Revision of the Lake Elsinore & Canyon Lake Nutrient TMDL

CDM Smith
Team & Risk Sciences

Key Changes in the Final Draft

August 15, 2018

Lake Elsinore/Canyon Lake Task Force Meeting

CDM Smith

Presentation Outline

- Allocations updated to allow for increased volume
- Watershed runoff model extended for 2016, 2017
- Daily modeled internal flux
- Agricultural field nutrient washoff

Watershed Allocations

Update for Increased Allowable Volume

- Allowing for current runoff volume at reference nutrient concentration
- Increased volume to Canyon Lake and Lake Elsinore supports MUN, REC, and WARM uses

	WLA/LAs for Canyon Lake Main Lake		WLA/LAs for Canyon Lake East Bay		WLA/LAs for Local Lake Elsinore		LA for Canyon Lake Overflow to Lake Elsinore	
	TP (kg/yr)	TN (kg/yr)	TP (kg/yr)	TN (kg/yr)	TP (kg/yr)	TN (kg/yr)	TP (kg/yr)	TN (kg/yr)
Increased Runoff	1,149	3,304	562	1,617	794	2,283	3,050	8,753
No impervious area	971	2,791	437	1,255	738	2,121	2,620	7,532

Basis for Compliance Demonstration

Approach 3 – Average concentration (10 yrs) of watershed runoff samples

Step 1. Compile 10 years of wet weather composite sample concentrations

Year	Storm 1 TP (mg/L)	Storm 2 TP (mg/L)	Storm 3 TP (mg/L)	Storm 1 TN (mg/L)	Storm 2 TN (mg/L)	Storm 3 TN (mg/L)
Year 1	0.47	0.71	0.41	2.80	2.40	1.73
Year 2	0.40	0.63	0.53	3.20	3.10	2.45
Year 3	0.38	0.52	1.10	5.00	2.90	2.14
Year 4	0.36	0.64	0.52	5.10	3.50	2.64
Year 5	0.30	0.34	0.34	2.90	4.57	4.08
Year 6	0.31	0.41	0.31	2.20	4.92	3.69
Year 7	0.53	0.44	2.88 *	2.00	2.91	6.02 *
Year 8	0.49	0.57	0.40	1.60	3.16	1.48
Year 9	0.62	0.73	0.41	1.76	1.58	1.63
Year 10	0.88	0.52	0.52	4.20	1.71	1.83

Step 2. Compute 10-yr Average Nutrient Concentration in Runoff	TP (mg/L)	TN (mg/L)
	0.51	2.87
* Sample removed from average calculation because of influence of burned hillside erosion (TSS = 3163 mg/L)		
Step 3. Compute 10-yr Average Annual Runoff from Co-located Gauge (AF/yr):		1800
Step 4. Compute Nutrient Loads in Runoff (Step 2 * Step 3)	TP (kg/yr)	TN (kg/yr)
	1,132	6,369
Step 5. Compute Allowable Nutrient Load (Step 3 * Ref Conc)	TP (kg/yr)	TN (kg/yr)
	711	2,043
Step 6. Compute Nutrient Offset	TP (kg/yr)	TN (kg/yr)
Offset to be demonstrated with in-lake BMPs (Step 4 - Step 5)	422	4,326
Step 7. Independent In-lake BMP Offset Effectiveness Demonstration:	**422 kg/yr TP**	Compliance √ - TP only

Step 1. Compile 10 years of wet weather compsoite sample concentrations

Year	Storm 1 TP (mg/L)	Storm 2 TP (mg/L)	Storm 3 TP (mg/L)	Storm 1 TN (mg/L)	Storm 2 TN (mg/L)	Storm 3 TN (mg/L)
Year 1	0.27	0.51	0.21	2.00	1.60	0.93
Year 2	0.20	0.43	0.33	2.40	2.30	1.65
Year 3	0.18	0.32	0.90	4.20	2.10	1.34
Year 4	0.16	0.44	0.32	4.30	2.70	1.84
Year 5	0.10	0.14	0.14	2.10	3.77	3.28
Year 6	0.11	0.21	0.11	1.40	4.12	2.89
Year 7	0.33	0.24	2.88 *	1.20	2.11	6.02 *
Year 8	0.29	0.37	0.20	0.80	2.36	0.68
Year 9	0.42	0.53	0.21	0.96	0.78	0.83
Year 10	0.68	0.32	0.32	3.40	0.91	1.03
Step 2. Compute 10-yr Average		**0.31**			**2.07**	
* Sample removed from average calculation because of influence of burned hillside erosion (TSS = 3163 mg/L)						
Step 3. Determine whether one or both nutrients are reduced to reference concentration				Compliance √ - TP only		

Approach 4 – In-lake offsets

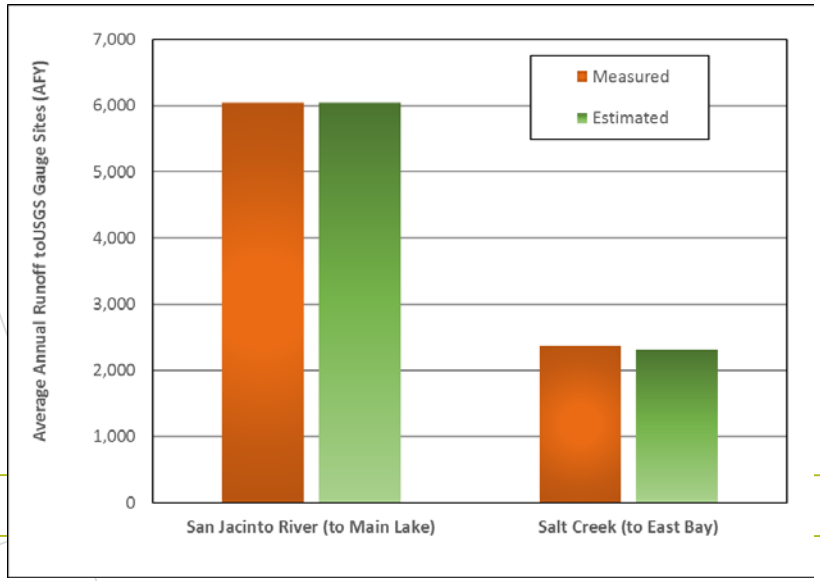
Watershed Model Extended to 2016, 2017

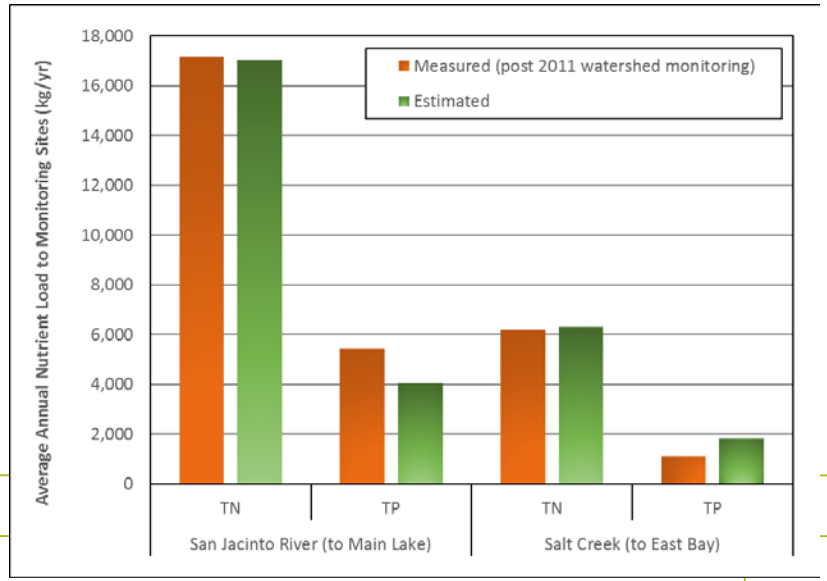
Watershed Model Extended

- Includes 2016-17 wet season

Station	Period of Record	Period of Record Average Rainfall (in/yr)	1948-2017 Average[1] Rainfall (in/yr)	2000-2017 Average[2] Rainfall (in/yr)	Subwatershed Zone
San Jacinto Station 186	1903 – Present	12.7	12.0	10.2	6, 7, 8, 9 (below 3,000 ft)
Elsinore NWS Station 67	1896 - Present	12.1	11.4	9.2	1, 2, 3
Perris CDF Station 152	1910 – Present	10.5	10.3	11.4	5
Winchester Station 248	1940 - Present	10.9	10.8	9.1	4
Idyllwild NWS Station 90	1929 – Present	25.8	25.7	22.1	7, 8, 9 (above 3,000 ft)

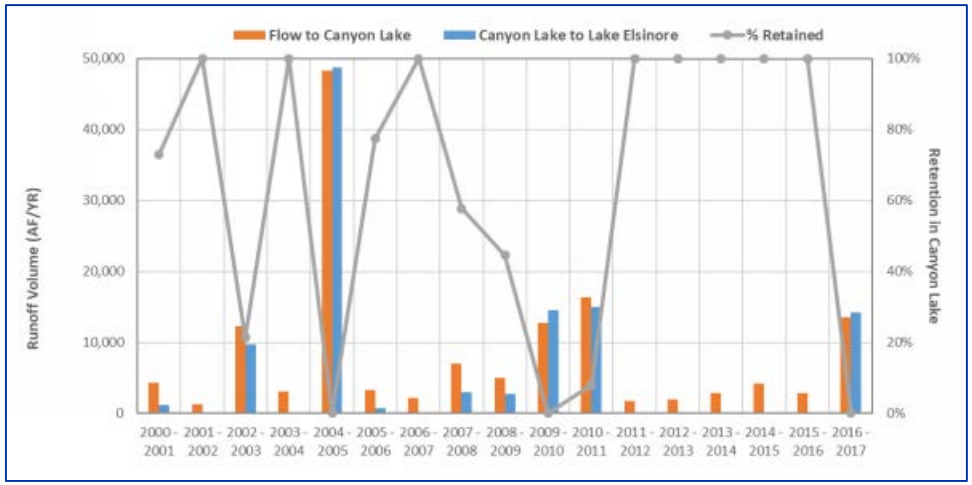
- Model fitting updated

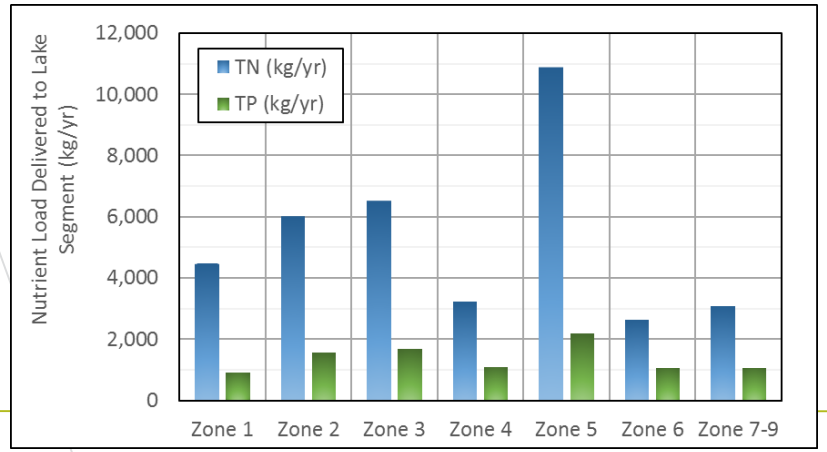


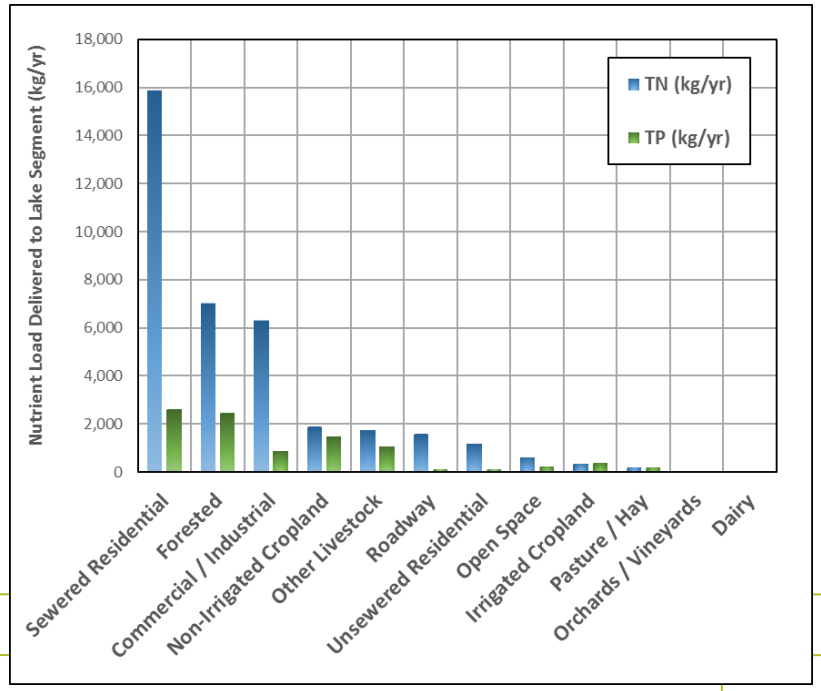


Watershed Model Extended

- Revised estimate of retention in Canyon Lake
- Mystic Lake overflow (add new years w/o spill)
- Long-term rainfall update for source assessment (1948-2017) runoff loads





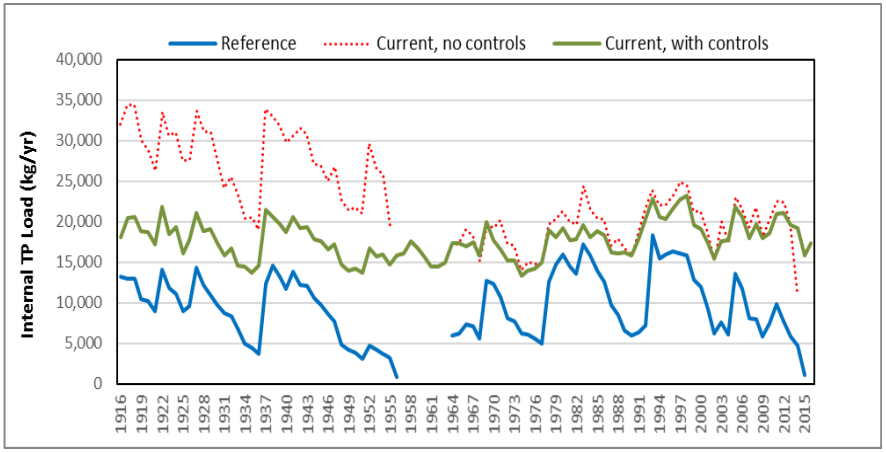


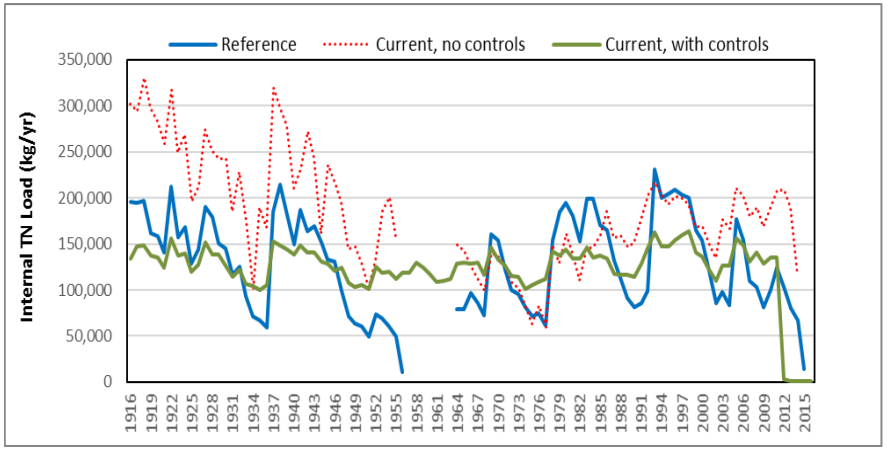
CDM Smith

Daily Sediment Nutrient Flux

CAEDYM simulation of sediment nutrient flux

- Flux rate parameter modulated daily by temperature and DO in bottom water, wetted area
- Reference scenario – flux rate parameter adjusted for predevelopment sediment enrichment
- With controls scenario - flux rate parameter adjusted for <125 fish/acre, LEAMS impact on bottom water DO changes daily flux





CAEDYM simulation of sediment nutrient flux

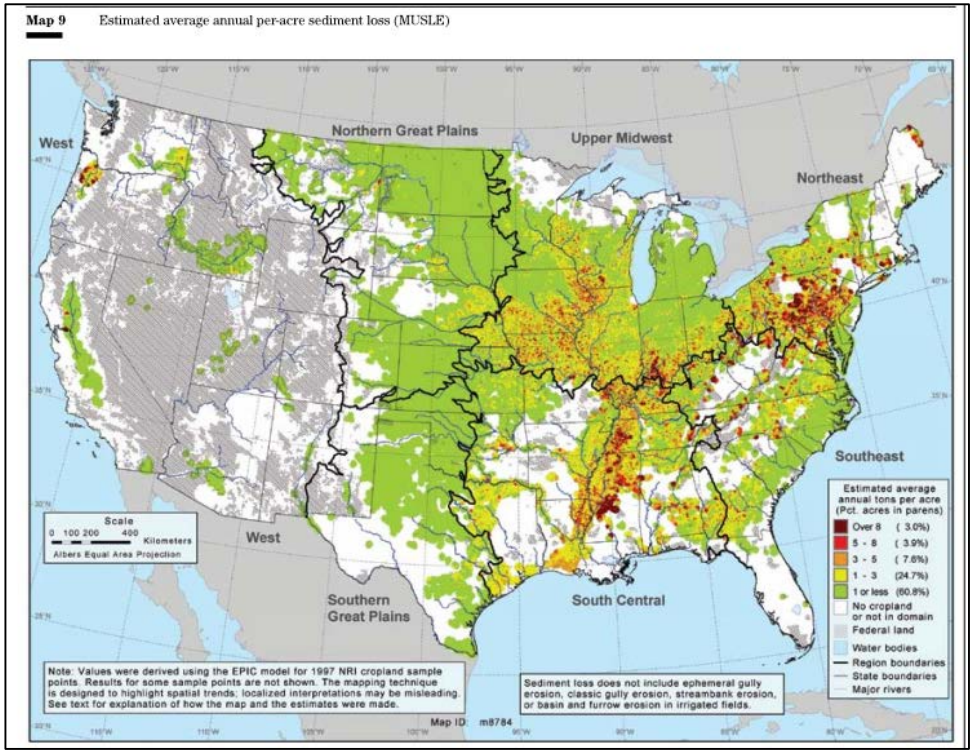
- Prior estimates by extrapolation of core-flux measurements (2004 TMDL basis)
- TMDL revision exports daily modeled flux to estimate average annual sediment nutrient flux
- Modeled flux accounts for diffusive exchange and physical resuspension
- Offsetting excess external load will reduce internal flux to reference levels over time

Lake	Reference		Current (No Controls)		Current (With Controls)	
	TP (kg/yr)	TN (kg/yr)	TP (kg/yr)	TN (kg/yr)	TP (kg/yr)	TN (kg/yr)
Lake Elsinore (1916-2016)	9,503	128,315	23,034	184,772	17,731	123,040
Canyon Lake (2007-2011)	1,190	3,955	2,997	11,023	n/a1	n/a1

Agricultural Field Nutrient Washoff

Agricultural land use nutrient washoff

- Multiple factors estimated in analysis
- Nutrient concentration in ag field soils (mg/kg) from preliminary sampling for CIG study (provided by WRCAC)
- Erosion of ag field soils by NRCS estimates for west
  - 0.5 tons/ac/yr for irrigated crops
  - 2.1 tons/ac/yr for non-irrigated crops



From NRCS, 2006. *Model Simulation of Soil Loss, Nutrient Loss, and Change in Soil Organic Carbon Associated with Crop Production*. U.S. Department of Agriculture. June 2006.

Agricultural land use nutrient washoff

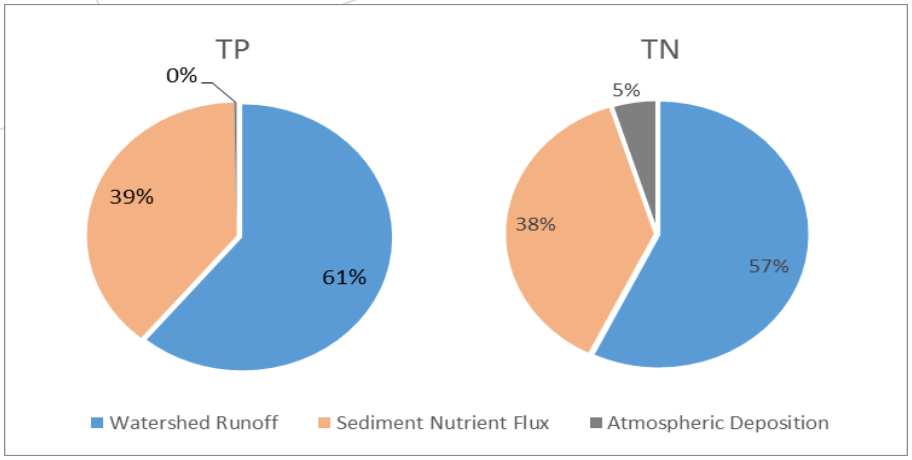
- Sediment delivery ratio – portion of eroded soil that is delivered to downstream waters (set to 5 percent)
  - Key calibration parameter in complex agricultural runoff models
  - Approximations from literature based on total watershed area
- Wet weather sampling data needed to validate estimated concentrations in source assessment

Used in source assessment model

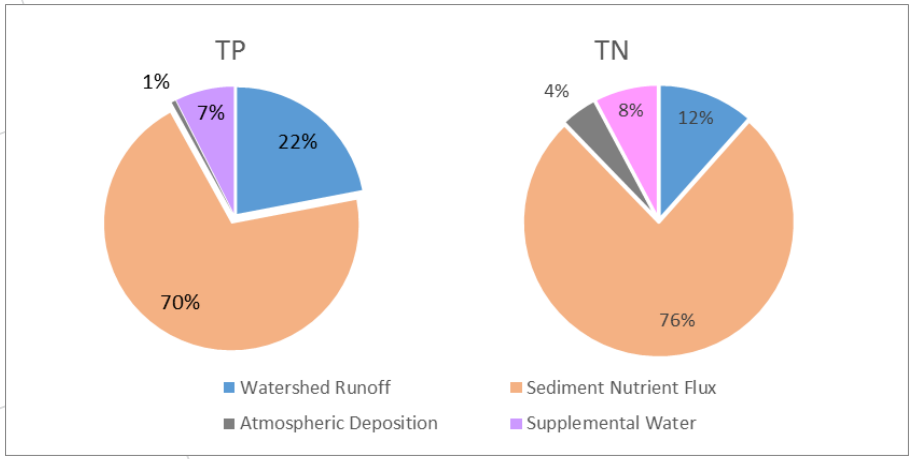
Land use	Pervious land Runoff (in/yr)	Soil Erosion (tons/ac /yr)	Sediment Delivery Ratio	P in Soils (ppm)	TP Export (kg/ac /yr)	TP (mg/L)	TKN in soils (ppm)	TN Export (kg/ac /yr)	TN (mg/L)
Irrigated Cropland (with BMPs)	0.66	0.5	5%	1400	0.03	0.47	1300	0.03	0.43
Non-Irrigated Cropland	0.66	2.1	5%	1100	0.10	1.54	1400	0.13	1.96
Orchards / Vineyards (with BMPs)	0.66	0.5	5%	800	0.02	0.27	550	0.01	0.18
Pasture/Hay	0.66	2.1	5%	1400	0.13	1.96	1300	0.12	1.82

Summary

Source Assessment Summary

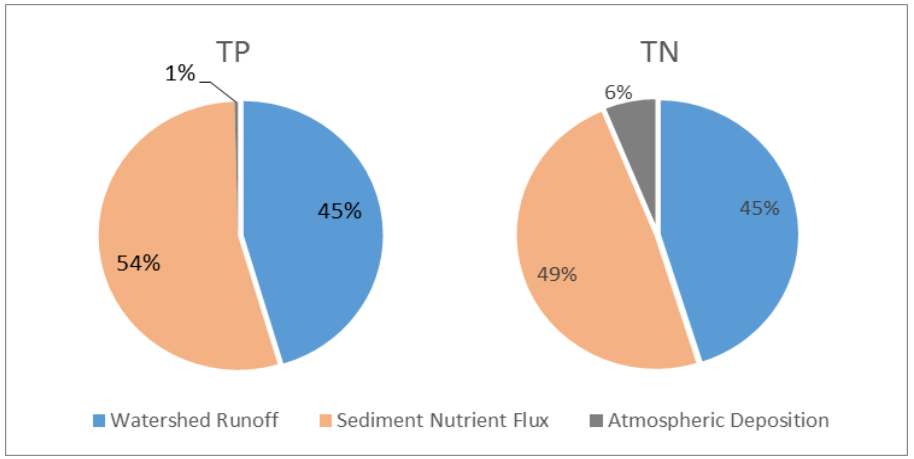


Canyon Lake East Bay



Lake Elsinore

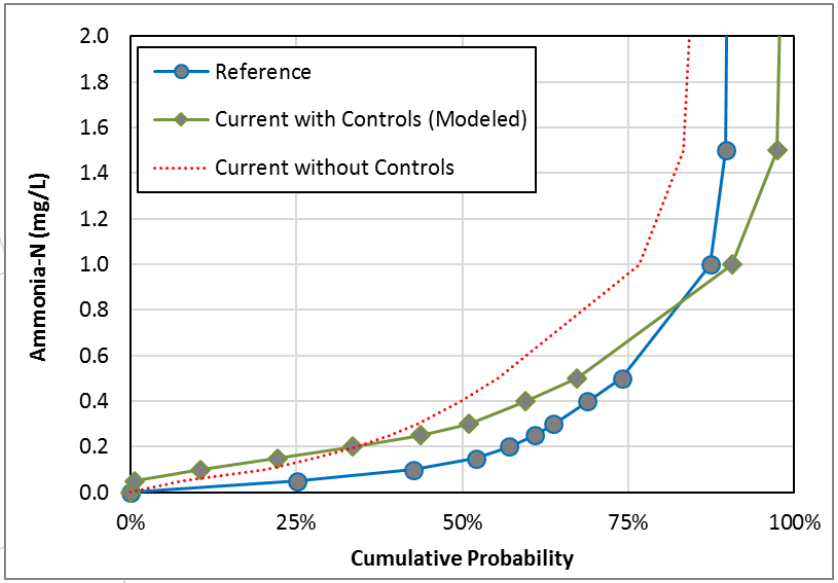
- Summary of nutrient sources for current conditions

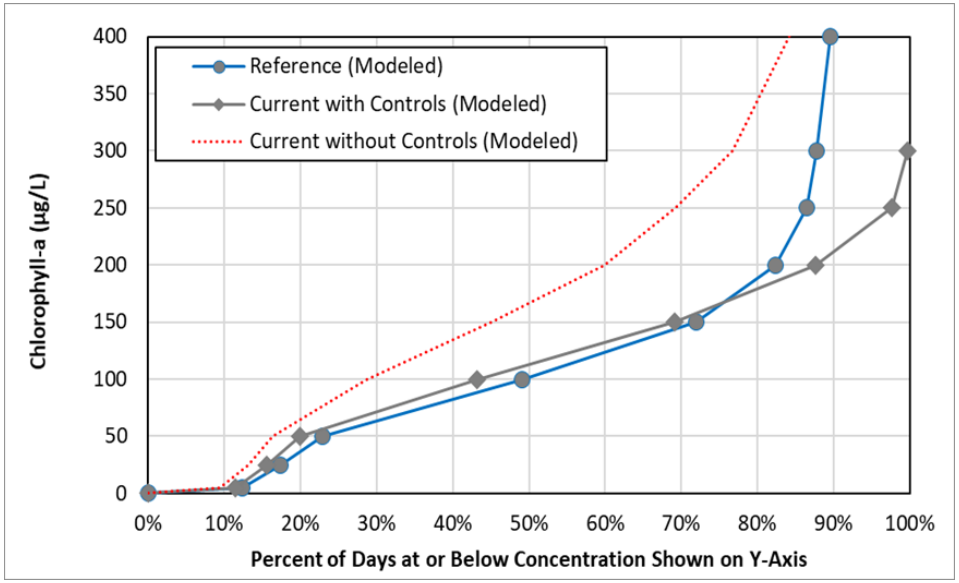


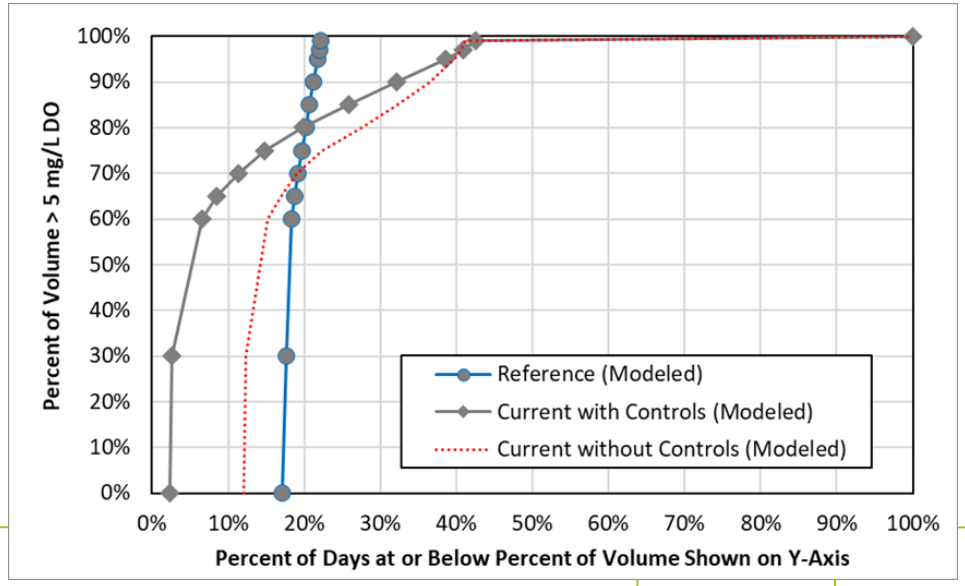
Canyon Lake Main Lake

Findings on Progress toward Compliance

- Comparison of current loading, with and without controls, to Lake Elsinore numeric target CDFs







CDM Smith

Findings on Progress toward Compliance

- Canyon Lake – single nutrient control strategy with alum providing offsets

Site	TP (kg/yr)	
	Main Lake	East Bay
1. Average External Load (1948-2017) (with existing watershed BMPs)[1]	1,916	1,110
2. Allowable Load[2]	1,149	562
3. Load Reduction Required (1 minus 2)	767	548
4. Average Annual Alum Additions (as dry alum)	215,000[2]	90,000
5. Estimated Nutrient Reduction from Alum Additions[3]	1,433	600
6. Unmet Load Reductions (3 minus 5)	-667	-52

[1] Load expressed as portion retained within Canyon Lake
[2] Includes alum additions to the North Ski Area
[3] Based on alum to sequestered P ratio of 150:1