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USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Development of a Budget for Mercury in Waters of the Upper Carson River Watershed

Focus: Hydrogeochemistry

Keywords: contaminant transport, geochemistry, heavy metals, fisheries, Indian water issues, mining, streams, rivers, solute transport

Duration: 3/99-2/00

Federal Funds: $14,106

Nonfederal Funds: $26,445

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Congressional District: Nevada District 2

Statement of Critical Regional or State Water Problems

This study will develop a seasonal inventory of mercury concentrations in water and sediments of tributaries of the East Fork of the Upper Carson River (EFUCR) over a one-year period. Mercury bioavailability to aquatic insects in several tributaries will be determined by measurement of mercury in total body burden. Mercury concentrations measured in waters of the Carson River in the 1990's, above the contamination associated with the Carson River Superfund site, ranged from 9 to 25 ng/L. These concentrations are above what is considered ambient background (1-3 ng/L), indicating that there is a mercury source in the Upper Carson Watershed. Major tributaries that could be contributing to the elevated mercury concentrations include Leviathan, Poison, Barney Riley, Bryant and Mountaineer Creeks. The Leviathan/Bryant Creek tributary is known to be highly impacted by acid mine drainage from the Leviathan mine, and the EFCR watershed contains numerous small historic gold, silver and mercury mines. Preliminary measurements of mercury in waters from the above mentioned creeks have indicated that mercury concentrations in these waters are in the 10's to possibly 100's of ng/L. In addition, analytical study of bottom sediment and crayfish tissue, as part of the National Water Quality Assessment Program, have demonstrated that concentrations of mercury in these media increased by > 100 percent in the East Fork of the Carson between the Markleville and Garnerville Gages. Bryant Creek, which drains the study area, enters the Carson between these two gages. It is hypothesized that, mercury is derived from small creeks in the EFUCR watershed which are associated with naturally mercury enriched rocks.

These waters impact:

1. The Washoe Tribe, the closest downstream community at Dresslerville;
2. The Carson River, which is listed as a priority watershed in Nevada;
3. The Mountaineer Watershed, an important trout fishery in the Sierra; and
4. All downstream organisms, that utilize the waters of the Carson River.

There is currently extensive chemical, biological and ecotoxicological research being done to assess the environmental impacts of wa aters draining the Leviathan Mine site. Mercury concentrations in water are being monitored by the USGS as part of this ongoing research, however their detection limit is 0.1 ? g/L. Our detection limit is 0.001 ?g/L. Concentrations of total mercury that have been determined to be lethal to sensitive, representative nonhuman species range from 0.1 to 2 ?g/L. The mercury criteria proposed by U.S.EPA for protection of freshwater aquatic life is 0.012 ?g/L for an exposure period of four days. The value of 0.012 ?g/L is also currently proposed as the Water Quality Criterion for the state of California. Preliminary data indicates that these concentrations are present in the EFUCR Watershed. In this project, methyl mercury in water and sediments will also be determi???? ned at a few select sampling sites. If available, methyl mercury may be bioaccumulated in fish up to 106 times the concentration in water. This project will compliment research currently being done in the Upper Carson River watershed, and will draw upon the hydrological, biological and water quality research being done by other organizations in the area.

Benefits and Results

This project will provide a database of mercury concentrations and mercury speciation for EFUCR. Data developed will identify the source of the elevated mercury concentrations measured in waters of the EFUCR. Measurement of mercury concentrations in waters of the EFUCR, will provide a basis for assessment of the mercury contribution from the anthropogenically impacted Leviathan Mine Site relative to that from natural mercury enrichment in the area. This will provide a means of assessing if the mercury concentrations in the watershed can be reduced or mitigated with remediation plans proposed for the Leviathan mine. Data developed will also provide a framework for assessing the potential impact of mercury on aquatic life and humans utilizing the river. This project will help with determination of mercury concentrations in the Carson River prior to the Comstock mining era. This data is needed to fully assess the impact of the Carson River Superfund Site on the Lower Carson River.

Nature, Scope, and Objectives of Research

This proposed project focuses on characterization of mercury concentrations in waters and sediments of tributaries of the EFUCR including Mountaineer, Poison, Leviathan, Bryant, and Barney Riley Creeks, along with the EFUCR (Figure 1). These data will be used to assess the sources of mercury to the drainage basin and the potential impact of mercury on aquatic organisms in the Mountaineer watershed, relative to the severely anthropogenically impacted Leviathan watershed. This project would provide data that compliments current research being done by numerous other groups in the EFUCR in response to environmental issues associated with the Leviathan Mine site.

The EFUCR Watershed hosts the Monitor Mining District which contains mineral deposits of silver, gold, lead, zinc, molybdenum, tungsten, copper, sulfur and mercury. Mercury occurs as cinnabar at the Mogul Peak mine, and mercury concentrations of >100 ppm were measured in substrate at the Morningstar mine (Figure 1). The Leviathan Mine, the largest in the district, was initially an underground copper mine and lastly, an open pit sulfur mine. The Leviathan mine adit and associated waste rock currently release acid mine drainage into Leviathan/Bryant Creek (Figure 1). There is substantial historic (1982) and on-going work in the Leviathan Drainage monitoring the concentrations of contaminants and their ecological effects downstream from the mine site. This has included hydrological investigations using conservative tracers, water/sediment monitoring for numerous metal contaminants, water/sediment toxicity testing, and a stream habitat survey. All of this research has used a reach of the Lower Mountaineer Creek as a best reference for "natural" conditions in the Leviathan/Bryant Creek Watershed prior to mining activities.

Recently, a set of water samples from Upper Mountaineer, Poison, Lower Mountaineer and Leviathan

Creeks were analyzed for mercury using clean technologies at UNR. The method applied can determine mercury concentrations in water at the ng/L (pptr) concentrations. Concentrations measured in these creeks indicate that all waters are enriched in mercury above concentrations considered representative of background concentrations (1-3 ng/L). The data suggest that there is a natural source of mercury in the drainage basins of Poison and Lower Mountaineer Creeks that is contributing to elevated mercury concentrations in their waters. This natural source may also be impacting Leviathan Creek, suggesting that on going clean up of the mine site may not reduce concentrations of mercury in Leviathan Creek waters nor reduce loading to the Upper Carson River.

The effect of acid mine drainage, from Leviathan mine, on aquatic insect communities and trout populations is being studied by several groups (i.e. USGS). They assessed the aquatic communities and metal concentration in the Leviathan \Bryant Creek watershed in 1998. They did not have control sites that addressed the fact that Poison Creek contains elevated concentrations of mercury. We would measure total mercury concentration in fish and aquatic insects associated with Poison and Mountaineer Creeks and use the data base developed for Leviathan to assess the impact of a natural mercury source on aquatic communities.

The major objectives of this project are:

1. Determine mercury concentrations and discharge at sampling points, noted in Figure 1, three times a year, during Spring runoff, during baseflow and in the late summer or early fall when flows should be lowest. These data would be used to assess the mercury being transported to the Carson River by the Upper Carson watershed.
2. Assess the form of the mercury being transported by determining if the mercury is dissolved or particulate bound, and at a few sites, whether methyl mercury is present.
3. Measure total mercury concentrations in sediments at all water sampling sites, as well as methyl mercury in sediments at select sites.

Collect aquatic insects and trout from Poison and Upper Mountaineer Creek and analyze them for total mercury. These objectives will allow for an assessment of the potential mercury bioavailability from natural undisturbed sources versus anthropogenically impacted areas (Leviathan) in the EFUCR.
