

I. Introduction

This document provides supplemental information to the 2011 Operational and Water-Quality Summary Report for the Three Lakes Report, dated June 4, 2013. The Three Lakes Water-Quality Model was in a state of flux when the June 4, 2013 report was submitted. The loading information described below was developed following the implementation of several changes to the model. These include:

1. Inflow concentrations were modified and refined based on a data QA/QC review of historical data.
2. Assumed gain concentrations were assumed to be the same as the major tributary for each water body. This assumption is based on the timing of gain inflows.
3. The methodology used to quantify Arapaho Creek flows was refined.
4. Provisional flow data was replaced with final flow data for the North Fork.
5. The model was re-calibrated incorporating learnings from the 2011 Operational and Water-Quality Summary Report.

Because of these changes, some of the loading amounts reported in the June 4, 2013 version of the report have changed. In addition, volume-weighted average nutrient concentrations were re-computed to reflect the modification described above. Updated loads and concentrations are described below.

II. Total Phosphorus Loading

Total phosphorus loads by water body are listed in Tables Sup-1 through Sup-3. In addition, the relative annual distributions of loads for the previous four-year period (2007-2010) and 2011 are displayed in Figures Sup-1 through Sup-6. Volume-weighted phosphorus concentrations are listed in Table Sup-4.

Table Sup-1. Total Phosphorus Loads (kg/yr) – Grand Lake

Source	2007	2008	2009	2010	2007-2010 Average	2011
North Inlet	520	1,088	780	685	768	1,230
East Inlet	283	519	440	394	409	722
From SMR	3,731	4,330	3,974	3,239	3,818	3,628
Gains	273	367	504	521	416	576
Precipitation	20	20	18	21	20	25
Stormwater	150	130	190	8	120	8
Internal Load	317	317	317	317	317	317
Total	5,294	6,772	6,223	5,184	5,868	6,506

Table Sup-2. Total Phosphorus Loads (kg/yr) – Shadow Mountain Reservoir

Source	2007	2008	2009	2010	2007-2010 Average	2011
North Fork	789	4,799	1,298	1,612	2,125	6,509
From Grand	636	593	1,417	1,277	981	1,741
From Granby	4,396	6,138	5,621	4,422	5,144	4,325
Gains	291	788	379	513	493	671
Precipitation	53	54	47	56	53	65
Stormwater	624	442	572	780	605	754
Internal Load	4,040	2,239	2,224	2,224	2,682	2,222
Macrophytes	3	3	3	3	3	3
Total	10,831	15,058	11,561	10,888	12,085	16,290

Table Sup-3. Total Phosphorus Loads (kg/yr) – Granby Reservoir

Source	2007	2008	2009	2010	2007-2010 Average	2011
Arapaho	473	1,030	783	641	732	1,106
Stillwater	1,053	1,690	1,267	1,164	1,293	1,658
Roaring Fork	38	73	85	64	65	127
Columbine	25	49	58	43	44	86
Windy Gap	2,696	3,535	1,897	384	2,128	0
Willow Creek	1,150	2,904	2,692	1,957	2,176	0
Gains	108	65	124	129	106	323
From SMR	1,212	4,350	2,584	2,893	2,760	7,614
Precipitation	286	293	255	302	284	353
Stormwater	5,904	4,182	5,412	7,380	5,720	7,134
Internal Load	6,850	6,907	7,678	8,541	7,494	8,610
Total	19,795	25,078	22,836	23,498	22,802	27,012

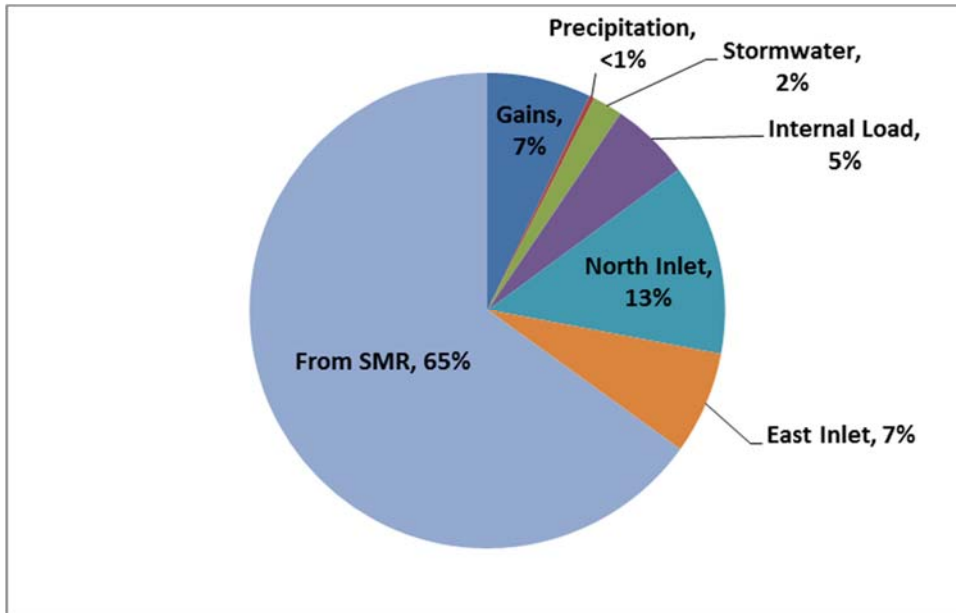


Figure Sup-1. Average Annual Total Phosphorus Load into Grand Lake
 (2007-2010 Average, Total = 5,868 kg/yr)

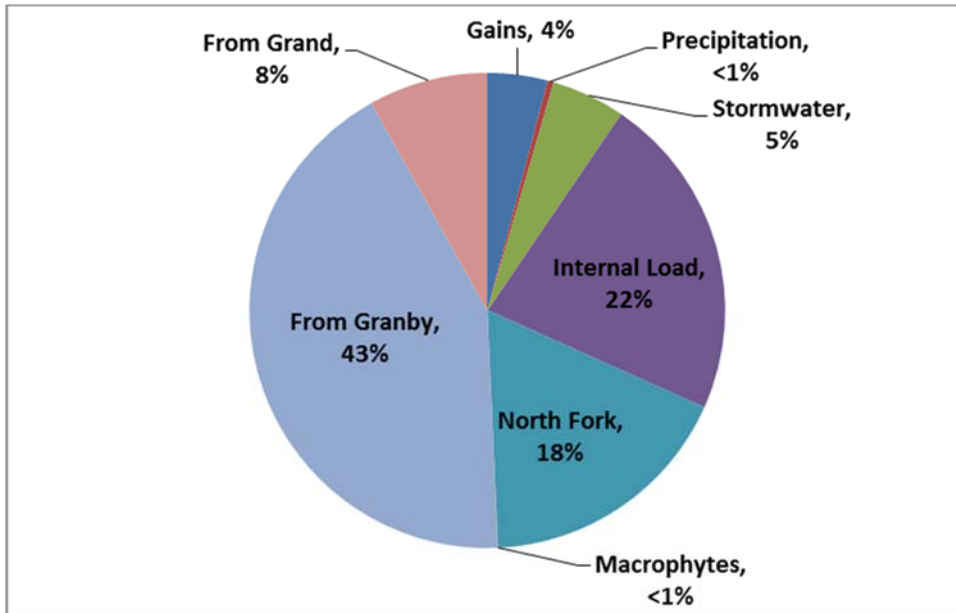


Figure Sup-2. Average Annual Total Phosphorus Load into Shadow Mountain Reservoir
 (2007-2010 Average, Total = 12,085 kg/yr)

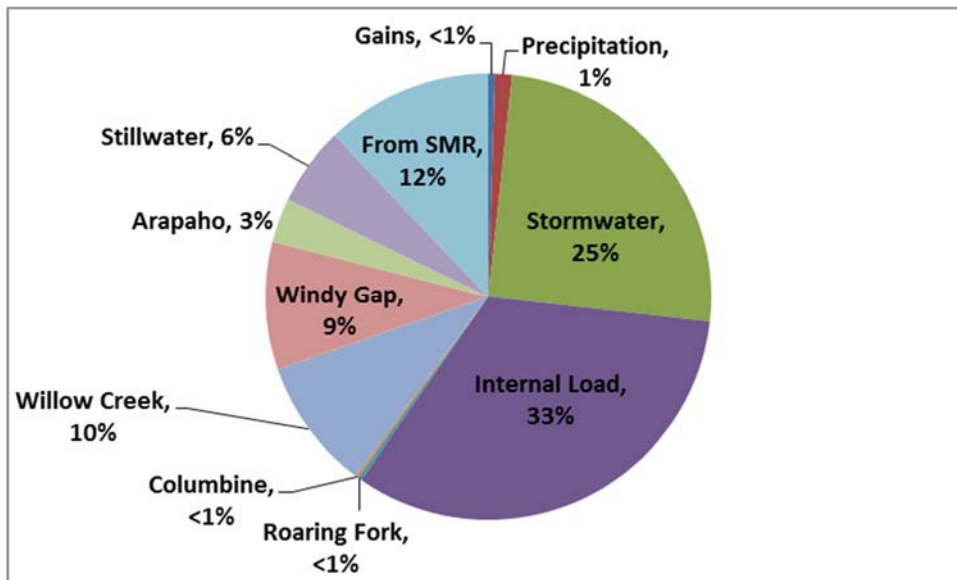


Figure Sup-3. Average Annual Total Phosphorus Load into Granby Reservoir (2007-2010 Average, Total = 22,802 kg/yr)

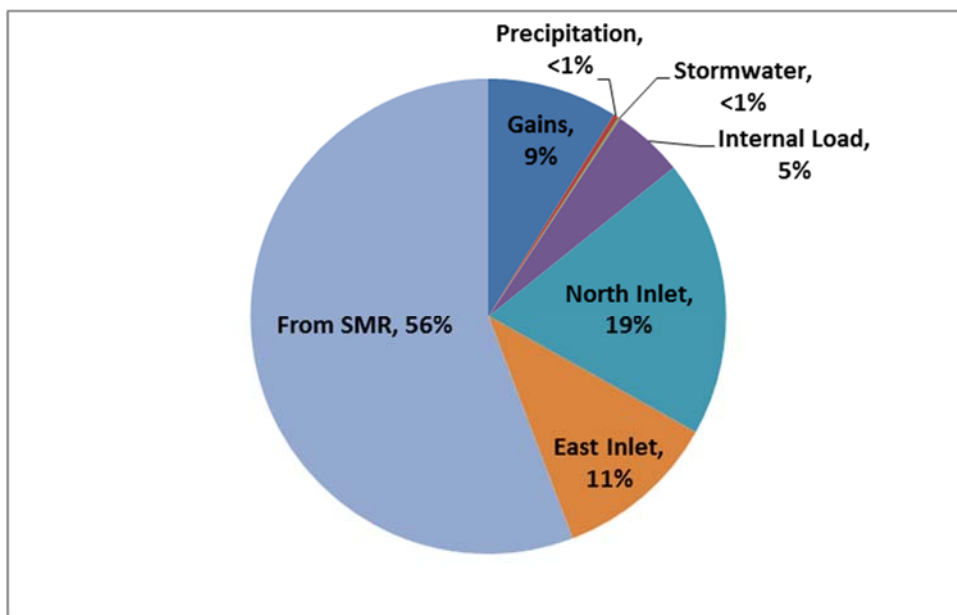


Figure Sup-4. Average Annual Total Phosphorus Load into Grand Lake (2011, Total = 6,506 kg/yr)

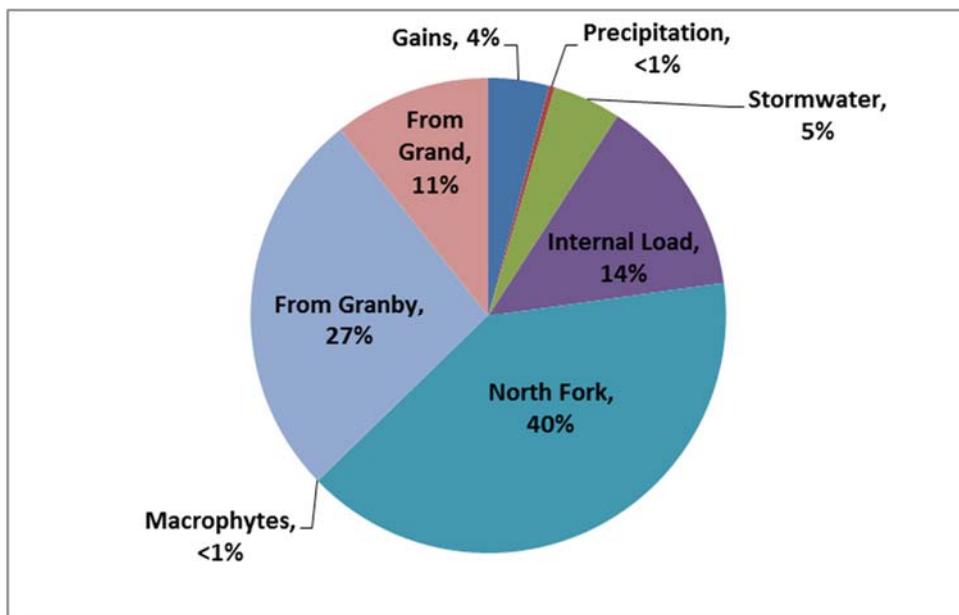


Figure Sup-5. Average Annual Total Phosphorus Load into Shadow Mountain Reservoir (2011, Total = 16,290 kg/yr)

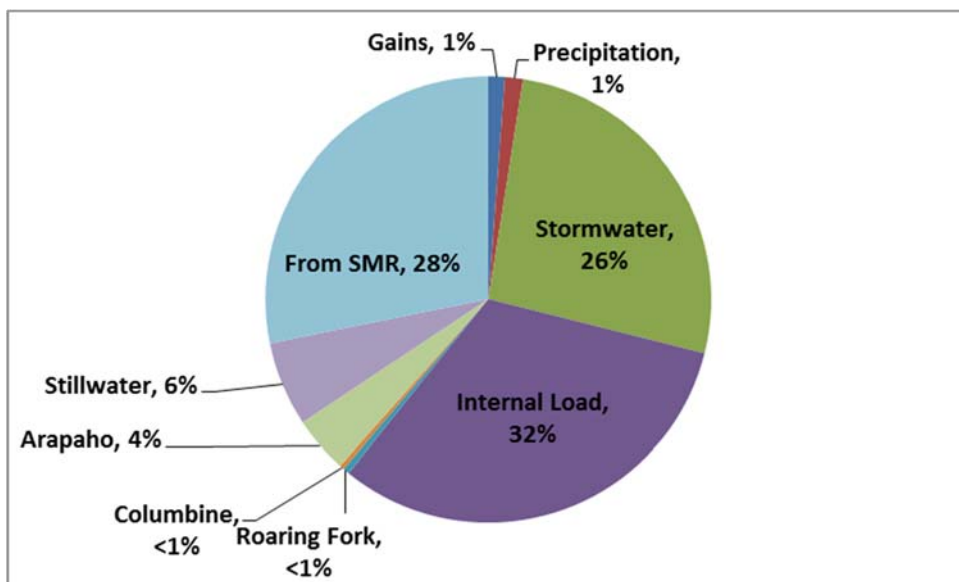


Figure Sup-6. Average Annual Total Phosphorus Load into Granby Reservoir (2011, Total = 27,012 kg/yr)

Table Sup-4. Annual Average Volume-Weighted Total Phosphorus Concentrations for Inflows (µg/L), 2007-2011. (Replaces Table 12 in Main Report)

Inflow Source	2007	2008	2009	2010	2011
North Inlet	9	14	11	11	12
East Inlet	7	11	9	10	10
North Fork	22	74	20	26	32
Arapaho Creek	7	10	8	8	8
Stillwater Creek	107	129	104	104	122
Roaring Fork	4	7	7	7	8
Columbine Creek	4	7	7	7	8
Windy Gap	53	85	58	46	-
Willow Creek	24	41	38	35	-

III. Total Nitrogen Loading

Total nitrogen¹ loads by water body are listed in Table Sup-5 through Table Sup-7. In addition, the relative annual distributions of loads for the previous four-year period (2007-2010) and for 2011 are displayed in Figures Sup-7 through Sup-12. Volume-weighted nitrogen concentrations are listed in Table Sup-8.

¹ Total nitrogen is computed by summing total Kjeldahl nitrogen (TKN) and nitrate + nitrite.

Table Sup-5. Total Nitrogen Loads (kg/yr) – Grand Lake

Source	2007	2008	2009	2010	2007-2010 Average	2011
North Inlet	15,116	19,684	17,344	15,206	16,838	26,511
East Inlet	10,103	11,798	9,550	9,659	10,277	17,196
From SMR	73,725	58,350	52,712	48,766	58,388	61,733
Gains	7,771	6,115	11,309	11,317	9,128	12,855
Precipitation	501	512	446	529	497	618
Stormwater	4,320	3,744	5,472	3,629	4,291	3,283
Internal Load	2,351	2,351	2,350	2,349	2,350	2,349
Total	113,885	102,553	99,183	91,454	101,769	124,544

Table Sup-6. Total Nitrogen Loads (kg/yr) – Shadow Mountain Reservoir

Source	2007	2008	2009	2010	2007-2010 Average	2011
North Fork	8,652	16,651	18,297	16,670	15,067	64,184
From Grand	17,809	10,084	27,562	26,676	20,533	40,192
From Granby	66,284	66,422	58,998	52,305	61,002	60,790
Gains	3,198	2,591	5,527	5,409	4,181	6,697
Precipitation	1,328	1,359	1,182	1,402	1,318	1,640
Stormwater	17,971	12,730	16,474	22,464	17,410	21,715
Internal Load	40,006	19,949	19,834	19,830	24,905	19,811
Macrophytes	25	25	25	25	25	25
Total	155,272	129,810	147,900	144,780	144,440	215,054

Table Sup-7. Total Nitrogen Loads (kg/yr) – Granby Reservoir

Source	2007	2008	2009	2010	2007-2010 Average	2011
Arapaho	15,724	21,313	15,121	15,209	16,842	28,976
Stillwater	4,463	7,397	5,253	4,826	5,485	6,065
Roaring Fork	1,176	1,987	1,742	1,582	1,622	2,719
Columbine	783	1,336	1,170	1,060	1,087	1,839
Windy Gap	18,918	29,170	13,751	2,964	16,201	0
Willow Creek	10,031	18,144	14,786	12,233	13,799	0
Gains	2,852	1,539	3,101	2,884	2,594	7,580
From SMR	27,168	26,442	51,715	51,859	39,296	107,997
Precipitation	7,163	7,330	6,379	7,566	7,109	8,847
Stormwater	51,011	36,132	46,760	63,763	49,416	61,638
Internal Load	37,307	37,754	40,877	46,361	40,575	49,246
Total	176,596	188,545	200,655	210,308	194,026	274,907

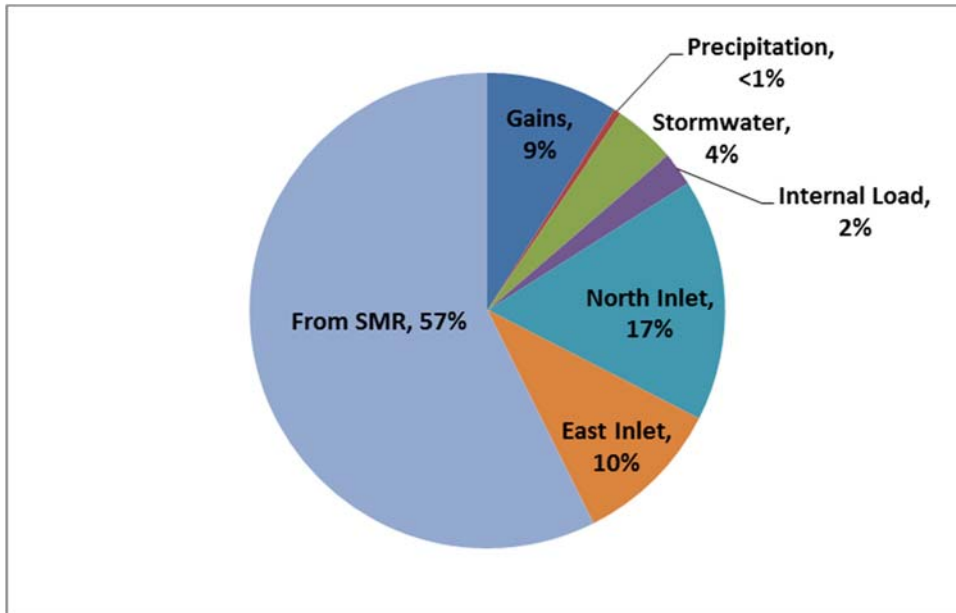


Figure Sup-7. Average Annual Total Nitrogen Load into Grand Lake
(2007-2010 Average, Total = 101,769 kg/yr)

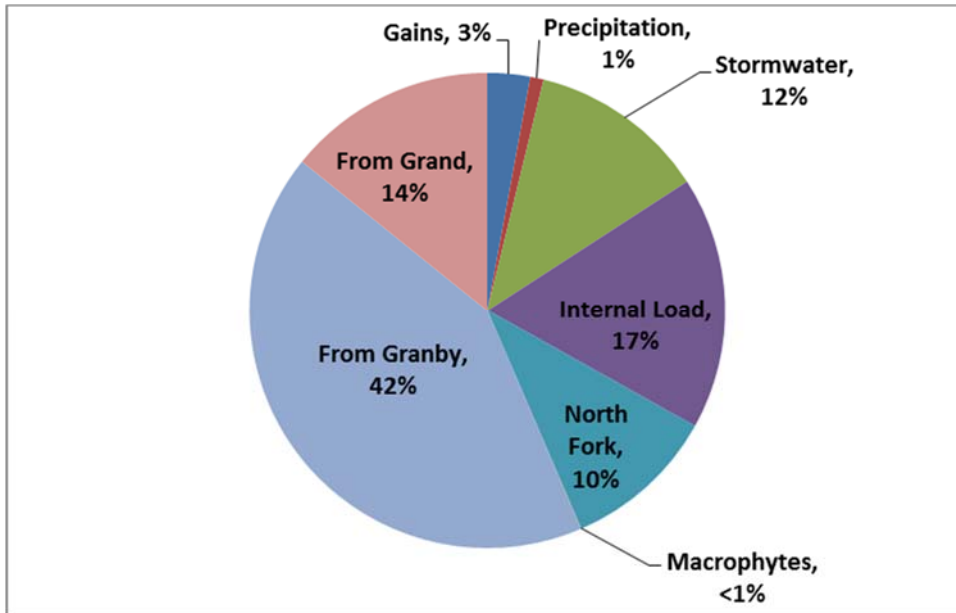


Figure Sup-8. Average Annual Total Nitrogen Load into Shadow Mountain Reservoir
(2007-2010 Average, Total =144,440 kg/yr)

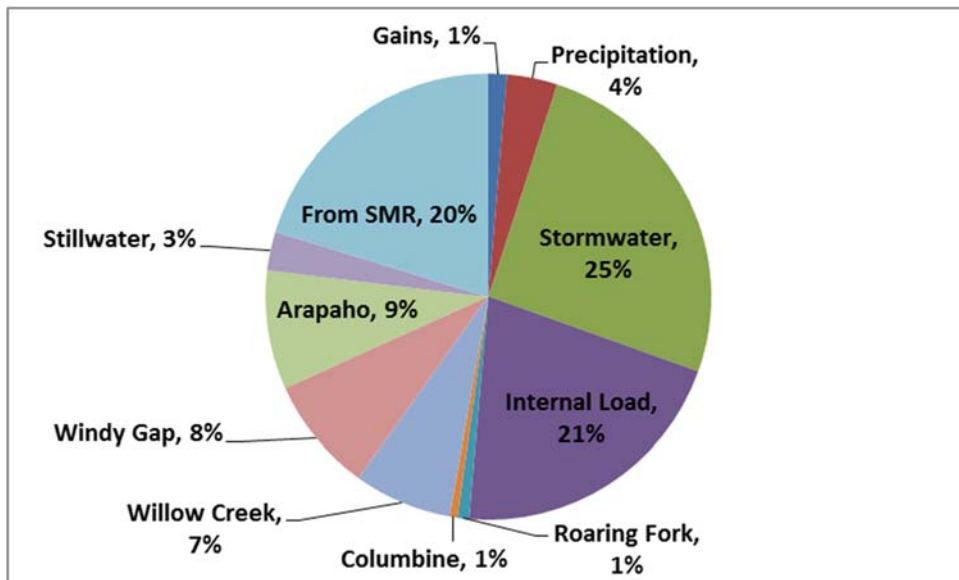


Figure Sup-9. Average Annual Total Nitrogen Load into Granby Reservoir
 (2007-2010 Average, Total = 194,026 kg/yr)

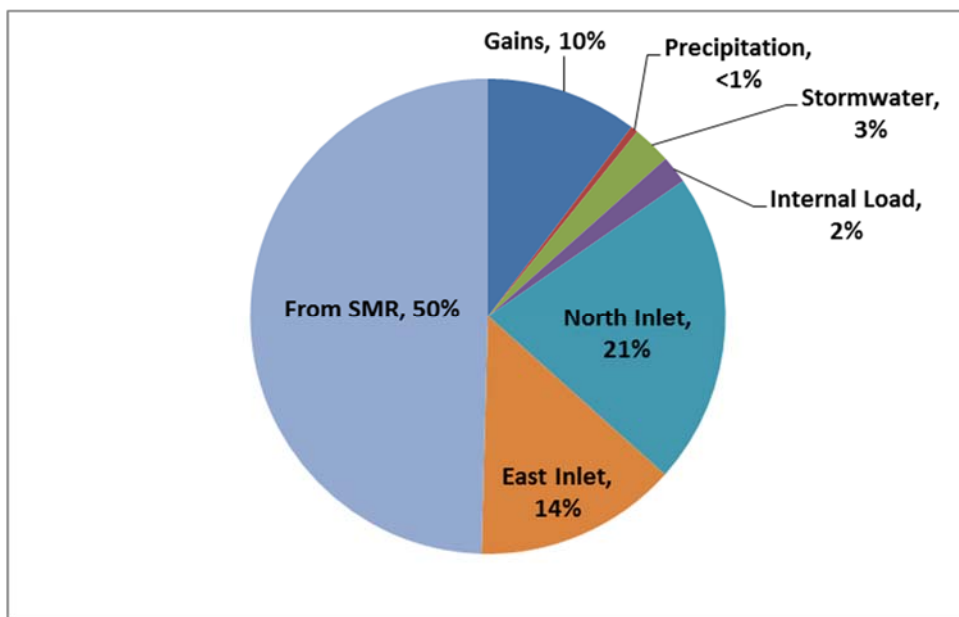


Figure Sup-10. Average Annual Total Nitrogen Load into Grand Lake
 (2011, Total = 124,544 kg/yr)

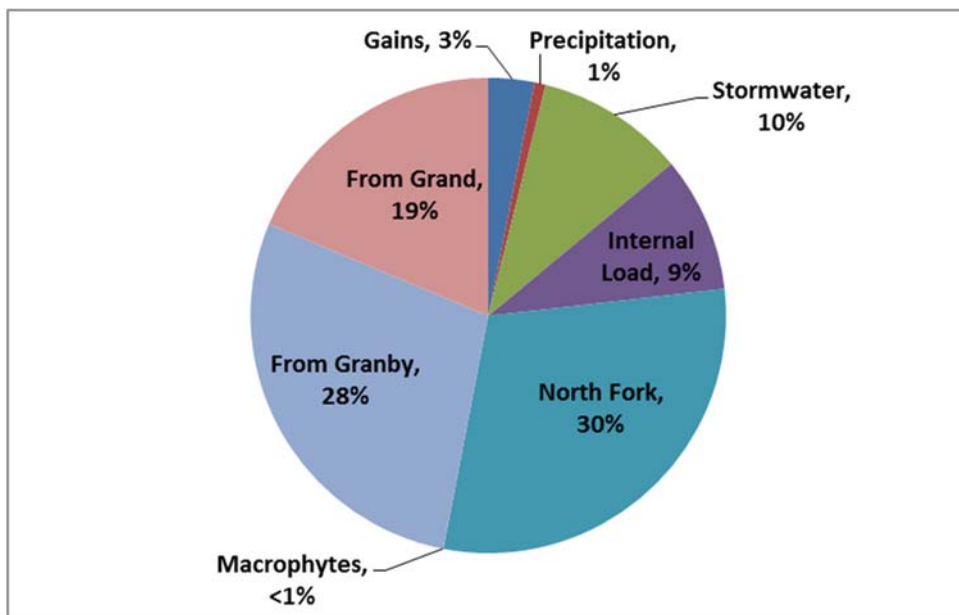


Figure Sup-11. Average Annual Total Nitrogen Load into Shadow Mountain Reservoir (2011, Total =215,054 kg/yr)

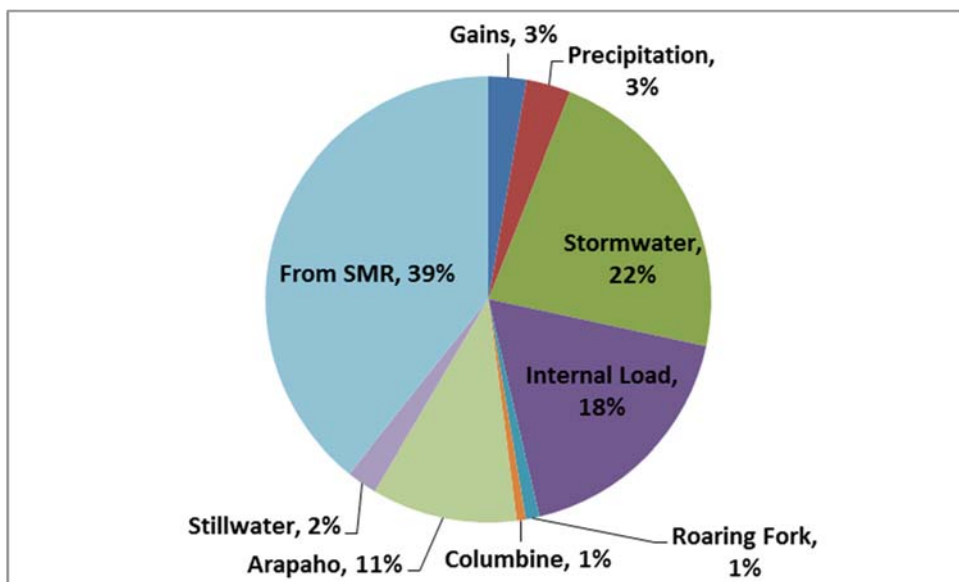


Figure Sup-12. Average Annual Total Nitrogen Load into Granby Reservoir (2011, Total = 274,907 kg/yr)

Table Sup-8. Annual Average Volume-Weighted Total Nitrogen Concentrations for Inflows (µg/L), 2007-2011. (Replaces Table 14 in Main Report)

Inflow Source	2007	2008	2009	2010	2011
North Inlet	264	259	237	239	252
East Inlet	251	243	185	235	245
North Fork	246	258	285	265	317
Arapaho Creek	217	208	159	188	204
Stillwater Creek	455	566	429	432	447
Roaring Fork	131	184	152	172	174
Columbine Creek	130	184	151	172	174
Windy Gap	374	705	423	356	-
Willow Creek	207	255	210	219	-