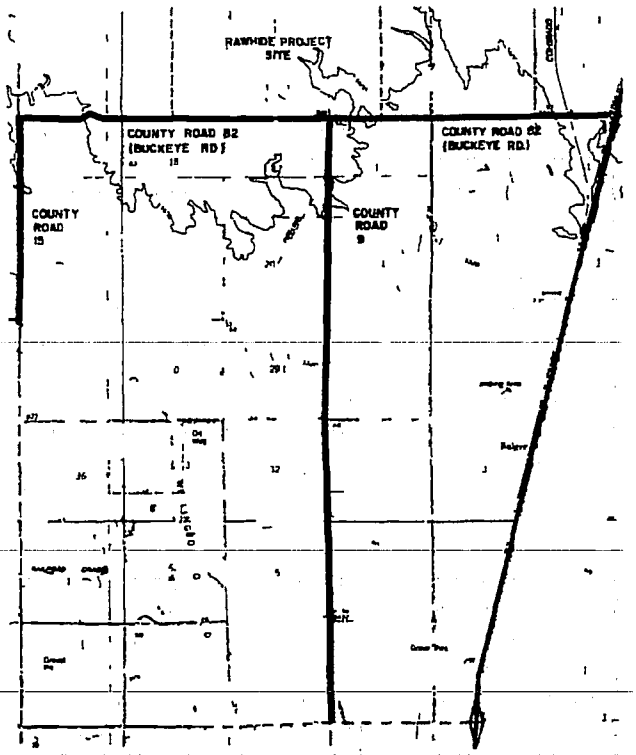
ATTEST:
Deputy and Acting Clerk of the Board

By

PLATTE RIVER POWER AUTHORITY

ATTEST:
Secretary of the Board

By

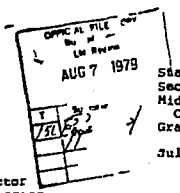


This map is anne ed to and made a part of the Agreement between Larimer County and Platte River dated (7(1979 It shows by the solid highlighted li es the oad improvements to be made at Platte Ri er s e pense pursuant to Article XI of that Agreement

Page	Revision
VII 2	Strike the figure $210 in the next-to last li e of the second paragraph of Section B and insert $298
VII 3	Strike the fig re 400 in the fo th li e on the page and insert 500
VII 3	Strike the ig es 30 and 230 in the ne t to the last sentence of the last par graph of Sectio C and insert 33 and 250
VII-4	Strike the figure 230 in the second l es of the fifth a d sixth paragraphs on page VII 4 and n ert 250 i the second line of the s t p ragraph strike the fig re 30 and i sert 33
VIII-1	Strike the figures 1400 d 400 i the fifth a d seventh lines of the second paragraph Inse t the figures 1500 and 500
VIII 1	In third paragraph seco d line evise Project t road projects
VIII-1	Strike the figures 30 a d 230 in the sixth and seventh lines of the fourth paragraph In ert the figures 33 and 250
VIII-2	This page is missing in the copies supplied to Platte River
IX-8	Change the heading 2 Energy Development Aspects to "C Rawhide Energy P oject"
IX 9	Strike the last two sentences of the first full para graph i e the final parag aph of subsection c Conservation and insert "O May 8 1978 Platte River and the fou c ties it serves organized the M icipal E ergy Saving Associ ation (MESA) The purpose of this organizat on is to (i) develop and implement consumer education a d aw e ness programs (ii) enco rage the efficie t use of elect i energy by consumers (iii) e courage opt n m til tio of municipal electric systems and (iv) discourage any wasteful use of electric energy The formation of MESA is the first step toward the impleme t tion of co ser vatio programs in all four cities

Page	Rev ion
IX 9 (cont)	The effect that MESA and other city operated programs will have on co serving electric energy is uncertain There has been virtually no impact on Pl tte River s load g owth since ene gy conservation first became a sensitive national issue in 1973 The high le el of comme cial a d industrial activity in and around the four cities served by Platte River and the attendant population inflows into the area have kept loads in the Platte River system growing at about 10% per year The si to eight yea lead times associated with planning conducting environmental studies obtaining the ecessary permits financing and constructing a odern coal fired power plant dictate th t Platte River must proceed with the Rawhide Project in the early sp i g of 1980 in order to have it available by April 1984 The MESA conse vation prog am will of course continue but their major impact may be on the timing of future generation additions rather than on Rawhide One
IX 12	Strike subsection e text and insert the following "A detailed evaluation of transmission corridors w s conducted for Platte River by the environmental planning firm of EDAW Inc Figure IX J shows the co r dors which were e al ated The two ro tes desig nated by solid lines were selected by the Platte River Board of Directors as having the least environmental impacts and submitted to County authorities (A suggested Figure IX 3 is submitted he ewith)
IX 13	Rev e fi t paragraph under g Alternative Water Supply to read "Alternatives to present water supply plans for the Rawhide Project and future Platte River generation projects include (1) Windy Gap (2) development of ground water resources in the vicinity of a project rea (3) requesting the fo r municipalities to provide proportional shares of water which they may have avail able and (4) purchase of water rights f om individuals or orga izations who are willing to sell The Windy Gap Project is described in detail in this document Platte River s allotment of Windy Gap water would be sufficient to meet the needs of fut e ge e ation projects including additio al units t R wh de
IX 13	Revise the first sentence of the second paragraph of "g Alter ative Water Supply by striki g Platte River Powe Authority (PRPA)" and inserting "Rawhide Energy Project in the seco d and fifth sentences strike PRPA and insert Rawhide evise the sixth sentence to read

Page	Revisio
	If PRPA were to obtain a supply from wells tapping bedrock aquifers that was on the same order of magnitude required for Unit One the total pumpage requirement would be about 2600 gpm Revise the last sentence of that paragraph to read "It is unlikely that pumping of ground water could support more than one 250 MW unit
X 6	Strike the heading b Energy Development Insert "J Rawhide E ergy Project"



Stanley W Cazier
Secretary
Middle Park Water
Conservancy District
Granby Colorado 80446

July 31 1979

Mr Joe D Hall Regional Director
United States Department of Interior
Bureau of Reclamation Regional Office
Lower Missouri Region
Post Office Box 25247
Building 20 De ve Federal Center
Denver Colorado 80225

RE Windy Gap P eliminary EIS LM 150

De r Mr Hall

The following is s bmitted as the comment of the Middle Park Water Conservancy District based upon te tiary review of the Draft Enviro-mental Statement as presented It is not intended that this commen should be considered all inclusive but hopefully encloses in a ve y short form many of the concerns of the Middle Park Water Conser ancy District as to the water portions of the project The D strict is certain that other entities will in fact address many other of your main points but Middle Pa k wanted to specifically address some of the items of concern regarding the effect on appropriators in Western Colorado

The Middle Park Water Conservancy District is n entity formed under Colorado Revised Statutes 37 45 101 et Seq 1973 as amended Middle Park Wate Conservancy District was formed in 1950 and is one of the successors of the Western Slope Protective Association One of the powers and duties of the Middle Park Water Conservancy District is the preservation and development of water within its District boundaries which encompass the entirety of Grand and Summit Counties Colorado It contains all of the storage and diversion facilities in the Colorado Big Thompson Project located in Western Colorado Any enlarged use of Colorado Big Thompson Project facilities has a direct and immediate effect on Middle Park Water Conservancy District

The conce ns of the Middle Park Water Conservancy District emanate both from state water law and federal law with the proposed Windy Gap facility Colorado is an appropriation state and operates under the principle of first in time first in right and first adjudicated has a right to utilize water and call out junior appropriators of water Any mas ive development of water such as the Windy Gap Project has the ultimate effect of preventing present and future growth and

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development by creating scarcity on the system due to Windy Gap s ability to call out junior appropriators comi g on to the system subsequent to the Windy Gap Project As such the Windy Gap Project is of vital concern to Middle Park Water Conserv ncy District in that it effectively prevents other utilization of this wate within the confines of Grand and Summit Counties and the entirety of Western Colorado

A copy of Colorado Revised Statutes 37-45-118 General Powers 1973 as amended is attached to this letter as Exhibit A and made a part hereof Said statute specifically states what the powe of a water co serva cy district such as the Middle Pa k W ter Conservancy District and the Mu icipal Subdistrict of the Northe n Colorado Water Conservancy District have the right to exercise Of particular note and underlined is the provision under (1)(b)(IV) which provides that any diversion of water by a water conservancy d strict out of the Colorado River Basin ca not be made in such a manner as to impair or increase the cost of water to water use s within the natural basin As mentioned in the Environmental Impact Statement the Windy Gap Project does in fact have a favorable uling on this from the Water Referee Additionally however the Water Court for Water Divisio No 5 has entered a Memorandum Opinion and an I terlocutory Decree awarding a decree to the Municipal Subdistrict of the Northern Colorado Water Conservancy District However in part the same decree provides that it is mandatory that the Municipal Subdistrict provide proof of compliance when it shows reasonable diligence on its project of this section Nowhere in the Draft Environmental Statement is there any evidence of compli ce by the Municipal Subdistrict and Northern Colorado Water Conservancy District of this equirement

This diversion will have a rubberband effect on the entire Colorado River Basin which has not been properly analyzed in the Draft Environmental Statement In other words the diversion of this w ter will cause a shortage to se-ior appropriators further on downstream who call for the water Since the call is operated to take the most junior water rights off of the system first and since Grand and Summit Counties have very junior water rights as a rule said call by senior water rights will have a dramatic effect in G and and Summit Co nties in preventing growth because there will be an undependable wate supply An analysis of this effect has been totally left out of the Draft Environmental Statement

Another important effect under Colorado Water Law which has not been analyzed by the Draft Environmental St tement as to Grand and Summit Counties is the possibility of condemnation or othe purchases of water rights The Report goes into some length about the problem on the Eastern Slope and the possibility that if water

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rights are not otherwise obtained by this project then it will be necessary for these cities to condemn water rights on the Easte n Slope However no mention is made of the fact that once this facility has been built and since it is a very junior water right it can be hypothesized that in order to protect its water right the Municipal Subdistrict in Northern Colorado Water Conservancy District s next step will be to purchase or otherwise acquire water rights to guarantee a more dependable supply This has the effect of drying up meadow land and also depleting the tax base in Grand County

The const ction of this project in fact preempts the construction of other projects which may be more beneficial to the Western Slope and the Report co tains no analysis of those other additional projects This is especially crucial in light of the fact of the United States energy position and new reliance on coal and oil shale particularly the oil shale which is plentiful in Western Colorado Any number of reports have said that the critical question on oil shale is in fact the availability of water to the industry This particular project if built will prevent the development of additional water storage projects along the Colorado Basin that can particularly be utilized by the oil shale industry and satisfy a part of the United States energy requirements No new analysis of this fact has been included in the Report

The Draft Environmental Statement seems to completely gloss over as non-existant the practical day-to-day actual effect on water users in Western Colorado Any number of times the Town of Hot Sulphur Springs has pointed out to the various representatives of the Municipal Subdistrict of Northern Colorado Water Conservancy District that the downg ading of flow in the Colorado River Basin at their points of diversion will create problems far greater than the Town of Hot Sulphur already has especially in light of major expenditures by a small town to improve their water system which will be completely for naught The Draft Environmental Statement also has no analysis of the tremendous adverse impact upon each and every individual rancher and appropriator from the point of diver io of Windy Gap to at least the Town of Kremmling The effect of this diversion is in fact to lower the headgates of said divertor and make it impossible for them to divert their water rights by their existing ditch headgates The original system installed by the Colorado Big Thompson Project has proven to be totally inadequate being a pump system because of the low flows in the Colorado River system itself the cost of energy and the problem with said pumps sanding up and maintenance thereof Also for any ditch divertor that needs to improve his ditch o headgates and run out to pick up water from the new mainstream of the Colorado Creek not the Colorado River they will have to obtain a Corps of Engineers Permit and spend some considerable amounts of money to find where the new channel of

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the River may be The position of the junior divertors is somewhat worse In the upper ends of Grand County with the advent of the Windy Gap Project there would be a call upon the River which will call out all junior divertors and stop all the growth that has been occurring in the County or force the growth areas to obtain and retire good meadow land from irrigation Especially critical are the cases such as Winter Park Water and Sanitation District where their entire wate supply is already controlled either by a Special Use Permit and/or the Denver Water Board another major Eastern Slope divertor No analysis of growth in Grand County is included in said Repo t which is especially important in the east end of the County where this particular diversio is going to have a critical impact

Another point that the Draft Environmental Statement has not addressed is the effect on fisheries of the lowered flow There could be little doubt that the 75 cfs as let out probably is inadequate to maintain the fishery in the Colorado River between Granby and Kremmling which has been in existence in the past Many ranchers depend on said fisheries and their fishing leases for supplemental income none of which is pointed out in said Report Inc eased shallowness of the Colorado River is going to be a complete detriment to the system of fishing as known along this str tch today Obviously as pointed out by the Report there will be an increase in suckers and other no -game fish The Report points out that the loss of the Colorado River along this stretch is not that bad because it is principally leased private fishing However it is utilized and has been for many years for private fishi g and since said private fishing is in fact a certain segment of the public a quality public fishery will be lost

Another point that probably eeds to be touched upon at this point in time in the question of federal law It is mentioned periodically in said Report and attempted to be glossed over The operation of the Big Thompson Project is subject to Senate Document 80 a copy of which s Xe pked and att ched hereto Th 1955 nd 1964 Dec ees as mentioned in the Draft Environmental Statement only address the question of what occurs when an Eastern Slope divertor besides the Municipal Subdistrict of Northe n Colorado Water Conservancy Distr ct and the Northern Water Conservancy District attempts to obtai de facto cont ol of the 100 000 ac e feet compensatory pool of Green Mountain Reservior The actual question of use of Green Mountain Reservoir water for supplying Western Colorado has not been addressed The position of at least this weste n ent ty i that as pointed out in Senate Document 80 it is for the present ard future use of Western Colorado However the Bureau of Reclamation in interpreting its obligations under said Document has been less than cha itable n

it outward manifestations as shown by the Draft Environmental Statement Also this is compounded by the fact that this 100 000 acre compensatory storage pool has not in fact been allowed to service Western Colorado This is shown by the fact that well permits have been denied in Grand a d Summit Counties and Three Lakes Water and Sanitation District has been requested to provide water to the Colorado Big Thompson Project even light of Gree Mountain Reservoir storage The Towns of Granby Kremmling and other entities in Grand and Summit Counties have requested water out of Green Mountain Reservoir with less than satisfactory results n light of time

The last critical question is the issue of salinity Tho Report fails to point out dramatically e ough that the wate that will be taken o t of Grand County is the best that is produced in Colorado The increase in salinity is detrimental to the entirety of the Colorado Rive Basin n degradatio of fodo al law

Obviously the D aft Environmental Statement as to just a small portion r viewed by Middle Pa k is inadequate The problem presented by this p rticular project as proposed and constructed without compensa tory storage to Western Colorado is dramatic The removal of this high qu lity wate is goirg to provent growth in Grand County and force obvious detrime tal results upon all water users along the Colorado River Basin Said impacts are not adequately addressed in the Report a d it is submitted under Colorado water law that it is impossible to analyze the effects of this project as if it is in a vacuum

Very truly yours

Stanley W Carier

SWC co

Enclosure

37 45 117 Employment of agents The secretary shall be custodian of the records of the district and of its corporate seal and shall assist the board in such particulars as it may direct in the performance of its duties The secretary shall attest under the corporate seal of the district all certified copies of the official records and files of the district that may be required of him by this article or by any person ordering the same and paying the reasonable cost of transcription and any portion of the record so certified and attested shall prima facie import verity The secretary shall serve as treasurer of the district unless a treasurer is otherwise provided for by the board The board may also employ a chief engineer who may be an individual partnership or corporation an attorney and such other engineers attorneys and other agents and assistants as may be necessary and may provide for their compensation which with all other necessary expenditures shall be taken as a part of the cost or maintenance of the improvement The chief engineer shall be superintendent of all the works and improvements and shall make a full report to the board each year or oftener if required by the board and may make such suggestions and recommendations to the board as he may deem proper The secretary and treasurer and such other agents or employees of the district as the court may direct, shall furnish corporate surety bonds at the expense of the district in amount and form fixed and approved by the court conditioned upon the faithful performance of their respective duties

Source L 37 p 1323 § 12 CSA C 173 B § 26 CRS 53 § 149 6 12 C R S 1963 § 150 5 12

Am Jur See 45 Am Jur 2d Irrigation § 61 50 Am Jur 2d Levees and Flood Control § 6

37-45 118 General powers (1) The board has power on behalf of said district

(a) To have perpetual succession

(b) (I) To take by appropriation grant purchase bequest devise or lease and to hold and enjoy water waterworks water rights and sources of water supply and any and all real and personal property of any kind within or without the district necessary or convenient to the full exercise of its powers

(II) To sell lease encumber alien or otherwise dispose of water water works water rights and sources of supply of water for use within the district

(III) To acquire construct or operate control and use any and all works facilities and means necessary or convenient to the exercise of its power both within and without the district for the purpose of providing for the use of such water within the district and to do and perform any and all things necessary or convenient to the full exercise of the powers granted in this paragraph (b)

(IV) However any works or facilities planned and designed for the exportation of water from the natural basin of the Colorado river and its tributaries in Colorado by any district created under this article shall be subject to the provisions of the Colorado river compact and the Boulder

Canyon Project Act Any such works or facilities shall be designed constructed and operated in such manner that the present appropriations of water and in addition thereto prospective uses of water for irrigation and other beneficial consumptive use purposes including consumptive uses for domestic mining and industrial purposes within the natural basin of the Colorado river in the state of Colorado from which water is exported will not be impaired nor increased in cost if the expense of the water users within the natural basin The facilities and other means for the accomplishment of said purpose shall be incorporated in and made a part of any project plans for the exportation of water from said natural basin in Colorado

(c) To have and to exercise the power of eminent domain and dominant eminent domain and in the manner provided by law for the condemnation of private property for public use to take any property necessary to the exercise of the powers granted in this article except that such district shall not have or exercise the power of eminent domain over or by means thereof to acquire the title to or beneficial use of vested water rights for transmountain diversion and in connection therewith such district shall not have the power to carry or transport water in transmountain diversion the title to which has been acquired by any municipality by virtue of eminent domain proceedings against any such vested rights

(d) (I) To construct and maintain works and establish and maintain facilities across or along any public street or highway and in upon or over any vacant public lands which public lands are now or may become the property of the state of Colorado and to construct works and establish and maintain facilities across any stream of water or watercourse except that the district shall promptly restore any such street or highway to its former state of usefulness as nearly as may be and shall not use the same in such manner as to completely or unnecessarily impair the usefulness thereof The grant of the right to use such vacant state lands shall be effective upon the filing by such district with the state board of land commissioners of an application showing the boundaries extent and locations of the lands rights of way or easements desired for such purposes

(II) If the land rights of way or easements for which application is made is for the construction of any aqueduct ditch pipeline conduit tunnel or other works for the conveyance of water or for roads or for poles or towers and wires for the conveyance of electrical energy or for telephonic or telegraphic communication no compensation shall be charged the district therefor unless in the opinion of the state board of land commissioners the construction of such works will render the remainder of the legal subdivision through which such works are to be constructed valueless or unsalable in which event the district shall pay for the lands to be taken and for such portion of any legal subdivision which in the opinion of the board is rendered valueless or unsalable at the rate of two dollars and fifty cents per acre If the lands for which application is made are for purposes other than the construction of roads or works for the conveyance of water or electricity or telephonic or telegraphic communication such district shall pay to the state for such lands at the rate of two dollars and fifty cents per acre

(III) Upon filing such application accompanied by map or plat showing the location or proposed location of such works or facilities the fee title to so much of such state lands as shall be necessary or convenient to enable such district efficiently and without interference to construct maintain and

EXHIBIT A
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operate its works and to establish maintain and operate its facilities shall be conveyed to said district by patent If an easement or right of way only over such lands is sought by the district such easement or right of way shall be evidenced by permit or grant executed by or on behalf of the state board of land commissioners The state board of land commissioners may reserve easements or rights of way in the public across any lands in such patents grants or permits described for streets roads and highways theretofore established according to law Before any such patent grant or permit is executed any compensation due to the state under the provisions hereof must be paid No fee shall be exacted from the district for any patent permit or grant so issued or for any service rendered hereunder

(IV) In the use of streets the district shall be subject to the reasonable rules and regulations of the county city or town where such streets lie concerning excavation and the refilling of excavation the relaying of pavements and the protection of the public during periods of construction except that the district shall not be required to pay any license or permit fees or file any bonds The district may be required to pay reasonable inspection fees

(e) To contract with the government of the United States or any agency thereof for the construction preservation operation and maintenance of tunnels reservoirs regulating basins diversion canals and works dams power plants and all necessary works incident thereto and to acquire perpetual rights to the use of water from such works to sell and dispose of perpetual rights to the use of water from such works to persons and corporations public and private

(f) To list in separate ownership the lands within the district which are susceptible of irrigation from district sources and to make an allotment of water to all such lands which allotment of water shall not exceed the maximum amount of water that the board determines could be beneficially used on such lands to levy assessments as provided in sections 37 45 121 to 37 45 126 against the lands within the district to which water is allotted on the basis of the value per acre foot of water allotted to said lands within the district except that the board may divide the district into units and fix a different value per acre foot of water in the respective units and in such case shall assess the lands within each unit upon the same basis of value per acre foot of water allotted to lands within such unit

(g) To fix rates at which water not allotted to lands as provided in paragraph (f) of this subsection (1) shall be sold leased or otherwise disposed of but rates shall be equitable although not necessarily equal or uniform for like classes of service throughout the district

(h) To enter into contracts employ and retain personal services and employ laborers to create establish and maintain such offices and positions as shall be necessary and convenient for the transaction of the business of the district and to elect appoint and employ such officers attorneys agents and employees therefor as found by the board to be necessary and convenient

(i) To adopt plans and specifications for the works for which the district was organized which plans and specifications may at any time be changed or modified by the board Such plans shall include maps profiles and such other data and descriptions as may be necessary to set forth the location [illegible] shall be kept in the office

(j) To appropriate and otherwise acquire water and water rights within or without the state to develop store and transport water to subscribe for purchase and acquire stock in canal companies water companies and water users associations to provide sell lease and deliver water for municipal and domestic purposes irrigation power milling manufacturing mining metallurgical and any and all other beneficial uses and to derive revenue and benefits therefrom to fix the terms and rates therefor and to make and adopt plans for and to acquire construct operate and maintain dams reservoirs canals conduits pipelines tunnels power plants and any and all works facilities improvements and property necessary or convenient therefor and in the doing of all of said things to obligate itself and execute and perform such obligations according to the tenor thereof but the sale leasing and delivery of water for irrigation and domestic purposes as provided in this section shall only be made for use within the district

(k) Nothing provided in this article shall be construed to grant to the district or board the power to generate distribute or sell electric energy except for the operation of the works and facilities of the district

(l) To invest any surplus money in the district treasury including such money as may be in any sinking or escrow fund established for the purpose of providing for the payment of the principal or interest of any contract or bonded or other indebtedness or for any other purpose not required for the immediate necessities of the district in its own bonds or in any legal investment authorized by the provisions of section 24 75 601 C R S 1973 for the investment of funds of political subdivisions of the state and such investment may be made by direct purchase of any issue of such legal investment or part thereof at the original sale of the same or by the subsequent purchase of such legal investment Any legal investment thus made and held may be sold from time to time and the proceeds reinvested in any such legal investment Sales of any such legal investment thus purchased and held shall be made in season so that the proceeds may be applied to the purposes for which the money with which the legal investments were originally purchased was placed in the treasury of the district The functions and duties authorized by this subsection (l) shall be performed under such rules and regulations as shall be prescribed by the board

(m) To refund bonded indebtedness incurred by the district under and pursuant to such rules and regulations as shall be prescribed by the board

(n) To borrow money and incur indebtedness and to issue bonds or other evidence of such indebtedness

(o) To adopt bylaws not in conflict with the constitution and laws of the state for carrying on the business objects and affairs of the board and of the district

Source L 37 p 1324 § 13 CSA C 173 B § 27 L 43 p 633 § 1 L 43 p 635 § 1 CRS 53 § 149 6 13 C R S 1963 § 150 5 13 L 71 p 1348 § 1

Am Jur Sec 45 Am Jur 2d Irrigation § 62 50 Am Jur 2d Levees and Flood Control § 1

C J S Sec 53A C J S Levees & Flood Control § 24 94 C J S Waters § § 313 370 371

Law reviews For article Factors Affecting Water Utilization in Colorado see 19 Rocky Mt L R v 341 (1947) For article Compensation by State see 2 Rocky Mt L Rev 453 (1930) For note Constitutionality of Colorado Statutes Providing for

Transmountain Water Diversions see 75 Rocky Mt L Rev 363 (1953) For article Reclamation Water Rights see 37 Rocky Mt L Rev 464 (1960) For note A Survey of Colorado Water Law see 47 Den L J 376 (1970)

The general powers over the affairs of the district after incorporation are granted to the members of the board of directors by this section with the jurisdiction of the district court limited by section 37 45 108 Peiker v Southeastern Colo Water Conservancy Dist 174 Colo 210 483 P 2d 232 (1971)

This section gives a district board the authority to adopt plans and specifications for the works for which the district was organized which plans and specifications may at any time be changed or modified by the board People ex rel Dunbar v South Platte Water Conservancy Dist 139 Colo 503 343 P 2d 817 (1959)

Board has duty to determine extent of property necessary to be taken In the exercise of the broad power vested in the district board there is a duty to determine among other things the extent of the property necessary to be taken to accomplish the public purpose and its determination of the question in the absence of fraud or bad faith is final accordingly the failure of the court to appoint a commission to determine the necessity of taking land above the high water line of the lake involved or to be involved was not error Kistler v Northern Colo Water Conservancy Dist 136 Colo 11 321 P 2d 616 (1957)

As to guides accompanying jurors inspecting lands during condemnation proceeding See Kistler v Northern Colo Water Conservancy Dist 136 Colo 11 321 P 2d 616 (1957)

37 45 119 Power to acquire rights of way Whenever pursuant to this article the electors of a water conservancy district have authorized a contract with the United States for construction and acquisition of works and water rights which contract has obligated the district to acquire rights of way therefor to be conveyed by the district to the United States upon reimbursement by the United States then the district without further election and through its board of directors has power to do all acts for acquiring such rights of way including borrowing of and paying interest upon such sums of money as shall be required to make deposits fixed by the court for possession and to pay awards on condemnation of said rights of way as well as amounts up to the appraised values of the particular rights of way as have been fixed by the appraisers for the United States in each instance of negotiated purchases notwithstanding the sum borrowed shall be greater than in the ordinary annual incomes and revenues of the district and all debts incurred and interest payments made prior to February 5 1943 for the aforesaid purposes are expressly authorized ratified and approved

Source L 43 p 641 § 1 CSA C 173 B § 27(1) CRS 53 § 149 6 14

CRS 1963 § 150 5 14

Cross references For the Colorado river compact see article 61 of this title for the Boulder Canyon Project Act see 43 U S C A § § 617 to 617u for eminent domain proceedings see articles 1 to 7 of title 38

Am Jur See 45 Am Jur 2d Irrigation § 62 50 Am Jur 2d Levees and Flood Control § 6

C J S See 93A C J S Levees & Flood Control § 73 94 C J S Waters § 321

37 45 120 Subdistricts (1) Subdistricts may be organized upon the petition of the owners of real property within or partly within and partly without the district which petition shall fulfill the same requirements concerning the subdistricts as the petition outlined in section 37 45 109 is required to fulfill concerning the organization of the main district and shall be filed with the clerk of the court and shall be accompanied by a bond as provided for in section 37 45 110 All proceedings relating to the organization of such subdistricts shall conform in all things to the provision of this article relating to the organization of districts except that not more than a majority of the owners of lands having one half or more of the aggregate valuation for assessment of the lands in the proposed subdistrict shall be required to sign the petition for the creation of a subdistrict and not more than twenty five percent of the owners of lands in the proposed subdistrict shall be required to sign the protesting petition against the creation of such subdistrict

(2) Whenever the court declares and decrees by its order duly entered of record such subdistricts to be organized the clerk of said court shall there upon give notice of such order to the directors of the district who shall there upon act also as directors of the subdistrict Thereafter the proceedings in reference to the subdistrict in all matters shall conform to the provisions of this article except that in the appraisal of benefits for the purpose of such subdistricts in the issuance of bonds in levying of assessments and in all other matters affecting only the subdistrict the provisions of this article shall apply to the subdistrict as though it were an independent district and it shall not in these things be amalgamated with the main district

(3) The petition for organization of a subdistrict shall also contain a statement of the amount or quantity of water for which said subdistrict desires to acquire the perpetual use and the amount of money that said subdistrict is willing to pay therefor and prior to the entry of its decree organizing any territory into a subdistrict the court shall obtain the verified consent of the board to furnish such perpetual use of water for the purposes therein specified to such subdistrict at a price and upon the terms mentioned in the petition then the court shall be authorized to enter its decree of organization of such subdistrict

Source L 37 p 1331 § 14 CSA C 173 B § 28 CRS 53 § 149 6 15

CRS 1963 § 150 5 15

Am Jur See 45 Am Jur 2d Irrigation § 58 50 Am Jur 2d Levees and Flood Control § 6

37-45 121 Classification of taxes and assessments powers (1) In addition to the other means of providing revenue for such districts the board has the power to levy and collect taxes and special assessments for maintaining and operating such works and paying the obligations and indebtedness of the district by any one or more of the methods or combinations thereof classified as follows

(a) Class A To levy and collect taxes upon all property within the district as provided in section 37 45 122

(b) Class B To levy and collect assessments for special benefits accruing to property within municipalities for which use of water is allotted as provided in section 37 45 123

(c) Class C To levy and collect assessments for special benefits accruing to property within public corporations for which use of water is allotted as provided in section 37 45 124

(d) Class D To levy and collect assessments for special benefits accruing to lands for which use of water is allotted is provided in section 37 45 125

Source L 37 p 1332 § 15 CSA C 173 B § 29 CRS 53 § 149 6 16

L 60 p 221 § 1 C R S 1963 § 150 5 16

75TH CONGRESS, 1st Session | SENATE | DOCUMENT No 80

COLORADO-BIG THOMPSON PROJECT

SYNOPSIS OF REPORT

ON

COLORADO BIG THOMPSON PROJECT, PLAN OF DEVELOPMENT AND COST ESTIMATE PREPARED BY THE BUREAU OF RECLAMATION, DEPARTMENT OF THE INTERIOR

PRESENTED BY MR ADAMS

JUNE 15, 1937—Ordered to be printed without illustrations

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON 1937

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LETTER OF TRANSMITTAL

FEBRUARY 3, 1937

From Senior Engineer Porter J Preston
To Chief Engineer
Subject Colorado Big Thompson project

1 Transmitted herewith is a synopsis of the report of plan of development and cost estimate of the Colorado-Big Thompson project

2 The plans and designs upon which the estimates are based are shown in the full report to follow this synopsis

3 The detail estimates have been worked out in the Denver office under the following divisions

Canals H R McBirney
Reservoirs K B Keener
Power L N McClellan
Hydraulics E B Debler

4 The field work was done under the supervision of M E Bunger

5 The economic study was carried on by R L Parshall, senior irrigation engineer Bureau of Agricultural Engineering, United States Department of Agriculture This study is later proposed to be issued as a separate document

PORTER J PRESTON

Revised synopsis of report submitted June 11, 1937

LETTERS OF SUBMITTAL

JUNE 11, 1937

Hon HAROLD L ICKES
Secretary of the Interior

MY DEAR MR SECRETARY There is attached hereto the portion of the report on the Colorado Big Thompson project in Colorado covering the principles and stipulations governing the construction and operation of said project for the protection of the rights and interests dependent on the Colorado River in Colorado

The provisions contained therein have been considered by the Northern Colorado Water Users Association representing the irrigation and other interests on the eastern slope in Colorado, and we respectfully submit that they are satisfactory and meet the approval of said association

We ask that acknowledgment be made of this communication

Respectfully yours

NORTHERN COLORADO WATER USERS ASSOCIATION
CHAS HANSEN *President*
MOSES E SMITH *Vice President*
THOMAS A NIXON *Attorney*

JUNE 11, 1937

Hon HAROLD L ICKES,
Secretary of the Interior

MY DEAR MR SECRETARY There is attached hereto the portion of the report on the Colorado Big Thompson project in Colorado covering the principles and stipulations governing the construction and operation of said project for the protection of the rights and interests dependent on the Colorado River in Colorado

The provisions contained therein have been considered by the Western Slope Protective Association representing the irrigation and other interests on the western slope in Colorado and we respectfully submit that they are satisfactory and meet the approval of said association

We ask that acknowledgment be made of this communication

Respectfully yours,

THE WESTERN SLOPE PROTECTIVE ASSOCIATION,
SIMON SMITH *Secretary*
CLIFFORD H STONE *Director*
A C SUDAN
Special Representative of Grand County

SYNOPSIS OF REPORT COLORADO BIG THOMPSON PROJECT

OUTLINE OF CONSTRUCTION AND OPERATING CONDITIONS

The Colorado Big Thompson project in Colorado contemplates the diversion of surplus waters from the headwaters of the Colorado River on the Pacific or western slope to lands in northeastern Colorado on the Atlantic or eastern slope greatly in need of supplemental irrigation water

To accomplish this diversion the following features are required

ON COLORADO RIVER

(1) Storage on the Blue River in what is called Green Mountain Reservoir located about 16 miles southeast of Kremmling Colo where the Blue enters the Colorado River This reservoir is to be used to replace water diverted to the eastern slope that would be required by prior rights along the Colorado River

(2) A hydroelectric plant below the Green Mountain Dam to utilize the flow of the Blue River and water stored in the reservoir for the generation of electrical energy

(3) A storage reservoir located on the Colorado River about 6 miles northeast of Granby Colo to be known as Granby Reservoir This reservoir will store the flow of the Colorado at this point as well as water diverted from Willow Creek a tributary of the Colorado and Strawberry and Meadow Creeks tributaries of the Fraser River

(4) A diversion dam located about one half mile below the junction of the North Fork and Grand Lake outlet and about 3 miles south of the village of Grand Lake This dam will create a lake known as Shadow Mountain Lake which will have the same elevation as Grand Lake and will aid in supplying the transmountain diversion tunnel with water pumped from Granby Reservoir This lake together with Grand Lake is to be kept at nearly constant level

(5) An electrically driven pumping plant on the shore of Granby Reservoir, where water will be pumped into a canal feeding Shadow Mountain and Grand Lakes The length of the canal is 4½ miles

(6) An outlet channel at the east end of Grand Lake connecting the lake with the portal of a transmountain diversion tunnel and provided with control features that will regulate the level of Grand Lake within a fluctuating range of 1 foot

(7) A transmountain diversion tunnel under the Continental Divide 13 1 miles in length extending from Grand Lake to a point in Wind River about 5 miles southwest of Estes Park village

ON EASTERN SLOPE

(8) A conduit 5 3 miles in length extending from diversion tunnel outlet to penstock of a power plant on the Big Thompson River just below Estes Park village This conduit will be made up of buried

pipe siphons, tunnels and open canal It will be entirely concealed through the area authorized to be taken into Rocky Mountain National Park

(9) The waste rock from the tunnel is to be terraced and landscaped and all structures connected with the tunnel will be constructed to blend into their natural surroundings

(10) A power plant known as power plant no 1 constructed along the Big Thompson River just below the village of Estes Park utilizing the western slope water

(11) Four additional power plants down the Big Thompson Canyon to utilize all available fall and also all water available for power in the Big Thompson River in addition to the western slope water diverted

(12) A diversion dam on Big Thompson River about 12 miles west of Loveland to divert the water by means of a canal 9 miles in length to a storage reservoir known as Carter Lake

(13) Carter Lake Reservoir located 8 miles northwest of Berthoud Colo to store water brought over during winter months Water is released from this reservoir through a 4 mile canal into the Big Thompson River and through a 9 mile canal into the St Vrain River for irrigation purposes

(14) A siphon across the Big Thompson River 9 miles west of Loveland Colo and a canal 10 miles in length to convey water from the fourth power plant to a storage reservoir located about 5 miles west of Fort Collins known as Horsetooth Reservoir

(15) A canal from Horsetooth Reservoir to the Cache La Poudre River and extended north to a pumping plant which lifts water high enough to serve the North Poudre Canal

(16) A storage reservoir near the mouth of Buckhorn Creek to be known as Arkins Reservoir supplied from a canal diverting from the Big Thompson River just below the last power plant It is to be used to aid in balancing the demands for power and irrigation also storing excess water available in the Big Thompson River Water will be released from the reservoir for supplemental irrigation in the South Platte area

(17) Transmission lines connecting the Valmont steam plant of the Public Service Co with all the hydroelectric plants contemplated also connecting with the transmountain tunnel portals and the Granby and North Poudre pumping plants The line connecting power plant no 1 and Granby pumping plant will run east and south of the outside boundaries of the Rocky Mountain National Park crossing the Continental Divide at Buchanan Pass

In order to carry out the construction operation and maintenance of the project as outlined above it will be necessary to comply with the following requirements as agreed to by representatives of the eastern and western slopes in Colorado and here made as a part of this report

MANNER OF OPERATION OF PROJECT FACILITIES AND AUXILIARY FEATURES

The construction and operation of this project will change the regimen of the Colorado River below the Granby Reservoir The project contemplates the maximum conservation and use of the waters of the Colorado River, and involves all of the construction features

heretofore listed In addition thereto certain supplemental construction will be necessary This will be for the primary purpose of preserving insofar as possible the rights and interests dependent on this water which exist on both slopes of the Continental Divide in Colorado The project therefore, must be operated in such a manner as to most nearly effect the following primary purposes

1 To preserve the vested and future rights in irrigation

2 To preserve the fishing and recreational facilities and the scenic attractions of Grand Lake, the Colorado River and the Rocky Mountain National Park

3 To preserve the present surface elevations of the water in Grand Lake and to prevent a variation in these elevations greater than their normal fluctuation

4 To so conserve and make use of these waters for irrigation power industrial development, and other purposes, as to create the greatest benefits

5 To maintain conditions of river flow for the benefit of domestic and sanitary uses of this water

In order to accomplish these purposes the project should be operated by an unprejudiced agency in a fair and efficient manner, equitable to all parties having interests therein, and in conformity with the following particular stipulations

(a) The Green Mountain Reservoir, or similar facilities, shall be constructed and maintained on the Colorado River above the present site of the diversion dam of the Shoshone power plant above Glenwood Springs, Colo with a capacity of 152 000 acre feet of water with a reasonable expectancy that it will fill annually Of said capacity 52,000 acre feet of water stored therein shall be available as replacement in western Colorado, of the water which would be usable there if not withheld or diverted by said project 100 000 acre feet shall be used for power purposes and all of said stored waters shall be released under the conditions and limitations hereinafter set forth

(b) Whenever the flow in the Colorado River at the present site of said Shoshone diversion dam is less than 1,250 cubic feet per second, there shall upon demand of the authorized irrigation division engineer or other State authority having charge of the distribution of the waters of this stream, be released from said reservoir as a part of said 52,000 acre feet the amount necessary with other waters available, to fill the vested appropriations of water up to the amount concurrently being diverted or withheld from such vested appropriations by the project for diversion to the eastern slope

(c) Said 100 000 acre feet shall be stored primarily for power purposes and the water released shall be available without charge, to supply existing irrigation and domestic appropriations of water including the Grand Valley reclamation project to supply all losses chargeable in the delivery of said 52 000 acre feet of water and for future use for domestic purposes and in the irrigation of lands thereafter to be brought under cultivation in western Colorado It shall be released within the period from April 15 to October 15 of each year as required to supply a sufficient quantity to maintain the specified flow of 1 250 cubic feet per second of water at the present site of said Shoshone diversion dam provided this amount is not supplied from the 52 000 acre feet heretofore specified Water not required for the above purposes shall also be available for disposal to agencies for the development of the shale oil or other industries

(d) The cost of construction and perpetual operation and maintenance of said reservoir or reservoirs shall be a charge against the project and shall be paid from revenues collected from this project as may be provided in contracts between the Secretary of the Interior and the beneficiaries of the project in eastern Colorado and any other contracting parties

(e) In the event said reservoir or reservoirs are not maintained with a capacity of 52 000 acre feet the Secretary of the Interior should withhold the diversion of water from the western to the eastern slope of Colorado until such storage capacity is made available

(f) The Secretary of the Interior shall have the option to require the transfer to the United States of any and all rights initiated or acquired by the appropriation or use of water through the works of the project in eastern Colorado at any time *Provided however* That the title so taken shall be subject to a beneficial use of such water as may be provided in the repayment contract or contracts and the rights to store water to the extent of said 152,000 acre feet shall be initiated, acquired, and held by the appropriate authorities for use in western Colorado, for replacement of water diverted to the eastern slope, and for other purposes contemplated for this project

(g) The Secretary of the Interior shall operate this project in accordance with the following stipulations as to priorities of water use as between the parties claiming or using project water and within the limits of his legal authority Said 52,000 acre feet of replacement storage in Green Mountain or other reservoirs shall be considered to have a date of priority for the storage and use of replacement water earlier than that of the priorities for the water diverted or stored for delivery to the eastern slope The 100 000 acre feet of storage in said reservoir shall be considered to have the same date of priority of appropriation as that for water diverted or stored for transmountain diversion

(h) Said Green Mountain Reservoir or such other replacement reservoirs as provided in paragraph (a) herein as are planned as a part of the project, shall be constructed at the same time as the other parts of the project and shall be completed before any water is diverted to the eastern slope of the Continental Divide by means of said project

(i) Inasmuch as the State of Colorado has ratified the Colorado River Compact and inasmuch as the construction of this project is to be undertaken by the United States the project its operation maintenance, and use must be subject to the provisions of said Colorado River Compact of November 24 1922 (42 Stat 171) and of section 13 of the Boulder Canyon Project Act, dated December 21 1928 (45 Stat 1057–1064) Notwithstanding the relative priorities specified in paragraph (g) herein if an obligation is created under said compact to augment the supply of water from the State of Colorado to satisfy the provisions of said compact the diversion for the benefit of the eastern slope shall be discontinued in advance of any western slope appropriations

(j) An adequate system as determined by the Secretary of the Interior shall be provided for the irrigation of the lands in the vicinity of Kremmling, now irrigated by either natural or artificial means and the installation made therefor shall be a part of this project The rights to the use of water for the irrigation of these lands shall be considered to have a date of priority earlier than that of the rights to the use of water to be diverted through the works of this project to the eastern slope This system shall be designed and built in a manner requiring the least possible continuing annual expense for operation

and maintenance but the cost thereof shall not exceed $300 000 and said system shall be provided and in operation before any water is stored for transmountain diversion In addition, the Secretary shall protect, add to, or improve the source of supply of domestic waters for the municipalities of Kremmling and Hot Sulphur Springs in the manner and to the extent which he may determine to be necessary to provide a source of supply not less than that now available for these municipalities The cost of these features shall be included in the total project cost

(*k*) To compensate Grand County for the loss of taxes through the transfer of property to the United States for the construction of this project, $100,000 shall be paid to said Grand County This payment shall be made in 10 annual installments of $10 000 each commencing upon the date when 10 percent of the total property in Grand County required for said project has been removed from taxation

(*l*) The project and all of its features shall be operated in a manner determined by the Secretary of the Interior as necessary to provide the water to preserve at all times that section of the Colorado River between the reservoir to be constructed near Granby and the mouth of the Fraser River as a live stream, and also to insure an adequate supply for irrigation, for sanitary purposes for the preservation of scenic attractions, and for the preservation of fish life The determination of the need for and the amount and times of release of water from Granby Reservoir to accomplish these purposes shall be made by the Secretary of the Interior, whose findings shall be final

In order to facilitate compliance with the stipulation in paragraphs (*j*) (*k*) and (*l*) hereof a representative may be selected and designated by the interests dependent thereon in Grand County Colo and when so designated he will be recognized as the official spokesman of said interests in all matters dealing with project operations affecting Grand County

The principles and provisions expressed in these stipulations have been approved by the Western Colorado Protective Association representing interests in western Colorado and the Northern Colorado Water Users Association as evidenced by the letters hereto attached

SUMMARY

The Colorado Big Thompson project comprises 615,000 acres of irrigated lands out of approximately 800,000 acres lying under the canal systems in the northern and northeastern portions of Colorado

The water supply for the area is to be derived from a portion of 782 square miles of drainage area above Hot Sulphur Springs lying west of the Continental Divide in Grand County, Colorado, and varying in elevation from 8,050 to 14 000 feet

HISTORY

The first irrigation in northeastern Colorado occurred about 1860 where the early settlers plowed out small ditches with sufficient grade and length to irrigate a few acres of land in the first bottom—i e lands not far above the high water line of the streams and adjacent to them

The first irrigation of the higher or second bench lands along the Cache La Poudre River was by the Old Union Colony, of Greeley, in 1870 This colony was organized by Horace Greeley then editor of the New York Tribune who will be remembered here especially for his advice to eastern young men to Go west and grow up with the country

This colony irrigated about 12 000 acres under their first project and it was a success from the start due in a large measure to the fact that they were people of considerable means and were then able to finance themselves over the period required to bring raw prairie land into profitable cultivation

This colony was soon followed by others along the Poudre at Fort Collins on the Big Thompson at Loveland and the St Vrain near Longmont

The difficulties experienced by these colonists in distributing the water between them led to the creation of Colorado s irrigation laws which have been copied by most of the irrigation States of the West

This irrigated area of six hundred to eight hundred thousand acres was developed by means of individual initiative and by small scale cooperative enterprises Today there are 6 400 irrigated farms served by 124 canals and ditches and 60 storage reservoirs

IRRIGATION USE

In the early days irrigation in this area was confined to growing crops to supply local needs, the lack of transportation contributing to high prices for the home grown production and prohibiting shipping to distant points The crops grown were mainly the grains and hay for local consumption with some vegetables Such irrigation corresponded with the run off of the streams

As mining developed in the State Denver and other towns grew into cities and after these cities were connected to the East by railroads the markets demanded a more diversified agriculture to supply their needs Thus a gradual demand developed for late water which the streams could not supply

This change created a need for storing the flood waters for late irrigation From 1890 to 1910 was a period of reservoir construction, during which storage was provided for all the available water supply of the streams over and above the direct irrigation requirements for the area here under discussion Much of this development took place during a decade of more than normal run off on the eastern slope and also during a period expanding the agricultural area throughout the West

Attempts to maintain the area under cultivation with the depleted run offs during the past 10 years have spread the water supply to such an extent that much acreage has had an insufficient water supply to produce full crops or crops producing the higher values Attempts have been made to supplement the individual farm water supply by the development of the underground sources by pumping from numerous wells throughout the region This is lowering the water table and already is affecting the water supply of the lower South Platte Valley which receives its irrigation supply largely from return waters

NEED OF SUPPLEMENTAL WATER

Under such conditions only the older water rights have any assurance of an adequate water supply and in the dryer years the owners of junior rights are forced to confine their farming to crops that can

be matured by the early flood flow or that require a minimum amount of water In years when the supply is not correctly estimated con siderable loss results Ordinarily the crops raised in this and other irrigated areas do not compete with those grown under rainfall condi tions but a shortage of water always leads to the ruining of more of the competing crops Such crops also cut the income of the irrigation farmer below what he can earn with the higher type noncompetitive crops

On fully three fourths of the 615 000 acres in the area the water supply is inadequate in spite of every effort to conserve store flood water or otherwise add to the water supply that has been within the financial ability of the farmer This inadequacy is due not only to a development probably too large for the period when run off of the streams was much higher than at present but to the fact that the last 10 years have seen a very marked decrease in the stream flow It must be emphasized that the additional water supply here contemplated is to be used for a supplemental supply and not to create a large new additional irrigated acreage

There has been expended in this area to date for various types of irrigation works including nearly $750 000 for pumping plants most of which have been installed in the last 10 years, about $35 000 000 against which there is an outstanding indebtedness of only $1 510 600 These people however, have about reached their limit as individuals and mutual irrigation companies to provide for themselves a supple mental water supply so badly needed to make their present water supply secure and are obliged to seek Government aid to bring this about

It has been conceded by a majority of the irrigation interests in this section of the State that the water supply in 1926 was ample for all then present acreage now irrigated In order therefore to deter mine the normal shortage in acre feet over a period of years a compar ison of the supply in these years with that of 1926 was made and the difference obtained These differences are set up in the following table

TABLE I —*Showing water districts acreage irrigated deficiencies 1925 to 1935 with tentative allocation of total supplemental supply*

Water district no	Area irrigated	1926 diversion acre feet	Average diversion 1925 35	Difference 1926 11 year average required supplementary water in acre feet	Tentative allocation of supplemental supply			
					Col relinquishing 75 acre feet per cubic foot of water	Mutual and J bar loan return flow	Present storage rights	Total supplemental supply acre-feet
	(1)	(2)	(3)	(7)	(15)	(16)	(17)	(18)	(19)
3	213 840	630 000	326 000	134 000	104 000		49 000	153 000
4	66 408	215 000	163 000	77 000	44 000		21 000	65 000
5	81 896	113 000	94 000	19 000	38 000		18 500	57 500
1	9 504	664 000	45 000	398 000	97 000	11 000	67 000	175 000
2	37 440	170 000	151 000	19 000	5 000	4 000	5 000	14 000
64	121 292	513 000	383 000	130 000	33 700	16 500	17 000	68 000
Total	615 436	2,226 000	1 049 000	575 000	310 000	30 000	218 500	554 500

It will be noted from column no 15 that the total average shortage in this project area which comprises water districts 3 4 5 1 2 and 64 is 575 000 acre feet Column no 16 is a tentative allocation of the proposed supplemental supply to the various districts Column no 18 is the estimated usable return flow that would arise from the addition of 310 000 acre feet of new water to this area Column no 19 is the total usable supplemental supply amounting to 554 520 acre feet, an amount within 5 percent of the 10 year average shortage The sale or rental of supplemental water when available, in the Poudre Valley has averaged $4 50 per acre foot over a period of years In extreme cases it has sold as high as $9 per acre foot

The deficiency in water supply for the period 1925 to 1934 inclusive reflected a direct economic loss in crop production of approximately $42 355 000

The following shows the approximate annual loss in value of crops because of inadequate water supply

Sugar beets	$1 900 000
Alfalfa	918 000
Small grain	470 000
Beans	302 000
Corn	228 000
Potatoes	425 000
All other crops	444 000
Total	4 700 000

This average annual direct crop loss is about 19 percent of the $24,600 000 estimated cost of the Colorado Big Thompson irrigation project

The crop loss in 1934 due to shortage of water as compared to 1926 after variation in price and acreage factors had been accounted for amounted to $12 400 000 or just one half the cost of the project

The losses here given are the farm losses and do not include the losses that are due to processing, transporting, or handling of that quantity or production which would add several million dollars to the loss of the community as a whole

The effect of such inadequate water supply for the period 1925–35 is shown graphically on drawing no 1 following

SUPPLEMENTAL WATER SUPPLY

In 1929 the State engineers of Colorado in cooperation with the Platte Valley Water Conservation League and the United States Army engineers, made a comprehensive study of the water resources of the South Platte Basin in northeastern Colorado This study included the Cache La Poudre River in water district no 3 the Big Thompson River in water district no 4 and the St Vrain River in district no 5 The investigators determined the excess water avail able on these streams above present normal demands and also above the normal demands on the South Platte River proper below where these streams enter

The investigators also determined the location capacity and cost of the most feasible reservoir sites for the storage of this excess water up to date by using the same demands for irrigation as set up in the report and using the water supply records furnished by the State engineer's office

Stream	Excess supply available for storage, April 1918-35	Capacity proposed reservoirs by Army engineers	Average annual yield at reservoirs	Total reservoir costs	Cost per acre-foot capacity	Cost per acre-foot yield
	Acre-feet	*Acre-feet*				
Cache la Poudre	30 000	52 000	28, 500	$1, 747 000	$73	$147
Big Thompson	16 000	32 700	11 300	2, 006 000	61	178
St Vrain	16 000	30 000	14 000	2, 150 000	73	153

From the foregoing table it is evident that there is not sufficient excess water available that originates in this area to supply the demands for supplemental water and the cost of making use of what is available is prohibitive It will be shown, however, that 16 000 acre feet of this surplus is available for storage in the Colorado Big Thompson project reservoirs on the eastern slope with no additional cost

The water users in northeastern Colorado have now exhausted every possible source of obtaining supplemental water or augmenting their present supply either by storage transmountain diversion within their individual cooperative means and by pumping Fortunately however, there exists a surplus of water on the headwaters of the Colorado River west of this area and separated from it by the Continental Divide

In the spring of 1935, $150 000 was allocated to the Bureau of Reclamation to make surveys and prepare plans and cost estimates for bringing water from the headwaters of the Colorado River into the area in northeastern Colorado in need of supplemental water

In August 1935 the Bureau of Reclamation started surveys for the project and previously there had been started a land classification to determine the irrigated and arable land in the Colorado River Basin in Colorado in order to arrive at the approximate amount of water now used in the area and how much might be used when full development has been made Both surveys have been completed insofar as this project is involved, and the following is the result of the land classification

LAND CLASSIFICATION—COLORADO RIVER AREA

Since the quantity of water available for diversion from the headwaters of Colorado River might be limited now by the water rights of lands already irrigated or might in the future limit in turn the development of lands in the Colorado Basin within the State all the land on Colorado River and its tributaries above the Colorado Utah line, except the Gunnison River area has been classified to show the location and extent of irrigated lands and of lands capable of irrigation

This classification was undertaken in all areas covered by former reports, supplemented by local information as to possible projects and by reconnaissance For localities with no records of water supply it was assumed to exist unless the contrary was obvious and doubtful areas were included rather than excluded from the classification The land was measured by plane table survey except some small isolated areas which were estimated

Land that had customarily been irrigated was so classed no matter how inadequate the supply Land capable of irrigation was

tested according to a set of standards which fairly represent the experience on this area and others as to what constitutes arable land Where pumping for irrigation was involved land was classified up to 200 feet above the source of supply

The result of the survey of the irrigated and arable land appears in the following table

It should be stated that as will be shown under the discussion of water supply which follows the present irrigated area above the Utah State line does not limit the diversion possible at the location chosen It is also true that the diversion when in operation and replacing the summer flow of Colorado River in the manner contemplated by the project plan will not limit the future development of all the arable land on Colorado River and its tributaries above Gunnison River

Colorado River drainage--Gunnison excepted—Colorado (land classification according to streams)

Stream name	Irrigated	Arable	Total
Colorado River	*Acres*	*Acres*	*Acres*
1 To Glenwood Dam	2 600	1 100	3 700
2 Granby Dam to Hot Sulphur Springs	1 300	350	1 650
3 Hot Sulphur Springs to Kremmling	1 300	1 100	2 400
4 Kremmling to Glenwood Springs	1 100	260	1 360
5 Glenwood Springs to Palisade	7 000	2 500	9 500
6 Palisade to State line	70 000	32, 850	103 400
Total	85 300	38 10	124 010
Tributaries			
Willow Creek	800	150	950
Troublesome Creek	7 [illegible]	650	7 750
South Fork Colorado River	[illegible]	30	640
Fraser River	2 [illegible]	4 [illegible]	6 300
Williams Fork River	3 [illegible]	11 [illegible]	14 500
Troublesome Creek	4 [illegible]	7 [illegible]	11 400
Muddy Creek	4 [illegible]	5 [illegible]	10 000
Blue River	8 [illegible]	3 [illegible]	11 500
Snake River	[illegible]	[illegible]	1 180
Blue Lake Creek	1 [illegible]	50	1 250
Piney Creek	800	50	850
Agate Creek	5 700	9 300	15 000
Cabin Creek area	5 [illegible]	2 000	6, 300
Catamount Creek	1 [illegible]	10	1 010
Sweetwater Creek area	1 [illegible]	300	1 450
Eagle River	18 [illegible]	6 [illegible]	21 400
Small streams	900	60	960
Roaring Fork River	33 [illegible]	9 400	42 500
Garfield Creek	2 [illegible]		2 100
Elk Creek	3 [illegible]	130	3 130
Divide and Miam Creeks	13 [illegible]	9 100	22 000
Rifle Creek	11 [illegible]	3 200	14 100
Parachute Creek	1 [illegible]	10	0 0
Roan Creek	5 [illegible]	3 300	8 900
Plateau Creek	24 [illegible]	7 [illegible]	31 600
Small streams	10 200	3 000	13 200
Grand total	256 300	122, 830	379 130

[1] Above Hot Sulphur Springs
[2] Between Hot Sulphur Springs and Kremmling
[3] Between Kremmling and Glenwood Springs
[4] Between Glenwood Springs and Palisade

WATER SUPPLY

The stream flow records at the different stations in the Colorado River Basin show the amount of water passing the stations after all present irrigation has taken place above so there is no need for any further adjustment of stream flow to take care of water consumed in this irrigation

It is assumed that all arable lands as shown will be irrigated some time in the future notwithstanding the fact that quite a percentage

is so located that it would never be feasible to irrigate It is also further assumed that reservoirs would be built on the tributaries to conserve a portion of the flood flows to make the irrigation of these arable lands possible

With the above assumptions it has been found that in a year like 1931, with the run-off only 40 percent of the average for a 31 year period and the lowest year of record the Colorado Big Thompson project would only have to supply approximately 53 000 acre feet to replace water diverted by the proposed project that could have been used by the Colorado River water users for power and irrigation, provided the project was in operation at that time

The average run-off of the Colorado for the years of record are Hot Sulphur 31 years 523 000 acre feet, Glenwood Springs including Roaring Fork, 3 413,000 acre feet Fruita 6 300,000 acre feet These amounts are exclusive of supply consumed in present irrigation of Colorado River Basin lands

The following is the estimated amount of water available for diversion from the drainage area above the Colorado Big Thompson collection system at 8 260 feet elevation

YIELD OF GRANBY RESERVOIR

Stream flow records available on the Colorado River near the Granby Dam site for the years 1908–11 and 1935–36 and on Willow Creek for the years of 1935 and 1936 were supplemented by estimates based on available stream flow records on the Colorado River at Hot Sulphur Springs and Glenwood Springs to cover the 37 year period 1900 to 1936 inclusive

A capacity of 482 000 acre feet was selected as the best capacity for the Granby Reservoir considering cost and use Of this capacity, 20 000 acre feet were set aside for dead storage to reduce pumping lifts for waters delivered to Shadow Mountain Reservoir A further objective is to keep to the lowest practicable area the exposure of reservoir bed when storage is exhausted This leaves an active capacity of 462 000 acre feet

Reservoir operating studies are based on the following conditions

(*a*) Recorded (or estimated) past flows of Colorado River at Shadow Mountain and Granby Dams reduced by 27 percent prior to 1906, and 13 percent thereafter of the flow of the North Fork at Grand Lake to allow for increasing diversions by the Grand River ditch

(*b*) Willow Creek diverted to reservoir to the extent of 90 percent of the flow of Willow Creek and other streams intercepted by the diversion canal from May to October inclusive of each year

(*c*) Strawberry Meadow and Walden Hollow Creeks also diverted whenever practicable The flow of these streams together with some additional waters capturable from Willow Creek at times are expected to offset evaporation and seepage losses in excess of present losses from the Granby and Shadow Mountain Reservoir sites

(*d*) No releases from Granby Dam for any reason

(*e*) Transmountain tunnel to be operated at full capacity from October 1 until March 31 following, with operations thereafter gaged to fit run-off conditions so as to avoid spills and yet concentrate flows in the period of July 15 to September 15 for the purposes of best

distribution in power production and to minimize reregulating storage requirements on the eastern slope The computations assumed infallible forecasts of run off

(*f*) A minimum storage hold-over of 100 000 acre feet on September 30 of each year to assure dependable power production in winter

Under these conditions, a yield of 320,000 acre-feet of primary water is secured as follows

Unit 1 000 acre feet

Run off year (October to September)	Inflow to Granby Reservoir		Tunnel diversion	Spills	Shortages
	Colorado River	Willow Creek			
1899-1900	243 8	82 4	320 0		
1900-1901	246 9	53 4	320 0		
1901 2	164 9	34 7	256 1		64 9
1902 3	222 0	48 8	270 8		49 2
1903-4	253 8	51 3	304 7		18 8
1904 5	287 9	54 9	310 2		9 8
1905-6	293 4	56 7	320 0		
1906-7	361 0	78 3	320 0		
1907 8	196 6	25 6	320 0		
1908-9	323 8	91 8	320 0		
1909-10	200 1	82 8	320 0	—	—
1910-11	268 6	53 6	320 0		
1911 12	350 4	79 3	320 0		
1912-13	316 4	60 3	320 0		
1913 14	371 0	85 1	320 0		
1914 15	322 2	43 8	320 0		
1915-16	249 6	67 8	320 0		
1916-17	348 3	79 7	320 0		
1917 18	372 9	81 1	356 4	18 7	—
1918-19	189 6	30 4	320 0		—
1919-20	351 2	78 4	345 6		
1920 21	347 9	90 7	368 6	70 0	
19 1 22	196 8	30 6	320 0		
1922 23	240 3	60 2	320 0		
1923-24	262 2	54 4	320 0		
1924 25	292 6	88 7	320 0		
1925 26	346 4	70 0	320 0		
1926 27	276 0	54 8	320 0		
1927 28	317 5	61 0	288 3		
1928 29	297 1	61 2	358 3		
1929-30	247 4	42 9	320 0		
1930 31	171 5	36 5	320 0	—	
1931 32	243 9	48 0	320 0		
1932-33	239 6	54 5	320 0		
1933 34	178 9	26 2	320 0		
1934 35	209 2	41 8	252 5		67 5
1935 36	279 7	53 9	310 0		10 0
Average	263 6	55 4	318.7	2 5	5 5

Operating results cannot be expected to result so favorably The operating conditions enumerated imply superhuman ability to forecast stream flow Occasional releases will be required from Granby Reservoir although small in amount Interruptions in tunnel operation cannot always be arranged so as to lose no water

In view of these conditions it is concluded that the firm yield of tunnel water from the Granby and Shadow Mountain Reservoirs should be taken as 300 000 acre feet annually Shortages of 5 percent may be expected on an average of once every 5 years and shortages of 25 percent may be expected on an average of once every 20 years Secondary water may be expected to be available in some years in amounts up to 50,000 acre feet

EFFECT OF THE PROPOSED TRANSMOUNTAIN DIVERSION ON FUTURE WESTERN SLOPE DEVELOPMENT

Most of the diverted water is derived from the spring floods when there is an excess of water over all present and future requirements along the Colorado River in the State To permit full use of the inflow to the Granby Reservoir Ranch Creek Reservoir may be constructed near Tabernash to store water locally surplus The waters there conserved would in part be utilized to replace the waters withheld at Granby Dam but the greater part of the conserved water would be used to augment irrigation supplies down to Hot Sulphur Springs and to maintain a satisfactory stream flow in this locality for recreational purposes

With the region above Hot Sulphur Springs taken care of by the Ranch Creek Reservoir the critical points along the Colorado River from the standpoint of present and future use of water are at Glenwood Springs where the Shoshone power plant of the Public Service Co uses present stream flows up to 1 250 second feet and near Palisades at the head of the Grand Valley, where the Government high line canal diverts water for irrigation and power purposes The present irrigated area along the Colorado River between Palisades and the Colorado Utah State line is 70 600 acres

The additional arable area in this region, not now irrigated is as follows

	Acres
Under constructed canals	13 800
Pumping unit of Grand Valley project for which canal capacity has been provided	10 000
Lands on Mack Flat no present provision for water service	9 000
Total	32 800

Maximum irrigation demand at the head of the Grand Valley for the present irrigated area and for the additional area of 23 800 acres for which provision has been made in the constructed canals is estimated as 1 700 second feet and this amount is being demanded in the pending adjudication proceeding

With maximum irrigation demands there is a full water supply for the Orchard Mesa pumping plant and for the Grand Valley power plant In the nonirrigation season the controlling requirement is for power with a total demand of 800 second-feet for power and for domestic needs under the higher canals With the new area of 9 000 acres developed the future demands are then estimated as 1,800 second feet in the months of May to August inclusive tapering off uniformly to 800 second feet on April 1 and on November 30

In determination of the effect of the Colorado Big Thompson transmountain diversion on the western slope the past stream flows at Glenwood Springs and at the head of the Grand Valley were first depleted to show the resulting stream flows with the following developments

(*a*) Full irrigation development of 270 000 acres of irrigated and arable lands along the Colorado River and tributaries above Palisades (the present irrigated area is 180 000 acres)

(*b*) Full development of Moffat Tunnel diversion from Fraser River and tributaries Jones Pass diversion from Williams River, and Independence Pass diversion from the Roaring Fork including

replacement storage so that these projects may divert all flows interceptible

From the reconstructed flows thus computed there was subtracted the water estimated to be withheld at the Granby Reservoir site The reductions in stream flow at Glenwood Springs and at the head of the Grand Valley during those periods of each year when the resulting stream flows would be less than the future demands above described then represents the effect of the project on the western slope if no replacement storage were provided These computations were made for the years 1926 to 1936 inclusive at Glenwood Springs, and for the entire period of record 1902 to 1936 inclusive at the head of the Grand Valley with the following results

Year	Shortages at Glenwood Springs (acre-feet)			Shortages at head of Grand Valley (acre feet)		
	End of flood season Oct 31	Nov 1 to flood season of following year	Total	Before flood season Jan 1 to flood season	After flood season to Oct 31	Total
1902	( )	( )		6 (est)	39 000	45 000
1903	( )	( )		3 (est)	12 000	15 000
1904	( )	( )		None	2 000	2 000
1905	( )	( )		None	14 000	14 000
1906	( )	( )		None	None	None
1907	( )	( )		?	None	None
1908	( )	( )		None	6 000	6 000
1909	( )	( )		None	None	None
1910	( )	( )		None	12 000	12 000
1911	( )	( )		None	1 000	1 000
1912	( )	( )		None	None	None
1913	( )	( )		None	7 000	7 000
1914	( )	( )		None	None	None
1915	( )	( )		None	9 000	9 000
1916	( )	( )		None	None	None
1917	( )	( )		None	None	None
1918	( )	( )		None	1 000	1 000
1919	( )	( )		None	7 000	7 000
1920	( )	( )		2 000	None	2 000
1921	( )	( )		None	None	None
1922	( )	( )		None	None	None
1923	( )	( )		None	None	None
1924	( )	( )		None	4 000	4 000
1925	( )	( )		None	None	None
1926	16 000	19 000	37 000	None	2 000	2 000
1927	7 000	22 000	9 000	None	None	None
1928	10 000	18 000	28 000	None	None	None
1929	None	30 000	30 000	None	None	None
1930	12 000	14 000	26 000	None	None	None
1931	37 000	16 000	53 000	1 000	27 000	28 000
1932	14 000	24 000	38 000	None	3 000	3 000
1933	23 000	21 000	44 000	5 000	15 000	20 000
1934	31 000	17 000	48 000	None	28 000	28 000
1935	20 000	15 000	35 000	2 000	11 000	13 000

Encroachment on irrigation supplies
Encroachment on white power waters
These shortages occur 1 years of late run-off when irrigation requirements rise faster than stream flow
Winter flows are low yet adequate Nov 1 to Apr 1
Not computed

DIVERSION PLAN AND STRUCTURES

REPLACEMENT

In order to protect the water users in the Colorado River Basin against any depletion of their water supply by diversions through the Continental Divide tunnel to northeastern Colorado a storage reservoir is planned on the Blue River about 16 miles southeast of Kremmling Colo This reservoir is to be known as the Green Mountain

The dam site is located in the E ½ of sec 15 T 2 S R 80 W sixth principal meridian near the head of a box canyon between Green and Little Green Mountains caused by the river cutting through a porphyry sill The foundation bedrock consists of sedimentary rocks, either Dakota sandstone or Morrison shales and the intrusive porphyry

The irrigation outlet capacity is 1,000 cubic feet per second and the power outlet capacity is 1,500 cubic feet per second The spillway capacity is 25,000 cubic feet per second

The reservoir will flood 2 100 acres of land and will have a capacity of 152 000 acre feet

From the water supply studies it was found assuming that full development had taken place in the Colorado River Basin and that the Big Thompson project had been in operation the last 35 years that in the year 1931 the lowest year of dependable run off record the Colorado Basin users above Glenwood Springs would have been shorted 37 000 acre feet for irrigation use and the Public Service Co would have been shorted 16 000 acre feet at their power plant at Shoshone during the nonirrigation season or a total shortage of 53 000 acre feet Accordingly, 50 000 acre feet of Green Mountain storage have been allocated to replacement purposes for which the water users in northeastern Colorado will pay $1 500 000 The remaining 100 000 acre feet are allocated to power and will be paid for out of power revenues

Since the average shortage for both power and irrigation for the last 10 years the lowest 10 years of run off record is 56 000 acre feet There would be the 16 000 acre feet difference and a portion of the 100 000 acre feet let out for power that could be used by the Colorado Basin users to supply shortages that might occur in their irrigation use in years of extreme low run-off these shortages not being caused by the transmountain diversion

The total estimated cost of the dam and reservoir is $3 776 032, $2 276,032 of which will be paid for from power revenues

GRANBY RESERVOIR AND STORAGE

The storage of Colorado River waters for the project is to be made in what is known as Granby Reservoir which is located in Tps 2 and 3 N Rs 75 and 76 W sixth principal meridian in Grand County, Colorado The reservoir basin occupies the valleys of Stillwater Creek the south fork or Arapaho Creek and the main Colorado River

The damsite is located about 4 miles northeast of the town of Granby Colo, in the NE¼ of sec 11 T 2 N R 76 W, in Grand County Colo It is located at the head of a short canyon which the river has cut through pre Cambrian rocks forming a spur of the main Rocky Mountain mass At the damsite the canyon at river bottom level is 200 feet wide while at elevation 8 275 it is 720 feet in width

The dam is to be a combination earth and rockfill structure with a maximum height of 223 feet The outlet capacity is 300 cubic feet per second and the spillway capacity is 12 000 cubic feet per second

With the high water line at elevation 8 275 feet the reservoir has a capacity of 482 800 acre feet and will flood an area of 6 943 acres

This reservoir will not only intercept the flow of the Colorado at that point but the flow of Willow Creek will be intercepted near Dexter, Colo and brought into the reservoir through a canal of 1,000

cubic feet per second capacity Willow Creek enters the Colorado about 2 miles below Granby Dam

It is estimated that Willow Creek will supply an average of about 60,000 acre feet per year and that the total estimated cost of this diversion is $733 203

The storage in Granby Reservoir will also be augmented by the flow of Meadow and Strawberry Creeks, tributaries of Fraser River which enters the Colorado about 5 miles below the dam The canal intercepting these two creeks will have a capacity of 500 cubic feet per second, and it is estimated they will produce an average of 12 000 acre feet a year The total estimated cost of this diversion is $133 600

If water supply records kept in the future show there is sufficient water supply left in the Fraser River below the City of Denver's diversion a canal could be taken out of it just below the mouth of St Louis Creek near the town of Fraser Colo and extend from there to Granby Reservoir, intercepting Ranch Meadow and Strawberry Creeks on the way A small regulating reservoir should be built on Ranch Creek above where the Canal intercepts it

NORTH FORK DIVERSION DAM AND SHADOW MOUNTAIN LAKE

In order to divert the water of the North Fork of the Colorado into Grand Lake and thence to the channel extending from it to the west portal of the Continental Divide tunnel it is planned to construct a concrete overflow dam 35 feet in height above streamed, across the North Fork about one half mile below its junction with the Grand Lake outlet

The dam site proper is located in the NW¼ of sec 19, T 3 N, R 75 W, and is a glacial moraine cut through by the river

The water backed up by this dam will form a lake called Shadow Mountain the name of a nearby mountain, which will have a surface area of 1 356 acres The elevation of this lake will be the same as Grand Lake and connected with it by means of the present outlet

NORTH FORK DIVERSION DAM

The dam proper is a concrete gravity overflow spillway section, 90 feet long with crest elevation at 8,370 This spillway is designed for maximum discharge of 1 800 cubic feet per second On each side of the overflow section is a concrete gravity section containing three automatic siphon spillways on each side The total spillway capacity is 9 400 cubic feet per second

The total estimated cost is $483 928

GRANBY PUMPING PLANT

As stated before the water surface elevation of Granby Reservoir is 8 275 and the water surface of Shadow Mountain and Grand Lakes is 8 369 In order to get the water stored in Granby Reservoir into Shadow Mountain Lake and available for delivery through the Continental Divide tunnel a pumping plant is located on the north shore of Granby Reservoir about one half mile above the junction of the South Fork with the Colorado A granite spur juts out into the reservoir site at that point making it ideal for the intake tunnels and a shaft for the pump

The proposed pumping plant will contain three motor-driven vertical-shaft pumping units having a total capacity of 900 cubic feet per second with full reservoir and 550 cubic second feet at low water At normal water surface the capacity will be 870 cubic feet per second

Each pump will be driven by a 6 500 horsepower synchronous motor

Power will be delivered to the plant from a 69 000 volt transmission line extending from power plant no 1 just below Estes Park, around the Rocky Mountain National Park, and crossing the Continental Divide at Buchanan Pass about 5 miles south of the park boundary

The water from the pumps empties into a canal of 900 cubic second feet capacity and runs by gravity into Shadow Mountain Lake It is planned to operate this canal all winter when temperatures get as low as 40° below zero The latent heat in the water and the friction heat absorbed from the pumps will prevent this water from freezing and will keep quite an area open after the water reaches Shadow Mountain Lake

The total estimated cost of the pumping plant is $1 250 000

The total estimated cost of the pump canal is $417 553

CONTINENTAL DIVIDE TUNNEL

The west tunnel portal is connected with Grand Lake by means of a channel constructed 67 5 feet in width and 15 feet in depth At the lake end of this channel a permanent concrete barrier or weir will be placed with a crest elevation at 8 368 which would be the minimum elevation to which the water in Grand Lake could be drawn Since the barrier is so constructed that it requires the water to be 1 foot in depth over it to supply the normal capacity of the tunnel, the normal elevation of Grand and Shadow Mountain Lakes would be 8 369 feet

The present maximum fluctuation of Grand Lake is about 4 feet or from an elevation of 8,368 in winter to 8 372 feet during the peak run-off from melting snow The automatic control gates at the North Fork Diversion Dam and at tunnel inlet will so control the elevation of the water surface in Grand Lake that it would never fluctuate more than 1 foot

The Continental Divide tunnel extends from the easterly end of Grand Lake to Wind River southwest of Estes Park with an azimuth of 242° 20 30 and length of 69 023 feet It is to be horseshoe shape 9 5 feet in diameter and lined throughout with a 9 inch concrete lining

It will be located entirely in pre Cambrian rock consisting of the Longs Peak and related granites and the gneisses and schists of the Idaho Springs formation The granites are strong massive rocks Gneisses predominate over schists and only a small proportion have prominent and continuous cleavage planes The proportion of granite to gneiss and schist is approximately 4 to 1

From a detailed geological survey of the tunnel and comparing it with conditions actually encountered in the Moffat Railroad tunnel which was built under the Continental Divide for the Denver & Salt Lake Railroad and about 25 miles due south of this one it was estimated there would be only 400 feet of bad ground and 5 200 feet of ground needing support However for purposes of estimate it was figured there would be 6 900 feet of bad ground and 17,500 feet of ground needing support

The total estimated cost is $7 271 371

POWER CONDUIT NO 1

Power conduit no 1 extends from the east portal of the Continental Divide tunnel in Wind River to the penstock of power plant no 1 on the northeast slope of Prospect Mountain

Both ends of the Continental Divide tunnel are without the national-park boundaries but the area east of the east portal is authorized by Congress to be taken in through that area The water will be taken through a closed conduit consisting of a 10 foot reinforced concrete pipe completely buried The total length of power conduit is 5 36 miles of which 1 86 miles is closed conduit 1 19 miles is concrete lined tunnel 0 98 mile is siphon and the remainder is open canal

The total estimated cost of power conduit no 1 is $1 101 000

POWER PLANT NO 1

Power plant no 1 will be located on the south bank of the Big Thompson River about one half mile east of Estes Park It will contain two 15 000 kilovolt-ampere generating units with auxiliaries Each unit will consist of a vertical-shaft, single-runner spiral-casing type hydraulic turbine operating under an effective head of 705 feet direct connected to a 15 000 kilovolt-ampere water wheel type generator A complete description with cost estimate will be found in Power and Pumping Summary

Until there has developed a sufficient market for power to justify the construction of power plants nos 2 and 3 the water will be turned into the Big Thompson at power plant no 1 and carried by that stream to a diversion dam located in SE¼ sec 1 T 5 N , R 71 W about midway between the present diversion dam and power plant for the town of Loveland, Colo

POWER CANAL NO 4

From this diversion dam the water will be carried in a canal of 750 cubic second feet capacity on the south side of the stream a distance of 4 93 miles to a point just above the mouth of the Big Thompson Canyon At this point a portion of the water will drop direct into the Big Thompson River to supply the supplemental water demands of that stream and a portion will be siphoned across to elevation 5 450 to supply the canal going to the Poudre River which will be described later Power plants nos 4 and 4–A will be constructed at this point to take advantage of a fall of 550 feet into the Thompson and 358 feet to the Poudre Canal when the power market justifies

CARTER LAKE SUPPLY CANAL

About 3 07 miles below the diversion dam mentioned above, a canal of 300 cubic feet per second takes off toward the south and supplies Carter Lake

This canal is 8 78 miles in length of which 7,040 feet is tunnel 1,878 feet siphon and the remainder is open canal

The estimated cost of this supply canal is $710,629

CARTER LAKE RESERVOIR

This site is located in Ts 4 and 5 N, R 70 W , of sixth principal meridian about 1 mile north and 7 miles west of Berthoud, Colo

The reservoir will occupy a valley about 2¾ miles long and from one-half to 1 mile wide The northern portion of the area is a natural

basin called Carter Lake This lake dried up during the last 5 drought years for the first time within the memory of the white settlers

The proposed maximum water surface in the reservoir is at elevation 5 760 with a capacity of 111 963 acre feet The area of high water line is 1,150 acres For this water surface three dams will be required Dam no 1 is located at the natural outlet of the valley and will contain the outlet works for the reservoir the other two dams will occupy saddles These dams are earth and rock fill the main dam is 243 feet high and the saddles 43 and 48 respectively

The capacity of the outlet to St Vrain supply canal is 300 cubic feet per second, the outlet to the Big Thompson has a capacity of 1,000 cubic feet per second

The total estimated cost of the reservoir is $1 822 202

ST VRAIN FEEDER CANAL

A canal of 300 cubic feet per second capacity will extend from the small outlet of Carter Lake to the St Vrain, reaching the St Vrain high enough to supply all ditches

The length of this canal is 9 76 miles with 3,445 feet in tunnel 1,575 feet of siphons and the remainder open canal

The estimated cost of the St Vrain feeder is $368 951

BIG THOMPSON FEEDER

About one half mile below Carter Lake Dam a canal will be taken out of the draw leading from the dam and will run into Cottonwood Creek a tributary of the Big Thompson This canal will have a capacity of 1 000 cubic feet per second and be 5 37 miles in length

The cost is estimated at $155 246

HORSETOOTH SUPPLY CANAL

This canal starts at the end of a siphon across the Big Thompson from power conduit no 4 This water will pass through power plant no 4-A when constructed The canal starts at elevation 5,450 with a capacity of 250 cubic feet per second The structures however, are designed for a capacity of 400 cubic feet per second on the theory that some time in the future it might be necessary to increase the capacity of the canal to that amount The length of this canal is 9 88 miles, of which 12 863 feet is tunnel 3 296 feet is siphons and the remainder open canal

The elevation of 5 450 was chosen because it not only puts the water above all present diversions on the Poudre River but it afforded the most direct and economical route

The estimated cost of this feeder is $1 208 391

HORSETOOTH RESERVOIR

The proposed Horsetooth Reservoir will occupy a valley 6 miles long, and from one quarter to three quarters miles wide extending in a north south direction formed by the erosion of soft red beds of Lykins formation between harder ridges of Lyons on the west and Dakota sandstone on the east There are three natural outlets to the east through the Dakota hogback, namely Soldier Dixon and

Spring Canyons which are the sites of three proposed dams of the same names The fourth proposed dam Horsetooth will cross the valley at the north end on a low saddle separating the valley from drainage to the north into the Poudre River The outlet will be through the Horsetooth Dam saddle There are no outlets through the other dams The proposed water surface is at 5 400 feet in elevation which gives a capacity of 96,756 acre feet The area flooded will be 1 513 acres The outlet capacity was designed for 1,200 cubic feet per second with reservoir full This large capacity is necessary as the irrigation use requires that the entire amount of supplemental water be delivered at a rate that would supply it in 60 days

The advantages of a reservoir at this point are It is high enough to supply all users from the main Cache La Poudre River and is located close to it It takes the place of 6 miles of canal through rough country and allows a canal of 250 cubic second feet to be constructed from the Big Thompson instead of one for 1,000 cubic feet per second

The estimated cost of the reservoir is $3,625,021

POUDRE FEEDER CANAL

From the outlet of Horsetooth Reservoir a canal of 1,000 cubic second feet capacity will extend north to Lewstone Creek, a tributary of the Poudre The water will run down this creek to the Poudre above all the diversions except the Poudre Valley

POUDRE VALLEY FEEDER CANAL

A canal will extend from Lewstone Creek to the Poudre Valley Canal about 1 mile below its headgate crossing the Poudre River in a siphon This canal will have a capacity of 400 cubic feet per second to take care of the supplemental demands of the Poudre Valley Canal and also the demands of the North Poudre irrigation district The total length of the two canals is 5 48 miles

The cost of the Poudre Feeder and Poudre Valley Canals is estimated at $632,843 46

NORTH POUDRE FEEDER CANAL

It is planned to enlarge the Poudre Valley Canal for a distance of 3 58 miles from the point the supply canal enters to the location of the pumping plant for the North Poudre district This will enlarge the canal from a capacity of 500 to 750 cubic feet per second and the estimated cost is $11,436

NORTH POUDRE PUMPING PLANT

This pumping plant constructed on the banks of the Poudre Valley Canal will consist of two 75 cubic second feet capacity vertical synchronous motor driven single stage pumps, operating against an effective head of 187 feet

The estimated cost is $200,000

NORTH POUDRE FEEDER CANAL

This canal of 150 cubic second feet capacity extends from the pressure outlets of the pumping plant to the North Poudre Canal a distance of 9 98 miles

The estimated cost is $128 889

ARKINS RESERVOIR

This reservoir is located on Buckhorn Creek a tributary of the Big Thompson in Tps 5 and 6 N R 70 W sixth principal meridian, and about 8 miles northwest of Loveland Colo The object of this reservoir is to provide storage for Colorado River waters brought over in the wintertime and to be used to supply supplemental water on the lower South Platte in water districts 1 2 and 64 It will also serve in connection with the use of the 16 000 acre feet of floodwater now available on the Big Thompson

The bringing of more of the supplemental water over in the winter time aids materially in the production of a maximum amount of power out of the waters of the Big Thompson River For that reason the entire cost of the inlet to Arkins Reservoir and one half the cost of the reservoir itself is assessed against power and paid for out of power revenues from plant no 1

The capacity of Arkins Reservoir is 50 000 acre feet with a high water line at 5 275 feet elevation and floods 929 acres of land

The dam site occupies a notch cut through the Dakota sandstone ridge by Buckhorn Creek

The main dam is an earth and rock fill structure 155 feet in height with an outlet capacity of 650 cubic feet per second and a spillway of 10 000 cubic second feet capacity

There is a saddle dam in addition to the main dam of earth and rock fill construction 50 feet maximum height built across a saddle at the southern extremity of the reservoir

The total estimated cost of the reservoir and dam is $1 740 737

The estimated cost of the Arkins Reservoir inlet is $351 488

This inlet diverts from the Big Thompson River just below the dam of the Handy Canal and follows around the north side of the river a distance of 2 33 miles to Arkins Reservoir

ROCKY MOUNTAIN NATIONAL PARK

Every effort has been made in the survey and design of this project to not disturb the natural beauties of the Rocky Mountain National Park and its surrounding areas The Continental Divide tunnel was lengthened 1 6 miles in order that its extremities should fall outside the boundaries of the park The conduit leading from the east portal of the tunnel to power plant no 1 is to be buried and the surface landscaped through the area authorized by Congress to be added to the park The waste from the east portal of the tunnel placed in this area is to be terraced and planted with evergreen trees The waste from the west portal is to be used to fill up some low areas and render the area suitable for the building of summer homes

The approach to the Western Gateway of the Rocky Mountain National Park will be along the shores of Shadow Mountain Lake with its fluctuation of only 1 foot instead of the swampy area that now breeds mosquitoes and exposes mud flats in low water

The bill authorizing the creation of the Rocky Mountain National Park reserved the right for the Bureau of Reclamation to survey and construct an irrigation project within the boundaries of the park

OPERATION OF THE SYSTEM

IRRIGATION PROJECT OPERATIONS

The system is planned and it is anticipated that it will be operated in a manner to have the water available in Carter Lake, Horsetooth and Arkins Reservoirs available by July 1 to the full capacity of those reservoirs 256 000 acre feet The usual demand for supplemental water begins July 1 to 15 and extends to September 15 to 30 The outlets of the reservoirs are planned to deliver the water from the reservoirs in 60 to 75 days, including the water that must pass through them for direct delivery that may be in the way of being transferred from the Colorado River Basin to the eastern slope during the period of irrigation application The balance of the 310 000 acre feet or 54 000 acre feet will be available for direct irrigation use as brought over during the above period or to some extent may be required prior to July 1

The run off of the waters of the Colorado River here contemplated to be used will largely be secured from the melting snows during May June and early July and stored in the Granby Reservoir During the fall of that year winter and spring of the following year the water will be transferred from the Granby Reservoir through the Continental Divide tunnel at a uniform rate and restored in the Carter Lake Horsetooth and Arkins Reservoirs This will permit a flow that is well suited to the development of firm power through the five power plants that will eventually be constructed along the Big Thompson as shown on the map of the general layout

Granby Reservoir will act as a hold over reservoir to carry the water from years of excessive run off to years of subnormal flow

POWER PROJECT OPERATION

Water will be carried through the Continental Divide tunnel at a uniform flow for the generation of power at the several power plants, except that the quantity will be reduced during the summer season when some water from the Big Thompson is available for power purposes in power plants nos 2 3 4, and 4-A At this period there will be little or no demand for power for pumping at the Granby pumping plant, which will permit the cutting down of the quantity of water to take care of the commercial power load

It is planned to construct the Granby pumping plant and the Granby pump canal 150 percent of the capacity of the Continental Divide tunnel This will permit the operation of the pumping plant at full capacity with off peak power and reduce the amount of pumping with firm power The varying discharge of the pump ditch during the 24 hour period will be equalized by the Shadow Mountain and Grand Lakes so that a uniform discharge will be maintained through the Continental Divide tunnel The range in height of water surface in Shadow Mountain and Grand Lake to equalize this

flow will not exceed two tenths of a foot and will be greatest in the winter and early spring months

There is an average of 16 000 acre feet of surplus water on the Big Thompson available for storage in the system mainly in May and June In order to take this water into the reservoirs it will be necessary to reserve capacity in the three reservoirs on the eastern slope until toward the latter part of June The snowfall the main source of this water supply, will be known well in advance so that operations of the several parts of the system including the production of power at the several power plants can be adjusted to take care of this water and hold back an equal amount in Granby Reservoir

TENTATIVE PROJECT FINANCIAL SET UPS

This proposed development consists of two projects first the irrigation project and second, the power project

It is planned that those features of the development that are used mainly for irrigation are grouped under the irrigation project set-up while those used entirely or are made of a greater capacity because of power development, are grouped in whole or in part in the power project set-up

IRRIGATION PROJECT

The following major features with their appurtenant structures are given with the estimated field costs including 10 percent for engineering and 15 percent for contingencies The full capacity of Arkins Reservoir is necessary to develop a larger portion of firm power than would otherwise be possible without it At the same time, a reservoir of half its capacity or additional capacity in Horsetooth or Carter Lake Reservoirs would be necessary to provide capacity to deliver the irrigation water as needed It is, therefore deemed equitable to divide the cost of this reservoir equally between the irrigation and power projects

The Green Mountain Reservoir with a capacity of 152 000 acre feet is larger than is necessary to furnish replacement for a like amount of water diverted by the project above Granby Dam at a time when it would be required for irrigation present and future and to furnish the Shoshone power plant 1 250 second feet or such lesser amount that they would be entitled to receive if the proposed project was not operating From studies made it appears that 50 000 acre feet will be sufficient to replace all the water that the proposed project will take at a time when required for use lower down in the stream within the State Therefore 52 000 acre feet of the Green Mountain Reservoir capacity is allocated for replacement (including evaporation losses) and charged to the irrigation project The balance of the capacity or 100,000 acre-feet is allocated to the power project and is to be paid for out of power revenues

The following is a summary of the irrigation project costs

Estimated cost chargeable to irrigation feature

Willow Creek feeder canal	$713 703
Granby Reservoir	813 703
Granby pumping plant	1 250 000
Granby pump canal	417 553
North Fork diversion dam	183 378
Continental Divide tunnel	7 271 371

Estimated cost chargeable to irrigation feature—Continued

Carter Lake supply canal		$710 629
Horsetooth supply canal		1 208 391
St Vrain feeder canal		368 951
Big Thompson feeder canal		155 246
Poudre feeder canal		632 843
Poudre Valley feeder canal		11 436
North Poudre feeder canal		128 889
North Poudre pumping plant		200 000
Horsetooth Reservoir		3 625 021
Arkins Reservoir		1 859 323
Carter Lake Reservoir		1 925 253
Green Mountain Reservoir (52 000 acre feet replacement) (100 000 acre feet for power)		3 776 032
Improvement of Colorado River above Kremmling to maintain fishing and to adjust the present irrigation system to the altered conditions		300 000
		27 871 772
Less the following items tentatively chargeable to power		
One half cost of Arkins Reservoir	$929 661	
Portion of cost of Green Mountain Reservoir for 100 000 acre feet	2 276 032	
		3 205 693
Cost of irrigation features		24 666 079
Say		24 800 000

REPAYMENT

Twenty four million eight hundred thousand dollars upon 310 000 acre feet at $80 per acre foot

Two dollars per acre foot on 40 year repayment basis

In the above repayment is predicated upon the contracts to be made upon a basis of 310 000 acre feet Beside the 320,000 acre feet available from the Colorado River drainage there is an average of 16 000 acre feet available for storage on the Big Thompson, making 336 000 acre feet in all leaving 26 000 acre feet for losses on the eastern slope and for the uncertain heretofore mentioned in operations on the western slope

The power costs are shown under the heading ' Power and pumping system '

The construction of power plant no 1 as shown in the power set up is a necessary development in order to secure power for pumping purposes at the Granby pumping plant

POWER AND PUMPING SYSTEMS

The ultimate power and pumping system is proposed to consist of the major pumping plant at Granby power plant no 1 near the town of Estes Park power plant no 2 near Drake post office power plant no 3 at Cedar Cove power plants nos 4 and 4-A near the mouth of the Big Thompson Canyon and power plant no 5 at the Green Mountain Reservoir If conditions justify there may also be a pumping plant on the Poudre River near the point where the proposed Poudre supply canal crosses the river Power plant no 5 Granby pumping plant and power plant no 1 would be interconnected by a single circuit 69 000 volt transmission line Power plants nos 1 to 4-A inclusive would be interconnected by two 115 000 volt transmission lines and these same lines would extend to one or more load centers where the power could be disposed of commercially

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The buildings for the power and pumping plants would be of reinforced concrete construction of suitable size to house the machinery and provide space for such facilities as would be required for efficient and economical operation For scenic reasons special care would be taken in the architectural design of the buildings to make them blend in with the beauties of the surrounding territory so as to be both as inconspicuous as possible and also as artistic as feasible without undue expenditure An artist's sketch of one of these buildings is included with the report

Following is a tabulation covering the essential data for each of the power and pumping plants

Power plants

Plant designation	Effective head in feet	Turbine capacity in cubic feet per second	Power available in horsepower	Number of units	Size of each unit in horsepower	Installed power in kilowatts
No 1	704	550	38,800	2	20,000	30,000
No 2	1,195	550	65,800	2	34,000	50,000
No 3	328	550	18,000	2	9,000	13,500
No 4	5[illegible]	400	2[illegible],000	1	22,000	16,000
No 4 A	381	2[illegible]	9,500	1	9,500	7,000
No 5	225	1,[illegible]	33,600	2	1[illegible],000	26,000
Total installed power in kilowatts						142,500

Pumping plants

Plant designation	Head in feet	Pump capacity in cubic feet per second	Capacity of [illegible] in cubic feet per second	Number of pumps	Rating of each motor in horsepower	Power required in kilowatts
Granby	130	870	200	3	6,500	15,000
Poudre	187	150		2	[illegible],000	3,000
Total installed pumping kilowatts						18,000

POWER PLANT NO 1

Power plant no 1 will be located on the south bank of the Big Thompson River about one half mile east of the village of Estes Park and will contain two 15 000 kilovolt ampere generating units with auxiliaries Each unit will consist of a vertical shaft single runner spiral casing type hydraulic turbine operating under an effective head of approximately 705 feet and direct connected to a 15 000 kilovolt ampere water wheel type generator with direct connected exciter and pilot exciter Water would be supplied to each turbine through a steel penstock approximately [illegible]000 feet long with synchronous bypasses provided so that the flow through the penstock can be discharged either through the turbines or the bypasses into the Big Thompson River The bypasses will be mechanically connected to the turbine gate operating mechanism so that rapid governing of the units under varying load conditions can be effected without creating excessive water hammer Trashracks with shut-off gates for

each penstock will be provided in the forebay structure The head gates will be controlled from the power plant A spillway will be provided to care for the flow when the headgates are closed and the penstocks inoperative The plant will be equipped with all necessary auxiliaries including a traveling crane for handling the large pieces of equipment A small machine shop will be provided for making minor repairs An outdoor type substation with self cooled transformers will be provided for stepping the voltage up to 69,000 for transmission to the Granby pumping plant and to 115 000 volts for transmission to commercial markets The substation structure will be of the conventional structural steel type with high voltage oil circuit breakers lightning arresters and necessary auxiliaries The control of the oil circuit breakers will be from the main power plant switchboard Operators' quarters a warehouse, and a large machine shop for general project repairs will be provided in the vicinity of the power plant

POWER PLANT NO 2

Power plant no 2 will be located about one half mile northwest of Drake on the south bank of the north fork of the Thompson River just above its junction with the Big Thompson The plant will contain two 25 000 kilovolt ampere generating units of the horizontal shaft type The net head will be approximately 1,195 feet Each unit will consist of a double overhung impulse wheel hydraulic turbine with the generator mounted in the center between the two runners A direct connected exciter and pilot exciter will be mounted at one end Water will be delivered to the turbines through two steel penstocks about 4 150 feet long Each penstock will be provided with two branches to the turbine nozzles and each branch will be provided with a synchronous bypass arranged so that the flow through the penstock can be discharged through either the nozzles of the bypasses to the river The bypasses will be mechanically connected to the turbine nozzle operating mechanism so that rapid governing can be effected under varying load conditions without excessive water hammer The head gate structure will be provided with trash racks and sliding gates at the end of the penstocks and a spillway to care for the flow when the gates are closed The plant will be complete with all necessary auxiliaries for station service requirements and with a crane for handling the machinery A structural steel outdoor type substation will be provided with self cooled transformers for stepping the voltage to 115 000 volts, and with outdoor type oil circuit breakers, lightning arresters and other necessary auxiliaries The operation of the substation will be handled from the main switchboard of the power plant Quarters for the operators will be provided adjacent to the power plant

POWER PLANT NO 3

Power plant no 3 will be located about one half mile east of the Loveland power diversion dam on the north bank of the Big Thompson River The plant will contain two 6 500 kilovolt ampere generating units, each consisting of a vertical hydraulic turbine direct connected to a generator with main exciter and pilot exciter The effective head will be approximately 328 feet Water from the head gate structure will be delivered to the turbines through steel

pen stocks about 650 feet long Each pen stock will be provided with a synchronous bypass arranged so that the flow through the pen stock can be discharged either through the turbines or the bypasses to the Big Thompson River and to allow rapid governing of the units without excessive water hammer The head gate structure will be provided with trash racks and sliding gates at the head of the pen stocks and a spillway to care for the flow when the gates are closed The plant will be complete with all necessary auxiliaries for station service operation and with a crane for handling equipment The plant will be provided with a structural steel outdoor type substation similar to that proposed for plant no 2

POWER PLANTS NOS 4 AND 4–A

Power plant no 4 will be located about 2 miles east of Cedar Cove on the south bank of the Big Thompson River while power plant no 4–A will be located a short distance upstream from plant no 4 and at an elevation about 175 feet above the river The capacity of plant no 4 will be 16 000 kilovolt amperes and of plant no 4 A 7 000 kilovolt amperes One unit only will be provided at each plant and will consist of a vertical shaft single runner spiral casing type turbine direct connected to a vertical water wheel generator with direct connected main and pilot exciters Plant no 4 will have an effective head of about 550 feet and plant no 4 A 180 feet Plant no 4 will receive its water through a single steel penstock about 1 960 feet long and plant no 4 A through a similar pipe about 1 400 feet long Each plant will be provided with synchronous bypasses similar to those in plants nos 1 and 3 Plant no 4 will discharge directly into the Big Thompson River Plant no 4–A will be siphoned under the river through a pressure tunnel to the proposed Poudre supply canal but will have provisions so that if so desired the water may be discharged directly into the Big Thompson River The headgate structure will be provided with trashracks sliding gates and spillways similar to those in plants nos 1 2 and 3 A single outdoor structural steel type switchyard will be provided for the two plants The equipment in this substation will be similar to that for plants nos 1 2 and 3 Plant no 4–A will be remotely controlled from plant no 4 so that the two plants can be operated with one set of operators The plant will be complete with auxiliaries and cranes similar to that in other plants Quarters for the operators will be provided in the vicinity of the plants

POWER PLANT NO 5

Power plant no 5 will be located about 12½ miles southeast of Kremmling on the east bank of the Blue River immediately downstream from the dam forming the proposed Green Mountain Reservoir The plant will contain two 13 000 kilovolt ampere generating units of the vertical hydraulic turbine driven type with direct connected generator with main and pilot exciters The plant will have a varying head depending upon reservoir water surface but it is expected that the average head will be about 225 feet The trashrack and intake structure will be located immediately upstream from the dam and a single steel penstock installed in the tunnel will conduct the water to the power plant Each turbine will be provided with a

pressure regulator or relief valve to limit the water hammer under sudden change of load conditions The plant will be complete with necessary auxiliaries for station service a small machine shop for minor repairs and a crane for handling equipment An outdoor structural steel substation will be provided complete with equipment for stepping the voltage up to 69 000 volts for transmission and with oil circuit breakers and other necessary auxiliaries for the control and protection of the lines and equipment The oil circuit breakers will be controlled from the main switchboard of the power plant Quarters for operators will be constructed in the vicinity of the power plant

GRANBY PUMPING PLANT

The Granby pumping plant will be located approximately 6 miles south of the village of Grand Lake on the north shore of the proposed Granby Reservoir The plant will contain three motor driven vertical shaft pumping units having a total capacity of 900 second feet at full reservoir and 550 second feet at low water The total capacity at the normal water surface will be approximately 870 second feet The motors will be of the synchronous type and arranged for semi magnetic operation That is the operator will be required only to close the main switch to the unit in order to place it in operation and to open the same switch to discontinue operation The motors will be equipped with direct connected exciters The water from the Granby Reservoir will be delivered to the pumps through tunnels about 155 feet long A channel in the reservoir will convey the water to the mouth of the intake tunnels in extreme low water Water from each pump will be discharged through about 175 feet of tunnel and 165 feet of steel pipe to the canal at elevation approximately 8 381 This canal, which will be approximately 4 miles in length will discharge into the proposed Shadow Mountain Lake The center line of each pump and propeller will be at approximately elevation 8 145 with the base of the motor driving the pump 135 feet above or at elevation 8 280 Vertical shafts in the rock between the underground pump room and the motor room on the surface will accommodate the shafts connecting the pumps to the motors Each pump will have a capacity of 290 second feet when operating under a total dynamic head of 130 feet and will be driven by a 6,500 horsepower synchronous motor

The entrances to the intake tunnels will be provided with trashrack and stop log structures, and sliding gates will be installed at the intake and discharge of each pump The intake gates will be located in the gallery adjoining the pump room and will be hydraulically operated The discharge gates will be located at the head of the canal and will be of a type which will close automatically in the event power service is interrupted so as to prevent water in the canal from running back down through the pump

The pumping plant will be complete with auxiliary pumping units for unwatering the intake and discharge tunnels and the drainage sump It will also be complete with all other necessary station auxiliaries including a crane for handling the equipment A small machine shop will be provided for making minor repairs Quarters for the operators will be provided in the vicinity of the plant

Power will be delivered to the plant from a 69 000 volt transmission line through an outdoor structural steel type substation containing self-cooled transformers together with all necessary protective appa

ratus and auxiliaries The operation of the substation will be handled from the main switchboard of the pumping plant

POUDRE PUMPING PLANT

The Poudre pumping plant will be located on the Poudre Valley Canal at a point about 3 miles below the crossing of the proposed Poudre supply canal It is proposed to have a capacity of 150 second feet composed of two 75 second foot vertical synchronous motor driven single stage pumps operating against an effective head of 187 feet The plant will be complete with all necessary auxiliaries including a crane for handling the equipment An outdoor substation will be provided for stepping the voltage down from transmission voltage to motor voltage Due to the relatively short periods of operation it is not probable that it will be necessary to construct operator s quarters at this plant

TRANSMISSION SYSTEM

The transmission system will consist of a single 69 000 volt circuit connecting power plant no 5 with the Granby pumping plant and power plant no 1 Power plants nos 1 to 4–A inclusive will be connected by two 115 000 volt lines and two 115 000 volt lines will continue to market For the purpose of this report only and to include a sufficient amount in the cost estimates for any probable transmission set up this market has been assumed as the valmont steam plant of the Public Service Co of Colorado Power plant no 4 will be connected with the Poudre pumping plant by one 34 500 volt transmission line The number of lines and mileage involved in each are as shown in the following tabulation

From—	To—	Number of lines	Number of miles	Voltage
Power plant no 5	Ka Rose	1	36	69 000
Granby pumping plant	Grand Lake	1	10	69 000
Do	Power plant no 1	1	38	69 000
Power plant no 1	Power plant no 2	2	12	115 000
Power plant no 2	Power plant no 3	2	3	115 000
Power plant no 3	Power plant no 4		4	115 000
Power plant no 4	Valmont	2	27	115 000
Do	Poudre pumping plant	1	18	34, 500

The line to the Poudre pumping plant would be a wood pole line with pin type insulators All other lines would be of the wood pole H frame type with suspension insulators and combining all of the most modern features for continuity of service ease of maintenance, and long life The line from power plant no 1 to the Granby pumping plant will probably require special construction to give added strength in the mountainous region near the Continental Divide

In order to provide power for construction it is proposed that one of the first features of the project would be to build one of the permanent 115 000 volt circuits from the Valmont plant to plant no 1, the permanent 69 000 volt lines from plant no 1 to Granby pumping plant and from Ka Rose to the Green Mountain dam site and an extension from the Granby Pumping Plant to the west portal of the proposed tunnel Initially this entire line would be operated at 69,000 volts, and under such operation would be adequate for all contemplated construction activities In connection with supplying construction power it would also be necessary to install a substation at the Valmont steam plant to step voltage up to 69 000 volts for transmission Preliminary studies indicate that it would be advisable to make this substation of approximately 5,000 kilovolt ampere capacity

The estimated cost of installing the facilities to provide construction power are as indicated in the following tabulation

From—	To—	Miles	Cost	
			Per mile	Total
Valmont	Power plant no 2	34	$6 750	$229 500
Power plant no 2	Power plant no 1	12	4 100	49 200
Power plant no 1	Granby pumping plant	38	3 400	129 200
Granby pumping plant	Grand Lake	10	3 200	32 000
Ka Rose	Power plant no 5	38	3 400	129 200
Total transmission lines		128		569 900
Substation at Valmont				61 300
Total to supply power for construction				631 200

The transmission system as provided to furnish construction power would be adequate for transmission of power to markets from power plant no 1 or power plant no 5 if either were built individually but the additional complete system would probably be constructed when two or more plants are constructed The additional costs of the lines involved in this construction are shown in the following tabulation

From—	To—	Miles	Cost	
			Per mile	Total
Power plant no 1	Power plant no 2	12	$4 100	$49 200
Power plant no 2	Valmont	34	6 750	279 500
Power plant no 4	Poudre pumping plant	18	1 800	32 400
Total additional cost of permanent transmission system		64		311 100

In addition to the transmission lines required for the disposal of power it may be necessary that the Government also construct a substation at the point of power disposal As a market survey has not been conducted to establish the points at which this power can be disposed of or the quantities involved at each point of disposal it is assumed for the purpose of this report that the substations will average in cost $10 per kilowatt of capacity Assuming that provision is made to dispose of a peak capacity of 140 000 kilowatts this will involve an additional expenditure of $1 400 000

POWER OUTPUT

Water supply studies indicate that with power plant no 1 only constructed there is available above all requirements for pumping purposes a constant power output at 100 percent load factor of 120 000 000 kilowatt-hours per year Since the pumping plant capac

ity proposed is sufficient to allow pumping to be done in 16 hours of each day it will be possible to handle peak commercial power requirements without undue interference With this in mind it has been assumed for the purpose of this report that a market can be found which has a load factor such that 60 percent of this power or 72,000 000 kilowatt-hours per year can be absorbed as firm energy The balance of this energy or 48 000 000 kilowatt-hours per year plus about 40 000 000 kilowatt-hours additional which is available during various parts of the year is classed as secondary energy

Since the Valmont steam plant of the Public Service Co of Colorado has an installed capacity of 75,000 kilowatts it appears that the 88 000 000 kilowatt-hours of secondary energy could be absorbed as a fuel saving measure if the price does not exceed fuel costs Allowing 10 percent for line losses, this is equivalent to an average load of about 9 000 kilowatts

FINANCIAL OPERATION OF POWER SYSTEM

It is contemplated that the initial power development would consist of the construction of power plant no 1 only, together with such transmission lines and substations as are required to supply power to the Granby pumping plant and to commercial markets The estimated construction cost of the strictly power features, as well as items which it is expected that power revenues will repay, is given below

It is assumed that 5 mills per kilowatt-hour can be secured for firm energy and 1 8 mills per kilowatt-hour for secondary energy with delivery at the market In each case 10 percent loss is allowed for transmission The following gives the financial set-up for power plant no 1 operation costs and returns

While for the purpose of this report the allocation of construction cost to irrigation and power has been made on the basis set out below it is understood that this allocation is not thereby fixed, and the same may be changed as further information may warrant until such time as the contract for repayment of the cost of the irrigation features has taken final form

Power plant no 1 construction costs

Power plant no 1 near Estes Park	$1 778 000
Conduit from east portal continental divide tunnel to power plant no 1	1 101 000
Transmission lines connecting power plant no 1 with Granby pumping plant—with Valmont and line to North Poudre pumping plant	440 000
Commercial substation (30 000 kilowatts)	300 000
Headquarters at power plant no 1 for operation of power system	100 000
Subtotal	3 719 000
Interest during construction 3 percent	112 000
Total repayable in 50 years with interest	3 831 000
One half cost of Arkins Reservoir	929 061
Portion of cost Green Mountain Reservoir for 100 000 acre feet allocated to power	2 276 032
Payable on 40-year basis without interest	3 205 693
Total cost power plant no 1 including other items that are required to be accomplished with the initial development	7 030 693

Annual revenues from power plant no 1

From sale of 65 000 000 kilowatt-hours firm power at $0 005	$325 000
From sale of 79 000 000 kilowatt hours secondary power at $0 0018	142 000
From rental of water for power development to privately owned plants	20 000
Gross annual income	487 000

Annual operation and maintenance plus retirement of principal

Brought forward	$487 000
3 887 percent on $3 831 000 interest and retirement of investment on basis of 50 years	148 000
Repayment of $3 205 693 on basis of 40 years without interest	80 000
Operation and maintenance of power plant	36 000
Operation and maintenance Granby pumping plant	27 000
Operation and maintenance of transmission lines	13 800
Operation and maintenance conduit tunnel and canals	15 000
Depreciation 1 5 percent on $3 831 000	57 000
General expense	18 200
Total annual costs	395 000
Annual surplus during 40 years repayment period of the non interest bearing obligation	92 000

FULL POWER DEVELOPMENT

The results of this study indicate that the initial installation proposed is sufficient from a financial standpoint to return all necessary costs of operation and repayments

There are five additional plants that can be developed in the future in a manner that will keep pace with the power requirements of the section that may be served and not have a large unearning investment tied up for some years

The following is an estimate of the cost of the additional power plants that may be constructed in the future but are not a part of the initial development

Power plant no 5	$1 190 000
Green Mountain Ka Rose transmission line	130 000
Operators quarters	60 000
Substation (20 000 kilowatts)	200 000
Subtotal	1 580 000
Interest during construction 3 percent	47 400
	1 627 400

The above plant together with plant no 1 will produce 113 000 000 kilowatt hours firm power annually 92 000 000 kilowatt-hours secondary power annually

The following are the construction costs of developing power plants nos 2 3, 4, and 4-A with appurtenant structures

Power plant no 2	$2 325 000
Power plant no 3	665 000
Power plant no 4	760 000
Power plant no 4-A	420 000
Power canal no 2	2, 444 000
Power canal no 3	493 000
Power canal no 3 A	113 000
Power canal no 4	1 194 000
Operators quarters	150 000

Substations (90 000 kilowatt hours)	$900 000
Additional transmission lines	311 000
Subtotal	9 775 000
Interest during construction 3 percent	293 250
Total repayable in 50 years with interest	10 068 250
Arkins Canal feeder payable in 40 years without interest	351 000
Total power plants nos 2 3 4 and 4 A	10 419 250
Total power plant no 5	1 627 400
Total second stage development	12 046 650
Primary development plant no 1	7 036 693
Cost of full power development	19 083 243

The total salable output of the full development is estimated as follows exclusive of that used for pumping

	Kilowatt hours
Firm power annually	360 000 000
Secondary power annually	[1] 200 000 000

[1] Out of an available production of 387 000 000 kilowatt hours secondary power

CONCLUSIONS

(1) There is a large area (615 000 acres) of irrigated land in north eastern Colorado the major portion of which has an inadequate water supply

(2) The feasible storage possibilities with the available water supply in the drainage area has been exhausted

(3) There is at least an available water supply of 310 000 acre feet on the upper drainage area of the Colorado River that can be diverted to supplement the present water supply on the eastern slope

(4) That the diversion of this quantity of water from the Colorado River watershed will not interfere with or encroach upon the present or future irrigation along the Colorado River and tributaries within the State with the protection provided in the Green Mountain Reservoir

(5) That the plan for the project here laid out appears entirely feasible from a construction point of view

(6) That the cost of construction estimated at $2 per acre foot per annum over the repayment period of 40 years is less than storage water is now commanding and that it will increase the crop values five or more times this annual cost showing its economic worth

(7) That the power developments that may be made in the six power plants will produce a large quantity of cheap hydroelectric power that will materially benefit Colorado

(8) That the revenues from the commercial power generated at power plant no 1 will pay for the power features as set up under the initial power development in addition to the power required for pumping at Granby pumping plant and in lieu of the irrigation features used in power development the operation of the system to a point where the water leaves the tailrace of the lower power plants can be taken care of by the power development

(9) That the cost of the irrigation feature of the project is within the ability of the water users to pay

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IN THE DISTRICT COURT

IN AND FOR THE COUNTY OF GRAND

STATE OF COLORADO

Civil Action No 1768

IN THE MATTER OF THE SUPPLE MENTAL ADJUDICATION OF PRIOR ITIES OF RIGHT TO THE USE OF WATER IN WATER DISTRICT NO 51 STATE OF COLORADO	))))	MEMORANDUM OPINION AND INTERLOCUTORY DECREE

On April 8 1974 a Partial Master Referee Report Regarding The Claims Of The Municipal Subdistrict Northern Colorado Water Conservancy District In And To The Various Component Structures Of The Windy Gap Water System was issued by Michael D White Master Referee A proposed decree granting conditional water rights for the various component structures of the Windy Gap water system is contained in the report On May 3 1974 Colorado River Water Conservation District (the 'River District) filed Objections And Exceptions To Partial Master Referee Report Regarding The Claims Of The Municipal Subdistrict Northern Colorado Water Conservancy District In And To The Various Component Structures Of The Windy Gap Water System On or about May 6 1974 Amended Objections And Exceptions To Partial Master Ref ree Report was filed by the River District

The issues raised by the objections and amended objections have been the subject of numerous thorough briefs by the Mu icipal Subdistrict Northern Colorado Water Conservancy District (the 'Municipal Subdistrict) and by the River District The Municipal Subdistrict has been represented throughout the proceedings by Davis Graham & Stubbs by John M Sayre Esq and others The River District has been represented throughout the proceedings by

Delaney & Balcomb by Kenneth Balcomb Esq and Scott Balcomb Esq

On February 4 1977 Hon Charles F Stewart Water Judge to whom this action was previously assigned ruled that the Court may not confirm modify reverse or reverse and remand the ruling (Report) of the Referee without conducting a hearing as required by 37 92 304 CRS 1973 The Municipal Subdistrict sought a writ of prohibition to prevent the water judge from implementing the February 4 1977 ruling This matter was resolved by stipula tion filed August 26 1977 in which the parties without waiver of the right of the parties to challenge the validity of the February 4 1977 ruling agreed to the content of the record of the hearing required by that ruling Pursuant to that stipulation on August 31 1977 there was presented to the water judge such record con sisting of the record of proceedings before the Master Referee taken on April 3 1972 including testimony transcripts and exhibits the Master Referee s report and orders and the River District s exhibits D and E

The Court has reviewed the Partial Master Referee Report and the transcript of proceedings of April 3 1972 before the Master R feree Exhibits MS 1 MS 6 MS 7 MS 8 MS 9 through MS 19 MS 20 MS 21 CRWCD A CRWCD B and CRWCD C which constitute the entire record upon which the Partial Master Referee Report was based The Court has also reviewed the River District s Exhibits D & E which were admitted in evidence by the Court subsequent to the issuance of the Partial Master Referee Report The Court has also reviewed the extensive briefs filed by the parties prior and subsequent to the issuance of the Partial Master Referee Report Upon the basis of such review the Court issues the follo ing

Memorandum Opinion and the following Interlocutory Decree

MEMORANDUM OPINION

STANDARD OF REVIEW

The different standards of review appropriate in judicial review of the draft of findings and draft of decree of a referee appointed under the Adjudication Act of 1943 (see C R S (1963) 148 9 12) and in judicial review of a ruling of a referee appointed under the Water Right Determination and Administration Act of 1969 (see C R S (1973) 37 92 304(3) (4) and (5)) create questions as to the standards for review of the Partial Master Referee Report in this action * Such questions have more than academic interest only if the different standards of review would yield different results The conclusions reached in this Memorandum Opinion make it unnecessa to resolve the question of the appropriate standard of review

OBJECTIONS OF RIVER DISTRICT

The objections raised by the River District will be groupe for discussion The Am nded Objections and Exceptions cover and include the o 'ginal Objections and Exceptions so no separate reference will be made to the latter

Necessity of Finding Unappropriated Water
(Objection To Finding Of Fact No 16 and Conclusion of Law No 2)

The objections to finding of fact no 16 and conclusion of law no 2 are based on a contention that a finding of availability of unappropriated water is necessary to support issuance of a conditional decree It is contended that a finding that water is physically available is not enough Reliance is placed on Article

*The Partial Master Referee Report states that the Referee was also appointed as a master under Rule 53 No order to that effect has been discovered in this proceeding If such order exists Rule 53 revie standards would also be involved

XVI Sec 6 of the Constitution of Colorado

This contention has been considered and rejected in Findings of Fact Conclusions of Law and Decree in Case No W 2109 in Water Division No 5 In The Matter Of The Application For Water Rights Of Vidler Tunnel Water Co In Grand County dated September 12 1977 The following analysis and conclusion from that case is adopted here

> Conditional decrees can be granted for two projects the construction of either of which would preclude construction of the other Colorado River Water Conservation District v Rocky Mountain Power Co 174 Colo 309 486 P 2d 438 (1971) cert den 405 U S 996 (1972)
>
> Conditional decrees have been granted to parties who wished to appropriate essentially the same water Elk River Water Co v Templeton 173 Colo 438 484 P 2d 1211 (1971) An appropriation may contemplate that others having water rights on the stream may abandon them See Rocky Mountain Power Co v White River Electric Association 151 Colo 45 376 P 2d 158 (1962) Appropriations have been recognized in situations where diversions could be accomplished only under unusual stream flow conditions Humphreys Tunnel and Mining Company v Frank 4 Colo 524 105 Pac 1013 (1909) Twin Lakes Reservoir and Canal Company v Aspen ___ Colo ___ 557 P 2d 825 (1976)
>
> Inherent in the appropriation and priority system is the possibility that in a given year there may not be water available to permit the exercise of a particular water right It is concluded that the creation of a conditional water right does not depend upon the presence of unappropriated water only the exercise of that right is so dependent See Humphreys Tunnel and Mining Company v Frank supra * It may be that a stream could be so over appropriated and that fact so well known as to establish a lack of good faith intent to appropriate that is not the case here P 22 23 Findings of Fact Conclusions of Law and Decree Case No W 2109 Water Division No 5

Effect of C R S (1963) 150 5 13(2)(d) Jurisdiction to Construe Sen Doc 80
(Objection To Findings Of Fact Nos 7 and 21 and Conclusions of Law Nos 2, 4, 5, 6, 8 and 9)

Several of the objections of the River District to the Partial Master Referee Report relate to the question of the necessity

*See also Article XVI Sec 6 of the Colorado Constitution relied on by the River District It states that The right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied (Emphasis added)

that the Municipal Subdistrict comply with C R S (1963) 150 5 13 (2)(d)* as a prerequisite to initiation of a conditional water right

That statute is part of the statute pursuant to which the Municipal Subdistrict was organized and is found among the list of powers granted to the board of directors of the district on behalf of the district The statute provides

> 150 5 13 General powers The board shall have power on behalf of said district
>
> (2) (a) To take by appropriation grant purchase bequest devise or lease and to hold and enjoy water waterworks water rights and sources of water supply and any and all real and personal property of any kind within or without the district necessary or convenient to the full exercise of its powers
>
> (c) To acquire construct or operate control and use any and all works facilities and means necessary or convenient to the exercise of its power both within and without the district for the purpose of providing for the use of such water within the district To do and perform any and all things necessary or convenient to the full exercise of the powers herein granted
>
> (d) However any works or facilities planned and designed for the exportation of water from the natural basin of the Colorado river and its tributaries in Colorado by any district created under this article shall be subject to the provisions of the Colorado river compact and the Boulder Canyon Project Act Any such works or facilities shall be designed constructed and operated in such manner that the present appropriations of water and in addition thereto prospective uses of water for irrigation and other beneficial consumptive use purposes including consumptive uses for domestic mining and industrial purposes within the natural basin of the Colorado river in the state of Colorado from which water is exported will not be impaired nor increased in cost at the expense of the water users within the natural basin The facilities and other means for the accomplishment of said purpose shall be incorporated in and made a part of any project plans for the exportation of water from said natural basin in Colorado
>
> (10) To appropriate and otherwise acquire water and water rights within or without the state

There is no indication in that statute or in C R S (1963)

*C R S (1973) 37 45 118(1)(b)(IV) the 1963 Revised Statutes citation has been used throughout the briefs and will be used here

148 9 8 the statute prescribing the contents of a statement of claim pursuant to the Adjudication Act of 1943 that an averment of development of project plans contemplated by C R S (1963) 150 5 13 must be contained in the statement of claim where applicable It is concluded that such an averment is not required

The Municipal Subdistrict cannot challenge the constitutionality of C R S (1963) 150 5 13(2)(d) for it is part of the statute authorizing creation of the Municipal Subdistrict Central Colorado Water Conservancy District v Colorado River Water Conservation District 186 Colo 193 526 P 2d 302 (1974) The Municipal Subdistrict is not asserting such a challenge in this case A water conservancy district claimant can be required by the water court to comply with that statute Cancellation of a conditional decree is an appropriate remedy for refusal to comply Central Colorado Water Conservancy District v Colorado River Water Conservation District supra

The Central Colorado case leaves unanswered the question whether a water conservancy district must demonstrate compliance with C R S (1963) 150 5 13 in order to obtain a conditional decree It would be unrealistic to expect that full blown project plans consistent with C R S (1963) 150 5 13 would have been created prior to initiation of a conditional water right Rather the recognition of a conditional water right by judicial decree provides the economic security upon which the development of detailed project plans can be expected to be predicated See Metropolitan Suburban Water Users Association v Colorado River Water Conservation District 148 Colo 173 365 P 2d 273 (1961)

It is concluded that at least hon opposition to a statement of claim is made predicated upon absence or inadequacy

of project plans complying with C R S (1963) 150 5 13 the Court should require evidence of project plans designed to satisfy that statute It is further concluded that at the time of initiation of a conditional water right such plans need only be in broad conceptual form

Proof of a project plan in broad conceptual form was introduced by the Municipal Subdistrict On the basis of such proof the Master Referee made finding of fact no 17 It states

> 17 The project is devised to divert only at those times and in such quantities as will provide compliance with the terms and conditions of Senate Document 80 which provides a manner of operation to be utilized in protection of present and prospective uses of water in the Colorado River Basin and in satisfying the requirements of 1963 C R S 150 5 13(1)(d) (sic should read 150 5 13(2)(d))

It is concluded that such finding is fully supported by the evidence and reflects adequate compliance with C R S (1963) 150 5 13(2)(d) to support a conditional decree

The project plans consist of two broad concepts insofar as such plans relate to creation of project plans satisfying the requirements of C R S (1963) 150 5 13(2)(d) First there is the operational concept that no diversion will be made by the Windy Gap project at any time that flow in the river is less than 75 c f s and that when flow in the river exceeds 75 c f s diversions will be limited to by pass 75 c f s at all times Second the Windy Gap project would be designed to utilize the Colorado Big Thompson facilities for carriage and to be operated in compliance with Senate Document 80

Senate Document 80 relates to the design construction and operation of the Colorado Big Thompson project It has been described by both the Municipal Subdistrict and the River District as a form of contractual agreement between eastern slope and western

slope water users In the Conclusions section of that document it is stated that diversion of 310 000 acre feet of water per annum from the Colorado river watershed as contemplated thereby will not interfere with or encroach upon the present or future irrigation along the Colorado river and tributaries within the State with the protection provided in the Green Mountain Reservoir Exhibit CRWCD A The Manner of Operation of Project Facilities and Auxiliary Features portion of Senate Document 80 imposes certain exceptions to the right to divert in priority The Municipal Subdistrict contemplates a carriage contract or contracts among Northern Colorado Water Conservancy District (the parent district) the Municipal Subdistrict and the United States of America to allow the Municipal Subdistrict to utilize carriage capacity of the Colorado Big Thompson facilities up to 310 000 acre feet per annum to the extent not needed to carry the water supply available to the parent district Carriage of water other than the water supply available to the parent district is contemplated by the parent district s own contract with the United States Exhibit MS 21 Sec 22 The Municipal Subdistric attempt would be to design a project to protect prior vested rights and the rights of others in the waters of the Colorado river (Transcript p 75)

In this case the Court did not specifically direct the claimant to show compliance with C R S (1963) 150 5 13(2)(d) as was the case in Central Colorado Water Conservancy District v Colorado River Water Conservation District supra The Municipal Subdistrict s proof on this point is undeniably in the form of broad concepts rather than detailed project plans It is concluded however that the Municipal Subdistrict established a prima facie case of compliance with that statute No contravening evidence was

presented Further studies and negotiations may prove the implementation of the broad concepts infeasible and may prove that the Municip Subdistrict s appropriation cannot be effected in compliance with C R S (1963) 150 5 13(2)(d) If so the Court has full power to cancel the conditional water right See Central Colorado Water Conservancy District v Colorado River Water Conservation District supra

It is to be expected that the project plans will become more detailed as diligence is exercised to apply water to beneficial use It may be that demonstration of an adequate degree of development of project plans meeting the requirements of C R S (1963) 150 5 13(2)(d) should be required at the time of consideration of each quadrennial application for a finding of reasonable diligence See C R S (1973) 37 92 301(4) Appropriate remedies may exist to prevent exportation of water from the natural basin of the Colorado river until appropriate project plans shall have been fully prepared and implemented See C R S (1963) 150 5 13(2)(d) These questions are for the future and need not be definitively answered at this time

A related contention of the River District is that finding of fact no 21 in the Master Referee report effectively shifts the burden of proof of compliance with C R S (1963) 150 5 13(2)(d) to the River District The finding states

> 21 The protestant CRWCD has not submitted any evidence in this matter hich would show any injury to any present or prospective water user by the operation of the proposed Windy Gap System

As a finding of fact it is impeccable The River District did not submit such evidence The River District s objection is to any implication that it had the burden to submit such evidence Taking

the findings of fact together finding of fact no 17 is adequate to reflect that the Municipal Subdistrict has carried its burden to demonstrate a prima facie case of compliance with C R S (1963) 150 5 13(2)(d) as discussed above Finding of fact no 21 simply declares that no contrary evidence was presented by the River District The finding may be unnecessary but it is unquestionably correct The River District s contention on this point is not well taken

The River District also objects to finding of fact no 17 on the basis that it requires interpretation of Senate Document 80 a matter reserved for the exclusive jurisdiction of the federal court Neither the referee nor this Court has jurisdiction to construe Senate Document 80 in a manner binding on parties whose rights are affected thereby The relevance of Senate Document 80 in this case relates to the good faith intent of the claimant to effect an appropriation one aspect of which is intent to develop project plans in accordance with C R S (1963) 150 5 13(2)(d) and to the adequacy of the project plans to satisfy that statute For such purposes the non binding construction of Senate Document 80 by the Municipal Subdistrict the referee and this Court are entirely appropriate Should future definitive interpretation of Senate Document 80 by a court having appropriate jurisdiction reflect that the Municipal Subdistrict s project plans are not su ceptible of accomplishment unless alternate plans can be developed to meet the requirements of C R S (1963) 150 5 3(2)(d) it may be that the Municipal Subdistrict s conditional decrees will be subject to cancellation See Central Colorado Water Conservancy District v Colorado River Water Conservation District supra

A reading of the decree in consolidated Civil Action Nos 2782 5016 and 5017 in the United States District Court for the

District of Colorado River District Exhibit Nos B and C makes it clear that any contention that adjudication of the applications for water rights in this case is reserved exclusively to the United States District Court is without merit See objection to conclusion of law no 9 River District s Amended Objections and Exceptions It may be that actual utilization of the physical facilities of the Colorado Big Thompson project by the Municipal Subdistrict to transport water for application to beneficial use will necessitate a prior determination of rights within the reserved jurisdiction of the United States District Court Such a determination is not a condition to init ation of a conditional water right The same may be said for the objection that any use of Green Mountain Reservoir inherent in utilization of Colorado Big Thompson facilities pursuant to Senate Document 80 may prove impermissible

Adequacy of Evidence to Support Appropriation Date (Conclusion of Law No 3)

The Master Referee s conclusion is

> 3 The date of appropriatio for said claims is June 22 1967 the date upon which ie prorequisite intent and the first step in furtherance thereof coexisted for the Windy Gap Project as a whole Elk Rifle Water Company v Tompleton 148 P 2d 1211 (Colo 1971) Colorado River Water Conservation District v Rocky Mountain Power Co , et al 486 P 2d 438 (Colo 1971) Taussig, et al v Moffat Tunnel Water and Development Company 106 P 2d 363 (Colo 1940) City and County of Denver, et al , v Northern Colorado Water Conserva cy District, et al 276 P 2d 992 (Colo 954) "

The obje tion as stated in the River District s Amended Objections and Exceptions is

> No 3 in that it ignores the Elk Rifle Water Company v T mpleton 148 P 2d 1211 (Colo 1971) requirement tha the date of appropriation shall be the later of field survey and owner claimant approval Finding (of Fact) No 10 puts this before 1969

Finding of fact no 10 states

> 10 Before 1969 al actions of the informal committee were ratified by the member cities

The River District would have it implied that the actions of the informal committee we unauthori d until ratified in 1969 The record supports the finding that the informal committee was formed by five and later six member cities in the latter part of 1965 (Finding of fact no 1) It further supports the finding that the informal committee indicated its intent to appropriate on May 24 1967 (Finding of fact no 5) Conclusion of law no 3 states that on June 22 1967 the intent and first step in furtherance thereof coexisted This implicitly constitutes a conclusion that the informal committee in forming its intent to appropriate was acting on behalf of and with authorization of the six cities This conclusion is a logical and permissible inference from the facts found all of which are supported by the record

The objection to Conclusion of law no 3 is not well taken

MOTIONS

On November 12 1975 the River District filed a Motion To Enlarge Grounds Of Amended Objections And Exceptions To Partial Master Referee Report Regarding The Claims Of The Municipal Sub district Northern Colorado Water Conservancy District In And To The Various Components Of The Windy Gap Water System By motion the River District seeks to assert two additional grounds for denyin the claims These grounds are as follows

> The claimant the Municipal Subdistrict or its predecessor Ralph R Price trustee for six Colorado cities Longmont Loveland Fort Collins Greeley Estes Park and Boulder failed to illustrate the requisit intent to make an appropriation of water in that someone allegedly made a decision to proceed with the project as required by the Colorado law without knowing either the fact that it was susceptible of being built the volume of water that would be developed and the price therefor
>
> The intent to appropriate is further lacking in that the evidence in the re ord shows only the intent to appro

priate as evidenced by the minutes of the Six Cities Steering Committee which committee was not a legal entity on May 24 1967 and the evidence is devoid of exhibits or testimony which would tend to show that any of the Six Cities by and through its governing council or board of trustees intended to make an appropriation known as the Windy Gap Project

These grounds are comprehended within the River District s general objection to sufficiency of the evidence to support the findings of fact and conclusions of law They were briefed by the parties pursuant to the consent of the Court prior to ruling on the Motion to Enlarge Whether or not they should be considered by the Court a review of the grounds on their merits reflects that they are not well taken Uncertainties about engineering feasibility and economic feasibility do not preclude a finding of good faith intent to appropriate Metropolitan Suburban Water Users Association v Colorado River Water Conservation District 148 Colo 173 365 P 2d 273 (1961) Four Counties Water Users Association v Colorado River Water Conservation Distri t 159 Colo 499 414 P 2d 469 (1966) Although no direct evidence of action by the governing council or board of trustees of any of the Six Cities reflecting intent to appropriate was presented it has previously been concluded that it is a permissible inference from the evidence and the findings that the action of the informal committee in initiating the appropriation was authorized by the Six Cities See the discussion above with respect to conclusion of law no 3

OTHER OBJECTIONS

The River District in paragraph 8 of its Amended Objections and Exceptions objects to the proposed decree in its entirety as being based on insufficient evidence and erroneous findings of fa t and conclusions of law Each of the specific objections has been considered and rejected this general objection is not well ta en

Objection is further made to inclusion of language and all other beneficial uses as a purpose of the appropriation It is concluded that such unspecific designation of uses is insufficient and inappropriate for inclusion in a decree

FINDINGS BY THE COURT, ORDERS AND DECREE

IT IS FOUND THAT

(1) Consideration of the record and briefs as reflected in the introductory portion of this Memorandum Opinion and the oral arguments previously heard before Judge Stewart and available to the undersigned Judge through reporters transcripts constitute an adequate hearing within the meaning of C R S (1963) 148 9 12 and C R S (1973) 37 92 304 whichever statute may be applicable

(2) The findings of fact and conclusions of law and draft interlocutory decree contained in the Partial Master Referee Report are fully supported by the evidence and are in accordance with law except as the conclusions of law are modified by the portion of this Memorandum Opinion dealing with Central Colorado Water Conservancy District v Colorado River Water Conservation Dist ict sup a and except for the inclusion of and all other beneficial uses among the purposes for which the conditional decree

(3) The Court would make findings of fact and conclusions of law identical in substance with the findings of fact and conclusions of law contained in the Partial Master Referee Report and would enter an interlocutory decree identical to that contained in such Report all subject to the exceptions noted in par (2) immediately preceding if it were to consider the matter independently on the record before it

(4) Whether the proceeding before the Court is considered to be governed by C R S (1963) 148 9 12 or C R S (1973) 37 92 304

or by Rule 53 C R C P the result would be the same Accordingly

IT IS ORDERED ADJUDGED AND DECREED that the findings of fact and conclusions of law contained in the Partial Master Referee Report dated April 8 1974 are approved and confirmed with the modifications referred to in par (2) of this section of the Memorandum Opinion and

IT IS FURTHER ORDERED ADJUDGED AND DECREED that the interlocutory decree heretofore issued in this proceeding is supplemented and amended by the addition of structures described as follows

Priority No _____

CLAIMANT	Municipal Subdistrict Northern Colorado Water Conservancy District
NAME OF STRUCTURE	Jasper Pump and Pipeline a part of the Windy Gap Water System
NATURE OF DECREE	Conditional
SOURCE	Willow Creek a tributary to the Colorado River through Jasper Reservoir
POINT OF DIVERSION	At a point on the north bank of Willow Creek whence the southeast corner of Section 16 T 2 N R 76 W of the 6th P M bears south 62 30 east a distance of 2 730 feet
PURPOSE	Municipal irrigation industrial recreational
DATE OF APPROPRIATION	June 22 1967
AMOUNT	300 c f s

Priority No _____

CLAIMANT	Municipal Subdistrict Northern Colorado Water Conservancy District
NAME OF STRUCTURE	Windy Gap Pump Pipeline and Canal a part o the Windy Gap Water System

NATURE OF DECREE	Conditional
SOURCE	Colorado River through the Windy Gap Reservoir
POINT OF DIVERSION	A point on the north bank of the Colorado River whence the northwest corner of Section 25 T 2 N R 77 W of the 6th P.M bears north 17 30 west a distance of 2 380 feet
PURPOSE	Municipal irrigation industrial recreational
DATE OF APPROPRIATION	June 22 1967
AMOUNT	300 c f s
	Priority No _____
CLAIMANT	Municipal Subdistrict Northern Colorado Water Conservancy District
NAME OF STRUCTURE	Windy Gap Reservoir a part of the Windy Gap Water system
NATURE OF DECREE	Conditional
SOURCE	Colorado River
LOCATION	An onstream reservoir located in Sections 25 and 26 T 2 N R 77 W of the 6th P M
INITIAL POINT OF SURVEY	The northwest corner of the proposed dam is located at a point which bears S 52 00 W 1660 feet from the N E corner of Section 26 T 2 N R 77 W of the 6th P.M
PURPOSE	Municipal irrigation industrial recreational
DATE OF APPROPRIATION	June 22 1967
AMOUNT	1 546 14 acre feet
	Priority No _____
CLAIMANT	Municipal Subdistrict Northern Colorado Water Conservancy District
NAME OF STRUCTURE	Jasper Reservoir a part of the Windy Gap Water System
NATURE OF DECREE	Conditional

SOURCE	Colorado River and Willow Creek a tributary of the Colorado River
LOCATION	An onstream reservoir located in Sections 8 16 17 and 21 T 2 N R 76 W of the 6th P M
INITIAL POINT OF SURVEY	The southwest corner of the proposed dam is located at a point which bears S 55 30 E 1800 feet from the N W corner of Section 21 T 2 N R 76 W of the 6th P.M
PURPOSE	Municipal irrigation industrial recreational
DATE OF APPROPRIATION	June 22 1967
AMOUNT	11 292 58 acre feet

IT IS FURTHER ORDERED THAT application for a quadrennial finding of reasonable diligence shall be filed in February of 1982 and in February of every fourth calendar year thereafter so long as claimant desires to maintain those conditional water rights or until a determination has been made that these conditional water rights have become absolute water rights by reason of the completion of the appropriation

IT IS FURTHER ORDERED THAT each such application for a quadrennial finding of reasonable diligence shall include evidence of the then current stage of development of project plans so that the Court may determine whether compliance with C R S (1963) 150 5 13 (2)(d) is being achieved

IT IS FURTHER ORDERED THAT a copy of this Memorandum Opinion and Interlocutory Decree be filed with the Division Engineer and the State Engineer

IT IS FURTHER ORDERED THAT the time for filing motions directed to this Memorandum Opinion and Interlocutory Decree is extended to March 20 1978 to reflect delays in receipt of copies

of this document sometimes to be expected incident to mailing

Done this 23 day of February 1978

BY THE COURT

Water Judge (Acting By Special Assignment)

Memorandum

To Files

Subject Response to August 3 1979 Comment Letter from Middle Park Water Conservancy District on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment The Windy Gap Project would prevent growth and utilization of water within Grand and Summit Counties The DES fails to provide evidence of the Subdistrict s compliance with C R S 37 45 118

Response The Intergovernmental Agreement (Attachment 1) provides compensation to west slope entities for impacts caused by the Windy Gap Project Middle Park is party to this agreement Compliance with C R S 37 45 118 is discussed in Chapter I of the FES

2 Comment The Windy Gap Project would have a negative effect on west slope water rights An analysis of this effect was left out of the DES

Response The Intergovernmental agreement provides protection to west slope water rights An analysis of this protection and potential impacts are discussed in Chapter IV of the FES

3 Comment Windy Gap would pre empt the development of other water projects which would provide water for west slope uses

Response The Intergovernmental Agreement (Attachment 1) provides a compensatory water supply for west slope uses This supply would be provided by a reservoir to be constructed at the Azure or Una Reservoir locations (see Attachment 1) or as otherwise specified by future planning efforts

4 Comment The DES did not adequately discuss the impacts on the Colorado River fishery

Response The FES contains a more extensive analysis of the impacts on the fishery Also see Attachment 2

5 Comment The use of Green Mountain Reservoir water for supplying the water needs of western Colorado has not been addressed

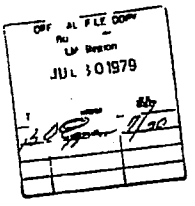
Response Pursuant to the Intergovernmental Agreement the Subdistrict has agreed to provide 2 000 acre feet of Windy Gap s yield to Middle Park Another 1 300 acre feet would be provided from a proposed Azure or Una Reservoir The Windy Gap Project will not affect current Green Mountain Reservoir operations Any potential contractee for Green Mountain Reservoir stored water will be required to provide NEPA documentation These potential uses have not changed and need not be addressed

6 Comment The DES fails to indicate the severity of salinity impacts on the Colorado River

Response The Colorado River Salinity Control Project is addressing the impacts of water depletions within Colorado on the Colorado River Basin The Salinity Control Project is analyzing all depletions within the State of Colorado which are allocated pursuant to the Colorado River Basin compacts The Windy Gap Project is part of this analysis

San Miguel Basin
Soil Conservation District

Bo 29 Norwood Colorado 81423 Phone 327-4245



July 25 1979

Mr Joe D Hall Regional Director
US Bureau of Reclamation Lower Missouri Regi n
PO Box 25247
Building 20 Denver Federal Center
Denver CO 80225

Attention: LM-150

Dear Sir

The Board of Supervisors of the San Miguel Basin Soil Conservation District reviewed the summary of the Draft Environmental Statement for the Colorado-Big Thompson/Windy Gap Projects at our regular meeting held July 23 1979 We wish to go on record as opposing the construction of the Colorado Big Thompson/Windy Gap Project for the following reasons:

1 Salinity Impacts - The expected increase in salinity load at the Imperial Dam resulting from construction is estimated to be 0 5 . The total Colorado Big Thompson Project could contribute as much as 3 % of the salinity at Imperial Dam It appears to be very inconsistent that some projects undertaken by the Bureau of Reclamation are designed to reduce th salinity of the Colorado River while other Bureau projects only serve to aggravate the situation In any respect it always seems that the government places the responsibility of mitigating the increase in salinity with farmers and ranchers - even though they have little or no control over federal actions

2 Endangered Species The Colorado River squawfish humpback chub and bonytail chub have been placed on the endangered species list by the state of Colorado The Colorado Division of Wildlife has stated that water storage projects on the Colorado River and Transbasin diversions have contributed to the decline of suitable habitat f r these species We suppo t the position of the Division of Wildlife in this regard We feel that it is irresponsible to propose projects which would further threaten an already endangered species

3 Water Requirements for Energy Development - The United States is presently faced with a critical energy shortage Western Colorado has a tremendous amount of energy reserves in the form of coal and oil shale

San Miguel Basin
Soil Conservation District

Bo 29 Norwood Colorado 81423 Phone 327-4245

To recover these energy sources and transpose them to a useable form will require a great deal of water Authorizat on of the Colorado Big Thompson/ Windy Gap Projects would only further deplete already short water supplies which would be available for energy development in western Colorado

4 Depletion of Agricultural Water Supplies To a very large extent agricultural water users in Western Colorado depend upon decreed and adjudicated water from streams and rivers We have very little stored water available for agricultural purposes Many of our streams and rivers are over decreed far beyond the capacity of the streams and rivers to meet the demand There is a great deal of land in Western Colorado that is considered to be prime and unique farmland Nearly all irrigated land can be considered important farmland at least from a local and state standpoint We resent the policies which permit Denver and other front range cities to deplete the already short water supplies on the Western Slope for the purpose of irrigating their lawns or washing their cars

The Supervisors of the San Miguel Basin Soil Conservation District feel that the disadvantages of this project far outweigh the possible advantages We strongly urge the Bureau of Reclamation to assume a more responsible position in regards to management of all natural resources, and withdraw the application for the Windy Gap Project

Sincerely

Glen L Gardner
Board of Supervisors
San Miguel Basin Soil Conservation District

cld

MEMORANDUM

To Files

S bject Response to the July 25 1979 San Miguel Basin Soil Conservation District Comment Letter on the Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment It appears i consistent that some Water and Powe p ojects reduce salinity and othe s i c ease it

Response Salinity i the Colo ado Ri er Basin is being addressed by the Colorado Ri er alinity Control Progra . This program is responsible for i estigati g problems and proposing and car yi g out solutions Se e al p ojects are authorized and mo e a e being investigated The pu pose of the p ogra is to alle iate the adverse eco omic a d environmental mpacts caused by high salinity concentrations

This cor ecti e and p e entive program assumes that water allocations bet een the upper and lower Colorado Ri er Basin states w ll be e e c sed accordi g to the Colorado Rive Compact Me ican T eaty of 1944 Uppe Colo ado Ri er Basi Compact Arizona vs California S it the Suo ene Cou t and the Colo ado Ri er Storage Project Act

It is t ue that some p ojects a e decreasi g salinity concentrations while othe s a e i creasing concentrations Howe er the net effect of th Colorado River Salinity Control Prog am will be to maintain salin ty co cent ations ithi acceptable limits at specific locations

2 Comment Go ernment places responsibility of mit gating salinity impacts on farmers and ranchers who ha e little cont ol over Federal actions

Respo se l itigation fo salinity impacts is being addressed pursuant to the Colorado River Sali ity Control Program Funding for this program is being prov ded p imarily through Federal sources however some epayment is equi ed for certain projects Thi epayment is based po an a ea s co t ibution to sali ity impacts and ability to repay

The enti e program s flue ced to a great deg ee by public and Go emme t i ol ement

The status of the Colorado Ri e Salinity Control Program is detailed in the repo t titled Quality of Water Colorado River Basin P ogress Report No 10 1981

3 Comme t It is irrespo s ble to p opose projects which would fu ther th eaten endangered fish in the Colo ado Rive

Response The mpacts a d mitigatio associated with e dangered species are being determined pu suant to Section 7 Endangered Spec es Act Federal invol ement in the Windy Gap Project would be se erely rest icted if the project jeopardizes the co tinued existence of a endangered species See Chapter IV C Threatened and Endangered Species Section 7 E dange ed Species Act Consultation has been completed Conditional cleara ce has been granted the Windy Gap Project (FWS 1981)

4 Comment A Windy Gap di ersion would fu ther deplete aluable west slope water supplies which wo ld othe wise be a ailable for e ergy development in weste n Colorado

Response Compensation for west slope depletions is discussed in the Intergovernmental Ag eement (Attachment 1) Replacement ater ould be pro ided by const uction of a sto age ese oir with n the upper Colo ado Ri er Basin

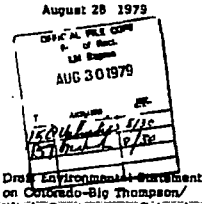
5 Comment Recent policies which permit f ont range cities to deplete potentially al able ater ag ic ltural ater s pplies f om the West Slope i o de to i rigate lawns and ash cars

Response Water fo the Windy Gap Project se ice a ea ill be used fo municipal as well as indust ial p rposes Appo i ately 16 000 ac e feet of Wi dy Gap s ave age annual yield of 48 000 acre feet ill be allocated to Platte Ri er Powe Authority The emainder ill be distributed to the cities of Boulder Longmont Fort Collins Greeley and Estes Pa k fo municipal and i dustrial ses The ate that is di e ted f om the east slope ill be compensated as descr bed in Respo se 4

6 Comment Water and Powe should ithd aw application fo the Windy Gap Project

Response E ecution of the ca iage cont act ith Water a d Powe are contingent upon satisfying umerous environmental laws and egulations The satisfaction of these e vironmental const aints will determi e whether or not Water and Power will grant the Distr ct the ght to convey Windy Gap ater th ough the Colo ado Big Thompson facilities

August 28 1979



Mr Joa D Hall Regional Director
Bureau of Reclamation
Regional Office Lower Missouri Region
P O Box 25247
Building 20 Denver Federal Center
Denver Colorado 80225

Dear Joe

Draft Environmental Statement on Colorado-Big Thompson/ Windy Gap Project Colorado
Your letter J ly 24 1979
LM 150

Enclosed are commen s of the Colorado River Water Co servation District on the above referenced draft Environmental Statement

Very truly yours

ROLAND C FISCHER
Secreta y Engineer

NOTICE
If you detach enclosures please insert your code number ____

RCF abg
Encl

COMMENTS OF THE COLORADO RIVER WATER CONSERVATION DISTRICT
ON
DEPARTMENT OF THE INTERIOR DES 79 33

Draft Environme tal Stateme t n Colo d B g Thomps /
Windy Gap Proje t Col d
August 28 1979

Th Col r d Ri er Water Co s tio Di t t (h s ft r fer ed t a th Ri District r Dist ict) i quasi mu icip l entity ted by th C lo do Stat l gislat re in 193 (Colorado Revi ed Stat t 37 46 101 1973)

Under thi t tute the l gi l ture mand ted to th Ri District esponsibil ty f r th cons rv tion and saf gu ding th waters of th C l rado Ri t h ch th State of Colorado is q it bly e titled under th Col do Riv r Comp ct of 1922 As part of its responsibility th Ri e Di t ict ha ppropriated wat s of th C lor do Ri er fo be ficial s a d h ids ua rous decr ed by th C l d t c rt in lodi g W te Di i i #5 the mai stem Color do the wat rs of hich re the s bj t of the Draft En ironme t l Impa t St tement f ced bo W ha made ge eral and specific comments The gener l comments re as follo s

The St teme t is ins ffi t in that it does n t dequately add s fish sp li ted s ndang red The Statem t acknowledges on p g IV 26 that th planned Windy Gap t ansmount i di i ill affect th habit t f th Col ado Ri qua fi h and th humpback ch b Th ndang ed peci qu sti n is add ssed only briefly i Chapte 5 (Mitigating Measu es and Ai nd Wat Quality Aspects) h e find th f llowing l gu ge on pag V 3

(4) Th t ned and Endang ed Specie Th e t ed d endang ed sp ci s of plants nd imals e g a ted Fed al protecti by th Endang ed Speci A t f 1973 (16 SC 1533) Lists f s ch protected spe publi hed pe iod lly i th Fed J R g st (Vol 4 No 206 et seq for ildlif and fishe i s Vol 41 N 117 t oq fo plants)

By acknowledg g the ist nc f an ff t th habit t of a dang red sp c s the statement hould lik wi chnowledg th t fed l i pre ts p y t tructi Th th Dr ft En ironmental Impact Statement should be ithdrawn

The subject of ater right for the Windy Gap Project is ns ffi iently dd d The Muni ipal Sub District has not pr wnted pl n to th water c t f ompliance ith the con rv y di rri t t Th proj ct as propo ed th d ft st teme t ill result in n incre se in cost to i ba in us s of th wat r of th Colorad Ri er be in and cannot be built unless an a pt ble pl addressi g the issu of c st is pr sented to nd pted by th t court

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R s oir t th We t rn Slope Any th op rti g p tt rn would s bst t lly
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G p l c t Th propo d proj ct should not be f ther c id ed until s ch
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P g s IV 36 d 37 Th disc ssion i the l st paragraph on p g 36 and the
f st p g ph o p g 37 is largely odito i li g and we requ st that they be
r k

P g VII 4 l the third p r gr ph n the page we fi d a disc ssion o th i
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h f co l to mu icip l Howhe e i the stateme t do w f nd
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mpro is d struction f A R s rvoir downst eam and ami t Windy G p

Memorandum

To Files

Subject Response to August 28 1979 Comment Letter from the Colorado River Water Conservation District on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment The DES does not sufficiently discuss endangered species Since Windy Gap will affect habitat of the Colorado River squawfish and humpback chub Federal law prevents project construction

Response The endangered species portion of the statement has been revised to reflect the biological assessment forwarded to the Fish and Wildlife Service and their subsequent biological opinion

2 Comment Windy Gap water rights is insufficiently addressed The Subdistrict has not complied with the State conservancy district statute in that it has not presented a plan assessing the increased cost to in basin water users (decrees entered by Water Court Division 5 in October 1980)

Response The Subdistrict plan for compliance with the Conservancy District Act C R S 1973 37 45 101 et seq is embodied in the Windy Gap settlement agreement concluded between affected West Slope entities including the Colorado River District The Colorado Supreme Court has ordered the Water Court Division No 5 to enter decrees in accordance with the Intergovernmental Agreement (Attachment 1)

3 Comment The operating criteria for Green Mountain Reservoir discussed on pages II 24 and II 25 of the DES are erroneous

Response The correct operations of Green Mountain Reservoir as governed by legal constraints are discussed in Chapter II of the FES

4 Comment It appears that Windy Gap will be diverting while compen satory water is being released from Green Mountain Reservoir The net effect will be an informal exchange which is not permitted by the actual operative criteria for Green Mountain Reservoir The subsequent impacts on in basin water supply are ignored

Response The operation of Windy Gap which is stipulated in the Windy Gap Intergovernmental Agreement (Attachment 1) will not be in conflict with the operating criteria for Green Mountain Reservoir Impacts on in basin water supply and compensation for these impacts are discussed in the Intergovernmental Agreement which is signed by the River District

5 Comment The statement incorrectly implies that project construction will not affect the availability for in basin beneficial water de elopme t

Response In the Intergovernmental Agreement the Subdistrict has agreed to subordi ate its decree to in bas n agricultural domestic and mun cipal uses above the Windy Gap diversion point and fu ther has agreed to at cept construction of Azure Reservoir o a s bstitute project for storage of water for in basin uses by the Colorado River Distr ct Const uction of su h a project will be subject to full compliance ith all environmental laws independent of the Windy Gap Project The Water Conservancy Act contains a provision for the p otection of futu e in basin water needs and the affected West Slope acti ities have agreed that the Subdi trict s plan contained in the Inte gove mental Agreement accomplishes the aim of this art

6 Comment The DES inadequately addresses increased salinity in the Colorado River due to Windy Gap It does not describe the effect on Colorado R ver irrigators o municipal and industrial users

Response A description of impacts and mitigation of these impacts is being addr ssed by the Colorado River Salinity Control Project

7 Comment Generally the DES is deficient in that it fails to discuss the impacts on the West Slope

Response The impacts of the Windy ap Project are discussed in more detail in the FES than the DES as a result of additional study Impacts have been minimized or avoided as a result of the Intergovernmental Agreement (Attachment 1) to which the River Dist ict is party

8 Comment The statement should discuss in more detail the use of and type of cooling wate to be used by Rawhide Powerplant

Response Chapter II of the FES discusses the use and type of cooling water to be used by Rawhide

9 Comment No West Slope newspapers were included in the DES distribution list

Response Newspapers ere sent review copies of the DES however they ere not listed in the distribution list This oversight has been corrected in the FES

10 Comment Concerning the interpretation of the August 1 1935 decree

Response Our statement on page II 1 states Up to 310 000 acre feet that infers that if the water is not physically available it cannot be dive ted

11 Comment At no place in the DES is there a discussion of Contract No 14 06 700 3123 which covers the transport of water through the C BT to the City of Englewood This contract would affect the space available for Windy Gap The statement should be withdrawn until this affect is analyzed

Response Contract No 14 06 700 3123 is no longer in effect Consequently it will not affect the Windy Gap Prc ect

1 Comment There is no mention on pages II 54 and II 55 of the stipulation requiring that the water supply and storage company must divert its east slope water before diverting from Grand River Ditch

Response The projected water demands for the service area considers the relationship between east slope and Grand River Ditch diversions

13 Comment The statement on page II 56 Any remaining allotments could then be sold on the open market implies speculation and should be clarified

Response The paragraph on page II-56 discusses scenarios for sale of water which may be excess to Rawhide s needs

The excess water if any would be due to a disparity between the projected water demands and the actual needs of Rawhide This possible disparity is inherent in almost any phased development and does not imply speculation

14 Comment The DES fails to discuss the interrelationships between other projects and proposals

Response All of the projects described on pages II 64 through II 67 are related in that they all divert water from the Colorado River Basin to the east slope of the Rocky Mountains

15 Comment The supporting data for the future estimated transmountain diversions shown in Table II 17 should be supplied for review and comment or the last column should be stricken

Response The information was drawn from Table II 9 of the final environmental statement Fryingpan Arkansas Project Colorado 1975 This citation has been added to Table II 17

The table lists future estimated transbasin diversions based upon decrees or filings which could be developed No implication is made as to whether these diversions are viable and in fact will ever occur However the effect of these diversions on the hydrology of the Windy Gap Project was considered in determining the economic and hydrologic viability of the Windy Gap Project Supporting data for these filings can be found in the records of the Division of Water Resources State Engineer s Office

16 Comment The DES does not discuss how the Bureau will operate Green Mountain Peservoir in relation to land slides and the effect on eservoir contant

Response Follow ng the last major movement of the two landslides in 1963 restric ive drawdown elevations were placed on reservoir operations Future drawdowns were to be kept above elevation 7870 and preferrably 7880 The reservoir storage capacity at elevation 7870 is 4 796 ac e feet and at elevation 7880 it is 50 458 acre feet

17 Comment why hasn t the Bureau installed a dishcharge and water qua ty gage at Windy Gap? Project should not proceed until such information can be furnished

Response Hydrologic studies and water quality studies used in th development of the Windy Gap p oject were based upon the gage located at Hot Sulphur Spring properly adjusted to reflect any tributary flows between the Windy Gap project and that gage It is felt that the nformation obtained from the U S G S gage is sufficient fo development of the Windy Gap Project Specific wate quality information is being obtained at the Windy Gap site In addition the Subdistrict and U S G S is exploring the feasib lity of installing a gage at the Windy Gap site

18 Comment Paragraphs 4 and 1 on pages IV 36 and IV 37 respectively a p editorializing and should be eliminated

Response The subject paragraphs are somewhat subjective and are not necessarily supported by facts Therefore we have eliminated these parag aphs from the final statement

19 Comment The DES fails to discuss the reduced agricultural benefits to the Colorado River Basin due to Windy Gap

Response A suitable mitigation for possible impacts has been agreed to as de cribed in the Intergo ernmental Agreement (Attachment 1) The Rive D st ict is pa ty to this agreement

20 Comment The River District was not consulted about the content of the DES

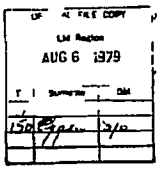
Re ponse The list of coordinating meetings does not imply that those meetings directly nvolved the environmental impact statement This list merely indicates the degre to which the Municipal Subdistrict attempted to pro ide adequate information about the Windy Gap Project f om the date of its fi st i tiation through to the draft environmental impact tatement hearings These meetings and contacts occurred over a per od from 1971 th o gh the date of the draft statement and included near l all contacts made co cerning the project

INDIVIDUALS



Winter Park Water and Sanitation
District
Jack Buchheister President
Winter Park Colorado 80482

July 30 1979



Mr Joe D Hall
Regional Di ector
United States Department
of Interior
Bure u of Reclamation
Regional Office
Lower Missouri Region
P O Box 25247
Building 20
Denver Federal Center
Denver Colo ado 80225

RE Colorado Big Thompson Windy Gap Project

Dea Mr Hall

This is just a short note to point out that the proposed Windy Gap P oject will have an adverse impact upon the Winter Park Water and Sanitat on District Winter Park Water and Sanitation District has for many years been attempting to install a municipal water system to service its service a ea of Eastern Grand County The Winter Park Water and Sanitat on District is fast approaching successful completion of that chore Howeve the water right that it presently owns if it is unable to precu e anothor one is junior to Windy Gap s and thus will be called out by the Windy Gap rights The Colorado Water Conservation Board and FHA have both refused to lend funds until there is a settlement of the water rights problem Winter Park Water and Sanitation District feels that it is fast approaching that required settlement The Windy Gap Project s going to have an impact on other similarly situated entities and cut down the future growth of Grand County which has been probably anging within the last 2 or 3 years from 20% to 25%

Sincerely

Jack Buchheister

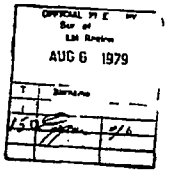
MEMORANDUM

To Files

5 bject Response to July 30 1979 Winte Park water and Sanitation District Comment Lette o the Colo ado Big Thompson/W ndy Gap Projects Final En ironme tal Stateme t

1 Comment Wi dy Gap ill p eve t completion of Winter Pa k s municipal ater systen and deter growth in other pa ts of G a d Co nty because of its senior ate right

Response According to the Intergove nmental Ag eement which Wi ter Park and G a d Co nty na e signed the Subdist ict agrees to subj gate Windy Gap s ater ight to Winter Park In addition the Agreement specifies certain mitigation to G ano County for potential est ictio s o ate s pply



Bob Baron
Jacques Ranch Partnership
Post Office Box 943
400 Rialto Sq
Joliet IL 60431

July 25 1979

Mr Joe D Hall
Regional Director
United States Department
of Interior
Bureau of Reclamation
Regional Office
Lower Missouri Region
P O Box 25247
Building 20
Denver Federal Center
Denver Colorado 80225

RE Windy Gap Project

Dear Mr Hall

This letter is to point out to you that we are the immediate owner of real property underneath the Windy Gap Dam As such we contemplate having serious problems ever subdividing our property if the project goes in since it will in fact create a flood plain Also the Draft Environmental Statement fails to address the problem created by our water rights in that it will lower the flow necessitating us going out in the river and recanalizing the river to p ovide water for our water rights located along the Colorado River The cost of such will be g at and the p oblems of obtaining a Corps of Engineer permit for the same will be extremely detrimental to us as well as the rest of the ranchers

Since ely

Bob Baron

Memorandum

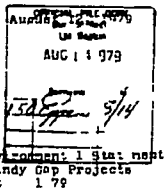
To Files

5 bject Respo se to J ly 25 1979 Comment Letter from Bob Baro of Jacques Ranch Partnership o Colorado Big Thompson/Windy Gap Projects Final Environme tal Statement

1 Comment The ability to subdi ide property would dimi ish because the project would create a flood plain The lower flows would be detrimental It ould necessitate the rehabilitation of dive sion works and the acquisition of a Corps of Engineers permit

Response The Windy Gap Intergovernmental Agreement (Attachment 1) addresses and pro ides for the aforementioned problems Mr Baron sig ed the agreement on behalf of the Jacques Ranch Pa tne ship

Howard K Schmuck J
6045 Johnson Way
Arvada Colorado 80004



Office of Environmental Affairs
Bureau of Reclamation
Liaison Region
Room 7524
Building 20
Denver Federal Center
Denver Colorado 80225

Reference Public Hearing on Draft Environmental Statement
Colorado-Big Thompson/Windy Gap Projects
Granby Colorado August 1979

Gentlemen

The following written comments are a supplement to the oral comments presented by Howard K Schmuck Jr at the refernce public hearing

1 The enclosed pertains to the operation of the Windy Gap project subsequent to construction

After serving the position of my property in Grand County Colorado required by them to the Municipal Subdistrict Northern Colorado Water Conservancy District I still retain land including a stretch of the Colorado River channel just below the diversion dam in like manner as my mother has sold her land that they require to the same agency but one still retains land and a river section just downstream and adjoining mine

As a part of sales contracts at our request were given letters by the Municipal Subdistrict which state that the district agrees to operate the Windy Gap project subsequent to construction in a manner which will not interfere with the status of the Colorado River as a live stream from the Windy Gap Dam bypass outlet downstream except in those instances when maintenance requirements necessitate a brief cessation of releases through the bypass outlet The bypass outlet releases which are intended under the present plan of operation are as follows

a. During periods of diversion by the Windy Gap Project release through the bypass outlet of at least 75 ft³/s

b. During periods of non diversion of the Windy Gap Project release of a minimum of the lesser of (i) 75 ft³/s or (ii) the run of the river

c. In either event the above releases will be less than an amount of water necessary to be passed over the spillway to maintain a stable reservoir surface Based upon hydrological records it appears that the run of this stretch of river under current conditions is not less than 15 ft³/s during the months from November through April and more than this amount during the remainder of the year

DES C BT/ Windy Gap page 2 H K Schmuck Jr

The terms of c above do not spell out the amount of water which will be necessary to be passed over the spillway at all times to maintain a stable reservoir surface Based on hydrological records the run of the river can drop as low as 15 ft³/s under current conditions during the months from November through April If the amount of water required to maintain the reserv ir surface is anywhere near 15 ft³/s (and I would judge this is very likely) the river below the bypass would effectively be dry for several months of the year

As shown on Fig II 9 General Plan Pumping Plant and Diversion Dam the centerline of the spillway does not re enter the river until approx 2200 feet downstream of the diversion dam bypass outlet This length of river could very possibly be effectively dried up due to the above Of this approx 1800 feet would be on property owned by myself and my mother and would constitute extreme damage to us

To eliminate any possibility of drying up the 2200 feet of river or reducing the flow to where it would not support fish and aquatic bug life between the bypass outlet and the currently proposed entry point of the spillway provision should be made so that when the run of the river falls below 75 ft³/s any water going over the spillway is returned immediately to the river below the bypass outlet rather than 2200 feet downstream This would also eliminate the possibility of damage to this section of the river during those instances when maintenance requirements necessitate a brief cessation of releases through the bypass outlet The duration of brief Cessation may be indefinite beyond anyone control good intentions to the contrary

2 This comment refers to the construction period of the Windy Gap diversion dam

Public Notice No 6520 14 March 1978 U S Corps of Engineers detailed construction of a diversion structure reservoir and pumping plant for the Windy Gap Project Stage 2 Second Season construction schedule is shown on their Sheet 7 of 12 (copy attached) This drawing shows the river diversion during Stage 2 dumping into the spillway channel This spillway channel does not re enter the Colorado River until approx 2200 feet below the bypass outlet of the diversion dam

The inescapable conclusion is that this 2200 feet of live river will be dried up and killed as regards fish insect and plant life My mother and I retain the present course of the river for approx 1800 feet of the 2 00 feet between the dam outlet bypass and the entry of the spillway back into the river By drying up this portion of the river for an indefinite period of at best 8 months and probably twice that long would damage the river for many years This in turn would damage our property far beyond the severance damages already determined

DES C BT/Windy Gap page 3 H K Schmuck Jr

The diverting of the river to the spillway during second stage construction must be modified so that this diversion or enough of it to keep the river flowing and sustaining the fish insect and plant life (at least 75 ft³/s or the run of the river if less) is diverted back into the river channel as soon as possible below the dam outlet bypass with the maximum allowable to be at the downstream end of the Subdistrict property where it adjoins my property A marked up copy of Sheet 7 showing the above is attached

3 Chapter II 38 g (1) 3rd paragraph states that A low level bypass structure will be provided at the maximum section of the diversion dam to release up to 75 ft³/s to satisfy downstream fish and irrigation requirements This structure will be located near the present Colorado River channel with the intake in the end bay of the pumping plant The structure will consist of an intake a 48 inch diameter reinforced concrete conduit and an outlet for dissipating energy at the downstream toe of the diversion dam The discharge will be automatically controlled by a valve operated from the pumping plant

I have underlined up to 75 ft³/s and a 48 inch diameter because it is my understanding after consultation with the Municipal Sub district NCWCD that the bypass structure is designed to pass 200 ft³/s rather than 75 ft³/s and that in operation during any period when the river inflow to the diversion reservoir exceeds the maximum pumping capacity plus 75 ft³/s water will be bypassed through the structure up to the capacity of the 48 inch diameter conduit Any excess above this would then go over the spillway

This increased flow when available would have a beneficial effect (e g flushing the stream bed) on the section of the Colorado River between the dam and the point where the spillway enters the river of approx 2200 feet This should mitigate to some extent the impacts described in paragraphs 4 through 7 Chapter VI H 2 which are classified as unavoidable in the DFS

4 Ground Water
As the nearest residents downstream from the Windy Gap diversion dam my mother and I are concerned as to the effect of the dam on the water levels in our wells To monitor this I have measured the distance from the top of our wells to water level at various time of the year We tabulated below so that we can check these against water levels of the Windy Gap dam This comparison will then enable us to judge what if any damage has been done to us in this regard

	R W Schmuck Jr Well	R M Schmuck Well
May 8 1977	39 inches	66 inches
Aug 20 1977	45	65
Oct 28 1977	47	65
Oct 29 1978	46 inches	65 inch

DES BT/Windy Gap pare 4 H K Schmuck Jr

5 Trees and Vegetation
As commented on orally construction of the Windy Gap dam and reservoir will require removal of 1 00 1300 trees of various sizes up to 36 inch diameter and 60 feet high and much other vegetation There are also a considerable but undetermined number in the spillway area Because this is an unavoidable impact both as to aesthetics and wildlife it makes it all the more imperative that great care be taken that no trees beyond those absolutely necessary are to be removed or damaged This means that trees to be removed are necessary for operation of the project and not merely that their removal would be convenient or helpful in the contruction activities of the contrac or

As a minimum no trees should be removed from the area between the normal maximum reservoir elevation 7827 and the maximum reservoir elevation 7835 The latter is based on an inflow of 63 000 ft³/s which has never been remotely approached since records have been maintained including the years bfore Granby Dam was in existence

For the same reason no trees should be removed from any auxiliary spillway below the dam which is predicated on the same 63 000 ft³/s flow

The basic purpose of obtaining water from Windy Gap is for the growth of the six cities comprising the six cities of the Municipal Sub district NCWCD At least this was the original premise Although the water requirements of the Rawhide Power Plant appeared out of the blue in ha DES A point of curiosity on this point is that 16 400 acre feet is alloted to the Rawhide plant yet at maximum output somewhere after the year 2000 its water requirement will only be 8 200 acre feet

Be that as it may the major part of the diversion is now to go to the 5 cities on the Western Slope (since Fort Collins seem to have dropped out) It should be a matter of record that the immediate negative aspects of the Windy Gap project are to be born by the Grand County area to enhance the future environment of the Eastern slope cities involved which eventually will include water for trees lawns shrubs swimming pools et al for the benefit of their expected citizens of the future Availability of this water for growth will also be of great financial benefit to present property owners developers speculators and business in general in the so called novice area far removed from the source of the water itself

On this basis it does not seem unreasonable but that some expenditure be made for organized landscape planning and work be done on the Windy Gap project after completion such as transplanting trees around the normal maximum reservoir elevation 7827 rather than letting nature take its course

DES C BT/Windy Gap page 5 H K Schmuck Jr

6 Fishery
The impact upon the fishery of the Colorado River from i s con fluence with the Fr ser River o Kremmling Colo ado is of ex reme importance Even though current y much of t flows through pri ate land the e are important and appreciable reaches availabl o the p bli Even so private owners as m s if a e entitled to whateve mitigation of adverse ef ects as are possible The DES covers mitigati n measures under Chapter and especially during construction on page 7 11 which sho ld be followed by the letter But beyond putting these in the DES and in the construction contracts it will be essential that action b taken on a regular basis during construction to make su e the meas re are car ied o t in the field

As to the long rang effect on the fishery the DES is confusing

For example in hop er IV 5 h 2 7th paragraph conc udes that the loss can be quan i ied since the flow of the river will be depender on bo h th ird ap ypase and the amount of water di v rted downstream Dames Moo e 1977)

Again o 5 paragra h 4 ome ish habitat will be lost but the role of the indy Gap depletion in this loss is unquantifiable

Dire tl opposi e to the above two references Chapter IV 29 2 a 8 3rd agraph states Fishing in he Colorado River between Windy Gap a d emmling would emain essen ially the same as with present condi i ns

As it stands I would say we do not know the effect on the fishery b tween Windy Gap and Kremmling except that the impact will not be bene icial If we sho ld end up with a s ream incapable of maintaining a natural y reproducing rout population of appreciable size (according to olorado Outdoors only % of Colo ado o mo ntain streams are capable of this) it would be a tragic loss to our state and the nation itself

Howard K Schmuck Jr

Howard K Schmuck Jr P

Memo a d m

To Files

Subject Response to August 12 1979 Comment Lette f om Howa d K Schmuck Jr o Colo ado Big Thompson/Windy Gap Projects F nal E i onme tal Statement

1 Comment The diversio dam wo ld cause lo flo s between the bypass a d he e the spill ay ente s the ive These lo flows wo ld cause damage to p ope ty and aquatic life

Response Since the hea ings on the draft envi onmental statem t desig changes ha e been made hich will allo bypasses to be made e the at the pump g pla t o th o gh a bypass o t et system hich ill br ng ate from the right abutme t of the spill ay Effo ts ill be made at al t es to a tain s fficient ate in the st etch of l e alo g Mr Sch uc s p ope ty to ma ta aquatic life (See the Windy Gap P oject Co tract Specs and Dra ings)

2 Co me t The section of i er bet ee the bypass a d where the spill ay eente s the i er would be d ied p du g the co struction period a d ca se se ere damage

Respo se P esent dam desig a d const uct on scheduling will p ovide bypasses a d flo s s ffic e t to ma nta n a st eam th o gh the Schmuck p operty at all times during const uct on

3 Comment Rega ding capacity of bypass o tlet system

Respo se P esent design of the bypass outlet system ill allow substantially more than 90 c bic feet pe seco d to be eleased through the natural stream channel through the Schm ck prope ty This ill allo the maintenance of atu al flushi g flo s through the section and m tigate any possible harm to the aquatic habitat (see Attachme t 2)

4 Comme t Regarding ground water levels i ells immediately downst eam of Wi dy Gap Dam

Response Mr Schmuck s tabulation of wate le els has bee noted along ith conside able i fo mation obtained by consultants to the Subdistrict In the event that any damage is caused to the ells by the constructio of the Windy Gap Dam the Subdistrict will take the necessary steps to m tigate this damage

5 Comment Ca e sho ld be take to emo e only those trees wh ch are nec ssary fo placing the st uctures and normal ope ations

Response O ly those t ees h ch ill be ithi the normal operat ng ese ol ill be emo ed In addition only those t ees hich a e necessa y to mai tain the effect veness and safety of the spill ay cha el ill be remo ed All effo ts ill be take to ma ntai existing vegetation and p ov de a aesthetic sc een to the Wi dy Gap Project

6 Comme t The allot ent of 16 400 acre feet to Rawhide is based on the plant s ma num o tput afte the yea 2000 Ho ever the ater equirement s only 8 200 acre feet?

Response The additio al 8 200 acre feet i l be held in ese ve by PRPA as protectio aga nst ate sho tages duri g d ought years The 8 200 ac e feet s 1 year of s pply fo it mate (750 MW) operations Du i g yea s hen wate is ot short the pack p ater supply ll be sold by tempo ary contract to local use s

7 Comment It should be a matter of record that Wi dy Gap wate ill g eatly benefit the Ser ice A ea and that Grand County will accrue the egati e aspects

Response The need fo wate by the pa ticipants of the S bdistrict have been ca ef l y analyzed by these participants They are p epared to make a s bstant al expe diture fo the de elopment of the water s pply to meet their p ojected growth requ rements

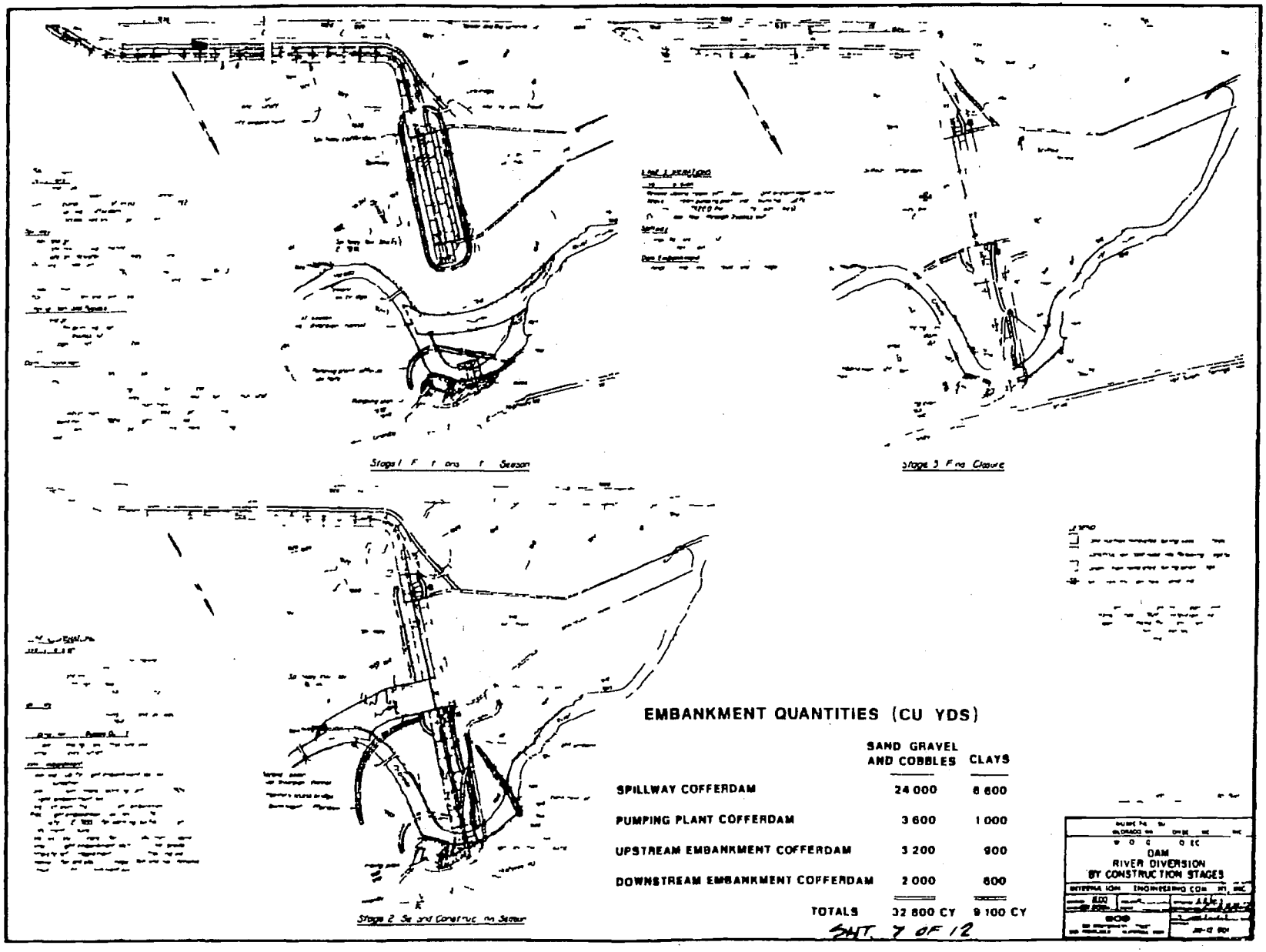
The adverse impacts o G a d County are add essed in the FES Hit gatio fo these mpacts are detailed in the attached ag eeme t (Attachment 1) between West Slope nterests and the Subdistrict

8 Comme t Actio sho ld occu o a regular basis to ass e that fishery mit gation measures are ca ied out

Respo se Co st ction inspecto s i l ass e that co tract specifications a e car ied out o a timely basis

9 Comment The discuss on of long ra ge effects o the f she y is co fusing

Response The entire section on fishe y impacts has bee augmented and edited Th s a gmentation i cludes the esults of fishery st dies pe formed by E ickson (1980) and coordinatio a d ag eement ith the DOW

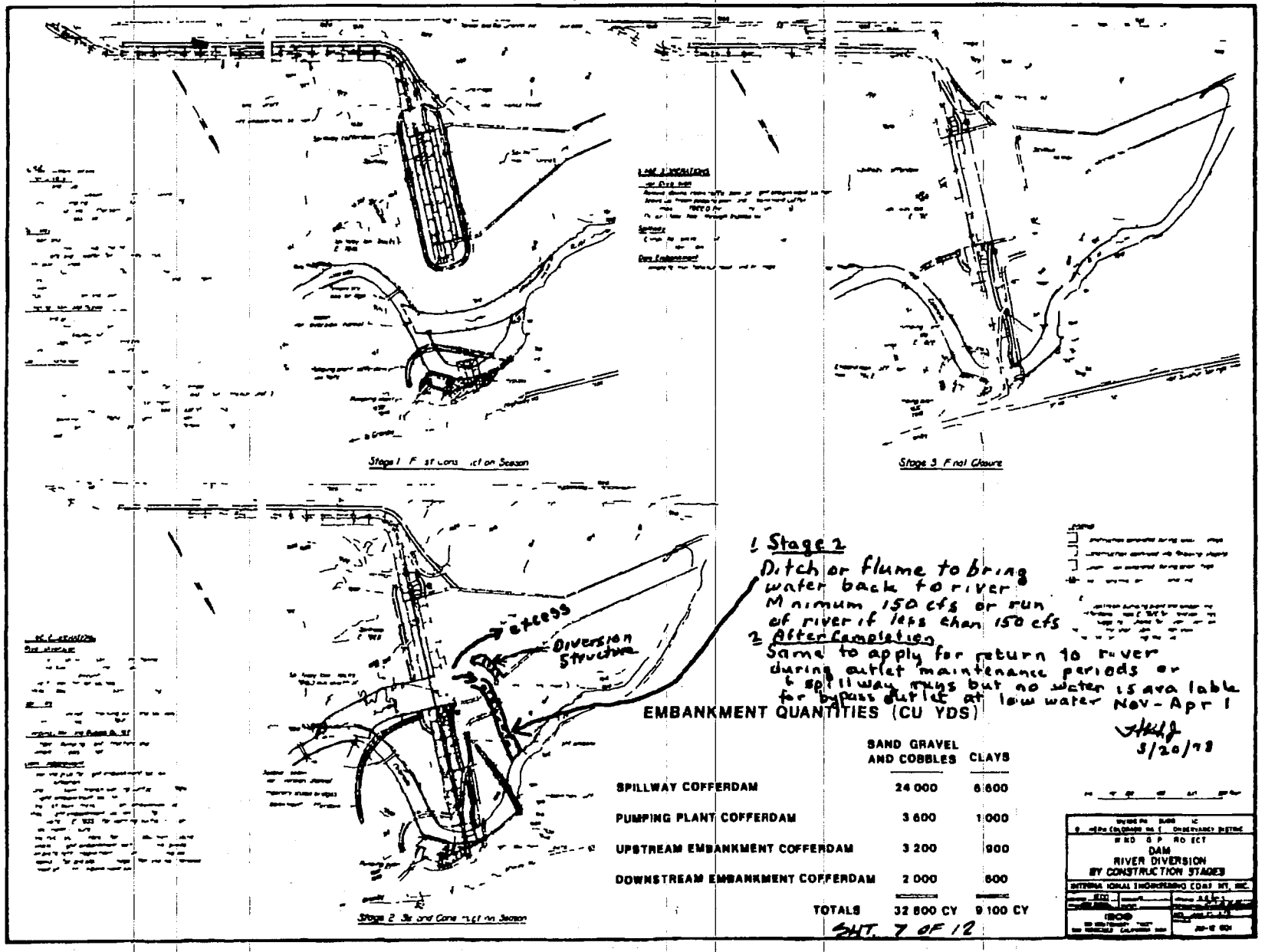


EMBANKMENT QUANTITIES (CU YDS)

	SAND GRAVEL AND COBBLES	CLAYS
SPILLWAY COFFERDAM	24 000	8 600
PUMPING PLANT COFFERDAM	3 600	1 000
UPSTREAM EMBANKMENT COFFERDAM	3 200	900
DOWNSTREAM EMBANKMENT COFFERDAM	2 000	600
TOTALS	32 800 CY	9 100 CY

DAM
RIVER DIVERSION
BY CONSTRUCTION STAGES

SHT. 7 OF 12


Stage 1 F st Cons ict on Season
Stage 3 F nal Closure
Stage 2 Sa and Cons ict on Season
excess
Diversion Structure
1 Stage 2
Ditch or flume to bring water back to river
Minimum 150 cfs or run of river if less than 150 cfs
2 After Completion
Same to apply for return to river during outlet maintenance periods or spillway runs but no water is available for bypass outlet at low water Nov - Apr 1
3/20/78
EMBANKMENT QUANTITIES (CU YDS)
SAND GRAVEL AND COBBLES
CLAYS
SPILLWAY COFFERDAM 24 000 6 600
PUMPING PLANT COFFERDAM 3 600 1 000
UPSTREAM EMBANKMENT COFFERDAM 3 200 900
DOWNSTREAM EMBANKMENT COFFERDAM 2 000 600
TOTALS 32 800 CY 9 100 CY
SHT. 7 OF 12
DAM
RIVER DIVERSION
BY CONSTRUCTION STAGES

Middle Park Stockgrowers
Kremmling Colorado 80459
August 11 1979

OFFICIAL FILE COPY
AUG 14 1979

Regional Director
Bureau of Reclamation
Upper Missouri Regional Office
P O Box 5477
Denver Colorado 80217

Dear

We would like to comment on the Environmental Impact Statement on the Windy Gap Project and express our concerns about the project

The project as proposed will have a severe effect on agriculture along with wildlife and recreation along the Colorado River from the Windy Gap Project to the diversion dam on the confluence of the Blue River The figures in this section are based on the following water rights

Water rights that concern us are diversions along the Colorado River from the Windy Gap Project to the diversion dam on the confluence of the Blue River that have been adjudicated prior to the Windy Gap Project and have been in use for many years Many of these water rights have been rebuilt or relocated due to the Colorado River and its tributaries in the Kremmling area Due to the fluctuation of the river that ranchers could not guarantee their water

The Windy Gap project will only divert 75 cubic feet per second from the stream to store for power generation and flush requirements This will result in a substantial reduction of water available for ranchers to divert their water rights from the river The water is there because of the high flows the river averages 1500 CFS wide in many places

Of equal concern to our ranchers is the operation of the Windy Gap Project during the 30-35 days of the year when the irrigators use the water

-2-

Gap Project and the confluence of the Blue is as good as any place in the state of Colorado Supplemental income from fishing licenses plays an important part for the ranch operations Ranch values would be greatly decrease because of the Windy Gap Project

We feel that if the Windy Gap Project is ever built all excess water should be returned to the Windy Gap Project developer We further feel that the suggested 75 cubic feet per second release will not adequately maintain the quantity of available water for the fishing industry nor the esthetic value of the Colorado River Any water rights owned by the Bureau of Reclamation for wildlife purposes should be released to the original owners for their requirements plus senior water rights This does not mean that we give up the Colorado River to protect our water rights from the Windy Gap

Because the Windy Gap project will have a severe impact on the project we would like to have a public hearing on the Windy Gap Project to answer questions and concerns that citizens may have Please notify us of the hearing date August 28 1979 at the Middle Park Fairgrounds in Kremmling Colorado

Before the Windy Gap project is built all ditch headings and pumps which were rebuilt or relocated due to the Colorado River and its tributaries in the Kremmling area should be rebuilt or relocated at the Bureau of Reclamation s expense so that ranchers could irrigate their land

Sincerely

Wayne Hurlbert
Middle Park Stockgrowers
Granby

Committee

Wayne Hurlbert
Dusty Gates
Jack Brown

Secretary

Ellen Heatley
Kremmling

Treasurer

Chuck Heatley
Kremmling

Organization

Middle Park Stockgrowers
Grand County Commissioners
Grand County Farmers and Ranchers Association

Memorandum

To Files

Subject Response to August 11 1979 Comment Letter from Middle Park Stockgrowers on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Project would adversely affect agricultural lands in Grand County especially along the Colorado River between Windy Gap and the Blue River The DES fails to mention the impacts on downstream senior water rights

Response Downstream senior water rights will not be impacted by the Windy Gap Project See Chapter IV of the FES and Attachment 1

2 Comment With the reduction in flow due to Windy Gap all ditch headings and pumps will have to be relocated at the landowner s expense It may be physically impossible to divert water because of low flows

Response Through the Windy Gap Intergovernmental Agreement (Attachment 1) the Subdistrict has agreed to analyze and modify if necessary any diversion structures which cannot divert water from the river as a result of the Windy Gap

3 Comment The 75 ft^3/s minimum fishery flow would not meet the criteria recommended by the Division of Wildlife The fishery and ranch values would greatly decrease because of Windy Gap

Response Minimum stream flows have been agreed to by the DOW (see Attachment 2)

4 Comment It should be the Bureau s responsibility to assure that Middle Park Stockgrower s concerns are satisfied

Response Under law it is the responsibility of Water and Power (formerly Bureau of Reclamation) to assure that environmental impacts and mitigation are analyzed before the C BT facilities can be used to convey Windy Gap water It appears the new information and project modifications addressed by the Subdistrict and incorporated into the FES adequately address Middle Park s concerns

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OFFICIAL FILE COPY
AUG 20 1979

August 17 1979

Office of Environmental Affairs
Bureau of Reclamation
Room E 2421 Building 20
Denver Federal Center
Denver CO 80225

Dear Sirs

This letter is to notify you of my objection to the finding reported in the Draft EIS on the Windy Gap project

I am from the opposed to construction at diversion on the western slope I feel that from a total impoundance that the EIS should done

Sincerely

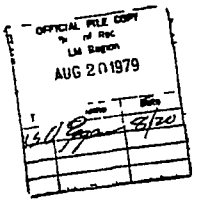
Jim Goodall
Attachment

Memorandum

To Files

Subject Response to August 17 1979 Comment Letter from J Gordon Auchincloss on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

NO RESPONSE REQUIRED The comment reflects the opinion of the author which is duly noted



18 August 1979
Box 215
Kremmling Co 80459

Regional Director
Bureau of Reclamation
Lower Missouri Regional Office
P O Box 25247
Denver Colo 80225

Dear Sir

We would like to voice our concern again about the proposed Windy Gap Project

The McElroy Ranch has been owned and operated by the same family for well over 70 years from the days of the overflow of the Colorado River until now When the Big Thompson Project was completed and the water table throughout the bottomland meadows was lowered it began to adversely affect the quantity and quality of hay we could produce Over the years we have been able to partially adapt to this lower water table by applying irrigation water during the time that the spring low from the Fraser River raised the water table somewhat Without this raise in the water table it is doubtful if we could get enough water onto our meadows in this sandy soil to raise a crop of hay

In addition our present pumping system could not possibly operate with only 75 c f s of water flowing in the River

We have watched the flow in the Colorado River (soon to become Colorado Creek) diminish for 50 years Surely before it becomes Dry Creek diversion of the flow must be stopped

McElroy Ranch
John R McElroy

jrm/sm

Memorandum

To Files

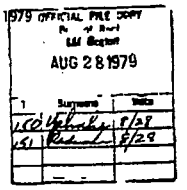
Subject Response to August 18 1979 Comment Letter from John H McElroy on the Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Present pumping system could not operate with a 75 ft^3/s flow

Response The Subdistrict has agreed in the Intergovernmental Agreement (Attachment 1) to provide rehabilitation of diversion structures which might be affected by the Windy Gap Project Minimum bypass flows for three reaches of the upper Colorado River are discussed in Attachment 2 of this document Since Mr McElroy is signatory to the agreement it is assumed he is agreeable to these mitigatory proposals

Patricia Ringer
1500 W Lake
Ft Collins Colo
80521

August 26 1979



Mr Joe D Hall
Regional Director
U S Bureau of Reclamation
Lower Mississippi River Basin
P O Box 25247 Denver Federal Center
Denver Colorado
80225

Dear Mr Hall

I wish to make a statement in regard to the Windy Gap EIS as it relates to Platt River Power Authority Mr Al Hamilton general manager of PRPA has repeatedly stated that the Rawhide Power plant will become cost effective with Units II and Units III The water for Unit I will be supplied throught an agreement with the City of Ft Collins until such a time as it can be replaced by Windy Gap water Since Units II and III are dependent on Windy Gap water and the project as planned is not reasonable without Units II and III it can be said that the project should not proceed without the total supply of water assured For that reason I do wish to commend you and your staff for wisely including the Rawhide project as you did in the EIS as the energy producing product of Windy Gap

Local authorities have had short vision here in not requiring secondary impact information They did not even allow discussion of need at the public hearings Concerned citizens have been overwhelmed by the full time staff that PRPA has hired to advance their grandiose scheme We are a self indulgent society and we burn out of interest/[illegible] up to such an untouchable authority as Platt River Power Authority It

2

therefore remains up to your staff to examine what effect the power project will impose I further urge you to examine statements which Mr Hamilton has made in the past which do not reconcile with his remarks concerning the EIS If you are interested I will be happy to supply local newspaper clippings documenting the history of the Rawhide project

Thank you for taking time to consider this appeal

Sincerely

Patricia Ringer

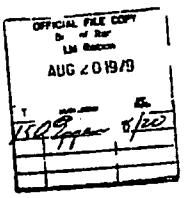
Patricia Ringer

Memorandum

To Files

Subject Response to August 26 1979 Comment Letter from Patricia Ringer on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

NO RESPONSE REQUIRED See Chapter I concerning the organization of the FES and the relationship to Rawhide



A g t 16 1979

OFFICE OF ENVIRONMENTAL AFFAIRS
BUREAU OF RECLAMATION LOWER MISSOURI REGION
ROOM E 2421 BUILDING 20
DENVER FEDERAL CENTER
DENVER CO 80225

De S

I w shocked and dismayed at the findings eported in the Draft EIS o the Windy C p p ject of the Colo d Big Thompson P oject It e d l k p op g d h et p t out by the Denve Water B d

I am tot l g ement with the EPA th t the Draft EIS must b don The life blood of the F ase V lley Recre tional a b ng t l n f om s to feed the lawns and other water abuses f the east rn sl pe We in th Fra r Valley are violently pposed to losing one mo e d op of our precious water to astern l p ab who complai abo t the mildest of water conservatio n es Waste not w nt or a ound adage and it is time the e tern slope ab se e t k heed

Very sincerely

Margaret Ann Rabe
P O Bo 164
Wi t Pa k CO 80450

Memorandum

To Files

Subject Response to August 16 1979 Comment Letter from Margaret Ann Rabe on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

NO RESPONSE REQUIRED The comment reflects the opinion of the author which is duly noted

FRONTIER AIRLINES

August 30, 1979

A L F Man
Pres d t
C Exec ve Office

Frontier Airlines Inc
8250 Smith Road
Denver Colorado 80207
Telephone (303) 398-4711

Reg onal D ecto
Low Mi sou i R gion
Bu au of R clamation
Denve F de al Center Build ng #20
Denver Colorado 80225

Dea Sir

It has been brought to my attention that consideration is being gi en to establishing an impoundment on the Colorado Rive in the vicinity of the Windy Gap Ranch

I would appr ciate it if every conside at on could be giv n to impos ng restr ctions on this proposed project in uch a way as to protect the natural fishery that ex sts downstat eam of Windy Gap The stretch of water between Windy Gap and Kremmling is one of the prime natural trout fisheri s in our state Trout pawn and grow ap diy n these exc pt onal waters a ded by the rema kable hatches f th la ge sto efly Pt ona cys Califo nica wh ch g ow here in abundan e

Any on ideat on that you could g ve that would help to protect th s outsta d ng and are stretch of water would be since ely appreciated

Best ega ds

A L Feldman

ALF/njs

Memorandum

To Files

Subject Response to August 30 1979 Comment Letter from Frontier Airlines on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment Measures to protect the existing fishery should be considered

Response See Chapter IV C Aquatic Biota and Attachment 2

Dep rme t f Fishery d Wildlife Biology

Colorado State University
Fort Collins, Colorado
80523

August 31 1979

Mr Joe D Hall
Regional Director
Lower Missouri Region
USDI Bureau of Reclamation
P O Box 25247
Denver CO 80225

Attention LM 150

Dear Mr Hall

These comments are on behalf of the National Wildlife Federation s Natural Resources Center (on which I serve as an advisor on natural resources matters) the Colorado Wildlife Federation and myself

Of concern in reading the Draft Environmental Statement (DES) for the Colorado Big Thompson Windy Gap projects is the ambiguity of language and confusion that results from combining the eastern slope Rawhide project with the western slope Windy Gap project At various places in the DES are statements that the project will directly impact 1000 acres of pasture land 1000 acres of rangeland plus 530 acres of wildlife habitat There is another mention of 1000 acres of wildlife habitat The nature of these impacts (also described by the terms destroyed and actual) is not clearly defined Terminology needs to be consistent and specific Descrip tion of these areas to be inundated needs to include vegetation cover types and successional stages that will be affected if the reviewer is to assess damage the project may have on terrestrial and aquatic components of the environment

We recognize the economic and social impacts on west slope communities but will confine these comments to environmental impacts In a cursory way the DES outlines some of the major ones The Colorado River below the Windy Gap diversion structure will be reduced in volume and velocity This will reduce the depth of water that covers the riverbed increase the temperature and by reducing the scouring of spawning gravels will allow increased sedimentation and collection of waste materials in those critical areas as well as elsewhere in the riverbed

These physical changes in the river will result in a number of adverse biological changes In addition to simply reducing the quantity of aquatic habitat The small sculpins and dace may be eliminated Trout populations will be reduced if not eliminated and less desirable suckers and squaw fish will increase in the changed environment Without question the quantity and quality of fishing below the diversion structure will be reduced substantially

Mr Joe D Hall
August 31 1979
Page Two

The Statement does not guarantee the 75 cfs minimum flow which a Colorado Division of Wildlife study indicated should be the minimum instream flow On page II 38 of the DES it is stated that a low level bypass will release up to 75 cfs to satisfy downstream fish and irrigation requirements However there are 42 cfs of water decrees between Windy Gap and Hot Sulphur Springs If all were used to the maximum the resultant flow could be as low as 33 cfs at Hot Sulphur Springs roughly 40 percent of the minimum flow recommended for the fishery resource

The prediction that salinity of downstream waters will increase from 0 5 to 1 3 percent is disturbing Current levels of salinity are not given nor is there a discussion of biological effects of this increase

The project will impound the effluent from the Granby waste treatment plant and return this to Granby reservoir Hot Sulphur Springs and Kremmling currently discharge treated wastewater into the river With decreased flows resulting from the Windy Gap project the concentration of wastewater in the river will be increased with a resultant reduction in water quality as in Granby reservoir where increased phosphorus and decreased oxygen content of the water can be expected as adverse impacts

Potential impacts on riparian vegetation of the proposed changes in downstream water regimens are not addressed They could be quite damaging

These are some of the concerns relative to biological degradation of the environment It is disconcerting that the extent and effect of these disturbances are not thoroughly identified nor discussed

Mitigation of adverse environmental impacts which should be an impor tant part of the DES is dismissed very briefly There is no mention of mitigative measures to reduce or eliminate the adverse effects of reduced streamflow or increased salinity Provisions are not made to insure adequate flushing flows to reduce sedimentation problems due to lack of scouring

In summary project impacts on the environment are not adequately addressed are often dismissed as no significant adverse impacts are anticipated and mitigation measures are generally ignored

The description of water savings in Boulder through water conservation was heartening However the alternative of water conservation by east slope municipalities and agricultural users was not explored

It is hoped that these inadequacies will be corrected in the Final Environmental Statement Thank you for the opportunity to provide these comments and also to present verbal comments at the August 3 hearing in Loveland

Sincerely yours

Dwight R Smith
Professor Wildlife Biology

Memorandum

To Files

Subject Response to August 31 1979 Comment Letter from Colorado State University Department of Fishery and Wildlife Biology on Colorado Big Thompson/Windy Gap Projects Final Environmental Statement

1 Comment There is an ambiguity and confusion of language resulting from combining Rawhide with Windy Gap

Response The FES has been edited and rearranged to hopefully eliminate this confusion

2 Comment The nature of the impacts on wildlife habitat is not clearly defined Terminology should be consistent and specific Vegetative cover types and successional stages that will be affected should be described

Response The sections dealing with wildlife habitat have been redone

3 Comment Without question the quantity and quality of fishing below Windy Gap will be reduced substantially

Response See Chapter IV C Aquatic Biota and Attachment 2

4 Comment The DES does not guarantee the 75 ft^3/s the Division of Wildlife (DOW) desired for minimum flow

Response The Memorandum of Understanding between the Subdistrict and DOW (Attachment 2) defines fixed flows for various segments of the Colorado River below Windy Gap The flows defined in the agreement takes into consideration the possibility of exercising the maximum senior water rights between Windy Gap and Hot Sulphur Springs

5 Comment Current levels of salinity and the biological effects of the increased salinity in the Colorado River are not discussed

Response The existing salinity impacts and mitigation are being addressed by the Colorado River Salinity Control Project Current levels of salinity were included in the DES and are similarly included in this document In accordance with CEQ Regulations salinity impacts are addressed elsewhere These analyses are incorporated herein by reference

6 Comment Windy Gap will impound effluent from Granby Waste Treatment Plant and return to Granby Reservoir

Response See Chapter IV C Water Quality

7 Comment The waste discharges from Kremmling and Hot Sulphur Springs will be concentrated in the Colorado River by the decreased flow due to Windy Gap

Response See Chapter IV C Water Quality

8 Comment Impacts on downstream riparian vegetation were not addressed

Response See Chapter IV C Vegetation

9 Comment Mitigation measures were ignored No mention of mitigation for reduced streamflow increased salinity and sedimentation

Response Mitigation measures are discussed in Chapter IV and confirmed in the Intergovernmental Agreement (Attachment 1) Mitigation for salinity impacts is considered to be part of the Colorado Salinity Control Project (U S D I 1981)

10 Comment The alternative of water conservation by East Slope municipalities and agricultural users was not explored

Response See Chapter II

DISTRIBUTION LIST

Distribution List for Final Environmental Statement
for Colorado-Big Thompson/Windy Gap Projects
Colorado

U S Congress
- Honorable Gary Hart
- Honorable William E Armstrong
- Honorable Patricia Schroeder
- Honorable Timothy E Wirth
- Honorable Ray P Kogovsek
- Honorable Hank Brown
- Honorable Kenneth Kramer

Federal Agencies
- Department of Agriculture
  - Forest Service
  - Soil Conservation Service
- Department of the Interior
  - Bureau of Indian Affairs
  - Bureau of Land Management
  - National Park Service
  - Fish and Wildlife Service
  - Bureau of Mines
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- Department of Energy
  - Federal Energy Regulatory Commission
- Environmental Protection Agency
- Advisory Council on Historic Preservation
- Missouri River Basin Commission
- Upper Colorado River Commission

State of Colorado
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  - Division of Water Resources
  - Colorado Water Conservation Board
  - Colorado Geological Survey
  - Colorado Division of Parks and Outdoor Recreation
- Department of Education
- Department of Highways
- Department of Agriculture
- Department of Health
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- State Historical Society of Colorado

State of Nebraska
Natural Resources Commission

States of the Colorado River Compact
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Other Government Entities, Cities, and Towns
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Sterling
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Estes Park
Boulder
Longmont
Fort Collins
Grand Lake
Loveland
Granby
Hot Sulphur Springs
Wellington

Conservation Entities
National Audubon Society
Colorado Water Congress
Colorado Mountain Club
Colorado Open Space Council
Izaak Walton League of America
National Wildlife Federation
Rocky Mountain Center on Environment
Sierra Club
Winter Park Water and Sanitation District
Wilderness Society

Conservation Entities - Continued
- Middle Park Water Conservancy District
- Trout Unlimited
- Colorado Council of Trout Unlimited
- Lower South Platte Water Conservancy District
- Central Colorado Water Conservancy District
- Ducks Unlimited Inc
- St Vrain Water Supply Co
- Colorado River Water Conservation District
- Water Supply and Storage Company
- Denver Water Department
- San Miguel Basin Soil Conservation District
- Left Hand St Vrain Conservancy District
- Northern Colorado Water Conservancy District

Council of Governments
- Northeastern Colorado Council of Governments
- Northwest Colorado Council of Governments
- Denver Regional Council of Governments
- Larimer-Weld Regional Planning Council of Governments

News Media
- Denver Post
- Rocky Mountain News
- Fort Morgan Times
- Julesburg Grit-Advocate
- Greeley Tribune and Republican
- Sterling Journal-Advocate
- Estes Park Trail
- Boulder Camera
- Longmont Times-Call
- Loveland Reporter-Herald
- Fort Collins Triangle Review
- Granby Sky-High News
- Middle Park Times
- Glenwood Post
- Winter Park Manifest

Businesses and Other Interests
- Rocky Mountain River Expeditions
- Wild Water West
- Timber Travels
- Rancho Del Rio
- Mountain Bell
- Morgan County Quality Water District
- Platte River Power Authority
- Mountain Parks Electric Inc
- Colorado Sportman's Council
- Envirosphere
- University of Colorado
- University of Northern Colorado

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Harvey A Tannenbaum
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John Wiener
Charles Willis

AVAILABILITY OF PUBLIC REVIEW DOCUMENTS

Copies of the final environmental statement have been distributed to and are available for public inspection at the following public entities and libraries

Municipalities

Greeley
Fort Morgan
Sterling
Julesburg
Grand Lake
Granby
Wellington
Estes Park
Boulder
Longmont
Fort Collings
Loveland
Hot Sulphur Springs

Council of Governments

Northeastern Colorado Council of Governments
Northwest Colorado Council of Governments
Denver Regional Council of Governments
Larimer-Weld Regional Planning Council of Governments

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Linda Hall Library (Missouri)
Loveland Public Library
Fort Morgan Public Library
Sterling Public Library
Julesburg Public Library
Greeley Public Library
University of Colorado Library
University of Denver Library
Grand County Public Library
Estes Park Public Library
Longmont Public Library
Boulder Public Library

Copies of the final environmental statement (FES) and the supporting material referenced in the FES are available for public review upon request at the following offices

Regional Director
Water and Power Resources Service
Lower Missouri Region
Building 20, Denver Federal Center
P O Box 25247
Denver, Colorado 80225
Telephone (303) 234-3779

Project Manager
Water and Power Resources Service
South Platte River Projects
995 Wilson Avenue
P O Box 449
Loveland, Colorado 80537
Telephone (303) 667-4410

Manager
Municipal Subdistrict, Northern
Colorado Water Conservancy District
1250 North Wilson Avenue
P O Box 679
Loveland, Colorado 80537
Telephone (303) 667-2437

BIBLIOGRAPHY

BIBLIOGRAPHY

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Bureau of Reclamation, 1979 Draft Environmental Statement on Colorado-Big Thompson/Windy Gap Projects, Colorado Lower Missouri Region, Denver, Colorado

Bureau of Outdoor Recreation, 1976 Outdoor Recreation in the Platte Subregion (A report prepared for use in the Missouri River Basin Comprehensive Framework Study) Bureau of Outdoor Recreation, Department of the Interior, Denver, Colorado

Burney, M S , C Coe, C Colle, and T J Lennon, 1979 An Archeological Study of Aboriginal Sites Within the Windy Gap Dam, Reservoir, and Pipeline Project Near Granby, Grand County, Colorado Western Cultural Resource Management, Boulder, Colorado

Chu, H F , 1949 The Immature Insects William C Brown Company, Publishers, Dubuque, Iowa

City of Boulder - Ordinance 4038, May 20, 1973

City of Greeley - Ordinance 41 of 1975, June 10, 1975

City of Longmont - Ordinance of 1975, June 10, 1975

City of Loveland - Ordinance 1443 of 1975, July 15, 1975

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GLOSSARY

GLOSSARY OF TERMS

Acre-foot - The quantity of water (43,560 cubic feet) that would cover 1 acre to a depth of 1 foot

Adit - An approach or entrance an almost horizontal passageway into a tunnel

Afterbay - A channel, short stretch of stream, or small reservoir conducting water away from a water turbine or into which a hydropowerplant discharges

Aggregate - The sand or gravel added to cement in making concrete or mortar

Agronomic - Pertaining to agronomy, which is the science of soil management and the production of field crops

A Horizon - The stratum of soil consisting of one or more of the following layers A_0 horizon, partly decomposed or matted plant remains lying on top of the mineral soil (duff) A_{00} horizon, the relatively fresh leaves and other plant debris, generally of the previous year lying on A_0 horizon (litter), A_1 horizon, the surface mineral layer, relatively high in organic matter, usually dark in color A_2 horizon, below the A_1 horizon, in places the surface layer, usually lighter in color than the underlying horizon, in which leaching of solutes and suspended materials occur A_3 horizon, transitional to the B horizon, more like A than B, sometimes absent

Allotment - A share or apportionment assigned to one

Aluvial fan - A gradually sloping mass of sand, clay, etc , that widens out like a fan from the place where a stream slows down little by little as it enters a plain

Ameliorate - To make better, improve

Anhydrite - Anhydrous calcium sulfate It represents gypsum without its water of crystallization

Andesite - A dark grayish rock consisting essentially of oligoclase or feldspar

Anticlinal - Having or relating to a fold in which the sides dip from a common line or crest

Anticline - A geological structure or arch formed by strata from opposite sides dipping from a common line

Appurtenant - Annexed or belonging legally to some more important thing

Aquaduct - A structure for conveying water

Aquifer - An underground layer of porous rock, sand, etc containing water

Artifact - Any man-made object

Atlatl - A notched or built-up stick used to propel darts or spears The stick acts as an extension of the thrower's arm and increases the speed with which the projectile can be thrown

Avian - Of or having to do with birds

Azonal - Designating or of zones of soil than cannot be sharply distinguished from one another because, for example, they are of recent formation

Basic - Having an alkaline reaction

Batch plant - A facility for mixing of materials to produce concrete in individual batches

Bench flume - A man-made channel used to carry water across a steep slope

Berm - A ledge or shoulder as along the edge of a road or canal

Bifurcation - Having two branches or parts a branch off of a canal

Biomass - The total mass or amount of organic material in a particular area or volume

Biota - The plant and animal life of a region

Bituminous - Made from or containing asphaltic material

Borrow - Material excavated from one area to be used as fill material in another area

B P - Before present Present is defined as 1950

Brooding habitat - Habitat in which a female raises young birds of a given nest

Bulkhead (gate) - A hydraulic gate installed in slots or guides (usually temporary) to hold back water May be used during construction until permanent works are completed or later to exclude water while repairs are made

Butterfly valve - A damper or throttle in a pipe consisting of a disk turning on a diametral axis

CEQ - Abbreviation for Council on Environmental Quality

cfs - A measure of a moving volume of water, i e , cubic feet per second Synonymous with ft^3/s and shortened to "second feet "

Chute section - A section of high velocity conduit for conveying water from a higher level to a lower level

Circuit - The complete path of an electric current, electric line

Cirque - A deep, steep-walled recess on a mountainside made by glacial erosion

Climatic climax - The plant community that is the end result of plant succession and will undergo no further succession unless there is a change in climate or a disturbance, e g , clearing or fire

Climax community - A self-perpetuating biotic community with presumably no net annual accumulation of organic matter

Clone - An aggregate of plants produced vegetatively from a single parent, the progeny and parent are geneticaLLY identical

Clovis - Prehistoric culture dating ca 11,500 bp The diagnostic Clovis projectile point is often associated with extinct elephants (mammoths)

Concrete plug - Filling of a void, chamber, turnout, or some water conveyance structure full of concrete so that it no longer can be used for conveyance

Conduit - An artificial or natural channel for conveying water or fluid

Conservation storage (or capacity) - That water (or capacity) that is stored for use and will be released as needed for project purposes

Core - The basic tool production unit for manufacturing chipped stone tools

Core reduction - Chipped stone tool manufacturing activity where flakes are selectively removed from a core

Cortex - The exterior surface of a rock

Crest - The top line or peak of a dam or hill

Cubic feet per second (ft^3/s) - A measure of a moving volume of water

Cuesta - The ridge formed by a layer of resistant rock when the layer is inclined gently It is a hogback when the layer is inclined steeply

Cultural resource - Any building, site, district, structure, or object significant in history, architecture, archeology, culture, or science

Cutoff trench - An impervious barrier beneath a dam to impede seepage

Cut section - A channel made solely by excavation

Dead storage - That water stored (or capacity) in a reservoir that is below the lowest outlet elevation

Debitage - Non-tool chipped stone artifacts

Deciduous - Shedding leaves annually

Depletion - Total cost of water to the stream due to consumptive uses, evaporation, seepage, and evapotranspiration

DES - Abbreviation for draft environmental statement

Diagnostic point or artifact - Artifacts that seem to be typical and/or definitive of a given time period

Diapiric - Pertaining to an anticlinal fold in which a mobile core has broken through the more brittle overlying rocks

Dike embankment - An embankment of earth for restraining the waters of a river

Dimictic - Lakes in which two circulations take place each year, in spring and autumn thermal stratification is inverse in winter and direct in summer

Disclimax - An enduring climax community which has arisen in an area due to some disturbance, e g , overgrazed range

Distribution line - Low voltage electric powerline usually 69 kilovolts or less

Diurnal - Daily, recurring every day

Diversion dam - A barrier across a stream built to turn all or some of the water into a diversion

Diversion structure - A channel excavated to cause a stream or river to bypass construction work either preliminary or during construction only

Drop inlet - An inlet to a pipe, tunnel, canal, or other hydraulic structure where the water is dropped vertically

Drop inlet shaft - The vertical pipe or shaft portion of drop inlet (see drop inlet)

Duncan - A McKean complex projectile point dating ca 4000 bp

Dynamic head - Energy in a stream of fluid due to its motion

Earth wing embankment - Small earth dam section (like wings) extending from the concrete structure to complete the dam or stream closure

Eastern slope - That portion of Colorado lying east of the Continental Divide

Easement - A nonpossessing interest held by one party in land of another party whereby the first person is accorded partial use of such land for a specific purpose It restricts but does not abridge the rights of the fee owner to the use and enjoyment of his land, subject to the enjoyment of the easement holder's rights

Ecological amplitude - The range of one or more environmental conditions in which an organism or process can function

Ecology - The branch of biology that deals with the relations between living organisms and their environments

Ecosystem - A system made up of a community of animals, plants, and bacteria and the physical and chemical environment with which it is interrelated

Edaphic - The chemical and physical characteristics of a given soil environment without reference to climate

Effluent - A stream flowing out of a body of water the outflow of a sewer, septic tank, and industrial sewage

EIS - Abbreviation for environmental impact statement

Environment - All the conditions, circumstances, and influences surrounding and affecting the development of an organism or group of organisms

Eolian - Applied to the erosive action of the wind, and to deposits which are due to the transporting action of the wind

EPA - Abbreviation for Environmental Protection Agency

Epicenter - That point on the earth's crust which is directly above the focus of an earthquake focus being that point within the earth which is the center of an earthquake

Epilimnion - Top layer of water (see stratification)

Euphotic - The upper, well-illuminated zone of a body of water where photosynthes occurs

Eutrophication - Enrichment of a body of water by the addition of nutrients which stimulate the growth of aquatic plants

Evaporite - A rock deposit resulting from the evaporation of an aqueous solution

Evapotranspiration - The total water loss from the soil including that by direct evaporation and that by transpiration from the surfaces of plants

Even-aged - Refers to a stand of trees in which only small differences in age occur between the individuals in young stands The differences should not exceed 10 to 12 years in mature stands not more than 30 to 40 years

Exclusive flood control capacity - Reservoir volume above the conservation or joint use pool that is kept empty to catch flood runoff and then evacuated as soon as possible to keep it in readiness for the next flood

Extirpated - To destroy totally, make extinct

Fault interrupter switch - A switch for isolating a section of a power transmission circuit

Fauna - The animals of a specified region

Fee Simple Title - An absolute fee A fee without limitations to any particular class of heirs or restrictions, but subject to the limitations of eminent domain, escheat, police power, and taxation An inheritable estate

FES - Abbreviation for Final Environmental Statement

Fill section - A channel made solely by constructing embankments

Firm water supply - An assured minimum supply of water under the most adverse water year supply conditions

Fish screens - A perforated or slotted plate used to prevent fish passage

Fixed wheel gate - A valve for controlling the passage of a fluid, operated by turning a wheel that remains in a stationary plane

Flakes - Pieces of lithic material left over from the manufacture of stone implements

Flocculant - An agent that produces small aggregated masses of material suspended in or precipitated from a liquid

Flora - The plants of a specified region

Focus - A unit of classification in the midwestern system for American archeology constituting a group of components yielding artifacts almost identical in those features determinative of type

Folsom - Prehistoric culture dating ca 10,000 bp The diagnostic Folsom projectile point is often associated with extinct forms of bison

Forb - A broad-leaved flowering plant as distinguished from the grasses, sedges, etc

Forebay - The upper water impoundment from which water is discharged to a hydroelectric generating plant

Foreshore - A strip of land margining a body of water, e g , a lake or stream, the bottomland is intermittently exposed when the reservoir water level fluctuates

Fossorial rodents - Adapted to digging or burrowing

ft^3/s - Symbol for cubic feet per second (see c f s)

Gabion - A cylinder filled with stones and sunk in water, used in laying the foundations of a dam

Gallery - A long narrow room

Geothermal - Of or pertaining to the earth's internal heat

gpm - Gallons per minute

Graben - A block, generally long compared to its width, that has been lowered relative to the blocks on either side It is bounded by faults on its long sides

Gypsiferous - A term applied to a sedimentary rock containing gypsum

Hanna - A McKean complex projectile point dating ca 4000 bp

Head - The height of a water column the difference in elevation between the imput and output water levels

Headworks - Structure at the head of a channel for diverting water into it

Herbaceous - Without persistent woody stems dying to the ground each year

Hydrodynamics - A branch of hydromechanics that deals with the motion of fluids and the forces acting on solid bodies immersed in fluids and in motion relative to them

Hydrographic bridge - A structure spanning a waterway from which flow measurements are taken

Hydrology - The science dealing with water on the land, its properties, laws, geographic distribution, etc

Hypolimnion zone - Bottom layer of water (see stratification)

Inactive storage (or capacity) - That water stored (or capacity) in a reservoir that is above dead storage but not used to store water which will be released from the reservoir for Project purposes

In situ - In the natural or original position

Insolation - The rate at which radiant energy is incident directly from the sun per unit horizontal area at any place on or above the surface of the earth

Interceptor ditch - A ditch that is placed either above or below a cut or embankment to intercept stormflows and concentrate them for disposal

Interspecific - Competition between species

Intraspecific - Competition of individuals within a species

Inundate - Flood to cover with water

Invader plant species - Species, often annuals, which are not a part of the climax vegetation

Joint use storage (or capacity) - That storage (or capacity) that is shared by more than one use on a time or some other priority basis

kVA - Kilovolt ampere

Kilowatt - One thousand watts

Kilowatt-hour - A unit of energy equivalent to that transferred or expended in one hour by one kilowatt of power, approximately 1 34 horsepower an hour

Knapping - The process of chipping flint by striking it with various implements at selective points with sharp quick blows

Krummholz - Shrubby, stunted growth-form of trees

Lacustrine - Of or pertaining to lakes, organisms living in a lake environment

Lenses - Geologic deposits bounded by converging surfaces (at least one of which is curved), thick in the middle and thinning out toward the edges, resembling a convex lens

Life zone - Any of a series of biogeographic zones into which a continent, region, etc , is divided both by latitude and altitude on the basis of the characteristic animal and plant life in a zone

Limnology - The science that deals with the physical, chemical, and biological properties and features of fresh waters

Lithic - Of or pertaining to stone

Lithosol - A soil having little or no evidence of soil development and consisting mainly of a partly weathered mass of rock fragments or of nearly barren rock

Littoral - The region along the shore

Lode claim - A mining claim on an area containing a vein or lode (stream, channel, or watercourse)

Loessial soil - Soil composed of fine silt or dust that has been transported to its present location by the wind

M&I - Abbreviation for municipal and industrial use of water

Macrobenthos - Large organisms living on or in the bottom of bodies of water

Mano - A handstone used as the upper millstone for grinding grains

McKean - A McKean complex projectile point dating ca 4000 bp

Megavolt amperes - A unit of electrical capacity, one million volt amperes

Megawatt - One million watts of electrical power

Metalimnion zone - Middle layer of water (see stratification)

Metamorphic parent materials - Unconsolidated metamorphic rock material from which soils are formed

Metasediments - Metamorphic rock of sedimentary origin

Metate - A stone with a concave surface used as the bottom millstone for grinding grains

mg/l - Abbreviation for milligrams per liter

Mineral right - The right or title to all, or to certain specified minerals in a given tract, which is enforceable by law

Monadnock - An isolated hill or mountain of resistant rock surmounting a peneplain (q v)

Monolithic - A single large piece

Montane - Refers to mountains

Moraine - A mass of rocks, gravel, sand, clay, etc , carried and deposited directly by a glacier

Morning glory intake or spillway - Spillway consisting of entrance structures shaped like a vertical flared funnel with its top as the lip of the spillway with central vertical or inclined shaft that carries discharge downward to tunnels leading to river channel below the dams

Neutral - Neither significantly acid or alkaline, i e , possessing a pH of or near 7 0

Nocturnal - Occuring/active at night

O&M - Abbreviation for operation and maintenance

Oligotrophic - Deficient in plant nutrients, usually having abundant dissolved oxygen with no marked stratification

Ogee-type crest - A weir crest having an "S"-shaped slope

Operational losses - Those losses due to evaporation and seepage

Orifice - A mouthlike aperture, an opening

Overchute - Structure that is constructed over a canal or road to carry water over the canal or road so that it does not flow into the canal or onto the road surface

Outlet channel - A waterway or drainage channel provided to collect and carry away discharge

Park floor - A grassy meadow occurring in a vegetative formation of widely and regularly spaced trees

Parshall flume - A device to measure the rate of streamflow

Pediments - Areas along the face of the uplifted mountainranges which are generally relatively gently sloping and which have been formed by several factors including sheet erosion and deposition, stream braiding, etc The general slope of these areas is governed by the slope and erodability of the underlying bedrock formations

Pedologic - Pertaining to the study of soils

Peneplain - An area in which erosion has reduced the landscape to almost a plain

Penstock - A tube or conduit used to carry water to a turbine for generating power
Periphyton - The community of organisms which live attached to rooted aquatic plants

Permeable material - That which allows water to pass through easily

pH - The acid or alkaline condition of the soil or water A value of pH7 is neutral Lower values are acid and higher values are basic or alkaline

Class III survey - An intensive on-the-ground survey of all the areas to be affected by a Reclamation action It is designed to locate and evaluate all cultural resources within a project area

Phreatophyte - A long-rooted plant that absorbs its water from the ground water

Placer mining claim - A mining claim or individual right on a given tract of surficial mineral deposit, usually a heavy metal such as gold, in which a discovery has been made This deposit was formed by mechanical concentration of mineral particles from weathered debris

Plankton - The floating or weakly swimming flora or fauna occurring at any depth in lakes, ponds, streams, or seas, often of microscopic size

p/m - Symbol for parts per million - same as ppm and mg/l

Podzol - A type of light-colored, relatively infertile soil, low in lime and iron, found typically in coniferous forests in cool, humid regions

Porphyritic - A type of rock texture of an igneous rock in which larger crystals (phenocrysts) are set in a finer groundmass

Portal - An entrance

ppb - Abbreviation for parts per billion

Primary Flake - A chipped stone artifact having the dorsal surface 100 percent cortex covered

Radial gate - An arc-shaped device radially operated to control a passageway
Rain shadow - The region of diminished rainfall on the lee side of a mountain or mountain range, where the rainfall is noticeably less than on the windward side
Range - The extent of the geographical area in which a plant or animal occurs
Raptor - Birds of prey, e g , hawks, eagles, falcons, osprey, vultures, and owls

Redd - The spawning area of trout or salmon

Right-of-way - The privilege or right which one person, or persons particularly described, may have of passing on or over the land of another Usually, an easement on or over the land of another

Riparian - Adjacent to bank of a river or lake

Riprap - Large rock loosely placed on a foundation or slope as protection against wave action

Scarp - The steep-faced edge of a cuesta or a plateau

Scottsbluff - A projectile point type associated with the Plano period (ca 9000 bp) This point is often associated with extinct forms of bison It was previously called a Yuma point

SCUBA - Abbreviation for self-contained underwater breathing apparatus

Secondary flake - A chipped stone artifact having < 100 percent but > 0 percent of the dorsal surface cortex covered

Second-feet - Shortened term for cubic feet per second (c f s) and the symbol ft^3/s

Seismicity - The phenomonon of earth movements or seismic activity

Shotcrete - A mixture of cement, sand, and water applied by pneumatic pressure

Siliceous rock - Rock largely comprised of the chemically resistant dioxide ($Si O_2$) of silicon

Siphon (inverted siphon) - A conduit for conducting water beneath a depressed place

Sluiceway - An artificial channel for water with a gate

Solid wastes - Garbage, refuse, sludges, and other discarded solid resulting from industrial, commercial, and agricultural operations and from community activities It does not include solids or dissolved material in domestic sewage or other significant pollutants in water resources, such as silt, dissolved or suspended solids in industrial wastewater effluents, dissolved materials in irrigation return flows or other common water pollutants

Solifluction terrace - A terrace formed by the movement of soil down slopes, i e terraced colluvial deposits

Spillway - Overflow channel of a dam

Spillway stilling basin - An enlargement and deepening of the river at the foot of a dam spillway to lower the speed of flow

Standing crop biomass - Expressed as the total dry weight of plant and animal matter present in a defined area at a specific point in time

Stilling basin - An area or basin downstream from a dam used to dissipate the energy of the flow

Stratification - Thermal layering of water both in lakes and streams Lakes usually have three zones of varying temperature, epilimnion - top layer, metalimnion (thermocline) is the middle zone of rapid temperature change, and hypolimnion bottom layer

Strike (Geology) - A line formed by the intersection of a horizontal plane and a geologic stratum

Subclimax - A subfinal stage in succession in which further progression is inhibited because of the influence of some factor other than climatic factors

Sublimation - The transition of a substance directly from the solid state to the vapor state, or vice versa, without passing through the intermediate liquid state

Substrate - The base on which an organism lives

Substratum - A layer beneath the surface soil

Succession - The replacement of one kind of community by another, progressing to the climatic climax if disturbance does not occur

Sump - A pit in which water collects before being bailed or pumped out

Superstructure - All that portion of a building above ground level

Supplemental irrigation water - Additional water applied to irrigate crops over and above that historically or normally used, which could be beneficially used to increase the crop yield

Surcharge - A sudden increase in the flow of water in a reservoir

Surface acre - The two-dimensional water surface of a lake amounting to 43,560 square feet

Surface right - A claim, title to, or interest in the ground surface, generally, which are enforceable by law

Surge tank - A vessel for leveling out sudden changes in flow of water

Switchyard - An area usually fenced containing equipment for routing the flow of electrical power

Tailrace - A channel for conveying discharged water from a hydroelectric powerplant

Takeline - The actual right-of-way boundary established for project use and authority granted by congressional approval and action

Talus - Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes

Talus slope - A mantle of rock fragments on a slope below a rock face

TDS - Abbreviation for total dissolved solids (see solid wastes)

Terminal storage - The ultimate or last storage facility of the system

Tertiary flake - A chipped stone artifact having no cortex

Thermocline - A place, relating to a lake's depth, where there is an abrupt temperature change An obvious temperature change between the upper warm portion of a lake and the cold portion

Thrust fault - A fault in which the upper rock layers have been pushed forward over the lower ones

Tool - Any specific-use artifact or object

Topographic climax - A climax (q v) that is determined by the nature of the topography

Topo-edaphic climax - A community that remains self-perpetuating due to a combination of topographic and edaphic (soil-related) factors

Trachyandesite - A lava intermediate in composition between trachyte and andesite

Transmission line - A facility for transmitting electrical energy at high voltage from one point to another point Transmission line voltages are normally 115 kV or larger

Trashrack - A screen of widely spaced bars used to catch large objects floating in a channel

Trifurcation - Having three branches or parts two branches off of a canal

Trophic - Having to do with the process of nutrition

Tuffaceous - A rock composed of the finer kinds of volcanic detritus

Tunnel spoil or muck - Material and rock excavated during construction of a tunnel It usually lacks organic material

Turbidity - The quality or state of being muddy or cloudy in physical appearance

Two-story fishery - The ability of a stratified reservoir (q v) to support a warmwater fishery in the epilimnion and a coldwater fishery in the hypolimnion with a mix of species in the metalimnion

Unappropriated - Not granted to anyone to the exclusion of others

Ungulates - Hooved animals

Unpatented mining claim - A mining claim where clear title has not been conveyed from the United States to a private party because the purported use for mining has not been proven to be economically feasible or required improvements have not been made by the private party

Upper Republican - Refers to a culture characterized by small permanent villages that is believed to have centered in the Upper Republican River Valley of northwestern Kansas and southwestern Nebraska This society may have extended into Colorado

Ventilation corridor - Permits air to flow through without establishing whirlwinds

Visit - A significant amount of time spent by one individual at a particular recreation facility during a 24-hour period

Visitor-day - Consists of 12 visitor hours which may be aggregated continuously, intermittently, or simultaneously by one or more persons at a recreation facility

Water right - A grant, permit, decree, appropriation, or claim to the use of water for beneficial purposes, limited by the economical use and subject to other rights of older date of use, called priority, or prior appropriation

Watershed - The whole region or area contributing to the water supply of a river or lake

Weir - An overflow structure built across a channel to measure the rate of flow of water

Western Slope - That portion of Colorado lying west of the Continental Divide

Wingwalls - Retaining walls extending from a structure to hold back the embankment

Wye - Where a pipe, penstock, or water conveyance structure splits to form the shape of a 'Y"

Zonal soils - Those soils with mature profiles developed under specific conditions of climate and vegetation

Zoned earth dam - A rolled-fill dam consisting essentfally of an inner or enclosed impervious section supported by two or more outer sections of relatively pervious material

Zooplankton - Free swimming or floating animals occuring in bodies of water, often microscopic in size

ATTACHMENT 1

A INTERGOVERNMENTAL AGREEMENT

B WATER RIGHT FOR WINDY GAP INTERLOCUTORY DECREE, AND FINDINGS OF FACT, CONCLUSIONS OF LAW, JUDGMENT, AND DECREE

A. INTERGOVERNMENTAL AGREEMENT

AGREEMENT CONCERNING THE WIND. GAP PROJECT
AND THE AZURE RESERVOIR AND POWER PROJECT

PART I

PARTIES

The following named entities and persons are the Parties to this Agreement

A Municipal Subdistrict Northern Colorado Water Conservancy District herein designated as "Subdistrict" is a political subdivision of the State of Colorado, created under the provisions of C R S 1973 37-45-101 et seq for the purposes stated therein and by Order of the Weld County District Court pursuant to said statute on July 6 1970

B Colorado River Water Conservation District herein designated as "River District " is a political subdivision of and a body corporate under the laws of Colorado created by the provisions of C R S 1973 37-46-101 et seq , for the purposes stated therein The River District was the only protestant in the hereinafter referred to proceedings in Civil Action No 1768

C Northwest Colorado Council of Governments herein designated as "NWCCOG," is a regional planning commission organized pursuant to C R S 1973, 30-28-105 and an association of local governments contracting pursuant to Article XIV Section 18 of the Constitution of Colorado and C R S 1973 29-1-201 et seq , encompassing the Colorado counties of Grand Eagle Summit Jackson Routt and Pitkin

D Grand County is a county of the State of Colorado created by Article XIV of the Colorado Constitution and C R S 1973, 30-5-128 for the purposes stated therein

E Middle Park Water Conservancy District herein designated as "Middle Park" is a political subdivision of the State of Colorado, created under the provisions of C R S 1973 37-45-101 et seq for the purposes stated therein

F Three Lakes Water and Sanitation District herein designated as "Three Lakes" is a special district created under the provisions of and for the purposes set forth in C R S 1973 32-10-101 et seq

G Ritschard Cattle Co Inc Joseph McElroy Isabel McElroy Olga Hill Clayton Hill Howard K Schmuck, Jr Richard P Doucette Christine O Doucette Jacques Ranch I and Jacques Ranch II Illinois limited partnerships Gene Ritschard David Mayhoffer John H McElroy Mary K McElroy Edna L Palmer Lloyd A Palmer Leo Marte Eunice Marte Jessie Joyce Thompson David Howard Thompson, John Sheriff Ida L Sheriff H Grady Culbreath J Gail Culbreath John L Kemp Crockett C Kemp William Henry Thompson Anita Lewis Thompson Skylark Ranch Company, a Colorado corporation Charles G Broady, Phyliss Broady, Blanche Cowperthwaite dba Gore Canyon, Ltd , Colorado River Land Corporation Sunset Associates, a partnership (herein designated as "Ranchers "), their successors and assigns, are among others, owners of ranches on the Colorado River below its confluence with the Fraser River and above its confluence with the Blue River, which in some manner may be affected injuriously by the construction of the Subdistrict's Windy Gap Project

H The Town of Granby, the Town of Hot Sulphur Springs Stanley Broome Richard P Doucette and Winter Park Water and Sanitation District and several of the Ranchers are objectors or have entered their appearance in Case No W-4001, Water Division 5

PART II

DEFINITIONS

A Windy Gap Project A water diversion storage and conveyance system commencing at a point on the Colorado River just below its confluence with the Fraser River and

terminating at Lake Granby which lake is a part of the Colorado - Big Thompson Project

B Azure Reservoir and Power Project A proposed water storage and hydroelectric power project located on the main stem of the Colorado River approximately 8-1/2 miles west of the Town of Kremmling

C Una Reservoir A proposed water storage and hydroelectric project on the mainstem of the Colorado River located in DeBeque Canyon near the Town of DeBeque

PART III

RECITALS

A In 1968 Ralph H Price, as trustee for the cities of Boulder, Longmont Estes Park Loveland Fort Collins and Greeley filed claims for certain conditional water rights for the Windy Gap Water System hereinafter termed the "Windy Gap Project" in the District Court for Grand County in a supplemental water adjudication Civil Action No 1768 and under the provisions of the 1943 Adjudication Act The claims were subsequently assigned and deeded to Subdistrict upon its creation

B In April, 1972, hearings on the claims were held by Michael D White a Referee appropriately appointed to conduct such hearings On April 8 1974, Referee White entered his findings, conclusions of law and recommendations and subsequently, after several additional hearings before both Charles F Stewart and George E Lohr, Water Judges for Water Division 5 Judge Lohr by Order dated February 23 1978 granted the conditional decrees sought by Subdistrict

C Upon the granting of the conditional decrees for Subdistrict's Windy Gap Project River District appealed Judge Lohr's decision to the Supreme Court of Colorado Docket No 28417 where on September 14, 1979 the Supreme Court reversed Judge Lohr's decision and remanded the action

to the Water Court or Water Division 5 for further proceedings Upon Petition of the Parties the Supreme Court has now extended the time for filing petitions for rehearing to May 1, 1980

D Since the decision of the Supreme Court on September 14 1979 representatives of Subdistrict, River District NWCCOG Grand County Middle Park and the Ranchers have met upon numerous occasions to resolve the differences existing between the Parties in an effort to reach an agreement which would permit Subdistrict to construct its Windy Gap Project by devising a plan for the design construction and operation of the Project which would comply with the provisions of C R S 1973, 37-45-118(1)(b)(IV) and to mitigate any and all adverse impacts thereof

E On December 12, 1978 Subdistrict filed an application for water right in the Water Court for Water Division 5 (Case No W-4001) seeking an enlargement of its conditional decree for the Windy Gap Pump, Pipeline and Canal by 100 cubic feet per second This application has been objected to or entries of appearance made by NWCCOG, River District Middle Park, Town of Granby, Jacques Ranch I and Jacques Ranch II, Richard P Doucette, Town of Hot Sulphur Springs Winter Park Water and Sanitation District Board of Grand County Commissioners for Grand County, Ritschard Cattle Co Inc and Stanley Broome The application is presently pending in Water Division 5

F The Parties have reached an agreement as a result of such meetings and discussions referred to above in Part III, paragraph D and now wish to execute this Agreement specifying the terms and conditions thereof

THEREFORE in view of the foregoing the Parties hereby agree as follows

PART IV

PURPOSE OF AGREEMENT

1 The purpose of this Agreement is (1) to permit the Subdistrict immediately to commence and complete the construction of its Windy Gap Project as evidenced by its decrees and (2) to permit the immediate planning of the Azure Reservoir and its power features herein designated as the "Azure Reservoir and Power Project," in order that the Project may be under construction within fifteen (15) years from the date hereof or sooner

2 Implementation of the provisions of this Agreement satisfies and constitutes compliance by Subdistrict of its obligations under C R S 1973 37-45-118(1)(b)(IV), insofar as the Parties hereto are concerned and is in compliance with all requirements for obtaining valid conditional water rights for all components of the Windy Gap Project

3 Implementation of the provisions of this Agreement will constitute compliance with all objections to the Draft Environmental Impact Statement for the Windy Gap Project by any Party hereto, furnishes satisfactory mitigation measures for the development of the Windy Gap Project and following a hearing and decision of the Grand County Commissioners under paragraph 36 (assuming the decision is favorable) will constitute compliance with all valid permitting requirements imposed by any of the Parties

4 Implementation of the provisions of this Agreement specifically Part V paragraph 16 is to insure that Subdistrict will plan, design and construct such facilities as are necessary to allow Ranchers to continue to divert their existing senior decrees at no additional cost other than that which would have occurred had the Windy Gap Project not have been constructed

5 The Agreement constitutes a desirable and practical method and approach for the financing and construction

of the Azure Reservoir and Power Project for the benefit of the prospective users of Colorado River water for irrigation and other beneficial consumptive uses, and further implementation of this Agreement by all Parties is a further step in providing continued cooperation of both the East and West Slopes of Colorado in the development of all of Colorado's water resources for the beneficial use of all citizens of the State of Colorado

PART V

AGREEMENTS OF SUBDISTRICT

6 Subdistrict, as expeditiously as reasonably possible, will use its best efforts to cause the Azure Reservoir and Power Project to be constructed at or near its decreed location on the Colorado River to its maximum feasible capacity at the Subdistrict's sole cost and at no cost to the River District, except as hereinafter provided, or to any citizen or entity of Colorado West of the Continental Divide, including Jackson County Provided however, that determination of the maximum feasible capacity of Azure Reservoir (estimated to be 28,000 to 30,000 acre feet) shall include an evaluation of the cost effectiveness of protective works and facilities required to prevent interference with the maintenance and use of the Denver and Rio Grande Railroad In determining cost effectiveness, if the incremental value (over the life of the Azure Project) of the gain in storage capacity and power production by construction of protective works exceeds the cost of such works, such protective works shall be included as part of the Project All necessary Federal, State or local permits and licenses required by law shall be obtained by Subdistrict at its sole cost River District will cooperate and aid, including participation as a joint applicant, Subdistrict in obtaining such permits and licenses Costs incurred by the River District in cooperating aiding, or as a joint applicant, in the obtaining of necessary permits or licenses shall be borne by River District

7 All water released from Azure Reservoir shall, unless impracticable, be released through the power plant, and all power produced from Azure Power Plant shall be marketed upon terms and conditions mutually satisfactory to the Subdistrict and River District by an entity to be selected by the Subdistrict and River District Revenues produced from the marketing of said power shall be applied in the following order

First To payment of all annual operation and maintenance costs associated with Azure Reservoir and Power Project including the maintenance of adequate contingency funds

Second To payment of annualized debt service (including therein preconstruction costs and those costs incurred by Subdistrict pursuant to paragraph 16) incurred by the Subdistrict in the construction of Azure Reservoir and Power Plant for the repayment period of any bonds issued to finance the Azure Reservoir and Power Project

Third To payment to Middle Park for hydroelectric power produced from Middle Park water released pursuant to paragraph 9, subparagraph First

Fourth All sums remaining after the payments contemplated in subparagraphs First, Second and Third (or after retirement of all debt described in subparagraph Second) shall be divided equally between Subdistrict and River District to be utilized as they may individually determine or Subdistrict may elect to receive its one half of the revenues in electrical energy or to have its one half of any such revenues applied to the payment of its power costs for the Windy Gap Project

8 Title to the Azure Reservoir and Power Project facilities or alternate facilities contemplated hereunder will be transferred by Subdistrict to River District upon

repayment of all advance costs incurred by Subdistrict following the date of this Agreement in the development of said Project or as may be provided for or required by any bond covenants entered into by Subdistrict for the financing of the Azure Reservoir and Power Project

9 The capacity of Azure Reservoir with due regard being given to Project hydroelectric capabilities shall be allocated as follows

First An amount not to exceed 2000 acre feet of water to Middle Park to be marketed by that entity within the geographic area of Middle Park or as may be authorized by statute On or before the first day of each water year Middle Park shall notify the entity operating Azure Reservoir and Power Plant the Subdistrict and the River District of the quantity of water to be allocated to Middle Park for which Middle Park has or expects contracts for the use thereof in the coming water year Such quantity of water will be retained to Middle Park's account to be released as directed by Middle Park The volume of water if any not disposed of by Middle Park up to said 2000 acre feet shall be disposed of pursuant to the provisions of subparagraph Third of this paragraph 9 provided, however that all power revenues produced from said 2000 acre feet shall be credited to the account of Middle Park pursuant to paragraph 7 subparagraph Third In the event Middle Park exercises its option upon completion of Azure Reservoir to utilize its additional 1000 acre feet of water in Azure Reservoir as set forth in paragraph 17 then the figure of 2000 acre feet herein shall be changed to 3000 acre feet

Second An amount not to exceed 3000 acre feet of water to Subdistrict to be used as replacement for out-of-priority diversions of the Windy Gap Project

provided if not so needed on an annual basis on or before October 31 of each year then such water will be subject to the provisions of subparagraph Third of this paragraph 9 The amount of water herein allocated to Subdistrict may be reduced to 2000 acre feet depending on the election of Middle Park as provided in Paragraph 17

Third The balance of the water yield of Azure Reservoir shall be marketed by River District in Colorado for the benefit of western Colorado on terms and conditions to be determined by River District All revenues derived from the marketing of this water shall be the property of River District Provided, the allocations herein made shall be subject to the operational priorities established in paragraph 10 hereof Should a dispute arise between the Parties hereto concerning any conflict between the operating priorities described in paragraph 10 and a specific contract for disposition of Azure water, it shall be resolved by the Water Judge for Water Division 5 subject to appeal as provided by law The Ranchers to the extent of their interest, if any, shall be represented in any such proceeding by Middle Park and River District pursuant to said District's statutory obligations at no cost to the Ranchers

10 Azure Reservoir and Power Project shall be operated by an entity to be selected by mutual agreement between Subdistrict and River District The reservoir shall be operated by the selected entity as nearly as practicable according to the following priorities

First To comply with and satisfy the terms and provisions of C R S 1973 37-45-118(1)(b)(IV)

Second To satisfy future beneficial consumptive uses of water in Colorado for the benefit of western Colorado and to replace out-of-priority Windy Gap Project diversions as set forth in paragraph 9 subparagraph Second hereof

Third To generate hydroelectric power

Fourth To the extent compatible with the foregoing primary priorities, for aesthetic, recreational and other nonconsumptive uses, provided, that the operational integrity of the Azure Reservoir and Power Project is maintained and the safety of the public is protected The governmental entity making use of the Project for these purposes shall assume in a separate agreement with Subdistrict and River District all resulting operational and maintenance costs and all liability of any nature arising from the use of the Project for such public purposes

11 During preconstruction, design and construction activities, it may be necessary to modify project design or relocate project features Should such situation arise, decisions related thereto will be made by mutual agreement of Subdistrict and River District with advice of all such changes to Middle Park

12 At any time during a period of 15 years, or of any extended time mutually agreed upon by Subdistrict and River District, from the date of initiation of construction of the Windy Gap Project, the Subdistrict and the River District may by mutual agreement determine that it is no longer feasible to pursue the construction of Azure Reservoir and Power Project for engineering or other reasons Should Subdistrict and River District so mutually agree, then likewise by mutual agreement of such parties, an alternate facility shall be selected for construction at the cost of the Subdistrict, which facility shall be located, if practicable, within the geographic area of Middle Park Said alternate facility shall be comparable to Azure Reservoir in the sense that it can provide substantially similar benefits to the Parties hereto, provided, the hydroelectric features may be omitted if not feasible and the costs and benefits related

thereto likewise may be omitted from the alternate selected If hydroelectric features are constructed as a part of such alternate facility, the power revenues therefrom shall be distributed and allocated as set forth in paragraph 7 The nonreimbursable costs of construction of such alternate facility shall not exceed, so far as the obligation of Subdistrict is concerned, excluding the costs of compliance with paragraph 16, the sum of $10,000,000 escalated or deescalated from the date of this Agreement in accordance with the ENR (Engineering News Record) "Irrigation and Hydro Cost Index for the West" to the date of award of contract for the construction of the alternate facility If said alternate facility has included therein hydroelectric features, Subdistrict shall include in said $10,000,000 the previously incurred costs relating to the Azure Reservoir and Power Project and the costs of compliance with paragraph 16

Should construction of the Azure Reservoir and Power Project not be initiated within 15 years from the date of initiation of construction of the Windy Gap Project, or in the case of an alternate facility, within 20 years of said date, and any extension thereof mutually agreed to by River District and Subdistrict, then the Subdistrict shall have the right to apply to the Water Judge for Water Division 5, subject to the right of appeal, for a determination that under the then extant conditions, the Subdistrict's actions hereunder, other than construction of the Azure Project or the alternate facility, constitute adequate compliance with C R S 1973, 37-45-118(1)(b)(IV) to the end that Subdistrict shall be relieved from any further duty in relation to its Windy Gap Project diversions and said statute

Should the parties hereto agree to forego additional work toward construction of the Azure Reservoir and Power Project or the alternate facility contemplated hereunder, and/or the Water Court should relieve the Subdistrict from any further duty, the Subdistrict shall forthwith assign to

the River District all permits, licenses, engineering plans drawings, specifications and other material acquired or produced by the Subdistrict or others in connection with the Azure Project or said alternate facility River District shall have the right to proceed with said Project(s) free of the obligations of this Agreement with respect thereto To the extent the failure to initiate construction within the periods herein contemplated for Azure Reservoir and Power Plant, or the alternate facility, is due to reasonably avoidable fault or delay on the part of Subdistrict, the time within which construction was to have been initiated shall be extended a like period For the purposes of this Agreement, the initiation of construction shall be deemed to have occurred on the date construction contracts are signed which result in physical onsite work on the facilities contemplated hereunder All lands and rights-of-way, if any, acquired by Subdistrict for said Project may be acquired by River District at cost, plus interest thereon at the rate being paid by Subdistrict thereon, if notice of River District's desire to obtain said lands and rights-of-way is given to Subdistrict in writing within six months after any agreement to forego said additional work

13 Windy Gap Project diversions will be made strictly under the priority system (including exchanges), thus protecting all conditional and absolute water rights senior in priority, unless specifically subordinated to Windy Gap decrees

14 Subdistrict will comply with all terms and provisions of Senate Document 80 in the design, construction and operation of the Windy Gap Project

15 The Parties acknowledge and agree that Subdistrict may initiate immediately the construction of its Windy Gap Project prior to the construction of Azure Reservoir and Power Project, which latter facility is intended to comply with the provisions of C R S 1973, 37-45-118(1)(b)(IV)

provided that no water may be diverted from the western slope of Colorado (from streams west of the Continental Divide) through said Wind Gap Project facilities prior to the initiation of construction of such facilities contemplated in paragraphs 6 and 12 hereof, or it is determined that such facilities will not be constructed pursuant to the provisions of paragraph 12, provided, however, that in the event of actual requirements by any or all of the Windy Gap Project participants for water for initial domestic, municipal or power purposes within the boundaries of the Subdistrict, directly or by exchange, diversions to the extent of such requirements may be made with the prior consent of River District and such consent shall not be unreasonably withheld

Subdistrict shall have the right to make the maximum diversion necessary or possible, pursuant to paragraph 3(d) of that Carriage Contract, Contract No 14-06-700-7497, between the Northern Colorado Conservancy District, United States of America and Subdistrict, dated October 3, 1973, in any one year only and when the diversion will not interfere with any beneficial consumptive use of water from the Colorado River and its tributaries in western Colorado

Diversions by the Windy Gap Project prior to completion of adequate facilities for diversion of water by Ranchers shall not interfere with the delivery into Ranchers' diversion facilities of their presently decreed prior rights to water

16 Subdistrict within one year after initiation of the construction of the Windy Gap Project is under construction, will advance a sum sufficient for the following purposes (1) payment of $25,000 to Grand County for salinity studies of the Colorado River (the results thereof to be made available without cost to all other parties hereto), (2) payment to the Town of Hot Sulphur Springs of $150,000 for assistance in improving its water treatment facility and $270,000 for assistance in improving its waste water treatment facility,

and (3) such additional sums as needed for Subdistrict to plan design and construct facilities needed by the Ranchers for the diversion and delivery of the Ranchers' senior decreed water rights from the Colorado River Said sums, when paid by the Subdistrict and expended or obligated, shall not be recoverable in the event the Subdistrict voids this Agreement under the terms of paragraph 41 below Subdistrict shall design and construct such facilities in accordance with specifications approved by the State Engineer Ranchers agree that the design of any such facility when approved by the State Engineer, constitutes compliance of the design requirements by Subdistrict Subdistrict agrees to replace and reconstruct such facilities at its own cost if the same prove to be defective at any time within seven (7) years after completion of the Windy Gap Project If the efficiency or purpose of such facility is rendered ineffective or defective for delivery of existing decreed water to a Rancher because of any action by or operation of Subdistrict, the Subdistrict agrees to correct such defect at its own cost Subdistrict agrees to process and obtain such permits as necessary to permit construction of Ranchers' facilities

Individual contracts shall be negotiated with each Rancher in order to meet the requirements of this paragraph, including necessary construction easements, subject, however, to the limitations contained in this Agreement The contracts for construction of such facilities shall be finalized within 90 days after the Windy Gap Project is under construction, and if not finalized within said period, Subdistrict may proceed to construct said facilities as designed by Subdistrict and approved by the State Engineer

17 Subdistrict will dedicate and set aside annually, but noncumulatively, the following amounts of water produced from the Windy Gap water supplies to be stored as follows

(a) Prior to the construction of Azure Reservoir and Power Project or alternate facility the Subdistrict will place 3000 acre feet of water in Granby Reservoir for beneficial use without waste in Middle Park and will release 2000 acre feet thereof for all beneficial uses except for instream uses and industrial uses (unless the industrial use is within a municipality and through its municipal water system) and the additional 1000 acre feet of such water for municipal and domestic uses in Middle Park The release of this 1000 acre feet shall be made only if domestic and municipal uses in Middle Park have not been met adequately from the 2000 acre feet of water previously released

(b) After the Azure Reservoir and Power Project, or alternate facility, has been constructed, the Subdistrict will place 2000 acre feet of water in Granby Reservoir for beneficial use, without waste, in Middle Park and will release said 2000 acre feet for all beneficial uses except for instream uses and industrial uses (unless the industrial use is within a municipality and through its municipal water system) Subdistrict will additionally place, at the direction of Middle Park 1000 acre feet of water in either (1) Azure Reservoir, or the alternate facility, for all beneficial uses in Middle Park and thereby reduce the 3000 acre foot capacity reserved to Subdistrict in paragraphs 9 Second and 29 to 2000 acre feet, or (2) Granby Reservoir for municipal and domestic uses in Middle Park If said 1000 acre feet is placed in Granby Reservoir, all pumping costs incurred by Subdistrict to store said water in Granby Reservoir shall be reimbursed annually to Subdistrict by Middle Park

These waters shall be released by Subdistrict upon request of Middle Park and subject to operational criteria

established by the United States Any water so stored in Granby Reservoir shall be the last of any Subdistrict water to be spilled from Granby Reservoir, if such spill is required

18 Subdistrict will not claim the use of Green Mountain Reservoir for replacement purposes for the Windy Gap Project operation

19 Subdistrict will apply for an NPDES permit for diversion and carriage of water to Granby Reservoir if the same is required by law

20 Subdistrict will pay its proportionate share of any direct mitigation costs attributable to salinity on the Colorado River which legally may be imposed at a future date by any competent authority and which is proportionately required of all users in Colorado of Colorado River water

21 Subdistrict agrees to a water classification for Granby Reservoir, Shadow Mountain Reservoir and Grand Lake which will permit all present beneficial uses of these reservoirs or lakes, but reserves its right to contest imposition of water quality regulations on its activities

22 Subdistrict will not oppose the dredging of Shadow Mountain Reservoir for water quality purposes, provided that such work is scheduled in such a manner as to not interfere with the essential operations of the Colorado-Big Thompson Project and the Windy Gap Project

23 Subdistrict shall withdraw its opposition to any present River District Water Court proceedings in Water Division 5 and 6 As long as Subdistrict is proceeding diligently in the planning and construction of the Azure Reservoir and Power Project, or its alternate, or the same is constructed, River District agrees not to make a call on Subdistrict water rights for the benefit of any of its present conditional decrees with diversion points on the main stem of the Colorado River above the confluence of the Colorado and Roaring Fork Rivers, nor as to storage below such point on the Colorado

River to the extent the same will probably fill from other sources as determined by mutual agreement between the River District and Subdistrict In the event of disagreement such determination shall be made by the Division Engineer Water Division No 5 Provided, further however that to the extent that vacant capacity in Una Reservoir is created by power releases only, and the water so released not beneficially consumptively used in Colorado, that capacity shall be subordinated to the Windy Gap Project This Agreement not to call shall become ineffective, except as to the capacity in Una Reservoir created by water releases for power purposes only, in the event of release by the Water Court of Subdistrict's duty to construct Azure Reservoir and Power Project, or its alternate facility Further, Subdistrict will not oppose any present or future applications of River District in Water Division 5 and 6 unless the same may affect the administration of the Subdistrict's Windy Gap water rights on the main stem of the Colorado River

24 Subdistrict agrees to bypass at the Windy Gap Reservoir diversion site at all times the lesser of the following (1) Such amount as may be necessary to satisfy all senior decrees of the Ranchers and to provide such minimum stream flow in that stream segment of the Colorado River below the Windy Gap Project and above the confluence of the Blue River and the Colorado River as may be determined by the Colorado Division of Wildlife and subsequently decreed to the Colorado Water Conservation Board pursuant to C R S 1973, 37-92-102(3), or (2) the natural flow of the river at the Windy Gap Reservoir diversion site if the natural flow is less than (1) hereof It is the intent of the Parties that the amount of bypass by Subdistrict contemplated herein is based upon valid existing decrees and shall not be increased by future changes in stream regimen caused by changes in point of diversion, changes in type, place or extent of use, or

future junior decrees on this segment of the River, including tributaries thereto Further, it is not the intent of this provision to preclude Ranchers from exercising their senior rights against any or all junior existing conditional or future rights on the Colorado River or its tributaries or to supersede those rights guaranteed to Ranchers by C R S 1973, 37-86-113

Further, Subdistrict agrees not to oppose the application for minimum stream flow made by the Colorado Water Conservation Board for this purpose if the same is not in conflict with the provisions hereof, and to assist in supporting the integrity thereof, if necessary

Subdistrict agrees to the installation, at no cost to Ranchers, of a stream gaging station on the Colorado River in the vicinity of the present diversion structure of the Kinney-Barriger Ditch, and at such other points on the Colorado River as may be necessary as determined by State Engineer and the Colorado Water Conservation Board, to adequately monitor the minimum stream flows as set forth in this paragraph

25 Subdistrict agrees to subordinate its Windy Gap decrees to all present and future in-basin irrigation, domestic and municipal uses, excluding industrial uses, on the Colorado and Fraser Rivers and their tributaries above the Windy Gap Reservoir site

26 Subdistrict agrees that no additional water or water supplies will be carried through the Windy Gap facilities unless such conveyance complies with the provisions of C R S 1973, 37-45-118(1)(b)(IV)

27 Subdistrict will cooperate with all parties in permitting public use for recreational purposes of the land owned by Subdistrict at the Windy Gap Reservoir site upstream of the diversion dam, provided that the operational integrity of the Windy Gap Project is maintained and the safety of the public is protected Grand County, or other responsible

governmental agenc , in a separate agreement with Subdistrict shall assume al_ operation and maintenance costs and all liabil_t/ of any nature for use of the facilit by the public for recreational purposes Subdistrict will maintain the Windy Gap Reservoir full at all times following the termination of diversions in the fall and prior to the start of diversions in the spring, provided, however, that the reservoir may be temporarily drained during this period for any maintenance or improvements

28 Three Lakes intends to construct a sewer project that will collect sewage effluent presently discharging into Grand Lake, Shadow Mountain Reservoir and Lake Granby and will carry such effluent to new treatment facilities to be constructed in the Willow Creek drainage At the request of the Northern Colorado Water Conservancy District, Three Lakes has agreed to construct such ditches and related facilities as are necessary to allow the effluent from its proposed new treatment facilities to flow by gravity to a point on Willow Creek above the headgate of the Bunte Highline Ditch in order to reduce the quantity of water required to be released from Willow Creek Reservoir to meet the call of said ditch Northern Colorado Water Conservancy District has agreed that the construction of such facilities will satisfy any obligation of Three Lakes that might be asserted to arise because of depletions to Colorado-Big Thompson Project water rights and storage facilities resulting from construction of the Three Lakes project Except for the costs of the initial construction of the treatment facilities, the ditches and related facilities, and maintenance of them, Subdistrict shall pay any and all costs required to implement the exchange, or incurred as a result of such exchange of Three Lakes sewage effluent for water that would otherwise be required to be released from Willow Creek Reservoir to meet the call of the Bunte Highline Ditch, including all costs incurred to

obtain any permits or other approvals required by law in order to implement such exchange

PART VI

AGREEMENTS OF RIVER DISTRICT

29 River District and Middle Park agree to provide for the purpose and subject to the limitation contained in paragraph 9 subparagraph Second 3 000 acre feet of capacity in Azure Reservoir or substitute facility built pursuant to this Agreement for the use and benefit of the Subdistrict thereby reducing the entitlement of Middle Park in Azure Reservoir to 2000 acre feet

30 River District will make satisfactory arrangements to permit joint or other appropriate use by Subdistrict of its pending Federal Energy Regulatory Commission (FERC) application for a preliminary permit for the Azure Reservoir power features or for such other appropriate arrangement as may be agreed upon by River District and Subdistrict

31 For the purposes of this Agreement the following decrees for Azure Reservoir and Power Plant shall be utilized

Structure	Water District	Case No	Adjudicated Date
a The Azure Reservoir	53	1277	10-19-62
b First Enlargement of Azure Reservoir	53	1416	9-13-67
c Azure Reservoir Power Conduit and Power Plant, First Enlargement	Division 5	W-3991	-

d Such other decrees as may be necessary to operate the Azure Project in accordance with this Agreement

Appropriation Date	Priority No	Amt Decreed
a 7-21-58	433	25 583 6 a f
b 7-21-58	482	63 803 5 a f
c 9-29-78	-	1,000 c f s

PART VII

MUTUAL AGREEMENTS OF ALL PARTIES

32 Each Party to this Agreement agrees not to object to the Subdistrict obtaining any and all licenses permits rights-of-way or other approvals required to permit the immediate construction of the Windy Gap Project All such Parties agree to withdraw any former opposition to any such licenses, permits rights-of-way or other approvals and further to not make any further objections or adverse comments concerning the granting thereof

33 Each Party to this Agreement will cooperate in obtaining all licenses permits, rights-of-way or other approvals necessary or required to permit the construction of the Azure Reservoir and Power Project If any person or entity not a party to this Agreement should oppose the construction of the Azure Reservoir and Power Project in such a manner that said Project cannot be under construction within 15 years each Party to the best of its ability, will do everything possible to encourage the withdrawal of any such objections so as to permit the construction of the Azure Reservoir and Power Project as expeditiously as possible

34 Each Party hereto will not oppose the granting of Subdistrict's 1967 and 1978 appropriation dates for the various features of the Windy Gap Project and for a new appropriation of not to exceed 200 c f s if such enlargement is necessitated by reason of a need for a bypass imposed by virtue of the provisions of paragraph 24 hereof Subdistrict may divert under its decrees an amount of water not in excess of 90 000 acre feet in any one year and not to exceed an average of 65 000 acre feet per year in any consecutive ten year period It is anticipated by the Parties that the long term annual yield of water to the Subdistrict will be approximately 54 000 acre feet

35 All Parties agree that Subdistrict may proceed immediately to construct the Windy Gap Project upon filing of a final Environmental Impact Statement by the Water and Power Resources Service (formerly United States Bureau of Reclamation) for the Windy Gap Project and after the appropriate 30 day waiting period has expired, and each agrees to not request or require that a draft Environmental Impact Statement simultaneously be prepared for the Azure Reservoir and Power Project as each Project is a separate and distinct Project which is not dependent upon any other Project for construction The Parties recognize that if Azure Reservoir and Power Project cannot be built for any reason, an appropriate alternative project may then be selected under the terms of this Agreement and it is impossible now to determine which project, if any, will be built The Subdistrict and River District agree that the Subdistrict will furnish all data and information necessary to enable the appropriate federal entity to comply with NEPA requirements for the Azure Reservoir and Power Project, or alternative thereto, as a separate project All environmental concerns among the Parties regarding the Windy Gap Project have been resolved by this Agreement regardless of whether none, all or only one facility is constructed and operated

36 Grand County, NWCCOG, and Subdistrict further agree that this Agreement is an intergovernmental agreement pursuant to Article XIV, Sec 18 of the Colorado Constitution and Sec 29-1-201 to 203, inclusive, among all governmental entities hereto and contains all standards upon which Grand County will base any or all decisions for the Windy Gap Project, including 1041, zoning and environmental decisions Each governmental entity, however, reserves the right to contest any 1041 and zoning regulations or actions which at any later time may be adopted or pursued by Grand County or others if such regulations or actions would in any manner affect the construction or operation of any such facility or

facilities If the decision of Grand County is not in accord with this Agreement it is understood and agreed to by all parties hereto that the Subdistrict reserves the right to contest the application of any or all Grand County requirements, including 1041, zoning or environmental application permit or approval requirements as to Subdistrict activities pursuant to this Agreement

37 Within the limits and conditions contained herein, Subdistrict may build and operate such facilities as needed to accomplish the purposes of this Agreement

38 All Parties agree that this Agreement shall not bind Ranchers to any financial commitment for implementation thereof

39 The Parties agree that upon request of any party to this Agreement they will join with Subdistrict, and other interested parties, in the defense of any litigation against the construction or operation of either the Windy Gap Project or Azure Reservoir and Power Project, or alternative project, by persons or entities who are not parties to this Agreement However, this provision shall not be construed to require any financial participation of any type from Ranchers or Three Lakes

40 Within 30 days after the issuance of a 1041 permit and any other necessary Grand County approvals pursuant to paragraph 36, Subdistrict and the Northern Colorado Water Conservancy District will withdraw from Civil Action 79CV173, Denver District Court, and from Civil Action 79CV5133, presently pending in the Denver District Court, Denver Colorado by stipulation of the Northern Colorado Water Conservancy District and Subdistrict and all parties defendant to these actions, which stipulation shall embody the terms of this Agreement, and agree that the actions and claims represented thereby shall not be refiled except in accordance with the rights reserved to Subdistrict under the terms of this Agreement

41 The Parties hereto agree that this Agreement shall be either void or extended in certain circumstances Therefore unless conditions (a) and (b) are met, this Agreement shall be void

(a) All signatory parties identified herein have validly executed this Agreement by June 30, 1980 unless the necessity thereof has been specifically waived by Subdistrict

(b) Approval of Agreement by all six of Subdistrict participants by June 30, 1980

To the extent that the conditions in the following subparagraphs (c), (d), (e) and (f) delay beyond June 30, 1983 the initiation of construction of the Windy Gap Project and the implementation of this Agreement, all time periods provided for in paragraph 12 herein shall be extended for a time equal to the period of delay

(c) A determination has been made that NEPA compliance for the Azure Reservoir and Power Project is not required as a condition precedent for NEPA compliance for the Windy Gap Project

(d) Approval is given by Subdistrict Bond Counsel on the legality and appropriateness of Subdistrict issuing revenue bonds for the construction of the Windy Gap Project and Azure Reservoir and Power Project, all as set forth herein, and if necessary, confirmation of this Agreement by the District Court for Weld County, Colorado, pursuant to C R S 1973, 37-45-143, and enactment of such legislation as may be needed to permit Subdistrict to accomplish the purpose and substance of this Agreement

(e) A final Environmental Impact Statement and all necessary federal, state and local permits and clearances for the Windy Gap Project are issued, no litigation is pending, and the Subdistrict is able to proceed with completion and operation of the Windy Gap Project in accordance with the terms of this Agreement

(f) Approval of this Agreement by the Water Judge, Water Division 5, State of Colorado in accord with the terms of this Agreement and entry of final decrees to Subdistrict for a total of 600 c f s of water for the Windy Gap Project

42 This Agreement may be filed by any Party hereto in any court or administrative proceedings as a Stipulation of and between the appropriate parties to any such proceedings

THIS AGREEMENT may be executed in counterparts, each of which must be executed by Subdistrict and River District, and shall inure to and be binding upon the Parties, their personal representatives, successors and assigns, as appropriate

Dated and signed as of the 30th day of April, 1980

ATTEST

Secretary

MUNICIPAL SUBDISTRICT, NORTHERN COLORADO WATER CONSERVANCY DISTRICT

By
President

ATTEST

Secretary

COLORADO RIVER WATER CONSERVATION DISTRICT

By
President

ATTEST

Clerk of the Board

BOARD OF COUNTY COMMISSIONERS OF THE COUNTY OF GRAND, COLORADO

By Herbert A Ritschard
Herbert Ritschard, Chairman

ATTEST

Tom Isaac,
Secretary/Treasurer

NORTHWEST COLORADO COUNCIL OF GOVERNMENTS

By
Keith Troxel, Chairman

ATTEST

Secretary

THREE LAKES WATER AND SANITATION DISTRICT

By
President

ATTEST

Asst Secretary

WINTER PARK WATER AND SANITATION DISTRICT

By
President

ATTEST

Secretary

MIDDLE PARK WATER CONSERVANCY DISTRICT

By
President

ATTEST

Town Clerk

TOWN OF HOT SULPHUR SPRINGS, COLORADO

By
Mayor

ATTEST

Town Clerk

TOWN OF GRANBY, COLORADO

By
Mayor

ATTEST

Secretary

RITSCHARD CATTLE CO., INC

By
President

ATTEST

Secretary

SKYLARK RANCH COMPANY, a Colorado corporation

By
President

ATTEST

Secretary

GORE CANYON LTD, a Colorado corporation

By
President

ATTEST

Secretary

COLORADO RIVER LAND CORPORATION

By
President

David Mayhoffer

Lloyd A Palmer

Edna L Palmer

Leo Marte

Eunice Marte

Jessie Joyce Thompson

JACQUES RANCH I, a limited partnership

By
General Partner

JACQUES RANCH-II, a limited partnership

By
General Partner

Joseph McElroy

Isabel McElroy

John H McElroy

David Howard Thompson

John Sheriff

Ida L Sheriff

H Grady Culbreath

J Gail Culbreath

John L Kemp

Crockett C Kemp

William Henry Thompson

Anita Lewis Thompson

Blanche Cowperthwaite

John Taussig

Mary K McElroy

Olga Hill

Howard K Schmuck, Jr

Richard P Doucette

Christine O Doucette

Gene Ritschard

Charles G Broady

Phyliss Broady

Stanley Broome

SUNSET ASSOCIATES, a partnership

By_____
General Partner

CORRAL CREEK RANCHES, INC

By_____

B. WATER RIGHT FOR WINDY GAP: INTERLOCUTORY DECREE; AND FINDINGS OF FACT, CONCLUSIONS OF LAW, JUDGMENT, AND DECREE

IN THE DISTRICT COURT

IN AND FOR THE COUNTY OF GRAND

STATE OF COLORADO

Civil Action No 1768

IN THE MATTER OF THE SUPPLEMENTAL ADJUDICATION OF PRIORITIES OF RIGHT TO THE USE OF WATER IN WATER DISTRICT NO 51, STATE OF COLORADO

INTERLOCUTORY DECREE

On April 8, 1974, a Partial Master-Referee Report Regarding the Claims of the Municipal Subdistrict, Northern Colorado Water Conservancy District, In And To The Various Component Structures Of The Windy Gap Water System was issued by Michael D White Master-Referee A proposed decree granting conditional water rights for the various component structures of the Windy Gap Water System is contained in the report Various objections to the Partial Master-Referee Report were filed by the Colorado River Water Conservation District ("River District") On February 23, 1978, a Memorandum Opinion and Interlocutory Decree was entered by George E Lohr Water Judge, granting conditional water rights for the various component structures of the Windy Gap Water System

The River District appealed the Memorandum Opinion and Interlocutory Decree entered by Judge Lohr to the Colorado Supreme Court On September 17, 1979, the Colorado Supreme Court reversed the Memorandum Opinion and Interlocutory Decree Subsequently, the Municipal Subdistrict, Northern Colorado Water Conservancy District ("Municipal Subdistrict"), the River District and other parties entered into negotiations and eventually executed an agreement entitled "Agreement Concerning the Windy Gap Project and the Azure Reservoir and Power Project " dated April 30 1980 regarding the construction of the Windy Gap water system and other matters which has been filed with this Court as a Stipulation in this and two

related cases ("Stipulation") On May 16 1980, the Colorado Supreme Court entered an Order remanding this case to the Water Judge, Water Division No 5, with directions to proceed in accordance with the Opinion of the Supreme Court dated September 17 1979, provided however that if the conditions set out in subparagraphs (a) and (b) of paragraph 41 of the Stipulation are met, the Water Judge shall enter the decrees requested in the Municipal Subdistrict's applications as a consent decree which shall include as part thereof the agreement of April 30 1980 (the Stipulation) as a stipulation of the parties

A hearing was held by the Court commencing at 10 00 a m on October 27 1980 to consider entry of a decree granting the applications for conditional water rights filed by the Municipal Subdistrict regarding the Windy Gap Water System whether compliance with the terms of the Stipulation satisfies and constitutes compliance by the Municipal Subdistrict of its obligations under C R S 1973 § 37-45-118(1)(b)(IV) and whether the conditions set out in subparagraphs (a) and (b) of Paragraph 41 of the Stipulation have been met Notice of said hearing was given in the resume published by the Water Clerk in July 1980 of applications filed in June, 1980 The River District has been represented throughout these proceedings and at said hearing by Kenneth Balcomb, Esq and others The Municipal Subdistrict has been represented throughout these proceedings and at said hearing by Davis Graham & Stubbs by John M Sayre Esq and others Based upon the evidence presented at said hearing and the transcripts and documents contained in the record of this case the Court issues the following Interlocutory Decree

FINDINGS AND CONCLUSIONS BY THE COURT ORDERS AND DECREE

IT IS FOUND AND CONCLUDED THAT

1 The findings of fact and conclusions of law and draft interlocutory decree contained in the Partial

Master-Referee Report are fully supported by the evidence and are in accordance with law, except as they relate to compliance by the Municipal Subdistrict with C R S 1973 §37-45-118(1)(b)(IV)

2 The conditions set out in subparagraphs (a) and (b) of paragraph 41 of the Stipulation have been met

3 Compliance by the Municipal Subdistrict with the terms and conditions contained in the Stipulation will constitute full and complete satisfaction by the Municipal Subdistrict of all requirements of C R S 1973 §37-45-118(1)(b)(IV)

IT IS ORDERED, ADJUDGED AND DECREED that the findings of fact and conclusions of law contained in the Partial Master-Referee Report dated April 8, 1974, are approved and confirmed except as they relate to compliance by the Municipal Subdistrict with C R S 1973 §37-45-118(1)(b)(IV)

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that the Stipulation is hereby approved and in full force and effect and binding upon the parties as provided in said Stipulation

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that the Interlocutory Decree heretofore issued in this proceeding is supplemented and amended by the addition of structures described as follows

Priority No _____

CLAIMANT	Municipal Subdistrict, Northern Colorado Conservancy District
NAME OF STRUCTURE	Jasper Pump and Pipeline, a part of the Windy Gap Water System
NATURE OF DECREE	Conditional
SOURCE	Willow Creek, a tributary to the Colorado River through Jasper Reservoir
POINT OF DIVERSION	At a point on the north bank of Willow Creek whence the southeast corner of Section 16, T 2 N , R 76 W of the 6th P M bears south 62°30' east a distance of 2,730 feet

PURPOSE	Municipal irrigation, industrial and recreational
DATE OF APPROPRIATION	June 22, 1967
AMOUNT	300 c f s

Priority No _____

CLAIMANT	Municipal Subdistrict Northern Colorado Water Conservancy District
NAME OF STRUCTURE	Windy Gap Pump Pipeline and Canal a part of the Windy Gap Water System
NATURE OF DECREE	Conditional
SOURCE	Colorado River through the Windy Gap Reservoir
POINT OF DIVERSION	A point on the north bank of the Colorado River whence the northwest corner of Section 25 T 2 N R 77 W of the 6th P M bears north 17°30' west a distance of 2,380 feet
PURPOSE	Municipal irrigation industrial and recreational
DATE OF APPROPRIATION	June 22, 1967
AMOUNT	300 c f s

Priority No _____

CLAIMANT	Municipal Subdistrict, Northern Colorado Water Conservancy District
NAME OF STRUCTURE	Windy Gap Reservoir, a part of the Windy Gap Water System
NATURE OF DECREE	Conditional
SOURCE	Colorado River
DESCRIPTION	An onstream reservoir located in Sections 25 and 26 T 2 N R 77 W of the 6th P M.
APPROXIMATE POINT OF DIVERSION	The northwest corner of the proposed dam is located at a point which bears S 52°00' W 1660 feet from the N E corner of Section 26, T 2 N R 77 W of the 6th P M

PURPOSE	Municipal irrigation industrial and recreational
DATE OF APPROPRIATION	June 22 1967
AMOUNT	1,546 14 acre-feet

Priority No _____

CLAIMANT	Municipal Subdistrict, Northern Colorado Water Conservancy District
NAME OF STRUCTURE	Jasper Reservoir, a part of the Windy Gap Water System
TYPE OF DECREE	Conditional
SOURCE	Colorado River and Willow Creek a tributary of the Colorado River
LOCATION	An onstream reservoir located in Sections 8, 16, 17 and 21, T 2 N , R 76 W of the 6th P M
INITIAL POINT OF SURVEY	The southwest corner of the proposed dam is located at a point which bears S 55°30' E 1800 feet, from the N W corner of Section 21, T 2 N , R 76 W of the 6th P M
PURPOSE	Municipal irrigation, industrial and recreational
DATE OF APPROPRIATION	June 22, 1967
AMOUNT	11,292 58 acre-feet

IT IS FURTHER ORDERED that an application for a quadrennial finding of reasonable diligence shall be filed in May of 1984 and in May of every fourth calendar year thereafter so long as the Municipal Subdistrict desires to maintain these conditional water rights or until a determination has been made that these conditional water rights have become absolute water rights by reason of the completion of the appropriations

IT IS FURTHER ORDERED that the Stipulation filed by the parties herein is hereby incorporated into this Interlocutory Decree by this reference and shall constitute an integral part of this Interlocutory Decree which may be

enforced by the parties as provided in said Stipulation

IT IS FURTHER ORDERED that the Memorandum Opinion and Interlocutory Decree entered herein on February 23, 1978, by Judge Lohr is vacated

IT IS FURTHER ORDERED that a copy of this Interlocutory Decree be filed with the Division Engineer and the State Engineer

DONE this 27th day of October, 1980

BY THE COURT

Water Judge, Water Division No 5

-6-

IN THE DISTRICT COURT IN AND FOR

WATER DIVISION NO 5

STATE OF COLORADO

Case No W-4001

IN THE MATTER OF THE APPLICATION FOR WATER RIGHTS OF THE MUNICIPAL SUBDISTRICT, NORTHERN COLORADO WATER CONSERVANCY DISTRICT IN THE COLORADO RIVER IN GRAND COUNTY	))))))	FINDINGS OF FACT CONCLUSIONS OF LAW JUDGMENT AND DECREE

THIS MATTER came on for consideration and hearing before the Court at 10 00 a m on October 27, 1980 The Court, being fully advised in the premises hereby finds concludes and decrees as follows

1 An Application for Water Rights (Surface) for the Windy Gap Pump, Pipeline and Canal, First Enlargement, a part of the Windy Gap Water System, was filed by the Municipal Subdistrict Northern Colorado Water Conservancy District ("Municipal Subdistrict") on December 29, 1978

2 Timely and adequate notice of the filing of the Application has been given in the manner required by law

3 Timely Statements of Opposition were filed by the Winter Park Water and Sanitation District, the Ritschard Cattle Company, Inc , the Middle Park Water Conservancy District, Jacques Ranch I and Jacques Ranch II, Illinois limited partnerships, Town of Hot Sulphur Springs, Colorado, Board of County Commissioners of Grand County, Town of Granby, Colorado a municipal corporation Richard P Doucette and Colorado River Water Conservation District

4 Entries of Appearance were filed by Standish Broome and the Northwest Colorado Council of Governments

5 The period for filing Statements of Opposition expired on the last day of February, 1979

6 This matter was re-referred to the Water Judge by the Water Referee on March 30 1979

7 All parties hereto have executed a document entitled "Agreement Concerning the Windy Gap Project and the Azure Reservoir and Power Project" dated April 30 1980 which has been filed with the Court as a stipulation in this and two related cases ("Stipulation")

8 The conditions set out in subparagraphs (a) and (b) of paragraph 41 of the Stipulation have been met

9 Compliance by the Municipal Subdistrict with the terms and conditions contained in the Stipulation will constitute full and complete satisfaction by the Municipal Subdistrict of all requirements of C R S 1973 § 37-45-118(1)(b)(IV)

10 The application should be approved

IT IS ORDERED ADJUDGED AND DECREED that the Stipulation is hereby approved and in full force and effect and binding upon all parties appearing in this proceeding

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that the Municipal Substrict is entitled to a conditional decree for the Windy Gap Pump Pipeline and Canal, First Enlargement, a part of the Windy Gap Water System as follows

A The name of the claimant is the Municipal Subdistrict, Northern Colorado Water Conservancy District

B The source of the water is the Colorado River mainstream in Grand County

C The point of diversion is located at a point on the north bank of the Colorado River whence the northwest corner of Section 25 Township 2 North Range 77 West of the 6th P M bears north 17°30' West a distance of 2 380 feet Said Pumping Plant shall discharge into the Windy Gap Pipeline which shall discharge into the Windy Gap Canal

D The date of appropriation is July 9 1976

E The amount of water is 100 cubic feet per second of time conditional

F The water shall be used for municipal, irrigation, industrial and recreational purposes

IT IS FURTHER ORDERED that an application for a quadrennial finding of reasonable diligence shall be filed in ___11___ or 1984 and in ___11___ of every fourth calendar year thereafter so long as the Municipal Subdistrict desires to maintain this conditional water right or until a determination has been made that this conditional water right has become an absolute water right by reason of the completion of the appropriation

IT IS FURTHER ORDERED that the Stipulation filed by the parties herein is hereby incorporated into this Decree by this reference and shall constitute an integral part of this Decree which may be enforced by the parties as provided in said Stipulation

IT IS FURTHER ORDERED that the priority herein awarded shall be junior to all priorities of water rights from the same source awarded on applications filed prior to 1978 As between all water rights awarded on applications filed during 1978, priorities shall be determined by historical dates of appropriation and not affected by the date of entry of the decree

IT IS FURTHER ORDERED that a copy of this Decree shall be filed with the Division Engineer and the State Engineer

Done this 27th day of October, 1980

BY THE COURT

Water Judge, Water Division No 5

IN THE DISTRICT COURT IN AND FOR

WATER DIVISION NO 5

STATE OF COLORADO

Case No 80CW108

IN THE MATTER OF THE APPLICATION FOR WATER RIGHTS OF THE MUNICIPAL SUBDISTRICT, NORTHERN COLORADO WATER CONSERVANCY DISTRICT IN THE COLORADO RIVER IN GRAND COUNTY	)	FINDINGS OF FACT, CONCLUSIONS OF LAW JUDGMENT AND DECREE

THIS MATTER came on for consideration and hearing before the Court at 10 00 a m on October 27, 1980 The Court, being fully advised in the premises hereby finds concludes and decrees as follows

1 An Application for Water Rights (Surface) for the Windy Gap Pump, Pipeline and Canal, Second Enlargement, a part of the Windy Gap Water System, was filed by the Municipal Subdistrict, Northern Colorado Water Conservancy District ("Municipal Subdistrict") on May 7, 1980

2 Timely and adequate notice of the filing of the Application has been given in the manner required by law

3 No Statements of Opposition to the Application have been filed However, Entries of Appearance have been filed by the Colorado River Water Conservation District, Richard P Doucette, the Town of Hot Sulphur Springs, Colorado, and the Middle Park Water Conservancy District

4 The period for filing Statements of Opposition expired on the last day of July 1980

5 This matter was re-referred to the Water Judge by the Water Referee on October 1 1980

6 All parties hereto have executed a document entitled "Agreement Concerning the Windy Gap Project and the Azure Reservoir and Power Project " dated April 30 1980 which has been filed with the Court as a stipulation in this and two related cases ("Stipulation")

7 The conditions set out in subparagraphs (a) and (b) of paragraph 4 of the Stipulation have been met

8 Compliance by the Municipal Subdistrict with the terms and conditions contained in the Stipulation will constitute full and complete satisfaction by the Municipal Subdistrict of all requirements of C R S 1973 § 37-45-118(1)(b)(IV)

9 The Application should be approved

IT IS ORDERED ADJUDGED AND DECREED that the Stipulation is hereby approved and in full force and effect and binding upon all parties appearing in this proceeding

IT IS FURTHER ORDERED ADJUDGED AND DECREED that the Municipal Substrict is entitled to a conditional decree for the Windy Gap Pump Pipeline and Canal Second Enlargement a part of the Windy Gap Water System, as follows

A The name of the claimant is the Municipal Subdistrict, Northern Colorado Water Conservancy District

B The source of the water is the Colorado River mainstream in Grand County

C The point of diversion is located at a point on the north bank of the Colorado River whence the northwest corner of Section 25, Township 2 North, Range 77 West of the 6th P M bears north 17°30' West a distance of 2,380 feet Said Pumping Plant shall discharge into the Windy Gap Pipeline which shall discharge into the Windy Gap Canal

D The date of appropriation is April 30, 1980

E The amount of water is 200 cubic feet per second of time conditional

F The water shall be used for municipal irrigation industrial and recreational purposes

IT IS FURTHER ORDERED that an application for a quadrennial finding of reasonable diligence shall be filed in April of 1984 and in April of every fourth calendar year thereafter so long as the Municipal Subdistrict desires

to maintain this conditional water right until a determination has been and that this conditional water right has become an absolute water right by reason of the completion of the appropriation

IT IS FURTHER ORDERED that the Stipulation filed by the parties herein is hereby incorporated into this Decree by this reference and shall constitute an integral part of this Decree which may be enforced by the parties as provided in said Stipulation

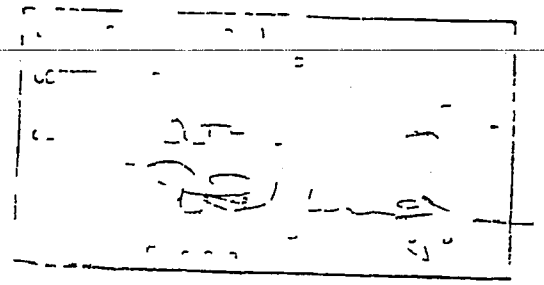
IT IS FURTHER ORDERED that the priority herein awarded shall be junior to all priorities of water rights from the same source awarded on applications filed prior to 1978 As between all water rights awarded on applications filed during 1978, priorities shall be determined by historical dates of appropriation and not affected by the date of entry of the decree

IT IS FURTHER ORDERED that a copy of this Decree shall be filed with the Division Engineer and the State Engineer

Done this 27th day of October, 1980

BY THE COURT

Water Judge, Water Division No 5



ATTACHMENT 2

A AGREEMENT BETWEEN SUBDISTRICT AND DIVISION OF WILDLIFE CONCERNING MINIMUM STREAM FLOWS

B BIOLOGICAL OPINION FOR WINDY GAP PROJECT

C BIOLOGICAL OPINION FOR COLORADO-BIG THPMPSON PROJECT, COLORADO

D RESOLUTION OF SUBDISTRICT REGARDING THREATENED AND ENDANGERED FISH IN THE COLORADO RIVER

A. AGREEMENT BETWEEN SUBDISTRICT AND DIVISION OF WILDLIFE CONCERNING MINIMUM STREAM FLOWS

MEMORANDUM OF UNDERSTANDING BETWEEN MUNICIPAL SUBDISTRICT, NORTHERN COLORADO WATER CONSERVANCY DISTRICT AND DIVISION OF WILDLIFE, COLORADO DEPARTMENT NATURAL RESOURCES, RELATING TO MINIMUM STREAM FLOW IN ASSOCIATION WITH THE WINDY GAP DIVERSION PROJECT

The Municipal Subdistrict, Northern Colorado Water Conservancy District, and the Division of Wildlife, Colorado Department Natural Resources, in the matter of a minimum stream flow from the Windy Gap Diversion site to the mouth of the Blue River, agree as follows

(1) The Subdistrict and the Division of Wildlife agree to fixed rates of flow as follows

A From Windy Gap Diversion Point to the mouth of the Williams Fork River 90 cfs

B From the mouth of Williams Fork River to the mouth of the Troublesome Creek 135 cfs

C From the mouth of the Troublesome Creek to the mouth of the Blue River 150 cfs

(2) Once in every three years, if equivalent flushing flows do not otherwise occur past the Windy Gap Diveision Point, Subdistrict shall release on call by the Colorado Water Conservation Board, on the recommendation of the Division of Wildlife, a total of 450 CFS of water for fifty hours, or its equivalent, during the period of April 1 through June 30, for flushing flow purposes

Such call cannot be made sooner than each third consecutive calendar year figured from the year of the initial diversion of the Windy Gap facility, except upon mutual agreement of the Subdistrict and the Division of Wildlife Each subsequent call shall be figured from the calendar year of the immediately preceding flushing flow, which has either occurred naturally or as a result of a call, as set forth above The Subdistrict and Division shall agree upon a mutually acceptable pattern for each such release

(3) It is understood that the Subdistrict cannot be required to bypass amounts of water in excess of the natural inflow to the Windy Gap Diversion Point

Dated this 23 day of June, 1980

E. F. Phipps

Earl Phipps, Manager
Municipal Subdistrict,
Northern Colorado Water
Conservancy District

Jack R. Grieb

Jack R Grieb, Director
Colorado Division of Wildlife

B. BIOLOGICAL OPINION FOR WINDY GAP PROJECT, COLORADO

United States Department of the Interior
FISH AND WILDLIFE SERVICE

MAILING ADDRESS
Post Office Box 25486
Denver Federal Center
Denver Colorado 80225

STREET LOCATION
134 Union Blvd
Lakewood Colorado 80228

IN REPLY REFER TO
FA/SE/WPRS--Windy
Gap Proj (6-5-81-F-107)

MAR 13 1981

MEMORANDUM

To: Regional Director, Lower Missouri Region
Water and Power Resources Service, Denver, Colorado

From: Regional Director, Region 6
U S Fish and Wildlife Service, Denver, Colorado

Subject: Biological Opinion for Windy Gap Project, Colorado

In response to your November 4, 1980, request for formal consultation on the Windy Gap Project, this biological opinion has been prepared as prescribed in the Section 7 Interagency Cooperation Regulations, 50 C F R 402, and the Endangered Species Act, 16 U S C et seq As mutually agreed to at a meeting on February 20, 1981, the date for the completion of this consultation has been extended to March 6, 1981 A separate biological opinion on the continued operation of the Colorado-Big Thompson Project, dated January 2, 1981, has already been issued

BIOLOGICAL OPINION

Operation of the Windy Gap Project as described below, which includes conservation measures designed to aid in the recovery of the endangered Colorado River fishes, is not likely to jeopardize the continued existence of the bald eagle (Haliaeetus leucocephalus), whooping crane (Grus americana), peregrine falcon (Falco peregrinus), Colorado squawfish (Ptychocheilus lucius), or the humpback chub (Gila cypha) While the bonytail chub (Gila elegans) historically occurred in the Upper Colorado River between Grand Junction, Colorado, and the mouth of the Green River in Utah, no individuals of this species have been found in this area in recent studies Therefore, for the purposes of this biological opinion, it is determined that the Windy Gap Project is likely to have no impact on the bonytail chub

PROJECT DESCRIPTION

The Windy Gap Project will use certain features of the Colorado-Big Thompson Project (CBT) The existing CBT is located in Grand, Summit, Weld, Boulder, and Larimer Counties, in north central Colorado CBT

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water is diverted from the Colorado River and its tributary Willow Creek in Grand County and transported via a transbasin tunnel to the Big Thompson River in Larimer County In the Colorado River watershed, the project includes Granby and Willow Creek Reservoirs, Shadow Mountain Lake and Grand Lake, and the Alva B Adams Diversion Tunnel which transports water to the eastern slope Storage capacity of Willow Creek Reservoir is 10,550 acre-feet while Granby Reservoir is 542,500 acre-feet Shadow Mountain Lake and Grand Lake have little storage capacity and serve essentially as a means to move water to the entrance of the diversion tunnel

Another part of the CBT project on the west slope is Green Mountain Reservoir on the Blue River in Summit County This reservoir is used to replace water which is diverted from the Colorado River as well as for power generation This reservoir has an active capacity of 152,000 acre-feet, 52,000 of which is for replacement purposes and 100,000 for peaking power production

The Colorado Big-Thompson Project provides supplemental irrigation water to some 720,000 acres of land In addition to irrigation uses, the 230,000 acre-feet of water diverted to the east slope annually is used for municipal and industrial purposes and power production

The proposed Windy Gap Project to be constructed and operated by the Muncipal Subdistrict, Northern Colorado Water Conservancy District (MS, NCWCD), would consist of a diversion dam, a pumping plant, and a pipeline The diversion dam would be located on the Colorado River approximately 1 mile downstream of its confluence with the Fraser River in Grand County, Colorado During periods of high flows, water would be pumped by the pumping plant from a small reservoir behind the diversion dam through the pipeline to Lake Granby From Lake Granby, the water would pass through the existing CBT Project System to the east slope cities located in Boulder, Larimer, and Weld Counties

The diversion dam would only provide storage for short-term variations in river flows With no inflow, the pumping plant would be able to empty the diversion dam reservoir live-storage capacity in about 10 hours of pumping at maximum capacity Thus, diversion dam storage would allow flexibility in pumping plant operation when there are significant daily fluctuations in river flow, however, insufficient capacity would be available for long-term storage The only storage facility to be utilized for Windy Gap water during the period between which it is diverted and delivered will be Lake Granby

Windy Gap will divert an average of 57,300 acre-feet and a maximum of 93,000 acre-feet in any one year Diversion rates will be up to 600 cfs and will be primarily in May, June, and July, but may also occur in other months (usually April and August) In addition to the maximum

diversion rates and total maximum annual diversion, factors limiting the timing and amount of withdrawal are 1) existing senior rights on the river, 2) minimum stream flow bypass agreement with the Colorado Division of Wildlife as decreed to the Colorado Water Conservation Board, 3) the amount of storage capacity available in the Colorado Big-Thompson system during times of no, or less than maximum, pumping of the CBT system, and 4) periods when Windy Gap could legally pump but the amount of water above minimum bypass is too small to be economical

BASIS FOR OPINION

Colorado squawfish, humpback chub, and bonytail chub were once abundant throughout the Colorado River System from the Gulf of California to southwestern Wyoming Presently, the squawfish is limited to the upper mainstem and major tributaries of the Colorado River system The humpback chub and the bonytail chub are found only in limited areas within the river system in Colorado, Utah, and Arizona The primary cause of decline for these fish species is human alteration and degradation of the river environment Major impoundments and water diversions have depleted water supplies and altered the temperatures, turbidity, salinity, and flows of the stream, thus reducing habitat for endemic fishes

It appears that there are three major interacting factors that explain the present status of the endemic species of the Colorado River Basin These are 1) reservoirs, 2) diversions from the Basin for land and water use, and 3) environmental changes in the river brought about by 1) and 2)

The most obvious and clearly identifiable factor contributing to the decline of native species is the large dams and reservoirs that converted hundreds of miles of river habitat into great impoundments Prior to the listing of the endangered fishes, the preservation of these fishes was not considered in the planning and operation of these projects It has been determined that Colorado squawfish, humpback chub, and bonytail chub do not reproduce successfully in large reservoirs The alterations resulting from the large dams changed a river of great extremes of flow, temperature, and turbidity into a series of reservoirs discharging cold, clear water at a relatively constant temperature Since the native fishes' life stage requirements are based on the natural river conditions, they could not adapt to the changed conditions, and populations rapidly declined The adults present in the river when a dam is constructed may continue to live in a reservoir and may thrive and grow, but the populations consist of fewer, larger and older fish each successive year until they all die of old age

Water diversions from the Colorado River Basin have drastically altered flow patterns, water quality perimeters, and river channel characteristics, and eliminated the quiet backwater nursery areas to a point that much essential habitat is no longer present There is general agreement

among Federal and State biologists studying endangered fishes of the Upper Colorado that higher than normal summer flows are beneficial to squawfish and humpback chub reproduction Lower than average flows could also result in decreased reproduction due to loss of quiet backwater areas used as nurseries by these species

These gradual, cumulative impacts on habitat are much less dramatic and not as obvious as the more sudden changes created by a large dam and reservoir, but the end result is similar in relation to the habitat needed for the continued existence of the endemic species

A less important cause of decline may be the increased number of exotic fishes, but this increase in exotics also is a function of habitat changes Although correlations exist between declining native fish populations and increasing populations of exotic fish, cause and effect are not fully understood The evidence of harmful effects of non-native species on the squawfish is largely circumstantial This is one aspect that will be addressed by the Colorado River Fishes Study referenced below However, there is no doubt that fewer exotic fishes would be present if the river more closely resembled its natural state

Although we do not know all the specific requirements and distribution of the Colorado squawfish, humpback chub, and bonytail chub, we are rapidly gathering additional information on these three species, as well as the razorback sucker which is still considered in a precarious state but is not under Federal protection Knowledge of these fishes has been limited partly because they have been of little interest to society until recent years Also, these fishes are difficult to capture or observe because the waters they inhabit are usually swift and turbid, and access is limited in many of the canyon reaches

To increase knowledge of the fishes' habitat requirements, a Colorado River Fishes Investigation Team was established in April 1979 This team is staffed with Fish and Wildlife Service (FWS) personnel and has funding from the FWS, Water and Power Resources Service (WPRS), and the Bureau of Land Management (BLM) Other participants are the Utah Division of Wildlife Resources and the Colorado Division of Wildlife Major objectives of the team's study are to learn additional life history requirements of the listed fishes Under our funding agreement with WPRS and BLM, most of the field work is in the Green and Colorado Rivers where impacts from WPRS and BLM projects will be the greatest Information obtained during the study via field, laboratory, and hatchery work will make it possible to provide recommendations to maintain and develop more favorable habitat for the listed fishes Results of the study will be available for use in 1982

Reports show that the squawfish and humpback chub have been declining throughout the Colorado River drainage However, recent FWS surveys have identified populations of squawfish and humpback chubs in the Black Rocks area of Ruby Canyon and in the Westwater Canyon along the main

Colorado River Additionally, the Walter Walker Wildlife Area, just downstream from Grand Junction, Colorado, has historically supported squawfish Several investigators have readily captured squawfish in this area in recent years Until recently, occurrence of endangered fishes above the Highline Diversion was questionable because the diversion was considered to be an effective fish barrier and has been in place since 1909 Also, several collection efforts had failed to capture endangered fish in this area However, during the summer of 1980, the FWS captured 14 adult humpback chubs in DeBeque Canyon a few miles above this diversion The extent and exact distribution of this population are unknown but its existence adds significance to this river section Protection of the population strongholds throughout this entire area of concern is essential for the maintenance and recovery of these endangered fishes

The continued existence of the Colorado squawfish, humpback chub, and the bonytail chub will require cooperation and communication between diverse interest groups Every effort will be made to avoid delaying water development projects because of the need to conserve the endangered fish species However, there may be some delay, compromises, and modifications in projects to maintain certain environmental conditions

To fully understand the basis for this, as well as any other biological opinion on the Colorado fishes, it is necessary to understand the phrase "jeopardize the continued existence of " This is defined as an "activity or program which reasonably would be expected to reduce the reproduction, numbers, or distribution of a listed species to such an extent as to appreciably reduce the likelihood of the survival and recovery of that species in the wild " 50 C F R 402 02 (Emphasis added)

Using the above definition of "jeopardy," the project was evaluated in two ways (1) Would the project appreciably reduce the likelihood of survival of the species? (2) Would the project appreciably reduce the likelihood of recovery of the species?

To answer the first question, "would the project appreciably reduce the likelihood of survival of the species?", it was necessary to evaluate the physical changes occurring in endangered fishes' habitat due to the project water diversions Four critical areas on the main stem of the Colorado River were selected for analysis, namely, the DeBeque and Loma areas upstream of Grand Junction, the Black Rocks area between Grand Junction and the Colorado-Utah state line and the Potash area near Moab, Utah These sites were selected because they represent two areas used by Colorado squawfish and two areas used by humpback chubs (The effect on the bonytail chub was not evaluated because it has not been found within the project's area of influence)

FWS biologist's recommendations were that ideally stage (water surface elevation) changes in the four identified areas should be investigated The velocity changes were expected to be so small as to be of little consequence

Physical data (cross-sectional information, stage-discharge relationships, etc) for two of the areas, DeBeque and Loma, were inadequate for this type of analysis Two hydrologic instream flow studies are underway in the other two areas, Black Rocks and Potash, however These studies are being supervised by the FWS Instream Flow Group in Fort Collins Accurate stage-discharge relationships and cross-sectional data for those two areas were available from the studies Since the Colorado River hydrologic system is extremely complex, and the Windy Gap Diversion is approximately 150 miles upstream of the nearest area of concern, the MS, NCWCD, consultant engineer suggested that a simplified flow analysis be used The method chosen was to theoretically transfer the water use of Windy Gap directly downstream to the two areas analyzed This is conservative and represents a "worsecase situation "

Computer analyses were conducted on the two areas, Black Rocks and Potash, using preproject and postproject flow conditions and the assumptions mentioned above Three varying hydrologic conditions were investigated to simulate conditions in wet, dry, and average years

Results of the studies show maximum stage changes of 5 to 6 inches during the month of April in the wet year, primarily due to the project diverting water prior to spring runoff in the Colorado River Due to the fact that spawning for the squawfish and the humpback chub takes place between May and July, reduced flows in April apparently have little impact on the life cycle of the endangered fishes, so this would pose no problem

Maximum stage changes during all other months and years are on the order of 2 to 3 inches Minimum stage changes are usually 1 inch or less The studies revealed that stage changes from day-to-day flow variations presently occurring in the basin often exceed the magnitude of changes associated with the project

In addition, the hydrologic impacts of the project are also smaller than the errors associated with stream gauging and river cross-section measurements

In short, it is reasonably expected that the impacts of the project on the likelihood of survival of the fish are extremely small Therefore, a decision was reached that the Windy Gap Project is not reasonably expected to appreciably reduce the likelihood of <u>survival</u> of the endangered fishes of concern

To answer the second part of the definition of jeopardy- "would the project appreciably reduce the likelihood of recovery of the species?"- it is necessary to look at historic flows of the Colorado River and how these flows have changed with development in the basin

Predevelopment flows in the Colorado River at Cisco, Utah, were determined to be 6 7 million acre-feet per year, based on flow records from 1906 to 1940 (The first major project in the Upper Basin was Green Mountain Reservoir, built in 1942) Current flows (1960-1978) are 4 4 million acre-feet per year, and represent approximately a one-third depletion The Windy Gap Project would increase this depletion by about 2 5 percent Conclusions drawn from biological studies of the endangered fishes show a close relationship between the precarious situation of the fish and decreasing flows in the basin We do not fully understand or know all the requirements of the fishes We do know that decreased flows in turn decrease spawning and quiet backwater areas necessary for survival The timing and magnitude of instantaneous flows are very important but are not yet fully understood

Flows in the Colorado River near Cameo, Colorado, (about 15 miles upstream of Grand Junction) are shown in the table below Average monthly flows, both theoretically with and historically without the project, are shown for a wet year (1962), and a dry year (1977) Average flows for a 20-year period (1958-1977) are also shown

	Wet Year (1962)		Average (1958-1977)		Dry Year (1977)	
Location	Preproject	Post Project	Preproject	Post Project	Preproject	Post Project
Colorado River near Cameo, Colorado			(1,000 acre-feet)			
October	200 2	200 2	139 6	139 6	138 4	138 4
March	160 5	160 5	115 2	115 2	80 0	80 0
April	512 6	491 6	177 5	175 8	109 5	109 5
May	892 6	855 7	486 1	460 4	156 0	156 0
June	882 4	847 0	620 6	595 8	176 1	175 6
July	544 9	544 9	303 8	300 2	112 4	112 4
August	185 6	185 6	157 2	157 2	108 3	108 3
September	120 9	120 9	132 0	132 0	103 2	103 2

During a wet year such as 1962, river flows would be reduced by the project 21,000 acre-feet, 36,900 acre-feet, and 35,400 acre-feet during the months of April, May, and June, respectively During the 20-year period analyzed (1958-1977), average flows would have been reduced 1,700 acre-feet in April, 5,700 acre-feet in May, 24,800 acre-feet in June, and 3,600 acre-feet in July Data in the table indicates that during a dry year, such as 1977, the project would reduce the flow of the Colorado River at Cameo about 500 acre-feet during the month of June

Since the status of the fish can be related to decreased flows in the basin, additional water use is likely to make recovery of the species more difficult This is particularly true when one recognizes that reservoir storage in the basin may be necessary to guarantee the proper timing of instantaneous discharges for future management purposes Windy Gap diversions will affect the availability of water for storage of such projects For these reasons, it has been concluded that the Windy Gap Project, without the proposed conservation measures, had been reasonably expected to appreciably reduce the likelihood of the recovery of the endangered fish species

Conservation and Recovery Measures

The following conservation and recovery measures have been approved by the Municipal Subdistrict to be carried out in accordance with the National Environmental Policy Act, the Fish and Wildlife Coordination Act, and the Endangered Species Act

In a Memorandum of Understanding with the Colorado Division of Wildlife dated June 23, 1980, the Municipal Subdistrict, Northern Colorado Water Conservancy District, agreed to bypass minimum stream flows from the Windy Gap Diversion Dam for the conservation of downstream aquatic habitat, as decreed to the Colorado Water Conservation Board pursuant to paragraph 24 of the Windy Gap settlement agreement dated April 30, 1980 These bypasses, which otherwise could have been diverted at different times and at different rates, amount to an average of approximately 11,000 acre-feet annually While these bypasses are primarily to protect the trout habitat extending from Windy Gap Diversion Dam to the mouth of the Blue River, the flows will also help to reduce the project impacts on the downstream endangered fishes

In a resolution dated March 3, 1981, the Board of Directors for the Municipal Subdistrict, Northern Colorado Water Conservancy District, informed WPRS that it would fund certain measures for the conservation of the endangered fish Project plans have been modified accordingly to include a mechanism to implement conservation measures which we believe will adequately reduce the impact of the Windy Gap Project on the endangered fishes These measures are briefly described below

(1) Fund the establishment of backwater habitat areas along the mainstem of the Colorado River between the upper end of DeBeque Canyon and the confluence of the Colorado River and the Green River

Habitat manipulation is an important part of an overall management recovery program for these fishes Attempts to create young squawfish rearing habitat have already been made in the river by gravel mining companies and others but, unfortunately, these areas have not been monitored to see how effective, if at all, they are for the endangered fishes The MS, NCWCD, will fund the creation of backwater habitat area(s) or modification of existing areas for experimental purposes Such action, in addition to the research discussed in (2) below will

yield valuable information on how future habitat areas should be designed These actions could include gravel placement for fish spawning, creation of still-water areas for rearing by excavation, or placement of large boulders, or manipulations that could alter velocities, depths, or substrate in the backwater areas

(2) Provide sufficient funds to support a field research team of three to four persons over a 3-year period to evaluate habitat improvement techniques for the endangered fish species and to continue collection of physical data needed to assess the impacts of water depletions, sedimentation, and water quality changes on the life cycles of fishes

Monitoring and continued research is definitely needed in the Basin A 3-year minimum effort is needed to yield significant results Intensive studies will examine backwater areas in the basin in an attempt to determine the value of these areas as nursery habitat for young squawfish Water velocities, depth, quality, and other parameters will be determined for backwater areas being used by squawfish Spawning habitat requirements for the endangered fishes will be studied in an attempt to learn the extent to which such habitats are a major limiting factor for recovery of the species

We will work with you and MS, NCWCD, to develop the details of the monitoring, research, and needed habitat improvement program

In addition, FWS also analyzed two other conservation measures that might be applied to offset the effects of the Windy Gap Project on the Colorado River endangered fishes These other prospective measures include flow releases or flow bypasses and a fish culture program

First, importance to the fish of certain flows cannot be overemphasized As previously mentioned, the MS, NCWCD, in an agreement with the Colorado Division of Wildlife, as decreed to the Colorado Water Conservation Board and in accordance with the Windy Gap Settlement Agreement of April 30, 1980, has agreed to bypass approximately 11,000 acre-feet per year more than originally planned This water is for trout habitat, but it also will benefit endangered fishes downriver The FWS has considered the bypassing of 11,000 acre-feet in arriving at the compensation needed

Second, fish culture should not be thought of as a recovery management program in itself because the Endangered Species Act sets forth the need to conserve natural ecosystems However, periodic stocking of fish in the Colorado River system could be a legitimate way to alleviate problems now encountered by the fishes We suspect that habitat problems associated with reproduction and early life stage have caused these fish to decline over the past few years If this proves to be the case, then a management program with fish culture and stocking may play a part in recovery and

delisting of these species At this point in time, we do not have adequate data to launch into such a propagation program and have not included fish culture measures as part of what is needed to offset the impacts of this project

Colorado Squawfish and Humpback Chub

Operation of the Windy Gap Project as presently proposed is not likely to jeopardize the existence of the Colorado squawfish or the humpback chub The conservation measures as proposed in the plan of operation are reasonably expected to adequately compensate for the adverse impacts which are likely to result from the operation of the Windy Gap Project The 11,000 acre-feet of water to be bypassed for maintenance of trout habitat will also reduce impacts to the downstream endangered fishes The habitat manipulation and the monitoring and research agreed to by the Board of Directors of the Municipal Subdistrict, Northern Colorado Water Conservancy District, will help determine the life requirements of the Colorado squawfish and the humpback chub These actions (habitat manipulation and monitoring and research) will contribute to the recovery of the Colorado squawfish and the humpback chub and adequately offset the Windy Gap Project's impact on the fishes

Peregrine Falcon

Operation of the Windy Gap Project is not likely to jeopardize the existence of the peregrine falcon The peregrine is found along the Colorado River and on the east slope project area at all times of the year The possibility exists that one or more eyries are located on the Colorado River between Grand Lake and the Gunnison River, however, the location of any specific nests is not known at this time Operation of the project will not cause a decrease in habitat which the peregrine is dependent upon for its future

Bald Eagle

Most bald eagle use in Colorado is by wintering birds Major concentrations are found along the Green, White, Yampa, Colorado, and South Platte Rivers A group estimated to peak at 40 to 50 birds is located along the Colorado River between DeBeque and Silt, Colorado This area also contains three nest sites at which eagles were observed in early 1980, but which produced no eggs Smaller numbers of bald eagles winter at Green Mountain, Shadow Mountain, and Granby Reservoirs, and Grand Lake Since essential habitat for bald eagles will not be impacted by the project, operation of the Windy Gap Project is not likely to jeopardize the existence of bald eagles

Whooping Crane

Whooping cranes are seldom found in the South Platte drainage in Colorado However, the Platte River and associated wet meadows along the river in

Nebraska are important nesting and feeding areas for migrating cranes The increased flows in the South Platte River, as a result of the Windy Gap Project, may help to maintain whooping crane habitat along the Platte River drainage

It should be recognized that this biological opinion covers the operation of the Windy Gap Project at an average annual diversion rate of 57,300 acre-feet and a maximum diversion of 93,000 acre-feet in any one year Should there be any change in the project as proposed which may affect any endangered or threatened species, the FWS should be contacted to determine if further consultation is required

The cooperation that you and the Subdistrict have extended to us is appreciated, and if we can be of any further assistance, please let us know

C. BIOLOGICAL OPINION FOR COLORADO-BIG THOMPSON PROJECT, COLORADO

United States Department of the Interior
FISH AND WILDLIFE SERVICE
AREA OFFICE COLORADO—UTAH
1311 FEDERAL BUILDING
125 SOUTH STATE STREET
SALT LAKE CITY UTAH 84138

IN REPLY REFER TO

2 JAN 1981

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Copy To 5-400	

MEMORANDUM

To Regional Director, Water and Power Resources Service
Lower Missouri Region, Denver, Colorado

From ACTING Area Manager, Fish and Wildlife Service,
Salt Lake City, Utah

Subject Biological Opinion for Colorado - Big Thompson Project, Colorado

In response to your November 9, 1980, request for formal consultation on the Colorado-Big Thompson Project, this biological opinion has been prepared as prescribed in the Section 7 Interagency Cooperation Regulations (50 CFR-402), published in the January 4, 1978, Federal Register and the Endangered Species Act, of 1973, 16 U S C 1531 et seq

BIOLOGICAL OPINION

The continued operation of the Colorado-Big Thompson Diversion Project is not likely to jeopardize the continued existence of the bald eagle (Haliaeetus leucocephalus), whooping crane (Grus americana), peregrine falcon (Falco peregrinus), Colorado squawfish (Ptychocheilus lucius), bonytail chub (Gila elegans), and humpback chub (Gila cypha)

When the Colorado River Fishes Study is complete, we may wish to meet with your agency and discuss modification of all WPRS projects operation for the preservation of endangered fish species

Project Description

The Colorado Big-Thompson Project (CBT) is located in Grand, Summit, and Larimer Counties in north central Colorado It diverts water from the Colorado River and its tributary Willow Creek in Grand County and sends it via a transbasin tunnel to the Big Thompson River in Larimer County In the Colorado River watershed, the project includes Granby and Willow Creek Reservoirs, Shadow Mountain Lake, and Grand Lake Water from Willow Creek Reservoir is pumped to Granby Reservoir Water in Granby Reservoir is pumped to Shadow Mountain Lake, flows through Grand Lake and then into the diversion tunnel to the eastern slope Storage capacity of Willow Creek Reservoir is 10,550 acre feet while Granby Reservoir is 542,500

acre feet Another part of the CBT project is the Green Mountain Reservoir on the Blue River in Summit County This reservoir is used to replace water which is diverted from the Colorado River as well as power generation This reservoir has a capacity of 152,000 acre feet, 52,000 of which is for replacement purposes, and 100,000 is for peaking power production This water is also available for replacement purposes The Colorado-Big Thompson Project provides supplemental water to some 720,000 acres of land

In addition to irrigation, the 260,000 acre feet of water diverted to the east slope annually, is used for municipal and industrial purposes and power production on the eastern slope

Basis for Opinion

Colorado Squawfish, Humpback Chub, and Bonytail Chub

These species were once abundant throughout the Colorado River System from the Gulf of California to southwestern Wyoming Presently, the squawfish is limited to the upper mainstem and major tributaries of the Colorado River System The humpback chub and the bonytail chub are found only in limited areas within the system in Colorado, Utah, and Arizona The primary cause of decline for these fish species is human alteration and degradation of the river environment Major impoundments and water diversions have depleted water supplies and altered temperature, turbidity, and stream flows, thus reducing habitat for endemic fishes

A less important cause of decline may be the increased number of exotic fishes, but this increase in exotics also is a function of habitat changes Although correlations exist between declining native fish populations and increasing populations of exotic fish, cause and effect are not fully understood However, we believe that fewer exotic fishes would be present if the river more closely resembled its natural state

Although we do not know all the specific requirements and distribution of the Colorado squawfish, humpback chub, and bonytail chub, we are rapidly gathering additional information on these three species, as well as the razorback sucker which is also considered in a precarious state but is not under Federal protection Knowledge of these fishes has been limited partly because they have been of little interest to society until recent years Also, these fishes are difficult to capture or observe because the waters they inhabit are usually swift and turbid, and access is limited in many of the canyon reaches

A Colorado River Fishes Investigation Team was established in April 1979 This team is staffed with Fish and Wildlife Service (FWS) personnel and has funding from the FWS, Water and Power Resources Service (WPRS), and the Bureau of Land Management (BLM) Other participants are the Utah Division of Wildlife Resources and the Colorado Division of Wildlife Major objectives of the study are to learn additional life history requirements

of the listed fishes Because WPRS and BLM are providing funds, most of the field work is in the Green and Colorado Rivers where the fishes reproduce and where impacts from WPRS and BLM projects will be the greatest Information obtained during the study via field, laboratory, and hatchery work will make it possible to provide specific recommendations to maintain and develop more favorable habitat for the listed fishes in the Green and Colorado Rivers

Reports show that the squawfish, borytail and humpback chub have been declining throughout the Colorado River drainage However, recent FWS surveys have identified populations of squawfish and humpback chubs in the Black Rocks area of Ruby Canyon and in the Westwater Canyon along the main Colorado River Additionally, the Walter Walker Wildlife Area, just downstream from Grand Junction, Colorado, has historically supported numerous squawfish Several investigators have readily captured squawfish in this area in recent years

Capture of endangered fishes in this area has been sporadic but with enough frequency to suggest use of available habitats by these fish Until recently, occurrence of endangered fishes above the Highline Diversion was questionable because the diversion may be a fish barrier and has been in place since 1909 Also, several collection efforts had failed to capture endangered fish in this area However, during the summer of 1980, the FWS captured 14 adult humpback chubs in Debeque Canyon a few miles above this diversion The extent and exact distribution of this population is unknown but its existence adds significance to this river section Protection of the population strongholds throughout this entire area of concern is essential for the maintenance and recovery of these endangered fishes

A continuation of the historical operation of the Colorado-Big Thompson Project will not jeopardize the continued existence of the Colorado squawfish, humpback chub or the bonytail chub The CBT project has been in existence since the early 1940's The first transbasin diversion took place in 1947. Since that time, there is evidence that the Colorado squawfish and the humpback chub have successfully reproduced in the Colorado River and appear to be maintaining their numbers, albeit much lower than what is needed to remove them from the endangered species list At the present time we have no evidence of bonytail chub reproduction in the Colorado River Without any increased diversions by the CBT project from the Colorado River Basin, there is no reason to assume that the continued historic operation of the project would result in a further decline of these species

Peregrine Falcon

Continued historic operation of the Colorado-Big Thompson Project will not jeopardize the existence of the peregrine falcon The peregrine is found along the Colorado River and on the east slope project areas at all times of the year The possibility exists that one or more eyries are located between Grand Lake and the Gunnison River, however, the location of any specific nests is not known at this time The continued historic operation

of the project will not cause a decrease in habitat which the peregrine is dependent upon for its existence

Bald Eagle

Most bald eagle use in Colorado is by wintering birds Major concentrations are found along the Green, White, Yampa, Colorado and South Platte Rivers A group estimated to peak at 40 to 50 birds is located along the Colorado River between Debeque and Silt, Colorado This area also contains three nest sites at which eagles were observed in early 1980, but which produced no eggs Lesser numbers of bald eagles winter at Green Mountain, Shadow Mountain, Granby Reservoir and Grand Lake Continued historic operation of the Colorado-Big Thompson Project will not jeopardize the existence of bald eagles Essential habitat will not be impacted by the continued operation of the project

Whooping Crane

Whooping cranes are seldom found in the South Platte drainage in Colorado However, the Platte River and associated wet meadows in Nebraska are important resting and feeding areas for migrating cranes The increased flows in the South Platte River as a result of the CBT project may have helped to maintain whooping crane critical habitat along the Platte River in Nebraska The continued operation of the Colorado-Big Thompson may help to maintain habitat for the whooping crane in Nebraska

It should be recognized that this biological opinion covers the continued historic operation of the Colorado-Big Thompson Project Should there be any change in project operation which may affect any endangered or threatened species, it will be necessary for you to consult with us again

William P. Stute

D. RESOLUTION OF SUBDISTRICT REGARDING THREATENED AND ENDANGERED FISH IN THE COLORADO RIVER

MS-94-3-81

RESOLUTION OF BOARD OF DIRECTORS

MUNICIPAL SUBDISTRICT

NORTHERN COLORADO WATER CONSERVANCY DISTRICT

Regarding Fish Conservation in the Colorado River
With Respect to the Windy Gap Project

The Board of Directors of the Municipal Subdistrict, having conferred in special session to consider a memorandum of the United States Fish and Wildlife Service dated February 26, 1981, (a copy of which is attached hereto), does hereby adopt the following resolution

1 Pursuant to the National Environmental Policy Act, the Fish and Wildlife Coordination Act, and the Endangered Species Act, the Municipal Subdistrict has been engaged in extensive discussions with the Water and Power Resources Service, the Fish and Wildlife Service, and the Colorado Division of Wildlife regarding the Windy Gap Project and its possible effect on fish life in the Colorado River These discussions grew out of comments which were made by various parties regarding the Draft Environmental Impact Statement in August of 1979 The Carriage Contract dated October 3, 1973, (a copy of which is attached hereto), between the Subdistrict and the United States recognizes that the procedures of the National Environmental Policy Act will be followed before Windy Gap water is introduced into the Colorado-Big Thompson facilities

2 On April 30, 1980, the Subdistrict entered into a settlement agreement with various governmental entities and individuals of Colorado's Western Slope, including Grand County, the Northwest Colorado Council of Governments, the Town of Granby, the Town of Hot Sulphur Springs, and the Colorado River Water Conservation District A central feature of that agreement (a copy of which is attached hereto) was the minimum stream flow provision contained in paragraph 24 of the Agreement, by which the Subdistrict has agreed to subordinate its water rights decrees to a minimum stream flow decree of the Colorado Water Conservation Board The flow rates set for purposes of paragraph 24 were fixed by a Memorandum of Understanding dated June 23, 1980, between the Subdistrict and the Colorado Division of Wildlife (a copy of which is attached hereto)

3 The Subdistrict has retained expert consultants for the purposes of studying Colorado River hydrology and fish, including those fish listed as endangered by the Secretary of Interior, and has concluded that the Windy Gap Project, operated pursuant to the Settlement Agreement of April 30, 1980, will not adversely affect or jeopardize any Colorado River fishes

4 For purposes of considering the possible effect of the Windy Gap Project on Colorado River fishes, the Fish and Wildlife Service should take into account the minimum stream flow provision of paragraph 24 The Subdistrict is pledged to preserve and defend the Colorado Water Conservation Board's instream right but will not be bound to make any other minimum flow or offsetting bypass with respect to the Project, other than as specified in said paragraph 24

5 Because of its association with the principal District and the District's long history of cooperation with the United States dating back to 1937 in the conception, construction, and operation of the Colorado-Big Thompson project, the Subdistrict recognizes a duty to cooperate with the United States, not only in the capture and conservation of water for beneficial consumptive uses but also fish conservation, so that water project development in the Upper Colorado Basin may proceed without the loss of fish species or valuable water rights To that end, the Subdistrict agrees to do the following to promote the intent of the National Environmental Policy Act, the Fish and Wildlife Coordination Act, and the Endangered Species Act, should the Project be allowed to proceed to construction and operation in accordance with the Carriage Contract, the Windy Gap Settlement Agreement, and the Subdistrict's water rights decrees (copies of which are attached hereto)

A Contract with the United States Fish and Wildlife Service to sponsor a habitat manipulation project, as identified on page 3 of the February 26, 1981, memorandum, provided that the Subdistrict's total obligation shall not exceed the payment of One Hundred Thousand Dollars ($100,000 00) to the United States Fish and Wildlife Service or such agents, consultants or entities as it may designate The Subdistrict will not be obligated to obtain any lands, property interest, water rights or permits for carrying out such project, all necessary arrangements to be made by the United States Fish and Wildlife Service, or others which the Service may designate The Subdistrict shall have the right of consultation, comment, and review regarding the habitat manipulation project

B Contract with the United States Fish and Wildlife Service to sponsor a biological investigation of Colorado River fishes, as identified on page 3 of the February 26, 1981, memorandum, provided that the Subdistrict's total obligation shall not exceed the payment of Four Hundred Fifty Thousand Dollars ($450,000 00) to the United States Fish and Wildlife Service or such agents, consultants, or entities as it may designate The Subdistrict will not be obligated to obtain any lands, property interest, water rights, or permits for carrying out such project, all necessary arrangements to be made by the United States Fish and Wildlife Service or others which the Service may designate The Subdistrict shall have the right of consultation, comment, and review regarding the biological investigation

6 The Manager of the Subdistrict is hereby directed to transmit this resolution, together with its attachments, to the Water and Power Resources Service and the Fish and Wildlife Service for all purposes of the National Environmental Policy Act, the Fish and Wildlife Coordination Act, and the Endangered Species Act

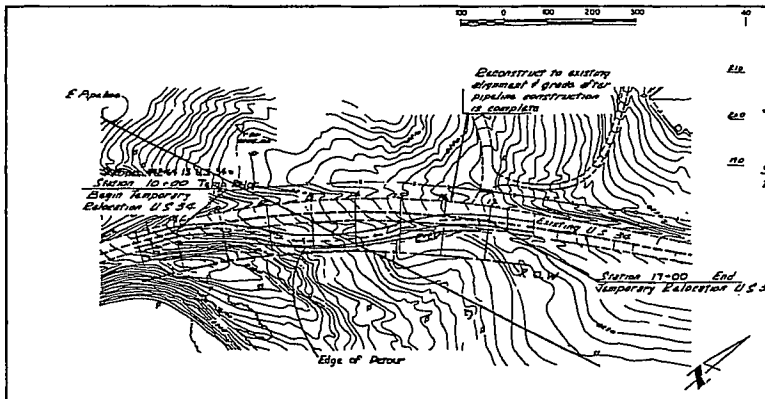
C E R T I F I C A T E

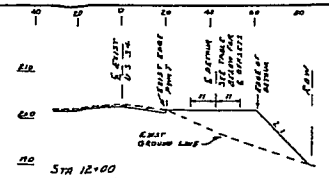
I, Larry D Simpson, do hereby certify that the above is a true and correct copy of a Resolution unanimously adopted by the Board of Directors of the Municipal Subdistrict, Northern Colorado Water Conservancy District, at a special meeting of said Board held in Loveland, Colorado, on March 3, 1981

Secretary

ATTACHMENT 3

DRAWINGS OF RELOCATED HIGHWAYS ASSOCIATED WITH THE WINDY GAP PROJECT





Sta 12+00
Typical Section

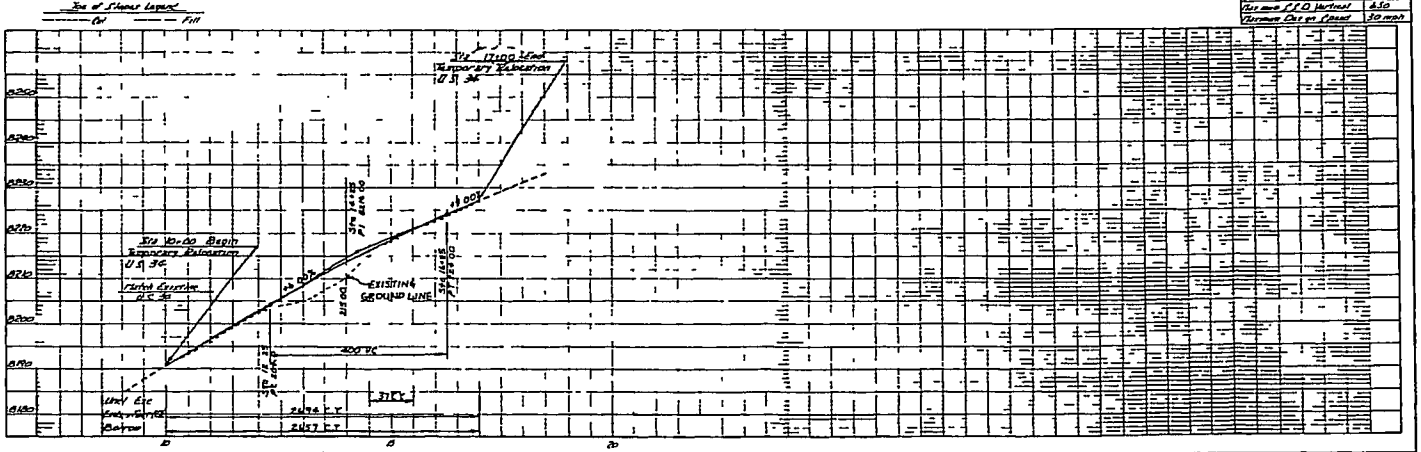
Detour Offset Table

Station	% Offset	Dist. from E. Exist. Edge of Pvmt.
10+00	0	50 ft
11+00	10	55
12+00	92	96
13+00	81	77
14+00	88	77
15+00	38	90
16+00	16	55
17+00	0	50 ft

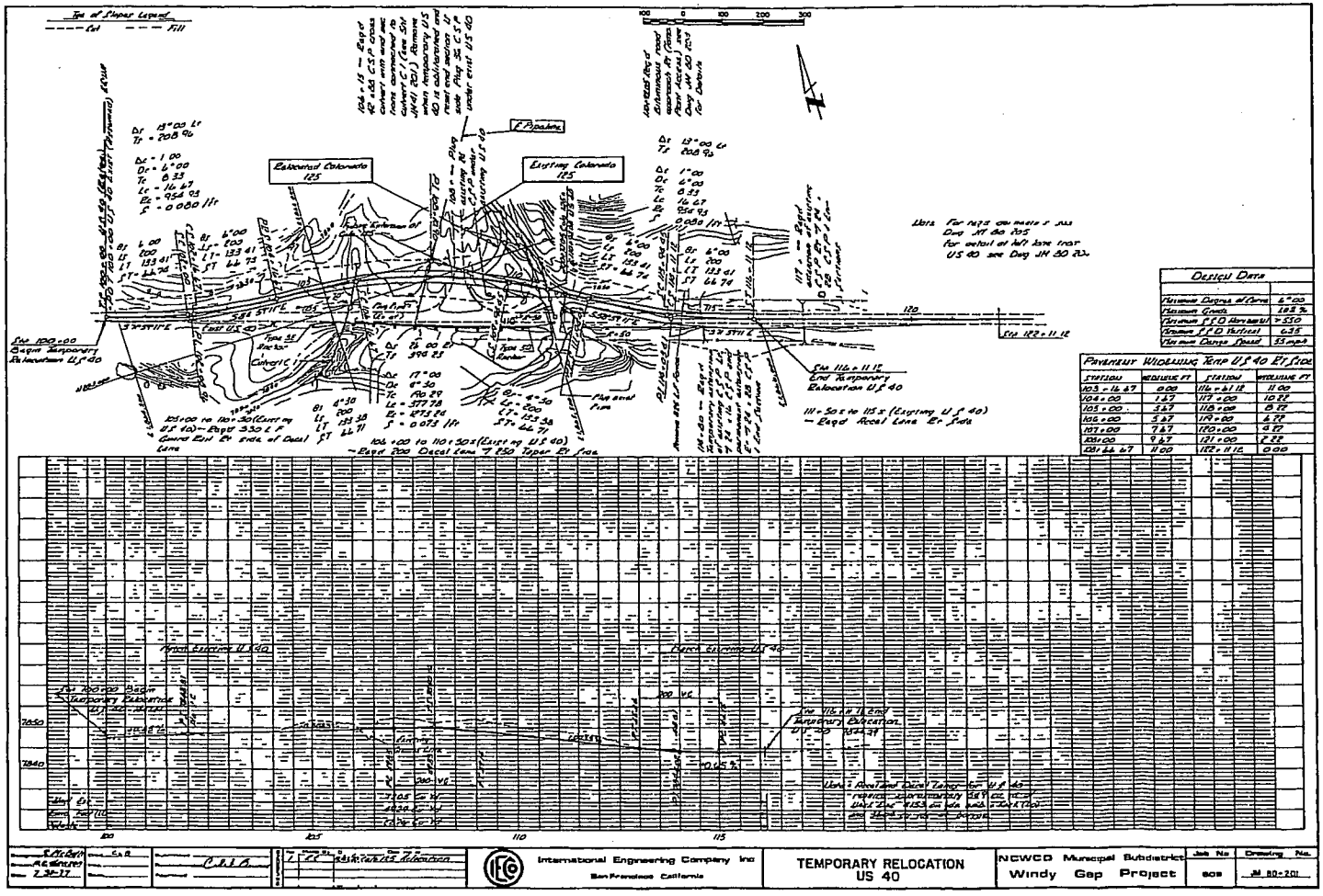
General Notes for all Highway Related Construction

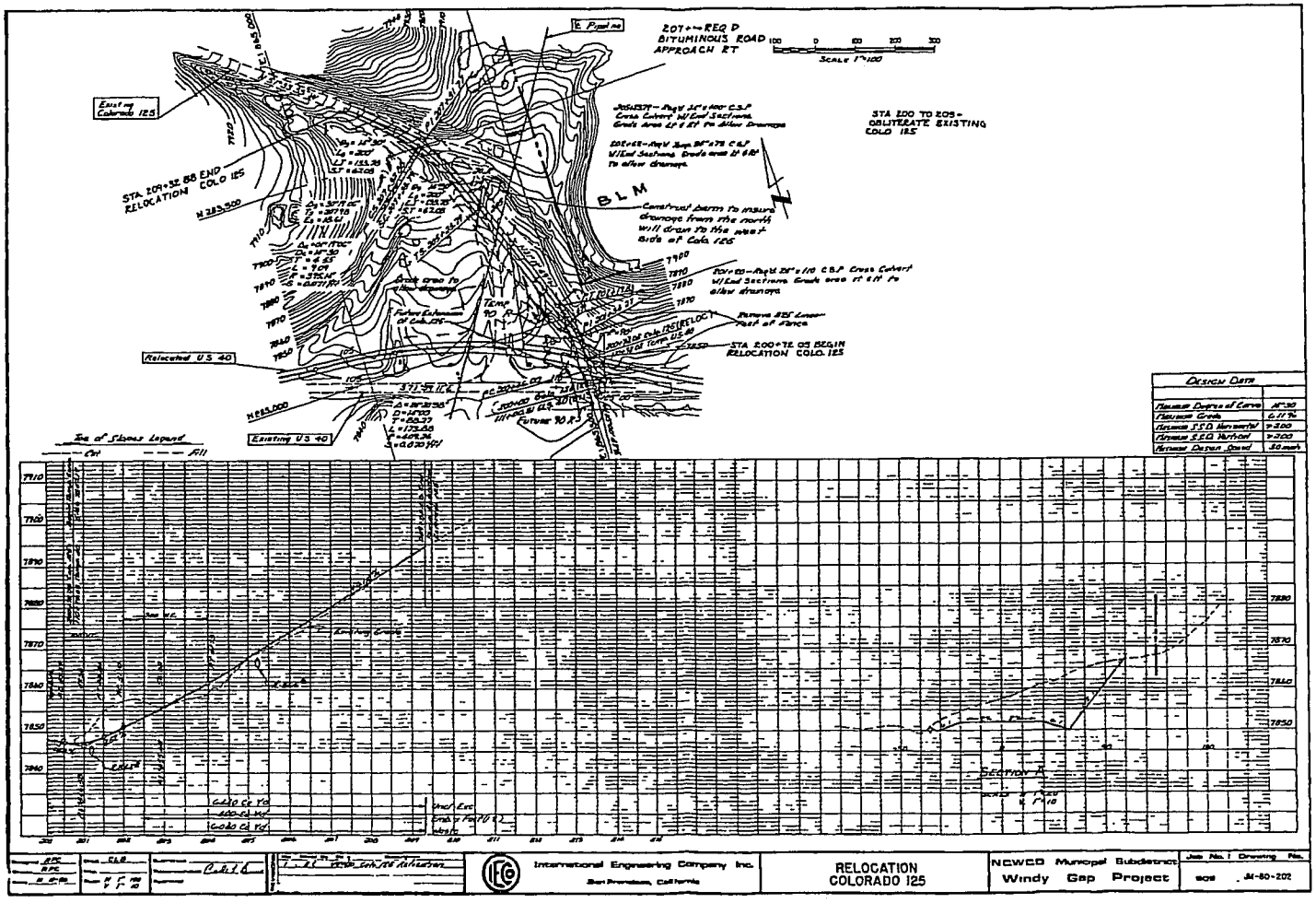
1. All work shall be done in accordance with State of Colorado Department of Highways Standard Specifications for Road and Bridge Construction.
2. For details of typical sections see sheet [illegible].
3. The existing Colorado 125 pavement shall be obliterated between station 209+32.88 and existing U.S. 40 where it does not overlap with the new pavement.
4. Relocated Colorado 125 shall extend from station 209+72 to existing U.S. 40 as shown on the plan when the temporary relocation of U.S. 40 is removed. Colorado 125 relocation is permanent.
5. All road approaches shall be gravel surfaced with a 4 inch thickness of aggregate base course extending approximately to the right-of-way line. Approaches requiring bituminous pavement shall be primed and a 2 thickness of pavement placed 50 feet out from edge of shoulder or to the right-of-way line, whichever is less.
6. Any temporary construction road entrance to U.S. 40 shall be approved by the Colorado Department of Highways.

Design Data	
Maximum Degree of Curve	22°55.02'
Maximum Grade	6.00 %
Use Sight Distance Horizontal	400
Use Sight Distance Vertical	450
Maximum Rate of Grade	30 mph



[illegible] 7-26-77	KLD	[illegible]	[illegible]	International Engineering Company, Inc. San Francisco, California	TEMPORARY RELOCATION US 34	NCWCD Municipal Subdistrict Windy Gap Project	Job No. 208	Drawing No. M-80 200


Existing Colorado 125
Relocated Colorado 125
Design Data
Maximum Degree of Curve 6°00
Maximum Grade 6.0 %
Minimum K for Horizontal 250
Minimum K for Vertical 635
Maximum Design Speed 55 mph
Pavement Widening Table US 40 Ft. Side
Station | Widening Ft | Station | Widening Ft
103+14.67 | 0.00 | 116+61.12 | 11.00
104+00 | 1.67 | 117+00 | 10.77
105+00 | 3.67 | 118+00 | 8.72
106+00 | 5.67 | 119+00 | 6.72
107+00 | 7.67 | 120+00 | 4.72
108+00 | 9.67 | 121+00 | 2.72
108+44.67 | 11.00 | 122+11.12 | 0.00
Exc 109+00 Begin Temporary Relocation US 40
Exc 112+11.12 End Temporary Relocation US 40
Exc 122+11.12
Existing US 40
Temporary Relocation US 40
Profile Existing US 40
Profile Temporary Relocation US 40
Profile Existing Colorado
Profile Relocated Colorado
Tie Into Ft & End Temporary Relocation US 40
Sta 112+11.12
Elev 7652.39
Elev 7650.00
Elev 7640.00
10.65 %
Sta 100+00 Begin Temporary Relocation US 40
Elev 7652.00
Sta 122+11.12
Elev 7652.39
Sta 103+14.67
Elev 7650.00
Sta 108+44.67
Elev 7640.00
Sta 116+61.12
Elev 7652.39
Sta 117+00
Elev 7652.00
Sta 122+11.12
Elev 7652.39
Sta 120+00
Elev 7652.00
Sta 125+00
Elev 7652.00
Sta 110+00
Elev 7652.00
Sta 115+00
Elev 7652.00
Sta 105+00
Elev 7650.00
Sta 100+00
Elev 7650.00
Sta 95+00
Elev 7650.00
Sta 90+00
Elev 7650.00
7650
7640
200 VC
300 VC
Elev Ft
Sta 100
Sta 105
Sta 110
Sta 115
Sta 120
Sta 125
Sta 130
Sta 135
Sta 140
Sta 145
Sta 150
Sta 155
Sta 160
Sta 165
Sta 170
Sta 175
Sta 180
Sta 185
Sta 190
Sta 195
Sta



International Engineering Company Inc. San Francisco, California	RELOCATION COLORADO 125	NCWCD Municipal Subdistrict Windy Gap Project	Job No. 1 Drawing No. 505 JM-80-202

ATTACHMENT 4

A WITH AND WITHOUT WINDY GAP HYDROGRAPHS FOR THE COLORADO RIVER AT HOT SULPHUR SPRINGS, COLORADO

B WEIGHTED-USABLE AREA CURVES FOR RAINBOW AND BROWN TROUT

C TRANSECTS OF VARIOUS REACHES OF THE COLORADO RIVER BETWEEN WINDY GAP AND THE MONTH OF THE BLUE RIVER

A. WITH AND WITHOUT WINDY GAP HYDROGRAPHS FOR THE COLORADO RIVER AT HOT SULPHUR SPRINGS, COLORADO

Figure 1

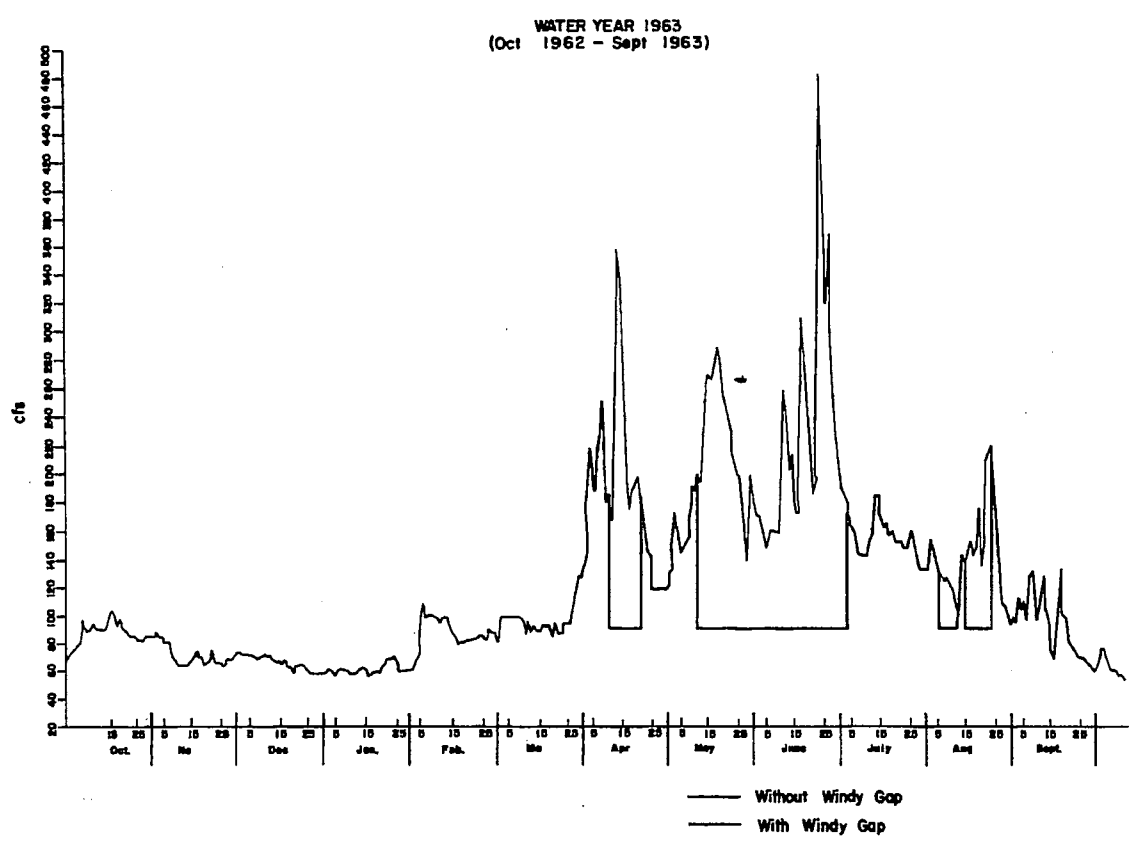


Figure 2

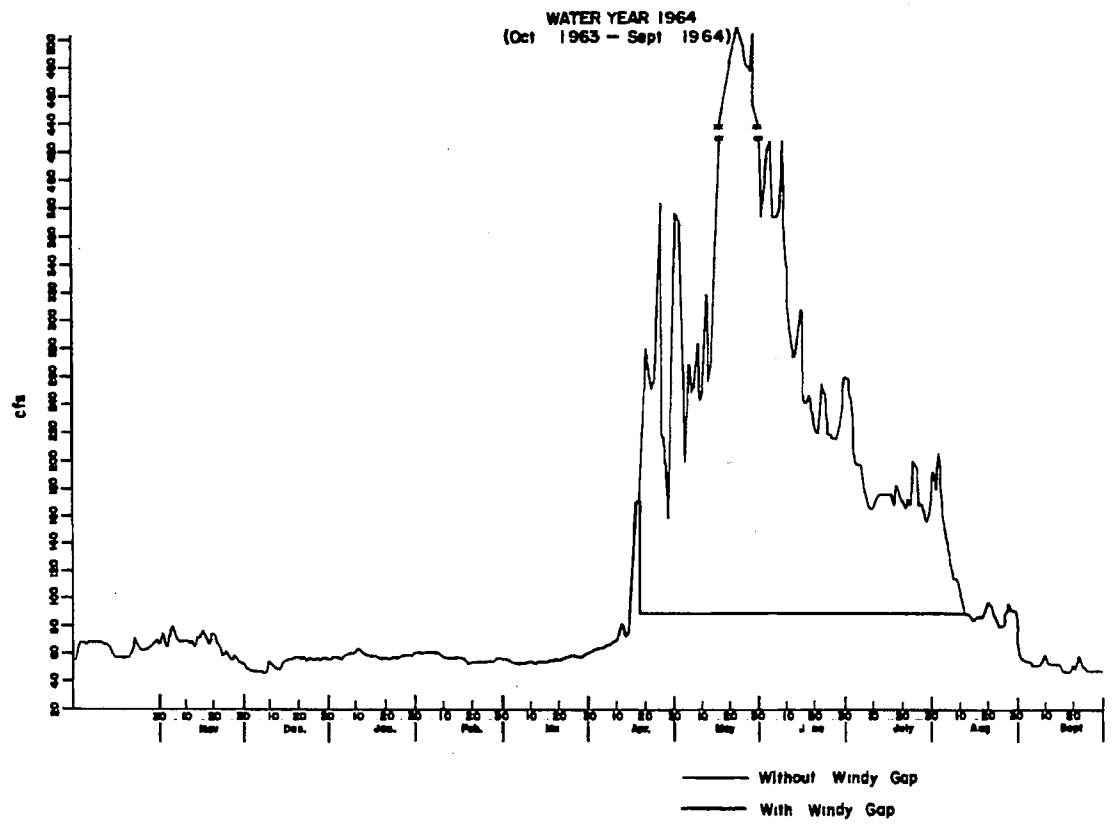


Figure 3

WATER YEAR 1965
(April — Aug 1965)

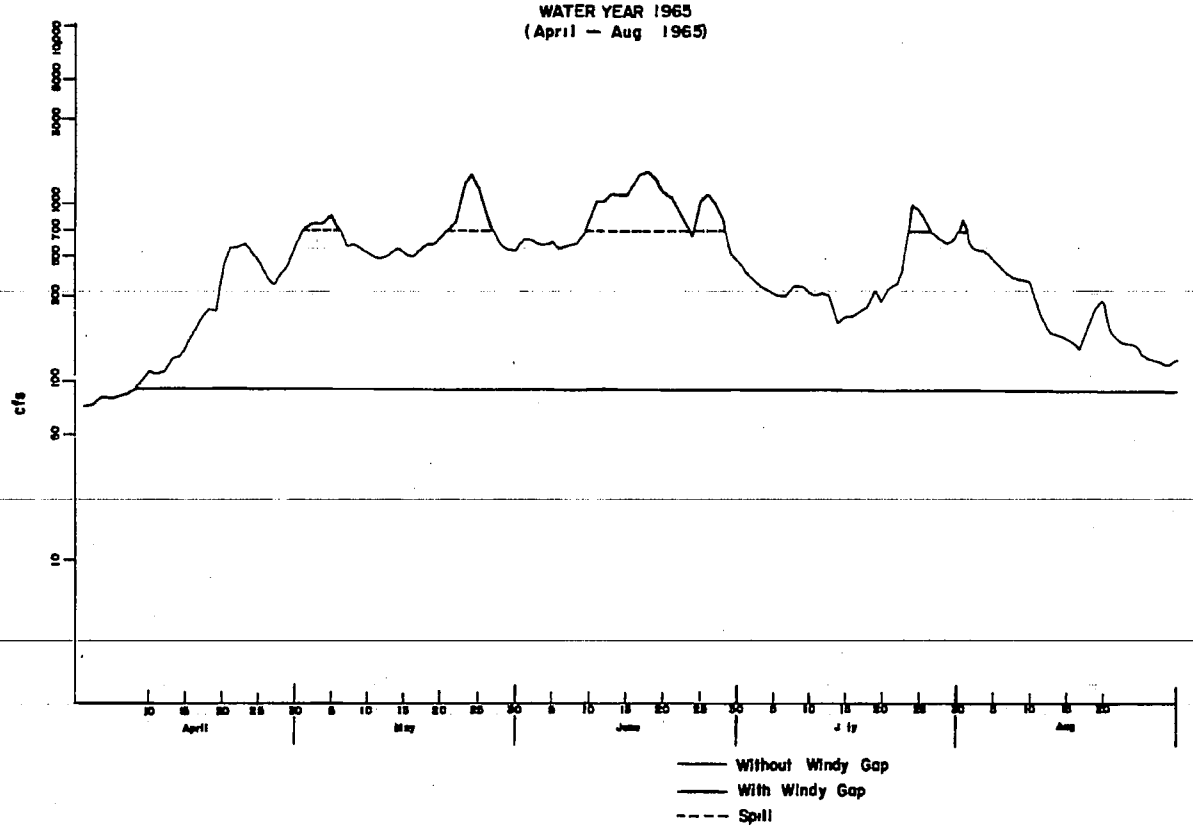


Figure 4

WATER YEAR 1966
(Oct 1965 - Sept 1966)

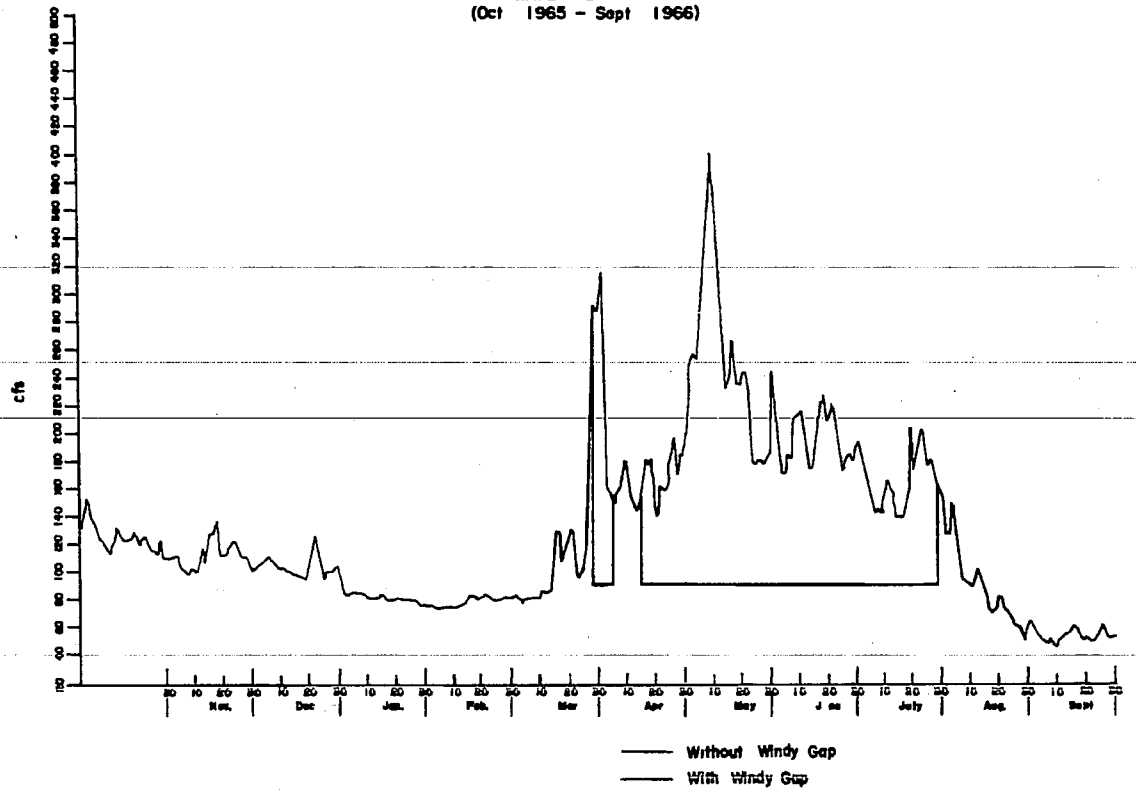


Figure 5

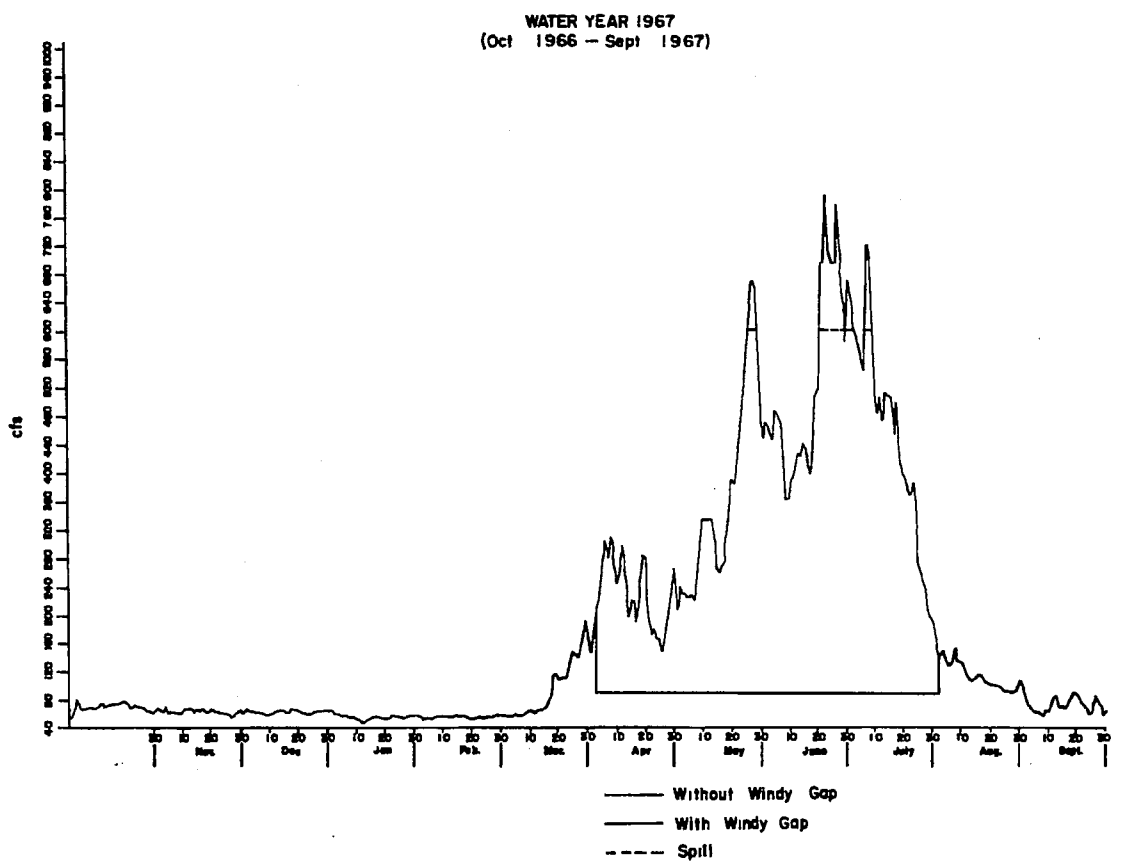


Figure 6

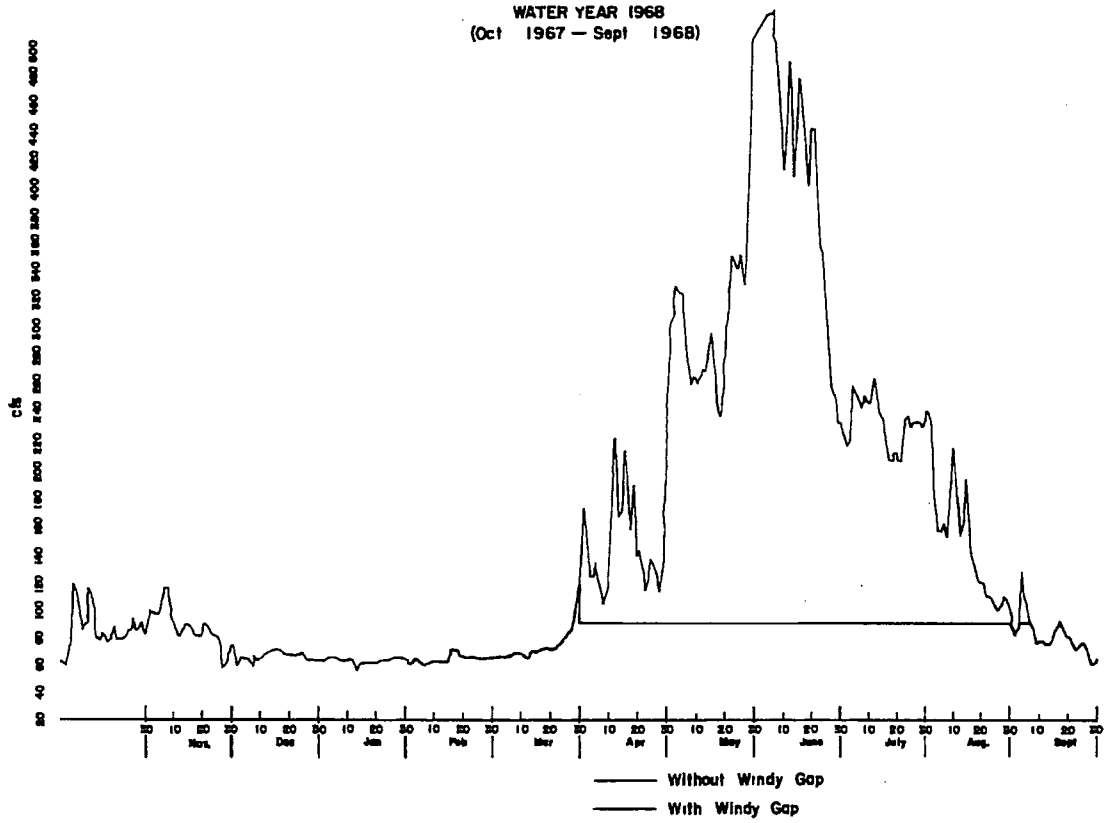


Figure 7
WATER YEAR 1969
(Oct 1968 – Sept 1969)

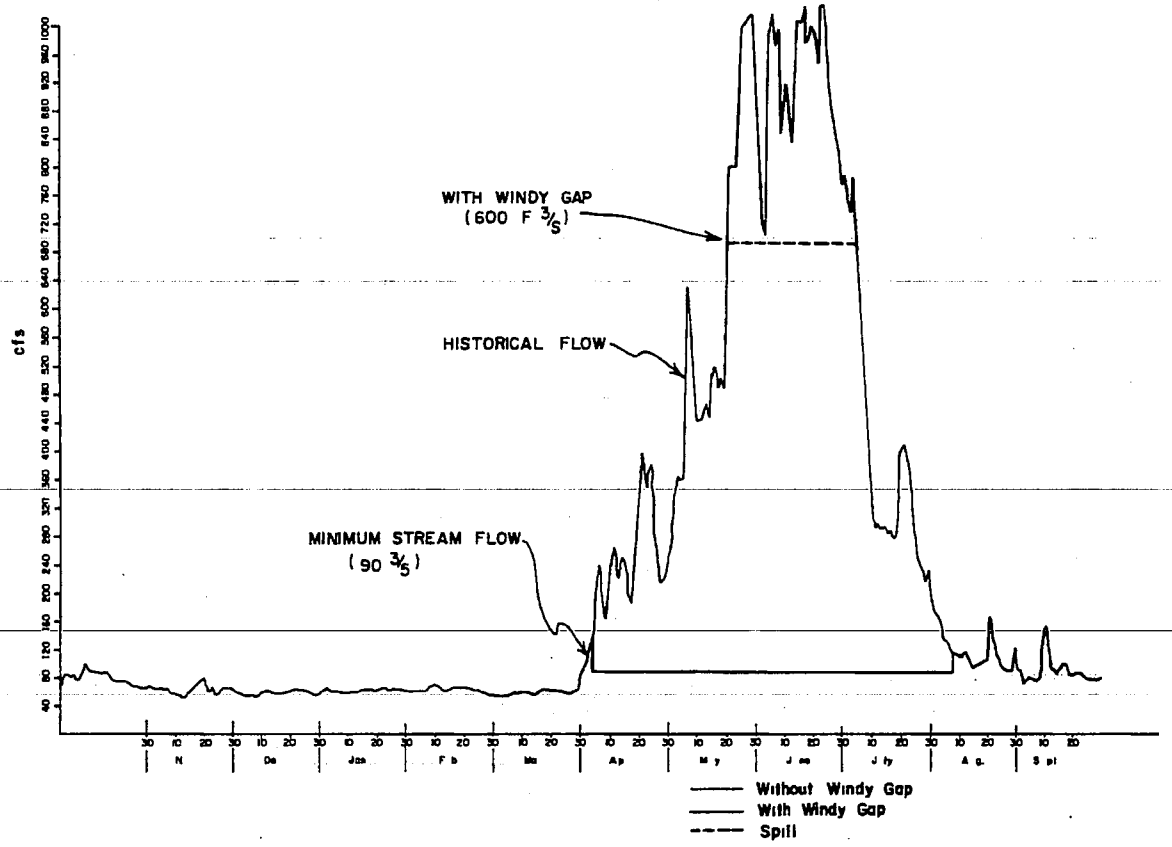


Figure 8
WATER YEAR 1970
(April – Aug 1970)

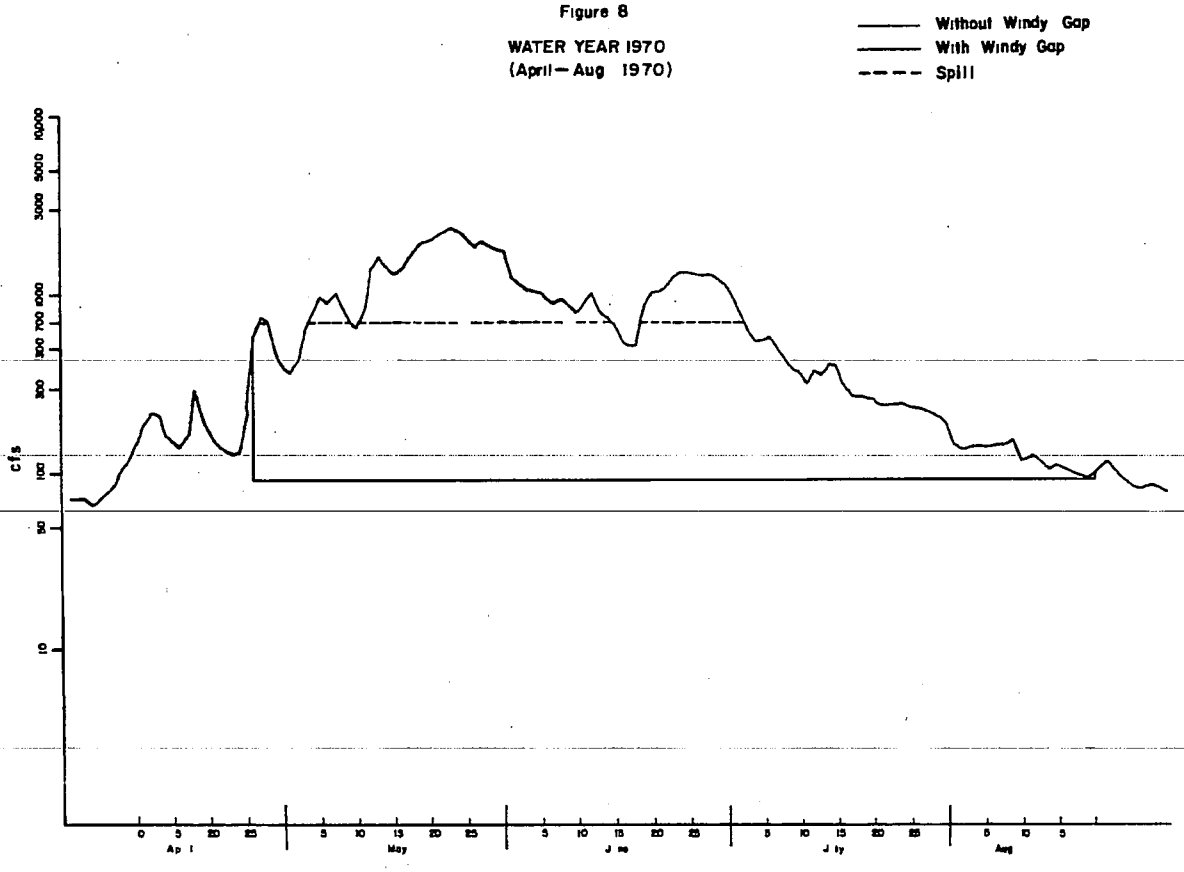


Figure 9

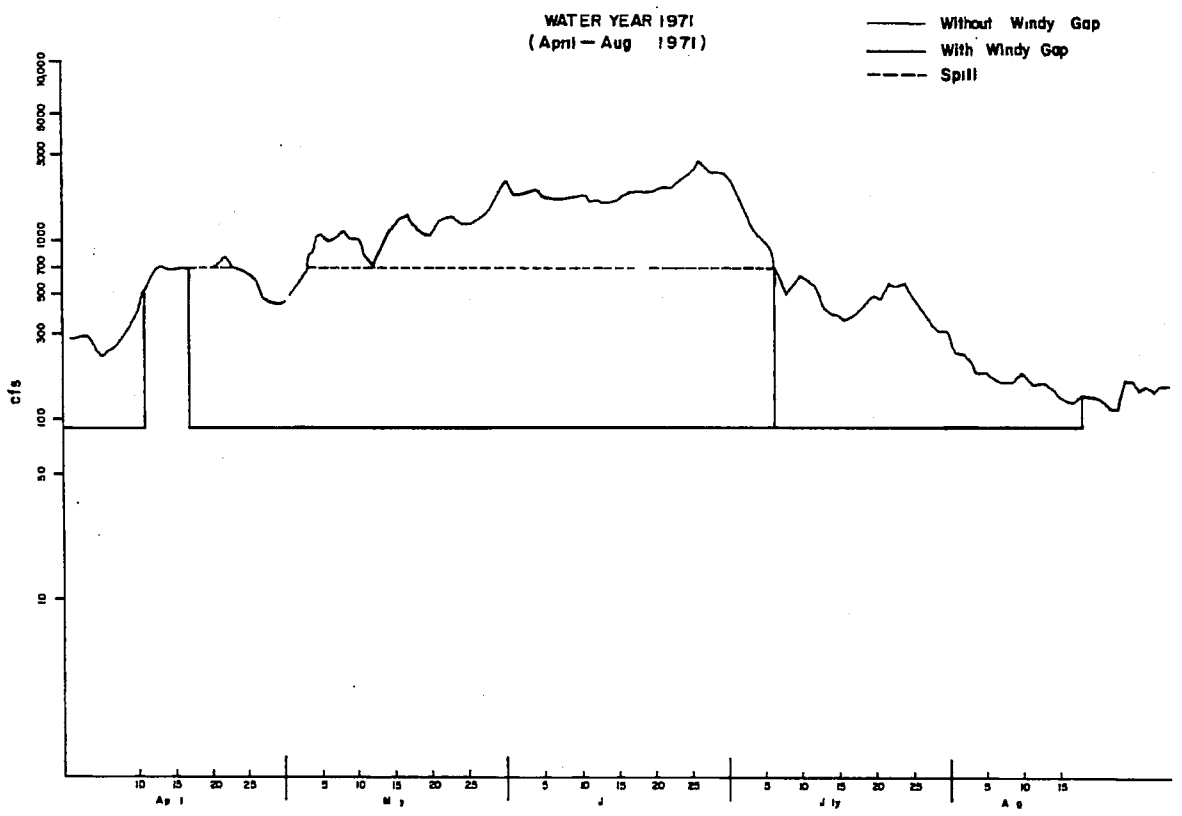


Figure 10

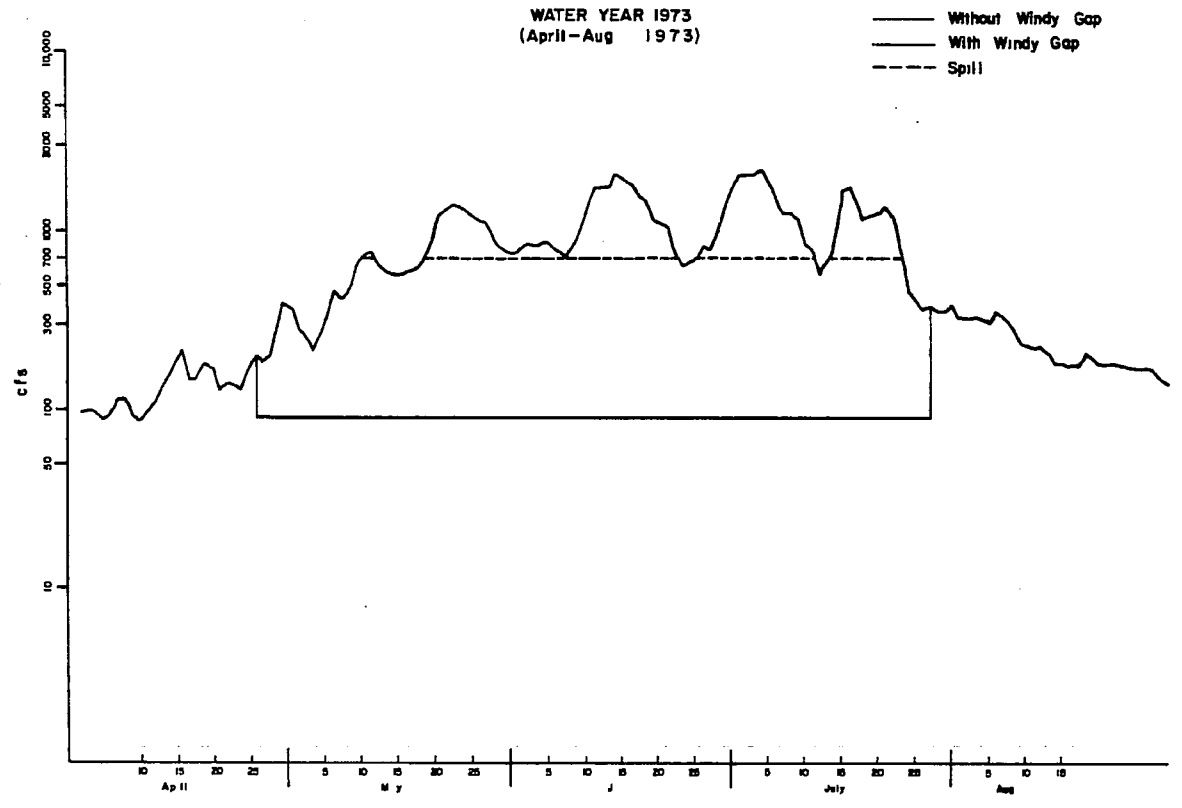


Figure 11

WATER YEAR 1974
(April—Aug. 1974)

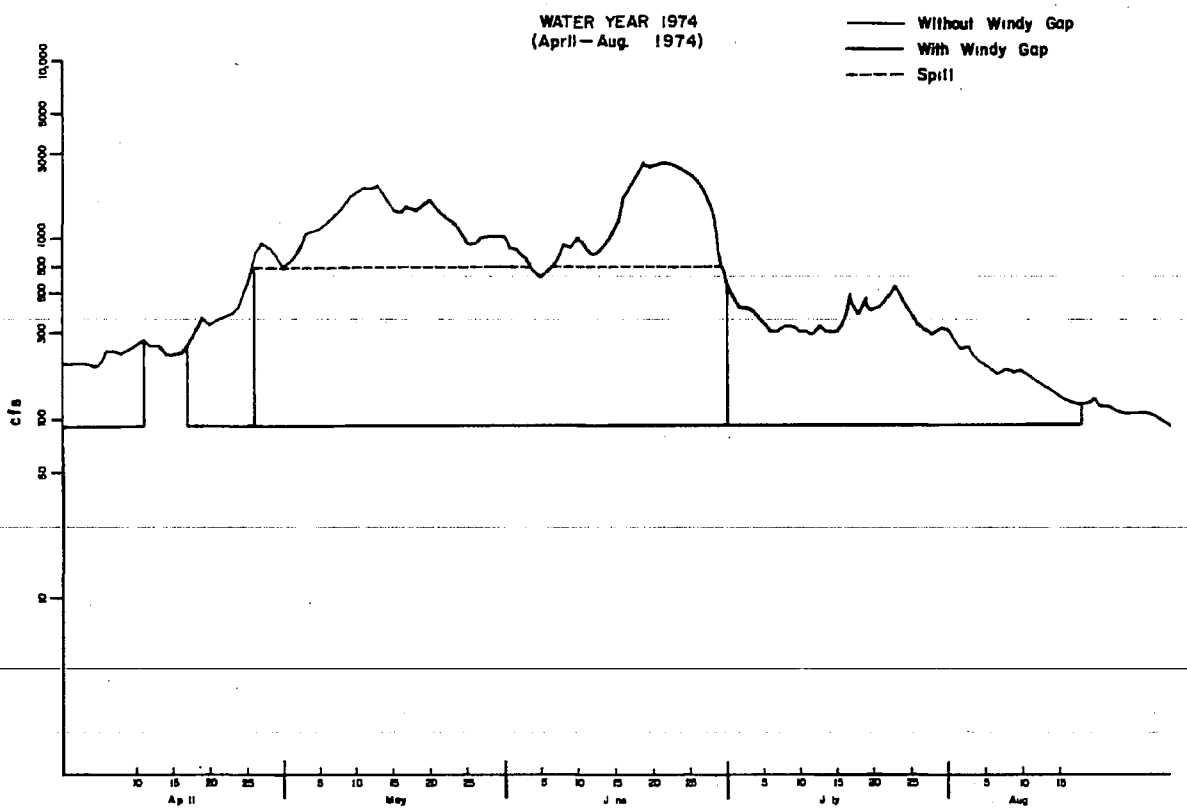


Figure 12

WATER YEAR 1975
(Oct 1974 — Sept 1975)

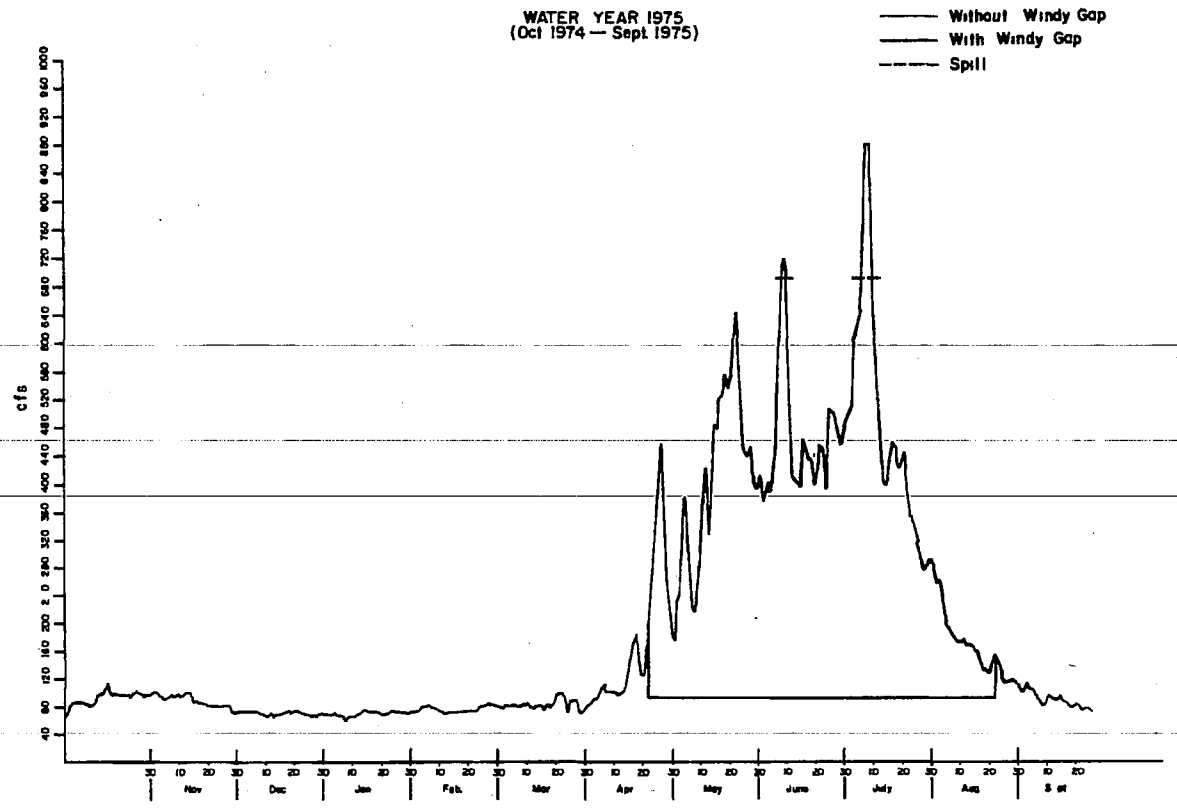


Figure 13
WATER YEAR 1976
(Oct 1975 Sept 1976)

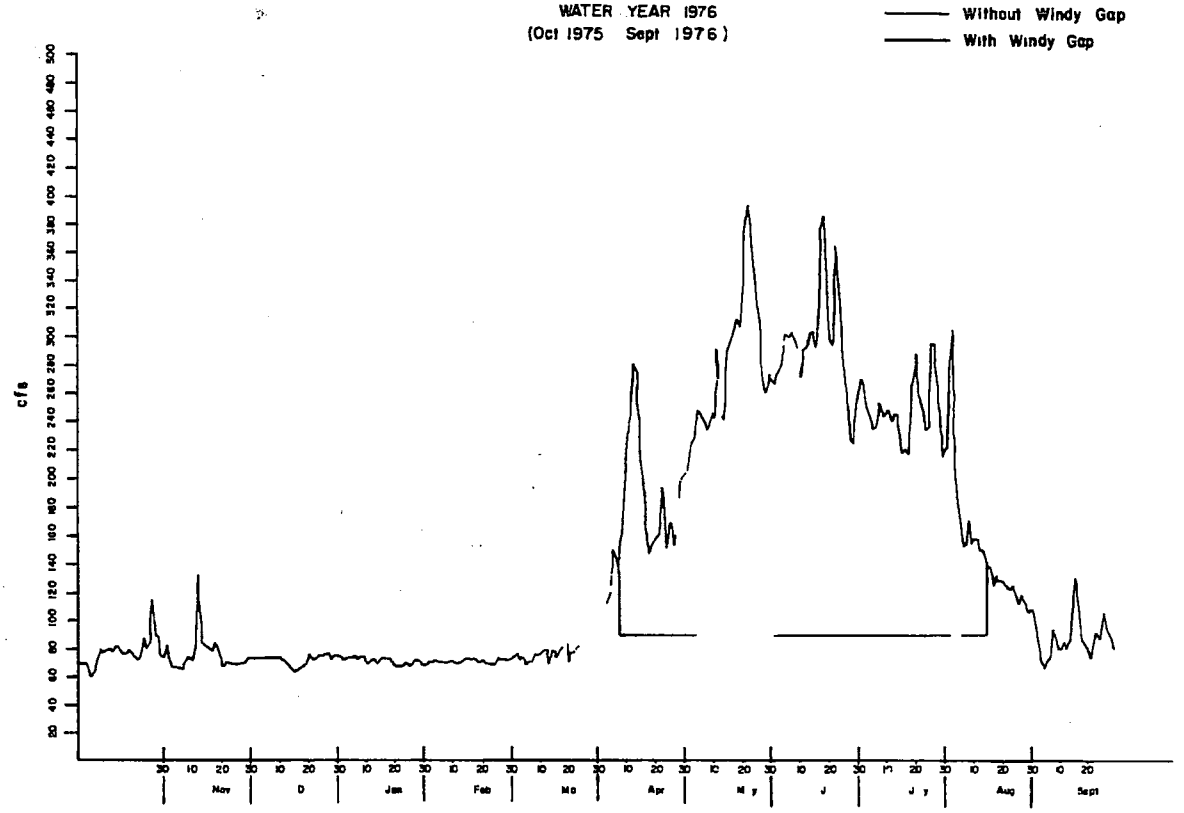


Figure 14
WATER YEAR 1977
(Oct 1976—Sept 1977)

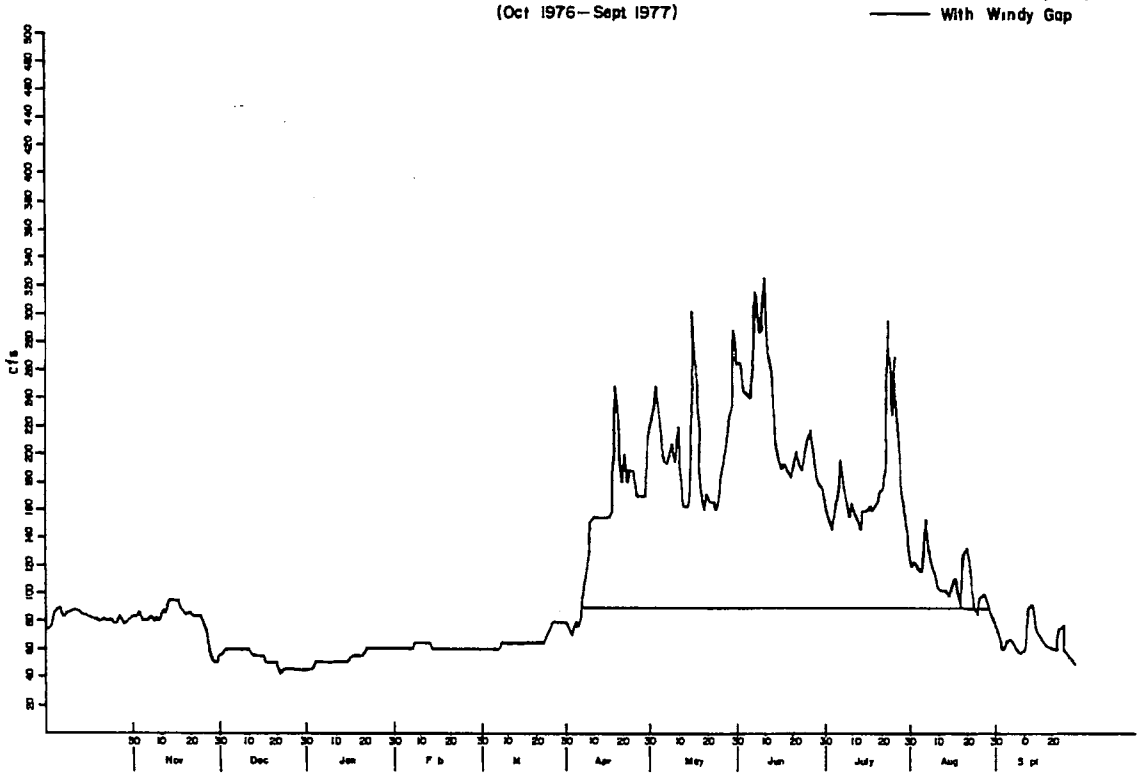
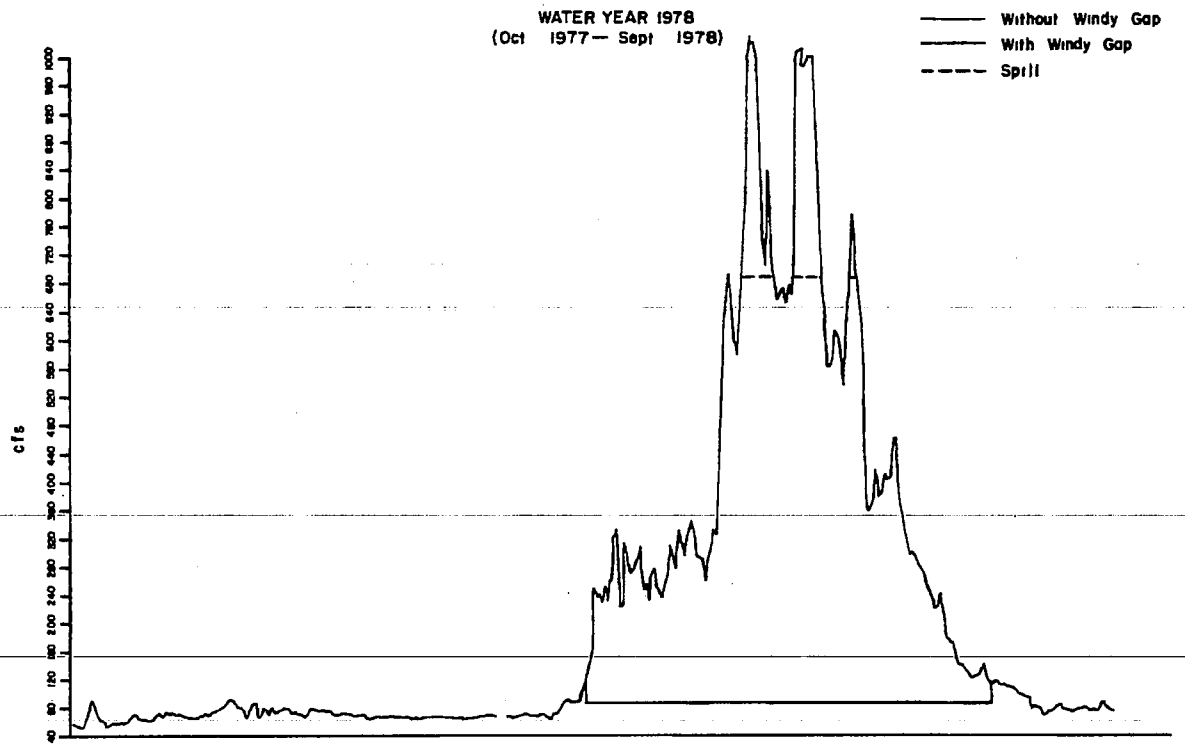


Figure 15


WATER YEAR 1978
(Oct 1977 — Sept 1978)
Without Windy Gap
With Windy Gap
Spill
cfs

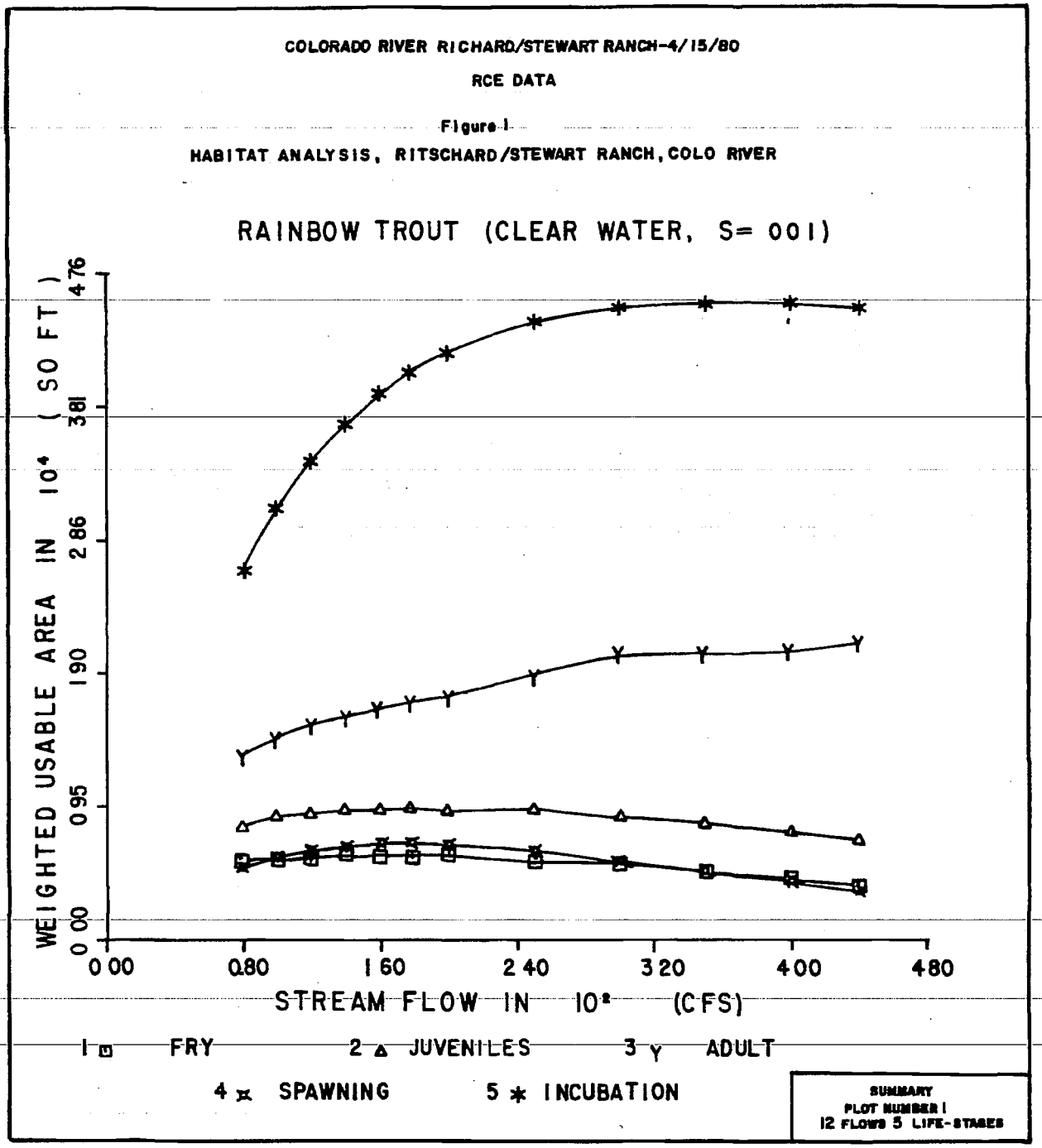
B. WEIGHTED-USABLE AREA CURVES FOR RAINBOW AND BROWN TROUT

COLORADO RIVER RICHARD/STEWART RANCH-4/15/80

RCE DATA

Figure 1

HABITAT ANALYSIS, RITSCHARD/STEWART RANCH, COLO RIVER

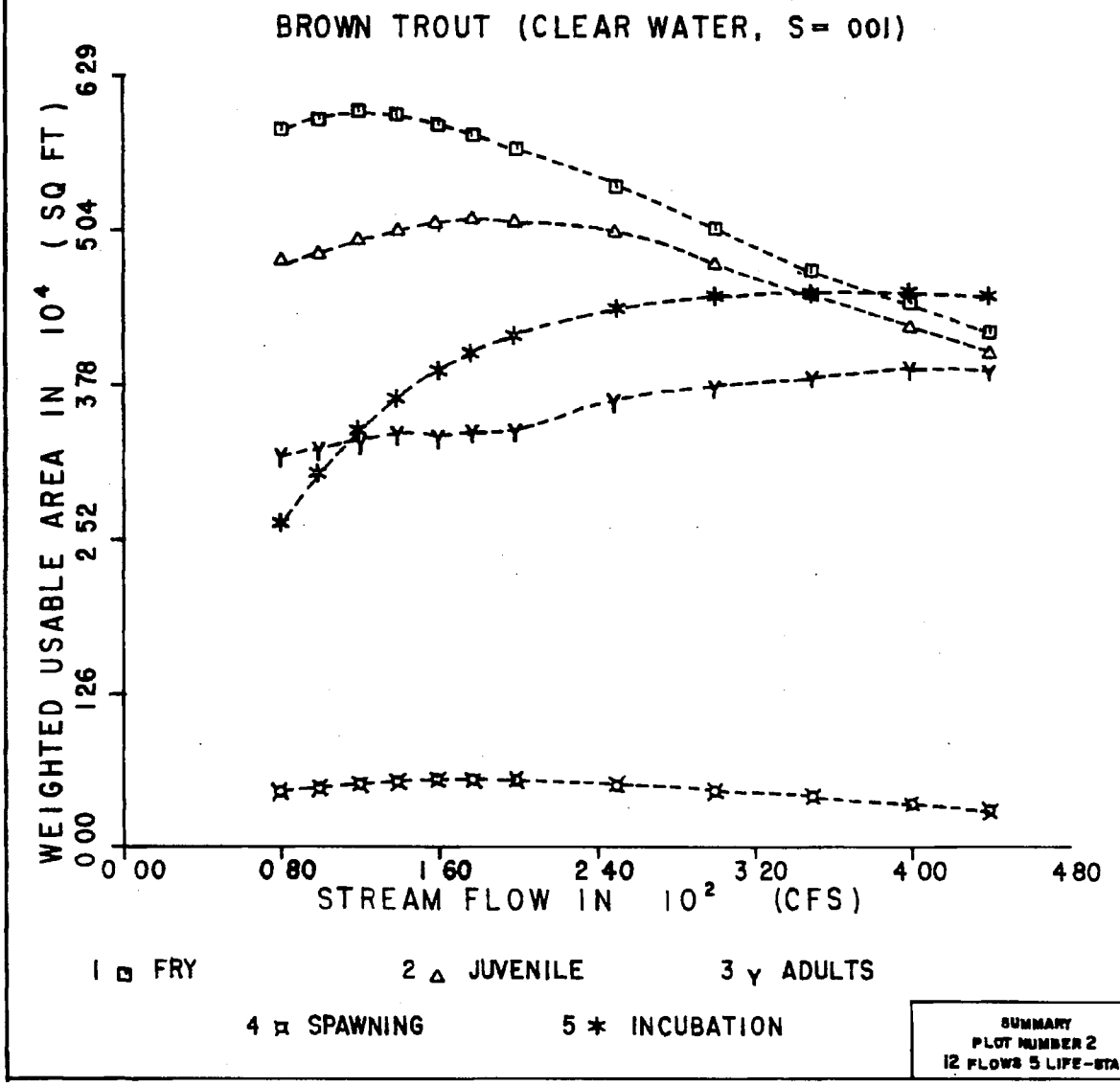


COLORADO RIVER RICHARD/STEWART RANCH-4/15/80

RCE DATA

Figure 2

HABITAT ANALYSIS, RITSCHARD/STEWART RANCH, COLO RIVER



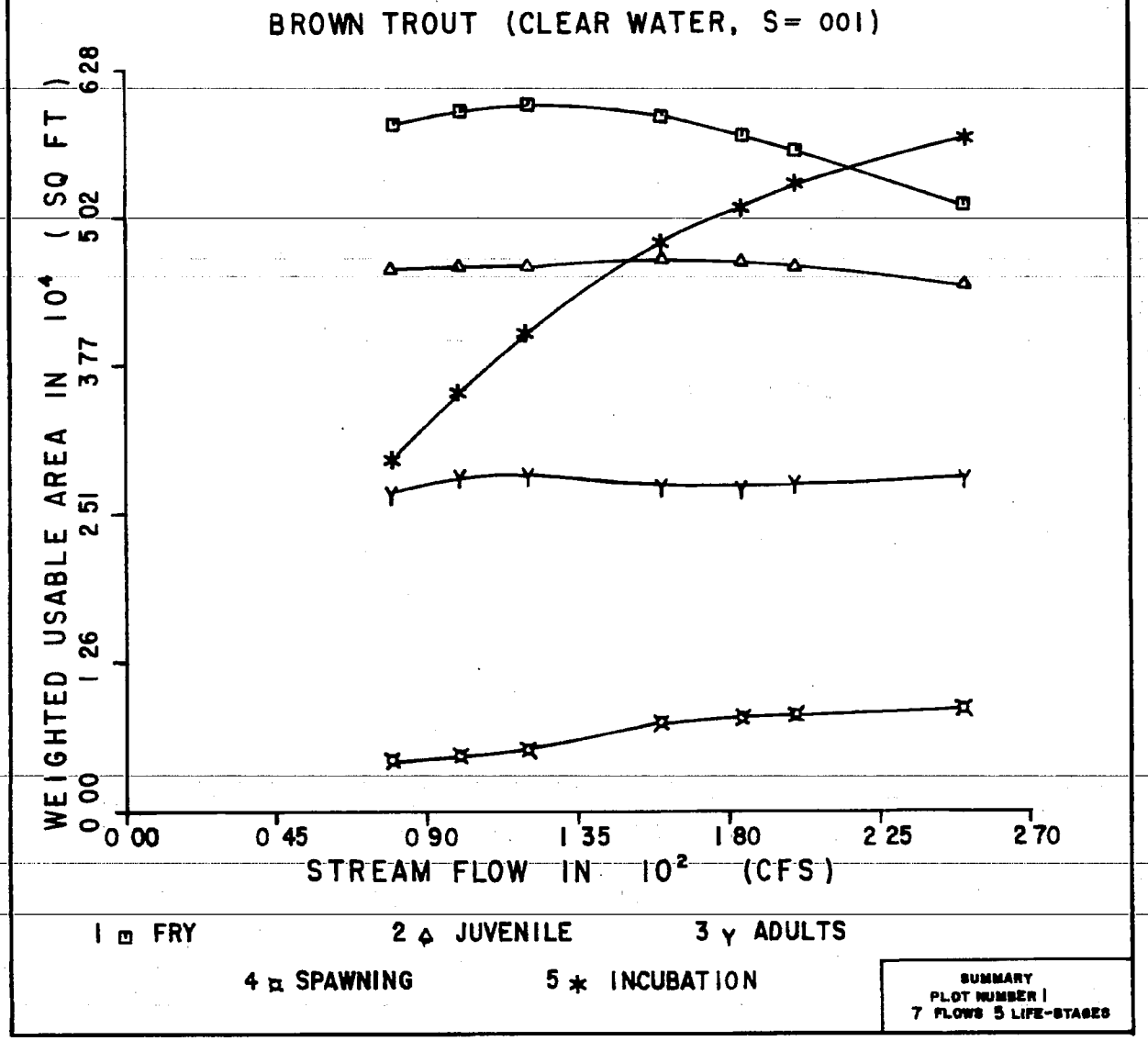
SUMMARY
PLOT NUMBER 2
12 FLOWS 5 LIFE-STAGES

COLORADO RIVER NEAR HILL-MAYHOFFER RANCH

RE OATA COLLECTED 4/17/80

Figure 3

HABITAT ANALYSIS, HILL /MAYHOFFER RANCH, COLORADO RIVER

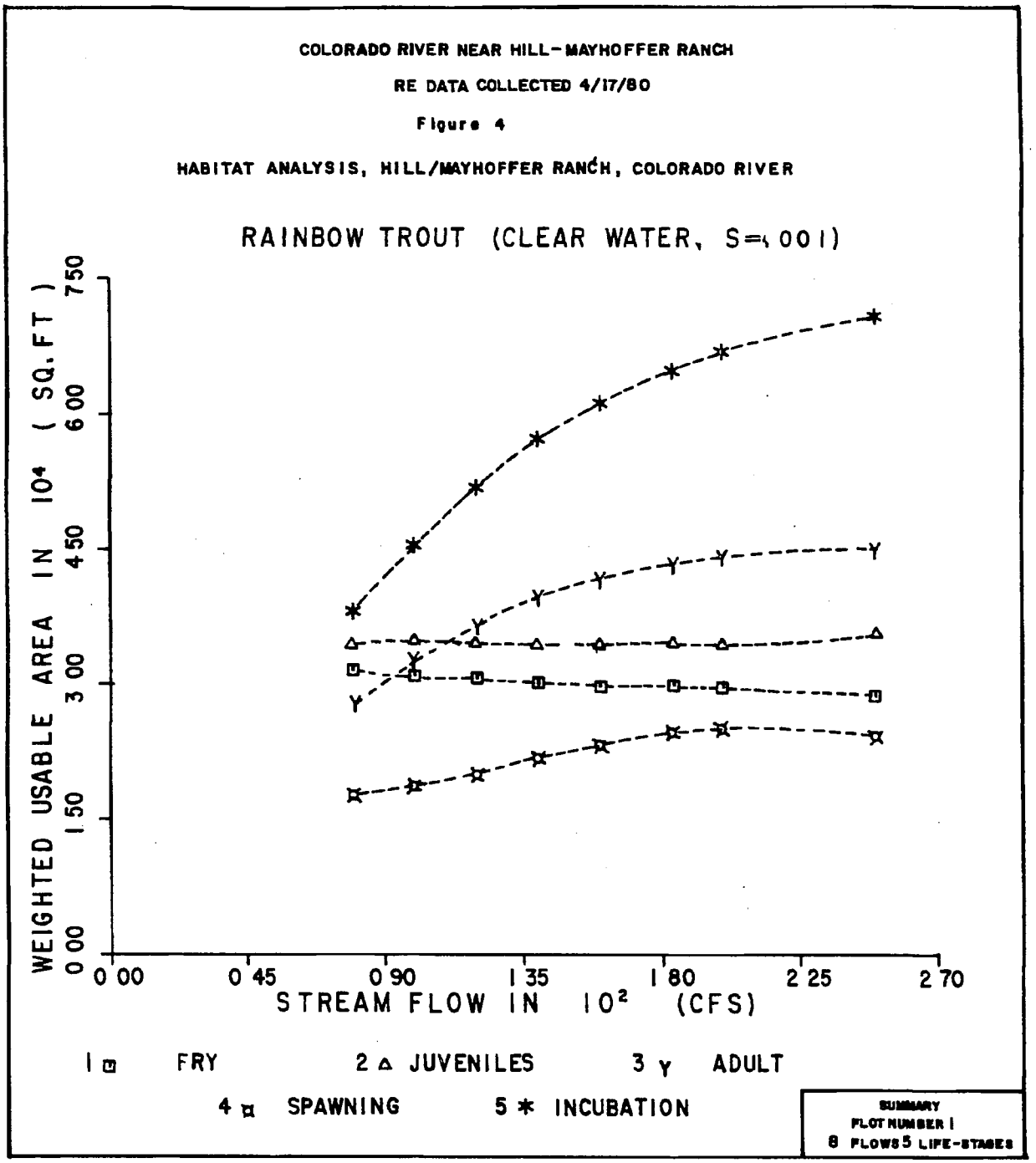


COLORADO RIVER NEAR HILL-MAYHOFFER RANCH

RE DATA COLLECTED 4/17/80

Figure 4

HABITAT ANALYSIS, HILL/MAYHOFFER RANCH, COLORADO RIVER



C. TRANSECTS OF VARIOUS REACHES OF THE COLORADO RIVER BETWEEN WINDY GAP AND THE MOUTH OF THE BLUE RIVER

FIGURE 1

TRANSECT 0 COLORADO RIVER RITSCHARDS RANCH

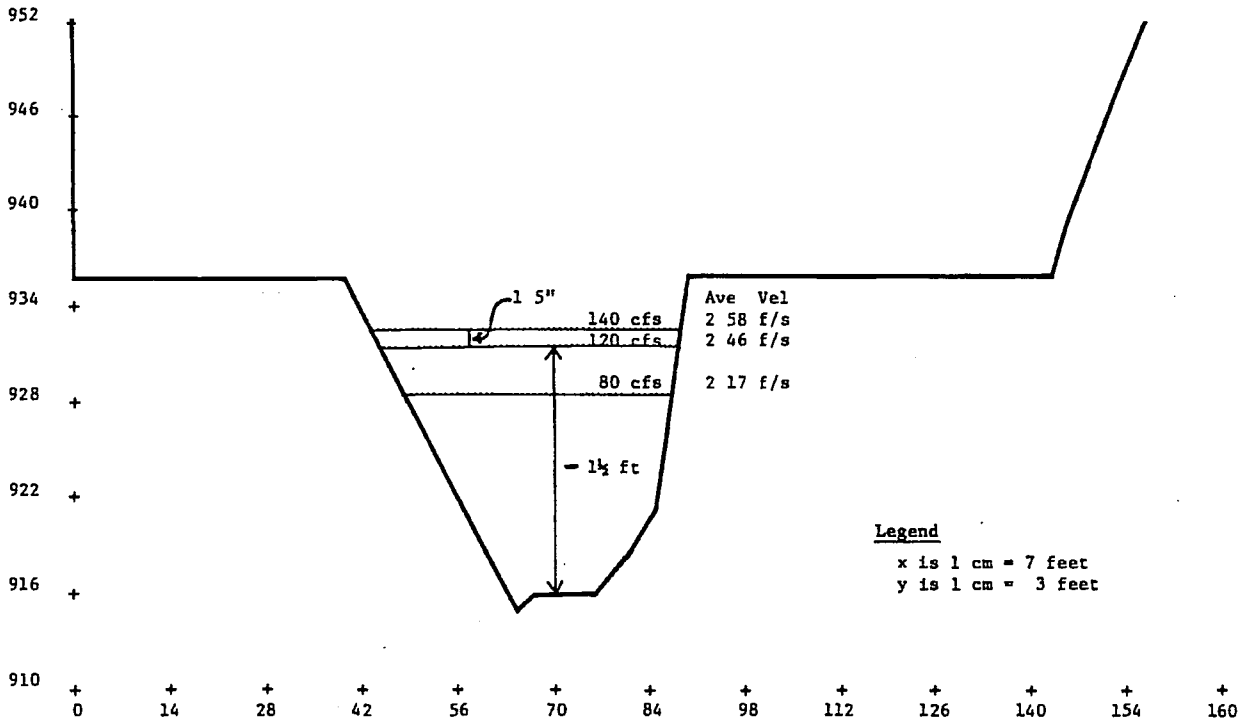


FIGURE 2

TRANSECT 148 COLORADO RIVER RITSCHARDS RANCH

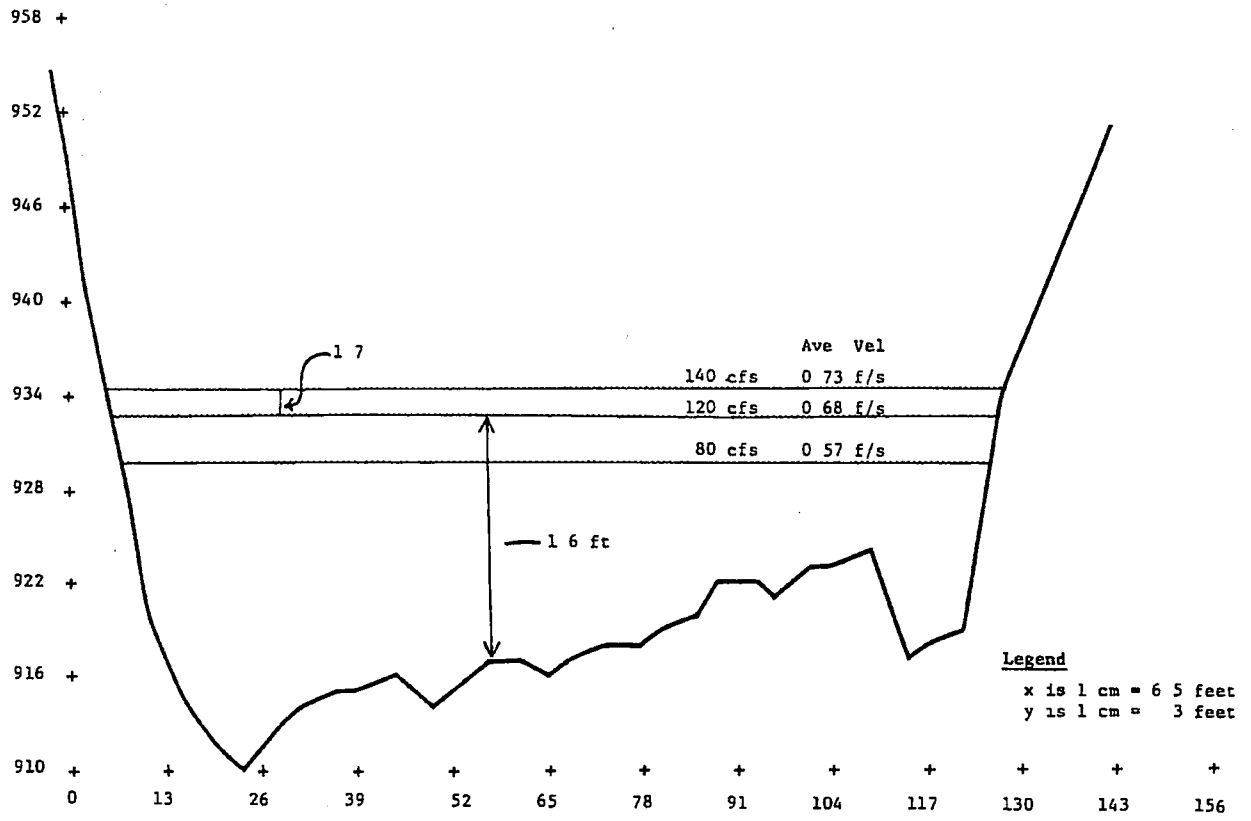


FIGURE 3

TRANSECT 252 COLORADO RIVER RITSCHARDS RANCH

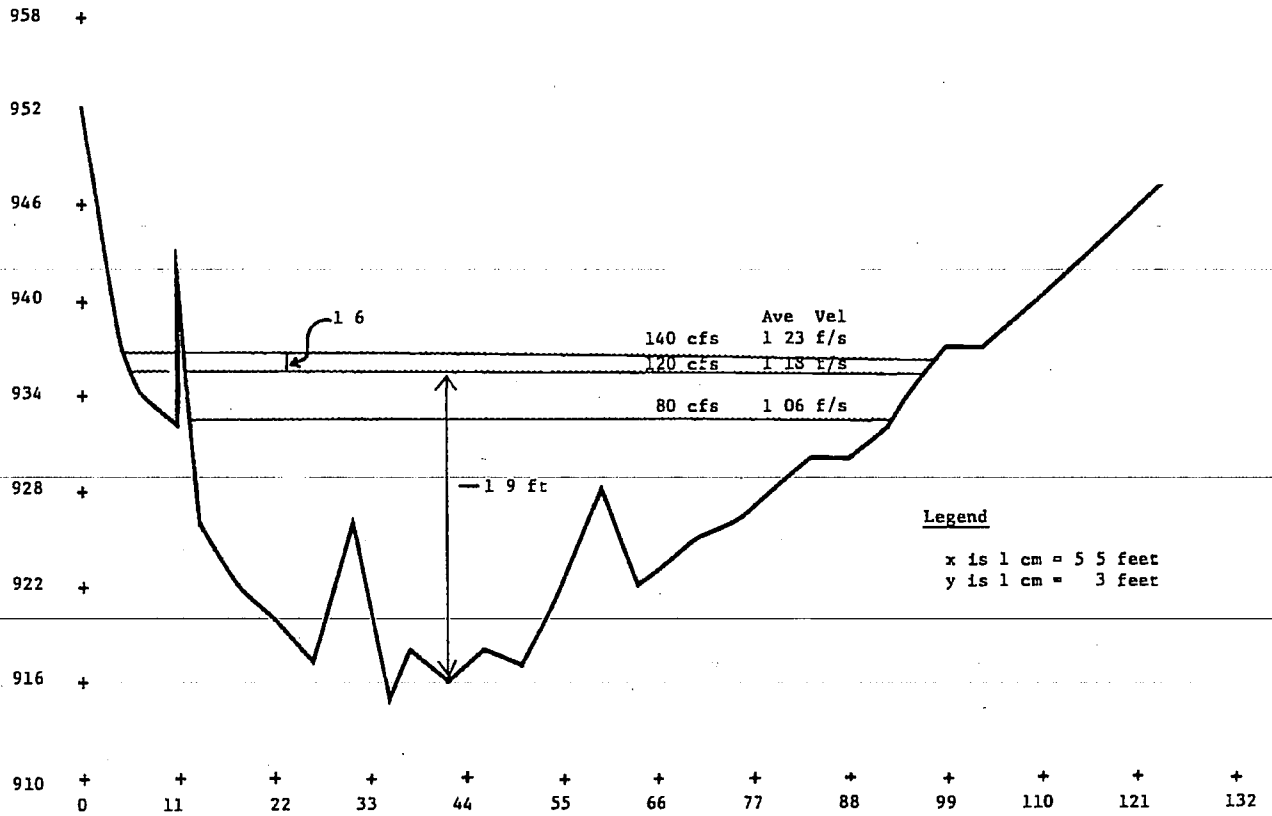


FIGURE 4

TRANSECT 420 COLORADO RIVER RITSCHARDS RANCH

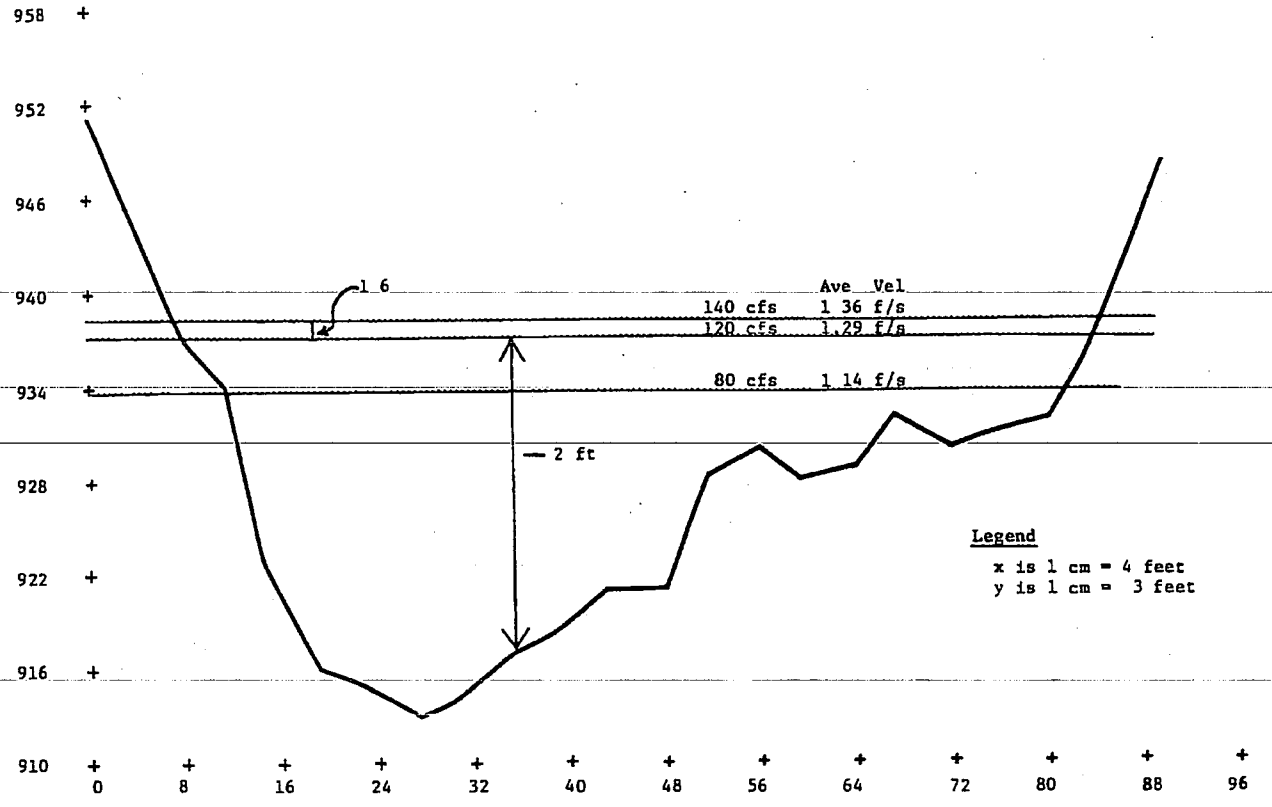


FIGURE 5

TRANSECT 494 COLORADO RIVER RITSCHARDS RANCH

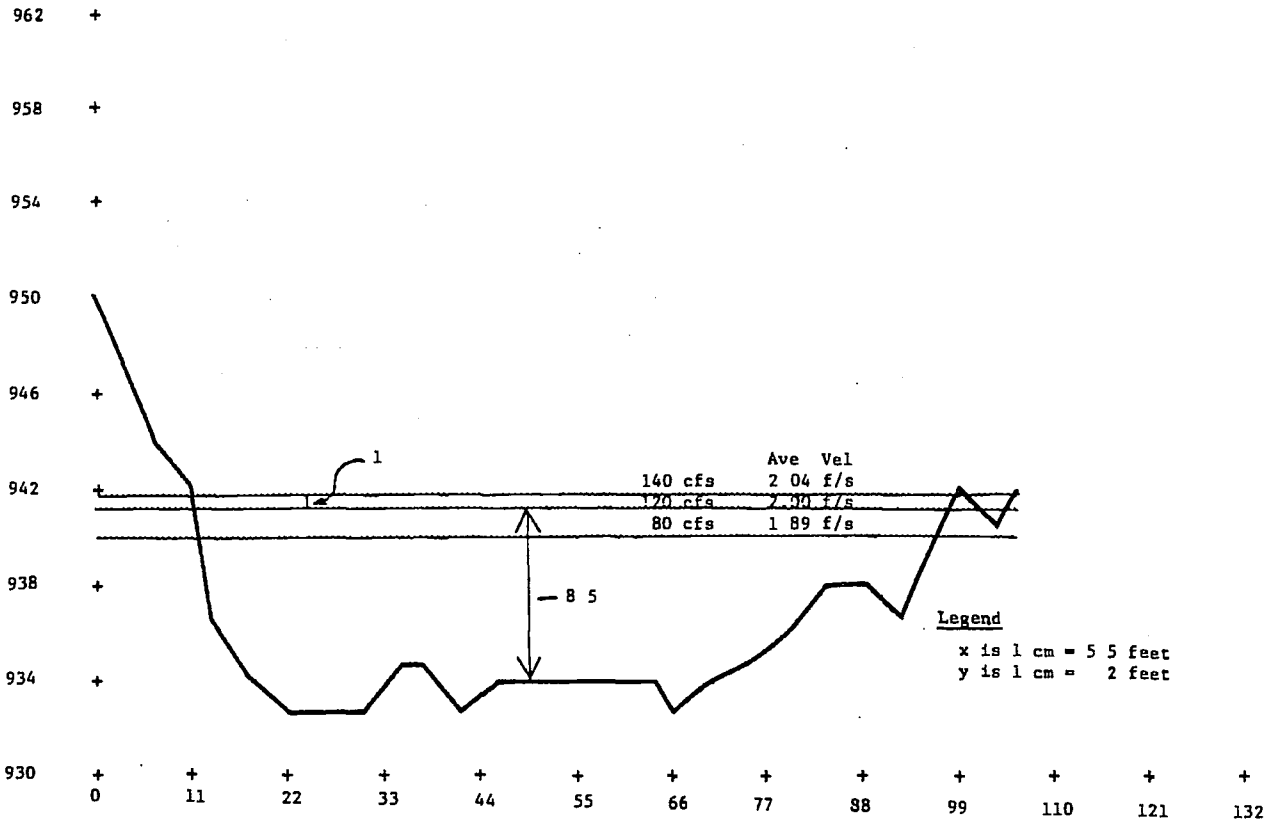


FIGURE 6

TRANSECT 0 COLORADO RIVER RITSCHARD-STEWART RANCH

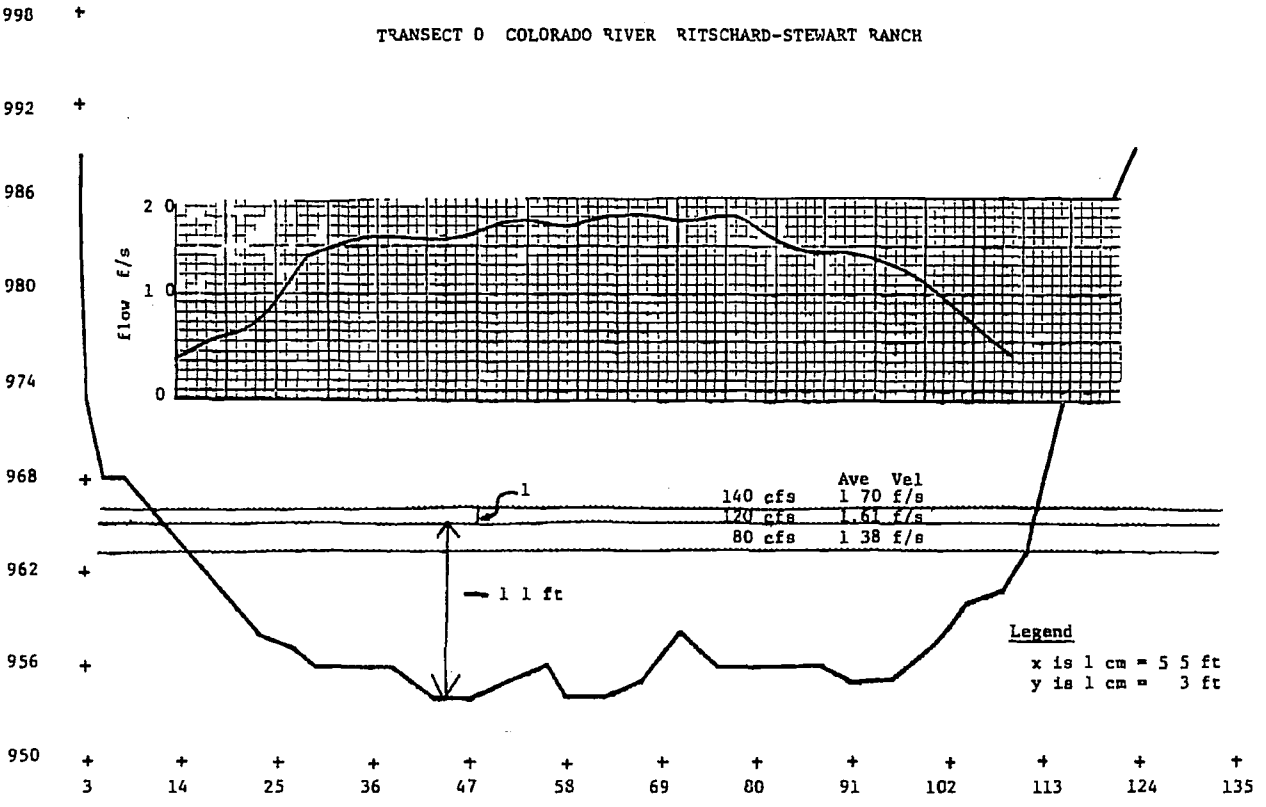


FIGURE 7

TRANSECT 78 COLORADO RIVER RITSCHARD-STEWART RANCH

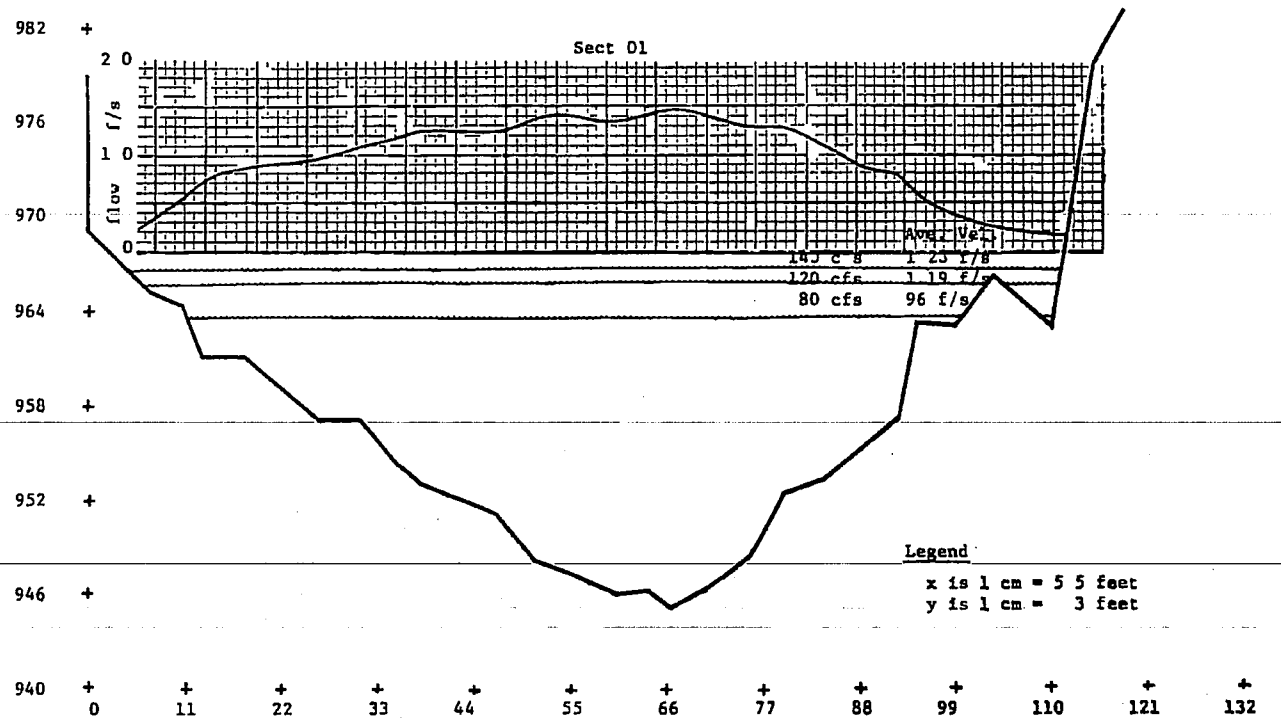


FIGURE 8

TRANSECT 164 COLORADO RIVER RITSCHARD-STEWART RANCH

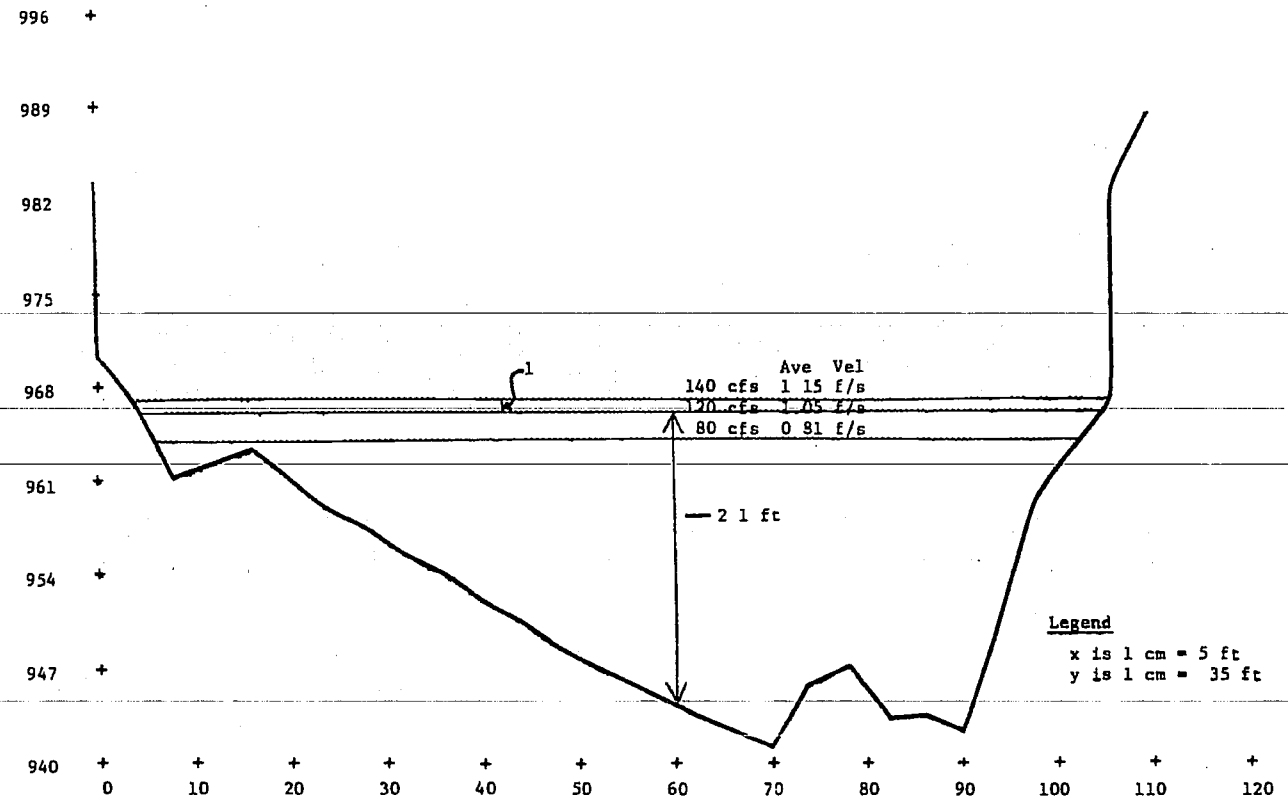


FIGURE 9

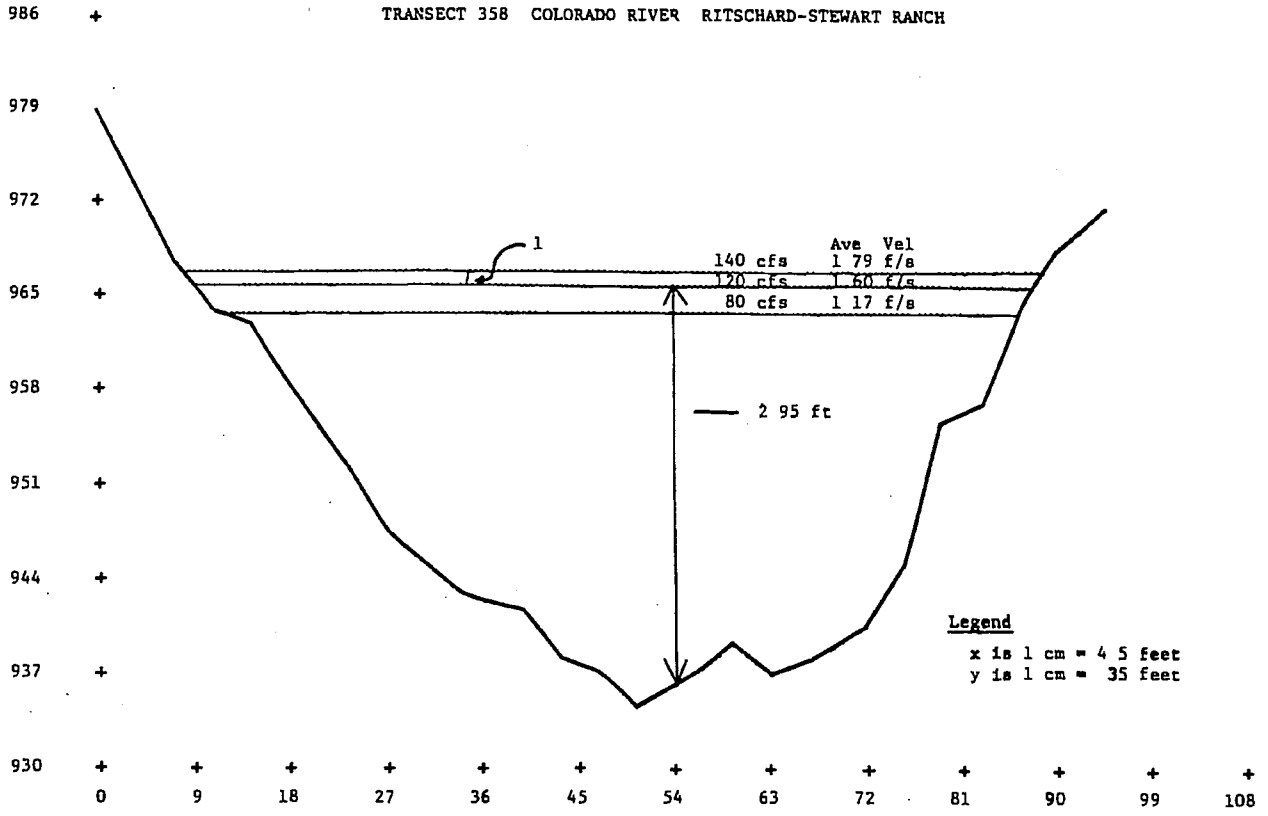


FIGURE 10

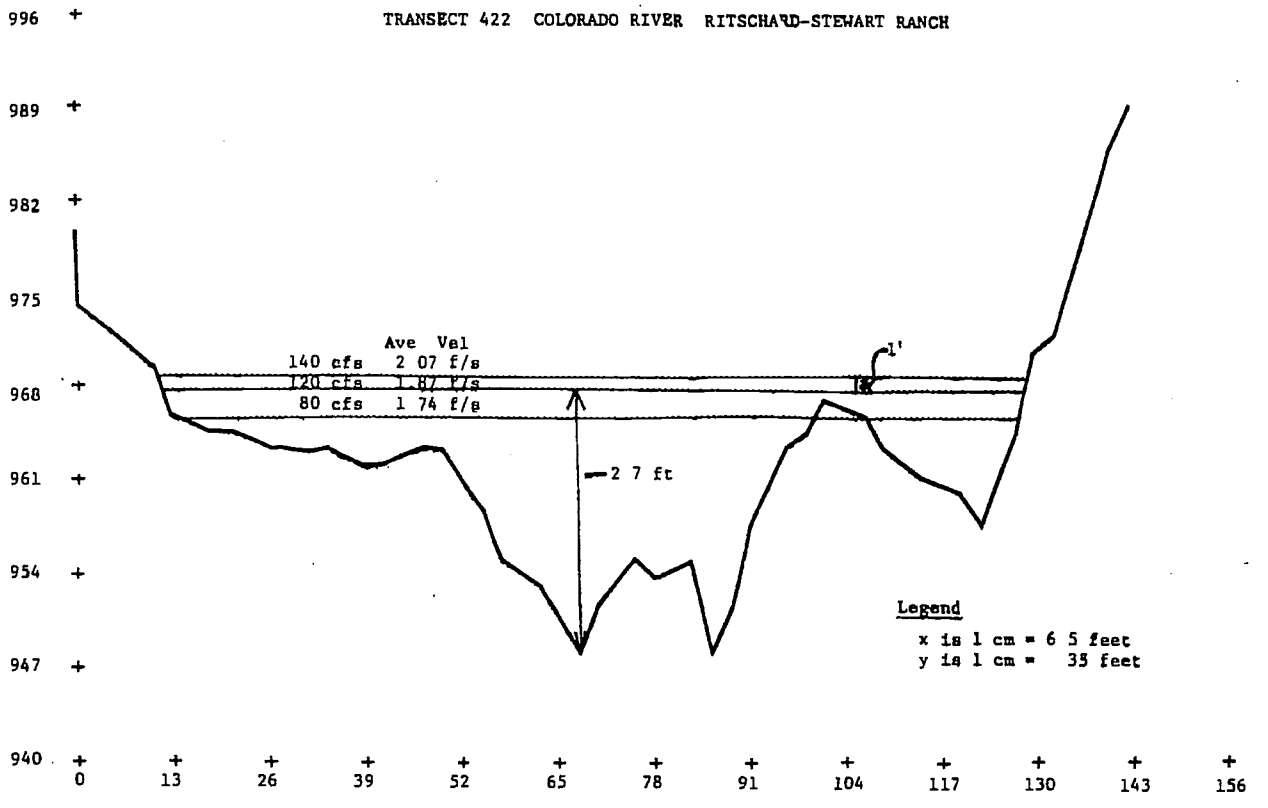


FIGURE 11

TRANSECT 0 COLORADO RIVER HILL-MAYHOFFER RANCH

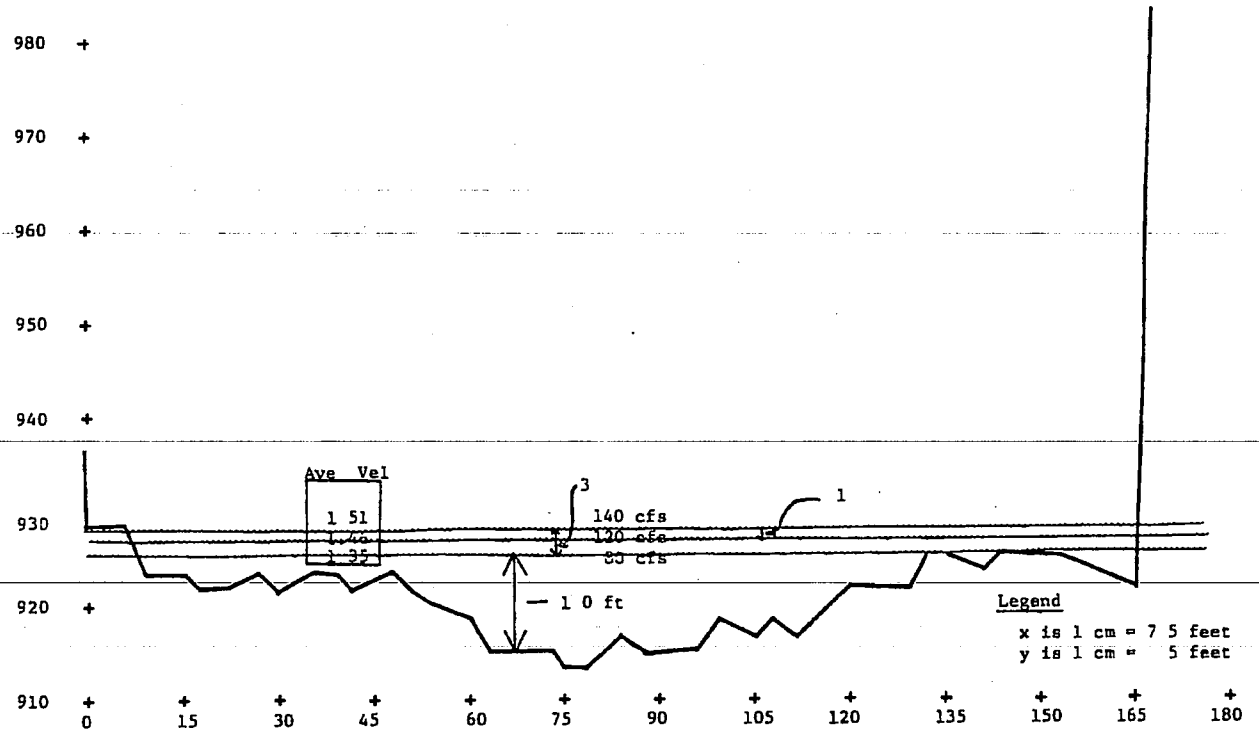


FIGURE 12

TRANSECT 91, COLORADO RIVER HILL-MAYHOFFER RANCH

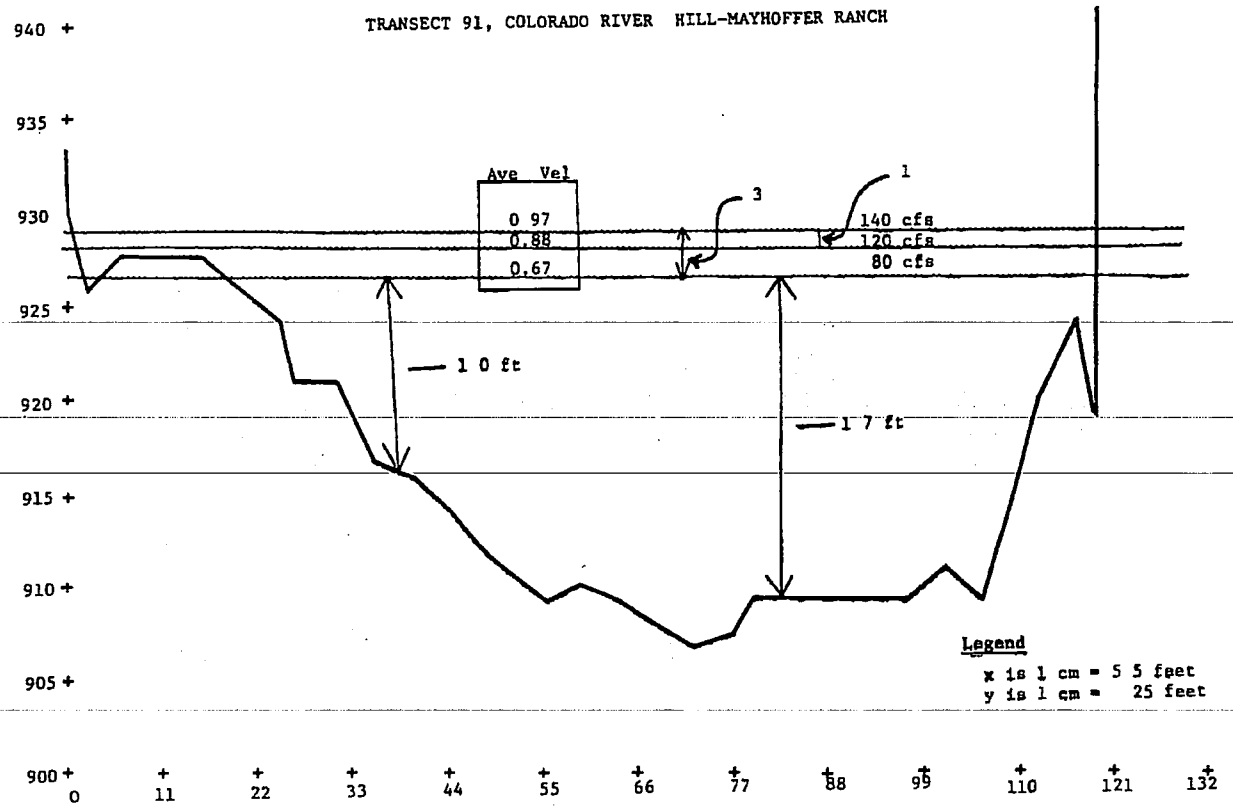


FIGURE 13

TRANSECT 176 COLORADO RIVER HILL-MAYHOFFER RANCH

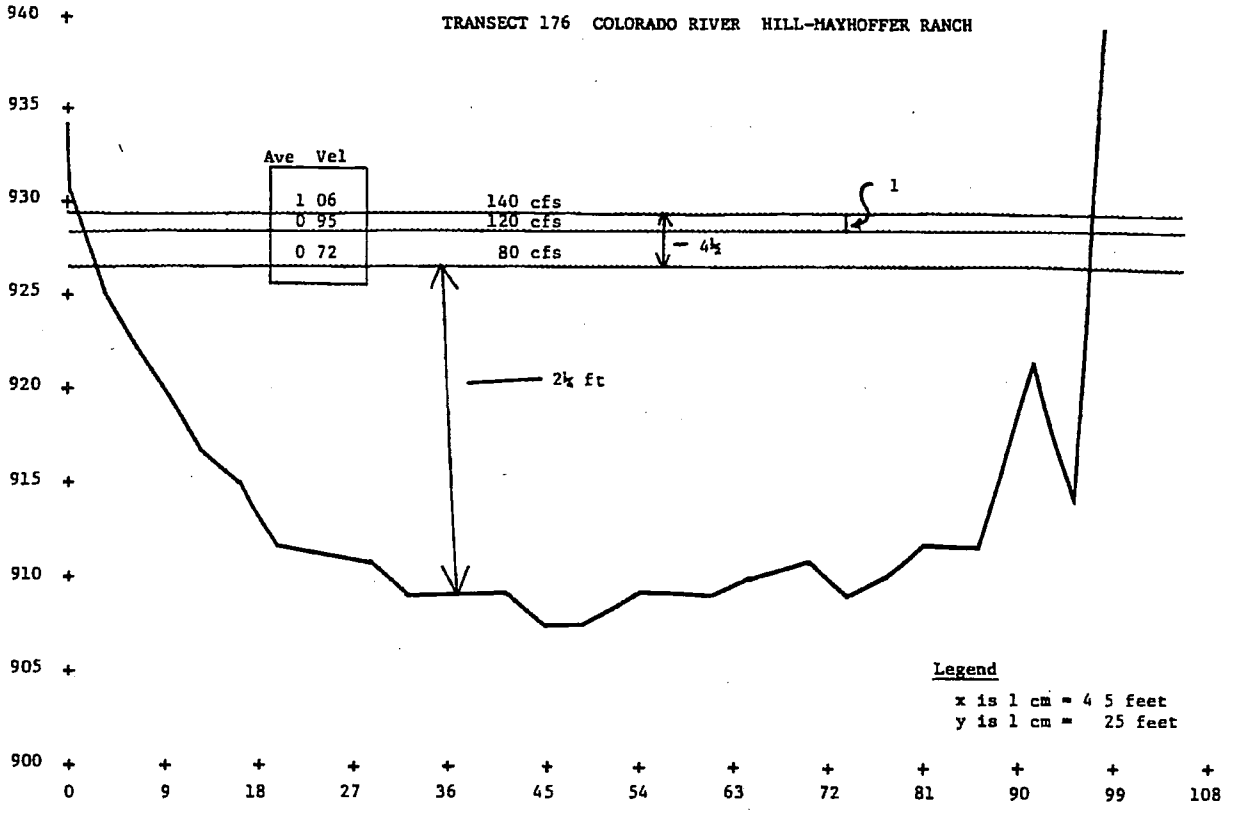


FIGURE 14

TRANSECT 276 COLORADO RIVER HILL-MAYHOFFER RANCH

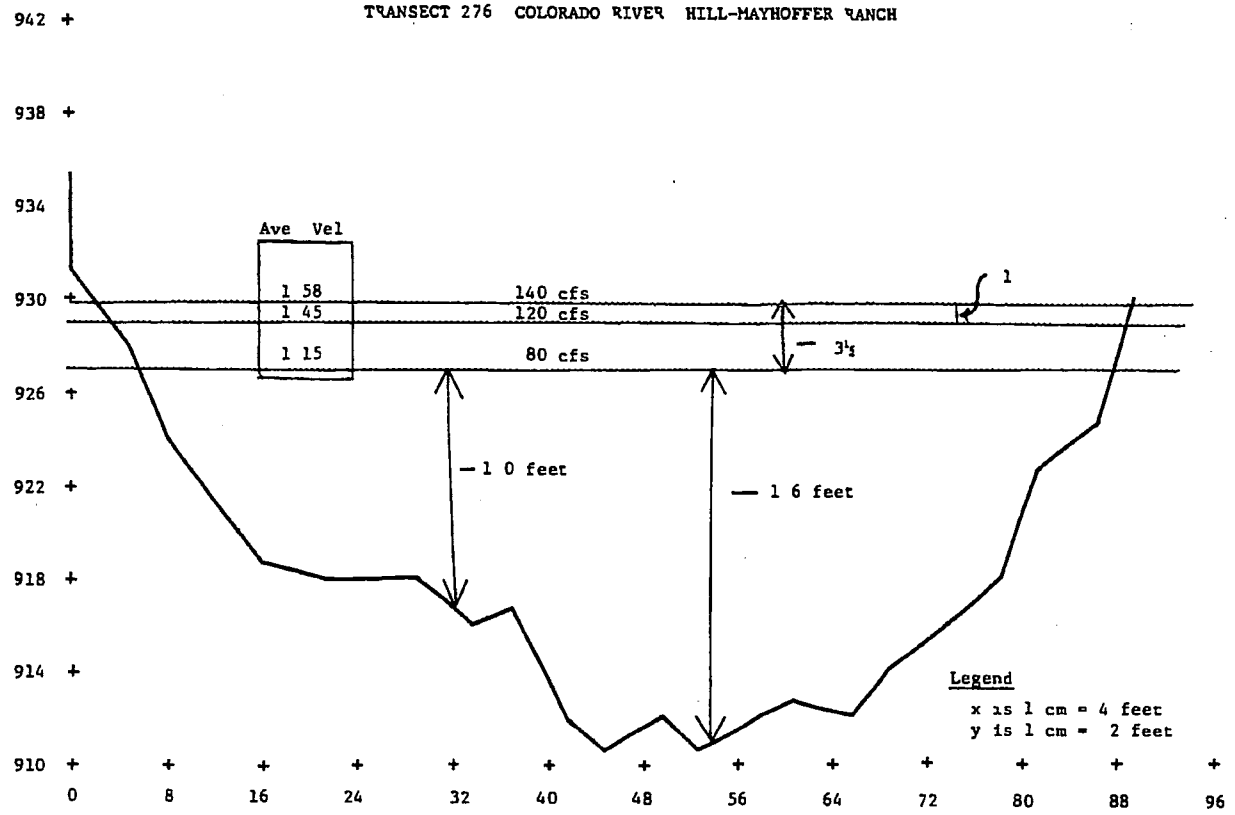
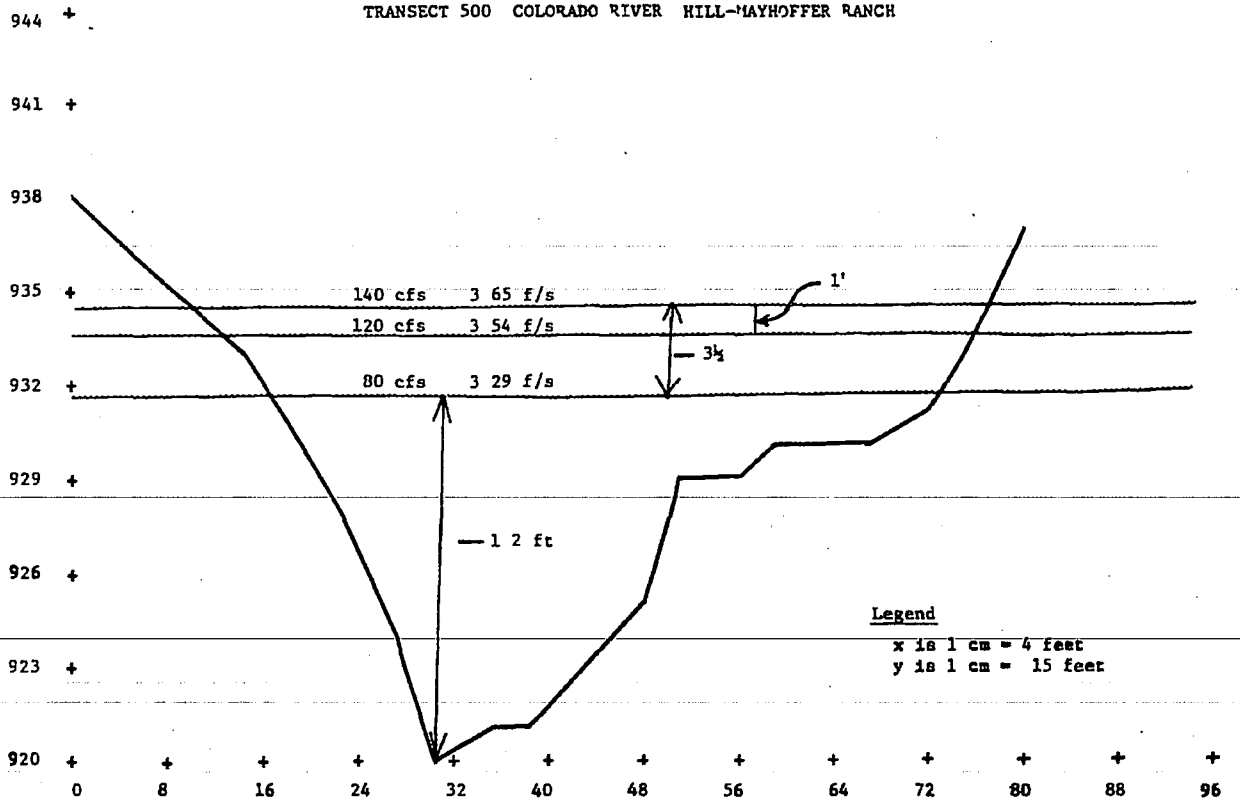


FIGURE 15


TRANSECT 500 COLORADO RIVER HILL-MAYHOFFER RANCH
944
941
938
935
932
929
926
923
920
140 cfs 3 65 f/s
120 cfs 3 54 f/s
80 cfs 3 29 f/s
1'
3½
1 2 ft
Legend
x is 1 cm = 4 feet
y is 1 cm = 15 feet
0
8
16
24
32
40
48
56
64
72
80
88
96

SUPPLEMENT TO AGREEMENT OF APRIL 30, 1980

The Agreement of April 30, 1980, entitled "Agreement Concerning the Windy Gap Project and the Azure Reservoir and Power Project" is hereby amended and supplemented as follows:

RECITALS

It has been determined by the undersigned parties that the Azure Project should not be pursued further by Subdistrict for the purpose of providing water for western Colorado. The term "western Colorado" means any area within the geographical boundaries of River District.

Moreover, the undersigned parties have determined that the provisions of the April 30, 1980 Agreement regarding Subdistrict construction of an alternate facility do not set forth a desirable method of proceeding.

Instead, it is desirable from the standpoint of western Colorado and the Subdistrict that funds, in a sum certain, be provided to the River District for the purpose of assisting western Colorado in the planning and construction of a facility that the River District determines shall be of benefit to the water users of that District, to be located as set forth in this Supplement in full and complete satisfaction of the Subdistrict's obligation to set forth and complete a plan which satisfies §37-45-118(1)(b)(IV) of the Water Conservancy Act. Further, the undersigned parties enter into this Supplement as a means to settle a current dispute regarding the Subdistrict's and the River District's

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rights and obligations under the April 30, 1980 Agreement. Absent this Supplement, litigation regarding the terms of the April 30, 1980 Agreement would have been likely.

While there are several signatories to the Agreement of April 30, 1980 in addition to the undersigned parties, the rights of those additional signatories under the Agreement of April 30, 1980 are not altered by this Supplement.

PURPOSE

The first purpose of this Supplement is to provide western Colorado with financial assistance to enable the River District to construct a water-storage facility or facilities in Water Division No. 5 for the benefit of water users in western Colorado, in full and complete satisfaction of the Subdistrict's obligation to set forth and complete a plan which satisfies §37-45-118(1)(b)(IV) of the Water Conservancy Act.

The second purpose of this Supplement is to remove from the Subdistrict any obligation it had under the April 30, 1980 Agreement to construct the Azure Reservoir and Power Project or an alternate facility for the benefit of western Colorado, and, at the same time, to remove restrictions on Windy Gap diversions as provided in paragraph 10 in this Supplement, which restrictions and conditions were imposed for the purpose of ensuring performance by the Subdistrict of its obligation to construct the Azure Project or an alternate facility.

Paragraphs 1 and 5 of the April 30, 1980 Agreement are superceded by this Supplement.

AGREEMENTS OF SUBDISTRICT

1. The Subdistrict shall, at the Closing provided for in this Supplement, pay into escrow Ten Million Two Hundred Thousand Dollars ($10,200,000.00) in cash, which sum, when paid to the River District from the escrow account, shall be in complete satisfaction of any obligation Subdistrict has under the April 30, 1980 Agreement to construct the Azure Reservoir and Power Project, or an alternate facility, for western Colorado. The escrowed funds shall be held in an escrow account in the First National Bank in Grand Junction, Colorado, or such other bank as River District and Subdistrict mutually agree upon, pursuant to the escrow instructions attached hereto as Exhibit A, with the escrowed funds and all interest which accrues thereon being dedicated for payment to the River District, as provided for by this Supplement. The River District may, at its sole discretion, demand and receive partial withdrawals of the escrowed funds as is specifically provided for in the escrow instructions. Any such partial withdrawals received by River District are not refundable, but Subdistrict shall receive credit therefor as provided in paragraph 18. Upon any partial withdrawal and upon payment and discharge of the escrow account to the River District, this money shall be utilized by the River District to construct a water-storage project or projects in Water

Division No. 5, as provided for in paragraph 17 of this Supplement. If the final order, not subject to appeal or further appeal, does approve this Supplement, the parties agree to obtain discharge of the escrow account as soon as practicable. If the final order, not subject to appeal or further appeal, does not approve this Supplement, all monies in escrow, plus accrued interest thereon, shall be returned to Subdistrict pursuant to the Escrow Instructions.

2. The Subdistrict will dedicate and set aside annually, but noncumulatively, at no cost to Middle Park, 3,000 acre feet of water in Granby Reservoir that is produced each water year from Subdistrict water supplies, for beneficial use without waste, either directly or by exchange or substitution, in Middle Park. Subdistrict will release this 3,000 acre feet of water for all beneficial uses, except for instream uses and industrial uses (unless the industrial use is within a municipality and through its municipal system). These waters shall be released by Subdistrict, upon request of Middle Park and subject to operational criteria established by the United States. Any water so stored in Granby Reservoir shall be the last of any Subdistrict water to be spilled from Granby Reservoir, if such spill is required. The provisions of this paragraph 2 replace and supersede the provisions of paragraph 17 of the April 30, 1980 Agreement. The word "divert" in paragraph 34 of the April 30, 1980

Agreement means diversion to northeastern Colorado measured through the Adams Tunnel.

3. Subdistrict will subordinate its Windy Gap water rights, for 600 c.f.s. from the Colorado River, to: (1) the Rock Creek Project for the purpose of storing the natural flow of Rock Creek only; or (2) the Wolford Mountain Project or any other project on Muddy Creek for the purpose of storing the natural flow of Muddy Creek only, if the River District elects to construct the Wolford Mountain Project with funds received pursuant to this Supplement; or (3) the first 28,000 acre feet of total storage of such other project or projects which the River District elects to build below the confluence of the Blue River and the Colorado River on the mainstem, or on tributaries which join the Colorado River below such confluence, utilizing the funds provided by Subdistrict under this Supplement.

MUTUAL AGREEMENTS OF ALL PARTIES

4. Except as specifically provided by this Supplement, all terms and conditions of the April 30, 1980 Agreement shall remain in full force and effect.

5. Paragraphs 6, 7, 8, 9, 10, 11, 12 and 29 of the April 30, 1980 Agreement are deleted and superseded by this Supplement.

6. The River District intends to utilize the funds received from Subdistrict pursuant to paragraph 1 of this Supplement in order to construct the Rock Creek Reservoir, a

water-storage facility on Rock Creek, a tributary of the Colorado River, substantially in accordance with the application filed by the River District in Case No. 83CW320 (Water Division No. 5) or the Wolford Mountain Project, a water-storage project on Muddy Creek, or another project at such other alternate site which, after further investigation, may prove to be feasible and provide the same or greater benefits as the Rock Creek Reservoir provides.

If the River District determines that Rock Creek Reservoir is not technically or economically feasible, or that another project at an alternate site provides the same or greater benefits, then the River District shall file with Water Court for Water Division No. 5 an application, for approval of the proposed alternate action, with notice as provided by law.

7. The first 2,000 acre feet of water stored each year in the water-storage project constructed by the River District pursuant to paragraph 6 of this Supplement shall be allocated to Middle Park to be utilized by that entity and any entity that it contracts with for use, directly or by exchange or replacement. On or before the first day of each water year, Middle Park shall notify the River District of the quantity of water to be allocated to Middle Park that Middle Park or its assigns expects to utilize in the coming water year. Such quantity of water will be retained to Middle Park's account, to be released as directed by Middle

Park. Except to the extent that operation and maintenance costs are paid pursuant to paragraph 8 of this Supplement, Middle Park shall be obligated to pay the River District ten percent of all of the operation and maintenance costs incurred in operating and maintaining the water-storage project. The volume of water, if any, not disposed of by Middle Park up to said 2,000 acre feet per year shall be utilized by the River District, according to the terms and conditions set forth in paragraph 9 of this Supplement. In return for the rights acquired under this paragraph and paragraph 2 of this Supplement, Middle Park relinquishes to the River District its rights to utilize up to 5,000 acre feet of water per year that were reserved to Middle Park in quit claim deed dated August 17, 1964 regarding the Azure Reservoir, recorded at book 149, page 431 of the real property records of Grand County, Colorado.

8. If the water-storage project that is constructed pursuant to paragraph 6 of this Supplement as hydro-electric generating features paid for by the funds received by the River District pursuant to this Supplement, then any revenues derived from the sale of hydroelectric power produced by these features shall be first utilized to pay the entire operation and maintenance costs of the water-storage and hydroelectric project. Middle Park shall be entitled to payment of that portion of the net proceeds (beyond those required to pay operation and maintenance costs) from the

sale of hydroelectric power that is attributable to the water released for the benefit of Middle Park pursuant to paragraph 7 of this Supplement. If hydro-electric generating features are later included in the project, Middle Park will be afforded the opportunity to participate, up to ten percent, in the financial and proportionate benefits, based upon its contribution.

9. The remainder of the yield of the water-storage project constructed by the River District pursuant to paragraph 6 of this Supplement shall be utilized by the River District in accordance with C.R.S. §37-45-118(1)(b)(IV) and 37-46-101 et seq. on terms and conditions to be determined by the River District. Any revenues derived from the utilization of this water shall be the property of the River District. Subdistrict shall have no rights to or in any of the water stored in, nor shall Subdistrict be entitled to any of the revenues derived or obtained from, the water-storage project constructed by the River District pursuant to paragraph 6 of this Supplement.

10. Upon entry of the final order not subject to appeal or further appeal contemplated by this Supplement, Subdistrict shall be entitled to divert water under its Windy Gap decrees without any requirement to construct the Azure Reservoir and Power Project, or an alternate facility for the benefit of western Colorado, which requirements were set forth in the April 30, 1980 Agreement. At such time, the

provisions of this paragraph shall also satisfy, replace, and supersede the conditions and restrictions on Windy Gap diversions which were contained in paragraph 15 of the April 30, 1980 Agreement, except that Subdistrict shall continue to meet the requirements of paragraph 15 regarding Ranchers' diversion facilities.

11. Subdistrict will withdraw all currently pending statements of opposition and entries of appearance, and will not oppose, directly or indirectly, any application of the River District, for the project or projects to which the Windy Gap Project is subordinated under the provisions of paragraph 3. Subdistrict will also withdraw all currently pending statements of opposition and entries of appearance, and will not oppose, directly or indirectly, the following proceedings currently pending in District Court for Water Division No. 5: 83CW70, 83CW71, 83CW72, 83CW73, 83CW74, 83CW383, 83CW384, and 84CW70. Subdistrict also will not oppose, directly or indirectly, subsequent proceedings involving substantially the same projects in these listed cases wherein the River District and/or another signatory to this Supplement seeks a finding of reasonable diligence or to make a conditional decree absolute. Subdistrict reserves its right to object to changes of water rights of the above listed claims which would cause injury to the water rights of Subdistrict, except that Subdistrict will not object to any change of water right of the River District's Azure

Storage decrees to the extent of the first 20,000 a.f. of storage thereunder at sites below the confluence of the Blue and Colorado Rivers, in order to implement the subordination provision of paragraph 3(3) of this Supplement.

12. The provisions of paragraph 23 of the April 30, 1980 Agreement shall remain in effect, except the language which incorporates Subdistrict's obligation to build the Azure Reservoir and Power Project or an alternate facility.

13. Paragraphs 30, 31, 33, 35 and 39, of the April 30, 1980 Agreement are deleted and superseded by this Supplement.

14. Subdistrict may keep, develop, or dispose of, in its discretion, all engineering, land, rights of way, license applications, water rights, or anything else of value that Subdistrict obtained or developed as a result of its expenditures in pursuing the Azure Reservoir and Power Project, and for which the Subdistrict currently has legal ownership. Any and all revenue or consideration which Subdistrict may obtain from any development, use, sale, lease, or other arrangement it may make regarding such items of value, shall belong solely to Subdistrict. Subdistrict recognizes and acknowledges that it has no right, title or interest in the River District's decrees listed in paragraph 31 of the April 30, 1980 Agreement.

15. The undersigned parties will not oppose Subdistrict's applications for due diligence and, after entry of a final decree approving this Supplement not subject to appeal

or further appeal, for an absolute decree for the Windy Gap Project. The undersigned parties also will not oppose, or protest, and will withdraw any statements of opposition or protests they have filed in the following cases currently pending in the District Court for Water Division No. 5: 83CW347, 83CW348, 84CW110, 84CW111, and 84CW112. The undersigned parties also will not oppose, directly or indirectly, subsequent proceedings involving substantially the same projects as those involved in these listed cases, wherein Subdistrict seeks a finding of reasonable diligence to make a conditional decree absolute. The undersigned parties will not object to any permits, licenses or approvals for a pumpback storage project on the Colorado River which Subdistrict, or persons or entities acting under an agreement with Subdistrict, or succeeding to the rights or interests of Subdistrict by assignment or otherwise, may seek. No water storage or diversion facilities for the purpose of assisting diversions, or obtaining water for beneficial uses, other than for power uses, shall ever be constructed in the vicinity of the Azure site by Subdistrict or its successors in interest or assigns, unless consent is given by River District prior to any construction.

16. All of the undersigned parties agree that the April 30, 1980 Agreement, as amended and supplemented hereby, upon approval by the Court not subject to appeal or further appeal, constitutes full and complete satisfaction of the

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requirement for a "plan" under C.R.S. §37-45-118(1)(b)(IV) and Colorado River Water Conservation District v. Municipal Subdistrict, 198 Colo. 352, 610 P.2d 81 (1979).

17. The funds which Subdistrict pays to River District under paragraph 1 of this Supplement shall be utilized by the River District only for the purpose of planning and constructing a water-storage project or projects in Water Division No. 5 which will satisfy the Subdistrict's obligation under C.R.S. §37-45-118(1)(b)(IV), including all necessary and appropriate activities in connection with such project or projects, including but not limited to such planning, studies, construction, operation, and maintenance (including all reasonably related legal, financial and engineering work) of such project or projects. Subdistrict shall not have any right to determine how the funds paid pursuant to this Supplement are utilized by the River District, if the funds are utilized as provided by this Supplement. Any remaining funds after completion of the project or projects described above shall be the property of the River District for use and disposition as it determines. Subdistrict shall not be entitled to exercise any control over the project or projects that are planned, studied, constructed, operated, and maintained with funds received pursuant to this Supplement, nor shall Subdistrict be entitled to any revenues from the project or projects that

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are planned, studied, constructed, operated, and maintained pursuant to this Supplement.

18. Subdistrict and the River District shall jointly apply for, and use their best efforts to obtain approval of this Supplement by the District Court for Water Division No. 5 and any other court which considers this Supplement, so that this Supplement will be incorporated into the Windy Gap decrees entered in Civil Action No. 1768, Grand County District Court, and Case Nos. W-4001 and 80CW108, Water Division No. 5, and they shall jointly apply in the same court or courts for a ruling that Subdistrict's obligation under this Supplement, constitutes full and complete satisfaction of all requirements placed on Subdistrict by C.R.S. §34-45-118(1)(b)(IV) and Colorado River Water Conservation District v. Municipal Subdistrict, 198 Colo. 352, 610 P.2d 81 (1979) in connection with the Windy Gap Project. Time is of the essence in obtaining judicial approval of this Supplement and both Subdistrict and the River District shall use their best efforts to attempt to obtain judicial approval as soon as possible. If the District Court for Water Division No. 5 does not enter a final decree approving this Supplement, and appellate review fails to obtain entry to such decree, then this Supplement shall be of no further force and effect, except for the provisions of the immediately succeeding sentence. If a final decree approving this Supplement is not entered following proceedings in Water

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Division No. 5 and appellate review, then the April 30, 1980 Agreement shall remain in full force and effect, unaltered by this Supplement, except that the (1) Subdistrict shall receive credit under the April 30, 1980 Agreement for all money paid to the River District pursuant to this Supplement, (2) Subdistrict's execution of this Supplement and performance thereunder shall constitute diligence under the April 30, 1980 Agreement, (3) River District's and Subdistrict's rights and obligations under paragraphs 6 and 12 of the April 30, 1980 Agreement shall be considered tolled in the interim s of April 1, 1983, to be resumed if and when final appellate review fails to obtain entry of a decree approving this Supplement, and (4) except as explicitly provided for by clauses (1), (2) and (3) of this sentence, nothing in this Supplement, or in the negotiations leading to this Supplement, shall be construed to affect or as affecting any of the rights of obligations of the signatories to this Supplement in subsequent litigation concerning the April 30, 1980 Agreement.

19. Until such time as the final order not subject to appeal or further appeal contemplated by this Supplement enters and so long as Subdistrict is not in default in its obligations under this Supplement, River District hereby consents to Windy Gap Project diversions in priority by the Subdistrict. In the event of default by Subdistrict of its payment or other obligations under this Supplement, River

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District may, at its option, withdraw such consent, and Subdistrict shall have no right to divert water by means of the Windy Gap Project until such default is cured.

20. This Supplement shall become effective upon Closing. The Closing shall be held at the offices of Davis, Graham & Stubbs, of Denver, Colorado, on March __, 1985, at the hour of 10 o'clock a.m.. At Closing all parties listed below shall deliver to each other duly executed copies of this Supplement, and the Subdistrict shall perfect payment of the sums required by this Supplement into the escrow account by wire transfer.

Dated this _____ day of March, 1985.

Signed

MUNICIPAL SUBDISTRICT, NORTHERN COLORADO WATER CONSERVANCY DISTRICT

ATTEST:

_____
Secretary

By_____
President

COLORADO RIVER WATER CONSERVATION DISTRICT

ATTEST:

_____
Secretary

By_____
President

BOARD OF COUNTY COMMISSIONERS OF THE COUNTY OF GRAND, COLORADO

ATTEST:

Secretary

By Herbert A. Ritschard
Chairman

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ATTEST:

NORTHWEST COLORADO COUNCIL OF GOVERNMENTS

Secretary

By
Chairman

ATTEST:

MIDDLE PARK WATER CONSERVANCY DISTRICT

Secretary

By
President

ESCROW AGREEMENT

THIS AGREEMENT is made and entered into this 21st day of March, 1985, by and among the MUNICIPAL SUBDISTRICT, NORTHERN COLORADO WATER CONSERVANCY DISTRICT (the "Subdistrict") and the COLORADO RIVER WATER CONSERVATION DISTRICT (the "River District"), as Depositors, and the First National Bank in Grand Junction (the "Bank"), as Escrow Agent.

RECITALS

WHEREAS, an Agreement dated April 30, 1980 (the "Windy Gap Agreement"), provided for the settlement of a dispute surrounding the construction of the Windy Gap Water Project on the Colorado River near Granby, Colorado; and

WHEREAS, the Subdistrict and the River District have entered into a Supplement to the Windy Gap Agreement dated March 21, 1985 (the "Supplement"); and

WHEREAS, the Supplement contemplates the execution of this escrow agreement; and

WHEREAS, the Subdistrict and the River District desire to have the Bank act as escrow agent under the Windy Gap Supplement, and the Bank desires to act as escrow agent in accordance with the terms set out below;

NOW, THEREFORE, in consideration of the premises, the parties hereto agree as follows:

1. Escrow Account Name. The Fund to be held under this Agreement shall be designated and known as the "WINDY GAP ESCROW ACCOUNT."

2. Escrow Deposit. Upon execution and delivery of the Windy Gap Supplement by all parties, the Subdistrict will deposit with the Bank the sum of 10.2 Million Dollars ($10,200,000.00) to be held in the Windy Gap Escrow Account, provided that the Subdistrict's obligation to make such deposit shall run solely to the River District. The parties acknowledge that the Bank has no duty to compel the Subdistrict to fund the Windy Gap Escrow Account.

3. Escrow Instructions. No disbursement of funds from this account shall be made by the Bank except as specifically provided below:

a. On or after July 1, 1985, upon written request by the River District, the Bank shall disburse and pay to the River District a sum of up to, but not to exceed, Five Hundred Thousand Dollars ($500,000.00).

b. On or after February 5, 1986, upon written request by the River District, the Bank shall disburse and pay to the River District an additional sum of up to, but not to exceed, One Million Dollars ($1,000,000.00).

c. Except as otherwise provided in Paragraph 4 below, after entry of the final court order and decree contemplated by the Supplement, not subject to appeal or further appeal, which approves the Windy Gap Supplement and finds that the provisions of the Supplement satisfy the Subdistrict's obligations under C.R.S. §37-45-118(1)(b)(IV), upon written request and submission of proof of such final

decree by the River District, the Bank, after complying with the notice requirements of subparagraph (c) below, shall disburse and pay to the River District any and all funds then remaining in the account, including any interest or earnings accrued on such funds, minus the Bank's fees and charges under paragraph 6 below.

d. Except as otherwise provided in paragraph 4 below, after entry of a final court order and decree, not subject to appeal or further appeal, which disapproves the Windy Gap Supplement or finds that the provisions of the Supplement do not satisfy the Subdistrict's obligations under C.R.S. §37-45-118(1)(b)(IV), upon written request and submission of proof of such final decree by the Subdistrict, the Bank, after complying with the notice requirements of subparagraph (c) below, shall disburse and pay to the Subdistrict any and all funds then remaining in the account, including any interest or earnings accrued on such funds, minus the Bank's fees and charges under paragraph 6 below.

e. Upon receipt of a request for disbursement from the River District or the Subdistrict pursuant to subparagraphs (c) or (d) above, if the conditions of those subparagraphs have been met, the Bank shall give written notice by certified or registered mail of such request to the other party, which shall have fifteen (15) days from the date of receipt of such notice to object to the Bank in writing concerning the disbursement of funds to the requesting

party. If no written objection is received by the Bank within the time period specified above, the Bank shall disburse funds from the account in accordance with such request. If a written objection is received by the Bank within the time period specified above, the Bank shall proceed in accordance with the terms of paragraph 4 below.

f. Notwithstanding the foregoing provisions, upon written request signed by authorized representatives of both the Subdistrict and the River District, the Bank shall disburse the funds in the account in accordance with such joint written request.

4. Disagreements. Notwithstanding the foregoing provisions, if any disagreement or dispute arises between the Subdistrict and the River District concerning the meaning, validity or operation of any provision under this Agreement, or if any objection to a requested disbursement of funds has been duly submitted to the Bank in accordance with paragraph 3(a) above, then the Bank:

a. Shall be under no obligation to act, except under process or order of court, or until it has been adequately indemnified to its full satisfaction, and shall sustain no liability for its failure to act pending such process, court order or indemnification; and

b. May, in its sole and absolute discretion, deposit the funds then remaining in the account with the Clerk of the District Court for Water Division 5, State of

Colorado, to interplead the Subdistrict and the River District. Upon such deposit and filing of interpleader, the Bank shall be relieved of all liability as to the escrowed funds and shall be entitled to recover from the Subdistrict or River District, as may be determined in the interpleader, its reasonable attorneys' fees and other costs incurred in commencing such action. The Subdistrict and the River District acknowledge the jurisdiction of such Court for the purposes of this Agreement.

5. Investment of Funds. The Bank shall invest all funds held and deposited in the account in any one or more of the following interest-bearing instruments:

a. Bonds or securities of the United States or of an agency of the United States if the bonds are guaranteed by the United States; or

b. Bonds of the State of Colorado or any county or municipal corporation in said State, which are rated in one of the two highest rating categories by Moody's Investors Service, Inc. and Standard & Poor's Corporation.

c. Any other security, bond or investment which is expressly authorized by Title 37, Article 46, Section 129, Colorado Revised Statutes, and any amendments thereto, to which the Subdistrict and the River District both consent in writing directed to the Bank.

Within this purview of permitted investments, the Bank shall invest all funds in accordance with the instructions of

an authorized representative of the River District, which instructions may be given from time to time at the discretion of the River District. No liability shall attach to the River District for the instructions it may give or not give pursuant to this paragraph.

6. Compensation of Escrow Agent. The Bank shall deduct from the funds deposited in the account and shall retain as compensation:

a. The sum of $_____ for all services rendered by the Bank under this Agreement, which sum shall be deducted by the Bank from the funds initially deposited into the escrow account; and

b. Its reasonable and actual costs incurred for services rendered in connection with this Agreement but not expressly provided for hereunder, if any, including but not limited to court costs and attorney's fees in the event of any dispute among the parties to the Agreement.

7. Non-Liability of Escrow Agent. The Bank shall not be liable for any act it may do or omit to do as Escrow Agent, so long as it is acting non-negligently, in good faith, in the exercise of its best judgment, pursuant to instructions of the authorized representatives of the River District and the Subdistrict, and in accordance with the terms of this Agreement and applicable law. Any act done or omitted by the Bank pursuant to the advice of its attorneys shall be conclusive evidence of its good faith. The Bank

shall have the right to consult with counsel whenever any question arises concerning this Agreement and shall incur no liability for any delay reasonably required to obtain such advice of counsel.

8. Indemnification of Escrow Agent. The Subdistrict and the River District, jointly and severally, agree to indemnify and hold harmless the Bank from any liability, cost or expense, including attorney's fees, necessarily incurred by the Bank to any other person, firm or corporation solely as a result of the Bank's accepting funds in the account, or solely as a result of the Bank's acts in accordance with instructions of the authorized representatives of the River District and the Subdistrict.

9. Assignment. No sale, assignment or transfer of any right or interest in and to the subject matter of this Agreement shall be effective unless approved in writing by the Bank, the Subdistrict and the River District. Any such duly approved sale, assignment or transfer shall be binding upon the Bank upon delivery of notice to the Bank of the assignment and payment to the Bank of all fees, if any, owed to the Bank in connection with that assignment.

10. Amendment. This Agreement may be amended, modified or superseded only by a written instrument executed by all parties to the Agreement.

11. Termination. This Agreement may be terminated at any time, without cause, upon ten (10) day's notice in

writing from both the Subdistrict and the River District to the Bank. Unless that termination notice is accompanied with written instructions to the Bank from the Subdistrict and the River District for transfer or disposition of the Windy Gap Escrow Account, the Bank shall deposit the Windy Gap Escrow Account with the Clerk of the District Court for Water Division 5, State of Colorado, and interplead the Subdistrict and the River District as provided in paragraph 4.b. above.

12. Notices. All notices required or permitted to be given hereunder shall be given in writing, and shall be sent by registered or certified mail addressed as follows:

If to the River District:

Colorado River Water Conservation District
Attention: Roland C. Fischer,
Secretary-Engineer
P. O. Box 1120
Glenwood Springs, Colorado 81601

If to the Subdistrict:

Municipal Subdistrict, Northern Colorado
Water Conservancy District
Attention: Larry Simpson,
Secretary-Manager
P. O. Box 679
Loveland, Colorado 80537

If to the Bank:

First National Bank in Grand Junction
Attention: Trust Department
P. O. Box 608
Grand Junction, Colorado 81502

The Subdistrict and the River District shall furnish to the Bank satisfactory evidence of the authority of the representative or representatives designated by them to give all notices, instructions, or other communications called for under this Escrow Agreement.

13. Governing Law. This Agreement shall be construed and enforced in accordance with the laws of the State of Colorado.

14. Headings. The headings of the paragraphs of this Agreement have been inserted for convenience of reference only and shall in no way restrict or otherwise modify any of the terms or provisions of the Agreement.

15. Counterparts. This Agreement maybe executed in one or more counterparts, each of which when executed shall be deemed to be an original, and such counterparts shall together constitute one and the same instrument.

16. Entire Agreement. This Agreement sets forth the entire agreement and understanding of the parties to the Agreement.

IN WITNESS WHEREOF, the parties to this Agreement have each caused the Agreement to be duly executed effective as of the day and year first above written.

MUNICIPAL SUBDISTRICT, NORTHERN COLORADO CONSERVANCY DISTRICT

By_____
President

ATTEST:

By_____
Secretary

COLORADO RIVER WATER CONSERVATION DISTRICT

By_____
President

ATTEST:

By_____
Secretary

FIRST NATIONAL BANK IN GRAND JUNCTION

By_____

Title:_____

ATTEST:

By_____

Title:_____



GRAND COUNTY:
ITS ECONOMY & WATER RESOURCES

PREPARED FOR:
GRAND COUNTY, COLORADO

PREPARED BY:
COLEY/FORREST, INC.

COLEY/FORREST

JULY 2007

EXHIBIT 43

GRAND COUNTY:
ITS ECONOMY AND WATER RESOURCES

PREPARED BY COLEY/FORREST, INC. FOR GRAND COUNTY, JULY 2007

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SUMMARY

Purpose. This paper provides context regarding Grand County's recent economic history relative to its water resources and summarizes some currently proposed actions affecting water resources in the County. Figures and findings presented in this Summary section are documented in subsequent sections of the text.

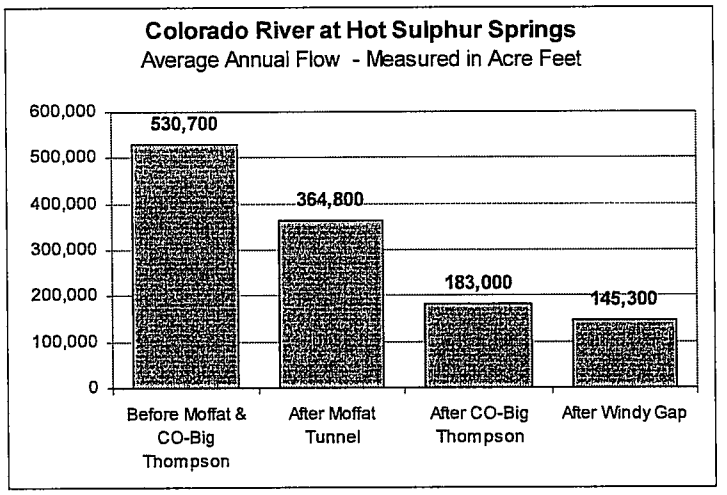
Economy. *(Sections 1.1-1.5)* The Grand County is relatively small in terms of population and employment, but provides a vital service to the Front Range residents and economic developers as its closest mountain respite and recreation destination. The flow of water is inextricably tied to the County's economy and character.

Grand County's historic roots are in agriculture, where low water flows stress irrigation systems. Since the 1940s, tourism has grown to become the County's primary economic driver. Unlike other, more urban environments, every tourist activity in the County relies directly on water.

Grand County's only source of water is annual snowfall and rainfall from the continental divide. It does not import water. [1] No water providers in Grand County own raw water storage facilities that could moderate the impacts of a drought.

Due to the legal characteristics of water rights in Colorado, any entity may purchase and divert water. In Grand County, there were large-scale purchases of water and subsequent transmountain diversions in the late 1880s and again in the first half of the 1900s. Local water and sanitation districts purchased modest amounts of water in the second half of the 1900s. But for the Colorado Water Conservation Board's relatively recent activity starting in the 1970s, no other entity has purchased water on behalf of the forest, its wildlife and natural environment. Yet, Grand County's economy is directly dependent on the health of its natural environment.

Current Water Resource Diversions. *(Sections 2.1 & 2.4)* Three sizeable Front Range water providers, Denver Water, the Northern Colorado Water Conservancy District (NCWCD), and the Municipal Subdistrict of the NCWCD (Subdistrict) divert a substantial amount of water that originates in Grand County to satisfy Front Range community water needs.[2] One illustration of the general magnitude of this

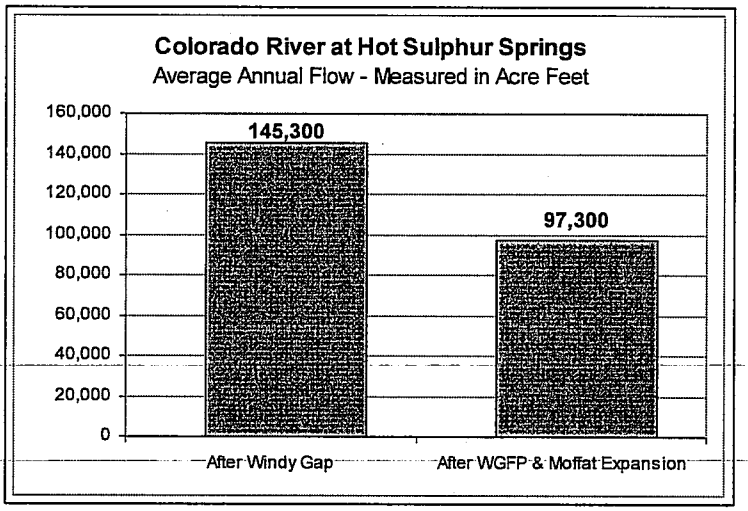


trans-mountain diversion is depicted in the graph to the right. It shows the average annual flow of water on the Colorado River at Hot Sulphur Springs during several different historical periods, including (a) the period before Denver Water, Bureau of Reclamation / NCWCD and Subdistrict trans-mountain diversions (1904-1935), (b) after construction of the Denver Water Moffat Tunnel (1937-1951), (c) after construction of the Moffat Tunnel and the Colorado-Big Thompson Project (1952-1984) and (d) after these two projects plus the Subdistrict's Windy Gap Project (1985-1994). This data is from a gage that was maintained by the USGS between 1904 and 1994. While annual changes in water flow are due not only to these Front Range water providers, but also to climatic conditions and related snowfall, in-basin uses, and other smaller factors, the graph is a good tool to illustrate the general magnitude of the diversions.

Annual transmountain diversion of water from the Moffat Tunnel and the Alva Adams Tunnel over the last 25 years has averaged about 280,600 acre feet. Assuming a 10% factor for evaporation during transport, this volume of water is sufficient to serve about 1.1 million people.

As explained in subsequent sections, these historic trans-mountain diversion projects have already created environmental constraints on the County that have compromised the aquatic and riparian ecosystems and triggered a number of related socio-economic impacts. Under drought conditions, some Upper Fraser Valley water and sanitation districts would not be able to deliver water to their anticipated customers. Grand County is at the tipping point with respect to water resources.

Pending Water Provider Actions. *(Section 2.5)* Two major water providers have proposed additional water diversion projects that would further exacerbate already strained water resource conditions. Denver Water proposes to withdraw an additional firm annual yield of 18,000 acre-feet of water through the Moffat Tunnel. The Subdistrict proposes to withdraw a firm annual yield of 30,000 acre-feet of water through the Alva Adams Tunnel, using its Windy Gap Project. As illustrated in the graph to the right, if both providers use the maximum additional diversion they seek, and if firm yield is equivalent to actual water diverted, then these actions could trigger an additional 33% reduction in water flow on the Colorado River at Hot Sulphur Springs (145,300 acre-feet to 97,300 acre-feet). This is equivalent to an 82% reduction in water flows from average annual pre-diversion conditions (530,700 acre-feet) that existed between 1904 and 1936. (530,700 acre-feet to 97,300 acre-feet = 82% reduction)



Current Grand County Actions. *(Section 3.1)* Grand County and its local water providers have been and continue to respond creatively to its constrained water resources through growth management guidelines contained in its *Master Plan,* imposition of a countywide water quality impact fee on new development, water conservation requirements imposed by water and sanitation districts, construction of a water recycling plant, research regarding proper streambed management practices, and research regarding techniques to re-use existing water in the Upper Fraser River.

New Water Resource Challenges. *(Sections 2.3, 2.6 & 3.2)* Grand County is gravely stressed from the cumulative environmental impacts of withdrawing hundreds of thousands of acre-feet of water annually via trans-mountain diversion projects. Except for the Windy Gap project, these cumulative impacts have gone substantially unmitigated as they were approved before local, state and federal regulations requiring mitigation were in place.[3] Further reductions in water resources may jeopardize the environment below the minimum flows necessary to maintain the already compromised ecosystem. Proponents of the proposed water diversion projects should carefully evaluate the environmental impacts of their proposals and related socio-economic consequences in light of these conditions.

There are a number of potential water resource management and construction opportunities that would cause no or relatively minimal problem to Front Range water providers and would enable Grand County to maintain its agricultural roots and continue to function as a primary mountain respite and recreation resource location for Front Range residents.

PART 1: THE GRAND COUNTY ECONOMY

1.1 CURRENT GRAND COUNTY ECONOMIC SNAPSHOT

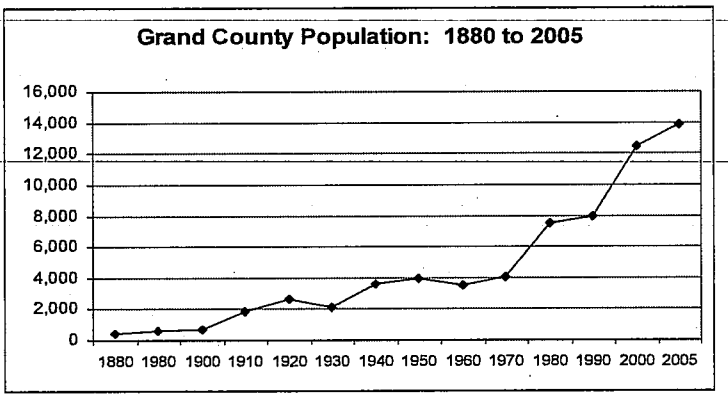
STATISTIC	ESTIMATE	PERSPECTIVE, DESCRIPTION
Population [4]	13,906	0.3% of State; 0.5% of 7-county Denver Metro Area
Average Annual Jobs [5]	6,853	0.3% of State; 0.5% of 7-county Denver Metro Area
Acres [6]	1,196,160,000	68% Public; 22% Agriculture; 10% Private-Non-Ag
Avg. People per Sq. Mile [7]	6.7	Colorado Average: 41.5
Privately Owned Property[8]	$4,823,553,550	30% Local (Grand County); 67% Non-Local
Visitors [9]	1,000,000 2,981,000	Skiers at Winter Park Visitors to Rocky Mountain National Park
Principle Drivers		Tourism and Agriculture

1.2 Economic History: 1874+ [10]

In 1874, the Territorial Governor of Colorado carved Grand County from Summit County. This is the same year that wagon roads were completed on Rollins Pass and Berthoud Pass, the first water rights claim was filed in Grand County (on Sheep Creek) and historical journals recorded the beginning of permanent "settlement" by White Americans. Its current boundaries were set in 1877 when Routt County was carved from a portion of Grand County.

Until relatively recently, Grand County's economy has been driven by extraction of its natural resources (water, minerals, and timber) and ranching. Only recently in the County's history has tourism begun to comprise a major portion of its economic activity.

The County's permanent population, as illustrated in the graph to the right, began to grow in the 1970s as the economy moved from its roots in resource-extraction and ranching to its new tourism-dependent orientation. Prior to the 1970s, the County's economy was not labor intensive. Ranches were spread widely; the first water diversion project was built by laborers from Japan and Mexico; the timber industry was staffed primarily by temporary laborers from Denver.

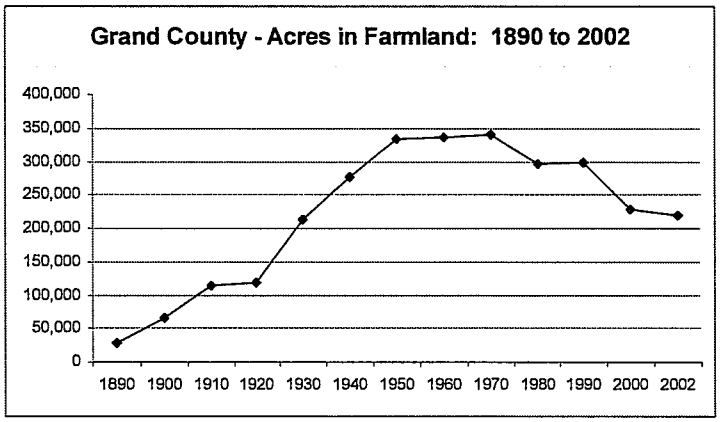


Trans-Mountain Water Diversion. In the late 1880s, the Water Supply and Storage Company began construction of the Grand River Ditch (now the Grand Ditch) across what is now Rocky Mountain National Park. This ditch functions today, serving ranchers and municipalities along the northern Front Range. Grand River's name was subsequently changed to the Colorado River. This project is at the origin of the Colorado River. The Ditch diverts an average of 20,000 acre-feet of water annually. [11]

Mining. While the 1860s brought a number of prospectors to Middle Park from the Blue River passageway to prospect for gold, it was in the late 1870s, that silver, lead, copper and gold ore discoveries were made near Grand Lake. However, relatively little ore was discovered and extracted. One benefit of this is that Grand County has pristine water in the high-elevation headwaters of the Colorado River. More than 100 years later, in 1976, the Henderson Mine opened; it is located in the Williams Fork Valley near Empire. Water that is downstream from this molybdenum mine flows into the West Fork of Clear Creek and Woods Creek. It is regulated by a National Pollution Discharge Elimination System (NPDES) Permit, issued by the Colorado Department of Public Health and Environment.

Ranching. Most large ranches started as small homesteads or pre-exemptions of government land grants. By the mid 1870s, there were homesteads on all major drainage ways: the Blue River, Muddy Creek, Troublesome, Grand River, Williams Fork, Eight and Nine Mile Creeks, Pole Creek, Ranch Creek, Fraser River, and St. Louis Creek. Ranchers expanded their operations by buying homesteads from other pioneers who were ready to sell. In 1875, records indicate that members of the Couzens family were the first permanent white settlers in the County.

By 1890, there were 105 ranches on 27,720 acres. By 1925, there were 269 ranches on 149,700 acres. Total acreage for ranching reached a peak in 1980, as illustrated in the graph to the right, and has been declining since that time. In 2002, the date of the most recent US Census of Agriculture, there were 173 ranches occupying 219,600 acres.



Timber. The advent of train service over Rollins Pass spurred logging and related sawmill and box manufacturing activity in the Upper Fraser Valley. From the early 1900s through the early 1950s, the timber industry was robust. The Fraser River and its tributary streams were used to transport logs to sawmills located in Tabernash, Fraser and Winter Park. The first man-made reservoir, Meadow Creek, was built by a timber industry company, Western Box Company. The proximity of rail service and nearby national forests made Kremmling an ideal location for a Louisiana Pacific wafer board factory. Until its closure in 1992, this factory was Kremmling's primary employer.

Tourism. Tourism played an important role in the County's early history. In the 1870s, rustic "resorts" were built in Hot Sulphur Springs and Grand Lake. These resorts attracted fisherman and hunters. In the early 1900s, tourism activity broadened as Grand Lake emerged as a recreation respite for affluent families escaping the summer heat. Rocky Mountain National Park was created in 1915. For several decades thereafter (1915 – 1925), the Upper Fraser Valley was a tourist travel-way to Grand Lake-based recreation.

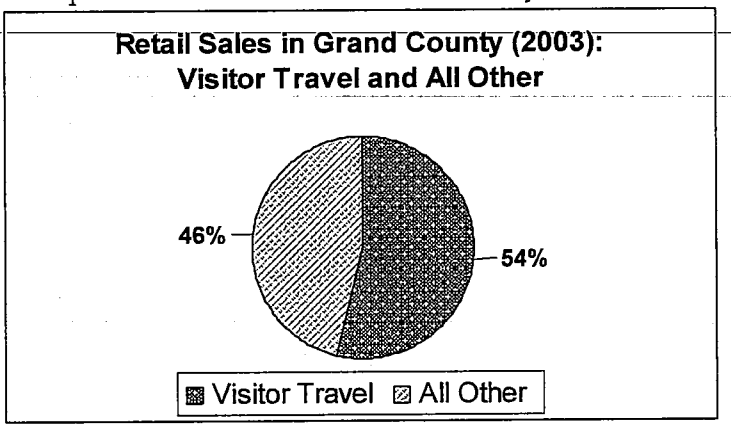
Alpine skiing for recreation purposes also started in Hot Sulphur Springs and Grand Lake in the early 1900s and expanded to Berthoud Pass in the 1930s. In the Fraser Valley, alpine skiing for recreation purposes began in the early 1930s with improvements built by the Colorado Arlberg Club and the US Forest Service. In 1936, George Cranmer, Denver Manager of Improvements and Parks, traded for land near West Portal and received permission from the US Forest Service and the Moffat Tunnel Commission to build a base area at Winter Park. January 1940 marked the formal opening of the Winter Park Ski Area.

Water Acquisition and Diversions. In 1921-1922, when Denver Water initiated and activated its long-range plans for western slope water acquisition and trans-mountain diversion, and in 1933 when the Grand Lake Committee organized to pursue construction of the Colorado River-Big Thompson Project, Grand County was a sparsely populated, resource based economy, driven primarily by ranching and timber production with a modest tourism base in Grand Lake. This local economic condition continued through the 1930s.

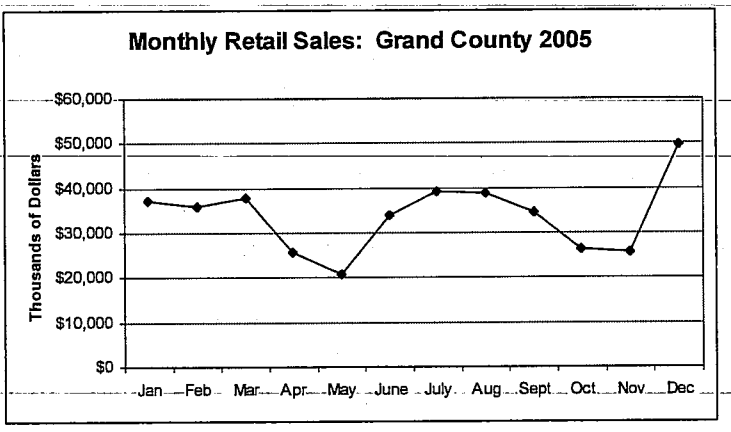
1.3 TOURISM, GRAND COUNTY'S ECONOMIC DRIVER

Gradually, since 1940, tourism has grown to become the primary economic driver in Grand County. Unlike other more urban environments, every tourist activity in Grand County relies directly on water.

The *Economic Impact of Travel on Colorado* report [12] estimates that in Grand County, the direct impact of spending by visitors equaled $169.7 million in 2003. These expenditures included only spending on travel, lodging, food and beverages, recreation and other visitor-related commodities. It understates the actual impact on the County's economy because it included no secondary (indirect and induced) impacts such as visitor-related construction activity and business services. This volume of spending comprised 54% of total retail expenditures in the County.[13] The Report also estimated that jobs directly related to visitors totaled 2,680; this equated to 39% of total jobs in the County. In addition, visitors paid $7.1 million in local government taxes, which include lodging, auto rental, and sales tax.



As illustrated in the graph to the right, monthly retail sales fluctuate with the height of the summer (July and August) and winter (January, February, March) tourism seasons. [14] Local businesses as well as municipal governments are highly dependent on retail sales.



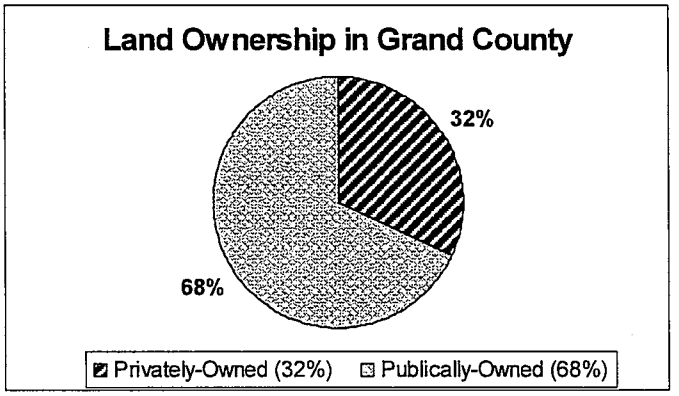
In the winter months, the primary

economic driver is skiing, with Winter Park attracting about 1,000,000 skier visits annually plus skier visits at Devil's Thumb, The YMCA of the Rockies, Sol Vista and Grand Lake. Dispersed snowmobile, snowshoe, ice-fishing, and trail cross-country skiing round out winter tourist activities.

In the summer months, the primary economic driver is visitors from Rocky Mountain National Park (2,981,039 during 2005) as well as visitors to the County's many fishing, mountain biking, hiking, rafting, kayaking, boating, or viewing and event venues. Grand County benefits from boating and fishing activities in man-made and natural lakes and reservoirs.

1.4 Land Ownership

More than two-thirds (68%) of Grand County land is owned by the federal, state or local governmental entities and less than one third (32%) is owned privately. Most of the privately held land (22% of the total) is in agricultural uses and the remainder (10% of the total) is residential and nonresidential uses.[15] This condition is both a reason for the County's attraction as a tourist destination and a reason why careful stewardship of the small proportion of remaining, privately-held land is vital.



1.5 Local and Non-Local Relationships

Grand County's economy is deeply intertwined with the residents and businesses in the Denver metropolitan area and the Front Range.

Front Range residents rely on Grand County as their respite from urban living. Front Range economic developers rely on the availability of quality of life experiences in nearby Grand County to promote future business activity on the Front Range. Grand County relies on the Front Range for a substantial portion of its visitor base. A few indicators of this economic inter-dependence are property ownership and skier visits.

PRIVATELY-OWNED PROPERTY
(2006 Actual Values)

All Owners:	Grand County	Fraser Valley
Local Owners	33%	30%
Non-Local Owners	67%	70%
Total	100%	100%
Non-Local Owners:		
Denver Metro	40%	40%
Other Front Range	3%	5%
All Other	24%	25%
Total	67%	70%

Source: Grand County Tax Assessor Data

- Based on information regarding actual values from the Grand County Tax Assessor's files,[16] 33% of all privately-owned property in Grand County is held by owners with local, Grand County addresses and 67% is held by other non-local owners.

- Similarly, within the Fraser Valley, 30% of privately owned property is held by owners with Grand County addresses and 70% is held by others. Forty percent (about 2,500) of all property owners in the Fraser Valley have addresses in the seven-County Denver metropolitan area.[17]

Another direct link between the Grand County economy and the Front Range is the Winter Park Ski Area, which was constructed and is owned by the City and County of Denver. Ski area staff estimates that 61%[18] of its 1,000,000 plus skiers are day visitors; nearly all of these skiers are from Front Range communities. Since Denver is a local government, it pays no property taxes to Grand County. It both requires services from and brings economic activity to Grand County.

PART 2: WATER RESOURCES & CHALLENGES

2.1 CORE ROLE OF WATER RESOURCES

Grand County's history and character is inextricably tied to its water resources.

- Grand County's name is taken from the Grand River, now known as the Colorado River.

- The first major construction project in Grand County was a trans-mountain water diversion ditch through what is now Rocky Mountain National Park.

- Early ranching activity developed from the banks of rivers, creeks and drainage ways in the County.

- The timber industry used the waterways to transport timber from the mountains to sawmills in Fraser, Tabernash and Winter Park.

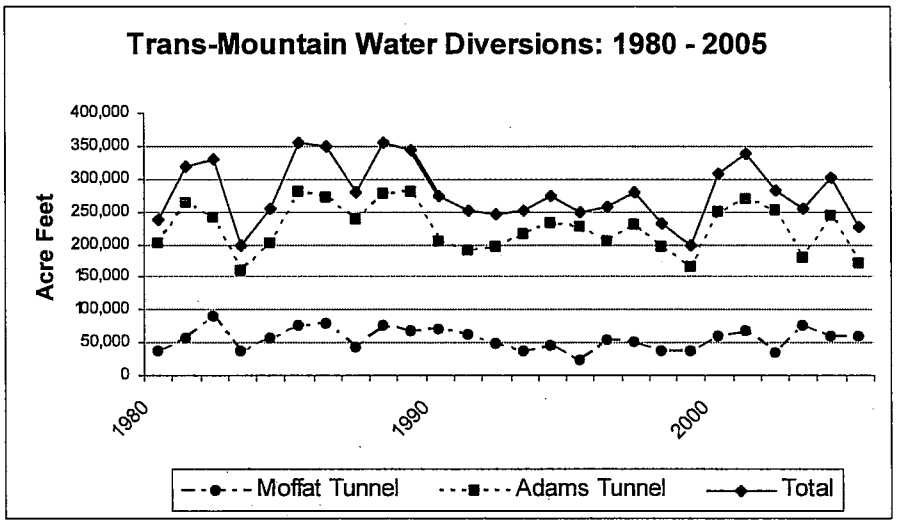
- The first tourist activity was fishing along the Grand River and in Grand Lake.

- Both drivers of the current economy, ranching and tourism, rely directly on the natural flow of surface water and a sufficient supply of ground water. Snowfall and rainfall in the Upper Colorado River and Upper Fraser River watersheds are the only sources of this water. Grand County does not import water from other locations. Local water providers do not own raw water storage facilities that could temper water shortages in drought conditions.

While all residents and businesses in Colorado need water to function, water resources and the natural flow of water is essential to the Grand County environment and economy in a way that is more fundamental than on the Front Range. Over 62% of Grand County is owned by the federal government and used primarily as part of a national forest or national park; the natural flow of water is essential to the vegetation and wildlife in these areas of national significance. In addition, the natural flow of water is essential to the County's tourism-driven economy. The Front Range residents rely on Grand County and other mountain counties to provide a respite from urban living.

2.2 Current Water Resource Constraints

The US Bureau of Reclamation and Front Range water providers currently own a substantial amount of water rights in the Upper Colorado River watershed.[19] More than one-half of the natural flow of the Upper Colorado River drainage in Grand County is diverted from the mountains to the Denver metropolitan area and other Front Range communities. [20]

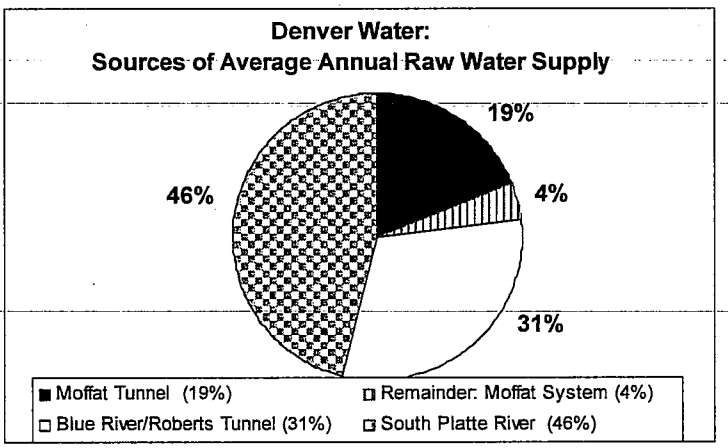


Over the last 25 years (1981 through 2005), transmountain diversion projects constructed by Denver Water, the US Bureau of Reclamation and the Subdistrict have diverted an average of 280,600 acre-feet of water per year, as illustrated in the graph to the right. [21] Assuming a 10% reduction factor for evaporation during transport, this is sufficient to serve about 1.1 million Front Range residents.[22]

Denver Water. From the 1920s through 1957, Denver Water purchased a substantial amount of water rights in the Upper Fraser Valley. [23] Between 1935 and 1950, Denver Water constructed a series of diversion canals and tunnels from about 25+ named and unnamed creeks and rivers [24] including the Fraser River, Big Vasquez Creek, Little Vasquez Creek, Ranch Creek, and St. Louis Creek. These cannels and tunnels divert water into the Moffat Tunnel and to the Front Range. Part of its Right-of-Way Grant from the US Forest Service requires Denver Water to release minimum bypass flows from the Fraser River, St. Louis Creek, Big Vasquez Creek and Ranch Creek but not from others. Denver Water may remove all water from other points of

diversion as long as it honors more senior downstream water rights and contractual obligations. Denver Water may reduce its bypass flow commitments during drought conditions as provided in the US Forest Service Agreement and the subsequent Clinton Reservoir-Fraser River Agreement. [25]

Over the last 25 years, Denver Water has diverted an average of 55,700 acre-feet of water per year through the Moffat Tunnel;[26] this volume of water is sufficient to serve about 266,000 people.[27] As illustrated in the graph to the right, historically, water from Grand County through the Moffat Tunnel[28] has comprised 19% of Denver Water's annual raw water supply; the Blue River / Roberts Tunnel comprised 31% and the South Platte River comprised 46%. [29]



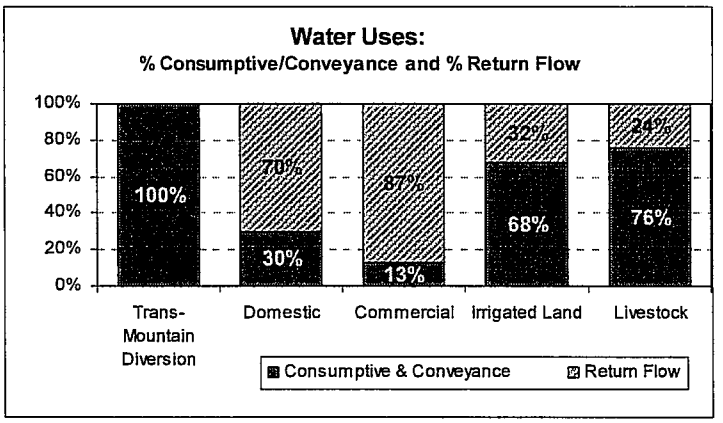
The annual flow of water through the Moffat Tunnel has ranged between a low of about 23,500 in 1995, to a high of about 90,800 acre-feet in 1982. There has been no consistent annual trend.

US Bureau of Reclamation (BOR), Northern Colorado Water Conservancy District (NCWCD) and the Municipal Subdistrict of the NCWCD. The BOR owns and the BOR and NCWCD jointly operate the Colorado-Big Thompson Project. This includes a set of fourteen storage dams, ten reservoirs, including Lake Granby and Shadow Mountain Lake, the Alva Adams Tunnel, which conveys transmountain water to the east slope, and associated canals, tunnels, pumping plants, power plants, transmission lines and substations. The NCWCD owns and operates the Windy Gap Project where water is diverted from the Colorado River downstream of the confluence of the Colorado and Fraser Rivers at the Windy Gap Reservoir and pumped to Lake Granby for storage and conveyance to the East Slope via the Alva Adams Tunnel. Over the last 25 years, the annual flow of water through the Alva Adams Tunnel has averaged 224,900 acre-feet and has ranged between about 160,000 acre-feet in 1983 and 299,400 acre-feet in 1963.[30] There has been no consistent annual trend.

Other Front Range Water Providers. There are several other smaller Front Range water diversion projects and providers. Among these, only two are not managed or operated by Denver Water or the NCWCD. These are the Grand Ditch, owned by Water Supply and Storage Company and the Berthoud Canal Tunnel, owned by Community Conservation Reservoir Company and the City of Northglenn. The City of Thornton is a 50% shareholder in the Grand Ditch. The City of Englewood owns water in Meadow Creek and contracts with Denver Water

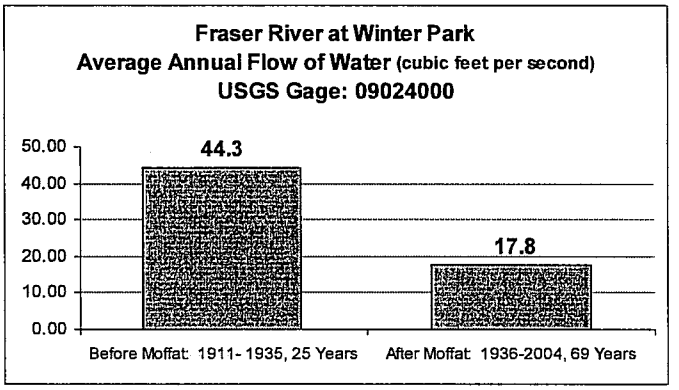
to divert through the Moffat Tunnel. There are no known proposed changes by these water providers.

Consequences in Grand County. Actual water flows in the County's streams and rivers are substantially less than natural flows, due primarily to major trans-mountain diversions by Front Range water providers. The exact amount of diversion due to these water providers is different at different locations. Changes in water flow are due not only to man-made diversion projects constructed by water providers but also by changes in climatic conditions, related snowfall and rainfall and in-basin agricultural, municipal, industrial and recreational water users.



Any water withdrawn from Grand County is either (a) consumed (consumptive use), (b) lost in conveyance or transmission, or (c) returned to a County water basin (return flow). Water used for trans-mountain diversion purposes is 100% consumed or lost in conveyance. That is, no amount of water is returned to water basins in Grand County for reuse; all water is diverted to the Front Range. In-basin water uses for domestic, commercial, recreation, and agriculture purposes also consume water. [31] However, the average proportion of water consumed or lost in conveyance for these purposes ranges between 13% and 76%, as highlighted in the graph above. These figures are averages for the State of Colorado that were prepared for the USGS.[32] The average portion of water returned to a County watershed (return flow) from these in-basin uses ranges from 24% to 70%. While domestic and commercial uses have been increasing in Grand County, the amount of irrigated land and livestock, which have the highest proportions of consumptive use, have been decreasing. [33]

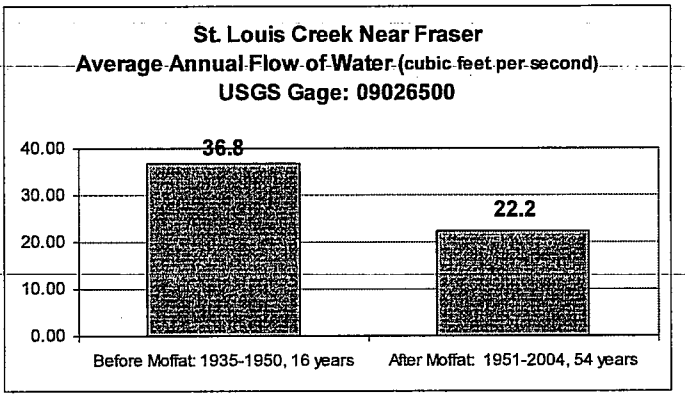
To provide perspective regarding the magnitude of change in water flow, data is provided below for three gage locations in the Fraser Valley and one location on the Colorado River. In each case, data is from the USGS gages at each site. These are the only locations where there is sufficient multi-year historical data before and after construction of the Moffat Tunnel and the Colorado-Big Thompson Project to provide meaningful information.



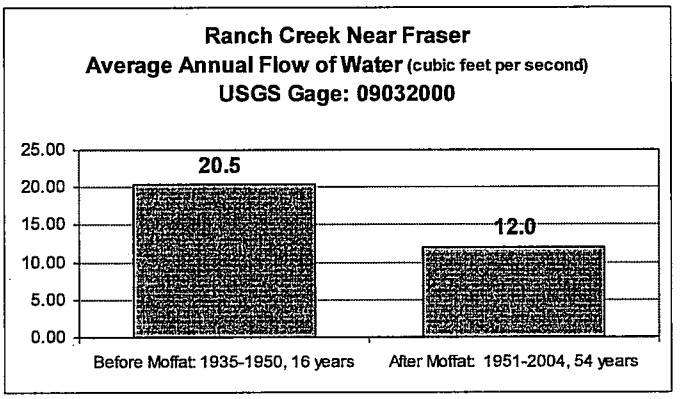
The USFS manages a gage on the Fraser River at Winter Park and has collected and recorded water flow information since 1911. During the 25

years prior to the first diversion of water through the Moffat Tunnel (1911 through 1935), the average annual flow of water was 44.3 cubic-feet-per second (cfs). During the last 69 years since the Moffat Tunnel diversion (1936 through 2004), the annual flow of water has averaged 17.8 cfs. This more recent flow activity represents a 60% reduction in the average annual water flow relative to the years before the Moffat Tunnel diversion.

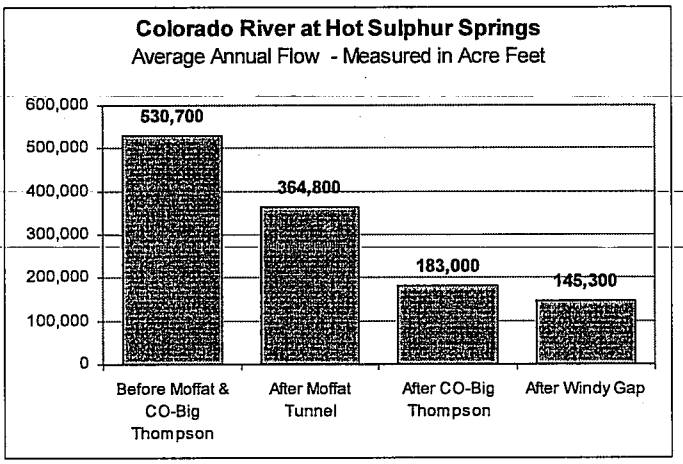
The USGS-managed gage on the St. Louis Creek near Fraser has produced data since 1935. During the 16 year prior (1935 through 1950) to the estimated completion of the St. Louis Creek diversion cannel to the Moffat Tunnel, the average annual flow of water was 36.8 cfs; during the last 54 years (1951 through 2004), the annual flow of water has averaged 22.2 cfs, which represents an average annual reduction of 40% from the prior period.



The USGS-managed gage on Ranch Creek near Fraser has also produced data since 1935. During the 16 year prior (1935 through 1950) to the estimated completion of the Ranch Creek diversion cannel to the Moffat Tunnel, the average annual flow of water was 20.5 cfs; during the last 54 years (1951 through 2004), the annual flow of water has averaged 12.0 cfs, an average annual reduction of 41%.



The graph to the right provides some perspective on the combined impacts of the Denver Water, the BOR / NCWCD, and the Subdistrict of NCWCD trans-mountain water diversion projects. It shows the average annual flow of water on the Colorado River at Hot Sulphur Springs for several historic time periods: (a) before construction of Denver Water's Moffat Tunnel and BOR's Colorado Big Thompson Project (1904 -1936);[34] (b) after construction of the Moffat Tunnel and before construction of the



Colorado Big-Thompson Project (1937-1951); (c) after construction of both the Moffat Tunnel and the Colorado-Big Thompson Project (1952-1984), and; (d) after construction of the Moffat Tunnel, the Colorado-Big Thompson Project and the Windy Gap Project. (1985-1994) [35]

The cumulative effect of these three diversion projects plus any natural changes in climatic conditions, in-basin users and other smaller factors reduced the flow of water from an average of 530,700 to 145,300 acre-feet per year, a reduction of 73%. This data is from a gage that was managed by the USGS for 90 years, from 1904 through 1994. More recent data from this site is not available because the gage location was subsequently relocated.

2.3 History of Water Resource Decisions

The history of trans-mountain diversion projects began in the 1880s with construction of the Grand River Ditch. During the first part of the 1900s, Denver Water and the Bureau of Reclamation began their trans-mountain diversion activities. Water diversion decisions by the Water Supply and Storage Company, and more recently Denver Water, NCWCD and the Subdistrict that impact Grand County were made decades ago when the County's economy was based on timber production and agriculture. A chronology that lists major Denver Water, Bureau of Reclamation / NCWCD/ Subdistrict, and Grand County events is presented at the end of this paper in Attachment A.

- The Water Supply and Storage Company formed in 1881 and began construction on the Grand River Ditch (later the Grand Ditch). By 1890, this hand-dug channel was diverting water across the continental divide at La Poudre Pass in what was subsequently Rocky Mountain National Park to farmers and ranchers on the east slope.

- Denver Water initiated efforts to buy water rights along the Fraser River and construct the Moffat Tunnel in 1921-1922. Water began flowing through the Moffat Tunnel in 1936. In 1957, Denver Water made another significant round of water rights purchases in the County. [36]

- The NCWCD was organized in 1937 when the US Senate authorized construction of the Colorado River – Big Thompson (C-BT) Project. The US Bureau of Reclamation initially financed, built and owns the C-BT Project. The NCWCD jointly operates the facility with the BOR and has a debt repayment contract with BOR that gives the NCWCD the perpetual yield of water from the Project. In 1947, water began flowing through the Alva Adams Tunnel via Shadow Mountain and Grand Lake. In 1951, Lake Granby was completed. In 1953, Willow Creek Reservoir was completed. In 1985, the Windy Gap Project was completed by the Municipal Subdistrict of the NCWCD. The Windy Gap Project provides supplemental water to Front Range municipalities in northern Colorado.

When Front Range water providers made their early decisions to begin diverting water from Grand County, it was a rugged outpost with little known need for water other than for

agriculture, timber, and its few hardy residents. These early actions have now triggered unanticipated consequences, as the Grand County economy has changed to a tourist-based economy that is visitor-intensive, not resource extraction.

2.4 Impacts from Existing Water Diversion Projects

Water diversions from these Front Range water providers have generated a number of significant types of challenges for Grand County. These are listed in the table to the right and summarized below. These challenges are particularly significant in the Fraser River Basin in East Grand County, which contains 70% of the County's existing and future water demand. [37]

Impacts from Existing Trans-Mountain Water Diversion Projects

Water Supply Impacts:
- (1) Surface Water for Local Needs
- (2) Ground Water Recharge
- (3) Passive Recreation
- (4) Agricultural Operations

Water Quality Impacts:
- (5) Grand Lake
- (6) Wastewater Treatment
- (7) Aquatic Environment
- (8) Road Sanding

Water Supply Impacts:

(1) ***Surface Water for Local Needs.*** The County is not prepared to withstand unusually severe or sustained drought conditions because water flows may be insufficient to meet both transmountain diversion calls and local needs. Unlike other larger communities, there are no raw water storage reservoirs available primarily for Grand County to ease it through temporary drought conditions. [38] Also, there are no suitable reservoir locations that are high enough in elevation to be helpful. Furthermore, under drought conditions, Denver Water has the authority to override its current by-pass flow commitments with the US Forest Service and divert all of the water from its 25+ diversion ditches and canals that flow to the Moffat Tunnel. Denver Water did reduce its minimum by-pass flows in 2002 and 2003 in response to drought conditions. In addition, under normal water conditions, there may be occasional shortages in water supply during the fall, winter and early spring months. Under future demand forecasts, the *UPCO Report* shows that some Upper Fraser Valley water and sanitation districts might not have sufficient water supply to meet currently anticipated build-out conditions. [39] Water supply systems for the Towns of Hot Sulphur Springs and Kremmling are adequate for existing water demands but are anticipated to experience shortages in future years.[40]

(2) Ground Water Recharge. Sustained water diversions in the upper reaches of the Fraser River basin have created concerns about ground water aquifer recharge. Fraser, Winter Park Ranch and Tabernash rely on ground water for their water supply.

(3) Passive Recreation. Low stream flows in the summer months compromise the pastoral beauty of naturally flowing water courses, which is an essential aesthetic quality of the local environment that attracts visitors, the economic engine of the County.

(4) Agricultural Operations. Grand County ranchers rely on irrigation ditches to produce crops and livestock. Low water flows, which are caused primarily by trans-mountain water diverters, create a lack of positive pressure in ditch heads and irrigation pumps making the process harder and more labor intensive. The combination of low flows and high water temperatures trigger more moths and more dead fish; both problems continuously clog irrigation pumps. Also, lower water levels add stress to ranchers' fisheries, handicapping their ability to lease fishing rights, a critical supplement to the income of many ranches on the riverfront [41] Senate Document 80, an agreement signed in 1937 authorizing construction of the C-BT, stated that "an adequate system ... shall be provided for the irrigation of the lands in the vicinity of Kremmling... and the installation... shall be a part of this project. [42]

Water Quality Impacts:

(5) Grand Lake. Grand Lake is the deepest natural lake in Colorado and has been a focal point of recreation and seasonal visitor activity for decades. The C-BT Project appears to be "degrading the quality of Grand Lake" by transferring water from Lake Granby and Shadow Mountain Lake through Grand Lake. [43]

(6) Wastewater Treatment. Low stream flows in the Fraser River challenge the stream's capacity to assimilate water from sewerage treatment plants. Streamflow during the winter months is particularly critical in the Fraser River as this is the time when wastewater treatment facilities are in high use due to demand from skiers and other winter visitors.

(7) Aquatic Environment. Low flows in the Fraser River and the Colorado River in the summer months increase water temperatures that stress cold-water fish and the aquatic environment.

(8) Road Sanding. General winter sanding operations on Berthoud Pass and the potential for an accident and hazardous materials dump on Berthoud Pass create water quality concerns, since runoff flows directly into the Fraser River, the source of water for Winter Park, Fraser, Tabernash, Grand Elk, Granby Ranch and the Town of Granby. Low stream flows and minimized flushing flows exacerbate this potential problem by hampering the proper movement of sand and sediment.

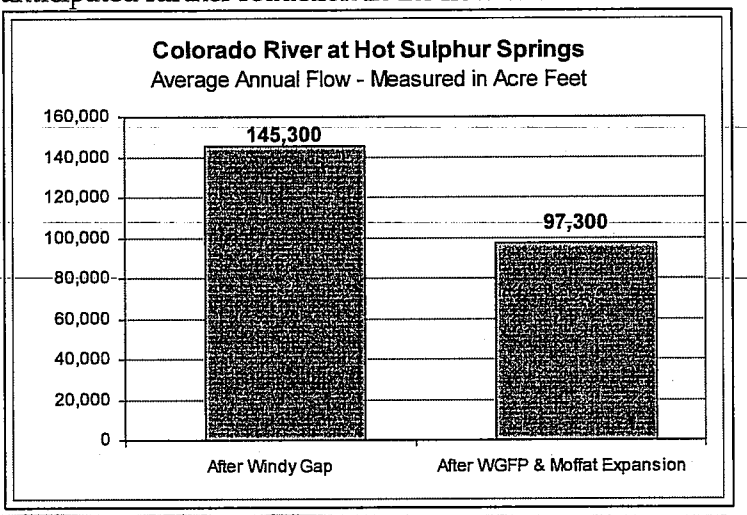
2.5 New Water Resource Challenges

Current water resource conditions place Grand County in a strained situation with respect to adequate stream flow, water quality, ground water and surface water supply, as described above. There are two proposed projects that, if approved, would exacerbate current conditions because each would divert more water from Grand County. These projects are the Moffat Expansion Project, which is proposed by Denver Water, and the Windy Gap Firming Project, which is proposed by the Municipal Subdistrict of the NCWCD. The cumulative effects from prior and proposed water diversion projects put Grand County in a precarious position.

Moffat Collection System Expansion Project. "The Denver Board of Water Commissioners has defined an immediate need for 18,000 acre-feet/year of additional, firm annual yield (called the Moffat Collection System Project) to supplement the existing water supply Denver Water receives from its Moffat Collection System." [44] Over the last 25 years, annual diversions through the Moffat Tunnel have averaged about 55,700 acre-feet. The expanded yield would be accomplished through diversions from the Fraser River and the Williams Fork River. While 18,000 acre-feet represents only about 4% of Denver Water's projected build-out water needs,[45] it also represents a 32% increase in diversion from current average annual conditions.[46]

Windy Gap Firming Project (WGFP). In 1985, the Municipal Subdistrict of the Northern Colorado Water Conservancy District (NCWCD) completed the Windy Gap Project near Granby to divert water from the Colorado River to the Front Range through the Colorado-Big Thompson Project.[47] Due to project limitations and other factors, the participants have not received the full benefit of their rights to Windy Gap water in dry years or wet years. In some dry years, water rights are insufficient in priority; in wet years, storage and conveyance capacity are insufficient. [48] Accordingly, an expanded group of Municipal Subdistrict – NCWCD participants[49] proposes to develop the Windy Gap Firming Project (WGFP). "The purpose of the ...Project is to deliver a firm annual yield of approximately 30,000 AF of water by 2010 from the existing Windy Gap Project ... and to provide up to 3,000 AF of storage to firm water deliveries for the Middle Park Water Conservancy District.[50] The NCWCD is examining several sites both on the west and east slopes to construct reservoirs for additional storage. It estimates that 110,000 acre-feet of additional storage will be needed to accomplish the purpose of the WGFP.[51] Due to annual variability in precipitation, evaporation and other incidental losses of water, as well as storage volume constructed and project operations, the consistent or firm delivery of 30,000 acre-feet may, during some years, require annual diversions that may be greater than this figure.[52] In addition, the WGFP includes a proposal to construct a new reservoir on the Front Range to create additional storage. The pre-positioning reservoir would act as a new storage facility for both the C-BT Project and Windy Gap Project.

The graph to the right illustrates the anticipated further reduction in the flow of water on the Colorado River at Hot Sulphur Springs due to the proposed Moffat Expansion Project (18,000 acre-feet) and Windy Gap Firming Project (30,000 acre-feet). Annual water flow at this site after construction of the Moffat Tunnel, the Colorado Big-Thompson Project and the Windy Gap Project averaged 145,300 acre-feet. This figure is the average annual stream flow, measured in acre-feet, between 1985 and 1994, the last year for which USGS river



gage information is available. Assuming that the additional annual firm acre-feet of water proposed in the Moffat Expansion Project and Windy Gap Firming Project equals annual total acre-feet of water diverted, then the additional average annual water flow diversion, 48,000 acre-feet, (18,000 acre-feet + 30,000 acre-feet) would reduce water flow by an additional 33% (145,300 to 97,300 acre-feet). This is also is equivalent to an 82% reduction from the original pre-trans-mountain diversion annual flow of 530,700 acre-feet. [53]

In addition, other proposed projects like the reductions of downstream water rights calls at the Shoshone Power Plant and the proposed Wolcott Reservoir could have additional incremental negative impacts to stream flows in Grand County.

2.6 Additional & Potential Impacts from Proposed Water Diversion Projects

In addition to exacerbating each impact presented in Section 2.4, there are additional water quality and water supply impacts that might occur due to two proposed water diversion projects if these projects do not include a mitigation component. Each water quality or water supply impact has related consequences to the economic fabric of the County. A list of potential, additional impacts is presented in the table to the right and summarized below. This list is based on information available today; it is not the result of a comprehensive analysis of impacts.

Additional & Potential Impacts: Proposed Water Diversion Projects

Water Supply Impacts:
(1) CWCB Minimum Flows
(2) Flushing Flows
(3) Rafting & Kayaking
(4) Fishing
(5) Surface Water for Local Needs
(6) Agricultural Operations

Water Quality Impacts:
(7) Lake Granby
(8) Wastewater Discharge Violations

Water Supply Impacts:

(1) CWCB Minimum Flows. Even in the absence of another severe drought like in 2002, if the proposed diversion projects are developed, the minimum instream flows established by the Colorado Water Conservation Board (CWCB) in areas of the Colorado and Fraser Rivers may be jeopardized. The CWCB is directed by State Statute to appropriate "such waters of natural streams and lakes as the board determines may be required for minimum stream flows ... to preserve the natural environment to a reasonable degree" [C.R.S. 37-92-102(3)].

(2) Flushing Flows. Annual high water flows, which naturally occur with spring runoff, are necessary to clear sediment from spawning beds, maintain stream channel structure, recharge aquifers, retain wetlands and vegetative cover and maintain aquatic and terrestrial habitats. If unmitigated, increased water diversions may significantly dampen or eliminate "flushing" flows. Because of the essential functions of periodic high water flows, the timing and severity of flushing flows are critical in the spring to maintain the natural environment.

(3) ***Rafting & Kayaking.*** The quality of rafting and kayaking may also be negatively impacted by additional reductions in stream flow in the Colorado River. The proposed diversions may cause the stretch of the Colorado River below the confluence with the Fraser River and above the Town of Kremmling to fall below minimal levels for kayaking during June in most years. [54] The Gore Canyon stretch of the Colorado River below the Town of Kremmling may fall below optimal levels for rafting and kayaking. [55] The Gore Canyon stretch is one of two premiere Class 5 white water areas for kayaking and rafting in the nation. For the last three years, this area has hosted the U.S. National White Water *(rafting)* Championships. Event organizers report that this area will continue to host this event indefinitely into the future, assuming adequate water flows. In addition, championship organizers are currently working to have this segment of the Colorado River designated as one of four sanctioned events sponsored by the International Rafting Federation. This would bring internationally ranked competitors to Grand County. [56] To the Kremmling area of Grand County, visitor revenues from rafting, kayaking and this national event are critical to its summer economy.

*(4) **Fishing.*** In portions of both the Fraser River and the Colorado River, additional water diversion may reduce flows below the minimum needed to support fish[57] in what have been significant recreational fishing environments. Currently, the Colorado River from the Fraser River downstream to the confluence with Troublesome Creek is designated a "Gold Medal" stream by the Colorado Wildlife Commission. This prestigious designation, given to only 168 miles of the more than 9,000 miles of trout streams in Colorado, is one reason that the County attracts so fisherman between May and October. A significant portion of Grand County's summer and fall tourism is based on fishing. While fishing is one of several visitor attractions in East Grand County, it is an economic lifeline to West Grand County. Grand County is among few counties to have two new, major developments focused around world-class fishing. Shore Fox is being developed by Orvis on the banks of the Colorado River as a premium quality fishing resort. Edgewater is being developed on the Fraser River.

*(5) **Water Supply for Local Uses.*** Both surface and ground water supplies in certain areas of the Fraser River and Colorado River watershed may be inadequate to meet local demands in future years. The Upper Colorado River Basin Report (*UPCO Report*) estimates that Grand County communities serviced by water districts may have municipal water shortages between 1,119 and 2,369 acre-feet in the future.[58] Additional in-stream needs, such as dilution of municipal wastewater and the maintenance of minimum CWCB and fish stream flows, bring this shortage significantly higher.[59]

*(6) **Agricultural Operations.*** Based on observation and communication with ranchers, further reductions in the flow of water, particularly in the summer months, will place further stress on existing irrigations systems and may trigger the failure of some. [60]

Water Quality Impacts:

*(7) **Lake Granby.*** The *UPCO Report* estimates that under all development scenarios (a) instream flows in the Colorado River below Lake Granby will be below CWCB minimums, and; (b) increased pumping into Lake Granby from Windy Gap could increase nutrient loading, which

stimulates algae growth that consumes oxygen necessary for aquatic life.[61] If unmitigated, these actions threaten the health of the fisheries, aesthetic beauty and along with them, the visitor expenditures attributable to fisheries and boating.

(8) Wastewater Discharge Violations. Further reductions in stream flows, particularly in the Fraser River, will impact water quality below wastewater treatment facilities and may trigger a violation of the facilities' discharge permits. If streamflows drop too low, then this will either cause the facilities to cut back on service or spend more money to upgrade their facilities to meet state discharge standards. [62]

PART 3: CONSIDERATIONS

This section describes how Grand County is currently responding to its water resource challenges.

3.1 GRAND COUNTY

Grand County is working to be a good steward of its land by focusing ways to maximize use of its constrained water resources and to be alert to additional consequences of any additional proposed constraints. While current restricted water resource conditions have cost Grand County service providers money and have hampered the County's tourism market opportunities, Grand County has learned to function within these existing, man-made constraints.

Master Plan. The *Grand County Strategic Growth Plan (1997)* recommended and the subsequent *Grand County Master Plan* designated specific town and county growth areas within which the County directs new development while working to lower densities and discourage development in all other areas to enhance open space and preserve critical agricultural and ranching land.

Water Quality Fee. Grand County is the only county in Colorado [63] that imposes a water quality fee on new development. Revenues from this fee are used to monitor and research water quality issues and construct water quality projects.

Fraser River Enhancement Project. The Towns of Winter Park and Fraser recently collaborated and received a state grant to construct $750,000 of streambed improvements to the Fraser River to enhance wildlife habitat and improve access and linkages. The improvements narrowed the streambed and added trails; water flow was not increased.

Stream Management Plan. The County is currently engaged in preparation of a stream management plan which will provide specific, technically-grounded advice regarding stream flow levels and other measures necessary to protect or restore stream conditions in the Upper Colorado River Watershed.

Conservation. A number of water and sanitation districts impose restrictions on new development to further conserve water resources. While Denver Water imposes water conservation measures in dry years, several other participants in the proposed Windy Gap Firming Project have no mandatory restrictions.

Water Recycle Plant. The town of Kremmling recently invested in a water recycling plant which enables it to recycle treated wastewater to the town's parks, ball fields and cemetery and lessen its reliance on the Colorado River during times of drought. It is the first Colorado mountain town to install a recycle facility.

Water Resource Solutions. The *UPCO Report* recommended a number of potential solutions to resolve water resource constraints in the Fraser and Colorado Rivers triggered by Front Range water diverters including revised water bypass and reservoir release management regimes, new or acquired storage reservoirs, pumpback systems to restore water flow during low flow periods, and others. [64] A number of these ideas are in consideration. The Winter Park Water and Sanitation District is actively pursuing construction of a pumpback program to re-circulate water through the Fraser River in order to provide needed water supply during low-flow periods for future planned development. Grand County Water and Sanitation District is reusing its old lagoons for augmentation purposes.

Water and sanitation districts in the Upper Fraser Valley (Grand County Water and Sanitation, Winter Park, Winter Park Ranch, Town of Fraser) are trying diligently to serve current and currently anticipated development with their respective, existing water resources. At a minimum, these providers need (a) Denver Water to continue to honor its contracts with local districts; (b) the physical volume of surface and ground water to remain constant with current conditions, and; (c) the flow of water to be sufficient to enable sewer plants to meet their discharge permit conditions. These conditions are not assured. Grand County water providers have no raw water storage facilities to protect themselves from temporary drought conditions. The *UPCO Report* produced several modeling scenarios based on historic hydrology that showed water resources will be insufficient to meet currently anticipated development.

At this juncture, Grand County is at the tipping point. Further reductions in the natural water flow, if not mitigated, may have dire environmental and economic consequences as highlighted in this paper. The County does not have sufficient water resources to withstand an unusually dry water year.

3.2 New Diversion Projects: Evaluation & Mitigation of Impacts

As presented above, Grand County is gravely stressed from the cumulative environmental impacts of withdrawing hundreds of thousands of acre-feet annually via trans-mountain diversion projects for decades. Except for Windy Gap, these cumulative impacts have gone substantially unmitigated as most were approved before state and federal regulations requiring mitigation were in place.

- It follows that any further reduction in the volume of water will jeopardize the conditions necessary to maintain the already compromised environment.

- Any further manipulation of the natural environmental flow regime by reducing flushing flows will further jeopardize the aquatic, terrestrial and riparian corridors of the Fraser and Colorado Rivers and their many tributaries.

The environmental impacts and related socio-economic consequences of further reductions in water resources need very careful evaluation.

There are a number of potential water bypass regimes, operational changes, and construction opportunities that would cause no or relatively minimal problem to Front Range water providers and would enable Grand County to continue function as a primary mountain respite and recreation location for Front Range residents.

ATTACHMENT A: CHRONOLOGY: DENVER WATER, US BUREAU OF RECLAMATION, NORTHERN COLORADO WATER CONSERVANCY DISTRICT AND GRAND COUNTY			
YEAR	DENVER WATER ACTION	US BUREAU OF RECLAMATION, NORTHERN COLORADO WATER CONSERVANCY DISTRICT & SUBDISTRICT OF NCWCD	GRAND COUNTY
1870	Denver City Water company was formed[65]		Wagon trains were under construction over Rollins Pass and Berthoud pass but not complete. There were no permanent (white) settlers in Grand County.
1890			Water Supply and Storage Company completes 8 miles of the Grand River Ditch which diverts water through the Rocky Mountain National Park.
1900			Grand County Population: 741
1902 - 1908			Medicine Bow National Forest established by Proclamation.
1903			Arapaho National Forest was established by Executive Order.
1908			Routt National Forest established by Executive Order.
1910			Grand County Population: 1,862
1915			Rocky Mountain National Park was established by Congressional legislation.
1920	Service Area Population: 272,000 (a)		Grand County Population: 2,659
1921	Initiated purchase of water rights on the Fraser River and other West Slope rivers. (b)		Economy is steeped in timber and ranching. In 1925, the number of ranches reached its peak at 265. Grand River name is changed to the Colorado River.
1922-1923	State passes Moffat Tunnel Act of 1922. (b)		
1923	Worked with Tunnel Commission to bring Fraser River water through the Tunnel. (b)		
1926	Received Right of Way Grant from USFS for the Fraser Diversion Project with stipulations that protect Arapaho National Forest. (a)		
1930	Service Area Population: 326,000 (a)		County Population: 2,108

ATTACHMENT A: CHRONOLOGY: DENVER WATER, US BUREAU OF RECLAMATION, NORTHERN COLORADO WATER CONSERVANCY DISTRICT AND GRAND COUNTY			
YEAR	DENVER WATER ACTION	US BUREAU OF RECLAMATION, NORTHERN COLORADO WATER CONSERVANCY DISTRICT & SUBDISTRICT OF NCWCD	GRAND COUNTY
1933		Grand Lake Committee, predecessor to NCWCD is organized to pursue a water diversion project.	Trail Ridge Road opens in 1932. Economy is still driven by timber and ranching.
1934	Received financial aid from Federal government to complete and enlarge Moffat Tunnel (b)		
1936	Moffat Tunnel diverts water from the Fraser River, Jim Creek and Buck Creek. (b)		Water Supply and Storage Company extends the Grand Ditch an additional 6 miles, leaving a visible scar through the National Park.
1937	Moffat Tunnel was improved to allow additional diversion from Big Vasquez and Little Vasquez Creeks; diversion canals built. (b)	Congress adopted Senate Document 80, which authorizes construction of the Colorado River – Big Thompson Project with stipulations by BOR. NCWCD is organized.	1937: USFS built a ski jump at Cooper Creek near the railroad. The following year, trans began to shuttle skiers from Denver.
1938		NCWCD election to assess 1 mill property tax to build and operate the C-BT and repay the federal government. (US Bureau of Reclamation)	
1940	Service Area Population: 370,000 (a)		Grand County Population: 3,587
1940-1941	Received loan from federal government to construct Ranch Creek and St. Louis Creek diversion network. Ranch Creek diversion canal construction begins. (a)	BOR completes construction on the Alva Adams Tunnel and Shadow Mountain Dam, Reservoir and Spillway.	1940: The Ski train makes its first official run.
1947	Began construction on St. Louis Creek diversion conduit line. (a)	Water diverted to East Slope through Adams Tunnel	
1951	Estimated completion of St. Louis and Ranch Creek diversion canals. (a)	BOR completes Lake Granby; water pumped into Shadow Mountain Reservoir	
1950	Service Area Population: 490,000 (a)		County Population: 3,963
1953		BOR completes Willow Creek Reservoir.	

ATTACHMENT A: CHRONOLOGY: DENVER WATER, US BUREAU OF RECLAMATION, NORTHERN COLORADO WATER CONSERVANCY DISTRICT AND GRAND COUNTY			
YEAR	DENVER WATER ACTION	US BUREAU OF RECLAMATION, NORTHERN COLORADO WATER CONSERVANCY DISTRICT & SUBDISTRICT OF NCWCD	GRAND COUNTY
1955	USFS executes Right-of-Way (ROW) Grant stipulations. Added St. Louis Creek pipes which boosted water diversion by 24,600 acre-feet. Purchased Williams Fork Dam, Williams Fork Collection System and Jones Pass Tunnel from City of Denver.		
1956-1959	Enlarged Williams Fork Dam to provide additional exchange water and constructed a power plant.		
1957	Purchased part or all water rights owned by 11 ranches in Upper Fraser Valley due to a drought.		1957: Grand County designated the "dude ranch" capital of Colorado.
1959	Completed Vazquez Tunnel enabling water from Williams Fork River to be diverted through Moffat Tunnel		
1960	Service Area Population: 612,000 (a)		County Population: 3,557
1970	Service Area Population: 724,000 (a)		County Population: 4,107
1970	Bypass flows established for the Fraser, Vasquez, St. Louis and Ranch Creek by amending Stipulation 13 of the USFS ROW Grant.	Municipal Subdistrict created to construct the Windy Gap Project which is to provide supplemental water to 7 Front Range municipalities. (d)	
1980	Service Area Population: 971,000 (a)		County Population: 7,475
1980		1980 Azure (Windy Gap) Agreement was approved. It settled water rights litigation issues and enabled the Windy Gap Project to proceed.	
1981-1985		Windy Gap Project constructed by Municipal Subdistrict of NCWCD.	

ATTACHMENT A: CHRONOLOGY: DENVER WATER, US BUREAU OF RECLAMATION, NORTHERN COLORADO WATER CONSERVANCY DISTRICT AND GRAND COUNTY			
YEAR	DENVER WATER ACTION	US BUREAU OF RECLAMATION, NORTHERN COLORADO WATER CONSERVANCY DISTRICT & SUBDISTRICT OF NCWCD	GRAND COUNTY
1985		Supplemental Windy Gap Agreement of 1985 was signed. It addressed obligations of the Subdistrict to the West Slope.	
1990	Service Area Population: 891,000 (a)		County Population: 7,966
1992	Clinton Reservoir – Fraser River Water Agreement		
2000	Service Area Population: 1,036,000 (a)		County Population: 12,442
2005	Service Area Population: 1,115,000 (a)	Service Area Population: 750,000	County Population: 13,906
(a) Denver Water Annual Reports, various years, Statistical Section (b) Wat*er for Denver*, Walter Eha, 1944, printed by Denver Water. (c) Right-of-Way Grant Document (d) Municipal Subdistrict NCWCD Service Area is comprised of 7 cities: Boulder, Broomfield, Estes Park, Greeley, Evans, Longmont and Loveland.			

[1] Grand County water providers have exchanged water out of the Clinton Reservoir with Denver Water for more bypass water during critical times of some years. This does not comprise a net addition of water to Grand County.

[2] There are other, smaller Front Range water providers that divert water from Grand County. These include the Water Supply and storage Company which diverts water from the Three Lakes area through the Grand River Ditch in Rocky Mountain National Park, the Community Conservation Reservoir Company and Northglenn which divert water via the Berthoud Canal Tunnel. The City of Englewood uses the Moffat Tunnel to divert its Grand County water. The City of Thornton owns about 50% of the Grand River Ditch. These water providers do not propose changes to their current diversion practices at this time.

[3] Mitigation provided by the Municipal Subdistrict of the NCWCD included the following: $10.2 million for the Wolford Mountain Reservoir; 3,000 acre feet of water for the Middle Park Water Conservation District (MPWCD); delivery of MPWCD Windy Gap water to Lake Granby; 11,000 acre feet of the 56,000 acre feet yield for bypass flows; $550,000 for rancher diversion improvements; $420,000 to Hot Sulphur Springs for water and wastewater facilities; $25,000 to Grand County for salinity studies; construction of the Windy Gap Watchable Wildlife Area, and; free use of rock and gravel from the Municipal Subdistrict's quarry pits.

[4] Provisional figures for 2005 provided via email from Colorado State Demographer, October 2006.

[5] Colorado Department of Labor and Employment, Wage and Salary Employment, 2005.

[6] Grand County Tax Assessor's Office.

[7] Colorado Counties Ranked, www.rootsweb.com.

[8] Grand County Tax Assessor's Office.

[9] Staff from the Colorado Ski Country and the National Park Service.

[10] This section uses a number of documents produced by the Grand County Historical Society including the book, *Island in the Rockies*, and these journals: "A Dude Ranch Is ... 1874-1986", "Timbering in the Fraser Valley," "Ranching and Ranchers: The Pioneer Breed", and "1859-1950 – Skiing in Middle Park."

[11] Telephone contact with Dennis Harmon, Manager, Water Supply and Storage Company, December 11, 2006 and *Summit Daily News* article, "Salazar Says Allard-Musgrave RMNP Bill goes too far." September 30, 2006.

[12] *Economic Impact of Travel on Colorado: 1996 – 2003*, Dean Runyon Associates, prepared for the Colorado Tourism Office, June 2004, page 41.

[13] 2003 Travel Expenditures in Grand County, $169,700,000 / 2003 retail sales in Grand County, $316,668,000 = 54%. Retail sales data are from the Colorado Department of Revenue.

[14] Data provided by Colorado Department of Revenue web site.

[15] These calculations were prepared by the Grand County Tax Assessor's office.

[16] Data provided by Grand County Tax Assessor's office and based on owner's mailing address.

[17] Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas and Jefferson counties.

[18] Memo prepared by EPS, April 18, 2006, for the forthcoming *Winter Park Master Plan*, page 12.

[19] Based on a review of water rights in the Colorado Division of Water Resources database and ownership data provided by water providers.

[20] A USGS gage recorded the flow of Colorado River at Hot Sulphur Springs prior to the Moffat Tunnel and Adams Tunnel transmountain diversions (but after the Grand Ditch diversion) was 530,700 acre-feet (based on annual average statistics between 1904 and 1936). The average annual flow at same location after construction of the Moffat Tunnel and Windy Gap projects was 145,300 acre-feet (average annual statistics between 1985 and 1994). Average annual trans-mountain diversion at Moffat Tunnel and Adams Tunnel over last 25 years was 280,600 acre-feet. In addition, the Water Supply and Storage Company has diverted an average of 20,000 acre-feet per year through the Grand Ditch.

[21] This graph is based on data provided within Denver Water Annual Reports and data provided by public information officer of Northern Colorado Water Conservancy District.

[22] *Data for NCWCD:* This applies a planning figure of 217 gallons per capita per day (79,205 gallons per person per year) which is used in the *Windy Gap Firming Project: Purpose and Need Report*, 9/05, page 34. [224,903 acre-feet x 90% = 202,413] [(202,413 acre-feet x 325,851 gallons-per-acre-foot) / 79,205 gallons per year] = 832,731 people.

Data for Denver Water: In 2005, Denver Water reported average daily water consumption per capita was 168 gallons, which is equivalent to average annual consumption of 61,320 gallons. (*2005 Annual Report*, Statistical Summary, page III-3) 1 acre-foot = 325,175 gallons. 55,628 x 90% = 50,065 acre-feet: [(50,065 acre-feet x 325,851 gallons-per-acre-feet) / 61,320 gallons] = 266,040 people.

Composite Calculations: NCWCD (832,731) + Denver Water (266,040) = 1,098,771people.

[23] Denver water rights are listed in Grand County District Water Court Civil Action #657 and 1430.

[24] Source: Map prepared by Denver Water, May 2003. Bobtail Creek, Cabin Creek, Dribble Creek, East St. Louis Creek, Elk Creek, Fraser River, Hamilton Creek, Hurd Creek, Iron Creek, Jim Creek, Jones Creek, Little Vazquez Creek, McQueary Creek, Meadow Creek, Middle Fork – Ranch Creek, North Fork – Ranch Creek, Ranch Creek, Range Creek, St. Louis Creek, South Fork – Ranch Creek, Steelman Creek, Tail Creek, Vasquez Creek.

[25] Original US Forest Service Land Office Decision of January 12, 1926; subsequent US Forest Service amendment to stipulation 13 of April 22, 1970. Additional conditions are contained in the Clinton Reservoir – Fraser River Water Agreement, July 21, 1992.

[26] Figures are averaged over the last 25 years (1981 through 2005). The data is from the Statistical Summary section of various Denver Water Annual Reports.

[27] See prior footnote.

[28] Throughout this paper, reference to water diverted through the Moffat Tunnel includes only water from the Fraser Collection System, the Williams Fork Collection System, and the Cabin-Meadow Creek System. There are two other collection systems in the "Moffat Tunnel Collection System"; they are South Boulder Creek and Ralston Creek. Water from South Boulder and Ralston Creek are shown as "other" in this graph. All figures are based on acre-feet of raw water supply for last 25 years, 1981 through 2005. Source: Denver Water Annual Reports, Statistical Summary Sections.

[29] This is based on information in the Statistical Summary section of Denver Water Annual Reports.

[30] Average annual statistics from 1981 through 2005 (25 years) provided in tabular format by the public information officer of the Northern Colorado Water Conservancy District.

[31] These categories of users are from the source document, prepared for the USGS. Using words more typical in water resources, "domestic" is generally comparable to "municipal" and "commercial" is generally comparable to "industrial."

[32] *Estimated Use of Water in the United States in 1995*, Wayne B. Solley, Robert R. Pierce, Howard A. Perlman, prepared for the USGS, Circular 1200. (domestic, page 27; commercial, page 31; irrigation, page 35; livestock, page 39)

[33] According to the US Census of Agriculture, irrigated acreage in Grand County has generally decreased from the first year that the Department of Agriculture recorded data (1949) to the most recent Census of Agriculture (2002). In 1949, there were 41,833 irrigated acres; in 2002 there were 35,492 irrigated acres. Livestock in Grand County has been decreasing from 1930 (34,437) to 2002 (15,291).

[34] The Water Supply and Storage Company's began its trans-mountain diversion of water through the Grand Ditch in the 1890s.

[35] This data is from the USGS gage that was located on the Colorado River at Hot Sulphur Springs between 1904 and 1944.

[36] Denver Water, various Annual Reports.

[37] *Upper Colorado River Basin Study* (UPCO Report), Phase II Report, Hydrosphere Resource Consultants, May 2003, page 13.

[38] Grand County water providers have exchanged water out of the Clinton Reservoir with Denver Water for more bypass water during critical times of some years. This does not comprise a net addition of water to Grand County.

[39] UPCO Report, page 34.

[40] UPCO Report, page vii.

[41] George Stark, Grand County ranch owner, "Colorado River Diversions Where West Meets East, NWCCOG, Water Quality / Water Quantity Committee, 2003.

[42] *Colorado-Big Thompson Project,* Senate Document No. 80, 75th Congress, 1st Session, June 15, 1937, Section 5(g), page 4.

[43] Memorandum: Steve Gunderson, Colorado Department of Public and Health and Environment to Water Quality Control Commission, October 31, 2006.

[44] *Purpose and Need Statement for the Moffat Collection System Project,* Denver Board of Water Commissioners, April 2004, page 1.

[45] *The History, Results, Projections and Update of the Integrated Resource Plan,* Denver Water, February 2002, page 9. This Report states that Denver Water's projected build out demand is 450,000 acre-feet for all needs, contracts, etc.; this figure includes a 30,000 acre-foot safety factor. The firm yield of the Moffat Expansion, 18,000 acre-feet, is 4% of 450,000 acre-feet. Note, however, that is not clear at this time whether 18,000 acre-feet of firm yield converts to 18,000 acre-feet of water diverted.

[46] (55,600 + 18,000) / 55,600 = 1.32 or 32% over 55,600 acre feet.

[47] *What is the Windy Gap Firming Project?* Reclamation: Managing Water in the West Windy Gap Firming Project, Project Update, December 2004, U.S. Dep't of Interior, Bureau of Reclamation and the Municipal Subdistrict, Northern Colorado Water Conservancy District, www.usbr.gov/gp/ecao/windy_update_0505.pdf

[48] *Windy Gap Firming Project: Alternatives Report,* September 2005, page 12.

[49] Participants in the WGFP that own, lease or that are in the process of acquiring units of Windy Gap Project water include the Front Range municipalities of Greeley, Longmont, Lafayette, Louisville, Loveland, Erie, Evans, Fort Lupton and Superior, the city and county of Broomfield, the Central Weld County Water District, the Little Thompson Water District, and the Platte River Power Authority. *Windy Gap Firming Project: Purpose and Need Report,* ERO Resources Corporation, September 2005, page 2.

[50] *Windy Gap Firming Project: Purpose and Need Report,* ERO Resources Corp., September 2005, page 4.

[51] *Windy Gap Firming Project: Scoping Announcement, Alternatives under Consideration,* City of Greeley website, page 4. www.ci.greeley.co.us/2n/PageX.asp?fkOrgId=43&PageURL=windy gap.

[52] The exact amount will depend upon the final alternative chosen, the amount of storage volume, and actual project operations. *Windy Gap Firming Project: Purpose and Need Report,* September 2005, page 56.

[53] Denver Water proposes to divert water for its firming project in "wet" years only. This would deprive Grand County of the benefits of flushing flows, which are essential to support native species of fish and sustain healthy river ecosystems. Anderson, K.E., Paul, A.J., McCauley, E., Jackson, K.J., Post, J.R., Nesbet, R.M. 2006 "Instream flow Needs in Streams and Rivers: The Importance of Understanding Ecological Dynamics." *Frontier Ecological Environment.* 4(6): 309-318 and Poff, N.R., Olden, J.D., Pepin, D.M., Bledsoe, B.P. 2006. "Placing Global Steam Flow Variability in Geographic and Geomorphic Contexts." *River Research and Applications* 22:149-166.

[54] UPCO Report, pages vii and 40.

[55] UPCO Report, page 42.

[56] Telephone conversation with Mark Joffee, owner of Rapidpulse and white water rafting championship event producer, 11/29/06.

[57] UPCO Report, pages vi-vii.

[58] UPCO Report, page v.

[59] UPCO Report, page vi.

[60] Conversation with Bill Thompson, Grand County rancher and water commissioner, December 2006.

[61] UPCO Report, page 32, Table 3.8.

[62] Interviews with local water and sanitation district operators and review of reports, summer 2006.

[63] Telephone research by staff of Colorado Counties, Inc., Octobeer 2006.

[64] *UPCO Report*, page 64-65.

[65] Denver Water web site, September 2006.

WALSH AQUATIC CONSULTANTS, INC.

Phone: 303 456 9247

Ref: Update of our February 1, 2008 Technical Review of revised Windy Gap Firming Project, Aquatic Resources Technical Report (Dec 2007) and our November 23, 2009 Technical Review of Preliminary Draft WGFP Fish and Wildlife Plan (August 2009) based on new information.

Date: January 10, 2011.

Prepared by William A. Walsh, Ph.D. and Jeremy Monroe, MS.

Walsh Aquatic initially reviewed and prepared a technical review of both the 2007 Draft EIS Aquatic Resources Technical Report and the 2009 Windy Gap Firming Project, Fish and Wildlife Plan (November 2009) which formed the basis of the WGFP DEIS. Our comments were focused on impacts of the WGFP on the Colorado River. Since then and after the DEIS was issued new information has become available, including the following reports:

- A Revised Windy Gap Firming Project Aquatic Resources Technical Report labeled January 2010;
- A Review of Aquatic Invertebrate Studies and Fish Population Survey Data for the Colorado River in Middle Park, Colorado from 1980 through 2009: What Does It Tell Us? R. Barry Nehring, Jon Ewert, and Sherman Hebein. (January 2010)
- Summary Report Benthic Macroinvertebrate Biomonitoring Program Fall 2008. David Rees (July 2009).
- Benthic Field Studies for the Windy Gap Study Reach, Colorado River, Colorado, fall, 1980 to Fall. Robert Erickson (1983).

The objective of this memo is to update our initial (2009) Technical Review on the basis of these new reports. Most of our initial comments are still valid, so we have included the original memos (Feb 2008 and Nov. 2009) as part of this memo. However our conclusions have changed in the following ways:

EXHIBIT 44

1. Based on the information in these new reports it is clear that the DEIS findings are misleading and cannot be relied on to assess the impacts of WGFP and/or develop mitigation for those impacts.
2. The 2010 Aquatics Resources Technical Report presents conclusions about changes in habitat or other WGFP impacts in a vacuum that are not useful because they do not accurately consider the existing quality of the aquatic resource.
3. The 2010 Aquatic Resources Technical Report fails to take into account significant data and information that is readily available.

Failure to Use Available Data

Our most significant criticism of the WGFP Aquatic Resources Technical Report is its failure to use the available data, reports, and other studies conducted within the Colorado River drainage. For example, there is no reference to the Stream Management Plan ("SMP") prepared for Grand County which is the most recent source of information and detailed data on existing conditions in the Colorado River drainage. Extensive data on Colorado River physical and aquatic habitat is contained in the SMP; the statement in the 2010 Aquatic Resources Report that "fish habitat data is not available for the Colorado River between Granby Reservoir and Windy Gap" is unsupportable. Grand County has repeatedly provided data from the SMP to the Bureau of Reclamation and its consultants, yet this data has not been included or used in this technical report

Failure to Assess Importance of Peak Flows

In our original review of the Aquatic Resources Report, WPFP (2009) we commented on the apparent omission of the importance of peak flows for maintaining aquatic habitat. In the 2010 Aquatics Resources Report, there is a section outlining the importance of the peak flows for "creating and maintaining in stream habitat"; however, all of the information provided is generic and textbook in nature. For example, a detailed account of how peak flows affect channel morphology, riparian habitat, aquatic biota, and stream productivity is NOT provided.

This 2010 Aquatics Resources Report concludes that the " the hydrology data for all the action alternatives for the Colorado River shows little change in peak flow magnitude and recurrence intervals"; the report also states that : " because fish habitat quantity can be lower at high flows, diversions that reduce high flows can result in increased available habitat during run-off.". As outlined in our previous review, these types of statements are misleading because they neglect the significant ecological function of peak and/or flushing flows, and their role in maintaining the quality of aquatic habitat. As determined by the field observations and data generated for the Stream Management Plan, the Colorado River between Granby Reservoir and Gore Canyon suffers from a lack of flushing flows and substrate quality is diminished by fine sediments and a general lack of gravel recruitment. Any further reductions in existing peak flows would compound the negative impacts of a drainage that already suffers from a lack of flushing flows (Figure ES-5, Page ES-14, SMP 2010).

Failure to Take into Account Impacts of Habitat Changes

The 2010 Aquatics Resources Report concludes that: "fish habitat changes for all alternatives are very similar" and "the greatest changes in habitat generally would occur between Windy Gap and the confluence with the Williams Fork River". The report outlines that during average years, adult rainbow trout habitat will be impacted mainly downstream of Windy Gap and upstream of the Williams Fork River and impacts to habitat will range from a loss of 28.7% to 33.5% in this river section. The report concludes that "*predicted maximum periodic decreases in fish habitat, with the exception of potential effects to adult rainbow trout above Williams Fork* (33.5% habitat loss), *are unlikely to impact fish populations*". Firstly, data presented in Table 21 of the 2010 Aquatics Resources Report, would suggest that negative impacts would also occur to the adult rainbow trout populations in the Hot Sulphur Spring (28.7% loss) and below Windy Gap (32.5% loss) rivers sections, the cumulative impact of these habitat losses are not being addressed in the report. In addition, negative impacts to adult rainbow would also be event in wet years below Windy Gap.

Secondly, there seems to be a change in the data results from the 2007 Technical Report which indicated a 19% loss of habitat for Below Windy Gap, 18 % loss at Hot Sulphur Springs and 24% loss at Above Williams Fork, in average years (Table 19, 2007 Technical Report).

Overall the finding in the 2010 Aquatics Resources Report is misleading because existing conditions are not well defined in the report. If existing conditions are near optimum stream flows then a 30% reduction in adult habitat in average years, may have only insignificant impact on the populations; however, if existing conditions are far less than optimum, then these additional 30% reductions in habitat may have far more significant impacts on a trout population. Data presented in the SMP (2010) shows that existing conditions in the Colorado River are far from optimum (Appendix F, SMP 2010); existing conditions included an overall lack of flushing flows, elevated water temperatures, water quality issues, increased sedimentation and algae. The Colorado Division of Wildlife (DOW) conducted a study in 2010 comparing macroinvertebrate abundance and fish population surveys for the Colorado River, downstream of Windy Gap; these data indicate the overall abundance and distribution of the stonefly *Pteronarcys californica (Pc)* and the mottled sculpin *Cottus bairdi* have been dramatically reduced downstream of Wind Gap Dam since the dam was constructed in the early 1980s. Based on this type of existing condition, already significantly impacted, we would contend that even small changes habitat availability will have highly significant impacts on both brown trout and rainbow trout populations in this section of the Colorado River.

Finally, the Aquatic Resources Technical Report outlines some information on macroinvertebrates but other available, macroinvertebrate data and reports should be included. For example Rees, (2008) provides comprehensive assessment and conclusions on the condition of the macroinvertebrate populations in the Colorado River. It confirms that existing conditions in some reaches are already "stressed" (page 26) and that declines in invertebrate metrics are likely attributable to "deviations from the natural temperature and flow regime" (page 28). This report should be included as part of the Aquatic Resources Technical Report as part of baseline characterization and would provide an excellent tool to monitor changes

associated future stream flow conditions. In addition, a very comprehensive account of historical macroinvertebrate population is provided in the Erickson report prepared in 1983. Information from both reports should have been used in the preparation of the Aquatic Resources Technical Report.

Our original comments on Aquatic Resources are included in Appendix 1 of this memo because our initial comments are still valid, particularly in terms of peak or flushing flows, water temperature and habitat loss. Nevertheless, our comments do not appear to have been considered in the 2010 Aquatics Resources Report.

Appendix 1 - Initial Comments on Aquatic Resources Report.

1. Walsh Aquatic Consultants' Technical Review of Draft WGFP Fish and Wildlife Plan (August 2009); Dated November 23, 2009

2. Walsh Aquatic Consultants' Technical Review of Draft WGFP Aquatic Resources Technical Report (Dec 2007); Dated February 1, 2008

WALSH AQUATIC CONSULTANTS, INC.

Ref: Technical Review of Draft WGFP Fish and Wildlife Plan (August 2009)

Date: November 23, 2009

Prepared by William A. Walsh, Ph.D. and Jeremy Monroe, MS.

Walsh Aquatic has reviewed the Windy Gap Firming Project Fish and Wildlife Mitigation Plan. We focused on water quality, temperature, and stream flow impacts to aquatic species and communities. Our major comments deal with temperature and stream flow in the Colorado River.

Colorado River stream flows

An apparent omission in the Fish and Wildlife Mitigation Plan is importance of peak flows for aquatic habitat, and the need to mitigate reductions in these flows. The Plan states, "the greatest reduction in Colorado River fish habitat would occur during high runoff for a few months in the spring and summer when Windy Gap diversions are greatest.....the projected change in aquatic habitat and water quality are not expected to adversely impact fish populations" (p.9). This conclusion is misleading because it is based on physical habitat quantity and neglects habitat quality. More specifically, this statement neglects the significant ecological function of peak and/or flushing flows, and their role maintaining the quality of aquatic habitat. Arguably, the Colorado River between Granby reservoir and Gore Canyon suffers from a lack of flushing flows that can scour filamentous and invasive algae (e.g. Didymo), replenish substrates for benthic macroinvertebrates, cleanse and redistribute spawning gravels, and benefit riparian and floodplain habitat. Any further reductions of the frequency and magnitude of these critical flows could have impacts far exceeding the reported physical reductions in fish habitat. Placing emphasis on reducing habitat quantity and

neglecting the aspect of habitat quality will in the long–run have potential negative impacts on a fish population and other aquatic communities.

We would like to see a mitigation of scouring flows in the Colorado River, and we would recommend annual May/June releases of flushing flows from Granby and Windy Gap reservoirs. Even if these flows could only by released for several days, they would provide numerous benefits to the aquatic and riparian communities, and would provide more resistance and resilience to other possible impacts (e.g., increased temperatures) from the WGFP and other water development projects

Colorado River Temperature effects

The Plan's statement of impacts (p.9) includes "the potential for exceedance of the aquatic life temperature standard in the Colorado River, primarily between the Windy Gap diversion and Williams Fork, would increase at lower flows, but measurable impacts to fish populations are unlikely because flow reductions in July and August, when temperatures are warmest, would be infrequent." We note that this impact may be somewhat understated, since temperature exceedances in this vulnerable time could be catastrophic (e.g., fish kills) with lasting effects (e.g., loss of fish population year classes), so the "infrequency" of flow reductions may have little bearing. In general, while the occurrence of impacts can be described as isolated events (e.g., 2/10 years), the fish population accumulates impacts over time through demographic processes, and so population impacts should not be viewed as isolated impacts at given frequencies.

Colorado River Temperature mitigation

Temperature mitigation measures should be protective against the risk of dangerously high temperatures for fish and aquatic life resulting from additional flow extractions. We support the planned development of a more detailed Colorado River temperature model, as well as a 3-year monitoring study to inform the temperature model. However, while the mitigation plan seeks to avoid stream flows that might cause exceedances of the established weekly and daily standards, we recommend that the plan aim to stay

somewhat below those standards throughout the Summer season, given the increasing stress on fish populations from angling, invasive species (e.g., Didymo algae), and climatic changes.

Company Background

Walsh Aquatic Consultants is owned and operated by Dr. William A. Walsh, Ph.D. (instream flows and freshwater ecology). Dr. Walsh holds a Ph.D. in brown trout and macroinvertebrate ecology. Areas of experience and expertise include instream flow assessments, habitat utilization, habitat evaluation methodologies, and fishery biology. Dr. Walsh has specific expertise in the freshwater ecology and habitat requirements of both salmon and trout species. He has conducted numerous studies on chinook salmon, steelhead trout, and resident trout species, including brown trout and rainbow trout. Dr. Walsh has designed numerous studies involving stream habitat mapping, instream flows, water temperature conditions, and fish habitat requirements. Dr. Walsh has received training in Instream Flow Incremental Methods and other hydrologic modeling techniques from the US Fish and Wildlife Service.

Area of Expertise of Dr. Walsh:

- Salmonid ecology
- Instream Flows
- Fish population monitoring
- Natural resource assessment
- Aquatic habitat inventories
- Macroinvertebrate studies
- Project design and management

Education

- University College, Galway, Ireland, BS, Zoology, 1981
- National University of Ireland, Ph.D., Zoology, 1988

WALSH AQUATIC CONSULTANTS, INC.

Ref: Technical Review of Draft WGFP Aquatic Resources Technical Report (Dec 2007)

Date: February 1, 2008

Prepared by William A. Walsh, Ph.D. and Jeremy Monroe, MS.

The Draft **Aquatic Resources Technical Report (Report)** evaluates potential environmental effects to aquatic resources associated with the proposed Windy Gap Firming Project (WGFP). The primary objectives of the report were to:

1. Use a two-dimensional hydraulic and habitat model to determine the relationship of habitat to flow in the Colorado River.
2. Examine cumulative effects on the aquatic resources to include other reasonable foreseeable projects.
3. Determine reservoir-related impacts for lakes (Granby, Shadow Mountain, & Grand Lake) and reservoirs (Jasper East, Chimney Hollow, Horsetooth and Carter). Stream related effects on the East Slope were assessed for direct and indirect impacts based hydrologic data and water quality data.

This technical review focuses on the Upper Colorado River basin; therefore, aquatic impacts to the Eastern Slope were not evaluated.

General Comments and Conclusions - Aquatic Resources Technical Report

The report focused on aquatic resources; however, we were surprised to find no mention of amphibian, riparian, and wetland floodplain species or potential impacts to other communities other than salmonid and macroinvertebrates. The species of interest for the analysis were rainbow trout and brown trout; as outlined in the report, these species were

selected in consultation with the CDOW during the site selection process. We agree that the primary focus of the report can be on these trout species; but these additional important aquatic components can not be entirely neglected in considering environmental impacts of the proposed management alternatives in the study area.

The format and organization of this report is such that information is somewhat difficult to access and interpret. In general, the reader has to rely on the numerous piecemeal graphs in the appendices, which requires too much information hunting and cross-referencing. Also, it is not reasonable to point to nearly 400 figures representing the results of various model runs, without providing any written interpretation and suggesting that these figures show little impact, this is not very useful. Asking the reader or reviewer to evaluate this many figures and make their own interpretation is laborious.

The addition of an executive summary section would greatly improve the quality and interpretation of these data. The executive summary should reiterate the study objectives, results and general conclusions from the various alternatives. Some concise figures and tables could be included to draw comparisons between WUA under each alterative, life stage and species.

Methods

An analytical model that combined 2-dimensional hydraulics, a GIS habitat model and hydrologic data into a habitat time-series was utilized. The approach follows the generally widely accepted concepts of the Physical Habitat Simulation System (PHABSIM). The purpose of PHABSIM is to develop a functional relationship between discharge and physical habitat for aquatic communities, including trout populations. Data on channel geometry, river hydraulics, and species-specific habitat suitability curves are used to predict changes in fish habitat as a function of discharge. Existing habitat suitability data from the Colorado Division of Wildlife was used for rainbow trout and brown trout; in general, we conclude that the methods used in the aquatic report are appropriate and adequate.

Study area

The study focused on riverine habitat in the Colorado River from Lake Granby downstream to the confluence with the Blue River (see p. 3), which is expected to input enough water to buffer any further effects downstream. However, this assumes that the Blue River will continue to be managed as it is presently, with high releases (commonly 350 – 1000+ cfs) from Green Mountain Reservoir through most of the year. Moreover, there appears to be some indication that Blue River flows may be reduced by a reduced call for Blue River water to the Shoshone power plant (see "reasonably foreseeable actions" on p. 45). It is reasonable to expect that the less water contributed from the Blue River, the less its buffering capacity. Lastly, capacity of the Blue River to "buffer" hydraulic and temperature changes does not necessarily imply a capacity to buffer ecological changes (e.g., increased downstream export of energy and organisms due to changes in ecosystem function and metabolism).

Representative Reaches

The Colorado River below Windy Gap reservoir was divided into two sections of habitat: one above the Williams Fork confluence and one below. The upstream section from Windy Gap reservoir to the Williams Fork confluence was represented by the Lone Buck State Wildlife Area and the downstream section from the Williams Fork confluence to Kremmling was represented by the Breeze State Wildlife Area. These may not be appropriate representative reaches, and it is perhaps unrealistic to presume that each segment could be represented by one representative reach for two reasons:

- Geomorphology – The "Lone Buck" reach represents the floodplain run-riffle habitat that characterizes much of the upstream segment. However this reach does not represent the constrained higher-gradient habitat which runs through Byers Canyon. Likewise the "Breeze" reach represents the floodplain run-riffle habitat that characterizes

much of the downstream segment, but does not represent the slow moving, low gradient habitat in the lower reaches nearer to Kremmling.

- Land management – Both representative reaches are located on State Wildlife Areas, which are managed to provide habitat for fish and wildlife. These areas have reduced livestock grazing regimes, and reduced livestock access to the stream and riparian zone. It is unlikely that other ranches in the Colorado River valley manage livestock, grazing, and other land uses in an equally sustainable way.

Predicted Colorado River and Willow Creek impacts

Modeled impacts to Colorado River habitat and water quality generally illustrated that effects would be most pronounced during May and June in average and wet years, and that changes to stream flows would primarily be the reduction of peak flows, which would have mostly minor and infrequent effects on areal availability of rainbow and brown trout habitat.

In the report we found some similar statements that may be misleading and somewhat inaccurate: "*average monthly flow reductions……may cause some shift in habitat as a response to reduction in peak flows, but is unlikely to impact fish populations*", "*fish habitat can be lower at high flows, diversions that reduce high flow can also increase available habitat*" (Report page 38), and "*fish habitat can be reduced at high flows and diversions that reduce flow increase available habitat*" (Report p. 74).

These statements are misleading because they neglect the significant ecological function of peak and/or flushing flows, and their role maintaining the quality of aquatic habitat. For example, flushing flows and increased flows aid in scouring and replenishing substrates for benthic macroinvertebrates, cleansing and redistributing spawning gravels, dispersing and promoting establishment of riparian tree species (i.e., cottonwoods), increasing and redistributing woody habitat, replenishing floodplain wetlands, etc. These are all vital processes of healthy river ecosystems which ultimately contribute to healthier and more sustainable fish populations, yet they are given no consideration in the aquatic resources study.

Placing emphasis on reducing habitat quantity and neglecting the aspect of habitat quality will in the long–run have potential negative impacts on a fish population and other aquatic communities.

Any further reductions of the frequency and magnitude of these critical flows could have impacts far exceeding those predicted in the aquatic resources report, and thus merit a more holistic examination beyond just areal habitat availability for fish.

One assumption of PHABSIM or instream modeling approaches is that there is a direct linear relationship between weighed useable area or habitat and fish populations. Accepting that assumption, then the data presented in Table 19 & 20 (pp. 39 – 40) and Tables 23 & 24 (pages 47 - 48), can be interpreted to mean that percent habitat changes at a specific frequency of occurrence interval will result in similar changes in the fish population. It is not clear from theses tables or the time-series analysis (Figures 27 – 410), if the frequencies of occurrence interval for juvenile and adult trout are independent or overlapping (i.e., could 2/10 for both juveniles and adults actually equal some impact to the population in 4 of 10 years)? Moreover, while the occurrence of habitat modification can be described as isolated events (e.g., 2/10 years), the fish population accumulates impacts over time through demographic processes, and so population impacts should not be viewed as isolated impacts at given annual frequencies. For example, in the case of Willow Creek brown trout (Table 19); if the proposed actions result in the 13% maximum reduction of juvenile habitat and a consequent 13% loss of juveniles, then we could conservatively speculate that a subsequent 21% impact to that year class as adults could result in a cumulative loss of 31% to that year class. When these demographic links are considered across year classes, isolated habitat impacts have deeper and more lasting impacts to populations than these results might indicate. We suggest that using statements like: *"Impacts to trout habitat that occur less frequently (e.g. 2 out 10 years or less) are less likely to affect populations"*, and *"The predicted maximum periodic decreases in fish habitat..... are unlikely to impact fish populations"* (page 41, Aquatic Report) may be misleading.

Macroinvertebrate sampling

Macroinvertebrate samples in the Colorado River were taken from riffles in the Lone Buck and Breeze sites in September (p. 10). These samples may be limited in their capacity to represent the reaches for a couple reasons:

- Seasonality – Samples collected in September would represent a Fall-Winter-Spring invertebrate community, which is distinctly different than the Spring-Summer community, which would be most impacted by the predicted impacts
- Habitat – Collecting samples only from riffles ignores a substantial portion of Colorado River habitat represented by runs and occasional pools. Macroinvertebrate communities are often most productive and diverse in riffles, but riffles nonetheless represent only portion of the available habitat.

Water Quality

Predicted changes in water quality are based on "average July 25 flows" (p. 37). It appears that July 25 was chosen since it was the highest risk to water quality impacts, and thus the most sensitive day to model. However, the rationale for this should be better explained, as should the methods used to model impacts. More detail in the water quality section would be helpful.

Modeled temperatures for WGFP alternatives in the Colorado River were less than 1 degree based on average July 25 flows (p. 37). However, continued water development is likely to bring flows more frequently closer to the 90 cfs minimum instream flow below Windy Gap, and so the large 4 degree increase predicted for that condition will presumably grow increasingly more likely. Furthermore, even though the worst case prediction (19 degrees C just upstream of the Williams Fork confluence) is not a lethal temperature for the trout species of concern, it is certainly more stressful when combined with fishing pressure. Perhaps more importantly, this degree of temperature stress would undoubtedly affect the benthic macroinvertebrates that trout rely on, such as the stenothermic stoneflies. Yet there is little mention of temperature effects beyond those for fish, or their obvious interaction with climate change and fire effects.

Company Background

Walsh Aquatic Consultants is owned and operated by Dr. William A. Walsh, Ph.D. (instream flows and freshwater ecology). Dr. Walsh holds a Ph.D. in brown trout and macroinvertebrate ecology. Areas of experience and expertise include instream flow assessments, habitat utilization, habitat evaluation methodologies, and fishery biology. Dr. Walsh has specific expertise in the freshwater ecology and habitat requirements of both salmon and trout species. He has conducted numerous studies on chinook salmon, steelhead trout, and resident trout species, including brown trout and rainbow trout. Dr. Walsh has designed numerous studies involving stream habitat mapping, instream flows, water temperature conditions, and fish habitat requirements. Dr. Walsh has received training in Instream Flow Incremental Methods and other hydrologic modeling techniques from the US Fish and Wildlife Service.

Area of Expertise of Dr. Walsh:

- Salmonid ecology
- Instream Flows
- Fish population monitoring
- Natural resource assessment
- Aquatic habitat inventories
- Macroinvertebrate studies
- Project design and management

Education

- University College, Galway, Ireland, BS, Zoology, 1981
- National University of Ireland, Ph.D., Zoology, 1988

AMENDED AND RESTATED
TRANSMISSION AND PUMPING SERVICE AGREEMENT

CONTRACT NO. TS-08-0026
(Replaces Contract TS-92-0003)

This AMENDED AND RESTATED TRANSMISSION AND PUMPING SERVICE AGREEMENT ("Amended and Restated Agreement") is made and entered into this 13th day of June, 2008, by and between TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION, INC. ("Tri-State"), a cooperative corporation organized and existing under the laws of the State of Colorado, MOUNTAIN PARKS ELECTRIC, INC. ("Mountain Parks"), a cooperative corporation organized and existing under the laws of the State of Colorado, and the MUNICIPAL SUBDISTRICT, NORTHERN COLORADO WATER CONSERVANCY DISTRICT (the "Subdistrict"), a political subdivision of the State of Colorado, each being a "Party" hereto and said entities being sometimes hereinafter collectively referred to as the "Parties", pursuant to the same authorities as the Original Agreement.

WITNESSETH

WHEREAS, Tri-State provides electric capacity and energy to Mountain Parks pursuant to the Wholesale Electric Service Contract, between Tri-State and Mountain Parks, dated July 1, 2007, as such may be amended or superseded ("Service Contract");

WHEREAS, the Subdistrict owns and operates the Windy Gap Project for the purpose of providing additional water supplies for certain entities located in northeastern Colorado;

WHEREAS, Tri-State owns various substation and transmission facilities in the area of the Windy Gap Project which reinforce the United States Department of Energy, Western Area Power Administration's (hereinafter referred to as "Western") transmission system;

WHEREAS , the Subdistrict and Western are parties to Firm Electric Service Contracts (Contract Nos. 87-LAO-141 and 87-LAO-267), as amended, which provide certain firm allocations of Federal power and associated firm monthly entitlements of capacity and energy to the Subdistrict from the Loveland Area Projects ("LAP") and Salt Lake City Area Integrated Projects ("SLCAIP"), respectively;

WHEREAS, the Subdistrict and Western are parties to the certain Designation Arrangements whereby Tri-State is designated responsibility for purchasing and scheduling of the Subdistrict's LAP Entitlements and SLCAIP Entitlements (as hereinafter defined);

WHEREAS, as of April 1, 1992 (the "Effective Date") the Parties entered into a certain Transmission and Pumping Service Agreement, Contract TS-92-003 (the "Original Agreement") for the deliveries of power and energy by Tri-State to Mountain Parks and by Mountain Parks to the Subdistrict;

WHEREAS, the Parties intend to clarify their relationships relating to the deliveries of power and energy under the Original Agreement, while maintaining the integrity of such agreement; and

WHEREAS, the Parties wish to amend and restate, in its entirety, the Original Agreement to read as set forth herein.

NOW, THEREFORE, for and in consideration of the promises and the mutual covenants hereinafter contained, the Original Agreement is hereby amended and restated in its entirety to read, and the Parties agree, as follows:

ARTICLE I
DEFINITIONS

The following terms, when used in this Amended and Restated Agreement with initial capitalization, shall have the meanings set forth as follows:

1.1. Allotted Energy shall mean 17,780,400 kilowatt-hours for each Pumping Season.

1.2. Allotted Power [DELETED]

1.3. Average Class A Rate shall mean the estimated average Tri-State Class A Rate to be paid by Tri-State members. This is an internal Tri-State annual calculation computed by dividing a) the Class A revenue requirement for each year by b) the estimated Class A energy to be sold to Tri-State members.

1.4. Designation Arrangements shall mean Amendment No. 2 to Contract No. 87-LAO-141 and Amendment No. 3 to Contract No. 87-LAO-267 between the Subdistrict and Western whereby Tri-State is designated as "agent" for the Subdistrict for purposes of purchasing and scheduling of the Subdistrict's LAP Entitlements and SLCAIP Entitlements, as hereinafter defined.

1.5. LAP Entitlements shall mean the Subdistrict's firm monthly entitlements of capacity and energy from Western's Loveland Area Projects as set forth in Contract No. 87-LAO-141, any amendment thereto, or any contract which may supersede said contract.

1.6. Major Repair and Replacements shall mean any required maintenance or replacement of the Windy Gap Dedicated Facilities, as hereinafter defined, for which the cost of materials exceeds one thousand dollars ($1,000) for any single occurrence.

1.7. Mountain Parks Override shall mean a percentage Mountain Parks shall add, when determining the rates Mountain Parks shall charge the Subdistrict, to the rates charged Mountain Parks by Tri-State for purchase of power to serve the Windy Gap Project. The Mountain Parks Override shall be eight and seven tenths percent (8.7%).

1.8. Outside Pumping Energy shall be the energy registered by the Pumping Power Meter during periods outside of the Pumping Season minus the energy registered by the Station Service Meter during those periods.

1.9. Outside Pumping Power [DELETED]

1.10. Overrun Power [DELETED]

1.11. Prudent Utility Practices means the practices, methods, standards and procedures that (a) are generally accepted and followed by owners and operators of transmission lines and facilities similar to the Windy Gap Dedicated Facilities and (b) would be expected by owners and operators of such transmission lines and facilities, at the time in question and in the exercise of reasonable judgment in light of facts or circumstances then known or that reasonably should have been known to accomplish the desired results and goals, including such goals as efficiency, reliability, economy and profitability in a manner consistent with applicable law, safety and environmental protection. Prudent Utility Practices is not intended to be limited to the optimum practice or method to the exclusion of all others, but rather to be a spectrum of reasonable and prudent practices, methods, standards and procedures, in each case taking into account the design and construction of the transmission lines and facilities in question.

1.12. Pumping Energy shall be the energy registered by the Pumping Power Meter during the Pumping Season minus the energy registered by the Station Service Meter during the Pumping season.

1.13. Pumping Power [DELETED]

1.14. Pumping Power Meter shall mean the meter at the 138 kV bus at Tri-State's Windy Gap Substation.

1.15. Pumping Season shall mean Tri-State's April, May, and June member power billing periods.

1.16. SLCAIP Entitlements shall mean the Subdistrict's firm monthly entitlements of capacity and energy from Western's Salt Lake City Area Integrated Projects as set forth in Contract No. 87-LAO-267, any amendment thereto, or any contract which may supersede said contract.

1.17. Station Service Meter shall mean the 480 volt meter at the Windy Gap Project.

1.18. Station Service Power shall mean the capacity and energy required to serve all electrical load at the Windy Gap Project, except Pumping Energy, as measured by the Station Service Meter.

1.19. Summer Season shall mean Western's summer season period as defined in the Western Contracts.

1.20. Supplemental Capacity [DELETED]

1.21. Supplemental Energy [DELETED]

1.22. Tier 1 Energy shall mean the sum of the firm monthly entitlements of energy available to the Subdistrict under its Western Contracts for use during each applicable Pumping Season, as determined by Western. The monthly entitlements for the 2008 Pumping Season are set forth in Exhibit A to this Amended and Restated Agreement.

1.23. Tier 1 Energy Price shall mean, for the applicable Pumping Season, the total dollar cost to be paid to Western by Tri-State associated with and arising from the Subdistrict's allocations under the Subdistrict's Western Contracts for the Summer Season in which each Pumping Season occurs, divided by the Tier 1 Energy for that applicable Pumping Season. The costs to be paid to Western by Tri-State for the 2008 Pumping Season and the methodology for the calculation of the Tier 1 Energy Price are set forth in Exhibit A to this Amended and Restated Agreement.

1.24. Tier 2 Energy shall mean the Pumping Energy supplied in excess of the Tier 1 Energy during each applicable Pumping Season; provided that the sum of the Tier 1 Energy and the Tier 2 Energy for the applicable Pumping Season shall not exceed the Allotted Energy. The calculation of the Tier 2 Energy available for the 2008 Pumping Season and the methodology is set forth in Exhibit A to this Amended and Restated Agreement.

1.25. Tier 2 Energy Price shall mean one hundred ten percent (110%) of the energy rate component of the Tri-State Class A Rate for Wholesale Firm Power Service in effect during the applicable Pumping Season. The methodology for the calculation of the Tier 2 Energy Price is set forth in Exhibit A to this Amended and Restated Agreement

1.26. Tier 3 Energy shall mean that Pumping Energy supplied during the Pumping Season in excess of the Allotted Energy.

1.27. Tier 3 Energy Price shall mean one hundred ten percent (110%) of the Average Class A Rate for the Tri-State Class A Rate for Wholesale Firm Power Service in effect during the applicable Pumping Season. The methodology for the

calculation of the Tier 3 Energy Price is set forth in Exhibit A to this Amended and Restated Agreement.

1.28. Tri-State Class A Rate shall mean the rate as published annually by Tri-State in its Class A Rate Book for wholesale firm power service.

1.29. Western Capacity [DELETED].

1.30. Western Contracts shall mean the contracts numbered 87-LAO-141 and 87-LAO-267 between the Subdistrict and Western, any amendments thereto, or any contract(s) which may supersede said contracts.

1.31. Western Energy [DELETED]

1.32. Windy Gap Dedicated Facilities shall mean the Windy Gap Substation to Windy Gap Pumping Plant 138 kV transmission line, the line disconnect switch numbered 671, three 138 kV lightning arrestors, 138 kV revenue metering, fiber equipment and all protective relaying equipment associated with such transmission line; all of which are owned by Tri-State.

1.33. Windy Gap Project shall mean the pumping project owned by the Subdistrict and located just west of the town of Granby on Colorado's West Slope, consisting of a diversion dam on the Colorado River, a 445-acre-foot reservoir, a pumping plant, and a six-mile pipeline to Lake Granby.

2. TERM OF AMENDED AND RESTATED AGREEMENT: This Amended and Restated Agreement shall become effective upon the date first written on page one of this Amended and Restated Agreement ("Restatement Date"), subject, however, to the approval of the Administrator of the Rural Utilities Service (RUS), and shall remain in effect until midnight of the last day of Western's September 2024 billing period. Additionally, this Amended and Restated Agreement shall continue thereafter unless terminated by any Party by written notice given to the other Parties not less than one year prior to the date of termination specified in said notice; Provided, however, that this Amended and Restated Agreement shall terminate upon termination of the Designation Arrangements; Provided, further, that all obligations incurred hereunder shall be preserved until satisfied.

3. AMENDMENT AND RESTATEMENT: This Amended and Restated Agreement supersedes, replaces and amends, in its entirety, the Original Agreement between the Parties as of the Restatement Date.

4. CURTAILMENT PROVISIONS: The Parties acknowledge that the provisions contained in the Settlement Agreement between Tri-State and the Subdistrict, dated July 25, 1989, attached hereto and made a part hereof as Exhibit C, shall apply to all transactions set forth in this Amended and Restated Agreement.

5. AMENDED AND RESTATED AGREEMENT FOR SALE TO THE SUBDISTRICT: Tri-State shall sell and Mountain Parks shall buy, and Mountain Parks shall sell and the Subdistrict shall buy, all capacity and energy required for operation of the Windy Gap Project, including Pumping Energy, Outside Pumping Energy, and Station Service Power. Except for the compensation provisions between Mountain Parks and Tri-State set forth in this Amended and Restated Agreement, the sale of capacity and energy by Tri-State to Mountain Parks, pursuant to this Amended and Restated Agreement, shall be subject to the terms and conditions of the Service Contract.

6. COMPENSATION RESPONSIBILITIES OF TRI-STATE: Throughout the term of the Designation Arrangements, Tri-State, as purchasing and scheduling agent of the Subdistrict, shall pay to Western all charges directly associated with the purchase of the SLCAIP and LAP Entitlements under the Western Contracts.

7. COMPENSATION BY MOUNTAIN PARKS TO TRI-STATE: Mountain Parks shall pay Tri-State monthly for the capacity and energy deemed to have been furnished by Tri-State through Mountain Parks to serve the Windy Gap Project as follows;

   7.1. Station Service Power shall be billed by Tri-State to Mountain Parks at the Tri-State Class A Rate. The readings from the Station Service meter shall be increased by four percent (4%) to compensate for two stages of transformation, and such increased readings shall be subtracted from the readings of the Pumping Power Meter before any billing for Pumping Energy.

   7.2. Billing for Pumping Energy:

      7.2.1. The total Pumping Energy billed by Tri-State to Mountain Parks in each monthly billing period during the Pumping Season shall be the sum of the Tier 1 Energy, Tier 2 Energy, and Tier 3 Energy for that monthly billing period as determined in accordance with Sections 7.2.2, 7.2.3, and 7.2.4, below.

      7.2.2. For each monthly billing period during the Pumping Season, the Tier 1 Energy available for use in the applicable month shall be applied first to meeting the Pumping Energy usage for the applicable month. The amount of Tier 1 Energy to be billed by Tri-State to Mountain Parks for the applicable monthly billing period shall be the lesser of (1) the Tier 1 Energy available for use in the applicable month or (2) the Pumping Energy usage for the applicable month. In the event that the remaining Tier 1 Energy available for use in any month exceeds the Pumping Energy usage for that month, the excess Tier 1 Energy amount will be available for use in subsequent months in that Pumping Season. Any unused Tier 1 Energy remaining at the end of the applicable Pumping Season cannot be carried forward and used in any subsequent Pumping Season.

7.2.2.1. For each month, if the Tier 1 Energy available for use is less than the Pumping Energy usage then the remainder of the energy consumed will be supplied by Tier 2 Energy and/or Tier 3 Energy.

7.2.2.2. The Tier 1 Energy shall be billed at the Tier 1 Energy Price.

7.2.3. For each monthly billing period during the Pumping Season, any Pumping Energy usage for the applicable month in excess of the remaining Tier 1 Energy available for use in the applicable month shall first be supplied from the remaining Tier 2 Energy available in that month. The amount of Tier 2 Energy to be billed by Tri-State to Mountain Parks for the applicable monthly billing period shall be the lesser of (1) the remaining Tier 2 Energy available for use or (2) the Pumping Energy usage for the applicable month in excess of the remaining Tier 1 Energy available. In the event that the remaining Tier 2 Energy available for use in the applicable month is greater than the Pumping Energy usage that is in excess of the remaining Tier 1 Energy available, the excess Tier 2 Energy amount will be available for use in subsequent months in the applicable Pumping Season. Any unused Tier 2 Energy remaining at the end of the applicable Pumping Season cannot be carried forward and used in any subsequent Pumping Season.

7.2.3.1. For each month, if the Tier 2 Energy available for use is less than the Pumping Energy usage then the remainder of the energy consumed will be supplied by Tier 3 Energy.

7.2.3.2. The Tier 2 Energy shall be billed at the Tier 2 Energy Price.

7.2.4. For each monthly billing period during the applicable Pumping Season, any Pumping Energy usage for the applicable month in excess of the remaining Tier 1 Energy and Tier 2 Energy available for use in the applicable month shall be supplied from Tier 3 Energy. The amount of Tier 3 Energy to be billed by Tri-State to Mountain Parks for the applicable monthly billing period shall be the Pumping Energy usage in excess of the remaining Tier 1 Energy and Tier 2 Energy available for use in the applicable month. The Tier 3 Energy shall be billed at the Tier 3 Energy Price.

7.3. Billing for Outside Pumping Energy: The Parties desire to provide for the operation of the Windy Gap Pumps outside of the Pumping Season and for the billing by Tri-State to Mountain Parks for such operation. As such, the Parties agree to set forth the procedures and pricing which shall govern the operation in Exhibit D to this Amended and Restated Agreement.

7.4. Mountain Parks shall also pay Tri-State monthly for transmission of the SLCAIP Entitlements to the Windy Gap Project as set forth in Exhibit B to this Amended and Restated Agreement.

8. COMPENSATION BY THE SUBDISTRICT TO MOUNTAIN PARKS:

8.1. The Subdistrict shall pay Mountain Parks monthly for all capacity and energy furnished by it to serve the Windy Gap Project in the same manner as described in Section 7 for the payment by Mountain Parks to Tri-State and at the rates determined by adding the Mountain Parks Override to the rates charged Mountain Parks by Tri-State.

8.2. The Subdistrict shall also reimburse Mountain Parks for the payment made pursuant to Section 7.4, above. The Mountain Parks Override shall not apply to such reimbursement.

9. BILLINGS AND PAYMENTS:

9.1. The amounts due Tri-State hereunder will be billed to Mountain Parks under the terms and conditions of the Service Contract.

9.2. The amounts due Mountain Parks hereunder will be billed to the Subdistrict on or before the twentieth (20th) day of each month for service furnished during the preceding monthly billing period and such amounts will be due and payable by the Subdistrict on or before the twentieth (20th) day of the next succeeding month. Amounts not paid when due shall bear interest at a rate of eighteen percent (18%) per annum from the date billed until the date such payment is made.

10. OWNERSHIP, OPERATION, MAINTENANCE AND CONTROL OF FACILITIES.

10.1. Tri-State shall continue to own, operate, and perform routine maintenance on the Windy Gap Dedicated Facilities and shall be solely responsible for all costs associated therewith, including taxes; Provided, that the Subdistrict shall pay Tri-State, in advance or as reimbursement, at Tri-State's option, the total actual cost of Major Repair and Replacements that are reasonable pursuant to Prudent Utility Practices. Tri-State shall provide the Subdistrict with an estimate of the total cost of the Major Repair and Replacements before the Major Repair and Replacements are undertaken, and may require payment for the Major Repair and Replacements in advance from the Subdistrict for either the total cost of the Major Repair and Replacements, or on a monthly basis if the Major Repair and Replacements are expected to last longer than one month. In any case, a final bill or refund shall be prepared and provided to the Subdistrict within 45 days after the end of the Major Repair and Replacements reconciling such estimate(s) to actual Major Repair and Replacements cost and, if billed, the Subdistrict shall pay said bill within thirty (30) days of such billing.

10.2. The Windy Gap Dedicated Facilities shall be dedicated solely to the provision of electric service to the Windy Gap Project and shall serve no other facility or user without the mutual agreement of the Parties hereto. In the event this Amended and Restated Agreement is terminated for any reason, the Subdistrict shall continue to have the absolute right to use the Windy Gap Dedicated Facilities for delivery of electric service to the Windy Gap Project.

10.3. The respective electric transmission systems of Tri-State and Mountain Parks shall at all times be and remain in the exclusive possession and control of Tri-State or Mountain Parks, and this Amended and Restated Agreement shall not be construed to grant the Subdistrict any rights of ownership in or possession of said transmission system. Tri-State and Mountain Parks will operate and maintain said transmission systems in accordance with Prudent Utility Practice.

10.4. Operating representatives of Tri-State, Mountain Parks, and the Subdistrict will develop operating agreements to cover pump operations, notifications, and related matters as required to implement this Amended and Restated Agreement.

10.5. The Subdistrict shall keep Tri-State and Mountain Parks informed of pumping schedules for its Windy Gap Project as set forth in the Settlement Agreement, attached hereto as Exhibit C. The Subdistrict shall also provide Tri-State and Mountain Parks with other information available to the Subdistrict that may be useful in predicting Windy Gap pump operation on a basis agreeable to the Parties.

10.6. Tri-State will construct, operate, and maintain its power system in a manner which will not unreasonably interfere with the operations of Western's power system, and which will coordinate with the protective relaying and other protective arrangements on the power system of Western.

10.7. The Subdistrict will construct, operate, and maintain its Windy Gap Project facilities in a manner which will not unreasonably interfere with the operations of the Western and Tri-State power systems. The Subdistrict shall make any changes to said facilities which are required to correct or alleviate any such interference, at no cost or expense to Tri-State.

11. RESPONSIBILITIES TO WESTERN:

11.1. As purchasing and scheduling agent for the Subdistrict in its dealings with Western, Tri-State shall promptly notify the Subdistrict of any material matters which may arise concerning Subdistrict's rights or responsibilities with respect to the Western Contracts.

11.2. The Subdistrict agrees that it is and shall remain responsible for the requirements of Section 10, entitled 'Power Factor', and Section 11, entitled 'Conservation and Renewable Energy Program', of the Western Contracts, and for Part IV, Section 16, entitled 'Resale of Firm Electric Service', of the General Power Contract

Provisions to said Western Contracts. The Subdistrict also agrees to provide such assistance as may be required by Tri-State in its efforts to comply with all other requirements of the Western Contracts.

12. EXHIBITS:

12.1. Exhibit A - Inasmuch as the Tier 1 Energy and Tier 2 Energy available for use by the Subdistrict, the rates set by Western for the Subdistrict's LAP Entitlements and SLCAIP Entitlements under its Western Contracts, and the Tri-State Class A Rate may change during the term of this Amended and Restated Agreement, the Tier 1 Energy, Tier 2 Energy, Tier 1 Energy Price, Tier 2 Energy Price, and Tier 3 Energy Price methodology are set forth in Exhibit A to this Amended and Restated Agreement. The Tier 1 Energy Price, Tier 2 Energy, Tier 2 Energy Price and Tier 3 Energy Price will be calculated not less than annually, by Tri-State using the methodology as set forth in Exhibit A. The Tier 1 Energy Price, Tier 2 Energy, Tier 2 Energy Price and Tier 3 Energy Price shall be provided annually by Tri-State to the Subdistrict, not later than April 1 of each year. Exhibit A may be revised from time to time as necessary.

12.2. Exhibit B shall set forth the pricing and methodology for determining the amounts that Mountain Parks shall pay Tri-State monthly for transmission of SLCAIP Entitlements to the Windy Gap Project during the applicable Pumping Season. The transmission charge for SLCAIP Entitlements will be calculated not less than annually by Tri-State using the methodology as set forth in Exhibit B. The transmission charge for SLCAIP Entitlements shall be provided annually, by Tri-State to the Subdistrict, not later than April 1 of each year. Exhibit B may be revised from time to time as necessary.

12.3. Exhibit C is a copy of the Settlement Agreement between Tri-State and the Subdistrict, dated July 25, 1989, and is attached hereto and made a part hereof.

12.4. Exhibit D shall set forth the procedures which shall govern the operation of the Windy Gap Pumps outside of the Pumping Season and the procedures and pricing for the billing by Tri-State to Mountain Parks for such operation of the Windy Gap Pumps outside of the Pumping Season. These procedures and pricing are subject to, among other things, the Tri-State Class A Rate structure and Tri-State's power supply conditions and may be revised from time to time as necessary.

13. UNCONTROLLABLE FORCES: No Party shall be considered to be in default in respect to any obligation under this Amended and Restated Agreement if prevented from fulfilling such obligation by reason of uncontrollable forces, the term "uncontrollable forces" being deemed to mean any cause which is beyond the control of the Party affected and which, by exercise of due diligence, it shall be unable to overcome. No Party shall, however, be relieved of liability for failure of performance if such failure be due to causes arising out of its own negligence or to removable or remediable causes

which it fails to remove or remedy with reasonable dispatch. Nothing contained herein shall be construed to obligate a Party to forestall or settle a strike against its will.

14. LIABILITY: To the extent authorized by law, each Party shall defend, indemnify, and hold harmless the other Parties, their officers, employees, and agents from any and all claims for injury to persons and damage to property occurring as a result of the activities described herein: Provided, however, that nothing herein contained shall be construed as relieving or releasing any Party from liability for injury or damage, whenever occurring, resulting from its own negligence or the negligence of any of its officers, employees, or agents; and in the event of concurrent negligence by the Parties there shall be contribution; and Provided, further, that each of the Parties shall be solely responsible for injury or damage to third parties, wherever occurring, due solely to any defect in equipment installed, furnished, or maintained by such Party. Each Party is solely responsible for the loss or damage to its equipment, unless the loss or damage results from the negligence or fault of another Party.

15. INSURANCE: Each Party shall be solely responsible for hazard and liability insurance for its own facilities and shall provide Workmen's Compensation Insurance for its employees in accordance with the laws of the State of Colorado.

16. WAIVER OF TERMS OR CONDITIONS: The failure of any Party to enforce or insist upon compliance with any of the terms or conditions of this Amended and Restated Agreement shall not constitute a general waiver or relinquishment of any such terms or conditions, but the same shall be and remain at all times in full force and effect.

17. ASSIGNMENT OF RIGHTS:

    17.1. No Party shall assign this Amended and Restated Agreement without the prior written consent of the other Parties, except;

        17.1.1. To any entity into which or with which the Party making the assignment is merged or consolidated or to which the Party transfers substantially all of its assets;

        17.1.2. To any person or entity wholly owning, wholly owned by, or wholly owned in common with the Party making the assignment; or

        17.1.3. Any Party shall have the right at any time and from time to time to mortgage or create or provide for a security interest in or convey in trust their respective rights, titles and interests in this Amended and Restated Agreement to a lender, trustee or mortgagee under deeds of trust, mortgages or indentures, or to secured parties under a security agreement, and to any successors or assigns thereof without need for the prior consent of the other Parties, and without such mortgagee, trustee or secured party assuming or becoming in any respect obligated to perform any of the obligations of the Parties. Any lender, mortgagee, trustee or a secured party under a present or future deed of

trust, mortgage, indenture or security agreements of any party and any successor thereof by action of law or otherwise, and any purchaser, transferee or assignee of any thereof may without need for the prior consent of the other Parties succeed to and acquire all the rights, titles and interests of such Party in this Amended and Restated Agreement and may foreclose upon said rights, titles and interests of such Party.

17.2. No assignment, merger or consolidation shall relieve any Party of any obligation under this Amended and Restated Agreement. Subject to the foregoing restrictions in this Section, this Amended and Restated Agreement shall be binding upon, inure to the benefit of and be enforceable by the Parties and their respective successors and assigns.

17.3. Pursuant to the provisions of the Assignment of Claims Act of 1940, as amended (31 U.S.C. Section 3727, 41 U.S.C. Section 15), claims for monies due, or to become due under this contract may be assigned to a bank, trust company, or other financing institution, including any Federal lending agency, and may thereafter be further assigned and reassigned to any such institution. Any such assignment or reassignment shall cover all amounts payable under this Contract and not already paid, and shall not be made to more than one party, except that any such assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in such financing.

18. SERVICE OF NOTICE:

Whenever notice is given hereunder by any Party, including changes of the addresses below, such notice shall be given in writing by U.S. Mail, or by personal delivery, or by fed-ex or other nationally recognized overnight carrier, to the other Parties at the following addresses.

If to the Subdistrict:

Secretary-Manager
Municipal Subdistrict, Northern Colorado
Water Conservancy District
220 Water Avenue
Berthoud, CO 80513

If to Tri-State:

Executive Vice President and General Manager
Tri-State Generation and Transmission Association
P.O. Box 33695
Denver, Colorado 80233

or

1100 W. 116th Ave.
Westminster, CO 80234

If to Mountain Parks:

General Manager
Mountain Parks Electric, Inc.
P.O. Box 170
321 West Agate Avenue
Granby, Colorado 80446

Such notice shall be effective three (3) days after mailing by U.S. Mail or immediately upon personal delivery or delivery by fed-ex or other nationally recognized overnight carrier.

19. GOVERNING LAW: This Amended and Restated Agreement shall be subject to and be construed under the laws of the State of Colorado.

IN WITNESS WHEREOF, this Amended and Restated Agreement, Contract No. TS-08-0026, has been signed on behalf of each of the Parties hereto as of the day and year first above written.

TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION, INC.

By: _____
Executive Vice President and General Manager

Date: 06/02/08

MUNICIPAL SUBDISTRICT, NORTHERN COLORADO WATER CONSERVANCY DISTRICT

By: _____
Secretary-Manager

Date: 06/13/08

MOUNTAIN PARKS ELECTRIC, INC.

By: _____
General Manager

Date: 6/10/08

EXHIBIT A

2008 PUMPING SEASON

		MONTHLY ENERGY (kWh)	MONTHLY SCHEDULING CAPACITY	MONTHLY BILLING CAPACITY (CROD)	ENERGY RATE ($/kWh)	CAPACITY RATE ($/Kw Mo)	ENERGY DOLLARS	CAPACITY DOLLARS	TOTAL DOLLARS
LAP RESOURCE	APR	728,326	2,545	3,082	$0 01621	$4 25	$11,806 16	$13,098 50	$24,904 66
	MAY	763,245	2,389	3,082	$0 01621	$4 25	$12,372 20	$13,098 50	$25,470 70
	JUN	877,982	2,865	3,082	$0 01621	$4 25	$14,232 09	$13,098 50	$27,330 59
	JUL	1,097,477	3,082	3,082	$0 01621	$4 25	$17,790 10	$13,098 50	$30,888 60
	AUG	877,982	2,709	3,082	$0 01621	$4 25	$14,232 09	$13,098 50	$27,330 59
	SEP	643,520	2,632	3,082	$0 01621	$4 25	$10,431 46	$13,098 50	$23,529 96
	LAP SUBTOTAL	4,988,532	16 222	18,492			$80,864 10	$78,591 00	$159,455 10
SLCAIP RESOURCE	APR	1,074,568	1,614	3,209	$0 01043	$4 43	$11,207 74	$14,215 87	$25,423 61
	MAY	1,424,210	1,878	3,209	$0 01043	$4 43	$14,854 51	$14,215 87	$29,070 38
	JUN	1,403,202	1,925	3,209	$0 01043	$4 43	$14,635 40	$14,215 87	$28,851 27
	JUL	1,519,794	2,020	3,209	$0 01043	$4 43	$15,851 45	$14,215 87	$30,067 32
	AUG	1,349,035	1,908	3,209	$0 01043	$4 43	$14,070 44	$14,215 87	$28,286 31
	SEP	1 274,871	1,716	3,209	$0 01043	$4 43	$13,296 90	$14,215 87	$27,512 77
	SLCAIP SUBTOTAL	8,045,680	11,061	19,254			$83,916 44	$85,295 22	$169,211 66
	TOTALS	13,034,212	27,283	37,746			$164,780 54	$163,886 22	$328,666.76

TIER 1 ENERGY PRICE METHODOLOGY

TOTAL COST FOR SUBDISTRICT ALLOCATIONS =	$ 328,666.76
DIVIDED BY TIER 1 ENERGY AVAILABLE FOR 2008 PUMPING SEASON =	13,034,212
TIER 1 ENERGY PRICE FOR 2008 PUMPING SEASON ($/kWh) =	$0.02522

TIER 2 ENERGY & ENERGY PRICE METHODOLOGY

ALLOTTED ENERGY (MWh) =		17,780,400
MINUS TIER 1 ENERGY (MWh)=		13,034,212
TIER 2 ENERGY AVAILABLE FOR 2008 PUMPING SEASON (MWh) =		4,746,188
TRI-STATE CLASS A RATE (ENERGY COMPONENT $/kWh) =	$	0.02643
		x 110%
TIER 2 ENERGY PRICE FOR 2008 PUMPING SEASON ($/kWh)=	$	0.02907

TIER 3 ENERGY PRICE METHODOLOGY

AVERAGE CLASS A RATE ($/kWh) =	$	0.06295
		x 110%
TIER 3 ENERGY PRICE FOR 2008 PUMPING SEASON ($/kWh) =	$	0.06925

Tri-State shall use these methodologies to calculate the Tier 1 Energy Price, Tier 2 Energy, Tier 2 Energy Price, and Tier 3 Energy Price, no less than annually as required.

EXHIBIT B

2008 PUMPING SEASON

		MONTHLY ENERGY (kWh)			TOTAL DEMAND LOAD (kW)	SLCAIP RESOURCE %	SLCAIP DEMAND LOAD SHARE (kW)	TSGT OATT RATE ($/kW Month)	TOTAL MAXIMUM DOLLARS
LAP RESOURCE	APR	728,326							
	MAY	763,245							
	JUN	877,982							
	JUL	1,097,477							
	AUG	877,982							
	SEP	643,520							
		4,988,532	**38.27%**						
SLCAIP RESOURCE	APR	1,074,568							
	MAY	1,424,210							
	JUN	1,403,202							
	JUL	1,519,794							
	AUG	1,349,035							
	SEP	1,274,871							
		8,045,680	**61.73%**	ONE-PUMP	8,332	61 73%	5,143	$2 8337	$14,573 72
				TWO-PUMP	16,363	61 73%	10,101	$2 8337	$28,623 20
TOTALS		**13,034,212**							**$43,196.92**

SLCAIP TRANSMISSION PRICING METHODOLOGY

TOTAL WESTERN ALLOCATION (kWh) =	13,034,212
TOTAL SLCAIP ENTITLEMENT (kWh) =	8,045,680
SLCAIP ENTITLEMENT AS PERCENT OF TOTAL ALLOCATION =	61.73%
TOTAL MAXIMUM DOLLARS OF ONE PUMP/TWO PUMP SCENARIO (SLCAIP %) =	$ 43,196.92
TOTAL SLCAIP ENTITLEMENT (kWh) =	8,045,680
TRANSMISSION CHARGE FOR SLCAIP ENERGY ($/KWh) =	$0 00537

Tri-State shall use this methodology to calculate the SLCAIP transmission no less than annually as necessary.

Exhibit C

SETTLEMENT AGREEMENT

This Settlement Agreement is entered into as of July 25, 1989, by and between the Municipal Subdistrict, Northern Colorado Water Conservancy District ("Subdistrict"), a quasi-municipal entity and political subdivision of the state of Colorado, and Tri-State Generation and Transmission Association, Inc. ("Tri-State"), a Colorado corporation.

RECITALS

A. The Subdistrict owns and operates the Windy Gap Pumping Plant located near Granby, Colorado which contains four 12,000 horsepower synchronous electric motors used for pumping water from the Colorado River to Granby Reservoir (the "Windy Gap Motors").

B. Tri-State provides transmission of electric power and energy for the Windy Gap Pumping Plant pursuant to a Transmission and Microwave Use Agreement between the parties dated July 13, 1984 (the "Transmission Agreement").

C. Initial starting of the Windy Gap Motors causes voltage dips on Tri-State's electric power system which may constitute an unreasonable interference therewith and the power system of other electric utilities which may cause problems to other electric power users.

D. Tri-State has adopted a flicker chart dated November 13, 1985, a copy of which is attached hereto and incorporated herein as Exhibit A, which Tri-State applies to the starting of the Windy Gap Motors. The Subdistrict acknowledges receipt of a copy of the flicker chart. Under such chart Tri-State has required the Subdistrict to meet a 6% maximum voltage dip criteria on starting the Windy Gap Motors measured at both the 69 kV and 138 kV buses of the Windy Gap Substation located near the Windy Gap Pumping Plant, when the west slope electrical system is intact.

E. The Subdistrict currently meets the 6% voltage dip criteria on starting the Windy Gap Motors on the 69 kV bus, but does not meet the 6% voltage dip criteria on the 138 kV bus, when the west slope electrical system is intact.

F. The Subdistrict is currently the only electric customer served directly from the 138 kV bus of the Windy Gap Substation.

G. The Subdistrict has joined Tri-State as a defendant in Municipal Subdistrict, Northern Colorado Water Conservancy District v. Morrison-Knudsen Engineers, Inc., et al., Case No. 86-CV-18894, Denver District Court, Colorado (the "Lawsuit").

H. The Subdistrict and Tri-State wish to resolve their disputes regarding the voltage dips caused by starting the Windy Gap Motors in a manner which will allow operation of the Windy Gap Motors with a minimum amount of restriction and dismissal of Tri-State from the Lawsuit without prejudice.

AGREEMENT

NOW, THEREFORE, the Subdistrict and Tri-State hereby agree as follows:

1. Upon execution of this Settlement Agreement the Subdistrict shall execute and file with the Denver District Court a Notice of Dismissal Without Prejudice of Tri-State from the Lawsuit in the form of Exhibit B attached hereto and incorporated herein. Each party shall bear its own costs of the Lawsuit.

2. Tri-State shall not be liable in any way to the Subdistrict for any harm or damage that may be caused to the Windy Gap Pumping Plant by voltage dips in excess of 6% caused by starting the Windy Gap Motors.

3. The west slope electrical system shall be considered intact, and the Subdistrict shall be allowed to operate in accordance with paragraphs 4 through 9 of this Settlement Agreement, so long as none of the following conditions exists:

- Outage of the Gore Pass-Hayden or Gore Pass-Blue River 230 kV lines
- Outage of the Blue River-Dillon 230 kV line
- Outage of the Gore Pass 230/138 kV autotransformers
- Outage of the Gore Pass-Windy Gap or Gore Pass-Hayden 138 kV lines
- Coinciding outages of the Windy Gap-Green Mountain and Windy Gap-Granby Pumping Plant-Estes 69 kV lines (existing system)
- Any other line outages, equipment outages, or system configurations as jointly determined necessary by Tri-State and the Western Area Power Administration ("Western") based on system studies to protect other electrical customers from unreasonable interference

- Abnormal system conditions, as determined by Tri-State and Western dispatch, which will cause unreasonable interference to other electrical customers.

The existence of one or more of the above conditions will restrict and may preclude motor starting. Under such conditions, the parties shall seek in good faith to develop and implement procedures which will protect other electrical customers from unreasonable interference and allow starting of the Windy Gap Motors. In the event that Tri-State and Western determine than an abnormal system condition will cause unreasonable interference to other electrical customers, Tri-State shall provide the Subdistrict with a written statement of the reasons for such determination as soon as possible.

4. During the 1989 pumping season with sections of the Windy Gap-Green Mountain 69 kV line out of service for construction, the number of starts will be limited to four (4) per day between the hours of 2400 (midnight) and 0600 (6 a.m.), so long as there is no unreasonable interference to other electrical customers.

5. So long as the Subdistrict is the sole customer on the 138 kV bus, Tri-State waives the referenced 6% voltage dip criteria as to such bus.

6. For the period defined in paragraph 5 above, or at such time as the voltage dip on both the 138 kV and 69 kV buses is 6% or less: (a) four (4) starts per day will be allowed during the hours of 0600 (6 a.m.) and 2400 (midnight), (b) a reasonable number of starts will be allowed during the hours of 2400 (midnight) and 0600 (6 a.m.), and (c) reasonable restarts subsequent to power system disturbances will be allowed.

7. The parties intend that the voltage dip limits set out herein will be applied within a reasonable degree of engineering judgment.

8. The high-side no-load taps on the Windy Gap Pumping Plant 138/13.8 kV transformers are to remain at the 144 kV tap.

9. The Subdistrict will provide a minimum of 15 minutes' notification to Tri-State dispatch before each motor start or restart.

10. The terms and conditions of the Transmission Agreement shall remain in full force and effect, except to the extent that they are altered by the terms and conditions of this Settlement Agreement.

11. The execution of this Settlement Agreement shall not constitute an admission by either party of any act or omission alleged by other parties in the Lawsuit or otherwise nor an admission of liability alleged by other parties regarding the subject matter of the Lawsuit.

In witness whereof the parties have executed this Settlement Agreement as of the day and year above first written.

MUNICIPAL SUBDISTRICT,
NORTHERN COLORADO WATER
CONSERVANCY DISTRICT

Attest: _____

Title: Acting Secretary

By _____

Title: General Manager

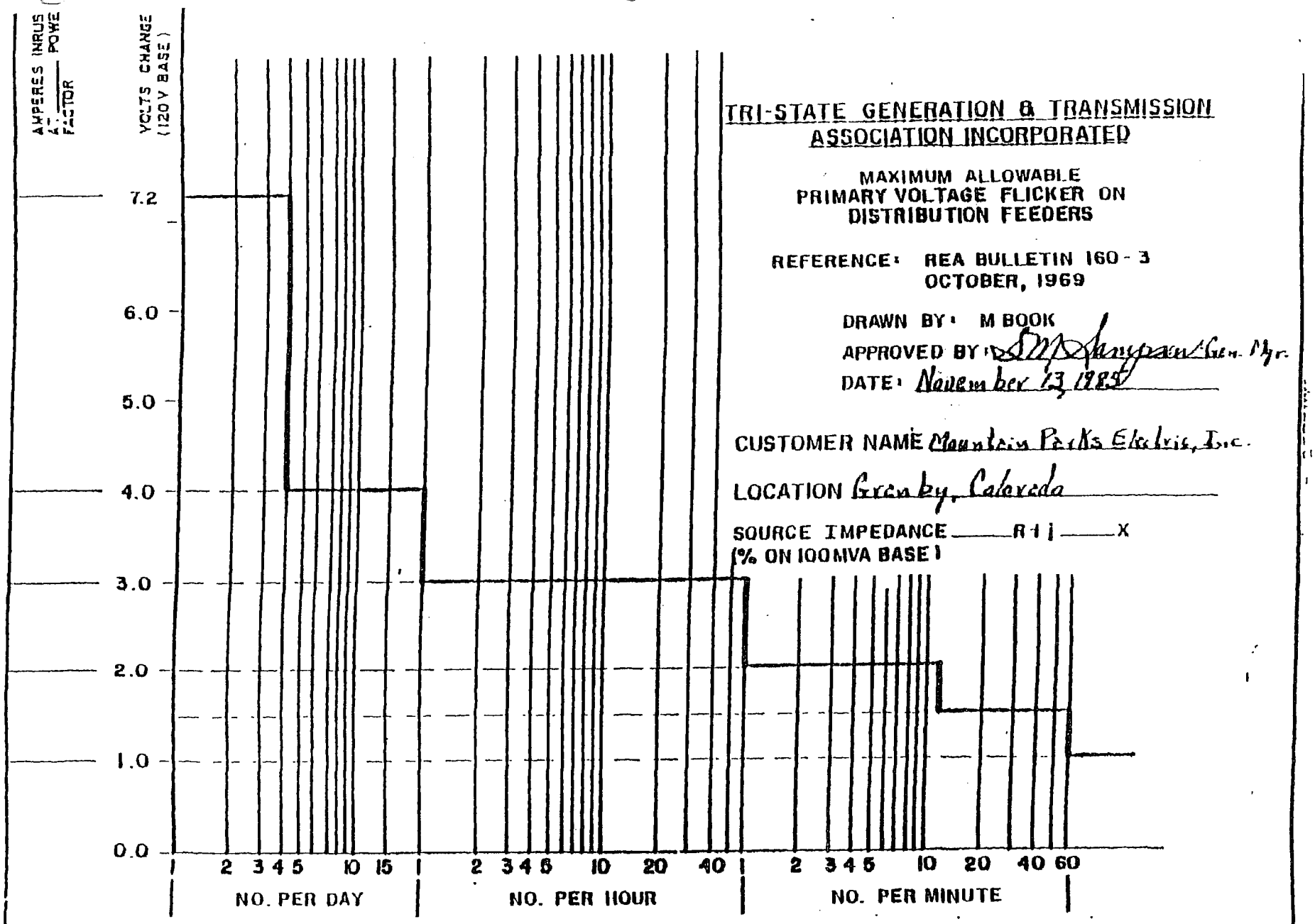
TRI-STATE GENERATION AND
TRANSMISSION ASSOCIATION, INC.

Attest: _____

Title: Assistant Secretary

By: _____

Title: General Manager



TRI-STATE GENERATION & TRANSMISSION ASSOCIATION INCORPORATED

MAXIMUM ALLOWABLE
PRIMARY VOLTAGE FLICKER ON
DISTRIBUTION FEEDERS

REFERENCE: REA BULLETIN 160-3
OCTOBER, 1969

DRAWN BY: M BOOK
APPROVED BY: S M Sampson Gen. Mgr.
DATE: November 13, 1985

CUSTOMER NAME Mountain Parks Electric, Inc.

LOCATION Granby, Colorado

SOURCE IMPEDANCE ____ R + j ____ X
(% ON 100MVA BASE)

EXHIBIT B

DISTRICT COURT, CITY AND COUNTY OF DENVER, COLORADO

Case No. 86-CV-18894, Courtroom 14

NOTICE OF DISMISSAL WITHOUT PREJUDICE OF TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION, INC.

MUNICIPAL SUBDISTRICT, NORTHERN COLORADO WATER CONSERVANCY DISTRICT, a quasi-municipal entity and political subdivision of the State of Colorado,

Plaintiff,

v.

MORRISON-KNUDSEN ENGINEERS, INC., a Nevada corporation, previously known as International Engineering Company, Inc., a Nevada corporation; ERIC E. KOLLGAARD; WILLIAM R. MOON; and TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION, INC., a Colorado corporation,

Defendants.

Plaintiff Municipal Subdistrict, Northern Colorado Water Conservancy District, by and through its attorneys Davis, Graham & Stubbs, hereby dismisses Tri-State Generation and Transmission Association, Inc. pursuant to Colorado Rule of Civil Procedure 41(a)(1) as a defendant in this lawsuit without prejudice.

Dated: _____, 1989.

DAVIS, GRAHAM & STUBBS

By_____
William A. Bianco, #2937
Robert V. Trout, #7190
370 Seventeenth Street, #4700
Post Office Box 185
Denver, Colorado 80201-0185
Telephone: (303) 892-9400

Attorneys for Plaintiff
Municipal Subdistrict,
Northern Colorado Water
Conservancy District

EXHIBIT D

Outside Pumping Season Billing

The currently effective Tri-State Class A Rate provides for billing of the demand component only during the defined on-peak billing period. As long as this rate design is effective, the billing for Outside Pumping Energy will be as follows:

1. For each monthly billing period outside of the Pumping Season, Tri-State will bill Mountain Parks for any Outside Pumping Energy usage during the non-peak period at one hundred ten percent (110%) of the Average Class A Rate then in effect and Mountain Parks will bill the District for that same amount plus the Mountain Parks Override.

2. For each monthly billing period outside of the Pumping Season, Tri-State will bill Mountain Parks for any Outside Pumping Energy usage during the peak period at one hundred ten percent (110%) of the Average Class A Rate then in effect plus a demand penalty surcharge equal to one hundred ten percent (110%) of the demand component of the Tri-State Class A Rate applied to the maximum 30-minute demand that occurs within the peak period for that billing cycle, and Mountain Parks will bill the District for those same amounts plus the Mountain Parks Override.

If, during the term of this Agreement, the Tri-State Class A Rate design is modified to either eliminate or alter the peak period of the Tri-State Class A Rate, the provisions of this Exhibit D will terminate and the Parties will develop a new Exhibit D which will specify the terms and conditions under which Outside Pumping Energy will be billed. If the parties have not agreed to the new terms and conditions by the end of the next Pumping Season following the modification, the peak period will be deemed to be 7:00 AM to 10:00 PM (the billing ½ hour period ending 7:30 AM through the billing ½ hour period ending at 10:00 PM) and the above methodology will continue to be applied.

SEPARATOR SHEET

TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION, INC.
1100 W. 116TH AVENUE • P.O. BOX 33695 • DENVER, COLORADO 80233 • 303-452-6111

5 June 2008

Mr. Joe Pandy
General Manager
Mountain Parks Electric, Inc.
321 West Agate Avenue
Granby, CO 80446

Mr. Jeff Drager
Deputy Manager, Engineering Department
Northern Colorado Water Conservancy District
220 Water Avenue
Berthoud, CO 80513

Dear Joe and Jeff:

Enclosed please find three originals of the Amended and Restated Transmission and Pumping Service Agreement between Tri-State Generation And Transmission Association, Inc., Mountain Parks Electric, Inc. and Northern Colorado Water Conservancy District. Per our previous correspondence, all three originals have been executed by Tri-State.

Note that one additional minor change was made to Section 1.3 Average Class A Rate. We inserted the words "Class A" between the words "estimated" and "energy" in the last line of the section to clarify the calculation. I have also enclosed a redline version of that page for your reference. If any party has any questions or issue on this addition, please call me to discuss.

Upon MPEI's final review and approval I request that they sign and forward all three originals to NCWCD. Upon NCWCD's final review and approval I request that they sign all three originals and forward one fully executed original to both MPEI and Tri-State while retaining one original.

Once each party has a fully executed original Tri-State will submit the agreement to RUS for their approval per Section 2 of the Agreement. Tri-State will notify all parties as soon as RUS approves or denies the agreement.

Sincerely,

Brad Nebergall

CRAIG STATION
2101 S RANNEY STREET
P O BOX 1307
CRAIG, CO 81626-1307
(970) 824-4411
FAX (970) 824-4502

ESCALANTE STATION
COUNTY ROAD 19
P O BOX 577
PREWITT, NM 87045
(505) 876-2271
FAX (505) 876-5201

LIMON GENERATING STATION
48303 STATE HIGHWAY 71
P O BOX 1180
LIMON, CO 80828
(719) 775-9300
FAX (719) 775-9385

NUCLA STATION
30739 DD 30 ROAD
P O BOX 698
NUCLA, CO 81424-0698
(970) 864-7316
FAX (970) 864-1110

WHEREAS, as of April 1, 1992 (the "Effective Date") the Parties entered into a certain Transmission and Pumping Service Agreement, Contract TS-92-003 (the "Original Agreement") for the deliveries of power and energy by Tri-State to Mountain Parks and by Mountain Parks to the Subdistrict;

WHEREAS, the Parties intend to clarify their relationships relating to the deliveries of power and energy under the Original Agreement, while maintaining the integrity of such agreement; and

WHEREAS, the Parties wish to amend and restate, in its entirety, the Original Agreement to read as set forth herein.

NOW, THEREFORE, for and in consideration of the promises and the mutual covenants hereinafter contained, the Original Agreement is hereby amended and restated in its entirety to read, and the Parties agree, as follows:

ARTICLE I
DEFINITIONS

The following terms, when used in this Amended and Restated Agreement with initial capitalization, shall have the meanings set forth as follows:

1.1. Allotted Energy shall mean 17,780,400 kilowatt-hours for each Pumping Season.

1.2. Allotted Power [DELETED]

1.3. Average Class A Rate shall mean the estimated average Tri-State Class A Rate to be paid by Tri-State members. This is an internal Tri-State annual calculation computed by dividing a) the Class A revenue requirement for each year by b) the estimated Class A energy to be sold to Tri-State members.

1.4. Designation Arrangements shall mean Amendment No. 2 to Contract No. 87-LAO-141 and Amendment No. 3 to Contract No. 87-LAO-267 between the Subdistrict and Western whereby Tri-State is designated as "agent" for the Subdistrict for purposes of purchasing and scheduling of the Subdistrict's LAP Entitlements and SLCAIP Entitlements, as hereinafter defined.

1.5. LAP Entitlements shall mean the Subdistrict's firm monthly entitlements of capacity and energy from Western's Loveland Area Projects as set forth in Contract No. 87-LAO-141, any amendment thereto, or any contract which may supersede said contract.

1.6. Major Repair and Replacements shall mean any required maintenance or replacement of the Windy Gap Dedicated Facilities, as hereinafter defined, for which the cost of materials exceeds one thousand dollars ($1,000) for any single occurrence.

Corresp

Municipal Subdistrict
Northern Colorado Water Conservancy District
220 Water Avenue • Berthoud, CO 80513 • 970-532-7700 • fax 970-532-0942

DM 120625

June 16, 2008

Mr. Brad Nebergall
Tri-State Generation and Transmission Association, Inc.
1100 West 116th Avenue
P.O. Box 33695
Denver, CO 80233

Dear Mr. Nebergall:

Re: Amended and Restated Transmission and Pumping Service Agreement - Contract No. TS-08-0026

Per your request letter dated June 5, 2008, enclosed for your records is a fully executed, original copy of the *Amended and Restated Transmission and Pumping Service Agreement - Contract No. TS-08-0026* among the Municipal Subdistrict, Northern Colorado Water Conservancy District (Subdistrict), Mountain Parks Electric, Inc. (Mountain Parks), and Tri-State Generation and Transmission Association, Inc., which replaces Contract No. TS-92-0003.

A fully executed original copy of the same document has also been mailed to Mr. Joe Pandy with Mountain Parks.

If you have any questions please feel free to contact me at (970) 622-2305, or Jeff Drager at (970) 622-2333.

Sincerely,

Candys Sinden

Candys Sinden
Administrative Support Specialist

Enclosure
cc: Jeff Drager
Joe Pandy w/o enclosure

Corresp

Municipal Subdistrict
Northern Colorado Water Conservancy District
220 Water Avenue • Berthoud, CO 80513 • 970-532-7700 • fax 970-532-0942

DM# 130625

June 16, 2008

Mr. Joe Pandy
General Manager
Mountain Parks Electric, Inc.
321 West Agate Avenue
Granby, CO 80446

Dear Mr. Pandy:

Re: Amended and Restated Transmission and Pumping Service Agreement - Contract No. TS-08-0026

Enclosed for your records is a fully executed, original copy of the *Amended and Restated Transmission and Pumping Service Agreement - Contract No. TS-08-0026* among the Municipal Subdistrict, Northern Colorado Water Conservancy District (Subdistrict), Tri-State Generation and Transmission Association, Inc., (Tri-State), and Mountain Parks Electric, Inc., which replaces Contract No. TS-92-0003.

A fully executed original copy of the same document has also been mailed to Mr. Brad Nebergall with Tri-State per his request stated in his June 5, 2008, transmittal letter directed to Mr. Jeff Drager.

If you have any questions please feel free to contact me at (970) 622-2305, or Jeff Drager at (970) 622-2333.

Sincerely.

Candys Sinden

Candys Sinden
Administrative Support Specialist

Enclosure
cc: Jeff Drager
Brad Nebergall w/o enclosure

Barbara J.B. Green
Phone: 303-355-4405 Fax: 303-322-5680
lawgreen@earthlink.net

December 29, 2008

VIA EMAIL: WTULLY@gp.usbr.gov
Mr. Will Tully
Bureau of Reclamation Eastern Colorado Area
11056 West County Road 18E
Loveland, CO 80537-9711

VIA EMAIL: chandler.j.peter@usace.army.mil
Mr. Chandler Peter, P.E.
Denver Regulatory Office
U.S. Army Corps of Engineers
9307 South Wadsworth Blvd.
Littleton, CO 80128-6901

Re: Northern Colorado Water Conservancy District, Windy Gap Firming Project Grand County Cooperating Agency Comments:

Windy Gap Firming Project Draft Environmental Impact Statement

Gentlemen:

This letter was prepared on behalf of our client, Grand County, acting in its capacity as a cooperating agency under the National Environmental Policy Act ("NEPA") for the Windy Gap Firming Project ("WGFP") Draft Environmental Impact Statement dated August 2008 ("DEIS"). This letter synthesizes comments prepared by Lurline Underbrink Curran and Katherine Morris, Grand County; Jeff Clark, Bishop Brogden; Lane Wyatt, Wyatt and Associates; Jean Townsend, Coley/Forrest, Tom Cope and Robert Tuchman, Holme Roberts & Owen LLP; Dave Taussig, White and Jankowski; and Barbara Green, Sullivan Green Seavy LLC. This letter also incorporates by reference all written comments previously submitted by or on behalf of Grand County during the WGFP EIS process, all of which should be included in the administrative record. Such comments include those in the letters listed in Exhibit A, as well as in our letter to you dated March 31, 2008 ("PDEIS Comments"), concerning the WGFP Preliminary Draft Environmental Impact Statement ("PDEIS").

Grand County continues to be concerned that the DEIS, like the PDEIS, fails to satisfy NEPA's fundamental requirement that an environmental impact statement ("EIS") "foster both informed decision-making and informed public participation." *See Colorado Environmental Coalition v. Dombeck,* 185 F.3d 1162, 1172 (10th Cir. 1999); *accord*

EXHIBIT 46

Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 349 (1989). None of our concerns with the DEIS is new. The most serious concern continues to be that the DEIS fails to use *existing* (actual) hydrologic conditions against which to measure the impacts of the Windy Gap Firming Project. The Windy Gap Reservoir stream depletions used in the DEIS to describe "existing" stream conditions are over three times greater than actual depletions. Consequently, the percentage of change in depletions at the Windy Gap Reservoir as presented in the DEIS for each alternative are much smaller than the percentage of change in depletions that actually will occur. The DEIS's failure to adequately describe the significance of new stream depletions calls into question all of the analysis of impacts to the aquatic environment likely to occur in the Colorado River. Thus, the DEIS is fatally flawed. This flaw is discussed in more detail, below.

General Comments

1. The Analysis of Impacts Caused by Hydrologic Modifications is Fatally Flawed

Some of the most significant impacts to Grand County result from hydrologic changes associated with flow depletions. The analysis of hydrologic conditions in the DEIS must document changes in magnitude, frequency, duration, timing, and rate of change before the impacts of flow depletions on the aquatic environment can be adequately understood. *See* B.D. Richter, J.V. Baumgartner, J. Powell and D.P. Braun, *A Method for Assessing Hydrologic Alteration within Ecosystems,* Conservation Biology 10(4) (1996). NEPA requires EISs to contain high quality information and accurate scientific analysis. 40 C.F.R. § 1500.1(b); *see also id.* §1502.24. When relevant information is incomplete or unavailable except at an exorbitant cost, the EIS must disclose that the information is incomplete or unavailable and discuss its significance. *Id.* § 1502.22.

To the extent that information on actual impacts to the Upper Colorado River Basin from the existing Windy Gap Project is available or readily obtainable, it should be used in preference to predicted impacts from modeling. Because Windy Gap diversions have occurred primarily in May and June, and only in specific years, the analysis should focus on actual stream conditions when the Windy Gap Project actually operated. An understanding of the actual impacts of the Windy Gap Project requires at a minimum a comparison of pre-Windy Gap Project conditions with *existing* conditions. Only then could predictions of future conditions be potentially reliable. Moreover, it is important to recognize that all models have limitations that information on actual impacts does not:

> I sometimes think we place too much faith in models -- computer programs, or similar patterns -- rather than

> walking the ground, looking, seeing, feeling. Models, rather than improving thought, often impose a barrier to thought. We get so wrapped up in our analogue we forget that *it is reality we seek to describe*.

Utahans for Better Transportation v. U.S. Department of Transportation, 180 F. Supp. 2d 1286, 1290 (D. Utah 2001) (emphasis added).

There are several problems with the way that the analysis of hydrologic impacts has been approached. A discussion of some of the key problems follows. For a more thorough discussion of problems with the model *see Report on Windy Gap Firming Project Hydrology Technical Report* by Bishop-Brogden Associates (*"BBA Report"*), attached to this letter as Exhibit B, and *Memo on Windy Gap Firming Project DEIS Aquatics Resources Technical Report* by Lane Wyatt (*"Wyatt Memorandum"*), attached to this letter as Exhibit C.

1.1 **The significance of hydrologic modifications is under-reported and therefore, the accuracy of the impact analysis is called into question.**

a. The amount of existing diversions are over-reported. The DEIS does not use actual existing diversions to determine baseline conditions, so the "existing" diversions from Windy Gap Reservoir are over-reported. Table 3 on page 22 of the DEIS Water Resources Technical Report states that the existing average diversions at the Windy Gap Reservoir total **11,080** af per year. (See column labeled "Total" and row labeled "Average".) This number is very close to the diversion records maintained by the Office of the State Engineer, so we believe it is reasonably accurate. On Table 3-2 on page 3-9 of the DEIS, however, the "existing" average annual diversions from Windy Gap Reservoir are reported as **36,532** af per year. (See column labeled "Existing Conditions/Average Annual Flow" and row labeled "Windy Gap Diversions.") This is a discrepancy of 25,452 af per year.

b. The percent increase in diversions over existing conditions is under-reported. Because of the failure to use *actual* existing average annual diversions, the percent increase in diversions at Windy Gap for all alternatives is *under-reported.* For example, Table 3-2 calculates the percent difference between "existing conditions" for Windy Gap diversions and Windy Gap diversions for each alternative. For the Proposed Action, Table 3-2 reports that the average annual Windy Gap diversions will be 46,084 af. (See column labeled "Alternative 2/Avg. Annual Flow" and row labeled "Windy Gap diversions".) This number is compared to "existing" average annual flows of 36,532 af to derive an increase of 9,552 af in average annual diversions, which is a percent difference of **26%**. (*See* column labeled "Alternative 2/Percent Diff" and row labeled "Windy Gap

diversions".) However, if the 46,084 af of average annual Windy Gap diversions for Alternative 2 is compared to the *actual* existing average annual diversions of **11,080** af, then the increase in diversions is **35,004** af which is a percent difference of over **300%.** Consequently, the significance of the future depletions that will be caused by the Proposed Action is grossly under-reported.

c. The average annual stream flows below Windy Gap for existing conditions is under-reported. Because of the failure to use the lower *actual* existing average annual diversions, the existing average annual stream flows below Windy Gap Reservoir are under-reported. For example, Table 3-2 reports that the Colorado River below Windy Gap Reservoir is **151,358** af under existing conditions. (See column labeled "Existing Conditions/Avg. Annual Flow" and Row labeled "Colorado River below Windy Gap.") This number is simply the difference between 187,889 af at the Colorado River above Windy Gap Reservoir, and the "existing" diversions of 36,532. If, however, the actual existing average annual diversions of 11,080 are used, then the existing average annual flows below Windy Gap Reservoir would actually be **176,809** af.

d. The percent decrease in annual average stream flows over existing conditions below Windy Gap Reservoir is under-reported. Because of the failure to use the *actual* existing average diversions to calculate existing stream flows below Windy Gap Reservoir, the percent change in stream flows below Windy Gap Reservoir that would result from each alternative are incorrect. For the Proposed Action, for example, Table 3-2 reports that flows in the Colorado River below Windy Gap will be **130,075** af. (*See* column labeled "Alternative 2/Avg. Annual Flow" and row labeled "Colorado River below Windy Gap.") This number is compared to "existing" flows below Windy Gap Reservoir of 151,358 af to derive a decrease in average annual flows of **21,283** af which is a percent difference of **14%** (*See* column labeled "Alternative 2/Percent Diff" and row labeled "Colorado River below Windy Gap".) However, if Alternative 2 is compared to the *actual* existing average annual diversions of **11,080** af and the corresponding existing flow of **176,809** af below Windy Gap Reservoir, then the reported 130,074 af flow in the Colorado River below Windy Gap Reservoir for Alternative 2 represents a decrease in average annual flows of **46,734** af, or a decrease in over **26%**. Consequently, the significance of stream flow depletions that will be caused by the Proposed Action is grossly under-reported.

e. The analysis of impacts to the aquatic environment cannot be accurate. Because the "existing" diversions are over-reported and the percent decrease in stream flows for each alternative is under-reported, the analysis of the impact of these changes to the aquatic environment, recreation and water and wastewater facilities is called into question

1.2 **The model study period is inadequate to evaluate west slope impacts.** A model study period of 1950 to 1996 was used. DEIS at 3-13. This period overstates projected stream flows for the alternatives and therefore understates resulting impacts to the Upper Colorado River Basin. Extending the model study period through approximately 2005 would result in a more accurate representation of water demands, stream flows, reservoir operations, and water administration under drought-year and dry-year conditions, when impacts are more significant. *See* Hydrosphere Resource Consultants, Inc., *Upper Colorado River Basin Study, Phase II* (May 29, 2003) ("UPCO Phase II Report") at 75 (discussing impacts of 2002-2003 drought). The DEIS provides no justification for omitting 2002 from its summary of annual changes in flow for the five driest years. DEIS at 3-17. Additionally, although the Windy Gap water rights might not be in priority during drought years such as 2002, the DEIS provides no justification for ignoring the impact of such conditions when analyzing cumulative effects. *Id.* at 3-14, 3-42.

1.3 **Average annual or monthly flows are not adequate to determine impacts to aquatic environment.** As Grand County has previously pointed out, what is important is not changes in *average* annual or monthly flows or water quality (or predicted water quality on a single day such as July 25), but actual changes in *daily* flows and *daily* water quality, including temperature. Reporting average annual or monthly flows and ignoring other flow factors can mask significant impacts that may occur on a given day or series of days, thereby creating the false impression that environmental impacts are insignificant, because *on average* they appear to be insignificant. The monthly time-step may be reasonable for estimating gross-level changes in yield or reservoir storage, but it is inadequate to address daily fluctuations in river flow, stage, channel width, and other factors that affect the aquatic environment. *See, e.g., id.* at 3-67, Figure 3-29 (exceedances of weekly average temperature standard in Colorado River during July and August 2007).

1.4 **The results of the QUAL2K model are inadequate to describe water quality impacts.** The modeling of water quality impacts by the QUAL2K model are even more problematic. *Id.* at 3-90 to 3-92. Although the DEIS uses disaggregated daily flows for analyzing surface water hydrology, it does not use daily flows for analyzing surface water quality. Instead, conditions on only a single day each year, July 25, were modeled, based on the apparently untested assertion that it represents a worst case analysis. *Id.* at 3-92, 3-141. The DEIS does not adequately explain why, in any given year, a day other than July 25 might not have worse water quality conditions than those modeled for July 25. *See Wyatt Memorandum,* Exhibit C.

2. Violations of Legal Requirements

Whether an environmental impact is significant depends on both its context and its intensity. 40 C.F.R. § 1508.27. "Intensity" means "severity of impact" and is determined by evaluating a number of factors, including "[w]hether the action threatens a violation of Federal, State, or local law or requirements imposed for protection of the environment." *Id.* § 1508.27(b)(10). Here, the Proposed Action threatens violation of such laws and requirements, thereby increasing the significance of the WGFP's environmental impacts, but the DEIS fails to acknowledge these potential violations.[1] A related requirement is that the environmental consequences section of an EIS must discuss "[p]ossible conflicts between the proposed action and the objectives of Federal, regional, State, and local . . . land use plans, policies, and controls for the area concerned. *Id.* § 1502.16(c); *see also id.* § 1506.2(d). Furthermore, when such laws or requirements are violated, heightened scrutiny of environmental impacts is required, which the DEIS also fails to do. *See Maryland-National Capital Park & Planning Comm'n v. U.S. Postal Service*, 487 F.2d 1029, 1037 (D.C. Cir. 1973) ("When . . . the Federal Government exercises its sovereignty so as to override local zoning protections, NEPA requires more careful scrutiny.").

The Proposed Action threatens to violate the following Federal, State, or local laws or requirements (as have operations of the existing Windy Gap Project and the Colorado-Big Thompson Project ("C-BT") in some instances):[2]

2.1 **Senate Document 80.** Requirements of Senate Document 80, including its provisions on "Manner of Operation of Project Facilities and Auxiliary Features" will control WGFP. DEIS at 1-42 to 1-43. Connection of WGFP facilities to C-BT facilities and storage of C-BT water in non-project facilities would require Congress to amend Senate Document 80 because Senate Document 80 does not include Chimney Hollow Reservoir as a C-BT project feature.

a. The Bureau of Reclamation's authority is constrained. Senate Document 80 is the legal foundation of the C-BT Project. Senate Document 80 describes C-BT facilities and conditions to protect the beneficiaries of those facilities, including Grand County. Senate Document 80 contains requirements for use of C-BT water by the Municipal Subdistrict as a supplemental supply on the east slope, use of Green Mountain Reservoir for west slope beneficiaries, and provisions that specifically protect the headwaters of the Colorado River system in Grand County. Senate Document 80 is

[1] It may be that the applicant intends to comply with all laws and requirements, but the DEIS fails to mention all applicable laws and requirements or the steps that will be taken to ensure compliance. As presented, the Proposed Action would violate several laws and requirements.

[2] Grand County has raised many of these issues in prior letters and meetings, but to no avail. Some of these violations may not necessarily involve environmental protection or land use laws or requirements, but are included because they must be addressed before the Bureau could approve the WGFP.

unique. But for the agreement between the east and west slopes contained in Senate Document 80, the project would not have been built. The 10th Circuit has described Senate Document 80 as "The Document, embodying the salient features of the project, [Senate Document 80] was Congressional sanction for a conciliation of conflicting interests of affected water users on both sides of the Rockies." *United States v. Northern Colo. Water Conservancy Dist.*, 608 F.2d 422, 430 (10th Cir. 1979) *citing*, *United States v. Martin*, 267 F.2d 764 (10th Cir. 1959). The Bureau of Reclamation's ("Reclamation") role in operating the C-BT Project is that of "a trustee responsible for the protection of West Slope interests and delivering water to northeastern Colorado." Consolidated Cases Nos. 2782, 5016 and 5017, Supplemental Judgment and Decree, p. 2 dated February 9, 1978; aff'd by *United States v. Northern Colorado Water Conservancy Dist.*, 608 F.2d 422, 429-30 (10th Cirt. 1979).

b. Any excess capacity contract that Reclamation enters with the Municipal Subdistrict must comply with Senate Document 80.

(1) Reclamation must include terms and conditions in any excess capacity contract to ensure that WGFP operations are consistent with Senate Document 80. Primary purposes of Senate Document 80 that concern Grand County are:

(a) Primary Purpose No. 1 "to preserve the vested and future rights in irrigation"

(b) Primary Purpose No. 2 "to preserve the fishing and recreational facilities and the scenic attractions of Grand Lake, the Colorado River, and Rocky Mountain National Park"

(c) Primary Purpose No. 3 "to preserve the present surface elevations of the water in Grand Lake and to prevent a variation in these elevations greater than their normal fluctuations"

(d) Primary Purpose No. 5 "to maintain conditions of river flow for the benefit of domestic and sanitary uses of this water"

(2) Senate Document 80 requires that to facilitate compliance with the stipulations in paragraphs (j), (k), and (l) a representative may be selected to represent the interests of Grand County and "will be

recognized as the official spokesman of said interests in all matters dealing with project operations affecting Grand County."

(3) Because the WGFP implicates Senate Document 80, through its use of C-BT facilities, the WGFP "deal[s] with project operations affecting Grand County", Grand County must be consulted regarding any determination on whether a C-BT excess capacity or carriage contract can be issued and must consent to any changes in operations to C-BT facilities contemplated by the WGFP.

(4) As Reclamation is aware, similar concerns were expressed by Grand County when Northern was seeking to transfer Operations and Maintenance, including water scheduling from Reclamation to Northern. In his letters dated May 14, June 1, and June 11, 2007 to Eric Wilkerson, Mr. Fred Ore made it clear that any changes in operations would require a "collaborative agreement" among all project beneficiaries due to the unique status of the C-BT Project and the mandates of Senate Document 80. The same rationale applies to the WGFP – Grand County's agreement is required for changes in project operations which includes such a major change in operations that would allow prepositioning.

2.2 **Section 402 of the Federal Water Pollution Control Act ("FWPCA"), 33 U.S.C. § 1342.** Transport of Windy Gap water through Grand Lake is an un-permitted point source discharge of pollutants (including nitrogen, phosphorus, and possibly elevated temperatures) into navigable waters, in violation of the FWPCA.

2.3 **Section 401 of the Federal Water Pollution Control Act ("FWPCA") 33 U.S.C. § 1341.** Section 401 of the FWPCA requires that in connection with issuance of a section 404 permit the State of Colorado certify that the project will not cause violations of State water quality standards. Given the water quality violations that would result from the Proposed Action, a 404 permit could not be issued.

2.4 **Water Conservancy Act, Colo. Rev. Stat. § 37-45-118(1)(b)(II).** The Act requires

> "Any works or facilities planned and designed for the exportation of water from the natural basin of the Colorado river and its tributaries in Colorado, by any district created under this article, shall be subject to the provision of the Colorado river compact, and the "Boulder Canyon Project

> Act.' Any such works or facilities shall be designed, constructed and operated in such manner that the present appropriations of water and, in addition thereto, prospective use of water for irrigation and other beneficial consumptive use purposes, including consumptive uses for domestic, mining, and industrial purposes, within the natural basin of the Colorado River in the state of Colorado from which water is exported will not be impaired nor increased in cost at the expense of the water users within the natural basin. The facilities and other means for the accomplishment of said purposes shall be in incorporated in and made a part of any project plans for the exportation of water from said natural basin of Colorado."

Each of the alternatives includes new "works or facilities planned and designed for the exportation of water from the Colorado River and its tributaries." Accordingly, facilities and other means to protect the Colorado River basin must be part of the project plan and permit conditions for the WGFP.

2.5 **Colo. Rev. Stat. § 37-60-122.2.** These provisions require mitigation of impacts to fish and wildlife.

2.6 **Grand County Areas and Activities of State Interest ("1041") Regulations**. A new or amended 1041 permit is required owing to changes in project participants and operations compared to the Windy Gap Project as originally permitted. Reclamation, however, has stated in the past that a new or amended 1041 permit may not be required for the WGFP and the DEIS continues to state that a 1041 permit will be required only if there is construction of facilities in Grand County.

2.7 **Reclamation Project Act of 1939, 43 U.S.C. § 389.** Section 14 of the Reclamation Project Act of 1939 requires a determination that a contract would be in the best interest of the United States and the project. DEIS at 1-43.

2.8 **Reclamation Act of 1902**. Section 8 of Reclamation Act of 1902 requires that the "Secretary of Interior, in carrying out the provision of this Act, shall proceed in conformity with State law" relating to the use water. *California v. US,* 438 US 645 (1978)

2.9 **Colorado Water Law.** Colorado water law requires a change of the Windy Gap water rights decree from a direct flow right to a storage right. Section 8 of the Reclamation Act of 1902 recognizes Colorado laws on the control, appropriation, use, or distribution of water and requires Reclamation to proceed in conformity with them.

See 43 U.S.C. § 383. Since none of the proposed WGFP east slope reservoirs were covered by the Blue River Decree, a change of C-BT water rights also would be required to store C-BT water in the east slope reservoirs described in the DEIS such as Chimney Hollow.

a. The Expansion of Use Doctrine. To protect water users, Colorado courts read limitations into decrees by implication. One such limitation is that an appropriator may not "**lend, rent**, or **sell** any **excess water** after completing the irrigation of the land for which the water was appropriated." (emphasis added) *Orr v. Arapahoe Water and Sanitation District*, 753 P.2d 1217, 1223 (Colo. 1988). Accordingly, if the original appropriators of the Windy Gap water rights do not have a need for the water, under Colorado law the water must be left in the Colorado River.

Pre-positioning will expand the use of the C-BT water rights. Colorado's statute on changes of use does not allow such expansion to the injury of other water rights. C.R.S. § 37-92-305(3) – (4). In *Twin Lakes Reservoir & Canal Co. v. City of Aspen*, 568 P.2d 45, 50 (Colo. 1977) the Colorado Supreme Court said the expanded use doctrine applies to water rights in the exporting basin of a transmountain diversion. The Proposed Alternative cannot be implemented without a change in the water rights decree

b. The Anti-Speculation Doctrine. Originally, the Windy Gap Project had only six participants. Presently thirteen entities are participating in the firming project, most of which are not those original six entities. *See* Exhibit D, *Windy Gap Ownership and Transfer History*. The Municipal Subdistrict proposes to use its Windy Gap water rights, with priority dates of 1968, 1976 and 1980, to serve new demands by cities that were not entitled to Windy Gap units at the time the project was built in 1985, much less when the rights were originally filed upon (and in the case of the City and County of Broomfield, not even in existence). The Municipal Subdistrict's attempt to serve these new municipalities under its 1968 priority violates Colorado's anti-speculation doctrine because the service of water to these new municipalities was not contemplated at the time the Windy Gap appropriations were made. *City of Thornton v. Bijou Irrigation Co.*, 926 P.2d 1, 37-40 (Colo. 1996) (applying the anti-speculation doctrine to municipal appropriators). Nor does the DEIS disclose any firm contracts for water service. To add these new municipalities to the Windy Gap system, the Municipal Subdistrict must (1) file for a change of water rights to change the place of use for these water rights for these new entities; or (2) seek a decree with appropriation dates reflecting the time at which it had firm contractual commitments to use the water.

2.10 **Water Supply Act.** The Water Supply Act ("WSA"), 43 U.S.C. §390b(b) provides that storage may be included in any reservoir project surveyed or constructed by the U.S. Army Corps of Engineers ("COE") or Reclamation for anticipated future

demand or need for municipal or industrial purposes. However, Section 390b(d) provides:

> Modifications of a reservoir project heretofore authorized, ...to include storage as provided in subsection (b) of this section which would seriously affect the purposes for which the project was authorized, surveyed, planned, or constructed, or which would involve **major structural or operational changes shall be made only upon approval of Congress** as now provided by law. (emphasis added).

The D.C. Circuit Court of Appeals concluded that a settlement agreement between COE, Southeastern Power Customers, Inc., a group of Georgia Water Supply providers and the State of Georgia providing for the reallocation of water stored in Lake Lanier to municipal purposes violated the W.S.A. *Southeastern Federal Power Customers v. Geren*, 514 F.3d 1316 (D.C. Cir. 2008). The Court held that the reallocation of Lake Lanier's storage capacity to local consumption constituted a "major operational change" and thus required congressional approval. *Id.* at 1325. *See also* Order and Memorandum of Decision, Dated September 25, 2008, *Lower Arkansas Valley Water Conservancy District v. United States, et.al*, Civil Action No. 07-cv-0224-EWN-MEH, United District Court for the District of Colorado at 38, "*Re Application of City and County of Denver*, 1989 WL 128576, at *5 (D. Colo. Oct 23, 1989) (noting that an application to change a "water right to a different point of diversion, use and place of use" is '[b]y definition . . . a major operational change that may only be made upon congressional approval").

The C-BT project was approved by Congress to bring water from the western slope to lands on the eastern slope greatly in need of "supplemental irrigation" using the facilities in Senate Document 80. Use of C-BT Project facilities for the delivery and storage of (1) Windy Gap municipal supplies and C-BT water rights (2) in a new 90,000 acre foot non-federal Chimney Hollow Reservoir (3) under the guise of prepositioning, all constitutes "major structural and operational change" and thus congressional approval for all of the alternatives that would rely on the C-BT.

2.11 **Warren Act, 43 U.S.C. §§ 523-525**. Warren Act of 1911 does not allow Reclamation to enter into a carriage contract for non-irrigation water. All of the proposed alternatives presented in the DEIS contemplate that there will be an Excess Capacity Contract between Reclamation and the Municipal Subdistrict. The Warren Act allows Reclamation to contract for the use of excess capacity in reclamation project facilities, but places strict limits on this authority. *Id.*, § 523. In particular, "[e]xcess capacity will

be made available **only for the storage and conveyance of non-project water to be used for *irrigation***...." *Id.*

During the 1980's, Reclamation developed principles to govern transfers of project water, including the use of excess capacity in projects owned by the Department of Interior. *See* Department of the Interior, *Principles Governing Voluntary Water Transactions that Involve or Affect Facilities Owned or Operated by the Department of Interior* (Dec. 16, 1988)("*1988 Principles*.") The policies emphasize that transactions must be agreed to among willing parties and must not adversely affect third parties. *Id.*, Preamble, § 3. The transaction must comply with applicable state and federal laws. *Id.*, § 1

In 2001, Reclamation issued a new policy - WTR-P04 - that specifically addresses contracts for excess capacity in reclamation projects. Reclamation Manual, Policy WTR-P04 (Jan. 10, 2001). The policy begins by reaffirming the 1988 Principles. *Id.*, ¶ 1. It also recites the Warren Act restriction that excess capacity is available only for irrigation. *Id.*, § 5.A (citing 43 U.S.C. § 523). . Policy WTR-P04 recites the Warren Act restriction that: "[e]xcess capacity will be made available **only for the storage and conveyance of non-project water to be used for *irrigation***...." *Id.*, § 5.A (citing 43 U.S.C. § 523) (emphasis added). According to these laws and policies, none of the proposed alternatives presented in the DEIS would be lawful because they will convey non-project water for purposes other than irrigation.

3. Purpose and Need; Range of Alternatives

As Grand County pointed out in its PDEIS Comments, the statement of purpose and need is too narrow, thereby unduly limiting the range of alternatives analyzed. This shortcoming persists in the DEIS, whose narrow range of alternative results in a document that fails to satisfy NEPA's requirement "that agencies take a 'hard look' at environmental consequences . . . ." *Robertson v. Methow Valley Citizens Council*, 490 U.S. at 350 (1989).

The DEIS states that the purpose of the WGFP is "to deliver a firm annual yield of about 30,000 af of water from the existing Windy Gap Project to meet a portion of the water deliveries anticipated from the original Windy Gap Project and to provide up to 3,000 af of storage to firm water deliveries for the [Middle Park Water Conservation District]." DEIS at 1-4. The justification for this purpose is the need "to meet a portion of the existing and future demands of the Project Participants." *Id.* The DEIS estimates future water needs of WGFP participants, which will eventually exceed water supplies available to them, due in part, but only in part, to limited historic yields from the Windy Gap Project. *Id.* at 1-20 to 1-40. What emerges from this information, however, is the

conclusion that even with the WGFP, all the participants are predicted to face significant water shortages in 2050. The total projected water demand for the WGFP participants in 2050 is 251,450 af, with an estimated shortage of 110,688 af, of which 26,138 af[3] would be met by the WGFP (excluding Middle Park Water Conservation District's 429 af of firm yield, since its water demand and shortage are not included in the 2050 totals). *See id.* Table ES-1. WGFP's contribution to meeting participants' 2050 water demand would only amount to 10% of total demand. *See id.* Figure ES-2. The remainder, 84,550 af (34% of total 2050 demand) would have to be met by new water supplies—as yet unidentified—and conservation—as yet unquantified and of doubtful efficacy because it is voluntary. *Id.* Participants' needs, therefore, are not so much to firm Windy Gap Project yields, but to obtain additional water supplies to meet their anticipated needs. *See id.* at 1-37.

Moreover, it is apparent that none of the alternatives in the DEIS will accomplish the stated purpose of the WGFP. Taking into account cumulative impacts, the Proposed Action would firm only about 24,000 af of water. DEIS Tables 3-20, 3-21. This is only 80% of the approximately 30,000 af included in the statement of purpose. The situation would be even worse for Middle Park, which would receive a firm yield of only 429 af, compared to the 3,000 af included in the statement of purpose.

One reason none of the alternatives analyzed in the DEIS satisfies the purpose and need is that the purpose and need is too narrow. Consideration of alternatives is "the heart of the environmental impact statement." 40 C.F.R. § 1502.14. Because of this, agencies may not define purpose and need "so narrowly that it foreclose[s] a reasonable consideration of alternatives." *Davis v. Mineta*, 302 F.3d at 1118. As Reclamation's NEPA Handbook explains,

> This brief statement [of purpose and need] is a critical element that sets the overall direction of the process and serves as an important screening criterion for determining which alternatives are reasonable. All reasonable alternatives examined in detail must meet the defined purpose and need.
>
> A brief background discussion may be included for additional information, as appropriate. . . . This background

[3] This actually overstates WGFP's potential contribution to meeting participants' water needs in 2050. Taking into account cumulative effects, the WGFP firm yield is predicted to be only 23,616 af (excluding 429 af for Middle Park). *See* DEIS Tables 3-20, 3-21. This represents only 9.4% of participants' total water demands.

> discussion should be general and not tied to any specific alternative.
>
> Care must be taken to ensure an objective presentation rather than a justification. A purpose and need statement will generally allow a range of reasonable alternatives. If a purpose and need statement appears to allow only one reasonable solution, the statement and the reasons for rejecting other alternatives should be re-examined and confirmed or revised, as appropriate.

U.S. Department of the Interior, Bureau of Reclamation, National Environmental Policy Act Handbook 8-5 to 8-6 (Public Review Draft: 2000) ("2000 NEPA Handbook"); *see also* United States Department of the Interior, Bureau of Reclamation, National Environmental Policy Act Handbook (Oct. 1990) 4-3 ("1990 NEPA Handbook").

As a result of the flawed statement of purpose and need in the DEIS, the range of alternatives it analyzes is unreasonably narrow. All alternatives - even the so-called "no action" alternative - rely on construction of one or more reservoirs to store water diverted from the Colorado River. The consequence of this, as the DEIS acknowledges, is that "[a]ll alternatives would result in an increase in water diversions from the Colorado River below the Windy Gap Reservoir." DEIS at 3-55. They are merely variations on the same theme. In addition, the DEIS reports that alternatives were excluded from consideration because Congressional approval would be required. Nevertheless, the Proposed Action would also require Congressional approval. Because of this, there is no way to ensure that the least environmentally damaging alternative will be selected as required under the COE's 404(b)(1) analysis.

Finally, the alternatives that are presented do not even make a significant contribution to the water needs used to justify the purpose. On the other hand, a statement of purpose and need such as the following would lead to a broader range of reasonable alternatives, some of which might even be more cost effective than or environmentally preferable to those analyzed in the DEIS: "Meet Participants' existing and future water demands to the extent of 30,000 af per year [or whatever quantity would be appropriate] by measures such as mandatory conservation measures or goals, new sources of water, firming the yield of the Windy Gap Project, and requiring that all Windy Gap water be reused to extinction." The mitigation measures listed below that should have been discussed in the DEIS could serve as alternatives, or parts of alternatives, for analysis.

4. Baseline, Cumulative Effects.

An understanding of baseline conditions in the Upper Colorado River Basin, including those that result from on-going human disturbances, is essential under NEPA. In discussions about the inadequate baseline used to measure impacts in the DEIS, Reclamation has insisted that the word "baseline" is not even mentioned in NEPA. This misses the point. NEPA requires an analysis of existing conditions, whether or not the word "baseline" is used. "Without establishing the baseline conditions which exist [before the Proposed Action occurs], there is simply no way to determine what effect the proposed [action] . . . will have on the environment, and, consequently, no way to comply with NEPA." *Half Moon Bay Fishermans' Mktg Ass'n v. Carlucci*, 857 F.2d 505, 510 (9th Cir. 1988). In this case, existing conditions consist of an aquatic environment that has been significantly altered. Not only does the DEIS fail to explain this, but it does not even accurately describe the existing hydrologic conditions. (*See* General Comments Section, above.)

The Upper Colorado River Basin has been severely degraded by human activities. On average, an estimated 65% of the water in the Upper Colorado River System is diverted to the east slope—a percentage that will increase to 85% if both the WGFP and Denver Water's Moffat Collection System Project are implemented. Graphs presented in Exhibit B, *BBA Report*, visually demonstrate the reduction in average daily stream flows at Hot Sulphur Springs before and after various water projects came online. As a result of such diversions to the east slope, the following impacts have occurred in Grand County in recent years (many of which constitute violations of Senate Document 80), largely due to C-BT and Windy Gap operations:

- reduced water quality in Grand Lake;
- insufficient flows for agricultural irrigators to pump water from the Colorado River;
- insufficient flows for Hot Sulphur Springs to pump water for its public water system;
- insufficient flows to preserve fishing on the Colorado River, despite the instream flow requirements of the June 23, 1980 Memorandum of Understanding;
- insufficient flows in late summer to maintain commercial fish ponds on some ranches;

- high temperatures in the Colorado River above Williams Fork, resulting in fish mortality;
- establishment of the didymo (rock snot) a nonnative algae that creates thick mats of moss that attach to rocks creating nuisances;
- reduction in the number of kayaking days;
- death of cottonwood trees along the river;
- increased nutrient loading and other potential impacts from birds (some nonnative, such as pelicans) attracted to the Windy Gap Reservoir; and
- spread of whirling disease.

Documentation of these conditions may be found in a number of technical reports, including the UPCO Phase II Report and Coley/Forrest, *Grand County: Its Economy & Water Resources* (July 2007).

A more detailed description of past water diversion projects and their resulting impacts (e.g., conditions before and after the C-BT, the Windy Gap Project, and Denver Water's Moffat Collection System project) is necessary to understand how these conditions came about as well as how they can be mitigated. *See Lands Council v. U.S. Forest Service*, 395 F.3d 1019, 1028 (9th Cir. 2004) (holding that EIS for a timber sale "should have provided adequate data of the time, type, place, and scale of past timber harvests and should have explained in sufficient detail how different project plans and harvest methods affected the environment.") As EPA explains:

> The identification of the effects of past actions is critical to understanding the environmental condition of the area. Knowing whether the resource is healthy, declining, near collapse, or completely devastated is necessary for determining the significance of any added impacts due to the proposed project. The NEPA document should consider how past activities have historically affected and will continue to detrimentally affect the resources of concern.

EPA, *Consideration of Cumulative Impacts in EPA Review of NEPA Documents*, EPA 315-R-99-002/May 1999, § 4.3.

A significant shortcoming of the DEIS is that it lacks a detailed description of on-going impacts from past water projects. A description of ongoing impacts to natural hydrologic conditions could enable Reclamation to develop a more defensible prediction of the likely effects of the WGFP, as well as improve the analysis of the incremental impacts of the WGFP when added to other past, present, and reasonably foreseeable future actions. Moreover, a more detailed description is especially important here because of the complex interactions among the various diversions from the Colorado River and its tributaries and the real possibility that implementation of the WGFP could be a "tipping point," resulting in disproportionately greater impacts in the river basin than otherwise would result if WGFP depletions did not occur in an already severely degraded stream system. Finally, a more detailed description would reveal that mitigation of many of the impacts associated with the existing Windy Gap Project could be mitigated by the project proponent through modifications to reservoir diversions and pumping schedules and coordination with the Denver Water Board and Reclamation.

In Grand County, existing impacts are of two kinds. The first result from permanent features constructed for past projects, such as the Windy Gap Reservoir. The second are more dynamic and result from actions that can be modified, such as the timing and quantity of diversions and of releases from reservoirs. Because existing and future hydrologic conditions—particularly the frequency, duration, and magnitude of stream depletions—are controlled, and can therefore be modified by the Municipal Subdistrict, Reclamation, and the Denver Water Board, hydrologic conditions can form the basis for an adaptive management plan that could significantly mitigate both existing and future impacts for the mutual benefit of all. Adaptive management is discussed below under mitigation.

5. No Action Alternative

Like the PDEIS, the DEIS improperly identifies the No Action Alternative (Alternative 1) as the possible future enlargement of the Ralph Price Reservoir by 13,000 af. DEIS 2-14 to 2-18. The DEIS admits that Alternative 1 "was analyzed along with the action alternatives *to provide a basis for comparison.*" *Id.* at 2-14 (emphasis added). As Table 2-6 of the DEIS illustrates, Reclamation uses Alternative 1 to advantage, by making changes in various parameters from the Proposed Action appear insignificant when compared to the changes predicted for Alternative 1. Such an approach is contrary to the purpose behind analyzing a no action alternative:

> In requiring consideration of a no-action alternative, the Council on Environmental Quality intended that agencies compare the potential impacts of the proposed major federal action to the *known impacts of maintaining the status quo*. . . .In other words, the *current level of activity is used as a benchmark.*

Custer County Action Assn' v. Garvey, 256 F.3d 1024, 1040 (10th Cir. 2001) (emphasis added).

It is true that CEQ guidance states that when "choice of 'no action' by the agency would result in *predictable* actions by others, this consequence of the 'no action' alternative should be included in the analysis." Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations, Question 3, 46 Fed. Reg. 18,026, 18,027 (Mar. 23, 1981) (emphasis added). Alternative 1 is not, however, predictable. It is speculative, because there is no assurance that the regulatory authorizations for enlargement of the Ralph Price Reservoir will be received, that Longmont will obtain funding for and actually construct the enlarged reservoir or that water rights will be properly decreed. The environmental impacts of Alternative 1 would need to be analyzed in an EA or EIS. DEIS at 2-17. In addition, a 404 permit from COE and a 1041 permit from Boulder County, as well as county location and extent review and special use review would be required. *Id.* at 2-17, 1-46. Detailed design studies for the enlargement of the Ralph Price Reservoir have not been conducted. *Id.* at 2-17. As a result, specific information on the construction, material requirements, scheduling, and cost is not available. *Id.* "To be a reasonable alternative, it must be non-speculative, and bounded by some notion of feasibility." *Utahans for Better Transportation v. U.S. Department of Transportation*, 305 F.3d 1152, 1172 (10th Cir. 2002) (citations omitted). Alternative 1 fails that test. The No Action Alternative should be maintaining the status quo. If anything, possible enlargement of the Ralph Price Reservoir should be included in the cumulative impact analysis for the no action alternative.

6. Reliance on Illegal Prepositioning

As Grand County has pointed out repeatedly, prepositioning is illegal, among other reasons, because it requires the C-BT project to be operated in violation of Senate Document 80, and requires changes in C-BT and Windy Gap water rights to allow storage in a non-federal facility on the east slope. *See e.g.,* letter dated March 22, 2004 from the Colorado River Conservation District, Grand County and Northwest Colorado Council of Governments to Richard Aldrich and John Chaffin, a copy of which is attached as Exhibit E. These concerns have never been satisfactorily addressed. The January 2007 personal communication with the Colorado State Engineer, who "indicated

that the Proposed Action to deliver and store water in Chimney Hollow Reservoir using prepositioning could be administered in compliance with current water right decrees and within the priority system," does not do so. DEIS at 3-7. The question is not whether prepositioning would pose an impediment to administering water rights under Colorado law, but whether prepositioning violates Senate Document 80 and other federal and state law. Grand County continues to believe that it is illegal.

The request by Reclamation to the State Engineer was misdirected – a declaratory judgment should be obtained. It has long been the law in Colorado that the courts – not the State Engineer - determine use rights in water. ("**Administrative action**, forbearance of enforcement or **State Engineer acquiescence** in water use practice **does not substitute for judicial determination of use rights**." (emphasis added) *Empire Lodge Homeowners' Ass'n. v. Moyer*, 39 P.3d 1139, 1156-7, (Colo. 2001). Moreover, the statement by the State Engineer is wrong. It is not within Northern's, or the Municipal Subdistrict's, or Reclamation's, or the State Engineer's discretion on whether a change of water rights application must be filed – rather it is a mandatory requirement. Colorado's Supreme Court has told the State Engineer and all water users that "[t]he change of water right and augmentation plan statutes provide that **applications for approval of the water use practices** they encompass **are mandatory, not discretionary**." (emphasis added) *Empire Lodge*, 39 P.3d at 1158.

NEPA requires that the lead agency evaluate "all reasonable alternatives." 40 C.F.R. § 1502.14(a). An illegal alternative is not a reasonable alternative. It is only a "phantom alternative." *National Resources Defense Council v. Evans*, 364 F. Supp. 2d 1083, 1116 (N.D. Cal. 2003). Because of the illegality of Alternative 2 and the DEIS's emphasis on it as the Proposed Action, the document fails to inform the public, let alone Reclamation, of a range of reasonable alternatives, thereby failing to promote informed decision making, and ultimately fails to fulfill NEPA's purposes. At a minimum, the DEIS should have analyzed an additional alternative, construction of Chimney Hollow Reservoir without use of prepositioning. This would enable Reclamation to take into account the uncertainty arising from the illegality of prepositioning and also inform the COE's section 404(b)(1) Guidelines analysis.

7. Inadequate Analysis of Socioeconomic Impacts Identified during Scoping

The west slope socioeconomic issues identified during scoping include, among others, "potential impacts to tourism and recreation industries in Grand County" (not just active recreation participants using publicly accessed facilities), "additional cost associated with the potential need to upgrade wastewater treatment plants in the Fraser River and Colorado River basins," and "economic impacts to the communities of Grand Lake, Kremmling and Hot Sulphur Springs and how each alternative would affect future

growth and real estate values." ERO Resources Corp., *Public Scoping Report* 14 (Dec. 19, 2003). While the DEIS addresses some of these potential impacts, its analysis is too narrow and excludes impacts of vital importance to Grand County and its citizens. Therefore, the DEIS fails to take the hard look that NEPA requires.

There are three types of impacts that are excluded from consideration, understated, or ignored in the DEIS's socio-economic analysis: (1) impacts referenced in ERO's Public Scoping Report and not pursued; (2) impacts referenced in the Recreation, Land Use or Visual Impacts sections of the DEIS and not pursued; and (3) impacts mentioned in earlier documents submitted by Grand County but are missing from the DEIS. Many of these impacts are discussed in sections 1.1, 1.2, and 1.3 of the memorandum dated December 15, 2008, from Coley/Forrest, *Windy Gap Firming Project - Draft Environmental Impact Report (DES 08-30)* ("*Coley/Forrest Memorandum*"), attached as Exhibit F.

7.1 **Pervasive Disregard for the Private Sector in Grand County**. Water resources and the local Grand County economy are inextricably linked, as set forth in Coley/Forrest, Inc., *Grand County: Its Economy and Water Resources* (2007) (prepared for Grand County). Although the WGFP directly impacts the environmental quality of the Colorado River, Lake Granby, Shadow Mountain Reservoir, and Grand Lake, there is a pervasive and nearly total disregard in the DEIS for private sector impacts arising from the WGFP's impacts on these surface waters. Some private sector impacts that are ignored include:

- ranchers whose irrigation systems fail due to reduced stream flow in the Colorado River;
- ranchers who rely on fishing leases along the Colorado River;
- real estate and resort developments where a healthy Colorado River is their primary or sole asset;
- lakefront and riverfront properties whose value is directly related to reservoir water clarity and water quality;
- numerous summer recreation-oriented and visitor-oriented businesses including private marinas, local motels, restaurants, recreation gear and apparel retailers, grocers and the like;
- construction-related impacts on adjacent properties and developments.

7.2 **Socioeconomic Impacts Excluded – Recreation.** The most significant exclusion arises from the DEIS's definition of recreation which is limited to active recreation where there is public access. There is a general bias in the DEIS that, if recreation is not active recreation that is accessible by the general public, then it merits no analysis. The only recreation activities quantified in the DEIS are commercial kayaking and commercial rafting on selected portions of the Colorado River and related camping. This is narrow and inadequate. While commercial kayaking and commercial rafting in selected reaches of the Colorado River are a few core summertime visitor activities, there are other more significant recreation activities that bolster the Grand County economy in the summer that are likely impacted by the WGFP. These include:

- commercial and private fishing in locations other than Reach 5 of the Colorado River;
- other commercial and private boating in reservoirs;
- camping in locations other than Reach 5 of the Colorado River, and
- passive recreation enjoyment of the Colorado River and the reservoirs.

Each of these affected recreation activities has related impacts on lodging, restaurant sales, recreation equipment, rental providers, guides or outfitters, and other related purchases.

In the summer, many out-of-state visitors come to Grand County because of Rocky Mountain National Park, a national destination, but they linger because of the fishing, boating, and scenic beauty that Grand County currently offers. The local economy relies on this recreation relationship. The water resources that are compromised by the WGFP are necessary components of Grand County's scenic beauty and tranquility and its more passive recreation venues. (See comments R-1, R-2, R-6 to R-8, R-11 in the attached *Coley/Forrest Memorandum.*)

Further, the DEIS drops certain recreation impacts from further consideration because they are "too difficult to quantify" or "unlikely to affect visitors." These are discussed in section 1.7 of the *Coley/Forrest Memorandum.* This is inconsistent with EPA *Guidelines for Economic Analyses* which provide extensive detail on how to treat qualitative or uncertain impacts. (See comments SE-3 - SE-7, SE-10, and SE-12 in the attached *Coley/Forrest Memorandum.*)

7.3 **Socioeconomic Impacts Excluded – Land Use / Agricultural Impacts.** The Land Use section (3.18) of the DEIS does not acknowledge a relationship between Colorado River hydrology and agricultural land use. Therefore, the DEIS's discussion of socioeconomic impacts does not address this important negative impact. Based on research conducted by Coley/Forrest, there are substantial potential negative relationships between further reductions in Colorado River streamflow and agricultural land uses through irrigation ditch failures, impacts to development directly dependent on river and reservoir views and usage. These are documented in communications with the Grand County ranching community. Coley/Forrest, Inc., *Grand County: Its Economy and Water Resources* (2007) (prepared for Grand County, Colorado). See *also* comments SE-1 and SE-9 in the attached *Coley/Forrest Memorandum.*

7.4 **Countywide Analysis.** The few socioeconomic impacts that are reported in the DEIS are presented on a countywide basis. This approach misses the significance of impacts that may seem small on a countywide basis, but comprise the economic lifeblood of smaller communities and some economic sectors. For example fishing and boating along some reaches of the Colorado River are significant areas of summer economic activity in the relatively small communities of Hot Sulphur Springs and Kremmling. The *Public Scoping Report* expressly mentions concerns about impacts on these communities; the DEIS ignores them.

7.5 **Cumulative Effects Analysis**. The DEIS states that the "cumulative socioeconomic effects were evaluated" but provides only the results of this analysis. DEIS at 3-286. The analytical steps are excluded from the DEIS and the Socioeconomic Technical Resource Report, so it is not possible to analyze the results.

If Reclamation had concluded that the socioeconomic issues identified during scoping were not significant or had been covered by prior environmental review, it was required to include "a brief presentation of why they will not have a significant effect on the human environment or providing a reference to their coverage elsewhere." 40 C.F.R. § 1501.7(a)(3). Therefore, the DEIS must include an analysis of *all* issues identified during scoping or an explanation of why they are insignificant or have already been analyzed. Furthermore, when the DEIS does analyze environmental impacts, it often fails to do so adequately by minimizing or overlooking impacts to Grand County. Such deficiencies are identified in this letter, the comment letters on technical reports, and the other letters that Grand County has submitted.

8. Criteria on Significance

The DEIS reports many impacts in numerical form, often without criteria for determining whether those impacts are significant and without explaining what those

numerical changes mean. For example, we are told that there would be increases in temperature, specific conductivity, ammonia concentrations, inorganic phosphorus concentrations, selenium concentrations, and aquatic plant growth and decreases in dissolved oxygen concentrations in the Colorado River on July 25; and that these changes vary by alternative. DEIS at 3-96 to 3-101. But we are not told what effect these changes would have on aquatic life in the Colorado River or whether any of the changes would be significant. Without knowing whether the changes would be significant or insignificant and the reasons therefore, it is impossible to make an informed comparison of the environmental impacts of different alternatives. Although the DEIS does refer to various water quality standards, they are not necessarily relevant to the issue of significance for purposes of NEPA. To correct this deficiency, the DEIS should include specific criteria for each impact category to determine whether a given impact would be less than significant, potentially significant, or significant, and explain the reasoning behind these conclusions It should also include a discussion of mitigation measures for impacts that are potentially significant or significant.

9. Inadequate Discussion of Mitigation

An EIS must include a discussion of "[m]eans to mitigate adverse environmental impacts . . . ." 40 C.F.R. § 1502.16(h); *see also* 73 Fed. Reg. at 61,316-17 (to be codified at 43 C.F.R. § 46.130). As the Supreme Court recognized, such a discussion is essential to ensure that agencies take a hard look at the environmental consequences of proposed actions. *Robertson v. Methow Valley Citizens Council*, 490 U.S. at 352. Furthermore,

> omission of a reasonably complete discussion of possible mitigation measures would undermine the "action-forcing" function of NEPA. *Without such a discussion, neither the agency nor other interested groups and individuals can properly evaluate the severity of the adverse effects.*

Id. (emphasis added); *see also Colorado Environmental Coalition v. Dombeck*, 185 F.3d at 1173 ("It is not enough to merely list possible mitigation measures.").

Judged by these requirements, the discussion of mitigation in the DEIS is still inadequate.[4] Many of the proposed west slope mitigation measures for the Proposed Action are too vague and uncertain to enable Reclamation, Grand County, or other

[4] The status of one mitigation measure is unclear, because it is found in the Executive Summary, but does not appear to be included in the body of the DEIS. DEIS at ES-21 ("Opportunities for improvements to aquatic life habitat in the Colorado River and mitigation of impacts to fish will be coordinated with CDOW, Grand County and other responsible agencies."), 3-145, 3-293.

interested groups and individuals to evaluate "the severity of the adverse effects." *Robertson v. Methow Valley Citizens Council*, 490 U.S. at 352. Some of the most significant west slope impacts from the WGFP would result, directly or indirectly, from reduced surface water flows. Yet the only proposed mitigation measures for surface water hydrology relate solely to Granby Reservoir. DEIS at 3-55. Even those are too uncertain to qualify as mitigation. Reclamation notes only that "*it may be possible* to modify prepositioning operations" and undertakes to conduct additional evaluations "*to determine if* changes in the timing of water deliveries to the East Slope can reduce impacts to Granby Reservoir while still meeting the purpose and need for the project." *Id* (emphasis added). As a cooperating agency, Grand County is entitled to review and comment on all such proposals and evaluations. *Memorandum of Agreement Between the Bureau of Reclamation and Grand County Board of County Commissioners for the Windy Gap Firming Project Proposed by the Municipal Subdistrict, Northern Colorado Water Conservancy District*, dated effective January 22, 2005 ("MOA"), § V.I.

With regard to surface water quality, Grand County appreciates the Municipal Subdistrict's commitment to continued participation and funding of ongoing nutrient studies in the Three Lakes System. DEIS at 3-129. Although the County also welcomes the proposal to determine whether increasing bypass flows from 90 to 135 cfs when Windy Gap is being pumped would result in reduced downstream temperatures, it is dismayed the Municipal Subdistrict would only "consider increasing required bypass flows under certain water supply conditions" if the studies are favorable. *Id.* As mitigation for recreation and socioeconomic impacts, the Municipal Subdistrict would curtail diversions from the Colorado River if flows at the Kremmling gage are less than 2,200 cfs during the annual Big Gore Race. Id. at 3-253, 3-290. While Grand County appreciates that gesture, the measure would not mitigate impacts to kayaking, rafting, fishing, and other recreational activities on days other than those on which the Big Gore Race are held, nor would it address the other significant socioeconomic impacts to Grand County discussed in these comments. *See also* comment letters dated February 11, 2008 on Draft Recreation Resources Technical Report and Draft Socioeconomic Resources Technical Report; and letter dated February 11, 2008 transmitting Coley/Forrest report on Draft Recreation Resources Technical Report and Draft Socioeconomic Resources Technical Report.

Another deficiency of the DEIS regarding mitigation is that it merely catalogs the mitigation measures included in the 1981 Windy Gap EIS, and does not include an adequate discussion of those measures. *See* DEIS at 1-7 to 1-8. What is needed is a comparison of the impacts predicted in the Windy Gap Project EIS with the actual impacts that have resulted from that project, together with an analysis of whether, and to what extent, the mitigation measures have been effective. For example, the Municipal Subdistrict paid $100,000 for a habitat manipulation project and $450,000 for biological

investigations. The DEIS should have reported on the effectiveness of the habitat mitigation project and what was learned from the biological investigations. *Id.* at 1-7. Another example is the proposal to determine whether increasing bypass flows from 90 cfs to 135 cfs when Windy Gap is being pumped would result in reduced downstream temperatures. *Id.* at 3-129. That study should have been completed before the DEIS was prepared. An analysis of the original Windy Gap mitigation could also provide a basis for Reclamation to determine whether existing mitigation measures satisfied the Municipal Subdistrict's obligation under Colo. Rev. Stat. § 37-45-118(1)(b)(II) for the original Windy Gap Project and to decide what additional mitigation measures would be necessary for the Windy Gap Project or the WGFP.

There are a number of obvious mitigation measures the DEIS should have considered, but does not. More detailed mitigation proposals are contained in Grand County's December 29, 2008 letter to COE regarding the Windy Gap Firming Project 404 Permit Application ("*404 Permit Comment Letter*"). Examples of mitigation that should have been discussed in the DEIS include, without limitation:

- Because Windy Gap water can be reused to extinction, unlike C-BT water, the DEIS should have discussed requiring WGFP participants to reuse to extinction all or a significant portion of their Windy Gap water. *See* DEIS at 1-12, 1-19.

- Although the DEIS rejects water conservation as an alternative, it does not explain why water conservation should not be proposed as an additional mitigation measure. The DEIS does, after all, recognize that "[t]o meet future water requirements will require continued improvements in water conservation in addition to the proposed WGFP." *Id.* at 1-18.

- The DEIS does not consider what would probably be the most effective mitigation measure, adaptive management of the Upper Colorado River. 73 Fed. Reg. at 61,315 (to be codified at 43 C.F.R. § 46.30) ("Adaptive management recognizes that knowledge about natural resource systems is sometimes uncertain."); 61,317 (to be codified at 43 C.F.R. § 46.145) ("Bureaus should use adaptive management, as appropriate, particularly in circumstances where long-term impacts may be uncertain . . . ."). *See generally* The NEPA Task Force Report to the Council on Environmental Quality: Modernizing NEPA Implementation 44-56 (Sept. 2003). In short, this would entail developing a stream management plan with all the major diverters. The plan would include qualitative goals, monitoring to identify whether the goals are being met, and specified triggers to require

changes in operation. A decision-making process would be established to adapt operations to achieve the management plan's goals for the benefit of all parties, when specified. The Grand County Stream Management Plan is the perfect basis for an Adaptive Management Plan.

- The DEIS does not consider integrated operations of the Denver Water Board and the Municipal Subdistrict systems to serve the City of Broomfield, a WGFP participant that wants to firm 13,739 af of water. Since the Denver Water Board and the Municipal Subdistrict both serve Broomfield, it would seem that allowing water to bypass the Denver Water Board diversion points in the headwaters of the Fraser River, be captured in Windy Gap, and then moved through the C-BT system to Broomfield could provide benefits to the Fraser River. Unlike water moved through the Moffat system which cannot be used to extinction, water provided from Windy Gap can be. This measure could provide additional water for the front range.

- The DEIS does not consider upgrading the Windy Gap Substation. Currently, Western Area Power Administration is in the process of preparing an EIS for upgrading a 69kV line to 138 kV from the Windy Gap Substation to the Granby Pump Plant. Prepositioning would require more pumping by a system that may not be able to meet future demands. This potential impact could be mitigated, at least in part, by upgrading the substation.

- Reclamation is a beneficiary of the WGFP through "shrink" water. This water could produce approximately $1.4 million in additional revenue to Reclamation, which could be used to fund the clean up of Grand Lake. If one of the short-term solutions is to draw down Shadow Mountain Reservoir, these funds should also be used to pay for the pumping and power interruption charges, so that no other agency or entity is required to bear any such costs.

10. Cumulative Actions

Cumulative actions are actions "which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement." 40 C.F.R. § 1508.25(a)(2). Although section 1508.25(a)(2) uses the word "should," courts have made preparation of a single EIS mandatory in the case of cumulative actions: "Under § 1508.25, two or more agency actions *must* be discussed in

the same impact statement where they are . . . 'cumulative' actions." *Klamath-Siskiyou Wildlands Center v. Bureau of Land Management*, 387 F.3d 989, 998-99 (9th Cir. 2004) (emphasis added). As explained in *Klamath-Siskiyou*, the environmental analysis must be done in a single document "when the record raises 'substantial questions' about whether there will be 'significant environmental impacts' from the collection of anticipated projects." *Id.* at 999. *See Blue Mountains Biodiversity Project v. Blackwood*, 161 F.3d 1208, 1215 (9th Cir. 1998) (single EIS required for five timber sales in same watershed).

The WGFP and the Denver Water Board's Moffat Collection System Expansion project are cumulative actions. The Denver Water Board proposes to develop 18,000 af of new firm yield to the Moffat Treatment Plant, primarily through diversions from the Upper Fraser River and Williams Fork River basins. DEIS at 2-42. Specifically, flows in the Fraser River and the Colorado River below the confluence with the Fraser will be reduced by average annual diversions of about 9,300 af. *Id.* at 3-42. Other impacts to the Colorado River will result from changes in the timing of flows below the Williams Fork Reservoir due to changes in the operation of the reservoir. *Id.* at 3-46. These impacts to the Colorado River are themselves significant, as are those of the WGFP. Together they are cumulatively significant and therefore must be analyzed in the same EIS.[5] 40 C.F.R. § 1508.25(a)(2). Cumulative impacts to the Platte River basin may also be cumulatively significant.

A single EIS analyzing the impacts of both projects is not a mere formality. Without such EIS, there can be no assurance that Reclamation and COE have, collectively, taken a hard look at alternatives to the simultaneous operation of the WGFP and Moffat Collection System Expansion project, the cumulative environmental impacts of those two projects (with emphasis on the hydrology, water quality, and aquatic resources of the Colorado River), and measures to mitigate those impacts. Here, a single EIS is particularly appropriate, given the complex interrelationships among present and future diversions from the Upper Colorado River Basin. *See Kleppe v. Sierra Club*, 427 U.S. 390, 413 (1976) ("Cumulative environmental impacts are, indeed, what requires a comprehensive impact statement."). Indeed such complexity argues for use of adaptive management, with development of a stream management plan and monitoring to ensure that the operation of both projects contributes to achieving the management plan's goals.

[5] The Environmental Protection Agency also suggested this in its comments on WGFP EIS scoping. Letter dated November 4, 2003, from EPA to the Bureau.

11. Wild and Scenic Designation

The DEIS notes that the Kremmling and Glenwood Springs Field Offices of the BLM analyzed river and stream segments that might be eligible for inclusion in the National Wild and Scenic Rivers System ("NWSRS") and identified several segments in Grand County that are eligible for inclusion. DEIS at 3-233 to 3-234. The DEIS also recognizes BLM's policy that when a river segment is determined to be eligible "its identified outstandingly remarkable values shall be afforded adequate protection, subject to valid existing rights, and until the eligibility determination is superseded, management activities and authorized uses shall not be allowed to adversely affect either eligibility or the tentative classification . . . ." BLM Manual § 8351.32.C (May 19, 1992); see also *id.* § 8351.52.C. But the DEIS fails to take the next step and analyze what effect the alternatives would have on BLM's interim management policy and whether Reclamation should use its own authorities to protect these segments until the eligibility determination is superseded.

In addition, "[o]nce a river is found eligible, the respective agency is committed to evaluate all actions within its control through the filter of the river's potential for designation. Some specific authorities for protecting river-related values include the Clean Water Act for free flow and water quality, the Endangered Species Act for plant and animal species within a river corridor, and the Archaeologic[al] Resources Protection Act for cultural resources." Interagency Wild and Scenic Rivers Coordinating Council, *The Wild & Scenic River Study Process* 30 (Dec. 1999). The DEIS also fails to evaluate the WGFP "through the filter of the river's potential for designation." Instead, it specifically declines to determine whether any of the alternatives would affect the suitability of the eligible segments for inclusion in the NWSRS. DEIS at 3-235.

The Nationwide Rivers Inventory compiled by the National Park Service ("NPS"), available at http://www.nps.gov/ncrc/programs/rtca/nri/states/co.html, includes a 23-mile reach of the Colorado River, from State Bridge to the Blue River. (As of December 4, 2008, the NPS webpage had not been updated to include the 5 segments BLM determined were eligible in March 2007.) "Each federal agency shall, as part of its normal planning and environmental review process, take care to avoid or mitigate adverse effects on rivers identified in the Nationwide Inventory . . . ." Presidential Memorandum for the Heads of Departments and Agencies (Aug. 2, 1979). The DEIS fails to do that. Further, "[a]gencies shall, as part of their normal environmental review process, consult with the Heritage Conservation and Recreation Service [now the NPS] prior to taking actions which could effectively foreclose wild, scenic, or recreational river status on rivers in the Inventory. *Id*; *see also* CEQ Memorandum for Heads of Agencies, Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory, 45 Fed. Reg. 59,190 (Sept. 8, 1980) ("CEQ Memorandum").

Such consultation did not occur. *See* DEIS at 4-4. The CEQ Memorandum also requires that "[w]hen environmental impact statements are prepared on proposals that affect Inventory rivers, the lead agency should request HCRS and the affected land managing agency to be cooperating agencies as soon as the Notice of Intent to prepare an EIS has been published." 45 Fed. Reg. at 59,192. It does not appear, however, that Reclamation requested either the NPS or BLM to be cooperating agencies.

12. Grand County's Status as a Cooperating Agency

In its congressional declaration of policy, NEPA provides that "it is the continuing policy of the Federal Government, *in cooperation with State and local governments* . . . to use all practicable means and measures . . . in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans." 42 U.S.C. § 4331(a) (emphasis added).

A cooperating agency is any federal, state, or local agency (other than a lead agency) that "has jurisdiction by law or special expertise[6] with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment." 40 C.F.R. § 1508.5. A cooperating agency is entitled to active and meaningful participation in preparation of an EIS. The CEQ regulations require a lead agency to "[u]se the environmental analysis and proposals of cooperating agencies with jurisdiction by law or special expertise, *to the maximum extent possible* consistent with its responsibility as lead agency." *Id.* § 1501.6(a)(2) (emphasis added).

Recently promulgated Department of the Interior regulations (based on 516 DM 1-6) also highlight the important role cooperating agencies should play in the NEPA process.[7] For example, "In accordance with 40 CFR 1501.6, throughout the development of an environmental document, the lead bureau will collaborate, *to the fullest extent possible*, with all cooperating agencies concerning those issues relating to their jurisdiction and special expertise." 73 Fed. Reg. at 61,320 (to be codified at 43 C.F.R. § 46.230) (emphasis added). Furthermore, the official of a bureau who is responsible for

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[6] "*Special expertise* means statutory responsibility, agency mission, or related program experience." 40 C.F.R. § 1508.26. Grand County's special expertise includes its 1041 permitting authority and special use permitting authority over the Windy Gap Project and any modifications thereto, as well as substantial knowledge about the west slope environmental impacts associated with the Windy Gap Project and the proposed WGFP, most of which would occur in Grand County.

[7] These regulations apply to the Bureau. *See* 73 Fed. Reg. 61,291, 61,314 (Oct. 15, 2008) (to be codified at 43 C.F.R. § 46.10(a)).

making and implementing a decision and ensuring NEPA compliance "must whenever possible consult, coordinate, and cooperate with relevant State, local, and tribal governments . . . concerning the environmental effects of any Federal action within the jurisdictions or related to the interests of these entities." 73 Fed. Reg. at 61,317 (to be codified at 43 C.F.R. § 46.155).

Grand County is a cooperating agency for preparation of the WGFP EIS pursuant to Memorandum of Agreement Between the Bureau of Reclamation and Grand County Board of County Commissioners for the Windy Gap Firming Project Proposed by the Municipal Subdistrict, Northern Colorado Water Conservancy District, dated effective January 22, 2005 ("MOA"). The MOA recognizes that Grand County qualifies as a cooperating agency because the WGFP may have impacts on the County's environment and may require the County to issue a new special use permit, a new 1041 permit, or amendments to the existing permits. MOA, § I.A, C. Among other things, Reclamation agreed to:

- Identify the County in the EIS as a cooperating agency and summarize its roles and responsibilities as a cooperating agency.

- Be available to discuss with the County any questions or issues related to County jurisdiction and special expertise.

- Use the environmental analyses and proposals of the County, where it has special expertise and jurisdiction, to the maximum extent possible, consistent with Reclamation's responsibilities as the lead agency.

- Prior to inclusion in the EIS, provide to the County for review and comment project information and study results concerning the County's jurisdiction and special expertise,[8] including:

  (1) Draft hydrology and water quality reports, data, and analyses for reservoirs, lakes and stream reaches in Grand County that may be impacted by the project and the analyzed alternatives.

  (2) Draft reports, data and analyses for environmental and social impacts within Grand County due to the project.

[8] Grand County retained the right, however, to comment on all issues relating to the EIS. MOA, § IX.C.

(3) Reports, data and analyses of alternatives to be evaluated in detail in the Draft and Final Environmental Impact Statements ("EISs").

(4) Preliminary draft Chapters of EISs describing existing conditions and impacts within Grand County likely to be caused by the project.

(5) Comment letters on the draft and final EISs that are specific to County data and impacts, for preparation of suggested responses.

(6) Mitigation proposals that address impacts that may occur in Grand County caused by the Project.

- Consult with Grand County on technical studies when the County has jurisdiction by law or special expertise associated with the resource being studied.

- Promptly inform the County of all schedule changes relative to comment deadlines and meetings.

MOA, § V.

As a cooperating agency, Grand County submitted detailed comments through its counsel, Sullivan Green Seavy LLC, on the technical reports prepared for the WGFP Preliminary Draft Environmental Impact Statement ("PDEIS"). Although Grand County submitted these comments in a timely manner, it did not learn until too late that Reclamation intended to release the PDEIS for comment before it had reviewed or, in the case of some reports before it had even received, all the County's comments. As a result, Reclamation could not have considered or taken into account in its DEIS any of Grand County's comments submitted in 2008, contrary to its responsibilities to Grand County as a cooperating agency generally, and specifically under § I of the MOA. *See* 40 C.F.R. § 1501.6(a)(2); 73 Fed. Reg. at 61,320 (to be codified at 43 C.F.R. § 46.230); *see also Davis v. Mineta*, 302 F.3d 1104, 1123 (10th Cir. 2002) ("a reviewing court may properly be skeptical as to whether an EIS's conclusions have a substantial basis in fact if the responsible agency has apparently ignored the conflicting views of other agencies having pertinent expertise.") (internal quotation marks and citation omitted); *Fund for Animals v. Norton*, 281 F. Supp. 2d 209, 227 (D.D.C. 2003) (inadequate review of public comments suggests a failure to take a "hard look" under NEPA). A list of the County's comment letters on the technical reports is provided in Exhibit A. Neither the County nor its

counsel ever received any response to these comments. From our review of the DEIS, it is apparent that Reclamation largely ignored Grand County's comments when it prepared the DEIS.

As a cooperating agency, Grand County also submitted comments on March 31, 2008 through its counsel, Sullivan Green Seavy LLC, on the PDEIS and requested a meeting to go through the comments in greater detail. Neither the County nor its counsel ever received any response to the PDEIS Comments. Nor did the requested meeting ever take place. Again, it is apparent that Reclamation largely ignored Grand County's comments when it prepared the DEIS.

More generally, Reclamation's failure to take Grand County's comments into account is contrary to Executive Order 13,352 on "Facilitation of Cooperative Conservation," which directs the Secretary of the Interior to "carry out the programs, projects, and activities of the agency . . . that implement laws relating to the environment and natural resources in a manner that: (i) facilitates cooperative conservation; . . . [and] (iii) properly accommodates local participation in Federal decision-making . . . ." Exec. Order No. 13,352, § 3(a), 69 Fed. Reg. 52,989 (Aug. 30, 2004). "Cooperative conservation" is defined as "actions that relate to use, enhancement, and enjoyment of natural resources, protection of the environment, or both, and that involve collaborative activity among Federal, State, local, and tribal governments . . . . *Id.* § 2. In the preamble to its NEPA rulemaking, Department of the Interior recognized that "an emphasis on the use of cooperating agencies may result in additional steps in the NEPA process, but is likely to lead to improved cooperative conservation and enhanced decision making." 73 Fed. Reg. at 61,301. Reclamation's actions are not consistent with these objectives.

In addition, Reclamation's lack of regard for Grand County's comments are contrary to the principle of consensus-based management, which "involves outreach to persons, organizations or communities directly who may be interested in or affected by a proposed action with the assurance that their input will be given consideration by the Responsible Official in selecting a course of action." 73 Fed. Reg. 61,316 (to be codified at 43 C.F.R. § 46.110(a)); see also Department of the Interior, Environmental Statement Memorandum ESM03-7, Procedures for Implementing Consensus-Based Management in Agency Planning and Operations (July 2, 2003). Understandably, Grand County has no assurance that its input was in fact given consideration.

Specific Comments by Section

Section 1.3.1 Municipal Subdistrict

Page 1-4

Comment. The purpose and need is drawn so narrowly as to foreclose other less environmentally damaging alternatives. The purpose is "to deliver 30,000 af of water from the existing Windy Gap Project to meet a portion of the water deliveries anticipated from the original Windy Gap Project and to provide up to 3,000 af of storage to firm water deliveries for the [Middle Park Water Conservation District]." The real purpose and need for the participants is for more water generally. The purpose and need statement might have more credibility if the original Windy Gap Project participants were the same as the WGFP participants. Instead, the DEIS ignores the fact that of the original eight cities in the original Windy Gap Project, only three are participating in the WGFP, and only one to the full extent of its ownership (Longmont 80 original and firming units).). See attached Exhibit D, *Windy Gap Ownership and Transfer History*. This Exhibit shows that only 28% of the requested storage volume is by original owners, who collectively need only 26,000 af. The City of Broomfield, the participant requesting the most storage at 25,000 af was not even located within the boundaries of Northern or the Municipal Subdistrict when the water rights were appropriated or the ROD issued for the original project.

Section 1.4.1 Colorado-Big Thompson Project

Page 1-4

Comment. Please note that the C-BT Project was approved by Congress in Senate Document 80 and decreed in the Blue River Decree for supplemental irrigation and industrial use, not municipal purposes. In addition note that the C-BT project does not allow for storage of C-BT water in Chimney Hollow Reservoir because Chimney Hollow reservoir is not a C-BT project feature approved by Congress.

Section 1.4.2.1 Windy Gap Project Environmental Impact Statement

Page 1-5

Comment. The June 8, 1981 ROD issued by the Corp of Engineers permitted a project (Application No. 6520) with a maximum diversion of 300 cfs according to Exhibit A to that ROD, which described "a pumping plant with a maximum discharge capacity of 300 cfs." The DEIS notes that diversions are limited to 600 cfs. Impacts greater than 300 cfs need to be included in this NEPA analysis and corresponding mitigation to substantially reduce impacts associated with diversions at 600 cfs.

Section 1.5.2 Windy Gap Project Delivery Shortage

Page 1-9

Comment. The actual diversions from Windy Gap averaged 11,080 af.

Page 1-10

Comment. Additional reasons that need to be added to the bullet points for lack of diversions are: (1) lack of demand by original participants; (2) sale of units to new entities which increased water demand over time; (3) power costs charged for pumping based on starting up a pump and costs to purchase "Overrun Power" at market rates which is considerably higher than the preferred rate for "Allotted Power".

Section 1.6.1 Sources of Water Supply

Page 1-11

Comment. What is the basis of the statement that extreme droughts are excluded from firm yield planning? How does the author define an "extreme drought?"

Page 1-12

Comment. The discussion of "reuse" of trans-mountain water is incomplete. First, the 404 (b)(1) Guidelines require applicants for 404 Permits to take steps to "minimize potential adverse effects" to the aquatic ecosystem. Second, Colorado law requires that: "In order to minimize the amount of water removed from Western Colorado eastern slope importers should, **to the maximum extent feasible**, reuse and make successive use of the foreign water." *Denver v. Fulton Irrigating Ditch Company*, 506 P.2d 145, 148 (Colo. 1972) (emphasis added). In *Fulton* 506 P.2 at 146-147, the Colorado Supreme Court defined the terms "reuse" "successive use" and "right of disposition" as follows: (1) "'Re-use' means a subsequent use of importer water for the same purpose as the original use." [for example treatment of sewage to potable water standards and re-cycled into the regular water system, which the Court noted that Denver's research was continuing such that in the future potable water will be extracted from sewage for delivery to the water mains] (2) "'Successive use' means a subsequent use by the water importer for a different purpose." [for example after municipal use the treated sewage is used for irrigation] and (3) "'Right of disposition" means the right to sell, lease, exchange or otherwise dispose of effluent containing foreign water after distribution through Denver's water system and collection in its sewer system." The DEIS discloses that these participants practice "successive use" and "disposition" through exchanges of some of trans-mountain water. None "reuse" Windy Gap water. To satisfy requirements of federal and state law, the discussion of reuse must be expanded.

Section 1.6.2.3 Water Conservation

Page 1-15

Comment. The DEIS notes that water conservation includes both supply-side and demand-side management. If the WGFP is to be permitted as the least damaging environmental alternative, then conservation measures need to be included as conditions to the Carriage Contract or the 404 Permit. We have proposed such a permit condition in the *404 Permit Comment Letter*.

Section 1.10 The Decision Process

Page 1-42

Comment. As noted above, the decision process will require resolution of many threshold legal questions that have not been resolved. Either execution of the Carriage Contract should be delayed until such questions can be resolved or any approvals must be contingent on resolving those questions.

Section 1.10.2 Senate Document 80 and Section 14 Analyses

Page 1-42

Comment. The DEIS notes that Reclamation's decision on whether an excess capacity contract is consistent with Senate Document 80 and other federal law will be made "later" and is not part of this EIS. Grand County reiterates that it must be included in the negotiation process for any excess capacity contract pursuant to Senate Document 80.

Pages 1-42 and 1-43

Comment. In a Reclamation study of nutrients in the C-BT system (Leiberman, 2008), there is a box and whisker plot showing the statistical similarity in secchi depths between Granby Reservoir, Grand Lake, Carter Lake, and Horsetooth Reservoir, and that also illustrates secchi depths are statistically different (shallower) on Shadow Mountain Reservoir. When Reclamation undertakes to "consider the effects of the proposed project on Reclamation's ability to continue meeting the five primary purposes of the C-BT Project and whether or not the C-BT Project can continue to be operated in accordance with lettered stipulations (a) through (l) in the Manner of Operation," please include in this consideration the fact that Grand Lake is the only natural lake of the five water bodies mentioned above, and that its trophic status prior to construction and operation of

the C-BT system was oligotrophic. This status has not been maintained, and in fact has been steadily degraded to the current conditions in which Grand Lake, contrary to the DEIS assertion that it is mesotrophic, can often be considered eutrophic.

Section 1.10.3.

Comment. Please add that Grand County will have 1041 permitting authority over all of the alternatives, not just those where there will be construction in Grand County. Grand County issued permits for the original Windy Gap Project. Each of the proposed alternatives will result in a change in the operation of and participants in the permitted Windy Gap Project thereby triggering either amendments to the existing permits or new permits.

Section 2.1.2.1 Level 1 Alternative Screening

Page 2-5

Comment. Prepositioning is carried forward as part of the preferred alternative even though it may be illegal. The DEIS does not disclose the factual or legal basis for the statements that: 1) Total allowable C-BT storage would not change; or 2) the existing C-BT water rights and diversion would not be expanded. As described above, prepositioning involves both a change of C-BT and Windy Gap water rights. Only the water court has jurisdiction to decide whether: 1) total allowable storage would not change; 2) whether C-BT and Windy Gap water rights would be expanded; and 3) what terms and conditions need to be included to protect from injury.

Page 2-6

Comment. The DEIS should explain why storage of CB-T water in Chimney Hollow Reservoir and prepositioning were not eliminated. Storage of Windy Gap water in Horsetooth Reservoir was eliminated because it would require Congressional action; Congressional action is required for storage of C-BT water in Chimney Hollow Reservoir.

Section 2.2.1 Current Windy Gap Project Operations

Page 2-14

Comment. The DEIS states that Windy Gap is not stored on the East Slope. Since the impact analysis is based on this assertion, any amendment to the Carriage Contract must

make this limitation a condition. For purposes of this condition, storage would mean that water shall not be held in any facility for more than 72 hours.

Section 2.2.2 Participant Operations under the No Action Alternative

Page 2-15

Comment. It is speculative to include the enlargement of Ralph Price Reservoir as the No Action Alternative.

Section 2.4.2 Operations

Page 2-24

Comment. The DEIS notes that Windy Gap is delivered instantaneously through the Adams Tunnel. However, in order to distinguish between Windy Gap water or C-BT water and to prevent unlawful enlargement of C-BT water rights, the Carriage Contract must require that each water right that is carried through the Adams Tunnel be accounted for separately based on actual - not instantaneous - diversion/deliveries.

Comment. The DEIS states that when C-BT water is stored in Chimney Hollow, that creates more space in Granby Reservoir. More space in Granby Reservoir creates the ability of the C-BT water rights, which are senior to Windy Gap, to store in that space. This creates the potential for expansion of use of the C-BT water rights. The DEIS says the C-BT diversions and water rights would not be expanded. We have proposed a permit condition in the *404 Permit Comment Letter* so that C-BT water rights will not be expanded.

Comment. Middle Park's 3,000 af should continue to be stored in Granby Reservoir. There is no need to deliver Middle Park's water to Chimney Hollow and then "exchange" it back Granby Reservoir for release.

Section 2.8.2 Reasonably Foreseeable Actions

Page 2-42

Comment. Add to reasonably foreseeable future projects the Colorado Springs Substitution and Green Mountain Reservoir Substitution and Power Interference Agreements as described in Grand County's letter dated October 30, 2008.

Page 2-44

Comment. (also page 3-42 and elsewhere) The reasonably foreseeable actions and cumulative effects sections should include a discussion of climate change. The United States Supreme Court has stated that the "harms associated with climate change are serious and well recognized." *Massachusetts v.* EPA, 127 S.Ct. 1438, 1455 (2007) (ruling that EPA can regulate greenhouse gases under the Clean Air Act). Therefore, global climate change must be analyzed under NEPA. See e.g. *Border Power Plant Working Group v. Department of* Energy, 260 F. Supp. 2d 997, 1028-1029 (S.D. Cal. 2007). At a minimum, the EIS could include a discussion of the influence of a 4 degree Fahrenheit temperature increase by 2050 and the possible influence on planning for increased winter precipitation matched by decreased summer precipitation as predicted in the Colorado Water Conservation Board's "Climate Change in Colorado" report. In considering climate change, Reclamation should follow the methods outline in its own document, appendix U of the "Final EIS- Colorado River Interim Guidelines For Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead, October 2007."

Section 2.10.2 Comparison of Alternative Impacts

Page 2-56

Comment. Table 2-6 lists average Windy Gap Diversions of 36,352 af as existing conditions. This is wrong. Actual diversions from Windy Gap have averaged 11,000 af from 1985 to 2004 (page 1-9). This is the existing condition against which to compare impacts.

Page 2-67

Comment. Table 2-7 Comparison of cumulative effects. The same error occurs in this table as in Table 2-6 with the incorrect reporting of Windy Gap diversions of 36,352 af

Chapter 3 Affected Environment and Environmental Consequences

Comment. The DEIS fails to describe that most of the alternatives are not consistent with the requirements of existing local and regional plans including the Grand County Master Plan and the NWCCOG Water Quality Management Plan.

Comment. Displaying Windy Gap Diversions of 36,352 af as "Existing Conditions" is a fatal flaw. Throughout the DEIS, Windy Gap Diversions for Existing Conditions are listed as 36,352 af as an average annual amount. This is a modeled number that is over

three times actual diversions. This flaw permeates every table, graph, text and makes it difficult to comment. See discussion in General Comments Section, above.

Section 3.3 Determination of Environmental Effects

Page 3-2

Comment. The DEIS states that "[f]or Reclamation purposes action alternatives are compared to the No Action alternative for determining effects." Reclamation should use existing conditions to compare effects.

Section 3.4 Area of Potential Effect

Page 3-3

Comment. Change "may" to "will" in the 8th line and put a period after "diminish" in the 13th line. As written, there are no bases for these statements without the changes.

Section 3.5.1.1 Affected Environment; Areas of Potential Effect

Pages 3-3, 3-4 and 3-6

Comment. For alternatives including Rockwell Mueller, affected area should include the Fraser River, which should also be considered due to impacts from the Moffat Firming Project. The statement "The Fraser River is not included in the study area because none of the alternatives affect Fraser River flows" cannot be true even during the filling of the Rockwell/Mueller Creek reservoir site.

Page 3-6

Comment. The sentence "Colorado River average monthly flow changes, as a percentage of total streamflow, would be less than 10 percent downstream of the confluence with the Blue River..." is misleading simply due to the location of the site downstream of two major confluences. Moreover, it probably is wrong owing to the inaccurate description of existing conditions discussed in General Comments Section, above. The percent change for each stream segment from the Granby Dam down to the study area boundary should be presented here in a table, or alternatively, the stream segments with the highest *and* lowest percent changes should be offered.

Section 3.5.1.3 Water Rights, Agreements and Contracts

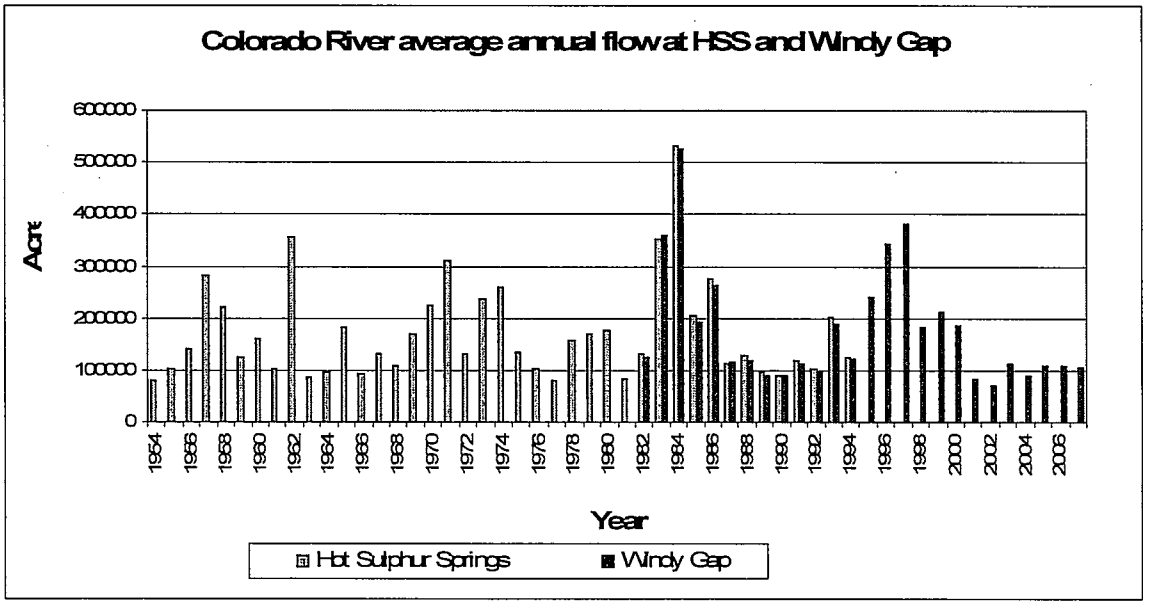
Page 3-6

Comment. As described above, there are a number of legal actions that are necessary to implement the WGFP.

Section 3.5.1.4 West Slope Surface Water Hydrology

Page 3-8

Comment. Figure 3-3. This figure should not stop at 1994, but should continue on through the latest date available. While the USGS gage at Hot Sulphur Springs was abandoned by GS, USGS continues to maintain the gage at Windy Gap, which has been proven[9] to be statistically consistent with the Hot Sulphur Springs data (see figure below). The additional period of record from 1995 to 2007 is important to show the cumulative year drought conditions during that time, in particular the driest year on record from 1905 to 2007, which was 2002. In addition, a figure ought to be included to display predicted future flows over the next 30 years with WGF.



The additional water years should be included when evaluating trends, and low flow conditions. Similarly, special consideration should be made for the years in which Windy Gap water was and was not diverted. In addition, consideration should also be made for

[9] Personal communication with Alan D. Druliner, Colorado Water Science Center, USGS, September 2008.

the fact that the last century was one of the wettest on record, and that "climate models predict a reduction of Colorado River flows ranging from 5 to 50% by mid-century".[10]

Comment. Figure 3-4 This diagram should be edited to include 2002 as the lowest water year. The difference in flow between the two years is 10,352 af (80,360.3 af versus 70,007.6). As the figure scale does not allow for adequate discernment of the changes to low flow, an additional figure should be added showing average flows from 1950-2008, the lowest flow year (2002) as represented by USGS Windy Gap gage data, and the flow due to proposed changes from the preferred alternative.

Page 3-9

Comment. Please note that the flows from the Windy Gap diversion point to the mouth of the Williams Fork River of 90 cfs is 10 cfs below the flow identified as being critical *in winter* in the Grand County Stream Management Plan, Phase II. It is 150 cfs below critical summer flow recommendations. Similarly, from the mouth of the Williams Fork River to the mouth of the Troublesome Creek, the flow of 135 cfs is 15 cfs below winter critical flows, and 115 below summer critical flows. The flushing flow recommended by the Azure Settlement is equivalent to the optimal flows recommended by the Stream Management Plan, and 300-750 cfs below that recommended for flushing flows.

In 2003, 64,200 af were diverted via Windy Gap. This is 91.7% of the annual flow in the 2002 water year.

Page 3-10

Comment. If no historic gage flow data is available, how can Reclamation plan to "bypass native flows" in the Rockwell Mueller or Jasper East areas?

Section 3.5.1.5 East Slope Surface Water Hydrology

Page 3-11

Comment. figure 3-6 Please attach year labels on the X axis.

Section 3.5.2.2 Method for Effect of Analysis

Page 3-14

[10] Colorado School of Mines Magazine, Summer 2008

Comment. Use of a daily time step model would not require "disaggregation" to get to daily diversions.

Section 3.5.2.3 Facilities and Stream Segments Affected by Windy Gap Operations

Page 3-14

Comment. The DEIS notes that Windy Gap water that is pumped into Granby Reservoir is assessed a 10% shrink charge upon introduction. It appears that this shrink is then attributed to the CB-T decree. This operation appears to create an expanded use of the C-BT decree, because the C-BT is not decreed for diversion at Windy Gap, but water diverted from Windy Gap is attributed to C-BT. This needs to be explained further and the decree that authorizes this operation referenced.

Comment. We are not aware of any decree for either Windy Gap or C-BT that allows an exchange of C-BT water with Windy Gap water that is called an "instantaneous delivery." This needs to be explained and the legal authority for doing so under Colorado law referenced. It appears that the fiction of "instantaneous delivery" will not be operated under the WGFP, but rather water would be routed to Chimney Hollow Reservoir.

Page 3-15

Comment. Willow Creek should not be affected by WGFP, but it apparently is. This appears to be the result of an undecreed exchange of Windy Gap water to Willow Creek Reservoir, which causes Willow Creek Reservoir rather than Granby Reservoir to spill. This operation makes no sense and needs to be explained. The DEIS needs to disclose the decree that authorizes this exchange of Windy Gap water to Willow Creek Reservoir.

Page 3-16

Comment. The DEIS states that "C-BT water delivered would not exceed current amounts." The impact analysis in the DEIS is based on this assumption. Therefore, the Carriage Contract must include a condition that limits deliveries of C-BT water through the Adams Tunnel to current amounts. We have proposed such a permit condition in our *404 Permit Comment Letter*.

Section 3.5.2.5 C-BT and Windy Gap Project Operations and Diversions

Pages 3-19 through 3-21

Comment. Tables 3-2, 3-3 and 3-4 erroneously lists Windy Gap Diversions at 36,532 af (average) at 7,804 af (dry) and 38,512 af (wet). Actual diversion records are much less in all types of years. See General Comments Section, above.

Comment. Table 3-2 purports to compare average annual flow and diversion amounts. This is an example of how it is deceiving to present Windy Gap Diversions of 36,532 af as "existing conditions" rather than actual diversion when deriving differences and percentage of change. In fact *actual* diversions at Windy Gap Reservoir are show in Table 3, p. 22 of the Water Resources Technical Report. Those diversions averaged 11,080 af. That amount is the "existing conditions;" that is the amount of effect on the river since Windy Gap came on line. It is not some hypothetical modeled amount that created the existing conditions. Accordingly when one puts in the actual diversions of Windy Gap, the comparison looks much different and the impacts are staggering. See General Comments Section, above.

Table 3-2 should be revised:

Location	Existing Conditions		Proposed Action	
	Avg Ann Flow	Avg Ann Flow	Diff	Percent diff
Windy Gap Diversions (**modeled**)	36,532 af	46,084 af	9,552 af	26% increase
Windy Gap Diversions (**actual**)	11,080 af	46,084 af	35,004	316% increase

Page 3-21

Comment. (also 3-25 and elsewhere). The assertion is regularly made that Windy Gap would not divert during dry years, yet there are tables that show diversions in dry years. Correct this conflict or limit diversions to dry years as a condition of the Carriage Contract.

Page 3-24

Comment. Please discuss nocturnal pumping scheme for Windy Gap which minimizes power cost during pumping and maximizes power generation and revenues during daylight hours when power demands are high. How will the WGFP influence this

schedule? A discussion of this schedule here would be appropriate to make way for the related impacts to water quality in section 3.8.

Section 3.5.2.6 West Slope Streams and Existing Reservoirs

Page 3-26

Comment. The DEIS states that average annual flows below Windy Gap would decrease 14% from existing conditions. As stated numerous times, the so called "existing" conditions do not reflect actual diversions by Windy Gap, which are much less. In fact, the average annual flows will decrease by 26% . See General Comments Section, above.

Comment. Figure 3-12. Please break hydrograph into two time periods so that changes in flow below 200 cfs can be distinguished.

Page 3-27

Comment. Figure 3-13. Please break hydrograph into two time periods so that changes in flow below 200 cfs can be distinguished.

Comment. The table on this page shows that the Proposed Action would increase the number of days that flows dropped below 100 cfs over the 47 year study period from about 1.8 days per year in August to 2.9 days. This 47 year period does not include the extended drought conditions and lowest flow year on record, so it underestimates the true number of low flow days. According to the Grand County Stream Management Plan the critical/minimum cfs for that stretch is 250 during the summer, optimal is 450 cfs. Critical flows are defined as "that flow below which habitat is lost at the greatest rate." (GC SMP, March 2008, pA-4).

Comment. Tables 3-7 and 3-8. The DEIS should state where these figures are derived. They might be helpful once corrected to determine the low flows in the critical reach below Windy Gap. Changes in stream flows should been shown in cfs as reported for increases in east slope streams. (Tables 3-9, 3-10, 3-11.) Similar tables in cfs should be prepared for West Slope streams where the decreases (impacts) will occur.

Page 3-28

Comment. Willow Creek is already seeing below standard levels of dissolved oxygen for its stream classification. The DEIS must describe how the reduction in flows will exacerbate this situation.

Page 3-30

Comment. Please explain what "reintroduction shrink" means; what percentage is charged in each East Slope firming reservoirs; which decree it is charged to; and the basis for a reintroduction shrink.

Section 3.5.2.9 Windy Gap Firming Project Yield

Page 3-41

Comment. Table 3-13. The WGFP does not satisfy the purpose and need statement. The firm yield reported is 26,600 af rather than 30,000 af. The WGFP also does not meet the Purpose and Need for Middle Park's firm yield of 3,000 af. Instead, it is reported that only 429 af of firm yield is generated for Middle Park.

Section 3.5.3 Cumulative Effects

Page 3-42

Comment. The additional foreseeable actions described for Section 2.8 above need to be added to the cumulative impacts section.

Section 3.5.3.1 Summary Comparison of Hydrologic Changes

Page 3-42

Comment. The cumulative impacts section demonstrates the need to use the same model to identify the impacts of the WGFP and the Moffat Collection System Expansion project. There are a number of assumptions on how the Denver Water Board may operate. Use of the Denver Water Board's daily point flow model would ensure those assumptions are accurate and applied to both projects. For example, when the Big Lake Ditch lease expires, that would take the call off of the Denver Water Board's Jones Pass Tunnel, and more water is likely to be diverted out of the Williams Fork River by the Denver Water Board, PLUS there is the lack of return flow down Reeder Creek. The timing of when those impacts occur is also critical. It is not adequate to look at the impacts on an average annual basis.

Section 3.5.3.2 Facilities, Streams and Lakes Affected by Reasonably Foreseeable Actions

Pages 3-43 through 3-45

Comment. The comparisons in Tables 3-14, 3-15, 3-16, are wrong because they start from the wrong baseline for Windy Gap diversions of existing conditions of 36,532 af rather than the actual diversions of 11,080 af. See General Comments Section, above.

Page 3-47

Comment. The Shoshone call reduction needs to examined more closely. In fact, when that agreement went into effect in 2003, that was also the greatest year of diversion by Windy Gap of 64,200 af. The report is replete with statements that Windy Gap will not divert during a dry year, but there is no analysis of the effects from the Shoshone call reduction.

Section 3.5.3.4 West Slope Streams and Existing Reservoirs

Page 3-50

Comment. Figure 3-25 excludes the months of December through March. In addition, the resolution is inadequate in the months shown where flow is below 200 cfs to be able to distinguish one condition from another, rendering the figure relatively useless for understanding much of the water year.

Page 3-51

Comment. Figure 3-26 excludes the months of December through March. In addition, the resolution is inadequate in the months shown where flow is below 200 cfs to be able to distinguish one condition from another, rendering the figure relatively useless for understanding much of the water year.

Page 3-52

Comment. The potential consecutive dry year reduction in the surface elevation of Granby Reservoir of 33 feet means that when compared to the average depth at full pool of 74 feet, the reduction will be 44%. When compared to the maximum depth at full pool of 221 feet, the reduction will be 15%. With such a significant potential reduction, the inclusion of a bathymetric map, with an evaluation of regions of the reservoir where water levels might be reduced significantly enough to prohibit access is necessary. In addition, a calculation of the potential reduction in water surface also would be instructive.

Comment. Please develop area-elevation curves for Granby Reservoir under different scenarios, similar to what was done for the Shadow Mountain Reservoir drawdown, showing reservoir surface area versus reservoir stage or area of reservoir bed exposed versus reservoir stage.

Comment. Please develop a figure to project future Granby Reservoir elevations under consecutive dry year, moderate, and wet year scenarios that can be compared side-by-side with, or that also includes historical elevations like those shown in figure 3-6, and that makes clear how the historical elevation fluctuations might be exacerbated.

Comment. Reductions in water surface elevation, water surface area, increases in exposed reservoir sediment surface areas call for accompanying discussions and mitigation in sections concerning water quality (3.8), recreation area, access to boat ramps (3.19), and air quality (due to potential dust issues) (3.16), and probably other sections as well.

Comment. All of these same issues may also be true for Willow Creek Reservoir and should be discussed both here and in other appropriate sections in the document.

Section 3.5.4 Proposed Mitigation.

Page 3-55

Comment. See the discussion of mitigation in the General Comments Section, above. Numerous additional mitigation conditions are required as detailed in the *404 Permit Comment Letter*.

Section 3.6.1.3 West Slope Ground Water Hydrology and Quality

Page 3-56

Comment. Water quality results are reported from: 1) Apodaca and Bails 2000, a survey study that looked at water quality in 12 Colorado counties in addition to Grand County. Sampling sites in Grand County were 5, maybe 6 in number: 2 on the upper Fraser, 2 in the extended Grand Lake area, 1 at the confluence of the Colorado River with the Blue River, and one, potentially in Grand County, on the Blue River. 2) Topper 2003, a survey of ground water in the entire state of Colorado, and *which relies upon data from the Apodaca and Bails article* for the upper Colorado River 3) Bauch and Bails 2004, which studied the Fraser River watershed with sites located only as far downstream as Tabernash. Based upon these resources it is difficult to understand from where water quality values specific to the Colorado River in the study area in question may have come

from. The Topper publication states that ground water quality in the Colorado River *can vary widely*.

Comment. The discussion of impacts to ground water is inadequate. For example, there is no analysis of potential degradation and influence from coal formations which extend just west of the Granby area, nor analysis of the influence from the hot springs in Hot Sulphur Springs. Also omitted is a discussion of potential degradation from leaking underground storage tanks which have been identified in Grand Lake, Heeney, Hot Sulphur Springs, Kremmling, Parshall, and Winter Park (Colorado Ground Water Atlas 2000). Any discussion of impacts to ground water quality from reduced flows in the Colorado River are missing.

In order to discuss ground water quality in the study area with any degree of certainty a study would have had to have been conducted, because without such a study, the data is entirely too sparse to draw any reliable conclusions.

Section 3.6.2.3 Ground Water Hydrology

Page 3-57

Comment. Please quantify the "temporary changes in ground water levels near the reservoirs" that might be expected due to "the occasional large decreases in reservoir elevations during a series of dry years" and account for the number of homeowners who would lose access to their water supplies, if any.

Comment. It is difficult to understand how the potential consecutive dry year reduction in the surface elevation of Granby Reservoir of 33 feet mentioned on p3-52 coincides with the statement "The historical variation in the lake surface elevation of Granby Reservoir (nearly 90 feet) is larger than the expected change due to any alternative." How can this variation be accounted for with a mean reservoir elevation of 74 feet? Again, a thorough examination of the issues identified in the comment for p3-52 are required to understand the increases in variations.

Section 3.6.2.4 Ground Water Quality

Page 3-58

Comment. In section 3-10 the statement is made that the Colorado River is a gaining river throughout most of the study area. The ground water section would be a good place to discuss this as well, in particular where the Colorado River is *not* a gaining river, and under what conditions. To say that changes in river stage and hence ground water levels,

due to the project, especially with attenuation over distance, would be insignificant compared to what currently exists ignores the fact that ground water quality in certain regions of the study area may already be unacceptably degraded. Without having accurate measurements of the current condition (measured water quality parameters), it is impossible to understand what "some changes in water quality that could increase as much as 38 to 45 percent" means.

Comment. "There may be some changes in water quality that could increase as much as 38 to 45 percent in some parts of the Colorado River. Similar changes in alluvial ground water quality along the Colorado River would be expected." The preceding statements suggest that ground water quality has been evaluated only as an extrapolation of surface water quality. This is inadequate because the effects to ground water quality are likely to be more strongly felt due to increasing influence from bedrock aquifers and decreasing contributions from recharge or any potential periods when the stream might switch to a "losing stream" due to excess flow. The requisite "hard look" requires an evaluation of carefully selected ground water samples on a regular basis.

Section 3.7 Stream Morphology and Floodplains.

Comment. The DEIS recognizes the need for channel maintenance flows ranging from 80 percent of 1.5-year discharge to the 25-year peak flow (p3-60). These flows maintain the physical characteristics of the river channel, banks and floodplain and to maintain unimpaired flow in the channel. In addition the channel will need periodic flushing flows to remove sediment and accumulated interstitial debris. These are two different functions.

Comment. Page 3-62 of the DEIS establishes the channel maintenance flows as the 2-year peak discharge (i.e. the lower end of the range previously identified), which the DEIS equates to about 1,240 cfs at Hot Sulphur Springs. The DEIS then indicates that under existing conditions this necessary channel maintenance flow is exceeded about 4% of the time, and with WGFP this would be reduced to about 3% frequency of exceedance, and a similar analysis for cumulative effects. The PDEIS concludes this change is about 1% less than existing conditions and so is a minor change and not an impact. This conclusion is completely unsupported.

(1) A change from 4% exceedance interval to a 3% exceedance interval is a 25% change, so describing it as occurring 1% less frequently is grossly inaccurate.

(2) The 2-yr peak discharge (1240 cfs) is based the current flow levels, not those that initially formed the channel, and so the flow criteria used is irrelevant and the conclusion is flawed.

(3) This issue is dismissed (p3-60) because aerial photos from the 1970's, 1990's and 2005 indicate only minor channel changes in river morphology, and the fact that the channel is currently fairly stable in spite of significant C-BT that started in 1947. The DEIS also dismisses the need for evaluation channel maintenance and flushing flows between Granby Reservoir and Windy Gap and the potential WGFP impacts from changes to these flows because flows in this reach are "controlled by instream flows; therefore, it is difficult to define a range of channel maintenance flows based on peak flow events" (p3-63).

(4) No mitigation is proposed (p3-65); we assume this is because the proposed action will maintain the existing requirement for 450 cfs sediment flushing flow for 50 hours once every three years (p 3-62). Flushing flows are different than channel maintenance flows.

Section 3.7.1.4 West Slope Stream Morphology and Sedimentation

Page 3-60

Comment. The statements that the Colorado River has continued to convey sediment without aggradation or degradation of the stream channel and that the river is a morphological stable stream are not supported by any data.

Comment. Please explain in quantitative terms what the following sentence means for this system: "The lower limit of channel maintenance flows has been defined as 80 percent of the 1.5-year discharge and the upper limit as the 25-year instantaneous peak flow."

Section 3.7.2.3 West Slope Streams

Page 3-62

Comment. The DEIS says that flushing flows were based on a 1981 study. This should be updated. Grand County's Stream Management Plan recommends a flushing flow of 750 to 1200 cfs for a 3 day duration with a frequency of 1 in 2 years during the May to late June period. Flushing flows are critical to transport the sediment. Tubifex worms thrive in sediment.

Section 3.7.3 Cumulative Effects

Page 3-65

Comment. A reduction of 1.5 in the current 4 percent exceedences rate of the 2-year peak discharge is a difference of 37.5%. Please correct and quantify reductions at the Kremmling gage similarly.

Section 3.7.4 Proposed Mitigation

Page 3-65

Comment. The argument in the mitigation section on this page ignores the fact that stream flows are already too low for healthy channel maintenance. The preceding discussion said nothing about pool depth, interconnectivity between pools, the influence of flow volumes and channel depth on water temperatures, or refuge. The assumption that everything's fine and that the status quo will prevail is inadequate. The channels either need increased flows, or they need rehabilitation.

Section 3.8 Surface Water Quality: General comments regarding issues with the DEIS modeling approach for Colorado River. (*See also BBA Report*, Exhibit B)

Comment. The DEIS concludes (p 3-129) that the only adverse impacts to streams in Grand County associated with WGFP diversions are an increase in stream temperatures and concentrations of ammonia, inorganic phosphorus, and total dissolved solids for the Colorado River. Proposed mitigation is to "consider increasing required bypass flows under certain water supply conditions" if it can be show that increases would result in measurable benefits to the trout fishery. Both statements are wrong.

The reason the DEIS only identifies minor stream impacts in the Colorado River is because of the inappropriate choice of the steady state QUAL2K model for the purpose of evaluating changes from WGFP alternatives and issues with the input parameters used for the modeling. The use of QUAL2K to model temperature impacts demonstrates this issue. QUAL2K evaluates increases in Colorado River temperature resulting from diversion of water at Windy Gap for a single day, July 25th, and considers both the average diversion for that day, and a diversion to the point where only the 90 cfs mandatory bypass flow remains in the Colorado River below Windy Gap. According to the DEIS this approach would represent worst case conditions (DEIS page 3-92 and

page 51, Stream Water Quality Technical Report). The conclusions from this modeling approach are flawed for many reasons including:

(1) The actual result from QUAL2K is that Colorado River temperature would increase as much as 4.0 degrees to a maximum of 18.9 just upstream of the Williams Fork confluence when average stream flows (approximately 425 cfs) are reduced to 90 cfs by WGFP diversions on the single day, July 25 given median meteorological conditions. QUAL2K does not consider a more realistic extended timeframe. For example, if the temperature is predicted to increase 4.0 degrees when flows are reduced from 425 cfs to 90 cfs on July 25, then the temperature of the Colorado River will continue to increase above 18.9 several days later if river flows are maintained at minimum levels due to WGFP diversions and the meteorological conditions (air temperature and sunlight) remain relatively unchanged. Depending on daily weather conditions, there would be a gradual warming of the river downstream from Windy Gap over time, not a single spike in temperature. QUAL2K cannot handle this, a dynamic model would be more appropriate.

(2) The DEIS concludes that WGFP will only increase temperature to exceed the temperature standard under worst case conditions, but this would not occur on average (p3-96). This statement cannot be supported. This statement is based on the median July temperature of 14.3 degrees as ambient conditions for input to QUAL2K. The source of this data is USGS grab samples which are collected 1 or 2 times per month (p3-67). Median data for 1 to 2 samples per month has no relevance to Colorado Water Quality Control Commission temperature standards which are determined as the Maximum Weekly Average Temperature (MWAT). Inputs to the QUAL2K model for many water quality parameters were based on the median value of measured water quality data for the period of record for July. The median value means that half of the data is greater than that value, which is why the State of Colorado defines existing quality as the 85th percentile for most parameters (5 CCR 1002-31, Section 31.5(20)).

(3) Despite the QUAL2K model conclusions that WGFP diversions will rarely be of a magnitude to result in exceedance of temperature standards (page 3-96), there are already instances where increased stream temperatures in the Colorado River below Windy Gap in summer exceed standards. Existing MWAT data for Colorado River near Windy Gap indicates water temperature is already at or exceeding the water quality

standard (MWAT standard = 18.2 degrees) in July and August (p3-67 and 68, Figure 3-29). Moreover, all of the conclusions assume less reductions in flows from current conditions than actually will occur. *See* General Comments Section, above.

(4) Conclusions about changes in temperature based on QUAL2K are shown in tenths of a degree Celsius (and concentrations of other water quality constituents are shown in tenths of a microgram per liter). This level of resolution is beyond the capabilities of QUAL2K Model. This shortcoming is demonstrated in the sensitivity analysis in the May 2008 Stream Water Quality Modeling and Methods Report (see for example Figure 14, p 21 MM Report).

Comment. QUAL2K is a steady-state model, meaning it simulates water quality based on a multitude of inputs and assumptions for a single instant in time and thus is not dynamic over time. The condition of a steady-state instant (day) that the DEIS assessment considers is July 25 for "average" streamflow years. The concept was that this date is when the Colorado River experiences low-flows and hot and sunny summertime conditions, and it is also when Windy Gap could be diverting. (Note that although the DEIS chose July 25 of an average year to represent a worst case for temperature exceedances and impacts on aquatic life, there is no history of the temperature influence of Windy Gap pumping on aquatic life in July, because between 1984 and 2006 Windy Gap has only diverted one time (in 1985) in the month of July).

Comment. The approach to evaluating Willow Creek water quality is different and found at page 3-92. SSTEMP was chosen to evaluate stream temperature changes in Willow Creek and a mass balance approach was used to evaluate changes in concentrations of ammonia, copper and iron on a single day, July 15. First of all, ammonia is not a conservative parameter and disassociates based on temperature and pH, so mass balance analysis is inappropriate. Further it was assumed that the WWTP plant discharge would not change pH or temperature as effluent becomes a greater percentage of the streamflow because Willow Creek Reservoir releases are reduced under WGFP alternatives (Stream Water Quality Technical Report, page 54). These assumptions are completely unjustified for the following reasons:

(1) The Preferred Alternative would reduce Willow Creek streamflow by 36% in July of average years (see Table D-15, Water Resources Technical Report Appendices).

(2) The DEIS assumes average Three Lakes WWTP flows (0.53 cfs) for Three Lakes WWTP (see page 36, Water Quality Monitoring and Methods

Technical Report) is continuous steady discharge when evaluating both alternatives and cumulative impacts (Stream Water Quality Technical Report, page 116). However, the Three Lakes Service Area population is projected to increase from 8,230 in 2005 to 12,821 by 2020. In addition, peak flows for Three Lakes Sanitation District occur typically in July, so average WWTP discharge flows are not appropriate. For example, the Stream Water Quality Technical Report (page 25) states the monthly average discharge from Three Lakes WWTP between 2003 and 2006 ranged from 0.46 cfs to 1.34 cfs.

(3) Existing noncompliance with current water-quality standards in Willow Creek (Stream Water Quality Technical Report, p. 26) are noteworthy and must be considered in the assessment of impacts.

Section 3.8 Surface Water Quality: General comments regarding issues with the DEIS modeling approach for Lakes and Reservoirs.

Comment. The DEIS (p 3-129) describes only minor adverse impacts to lakes and reservoirs in Grand County from WGFP. The identified impacts are lower dissolved oxygen resulting in manganese concentrations that would continue to exceed water quality standards, nutrient concentrations would increase in the Three Lakes system, and clarity in Grand Lake would decrease (0.1 meters). As with the DEIS stream impact analysis, this conclusion is a result of a flawed approach to evaluating impacts. The minor impacts to the Three Lakes system summarized by the DEIS in Tables 3-48 to 3-55 are based on modeling by the Three Lakes Water Quality Model and are problematic for many reasons, including:

(1) The DEIS describes increases in annual average nutrient concentrations (Table 3-47, p 3-103). However, impacts from nutrients are primarily related to algae growth and eutrophication in these waterbodies (page 3-93) which is a seasonal problem. Nutrient concentrations during the algae growing season are more relevant than annual averages. The growing season primarily coincides with the pumping of Colorado River water into Three Lakes which will increase with the WGFP, so actual impacts will be greater than depicted by annual averages.

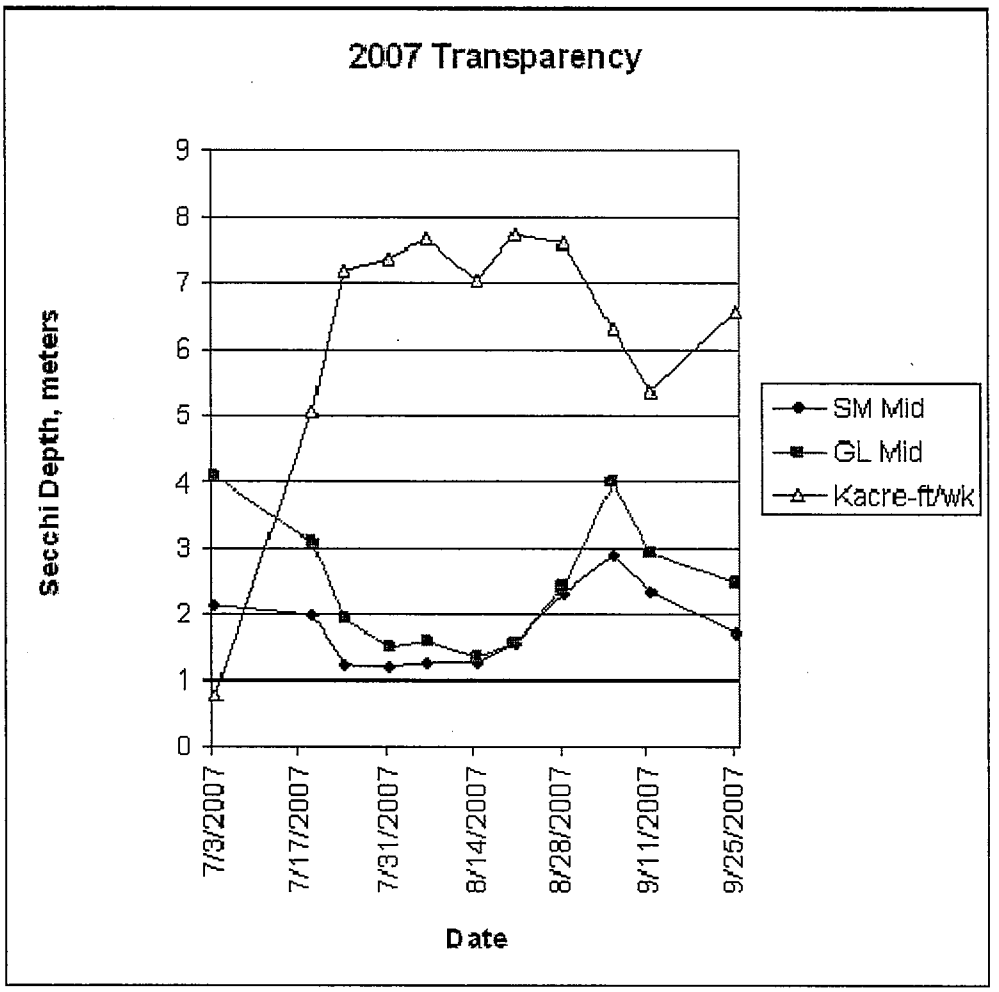
(2) Future nutrient concentrations used as input to the Three Lakes Water Quality Model for waters pumped by Windy Gap are based on completely unrealistic projections of nutrient concentration, particularly phosphorus, discharged from WWTPs in the Fraser River watershed. Fraser River water is then pumped by Windy Gap into the Three Lakes system (page 30

Stream Water Quality Modeling and Methods Report). Therefore, both the in-lake concentrations and the algal response are underestimated. Since the conclusion that WGFP alternatives create no nutrient related impacts to streams or the Three Lakes System is based on the assumption of advanced treatment, then the WGFP project beneficiaries should be responsible for building the WWTP improvements necessary to make this assumption real.

(3) Conclusions regarding changes in trophic Status Index are based on average chlorophyll *a* concentrations (p 3-93). Evaluating impacts of WGFP on Three Lakes should be weighted by pumping schedules instead of averaging.

Comment. The overall approach to evaluating impacts to the Three Lakes system is flawed. The assessment of impacts from WGFP is focused on eutrophication and does not consider the exacerbation of the existing problems associated with the discharge of pollutants into the 3-Lakes from C-BT pumping. Eutrophication is the increase in productivity of a waterbody, meaning the acceleration of algae and aquatic weed growth as a result of the addition of nutrients or other elements otherwise limiting this growth. Eutrophication is associated with decreased clarity and dissolved oxygen and potential increased concentrations of certain metals. It is usually associated with the gradual worsening of water quality.

The pumping of pollutants problem manifests itself in Grand Lake. It is seasonal in nature and can be best demonstrated by the following example from 2007.



The graph shows a period of about three months in late summer of 2007. Transparency in Shadow Mountain Reservoir ("SMR"), as measured by Secchi Disk depth, begins to decline in July. This is probably because of eutrophication of the SMR, the well documented seasonal blooms of algae and rooted aquatic vegetation in SMR. It is also documented that pollution levels in Grand Lake are a affected by water quality in SMR (see Page 37, US Bureau of Reclamation Report *Nutrients, Chlorophyll a and Secchi Disk Transparency of Five Reservoirs on the Colorado Big Thompson Project, 2005 to 2006*, Davine Lieberman, April 2007; "This late season peak [of total phosphorus] does not occur in Lake Granby, indicating that SMR and Grand Lake are linked by the overflow of SMR water flowing into the epilimnion of Grand Lake during pumping operations.").

From the graph it is obvious that as C-BT pumping begins in earnest in late July, Grand Lake clarity is diminished and essentially matches that of SMR. In early September the SMR bloom begins to die off, pumping is reduced and Grand Lake regains its 4 meter clarity briefly. Transparency of SMR again is diminished and the pumping increases toward the end of September and the transparency of Grand Lake responds accordingly.

The average of the Secchi disk depth in Grand Lake during this period is 2.45 meters. This is almost the same value as what is shown as the average annual value of the 15-Year modeling period for both existing conditions and projected alternatives in the WGFP water quality assessment (see Table 45, page 103 of the Lake and Reservoir Technical Report). Although there is a seasonal reduction in Grand Lake's 4 meter clarity by over 65% during this same period as a result of pumping, on *average* there is little change. The approach to analysis of projected impacts focuses on annual averages and fails to incorporate the real problem of seasonal impacts to the 3-Lakes from pumping, and so the DEIS fails to project how WGFP will really affect this existing water quality problem.

Comment. Note that predicted changes for both SMR and Grand Lake for water quality parameters associated with algae growth and affecting clarity are slightly worsened for all WGFP alternatives *on average* (DEIS Table 43 page 91 and Table 46 page 103 of Lake and Reservoir Water Quality Report, July 2008). Given that slight worsening *on average*, it is reasonable to expect that this seasonal polluting of Grand Lake associated with pumping will get significantly worse. The Three-Lakes Water Quality Model does not account for this situation.

Comment. The model assumes instantaneous dispersal of constituents introduced into 3-Lakes (page 65 of WGFP Lake and Reservoir Water Quality Report, July 2008). However, it has been shown that because of temperature differences SMR waters "tend to slide over the surface waters of Grand Lake when water is being pumped down the Adams Tunnel" (see page 8, US Bureau of Reclamation Report *Physical Attributes of Five Reservoirs on the Colorado Big Thompson Project, 2005 to 2006*, Davine Lieberman, undated). This confirms that physical circumstances related to pumping in Grand Lake, at least, partially limit the possibility of eutrophication because pollutants are stripped out of the Lake instead of mixing. It also confirms that the DEIS may be looking at the wrong problem, using incorrect assumptions about mixing, and drawing faulty or misleading conclusions about impacts. Given this, the proposed mitigation to continue participation in ongoing Nutrient Studies in the Three Lakes system is meaningless.

Comment. In the surface water quality section, the statement "Windy Gap Reservoir is a small in channel reservoir and would have water quality similar to that of the Colorado River; therefore it was not evaluated separately" is unsupportable; monitoring on the reservoir was only begun in earnest in 2008. Windy Gap Reservoir slows and heats discharges from both the Fraser and Colorado Rivers, promoting the growth of algae and vast amounts of aquatic plants. In addition the contributions of migratory and summer populations of water fowl are at this time unknown. The effects to water quality from these influences can only be negative, and warrant further study and separate consideration. (An example of this is the low dissolved oxygen values mentioned below Windy Gap on p 3-66).

Section 3.8.1.3 West Slope Affected Environment

Page 3-66

Comment. The didymo (rock snot algae) also has effects on irrigators and water diverters because it plugs their pumps and intakes. The (Spaulding 2007) cite is not included in the references.

Comment. The statement "Colorado River water is generally of good quality throughout the study area" was grafted from p21 of the Stream Water Quality Technical Report and *refers to water quality data presented for the Colorado River below Baker Gulch, a site on the Colorado located in Rocky Mountain National Park that is of exceptional water quality and is not representative of conditions in the study area.* Data for the Baker Gulch site is presented on p16 of the Stream Water Quality Technical Report and in the cases of specific conductivity, dissolved oxygen, pH, ammonia, nitrate and nitrite, sodium, manganese, and selenium, nearly all of the upper range values are considerably lower than any reported in table 3-23 of the DEIS, and some of the ranges are entirely below those reported in 3-23.

This statement and presentation of the water quality data from that site as being representative of the whole region or even as being inside the study area is deliberately misleading. The statement should read that Colorado River water quality is quite variable throughout the study area.

Comment. While it is the convention of sanitation plants and associated permits to use the units of gallons per day or per minute, these units are inconsistent with the cubic feet per second and acre feet per year units used elsewhere in this document, making this section unintelligible.

Comment. The Three Lakes Water and Sanitation District should be included in the listing of dischargers to the Colorado River here, and their effluent should be considered a part of the water quality modeling if it was not, as it will be included in the total Windy Gap nutrient load that is returned to the Three Lakes.

Page 3-67

Comment. Figure 3-29. As discussed above, water temperature standards are currently being exceeded. The Proposed Action will make things worse.

Comment. Table 3-26. Water Quality standards are not being met for Granby Reservoir for: dissolved oxygen; chronic summer temperature; and manganese.

Page 3-68

Comment. Table 3-24 for Willow Creek water quality demonstrates that water quality in the study area is variable and quite different from that of Baker Gulch, which has better water quality in nearly all parameters than that of Willow Creek.

Comment. A hard look requires an analysis of the impacts of pumping on the Three Lakes paying particular attention 1) to how the WGFP will reduce flexibility in the system to turn off pumping to stop the export and feeding of algae blooms in Shadow Mountain Reservoir to Grand Lake, 2) to how pumping to optimize nighttime energy consumption when power costs are low and daytime releases through the Adams Tunnel to maximize revenues from energy generation influences water quality.

Comment. For the section including surface water quality and the Three Lakes region, please discuss the fact that 1) the west slope water bodies are more productive than the east slope water bodies (higher chlorophyll α), and 2) the west slope water bodies produce bluegreen algae where the east slope do not. Please include in this discussion 1) why this might be, 2) and what these circumstances mean operationally for the system, and 3) what special challenges they pose to operating in a fair and equitable manner on both sides of the Continental Divide.

Page 3-74

Comment. Grand Lake is not only the largest natural lake in Colorado, it was specifically protected by Senate Document 80 as a primary purpose of the CB-T project: 2. To preserve the fishing and recreational facilities and the scenic attractions of Grand Lake . . ." (emphasis added). "Preserve" is defined as

> 1. To keep safe, as from injury or peril: PROTECT. 2. To maintain unchanged. 3. To keep or maintain intact. Webster's II New College Dictionary (1999).

The DEIS demonstrates that water quality has not been preserved in Grand Lake. Instead it has been degraded. The DEIS needs to analyze the alternatives beginning with this key existing problem. The DEIS should explain whether and to what extent the WGFP will "preserve" the water quality in Grand Lake, or whether pumping more polluted water from the Colorado River into Lake Granby, through Shadow Mountain, and into Grand Lake will exacerbate the existing water quality concerns.

Comment. Please update the discussion of dissolved oxygen in Shadow Mountain Reservoir to include what we know to be true, that dissolved oxygen standards are regularly exceeded in the southern end of the reservoir, also updating your table, and especially including a thorough discussion and consideration of the impacts to water quality beyond the mere statement that "Low DO concentrations can be a concern because of the potential release of orthophosphate, ammonia, iron, and manganese from the sediments under anoxic conditions."

Comment. Algae and Trophic State. The statement "All microcystin results received through July 24, 2007 for Shadow Mountain Reservoir have been below the detection limit" tells a partial truth because it stops short of the date for which we do have a value above the detection limit. Results for 8/6/2007 indicate a microcystin toxin value of 1.15 micrograms per liter by ELISA in Shadow. While HPLC results do not corroborate this value, it is not certain that they would, and in any case would likely have required sample concentration techniques, the need for which were unknown at the time. As such, the ELISA value, while acknowledged to be subject to false positives, is the best value we have from the time and should be mentioned with explanation of its limitations.

Comment. Algae and Trophic State. If Ms. Leiberman's data is used, 7.3 micrograms per liter of chlorophyll is an inaccurate average, and peak concentrations have risen to 28 micrograms per liter, or nearly double the value cited here. Nonetheless, a value of 7.3 micrograms per liter does not define the lake as mesotrophic, but rather places it on the meso/eutrophic boundary. Using Ms. Leiberman's averages instead for 1, 5, or 1-5 meter sample collections puts the lake squarely in the eutrophic category, which is unacceptably degraded over pre-Windy Gap and especially pre-C-BT values. Please see comment regarding Jahnke, 1981 document in Lake and Reservoir Water Quality Technical Report section.

Comment. Nutrients. "No recent bioassays have been conducted to determine if this situation has changed." is untrue. Davine Leiberman has completed her three year study

on the Three Lakes and from my understanding the final report has been submitted to Northern. Data from this report is new, more thorough than what was provided previously to the EIS process, and should be brought to bear on the document.

Comment. Grand Lake. "The residence time…is short due to the operation of the C-BT Project and varies according to operations." This cannot be true for the entire volume of the lake, particularly with the strong stratification that is acknowledged to occur during the summer. Please see comments on p3-93. Again we have a case where it is very inappropriate to use an averaged value, in this case residence time, to represent such a complex system with any degree of accuracy.

Discussion of microcystin toxin in Grand Lake is improved over the PDEIS but still leaves out ELISA value of 1.48 ug/L for 8/6/2008. This value is potentially more reliable than the HPLC values which most likely require concentration of the sample, concentration that did not occur, before they can accurately be relied upon for quantitative values, if at all. Though the ELISA is susceptible to false positives, far better to state this than to omit a potentially significant value. In addition a concentration of 0.19 ug/L was detected in the lake on 8/20/08, and a Grand Lake homeowner's tap checked in at 0.19 ug/L on 8/14/07.

Comment. The section on clarity notes that Grand Lake clarity has varied between 1.8 meters and 5.6 meters. The 5.6 meter Secchi depth measurement is the second best measurement ever documented on Grand Lake (second only to Pennak's 9.2 meter measurement in 1941). That data was taken in November of 2006, at a time when water temperatures had cooled, summer algal blooms had died off, and C-BT pumping had ceased three weeks earlier to facilitate the draw-down of Shadow Mountain reservoir for weed mitigation. Only East and North Inlet stream flows were providing water to Grand Lake during that time period. These circumstances serve to highlight the fact that pumping schedules and seasonal algae blooms have a very substantial effect on water quality especially in terms of clarity.

Section 3.8.2.2 Regulatory Requirements

Page 3-86

Comment. The need for a 401 Certification from the State of Colorado as part of the 404 permit and an anti-degradation review by CDPHE are noted. However, in spite of conclusions throughout the DEIS regarding exceedances of water quality standards, the DEIS analysis is not consistent with the approach used by CDPHE for evaluating compliance with standards or the anti-degradation review. The DEIS typically considers median water quality values and average flow conditions, which is not the approach

CDPHE uses for determining compliance with standards (5 CCR 1002-82) or in an anti-degradation review (5 CCR 1002-31.8(3)). The DEIS is inadequate to form the basis of the 404 permit.

Pages 3-87 and 3-88

Comment. The requirement to obtain a 404 permit applies to alternatives that construct reservoirs in waters subject to the jurisdiction of COE.

Section 3.8.2.3 Method for Effects Analysis

Page 3-93

Comment. The representation of flow down the Adams Tunnel as coming entirely from the epilimnion is incorrect. For this concept we are working from a diagram found in a Reclamation document entitled "Hydraulic Lab Report Number 151: Model Studies of the Alva B. Adams Tunnel Inlet Control Structure..." dated September 21, 1944. Some of what follows is contingent on this diagram accurately representing or at least approximating the actual structure of the current Adams Tunnel Inlet.

According to this diagram, the inlet mouth is about four feet high, spanning a distance from roughly 7.4 feet to 12 feet below water surface, calculated from the top possible elevation of the water surface. The location of the Adams Tunnel inlet between the North Inlet and the East Inlet is ideal for maximizing capture of the clean water that flows into Grand Lake from these two very pure rivers. In addition, we believe that the elevation of the Adams Tunnel inlet structure is well placed to "high grade" (to borrow a term from mining) the good quality water that flows into Grand Lake for much of the summer.

In the spring after ice-off the lake turns over and is well mixed. Stratification begins immediately, and an epilimnion, metalimnion and hypolimnion begin to develop. During May, June and possibly all of July (depending on the time of ice off), these layers are thin enough that the water flowing into the inlet is either derived entirely from the mixed waters, the diluted hypolimnion which at this time of year has desirable water quality roughly the same as the mixed waters, or from the very high quality metalimnion, into which we believe the rivers flow once stratification has become established. It is not until roughly late July or early August that the epilimnion has become wide enough (about 4 meters or 16 feet at that time of year) that it is finally able to span the entirety of the Adams Tunnel mouth. At this time all of the water flowing down the Adams Tunnel does appear to be coming from the epilimnion, which is believed to be composed almost entirely of the poorer quality water pumped in from Shadow Mountain Reservoir. From late July or early August, until fall turnover in either October or November, sediment and

algae laden water from Shadow Mountain Reservoir is thought to spread out over the entire epilimnion, some of which is siphoned off by the Adams Tunnel.

At the time of fall turnover, Grand Lake is capped with a layer of low transparency, high algae and sediment content water. When turnover occurs, this load is incorporated into the whole of Grand Lake, and again the diluted mixed waters are made available to the Adams Tunnel. The flow down the Adams Tunnel is composed of water from Shadow Mountain Reservoir only about three months out of the year, rather than six.

The continual loading of the epilimnion in summer, as well as of the entire mixed water body in winter, year after year, can only mean that Grand Lake has had to arrive at, or continues to approach, a new equilibrium which reflects those undesirable contributions from Shadow Mountain Reservoir. This is evident, among other indicators, in reduced clarity, increased algae growth, and the formation of a significant delta at the channel entrance.

Pages 3-104 and 3-107

Comment. The argument is made that increased pumping will decrease residence times in the three lakes, thereby reducing impacts from increased nitrogen concentrations. This argument appears to be erroneous at least for Grand Lake, but probably also for Granby Reservoir, when according to Davine Leiberman's 2008 study, algae blooms persist in Grand Lake even when pumping is high and flushing rates increase to within the range of days.

Section 3.8.3 Cumulative Effects

Page 3-115

Comment. Pine-bark beetle infestation and climate change must be considered as part of the cumulative impacts for lake and reservoir water quality report and for stream water quality.

Comment. The use of one day of July 25th as a worst case scenario makes no sense.

Section 3-8.3.1 West Slope Cumulative Effects

Page 3-121

Comment. Granby Reservoir. "Phosphorus concentrations would be lower than in the direct effects analysis due to anticipated advanced wastewater treatment in the Fraser

River basin in the future." If the analysis of phosphorous concentrations in the DEIS is based on the assumption that treatment plants will be upgraded, then the Carriage Contract must be conditioned on such upgrades being constructed by the applicant for the predictions about phosphorous to be accurate.

Comment. There is no discussion of how the possible consecutive dry year reduction in water levels of up to 44% from the mean depth of 74 meters, 15% difference from the maximum depth (p3-53 WGFP DEIS), will influence water quality. Repeated freezing and thawing of exposed sediments is likely to increase nutrient and potentially metals loading in the reservoir which is not accounted for in any way.

Section 3.9 Aquatic Resources

Comment. The conclusions in the Aquatic Resources section are based on the information contained in the Aquatic Resources Technical Report dated July, 2008. The conclusions brought forward into the DEIS are inaccurate because of the many problems with that technical report. Please refer to the *Wyatt Memorandum*, Exhibit C for a detailed discussion of the inadequacies of the aquatic resources impact assessment. In addition, all of the conclusions about impacts to aquatic resources are called into question by the failure to use existing conditions to measure the significance of stream depletions. See General Comments Section, above.

Comment. This section should refer to Grand County's Stream Management Plan. See comment under Chapter 5, below.

Page 3-137

Comment. The reduction of 24% habitat for fishery is significant and is likely to be far more significant if the impacts were measured against actual *existing* stream flow conditions. *See* General Comments Section above.

Section 3.9.3 Cumulative Effects

Comment. Senate Document 80, the document that controls operation of the C-BT, states that one of the primary purposes of C-BT is "[T]o preserve the fishing and recreational facilities and the scenic attraction of Grand Lake, the Colorado River..." As part of discussion of the cumulative effects, there should be a discussion of whether fishing and recreation actually have been preserved under current conditions. The DEIS also should make reference to the 1951 report prepared by the US Fish and Wildlife for Reclamation which detailed the devastating effects of Granby Dam on the Colorado River. We are aware of two scientific assessments of the stream reach below Granby

Reservoir the 1951 United States FWS report and the Grand County Stream Management Plan. Exhibit G attached shows comparisons of the flows below Granby Reservoir. There is no assessment whether existing bypass flow requirements below Lake Granby and Windy Gap are appropriate for protection of the environment or whether prolonged durations at those flow levels as a result of WGFP alternatives will have an adverse impact.

Section 3.9.4 Proposed Mitigation

Page 3-145

Comment. The discussion of mitigation of impacts to aquatic resources is inadequate.

Section 3.13.2.2 Methods for Effects Analysis

Page 3-195

Comment. If the original Windy Gap was purported to divert an average of 56,000 af why is only 18,779 af of average depletions being paid for under the Fish and Wildlife Service Programmatic Biological Opinion for recovery of endangered fish?

Section 3.18 Land Use

Page 3-216

Please see attached *Coley/Forrest Memorandum*, Exhibit F pg 7 section 1.6, and page specific comments at pg 28 section 2.1 for a complete discussion of the problems with the land use impact assessment.

Section 3.19 Recreation

Page 3-230

The discussion of impacts to recreation is inadequate to satisfy the "hard look" test. Please see attached *Coley/Forrest Memorandum*, Exhibit F pg 9 section 1.7, and page specific comments at pg 29 section 2.2 for a complete discussion of the problems with the recreation impact assessment.

Section 3.21 Visual Quality

Page 3-265

The discussion of impacts to visual quality is inadequate to satisfy the "hard look" test. Please see attached *Coley/Forrest Memorandum*, Exhibit F pg 24 section 1.8, and page specific comments at pg 33 section 2.3 for a complete discussion of the problems with the visual quality impact assessment.

Section 3.22 Socioeconomics.

Page 3-272

The discussion of socioeconomic impacts is inadequate to satisfy the "hard look" test. Please see attached *Coley/Forrest Memorandum*, Exhibit F pg 25 section 1.9, and page specific comments at pg 35 section 2.4 for a complete discussion of the problems with the socioeconomics impact assessment.

Chapter 5 References

Comment. The DEIS fails to consider or discuss *Grand County's Stream Management Plan, Phase 2, Environmental and Water Users Flow Recommendations*, April 2008 and mitigation.

Grand County has been involved in an ongoing effort to provide a scientific study for the analysis and recommendation for preferred flow regimen for streams and rivers in Grand County. Phase 2 of that study focused among other things on an environmental flow regimen "determined to best maintain the ecological needs of the stream in relation to fisheries." *Grand County's Stream Management Plan, Phase 2, Environmental and Water Users Flow Recommendations*, April 2008, ES-1. ("GCSMP"). The GCSMP has been and is still on the Grand County website. Although the DEIS was completed months after Phase 2 of the GCSMP, the DEIS does not cite this study as a reference or discuss the findings and recommendations for environmental flows. The DEIS needs to be supplemented to include the information from the GCSMP and to include a discussion of potential mitigation measures developed in the GCSMP.

The stream reaches that are affected by the proposed alternatives included in the GCSMP are:

- CR3, Colorado River – Granby Reservoir to Windy Gap.
- CR4, Colorado River – Windy Gap to Williams Fork.
- CR5, Colorado River - Williams Fork to KB Ditch.

- CR6, Colorado River - KB Ditch to Blue River Confluence.
- CR7, Colorado River - Gore Canyon to Grand-Eagle County Line.
- WC, Willow Creek – Willow Creek Reservoir to Colorado River.
- BR, Blue River - Green Mountain Reservoir to Colorado River.

We would look forward to a meeting to discuss these concerns at any time.

Sincerely,

Barbara J.B. Green

cc: Board of County Commissioners of Grand County
Lurline Underbrink Curran
J. Scott Franklin (via email: j.scott.franklin@usace.army.mil)
Deborah Lebow-Aal, EPA

EXHIBIT LIST

Exhibit A
List of Grand County comment letters on WGFP Technical Reports

Exhibit B
Report on Windy Gap Firming Project Hydrology Technical Report, by Bishop-Brogden Associates (*BBA Report*)

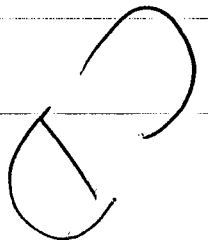
Exhibit *C*
Memo, *Windy Gap Firming Project DEIS Aquatics Resources Technical Report*, by Lane Wyatt (*Wyatt Memorandum*)

Exhibit D
Table, *Windy Gap Ownership and Transfer History.*

Exhibit E
Letter dated March 22, 2004 from the Colorado River Conservation District, Grand County and Northwest Colorado Council of Governments to Richard Aldrich and John Chaffin (p 21)

Exhibit F
Memo, *Windy Gap Firming Project - Draft Environmental Impact Report (DES 08-30,* by Coley/Forrest (*Coley/Forrest Memorandum*)

Exhibit G
Table Comparing Flows Below Granby Reservoir



August 27, 2010

INTERGOVERNMENTAL AGREEMENT FOR THE LEARNING BY DOING COOPERATIVE EFFORT

This Intergovernmental Agreement (Agreement) is entered into between the CITY AND COUNTY OF DENVER, acting by and through its BOARD OF WATER COMMISSIONERS (Board); GRAND COUNTY BOARD OF COUNTY COMMISSIONERS (Grand County) MIDDLE PARK WATER CONSERVANCY DISTRICT (Middle Park) and COLORADO RIVER WATER CONSERVATION DISTRICT (River District), collectively, the "parties."

WHEREAS, the Board, Grand County, Middle Park, and the River District desire to engage in a cooperative, iterative and on-going process (Cooperative Effort) to maintain, and when reasonably possible, restore or enhance the stream environment in the Fraser and Williams Fork River Basins and in the mainstem of the Colorado River from the outflow of Windy Gap Reservoir to its confluence with the Blue River (the Cooperative Effort Area); and

WHEREAS, in addition to other data and information, this Cooperative Effort will rely on the information contained in the draft Grand County Stream Management Plan (SMP). The current draft SMP is dated August 2010, but the parties anticipate that the SMP will evolve over time with the addition of real time information and data; and

WHEREAS, this Cooperative Effort is intended to address impacts that may be associated with existing operations by the Board, Grand County and other water users in the Cooperative Effort Area. Any new impacts to the stream environment projected to be caused by the Board's proposed Moffat Project will be addressed by mitigation plans to be developed by regulatory agencies as part of the permitting process for the Moffat Project; and

WHEREAS, the parties to this Cooperative Effort will develop a process to monitor the stream conditions to identify and respond to potential changes in or desired improvements to the stream environment, based upon the concepts embodied in this Agreement; and

WHEREAS, the Cooperative Effort will allow the participants to identify and react to changes in the stream environment in a manner that maximizes the benefits to be realized from the defined resources available to the entities, and that minimizes adverse changes to the stream environment whenever possible; and

WHEREAS, the parties are authorized to enter into this Agreement by, *inter alia,* Section 29-1-201, *et seq*., C.R.S.; Section 29-10-101, *et seq*., C.R.S.; and Article XIV, Section 18(2) of the Colorado Constitution.

NOW THEREFORE, the parties agree to implement thise Cooperative Effort in accordance with the following provisions:

I. Guiding Principles

The overarching goal for the Cooperative Effort is to maintain and, where reasonably possible, restore or enhance the condition of the stream environment in Grand County. The Upper

EXHIBIT 48

Colorado River system and the Fraser and Williams Fork rivers serve as a critical municipal, agricultural, recreational and industrial water supply source for the state as a whole and provide important aquatic habitat. The participants in the Cooperative Effort have a mutual interest in protecting the stream environment and commit to work together in a cooperative and comprehensive manner to address issues related to maintaining and, when reasonably possible, enhancing the condition of the stream environment in Grand County. To that end, the parties agree to the following principles to build and promote a stable, permanent, relationship that respects the interests and legal responsibilities of the parties, while achieving the goals of the Cooperative Effort.

A. The Cooperative Effort will not seek a culprit for changes in the condition of the stream, but will provide a mechanism to identify issues of concern and focus available resources to address those issues.

B. The parties to this Agreement have been involved since 2007, along with numerous other West Slope entities, in negotiating an agreement (Mediation Agreement) to resolve longstanding issues. The Board has committed to Grand County a substantial, but defined amount of resources described in Article III.E of the Mediation Agreement for the purpose of maintaining, restoring or enhancing the Upper Colorado, Fraser and Williams Fork watersheds. Grand County commits to using the resources provided under Article III.E of the Mediation Agreement in a manner consistent with the purposes of the Cooperative Effort. In addition, Grand County, Middle Park and the River District agree to contribute resources to the Cooperative Effort on an ongoing basis, as available and appropriate. Because resources available to the Parties are limited, the use of those resources will be prioritized as part of the Cooperative Effort. Grand County agrees, consistent with the provisions of Article III.E.9 of the Mediation Agreement, that amounts in excess of $2 million in the WG Pumping Fund will be dedicated to the Cooperative Effort.

C. The Cooperative Effort does not constitute mitigation for the Moffat Project. The Board agrees to undertake all mitigation measures related to Grand County (Mitigation Measures) required in the permit for the Moffat Project to be issued by the Corps of Engineers (COE). The parties to the Cooperative Effort agree not to pursue a challenge to the Mitigation Measures described in the COE permit for the Moffat Project. All the parties to the Cooperative Effort will work in good faith to implement the Cooperative Effort in a way that complements the Mitigation Measures.

D. If the Management Committee desires additional resources beyond the Grand County Article III.E resources, and resources contributed by Middle Park, Grand County and the River District, to implement the Cooperative Effort, the parties will work with other stakeholders, granting agencies, and identify other sources of funding to provide additional resources. If mutually defined additional resources are still desired, the parties may agree to consider contributing more of their own resources on a case-by-case basis and within the context of the other principles listed herein. Each party retains its sole discretion whether to provide any additional resources without future judgment or prejudice by the other parties.

E. The parties to this Agreement agree that active participation in the Cooperative Effort by the Board will commence after Issuance and Acceptance by the Board of Permits Necessary for the Moffat Project, as defined in the Mediation Agreement. Prior to the issuance and acceptance of permits, the parties agree that they will continue to work together on completing and improving the draft SMP.

F. The parties acknowledge that actions not the subject of other contractual obligations that would impair a party's ability to meet its water supply commitments will not be undertaken as part of the Cooperative Effort, unless agreed to voluntarily by the owner of the water supply.

G. For a period of five years from the date of the first diversions into the constructed Moffat Project, no party will unilaterally request, or cause others to request, that the COE or other applicable regulatory agencies reopen a permit or license for the Moffat Project for any reason. Each party reserves the right to oppose any such efforts to reopen the permits or licenses for the Moffat Project.

II. The Cooperative Effort

A. Organization.

1. **Management Committee.** The parties will form a Management Committee within six months after this Agreement becomes effective.

2. **Representation.** The initial Management Committee will comprise five members, one representative each from Grand County, the Board, the River District, Middle Park, and Trout Unlimited. If Grand County and Northern Colorado Water Conservancy District (Northern Water), and the Municipal Subdistrict of the Northern Colorado Water Conservancy District (Subdistrict) enter into an agreement similar to this agreement, the Management Committee will be expanded by one to accommodate a representative from Northern Water or the Subdistrict. The Management Committee may decide to invite others to be members, such as representatives from agricultural, environmental, recreational, industrial, and governmental interests. It is anticipated that the Colorado Division of Wildlife and the United State Forest Service will be invited to play an advisory role in the Management Committee. Any decision to add other members to the Management Committee will be by consensus, with consideration being given to the resources and contributions other potential members may provide to the Cooperative Effort.

3. **Decision-making.** The Management Committee will operate by consensus; i.e. unanimous vote. The Management Committee will make a good faith effort to resolve any issues. If the good faith effort does not result in

consensus, the Management Committee will implement the Conflict Resolution process.

4. **Organizational Structure.** The Management Committee may establish a not-for-profit organization to implement the Cooperative Effort if it determines that such a vehicle is the most effective means for accomplishing its objectives.

B. **Tasks and Responsibilities.** The following are expected under the Cooperative Effort:

1. **Continue to Improve the Grand County Stream Management Plan.** Phase 1, 2, and 3 of the draft SMP have been completed. The parties will continue to adapt and improve the draft SMP cooperatively as additional information is developed, the understanding of desired stream conditions is better defined, and the management goals for each stream reach are agreed upon.

2. **Management Goals and Priorities.** The Management Committee will define the management goals for each stream reach of interest. By way of example, one reach may be managed to increase the fishing experience for rainbow trout, while another reach may be managed for a specific stream characteristic such as macro-invertebrate diversity. Which management goals are practicable for a specific reach could be influenced by the resources available for use in that reach. It is expected that the Management Committee might also define secondary management goals for specific reaches. Once the management goals for the stream reaches are agreed upon, the Management Committee will prioritize the reaches based upon the agreed upon management goals, the desired stream conditions for each reach, and the available resources.

3. **Coordinate with the COE.** If applicable, the Management Committee may work with the COE to coordinate, to the extent practicable, Mitigation Measures for the Moffat Project with the management goals, priorities and projects undertaken as part of the Cooperative Effort. The Management Committee will work to ensure that the Board is not required to engage in duplicative or conflicting actions, nor implement measures that do not accomplish their stated benefits.

4. **Water Quality Standards.** CDPHE has listed several stream reaches in the Cooperative Effort Area on the 2010 303d list of impaired waters. The Cooperative Effort will participate in developing the appropriate management actions for these segments.

5. **Monitoring Plan.** The ability to fully identify cause and effect relationships in a complex aquatic environment is difficult. Therefore, the parties agree to implement a monitoring plan to identify undesirable changes in, and agree

upon desired modifications to, the stream environment, and to measure the effectiveness of actions taken to protect or improve the stream environment. This approach will allow the available resources to be focused on avoiding problems, responding to changing conditions, and achieving stream goals. The Cooperative Effort will rely on existing data and new data gathering under existing programs to provide the primary source of information for designing the management goals and for prioritizing those goals and reaches where the goals will be applied. The Management Committee can initiate additional monitoring, data gathering and analysis, and may choose to focus on specific measurable indicators, as circumstances warrant, to guide in applying the resources and to monitor the effectiveness of the resources in meeting a management goal. The principles of the potential monitoring plan are described in Attachment A.

6. **Implementation.** The Management Committee will review the results of monitoring to evaluate the effectiveness of the Cooperative Effort and of the allocation of available resources in meeting the management goals and priorities. The results of the monitoring program also may be used to identify measures that might be desirable to maintain or improve the stream environment.

7. **Independent Experts.** The Management Committee may retain independent experts and consultants if deemed necessary to perform the Committee's work. The cost of such independent experts and consultants shall be allocated among the parties as agreed to by the Management Committee.

8. **Operations Plan.** The Management Committee will develop an annual operations plan to maximize the stream environmental benefits of the available resources (including water commitments, system flexibility and funding. The plan will explore opportunities for coordinated operations of diversion structures and reservoir releases among all water users in Grand County, including Northern Water; the Subdistrict; the Bureau of Reclamation, the Board; Middle Park; River District; and in-county diversions for agricultural, municipal, industrial, and others uses. The purpose of coordinated operations is to allow the water users to meet the supply requirements of their systems, while maximizing the effectiveness of the Cooperative Effort. Subject to any contractual commitments regarding system operations, all water users retain sole discretion over their water supply system demands and opportunities and available system flexibility. The decisions and actions by the Management Committee in developing and implementing the operations plan shall take into account water rights priorities, draft SMP flow ranges as they change over time, naturally occurring hydrologic conditions, recreational flow needs, CWCB instream flows, and the results of monitoring.

9. **Incorporate New Knowledge into Management Actions.** As the results of testing various operational changes, monitoring the effectiveness of measures, and collecting and analyzing additional data, the Management Committee will have new information to inform its decision-making. The Management Committee will address data management and access issues in a timely fashion.

10. **Obtain and Manage Funding.** The Management Committee will explore whether the most effective use of funds made available for the benefit of the stream environment is to set up an endowment fund dedicated to the goals of the Cooperative Effort. For example, the interest from such a fund could be used as matching funds for grants. The Management Committee also will research available sources of funding for planning, monitoring and implementing measures identified during the Cooperative Effort, including, but not limited to grants, contributions, assessments, or fees on water or sewer services.

11. **Weekly Coordination.** The Management Committee will conduct weekly coordination meetings or calls from May through September or at such other times as mutually agreed by the Management Committee. The purpose of these meetings/calls is to highlight upcoming operational issues, discuss potential options to reduce possible negative impacts to the stream environment, and to coordinate implementation of actions under the Cooperative Effort. The Management Committee can agree to include other entities in the meetings or calls, as a general practice or as warranted. However, the other entities participating in these calls would act as advisors only unless they were providing water, usable resources, or system flexibility to a particular solution or action of the Management Committee.

12. **Annual Review and Stream Management Plan Adaptations.** The Management Committee will conduct an annual review in January or February before the next spring and summer field season to assess whether management goals are being met, evaluate the monitoring data gathered, assess the use of available resources, identify additional data and analysis needs, determine if refinements are needed to the Grand County draft SMP or the operations plan, and provide an annual summary to each of the parties.

III. Conflict Resolution

The parties agree that, if the Management Committee cannot adequately address an issue to the satisfaction of one of the parties, the parties will confer in good faith and endeavor to resolve the concern.

Where the Management Committee cannot make a decision by consensus and any single entity believes that issue warrants mediation, the Management Committee will select a neutral third party mediator who would seek an acceptable voluntary solution to the conflict.

For conflicts that involve a technical or scientific matter, the neutral third party mediator may select an independent technical or scientific expert, acceptable to all parties, to review and make a recommendation on the matter. If the conflict cannot be resolved through the efforts of the mediator, then the Management Committee would agree to disagree, and move forward with the other elements of the Cooperative Effort where they had reached agreement.

In the specific case of water resources included in Article III.E of the Mediation Agreement, those water resources will continue to be released annually in the pattern and location previously agreed to by the Management Committee to protect the environment until another pattern or location is identified by the Management Committee.

If the conflict cannot be resolved by the efforts of the mediator and the Management Committee is prevented from moving forward with the other aspects of the Cooperative Effort, then the parties can pursue any available legal or administrative recourse.

IV. Effective Date

This Agreement shall become effective upon the Issuance and Acceptance by the Board of Permits Necessary for the Moffat Project, as defined in the Mediation Agreement.

V. Miscellaneous Provisions

A. Regulatory Action or Litigation

In the event any person or entity files a petition to the COE, FERC or other regulatory agency for regulatory action, or commences litigation, which would materially adversely affect the Moffat Project (Adverse Action), the parties to the Cooperative Effort agree to meet and discuss in good faith the potential detrimental effect of such Adverse Action, with the goal of determining whether any action by one or more parties could avoid the Adverse Action or mitigate its impact on the affected party. Each party agrees to evaluate in good faith whether it can implement changes in its operations or undertake other efforts that would achieve this goal, and to implement any such efforts as may be agreed to by the parties. If the Moffat Project is denied an acceptable permit, or if the Board decides not to proceed with its project, then the Board shall provide notice to the parties to this Agreement within ten days of the decision and shall be released from its obligation to participate in the Cooperative Effort. Nothing in this paragraph modifies the Board's independent obligations under Article III.E of the Mediation Agreement.

B. No Property Rights or Servitude

Nothing in this Agreement shall be deemed or construed as granting or creating any property right or servitude whatsoever on any party's water rights or facilities. The foregoing sentence shall not impair the rights of any party to specific performance of this Agreement.

C. No Operating Obligation

Except for those Article III E resources which will require operational changes, nothing in this Agreement shall be deemed or construed as creating any obligation on any party to

operate its raw or treated waterworks system in any particular manner, so long as the party complies with the terms of this Agreement. Each party retains sole and exclusive discretion concerning the operation of its system.

D. **Right of Specific Performance**

If any party shall fail to cure any default or breach of this Agreement within 120 days after receipt of notice from the non-defaulting or non-breaching party, then the non-defaulting or non-breaching party may elect to file suit, without further notice, for specific performance of this Agreement. The parties agree that the terms and conditions of this Agreement are enforceable by specific performance, and the parties hereby waive any defenses to specific performance based on the doctrine of sovereign immunity

E. **Force Majeure**

A party shall be excused from performing its obligations under this Agreement during the time and to the extent that it is prevented from performing by a cause beyond its control, provided that such nonperformance is beyond the reasonable control of, and is not due to the fault or negligence of the party not performing.

F. **Severability**

If any provision of this Agreement shall prove to be illegal, invalid, unenforceable or impossible of performance, the remainder of this Agreement shall remain in full force and effect.

G. **Assignment**

Neither this Agreement nor any of a party's rights, obligations, duties or authority hereunder may be assigned in whole or in part without the prior written consent of the other parties.

H. **Colorado Law**

This Agreement shall be construed in accordance with the laws of the state of Colorado.

I. **Termination**

This Agreement will remain in effect unless terminated in writing by all the parties.

I. **Admission of New Parties**

The original parties to this Agreement may, upon unanimous consent, admit new parties upon such terms and conditions as they determine appropriate.

August 27, 2010

ATTEST:

CITY AND COUNTY OF DENVER,
acting by and through its
BOARD OF WATER COMMISSIONERS

By:_____
Secretary

By: _____
President

Date: _____

APPROVED:

By:_____
Director of Planning

APPROVED AS TO FORM:

By:_____
Legal Division

COLORADO RIVER WATER
CONSERVATION DISTRICT

By:_____

Date:_____

MIDDLE PARK WATER
CONSERVANCY DISTRICT

By:_____

Date: _____

GRAND COUNTY BOARD OF
COUNTY COMMISSIONERS

By: _____

Date: _____

ATTEST: _____

ATTACHMENT A
Monitoring Plan

Some level of effective monitoring of the stream environment is essential to understanding and measuring success of applied prescriptions. The Management Committee will design an Aquatic Resource Monitoring Plan, which will cover the Cooperative Effort Area. The Monitoring Plan will focus on understanding the resource and preparing to measure the success of the applied prescriptions.

The Monitoring Plan will be developed and implemented as part of the Cooperative Effort, and will incorporate the elements of the monitoring plan prepared during Phase 3B of the draft SMP that the Management Committee determines are appropriate. The monitoring data will be used by the Management Committee for its decision-making. For example, monitoring will be used to identify changes in the aquatic environment, identify critical stream reaches, assign priorities for action steps, evaluate the effectiveness of actions taken, and to modify and refine strategies for achieving goals of the Cooperative Effort.

The elements of the plan will be determined as part of the Cooperative Effort. The Plan could include some or all of the following elements:

- Identification of key stream segments and groundwater to monitor.
- Existing hydrologic conditions.
- Specific existing ecological conditions at key locations.
- Permanent stream transects to monitor and evaluate any future changes in ecological conditions (e.g., shifts in riffle/pool ratios, increases in sedimentation, reduction in stream habitat diversity) associated with changes in channel maintenance and applied flushing flows proscribed in the Cooperative Effort.
- Establish key indicators of aquatic life and stream health (e.g., fish biomass) and threshold levels at specific locations that reflect increases or declines in aquatic life and stream health from application of measures defined in the Cooperative Effort.

Grand County
Learning by Doing: Stream Management Plan
Outline of Technical Support for Implementation
Oct. 3, 2011

The purpose of this outline is to identify potential technical support for implementing and advancing the Learning by Doing (LBD) process. This will be an iterative process, subject to modifications as the individual tasks are completed and LBD advances. This outline is presented in three categories: 1) tasks recommended to perform this year (fall of 2011) which are focused on physical data reflective of, or impacted by the high flows experienced this year, 2) additional technical tasks and/or data that would provide technical input to the LBD process, and would be preferable to complete within the next 12 months (2011-2012), and 3) a broad-based list of information that should be considered as part of the LBD process.

1.0 Additional 2011 Field Work

	2011 Tasks	Description	When
1.1	Spawning bed core samples	Evaluate accumulation of fine sedimentation during the summer. Focus on Upper Fraser, Lower Ranch and Colorado below Windy Gap	October 2011
1.2	Update spawning bed locations	Locate spawning beds, post 2011 flush, and compare to 2008	October 2011
1.3	Additional core samples	Collect core samples and survey two cross sections downstream of Denver Water diversion to provide basis for evaluating impacts of sediment basin	September 2011 (work completed)

2.0 Additional Tasks for 2011-2012

	2011-2012 Tasks	Description	When
2.1	Develop recommended flows for additional stream reaches	Survey channel cross sections and prepare R2 CROSS. This work may be performed in conjunction with staff from DOW.	October 2011
2.2	Bed load sampling	Sample bed loads during spring runoff and perform sediment transport and channel maintenance flow evaluation in select reaches.	Spring/summer 2012
2.3	Core samples	Evaluate core sampling results, update SMP and develop and implement continued sampling program.	2011-2012

3.0 Additional Technical Effort for Support of LBD

Tasks		Description	When
3.1	Prepare Master Plan	Expand the SMP to include recommendations on integrated improvements (both in terms of analysis and implementation) across all the reaches, phasing recommendations for implementing improvements in a logical progression, and recommendations for evaluation of effectiveness of the plan relative to the project goals.	TBD
3.1.1	Identify specific goals, objectives, desired outcome and identify LBD techniques	Not all reaches will have the same goals and objectives so it is important the goals for each reach consider the other reaches. Utilize SMP as the starting point, expanded by specific targeted outcomes. Include phasing and 'what if' scenarios should the desired outcomes not meet the established goals.	
3.1.2	Integrate work being done by others	This might include improvements on private properties, or by Federal, State and/or local agencies; and/or efforts in compliance with new water quality standards.	
3.1.3	Technical analysis and detailed design	For reaches that will be effected by proposed physical improvements, perform hydrologic, hydraulic and sediment transport analyses; and detailed design. Integrate operational adjustments.	
3.1.4	Implementation of improvements	Ultimately the LBD will need to consider: ✓ phasing of improvements, ✓ quantity and conceptual cost estimates, ✓ potential permitting requirements, ✓ land acquisition issues ✓ operation and maintenance requirements and ✓ requirements for monitoring.	
3.2	Centralize information	Identify other similar or related work efforts (studies, analyses and monitoring) and organizations implementing such efforts, and establish a centralize repository for collection and tracking of information.	TBD
3.3	Nutrient Standards	In anticipation of upcoming nutrient criteria, coordinate with the nutrient criteria work group, and integrate the ongoing efforts by the work group and the LBD. The goal being to consider possible impacts to the SMP and the LBD implementation, avoid duplicate or contradicting efforts and understand and account for the parallel efforts.	TBD
3.4	Aquatic Life Study	Review potential future aquatic life use attainment policy. Identify existing data and future testing requirements and monitoring efforts. Consider possible impacts to the SMP and the LBD implementation.	TBD

1. Participate in Cooperative Effort/Learning By Doing for the Upper Colorado Watershed. The Record of Decision and other State and Federal approval documents should acknowledge that the Municipal Subdistrict has agreed to participate in a Learning By Doing/Cooperative Effort designed to protect and enhance the Fraser and Williams Fork Rivers and affected tributaries, and the Colorado River from the outflow of Windy Gap Reservoir to its confluence with the Blue River, and the Blue River from Green Mountain Reservoir to the confluence with the Colorado River. The Municipal Subdistrict will serve as a member of the Management Committee for the Cooperative Effort. **2. Monitoring Plan.** Rationale: Effective monitoring of the stream environment is essential to protecting the resource because it truths the conclusions in the DEIS and forms the basis for measuring changes to the aquatic environment as well as effectiveness of mitigation. Scope of Plan. Within two (2) years after issuance of the 404 permit or prior to Project diversions, whichever occurs first, the Municipal Subdistrict will fund an Aquatic Resource Monitoring Plan, approved by the COE and the Colorado Division of Wildlife. The Plan will cover the Colorado River from the Windy Gap Reservoir diversion structure to a point downstream from Kremmling. The Plan will be developed and implemented as part of the Learning By Doing/Cooperative Effort. The results of monitoring will be used to identify measures to avoid or mitigate impacts to the aquatic environment caused by the WGFP. Elements of the Plan. The elements of the plan will be determined as part of the Cooperative Effort, but the Plan should, at a minimum, include the following elements: ▪ Identification of key stream segments and groundwater to monitor. ▪ Baseline of existing hydrologic conditions prior to	**40 CFR § 230.10(d)** [*minimize adverse impacts to aquatic ecosystem*] Except as provided under section 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem. **40 CFR 1505.2(c)** [*means to avoid or minimize environmental harm / monitoring]* The record of decision shall . . . state whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and if not, why they were not. A monitoring and enforcement program shall be adopted . . . for any mitigation. **40 CFR § 230.10(d)** [*minimize adverse impacts to aquatic ecosystem*] **33 CFR § 320.4(a)(1) Public Interest Review.** The decision whether to issue a permit will be based on an evaluation of the probable impacts, including cumulative impacts . . . on the public interest. . . . The benefits . . . must be balanced against . . . reasonably foreseeable detriments. . . . factors which may be relevant . . .are . . . aesthetics, general

Project depletions (based on analysis of the hydrologic record at all pertinent stream gages within affected stream reaches), to be developed. ▪ Baseline of existing ecological conditions prior to Project operation including any existing fishery, aquatic macroinvertebrate and channel geometry data and groundwater data. ▪ Baseline water quality, water temperature and sediment loading and transport conditions by stream reach. ▪ Baseline morphology. Permanent stream transects to monitor and evaluate any future changes in ecological conditions (e.g., shifts in riffle/pool ratios, increases in sedimentation, reduction in stream habitat diversity) associated with changes in channel maintenance and flushing flows associated with Project depletions. ▪ Development of a baseline relationship between changes in ecologic conditions and changes in hydrology. ▪ Establish key indicators of aquatic life and stream health (e.g., fish biomass) and threshold levels that reflect declines in aquatic life and stream health. ▪ Incorporate base flow targets, as developed through the Grand County Streamflow Management Plan. ▪ Using key indicators, biologic monitoring to evaluate changes in fish, aquatic invertebrate, and aquatic plant populations. If on the basis of monitoring the CDOW determines that flows in the Colorado River below Windy Gap have been depleted to the levels that will negatively impact the trout fishery, then bypass flows shall be increased or other mitigation agreed to by CDOW shall be implemented.	environmental concerns, fish and wildlife values, . . . land use, . . . recreation, water supply and conservation, water quality, . . . the needs and welfare of the people. . . . For activities involving 404 discharges, a permit will be denied if the discharge that would be authorized by such permit would not comply with the [EPA] 404(b)(1) guidelines . . . **33 CFR § 320.4(r)(1) Mitigation** Mitigation is an important aspect of the review and balancing process . . . **33 CFR § 332.4(c) Mitigation Plan.** (10) Monitoring Requirements. A description of parameters to be monitored in order to determine if the compensatory mitigation project is on track to meet performance standards and if adaptive management is needed . . . **33 CFR § 332.6 Monitoring.** (a)(1) Monitoring the compensatory mitigation project site is necessary to determine if the project is meeting its performance standards, and to determine if measures are necessary to ensure that the compensatory mitigation project is accomplishing its objectives . . . (b) Monitoring period. The mitigation plan must provide for a monitoring period that is sufficient to demonstrate that the compensatory mitigation

	project has met performance standards . . .

Colorado River Aquatic Resources Investigations
Federal Aid Project F-237R-18

R. Barry Nehring
General Professional V

Co-Authors
Brian Heinold
Justin Pomeranz

Tom Remington, Director

Federal Aid in Fish and Wildlife Restoration

Job Progress Report

Colorado Division of Wildlife

Aquatic Wildlife Research Section

Fort Collins, Colorado

June 2011

EXHIBIT 49

STATE OF COLORADO

John W. Hickenlooper, Governor

COLORADO DEPARTMENT OF NATURAL RESOURCES

Mike King, Executive Director

COLORADO DIVISION OF WILDLIFE

Tom Remington, Director

WILDLIFE COMMISSION

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Kenneth M. Smith, Secretary	David R. Brougham
Dennis G. Buechler	Dorothea Farris
Allan Jones	John W. Singletary
Dean Wingfield	

Ex Officio/Non-Voting Members:
Mike King, Department of Natural Resources
John Stulp, Department of Agriculture

AQUATIC RESEARCH STAFF

Mark S. Jones, General Professional VI, Aquatic Wildlife Research Leader
Rosemary Black, Program Assistant I
Stephen Brinkman, General Professional IV, Water Pollution Studies
Ryan Fitzpatrick, General Professional IV, Eastern Plains Native Fishes
Matt Kondratieff, General Professional IV, Stream Habitat Restoration
Jesse M. Lepak, General Professional V, Coldwater Lakes and Reservoirs
R. Barry Nehring, General Professional V, Stream Fisheries Investigations
Brad Neuschwanger, Hatchery Technician IV, Research Hatchery
Kyle Okeson, Technician III, Fish Research Hatchery
Christopher Praamsma, Technician III, Fish Research Hatchery
Kevin B. Rogers, General Professional IV, Colorado Cutthroat Studies
George Schisler, General Professional IV, Salmonid Disease Investigations
Kevin G. Thompson, General Professional IV, GOCO - Boreal Toad Studies
Harry Vermillion, General Professional III, F-239, Aquatic Data Analysis
Nicole Vieira, Physical Scientist III, Toxicologist

Paula Nichols, Federal Aid Coordinator
Kay Knudsen, Librarian

Prepared by: R. Barry Nehring

R. Barry Nehring, General Professional V, Aquatic Wildlife Researcher

Approved by: George J. Schisler

George J. Schisler, Aquatic Wildlife Research Leader

Date: 9/1/11

The results of the research investigations contained in this report represent work of the authors and may or may not have been implemented as Division of Wildlife policy by the Director or the Wildlife Commission.

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Job 1: Colorado River Aquatic Invertebrate Investigations

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State: Colorado Project Number: F-237R

Project Title: Colorado River Aquatic Resources Investigations

Project Objective: To document the relative distribution and abundance of the mottled sculpin *Cottus bairdi* and the aquatic invertebrate fauna of the Colorado River in Middle Park, Colorado in 2010 and compare the results with historical data and records compiled over the past 25-40 years, prior to the construction and operation of Windy Gap Dam in 1983.

Job No. 1 Colorado River Aquatic Invertebrate Investigations

Job Objective: Document the relative abundance and distribution of the aquatic invertebrate fauna of the upper Colorado River between the confluence with the Blue River and Windy Gap Dam west of Granby, Colorado.

INTRODUCTION

History - In the early 1980s, the Northern Colorado Water Conservancy District (NCWCD) was granted a permit to build Windy Gap Dam (WGD), the fifth of six mainstem impoundments constructed on major streams within upper Colorado River basin in Grand County during the 20thcentury. WGD created a shallow lake approximately 40 hectares (113 acres) in surface area just downstream of the confluence of the Colorado and Fraser rivers, west of Granby, Colorado. The initial purpose of WGD was to capture and pump up to 56,300 acre-feet (AF) of water annually from the upper Colorado River basin into Granby Reservoir and deliver it to the Front Range via the United States Bureau of Reclamation's (USBOR) Colorado-Big Thompson Project (C-BT) Project. Collected primarily from the Fraser River Basin, the water is pumped into Lake Granby, pumped again into Shadow Mountain Reservoir, whereupon it flows via gravity into Grand Lake for delivery to the East Slope via the Alva B. Adams Tunnel.

The infrastructure that comprises the C-BT Project was built between 1938 and 1957. Three other man-made impoundments that are part of the C-BT project on the West Slope include Granby, Shadow Mountain and Willow Creek reservoirs. Granby and Shadow Mountain dams collect and impound water from the North Fork of the Colorado River, Arapaho Creek and

other tributary streams flowing out of the west side of Rocky Mountain National Park (RMNP). Willow Creek Reservoir (WCR) collects, impounds, stores and diverts water from Willow Creek through a canal for storage in Lake Granby and subsequent pumping into Shadow Mountain Reservoir.

Williams Fork Reservoir (WFR), the fifth impoundment in the upper Colorado River Basin in Grand County, owned and operated by the Denver Water Department (DWD), captures and stores water from the Williams Fork River Basin for later release to service senior water rights downstream in western Colorado. Wolford Mountain Reservoir impounds water flowing down Muddy Creek north of Kremmling, Colorado. In addition, the DWD captures water from numerous headwater streams that are tributary to the Fraser and Williams Fork rivers via an elaborate system of canals, delivering it to the Moffat Tunnel east of Winter Park, Colorado, for transmountain diversion to the East Slope.

According to the NCWCD web-page, the C-BT Project is the largest transmountain water diversion project in Colorado, providing supplemental water to 30 cities and towns, helping to irrigate approximately 693,000 acres of farmland in northeastern Colorado. Annually, the project delivers 213,000 acre feet (AF) of water to northeastern Colorado for agricultural, municipal and industrial uses. On the East Slope, the water is used to generate electricity as it falls almost half a mile through five power plants on its way to Colorado's Front Range for storage in Carter Lake, Horsetooth Reservoir and Boulder Reservoir. The water is subsequently released as needed to supplement native water supplies in the South Platte River basin.

During the 1980s, two studies were undertaken that developed baseline information on the fish and aquatic invertebrate fauna of the upper Colorado River from WGD downstream to the confluence with the Blue River near Kremmling, Colorado. The first study, an intensive, year-long sampling effort from September 1980 to September 1981, provided detailed, in-depth documentation of the species composition, diversity and relative abundance of the aquatic invertebrate fauna at seven sampling sites in this reach of the river prior to WGD construction (Figure 1). That study was funded by the NCWCD and conducted by Dr. Robert Erickson. Study results are contained in a report titled Benthic Field Studies for the Windy Gap Study Reach, Colorado River, Colorado – Fall 1980 to Fall 1981 (Erickson 1983). In this study, the density (numbers/m^2), relative abundance and distribution of the large stonefly larvae *Pteronarcys californica* was well documented throughout the 48 km (29.5-mile) reach of the upper Colorado River. Moreover, the Erickson study documented the distribution and relative abundance of many dozens of species of aquatic insects belonging to five major insect orders

(Ephemeroptera, Plecoptera, Trichoptera, Diptera and Coleoptera) as well as other aquatic invertebrate fauna.

The second study, an eight-year research project (Colorado River Aquatic Invertebrate Investigations) was initiated by the Colorado Division of Wildlife (CDOW) in April 1982 (Nehring 1983). The overall study objective was to develop baseline information on the various aspects of the riverine ecosystem for effective evaluation of the long-term effects of water withdrawals on the fish and aquatic invertebrate biota of the Colorado River in Middle Park. *Pteronarcys californica*, known to anglers as the willowfly, salmonfly or giant stonefly, was the primary aquatic invertebrate species chosen for study because of its importance as a food item for wild rainbow and brown trout in the river. The results from the first six years of this investigation are summarized in a 1987 report (Nehring 1987).

At the end of the 20th century, well over half of the average annual water yield of the upper Colorado River Basin (at the confluence of the Colorado and Fraser rivers near Granby) was being diverted through transmountain diversions to the East Slope. Now, two additional diversion projects are being proposed to transfer substantially more of the basin yield to Colorado's Front Range. The Windy Gap Firming Project as proposed by the NCWCD would divert additional water to the East Slope via the C-BT Project. The Moffat Tunnel Enhancement Project, as proposed by the DWD, would divert an additional 15,000 AF of water from the headwaters of the Fraser and Williams Fork rivers.

As these two water-yield enhancement proposals have moved through the process of public comment and review, environmental impact statements (EIS), permit application and approval, serious concerns about numerous potential impacts to the aquatic ecosystem of the upper Colorado River basin have been raised by many interested parties. The Colorado Division of Wildlife (CDOW) is the lead agency legally mandated by the state of Colorado to evaluate the validity and adequacy of any proposed mitigation measures set forth by the project proponents. As a result, researchers and managers of the Aquatic Program section of the CDOW were assigned various tasks to review historical data available from previous studies within the upper Colorado River basin as well as collect and analyze additional field data to address these concerns on behalf of the people of Colorado. The data collected and summarized in this report are (in part) the result of that assignment.

LITERATURE REVIEW

Freshwater resources worldwide have been negatively impacted from over appropriation and flow alteration due to centuries of human modification (Robarts and Wetzel 2000, Vörösmarty et al. 2000, Wohl 2006, Bates et al. 2008). The declining quality of water and these aquatic ecosystems is elucidated by documented extirpations and extinctions of aquatic organisms (Stein et al. 2000, Fochetti and Tierno De Figueroa 2006, IUCN 2008). In regulated rivers throughout the world, biodiversity is markedly decreased in areas directly below dams, whereas total invertebrate biomass may increase (Vinson 2001, Ward 1998). In a long-term analysis of macroinvertebrate assemblages below Flaming Gorge Dam in Wyoming, Vinson (2001) reported that nearly 40 years after the dam was completed, 23 insect taxa were extirpated from the riverine reaches directly below the dam. Sampling much further downstream revealed most of these 23 taxa were still present. The naturally complex habitats of the upper Colorado River host relatively diverse communities of aquatic fauna. Anthropogenic effects, particularly through river regulation, can change these natural flow regimes, leading to changes in native aquatic plants and animals that are important in natural ecosystem processes (Vinson 2001, Strange et al. 1999, Ward 1998). Long-term biomonitoring of aquatic insect communities may provide insight into how human induced alterations are affecting community structure, ecosystem functions and water quality.

Aquatic insects are a vital component of freshwater ecosystems. They process large amounts of organic material in the stream and transfer that energy to animals in higher trophic levels such as fish, crayfish, frogs, bats, birds, and spiders, making them a critical link connecting the aquatic and riparian communities (Baxter et al. 2005). Aquatic insect larvae occur in both lotic (running water) and lentic (standing water) habitats. Emerging from the water as larvae or adults, they exist in the terrestrial environment for a few hours to a few weeks. Reproduction is the primary function of the adult life stage (Hynes 1976, Brittain 1982). Many species in temperate regions have a one-year life cycle with much of that time spent feeding and growing as larvae in the stream.

Larvae can be divided into four functional feeding groups (FFGs), shredders, collectors, scrapers, and predators, based on morphology, food ingested, and behavior (Merritt et al. 2008, Cummins 1973). All FFGs have critical roles in nutrient cycling and the food chain. Shredders consume Coarse Particulate Organic Matter (CPOM, >1mm), collectors filter Fine Particulate Organic Matter (FPOM, <1mm) out of the water column, scrapers shear algae from the benthic substrate and predators consume living animal tissue (Cummins 1974, Vannote et al. 1980).

Although most larvae are generally placed in only one FFG, many show a degree of omnivory, i.e., shredders will incidentally consume small amounts of living animal tissue (Cummins and Klug 1979). A large portion of the energy in streams comes from the riparian area as CPOM and forms the base of the food web between the stream and the adjacent riparian areas (Cummins and Klug 1979, Vannote et al. 1980).

During aquatic larval stages, downstream drift is the major direction of movement, both unintentionally when disturbed and as a natural behavior usually at night to seek optimal habitat, avoid predators and competitors, and to avoid pollutants (Williams and Hynes 1976). Williams and Hynes (1976) reported that downstream drift of benthic fauna was responsible for 44.4 percent of recolonization. Several investigations have found the downstream drift is the most important pathway for colonization of downstream areas by aquatic insects (Vinson 2001, Townsend and Hildrew 1976, Williams and Hynes 1976). Upstream flight of adult aquatic insects accounted for only 18.2 percent of recolonization in one study (Hershey et al. 1993). The short life span and fragile nature of adult mayflies can limit their dispersal over long distances (Brittain 1982). Adult male stoneflies are generally weak fliers and some are wingless or have only vestigial wings (Hynes 1976). Downstream drift increases dramatically during the night time hours, increasing exponentially beginning at dusk (Anderson 1966, Elliott 1965, Hynes 1972, Müller 1963). Nocturnal drift also is higher during the dark phases of the moon (Anderson 1966; Müller 1963). Impoundments such as WGD interrupt this process, significantly compromising the biotic integrity and proper functioning of the stream ecosystem.

Mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera), collectively referred to as the EPT taxa, are often the dominant groups in coldwater streams in mountainous regions of western North America. EPT species are the preferred groups for biological monitoring of freshwater ecosystems. Their long aquatic larval life stage, widespread distributions, predictable response to disturbance, high population densities, wide range in sensitivity to disturbances, and relatively low cost of quantitative methods to collect data make them reliable biological indicators for assessing ecosystem health (Brittain 1982, Hynes 1976, Lenat and Penrose 1996, Wallace et al. 1996, Barbour et al, 1999). Johnson et al. (1993) list eight attributes of an ideal indicator species; 1) easily identifiable, 2) cosmopolitan distribution, 3) numerical abundance, 4) low genetic and ecological variability, 5) large body size, 6) limited mobility and long life history, 7) ecological characteristics well known, and 8) suitable for use in laboratory studies. *Pteronarcys californica* (see below) has many of these attributes of an ideal indicator species.

The construction of man-made water impoundments may be responsible for eliminating or reducing local aquatic insect populations through dewatering, reductions in time and duration of flushing flows, and physical river bed disturbance. Additionally, they may alter natural temperatures and flow regimes which are considered to be the most important factors in regulating community structure (Brittain 1982, Ward 1976b, Hynes 1976, Steel and Lange 2007, Vinson 2001, Ward 1998). Dams pose a unique set of barriers and ecological conditions that may inhibit upstream larval migration, eliminate downstream drift, as well as reduce water quantity and quality required for aquatic insect survival. These changes in habitat combined with the difficulty that insects have recolonizing upstream habitat can contribute to the marked decline in species diversity usually seen at sites immediately below a dam.

Temperature can vary daily, monthly, seasonally and on an annual scale (Steel and Lange 2007). The life histories of many species of aquatic insects are often synchronized to a specific set of abiotic factors like day length and heating degree days (Hynes 1976, Brittain 1982, Wiggins 1996). Increased water temperature below dams may cause insect larvae to mature more quickly either through increased degree days or by increasing primary production (Gregory et al. 2000, Rockwell and Newell 2009, Hynes 1976), disrupting adult emergence patterns and successful larval recruitment (Rockwell and Newell 2009, Bunn and Arthington 2002).

Flow variability is another important factor affecting the life histories of aquatic insects. Snow-fed streams, like the Colorado River, experience dramatic changes from low to peak flows (Rockwell & Newell 2009, Poff et al. 1997). Peak flows inundate lateral margins of the stream bed, which may cue adult emergence and mating, providing more suitable habitat for oviposition and larval recruitment (Vinson 2001). Regular flushing flows are critically important for maintaining habitat quality by scouring out fine sediment and creating interstitial spaces under and around cobbles where larvae feed and find shelter. Many species of aquatic insects require this microhabitat type compared to embedded cobble or fine particle substrates (Brusven & Prather 1974, Bunn and Arthington 2002).

Natural flow regimes can act as cues in the timing of events such as egg hatch for aquatic insects (Brusven & Prather 1974, Bunn and Arthington 2002). Once mating and egg deposition in the stream has occurred, *Pc* eggs undergo a diapause phase that can last nine months to a year before hatching (Townsend and Pritchard 2000). During the diapause, little or no embryonic development occurs. Alterations in streamflow after oviposition can have a detrimental effect on long-term persistence and survival by desiccating developing eggs on dewatered, lateral margins of river banks. Analysis of long-term changes in the aquatic invertebrate community structure

can elucidate both past and present factors contributing to the contemporary assemblage and point to bottlenecks or disconnects in ecosystem function (Lenat and Penrose 1996).

Pteronarcys californica is an excellent organism for biomonitoring. Large and easily identifiable, it occurs in many large streams and rivers in the western United States (Rockwell and Newell 2009, Kauwe et al. 2004). The larvae are restricted to swift, mountain streams among high gradient riffles dominated by cobble and boulder substrates. While this species usually occurs at elevations between 1,905 and 2,500 m (6,250 and 8,200 feet) (Rockwell and Newell 2009, Kauwe et al. 2004, Surdick and Gaufin 1978), in Colorado they can be found at elevations ≤1,524 m (5,000 feet) in the Gunnison River Gorge, and > 2,744 m (9,000 feet) in the Rio Grande basin near Creede. Larvae feed on coarse organic material and can reach high densities in areas with high concentrations of organic matter such as growth of filamentous green algae like *Cladophora,* leaf packs and woody debri. This species has relatively narrow environmental requirements and is given a very low tolerance level by western standards in rapid bioassessment (Barbour et al. 1999, Erickson 1983, Surdick and Gaufin 1978). It has a four to five year larval life cycle and undergoes incomplete metamorphosis (Nehring 1987, DeWalt and Stewart 1995, Townsend and Pritchard 1998, 2000). *Pc* larvae emerge and molt in late spring in a highly synchronous event with average adult survival spanning one week (DeWalt and Stewart 1995).

Pteronarcys californica larvae link the aquatic and terrestrial ecosystems as an important food item for fish, frogs, and crayfish. The adults are an important energy source for trout, birds, bats and spiders (Baxter et al. 2005). Late instar larvae and adults can exceed weights of 1g and lengths of 50 mm (Rockwell and Newell 2009). When present in high densities, *Pc* larvae can constitute a large portion of the total benthic biomass (Erickson 1983; Nehring 1983, 1984, 1985, 1986, 1987). In a diet study of wild rainbow and brown trout on the Colorado River in Middle Park, Grand County, Nehring (1987) reported that *P. californica* was consistently the single most important food item found in trout stomachs, comprising 64 to 75 percent of the mean stomach content over the course of a four-year study from 1980 through 1983. Among 72 stomach samples examined, the volumetric contribution of *Pc* larvae ranged from 42 to 95 percent of the gut content among individual fish. Erickson (1983) and Nehring (1987) agree that this one species of stonefly was a critically important component of the diet of wild trout in the upper Colorado River in Grand County.

BENTHIC SAMPLING METHODS

Sampling sites – During the 2010 field season, our intention was to collect benthic invertebrates at the same riffle areas that were sampled during the 1980-1981 study using the same sampling protocol (Erickson 1983). A map of the sampling sites for both the 1980-1981 and 2010 studies can be seen in Figure 1 in the Appendix. In the original study, the Colorado River was divided into three reaches. Sampling sites WG11, WG 12 and WG 13 were in Reach One, bounded by WGD and the confluence with the Williams Fork River. Sampling sites WG 21 and WG22 were in Reach Two, bounded upstream by the confluence with the Williams Fork River and downstream by the confluence with Troublesome Creek. The sampling sites in Reach three were WG31 and WG32, bounded upstream and downstream by Troublesome Creek and the Colorado Highway 9 Bridge near the confluence with the Blue River. This reach of river is negatively impacted by large inputs of sediment from Troublesome Creek.

Dr. Robert Erickson was hired for a day to visit the river in early April 2010, to insure that (if possible) the 2010 samples would be collected from the same seven riffle areas that were sampled during his 1980-1981 study. At five of the seven original sites we were able to accomplish that goal. The two sites where this was not possible were WG11 and WG32. The original WG11 site was located just 100 m downstream from the superstructure of Windy Gap Dam (WGD). That site was not sampled because the channel was completely modified during and after construction of WGD and is now extremely wide, very shallow, and matches the width of the entire spillway of WGD. Therefore it made no sense to sample at that site and we did not collect any sample for WG11 in the spring of 2010. However, in the fall of 2010, we added a station 1.45 km (0.9 miles) downstream of WGD, at a steep riffle area approximately 100 m upstream of the Grand County Road 57/578 Bridge, referred to as the "New WG11" or "Hitching Post Bridge" at times in this report.

Similarly, it made no sense to sample at the original WG32 site in the 1980-81 study. That riffle area was completely buried in sediment. Therefore, the 2010 – new WG32 sample site is approximately 3 km upstream from the original site. It is located at the first visible riffle area upstream at the point where the Colorado River and U.S. Highway 40 are in closest proximity to each other in the reach of the river downstream of the confluence with Troublesome Creek. In the interest of continuity and comparability of data between the 1980-1981 Erickson study and the 2010 collections, we used the same sample site identification system set forth in the earlier study (Table 1). However, in comparisons of invertebrate data from the 1980-1981 study and the 2010 study, we did not include any data from the June 30-July 1, 1981 (summer) collections.

Only data from the spring and fall collections were compared between the two studies. In the sampling matrix shown in Table 1, the year 2009 is also included. However, in the 2009 study, the only invertebrate species targeted was *Pteronarcys californica.* Data from the 2009 study was summarized and reported previously (Nehring et al. 2010).

Table 1. Benthic sampling site locations (stream and designation) and sampling periods (month and year) between the 1980-1981 (Erickson 1983) study compared with samples collected by the Colorado Division of Wildlife from 2009 through 2011.

Stream Name	Site Descriptor	Sampling Period(s) – month/year						
		Sept 1980	May 1981	July 1981	Sept 1981	2009	Spring 2010	Fall 2010
Fraser River	Solvista	no	no	no	no	no	no	Yes
Fraser River	Kaibab Park	no	no	no	no	Yes	Yes	Yes
Willow Creek	Above Willow Crk Rsvr	no	no	no	no	no	no	Yes
Colorado River	Old WG11	Yes	Yes	Yes	Yes	no	no	no
Colorado River	New WG11	no	no	no	no	Yes	no	Yes
Colorado River	WG12	Yes	Yes	Yes	Yes	no	Yes	Yes
Colorado River	Highway 40 Bridge	no	no	no	no	Yes	no	Yes
Colorado River	WG13	Yes	Yes	Yes	Yes	no	Yes	Yes
Colorado River	WG21	Yes	Yes	Yes	Yes	no	Yes	Yes
Colorado River	Skylark Ranch[a]	no	no	no	no	no	Yes[a]	no
Colorado River	WG22	Yes	Yes	Yes	Yes	no	Yes	Yes
Colorado River	WG31	no	Yes	Yes	Yes	no	Yes	Yes
Colorado River	New WG32	no	no	no	no	no	Yes	Yes
Colorado River	Old WG32	Yes	Yes	Yes	Yes	no	no	no
Gunnison River	Ute Park	no	no	no	no	no	Yes	no
Colorado River	Pumphouse	no	no	no	no	no	Yes	Yes

Note: [a]: the site at Skylark Ranch was sampled in early April 2011.

In order to provide a broader perspective and assessment of the status of the aquatic invertebrate community, eight additional sites were sampled. Four of these are shown in Figure 1 as yellow dots. Six were in the Colorado River Basin, three upstream and four downstream from the WGD (Table 1) and one on the Gunnison River. Two of the upstream sites were on the Fraser River, one approximately 100 m downstream of the U.S. Highway 40 Bridge across the river at the east end of Granby, and the other approximately 3 km upstream of the Highway 40 Bridge and 3 km downstream of the Fraser River Canyon on the Grand Elk/Solvista Ranch property. The third upstream site was on Willow Creek, approximately 10 km upstream of WCR and 1 km upstream of the confluence with Cabin Creek. These sites were added to provide an assessment of the aquatic invertebrate fauna on two tributary streams and three sites not affected by impoundments. Also within the basin, three sample sites on the Colorado River downstream

of WGD were added to provide a better longitudinal perspective in that reach of the study area. The Highway 40 Bridge site (approximately 3 km east of Hot Sulphur Springs) is located between WG12 and WG13, well upstream of the confluence with the Williams Fork River. The Skylark Ranch site was added in April 2011 as an additional site in Reach Two, between WG 21 and WG22, upstream of the confluence with Troublesome Creek. The Pumphouse sample site is located downstream of the mouth of Gore Canyon, near the Bureau of Land Management (BLM) Pumphouse Boat Launch. This site is well downstream of the Blue River confluence. Blue River water releases from Green Mountain Reservoir during the spring to fall season (to service senior water calls downstream) essentially restores a more natural hydrograph to the Colorado River by providing flushing flows on an annual basis. In average and above average water years those flushing flows can be very high and sustained for several weeks.

Finally, the seventh site was on the Gunnison River, within the Black Canyon of the Gunnison River Gorge (GRG) downstream of Black Canyon National Park, and downstream of the largest reservoir system in Colorado. Since the width of river running through the GRG is only 10-20% greater than that of the Colorado River at site WG11, this study site was added as an "external" control, for comparative purposes. The average width of the Gunnison River at the invertebrate sampling site is only 6% wider than that of the Colorado River at WG21. It has a managed flow regime downstream of the largest capacity reservoir system in Colorado.

Approximately 33% (over 300,000 AF/yr) of the average annual water yield of the Gunnison Basin at Blue Mesa Dam is diverted through the Gunnison Tunnel to the Uncompahgre River Basin for agricultural, municipal and industrial purposes. The Curecanti (Aspinall) Unit on the Gunnison River is a series of dams that are part of the Colorado River Storage Project. It consists of three reservoirs, Blue Mesa, Morrow Point, and Crystal Dams. Blue Mesa Dam has a total storage capacity of slightly less than 1 million AF of water, the approximate average annual water yield of the Gunnison River basin upstream of Blue Mesa. The Blue Mesa and Morrow Point units operate as peak-power hydroelectric generation facilities. Each unit requires a volume of 5,000 ft^3/s under full load. Bypass flows of 150 ft^3/s occur when the turbines are not operating. Crystal Dam captures the water flowing from the two upstream hydropower units, and stabilizes the flows released to the river in the Gunnison Gorge.

Sampling Protocols - Three replicate samples were collected at riffles with visually similar depth, substrate, and velocity at each sampling location. For each replicate, a 0.25m^2 rectangular-shaped sampling frame was placed on the stream bed and a trailing, cone-shaped benthic drift net (150 micron mesh) over 2 m in length was set up immediately downstream and

held in place with steel rods driven into the substrate. Wings attached to the sides of the cone-shaped net extended 1 m upstream, directing the flow and dislodged macro-invertebrates into the net (Figure 2 in the Appendix). The length and total surface area of the benthic drift net was great enough to allow water velocities up to 2-3 m/s to pass through the cone without any resistance or backwash, thereby reducing the possibility of loss of dislodged invertebrates being able to bypass the throat of the net. All rocks and cobbles ≥ 50 mm in diameter were individually scrubbed with a vegetable brush and invertebrates washed into the net. The rocks were placed back into the stream outside of the sampling rectangle. Once cleared of rock and cobble, the remaining substrate within the frame was stirred by foot and hand action to a depth of about 10-12 cm to dislodge macroinvertebrates. Replicates were generally collected within 3-4 m of each other at each sampling site. The trailing net was rinsed with stream water to concentrate the sample at the end of the cone. The cone was then inverted and washed into a 20 L plastic pail. The sample was then drained, transferred by hand into 1.9 L (1/2 gallon) plastic jars, and preserved in 70% ethanol (ETOH). Three separate benthic drift nets were used at each sampling location. The nets were thoroughly rinsed, cleaned and examined for any material clinging to the net to prevent cross-contamination between stations.

Preserved samples were transported to a lab at Colorado State University for processing by Division of Wildlife invertebrate taxonomists. Specimens were sorted, identified to the lowest practical taxonomic level, counted, and entered into a database. All aquatic insect and invertebrate taxa data reported were standardized to 1 m^2 for comparative purposes between sample sites, seasons and years (Appendix Tables A1 through A12).

During the spring of 2010, nine sites (27 replicates) were sampled. All of the spring 2010 replicates were completely sorted and sampled (100%). During the late-summer of 2010, benthic collections were made at 12 locations (36 replicates). Six of those replicates were sampled at 50%, 30 at 100%, and the April 2011 (Skylark Ranch) replicates were sampled at 50%. A reference collection was prepared and deposited at the C.P. Gillette Museum of Arthropod Diversity at Colorado State University. Taxonomic name changes that occurred between 1980-1981 and 2010 required an alteration of identifications from1980-1981 data in a few instances in order to allow better comparison with the 2010 data. One example was moving all *Alloperla* sp. from the 1980-81 data to family Chloroperlidae in 2010 because in 1980-1981 the genus *Alloperla* was comprised of several subgenera that are currently recognized as separate genera.

Pteronarcys californica Sampling Protocols - Among all replicate benthic samples collected during the 2010 study, total body length (mm) was determined for every *Pc* larva at

every site. This afforded the development of a length-frequency distribution for all *Pc* larvae collected in the spring and fall. In addition, determination of sex for each *Pc* larva was also made. This was possible using techniques originally developed by Branham and Hathaway (1975) and described by Nehring (1987). Each *Pc* larva was examined under a binocular stereozoom microscope for the presence (or absence) of a vaginal "scar" on the ventral posterior edge of the 7th abdominal segment. Presence of the vaginal scar indicated the larva was a female. Absence of the scar indicated the larva was a male. This afforded determination of sex among *Pc* larvae down to 4-5 mm total body length (not including the length of the cerci or the antennae). Male *Pc* larvae in their 3rd and 4th years of life develop a curved shield or hood on the dorsal surface of the terminal abdominal segment that covers the male genitalia. During the study in the 1980s, numerous benthic samples were collected during the spring, early summer, late summer and fall seasons to determine the length frequencies distributions of the pre-emergent male and female *Pc* larvae (in April) and compare with the post-emergence length-frequency distributions in July, a month after emergence (Nehring 1983,1984,1985,1986, 1987). This sampling protocol afforded an accurate assessment of the minimum and maximum body length for each sex for pre-emergent *Pc* larvae. It also affords visual representation of growth increments and supports the conclusion that the life cycle of *Pteronarcys californica* in the Colorado River is four years post-hatching (see Figures 9 and 10 in the Appendix of the report).

In addition, during May and June 2010, we physically collected and counted the cast exoskeletons of *Pc* larvae at two – 30.5m (100 feet) sections of riffle areas along one bank of the Colorado River at all seven WG benthic sample collection sites, at the BLM Pumphouse sampling area, at three sites on the Fraser River upstream of WGD, and on the Gunnison River in the same area as the benthic samples were collected. We were able to determine the statistical correlation between the last instar, pre-emergent *Pc* larval density with *Pc* adult density by 1) comparing the number of pre-emergent *Pc* larvae at the benthic sites sampled in April 2010 (standardized to $1m^2$) with 2) the number of cast exoskeletons of *Pc* larvae collected and counted at the same riffle areas in June 2010. The *Pc* adult density was standardized to individuals/m^2 by dividing the total exoskeletons counted by the estimated stream reach cross sectional area (m^2) at those sites.

This component of the study required almost four weeks to complete as *Pc* larval emergence to the adult stage typically begins in the downstream reaches, where the water is warmer, and then moves upstream to the highest elevation reaches as the water warms. Monitoring of the water temperatures at each sampling site demonstrated that *Pc* larval emergence to the adult life stage in both the Colorado and Gunnison rivers was triggered when

the water temperature at a given location reached 10° C. The 2010 snowpack in the Colorado River and Gunnison River basins was well above average, and the spring was cold and wet. *Pc* larval emergence began at the BLM Pumphouse Launch site May 28 and proceeded slowly upstream. Emergence of *Pc* larvae at the sample sites on the Fraser River was not complete until June 21st.

RESULTS AND DISCUSSION

Aquatic Macroinvertebrate Results - The results of the spring 2010 benthic invertebrate samples are summarized in Tables A.1 through A.6 in the Appendix of the report. Results of the fall 2010 benthic invertebrate samples are summarized in Tables A.7 through A.12 in the Appendix. The data are all standardized and reported as numbers (per taxa) per m^2.

Benthic samples were collected from 14 stations in the Upper Colorado River basin between April 2010 and April 2011. Ten stations were from the Colorado River (five were the same locations as 1980-1981 stations, one from Willow Creek, two from the Fraser River, and one from the Gunnison River. Unless otherwise noted, this summary refers to the seven WG stations taken in spring and fall 2010. Table 1 above contains a matrix of the sample sites and sampling periods.

Sixty-nine macroinvertebrate taxa were identified from the Colorado River at seven WG stations in 2010 (Table 2). The insect taxa were primarily represented by 67 species in five orders. The station closest to Windy Gap dam (WG11) displayed the lowest diversity of total taxa and the middle station (WG21) displayed the highest, with a general increase in diversity at sites further downstream from the WGD (Table 2).

Mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera), known collectively as the EPT taxa, are considered sensitive to changes in habitat and are widely accepted as a means to measure stream health (Gaufin and Tarzwell 1952, Barbour et al. 1999, Lenat and Penrose 1996) and are the focus of this brief summary. Eight EPT taxa that were common in the lower WG stations were rare or absent at the upper WG stations including the mayflies *Drunella grandis*, *Epeorus* sp., and *Rhithrogena* sp., the stoneflies *Isogenoides* sp., *Pteronarcella badia, Pteronarcys californica,* and *Cultus aestivalis*, and the caddisfly *Psychomyia flavida.* There were five EPT taxa unique but not common, in the upper WG stations including the stoneflies *Paracapnia angulata* and *Prostoia besametsa* and the caddisflies

Amiocentrus sp., *Agraylea* sp., and *Psychoglypha* sp. Simulids, Isopods, and segmented worms, organisms considered more tolerant to environmental perturbations, were more abundant in samples from the upper stations.

Table 2. Number of taxa from each station in spring and fall 2010 individually and combined and distance in river miles downstream from Windy Gap Dam. The data presented here are summarized from Appendix Tables A.1 through A.12

69 taxa total	WG11*	WG12	WG13	WG21	WG 22	WG31	WG32
Mayflies	10	11	9	15	11	10	13
Stoneflies	6	6	10	9	9	9	9
Caddisflies	9	14	10	10	11	13	9
Beetles	5	4	4	3	4	3	3
Dipterans	5	7	5	5	6	7	5
Non-Insects	11	11	6	12	10	8	8
Other Insects	0	1	0	1	1	0	1
Species per station	46	54	44	55	52	50	48
Distance↓WGD (km)	1.5	3.2	16.1	28.2	39.5	41.1	47.6

* = fall sample only

The stations upstream of WGD (Willow Creek and Fraser River) exhibited the greatest diversity of macroinvertebrate fauna, harboring 29 taxa not found in stations downstream from WGD in 2010. Willow Creek had the highest number of taxa with 53. Nine were unique to that station. See Appendix Tables A.1 through A.12 for details.

Table 3. Numbers of species in each major group of aquatic macroinvertebrates from Windy Gap sampling stations in 2010 and 1980-1981. The data presented here are summarized from Appendix Tables A.1 through A.12

WG Stations	Total	Mayflies	Stoneflies	Caddisflies	Beetles	Diptera	Other insects	Non-insects
1980-1981	95	35	14	21	7	26	2-4	11
2010	69	16	10	13	7	8*	2	13
% change ± since 80-81	-38%	-54%	-40%	-62%	0%	-69%	0	+18%
All stations 2010	98	21	17	20	10	12	2	16

*= Probably an underestimate as true flies were identified with more resolution in 1980-1981 than in 2010.

Although 2010 data exhibited greater diversity with increasing distance downstream, there was an approximate 38% loss of total diversity from 1980-1981 to 2010 (Table 3). The three most sensitive insect groups (EPT) experienced losses from 1980-1981 to 2010 including

19 mayfly, four stonefly, and eight caddisfly species. As sensitive species like *Pteronarcys californica*, *Pternarcella badia*, and *Drunella grandis* were eliminated below Windy Gap Dam, density of more tolerant taxa like the mayflies *Ephemerella dorothea infrequens,* some *Baetis* sp. and the caddisfly *Hydropsyche* sp. increased. This pattern agrees with Vinson (2001), Ward and Short (1978), and Ward (1976a) who showed aquatic macroinvertebrate diversity decreased while density increased below dams in large and small streams.

Lower numbers of stonefly species and individuals were apparent in the upper stations but appeared to slightly recover further downstream (Figure 3). Since 1980-1981 however, the percentages of stoneflies have declined by 40% with the greatest losses at stations nearest WGD. During the four sampling periods from September 1980 to late-August 1981 (prior to the dam construction), stoneflies were often the dominant order and the greatest contributor to total invertebrate biomass (Erickson 1983).

Pteronarcys californica (the giant stonefly) - The stonefly most noticeably absent from the upper stations in the benthic samples for both spring and fall 2010, was the salmonfly or giant stonefly, *Pteronarcys californica (Pc)*. Erickson (1983) provided a detailed, longitudinal assessment of biomass and density of *Pc* larvae in the 1980-1981 study, highlighting the critical ecological role of this species and its importance for measuring stream health. Examination of the relative abundance of *Pc* nymphs in Appendix Tables A.2 (spring 2010) and A.8 (fall 2010) reveals that this species was present in benthic samples at all sites upstream of WGD. Those sampling sites include the Fraser River at Kaibab Park (FRRKBP), Fraser River at Solvista (FRRSOL), and even in Willow Creek (WLOCRK) approximately 1 km upstream of the confluence with Cabin Creek. It is especially noteworthy that *Pc* nymphs and larvae of a closely related stonefly *Pteronarcella badia* did not occur in the benthic samples in the spring or fall 2010 at sites WG11 and WG12, the two sampling locations that are nearest WGD (see Table 2 for the approximate downstream distance). Moreover, WG12 was the one site during the 1980-1981 study that consistently had the highest densities of *Pc* larvae (Erickson 1983) as can be seen in Figures 3, 5 and 6 in the Appendix).

Percent density in m^2 of *Pteronarcys californica* (*Pc*) larvae in 2010 plotted longitudinally by station (Figure 4, Appendix tables A2 and A8) varied throughout the study reach. No *Pc* larvae were found in any of the replicate benthic samples collected at WG 11 or WG12 during either the spring or fall surveys in 2010. It was at WG12 where they were most abundant in 1980-1981. All stations below WG12 had detectable percentages of *Pc* larvae, although some of them were at extremely low levels. The only station with an increase in *Pc*

larvae in 2010 compared to the 1980-1981 study was WG13 in the September 2010 collection (Figure 5). The Pumphouse station, the furthest station from WGD, had the largest percent *Pc* in 2010 and Gunnison River station had the second (Figure 4). Both of these reaches of river experience large, sustained flushing flows in all average and above average water years (see Table 6). All other stations (HWY 40 Bridge, WG21, Skylark, WG31 and WG32) had low to extremely low percentages of *Pc* in 2010. *Pc* larvae were present at all sampling sites (WLO, SOL and FRKBP) above WGD on the Fraser River and Willow Creek in the fall of 2010 (see Appendix Tables A2 and A8 for details on the data).

It is important to understand that even though stonefly larvae and in particular *Pc* larvae do not comprise a great amount of the total benthos sample (when expressed numerically or as a percentage of the total benthos), physically they are the largest aquatic insect larvae by weight and/or volume, and therefore often comprise the majority of the aquatic insect biomass. This phenomenon was most evident in the 1980-1981 study (Erickson 1983). Across all four sampling periods in that study, stonefly larvae comprised between 2.5% and 21.7% of the EPT and Diptera (D) invertebrate density at the seven WG sampling stations. However, stonefly larvae comprised an average of 42.7% of the total EPT&D biomass (g/m^2) across all sampling sites and dates. Among the five stations between WGD and the confluence with Troublesome Creek, the contribution of stonefly larvae to the EPT&D biomass ranged from a 37.2% to 67.3% and averaged 50.1% (see Table 3.5-2 on page 3.5-35 in Erickson 1983 for details).

Pc larvae often contributed more than 50% to the total wet weight biomass (g/m^2) of all aquatic invertebrate organisms in the 1980-1981 study. This was particularly true at sampling site WG12 approximately 3 km (2 miles) downstream from WGD (See Figures 3.5-48 through 3.5-55 in Erickson 1983). At WG12, *Pc* larvae comprised 34 to 37 g/m^2 wet weight biomass on three of four sampling occasions, while total wet weight biomass ranged between 45 and 50 g/m^2. (See Figures 3.5-48 through 3.5-51 in Erickson 1983 for details). In a separate study *Pc* larval densities at a collection site below the Byers Canyon Bridge west of Hot Sulphur Springs (synonymous with WG 13 in the Erickson study), Anderson et al. (1984) demonstrated that *Pc* larval densities in May 1983 (prior to adult emergence) ranged up to 1,040/m^2 and accounted for 94% of the total dry weight invertebrate biomass. Dry weight biomass for *Pc* larvae was 35.3 g/m^2 while total dry weight invertebrate biomass was 37.4 g/m^2. Thirty years later the contribution of the giant stonefly to the total benthic invertebrate density or biomass at sampling sites WG11 and WG 12 are below detectible levels (see Figures 4,5,6,7 and 8 in the Appendix of this report).

The m^2 density of *Pc* larvae exhibit an overall loss from 1980-1981 to 2010 (Figure 5). They were completely eliminated at WG11 and WG12, the two stations closest to WG. All other stations, WG21, WG22 and WG32, saw a reduction in the number of *Pc* larvae since 1980-1981 except WG13. Not until 10 miles downstream of WGD at WG 13, was there an increase of individuals from 1980-1981 to 2010. It is important to point out that the density of all benthic macroinvertebrates in 2010 was much higher than in 1980-1981 (Average density of WG stations 1980-1981 = 4,568; average density of WG stations from 2010 = 9,917). With this in mind, the decrease in *Pc* larvae numbers is largely understated when considering numbers of individuals. The decrease in *Pc* larvae (and therefore adults) has a much larger corresponding ecological impact.

We also analyzed the percent *Pc* of all benthic density. Figure 6 compares the percent *Pc* by season for the WG stations in 1980-1981 and 2010. *Pc* percentages are reduced in both seasons at all stations in 2010 except for WG13 (0.06% in spring 2010 from 0.00% in spring 1981 and 2.35% in spring 2010 from 2.03% in spring 1980-1981). Two stations increased in *Pc* percentage in just one season, station WG22 increased from 0.04% to 0.37% in spring and WG31 from 0.00% to 0.05% at station in fall, but spring and fall combined there was an overall loss at those stations. Percentages of *Pc* at stations WG11 and WG12 are reduced to 0.00%. This is especially significant at station WG12 because historically this station had the highest percentage of all stations.

Spring and fall percentages of *Pc* larvae were averaged together by year and station to approximate the overall trend of *Pc* from 1980-1981 to 2010 (Figure 7). The populations appear to follow a similar trend from 1980-1981 to 2010, except at WG11 and WG12 where they were below detectible levels in the benthic samples. This trend clearly shows a common stressor that has negatively impacted *Pc* larvae populations throughout the entire reach of the Colorado River from WGD to the confluence with the Blue River. High quality habitat in 1980-1981 at WG11, WG12, and WG22 experienced 100% and 67% losses and at apparent marginal habitat (WG21 and WG31), small populations were nearly extirpated (Figure 8). Station WG31 was the only station to increase in *Pc* (+0.02%). WG13 had the smallest decrease in percent *Pc* (-11.03%). All other stations experienced more drastic decreases in percent of *Pc,* from -67.07% to -100.00% (Figure 8).

During May and June 2010 and again in June 2011, we collected and counted cast exoskeletons of emergent *Pc* adults at 10 locations on the Colorado River beginning 100 m upstream of the Grand County Road 57/578 Bridge (also known as the Hitching Post Bridge)

downstream to the BLM Boat Launch recreation site downstream of Gore Canyon, and at two or three locations on the Fraser River upstream of WGD. For comparative purposes, we also collected and counted exoskeletons of emergent *Pc* adults at two sites on the Gunnison River in June 2010, and at 15 sites throughout a 30 km reach of the Rio Grande in SW Colorado during June 2011. At each location, cast exoskeletons were collected and counted along two - 30.5 meter (100 foot) reaches of bank at the riffle areas where the benthic invertebrate samples were collected in April 2010. Results of this portion of the study are summarized in Table 4. The data are arranged in an upstream to downstream manner. Moderate numbers of *Pc* exoskeletons were seen at two of three sampling sites on the Fraser River upstream of WGD. It is noteworthy that among the sampling sites where the substrate type was considered "prime" (cobble and boulder substrates), the fewest *Pc* exoskeletons were found at the two sites (new WG11 and WG12) which are in closest proximity to WGD. Moreover, it was at site WG12 where the density of *Pc* larvae was consistently the highest among all seven sampling sites during the 1980-1981 study (Erickson 1983).

The numbers of exoskeletons of emergent *Pc* adults counted at all sampling sites on the Colorado River in 2011 stayed approximately the same or increased substantially compared to 2010 except for the first 3 sample sites downstream of WGD (new WG11, WG12 and Hwy 40 Bridge. At these three sites the numbers of *Pc* exoskeletons declined more than 90% in 2011 compared to 2010. In contrast, the number of *Pc* exoskeletons counted on the Fraser River in June 2011 increased by 355% and1,270% (compared to June 2010) at the Kaibab Park and Solvista sites, respectively. (See Table 4 and Figure 14 in the Appendix for details.)

There were only three sampling sites where the substrate type was considered poor, Erickson's WG32, the new WG32 and WG31. All three sites are downstream of the Troublesome Creek confluence and receive large amounts of sand and silt input due to the highly erosive nature of the drainage. Not surprisingly, very few *Pc* exoskeletons were present at these sites (Table 4).

Among the sampling areas where the substrate type was considered prime habitat for *Pc* larvae, it is noteworthy that the highest exoskeleton counts were at the BLM Pumphouse Launch area and the Gunnison River at Ute Park. In average and above average water years, both of these stream reaches experience flushing flows ranging from 1,000 to 8,000 ft^3/s. These discharges often extend over several weeks each year (see Table 6 below).

At a given sampling site, *Pc* larval emergence was always completed within three to four days after it began. *Pc* larvae begin migration out of the water at dusk, crawl onto surrounding vegetation or debris, such as rocks or wood, lock their legs onto the surface, and split down the dorsal midline beginning in the thoracic area. The adult extracts its body from the exoskeleton by pushing and flexing upward and outward. The wings emerge first (and begin drying immediately) then the head, and finally the abdomen. The entire process is usually accomplished

Table 4. Population estimates of *Pteronarcys californica* nymphal exuviae (exoskeletons) per 30.5 m or 100 feet of stream channel along one bank within prime riffle habitat at various sampling sites on the Colorado River during late May and early June 2010 and 2011 compared with sampling sites on the Gunnison River downstream of Blue Mesa, Morrow Point and Crystal dams (2010) and the Rio Grande between Creede and South Fork, Colorado in June 2011.

Date	Site Description/≈ Distance in miles from Windy Gap Dam (WGD)	N	2010 Ave.	Range	2011
06/10	Fraser River on Solvista Ranch 5 mi.↑ WGD - prime habitat	2	122.5	46 – 199	1,689
06/10	Fraser River @ Granby ballpark 4 mi.↑ WGD - prime habitat	2	199	168 – 230	706
06/10	Fraser R. @ Hackstaff Ranch ≈ 1 mi. ↑ WGD - moderate habitat	2	19.5	4 – 35	-----
06/10	New WG 11 ≈ 0.9 mi. ↓ WGD - prime habitat	2	25	17 – 33	2
06/10	Erickson's WG 12 ≈ 2 mi. ↓ WGD- prime habitat	2	27.5	25 – 30	1
06/10	Hwy 40 Bridge E. of Hot Sulphur Springs ≈ 5.0 mi. ↓WGD - prime	1	280	270	26
06/10	Erickson WG 13; ↓ Byers Canyon Bridge ≈ 10.2 mi↓ WGD – prime	2	992	797 – 1,186	2,134
06/10	Erickson's WG 21≈ 18.5 mi.↓WGD –prime habitat	2	352	343 – 361	252
06/10	Erickson's WG 22≈ 21.7 mi.↓WGD – prime habitat	2	129	69 - 188	302
06/10	Erickson's WG 31 ≈ 22.7 mi.↓WGD - sediment laden poor habitat	2	1	0 – 2	187
06/10	New WG 32 ≈ 27.5 mi.↓WGD - sediment laden poor habitat	2	2	0 – 4	19
06/10	Erickson's WG 32 ≈ 28.9 mi.↓WGD –sediment laden poor habitat	2	0	0	0
06/10	Pumphouse Area in Gore Canyon ≈ 41 mi.↓WGD – prime habitat	2	5,514	4,195 - 6,833	6,225
06/10	Gunnison River Gorge in Ute Park – prime habitat	2	3,500	2,400 – 4,600	-----
06/11	Rio Grande between Creede and South Fork, CO	15	690.2	101 – 2,242	690.2

within 10-15 minutes. At all sampling sites upstream of the Blue River confluence, each exoskeleton sampling location was visited at least four times over a four to seven day period, beginning at or prior to the beginning of emergence, and continued until emergence was complete, as determined by the absence of additional exoskeletons. All exoskeletons were tabulated when collected with a hand-held counting device, collected and stored in a ziplock bag to insure that no double-counting of exoskeletons occurred at any location. At those sampling

sites where larval densities were low to moderate, we separated exoskeletons by sex and were able to determine that on the first night male *Pc* larvae account for 75-100% of the emergence. The second night the male to female sex ratio usually ranged from 60:40 to 50:50. The third night the ratio was usually 25:75 to 40:60, and the forth night the female larvae accounted for 75-100% of the emergence. Peak emergence invariably occurred on the second or third evenings. The phenomenon of male *Pc* larvae emergence preceding the females by a day or two is congruent with the findings of Richards et al. 2000, on the Madison River in Montana.

Male *Pc* larvae are substantially smaller than female larvae. The results of length-frequency measurements of pre-emergent male and female larvae in April 1987 and July 1987, one month after emergence of the adults indicated that the body length of last instar female larvae ranged from 36 mm to 50 mm, while last instar male larvae ranged from approximately 33 mm to 40 mm in length (see Appendix Figures 2, 3, 4 and 5 in Nehring 1987). Standardization of densities of pre-emergent *Pc* larvae from the April 2010 benthic invertebrate samples and the *Pc* exoskeleton counts to numbers per m^2 afforded a statistical correlation to see if there was a significant relationship between the two independent measures. The correlation coefficient (r) was 0.9505 with 23 observations, a highly significant relationship.

Two doctoral research studies in the last half of the 20th century (Knight 1965, Poole 1981) suggested that *Pteronarcys californica* most likely had a three-year life cycle. However, subsequent studies of the population dynamics of the giant stonefly on the Colorado River that began in 1982 and continued into 1989 concluded that this species had a four-year life cycle after the eggs had gone through a diapause phase of 90 days or more prior to hatching (Nehring 1987). Body length measurements made on every male and female *Pc* larvae collected on the Colorado River in 2010 summarized in length-frequency distribution graphs support that conclusion (see Figures 9A, 9B, 10A and 10B in the Appendix, as well as Figures 2,3 and 4 in Nehring 1987). Our determination of a four-year life cycle is congruent with the findings of Dewalt and Stewart (1995) and Townsend and Pratt (1998).

Other stoneflies - During the 1980-1981 study, *Pteronarcella badia (Pd)* larvae were common in the collections at the first five sampling sites below WGD (WG11, WG12, WG13, WG21 and WG22) upstream of the confluence with Troublesome Creek. They were rarely collected during the 2010 field season and were not observed at all in the fall 2010 samples in Reach One between WGD and the confluence with the Williams Fork River. It is especially noteworthy that *Pd* larvae were very abundant in all three replicates collected in Willow Creek upstream of Willow Creek Reservoir in September 2010. The estimated density of *Pd* larvae at

the Willow Creek site was 117/m^2 compared to only one and 3/m^2 at two of five WG sites between WGD and the confluence with Troublesome Creek (see Appendix Tables A2 and A8 for details).

Total stonefly (Plecoptera) densities in Reach One (WG11, WG12 and WG13) of the Colorado River tended to be lower in 2010, compared to the levels observed in 1980-1981 (Figure 3). In river reaches two and three, the densities were higher in 2010 compared to 1980-1981. At sample sites WG22 and WG 32 the densities in 2010 were much higher, primarily due to very high numbers of three taxa belonging to the families Chloroperlidae and Perlodidae (*Swallia* sp., *Cultus aestivalis* and *Isoperla* sp.). Detailed comparisons of the relative abundance of stonefly larvae can be reviewed in Appendix Table A2 and A8.

Mayfly larvae – Detailed estimates of density and relative abundance of the order Ephemeroptera (mayflies) can be reviewed in Appendix Tables A1 and A7. Those data are summarized graphically in Figure 11 in the Appendix. The percentage of mayfly larvae in the benthic samples in 2010 were substantially higher in Reach One of the Colorado River in 2010 compared to 1980-1981. The differences between the two sampling periods (1980-81 vs 2010) decreased in river reaches two and three (Figure 11 in the Appendix). However, the increased numerical density in 2010 was the result of a high abundance of four taxa of Ephemeroptera (*Baetis* sp., *Ephemerella dorothea infrequens, Rithrogenia* sp., and *Paraleptophlebia* sp.). Larger ephemeropteran species that were much less numerous or totally absent throughout most or all of the WG study sites in 2010 that were common and abundant in the 1980-1981 study include *Drunella grandis, Drunella doddsi,* and *Baetis tricaudatus.*

Caddisfly larvae - Detailed estimates of density and relative abundance of the order Trichoptera (caddisflies) can be reviewed in Appendix Tables A3 and A9. Those data are summarized graphically in Figure 12 in the Appendix. Tricopteran taxa that were dominant in the 2010 collections included *Brachycentrus* sp., *Glossosoma* sp., *Hydropsyche* sp., and *Lepidostoma* sp. Species that were present and/or abundant at Reach One study sites WG11 and WG12 for most or all of the 1980-1981 period but greatly diminished in number or totally absent at these two sites nearest WGD in 2010 include *Psychomia flavida,* and the large free-living taxa *Arctopsyche* sp. and *Cheumatopsyche* sp.

True flies (Diptera) larvae – The densities and relative abundance of dipteran larvae were higher at all WG sampling sites in 2010 compared to the 1980-1981 study. Two families (Simuliidae and Chironomidae) comprised more than 90% of the density for this order of insects

at virtually all sampling sites for both seasons in 2010. Both of the families have numerous taxa that go through several life cycles each year and are known to thrive in altered aquatic ecosystems. Detailed estimates of density and relative abundance of the order Diptera (true flies) can be reviewed in Appendix Tables A4 and A10.

Beetle (Coleoptera) larvae – two taxa (*Zaitzevia parvula* and *Optioservus* sp.) dominated the collections for the order Coleoptera at all WG study sites in 2010. Detailed estimates of density and relative abundance of the beetle larvae can be reviewed in Appendix Tables A5 and A11.

Other Macroinvertebrate fauna - Detailed estimates of density and relative abundance of non-insect invertebrate fauna encountered during the collections of 2010 can be reviewed in Appendix Tables A6 and A12. These taxa included scuds (Amphipoda), sow bugs (Isopoda), dragonfly larvae (Odonata), mollusks (Bivalvia), zooplankton (Cladocera), leeches (Hirudinea), aquatic worms (Oligochaeta), snails (Gastropoda), nematodes (Nematoda), springtails (Collembola), and flatworms (Turbellaria).

Impact(s) of Altered Discharge on Stream Ecosystems – In this study, the greatest numbers of aquatic insect taxa were present at the study sites upstream of WGD on the Fraser River and Willow Creek (upstream of Willow Creek Reservoir). Among the study sites downstream of WGD, it is especially noteworthy that the station closest to the dam (WG11) displayed the lowest diversity of total taxa. In contrast, station WG21 in Reach Two displayed the highest diversity. This site is downstream of the confluence with the Williams Fork River, where discharge levels are greater due to water releases from Williams Fork Reservoir during the summer and early fall months, particularly during average and below average water years. However, sampling sites upstream of WGD on Willow Creek (upstream of Willow Creek Reservoir) and on the Fraser River exhibited the most diverse macroinvertebrate fauna, harboring 29 taxa not found in stations downstream from WGD in 2010. Willow Creek had the highest number of taxa with 53. Nine taxa were unique to that station. Willow Creek at this site is a free-flowing stream, unimpacted by water storage or diversions. This pattern of decreasing diversity of aquatic insect taxa downstream of impoundments is not uncommon (Vinson 2001; Ward and Short 1978; Ward 1976a,b).

A review of the stream discharge patterns for the Colorado River downstream of WGD from 1977 through 2010 (utilizing mean daily discharge data from the two stream gages below WGD and at Hot Sulphur Springs) is informative. That data is summarized in Table 5. It is

evident that there has been a very large decline in the occurrence, amplitude and duration of true flushing flows since diversions of water at WGD began to occur in the mid to late 1980s. This pattern has been the most evident since the year 2000. Landowners and local fly fishermen with an intimate knowledge of the river since the early 1970s began to notice substantial declines in abundance of the adult giant stonefly *Pteronarcys californica* and larger adult mayflies like the green drake *Drunella grandis* during the past ten years.

As indicated earlier in this report, the greatest densities of *Pc* larvae and emergent adults in the upper Colorado River basin were present in the reach of river below the Blue River confluence near Kremmling, at the BLM Pumphouse boat launch access point. Similar densities of *Pc* larvae and emergent adults were found on the Gunnison River in the Gunnison River Gorge, downstream of the Aspinall or Curecanti Unit of the Colorado River Storage Project, with three mainstem impoundments with a total storage capacity > 1 million AF. Finally, densities of both *Pc* larvae (in the spring and fall benthic samples) and emergent adults (in the riparian surveys in June) were substantially higher on the Fraser River at the survey sites at Kaibab Park and Solvista compared to sampling sites WG11 and WG12, the two sites closest to WGD (see Table 4 above and Appendix Tables A2 and A8).

A summary of the discharge records for the Fraser River at Granby, the Colorado River downstream of the Blue River confluence near Kremmling (upstream of the BLM Pumphouse boat launch sampling sites) and the Gunnison River in the Gunnison River Gorge are shown in Table 6. There is a marked increase in the number of days, amplitudes and duration of flushing flows $\geq$ 1,000, 2,000, 3,000 and 4,000 ft^3/s for the Colorado River below Blue River confluence and in the Gunnison Gorge in comparison to that experienced by the Colorado River in Reach One, downstream of WGD. As alluded to earlier, the average width of the Gunnison River at the sampling site in the GRG is only 10-20% greater than that of the Colorado River at sampling sites WG11 and WG12. There have been only 2 days when the discharge of the Colorado River at WGD exceeded 2,000 ft^3/s for the water years 1998 through 2010. In contrast, discharges in the Gunnison River at Ute Park have exceeded 2,000 ft^3/s 182 days for the water years 1999 through 2010. The last time the Colorado River below WGD experienced discharges exceeding 3,000 or 4,000 ft^3/s was in 1997 (Table 5). There have been none since then through the 2010 water year. In contrast, the Gunnison River at Ute Park has experienced flows exceeding 3,000 and 4,000 ft^3/s for 151 days and 27 days, respectively (Table 6). Similar discharge scenarios are obvious for the Colorado River below the Blue River confluence. It is possible that the amplitude and duration of scouring flushing flows are related to the densities and relative

abundance of *Pc* larvae and emergent adults at these two locations compared to sites WG11 and WG12.

Table 5. Number of days when the average daily discharge at the Windy Gap or Hot Sulphur Springs gage were equal to or exceeded various flows, for the water years from 1977 through 2010. Three dashed lines in the≥ 500 ft^3/s column indicate none were counted since in those years there were days when the average daily discharge was ≥ 1,000 ft^3/s.

Water Year	≥ 1,000 ft^3/s	≥2,000 ft^3/s	≥3,000 ft^3/s	≥4,000 ft^3/s	≥ 500 ft^3/s
1977	0	0	0	0	0
1978	7	0	0	0	---
1979	19	0	0	0	---
1980	14	0	0	0	---
1981	0	0	0	0	---
1982	0	0	0	0	---
1983	61	28	6	2	---
1984	76	53	28	7	---
1985	11	0	0	0	---
1986	53	0	0	0	---
1987	1	0	0	0	---
1988	2	0	0	0	---
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	18
1992	0	0	0	0	0
1993	21	0	0	0	---
1994	0	0	0	0	12
1995	49	4	0	0	---
1996	62	17	3	0	---
1997	56	31	10	7	---
1998	4	0	0	0	---
1999	33	0	0	0	---
2000	13	1	0	0	57
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	5	0	0	0	10
2004	0	0	0	0	0
2005	0	0	0	0	17
2006	0	0	0	0	7
2007	0	0	0	0	15
2008	5	0	0	0	50
2009	9	0	0	0	67
2010	25	1	0	0	46

Perhaps the most valid comparisons that can be made are for the stream discharge data for the Fraser River at Granby and the Colorado River below WGD. At first glance there does not appear to be a great deal of difference in the occurrence and amplitude of flushing flows between these two gaging stations. However, it is important to understand that the average

channel width at the Kaibab Park sampling station on the Fraser River is only 10.2 m (33.4 feet) compared to 27.9 m (91.6 feet) at WG11 (Hitching Post Bridge) below WGD. Therefore, the stream power available for effective sediment transport and flushing flows at the Kaibab Park station on the Fraser River is considerably greater. It is possible that this could contribute to the somewhat higher densities and relative abundance of *Pc* larvae and emergent adults at this site relative to WG11 and WG12 below WGD (as shown in Table 4 in the text and Appendix Tables A2 and A8).

There are other complicating factors that can have serious long-term negative consequences for the proper biotic functioning and ecological integrity of stream ecosystems that result from mainstem impoundments, especially when diversions of substantial amounts of water are involved with Granby, Willow Creek and Windy Gap reservoirs. These complicating factors include 1) loss of channel connectivity, 2) elevated water temperatures, 3) fine sediment deposition and transport, and 4) rooted aquatic vegetation.

Loss of Channel Connectivity - Windy Gap Reservoir (WGR) has been a mainstem impoundment on the Colorado River at Granby since the early 1980s. Since it came on line, movement of fish species up and down the river has been interrupted. It has also interrupted downstream drift of aquatic insect larvae that is a critical function of free-flowing streams for maintenance of the biological integrity of the stream benthos community (Townsend and Hildrew 1976). Numerous adult aquatic insects often fly upstream from the point of emergence and lay their eggs. Once hatched, aquatic insect larvae drift downstream during the night. Nocturnal drift is especially heavy during the dark phases of the lunar cycle, from the last quarter through the new moon and onto the first quarter. Nocturnal drift of benthic invertebrates in streams is critically important in maintaining the greatest diversity of aquatic invertebrate fauna in stream ecosystems.

The elimination of downstream invertebrate drift from the Fraser and Colorado rivers above WGD for the past 25 years has undoubtedly played a major role in the reductions or loss of 22 species of mayfly, stonefly and caddis fly that were either not found or have declined substantially in abundance since the 1980-1981 study. In 1980-1981, the giant stonefly, *Pteronarcys californica*, was found in greatest abundance at the sampling site less than 2 miles downstream from Windy Gap. Our 2010 studies demonstrate that it is almost gone from the river between Windy Gap and Hot Sulphur Springs. Two species of large mayflies that occurred at all seven sampling sites in 1980-1981 no longer occur upstream of the confluence with the Williams Fork River near Parshall. One of those species was not found at any of the seven

sampling sites on the river between Windy Gap and Kremmling. However, all three species still occur in the Fraser River upstream of Windy Gap and in Willow Creek upstream of Willow Creek Reservoir.

Table 6. Number of days when the average daily discharge at the Fraser River at Granby, the Colorado River below Kremmling and the Gunnison River at Ute Park were equal to or exceeded various flows, for the water years from 1999 through 2010. Three dashed lines in the ≥ 500 ft^3/s column indicate none were counted since in those years there were days when the average daily discharge was ≥ 1,000 ft^3/s.

Water Year	≥ 1,000 ft^3/s	≥2,000 ft^3/s	≥3,000 ft^3/s	≥4,000 ft^3/s	≥ 500 ft^3/s
Fraser River at Granby above Windy Gap Reservoir					
2000	0	0	0	0	9
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	5	0	0	0	23
2004	0	0	0	0	0
2005	0	0	0	0	17
2006	0	0	0	0	4
2007	0	0	0	0	19
2008	4	0	0	0	49
2009	0	0	0	0	63
2010	11	0	0	0	30
Colorado River @ Kremmling below the Blue River confluence					
2000	174	19	1	0	----
2001	54	0	0	0	----
2002	0	0	0	0	160
2003	29	4	0	0	----
2004	18	0	0	0	----
2005	68	8	0	0	----
2006	109	5	0	0	----
2007	78	22	5	1	----
2008	156	68	25	16	----
2009	181	71	45	11	----
2010	136	35	21	11	----
Gunnison River at Ute Park					
1999	107	21	0	0	----
2000	145	14	70	3	---
2001	7	1	0	0	365
2002	0	0	0	0	250
2003	5	0	0	0	88
2004	1	0	0	0	82
2005	96	0	0	0	----
2006	99	0	0	0	----
2007	112	0	0	0	----
2008	318	82	56	17	----
2009	126	55	20	6	----
2010	13	9	5	1	----

Elevated Water Temperatures – Any time water is impounded and held in a lake or a reservoir, solar radiation will heat the water. In shallow impoundments such as WGR heating is faster than in large deep lakes. In late summer, at a time when the Colorado River flows are at the seasonal low and the stream water temperatures are already high, the risks to aquatic fauna are the greatest. Water temperatures have been monitored periodically for extended periods of time at numerous locations throughout the Colorado River basin in Grand County from 1980 into the early part of the 21st century. Those records indicate that daytime water temperatures can range from 20 the 25 °C, particularly during the late summer months during periods of drought (Nehring and Thompson 2001, 2003).

Townsend and Pritchard (2000) conducted extensive tests of the embryonic development and hatching success of eggs of *Pteronarcys californica* in laboratory exposures over a wide range of temperatures and with eggs placed in the Crows Nest River, Alberta, Canada. The results of those studies indicated the greatest hatching success, ranging from 50% to 75%, occurred at 15.0 – 17.5 °C. At temperatures < 10 °C and ≥ 20 °C, hatching success declined exponentially. At an incubation temperature of 20 °C, the percent hatch was only 25.1% and 29% in two tests, and dropped to 4.5% and 12% after 261 days of exposure at a temperature of 22.5°C. Similarly, for *Pc* eggs incubated at temperatures of 5.0 and 7.5 °C, the percent hatch was 0.9% and 6.7%, respectively. In the high temperature exposures of 20°C and 22.5°C, first egg hatch occurred at days 194 and 200, respectively. At the low incubation temperatures of 5.0 and 7.5 °C, first hatch of *Pc* eggs occurred at day 526 and 757, respectively. These results indicate that the life stage from oviposition to egg hatching for *Pteronarcys californica* has a very narrow thermal window for optimum hatching success. That is the most likely explanation why this species does not reproduce successfully in the tailrace regions immediately downstream of large, deep, bottom-release dams (Vinson 2001). It also indicates that elevated water temperatures, especially during times of drought or anthropogenic reductions in stream discharge will result in dramatic reductions in egg hatching success for *Pc* eggs (Stagliano 2011).

Fine Sediment Deposition and Transport – Sediment deposition and armoring of the Colorado River below Windy Gap Dam has been greatly exacerbated over the past 10-20 years, due to extended droughts, impoundment and storage of spring flushing flows in Willow Creek and Granby Reservoirs, and depletions from transmountain diversions through the Moffat Tunnel and Alva B. Adams Tunnel at Grand Lake. At least twice since 2001, Windy Gap Dam has been drained and untold tons of sediment has been flushed into the Colorado River in mid to late summer, long after spring flushing flows were available to transport the sediment downstream. These sediments settle out in the largest amounts in the first few miles of river below the channel

for two reasons. The Colorado River channel is over width by approximately 50% due to the withdrawals of flow upstream in the Colorado and Fraser River basins and therefore the stream power (to transport sediment) has been adversely impacted. Sediment deposition clogs the interstitial spaces between and beneath the rocks and cobbles in the riffle areas, setting up a series of cascading negative impacts on the stream ecosystem. Riffle areas are critical to maintenance of the biotic integrity of the stream on a number of levels. They are the primary zones of aquatic insect production. Aquatic insects are the primary source of food for foraging fish. Sediment accumulation among the gravel, cobble and boulder substrates leads to armoring of the stream channel, dramatically reducing the carrying capacity of the stream for benthic invertebrates and aquatic insects that do not tolerate sediment accumulation. Over time, invertebrate species diversity declines and the overall biotic integrity of the stream is reduced.

Richards et al. (2000) found that the number of emergent adult *Pteronarcys californica* stoneflies were negatively correlated with the percent embeddedness of the substrate at 11 study sites over consecutive years in the Madison River in Montana ($r = -0.70$ and $P = 0.02$ for 1994; $r = -0.62$ and $P = 0.04$ for 1995). Stagliano (2011) concluded that elevated water temperatures, loss of habitat due to sedimentation and lack of flushing flows were the overarching factors implicated in the demise of the *Pteronarcys californica* population in the Smith River in Montana.

In contrast, it is noteworthy that a stream in western Colorado that experiences massive inputs of sediment annually during the spring run-off has continued to sustain populations of both *Pteronarcys californica* and *Pteronarcella badia* for more 35 years (1977 through 2010). The North Fork of the Gunnison River downstream of Paonia Reservoir right in the town of Somerset, Colorado (a center of major coal-mining activity) harbors a good population of both species (Nehring, unpublished data). Paonia Reservoir is substantially larger than WGR and it has received and trapped so much sediment over the past half century from West Muddy Creek, that much of the storage capacity of the reservoir has been lost. The question arises, *How can these two species of stoneflies continue to exist and apparently thrive in such an unfavorable environment*? The obvious difference is that all of the water flowing into Paonia Reservoir is stored only temporarily, for delivery downstream during the summer months for agricultural and municipal needs. However, during the spring snow melt and run-off, the reservoir fills and spills, and no water is diverted out of the stream channel until it has flowed past Somerset. Therefore, the stream power of the North Fork of the Gunnison River is not impacted by water storage and/or out of channel diversions during the period when the greatest amounts of sediment are mobilized and carried downstream. The North Fork of the Gunnison River is "exercised" annually by the normal spring snowmelt and run-off from the Grand Mesa, the Raggeds

Mountains, and the West Elk Wilderness area. Once the run-off is over, the continuing chronic input of sediment from West Muddy Creek settles out in the upstream end of Paonia Reservoir, and the sediment content of the outflow is low enough that these two species of stoneflies continue to exist. The same situation applies (in part) for the Colorado River in the Gore Canyon west of Kremmling, where an incredibly dense population of *Pteronarcys californica* thrives in the face of considerable sediment input. Yet, like the North Fork of the Gunnison River, the sediment input from Muddy Creek and other smaller erosive tributary streams remains mobilized by high levels of flushing flows on an annual basis.

Rooted Aquatic Vegetation – Over the past 10-20 years there has been an amazing expansion of aquatic vegetation mats in the Colorado River. That problem has been especially problematic between WGR and the confluence with the Williams Fork River at Parshall, Colorado. Due to the shallow nature of WGR, rooted aquatic vegetation quickly invaded and colonized all parts of the lake soon after construction was completed. Rich fertile soils, warm water temperatures and extensive sunlight provided optimum growing conditions for rooted aquatic macrophytes in WGR. These aquatic plants fragment throughout the summer months, flow out of WGR and settle out in the slower moving parts of the river. Once established they continue to grow in size and number over the decades, slowing the flow of water, trapping fine sediments and particulate organics that provide a nutrient base and substrate for growth and expansion of the vegetation mat. These can be seen everywhere on the river between WGR and the confluence with the Blue River. The problem is greatest between WGR and the confluence with the Williams Fork River. These vegetation mats also choke out the interstitial spaces in the cobble-strewn habitats throughout the river that are critical microhabitats for aquatic invertebrates, especially those species of aquatic insects that require sediment-free, cobble-rubble substrates.

Vegetation mats become increasingly difficult to dislodge or remove when true flushing flows have become all but a thing of the past as flow depletions have increased, particularly during the spring flush period. As an example, the Gunnison River in western Colorado, downstream of Black Canyon National Park (BCNP) is only about 10%-20% wider than the average channel width of the Colorado River in Reach One below WGR. The Gunnison River Gorge receives large sediment inputs during the summer months from side canyon flash floods that result from summer thunderstorms. These large inputs of sediment led to development of huge sediment laden vegetation mats during periods of extended drought. However, these vegetation mats and massive amounts of sediment have been largely eliminated from long sections of the Gunnison River Gorge by flushing flows$\geq$ 3,000 ft^3/s that are sustained for 2-4

weeks in many years, with peak flows ranging from 6,000 – 8,000 ft^3/s. The Gunnison River Gorge, only 10%-20% wider than the Colorado River below WGR rarely experiences flows below 300 cfs, due to minimum flow agreements. It is noteworthy that the Gunnison River downstream of BCNP has outstanding populations of the giant stonefly and sculpins, both of which coexist with perhaps the best stream trout sport fishery in Colorado. Predatory brown trout ≥ 500 mm in length occur throughout the Gunnison River and coexist in sympatry with sculpins and *Pteronarcys californica.*

CONCLUSIONS

Dave Stagliano (2011), an aquatic ecologist in Montana, published an article in the May-June 2011 issue of Montana Outdoors titled *Searching for Salmonflies: Scouring River Records for Data on Montana's Biggest Trout Bugs.* The article summarized the results of a year-long study to determine whether or not the numbers and populations of the salmonfly *Pteronarcys californica* in streams across Montana were in decline. The results were mixed and varied from stream to stream. Some populations seemed to be stable, some decreasing, some extirpated from long reaches of some rivers, and rarely, one was thought to be increasing. For those streams in Montana where populations of the salmonfly were in decline or extirpated, Stagliano concluded that elevated water temperatures and loss of habitat due to sedimentation and lack of flushing flows were the overarching factors implicated. The Smith River, a famous trout stream in SW Montana, historically had a large salmonfly hatch up into the early 1990s. However, between 1993 (when a large emergence occurred) and 1997, the population went into rapid decline. The salmonfly hatches on this river have been almost non-existent since 1997 according to one river guide who "*has been quantitatively sampling salmonfly larvae populations*" since 1991, according to Stagliano. In his article Stagliano states that his own *"anecdotal observations of the river's increased silt and water temperatures support his findings"*. The Smith River, approximately 160 km (100 miles) in length from the headwaters to the confluence with the Missouri River, is heavily diverted for irrigation and flows decline rapidly as the run-off from snowmelt decreases and diversions increase, rendering the river too wide and shallow for float fishing from a raft after mid-June in most years.

After studying the *Pteronarcys californica* population in the upper Colorado River in Middle Park throughout most of the 1980s, Nehring (1987) concluded (in part) the following: " *If Pteronarcys californica is to succumb to man-induced environmental stresses (that rudimentary populations of salmonids might withstand) it would probably be in the arena of pesticide*

pollution, heavy metal pollution such as cadmium (Colburn 1985), or loss of interstitial spaces among the boulder-cobble substrates to excessive silt accumulation. Loss of this critical portion of microhabitat through siltation probably poses the greatest threat to survival of this species in the upper Colorado River. The Windy Gap Project is just one more incremental assault on riverine aquatic habitats in the upper Colorado River basin that have been going on in Colorado for more than half a century. And it certainly will not be the last. ... According to Ward (1984) the annual flow of the Colorado River was reduced 91% with the construction of Lake Granby. Without the annual spring run-off, silt rapidly choked and forever altered the stream habitat and benthic fauna of the Colorado River below Lake Granby. ... Thus, if Pteronarcys californica disappears from the Colorado River it will probably be over a very long period of time due to the slow incremental accumulation of silt and loss of microhabitats, and not due to thermal and/or dissolved oxygen stress."

Twenty-five years later it appears that prognostication has largely come to pass. The numbers of *Pteronarcella badia,* a closely related species that was common throughout the Colorado River from Windy Gap to the confluence with the Blue River in the early 1980s, have dwindled to barely detectible levels, particularly in Reach One. Likewise, the large mayfly species such as *Drunella grandis* and *Drunella doddsi*, also common in the same reach in the early 1980s are now gone. Among the caddisflies, *Arctopsyche* sp., *Cheumatopsyche* sp., and *Psychomyia flavida* were common in all collections at all seasons at site WG11 in the 1980-1981 study. They were rarely observed in 2010.

It is our conclusion that chronic sedimentation and clogging of the interstitial spaces in the cobble-rubble dominated riffles areas of the upper Colorado River below WGD is the overarching problem that has increasingly compromised the biotic integrity and proper function of the river over the past 25 years. The proposed firming projects at Windy Gap and the Moffat Tunnel are only going to further exacerbate this situation. Storage, impoundment and diversion of the waters of almost all creeks and major streams in Grand County have created and untenable situation that will soon be impossible to correct unless a massive investment and commitment of time, manpower and capital is forthcoming on a number of fronts.

The title of Job Number Two within this study (Colorado River Aquatic Resources Investigations) is Colorado River Mottled Sculpin Population Studies. After the conclusions section of Job Number Two, recommendations will be set forth for future study and approaches for continued monitoring of the upper Colorado River aquatic ecosystem in Grand County to help insure that this very important resource does not continue to degrade further. Given an

adequate level of funding and a sustained investment of time and manpower, it should be possible to restore the Fraser and Colorado rivers to some semblance of a healthy coldwater stream ecosystem.

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Appendix For Job 1

Tables

and

Figures

Table A1. Estimated densities (numbers/m^2) of mayfly larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the spring (April-May) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Ephemeroptera – Mayflies													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK[n]	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Ameletidae	*Ameletus* sp.	nss	nss	0	nss	0	nss	0	0	0	0	0	0	0	0
Baetidae	*Acentrella insignificans*	nss	nss	0	nss	0	nss	0	0	0	0	0	0	0	0
Baetidae	Baetidae*	nss	nss	103	nss	2,613	nss	755	472	nss	451	185	788	2,507	784
Baetidae	*Baetis bicaudatus*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Baetidae	*Baetis flavistriga*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Baetidae	*Baetis* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Baetidae	*Baetis tricaudatus*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Baetidae	*Diphetor hageni*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Baetidae	*Fallceon quilleri*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Baetidae	*Plauditis* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Caenidae	*Brachycercus* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Caenidae	*Caenis* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Ephemerellidae	*Attenella margarita*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Ephemerellidae	*Drunella doddsii*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Ephemerellidae	*Drunella grandis*	nss	nss	0	nss	0	nss	0	9	nss	9	1	7	4	0
Ephemerellidae	*Drunella* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Ephemerellidae	*Ephemerella dorothea infrequens*	nss	nss	475	nss	2,109	nss	1,169	856	nss	2,347	640	331	87	596
Ephemerellidae	*Ephemerella excrucians*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Ephemerellidae	*Ephemerella* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Ephemerellidae	Ephemerellidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Ephemerellidae	*Serratella micheneri*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Ephemerellidae	*Serratella* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Ephemerellidae	*Timpanoga hecuba hecuba*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Heptageniidae	*Cinygmula* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Heptageniidae	*Ecdyonurus simplicioides*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Heptageniidae	*Epeorus albertae*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Heptageniidae	*Epeorus* sp.	nss	nss	1	nss	68	nss	8	13	nss	29	0	5	43	0
Heptageniidae	*Heptagenia elegantula*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Heptageniidae	*Heptagenia solitaria*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Heptageniidae	*Heptagenia* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Heptageniidae	*Rhithrogena hageni*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Heptageniidae	*Rhithrogena* sp.	nss	nss	0	nss	9	nss	41	96	nss	891	477	937	67	145

Notes: nss = no spring sample; [n] = spring sample collected in Early April 2011, *= all baetid taxa included in this row.

Table A1 (continued). Estimated densities (numbers/m^2) of mayfly larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the spring (April-May) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Ephemeroptera – Mayflies													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK[a]	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Leptohyphidae	*Tricorythodes explicatus*	nss	nss	0	nss	0	nss	0	1	nss	4	4	31	0	0
Leptophlebiidae	*Choroterpes albiannulata*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Leptophlebiidae	*Leptophlebia* sp.	nss	nss	0	nss	0	nss	0	1	nss	0	0	0	0	0
Leptophlebiidae	*Paraleptophlebia bicornuta*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Leptophlebiidae	*Paraleptophlebia debilis*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Leptophlebiidae	*Paraleptophlebia heteronea*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Leptophlebiidae	*Paraleptophlebia memorialis*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Leptophlebiidae	*Paraleptophlebia packii*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Leptophlebiidae	*Paraleptophlebia* sp.	nss	nss	57	nss	133	nss	96	276	nss	109	32	167	17	137
Siphlonuridae	*Siphlonurus occidentalis*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0

Notes: nss = no spring sample; [a] = spring sample collected in Early April 2011

Table A2. Estimated densities (numbers/m^2) of stonefly larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the spring (April-May) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Plecoptera – Stoneflies													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK[a]	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Capniidae	*Capnia* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Capniidae	*Paracapnia angulata*	nss	nss	4	nss	0	nss	0	0	nss	0	0	0	0	0
Chloroperlidae	*Alloperla* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Chloroperlidae	Chloroperlidae	nss	nss	39	nss	0	nss	0	197	nss	148	0	123	0	0
Chloroperlidae	*Haploperla brevis*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Chloroperlidae	*Suwallia* sp.	nss	nss	37	nss	0	nss	0	0	nss	81	5	1,757	0	0
Chloroperlidae	*Sweltsa* sp.	nss	nss	120	nss	15	nss	32	33	nss	255	19	5	9	15
Chloroperlidae	*Triznaka* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	49	0	0	0
Nemouridae	*Prostoia besametsa*	nss	nss	0	nss	0	nss	1	0	nss	0	0	0	0	0
Nemouridae	*Zapada cinctipes*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Perlidae	*Claassenia sabulosa*	nss	nss	5	nss	93	nss	1	4	nss	225	23	29	0	7
Perlidae	*Hesperoperla pacifica*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	279
Perlidae	Perlidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Perlodidae	*Cultus aestivalis*	nss	nss	69	nss	0	nss	8	29	nss	393	81	555	0	0
Perlodidae	*Diura knowltoni*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Perlodidae	*Isogenoides* sp.	nss	nss	51	nss	21	nss	41	33	nss	13	15	23	17	92
Perlodidae	*Isoperla pinta*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Perlodidae	*Isoperla quinquepunctata*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Perlodidae	*Isoperla* sp.	nss	nss	3	nss	87	nss	272	40	nss	423	153	1,095	227	1,525
Perlodidae	Perlodidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Perlodidae	*Skwala americana*	nss	nss	25	nss	1	nss	44	11	nss	13	11	25	60	168
Pteronarcyidae	*Pteronarcella badia*	nss	nss	0	nss	0	nss	1	0	nss	1	0	4	3	0
Pteronarcyidae	*Pteronarcys californica*	nss	nss	7	nss	0	nss	4	4	nss	44	0	5	363	449
Taeniopterygidae	*Taenionema* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Taeniopterygidae	Taeniopterygidae	nss	nss	0	nss	0	nss	1	0	nss	0	0	0	0	0
Plecoptera	Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes: nss = no spring sample; [a] = spring sample collected in Early April 2011

Table A3. Estimated densities (numbers/m^2) of caddisfly larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the spring (April-May) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Trichoptera – Caddisflies													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK[a]	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Brachycentridae	*Amiocentrus* sp.	nss	nss	0	nss	1	nss	0	0	nss	0	0	0	0	0
Brachycentridae	*Brachycentrus americanus*	nss	nss	0	nss	783	nss	49	0	nss	0	65	0	175	69
Brachycentridae	*Brachycentrus occidentalis*	nss	nss	0	nss	0	nss	0	0	nss	0	3	0	0	0
Brachycentridae	*Brachycentrus* sp.	nss	nss	49	nss	0	nss	0	263	nss	379	0	155	0	0
Brachycentridae	*Micrasema* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Glossosomatidae	*Agapetus* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Glossosomatidae	*Glossosoma* sp.	nss	nss	0	nss	0	nss	0	208	nss	896	220	155	1	415
Glossosomatidae	Glossosomatidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Glossosomatidae	*Protoptila* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Helicopsychidae	*Helicopsyche* sp.	nss	nss	0	nss	28	nss	209	0	nss	3	13	0	0	0
Hydropsychidae	*Arctopsyche* sp.	nss	nss	185	nss	43	nss	0	19	nss	5	0	9	0	116
Hydropsychidae	*Cheumatopsyche* sp.	nss	nss	85	nss	4	nss	1	44	nss	48	1	65	3	1
Hydropsychidae	*Hydropsyche* sp.	nss	nss	187	nss	263	nss	21	232	nss	364	91	335	395	1,629
Hydropsychidae	Hydropsychidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Hydroptilidae	*Agraylea* sp.	nss	nss	0	nss	3	nss	0	0	nss	0	0	0	0	0
Hydroptilidae	*Allotrichia* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Hydroptilidae	*Hydroptila* sp.	nss	nss	0	nss	1	nss	0	0	nss	0	0	0	0	4
Hydroptilidae	*Hydroptilidae* sp.	nss	nss	0	nss	3	nss	0	0	nss	0	0	0	0	0
Hydroptilidae	*Leucotrichia* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Hydroptilidae	*Ochrotrichia* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Hydroptilidae	*Stactobiella* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Lepidostomatidae	*Lepidostoma* sp.	nss	nss	95	nss	436	nss	132	532	nss	2,129	151	351	31	0
Leptoceridae	*Ceraclea* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Leptoceridae	*Oecetis* sp.	nss	nss	3	nss	5	nss	104	19	nss	1	28	1	0	0
Limnephilidae	*Clistoronia* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	1	0	0	0
Limnephilidae	*Psychoglypha* sp.	nss	nss	0	nss	1	nss	0	0	nss	0	0	0	0	0
Philopotamidae	*Wormaldia* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Polycentropodidae	*Polycentropus* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	3	0	0	0
Psychomyidae	*Psychomyia flavida*	nss	nss	0	nss	0	nss	0	0	nss	0	7	0	0	0
Rhyacophilidae	*Rhyacophila* sp.	nss	nss	4	nss	4	nss	3	7	nss	57	1	0	19	240
Unoidae	*Oligophlebodes* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0

Notes: nss = no spring sample; [a] = spring sample collected in Early April 2011

Table A4. Estimated densities (numbers/m^2) of true fly larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the spring (April-May) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Diptera – True flies													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK[a]	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Athericidae	*Atherix pachypus*	nss	nss	1	nss	0	nss	1	0	nss	0	0	0	73	172
Ceratopogonidae	Ceratopogonidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Ceratopogonidae	*Palpomyia* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Chironomidae	Chironomidae	nss	nss	1,341	nss	3,324	nss	3,255	2,171	nss	1,228	1,535	537	2,040	18,517
Culicidae	*Aedes* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Empididae	Empididae sp.	nss	nss	5	nss	32	nss	1	5	nss	19	8	8	8	91
Empididae	*Wiedemannia* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Heleidae	Heleidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Muscidae	*Limnophora* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Psychodidae	*Chelifera* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Psychodidae	*Hemerodromia* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Psychodidae	*Pericoma* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Psychodidae	Psychodidae	nss	nss	1	nss	7	nss	0	9	nss	33	0	0	0	0
Simuliidae	Simuliidae	nss	nss	3,212	nss	2,647	nss	143	51	nss	112	5	76	80	3
Tabanidae	*Chrysops* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Tipulidae	*Antocha* sp.	nss	nss	0	nss	17	nss	0	0	nss	0	0	0	3	263
Tipulidae	*Dicranota* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Tipulidae	*Hexatoma* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Tipulidae	*Tipula* sp.	nss	nss	0	nss	12	nss	0	0	nss	0	0	0	1	0
Tipulidae	Tipulidae	nss	nss	0	nss	0	nss	0	0	nss	0	5	0	0	123
Blephariceridae	*Agathon* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Dipterasp.	Diptera	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Tanyderidae	*Protanyderus* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0

Notes: nss = no spring sample; [a] = spring sample collected in Early April 2011

Table A5. Estimated densities (numbers/m^2) of aquatic beetle larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the spring (April-May) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Coleoptera – Aquatic Beetles													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK[n]	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Carabidae	Carabidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Dytiscidae	Dytiscidae	nss	nss	0	nss	3	nss	3	0	nss	0	0	0	9	0
Dytiscidae	*Hydroporus* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Dytiscidae	*Liodessus* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	55	0	0	0
Elmidae	*Cleptelmis addenda*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Elmidae	Elmidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Elmidae	*Narpus concolor*	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Elmidae	*Optioservus* sp.	nss	nss	217	nss	415	nss	11	140	nss	548	377	1,412	636	616
Elmidae	*Zaitzevia parvula*	nss	nss	84	nss	0	nss	0	41	nss	459	0	95	0	0
Hydrophilidae	*Helophorus* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Hydrophilidae	Hydrophilidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Staphylinidae	Staphylinidae	nss	nss	0	nss	0	nss	0	0	nss	0	7	0	0	0

Notes: nss = no spring sample; [n] = spring sample collected in Early April 2011

Table A6. Estimated densities (numbers/m^2) non-insect aquatic invertebrates at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the spring (April-May) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	Non-Insect Aquatic Invertebrate Taxa													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK[n]	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Amphipoda	Amphipoda	nss	nss	0	nss	0	nss	0	3	nss	1	0	0	0	0
Gammaraidae	*Gammarus lacustris*	nss	nss	0	nss	0	nss	0	0	nss	0	3	0	0	0
Bivlavia	Bivlavia	nss	nss	0	nss	35	nss	24	0	nss	0	0	0	0	0
Bosminidae	Bosmina	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Eubranchipoda	Eubranchipoda	nss	nss	0	nss	8	nss	0	0	nss	0	0	0	0	0
Ancylidae	*Ferrissia* sp.	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	1	0
Corbiculidae	Corbiculidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Gastropoda	Gastropoda	nss	nss	0	nss	0	nss	0	11	nss	20	0	0	0	0
Lymnaeidae	Lymnaeidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Physidae	Physidae	nss	nss	0	nss	0	nss	0	0	nss	0	3	0	1	8
Planorbidae	Planorbidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Sphaeridae	Sphaeridae	nss	nss	0	nss	0	nss	0	0	nss	0	1	0	0	0
Hirudinea	Hirudinea	nss	nss	0	nss	52	nss	0	0	nss	0	17	0	0	0
Hydracarina	Hydracarina	nss	nss	0	nss	8	nss	0	0	nss	0	0	0	36	0
Asellidae	*Caecidota* sp.	nss	nss	0	nss	425	nss	8	0	nss	0	0	0	0	0
Hyalellidae	*Hyalella azteca*	nss	nss	0	nss	292	nss	0	0	nss	0	0	0	0	0
Asellidae	*Lirceus* sp.	nss	nss	4	nss	0	nss	0	1	nss	1	0	0	0	0
Nematoda	Nematoda	nss	nss	0	nss	5	nss	17	0	nss	0	1	0	8	0
Oligochaeta	Oligochaeta	nss	nss	52	nss	1,313	nss	32	41	nss	157	1,411	33	7	409
Turbellaria	Turbellaria	nss	nss	0	nss	0	nss	0	104	nss	1	0	0	0	0
Collembola	Collembola	nss	nss	0	nss	0	nss	0	0	nss	0	0	0	0	0
Gomphidae	Gomphidae	nss	nss	0	nss	0	nss	0	0	nss	0	0	1	0	0

Notes: nss = no spring sample; [n] = spring sample collected in Early April 2011 * = uncommonly found insect groups.

Table A7. Estimated densities (numbers/m^2) of mayfly larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the fall (August-September) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Ephemeroptera – Mayflies													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Ameletidae	*Ameletus* sp.	39	4	1	0	1	0	0	1	0	0	0	0	0	nss
Baetidae	*Acentrella insignificans*	105	4	5	8	0	29	0	72	0	163	73	177	7	nss
Baetidae	Baetidae	20	516	131	0	195	621	0	20	0	57	20	45	60	nss
Baetidae	*Baetis bicaudatus*	0	51	15	0	0	3	0	20	0	5	5	5	0	nss
Baetidae	*Baetis flavistriga*	0	0	0	1	0	11	0	0	0	0	0	0	0	nss
Baetidae	*Baetis* sp.	53	3993	3557	3943	4149	3475	2265	1017	152	701	341	1109	660	nss
Baetidae	*Baetis tricaudatus*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Baetidae	*Diphetor hageni*	0	24	25	9	371	27	12	292	1	45	23	185	1	nss
Baetidae	*Fallceon quilleri*	0	0	0	0	0	3	0	0	0	0	0	0	0	nss
Baetidae	*Plauditis* sp.	0	0	0	0	8	5	0	3	0	0	0	13	0	nss
Caenidae	*Brachycercus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Caenidae	*Caenis* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Ephemerellidae	*Attenella margarita*	4	0	0	5	1	3	3	19	0	5	0	93	3	nss
Ephemerellidae	*Drunella doddsii*	173	0	0	0	0	0	0	0	0	0	0	0	0	nss
Ephemerellidae	*Drunella grandis*	425	1	0	0	0	3	0	65	23	79	12	56	0	nss
Ephemerellidae	*Drunella* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Ephemerellidae	*Ephemerella dorothea infrequens*	812	16	11	23	71	1104	56	453	1233	125	95	784	17	nss
Ephemerellidae	*Ephemerella excrucians*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Ephemerellidae	*Ephemerella* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Ephemerellidae	Ephemerellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Ephemerellidae	*Serratella micheneri*	0	0	1	5	31	11	4	24	0	11	1	35	3	nss
Ephemerellidae	*Serratella* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Ephemerellidae	*Timpanoga hecuba hecuba*	5	0	0	0	0	0	0	0	0	0	0	0	0	nss

Notes: nss = no fall sample.

Table A7 (continued). Estimated densities (numbers/m^2) of mayfly larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the fall (August-September) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Ephemeroptera – Mayflies													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Heptageniidae	*Cinygmula* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Heptageniidae	*Ecdyonurus simplicioides*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Heptageniidae	*Epeorus albertae*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Heptageniidae	*Epeorus* sp.	0	0	1	0	0	91	0	68	401	5	0	0	33	nss
Heptageniidae	*Heptagenia elegantula*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Heptageniidae	*Heptagenia solitaria*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Heptageniidae	*Heptagenia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Heptageniidae	*Rhithrogena hageni*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Heptageniidae	*Rhithrogena* sp.	1588	0	0	1	9	48	31	219	488	695	388	1559	3	nss
Leptohyphidae	*Tricorythodes explicates*	0	15	47	196	132	56	1	97	4	27	31	415	240	nss
Leptophlebiidae	*Choroterpes albiannulata*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Leptophlebiidae	*Leptophlebia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Leptophlebiidae	*Paraleptophlebia bicornuta*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Leptophlebiidae	*Paraleptophlebia debilis*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Leptophlebiidae	*Paraleptophlebia heteronea*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Leptophlebiidae	*Paraleptophlebia memorialis*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Leptophlebiidae	*Paraleptophlebia packii*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Leptophlebiidae	*Paraleptophlebia* sp.	155	72	109	40	117	259	56	363	563	159	15	755	5	nss
Siphlonuridae	*Siphlonurus occidentalis*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss

Notes: nss = no fall sample.

Table A8. Estimated densities (numbers/m^2) of stonefly larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the fall (August-September) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Plecoptera – Stoneflies													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Capniidae	*Capnia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Capniidae	*Paracapnia angulata*	0	0	0	1	0	0	0	0	28	0	0	0	0	nss
Chloroperlidae	*Alloperla* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Chloroperlidae	Chloroperlidae	88	24	44	4	1	37	3	4	49	11	25	33	0	nss
Chloroperlidae	*Haploperla brevis*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Chloroperlidae	*Suwallia* sp.	0	0	5	0	0	0	0	0	0	0	0	0	0	nss
Chloroperlidae	*Sweltsa* sp.	372	24	11	0	0	0	0	0	0	0	0	0	0	nss
Chloroperlidae	*Triznaka* sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	nss
Nemouridae	*Prostoia besametsa*	0	0	0	0	0	0	0	0	3	0	0	0	0	nss
Nemouridae	*Zapada cinctipes*	3	0	0	0	0	0	0	1	0	0	0	0	0	nss
Perlidae	*Claassenia sabulosa*	36	79	107	131	81	461	155	11	59	195	324	212	0	nss
Perlidae	*Hesperoperla pacifica*	4	0	0	0	0	0	0	0	0	0	0	0	0	nss
Perlidae	Perlidae	0	0	7	0	0	8	0	0	0	0	0	0	0	nss
Perlodidae	*Cultus aestivalis*	1	5	33	1	1	40	7	3	27	52	21	168	11	nss
Perlodidae	*Diura knowltoni*	4	0	0	0	0	0	0	0	0	0	0	0	0	nss
Perlodidae	*Isogenoides* sp.	0	0	0	0	0	3	0	0	0	0	1	48	0	nss
Perlodidae	*Isoperla pinta*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Perlodidae	*Isoperla quinquepunctata*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Perlodidae	*Isoperla* sp.	16	0	1	1	0	16	1	76	112	24	11	35	0	nss
Perlodidae	Perlodidae	45	13	11	4	7	69	15	147	0	48	80	45	1	nss
Perlodidae	*Skwala Americana*	44	57	31	23	4	16	0	7	19	7	21	80	0	nss
Pteronarcyidae	*Pteronarcella badia*	117	0	0	0	0	0	0	1	0	3	0	29	0	nss
Pteronarcyidae	*Pteronarcys californica*	1	55	3	0	0	3	239	12	32	116	5	21	253	nss
Taeniopterygidae	*Taenionema* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Taeniopterygidae	Taeniopterygidae	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Plecoptera	Plecoptera	3	4	5	0	3	21	1	1	0	11	3	11	0	nss

Notes: nss = no fall sample.

Table A9. Estimated densities (numbers/m^2) of caddisfly larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the fall (August-September) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Trichoptera – Caddisflies													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Brachycentridae	*Amiocentrus* sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	nss
Brachycentridae	*Brachycentrus americanus*	1111	552	1048	0	79	304	109	697	361	237	89	277	3477	nss
Brachycentridae	*Brachycentrus occidentalis*	356	101	31	0	3	3	0	1	0	0	0	0	0	nss
Brachycentridae	*Brachycentrus* sp.	0	0	0	172	0	0	0	0	0	0	0	0	0	nss
Brachycentridae	*Micrasema* sp.	24	0	0	0	0	0	0	0	0	0	0	0	0	nss
Glossosomatidae	*Agapetus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Glossosomatidae	*Glossosoma* sp.	163	1636	303	19	48	1456	2593	313	1271	3173	3597	456	5	nss
Glossosomatidae	Glossosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Glossosomatidae	*Protoptila* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Helicopsychidae	*Helicopsyche* sp.	0	0	0	0	1	59	11	0	65	4	3	0	0	nss
Hydropsychidae	*Arctopsyche* sp.	289	803	164	4	143	24	3	96	15	36	11	7	0	nss
Hydropsychidae	*Cheumatopsyche* sp.	0	1012	269	17	1	760	116	12	9	179	29	584	15	nss
Hydropsychidae	*Hydropsyche* sp.	28	2003	681	2311	1205	6120	1401	1003	521	1232	487	1203	412	nss
Hydropsychidae	Hydropsychidae	15	47	31	0	0	107	3	0	0	12	1	43	95	nss
Hydroptilidae	*Agraylea* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Hydroptilidae	*Allotrichia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Hydroptilidae	*Hydroptila* sp.	0	0	0	0	3	3	0	3	0	0	0	0	149	nss
Hydroptilidae	*Hydroptilidae* sp.	0	3	4	0	23	3	0	0	0	3	0	13	0	nss
Hydroptilidae	*Leucotrichia* sp.	0	0	0	0	0	5	9	0	0	0	0	0	0	nss
Hydroptilidae	*Ochrotrichia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Hydroptilidae	*Stactobiella* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Lepidostomatidae	*Lepidostoma* sp.	1504	475	195	163	227	765	279	2591	2811	1545	1264	3331	121	nss
Leptoceridae	*Ceraclea* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Leptoceridae	*Oecetis* sp.	0	0	11	15	59	99	4	100	19	5	15	53	4	nss
Limnephilidae	*Clistoronia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Limnephilidae	*Psychoglypha* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Philopotamidae	*Wormaldia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Polycentropodidae	*Polycentropus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Psychomyidae	*Psychomyia flavida*	0	0	3	4	0	29	0	0	55	179	81	8	9	nss
Rhyacophilidae	*Rhyacophila* sp.	20	0	13	1	4	29	12	15	21	0	0	0	8	nss
Unoidae	*Oligophlebodes* sp.	919	0	0	0	0	0	0	0	0	0	0	0	0	nss

Notes: nss = no fall sample.

Table A10. Estimated densities (numbers/m^2) of true fly larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the fall (August-September) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Diptera – True flies													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Athericidae	*Atherix pachypus*	12	187	3	31	19	3	471	16	17	20	4	9	123	nss
Ceratopogonidae	Ceratopogonidae	17	0	1	0	0	3	0	0	0	0	1	0	4	nss
Ceratopogonidae	*Palpomyia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Chironomidae	Chironomidae	1204	1795	1067	1757	2027	1837	431	1817	2148	1536	2049	3044	12293	nss
Culicidae	*Aedes* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Empididae	Empididae sp.	0	16	23	13	19	83	1	4	32	21	61	16	61	nss
Empididae	*Wiedemannia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Heleidae	Heleidae	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Muscidae	*Limnophora* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Psychodidae	*Chelifera* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Psychodidae	*Hemerodromia* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Psychodidae	*Pericoma* sp.	379	0	0	0	0	3	0	0	0	0	0	0	0	nss
Psychodidae	Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Simuliidae	Simuliidae	68	1733	220	1197	689	643	156	244	71	268	68	461	144	nss
Tabanidae	*Chrysops* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Tipulidae	*Antocha* sp.	8	0	5	11	23	72	35	137	107	16	3	0	15	nss
Tipulidae	*Dicranota* sp.	31	0	0	0	0	0	0	0	0	0	0	0	0	nss
Tipulidae	*Hexatoma* sp.	49	16	4	0	0	0	0	0	0	0	3	0	0	nss
Tipulidae	*Tipula* sp.	0	0	0	0	0	3	0	0	0	0	0	0	3	nss
Tipulidae	Tipulidae	0	4	7	0	5	3	0	0	0	0	0	4	0	nss
Blephariceridae	*Agathon* sp.	27	0	0	0	0	0	0	0	0	0	0	0	0	nss
Diptera	Diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Tanyderidae	*Protanyderus* sp.	3	0	0	0	0	0	0	0	0	0	0	0	0	nss

Notes: nss = no fall sample.

Table A11. Estimated densities (numbers/m^2) of aquatic beetle larvae at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the fall (August-September) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	ORDER – Coleoptera – Aquatic Beetles													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Carabidae	Carabidae	0	0	0	0	0	0	0	0	0	0	0	0	1	nss
Dytiscidae	Dytiscidae	0	3	0	1	0	0	0	0	0	0	0	0	1	nss
Dytiscidae	*Hydroporus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Dytiscidae	*Liodessus* sp.	0	0	0	3	4	3	7	35	17	21	8	1	0	nss
Elmidae	*Cleptelmis addenda*	49	0	0	0	0	0	0	0	0	0	0	0	0	nss
Elmidae	Elmidae	9	387	457	0	13	45	19	0	20	80	131	405	477	nss
Elmidae	*Narpus concolor*	31	0	0	0	0	0	0	0	0	0	0	0	0	nss
Elmidae	*Optioservus* sp.	761	3513	2711	687	709	456	900	505	339	1211	1300	3799	1204	nss
Elmidae	*Zaitzevia parvula*	1940	544	863	155	195	229	455	167	60	551	355	900	27	nss
Hydrophilidae	*Helophorus* sp.	0	0	0	0	0	0	0	0	0	1	0	0	0	nss
Hydrophilidae	Hydrophilidae	0	0	0	1	0	0	0	0	0	0	0	0	0	nss
Staphylinidae	Staphylinidae	0	0	0	0	0	0	0	0	0	0	0	0	0	nss

Notes: nss = no fall sample.

Table A12. Estimated densities (numbers/m^2) of non-insect aquatic invertebrates at various sampling sites on Willow Creek, the Fraser River and Colorado River in Middle Park, Grand County, and the Gunnison River in Ute Park (Black Canyon of the Gunnison River Gorge) on the Montrose-Delta County line, during the fall (August-September) 2010. Three substrate samples (0.25 m^2) were taken at each sample site for a total sample area of 0.75 m^2 for each season. All data reported are standardized to 1 m^2.

Family	Invertebrate Classification (Taxon - Genus/species/subspecies)	Non-Insect Aquatic Invertebrate Taxa													
		WLO CRK	FRR SOL	FRR KBP	COL NEW WG11	COL WG12	COL Hwy40 BR	COL WG13	COL WG21	COL SKY LARK	COL WG22	COL WG31	COL NEW WG32	COL PUMP	GUNN
Amphipoda	Amphipoda	0	0	0	1	0	0	0	0	0	0	0	0	0	nss
Gammaraidae	*Gammarus lacustris*	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Bivlavia	Bivlavia	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Bosminidae	Bosmina	3	0	4	3	0	5	0	0	9	0	0	0	20	nss
Eubranchipoda	Eubranchipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Ancylidae	*Ferrissia* sp.	0	0	0	0	0	0	0	0	0	0	0	12	235	nss
Corbiculidae	Corbiculidae	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Gastropoda	Gastropoda	0	0	1	0	1	0	0	0	0	0	0	0	7	nss
Lymnaeidae	Lymnaeidae	0	0	0	0	1	0	0	0	0	0	0	0	117	nss
Physidae	Physidae	0	0	3	4	4	72	0	89	35	64	9	1	153	nss
Planorbidae	Planorbidae	3	1	3	3	16	13	0	40	1	3	3	4	1	nss
Sphaeridae	Sphaeridae	0	31	11	5	61	64	1	553	229	31	13	4	8	nss
Hirudinea	Hirudinea	1	1	0	11	21	43	0	224	7	0	3	4	0	nss
Hydracarina	Hydracarina	199	111	32	12	75	101	27	115	37	148	47	209	1773	nss
Asellidae	*Caecidota* sp.	0	0	0	16	35	0	0	1	0	0	0	0	0	nss
Hyalellidae	*Hyalella azteca*	0	0	0	0	17	11	4	9	1	3	0	0	0	nss
Asellidae	*Lirceus* sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	nss
Nematoda	Nematoda	75	263	111	41	72	48	23	75	12	33	28	88	193	nss
Oligochaeta	Oligochaeta	0	333	97	336	1337	677	231	189	149	260	67	240	14120	nss
Turbellaria	Turbellaria	0	0	0	3	0	0	0	0	0	0	0	0	0	nss
Gomphidae*	Gomphidae	0	0	0	0	0	0	0	0	0	0	0	5	3	nss
Collembola*	Collembola	0	0	1	0	1	0	0	4	0	5	0	0	0	nss

Notes: nss = no fall sample. * = uncommonly found insect groups.

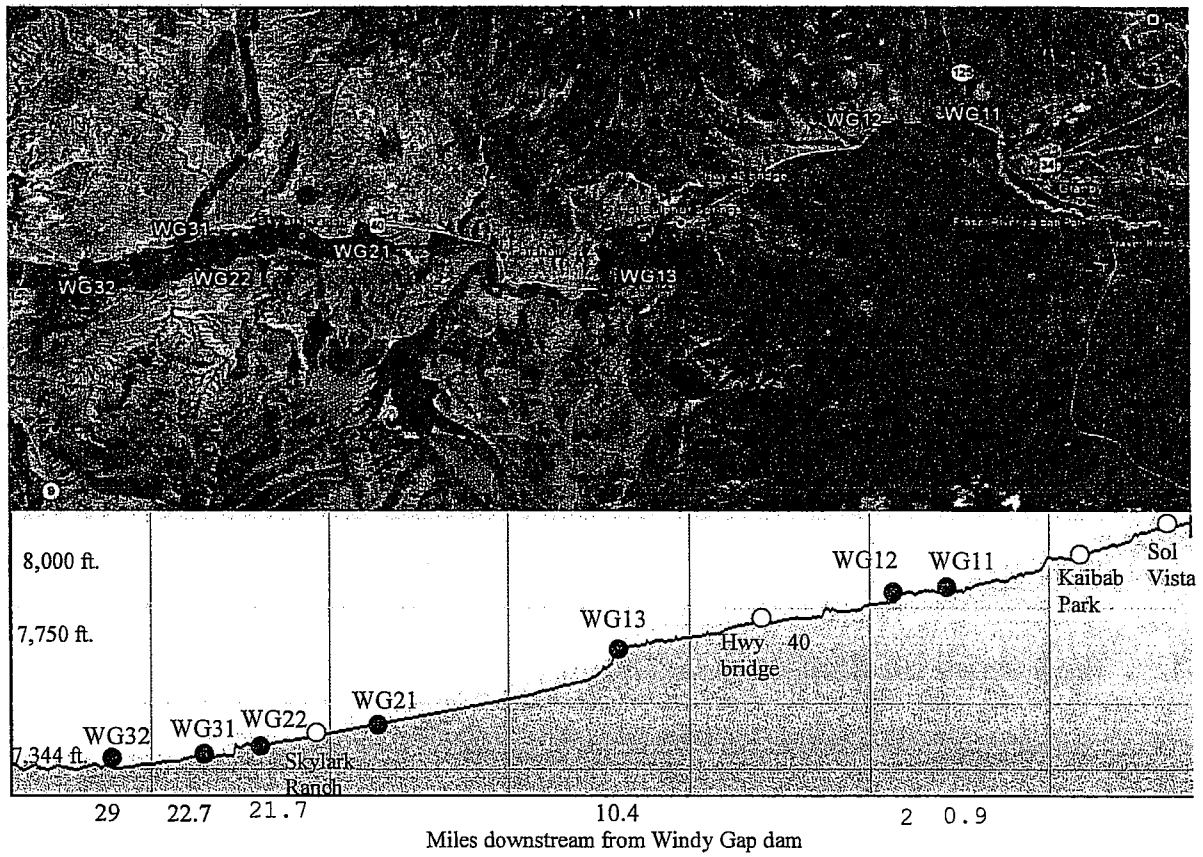


Figure 1: Map of the Windy Gap study area. Red dots are locations of Erickson 1983 original stations, dots are location of additional stations added in 2010. Willow Creek, Pumphouse and Gunnison River stations are not shown. Blue line is the Colorado River, turquoise line is the Fraser River.

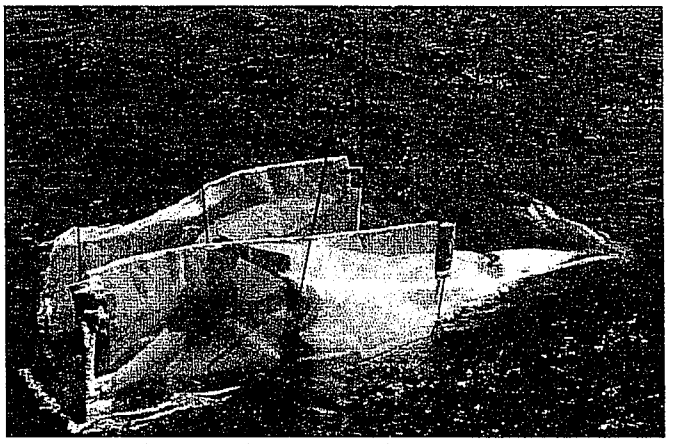


Figure 2: 0.25m² benthic sampling net used at all Windy Gap study sites.

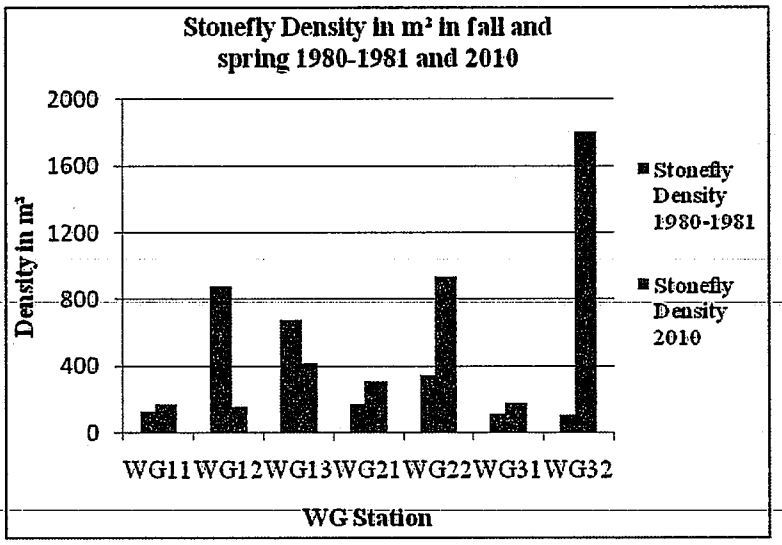


Figure 3: Density of stoneflies (individual / m^2) of the Colorado River at WG sites in spring and fall 2010 and 1980-1981.

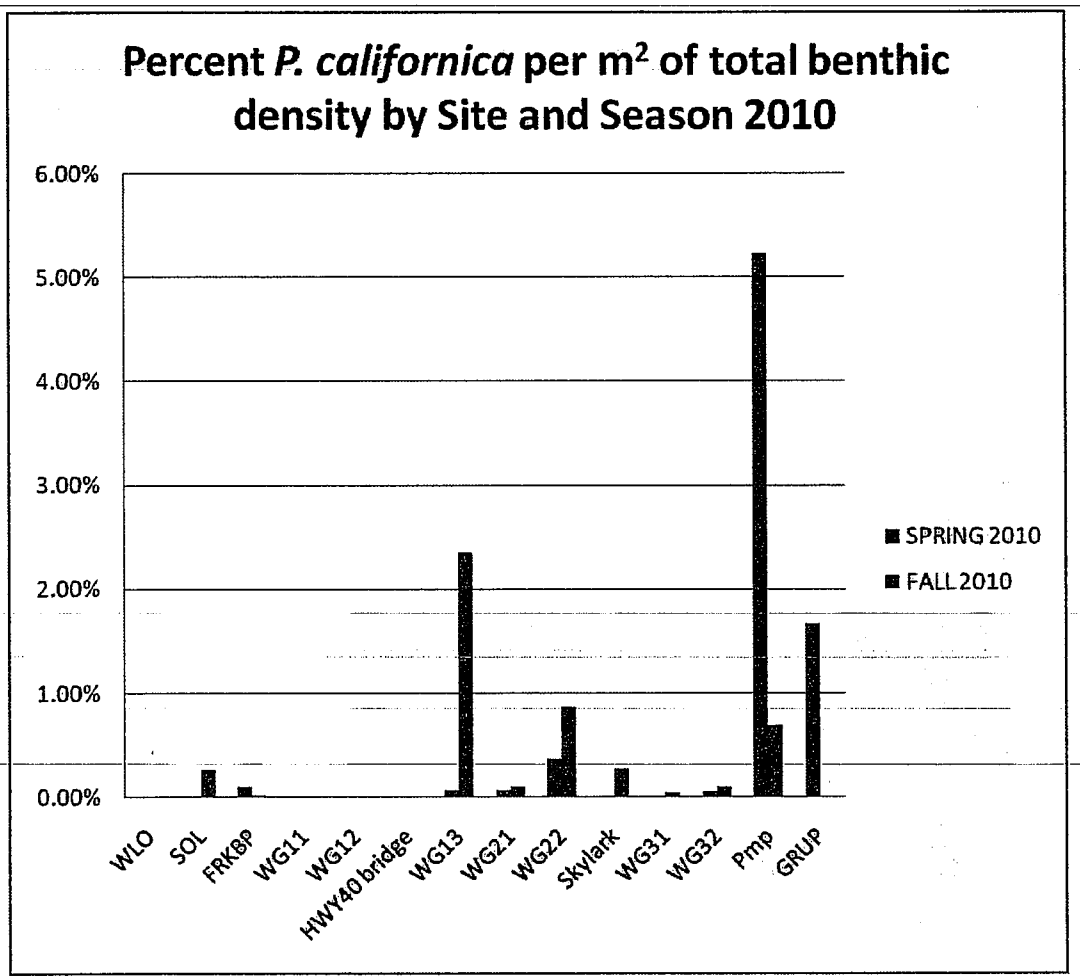


Figure 4: Percent *Pteronarcys californica* in spring and fall 2010. All replicates per season averaged. No spring sample at WLO, SOL, WG11, HWY40bridge and Skylark, no fall sample from GRUP.

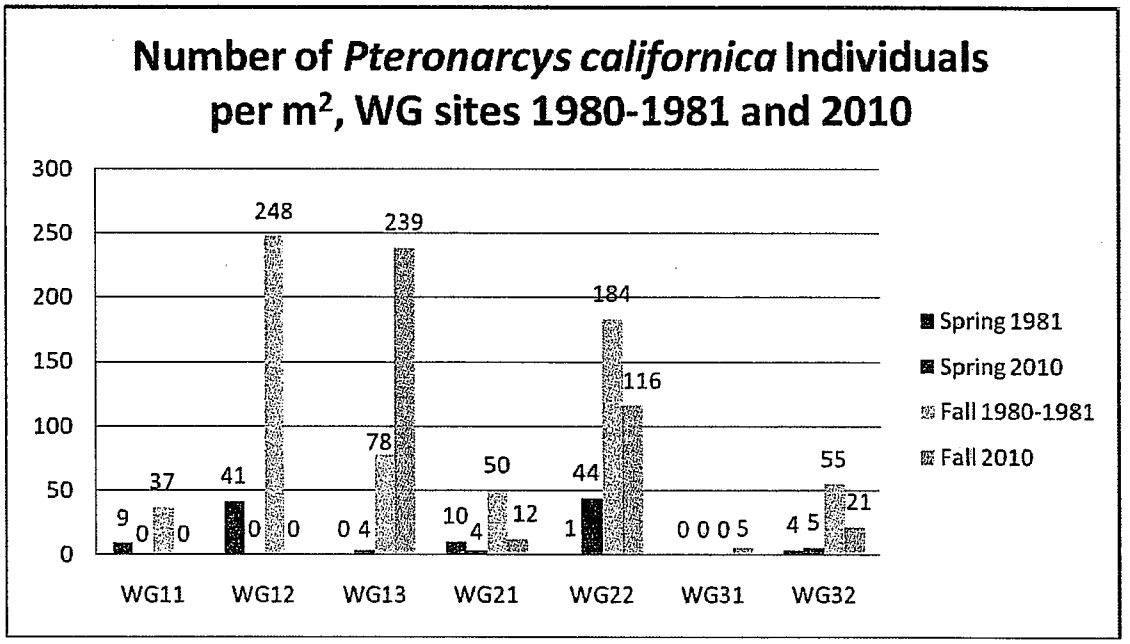


Figure 5: Number of individual *Pteronarcys californica* collected, transformed into m^2 per WG station, 1980-1981 and 2010.

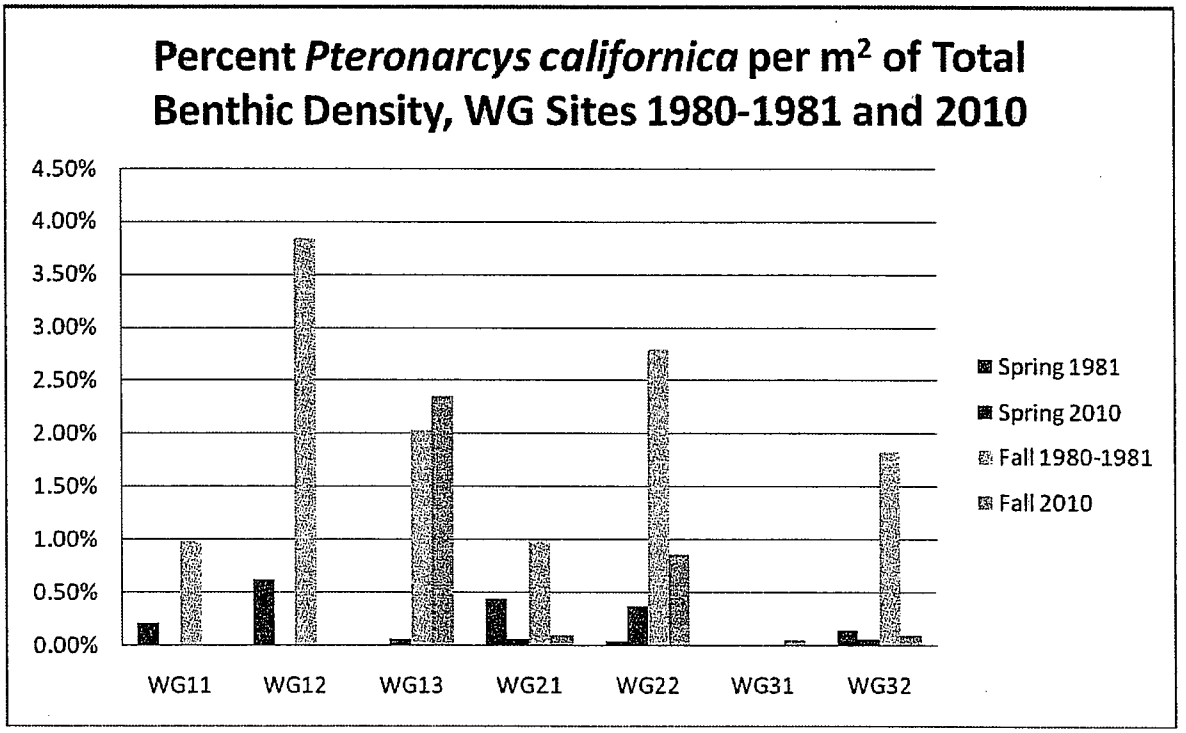


Figure 6: Percent *Pteronarcys californica* by station, season and year. No spring sample at WG11 in 2010.

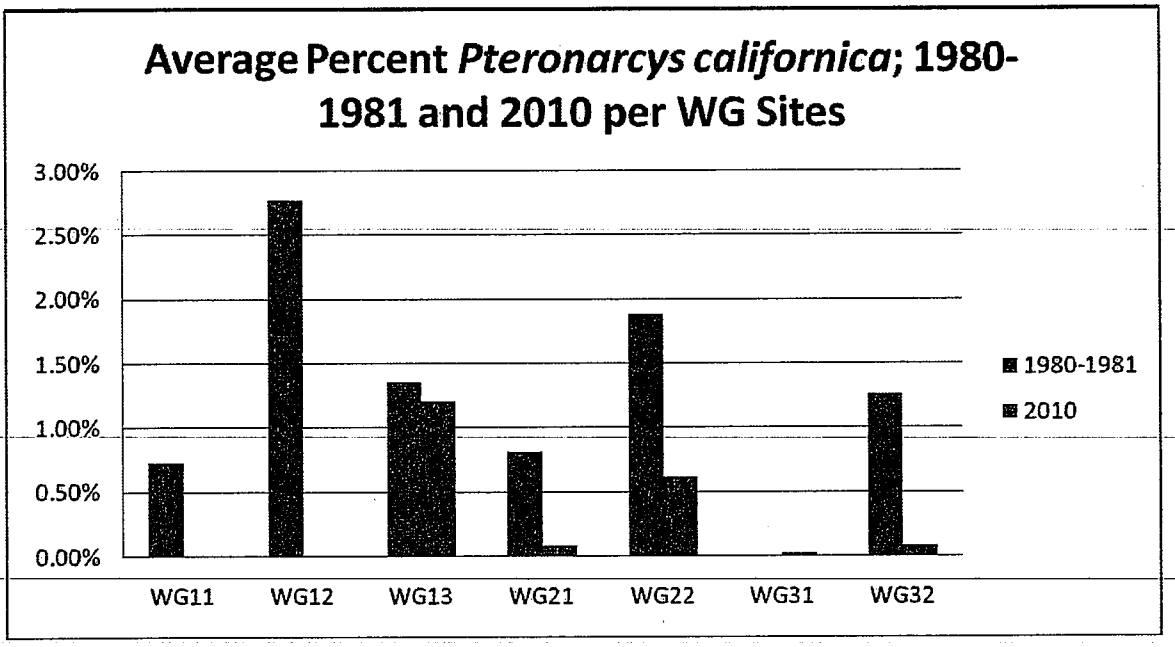


Figure 7: Percent *Pteronarcys californica* for 1980-1981 and 2010 averaged for all sampling periods per WG Station.

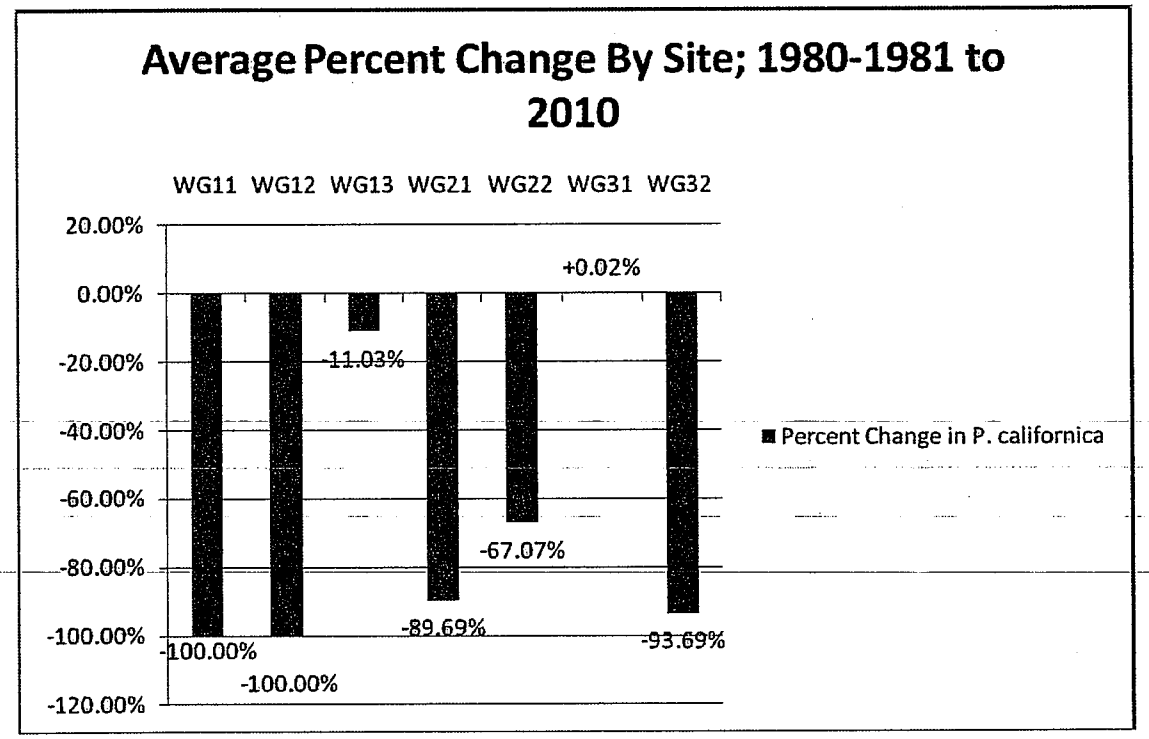


Figure 8: Average percent change of *Pteronarcys californica* by station with all sampling periods combined ((2010 average - 1980-1981 average) / 1980-1981 average).

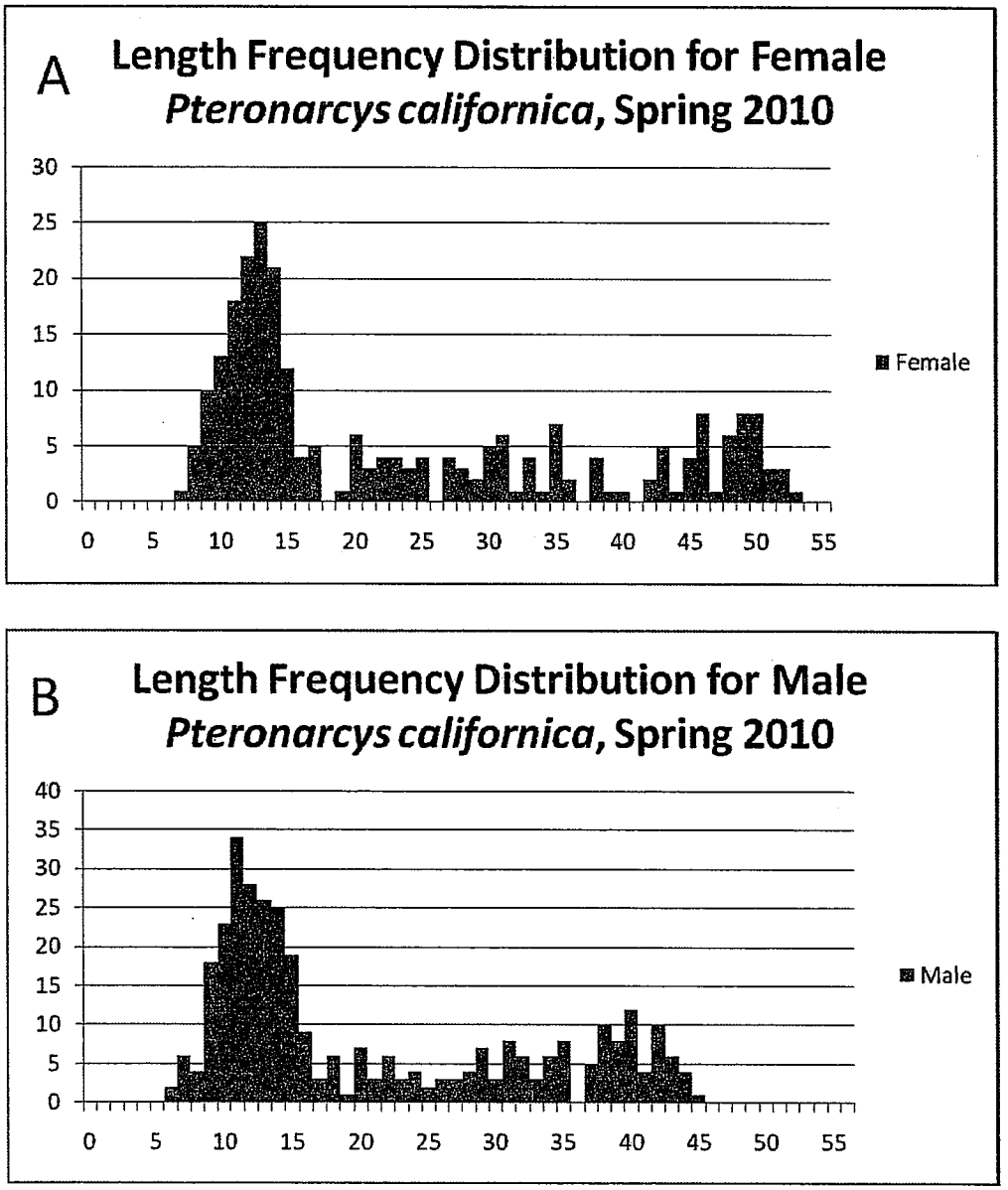


Figure 9: Length frequency distribution for female (A) and male (B) *Pteronarcys californica* from spring 2010.

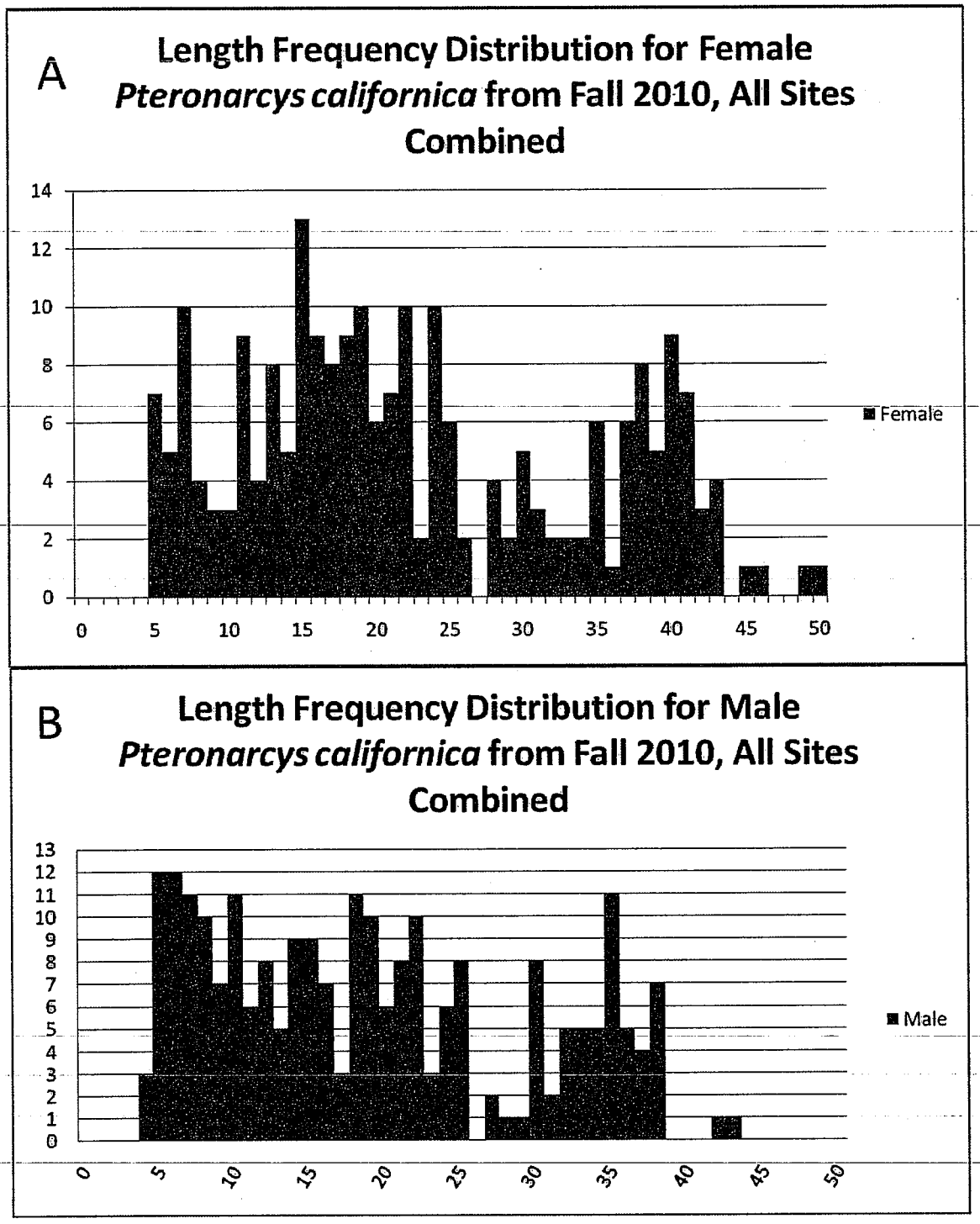


Figure 10: Length frequency distribution for female (A) and male (B) *Pteronarcys californica* from fall 2010.

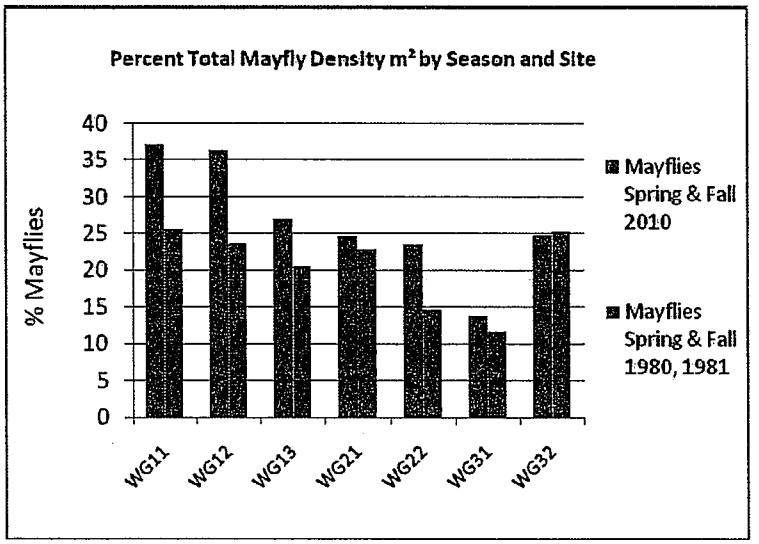


Figure 11. Percent density of mayflies of the Colorado River at WG sites in spring and fall 2010 and 1980-1981.

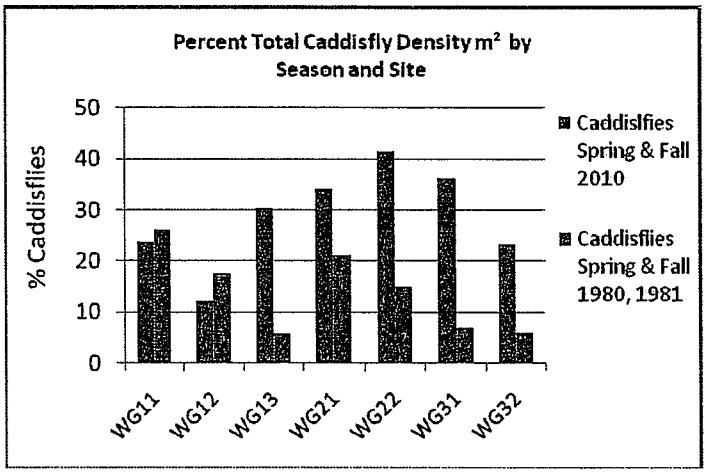


Figure 12: Percent density of caddisflies of the Colorado River at WG sites in spring and fall 2010 and 1980-1981.

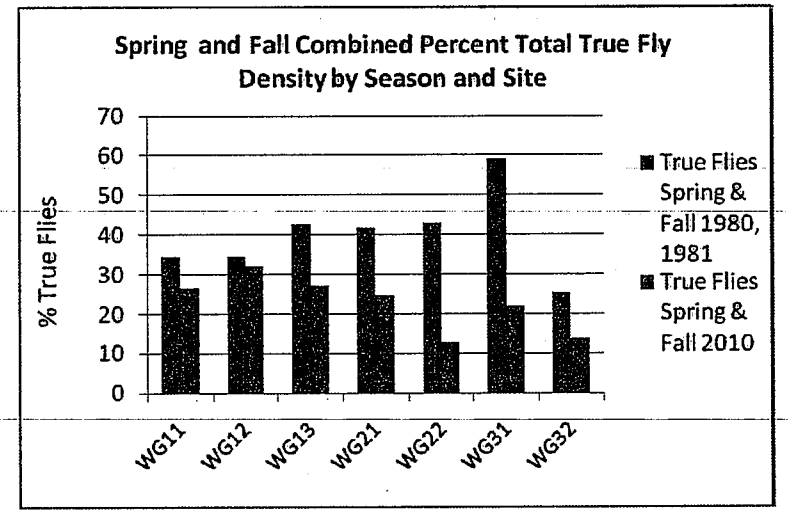
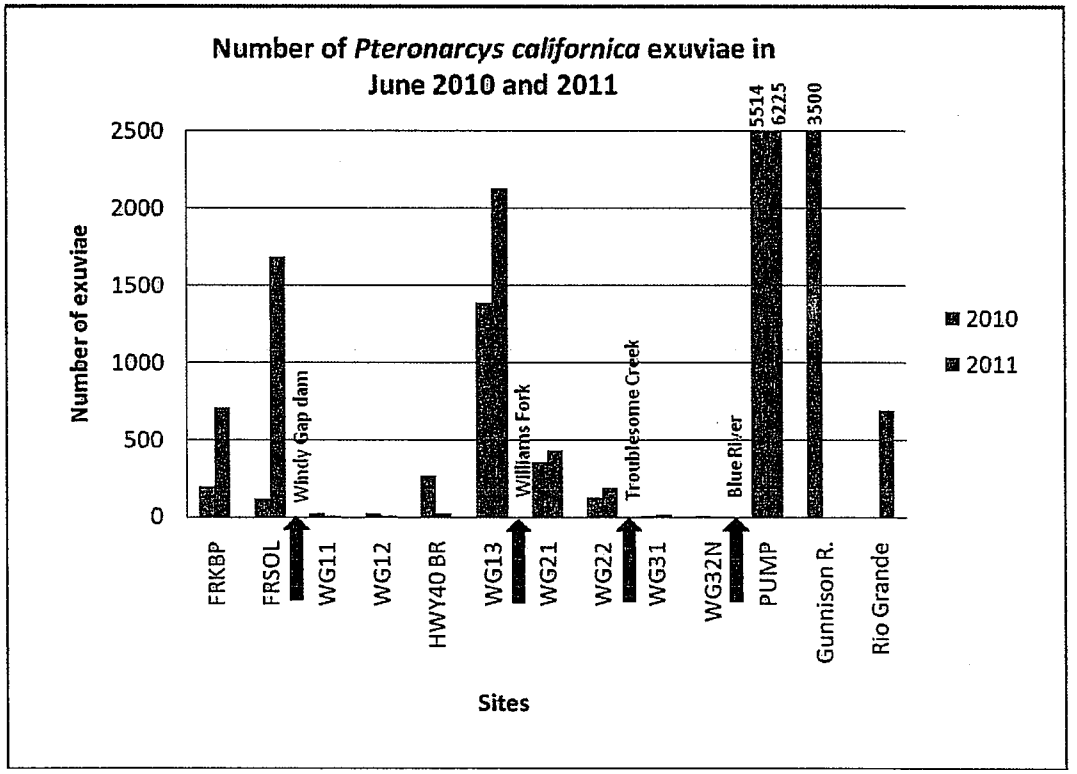


Figure 13: Percent density of true flies of the Colorado River at WG sites in spring and fall 2010 and 1980-1981.



NOTE: All sites are on the Colorado River except FRKBP and FRSOL on the Fraser River upstream of Windy Gap dam, Gunnison River in Black Canyon of the Gunnison and Rio Grande near South Fork.

Figure 14: Number of Pteronarcys californica exuviae from sample stations in June 2010 and 2011. Black arrows indicate the location of Windy Gap Dam and points where major tributaries meet the Colorado River. Pumphouse and Gunnison River station actual numbers are labeled on top of the bars for easier reading. Data for the Gunnison River and the Rio Grande are included for comparative purposes. For more detailed information on the data summarized in Figure 14, see Table 4 in the text of Job No. 1.

Job No. 2. Colorado River Mottled Sculpin Population Studies

Job Objective: Document the relative abundance and distribution of the mottled sculpin *Cottus bairdi* in the upper Colorado River basin from the upstream end of Gore Canyon to the upstream end of the Fraser River Canyon near Tabernash, Colorado, including Willow Creek and the Fraser, Colorado and Williams Fork rivers, upstream and downstream of the mainstem impoundments (Granby, Windy Gap, Williams Fork and Willow Creek reservoirs).

INTRODUCTION

The 5th edition (1991) of the American Fisheries Society (AFS) Special Publication 20 lists 39 different genera for the family Cottidae, commonly known as the sculpins that occur in the United States and Canada. The same publication lists 25 different species belonging to the genus *Cottus* in this family, making it one of the most widely dispersed species occurring in freshwater habitats in North America. Numerous species and subspecies belonging to the genus *Cottus* commonly occur in streams and in some lakes throughout the intermountain and coastal regions of western North America. In Colorado, sculpins commonly occur in streams of all sizes at elevations ranging from 1,524 m to near 3,048 m (5,000 - 10,000 feet). The Gunnison River basin upstream of the Smith Fork of the Gunnison River is only major drainage in Colorado where sculpins do not occur. Extreme water velocities and cascading waterfalls with vertical drops > 15 m in the Black Canyon of the Gunnison have blocked upstream migration by this bottom-dwelling, benthic species.

Historically, two species of sculpin have been considered native to western Colorado, the Paiute sculpin - *Cottus beldingi* and the mottled sculpin - *Cottus bairdi*. Until recently, the mottled sculpin was long considered to be the most common and widely distributed compared to the Pauite sculpin. Recent research efforts using DNA-based genetic markers on sculpins from 20 separate locations across western Colorado seem to suggest that both species occur across wide geographic areas in the Colorado River Basin (Shiozawa et al. 2010). However, the taxonomy and exact distributions of the two species remains to be thoroughly elucidated. For our purposes, the sculpin occurring in the upper Colorado River basin in Middle Park (Grand County) is the native fish of interest, whether the populations under study are the mottled sculpin, the Paiute sculpin, or mixed populations of both species. A systematic review of fishery survey data collected over the past two decades suggested that sculpins rarely occur in significant

numbers in the Colorado River between Windy Gap Dam and Kremmling or in the reaches of tributary streams (such as Willow Creek and the Williams Fork River) downstream of the mainstem impoundments on these drainages (Nehring et al. 2010). The purpose of this study is to assess whether or not this is the case, and if so, discern what might be limiting their distribution. An in-depth review of the published, peer-reviewed literature was undertaken in conjunction with field investigations during 2010 to guide this investigation (see the **Literature Cited** section for a list of publications and documents reviewed). All peer-reviewed literature actually cited in the text of this report is highlighted by an asterisk (*) in the **Literature Cited** section.

Interspecific Interactions – Some have suggested that the high density and biomass of brown trout (*Salmo trutta*) in the Colorado River below Windy Gap Reservoir is a plausible explanation for the lack of sculpins in this reach of the river, allegedly due to predation and/or interspecific competition. However, there is ample empirical evidence from many streams in Colorado that demonstrate these two species are capable of maintaining high densities and biomass while occurring in sympatry. The Gunnison River downstream of the confluence with the Smith Fork (SF) of the Gunnison River in Delta County is probably the best direct comparison with the Colorado River in Middle Park. The Gunnison River upstream of the SF confluence has three mainstem reservoirs with a storage capacity >1 million acre-feet (AF). During most of the 1980s, adult brown trout biomass within this 6 km reach averaged 52 kg/ha and ranged up to more than 104 kg/ha. Total trout biomass averaged 146 kg/ha, ranging as high as 251 kg/ha with more than 2,000 brown and rainbow trout in the 6 km reach ≥ 400 mm total length (Nehring 1988). Nonetheless, mottled sculpin have been thriving in sympatry with these high densities of potential competitors capable of predation for 30 years.

Other investigators have demonstrated that sculpins and brown trout occur in sympatry without any apparent adverse impacts on either species, despite the fact that brown trout are an introduced, non-native predator. In Valley Creek, Minnesota, the density of the slimy sculpin (*Cottus cognatus*) ranges between 10,000 and 60,000/ha. The slimy sculpin in Valley Creek remained the most abundant fish in the stream for more than three decades, despite the fact that it existed in sympatry with brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*) and brown trout (Reutz et al. 2002, 2003; Petrosky and Waters 1975). Moreover, average densities of non-native brown trout in Valley Creek were as high as 7,000/ha (Waters 1999).

Similarly, mean density and biomass of slimy sculpins (*C. cognatus*) in South Branch Creek, Minnesota were 8,000/ha and 63.7 kg/ha, respectively. In this stream, brown trout density existing in sympatry with the slimy sculpin ranged between 500 and 3,000/ha while biomass

estimates ranged from 61 to 205 kg/ha among eight study sections over a three-year period (Newman and Waters 1989). Likewise, mottled sculpins were the numerically dominant species in three separate streams including Prickly Pear Creek, Wolf Creek and the West Gallatin River in southwestern Montana (Bailey 1952). It is noteworthy that this was true despite the fact that these streams varied greatly in width and discharge and that the sculpins occurred in sympatry with brown trout, rainbow trout, brook trout, cutthroat trout, rainbow-cutthroat hybrids, mountain whitefish (*Prosopium williamsoni*), longnose sucker (*Catostomus catostomus*), white sucker (*Catostomus commersoni*) and longnose dace (*Rhinichthys cataractae*).

The White River in Arkansas is impounded by a series of peak-power hydroelectric dams that created tailrace habitats that have been stocked with four species of non-native salmonids, including brown, brook, rainbow and cutthroat trout. These non-native salmonids were managed with restrictive size and bag limits to produce and maintain a high-quality sport fishery that has produced world record brown trout (Hudy and Rider 1989). These tailrace habitats experience wild fluctuations in flow (1 m^3/s, 129 m^3/s and 258 m^3/s) that result from the number of turbines in use for hydropower generation as well as high releases (1,416 m^3/s) for flood control (Quinn and Kwak 2000). Despite these perturbations in stream discharge and potential competition for food and living space, the Ozark sculpin (*Cottus hypselurus*) a native species in the White River thrives in sympatry with these non-native salmonids (Quinn and Kwak 2000; Pender and Kwak 2002). Densities of the Ozark sculpin ranged from approximately 16,600 to 34,000/ha across three study reaches. Similarly, sculpin biomass was estimated at 68.1, 86.2 and 89.1 kg/ha among the three reaches (Pender and Kwak 2002). Total trout biomass in the study reaches ranged from 103 to 252 kg/ha) and trout density ranged from 300 and 2,700/ha over the two-year study period.

In summary, investigators worldwide have been conducting studies for more than half a century, attempting to evaluate interspecific interactions between sculpins and salmonids, assessing predation risks and effects between these taxa (Dineen 1951; Bailey 1952; Straskraba et al. 1966; Brocksen et al. 1968; Petrosky and Waters 1975; Moyle 1977; Newman and Waters 1984, 1989; Gabler and Amundsen 1999; Pender and Kwak 2002; Ruetz et al. 2003). The results have been mixed. Some studies have purportedly demonstrated that sculpins decreased densities of benthic prey, thereby reducing the number of drifting prey available to drift-feeding trout (Brocksen et al. 1968) while other studies suggest the brown trout were the superior competitor (Reutz et al. 2003). However, Moyle (1977) concluded after review of the literature available at the time that the scientific evidence supporting competition between sculpins and trout was weak. Review of the literature in the preceding paragraphs, much of it published subsequent to

the Moyle (1977) review, indicates that this still the case. Sculpins lack a swim bladder and are poor swimmers. They are benthic feeders that are cryptic by nature, whose preferred habitat is among the interstitial spaces between and beneath cobble-boulder substrates. Compared to most other fishes with which they coexist, sculpins are largely inactive, sedentary and non-migratory. All of these factors allow them to avoid predation and coexist with larger, potential predators such as brown trout or others salmonids (Brown 1999; Polivka 2007).

Growth Rates – Sculpins belonging to the genus *Cottus* rarely exceed 40 mm TL at age I and the maximum terminal length rarely exceeds 140 mm. Petrosky and Waters (1975) reported young-of-the-year (YOY) slimy sculpins averaged almost 40 mm TL by mid-September in Valley Creek Minnesota. A gravid-five year old female was only 111 mm TL in the same stream. In the West Gallatin River in Montana, YOY mottled sculpins averaged 29 mm TL on October 28, 1950 (Bailey 1952). In the same study the maximum length among 112 male and female sculpins that were aged using otoliths was 119 mm TL and 94 mm TL, respectively. During the late summer and fall of 2010, more than 1,000 mottled sculpins were measured individually measured at 20 sampling sites across 10 different streams in Colorado. Only three sculpins exceeded 130 mm TL and the largest was 140 mm TL and weighed 42.2 g (wet weight).

Life Expectancy - Among those studies where age was determined for species of *Cottus*, the maximum age attained was generally five years, with relatively few fish reaching that age. Bailey (1952) reported five years as the maximum age observed among mottled sculpins in the West Gallatin River in southwestern Montana. The same was true among slimy sculpins in Valley Creek, Minnesota (Petrosky and Waters 1975), the Utah sculpin - *C. bairdi semiscaber* (Zarbock 1952) and the river sculpin *C. hangiongensis* in Japan (Goto 1984). However, Goto (1987b, 1989b) reported river sculpins belonging to the species *C. hangiongensis* can attain a maximum age of seven to nine years in the Daitobetsu River, in southern Hokkaido, Japan.

Spawning and Reproduction – Onset of spawning activity is variable among *Cottus* species and appears to be largely dependent on water temperature. Spawning among slimy sculpins in Valley Creek, Minnesota occurs in late April with fry emergence commencing in June (Petrosky and Waters 1975). Bailey (1952) reported that mottled sculpin spawned in the West Gallatin River, Montana throughout the month of June, while egg hatching was observed the first three weeks of July, indicating that the incubation period ranged from 21-28 days. Afternoon water temperatures ranged from 7.7 – 17.2 °C during the spawning-egg incubation period. Mottled sculpin eggs hatched successfully when incubated in hatchery water at temperatures of 10 – 12.8 °C. Sac-fry averaged 7.1 mm TL at day one after hatching, and ranged

in size from 5.8 – 8.1mm TL. At this temperature range, 14 days were required for total absorption of the yolk sac. Two-week old fry averaged 9.5 mm TL, ranging in size from 9.0 – 9.9 mm TL. Mottled sculpin fry ranging in size from 10-12 mm TL have been observed in the Gunnison River downstream of the confluence with the Smith Fork of the Gunnison River during the first two weeks of August on numerous sampling occasions over the past two decades.

Among the genus *Cottus*, the males (on average for a given age) are larger than the females. The males are nest builders that become sexually active earlier than the females. They court females through mating displays at the entrance to the nest. Larger males are polygynous, spawning with multiple females (Goto 1987a). Females tend to spawn with larger males and attach the egg clutch to the ceiling of the nest cavity, where the clutch is fertilized by the attendant male. Males guard and defend the nest from potential predators, at times fanning the incubating eggs, cleaning the clutches of dead or fungused eggs, and guarding the sac fry after hatching until the fry have absorbed the yolk sac and dispersed from the nest (Goto 1989a). These reproductive behavioural traits are consistent among numerous congeneric sculpin species, including but not limited to *C. bairdi* (Downhower and Brown 1980; Brown 1982), *C. gobio* (Marconato and Rasotto 1983; Marconato and Bisazza 1988) and *C. cognatus* (Mousseau et al. 1987) and even among marine sculpins as well (Westin 1969). In riverine habitats within the temperate climatic zone, the egg incubation period is temperature dependent but usually lasts from 21 to 28 days, with another 10 to 14 days from hatching to dispersal of the fry from the nest (Bailey 1952; Brown 1981; Downhower and Brown 1980; Goto 1982, 1983, 1984).

Few studies have been done to evaluate the importance of paternal care and protection for the incubating eggs, successful embryonic development and hatching. However, those studies that have been done suggest that this behavioural characteristic is of critical importance. Goto (1989a) evaluated the survival rate to hatching among 11 nests containing fertilized eggs of the river sculpin *C. amblystomopsis* where the guarding male was removed from five nests compared to six nests where the male was left undisturbed through the hatching process. Among the undisturbed nests, hatching success was 30, 50, 70, 80, 90 and 90%. Time to hatching among these nests ranged from eight to 14 days. In contrast, hatching success was zero among all nests that were left unguarded. Egg survivorship among all 11 nests remained at 95 to 99% for the first 48 hours after removal of the males. However, survivorship of developing eggs and embryos among the five unguarded nests dropped to zero at four, six, eight, 10 and 12 days post removal of the males. These findings strongly suggest that paternal parental care of the nest is of critical importance for successful natural reproduction and the long-term survival of a sculpin population. Moreover, fluctuations in stream discharge, and in particular large depletions in

discharge during the three to four week egg incubation period, are likely to have deleterious consequences for population viability (Adams and Schmetterling 2007).

Food Habits – The aquatic invertebrate fauna consumed by most species of sculpins belonging to the genus *Cottus* is quite similar despite the large number of species and very wide range of habitats and climatic zones where they occur. Dipteran larvae from the families Chironomidae and Simuliidae are usually the dominant food items found in stomach samples of young-of-the-year (YOY) sculpins. This holds true for *Cottus cognatus* in Valley Creek, Minnesota (Petrosky and Waters 1975), *C. bairdi* in the Gallatin River and Prickly Pear Creek in Montana (Bailey 1952), cottids in New York (Koster 1937), *C. gobio* in Sweden (Andreasson 1971), and *C. hypselurus* in the White River in Arkansas (Pender and Kwak 2002).

Microhabitat Requirements – Sculpin species belonging to the genus *Cottus* occur in both lentic (Hanson et al 1992) and lotic environments (Zarbock 1952; Bailey 1952; Goto 1983; Petrosky and Waters 1975). Many cottid fishes live exclusively in freshwater; however some species live part or all of their life in marine habitats (Westin 1969; Goto 1983). Life histories of cottid species can vary greatly even among species existing in close proximity to each other. At least seven separate cottid species (including six belonging to the genus *Cottus*) occur on the islands of Japan that have wildly divergent life histories, including catadromous, amphidromous, lacustrine-landlocked and fluvial-landlocked (Goto 1990).

In Colorado, mottled and Pauite sculpins occur primarily in streams, but can be found in lakes and reservoirs receiving inflow from streams where they are endemic. For purposes of this study, our focus is upon those populations living primarily in stream environments. While they can occur in moderate numbers in pool habitats, juvenile and adult sculpins in Colorado are generally found in the greatest densities in rocky, cobble and boulder strewn riffle and run sections of streams. By the fall, YOY sculpins ($\leq$ 40 mm TL) tend to be concentrated at the stream margins, living cryptically among and beneath leaves or other detritus, or burrowed into shallow sand or mud substrates during daylight hours. Adult sculpins are more concentrated in the deeper portions of the channel, preferring the interstitial spaces beneath cobble and boulder substrates ranging in diameter from 150 – 400 mm and can occur in very high densities where these substrates are not imbedded in fine sediments, mud or small gravels. Surface water velocities can exceed 1 m/s; however, preferred nose velocities are mostly likely near zero.

Thermal Tolerance and Preferences – Studies conducted on the range of thermal tolerances and preferences for any species of sculpin are rare. One was completed in the 1970s

on the freshwater sculpin (*Cottus cognatus gracilis*) by Otto and O'Hara-Rice (1977). These investigators reported that the upper lethal temperature was approximately 26.5 °C. However, the critical thermal tolerances were variable and dependent upon the acclimation temperature. Incipient lethal temperatures ranged from 18.5 to 23.5 °C. Avoidance temperatures ranged from 15.2°C for sculpins acclimated at 5°C and 21.5°C for fish acclimated at 15°C. Preferred temperatures for 5°C and 15°C-acclimated fish were 9°C and 12°C, respectively, and the final temperature preferendum was about 10°C. Symons et al. (1976) in another study reported the mean and median preferred temperatures for the slimy sculpin as 13.1 and 13.3°C. These investigators reported upper lethal temperatures in the range of 25-26 °C. Across their range in western North America, it is well known that the mottled sculpin and Paiute sculpins occur in sympatry with many salmonid species whose temperature tolerances, preferences and incipient lethal levels are in a range very similar to those for *C. cognatus gracilis* (Coutant 1977). Ferguson (1958) reports the final thermal preferendum for the mottled sculpin as 16.5 °C.

Life History and Distribution - Sculpins (family Cottidae) are among the most widely distributed species of fish capable of occupying a great range of aquatic and marine environments in the Northern Hemisphere. They occur throughout Scandanavia, Europe and Asia. In North America *Cottus* species occur as far south as the Carolinas on the Atlantic coast and northward into Canada, throughout much of interior North America, including the Great Lakes all the way to the Arctic Circle, in the intermountain west from New Mexico and Arizona into the Canadian Rockies and on the Pacific coast from California to Alaska. In North America, *Cottus* species occurring in streams tend to lead a very sedentary existence, and are often very territorial. Petty and Grossman (2007) demonstrated that adult mottled sculpin in a 1-km study reach of Shope Fork, a 4th order tributary of Coweeta Creek, NC are highly territorial, and extremely sedentary, with a median movement distance of only 1.42 m, while more than 80% of all movements were less than 3 m linear distance. Mean home-range size varied inversely with size and age. Among juvenile mottled sculpin ($\leq$ 48 mm standard length-SL) mean home range size varied from 1.6 to 10.9 m^2 over the three-year study. The mean home-range size among small adults (49-64 mm SL) varied from 0.8 to 8.7 m^2 over the same time period. Mean home-range size was the smallest among large adults and varied less over the course of the study (1.7 m^2 to 2.8 m^2). They found that small and larger adults occupied territories that were deeper and that had higher current velocities and higher amounts of cobble and boulder than areas used by juveniles. Territories of adults were more likely to be located in areas of stable substrate that never went dry. All life stages (juvenile, small adult and large adult) selected home ranges and habitat patches dominated by cobble and boulders and areas where the mean column water velocities were $\geq$ 38 cm/s. The mean column water velocity for large adults ($\geq$ 65 mm SL) was

48 cm/s. All three life stages of mottled sculpins in Shope Fork avoided habitats dominated by gravel, sand, silt and debris (Petty and Grossman 2007). Other investigators have shown that sculpins in montane streams move greater distances, in some cases ≥ 200 m in just a few weeks time (Schmetterling and Adams 2004; Natsumeda 2007). Natsumeda (2007) found that higher numbers of Japanese fluvial sculpin *Cottus pollux* moved farther in high-flow years compared to a low-flow year, but that a weir < 0.5 m high blocked all upstream movement of these fish.

Sculpins as Indicator Species – Traditional fisheries management in coldwater stream ecosystems historically has focused on salmonids as the umbrella species to conserve and protect all aquatic vertebrates (Adams and Schmetterling 2007). Often times the salmonids are introduced or non-native species that may have different spatial and temporal microhabitat requirements that may not coincide with those of the native fish assemblage. Adams and Schmetterling (2007) point out that sculpins are well suited for use as a bioindicator species for several reasons. First, sculpins are a sedentary benthic fish, and poor swimmers that do not have a large home range. This makes studying them easier. Second, man-made barriers or in-channel obstructions that can be negotiated by sculpins will almost certainly be passable to almost all other fish species; but the converse is not true (Schmetterling and Adams 2004; Natsumeda 2007). Third, sculpins are very sensitive to metal contaminants (Maret and MacCoy 2002). Brinkman and Woodling (2005) reported that mottled sculpins are so sensitive to zinc that they are not adequately protected by existing federal water quality standards. Fourth, sculpins are a nest-building species that require five to six weeks from spawning to fry dispersal from the nest. In most freshwater streams spawning occurs between spring and mid-summer, at a time in the intermountain west when stream flows are near the peak discharge during snow melt and then declining. Sudden changes in streamflow during the egg incubation period could result in nest abandonment or drying out of the nest. Sculpin egg clutches incubate on the underside of rocks up in the water column as opposed to salmonid eggs that incubate in gravels on the stream bottom. This makes incubating eggs of sculpins more sensitive to alterations or reductions in stream discharge than those of salmonids.

STUDY DESIGN

The job objective for this study is to document the relative abundance and distribution of the mottled sculpin *Cottus bairdi* throughout the upper Colorado River basin. The lower terminus of the study area was downstream of Gore Canyon near Radium, Colorado. The upstream terminus was on the Fraser River near the confluence with St. Louis Creek near Fraser, Colorado. The upstream electrofishing station on the Colorado River was northwest of Grand Lake, Colorado near the Winding River Ranch. Other streams and stream reaches within the study area included Arapaho, Beaver, Little Muddy and Troublesome creeks, the Colorado and Williams Fork rivers, upstream and downstream of the mainstem impoundments (Granby, Windy Gap, and Williams Fork reservoirs) as well as Willow Creek upstream and downstream of Willow Creek Reservoir). Bank electrofishing surveys were conducted at 26 separate locations in the upper Colorado River basin in Grand County. Results of three additional bank electrofishing surveys from other westslope streams downstream of major mainstem impoundments were included for comparison purposes with fish population data from the survey sites in Grand County. These streams were the Dolores River below McPhee Dam, the Gunnison River below Crystal Dam and the Yampa River below Stagecoach Dam.

We used the two pass removal method (Seber and LeCren 1967) to estimate the population size at 28 of 29 study sites. At the study site on the Dolores River, four electrofishing passes were needed to deplete the sculpin population to the level required to obtain a satisfactory level of precision and accuracy for estimating population size. At most sampling sites, length and weight information was taken on up to 100 individual fish of all fish species collected with the exception of speckled dace (*Rhinichthys osculus*). In most cases, at most sampling sites, all fish collected were identified to the species level. In a few instances, it was not possible to definitely identify small members (< 70 mm TL) of the sucker (Catostomidae) or minnow (Cyprinidae) families to the species level. The body conformation and dorso-ventrally flattened head of sculpins made it easy to identify members of the genus *Cottus* down to the minimum sizes encountered (< 20 mm TL). An ultra-light weighing scale made it possible to determine the wet weight of sculpins down to a minimum detection limit of 0.1 g with a precision of ±0.1 g. Larger fish (≥ 150 mm TL) were weighed on larger platform balances with a precision level of approximately ±10 g. At all sites we attempted to gather enough length-weight data pairs to generate a length-weight regression for estimation of biomass for each species. When the sample size was inadequate a standard weight equation was used to estimate biomass. All data sets were run through the Division of Wildlife software program JAKOMATIC to determine

population estimates with 95% confidence limits, density estimates (numbers/ha) and estimate biomass (kg/ha).

Study section length was measured along one bank to the nearest meter. The average width was determined to the nearest 0.1 m by measuring the cross-sectional width at a minimum of 10 transects between the upper and lower terminus at each study site. Study section length varied with stream size and the relative abundance of the target species, ranging from 61 m to 335 m. All study reaches included riffle areas where the predominant substrate types included cobble, rubble and/or small boulders, the substrate type preferred by sculpins in streams. The stream names and stream reaches, including study reach length, width, area, GPS coordinates and sampling dates are shown in Table A.1 in the Appendix of this report. Fish population density and biomass estimates for brown, rainbow and brook trout and sculpins at the 29 stream reaches sampled are summarized in Table A.2 in the Appendix of this report.

RESULTS AND DISCUSSION

Fish Population Density and Biomass Estimates –Brown trout densities (numbers/ha) across the 26 sampling stations within the Colorado River basin ranged from 79 to 3,333. Brown trout biomass estimates (kg/ha) at those same sites ranged from one to 236. Rainbow trout were present at 19 of 26 sampling sites. Brook trout were present at eight of 26 sample sites. At those sites where two or three salmonid species were present, total trout biomass across the 26 sampling locations within the Colorado River basin ranged from nine to 312 kg/ha.

Sculpins were collected at 18 of 26 sampling reaches within the Colorado River basin. Among the sites where sculpin were present, densities ranged from one to 21,252/ha. At those same sites sculpin biomass ranged from <0.01 to 70 kg/ha. Sculpins were abundant at 12 of 14 sampling stations located on streams that were either upstream of mainstem impoundments or tributary streams unaffected by impoundments (Table 1). The only two streams in this category where sculpins were not collected were at the downstream terminus of Little Muddy Creek and Troublesome Creek at the confluence with the Colorado River. In both cases, the effects of heavy sedimentation and lack of any cobble-rubble habitats rendered those stream reaches unsuitable for sustaining mottled sculpins. At the 14 sampling sites, sculpin densities averaged 4,228/ha, ranging from 0 to 21,252/ha (see Table 1 and Appendix Table A.2 for details).

Smaller creeks that are tributary to the Colorado and Fraser rivers sampled in 2010 included Arapaho, Beaver, Little Muddy, Troublesome and Willow creeks. YOY sculpins were collected from four of the five creeks at five of seven sites sampled. The only two sampling sites where no sculpins were collected were on the Troublesome and Little Muddy creeks at the confluence with the Colorado River. Both sampling sites were inundated with sand, silt and clay sediments and were largely devoid of any cobble-rubble substrates that are the preferred substrate type for sculpins.

At the 11 sampling stations downstream of mainstem impoundments in the Colorado River basin, sculpins were collected from only five stream reaches. Only one sculpin was collected from four sampling stations on the Colorado River between Windy Gap Dam (WGD) and the confluence with the Blue River at Kremmling. That fish measured 138 mm TL and was captured in a steep riffle approximately 50 m upstream of Grand County Road 57/578 (Hitching Post) Bridge, 1.5 km downstream of WGD. The combined reach length sampled at those four sites was 0.976 km (0.61 miles or 3,200 feet). Excluding the sampling site approximately 0.1 km downstream of Willow Creek Reservoir (WCR), average sculpin densities were only 21/ha, ranging from zero to 167/ha (Table 1). The estimated density of sculpins at the site immediately below WCR was extremely high (15,003) and inflated due to a low capture probability ($p=0.11$) on the first electrofishing pass, resulting in a very imprecise estimate with a 95% confidence limit (CL) of ±25,746. At the sampling site on Willow Creek at the C Lazy U Ranch upstream of WCR the density estimate was higher (21,252/ha) but much more precise with a 95% CL of ±3,531, owing to a much higher capture probability ($p=0.39$).

Table 1 Average densities (N/Ha) for trout and sculpins upstream and downstream of mainstem impoundments (Granby, Williams Fork, Willow Creek-WC and Windy Gap reservoirs) versus streams downstream of mainstem impoundments outside of the Colorado River drainage.

Category	Sample Size (N)	Trout Density (N/Ha)		Sculpin Density (N/Ha)		Trout %	Sculpin %
		Ave	Range	Ave.	Range		
Above Impoundments Av.	13	1,842	192 – 9,585	4,228	0 – 21,252	30	70
Below Impoundments Av.	11	1,020	626 – 1,742	1,611[a]	0 – 15,003[a]	39	61
BelowImpoundments Av.[b]	10	1,023	626 – 1,742	272	0 – 2,524	79	21
Colorado R. @ Radium	1	1,335	--------	7,194	-------	16	84
Dolores R. ↓ McPhee Dam	1	95	--------	6,453	-------	2	99
Gunnison R. ↓ Curecanti Dams	1	2,070	--------	4,348	-------	32	68
Yampa R.↓ Stagecoach Dam	1	194	--------	968	-------	18	82

Notes: [a] Includes reach on Willow Creek 100 meters below Willow Creek Reservoir (WCR).
[b]: Below mainstem impoundments without the Willow Creek site 100 meters below WCR.

We suspect that the sculpins captured at the Willow Creek site immediately below WCR had spilled or been flushed out of WCR during releases from the dam, for two reasons. First, these sculpins were mostly larger, older fish based on the range of sizes captured. Only 2.1% (8 of 376) of the sculpins collected were ≤ 60 mm TL, indicating that the 98% of the sculpin collected were ≥ two years of age. It is noteworthy that water releases from WCR for 18 consecutive days during May and June of 2008 averaged 334 ft^3/s, ranging from 161 to 857 ft^3/s. Similarly, in 2009 water releases from WCR averaged 172 ft^3/s for 15 days, ranging from 100 to 225 ft^3/s. Sculpins do live in reservoirs, but are weak swimmers and when accidentally entrained in fast moving water, they would be subject to flushing over an overflow outlet or through a discharge valve. In 2010, water releases into Willow Creek were a rare occurrence, never exceeded 98 ft^3/s and never lasted for more than one to two days. June is the month that male sculpins would most likely be seeking out an acceptable nesting site for spawning. July and early August would be the period of egg incubation and hatching. During June, July and August of 2010, the mean monthly discharges from WCR were 15.1, 19.8 and 7.3 ft^3/s and ranged between

one and 7 ft^3/s for 23 days during June. Due to the average width of the channel (10.7 m) and low discharge, very low spawning success would be expected. Not surprisingly, only 0.5% (2 of 376) sculpins measured during the survey on September 15, 2010 were ≤ 34 mm TL, the maximum size to be expected for YOY mottled sculpins in September. Second, if the very high density of sculpins observed at this site immediately below WCR was representative of natural reproduction and a healthy, self-sustaining population, we would expect to capture sculpins in the creek downstream as well. However, none were captured or observed at the survey site approximately 2 km downstream from WCR.

The sculpin population size and age structure was much different at the sampling reach on Willow Creek approximately 3 km above WCR at the C Lazy U Ranch. Forty-seven of 159 sculpins (29.6%) measured were ≤ 34 mm TL, the maximum expected size for YOY sculpins. These fish averaged 27.8mm TL, ranging from 20 to 34 mm TL. At this site the average channel width was 7.3 m and mean monthly discharges for June, July and August were 328, 55 and 27 ft^3/s. At the upstream sampling site on Willow Creek approximately 1.5 km above confluence with Cabin Creek, YOY sculpins were smaller, averaging 20.5 mm TL and ranging from 17-24 mm TL. Age-one sculpins at this site averaged 44 mm TL, ranging in size from 34 – 51 mm TL.

Two sampling surveys were completed on the Williams Fork River upstream of Williams Fork Reservoir (WFR) during 2010. The upstream site was at the confluence with Ute Creek approximately 16 km upstream of WFR, and 1 km upstream of the Keyser Creek confluence. Estimated sculpin density was 1,964/ha at this site, comprising 82.5% of the fish density. At the lower site above the first bridge crossing 0.2 km upstream of WFR, estimated sculpin density was 5,404/ha, comprising 81.5% of the fish density. (See Appendix Tables A.1 and A.2 for details).

No sampling was conducted on the Williams Fork River downstream of WFR in the fall of 2010. However, at least 16 electrofishing surveys have been completed at three separate sampling locations on this reach between May 2001 and November 2006. Sculpins were collected on only five of the 16 surveys, and four of the five collections were at the sampling site immediately below WFR at the USGS gaging station, less than 50 m below the dam outlet. The total number of sculpins collected during each of those five surveys ranged from one to four, never comprising more than 0.9% of the total number of fish collected, a sharp contrast with the surveys upstream of WFR where sculpins comprised more than 80% of the total fish density.

Four separate reaches of the Fraser River upstream of WGR were surveyed by electrofishing in the fall of 2009 and 2010. Estimated sculpin numbers ranged from 64% to 85% of the total trout and sculpin density, averaging 2,673/ha and ranging from 1,651 to 4407/ha. See Tables A.1 and A.2 in the Appendix for detailed information on site location, density and biomass estimates.

On the Colorado River at Winding River Resort, upstream of Shadow Mountain and Granby reservoirs, the estimated densities of brown trout and sculpin were 1,630 and 2,912/ha. Similarly, estimated densities of sculpin and brown trout on the Colorado River between Shadow Mountain and Granby reservoirs were 2,524 and 98/ha, respectively. However, at the sampling site at the Grand County Road 627 Bridge, approximately 3 km downstream of the Granby Dam outlet, estimated brown trout density was 1,678/ha while estimated sculpin density was 167/ha. At the Horn Ranch sampling station, approximately 0.2 km upstream of the confluence with the Fraser River above WGR, the estimated densities of trout and sculpins were 974/ha and 24/ha, respectively.

On the Colorado River upstream of WGR, the size and age structure of the sculpin population varied greatly between the four sampling sites. At the Horn Ranch, five of the six sculpins captured ranged in size from 107 to 140 mm TL, suggesting those fish were ≥ age four and most likely immigrants from the Fraser River some 200 m downstream. There were no YOY sculpins collected at this sampling station. Similarly, 33 of the 44 sculpins captured at the Grand County Road 627 Bridge sampling site were ≥ 100 mm TL and 43 of 44 were ≥ 72 m TL, suggesting that virtually all of the sculpins were age three or older, and 75% (those ≥ 100 mm TL) were probably at least age four or older. Only one sculpin at this site was of a size (25 mm TL) suggesting that it was a young-of-the-year. A review of the discharge records for the Colorado River below Granby Dam indicate that mean monthly discharge levels have never approached 100 ft^3/s for the months of May through September from 2001 through 2010, ranging from a low of 15.6 ft^3/s in September 2001 to a high of 84.5 ft^3/s in May 2008. The lack of natural reproduction by sculpins is not surprising, given the lack of flushing flows for more than a decade, an over width channel, chronically low water velocities, and the interstitial spaces beneath cobble-rubble substrates clogged with sediment or covered with beds of rooted aquatic macrophytes, High velocities riffles dominated by sediment-free, cobble-rubble substrates are the preferred microhabitats that male sculpins seek out for nesting sites during the late-spring, early summer months (June to mid-August).

Sculpins were captured in significantly greater numbers on the reach of the Colorado River between Granby Reservoir and Shadow Mountain Dam outlet. A total of 307 sculpin were captured, including 15 YOY sculpins, ranging in size from 22 to 25 mm TL. Fifty-nine of 115 sculpins measured were≥ 100 mm TL and most likely ≥ age four. Only nine of 100 sculpins measured that were greater than age one ranged in size from 74-88 mm TL. These fish were probably the 3-year old cohort (2008 year class). Ninety-one of 100 were ≥ 92 mm TL, and probably ≥ age four (age classes 2006 and 2005) in a reach of stream 91.5 m in length and dominated by sediment-free, large cobble and small boulder substrates. Given that the sculpin population in this reach is dominated by fish likely to be age four and older and that most sculpins are sexually mature at age two and the substrate and microhabitat are ideal for sculpin nesting sites, the apparent lack of reproductive success is somewhat enigmatic. A thorough review of the scientific literature (see the Introduction section in this report) indicated that the time from spawning to hatching for many species of sculpins in temperate climatic zones in the northern hemisphere is four to six weeks. Given that 1) the nests must be guarded by mature male sculpins from spawning to hatching, 2) nesting site selection will be dependent on stream discharge, and 3) nests will be vulnerable to large fluctuations in flow, particularly dramatic reductions in discharge, it is possible that spawning success in this reach could be closely tied to variations in flow between June (presumed period of spawning) and mid-August (presumed period of hatching and dispersal of fry from the nests.

Table 2 Summary of discharge records for various time periods for estimated spawning, egg incubation and hatching periods of sculpins in the Colorado River basin in Grand County versus estimated sculpin year class size (n/ha) for various years from 2006 through 2010.

Sculpin Age(yr) & (n/ha)	Year	Discharge (ft^3/s) records for various time periods						
		Average June Discharges			July Discharge		8/1-15 Discharges	
		Mo. Mean	6/15-30 Av.	Range 6/15/-30	Mo. Mean	7 Day Min./(% Δ)	15 D Mean	7 Day Min./(% Δ)
Colorado River between Shadow Mountain Dam and Lake Granby								
0+ (75)	2010	1,579	913	50-1,566	50	50/ -95%	41	40
1+ (5)	2009	1,292	1,466	905-2,080	224	50/ -97%	56	40
2+ (86)	2008	768	730	482-1,234	72	50/ -93%	102	67
3+ (707)[a]	2007	655	678	257-1,401	79	50/ -93%	40	40
4+ (610)[a]	2006	439	50	50	50	50/ 0%	40	40
Fraser River above Windy Gap Reservoir at Kaibab Park in Granby								
0+ (292)	2010	931	597	331-849	143	83/ -86%	98	79
Willow Creek @ C Lazy U Ranch above Willow Creek Reservoir								
0+ (4,142)	2010	328	164	88-283	55	37/ -77%	35	29
Williams Fork River 0.2 km upstream of Williams Fork Reservoir								
0+ (155)	2010	625	342	168-540	61	23/ -93%	103	78
1+ (1,174)	2009	669	612	474-814	194	109/ -82%	84	71

[a]: These estimates of year class strength are probably fairly accurate based on excellent separations of year classes based on length-frequency distributions; however, the size of these year classes may be due in part to immigration out of Shadow Mountain Reservoir.

A review of discharge records from Shadow Mountain Dam from 2006 through 2010 suggest that between year variations in flow for the critical period from June through mid-August may well explain the explain the apparent low reproductive success in 2008, 2009 and 2010 compared to 2006 and 2007 (Table 2). A similar analysis for sculpin year-class strength for 2009 and/or 2010 versus discharge patterns from mid-June through mid-August for sampling sites on the Fraser and Williams Fork rivers upstream of mainstem impoundments and Willow Creek upstream of WCR reveal similar results. These data sets imply that the greater the percent decrease in discharge between June 15-30 (estimated spawning period) compared to the seven-day minimum discharge during July (estimated egg incubation period) or the first 15 days in August (fry hatching/yolk sac absorption period) the greater the depression of YOY sculpin year-class strength. This sort of a negative relationship between high discharge levels and fluctuations in stream discharge during the early life stages (incubating eggs, intra-gravel, post-hatch alevin, and two to four week old fry emergence) among salmonids is well documented in Colorado (Nehring and Anderson 1993). Likewise, spawning and nesting success among stream-dwelling sculpins are also highly vulnerable to discharge fluctuations (Adams and Schmetterling 2007).

A total of 453 YOY sculpin (based on length-frequency distribution) were collected at nine of 14 sampling sites upstream of mainstem impoundments in the Colorado River basin in 2010. In contrast, a total of 18 YOY sculpins were collected at all sampling sites combined downstream of the five mainstem impoundments, Granby, Shadow Mountain, Willow Creek, Williams Fork, and Windy Gap reservoirs. Fourteen of those 18 YOY sculpins were collected downstream of Shadow Mountain Dam, the one stream reach that is largely not impacted by sedimentation, and usually experiences substantial flushing flows during the month of June.

CONCLUSIONS

Transmountain diversions and mainstem water storage reservoirs have been used to supply the needs of agriculture and development of the infrastructure required to support an expanding population base in Colorado for a century or more. This has been especially true for the Colorado River basin. Lying just across the Continental Divide west of the Front Range population centers of Fort Collins, Greeley, Boulder and the greater Denver Metropolitan area, the headwater streams in the basin have been diverted through direct transmountain diversions such as the Grand Ditch in the northern part of Grand County and the Moffat Tunnel, which collects and transports water from almost every stream tributary to the Williams Fork and Fraser rivers in the southeast portion of the county. Five mainstem dams (Granby, Shadow Mountain,

Williams Fork, Willow Creek and Windy Gap) all collect, store, divert and release water to satisfy a variety of water rights, agricultural, municipal and industrial needs and purposes. Windy Gap was the last mainstem dam on the upper Colorado River in Grand County, completed in the early 1980s.

While there have been attempts to address the environmental costs and impacts accruing to the upper Colorado River as new projects and diversions came on line during the last half of the 20th century, it is only within the last decade that the total cumulative impacts have begun to be noticed and serious attempts made to address the issue(s). There are at least six significant issues that need to be taken into account when considering the overall health of the Colorado River downstream of Windy Gap Dam through Middle Park to the confluence with the Blue River near Kremmling. These are 1) restoration of channel connectivity, 2) channel reconfiguration, stream power and flushing flows, 3) sediment deposition and transport, 4) water temperature, 5) encroachment of rooted aquatic vegetation, and 6) whirling disease.

While the six issues listed above are all important, we have ranked them (from highest to lowest) in what we consider a descending order of priority. The problems of channel armoring and chronic sedimentation and clogging of the interstitial spaces in the cobble-rubble dominated riffles areas has been ongoing in the upper Colorado River basin for more than half a century. These proposed firming projects at Windy Gap and the Moffat Tunnel are only going to further exacerbate this situation. Two things must be done if there is to truly be any hope of enhancement of aquatic ecosystem in the upper Colorado River in the future. A bypass channel around Windy Gap Dam and a major investment in stream channel reconfiguration for the Colorado River below WGD are both equally important and the only way true enhancement has any possibility of success. Either one without the other will have virtually no chance of succeeding.

Restoration of Channel Connectivity - Since WGR came on line, movement of all fish species up and down the river has been impeded. Downstream drift of aquatic insect larvae has been interrupted. A bypass channel around WGR would re-establish channel connectivity and allow both of these important biological functions to be restored. It would allow free movement of spawning trout and other species of fish in both directions and open the river below WGD for recolonization by aquatic insect species and other invertebrates through downstream drift.

Our 2010 study of 26 sites in the basin has conclusively demonstrated that a native fish, the mottled sculpin, has been extirpated from the Colorado River below WGR all the way to the Blue River confluence. A bypass channel around WGR would open the river below the lake to the possibility of re-colonization by sculpins from the Fraser River upstream. It is noteworthy that the densities of mottled sculpins are very high in the Colorado, Fraser, and Williams Fork rivers, as well as Arapaho and Willow creeks upstream of the mainstem impoundments. Sculpin density is also high in the Colorado River downstream in and below Gore Canyon, after the inflow of water from the Blue River essentially restores the "health" and flows of the river in a manner that largely mimics the natural hydrograph. Likewise, sculpins occur in significant densities with multiple year classes present in non-impounded tributary streams such as Beaver and Troublesome creeks. Given these distributions, it is not likely that the factor(s) responsible for extirpation of the species downstream of WGR are associated with water quality parameters as they exist in these other locations. It is a function of flow depletions beginning in the late-spring and early-summer months during run-off period and the loss and impairment of physical habitat due to lack of sustained flushing flows.

Similarly, the giant stonefly *Pteronarcys californica* still exists in low to moderate densities in the Fraser River upstream of WGD, along with other aquatic insect species that have been significantly reduced or extirpated below WGD. Reconnection of the river channel with a bypass around WGD would open the stream of recolonization by aquatic insects of many species through downstream drift.

Channel Reconfiguration, Stream Power and Flushing Flows – The combined effects of 1) collection and diversion of water in the Fraser River Basin by the DWD through the Moffat Tunnel, and 2) impoundment, pumping, storage and export of water from the Colorado River basin to the East Slope via the Grand Ditch and the Alva B. Adams Tunnel at Grand Lake have resulted in significant, cumulative degradation of the stream ecosystems in Grand County. These more serious initial impacts began on the Colorado River downstream of Granby Dam mid-way through the 20th century, due to the lack of flushing flows and the associated decrease in stream power. The severe reductions in the frequency, magnitude and duration of high flushing flows below WGD since its construction in the 1980s, has severely reduced the stream power in the Colorado River downstream of Windy Gap. The combined, cumulative effects of the proposed DWD Moffat Tunnel Enhancement Project and the NCWCD Windy Gap Firming Project will greatly exacerbate this situation unless the Colorado River stream channel width is significantly reduced. That is the only way to increase stream power in the face of larger and continuing water withdrawal from the basin.

Periodic flushing flows of sufficient magnitude and duration are critically important for maintaining the biotic integrity of stream ecosystems. Project proponents have proposed at various times that a discharge in the range of 450 to 600 ft^3/s for less than 3 days is an adequate flushing flow for the Colorado River below WGD. However, a true flushing flow requires a discharge substantially greater than 1,000 ft^3/s for several weeks, as occurred in 2010 and 2011. Flows of lower magnitude and shorter duration will not result in the deep cleaning of the cobble-boulder substrates in the riffles, chutes or pools.

Fine Sediment Deposition and Transport – The combined impacts of extended droughts, impoundment, storage of spring flushing flows in Willow Creek, Williams Fork and Granby reservoirs, interception and pumping of water out of WGR, and depletions as a result of transmountain diversions through the Moffat and Alva B. Adams tunnels have greatly exacerbated sediment deposition in the Colorado River below Granby and Windy Gap dams. Sediment deposition can be ameliorated and even prevented by adequate flushing flows of sufficient periodicity, magnitude and duration. However, all the benefits of a true flushing flow are negated when accumulated sediments in a reservoir are mobilized, entrained and then flushed downstream during the low-flow period in late summer and fall. At least twice since 2001, WGR has been drained and large volumes of sediment flushed into the Colorado River in mid to late summer, long after spring flushing flows were available to transport the sediment downstream. The first occurrence was during the severe drought during 2001-2002 when WGR was drained in mid-summer to eliminate evaporation losses. The second occurrence was in late summer 2010, when the lake was drained to dredge sediments out of the lake that had accumulated in front of the penstock intakes for the pumps in WGR. On both occasions, accumulated sediments in the reservoir were mobilized, entrained and subsequently settled out in the first few miles of river below the dam.

Sediments are most efficiently flushed and transported out of the receiving stream at the time of entrainment. When this does not happen, deposited sediments harden and require greater stream power for a longer duration to be mobilized and transported. Due to the aforementioned problems resulting from these transbasin diversions over the past half century, the Colorado River channel is approximately 50% overwidth. Stream power (to transport sediment) has been adversely impacted. Sediment deposits choke the interstitial spaces among the gravel, cobble and boulder substrates in the riffle areas.

Riffle areas are critical to maintenance of the biotic integrity of the stream on at least four levels. First, riffles are the primary zones of aquatic insect production. Second, healthy aquatic insect populations are the primary food source for foraging fish. Third, riffle habitats are the primary spawning zone for rainbow trout, brown trout, and sculpins. Gravels and cobbles imbedded with sediments are an impediment to spawning success of trout and sculpins. Large cobble, rubble and small boulder substrates in the steep gradient riffles that are sediment-free and un-imbedded are the prime habitats necessary for maintaining healthy populations of sculpin, the giant stonefly *Pteronarcys californica* and other aquatic insects. Fourth, free-stone cobble substrates at the margins of the channel, even in pools are critically important microhabitats for young-of-the-year (YOY) rainbow and brown trout as well as sculpins and dace. When those areas are clogged with sediment build-up, the carrying capacity of the stream for successful rearing of YOY trout and sculpins is greatly degraded. A bypass channel around WGR should eliminate the need for inadvertent or intentional flushing of sediments during the low-flow summer periods, adding a significant layer of protection for the river below the WGR at the times when it is most vulnerable to stress. When WGR needs to be drawn down to eliminate evaporation losses (which happened at least once in the past decade) sediment flushing would not occur since all the water would be flowing through the bypass channel around WGR once the lake pool was drained and the outlet works closed off.

Water Temperatures – Any time water is impounded, solar radiation will heat the water. Impounded water always heats faster in shallow reservoirs such as WGR. Water heating in the Colorado River in Grand County will be most problematic for coldwater species such as trout and sculpins in late summer, at a time when the river flows are at the seasonal low and the stream water temperatures are already high. Periodic monitoring of water temperatures at various locations in the Colorado River basin carried out by the CDOW since the early 1980s has shown that daytime water temperatures can range from 20 to 25 ° C during the summer months, particularly in below average water years (Nehring and Thompson 2001, 2003). The combined effects of elevated water temperatures and severely reduced flow can act in a negatively synergistic manner, posing serious risks to the aquatic fauna. A bypass channel around WGR eliminates the problem of additional heating of the impounded water during the late-summer low flow period prior to its release to the river.

Rooted Aquatic Vegetation – Growth and expansion of aquatic vegetation mats in the Colorado River since the construction of WGR has been extensive. It has been especially problematic between WGR and the confluence with the Williams Fork River at Parshall, Colorado. Rooted aquatic vegetation now essentially has invaded all parts of WGR. Many

aquatic plants seed and populate other habitats through fragmentation. Fragments float out of WGR, settling out in the slower moving areas of the river. Once established, they continue growing in size and number, slowing the flow of water, trapping fine sediments and particulate organics that (in turn) provide a nutrient base for growth and expansion of the vegetation mat. Vegetation mats choke out the interstitial spaces in the cobble-strewn margins of the river that are critical microhabitat rearing areas for YOY trout, sculpins, dace, and other fishes. Vegetation mats can be seen everywhere on the river between WGR and the confluence with the Blue River. Downstream of WGR, the problem is greatest between the dam and the confluence with the Williams Fork River. However, after more than a half century of impoundment of the Colorado River at Granby Dam, and no flushing flows at all except during rare spilling events, the choking of the river channel with sediment and aquatic vegetation mats is most severe from Granby Dam to the confluence with the Fraser River.

Vegetation mats become increasingly difficult to dislodge when true flushing flows have become all but a thing of the past as flow depletions have increased, particularly during the spring flush period. The Gunnison River in western Colorado, downstream of Black Canyon National Park (BCNP) is an outstanding example of a healthy river corridor. Above the confluence with the Smith Fork of the Gunnison, it is only about 10%-20% wider than the average channel width of the Colorado River below WGR. The Gunnison River Gorge (GRG) receives large, annual sediment inputs during the summer months from side canyon flash floods that result from summer thunderstorms. These large inputs of sediment led to development of huge sediment laden vegetation mats during periods of extended drought, such as occurred in 2001 and 2002. However, these vegetation mats and massive amounts of sediment have been largely eliminated from long sections of the GRG by flushing flows $\geq$ 3,000 ft^3/s that are sustained for 2-4 weeks in many years, with peak discharge levels as high as 6,000 – 8,000 ft^3/s. The GRG rarely experiences flows below 300 ft^3/s, due to minimum flow agreements. The only time between October 1991 and September 2010 that flows in the GRG dropped below 300 ft^3/s, was from November 2002 until early May 2003 at the end of the extended, severe drought of 2001-2002 when daily discharge levels ranged from 248 – 313 ft^3/s. Mean monthly flows in the GRG have exceeded 1,000 ft^3/s for 85 of 240 months between October 1991 and September 2010. The GRG downstream of BCNP has outstanding populations of the giant stonefly and sculpins, both of which coexist with perhaps the best stream trout sport fishery in Colorado. A bypass channel around WGR would eliminate the seeding of the Colorado River by fragmentation of rooted aquatic vegetation flowing out of the lake. Over time, with true flushing flows (as will occur this year), the rooted aquatic vegetation mats could be dramatically reduced in size and number.

Whirling Disease - The Whirling Disease (WD) issue with WGR being a serious point source of infection is the one issue that has largely resolved naturally over the past decade. Much has been learned through intensive, worldwide research efforts beginning in the mid-1990s about the way this parasitic disease of trout and salmon operates in lake and stream ecosystems. What has been learned that applies directly to WD in WGR is that the aquatic worm population in the lake during the 1990s was complex of at least six different types of tubificid worms. Only one of those types of worms was the worm host for the *Myxobolus cerebralis (Mc)*, the parasite that can cause WD. However, in the 1990s the worm that was susceptible to infection by the *Mc* parasite was one of the dominant worm types in WGR, especially in the main channel of water flowing into and through WGR. The high densities of those worms in the main channel of water flowing into WGR resulted in very high levels of the floating TAM spores that were infectious to trout flowing out the lake and into the Colorado River (Nehring et al. 2003). Most parasites have a deleterious effect on the host, in this case the lineage 3 *Tubifex tubifex*. When the infection is serious enough, the lineage 3worm is reproductively impaired (Shirakashi and El-Matbouli 2009). However, the other species or strains of worms in the lake (*T. tubifex* lineages 1, 5 and 6 and at least two other species) do not become infected by the parasite, and therefore continue to reproduce successfully, while the heavily infected lineage 3 worms do not. Over time (apparently about a decade-from 1991 to 2001) the once-dominant lineage 3 worm which comprised about 75% of the *T. tubifex* (*Tt*) population in 1998 decreased in abundance such that by 2005 it accounted for only 5% of the *Tt* population, while and the non-infectible lineage 1, 5 and 6 worms made up 95% of the population (R. B. Nehring unpublished data). Numerous laboratory exposures of all 4 lineages of *Tt* worms have repeatedly shown that 250 *Tt* worms can produce 2,000 to 10,000 progeny in 6 months. Given that sort of a reproductive advantage over the once-dominant lineage 3 *Tt* worms, at some point in time a shift could occur in the composition of the *Tt* worm population structure favoring the non-infectible lineage 1, 5 and 6 worms. This sort of shift in the *Tt* worm population structure has been observed in other aquatic ecosystems where the *Mc* parasite has been enzootic for a decade or longer, including the Gunnison River below the BCNP (Nehring, unpublished data). These worms have been proven (through CDOW research efforts) to function as biological controls of the fish-produced myxospores that infect the worms, thereby further reducing the rate of exposure of the now increasingly rare lineage 3 worms in WGR.

Evidence from research efforts across Colorado indicate that the WGR population is unlikely to shift back toward dominance by lineage 3 strain worms.. Nonetheless, the WD problem in the Colorado River downstream of WGR as well as in the Fraser River upstream of

WGR still exists. A bypass channel around WGR serves to reduce the exposure of the Colorado River downstream of WGR to WD in three significant ways. First, the worm-infective myxospores of the WD parasite that are produced in brown, brook and rainbow trout in the Fraser River upstream of WGR get mobilized from the sediments into the water column during spring run-off (May and June) and are deposited in WGR when the water velocity slows to almost zero in the lake. Those myxospores are ingested by aquatic worms, some of which are still lineage 3 *Tt* worms. Those worms will produce the fish-infective TAM spores beginning in July and would be released downstream into the river (Nehring et al. 2003). However, with WGR managed and operated as a no-spill impoundment, especially during the low flow, non-pumping periods (usually July through March), all TAMs spores produced in WGR stay impounded in the lake. Second, the water bypassed around the lake through a bypass channel is largely devoid of myxospores because they are not so easily mobilized during low flow periods and seasons. Third, since the aquatic worm population in WGR is comprised of more than 95% strains and species that are not susceptible to the *Mc* parasite, they truly function as biological filters by deactivating and destroying the myxospores in the lake, thereby significantly reducing the level of exposure to the trout populations below the lake, compared to a system operating without the bypass.

A bypass channel around WGR is important in numerous ways for restoration of functionality of the Colorado River between WGR and the confluence with the Blue River in Middle Park. Over time, with true flushing flows the biotic integrity of the river could be restored. However, true functionality and biotic integrity cannot be restored without re-establishment of the connectivity of the river.

RECOMMENDATIONS

Indicators of Biotic Integrity - In the event that the proposed Windy Gap Firming Project and the Moffat Tunnel Enhancement Project become a reality, one of the mitigation requirements will be a much more concerted effort on a number of fronts to try and return the upper Colorado River to some semblance of a more properly functioning ecosystem. One of the proposals to help insure that becomes a reality is a process called "***Learning by Doing***". A part of that process will entail regular monitoring the aquatic ecosystem and observation of physical, chemical and biological indicators for evidence of restoration and hopefully enhancement of the affected aquatic ecosystems. This will require (among other things) selecting species of aquatic insects and fish to function as biological indicators of ecosystem health.

Aquatic insects that have been adversely impacted by WGD and flow depletions, as shown in this report, can best serve in that capacity. EPT taxa that should be considered as indicator species are the following; among the stoneflies, *Pteronarcys californica, Pteronarcella badia* and an *Isogenoides* species. Among the mayflies such species as *Drunella grandis, Drunella doddsii,* and *Tricoythodes explicates* should be considered. Among the caddisflies such taxa as *Ochrotrichia, Protoptila, Arctopsyche, Cheumatopsyche* and *Psychomyia flavida* should be considered.

The mottled sculpin is the best species of fish to use as a biological indicator of ecosystem health for a multiplicity of reasons. First, it is a native species that once occurred throughout the upper Colorado River basin, and still does in most of the creeks and major tributary streams upstream of the mainstem impoundments on Willow Creek, as well as the Colorado, Fraser and Williams Fork rivers. Therefore, continued monitoring of this species in the unimpounded headwater reaches will quickly give an indication of microhabitat degradation in those areas. Second, sculpins are a benthic dwelling species that are much less mobile, quite sedentary. Their prime microhabitat is among the cobble-boulder strewn riffle areas that are prone to sedimentation and clogging when stream function has been compromised due to excessive flow depletions. They have been extirpated from the mainstem of the Colorado River from WGD downstream to the confluence with the Blue River. Restoration of a sculpin species in this reach of river would be the hallmark of success and *prima facie* evidence that "enhancement of the river" has truly happened. Third, because sculpins are largely a sedentary species, with a very limited home range, monitoring of their population levels and relative abundance can be much more easily accomplished with less time and manpower than is necessary to monitor trout populations. Fourth, the sculpin spawning period runs from late spring through mid-summer, spanning a period of 6-8 weeks that probably begins in mid-June and ends in early to mid-August. Male sculpins attract females into a nest beneath cobble-boulder substrates in riffle areas, guard and clean incubating eggs until they hatch. During this 6-8 week period, the nests are vulnerable to dewatering and destruction by desiccation. Failure of sculpin reproduction will be most likely the result of severe fluctuations and depletions of stream flow between spawning and hatching. In contrast, successful reproduction will once again be *prima facie* evidence that "enhancement of the river" has truly happened. Fifth, sculpins exist in sympatry with all salmonid species (cutthroat, brook, rainbow and brown trout, grayling and mountain whitefish) in streams all across western Colorado and the Intermountain West. Mottled and Paiute sculpins are native species that are easy to study. Sixth, their thermal tolerances are

very similar to the stream-dwelling salmonids that they coexist with throughout the west. Seventh, they are a nongame species and are not exploited by anglers, making them a better target species for assessment of impacts due to water diversion and man-made manipulation of stream flows over short reaches of stream. For all of those reasons they are an excellent indicator species for assessing the functionality and biotic integrity of mountain stream ecosystems.

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Appendix for Job 2

Tables

Table A.1. Summer and fall 2010 electrofishing station descriptions, length, width, area, GPS coordinates and sampling dates.

Stream Name	Station Location & Description	Length (m)	Width (m)	Area (ha)	X & Y Coordinates (NAD 83)		Date
Arapaho Creek	Below Monarch Lake	97.6	11.5	0.1121	13T 436112	4440537	10/20/2010
Beaver Creek	Beaver Creek SWA	61	4	0.0224	13T403755	4433733	9/16/2010
Colorado River	Winding River Resort	91.5	11.4	0.1043	13T427656	4458874	9/15/2010
Colorado River	Double A Barns below Shadow Mtn Rsvr	91.5	20.4	0.1867	13T428710	4450559	9/9/2010
Colorado River	County Rd. 627 Rd Bridge below L. Granby	106.7	27.5	0.2934	13T424169	4442110	10/19/2010
Colorado River	Jack Horn Ranch	182.9	15.8	0.289	13T417391	4439633	10/20/2010
Colorado River	Hitchin Post	304.9	27.9	0.8507	13T414734	4440532	9/14/2010
Colorado River	Red Barns	335.4	29.2	0.9794	13T412699	4439618	9/9/2010
Colorado River	Lone Buck SWA	243.9	29.9	0.7293	13T402733	4433676	9/9/2010
Colorado River	BLM above the Ritschards Ranch	91.5	34.1	0.312	13T394848	4435729	10/19/2010
Colorado River	BLM Pumphouse	61	6.4	0.039	13S370978	4427501	9/22/2010
Fraser River	Behind Safeway	190.5	6.4	0.1219	13S430424	4422619	9/7/2010
Fraser River	At Elkdale in Fraser River Canyon	192.1	18.5	0.3554	13T424704	4432658	9/11/2009
Fraser River	Solvista	122	21.9	0.2672	13T424497	4435696	9/2/2010
Fraser River	Kaibab Park	198.2	10.2	0.2022	13T420741	4437199	9/2/2010
Little Muddy Creek	200 m North Grand County 361 Bridge	34.8	3.67	0.0128	13T402933	4432456	9/17/2010
Troublesome Creek	1.5 mi above E. Fork confluence	88.4	3.14	0.0278	13T389344	4448510	10/22/2010
Troublesome Creek	Below Hwy 40 Bridge Colo R. confluence	122	9.1	0.111	13T388710	4434818	9/21/2010

Table A.1 (Continued) Summer and fall 2010 electrofishing station descriptions, length, width, area, GPS coordinates and sampling dates.

Stream Name	Station Location & Description	Length (m)	Width (m)	Area (ha)	X & Y Coordinates (NAD 83)		Date
Williams Fork River	Above Bridge Crossing Reservoir	104	8.7	0.0905	13S399324	4428292	9/8/2010
Williams Fork River	Ute Creek confluence	182.9	13.1	0.2396	13S406704	4415663	9/21/2010
Williams Fork River	0.1 km below Williams Fork Reservoir	182.9	9.5	0.1729	13T397183	4432363	9/12/2001
Williams Fork River	Below DOW Irrigation Diversion headgate	266.8	12.8	0.3415	13T398369	4434068	9/12/2001
Willow Creek	1 mi above Cabin Creek confluence	122	7.7	0.0939	13T410299	4452711	9/7/2010
Willow Creek	CLazyU Ranch	91.5	7.3	0.0668	13T415666	4446516	9/10/2010
Willow Creek	Upper site below Willow Creek Reservoir	122	10.7	0.1305	13T420008	4444396	9/15/2010
Willow Creek	2 miles below Willow Creek Reservoir	106.7	7.5	0.08	13T421231	4443103	9/16/2010
Gunnison River	Above North Fork	122	4.9	0.0598	13S253612	4296301	11/9/2010
Yampa River	Above Sarvis Creek	152.4	13.2	0.2011	13T346451	4462224	11/4/2010
Dolores River	Lower Metaska Day Use Area	61	19.4	0.1183	12S713113	4161698	11/11/2010

Table A.2. Fish population density and biomass for 2010 in the Colorado River basin and at three reference sampling sites, outside the basin for comparative purposes.

Stream Name	General Sample Location Description	Brown Trout		Rainbow		Brook Trout		Mottled Sculpin		Smallest
		N/ha	Kg/ha	N/ha	Kg/ha	N/ha	Kg/ha	N/ha	Kg/ha	(mm TL)
Arapaho Creek	Below Monarch Lake	1,386	236	2,754	72	288	4	3,455	24	35
Beaver Creek	Beaver Creek SWA	204	1	0	0	9,381	84	3,666	16	33
Colorado River	Winding River Resort	1,630	47					2,912	9	32
Colorado River	Double A Barns below Shadow Mtn Rsvr	98	19	7,918				2,524	36	22
Colorado River	Grand County 627 Rd Bridge below L. Granby	1,678	89	29	11			167	3	25
Colorado River	Jack Horn Ranch	971	87	3	1			24	1	52
Colorado River	Hitchin Post	1,031	170	176	30			1	0	134
Colorado River	Red Barns	773	139	97	21			0	0	
Colorado River	Lone Buck SWA	532	111	94	10			0	0	
Colorado River	BLM above the Ritschards Ranch	789	31	6	0			0	0	
Colorado River	BLM Pumphouse	1,335	75					7,194	38	39
Fraser River	Behind Safeway	206	54	41	8	712	52	4,407	45	46
Fraser River	at Elkdale in Fraser River Canyon	654	116	265	18			1,651	17	57(a)
Fraser River	Solvista	286	56	11	0	8	0	1,797	17	27
Fraser River	Kaibab Park	589	73	79	11			2,838	20	25
Little Muddy Creek	200 m North Grand County 361 Bridge	236	6					0	0	
Troublesome Creek	1.5 mi above E. Fork confluence	3,333	109			1,090	21	4,477	25	28
Troublesome Creek	Below Hwy 40 Bridge at Colo R. confluence	502	63					0	0	

Table A.2 (continued). Fish population density and biomass for 2010 in the Colorado River basin and at three reference sampling sites, outside the basin for comparative purposes.

Stream Name	General Sample Location Description	Brown Trout		Rainbow		Brook Trout		Mottled Sculpin		Smallest
		N/ha	Kg/ha	N/ha	Kg/ha	N/ha	Kg/ha	N/ha	Kg/ha	(mm TL)
Williams Fork River	Above Bridge Crossing Reservoir	924	48	171	34	213	2	5,404	20	31
Williams Fork River	Ute Creek confluence	79	7	79	2	258	12	1,964	15	45
Williams Fork River	0.1 km below Williams Fork Reservoir	638	179	215	63			0	0	
Williams Fork River	Below DOW Irrigation Diversion headgate	1,197	191	164	57			0	0	
Williams Fork River	At raft launchgate station	4,258	274	65	25			0	0	
Willow Creek	1 mi above Cabin Creek confluence	160	26			32	0.5	6,370	19	17
Willow Creek	CLazyU Ranch	135	70	75	56			21,252	70	23
Willow Creek	Uppersite below Willow Creek Reservoir	978	16	8	0			15,003	122	40
Willow Creek	2 miles below Willow Creek Reservoir	1,730	187	12	1			0	0	
Gunnison River	Above North Fork	2,070	26					4,348	70	64
Yampa River	Above Sarvis Creek	24	9	170	66	19	1	968	13	47
Dolores River	Lower Metaska Day Use Area	86	13	9	5			6,453	69	49

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Colorado's Official State Position Regarding Fish and Wildlife Mitigation Plans

by Brian W. Bevan

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Coordinating Editors
Kevin Kinnear (Water), Boulder, Porzak Browning and Bushong LLP-(303) 443-6800, kkinnear@pbblaw.com; Melanie Granberg (Environmental), Denver, Gablehouse Calkins and Granberg, LLC-(303) 572-0050, mgranberg@gcgllc.com; Joel Benson (Natural Resources and Energy), Denver, Davis Graham and Stubbs LLP-(303) 892-7470, joel.benson@dgslaw.com
About the Author
Brian W. Bevan is an associate in the Civil Litigation Practice Group at Feldmann Nagel, LLC in Denver-(970) 331-9900, brianbevan19@hotmail.com.

This article analyzes the environmental mitigation process that water development projects must complete to obtain a federal permit. It also compares requirements under the federal Clean Water Act with Colorado's Fish and Wildlife Mitigation statute.

After passage of the Clean Water Act (CWA) in 1972, the U.S. Army Corps of Engineers (Corps) became the federal authority that regulates the discharge of dredged or fill material into the waters of the United States. The implementing regulations require a water development project to mitigate the harmful effects on the aquatic environment, including both direct and indirect effects to fish and wildlife.

In 1987, the Colorado General Assembly passed House Bill (HB) 1158, which also attempted to mitigate the environmental effects of water development projects. HB 1158, compared to the CWA, has a narrower scope and does not go as far to mitigate harmful effects.

This article provides an overview of the requirements a water development project must fulfill under the CWA to obtain a Corps-issued permit. It also discusses HB 1158, including its process and statutory structure, as well as the legal effect of Colorado's "official state position" on mitigation. Finally, the article analyzes the differences between the CWA and HB 1158 and the

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limited deference that Colorado's official state position should be given during the federal permitting process.

Permit Requirements Under the CWA

The CWA's objective is to restore and maintain the chemical, physical, and biological integrity of the nation's waters.(fn1) To achieve this lofty goal, the CWA prohibits the discharge of dredged or fill material into the waters of the United States without a Corps-issued permit.(fn2)

Almost every major water project will require that dredged or fill material be placed in waters of the United States and, consequently, will require a Corps-issued permit. CWA § 404(b) and its corresponding regulations require a detailed analysis of water development project impacts and mitigation measures to obtain a 404(b) permit.(fn3) The 404(b) Guidelines direct that dredged or fill material should not be discharged into the aquatic ecosystem if an "unacceptable adverse impact" will result.(fn4) The Tenth Circuit Court of Appeals has interpreted these Guidelines to require that a "[404(b)] permit may not be issued if . . . the discharge will result in significant degradation. . . ."(fn5) Thus, the starting point of the Guidelines is that all practicable steps must first be taken to avoid significant degradation of the nation's waters. Accordingly, this is consistent with the CWA's objective to restore and maintain America's waters.

The Guidelines then provide strict requirements to ensure proper issuance of a 404(b) permit and are organized into nine subparts. Subpart A generally describes the statute's purpose and policy. Subpart B establishes conditions that must be satisfied to make a finding that a proposed discharge complies with the Guidelines.(fn6) It also sets forth factual determinations to be considered in deciding whether a proposed discharge satisfies the conditions of compliance. These determinations include analyzing each of the following: the physical substrate of a disposal site, water circulation, fluctuation and salinity, suspended particulate and turbidity, contaminants, and the aquatic ecosystem and its organisms.(fn7)

Subpart C describes the physical and chemical components of a site and how proposed dredged or fill material may affect it.(fn8) Subparts D through F detail aquatic ecosystems in terms of value and the possible loss of that value with dredged or fill material discharges.(fn9) Subpart G prescribes a number of physical, chemical, and biological evaluations and testing procedures to be used in reaching the required factual determinations.(fn10) Subpart H details preventing or minimizing adverse effects.(fn11) Finally, Subpart I concerns identification of disposal areas.(fn12)

The Guidelines further require the Corps to determine the potential short- or long-term effects the discharge will have, both individually and cumulatively. A determination of secondary or "indirect" effects also must be analyzed.(fn13) The Guidelines point to fluctuating water levels in impoundment projects and downstream water levels associated with the operation of a dam as examples of indirect effects.(fn14) The Tenth Circuit has voiced its concern over limiting the 404(b) analysis to direct impacts only when it summarized: There is no authority for the proposition that, once it is required to consider the environmental impact of the discharge that it is authorizing, the Corps is limited to consideration of the direct effects of the discharge. The reduction of water flows resulting from the increased consumptive use *is* an effect, albeit indirect, of the discharge to be authorized by the Corps.(fn15) (Emphasis in original.)In short, the Guidelines require a comprehensive analysis of numerous factors to achieve CWA compliance.

Mitigation Under the CWA

In addition to proving a project is the least environmentally damaging practicable alternative,(fn16) the Guidelines require mitigation for any potential adverse impacts to the environment.(fn17) The Corps has the authority to deny a 404(b) permit if sufficient mitigation is not proposed.(fn18) The U.S. Environmental Protection Agency (EPA) and the Department of the Army, under the Corps' authority, signed a Memorandum of Agreement (MOA) articulating the timing, type, and level of mitigation necessary for a qualifying water development project to comply with the Guidelines.(fn19) The MOA and EPA guidance require the following three-step sequence of actions to offset impacts to aquatic resources: (1) avoidance; (2) minimization; and (3) compensatory mitigation.(fn20) Compensatory mitigation should be discussed only after the project proponent proves that impacts cannot be avoided and appropriate and practicable steps have been taken to minimize adverse impacts.(fn21)

The District of Columbia has recognized that the mitigation analysis is a major component that determines a water development project's compliance with the CWA.(fn22) In *Environmental Defense v. United States Army Corps of Engineers*, the court found that the Corps had violated the CWA and stated: The Corps may approve a project only if it is the least damaging practicable alternative, if its discharges do not cause or contribute to significant degradation of the water of the United States (including, in relevant part, loss of fish and wildlife habitat), and if potential adverse impacts to aquatic ecosystems are minimized to the extent practicable.(fn23)

The Council on Environmental Quality (CEQ) defines mitigation to include: (1) avoiding the impacts altogether; (2) minimizing the impacts; (3) rectifying the impacts by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impacts over time; and (5) compensating for the impacts by replacing or providing substitute resources or environments.(fn24) Toward mitigation's achievement, the Guidelines require the Corps to analyze myriad factors in determining CWA compliance. These mitigation factors include all effects on the aquatic environment, such as water quantity, including the effects of the discharge on water velocity; current patterns; water circulation; normal water fluctuations; suspended particulates; turbidity; salinity gradients; fish and other aquatic organisms, wildlife, sanctuaries, and refuges; and riffle and pool complexes.(fn25)

Consistent with these factors, the Corps must determine the amount and appropriate method of compensatory mitigation. There are four Corps- and EPA-approved methods of compensatory mitigation:(fn26) 1) restoration of the impacted aquatic resource;(fn27)2) establishment of another aquatic resource through manipulation of the physical, chemical, and/or biological characteristics of the site;(fn28)3) enhancement that heightens, intensifies, or improves the aquatic resource;(fn29) and4) preservation, which means permanent protection of the aquatic resource through legal and physical mechanisms (such as conservation easements or title transfers).(fn30) Furthermore, there are three mechanisms that provide for compensatory mitigation: (1) permittee-responsible compensatory mitigation; (2) mitigation banks; and (3) in-lieu fee mitigation.(fn31)

In sum, the CWA mitigation process has a broad scope with detailed requirements to obtain a 404(b) permit. The Guidelines focus on direct and indirect impacts to the entire aquatic environment,(fn32) set against the CWA backdrop of restoring and maintaining the integrity of

America's waters.

Mitigation Under Colorado's Fish and Wildlife Statute

The stated purpose of HB 1158 (CRS § 37-60-122.2) is to mitigate fish and wildlife impacts in a manner that is economically reasonable and maintains a balance between fish and wildlife protection and water resources development.(fn33) The statute provides procedural steps for Colorado to arrive at an official state position regarding mitigation actions required by a water development project.

An applicant requiring a 404(b) permit must submit a mitigation plan to the Colorado Wildlife Commission (WLC).(fn34) If the WLC approves the mitigation plan, the Colorado Water Conservation Board (CWCB) will adopt the plan as the official state position on mitigation.(fn35) If the WLC proposes changes to the applicant's mitigation plan, it will transmit those changes to the CWCB.(fn36) The CWCB can either affirm the WLC's recommendations as the official state position or make modifications of its own.(fn37) If modifications are made, the governor then either affirms the CWCB's recommendations or modifies the mitigation plan again, which then becomes the official state position.(fn38) The official state position is then communicated to the Corps.(fn39) HB 1158 and its implementing regulations limit the WLC to enumerated factors it may consider when deciding whether a mitigation plan is economically reasonable and reflects a balance between fish and wildlife protection and developing the state's waters.(fn40) Unlike the numerous mitigation factors listed in the federal Guidelines that generally relate to the aquatic environment, the WLC is restricted and can consider only the following criteria: (1) the value and significance of the affected resource; (2) potential impacts of the project to wildlife; (3) the availability of technology to implement and monitor the mitigation plan; (4) the degree of mitigation and permanence of mitigation measures; (5) cost of mitigation compared to its benefits; (6) net benefits of the project and its mitigation to wildlife; (7) consistency of mitigation with other environmental goals; and (8) legal ramifications of state water law on implementing mitigation.(fn41) The WLC is limited to the foregoing criteria because mitigation measures must be balanced against the economy of water development; this was the General Assembly's intent when it passed the original bill.

The legislative history behind the statute reflects a compromise between environmentalists and water developers. The original proponents of HB 1158, Executive Director of the Department of Natural Resources Clyde Martz and Senator Tillman Bishop, repeatedly stated this concern during congressional hearings and debates. For example, Martz said, "I say again that it is our opinion that this is a means of bringing assurance to wildlife mitigation in connection with project development at a reasonable level of obligation."(fn42) Senator Bishop later said: This really becomes a major, major piece of legislation in bringing about an accomplishment of balance between the preservation and protection of wildlife and yet recognizing that there are needs for water projects in the State of Colorado.(fn43)

The legislative history is full of similar comments stating that the ultimate goal of HB 1158 was balancing fish and wildlife protection with developing the state's waters at a reasonable cost.

The Legal Effect of Colorado's Official State Position

HB 1158 is wholly untested by the courts. The Colorado Attorney General's office has issued a

Memorandum that interprets the statute's enforceability and scope.(fn44) The Memorandum explicitly states that a mitigation plan adopted pursuant to HB 1158 is not enforceable as a matter of state statutory law.(fn45) This conclusion is largely a result of the language used throughout the statute, which characterizes the mitigation plan as a "recommendation" to the federal permitting agency-that is, the Corps.(fn46) The mitigation plan could be enforceable as law only if: (1) the plan or its provisions became conditions of the Corps-issued 404(b) permit; or (2) the plan could be enforceable under contract law if the applicant and the WLC made separate agreements as to implementation of the mitigation plan.(fn47)

The scope of the mitigation plan need not address any fish and wildlife impacts from past water development projects or facilities. Rather, the scope addresses only future impacts of the proposed water project measured against presently existing conditions.(fn48) This is apparent in both the plain language of HB 1158 and its implementing regulations.(fn49)

The mitigation plan is not necessarily required to address all impacts on fish and wildlife resources.(fn50) A mitigation plan's starting point may attempt to mitigate all impacts, but the language in the statute does not compel it. That means at least some fish and wildlife resources will yield to the economy of a water development project. This is plainly indicated where the statute states: [I]mpacts on such resources [such as fish and wildlife] should be mitigated by the project applicants in a *reasonable manner*. It is the intent of the general assembly that fish and wildlife resources that are affected by the construction, operation, or maintenance of water diversion, delivery, or storage facilities should be mitigated to the extent, and in a manner, that is *economically reasonable*. . . .(fn51) (Emphasis added.)

Colorado's official state position, therefore, does not carry significant legal weight concerning the requirements under the CWA. The official state position is indeed a recommendation, but the state-approved mitigation plan cannot legally bind the Corps.

Differences Between the CWA and HB 1158

The most striking difference between the CWA and HB 1158 is the legal standard each statute employs. The CWA's stated purpose is to restore and maintain the integrity of the nation's waters. HB 1158's stated purpose is to provide a balancing test between fish and wildlife mitigation and water development and the economic reasonableness of doing so. The federal standard relates to water quality and fixing rivers; the state standard focuses on mitigation if it is not too expensive. The scope of the two statutes also varies significantly. The CWA mandates that "no significant degradation" shall occur to the nation's waters. HB 1158 does not mention the health of the aquatic environment generally; instead, it requires mitigation to fish and wildlife, but only if it is economically reasonable. The mitigation required under Colorado's statute pertains only to fish and wildlife. The federal statutory mitigation scheme includes fish and wildlife and attempts to diminish environmental effects on the whole aquatic environment, whether those effects are direct or indirect and individual or cumulative.

In sum, the CWA requires a comprehensive analysis of numerous factors to obtain a 404(b) permit. These factors are stricter and more varied than any mitigation analysis required by HB 1158. Accordingly, Colorado's official state position should be given limited deference by the Corps when it issues a 404(b) permit to Colorado water development projects. The Corps may

consider implementing some of the state's recommendations as permit conditions, but the Corps cannot rely solely on the official state position as a sufficient mitigation plan. The federal law is crafted around a much more stringent statutory scheme. Colorado's official state position is simply a recommendation based on a balancing test.

Conclusion

The permitting process under the CWA is an extensive and comprehensive process. The Corps analyzes a plethora of physical, chemical, and biological factors related to a water development project. Colorado's mitigation statute is not nearly as strict. It focuses merely on impacts to fish and wildlife, rather than on the direct and indirect effects of the aquatic environment as a whole, and requires mitigation to be economically reasonable. As such, Colorado's official state position does not carry legal weight when the Corps determines whether to issue or deny a 404(b) permit.

Footnotes:

1. 33 U.S.C. § 1251(a).
2. *See* 33 U.S.C. § 1344(b)(1).
3. *See id.*; 40 C.F.R. §§ 230.1 *et seq.*
4. 40 C.F.R. § 230.1(c) and (d) state: Fundamental to these Guidelines is the precept that dredged or fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern. . . . From a national perspective, the degradation or destruction of special aquatic sites, such as filling operations in wetlands, is considered to be among the most severe environmental impacts covered by these Guidelines. . . .*See also Sierra Club v. U.S. Army Corps of Eng'rs*,772 F.2d 1043, 1050 (2d Cir. 1985) ("The Guidelines further prohibit landfilling 'unless it can be demonstrated' that the activity will not have an 'unacceptable adverse impact' on the aquatic ecosystem.").
5. *Utahns for Better Transp. v. U.S. Dep't of Transp.*, 305 F.3d 1152, 1163 (10th Cir. 2002), *citing* 40 C.F.R. § 230.12(a)(3)(i) to (iv).
6. The Guidelines state that no discharge of dredged or fill material shall be permitted if: (1) there is a practicable alternative; (2) it causes violation of applicable state water quality standards or jeopardizes endangered or threatened species or violates the Marine Protection, Research, and Sanctuaries Act; (3) it will cause or contribute to significant degradation of the waters of the United States; and (4) unless appropriate and practicable steps have been taken that will minimize adverse impacts of the discharge on the aquatic ecosystem. 40 C.F.R. § 230.10(a) to (d).
7. 40 C.F.R. § 230.11.
8. *See* 40 C.F.R. §§ 230.20 to 230.25.
9. *See* 40 C.F.R. §§ 230.30 to 230.54.
10. *See* 40 C.F.R. §§ 230.60 and 230.61.
11. *See* 40 C.F.R. §§ 230.70 to 230.77.
12. *See* 40 C.F.R. § 230.80.

13. *See* 40 C.F.R. § 230.11(h).
14. *See* 40 C.F.R. § 230.11(h)(2).
15. *Riverside Irrigation Dist. v. Andrews*, 758 F.2d 508, 513 (10th Cir. 1985).
16. *See infra* text accompanying note 23.
17. *See* 40 C.F.R. §§ 230.91 to 230.98.
18. 33 C.F.R. § 332.1(c)(3) states: During the 404(b)(1) Guidelines compliance analysis, the district engineer may determine that a DA permit for the proposed activity cannot be issued because of the lack of appropriate and practicable compensatory mitigation options.
19. The Memorandum of Agreement was signed by the U.S. Environmental Protection Agency and Department of the Army in 1990 and is available at www.epa.gov/wetlands/regs/mitigate.html.
20. *Id.* This three-step sequence of actions is commonly referred to as the "Mitigation Sequence."
21. *See Park v. U.S.*, 286 F.Supp.2d 201, 207 (D. Puerto Rico 2003) (holding that the U.S. Army Corps of Engineers (Corps) was not required to consider a mitigation proposal because a practicable alternative was available for the development project). *See also* 40 C.F.R. §§ 230.91 *et seq.* and 33 C.F.R. §§ 332 *et seq.*, defining "practicable" as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." *Id.* at § 230.3(q).
22. *See Environmental Def. v. U.S. Army Corps of Eng'rs,* 515 F.Supp.2d 69, 77 (D.D.C. 2007).
23. *Id.*
24. The Council on Environmental Quality (CEQ) was given authority to issue regulations that would be binding on all federal agencies by Exec. Order No. 11991 (May 24, 1977). CEQ's definition of mitigation is codified at 40 C.F.R. § 1508.20.
25. *See Riverside Irrigation Dist., supra* note 15 at 512; 40 C.F.R. §§ 230.1 *et seq.*
26. Compensatory mitigation guidance is available at www.epa.gov/owow/wetlands/pdf/CMitigation.pdf.
27. *Id.*
28. *Id.*
29. *Id.*
30. *Id.*
31. Compensatory Mitigation for Losses of Aquatic Resources, Final Rule, 73 Fed. Reg. 19,594 (April 10, 2008). Permittee-responsible mitigation is the most common type of mitigation in which the permittee retains responsibility. Mitigation banks and in-lieu fee mitigation involve third-party compensatory mitigation activities where responsibility shifts from the permittee to the bank or in-lieu fee sponsor. *Id.*
32. *See Riverside Irrigation Dist., supra* note 15 at 512.
33. CRS § 37-60-122.2(1)(a) states: It is the intent of the general assembly that fish and wildlife resources that are affected by the construction, operation, or maintenance of water diversion, delivery, or storage facilities should be mitigated to the extent, and in a manner, that is economically reasonable and maintains a balance between the development of the state's water resources and the protection of the state's fish and wildlife resources.
34. *See* CRS § 37-60-122.2(b).

35. *Id.*
36. *See* CRS § 37-60-122.2(c).
37. *Id.*
38. *Id.*
39. *Id.*
40. *See* 2 C.C.R. § 406-16:1604 B.3.
41. *Id.*
42. Hearing on HB 87-1158 Before the House Agriculture Committee (March 4, 1987) (statement of Clyde Martz, Executive Director of the Department of Natural Resources).
43. Hearing on HB 87-1158 Before the Senate Agriculture Committee (April 16, 1987) (statement of Senator Tillman Bishop).
44. *See* Monohan, "Memorandum on Mitigation of Fish and Wildlife Impacts Under § 37-60-122.2, C.R.S.," available at wildlife.state.co.us/NR/rdonlyres/64A55241-4B4E-400A-A220-23885D8CF08B/0/MitigationMemo12910.pdf.
45. *Id.* at 6.
46. *See, e.g.*, CRS § 37-60-122.2(1)(c). *See also* Monohan, *supra* note 44 at 7: Mitigation plans are only recommendations submitted to federal authorizing agencies for their consideration. In that sense they are more in the nature of the multitude of comments submitted by state agencies as part of a federal permitting process.
47. Monohan, *supra* note 44 at 6-7.
48. *Id.* at 3.
49. 2 C.C.R. §§ 406-16:1603.M ("Mitigation plan means a document describing the measures to be completed by the applicant which will mitigate losses to fish and wildlife resources resulting from the project.") and 406-16:1604.A(1) ("A wildlife assessment . . . is dependent upon baseline data that provides an overview of the wildlife resources and related conditions as they currently exist in the area."). *See also* CRS § 37-60-122.2(2)(c) ("An applicant may apply for . . . enhancing fish and wildlife resources over and above the levels existing without such facilities.").
50. Monohan, *supra* note 44 at 4.
51. CRS § 37-60-122.2(1)(a).

JOHN W. SUTHERS
Attorney General

CYNTHIA H. COFFMAN
Chief Deputy Attorney General

DANIEL D. DOMENICO
Solicitor General

STATE OF COLORADO
DEPARTMENT OF LAW
OFFICE OF THE ATTORNEY GENERAL

STATE SERVICES BUILDING
1525 Sherman Street - 7th Floor
Denver, Colorado 80203
Phone (303) 866-4500

December 9, 2010

TO: Tom Remington
Director
Colorado Division of Wildlife

Wildlife Commission

FROM: Tim Monahan
First Assistant Attorney General
Natural Resources and Environment Section

RE: Mitigation of fish and wildlife impacts under § 37-60-122.2, C.R.S.

This memorandum is in response to your request for advice with regard to the fish and wildlife mitigation requirements under state law, specifically §37-60-122.2, C.R.S.

Generally, § 37-60-122.2, C.R.S., sets forth the process and the statutory constraints for the establishment of an "official state position" on the mitigation recommended to address the impacts to fish and wildlife resources from the construction, operation or maintenance of any proposed water diversion, delivery or storage facility requiring a permit, license or other approval from the United States. Section 37-60-122.2, C.R.S., also establishes the process and the statutory requirements for the issuance of state fish and wildlife mitigation and enhancement grants.

And as concerns such state fish and wildlife mitigation plans, I think it is important to note at the onset that the project applicant is largely in control of the process, particularly with regard to the timeline and whether there is Division of Wildlife or public participation in the initial development of their mitigation proposal. Certainly, the Division recommends to all applicants that it is clearly in their best interest to work with staff prior to formal submittal of a mitigation proposal to increase the prospects of subsequent Wildlife Commission approval and public support. However, the timing of submittal and whether there is any pre-submittal coordination/consultation with the Division is ultimately up to the project applicant.

I have included a copy of 37-60-122.2, C.R.S., as attachment 1 to this memorandum. I have also included a copy of the Wildlife Commission's regulations implementing 37-60-122.2, C.R.S., as attachment 2. Both attachments are instrumental in answering the questions you have raised

EXHIBIT 51

regarding the scope, extent and enforceability of state fish and wildlife mitigation plans and the administrative process to be used in their development.

In that regard and as we have discussed numerous times before, statutes are to be construed wherever possible according to their plain language and obvious meaning and without resort to strained or forced interpretations. See e.g. People v. Browning, 809 P.2d 1086 (Colo. App. 1990); People v. Thomas, 867 P.2d 880 (Colo. 1994). And where statutory language is not clear, courts will typically defer to an agency's reasonable construction of a statute that it is charged with administering, such as expressed by implementing regulations. See e.g. Larimer County School District v. Industrial Commission, 727 P.2d 401 (Colo. App. 1986), cert. denied, 752 P.2d 80 (Colo. 1988); Bluewater Ins. Ltd. V. Balzano, 823 P.2d 1365 (Colo. 1992).

The Wildlife Commission recently adopted a state mitigation plan for the Southern Delivery System ("SDS"), a water storage project in the Arkansas River basin, and is currently preparing to receive and consider two fish and wildlife mitigation plans involving proposed water projects within the Colorado River basin. Unlike the previous projects and mitigation proposals considered by the Wildlife Commission under §37-60-122.2, C.R.S., including SDS, Elkhead Reservoir and Wolford Mountain Reservoir, the two proposed water projects in the Colorado River basin – the Windy Gap Firming Project (proposed by Northern Colorado Water Conservancy) and the Moffat Tunnel Firming Project (proposed by Denver Water) – have generated a significant level of public discussion and it is likely that any mitigation proposal made by the two project applicants will be subject to significant scrutiny by parties concerned about the environmental impacts of the projects, including impacts to fish and wildlife resources.

In anticipation of the Wildlife Commission's consideration of these projects and associated mitigation proposals pursuant to §37-60-122.2, C.R.S., you requested advice on a number of questions related to the appropriate scope of such mitigation proposals, their enforceability and the procedures the Wildlife Commission might employ in providing for effective public discussions of those proposals.

Scope and Enforcement of Mitigation Proposals

Based on prior public discussions regarding the Colorado River and the two proposed water projects, there appears to be little doubt among some parties that the fish and wildlife resources of the Colorado River have been significantly impacted by prior water projects and that some of those impacts have gone unmitigated. Some parties may consider the current mitigation proposals as a vehicle for addressing those prior unmitigated impacts.

1. Whether prior impacts to fish and wildlife resources from existing water diversion, delivery or storage facilities that are related to or could be affected by the construction, operation or maintenance of new facilities, including modification of existing facilities, are properly the subject of the current state mitigation plan proposals?

No, not as part of a mitigation plan, such prior impacts would be more appropriately addressed as part of an enhancement plan pursuant to § 37-60-122.2(2)(c), C.R.S., should the project applicant choose to undertake such enhancement.

The focus of the plain language of § 37-60-122.2, C.R.S., with regard to the scope of the mitigation plan is on addressing the future impacts of the "proposed facility" and not at all on past impacts of other projects or facilities. The plain language of the statute indicates that the scope of the appropriate mitigation for the proposed facility is evaluated from a baseline established by the fish and wildlife resources that currently exist without the proposed facility.

And perhaps the clearest statement in that regard is set forth in the statutory provision that addresses the distinction between mitigation and enhancement grants, which states:

> "An applicant may apply for an enhancement grant by submitting to the commission and the board an enhancement proposal for enhancing fish and wildlife resources **over and above the levels existing without such facilities.**"

Section 37-60-122.2(2)(c), C.R.S. (emphasis added).

This "baseline" approach is also what is found in the regulations implementing 37-60-122.2, C.R.S., as adopted by the Wildlife Commission. For example, Regulation No. 1604.A.2, 2 requires project applicants to submit a mitigation plan that has as its basis a wildlife impact assessment that is:

> "dependent upon **baseline data** that provides an overview of the wildlife resources and related **conditions as they currently exist in the area.**"

See also Regulation No. 1603.M ("Mitigation means any action or measures taken to address undesirable project impacts on fish and wildlife resources ..."), 1603.H ("Enhancement means the improvement of the total value of fish and wildlife resources affected by the project beyond that required by mitigation and beyond that which would occur without the project") and 1603.O ("Mitigation Plan means a document describing the measures to be completed by the applicant which will mitigate losses to fish and wildlife resources resulting from the project").

Simply put, I find no support in the plain language of the statute or the implementing regulations for requiring a project applicant to address past impacts from prior projects as part of a mitigation plan under 37-60-122.2, C.R.S. The focus of the statute and the implementing regulations is clearly on the proposed project and future impacts.

Certainly, a project applicant might voluntarily agree to address past unmitigated impacts as part of a mitigation plan or, perhaps more appropriately, as part of an enhancement plan, but there is nothing in statute or regulations that would otherwise require the applicant to do so.

> 2. Whether all impacts on fish and wildlife resources that result from the construction, operation or maintenance of a water diversion, delivery or storage facility are required to be addressed in a state mitigation plan?

Not necessarily. Section 37-60-122.2 does not state such an absolute position with regard to the scope of or requirement for mitigation.

In fact, the statute, in what appears to be very carefully worded language, first declares that any impacts on fish and wildlife resources:

> "should be mitigated by the project applicants in a **reasonable** manner"

and then goes on to state that it is the intent of the General Assembly that:

> "fish and wildlife resources that are affected by the construction, operation, or maintenance of water diversion, delivery or storage facilities should be mitigated to the extent, and in a manner, that is **economically reasonable** and **maintains a balance** between the development of the state's water resources and the protection of the state's fish and wildlife resources."

Section 37-60-122.2(1)(a), C.R.S. (emphasis added). The qualified nature of the language used plainly indicates that some impacts to fish and wildlife resources may not need to be mitigated if it were economically unreasonable to do so and would not reflect the balance between protection of fish and wildlife resources and development of water resources intended by the General Assembly. This qualified language is also repeated in the implementing regulations. See Regulation No. 1604.B.3.

Certainly, there may be instances where requiring all impacts to be mitigated will be both economically reasonable and reflect a proper balance between fish and wildlife and water resources and this is the appropriate, and should be the presumed, starting point for any mitigation analysis, but it is not an absolute requirement that all impacts be mitigated all the time given the qualification placed upon mitigation by the General Assembly.

> 3. Whether the mitigation plan developed under state law is limited to addressing the impacts to fish and wildlife resources identified as part of the environmental assessment process required under federal law (the National Environmental Policy Act)?

Not necessarily. There is no such express limitation in §37-60-122.2, C.R.S. And while there is some language in the implementing regulations that might support an argument for such a limitation, there is other regulatory language that appears to require all impacts to fish and wildlife resources to be identified and recommendations made for their mitigation.

In addressing the preparation of the wildlife mitigation plan, the implementing regulations direct applicants to prepare information:

> "within the time sequences and framework of established federal environmental impact review requirements"

and that the wildlife impact assessment required of all applicants:

> "is an integral part of the environmental impact assessment process and is not intended to be separate from or beyond the scope of that process."

See Regulation Nos. 1604.A.2 and 1604A.2.c.1. Both of these provisions could be read as support for limiting the impacts to be addressed by the state mitigation plan to only those specifically identified as part of the federal process.

However, within the same regulatory provision, applicants are then directed to prepare the wildlife impact assessment and recommendations for mitigating losses:

> "based upon a systematic evaluation of fish and wildlife resources and habitats using the best available scientific information and professional judgment."

See Regulation Nos. 1604.A.2.c.3. This provision would appear to require an independent analysis of the impacts and possible mitigation and not necessarily be limited to only those impacts identified as part of the federal process.

In that regard, it is more appropriate to read the "limiting" provisions as more general references to simply ensure the mitigation plan is prepared in a time frame that fits within the federal time sequence and framework and otherwise occurs concurrently with the federal process. That is, the intent of the "limiting" provisions are to ensure that the state mitigation plan is available for timely consideration by the federal agency as part of its permitting, licensing or approval procedures, and to minimize the potential for a duplicative state process that could otherwise delay the project. Those provisions should not be construed as a substantive limitation on what impacts or mitigation requirements might be considered as part of the state mitigation plan. And to the extent that is not clear, the Wildlife Commission should consider amending the regulation to ensure that it is.

> 4. Whether cumulative impacts on fish and wildlife resources that result from the construction, operation or maintenance of a water diversion, delivery or storage facility are required to be addressed in a state mitigation plan?

Yes. While there is no such express requirement in §37-60-122.2, C.R.S., to consider cumulative impacts, there is some language in the implementing regulations (albeit somewhat limited in nature) that supports their identification and mitigation as part of the fish and wildlife mitigation plan.

Regulation No. 1604.A.2.c.4 requires in the preparation of the mitigation plan that:

> "Where possible, impacts to wildlife and habitat will be separated into the following categories: direct and indirect; on-site and off-site; public lands and private lands; and cumulative impacts. In the disclosure of predicted impacts, each category may have separate mitigation measures associated with it, which when assembled make up a mitigation plan."

Literally, cumulative impacts are required to be addressed. However, there is no definition of "cumulative impacts" in the implementing regulations. As such, the term is open for interpretation by the Wildlife Commission, provided that interpretation reasonably complies with the stated intent of §36-60-122.2 – to mitigate impacts in an economically reasonable manner and which maintains a balance between the development of the state's water resources and the protection of the state's fish and wildlife resources.

The term could possibly include consideration of the synergistic impacts created or associated with other concurrently proposed projects, if any. It could also possibly include the impacts of future projects that will occur because of the completion of the proposed project and perhaps particularly if those future projects would not independently require a federal permit, license or approval and their own fish and wildlife mitigation plan.

However, I think the term would include only concurrent or future projects. For the reasons discussed above, I do not believe it reasonably would include past impacts to fish and wildlife resources, even if the proposed project has some connection to a prior project that has unmitigated impacts associated with it. Certainly, an impact that exacerbates a condition resulting from a prior project must be addressed, but the project applicant would only be responsible for maintaining the baseline condition existing at the time of the proposed project. That is, such an impact would be cumulative in nature, but the applicant would only be required to maintain the baseline, not to mitigate the prior impact.

> 5. Whether the mitigation plan adopted or agreed to pursuant to 37-60-122.2, C.R.S., is enforceable as a matter of state statutory law?

No. Mitigation plans adopted pursuant to § 37-60-122.2, C.R.S., are not themselves independently enforceable as a matter of state law.

Mitigation plans simply represent the "official state position" on appropriate mitigation of the fish and wildlife impacts that are expected to result from the construction, operation and maintenance of the proposed facility. In fact, the mitigation plan is characterized throughout the statute as a "recommendation." See e.g. § 37-60-122.2(1)(c), C.R.S.

After its adoption, the recommended mitigation plan is transmitted to the federal agency from which the project applicant must obtain a permit, license or approval. Such plans then become enforceable as a matter of law only if compliance with them is ultimately made a term or condition of the permit, license or approval issued by the authorizing agency.

Such mitigation plan may also become enforceable as a matter of contract between the project applicant and the Wildlife Commission should the parties make separate agreements as to implementation of the mitigation plan as was the case for the mitigation plan for the Southern Delivery System. In that case, Colorado Springs Utilities entered into a separate memorandum of understanding that bound it to the funding and implementation of the mitigation plan.

However, in the absence of their incorporation by the authorizing agency or a separate contract such mitigation plans are not independently enforceable as a matter of state law.

> 6. Are there any specific hearing procedures that apply to the adoption of a state mitigation plan, particularly with respect to public input?

Section 37-60-122.2, C.R.S., quite specifically sets forth the roles that the Wildlife Commission, the Colorado Water Conservation Board and the Governor play in considering and adopting mitigation plans. And the regulations of the Wildlife Commission quite specifically outline the requirements placed upon the applicant in preparing and submitting the proposed mitigation plan for consideration. See generally Chapter 16 "Procedural Rules of the Wildlife Commission, Article II – Implementation of HB 1158," 2 CCR 406-16. However, neither the statute nor the regulations specifically address how stakeholder groups or other interested members of the public may challenge or otherwise comment on a proposed mitigation plan being considered by the Wildlife Commission.

Some parties may argue for a "trial-like" hearing for the consideration and adoption of state mitigation plans such as provided for in the state Administrative Procedures Act ("APA"), specifically 24-4-105, C.R.S., for agency adjudications and that certainly could be an option if the Wildlife Commission is so inclined. Such trials rely in large part on live direct and cross examination of witnesses and argument made by attorneys and can be extremely time consuming.

However, the adoption of a mitigation plan, because it is not binding, is not in the nature of a "license" or "order" under the APA, which might otherwise require these more formal adjudicatory procedures. Mitigation plans are only recommendations submitted to federal authorizing agencies for their consideration. In that sense they are more in the nature of the multitude of comments submitted by state agencies to federal agencies as part of a federal permitting or licensing process.[1]

In addition, the Wildlife Commission is required by statute to act upon a proposed mitigation plan within 60 days of its submittal, unless the applicant agrees to extend the deadline, but is under no obligation to do so. See §37-60-122.2(1)(b), C.R.S. That short timeframe makes it virtually impossible to employ a "trial-like" hearing process.

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[1] The fact that state mitigation plans are only "recommendations" made to the federal agency, and not otherwise independently enforceable, is likely why decisions made regarding state mitigations plans are not subject to judicial review. See §37-60-122.2(3), C.R.S.

As such, a very reasonable argument can be made that the formal hearing procedures, such as though set forth in the APA, are not required and that the Wildlife Commission is entitled to allow for more informal procedures provided they comply with state Open Meetings law and procedural due process requirements (basically notice to interested parties and an opportunity to be heard on the issue). And such informal procedures are more consistent with the limited amount of time the Wildlife Commission meets each month and the time it has available to consider the adoption of mitigation plans.

Having limited amounts of time during meetings does not in any way limit the amount of information that the parties can provide to the Wildlife Commission for its consideration. It may simply require that information be provided in written form, including witness statements, prior to the Commission meeting so that the time available at the meeting can be used primarily by the Wildlife Commission to ask questions of the parties and their witnesses with some time allotment for statements by the interested parties.

The process you have proposed for the Windy Gap and Moffat Tunnel Firming Projects, whereby when the proponent submits a proposed mitigation plan, the Wildlife Commission gives notice of the plan and publishes a schedule for commenting on the plan, including the submission of position statements by interested parties and supporting witness statements in a time frame that would allow Wildlife Commission consideration prior to its next meeting would be an appropriate hearing procedure. I would then recommend that the applicant then submit its response to those position statements with supporting witness statements in a time frame that would allow Wildlife Commission consideration prior to the second meeting at which time the Wildlife Commission would be required to complete its evaluation and recommendation with regard to the proposed mitigation plan.

Certainly, the 60-day time frame presents a number of challenges if it is not voluntarily extended by the applicant. However, the above proposal is a reasonable means for providing interested parties the opportunity to impact the Wildlife Commission's consideration of the mitigation plan, as well as an opportunity for the applicant to rebut whatever comments may come in within the statutory time frame. [2]

This memorandum reflects the opinion of the authoring attorney and is not to be construed as that of the Attorney General.

Attachments

cc: Mike King, Executive Director, Department of Natural Resources

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[2] I would also note that there is nothing in the statutes or regulations that requires consultation between or otherwise envisions a role for such stakeholder groups or members of the public to interact directly with the project applicant. As is the case with any extension of the 60-day timeframe for consideration of a proposed mitigation plan, such interaction would ultimately be up to the project applicant. However, there clearly needs to be a role for stakeholder groups and members of the public to interact with the Wildlife Commission on the issues.

Lurline Curran

From: David Taussig <DaveT@white-jankowski.com>
Sent: Wednesday, July 18, 2012 9:38 PM
To: Lurline Underbrink Curran
Cc: 'Edward Moyer'; Barbara Green; Mitra Pemberton; Melanie Cabral; Teri Mordick
Subject: Windy Gap Decrees
Attachments: 20120718 Windy Gap Water Rights Report (00113381).PDF; 19780223 Memo Opinion Interlocutory Decree CA 1768 (00113392).PDF; 19801027 Interlocutory Decree CA 1768 (00113393).PDF; 19801027 Decree W-4001 WG PPLC 1st Enlargement (00113382).PDF; 19801027 Decree 80CW108 WG PPLC 2nd Enlargement (00113383).PDF; 19890206 Decree 88CW169 (00113385).PDF; 19900719 Decree 89CW298 WG PPLC Enlargements (00113384).PDF; 20120412 Diligence Decree 08CW92 Jasper PPL Res-WG Res (00113394).PDF

Lurline:

Attached as you requested are the decrees for the Windy Gap along with some summary pages that Melanie created from the State Engineers water right report. In a nutshell, the **current status** of the amounts absolute and conditional for the various components of the Windy Gap Water System, is as follows:

1. **Windy Gap Pump, Pipeline and Canal.** 600 cfs absolute direct flow right from the Colorado River (no amount remain conditional). This started out as 300 cfs (conditional) with an appropriation date of 6-22-1967 in CA 1768 decreed 2-24-1978, with the amount confirmed on remand in an Interlocutory Decree dated 10-27-1980. In Case No. W-4001 the **1st Enlargement** was decreed 10-27-1980, for an additional 100 cfs (conditional) with an appropriation date of 7-9-1976. In Case No. 80CW108 the **2nd Enlargement** was decreed 10-27-1980, for an additional 200 cfs (conditional) with an appropriation date of 4-30-1980, thus bringing the total to 600 cfs in 1980. After the system was built in 1985, the district began to make the right absolute. In Case No. 88CW169 decreed 2-6-1989, 190 cfs of the original 300 cfs was made absolute, leaving 110 cfs conditional. Finally in Case No. 89CW298 decreed 7-19-1990, the remaining 110 cfs of the original right was made absolute (110 + 190 = 300), plus the 100 cfs of the 1st Enlargement and the 200 cfs of the 2nd Enlargement were made absolute, thus making the entire 600 cfs for the direct right absolute as of 1990.

2. **Windy Gap Reservoir**. Out of the total amount of 1,546.14 af, 445 af is absolute and 1,101.14 is conditional for a storage right from the Colorado River. This started out as 1,546.14 af (conditional) with an appropriation date of 6-22-1967 in CA 1768 decreed 2-24-1978, with the amount confirmed on remand in an Interlocutory Decree dated 10-27-1980. In Case No. 88CW169 decreed 2-6-1989, 445 af of the original 1546.14 af was made absolute, leaving 1,101.14 af conditional. In Case No. 08CW92 decreed 4-12-12 (which is the latest diligence decree) the 1,101.14 af was continued as conditional until April 2018.

3. **Jasper Pump and Pipeline.** All 300 cfs remains conditional for this direct flow right from Willow Creek. This right has an appropriation date of 6-22-1967 in CA 1768 decreed 2-24-1978, with the amount confirmed on remand in an Interlocutory Decree dated 10-27-1980. In Case No. 08CW92 decreed 4-12-12 (which is the latest diligence decree) the 300 cfs was continued as conditional until April 2018.

4. **Jasper Reservoir**. All 11,292.58 af remains conditional for this storage right from the Colorado River and Willow Creek. This right has an appropriation date of 6-22-1967 in CA 1768 decreed 2-24-1978, with the amount confirmed on remand in an Interlocutory Decree dated 10-27-1980. In Case No. 08CW92 decreed 4-12-12 (which is the latest diligence decree) the 11,292.58 af was continued as conditional until April 2018.

So in summary:

all 600 cfs is absolute for the Windy Gap direct flow diversion

EXHIBIT 52

445 af is absolute for the Windy Gap Reservoir storage right with 1,101.14 af remaining condtional
all 300 cfs of the Jasper direct flow right remains condtional
all 11,292.58 af of the Jasper Reservoir stoarge right remains condtional

Let me know if you have any further questions. David

----- Reply message -----
From: "Lurline Curran" <lcurran@co.grand.co.us>
To: "David Taussig" <DaveT@white-jankowski.com>
Subject: windy Gap decrees
Date: Wed, Jul 18, 2012 10:28 am

David:

Could you please send me copies of the Windy Gap decrees, tell me if they are conditional or absolute and detail how much water they can divert? Thanks. Lurline

Water Rights Report by Structure Name

State of Colorado

HydroBase

WD	ID	Water Right Name	Struct Type	Stream Information #	Stream Information Name	Cty	Legal Location Q10 Q40 Q160 sec ts rng pm	Use Type	Decreed Amt	U	Adj. Type	Adj. Date	Padj Date	Apro Date	Admin No	O #	Priority No.	Court Case	Seq #	P/A	Alter ID	Comment
36	7941	SUMMIT CTY WINDY GAP EXC	0	1	BLUE RIVER	SUM	NE NW NE 19 1 N 81 W S	Q	10.0000	C	S,C,EX	1993-12-31	1992-12-31	1993-12-23	52587.00000	0		93CW0288			3607941	STORAGE IN OLD DILLON RES VIA EXCH FROM WINDY GAP, LTD TO 53.4 AF
51	1238	WINDY GAP DITCH	1	1	COLORADO RIVER	GRA	NE NE 27 2 N 77 W S	1	2.0000	C	S,C	1978-12-31	1977-12-31	1978-09-01	46995.00000	0		W3924				
51	1239	WINDY GAP DITCH NO 2	1	121	DROWSY WATER CREEK	GRA	SE NW 29 2 N 77 W S	1	2.5000	C	S	1978-12-31	1977-12-31	1970-12-31	46751.44194	0		W3923				
51	1241	WINDY GAP DITCH NO 3	1	121	DROWSY WATER CREEK	GRA	SW SW 28 2 N 77 W S	1	1.0000	C	S	1978-12-31	1977-12-31	1970-12-31	46751.44194	0		W3922				
51	1093	WINDY GAP PROJ JASPER PL	8	6	WILLOW CREEK	GRA	NW SW SE 16 2 N 76 W S	1245	300.0000	C	S,C	1972-05-31	1969-06-06	1967-06-22	43621.42906	0		CA1768				DIL 84CW112 88CW169 95CW33 01CW203, JASPER PUMP AND PL 02/23/1978
51	3743	WINDY GAP PROJ JASPER R	3	6	WILLOW CREEK	GRA	NE SW NW 21 2 N 76 W S	1245	11292.59	A	S,C	1972-05-31	1969-06-06	1967-06-22	43621.42906	0		CA1768				DIL 84CW112 88CW169 95CW33 01CW203, JASPER RESERVOIR 02/23/1978
51	4700	WINDY GAP PUMP PL CANAL	8	1	COLORADO RIVER	GRA	NE NW SW 25 2 N 77 W S	1245	300.0000	C	S,C	1972-05-31	1969-06-06	1967-06-22	43621.42906	0		CA1768				DIL 84CW112 88CW169 WINDY GAP PUMP PL CANAL 02 23 1978
51	4700	WINDY GAP PUMP PL CANAL	8	1	COLORADO RIVER	GRA	NE NW SW 25 2 N 77 W S	1245	190.0000	C	S,CA	1972-05-31	1969-06-06	1967-06-22	43621.42906	0		88CW0169				110CFS REMAIN CONDITIONAL
51	4700	WINDY GAP PUMP PL CANAL	8	1	COLORADO RIVER	GRA	NE NW SW 25 2 N 77 W S	1245	110.0000	C	S,CA	1972-05-31	1969-06-06	1967-06-22	43621.42906	0		89CW0298				ALL 300CFS NOW ABSOL
51	4700	WINDY GAP PUMP PL CANAL	8	1	COLORADO RIVER	GRA	NE NW SW 25 2 N 77 W S	1245	100.0000	C	S,C	1978-12-31	1977-12-31	1976-07-09	46751.46211	0		W4001				FIRST ENL DIL 88CW170 84CW110
51	4700	WINDY GAP PUMP PL CANAL	8	1	COLORADO RIVER	GRA	NE NW SW 25 2 N 77 W S	1245	100.0000	C	S,CA	1978-12-31	1977-12-31	1976-07-09	46751.46211	0		89CW0298				FIRST ENL ALL NOW ABSOL
51	4700	WINDY GAP PUMP PL CANAL	8	1	COLORADO RIVER	GRA	NE NW SW 25 2 N 77 W S	1245	200.0000	C	S,C	1980-12-31	1979-12-31	1980-04-30	47602.00000	0		80CW0108				SECOND ENL DIL 88CW171 84CW111
51	4700	WINDY GAP PUMP PL CANAL	8	1	COLORADO RIVER	GRA	NE NW SW 25 2 N 77 W S	1245	200.0000	C	S,CA	1980-12-31	1979-12-31	1980-04-30	47602.00000	0		89CW0298				SECOND ENL ALL NOW ABSOL TOTAL 600CFS NOW ABSOL ALL PRIORITIES
51	3742	WINDY GAP RESERVOIR	3	1	COLORADO RIVER	GRA	SE SW NW 25 2 N 77 W S	1245	445.0000	A	S,CA	1972-05-31	1969-06-06	1967-06-22	43621.42906	0		88CW0169				1101.14AF REMAIN CONDITIONAL
51	3742	WINDY GAP RESERVOIR	3	1	COLORADO RIVER	GRA	SE SW NW 25 2 N 77 W S	1245	1546.140	A	S,C	1972-05-31	1969-06-06	1967-06-22	43621.42906	0		CA1768				DIL 88CW169 95CW33 01CW203 ON 1101.14AF, WINDY GAP RES 02/23/1978

Explanation of Codes:

Struct Type: 0 - other, 1 - ditch, 2 - well, 3 - reservoir, 4 - spring, 5 - seep, 6 - mine, 7 - pipeline, 8 - pump, 9 - power plant

Use Codes: 0 - storage, 1 - irrigation, 2 - municipal, 3 - commercial, 4 - industrial, 5 - recreation, 6 - fishery, 7 - fire, 8 - domestic, 9 - stock, A - augmentation, B - export from basin, C - cumulative accretion to river, D - cumulative depletion from river, E - evaporation, F - federal reserve, G - geothermal, H - household use only, K - snow making, M - minimum streamflow, N - net effect of river, P - power generation, Q - other, R - recharge, S - export from state, T - transmountain export, W - wildlife, X - all beneficial use

Adj Type: AB - abandoned, AP - alternate point, C - conditional, CA - conditional made absolute, EX - exchange, O - original, S - supplemental, TF - transfer from, TT - transfer to

Admin Number is a number developed by DWR to provide a simple and efficient method of ranking decrees in order of seniority.

IN THE DISTRICT COURT

IN AND FOR THE COUNTY OF GRAND

STATE OF COLORADO

Civil Action No. 1768

IN THE MATTER OF THE SUPPLEMENTAL ADJUDICATION OF PRIORITIES OF RIGHT TO THE USE OF WATER IN WATER DISTRICT NO. 51, STATE OF COLORADO	)))))	MEMORANDUM OPINION AND INTERLOCUTORY DECREE

On April 8, 1974, a Partial Master-Referee Report Regarding The Claims Of The Municipal Subdistrict, Northern Colorado Water Conservancy District, In And To The Various Component Structures Of The Windy Gap Water System was issued by Michael D. White, Master-Referee. A proposed decree granting conditional water rights for the various component structures of the Windy Gap water system is contained in the report. On May 3, 1974, Colorado River Water Conservation District (the "River District") filed Objections And Exceptions To Partial Master-Referee Report Regarding The Claims Of The Municipal Subdistrict, Northern Colorado Water Conservancy District, In And To The Various Component Structures Of The Windy Gap Water System. On or about May 6, 1974, Amended Objections And Exceptions To Partial Master-Referee Report was filed by the River District.

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The issues raised by the objections and amended objections have been the subject of numerous thorough briefs by the Municipal Subdistrict, Northern Colorado Water Conservancy District (the "Municipal Subdistrict") and by the River District. The Municipal Subdistrict has been represented throughout the proceedings by Davis, Graham & Stubbs, by John M. Sayre, Esq. and others. The River District has been represented throughout the proceedings by

Delaney & Balcomb, by Kenneth Balcomb, Esq. and Scott Balcomb, Esq.

On February 4, 1977, Hon. Charles F. Stewart, Water Judge, to whom this action was previously assigned, ruled that "...the Court may not confirm, modify, reverse or reverse and remand the ruling (Report) of the Referee without conducting a hearing as required by 37-92-304 CRS 1973." The Municipal Subdistrict sought a writ of prohibition to prevent the water judge from implementing the February 4, 1977, ruling. This matter was resolved by stipulation filed August 26, 1977, in which the parties, without waiver of the right of the parties to challenge the validity of the February 4, 1977, ruling, agreed to the content of the record of the hearing required by that ruling. Pursuant to that stipulation, on August 31, 1977, there was presented to the water judge such record, consisting of the record of proceedings before the Master-Referee taken on April 3, 1972, including testimony, transcripts and exhibits, the Master-Referee's report and orders; and the River District's exhibits D and E.

The Court has reviewed the Partial Master-Referee Report, and the transcript of proceedings of April 3, 1972, before the Master-Referee, Exhibits MS-1, MS-6, MS-7, MS-8, MS-9 through MS-19, MS-20, MS-21, CRWCD A, CRWCD B, and CRWCD C, which constitute the entire record upon which the Partial Master-Referee Report was based. The Court has also reviewed the River District's Exhibits D & E which were admitted in evidence by the Court subsequent to the issuance of the Partial Master-Referee Report. The Court has also reviewed the extensive briefs filed by the parties prior and subsequent to the issuance of the Partial Master-Referee Report. Upon the basis of such review, the Court issues the following

Memorandum Opinion and the following Interlocutory Decree.

MEMORANDUM OPINION

STANDARD OF REVIEW:

The different standards of review appropriate in judicial review of the draft of findings and draft of decree of a referee appointed under the Adjudication Act of 1943 (see C.R.S. (1963) 148-9-12), and in judicial review of a ruling of a referee appointed under the Water Right Determination and Administration Act of 1969. (see C.R.S. (1973) 37-92-304(3), (4) and (5)), create questions as to the standards for review of the Partial Master-Referee Report in this action.* Such questions have more than academic interest only if the different standards of review would yield different results. The conclusions reached in this Memorandum Opinion make it unnecessa to resolve the question of the appropriate standard of review.

OBJECTIONS OF RIVER DISTRICT:

The objections raised by the River District will be groupe for discussion. The Amended Objections and Exceptions cover and include the original Objections and Exceptions, so no separate reference will be made to the latter.

Necessity of Finding Unappropriated Water
(Objection To Finding Of Fact No. 16 and Conclusion of Law No. 2)

The objections to finding of fact no. 16 and conclusion of law no. 2 are based on a contention that a finding of availability of unappropriated water is necessary to support issuance of a conditional decree. It is contended that a finding that water is physically available is not enough. Reliance is placed on Article

*The Partial Master-Referee Report states that the Referee was also appointed as a master under Rule 53. No order to that effect has been discovered in this proceeding. If such order exists, Rule 53 review standards would also be involved.

XVI, Sec. 6 of the Constitution of Colorado.

This contention has been considered and rejected in Findings of Fact, Conclusions of Law and Decree in Case No. W-2109 in Water Division No. 5, In The Matter Of The Application For Water Rights Of Vidler Tunnel Water Co. In Grand County, dated September 12, 1977. The following analysis and conclusion from that case is adopted here:

> "Conditional decrees can be granted for two projects, the construction of either of which would preclude construction of the other. Colorado River Water Conservation District v. Rocky Mountain Power Co., 174 Colo. 309, 486 P.2d 438 (1971) cert. den. 405 U.S. 996 (1972).
>
> Conditional decrees have been granted to parties who wished to appropriate essentially the same water. Elk River Water Co. v. Templeton, 173 Colo. 438, 484 P.2d 1211 (1971). An appropriation may contemplate that others having water rights on the stream may abandon them. See Rocky Mountain Power Co. v. White River Electric Association, 151 Colo. 45, 376 P.2d 158 (1962). Appropriations have been recognized in situations where diversions could be accomplished only under unusual stream flow conditions. Humphreys Tunnel and Mining Company v. Frank, 4 Colo. 524, 105 Pac. 1013 (1909); Twin Lakes Reservoir and Canal Company v. Aspen, ____Colo.____, 557 P.2d 825 (1976).
>
> Inherent in the appropriation and priority system is the possibility that in a given year there may not be water available to permit the exercise of a particular water right. It is concluded that the creation of a conditional water right does not depend upon the presence of unappropriated water; only the exercise of that right is so dependent. See Humphreys Tunnel and Mining Company v. Frank, supra.* It may be that a stream could be so over-appropriated and that fact so well known as to establish a lack of good faith intent to appropriate; that is not the case here." P. 22-23, Findings of Fact, Conclusions of Law and Decree, Case No. W-2109, Water Division No. 5.

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Effect of C.R.S. (1963) 150-5-13(2)(d); Jurisdiction to Construe Sen. Doc. 80

(Objection To Findings Of Fact Nos. 17 and 21 and Conclusions of Law Nos. 2, 4, 5, 6, 8 and 9)

Several of the objections of the River District to the Partial Master-Referee Report relate to the question of the necessity

*See also Article XVI, Sec. 6 of the Colorado Constitution, relied on by the River District. It states that "The right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied." (Emphasis added)

that the Municipal Subdistrict comply with C.R.S. (1963) 150-5-13 (2)(d)* as a prerequisite to initiation of a conditional water right.

That statute is part of the statute pursuant to which the Municipal Subdistrict was organized and is found among the list of powers granted to the board of directors of the district on behalf of the district. The statute provides:

> "150-5-13. General powers. - The board shall have power on behalf of said district:
>
> . . .
>
> (2) (a) To take by appropriation, grant, purchase, bequest, devise or lease, and to hold and enjoy water, waterworks, water rights and sources of water supply and any and all real and personal property of any kind within or without the district necessary or convenient to the full exercise of its powers.
>
> . . .
>
> (c) To acquire, construct or operate, control and use any and all works, facilities and means necessary or convenient to the exercise of its power, both within and without the district for the purpose of providing for the use of such water within the district. To do and perform any and all things necessary or convenient to the full exercise of the powers herein granted.
>
> (d) However, any works or facilities planned and designed for the exportation of water from the natural basin of the Colorado river and its tributaries in Colorado, by any district created under this article, shall be subject to the provisions of the Colorado river compact and the Boulder Canyon Project Act. Any such works or facilities shall be designed, constructed and operated in such manner that the present appropriations of water, and in addition thereto prospective uses of water for irrigation and other beneficial consumptive use purposes, including consumptive uses for domestic, mining and industrial purposes, within the natural basin of the Colorado river in the state of Colorado, from which water is exported, will not be impaired nor increased in cost at the expense of the water users within the natural basin. The facilities and other means for the accomplishment of said purpose shall be incorporated in, and made a part of any project plans for the exportation of water from said natural basin in Colorado.
>
> . . .
>
> (10) To appropriate and otherwise acquire water and water rights within or without the state;. . .

There is no indication in that statute or in C.R.S. (1963)

*C.R.S. (1973) 37-45-118(1)(b)(IV); the 1963 Revised Statutes citation has been used throughout the briefs and will be used here.

-9-8, the statute prescribing the contents of a statement of claim pursuant to the Adjudication Act of 1943, that an averment of development of project plans contemplated by C.R.S. (1963) 150-5-13 must be contained in the statement of claim, where applicable. It is concluded that such an averment is not required.

The Municipal Subdistrict cannot challenge the constitutionality of C.R.S. (1963) 150-5-13(2)(a), for it is part of the statute authorizing creation of the Municipal Subdistrict. Central Colora Water Conservancy District v. Colorado River Water Conservation District, 186 Colo. 193, 526 P.2d 302 (1974). The Municipal Subdistrict is not asserting such a challenge in this case. A water conservancy district claimant can be required by the water court to comply with that statute; cancellation of a conditional decree is an appropriate remedy for refusal to comply. Central Colorado Water Conservancy District v. Colorado River Water Conservation District, supra.

The Central Colorado case leaves unanswered the question whether a water conservancy district must demonstrate compliance with C.R.S. (1963) 150-5-13 in order to obtain a conditional decree. It would be unrealistic to expect that full blown project plans consistent with C.R.S. (1963) 150-5-13 would have been created prior to initiation of a conditional water right. Rather, the recognition of a conditional water right by judicial decree provides the economic security upon which the development of detailed project plans can be expected to be predicated. See Metropolitan Suburban Water Users Association v. Colorado River Water Conservation District, 148 Colo. 173, 365 P.2d 273 (1961).

It is concluded that, at least when opposition to a statement of claim is made predicated upon absence or inadequacy

of project plans complying with C.R.S. (1963) 150-5-13, the Court should require evidence of project plans designed to satisfy that statute. It is further concluded that at the time of initiation of a conditional water right, such plans need only be in broad conceptual form.

Proof of a project plan in broad conceptual form was introduced by the Municipal Subdistrict. On the basis of such proof, the Master-Referee made finding of fact no. 17. It states:

> "17. The project is devised to divert only at those times and in such quantities as will provide compliance with the terms and conditions of Senate Document 80, which provides a manner of operation to be utilized in protection of present and prospective uses of water in the Colorado River Basin and in satisfying the requirements of 1963 C.R.S. 150-5-13(1)(d)." (sic; should read 150-5-13(2)(d)).

It is concluded that such finding is fully supported by the evidence and reflects adequate compliance with C.R.S. (1963) 150-5-13(2)(d) to support a conditional decree.

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The project plans consist of two broad concepts insofar as such plans relate to creation of project plans satisfying the requirements of C.R.S. (1963) 150-5-13(2)(d). First, there is the operational concept that no diversion will be made by the Windy Gap project at any time that flow in the river is less than 75 c.f.s. and that when flow in the river exceeds 75 c.f.s., diversions will be limited to by-pass 75 c.f.s. at all times. Second, the Windy Gap project would be designed to utilize the Colorado-Big Thompson facilities for carriage and to be operated in compliance with Senate Document 80.

Senate Document 80 relates to the design, construction and operation of the Colorado-Big Thompson project. It has been described by both the Municipal Subdistrict and the River District as a form of contractual agreement between eastern slope and western

slope water users. In the "Conclusions" section of that document, it is stated that diversion of 310,000 acre feet of water per annum from the Colorado river watershed as contemplated thereby "will not interfere with or encroach upon the present or future irrigation along the Colorado river and tributaries within the State, with the protection provided in the Green Mountain Reservoir." Exhibit CRWCD A. The "Manner of Operation of Project Facilities and Auxiliary Features" portion of Senate Document 80 imposes certain exceptions to the right to divert in priority. The Municipal Subdistrict contemplates a carriage contract or contracts among Northern Colorado Water Conservancy District (the "parent district"), the Municipal Subdistrict and the United States of America to allow the Municipal Subdistrict to utilize carriage capacity of the Colorado-Big Thompson facilities up to 310,000 acre feet per annum to the extent not needed to carry the water supply available to the parent district. Carriage of water other than the water supply available to the parent district is contemplated by the parent district's own contract with the United States. Exhibit MS 21, Sec. 22. The Municipal Subdistrict's attempt would be to design a project to protect prior vested rights and the rights of others in the waters of the Colorado river. (Transcript, p. 75).

In this case, the Court did not specifically direct the claimant to show compliance with C.R.S. (1963) 150-5-13(2)(d), as was the case in Central Colorado Water Conservancy District v. Colorado River Water Conservation District, supra. The Municipal Subdistrict's proof on this point is undeniably in the form of broad concepts rather than detailed project plans. It is concluded, however, that the Municipal Subdistrict established a prima facie case of compliance with that statute. No contravening evidence was

presented. Further studies and negotiations may prove the implementation of the broad concepts infeasible and may prove that the Municipal Subdistrict's appropriation cannot be effected in compliance with C.R.S. (1963) 150-5-13(2)(d). If so, the Court has full power to cancel the conditional water right. See Central Colorado Water Conservancy District v. Colorado River Water Conservation District, supra.

It is to be expected that the project plans will become more detailed as diligence is exercised to apply water to beneficial use. It may be that demonstration of an adequate degree of development of project plans meeting the requirements of C.R.S. (1963) 150-5-13(2)(d) should be required at the time of consideration of each quadrennial application for a finding of reasonable diligence. See C.R.S. (1973) 37-92-301(4). Appropriate remedies may exist to prevent exportation of water from the natural basin of the Colorado river until appropriate project plans shall have been fully prepared and implemented. See C.R.S. (1963) 150-5-13(2)(d). These questions are for the future and need not be definitively answered at this time.

A related contention of the River District is that finding of fact no. 21 in the Master-Referee report effectively shifts the burden of proof of compliance with C.R.S. (1963) 150-5-13(2)(d) to the River District. The finding states:

> "21. The protestant CRWCD has not submitted any evidence in this matter which would show any injury to any present or prospective water user by the operation of the proposed Windy Gap System."

As a finding of fact, it is impeccable. The River District did not submit such evidence. The River District's objection is to any implication that it had the burden to submit such evidence. Taking

the findings of fact together, finding of fact no. 17 is adequate to reflect that the Municipal Subdistrict has carried its burden to demonstrate a prima facie case of compliance with C.R.S. (1963) 150-5-13(2)(d), as discussed above. Finding of fact no. 21 simply declares that no contrary evidence was presented by the River District. The finding may be unnecessary, but it is unquestionably correct. The River District's contention on this point is not well taken.

The River District also objects to finding of fact no. 17 on the basis that it requires interpretation of Senate Document 80, a matter reserved for the exclusive jurisdiction of the federal court. Neither the referee nor this Court has jurisdiction to construe Senate Document 80 in a manner binding on parties whose rights are affected thereby. The relevance of Senate Document 80 in this case relates to the good faith intent of the claimant to effect an appropriation, one aspect of which is intent to develop project plans in accordance with C.R.S. (1963) 150-5-13(2)(d), and to the adequacy of the project plans to satisfy that statute. For such purposes, the non-binding construction of Senate Document 80 by the Municipal Subdistrict, the referee and this Court are entirely appropriate. Should future definitive interpretation of Senate Document 80 by a court having appropriate jurisdiction reflect that the Municipal Subdistrict's project plans are not susceptible of accomplishment, unless alternate plans can be developed to meet the requirements of C.R.S. (1963) 150-5-13(2)(d), it may be that the Municipal Subdistrict's conditional decrees will be subject to cancellation. See Central Colorado Water Conservancy District v. Colorado River Water Conservation District, supra.

A reading of the decree in consolidated Civil Action Nos. 2782, 5016 and 5017 in the United States District Court for the

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District of Colorado, River District Exhibit Nos. B and C, makes it clear that any contention that adjudication of the applications for water rights in this case is reserved exclusively to the United States District Court is without merit. See objection to conclusion of law no. 9, River District's Amended Objections and Exceptions. It may be that actual utilization of the physical facilities of the Colorado-Big Thompson project by the Municipal Subdistrict to transport water for application to beneficial use will necessitate a prior determination of rights within the reserved jurisdiction of the United States District Court. Such a determination is not a condition to initiation of a conditional water right. The same may be said for the objection that any use of Green Mountain Reservoir inherent in utilization of Colorado-Big Thompson facilities pursuant to Senate Document 80 may prove impermissible.

Adequacy of Evidence to Support Appropriation Date (Conclusion of Law No. 3)

The Master-Referee's conclusion is:

> "3. The date of appropriation for said claims is June 22, 1967, the date upon which the prerequisite intent and the first step in furtherance thereof coexisted for the Windy Gap Project as a whole. Elk Rifle Water Company v. Templeton, 148 P.2d 1211 (Colo. 1971); Colorado River Water Conservation District v. Rocky Mountain Power Co., et al., 486 P.2d 438 (Colo. 1971); Taussig, et al. v. Moffat Tunnel Water and Development Company, 106 P.2d 363 (Colo. 1940); City and County of Denver, et al., v. Northern Colorado Water Conservancy District, et al., 276 P.2d 992 (Colo. 1954)."

The objection, as stated in the River District's Amended Objections and Exceptions, is:

> "No. 3, in that it ignores the Elk-Rifle Water Company v. Templeton, 148 P.2d 1211 (Colo. 1971) requirement that the date of appropriation shall be the later of field survey and owner-claimant approval. Finding (of Fact) No. 10 puts this 'before 1969, . . .'"

Finding of fact no. 10 states:

> "10. Before 1969, all actions of the informal committee were ratified by the member cities."

The River District would have it implied that the actions of the informal committee were unauthorized until ratified in 1969. The record supports the finding that the informal committee was formed by five, and later six, member cities in the latter part of 1965. (Finding of fact no. 1). It further supports the finding that the informal committee indicated its intent to appropriate on May 24, 1967 (Finding of fact no. 5). Conclusion of law no. 3 states that on June 22, 1967, the intent and first step in furtherance thereof coexisted. This implicitly constitutes a conclusion that the informal committee in forming its intent to appropriate was acting on behalf of and with authorization of the six cities. This conclusion is a logical and permissible inference from the facts found, all of which are supported by the record.

The objection to Conclusion of law no. 3 is not well taken.

MOTIONS:

On November 12, 1975, the River District filed a Motion To Enlarge Grounds Of Amended Objections And Exceptions To Partial Master-Referee Report Regarding The Claims Of The Municipal Subdistrict, Northern Colorado Water Conservancy District In And To The Various Components Of The Windy Gap Water System. By motion, the River District seeks to assert two additional grounds for denying the claims. These grounds are as follows:

> "The claimant, the Municipal-Subdistrict, or its predecessor, Ralph R. Price, trustee for six Colorado cities; Longmont, Loveland, Fort Collins, Greeley, Estes Park and Boulder, failed to illustrate the requisite intent to make an appropriation of water, in that someone allegedly made a decision to proceed with the project as required by the Colorado law, without knowing either the fact that it was susceptible of being built, the volume of water that would be developed, and the price therefor.
>
> The intent to appropriate is further lacking, in that the evidence in the record shows only the intent to appro-

priate as evidenced by the minutes of the Six Cities Steering Committee, which committee was not a legal entity on May 24, 1967, and the evidence is devoid of exhibits or testimony which would tend to show that any of the Six Cities by and through its governing council or board of trustees intended to make an appropriation known as the Windy Gap Project."

These grounds are comprehended within the River District's general objection to sufficiency of the evidence to support the findings of fact and conclusions of law. They were briefed by the parties pursuant to the consent of the Court, prior to ruling on the Motion to Enlarge. Whether or not they should be considered by the Court, a review of the grounds on their merits reflects that they are not well taken. Uncertainties about engineering feasibility and economic feasibility do not preclude a finding of good faith intent to appropriate. Metropolitan Suburban Water Users Association v. Colorado River Water Conservation District, 148 Colo. 173, 365 P.2d 273 (1961); Four Counties Water Users Association v. Colorado River Water Conservation District, 159 Colo. 499, 414 P.2d 469 (1966). Although no direct evidence of action by the governing council or board of trustees of any of the Six Cities reflecting intent to appropriate was presented, it has previously been concluded that it is a permissible inference from the evidence and the findings that the action of the informal committee in initiating the appropriation was authorized by the Six Cities. See the discussion above with respect to conclusion of law no. 3.

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OTHER OBJECTIONS:

The River District, in paragraph 8 of its Amended Objections and Exceptions, objects to the proposed decree in its entirety as being based on insufficient evidence and erroneous findings of fact and conclusions of law. Each of the specific objections has been considered and rejected; this general objection is not well taken

Objection is further made to inclusion of language "and all other beneficial uses" as a purpose of the appropriation. It is concluded that such unspecific designation of uses is insufficient and inappropriate for inclusion in a decree.

FINDINGS BY THE COURT, ORDERS AND DECREE:

IT IS FOUND THAT:

(1) Consideration of the record and briefs as reflected in the introductory portion of this Memorandum Opinion and the oral arguments previously heard before Judge Stewart and available to the undersigned Judge through reporters' transcripts constitute an adequate hearing within the meaning of C.R.S. (1963) 148-9-12 and C.R.S. (1973) 37-92-304, whichever statute may be applicable.

(2) The findings of fact and conclusions of law and draft interlocutory decree contained in the Partial Master-Referee Report are fully supported by the evidence and are in accordance with law, except as the conclusions of law are modified by the portion of this Memorandum Opinion dealing with Central Colorado Water Conservancy District v. Colorado River Water Conservation District, supra, and except for the inclusion of "and all other beneficial uses" among the purposes for which the conditional decree.

(3) The Court would make findings of fact and conclusions of law identical in substance with the findings of fact and conclusions of law contained in the Partial Master-Referee Report and would enter an interlocutory decree identical to that contained in such Report, all subject to the exceptions noted in par. (2) immediately preceding, if it were to consider the matter independently on the record before it.

(4) Whether the proceeding before the Court is considered to be governed by C.R.S. (1963) 148-9-12 or C.R.S. (1973) 37-92-304,

or by Rule 53, C.R.C.P., the result would be the same. Accordingly

IT IS ORDERED, ADJUDGED AND DECREED that the findings of fact and conclusions of law contained in the Partial Master-Referee Report dated April 8, 1974 are approved and confirmed, with the modifications referred to in par. (2) of this section of the Memorandum Opinion; and

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that the interlocutory decree heretofore issued in this proceeding is supplemented and amended by the addition of structures described as follows:

Priority No. _____

CLAIMANT:	Municipal Subdistrict, Northern Colorado Water Conservancy District.
NAME OF STRUCTURE:	Jasper Pump and Pipeline, a part of the Windy Gap Water System.
NATURE OF DECREE:	Conditional.
SOURCE:	Willow Creek, a tributary to the Colorado River, through Jasper Reservoir.
POINT OF DIVERSION:	At a point on the north bank of Willow Creek whence the southeast corner of Section 16, T. 2 N., R. 76 W. of the 6th P.M. bears south 62°30' east a distance of 2,730 feet.
PURPOSE:	Municipal, irrigation, industrial recreational.
DATE OF APPROPRIATION:	June 22, 1967
AMOUNT:	300 c.f.s.

Priority No. _____

CLAIMANT:	Municipal Subdistrict, Northern Colorado Water Conservancy District.
NAME OF STRUCTURE:	Windy Gap Pump, Pipeline and Canal, a part of the Windy Gap Water System.

NATURE OF DECREE: Conditional.

SOURCE: Colorado River through the Windy Gap Reservoir.

POINT OF DIVERSION: A point on the north bank of the Colorado River whence the northwest corner of Section 25, T. 2 N., R. 77 W. of the 6th P.M. bears north 17°30' west a distance of 2,380 feet.

PURPOSE: Municipal, irrigation, industrial, recreational.

DATE OF APPROPRIATION: June 22, 1967

AMOUNT: 300 c.f.s.

Priority No. _____

CLAIMANT: Municipal Subdistrict, Northern Colorado Water Conservancy District.

NAME OF STRUCTURE: Windy Gap Reservoir, a part of the Windy Gap Water system.

NATURE OF DECREE: Conditional.

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SOURCE: Colorado River.

LOCATION: An onstream reservoir located in Sections 25 and 26, T. 2 N., R. 77 W. of the 6th P.M.

INITIAL POINT OF SURVEY: The northwest corner of the proposed dam is located at a point which bears S. 52°00' W. 1660 feet from the N.E. corner of Section 26, T. 2 N., R. 77 W. of the 6th P.M.

PURPOSE: Municipal, irrigation, industrial, recreational.

DATE OF APPROPRIATION: June 22, 1967

AMOUNT: 1,546.14 acre feet

Priority No._____

CLAIMANT: Municipal Subdistrict, Northern Colorado Water Conservancy District.

NAME OF STRUCTURE: Jasper Reservoir, a part of the Windy Gap Water System.

NATURE OF DECREE: Conditional.

SOURCE:	Colorado River and Willow Creek, a tributary of the Colorado River.
LOCATION:	An onstream reservoir located in Sections 8, 16, 17 and 21, T. 2 N., R. 76 W. of the 6th P.M.
INITIAL POINT OF SURVEY:	The southwest corner of the proposed dam is located at a point which bears S. 55°30' E. 1800 feet, from the N.W. corner of Section 21, T. 2 N., R. 76 W. of the 6th P.M.
PURPOSE:	Municipal, irrigation, industrial, recreational.
DATE OF APPROPRIATION:	June 22, 1967
AMOUNT:	11,292.58 acre feet

IT IS FURTHER ORDERED THAT application for a quadrennial finding of reasonable diligence shall be filed in February of 1982 and in February of every fourth calendar year thereafter so long as claimant desires to maintain these conditional water rights or until a determination has been made that these conditional water rights have become absolute water rights by reason of the completion of the appropriation.

IT IS FURTHER ORDERED THAT each such application for a quadrennial finding of reasonable diligence shall include evidence of the then-current stage of development of project plans so that the Court may determine whether compliance with C.R.S. (1963) 150-5-13 (2)(d) is being achieved.

IT IS FURTHER ORDERED THAT a copy of this Memorandum Opinion and Interlocutory Decree be filed with the Division Engineer and the State Engineer.

IT IS FURTHER ORDERED THAT the time for filing motions directed to this Memorandum Opinion and Interlocutory Decree is extended to March 20, 1978, to reflect delays in receipt of copies

of this document sometimes to be expected incident to mailing.

Done this 23 day of February, 1978.

BY THE COURT:

George E. Lohr

Water Judge (Acting By Special Assignment)

IN THE DISTRICT COURT

IN AND FOR THE COUNTY OF GRAND

STATE OF COLORADO

Civil Action No. 1768

IN THE MATTER OF THE SUPPLEMENTAL ADJUDICATION OF PRIORITIES OF RIGHT TO THE USE OF WATER IN WATER DISTRICT NO. 51, STATE OF COLORADO	INTERLOCUTORY DECREE

On April 8, 1974, a Partial Master-Referee Report Regarding the Claims of the Municipal Subdistrict, Northern Colorado Water Conservancy District, In And To The Various Component Structures Of The Windy Gap Water System was issued by Michael D. White, Master-Referee. A proposed decree granting conditional water rights for the various component structures of the Windy Gap Water System is contained in the report. Various objections to the Partial Master-Referee Report were filed by the Colorado River Water Conservation District ("River District"). On February 23, 1978, a Memorandu Opinion and Interlocutory Decree was entered by George E. Lohr, Water Judge, granting conditional water rights for the various component structures of the Windy Gap Water System.

The River District appealed the Memorandum Opinion and Interlocutory Decree entered by Judge Lohr to the Colorado Supreme Court. On September 17, 1979, the Colorado Supreme Court reversed the Memorandum Opinion and Interlocutory Decree. Subsequently, the Municipal Subdistrict, Northern Colorado Water Conservancy District ("Municipal Subdistrict"), the River District and other parties entered into negotiations and eventually executed an agreement entitled "Agreement Concerning the Windy Gap Project and the Azure Reservoir and Power Project," dated April 30, 1980, regarding the constructi of the Windy Gap water system and other matters, which has been filed with this Court as a Stipulation in this and two

EXHIBIT A

related cases ("Stipulation"). On May 16, 1980, the Colorado Supreme Court entered an Order remanding this case to the Water Judge, Water Division No. 5, with directions to proceed in accordance with the Opinion of the Supreme Court dated September 17, 1979, provided, however, that if the conditions set out in subparagraphs (a) and (b) of paragraph 41 of the Stipulation are met, the Water Judge shall enter the decrees requested in the Municipal Subdistrict's applications as a consent decree which shall include as part thereof the agreement of April 30, 1980 (the Stipulation), as a stipulation of the parties.

A hearing was held by the Court commencing at 10:00 a.m. on October 27, 1980, to consider entry of a decree granting the applications for conditional water rights filed by the Municipal Subdistrict regarding the Windy Gap Water System, whether compliance with the terms of the Stipulation satisfies and constitutes compliance by the Municipal Subdistrict of its obligations under C.R.S. 1973 § 37-45-118(1)(b)(IV) and whether the conditions set out in subparagraphs (a) and (b) of Paragraph 41 of the Stipulation have been met. Notice of said hearing was given in the resume published by the Water Clerk in July, 1980, of applications filed in June, 1980. The River District has been represented throughout these proceedings and at said hearing by Kenneth Balcomb, Esq. and others. The Municipal Subdistrict has been represented throughout these proceedings and at said hearing by Davis, Graham & Stubbs, by John M. Sayre, Esq. and others. Based upon the evidence presented at said hearing and the transcripts and documents contained in the record of this case, the Court issues the following Interlocutory Decree.

FINDINGS AND CONCLUSIONS BY THE COURT, ORDERS AND DECREE:

IT IS FOUND AND CONCLUDED THAT:

1. The findings of fact and conclusions of law and draft interlocutory decree contained in the Partial

Master-Referee Report are fully supported by the evidence and are in accordance with law, except as they relate to compliance by the Municipal Subdistrict with C.R.S. 1973 §37-45-118(1)(b)(I

2. The conditions set out in subparagraphs (a) and (b) of paragraph 41 of the Stipulation have been met.

3. Compliance by the Municipal Subdistrict with the terms and conditions contained in the Stipulation will constitute full and complete satisfaction by the Municipal Subdistrict of all requirements of C.R.S. 1973 §37-45-118(1)(b)

IT IS ORDERED, ADJUDGED AND DECREED that the findings of fact and conclusions of law contained in the Partial Master-Referee Report dated April 8, 1974, are approved and confirmed except as they relate to compliance by the Municipal Subdistrict with C.R.S. 1973 §37-45-118(1)(b)(IV).

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that the Stipulation is hereby approved and in full force and effect and binding upon the parties as provided in said Stipulation.

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that the Interlocutory Decree heretofore issued in this proceeding is supplemented and amended by the addition of structures described as follows:

Priority No. _____

CLAIMANT:	Municipal Subdistrict, Northern Colorado Conservancy District.
NAME OF STRUCTURE:	Jasper Pump and Pipeline, a part of the Windy Gap Water System.
NATURE OF DECREE:	Conditional.
SOURCE:	Willow Creek, a tributary to the Colorado River, through Jasper Reservoir.
POINT OF DIVERSION:	At a point on the north bank of Willow Creek whence the southeast corner of Section 16, T. 2 N., R. 76 W. of the 6th P.M. bears south 62°30' east a distance of 2,730 feet.

PURPOSE:	Municipal, irrigation, industrial and recreational.
DATE OF APPROPRIATION:	June 22, 1967
AMOUNT:	300 c.f.s.

Priority No. _____

CLAIMANT:	Municipal Subdistrict, Northern Colorado Water Conservancy District.
NAME OF STRUCTURE:	Windy Gap Pump, Pipeline and Canal, a part of the Windy Gap Water System.
NAME OF DECREE:	Conditional.
SOURCE:	Colorado River through the Windy Gap Reservoir.
POINT OF DIVERSION:	A point on the north bank of the Colorado River whence the northwest corner of Section 25, T. 2 N., R. 77 W. of the 6th P.M. bears north 17°30' west a distance of 2,380 feet.
PURPOSE:	Municipal, irrigation, industrial and recreational.
DATE OF APPROPRIATION:	June 22, 1967
AMOUNT:	300 c.f.s.

Priority No. _____

CLAIMANT:	Municipal Subdistrict, Northern Colorado Water Conservancy District.
NAME OF STRUCTURE:	Windy Gap Reservoir, a part of the Windy Gap Water System.
NATURE OF DECREE:	Conditional.
SOURCE:	Colorado River.
LOCATION:	An onstream reservoir located in Sections 25 and 26, T. 2 N., R 77 W. of the 6th P.M.
INITIAL POINT OF SURVEY:	The northwest corner of the proposed dam is located at a point which bears S. 52°00' W. 1660 feet from the N.E. corner of Section 26, T. 2 N., R. 77 W. of the 6th P.M.

PURPOSE: Municipal, irrigation, industrial and recreational.

DATE OF APPROPRIATION: June 22, 1967

AMOUNT: 1,546.14 acre-feet

Priority No. _____

CLAIMANT: Municipal Subdistrict, Northern Colorado Water Conservancy District.

NAME OF STRUCTURE: Jasper Reservoir, a part of the Windy Gap Water System.

NATURE OF DECREE: Conditional.

SOURCE: Colorado River and Willow Creek, a tributary of the Colorado River.

LOCATION: An onstream reservoir located in Sections 8, 16, 17 and 21, T. 2 N., R. 76 W. of the 6th P.M.

INITIAL POINT OF SURVEY: The southwest corner of the proposed dam is located at a point which bears S. 55°30' E. 1800 feet, from the N.W. corner of Section 21, T. 2 N., R. 76 W. of the 6th P.M.

PURPOSE: Municipal, irrigation, industrial and recreational.

DATE OF APPROPRIATION: June 22, 1967

AMOUNT: 11,292.58 acre-feet

IT IS FURTHER ORDERED that an application for a quadrennial finding of reasonable diligence shall be filed in May of 1984 and in May of every fourth calendar year thereafter so long as the Municipal Subdistrict desires to maintain these conditional water rights or until a determination has been made that these conditional water rights have become absolute water rights by reason of the completion of the appropriations.

IT IS FURTHER ORDERED that the Stipulation filed by the parties herein is hereby incorporated into this Interlocutory Decree by this reference and shall constitute an integral part of this Interlocutory Decree which may be

enforced by the parties as provided in said Stipulation.

IT IS FURTHER ORDERED that the Memorandum Opinion and Interlocutory Decree entered herein on February 23, 1978, by Judge Lohr is vacated.

IT IS FURTHER ORDERED that a copy of this Interlocutory Decree be filed with the Division Engineer and the State Engineer.

DONE this 27th day of October, 1980.

BY THE COURT:

Water Judge, Water Division No. 5

STATE OF COLORADO)
) ss
[illegible])

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Maria Talamas
[illegible] No. 5
Colorado

DRAFT 7/~~18~~27/12
REQUEST FOR PROPOSALS

WINDY GAP RESERVOIR MODIFICATIONS

The Colorado Division of Parks and Wildlife ("CPW") is requesting Proposals from qualified consultants to assist them with the conceptual design and evaluations of Windy Gap Reservoir modifications intended to improve the aquatic habitat in the vicinity of and downstream of the Windy Gap Reservoir.

1. Purposes of the RFP. Subject to Guidelines described in paragraph 3, the purposes of this RFP is to obtain a proposal from a consultant or team of consultants to conduct a study that will evaluate, prioritize and recommend modifications to the existing Windy Gap Dam and related work necessary to bypass flows through and/or around Windy Gap Reservoir (WG Study). The objective of those modifications is to improve the aquatic biological health of the Colorado River at and below Windy Gap Reservoir, including reducing sedimentation and stream channel armoring problems; supporting a healthy riparian zone; and accommodating flows anticipated in the future. The consultant(s) shall propose a Scope of Work (SOW) for conducting the WG Study and provide a Statement of Qualifications (SOQ) that clearly demonstrates their experience and successful accomplishments of similar projects.

2. Technical Advisory Team. CPW will use funding for the WG Study as described in paragraph 4 to contract with the consultant(s) (collectively "Consultant") who will be chosen jointly by CPW and the Technical Advisory Team. The Technical Advisory Team will also review and provide technical advice and input to CPW regarding the preparation of the RFP, the SOW submitted by the Consultant, the alternative(s) to implement from the WG Study, and other matters identified in this document. CPW will direct and manage the WG Study consistent with the SOW approved pursuant to paragraph 7 and provide regular updates to the Technical Advisory Team who will provide additional advice and input to CPW as needed on the conduct of the WG Study.

The Technical Advisory Team will be comprised of one representative each from:

- Colorado River Water Conservation District
- Trout Unlimited
- Denver Water
- Grand County
- Middle Park Water Conservancy District
- Municipal Subdistrict of the Northern Colorado Water Conservancy District (Subdistrict)
- Schmuck Children's Trust
- Upper Colorado River Alliance.

Each representative will have or be accompanied by a person who has a background in engineering, aquatic science or other relevant disciplines.

EXHIBIT 53

The hiring of the Consultant will be based upon responses to the RFP. The Consultant will be a professional company or a team of companies with experience in engineering, aquatic biology and other relevant disciplines.

3. Guidelines for the WG Study and Potential Modifications to the Windy Gap Dam. The SOW and WG study will satisfy the purposes set forth above in paragraph 1 and are subject to the following Guidelines:

A. Must not negatively impact the ability of the Subdistrict and Denver Water to exercise its water rights. If the WG bypass/flow-through provides a benefit to the Subdistrict in exercising its water rights, such as reduced need for maintenance or sedimentation removal, those benefits will be described.

B. Must be proposed and implemented in ways that do not negatively impact the location or amount of water available to lawfully divert at headgates or other diversion points within the reach where the proposed work will be completed and will not negatively impact the rights and obligations contained in that Supplemental Agreement between the Subdistrict and Schmucks dated April 2, 1982.

C. Will seek to facilitate recovery of aquatic species diversity, including mayflies and stoneflies, sculpin, trout, and other species.

D. Will seek to reduce harmful silt releases, reduce the capture of coarser materials, improve stream temperatures for coldwater vertebrates and invertebrates, reduce rooted aquatic vegetation, improve water quality, accommodate movement of species upstream and downstream of the Windy Gap Reservoir, and provide other benefits that have or may be identified associated with reconnecting the Colorado River upstream and downstream of Windy Gap Reservoir.

E. Will seek to prevent stream bed armoring and embeddedness.

F. Will describe the expected aquatic benefits, permanence of the benefits, ongoing maintenance concerns, impacts on riparian zone, ability to perform under expected low flow and high flow conditions, additional public benefits and any other factors deemed important by the CPW and the Technical Advisory Team.

G. Will complement the in-channel improvements described in the Fish and Wildlife Enhancement Plans (FWEPs) prepared by the Subdistrict and Denver Water, which were presented to the Colorado Wildlife Commission on June 9, 2011. Specifically, the goal of the FWEPs is to design and implement a stream restoration program to improve the existing aquatic environment in the Colorado River from the Windy Gap Diversion to the lower terminus of the Kemp-Breeze State Wildlife Area. The specific in-channel improvement activities associated with the Upper Colorado River Habitat Project will be determined in an effort separate from this RFP.

H. The WG bypass/flow-through should be designed to accomplish and to the extent practicable optimize the purposes and objectives described above in paragraph 1 while being cost efficient and subject to these Guidelines. The WG bypass/flow-through should be sufficiently planned and/or designed to allow a reasonable cost estimate for each option, with the understanding that more planning, permitting and design will be needed before implementing the selected option.

4. Study Budget and Funding. The budget for the WG Study is $250,000. The proposed, but not finalized nor executed, Windy Gap Firming Project (WGFP) Intergovernmental Agreement (IGA) pursuant to commitments in the WGFP FWEP that the Subdistrict provides $250,000 to CPW for this Study. If the Study is initiated prior to finalization of the WGFP IGA Denver Water may provide funding to CPW and be reimbursed by the Subdistrict. Denver Water and the Subdistrict will enter into an IGA with the State of Colorado to transfer funds that will be used by CPW to complete this study.

5. Study Area. The study area for the WG bypass/flow-through will be the Upper Colorado River from immediately upstream of the confluence of the Colorado and Fraser rivers to an area immediately downstream of the Windy Gap Reservoir, although a larger area will be considered in identifying the benefits of such a structure.

6. Schedule. CPW anticipates hiring a consultant and beginning the WG Study during the third quarter of 2012. The approved SOW will identify the WG Study schedule.

7. The SOW and the Study. In the proposal, the Consultant will prepare a Preliminary SOW to complete the work tasks listed below. The Consultant's Preliminary SOW should contain a detailed description of each task, proposed study methodologies, a budget and schedule for each task, and an overall Study schedule. The successful Consultant will finalize the detailed SOW with the CPW. Once the detailed SOW is approved by the CPW and the Technical Advisory Team, the Consultant will conduct the WG Study.

For purposes of the RFP the following work tasks will apply:

- Develop engineering alternatives for a structure that will bypass flows through and/or around Windy Gap Reservoir to best achieve the purposes and objectives described in paragraph 1 and consistent with the Guidelines in paragraph 3.
- Review available data. The Technical Advisory Team will provide a list of existing studies to be included in the background research. If necessary, perform sediment sampling to characterize sediment load upstream of Windy Gap Reservoir and embeddedness upstream and downstream of Windy Gap Reservoir.
- Evaluate hydrology for alternatives including ability to pass peak flows and low flows and the ability of the new structures to withstand high flows.
- Perform hydraulic analysis of identified hydrology for the ability to move fine sediment and coarse bed loads.
- Evaluate ability of each alternative to affect sediment transport, sediment deposition, water quality (effects on temperature and/or nutrients) and fish passage.
- Identify any alternatives with fatal flaws or inability to satisfy the Guidelines.

- Provide cost estimates for alternatives.
- Identify ongoing operation and maintenance requirements of each alternative and associated costs.
- Identify permitting requirements of each alternative.
- Assess relative ability of proposed alternatives to improve the aquatic environment and enhance river conditions to meet the purposes and objectives in paragraph 1 within the Guidelines in paragraph 3.
- Provide a matrix that summarizes each option by cost, hydraulic benefits, aquatic benefits, and constraints/issues.
- Provide a recommended course of action that meets the purposes and objectives in paragraph 1 within the Guidelines in paragraph 3.
- Deliverables: Technical Memorandum (draft and final versions). The CPW and Technical Advisory Team will review the draft Memorandum and provide comments to the Consultant.

8. Selection of Preferred Option. CPW and the Technical Team will cooperate in selecting the mutually acceptable WG bypass/flow-through design to implement consistent with the purposes and objectives set forth in paragraph 1 within the Guidelines in paragraph 3.

9. Funding of Construction of Preferred Option. CPW and the Technical Advisory Team are proceeding with this RFP to investigate, and analyze potential alternatives, as well as to designate a preferred alternative that best accomplishes the purposes and objectives set forth in paragraph 1 within the Guidelines in paragraph 3~~,~~ for the WG bypass/flow-through utilizing~~-~~ the $250,000 committed by the Subdistrict to complete the study. Alternatives for the funding for the construction of the bypass/flow-through have not been specifically identified. Commitments for funding are being evaluated by the Subdistrict, Denver Water, and the State of Colorado with the intent of developing a new, mutually acceptable agreement among the members of the Technical Team and CPW regarding the commitment to, amount of, and conditions associated with, funding the WG bypass/flow-through (the "Implementation Agreement")~~announced by the Subdistrict, Denver Water and the State of Colorado following that evaluation~~. If the cost to implement the selected preferred alternative exceeds the amount committed in the Implementation Agreement~~by the Subdistrict, Denver Water, and the State of Colorado~~, the Technical Team, CPW and others as appropriate will cooperatively pursue additional funding. If, after the best efforts of the parties, the additional funding cannot be obtained voluntarily, the Technical Team and CPW may elect to modify the selected preferred alternative ~~will be modified~~ utilizing the findings of the WG Study to allow construction to proceed within the budget of the committed funds.

10. Flow Regime. This WG Study is not meant to address or evaluate the flow regime, including flushing flows, necessary to protect or optimize aquatic biological health of the Colorado River at and below Windy Gap Reservoir. While some parties to the Technical Advisory Team believe this is an important issue, the flow issue is not a component of the WG Study.

Chapter 1
ADMINISTRATIVE REGULATIONS

Article 1
INTRODUCTORY AND GENERAL PROVISIONS

1-101 Title and Citation

(1) These various chapters and articles that are organized into a comprehensive set of regulations are entitled and may be cited as the "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand, State of Colorado".

(2) This Chapter 1 is entitled and may be cited as the "Administrative Regulations".

1-102 Purpose and Findings

(1) The purpose of these regulations is to facilitate identification, designation, and administrations of matters of State interest consistent with the statutory requirements and criteria set forth in §24-65.1-101, et seq., C.R.S., 1973, and Guidelines for Identification and Designation approved by the Colorado Land Use Commission.

(2) The governing body finds that:

(a) The notice and public hearing requirements of §24-65.1-404, C.R.S., 1973 have been followed;

(b) These regulations are necessary because of the intensity of current and foreseeable development pressures on and within the County of Grand;

(c) These regulations were adopted after taking into consideration applicable guidelines adopted and issued by the Colorado Land Use Commission;

(d) These regulations apply to the entire unincorporated territory of the County of Grand;

(e) These regulations interpret and apply to any regulations adopted for specific areas of State interest and specific activities of State interest, which have been or may be designated by the Board of County Commissioners of the County of Grand.

1-103 Authority

These regulations are authorized by, inter alia, §§24-65.1-101, et seq., 30-28-101, et seq., 30-28-201, et seq., 29-20-101, et seq., and 24-32-111, C.R.S., 1973.

1-104 Applicability

These guidelines and regulations shall apply to all proceedings concerning identification and designation of and developments in any area of State interest or any activity of State interest, which has been or may hereafter be designated by the Board of County Commissioners of the County of Grand.

1-105 Exemptions

The portions of these regulations authorized exclusively under §24-65.1-101, et seq., C.R.S. 1973, shall not apply to any development in an area of State interest or any activity of State interest if, on May 17, 1974:

(1) The specific development or activity was covered by a current building permit issued by the County of Grand:

(2) The specific development or activity was directly approved by the electorate of the state or the County of Grand; provided that, approval by the electorate of any bond issue by itself shall not be construed as approval of the specific development or activity;

(3) The specific development or activity is on land which had been finally approved, with or without conditions, for planned unit development or for a use other than a subdivision, substantially the same as planned unit development;

(4) The specific development or activity is on land which was either zoned or rezoned in response to an application which specifically contemplated said specific development or activity; or

(5) The specific development or activity is on land with respect to which a final plat for a subdivision had been approved, with or without condition, pursuant to the provisions of sections 2-11 of chapter 81, Session Laws of Colorado 1972, codified at §§30-28-101, 110, 133, 136, and 137, C.R.S. 1973.

1-106 **Interpretation with Other Enactments and Plans**

Whenever the provisions of these guidelines and regulations are found to be inconsistent with any other resolution, ordinance, code, regulation, other enactment or master plan of the County of Grand, the enactment imposing the more restrictive standards or requirements shall control.

(1) In the event that these guidelines and regulations are found to be less stringent than the statutory criteria for administration of matters of State interest set forth in §§24-65.1-202, 204, C.R.S. 1973, the statutory criteria shall control.

1-107 Maps

(1) Each map referred to in designations and regulations for any particular matter of state interest adopted by the Board of County Commissioners of the County of Grand is deemed adopted therein as if set out in full.

(2) Maps referred to in any such designation and regulation shall be filed with and be available for inspection at the office of the Clerk and Recorder of the County of Grand and shall also be available for inspection in the office of the administrator.

1-108 Duties of the Administrator

Unless otherwise specifically provided, it shall be the duty of the administrator to perform all functions set forth in all regulations for matters of state interest.

1-109 Severability

If any section, clause, provision, or portion of those regulations should be found to be unconstitutional or otherwise invalid by a court of competent jurisdiction, the remainder of this regulation shall not be affected thereby and is hereby declared to be necessary for the public health, safety, and welfare.

1-110 Definitions

The words and terms used in these guidelines and regulations for administration of areas and activities of state interest shall have the meanings set forth below unless the context requires otherwise:

(1) **Administrator:** The Permit Authority.

(2) **Designation:** Only that legal procedure specified by §§24-65.1-101, et seq., C.R.S. 1973. It is carried out by the Board of County Commissioners.

(3) **Development:** Any construction or activity, which changes the basic character or the use of the land on which the construction or activity occurs.

(4) **Layman's description:** A general, non-legal description and the popular name, if any, of the tract of land upon which the activity or development is to be conducted. The term "general description" means "layman's description."

(5) **Legal description:** Any description from which it is possible to locate accurately on the ground the boundaries of the land being described.

(6) **Matter of state interest:** An area of state interest or an activity of state interest or both.

(7) **Permit Authority:** The Board of County Commissioners, or the designee thereof.

(8) **Person:** Any individual, partnership, corporation, association, company, or other public or corporate body, including the federal government, and includes any political subdivision, agency, instrumentality, or corporation of the state or the United States Government.

(9) **Receipt of application:** The time at which the completed application is accepted by the Permit Authority.

(10) **Regulation:** Both regulation and guideline as the terms are used in §24-65.1-101, et seq., C.R.S. 1973.

(11) **Technical step:** in identification of an activity of state interest is the act of formulating a plan or program for the administration of any one of the activities of state interest in a specific jurisdiction consistent with the criteria of §24-65.1-204, C.R.S. 1973. An identification of an area of state interest is the act of viewing and preparing a description of the land within the borders of which is located that area of state interest.

Article 2
DESIGNATION OF MATTER OF STATE INTEREST

1-201 Board of County Commissioners of the County of Grand to Make Designations

Designations and amendments or revocations of designations may be initiated in two ways:

(1) The Board of County Commissioners shall at its discretion designate and adopt regulations for the administration of any matter of state interest.

(2) If the Colorado Land Use Commission submits a formal request to the Board of County Commissioners with regard to a specific matter, which the Colorado Land Use Commission considers to be of state interest within the County of Grand, the Board of County Commissioners shall publish notice and conduct a hearing pursuant to §24-65.1-407 (1) (a), C.R.S. 1973.

1-202 Moratorium

After the Board of County Commissioners has received a formal request to take action with regard to a specific matter which the Colorado Land Use Commission considers to be of state interest within the Board's jurisdiction, no person shall engage in development in the area or conduct the activity specifically described in said request until the Board of County Commissioners has held its hearing and issued its order relating thereto.

1-203 Public Hearing Required

(1) The Board of County Commissioners shall hold a public hearing before designating any matter of state interest and adopting regulations for the administration thereof. Said hearing shall be held not less than thirty (30) days nor more than sixty (60) days after the giving of public notice of said hearing.

(2) In the event that the Colorado Land Use Commission submits a formal request to take action, such public hearing for designation shall be held within ninety (90) days after receipt of the formal request.

1-204 Notice of Public Hearing, Mailing List, Publication

(1) The administrator shall prepare a notice of the designation hearing which shall include:

(a) The time and place of the hearing.

(b) The place at which materials relating to the matter to be designated and any guidelines and regulations for the administration thereof may be examined.

(c) The telephone number where inquiries may be answered.

(d) A description of the area or activity proposed to be designated in sufficient detail to provide reasonable notice as to property, which would be included. The notice should include, when practicable, both the legal description of the property as well as any general or popular names of the property.

(2) The administrator may maintain a mailing list of the names of those persons requesting that their names and addresses be placed on the list and paying an annual fee, the amount of which shall be determined from time to time by the Permit Authority. In order to have his name and address retained on said mailing list, the person shall resubmit his name and address and pay such fee before January 31 of each year.

(3) At least thirty (30) days, but no more than sixty (60) days before the public hearing, the administrator shall publish the notice in a newspaper of general circulation in the County, and shall mail the notice by first class mail to each of the following:

(a) The Colorado Land Use Commission and other State and Federal agencies, as deemed appropriate in the discretion of the administrator.

(b) Persons on the mailing list.

(c) In the discretion of the administrator, members of the news media and any other person considered to be likely to be affected by the proposed designation.

(d) If any other local governmental jurisdiction would be directly or indirectly affected, the proposed designation similarly may be mailed to such government and to the regional Planning Commission and/or Council of Governments.

1-205 Matters to be Considered at Designation Hearings

(1) At the public hearing described above, the Board of County Commissioners shall consider such evidence as may appear appropriate including, as a minimum:

(a) The intensity of current and foreseeable development pressures;

(b) The matters and considerations set forth in any applicable guidelines for identification and designation;

(c) Model regulations issued by the Colorado Land Use Commission and other State agencies;

(d) The boundaries of the proposed area;

(e) Reasons why the particular area or activity is of State interest, the dangers that would result from uncontrolled development of any such area or uncontrolled conduct of such activity, and the advantages of development of such area or conduct of such activity in a coordinated manner; and

(f) Any master or comprehensive plan pertaining to or affected by the area or activity under consideration.

(2) The Board of County Commissioners shall hear testimony and receive evidence, including:

(a) The recommendations of the County Planning Commission; and

(b) Relevant testimony and documents presented.

1-206 Record of Designation Proceedings

(1) The administrator will collect and preserve the following record of the public hearing, as a minimum:

(a) Notice of the hearing;

(b) Certification of publication of the notice;

(c) Names and addresses of persons who presented written or oral statements;

(d) Evidence of the identification of the matter of State interest proposed to be designated;

(e) Written findings concerning each of the matters referred to in 1-205(1), above.

(2) Any person may, at his own expense, provide for the recording of the hearing and transcription thereof, provided, however, that a copy of the recording or transcript thereof, if transcribed, shall be furnished free of charge to the administrator and shall become part of the records.

1-207 Adoption of Designation and Regulations

(1) At the conclusion of such hearing, or within thirty (30) days thereafter, the Board of County Commissioners may adopt, adopt with modification, or reject the proposed designation which was the subject of public hearing; if designation and regulation under §24-65.1-101, et seq., C.R.S. 1973, is rejected, the Board of County Commissioners may regulate the matter under any other available land use control authority or it may reject the regulation of the matter entirely.

(2) Such action shall be taken by resolution.

(3) In the event that the Board of County Commissioners finally determines that any matter is a matter of State interest, it shall be the Board's duty to designate such matter and adopt regulations for the administration thereof.

(4) Each designation order adopted by the Board of County Commissioners shall, as a minimum:

(a) Specify the boundaries of the designated area of state interest or the boundary of the area in which an activity of state interest has been designated.

(b) State reasons why the particular area or activity is of state interest, the dangers that would result from uncontrolled development of any such area or uncontrolled conduct of such activity, and the advantages of development of such area or conduct of such activity in a coordinated manner.

(c) Specify the regulations applicable to the designated matter of state interest.

1-208 Submission of Material to Land Use Commission

Upon adoption of a designation order, all relevant materials including the record of any public hearing relating to the designation and regulations, as described in 1-206, above, shall be forwarded by the Board of County Commissioners to the Colorado Land Use Commission for review. If within thirty (30) days after receipt of a designation order and regulation the Land Use Commission has notified the Board of County Commissioners that modification of the designation or regulations is required, the Board of County Commissioners shall, within thirty (30) days after the receipt of the recommended modifications:

(1) Modify the original order in a manner consistent with the recommendations of the Colorado Land Use Commission and resubmit the order to the order to the Colorado Land Use Commission, or

(2) Notify the Colorado Land Use Commission that the Colorado Land Use Commission's recommendations are rejected and the reasons therefore.

1-209 Recording of Notice of Designation

A notice of the designation shall be certified by the Board of County Commissioners to the County Clerk and Recorder for filing in the same manner as any document affecting real property.

1-210 Effect of Designation – Moratorium until Final Determination

After a matter of state interest is designated pursuant to Section 1-207, no person shall engage in development in such area and no such activity shall be conducted until the designation and regulations for such area or activity are finally determined as required by §24-65.1-404(4), C.R.S., 1973.

Article 3
PERMITS

1-301 Permits Required after Designation; Receipt of Application Form

(1) Any person desiring to engage in a development in a designated area of State interest or to conduct a designated activity of State interest must obtain a permit from the Permit Authority.

(2) An application shall not be accepted unless it is complete. If the application is considered incomplete by the Permit Authority, the Permit Authority shall specify what additional information is required. When a submitted application is considered to be complete by the Permit Authority or the applicant, the Permit Authority shall note upon the application the date and hour of its receipt.

(3) When the applicant seeks a permit to engage in development in more than one (1) area of State interest and/or to conduct more than one (1) activity of State interest and/or to engage in development in one area of State interest and to conduct one activity of State interest, the application may be completed for all such activities or developments and may be reviewed by the Permit Authority in one consolidated hearing.

1-302 Application Fee

The application shall be accompanied by an application fee in the amount (s) set forth in the regulation (s) for the matter (s) of state interest involved in the application or in such lesser amount as may be determined by the Permit Authority.

1-303 Notice of Permit Hearing

Not later than thirty (30) days after receipt of a completed application for a permit, the Permit Authority shall set and publish notice of a date, time, and place for a hearing on said application. Such notice shall be published once in a newspaper of general circulation in the County of Grand, not less than thirty (30) days nor more than (60) days before the date set for hearing and shall also be given to other persons and entities in the same manner as set forth above for the notice of a designation hearing in 1-204.

1-304 Conduct of Permit Hearing

(1) The Permit Authority shall conduct the public hearing in such a manner to afford procedural due process to the applicant as well as to any person who opposes issuance of the permit.

(2) The Permit Authority shall hear testimony and receive evidence, including:

(a) The recommendations of the planning commission, if it is not the Permit Authority, and

(b) Relevant testimony and documents presented.

(3) Although the Colorado Rules of Civil Procedure do not govern the conduct of the hearing, all persons appearing at the hearing, in person or by counsel, shall be afforded the right of cross-examination as well as reasonable opportunity to offer evidence in rebuttal. Any person engaging in cross-examination or offering evidence in rebuttal shall thereby become a party.

(4) Any person may, at his own expense, provide for the recording of the hearing and transcription thereof, provided, however, that a copy of the recording or transcript thereof, if transcribed, shall be furnished free of charge to the administrator and shall become part of the record.

(5) The administrator shall collect and preserve the following record of the public hearing:

(a) The permit application;

(b) Any written statements or documents presented in support of or in opposition to the permit application;

(c) The names and addresses of all persons making oral or written statements, appearing as witnesses, or offering documentary evidence;

(d) Any recording or transcript, if any, of the hearing as provided in subsection (4) above;

(e) Written minutes of the Permit Authority relating to the public hearing;

(f) The resolution of the Permit Authority granting or denying the permit application; and

(g) A copy of the permit, if issued.

1-305 Approval or Denial of Permit Application

(1) If the Permit Authority finds that there is not sufficient information concerning any material feature of a proposed development or activity, the Permit Authority may deny the application or it may continue the hearing until the additional information has been received. However, no such continuance may exceed sixty (60) days unless agreed to by the applicant.

(2) The Permit Authority shall approve an application for a permit to engage in development in an area of state interest or for the conduct of an activity of state interest if the proposed development or activity complies with the provisions of the regulations governing such area or activity. If the proposed development does not comply with such regulations, the permit shall be denied.

(3) The Permit Authority conducting a hearing pursuant to this section shall state, in writing, reasons for its decision, and its findings and conclusions.

(4) The Permit Authority shall reach a decision on a permit application within one hundred twenty (120) days after the completion of the permit hearing, or the permit shall be deemed approved.

1-306 Combined Designation and Permit Hearing

If a person proposes to engage in development in an area of state interest or to conduct an activity of state interest not previously identified, designated, or for which regulations have not been adopted, the Board of County Commissioners alone may hold one (1) hearing for determination of identification, designation, and regulations as well as for granting or denying the permit. No permit that is granted at the conclusion of any such hearing shall be authority to engage in development or to conduct an activity until the identification, designation and regulations are finally determined.

1-307 Issuance of Permits

(1) The permit shall be issued on the form adopted by the Board of County Commissioners.

(2) The permit may be issued for an indefinite term, or for a specific period of years.

(3) Copies or notice of the permit shall be sent to the Colorado Land Use Commission and, at the Board's discretion, may be sent to any regional planning commission in which the county may be located, and to any other person requesting a copy thereof on payment of the cost of reproduction.

(4) A copy of the permit shall be certified by the Permit Authority to the County Clerk and Recorder for recording in the same manner as any other document relating to real property, and the certified copy of the permit shall be presented by the Permit Authority to the Clerk and Recorder for recording.

1-308 Financial Security

(1) Before any permit is issued, the Permit Authority may, in its discretion, require the applicant to file a guarantee of financial security deemed adequate by the Permit Authority and payable to the County of Grand.

(2) The purpose of said financial security guarantee shall be to assure that the applicant or permittee shall faithfully perform all requirements of the permit or applicable regulations adopted by the Board of County Commissioners.

(3) The amount of said financial guarantee shall be established by the Permit Authority upon consideration of the following applicable criteria:

(c) The estimated cost of returning the site of the permitted development or activity to its original condition or to a condition acceptable to the County in accordance with standards adopted by the County for the matter of state interest for which the permit is being granted;

(c) The estimated cost of completing the permitted development or activity; and

(c) The estimated cost of complying with any conditions of the permit.

(4) Estimated cost shall be based on the applicant's submitted cost estimate plus the Permit Authority's estimate of the additional cost to the County of bringing in personnel and equipment to accomplish any unperformed purposes of the financial guarantee. The Permit Authority shall consider the duration of the development or activity and compute a reasonable projection of increases due to inflation. The Permit Authority may require, as a condition of the permit, that the financial security shall be adjusted upon receipt of bids.

(5) At least ten percent (10%) of the amount of the financial guarantee shall be in cash deposited with the County Treasurer and shall be placed in an earmarked escrow account mutually agreeable to the County and the applicant.

(6) The financial guarantee may be released only when:

(a) The permit has been surrendered to the Permit Authority before commencement of any physical activity on the site of the permitted development or activity;

(b) The development or activity has been abandoned and the site thereof has been returned to its original condition or to a condition acceptable to the County in accordance with standards adopted by the County for the matter of state interest for which the permit is being granted.

(c) The project has been satisfactorily completed, or

(d) Applicable guaranteed conditions have been satisfied.

(7) Any security may be cancelled by a surety only upon receipt of the Permit Authority's written consent which may be granted only when such cancellation will not detract from the purposes of the security.

(8) If the license to do business in Colorado of any surety upon a security filed pursuant to this regulation is suspended or revoked by any state authority, then the applicant or permittee, within sixty (60) days after receiving notice thereof, shall substitute a good and sufficient surety licensed to do business in the state. Upon failure of the permittee to make substitution of surety within the time allowed, the Permit Authority shall suspend the permit until proper substitution has been made.

(9) (a) If the Permit Authority determines that a financial guarantee should be forfeited because of any violation of the permit or any applicable regulations adopted by the Board of County Commissioners, it shall provide written notice to the surety and to the permittee that the financial guarantee will be forfeited unless the permittee makes written demand to the Permit Authority within thirty (30) days after permittee's receipt of notice, requesting a hearing before the Permit Authority. If no demand is made by the permittee within said period, then the Permit Authority shall order the financial guarantee forfeited.

(b) The Permit Authority shall hold a hearing within thirty (30) days after the receipt of the demand by the permittee. At the hearing, the permittee may present for the consideration of the Permit Authority statements, documents, and other information with respect to the alleged violation. At the conclusion of the hearing, the Permit Authority shall either withdraw the notice of violation or enter an order forfeiting the financial guarantee.

(c) The cash deposit described in subsection (5), above, may be used by the Permit Authority of the County in the event of the default or alleged default of the permit holder only for the purposes of recovering on the

surety or fulfilling the permit obligations of the permit holder. In the event that the ultimate reviewing court determines that there has been no default by the permit holder, that portion of any moneys expended by the County from the escrow funds relating to such default shall be replaced in the escrow account by the Board of County Commissioners immediately following such determination. The County may arrange with a lending institution, which provides money for the permit holder; that said institution may hold in escrow any funds required for said cash deposit. Funds shall be disbursed out of escrow by the institution to the County upon County's demand for the purposes specified in the section.

(10) If the forfeitures results in inadequate revenue to cover the costs of accomplishing the purposes of the financial guarantee, this County's attorney shall take such steps as he deems proper to recover such costs where recovery is deemed possible.

1-309 Review of Permit Authority Decision by the Board of County Commissioners

(1) The provisions of this section shall apply only if the Board of County Commissioners is not the Permit Authority for the County or if the Board has designated some other person (s) or body to be the Permit Authority.

(2) Any person affected by a decision of the Permit Authority may obtain review of that decision by the Board of County Commissioners by written notice of appeal which specifies the basis of objections and which is filed with the Permit Authority and the Board of County Commissioners not later than twenty (20) days after the Permit Authority makes the decision. The County Attorney is to be deemed a person affected by a decision of the Permit Authority and may bring an appeal pursuant to this section.

(3) The Board of County Commissioners shall review the decision of the Permit Authority at a public hearing held within forty-five (45) days, or at the Board of County Commissioners' next regular meeting, after the Notice of Appeal is filed, whichever is later. If the Board of County Commissioners fails to reach a decision within one hundred twenty (120) days of filing of appeal, the appeal shall be deemed to be successful.

(4) Notice shall be given and the public hearing shall be conducted in substantially the same manner as the permit hearing conducted by the Permit Authority. The Board of County Commissioners shall give due consideration to the reasons given in support of the Permit Authority's decision.

(5) During the pendency of any appeal to the Board of County Commissioners and during any judicial review thereof, the Applicant may not engage in development or activity requested in the application, unless the permittee can obtain a court order permitting the development or activity under the provisions of the permit.

(6) Any action seeking judicial review of the decision of the Board of County Commissioners shall be initiated within thirty (30) days after the decision is made, in the District Court in and for the County of Grand pursuant to Rule 106 of the Colorado Rules of Civil Procedure.

1-310 Revocation or Suspension of Permits

(1) When it comes to the attention of the Permit Authority that the provisions of any permit or the terms of any regulation for administration have been violated by the holder of the permit, the Permit Authority may temporarily suspend the permit for a period of thirty (30) days. Before making such a temporary suspension, the Permit Authority shall give the permit holder written notice of the specific violation and shall allow the permit holder a period of at least fifteen (15) days to correct the violations. If the permit holder does not concur that he is in violation, he shall, within fifteen (15) days of his receipt of such notice, show cause to the Permit Authority why temporary suspension should not be ordered. A hearing shall be held within said thirty (30) day period pursuant to subsection (2) below.

(2) Either prior to or subsequent to a temporary suspension, the Permit Authority may permanently revoke or suspend the permit after conducting a public hearing in substantially the same manner and after substantially the same notice as for permit hearings, and if it finds:

(a) A violation of the provisions of the permit or any applicable regulation for administration which may have been adopted by this Board of County Commissioners; or

(b) That the applicant has failed to take substantial steps to initiate the permitted development or activity within twelve (12) months from the date of the permit, or, if such steps have been taken, the applicant has failed to complete the development or activity with reasonable diligence.

Article 4
Administration, Enforcement, and Penalties

1-401 Enforcement and Penalties

(1) Any person engaging in a development in a designated area of a state interest or conducting a designated activity of state interest who does not obtain a permit pursuant to these Regulations for administration, who does not comply with permit requirements, or who acts outside the authority of the permit, may be enjoined by the County or the Land Use Commission from engaging in such development or conducting such activity, and may be subject to such other criminal or civil liability as may be prescribed by law.

1-402 Mapping Disputes

(1) Where interpretation is needed as to the exact location of the boundary of any designated area and where there appears to be a conflict between a mapped boundary and actual field conditions, the Permit Authority shall make the necessary determination of the boundary. Any person contesting the location of the boundary shall be given an opportunity to present his case to the Permit Authority.

(2) The determination of the Permit Authority may be appealed to the Board of County Commissioners, which shall hold a hearing in substantially the same manner as the hearing permitted under section 1-309.

1-403 Inspection

(1) The Permit Authority or its authorized representative is hereby empowered and directed to inspect and examine the use, occupation or development of or activity in each and every area or activity subject to these Regulations for the purpose of determining from time to time whether or not any use, occupation, development or activity is in violation of any of the provisions of this Regulation or of any permit issued or required pursuant to this or other applicable regulations.

(2) If a violation shall be found to exist, said Permit Authority or its authorized representative shall by written order direct that such remedial action be taken forthwith as will result in full compliance with the applicable regulations; provided, however, that the issuance of such order shall in no way or manner be deemed a prerequisite to the institution of such enforcement proceedings as are set forth in the regulations; and provided further, be a defense to any alleged violation of this or other applicable regulations in any court action instituted seeking full compliance therewith.

EXHIBIT "2"
TO BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY, COLORADO
RESOLUTION NO. 1978-5-4

CHAPTER 2
PERMIT AUTHORITY

2-101 Purpose and Intent

The purpose of this Chapter 2 is to facilitate designation and administration of matters of state interest consistent with statutory requirements and criteria set forth in Article 65, Title 24, of Colorado Revised Statutes, 1973, as amended.

2-102 Findings

The Board of County Commissioners finds that:

(1) The notice and public hearing required by law have been followed;

(2) These regulations are necessary because of the intensity of current and foreseeable development pressures on and within the County;

(3) These regulations were adopted after taking into consideration applicable guidelines adopted and issued by the Colorado Land Use Commission;

(4) These regulations apply to the entire unincorporated portion of the County of Grand, State of Colorado.

2-103 Authority

These regulations are authorized by inter alia, §24-65.1-101, et seq., §30-28-101, et seq., §30-28-201, et seq., §29-20-101, et seq., and §24-32-111, Colorado Revised Statutes, 1973, as amended.

2-104 Permit Authority Established

(1) The Grand County Permit Authority is hereby established, the members of which shall be the Board of County Commissioners.

(2) The Permit Authority shall exercise all powers and duties granted it by Chapter 1 of the "Grand County Guidelines and Regulations of Areas and Activities of State Interest", and as amended.

CHAPTER 3
SITE SELECTION AND CONSTRUCTION OF MAJOR NEW DOMESTIC WATER AND SEWAGE TREATMENT SYSTEMS

Article 1
General and Introductory Provisions

3-101 Title and Citation

These various sections constituting Chapter 3 of the "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand" may be cited as the "Regulations for Site Selection and Construction of Major New Domestic Water and Sewage Treatment Systems" of Grand County.

3-102 Purpose and Intent

The purpose and intent of the regulations contained in this chapter are as follows:

(1) To insure that new domestic water and sewage treatment systems are constructed in areas which will result in the proper utilization of existing treatment plants and the orderly development of domestic water and sewage treatment systems within this County.

(2) To insure that site selection and construction of major new domestic water and sewage treatment systems are conducted in such a manner as to minimize environmental impacts associated with such development.

(3) To insure that site selection and construction of major new domestic water and sewage treatment systems are planned and developed in a manner so as not to impose an undue economic burden on existing or proposed communities within this County.

(4) To insure that municipal and industrial water projects shall emphasize the most efficient use of water, including, to the extent permissible under existing law, the recycling and reuse of water. Urban development, population densities, and site layout and design of storm water and sanitation systems shall be accomplished in a manner that will prevent the pollution of aquifer recharge areas.

3-103 Definitions

(1) **Major new domestic water system:** A system for provision to the public of piped water for human consumption or a system for the provision to the public of piped water which will be used in exchange for water for human consumption, if such system is proposed to service a population equivalent of twenty (20) single family dwelling units or the equivalent thereof in other uses.

(2) **Major new domestic sewage treatment system**: A new sewage treatment system and collector system capable of treating the wastewater generated by twenty (20) or more people through domestic uses or the equivalent thereof in commercial and/or industrial needs.

(3) **Domestic water and sewage treatment system**: A wastewater treatment plant, water treatment plant, or water supply system and any system of pipes, structures, and facilities through, which wastewater is collected for treatment.

(a) **Wastewater treatment plant:** The facility or group of units used for treatment of wastewater from sewer systems and for the reduction and handling of solids and gases removed from such wastes.

(b) **Water supply system**: The system of pipes, structures and facilities through which a water supply is obtained, treated and sold or distributed for human consumption or the system of pipes, structures and facilities through which a water supply is obtained which will be exchanged or traded for water, which will be used for human consumption.

(c) **Water treatment plant**: The facility or facilities within the water supply system which can alter the physical, chemical or bacteriological quality of the water.

(4) **Source area**: A geographic area or region where moisture falls and drains through natural processes to either streams or lakes or permeates to the groundwater table, analogous to catchment's basin or watershed.

(5) **Collector system**: A network of pipes and conduits through which sewage flows to a sewage treatment plant.

(6) **Distribution system**: A network of pipes and conduits through which water is piped to the public for human consumption or through which water is piped for exchange of trade for water which will be used for human consumption.

(7) **Proposed development**: A major new domestic water or sewage treatment system, as defined in 3-103(1) and (2), and includes any proposed land development directly related to such system if such development is to be located wholly or partially within this County and if such development specifically generates the need for the system. (This definition includes development area.)

(8) **Source development area**: That geographic area or region wholly or partially within this County which will be developed or altered in connection with the development of a major new domestic water of sewage treatment system, as defined in 3-102(1) and (2). The source development area may or may not be wholly or partially within the development area.

3-104 Authority

These Regulations are adopted pursuant to, inter alia, §24-65.1-101 et seq. and §29-20-101, et seq., C.R.S., 1973.

3-105 Applicability

(1) These Regulations shall apply to the site selection for all major new domestic water and sewage treatment systems and construction thereof.

(2) These Regulations shall not apply to expansion of existing domestic water of sewage treatment systems.

3-106 Nonconforming Uses

(1) The provisions of this chapter shall not apply to or affect any development described in §1-105 of the Administrative Regulations adopted by this County, if these Regulations were adopted pursuant to only §§24-65.1, et seq., C.R.S., 1973.

(2) The provisions of this chapter shall not apply to any nonconforming use existing on the date the area is designated or subjected to regulation, provided that, when such a nonconforming use, except seasonal uses, shall be discontinued, or a nonconforming structure is damaged or destroyed to the extent of at least fifty percent (50%) of the appraised value. Any reuse, reconstruction, or replacement of such structure shall be deemed a new use and shall be subject to the provisions of these regulations, except when detrimental to the public health and safety.

For the purpose of this section, seasonal uses shall include but not be limited to irrigation systems and recreational areas that operate less than six (6) months per year.

3-107 Relationship of Regulations to Other State and Federal Requirements

(1) Nothing in these regulations shall be construed as exempting an applicant for a permit from any other requirements of this County or other State or Federal laws and regulations.

(2) To the extent that the requirements of these regulations differ from any other applicable requirements, the more restrictive requirements shall apply.

(3) Permit requirements included in these regulations shall be in addition to and in conformance with all applicable state and federal water quality laws, rules and regulations, including, but not limited, to the following:

(a) §25-8-704 (1)(a), C.R.S., 1973, sewage treatment plant site approval, which provides that no person shall commence the construction or expansion of any sewage treatment works intended to serve more than twenty (20) persons unless site location and the construction or expansion have been approved and designs therefore reviewed by the Colorado Water Quality Control Commission;

(b) §25-8-501, C.R.S., 1973, point source pollutant discharge permit;

(c) §208 (33 U.S.C. §1288) area wide wastewater treatment management planning;

(d) §303 (33 U.S.C. §1313) river basin water quality management planning;

(e) Disposal of sewage sludge (33 U.S.C. §1345);

(f) §32-1-201, C.R.S., 1963, Special District Control Act;

(g) 16 U.S.C. §661-666(c) (1970), the Fish and Wildlife Coordination Act;

(h) §102(c) (42 U.S.C. §4321, et seq.), the National Environmental Policy Act.

Article 2
DESIGNATION OF SITE SELECTION AND CONSTRUCTION OF MAJOR NEW DOMESTIC WATER AND SEWAGE TREATMENT PLANTS

3-201 Designation of Site Selection and Construction of Major New Domestic Water and Sewage Treatment Plants

The Board of County Commissioners having considered the intensity of current and foreseeable development pressures and applicable Guidelines for Identification and Designation adopted and issued by the Colorado Land Use Commission, it is the order of the Board of County Commissioners that site selection and construction of major new domestic water and sewage treatment systems be designated a matter of State interest and regulated pursuant to the provisions of this Chapter.

3-202 Boundaries of Area Covered by Designation

The site selection and construction of any major new domestic water and sewage treatment plants within the boundaries of this County shall be subject to this designation and regulation.

3-203 Reasons for Designation

Site selection and construction of major new domestic water and sewage treatment plants is hereby designated as a matter of State interest for the reasons stated in Section 3-102 of this Chapter.

Article 3
PERMIT APPLICATIONS AND PERMITS

3-301 Application Procedure

The procedures concerning permit applications, notice and conduct of permit hearings, review of Permit Authority decisions, and the issuance and content of permits to engage in site selection and development of major new domestic water and sewage treatment systems shall comply with the provisions set forth in Article 3 of the Administrative Regulations adopted by this County.

3-302 Prohibition on the Site Selection and Construction of Major New Domestic Water and Sewage Treatment Plants

(1) No person may locate a major new domestic water or sewage treatment system wholly or partially within this County without first obtaining a permit pursuant to these regulations.

(2) No local authority shall issue a building permit for purposes of selecting a site for or constructing a major new domestic water or sewage treatment plant without the applicant first having obtained a permit pursuant to these regulations.

3-303 Application for Permit

(1) Any person seeking to locate or construct a major new domestic water or sewage treatment system wholly or partially in this County shall apply for a permit form the Permit Authority on the appropriate form prescribed by the Colorado Land Use Commission. (For sewage systems the site application form adopted by the Water Quality Control Commission will be completed and attached to the application form. If the site location is approved by the Permit Authority, the same form may be submitted for action by the Colorado Water Quality Control Commission).

(2) Any application for a permit to locate or construct a major new domestic water or sewage treatment system shall be accompanied by nonrefundable certified funds in the amount of not more than ten percent (10%) of the total cost of the development, but shall not exceed the amount necessary to cover the costs incurred in the review and approval of the permit application, including all hearings conducted therefore.

(3) An application for a permit to locate or construct a major new domestic water or sewage treatment system shall be accompanied by five (5) copies of the following documents and information:

(a) An abstract of the proposal indicating the scope and need for the development;

(b) Preliminary review and comment on the proposal by the appropriate agency of the Colorado Department of Natural Resources and the Colorado Department of Health within sixty (60) days;

(c) Alternative potential site locations and degree of feasibility of each;

(d) For each alternative site or expansion area being considered by the applicant, the information specified in §3-304 of these Regulations.

(4) Any demographic data needed to fulfill the requirements of this regulation shall be consistent with those used for the 208 area wide waste treatment management planning.

3-304 Submission Requirements

(1) **Proponents of Proposal**

(a) Names, addresses and businesses of all local or other interests proposing site selection and construction of a major new water or sewage treatment system.

(b) Name and qualifications of the person (persons) responding to the requirements detailed in this regulation.

(2) **Scope of Proposal**

(a) Provide detailed plans of the proposal including proposed system capacity and service area plans mapped at a scale determined by the Permit granting Authority.

(b) Provide a description of all existing or approved proposed domestic water or sewage treatment systems within the development area and source development area.

(c) Detail the design capacity of each domestic water or sewage treatment system and the distribution or collection network in the development area and source development area.

(d) Detail the excess capacity of each treatment system and distribution or collection network in the community or development area and source development area.

(e) Provide an inventory of total commitments already made for current water or sewage services.

(f) Detail the operational efficiency of each existing system in the development area and source development area, including age, state of repair, and level of treatment.

(g) Detail the source, rights and quality of existing water supply.

(h) Detail existing water utilization including historic yield from rights and use by category such as agricultural, municipal and industrial and supply obligations to other systems.

(3) **Demonstrate the need for a new water or sewage treatment system.**

(a) Provide population trends for the development area and source development area, e.g., present population, population projections, and growth rates.

(b) Specify the predominant types of developments to be served by the proposed new water or sewage treatment system.

(c) Specify at what percentage of the design capacity the current system is now operating.

Water treatment system _____.
Wastewater treatment system _____.

(d) Specify whether or not present facilities can be upgraded to adequately accommodate the ten (10) year projected increased need in treatment and/or hydraulic capacity.

(4) **Environmental impact analysis.**

(a) **Land Use:**

(i) Provide a map (at an appropriate scale) detailing existing land uses of the proposed development, source development area, and the project service area including peripheral lands, which may be impacted. The land use map should include, but not necessarily be restricted to the following categories: residential, commercial, industrial, open space, outdoor recreation, agricultural, forest land and water bodies.

(ii) All immediately affected public land boundaries should be indicated on the map. Potential impacts of the proposed development upon public lands will be visually illustrated on the map as well as described in textural form.

(iii) Specify whether the proposed project conforms to Grand County's planning policies.

(iv) Specify whether the proposed project conforms to regional and state planning policies.

(v) Specify whether the proposed project conforms to federal land management policies.

(vi) Describe the present use of the land in the development area and source development area.

(vii) Detail the present zoning of the land in the development area and source development area.

(viii) Detail the agricultural productivity capability of the land in the development area and source development area (SCS classification).

(ix) Specify how the proposed development will utilize existing easements or rights-of-way for new associated distribution or collector networks.

(x) Specify if excess service capabilities created by the proposed development will generate sprawl or strip development.

(xi) Specify whether the demand for this project is associated with development within or contiguous to existing service areas.

(b) **Water Resources:**

(i) Describe and indicate on an appropriate map relevant surface water bodies (streams, lakes and reservoirs) and groundwater aquifers in the area and their uses. Describe the potential effects of the proposed project on the above-detailed water feature including the effects on present water quality and current uses.

(ii) On the same, or another appropriate map, indicate any floodplain associated with the proposed development. Documentation of historical flooding activity should be included. Detail potential, adverse impacts of associated floodplain.

(iii) Describe the potential adverse effects of the proposed development upon plant and animal life dependent upon the water resources in question.

(c) **Air Quality:**

(i) Detail the impact of the proposed development on ambient air quality of the area or community in question.

(d) **Significant Environmentally-sensitive Factors:**
Identify and locate on a map of an appropriate scale the juxtaposition of any of the following features present in the proposed development and source development area and its environs and detail the potential impact of the proposed development upon each feature.

(i) Marshlands and wetlands.

(ii) Groundwater recharge areas.

(iii) Potential natural hazards.

(iv) Forests and woodlands.

(v) Critical wildlife habitat.

(vi) Public, outdoor recreation areas.

(vii) Unique areas of geologic, historic and archeological importance.

(e) **Visual Aesthetics and Nuisance Factors:**

Identify any significant deterioration of existing natural aesthetics, creation of visual blight, noise pollution or obnoxious odors, which may stem from development.

(f) **Describe what impact the development will have upon transportation matters in the area.**

(5) **Financial impact analysis of site selection and construction of major new water and sewage treatment facilities will include but not be limited to the following:**

(a) Review and summary of any existing engineering and/or financial feasibility studies, assessed taxable property valuations, property tax collection experience, and all other matters of aid in determining the feasibility of the new facility, including such as related to:

(i) Service area and/or boundaries.

(ii) Applicable methods of transmitting, storing, treating and delivering water, and collecting, transmitting, treating and discharging sewerage (including effluent and/or sludge disposal)

(iii) Estimated construction costs and period of construction of each new facility component.

(iv) Assessed valuation of the property to be included within the service area and/or boundaries.

(v) Revenues and operating expenses of the new facility including but not limited to historical and estimated property taxation, service charges and rates, assessments, connection and tap fees, standby charges and all other revenues of the new facility.

(vi) Amount and security of proposed debt and method and estimated cost of debt service.

(vii) Details of any substantial contract or agreement for revenues (as in "(v)" above) or for services to be paid, furnished or used by or with any person, association, corporation and governmental body.

(b) Provide a debt retirement schedule based upon anticipated service fees and tax base.

(c) Identification of the person, association, corporation and governmental body that will benefit by, use and will pay any or all of the revenues (as in "(v)" above).

(d) If the new water or sewage treatment system exceeds the proposed ten (10) year population growth needs as detailed by the appropriate region's 208 planning demographic projections, then detail the excess service capacity and the cost of such excess capacity to the community.

3-305 Waiver of Submission Requirements

(1) The permit authority may waive any part but not all of the submission requirements imposed by this regulation upon petition of the applicant that full compliance with the submission requirements would be unreasonably burdensome for the applicant and that the proposed development will have an insubstantial impact on the surrounding area. Such a waiver may be granted, after due consideration by the permit authority, upon a written determination that the information to be submitted is sufficient for the permit authority to arrive at a permit decision in full compliance with the law and these regulations and that the proposed development will have and insubstantial impact on the surrounding area. If the permit authority decides to waive any part of the submission requirements, such a decision may be immediately re-viewable by the Board of County Commissioners pursuant to an appeal brought in accordance with §1-409 or by the Board's own motion entered at its next regularly scheduled meeting or twenty (20) days after the permit authority's decision, whichever is later. The Board may reinstate all or part of the submission requirements waive by the permit authority. Provided however, that nothing herein is to be construed as limiting the Board's power to reverse the permit authority's grant or denial of a permit for waiver of any of the submission requirements, which the Board considers necessary when a later appeal is brought pursuant to §1-409 objecting to the permit authority's ultimate decision.

(2) The petition shall be considered and the decision rendered by the permit authority at a public hearing held in compliance with the provisions of Section 403 of the Administrative Regulations adopted by this jurisdiction.

3-306 Approval of Permit Authority

(1) A permit application for site selection and construction of a major new domestic water or sewage treatment system shall be approved if the proposed development complies with the following criteria:

(a) New domestic water and sewage treatment systems shall be constructed in areas which will result in the proper utilization of existing treatment plants and the orderly development of domestic water and sewage treatment systems of communities within this County within the development area and source development area;

(b) The proposed development does not conflict with an approved local master plan or other applicable regional, state or federal land use or water plan;

(c) The proposed development does not adversely affect either surface or subsurface water rights of upstream or downstream users;

(d) Adequate water supplies, as determined by the Colorado Department of Health, are available for efficient operational needs;

(e) Existing domestic water treatment systems servicing the area must be at or near operational capacity;

(f) Existing domestic sewage treatment facilities servicing the area must be at or greater than eighty percent (80%) of operational capacity;

(g) The scope and nature of the proposed development will not compete with existing water and sewage services or create duplicate services;

(h) Age of existing water and sewage systems operational efficiency, state of repair or level of treatment is such that replacement is warranted;

(i) Area and community development and population trends demonstrate clearly a need for such development;

(j) Existing facilities cannot be upgraded or expanded to meet waste discharge permit conditions of the Colorado Water Quality Control Division;

(k) Appropriate easements can be obtained for any associated collector or distribution system that will serve existing and proposed needs;

(l) Such development will not encourage strip development or leapfrog-development;

(m) The benefits of the proposed development outweigh the losses of any natural resources or agricultural lands rendered unavailable as a result of the proposed development;

(n) The proposed development will not decrease the quality of peripheral or downstream surface or subsurface water resources below that designated by the Colorado Water Quality Control Commission as established on January 15, 1974 and effective June 19, 1974;

(o) The proposed development or its associated collector or distribution system will not be subjected to potential natural hazards;

(p) The proposed development or its associated collector or distribution system or new service areas will not violate federal or state air quality standards;

(q) The proposed development or its associated collector or distribution system will not significantly deteriorate aquatic habitats, marshlands and wetlands, groundwater recharge areas, steeply sloping or unstable terrain, forests and woodlands, critical wildlife habitat, big game migratory routes, calving grounds, migratory

ponds, nesting areas and the habitats of rare and endangered species, public outdoor recreation areas, and unique areas of geologic, historic, or archaeological importance;

(r) The proposed development or its associated collector or distribution system will not significantly degrade existing natural scenic characteristics, create blight, or cause other nuisance factors such as excessive noise or obnoxious odors;

(s) The proposed development or its associated collector or distribution system will not create an undue financial burden on existing or future residents within the development area and the source development area. The cost of securing an adequate supply of water for existing and future needs of the residents shall be considered in determining whether an "undue financial burden" will result;

(t) The development site of a major new domestic water or sewage treatment system is not subject to significant risk from earthquakes, floods, fires or other disasters, which could cause a system operational breakdown.

(2) The permit shall be denied if the applicant fails to satisfy all the criteria outlined in 3-306 (1).

Article 4
ADMINISTRATION, ENFORCEMENT AND PENALTIES

3-401 Administration, Enforcement and Penalties
The provisions of this regulation and any permits issued hereunder shall be administered and enforced according to the provisions of the Administrative Regulations adopted by this County.

3-402 Severability
If any section, clause, provision, or portion of these regulations should be found to be unconstitutional or otherwise invalid by a court of competent jurisdiction, the remainder of this regulation shall not be affected thereby and is hereby declared to be necessary for the public health, safety and welfare.

EXHIBIT "4"
TO BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY, COLORADO, RESOLUTION NO. 1978-5-4

CHAPTER 4
MAJOR EXTENSIONS OF EXISTING DOMESTIC WATER AND SEWAGE TREATMENT SYSTEMS

Article 1
GENERAL AND INTRODUCTORY PROVISIONS

4-101 Title and Citation
These various sections constituting Chapter 4 of the "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand" may be cited as the "Regulations for Major Extensions of Existing Domestic Water Supply and Sewage Treatment Systems" of Grand County.

4-102 Purpose and Intent
The purpose and intent of the regulations contained in this Chapter are as follows:

(1) To insure that anticipated growth and development that may occur as a result of major extensions of domestic water and sewage treatment systems can be accommodated within the financial and environmental capacity of the development area and source development area to sustain such growth and development.

(2) To insure the planned and orderly land use development that may occur as a result of major extensions of domestic water and sewage treatment systems within the development area and source development area.

(3) To regulate the use of land on the basis of the financial and environmental impact thereof on the community or surrounding areas within the development area and source development area.

4-103 Definitions

(1) **Domestic water and sewage treatment system:** A wastewater treatment plant, water treatment plant, or water supply system and any system of pipes, structures, and facilities; through which wastewater is collected for treatment.

(a) **Wastewater treatment plant:** The facility or group of units used for treatment of wastewater from sewer systems and for the reduction and handling of solids and gases removed from such wastes.

(b) **Water supply system:** The system of pipes and structures and facilities through which a water supply is obtained, treated and sold or distributed for human consumption or the system of pipes and structures and facilities through which water is obtained which will be exchanged or traded for water which will be exchanged or traded for water which will be used for human consumption.

(c) **Water treatment plant:** The facility or facilities within the water supply system, which can alter the physical, chemical or bacteriological quality of the water.

(2) **Major extension of an existing domestic water treatment system:** The expansion of existing domestic water treatment plants or any extension of existing water supply systems to service an additional population equivalent of twenty (20) single family dwelling units or the equivalent thereof in other areas.

(3) **Major extension of an existing sewage treatment system:** Any modification of existing sewage treatment plant to increase hydraulic capacity or upgrade treatment capability or any extension of existing main collector sewer lines or any increase in capacity of existing main sewer lines or any extensions to service a population of twenty (20) or more people or the equivalent thereof in other uses.

(4) **Source area:** A geographic area or region where moisture falls and drains through natural processes to either streams or lakes or permeates to the groundwater table, analogous to catchment's basin or watershed.

(5) **Collector system:** A network or pipes and conduits through which sewage flows to a sewage treatment plant.

(6) **Distribution system:** A network of pipes and conduits through which water is piped to the public for human consumption or a network of pipes and conduits through which water is piped to the public in exchange or trade for water for human consumption.

(7) **Proposed development:** A major extension of an existing domestic water or sewage treatment system as defined in 4-103 (2) or (3) and includes any proposed land development related to such system if such development is to be located wholly or partially within this County and if such development specifically generates the need for a major extension of an existing major water or sewage treatment system. The term "development area" as used in this regulation, is included within the meaning of "proposed development".

(8) **Source area development:** That geographic area or region wholly or partially within this County which will be developed or altered in connection with a major extension of existing domestic water and sewage treatment systems, as those terms are defined in 4-102 (2) and (3). The source development area may or may not be the same as the development area.

4-104 Authority

These regulations area adopted pursuant to, inter alia, §24-65.1-101, et seq., and §29-20-101, et seq., C.R.S., 1973.

4-105 Applicability

(1) These regulations shall apply to the site selection and construction of all major extensions of existing domestic water and sewage treatment systems.

4-106 Non-conforming Uses

(1) The provisions of this Chapter shall not apply to or affect any development described in §1-105 of the Administrative Regulations adopted by this County, if these regulations were adopted pursuant to only §§24-65.1-101, et seq., C.R.S., 1973.

(2) The provisions of this chapter shall not apply to any nonconforming use existing on the date the area is designated or subject to regulation, provided that, when such a nonconforming use, except seasonal uses, shall be discontinued, or a nonconforming structure is damaged or destroyed to the extent of at least fifty percent (50%) of the appraised value, any reuse, reconstruction, or replacement of such structure shall be deemed a new use and shall be subject to the provisions of these regulations, except when detrimental to the public health and safety. For the purpose of this section, seasonal uses shall include but not be limited to irrigation systems and recreational areas that operate less than six (6) months per year.

4-107 Relationship of Regulations to Other State and Federal Requirements

(1) Nothing in these regulations shall be construed as exempting an applicant for a permit from any other requirements of this County or other State or Federal laws and regulations.

(2) To the extent that the requirements of these regulations differ from any other applicable requirements, the more restrictive requirements shall apply.

(3) Permit requirements included in these regulations shall be in addition to and conformance with all applicable state and federal water quality laws, rules and regulations, including but not limited to, the following:

(a) §§25-8-704(1) (a), C.R.S., 1973, sewage treatment plant site approval which provides that no person shall commence the construction or expansion of any sewage treatment works intended to serve more than twenty (20) persons unless site locations and the construction or expansion have been approved and designs therefore reviewed by the Colorado Water Quality Control Commission.

(b) §25-8-501, C.R.S., 1973, point source pollutant discharge permit.

(c) §208(33 U.S.C. §1288) area wide wastewater treatment management planning.

(d) §303(33 U.S.C. §1313) river basin water quality management planning.

(e) Disposal of sewage sludge (33 U.S.C. §1345).

(f) §32-1-201, C.R.S., 1973, Special District Control Act.

(g) 16 U.S.C §661-666(c) (1970), The Fish and Wildlife Coordination Act.

(h) §102(c) (42U.S.C. §4321 et seq.), The National Environment Policy Act.

Article 2
DESIGNATION OF MAJOR EXTENSIONS OF EXISTING DOMESTIC WATER AND SEWAGE TREATMENT SYSTEMS

4-201 Designation of Major Extensions of Existing Domestic Water and Sewage Treatment Systems

The Board of County Commissioners having considered the intensity of current and foreseeable development pressures and applicable Guidelines for Identification and Designation adopted and issued by the Colorado Land Use Commission, it is the order of the Board of County Commissioners that major extensions or existing domestic water and sewage treatment systems be designated a matter of state interest and regulated pursuant to the provisions of this Chapter.

4-202 Boundaries of Area Covered by Designation

Major extensions of existing domestic water and sewage treatment systems wholly or partially within this County shall be subject to this designation and regulation.

4-203 Reasons for Designation

Major extensions of existing domestic water and sewage treatment systems is hereby designated as a matter of State interest for the reasons stated in Section 4-102 of this Chapter.

Article 3
PERMIT APPLICATIONS AND PERMITS

4-301 Application Procedures

The procedures concerning permit applications, notice and conduct of permit hearings, review of permit authority decisions, and the issuance and content of permits to engage in major extension of existing domestic water and sewage treatment systems shall comply with the provisions set forth in Article 4 of the Administrative Regulations adopted by this jurisdiction.

4-302 Prohibition of Major Extensions of Existing Domestic Water and Sewage Treatment Systems

(1) No person may engage in a major extension of a domestic water of sewage treatment system wholly or partially within this County without first obtaining a permit pursuant to these regulations.

(2) No local authority shall issue a building permit for purposes of a major extension of an existing domestic water or sewage treatment system without the applicant first having obtained a permit pursuant to these regulations.

4-303 Application for Permit

(1) Any person seeking to develop a major extension of an existing domestic water or sewage treatment system wholly or partially within this County shall apply for a permit from the Permit Authority on the appropriate form prescribed by the Colorado Land Use Commission. (For sewage systems the site application form adopted by the Water Quality Control Commission will be completed and attached to the application form. If the site location is approved by the Permit Authority, the same form may be submitted for action by the Colorado Water Quality Control Commission.)

(2) Any application for a permit to construct a major extension of an existing domestic water or sewage treatment system shall be accompanied by non-refundable certified funds in the amount of not more than ten percent (10%) of the total cost of the development, but shall not exceed the amount necessary to cover the costs incurred in the review and approval of the permit application, including all hearings conducted therefore.

(3) An application for a permit to develop a major extension of an existing domestic water of sewage treatment system shall be accompanied by five (5) copies of the following documents and information:

(a) An abstract of the proposal indicating the scope and need for the development.

(b) Preliminary review and comment on the proposal by the appropriate agency of the Colorado Department of Natural Resources and Colorado Department of Health within sixty (60) days.

(c) Alternative potential site locations and degree of feasibility of each.

(d) For each alternative expansion being considered by the applicant, the information specified in §4-304 of these regulations.

(4) Any demographic data needed to fulfill the requirements of this regulation shall be consistent with those used for the 208 area wide waste treatment management planning.

4-304 Submission Requirements

(1) Proponents of Proposal

(a) Names, addresses and business of all local and other interests proposing site of a major expansion of a domestic water or sewage treatment system.

(b) Name and qualifications of the person (persons) responding to the requirements detailed in this regulation.

(2) Scope of Proposal

(a) Provide detailed plans of proposal including proposed system capacity and service area plans mapped at an appropriate scale.

(b) Provide a description of all existing or approved proposed systems within the development area and source development area.

(c) Detail the design capacity of each treatment system, and distribution or collection network in the community or development area and source development area.

(d) Specify the excess capacity of each treatment system and distribution or collection network in the community or development area and source development area.

(e) Provide an inventory of total commitments already made for current water or sewage services.

(f) Detail the operational efficiency of each existing system in the development area and source development area, including age, state of repair and level of treatment.

(g) Detail the source, rights and quality of existing water supply.

(h) Detail water utilization including historic yield from rights and uses by category such as agricultural, municipal and industrial and supply obligations to other systems.

(3) Demonstrate the need for a major expansion of a domestic water or sewage treatment system.

(a) Provide population trends for the development area and source development area, e.g., present population, population projections and growth rates.

(b) Specify the predominant types of developments to be served by the proposed extension water or sewage treatment system.

(c) Specify at what percentage of the design capacity the current system is now operating.

Water treatment system _____.
Wastewater treatment system _____.

(d) Specify whether or not present facilities can be upgraded to adequately the ten (10) year projected increased need in treatment and/or hydraulic capacity.

(4) Environmental impact analysis

(a) **Land Use:**

(i) Provide a map (at an appropriate scale) detailing existing land uses of the proposed development, source development area and the project service area, including peripheral lands, which may be impacted. The land use map should include, but not necessarily be restricted to the following categories: residential, commercial, industrial, extractive, transportation, communication and utility, institutional, open space, outdoor recreation, agricultural, forest land and water bodies.

(ii) All immediately affected public land boundaries should be indicated on the map. Potential impacts of the proposed development upon public lands will be visually illustrated on the map as well as described in textual form.

(iii) Specify whether the proposed project conforms to this County's planning policies.

(iv) Specify whether the proposed project conforms to regional and state planning policies.

(v) Specify whether the proposed project conforms to federal land management policies.

(vi) Describe the present use of the land in this development area and source development area.

(vii) Detail the present zoning of the land in the development area and source development area.

(viii) Detail the agricultural productivity capability of the land in the development area and source development area. (SCS classification.)

(ix) Specify how the proposed development will utilize existing easements or rights-of-way for new associated distribution of collector networks.

(x) Specify if excess service capabilities created by the proposed development will generate sprawl or strip development.

(xi) Specify whether the demand for this project is associated with development within or contiguous to existing service areas.

(b) **Water Resources:**

(i) Describe and indicate on an appropriate map relevant surface water bodies (streams, lakes and reservoirs) and groundwater aquifers in the area and their uses. Describe the potential effects of the proposed project on the above-detailed water feature including the effects on present water quality and current uses.

(ii) On the same, or another appropriate map, indicate any floodplain associated with the proposed development. Documentation of historical flooding activity should be included. Detail potential, adverse impacts of associated floodplain.

(iii) Describe the potential adverse effects of the proposed development upon plant and animal life dependent upon the water resources in question.

(c) **Air Quality:**

(i) Detail the impact of proposed development on ambient air quality of the area or community in question.

(d) **Significant Environmentally-Sensitive Factors:**
Identify and locate on a map of an appropriate scale the juxtaposition of any of the following features present in the proposed development and source development area and its environs and detail the potential impact of the proposed development upon each feature.

(i) Marshlands and wetlands.

(ii) Groundwater recharge areas.

(iii) Potential natural hazards.

(iv) Forests and woodlands.

(v) Critical wildlife habitat.

(vi) Public, outdoor recreation areas.

(vii) Unique areas of geologic, historic and archaeological importance.

(e) Visual aesthetics and nuisance factors.

(f) Describe what impact the development will have upon transportation patterns in the area.

(5) Financial impact analysis of major extensions of existing domestic water and sewage treatment facilities will include but not be limited to the following:

(a) Review and summary of any existing engineering and/or financial feasibility studies, assessed taxable property valuations, property tax collection experience, and all other matter of aid in determining the feasibility of the extension, including such as related to:

(i) Service area and/or boundaries.

(ii) Applicable methods of transmitting, storing, treating and delivering water and collecting, transmitting, treating and discharging sewerage (including effluent and/or sludge disposal).

(iii) Estimated construction costs and period of construction of each major extension component.

(iv) Assessed valuation of the property to be included within the service area and/or boundaries.

(v) Revenues and operating expenses of the new facility including but not limited to historical and estimated property taxation, service charges and rates, assessments, connection and tap fees, standby charges and all other revenues of the new facility.

(vi) Amount and security of proposed debt and method and estimated cost of debt service.

(vii) Details of any substantial contract or agreement for revenues (as in "(v)" above) or for services to be paid, furnished or used by or with any person, association, corporation and governmental body.

(b) Provide a debt retirement schedule based upon anticipated service fees and tax base.

(c) Identification of the person, association, corporation and governmental body that will benefit by, use and will pay any or all of the revenues (as in "(v)" above).

(d) If the major extension capacity exceeds the proposed ten (10) year population growth needs as detailed by the appropriate region's 208 planning demographic projections, then detail the excess service capacity and the cost of such excess capacity to the community.

4-305 Waiver of Submission Requirements

(1) The permit authority may waive any part but not all of the submission requirements imposed by this regulation upon petition of the applicant that full compliance with the submission requirements would be unreasonably burdensome for the applicant and that the proposed development will have an insubstantial impact on the surrounding area. Such a waiver may be granted, after due consideration by the permit authority, upon a written determination that the proposed development will have an insubstantial impact on the surrounding area. If the Permit Authority decides to waive any part of the submission requirements, such a decision may be immediately re-viewable by the Board of County Commissioners pursuant to an appeal brought in accordance with §1-409 or by the Board's own motion entered at its next regularly scheduled meeting or twenty (20) days after the permit authority's decision whichever is later. The Board may reinstate all or part of the submission requirements waived by the Permit Authority. Provided however, that nothing herein is to be construed as limiting the Board's power to reverse the permit authority's grant or denial of a permit for the waiver of any of the submission requirements, which the Board considers necessary when a later appeal is brought pursuant to §1-409 objecting to the permit authority's ultimate decision.

(2) The petition shall be considered and the decision rendered by the permit authority at a public hearing held in compliance with the provisions of Section 403 of the Administrative Regulations adopted by this County.

4-306 Approval of Permit Application

(1) A permit application for a major extension of existing domestic water or sewage treatment system shall be approved if the proposed development complies with the following criteria:

(a) Major extensions of domestic water and sewage treatment systems shall be permitted in those areas in which the anticipated growth and development that may occur as a result of such extension can be accommodated within the financial and environmental capacity of the development area and source development area to sustain such growth and development;

(b) The proposed development does not conflict with an approved local master plan or other applicable regional, state or federal land use or water plan;

(c) The proposed development does not adversely affect either surface or sub-surface water rights of upstream or downstream users within the development area and source development area;

(d) Adequate water supplies as determined by the Colorado Department of Health, are available for efficient operational needs;

(e) Existing domestic water treatment systems servicing the area must be at or near operational capacity;

(f) Existing domestic sewage treatment facilities servicing the area must be at or greater than eighty percent (80%) of operational capacity;

(g) The scope and nature of the proposed development will not compete with existing water and sewage services or create duplicate services;

(h) Age of existing water and sewage systems, operational efficiency, state of repair or level of treatment is such that replacement is warranted;

(i) Area and community development and population trends demonstrate clearly a need for such development;

(j) Existing facilities cannot be upgraded or expanded to meet waste discharge permit conditions of the Colorado Water Quality Control Commission;

(k) Appropriate easements can be obtained for any associated collector or distribution system that will serve existing and proposed needs;

(l) Such development will not encourage strip development or leapfrog development;

(m) The benefits of the proposed development outweighs the losses of any natural resources or agricultural lands rendered unavailable as a result of the proposed development;

(n) The proposed development will not decrease the quality of peripheral or downstream surface or subsurface water resources below that designated by the Colorado Water Quality Control Commission as established on January 15, 1974 and effective June 19, 1974.

(o) The proposed development or its associated collection or distribution system will not be subject to potential natural hazards;

(p) The proposed development or its associated collector or distribution system or new service areas will not violate federal or state air quality standards;

(q) The proposed development or its associated collector or distribution system will not significantly deteriorate aquatic habitats, marshlands and wetlands, groundwater recharge areas, steeply sloping or unstable terrain, forests and woodlands, critical wildlife habitat, big game migratory routes, calving grounds, migratory ponds, nesting areas and the habitats of rare and endangered species, public outdoor recreational areas, and unique areas of geologic, historic, or archaeological importance;

(r) The proposed development or its associated collector or distribution system will not significantly degrade existing natural scenic characteristics, create blight, or cause other nuisance factors such as excessive noise or obnoxious odors;

(s) The proposed development or its associated collection or distribution system will not create an undue financial burden on existing or future residents within the development area and source development area. The cost of securing an adequate supply of water for existing and future needs of the residents shall be considered in determining whether an "undue financial burden" will result;

(t) The development site of a proposed major extension of an existing domestic water or sewage treatment system is not subject to significant risk from earthquakes, floods, fires or other disasters which could cause a system operational breakdown;

(u) Any proposed domestic water treatment and distribution system is capable of providing water meeting the requirements of the Colorado Department of Health;

(2) The permit shall be denied if the applicant fails to satisfy all the criteria outlined in 4-306(1).

Article 4
ADMINISTRATION, ENFORCEMENT AND PENALTIES

4-401 Administration, Enforcement and Penalties
The provisions of this regulation and any permits issued hereunder shall be administered and enforced according to the provisions of the Administrative Regulations adopted by this County.

4-402 **Severability**
If any section, clause, provision, or portion of these regulations should be found to be unconstitutional or otherwise invalid by a court of competent jurisdiction, the remainder of this regulation shall not be affected thereby and is hereby declared to be necessary for the public health, safety and welfare.

EXHIBIT "5"
TO BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY COLORADO
RESOLUTION NO.1978-5-4

CHAPTER 5
MUNICIPAL AND INDUSTRIAL WATER PROJECTS

Article 1
GENERAL AND INTRODUCTORY PROVISIONS

5-101 Title and Citation
These various sections constituting Chapter 5 of the "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand" may be cited as the "Regulations for Municipal and Industrial Water Projects" of Grand County.

5-102 Purpose and Intent
The purpose and intent of regulations contained in this chapter shall be to:

(1) Insure that municipal and industrial water projects are developed in a manner so as to emphasize the most efficient use of water including to the extent permissible under law, the recycling and reuse of water.

(2) Insure that urban development, population densities, and site layout and design of storm water and sanitation systems shall be accomplished in a manner that will prevent the pollution of aquifer recharge areas.

(3) Insure that municipal and industrial water projects are developed in such a manner so as not to pollute rivers, streams, lakes, reservoirs, ponds and aquifer recharge areas within the source development area.

5-103 Definitions

(1) **Aquifer recharge area:** Any area where surface waters may infiltrate to a water-bearing stratum of permeable rock, sand or gravel. This definition will also include wells used for disposal of wastewater or other toxic pollutants.

(2) **Efficient use of water:** The employment of methods, procedures, techniques, and controls to insure that the amount of water and purpose for which water is used in this County will yield the greatest possible benefit to the greatest number of people. Such benefits will consider, but not be limited to economic, social, esthetic, environmental and recreational.

(3) **Municipal and industrial water project:** A system and all integrated components thereof through which a municipality or industry derives its water supply from either surface or subsurface sources. This includes a system and all integrated components thereof through which a municipality or industry derives water exchanged or traded for water it uses for its own needs.

"Municipal and industrial water projects" also means storm water and wastewater disposal systems of a municipality or industry.

(4) **Recycling:** The treatment of wastewater in a manner that will replenish its quality to the standard established by the Colorado Department of Public Health where permissible by Colorado water law.

(5) **Source development area:** That geographic area or region wholly or partially within this County which will be developed or altered in connection with the development of a municipal or industrial water project as these terms are defined in §5-102 (3).

5-104 Authority

These regulations are adopted pursuant to inter alia §§24-65.1, et seq., and §29-20-101, et seq., C.R.S., 1973.

5-105 Applicability

(1) These regulations shall apply to development of municipal and industrial water projects wholly or partially within this County.

(2) Any person seeking to develop a municipal or industrial water project shall obtain a permit pursuant to these regulations prior to seeking any other permit, rezoning or other action by this County.

5-106 Nonconforming Uses

The provision of this Chapter shall not apply to or affect any development described in §1-105 of the Administrative Regulations adopted by this County, if these regulations were adopted pursuant to only §§24-65.1-101, et seq., C.R.S., 1973.

5-107 Relationship to Other Requirements

(1) Nothing in these regulations shall be construed as exempting an applicant for a permit from any other requirements of this County or other State or Federal laws and regulations.

(2) To the extent that the requirements of these regulations differ from any other applicable requirements, the more restrictive requirements shall apply.

Article 2
DESIGNATION OF MUNICIPAL AND INDUSTRIAL WATER PROJECTS

5-201 Designation of Municipal and Industrial Water Projects

The Board of County Commissioners having considered the intensity of current and foreseeable development pressures and applicable Guidelines for Identification and Designation adopted and issued by the Colorado Land Use Commission, it is the

order of the Board of County Commissioners that municipal and industrial water projects be designated a matter of State interest and regulated pursuant to the provisions of this Chapter.

5-202 Boundaries of Area Covered by Designation

Development of municipal and industrial water projects within the boundaries of this County shall be subject to this designation and regulation.

5-203 Reasons for Designation

Development of municipal and industrial water projects is hereby designated as a matter of State interest for the reasons stated in §5-102 of this Chapter.

Article 3
PERMIT APPLICATION AND PERMITS

5-301 Application Procedure

The procedures concerning permit applications, notice and conduct of permit hearings, review of permit authority decisions, and the issuance and content of permits to engage in development of a municipal or industrial water project shall comply with the provisions set forth in Article 4 of the Administrative Regulations adopted by this County.

5-302 Prohibition of Development of Municipal and Industrial Water Projects

(1) No person may engage in development of a municipal or industrial water project in this County without first obtaining a permit pursuant to these regulations.

(2) No local authority shall issue a building permit for purposes of developing or construction of a municipal or industrial water project without the applicant first having obtained a permit pursuant to these regulations.

5-303 Application for Permit

(1) Any person seeking to engage in development of a municipal or industrial water project in this County shall apply for a permit from the permit authority on the appropriate form prescribed by the Colorado Land Use Commission.

(2) Any application for a permit to engage in development of a municipal or industrial water project shall be accompanied by nonrefundable certified funds in the amount of not more than ten percent (10%) of the total cost of the development but shall not exceed the amount necessary to cover the costs incurred in the review and approval of the permit application including all hearings conducted therefore.

(3) Any application for a permit to engage in development of a municipal or industrial water project shall be accompanied by five (5) copies of the following documents and information:

(a) An abstract of the proposal indicating the scope and need for the development.

(b) Preliminary review and comments on the proposal by the Colorado Health Department and Colorado Department of Natural Resources within sixty (60) days.

(c) Alternative potential site locations and degree of feasibility of each.

(d) For each alternative site or expansion area being considered by the applicant, the information specified in §5-304 of these regulations.

(4) Any demographic data needed to fulfill the requirements of this regulation shall be consistent with those used for the 208 area wide wastewater treatment management planning.

5-304 Submission Requirements

(1) Proponents of Proposal

(a) Names, addresses and businesses of all interests proposing the development of a municipal or industrial water project.

(b) Name and qualification of persons responding to the requirements of this regulation.

(2) A detailed report on the proposed municipal or industrial water project to include:

(a) Location and scope of the proposed project.

(b) Current and future needs for such development.

(c) Inventory of existing water projects presently serving the municipality or area in question and excess service capacity of each project.

(d) Population trends, projections and growth rates (if a municipal project).

(e) Primary source of proposed water resource.

(3) Verification that the proposed water project will not conflict with Federal, State, regional or County planning policies or regulations applicable to land or water resources.

(4) Detail proposed methods of insuring efficient use of water resources within the municipality or industrial area and the source development area. Such methods should consider metering of all users, examination of rate structures to discourage waste and recycling of water for reuse where permissible by Colorado water law.

(5) In instances where municipal or industrial wastewater or storm water disposal methods are not subject to and regulated by other State and/or Federal statutes or regulations, detail the proposed methods by which storm waters or wastewaters will be prevented from contaminating aquifers.

(6) Provide assurance that the proposed municipal or industrial water project is capable of supplying water of a quality to be determined by the Colorado Department of Health.

(7) Identify and locate on a map of an appropriate scale the juxtaposition of any of the following features present in the source development area and detail the potential impact of the municipal or industrial water project upon each feature:

(a) Marshlands and wetlands.

(b) Groundwater recharge areas.

(c) Potential natural hazards.

(d) Forests and woodlands.

(e) Critical wildlife habitat.

(f) Public, outdoor recreation areas.

(g) Unique areas of geologic, historic and archaeological importance.

(8) Describe the potential adverse effects of the diversions of water from the source development area upon plant and animal life dependent upon the water resources in question.

(9) Describe and indicate on an appropriate map relevant surface water bodies (streams, lakes, reservoirs, etc.) and groundwater aquifers in the source development area and their uses. Describe the affects of the diversion of water for the municipal or industrial water project on the above-detailed water feature (s) including the effects on present water quality, current and foreseeable uses.

(10) Detail the present zoning of the land in the source development area.

(11) Detail the agricultural productivity capability of the land in the source development area (SCS classification) and describe the potential effects of the diversion of water for the municipal or industrial water project on that agricultural productivity capability.

5-305 Waiver of Submission Requirements

(1) The permit authority may waive any part but not all of the submission requirements imposed by this regulation upon petition of the applicant that full compliance with the submission requirements would be unreasonably burdensome for the applicant and that the proposed development will have an impact on the surrounding area. Such a waiver may be granted, after due consideration by the permit authority, upon a written determination that the information to be submitted is sufficient for the permit authority to arrive at a permit decision in full compliance with the law and these regulations and that the proposed development will have an insubstantial impact on the surrounding area. If the permit authority decides to waive any part of the submission requirements, such a decision may be immediately reviewable by the Board of County Commissioners pursuant to an appeal brought in accordance with §1-409 or by the Board's own motion entered at its next regularly scheduled meeting or twenty (20) days after the permit authority's decision whichever is later. The Board may reinstate all or part of the submission requirement waived by the permit authority. Provided however, that nothing herein is to be construed as limiting the Board's power to reverse the permit authority's grant or denial of a permit for the waiver of any of the submission requirements, which the Board considers necessary when a later appeal is brought pursuant to §1-409 objecting to the permit authority's ultimate decision.

(2) The petition shall be considered and the decision rendered by the Permit Authority at a public hearing held in compliance with the provision of Section 304 of the Administrative Regulations adopted by this jurisdiction.

5-306 Approval of Permit Application

(1) A permit application for development of a municipal or industrial water project shall be approved if the proposed development complies with the following criteria:

(a) The need for the proposed water project can be substantiated.

(b) Assurances of compatibility of the proposed water project with federal, state, regional and county planning policies regarding land use and water resources.

(c) Municipal and industrial water projects shall emphasize the most efficient use of water, including, to the extent permissible under existing law, the recycling and reuse of water. Urban development, population densities, and site layout and design of storm water and sanitation systems shall be accomplished in a manner that will prevent the pollution of aquifer recharge areas.

(d) Provisions to insure that the proposed water project will not contaminate surface water resources.

(e) The proposed water project is capable of providing water pursuant to standards of the Colorado Department of Health.

(f) The proposed diversion of water from the source development area will not decrease the quality of peripheral or downstream surface and subsurface water resources in the source development area below that designated by the Colorado Water Quality Control Division on January 15, 1974 and effective June 19, 1974 or below stricter standards subsequently adopted.

(g) The proposed development and the potential diversions of water from the source development area will not significantly deteriorate aquatic habitats, marshlands and wetlands, groundwater recharge areas, steeply sloping or unstable terrain, forests and woodlands, critical wildlife habitat, big game migratory routes, calving grounds, migratory ponds, nesting areas and the habitats of rare and endangered species, public outdoor recreational areas, and unique areas of geologic, historic or archaeological importance.

(2) The permit shall be denied if the applicant fails to satisfy all the criteria outlined above.

Article 4
ADMINISTRATION, ENFORCEMENT AND PENALTIES

5-401 Administration, Enforcement and Penalties

The provision of this regulation and any permits issued hereunder shall be administered and enforced according to the provisions of the Administrative Regulations adopted by this County.

5-402 Severability

If any section, clause, provision, or portion of these regulations should be found to be unconstitutional or otherwise invalid by a court of competent jurisdiction, the remainder of this regulation shall not be affected thereby and is hereby declared to be necessary for the public health, safety, and welfare.

EXHIBIT "6"
TO BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY, COLORADO
RESOLUTION NO. 1978-5-4

DESIGNATION OF AREA OF STATE INTEREST

Pursuant to C.R.S., 1973, §24-65.1-101, et seq., (1974 Colo. S.L., pp. 335-352), on _____, the Board of County Commissioners of Grand County, Colorado, designated portions of the following lands as a _____ area, and area of State interest: _____

_____

_____

_____

_____

No one may engage in development of said lands without a permit. Maps or other descriptive materials showing the precise boundary of the _____ area and procedures for obtaining a permit area available at the office of the Board of County Commissioners of Grand County in the Grand County Courthouse, Hot Sulphur Springs, Colorado.

DATED THIS _____ day of _____, 20_____.

_____
Chairman
Board of County Commissioners of
Grand County, Colorado

EXHIBIT "6"
TO BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY, COLORADO
RESOLUTION NO. 1978-5-4

DESIGNATION OF ACTIVITY OF STATE INTEREST

Pursuant to C.R.S., 1973, §24-65.1-101, et seq., (1974 Colo. S.L., pp. 335-352), on _____, the Board of County Commissioners of Grand County, Colorado designated major extensions of existing domestic water and sewage treatment systems as an activity of State interest. Such activities may not be conducted within Grand County without a permit.

Procedures for obtaining such a Permit are available at the office of the Board of County Commissioners, which is located in the Grand County Courthouse at Hot Sulphur Springs, Colorado.

DATED THIS _____ day of _____, 20 ____.

_____
Chairman
Board of County Commissioners of
Grand County, Colorado

EXHIBIT "6"
TO BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY, COLORADO
RESOLUTION NO. 1978-5-4

DESIGNATION OF ACTIVITY OF STATE INTEREST

Pursuant to C.R.S., 1973, §24-65.1-101, et seq., (1974 Colo. S.L., pp. 335-352), on _____, the Board of County Commissioners of Grand County, Colorado designated site selection and construction of major new domestic water and sewage treatment systems as an activity of State Interest. Such activities may not be conducted within Grand County without a permit.

Procedures for obtaining such a permit are available at the office of the Board of County Commissioners, which is located in the Grand County Courthouse at Hot Sulphur Springs, Colorado

Dated this _____ day of _____, 20_____.

_____
Chairman
Board of County Commissioners of
Grand County, Colorado

EXHIBIT "6"
TO BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY COLORADO
RESOLUTION NO. 1978-5-4

DESIGNATION OF ACTIVITY OF STATE INTEREST

Pursuant to C.R.S., 1973, §24-65.1-101, et seq. (1974 Colo. S.L., pp. 335-352), on _____, the Board of County Commissioners of Grand County, Colorado designated municipal and industrial water projects as an activity of State Interest. Such activities may not be conducted within Grand County without a permit.

Procedures for obtaining such a permit are available at the office of the Board of County Commissioners of Grand County, which is located in the Grand County Courthouse at Hot Sulphur Springs, Colorado.

Dated this _____day of _____, 20 _____.

_____
Chairman
Board of County Commissioners of
Grand County, Colorado

EXHIBIT "6"
TO BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY, COLORADO
RESOLUTION NO. 1978-5-4

APPLICATION FOR A PERMIT
TO CONDUCT A DESIGNATED ACTIVITY OF STATE INTEREST
OR TO ENGAGE IN DEVELOPMENT
IN A DESIGNATED AREA OF STATE INTEREST

To: Permit Authority, _____
(Name of Jurisdiction)

Re: _____, a matter of state interest.

From: _____
(Applicant's name)

_____
(Address)

_____
(Telephone)

Date Submitted: _____

Date Received: _____

1. Matter of State Interest.

The applicant requests that a permit be issued for each of the items checked below:

A permit to engage in development in one or more of the following areas of state interest:

( ) Mineral Resource areas
( ) Geologic hazard areas
( ) Wildfire hazard areas
( ) Flood hazard areas
( ) Historical and archeological resource areas
( ) Significant wildlife area habitats
( ) Shorelands of major publicly-owned reservoirs
( ) Areas around airports
( ) Areas around major facilities of a public utility
( ) Areas around interchanges involving arterial highways
( ) Areas around rapid or mass transit facilities

A permit to conduct one or more of the following activities of state interest:

( ) Site selection and construction of major new domestic water and sewage treatment systems
( ) Major extensions of existing domestic water and sewage treatment systems

( ) Site selection and development of solid waste disposal sites

( ) Site selection of airports

( ) Site selection of rapid or mass transit facilities

( ) Site selection of arterial highways and interchanges and collector highways

( ) Site selection and construction of major facilities of a public utility

( ) Site selection and development of new communities

( ) Efficient utilization of municipal and industrial water projects

( ) Conduct of nuclear detonations

2. Proposed Activity or Development.

General description of the specific activity or development proposed (attach additional sheets if necessary): _____

_____

_____

_____

3. General Description.

A general, non-legal description and the popular name, if any, of the tract of land upon which the activity or development is to be conducted (attach additional sheets if necessary): _____

_____

_____

4. Legal Description.

The legal description, including the acreage, of the tract of land upon which the development or the activity is to be conducted, by metes and bounds or by government survey description: (attach additional sheets if necessary): _____

_____

_____

_____

5. Owners and Interests.

Set out below the names of those persons holding recorded legal, equitable, contractual and option interests and any other person known to the applicant having an interest in the property described in paragraph 4, above, as well as the nature and extent of those interests for each person, provided that such recorded interests shall be limited to those which are recorded in the County Recorder's Office of this jurisdiction, the land office of the Bureau of Land Management for this State, the Office of the State Board of Land Commissioners of the Department of Natural Resources, or the Secretary of State's Office of this State. (Attach additional sheets if necessary): _____

_____

_____

_____

6. Submission Requirements.

Submission requirements described in the regulations, which have been adopted by this jurisdiction for each of the activities or areas checked in paragraph 1 above, are attached to this application. Those attachments area identified, by letter or number, and described by title below:

7. Design and Performance Standards.

The attached analyses show that each of the design and performance standards set forth in the regulations for each of the activities or areas checked in paragraph 1 above, will be met. The individual analyses are identified by reference to the

appropriate paragraph or section numbers corresponding to each standard in the appropriate regulations adopted by this jurisdiction.

8. Master Plan.

a. Does the activity or development comply with the master plan of this jurisdiction? Yes _____ No _____.

b. If it does not comply, please explain how it does not comply. _____
_____
_____

9. Additional Information Required by Local Government

Attach any additional information required by this jurisdiction.

10. Duration of Permit.

The applicant requests a permit for a period of _____
_____

11. Application Fee.

An application fee of _____, ($_____), accompanies this application.

APPLICANT:

By _____
(Name)

_____
(Title)

EXHIBIT "6"
TO BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY, COLORADO
RESOLUTION NO. 1978-5-4

PERMIT ISSUED TO CONDUCT
A DESIGNATED ACTIVITY OF STATE INTEREST

OR

TO ENGAGE IN DEVELOPMENT IN A
DESIGNATED AREA OF STATE INTEREST

IN

THE COUNTY OF GRAND, STATE OF COLORADO

Pursuant to Administrative Regulations and Guidelines for Administration heretofore adopted by the Board of County Commissioners of Grand County, said County has received an application from _____ _____(hereinafter called "Applicant") for a permit involving the following matter(s) of State interest:

_____

_____

_____

and has approved that application.

This permit authorizes the Applicant:

1. To _____

   _____

   _____

   _____

2. On the following described tract of land: _____

   _____

   _____

3. For the following period: _____

   _____

4. In accordance with the plans and/or specifications approved by the Permit Authority on the _____day of _____, 20 _____, as well as the Guidelines for Administration adopted by Grand County for: _____

   _____

   _____

   _____

   _____

   _____

5. On the condition that the Applicant proceeds in conformity with all applicable Federal and State Statutes and Regulations as well as all applicable local land use controls including, but not limited to, master plans, subdivision regulations, zoning ordinance and building code.

This Permit shall not be effective until:

1. Applicant has filed the proper security with the Permit Authority, pursuant to the provisions of the Administrative Regulations of this jurisdiction in the amount of _____ ($_____).

2. The designation of any guidelines for the appropriate matter(s) have been finally determined pursuant to C.R.S., 1973, §24-65.1-404.

This Permit is valid for use only by the Applicant and may not be transferred. In the event that the Applicant fails to take substantial steps to initiate the above development or activity within twelve (12) months from the date of this Permit or, if such steps are taken, in the event the Applicant fails to complete the development or activity with reasonable diligence, this Permit may be revoked by the Permit Authority.

Dated this _____ day of _____, 20_____.

_____
Chairman
Permit Authority

STATE OF COLORADO)
County of Grand) ss.

At a regular meeting of the Board of County Commissioners for Grand County, Colorado, held at the Court House in Hot Sulphur Springs on Tuesday the 14th day of August A.D. 19 90 there were present:

James L. Newberry (Absent) Commissioner Chairman
Robert F. Andersen Commissioner
Duane E. Gallup Commissioner
Anthony J. DiCola County Attorney
Darline Underbrink Curran County Manager
Sara L. Rosman Clerk of the Board

when the following proceedings, among others were had and done, to wit:

RESOLUTION NO. 1990-8- 5

A RESOLUTION OF THE BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY, COLORADO ESTABLISHING A "RIGHT TO FARM AND RANCH" POLICY.

WHEREAS, Production Agriculture in Grand County is defined as property that has produced net less than $5,000.00 of gross market value agricultural product (food and/or fiber) in four of the past five years. Property that has been deemed to be in production agriculture will no longer be considered as such, if sold for development of any kind. Family transfers for estate purposes, etc., that continue to function as an integral part of the property deemed to be in Production Agriculture, will continue to be defined as Production Agriculture; and

WHEREAS, pursuant to Article 3.5, Title 35, C.R.S., it is declared policy of the State of Colorado to conserve, protect, and encourage the development and improvement of its agricultural land for the production of food and other agricultural products; and further that the general assembly recognizes that when nonagricultural land uses extend into agricultural areas, agricultural operations are forced to cease operations and many others are discouraged from making investments in farm improvements; and that it is the purpose of the Article to reduce the loss to the State of Colorado of its agricultural resources by limiting the circumstances under which agricultural operations may be deemed to be a nuisance. It is further recognized that units of local government may adopt ordinances or pass resolutions that provide additional protection for agricultural operations consistent with the interests of the affected agricultural community, without diminishing the rights of any real property interest; and

WHEREAS, the Board of County Commissioners has determined that it is desirable to establish and adopt by resolution a "Right to Farm and Ranch" Policy involving the elements of protection of agricultural operations, education of property owners and the public; and resolution of disputes; and

WHEREAS, the establishment and adoption of such a "Right to Farm and Ranch" Policy would serve and promote the public health, safety and welfare of the citizens of Grand County.

NOW, THEREFORE, BE IT RESOLVED by the Board of County Commissioners of Grand County, Colorado, that:

1. Policy Statement. It is the policy of the Board of County Commissioners of Grand County, as set forth herein that: Ranching, farming and all manner of agricultural activities and operations within and throughout Grand County are integral elements of and necessary for the continued viality of the County's history, economy, landscape, open space, lifestyle and culture. Given their importance to Grand County, Northwestern Colorado, and the State, agricultural land and operations are worthy of recognition and protection. Notice is hereby given as follows:

    a. Colorado is a "Right to Farm" State pursuant to C.R.S. 35-3.5-101, et. seq. Landowners, residents and visitors must be prepared to accept the activities, sights, sounds, and smells of Grand County's agricultural operations as a normal necessary aspect of living in a County with a strong

rural character and a healthy ranching sector. Those with an urban sensitivity may perceive such activities, sights, sounds and smells only as inconvenience, eyesore, noise and odor. However, State law and County policy provide that ranching, farming and other agricultural activities and operations within Grand County shall not be considered to be nuisances so long as operated in conformance with law and in a non-negligent manner. Therefore, all must be prepared to accept noises odors, lights, mud, dust, smoke, chemicals, machinery on public roads, livestock on public roads storage and disposal of manure predator control, on site storage and marketing of crops or livestock, and the application by spraying or otherwise of chemical fertilizers, soil amendments, herbicides and pesticides, pursuant to C.R.S. 35-5.5-101 and C.R.S. 35-5.5-104, any one or more of which may naturally occur as a part of a legal and non-negligent agricultural operations.

b. In addition, all owners of land, whether Agricultural Business, Farm, Ranch or Residence, have obligations under State law and County regulation with regard to the maintenance of fences, livestock must be fenced out (open range) as pursuant to C.R.S. 35-46-106, et. seq. Irrigators have the right to maintain ditches through established easements that transports water for their use and said irrigation ditches are not to be used for the dumping of refuse. Landowners are responsible for controlling weeds, keeping pets under control, using property in accordance with zoning, and maintenance of resources of the property wisely (water, soil, animals, plants, air and human resources). Residents and landowners are encourage to learn about these rights and responsibilities and act as good neighbors and citizens of the County. It is not the intent of this policy to require Production Agriculture to be "open space."

2. The Board of County Commissioners hereby establishes a dispute resolution procedure with mediators to informally resolve breach of property right conflicts that may arise between landowners or residents relating to agricultural operations or activities.

a. Breach of property rights include, but are not limited to: trespass; harassment of livestock and livestock losses due to free roaming dogs, pursuant to C.R.S. 35-43-126; trespass by livestock and pets; penalties for disrespect of water rights, pursuant to C.R.S. 37-89-101; and open gates or breaking fences, pursuant to C.R.S. 36-46-107.

b. Mediators must be knowledgeable with regard to land use conflicts. The Board of County Commissioners will maintain a list of qualified mediators.

c. No attorney shall be present at a mediation unless such attorney is the mediator or a party directly involved with the mediation.

3. Public Education and Information Campaign. The Board of County Commissioners, with the primary assistance of the Colorado State University Cooperative Extension, Grand County Office(s) and through the use of County Staff as needed, shall support efforts to educate and inform the public of the "Right to Farm and Ranch" Policy

4. Property Owner Notification: The Board of County Commissioners shall notify the owners of land within the County by the following means:

a. Whenever, a building permit is issued for new construction in the unincorporated area of Grand County, the Building Department shall provide owner educational material.

b. The Board of County Commissioners shall initiate amendments to the County subdivision regulations to provide that notification of the Policy and the Policy Statement shall be made at the time of subdivision ore related land use approval and note to the effect shall appear on any Plat outside municipalities urban growth areas so approved.

5. This resolution may be amended from time to time by the Board of County Commissioners, Grand County, Colorado.

ADOPTED this 17th day of August, 1999.

BY THE BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY, COLORADO.

Robert F. Anderson, Chairman

Lurline Underbrink Curran
County Manager
frm&mchres.wpd.no.1

Upon motion duly made and seconded the foregoing Resolution was adopted by the following vote:

James L. Newberry (Absent) ..... Aye

Robert F. Anderson ..... Aye

Duane E. Dailey ..... Aye

Commissioners

STATE OF COLORADO
County of Grand } ss.

I, ..., County Clerk and ex-officio Clerk of the Board of County Commissioners in and for the County and State aforesaid do hereby certify that the annexed and foregoing Order is truly copied from the Records of the Proceedings of the Board of County Commissioners for said Grand County, now in my office.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of said County, at Hot Sulphur Springs, this ..... day of ..... A.D. 19.....

County Clerk and ex-officio Clerk of the Board of County Commissioners.

.....

STATE OF COLORADO
County of Grant } ss.

At a regular meeting of the Board of County Commissioners for Grand County, Colorado, held at the Court House in Hot Sulphur Springs on Tuesday the 21st day of December A.D. 19 99, there were present:

James L. Newberry, Commissioner Chairman
Robert E. Anderson, Commissioner
Duane R. Bailey, Commissioner
Anthony L. DiCola, County Attorney
Lurline Underhill Curran, County Manager
Sara L. Rosson, Clerk of the Board

when the following proceedings, among others were had and done, to wit:

RESOLUTION NO. 1999-12-31

A RESOLUTION PURSUANT TO C.R.S. § 24-68-102(4) SPECIFICALLY IDENTIFYING THE TYPE OR TYPES OF SITE SPECIFIC DEVELOPMENT PLAN APPROVALS WITHIN GRAND COUNTY'S JURISDICTION THAT WILL CAUSE PROPERTY RIGHTS TO VEST AS PROVIDED IN ARTICLE 68 TITLE 24 C.R.S.

WHEREAS, in light of amendments made to the existing vested rights statutes by HB99-1280, this resolution is adopted to establish a vested property right for a subdivision final plat, subdivision exemption final plat, outright exemption final plat, final cluster development plan or as otherwise agreed between the Board of County Commissioners and the landowners for a specific project or development:

DEFINITIONS

"Site Specific Development Plan"

A final plat which has been submitted to the county as part of a subdivision final plat, subdivision exemption final plat, outright exemption final plat, final cluster development plan or as otherwise agreed between the Planning Commission, Board of County Commissioners and the landowner(s) for a specific project or development, to establish a vested right pursuant to Article 68 of Title 24, C.R.S., and which describes with reasonable certainty the type and intensity of the proposed land use for a specific parcel or parcels of property.

"Development Agreement"

The agreement between the owner and county which specifies the terms and conditions of approval. This agreement implements the site specific development plan which establishes vested rights under Article 68 of Title 24, C.R.S.

VESTED RIGHTS

(A) A vested property right may be established pursuant to Article 68 of Title 24, C.R.S., as amended, after the following events occur:

(1) A site specific development plan is reviewed by the Planning Commission and approved by the Board of County Commissioners as part of a subdivision final plat (or amended final plat), subdivision exemption final plat (or amended final plat), outright exemption final plat (or amended final plat), final cluster development plan (or amended final cluster development plan) or as otherwise agreed between the Board of County Commissioners and the landowners for a specific project or development

(B) The Board of County Commissioners shall sign a resolution approving the final plat or final cluster development (or amended final plat or amended final cluster development plan) and associated site specific development plan request, and the Chairman of the Board shall sign a development agreement in a form acceptable to the County or a development agreement where warranted in light of all relevant circumstances is entered into by the Board of County Commissioners with the landowner, which by its terms

specifically grants a vested property right. Those circumstances may include but are not limited to the type and intensity of use, the size and phasing of the development, economic cycles, and market conditions. If these documents are signed on different dates, the date of the later signature shall be the date of establishment of the vested rights.

(C) Once established, the vested right shall remain in effect for three years, unless the Board of County Commissioners determines, as part of the site specific development plan approval, that a longer period is warranted in light of relevant circumstances. Those circumstances may include but are not limited to the type and intensity of use, the size and phasing of the development, economic cycles, and market conditions. Any amendment to an approved site specific development plan shall not extend the three year vesting period unless the Board of County Commissioners expressly authorizes an extension based on the foregoing criteria.

(D) No activity or use authorized by an approval granted under this resolution shall be allowed to commence unless a vested right is first established as required in this resolution, and all other post-approval requirements have been met.

A notice shall be published in a local newspaper of general circulation no later than 14 days after the Board of County Commissioners approve and sign the resolution (Development Agreement).

(B) This notice shall advise the general public that a development agreement has been approved and that a vested property right has been created pursuant to this resolution.

(C) The notice shall read as follows:

NOTICE

Notice is hereby given that on the _____ day of _____, 20__, the Grand County Board of County Commissioners approved by Resolution No. _____ a site specific development plan for the property and purpose described below, which approval may have created a vested property right pursuant to C.R.S. 24-68-101, et. seq.
Owner: _____
Legal Description: _____
Type and intensity of proposed use: _____
Published in [newspaper] [date]

The effective date of this Resolution is December 31, 1999.

Upon motion duly made and seconded the foregoing Resolution was adopted by the following vote:

James L. Newberry ..... Aye
Robert L. Anderson ..... Aye
Duane E. Darley ..... Aye

Commissioners

STATE OF COLORADO }
County of Grand } ss.

I, _____, County Clerk and ex-officio Clerk of the Board of County Commissioners in and for the County and State aforesaid do hereby certify that the annexed and foregoing Order is truly copied from the Records of the Proceedings of the Board of County Commissioners for said Grand County, now in my office.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of said County, at Hot Sulphur Springs, this _____ day of _____, A.D. 19_____

County Clerk and ex-officio Clerk of the Board of County Commissioners.

_____

Filed for record at 4:30 P. M. o'Clock MAY 17 1978 A.D.
Reception No. 153648 Johnny Lee Petty BOOK 245 PAGE 61

DESIGNATION OF ACTIVITY OF STATE INTEREST

Pursuant to C.R.S., 1973, §24-65.1-101, et seq. (1974 Colo. S.L., pp. 335-352), on Tuesday, the 16th day of May, 1978, the Board of County Commissioners of Grand County, Colorado designated municipal and industrial water projects as an activity of State interest. Such activities may not be conducted within Grand County without a permit.

Procedures for obtaining such a permit are available at the office of the Board of County Commissioners of Grand County, which is located in the Grand County Courthouse at Hot Sulphur Springs, Colorado.

DATED THIS 16th day of May, 1978.

SEAL
ATTEST:

Grand County Clerk & Recorder

Chairman
Board of County Commissioners of
Grand County, Colorado

BOOK 245 PAGE 62

DESIGNATION OF ACTIVITY OF STATE INTEREST

Pursuant to C.R.S., 1973, §24-65.1-101, et seq., (1974 Colo. S.L., pp. 335-352), on Tuesday, the 16th day of May, 1978 the Board of County Commissioners of Grand County, Colorado designated major extensions of existing domestic water and sewage treatment systems as an activity of State interest. Such activities may not be conducted within Grand County without a permit.

Procedures for obtaining such a Permit are available at the office of the Board of County Commissioners, which is located in the Grand County Courthouse at Hot Sulphur Springs, Colorado.

DATED THIS 16th day of May, 1978.

S E A L

ATTEST:

Grand County Clerk & Recorder

Chairman
Board of County Commissioners of
Grand County, Colorado

DESIGNATION OF ACTIVITY OF STATE INTEREST

Pursuant to C.R.S., 1973, §24-65.1-101, et seq., (1974 Colo. S.L., pp. 335-352), on Tuesday, the 16th day of May, 1978, the Board of County Commissioners of Grand County, Colorado designated site selection and construction of major new domestic water and sewage treatment systems as an activity of State interest. Such activities may not be conducted within Grand County without a permit.

Procedures for obtaining such a permit are available at the office of the Board of County Commissioners, which is located in the Grand County Courthouse at Hot Sulphur Springs, Colorado.

DATED THIS 16th day of May, 1978.

Chairman
Board of County Commissioners of
Grand County, Colorado

SEAL
ATTEST:

Grand County Clerk & Recorder

State of Colorado
County of Grand } ss.

BOOK 245 PAGE 04

At a regular meeting of the Board of County Commissioners for Grand County, Colorado, held at the Court House in Hot Sulphur Springs on, Tuesday, the 16th day of May, A.D. 1978, there were present:

Elwin E. Crabtree, Commissioner Chairman
John E. Hartling, Commissioner
Herbert A. Ritschard, Commissioner
Richard D. Doucette, County Attorney
S.R. Broome, County Manager
Rosella Simmons, Spec. Dep., Clerk of the Board

when the following proceedings, among others were had and done, to-wit:

RESOLUTION NO. 1978-5-4

A RESOLUTION AND ORDER DESIGNATING CERTAIN ACTIVITIES AS BEING OF STATE INTEREST; ADOPTING REGULATIONS AND GUIDELINES TO BE USED IN CONNECTION WITH MATTERS OF STATE INTEREST; ESTABLISHING THE BOARD OF COUNTY COMMISSIONERS OF GRAND COUNTY AS THE GRAND COUNTY PERMIT AUTHORITY TO RECEIVE APPLICATIONS FOR DEVELOPMENT IN AN AREA OF STATE INTEREST OR FOR CONDUCT OF AN ACTIVITY OF STATE INTEREST AND TO EXERCISE OTHER POWERS GRANTED IT IN CONNECTION THEREWITH; ADOPTING CERTAIN FORMS TO BE USED IN DESIGNATING MATTERS OF STATE INTEREST AND A PERMIT APPLICATION AND PERMIT FORM FOR DEVELOPMENT IN OR CONDUCT OF A MATTER OF STATE INTEREST; AND ESTABLISHING A REASONABLE FEE FOR THE COST OF PROCESSING A PERMIT APPLICATION AND HEARINGS IN CONNECTION THEREWITH.

WHEREAS, the Board of County Commissioners of Grand County, State of Colorado, is authorized pursuant to Article 65.1, Title 24 of the Colorado Revised Statutes, 1973, as amended, to establish and designate certain areas and activities of State interest;

AND WHEREAS, the Board of County Commissioners is authorized pursuant to Article 65.1, Title 24, of the Colorado Revised Statutes, 1973, as amended, to adopt guidelines and regulations for administration of areas and activities of State interest;

AND WHEREAS, the Board of County Commissioners is authorized pursuant to Article 65.1, Title 24, of the Colorado Revised Statutes, 1973, as amended, to establish and designate a local Permit Authority to receive applications for development in or conduct of matters of State interest and to exercise other powers in connection therewith;

AND WHEREAS, the Board of County Commissioners is authorized pursuant to Article 65.1, Title 24 of the Colorado Revised Statutes, 1973, as amended, to establish a reasonable fee for the cost of processing applications for development in or conduct of matters of State interest and the holding of hearings in connection therewith;

AND WHEREAS, a public hearing was scheduled and held on May 1, 1978 and continued to this date to consider this Resolution;

AND WHEREAS, public notice of such hearing was published in the Middle Park Times and the Sky-Hi News at least thirty (30) days prior to but within sixty (60) days of such hearing;

AND WHEREAS, copies of the proposed Guidelines and Regulations were made available to the public at the office of this Board of County Commissioners prior to public hearing;

AND WHEREAS, the intensity of current and foreseeable development pressures within the County and applicable guidelines adopted and issued by the Colorado Land Use Commission were considered;

AND WHEREAS, this Board has been granted general authority by the State Legislature to adopt land use regulations;

AND WHEREAS, the Board having considered all of the testimony, regulations, guidelines, exhibits and other evidence presented at said public hearing;

BOTH FIND AS FOLLOWS:

1. That the present and foreseeable intensity of growth and development of the County and resulting demands on its resources make new and innovative measures, including the adoption of the appended Regulations, necessary to encourage planned and orderly land use development; to prevent the waste of unplanned development; to provide for and protect the needs of agriculture, forestry, industry, business, residential communities, and recreation in future growth; to encourage uses of land and other natural resources which are in accordance with their character and adaptability; to conserve soil, water and forest resources; to protect the beauty of the landscape and to promote the efficient and economical use of public resources.

2. That the adoption of "Administrative Regulations" comprising Chapter 1 of the proposed "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand", in addition to the purposes and findings expressed in such "Administrative Regulations", are necessary to achieve the above objectives and promote the health, welfare and safety of the people of this County and for the protection of the environment of the County.

3. That the establishment of a Grand County Permit Authority and the adoption of Chapter 2 of the proposed "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand", in addition to the purposes and findings expressed in such Chapter 2, are necessary to achieve the objectives set forth above and to promote the health, welfare and safety of the people of this County and for the protection of the environment of the County.

4. That the designation of site selection and construction of major new domestic water and sewage treatment systems as an activity of State interest and adoption of "Regulations for Site Selections and Construction of Major New Domestic Water and Sewage Treatment Systems" comprising Chapter 3 of the proposed "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand", in addition to the purposes and findings expressed in such "Regulations for Site Selection and Construction of Major New Domestic Water and Sewage Treatment Systems", are necessary to achieve the above objectives and to promote the health, welfare and safety of the people of this County and for the protection of the environment of the County.

5. That the designation of major extensions of existing domestic water supply and sewage treatment systems as an activity of State interest and adoption of "Regulations for Major Extensions of Existing Domestic Water Supply and Sewage Treatment Systems" comprising Chapter 4 of the proposed "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand", in addition to the purposes and findings expressed in such "Regulations for Major Extensions of Existing Domestic Water Supply and Sewage Treatment Systems", are necessary to achieve the above objectives and to promote the health, welfare and safety of the people of this County and for the protection of the environment of this County.

6. That the designation of municipal and industrial water projects as an activity of State interest and adoption of "Regulations

for Municipal and Industrial Water Projects" comprising Chapter 5 of the proposed "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand", in addition to the purposes and findings expressed in such "Regulations for Municipal and Industrial Water Projects", are necessary to achieve the above objectives and to promote the health, welfare and safety of the people of this County and for the protection of the environment of this County.

7. That the adoption of the forms appended to this Resolution, specifically "Designation of Areas of State Interest", "Designation of Activity of State Interest", "Permit Application", and "Permit" will facilitate the designation and administration of matters of State Interest.

8. That a fee of ten per cent (10%) of the anticipated development cost of any specific designation activity will reasonably cover the cost of processing Permit Applications and hearings held in connection therewith but under no circumstances shall such fee be more than the actual cost of such processing and hearings.

9. That all requirements of law have been met, all public notices required have been given, and a public hearing has been held as required.

NOW THEREFORE, BE IT RESOLVED:

A. That Chapter 1 of the "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand" (said Chapter being attached hereto as Exhibit "1"), hereinafter to be cited as "Administrative Regulations" is adopted.

B. That Chapter 2 of the "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand" (said Chapter being attached hereto as Exhibit "2"), hereinafter cited as "Permit Authority" is adopted.

C. That the site selection and construction of major new domestic water and sewage treatment systems is designated as an activity of State interest and Chapter 3 of the "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand" (said Chapter being attached hereto as Exhibit "3"), hereinafter cited as "Regulations for Site Selections and Construction of Major New Domestic Water and Sewage Treatment Systems" is adopted.

D. That the major extensions of existing domestic water supply and sewage treatment systems are designated an activity of State interest and Chapter 4 of the "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand" (said Chapter being attached hereto as Exhibit "4"), hereinafter cited as "Regulations for Major Extensions of Existing Domestic Water Supply and Sewage Treatment Systems" is adopted.

E. That municipal and industrial water projects are designated an activity of State interest and Chapter 5 of the "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand" (said Chapter being attached hereto as Exhibit "5"), hereinafter cited as "Regulations for Municipal and Industrial Water Projects" is adopted.

F. That all of the above designations and regulations shall apply to all unincorporated territory of the County of Grand, State of Colorado.

G. That the appended forms (attached hereto as Exhibit "6"), specifically, "Designation of Area of State Interest"; "Designation of Activity of State Interest"; "Permit Application", and "Permit" shall serve, until amended, as the official forms of Grand County to be used in connection with the designation and regulation of all matters of State interest.

H. That a fee of ten per cent (10%) of the anticipated development cost of any designated area or activity of State interest shall be assessed as the cost of processing all Permit Applications and to cover the cost of hearings held in connection therewith, provided however, that such fee shall not be greater than necessary to cover the reasonable costs of processing of all Permit Applications and the hearings held in connection therewith.

I. That a copy of the above specified forms, and the above adopted Regulations shall comprise Chapters 1, 2, 3, 4, 5 and the Appendix of the "Guidelines and Regulations for Areas and Activities of State Interest of the County of Grand" to be kept in the office of the Board of County Commissioners of the County of Grand, State of Colorado and available for public inspection.

Upon motion duly made and seconded the foregoing Resolution was adopted by the following vote:

Elwin E. Crabtree ..... Aye

John C. Martin ..... Aye

Herbert A. Ritschard ..... Aye

Commissioners

STATE OF COLORADO }
County of Grand } ss.

I, Nehemiah L. Potter, County Clerk and ex-officio Clerk of the Board of County Commissioners in and for the County and State aforesaid do hereby certify that the annexed and foregoing Order is truly copied from the Records of the proceedings of the Board of County Commissioners for said Grand County, now in my office.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of said County, at Hot Sulphur

Trout, Raley, Montaño,
Witwer & Freeman, P.C.

Attorneys at Law
1120 Lincoln Street • Suite 1600
Denver, Colorado 80203-2141
(303) 861-1963 • Fax (303) 832-4465
www.troutlaw.com

pmontano@troutlaw.com
Direct: 303-339-5833

July 31, 2012

Jack DiCola, Esq.
Grand County Attorney
308 Byers Ave.
Hot Sulphur Springs, CO 80451

Re: Legal issues concerning the requested 1041 permit from Grand County for the Windy Gap Firming Project.

Dear Mr. DiCola,

Prior to the August 1 and 2 hearing I submit for the record, on behalf of the Applicant Municipal Subdistrict, Northern Colorado Water Conservancy District, the following legal analysis of issues pertinent to the certificate and 1041 requested permit. As you know the Subdistrict has filed its application for the 1041 under protest, reserving all rights to challenge the permit in its entirety and/or specific permit conditions or limitations and this legal analysis supports a number of the concerns regarding conditions in the existing certificate. We are hopeful that such litigation is not necessary, however, in an abundance of caution I am submitting this for inclusion in the record so as not to be precluded from raising these legal issues at a later date.

I. Grand County may not preempt or enforce Federal or State laws or regulations unless that authority is specifically delegated to Grand County by the State or Federal Government, but may condition a 1041 Permit from becoming effective until such time as the Applicant receives its Federal or State approvals.

A. Limitations on County Regulations Promulgated Under the Areas and Activities of State Interest Act

The Areas and Activities of State Interest Act (AASIA or 1041 permit herein) permits a county government to designate matters of state interest within its jurisdiction and adopt guidelines by which county officials can administer these matters. § 24-65.1-402(1), C.R.S.

EXHIBIT 55

The county is also authorized to enact regulations that interpret its guidelines and explain how these guidelines apply in specific situations. § 24–65.1–402(2), C.R.S.

B. Preemption of County 1041 Regulations

Under Colorado law, counties are expressly prohibited from adopting a law or regulation that "is in conflict with any state statute." § 30–15–411, C.R.S.; *see also Colo. Mining Ass'n v. Bd. of County Comm'rs*, 170 P.3d. 749, 758 (Colo. Ct. App. 2007). If any regulation adopted by the county with regard to activities of state interest conflicts with any state statutory provision, the county regulations can be either partially or completely preempted. *Bd. of County Comm'rs v. Vandemoer*, 205 P. 3d 423, 428 (Colo. Ct. App. 2008).

The Colorado Supreme Court, in *Colorado Mining Association v. Board of County Commissioners of Summit County*, has indicated that preemption analysis routinely applies to conflicts in state and local legislation concerning land use authority. 199 P. 3d 718, 723 (Colo. 2009). Because Grand County as a statutory county only possess the powers expressly granted to it by either the state constitution or the General Assembly, Colorado courts typically apply the general rules for statutory construction to establish whether the state and local regulations may be harmoniously applied or whether the state statute must preempt any conflicting local regulation or permit condition. *See id.* at 723–224 (citing *Bd. of County Comm'rs v. Bainbridge*, 929 P. 2d 691, 698–99 (Colo. 1996). Where a conflict exists between the state statute and local regulation, the state statute must govern the issue and will preempt the county's authority to regulate land use issues. *Id.* at 724 (citing *Bainbridge*, 929 P. 2d at 705). This analysis is equally applicable to any condition on a permit.

The preemption doctrine recognizes that different levels of government may simultaneously attempt to regulate the same field. Requiring state statutes to take precedence over contradictory local or county regulations establishes a distinct system of priority in which state–level regulations must be given effect over a conflicting county regulations. *Id.* (citing *Bd. of County Comm'rs v. Bowen/Edwards Assocs., Inc.*, 830 P. 2d 1045, 1049 (Colo. 1992)). Where the potentially conflicting regulations address issues in which both the state and local governments have an interest, Colorado courts have typically applied a three–part analysis to determine whether state law will preempt the local regulation. *Town of Frederick v. North American Resources Co.*, 60 P. 3d 758, 761 (Colo. Ct. App. 2002).

First, state law will preempt conflicting local regulations if the state statute contains express language of preemption. *Id.* Second, a state statute may impliedly demonstrate a legislative intent to completely occupy a given field. *Id.* Finally, local regulations will be preempted by state law if the operational effect of the regulation conflicts with the application of the statute. *Id.*

1. Express Preemption

Express preemption is generally considered a matter of statutory interpretation. *Town of Carbondale v. GSS Props., LLC,* 169 P.3d 675, 682 (Colo.2007). A county regulation can be partially or completely preempted by conflicting state law if a state statute contains express language of preemption. Generally, Colorado courts will "recognize a legislative intent to preempt local authority only if that intent is expressed in unequivocal language." *Colo. Dep't of Transp. v. City of Idaho Springs,* 192 P. 3d 490, 495 (citing *Bainbridge,* 929 P. 2d at 710-11).

Where the statute does not specifically foreclose and prevent all local regulation, the statute has not expressly indicated that the state alone will be responsible for regulating in the area at issue. *Id.* Without an express indication that the intent behind the statute's enactment was to bar local regulation, the statute thus "remains open to the possibility that the statewide planning process will leave some questions unresolved." *Id.* In such a case, the absence of an express intent to preempt local authority allows local and county governments to fill the gaps left by the regulatory process at the state level. *Id.*

2. Implied Preemption

Like express preemption, implied preemption is also generally considered a matter of statutory interpretation. *Town of Carbondale,* 169 P.3d at 682. The preemption of local regulations "may be inferred if the state statute impliedly evinces a legislative intent to completely occupy a given field by reason of a dominant state interest." *Bowen-Edwards,* 830 P. 2d at 1056-57. The legislature's intent to preempt local regulations in certain fields "cannot be inferred merely from the enactment of a state statute addressing certain aspects of those activities." *Id.* at 1058. Such an intent, where not expressly stated, may be inferred after considering the language used by the legislature when enacting the statute, the legislature's purpose behind adopting such regulations, the scope of the legislation, and the circumstances under which the legislature intended the statute to operate. *Id.*

3. Operational Preemption

Operational conflicts between state and local regulations can arise "when a local interest is implemented in a way that materially impedes or destroys a state interest." *City of Idaho Springs*, 192 P. 3d 490, 496 (citing *Bowen-Edwards*, 830 P. 2d at 1059). In these situations, the state law may partially or completely preempt the local regulations "to the extent that [the local regulations] conflict with the achievement of the state interest." *Bowen-Edwards*, 830 P. 2d at 1059

C. Preemption of Grand County's Conditions on Approval of Windy Gap Firming Project Permit

The conditions that Grand County may seek to impose on the Subdistrict's 1041 permit for the Windy Gap Firming Project include, among others, fish and wildlife mitigation measures, water quality improvement efforts in Grand Lake, and the maintenance of temperature standards in the Lower Colorado River. On June 9, 2011, the Municipal Subdistrict, Northern Colorado Water Conservancy District submitted its Fish and Wildlife Mitigation Plan (FWMP) to the Colorado Wildlife Commission in accordance with § 37-60-122.2, C.R.S. In this FWMP, the Subdistrict has proposed a variety of mitigation measures for the effects that the WGFP may cause on either side of the Continental Divide. *See* Windy Gap Firming Project Fish and Wildlife Mitigation Plan 13 - 20. On the western slope, the Subdistrict has proposed two mitigation measures of particular relevance to Grand County: nutrient mitigation to lessen the impact to the water quality of Grand Lake and mitigation of temperature changes in the Colorado River. *See id.* at 15-17. Specifically, the Subdistrict's mitigation plan includes the development of nutrient reduction and removal efforts to be approved by the Bureau of Reclamation and the Corps of Engineers intended to offset any incremental impacts that the project may have on the water quality of Grand Lake. *Id.* at 17, 21. Additionally, the mitigation plan also outlines the Subdistrict's intention to install temperature monitoring stations to track the temperature in this segment of the river and to reduce pumping as necessary to maintain the river's temperature below the daily and weekly maximum average temperature thresholds. *Id.* at 15-16.

Section 37-60-122.2, C.R.S. requires the state to adopt the approved fish and wildlife mitigation plan as the "official position" with regards to the mitigation efforts developed by any applicant seeking to operate and maintain a water development project. At the same time, the state, through the Areas and Activities of State Interest Act, has authorized county governments to designate activities that constitute matters of state interest within the county's jurisdiction. *Gartrell,* 33 P.3d at 1247. Grand County, pursuant to the AASIA, has designated the efficient use of municipal and industrial water projects as an activity of state interest and has enacted regulations concerning the development of these water projects. Though no portion of the WGFP will be constructed or operated in Grand County, the Subdistrict has applied for a permit with the Grand County Board of Commissioners under protest. *See* Windy Gap Firming Project Fish and Wildlife Mitigation Plan at 13.

Of particular concern to the Subdistrict is the Grand County's potential to impose conditions on its permit that conflict with the fish and wildlife mitigation plan that has been approved by the state. However, because the Subdistrict's FWMP has become the official state position with regard to the mitigation measures outlined therein, any conditions that Grand County may impose on the approval of the Subdistrict's 1041 permit will be preempted by the provisions of § 37-60-122.2, C.R.S. *See* Letter from Governor John Hickenlooper to Will Tully, Bureau of Reclamation, October 6, 2011 ("[T]he fish and wildlife

mitigation plan for the Windy Gap Firming Project ... constitutes the official State of Colorado position with regard to mitigation of impacts from this project to these resources.").

1. Official State Position

The General Assembly has recognized that the state is responsible for all "fish and wildlife resources found in and around state waters which are affected by the construction, operation, or maintenance of water diversion, delivery, or storage facilities." § 37-60-122.2(a), C.R.S. To ensure that the state's fish and wildlife are not adversely impacted by water projects, this measure requires project applicants to mitigate the harm caused by their projects "to the extent, and in a manner, that is economically reasonable and maintains a balance between the development of the state's water resources and the protection of the state's fish and wildlife resources." *Id.* Under the terms of this statute, any applicant seeking to operate or maintain a water diversion, delivery, or storage facility, subject to certain exceptions, must submit a mitigation proposal to the Colorado Wildlife Commission. § 37-60-122.2(b), C.R.S. Once the Commission and the applicant agree to the terms of the mitigation plan, the Commission must forward the agreement to the Colorado Water Conservation Board. *Id.* If the Board approves of the agreement, the Board will then adopt the mitigation plan as the official state position as to the mitigation actions to be taken by the applicant. *Id.* Once an official state position regarding the mitigation plan has been approved, this position must be "communicated to each federal, state, *or other governmental agency from which the applicant must obtain a permit, license, or other approval.*" § 37-60-122.2(c), C.R.S. (emphasis added).

i. The Official State Position Adopted Pursuant to § 37-60-122.2 Preempts Any Contradictory Conditions Imposed by Grand County

The express terms of § 37-60-122.2 expressly mandate state-level regulation of the mitigation activities taken by applicants for water project permits on fish and wildlife resources. Only two state-level agencies – the Colorado Wildlife Commission and the Colorado Water Conservation Board – are responsible for approving the mitigation actions that are to be taken by these permit applicants. § 37-60-122.2(b), C.R.S. Moreover, once these agencies have approved the mitigation plan proposed by the applicant, this plan becomes the official *state* position as to the actions that the applicant must take with regard to mitigating the harm that the proposed project may caused to the state's fish and wildlife populations. *Id.* These express terms articulated by the General Assembly in § 37-60-122.2, C.R.S. unequivocally mandate that the state alone regulate the area of fish and wildlife mitigation with regard to water projects.

Accordingly, this statute expressly forecloses and prevents all inconsistent or contradictory local regulation in this area and, thus, preempts any conditions that Grand County may seek to impose on the Subdistrict's 1041 Permit concerning fish and wildlife.

See Colo. Dep't of Transp. v. City of Idaho Springs, 192 P. 3d 490, 495 (finding that local regulations are expressly preempted by state statutory authority if the legislature indicates its intent to preempt using "unequivocal language"). Under no circumstances did the General Assembly, in enacting this measure, expressly indicate that local governments, in addition to these two state agencies, would be allowed to also impose mitigation requirements on water project applicants. In fact, the General Assembly specifically stated that, once the official state position had been approved, the requirements of the mitigation plan must "be communicated to each federal, state, or *other governmental agency* from which the applicant must obtain a permit, license, or other approval." § 37-60-122.2(c), C.R.S. (emphasis added). This is applicable to Grand County as a governmental agency and the Windy Gap Firming Project 1041 permit.

ii. The Official State Position Adopted Pursuant to § 37-60-122.2 Impliedly Preempts Contradictory Conditions Imposed by Grand County

The legislature's intent to preempt local regulation of fish and wildlife mitigation actions required by an applicant's water project can be clearly inferred from the testimony given by supporters of the measure in the State Senate and House of Representatives, statements made by the drafters of the statute, the purpose driving the adoption of the statute, and the conditions under which the statute is designed to operate. *See id.*

Senator Tillman Bishop, in his testimony before the Senate, emphasizes that the purpose of creating an official state position as to the applicant's mitigation plan is to achieve and "maintain a balance between the development of the state's water resources and the protection of the state's fish and wildlife resources." Testimony of Sen. Tillman Bishop, Senate Testimony HB 87-1158, Apr. 9, 1987. Clyde Martz, the Director of the Department of Natural Resources at the time this statute was enacted, echoed Senator Bishop's sentiments in this regard; according to Martz, this statute provides the state with "an opportunity to establish a state position of balance, declare a policy of the state for balance in the development and protection of our water and wildlife resource[s] *and keep the decision-making on this policy at the state level where it belongs.*" Testimony of Clyde Martz, Senate Testimony HB 87-1158, Apr. 9, 1987.

Based on the statements made by Senator Bishop and Clyde Martz, the purpose of this statute is clearly to strike a balance between promoting the development of the state's water resources while simultaneously ensuring that such development does not have an adverse impact on the state's wildlife and water resources. According to this testimony, the balance between these two significant state resources must be articulated at the state level, in the form of an official state position on the mitigation measures to be taken by the water project applicant. Most importantly, however, is the assertion made by Clyde Martz that the decision-making concerning the development and protection of the state's water and wildlife resources should be retained by the state; these words clearly indicate that the

drafters of this fish and wildlife mitigation statute intended for the state alone to regulate the development and conservation of the state's water and wildlife. *See id.*

Additionally, testimony offered before the Senate discussing these mitigation requirements makes no room for local regulation of the state's water and wildlife resources. Martz specifically indicates that the intricate balance between developing water resources while conserving the state's wildlife population should be undertaken by specific agencies at the state level that are capable and qualified to address the impacts of water developments on wildlife. *See id.* In particular, Martz points to the expertise of the State Division of Wildlife and the Colorado Water Conservation Board; according to Martz, the legislature established the wildlife division to further the protection and preservation of the state's wildlife and related environment, while the Colorado Water Conservation Board was charged with responsibly regulating the development of water resources. *Id.* Consequently, these two agencies are most appropriately situated to regulate and any impacts that the development of the state's water resources will have on the state's wildlife populations and articulate a balance between these two state interests. *See id.*

According to Martz, this balance will be best achieved if the mitigation plan is initially created by the applicant and the Division of Wildlife and is subsequently reviewed and modified by the Colorado Water Conservation Board. *Id.* The goal of allowing these specific agencies to review and approve the mitigation plan is to take advantage of the expertise of these agencies and, therefore, ensure that the needs of both the developer and the affected resources are given adequate consideration. *See id.* Nowhere in their respective testimony does either Senator Bishop or Clyde Martz make room for the possibility that local government agencies will also take action to mitigate the potential harm caused by water development projects in their jurisdiction.

The implication of this testimony is that, because of the relative expertise of the Division of Wildlife and the Colorado Water Conservation Board, these two agencies should bear the sole responsibility of regulating the impacts to wildlife caused by water development projects. Consequently, based on the testimony by the drafters of the statute concerning the purpose and application of the state's mitigation rubric, the legislature clearly intended that regulation of the potential impacts by water development projects on state wildlife populations only occur at the state level; therefore, any conditions that Grand County should seek to impose on the Windy Gap Firming Project with regard to its impact on local fish and wildlife is preempted.

2. The Official State Position Adopted Pursuant to § 37-60-122.2 Operationally Preempts Contradictory Conditions Imposed by Grand County

The primary purpose of § 37-60-122.2, C.R.S. is to provide a means by which the state can balance the need for the development of water resources with the goal of preserving fish and wildlife populations that may be harmed by the construction,

operation, and maintenance of water development facilities. The Municipal Subdistrict, Northern Colorado Water Conservancy District submitted its Fish and Wildlife Mitigation Plan (FWMP) to the Colorado Wildlife Commission in accordance with § 37-60-122.2, C.R.S. In this FWMP, the Subdistrict has proposed a variety of mitigation measures for the effects that the WGFP may cause on either slope of the Continental Divide. *See* Windy Gap Firming Project Fish and Wildlife Mitigation Plan 13 - 20. On the western slope, the Subdistrict has proposed mitigation of temperature changes in the Colorado River. *See id.* at 15-17.

As previously discussed, § 37-60-122.2, C.R.S. requires the state to adopt an official position with regards to the fish and wildlife mitigation plan developed by any applicant seeking to operate and maintain a water development project. At the same time, the state, through the Areas and Activities of State Interest Act, has authorized county governments to designate activities that constitute matters of state interest within the county's jurisdiction. *Gartrell,* 33 P.3d at 1247. Of particular concern to the Subdistrict is the Grand County's potential to impose conditions on its permit application that conflict with the fish and wildlife mitigation plan that the Subdistrict has filed with the state.

The Subdistrict contends that operational conflicts may exist, depending on those conditions, between the state's mitigation requirements and any similar conditions that Grand County may seek to impose onto the Subdistrict's WGFP application. By approving the Subdistrict's FWMP, the state has designated this plan as the official state position with regard to all fish and wildlife mitigation measures required by the project. *See* Letter from Governor John Hickenlooper to Will Tully, Bureau of Reclamation, October 6, 2011 ("[T]he fish and wildlife mitigation plan for the Windy Gap Firming Project ... constitutes the official State of Colorado position with regard to mitigation of impacts from this project to these resources."). Consequently, though Grand County may have an intense local interest in the temperatures of the Colorado River, these issues under the authority granted by the AASIA may well destroy the state's objective in achieving a balance between the development of water resources and the protection of wildlife. In enacting § 37-60-122.2, C.R.S., the General Assembly specifically intended to allow the state to regulate the impacts that water resources developments may have on state wildlife populations, and to allow local governments to modify the mitigation plan adopted as the "official state position" would frustrate the legislature's objectives.

Moreover, allowing Grand County to impose conditions that would conflict with or place more stringent mitigation requirements on the Subdistrict's FWMP would destroy the state's interest in articulating an official state position for this issue. Had the state contemplated the possibility that local governments could impose conditions on water resources development permits, the state would have no reason to articulate an official *state* position for the mitigation measures. If Grand County is permitted to impose conflicting or more stringent conditions on the permit, the state interest in balancing water resources development and wildlife conservation at the state level will be destroyed. *See City of Idaho Springs,* 192 P. 3d 490, 496 (citing *Bowen-Edwards,* 830 P. 2d at 1059). The

Subdistrict has included in its approved mitigation plan provisions requiring water quality and temperature monitoring; consequently, any conditions that Grand County seeks to impose on the Subdistrict's permit with regard to water quality and temperature will completely conflict with the state's statutory structure governing fish and wildlife mitigation plans for water development projects. *Bowen–Edwards*, 830 P.2d at 1059 (noting that state law can completely preempt local regulations "to the extent that [the local regulations] conflict with the achievement of the state interest").

II. Regulatory Impairment of Property Rights Act

A. Conditions Imposed by Grand County Requiring the Power to Release Water are Invalid

An additional condition that the Grand County may impose on the approval of the Subdistrict's 1041 permit concerns the County's power to release water in response to fluctuations of water quality or temperature in the Colorado River that are unrelated to the WGFP or a requirement to provide for public access for fishing on Northern Colorado water Conservancy District property on Willow Creek. A condition requiring the Subdistrict to allow the County to release WGFP water into the Colorado River or provide public access on the lands of the other District for impacts unrelated to the Project will constitute a violation of the Colorado Regulatory Impairment of Property Rights Act, § 29–20–201 *et seq.*, C.R.S.

1. Regulatory Impairment of Property Rights Act

The Regulatory Impairment of Property Rights Act (RIPRA) is a codification of constitutionally based standards established by the United States Supreme Court and routinely applied to promote the fair adjudication of land use disputes. *See* § 29–20–201, C.R.S. The Act prohibits local governments, when conditionally granting land use approvals, from requiring property owners to dedicate real property to the public "unless there is an essential nexus between the dedication ... and a legitimate local government interest, and the dedication ... is roughly proportional both in nature and extent to the impact of the proposed use or development of such property." § 29–20–203(1), C.R.S. Moreover, local governments are further prohibited from conditioning land use approvals unless the condition is based upon "duly adopted standards that are sufficiently specific to ensure that the condition is imposed in a rationally consistent manner." § 29–20–203(2), C.R.S.

Before the Act will apply in a given situation, the local government action must 1) impose conditions onto the granting of a land use approval and 2) require property owners to dedicate real property to the public. *See* § 29–20–203(1), C.R.S.; *see also Wolf Ranch, LLC v. City of Colorado Springs*, 207 P. 3d 875, 878–79 (Colo. Ct. App. 2008). If these two prerequisites are satisfied, the local government bears the burden of justifying its action based upon substantial evidence that the dedication of real property is "roughly

proportional to the impact of the proposed use of the subject property" and that the dedication bears an essential nexus to a legitimate government interest. § 29-20-204(2), C.R.S. No loss of public fishing access is documented in the record of impacts from WGFP so no commandeering of Northern Water property is allowed as a 1041 permit condition by RIPRA.

2. Conditions Imposed onto Grand County's Approval of The Subdistrict's 1041 Permit Constitutes "Conditions Imposed onto the Granting of a Land Use Approval"

The AASIA (House Bill 1041) has been recognized by Colorado courts as a "comprehensive land use law" authorizing counties to engage in a specific manner of land use planning by regulating land use developments involving activities of statewide interest. *Bd. of County Comm'rs v. Gartrell Inv. Co., LLC,* 33 P.3d 1244, 1247 (Colo. Ct. App. 2001). Because the AASIA has been historically considered a comprehensive land use law and because Grand County regulates municipal water projects pursuant to the AASIA, Grand County's approval of the Subdistrict's permit application would constitute a land use approval. As such, any conditions imposed onto Grand County's approval of the Subdistrict's permit would constitute conditions imposed onto the granting of a land use approval and would, thus, fall within the scope of RIPRA. *See* § 29-20-203(1), C.R.S.

3. Perfected Water Rights Constitute Real Property

Colorado courts have determined that "[n]ot every condition on land use triggers the Act;" however, any condition requiring the dedication of real property to the public is sufficient to trigger the application of RIPRA. *Wolf Ranch,* 207 P. 3d at 879. Northern water property along Willow Creek falls squarely into this category. The Colorado Supreme Court has noted that, "[w]hen perfected, water rights exist as real property in Colorado under its constitution and laws." *Dallas Creek Water Co. v. Huey,* 933 P. 2d 27, 37, n.8 (Colo. 1997). Because water rights constitute real property under Colorado law, RIPRA applies to conditions imposed by Grand County mandating the Subdistrict allow the County to release water belonging to the participants in the WGFP. *See id.*

4. The Power to Require Public Access to Land of Northern Water and the Power to Release WGFP Water Bears No Essential Nexus to a Legitimate Local Government Interest

A condition imposed by a local government onto a development approval bears no essential nexus to a legitimate government interest where "the condition ... utterly fails to further the end advanced as the justification for the prohibition." *Nollan* v. *California Coastal Commission,* 483 U.S. 825, 837 (1987). Some of the certificate's conditions of approval of the Subdistrict's 1041 permit rest on the County's ability to release WGFP water to remedy water quality, fish flows, or temperature fluctuations are to address current conditions. The environmental impacts of concern to Grand County result not from

WGFP but from other water development projects that are currently ongoing. Though Grand County may have an interest in maintaining the environmental quality of its waters, these proposed conditions fails to further the County's goal of promoting water quality since the impacts about which the County is concerned are unrelated to the impacts caused by WGFP. Similarly, a wholesale importation of the County Master Plan desire to promote recreation into the 1041 permit conditions by the requirement to provide access for fishing on Northern Water's property is unrelated to the impact of WGF and in violation of RIPRA. Even in situations involving a legitimate government purpose, a condition entirely unrelated to this purpose is inadequate to justify the imposition of the condition on the permit's approval. *Id.*

5. The Power to Release WGFP Water and to provide Fishing Access for Recreation on the Lands of Another Water District is not a Condition Roughly Proportional to the Impacts Caused by the WGFP

In addition to demonstrating that a condition imposed on a development permit bears an essential nexus to a local government interest, the government must also show that the condition "is related both in nature and extent to the impact of the proposed development." *Dolan v. City of Tigard*, 512 U.S. 374, 391 (1994). In other words, the condition must be roughly proportional to the impacts caused by the development. These impacts are the existing condition and more directly linked to prior water development projects than to WGFP. Furthermore, requiring the Subdistrict to allow the County to release WGFP water interferes with the participant's ability to control the uses to which their water is put and, accordingly, this condition interferes with the Subdistrict's property interest in its water rights and land interests of Northern Water.

B. The Regulatory Impairment of Property Rights Act is Applicable to Public Entities

RIPRA does not specifically regulate actions against "private landowners," but the Act does focus its attention on "private property." Northern Water, as a water conservancy district, is authorized "to take by appropriation, grant, purchase, bequest, devise, or lease, and to hold and enjoy ... water rights, and sources of water supply, and any and all real and personal property of any kind within or without the district necessary or convenient to the full exercise of its powers." § 37-45-118, C.R.S. Water Conservancy districts are authorized to own water rights and real and personal property and water rights are construed as private property under Colorado law. *Dallas Creek Water Co. v. Huey*, 933 P. 2d 27, 37, n.8 (Colo. 1997) ("[w]hen perfected, water rights exist as real property in Colorado under its constitution and laws."). The language of the Act does not specifically preclude its applicability to government-owned property as long as the property in question is "private property." Several cases that categorize vested water rights as private property: Gardner v. State, 614 P.2d 357, 360 (Colo. 1980) ("A water right is a legal right to use water; often, it is characterized as a property right."); *Sherwood Irr. Co. v. Vandewark*, 138 Colo. 261, 263-64,

331 P.2d 810, 812 (1958) ("That water is a valuable property right, subject to sale and conveyance, is recognized in Colorado."). *Armstrong v. Larimer County Ditch Co.*, 1 Colo. App. 49, 27 P. 235 (1891) ("The right to the use of water secured by legal appropriation is property, and a proper construction of the various provisions of the constitution on the subject harmonizes that instrument with the declaration of the Bill of Rights, 'that private property shall not be taken or damaged for public or private use without just compensation.'").

III. Scope of Conditions that Grand County May Place on the Subdistrict's 1041 Permit for the Windy Gap Firming Project

A. Conditions Placed on Permits

Generally, the county may only deny an applicant's permit to conduct an activity of state interest if the county cannot impose conditions that are sufficient to bring the application into compliance with the county's regulations. Grand County's AASIA regulations indicated that all permits for the efficient use of municipal and industrial water projects shall be approved if the applicant meets certain enumerated criteria. *See* Grand County Activity of State Interest Regulations § 5-306(1), at 41.

The criteria outlined in Grand County's regulations require that the applicant comply with state, regional, and county planning policies, emphasize the efficient use of water through recycling and reuse to the extent permissible, ensure that the project will not contaminate surface water resources, provide water pursuant to the standards articulated by the stated Department of Health, maintain and not decrease the quality of the peripheral and downstream surface and subsurface water resources in compliance with state water quality standards, ensure that the project will not significantly deteriorate wildlife habitats, recreational areas, and areas of particular geologic, historic, or archeological importance. *Id.*

Because the county can only deny the applicant's permit for failure to satisfy the criteria outlined in the county's regulations, any conditions placed on the permit's approval must concern compliance with the above-stated criteria. Consequently, Grand County cannot impose any conditions on the approval of the Subdistrict's WGFP permit that do not relate to the Subdistrict's compliance with the county's regulations. For instance, considering the phrasing of the county's regulations, the approval of the permit is contingent on the project not decreasing the quality of peripheral or downstream surface or subsurface water; accordingly, Grand County cannot condition the approval of WGFP's permit on improving the quality of the water in Grand Lake that has, in the past, been negatively impacted by previous water projects. Similarly, it cannot require action that the Subdistrict does not have the ability to perform such as requiring the Bureau of Reclamation or other entity to take a certain action.

IV. Conclusion

A 1041 Permit is not a vehicle to be used to resolve issues with parties who are not applicants for a permit, nor concerns due to conditions which pre-exist WGFP. Many of the Permit conditions unfortunately seem designed to address those concerns. The Applicant respectfully submits that other agreements and processes underway are more fitting for those purposes.

DATED: July 31, 2012

TROUT, RALEY, MONTAÑO,
WITWER & FREEMAN, P.C.

Peggy E. Montaño, #11075
1120 Lincoln Street, Suite 1600
Denver, Colorado 80203
Tele: 303–861–1963

Attorney for Municipal Subdistrict, Northern
Colorado Water Conservancy District

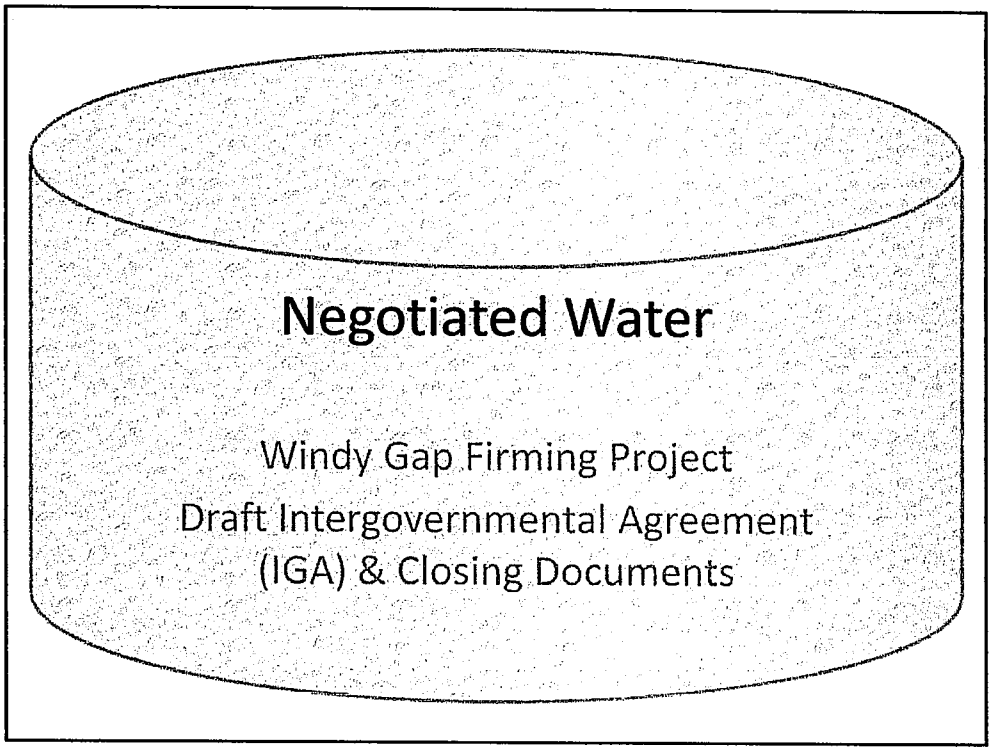
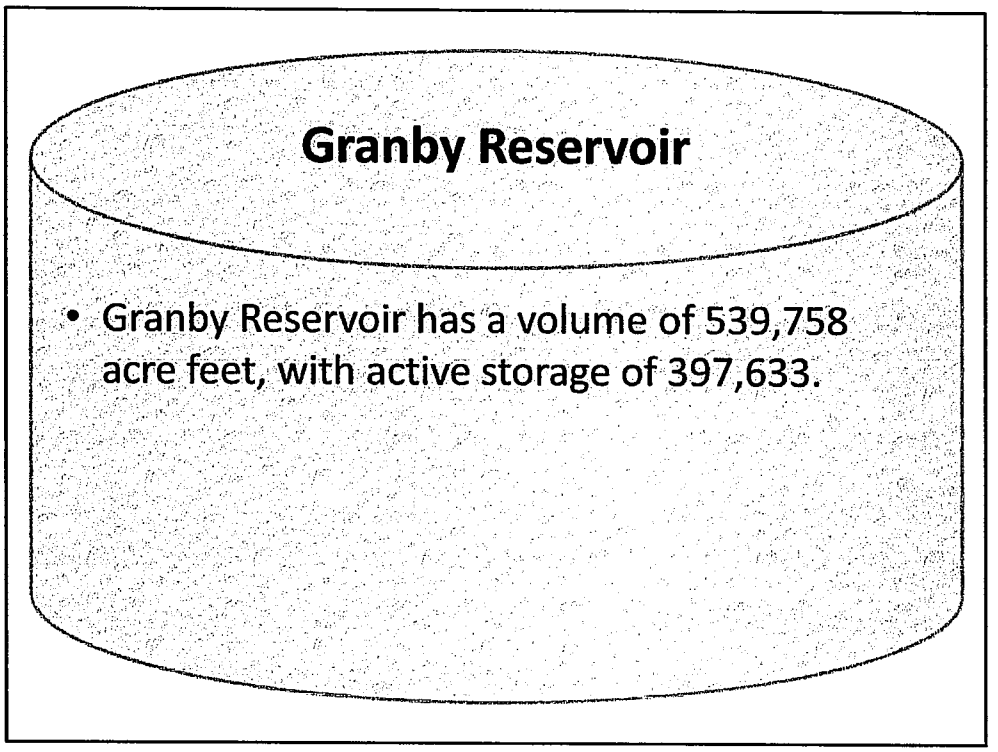
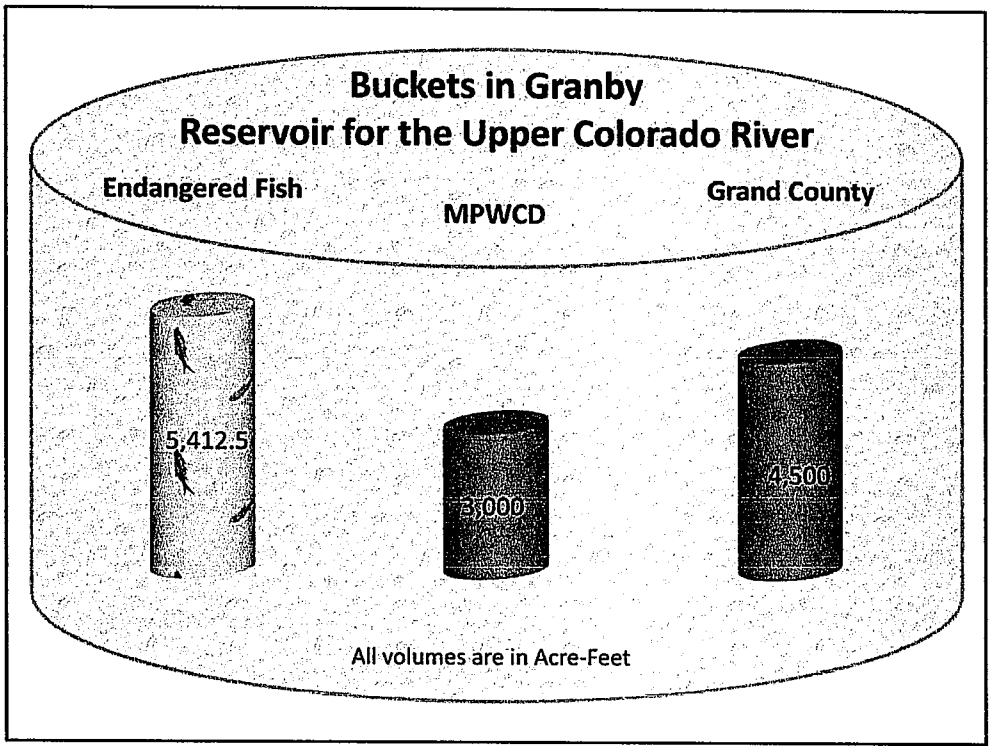

Negotiated Water
Windy Gap Firming Project
Draft Intergovernmental Agreement
(IGA) & Closing Documents

EXHIBIT 57



Big Bucket—sometimes full—many times not.



5412.5

•Endangered Fish Water

•Usually released from mid-July to October

•Grand County can call even if Fish & Wildlife Service does not need

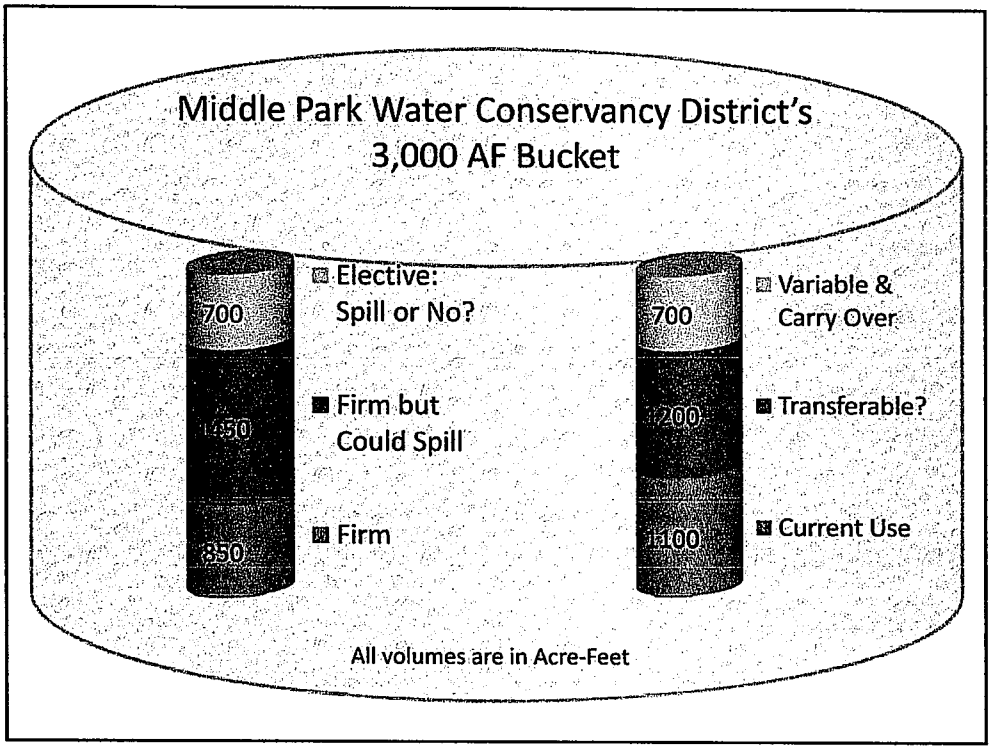
•Water to be perpetual

3000

Middle Park bucket

4500

•(Starts out at 7500/6000/4500) can be shared with Middle Park



•No Cost

•850 firm each and every year

•1450 firm each and every year if Chimney Hollow is at 32% constructed capacity on 8/1

•If not—1450 reduced proportionally based on WG water in Chimney Hollow & WGFP water in Granby

•If MP receives less than 1450—can carryover prior year

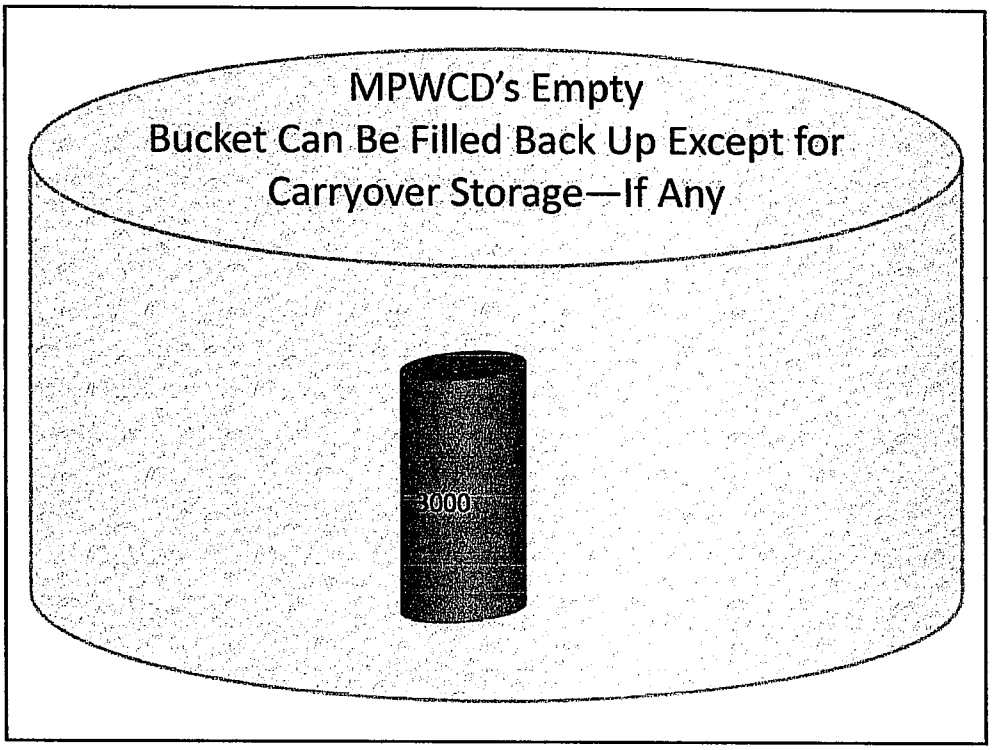
•Pay

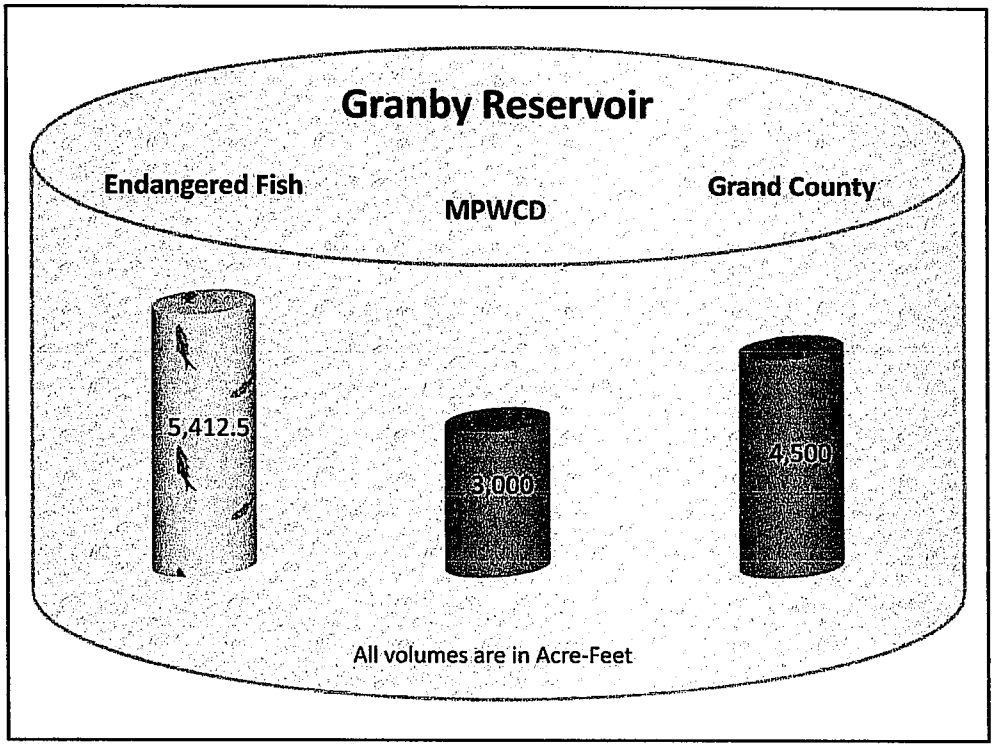
•Variable –Can carry over

•Can choose either

•3.8% after 15,000 up to to 1500—can spill, or

•700AF—cannot spill


MPWCD's Empty
Bucket Can Be Filled Back Up Except for
Carryover Storage—If Any
3000


Granby Reservoir
Endangered Fish
MPWCD
Grand County
5,412.5
3,000
4,500
All volumes are in Acre-Feet

1961 Principles
What we have right now

Dates	Flow below Granby Dam (cfs)	Drought Year 30% Reduction (cfs)
May 1 – July 31	75	52.5
Aug 1 – Aug 31	40	28
Sep 1 - Apr 30	20	14

Summary of What We Could Have from Granby Reservoir

	Minimum Possible from Granby Reservoir
5,412.5	Endangered Fish
2,300	MPWCD (includes 1200 possible transfer to Grand County)
(1,100)	Less current Middle Park use
570	3.8% of pumping in excess of 15,000 (up to 1,500)
2,800	End of year pumping (may be > 2800)
9,983	9,983 + 930 = 10,913

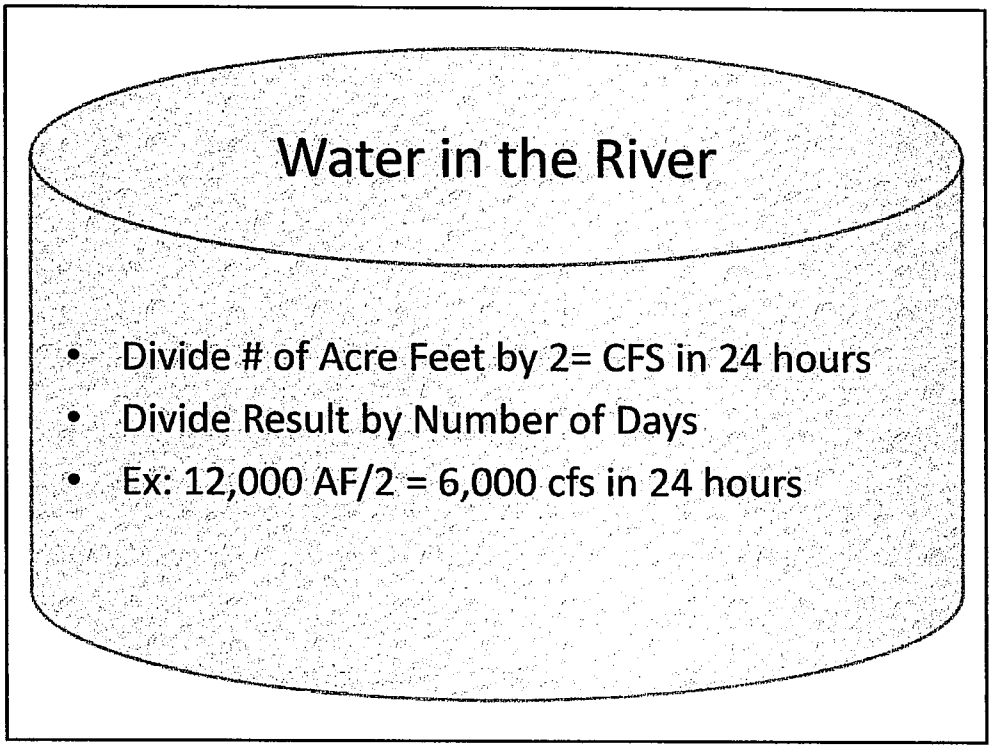
All volumes are in Acre-Feet

What would this amount of storage and water be worth?

Summary of What We Could Have in the Upper Colorado

	Upper Colorado River Region
9,983	Maximum possible from Granby Reservoir
1,000	Denver Water to Fraser River
1,000	Possible carryover in Williams Fork (up to 2,500)
11,983	11,983 + 1,500 + 930 = 12,413 + anything above 2,800??

All volumes are in Acre-Feet



To continue example: 90 days → 66.6 cfs

This could substantially augment low flows

List of Exhibits
Windy Gap Firming Project
1041 Permit
August 1 & 2, 2012 8:30 a.m.

Grand County Exhibits

(1) Letter of Application dated June 11, 2012 and Grand County 1041 Application of Municipal Subdistrict, Northern Colorado Water Conservancy District, acting by and through the Windy Gap Firming Project Water Activity Enterprise date June 11, 2012.

(2) Letter dated June 21, 2012 from Anthony J. DiCola, County Attorney to Peggy E. Montano, deeming the 1041 Application to be complete.

(3) Public Notice – Middle Park Times, June 21, 2012.

(4) Proof of Publication – Middle Park Times, June 21, 2012.

(5) List of Agencies and Interested Parties notified.

(6) Public Review Sheets (no names or signatures).

(7) Grand County Letter mailed with electronic copies of Application to Review Agencies dated June 13, 2012.

(8) WGFP IGA Draft dated July 3, 2012 and Draft Closing Documents;
Draft Memorandum of Understanding: Grand Lake Clarity Project dated 4-26-12; Draft Intergovernmental Agreement between Northern Water Conservancy District, Grand County, Middle Park Water Conservancy District and Colorado River Water Conservation District dated 6-4-12. Draft Processed Material Supply Agreement dated 6-20-12;

(9) Letter from Northwest Colorado Council of Governments dated July 6, 2012.

(10)Letter of from Carol Sidofsky & Dave Hazelrigg dated July 9, 2012.

(11)Letter of from Melanie Zwick dated July 9, 201.2

(12)Letter from Colorado Parks and Wildlife dated July 9, 2012.

(13)July 9, 2012 Update to Section IV.C of WGFP IGA Draft dated July 3, 2012.

(14)Certificate of Recommendation to Grand County Planning Commission dated July 11, 2012.

(15)Grand County Planning Commission Meeting Minutes dated July 11, 2012.

(16)Grand County Planning Commission Resolution No. 2012-7-1.

(17)Certificate of Recommendation to Grand County Permit Authority dated August 1 and 2, 2012.

(18)Grand County Public Hearing reminder and link to Certificate of Recommendation mailed and emailed to Interested Parties dated July 24, 2012.

(19)Email revisions dated July 25, 2012: Certificate of Recommendation to Grand County Permit Authority dated August 1 and 2, 2012.

(20)Letter from Paul Hollrah dated July 22, 2012

(21)Letter from Kirk Klancke dated July 24, 2012.

(22)Email from Jon Weimer dated July 24, 2012.

(23)Email from Jim Ross dated July 24, 2012.

(24)Grand County email dated July 27, 2012 to Interested Parties: Tentative WGFP 1041 Permit Agenda August 1 & 2, 2012.

(25)Opinion Column in the July 27, 2012 Sky Hi News by Kirk Klancke, Headwaters Chapter of Trout Unlimited and Windy Gap Hearing Meeting Reminder on Front Page.

(26)Email from Charles W. Howe, dated July 29, 2012.

(27)Email from Ken Gillis, Ouray Ranch Homeowner's Association dated July 30, 2012.

(28)Email from Jeff Metzger dated July 30, 2012 with attached letter to BOCC dated August 1, 2012 for Public Hearing testimony.

(29)Email from Peggy Montano dated July 30, 2012 with regard to two (2) errors in the Certificate of Recommendation.

(30)Letter from Richard E. Newton dated July 30, 2012.

(31)Email dated July 31, 2012 from Ron Johnson.

(32)Letter dated July 31, 2012 from Dennis G. Buechler and Suzanne O'Neill, Colorado Wildlife Federation.

(33)Senate Document No. 80, Colorado-Big Thompson Project, Synopsis of Report dated 1937

(34)Letters documenting Grand Lake clarity issues: 1954

(35)Public Law 95-450, creating the Arapaho National Recreation Area and Colorado Big Thompson Project, dated October 11, 1978.

(36)Agreement Concerning the Windy Gap Project and the Azure Reservoir and Power Plant dated April 30, 1980.

(37)Resolution No. 1980-6-1,dated June 17, 1980, A Resolution Of The Grand County Permit Authority Granting To The Municipal Subdistrict, Northern Colorado Conservancy District, A Permit To Engage In An Activity Previously Designated An Activity Of State Interest Pursuant To The Board Of County Commissioners Of Grand County Resolution No. 1978-5-4, As Amended (Design, Construction and Operation of Applicant's Windy Gap Project, Reservoir and Pipeline as proposed).

(38)Agreement dated July 7, 1980 between Grand County and Middle Park Water Conservancy District.

(39)Corps of Engineers Record of Decision, Windy Gap Project, June 8, 1981.

(40)Bureau of Reclamation Record of Decision, Windy Gap Project, Colorado, June 18, 1981.

(41)Final Environmental Statement Colorado-Big Thomson Windy Gap Projects Colorado dated April 28, 1981.

(42)Supplement to Agreement of April 30, 1980, entitled "Agreement Concerning the Windy Gap Project and the Azure Reservoir and Power Project.

(43)Report by Coley/Forrest, Inc. date July 2007: Grand County: Its Economy & Water Resources.

(44)Walsh Aquatic Consultants, Inc.: Update of [Walsh] February 1, 2008 Technical Review of revised Windy Gap Firming Project Aquatic Resources Technical Report (Dec 2007) and [Walsh] November 23, 2009 Technical Review of Preliminary Draft WGFP Fish and Wildlife Plan (August 2009) based on new information (update dated 01/10/11).

(45)Amended and Restated Transmission and Pumping Service Agreement, Contract No. TS-08-0026, dated June 13, 2008, between Tri-State, Mountain Parks Electric and the Municipal Subdistrict.

(46)Letter from Barbara J.B. Green dated 12-29-08 to Will Tully and Chandler Peter: Northern Colorado Water Conservancy District, Windy Gap Firming Project, Grand County Cooperating Agency Comments, Windy Gap Firming Project Draft Environmental Impact Statement.

(47)Stream Management Plan, Grand County, Colorado – Phase 3 dated August 2010.

(48)Intergovernmental Agreement for the Learning By Doing Cooperative Effort date August 27, 2010.

(49)Colorado River Aquatic Resources Investigations, Federal Aid Project F-237R-18, R. Barry Nehring, General Professional V, Co-Authors Brian Heinold and Justin Pomeranz, June 2011.

(50)Windy Gap Firming Project – CD's: Final Environmental Impact Statement dated and Response to DEIS Comments dated November 2011; Technical Reports dated June 2012

(51)Colorado's Official State Position regarding Fish and Wildlife Mitigation Plans, The Colorado Lawyer, February 2012, Vol.41, No.2 [page 41] and Letter dated 12-9-10 from Tim Monahan, First Assistant Attorney General re: fish and wildlife mitigation requirements under state law.

(52)Email from David Taussig dated July 18, 2012 regarding Windy Gap Decrees.

(53)Draft Request for Proposals dated 7-27-12: Windy Gap Reservoir Modifications

(54)Grand County Administrative Regulations for Areas and Activities Designated as Matters of State Interest (1041 Regulations).

(55)Peggy E. Montano letter dated July 31, 2012 to Jack DiCola, Esq. re: legal issues concerning the requested 1041 permit from Grand County for the Windy Gap Firming Project.

(56) Grand County Planning Commission CD, West Grand Firming Project, dated July 11, 2012

(57)Grand County Power Point Presentation presented at Hearing.

(58)Factors Controlling Transparency in Grand Lake, Colorado prepared by James McCutchan, Jr., dated April 2, 2010, and Revised July 2, 2010 & March 9, 2012.

Colorado River Water Conservation District Exhibits

A. Green Mountain Reservoir Administrative Protocol Draft dated 7-13-12.

B. Shoshone Outage Protocol Operating Agreement - Draft dated 6-4-12: Agreement Among the United States Department of the Interior, Bureau of Reclamation, the State of Colorado, Division of Water Resources, Denver Water, The Colorado River Water Conservation District, The Middle Park Water Conservancy District, The Northern Colorado Water Conservancy District, The Municipal Subdistrict, Northern Colorado Water Conservancy District, The Grand Valley Water Users Association, The Orchard Mesa Irrigation District, and The Grand Valley Irrigation Company.

C. Upper Colorado River Wild & Scenic Stakeholder Group Summary of Alternative Management Plan.

D. Environmental Assessment: Finding of No Significant Impact - Colorado Water Users' Commitment to Provide 10,825 acre-feet to the 15-Mile Reach of the Upper Colorado River, Great Plains Region, Eastern Colorado Area Office dated March 2012.

E. Colorado River District Eric Kuhn WGFP 1041 Permit Testimony August 1-2, 2012.

Municipal Subdistrict Exhibits

A. Letter dated July 30, 2012 from Peggy E. Montano re: WGFP witness summary and list of exhibits for public hearing.

B. Exhibits presented at the July 11, 2012 Grand County Planning Commission hearing.

C. Annual deliveries to WGF and Spill Years from 1950 to 1996.

D. Deliveries with Windy Gap Firming from 1950-1996.

E. Flows in Colorado River at Windy Gap Historic Flows 2002, 2010, 2011, 2012.

F. 2011 flows with 100,000 acre-feet pumped Windy Gap Firming.

G. 2012 Colorado River flows with enhancements.

H. 2010 Colorado River flows with enhancements.

I. Bar Chart with flushing flows above 600 cfs.

J. Graphic of waste water treatment plants on which nutrient reductions in the three lakes system are possible.

K. Graphic of three waste water treatment plants for nutrient reductions are focused.

L. Nutrient reduction non point source evaluation graphic.

M. A photograph Windy Gap Reservoir to illustrate by or through pass.

N. CLazyU Ranch and Miller-Hereford Agricultural Properties.

O. Windy Gap Firming Project Summary of Mitigation and Enhancement Measures.

P. Letter from Peggy Montano, Legal Counsel for Municipal Subdistrict, dated August 1, 2012 regarding conditions of the 1041 Permit.

Q. Municipal Subdistrict Power Point Presentation presented at the Hearing.

Trout Unlimited Exhibits

A. Letter Dated July 30, 2012 from Mely Whiting, Legal Counsel, Trout Unlimited Colorado Water Project re: WGFP Testimony and Exhibits.

B. Power Point Slides: Windy Gap Firming Project 1041 Permit Trout Unlimited August 2012.

C. EPA letter dated 12-19-2008 to Michael Ryan, Bureau of Reclamation re: WGFP DEIS.

D. Carol Rushin, EPA letter dated 12-24-08 to Colonel David C. Press, Corps of Engineers regarding Public Notice No. 200380523.

E. Western Resource Advocates letter dated 12-29-08 to Kara Lamb and Will Tully, Bureau of Reclamation and Chandler Peter, Corps of Engineers re: Comments on WGFP DEIS and 404 Permit Application.

F. Letter from Barbara J.B. Green dated 12-29-08 to Will Tully and Chandler Peter: Northern Colorado Water Conservancy District, Windy Gap Firming Project, Grand County Cooperating Agency Comments, Windy Gap Firming Project Draft Environmental Impact Statement.

G. Thomas E. Remington, Director Colorado Division of Wildlife letter date 12-29-08 to Will Tully, Bureau of Reclamation re: WGFP Draft EIS comments.

H. Trout Unlimited letter dated 12-29-08 to Will Tully, Bureau of Reclamation and Chandler Peter, Corps of Engineers re: Comments on WGFP DEIS.

I. Moffat Expansion and WGFP: Impacts of Mitigation from Colorado Wildlife Commission Hearing 5-6-11 from Western Resource Advocates.

J. Public Comment Letter date 11-7-2011 to Governor Hickenlooper signed by Grand County business owners.

K. EPA letter date 2-6-12 to Tim Carey, Corps of Engineers re: EPA remaining concerns on WGFP following FEIS release.

L. EPA letter dated 2-6-12 to Michael Ryan, Bureau of Reclamation re: EPA comments on WGFP Final EIS.; CEQ # 20110413.

M. Analysis of The Relationship Between Minimum Flow Below Windy Gap And Water Temperature Above The Williams Fork, by Blair Hanna, AMEC Earth and Environmental 2/5/2009.

N. Detailed Comments Public Notice No. 200980523 WGFP DEIS.

O. Trout Unlimited Power Point Presentation presented at Hearing.

Upper Colorado River Alliance Exhibits

A. Letter dated July 30, 2012 from Steve Bushong of Porzak, Browning & Bushong re: Summary of WGFP Witness Testimony and Exhibit Disclosures.

B. Colorado River Aquatic Resources Investigations, Federal Aid Project F-237R-18, R. Barry Nehring, General Professional V, Co-Authors Brian Heinold and Justin Pomeranz, June 2011.

C. Steve Bushong, Attorney for UCRA letter dated 1-3-12 to Michael Collins and Will Tully, Bureau of Reclamation; and John Bezdek, Asst. Solicitor, Department of Interior re: WGFP EIS.

D. Steve Bushong, Attorney for UCRA letter dated 2-3-12 to Michael Collins, Lucy Maldonado and Mike Ryan, Bureau of Reclamation; and John Bezdek, Asst. Solicitor, Department of Interior re: WGFP EIS.

E. Mely Whiting, Legal Counsel, Trout Unlimited letter dated 1-31-12 to Michael Collins, Lucy Maldonado and Mike Ryan, Bureau of Reclamation; and John Bezdek, Asst. Solicitor, Department of Interior re: WGFP Final EIS.

F. EPA letter date 2-6-12 to Tim Carey, Corps of Engineers re: EPA remaining concerns on WGFP following FEIS release.

G. EPA letter dated 2-6-12 to Michael Ryan, Bureau of Reclamation re: EPA comments on WGFP Final EIS; CEQ # 20110413.

H. Andrew Todd, Ph.D., USGS letter dated 4-29-11 to Melanie Wasco, EPA re: EPA comments on the development of a comprehensive water temperature impact analysis for WGFP EIS.

I. Graph: Colorado River average daily flow at Hot Sulphur Springs 1904-1994.

J. Bureau of Reclamation Record of Decision, Windy Gap Project, Colorado, June 18, 1981.

K. Resolution No. 1980-6-1,dated June 17, 1980, A Resolution Of The Grand County Permit Authority Granting To The Municipal Subdistrict, Northern Colorado Conservancy District, A Permit To Engage In An Activity Previously Designated An Activity Of State Interest Pursuant To The Board Of County Commissioners Of Grand County Resolution No. 1978-5-4, As Amended.

L. Thomas E. Remington, Director Colorado Division of Wildlife letter date 12-29-08 to Will Tully, Bureau of Reclamation re: WGFP Draft EIS comments.

M. Carol Rushin, EPA letter dated 12-24-08 to Colonel David C. Press, Corps of Engineers regarding Public Notice No. 200380523.

N. Letter dated 12-29-08 from Fritz Holleman, Attorney for Chimney Rock Ranch, of Porzak, Browning & Bushong re: WGFP Draft EIS.

O. Letter from Barbara J.B. Green dated 12-29-08 to Will Tully and Chandler Peter: Northern Colorado Water Conservancy District, Windy Gap Firming Project, Grand County Cooperating Agency Comments, Windy Gap Firming Project Draft Environmental Impact Statement with Exhibits A-G.

P. Colorado Division of Wildlife, Colorado River near Parshall, Fish Survey and Management Information.

Q. WGFP 1041 Hearing, August 1-2, 2012, Upper Colorado River Alliance Presentation.

Public Exhibits

A. Letter from Town of Kremmling received August 2, 2012.

B. Email from Mike Collins, Mountain Meadows HOA dated August 1, 2012.

C. Letter from Stephanie Young, Ouray Ranch HOA & Brain Young, Ouray Ranch Angler's Club dated July 31, 2012.

D. Letter from Richard Sprague dated August 2, 2012.

E. Email from Jim Woodside (forwarded from McCranewood@g.com) dated August 2, 2012.

F. Email from Brad McDaniel dated August 2, 2012.

G. Norm Carpenter, Graph of Colorado River below Windy Gap, Peak Day Streamflow.

H. Letter with attachments from Judy Burke, Mayor, Town of Grand Lake, dated August 1, 2012.

I. Aerial Photographs of Grand Lake dated August 30, 2011, and September 8, 2011.

J. Presentation by Canton O'Donnell, President of Three Lakes Watershed Assoc., dated August 2, 2012.

K. Comments by K. John Stall dated August 2, 2012.

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Factors Controlling Transparency in Grand Lake, Colorado

Prepared by:
James H. McCutchan, Jr.
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Rpt 299

EXHIBIT 58

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Introduction

Grand County, in cooperation other stakeholders, sponsored during 2009 collection of data on water quality constituents in Grand Lake and its water sources relevant to the transparency of Grand Lake[1]. The 2009 Transparency Study extended from 30 July to 16 September and included a 14-day cessation of pumped flow into Grand Lake during the normal pumping season (August 13 through 26). This special feature of the study, which was arranged by the Bureau of Reclamation and the Northern Colorado Water Conservancy District, was designed to allow more secure identification of factors related to pumped water that may influence the transparency of Grand Lake. The purpose of this report is to summarize and interpret the information that was collected during the 2009 Transparency Study.

Background Information on Grand Lake and Its Water Sources

Grand Lake (8367 feet amsl) is Colorado's largest and deepest natural lake. Originally, it received water from streams designated as North Inlet and East Inlet (Figure 1), as well as smaller streams surrounding other parts of the lake. The outflow was west, to the North Fork of the Colorado River. At present Shadow Mountain Reservoir, which was completed in 1946 as part of the Colorado Big Thompson Project, impounds the flow of the North Fork of the Colorado and Columbine Creek adjacent to Grand Lake. Operation of Shadow Mountain Reservoir stabilizes the level of Grand Lake, which by law cannot be altered by more than one foot. The Granby Pump Canal joins Shadow Mountain Reservoir at its southern end, allowing water to be pumped from Lake Granby (completed in 1951) to Shadow Mountain Reservoir. The short channel attaching Shadow Mountain Reservoir to Grand Lake allows flow from

[1] Funding for the 2009 Transparency Study was provided by Grand County, the Colorado River Water Conservation District, the Northern Colorado Water Conservancy District, the U.S. Bureau of Reclamation, the Greater Grand Lake Shoreline Association, and the Three Lakes Watershed Association.

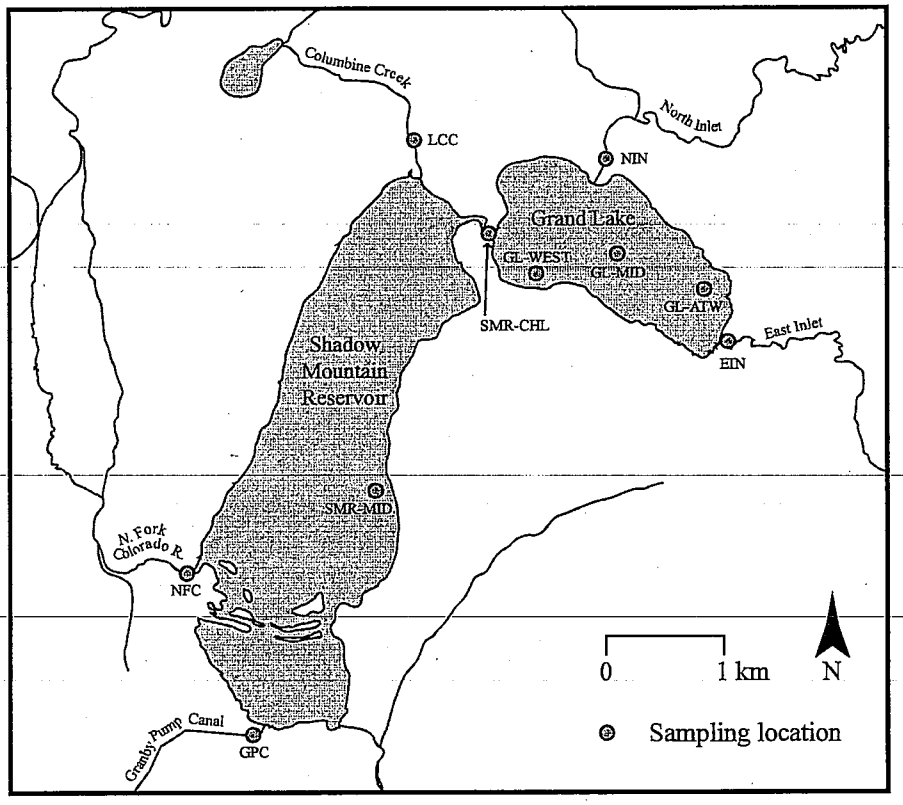

Figure 1. Shadow Mountain Reservoir, Grand Lake, their water sources, and sampling locations for the 2009 study.

Shadow Mountain Reservoir, much of which originates from the Granby Pump Canal, to displace water from Shadow Mountain Reservoir into Grand Lake, or the reverse if water rises in Grand Lake. Water in Grand Lake can be released to the Adams Tunnel (Figure 1: near GL-ATW), which serves water rights on the Eastern Slope of Colorado. Thus Grand Lake, which previously received no water from lower elevation, now receives water seasonally from Lake Granby, Shadow Mountain Reservoir, and their tributaries (including diversions from Willow Creek Reservoir and the Windy Gap Project).

The three lakes that now contribute to flow at the Adams Tunnel differ considerably in their morphometric characteristics. Grand Lake is by far the smallest of the three by area, but has high relative depth. Lake Granby has great depth and also is the largest of the three lakes;

Shadow Mountain Reservoir is intermediate in size but shallow. Lake Granby and Grand Lake would be expected to develop a fully formed three layer stratification system during summer (epilimnion, metalimnion, hypolimnion), whereas Shadow Mountain Reservoir would be expected to show at most temporary stratification and lack a fully formed hypolimnion.

	Lake Granby	Shadow Mtn. Res.	Grand Lake*
Volume, acre feet	540,000	17,400	68,600
Surface area, acres	7,260	1,850	507
Maximum depth, ft (m)	220 (67)	23 (7)	265 (81)

*The assumed maximum epilimnion volume (0-4.6 m) of Grand Lake is 3,977 acre feet.

Table 1. Physical characteristics of Lake Granby, Shadow Mountain Reservoir, and Grand Lake.

Hydrology

A complete review of the hydrology of the three lake system is beyond the scope of this report, but an overview of the native flows and flow management is important to the interpretation of factors affecting the transparency of Grand Lake. Native flows reaching Grand Lake and Shadow Mountain Reservoir show the expected seasonal runoff cycle (Figure 2). Flows of the Colorado North Fork (to Shadow Mountain Reservoir) and the East and North Inlets (to Grand Lake) were similar during 2009, rising from 100-200 cfs at the beginning of May to peaks in the vicinity of 400-500 cfs between the middle of May and early July, followed by a rapid decline to base flows below 50 cfs. Columbine Creek carries smaller flows. The native flows contribute significantly to withdrawals through the Adams Tunnel during the early part of the irrigation season.

Year 2009 was unusual with respect to flow management in that larger than normal amounts of native flow were available early in the irrigation year. The Adams Tunnel, whose intake lies near the surface (spanning 3-4 m depth), withdrew large amounts of water in the first

part of May (Figure 3). Withdrawals subsequently were erratic until early July, when withdrawals increased corresponding to the seasonal decline in runoff throughout the high country. The Granby Pump Canal flowed very little until the end of the first week in July, and then flowed well below capacity into August. In some years, the pump canal would have been a larger source of water over this interval.

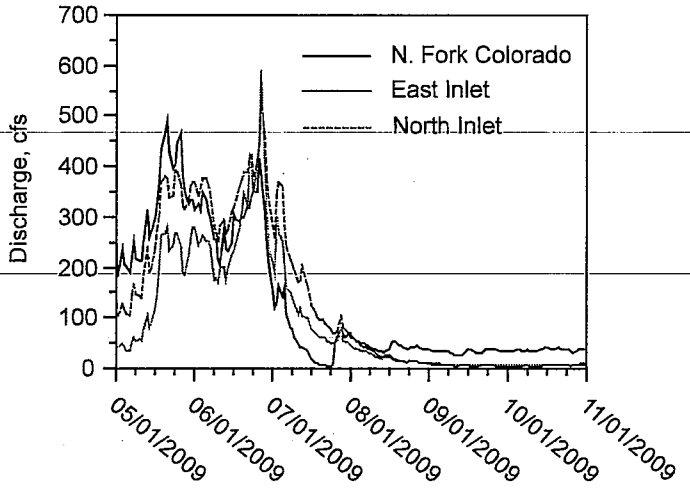

Figure 2. Native flows reaching Shadow Mountain Reservoir and Grand Lake.

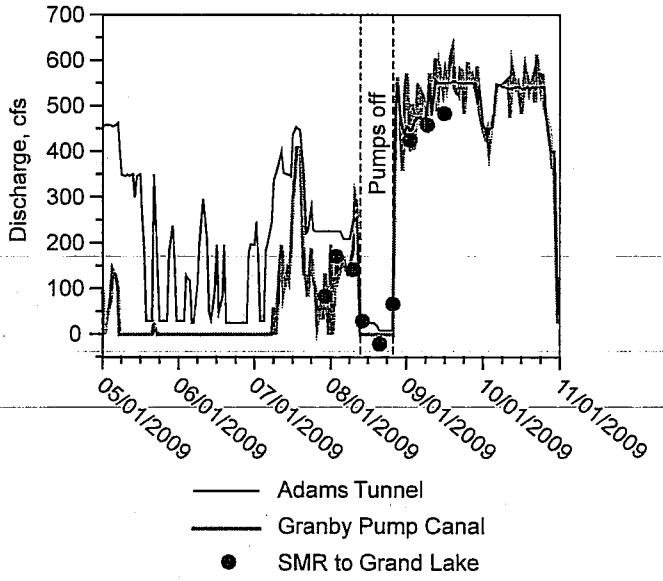

Figure 3. Pump and tunnel operation, 2009.

In 2009 the pumps were turned off on the 13th of August and remained off through the 26nd of August. The complete lack of flow attributable to pumping for the 14 day interval during August, which was abnormal, was intended to generate experimental conditions useful to the transparency analysis.

When the pumps were turned on (27 August), the pump canal flow stabilized between 500 and 600 cfs, which is equivalent to the peak annual flow during runoff season for any one of the three major native flows entering Shadow Mountain Reservoir or Grand Lake (Figure 2).

Figure 3 shows individual measurements of flow through the channel connecting Shadow Mountain Reservoir to Grand Lake. As expected, the flows estimated for this channel correlate well with the flow in the pump canal, even though the two are separated by the length of Shadow Mountain Reservoir, as the management system is designed to allow pumped water to flow freely from the pump canal intake to Grand Lake via the connecting channel that joins Shadow Mountain Reservoir to Grand Lake. The pumping rate was continuously high for early September through late October, after which it declined abruptly.

The influence of a water source on the water quality of a lake is related to the volume of the source over a given period of time relative to the volume of the lake or the lake layer that it enters. Hydraulic residence time, which is the ratio of lake volume to lake inflow (in this case expressed as days) is a convenient metric for the relative influence of a water source on a lake over a specific period of time.

Figure 4 shows hydraulic residence times for water from specific sources over the study interval entering Shadow Mountain Reservoir and Grand Lake. For Shadow Mountain Reservoir, the entire lake volume is used in the hydraulic residence time calculation because the lake is very shallow and does not develop stable thermal layering. For Grand Lake, the hydraulic

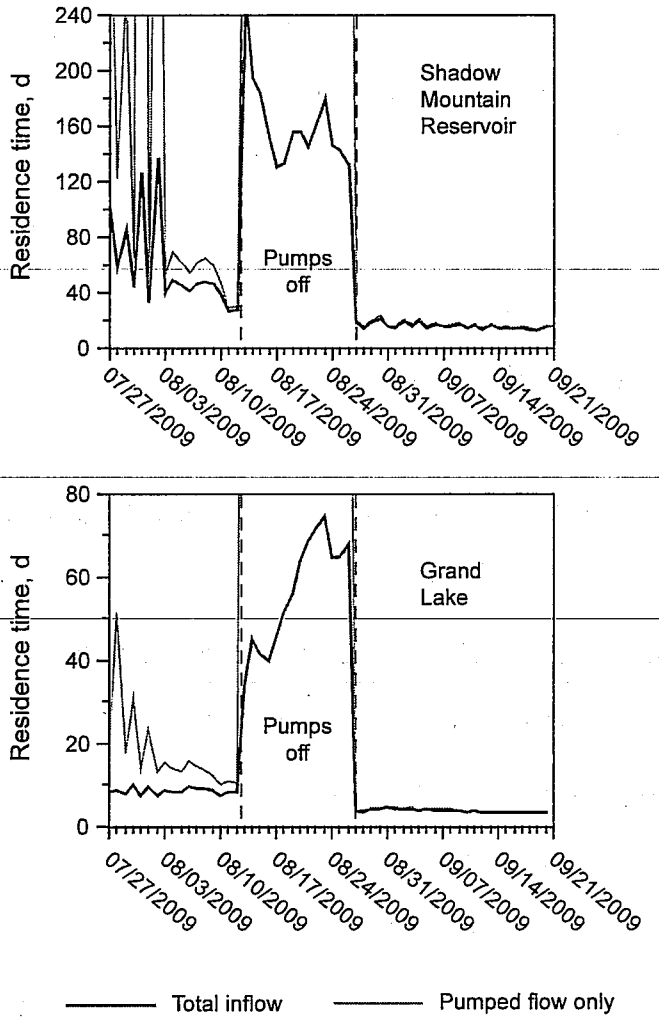

Figure 4. Hydraulic residence time for components of flow to Grand Lake and Shadow Mountain Reservoir during the 2009 study.

residence time refers in this case only to the upper mixed layer (epilimnion; 0-4.6 m), because the deeper layers are not mixed with the incoming flows during the warm season.

For Shadow Mountain Reservoir, hydraulic residence time was moderately low during late July and early August because of runoff (July) and pumped flow (August). During the experimental interval in August (13-26) when the pumps were off, hydraulic residence times were long and were dominated by post-runoff native flow. When the pumps were turned on

toward the end of August, residence time declined to about 15 days and remained at that level until the end of the study interval in September.

In Grand Lake, hydraulic residence times during runoff were below 10 days in July and early August for the epilimnion; both pumped flow and native flow made contributions. With the pumps off, residence times became moderately high and were dominated by post-runoff native flow. When the pumps were turned on (27 August), pumped flow routed through Shadow Mountain Reservoir held the epilimnetic residence time at a few days and accounted for most of the inflow.

Table 2 summarizes the dominant water sources and hydraulic residence times for the three time intervals relevant to this study. Beginning on August 27, Granby is listed as a source for Grand Lake, even though Grand Lake received its water from Shadow Mountain Reservoir through the connecting channel, as hypolimnetic water from Granby was entering Shadow Mountain Reservoir in large amounts (the Granby intake is 26 m above bottom, 30 m below the surface when Granby is full).

	Shadow Mountain Reservoir		Grand Lake*	
Time Interval	Water Sources	Residence Times	Important Water Sources	Residence Times
Slow Pumping 1 July – 12 August	Runoff, Granby**	Moderate	Shadow Mtn, Runoff	Low
No Pumping 13 August – 26 August	Runoff	High	Runoff	Moderate
Fast Pumping 27 August – 9 September	Granby**	Low	Shadow Mtn, Granby**	Low

*Epilimnion
**Hypolimnion

Table 2. Dominant water sources and hydraulic residence times for the three time intervals of the 2009 study.

General Characteristics of Grand Lake and Shadow Mountain Reservoir during the 2009 Transparency Study

The 2009 study incorporated some collection of data on physical and chemical variables in Grand Lake and Shadow Mountain Reservoir that are not expected to have direct effects on transparency. This information provides insight into physical structure of the water column, nutrient concentrations reflecting potential to produce algal biomass (measured as chlorophyll), and other related matters that may affect the interpretation of factors influencing transparency. These general water quality conditions are summarized and interpreted here. Methods are given in Appendix A and data are given in Appendix B. A valuable 10-year data set generated by the USGS also was consulted.

Temperature profiles over the 9 sampling dates extending from 31 July to 16 September show that Grand Lake has the characteristics of a dimictic temperate lake, as expected. The uppermost water column over the warm months, when the samples were taken, consisted of a relatively warm epilimnion (15-16 °C) and the lowermost part of the water column consisted of a hypolimnion with a temperature near 4 °C, the maximum density of water (Figure 5). The epilimnion (upper 2-4 m) of Grand Lake was not as well defined as might have been expected. Also, the metalimnion, or middle layer, was thicker than might be expected for a lake of this size and depth. High rates of water flow from points outside the watershed and withdrawal from 3-4 m via the Adams Tunnel probably reduced heat accumulation, thus reducing the stability of layering. A comparison with temperature data taken by R. Pennak (6 September 1941, unpublished data, CU Center for Limnology) shows the effects of water transfer on the thermal profile (Figure 6).

The thermal profiles for Grand Lake changed only slightly over the course of the 2009

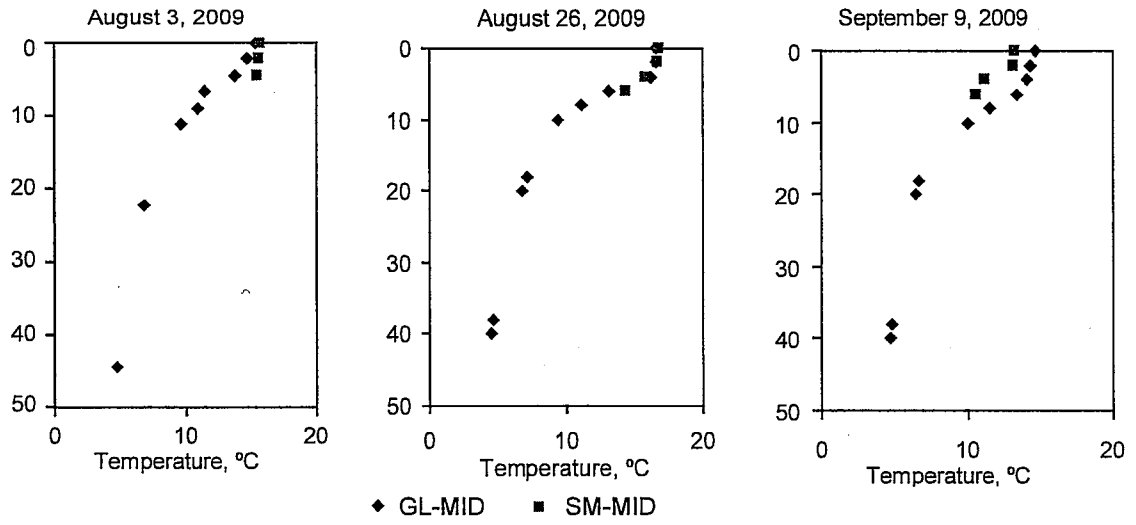

Figure 5. Temperature profiles: slow pumping (August 3), no pumping (August 26), and high pumping (September 9).

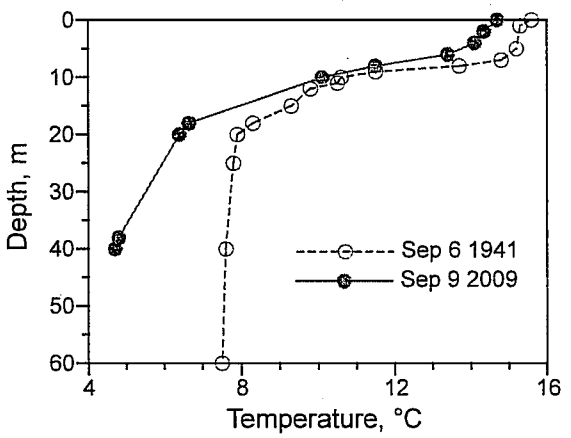

Figure 6. Thermal profile of Grand Lake 9 September 2009 and 6 September 1941.

Transparency Study. As expected, maximum temperatures for the epilimnion occurred during August.

Thermal profiles for Shadow Mountain Reservoir show no evidence of stable stratification. Stable stratification was not expected because Shadow Mountain Reservoir is shallow. Deviations between the bottom and surface temperatures suggest the possibility of temporary stratification of Shadow Mountain Reservoir, but the warmth of the water on the

bottom of the reservoir shows that the bottom water was frequently affected by mixing. There was a downward trend after August in the bottom temperatures, probably reflecting the effect of large volumes of water entering from Lake Granby. The Granby water is drawn from ~30 m below the surface, thus introducing cold water into Shadow Mountain Reservoir.

Specific Conductance

Specific conductance is an indicator of dissolved solids content (salinity, i.e., total ionic solids). The specific conductances of all CBT waters in the study area were quite low, reflecting their origin from nearby high elevation sources dominated by snowmelt and without extensive soil contact or evaporation losses. Specific conductance is useful in indicating water sources when conductances of sources differ.

The natural sources of water for Grand Lake had median specific conductances near 25 µS/cm, July to September. Waters of the North Fork of the Colorado and Columbine Creek were about four times higher in conductance, and water from Granby was about three times higher, as was Shadow Mountain Reservoir. The deepest water in Grand Lake had higher conductance than the upper water column throughout the stratification season. This water was residual from the previous cool season, and probably originated from Shadow Mountain Reservoir. The upper water column of Grand Lake had low conductances through most of August, indicating predominance of native flow as a source, over which time pumping was either modest or the pumps were off (Figure 7). In September, a bias toward water of higher conductance appeared at 0-6 or 0-8m as a result of the dominance of pumping from Granby, which brought water of higher conductance through the connecting channel over the top of water from the Grand Lake watershed.

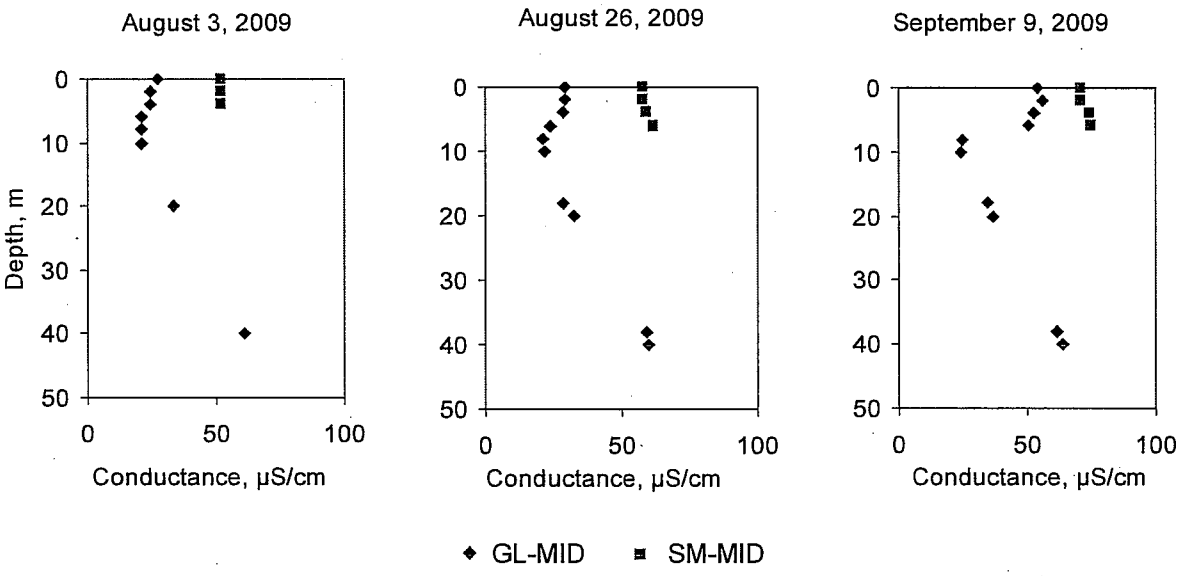

Figure 7. Specific conductance (midlake): slow pumping (August 3), no pumping (August 26), and high pumping (September 9).

Dissolved Oxygen and pH

Dissolved oxygen in dimictic lakes tends to be slightly above saturation in epilimnetic waters during the warm season and somewhat depleted or completely depleted toward the bottom (hypolimnion) during the warm season. Slight supersaturation (saturation = 7.2 for Grand Lake at 16 °C) occurred near the surface in Grand Lake, as expected with dominance of photosynthesis over respiration. Oxygen depletion occurred in the deepest water because of respiration but was mild because of the very large hypolimnetic volume and low productivity of Grand Lake. Shadow Mountain Reservoir showed some oxygen depletion at 6 m but the depletion was relieved at intervals by mixing that occurred because the reservoir is shallow.

The waters of Grand Lake and the two nearby reservoirs are weakly buffered because the drainages provide only small amounts of bicarbonate. Under these circumstances, pH in equilibrium with the atmosphere will be near 7. Positive deviations from 7 that are substantial are typically caused by photosynthesis, and negative deviations are typically caused by

respiration.

Grand Lake showed moderately high to high pH in the epilimnion during the warm season, particularly in September. Maximum pH was near 8.8 in early September. The water quality standard for protection of coldwater aquatic life in Colorado is 9.0. Thus, the September pH can be considered high with reference to the standard. This is an influence of photosynthesis on waters that have very little natural buffering capacity. Waters below the epilimnion, which support little or no photosynthesis, were influenced by respiration, which caused the pH to be as low as 6.7.

Shadow Mountain Reservoir also showed high pH (2 September, 9.0), and generally showed pH reflective of a predominance of photosynthesis, as expected in a shallow reservoir. Flowing waters showed pH within the range of Grand Lake and Shadow Mountain Reservoir.

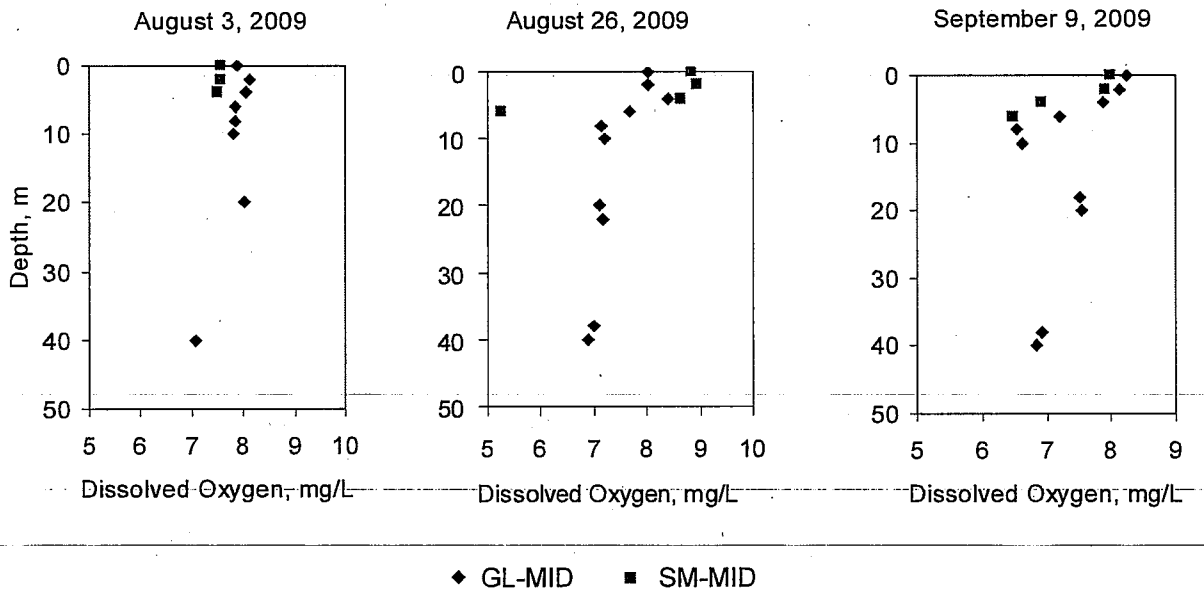

Figure 8. Dissolved oxygen profiles: slow pumping (August 3), no pumping (August 26), and high pumping (September 9).

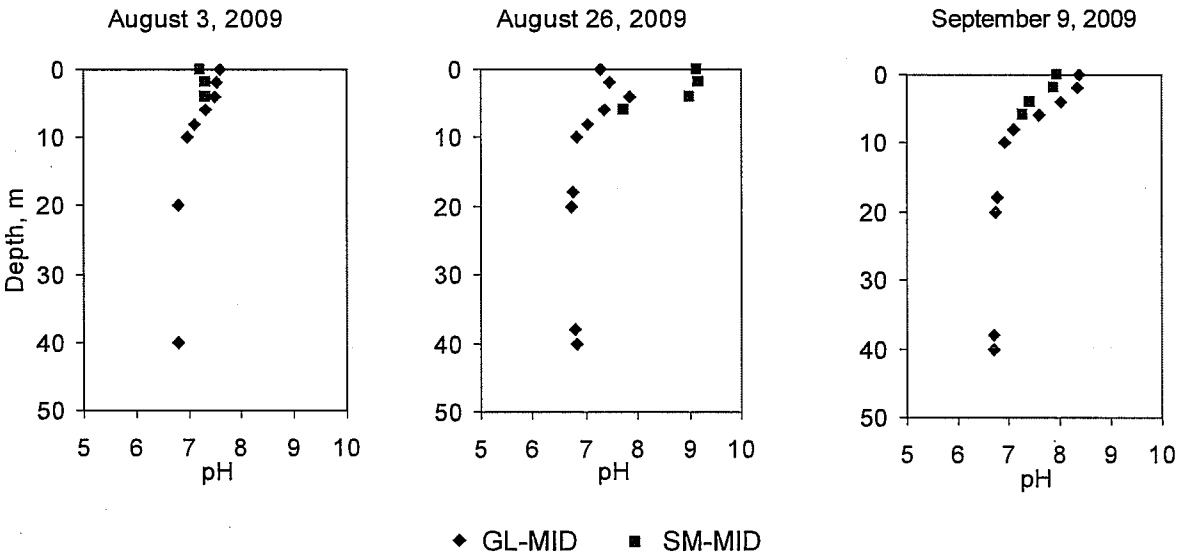

Figure 9. pH profiles, 2009 (midlake): slow pumping (August 3), no pumping (August 26), and high pumping (September 9).

Nutrients

Nitrogen and phosphorus are the key nutrients limiting growth of algae in aquatic ecosystems. Typically the growth of phytoplankton is limited by one or the other of these two elements, especially toward the end of the growing season.

Phosphorus was analyzed as three fractions. Soluble reactive phosphorus (SRP) is primarily inorganic, and is considered to be most available for uptake by algae. Total dissolved phosphorus (TDP) includes dissolved organic phosphorus along with SRP. Because algae have external phosphatases that release phosphate from soluble organic phosphorus compounds, TDP is considered to be available, but not quite so readily available as SRP. Particulate phosphorus consists of inorganic and organic components. Typically in lakes, the organic component predominates for particulate P. Summation of total dissolved phosphorus and particulate phosphorus gives total phosphorus.

As judged by total phosphorus, Grand Lake has high phosphorus concentrations with

	Location							
							Grand Lake (GL-MID)	
Nutrients	Pump Canal*	N. Fork Colorado	Columbine Creek	Shadow Mountain	North Inlet	East Inlet	0 m	38 m
Soluble Reactive P	8.5	1.5	4.9	1.2	1.3	1.0	0.6	0.9
Total Soluble P	12.5	4.3	11.3	5.9	4.2	4.3	4.0	4.3
Particulate P	4.1	2.2	9.2	9.4	1.7	1.7	6.0	1.6
Total P	16.6	6.4	20.5	15.3	5.8	6.0	10.0	5.8
Ammonium N	3.7	3.3	3.7	7.1	4.1	4.8	5.2	3.6
Nitrate N	75	4	1	2	15	13	2	77

* September only, canal not flowing strongly on other dates.

Table 3. Mean nutrient concentrations (µg/L, surface), August – September 2009.

reference to background for montane waters. Montane lake waters at high elevation typically have phosphorus concentrations below 7 µg/L under natural conditions or with weak anthropogenic sources of phosphorus. The Grand Lake epilimnion shows phosphorus augmentation from Shadow Mountain Reservoir and the Lake Granby hypolimnion (pump canal). The North and East Inlets had P concentrations near background for post-runoff conditions (concentrations would have been higher during runoff). Total phosphorus concentrations in the epilimnion of Grand Lake increased by 50% or more when pumping rates were high because of higher concentrations in Shadow Mountain and Granby (approximately double the native concentrations for Grand Lake).

About half of the total phosphorus in the water column of Grand Lake and Shadow Mountain Reservoir is particulate and half is total soluble phosphorus. This is typical for mountain lakes and reservoirs. A significant portion of the particulate phosphorus is tied up in living biomass, especially phytoplankton. Mineral particulate phosphorus settles more rapidly than organic particulate P. The total soluble phosphorus available to phytoplankton in Grand

Lake and Shadow Mountain Reservoir would be sufficient to support sustained growth of algae (phytoplankton). As shown by previous studies (Morris and Lewis 1988), these two lakes are nitrogen limited rather than phosphorus limited, i.e., nitrogen is depleted before phosphorus.

Nitrogen components include ammonium and nitrate (nitrite is present only at negligible concentrations). Other nitrogen components include dissolved organic nitrogen (170 µg/L for Shadow Mountain, 60 µg/L Grand Lake; Morris and Lewis 1988) and particulate nitrogen (which is principally organic: 68-269 µg/L Shadow Mountain, 14-194 µg/L Grand Lake; this study). Dissolved organic nitrogen and particulate nitrogen are not very useful for diagnosing the nutrient status of water with respect to the needs of algae. Organic N is dominated by refractory molecule types that do not nourish phytoplankton well. Therefore, the most meaningful interpretation of the nutrient status for phytoplankton with respect to nitrogen is based on ammonium and nitrate.

Ammonium was present at low concentrations (less than 8 µg/L) until the pumping of deep waters from Granby began to dominate the throughflow for Shadow Mountain Reservoir and Grand Lake (Table 3). Rapid pumping of Granby water forced water from Shadow Mountain Reservoir into Grand Lake, causing peaks of ammonium between 4 and 6 meters for Grand Lake on September 9. These concentrations are higher than background but do not indicate pollution. They are explained by a modest buildup of ammonium in Shadow Mountain Reservoir near September 9.

Nitrate was exhausted entirely from the upper water column of Grand Lake and Shadow Mountain Reservoir until September, when measurable nitrate appeared in Shadow Mountain Reservoir and was transferred to Grand Lake with the increased pumping. Nitrate depletion in epilimnetic waters is explained by nitrogen demand of phytoplankton. Grand Lake and Shadow

Mountain Reservoir probably experienced nitrogen deficiency for phytoplankton as indicated by severe depletion of nitrate from the growth zone. Pumping leading to transfer of Shadow Mountain Reservoir water to Grand Lake water in large amounts probably stimulated phytoplankton growth during September in Grand Lake (when chlorophyll doubled) by relieving nitrogen deficiency.

Overview

Water quality analysis indicates that Grand Lake has weakly buffered waters of low specific conductance, as is common in Colorado at high elevation, and that there is sufficient algal growth during the latter part of the growing season to produce high pH in the upper water column. Grand Lake is strongly affected by native water sources early in the warm season. Cessation of pumping followed by pumping at high volume demonstrated the capacity of the water management system to pass water from Shadow Mountain Reservoir, with a mixture of some Lake Granby water, across the upper water column of Grand Lake when pumping was at its maximum. Introduction of water from Shadow Mountain Reservoir changed the characteristics of Grand Lake. Changes included higher nutrient concentrations and higher specific conductances (dissolved solids content), and probably higher phytoplankton abundances. Previous studies and currently observed concentrations of phosphorus and nitrogen suggest that phosphorus is not limiting in Grand Lake for phytoplankton, but that inorganic nitrogen depletion causes nitrogen deficiency in phytoplankton. Relief from nitrogen deficiency may occur in the late growing season because of rapid pumping-induced flow of water from Shadow Mountain Reservoir, which at times carries inorganic nitrogen sufficient to stimulate phytoplankton growth.

Control of Transparency in Grand Lake

The extinction of light within a water body follows a negative exponential function for any given wavelength, provided that the water body over the interval of measurement is uniform in concentration of substances that control absorption or scattering of light. The negative exponential curve can be presented as follows:

$$I_z = I_o e^{-K_t z}$$

where I is photon flux or energy flux, z is depth, and the subscript t denotes total extinction from all causes. K is the extinction coefficient. If z is given in meters, the extinction coefficient has units m^{-1}.

For present purposes, quantum units are used for irradiance ($\mu M/m^2/sec$). Use of energy units ($Watts/m^2$) gives slightly different coefficients but the difference is not meaningful for present purposes.

For a given wavelength, K_t is composed of parts, as follows:

$$K_t = K_w + K_d + K_a + K_p$$

where t denotes total, w denotes pure water, d denotes dissolved solids, a denotes algae, and p denotes non-algal particles. Thus, the problem of explaining transparency in any given natural water is to quantify each of the separate components of K_t for each wavelength of irradiance.

Wavelengths of solar radiation can be broken into three groups: ultraviolet (less than or near 380 nm), PAR (photosynthetically available irradiance; 400-700 nm), and infrared (>700 nm). Visible light includes a narrow band (380-400 nm) that is not included in PAR. Ultraviolet accounts for about 3%, PAR accounts for about 46%, and infrared accounts for the balance. The exact partitioning depends on a number of factors, including elevation and atmospheric conditions.

Ultraviolet wavelengths receive attention in connection with potential damage to protoplasm, but are taken up rapidly in most inland waters because they are absorbed selectively by dissolved organic matter. Infrared wavelengths are absorbed rapidly by water, and thus do not contribute significantly to irradiance below 2 m within the water column. Thus, the PAR spectrum dominates penetrating light. This is also the portion of the spectrum that accounts for photosynthesis and is visible to the human eye. For present purposes, the analysis focuses on the PAR range (400-700 nm), although attenuation spectra are available over the range of 350-700 nm.

The amount of irradiance available across the PAR range is not constant. More photons are available at the medium and longer wavelengths than at the short wavelengths. In addition, the value of K for each absorbance component varies across the wavelength spectrum. As PAR passes downward in the water column, its spectral composition is changed by the additive influence of each of the absorption spectra. By use of a model, the intensity and wavelength distribution of PAR were computed at 2 cm intervals below the surface of Shadow Mountain Reservoir and Grand Lake from the spectra and the concentrations of the substances that generate the spectra, as explained in the final section of this report.

The Transparency Record

There is no long-term transparency record for Grand Lake prior to creation of the CBT project. Robert Pennak measured a Secchi depth of 9.2 m in 1941 (Pennak, 1955) prior to creation of the CBT project, but this single measurement does not establish a transparency record, as transparency varies greatly over an annual cycle and interannually.

USGS Data

The US Geological Survey established a significant transparency record for Grand Lake through the collection of Secchi depth readings during the ice free season (Figure 10). For measurement since 2000, the cool season mean is 3.8 m. Mean for the warm season, which includes the season of pumping and the season of maximum algal biomass, is 3.2 m. Individual readings were as low as 2 m and as high as 5.8 m. Most of the values fall below the transparency standard that the State of Colorado Water Quality Control Division has set for Grand Lake (4.0 m).

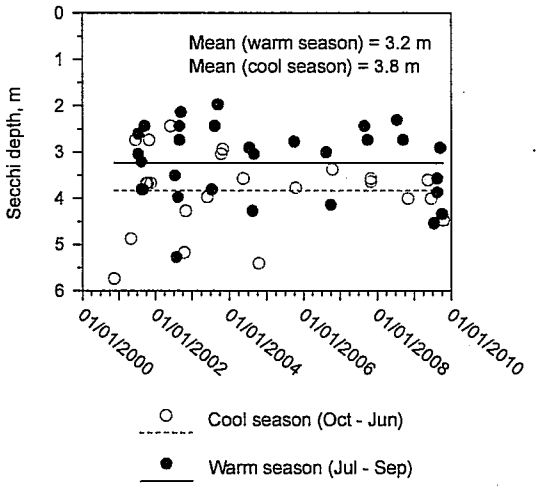

Figure 10. USGS data for Secchi depth, Grand Lake (midlake station).

GCWIN Data

Monitoring of transparency also is available for June through September of 2009 as obtained by the Grand County Water Information Network (GCWIN). Secchi depth readings were taken at multiple points on Grand Lake and at three points on Shadow Mountain Reservoir (Figure 11). Measurements were made with and without use of a view scope. A view scope improves the visibility of the disk by about half a meter when the water surface is disturbed. Use

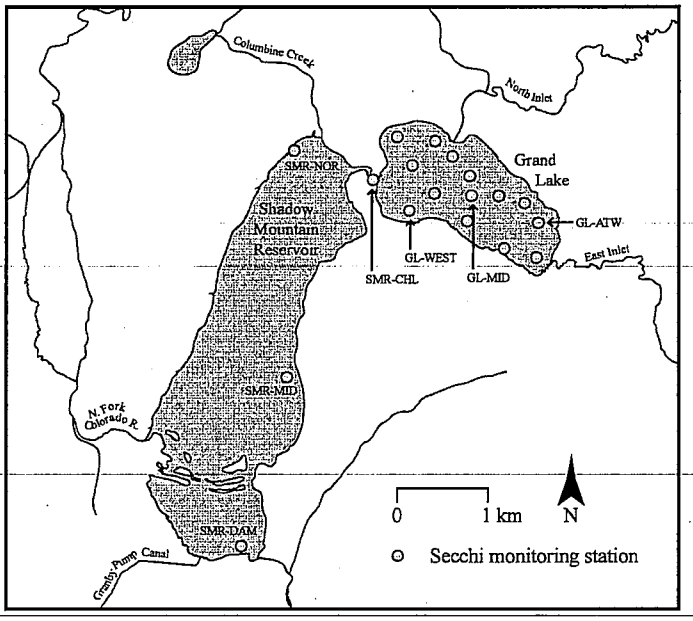

Figure 11. Sampling stations for the GCWIN monitoring program.

of a view scope is not standard for Secchi depth measurements, so it is better for present purposes to make evaluations based on Secchi depth measurements taken without a view scope. Secchi depths for Shadow Mountain Reservoir (Figure 12) showed low Secchi depths during runoff (2-3 m), decline in Secchi depths just before, during, and just after the pumps were turned off, and an increase in Secchi depths during the month of September and October to about 3 m north and 4 m south (at the dam) when pumps were operating continuously at high volume. Grand Lake (Figure 13) showed a cross-lake gradient of Secchi depths between 1 June and late August. Secchi depths were near 3 m to the west, 3.5 m at midlake, and near 4.0 m at the tunnel. Onset of high volume pumping at the beginning of September initially reduced Secchi depths by about 0.5 m (through transfer of water from Shadow Mountain Reservoir possibly by mobilization of sediment in the connecting channel between lakes), but transparency then increased steadily through September and October and reached approximately 4 m or higher at all stations by the end of October.

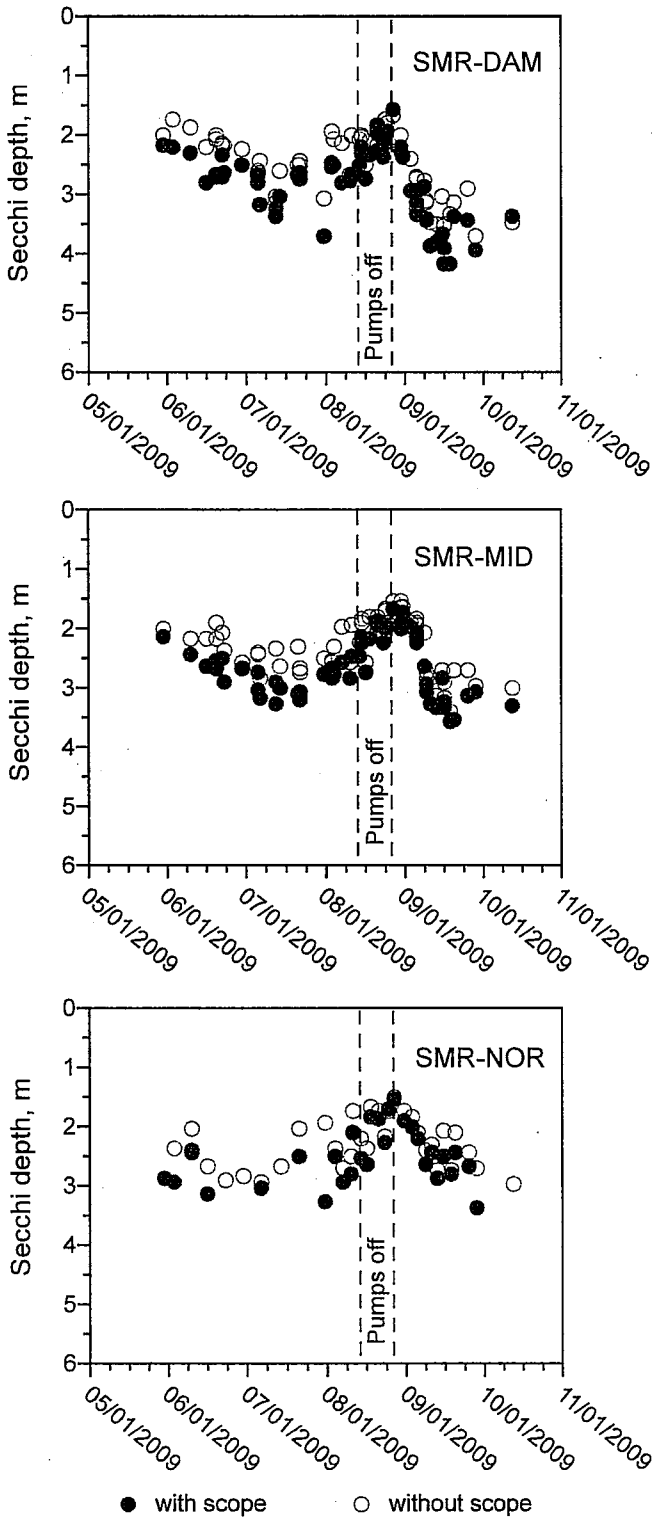

Figure 12. Data for the GCWIN monitoring program, Shadow Mountain Reservoir.

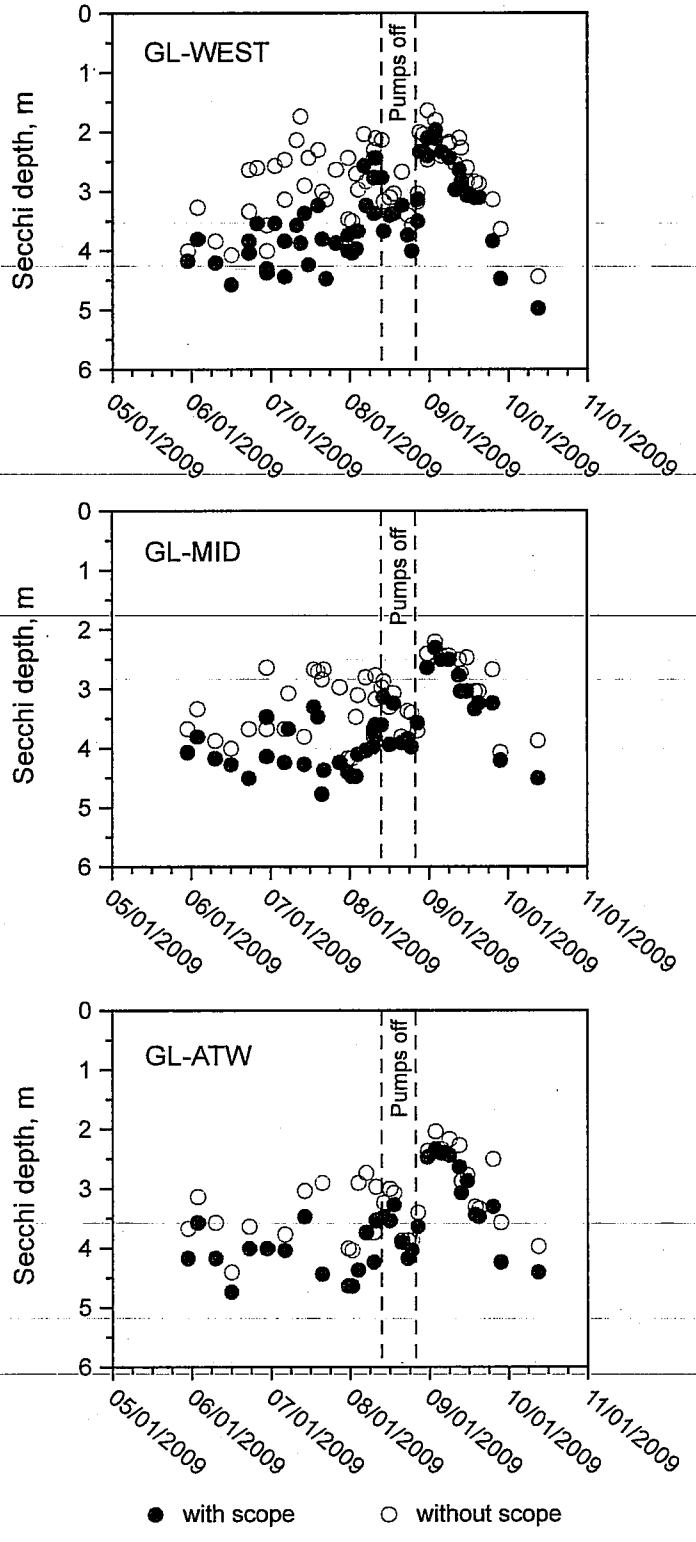

Figure 13. Data for the GCWIN monitoring program, Grand Lake.

Transparency measurements by GCWIN at numerous stations on Grand Lake allow mapping of transparency over the period of monitoring (Figure 14) in support of an interpretation of changes in transparency. Three factors are important to the interpretation. First, the transparency of water in Shadow Mountain Reservoir was consistently lower than the transparency of water in Grand Lake. Factors contributing to the lower transparency of Shadow Mountain Reservoir will be analyzed in later sections of this report. Second, water pumped from the hypolimnion of Lake Granby had high transparency, for reasons explained later in this report. Third, pumping (and to a lesser degree, tributary inflows to Shadow Mountain Reservoir) forced water from Shadow Mountain Reservoir into Grand Lake beginning in the runoff season and, after a scheduled pumping interruption of 13-26 August, continuing at an accelerated rate after August 26. These three factors indicate that the main effect of spring runoff and pumping was to push water of lower transparency from Shadow Mountain Reservoir into water of higher transparency in Grand Lake, thus lowering the transparency of Grand Lake. Because the water of lower transparency entered Grand Lake from the west, a gradient of transparency was established from west to east and west to north, with the highest transparencies in the east and north, furthest from the entry point of the water Shadow Mountain Reservoir.

When pumping volume was high, and runoff had passed, there was a gradual displacement of low transparency water in Shadow Mountain Reservoir with higher transparency water from the Lake Granby hypolimnion. This trend led to a restoration of higher transparency in Grand Lake progressively from mid-September to the end of October, culminating in the domination of Lake Granby water in the upper parts of Grand Lake at Secchi depths near or above 4.0 m. The progression toward higher transparency caused by Lake Granby water can be seen not only in Grand Lake, but also in Shadow Mountain Reservoir.

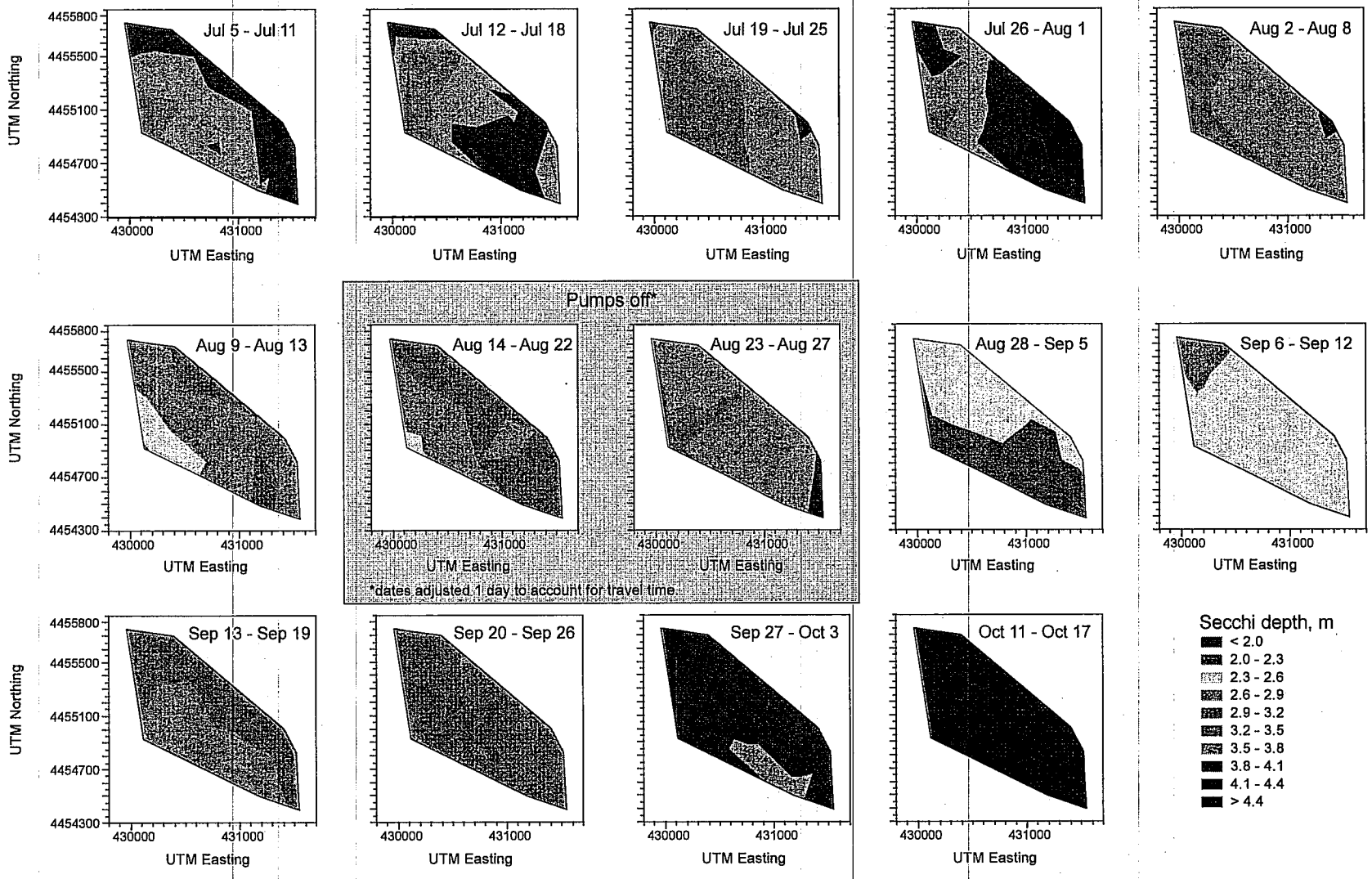

Figure 14. Maps of transparency data from GCWIN, 2009.

The 2009 Transparency Study

The 2009 Transparency Study also included Secchi depth measurements (Figure 15). In addition, estimates of the PAR extinction coefficient (K_t) were made for the first time on Grand Lake and Shadow Mountain Reservoir during the study (Figure 16). The extinction coefficients are a quantitative measurement of transparency. Because the human eye is sensitive to PAR, the Secchi depth is related to the extinction coefficient for PAR (K_t). The two are not the same, however, in that scattering, which is caused by particles in the water, reduces the Secchi depth more quickly than it reduces the extinction coefficient. The Secchi depth is relevant to the general appearance of the lake for recreational or aesthetic purposes. The extinction coefficient is most valuable for analytical purposes because it can be divided into components of absorbance that can be attributed to specific water quality variables.

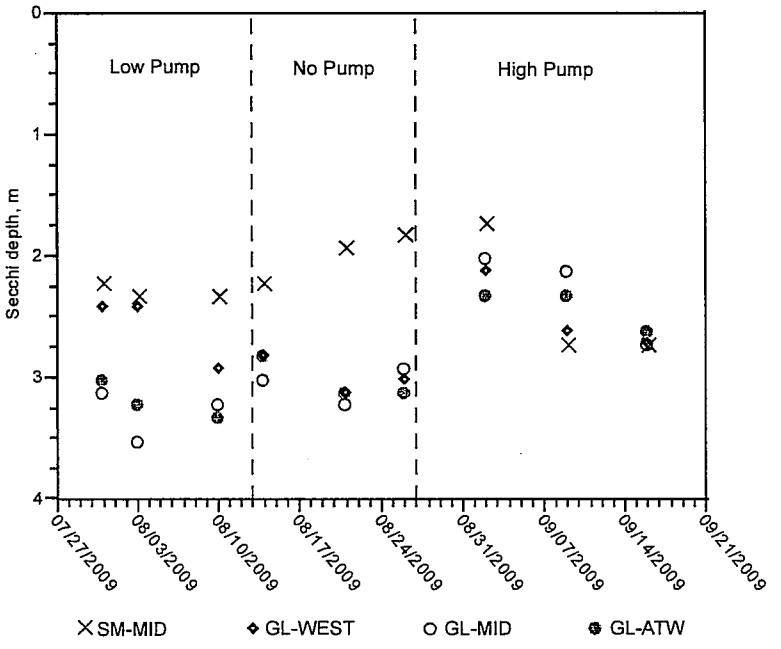

Figure 15. Secchi depth data, 2009 Transparency Study.

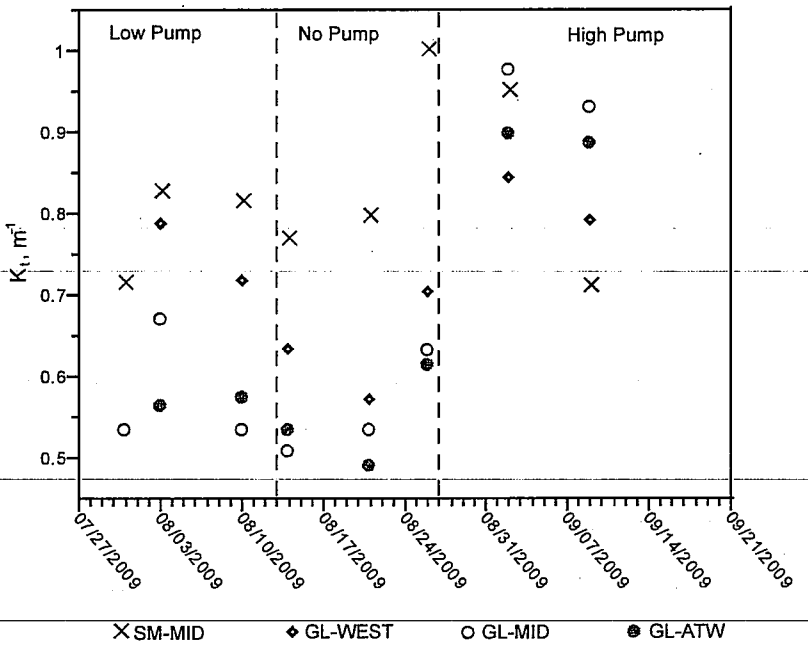

Figure 16. PAR absorbance at 4 m (K_t, m^{-1}), 2009 Transparency Study.

Secchi depths can be obtained only for waters that are deeper than the Secchi depth, and are difficult to obtain in flowing water. Therefore, Secchi depth measurements are available only for Shadow Mountain Reservoir and Grand Lake, and not flowing waters. Similarly, field estimates of PAR extinction coefficients can be obtained only when irradiance measurements can be made over a range of depths. Thus, field based measurements of PAR extinction are available only for the two lakes. Extinction coefficients and Secchi depths can be calculated for flowing waters when absorbance components are known, however, as shown later in this report.

Shadow Mountain Reservoir consistently had Secchi depths below those of the Grand Lake during the 2009 Transparency Study until the interval between September 2 and September 9, when the Secchi depths for Shadow Mountain increased to match those of Grand Lake (Figure 15, see corresponding values of K_t, Figure 16). The western side of Grand Lake had Secchi depths similar to those of Shadow Mountain Reservoir early in the study, reflecting the

concentrated influence of water entering Grand Lake from Shadow Mountain Reservoir through the channel. The middle of Grand Lake and Grand Lake near the Adams Tunnel had higher transparency. The Secchi depths of the 2009 Transparency Study are consistent with the more extensive Secchi depth data collected by GCWIN.

For any given set of observations, there is a specific relationship between the Secchi depth and K_t. This relationship for the Shadow Mountain Reservoir and Grand Lake is shown in Figure 17. Given the relationships in Figure 17, it is possible to define an approximate Secchi depth corresponding to the depth of 1% irradiance (the lower margin for photosynthesis), as shown in Figure 18. The depth of 1% irradiance is approximately twice the Secchi depth for Shadow Mountain Reservoir and Grand Lake.

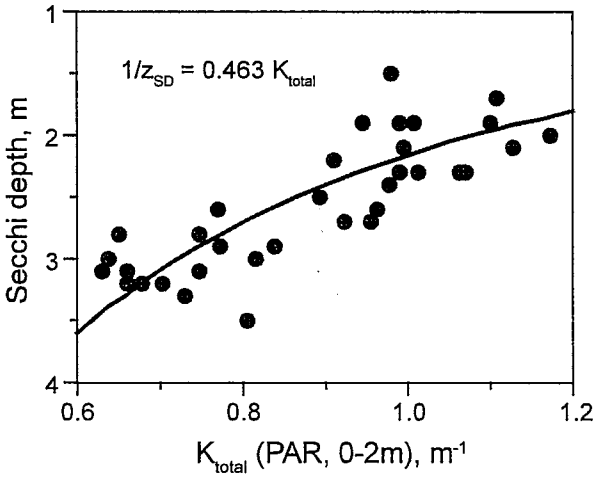

Figure 17. Relationship of Secchi depth to K_t, Shadow Mountain Reservoir and Grand Lake.

Components of Transparency

The components of transparency include pure water, dissolved substances, algae, and non-algal particulate matter. The effect of each of these components was estimated for Shadow Mountain Reservoir and Grand Lake during the 2009 Transparency Study. The effect of pure water is a physical constant; it does not vary from time to time or place to place (Figure 19).

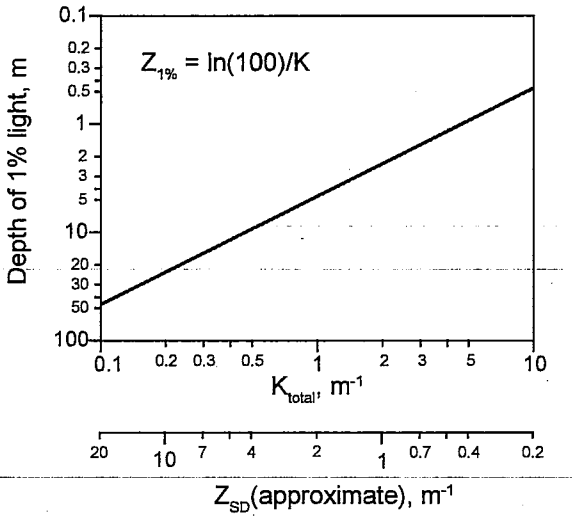

Figure 18. Depth of 1% PAR to K_t and to Secchi depth, Shadow Mountain Reservoir and Grand Lake.

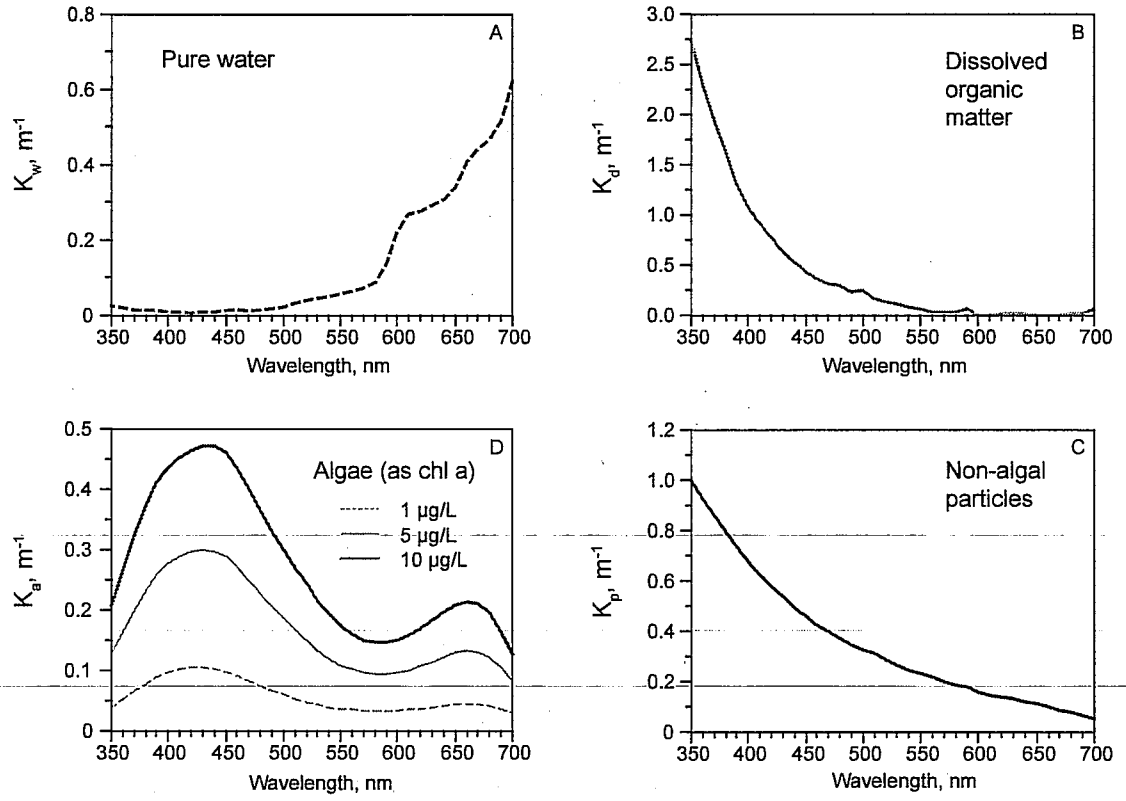

Figure 19. Absorption specta for water and substances in water. (Sources: A, D, Morel and Maritorena 2001; B, empirically derived for East Inlet, 26 August; C, Bowers et al. 1996, Iturriaga et al. 1988).

Dissolved Solids

Total dissolved solids include inorganic dissolved solids (mostly salts) that are common in inland waters (C_a^{++}, M_g^{++}, N_a^{+}, K^{+}, HCO^{-}_3, $SO^{=}_4$, Cl^{-}, H_4SiO_4). These have no significant PAR absorption. Therefore, the substances contributing to total ionic solids (as estimated by specific conductance) are irrelevant to transparency. Also included in total dissolved solids, however, is dissolved organic matter (DOM). It is typical to measure DOM in water as dissolved organic carbon (DOC, mg/L). DOM is approximately two times DOC. Thus, a DOC measurement of 5 mg/L corresponds approximately to 10 mg/L of DOM.

DOM can be divided into two parts: achromatic and chromatic. The achromatic compounds come primarily from the release of simple molecules from organisms as the organisms die or excrete metabolites. Examples include amino acids, simple sugars, and intermediary metabolic compounds. These compounds have no color within the PAR range; they do not contribute to the extinction of light. The chromatic compounds are mostly of terrestrial origin, i.e., they come into streams and lakes from watersheds. Chromatic compounds form in soils as a result of the decomposition of complex carbohydrates that are derived from vascular plants. They absorb light selectively at the short wavelengths (Figure 19). Consequently, when they are abundant (above 5-10 mg/L DOC), they impart a visible brown color to water. The chromatic effect of these compounds, which are typically referred to as humic and fulvic acids or simply as humic substances, is quite strong, even for relatively low concentrations (e.g., 3-4 mg/L DOC).

Typically, inland waters have a significant fraction (e.g., 50%) of chromatic compounds within the DOM pool. The chromatic fraction is increased where there is drainage from wetlands or organic-rich soils. The transmission of humic compounds in mountainous terrain is

accentuated by low hardness, which favors movement of humic substances.

A way of estimating the importance of the chromatic component of DOC is to measure absorbance for a short wavelength of PAR irradiance. In the present case, absorbance at 350 nm is used as an index of the relative amount of chromatic DOC within the total DOM pool.

Near the beginning of the 2009 Transparency Study, when Shadow Mountain Reservoir had not been strongly affected by water pumped from the hypolimnion of Lake Granby, Shadow Mountain Reservoir had DOC concentrations between 4 and 5 mg/L (Figure 20). Pumping showed that water from the hypolimnion of Lake Granby also had DOC concentrations near 4 mg/L. Therefore, water entering Grand Lake through the Shadow Mountain connection channel had DOC concentrations between 4 and 5 mg/L during the study, whether these waters were derived from the tributaries to Shadow Mountain Reservoir or from the hypolimnion of Lake Granby.

Grand Lake near the surface had DOC concentrations between 3 and 4 mg/L (Figure 20).

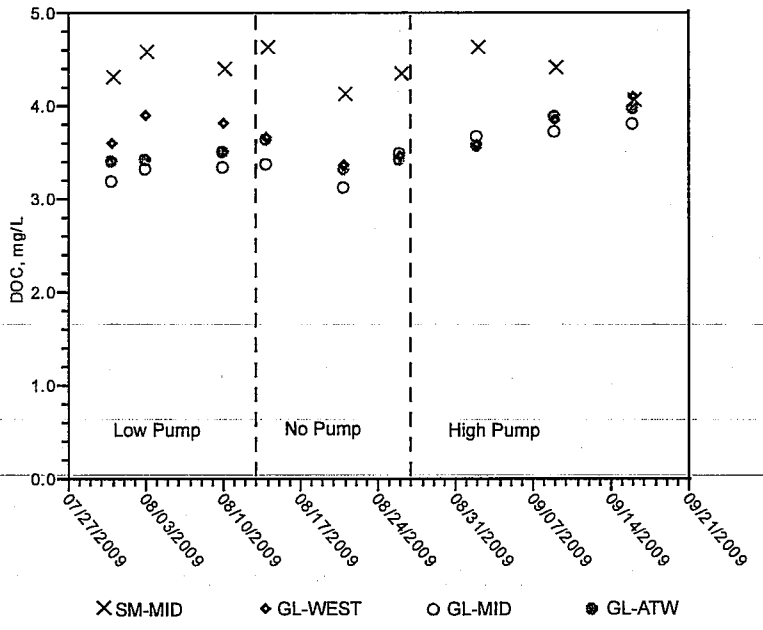

Figure 20. DOC for the 2009 Transparency Study (surface).

The two natural tributaries to Grand Lake, East Inlet and North Inlet, had concentrations of DOC close to 2 mg/L during the 2009 Transparency Study. As shown by USGS data, concentrations of DOC are near 2 mg/L August through March, rise to about 6 mg/L in April and May, then decline slowly to 2 mg/L. It appears that the passage of water through the connecting channel to Grand Lake, when joined by the natural tributary waters, produced a mixed DOC of 3-4 mg/L near the surface of Grand Lake. The deepest water of Grand Lake, at 4-5 mg/L DOC, was a remnant of earlier seasonal conditions (mixing) not documented in the 2009 Transparency Study.

The relationship of DOC to absorbance at 350 nm (Figure 21) was nearly linear (Figure 22). Shallow lake stations in some cases showed a higher ratio of DOC to absorbance, which reflects strong contributions from aquatic biomass during the growing season.

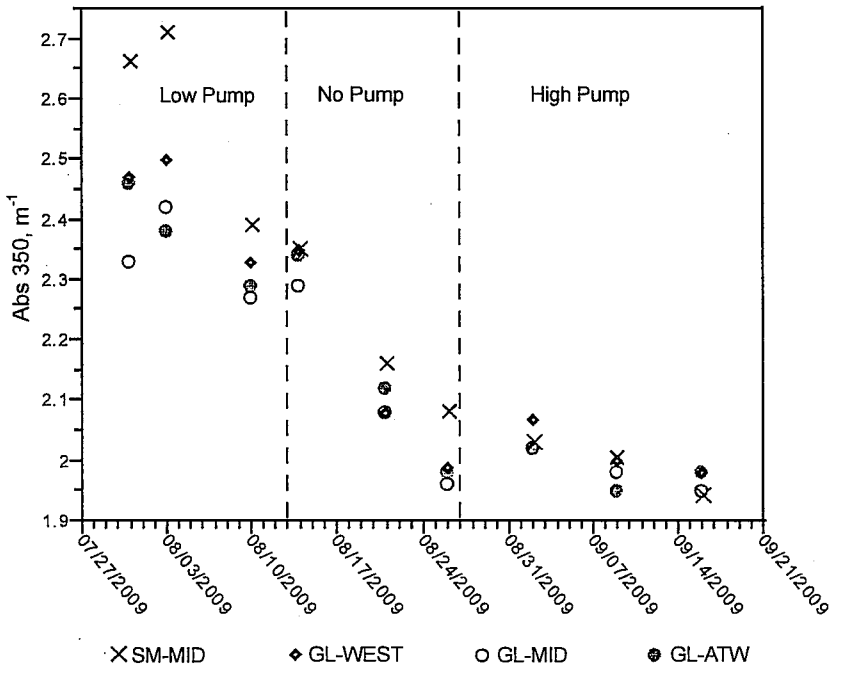

Figure 21. Absorbance of water at 350 nm, m^{-1} during the 2009 Transparency Study.

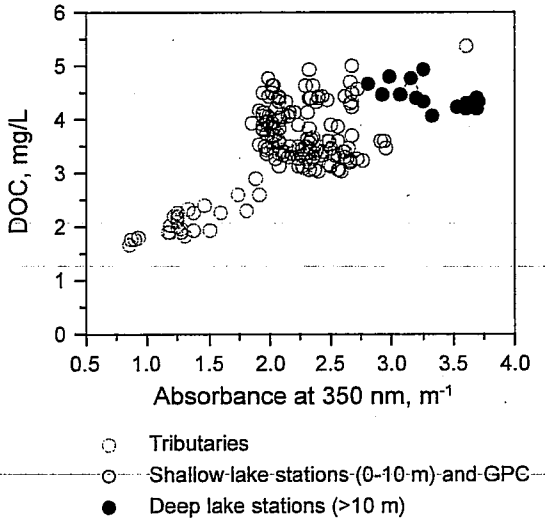

Figure 22. Relationship between DOC and absorbance at 350 nm, 2009 Transparency Study.

Algae

The abundance of algae can be estimated from chlorophyll, which constitutes approximately 1% of the dry mass of algae. Algal absorbance, including chlorophyll plus the algal non-chlorophyll components, has peaks at both high at low wavelengths (Figure 19).

During pumping, the pump canal contained virtually no chlorophyll, as would be expected for the hypolimnion of Lake Granby. Shadow Mountain Reservoir showed a steady rise in chlorophyll from the beginning of the study interval to the end of the pumps off interval (Figure 23). This probably was a typical spring rise in biomass in response to increasing warmth and intermittent stability of the water column associated with heating. Onset of pumping introduced cold water from Lake Granby containing virtually no chlorophyll, which diluted algal biomass and weakened water column stability, driving down the chlorophyll in Shadow Mountain Reservoir. Peak concentrations of chlorophyll in Shadow Mountain Reservoir were higher than would be typical for montane lakes in a natural state (< 5 µg/L), but did not reach nuisance levels.

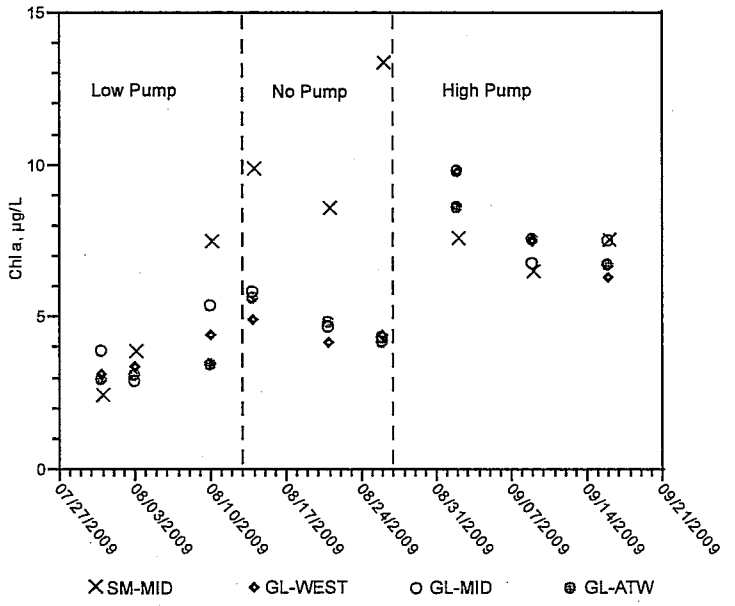

Figure 23. Chlorophyll for the 2009 Transparency Study.

At the beginning of the study, Grand Lake at the west station had about 3 µg/L of chlorophyll in the surface waters. Chlorophyll increased to 4-6 µg/L, then declined during the pumps off interval. Early in the interval of rapid pumping at the end of August and into September, chlorophyll concentrations increased further, probably because algae passed through the connecting channel along with water pumped through Shadow Mountain Reservoir. Peak concentrations were above what would be expected for natural conditions in mountain lakes. Chlorophyll was not present in significant amounts in any of the tributaries because growth of phytoplankton does not occur in tributaries (small amounts of detached biofilm algae were present).

Suspended Solids

Suspended solids were measured in three complementary ways: total suspended solids, turbidity, and particulate carbon. Total suspended solids were measured gravimetrically for

water taken at specific depths. Because particulate matter scatters light, an associated variable that need not be taken to the laboratory for measurement is turbidity, which is a measure of scattering. For the 2009 Transparency Study, the total suspended solids and turbidity measurements (Figures 24, 25) are well correlated and need not be analyzed separately.

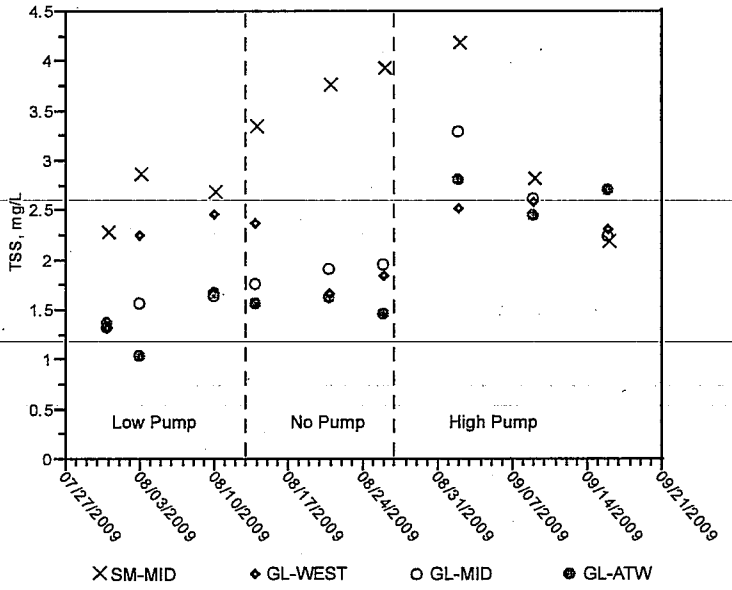

Figure 24. Total suspended solids, 2009 Transparency Study.

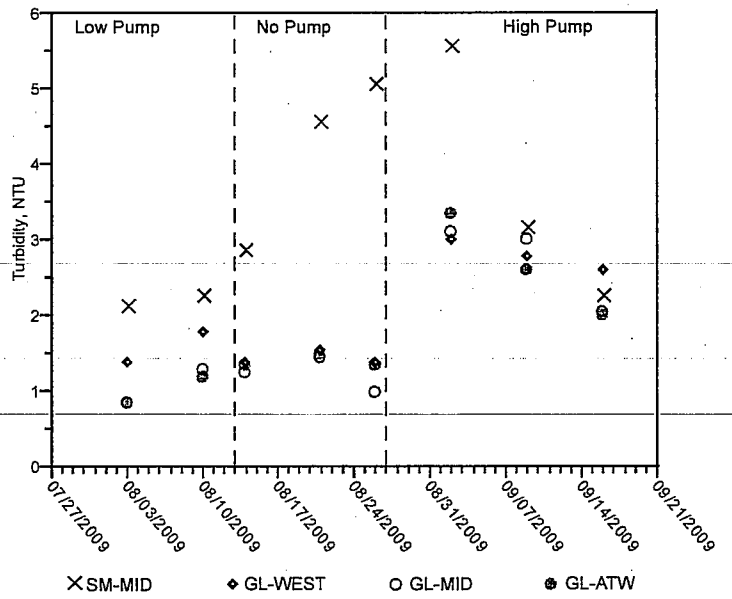

Figure 25. Turbidity, 2009 Transparency Study.

Suspended solids consist of two fractions: organic and inorganic. The organic fraction consists of two subfractions: living and nonliving. The living portion is composed primarily of algae (phytoplankton). The ratio of chlorophyll to biomass for algae allows the living particulate component (phytoplankton cells) to be estimated. Because the carbon content of phytoplankton biomass is close to 50% of the dry mass, the contribution of nonliving organic matter can be estimated as the residual in excess of the particulate carbon that can be attributed to algal biomass (Figure 26). This fraction absorbs similarly to chromatic DOC (Figure 19). Thus, the measurements at hand allow an estimate of total solids, mass of phytoplankton, mass of non-algal organic particulate matter, and mass of inorganic particulate matter (total – organic).

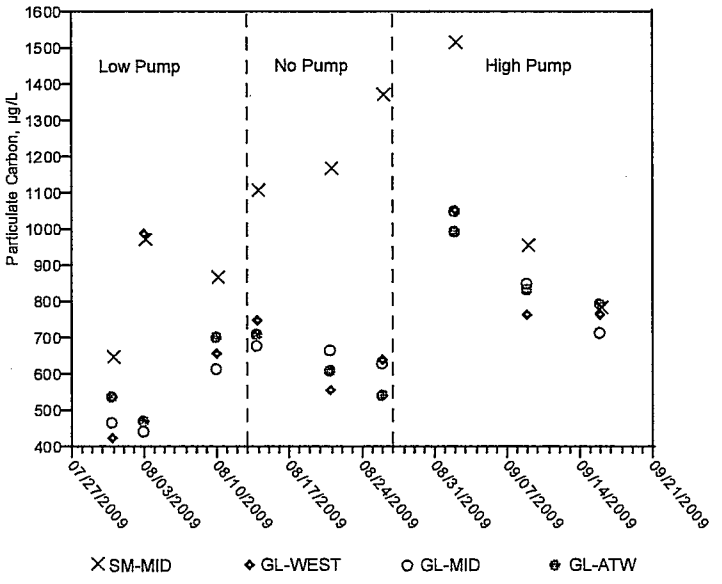

Figure 26. Particulate carbon, 2009 Transparency Study.

Separation of Transparency Components

The effects of individual components of transparency can be computed from the attenuation spectra for pure water, chromatic dissolved organic compounds, phytoplankton, and non-algal particulate material.

Dissolved Organic Matter

For each water source on a given date, the absorbance spectrum for chromatic DOC was determined by spectrophotometry of filtered samples. Absorbance spectra varied somewhat across samples, but the spectrum shown in Figure 19 is typical.

Phytoplankton

The absorption spectrum for suspended algae (phytoplankton) retains the same shape for varying abundances of algae, but the absorption for each wavelength is adjusted for the quantity of algae, measured as chlorophyll (Figure 19). The spectra for algal absorption vary according to the size distribution of algal cells. For the present study, the size of algal cells was not measured. The spectra that are used here are drawn from the assumption that cells were of mixed size composition.

Non-Algal Particles

The calculations reported here use an equal mixture of mineral and organic (non-algal) particle spectra, adjusted for particle mass per unit volume. The mineral and organic particle spectra are very similar in shape, which allows them to be combined easily (Figure 19). The adjustment for particle mass per unit volume is accomplished empirically with the assumption that residual absorbance not explained by the other three absorbing components (pure water, dissolved organic matter, and algae) is caused by non-algal particles. Thus, the final combination of absorbances matches the measured absorbance spectrum derived from specific water samples from the study sites.

Spectral Interactions

Because the individual absorbing components absorb differentially over the PAR spectrum, they cause changes in the wavelength distribution of light at progressive depths below the surface. For example, pure water, which absorbs selectively at longer wavelengths, enriches the violet and blue components of downwelling irradiance, whereas dissolved organic matter and non-algal particles have the opposite effect. Algae enhance the middle portion of the spectrum. The mixture of these effects is computed progressively at 2 cm intervals for the water columns of Grand Lake and Shadow Mountain Reservoir from the spectral information on individual components and empirical data on the abundance of each component.

Relative contributions of individual components to extinction at any given wavelength or across the entire range of wavelengths change with depth. At greater depths, the more readily absorbed wavelengths become scarce and the most penetrating portions of the spectrum predominate. Therefore, the spectrum at one depth will differ from the spectrum below it, and K_t will decline with depth. Figure 27 shows an example from the middle of Grand Lake. The relative importance of DOC and non-algal particles changes somewhat with depth as the

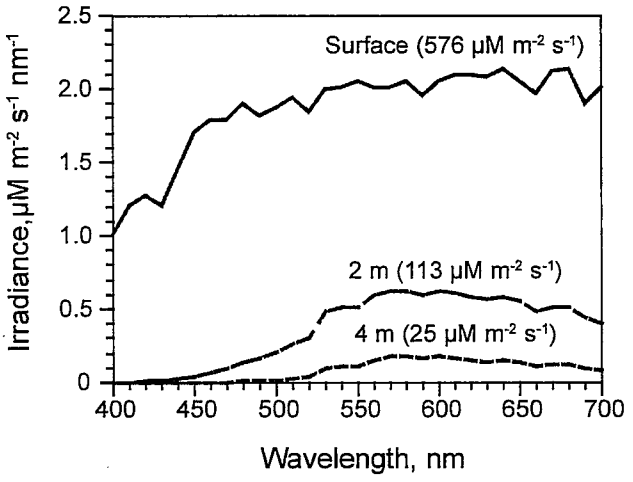

Figure 27. Spectral change with depth in Grand Lake (West Station, 26 August)

spectrum changes, but these changes are fairly consistent across stations. For present purposes, the analysis will be focused on spectra obtained at a depth of 4 m.

The dominant absorbance of PAR irradiance in waters of Shadow Mountain Reservoir throughout the entire study was non-algal particles (Figure 28, Table 4, Appendix C), which accounted for 40-60% of the total attenuation of light on all dates except one (August 14), when the attenuation was closer to 33% (Table 4).

Absorbance Component	Jul 31	Aug 3	Aug 10	Aug 14	Aug 21	Aug 26	Sept 2	Sept 9
SMR-Mid, 4m								
K_w	11	10	10	11	10	8	9	11
K_d	14	11	11	14	10	6	8	11
K_a	16	16	21	27	25	25	24	15
K_p	59	63	58	49	54	61	60	64
GL-MID, 4m								
K_w	15	12	15	16	15	13	8	9
K_d	21	15	21	21	17	10	8	9
K_a	23	16	24	30	23	20	23	21
K_p	41	57	40	33	45	57	61	61

Table 4. Percent contribution to PAR absorbance by four spectral components, 2009 Transparency Study. K_w = extinction by water, K_d=extinction by dissolved organic matter, K_a=extinction by algal cells, K_p=extinction by non-algal particles. Units of K are m^{-1}.

During the period when pumping was low (the first three sampling dates), the proportionate influence of non-algal particulate matter at the west end of Grand Lake was generally the same as in Shadow Mountain Reservoir (Figure 28). The Shadow Mountain influence persisted strongly at this location when the pumps were off and continued when the pumping resumed. The effect of non-algal particles was somewhat weaker at the mid-lake and at the Adams Tunnel locations, but still made a dominant contribution to attenuation of PAR

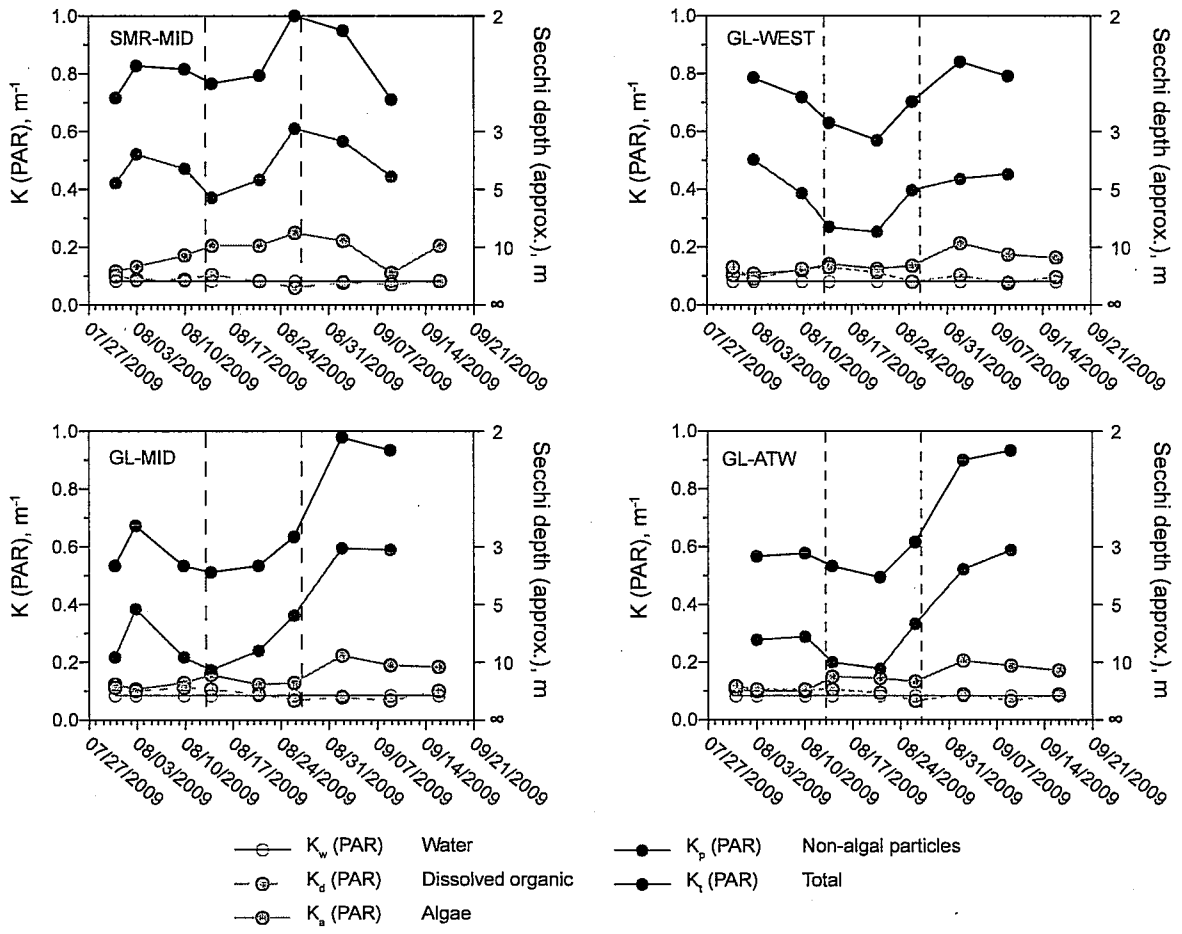

Figure 28. Components of absorbance, expressed as K, for PAR at 4 m depth.

(Figure 28). Pumped water from Lake Granby would have had a moderating effect on the absorbance attributable to non-algal particles had it been available to Grand Lake over a longer interval during the study, as shown by the GCWIN monitoring.

The absorbance of Lake Granby hypolimnetic water can be estimated from laboratory data even though no Secchi depths or extinction coefficients were measured in the field for this water. Panel D of Figure 19 gives the shape of the absorbance spectrum for non-algal particles. The position of the spectrum on the y axis is determined by a scaling factor derived from empirical data on non-algal suspended solids (Figure 29). The absorbance shown in Figure 19 D

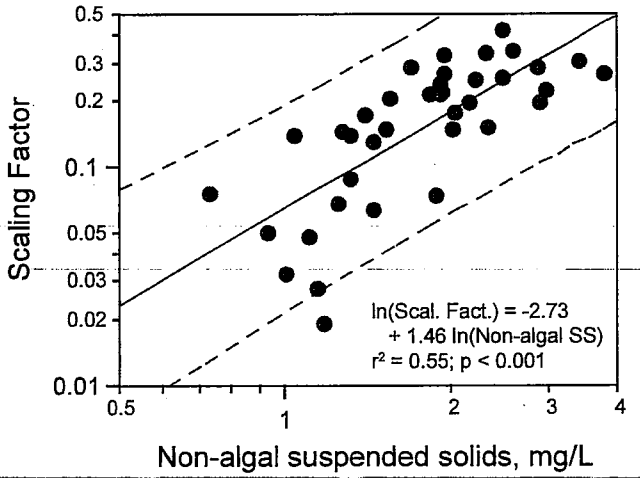

Figure 29. Relationship between the scaling factor non-algal particle absorption and the mass per unit volume of non-algal particles, 2009 Transparency Study (see text for explanation).

at each PAR wavelength was multiplied by the appropriate scaling factor (Figure 29), which adjusted the spectrum for the observed concentration of non-algal suspended solids. Other spectral contributions were computed from field data plus the spectral shapes shown in Figure 19. The results are shown in Figure 30, which confirms that Granby hypolimnetic water would produce a Secchi depth of 4-5 m if it were to dominate the epilimnion of Grand Lake, as it did progressively from September through October (GCWIN monitoring). Because the Lake Granby hypolimnetic water must pass through Shadow Mountain Reservoir from south to north prior to entering Grand Lake, however, the beneficial effect of the low particle content of Lake Granby water was slow to develop fully. The beneficial effect of the Lake Granby water was fully realized in October, when the transparency of Grand Lake was highest (Figure 14, GCWIN Study).

Absorbance of algae in Grand Lake was slightly greater than absorbance of dissolved organic matter and well below the absorbance of non-algal particulate matter (Figure 28). The effect of algae at their low initial abundances as indicated by low chlorophyll concentrations (ca.

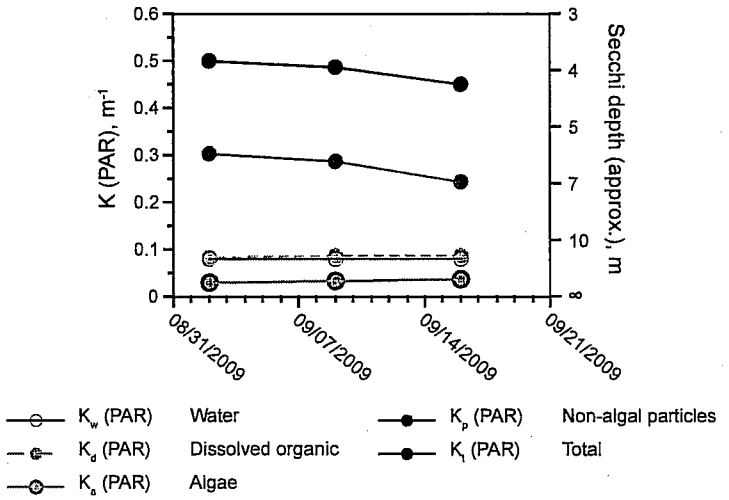

Figure 30. Absorbance components for Lake Granby hypolimnetic water as sampled in the pump canal.

2 µg/L) was approximately the same magnitude as the effect of pure water in Shadow Mountain Reservoir and in Grand Lake. The absorbance of algae grew substantially over the course of the 2009 Transparency Study, but did not overtake the effect of non-algal particulate matter.

Dissolved organic matter was the third most important cause of PAR extinction. In Shadow Mountain Reservoir, the extinction contribution at 4 m was 1/3 to 1/2 as important as non-algal particles. The water in the pump canal toward the end of the study, which was drawn from the hypolimnetic waters of Lake Granby, showed DOC concentrations very similar to the water in Shadow Mountain Reservoir. Thus the contrast between the two water sources (Shadow Mountain Reservoir, Lake Granby hypolimnion) was not important for dissolved organic matter, as it was with non-algal particles. In Grand Lake, the effect of dissolved organic matter at 4 m was much less than the effect of non-algal particles.

Regression Analysis of Variation in Transparency

An alternate way of summarizing controls on variability of transparency across all the

waters that were sampled for the 2009 Transparency Study involves regression analysis. Transparency, measured as K_t at 0-2 m (calculated from field data), is used as the dependent variable (i.e., the responding variable) and each of the measured components of absorbance is used as an independent variable (causal variable). The regression procedure operates in step-wise fashion. It selects first the variable that provides the greatest explanation of variability. It then searches for additional explanation beyond what was explained by the first variable, and progresses step-wise to the point at which there is no further significant explanation of variability.

For K_t, abundance of non-algal particles explains 55% of variance. Adding algal particles brings the total to 66%, and non-algal inorganic particles brings the total to 72% (Table 5). No significant result was obtained for DOC concentration. Thus, virtually all of the variability among sites can be attributed to particles (algal, non-algal). The results should not be taken to mean that DOC is unimportant, as it does account for some significant absorbance of light that reduces transparency. The regression analysis shows that DOC has an effect that does not vary greatly from one place to another or one time to another for the 2009 Transparency Study. The variability that accounts for differences in K_t (or Secchi depth) relates almost entirely to particles.

Parameter	Estimate (±SE)	Sequential R^2	Significance
Intercept	0.39 (±0.029)	---	---
Non-algal organic particles, mg/L	0.22 (±0.038)	0.55	$p < 0.0001$
Algal particles, mg/L	0.20 (±0.047)	0.66	$p < 0.0001$
Inorganic particles, mg/L	0.11 (±0.027)	0.72	$p < 0.0002$

Table 5. Results of stepwise multiple regression of K_t (PAR). K_t was calculated from field measurements of irradiance over the interval 0-2 m. Units of K_t are m^{-1}.

Conclusions about Transparency

Transparency near the surface of Grand Lake is controlled by three distinct water types. First is the native water supply for Grand Lake, consisting of the North and East Inlets. During runoff the native sources bring into Grand Lake water that averages about 4 mg/L dissolved organic carbon (post runoff = 2 mg/L). For suspended solids, post runoff concentrations have a median concentration of 0.3 mg/L (2009 Transparency Study), but would have been higher during runoff (no data; below detection limits of the USGS analyses). The spring flow probably moved to the middle or deep water portions of the column, but summer flows stayed near the top, as shown by conductance. Substantial portions of the total suspended solids probably settled within the water column prior to or just after stratification. The volume of flow from the native sources is low in summer as compared with managed flows that enter from Shadow Mountain Reservoir (including pumped water from Lake Granby).

Shadow Mountain Reservoir, the second type, has high concentrations of non-algal organic particulate matter, which reduces the transparency of Grand Lake beginning in the period of runoff and extending into September. Hypolimnetic water from Lake Granby, the third source, contains low suspended solids. High rates of pumping from this source ultimately displaces the water from Shadow Mountain Reservoir, thus reducing the total particulate content of surface waters in Grand Lake. The deep water of Lake Granby, like the deep water of Grand Lake, has higher DOC concentrations than the surface water because the deep waters of both reservoirs are affected by DOC that enters during spring runoff, and passes to deep water because it is cold. Therefore, the main benefit of water from the hypolimnion in Lake Granby is low particle content rather than low DOC.

Hypothetical Transparency of Grand Lake Prior to the CBT Project

Prior to the CBT project, the transparency of Grand Lake was determined by water entering through the East Inlet and North Inlet. Using the method of transparency components, it is possible to make an approximation of expected summer and fall transparencies of Grand Lake prior to the CBT project (Figure 31). The underlying assumptions for this projection determine the outcome, and they are to some degree a matter of judgment, given the absence of transparency data prior to the CBT project.

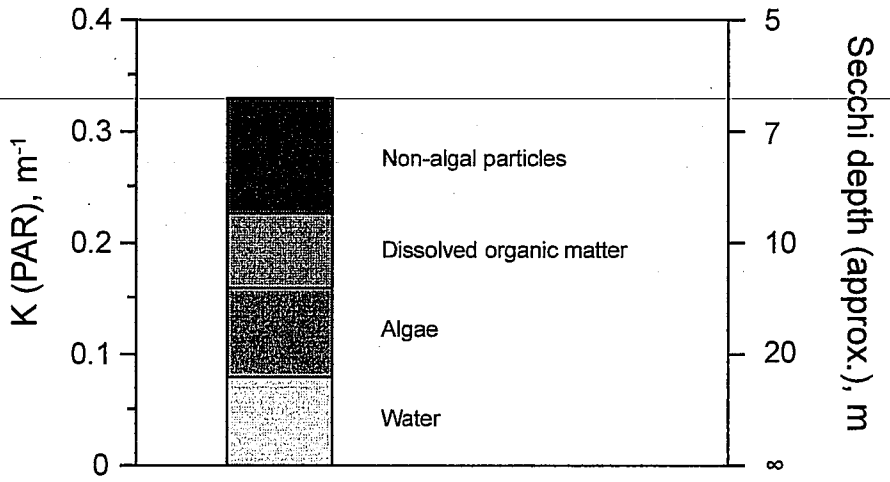

Figure 31. Estimated transparency for Grand Lake prior to the CBT project.

The time frame for the projection coincides with the time frame for the 2009 Transparency Study. Projection of transparencies at other times of the year could require other assumptions. For present purposes, the effect of dissolved organic matter on transparency (K_d) is determined from the DOC concentration observed during September of 2009 for East Inlet and North Inlet. In addition, it is assumed that chlorophyll in the lake would be near 2 µg/L, i.e., below the concentrations observed in the 2009 Transparency Study. The lower chlorophyll concentration is used because the current algal growth in the lake appears to reflect stimulation

by inorganic nitrogen that is related to water management. The abundance of nonalgal particles is obtained from the observed total suspended solids entering the lake through the two inlets during August and September, with algal particles subtracted. The estimate is 0.2 mg/L.

The PAR extinction coefficient (K_t) under the assumptions given here would be between 0.3 and 0.4 per meter. The corresponding Secchi depth, as determined by the empirical relationship between K_t and Secchi depth shown in Figure 17, would be between 5 and 7 m. The mean Secchi depth would be near 6 m.

References

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Appendix A

Sampling Plan and Analytical Methods

Sampling Plan and Analytical Methods

The primary goals of this study were 1) to document changes in transparency of Grand Lake and Shadow Mountain Reservoir during a seven-week period that begins 30 July 2009 and ends 16 September 2009, and 2) to identify the factor or factors contributing to changes in transparency in the lakes, if such changes are observed.

Sampling date	Pumping from Granby Reservoir
30/31 July*	Limited pumping
3 August	Limited pumping
10 August	Limited pumping
14 August	Pumps off
21 August	Pumps off
26 August	Pumps off
2 September	Pumps on
9 September	Pumps on
16 September	Pumps on

Table A-1. List of sampling dates. Sampling on 30 Jul was suspended due to weather conditions. The tributary stations (EIN, NIN, NFC, LCC) and GPC were sampled on 30 Jul; the first sampling date for the lake stations was the following day (31 Jul). LCC was sampled only on 30 Jul and on 3 Aug.

Field measurements included temperature, specific conductance, pH, dissolved oxygen, turbidity, and irradiance (Secchi depth, PAR; lake stations only). Water samples were analyzed for total suspended solids, chlorophyll *a*, dissolved organic carbon, particulate organic carbon, nitrate, nitrite, ammonia, particulate nitrogen, soluble reactive phosphorus, total dissolved phosphorus, particulate phosphorus, and absorbance spectra (PAR, photosynthetically available radiation: 350-700 nm).

Station name	Lat	Lon	Sampling depth, m						
			0-2	2-4	4-6	6-8	8-10	18-20	38-40
Grand Lake									
GL-MID	40.2435	-105.8134	X	X	X	X	X	X	X
GL-ATW	40.2410	-105.8045	X		X		X		
GL-WEST	40.2419	-105.8215	X		X		X		
North Inlet (NIN)*	40.2507	-105.8144	X						
East Inlet (EIN)*	40.2367	-105.8023	X						
Shadow Mountain Reservoir									
SMR-MID	40.2252	-105.8372	X	X	X				
SMR-CHL	40.2448	-105.8264	X						
N. Fork Colorado R. (NFC)*	40.2188	-105.8563	X						
Granby Pump Canal (GPC)*	40.2064	-105.8495	X						
Little Columbine Cr. (LCC)*	40.2517	-105.8339	X						

* Single integrated sample for flowing waters; surface sample for GPC on 16 September.

Table A-2. List of sampling locations. X = sample taken for laboratory analyses. Abbreviated station names are given in parentheses.

Station name	Lat, °	Lon, °	Pairs of measurements
GL-WEST	40.2419	-105.8215	58
GL-KEMP	40.2493	-105.8234	35
GL-SB	40.2489	-105.8183	35
GL-NI	40.2473	-105.8159	49
GL-MID	40.2434	-105.8138	45
GL-ATW	40.2411	-105.8050	34
GL-EI	40.2372	-105.8047	34
GL-AR	40.2381	-105.8090	55
GL-NB	40.2453	-105.8138	45
GL-2009-A1	40.2435	-105.8183	65
GL-2009-A2	40.2434	-105.8099	41
GL-2009-A3	40.2409	-105.8139	33
GL-2009-A4	40.2427	-105.8064	33
GL-2009-A5	40.2466	-105.8212	32
SMR-NOR	40.2479	-105.8372	30
SMR-MID	40.2249	-105.8375	58
SMR-DAM	40.2086	-105.8431	59

Table A-3. Monitoring stations for the GCWIN Secchi monitoring program. Measurements (with and without viewing scope) were made during the months of May – Nov, 2009.

Test	Method	References	Typical reporting limit
Nitrogen series			
Ammonia-N	Modified Solarzano method	Grashoff 1976	1-2 µg/L
Nitrate-N, Nitrite-N	Ion chromatography (Dionex DX-120)		3 µg/L
Particulate N	Elemental analyzer (Fisons EA-1108)		10 µg/L
Phosphorus series			
Soluble reactive P	Ascorbic acid-molybdate method	Murphey & Riley 1962	0.5 µg/L
Total dissolved P, Toal particulate P	Oxidation followed by ascorbic acid-molybdate	Lagler & Hendrix 1981, Murphey & Riley 1962	0.5 µg/L
Total P	Sum of TDP and TPP		1 µg/L
Carbon series			
Dissolved organic carbon	High temperature combustion, IRGA (Shimadzu TOC 5000A)		0.3 mg/L
Particulate carbon	Elemental analyzer (Fisons EA-1108)		25 µg/L
Field measurements			
Temperature*	Field meter (YSI 6920V2)		0.01°C
Dissolved oxygen*	Field meter (YSI 6920V2)		0.01 mg/L
Specific conductance*	Field meter (YSI 6920V2)		1 µS/cm
pH*	Field meter (YSI 6920V2)		0.01 units
Turbidity*	Field meter (YSI 6920V2)		0.1 NTU
Chlorophyll *a*	Hot ethanol extraction followed by spectrophotometry	Marker et al. 1980, Nusch 1980	0.2 µg/L
Irradiance (PAR)	Li-Cor quantum sensor		0.1 µE m^{-2} s^{-1}
Secchi depth	20 cm diameter disk		0.1 m

* Resolution, not reporting limit.

Table A-4. Summary of analytical methods.

Appendix B

Water Quality Data, 2009 Transparency Study

Grand Lake Monitoring Program
Temperature, °C

SITE	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMid-00	14.62	15.36	16.66	16.52	16.03	16.59	14.99	14.70	13.41
GLMid-02	14.47	14.71	15.97	16.44	14.98	16.57	15.01	14.34	13.41
GLMid-04	12.35	13.82	14.38	15.38	14.55	16.18	14.96	14.10	12.90
GLMid-06	11.87	11.44	12.11	12.55	12.89	13.04	13.33	13.39	12.56
GLMid-08	11.21	10.92	10.94	11.05	11.48	11.09	11.80	11.52	11.95
GLMid-10	9.02	9.68	9.77	9.48	9.44	9.43	9.74	10.09	10.34
GLMid-18			7.07	7.20	7.07	7.19	7.05	6.65	7.22
GLMid-20	6.59	6.84	6.71	6.88	6.60	6.78	6.77	6.42	6.87
GLMid-38			4.73	4.65	4.74	4.71	4.79	4.81	4.77
GLMid-40	4.67	4.74	4.65	4.58	4.65	4.60	4.68	4.71	4.63

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLATW-00	14.61	15.58	17.00	16.80	16.18	16.78	15.18	14.60	13.37
GLATW-02	14.58	15.19	16.15	16.68	15.17	16.78	15.19	14.00	13.32
GLATW-04	14.54	13.63	15.70	14.38	14.55	14.57	14.73	13.68	13.22
GLATW-06	12.31	12.33	12.31	12.00	12.17	12.07	13.00	13.16	12.85
GLATW-08	10.57	10.54	10.08	10.48	10.84	10.70	11.64	11.14	12.29
GLATW-10	8.90	9.43	10.50	9.67	9.62	9.68	9.78	9.10	9.92

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLWEST-00	14.48	15.13	16.45	16.01	15.07	16.27	14.87	14.27	13.24
GLWEST-02	14.14	14.36	15.81	15.97	14.67	16.25	14.81	14.12	13.01
GLWEST-04	14.01	14.28	15.53	15.92	14.69	15.52	14.74	13.99	12.97
GLWEST-06	11.60	13.79	11.90	12.41	14.28	14.83	14.34	13.75	12.77
GLWEST-08	10.49	11.60	10.58	10.96	10.71	11.33	12.54	10.77	12.48
GLWEST-10	9.36		10.31	9.85	9.12	9.15	10.14	9.00	10.38

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
SMMID-00	15.18	15.70	16.47	16.74	15.55	16.84	14.39	13.33	11.95
SMMID-02	15.01	15.58	16.26	16.68	15.59	16.63	14.18	13.13	11.82
SMMID-04	14.59	15.52	13.95	13.74	14.61	15.81	11.65	11.24	9.97
SMMID-06			13.17	12.30	13.77	14.33	11.09	10.64	9.82

	30-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
SMCC-00	14.84	15.71	16.37	15.93	13.86	15.70	14.30	13.28	12.28
SMCC-01				15.90	13.75	15.57	14.29	13.28	12.27
SMCC-02	14.59	15.60	16.34	15.90	13.81	15.53	14.29	13.29	12.27
SMCC-02.3						15.50	14.29		
SMCC-02.4								13.29	
SMCC-03									12.27

STREAMS Site	30-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
E. Inlet	9.85	11.92	12.70	12.51	12.91	11.12	8.98	10.74	10.13
N. Inlet	10.11	11.17	11.93	11.90	12.49	10.51	10.28	9.67	10.00
NF. Colorado	12.82	13.91	15.64	13.55	15.20	12.40	10.81	11.70	11.60
GPC*	14.18	15.61	17.14	16.40	17.03	17.28	8.41	7.87	8.46
Columbine Cr	13.13	13.32							

*GPC only September data are for flowing waters

Grand Lake Monitoring Program
Specific Conductance, µS/cm

SITE	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMid-00	25	27	29	32	29	28	46	54	60
GLMid-02	25	24	29	33	29	28	46	56	60
GLMid-04	21	24	26	29	28	28	47	53	58
GLMid-06	20	21	21	22	24	23	31	51	57
GLMid-08	20	21	21	21	21	21	25	25	50
GLMid-10	22	21	21	22	22	21	23	24	26
GLMid-18			29	28	28	27	31	35	31
GLMid-20	33	33	32	30	32	30	33	37	34
GLMid-38			60	60	59	57	62	62	64
GLMid-40	61	61	61	62	60	59	64	64	67

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLATW-00	24	24	28	32	29	28	43	54	59
GLATW-02	23	24	28	32	29	28	43	54	59
GLATW-04	23	21	29	24	27	25	43	54	59
GLATW-06	20	21	21	21	22	22	26	48	57
GLATW-08	20	21	21	21	21	21	24	27	53
GLATW-10	22	21	21	22	22	21	23	25	27

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLWEST-00	26	36	39	34	29	28	42	57	62
GLWEST-02	26	27	39	34	28	28	43	58	64
GLWEST-04	26	27	32	34	28	28	45	59	64
GLWEST-06	20	24	22	22	28	26	52	57	65
GLWEST-08	20	21	22	21	22	22	29	29	58
GLWEST-10	21		22	22	23	22	24	26	33

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
SMMID-00	48	52	53	55	59	58	66	71	76
SMMID-02	49	52	53	55	59	58	66	71	75
SMMID-04	52	52	60	62	60	59	71	74	78
SMMID-06			62	64	65	62	71	75	78

	30-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
SMCC-00	49	52	51	34	29	28	66	71	75
SMCC-01				34	29	28	66	71	75
SMCC-02	48	52	52	34	29	28	65	71	75
SMCC-02.3						28	65		
SMCC-02.4								71	
SMCC-03									75

STREAMS

Site	30-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
E. Inlet	9	15	16	17	20	18	23	21	22
N. Inlet	15	21	18	19	22	20	20	24	25
NF. Colorado	69	74	80	84	90	80	92	95	94
GPC*	51	54	57	57	66	60	77	79	78
Columbine Cr	94	87							

*GPC only September data are for flowing waters

Grand Lake Monitoring Program
Dissolved Oxygen, mg/L

SITE	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMid-00	8.17	7.89	8.19	8.24	8.20	8.02	8.28	8.24	8.27
GLMid-02	8.17	8.13	8.24	8.28	8.33	8.04	8.29	8.14	8.24
GLMid-04	8.12	8.07	8.16	8.24	8.29	8.39	8.22	7.89	7.74
GLMid-06	8.02	7.86	8.00	8.15	7.86	7.68	7.37	7.20	7.50
GLMid-08	7.99	7.85	7.75	7.62	7.33	7.14	6.87	6.54	7.08
GLMid-10	8.10	7.82	7.77	7.56	7.41	7.21	6.89	6.63	6.39
GLMid-18			8.04	7.92	7.81	7.11	7.60	7.53	7.30
GLMid-20	8.11	8.02	8.00	7.95	7.82	7.17	7.54	7.55	7.40
GLMid-38			7.15	7.02	7.06	7.02	6.89	6.92	6.80
GLMid-40	7.22	7.09	7.06	7.12	6.92	6.91	6.81	6.86	6.67

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLATW-00	8.18	8.03	8.13	8.19	8.09	7.99	8.33	8.20	8.33
GLATW-02	8.18	8.13	8.25	8.19	8.32	8.01	8.35	7.88	8.33
GLATW-04	8.17	8.06	8.21	8.20	8.18	8.17	7.89	7.56	8.30
GLATW-06	7.93	7.95	8.02	7.91	7.46	7.41	7.34	7.15	7.75
GLATW-08	8.05	7.92	7.83	7.66	7.28	7.09	6.88	6.61	6.99
GLATW-10	8.11	7.85	7.88	7.67	7.31	7.14	6.89	6.85	6.53

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLWEST-00	7.86	8.07	8.23	8.22	8.22	8.19	8.31	8.17	8.26
GLWEST-02	8.11	8.13	8.18	8.27	8.26	8.22	8.32	8.10	8.17
GLWEST-04	8.11	8.08	8.17	8.22	8.25	8.49	8.30	7.99	8.16
GLWEST-06	8.01	8.08	7.96	7.92	8.00	8.26	8.09	7.83	8.04
GLWEST-08	8.01	7.87	7.64	7.84	7.23	7.20	7.17	6.64	7.64
GLWEST-10	8.07		7.69	7.35	7.19	7.16	6.78	6.95	6.73

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
SMMID-00	7.50	7.57	8.16	8.42	8.41	8.84	8.36	8.00	8.30
SMMID-02	7.48	7.58	8.15	8.43	8.39	8.96	8.35	7.90	8.27
SMMID-04	7.68	7.51	7.34	7.63	8.29	8.65	6.86	6.94	6.53
SMMID-06				6.40	7.12	5.27	6.47	6.49	6.07

	30-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
SMCC-00	7.81	8.01	8.09	8.07	8.13	7.89	8.14	7.91	8.31
SMCC-01				8.14	8.11	7.86	8.18	7.89	8.31
SMCC-02	7.81	8.06	8.15	8.16	8.08	7.82	8.18	7.89	8.32
SMCC-02.3						7.85	8.18	0.00	
SMCC-02.4								7.89	
SMCC-03									8.33

STREAMS

Site	30-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
E. Inlet	8.70	8.37	8.46	8.23	8.42	8.47	9.15	8.66	8.74
N. Inlet	8.33	8.26	8.43	8.45	8.42	8.78	8.84	8.90	8.91
NF. Colorado	8.12	7.84	7.89	8.23	7.85	8.48	8.92	8.79	8.78
GPC*	7.87	8.18	9.21	7.68	9.42	9.03	5.59	4.85	5.43
Columbine Cr	7.84	7.64							

*GPC only September data are for flowing waters

Grand Lake Monitoring Program
pH, S.U.

SITE	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMid-00	7.50	7.61	7.77	8.44	8.00	7.29	8.82	8.39	7.98
GLMid-02	7.51	7.55	7.83	8.49	8.17	7.45	8.85	8.34	7.98
GLMid-04	7.29	7.50	7.69	8.09	8.04	7.85	8.82	8.04	7.71
GLMid-06	7.16	7.33	7.33	7.65	7.52	7.35	7.73	7.62	7.56
GLMid-08	7.02	7.12	7.04	7.35	6.82	7.03	7.26	7.09	7.43
GLMid-10	6.78	6.97	6.93	7.26	7.09	6.83	6.68	6.93	7.08
GLMid-18			6.80	7.14	6.81	6.76	6.63	6.79	6.88
GLMid-20	6.77	6.82	6.77	7.11	6.72	6.73	6.56	6.74	6.75
GLMid-38			6.81	7.03	6.72	6.81	6.73	6.73	6.72
GLMid-40	6.81	6.81	6.82	7.00	6.75	6.83	6.76	6.73	6.74

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLATW-00	7.49	7.41	7.39	8.32	7.94	7.84	8.86	8.33	8.04
GLATW-02	7.49	7.45	7.62	8.32	8.19	7.91	8.87	7.96	8.09
GLATW-04	7.47	7.39	7.64	7.90	7.84	7.77	8.42	7.76	8.06
GLATW-06	7.34	7.30	7.23	7.65	7.23	7.42	7.78	7.47	7.70
GLATW-08	7.17	7.19	7.08	7.42	7.04	6.93	7.43	7.22	7.50
GLATW-10	7.01	7.04	7.30	7.30	6.92	6.81	7.00	7.00	7.26

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLWEST-00	7.55	7.89	8.55	8.48	8.06	7.98	8.79	8.34	7.87
GLWEST-02	7.48	7.72	8.52	8.50	8.07	8.10	8.82	8.22	7.85
GLWEST-04	7.47	7.57	8.11	8.47	8.06	8.29	8.84	8.12	7.84
GLWEST-06	7.11	7.48	7.69	7.72	7.86	7.95	8.82	7.91	7.76
GLWEST-08	6.94	7.26	7.36	7.48	7.13	7.46	7.69	7.33	7.60
GLWEST-10	6.85		7.57	7.33	6.77	7.06	7.20	7.06	7.34

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
SMMID-00	7.37	7.22	8.30	8.84	8.77	9.17	8.98	7.97	7.78
SMMID-02	7.46	7.31	8.32	8.83	8.79	9.20	8.97	7.91	7.76
SMMID-04	7.39	7.31	7.69	8.03	8.63	9.02	7.81	7.44	7.43
SMMID-06			7.60	7.62	7.79	7.76	7.45	7.27	7.21

	30-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
SMCC-00	7.64	7.94	8.68	8.46	8.10	7.73	8.90	7.80	7.74
SMCC-01				8.45	8.07	7.76	8.92	7.81	7.78
SMCC-02	7.70	8.01	8.15	8.45	7.99	7.77	8.90	7.81	7.78
SMCC-02.3						7.78	8.91		
SMCC-02.4								7.82	
SMCC-03									7.80

STREAMS

Site	30-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
E. Inlet	7.50	7.14	7.61	7.72	7.60	7.14	7.16	7.43	7.83
N. Inlet	7.32	7.22	7.64	7.69	7.79	6.97	7.27	7.43	7.52
NF. Colorado	7.88	7.88	8.03	7.49	7.88	7.90	8.01	8.06	8.12
GPC*	8.03	8.18	8.74	8.60	9.01	9.13	7.22	6.99	7.02
Columbine Cr	7.84	7.65							

*GPC only September data are for flowing waters

Grand Lake Monitoring Program
Soluble Reactive Phosphorus, µg/L

SITE	30-Jul	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID-00		0.9	0.3	1.0	0.7	0.6	0.4	0.3	0.4	0.6
GLMID-02		0.9	0.9	0.5	0.7	0.6	0.4	0.4	0.5	0.9
GLMID-04		0.6	0.6	0.5	0.6	0.4	0.6	0.6	0.4	0.7
GLMID-06		0.4	0.8	0.5	0.7	0.4	0.6	1.0	0.4	1.0
GLMID-08		0.4	0.6	0.5	0.6	0.7	1.3	0.3	0.4	0.7
GLMID-18		1.0	1.1	0.7	1.2	0.9	0.6	0.6	0.5	0.9
GLMID-38		1.0	0.6	0.8	1.0	1.2	0.9	0.7	0.7	1.0
GLATW-00		0.7	1.1	1.3	0.9	0.7	0.7	0.3	0.5	0.7
GLATW-04		0.9	0.9	0.7	0.6	0.6	0.4	0.6	0.5	0.9
GLATW-08		0.6	0.6	0.7	0.6	0.4	0.4	0.3	0.4	0.7
GLWEST-00		0.9	0.6	0.8	0.6	0.6	0.4	0.4	0.5	0.9
GLWEST-04		0.7	0.3	0.5	0.4	0.6	0.4	0.6	0.5	0.9
GLWEST-08		0.4	0.6	0.7	0.7	0.4	0.4	0.4	0.5	0.9
SMMID-00		1.2	0.9	2.3	1.3	1.0	0.6	0.7	0.8	2.1
SMMID-02		1.3	1.1	1.6	1.0	0.7	0.6	0.7	0.8	1.8
SMMID-04				1.3	0.9	0.9	0.7	1.0	1.1	2.1
SMCC	1.0		0.9	1.4	0.9	0.6	0.4	1.0	0.7	1.5
N. INLET	3.9		1.7	0.8	0.9	0.3	0.9	0.7	0.8	1.3
E. INLET	1.5		0.9	0.7	0.7	0.9	0.9	1.2	1.3	0.9
N.F. CO	2.3		1.4	1.4	1.5	1.2	1.2	1.6	1.3	2.1
GPC*	4.3		2.7	1.3	1.6	1.8	0.7	8.3	8.2	9.0
Col. Cr	5.1		4.6							

Grand Lake Monitoring Program
Total Soluble Phosphorus, µg/L

SITE	30-Jul	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID-00		4.0	3.8	4.4	4.5	2.8	2.3	4.2	4.8	5.1
GLMID-02		3.9	4.1	3.9	4.4	2.7	2.8	3.9	5.0	5.3
GLMID-04		3.4	3.8	3.2	4.6	3.3	2.8	4.5	4.7	5.1
GLMID-06		3.4	4.1	3.4	3.7	3.5	2.6	4.7	4.7	5.1
GLMID-08		3.4	3.4	3.2	3.5	3.7	2.9	2.9	3.9	4.6
GLMID-18		4.0	4.1	4.0	4.7	5.1	3.1	3.2	4.2	3.9
GLMID-38		4.4	4.3	4.0	4.5	5.1	4.4	3.5	4.4	3.8
GLATW-00		3.7	3.8	4.7	4.5	3.2	1.9	3.5	5.7	5.1
GLATW-04		4.2	4.3	3.5	3.5	3.3	2.1	4.0	5.3	5.1
GLATW-08		3.7	3.6	3.5	3.9	3.5	2.4	2.9	4.2	4.6
GLWEST-00		4.0	5.3	4.7	5.0	4.6	2.4	4.2	5.2	5.3
GLWEST-04		3.9	3.8	3.9	4.2	3.7	2.1	4.2	5.2	5.6
GLWEST-08		4.4	3.9	3.7	3.9	4.6	2.9	3.4	4.4	5.1
SMMID-00		6.0	6.4	6.3	6.0	6.3	3.9	4.7	6.0	7.7
SMMID-02		5.8	6.1	5.7	5.5	6.4	4.2	4.5	5.7	7.7
SMMID-04				5.7	5.2	6.6	4.2	4.5	6.0	6.4
SMCC	6.3		6.2	5.8	4.8	4.5	2.1	5.0	6.3	6.4
N. INLET	7.6		4.1	3.5	3.7	4.1	3.1	3.0	4.7	3.6
E. INLET	4.4		5.4	3.9	4.2	4.6	3.9	3.9	4.4	4.1
N.F. CO	5.3		4.3	4.2	5.0	5.0	3.2	3.0	4.2	4.1
GPC*	10.6		12.2	5.5	6.3	7.6	5.1	12.2	12.4	13.0
Col. Cr	11.1		11.5							

*GPC only September data are for flowing waters

Grand Lake Monitoring Program
Total Particulate Phosphorus, µg/L

SITE	30-Jul	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID-00		4.8	4.4	5.9	6.0	6.3	5.1	8.0	6.6	7.2
GLMID-02		5.6	5.3	5.6	6.6	6.9	5.0	7.6	10.9	7.2
GLMID-04		4.9	4.0	4.3	5.5	7.3	5.5	8.0	8.8	7.1
GLMID-06		4.2	3.5	4.0	4.7	5.7	5.8	8.2	7.9	6.8
GLMID-08		3.8	3.2	3.2	4.6	4.5	4.6	5.3	8.0	6.3
GLMID-18		2.7	2.0	1.8	1.8	1.9	1.6	1.7	1.6	2.1
GLMID-38		1.9	1.8	1.4	1.8	1.5	1.5	1.3	1.3	1.4
GLATW-00		4.9	4.0	6.1	6.1	5.8	5.2	6.9	6.9	5.8
GLATW-04		4.8	2.1	4.7	5.2	7.0	5.0	7.6	7.5	5.9
GLATW-08		4.5	2.7	2.5	3.3	4.2	4.3	5.6	6.3	5.8
GLWEST-00		5.0	6.5	6.7	7.7	4.8	5.6	7.4	7.1	8.8
GLWEST-04		5.4	5.9	7.5	7.5	5.7	6.6	8.3	9.0	6.0
GLWEST-08		3.9	7.6	5.5	5.0	5.7	5.1	7.5	8.4	6.1
SMMID-00		7.5	9.9	10.0	9.4	11.7	8.7	10.7	8.2	8.6
SMMID-02		8.0	9.4	8.6	9.7	10.3	8.9	10.6	8.2	8.5
SMMID-04				11.8	10.1	10.7	9.9	11.6	9.1	6.1
SMCC	9.4		9.1	9.5	7.2	5.1	6.2	10.7	8.7	5.4
N. INLET	1.7		1.5	1.4	2.8	1.9	1.6	1.3	1.7	1.2
E. INLET	2.1		2.7	1.4	1.9	1.7	1.7	1.3	1.3	1.2
N.F. CO	3.0		3.0	1.8	2.0	2.4	2.2	1.4	1.5	2.3
GPC*	12.7		11.1	9.6	8.8	10.3	9.7	4.2	4.1	3.9
Col. Cr	12.2		6.1							

Grand Lake Monitoring Program
Total Phosphorus, µg/L

SITE	30-Jul	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID-00		8.8	8.2	10.2	10.5	9.1	7.3	12.2	11.4	12.3
GLMID-02		9.5	9.4	9.5	10.9	9.6	7.7	11.5	15.9	12.4
GLMID-04		8.2	7.8	7.5	10.1	10.6	8.3	12.6	13.5	12.1
GLMID-06		7.6	7.6	7.4	8.4	9.2	8.4	12.9	12.5	11.8
GLMID-08		7.2	6.6	6.4	8.1	8.1	7.5	8.2	11.9	10.9
GLMID-18		6.7	6.1	5.8	6.5	7.0	4.7	4.9	5.8	6.0
GLMID-38		6.3	6.1	5.4	6.3	6.6	5.9	4.9	5.7	5.2
GLATW-00		8.6	7.7	10.8	10.7	9.0	7.1	10.4	12.6	10.9
GLATW-04		9.0	6.4	8.2	8.7	10.3	7.1	11.7	12.8	11.0
GLATW-08		8.2	6.3	6.0	7.1	7.7	6.7	8.5	10.5	10.4
GLWEST-00		9.0	11.8	11.3	12.7	9.5	8.0	11.6	12.2	14.1
GLWEST-04		9.3	9.7	11.4	11.7	9.3	8.7	12.5	14.2	11.6
GLWEST-08		8.2	11.5	9.2	8.9	10.3	8.0	10.8	12.7	11.2
SMMID-00		13.5	16.4	16.3	15.4	17.9	12.6	15.4	14.2	16.3
SMMID-02		13.8	15.4	14.3	15.2	16.8	13.1	15.1	13.9	16.2
SMMID-04				17.4	15.2	17.3	14.2	16.1	15.1	12.5
SMCC	15.7		15.3	15.3	12.1	9.6	8.3	15.7	15.0	11.8
N. INLET	9.3		5.6	5.0	6.5	6.1	4.7	4.4	6.4	4.8
E. INLET	6.5		8.1	5.2	6.1	6.4	5.6	5.2	5.6	5.3
N.F. CO	8.3		7.2	6.0	7.0	7.3	5.4	4.5	5.7	6.4
GPC*	23.3		23.2	15.1	15.1	17.9	14.7	16.4	16.5	16.9
Col. Cr	23.3		17.6							

*GPC only September data are for flowing waters

Grand Lake Monitoring Program
Ammonia-Nitrogen, µg/L

SITE	30-Jul	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID-00		2.7	4.9	5.3	5.0	6.9	4.0	5.9	6.1	5.6
GLMID-02		3.1	3.8	4.4	5.1	6.4	4.0	5.4	8.2	5.9
GLMID-04		3.8	5.1	6.3	5.7	6.6	4.4	5.8	12.0	6.4
GLMID-06		3.7	4.2	4.9	6.4	5.7	5.2	7.6	19.8	11.1
GLMID-08		4.7	4.4	5.0	6.0	6.4	8.5	14.3	21.5	13.4
GLMID-18		9.1	8.7	5.6	5.6	6.8	5.5	6.9	3.0	7.7
GLMID-38		3.7	3.9	3.4	4.8	4.6	3.3	5.1	1.3	1.9
GLATW-00		5.2	3.4	3.4	4.4	4.7	3.0	6.0	6.7	3.7
GLATW-04		6.1	4.9	3.8	5.7	5.2	4.5	5.5	18.0	4.3
GLATW-08		6.4	4.2	4.8	6.2	8.8	10.5	10.3	19.9	11.6
GLWEST-00		4.1	4.4	3.8	4.2	5.2	3.4	6.6	10.4	6.7
GLWEST-04		7.4	3.5	3.5	4.7	5.3	3.4	6.2	10.0	5.2
GLWEST-08		7.0	3.3	4.8	6.2	7.7	6.4	10.2	17.0	8.3
SMMID-00		7.3	9.3	6.5	5.2	6.6	3.1	7.8	15.2	2.9
SMMID-02		3.4	3.8	3.9	4.4	5.2	3.1	8.5	15.7	2.8
SMMID-04				4.6	4.6	4.4	6.3	5.8	10.5	3.4
SMCC	3.1		3.7	3.1	4.8	5.1	3.2	6.7	7.7	4.9
N. INLET	4.6		5.0	5.2	5.5	4.1	3.0	4.3	1.9	3.4
E. INLET	4.6		4.6	4.1	4.7	6.2	5.9	7.0	2.6	3.6
N.F. CO	5.9		3.1	3.1	4.0	4.4	2.5	4.4	0.3	2.4
GPC*	5.5		4.4	3.4	4.2	3.3	3.1	6.3	1.2	3.6
Col. Cr	4.8		2.7							

Grand Lake Monitoring Program
Nitrate-Nitrogen, µg/L

SITE	30-Jul	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID-00		0	0	0	0	0	0	20	2	0
GLMID-02		0	0	0	0	0	6	26	4	0
GLMID-04		0	0	0	0	0	0	0	7	0
GLMID-06		0	2	0	2	3	8	5	3	3
GLMID-08		3	11	5	0	0	0	0	13	8
GLMID-18		27	36	32	30	36	30	30	42	29
GLMID-38		71	75	70	64	80	82	80	81	88
GLATW-00		0	0	0	0	0	0	0	0	0
GLATW-04		0	0	3	0	0	0	0	2	0
GLATW-08		0	8	5	0	2	0	0	3	4
GLWEST-00		12	0	0	0	0	0	0	4	0
GLWEST-04		19	0	0	0	0	0	0	3	0
GLWEST-08		10	0	0	0	3	0	5	3	3
SMMID-00		3	2	0	0	2	0	3	10	0
SMMID-02		0	0	0	0	0	0	3	10	19
SMMID-04				0	0	0	4	22	30	32
SMCC	3		0	0	0	0	0	3	9	0
N. INLET	24		19	12	7	15	11	12	18	20
E. INLET	18		13	11	10	17	18	10	10	11
N.F. CO	11		0	0	2	0	0	20	0	0
GPC*	16		4	0	0	0	0	72	77	76
Col. Cr	1		0							

*GPC only September data are for flowing waters

Grand Lake Monitoring Program
Particulate N, µg/L

SITE	30-Jul	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID-00		82	78	106	117	124	113	184	154	128
GLMID-02		84	90	108	123	120	101	188	158	134
GLMID-04		66	62	83	119	122	121	189	148	122
GLMID-06		58	57	73	81	94	111	102	142	127
GLMID-08		49	59	60	72	68	61	75	98	102
GLMID-18		38	44	35	26	29	30	28	28	33
GLMID-38		16	31	21	27	18	22	19	24	14
GLATW-00		97	76	114	130	108	103	174	152	139
GLATW-04		76	84	97	111	126	117	178	157	125
GLATW-08		62	82	44	45	58	60	85	99	116
GLWEST-00		69	183	118	137	97	118	194	136	141
GLWEST-04		86	99	117	134	121	123	180	157	128
GLWEST-08		51	81	80	79	78	85	133	102	133
SMMID-00		102	174	154	203	210	242	269	176	141
SMMID-02		95	178	149	184	219	262	268	168	141
SMMID-04				117	171	223	214	183	146	68
SMCC	124		113	142	115	109	119	240	136	121
N. INLET	28		30	23	42	30	36	22	34	27
E. INLET	26		47	30	36	23	32	20	27	24
N.F. CO	33		126	30	38	31	28	22	22	31
GPC*	155		86	145	183	208	258	33	40	35
Col. Cr	83		184							

Grand Lake Monitoring Program
Secchi Depth, m

SITE	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID	3.10	3.50	3.20	3.00	3.20	2.90	2.00	2.10	2.70
GLWEST	2.40	2.40	2.90	2.80	3.10	3.00	2.10	2.60	2.70
SMCC	1.5**	1.90	1.90	2.60	1.80	2.70	1.90	2.50	2.60
GLATW	3.00	3.20	3.30	2.80	3.10	3.10	2.30	2.30	2.60
SMMID	2.20	2.30	2.30	2.20	1.90	1.80	1.70	2.70	2.70

*GPC only September data are for flowing waters
**Taken 30-Jul-09

Grand Lake Monitoring Program
Dissolved Organic Carbon, mg/L

SITE	30-Jul	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID-00		3.19	3.32	3.33	3.37	3.12	3.49	3.68	3.73	3.81
GLMID-02		3.37	3.39	3.43	3.44	3.39	3.52	3.84	3.82	3.88
GLMID-04		3.26	3.14	3.26	3.14	3.33	3.44	3.69	3.83	3.98
GLMID-06		3.06	3.08	3.05	3.05	3.09	3.31	3.35	3.49	3.84
GLMID-08		3.26	3.61	3.28	3.33	3.18	3.41	3.05	3.27	4.06
GLMID-18		4.05	4.41	4.34	4.21	4.30	4.35	4.21	4.29	4.24
GLMID-38		4.95	4.79	4.77	4.35	4.78	4.68	4.45	4.40	4.47
GLATW-00		3.41	3.43	3.52	3.65	3.32	3.42	3.58	3.90	3.97
GLATW-04		3.46	3.44	3.42	3.56	3.39	3.27	3.58	3.72	4.12
GLATW-08		3.41	3.58	3.47	3.24	3.30	3.46	3.06	3.12	4.00
GLWEST-00		3.61	3.91	3.83	3.67	3.38	3.48	3.60	3.86	4.11
GLWEST-04		3.59	3.29	3.47	3.65	3.44	3.47	3.70	3.94	4.06
GLWEST-08		3.71	3.34	3.20	3.23	3.86	3.61	3.50	3.35	4.02
SMMID-00		4.93	4.58	4.39	4.63	4.13	4.35	4.63	4.40	4.06
SMMID-02		4.42	4.25	4.34	4.44	4.33	4.41	4.49	4.42	3.94
SMMID-04				4.13	4.43	4.09	4.14	4.18	4.37	3.94
SMCC	4.51		4.33	4.37	4.93	3.32	3.38	4.62	4.49	4.18
N. INLET	2.60		2.27	1.92	2.41	2.19	2.18	2.00	1.91	2.10
E. INLET	2.30		1.93	1.84	2.27	1.95	1.91	2.19	1.90	2.05
N.F. CO	2.90		2.59	2.15	2.26	1.79	1.76	1.68	1.76	2.33
GPC*	4.99		4.71	4.41	4.65	4.45	4.76	4.15	3.90	4.08
Col. Cr	5.36		4.57							

Grand Lake Monitoring Program
Chlorophyll-a, µg/L

SITE	30-Jul	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID-00		3.91	2.92	5.37	5.85	4.71	4.36	9.82	6.79	7.53
GLMID-02		4.01	3.23	4.33	5.75	4.02	4.33	10.93	8.29	7.74
GLMID-04		3.68	2.55	3.14	5.03	3.99	5.68	10.55	7.84	7.98
GLMID-06		2.96	2.27	1.60	3.83	3.82	7.05	7.23	6.58	7.56
GLMID-08		2.66	1.47	1.04	3.40	2.97	2.78	2.99	4.40	5.48
GLMID-18		1.21	0.67	0.98	0.77	0.65	0.57	0.36	0.68	0.82
GLMID-38		0.44	0.30	0.31	0.59	0.30	0.39	0.19	0.21	0.22
GLATW-00		2.96	3.11	3.46	5.64	4.85	4.20	8.64	7.58	6.73
GLATW-04		3.41	2.60	2.33	5.24	5.32	5.07	10.62	8.52	7.44
GLATW-08		2.84	1.41	1.28	2.07	2.34	2.04	6.33	4.70	6.51
GLWEST-00		3.16	3.40	4.45	4.92	4.21	4.43	9.79	7.52	6.31
GLWEST-04		3.24	3.16	3.58	5.73	4.17	5.51	10.76	7.52	6.61
GLWEST-08		2.60	2.71	5.09	4.47	4.50	4.74	7.81	4.89	6.29
SMMID-00		2.39	3.87	7.48	9.87	8.58	13.36	7.58	6.50	7.52
SMMID-02		3.54	4.49	7.01	9.76	9.31	13.35	10.85	3.53	9.49
SMMID-04				5.29	7.30	9.95	12.24	9.29	6.94	3.79
SMCC	3.76		4.31	7.37	5.01	4.22	4.85	11.99	6.20	5.30
N. INLET	0.92		0.84	0.79	1.27	0.89	1.10	0.86	0.92	0.75
E. INLET	0.57		0.93	0.63	1.24	0.38	0.53	0.41	0.53	0.38
N.F. CO	0.98		3.77	0.78	1.24	0.80	0.62	0.62	0.62	0.92
GPC*	6.27		0.78	3.67	9.03	8.64	7.84	0.47	0.50	0.62
Col. Cr	5.13		1.58							

*GPC only September data are for flowing waters

Grand Lake Monitoring Program
TSS, mg/L

SITE	30-Jul	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID-00		1.32	1.57	1.65	1.76	1.92	1.96	3.29	2.62	2.24
GLMID-02		0.92	1.41	1.77	1.45	2.10	1.55	3.09	2.66	2.17
GLMID-04		1.10	1.02	1.69	1.57	2.12	1.47	3.14	2.82	2.05
GLMID-06		1.03	0.81	1.20	1.15	1.48	1.54	1.92	2.41	1.92
GLMID-08		0.80	0.78	0.88	0.99	1.01	0.94	1.20	1.75	1.75
GLMID-18		0.58	0.40	0.60	0.17	0.17	0.47	0.47	0.35	0.64
GLMID-38		0.21	0.39	0.37	0.08	0.25	0.32	0.13	0.29	0.37
GLATW-00		1.37	1.04	1.67	1.57	1.63	1.46	2.82	2.45	2.70
GLATW-04		1.18	1.72	1.76	1.53	1.83	1.65	2.58	2.52	2.09
GLATW-08		0.56	0.64	0.74	0.58	0.82	0.81	1.26	1.85	1.97
GLWEST-00		1.33	2.25	2.46	2.37	1.67	1.85	2.53	2.58	2.31
GLWEST-04		1.18	0.97	2.52	1.90	1.54	1.92	3.06	2.59	2.42
GLWEST-08		0.74	3.65	1.36	1.04	1.23	1.20	2.35	2.14	2.41
SMMID-00		2.28	2.86	2.68	3.33	3.75	3.92	4.17	2.82	2.18
SMMID-02		2.07	2.42	2.07	2.91	3.53	3.42	4.22	2.53	2.20
SMMID-04				2.67	2.59	3.76	3.54	3.48	2.34	1.71
SMCC	2.87		4.23	3.71	1.95	1.74	2.71	4.07	2.54	1.80
N. INLET	0.08		0.66	0.41	0.21	0.54	0.88	0.31	0.70	0.55
E. INLET	0.28		1.01	0.51	0.10	0.26	0.68	0.08	0.10	0.31
N.F. CO	1.36		1.70	0.99	3.98	0.78	1.15	0.35	0.42	1.10
GPC*	3.96		2.79	3.09	2.72	4.46	4.70	1.29	1.18	0.93
Col. Cr	6.07		2.62							

Grand Lake Monitoring Program
Turbidity, NTU

SITE	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMid-00		0.70	1.30	1.20	1.40	1.00	3.10	3.00	2.10
GLMid-02		1.00	1.30	1.30	1.50	1.00	3.10	3.00	2.00
GLMid-04		1.20	1.10	1.20	1.50	1.30	3.30	2.90	2.00
GLMid-06		0.80	1.20	0.40	1.00	0.60	1.30	2.20	1.80
GLMid-08		0.90	0.70	0.30	1.00	0.40	0.60	0.90	1.50
GLMid-10		0.90		0.20	0.70	0.00	0.30	0.60	0.90
GLMid-18		0.80	0.40	0.20	0.60	0.40	0.40	0.40	0.40
GLMid-20				0.30	0.60	0.50	0.60	0.50	0.50
GLMid-38		0.50	1.10	0.40	0.80	0.70	0.70	0.60	0.60
GLMid-40				0.50	0.90	0.70	0.80	0.70	0.70

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLATW-00		0.90	1.30	1.40	1.40	1.40	3.50	2.80	2.10
GLATW-02		0.80	1.10	1.30	1.60	1.30	3.20	2.40	1.90
GLATW-04		0.70	0.60	0.80	1.60	1.30	2.80	2.70	1.80
GLATW-06		0.60		0.30	0.80	0.60	0.80	2.20	1.70
GLATW-08		0.50		0.30	0.60	0.50	0.60	1.40	1.60
GLATW-10		0.50		0.30	0.70	0.50	0.60	0.60	0.90

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLWEST-00		1.60	1.80	1.40	1.60	1.40	3.00	2.80	2.60
GLWEST-02		1.20		1.40	1.50	1.40	3.00	2.80	2.60
GLWEST-04		0.80	1.80	1.40	1.70	1.70	3.10	2.70	2.30
GLWEST-06		1.15		0.50	1.50	1.50	4.00	2.50	2.10
GLWEST-08		1.50	0.60	0.30	0.90	0.90	1.10	0.80	1.90
GLWEST-10		1.50		0.40	0.90	0.70	0.60	0.70	1.20

	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
SMMID-00		2.30	2.30	2.90	4.40	4.70	5.20	3.20	2.20
SMMID-02		1.90	2.20	2.80	4.70	5.40	5.90	3.10	2.30
SMMID-04		1.90	2.10	2.60	4.70	5.10	3.60	2.10	1.60
SMMID-06				2.40	4.50	5.30	4.20	2.80	1.90

	30-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
SMCC-00		2.50	2.80	1.50	1.70	1.90	5.60	3.00	2.60
SMCC-01				1.60	1.90	1.90	5.50	2.90	2.30
SMCC-02		2.50		1.70	2.00	2.30	5.30	3.00	2.50
SMCC-02.3						2.00	5.70		
SMCC-02.4								3.00	
SMCC-03									2.30

STREAMS

Site	30-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
E. Inlet		0.70	0.40	0.30	0.50	0.40	0.40	0.30	0.40
N. Inlet		0.50	0.40	0.40	0.50	0.50	0.50	0.70	0.40
NF. Colorado		1.40	0.80	0.40	0.90	1.10	1.10	0.60	1.40
GPC*		1.50	2.50	2.30	5.20	6.70	1.40	1.20	1.20
Columbine Cr		1.80							

*GPC only September data are for flowing waters

Grand Lake Monitoring Program
Irradiance, $\mu E/m^2/s$

Site	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep**
GLMid-00	1550	1600	1500	184	1550	96	267.2	305.1	59.3
GLMid-01	820	650	800			46	77.6	96.6	30.4
GLMid-02	440	320	400	51.5	400	20.5	25.6	32.06	19.6
GLMid-03	215	155	190			11.8	9.2	13.5	12.9
GLMid-04	110	79	100	16.3	140	6.4	3.9	5.6	9.4
GLMid-05	57	42	60			3.1	1.4	2.5	7.8
GLMid-06	31	23.5	30	4.55	70	1.6		1.1	7
GLMid-07	18	13.5	16			0.84		0.49	6.6
GLMid-08	10.5	7.7	10	1.29		0.46		0.25	6.5
GLMid-09	6.7	4.5	5			0.25		0.12	3.4
GLMid-10	4.1	2.3	2.5	0.5					
GLMid-11	2.8	1.55	1.3						
GLMid-12	2.4	0.9	0.6	0.17					
GLMid-13	1.2	0.75							
GLMid-14	0.55	0.6		0.05					
GLMid-15	0.4	0.5							
GLMid-16	0.2	0.4							
GLMid-17	0.15	0.35							
GLMid-18	0.05	0.3							
GLMid-19	0.02	0.3							

Site	31-Jul**	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep**
GLATW-00	420	1550	1550	315	1500	399.4	395.8	424.2	40.9
GLATW-01	84	740	800			175.3	139	149.4	17.7
GLATW-02	76	380	360	86	425	89.5	46.5	50.6	4.9
GLATW-03	70	195	210			49	16.6	19.9	0.34
GLATW-04	44	105	120	23.1	190	23.4	7.2	8.2	
GLATW-05	33	56	60			15.5	2.7	3.5	
GLATW-06	17	34	35	8.7		5.7	1.5	1.6	
GLATW-07	12	19	21			2.9	1.1	0.76	
GLATW-08	8.6	11	12	2.61		1.5		0.35	
GLATW-09	6.1	6.1	6			0.88		0.19	
GLATW-10	3.9	3.7	3.5	0.8					
GLATW-11	2.6	1.9	1.7						
GLATW-12				0.16					

Site	31-Jul**	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep**
GLWEST-00	195	1200	1600	154	1500	576.3	526.2	513.8	159.4
GLWEST-01	79	500	650			272.2	195.5	204.9	84.6
GLWEST-02	47	170	300	34.5	400	112.7	72.1	75.1	49.5
GLWEST-03	175	58	140			53.91	26.9	30.4	27.6
GLWEST-04	105	41	60	10.1	100	24.91	10.8	13	18.4
GLWEST-05	75	23.5	28			10.8	4.1	5.9	12.9
GLWEST-06	9.2	15	14	2.75	42	5.24	1.7	2.5	10.2
GLWEST-07	3.9	7.3	4.5			2.56	0.95	1.1	8.7
GLWEST-08	2.2	4.2	1.4	1.05	25	1.29		0.56	6.2
GLWEST-09	1.8	1.9	0.5			0.63		0.34	4.2
GLWEST-10	1.1	1.4		0.49					
GLWEST-11									
GLWEST-12				0.2					

**Surface irradiance varied over profile

Grand Lake Monitoring Program
Irradiance, $\mu E/m^2/s$

Site	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep**
SMMID-00	440	1100	1450	185	1750	814	701.8	770.3	259.6
SMMID-01	195	380	525	72	700	270.2	260.7	306.1	133.5
SMMID-02	73	145	200	30	265	73.2	76.6	114.1	29.9
SMMID-03	37	61	87	13.1	100	24.7	24.1	48.3	30.8
SMMID-04	32	26.5	36	4.75	35	7.9	9.4	22.6	18.5
SMMID-05				1.66	17	2.8	3.8	10.9	11
SMMID-06				0.66		1.1	1.9		8.2

Site	31-Jul**	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep**
SMCC-00	520	1200	1300	145	1550	665.3	551.7	529.8	281.2
SMCC-00.5						371.6	335.1	376.2	192.3
SMCC-01	195	405	450	59	740	178.2	177.9	228.9	128.1
SMCC-01.5						125.1	96.5	139.2	85.9
SMCC-02	42	160	180	31	350	105.3	61	88.9	52.4
SMCC-02.5						42.7	35.5	56.2	45.4
SMCC-03								35.1	26.1

**Surface irradiance varied over profile

Grand Lake Monitoring Program
Particulate Carbon, µg/L

SITE	30-Jul	31-Jul	3-Aug	10-Aug	14-Aug	21-Aug	26-Aug	2-Sep	9-Sep	16-Sep
GLMID-00		465	443	615	680	667	630	1050	849	714
GLMID-02		488	478	606	683	671	573	1040	835	738
GLMID-04		363	345	447	629	676	657	1025	807	690
GLMID-06		304	284	399	415	495	565	533	741	694
GLMID-08		237	286	291	383	338	328	339	510	524
GLMID-18		185	203	153	112	128	121	128	109	175
GLMID-38		86	125	89	119	77	71	94	93	73
GLATW-00		537	470	703	710	612	542	993	835	795
GLATW-04		453	453	561	587	680	602	994	835	700
GLATW-08		343	464	207	235	284	306	433	516	636
GLWEST-00		427	992	657	751	559	642	1056	765	768
GLWEST-04		539	484	616	697	640	688	1008	853	709
GLWEST-08		347	331	405	415	396	422	733	550	706
SMMID-00		645	972	867	1106	1167	1371	1514	955	783
SMMID-02		646	962	797	968	1173	1414	1471	881	753
SMMID-04				647	886	1167	1113	1028	763	378
SMCC	822		665	792	645	619	686	1331	740	639
N. INLET	218		212	143	347	168	222	112	222	147
E. INLET	202		271	170	266	127	164	122	112	122
N.F. CO	247		675	184	320	152	168	112	134	213
GPC*	1066		402	835	1076	1157	1393	217	222	211
Col. Cr	759		978							

*GPC only September data are for flowing waters

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLM-00 31-Jul	GLM-02 31-Jul	GLM-04 31-Jul	GLM-06 31-Jul	GLM-08 31-Jul	GLM-18 31-Jul	GLM-38 31-Jul	GLA-00 31-Jul	GLA-04 31-Jul	GLA-08 31-Jul	GLW-00 31-Jul
350	0.233	0.231	0.224	0.256	0.263	0.333	0.326	0.246	0.25	0.26	0.247
360	0.195	0.193	0.187	0.215	0.221	0.28	0.273	0.207	0.211	0.219	0.208
370	0.163	0.162	0.156	0.181	0.186	0.236	0.228	0.175	0.178	0.184	0.175
380	0.136	0.134	0.129	0.151	0.154	0.196	0.19	0.145	0.149	0.153	0.146
390	0.113	0.111	0.107	0.126	0.128	0.163	0.159	0.121	0.125	0.128	0.121
400	0.094	0.092	0.088	0.106	0.107	0.136	0.132	0.1	0.105	0.107	0.102
410	0.078	0.077	0.074	0.088	0.089	0.115	0.112	0.085	0.088	0.09	0.085
420	0.065	0.065	0.061	0.074	0.076	0.097	0.094	0.072	0.074	0.076	0.071
430	0.054	0.055	0.051	0.062	0.064	0.083	0.08	0.061	0.061	0.065	0.059
440	0.045	0.046	0.043	0.052	0.054	0.071	0.068	0.052	0.053	0.056	0.05
450	0.039	0.04	0.036	0.045	0.047	0.061	0.058	0.045	0.045	0.047	0.042
460	0.032	0.033	0.031	0.038	0.039	0.052	0.049	0.037	0.039	0.04	0.036
470	0.027	0.029	0.026	0.033	0.035	0.046	0.043	0.032	0.032	0.036	0.031
480	0.023	0.025	0.023	0.03	0.031	0.041	0.037	0.027	0.028	0.03	0.028
490	0.02	0.022	0.019	0.025	0.027	0.034	0.032	0.024	0.023	0.026	0.024
500	0.018	0.021	0.018	0.024	0.026	0.032	0.03	0.021	0.022	0.025	0.023
510	0.015	0.016	0.014	0.019	0.020	0.026	0.024	0.018	0.018	0.020	0.018
520	0.014	0.015	0.014	0.017	0.018	0.024	0.022	0.017	0.017	0.018	0.016
530	0.011	0.013	0.011	0.014	0.015	0.021	0.019	0.014	0.014	0.016	0.013
540	0.012	0.012	0.010	0.014	0.014	0.019	0.018	0.014	0.013	0.015	0.012
550	0.010	0.009	0.009	0.012	0.012	0.018	0.016	0.012	0.011	0.012	0.010
560	0.007	0.007	0.007	0.008	0.008	0.013	0.013	0.009	0.009	0.010	0.008
570	0.006	0.007	0.005	0.007	0.008	0.012	0.011	0.008	0.007	0.009	0.006
580	0.004	0.006	0.003	0.006	0.008	0.011	0.010	0.007	0.006	0.007	0.005
590	0.004	0.006	0.003	0.006	0.006	0.010	0.008	0.005	0.005	0.006	0.006
600	0.003	0.003	0.003	0.006	0.006	0.007	0.006	0.003	0.004	0.005	0.005
610	0.003	0.002	0.003	0.005	0.005	0.006	0.006	0.004	0.004	0.004	0.003
620	0.004	0.004	0.005	0.005	0.006	0.007	0.006	0.004	0.004	0.005	0.004
630	0.004	0.004	0.005	0.005	0.005	0.006	0.006	0.004	0.004	0.005	0.003
640	0.003	0.003	0.002	0.004	0.004	0.005	0.004	0.002	0.003	0.004	0.003
650	0.003	0.003	0.001	0.004	0.003	0.004	0.005	0.002	0.003	0.003	0.003
660	0.002	0.003	0.002	0.003	0.003	0.004	0.005	0.001	0.002	0.004	0.003
670	0.001	0.002	0.001	0.002	0.002	0.002	0.003	0.000	0.001	0.002	0.002
680	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
690	0.001	0.000	0.001	0.002	0.001	0.001	0.001	0.001	0.000	0.001	0.002
700	0.002	0.000	0.002	0.002	0.001	0.002	0.002	0.003	0.001	0.002	0.003

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLW-04 31-Jul	GLW-08 31-Jul	SMM-00 31-Jul	SMM-02 31-Jul	SMCC 31-Jul	N. INLET 30-Jul	E. INLET 30-Jul	NF CO. 30-Jul	GPC 30-Jul	Col Cr 30-Jul	GPC/F 30-Jul
350	0.248	0.268	0.266	0.262	0.267	0.191	0.181	0.189	0.267	0.36	0.265
360	0.208	0.225	0.224	0.22	0.224	0.161	0.153	0.159	0.224	0.302	0.222
370	0.175	0.191	0.189	0.184	0.188	0.137	0.127	0.135	0.189	0.253	0.185
380	0.145	0.158	0.157	0.152	0.155	0.113	0.107	0.113	0.156	0.209	0.153
390	0.12	0.131	0.13	0.127	0.128	0.094	0.09	0.094	0.129	0.173	0.126
400	0.1	0.11	0.108	0.105	0.107	0.079	0.076	0.08	0.108	0.146	0.104
410	0.084	0.091	0.09	0.088	0.088	0.066	0.064	0.066	0.089	0.122	0.086
420	0.071	0.077	0.075	0.074	0.074	0.056	0.054	0.056	0.075	0.102	0.072
430	0.061	0.064	0.064	0.063	0.063	0.048	0.046	0.047	0.062	0.085	0.061
440	0.051	0.055	0.053	0.052	0.052	0.041	0.039	0.038	0.051	0.071	0.051
450	0.044	0.047	0.045	0.045	0.044	0.035	0.033	0.033	0.043	0.06	0.043
460	0.037	0.039	0.037	0.037	0.037	0.029	0.029	0.028	0.036	0.051	0.035
470	0.032	0.035	0.033	0.033	0.033	0.026	0.024	0.023	0.031	0.043	0.031
480	0.028	0.031	0.029	0.027	0.028	0.023	0.019	0.02	0.028	0.035	0.026
490	0.024	0.026	0.024	0.023	0.024	0.02	0.017	0.016	0.023	0.03	0.022
500	0.023	0.026	0.024	0.022	0.024	0.02	0.016	0.016	0.023	0.027	0.021
510	0.018	0.019	0.018	0.017	0.018	0.014	0.013	0.013	0.016	0.023	0.016
520	0.016	0.017	0.016	0.016	0.016	0.013	0.012	0.011	0.015	0.020	0.015
530	0.014	0.015	0.013	0.013	0.013	0.011	0.011	0.009	0.012	0.018	0.013
540	0.013	0.014	0.012	0.012	0.012	0.010	0.010	0.009	0.011	0.016	0.012
550	0.011	0.011	0.010	0.010	0.010	0.009	0.008	0.008	0.009	0.015	0.010
560	0.009	0.009	0.008	0.008	0.008	0.007	0.006	0.005	0.006	0.011	0.007
570	0.008	0.008	0.006	0.007	0.007	0.006	0.005	0.004	0.005	0.009	0.006
580	0.006	0.007	0.006	0.006	0.006	0.005	0.005	0.002	0.004	0.007	0.005
590	0.006	0.006	0.005	0.005	0.005	0.004	0.004	0.002	0.005	0.006	0.004
600	0.005	0.005	0.004	0.003	0.004	0.003	0.003	0.002	0.003	0.005	0.003
610	0.004	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.005	0.002
620	0.004	0.004	0.003	0.004	0.003	0.003	0.003	0.002	0.001	0.005	0.003
630	0.004	0.005	0.003	0.004	0.004	0.003	0.003	0.002	0.000	0.005	0.003
640	0.002	0.004	0.001	0.002	0.003	0.002	0.003	0.001	0.000	0.003	0.002
650	0.001	0.004	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002
660	0.002	0.004	0.002	0.002	0.003	0.002	0.001	0.002	0.002	0.002	0.001
670	0.002	0.002	0.001	0.000	0.002	0.002	0.000	0.001	0.001	0.001	0.000
680	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
690	0.012	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
700	0.000	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.002	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLM-00 3-Aug	GLM-02 3-Aug	GLM-04 3-Aug	GLM-06 3-Aug	GLM-08 3-Aug	GLM-18 3-Aug	GLM-38 3-Aug	GLA-00 3-Aug	GLA-04 3-Aug	GLA-08 3-Aug	GLW-00 3-Aug
350	0.242	0.243	0.25	0.257	0.293	0.369	0.298	0.238	0.248	0.29	0.25
360	0.204	0.205	0.211	0.217	0.247	0.31	0.251	0.201	0.208	0.244	0.211
370	0.172	0.173	0.177	0.183	0.209	0.26	0.211	0.169	0.176	0.206	0.177
380	0.143	0.144	0.148	0.152	0.174	0.217	0.176	0.14	0.146	0.171	0.147
390	0.119	0.12	0.124	0.127	0.145	0.181	0.146	0.116	0.121	0.143	0.123
400	0.099	0.099	0.103	0.105	0.121	0.151	0.122	0.097	0.1	0.119	0.102
410	0.083	0.084	0.087	0.09	0.103	0.128	0.103	0.082	0.085	0.101	0.087
420	0.069	0.07	0.073	0.075	0.086	0.107	0.086	0.068	0.071	0.085	0.072
430	0.059	0.06	0.062	0.063	0.074	0.091	0.073	0.058	0.06	0.072	0.061
440	0.05	0.05	0.052	0.054	0.063	0.077	0.061	0.049	0.051	0.061	0.051
450	0.042	0.043	0.045	0.046	0.053	0.066	0.052	0.042	0.043	0.052	0.043
460	0.036	0.036	0.038	0.039	0.046	0.057	0.044	0.036	0.037	0.045	0.037
470	0.031	0.031	0.032	0.033	0.04	0.049	0.038	0.031	0.031	0.039	0.032
480	0.026	0.027	0.028	0.029	0.035	0.042	0.032	0.027	0.027	0.033	0.027
490	0.022	0.023	0.024	0.025	0.029	0.037	0.028	0.023	0.023	0.029	0.023
500	0.02	0.02	0.021	0.022	0.027	0.032	0.024	0.021	0.02	0.025	0.021
510	0.017	0.018	0.017	0.018	0.022	0.028	0.021	0.016	0.018	0.022	0.017
520	0.015	0.015	0.015	0.016	0.019	0.025	0.019	0.015	0.015	0.019	0.015
530	0.013	0.013	0.013	0.014	0.017	0.022	0.017	0.013	0.013	0.017	0.012
540	0.011	0.012	0.012	0.012	0.015	0.019	0.014	0.012	0.010	0.015	0.011
550	0.010	0.010	0.011	0.011	0.014	0.017	0.011	0.010	0.010	0.012	0.009
560	0.007	0.008	0.009	0.008	0.011	0.013	0.009	0.008	0.008	0.010	0.008
570	0.006	0.007	0.007	0.008	0.009	0.011	0.007	0.008	0.008	0.009	0.007
580	0.005	0.006	0.005	0.007	0.009	0.011	0.008	0.007	0.007	0.008	0.004
590	0.005	0.005	0.004	0.005	0.008	0.009	0.009	0.008	0.004	0.005	0.005
600	0.003	0.004	0.003	0.004	0.006	0.007	0.003	0.007	0.003	0.006	0.003
610	0.003	0.004	0.003	0.004	0.005	0.007	0.003	0.005	0.003	0.005	0.002
620	0.002	0.003	0.003	0.004	0.004	0.006	0.003	0.003	0.003	0.004	0.002
630	0.002	0.003	0.003	0.003	0.004	0.006	0.003	0.003	0.002	0.004	0.002
640	0.001	0.002	0.002	0.002	0.003	0.004	0.002	0.002	0.001	0.003	0.001
650	0.000	0.001	0.001	0.001	0.002	0.003	0.001	0.002	0.000	0.002	0.001
660	0.001	0.001	0.001	0.001	0.002	0.003	0.000	0.002	0.000	0.002	0.001
670	0.000	0.001	0.001	0.001	0.001	0.002	0.000	0.001	0.000	0.001	0.001
680	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.000	0.001	0.000
690	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.000	0.001	0.000
700	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.000	0.001	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLW-04 3-Aug	GLW-08 3-Aug	SMM-00 3-Aug	SMM-02 3-Aug	SMCC 3-Aug	N. INLET 3-Aug	E. INLET 3-Aug	NF CO. 3-Aug	GPC 3-Aug	Col Cr 3-Aug	SMM-00/F 3-Aug
350	0.235	0.252	0.271	0.268	0.267	0.16	0.151	0.174	0.266	0.316	0.273
360	0.197	0.213	0.229	0.227	0.225	0.135	0.126	0.147	0.224	0.268	0.231
370	0.166	0.18	0.194	0.193	0.189	0.113	0.106	0.125	0.188	0.225	0.196
380	0.138	0.15	0.161	0.16	0.157	0.094	0.089	0.103	0.157	0.187	0.162
390	0.115	0.124	0.134	0.133	0.13	0.078	0.074	0.086	0.131	0.155	0.134
400	0.096	0.104	0.112	0.111	0.108	0.065	0.061	0.071	0.109	0.129	0.112
410	0.081	0.088	0.095	0.094	0.092	0.055	0.052	0.061	0.092	0.108	0.095
420	0.067	0.074	0.079	0.078	0.076	0.045	0.044	0.05	0.076	0.09	0.079
430	0.057	0.062	0.066	0.066	0.064	0.038	0.038	0.042	0.064	0.075	0.067
440	0.048	0.053	0.056	0.056	0.054	0.032	0.032	0.035	0.053	0.062	0.056
450	0.041	0.045	0.047	0.047	0.045	0.027	0.027	0.029	0.044	0.052	0.047
460	0.035	0.039	0.04	0.04	0.038	0.023	0.023	0.025	0.038	0.044	0.04
470	0.03	0.034	0.034	0.034	0.032	0.02	0.02	0.021	0.032	0.037	0.033
480	0.026	0.028	0.03	0.029	0.027	0.017	0.017	0.018	0.027	0.032	0.029
490	0.022	0.025	0.025	0.025	0.024	0.014	0.014	0.015	0.023	0.027	0.025
500	0.02	0.021	0.023	0.022	0.021	0.012	0.013	0.013	0.02	0.023	0.022
510	0.017	0.018	0.017	0.018	0.018	0.010	0.010	0.011	0.017	0.020	0.019
520	0.015	0.017	0.016	0.016	0.016	0.009	0.009	0.010	0.015	0.018	0.016
530	0.013	0.014	0.014	0.014	0.014	0.008	0.008	0.009	0.013	0.015	0.014
540	0.011	0.012	0.012	0.012	0.012	0.006	0.006	0.007	0.011	0.013	0.012
550	0.010	0.011	0.010	0.011	0.010	0.006	0.006	0.006	0.009	0.011	0.010
560	0.008	0.009	0.009	0.008	0.008	0.005	0.005	0.004	0.007	0.009	0.008
570	0.007	0.007	0.007	0.007	0.006	0.003	0.004	0.003	0.006	0.007	0.007
580	0.006	0.007	0.006	0.007	0.006	0.003	0.003	0.003	0.006	0.006	0.006
590	0.005	0.006	0.005	0.004	0.005	0.001	0.002	0.002	0.005	0.005	0.005
600	0.004	0.004	0.004	0.003	0.003	0.000	0.002	0.001	0.003	0.003	0.003
610	0.004	0.003	0.003	0.003	0.003	0.001	0.001	0.001	0.003	0.003	0.003
620	0.003	0.003	0.003	0.003	0.002	0.001	0.001	0.001	0.002	0.003	0.003
630	0.003	0.003	0.002	0.002	0.002	0.000	0.001	0.001	0.002	0.002	0.002
640	0.002	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.001	0.001	0.001
650	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000
660	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000
670	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
680	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
690	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLM-00 10-Aug	GLM-02 10-Aug	GLM-04 10-Aug	GLM-06 10-Aug	GLM-08 10-Aug	GLM-18 10-Aug	GLM-38 10-Aug	GLA-00 10-Aug	GLA-04 10-Aug	GLA-08 10-Aug	GLW-00 10-Aug
350	0.227	0.227	0.229	0.24	0.271	0.366	0.315	0.229	0.223	0.295	0.233
360	0.192	0.192	0.193	0.202	0.228	0.307	0.265	0.192	0.188	0.249	0.197
370	0.162	0.162	0.163	0.17	0.191	0.258	0.222	0.161	0.158	0.209	0.165
380	0.135	0.135	0.135	0.141	0.159	0.215	0.185	0.134	0.131	0.174	0.136
390	0.112	0.112	0.112	0.118	0.133	0.18	0.154	0.112	0.11	0.146	0.114
400	0.093	0.093	0.094	0.099	0.111	0.151	0.129	0.093	0.091	0.122	0.095
410	0.078	0.078	0.078	0.083	0.093	0.127	0.108	0.078	0.077	0.102	0.079
420	0.066	0.066	0.066	0.069	0.078	0.106	0.091	0.065	0.064	0.086	0.066
430	0.055	0.055	0.056	0.059	0.067	0.091	0.077	0.055	0.054	0.073	0.056
440	0.047	0.047	0.047	0.05	0.056	0.077	0.065	0.046	0.045	0.062	0.047
450	0.039	0.039	0.04	0.043	0.048	0.066	0.055	0.04	0.039	0.054	0.04
460	0.034	0.034	0.034	0.036	0.041	0.056	0.047	0.033	0.033	0.046	0.034
470	0.029	0.029	0.029	0.032	0.036	0.049	0.04	0.029	0.029	0.04	0.029
480	0.025	0.025	0.025	0.027	0.031	0.043	0.035	0.025	0.024	0.035	0.025
490	0.021	0.021	0.022	0.023	0.027	0.037	0.03	0.021	0.021	0.03	0.021
500	0.018	0.018	0.019	0.021	0.024	0.033	0.026	0.019	0.018	0.026	0.018
510	0.016	0.016	0.017	0.018	0.020	0.028	0.023	0.016	0.016	0.023	0.016
520	0.014	0.014	0.014	0.016	0.018	0.025	0.020	0.014	0.014	0.021	0.013
530	0.013	0.013	0.012	0.014	0.016	0.022	0.018	0.013	0.012	0.018	0.012
540	0.011	0.011	0.011	0.012	0.014	0.020	0.016	0.011	0.011	0.016	0.011
550	0.009	0.009	0.010	0.010	0.012	0.017	0.013	0.009	0.009	0.014	0.009
560	0.008	0.008	0.009	0.009	0.011	0.016	0.012	0.009	0.008	0.013	0.008
570	0.007	0.007	0.007	0.008	0.009	0.014	0.009	0.007	0.006	0.011	0.007
580	0.006	0.006	0.006	0.007	0.008	0.012	0.008	0.006	0.005	0.010	0.006
590	0.006	0.006	0.006	0.007	0.008	0.011	0.008	0.006	0.005	0.009	0.005
600	0.004	0.004	0.005	0.006	0.007	0.009	0.006	0.004	0.004	0.007	0.004
610	0.004	0.004	0.004	0.005	0.006	0.008	0.005	0.004	0.004	0.007	0.004
620	0.004	0.004	0.003	0.004	0.005	0.007	0.005	0.003	0.003	0.006	0.003
630	0.003	0.003	0.002	0.003	0.005	0.006	0.004	0.003	0.003	0.005	0.002
640	0.002	0.002	0.001	0.003	0.004	0.004	0.002	0.002	0.002	0.004	0.002
650	0.002	0.002	0.001	0.002	0.003	0.004	0.002	0.002	0.001	0.003	0.001
660	0.002	0.002	0.001	0.002	0.002	0.004	0.002	0.001	0.001	0.003	0.001
670	0.002	0.002	0.001	0.001	0.002	0.003	0.002	0.001	0.001	0.003	0.001
680	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.002	0.001	0.002	0.000
690	0.000	0.000	0.001	0.000	0.001	0.002	0.001	0.001	0.000	0.002	0.000
700	0.000	0.000	0.001	0.000	0.001	0.002	0.000	0.000	0.000	0.001	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLW-04 10-Aug	GLW-08 10-Aug	SMM-00 10-Aug	SMM-02 10-Aug	SMM-04 10-Aug	SMCC 10-Aug	N. INLET 10-Aug	E. INLET 10-Aug	NF CO. 10-Aug	GPC 10-Aug	E. INLET/F 10-Aug
350	0.295	0.266	0.239	0.238	0.231	0.247	0.137	0.13	0.125	0.233	0.127
360	0.249	0.224	0.201	0.202	0.194	0.207	0.116	0.11	0.106	0.195	0.108
370	0.209	0.188	0.167	0.168	0.162	0.174	0.098	0.094	0.088	0.163	0.091
380	0.174	0.156	0.138	0.138	0.133	0.144	0.081	0.078	0.073	0.134	0.076
390	0.146	0.131	0.115	0.114	0.111	0.119	0.067	0.065	0.062	0.112	0.063
400	0.122	0.11	0.095	0.095	0.092	0.1	0.056	0.055	0.051	0.093	0.053
410	0.102	0.092	0.079	0.079	0.076	0.082	0.047	0.046	0.043	0.077	0.044
420	0.086	0.077	0.066	0.066	0.064	0.069	0.04	0.039	0.035	0.064	0.038
430	0.073	0.066	0.055	0.056	0.053	0.058	0.034	0.033	0.03	0.054	0.032
440	0.062	0.055	0.046	0.046	0.044	0.048	0.029	0.028	0.025	0.045	0.027
450	0.054	0.047	0.039	0.039	0.037	0.041	0.024	0.024	0.021	0.038	0.023
460	0.046	0.04	0.032	0.033	0.031	0.034	0.02	0.021	0.017	0.032	0.02
470	0.04	0.035	0.028	0.028	0.027	0.03	0.017	0.018	0.014	0.027	0.017
480	0.035	0.03	0.024	0.024	0.023	0.026	0.015	0.016	0.012	0.023	0.014
490	0.03	0.026	0.02	0.021	0.019	0.021	0.013	0.013	0.01	0.019	0.012
500	0.026	0.023	0.018	0.018	0.016	0.019	0.011	0.011	0.009	0.017	0.011
510	0.023	0.019	0.015	0.015	0.015	0.016	0.009	0.010	0.008	0.015	0.010
520	0.021	0.017	0.013	0.013	0.013	0.014	0.008	0.009	0.007	0.013	0.009
530	0.018	0.015	0.012	0.011	0.011	0.012	0.007	0.008	0.006	0.012	0.007
540	0.016	0.014	0.010	0.010	0.009	0.011	0.006	0.006	0.005	0.010	0.006
550	0.014	0.012	0.008	0.008	0.008	0.009	0.005	0.005	0.004	0.008	0.005
560	0.013	0.011	0.007	0.008	0.007	0.008	0.005	0.005	0.003	0.007	0.005
570	0.011	0.009	0.006	0.006	0.005	0.007	0.003	0.004	0.002	0.005	0.003
580	0.010	0.008	0.005	0.005	0.004	0.006	0.002	0.004	0.002	0.005	0.003
590	0.009	0.007	0.004	0.005	0.004	0.005	0.003	0.003	0.002	0.004	0.003
600	0.007	0.006	0.003	0.004	0.003	0.005	0.002	0.002	0.001	0.003	0.002
610	0.007	0.006	0.003	0.003	0.003	0.004	0.001	0.002	0.001	0.003	0.002
620	0.006	0.005	0.002	0.003	0.002	0.003	0.001	0.002	0.001	0.002	0.002
630	0.005	0.005	0.001	0.002	0.001	0.003	0.001	0.001	0.000	0.001	0.001
640	0.004	0.003	0.001	0.001	0.001	0.002	0.000	0.001	0.000	0.001	0.000
650	0.003	0.003	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
660	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
670	0.003	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.000
680	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
690	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
700	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLM-00 14-Aug	GLM-02 14-Aug	GLM-04 14-Aug	GLM-06 14-Aug	GLM-08 14-Aug	GLM-18 14-Aug	GLM-38 14-Aug	GLA-00 14-Aug	GLA-04 14-Aug	GLA-08 14-Aug	GLW-00 14-Aug
350	0.229	0.23	0.224	0.237	0.256	0.37	0.326	0.234	0.232	0.276	0.235
360	0.194	0.194	0.188	0.201	0.216	0.311	0.274	0.198	0.196	0.234	0.199
370	0.164	0.165	0.159	0.17	0.179	0.262	0.23	0.167	0.167	0.198	0.168
380	0.137	0.138	0.133	0.143	0.152	0.22	0.192	0.14	0.14	0.166	0.141
390	0.115	0.116	0.111	0.12	0.128	0.184	0.162	0.118	0.117	0.139	0.119
400	0.096	0.097	0.092	0.101	0.108	0.155	0.135	0.099	0.098	0.115	0.099
410	0.081	0.082	0.077	0.085	0.09	0.129	0.114	0.082	0.083	0.098	0.089
420	0.068	0.068	0.066	0.072	0.076	0.11	0.096	0.069	0.07	0.084	0.07
430	0.058	0.058	0.055	0.061	0.064	0.093	0.081	0.059	0.059	0.071	0.059
440	0.048	0.047	0.046	0.051	0.055	0.079	0.068	0.049	0.05	0.06	0.049
450	0.041	0.042	0.04	0.044	0.047	0.068	0.058	0.042	0.043	0.052	0.042
460	0.035	0.035	0.035	0.037	0.04	0.059	0.05	0.036	0.037	0.045	0.037
470	0.031	0.03	0.03	0.032	0.034	0.051	0.043	0.031	0.032	0.039	0.032
480	0.026	0.026	0.025	0.028	0.03	0.044	0.037	0.026	0.027	0.033	0.026
490	0.023	0.023	0.022	0.024	0.026	0.039	0.033	0.023	0.024	0.03	0.024
500	0.02	0.019	0.02	0.021	0.022	0.034	0.026	0.02	0.021	0.026	0.021
510	0.017	0.016	0.016	0.018	0.020	0.029	0.024	0.018	0.017	0.022	0.017
520	0.015	0.015	0.014	0.016	0.018	0.027	0.022	0.015	0.016	0.019	0.015
530	0.014	0.013	0.013	0.014	0.016	0.023	0.019	0.014	0.014	0.017	0.014
540	0.012	0.012	0.011	0.013	0.014	0.021	0.017	0.012	0.011	0.015	0.012
550	0.010	0.010	0.010	0.011	0.012	0.018	0.015	0.009	0.010	0.014	0.011
560	0.008	0.008	0.008	0.009	0.008	0.015	0.011	0.007	0.009	0.010	0.008
570	0.007	0.008	0.008	0.008	0.010	0.014	0.010	0.009	0.008	0.011	0.008
580	0.007	0.006	0.007	0.007	0.008	0.012	0.010	0.007	0.008	0.009	0.007
590	0.005	0.005	0.006	0.006	0.006	0.011	0.008	0.006	0.007	0.008	0.006
600	0.004	0.004	0.005	0.005	0.005	0.009	0.008	0.004	0.005	0.007	0.005
610	0.004	0.004	0.005	0.005	0.006	0.010	0.007	0.004	0.005	0.006	0.005
620	0.003	0.003	0.005	0.004	0.005	0.009	0.006	0.003	0.003	0.006	0.004
630	0.003	0.003	0.004	0.003	0.004	0.006	0.005	0.002	0.001	0.005	0.003
640	0.002	0.002	0.003	0.003	0.003	0.006	0.004	0.003	0.003	0.004	0.003
650	0.002	0.002	0.003	0.003	0.003	0.005	0.004	0.002	0.003	0.003	0.002
660	0.002	0.001	0.001	0.003	0.003	0.003	0.004	0.001	0.000	0.003	0.001
670	0.001	0.001	0.001	0.002	0.003	0.002	0.004	0.001	0.000	0.003	0.001
680	0.001	0.001	0.001	0.002	0.002	0.002	0.003	0.000	0.000	0.002	0.001
690	0.001	0.000	0.001	0.000	0.001	0.002	0.002	0.000	0.001	0.001	0.001
700	0.001	0.000	0.000	0.000	0.000	0.002	0.003	0.000	0.001	0.000	0.001

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLW-04 14-Aug	GLW-08 14-Aug	SMM-00 14-Aug	SMM-02 14-Aug	SMM-04 14-Aug	SMCC 14-Aug	N. INLET 14-Aug	E. INLET 14-Aug	NF CO. 14-Aug	GPC 14-Aug	E. INLET/F 14-Aug
350	0.276	0.266	0.235	0.239	0.242	0.233	0.146	0.137	0.124	0.229	0.133
360	0.234	0.224	0.197	0.201	0.204	0.194	0.123	0.113	0.105	0.191	0.113
370	0.198	0.188	0.165	0.169	0.171	0.163	0.105	0.097	0.089	0.16	0.096
380	0.166	0.158	0.137	0.141	0.143	0.137	0.088	0.081	0.074	0.133	0.08
390	0.139	0.133	0.114	0.118	0.12	0.115	0.073	0.068	0.062	0.11	0.068
400	0.115	0.111	0.094	0.098	0.099	0.095	0.061	0.057	0.052	0.091	0.057
410	0.098	0.093	0.079	0.082	0.083	0.08	0.052	0.048	0.044	0.076	0.048
420	0.084	0.079	0.066	0.069	0.07	0.067	0.044	0.041	0.037	0.064	0.041
430	0.071	0.067	0.055	0.058	0.058	0.057	0.037	0.035	0.031	0.053	0.035
440	0.06	0.057	0.046	0.048	0.048	0.047	0.031	0.029	0.026	0.044	0.029
450	0.052	0.049	0.039	0.041	0.041	0.041	0.027	0.026	0.021	0.038	0.025
460	0.045	0.042	0.033	0.035	0.035	0.035	0.024	0.023	0.019	0.033	0.022
470	0.039	0.036	0.028	0.03	0.03	0.03	0.021	0.019	0.016	0.028	0.019
480	0.033	0.031	0.024	0.026	0.025	0.025	0.018	0.016	0.013	0.023	0.016
490	0.03	0.027	0.021	0.022	0.022	0.022	0.016	0.015	0.012	0.02	0.014
500	0.026	0.024	0.018	0.02	0.019	0.019	0.014	0.013	0.011	0.018	0.013
510	0.022	0.020	0.015	0.016	0.016	0.017	0.010	0.010	0.008	0.014	0.010
520	0.019	0.018	0.014	0.014	0.015	0.015	0.009	0.009	0.007	0.012	0.010
530	0.017	0.016	0.012	0.012	0.013	0.013	0.008	0.008	0.007	0.011	0.009
540	0.015	0.013	0.010	0.011	0.011	0.011	0.008	0.007	0.006	0.010	0.007
550	0.014	0.012	0.009	0.011	0.009	0.010	0.007	0.005	0.004	0.008	0.006
560	0.010	0.011	0.007	0.008	0.008	0.008	0.006	0.005	0.004	0.007	0.006
570	0.011	0.009	0.006	0.007	0.007	0.008	0.006	0.005	0.003	0.006	0.005
580	0.009	0.008	0.005	0.006	0.005	0.002	0.005	0.005	0.003	0.005	0.004
590	0.008	0.008	0.004	0.005	0.005	0.006	0.004	0.004	0.002	0.004	0.003
600	0.007	0.007	0.003	0.004	0.004	0.004	0.003	0.003	0.001	0.003	0.002
610	0.006	0.005	0.003	0.004	0.004	0.004	0.003	0.003	0.001	0.002	0.003
620	0.006	0.004	0.002	0.004	0.004	0.004	0.002	0.002	0.001	0.003	0.002
630	0.005	0.004	0.002	0.002	0.003	0.002	0.002	0.002	0.000	0.002	0.002
640	0.004	0.003	0.001	0.001	0.002	0.001	0.000	0.001	0.000	0.001	0.001
650	0.003	0.003	0.002	0.001	0.002	0.003	0.000	0.001	0.001	0.002	0.001
660	0.003	0.005	0.002	0.001	0.003	0.001	0.002	0.001	0.000	0.001	0.003
670	0.003	0.004	0.001	0.001	0.002	0.001	0.001	0.001	0.000	0.001	0.004
680	0.002	0.003	0.000	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.001
690	0.001	0.002	0.000	0.001	0.000	0.001	0.001	0.000	0.002	0.000	0.001
700	0.000	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.003	0.000	0.001

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLM-00 21-Aug	GLM-02 21-Aug	GLM-04 21-Aug	GLM-06 21-Aug	GLM-08 21-Aug	GLM-18 21-Aug	GLM-38 21-Aug	GLA-00 21-Aug	GLA-04 21-Aug	GLA-08 21-Aug	GLW-00 21-Aug
350	0.208	0.212	0.21	0.228	0.249	0.361	0.316	0.212	0.211	0.262	0.208
360	0.175	0.178	0.177	0.192	0.21	0.303	0.267	0.179	0.177	0.22	0.175
370	0.147	0.149	0.15	0.162	0.177	0.253	0.224	0.15	0.148	0.185	0.147
380	0.122	0.123	0.124	0.134	0.147	0.211	0.187	0.124	0.123	0.154	0.122
390	0.102	0.103	0.103	0.112	0.122	0.177	0.157	0.104	0.103	0.128	0.102
400	0.085	0.086	0.086	0.093	0.102	0.148	0.132	0.087	0.085	0.108	0.085
410	0.071	0.072	0.072	0.078	0.085	0.124	0.111	0.072	0.071	0.09	0.071
420	0.059	0.06	0.061	0.066	0.072	0.104	0.093	0.06	0.059	0.076	0.059
430	0.05	0.051	0.051	0.055	0.061	0.088	0.079	0.051	0.05	0.065	0.05
440	0.042	0.043	0.043	0.047	0.052	0.075	0.066	0.043	0.042	0.055	0.042
450	0.035	0.036	0.036	0.04	0.044	0.064	0.056	0.036	0.036	0.047	0.036
460	0.03	0.031	0.031	0.034	0.037	0.055	0.048	0.03	0.03	0.04	0.03
470	0.026	0.026	0.027	0.029	0.032	0.048	0.041	0.026	0.026	0.034	0.026
480	0.022	0.023	0.023	0.025	0.027	0.042	0.036	0.023	0.022	0.03	0.023
490	0.019	0.019	0.019	0.022	0.024	0.036	0.03	0.019	0.019	0.026	0.019
500	0.017	0.017	0.017	0.019	0.021	0.032	0.028	0.017	0.017	0.023	0.017
510	0.014	0.014	0.014	0.017	0.018	0.027	0.023	0.015	0.014	0.019	0.014
520	0.012	0.012	0.012	0.015	0.016	0.024	0.020	0.013	0.013	0.017	0.012
530	0.011	0.011	0.011	0.013	0.014	0.021	0.018	0.011	0.011	0.015	0.011
540	0.009	0.009	0.009	0.011	0.012	0.019	0.016	0.010	0.010	0.013	0.009
550	0.008	0.008	0.008	0.009	0.010	0.017	0.014	0.008	0.008	0.011	0.008
560	0.007	0.007	0.007	0.008	0.009	0.015	0.013	0.007	0.007	0.010	0.007
570	0.006	0.005	0.006	0.007	0.007	0.013	0.010	0.006	0.006	0.008	0.006
580	0.005	0.005	0.005	0.006	0.006	0.012	0.009	0.005	0.005	0.007	0.005
590	0.004	0.004	0.005	0.005	0.006	0.011	0.008	0.005	0.005	0.007	0.005
600	0.004	0.003	0.003	0.004	0.005	0.009	0.007	0.004	0.003	0.005	0.004
610	0.003	0.003	0.003	0.004	0.005	0.008	0.006	0.003	0.003	0.005	0.003
620	0.003	0.003	0.002	0.003	0.004	0.007	0.005	0.003	0.003	0.004	0.003
630	0.002	0.002	0.002	0.003	0.003	0.006	0.004	0.002	0.002	0.003	0.002
640	0.001	0.001	0.001	0.002	0.002	0.004	0.003	0.001	0.001	0.003	0.002
650	0.000	0.000	0.000	0.001	0.002	0.004	0.003	0.001	0.001	0.002	0.001
660	0.000	0.000	0.000	0.001	0.001	0.004	0.002	0.000	0.001	0.002	0.001
670	0.000	0.001	0.001	0.002	0.002	0.003	0.002	0.000	0.001	0.002	0.001
680	0.000	0.000	0.000	0.001	0.001	0.002	0.001	0.000	0.000	0.001	0.000
690	0.000	0.000	0.000	0.001	0.001	0.002	0.001	0.000	0.000	0.001	0.000
700	0.000	0.000	0.000	0.001	0.001	0.002	0.001	0.000	0.000	0.001	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLW-04 21-Aug	GLW-08 21-Aug	SMM-00 21-Aug	SMM-02 21-Aug	SMM-04 21-Aug	SMCC 21-Aug	N. INLET 21-Aug	E. INLET 21-Aug	NF CO. 21-Aug	GPC 21-Aug	N. INLET/F 21-Aug
350	0.262	0.256	0.216	0.214	0.21	0.21	0.125	0.128	0.092	0.207	0.13
360	0.22	0.216	0.181	0.18	0.176	0.177	0.106	0.109	0.078	0.174	0.11
370	0.185	0.182	0.151	0.15	0.148	0.148	0.089	0.092	0.066	0.147	0.092
380	0.154	0.152	0.124	0.124	0.122	0.123	0.074	0.076	0.054	0.121	0.076
390	0.128	0.127	0.104	0.103	0.101	0.103	0.063	0.063	0.044	0.101	0.065
400	0.108	0.106	0.086	0.085	0.084	0.086	0.053	0.053	0.037	0.084	0.054
410	0.09	0.089	0.071	0.071	0.07	0.072	0.045	0.045	0.031	0.07	0.045
420	0.076	0.075	0.059	0.059	0.058	0.059	0.037	0.038	0.026	0.058	0.038
430	0.065	0.064	0.049	0.049	0.049	0.05	0.032	0.032	0.021	0.048	0.032
440	0.055	0.054	0.041	0.041	0.041	0.042	0.027	0.027	0.018	0.04	0.027
450	0.047	0.046	0.035	0.034	0.034	0.036	0.023	0.023	0.014	0.033	0.023
460	0.04	0.039	0.029	0.029	0.029	0.03	0.02	0.019	0.012	0.028	0.019
470	0.034	0.033	0.025	0.025	0.024	0.026	0.017	0.016	0.01	0.024	0.017
480	0.03	0.029	0.021	0.021	0.021	0.022	0.015	0.014	0.008	0.02	0.015
490	0.026	0.025	0.018	0.018	0.018	0.019	0.012	0.012	0.007	0.017	0.012
500	0.023	0.022	0.016	0.016	0.016	0.017	0.012	0.01	0.006	0.015	0.011
510	0.019	0.019	0.013	0.013	0.013	0.014	0.009	0.009	0.005	0.013	0.009
520	0.017	0.017	0.012	0.011	0.011	0.012	0.008	0.008	0.004	0.012	0.008
530	0.015	0.015	0.010	0.010	0.010	0.011	0.007	0.006	0.003	0.010	0.007
540	0.013	0.013	0.008	0.008	0.009	0.009	0.006	0.005	0.003	0.008	0.006
550	0.011	0.011	0.007	0.007	0.007	0.008	0.005	0.004	0.002	0.007	0.004
560	0.010	0.010	0.006	0.007	0.006	0.007	0.005	0.004	0.002	0.006	0.004
570	0.008	0.008	0.005	0.005	0.005	0.006	0.004	0.003	0.001	0.005	0.003
580	0.007	0.007	0.005	0.004	0.004	0.005	0.003	0.002	0.001	0.004	0.003
590	0.007	0.007	0.004	0.004	0.004	0.004	0.003	0.002	0.001	0.003	0.003
600	0.005	0.005	0.003	0.003	0.003	0.004	0.003	0.002	0.000	0.003	0.002
610	0.005	0.004	0.003	0.002	0.002	0.003	0.002	0.001	0.000	0.002	0.002
620	0.004	0.004	0.002	0.002	0.002	0.003	0.001	0.001	0.000	0.002	0.002
630	0.003	0.003	0.001	0.001	0.001	0.002	0.001	0.000	0.000	0.001	0.001
640	0.003	0.002	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000
650	0.002	0.002	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
660	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
670	0.002	0.002	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
680	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
690	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLM-00 26-Aug	GLM-02 26-Aug	GLM-04 26-Aug	GLM-06 26-Aug	GLM-08 26-Aug	GLM-18 26-Aug	GLM-38 26-Aug	GLA-00 26-Aug	GLA-04 26-Aug	GLA-08 26-Aug	GLW-00 26-Aug
350	0.196	0.192	0.198	0.215	0.261	0.366	0.281	0.198	0.205	0.264	0.199
360	0.164	0.161	0.166	0.18	0.219	0.307	0.235	0.165	0.172	0.222	0.167
370	0.137	0.134	0.139	0.15	0.182	0.258	0.196	0.138	0.144	0.185	0.14
380	0.114	0.111	0.115	0.125	0.153	0.215	0.161	0.115	0.12	0.155	0.116
390	0.094	0.091	0.094	0.105	0.128	0.179	0.134	0.095	0.1	0.129	0.095
400	0.077	0.075	0.077	0.086	0.106	0.149	0.11	0.078	0.082	0.106	0.078
410	0.064	0.062	0.064	0.072	0.089	0.125	0.093	0.065	0.069	0.09	0.065
420	0.053	0.052	0.053	0.06	0.074	0.105	0.077	0.054	0.057	0.075	0.039
430	0.043	0.044	0.045	0.049	0.062	0.089	0.066	0.044	0.047	0.063	0.046
440	0.036	0.036	0.037	0.041	0.052	0.075	0.054	0.036	0.039	0.053	0.038
450	0.03	0.031	0.032	0.034	0.044	0.065	0.046	0.03	0.033	0.046	0.032
460	0.025	0.025	0.026	0.029	0.037	0.055	0.038	0.025	0.027	0.038	0.026
470	0.021	0.022	0.023	0.024	0.031	0.049	0.032	0.021	0.023	0.033	0.024
480	0.018	0.019	0.02	0.021	0.026	0.043	0.027	0.017	0.019	0.026	0.02
490	0.014	0.015	0.016	0.018	0.022	0.037	0.023	0.015	0.016	0.023	0.017
500	0.015	0.015	0.015	0.017	0.021	0.034	0.02	0.014	0.015	0.021	0.015
510	0.010	0.011	0.011	0.012	0.017	0.028	0.017	0.011	0.012	0.018	0.011
520	0.008	0.010	0.010	0.010	0.015	0.025	0.015	0.009	0.010	0.015	0.009
530	0.007	0.008	0.008	0.008	0.012	0.021	0.012	0.007	0.008	0.013	0.003
540	0.006	0.007	0.007	0.008	0.011	0.019	0.011	0.006	0.007	0.012	0.004
550	0.004	0.005	0.005	0.006	0.009	0.016	0.009	0.004	0.005	0.010	0.005
560	0.002	0.003	0.003	0.004	0.007	0.013	0.007	0.000	0.003	0.007	0.003
570	0.001	0.003	0.003	0.002	0.004	0.012	0.005	0.000	0.002	0.005	0.003
580	0.002	0.004	0.005	0.004	0.005	0.013	0.005	0.002	0.003	0.006	0.004
590	0.002	0.003	0.003	0.004	0.004	0.011	0.005	0.004	0.003	0.005	0.003
600	0.000	0.000	0.000	0.002	0.001	0.007	0.001	0.000	0.000	0.001	0.000
610	0.000	0.000	0.000	0.000	0.002	0.006	0.001	0.000	0.000	0.003	0.000
620	0.000	0.000	0.000	0.000	0.002	0.005	0.002	0.000	0.001	0.004	0.001
630	0.000	0.000	0.001	0.001	0.001	0.005	0.002	0.000	0.001	0.003	0.001
640	0.000	0.000	0.001	0.001	0.001	0.004	0.001	0.000	0.001	0.002	0.000
650	0.000	0.000	0.000	0.000	0.001	0.004	0.001	0.000	0.001	0.001	0.000
660	0.000	0.000	0.000	0.000	0.001	0.004	0.000	0.001	0.001	0.001	0.000
670	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.005	0.000	0.000	0.000
680	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000
690	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
700	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.001	0.001

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLW-04 26-Aug	GLW-08 26-Aug	SMM-00 26-Aug	SMM-02 26-Aug	SMM-04 26-Aug	SMCC 26-Aug	N. INLET 26-Aug	E. INLET 26-Aug	NF CO. 26-Aug	GPC 26-Aug	NF CO./F 26-Aug
350	0.264	0.256	0.208	0.207	0.196	0.198	0.125	0.119	0.087	0.199	0.089
360	0.222	0.214	0.173	0.174	0.163	0.165	0.105	0.1	0.073	0.166	0.075
370	0.185	0.178	0.144	0.144	0.136	0.137	0.086	0.084	0.06	0.136	0.062
380	0.155	0.149	0.119	0.119	0.111	0.114	0.072	0.07	0.05	0.112	0.051
390	0.129	0.125	0.098	0.098	0.091	0.095	0.06	0.057	0.041	0.093	0.042
400	0.106	0.103	0.08	0.08	0.074	0.077	0.048	0.047	0.033	0.075	0.034
410	0.09	0.087	0.066	0.065	0.061	0.065	0.044	0.04	0.028	0.063	0.028
420	0.075	0.072	0.055	0.054	0.05	0.054	0.034	0.034	0.023	0.052	0.023
430	0.063	0.061	0.044	0.044	0.042	0.044	0.028	0.028	0.019	0.043	0.019
440	0.053	0.051	0.036	0.035	0.034	0.036	0.024	0.023	0.015	0.035	0.015
450	0.046	0.044	0.03	0.03	0.029	0.031	0.02	0.019	0.013	0.03	0.015
460	0.038	0.037	0.025	0.025	0.023	0.025	0.016	0.016	0.01	0.024	0.01
470	0.033	0.031	0.021	0.021	0.02	0.021	0.014	0.014	0.007	0.021	0.009
480	0.026	0.026	0.017	0.018	0.017	0.017	0.009	0.013	0.005	0.016	0.006
490	0.023	0.022	0.015	0.015	0.014	0.015	0.009	0.01	0.004	0.014	0.005
500	0.021	0.019	0.014	0.015	0.014	0.014	0.007	0.011	0.005	0.012	0.005
510	0.018	0.017	0.010	0.010	0.010	0.012	0.006	0.007	0.002	0.010	0.003
520	0.015	0.015	0.009	0.009	0.008	0.009	0.004	0.006	0.002	0.009	0.002
530	0.013	0.012	0.006	0.007	0.007	0.007	0.003	0.005	0.001	0.007	0.002
540	0.012	0.011	0.006	0.006	0.006	0.007	0.003	0.004	0.001	0.006	0.002
550	0.010	0.009	0.005	0.004	0.004	0.005	0.002	0.003	0.000	0.004	0.000
560	0.007	0.006	0.002	0.003	0.002	0.002	0.000	0.002	0.000	0.002	0.000
570	0.005	0.005	0.001	0.002	0.003	0.001	0.000	0.002	0.000	0.001	0.000
580	0.006	0.005	0.002	0.004	0.004	0.003	0.000	0.002	0.000	0.003	0.000
590	0.005	0.005	0.002	0.003	0.003	0.001	0.000	0.003	0.000	0.002	0.001
600	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
610	0.003	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
620	0.004	0.002	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
630	0.003	0.002	0.000	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.000
640	0.002	0.001	0.000	0.000	0.000	0.002	0.000	0.001	0.000	0.000	0.000
650	0.001	0.001	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000
660	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
670	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
680	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
690	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
700	0.000	0.000	0.003	0.000	0.000	0.001	0.002	0.003	0.000	0.000	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLM-00 2-Sep	GLM-02 2-Sep	GLM-04 2-Sep	GLM-06 2-Sep	GLM-08 2-Sep	GLM-18 2-Sep	GLM-38 2-Sep	GLA-00 2-Sep	GLA-04 2-Sep	GLA-08 2-Sep	GLW-00 2-Sep
350	0.202	0.201	0.205	0.217	0.259	0.361	0.306	0.202	0.208	0.232	0.207
360	0.169	0.168	0.172	0.182	0.217	0.303	0.256	0.169	0.176	0.196	0.174
370	0.141	0.141	0.143	0.153	0.182	0.255	0.215	0.142	0.146	0.164	0.147
380	0.117	0.117	0.12	0.128	0.153	0.213	0.179	0.118	0.122	0.137	0.122
390	0.098	0.098	0.1	0.107	0.128	0.178	0.149	0.099	0.103	0.115	0.101
400	0.08	0.08	0.083	0.089	0.106	0.148	0.124	0.081	0.085	0.096	0.084
410	0.067	0.067	0.069	0.074	0.089	0.124	0.104	0.068	0.071	0.081	0.07
420	0.056	0.056	0.057	0.062	0.076	0.105	0.088	0.057	0.06	0.068	0.059
430	0.047	0.047	0.049	0.052	0.064	0.089	0.074	0.048	0.05	0.057	0.05
440	0.038	0.038	0.04	0.044	0.053	0.074	0.062	0.039	0.041	0.048	0.041
450	0.033	0.033	0.034	0.037	0.046	0.064	0.052	0.034	0.036	0.041	0.035
460	0.028	0.028	0.029	0.031	0.04	0.055	0.045	0.029	0.03	0.035	0.03
470	0.023	0.024	0.024	0.027	0.034	0.048	0.039	0.024	0.025	0.03	0.026
480	0.02	0.02	0.02	0.023	0.029	0.041	0.033	0.02	0.022	0.025	0.022
490	0.017	0.017	0.018	0.02	0.026	0.036	0.029	0.018	0.019	0.022	0.019
500	0.015	0.015	0.015	0.016	0.023	0.032	0.025	0.015	0.016	0.019	0.017
510	0.012	0.012	0.013	0.014	0.018	0.027	0.021	0.013	0.014	0.016	0.013
520	0.011	0.011	0.011	0.012	0.017	0.024	0.019	0.011	0.012	0.014	0.012
530	0.009	0.009	0.010	0.011	0.014	0.021	0.017	0.011	0.010	0.013	0.010
540	0.008	0.008	0.009	0.009	0.013	0.019	0.015	0.008	0.009	0.011	0.009
550	0.006	0.006	0.007	0.008	0.011	0.016	0.012	0.007	0.008	0.009	0.008
560	0.005	0.005	0.006	0.006	0.009	0.014	0.010	0.005	0.006	0.008	0.006
570	0.004	0.004	0.005	0.005	0.008	0.013	0.008	0.004	0.005	0.007	0.006
580	0.004	0.004	0.003	0.005	0.007	0.012	0.008	0.004	0.005	0.006	0.005
590	0.003	0.003	0.002	0.004	0.006	0.010	0.007	0.004	0.004	0.005	0.004
600	0.002	0.002	0.003	0.003	0.005	0.009	0.005	0.002	0.003	0.005	0.003
610	0.001	0.003	0.003	0.003	0.005	0.008	0.005	0.003	0.003	0.004	0.003
620	0.001	0.002	0.002	0.002	0.004	0.007	0.005	0.003	0.002	0.003	0.002
630	0.000	0.001	0.001	0.002	0.003	0.006	0.003	0.001	0.001	0.003	0.002
640	0.000	0.000	0.001	0.000	0.002	0.005	0.002	0.001	0.001	0.002	0.001
650	0.000	0.000	0.001	0.000	0.002	0.004	0.003	0.001	0.001	0.002	0.001
660	0.000	0.000	0.000	0.000	0.001	0.004	0.002	0.000	0.000	0.002	0.001
670	0.000	0.000	0.000	0.000	0.001	0.003	0.002	0.000	0.000	0.001	0.000
680	0.000	0.000	0.000	0.000	0.001	0.003	0.001	0.000	0.000	0.001	0.000
690	0.001	0.000	0.000	0.000	0.001	0.002	0.002	0.000	0.000	0.002	0.001
700	0.002	0.000	0.001	0.000	0.000	0.002	0.002	0.001	0.001	0.003	0.002

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLW-04 2-Sep	GLW-08 2-Sep	SMM-00 2-Sep	SMM-02 2-Sep	SMM-04 2-Sep	SMCC 2-Sep	N. INLET 2-Sep	E. INLET 2-Sep	NF CO. 2-Sep	GPC 2-Sep	E. INLET/F 2-Sep
350	0.232	0.224	0.203	0.202	0.205	0.202	0.124	0.121	0.085	0.22	0.119
360	0.196	0.188	0.171	0.168	0.171	0.168	0.104	0.102	0.071	0.184	0.101
370	0.164	0.158	0.143	0.139	0.143	0.14	0.088	0.087	0.06	0.154	0.086
380	0.137	0.132	0.118	0.115	0.119	0.116	0.073	0.073	0.05	0.128	0.072
390	0.115	0.11	0.098	0.096	0.099	0.096	0.061	0.061	0.041	0.107	0.06
400	0.096	0.091	0.081	0.078	0.082	0.079	0.05	0.051	0.034	0.088	0.05
410	0.081	0.076	0.067	0.065	0.068	0.065	0.042	0.043	0.028	0.073	0.042
420	0.068	0.064	0.056	0.054	0.057	0.054	0.036	0.036	0.024	0.062	0.036
430	0.057	0.054	0.047	0.045	0.047	0.045	0.03	0.031	0.019	0.052	0.03
440	0.048	0.045	0.038	0.037	0.039	0.037	0.025	0.025	0.015	0.042	0.025
450	0.041	0.039	0.033	0.031	0.033	0.031	0.022	0.022	0.013	0.036	0.022
460	0.035	0.033	0.028	0.027	0.028	0.026	0.019	0.019	0.011	0.031	0.019
470	0.03	0.028	0.024	0.023	0.024	0.022	0.016	0.016	0.009	0.027	0.016
480	0.025	0.024	0.02	0.019	0.02	0.018	0.013	0.014	0.007	0.022	0.013
490	0.022	0.021	0.017	0.016	0.017	0.016	0.011	0.012	0.006	0.019	0.012
500	0.019	0.017	0.015	0.014	0.015	0.014	0.01	0.01	0.005	0.017	0.01
510	0.016	0.015	0.012	0.012	0.012	0.011	0.007	0.008	0.003	0.014	0.008
520	0.014	0.013	0.010	0.010	0.011	0.010	0.006	0.007	0.003	0.012	0.007
530	0.013	0.011	0.009	0.009	0.009	0.009	0.005	0.006	0.002	0.011	0.006
540	0.011	0.010	0.008	0.008	0.008	0.008	0.005	0.006	0.002	0.009	0.005
550	0.009	0.008	0.007	0.006	0.007	0.006	0.003	0.005	0.001	0.007	0.004
560	0.008	0.007	0.005	0.005	0.005	0.005	0.002	0.003	0.000	0.006	0.003
570	0.007	0.006	0.005	0.004	0.005	0.004	0.002	0.003	0.000	0.005	0.002
580	0.006	0.005	0.003	0.003	0.004	0.003	0.002	0.003	0.000	0.005	0.002
590	0.005	0.004	0.003	0.003	0.003	0.003	0.002	0.002	0.000	0.004	0.002
600	0.005	0.004	0.002	0.002	0.002	0.002	0.001	0.002	0.000	0.003	0.001
610	0.004	0.003	0.002	0.002	0.002	0.002	0.000	0.001	0.000	0.003	0.001
620	0.003	0.003	0.001	0.002	0.002	0.002	0.000	0.001	0.000	0.002	0.001
630	0.003	0.002	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.001	0.000
640	0.002	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.000
650	0.002	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.001	0.000
660	0.002	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
670	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
680	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
690	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
700	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLM-00 9-Sep	GLM-02 9-Sep	GLM-04 9-Sep	GLM-06 9-Sep	GLM-08 9-Sep	GLM-18 9-Sep	GLM-38 9-Sep	GLA-00 9-Sep	GLA-04 9-Sep	GLA-08 9-Sep	GLW-00 9-Sep
350	0.198	0.195	0.203	0.216	0.235	0.36	0.32	0.195	0.206	0.226	0.2
360	0.166	0.163	0.169	0.182	0.197	0.301	0.268	0.162	0.172	0.189	0.167
370	0.139	0.135	0.143	0.153	0.165	0.252	0.225	0.136	0.143	0.159	0.14
380	0.115	0.112	0.118	0.128	0.138	0.21	0.188	0.112	0.119	0.133	0.116
390	0.096	0.094	0.098	0.108	0.115	0.176	0.156	0.093	0.1	0.11	0.096
400	0.079	0.077	0.081	0.089	0.095	0.146	0.13	0.076	0.082	0.091	0.079
410	0.066	0.064	0.067	0.075	0.079	0.122	0.109	0.063	0.069	0.076	0.066
420	0.055	0.053	0.056	0.063	0.067	0.103	0.092	0.053	0.057	0.065	0.055
430	0.046	0.044	0.047	0.053	0.056	0.088	0.078	0.044	0.048	0.054	0.046
440	0.038	0.036	0.038	0.044	0.047	0.073	0.065	0.036	0.039	0.045	0.038
450	0.032	0.031	0.032	0.038	0.04	0.063	0.056	0.031	0.033	0.039	0.033
460	0.027	0.026	0.027	0.032	0.035	0.055	0.047	0.026	0.029	0.033	0.028
470	0.023	0.022	0.023	0.028	0.029	0.048	0.041	0.022	0.024	0.028	0.024
480	0.02	0.018	0.019	0.023	0.025	0.041	0.035	0.018	0.02	0.024	0.02
490	0.017	0.016	0.017	0.021	0.022	0.036	0.03	0.016	0.018	0.021	0.017
500	0.015	0.014	0.014	0.018	0.019	0.031	0.026	0.013	0.015	0.018	0.015
510	0.012	0.012	0.012	0.015	0.016	0.027	0.023	0.011	0.013	0.014	0.012
520	0.010	0.010	0.011	0.013	0.014	0.024	0.020	0.010	0.011	0.013	0.011
530	0.009	0.009	0.009	0.011	0.013	0.021	0.018	0.008	0.009	0.011	0.009
540	0.008	0.007	0.008	0.010	0.011	0.019	0.016	0.008	0.008	0.010	0.008
550	0.007	0.006	0.006	0.009	0.009	0.016	0.013	0.006	0.007	0.008	0.007
560	0.005	0.004	0.005	0.007	0.007	0.014	0.011	0.005	0.005	0.006	0.006
570	0.005	0.004	0.003	0.006	0.006	0.013	0.011	0.004	0.004	0.006	0.005
580	0.004	0.003	0.003	0.006	0.006	0.011	0.009	0.003	0.004	0.006	0.004
590	0.003	0.002	0.003	0.006	0.004	0.010	0.008	0.002	0.003	0.004	0.003
600	0.002	0.001	0.002	0.004	0.003	0.008	0.006	0.001	0.002	0.003	0.003
610	0.002	0.001	0.002	0.003	0.003	0.007	0.006	0.001	0.002	0.003	0.002
620	0.002	0.001	0.001	0.003	0.003	0.006	0.005	0.001	0.001	0.002	0.002
630	0.001	0.001	0.000	0.002	0.002	0.005	0.004	0.001	0.001	0.001	0.001
640	0.000	0.000	0.000	0.001	0.002	0.004	0.003	0.000	0.000	0.001	0.001
650	0.001	0.000	0.000	0.001	0.002	0.004	0.003	0.000	0.001	0.001	0.001
660	0.000	0.000	0.000	0.000	0.002	0.003	0.002	0.000	0.000	0.001	0.000
670	0.000	0.000	0.000	0.000	0.001	0.004	0.002	0.000	0.000	0.000	0.000
680	0.000	0.000	0.000	0.000	0.000	0.004	0.002	0.000	0.000	0.000	0.000
690	0.000	0.000	0.000	0.002	0.000	0.003	0.001	0.000	0.000	0.001	0.000
700	0.000	0.000	0.001	0.002	0.000	0.003	0.002	0.000	0.001	0.002	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLW-04 9-Sep	GLW-08 9-Sep	SMM-00 9-Sep	SMM-02 9-Sep	SMM-04 9-Sep	SMCC 9-Sep	N. INLET 9-Sep	E. INLET 9-Sep	NF CO. 9-Sep	GPC 9-Sep	N. INLET/F 9-Sep
350	0.198	0.237	0.203	0.199	0.206	0.195	0.127	0.117	0.089	0.224	0.12
360	0.165	0.199	0.170	0.166	0.173	0.163	0.107	0.098	0.075	0.187	0.101
370	0.139	0.167	0.142	0.139	0.144	0.136	0.091	0.082	0.065	0.157	0.085
380	0.115	0.139	0.118	0.115	0.12	0.112	0.077	0.069	0.055	0.131	0.071
390	0.096	0.116	0.098	0.095	0.1	0.092	0.066	0.058	0.045	0.109	0.059
400	0.078	0.097	0.080	0.078	0.082	0.075	0.055	0.048	0.038	0.09	0.048
410	0.065	0.081	0.067	0.064	0.069	0.062	0.047	0.04	0.032	0.076	0.04
420	0.054	0.069	0.056	0.054	0.057	0.052	0.041	0.034	0.028	0.064	0.034
430	0.045	0.058	0.047	0.045	0.048	0.043	0.035	0.028	0.024	0.053	0.029
440	0.037	0.048	0.038	0.037	0.039	0.035	0.03	0.023	0.02	0.044	0.023
450	0.031	0.042	0.033	0.032	0.033	0.03	0.027	0.02	0.017	0.037	0.02
460	0.027	0.035	0.028	0.027	0.028	0.026	0.025	0.018	0.015	0.032	0.018
470	0.023	0.03	0.024	0.023	0.024	0.022	0.021	0.015	0.012	0.027	0.015
480	0.019	0.026	0.020	0.019	0.02	0.018	0.018	0.012	0.01	0.023	0.012
490	0.017	0.023	0.017	0.017	0.017	0.016	0.017	0.011	0.009	0.02	0.011
500	0.014	0.019	0.015	0.015	0.015	0.014	0.016	0.01	0.007	0.017	0.01
510	0.011	0.016	0.012	0.011	0.013	0.011	0.014	0.007	0.006	0.014	0.007
520	0.010	0.014	0.011	0.010	0.011	0.009	0.013	0.006	0.006	0.012	0.006
530	0.009	0.012	0.009	0.008	0.010	0.008	0.012	0.005	0.006	0.011	0.005
540	0.008	0.011	0.008	0.008	0.008	0.007	0.011	0.005	0.005	0.009	0.004
550	0.006	0.010	0.006	0.006	0.007	0.006	0.010	0.004	0.004	0.008	0.004
560	0.005	0.008	0.005	0.005	0.005	0.005	0.010	0.003	0.003	0.006	0.003
570	0.004	0.007	0.005	0.005	0.005	0.004	0.009	0.003	0.003	0.006	0.003
580	0.004	0.006	0.004	0.004	0.004	0.003	0.009	0.002	0.003	0.005	0.003
590	0.003	0.005	0.003	0.003	0.003	0.003	0.009	0.002	0.002	0.004	0.001
600	0.002	0.004	0.002	0.003	0.002	0.002	0.008	0.001	0.002	0.003	0.001
610	0.001	0.004	0.002	0.002	0.002	0.001	0.008	0.001	0.002	0.003	0.001
620	0.001	0.003	0.002	0.002	0.002	0.001	0.008	0.001	0.002	0.003	0.001
630	0.000	0.002	0.001	0.001	0.001	0.000	0.007	0.000	0.001	0.001	0.000
640	0.000	0.002	0.000	0.001	0.000	0.000	0.006	0.000	0.001	0.001	0.000
650	0.000	0.002	0.001	0.001	0.000	0.000	0.007	0.000	0.002	0.001	0.000
660	0.000	0.002	0.000	0.000	0.000	0.000	0.006	0.000	0.002	0.000	0.000
670	0.000	0.001	0.000	0.000	0.000	0.000	0.006	0.000	0.001	0.000	0.000
680	0.000	0.001	0.000	0.000	0.000	0.000	0.005	0.000	0.001	0.000	0.000
690	0.000	0.001	0.000	0.000	0.000	0.000	0.005	0.000	0.001	0.000	0.000
700	0.000	0.002	0.000	0.000	0.000	0.000	0.004	0.000	0.001	0.000	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLM-00 16-Sep	GLM-02 16-Sep	GLM-04 16-Sep	GLM-06 16-Sep	GLM-08 16-Sep	GLM-18 16-Sep	GLM-38 16-Sep	GLA-00 16-Sep	GLA-04 16-Sep	GLA-08 16-Sep	GLW-00 16-Sep
350	0.195	0.203	0.199	0.208	0.215	0.353	0.292	0.198	0.195	0.209	0.198
360	0.164	0.171	0.168	0.176	0.181	0.297	0.245	0.166	0.164	0.176	0.167
370	0.138	0.144	0.141	0.147	0.151	0.249	0.206	0.14	0.137	0.148	0.14
380	0.114	0.12	0.116	0.122	0.125	0.207	0.171	0.114	0.113	0.122	0.116
390	0.095	0.1	0.096	0.102	0.105	0.173	0.143	0.096	0.095	0.102	0.096
400	0.08	0.083	0.08	0.085	0.088	0.145	0.119	0.08	0.078	0.086	0.081
410	0.066	0.07	0.066	0.071	0.073	0.122	0.1	0.066	0.065	0.071	0.067
420	0.056	0.059	0.056	0.059	0.061	0.103	0.084	0.056	0.055	0.06	0.057
430	0.047	0.049	0.047	0.05	0.052	0.088	0.071	0.047	0.046	0.051	0.048
440	0.039	0.041	0.039	0.041	0.043	0.074	0.059	0.038	0.038	0.042	0.04
450	0.033	0.035	0.033	0.035	0.036	0.064	0.051	0.033	0.032	0.036	0.034
460	0.028	0.03	0.029	0.03	0.031	0.055	0.043	0.029	0.028	0.03	0.029
470	0.024	0.026	0.024	0.025	0.026	0.048	0.037	0.024	0.023	0.026	0.025
480	0.021	0.022	0.019	0.022	0.023	0.042	0.033	0.021	0.021	0.023	0.022
490	0.017	0.019	0.018	0.019	0.019	0.036	0.027	0.018	0.017	0.019	0.018
500	0.016	0.017	0.017	0.017	0.017	0.033	0.025	0.015	0.015	0.018	0.017
510	0.012	0.014	0.013	0.014	0.014	0.028	0.021	0.013	0.013	0.014	0.013
520	0.011	0.012	0.011	0.013	0.013	0.025	0.019	0.012	0.012	0.013	0.012
530	0.010	0.010	0.010	0.012	0.012	0.022	0.016	0.011	0.010	0.011	0.010
540	0.008	0.009	0.008	0.010	0.010	0.019	0.013	0.009	0.009	0.010	0.010
550	0.008	0.008	0.008	0.008	0.009	0.018	0.013	0.008	0.007	0.010	0.009
560	0.006	0.005	0.006	0.007	0.007	0.015	0.011	0.006	0.005	0.007	0.007
570	0.005	0.006	0.004	0.006	0.006	0.013	0.009	0.005	0.005	0.006	0.006
580	0.005	0.005	0.005	0.005	0.006	0.012	0.009	0.005	0.005	0.006	0.006
590	0.005	0.005	0.004	0.005	0.005	0.011	0.007	0.004	0.004	0.006	0.005
600	0.003	0.003	0.002	0.003	0.004	0.009	0.006	0.003	0.002	0.004	0.004
610	0.002	0.003	0.002	0.003	0.003	0.007	0.004	0.002	0.001	0.003	0.003
620	0.002	0.003	0.002	0.003	0.003	0.007	0.004	0.002	0.001	0.003	0.003
630	0.001	0.002	0.001	0.002	0.002	0.005	0.003	0.001	0.001	0.002	0.002
640	0.001	0.002	0.001	0.002	0.002	0.004	0.003	0.001	0.001	0.002	0.001
650	0.002	0.002	0.002	0.002	0.002	0.004	0.003	0.002	0.002	0.002	0.002
660	0.001	0.002	0.001	0.002	0.002	0.004	0.003	0.001	0.002	0.002	0.001
670	0.000	0.001	0.001	0.001	0.001	0.004	0.002	0.001	0.001	0.001	0.001
680	0.000	0.001	0.000	0.000	0.000	0.003	0.001	0.000	0.000	0.000	0.000
690	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000
700	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000

Grand Lake Monitoring Program
Absorbance (10 cm path length)

Wavelength nm	GLW-04 16-Sep	GLW-08 16-Sep	SMM-00 16-Sep	SMM-02 16-Sep	SMM-04 16-Sep	SMCC 16-Sep	N. INLET 16-Sep	E. INLET 16-Sep	NF CO. 16-Sep	GPC 16-Sep	NF CO./F 16-Sep
350	0.209	0.207	0.194	0.186	0.202	0.192	0.124	0.118	0.133	0.216	0.129
360	0.176	0.174	0.162	0.155	0.17	0.161	0.105	0.101	0.112	0.182	0.109
370	0.148	0.145	0.135	0.13	0.143	0.134	0.089	0.086	0.094	0.153	0.09
380	0.122	0.12	0.111	0.107	0.118	0.111	0.074	0.071	0.077	0.127	0.075
390	0.102	0.101	0.092	0.089	0.097	0.092	0.061	0.059	0.065	0.105	0.063
400	0.086	0.084	0.077	0.075	0.082	0.077	0.052	0.05	0.054	0.088	0.053
410	0.071	0.07	0.064	0.062	0.068	0.064	0.043	0.042	0.046	0.073	0.044
420	0.06	0.059	0.053	0.052	0.057	0.053	0.036	0.036	0.038	0.062	0.037
430	0.051	0.05	0.044	0.043	0.047	0.044	0.03	0.03	0.032	0.05	0.031
440	0.042	0.041	0.037	0.036	0.039	0.037	0.025	0.026	0.026	0.043	0.025
450	0.036	0.035	0.031	0.031	0.034	0.031	0.022	0.023	0.022	0.035	0.022
460	0.03	0.029	0.026	0.026	0.029	0.026	0.018	0.02	0.019	0.031	0.018
470	0.026	0.025	0.022	0.022	0.025	0.022	0.016	0.017	0.016	0.027	0.016
480	0.023	0.022	0.019	0.019	0.021	0.019	0.014	0.015	0.015	0.023	0.014
490	0.019	0.018	0.016	0.016	0.018	0.016	0.011	0.012	0.013	0.02	0.011
500	0.018	0.016	0.014	0.014	0.016	0.014	0.009	0.011	0.011	0.018	0.011
510	0.014	0.014	0.012	0.011	0.013	0.012	0.009	0.009	0.009	0.014	0.009
520	0.013	0.012	0.011	0.010	0.012	0.011	0.008	0.008	0.009	0.013	0.008
530	0.011	0.011	0.010	0.009	0.010	0.010	0.007	0.007	0.008	0.011	0.007
540	0.010	0.009	0.008	0.008	0.009	0.008	0.005	0.006	0.006	0.010	0.006
550	0.010	0.008	0.007	0.007	0.008	0.007	0.005	0.006	0.005	0.009	0.005
560	0.007	0.006	0.006	0.005	0.006	0.006	0.004	0.004	0.004	0.007	0.004
570	0.006	0.005	0.005	0.004	0.005	0.005	0.004	0.003	0.004	0.005	0.003
580	0.006	0.005	0.005	0.004	0.005	0.004	0.004	0.004	0.003	0.005	0.004
590	0.006	0.005	0.005	0.004	0.004	0.004	0.003	0.004	0.004	0.004	0.002
600	0.004	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.001
610	0.003	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.002	0.001
620	0.003	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.002	0.001
630	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001
640	0.002	0.002	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.001	0.001
650	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
660	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
670	0.001	0.001	0.000	0.001	0.000	0.001	0.000	0.000	0.001	0.000	0.001
680	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
690	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix C

Absorbance Components Expressed as K, m^{-1} or % of Total Absorbance

	SMR-MID			SMR-CHL		GL-WEST			GL-MID			GL-ATW		
Coefficient	0 m	2 m	4 m	0 m	2 m	0 m	2 m	4 m	0 m	2 m	4 m	0 m	2 m	4 m
Jul 31														
K_w	0.17	0.12	0.08	0.17	0.12	0.17	0.12	0.08	0.17	0.12	0.08	0.17	0.12	0.08
K_d	0.41	0.15	0.10	0.41	0.16	0.41	0.17	0.14	0.36	0.16	0.11	0.41	0.17	0.12
K_a	0.10	0.09	0.11	0.13	0.13	0.12	0.11	0.11	0.13	0.13	0.12	0.11	0.11	0.11
K_p	0.44	0.38	0.42						0.13	0.17	0.22			
K_{total}	1.12	0.74	0.72						0.79	0.57	0.54			
Aug 3														
K_w	0.17	0.12	0.08	0.17	0.12	0.17	0.12	0.08	0.17	0.12	0.08	0.17	0.12	0.08
K_d	0.42	0.15	0.09	0.40	0.14	0.39	0.15	0.09	0.38	0.15	0.10	0.40	0.18	0.11
K_a	0.13	0.13	0.13	0.14	0.14	0.12	0.12	0.11	0.11	0.11	0.11	0.12	0.11	0.10
K_p	0.64	0.48	0.52	0.67	0.50	0.60	0.46	0.51	0.37	0.33	0.38	0.19	0.23	0.28
K_{total}	1.37	0.87	0.83	1.39	0.89	1.28	0.84	0.79	1.03	0.70	0.67	0.87	0.63	0.57
Aug 10														
K_w	0.17	0.12	0.08	0.17	0.12	0.17	0.12	0.08	0.17	0.12	0.08	0.17	0.12	0.08
K_d	0.35	0.14	0.09	0.38	0.15	0.37	0.15	0.13	0.37	0.17	0.11	0.37	0.16	0.11
K_a	0.21	0.19	0.17	0.20	0.19	0.15	0.14	0.12	0.17	0.16	0.13	0.12	0.12	0.10
K_p	0.55	0.42	0.47	0.57	0.43	0.37	0.33	0.39	0.12	0.17	0.22	0.22	0.24	0.29
K_{total}	1.28	0.87	0.82	1.32	0.89	1.06	0.74	0.72	0.83	0.60	0.54	0.89	0.64	0.58
Aug 14														
K_w	0.17	0.12	0.08	0.17	0.12	0.17	0.12	0.08	0.17	0.12	0.08	0.17	0.12	0.08
K_d	0.36	0.15	0.11	0.38	0.16	0.41	0.17	0.13	0.39	0.17	0.11	0.39	0.16	0.11
K_a	0.25	0.23	0.21	0.16	0.15	0.16	0.15	0.15	0.18	0.16	0.15	0.17	0.16	0.15
K_p	0.38	0.32	0.37	0.33	0.30	0.19	0.22	0.27	0.05	0.12	0.17	0.08	0.15	0.20
K_{total}	1.16	0.81	0.77	1.04	0.73	0.92	0.66	0.64	0.78	0.57	0.51	0.82	0.59	0.54
Aug 21														
K_w	0.17	0.12	0.08	0.17	0.12	0.17	0.12	0.08	0.17	0.12	0.08	0.17	0.12	0.08
K_d	0.31	0.13	0.08	0.33	0.14	0.33	0.15	0.11	0.32	0.14	0.09	0.33	0.14	0.09
K_a	0.23	0.21	0.20	0.14	0.13	0.14	0.13	0.13	0.15	0.14	0.12	0.15	0.15	0.14
K_p	0.49	0.38	0.43	0.35	0.32	0.17	0.20	0.25	0.16	0.20	0.24	0.07	0.13	0.18
K_{total}	1.20	0.84	0.80	0.99	0.71	0.81	0.60	0.57	0.81	0.60	0.54	0.73	0.54	0.49

	SMR-MID			SMR-CHL		GL-WEST			GL-MID			GL-ATW		
Coefficient	0 m	2 m	4 m	0 m	2 m	0 m	2 m	4 m	0 m	2 m	4 m	0 m	2 m	4 m
Aug 26														
K_w	0.17	0.12	0.08	0.17	0.12	0.17	0.12	0.08	0.17	0.12	0.08	0.17	0.12	0.08
K_d	0.26	0.10	0.06	0.26	0.11	0.26	0.11	0.08	0.25	0.10	0.06	0.26	0.11	0.07
K_a	0.30	0.27	0.25	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.14	0.13	0.14
K_p	0.85	0.57	0.61	0.62	0.47	0.43	0.36	0.40	0.37	0.32	0.36	0.35	0.30	0.33
K_{total}	1.58	1.05	1.00	1.21	0.84	1.01	0.72	0.71	0.94	0.67	0.63	0.93	0.66	0.62
Sep 2														
K_w	0.17	0.12	0.08	0.17	0.12	0.17	0.12	0.08	0.17	0.12	0.08	0.17	0.12	0.08
K_d	0.29	0.12	0.08	0.28	0.12	0.32	0.14	0.11	0.29	0.12	0.08	0.30	0.13	0.09
K_a	0.21	0.19	0.23	0.28	0.26	0.25	0.23	0.22	0.25	0.23	0.22	0.23	0.21	0.21
K_p	0.77	0.54	0.57	0.71	0.49	0.52	0.39	0.44	0.82	0.56	0.60	0.67	0.48	0.52
K_{total}	1.44	0.97	0.95	1.44	0.98	1.26	0.88	0.85	1.53	1.02	0.98	1.37	0.94	0.90
Sep 9														
K_w	0.17	0.12	0.08	0.17	0.12	0.17	0.12	0.08	0.17	0.12	0.08	0.17	0.12	0.08
K_d	0.29	0.13	0.08	0.26	0.11	0.29	0.13	0.08	0.29	0.12	0.07	0.27	0.12	0.08
K_a	0.19	0.15	0.11	0.18	0.17	0.21	0.19	0.18	0.19	0.18	0.19	0.21	0.20	0.19
K_p	0.55	0.43	0.48	0.54	0.42	0.54	0.41	0.46	0.81	0.56	0.59	0.71	0.50	0.54
K_{total}	1.20	0.82	0.75	1.16	0.82	1.21	0.85	0.79	1.46	0.98	0.93	1.36	0.94	0.89
Sep 16														
K_w	0.17	0.12	0.08	0.17	0.12	0.17	0.12	0.08	0.17	0.12	0.08	0.17	0.12	0.08
K_d	0.29	0.13	0.09	0.29	0.13	0.32	0.15	0.10	0.30	0.14	0.10	0.30	0.14	0.09
K_a	0.21	0.19	0.21	0.16	0.15	0.18	0.17	0.16	0.21	0.19	0.18	0.19	0.18	0.17
K_p														
K_{total}														

Table C-1. Total extinction coefficients for PAR and extinction coefficients calculated from modeling. K_w = extinction by water, K_d=extinction by dissolved substances, K_a=extinction by algal cells, K_p=extinction by non-algal particulates. Units of K are /m.

Coefficient	SMR-MID			SMR-CHL		GL-WEST			GL-MID			GL-ATW		
	0 m	2 m	4 m	0 m	2 m	0 m	2 m	4 m	0 m	2 m	4 m	0 m	2 m	4 m
Jul 31														
K_w	15	16	11						22	20	15			
K_d	37	21	14						45	28	21			
K_a	9	13	16						17	22	23			
K_p	39	51	59						16	30	41			
Aug 3														
K_w	13	13	10	12	13	13	14	10	17	17	12	20	19	14
K_d	31	17	11	29	16	30	17	12	37	21	15	45	28	19
K_a	10	14	16	10	15	10	14	14	11	15	16	13	18	18
K_p	47	55	63	48	56	47	55	64	36	48	57	22	36	49
Aug 10														
K_w	13	14	10	13	13	16	16	11	21	19	15	19	18	14
K_d	27	16	11	29	17	35	21	18	45	27	21	42	26	18
K_a	16	22	21	15	21	14	19	17	20	26	24	14	18	17
K_p	43	49	58	43	48	35	45	54	14	28	40	25	38	50
Aug 14														
K_w	15	15	11	17	16	19	18	13	22	21	16	21	20	15
K_d	31	18	14	36	22	44	27	21	49	30	21	48	28	20
K_a	21	28	27	15	20	17	22	23	22	29	30	21	27	28
K_p	33	39	49	32	41	20	33	43	6	21	33	10	25	38
Aug 21														
K_w	14	14	10	17	17	21	20	14	21	20	15	24	22	16
K_d	26	16	10	33	20	41	25	20	40	24	17	46	26	19
K_a	19	25	25	14	19	17	22	22	19	24	23	21	27	29
K_p	41	46	54	35	45	21	34	44	20	33	45	10	25	36
Aug 26														
K_w	11	11	8	14	14	17	16	11	18	17	13	19	18	13
K_d	16	9	6	22	13	26	15	12	27	14	10	28	16	11
K_a	19	26	25	13	17	14	19	20	15	20	20	15	20	22
K_p	54	54	61	51	56	43	50	57	40	48	57	38	46	54

	SMR-MID			SMR-CHL		GL-WEST			GL-MID			GL-ATW		
Coefficient	0 m	2 m	4 m	0 m	2 m	0 m	2 m	4 m	0 m	2 m	4 m	0 m	2 m	4 m
Aug 26														
K_w	11	11	8	14	14	17	16	11	18	17	13	19	18	13
K_d	16	9	6	22	13	26	15	12	27	14	10	28	16	11
K_a	19	26	25	13	17	14	19	20	15	20	20	15	20	22
K_p	54	54	61	51	56	43	50	57	40	48	57	38	46	54
Sep 2														
K_w	12	12	9	12	12	14	13	10	11	11	8	13	12	9
K_d	20	13	8	19	12	26	16	13	19	12	8	22	14	10
K_a	14	20	24	20	26	20	26	25	16	22	23	17	22	23
K_p	53	55	60	49	50	41	45	52	54	55	61	49	51	58
Sep 9														
K_w	14	14	11	15	14	14	14	10	13	13	9	12	12	9
K_d	24	15	11	23	14	24	15	10	20	13	9	20	13	7
K_a	16	18	15	16	21	17	22	23	15	21	21	13	18	20
K_p	46	53	64	47	51	44	48	58	52	54	61	55	57	63

Table C-2. Relative contributions (%) of individual components to total extinction. K_w = extinction by water, K_d=extinction by dissolved substances, K_a=extinction by algal cells, K_p=extinction by non-algal particulates. Units of K are /m.