Letter Health Consultation

SELENIUM WATER QUALITY ASSESSMENT FOR
SOUTH MAYBE MINE, CARIBOU, IDAHO

Prepared by
Idaho Department of Health and Welfare

JULY 10, 2014

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

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In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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LETTER HEALTH CONSULTATION

SELENIUM WATER QUALITY ASSESSMENT FOR SOUTH MAYBE MINE, CARIBOU, IDAHO

Prepared By:

Idaho Department of Health and Welfare
Division of Public Health
Bureau of Community and Environmental Health
Under Cooperative Agreement with
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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July 10, 2014

Douglas Tanner
Waste/Remediation Manager
Idaho Department of Environmental Quality Pocatello Regional Office
444 Hospital Way #300
Pocatello, ID 83201

Dear Mr. Tanner:

Per your request of August 7, 2013, the Bureau of Community and Environmental Health (BCEH) has developed this letter health consultation to assess whether mine-related surface water contaminants in South Maybe Creek pose a health risk to local residents and recreational campers who may consume the water. After reviewing the water quality data, we determined that those who use the creek water during occasional camping trips for drink and food preparation are not likely to be harmed. Limitations of this report include lack of reliable estimates for the number of days campers use the water from the creek and that our assessment only targets site-related selenium water contamination, but not other biological or chemical contaminants. While we have determined that harm is unlikely, to be prudent we recommend posting signs to alert recreationalists that the water from the creek is not for drinking. Our program is available to assist with developing warning signs for the area.

Background and Statement of Issues

The Maybe Mines (North and South) are located on the east side of Dry Valley, about 17 miles northeast of Soda Springs, in Caribou County, Idaho (Lee, 2000). Phosphate ore deposits were investigated since 1910 and mining activities started in 1948. Throughout the years, several mining companies acquired mineral rights and were able to mine the leases (Lee, 2000). In 1993, the North Maybe Mine was mined out and closed with only reclamation activities conducted. The South Maybe Mine went to an inactive status in 1995, but was not formally closed (Lee, 2000).

Past mining operations at the South Maybe Mine included the construction of a pit and a dump. The waste rock was placed on a constructed French drain in a cross-valley fill that spanned the south fork of Maybe Creek (Ecology and Environment Inc, 2013). The surface of the waste rock

dump was later covered with topsoil and planted with vegetation to stabilize the site. Much of this material has eroded, and the waste rock that is currently exposed constitutes the primary source of selenium contamination at the South Maybe Mine (Ecology and Environment Inc, 2013). Selenium exists in different forms; the most common form found in surface waters appears to be inorganic selenium occurring as selenate (hexavalent selenium) and less abundantly as selenite (tetravalent selenium) (Hu, et al., 2009). Selenate and selenite are easily absorbed from the digestive tract. The relative toxicity of selenate compared with selenite in humans is not clear. While some animal studies suggest selenite to be the more toxic of the two forms (NTP, 1994) (Palmer & Olson, 1974), other studies suggest the opposite (Ferm, et al., 1990). This health consultation is based on total selenium concentrations since speciated forms were not available. The organic forms generally exhibit less toxicity compared to inorganic forms (Vincenti, et al., 2010).

Selenium has both beneficial and harmful effects. Low doses of selenium are needed to maintain good health. However, exposure to high levels can cause adverse health effects. Short-term oral exposure to high concentrations of selenium may cause nausea, vomiting, and diarrhea. Chronic oral exposure to high concentrations of selenium compounds can produce a disease called selenosis. The major signs of selenosis are hair loss, nail brittleness, and neurological abnormalities, such as numbness and other odd sensations in the extremities (ATSDR, 2011). Few recent studies are available in the literature regarding human health chronic effects of exposures to low levels of selenium (0.07–0.09 mg/L) through drinking water. The findings in these studies are not categorical and authors recommend further research (Vincenti, et al., 2010). While it appears that amyotrophic lateral sclerosis (ALS), a disease characterized by the gradual degeneration and death of motor neurons, (Vincenti, et al., 2010) may be attributed to selenium exposures, it is likely that ALS is caused by a combination of other environmental contaminants besides selenium (i.e., heavy metals, pesticides, and cyanobacteria) (Trojsi, et al., 2013) (Roos, et al., 2013).

According to the Idaho Department of Environmental Quality (IDEQ) records, Maybe Creek flows underneath and exits at the base of the cross-valley fill waste dump associated with the South Maybe Mine. It is easily accessed at the end of a public access Forest Service road. The creek/spring discharge at the base of the waste pile is visually inviting (clear water, babbling brook, moss everywhere) and it is suspected that campers might sporadically obtain water for human consumption from this stream (Ansley, Shannon. Idaho Department of Environmental Quality, August 20, 2013, personal communication).

Results and Discussion

Environmental Data

For this health consultation BCEH evaluated dissolved selenium data for surface water samples collected by Ecology and Environment, Inc. This sampling was performed at the request of the United States Department of Agriculture - Forest Service (USFS) in May and September 2012 (Ecology and Environment Inc, 2013). Eleven surface water samples were collected during the peak flow sampling event (May). Ten surface water samples were collected during the low flow sampling event (September). Both sampling events included one blind field duplicate, one equipment blank, and one matrix spike/matrix spike duplicate sample (Ecology and Environment Inc, 2013). Samples collected as part of this investigation

were submitted for analysis at the USFS-approved TestAmerica Laboratories, Inc., in Tacoma, Washington. Total selenium levels from the May sampling effort ranged from 0.0006 to 1.7 mg/L and from the September sampling effort total selenium levels varied from 0.18 to 1.4 mg/L (Ecology and Environment Inc, 2013). BCEH used the highest selenium level (1.7 mg/L) to estimate dose and daily intake. This is a conservative (i.e., more health protective) approach since the selenium level nearest the site where camping takes place during low flow was measured at 1.4 mg/L, and, thus, exposure is likely to be lower than the highest value (1.7 mg/L).

Exposure Pathways

To determine whether people are, were, or could be exposed in the future to selenium in water from Maybe Creek, the environmental and human components that lead to exposure were evaluated. Selenium present in Maybe Creek comes from waste containing naturally occurring selenium, the source of which is geologic formations and past phosphate mining activities (i.e., South Maybe Mine). Selenium enters Maybe Creek as inorganic selenium from natural weathering of indigenous rock and waste rock from mining activities. People (local residents and visitors) can get exposed to selenium in water when they drink water from Maybe Creek during recreational activities such as camping (drinking the water and using the water to prepare food, coffee, etc.). The accidental exposure scenario of drinking water while swimming was not considered because according to a recent report Maybe Creek is not deep or wide enough to allow swimming (Ecology and Environment Inc, 2013). While there may be other exposure pathways, this health consultation only discusses the water ingestion pathway.

Scenario Analyses

Table 1 lists all the exposure parameters used in the calculations of the estimated dose and daily intake. For the two exposure scenarios the same values were used for selenium concentration, body weight, time spent at the site and the exposure factor. BCEH considered the "worst case scenario" by using the highest concentration of selenium found in water (1.7 mg/L) measured in May 2012. Based on the information received from IDEQ, people who frequent the site are teenagers. Thus, BCEH used a body weight of 71.6 kg (157.8 lbs.), which is the recommended value from the 2011 Exposure Factors Handbook for young adults 16 to <21 years of age (EPA, 2011). The exposure factor (0.11) was calculated using the Agency for Toxic Substances and Disease Registry (ATSDR) methodology (ATSDR, 2005) with the following assumptions: teenagers spending three days per week for 13 weeks (over summer vacation months) during one year.

Each of the exposure scenarios had different water ingestion rates (Table 1). For intentional water consumption, BCEH used the consumers-only drinking water ingestion value[1] of 0.82 L/day recommended by the 2011 EPA Exposure Factors Handbook for people ages 18< 21 (EPA, 2011). For the intentional water ingestion of drinking coffee prepared using the water from the stream, BCEH assumed the consumption rate for teenagers of two cups per day or

[1] The consumer-only intake rates are from the EPA's 2010 analysis of National Health and Nutrition Examination Survey data from 2003–2006 for individuals ≥3 years of age. Consumer-only intake rates represent the quantity of water consumed only by individuals who reported water intake during the survey period. These rates do not include individuals who reported no water consumption during survey period.

0.47 L/day. To account for possible food preparation, BCEH assumed using 1 cup (0.24 L) of water a day to make soup.

Results of the estimated doses for both scenarios were compared to the ATSDR Minimal Risk Level (MRL) of 0.005 mg/kg/day for an oral chronic selenium exposure (ATSDR, 2003) and the National Academies' Institute of Medicine (IOM) Tolerable Upper Intake Level (UL) of 0.4 mg/day (approximately 0.0057 mg/kg/day) for selenium daily intake (IOM, 2000). ATSDR defines an MRL as an estimate of daily human exposure to a substance that is likely to be without appreciable risk of adverse, non-carcinogenic effects over a specified duration of exposure. Likewise, the UL is considered the maximum intake of selenium that an adult could ingest daily without suffering any adverse effects (IOM, 2000). When the MRL or the UL for selenium is exceeded, it is possible that selenium compounds can be harmful to human health. The negative effects of excess selenium in the diet depend on the amount of selenium consumed and the frequency of consumption (Pinheiro, et al., 2006).

Table 1: Intentional Exposure Scenarios

Parameters	Intentional (drinking water)	Intentional Drink/Food Preparation (making coffee, soup)	Comparison Value ATSDR MRL/ Upper intake level
Selenium water concentration (mg/L)	1.7	1.7	NA
Ingestion rate (L/day)	0.8	0.71	NA
Body weight (kg)	71.6	71.6	NA
Exposure Factor (unitless)	0.11	0.11	NA
Estimated dose	0.002	0.002	0.005 (ATSDR MRL)
Estimated daily intake (mg/day)	0.15	0.13	0.4 (IOM UL)
Average daily intake (mg/day)	0.114	0.114	NA
Calculation of Totals			
Total = Estimated daily intake (mg/day) + Average daily intake	0.26	0.24	0.4 (IOM UL)
Total intentional drinking water + Total intentional coffee and soup consumption (mg/day)	0.5		0.4 (IOM UL)

mg/L = milligram per liter
L/day = liters of water per day kg = kilograms
mg/kg/day = milligram per kilogram of body weight per day
mg/day = milligrams per day

ATSDR = Agency for Toxic Substances and Disease Registry
Minimal Risk Level = MRL
IOM = National Academies' Institute of Medicine
UL = Tolerable Upper Intake Level

Selenium is found in many foods (e.g., Brazil nuts, oysters, tuna fish, sunflower seeds, and mushrooms) and through a normal diet people consume selenium on a daily basis (e.g., whole wheat bread, pork, lamb, chicken, and beef). In fact, selenium is an important part of the diet but is only needed in small amounts. Studies show that the average daily intake of selenium (0.114 mg/day) by the U.S. population is well below the IOM's UL (US DHHS, 2002). For the calculation of the total selenium intake from the intentional drinking water, BCEH added the average daily intake of 0.114 mg/day to the daily intake calculated for the intentional exposure scenario (0.19 mg/day) with a final value of 0.3 mg/day, which is below the UL of 0.4 mg/day. Using the same approach for those who drink coffee prepared using water from the stream, the total selenium daily intake is 0.22 mg/day (0.11mg/day + 0.114 mg/day), which is half of the UL of 0.4 mg/day. The overall selenium intake from both scenarios for teenage campers will be 0.52 mg/day (0.30 mg/day + 0.22 mg/day), value slightly above the UL; however, because of the infrequent exposure limited to three days per week for 13 weeks per year and the conservative approach of using the highest selenium concentration for the exposure scenarios, BCEH does not consider that sporadically drinking water from Maybe Creek would cause harmful human health effects from selenium exposure.

Conclusion

Based on our estimated dose calculations and possible scenarios, BCEH concludes that occasional ingestion of a normal amount of water for a few days a week during summer months from Maybe Creek is not likely to cause harm to people from selenium exposure. The remoteness of the site and the harsh winter conditions at the site make frequent exposure outside of the summer months unlikely and further reduces the likelihood of harm.

Recommendation

To be cautious and to avoid intentional exposures, BCEH recommends the placement of appropriate signage in specific areas of Maybe Creek to warn local residents and visitors that the water of the creek is not recommended for human consumption. Our program would be available to assist with the creation of signage.

I hope this information is useful. If you have further questions, please do not hesitate to contact me at 208-334-5682 or padenn@dhw.idaho.gov

Sincerely,

Norka E. Paden, Ph.D.
Toxicologist/Public Health Assessor

cc: Jim Vannoy
Jeff Fromm
Shannon Ansley

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REPORT PREPARATION

This Health Consultation for the South Maybe Mine site was prepared by the Bureau of Community and Environmental Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented.

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