SOUTHWEST JORDAN VALLEY GROUND WATER CLEANUP PROJECT
STATE OF UTAH NATURAL RESOURCE DAMAGE TRUSTEE

COMMENT RESPONSE SUMMARY
AUGUST 31, 2004

Response to Common Comment No. 9 – Potential Impacts to Great Salt Lake as a Result of Concentrate Discharge

A number of comments addressed the potential impact to the Great Salt Lake from discharge of reverse osmosis (RO) treatment concentrates. The Trustee, DEQ, Kennecott, and Jordan Valley Water Conservancy District (JVWCD) recognize the importance of the Great Salt Lake and associated wetlands. As described below, a number of studies of selenium and the Great Salt Lake have already been conducted. Interpretation of those studies suggest that the selenium concentrations in the RO concentrates from this project would not have a negative impact to the Lake's ecosystem. However, some commenters indicated that additional information is needed, particularly with respect to impacts on aquatic species.

Standards for the Great Salt Lake

Direct discharge of concentrates will be the subject of additional studies. These studies will be part of the evaluation by the DEQ Division of Water Quality (DWQ) to set a numeric selenium standard for the Great Salt Lake, as described below. JVWCD has also committed to studies of selenium and the Great Salt Lake Ecosystem. Any future direct discharge of concentrates to the Great Salt Lake will be subject to DEQ permitting and ongoing regulatory oversight to assure that the Great Salt Lake and associated wetlands are not adversely affected by the project.

The open water of the Great Salt Lake is protected for its current beneficial uses through the application of the narrative criteria clause in the state water quality standards, R317-8.[1] As described below, the DWQ in connection with work performed by Kennecott under its UPDES permit, has set a site-specific permit limit for selenium discharge to the Great Salt Lake.

Any direct discharge to the Great Salt Lake is subject to DEQ's regulatory oversight and approval to assure that the Great Salt Lake and associated wetlands are not adversely affected. The regulation of discharges to the waters of the State of Utah through a Utah Pollution Discharge Elimination System (UPDES) permit provides the authority to limit concentrations of pollutants discharged to a water body such as the Great Salt Lake and allows for continued monitoring of conditions and protection of the designated beneficial uses of that water body.

Furthermore, the DEQ Division of Water Quality is establishing a process to study and adopt specific numeric water quality standards for the open waters of the Great Salt Lake, beginning with the studies to establish a numeric standard for selenium for the Lake. The process will

[1] The freshwater wetlands associated with the shore of the Great Salt Lake are protected by the beneficial use classification 3D with its associated numeric criteria. This is the same level of protection given to all fresh water streams, rivers and lakes throughout Utah.

include review of existing studies and conduct of additional work, in conjunction with a Science Panel and stakeholder-based Steering Committee.

Project Impacts on Great Salt Lake

The impacts to the Great Salt Lake were considered throughout the Technical Review Committee (TRC) review of potential remedies for the groundwater contamination addressed by the project outlined in the Joint NRD Proposal. The TRC formed work groups to examine the issues associated with discharge to the Great Salt Lake, and contractors were hired to review potential discharge issues. Kennecott has provided extensive data to show that the concentrates to be derived from the Zone A RO treatment plant are either at or below Great Salt Lake background concentrations for all constituents except selenium. Kennecott has extensively studied selenium in connection with its existing UPDES permit to help quantify the numeric permit limit for selenium discharge to the Great Salt Lake, as mentioned above. The principal concern with selenium is the extent to which it may bioaccumulate in the Great Salt Lake food chain.

The studies cited below have been reviewed by the TRC, including EPA and DEQ. The studies consider the chemistry, geochemistry and toxicological effects of selenium to determine concentrations of selenium that could be safely discharged to the Great Salt Lake without acute or bioaccumulative impacts to the food chain of the Lake. Although the studies showed that brine shrimp were not affected by selenium until concentrations exceeded 3000 ppb, the studies showed that the shrimp could accumulate selenium that could be ingested when birds fed upon the shrimp. Looking at the dietary exposure of birds that preyed upon the shrimp, it was calculated that as long as the selenium concentration in a discharge to the Great Salt Lake is less than 27 ppb, the brine shrimp would not accumulate enough selenium to affect birds that consume them.

Recent chemical data indicate that the background concentration of selenium in the open water of the Great Salt Lake is approximately 0.7 ppb. Since the concentration of selenium coming into the Lake from the Bear River, Weber River and Jordan River exceeds that value by 2 to 3 times, the question arises: “Why isn’t the concentration of selenium in the Great Salt Lake higher due to centuries of evaporation? For example, the total dissolved solids (TDS) in the rivers is approximately 500 mg/l, and the TDS in the Great Salt Lake is much greater than 100,000 TDS – more than 200 times greater. Why then isn’t the concentration of selenium in the Great Salt Lake over 200 ppb?” Specifically in the case of selenium (and potentially other metals as well) there is a precipitation effect where selenium converts to a solid phase in the Great Salt Lake and becomes part of the Lake sediments. Studies have shown that the lake is not likely to have elevated concentrations of selenium due to (1) the very high concentrations of sulfate in the lake, and (2) the anaerobic lower layers of the lake with its associated large negative reduction-oxidation potential, which enhances the precipitation of metals, including selenium, as sulfides. These two factors maintain low concentration of selenium and other metals in the water of the Great Salt Lake. For that reason, discharges of metals into the Great Salt Lake from rivers and other sources will be precipitated, and their concentrations in the water are not expected to rise significantly above present levels.

The form of selenium present in the RO concentrate and acid plume water is selenate. The studies cited below have documented that sulfate has an antagonistic relationship with the bioavailability of selenate. Thus, less selenium will be assimilated by algae and brine shrimp in the Great Salt Lake, due to elevated sulfate concentrations in the Great Salt Lake and in the proposed discharges, than would be assimilated by organisms in a fresh water system.

SELENIUM RELATED REFERENCES

Kennecott has commissioned, conducted or used all or parts of the following list of selenium-related studies:

Kennecott Utah Copper, 2003, Miscellaneous water quality data from the Inland Sea Shorebird Reserve.

Brix, K.V., DeForest, D.K., Fairbrother, A., and Adams, W.J., 2000, Critical review of tissue-based selenium toxicity thresholds for fish and birds: Mine Reclamation Symposium Proceedings, June 21-22, 2000: Selenium Session, sponsored by Ministry of Energy and Mines, Williams Lake, British Columbia, Canada.

2000, Changes and current status of CoC in wetlands near industrial sites of Kennecott: Contractor report to Kennecott, March 2000.

DeForest, D. K., Brix, K., and Adams, W.J., 1999, Critical review of proposed residue-based selenium toxicity thresholds for freshwater fish: Human and Ecological Risk Assessments, 5(6), p. 1187-1228.

Fairbrother, A., Brix, K.V., DeForest, D.K., and Adams, W.J., 1999, Egg selenium thresholds for birds: A response to J. Skorupa's critique of Fairbrother et al., Human and Ecological Risk Assessment 6(1), p. 203-212.

Fairbrother, A., Brix, K.V., Toll, J.E., McKay, S., and Adams, W.J., 1999, Egg selenium concentrations as predictors of avian toxicity: Human and Ecological Risk Assessment, 5, p. 1229-1253.

1999a, Ecological risk assessment of Kennecott SU1 area, results of supplemental field studies conducted during the 1999 nesting season: Contractor report to Kennecott, October 1999.

1999b, Deriving a UPDES permit value for selenium in the Great Salt Lake: Contractor report to Kennecott, August 1999.

EP and T, Inc., and Parametrix, Inc., 1998, Ecological risk assessment – southshore wetlands: final report: Contractor report to Kennecott, June 1998.

1998a, Chronic toxicity of selenium to brine shrimp, *Artemia franciscana*: Contractor report to Kennecott.

1998b, Evaluation of selenium toxicity to larvae of the brine fly, *Ephydra cinerea*: Contractor report to Kennecott.

1998c, Evaluation of selenium toxicity to the algae, *Dunaliela viridis*: Contractor report to Kennecott.

1998d, Ecological risk assessment: Great Salt Lake: Contractor report to Kennecott.

Parametrix, Inc., 1996, Selenium fate and transport study sampling and analysis plan for the Kennecott Utah Copper south shore wetlands: Contractor report to Kennecott.

1996a, Ecological risk assessment: northern Oquirrh Mountains final report: Contractor report to Kennecott.

1996b, Chronic toxicity of arsenic to brine shrimp, *Artemia franciscana*: Contractor report to Kennecott.

United States Army Corp of Engineers (USACE), 1995, Final Environmental Impact Statement (EIS), Tailings Modernization Project, Kennecott Utah Copper, December 1995.

1995a, Problem formulation report: screening level for the ecological risk assessment: Contractor report to Kennecott.

1995b, Analysis report: screening level for the ecological risk assessment: Contractor report to Kennecott.

1995c, Risk characterization report: screening level for the ecological risk assessment: Contractor report to Kennecott.

EP and T., Inc., 1993, Developing assessment endpoints for the ecological risk assessment: Contractor report to Kennecott.

1980, Heavy metals in the Great Salt Lake: in Gwynn, J. W., ed., Great Salt Lake: A Scientific, Historical, and Economic Overview: Utah Geological and Mineral Survey, Salt Lake City, UT, p. 195-202.

1978, Manganese, molybdenum, and selenium in the Great Salt Lake, Utah: Utah Geology, 5, p. 27-32.

Tayler, P. L., Hutchinson, L.A., and Muir, M.K., 1977, Heavy metals in the Great Salt Lake, Utah: Utah Geology, 4, p.19-28.