RESPONSE TO EXTERNAL PEER REVIEW COMMENTS

Response to Peer Review Comments from Dr. Marc Beutel

Comment 1 (September 31, 2016)

Perhaps my most significant question is could you more precisely present the justification for basing the WER on the geometric mean of four sampling events in the context of the USEPA's 1994 Interim Guidance on the Determination and Use of Water-Effects Ratios for Metals? Much of the guidance document was couched in terms of point source pollution, design flows, and the assessment of toxicity in "effluent" combined with "upstream waters," thus making it difficult to clearly understand how the guidelines inform assessment of toxicity in a flowing creek that is integrating non-point pollution loading from throughout its watershed. The guidelines seem to state that more than three sampling events are needed to develop a WER, and that use of the geometric mean, rather than an arithmetic mean or use of a the maximum value from a set WERs, is appropriate in some cases. But a more detailed description of how you interpreted the guidance document to support your approach would be helpful. Can you also expand on the statement on page 19 of the 2014 WER development study that four monitoring events were "able to capture site-specific variability associated with temporal seasonality and flow"? The rainfall totals and intensities appeared to be fairly similar for the monitoring events, though there was some variability in hydrograph response and peak flows. In essence I am asking if the four sampling events provide enough data on which to confidently estimate WERs for the site.

Response to Comment 1

The United States Environmental Protection Agency's (USEPA's) 1994 *Interim Guidance on Determination and Use of Water Effect Ratios* (Interim Guidance, pp. 36-38) recommends using the geometric mean of WER values to derive the final WER when the range of WERs is not greater than a factor 5. Reasons for this recommendation are that:

1. The geometric mean, as opposed to the arithmetic mean, is less influenced by high values; and
2. Using the geometric mean is consistent with USEPA's methodology for deriving water quality criteria, in terms of level of protection of aquatic life.

USEPA does suggest examining the individual WER values in cases where there is an unusually high (or low) value (Interim Guidance, p. 29).

WER values for the proposed Basin Plan amendment come from the study titled *Development of Site-Specific Water Quality Objectives for Trace Metals in Chollas Creek: Water-Effect Ratio Study for Copper and Zinc, and Recalculation of Lead* (WER Study). The individual WERs presented in the WER Study varied by no more than a factor of 2.5 and 2 for copper and zinc, respectively. Thus, variability amongst individual WERs was small compared to USEPA's recommendation of a factor of 5 or less.

USEPA's WER guidance recommends WER testing under conditions that are representative of the site. Stream flow occurs only when there is sufficient precipitation to produce runoff to Chollas Creek. The WER Study examined five rain events in 2010, resulting in four samples from location SD8(1) (north fork) and five samples from location DPR2 (south fork). This covered the range of precipitation typically observed in this creek (WER Study, p. 36). The use of four and five WER values from the two sites is consistent with the Interim Guidance (p. 36). Final WER values for copper and zinc in Chollas Creek were derived based on the nine individual WERs at the two sites.

Comment 2 (September 31, 2016)

A related question is the rationale for using flow-weighted composites as the method for assessing WERs. Was this an approach recommended in the 1994 WER USEPA guidance manual or an approach that has been used in California sites (e.g., Los Angeles River copper WER study)? Is there a concern that any toxicity associated with a first-flush associated with the rising arm of the hydrograph may be subsequently diluted as a storm event progresses? Is it enough of a rationale to say that sampling methods used to develop WERs should be consistent with compliance monitoring, which is also based on flow-weighted sampling?

Response to Comment 2

The Chollas WER Study used flow-weighted composite samples because that is the type of water quality sampling required by the San Diego Regional Water Quality Control Board in Order No. R9-2013-0001 as amended by Order Nos. R9-2015-0001 and R9-2015-0100 (Regional MS4 Permit). Flow-weighted composite samples constitute the most representative type of sample for wet weather monitoring, and for WER studies in particular, because they more accurately capture the concentration of metals and other pollutants to which aquatic life are exposed throughout the storm event. Studies such as one conducted by Caltrans in 2005, *First Flush Phenomenon Characterization*[1], demonstrate that the first flush of a wet weather event (when flow is at peak or near peak levels) contains the highest concentration of pollutants.

[1] Stenstrom, M. and M. Kayhanian. 2005. First Flush Phenomenon Characterization. California Department of Transportation, CTSW-RT-05-73-02.6. Caltrans Division of Environmental Analysis, Sacramento, CA

USEPA recommends collecting WER samples when metal concentrations are likely to be highest (worst case scenario; first flush) because that is the critical condition for determining WERs (Interim Guidance, p.20). Using flow-weighted composite samples from sampling performed throughout the storm event in the WER Study helps ensure that WER samples reflect the actual metal concentrations that occurred during the storm event.

Another reason to collect flow-weighted composite samples to determine WERs is that the concentrations of water quality parameters that influence toxicity from metals are related to flow. In general, flow conditions that occur after the first flush tend to dilute metal concentrations as well as constituents in water that affect copper and zinc toxicity. For example, the 2005 study by Stenstrom and Kayhanian referred to above reported higher dissolved organic carbon (DOC) concentrations during the first flush period in other Southern California streams. Using flow-weighted composite samples helps to ensure that the actual water quality conditions that occurred over a storm event are accurately represented and used in WER testing.

Finally, it should be noted that wet weather events are generally short-lived in the Chollas Creek watershed. As shown in the WER Study (pp. 38-40), wet weather events last between four and eight hours on average. Given this fairly short period of time, it is more appropriate to collect and analyze flow-weighted composite samples rather than test particular subsamples that represent a very short exposure. For comparison, toxicity tests are conducted over a period of 48 hours.

Comment 3 (September 31, 2016)

As detailed in Tables 6-2 and 6-3 of the 2014 WER development study, the copper LC50 for C. dubia measured in dilute mineral water was an order of magnitude lower than USEPA species mean acute value, which was appropriately used to subsequently calculate WERs. Is this a common outcome in toxicity testing? How did the zinc LC50 for C. dubia measured in dilute mineral water compare to the USEPA species mean acute value, presuming there is a reported value for zinc? Why the difference in response between copper and zinc relative to USEPA species mean acute values, if any? Do the results for copper LC50 for C. dubia measured in dilute mineral water call into question the LC50 values measured for the creek water samples?

Response to Comment 3

The copper median lethal dose (LC50) values for *Ceriodaphnia dubia* (*C. dubia*) in lab water in the WER Study were lower than the USEPA species mean acute value (SMAV). Therefore, to be conservative, the species mean acute value was used in WER calculations rather than actual lab water LC50 values, as recommended in USEPA's streamlined copper WER guidance (pp. 5 and 14). This is a common occurrence with copper WER studies because the lab water required by USEPA for toxicity testing, including WER testing, contains almost no constituents that could bind copper and alter its toxicity to aquatic life. Therefore, the USEPA SMAV for *C. dubia* is higher than the acute value (LC50) generated by most laboratories using current toxicity test protocols. USEPA recommends using the USEPA SMAV for this species (and other closely related species) in their streamlined copper WER guidance unless the lab water LC50 is higher (more conservative) (p. 5). Using the USEPA SMAV in copper WER calculations resulted in a lower (more conservative) final WER than would have been obtained using actual lab water LC50 values.

The LC50 values for *C. dubia* in lab water in the WER Study were comparable to the USEPA SMAV. The mean lab water LC50 ± standard deviation in the study was 376 ± 78 µg/L, while the SMAV values for a similar hardness of 100 mg/L was 313 µg/L.

The reason for the different relative response of *C. dubia* copper and zinc LC50 values with respect to their USEPA SMAV values is that zinc is much less affected than copper by differences in lab water composition. This is also demonstrated in the WER values for zinc, which are much closer to 1.0 than those measured for copper, indicating that the water quality composition of the site water has relatively less effect on zinc toxicity as compared to lab water.

Comment 4 (September 31, 2016)

In Table ES-2 of the 2014 WER development study, there is a footnote stating that during dry weather the WERs are equal to 1. Is there a reason this seasonal overlay on the WERs is not a part of the recommended revisions to Table 7-21a. Is it reasonable to apply WERs developed for wet weather events between October and April to dry weather conditions? Is this considered a non-issue because of the very limited precipitation during the dry season? Is there direction in the 1994 USEPA WER guidance manual on how to handle this situation?

Response to Comment 4

Because of low rainfall in the area, Chollas Creek is a dry channel with intermittent inputs of urban runoff from groundwater seeps, lawn watering, and other activities under ambient conditions (WER Study, p. 4; Weston Solutions 2008-2009 TMDL Report[2]). In areas where water is present during these conditions, field observations have indicated that the water is usually absorbed back into the creek bed a short distance downstream. The tidal prism is not hydrologically connected to other portions of the creek system during dry weather conditions. Therefore, under dry conditions, the WER is considered to be equal to the national and statewide WER value of 1.0, indicating that there is no change to the current copper and zinc water quality objectives (WQOs) in the Basin Plan. The WERs and the site-specific WQOs developed based on the WER Study apply only to wet weather conditions, when there is continuous flow in Chollas Creek.

Comment 5 (October 9, 2016)

I have reviewed the CEQA checklist and the Board's response letter to comments from the San Diego Coastkeeper and US FWS dated February 5, 2016. I also reviewed key supporting documents including the executive summaries of the 2011 SCWRRP sediment toxicity study and the 2005 Navy sediment assessment. I did not find any significant areas of concern related to the scientific rationale used to support the CEQA checklist or the contention that adopting the site-specific WERs for copper and zinc will be protective of downstream water quality. The 2011 SCWRRP study clearly found that sediment toxicity was associated with exposure to organic compounds. As noted in the study, PAH concentrations in Chollas Creek mouth sediments were "greater than most other locations in southern California." In contrast, metals were not a substantial source of toxicity since "bioavailability of divalent metal contaminates in sediment and pore water was very low." The 2005 Navy study reported that sediment toxicity to aquatic-dependent life was likely associated with PAHs, PCBs, chlordane and DDT. Based on these sediment studies, it is clear that adopting site-specific WERs for copper and zinc will not substantially exacerbate toxicity in downstream sediments located at the mouth of Chollas Creek.

[2] Weston Solutions. 2010. Chollas Creek Total Maximum Daily Load Compliance Monitoring Investigation Order No. R9-2004-0277 2008–2009 Water Quality Monitoring Final Report. Carlsbad, CA.

In addition, I agree with the Board's assessment that adopting site-specific WERs for copper and zinc is protective of downstream water quality. Since the WERs were developed based on storm water collected in the creek, they are reasonably representative of water quality conditions throughout Chollas Creek. And since metals have been show to not drive toxicity in sediment at the creek's mouth, the settling out of copper and zinc in the mouth is not a significant toxicity concern. As noted in the Board's February 6, 2016 letter and detailed in the WER study, even with the adoption of the WERs, the loading of copper and zinc into Chollas Creek is expected to decrease. And over the long term this will result in a decreases in metals concentration in the water column, sediments and sediment pore water in the creek and creek mouth.

Note that my comments above should be considered in the context of my original peer review summary letter dated September 31, 2016, which details a number of comments related to the WER study and proposed Basin Plan amendment.

Response to Comment 5

Comment noted. Please note the original peer review summary letter is dated August 31, 2016.

Response to Peer Review Comments from Dr. Robert Mason

Comment 1 (September 12, 2016)

Perhaps the consideration could be made that the proposed WER values be the lowest determined value, which would be more protective….Another reason for considering a lower WER value is the fact that the relative variability in the four tests for each site are quite high."

Response to Comment 1

USEPA recommends using the geometric mean of WER values to derive the final WER when the range of WERs is not greater than a factor 5 (Interim Guidance, pp. 36-38). The individual WERs presented in the WER Study varied by no more than a factor of 2.5 and 2 for copper and zinc, respectively. These represent very repeatable WER values and were the ones used to calculate the final WERs for copper and zinc. Given the similarity in WER values for individual samples, final WERs based on geometric means are consistent with USEPA recommendations (Interim Guidance, p.38).

RESPONSE TO EXTERNAL PEER REVIEW COMMENTS

Comment 2 (October 7, 2016)

My evaluation of the documentation in terms of the statements there is no downstream impact of the new WER criteria is that these statements represent a scientifically defensible position as they are based on the impact of the water quality on the bioavailability of the metals and this will not change downstream at the mouth given that these are determined by water hardness – more specifically its role on complexation of the metals as well as the impact of the major cations on interactions of the metals with biological surfaces. The criteria will remain valid downstream given the expected changes on water hardness and pH would not lead to any substantial difference in the metals' bioavailability.

The role of sediment toxicity is not an issue as explained in the documentation as the major cause of this toxicity has been shown to be organic contamination and not metals, and indeed it seems that the metal levels reflect background conditions. It is also indicated, however, that this will be further evaluated and if found to be different, then there could be further amendments in the future, But the role of sediment toxicity is a different issue and will not impact the outcome that is a consequence of the changes in the WERs on the downstream regions. As indicated as well, given the nature of the system and its "flashiness" in flow, any downstream impacts would be short-lived due to rapid mixing and dilution. While this is not a justification for allowing the new WER in lieu of other scientific validation, it represents an additional level of safety as this would potentially mitigate any effects.

Overall, based on my reading of the documents, I conclude that the statements about the lack of any downstream impacts are scientifically valid.

Response to Comment 2

Comment noted.