To: CREST Steering Committee and Working Technical Group

From: CREST Consulting Team

Re: DRAFT LA River Bacteria TMDL Targets Approach – For Discussion Only

Numeric targets identify specific goals for the Bacteria TMDL which equate to attainment of water quality standards and provide the basis for development of wasteload allocations. This document presents information on potential numeric targets for discussion. The early portion of this document presents **potential** draft language for the TMDL section, while the latter portion presents considerations for numeric targets during TMDL development and implementation.

Potential Language for TMDL Targets Section

The purpose of the LA River Bacteria TMDL is to protect users of recreational waters within the LA River Watershed. Monitoring of all waterborne pathogens is infeasible and therefore "indicators" are used to predict the presence of pathogens and/or fecal sources. To date, epidemiological studies and quantitative microbial risk assessment (QMRA) have been used to develop recreational water quality criteria given an accepted health risk. In the U.S., recreational water quality criteria are currently based on epidemiological studies that simultaneously measured densities of indicator bacteria (*E. coli*, fecal coliform, total coliform, and/or *Enterococcus*) and rates of highly-credible gastrointestinal illness in swimmers (Dufour, 1983; Cabelli et al., 1981; Haile et al., 1999). The federally-accepted health risk is 8 of 1000 (0.008) and 19 of 1000 (0.019) recreational users in fresh- and marine waters, respectively.

The science of recreational water quality is rapidly advancing. The federal BEACH Act (40 CFR 32.1) requires USEPA to conduct a *Criteria Development Plan* (R/7-097-432). The *Plan* includes epidemiological studies and quantitative microbial risk assessments (QMRAs) for fresh- and marine waters impacted by both point- and non-point sources. In 2012, USEPA shall develop new or alternative recreational water quality criteria for fresh- and marine waters in coastal states including California. The expected timeframe for implementation of this TMDL supports the use of indicators that evolve with the latest science of recreational water quality.

The Basin Plan currently includes REC-1 standards based on *E. coli* concentrations. Thus, the initial numeric targets for this TMDL will also be based on *E. coli*. During TMDL implementation, the state of the science will be used to evaluate the most appropriate indicator(s) to protect existing recreational uses, and the target for this TMDL may be revised by the Regional Board through a Basin Plan Amendment, if appropriate. This iterative evaluation of the utilized target shall include consideration of available USEPA criteria, epidemiological studies and/or QMRAs that are representative of site-specific conditions, conditions in natural/reference waters, and other relevant information. The indicator can be proposed either during a TMDL Phase or at the end of a TMDL Phase for consideration by the Regional Board.

As allowed by the Basin Plan, this TMDL uses a "reference system/anti-degradation approach" which means that on the basis of historical exceedance levels at reference system monitoring locations, a certain number of exceedances are permitted. The numeric target in the TMDL is

expressed as 'allowable exceedance days' of the utilized indicator since bacterial density and the frequency of exceedances is most relevant to public health. The USEPA allows states to select the most appropriate measure to express the TMDL; and allowable exceedance days are considered an 'appropriate measure' consistent with the definition in 40 CFR 130.2(i).

The number of allowable exceedance days is based on two criteria: (1) bacteriological water quality at any site is *at least* as good as at a designated reference site, and (2) there is no degradation of existing bacteriological water quality if historical water quality at a particular site is *better than* the designated reference sites. This approach recognizes that there are natural sources of bacteria that may cause or contribute to exceedances of the bacteriological WQOs (both SSM and geometric mean) and that it is not the intent of the Regional Board to require treatment or diversion of natural creeks or to require treatment of natural sources of bacteria. Additionally, this approach allows for natural waterbodies to not be placed on the 303(d) list as being impaired for indicator bacteria. This approach is consistent with the Bacteria TMDLs for Santa Monica Bay Beaches, Ballona Creek, and Malibu Creek.

Each LA River and tributary reach designated REC-1 will be assigned an allowable number of exceedance days of the TMDL target set on an annual basis based on rainfall conditions, namely:

1. Dry weather days
2. Wet-weather days

Wet weather is defined as days with 0.1 inch of rain or more plus three days following the rain event. However, note that REC-1 uses are suspended during the High Flow Suspension, which is applied to concrete-lined channels during days with greater than 0.5 inch of rain and the following 24 hours.

For this TMDL, *E. coli* data collected by the Southern California Coastal Water Research Program (SCCWRP) during multiple studies of inland freshwater sites were utilized to calculate natural exceedance probabilities. Using the SCCWRP datasets, the natural exceedance probabilities for the single sample maximum and the geometric means water quality objectivs (WQOs) were determined. Please see the separate Freshwater Exceedance Days Memo for details regarding the analysis of SCCWRP data. Also note the exceedance rate and number of days presented in this document may decrease significantly based on ongoing considerations presented in that memo. As shown in **Table 1**, to calculate the number of allowable exceedance days, the measured exceedance probability is multiplied by the number of days during a critical year, as follows:

Allowable Exceedance Days = WQO Exceedance Probability in Reference Watershed(s) x Number of Days during a Critical Year

For example, the single sample maximum (SSM) limit (235 MPN/100mL) exceedance rate during dry weather is 19.72% based on the SCCWRP dataset. Per the Santa Monica Bay Beaches TMDL there are 75 dry weather days during a 90^{th} percentile critical wet year, which corresponds to rainfall during the year 1993. Therefore, using the calculation methodology of previous TMDLs, the number of allowable wet weather exceedance days is 15 (75 days * 19.72%). It should be noted that if a TMDL waterbody exceeded WQOs less frequently than the

reference sites, then the allowable exceedance days would be "capped" at the existing exceedance rate.

The calculated number of exceedance days assumes that daily sampling is conducted. To determine the number of allowable exceedances for less frequent sampling, a ratio is used. For example, in the case of weekly sampling:

1. The number of weeks associated with a dry conditions is determined as follows:

   (290 dry weather days/365 total days) x 52 weeks = 41.32 dry weeks in a year.

2. The number of allowable dry weather weeks SSM exceedances is as follows:

   41.32 dry weather weeks x 7.36% SSM exceedance frequency = 3.

In the case of monthly sampling:

1. The number of months associated with a dry conditions is determined as follows:

   (290 dry weather days/365 total days) x 12 months = 9.53 dry months in a year.

2. The number of allowable dry weather month SSM exceedances is as follows:

   9.53 dry weather months x 7.36% SSM exceedance frequency = 1.

This is consistent with the approach used to calculate exceedance days in the Santa Monica Bay Beaches TMDL.

Based on the analyzed SCCWRP reference watershed data and the utilized approach to calculating allowable exceedance days, the numeric targets are shown in **Table 2**. Again, note that the exceedance rate and number of days presented in this document may decrease significantly based on considerations presented in the Freshwater Exceedance Days memo.

Table 1. Approach to Calculating Allowable Exceedance Days using SCCWRP Freshwater Reference Watershed Data[1,2]

Day Type	Number of Days during Critical Year	*E. coli* WQO based on REC Use Frequency (MPN/100mL)	WQO Exceedance Rate at Freshwater Reference Sites		Allowable Number of Exceedance Days based on Daily Sampling		Allowable Number of Exceedance Days based on Weekly Sampling		Allowable Number of Exceedance Days based on Monthly Sampling	
			SSM	30-day Geomean	SSM	30-day Geomean	SSM	30-day Geomean	SSM	30-day Geomean
Dry	290	SSM = 235 Geo = 126	7.36%	15.90%	22	47	3	7	1	2
Wet	75	SSM = 235 Geo = NA	19.72%	NA	15	NA	2	NA	1	NA

1 – The allowable exceedance rates listed herein may decrease significantly based on the utilized reference data (see the Freshwater Exceedance Days Memo).

2 – Consistent with the SMB Beaches TMDL, where the fractional remainder for the calculated allowable exceedance days (or weeks or months) exceeds 1/10th then the number of days are rounded up (e.g., 4.12 is rounded up to 5). In instances where the tenth decimal place for the allowable exceedance days (or weeks or months) is lower than 1/10th then the number of days are rounded down (e.g., 4.02 is rounded down to 4).

Table 2. Potential Numeric Targets/Exceedance Days for the LA River Bacteria TMDL

Weather Condition	Indicator[2]	Geometric Mean Limit[3] (MPN/100mL)	Single Sample Maximum Limit (MPN/100mL)	Annual Allowable Exceedance Days[1]	
				30-day Geometric Mean	Single Sample Maximum
Dry	*E. coli*	126	235	46 [6]	21 [7]
Wet[4,5]	*E. coli*	NA	235	NA	15 [8]

NA – not applicable. The geometric mean limit is not applicable to wet weather conditions as these conditions do no persist for a sufficient time for samples collected in this condition to be compared to a geometric mean. Additionally, wet weather samples are not included when calculating the geometric mean for dry weather. **← See Consideration Point #1**

1. The allowable number of exceedance days is calculated as the product of the reference watershed WQO exceedance rate and the number of days during a critical year. **← See Consideration Point #2 and Consideration Point #3**.
2. The utilized indicator and exceedance days may be revised through a Basin Plan Amendment if the state of the science suggests an alternative indicator more appropriately protects public health.
3. The geometric mean could be calculated as one of the following: rolling 30-day geometric mean, calendar month geometric mean, or seasonal geometric mean. **← See Consideration Point #4** When calculating the geometric mean, exceptionally high single samples may be removed to prevent continued exceedances after water quality conditions have returned to normal. **← See Consideration Point #5**
4. Days of 0.1 inch of rainfall or more plus three days following the rain event.
5. Targets do not apply during the High Flow Suspension, which applies to concrete-lined channels on days with greater than 0.5 inch of rainfall plus the following 24 hours. High flow suspension days result in reducing either the number of exceedance days or critical days used to calculate exceedance days **← See Consideration Point #6**
6. Assumes daily samples are collected, if weekly or monthly sampling was conducted then seven (7) and two (2) allowable exceedance days would apply, respectively.
7. Assumes daily samples are collected, if weekly or monthly sampling was conducted then three (3) and one (1) allowable exceedance days would apply, respectively.
8. Assumes daily samples are collected, if weekly or monthly sampling was conducted then one (2) and one (1) allowable exceedance days would apply, respectively.

CONSIDERATIONS FOR LA RIVER BACTERIA TMDL NUMERIC TARGETS

Development of Table 2 highlights several considerations for development and implementation of LA River Bacteria TMDL, as described below.

Consideration Point #1: Use of Wet Weather Data for Calculation of Geometric Means

Wet weather events in southern California are often of short duration. Thus, wet weather conditions do not persist for time periods that are long enough to allow for calculation of geometric means that are representative of storm events. In addition, recreational uses are much less frequent during wet weather events. Wet weather data could be excluded from geometric mean calculations with all geometric mean calculations based on data collected during dry weather.

> **For Consideration**: Should the geometric mean WQO be applicable during wet weather? Should geometric means only be calculated with dry weather data?

Consideration Point #2: Exceedances of Geometric Mean WQO and SSM during Dry Weather

Previous Bacteria TMDLs in Region 4 have neither allowed exceedances of the geometric mean WQO nor the SSM WQO during dry weather. This non-allowance, at least in part, is due to the fact that during dry weather the marine reference site Leo Carrillo Beach did not exceed these WQOs during the analyzed years. The freshwater reference sites, however, do exceed these WQOs.

> **For Consideration**: Should geometric mean exceedance days be allowed? Should exceedances days of the SSM WQO be allowed during dry weather?

Consideration Point #3: Determination of Critical Dry Year

The allowable exceedance days for the LA River Bacteria TMDL could use the same critical year of previous TMDLs. Application of a 90^{th} percentile wet year was chosen to ensure reference sites are not frequently exceeding the allowable exceedance days. It leads to an allowable number of dry weather exceedance days that is often relatively low. That is, most years have more dry days than the critical wet year (290 days). If a drier year were utilized for the calculation, a higher number of exceedance days would be allowed during dry weather.

> **For Consideration**: Should the number of dry days in the year be based on a critical wet year or a critical dry year? For instance, the same analysis could be conducted to determine the reference year for dry weather based on the 90^{th} percentile year in terms of dry weather days. Or, rather than using the same reference year to calculate the number of allowable exceedances for both wet weather and dry weather, should different years be used for dry and wet critical conditions?

Consideration Point #4: Temporal Calculation of the Geometric Mean

The Basin Plan includes bacteria WQOs for REC uses that are based on 30-day geometric mean concentrations. The USEPA criteria are based on geometric mean concentrations that were calculated seasonally during epidemiological studies. Implementation of the SMB Beaches Bacteria TMDL has relied on a rolling 30-day geometric mean WQO to date, but the stakeholder

process for the TMDL reopener is considering use of a calendar month geometric mean. In part, a calendar as opposed to rolling geometric mean calculation is being considered because a rolling geometric mean can put implementing agencies into "double jeopardy" for all collected samples.

> **For Consideration**: How should the geometric mean be calculated? Rolling 30-day? Calendar month? Or seasonal?

Consideration Point #5: Effect of Exceptionally-High Single Samples on Geometric Mean

If a rolling geometric mean is used, then exceptionally-high single samples can lead to continued geometric mean WQO exceedances even after concentrations have returned to low levels. It may be possible to develop a protocol remove such "outliers" when calculation geometric means. The reference watershed data would need to be analyzed using the same protocol when calculating the allowable number of exceedance days. Thus the calculated allowable exceedance days would change.

> **For Consideration**: Should exceptionally-high single samples be included in geometric mean calculations? What protocol should be used to remove single sample "outliers"?

Consideration Point #6: Application of High Flow Suspension

Many of the 303(d)-listed waterbodies in the LA River watershed are subject to a high flow suspension (HFS). When HFS conditions occur, the REC-1 use is suspended and the REC-1 target does not apply. For previous TMDLs, when an HFS day occurs it "uses up" one of the allowable wet weather exceedance days. For example, if there are 10 HFS days and there are 15 allowable wet weather exceedance days, then 5 exceedance days would be allowed for wet weather days that are not subject to the HFS.

An alternative approach would be to remove HFS days from the total number of wet weather days when calculating the exceedance days. For example, if there are 10 HFS days then the allowable number of exceedance days would be: 75 (wet weather days) – 10 (HFS days) * 20% (Reference Exceedance Rate) = 13 days.

> **For Consideration**: How should HFS days be incorporated into annual allowable exceedance days? Should HFS days be removed from allowable exceedances days or from total number of critical year wet days?