PUBLIC HEALTH ASSESSMENT
Public Comment Release

Eastland Woolen Mill Site

Corinna, Penobscot County, Maine

EPA Facility No. MED980915474

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Prepared by

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Summary

The Eastland Woolen Mill (EWM) site is located in Corinna, Maine. The site consists of a former woolen mill complex and several nearby areas where contamination from the mill is believed to be present. Chemicals used in past operations have contaminated the site with chlorinated benzenes and other contaminants. The former processing buildings have been removed, and several areas of the site have been subject to past and ongoing cleanup activities.

On the basis of available information, the Agency for Toxic Substances and Disease Registry (ATSDR) has made the following conclusions about the Eastland Woolen Mill site:

- ATSDR did not identify any ongoing exposure which would result in health effects. Residents with contaminated wells have been provided clean water, and highly contaminated soil and sediment in the areas most likely to be accessed often have been removed. Therefore, ATSDR classifies the former EWM site as a **current no apparent public health hazard**.

- ATSDR considers the cleanup plan documented in the record of decision (ROD) for Operable Unit 1 (OU1) to be protective of public health. Assuming the ROD for Operable Unit 2 is also protective, and that remedial alternatives are implemented successfully, health risks from potential future exposures will be minimal.

- People who drank contaminated water from private wells over several years had an increased risk of cancer. In addition, past exposures of former workers to process chemicals could have increased their risk of cancer, although we do not know enough about the past exposures to give an accurate estimate of risk. Because past exposures were high enough to increase the risk of adverse health effects, ATSDR classifies the site as a **past public health hazard**.

- The analysis of cancer performed by the Maine Cancer Registry for 1983 – 1998 in the Corinna area indicated that cancer rates were no different than for the rest of Maine. However, the available cancer data are not detailed enough to draw specific conclusions about cancer rates in the relatively small number of people who were exposed, including EWM workers and residents near EWM.

- For the current situation, contaminant concentrations in the sediment/floodplain soil and Old Dump site soil pathways are below levels of health concern. However, the lead levels would represent a health concern for children if homes were built at this location without any remediation. The Environmental Protection Agency (EPA) considers future residential development of the Old Dump site unlikely.

- Elevated mercury and dioxin concentrations in fish are not site-related, but may be a health concern for those consuming more than 27 meals a year of perch or large mouth bass from the East Branch of the Sebasticook River.

- Not enough information exists to evaluate the effects of airborne releases of EWM chemicals to the surrounding area, a past potential exposure pathway.

ATSDR has made the following recommendations about the Eastland Woolen Mill site:

- ATSDR recommends that EPA and/or Maine Department of Environmental Protection (MEDEP) continue to monitor groundwater and provide clean water to residents whose wells are contaminated.

- In the unlikely event that the Old Dump site is developed for residential use, ATSDR recommends that EPA, MEDEP, or the developer of the site fully characterize the soil lead levels in the area being developed and clean up to a concentration acceptable to EPA.

- ATSDR recommends that state and local officials increase vigilance to ensure that people follow applicable state fish advisories for contaminants that are not site-related.

Purpose and Health Issues

The Eastland Woolen Mill (EWM) site was proposed for inclusion on the National Priorities List (NPL) on April 23,1999 and listed on the NPL on July 22, 1999 [1]. In this public health assessment, the Agency for Toxic Substances and Disease Registry (ATSDR) evaluates the public health significance of the site as mandated by Congress. ATSDR has reviewed available environmental data and community health concerns to determine whether adverse health effects are possible. In addition, this public health assessment recommends actions to prevent, reduce, or further identify the possibility for site-related adverse health effects.

This public health assessment is differentiated from EPA's Baseline Human Health Risk Assessment in several ways. Both documents assess risk to human health from exposure to site contaminants using similar evaluation methods, especially in assessing exposure. However, ATSDR's public health assessment determines the qualitative implications of present and past exposures to site contaminants and identifies the public health actions that should be taken to prevent or minimize those exposures. EPA's risk assessment determines quantitative risk for present and future exposures to facilitate selection of appropriate remedial actions, especially site cleanup levels.

Background

Site Description and History

The following site description comes in part from the EWM Baseline Risk Assessment (February 2002) and the Feasibility Study Report (May 2002) [2,3] The EWM site is located in the town of Corinna, Maine, approximately 25 miles northwest of Bangor (Figure 1). The site consists of a former woolen mill complex and several nearby areas where contamination from the mill is believed to be present, including Moosehead Mill and a location where EWM materials were disposed called the "Old Dump" site. EPA has split the site in two operable units. OU1 consists of the site of the EWM complex buildings, including groundwater, soils, and stream areas where contaminated sediment removal has already occurred. OU2 includes surface water, sediments, and streambeds downstream of the removal area and also includes Moosehead Mill and the Old Dump.

The EWM was built over the East Branch of the Sebasticook River (EBSR), with the river running through the mill building, and reportedly began operating in 1909 [2]. Eastland took ownership of the mill in the 1930s, manufacturing wool yarn and fabrics until the fall of 1996, when the company declared bankruptcy and closed the mill. Most of the former mill complex was demolished in 2000 and 2001.

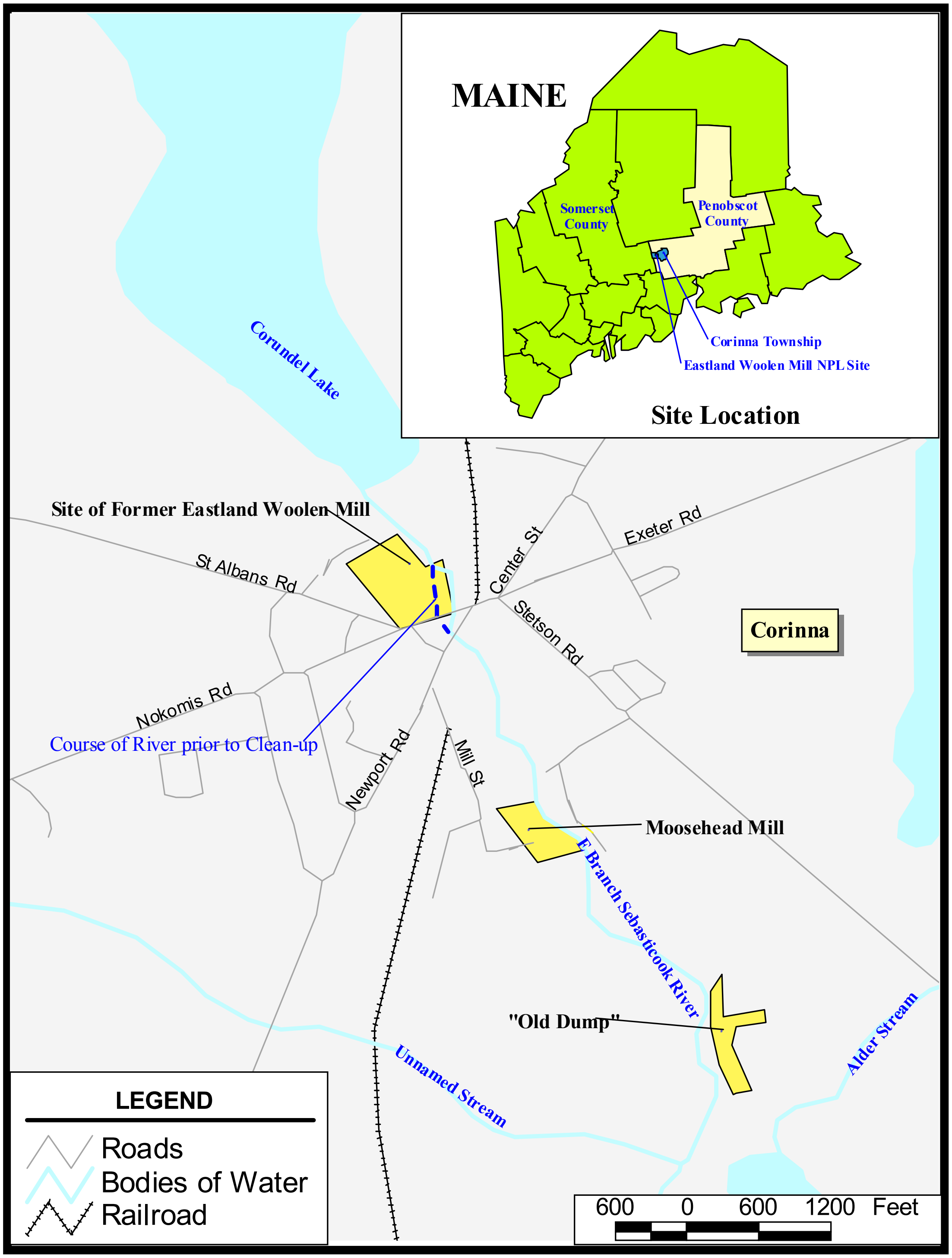

Figure 1 - Eastland Woolen Mill NPL Site
Corinna, Maine

EWM Public Health Assessment - Public Comment Release

John R. Crellin, PhD - 06242003

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The release of chlorinated benzenes and other hazardous substances from the mill resulted in significant contamination of soils and groundwater beneath and adjacent to the mill [2,3]. This contamination occurred from the discharge of wastewater from the mill's fabric dyeing operations, chemical spills inside the mill buildings, and leaks from the mill's underground storage tanks. Contaminants from the site have migrated several miles down the EBSR into sediments, floodplain soils, and groundwater adjacent to the river.

The groundwater contamination in Corinna was discovered in 1983 when a Maine Department of Environmental Protection (MEDEP) employee noticed that the water in a local restaurant across the street from the mill had a strange taste and odor [2,3]. Subsequent sampling and analysis of the restaurant's well water revealed that the well was contaminated with chlorinated benzenes (mono-, di-, and tri-). Further testing of nearby water supply wells revealed that 5 of the wells along Main Street contained chlorinated benzenes at levels above drinking water standards. Eastland arranged for installation of granular activated carbon filters at these 5 locations. Eastland also initiated a quarterly sampling program, under the oversight of the MEDEP, to insure effective operation of the filters and to identify other wells which might become contaminated. By 1988, testing of wells at private residences and local businesses revealed 11 locations with chlorobenzene levels warranting the installation of carbon filters. Groundwater contamination was detected up to 800 feet from the mill.

Since 1999, EPA has been conducting a non-time critical removal action (NTCRA), or early cleanup, at the EWM site [3,4]. The goal of the early cleanup is to remove the source of contamination in site soils, thereby reducing the amount of contamination that is migrating into groundwater and into the EBSR.

The basic components of the removal action and current status are:

- demolish and remove the EWM buildings - completed April 2000
- excavate contaminated soils beneath and near the building foundation and in the EBSR channel - completed August 2001
- permanently divert the EBSR, including rerouting Route 7 and replacing Main Street - completed August 2001
- restore EBSR channel - completed September 2002
- treat contaminated soils - projected completion 2004

Also, in 1999, EPA began field activities at the site related to the Remedial Investigation/Feasibility Study (RI/FS) of the site [3,4]. The RI/FS provides detailed information and data regarding the nature and extent of contamination from the EWM in groundwater, surface water, sediment, and soils.

The RI for the four major areas of contamination is now complete [4]. The key results for these areas follow:

(1) Bedrock and overburden groundwater

- Private drinking water wells drawing from the bedrock or overburden (i.e., the sand and soil on top of the bedrock) aquifers contain elevated levels of site contaminants.

- The bedrock aquifer is heavily contaminated by chlorinated benzenes to a depth of 350 feet in some locations. This aquifer discharges contaminants to the EBSR near the EWM site. Extraction of groundwater by water supply wells tends to pull contaminants away from the river.
- The overburden aquifer is also contaminated and is discharging to the EBSR near the EWM site.

(2) River sediments and floodplain soils of EBSR
- Chlorinated benzenes, dieldrin, cadmium, chromium, and zinc are the site-related contaminants found in the sediment and floodplain soil tested downstream of the site.
- "Hot spots" of contaminants exist in sediment depositional and floodplain areas of the EBSR near Moosehead Mill and the Old Dump.

(3) Old Dump site
- The results of the RI indicate that this area, which is about one mile south of the EWM complex, was used to dispose of waste from the mill.
- There are chlorinated benzenes, pesticides, cadmium, and polyaromatic hydrocarbons in the waste material and chlorinated benzenes in small portions of the overburden and bedrock aquifers beneath this area.

(4) EWM complex
- Two areas of soil contaminated with chlorinated benzenes remain near the former EWM complex. One area was so deep as to be inaccessible during early cleanup efforts, and the other smaller area could not be cleaned up due to logistical issues with an overlying roadway. These areas present a continuing source of contamination to the groundwater.

Demographics

As indicated on Figure 2, the EWM site is located in the town of Corinna, which has a population of 2,145, based on the 2000 census [5]. The population of Corinna is about 98% White with the rest being African-American, Hispanic, and American Indian. Approximately 642 people live within a 1-mile radius of the site.

Eastland Woolen Mill

INTRO MAP

Corinna, Maine

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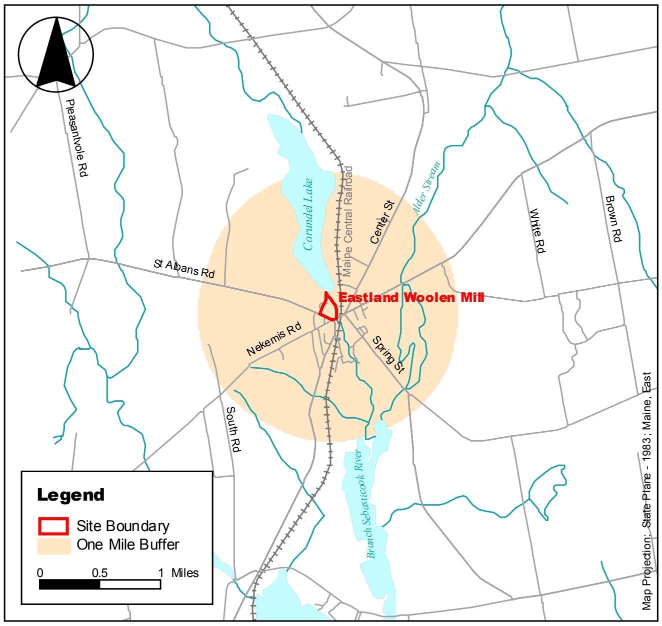
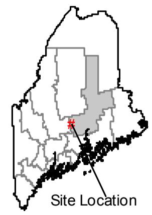


Base Map Source: 1995 TIGER/Line Files



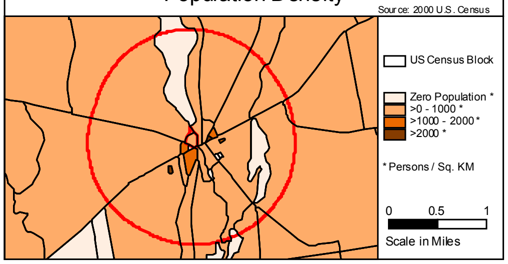
Penobscot County, Maine

Demographic Statistics Within Area of Concern*	
Total Population	642
White alone	623
Black alone	5
Am. Indian and Alaska Native alone	3
Asian alone	1
Native Hawaiian and Other Pacific Islander alone	0
Some other race alone	0
Two or More races	10
Hispanic or Latino	0
Children Aged 6 and Younger	65
Adults Aged 65 and Older	109
Females Aged 15 - 44	121
Total Housing Units	309

Demographics Statistics Source: 2000 US Census
*Calculated using an area-proportion spatial analysis technique

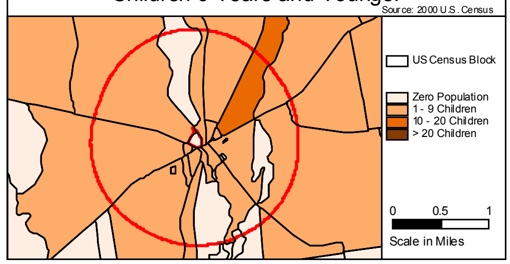
Population Density

Source: 2000 U.S. Census



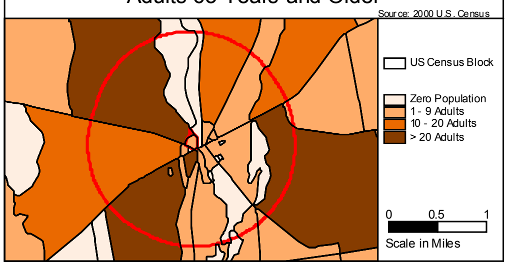
Children 6 Years and Younger

Source: 2000 U.S. Census



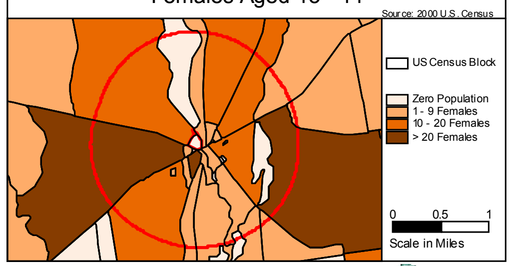
Adults 65 Years and Older

Source: 2000 U.S. Census



Females Aged 15 - 44

Source: 2000 U.S. Census



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Land and Natural Resource Use

The EWM was built over the EBSR, with the river running through the mill building, in the center of Corinna's downtown [2,3]. The surrounding area is currently a mix of businesses and residences. Redevelopment of this area could include retail, commercial/industrial, residential, and recreational uses such as a park. The EBSR is used for fishing, wading, swimming and other recreational activities downstream of the former mill site.

Groundwater

Groundwater in the Corinna area is found in the shallow overburden and deeper bedrock aquifers [2,3]. These aquifers in the former EWM site area are heavily contaminated with chlorinated benzenes and other site contaminants. The residences and businesses in the area with the contaminated groundwater now obtain their drinking water from a municipal water system; however, they previously used water from the contaminated bedrock aquifer. Residences and businesses outside of the groundwater contamination area continue to obtain their drinking water from wells installed in the bedrock aquifer. EPA has indicated that long-term monitoring of these wells is planned and that some limited sampling may be done in 2003.

Discussion

Data used

The primary source for the data evaluated in this public health assessment was the Baseline Risk Assessment for the EWM site [2], which included data from the 1999-2001 EWM Site Remedial Investigation and data from Non-Time Critical Removal Actions (NTCRAs) performed in 2000 and 2001. The EWM Site Remedial Investigation Report and the Record of Decision (ROD) for OU1 were also used [6,7,8].

ATSDR visited the Corinna area to better understand the physical and geographic setting of the site.[1] We also met with community members and local, state, federal officials to learn more about the site and the health concerns of the community.

Evaluation Process

In this section of the public health assessment, ATSDR (1) evaluates available environmental sampling data for the EWM site and determines which site contaminants are of potential health concern, (2) identifies pathways by which persons may be exposed to the contaminants of concern (COCs) from the site, and (3) evaluates the public health implications of those exposures. More details about the evaluation process can be found in Appendix A.

[1] ATSDR staff (Steve Richardson, John Crellin, Perstephanie Thompson, Bill Sweet, and Susanne Simon) visited the site in November 1999. Information obtained during this visit is described in the pertinent sections of this document.

ATSDR selects COCs by comparing contaminant concentrations in specific environmental media (e.g., soil, water, air) at the site with health-based comparison values. When the concentration of a contaminant detected at the site exceeds a comparison value, the contaminant is selected for further evaluation in the public health assessment. See Appendix A for more information about ATSDR comparison values.

Identification of a COC does not imply that people will experience adverse health effects. Instead, it indicates that the contaminant will be further evaluated using site-specific exposure conditions to determine whether people are at risk of experiencing adverse health effects. This depends on the frequency and length which people come in contact with the contaminants as well as the level of contamination. Regardless of the level of contamination, a public health hazard can exist only if people actually come into contact with, that is, are exposed to, the contaminated media.

ATSDR evaluates pathways by which persons may be exposed to contaminants of concern by examining the following five elements: (1) a source of contamination; (2) an environmental medium through which contaminants are transported; (3) a point of exposure (i.e., a place where people come into contact with contaminated media); (4) a route of human exposure (i.e., how contaminants enter the body); and (5) an exposed population. An exposure pathway is considered complete if all five elements are present. If one or more elements is not proven, the pathway is considered potential. If one or more elements is proven not to exist, the pathway is incomplete.

ATSDR identified several exposure pathways which are summarized in Table B1 in Appendix B. Not all exposures related to the EWM site are significant enough to cause adverse health effects. The potential for adverse health effects as a result of human exposures at the EWM is evaluated in the following sections.

Completed Exposure Pathways, Contaminants of Concern, and Toxicological Evaluation

Private Well Exposure Pathway

The private wells at residences and businesses in the downtown Corinna area were found to be contaminated with chlorinated benzenes and other site-related contaminants in 1983 [2]. The historical sampling data show high levels of chlorinated benzenes in supply wells close to THE mill with lower levels extending away from the mill in several directions, including the northeast and southwest. The 7 contaminants found above a comparison value in private wells are identified in Table 1.

Table 1. Contaminants Detected Above Comparison Values in Private Wells

Chemical	Range* in ppb†*	#E/#D‡	Comparison Value (CV) in ppb	Source of CV
Benzene	ND§ – 454	27/35	0.6	CREG¶
Chlorobenzene	ND - 9,000	62/148	200	RMEG**
1,2-Dichlorobenzene	ND - 3,015	26/157	900	RMEG
1,3-Dichlorobenzene	ND - 1,160	3/136	600	LTHA††
1,4-Dichlorobenzene	ND - 4,300	64/154	75	LTHA
1,2,3-Trichlorobenzene	15 - 1,750	117/117	40	LTHA
1,2,4-Trichlorobenzene	ND - 2,335	64/147	100	RMEG

* Range = range of the means for the individual wells sampled
† ppb = parts per billion
‡ #E/#D = number of detects exceeding comparison value/total number of detects. ATSDR calculated the mean levels for every contaminant, using the highest mean for exposure dose calculations.
§ ND = non-detected
¶ CREG = Cancer risk evaluation guide
** RMEG = Reference dose media evaluation guide
†† LTHA = Lifetime health advisory

Exposure to these contaminants in well water could have occurred through drinking (ingesting) them; breathing them through evaporation from water during bathing, showering, dishwashing; and absorbing them through the skin while showering or bathing. Exposures may have occurred for up to 40 years based on reports that chlorinated benzenes were first used in the mill's fabric dyeing operations in the 1950s or early 1960s [3]. ATSDR assumes that all exposures through drinking contaminated water ceased by 1995 when clean water from a public water supply was provided to all those with contaminated wells. For 10 of the contaminated wells, exposure was reduced in the mid-1980s by fitting the wells with activated carbon filters. The private well pathway is considered to be a past exposure pathway because exposure to contaminants from private wells is no longer occurring. The conclusion that current and future exposures are not occurring is based on the following assumptions: (1) groundwater monitoring and predictive groundwater modeling have identified all contaminated wells, (2) people with contaminated wells continue to have access to and use clean water, and (3) remediation in conjunction with institutional controls is successful in eventually reducing contamination in groundwater to safe levels.

Public Health Implications

We used conservative default assumptions to calculate exposure doses for the COCs in Table 1. For child dose, we assumed a 1-year-old weighing 10 kilograms (kg) drank 1 liter of water with the highest mean concentration for a contaminant per day [7].[2] For adults and for evaluating the risk of cancer, we assumed that adults weighing 70 kg drank 2 liters of water with the highest

2 For every private drinking water well in the Corinna area, ATSDR calculated the mean levels for every contaminant. We used the highest mean for our exposure dose calculations.

mean concentration for a contaminant per day for 40 years. These doses were multiplied by 2 to account for additional dermal and inhalation exposure to volatile compounds during showering [9]. The estimated past exposure doses were higher than applicable cancer and noncancer health guidelines. The following paragraphs include a discussion of possible health effects.

Benzene – The estimated child and adult doses were calculated to be about 10-30 times higher than the reference dose generally considered safe. However, the estimated doses were 30-100 times smaller than the dose shown to cause mild effects on the nervous system and liver in toxicological studies of rodents [10]. Noncancer health effects are considered unlikely from this exposure. However, benzene is a known carcinogen and contributes to cancer risk (see *Cancer Risk* section below).

Chlorobenzene – The estimated child and adult doses were calculated to be about 25-90 times higher than the reference dose generally considered safe. However, the estimated doses were 30-100 times smaller than the dose shown to cause microscopic changes in the liver in toxicological studies of dogs [11]. Noncancer health effects are considered unlikely from this exposure. Chlorobenzene is not classified as a human carcinogen.

Dichlorobenzenes – The estimated child and adult doses are slightly higher than the range generally accepted as safe. All the doses were hundreds of times smaller than no adverse effect levels seen in toxicological studies [12]. Noncancer health effects are considered unlikely from this exposure. 1,4-dichlorobenzene is a possible human carcinogen and may contribute to cancer risk (see *Cancer Risk* section below).

Trichlorobenzenes – The estimated child and adult doses were calculated to be about 10-50 times higher than the reference dose generally considered safe. However, the estimated doses were 30-150 times smaller than the dose shown to cause no adverse effects in toxicological studies [13]. Noncancer health effects are considered unlikely from this exposure. Trichlorobenzenes are not classified as human carcinogens.

Cancer Risk – Of the above COCs, benzene is known to cause leukemia (cancer of the blood-forming organs), and 1,4-dichlorobenzene is linked with kidney and liver cancers in animals [10,12]. Drinking water containing the maximum detected concentrations of benzene and 1,4-dichlorobenzene over the entire 40-year period possible would have increased a person's risk of cancer by a moderate to high amount.

To summarize, past exposures to contaminants through the private well pathway were not likely to lead to noncancer health effects. However, people who regularly drank highly contaminated water over the 40-year period had a moderate to high increased risk of developing cancer.

On the basis of available information, no one is currently drinking the water, and any continuing use of this water for nondrinking purposes is expected to occur infrequently. No health effects are expected from such use.

Soil Exposure Pathways

EWM site (Including Main EWM Complex, Building 14 and the Underground Storage Tank Area)

The soils at the Former EWM site were contaminated with benzene and various chlorinated benzenes both at the surface and below the surface [6]. Significant exposures are not currently occurring because the surface contamination at these locations was removed during the NTCRA. However, workers on the site may have been exposed to contaminants before the cleanup, so ATSDR considers the soil exposure pathway to be a past completed pathway.

In general, soil samples obtained from the surface (0-3 inches) provide the best information when evaluating people's exposure to soil. However, the available data were mostly from subsurface soil borings taken to characterize the nature and extent of contamination. Since no past surface sampling was available, we estimated exposures using the maximum subsurface concentration found in soil and reported in the RI. Because the contaminants apparently filtered down through the surface soils towards the bedrock, the use of subsurface contaminant concentrations should give a conservative estimate of past surface concentrations. Currently, the actual surface contaminant concentrations would likely be lower than the maximums used here, because some of the volatile contaminants would evaporate from the soil. The maximum values detected in subsurface soils above comparison values are listed in Table 2.

Table 2. Contaminants Detected Above Comparison Values in EWM Soils

Chemical	**Maximum Concentration (mg/kg* or ppm†)**	**Comparison Value (mg/kg or ppm)**	**Source of CV**
Benzene	15	10	CREG¶
Chlorobenzene	1,800	1,000	RMEG‡
1,2,3-Trichlorobenzene	2,000	500	RMEG (for 1,2,4-)
1,2,4-Trichlorobenzene	12,000	500	RMEG

*mg/kg = milligrams per kilogram
†ppm = parts per million, equal to milligrams per kilogram
¶ CREG = Cancer risk evaluation guide
‡ RMEG = Reference dose media evaluation guide

Public Health Implications

Conservative assumptions were used to calculate exposure doses for the COCs in Table 2. For each contaminant, we assumed that an adult worker weighing 70 kilograms (kg) would consume 50 g of soil containing the maximum concentration for 250 days a year. For evaluating the risk of cancer, we assumed that this exposure would occur for 40 years. The calculated doses for each contaminant in Table 2 were much lower than applicable cancer and noncancer health guidelines. Therefore, the soil exposure pathway did not contribute significantly to the workers’ overall risk of health effects.

Old Dump Site

Soil at the Old Dump site is contaminated with organic materials, pesticides, and heavy metals [6]. The soil here represents a completed present and past exposure pathway, because adolescents and adults may breathe in, accidentally swallow, or contact contaminants in surface soil during recreational activities. The only data available were soil borings from 0 - 17 feet which are not best for evaluating the possibility of health effects from exposure to the top few inches of soil. However, on the basis of this limited data, occasional recreational use of the site is not expected to result in any health effects. The lead level in the soil could pose a risk to young children if they spent most of their time on the site (for example, if the site was developed for residential use). We consider it unlikely that the site would be developed without further characterization and/or cleanup.

Past Mill Work

While the mill was operating, workers, especially those who worked in the fabric finishing operations, were exposed to coal-tar derivative dyes, dye aids containing chlorinated benzenes, and other process chemicals, including caustics, acid, and ammonia. According to anecdotal information, workers had direct contact with dyes; their exposed skin was colored according to the dye currently in use[3]. Also, use of personal protective equipment in the past was generally not common. We can assume that workers had direct contact with or breathed in the volatile process chemicals used.

Both immediate and long-term health effects are possible from worker exposure to process chemicals such as those used at EWM in the past [2,6]. Unfortunately, little information on the specific chemical identities and amounts used in EWM processes was available, so only general conclusions can be made. Inhalation of high levels of the volatile organic chemicals[4] used in the mill process is associated with various health effects, including blood problems; liver, kidney, or nervous system effects; and lung and eye irritation. Long-term exposure effects may include increased risk of cancer associated with the use of benzene, 1,4-dichlorobenzene, and coal-tar derivative dyes.

Possible Health Consequences from Worker Exposures

Here is a brief summary of the health consequences possible from prolonged exposure to benzene, chlorobenzene, 1,4-dichlorobenzene, and coal-tar derivative dyes. There is insufficient information to determine if workers were exposed long enough and to sufficient levels for any of these effects to occur. The information on benzene, chlorobenzene, and 1,4-dichlorobenzene is excerpted from the Public Health Statements in the ATSDR Toxicological Profiles for these chemicals while the information on coal-tar derivative dyes was compiled from three sources [14-16].

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[3] This information was provided by the Sebasticook Committee for a Clean Environment (SCCE).
[4] These include benzene, chlorobenzene, dichlorobenzenes, and trichlorobenzenes.

Benzene

Benzene causes problems in the blood [10]. People who breathe benzene for long periods may experience harmful effects in the tissues that form blood cells, especially the bone marrow. These effects can disrupt normal blood production and cause a decrease in important blood components. A decrease in red blood cells can lead to anemia. Reduction in other components in the blood can cause excessive bleeding. Blood production may return to normal after exposure to benzene stops. Excessive exposure to benzene can be harmful to the immune system, increasing the chance for infection and perhaps lowering the body's defense against cancer.

Exposure to benzene may be harmful to the reproductive organs [10]. Some women workers who breathed high levels of benzene for many months had irregular menstrual periods. When examined, these women showed a decrease in the size of their ovaries. However, exact exposure levels were unknown, and the studies of these women did not prove that benzene caused these effects. It is not known what effects exposure to benzene might have on the developing fetus in pregnant women or on fertility in men. Studies with pregnant animals show that breathing benzene has harmful effects on the developing fetus. These effects include low birth weight, delayed bone formation, and bone marrow damage.

Benzene can cause cancer of the blood-forming organs [10]. The Department of Health and Human Services (DHHS) has determined that benzene is a known carcinogen. The International Agency for Cancer Research (IARC) has determined that benzene is carcinogenic to humans, and the EPA has determined that benzene is a human carcinogen. Long-term exposure to relatively high levels of benzene in the air can cause cancer of the blood-forming organs. This condition is called leukemia. Exposure to benzene has been associated with development of a particular type of leukemia called acute myeloid leukemia (AML).

Chlorobenzene

Workers exposed to high levels of chlorobenzene complained of headaches, numbness, sleepiness, nausea, and vomiting [11]. However, it is not known if chlorobenzene alone was responsible for these health effects since the workers may have also been exposed to other chemicals at the same time. Mild to severe depression of functions of parts of the nervous system is a common response to exposure to a wide variety of industrial solvents.

In animals, exposure to high concentrations of chlorobenzene affects the brain, liver, and kidneys [11]. Unconsciousness, tremors and restlessness have been observed. The chemical can cause severe injury to the liver and kidneys. Data indicate that chlorobenzene does not affect reproduction or cause birth defects. Studies in animals have shown that chlorobenzene can produce liver nodules, providing some but not clear evidence of cancer risk.

1,4-Dichlorobenzene

Inhaling the vapor or dusts of 1,4-dichlorobenzene at very high concentrations can be very irritating to a person's lungs [12]. It may also cause burning and tearing of the eyes, coughing, difficult breathing, and an upset stomach. There are some medical reports of patients who have developed some health effects, such as dizziness, headaches, and liver problems as a result of very high levels of 1,4-dichlorobenzene in the home[5]. However, these were reports of extremely high usage of 1,4-dichlorobenzene products, and the persons continued to use the products for months or even years, even though they felt ill. There are also cases of people who have eaten 1,4-dichlorobenzene products regularly for long periods (months to years) because of its sweet taste. This has caused skin blotches and problems with red blood cells, such as anemia. Workers breathing high levels of 1,4-dichlorobenzene (80-l60 ppm) have reported painful irritation of the nose and eyes.

In laboratory animals, breathing or eating 1,4-dichlorobenzene can cause harmful effects in the liver, kidneys, and blood [12]. Rats and mice given oral doses of 1,4-dichlorobenzene in lifetime studies had increased rates of liver cancer when compared with animals that did not receive 1,4-dichlorobenzene.

We do not definitely know if 1,4-dichlorobenzene plays a role in the development of cancer in humans [12]. Based on animal data, the Department of Health and Human Services (DHHS), International Agency for Research on Cancer (IARC), and EPA have all determined that 1,4-dichlorobenzene is possibly carcinogenic to humans. The EPA has determined that 1,4-dichlorobenzene is a possible human carcinogen.

There is no reliable evidence that suggests that 1,4-dichlorobenzene affects reproduction in humans [12].

Coal-Tar Derivative Dyes

We were unable to identify information that described the health effects that might occur from exposure to coal tar derivative dyes. There is information on health effects from exposure to coal tar which will be summarized here [14-16]. This information may not be directly applicable to the exposure of EWM workers to coal tar derivative dyes because coal tars are complex and variable combinations of polycyclic aromatic hydrocarbons (PAHs), phenols, heterocyclic oxygen, sulfur, and nitrogen compounds [14]. For example, analyses of PAHs in four coal tar samples revealed 2- to 20-fold differences in concentration of selected PAHs among the samples. Benzo(a)pyrene, the most potent carcinogen of the PAHs, varied from non-detectable to 6.4 %. We were unable to identify any information on the specific composition of the dyes used at EWM other than that they were derived from coal tars.

Coal tar is considered a human carcinogen by the National Toxicology Program (NTP) and EPA [15,16]. There is good evidence from human exposures that coal tar causes skin cancer, especially on the scrotum, through skin contact [15]. There is also good evidence that inhalation of coal tar fumes causes lung cancer. There is also some indication that inhalation of coal tar fumes may cause cancers of the oral cavity, larynx, esophagus, stomach, skin, and bladder, and leukemia.

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[5] Exposure to 1,4-dichlorobenzene in the home is largely through the inappropriate use of mothballs made from this chemical.

Skin exposure to coal tar is linked to dermal irritation, burning, erythema (abnormal redness of the skin), dry peeling skin on the face and neck with irritation, and folliculitis (inflammation of the hair follicles) on the forearms in several worker studies [14,16]. Workers using coal tar exhibited mild to moderate pulmonary restrictive and obstructive deficits, including obstructive lung disease.

In summary, worker exposures, especially those who worked in the fabric finishing operations, likely contributed the greatest to the past risk of health effects from mill operations because workers had the most opportunity for exposure to the chemicals at EWM. However, the risk cannot be specified because not enough information on exposure length, concentration of the chemical exposed to, and, for the coal tar derivative dyes, the specific chemical composition of the dyes exists.

Sediment/Floodplain Soil Exposure Pathway

Sediments in the EBSR downstream from the former EWM site are contaminated with chlorinated benzenes, PAHs, dieldrin, arsenic, cadmium, and chromium [6]. The floodplain soils along EBSR are contaminated with PAHs, dioxins, dieldrin, arsenic, chromium, and lead at a number of places downstream of the site. Tables 3 and 4 show contaminants detected above soil comparison values in sediments and floodplain soil, respectively.

Sediments and floodplain soil constitute a past and present completed exposure pathway, because people who wade or play in or along the river may be exposed to contaminants through incidental ingestion and dermal contact. EPA has excavated heavily contaminated river sediment and underlying soils near the EWM, significantly reducing the potential human exposure to contaminants in river sediments. Exposure to contaminants in sediments downstream of the removal area and in the floodplain soils may continue unless these sediments and soils are also excavated.

Public Health Implications

We used conservative assumptions to calculate exposure doses for swimmers and fishers for the COCs in Tables 3 and 4. For child dose, we assumed that a 10-year old child weighing 36 kg swam 24 days out of the year and accidentally swallowed 100 milligrams of sediment or soil with the maximum contaminant concentration each time. For adults and for evaluating the risk of cancer, we assumed adults weighing 70 kg fished or swam 52 days of year and accidentally swallowed 50 mg of sediment or soil containing the maximum contaminant concentration each time. For evaluating the risk of cancer, we assumed that this exposure would occur for 40 years. We also calculated exposure from dermal absorption by child swimmers and adult swimmers and fishers, and children playing in contaminated mud, using default soil-to skin adherence factors and absorption values. The children playing in mud scenario refers to children who become essentially covered in mud – assumed to happen very infrequently (4 times a year). The calculated doses for each of the contaminants in Tables 3 and 4 were lower than applicable noncancer health guidelines, and the excess cancer risk from carcinogenic contaminants was not elevated. Therefore, no health effects are expected from exposure to contaminants in the sediment/floodplain pathway.

Table 3. Contaminants Detected Above Soil Comparison Values in River Sediment

Chemical	Maximum Concentration (mg/kg* or ppm†)	Comparison Value (mg/kg or ppm)	Source
1,2,3-Trichlorobenzenes	2,000	500	RMEG (for 1,2,4-)
1,2,4-Trichlorobenzenes	8,200	500	RMEG‡
Benzo[a]anthracene	5.6	0.9	EPA SSL§
Benzo[a]pyrene	4.9	0.1	CREG¶
Benzo[b]fluoranthene	4.7	0.9	EPA SSL
Dibenz[a,h]anthracene	1.5	0.09	EPA SSL
Indeno[1,2,3-cd]pyrene	3.8	0.9	EPA SSL
Dieldrin	1	0.04/3	CREG/EMEG**
Arsenic	54	0.5/20	CREG/RMEG
Cadmium	56.3	10	EMEG**
Chromium	414	200	RMEG

*mg/kg = milligrams per kilogram
†ppm = parts per million, equal to milligrams per kilogram
‡RMEG = Reference dose media evaluation guide
§EPA SSL = EPA soil screening levels
¶CREG = Cancer risk evaluation guide
**EMEG = Environmental media evaluation guide
Source: [7]

Table 4. Contaminants Detected Above Soil Comparison Values in Floodplain Soil

Chemical	Maximum Concentration (mg/kg* or ppm†)	Comparison Value (mg/kg or ppm)	Source
Benzo[a]anthracene	4.4	0.9	EPA SSL‡
Benzo[a]pyrene	4.2	0.1	CREG§
Benzo[b]fluoranthene	6.5	0.9	EPA SSL
Dibenz[a,h]anthracene	1.8	0.09	EPA SSL
Indeno[1,2,3-cd]pyrene	5.6	0.9	EPA SSL
Dieldrin	2.3	0.04/3	CREG/EMEG¶
Arsenic	31	0.5/20	CREG/EMEG
Chromium	670	200	RMEG**
Lead	658	400	EPA SSL

*mg/kg = milligrams/kilogram
†ppm = parts per million
‡ EPA SSL = EPA soil screening level
§CREG = Cancer risk evaluation guide
¶EMEG = Environmental media evaluation guide
**RMEG = Reference dose media evaluation guide
Source: [7]

Surface Water Exposure Pathway

While the mill was in operation, process wastewater was discharged to the river from the dye kettles [6]. It can be assumed that these discharges contained chlorinated benzenes from the dye aid and polycyclic aromatic hydrocarbons (PAHs) from the coal-tar derivative dye. In addition, spills of dye and other process chemicals contributed contaminants to the surface water in the river. People who waded or played in the river downstream of the mill, especially when the dye kettles were emptied, were likely to be exposed to contaminants through skin contact, accidental swallowing of contaminated water, or breathing chemicals evaporating from the water. Therefore, the surface water exposure is a completed past exposure pathway.

Surface water samples collected from the EBSR in 1999 showed low but detectable levels of chlorobenzene, dichlorobenzenes, and trichlorobenzenes [6]. None of the concentrations measured were higher than comparison values. Therefore, no health effects are expected from current exposure to surface water.

Public Health Implications

A rough estimate of past contaminant levels in the surface water is given by measurements in 1988 of the mill's wastewater (influent to the Corinna sewage treatment plant) showing 1,2-dichlorobenzene around 5,500 ppb and 1,2,4-trichlorobenzene around 800 ppb.[17] These values are lower than the maximum concentrations detected in the private well pathway. Because exposure through surface water was occasional, no adverse health effects are expected from past exposure to these contaminants.

No information is available to estimate levels of dye or other process chemicals released to the surface water in the past. The coal-tar derivative based dyes are suspected of causing cancer after long-term exposures to high levels. People occasionally exposed to surface water would not have enough cumulative exposure to increase the risk of cancer. Workers exposed to the dye probably were at increased risk for cancer; however the contribution from the surface water pathway would be minimal compared to direct occupational exposures at the mill. Likewise, while we cannot speculate about possible health effects of other process chemicals, the contribution of the surface water pathway to overall past exposures appears minimal.

Fish Exposure Pathway

In 2001, EPA conducted a fish tissue sampling program to identify human health risk from eating fish from the EWM area [2,6]. Perch, small and largemouth bass, brown bullhead catfish, and suckers were collected from Corundel Lake, which is upstream from the former EWM site, several locations in the EBSR downstream between the site and Sebasticook Lake, and from Sebasticook Lake. These fish were analyzed for chlorinated benzenes, PAHs, PCBs, dioxins, pesticides, and metals.

The EPA sampling found that some perch and large mouth bass caught in the EBSR had mercury and dioxin levels that would represent a health concern if an individual ate at least 27 half-pound meals a year of these species [2,6].[6] However, these contaminant concentrations are similar to those measured in background locations, suggesting that this contamination is not site-related.

Multiple Exposure Pathways

It is difficult to quantify cumulative risk or speculate on interactions between chemicals because so little is known about the exact chemicals and amounts used in the process. However, it is important to note that, although the pathways are treated separately in the preceding sections, many people would have been exposed through multiple pathways. For example, an occupationally-exposed worker may have also lived near the mill and fished or waded in the river. As discussed above, occupational exposures and drinking contaminated well water appear to be the major contributors to overall risk. Any exposure through additional pathways would slightly increase that risk.

Past Potential Exposure Pathways

Air

In the past, people who lived or worked near the mill were likely exposed to chlorinated benzenes released from the mill into the air, especially when the mill emptied its dye kettles.

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[6]The number of meals is based on information provided to ATSDR by Ed Hathway, the EPA Eastland Woolen project manger in May 2002.

The extent of these past exposures is not known because air sampling was not conducted routinely in the past (while the mill was operating), and, therefore, data regarding the ambient levels of contaminants do not exist. Therefore, ATSDR cannot evaluate the significance of past exposures to chlorinated benzenes released from the mill to the air.

Exposure to contaminants released into the air from soils/sediments during excavation is also possible. However, EPA is taking measures to minimize such releases and is monitoring the ambient air around the excavation areas to ensure that contaminants levels are not a threat to human health. Therefore, exposure to contaminants during the excavation of soils/sediments should not occur at levels of health concern.

Evaluation of Health Outcome Data

Health outcome data (HOD) may give a more thorough evaluation of the public health implications of a given exposure. HOD may include mortality information (e.g., the number of people dying from a certain disease) or morbidity information (e.g., the number of people in an area getting a certain disease or illness). The review is most effective when (1) a completed human exposure pathway exists, (2) contaminant levels are high enough to result in measurable health effects, (3) enough people are affected for the health effect to be measured, and (4) a database is available to identify disease rates for populations of concern.

Completed exposure pathways existed at the EWM site, and contaminant levels in drinking water, and probably the mill environment, were high enough to result in increased cancer risk. We contacted the Maine Cancer Registry (MCR) about the feasibility of reviewing data in the state cancer registry.[7] The MCR indicated that they can evaluate data down to the zip code level. The zip code for Corinna has about 2,200 people in it, according to the 2000 census. As indicated on Figure 2, there are about 700 people within one mile of EWM, so an evaluation by MCR would include many more people than those who may have been exposed in the past. Based on ATSDR's discussions with EPA during our 1999 site visit, probably less than half of these 700 actually drank contaminated water. Therefore, an evaluation of cancer rates among those potentially exposed to EWM contaminants is not possible because you would be trying to identify possible site-related health effects of about 300 exposed individuals in a population of over 2,000. However, an evaluation of cancer rates in the Corinna zip code would provide useful information on cancer for residents in the Corinna. MCR agreed to perform this evaluation. The results are provided in Appendix C beginning on page 38.

The summary results from the MCR report were:

> *"The investigation reviewed individual types of cancer to determine if there was a higher rate in Corinna than in the state of Maine. Cancer data from 1983 through 1998 was included in the analysis. The results indicate that the cancer rates in Corinna were not statistically significantly higher than the rates in Maine."*

[7] Conversation between John Crellin, ATSDR, and Castine Verrill, Maine Cancer Registry, on December 6, 2002.

Health Hazard

People who drank contaminated water from private wells over several years have an increased risk of cancer. In addition, past exposures of former workers to dyes and other chemicals used in the textile manufacturing process could have increased their risk of cancer, although we do not know enough about the past exposures to give a quantitative estimate of risk. Because past exposures were high enough to increase the risk of adverse health effects, ATSDR classifies the site as a *past public health hazard*.

On the basis of the available data, no appreciable ongoing exposures are occurring because residents were provided uncontaminated drinking water and EPA removed easily-accessed contaminated soil and sediment near the former mill complex. In addition, current exposure to contaminants in areas that have not been cleaned yet are too small to result in adverse health effects. Therefore, ATSDR classifies the site as a *current no apparent public health hazard*.

ATSDR Children's Health Concerns

ATSDR recognizes that infants and children may be more vulnerable to environmental exposure than adults in communities faced with contamination of their water, soil, air, or food. This vulnerability is a result of the following factors: (1) children are more likely to be exposed to certain media (e.g., surface soil) because they play outdoors and have more hand-to-mouth behaviors; (2) children are more likely to come into contact with dust, soil, and vapors close to the ground; and (3) children tend to receive higher doses of chemical exposure due to their lower body weight. Children can sustain permanent damage if toxic exposures occur as a result of these factors during critical growth stages. ATSDR is committed to evaluating the special interests of children at the EWM site.

We considered risk to children in evaluating past exposures at the EWM site. Anecdotal reports indicated that children were occasionally present in the mill or on the mill property while the mill was operating in the 1950s and 1960s. However, these visits were infrequent and visiting children were most likely not directly exposed to process chemicals. Thus, their exposure at EWM was not likely to be as great as that of the adult workers. Children at the EWM (past or present) are not more likely than adults to either be exposed to contaminants or to develop health effects.

Community Health Concerns

On November 16, 1999, ATSDR staff participated in two meetings with the public in the American Legion Hall in Corinna regarding the EWM NPL site. ATSDR staff conducted a public availability session to allow area residents to discuss their health concerns about the EWM site. In the evening, ATSDR, EPA, MEDEP, and the Town of Corinna conducted a public meeting to provide an update on the site and for ATSDR to discuss the EWM PHA and the community's health concerns.

The public health concerns expressed by area residents at these meetings follow:

1. Concern that Corinna has excessive rates of cancer, especially brain, bone, and lung cancer.

Response

Some of the COCs ATSDR identified in this PHA are known to cause cancer. However, they are associated with blood, liver, and kidney cancers, and are not known to be linked to brain, bone, or lung cancer. We did not have information on all the chemicals used in the process and therefore cannot comment on their associated cancer risks. As discussed in the Health Outcome Data section, the Maine Cancer Registry did review cancer registry data for the Corinna zip code at the request of ATSDR. The results of that review, presented in Appendix C, indicated that Corinna does not have higher rates of cancer compared to the state of Maine as a whole.

2. Concern that residential wells are contaminated.

Response

Some of the residential wells in Corinna have been tested by EPA; the owners of wells found to be contaminated have been notified and provided with a clean water source. EPA installed groundwater monitoring wells and used the data from these wells in conjunction with the data from wells known to be contaminated to determine the extent of groundwater contamination. Groundwater usage restrictions and mechanisms to manage usage are being developed.

Conclusions

1. ATSDR did not identify any ongoing exposure which would result in health effects. Residents with contaminated wells have been provided clean water, and highly contaminated soil and sediment in the areas most likely to be accessed often have been removed. Therefore, ATSDR classifies the former EWM site as a **current no apparent public health hazard**.

2. ATSDR considers the cleanup plan documented in the record of decision (ROD) for OU1 to be protective of public health. Assuming the ROD for OU2 is also protective, and that remedial alternatives are implemented successfully, health risks from potential future exposures will be minimal.

3. People who drank contaminated water from private wells over several years had an increased risk of cancer. In addition, past exposures of former workers to process chemicals could have increased their risk of cancer, although we do not know enough about the past exposures to give an accurate estimate of risk. Because past exposures were high enough to increase the risk of adverse health effects, ATSDR classifies the site as a **past public health hazard**.

4. The analysis of cancer performed by the Maine Cancer Registry for 1983 – 1998 in the Corinna area indicated that cancer rates were no different than for the rest of Maine.. However, the available cancer data are not detailed enough to draw specific conclusions

about cancer rates in the relatively small number of people who were exposed, including EWM workers and residents near EWM.

5. For the current situation, contaminant concentrations in the sediment/floodplain soil and Old Dump site soil pathways are below levels of health concern. However, the lead levels would represent a health concern for children if homes were built at this location without any remediation. EPA considers future residential development of the Old Dump site unlikely.

6. Elevated mercury and dioxin concentrations in fish are not site-related, but may be a health concern for those consuming more than 27 meals a year of perch or large mouth bass from the EBSR.

7. Not enough information exists to evaluate the effects of airborne releases of EWM chemicals to the surrounding area, a past potential exposure pathway.

Recommendations

1. ATSDR recommends that EPA and/or MEDEP continue to monitor groundwater and provide clean water to residents whose wells are contaminated.

2. In the unlikely event that the Old Dump site is developed for residential use, ATSDR recommends that EPA, MEDEP, or the developer of the site fully characterize the soil lead levels in the area being developed and clean up to a concentration acceptable to EPA.

3. ATSDR recommends that state and local officials increase vigilance to ensure that people follow applicable state fish advisories for contaminants that are not site-related.

Public Health Action Plan

The Public Health Action Plan (PHAP) for the EWM site contains a description of actions that have been or will be taken by ATSDR and other government agencies at the site. The purpose of the PHAP is to ensure that this PHA not only identifies public health hazards associated with the site, but also provides a plan of action to prevent or minimize the potential for adverse human health effects from exposure to site-related hazardous substances.

Actions Completed

1. EPA conducted a number of actions at the site, including insuring that everyone near EWM had safe drinking water, and removal and/or remediation of soils and sediments, which reduced the opportunity for exposure.

2. The MCR reviewed cancer data for smallest area they are able to evaluate--the Corinna zip code.

Actions Ongoing and Planned

1. Actions by EPA to remove and/or remediate soils and sediments downstream from the site and to treat the groundwater at the site are ongoing and planned.

ATSDR will reevaluate and expand the PHAP as needed. New environmental, toxicological, or health outcome data may determine the need for additional actions at this site.

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[9] Perstephanie Thompson was the community involvement specialist originally assigned to this site and participated in the 1999 site visit.

[10] Susanne Simon was the regional representative originally assigned to this site and participated in the 1999 site visit. She is no longer with ATSDR.

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Appendix A - Evaluation Process

Explanation of Evaluation Process

Screening Process

In evaluating these data, ATSDR used comparison values (CVs) to determine which chemicals to examine more closely. CVs are the contaminant concentrations found in a specific media (soil or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of water and soil that someone may inhale or ingest each day.

CVs are set at a concentration below which no known or anticipated adverse human health effects are expected to occur. Different CVs are developed for cancer and noncancer health effects. Noncancer levels are based on valid toxicological studies for a chemical, with appropriate safety factors included, and the assumption that small children (22 pounds) and adults are exposed every day. Cancer levels are the media concentrations at which there could be a one in a million excess cancer risk for an adult eating contaminated soil or drinking contaminated water every day for 70 years. For chemicals for which both cancer and noncancer numbers exist, the lower level is used to be protective. Exceeding a CV does not mean that health effects will occur, just that more evaluation is needed.

CVs used in this document are listed below:

> *Environmental Media Evaluation Guides (EMEGs)* are estimated contaminant concentrations in a media where non-carcinogenic health effects are unlikely. The EMEG is derived from the Agency for Toxic Substances and Disease Registry's (ATSDR) minimal risk level (MRL).
>
> *Reference dose Media Evaluation Guides (RMEGs)* are estimated contaminant concentrations in a media where non-carcinogenic health effects are unlikely. The RMEG is derived from the Environmental Protection Agency's (EPA's) reference dose (RfD).
>
> *Cancer Risk Evaluation Guides (CREGs)* are estimated contaminant concentrations that would be expected to cause no more than one additional excess cancer in one million persons exposed over a lifetime. CREGs are calculated from EPA's cancer slope factors (CSFs).
>
> *EPA Soil Screening Levels (SSLs)* are estimated contaminant concentrations in soil at which additional evaluation is needed to determine if action is required to eliminate or reduce exposure.

Evaluation of Public Health Implications

The next step is to take those contaminants that are above the CVs and further identify which chemicals and exposure situations are likely to be a health hazard.

Estimation of Exposure Dose

Child and adult exposure doses are calculated assuming a worst-case scenario where exposure occurs every day. The exposure dose is the amount of a contaminant that gets into a person's body.

The ATSDR exposure dose formula is:

$$ed = c * ir * ef * af / bw$$, where

ed = exposure dose; *c* = concentration in media of interest; *ir* = ingestion rate; *ef* = exposure factor; *af* = absorption factor; *bw* = body weight

Noncancer Health Effects

The calculated exposure doses are then compared to an appropriate health guideline for that chemical. Health guideline values are considered safe doses; that is, health effects are unlikely below this level. The health guideline value is based on valid toxicological studies for a chemical, with appropriate safety factors built in to account for human variation, animal-to-human differences, and/or the use of the lowest adverse effect level. For noncancer health effects, the following health guideline values are used.

Minimal Risk Level (MRLs) - developed by ATSDR
An estimate of daily human exposure – by a specified route and length of time – to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects. An MRL should not be used as a predictor of adverse health effects. A list of MRLs can be found at http://www.atsdr.cdc.gov/mrls.html. The MRL for a chemical is described in detail in the ATSDR Toxicological Profile for that chemical

Reference Dose (RfD) - developed by EPA
An estimate, with safety factors built in, of the daily, life-time exposure of human populations to a possible hazard that is not likely to cause noncancerous health effects. The RfDs can be found in the Integrated Risk Information System (IRIS) at http://www.epa.gov/iris/.

Provisional Reference Dose (RfD) - developed by EPA's National Center for Environmental Assessment (NCEA)
Provisional RfDs are established to identify clean-up levels at NPL sites for chemicals for which the toxicological data do not meet the standards used for RfDs and MRLs. Therefore, there is more uncertainty in the number identified. Provisional RfDs can be found at http://www.epa.gov/Region9/waste/sfund/prg/index.htm or http://www.epa.gov/reg3hwmd/risk/index.htm.

If the worst-case exposure dose for a chemical is less than the health guideline value, then the exposure is unlikely to cause a non-carcinogenic health affect in any situation. If exposure dose for the worst-case exposure scenario is greater than the health guideline, child and adult exposure doses are re-calculated using site-specific estimates of who goes on the site and how often they contact the site contaminants. If the site-specific exposure dose for a chemical is less than the health guideline value, then the exposure is unlikely to cause a non-carcinogenic health affect in that specific situation.

When the health guideline is exceeded, the site-specific exposure dose is compared to known toxicological values for that chemical starting with the no observed and lowest observed adverse effect levels (NOAEL and LOAEL) used to derive the MRL or RfD. These toxicological values are doses derived from human and animal studies which are summarized in the ATSDR Toxicological Profile for that chemical or in EPA's IRIS.

The first step in this comparison to toxicological values is the calculation of a "margin of effect" or MOE by dividing the LOAEL and/or NOAEL by the site-specific exposure dose. In general, when the MOE is greater than 1,000, harmful effects are not expected. When the MOE ranges from approximately 100 – 1000, harmful effects are unlikely but further toxicological evaluation is done to confirm this. If the MOE is between 10 to 100, harmful effects are more likely, but further toxicological evaluation is needed. When the MOE is 10 or less, it is usually concluded that health effects are likely.

Interpretation of the MOE, however, is somewhat subjective and dependent on a host of toxicological factors. Further evaluation consists of a careful comparison of the site-specific exposure doses and circumstances to the epidemiological and experimental data on the chemical. The underlying premise in this comparison is how well the available data might predict human health effects in the past or on-going exposure scenarios.

Calculation of Risk of Carcinogenic Effects

The estimated risk of developing cancer from exposure to the contaminants was calculated by multiplying the site-specific adult exposure dose by EPA's corresponding Cancer Slope Factor (which can be found at http://www.epa.gov/iris/). The results estimate the maximum increase in risk of developing cancer after 70 years of exposure to the contaminant.

The actual risk of cancer is probably lower than the calculated number. The method used to calculate EPA's Cancer Slope Factor assumes that high-dose animal data can be used to estimate the risk for low dose exposures in humans. The method also assumes that there is no safe level for exposure. Little experimental evidence exists to confirm or refute those two assumptions. Lastly, the method computes the 95% upper bound for the risk, rather than the average risk, suggesting that the cancer risk is actually lower, perhaps by several orders of magnitude [18].

ATSDR considers a maximum additional lifetime cancer risk of greater than 1 in 10,000 (1×10^{-4}) to potentially be a public health problem and thus further evaluation is needed [19]. Cancer risks less than 1 in 10,000 are not usually considered a health concern.

ATSDR employs a weight-of-evidence approach in further evaluating carcinogenic risk [19]. The numerical risk estimate is considered in the context of the variables and assumptions involved in their derivation and in the broader context of biomedical opinion, host factors, and actual exposure conditions.

Decision Points

Besides the results of the toxicological evaluation, identifying a specific exposure scenario as a health hazard includes consideration of whether the exposure is ongoing and needs to be stopped or avoided. When those conditions are met, ATSDR takes a conservative (health-protective) approach where the decision point is near the health guideline. Factors such as background chemical levels and the uncertainty factor used in deriving the health guideline may play a mitigating role in this decision. The decision point will always be greater than the natural background level for an area. The larger the uncertainty factor the greater flexibility there is in the decision point.

When the exposure scenario being evaluated occurred in the past, the question being answered now becomes whether those exposed likely did or will become sick. In this situation, the decision point tends to be closer to the lowest observed adverse health effects rather than the health guideline.

Appendix B- Exposure Pathways for the EWM Site

Table B1. Completed Exposure Pathways for the Eastland Woolen Mill (EWM) Site - Source: Former Eastland Woolen Mill

Pathway Name	Media	Point of Exposure	Route of Exposure	Exposed Population	Exposure Period	Contaminants of Concern	Notes
Private Well	Groundwater	Residences & businesses in Corinna	Ingestion, inhalation, skin contact	Residents, employees, & customers	Past	Chlorinated benzenes, benzene	Everyone in contaminant plume uses municipal water system for drinking water.
Soil	Soil	Former EWM site, old dump	Ingestion, inhalation, skin contact	Former EWM workers, trespassers, hunters and all terrain vehicle riders at old dump	EWM Site: Past; Old dump: Past, Present, Future	Chlorinated benzenes , other volatile organic compounds (VOCs) pesticides, heavy metals	Contaminated surface soils have been removed or covered at EWM site.
Past Mill Work	Indoor Air, direct contact with chemicals	Textile finishing process areas (vats, basement of old building)	Ingestion, inhalation, skin contact	Workers	Past	Chlorinated benzenes, coal-tar derivative dyes, other process chemicals	Little information exists about exact chemicals used.
Sediment/ Floodplain Soil	Sediment in riverbed and floodplain	Along or in EBSR	Ingestion, inhalation, skin contact	Fishers & others who contact sediment	Past, Present, Future	Chlorinated benzenes, polyaromatic hydrocarbons , dieldrin, and several metals	
Surface Water	River water	In the EBSR	Ingestion	Anglers and others with contact with the water	Past	Chlorinated benzenes and other VOCs	
Fish	Fish	Places where fish are eaten	Ingestion	Persons who eat fish from the EBSR	Past, Present, Future	Mercury & dioxins	Contaminant levels above comparison values but not site-related
Air	Ambient Air	Areas in, close to and downwind of the mill	Inhalation	Workers, nearby residents and business employees	Past	Chlorinated benzenes and other VOCs	Exposures to VOCs probable for those working in or living near the mill when the mill was in operation; no data are available on this pathway

Appendix C- Evaluation of Cancer Rates in Corinna Area

Evaluation of Cancer Incidence in Corinna, Maine[11]

Summary of Findings

The Agency for Toxic Substances and Disease Registry (ATSDR) requested that the Maine Bureau of Health's Cancer Registry investigate the cancer incidence rate in Corinna, Maine. The town of Corinna was the site of the former Eastland Woolen Mill.

The investigation reviewed individual types of cancer to determine if there was a higher rate in Corinna than in the state of Maine. Cancer data from 1983 through 1998 was included in the analysis. The results indicate that the cancer rates in Corinna were not statistically significantly higher than the rates in Maine.

Methodology

The Bureau of Health's Maine Cancer Registry provided the cancer incidence rates in the town of Corinna from 1983 through 1998. The Bureau of Health's Office of Data, Research, and Vital Statistics provided 1983-1998 population figures for this town.

Several cancer sites were evaluated to determine if there were statistically more observed cases in Corinna than expected. The expected number of cases in Corinna was estimated using the standardized morbidity ratio. The 1983-1998, age- and site-specific rates in Maine were multiplied by the population of Corinna during the same time period.

Statistical Analysis

For cancer sites with more than 15 cases occurring in Corinna from 1983 to 1998, the age-adjusted incidence rate was computed and compared to the Maine rate. Statistical significance was determined by whether or not the 95% confidence interval for Corinna included the Maine age-adjusted rate. If the Corinna confidence interval did include the Maine rate, the number of cases in Corinna would not be statistically different from Maine. If the confidence interval did not include the Maine rate, then the cancer rate in Corinna would be statistically significantly lower or higher than the Maine rate.

[11] This evaluation was provided to ATSDR by its author, Castine Verrill of the Maine Cancer Registry. Ms. Verrill can be contacted at 207-287-5190. Her address is: Maine Cancer Registry; 11 State House Station; Key Bank Plaza, 4th Floor; Augusta, ME 04333.

For cancer sites with 15 or fewer cases in Corinna from 1983 to 1998, the statistical significance was determined by comparing the observed cases in Corinna with the expected cases in Corinna under the Poisson distribution. The Poisson distribution is an appropriate test of significance when the disease occurrence is rare (a small number of cases relative to the size of the population). A conservative p-value ($p \leq 0.001$) was used based on the Maine Cancer Registry's Cancer Inquiry Protocol, the nature of the Poisson analysis, and because multiple comparisons were done on the data. The formula for calculating the p-value under the Poisson distribution is as follows:

$$p = \frac{e^{-\lambda} \lambda^n}{n!}$$

where p = probability of outcome (must be $\leq .001$)
e = constant ≈ 2.718
λ = expected number of cases (based on the standardized morbidity ratio)
n = actual number of cases reported

Results

The age-adjusted incidence rates and 95% confidence intervals (p-value = 0.05) were calculated for cancer sites with more than 15 cases (Table 1). Because the confidence intervals in Corinna include the Maine rates for each cancer site, the analysis indicates that none of the rates are statistically higher or lower in Corinna than in Maine.

The confidence intervals are wide in Corinna due to a small number of observed cases (Table 2). Calculating 99.9% confidence interval to match the p-value of 0.001 in the Poisson analysis would cause the confidence interval for Corinna to become even wider and more likely to include the Maine age-adjusted rate.

For cancers with 15 or fewer cases during the1983-1998 time period, the Poisson method was used to determine if the observed number of cases in Corinna was higher than expected (Table 3). For these cancer sites, none of the statistical tests resulted in a p-value less than or equal to 0.001, indicating that there were not statistically significantly more or less observed cases in Corinna than expected. Table 3 shows the difference between the observed (X) and expected (Y) cases in Corinna and the probability of observing X or more cases in Corinna when the expected number of cases is Y.

Discussion

The age-adjusted overall cancer incidence rate in Maine from 1983 to1998 was 365.6 per 100,000. Corinna had an overall cancer incidence rate of 365.7, which was not significantly different from the Maine rate. None of the common cancer sites (lung, female breast, prostate, and colorectal) were significantly higher in Corinna than in Maine. Corinna had a slightly higher rate of lung and bronchus cancer, 65.6 per 100,000, than the state, 61.3 per 100,000, but this difference was not statistically significant. The age-adjusted rates of prostate, colorectal, and female breast cancer in Corinna were lower than the rates in Maine, although the differences were not statistically significant. Analysis of the less common cancer sites did not reveal any statistically significant excess in the number of observed versus expected cases in Corinna for this time period.

Table 1: Age-Adjusted Cancer Incidence Rates for the Most Common Cancer Sites, 1983-1998

Cancer Site	Geographic Location	Age-Adjusted Rate	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Colon & Rectum	Maine	49.9	49.0	50.9
	Corinna	45.5	27.9	72.7
Lung & Bronchus	Maine	61.3	60.3	62.4
	Corinna	65.6	43.4	97.8
Female Breast	Maine	99.4	97.6	101.2
	Corinna	86.6	50.4	144.3
Prostate	Maine	98.6	96.7	100.5
	Corinna	95.7	57.0	156.5
All Cancers	Maine	365.6	363.1	368.1
	Corinna	365.7	310.1	430.8

Note: Rates are per 100,000 and age-adjusted to the 1970 U.S. Standard

Table 2: Common Cancer Case Count in Corinna, 1983-1998

Cancer Site	Count
Lung & Bronchus	28
Prostate	19
Colon & Rectum	21
Breast (Female)	18
All Cancers	158

Table 3: Cancer Site Analysis for Corinna vs. Maine, 1983-1998		
Cancer Site	Observed - Expected (X - Y)	Poisson p-value
Oral Cavity & Pharynx	4.7	0.02
Non-Hodgkin's Lymphoma	3.5	0.05
Brain & CNS	2.5	0.07
Esophagus	2.3	0.06
Melanoma	1.6	0.13
Multiple Myeloma	1.4	0.14
Testis	1.2	0.14
Larynx	0.9	0.19
Bones & Connective Tissue	0.8	0.22
Ureter	0.7	0.22
Thyroid	0.7	0.23
Anus	0.6	0.27
Gallbladder	0.6	0.27
Vulva	0.5	0.30
Stomach	0.3	0.22
Liver	0.3	0.35
Cervix	0.1	0.26
Pancreas	-0.3	0.22
Ovary	-1.0	0.22
Kidney & Renal Pelvis	-1.0	0.20
Uterine	-1.6	0.16
Leukemia	-2.5	0.11
Urinary Bladder	-5.7	0.02

Appendix D - ATSDR Plain Language Glossary

ATSDR Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

General Terms

Absorption
The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with chronic].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems

Aerobic
Requiring oxygen [compare with anaerobic].

Ambient
Surrounding (for example, ambient air).

Anaerobic
Requiring the absence of oxygen [compare with aerobic].

Analyte
A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study
A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect
A biologic response to exposure to multiple substances that is less than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation
Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study
A study that uses (a) biomedical testing or (b) the measurement of a substance [an analyte], its metabolite, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see exposure investigation].

Biologic monitoring
Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing
Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden
The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP [see Community Assistance Panel.]

Cancer
Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number
A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic
Occurring over a long time [compare with acute].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)
A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect
A disease or an injury that happens as a result of exposures that might have occurred in the past.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see route of exposure].

Descriptive epidemiology
The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention
Measures used to prevent a disease or reduce its severity.

Disease registry
A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD
United States Department of Defense.

DOE
United States Department of Energy.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship
The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can

occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA
United States Environmental Protection Agency.

Epidemiologic surveillance [see Public health surveillance].

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction
A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Exposure registry
A system of ongoing follow-up of people who have had documented environmental exposures.

Feasibility study
A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)
A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds
Training sessions for physicians and other health care providers about health topics.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Half-life ($t^{1/2}$)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat)
The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Health promotion
The process of enabling people to increase control over, and to improve, their health.

Health statistics review
The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

In vitro
In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with in vivo].

In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of metabolism.

mg/kg
Milligram per kilogram.

mg/cm2
Milligram per square centimeter (of a surface).

mg/m3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality
Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

Mutagen
A substance that causes mutations (genetic damage).

Mutation
A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP)
Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement
The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Public meeting
A public forum with community members for communication about a site.

Radioisotope
An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide
Any radioactive isotope (form) of any element.

RCRA [see Resource Conservation and Recovery Act (1976, 1984)]

Receptor population
People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD [see reference dose]

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor [see uncertainty factor]

SARA [see Superfund Amendments and Reauthorization Act]

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or an environment.

Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance
A chemical.

Substance-specific applied research
A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's toxicological profiles. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance [see public health surveillance]

Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:
Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)

National Center for Environmental Health (CDC)
(http://www.cdc.gov/nceh/dls/report/glossary.htm)

National Library of Medicine (NIH)
(http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

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