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Review of technical basis of proposed Basin Plan amendment for organochlorine compounds TMDLs for San Diego Creek and Newport Bay

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Introduction

This is a technical review of the proposed basin plan amendment for organochlorine compound total maximum daily loads (TMDLs) for San Diego Creek and Newport Bay, California. The review task is described in Cross (2006). From the materials made available it appears that the technical staff report (Rose 2006) containing proposed TMDLs along with Attachment to Resolution No. R8-2007-00XX (2006) are the primary documents to be examined with specific reference to TMDLs established by USEPA (2002). Attachment 1 in Cross (2006) is a summary of the proposed Basin Plan amendment, and while it is not specifically mentioned, it appears that Attachment to Resolution No. R8-207-00XX (2006) is the actual amendment referred to. This would be an amendment to Chapter 5 of the Basin Plan which was not sent to this reviewer.

According to Cross (2006), the "overarching" questions that the reviewers are asked to address are (a) whether there are any additional technical issues in the staff technical report (Rose 2006) and the draft Basin Plan Amendment that should be part of the scientific basis of the proposed TMDLs, but are not described, and (b) taken as a whole is the proposed Basin Plan Amendment based on sound scientific knowledge, methods, and practices?

Organochlorine Compounds

The organochlorine compounds considered here, DDT, toxaphene, PCBs, and chlordane have all been banned, and except for PCBs and small amount of DDT in the pesticide Dicofol, they are no longer discharged in the watershed other than by erosion of sediments to which these pollutants may have been adsorbed in the past.

DDT (Dichloro-diphenyl-trichloroethane) was used traditionally to eradicate malaria by killing the mosquito acting as a vector of the disease. Use of DDT for control of disease-causing insects and agricultural pests peaked in the 1960. Because of its adverse environmental effects DDT was banned in 1972 except in special cases. Toxaphene, an insecticide, is a mixture of more than 600 chemicals. It was used extensively in the U.S. until 1982 when it was banned for most uses because of undesirable environmental effects. In 1990 the ban was made complete (USEPA 2002).

Polychlorinated bipbenyls (PCBs) were used as synthetic oils in transformers and hydraulic fluids until the mid-1970s when it was banned due to adverse mainly human environmental effects such as liver, thyroid, and dermal changes, reduced birth weight, reproductive toxicity, and cancer (Rose 2006). PCBs can degrade aerobically and anaerobically, for example in aquatic sediments. The ban was in two stages, first it was restricted for use in closed systems, and then there was a complete ban. Chlordane is an insecticide that was used in the U.S. from 1948 to 1988. It was used for control of insects during production of crops such as corn. In 1983 it was restricted for use for subterranean termite control, and then it was phased out completely due to concern for mainly human health effects. It is also moderately toxic to birds and highly toxic to invertebrates and fish (USEPA 2002, Rose 2006).

Development of TMDLs

A total maximum daily load (TMDL) is the maximum amount of a pollutant that may be discharged to a water body while maintaining water quality standards. The loading capacity is the maximum loading that a water body can assimilate and still meet and maintain water quality standards, and the existing loading is the actual mass discharged to the water body per day. The TMDL is usually set as the loading capacity if the existing load is greater than the loading capacity, but as the existing load if this is lower than the loading capacity. For example, for chlordane discharge into Upper Newport Bay, the existing load is 290.7 g/yr and the loading capacity 160.6 g/yr. Thus the TMDL is set at the loading capacity 160.6 g/yr. However, for PCBs the existing load 858.7 g/yr is less than the loading capacity 1528.2 g/yr, and the TMDL is then conservatively set at the existing loading, 858.7 g/yr (USEPA, p. 58, 2002).

The legal basis for TMDLs is Section 303(d) of the Clean Water Act requires states to establish a priority ranking for waters for which effluent limitations are not stringent enough to implement water quality standards, and to establish TMDLs for such waters. EPA will review state submitted TMDLs to determine if they meet all TMDL requirements. If EPA approves the State TMDLs, they will supersede the TMDLs being established now by EPA (USEPA, p. 3, 2002).

The nature of the water quality problem. Even though the concentrations of these organochlorine pollutants are declining in mussels and fish during the last 20-25 years (Figs. 2.2 - 2.4, Rose 2006 and Fig. H-5, H-7a, and Fig. H-8, USEPA 2002), there is a concern that the pollutants can enter the aquatic foodweb and cause adverse ecosystem impact and human health effects. Environmental impacts are evident from Rose (2006) of several of these pollutants using fish tissue screening values established by OEHHA and the National Academy of Sciences (NAS). For example for DDT in Upper Newport Bay there were several samples during 1995-2004 that exceeded both OEHHA and NAS standards (Appendix B, Rose 2006).

Note that Food and Drug Administration (FDA) criteria are less stringent than OEHHA criteria for fish tissue concentrations of total PCBs (Table 2, Appendix B, Rose 2006). For example, FDA's limit for PCBs is 2000 ppb compared with OEHHA's more stringent limit of 20 ppb. Sediment quality guidelines are given in Table 3 of Appendix B (Rose 2006). Sediment toxicity data are more scattered, but contaminated sediments do show some effect, for example for chlordane in Upper Newport Bay where 27/36 samples exceeded the NOAA ERM of 6 µg/kg dw (Appendix B, Rose 2006. Note: page numbers should have been included in the appendices). Water quality criteria exist (Table 1, Appendix B, Rose 2006) but most measurements show nondetectable concentrations with the methodologies used.

Fish and to a lesser extent sediment concentrations indicate that there is a valid concern for water quality with respect to organochlorine compounds in San Diego Creek and Newport Bay. This is despite the fact that concentrations are declining because of the ban on these compounds.

Numeric targets. The numeric targets for organochlorine compounds for the water bodies are given in Table 6-1a (USEPA 2002) and Table 3.1 (Rose 2006). They are in general agreement except for total PCBs in fish tissue of Newport Bay (30 vs. 20 ppb). The values seem to be reasonably well established except that further rationale should be given for human health vs aquatic life target values (Rose 2006). PCBs should be analyzed by congener and not aroclor since congeners can be very different in their toxicity. Co-planar congeners or dioxin-like PCBs are generally considered to be more toxic.

The calculations of sediment targets targets through eq. 3, p. 38 (Rose 2006) is reasonable. A better rationale for using NAS guidelines for fish tissue targets is needed. It is not clear how fish tissue targets were calculated. The calculation of targets for human health protection through the 70 yr, 70 kg body weight calculation may be ok provided that consideration is given to declining input concentrations and that dose-response factors need to be well determined (p. 38, Rose 2006).

Some consideration needs to be given to mixture effects in the biological response to many pollutants. For similar compounds toxic units tend to add up, but for different modes of action, there are many possibilities. Generally, mixture effects would lower permissible concentrations and TMDLs. Some further discussion of this issue could be included p. 77, Rose (2006).

Source identification. The outlined source identification distinguishing between point and non-point sources (WLA vs. LA) makes sense. See for example Attachment to Resolution No. R8-2007-00XX Tables NB-OCs-9 and 10. The role of margin of safety (MOS) is understandable. One recommendation is that source identification should rely not only on enumeration or quantification of known sources but also on modeling. For example chemical mass balance (CMB) and factor analysis using for example positive

matrix factorization (PMF) can based on pollutant or congener profiles identify sources and their contributions.

Linkage analysis/loading capacity. The linkage analysis is fairly well described in USEPA (2002) compared to Rose (2006). The diagrams p. F-7 and F-2 are clear although there should be a division sign between fish tissue and BCF in Fig. F-1, and Fig. F-2 reflects an oversimplification of the problem. The case of Newport Bay and to some extent San Diego Creek illustrates the difficulty in using the loading concept in that sediments have a different role in releasing pollutants to the water column depending on sedimentation rate and sediment mixing. Significant mixing in upper sediment layers can release more pollutants to the water column. This issue should be addressed. Also, the pollutant inventory in the Newport Bay sediments should be estimated and compared with annual TMDLs, for example 160 g/yr of DDT input to Upper Newport Bay. I suspect that this and other TMDLs are small compared with the pollutant inventories in the sediments. Thus, even with zero input to the Bay there can be a significant recycling of DDT from bottom sediments which means that it can take a long time before DDT can be delisted. Note, however, that DDT concentrations do decline over the years (Fig. 2-3, Rose 2006). This decline is likely to be influenced both by lower inventories and lower inputs.

USEPA established TMDLs. Values of TMDLs are listed in Tables 6-5 – 6-8 of USEPA (2002). The following compounds have generally larger existing loads than loading capacities (condition 2), and should therefore have reduced inputs: San Diego Creek, chlordane, DDT and toxaphene; Upper Newport Bay, chlordane, and DDT; Lower Newport Bay, DDT. Tables showing allocations, e.g., WLA, LA, and MOS, for all three water bodies and the Rhine Channel are shown pp. 59-60 of USEPA (2002).

SARWQCB proposed TMDLs. Similar values of TMDLs proposed by SARWQCB are listed in Table 6-1a (Rose 2006). In the same order, condition 2 is valid for San Diego Creek, chlordane, DDT, and Toxaphene; Upper Newport Bay, chlordane and DDT; Lower Newport Bay, DDT and chlordane. Load allocations by source type, similar to those in the EPA report are shown in Table 6-2b. The numbers are fairly similar, mostly within a factor 2, for corresponding pollutants, source categories, and water bodies. One significant deviation is for example for chlordane, in Upper Newport Bay from urban runoff. EPA shows 120.5 g/yr and SARWQCB 30.1 g/yr. Another example is total PCBs in Lower Newport Bay which is 409.8 g/yr by EPA and 241 g/yr by SARWQCB. Some further work should be done to seek to clarify or justify these numbers. Clearly, there is significant uncertainty in this evaluation.

Comparison of USEPA and SARWQCB TMDLs. USEPAs and SARWQCB TMDL requirements differ in that SARWQCB only suggest TMDL for informational purposes for Total PCBs and Chlordane for San Diego Creek (Cross 2006), whereas USEPA have established TMDLs in these cases. This is supported by fish tissue concentrations with no wildlife exceedances for total PCB, Reach 1, but only partially for chlordane where there were no data for reach 2. However, Peters Canyon Wash

(tributary to San Diego Creek) show no chlordane exceedances out of 11 fish composite samples 1995-2004 (Rose 2006). The table below illustrates the comparison:

Pollutant	San Diego Creek	Upper Newport Bay	Lower Newport Bay
Total DDT	X	X	X
Total PCBs	*	X	X
Chlordane	*	X	X
Toxaphene	X		

X, Impairment identified by both USEPA and SARWQCB

*No impairment identified by SARWQCB, but informational TMDLs have been prepared

Margin of safety/seasonal variation and critical conditions. The margin of safety is taken as 10% of the total TMDL. This seems to be reasonable. The area has a strong seasonality as evidenced by the annual rainfall pattern, Fig. 7-1 (Rose 2006). Thus much of the sediment input to the estuary comes during episodic events with a few heavy rainfalls. The implication for BMPs and WDRs is that they must be geared towards an accurate description of these events.

Implementation and monitoring. The implementation plan indicated in Tables NB-OCs-13 and 14 makes sense. The phased approach is reasonable. One should be prepared for an adaptive strategy depending on climate. A certain amount of dredging may be necessary in the most contaminated areas. The use of polyacrylamide (PAM) in stabilizing graded areas (p. 107, Rose 2006) and enhance flocculation should probably be limited as the introduction of chemicals in the environment should be avoided if possible.

Discussion

The staff report (Rose 2006) and draft Basin Amendment (Attachment to Resolution No. R8-2007-00XX 2006) constitute a solid and comprehensive response the TMDLs established by USEPA (2002). Most data confirm the EPA loads. However, there are some new data and analysis which indicate that the emphasis on pollutants in certain water bodies should be changed. TMDLs for PCBs and chlordane in San Diego Creek may in fact not be required. The different role of suspended sediment in San Diego Creek and Newport Bay should be realized and used in the linking analysis. Sedimentation rate and sediment mixing can impact the concentrations and biological uptake of pollutants.

As the phased process of TMDL implementation continues, The Santa Ana Regional Water Quality Board should pay attention to the advice from the public following the June 2005 CEQA scoping meeting listed p. 114 in Rose (2006). Some of the points raised were that future meetings should be properly noticed, that there should

be appropriate coordination with other California agencies such as the Department of Fish and Game, and that some facts are encouraging despite the OC contamination, for example that the population of endangered bird species such as the clapper rail population has doubled in a relatively short period.

Summary

- The staff report and draft basin amendment is a solid and comprehensive response to the TMDLs for organochlorines established by EPA.

- Calculation methods for targets for human health protection should be improved to take the declining concentration of organochlorines into account as well as to document the use of appropriate dose-response factors

- The inventory of organochlorines in the sediments of the water bodies should be estimated and compared to proposed TMDLs. If TMDLs are small compared to inventories of pollutants, that would indicate that recycling of pollutants in the ecosystem is an important factor

- The role of sedimentation rates and sediment mixing in making pollutants available to the ecosystem should be clarified by models and observations. Volatilization could also be considered.

- Some further work could be done in reconciling or explaining EPA and SARWQCB determined TMDLs for various sources, pollutants and water bodies.

- An attempt to consider mixture effects may be desirable or necessary since there are a variety of pollutants, not just organochlorines

- PCBs should be analyzed by congener, and consideration should be given to co-planar congeners that are considered more toxic than other congeners

- Source allocation should be done not just by quantifying known sources, but also by receptor modeling using chemical mass balance (CMB) modeling and positive matrix factorization (PMF).

References

Attachment to Resolution No. R8-2007-00XX. 2006. (Draft Basin Plan Amendment).

Cross, W.M. 2006. Letter to peer reviewers. Santa Ana Regional Water Quality Control Board, Santa Ana Region.

Rose, K.L. 2006. Total maximum daily loads for organoochlorine compounds. San Diego Creek.: Total DDT and Toxaphene, Upper and Lower Newport Bay: Total DDT, Chlordane, Total PCBs. Santa Ana Regional Water Quality Control Board. Orange County, California.,

U.S. Environmental Protection Agency, Region 9. 2002. Total maximum daily loads for toxic pollutants, San Diego Creek and Newport Bay, California. Alexis Strauss Director Water Division.