Appendix C: Recalculation of Load Allocation

Purpose

According to the revised Marina del Rey (MdR) Toxic Pollutants TMDL Staff Report (April 2015), a steady-state copper model developed for Shelter Island Yacht Basin (SIYB) was used to calculate the target load allocation for the Marina del Rey Dissolved Copper TMDL. The model results led to an establishment of 554 kg/year copper load allocation or 85% copper reduction required from the existing load to the harbor. In light of new information and more recent data, the load allocation was revised by updating the salinity values and copper target in the model.

The Copper Model

The copper model was developed based on a mass-balance of copper in and out of the Basin; the main mechanism of transport and dispersion is tidal flushing which is driven by salinity gradient inside and outside of the Basin. The MdR TMDL Staff Report justified the use of the Copper Model as "Given the similarities between Shelter Island Yacht Basin and Marina del Rey Harbor, for purposes of this TMDL, use of the Shelter Island model is found to be valid for Marina del Rey Harbor." (TMDL Staff Report, Page 35).

As stated by the technical report for the copper model (TMDL Staff Report Appendix B), dispersion, or constituent transport, is driven by tidal flushing; therefore, salinity gradient between inside and outside of the Basin significantly affects the model results.

For MdR, salinity gradient was determined by using salinity data collected in MdR between 2007 and 2008 as one of the model inputs.

Recent Salinity Data and Analysis

Since the adoption of the MdR Dissolved Copper TMDL, additional salinity data has been collected under the MdR Coordinated Integrated Monitoring Program (CIMP) and the MdR Copper Site-Specific Objective (SSO) Study. The data sources are summarized in Table 1. Wet weather salinity data were also collected but are not considered in this analysis because the copper model assumes a steady state which occurs during dry weather. Figure 1 shows sampling locations.

Table 1 Summary of Newly Available Salinity Data.

Source	Sampling Period	Condition	# Samples
MdR CIMP	4/24/2019 – 7/28/2020	Dry	91
SSO Site Characterization	3/23/2018 – 9/10/2018	Dry	34
SSO WER Sampling	9/26/2019 – 3/5/2020	Dry	58
		Total	177

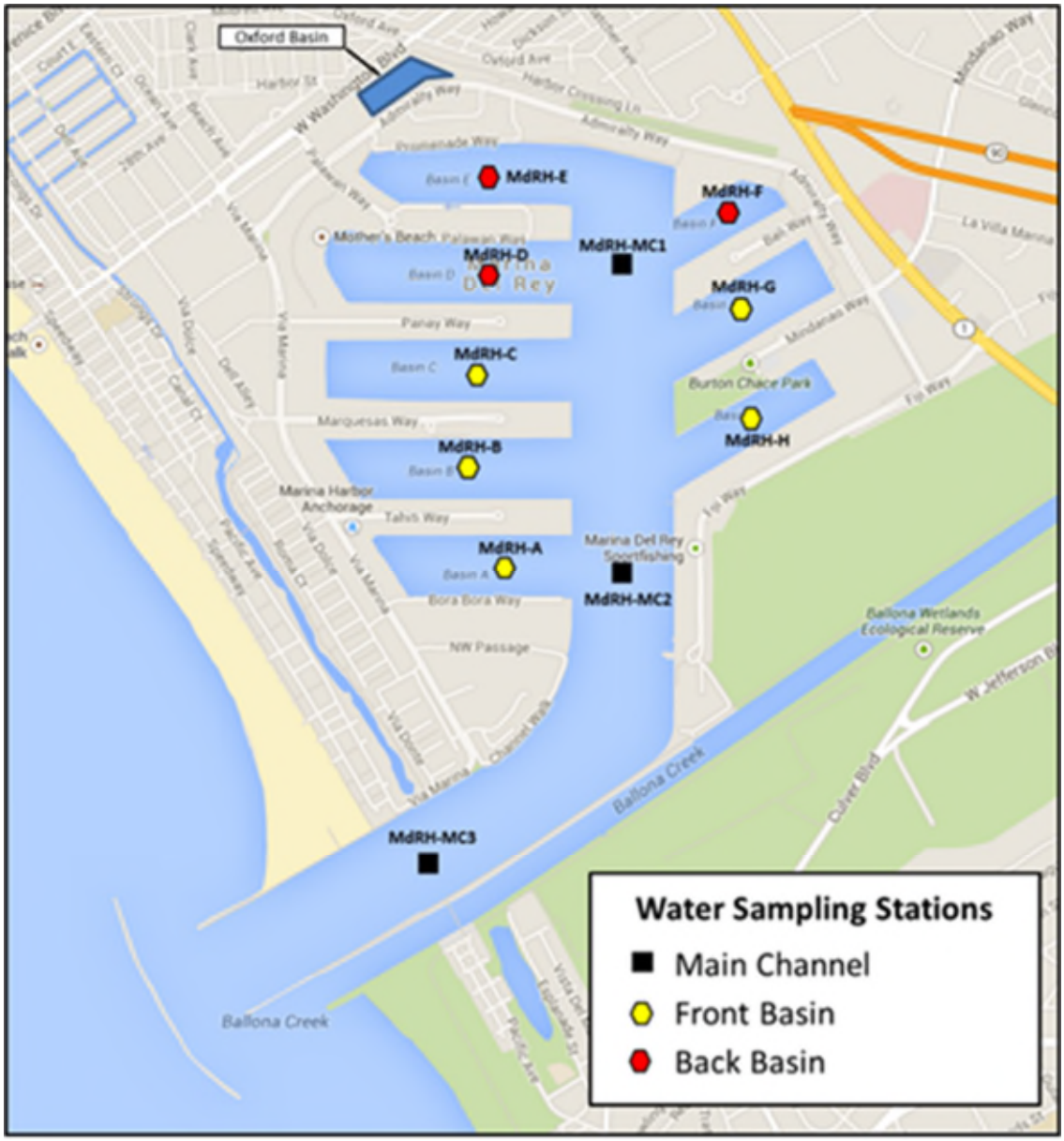


Figure 1 Sampling Locations.

Salinity data from MdRH-A, MdRH-B, MdRH-C, MdRH-D, MdRH-E, MdRH-F, MdRH-G, MdRH-H, MdRH-MC1, and MdRH-MC2 were used to determine the box salinity (S2), and MdRH-MC3 was used for the boundary salinity (S1). Salinity data were summarized in Table 2.

Table 2 Summary of Salinity Data.

Model Parameter	# Sample	Min. (ppt)	Average (ppt)	Median (ppt)	Max. (ppt)
S1	11	33.30	34.00	**33.70**	35.80
S2	166	31.76	33.90	**33.90**	35.90

Proposed Update

To be consistent with the model assumption and reflective of the current MdR condition, the salinity inputs in the copper model were updated using the median value of the data collected under the SSO study and MdR CIMP for both boundary salinity (S1=33.7 ppt) and box salinity (S2=33.9 ppt).

All dry weather salinity data were plotted to make a percentile curve for S1 and S2 in Figure 2. The salinity values used in the MdR TMDL were added for comparison. Notably, the S2 value used for the MdR TMDL was slightly less than the minimum salinity measured in recent years, demonstrating the value does not represent the current "normal" condition for MdR. Selecting the median value for both S1 and S2 is more appropriate to represent the "normal" condition, and is consistent with the model assumption where the box salinity is slightly higher than the boundary salinity in a steady state. In addition, the resulting residence time of 9.6 days falls within the range determined by the 2000 Moffat and Nichol study (Exhibit 1).

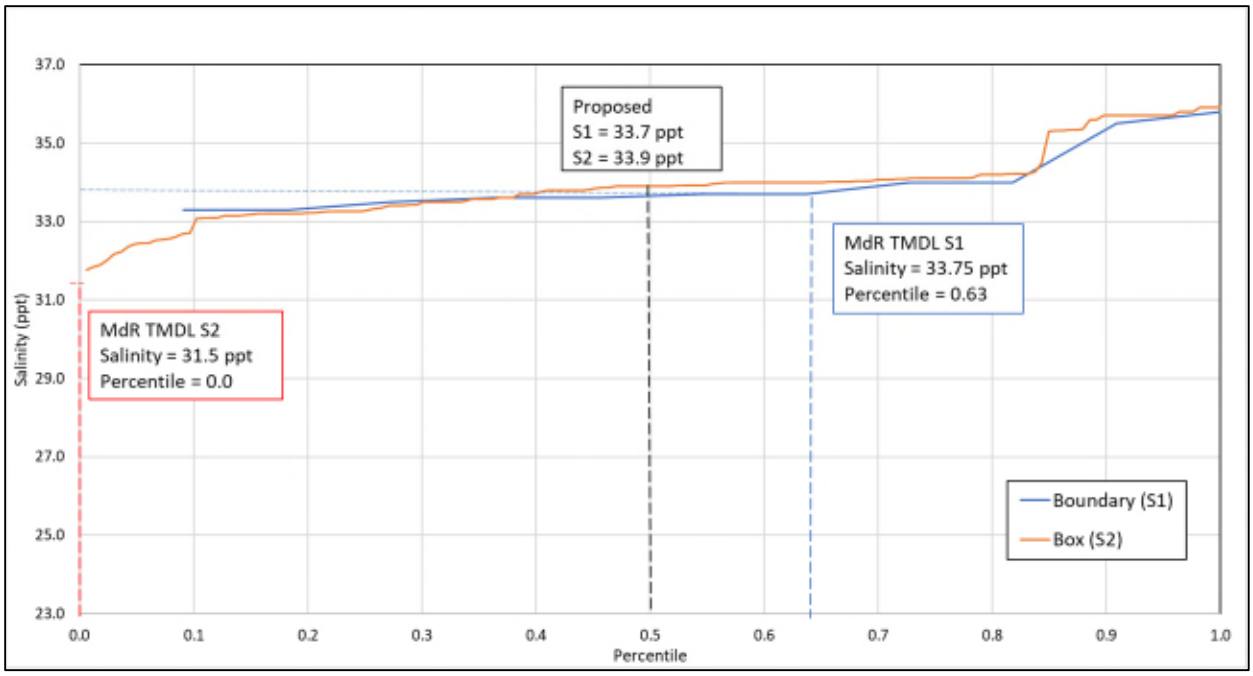


Figure 2 Salinity Percentile Curve Using All Dry Weather Data.

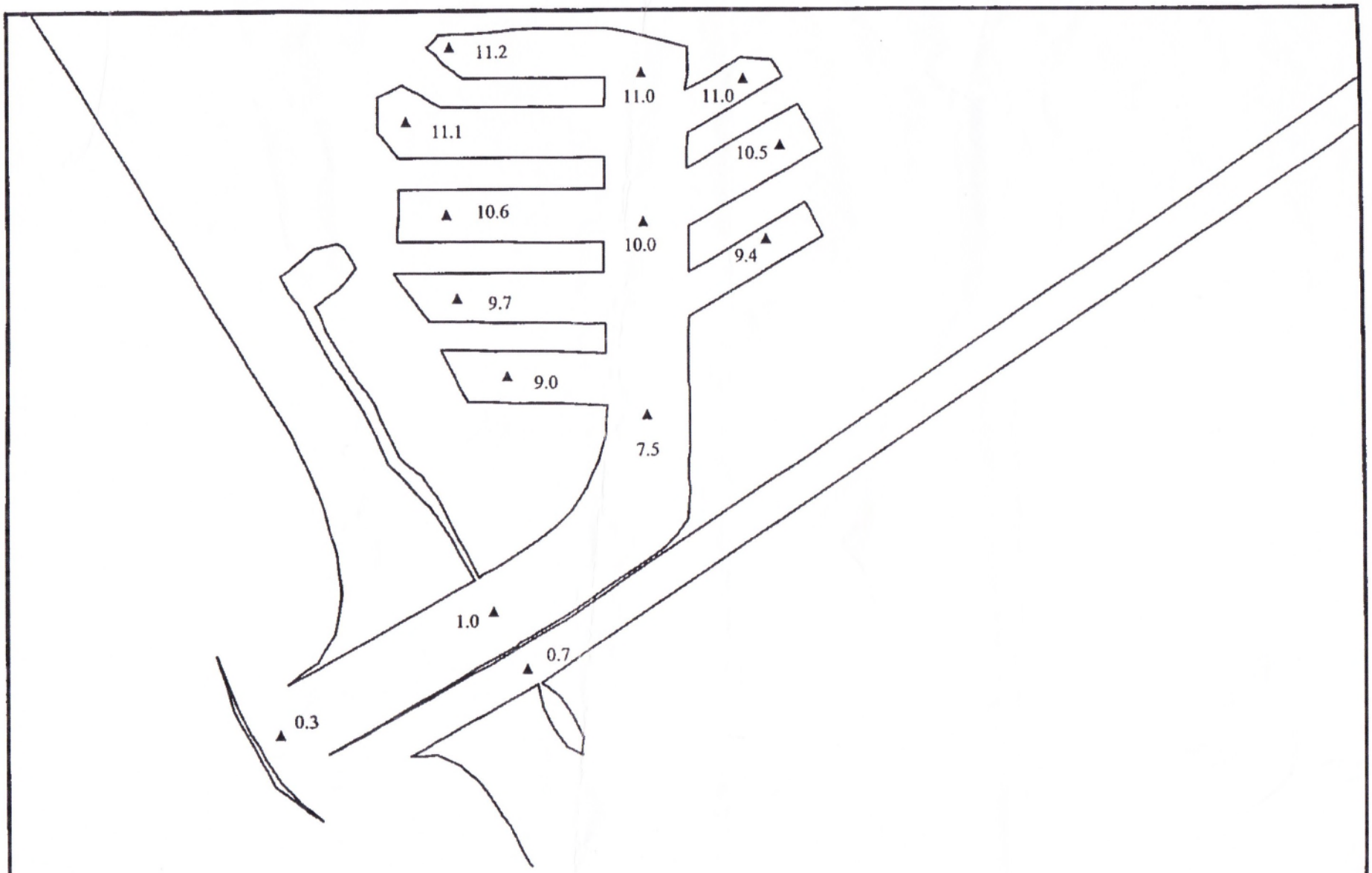
Table 3 compares the model inputs and outputs between the MdR TMDL, salinity update and salinity update plus the proposed SSO. The MdR salinity difference between outside (S1) and inside (S2) of the basin was 2.65 ppt, with dispersion coefficient of 0.52 m^2/s and residence time of -126.8 days. This negative residence time was caused by inputting the S2 value that is smaller than the S1 value, which was inconsistent with the model assumption where salinity in the Basin (S2) in a steady-state is slightly higher than outside salinity (S1) due to evaporation.

The proposed update with an expected outcome of the SSO (Water Effect Ratio of 1.40) is also included in Table 3. The new copper load allocation was determined to be 1,666 kg/year, and the copper reduction requirement of 54.2%.

Table 3 Model Inputs and Outputs

	Unit	MdR TMDL (2015)	Salinity Update	Salinity Update + SSO
Input				
S1: boundary salinity (outside)	ppt	33.75	33.70	33.70
S2: box salinity (inside)	ppt	31.1	33.90	33.90
C1: boundary concentration	ug/L	0.5	0.5	0.5
Ac: cross sectional area at boundary	m2	1463	1463	1463
As: surface area of box	m2	1,200,000	1,200,000	1,200,000
e: evaporation rate	cm/d	0.33	0.33	0.33
dx: gradient length scale	m	1310	1310	1310
V2: box volume	m3	6,400,800	6,400,800	6,400,800
RL: loss rate to sediment	%/d	7	7	7
RS: input rate to box	kg/d	1.83	3.83	5.09
Output				
K: dispersion coeffcient	m2/s	0.52	6.9	6.9
dS/dx: salinity gradient	psu/m	2.02E-03	1.53E-04	1.53E-04
Ue: evaporative advective velocity	m/s	3.14E-05	3.14E-05	3.14E-05
Tres: residence time	d	-126.8	9.6	9.6
C2: box concentration (total copper)	ug/L	3.73	3.73	5.19
C2o: box concentration (no loss)	ug/L	36.78	6.24	8.68
F: flushing rate to bay	kg/d	0.16	2.16	3.14
LS: sediment loading	kg/d	1.67	1.67	2.33
Dissolved Cu TMDL to achieve CCC	**kg/year**	**554**	**1160**	**1666**
% Cu reduction required	**%**	**84.6**	**67.8**	**54.2**

Exhibit 1.



Playa Vista **Water Quality Modeling: Alternative 5**	**Residence Time (Days) Under Existing Condition**	Figure 4-2