Health Assessment for

RINGWOOD MINES/LANDFILL NATIONAL PRIORITIES LIST (NPL) SITE

RINGWOOD, PASSAIC COUNTY, NEW JERSEY

Agency for Toxic Substances and Disease Registry
U.S. Public Health Service

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SUMMARY

The Ringwood Mines/Landfill located in Ringwood, Passaic County, New Jersey is on the National Priorities List. Magnetite mines were operated on the site as early as the 1700s and disposal of wastes at the site has occurred since the 1960s. Municipal refuse and industrial wastes were deposited in an on-site landfill. The primary contaminants found at this site are arsenic, cadmium, lead and methylene chloride. Off-site migration of contaminants can occur via ground water, surface water, and suspended sediments. Based upon the information reviewed, the Agency for Toxic Substances and Disease Registry (ATSDR) has concluded that this site poses a potential public health concern because of the risk to human health that could result from possible exposure to hazardous substances at levels that may result in long terms adverse health effects. As noted in the Human Exposure Pathways Section, human exposure to lead may occur primarily via incidental ingestion and inhalation of contaminated soils. If on-site ground water is used for domestic purposes, ingestion of contaminated ground water is also possible.

BACKGROUND

A. SITE DESCRIPTION

The Ringwood Mines/Landfill site (Ringwood) is on the National Priorities List (NPL). The site is just north of the borough of Ringwood, Passaic County, New Jersey, and about 28 miles northwest of Newark. Ringwood is located within a 500-acre tract of land; the exact size of the site is undetermined. The site consists of forested areas, areas overgrown with vegetation, abandoned mine shafts and surface pits, an inactive landfill, an industrial refuse disposal area, small dumps, a municipal recycling area, a garage, and about 50 homes. Ringwood is bordered on the west by Sterling Forest, a National Historic Landmark; on the north and the east by Ringwood Manor State Forest; and on the south by the Wanaque River watershed and the Borough of Ringwood. Surface drainage at the site is generally toward the east and southeast via several small brooks. The Peters Mine area (one of the on-site mines) is drained by an unnamed brook that flows east to Furnace Dam Pond then to Ringwood Creek and to Wanaque Reservoir. Wanaque Reservoir provides potable water to about 650,000 persons. The water intake is located about 8 miles downstream from the site. An intermittent stream, Peters Mine Brook, originates about 400 feet south of the Peter's Mine area. The southern portion of the site is drained by Mine Brook, which flows east-southeast past the municipal landfill.

The site is an inactive magnetite mine which was worked from the mid-1700s to the early 1900s. Sometime before 1940, the land was purchased by the U.S. Government. No mining took place during Government ownership. In 1956, the property was sold to the Pittsburgh Pacific Company (PPC). The use of the property was not well documented during PPC's ownership. In 1965, the Ringwood Realty Corporation, a wholly owned subsidiary of the Ford Motor Corporation (Ford), bought the mine and in 1967, began depositing waste products from the Ford factory, including car parts, solvents, and paint sludges at the site. In 1970, part of the land (about 290 acres) was donated to the Ringwood Solid Waste Management Authority (RSWMA) and in 1972, development of a municipal refuse area was permitted on the RSWMA property. The landfill was closed in 1976, however, when leachate from the landfill was found to be contaminating surface water. A portion of the remaining 150 acres was used by Ford for disposal of industrial wastes and was known as the O'Connor Disposal Area. In 1973, the remaining 150 acres were donated to Housing Operation with Training Opportunity (HOWTO) Inc. By 1974, Ford apparently no longer used this land as a disposal area.

The potential sources of contamination on-site include the Cannon Mine Group and Peters Mine Shaft, the municipal landfill, the O'Connor Disposal Area, and the paint sludge disposal areas.

A Remedial Investigation (RI) for this site was conducted in three phases. Phase I was devoted to gathering background information. In Phase II, actual sampling and analyses of the environmental media took place. Following Phase II, a supplementary round of surface water sampling was conducted at the request of the United States Environmental Protection Agency (EPA). Phase III of the RI was also undertaken at the request of EPA to gather more data about the site. The final Phase III report was issued in September 1986. A Record of Decision (ROD) was issued for this site on September 29, 1988. Remedial actions identified in the ROD include the following.

1. Removal of any soil contaminated with lead or total petroleum hydrocarbons at concentrations that exceed the New Jersey Cleanup Objectives for Soil.

2. Establishment of a long-term monitoring program that includes a) sampling and analysis of potable wells in the vicinity of the site; b) performance of geophysical surveys to determine ground water flow and optimum placement of monitoring wells; c) performance of soil and rock geochemical surveys to determine background concentrations of metals; and d) sampling and analyses of new and existing ground water monitoring wells, surface waters, and wetlands exiting the site.

The removal and off-site disposal of 7000 cubic yards of paint sludges containing arsenic and lead was completed in February 1988. Two feet of clean soil were placed over the most contaminated on-site soil areas.

B. SITE VISIT

ATSDR did not perform a site visit. After discussing the site with the EPA project manager and the ATSDR regional representative, the preparers of this report concluded that a site visit would not presently facilitate assessment of health concerns at this site.

ENVIRONMENTAL CONTAMINATION AND PHYSICAL HAZARDS

A. ON-SITE CONTAMINATION

The site was divided into four study areas for the RI. All these areas are considered on-site for this Health Assessment (HA). The monitoring data used in this HA were collected during Phase II Investigations (May - October 1984), the Second Round of Surface Water Quality Sampling (April 1985), and Phase III Investigations (March - July 1986). Soil samples were analyzed for the heavy metals specified in EPA's Primary Drinking Water Standards (Metals) and also for volatile organic compounds (VOCs) when an Organic Vapor Analyzer (OVA) used for screening samples in the field showed more than 5 ppm VOCs. Ground water samples were analyzed for Metals and VOCs. Surface water samples were analyzed for EPA's Primary and Secondary Drinking Water parameters and a few other miscellaneous parameters. Table I lists the contaminants of concern and the media in which they appear.

B. OFF-SITE CONTAMINATION

The only off-site sampling performed was for surface water and sediments. No contaminants were detected in off-site samples at levels of concern to public health.

C. PHYSICAL HAZARDS

The physical hazards associated with this site are abandoned, open mining shafts and pits in which water may collect. These could pose a risk for drowning or injuries from falling.

DEMOGRAPHICS OF POPULATION NEAR SITE

The area around the site is primarily residential with about 50 residences located on or adjacent to disposal areas. Approximately 20 water supply wells are completed in the bedrock aquifer which supplies a few residences and industries in the area.

TABLE I: ON-SITE CONTAMINATION*

CONTAMINANTS	SOIL	GROUND WATER	SURFACE WATER	SEDIMENT
	(ug/kg)	(ug/l)	(ug/l)	(ug/kg)
		(Range detected)		
Cadmium	ND	20	ND	820-3400
Lead	1300	50-760	ND	2800-19000
Methylene Chloride	ND	13-17	86	ND

* When only one number appears, the contaminant was detected only once at the indicated concentration.

ND=Not Detected or Sample Unusable
ug/kg=micrograms per kilogram
ug/l=micrograms per liter

Approximately 13,000 persons reside in the Borough of Ringwood. Most residents in the area are served by a municipal water supply system using a surficial spring located about 1/2 mile southeast of the southern portion of the on-site sludge disposal area.

EVALUATION

A. SITE CHARACTERIZATION (DATA NEEDS AND EVALUATION)

1. Environmental Media

No air sampling, other than OVA screening, was performed during the RI. Air sampling was not considered appropriate because VOCs were found only at low levels on-site and none at high levels in the soil. In addition, contaminated fugitive dust would probably not be a public health concern since only low levels of metals were found in surface soil. Samples were taken from 21 monitoring wells. Water levels were measured for ground water flow determinations three times during the RI. Because of the faulted and fractured nature of the geology that underlies the site and its vicinity, however, further investigation is needed to accurately determine the direction of ground water flow. Three rounds of sediment and surface water sampling were performed at 12 locations of streams on and near the site. Twenty-three test pits were excavated during the RI. Because an OVA was used for screening to determine whether further analyses of test pit samples were needed, some non-volatile and low levels of volatile contamination may have been overlooked.

2. Demographics and Land Use

Although information on the number of houses near the site was included, very little information about the population near the site was provided to ATSDR. The extent to which hunting, fishing, gathering of consumable wild plants, farming, or raising of livestock take place on or near the site is not clear. Precise information on the age, sex distribution, socioeconomic status, and ethnic background of the local residential population would have been helpful in determining potentially exposed populations.

3. Quality Assurance and Quality Control (QA/QC)

The QA/QC reports were included in the Phase II and III reports. The general quality of the data appears acceptable. Spike recoveries were mostly within QA/QC acceptance limits with only a few exceptions. In addition, low levels of some compounds were detected in some blank samples. Results not within QA/QC acceptance limits were flagged as unusable and were not used in preparing this HA. Conclusions presented in this HA are based on the data contained in the RI reports, and the validity of these conclusions is, therefore, dependent on the accuracy and reliability of the data provided.

B. ENVIRONMENTAL PATHWAYS

Monitoring and analyses performed during the RI revealed contamination in surface water, sediments, soils, and ground water. The highest concentrations of contaminants were found on-site in surface water sediments. Contamination was also present on site in the surface waters. Cadmium and lead concentrations in the sediments were substantially higher than background levels. The presence of contaminants in the sediments and surface water may facilitate off-site transport of these contaminants.

Test pit excavation and analyses revealed lead contamination of primarily the subsurface soils. A few organic compounds were detected in these samples. The presence of these compounds in soil can serve as a reservoir for future ground water contamination. The 2 feet of clean soil used to cover areas of high contamination on-site should serve to limit the potential for off-site transport if the cover is properly maintained.

The upper group of geological deposits at the site consists of sandy-to-stony soil found as deep as 50 feet. The bedrock underlying these deposits contains significant ore bodies and is exposed over 15 to 50 percent of the site. The bedrock is fractured and at least two faults are present in the area. Whether these faults may serve as conduits for ground water flow toward Wanaque Reservoir is not known. The density of the fractures appears to decrease with depth. The upper of the two aquifers underlying the site is located in the overburden and upper bedrock, the lower aquifer is in the deep bedrock. Interconnection between the aquifers exists at most places but vertical permeability between aquifers appears to be low. Although in general, ground water in the vicinity of the site flows with the contours of the land, the faulted and fractured nature of the geology may cause significant deviations in ground water flow. This could result in movement of contaminants into areas not expected to be impacted. To date, the specific ground water pathway for the site has not been investigated sufficiently to make reliable predictions of contaminant transport. Elevated levels of metals and organic compounds were detected in the monitoring wells on-site. The potential for movement of these contaminants increases greatly once they are in the ground water. Some ground water appears to be discharging to surface water on-site; this may facilitate the movement of contaminants off site. The surface water on-site eventually flows to Wanaque Reservoir.

No monitoring was conducted during the RI for air contamination (other than OVA screening) or for possible contamination of consumable biota (plants and animals) in the vicinity of the site. Air is unlikely to be an environmental pathway because of the non-volatile nature and location (subsurface) of the contaminants. Biota may be a potential environmental pathway if contaminated ground water is used for watering gardens.

C. HUMAN EXPOSURE PATHWAYS

The contamination of environmental media identified above results in the following potential human exposure pathways.

1. Ingestion and dermal absorption of contaminated soils. Because access is not restricted and on-site soils showed contamination, this pathway could be important to anyone living or working on or near the site. Although incidental ingestion or dermal absorption of contaminants is possible for anyone coming in contact with the contaminated soils, the potential for this exposure has been lessened by removing paint sludges and adding 2 feet of clean soil cover on the most contaminated soil areas.

2. Ingestion, inhalation, and dermal absorption of contaminated ground water. The overburden aquifer and the bedrock aquifer at the site have both shown contamination. The RI does not indicate the locations of wells in the area used to supply potable water. If any contaminated wells are being used to supply drinking water, contact with the contaminants could occur through drinking, bathing, showering, and other household uses of the contaminated water.

3. Ingestion and dermal absorption of contaminated surface water and sediments. Incidental ingestion or dermal absorption of contaminants is possible for anyone allowed to come into contact with the contaminated sediments. Because sediments are contaminated and ground water, which is also contaminated, appears to discharge to surface water, surface water flow may transport contamination so that these pathways may be of concern both on-site and off-site.

Air and biota were not analyzed for chemical contamination. Because, as stated in the previous section, no environmental pathway exist associated with air, no potential human exposure pathways are expected by this route. ATSDR did not review information about the use of contaminated ground water for watering of private gardens; and therefore, ingestion of contaminated biota is considered a potential human exposure pathway.

PUBLIC HEALTH IMPLICATIONS

The public health implications, resulting from potential human exposure to contaminants at the Ringwood Mines NPL site, are discussed below according to potential human exposure pathways and the contaminants of concern for each of those pathways.

1. Ingestion and Inhalation of Contaminated Soils and Dusts

Since access to the site is not restricted, oral and inhalation exposure to contaminated soils are the primary exposure pathways of concern to human health. Lead is the primary contaminant of concern at the Ringwood Mine site and was detected in on-site soils at a maximum level of 1,300 mg/kg. This is greater than the maximum level typically found in soils. It is also greater than the Centers for Disease Control (CDC) and ATSDR Advisory Level of 500 - 1,000 mg/kg, indicative of a potential for increased blood lead levels in children as a result of ingestion and inhalation of contaminated soils and soil dusts (U.S. Department of Health and Human Services, 1988). Because lead is absorbed via the gastrointestinal tract more efficiently in children than in adults (Casarett et al. (1986), children are particularly susceptible to lead toxicity via ingestion. Fetuses, neonates, and young children also have increased susceptibility to lead because their nervous systems are in the developmental stage, and adverse neurobehavioral effects have been associated with lead exposure in children.

Clean soil (approximately 2 feet) was added to the contaminated soil areas to prevent human exposure and mitigate adverse human health effects. However, this measure may not be adequate in addressing potential future exposure. If a vegetative cover is not provided over this soil cap, the following factors may be significant in promoting potential future exposure: 1) Erosion of the on-site soil cap, through surface water runoff into nearby water bodies (e.g., Ringwood Creek), may be significant in potential future exposure via ingestion and inhalation exposure of on-site children. 2) Since there are people residing on-site and access to the contaminated areas is not limited, children may play in these possibly re-exposed areas, and oral and inhalation exposure may occur.

Other contaminants were not present at levels in on-site soil that merit concern for human health.

Lead was not detected in off-site media at levels posing a risk to human health.

2. Ingestion of Contaminated Ground Water

Metals and the volatile organic compound, methylene chloride, were detected in on-site ground water at levels of concern to human health via oral exposure. Chronic ingestion of cadmium-contaminated water (20 ug/l) may result in adverse human health effects. The toxic nature of cadmium is exacerbated by its long half-life (10-30 years) in the kidney and liver, where it tends to accumulate (Friberg et al. (1986)). Renal damage is a primary clinical manifestation of oral, low-level, long-term exposure and may result in proteinuria. This proteinuria may be secondary to cadmium-induced interstitial nephritis. Arsenic was also detected at a level of concern to human health (57 ug/1) in on-site ground water. Long-term ingestion of arsenic-contaminated ground water, at this level, may pose a significant carcinogenic risk to human health. Lead is present in on-site ground water (760 ug/1) at a level of concern to human health. This is greater than both the present Maximum Contaminant Level (MCL) of 50 ug/1 for drinking water and the proposed MCL (PMCL) value of 5 ug/1. The primary human exposure pathway of concern is through possible ingestion of on-site ground water. Possible adverse health effects from long-term oral exposure of children to lead are discussed above. Other particularly sensitive populations would include people genetically predisposed to renal disease or those who excrete a lower than normal percentage of absorbed lead (National Research Council, Canada, (1978). Although methylene chloride was detected in on-site ground water samples at a level of concern to human health, this compound may be a laboratory contaminant rather than a site-related contaminant. However, long-term oral exposure to methylene chloride may result in adverse human health effects, including an increased risk of carcinogenicity.

The health effects described above may be expected with long-term oral exposure to these contaminants. Since most residents in the area are supplied by municipal water, there is no current probable human health concern. Nevertheless, there are receptors living on-site and the possible use of on-site contaminated ground water for domestic purposes (e.g., potable water source, irrigation of lawns and gardens) may pose a potential health risk.

Currently, metals and organic contaminants are not at levels in off-site ground water of concern to human health; however, if the maximum levels of contaminants discussed above migrate to off-site ground water, off-site receptors may also be at risk. The RI did not indicate the number and location of off-site private wells. Thus, the possible human exposure pathways and subsequent adverse health effects from exposure to off-site ground water cannot currently be defined.

3. Incidental Ingestion of Sediment and Surface Water

Several metals and volatile organic compounds were detected in on-site surface water and sediment. Maximum concentrations of cadmium and methylene chloride were at levels of concern to human health. Although incidental ingestion of cadmium-contaminated sediment and methylene chloride-contaminated surface water may be of concern to human health, adverse health effects from oral exposure to these contaminants result primarily from long-term exposure. Thus, exposure to on-site sediment and surface water and any resultant adverse human health effects are highly unlikely and not a probable concern to human health.

Current and future contamination of on-site surface water and sediment may, however, also contribute to future contamination of off-site media.

4. <u>Ingestion of Contaminated Consumable Plants/Animals</u>

Because a consumption survey and sampling data are lacking, we cannot be conclusive on human exposure or any subsequent adverse health effects via this pathway.

CONCLUSIONS AND RECOMMENDATIONS

Based on the data needs identified in the Site Evaluation Section and the public health concerns associated with the Ringwood Mines site, the following conclusions and recommendations are warranted.

From the information reviewed, ATSDR has concluded that this site poses a potential public health concern because of the risk to human health that could result from possible exposure to hazardous substances at levels that may result in adverse long-term health effects over time. As noted in the Human Exposure Pathways Section above, human exposure to organic compounds and metals may occur primarily via incidental ingestion of contaminated soils. If on-site ground water is used for domestic purposes, ingestion of the contaminants in ground water is also possible.

Remedial actions cited in the ROD (i.e., determination of ground water flow [geophysical surveys] and monitoring of ground water and surface water) for the Ringwood Mines/Landfill NPL site (September 29, 1988) will help to further define human exposure pathways and will help determine the potential for adverse health effects. The excavation of contaminated soils should mitigate oral and inhalation exposure, possible exposure via the food chain, and any possible subsequent adverse health effects.

In addition, ATSDR recommends the following:

1. Because contamination at the site exists at levels of concern to public health, access to the contaminated areas should be limited.

2. Provide remedial workers who may be exposed to on-site contamination with adequate personal protective equipment, as required by the Occupational Safety and Health Administration (OSHA). Require remedial workers to follow all applicable OSHA regulations and National Institute for Occupational Safety and Health recommendations.

3. Conduct real-time air monitoring under varying weather conditions during remedial activities to ensure that workers and nearby residents are not exposed to unacceptable levels of chemicals released to the air during the excavation of contaminated materials.

4. Perform a detailed well inventory within a 1-mile radius of the site. The inventory should include a description of well construction (including depth and screen intervals), the use of ground water, and a precise location of the well. All nearby municipal or community wells should be described, even if they are located outside the 1-mile radius.

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended, the Ringwood Mines/Landfill NPL site has been evaluated for appropriate follow-up with respect to health effects studies. Although there is currently a potential for human exposure to on-site and off-site contaminants, there are no indications in the information and data reviewed for this Health Assessment that human exposure is actually occurring at the present time or has occurred in the past. Accordingly, this site is not being considered for follow-up health studies at this time. However, if data become available suggesting that human exposure to significant levels of hazardous substances is currently occurring or has occurred in the past, ATSDR will re-evaluate this site for any indicated follow-up.

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