Letter Health Consultation

Hope Elementary School,
Bonner County, Idaho

October 23, 2014

Prepared by

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Division of Public Health
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October 23, 2014

Mr. Matt Diel
Facilities Director
Lake Pend Oreille School District
901 Triangle Drive
Ponderay, ID 83852

Dear Mr. Diel:

On March 21, 2014, the Bureau of Community and Environmental Health (BCEH) staff began communication with the Lake Pend Oreille School District. The District's Facilities Director requested that BCEH review water quality data to determine whether nitrates or other contaminants in Hope Elementary School's drinking water pose a health problem. Students who regularly attend the school and staff who work at the school are the populations most likely to be exposed to nitrates and other contaminants by drinking the water. Based on the available data, BCEH determined that students and staff who drink water from Hope Elementary are unlikely to be harmed from exposures to nitrates or any other contaminants found in the drinking water. However, levels of copper in the water may cause some students and staff who are sensitive to copper may experience an upset stomach. Limitations of this health consultation include the small number of samples taken from some of the sampling locations, and uncertainty regarding what, if any, health risks there may be to the general public and sensitive populations from exposure to low levels of nitrates. In addition, human health effects from the interaction of nitrates with other contaminants are also unknown. BCEH recommends continuing to monitor drinking water contaminants at the school, maintaining drinking water supply lines by flushing them regularly, and coordinating with Ellis Bay Sewer District and other stakeholders on reducing nitrate levels in groundwater. Our program is available to assist with evaluating human health effects of future water quality testing and provide outreach to the students and staff concerning human health effects of nitrates and other contaminants present in drinking water.

Background and Statement of Issues

Hope Elementary School is located on the Hope Peninsula next to the Denton Slough of Lake Pend Oreille, approximately three miles Southeast of Hope, Idaho. The water system for Hope Elementary is comprised of a single well located immediately adjacent to the school (Stevens,

2013). The School District is concerned about the increasing levels of nitrates in the water and potential impacts on the health of students and staff. Based on the 2013 online records, Hope Elementary had 113 enrolled students from pre-kindergarten to sixth grade and 17 staff members. Students and staff have access to drinking water from the Hope Elementary well during school hours when school is in session.

The Ellisport Bay Sewer District (EBSD) Wastewater Reuse site is located approximately 650-feet from the Hope Elementary well. Also, there is an agricultural field nearby. Due to an increasing upward trend of nitrate levels at the Hope Elementary School well a groundwater investigation study was conducted in 2012, by the Idaho Department of Environmental Quality (IDEQ), to determine potential source(s) of nitrates. The IDEQ investigation found four probable sources: the Hope Elementary septic drain field, an agriculture field, the EBSD wastewater reuse site, and the Denton Slough of Lake Pend Oreille. IDEQ concluded that leakage from the EBSD lower lagoon and/or seasonal water overloading on the agricultural field are causing nitrates to move into the ground water; thus causing increased nitrate concentrations in the Hope Elementary well (Stevens, 2013).

Results and Discussion

Environmental Data

Data used for this document included the 2012 IDEQ investigation (i.e., well water sampling) and the school's routine water system compliance monitoring report (1994 to 2014). For this letter health consultation, BCEH only analyzed water quality data from the school well, the distribution system and sampling locations in the school where people are most likely to be exposed to nitrates through drinking water (i.e., the drinking fountains and the kitchen).

Pathway Analysis and Public Health Implications

For any environmental contaminant to be considered a health concern the contaminant has to be present at a high enough concentration to cause potential harm and a completed exposure pathway needs to be present. A pathway analysis considers five principle elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and a receptor population. Completed exposure pathways are those in which all five elements are present, and indicate that exposure to a contaminant has occurred in the past, is presently occurring, or will occur in the future. BCEH found there is a completed pathway with groundwater since it is used by the school for drinking and cooking.

Evaluation Process

The Agency for Toxic Substances and Disease Registry (ATSDR) has developed health-based comparison values (CVs) to determine the likelihood of possible health effects of site-specific chemicals. These CVs include Environmental Media Guides (EMEGs)[1] for non-cancerous health effects (ATSDR, 2005). If a contaminant concentration exceeds the comparison value (CV) it is selected for further evaluation. Contaminant concentrations below CVs are considered safe and

[1] Environmental Media Evaluation Guides (EMEGs) represent concentrations of substances in water, soil, and air to which humans may be exposed during a specified period of time (acute, intermediate or chronic) without experiencing non-cancerous adverse health effects.

are not evaluated further. Concentrations above CVs are not necessarily a health concern, but further investigation is needed to determine the likelihood of adverse health effects. Site specific exposure scenarios are part of the evaluation, and they are incorporated into health risk estimations.

Scenario Analysis for drinking water ingestion
For those contaminants above a CV, BCEH evaluates the toxicological effects associated with potential ingestion of drinking water by calculating an estimated dose. For all calculations BCEH assumed a conservative (i.e., health protective) approach using the standard ATSDR assumption values for children (i.e., one liter of water consumed per day and body weight of 16 kilograms or 35 pounds). For the time of exposure BCEH assumed a child spending five days per week for nine months during the school year.

Nitrate Levels
All the nitrate levels were below the ATSDR Reference Dose Media Evaluation Guide (RMEG) of 16 mg/L and the EPA Maximum Contaminant Level (MCL) of 10 mg/L (Table 1). The highest nitrate levels were detected at the teacher's lounge and the main hall faucet; however, only two samples were taken at these locations. Currently, there is enough scientific evidence to demonstrate that high levels of nitrates (i.e., higher than the MCL) can cause methemoglobinemia (blue baby syndrome) in infants; however there is not enough evidence concerning human health effects of nitrates in other populations (See uncertainties section). Since the age of the children attending Hope Elementary is an age that is not susceptible to blue baby syndrome, BCEH determined that those who drink the tap water from Hope Elementary are not likely to be harmed from nitrate exposures.

Table 1. Average Concentrations of Nitrates in Hope Elementary School (1996–2014)

Sample Location	Number of Samples	Average Nitrate Levels in mg/L	Health-based Comparison Value (CV) in mg/L
Teachers' lounge	2	5.15	16[a] 10[b]
Main hall faucet	2	5.10	
Raw well water	5	5.00	
Distribution	1	4.90	
Restroom	1	4.80	
Well	17	3.92	
Well[c]	3	3.20	
Plant tap	13	3.02	
Room 110	1	2.6	
Well house	4	1.85	

a = ATSDR Reference Dose Media Evaluation Guide for children's exposure (RMEG)
b = Maximum Contaminant Level (MCL) for drinking water
c = IDEQ 2012 Sampling results
mg/L = milligram per liter

Metals

Seven metals (arsenic, copper, manganese, lead, calcium, magnesium, and iron) were tested in the drinking water at Hope Elementary School. Data analysis of drinking water showed that arsenic, manganese, and lead were below the health-based CVs; however, with the exception of lead and copper, sampling of other metals was limited to one or two samples from 1994 to 2014. Calcium and magnesium are essential nutrients and are typically not harmful under most environmental exposure scenarios. Therefore, no public health standards have been established for these metals in drinking water (Skipton & Dvorak, 2009). EPA has established secondary maximum contaminant level (SMCL) for iron as guideline to assist public water systems in managing drinking water for taste, color, and odor; however, iron in drinking water is not considered a threat to human health ((EPA, 2013). All iron levels tested were below the SMCL.

Copper is a reddish metal that occurs naturally in rock, soil, water, and sediment. At low levels, it is an essential element for all known living organisms but when high levels are ingested toxic effects can occur. The greatest potential source of copper exposure is through drinking water, particularly when water is first drawn in the morning after sitting in copper piping and brass faucets overnight (ATSDR, 2004). Drinking water that contains higher than normal levels of copper may cause nausea, vomiting, stomach cramps, or diarrhea (ATSDR, 2004). All nine classrooms, teacher's room, main hall drinking fountain, kitchen, and well house had copper values above the heath-based CV (Table 2). Thus, BCEH further analyzed copper exposure by deriving estimated dose calculations using the children exposure scenario described above. The estimated dose calculations were compared to ATSDR's Minimal Risk Level (MRL) to determine if harmful health effects were possible.

The estimated dose (0.024 mg/kg/day) from exposure to copper in drinking water using the highest average copper concentration of 0.78 mg/L for a child exceeded the MRL of 0.01 mg/kg/day. To determine if the estimated daily dose of 0.024 mg/kg/day represents a health problem for children, BCEH reviewed toxicological information concerning copper. Where possible, comparison values are generally available for three specified exposure periods: acute (14 days or less), intermediate (15 to 365 days), and chronic (more than 365 days). According to the ATSDR toxicological profile for copper, the intermediate MRL for copper (0.01 mg/kg/day) was derived from a study in which men and women were exposed to copper sulfate in drinking water for two months and showed gastrointestinal symptoms (ATSDR, 2004). This study calculated the lowest-observed-adverse-effect level (LOAEL) for copper was 0.091 mg/kg/day. The LOAEL is the lowest dose of a contaminant that has been reported to cause harmful health effects on people or animals. The no observed-adverse-effect level (NOAEL) for copper identified in the same study was 0.042 mg/kg/day (ATSDR, 2004). The NOAEL is the highest dose of a substance that has been reported to have no harmful health effects on people or animals. The calculated dose for Hope Elementary was four times lower than the LOAEL and two times lower than the NOAEL. Based on the NOAEL, it is unlikely that the dose estimated for a child (0.024 mg/kg/day) will cause adverse health effects. However, children who are sensitive to copper may experience gastrointestinal symptoms and some complications of Wilson's disease could occur in genetically predisposed people.

Table 2. Concentrations of Copper and Comparison Values in Hope Elementary School (1996–2014)

Sampling Locations	Concentration range (mg/L)	Number of detected samples (mg/L)	Average concentration (mg/L)	Non-Cancer CV for Child (mg/L)	Non-Cancer CV for Adult (mg/L)
Room 101	0.06–3.08	8	0.73	0.1[a]	0.35[a]
Room 102	0.06–1.26	9	0.63		
Room 103	0.01–1.7	4	0.49		
Room 104	0.05–1.2	7	0.33		
Room 105	0.2–1.74	4	0.76		
Room 106	0.3–1.45	5	**0.78**		
Room 108	0.13–0.25	2	0.19		
Room 109	0.31–0.8	4	0.49		
Room 110	0.57–1.33	4	0.77		
Teachers Room	0.14–1.5	7	0.58		
Main Hall Drinking Fountain	0.22–0.54	3	0.68		
Kitchen	0.21–1.57	8	0.75		
Well House	0.01–0.04	5	0.026		

a = ATSDR Environmental Media Guides (EMEGs) for copper
mg/L = milligram/liter
ND = non-detected value
Value in bold represents highest average concentration used for dose calculation

Uncertainties

In 2012, BCEH performed a literature review regarding the human health effects of nitrates in drinking water. The literature review revealed limited and contradictory information regarding cancer risk, reproductive and developmental effects of nitrates through drinking water. The literature review also showed the need for additional comprehensive epidemiological studies (BCEH, 2012). In addition, the interaction of nitrates with other water contaminants is not well understood. Some studies suggest that copper in combination with high levels of nitrates may induce methemoglobinemia in infants (CDC, 1993).

Exposure to high levels of copper will result in the same types of effects in children and adults. Studies in animals suggest that children may have more severe effects than adults but we do not know if this would also be true in humans. There are a very small percentage of infants and children who are unusually sensitive to copper. It is unknown if copper can cause birth defects or other developmental effects in humans. Studies in animals suggest that ingestion of high levels of copper may cause a decrease in fetal growth (ATSDR, 2004).

Food naturally contains copper. According to ATSDR, the amount of copper consumed (eating and drinking) is (1/1,000 of a gram or 4/100,000 ounces) and recommended copper daily amount is 0.013 mg/kg/day (ATSDR, 2004). It is good to point out that to protect public health we used

the highest copper concentration tested in drinking water; however, other factors such diet and exposures at home (i.e., drinking tap water or playing with contaminated soil) were not considered for the analysis. Thus, it is uncertain if children attending Hope Elementary may have higher exposures than what is considered in this letter.

Conclusion

BCEH concludes that nitrates found in drinking water at Hope Elementary School are not likely to harm the health of students or staff because the levels of nitrates detected in drinking water at the school were below the levels known to cause harmful health effects. Copper levels detected in drinking water at Hope Elementary School are not expected to harm people's health; however, people sensitive to copper who drink water from Hope Elementary on a regular basis may experience nausea, vomiting, stomach cramps, or diarrhea.

Recommendations

BCEH recommends that the School District:

- Continue monitoring for nitrates and heavy metals in the Hope Elementary School water system.
- Maintain and regularly flush drinking water supply lines in the distribution system to reduce the levels of metals in the tap water.
- Instruct users to let the water run for several minutes prior to collecting water to be used for drinking or cooking to reduce levels of metals in water.
- Coordinate with Ellis Bay Sewer District and others on reducing nitrates in groundwater as time and resources allow.

Public Health Action Plan

- BCEH will communicate findings to the School Facilities Director, offer any assistance for water quality data analysis, and provide outreach to the students and staff concerning nitrates and metals present in water and human health effects.

If you have any questions, please do not hesitate to contact me at 208-334-5682 or at padenn@dhw.idaho.gov

Best regards,

Norka E. Paden, PhD.
Toxicologist/Public Health Assessor
Bureau of Community and Environmental Health

cc: Jim Vannoy

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