6/12/07 Workshop
Suction Dredge Mining
Deadline: 6/22/07 Noon

RECEIVED
JUN 1 6 2007
SWRCB EXECUTIVE

State Water Resources Control Board
Division of Water Quality
P.O. Box 100
Sacramento, California 95812-0100
Fax: 916-341-5620
email: commentletters@waterboards.ca.gov

June 15, 2007

Subject: **SUCTION DREDGE MINING**

Dear Board Members,

It has been claimed, at your recent June 12th Board meeting, that reintroduction of mercury in the water traveling through a suction dredge will pose an environmental risk. In the unlikely event that mercury would escape the sluice box recovery system on a suction dredge, it's very nature, would cause it to instantly mix with the other bottom materials moving through the sluice box and cause it to settle deep within the stream or river bottom overburden. The density of mercury is 13.53 grams per cubic centimeter (g/cm^3). The density of gold and lead are, respectively, 19.28 g/cm^3 and 11.34 g/cm^3. Lead, the least dense of the three metals, is routinely found in the cleanup of the dredge sluice boxes which are also collecting lost fishing weights.. That is a very good indicator that the heavier mercury is being captured and held in the sluice box. There is no new harm… but there is the very real benefit to the environment from the removal of the associated mercury and lead.

It has been proven that suction dredges are ideal for the safe recovery of lead and mercury from stream and riverbed sediments. In fact, they do such a good job that rather than disparage the use of suction dredges, it would serve the public good and increase the effectiveness of it's own mission (i.e.; to protect the environment) by encouraging even more suction dredge activity, and providing safe and secure disposal sites for these recovered metals.

Studies and a trial program prove the effectiveness and benefits of the recovery of mercury during suction dredge mining operations. **The US EPA Region 9** (San Francisco, CA office) **has recognized the benefits associated with suction dredger mining as a method of aiding their efforts in environmental cleanup at no cost to the tax payer and have touted the benefits of suction dredgers removing mercury from the environment.**

US EPA REGION 9, MERCURY RECOVERY FROM RECREATIONAL GOLD MINERS

The Challenge:

Looking for gold in California streams and rivers is a recreational activity for thousands of state residents. Many gold enthusiasts simply pan gravels and sediments. Serious recreational miners may have small sluice boxes or suction dredges to recover gold bearing sediments. **As these miners remove sediments, sands, and gravel from streams and former mine sites to separate out the gold, they are also removing mercury**.

This mercury is the remnant of millions of pounds of pure mercury that was added to sluice boxes used by historic mining operations between 1850 and 1890. Mercury is a toxic, persistent, and bioaccumulative pollutant that affects the nervous system and has long been known to be toxic to humans, fish, and wildlife. Mercury in streams can bioaccumulate in fish and make them unfit for human consumption.

The Solution:

Taking mercury out of the streams benefits the environment. Efforts to collect mercury from recreational gold miners in the past however have been stymied due to perceived regulatory barriers. Disposal of mercury is normally subject to all regulations applicable to hazardous waste.

In 2000, EPA and California's Division of Toxic Substance Control worked in concert with other State and local agencies to find the regulatory flexibility needed to collect mercury in a simple and effective manner. These groups agreed to test two different mechanisms for collecting mercury during the summer of 2000. One approach was to add mercury to the list of materials that are collected at regularly scheduled or periodic household hazardous waste collection events sponsored by local county agencies.

Another mercury collection approach was to set up collection stations in areas where mercury is being found by recreational miners. One possibility would be to advertise a fixed location where people could bring mercury on a specific date and time. Another was to create a mercury "milk run" where state, local, or federal agency staff would come to locations specified by individuals or organizations such as suction dredging clubs, and pick up mercury that had been collected.

The Results:

In August and September, 2000 the first mercury "milk runs" collected **230 pounds of mercury**. The total amount of mercury collected was equivalent to the mercury load in 47 years worth of wastewater discharge from the city of Sacramento's sewage treatment plant or the mercury in a million mercury thermometers. This successful pilot program demonstrates how recreational **gold miners and government agencies can work**

together to protect the environment. In the summer of 2001, State agencies planned to extend the program to six counties and include collection of mercury at summer mining fairs. (US EPA, 2001)

Getting 230 pounds of mercury out of the environment is an achievement that would not have been accomplished without the aide of the suction dredgers. The mining community of today is in my opinion the only group that are in a position with the technology to help out and at a very economical price to the public. Any residual mercury remaining after dredging in a location is that much less to worry about in our nations waterways.

THE 1999 FINAL REPORT FOR THE 40-MILE RIVER STUDY

Heavy Metals

For the unfiltered samples, two metals, copper and zinc, showed distinct increases downstream of the dredge. Total copper increased approximately 5-fold and zinc approximately 9-fold at the transect immediately downstream of the dredge, relative to the concentrations measured upstream of the dredge. For both metals, the concentrations declined to near upstream values by 80 m downstream of the dredge. The pattern observed for total copper and zinc concentration is similar to that for turbidity and TFS, suggesting that the metals were in particulate form, or associated with other sediment particles. Zinc, arsenic, and copper displayed an average value downstream of the dredge that was greater than the average value measured upstream of the dredge (note that samples sizes are low, particularly upstream of the dredge). Copper displayed the greatest change, increasing by approximately 3-fold downstream of the dredge. Dissolved lead concentrations did not appear to be affected by operation of the dredge. **Values of dissolved mercury actually were greater upstream of the dredge, suggesting that any effect of the dredge was likely within the range of natural variation.** (The operator reported observing deposits of liquid mercury within the sediments he was working.) For both dissolved and total concentrations, budgetary limitations precluded multiple sampling across either space or time, thus the results of heavy metal sampling are only indicative of likely conditions. (Prussian, A.M., T.V. Royer and G.W. Minshall, 1999)

Conclusions from the US EPA's commissioned Forty-Mile River study documented that heavy metals in sediments were not a concern and any contaminated sediments containing mercury were not a problem in gold bearing rivers and streams.

An important benefit of suction dredging for gold is that through gravity separation other heavy metals such as mercury are also trapped in the riffles of the sluice box and can be readily collected for disposal or resale.

Mercury Contamination from Historic Gold Mining in California. (USGS, 2005)

MERCURY METHYLATION and BIOMAGNIFICATION

Mercury occurs in several different geochemical forms, including elemental mercury [Hg(0)], ionic (or oxidized) mercury [Hg(II)], and a suite of organic forms, the most important of which is **methylmercury** (CH_3Hg^+). Methylmercury is the form most readily incorporated into biological tissues and most toxic to humans. The transformation from elemental mercury to methylmercury is a complex biogeochemical process that requires at least two steps, (1) oxidation of Hg(0) to Hg(II), followed by (2) transformation from Hg(II) to CH_3Hg^+; step 2 is referred to as **methylation.**

Methylation of mercury is controlled by sulfate-reducing bacteria and other microbes that tend to thrive in conditions of low dissolved oxygen, such as near the sediment-water interface or in algal mats. Numerous environmental factors influence the rates of mercury methylation and the reverse reaction known as demethylation. These factors include temperature, dissolved organic carbon, salinity, acidity (pH), oxidation-reduction conditions, and the form and concentration of sulfur in water and sediments. (USGS 2005)

An important fate of mercury, in contaminated overburden, is to be transported to downstream areas. **This occurs naturally every year during high flow episodes.** However, because the rivers and streams of the Northwest are highly oxygenated, and would be slow in transforming mercury to methyl mercury, there have been few methyl mercury problems reported.

MERCURY IN THE ENVIRONMENT, USGS FACT SHEET 146-00 (October 2000) WHERE METHYL MERCURY IS A PROBLEM

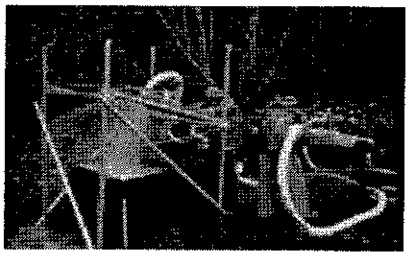
Although mercury is a globally dispersed contaminant, it is not a problem everywhere. Aside from grossly polluted environments, **mercury is normally a problem only where the rate of natural formation of methyl mercury from inorganic mercury is greater than the reverse reaction. Methyl mercury is the only form of mercury that accumulates appreciably in fish.** Environments that are known to favor the production of methyl mercury include certain types of wetlands, dilute low-pH lakes in Northeast and North central United States, parts of the Florida Everglades, newly flooded reservoirs, and coastal wetlands, particularly along the Gulf of Mexico, Atlantic Ocean, and San Francisco Bay. (USGS 2000)

Since none of these areas listed by the USGS are areas that suction dredge mining occur to a large extent and for the fact that methylation occurs in anaerobic sediments under complex conditions effected by many factors including pH and temperature **the likelihood of any major mercury problem is highly unlikely in most gold bearing rivers and streams.**

Suction dredging is used by other agencies as a means to clean up streambed sediments for habitat restoration activities:

NOAA: http://www.photolib.noaa.gov/ habrest/crp_duc.html

DUCK CREEK WATER QUALITY AND ANADROMOUS FISH HABITAT RESTORATION



Duck Creek, a surface water body in Alaska, is impaired by urban runoff from non-point source **pollutants including, heavy metals**, hydrocarbons, iron flocs and excess nutrients. This small coastal stream originates from a spring that drains runoff from Mendanhall Valley, a relatively high residential and business area.

Historically there were runs of nearly 10,000 chum salmon and Coho runs of about 500 fish in Duck Creek. Currently the chum run is extinct and the Coho run consists of only 20 fish. Restoration at Duck Creek involves the development and implementation of bio-remediation methods to restore water quality and anadromous fish habitat in impaired streams.

NOAA scientists attempted to correct the degraded conditions by using high-pressure jet pumps and **suction dredges to remove fine sediment from the streambed**. Researchers also added natural structures to direct stream flow and increase oxygen levels. The removal or replacement of perched culverts that impair fish habitat will also take place to reduce flood hazards. **This project demonstrates the benefits of restoration and the importance of aquatic habitat protection in maintaining healthy aquatic ecosystems.** (NOAA, 2006)

As should be obvious to all, the benefits extremely outweigh any negative concerns of heavy metals in sediments of gold bearing streams and rivers mined using suction dredge techniques.

A recent study was conducted by Washington State Department of Ecology, entitled:

THE EFFECTS OF SMALL-SCALE GOLD DREDGING ON ARSENIC, COPPER, LEAD AND ZINC CONCENTRATION IN THE SIMILKAMEEN RIVER (March 2005).

Their findings were deemed a "*worst-case assessment in several respects*". The study was conducted because ambient arsenic concentrations in the Similkameen River substantially exceed Washington State human health criteria due to natural conditions. The following depicts these findings: (1) Metals concentrations in the effluent and plumes would be subjected to further dilution in the river; (2) Sub-samples for the effluent composites were only taken when the suction hose was in contact with the streambed; (3) Less restrictive water quality criteria would apply at other times of the dredging season when hardness levels are higher; and, (4) Once the effluents are discharged, the metals will partition in to dissolved and particulate fractions. The dissolved fraction is the primary toxicity concern.

It was interesting to note that the Department of Ecology found, ***"The metals concentration measured in gold dredge effluents during the present study were at or below aquatic life criteria"***. Therefore, criteria exceedances would not be anticipated in the Similkameen River, regardless of the number of dredges operating.

A series of dilution calculations were done to estimate what effect multiple dredges would have on metals concentration in the river. As a point of reference, the maximum number of dredges Ecology personnel have observed on the Similkameen is approximately 20, during average September flows. The report estimates that it would take somewhere between 17 and 57 dredges operating continuously (i.e. 24 hours a day) to increase dissolved zinc, lead and copper concentrations by 10%. Further, the report states, *"It would take between approximately 200 and 520 dredges to have the same effects on total recoverable and dissolved arsenic, respectively. In order for zinc, lead, or copper concentrations to be doubled in the river, anywhere from 170 to 570 dredges would need to be operating. Arsenic concentrations in the dredge effluents are too low to cause an increase of that magnitude, regardless of river flow. As demonstrated elsewhere in this report, a 100% increase in the ambient arsenic, copper, lead, or zinc concentrations in the Similkameen River would not result in exceedances of aquatic life criteria."* (Johnson, A. and M. Peterschmidt, 2005)

Results showed that the metals concentrations discharged from small-scale gold dredges are not a significant toxicity concern for aquatic life in the Similkameen and that it would take large numbers of dredges to effect a small change in the river's arsenic levels, even at low-flow conditions. (Johnson, A. and M. Peterschmidt, 2005)

As the scientific literature clearly shows that suction dredging has little effect, if any, on heavy metal contamination that may arise from redistribution of the bottom substrate during normal mining activity. Most importantly, suction dredge miners aid in recapturing mercury and other heavy metals such as lead that otherwise would be continuously transported in heavy winter flows to be relocated further down stream.

I hope you find this information of value and I appreciated the chance to provide it for your consideration in this matter.

LITERATURE CITED

Johnson, A. and M. Peterschmidt, 2005. The effects of small-scale gold dredging on arsenic, copper, lead and zinc concentration in the Similkameen River.

NOAA, 2006: Duck Creek Water Quality and Anadromous Fish Habitat Restoration **http://www.photolib.noaa.gov/ habrest/crp_duc.html**

Prussian, A.M., T.V. Royer and G.W. Minshall, 1999. Impact of suction dredging on water quality, benthic habitat, and biota in the Fortymile River, Resurrection Creek, and Chatanika River, Alaska, FINAL REPORT. US Environmental Protection Agency, Region 10, Seattle, Washington.

USEPA, 2001. Mercury Recovery from Recreational Gold Miners. **http://www.epa.gov/region09/cross_pr/innovations/merrec.html**

USGS, 2000. Mercury in the Environment, USGS Fact Sheet 146-00 (October 2000) Environments Where Methyl mercury is a Problem.

USGS, 2005. Mercury Contamination from Historic Gold Mining in California. USGS Fact Sheet FS-061-00 (2005). Charles N. Alpers, Michael P. Hunerlach, Jason T. May, and Roger L. Hothem **http://ca.water.usgs.gov/mercury/fs06100.html**

Claudia M Wise
Physical Scientist / Chemist, US EPA Retired
34519 Riverside Drive SW
Albany, OR 97321