PRELIMINARY Health Assessment for

7123

335106

ADMINISTRATIVE RECORD

FILE PLAN
3.07

RICHARDSON FLAT TAILINGS

PARK CITY, SUMMIT COUNTY, UTAH

CERCLIS NO. UTD980952840

JUL 24 1990

THE ATSDR HEALTH ASSESSMENT: A NOTE OF EXPLANATION

Section 104 (i) (7) (A) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, states "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure or tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR shall use appropriate data, risks assessments, risk evaluations and studies available from the Administrator of EPA."

In accordance with the CERCLA section cited, ATSDR has conducted this preliminary health assessment on the data in the site summary form. Additional health assessments may be conducted for this site as more information becomes available to ATSDR.

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

SUMMARY

The Richardson Flat Tailings, an Update 7 site proposed for the National Priorities List, is located 3.5 miles northeast of Park City, Summit County, Utah. From 1975 to 1981, the 160-acre site was used for disposing mine tailing wastes from the Keetly Ontario Mine and other mines owned by United Park City Mines. Currently no tailings are dumped at the site; however, soil from the site is being excavated and used to cover the tailings piles. Several metal contaminants, including arsenic, cadmium, chromium, lead, and zinc, have been detected in on-site and off-site areas. Contaminants may migrate from the site to off-site areas through surface water, groundwater, and airborne-associated pathways. Human exposure to site contaminants may occur through the ingestion of contaminated groundwater, food-chain entities, and soil; through dermal contact with contaminants; and through the inhalation of airborne dusts. The site is considered to be of potential public health concern because of the high levels of on-site contaminants.

BACKGROUND

A. Site Description and History

The Richardson Flat Tailings site (RFT), consisting of 160 acres located in a topographic depression approximately 3.5 miles northeast of Park City, in Summit County, Utah, is an Update 7 site proposed for the National Priorities List (NPL) (see Figures 1 and 2). From 1975 until 1981, mine tailings from the Keetly Ontario Mine and other mining operations in the area were disposed of at the site and currently range up to 10 feet in depth. Until 1987, mine tailings were removed from the site and used as backfill for sewer construction projects.

Currently, mine tailings at the site are being covered by soil excavated from on-site areas. The thickness of the soil cover varies over the surface of the site, and, as noted during the April 1989 site visit, the soil layer covering the mine tailings was less than 1-inch thick in certain areas. Site features include a pond that covers the northeastern corner of the site and is contained by a dam at the northwestern corner, and a ditch in the central portion of the site.

B. Site Visit

Staff from the Agency for Toxic Substances and Disease Registry (ATSDR) and the Utah Department of Health conducted a visit to the RFT site on April 19, 1989. During the site visit, conditions on-site and off-site were observed, including land uses in areas adjacent to the site, the proximity of residential areas to the site, the ease of site access, the presence of on-site physical hazards, and the general physical characteristics of the site. Specific observations made during the site visit will be discussed in appropriate sections of this Preliminary Health Assessment.

C. Community Health Concerns

Staff from the Utah Department of Health indicated that they were not aware of any community health concerns related to the RFT site.

DEMOGRAPHICS, LAND USE, AND NATURAL RESOURCE USE

The site lies in a rural area with very widely scattered residences. It is within 1.5 miles of Prospector Square, which is an extension of Park City, a popular recreational and ski area of Utah. The area within a 1-mile radius of the site consists of open, undeveloped rangeland and agricultural fields. Only three residences are within a 1-mile radius of the site; however, because the site is close to a popular resort, which has expanded in recent years, future development of the area may increase residential, commercial, and recreational land uses (1).

Recreational land uses in the site vicinity include fishing in Silver Creek, a popular stream for trout fishing, and downhill skiing at nearby ski slopes. Piles of mine tailings on-site are commonly used for unauthorized recreational motorcycling.

Other land uses in the site vicinity include pastureland for cattle and sheep and land parcels used for cultivating hay and grain. No industrial or commercial land uses are within 1-mile of the site.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. On-Site and Off-Site Contamination

Monitoring results were analyzed for groundwater, surface water, soil, and air samples collected during initial site investigations conducted in 1985. These results are only of preliminary and are not sufficient to characterize the full nature and extent of site contamination.

1. Groundwater

Groundwater samples were collected from monitoring wells located upgradient and downgradient from the site. Groundwater samples were analyzed for total metals, cyanide, sulfate, and dissolved metals. The highest concentrations of contaminants were detected in unfiltered groundwater samples collected from monitoring wells located downgradient from the site (see Table 1).

Table 1.
Groundwater*, 1985

Contaminant	Maximum Concentration [ppb] Off-Site Upgradient	On-Site	Drinking Water Criteria+
Arsenic	<5	349	50
Cadmium	<5	48	10
Chromium	<5	104	50
Lead	<30	1,080	20#
Manganese	20	10,400	50

*Unfiltered samples.
+National Interim Primary Drinking Water Regulations. U.S. Environmental Protection Agency, Office of Drinking Water, 1976.
#Proposed Maximum Contaminant Level at the tap.

2. Surface Water

Surface water samples were collected from the east bank of Silver Creek and from an intermittent stream that flows through the tailings. Surface water samples were analyzed for total metals and sulfate. The highest contaminant levels in Silver Creek were found immediately downstream from the site and at the discharge point for the intermittent, on-site stream (see Table 2). Approximately 2 miles upstream from the RFT site, the Prospector Square tailings may also serve as an important source of surface water contaminants.

Table 2.
Surface Water, 1986

Contaminant	Maximum Concentration [ppb] Upstream Silver Creek	Downstream Silver Creek
Arsenic	14	65
Copper	12	60
Lead	147	1,985

3. Soil

Samples of surface and subsurface soil were collected from on-site and off-site areas (see Table 3 and 4). Soil samples were analyzed for total metals. Samples of subsurface, on-site soil samples (tailings) were analyzed for total metals and cyanide. Results of analyses of on-site surface soil (tailings) and off-site surface soil indicate levels of arsenic, cadmium, lead, and zinc substantially higher than the mean concentrations for the western United States.

Results of sample analyses of subsurface mine tailings indicated elevated levels of heavy metals and arsenic (see Table 4). Off-site, subsurface samples did not have contaminant levels above mean concentrations for the western United States, indicating the likelihood that off-site soil contamination is generally limited to the upper portions of the soil profile (2).

Table 3.
Surface Soil and Tailings, 1986

Maximum Concentration [ppb]

	Background*	On-Site	Mean for Western U.S.
Arsenic	58,000	3,600,000	5,500
Cadmium	17,000	80,000	200
Lead	1,110,000	8,530,000	17,000
Selenium	6,700	<400,000	230
Zinc	1,570,000	6.360,000	55,000

*Levels reported as background may not be true background because they were collected adjacent to the site and in an area with a history of mining activity.

Table 4.
Subsurface Soil and Tailings, 1986

Maximum Concentrations [ppb]

Contaminant	Background*	On-Site	Mean for Western U.S.
Arsenic	6,500	328,000	5,500
Cadmium	7,400	169,000	200
Lead	37,000	4,920,000	17,000
Selenium	<100	9,400	230
Zinc	70,000	23,200,000	55,000

*Levels reported as background may not be true background because they were collected adjacent to the site and in an area with a history of mining activity.

4. Air

Preliminary air monitoring was conducted using five high-volume air samplers at four sampling locations over a 5-day period. Air samples were analyzed for arsenic, cadmium, lead, and zinc. During air monitoring, weather conditions were dry with winds varying up to 20 miles per hour, although winds gusted up to 40 miles per hour during the first day of sample collection. The highest levels of airborne contaminants were detected during the first day of sampling at the air monitoring station downwind from the site (see Table 5). Air monitoring results verify that releases of airborne contaminants have occurred at the RFT site.

Table 5.
Air, 1986

Maximum Concentration [micrograms per cubic meter]

Contaminant	Upwind	Downwind
Arsenic	0.002	0.093
Cadmium	< 0.010*	0.082*
Lead	0.103	1.648
Zinc	0.091+	1.155+

*Matrix spike recovery was 65% for cadmium; actual value may be higher.
+Matrix spike recovery was 60% for zinc; values given are estimates.

B. Quality Assurance and Quality Control

Quality assurance and quality control procedures were used to ensure the accuracy of the monitoring programs conducted during site investigations at the RFT site. Sample collection and analyses were determined to have been performed according to approved procedures; therefore, monitoring results were determined to be acceptable. The conclusions contained in this report are based on the data package supplied to ATSDR. The accuracy of these conclusions depends on the reliability and comprehensiveness of the data contained in the materials reviewed.

C. Physical and Other Hazards

No on-site physical hazards were noted during the site visit.

PATHWAYS ANALYSES

A. Environmental Pathways (Fate and Transport)

1. Groundwater

Groundwater was encountered within 12 feet of the site's surface during the collection of on-site soil samples. In the site vicinity, the uppermost aquifer, with an average depth of 60 feet, lies within alluvial

deposits overlying consolidated rocks of tertiary origin. It is not clear whether this alluvial aquifer is hydrologically connected to the deeper aquifer found in the consolidated rock formation. Groundwater flow beneath the site and in the site vicinity is to the north-northwest.

No private or monitoring wells are on-site. Two private domestic wells are located about 4,000 feet southwest of the site. Both of these wells are completed to a depth of about 210 feet below the ground's surface. A single municipal well used as a backup source for the Park City municipal water system is located 2.5 miles southwest of the RFT site (1). Groundwater samples were not collected from the above-mentioned private and municipal wells; however, because these wells are located upgradient from the site, they are not expected to be impacted by site contaminants.

2. Surface Water

Surface water and leachate from the site may transport site contaminants into nearby streams and creeks. The largest surface water feature in the site vicinity is Silver Creek, located about 200 feet west of the site. Approximately 1,000 feet downstream from the site, surface water from Silver Creek is diverted for the irrigation of pastureland and hay fields. Silver Creek does not serve as a source of drinking water source for humans.

Several leachate (mine tailing drainage) seeps were noted on the northwest side of the on-site earth dam; however, surface water samples were not collected in this area. These seeps flow from the site to the northwest into a swampy area that drains into Silver Creek. Leachate from the mine tailings pile may serve as an important source of surface water contamination.

3. Soil

Mine tailings consist of finely crushed rock that are easily eroded by surface water runoff and wind. Erosion of the mine tailings is likely because portions of the mine tailing piles are uncovered and lack a vegetative cover. Although a soil cover is being placed over the surface of the mine tailings, the thickness of the cover varies considerably and may be less than 1 inch. Soil used to cover the tailings may also be contaminated because it is being excavated from on-site areas in which mine tailings were dumped. The soil covering the tailings is expected to have a minimal impact on the migration of tailing contaminants into groundwater.

As precipitation percolates through the mine tailings, sulfates in the tailings dissolve, increasing the acidity of water as it seeps downward. As infiltrating water becomes more acidic, it dissolves the arsenic and heavy metal compounds in the tailings and carries these contaminants downward. Monitoring results indicate that contaminants have already migrated to lower levels of the tailing piles and impacted local groundwater and nearby surface waters. Contaminants will continue to impact groundwater and surface water if no remediation is performed.

4. Air

The small particle size of the tailings increases the likelihood that wind may be an important mechanism for dust transport to off-site areas. Site documents indicate that releases of windblown contaminants to off-site areas have been observed, especially in the summer months when winds from the southwest blow dust from the site across Interstate 40.

5. Contaminated Food-Chain Entities

Site contaminants may bioaccumulate in food-chain entities. In the site vicinity, approximately 315 acres of agricultural land are irrigated with surface water diverted from Silver Creek. Irrigated lands are used for pastureland and the production of grains and hay. Crops irrigated with contaminated surface water may bioaccumulate contaminants.

Animals may also become contaminated if they graze in areas impacted by the site, feed on crops irrigated with contaminated water, or ingest contaminated surface water, soil, or sediments. Cattle and sheep are known to graze in shrub land adjacent to the site.

Fish from Silver Creek may also bioaccumulate contaminants from surface water and sediment. Silver Creek is known to support recreational trout fishing.

B. Human Exposure Pathways

Several potential routes exist by which humans may be exposed to contaminants from the RFT site. Ingestion of contaminated groundwater, soil, and food-chain entities and inhalation of dust are all potential routes of human contaminant exposure.

1. Soil- and Tailings- Associated Pathways

Ingestion, inhalation, and dermal exposures to soil and tailings may adversely impact human health. The highest contaminant levels were found in on-site subsurface soil and tailings; however, on-site and off-site surface soil and tailings were also contaminated. The site is located in a rural area and because access to it is not restricted, trespassers may come in contact with these contaminated media during cycling or other activities on or near the site.

2. Groundwater-Associated Pathways

Human exposure to groundwater contaminants may result from the use of contaminated groundwater for domestic, industrial, and agricultural purposes. Local residents are known to rely on groundwater as a potable water supply; however, monitoring data for off-site groundwater are limited to results from a single upgradient well and two downgradient wells. The likelihood of human exposure to groundwater contaminants is minimized by the rural nature of the site and the lack of supply wells for potable water downgradient from the site; however, without monitoring

results from nearby private wells, this pathway of human exposure can not be ignored. The potential exists for completing this pathway of human exposure in the future if groundwater wells are installed on-site or downgradient from the site.

3. Food-Chain-Associated Pathways

Another potential pathway for human exposure to contaminants is through the consumption of food-chain entities that may bioaccumulate contaminants. Cultivated grains and vegetables and other edible plants may bioaccumulate soil contaminants and result in food-chain contamination. Cattle, sheep, and wildlife that consume contaminated plant material or surface water may also bioaccumulate contaminants.

Aquatic animals, such as trout in Silver Creek, that inhabit contaminated surface water or aquatic systems with contaminated sediments may also bioaccumulate contaminants. Analytical results of surface water samples collected from Silver Creek indicate contaminants at levels significantly in excess of Federal Ambient Water Quality Criteria. These contaminants are known to bioaccumulate in fish and may reach levels that make Silver Creek trout unsuitable for human consumption.

4. Airborne-Associated Pathways

Inhalation of contaminated dusts may be a human exposure pathway. On-site activities, including cycling, soil remediation, or excavation of tailings for use as fill may result in the generation of dust and the exposure of motorcyclists, on-site workers, and area residents to site contaminants. The relative remoteness of the site may help reduce the impact of this pathway of human exposure.

5. Surface-Water-Associated Pathways

Surface water obtained from local sources is not a source of drinking water within the site vicinity; however, surface water is used to irrigate pastureland and hay and grain fields. As a result, human exposure to site-related contaminants may result from the ingestion of contaminated grains, animal products, or fish.

PUBLIC HEALTH IMPLICATIONS

Results of preliminary groundwater and soil sampling indicate that the RFT site is of potential public health concern because of contaminants in on-site air, soil, mine tailings, and groundwater and on-site and off-site surface water and sediments.

A brief discussion of the identified site contaminants of public health concern follows.

Arsenic

Human exposure to arsenic is possible through three major pathways: ingestion, inhalation, and dermal contact. Common effects from ingestion of arsenic include irritation of the digestive tract leading to pain, nausea. vomiting, and diarrhea. Ingestion of inorganic arsenic, the form most likely found at the RFT site, also causes a pattern of skin abnormalities, such as dark and light spots on the skin and small "corns" on the palms, soles, and trunk. Some of the corns may progress to skin cancer. Other health effects of arsenic ingestion include an increased risk of liver, bladder, kidney, and lung cancer. Long-term exposure (greater than 14 days) to inorganic arsenic at levels as low as 20 micrograms per kilogram of body weight per day may result in mild health effects. The severity of symptoms tends to increase as exposure duration increases. The Environmental Protection Agency (EPA) estimates that a dose of 1 microgram per kilogram of body weight per day corresponds to a cancer risk of 1.5 in 1,000 (3). Arsenic levels are sufficiently high in surface soil to be of public health concern for ingestion, inhalation, or dermal exposures.

Inhalation of inorganic arsenic dusts may also result in mild irritation of the digestive tract. The inhalation route of human exposure is more likely to increase the risk of lung cancer than is the ingestion route. Air concentrations of about 200 micrograms per cubic meter are associated with irritation of the nose, throat, and exposed skin. The National Institute for Occupational Safety and Health (NIOSH) has set a recommended exposure limit (REL) for occupational exposure to arsenic in air at 2 micrograms per cubic meter not to be exceeded for more than 15-minutes. EPA has estimated that a lifetime inhalation exposure to 1 microgram per cubic meter causes a lifetime cancer risk of 4 in 1,000 (3). The maximum level of airborne arsenic detected at the RFT site (0.093 micrograms per cubic meter) is at a level of public health concern. Soil-disturbing activities, such as excavation of soils or motorcycling, are likely to cause an increase in airborne arsenic levels.

Dermal exposure to arsenic-containing compounds may result in mild-to-severe irritation of the skin, eyes, or throat. No reliable dose estimates are available on the exposure levels at which these effects begin to appear.

Cadmium

Human exposure to cadmium at the RFT site can occur either through the ingestion of contaminated soil, mine tailings, and food-chain entities or through the inhalation of contaminated dusts. Very small amounts of ingested cadmium are absorbed into the blood (1%-5%) while 30%-50% of that which is inhaled is taken into the blood (4). Once cadmium enters the body, it is retained very strongly. A proposed reference dose (a daily dose that is estimated to be without appreciable human health risk) of 0.5 micrograms per kilogram of body weight per day for oral exposure is currently under review (4).

Ingestion of cadmium may result in damage to the kidneys and may cause hypertension, although the importance of cadmium in hypertension is unclear. Dermal exposure to cadmium compounds has not been observed to cause significant health effects.
Long-term inhalation exposures to cadmium at levels of 100 micrograms per cubic meter may increase the risk of lung disease, such as emphysema, and may also cause kidney injury. Lifelong inhalation of air containing 0.03 micrograms per cubic meter is estimated to cause a lifetime cancer risk of 1 in 10,000 (4). Air monitoring results at the RFT site detected airborne cadmium levels (0.082 microgram per cubic meter) at levels of public health concern (1). Site remediation activities or on-site cycling activities are likely to increase airborne cadmium levels.

Under current land use, cadmium levels in surface soil are not high enough to be of public health concern. If the site is developed for residential or recreational uses, the levels may become a public health concern.

Lead

Human exposure to lead at the RFT site may occur through two major pathways: the ingestion of contaminated soil, mine tailings, and food-chain entities or the inhalation of airborne contaminated dusts. Levels of lead in surface soil and tailings, subsurface soil and tailings, and air are sufficiently high to be of public health concern.

Children are especially susceptible to the health effects of lead exposure. Low levels of lead exposure may cause decreased growth and may result in lower intelligence quotient (IQ) scores. Low levels of lead exposure may also cause hypertension in middle-aged men. Pregnant women exposed to lead transfer lead to the fetus, and this may cause preterm birth, reduced birth weight, and decreased neurological development in the infant. Results of studies have shown that lead causes cancer in laboratory animals; however, it is not known whether lead causes cancer in humans.

Human inhalation of lead-contaminated dust or lead fumes may result in the same health effects that ingestion exposure causes. Air monitoring results at the RFT site indicated lead (1.65 micrograms per cubic meter) at levels above EPA's National Primary and Secondary Ambient Air Quality Standards for lead (1.5 micrograms per cubic meter) (5). Airborne lead levels are expected to be even higher if soil is disturbed by on-site activities such as soil excavating or cycling.

The Centers for Disease Control (CDC) has cautioned that concentrations of lead greater than 500-1,000 parts per million (ppm) in residential soil could lead to elevated blood lead levels in children who inhale or ingest soil. Lead levels in excess of these values were found in on-site surface soil and mine tailings and in subsurface soil and tailings. Site trespassers, site workers, and recreational cyclists may experience short-term exposures to lead-contaminated media.

Selenium

Human exposure to selenium at the RFT site may occur through the ingestion of contaminated groundwater or soil and through the inhalation of airborne dust. Once ingested, selenium in both the organic and inorganic forms is readily absorbed. Although selenium is an essential nutrient, it may have toxic effects at levels moderately above the daily nutritional requirement. The Food and Nutrition Board of the National Academy of Sciences (NAS) suggests that 0.05 to 0.20 mg of selenium per person per day is an adequate and safe level of dietary intake in adults (6).

Inhalation of selenium may cause damage to the respiratory tract, gastrointestinal and cardiovascular effects, and irritation of the skin and eyes (7). Air samples collected from the RFT site were not analyzed for selenium; however, the levels found in surface soil and tailings and the air monitoring results for other site contaminants indicate that airborne selenium levels may be of public health concern under normal site conditions. Soil disruption by such activities as soil excavation or cycling could increase airborne selenium levels.

Selenium may also bioaccumulate in plants and animals. The health effects from long-term exposure to selenium via ingestion of contaminated food or water include loss of hair, loss and deformities of nails, problems with walking, diminished reflexes, and some paralysis. These health effects were reported from a study of populations in China that lived in areas with extremely high selenium levels in the soil and in the rice and vegetables they consumed. Selenium levels in the food were 1.6 parts per million or higher, and the period of exposure was months or even years (8).

Zinc

Human exposure to zinc at the RFT site may occur through two major pathways: the ingestion of contaminated soil, tailings, and groundwater or the inhalation of airborne contaminated dust. Which health effects result from exposure to excess levels of zinc depends on the pathway of exposure.

Ingestion of excess zinc may cause stomach or digestive problems. NAS has estimated the recommended dietary allowance (RDA) for zinc to be 15 milligrams per day (6). Long-term exposure to excessive levels of zinc (2.1 milligrams per kilogram of body weight per day) may result in copper deficiency (8); however, exposures of this magnitude are not expected to occur at the RFT site.

Inhalation of zinc dust may lead to breathing difficulties and nonspecific neurological effects such as headaches and malaise (9). Air monitoring results at the RFT site did not show zinc to be at levels of public health concern; however, during soil-disturbing activities, such as soil excavation or cycling, airborne zinc levels may become a public health concern.

CONCLUSIONS

Using the available information, ATSDR has concluded that this site is of potential public health concern because humans may be exposed to hazardous substances by ingestion of contaminated soil, groundwater, and food-chain entities; dermal contact with contaminated soil; and inhalation of contaminated dust. This Preliminary Health Assessment is based on incomplete monitoring data for groundwater and surface water. A full assessment of the public health implications of this site is not possible with the information presently available.
In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, the Richardson Flat Tailings site has been evaluated for possible follow-up with health effects studies. However, because no documentation or indication exists that human exposure to site-related contaminants is occurring or has occurred in the past, this site is not being considered for follow-up health studies at this time.

As ATSDR receives additional information, such information may indicate that further assessment is warranted by site-specific public health issues.

RECOMMENDATIONS

ATSDR recommends the following:

1. Restrict public access to the site to reduce unauthorized site entry and use of the site for recreational purposes.

2. Monitor private wells within 1 mile of the site to determine whether these wells are being impacted by site contaminants and whether water from these wells can continue to be used for potable purposes.

3. Conduct additional surface water monitoring, both upgradient and downgradient from the site, to determine the site's impact on Silver Creek and other nearby bodies of surface water.

4. Sample leachate seeps from along the north side of the on-site earthen dam, and analyze these samples for site-associated contaminants.

5. Collect additional off-site soil samples from areas adjacent to the site, especially downwind of the site, to characterize off-site contamination.

6. Collect and analyze edible portions of trout from Silver Creek to determine whether they are suitable for continued human consumption.

7. Include the following in the remediation workplan if additional site remediation occurs:

   Provide adequate personal protective equipment that meets the standards of the Occupational Safety and Health Administration (OSHA) for workers conducting remedial activities in and around the site.

   Follow appropriate precautionary guidelines, regulations, and advisories from the National Institute for Occupational Safety and Health (NIOSH) and OSHA.

   Employ optimal dust control measures if remedial activities will involve ground-disturbing activities. In addition to on-site air monitoring, appropriate real-time air monitoring at the worksite periphery should be conducted during working hours in addition to on-site air monitoring. Levels of contaminants in the ambient air at the periphery of the site should not exceed National Ambient Air Quality Standards (NAAQS) or NIOSH recommendations.

8. When indicated by public health needs, and as resources permit, the evaluation of additional relevant health outcome data and community health concerns, if available, is recommended.

PREPARERS OF REPORT

Environmental and Health Effects Assessor:	Richard Earl Gillig, M.C.P. Environmental Health Scientist Remedial Programs Branch
ATSDR Regional Representative	Tamara Kicera Regional Services Office of the Assistant Administrator, ATSDR

REFERENCES

1. Hazardous Ranking Score Package, Richardson Flat Tailings Site, Park City, Utah.

2. Shacklette, J.T., and Boerngen, J.G., 1984, Elemental Concentrations in Soil and Other Surficial Materials of the Conterminous United States. U.S. Geological Survey Professional Paper 1270.

3. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Arsenic. Atlanta: ATSDR, March 1989.

4. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Cadmium. Atlanta: ATSDR, March 1989.

5. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Lead. Atlanta: ATSDR, 1987.

6. Recommended dietary allowances. 1980. 9th Rev. National Resource Council. Washington, DC: Food and Nutrition Board, National Academy of Sciences., 162-164.

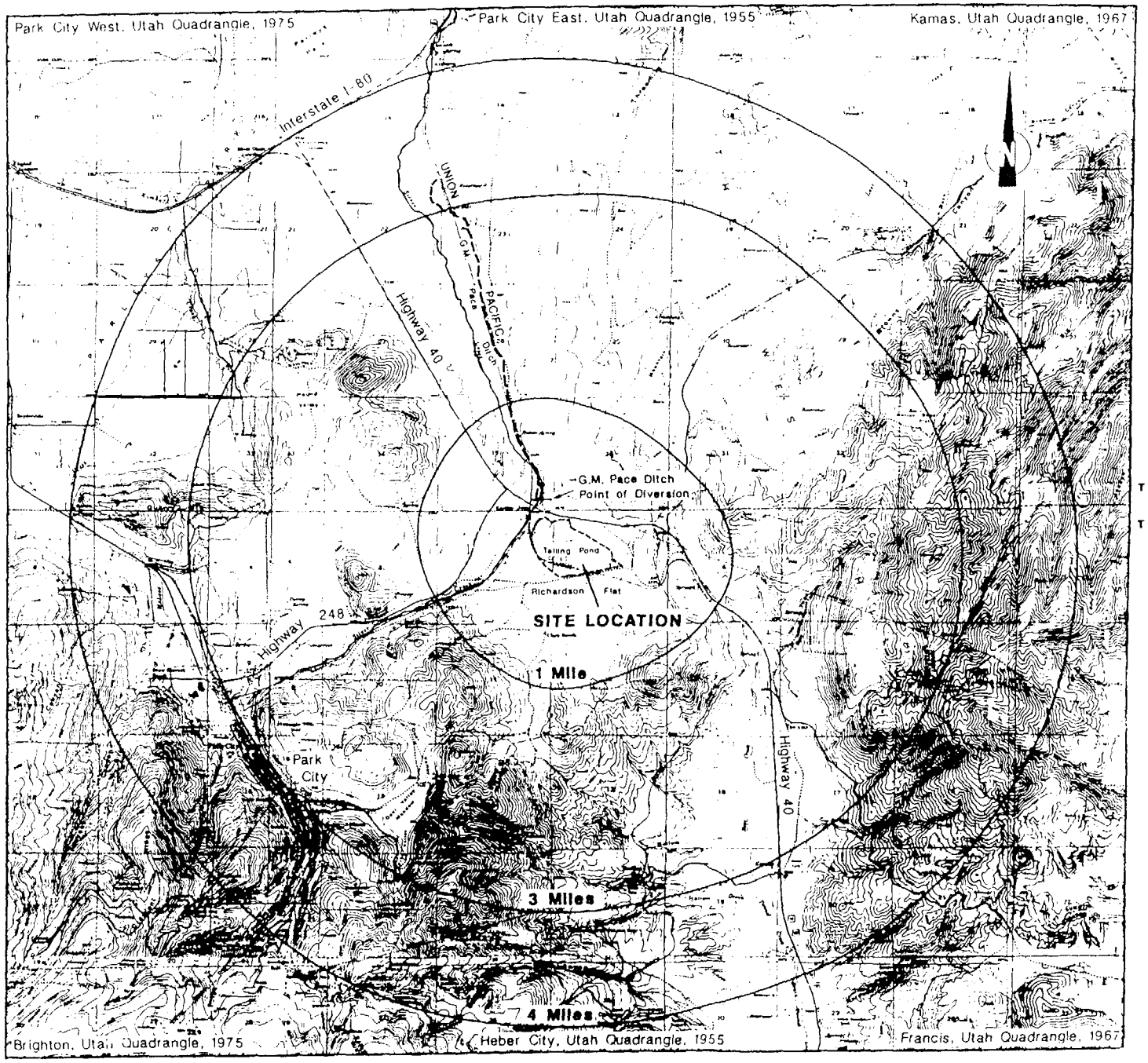
7. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Selenium. Atlanta: ATSDR, December 1989.

8. Yang, G., Wang, S., Zhou, R., et al. 1983: Endemic selenium intoxication of humans in China. Am J Clin Nutr 37:872-881.

9. Porter K.G., McMaster D., Elmes M.E., et al. 1977. Anemia and low serum-copper during zinc therapy. Lancet:744.

10. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Zinc. Atlanta: ATSDR, December 1989.

APPENDIX



Source: U.S. Geological Survey Map 7.5 Minutes

FIGURE I

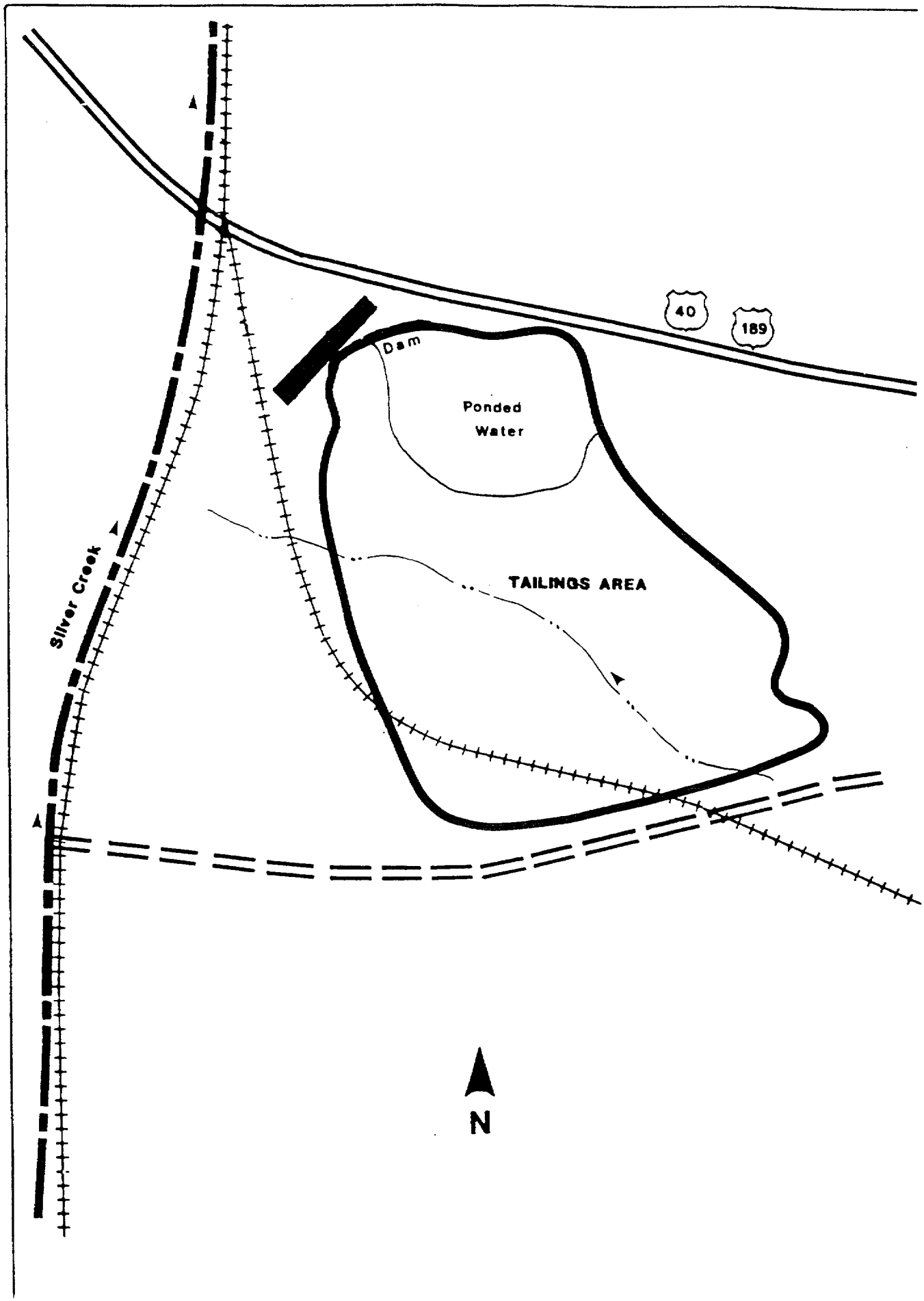



FIGURE II