

**GREAT SALT LAKE WATER QUALITY STEERING COMMITTEE
MAJORITY RECOMMENDATION TO THE UTAH WATER QUALITY BOARD
FOR A NUMERIC SELENIUM STANDARD
IN THE OPEN WATERS OF GREAT SALT LAKE**

June 13, 2008

This recommendation is made by the following ten members of the 16-member Great Salt Lake Water Quality Steering Committee (Steering Committee):

Walt Baker	Richard Bay	Dave Grierson	Karen Hamilton
Jim Huizingh	Delane McGarvey	Leland Myers	Kelly Payne
Richard Sprott	Richard West		

Affiliations and stakeholder groups representation of the ten members making the recommendation are shown in Appendix A

Background Issues

See Appendix B for a summary of background issues that are pertinent to this recommendation.

The Majority Recommendation from the Steering Committee for a Numeric Selenium Standard

The ten Steering Committee members listed above recommend:

- The selenium standard for the open waters of Great Salt Lake should be tissue-based, using bird eggs as the most sensitive endpoint;
- The standard should be derived from a 10 percent effect concentration (EC10) as determined from laboratory studies of mallard ducks by Ohlendorf (2003); and
- The numeric selenium standard should be 12.5 mg/kg dry weight¹

Recommendation for a Tiered Assessment Methodology

Because of many unique features of the Great Salt Lake ecosystem, nine² members recommend that a tiered assessment methodology be adopted with the numeric standard. The assessment methodology should provide for ongoing monitoring under conditions comparable to current conditions and increased monitoring and other actions, including studying or capping of selenium point loads, at increasing tiers of selenium concentrations in water column, brine shrimp, and bird eggs. Attached in Appendix C is an assessment methodology developed by UDWQ staff which is recommended for consideration during the public comment process.

The reasons for the above-noted recommendations are as follows:

The Great Salt Lake Ecosystem Is Currently In Good Condition and Far From Being Impaired

This is good news! As previously stated, the study findings include:

- Water column selenium concentrations are well below the concentrations in tributary rivers and streams, despite thousands of years of loading;
- No hatchability or deformity effects were observed for gulls, avocets and stilts; and
- Bird egg selenium concentrations were found to be well below all potential protective levels.

¹ Measured as a geometric mean in bird eggs

² Kennecott Utah Copper's representative has respectfully declined to concur with the assessment methodology as presented in this Majority Opinion; whereas Kennecott fully supports the referenced numeric selenium standard and generally supports a tiered assessment approach, it does not agree with the concepts in this particular assessment methodology and will provide separate, specific comments to the Water Quality Board.

EC10 is the Lower End of the Precedent Range of Effect Concentrations Used Nationally and in Utah

EC20 is a more common basis used nationally in the development of metals toxicity standards. EC10 is the lower end of the national range, taking into account societal risks, costs and values.

Substantial Levels of Conservatism Have Been Incorporated Into the Calculation of the EC10 Value of 12.5 mg/kg

Desirable conservatism has already been incorporated into the EC10 calculations, including:

- Hatchability is the most sensitive ecological endpoint and is directly impacted by egg selenium concentration;
- A mallard duck toxicity curve for hatchability success was used to determine the EC10, recognizing that the mallard is the most sensitive aquatic-dependant bird species for which selenium toxicological response has been studied;
- Even though mallards do not generally populate Great Salt Lake, common species using the lake, such as stilts and avocets, are 2-3 times less sensitive than mallards in selenium reproductive toxicity relationships; and
- The mallard selenium toxicity curve is based on laboratory feeding studies which generally show effects at lower concentrations than observed in the field.

A Tiered Assessment Methodology Will Provide Substantial Levels of Safety toward Ensuring that Great Salt Lake Will Not Approach the Standard

Studies indicate that selenium concentration changes in the Great Salt Lake open waters ecosystem occur relatively slowly. A tiered assessment methodology will provide for increasing focus on monitoring, studies, and regulatory actions to slow and reverse any trend that may be detected. These actions would, as currently contemplated, occur well before approaching the standard.

The Recommended Standard Results from the Best Science Currently Available, and Periodic Standards Reviews by the Water Quality Board Will Offer Opportunities to Modify the Selenium Standard Following Results from New Studies Emerging Data

Therefore, additional levels of conservatism need not be built in at this time to deal with uncertainties in the current science and studies.

Most Science Panel Members Submitted this Same Recommendation

The majority recommendation from selenium expert scientists who also have knowledge regarding relevant actions by other regulatory agencies underscores the defensible foundation for the standard recommended by the Steering Committee majority.

APPENDIX A

Primary Affiliations and Stakeholder Representation of Ten Steering Committee Members Making This Recommendation

Walt Baker, Utah Department of Environmental Quality (representing state government)

Richard Bay, Jordan Valley Water Conservancy District (representing municipalities)

Dave Grierson, Utah Division of Forestry, Fire and State Lands (representing state government)

Karen Hamilton, U.S. EPA, Region 8 (representing federal government)

Jim Huizingh, Morton Salt (representing industry)

Delane McGarvey, Davis County Health Department (representing local government)

Leland Myers, Central Davis Sewer District (representing publically owned treatment works (POTW))

Kelly Payne, Kennecott Utah Copper Corporation (representing industry)

Richard Sprott, Utah Department of Environmental Quality (representing state government)

Richard West, West Side Associated Duck Clubs (representing West Side Associated Duck Clubs)

APPENDIX B

BACKGROUND ISSUES

Creation of the Great Salt Lake Water Quality Steering Committee

UDEQ³, in consultation with key stakeholders, established the Steering Committee to guide the process of recommending site-specific numeric water quality standards, beginning with selenium, for the open waters of Great Salt Lake that will prevent impairment of beneficial uses and sustain the natural resources of the lake. Sixteen Steering Committee members were appointed in 2004, representing federal and state regulatory agencies, other public entities, conservation organizations, recreation groups, and industrial users of the lake. Steering Committee membership can be seen at http://www.deq.utah.gov/Issues/GSL_WQSC/index.htm.

A Science Advisory Panel Was Assembled

A Science Advisory Panel⁴ (Science Panel) of nine experts was convened by the Steering Committee. The Science Panel was charged with identifying gaps in scientific understanding, specifying appropriate sampling and methodologies for selenium in Great Salt Lake, prioritizing and recommending needed research, and assisting in the guidance and oversight of research and studies.

Substantial Funds Were Raised

The Utah Division of Water Quality (UDWQ) and the Steering Committee generated \$2.3 million. These funds were exhausted in performing Great Salt Lake selenium studies.

Key Studies Were Commissioned

These studies included:

- Identifying best laboratory methods for measuring selenium in Great Salt Lake;
- Broad sampling and analyses of selenium in Great Salt Lake water, avian diet components, and bird populations;
- Identifying selenium loading and transport/flux in the lake;
- Describing relationships between selenium concentrations from the water column, to bird diets, and to bird tissue/eggs;
- Relative importance and toxicity of selenium concentrations in the food chain pathways to aquatic wildlife; and
- Ecological effects to aquatic wildlife.

These studies are described in an executive summary report⁵. The “open waters of Great Salt Lake” were defined as Gilbert Bay, or the south arm.

Background Selenium Concentrations Were Identified

After identifying the appropriate laboratory methodologies for analyzing selenium in the Great Salt Lake open waters, a background concentration of 0.6 ug/L was identified as the average. Other important background selenium concentrations included:

brine shrimp - 3.9 mg/kg

bird eggs - 2.7 mg/kg

³ The Utah Department of Environmental Quality

⁴ See http://www.deq.utah.gov/Issues/GSL_WQSC/index.htm

⁵ Executive Summary – Selenium Program Development of a Selenium Standard for the Open Water of Great Salt Lake. See at http://www.deq.utah.gov/Issues/GSL_WQSC/index.htm.

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The Loading and Flux of Selenium in Great Salt Lake Were Estimated

While the Science Panel acknowledged a level of uncertainty, it estimated selenium loading and flux in the open waters of Great Salt Lake as follows:

Annual Loading (Inputs)		Annual Flux (Outputs)	
• Tributary rivers, streams	1,500 kg	• Volatilization to atmosphere	-2,100 kg
• Unmeasured inflows (including groundwater)	600-1500 kg (?)	• Permanent sedimentation	-500 kg
		• Output to food chain	-4 kg

Noteworthy findings included:

- The large amount (2,100 kg per year) of selenium discharged to the atmosphere through volatilization;
- The relatively small flux through the food chain (4 kg per year); and
- The tributary rivers and streams have higher selenium concentrations (1-2 ug/L) than the Great Salt Lake water column concentration (0.6 ug/L).

Birds Were Identified as the Most Selenium–Sensitive Sector of the Lake Ecosystem

Furthermore, reproductive success of birds was considered the most critical endpoint. This was studied using the conservative indicator of hatchability.

The Food Chain Was Studied

Because of the bioaccumulative nature of selenium, the inputs from selenium to the critical avian endpoint were studied as selenium moves “up” through the food chain, generally from water to algae to brine shrimp to birds. (See studies⁵)

Current Selenium–Related Conditions at Great Salt Lake Were Found To Be Favorable, with No Significant Ecological Effects Occurring In Aquatic Wildlife

The study findings found that:

- In spite of thousands of years of natural selenium loading to the lake, the water column selenium concentration is substantially lower than its natural tributaries;
- Bird dietary items, including brine shrimp, have selenium concentrations below 10 percent effect concentrations (EC10);
- No egg hatchability or teratogenic (deformity) effects have been observed; and
- Eggs from birds utilizing lake dietary food sources are well below all potential protective thresholds.

Selenium Toxicity Data for Avian Reproduction Were Reviewed and Selected

Although gulls, avocets and stilts are the birds of most concern which use dietary sources from Great Salt Lake during the nesting season, laboratory toxicity data for mallard ducks was selected for use, providing a substantial level of conservatism.⁵

A Selenium Bioaccumulation Model Was Created

A bioaccumulation model was developed from data collected from Great Salt Lake to describe and simulate the transfer of selenium from water up through the food web and into bird eggs. The model allows the user to estimate diet and egg selenium concentrations from assumed waterborne selenium concentrations (within a limited range), and also allows back-calculating from egg or diet selenium concentrations to waterborne concentrations.⁵

APPENDIX B cont.

The Science Advisory Panel Submitted Recommendations for a Numeric Selenium Standard

Based upon the studies, the Science Panel recommended:

- The standard should be tissue-based, using bird eggs
- A selenium standard that prevents impairment for aquatic wildlife of Great Salt Lake lies within the range of 6.4-16 mg/kg for bird eggs; and
- The standard should be implemented with a tiered assessment approach to further mitigate risk.

In addition, all but one Science Panel member provided individual recommendations for the selenium standard, as follows:

- 12-12.5 mg/kg - 6 panel members
- 10.4 mg/kg - 1 panel member
- 5 mg/kg - 1 panel member
- Abstained - 1 panel member