Nutrient Management Strategy for San Francisco Bay, March 2012 Draft

State and Federal Contractors Water Agency Comments
May 10, 2012

Thank you for the opportunity to comment on the Nutrient Management Strategy for San Francisco Bay, draft version March 2012. A comprehensive nutrient strategy is critically needed and we applaud you for your efforts to develop one with stakeholder input. We have broken our comments into two types. First we provide more general comments on the overall strategy, particularly highlighting elements that should be added. Then, we provide more specific comments on the existing strategy text. It should be noted that the specific comments do not address the missing elements described in the general comments.

General comments:

As currently written, the strategy takes a too narrow view of the nutrient problem. The strategy problem definition rests on classic relationships of eutrophication: too much nutrient leads to changes in biodiversity, hypoxia, HABs. While this is the approach being undertaken in many places, and has been used for years in others, it is an approach that gives a very limited perspective of effects of nutrients in ecosystems. Load response models do not allow effects such as changes in nutrient form or proportion to be established. For example, the McKee et al. 2011 report examines the effects of ammonium and urea and asks whether a direct link with certain phytoplankton species can be developed. This purely classic eutrophication perspective does not allow more sophisticated questions related to nutrient effects through the food web, mediated by physiology and biogeochemistry, to be investigated. The McKee report and this strategy outline have explored a very limited subset of the literature on nutrients and effects.

The load-response model approach described in the strategy, by its very nature, leads to an overemphasis on ammonium as a "toxicant". While it is well recognized in the strategy and McKee et al documents that ammonium is inhibitory to phytoplankton uptake under some circumstances, and this should be commended, the broader literature and understanding on these effects is totally lacking. Not a single reference is made to the growing understanding of the physiological requirement by some diatoms for nitrate. Not a single reference is made to the literature on ammonium inhibition effects outside of California. Rather, the entire focus of studies is on determining ammonium's role as a toxicant. There is a wealth of literature on ammonium inhibition that can and should be explored in relation to San Francisco. Delving into the literature in depth will go a long way in resolving the uncertainties about ammonium effects that continue to be stated in these documents.

The strategy does not really address the issue of scale. Defining the role of nutrients is all about scale—the scale of phytoplankton growth, versus long-term ecosystem scale effects. This is central to defining the problem. This is also central to understanding how nutrient effects propagate through the ecosystem, beyond the acute toxic effects.

The strategy needs to pay more attention to biogeochemical pathways and the role of nutrient processing. Other than saying that biogeochemistry might be important (it is), nothing is conveyed in this document that indicates that there is an understanding of how biogeochemistry might drive the system on either short or long time scales. In fact, the recommended action under the need for understanding these pathways is more monitoring, yet, there is no indication that process studies are to be included in the monitoring efforts. One can never get to an understanding of nutrient cycling by measuring nutrient pools. The lack of process-oriented measurements of nutrients in San Francisco Bay and Delta is one of the most important holes to fill.

Relationships with productivity are discussed in the strategy, but nowhere is it recognized that most of the existing data are not from direct measurements of productivity. This is another example where improved process-level measurements need to be conducted. An understanding of bacterial processes is also critical and has been completely left out of the strategy.

The document recommends a spatially-explicit approach; this is appropriate. However, the strategy does not convey an understanding of how nutrients are processed differently in more lagoonal conditions than riverine- high flow conditions. There is a large literature on this that should be referenced in developing this strategy. This distinction is especially important with respect to dissolved oxygen; the former being more likely to have depressed oxygen levels on a diel basis. The classic view that large hypoxic zones must develop in order for a system to be considered eutrophic fails to recognize that many systems are eutrophic but exhibit diel hypoxia. We are not aware of any diel measurements of oxygen reported in the strategy or McKee et al. 2011. Oxygen objectives cannot be established until the right measurements are made on the right scale.

Overall, in principle, monitoring, modeling, control strategies and regulations should follow logically. The crux of the problem here is that until the problem is more completely defined, the strategy will fail to achieve its desired outcome.

<u>Specific comments:</u>

Page 1, paragraph 2: The background discussion needs to include a statement on literature related to nutrient stoichiometry limiting phytoplankton growth and accumulation. (Dugdale et al., 2007; Wilkerson et al., 2006; Glibert 2010; Glibert et al., 2011)

Page 1, paragraph 3: Changes in phytoplankton community composition in Suisun Bay have also been noted by Glibert 2010, Glibert et al., 2011, and Winder and Jassby 2010.

Page 3, paragraph 1, line 1: Several papers have been published, not just submitted, by the Dugdale team at RTC addressing the effects of ammonium on primary productivity in Suisun Bay, including Dugdale et al., 2007, Wilkerson et al., 2006, and Parker et al., 2012.

Page 3, paragraph 1: While there may be scientists in the San Francisco Estuary area who verbally do not agree that ammonium has a role in limiting primary productivity, there have been no published papers in this area that refute this hypothesis, only papers that support it.

Page 3, paragraph 1: Suggest adding the following paragraph addressing the role of N:P ratios in controlling phytoplankton community composition.

"Another issue of importance to the Water Board and stakeholders is that of the potential impact of nutrient form and ratio on Bay beneficial uses. Glibert 1010 and Glibert et al., 2011 argue that not just ammonium concentrations, but also the ratio of ammonium to nitrate and nitrogen to phosphorus play a major role in determining community composition at all trophic levels. The Delta Science Program has funded a 3-year study to look at the role of nutrient form and ratio by conducting experimental manipulations with different ambient communities from different sites and seasons and enriched with different combinations of nitrogen and phosphorus in different chemical forms."

Page 3, paragraph 2: Add nutrient stoichiometry to list of factors contributing to maintaining biomass at low levels.

Page 4, section 4, paragraph 1: We disagree with the statement that "generating the scientific understanding needed to fully support all of the management decisions and questions will likely take a decade or more." The strategy does not have to, and should be prioritized so as not to, take a decade or more to generate sufficient scientific understanding to make management decisions. There is a tremendous amount already known in this system, substantial additional work currently underway, and even more that can be adapted from other systems that are farther ahead of us on nutrient management questions.

Page 6, paragraph 4: The strategy needs to describe the process for developing the consensus statement.

Page 7, Task 2.2: Again, the strategy needs to describe the process for developing the consensus for this task. Also, we agree with the strategy recommendation to designate the need to revise objectives for ammonium as a high priority. It is important that the schedule for the ammonium evaluation be consistent with the requirements of the Central Contra Costa Sanitary District NPDES permit to conduct studies related to ammonium effects in Suisun Bay.

Page 9, Task 3.1: Development of a monitoring program addressing nutrients should also be designated as a high priority for the nutrient strategy. Given that there are existing monitoring programs in place, and additional data collected over the next two years under the Water Board's March 2, 2012, section 13267 Order, it should not take four years to develop the monitoring program.

Page 10, paragraph 2: Task 4.1 should also consider agricultural sources of nutrients to the San Francisco Bay region, such as agricultural sources of nutrients to the Napa River.

Page 15, Table 3, row 3: Developing consensus on the relative importance of ammonium inhibition of phytoplankton blooms to Baywide primary productivity is a rather high standard to attain, and may not be possible given the diversity of stakeholders and stakeholder interests. A weight of evidence approach may be more appropriate. This recommendation should be expanded beyond just ammonium to nutrient stoichiometry including ammonium to nitrate and nitrogen to phosphorus ratios.

Page 15-16, Table 3: Please see the attached specific revisions to Table 3.

Page 17, Appendix 1, Diagnostic pigments: Erika Kress, Wilkerson's graduate student at SFSU RTC, provided a presentation at the April 2012 IEP Workshop on her work "Assessing Phytoplankton Communities in the Sacramento and San Joaquin Rivers Using Microscopic and Indirect Analytical Approaches", using fluoroprobe and flow cytometer techniques.

Page 17, Appendix 1, Urea: The Water Board's March 2, 2012, Water Code 13267 letter requires larger POTWs to monitor urea.

Page 20: The list of on-going studies should also include the sediment flux study being conducted by Glibert, Cornwell and colleagues at the University of Maryland.

Table 3 –– Suggested Revisions

Habitat Type	Recommended Action	Priority
All subtidal	Sponsor a series of expert workshops to develop a draft assessment framework based on indicators of phytoplankton (biomass, productivity, assemblage, cyanobacteria cell counts and toxin concentrations) and dissolved oxygen	High
	Form a working group of Bay scientists to synthesize available data on factors known to control primary productivity in different regions in the Bay, developing consensus on relative importance of ammonium inhibition of phytoplankton blooms to Baywide primary productivity, and determining next steps with respect to incorporating ammonium and nutrient stoichiometry into the NNE assessment framework for the Bay.	High
	Consider a review of the Bay dissolved oxygen objectives, either Bay-wide or for specific habitat types such as tidally muted areas (tidal sloughs, estuarine diked Baylands)	High
Un-vegetated Subtidal	Utilize IEP-EMP data to explore use of macrobenthos to assess ~~eutrophication~~beneficial use impairment in oligohaline habitats. Consider including biomass and species composition in the protocol to improve diagnosis of ~~eutrophication~~beneficial use impairment. Determine whether combination of indicators can be used reliably to diagnose ~~eutrophication~~ beneficial use impairment from nutrient loading distinctly from other stressors.	Low
Submerged Aquatic Vegetation	Conduct studies to establish light requirements for the Bay seagrass species;	Low
	Collect baseline data to characterize prevalence of macroalgal blooms and other stressors on seagrass beds	Moderate
	Evaluate the findings of statewide NNE studies characterizing effects of macroalgae on seagrass for applicability to the Bay	Moderate
	Participate in statewide group to develop an assessment framework for eutrophication in seagrass, based on phytoplankton biomass, macroalgae, and epiphyte load.	High
Intertidal Flats	Evaluate the findings of studies characterizing effects of macroalgae on intertidal flats for applicability to the Bay	Moderate
	Participate in statewide group to develop an assessment framework for ~~eutrophication~~beneficial use impairment in intertidal flats, based on macroalgae and other supporting indicators.	High

Habitat Type	Recommended Action	Priority
Tidally muted habitats - managed ponds	Synthesize existing DO oxygen data for tidally muted areas and collect baseline data primary and supporting indicators (macroalgal biomass and cover and phytoplankton biomass, taxonomic composition, and HAB toxin concentrations) in these habitats needed to make a full assessment of status of ~~eutrophication~~beneficial use impairment.	High