To: CREST Steering Committee and Working Technical Group

From: CREST Consulting Team

Re: DRAFT Potential Approach to Developing LA River Bacteria TMDL Wasteload Allocations for Dry Weather

In response to potential in-channel sources highlighted during the BSI Study, the LA River Bacteria TMDL could include wasteload allocations (WLAs) for storm drain discharges. This differs from the approach of previous bacteria TMDLs in Region 4, which utilized in-stream WLAs. Development of WLAs for storm drain discharges must incorporate at least three factors:

1. **Assimilative Capacity of the LA River** – the ability of the LA River to assimilate bacteria loadings is largely a function of flow rate and bacteria decay. Available dilution increases with flow rate. That is, the WRP discharges effectively increase the WLA for storm drains. Bacteria decay rates increase with sunlight intensity.

2. **Loading from upstream reaches that have WLAs** – a portion of the assimilative capacity is normally already allocated to upstream compliance points. Thus, the WLA for a given reach must account for the allocations for upstream reaches.

3. **Loading from upstream tributaries that have WLAs** – similarly, a portion of available assimilative capacity may already be allocated to upstream tributaries that are 303(d)-listed. Thus, the WLA for a given reach must account for the allocations for tributaries that discharge into the reach.

Load duration curves (LDCs) provide a simple methodology to calculate assimilative capacity and have been used in many TMDLs nationwide. The Malibu Creek TMDL utilized LDCs. An LDC is simply the flow rate multiplied by the SSM WQO. It is based on the flow duration curve, which plots the distribution of flow rates (high flows on right, low flows on left). The SSM WQO instead of geometric mean WQO is used to develop the LDC because:

1. The SSM WQO more closely corresponds to a "daily" value, which is consistent with the recent "Anacostia" decision and subsequent USEPA guidance (U.S. Court of Appeals for the D.C. Circuit in *Friends of the Earth, Inc. v. EPA, et al.*, No. 05-5015 [D.C. Cir. 2006]).
2. The SSM has been used during previous LDC Bacteria TMDLs, including Malibu Creek.

The LDC for Rosecrans Avenue is shown in **Figure 1** (the blue line). The measured in-stream loading rates, based on dry weather Status and Trends *E. coli* data from Rosecrans Avenue and flow rates at Firestone Avenue are also plotted (diamonds). A large majority of the measured loading rates are greater than the allowable loading, meaning the measured concentrations were greater than the WQO.

The LDC in Figure 1 (blue line) represents the total "allowable" in-stream loading at the site, including discharges from upstream and from tributaries. Thus to calculate the loading that is "available" to storm drain discharges (i.e., the WLA), loadings that are allocated to upstream sites and tributaries must be subtracted. As shown in **Figure 2**, the "effect" of the loading that is allocated to Figueroa Street (the beginning of Reach 2) on the available loading at Rosecrans

Avenue depends on the decay rate. Three different decay rates are analyzed herein, based on seasonal sunlight intensity. The decay rates utilized are based on SCCWRP laboratory studies, which used "winter" and "summer" sunlight (Noble et al., 2004). The more intense the sunlight, the more decay that occurs during downstream travel. An "intermediate" sunlight condition was calculated using an average of summer and winter sunlight conditions. The use of "intermediate" sunlight seems reasonable for the TMDL. Note that if there were no tributaries then the difference in the decayed Figueroa Street LDC and the Rosecrans LDC would be the WLA for storm drains.

The loading from upstream tributaries also needs to be considered, as shown in **Figure 3**. Using the intermediate sunlight scenario, the LDCs from Arroyo Seco and Rio Hondo are represented. They have a small effect on the available storm drain loading.

The flow rate that is selected for calculation of the WLA is important, as shown in **Table 1** and **Table 2**. For dry weather (the focus of this memo), relatively low flow conditions should be used. Counter intuitively, if the median flow rate along the LDC is selected, then the WLA for Reach 2 storm drains is smaller than if a 10^{th} percentile flow value is used (compare Table 1 to Table 2). This may not be the case in other reaches. An advantage to using the median flow is that results of previous monitoring studies (e.g., BSI Study) and/or outputs from the hydrologic model utilized for the Metals TMDL could be used to estimate flows in reaches that do not have a flow gage. In contrast, 10^{th} percentile values are more difficult to estimate.

The values highlighted in yellow in Table 1 and Table 2 show the calculated WLA for storm drains, using intermediate sunlight. The calculated available loadings for storm drains between Figueroa Street and Rosecrans Avenue are 453 and 501 $x10^9$ MPN/day for the median and 10^{th} percentile LA River flow rates, respectively (Table 1 and Table 2). For comparison, the loading rates measured during the BSI Study and simulated with the Monte Carlo model are also shown (**Table 3**). Based on this LDC approach, to achieve the available loading of 453 or 501 $x10^9$ MPN/day, the storm drain loading rate would need to be reduced by 65% or 69%, respectively (**Table 4**). In fact, either 65% or 69% is the recommended WLA for the TMDL, as opposed to the corresponding numeric values.

It should be noted that natural or non-permitted sources (e.g., birds and regrowth) were not given a numeric WLA. Natural sources do not require a numeric WLA because they can be "given" the allowable exceedance days. In other words, there is an allowable frequency that the SSM WQO can be exceeded (loading can be above the blue line), which is "allocated" to the natural/non-permitted sources. In fact, this is the very intent of the Exceedance Day Approach; a low rate of WQO exceedance is allowed due to inputs from natural sources.

Overall, this approach results in WLAs that are both reasonable and scientifically-defensible by (1) incorporating decay due to sunlight, (2) utilizing the dilution that is provided by upstream WRPs and (3) allocating the allowable exceedance days to the natural/in-stream sources. In addition, this simple approach to developing WLAs does not require a sophisticated watershed model.

Table 1. *E. coli* Dry Weather WLA Analysis for Rosecrans Avenue using Median LA River Flow Rate (50th Percentile)

Sunlight Condition	Loading Rate (10^9 MPN/day)				
	Allowable Instream Loading at Rosecrans Ave. (1)	**Allowable Loading Upstream from Figueroa St.** (2)	**Allowable Loading Upstream from Arroyo Seco** (3)	**Allowable Loading Upstream from Rio Hondo** (4)	**WLA for Storm Drains between Figueroa St. and Rosecrans Ave.** (1)-(2)-(3)-(4)
Winter Sunlight	764	417	13	1.4	333
Intermediate Sunlight	764	301	9	1.3	**453**
Summer Sunlight	764	185	5	1.2	573

Table 2. *E. coli* Dry Weather WLA Analysis for Rosecrans Avenue using a Low LA River Flow Rate (10th Percentile)

Sunlight Condition	Loading Rate (10^9 MPN/day)				
	Allowable Instream Loading at Rosecrans Ave. (1)	**Allowable Loading Upstream from Figueroa St.** (2)	**Allowable Loading Upstream from Arroyo Seco** (3)	**Allowable Loading Upstream from Rio Hondo** (4)	**WLA for Storm Drains between Figueroa St. and Rosecrans Ave.** (1)-(2)-(3)-(4)
Winter Sunlight	731	316	1.3	0.3	413
Intermediate Sunlight	731	229	1.0	0.3	**501**
Summer Sunlight	731	141	0.6	0.2	589

Table 3. Reach 2 Storm Drain *E. coli* Loading Rates Measured during BSI Study

Monitoring Event	Loading Rate (10^9 MPN/day)		
	Total Loading from All Outfalls between Figueroa St. and Rosecrans Ave.[1]	Loading from Arroyo Seco	Loading from Rio Hondo
Event 1	2,900	2867	0.01
Event 2	1,700	66	164
Event 3	900	95	39
Event 4	1,100	164	237
Event 5	3,300	162	43
Event 6	16,000	23	0.17
Median Monte Carlo-Simulated Loading Rate	1,431	263	

1 – Does not include the R2-N during Events 1, 2 and 3

Table 4. Comparison to WLAs to Reach 2 Monte Carlo-Simulated Storm Drain Loading Rate

Sunlight Factor	Flow Rate Percentile	Calculated Available Loading (10^9 MPN/day)	Storm Drain WLA based on % Reduction to Achieve Available Loading given Median Monte Carlo Loading Rate of 1,431
Intermediate	50th	453	**68%**
	10th	501	**65%**

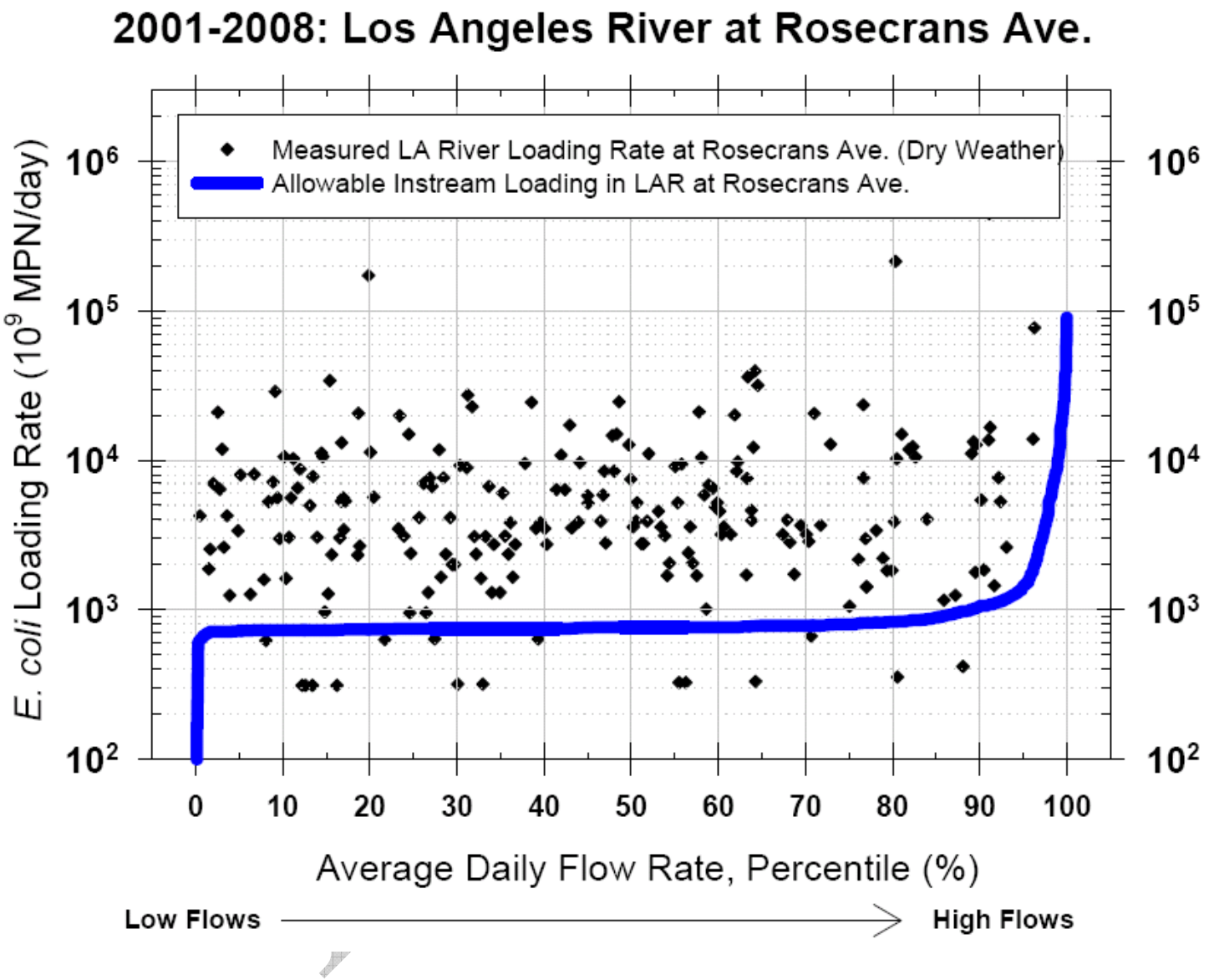

Figure 1. *E. coli* Load Duration Curve and Measured Dry Weather Loading Rates at Rosecrans Avenue

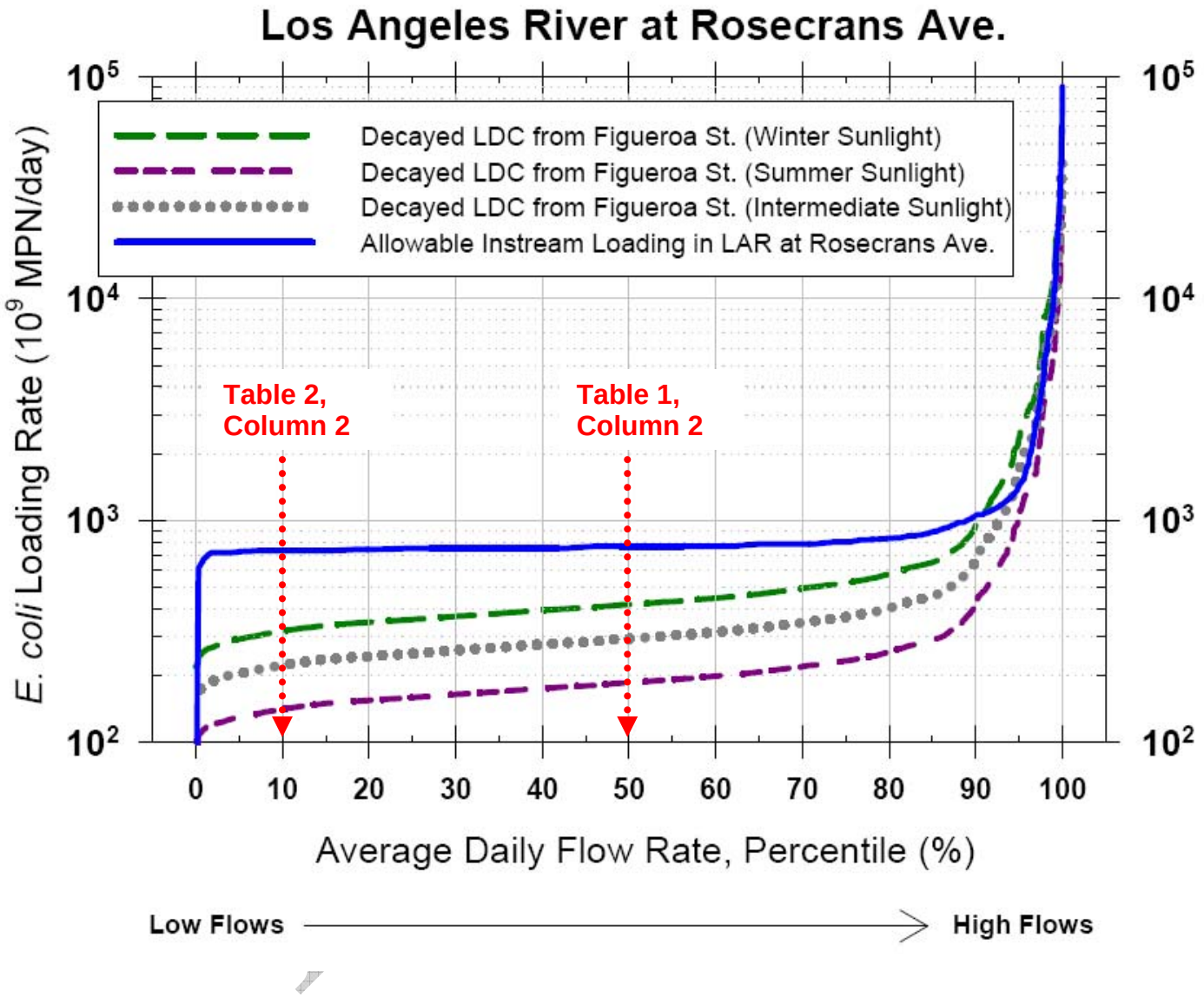

Figure 2. Effect of *E. coli* Loading Allocated to Figueroa Street on Rosecrans Avenue LDC at Varying Sunlight Levels

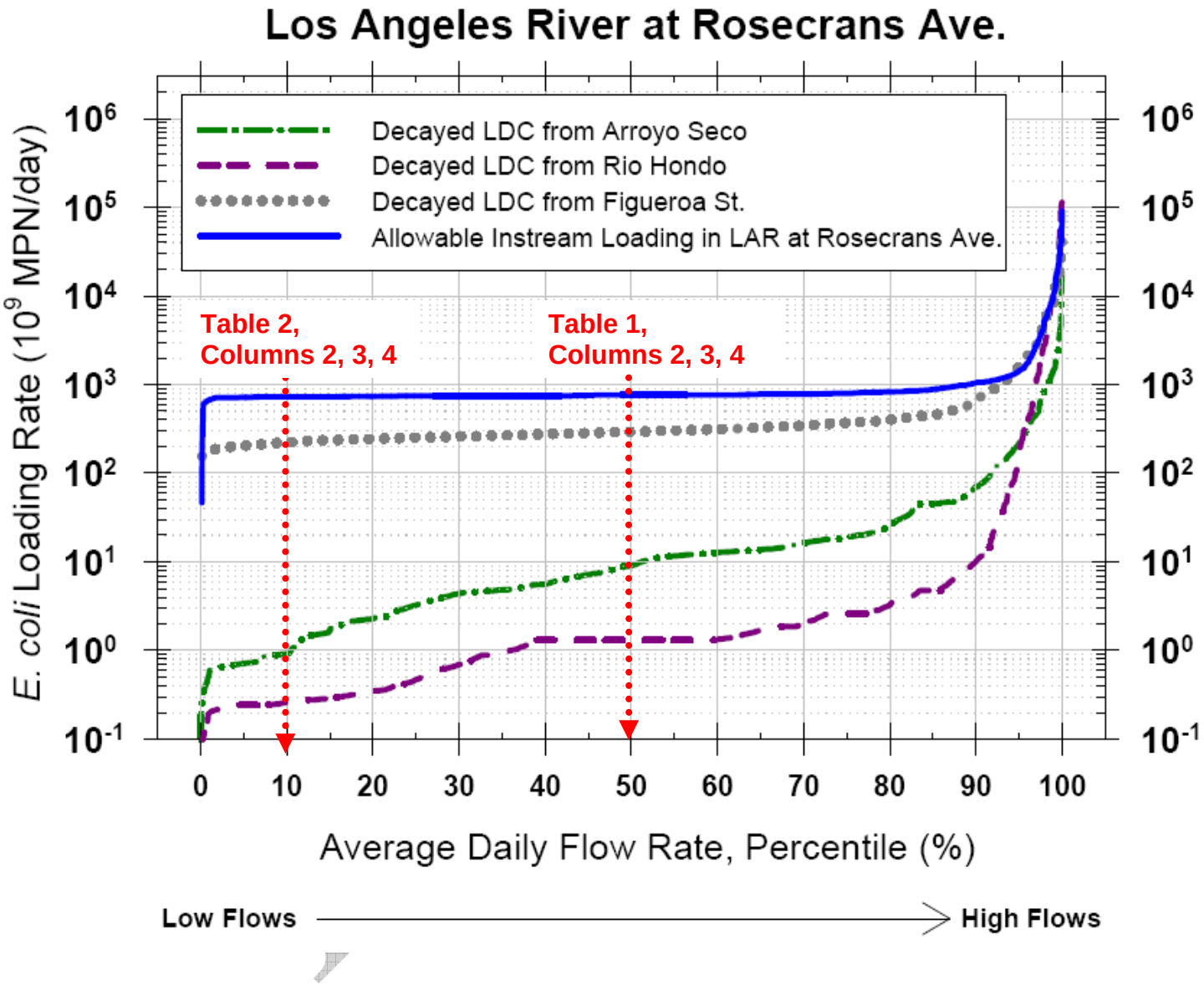

Figure 3. Effect of *E. coli* Loading Allocated to Figueroa Street, Rio Hondo, and Arroyo Seco with Intermediate Sunlight