

NATIONAL WATER RESEARCH INSTITUTE

Final Interim Report

of the First Meeting of the

Independent Advisory Panel

on Reviewing the

**County of Orange's Nitrogen and Selenium
Management Program**

(February 2-3, 2006)

Prepared March 18, 2006
Fountain Valley, California

Introduction

In 2005, the County of Orange, California, requested that the National Water Research Institute (NWRI) of Fountain, Valley, California, organize an independent third-party advisory panel (Panel) to review and provide guidance on the County's Nitrogen and Selenium Management Program (NSMP), which is a 5-year work plan to address selenium and nitrogen in the Newport Bay Watershed, focusing on groundwater contamination.

The overall charge to the Panel is to determine whether the NSMP should pursue the development of site-specific objectives (SSO) for selenium.

Panel members include:

- Chair: Brock B. Bernstein, Ph.D., Independent Consultant
- Gerald Combs, Ph.D., U.S. Department of Agriculture
- Roger L. Hothem, U.S. Geological Survey
- Mohsen Mehran, Ph.D., Rubicon Engineering, Inc.
- Roy A. Schroeder, Ph.D., U.S. Geological Survey
- JoAnn Silverstein, Ph.D., P.E., University of Colorado, Boulder

The Panel met for the first time with County representatives and consultants at the Doubletree Anaheim/Orange County on February 2-3, 2006. An agenda from that meeting is included in Appendix A. At that meeting, the County specifically requested that the Panel provide recommendations on both the Selenium Conceptual Model and Selenium Speciation Analytical Method.

This interim report presents the Panel's preliminary observations, expectations, and recommendations on the NSMP. The Panel's comments and recommendations are based on a review of written material and on presentations and discussions at the February 2006 meeting. The Panel's comments are organized into three sections:

- *Observations*: Comments on and judgments about specific aspects of the NSMP and its approaches and methodologies
- *Expectations about Future Work*: Additional technical efforts that are part of the work plan (as well as are scheduled to occur over the next few months), which should be reported on at the next Panel meeting
- *Recommendations*: Adjustments and/or extensions of work plan elements that the Panel believes will improve the program's chances for success.

Observations

The Panel makes the following observations about the material presented for discussion at the February 2006 meeting:

1. The comparison of analytical methods was well done. It was well organized and based on a detailed understanding of the issues that affect various methods for

quantifying selenium concentrations. In addition, the study was able to adapt effectively to increase the number of laboratories participating in the study. Overall, the Panel agrees with the NSMP's conclusions regarding the choice of methods for analyzing both total selenium and selenium species in water samples. However, the Panel also noted the anomalous relationship between filtered and unfiltered measurements (i.e., filtered values slightly larger than unfiltered). The consistency of the discrepancy in the data presented during the meeting strongly suggests that this is not simply random measurement error. The Panel notes that this discrepancy has been seen before due to impaired sample flow at the nebulizer as a result of particulates in the unfiltered sample causing the loss of analyte.

2. The Panel also encourages the investigators to utilize electrothermal methods, which are advantageous in that there is no loss of selenium due to processing steps, and/or atomic fluorescence, which may have greater sensitivity than the proposed methods. However, any assessment of these methods should not delay moving forward with the monitoring plan; the methods presented are adequate for the NSMP's purposes at this point. Finally, given that a major focus of the program is the bioaccumulation of selenium in the tissue of organisms, the program may want to focus more directly on measuring biological forms of selenium.
3. The Panel was impressed by the detail and thoroughness of the selenium conceptual model. The model clearly reflects an effort to collect and integrate information from a variety of sources. It is comprehensive and complete enough to provide the basis for quantitative modeling and for ground truthing anomalous results. The model's use of specific indicator species also provides needed focus to subsequent analysis and monitoring efforts (however, please see Recommendation #2 on indicator species, provided below). The Panel also noted a preliminary attempt to rank the relative strength of connections in the conceptual model using connecting lines of varying thickness. This is a useful first step toward the necessary quantification of these linkages as a basis for prioritizing further monitoring and Best Management Practices (BMP) development efforts. The issue of data quality was not explicitly addressed, but the Panel suggests that the data used to build the conceptual model be filtered through a quality control step to ensure validity and reliability.
4. The Panel was impressed by the knowledge displayed by the Working Group, County staff, and consultant team. Every individual present was well informed, participated actively in the discussion, and provided relevant comments. It was clear to the Panel that the well-coordinated working relationships among members of the program are key to the NSMP's ability to work quickly and efficiently. As a result, the NSMP has accomplished an impressive amount in a relatively short period of time.

Expectations about Future Work

The NSMP assured the Panel that two vital technical issues are currently being addressed by the consultant team:

1. More detailed quantitative information on flows, sources of selenium, loads at key points in the watershed, and transport mechanisms will be needed to expand the conceptual model from a narrative process description to a quantifiable description of movement of selenium within the watershed.
2. A quantitative framework for developing an overall mass balance for the system is essential. Such a mass balance framework, at the appropriate spatial scale, will be needed to evaluate alternative BMPs and in decision making regarding any SSO.

The Panel expects to hear a report on progress in these two areas at its next meeting.

Recommendations

The Panel submits the following recommendations to enhance the technical basis of the program and to improve coordination with other related efforts:

1. The NSMP should expand the conceptual model to achieve more spatial and temporal resolution. For example, in the conceptual model presented, sources are spatially generic; however, if spatially explicit selenium “hotspots” can be identified, it may be useful to include these in the model. As another example, large seasonal differences in flows may affect not only transport, but also bioaccumulation processes identified in the conceptual model. While hydrologic and geochemical processes are captured in the model, the specifics of these processes should be matched to particular habitats and the wildlife that inhabit them. This may require adding submodels or compartments, but will provide a basis for estimating different risks to populations and habitats. The inclusion of a temporal component to the model will allow for estimates of differential risk to be based on seasonality.
2. The indicator species suggested in the conceptual model should be reevaluated and, perhaps, revised based on their abundance and distribution. For example, black skimmers are very rare and are only recorded from June to September. While Forster’s terns are the most common terns, they are rare except from May to September. Coots are common, and there is a large data set for selenium effects. Mallards, however, are more common and also have an extensive field and laboratory data set for selenium effects. Stilts and avocets are present, but stilts have a better database and are more affected by selenium than are avocets. The NSMP may want to consider using night herons, which are a fairly common piscivore/carnivore in the marsh, assuming that they are breeding there. Finally, the NSMP should consider using either cliff swallows or tree swallows (in nest

boxes). Both are insectivores that rely on emerging insects from water near their nests.

3. The multiple lines of evidence (MLOE) approach and the selenium hazard index are appropriate starting points for assessment, but they should be developed more fully. The basis for scoring the separate lines of evidence and for establishing thresholds of effect is not yet explicit. There is, as yet, no discussion of whether the separate lines of evidence will be weighted equally or of what algorithm will be used to combine them to produce an overall site score. The State Water Resources Control Board's Sediment Quality Objectives (SQO) project is developing a very systematic approach to using MLOE for both direct impacts on biological communities and indirect effects that operate through bioaccumulation processes. The NSMP should evaluate the SQO approaches for relevance to the selenium issue.
4. The NSMP should attempt to resolve the apparent contradiction between the presence of elevated selenium tissue levels and the lack to date of evidence of adverse wildlife impacts. Because of the complex and poorly understood nature of selenium toxicity, there is an imperfect correlation between tissue levels and toxicological response. This relationship is species-specific, as well as habitat-specific. Thus, the NSMP should use an extensive literature review to reexamine the robustness of tissue levels as a measure of risk. It would be useful to identify a subset of high-quality existing studies with conditions similar to those in the Newport Bay watershed. This may help to narrow the range of tissue levels representative of ecological risk and help to establish thresholds for the MLOE. Past experience shows that such thresholds will not be distinct levels, but will have some variability or uncertainty around them. Thus, it would be helpful to use the literature to identify selenium concentrations in tissues ranging from those that show no effects to those that show the first measurable effects (lowest observable effects level). This will help to parameterize inputs to the bioaccumulation modeling that will be used to assess the likelihood of ecological risk in the watershed, a key input to the decision regarding pursuit of an SSO.
5. The Panel believes that the NSMP should make it a high priority to identify the fate of the "missing" 30 to 40 percent of selenium in the current watershed mass balance. This amount is so large that it could undermine the credibility of any recommendations proposed by the NSMP. The proposed effort should include: a) further characterization of known sources, b) an estimation of the potential size of analytical error and how it propagates through the calculated mass balances, and c) a more complete investigation of other potential sources of error, bias, and uncertainty. One approach might be to identify possible mechanisms that could contribute to the unaccounted for selenium, followed by a combination of logical reasoning, calculations, and modeling to potentially remove them from consideration.

6. The Panel strongly recommends that the NSMP consider the broadest possible range of BMPs and mitigation options and conduct at least preliminary feasibility analyses of all such options. Because the sources of selenium (and nitrogen) in the watershed are so diffuse, it will be important to extend the boundaries of consideration well beyond the more typical treatment approaches.
7. Given the relatively short timeframe for making a decision about whether or not to pursue the development of an SSO, the Panel suggests that the NSMP identify and examine examples of SSOs implemented in other watersheds for selenium or other bioaccumulative contaminants. This examination should include a description of the criteria and processes used in making the decision to pursue the SSO and the scientific evidence that was developed in support of the SSO. It would also be useful to have a draft timeline for the development of an SSO, with key milestones identified.
8. The NSMP should ensure that its monitoring and modeling efforts are closely coordinated with other related efforts being carried out in the watershed, including:
 - Dr. Barry Hibbs' modeling of surface and groundwater interactions.
 - Groundwater sampling and remediation efforts at the Tustin Marine Corps Air Station.
 - The Santa Ana Regional Water Quality Control Board's sampling to estimate selenium levels in tissues of selected organisms.

Summary

The Panel believes that the scientific and technical activities being conducted by the NSMP are well planned, coordinated, and of high quality. While the Panel made a number of specific recommendations to enhance the study, the program's approach is sound.

Appendix A

**NWRI's Independent Advisory Panel on the County of Orange's
Nitrogen and Selenium Management Program**

**Meeting Agenda
February 2-3, 2006**

Meeting Location:

Doubletree Anaheim/Orange County
100 The City Drive
Orange, CA 92868
Phone: 714-634-4500

On-Site Contacts:

Tammy Russo (NWRI)
Cell: (714) 614-7386
Jeff Mosher (NWRI)
Cell: (714) 705-3722

Meeting Objectives:

1. Provide panel with appropriate context and background information regarding the County of Orange's development of a Nitrogen and Selenium Management Program.
2. Review the selenium conceptual model (including existing data, data gaps, anticipated analysis, speciation analytical methods, and uncertainty) that describe the important processes that determine the effects of selenium in the watershed.
3. Develop recommendations on the appropriateness of the model and its output (including findings and conclusions) for the proposed application.
4. Develop recommendations on the appropriateness of an analytical method for selenium speciation.

Wednesday – February 1, 2006

| | | |
|---------|--|--------------------------------|
| 6:30 pm | DINNER | <i>Sequoia Conference Room</i> |
| | - Panel and County of Orange Representatives | |

Thursday – February 2, 2006

| | | |
|---------|---------------------------------|---|
| 8:30 am | Welcome and Introductions | <i>Sequoia Conference Room</i> |
| | - Jeff Mosher (NWRI) | |
| | - Brock Bernstein (Panel Chair) | |
| 8:45 am | Overview | Chris Compton/Larry McKenny (County of Orange) |

| | | |
|----------|--|--|
| 9:00 am | Project Background - Working Group - Work Plan - Charge for Panel | Karen Hauptly (County of Orange) |
| 9:30 am | Regional Board Perspective | Terri Reeder (Regional Board) |
| 10:00 am | BREAK | |
| 10:15 am | Selenium Conceptual Model - Model Description Associates) - Desired Outputs - Data Gaps (collection efforts) - Speciation Analytical Method | Harry Ohlendorf (CH2M Hill) and Khalil Abu-Saba (Larry Walker |
| 12:30 pm | LUNCH | <i>Shasta Conference Room</i> |
| 1:45 pm | Panel: Open Discussion - Brock Bernstein | <i>Sequoia Conference Room</i> |
| 2:45 pm | BREAK | |
| 3:00 pm | Panel-Only Discussion | Brock Bernstein |
| 5:30 pm | MEETING ADJOURNS | |
| 6:30 pm | DINNER | <i>Wolfgang Puck Restaurant</i> |

Friday – February 3, 2006

| | | |
|------------|---|-------------------------------|
| 8:30 am | Welcome and Summary of First Day | Brock Bernstein |
| 8:45 am | Panel Review with County of Orange Staff | |
| 10:00 am | BREAK | |
| 10:15 am | Panel-Only Discussion | |
| 12:00 noon | MEETING ADJOURNS | |
| 12:00 noon | LUNCH | <i>Shasta Conference Room</i> |