State of California

Department of Health Services

Memorandum

SDMS # 54052

To : Mark Gallaway
Site Cleanup and Emergency
Response Section
TSCD

Date : August 22, 1984

Subject: Endangerment Assessment of Iron Mountain Mine

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From : Epidemiological Studies Section
2151 Berkeley Way, Room 515
Berkeley, CA 94704

As requested by your section, Epidemiological Studies Section is providing an endangerment assessment of Iron Mountain Mine, located in Shasta County, California. The assessment is based upon data which you provided, including:

1) December 1983, Sampling Results in the Report on Evaluation of the Iron Mountain Mine, by Office of Environmental Services, EPA.

2) February 1979, memorandum to Gerald J. Behnke of the Regional Water Quality from the Department of Fish and Game.

3) September 1980, memorandum to James C. Pedri from Dennis R. Heiman of the Regional water Quality Control Board.

4) Data and Summary of the Iron Mountain Mine Case Development Plan.

Results of Sampling

A. Stream Water:

Analysis of stream water which receive drainage and runoff from Iron Mountain Mine indicates that area streams contain contaminants exceeding California domestic water quality regulations. The water near the mine also exceeds EPA criteria for freshwater aquatic life (Table 1).

These contaminated streams feed into the Sacramento River from which the City of Redding receives its municipal drinking water supplies. Exceedences of metals, however, have not been detected at the Redding water treatment plant, except on one pre-treatment sample when the cadmium concentration in the raw water equalled the domestic drinking water standard of 10 µg/L.

The fact that additional exceedences have not been observed is mainly due to the great dilution of the contaminated tributary waters by the Sacramento River. It is our understanding that the construction of the flow control facility on Spring Creek below Iron Mountain Mine has also had some effect on reducing metal concentration in receiving water.

B. Fish Tissue:

Metal analysis was performed on the tissues of resident rainbow trout collected below Keswick Dam. The analysis was performed on fish livers except for mercury, which was taken from the flesh. The results indicate that the concentration of metals observed in these fish are comparable to the levels seen in fish collected at other locations in California with the possible exception of cadmium and copper (Table 2).

Endangerment Assessment

The extent of the health risk posed by any chemical agent depends upon the toxicity of the agent and the extent to which people become exposed. No matter how hazardous a substance might be, if it never comes in contact with people, the human health risk is zero. In the case of Iron Mountain Mine direct human exposure will probably be rare because of the remoteness of the area. However, direct contact by an occasional hiker cannot be excluded. For these persons exposure can occur by direct dermal contact with the mine effluent or by ingestion of stream water. In this instance dermal contact represents the greater hazard. The mine is generating quantities of sulfuric acid in concentrations that could lead to substantial eye injury if exposed.

Ingestion of Fish

In table 3 the yearly dietary intake of selected metals is compared to the estimated yearly intake of a person ingesting 60 fish meals (250 g each) per year. In this exposure scenerio cadmium exceeds the normal yearly dietary intake by 2.1 to 4.7 times; copper by 2.2 to 5.5 times and; zinc 2.2 to 3.3 times.

Toxicology of Cadmium

Of the three metals that exceed the normal yearly dietary intake as a result of ingesting fish from Keswick Dam only cadmium poses a potential health hazard. Cadmium may cause both acute and chronic types of poisioning. In mild, acute cadmium poisoning by ingestion, symptons include nausea, vomiting, abdominal cramps, and headache. In severe cases diarrhea and shock may develop. These symptoms are usually manefested only a few minutes after eating contaminated food or drink. The concentration of cadmium in water that produces vomiting is about 15 mg/L.

Long-term ingestion of cadmium has taken place in Japan which has given use to renal tubular disease and severe bone disease. Gastrointestinal changes anemia, and liver disturbances also occurred.

The most typical feature of chronic cadmium intoxication is the kidney damage. Cadmium affects reabsorption functions of the proximal tubules of the kidney. Effects may include aminoaciduria, glucosuria, and phosphaturia. The tubular dysfunction may also induce osteomalacia due to losses of calcium particularly in women during pregnancy and lactation. Slight decreases in hemoglobin levels have also been seen in cadmium exposed workers. Animal studies also show that hypertension can be induced by cadmium. The liver is one of the major storage organs of cadmium and may be adversely affected by this metal.

US EPA stated that "the available epidemiological evidence does not suggest that cadmium can be definitely implicated as a human carcinogen". IARC stated that "available studies indicate that occupational exposure to cadmium in some form (possibly the oxide) increases the risk of prostate cancer in man. In addition, one of these studies suggest increased risk of respiratory tract cancer". Inhalation and oral laboratory animal studies are inadequate for the determination of Cd carcinogenicity. Substaneous injections of Cd on the other hand, do appear to be carcinogenic in rats and mice.

Conclusion

Although Iron Mountain Mine is generating a large volume of acidic effluent containing very high concentrations of metals, particularly cadmium, copper, and zinc, it is located in a remote area of California. The potential hazard from this mine would be much greater in a more heavily populated area. However, the mine area is certainly within walking range of populated areas (10 miles from Redding) and therefore poses a significant danger to hikers who would go to that area. In addition, the uncontrolled release of the metals are apparently concentrating in fish tissues which poses an indirect hazard to people

ingesting the fish in moderate quantities. Cadmium particularly poses a long term to those who frequently ingest fish affected by the mine effluent. It is our opinion that the mine directly and indirectly threatens a segment of the population and that steps should be taken to mitigate the hazard.

MD for

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cc: Jim Stratton
Richard Jackson

Table 1

Comparison of Highest Contaminants Found in Receiving Waters from Iron Mountain Mine to Water Standards

Constituent	Highest Levels Found in Water Below Mine (µg/L)	California Drinking Water Limits (µg/L)	EPA Criteria for Aquatic Life
Cd	17.5	0.01	0.0004
Cu	243	1.0	0.1 *
Pb	2.3	0.05	0.01**
Zn	2,470	5	.01**
Sulfate	47,000	250	NA
pH	1.42	NA	6.5-9.0

* 0.1 times a 96-hour LC_{50} bioassay on sensitive resident species.

** 0.01 times a 96-hour LC_{50} bioassay on sensitive resident species.

Table 2

Metal Concentrations in Fish *
Collected Below Iron Mountain Mine
Compared to the Levels Found in other Sampling Areas

Metal	Levels Found in Fish Collected Below Keswick Dam (µg/g) 1980	1981	1982	Range of Metals Found in Calif. Fish** (µg/g)
Ag	0.1	0.06	< 0.02	< 0.02 - 1.8
Hg	0.05	0.03	0.06	< 0.02 - 0.48
Pb	0.2	0.2	< 0.01	< 0.1 - 0.3
As	0.1	0.1	< 0.01	< 0.1 - 1.4
Ni	0.3	0.1	< 0.01	< 0.1 - 0.2
Cr	0.06	0.04	0.05	< 0.02 - 0.06
Cd	2.6	0.92	3	< 0.02 - 2.4
Cu	176	207	150	< 0.02 - 445
Zn	31	26	32	< 0.05 - 47

* Resident rainbow trout collected below Keswick Dam
** Information derived from Toxic Substances Monitoring Program, 1981, State Water Resources Control Board

Table 3

COMPARISON OF YEARLY METAL INTAKE
TO METAL INTAKE FROM EATING KESWICK FISH

Metal	Highest Metal Found In Keswick Fish (ppm)	Normal Yearly Intake of Metals (70 kg person) (mg)	Yearly Metal From Eating Keswick Fish * (mg)	Ratio of Yearly Metal Intake from Eating Keswick Fish vs. Normal Yearly Metal Dietary Intake
Ag	0.06	0.7	0.9	1.2
Hg	0.06	0.4- 1.1	0.9	0.8 - 2.25
Pb	0.2	111	3	0.27
As	0.1	730 - 1.460	1.5	0.001 - 0.002
Ni	0.3	110 - 219	4.5	0.02 - 0.04
Cr	0.06	1.8- 42	0.9	0.02 - 0.5
Cd	3	9.5- 22	45	2.1 - 4.7
Cu	270	730 - 1825	4000	2.2 - 5.5
Zn	32	3650 - 5475	12000	2.2 - 3.3

* Assuming all fish eaten have highest metal concentration observed in samples: 60 fish meals eaten /year; each fish meal eaten is 250 g.