Health Consultation

BURLINGTON NORTHERN FUELING FACILITY

HELENA, MONTANA

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
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Health Consultation: A Note of Explanation

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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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Prepared by:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
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Background

Burlington Northern Fueling Facility - Helena, Montana at Phoenix Avenue and Harris Street, is an active, > 50 acre locomotive fueling facility and former maintenance shop. The facility has been in operation since the 1890s. Spills and leaks from fueling activities contaminated soils and shallow groundwater with petroleum hydrocarbons, primarily diesel. In 1994, the Montana Department of Environmental Quality CECRA[a] program became the lead regulatory program for the facility and ranked it a high priority. Burlington Northern Santa Fe (BNSF) is currently addressing the contamination issues at the facility voluntarily.

The facility is located in a commercial and residential area in northwest Helena. Most of the area is reportedly on city drinking water (Dan Strausbaugh, ATSDR Regional Representative, Personal Communication). A few deep commercial wells are in the vicinity (Dan Strausbaugh, ATSDR Regional Representative, Personal Communication). According to data from the state of Montana Natural Resource Information System (http://nris.state.mt.us/default.asp), approximately 18 wells are within ½ mile of the site's location [1]. These wells range from 42 to 660 feet in depth, with an average depth of 139 feet [1]. Many of the well's actual locations are unconfirmed, and a highly uncertain method was used for georeferencing them. A map supplied by the Burlington Northern Santa Fe contractor shows groundwater wells, however, only 10 are shown within a half of a mile of the site [2]. City of Helena retention ponds are about 4,000 feet north of the facility (Dan Strausbaugh, ATSDR Regional Representative, Personal Communication). Groundwater generally flows too the north [2].

From 1981 through 1986, BNSF consultants conducted several limited investigations to determine the presence and extent of ground water contamination at the railyard. The consultants delineated a plume of diesel contamination, which extended offsite to the north and may have reached the City of Helena retention ponds via leaky city storm drains. A large release in 1986 resulted in diesel fuel accumulating in these retention ponds. In 1986, BNSF contractors implemented a system to recover free diesel product from groundwater via trenches and an oil separator. As of August 1990, over 109,000 gallons of free product had been recovered from groundwater at the facility.

In 2004, BNSF discovered solvents, including tetrachloroethylene, in the groundwater at the facility [2]. BNSF plans to investigate to determine the source and extent of the solvent contamination. The community is concerned that exposure to fuel and solvent contamination in the groundwater has resulted in increases in Graves Disease incidence (Dan Strausbaugh, ATSDR Regional Representative, Personal Communication). There is also some concern regarding the potential for vapor from groundwater contaminants to seep into homes [3]. Maximum concentrations of contaminants detected are shown in Table 1. Following the methodology outlined in chapter 7 of ATSDR's Public Health Assessment Guidance Manual, ATSDR used health based comparison values to screen ground water contaminant levels at this site [4]. Briefly, this procedure compares environmental contaminant levels with comparison values set well below levels that are known or anticipated to result in adverse health effects. ATSDR and other government agencies have developed these values to help health assessors

[a] Montana Comprehensive Environmental Cleanup and Responsibility Act (CECRA)

make consistent decisions about what substance concentrations or dose levels associated with site exposures require further evaluation.

Discussion

MDEQ asked the following question of ATSDR:

Could exposure to solvents in the groundwater be associated with thyroid problems such as Graves Disease?

In evaluating for chemical exposures, ATSDR first evaluates for a completed exposure pathway. An exposure pathway is the process by which an individual is exposed to contaminants originating from a contamination source. An exposure pathway consists of the following five elements: 1) a *source* of contamination; 2) a *media* such as air or soil through which the contaminant is transported; 3) a *point of exposure* where people can contact the contaminant; 4) a *route of exposure* by which the contaminant enters or contacts the body; and 5) a *receptor population*. A pathway is complete if all five elements are present and connected. If one of these elements is missing, the pathway is incomplete and human exposure and health effects are not possible.

The probable source of contamination for most of the metals and fuel associated contaminants is past rail-yard activities. However, it is unclear at this time what the source of the halogenated solvent plume in ground water could be. In October 2004, BNSF reported detections of tetrachloroethylene, trichloroethene, 1,3-dichlorobenzene, and cis-1,2 dichlorothene in 1 groundwater monitoring well, MMW-1 (12' below ground surface) and 3 soil borings. BNSF consultants state that there is no historical record of halogenated solvents upgradient from the detections [2]. BNSF consultants speculated that the source of the solvent plume is a former dry cleaner and/or a carpet cleaning facility that operated until the 1990s [2].

While a media, shallow ground water, is contaminated in some locations, no one is apparently using this groundwater as a source of drinking water and there is no point of exposure for a drinking water exposure pathway. However, other pathways of exposure are possible to the contaminants detected in the shallow groundwater. One potential pathway of exposure is through groundwater vapor intrusion, where vapor from the solvent contamination infiltrates nearby homes and presents an inhalation exposure to residents [5]. EPA has published draft guidance for evaluating this pathway [5]. We note that residential properties are located within 360 feet of the maximum detection of tetrachlorethylene in the shallow groundwater, and businesses and office buildings are located near the plume as well. That said, however, only 8 of the 27 soil borings encountered groundwater, and three of the dry soil borings are located between the MMW-1 and the residential properties to the north, suggesting the contaminated groundwater is not below residential homes. However, without a better understanding of the source of the halogenated solvent contamination, as well as further characterization of the plume, we can not completely rule out possible groundwater vapor intrusion at this time. Other contaminants detected in the diesel fuel plume are unlikely to pose a current groundwater vapor intrusion hazard because there are groundwater recovery trenches located to intercept these contaminants.

Anecdotal reports have been made that there are irrigation wells that may be in use [3]. These wells, unless completed in or very near a contaminant plume will not be a point of exposure to anyone. Given the infrequent presence of groundwater in the soil borings, it seems unlikely that a useful amount of groundwater would be generated from this aquifer.

Graves disease is an autoimmune disease, in which a person's immune system mistakenly attacks the thyroid gland, resulting in the production of high levels of thyroid hormone [6]. It is more common in women and usually begins after age 20 [7]. It is not known what causes a person's immune system to attack their thyroid gland [6,7]. Many of the contaminants detected in the water samples are below applicable health based comparison values, and are not likely to result in any effect. There are sixteen contaminants that are higher than comparison values or no comparison values exist. However, no thyroid effect data exist in these compounds' toxicological profiles [8,9,10,11,12,13,14,15, 16]. These compounds are two VOCs (benzene, tetrachloroethylene), six metals (arsenic, lead, antimony cadmium, mercury, silver) and 8 polycyclic aromatic hydrocarbons.

One of the chemicals detected below screening values, 1,3-dichlorobenzene (1,3-DCB), detected in the solvent plume have shown effects to the thyroid in animal testing. In a 90-day study, histological effects in rat thyroids were found. At the oral dose level of 9 mg/kg/day, 1,3-DCB reduced the colloidal density in thyroid follicles of male rats [17]. The endocrine effect of 1,3-DCB was cited in the toxicological profile. As described by McCauley et al., 1995, the incidence of colloidal density reduction in the follicular cells in thyroids was significantly increased in male rats at dose level of 9 mg/kg/day or higher and in female rats at 37 mg/kg/day or higher [17].

Based on the lowest observed effect level (LOAEL) value of 9 mg/kg/day for the thyroids effects in the intermediate study, the 1,3-DCB concentration in drinking water should be as high as 315 mg/l to reach this harmful dose for an 70-kg person who drinks 2 liter of water a day. The concentration of 1,3-DCB found at this site, 0.410 µg/l is 768,293 times lower than the harmful level.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health. If the solvent plume is affecting nearby irrigation wells, children at this site may be vulnerable as they may play in or with water from the irrigation wells. If children's play areas inside the home includes the basement, and if the solvent plume is creating a vapor intrusion problem, they may be at higher risk of exposure. Further characterization of the solvent plume is needed to address this concern.

Conclusions

There is no known association with the chemicals detected in groundwater samples at the BNSF Helena rail yard and Graves disease. However, the available information does not allow us to conclude if people are or are not being exposed to solvents from this site.

Recommendations

ATSDR recommends further investigation of the source and the extent of the groundwater solvent plume. Further investigation of groundwater vapor intrusion may be warranted, depending on the location and concentrations of the contaminants detected with respect to the locations of nearby houses.

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Tables

Table 1: Groundwater Analytical Results for Contaminants – Former BN Helena Fueling Facility, µg/l

Chemical	Maximum Result	Comparison Value	Comparison Value Source
Acetone	180	9000	RMEG-Child[†]
Benzene	**12**	**0.6**	**CREG[‡]**
Chloroform	2	100	Chronic EMEG Child
Ethylbenzene	47	1000	RMEG-Child
Toluene	6	2000	RMEG-Child
meta- and para- Xylenes	4.1		
ortho-xylenes	2		
Xylenes (total)	350	2000	RMEG-Child
1,3-Dichlorobenzene	0.41	600	LTHA[§]
cis-1,2-Dichloroethene	0.33	70	LTHA
Tetrachloroethene	**107**	**10**	**LTHA**
Trichloroethene	0.51	5	MCL[**]
Methyl-t-butyl-ether	Non-detect	200	LTHA
Naphthalene	Non-detect	100	LTHA
Fluorene	9.3	600	RMEG-Child
Phenanthrene	**14**	**None**	
1-Methylnaphthalene	11	700	Chronic EMEG-Child[††]
Acenaphthene	1.7	600	RMEG-Child
Anthracene	3.6	3000	RMEG-Child
Benzo(a)anthracene	**8.2**	**None**	
Benzo(b)fluoranthene	**10**	**None**	
Benzo(g,h,i)perylene	**3.7**	**None**	
Benzo(a)pyrene	**6.3**	**0.005**	**CREG**
Chrysene	**8.8**	**None**	
Dibenzo(a,h)anthracene	**1.7**	**None**	
Fluoranthene	17	400	RMEG-Child
Indeno(1,2,3-c,d)pyrene	**3.2**	**None**	
Pyrene	16	300	RMEG-Child
Bis(2-ethylhexyl)phthalate	71	600	Chronic EMEG-Child
Phenol	2.2	3000	RMEG-Child
Arsenic	**20**	**3**	**Chronic EMEG-Child**
Lead	**90**	**0**	**MCLG[‡‡]**
Antimony	**160**	**4**	**RMEG-Child**

[†] RMEG-Child: Reference Dose Media Evaluation Guide (Child)
[‡] CREG: Cancer Risk Guide
[§] LTHA: Lifetime Health Advisory
[**] MCL: Maximum Contaminant Level
[††] Chronic EMEG-Child: Chronic Environmental Media Evaluation Guide (Child)
[‡‡] MCLG: Maximum Contaminant Level Goal

Chemical	Maximum Result	Comparison Value	Comparison Value Source
Beryllium	7	20	Chronic EMEG-Child
Cadmium	**14**	**2**	**Chronic EMEG-Child**
Chromium	52	100	LTHA
Copper	70	100	Intermediate EMEG-Child
Mercury	**4**	**None**	
Nickel	21	100	LTHA
Selenium	20		
Silver	**650**	**50**	**RMEG-Child**
Thallium	Non-detect	0.5	LTHA
Zinc	100	2000	LTHA