Revision of the Lake Elsinore & Canyon Lake Nutrient TMDL

CDM Smith Team & Risk Sciences

Compliance Demonstration
Substitute Environmental Document
Economic Considerations

January 17, 2018

Lake Elsinore/Canyon Lake Task Force Meeting

RISK SCIENCES

CDM Smith

Presentation Outline

- Demonstration of Compliance
- Economic Analysis & CEQA
- Source Assessment & Allocation Updates

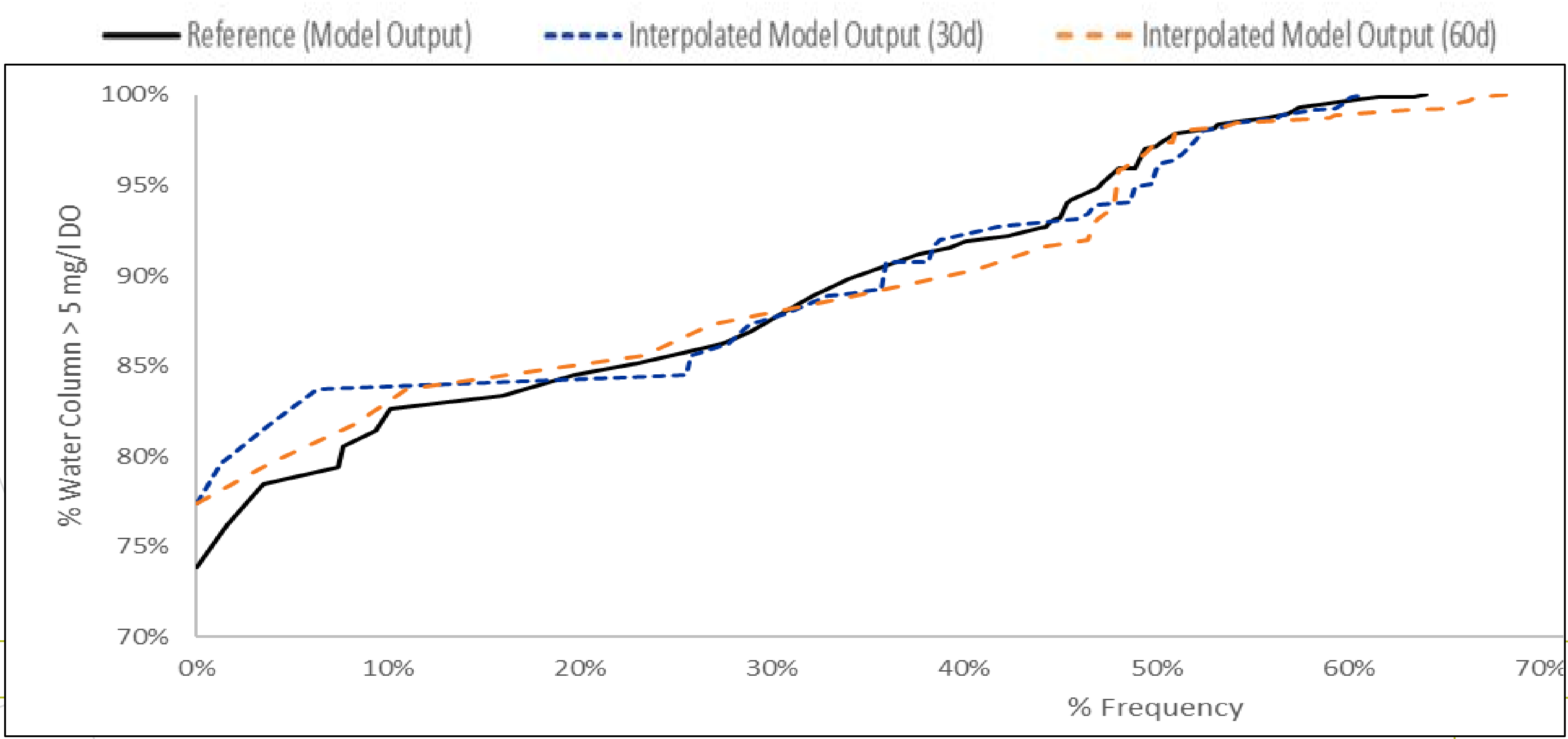
Compliance Demonstration

Multiple Paths to Compliance

- Five approaches for demonstrating progress toward TMDL compliance
- Two involve response targets
  - Requires all sources with WLA/LA to address excess nutrient loads to meet in-lake numeric targets
- Three involve nutrient mass loading
  - Can be used at three primary lake inflow locations or downstream of jurisdictional areas

Approach 1 - Numeric Targets

- CDFs for 10 years of in-lake monitoring data equal or better than numeric target CDF
- Bimonthly vertical profile data used to develop CDFs for comparison to numeric target



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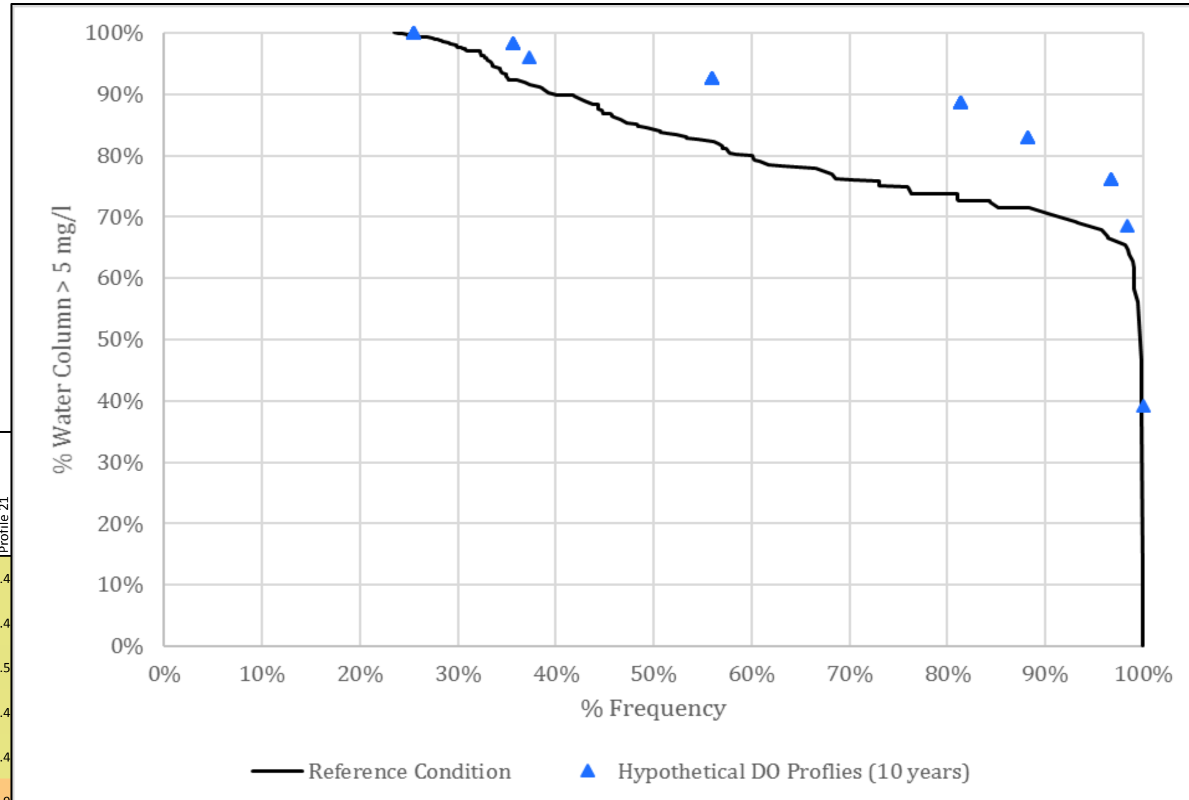
Approach 1 - Numeric Targets

- Example – Dissolved oxygen in Canyon Lake Main Lake

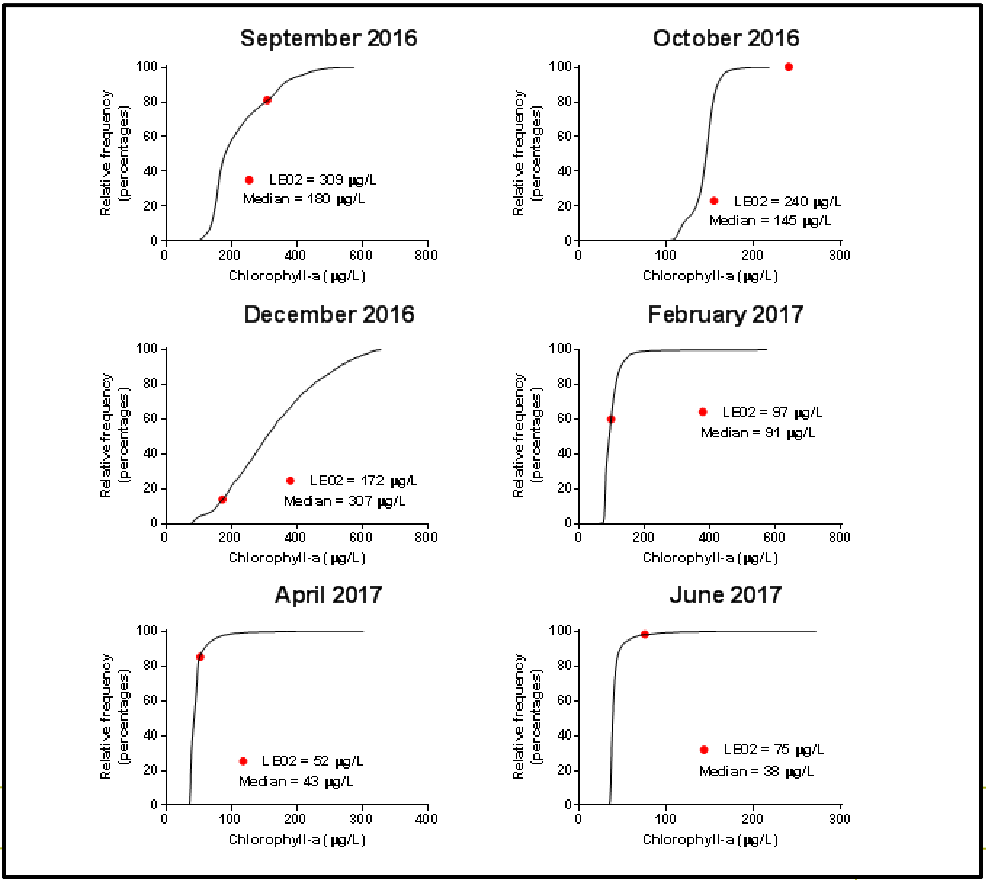


Depth (m)	Profile 1	Profile 2	Profile 3	Profile 4	Profile 5	Profile 6	Profile 7	Profile 8	Profile 9	Profile 10	Profile 11	Profile 12	Profile 13	Profile 14	Profile 15	Profile 16	Profile 17	Profile 18	Profile 19	Profile 20	Profile 21
1	8.5	11.1	8.7	7.6	7.1	6.7	7.0	8.6	7.6	6.9	6.3	6.5	6.5	7.6	7.8	7.3	7.0	6.7	7.4	7.7	7.4
2	8.5	11.1	8.7	7.6	7.1	6.7	7.0	8.6	7.6	6.9	6.3	6.5	6.6	7.6	7.8	7.3	7.1	6.7	7.4	7.7	7.4
3	8.5	11.1	8.7	7.6	7.1	6.7	7.0	8.6	7.6	6.9	6.4	6.5	6.6	7.5	7.8	7.3	7.1	6.7	7.4	7.7	7.5
4	8.5	11.2	8.7	7.6	7.1	6.7	7.0	8.3	7.6	7.0	6.4	6.6	6.5	7.3	7.8	7.3	7.1	6.7	7.4	7.7	7.4
5	8.5	11.2	8.7	7.6	7.0	6.7	7.0	8.2	7.6	7.0	6.4	6.6	6.5	7.2	7.8	6.6	6.6	6.7	7.4	7.6	7.4
6	8.5	11.1	8.6	7.5	6.6	6.7	7.0	8.1	6.9	6.2	6.4	6.6	6.5	6.9	7.4	7.6	6.0	6.7	7.4	6.9	4.9
7	8.5	10.8	8.4	6.4	6.4	6.7	7.0	7.4	5.9	6.0	6.3	6.6	6.6	6.6	6.5	6.0	6.8	6.7	7.4	7.7	4.0
8	8.5	9.0	7.7	6.2	6.1	6.7	7.1	6.5	4.0	5.5	6.4	6.6	6.5	6.4	6.5	6.0	6.5	6.7	7.4	7.4	1.6
9	8.5	7.7	6.5	5.5	6.4	6.6	7.0	6.3	3.5	1.0	6.0	6.4	6.4	7.4	6.5	5.8	6.3	6.6	7.4	7.3	0.8
10	8.5	7.9	6.9	3.9	1.6	6.4	7.0	6.4	4.1	0.5	1.0	6.6	6.4	5.7	6.0	0.2	6.2	6.4	7.2	7.5	1.3
11	8.5	7.7	5.9	2.7	0.3	6.4	7.0	6.3	3.6	0.5	0.5	3.1	6.5	4.5	5.0	0.0	0.0	6.4	7.2	7.3	1.1
12	8.5	7.6	5.4	2.3	0.2	6.1	7.0	6.2	3.1	0.1	0.5	0.3	6.5	4.2	1.2	0.0	0.0	6.9	7.2	7.2	1.0
13	8.5	7.6	6.2	2.9	0.4	3.6	7.0	6.1	3.4	0.2	0.0	0.0	6.5	4.5	1.4	0.0	0.0	0.6	4.0	7.1	1.5
14	8.5	7.0	5.7	1.8	0.1	0.2	7.0	7.4	2.8	0.0	0.0	0.0	6.4	3.9	0.7	0.0	0.0	0.0	4.0	6.7	0.9

Depth (m)																																							
7	6.0	6.2	6.5	7.6	7.8	6.9	7.1	6.4	7.1	8.7	11.1	8.6	6.6	6.5	6.9	7.2	7.5	6.1	6.2	6.5	6.7	6.7	6.7	6.7	6.2	7.0	6.9	7.6	7.9	4.1	6.2	6.3	6.7	7.8	8.0	7.1	7.3	6.6	7.3
8	3.9	5.8	6.5	7.6	7.4	6.3	7.0	5.0	7.1	8.7	9.2	7.9	6.4	6.3	6.9	7.3	6.7	4.1	5.6	6.5	6.7	6.7	6.5	6.7	6.2	6.7	6.9	7.6	7.6	1.6	4.0	5.9	6.7	7.8	7.6	6.5	7.2	5.1	7.3
9	3.5	5.7	6.3	7.6	7.3	6.2	4.0	4.9	6.8	8.7	7.9	6.6	5.6	6.6	6.8	7.2	6.4	3.6	1.0	6.2	6.6	6.6	7.6	6.7	5.9	6.5	6.7	7.5	7.5	0.8	3.6	5.8	6.4	7.7	7.5	6.4	4.1	5.0	7.0
10	3.0	0.0	5.3	7.4	4.2	3.0	3.5	4.8	6.1	8.7	8.0	7.1	4.0	1.7	6.6	7.1	6.6	4.2	0.5	1.0	6.8	6.6	5.9	6.2	0.2	6.4	6.6	7.4	7.7	1.3	3.1	0.0	5.4	7.6	4.3	3.1	3.6	4.9	6.2
11	0.0	0.0	2.7	7.4	3.9	2.9	3.2	4.0	3.2	8.7	7.9	6.0	2.8	0.3	6.6	7.2	6.4	3.7	0.5	0.5	3.2	6.6	4.6	5.1	0.0	0.0	6.5	7.4	7.5	1.1	0.0	0.0	2.7	7.6	4.0	3.0	3.3	4.1	3.3
12	0.0	0.0	0.0	7.4	3.8	2.2	0.0	3.2	0.1	8.7	7.7	5.5	2.4	0.2	6.3	7.2	6.3	3.2	0.2	0.5	0.3	6.6	4.3	1.2	0.0	0.0	7.1	7.4	7.3	1.0	0.0	0.0	0.0	7.6	3.9	2.3	0.0	3.3	0.1
13	0.0	0.0	0.0	7.4	3.8	0.0	0.0	0.0	0.0	8.7	7.8	6.4	3.0	0.4	3.7	7.2	6.3	3.5	0.2	0.0	0.0	6.6	4.6	1.4	0.0	0.0	0.7	4.1	7.3	1.5	0.0	0.0	0.0	7.6	3.9	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	7.4	3.6	0.0	0.0	0.0	0.0	8.7	7.2	5.8	1.9	0.1	0.2	7.2	7.6	2.9	0.0	0.0	0.0	6.6	4.0	0.7	0.0	0.0	0.0	4.1	6.9	0.9	0.0	0.0	0.0	7.6	3.6	0.0	0.0	0.0	0.0

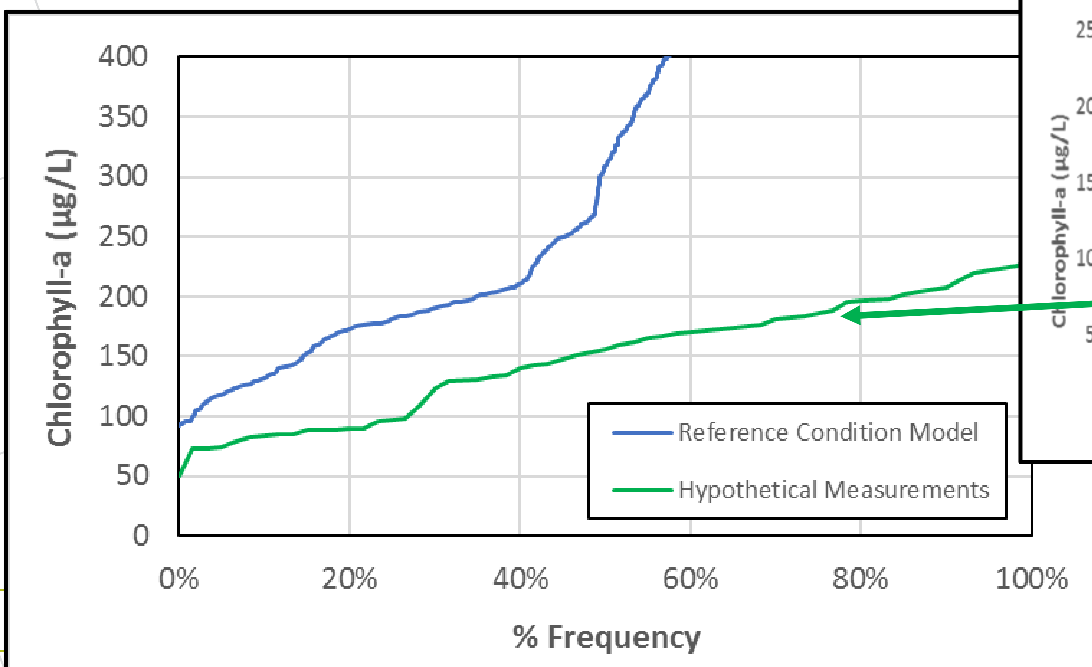
Approach 2 – Reference Condition Model

- CDFs of in-lake water quality monitoring data are equal to or better than model results for the reference scenario over the same period
- Run lake WQ model for preceding ten year period for reference condition – plot as CDF
- Satellite image provide estimates for lake-wide average chlorophyll-a

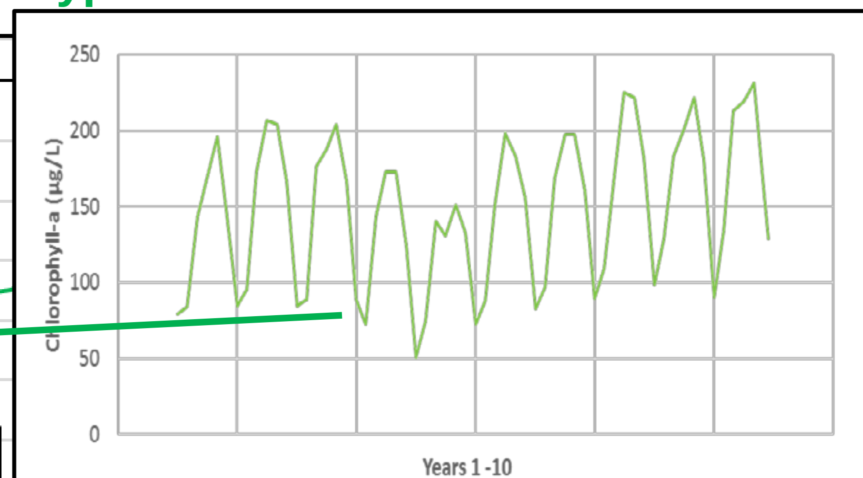


Approach 2 – Reference Condition Model

- Example – Chlorophyll-a in Lake Elsinore
  - Spatially averaged surface chlorophyll-a from 10 years of continuous satellite images plotted as CDF (green line)
  - Daily modeling results for same 10 year period plotted as CDF (blue line)



Hypothetical data



Approach 3 - External Loads

- Average TP or TN concentration less than 0.32 mg/L TP or 0.92 mg/L TN
- Example – Average TP in Salt Creek over 10 years of watershed data is less than 0.32 mg/L
- Allowing for consideration of outliers – e.g samples that may be influenced by fire in undeveloped canyons

Example: Given composite sample TP concentration data from any station over ten years (3 storms/yr)				
	Year	**Storm 1 TP (mg/L)**	**Storm 2 TP (mg/L)**	**Storm 3 TP (mg/L)**
Given:	Year 1	0.27	0.51	0.21
Given:	Year 2	0.20	0.43	0.33
Given:	Year 3	0.18	0.32	0.90
Given:	Year 4	0.16	0.44	0.32
Given:	Year 5	0.10	0.14	0.14
Given:	Year 6	0.11	0.21	0.11
Given:	Year 7	0.33	0.24	
Given:	Year 8	0.29	0.37	0.20
Given:	Year 9	0.42	0.53	0.21
Given:	Year 10	0.68	0.32	0.32
Compute:	10-yr Average TP less than 0.32 mg/L			**0.31**
Note: Water quality samples that may be influenced by significant erosion of undeveloped hillslopes in wet seasons following a fire disturbance may be removed from basis for calculating the 10-yr rolling average				

Approach 4 – In-lake Offsets

- Meet LA/WLAs by offsetting nutrient loads in excess of reference conditions over the same hydrologic period
- Example – TP in San Jacinto River with offset in Canyon Lake Main Lake

Example: Given composite sample TP concentration (3 storms/yr) and runoff volume data in any single year		
	Variable	**Amount**
Given:	Annual Runoff (AF)	1,800
Given:	Storm 1 TP (mg/L)	0.39
Given:	Storm 2 TP (mg/L)	0.74
Given:	Storm 3 TP (mg/L)	0.49
Compute:	Average TP (mg/L)	0.54
Compute :	Measured TP Load (kg/yr)	1,199
Compute:	Reference TP Load (kg/yr)	711
Next, demonstrate:	TP offset to be achieved with in-lake BMPs (kg/yr) [1]	586
1) Includes margin of safety factor for in-lake offsets of 1.2		

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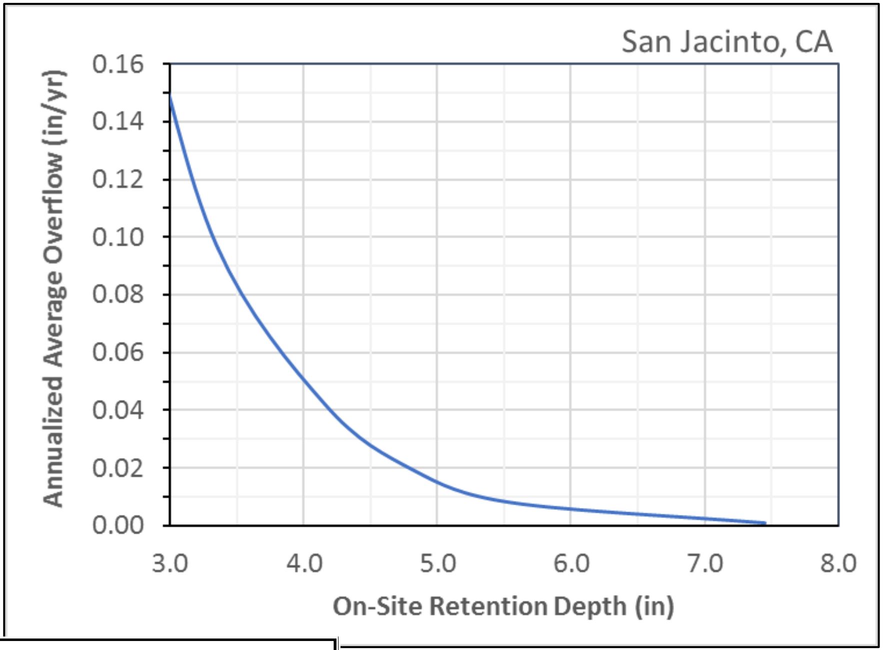
Approach 5 – Extreme event offset

- Document on-site retention for all rainfall up to a design event depth
- Use extreme rainfall analysis to estimate annualized overflow volume over a long-term planning horizon
- Pay as you spill not an option – no in-lake controls can offset the extreme event load in a single year
- Assumes no downstream nutrient retention during extreme events
- Annualize overflow nutrient load compared to reference condition to estimate offset

Annual Return Interval (yr)	Atlas 14 24-hr Rainfall (inches)
2	2.13
5	2.78
10	3.35
25	4.16
50	4.83
100	5.55
200	6.32
500	7.45
1000	8.39

Approach 5 – Extreme event offset

- Example – CAFO in Salt Creek watershed
- Given all runoff up to 25 year return period rainfall is retained on site
- Statistical analysis of extreme rainfall



Example: CAFO in Salt Creek watershed with all runoff up to 25-year storm event retained on site

	Variable	Amount
Given:	On-site Rainfall Retention Capacity (in/event)	4.16
Given:	Site acres	70
Given:	TP in site runoff (mg/L)	9.1
Compute:	Annualized overflow depth - from curve (in/yr)	0.04
Compute :	Estimated Annualized Overflow TP Load (kg/yr)	2.6
Compute:	Reference TP Load (kg/yr)	1.8
Next, demonstrate:	TP offset to be achieved with in-lake BMPs (kg/yr) [1]	1.0

1) Includes margin of safety factor for in-lake offsets of 1.2

Single Nutrient Control

- Mass based approaches to compliance may involve single nutrient control
  - Reduce nitrogen OR phosphorus to limit algae growth
  - Ex. alum for P control in Canyon Lake
- If relying on single nutrient control as a method to demonstrate compliance, necessary to also demonstrate effective control of response variables

Economic Considerations and CEQA

Substitute Environmental Document

- Alternatives involving specific implementation options cannot be evaluated in context of water quality regulation
- Alternative
  - No action = current TMDL
  - TMDL revision
- CEQA - both alternatives will improve water quality

Economic Analysis in TMDL

- Economics must be considered in water quality regulations
  - Amending the Basin Plan to include a revised Canyon Lake / Lake Elsinore TMDL
- Water quality regulations set objectives and targets and allocations in TMDLs, but cannot prescribe HOW discharges will comply
  - Implementation actions in TMDL revision involves updating the CNRP and AgNMP
- Multiple implementation actions have already been taken to improve water quality – continuation of such actions is assumed to be economically feasible

Economic Analysis - Cost

- Approximation of costs for existing projects
- Approximations of costs for supplemental projects to show
  - Reasonably achievable paths to compliance with the TMDL revision
- Cost and value of water (stormwater, reclaimed water, potable supply)

Economic Analysis - Benefits

- Environmental and economic:
  - Recreation (e.g., boating and fishing)
  - Nonuser benefits (benefits not directly associated with activities on or near a water body; e.g., home value)
  - Diversionary uses (e.g. reducing risks to human health and decreased costs for municipal water supplies)

Source Assessment & Allocations

Source Assessment / Allocations Chapters

- Key Refinements
  - Mapping of sources, allocations, and load reductions from subwatersheds to lakes (August 2017 Task Force meeting)
  - Completion of internal load estimates for Lake Elsinore (November 2017 Task Force meeting)
  - Changes to CAFO source assessment (below)
  - Inclusion of CR&R site (below)
  - Refinement of agricultural EMCs (ongoing)

CAFO Source Assessment

- Nutrient concentrations from Integrated Regional Dairy Management Plan (Tetra Tech, 2009)
- New statistical method to estimate rainfall in excess of 25-year onsite retention capacity
- GEV distribution for extreme event occurrence

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25	4.16
50	4.83
100	5.55
200	6.32
500	7.45
1000	8.39

Annualizing potential overflows from extreme rainfall

CR&R Site

- Site plan includes on-site retention of greater than 100-yr rainfall event
  - Extremely high nutrient concentrations in leachate and within stockpiled material
  - Annualized overflow load from extreme events is minimal
- Inundation of site by SJR flood flows a much greater concern
  - On-site retention basin below flood stage – potential to be washed out
  - Mobilization of stockpiled material would amount to substantial load to Canyon Lake and Lake Elsinore
  - Worst case assumptions used to estimated annualized demand for offsetting extreme event washout

Extreme Events Floodplain