EPA R05-R92-215
1992

EPA Superfund
Record of Decision:

Torch Lake
OUs 1 & 3
Houghton County, MI
09/30/1992

TORCH LAKE SITE, MI OPERABLE UNITS I AND III

DECLARATION FOR THE RECORD OF DECISION

Site Name and Location

Torch Lake Site, Operable Units I and III
Houghton County, Michigan

Statement of Basis and Purpose

This decision document represents the selected remedial action for the Torch Lake site, in Houghton County, Michigan, Operable Units I and III, which was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This decision is based on the Administrative Record for the Torch Lake site.

The State of Michigan concurs with the selected remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of Remedy

These operable units are the first and third of three operable units for the site. The selected remedial action for these operable units addresses the tailings and slag piles/beach at the site. Operable Unit II, which is not a part of this ROD, addresses the groundwater, surface water, and sediments.

The major components of the selected remedy include:

- Deed restrictions to control the use of tailing piles so that tailings will not be left in a condition which is contrary to the intent of this ROD;
- Removal of debris such as wood, empty drums, and other garbage in the tailing piles for off-site disposal in order to effectively implement the soil cover with vegetation;
- Soil cover with vegetation in the following areas:
    - Operable Unit I tailings in Lake Linden, Hubbell/Tamarack City, and Mason (approximately 442 acres),
    - Operable Unit III tailings in Calumet Lake, Boston Pond, Michigan Smelter, Dollar Bay, and Grosse-Point (approximately 229 acres), and
    - Operable Unit I slag pile/beach in Hubbell (approximately 9 acres);
- The Isle-Royale tailings in OU III will be excluded from the area to be covered with soil and vegetation under this ROD as follows:
    - The portion of Isle-Royale tailings in OU III which is being developed as a sewage treatment plant will be excluded from the area to be covered with soil and vegetation under this ROD. The part of this area to be covered by conventional sewage treatment tanks is approximately 12 acres. The remaining part, approximately 48 acres, will be covered with soil and vegetation by the Portage Lake Water and Sewage Authority as part of the sewage treatment facility development plan. However, if this area is not covered and vegetated within 5 years after the date that the final Remedial Design is submitted, then this area shall be subject to the requirements of this ROD;

- The portion of the Isle-Royale tailings which is designated to be developed as a residential area will be excluded from the area to be covered with soil and vegetation under this ROD. This area covers approximately 90 acres. However, if this area is not developed as a residential area within 5 years after the date that the final Remedial Design is submitted, then this area shall be subject to the requirements of this ROD;

- The portion of the Isle-Royale tailings which is currently being used as source material to make cement blocks and as a finished block storage area for the Superior Block Company will be excluded from the area to be covered with soil and vegetation under this ROD. This area covers approximately 60 acres. However, if any portion of the area is no longer to be used as a storage and source area, soil cover with vegetation must be implemented pursuant to this ROD. The owner and/or operator of Superior Block Co. must use dust control measures such as water spray during the operation of mining and other activities in order to reduce the release of dust into the air;

- The area designated by the Houghton County Road Commission as source material to spread on the road during winter to provide traction for motor vehicles will be excluded from the area to be covered with soil and vegetation. This area is located in Grosse-Point in OU III and is estimated to be 46 acres. While this area is being utilized, the following procedures must be observed:

  - The area should be covered with enough soil to prevent the release of tailings to the air and lake;

  - Excavation should stop at seven (7) feet above the water table (defined as the average of seasonal highs and lows over a two year period). This portion must subsequently be covered with soil or soil and vegetation;

  - Once the entire area is excavated to seven (7) feet above the water table, it must be covered with soil and vegetation pursuant to this ROD;

- Assuming that the slag pile located in the Quincy Smelter area (approximately 25 acres) will be developed as part of a National Park, no action will be taken. If this area is not developed as a National Park in the future, deed restrictions will be sought to prevent the development of residences in the slag pile area; and

- The North Entry (location 4), Redridge (location 11) and Freda (location 12) tailings are excluded from the area to be covered under this ROD. Locations 4, 11, and 12 are along the Lake Superior shore where pounding waves and water currents will likely retard or destroy any remedial actions. As a result, U.S. EPA currently believes it to be technically impracticable to implement the chosen remedy at these locations. However, the North Entry (location 4) and Freda (location 12) tailings, approximately 46 acres, shall be studied during Remedial Design. If U.S. EPA determines that any portion of these areas is sufficiently unaffected by Lake Superior wave activity such that it can be effectively covered with soil and vegetated, then the unaffected area or areas shall be subject to the requirements of this ROD.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State environmental requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable; however, because treatment of the principal threats of the Site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element.

Because this remedy will result in hazardous substances remaining on-site, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

RECORD OF DECISION

DECISION SUMMARY

TORCH LAKE SITE

OPERABLE UNITS I AND III

HOUGHTON COUNTY, MICHIGAN

Prepared By:

U.S. Environmental Protection Agency

Region V

Chicago, Illinois

September, 1992

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ROD SUMMARY
TORCH LAKE SUPERFUND SITE
OPERABLE UNITS I AND III
HOUGHTON COUNTY, MICHIGAN

I. SITE NAME, LOCATION, AND DESCRIPTION

The Torch Lake Superfund site (the "Site") is located on the Keweenaw Peninsula in Houghton County, Michigan (See Figure 1). The Site includes Torch Lake, the west shore of Torch Lake, the northern portion of Portage Lake, the Portage Lake Canal, Keweenaw Waterway, the North Entry to Lake Superior, Boston Pond, Calumet Lake, and other areas associated with the Keweenaw Basin. Tailing piles and slag piles/beach deposited along the western shore of Torch Lake, Northern Portage Lake, Keweenaw Waterway, Lake Superior, Boston Pond, and Calumet Lake are also included as part of the Site. These tailing piles include tailings in Lake Linden, Hubbell/Tamarack City, Mason, Calumet Lake, Boston Pond, Michigan Smelter, Isle-Royale, Lake Superior, and Gross Point. The slag piles/beach are located in Quincy Smelter and Hubbell (See Figure 2).

The northeast/southwest trending Keweenaw Peninsula lies within the Superior bedrock controlled uplands province of the Lake Superior basin. Drainage patterns in the peninsula are controlled largely by bedrock type, and follow faults and fractures in the Precambrian bedrock. Soils in the area primarily consist of sandy loams, and silty loams. They are developed in till, outwash, holocene alluvium, and red clay. The major surface water bodies in the region comprise the Keweenaw Waterway including Torch Lake, Portage Lake, and Lake Superior. The Torch Lake is a tributary to the larger Portage Lake which in turn has outlets to Lake Superior via the Portage Canal 14 miles to the northwest and to Keweenaw Bay via the Portage River. Streams in the region drain to the Keweenaw Waterway and Lake Superior. The Torch Lake watershed comprises about 12 percent of the larger Portage Lake basin. Forest vegetation in the area is primarily coniferous. Spruce, larch, fir, and pine are the common species. Deciduous vegetation also occurs in the area although to a lesser degree. Important species include sugar maple, birch, and aspen. Several small communities are located on the west shore of Torch Lake, the largest of which are Lake Linden, Hubbell/Tamarack City, and Mason. Two large cities, Houghton and Hancock, are located on the south and north side of Keweenaw Waterway. Calumet City is located 5 miles north of Torch Lake (See Figure 2).

Torch Lake has a surface area of approximately 2,700 acres, a mean depth of 56 feet, a maximum depth of 115 feet, and a volume of 5.2 x 10[9] cubic feet. The Trap Rock river and several small creeks discharge into Torch Lake.

Torch Lake is used for fishing, boating, limited contact recreation (swimming), non-contact cooling water supply, treated municipal waste assimilation, and wildlife habitat. The Village of Lake Linden has been developing a facility with a bathing beach, camping, park, and boat ramps at the northeast end of the Torch Lake.

The municipal well for Lake Linden is located upstream of the Trap Rock river, 0.7 miles north of Lake Linden. The supply of drinking water for Hubbell/Tamarack City is piped from wells located on the shore of Lake Superior, 9 miles west of Torch lake. The municipal well for Mason is located on the tailing pile in Mason, and the municipal well for Houghton is located on the Isle-Royale tailing pile. The municipal well for Hancock is located in Adams Township, 5 miles southeast of Hancock. Several homes are located in the Isle-Royale tailing pile with their own private wells. (See Section V, below)

Wetlands are located on the east portion of the Lake Linden tailing pile, on the eastern edge of the Hubbell tailing pile, around Boston Pond, and the eastern shore of Torch Lake. Two nests of bald eagles, which are designated as Endangered Species, are located on the northern side of Portage Lake. The Site does not lie within the 100 year flood-plain. The Quincy Mining Company Historic District and Calumet Historic District, which were proposed as a National Historical Park in September 1987, are located within the Site.

While most of the area of the various tailing piles are barren and unused, there is some development on the tailing piles. Two sewage lagoons are located on the Lake Linden tailing pile. Two sewage lagoons are also located on the Hubbell/Tamarack City tailing pile. Portage Lake Water and Sewage Authority has set aside 12 acres on the Isle-Royale tailings to construct a sewage treatment plant. Construction of the plant is on-going. Superior Block Co., located on the Isle-Royale tailing pile, is currently utilizing 60 acres of the Isle-Royale tailings for the production and storage of cement blocks. The residential homes located on Isle-Royale tailing are estimated to cover 10 acres of surface area. The City of Houghton indicated that the City has a plan to develop approximately 90 acres of Isle-Royale tailings into a residential area. The plan includes covering the tailings with two feet of clean soils and is expected to be implemented within the next five years. The Houghton County Road Commission is

currently using tailing materials, approximately 46 acres at Grosse-Point, to spread on the roads during winter to provide traction for motor vehicles. Tailings also had been used in the past as a base for road construction because of good drainage characteristics.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

Torch Lake was the site of copper milling and smelting facilities and operations for over 100 years. The lake was a repository of milling wastes, and served as the waterway for transportation to support the mining industry. The first mill opened on Torch Lake in 1868. At the mills, copper was extracted by crushing or "stamping" the rock into smaller pieces, grinding the pieces, and driving them through successively smaller meshes. The copper and crushed rock were separated by gravimetric sorting in a liquid medium. The copper was sent to a smelter. The crushed rock particles, called "tailings," were discarded along with mill processing water, typically by pumping into the lakes.

Mining output, milling activity, and tailing production peaked in the Keweenaw Peninsula in the early 1900s to 1920. All of the mills at Torch Lake were located on the west shore of the lake and many other mining mills and smelters were located throughout the peninsula. In about 1916, advances in technology allowed recovery of copper from tailings previously deposited in Torch Lake. Dredges were used to collect submerged tailings, which were then screened, recrushed, and gravity separated. An ammonia leaching process involving cupric ammonium carbonate was used to recover copper and other metals from conglomerate tailings. During the 1920s, chemical reagents were used to further increase the efficiency of reclamation. The chemical reagents included lime, pyridine oil, coal tar creosotes, wood creosote, pine oil, and xanthates. After reclamation activities were complete, chemically treated tailings were returned to the lakes. In the 1930s and 1940s, the Torch Lake mills operated mainly to recover tailings in Torch Lake. In the 1950s, copper mills were still active, but by the late 1960s, copper milling had ceased.

Over 5 million tons of native copper was produced from the Keweenaw Peninsula and more than half of this was processed along the shores of Torch Lake. Between 1868 and 1968, approximately 200 million tons of tailings were dumped into Torch Lake filling at least 20 percent of the lake's original volume.

In June 1972, a discharge of 27,000 gallons of cupric ammonium carbonate leaching liquor occurred into the north end of Torch Lake from the storage vats at the Lake Linden Leaching Plant. The Michigan Water Resources Commission (MWRC) investigated the spill. The 1973 MWRC report discerned no deleterious effects associated with the spill, but did observe that discoloration of several acres of lake bottom indicated previous discharges.

In the 1970s, environmental concern developed regarding the century-long deposition of tailings into Torch Lake. High concentrations of copper and other heavy metals in Torch Lake sediments, toxic discharges into the lakes, and fish abnormalities prompted many investigations into long-and short-term impacts attributed to mine waste disposal. The International Joint Commission Water Quality Board designated Torch Lake as a Great Lakes Area of Concern in 1983. Also in 1983, the Michigan Department of Public Health announced an advisory against the consumption of Torch Lake sauger and walleye. The Torch Lake site was proposed for inclusion on the National Priorities List (NPL) in October of 1984. The Site was placed on the NPL in June 1986. The Torch Lake site is also on the Act 307 Michigan Sites of Environmental Contamination Priority List.

A Draft Remedial Action Plan ("RAP") for Torch Lake was developed by MDNR in October, 1987 to address the contamination problems and to recommend the remedial action for Torch Lake. Revegetation of lakeshore tailings to minimize air-borne particulate matter was one of the recommended remedial actions in the RAP.

Attempts to establish vegetation on the tailing piles in Hubbell/Tamarack City have been conducted since the 1960s to stabilize the shoreline and to reduce air particulate from tailings. It has been estimated that 40 to 50 percent of tailings in this area are vegetated. The Portage Lake Water and Sewage Authority has been spray-irrigating sewage sludge on tailings in Mason to promote natural vegetation.

On May 9, 1988, Remedial Investigation/Feasibility Study (RI/FS) Special Notice Letters were issued to Universal Oil Products (UOP) and Quincy Mining Co. UOP is the successor of Calumet Hecla Mining Company which operated its milling and smelting on the shore of Lake Linden and disposed the generated tailings in the area. Quincy Mining Co. conducted smelting operations in the Hubbell area and disposed of tailings. On June 13, 1988, a Notice Letter was issued to Quincy Development Company, which was the current owner of a tailing pile located on the lake shore in Mason. Negotiations for the RI/FS Consent Order with these Potentially Responsible Parties (PRPs) were not successful due to issues such as the extent of the Site, and the number of PRPs. Subsequently, U.S. EPA contracted with Donohue & Associates in November 1988 to perform the RI/FS at the Site.

Due to the size and complex nature of the Site, three Operable Units ("Ous") have been defined for the Site. Torch Lake and the surrounding shoreline comprise OU I and OU II. OU III consists of locations outside this area. Figure 3 shows the location of OU I and OU III. This ROD is being developed for Operable Units I and III.

OU I includes surface tailings, drums, and slag pile/beach on the western shore of Torch Lake. An estimated 440 acres of tailings are exposed surficially in OU I. A smaller deposit of smelter slag pile/beach, encompassing approximately 9 acres, is located near Hubbell, south of the Peninsula Reclamation Plant.

OU II includes groundwater, surface water, submerged tailings and sediments in Torch Lake, Portage Lake, the Portage Channel, and other water bodies at the Site.

OU III includes tailings and slag deposits located in the north entry of Lake Superior, Michigan Smelter, Quincy Smelter, Calumet Lake, Isle Royale, Boston Pond, and Grosse-Point. Figure 3 shows the locations of the OU III sampling locations. Quincy Smelter (Location 6) is part of the Quincy Mining Historic District which is proposed as the National Historical Park.

Depending on the boundary of the proposed National Historic Park for the Calumet Historic District, the Calumet Lake tailings (Location 1) might be part of the proposed National Historic Park.

The Remedial Investigations (RI) have been completed for all three operable units. The RI and Baseline Risk Assessment (BRA) reports for OU I were finalized in July 1991. The RI and BRA reports for OU III were finalized on February 7, 1992. The RI and BRA reports for OU II were finalized in April 1992. The Ecological Assessment for the Site was finalized in May 1992. The Feasibility Study (FS) and Proposed Plan which contains the U.S. EPA's recommended remedy for OU I and III were issued to the public on May 1, 1992. U.S. EPA is currently evaluating the scope of FS for OU II, and the FS and Proposed Plan for OU II are expected to be issued to the public in late Fall of 1993.

On June 21, 1989, U.S. EPA collected a total of eight samples from drums located in the old Calumet and Hecla smelting mill site near Lake Linden, Ahmeek Mill site near Hubbell, and Quincy site near Mason. On August 1, 1990, nine more samples were collected from drums located above the Tamarack site near Tamarack city. Based on the results of these samples, U.S. EPA determined that some of these drums may have contained hazardous substances. During the week of May 8, 1989, the U.S. EPA also conducted ground penetrating radar and a subbottom profile (seismic) survey of the lake bottom. The area in which this survey was conducted is immediately offshore from the old Calumet and Hecla smelting mill site. The survey located several point targets (possibly drums) on the bottom of Torch Lake. Based on the drum sampling results and seismic survey, U.S. EPA executed an Administrative Order by Consent, dated July 30, 1991, which required six companies and individuals to sample and remove drums located on the shore and lake bottom. Pursuant to the Administrative Order, these entities removed 20 drums with unknown contents from off-shore of Peninsula Copper Inc., and the old Calumet and Hecla smelting mill site in September 1991. 808 empty drums were found in the lake bottom. These empty drums were not removed from the lake bottom. A total of 82 drums and minor quantities of underlying soils were removed from the shore of Torch Lake. The removed drums and soils were sampled, overpacked, and disposed off-site at a hazardous waste landfill.

III. COMMUNITY RELATIONS ACTIVITIES

A Community Relations Plan for the Site was finalized in July 1988. This document lists contacts and interested parties throughout the local government and community. It also establishes communication pathways to ensure timely dissemination of pertinent information.

An RI "Kickoff" meeting was held on August 8, 1989 to explain the RI process for the Site. A fact sheet was developed in conjunction with this meeting. Advertisements were placed in the Daily Mining Gazette and a press release was sent to all local media.

A public meeting was held on August 27, 1990 to explain the results of the OU I investigation and the scope of work for the OU II and III investigations. A fact sheet was developed in conjunction with this meeting. Advertisements were placed to announce the meeting and a press release was sent to all local media.

A public meeting was held on October 17, 1991 to update the investigation results for OUs II and III, and the drum removal activity. A fact sheet was developed in conjunction with this meeting. Advertisements were placed to announce the meeting and a press release was sent to all local media.

The RI/FS and the Proposed Plan for OUs I and III were released to the public in May 1992. All of these documents were made available in the information repositories maintained at the Lake Linden-Hubbell Public Library and Portage Lake District Library. An administrative record containing these documents and other site-related documents was placed at the Portage Lake District Library. The notice of availability of these documents was published in the Daily Mining Gazette on April 29, 1992. Press releases were also sent to all local media. A public comment period was held from May 1, 1992 to June 1, 1992. Requests for an extension of the comment period were made and the public comment period was extended until July 13, 1992. In addition, a public meeting was held on May 12, 1992 to present the results of the RI/FS and the recommended alternatives as presented in the Proposed Plan for the Site. All comments which were received by U.S. EPA during the public comment period, including those expressed verbally at the public meeting, are addressed in the Responsiveness Summary which is the third section of this ROD.

IV. SCOPE AND ROLE OF OPERABLE UNIT

As discussed in Section III, U.S. EPA has divided the Site into three operable units. Operable Unit I consists of surface tailings and the slag pile/beach, and disposed drums on the western shore of Torch Lake. Operable Unit II includes areas of potential contamination in and around Torch Lake, including groundwater, submerged tailings at the bottom of the lake, sediment, and surface water. Operable Unit III consists of 12 areas of tailings and slag pile locations throughout the mid-Keweenaw Peninsula. Operable Units I and III are the subject of this Record of Decision.

U.S. EPA identified contaminated surface tailings and the slag piles/beach located in Operable Units I and III as potential risks to human health and the environment. To address these risks, U.S. EPA developed the following remedial objectives for Operable Units I and III based on the data obtained during the RI:

1. Reduce or minimize potential risks to human health associated with the inhalation of airborne contaminants from the tailings and/or slag located at the Site;

2. Reduce or minimize potential risks to human health associated with direct contact with and/or the ingestion of the tailings and/or the slag located at the Site;

3. Reduce or minimize the release of contaminants in tailings to the groundwater through leaching; and

4. Reduce or minimize the release of contaminants in tailings to the surface water and sediment by soil erosion and/or air deposition.

This ROD was developed to meet these objectives and it addresses the contamination problems identified in Operable Units I and III. This response action is being implemented to protect human health and the environment from risks posed by the contamination problems.

This present response action, by addressing contaminated surface tailings and slag piles/beach in Operable Units I and III, is fully consistent with all future site investigation and cleanup work, including the on-going study in Operable Unit II. The contamination problems in and around Torch Lake, including groundwater, sediments, submerged tailings, surface water, and the risks posed thereby will be evaluated and addressed during Operable Unit II.

V. SITE CHARACTERISTICS

In November 1990 and January 1992, a Remedial Investigation (RI) report for Operable Unit I and Operable Unit III was completed. The RI for Operable Units I and III was to determine the nature and extent of contamination in the surface tailings and slag piles/beach deposited on the shore of Torch Lake and other water bodies at the Site, and evaluate possible exposure pathways. These reports summarized all sampling of the surface tailings and slagpiles/beach, drums, residential soil, background soil, air monitoring, and site survey data that had been collected. In addition, a RI report for Operable Unit II was completed in January 1992. The RI for Operable Unit II was to determine the nature and extent of contamination in the groundwater, surface water, submerged tailings, and sediments of Torch Lake and other water bodies in the Site. This report summarized all groundwater, surface water, and sediment data that had been collected. U.S. EPA also conducted long-term leachability tests for tailings, a fish reproduction study, a bald eagle and bird study, a bio-assay test for the sediment and surface water of Torch Lake, fish survey, wetlands identification study, Toxicity Characteristic Leaching Procedure (TCLP) test for tailings and the slag piles/beach, and a treatability study for soil cover with vegetation. These reports should be consulted for a more thorough description of the Site.

Although this ROD does not address the contamination problems for OU II, the data collected during the RI of OU II are discussed in order to determine the nature and extent of contamination problems in OU II caused by the contaminants located in Operable Unit I and III.

The following are the results of the RI at the Site:

- Based on the site survey activity conducted during the RI, the following acreage was estimated for each tailing and slag pile/beach:

		Area (acres)
OU I :	Lake Linden tailings	124
	Hubbell/Tamarack City tailings	121
	Mason tailings	197
	Hubbell slag pile/beach	9
OU III:	Calumet Lake tailings (location 1)	2
	Calumet Poor Rock (location 2)	-
	Boston Pond tailings (location 3)	65
	North Entry tailings (location 4)	46
	Michigan Smelter tailings (location 5)	23
	Quincy Smelter slag (location 6)	25
	Isle-Royale tailings (location 7)	223
	Dollar Bay slag (location 8)	28
	Grosse-Point tailings (location 9)	63
	Grosse-Point tailings (location 10)	94
	Redridge tailings (location 11)	85
	Freda tailings (location 12)	4

- An archive search was conducted to determine the type and source of tailings in OUs I and III. Based on this search, tailings were assigned to sectors which reflect uniqueness of tailing type and source. The tailings in OUs I and III are either red conglomerate or black amygdaloid tailings.

- Ambient air samples were collected in the Torch Lake area to determine the type and level of contaminants in the air released from tailing piles. Contaminants such as arsenic (0.0016 g/m[3]), cadmium (0.0276 g/m[3]), and copper (0.202 g/m[3]) were detected in the air. The highest PM[10] concentrations predicted by modeling was 42 g/m[3] in OU I and 16 g/m[3] in OU III. The National Ambient Air Quality Standard for PM[10] is 50 g/m[3]. It should be noted that cadmium was not found in OU I tailings, but was found in OU III tailings.

Magnetometry and ground penetrating radar surveys were conducted on OU I tailings to locate buried drums. A geophysical survey utilizing a remotely operated vehicle to locate drums in the lake bottom was also conducted. Based on ground-surface geophysical survey data, 10 test pits were excavated in OU I tailings area. No drums were discovered. Drums exposed on the surface were sampled. One overturned and leaking drum contained 4,000 parts per million (ppm) of trichloroethylene. Composite samples from these drums indicate that these drums contained hazardous substances. A total of 82 drums and minor quantities of underlying soils, along with 28 drums containing unidentified materials from the bottom of Torch Lake, were removed from the shore of Torch Lake. The removed drums and soils were sampled, overpacked, and disposed off-site in a hazardous waste landfill.

- Prior to the field sampling, field monitoring was conducted to detect alpha/beta/gamma radiation using a Monitor 4 detector. No radiation readings above background were measured for any tailing sample.

- Composite samples were collected from tailings and slag pile/beach in OU I. Two classes of Semi-Volatile Organic Compounds (SVOCs), phthalates and polycyclic aromatic hydrocarbons (PAHs) and inorganic compounds were found in surface tailings and slag pile/beach in OU I. Bis(2Ethylhexyl) phthalate (1.2 mg/kg), naphthalene (0.17 mg/kg), benzo(k)fluoranthene (0.56 mg/kg), benzo(a)pyrene (0.44 mg/kg), arsenic (8.3 mg/kg), chromium (46.3 mg/kg), copper (3,020 mg/kg), and lead (104 mg/kg) were found in OU I tailings.

Bis(2-Ethylhexyl)phthalate (0.11 mg/kg), arsenic (118 mg/kg), chromium (649 mg/kg), copper (12,800 mg/kg), and lead (113 mg/kg) were found in OU I slag pile/beach. No PCBs or Pesticides were detected in OU I tailings (See Table 1).

- Composite samples were collected from tailings and slag pile in OU III. No SVOCs were detected above the Contract Required Quantification Limits (CRQL). Inorganic compounds such as arsenic (55.8 mg/kg), cadmium (13.9 mg/kg), chromium (745 mg/kg), copper (15,900 mg/kg), and lead (39.6 mg/kg) were detected in OU III tailings. Arsenic (150 mg/kg), and lead (63.6 mg/kg) were detected in OU III Quincy Smelter slag pile (See Table 1).

- Geotechnical analysis was done for tailings, and slag samples collected in OU I and III to determine moisture content, grain size distribution, Atterberg Limits, water holding capacity, volume calculations, and cation exchange capacity. The results of this analysis indicate that surface tailings in OU I are predominantly silty sands and poorly graded sand with silt. The most heavily vegetated tailings exhibit the greatest moisture content. Water holding capacity ranges from 22 to 43 percent.

- Eleven soil samples were collected from nine residential backyards and a football field in Lake Linden, Hubbell/Tamarack City, and Mason to determine if contaminants from the tailings along the Torch Lake have impacted soil adjacent to or near the tailing sources. PAH compounds such as benzo(a)pyrene (1.6 mg/kg), pyrene (2.6 mg/kg), and inorganic compounds such as arsenic (7 mg/kg), chromium (20.1 mg/kg), copper (459 mg/kg), and lead (329 mg/kg) were detected in the residential soil. The U.S. EPA has determined that the level of these contaminants does not pose a significant threat to human health (See Table 1).

- Four soil background samples were collected from the Torch Lake area which were not affected by tailing deposition. Bis(2ethylhexyl_phthalate (925 mg/kg), naphthalene (5 mg/kg), and benzo(b)fluoranthene (0.03 mg/kg) were detected in the background soil samples. Inorganic compounds such as arsenic (6.3 mg/kg), chromium (23.3 mg/kg), copper (1,670 mg/kg), and lead (52.6 mg/kg) were detected (See Table 1).

- TCLP tests were conducted for the tailings and slag pile/beach in OU I to determine the leachability of the contaminants in tailings and slag piles/beach. Cadmium, copper, and lead were detected in leachate above the background level.

- Eight groundwater monitoring wells were installed in the OU I tailings to evaluate groundwater flow direction and to determine if contaminants are leaching from the tailings into groundwater. Groundwater flow within OU I tailings is to the south-southeast with groundwater discharge to Torch Lake. Acetone (14 g/l), bis(2-Ethylhexyl)phthalate (36 g/l), arsenic (25.2 g/l), chromium (119 g/l), copper (6,150 g/l), and lead (30 g/l) were detected in the groundwater. Two private wells, which are located north from the tailings, were sampled to determine the background ground-water levels. Copper (48.4 g/l) was detected in the background groundwater. Arsenic, chromium, and lead were not detected in the background wells (See Table 2).

- Four private wells in the Torch Lake area, a municipal well in Mason's tailings, four private wells in the Dollar Bay area, three private wells in the Isle-Royale tailing area, and the municipal well of Houghton in Isle-Royale tailings were sampled to determine whether it is safe to drink from these wells. All contaminants detected were below health standards specified by U.S. EPA and the Michigan Department of Public Health (MDPH) (See Table 2).

- 25 surface water samples from Torch Lake, and 15 surface water samples from Keweenaw waterway were collected to determine the contaminant levels in the lakes. Arsenic (3.4 g/l), copper (73.8 g/l), lead (7.2 g/l), and mercury (98 g/l) were found in Torch Lake water. Arsenic (5.7 g/l), copper (44.4 g/l), and lead (41.1 g/l) were found in Keweenaw Waterway. Surface water samples were collected from Lake Gogebic which is located 80 miles south-west from Torch Lake as background samples. Arsenic (2 g/l) and lead (2.5 g/l) were detected. Copper was not detected in the background lake sample (See Table 2). The contaminant level of arsenic, copper, lead, and mercury found in Torch Lake are above the human health and aquatic life protection criteria under the Clean Water Act.

- Based on a bathymetric survey conducted on Torch Lake, 25 sediment samples were collected from Torch Lake where tailing deposition had occurred. In addition, 15 sediment samples were collected from Keweenaw Waterway. Arsenic (41.2 mg/kg), chromium (83.8 mg/kg), copper (3,760 mg/kg), and lead (187 mg/kg) were found in Torch Lake sediment samples (excluding SD9 and SD10). A hot-spot area near Peninsula Copper Inc. in Torch Lake was identified (samples SD9 and SD10). Arsenic (4,560 mg/kg), cadmium (57.2 mg/kg), chromium (179 mg/kg), copper (6,890 mg/kg), lead (2,240 mg/kg), and aroclor-1254 (1,800 g/kg) were detected in the hot-spot. Arsenic (311 mg/kg), chromium (124 mg/kg), copper (4,200 mg/kg), and lead (93.6 mg/kg) were found in the Keweenaw Waterway. Arsenic (5.6 mg/kg), chromium (16.8 mg/kg), copper (47.6 mg/kg), and lead (27 mg/kg) were found in Lake Gogebic. Cadmium and Mercury were not found in Lake Gogebic (See Table 3).

A bio-assay test was conducted in the surface water samples from Torch Lake to determine the chronic effect of contaminants. The results of this test indicate that surface water of Torch Lake is not toxic relative to the test control. A bio-assay test also was conducted in the sediment samples from Torch Lake to determine both acute and toxic effect levels in the Torch Lake sediment. Lethal Concentration[50]s (LC[50]s) for copper as the sole contaminant was calculated as 498 parts per million (ppm) with a 95 percent confidence range of 480 ppm to 520 ppm. Most of sediment samples collected from Torch Lake and Keweenaw Waterway have higher copper concentration levels than LC[50]s. The results of this sediment bio-assay test indicate that the vast majority of the sediments in Torch Lake are toxic and not able to support a normal benthic community.

- A reproduction study was conducted in bald eagles and gulls nested in the Portage Lake and Torch Lake areas to determine whether bald eagles and gulls have been impacted by contaminants in the tailings. The reproduction study includes observation of food habits, and analysis of feather, egg, and blood. Based on the analytical chemistry results for copper, there does not appear to be any adverse reproductive effect on gulls or eagles that can be associated with exposure to copper in the tailings. Reproductive anomalies such as bill defects in two ring-billed gulls are usually attributed to PCB pollution in the Great Lakes.

- Reproduction by yellow perch was studied to determine if chronic exposure to elevated copper concentrations in Torch Lake has reduced the reproductive success of yellow perch. The results of this study indicate that copper concentration in Torch Lake did not significantly reduce hatching success. Duration of hatching was significantly longer for Torch Lake egg masses than was for reference lake egg masses, indicating that copper may be affecting hatching rates.

- In 1988, 458 fish were collected from the Torch Lake and Portage Lake and analyzed to determine the presence of fish contaminants and tumors. Only four of the 56 fish analyzed for mercury had concentrations that exceeded the 0.5 mg/kg consumption advisory action limit and none exceeded 1.0 mg/kg. No internal or external growth anomalies were observed among the 458 fish collected. No liver neoplasms (cancerous growths) were found among the 47 walleyes collected. Saugers were not collected in 1988 following an extended period of population decline which began in the 1960's.

- A treatability study is currently being conducted by the Soil Conservation Service to determine the effectiveness of soil cover with vegetation in the tailings and slag pile/beach. The preliminary results of this study indicate that 4 to 6 inches of sandy loam soils with a grass/legume mixture would be necessary in the non-vegetated area to achieve the remediation objectives. The study also indicates that a good maintenance program such as mulching, fertilizing, and irrigation would be necessary to increase the effectiveness of soil cover with vegetation.

- A study was conducted to identify the wetlands located at the Site. The study indicates that wetlands are located in the Boston Pond, Lake Linden, Hubbell and Portage Canal.

It should be noted that one composite sample per 10 acres for OU I tailing and one composite sample per 20 acres for OU III tailings were collected. Composite samples consisted of 4 subsamples collected. This small number of samples is based on the assessment that the tailings would be homogeneous in terms of their origin and chemical contents. However, based on the finding of hot-spots in the sediment, the disposal practice of waste in the tailings, and the detection of cadmium in the air but not in OU I tailings, it is possible that concentrations in the tailings would be higher if the sampling size was increased.

VI. SUMMARY OF SITE RISKS

The baseline risk assessments for OUs I and III were conducted to characterize the current and potential future threat to public health that may be posed by contaminants in the tailings and slag piles/beach. The ecological assessment for the entire site was also conducted to determine the current and potential future effects of contaminants to the environment. Both current and potential future use conditions were examined in the baseline risk assessment. Under current conditions, the Site was assessed in the absence of any remedial action for tailings and slag piles/beach.

A risk assessment consists of four primary parts: identifying chemicals of potential concern; assessing pathways through which humans, plants, and animals could be exposed to contamination; assessing the toxicity of the contaminants; and characterizing cancerous and non-cancerous health effects on humans.

a. Human Health Risks

1. Contaminant Identification

The first step of the risk assessment was to select chemicals of potential concern for detailed evaluation. This was conducted by summarizing and evaluating RI data, including a consideration of the presence of chemicals in blank samples. Based on this evaluation, 31 chemicals of potential concern were selected for detailed assessment for OU I. These chemicals were considered most likely to be of concern to human health and environment. The following compounds were selected as the chemicals of potential concern for OU I;

Organic Compounds	Inorganics
bis(2-Ethylhexyl)phthalate	Aluminum
PAHs	Antimony
Naphthalene	Arsenic
2-Methylnaphthalene	Barium
Acenaphthylene	Beryllium
Phenanthrene	Boron
Fluoranthene	Chromium
Pyrene	Cobalt
Benzo(a)fluoranthene	Copper
Chrysene	Lead
Benzo(b)fluoranthene	Manganese
Benzo(k)fluoranthene	Mercury
Benzo(a)pyrene	Nickel
Indeno(1,2,3-cd)pyrene	Silver
Dibenzo(a,h)anthracene	Titanium
Benzo(g,h,i)perylene	Vanadium

The chemicals of concern for OU III includes cadmium and the inorganic compounds listed above (except for boron, titanium, iron and thallium) and 6 organic compounds (benzo(b)fluoranthene, benzo(k)fluoranthene, butylbenzylphthalate, chrysene, diethylphthalate, fluoranthene, pyrene, and bis(2-ethylhexyl)phthalate).

These contaminants were detected in tailings and slag piles/beach of OUs I and III. Table 1 identifies the maximum concentration of contaminants in tailings and slag piles/beach.

2. Exposure Assessment

An exposure assessment was conducted to identify potential pathways of exposure under both current and future site and surrounding land use conditions.

Exposure Scenarios for OU I

The exposure pathways quantified in the OU I baseline risk assessment for current and future populations are based on the following scenarios:

(a) Current Populations Exposure Pathways

- Adult and child residents in off-site dwellings exposed to tailings, slag, and particulate;
- Occupational populations (lagoon workers and sludge spreaders) exposed to tailings and particulate from the tailings; and
- Adult and child campers exposed to tailings and particulate from the tailings.

(b) Future Populations Exposure Pathways

- Adult and child residents of on-site dwellings exposed to tailings and particulate from the tailings; and
- Adult and child residents of off-site dwelling exposed to tailings and particulate from tailings and slag.

For the ingestion of tailings by current and future residents, adult residents were assumed to weigh 70 kg and ingest 100 mg of tailings per day, 365 days per year and to live in the same location for 70 years

of their 70-year expected lifetime. For the inhalation of air-borne contaminants by current and future residents, adult residents were assumed to weigh 70 kg and inhale 0.84 m[3] of air per hour. A frequency of exposure of 365 days per year, and a duration of exposure of 70 years were assumed.

Scenarios involving children consider children to be between the ages of 0 and 6 years old. Generally, children above 6 years old are assumed to ingest and inhale particulate on a per kilogram body weight basis which is similar to adults. The occupational populations represent workers at four existing sewage lagoons in Lake Linden and Tamarack City and workers currently spreading sewage sludge on tailings in Mason.

The upper bound (95% confidence limit) of the arithmetic average of concentration of contaminants of concern at each assumed exposure location was used for tailings and slag piles/beach to calculate the risk. For the inhalation exposures, the exposure point concentrations were calculated using air emission and transport models.

Exposure Scenarios for OU III

The exposure pathways quantified in the OU III baseline risk assessment for both current and future populations are based on the following scenarios:

(a) Current Populations Exposure Pathways

- Adult residents of on-site dwellings exposed to tailings and tailing particulate at the Isle-Royale tailings;
- Adults scavenging in areas of OU III exposed to tailings;
- Teenagers scavenging in areas of OU III exposed to tailings and tailing particulate;
- Workers exposed to tailings and tailing particulate; and
- Adult and child visitors exposed to tailings and tailing particulate.

(b) Future Populations Exposure Pathways

- Adult and child residents of on-site dwellings exposed to tailings and tailings particulate; and
- Workers exposed to tailings.

(c) Future National Park Scenario

- Visitors and workers exposed to slag.

The human activity patterns and physical features of each area were evaluated to determine the exposure pathways likely to occur at each location. The OU III Baseline Risk assessment included the exposure pathway of "Teenage Scavenger". This separate scenario is predicated on the exposure of teenagers (considered adults for other exposure scenarios) to tailings based on their likely social/leisure activities which may be around tailings and/or slag piles. The same exposure factor assumptions were made as in OU I.

3. Toxicity Assessment

The purpose of the toxicity assessment is to evaluate the available evidence regarding the potential for a chemical to cause adverse health effects. This evidence, initially derived through the research of the potential cancerous and non-cancerous health effects (i.e. toxicity) of individual chemicals, is subsequently obtainable and can be employed in the assessment of site-related contamination. In the research of a chemical's toxicity, the effects of low levels of chemical exposure on people in the workplace are studied over long periods of time. Also, test animals are studied in laboratories, where animals are exposed to varying levels of chemicals over different lengths of time.

Cancer slope factors have been developed by EPA's Carcinogen Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. Slope factors, which are expressed in units of (mg/kg-day)[-1], are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the cancer slope factor. Use of this approach makes underestimation of the

actual cancer risk highly unlikely. Cancer slope factors are derived from the results of human epidemiological studies or chronic animal bioassays. Table 4 contains the cancer slope factors for carcinogenic contaminants of concern at the Site. The cancer risks resulting from these calculations are expressed in terms of the probability that an individual exposed for his or her entire lifetime will develop cancer (i.e. one chance in one million = 1 x 10[-6], one chance in one thousand = 1 x 10[-3]. Typically, excess cancer risks of 1 x 10[-6] or lower are considered acceptable, while higher excess cancer risk levels may be cause for concern. U.S. EPA has the discretion to select remedies resulting in upperbound cancer risks that fall within a range of 1x 10[-4] to 1 x 10[-6] based on site-specific factors. A cancer risk of 1 x 10[6] serves as the point of departure for U.S. EPA's cancer risk goal when selecting a remedy.

Reference doses (RfDs) have been developed by U.S. EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting non-carcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of the daily exposure to the human population (including sensitive subpopulations) that is likely to be without an appreciable risk of deleterious effects during a chronic or subchronic exposure duration. RfDs are derived from human epidemiological studies or animal studies; uncertainty factors are applied to help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects. The reference doses for contaminants of concern at this Site are specified in Table 4.

4. Risk Characterization

OU I Cancer Risks

A summary of cancer risks is presented in Table 5. The OU I risk assessment results showed that cancer risks to all current residential populations are equal to or below 1 X 10[-6] except in the vicinity of the Hubbell slag pile and slag beach. Cancer risks for these current residents are 9 X 10[6] (inhalation and ingestion at slag beach) and 9 X 10[-5] (inhalation and ingestion at slag pile) for a combined excess cancer risk of 1 X 10[-4]. However, due to the nature of the slag and snow cover, this area does not present an unacceptable health risk to humans. Total cancer risks for future residents at tailings in Lake Linden, Hubbell/Tamarack City, and Mason range from 8 X 10[-6] to 3 X 10[-5]. The risks are attributable primarily to arsenic, beryllium, and chromium. As indicated in the table, cancer risks for children are generally less than cancer risks for adults.

Risks to lagoon workers range from 8 X 10[-6] to 1 X 10[-5]. This risk is attributable primarily to ingestion of tailings containing arsenic and beryllium.

OU I Non-Cancer Risks

A hazard index, determined by summing the hazard quotients (HQs) for each chemical, greater than one indicates that some possibility that non-cancer, chronic or subchronic health effects exists. Chronic hazard indices do not exceed 1.0 for any exposure pathway evaluated in OU I. Subchronic hazard indices exceed 1.0 for exposure pathways involving children at the Lake Linden Campground, at current residences near the slag pile/beach, and future residences assumed to be built on the tailings piles. Chemicals contributing to these hazard indices include antimony, arsenic, barium, chromium, copper, manganese and vanadium. However, since these chemicals impact different systems and organs in the human body, it is appropriate to evaluate each chemical separately. In only one instance did any chemical exceed an HQ of 1.0. At the slag pile and beach, both copper and arsenic had an HQ of approximately 2.0 for a current child resident. For the other two exposure pathways involving children, listed above, which have subchronic hazard indices which exceed 1.0, copper was the dominant compound contributing to the hazard indices calculations for ingestion of contaminants. For a future child resident at Mason, a subchronic inhalation risk was driven by manganese and chromium. A summary of subchronic non-cancer risks is presented in Table 5. U.S. EPA has determined that, except at the slag pile/beach, OU I does not present an unacceptable non-cancer health risk to humans.

OU III Cancer Risks

Estimated cancer risks from exposures to the chemicals of potential concern at Torch Lake OU III for current and future populations are summarized in Table 6. Cancer risks which exceeded 1 X 10[-6] for OU III are primarily attributed to the ingestion of tailings by current or future adult or child residents at all of the OU III locations. Estimated excess cancer risks for current populations range from 3 X 10[-8] to 9 X 10[-5]. Cancer risks exceed 1 X 10[6] for current residents at Isle-Royale, Gross Point, and Lake Superior shoreline, for current workers at Isle-Royale and Quincy Smelter, and visitors (adult and child) to Boston Pond and North entry of Lake Superior. The estimated risks for future residents range from 1 X 10[-5] to 2 X 10[-4]. Cancer risks exceed 1 X 10[-6] for hypothetical future residents (adults and children) at all areas evaluated, however, only one location, Michigan Smelter, presents an

unacceptable cancer risk (2 X 10[-4]). Chemicals contributing to these risks are mainly arsenic and beryllium via ingestion of contaminated tailing and slag. Inhalation of air-borne chromium contaminated materials also contributes to the risk in those areas where this pathway was evaluated.

Estimated cancer risks to workers range from 2 X 10[-7] to 1 X 10[5] and for scavengers and visitors, risks range from 3 X 10[-8] to 8 X 10[-6].

OU III Non-Cancer Risks

Ingestion of tailings by current or future child residents poses most of the potential non-cancer risks. Subchronic hazard indices calculated for the OU III exposure scenarios are summarized in Table 6.

Subchronic health hazards (hazard indices greater than 1.0) were calculated for current child residents at locations 7, 9, 10, 11, and 12 and for future child residents at all other areas. These risks are due principally to ingestion of tailings or slag containing antimony, arsenic, copper and vanadium. Copper is the most pronounced contaminant contributing to these hazard indices, with hazard quotients greater than 1.0 for current child residents at location 12 and for future child residents at locations 1, 3, 4, 5, 6, and 8. Arsenic has an HQ of 2.0 for a future resident child at location 5 and antimony has an HQ of 5.0 for a future resident child at location 6.

The only calculated chronic hazard index which exceeds 1.0 is for future adult residents at location 6. The chemicals contributing to this hazard index include antimony, copper and chromium, although no single chemical contributed an HQ greater than 1.0.

OU III National Park Scenario

Because location 6 (Quincy Smelter area) is a part of the Quincy Mining Company Historic District which is proposed for inclusion in the National Historical Park, an exposure pathway was formulated to investigate the potential risks to future populations who might be exposed to the slag pile deposited at the Quincy Smelting area if this area were developed as a National Historical Park.

The potentially exposed populations at a national historical park are visitors to the park (adults and children) and workers at the site, including guides, caretakers and administrative personnel. Considering the location of the site and the proposed development of the Quincy smelting works, local residents may visit the park with their children for picnicking and/or other recreational activities.

Of the several types of workers at the site, the caretaker is likely to have the greater exposure. This individual is assumed to work outdoors during the five months of the year without snow cover and indoors during the remaining months. He is assumed to engage in activities (cleaning, building maintenance, etc.) which involve direct or indirect contact with tailings.

The estimated cancer risks for visitors to the Quincy Smelting area are 3 X 10[-6] for both adults and children and the risk to workers is 2 X 10[-5]. Arsenic is the major contributor to these risks. Hazard index (HI) values (subchronic an chronic) calculated for all populations are less than 1.0, indicating that noncarcinogenic health effects are not of concern.

Depending on the boundary line of the Calumet Historic District, location 1 (Calumet Lake tailings) would be a part of the proposed National Historic Park. It is estimated that the cancer risk from the tailings located in Calumet Lake, if developed as a National Historic Park in the future, is less than 1 X 10[-6] and non-cancer risk is less than 1.0. This estimation is based on the extrapolation from the risk data for a current exposure scenario. However, the release of tailing materials from this location to the lake would continue.

5. Ecological Assessment

As part of the Baseline Risk Assessment, an environmental evaluation, or ecological assessment, was conducted. The Ecological Assessment identified terrestrial, wetland and aquatic environments as potentially affected by the tailings in and around the lakes.

(a) Adverse Effects in the Terrestrial Environment

Although well established and healthy plant communities exist in areas surrounding tailing deposits, most of the tailings remain barren. Pioneer vegetation is conspicuously absent except in localized, isolated patches where streams flow through tailings, along wooded edges of deposits, and in depressions where moisture and organic matter accumulate. Plant survival and growth on tailings are impaired by a combination of chemical and non-chemical stresses, including poor water retention, extreme temperature

fluctuation, low organic content, and presence of toxic substances. Studies have shown that high levels of copper inhibit vascular development in some plants (Strieleman 1979). Six species of plants classified as State threatened or of special concern have been recorded in the vicinity of tailings deposits. Several are shoreline species or have habitat requirements which increase the likelihood that the species may be exposed to tailing deposits. Populations of these species have not been investigated to determine whether adverse effects from exposure to tailings are occurring or tailings deposits have destroyed their habitat in the study area.

Animal populations are likely to avoid tailing deposits for many of the same reasons that the tailings have not been colonized by plants. In addition, tailings lack food and cover required for establishment of ecologically or recreationally important wildlife populations.

(b) Adverse Effects in Wetlands

Deposition of tailings in surface waters is likely to have destroyed existing wetlands in a number of areas, including Boston Pond and along the western shore of Torch Lake. Wetlands are generally absent along Torch Lake shores where the most significant deposition of tailings took place, except where streams flow into the lake.

Failure of wetlands to develop on tailing deposits in Torch Lake is a serious problem. Large areas of the Torch Lake shoreline where water is sufficiently shallow and suitable for growth of wetland plants are devoid of wetland communities. The reasons for failure of wetland vegetation to become established along shoreline areas of Torch Lake have not been investigated, but substrate and surface water toxicity are likely to be involved. Ionic copper is likely to be the toxic factor.

The loss of wetland habitat in Torch Lake is likely to impact a number of migratory and residential animal populations that use this type of habitat for resting, feeding, and breeding at other locations.

(c) Adverse Effects in Aquatic Environments

Severe degradation of benthic communities is the most significant impact associated with tailing deposits and contaminated sediments in Torch Lake and other surface waters at the Site. The benthic community is an integral part of the base of a complex food web in lakes. A severely impacted benthic community would impact the entire food web. Data is available to indicate that most of Torch Lake, the northern 6 miles of the Portage Lake Shipping Canal and nearshore areas of Lake Superior between Redridge and the North Entry suffer these adverse effects (Charters 1991, Leddy 1984, Malueg et al. 1984b). Field and laboratory studies indicate that toxicity due primarily to elevated copper concentrations in sediments is responsible for observed environmental degradation.

Very few locations where sediment was sampled in Torch Lake have sediment copper concentrations that are below laboratory estimates of the LC[50] (400 to 630 mg/kg) for Hyalella exposed to copper in contaminated sediment. These include three areas farthest removed from the tailing deposits: in the mouth of the Trap Rock River; near the mouth of the Trap Rock River; and in the south-central area of the lake near the entrance to drainage into Portage Lake. Extremely high concentrations of arsenic and lead in submerged tailings near Hubbell are likely to enhance copper toxicity, so this area represents the greatest risk to aquatic life in Torch Lake. All other areas of the lake where tailings have been deposited are likely to be too toxic for development of pollution intolerant benthic organisms.

All measurements of copper concentrations in samples from tailings at Boston Pond exceed the LC[50]. Therefore, major reduction of benthic populations is expected at that location.

Other metals in tailings and contaminated sediment are likely to contribute to aquatic impacts in the study area. A series of benchmark sediment concentrations have been developed for evaluating biological effects of sediment contamination by the National Oceanic and Atmospheric Administration from data collected for the National Status and Trends Program. One of these, the Effects Range-Low (ER-L) is the lower ten percentile concentration of the range over which adverse effects have been observed at contaminated sites. A comparison of ER-Ls to Torch Lake sediment concentrations indicates that most other metals are present at levels that have the potential to contribute to adverse biological effects in the Torch Lake ecosystem. This is not the case in Lake Gogebic, 60 miles to the southwest.

The extremely limited benthic communities in Torch Lake suggest the lake is below its full potential for supporting fish production. Plankton are assumed to provide a food base for a portion of the fish community in Torch and Portage Lakes. Data on plankton communities is too limited to estimate the productive potential provided by this portion of the aquatic ecosystem in the study area.

A major issue in evaluating adverse effects of contaminants on fish communities is reproduction of fish populations in Torch and Portage Lakes. Adult fish are likely to migrate extensively throughout the

waterway. Data on fish migration and reproduction in the waterway are not available, so the relative contributions of exogenous and endogenous production cannot be evaluated. Hatching duration in perch eggs from Torch Lake are significantly longer than the hatching duration in eggs from a control lake. However, yellow perch are well represented in recent samples from Torch and Portage Lakes.

Fish may be reproducing along the eastern and southern shores of Torch Lake and in its tributaries. Areas where tailings deposits occur are unlikely to provide suitable habitat for breeding. Given the extensive area covered by tailings, it appears that Torch Lake now contains less suitable habitat for fish spawning than existed before tailings were deposited in the lake. Tumors and accumulation of toxic chemicals are two adverse effects in fish populations attributed in the past to contamination in the lakes. Liver tumors in fish, once an obvious problem in the study area, were not observed in the most recent samples from Torch and Portage Lakes. Other types of tumors were not included in the examinations. Mercury, PCBs and 4-4'-DDE have been observed at trace levels in northern pike, smallmouth bass and walleye in recent samples from Torch Lake. These chemicals are likely to be associated with sources other than contaminated tailings.

Copper concentrations in surface water in Torch Lake generally exceed Federal acute and chronic ambient water quality criteria for protection of aquatic life. Aluminum, cadmium, iron, lead and mercury also exceed criteria for protection of aquatic life at one or more sampling locations. However, fish bioassays using the fathead minnow do not indicate that surface water in Torch Lake is toxic to fish. This lack of toxicity in bioassays may be due to complexation of metals by dissolved humic substances.

Study results indicate that the short-term reproductive biology of bald eagles and gulls nesting within the Site ecosystem appears normal. The effect of copper on long term productivity is unclear. Long-term productivity data on the Portage Lake eagle nest indicated a poor reproductive history. However, poor productivity in eagles nesting near the Great Lakes has been associated with organochlorine and PCB contamination, making interpretation of the effects of other contaminants such as copper more difficult. Based on the analytical chemistry results for copper, there does not appear to be an adverse reproductive effect on gulls or eagles that can be associated with exposure to Torch Lake copper concentrations.

U.S. EPA has determined that actual or threatened releases of hazardous substances from this site, if not addressed by implementing the remedy selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

VII. DESCRIPTION OF REMEDIAL ALTERNATIVES

Based on the results of the RIs and risk assessments for OUs I and III, a Feasibility Study was conducted to identify and evaluate a variety of alternatives for protecting human health and the environment from the contamination associated with tailings and slag piles/beach at the Site. After identifying and screening potential remedial technologies for the Site, two alternatives for the tailing piles and four alternatives for the slag piles/beach were selected for further evaluation. The selection of these six alternatives from various remedial technologies was based on the screening process considering the remediation goal, state-of art technology, technical impracticability, cost, volume of tailings to be addressed, contaminant levels, and the merit of the technology. Each of the alternatives is evaluated using a set of nine criteria that reflect the goals of the Superfund program and are used by U.S. EPA to compare the merits of each alternative. These criteria are explained in Section VIII.

Four locations in OU III are not being considered for further evaluation of alternatives at this time. These locations are Location 2, Calumet Poor Rock; Location 4, the North Entry to Lake Superior; and Locations 11 and 12 along the Lake Superior shoreline of the Keweenaw Peninsula. Location 2 is a site of disturbed but unprocessed rock piles which present no risk, and do not contain the properties of tailings or slag materials. Locations 4, 11, and 12 are along the Lake Superior shore where pounding waves and water currents will likely retard or destroy any remedial action. As a result, U.S. EPA currently believes it to be technically impracticable to implement the chosen remedy at these locations. However, a portion of the tailings at locations 4 and 12 may be sufficiently unaffected by the lake to effectively implement the soil cover and vegetation remedy. This possibility will be explored during Remedial Design. The poor rock and slag materials located upstream of Trap Rock river are also excluded because these materials are unprocessed rocks.

Descriptions of the six alternatives considered by U.S. EPA are provided below, including costs, estimated in terms of capital cost and annual operation and maintenance cost. Together these two dollar amounts are converted to net present worth. U.S. EPA's evaluation of each remedial alternative using the evaluation criteria is summarized in Section VIII.

The alternatives considered for tailing piles in OUs I and III are:

- Alternative T1: No Action.
- Alternative T2: Soil cover with Vegetation.

The alternatives considered for slag piles/beach in OUs I and III are:

- Alternative S1: No Action.
- Alternative S2: Fencing.
- Alternative S3: Soil cover with vegetation for slag pile/beach located in Hubbell.
- Alternative S4: Excavation and Off-site Disposal.

A Description of each of these alternatives follows:

Alternative T1: No Action

U.S. EPA requires consideration of a no-action alternative to serve as a basis against which other remedial alternatives can be compared. The no action alternative involves no treatment or containment of the contaminants present in the tailings. Therefore, the potential risk to human health at a few of the tailing piles in OU III through the inhalation and ingestion pathways will remain the same. The environmental impact from the tailings will also remain the same.

Alternative T2: Soil Cover with Vegetation

Alternative T2 consists of installing a soil cover over the exposed tailings, and then vegetating the cover by seeding with appropriate native plant species. A maintenance program including mulching, fertilizing, and irrigating would be also implemented. Deed restrictions would be sought to control the use of tailing piles so that tailings will not be left, long term, in a state that will expose humans and animals to contaminants. Before the soil cover is installed, debris such as wood, empty drums, and other garbage in the tailing piles would be removed for off-site disposal in order to effectively implement the soil cover with vegetation.

The total area of tailing piles to be addressed under this alternative would be approximately 671 acres; 442 acres for OU I tailings and 229 acres for OU III tailings.

The costs for Alternative T2 for OUs I and III would be:

	OU I	OU III	Total
Capital Cost:	$3,297,500	$2,890,000	$6,187,500
Operation and Maintenance:	$ 50,000	$ 58,000	$ 108,000
Present Net Worth:	$3,146,000	$2,868,000	$6,014,000

The implementation time for this alternative would be 5 years. Operation and Maintenance includes 10 years of a maintenance program of planted vegetation such as mulching, fertilizing and irrigating.

(The total present net worth is lower than the capital cost because the placement of soil cover is estimated to take 5 years. The interest accrued over five years would cover the increased cost).

Alternative S1: No Action

The no action alternative, S1, for slag piles/beach involves no treatment or containment of the slag piles/beach. Therefore, the potential for these contaminants at a few of the slag piles in OU III to be ingested or to be released to air and inhaled by humans will continue to exist. The environmental impact from the slag pile should remain the same.

Alternative S2: Fencing

This alternative consists of a 4-foot high fence around the slag piles/beach located in OUs I and III, three strands of barbed wire, and warning signs to restrict access.

The perimeter of slag material to be fenced would be approximately 7,000 linear feet, 4,000 linear feet for OU I slag and 3,000 linear feet for OU III slag.

The costs for Alternative S2 are:

	OU I	OU III	Total
Capital Cost:	$ 30,000	$ 22,000	$ 52,000
Operation and Maintenance:	$ 300	$ 300	$ 600
Present Net Worth:	$ 34,000	$ 26,100	$ 60,100

The implementation time for this alternative would be 1 month.

Alternative S3: Soil Cover with Vegetation (Slag pile/beach in Hubbell)

Alternative S3 consists of installing a soil cover over the exposed slag pile/beach in Hubbell (OU I), and then vegetating the cover by seeding with appropriate native plant species. The maintenance program including mulching, fertilizing, and irrigating would be also implemented. Deed restrictions would be sought to prevent the use of slag pile/beach that will expose humans and animals to contaminants.

This alternative only applies to the slag piles/beach at Hubbell (OU I), and does not apply to the slag pile at the Quincy Smelter (Location 6, OU III) for the following reasons:

- The slag pile at Hubbell (OU I) is located in the middle of a residential area and therefore poses a greater risk of exposure to the residents living near the slag pile/beach at Hubbell than the Quincy slag pile which is located in an industrial area.
- The Hubbell slag pile (OU I) is amenable to the installation of soil cover and vegetation.
- The Quincy slag pile (OU III) is very steep and requires regrading before an effective soil cover can be installed.

The capital cost for implementing this alternative is $105,000 and operation and maintenance cost is anticipated to be $1,000. Present net worth is $112,400. The implementation time for this alternative would be 3 months.

Alternative S4: Excavation for off-site Disposal

This alternative consists of excavation of the slag piles/beach in OUs and II and III, transportation of the excavated material, and disposal of the material in an off-site landfill.

Implementing this alternative should allow for unrestricted future development of the property on which the slag piles/beach are presently situated if it is determined that no institutional controls are required after slag removal.

The volume of slag materials to be addressed under this alternative would be approximately 236,000 cubic yards, 94,000 cubic yards for OU I slag and 141,000 cubic yards for OU III slag.

The costs for Alternative S4 for OUs I and III would be:

	OU I	OU III	Total
Capital Cost:	$4,463,000	$6,685,000	$11,148,000
Operation and Maintenance:	$ 0	$ 0	$ 0
Present Net Worth:	$4,463,000	$6,685,000	$11,148,000

The implementation time for this alternative would be 1 year.

VIII. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

A detailed analysis was performed on the six alternatives using the nine evaluation criteria in order to select control remedies for tailings and slag piles/beach. The following is a summary of the comparison of each alternative's strength and weakness with respect to the nine evaluation criteria. These nine criteria are:

1) Overall Protection of Human Health and the Environment
2) Compliance with Applicable or Relevant and Appropriate Requirements (ARAR's)
3) Long-Term Effectiveness and Permanence
4) Reduction of Toxicity, Mobility, or Volume through Treatment
5) Short-Term Effectiveness
6) Implementability
7) Cost
8) State Acceptance
9) Community Acceptance

1. Overall Protection of Human Health and the Environment

Alternative T1 represents the no action alternative for the tailings. This alternative does not satisfy the requirement for overall protection of human health and the environment. Non-cancer risks at OU III Locations 1, 3 through 6, 8, and 12 were higher than acceptable levels due principally to copper and, at Location 5, arsenic. Alternative T1 will not mitigate these risks. Further, Alternative T1 will not address environmental harm.

Severe degradation of benthic communities and absence of wetlands in shallow areas are the most significant impacts associated with tailing deposits and contaminated sediments in Torch Lake and other surface waters in the area. Data is available to indicate that most of Torch Lake and the northern 6 miles of the Portage Lake Shipping Canal suffer these adverse affects. Reduction of productivity in fish populations is a possible secondary result of these impacts. Under a no-action alternative, degradation of the lake environment could continue. This may preclude the re-establishment of a more typical lake environment found in northern Michigan lakes. Alternative T2 is protective of human health and the environment in those few areas where the risk to human health is unacceptable. Soil cover over exposed tailings will reduce or eliminate the potential risks due to the inhalation and ingestion pathways. Vegetation will control erosion of the soil cover. Alternative T2 will also minimize surface water run-off from the tailings and will reduce potential transport of contaminants into the lake. Thus, installing soil cover and vegetation would benefit the aquatic environment by substantially reducing the potential for contaminant transport via surface water erosion of and air borne from tailings into the lake. The establishment of healthy vegetation will facilitate potential development of animal habitat by providing forage and cover for terrestrial animals.

Alternative S1 represents the no action alternative for the slag piles/beach. This alternative is not protective of human health for OU I slag. Contaminants would continue to be transported off-site by wind dispersion. The OU I slag piles/beach do not promote vegetation and could be detrimental to establishment of habitat in the future. The risk scenario for OU III slag is different as it is located in an industrial area. Under the National Historic Park scenario in which a national historic park will be developed, which includes Quincy Smelter (OU III, Location 6), in the future, risks to human health for potential visitors and workers are in the acceptable range. In addition, because the slag at this location is in a massive, vitrified form, it is not thought to be a contaminant source to the lake.

Alternative S2 includes fencing the slag piles/beach. Although fencing does not treat or contain contaminants, it reduces the risk of exposure to contaminants by limiting the opportunity for ingestion. Currently, unrestricted access permits certain areas of the slag piles/beach to be used for unauthorized dumping or other activities. Fencing will deter such activities and reduce associated exposure scenarios. In this way, Alternative S2 could be sufficiently protective of human health. However, contaminants would continue to be carried off-site by wind dispersion and the slag will not promote vegetation.

Alternative S3 will achieve the established remedial objectives because exposure to contaminants will be eliminated since the principle source of threat would be contained.

Alternative S4 will achieve the established remedial objectives and will protect human health because contaminants will be removed from the site. Risk associated with exposure to contaminants from the slag will be eliminated because the source of the threat will be removed from the site.

2. Compliance with ARARs

A detailed evaluation of ARARs pertaining to each tailing and slag pile/beach alternative is presented in the FS.

Alternative T2 complies with pertinent ARARs specific to this alternative. The Michigan Environmental Response Act 307 is an applicable requirement for this site. U.S. EPA has determined that this alternative complies with an Act 307 Type "C" cleanup. Under the MDNR's reading of Act 307, this ROD is

to be considered an Act 307 interim remedy, as allowed by R 299.5509. U.S. EPA considers this remedy to be a final remedy for Operable Units I and III.

The Clean Air Act (CAA), 40 CFR Parts 50, 51 and Michigan Air Pollution Act 348 are relevant and appropriate because air-borne tailings dust generated during construction of the site cover could migrate through the air pathway which could affect human residents as well as environmental recipients of the contaminants including animals (including endangered species) and the lakes. During implementation, air sampling will be performed to monitor potential release of contaminants into the air. In addition, dust control measures will be employed to assure compliance with these ARARs.

The Protection of Wetlands Act and Michigan Act 203 (1974) are relevant and appropriate because of wetlands in OUs I and III which may be affected by Alternative T2. To comply with this ARAR, care will be taken to ensure that wetland areas are clearly delineated and protected from soil cover installation at all locations within OU I and OU III.

Alternative T2 will comply with the requirements of Michigan Act 347 (1972), Soil Erosion and Sedimentation Control Act.

Alternative S2 complies with the Federal ARARs. The State of Michigan has indicated that it believes that Alternative S2 does not meet Michigan Act 245, Act 348, or Act 307 Type C cleanup criteria triggered by this alternative. Fencing cannot prevent migration of contaminants via wind dispersion, groundwater movement, and/or surface water runoff. If this alternative were selected for slag materials, then a waiver of ARARs would potentially be needed.

Alternative S3 complies with all listed ARARs for Alternative T2. Alternative S4 complies with all applicable ARARs listed for Alternative T2 except that the Quincy Smelter historic area could be impaired.

3. Long-Term Effectiveness and Permanence

The evaluation of alternatives under this criterion address the risk remaining at the Torch Lake site at the conclusion of remedial activities and the ability of alternatives to maintain reliable protection of human health and the environment over time.

Alternative T1 provides no long-term protection and would allow the current conditions to remain at the Torch Lake site. Alternative T2 on the other hand, is effective because the contaminants would be contained, minimizing tailing erosion into the lake and enhancing the development of terrestrial habitat. Residual risk is minimal as long as the integrity of the soil cover is maintained.

Alternatives S1 provides no long-term effectiveness and would result in the elevated risk levels that currently exist where the slag piles/beach are located. Alternative S2 provides some degree of effectiveness because fencing will reduce the risk of exposure to contaminants by ingestion. Alternative S3 will provide long-term effectiveness because it would reduce the risks of environmental harm and would reduce inhalation and ingestion of material from a few of the contaminated piles. Alternative S4 will provide long-term effectiveness because the source of contamination will be permanently removed from the site.

4. Reduction of Toxicity, Mobility and Volume through treatment

This criterion addresses the statutory preference for selecting remedial actions which use treatment technologies that permanently and significantly reduce toxicity, mobility or volume of contaminants. Because of the large area covered by the contaminants and the volume of material to be treated, potential remedial actions involving treatment were determined to be impractical for the Torch Lake site. Consequently, none of the proposed alternatives involve treatment of contaminants.

Alternative T1 does not reduce toxicity, mobility or volume of contaminants on-site. Alternative T2 also does not reduce toxicity or volume of the contaminants through treatment. However, this alternative reduces the release of the contaminants through the air, groundwater and lakes.

Alternatives S1, S2, S3, and S4 do not reduce toxicity, mobility or volume of contaminants through treatment. However, Alternative S4 eliminates the toxicity, mobility, or volume of contaminants with respect to the site via off-site shipment of slag to a landfill. Alternative S3 reduces the mobility of contaminants by reducing the potential for redistribution via wind, surface water runoff (erosion), or by water infiltration.

5. Short-Term Effectiveness

This criterion addresses the effects of the alternatives on human health and the environment during the construction and implementation phases. The short-term effectiveness period extends until the remedial response objectives are met.

This criterion is not applicable to Alternative T1 because no action will be taken. Alternative T2 will potentially generate short-term particulate emissions and noise. Dust control measures and development of health and safety plans are proposed as part of this alternative to minimize these hazards. Incidental noise pollution will be minimized by proper scheduling of work hours.

Alternative S1 poses no short-term hazards. Alternative S2 would need to include health and safety measures to protect workers installing the fence from exposure to contaminants. Alternatives S3 and S4 would need to include a health and safety plan, as well as dust control measures to control fugitive emissions. For Alternative S3, the soil cover can be placed within 1 year.

6. Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative, and the availability of various services and materials required for its implementation.

Alternative T1 involves no action and thus, no implementation. Alternative T2 can be readily implemented, except in those areas wherein U.S. EPA believes implementation to be technically impracticable, because installing a vegetated soil cover is an established technology and competitive bids can be obtained from many commercial vendors.

Alternative S1 requires no implementation because it represents the no action alternative. Alternatives S2 and S3 can both be implemented. Alternatives S3 and S4 are more difficult to implement than Alternative S2 because they require more detailed planning. Alternative S3 may be more efficiently implemented and cost-effective if Alternative T2 is also implemented. Because large quantities of slag have to be transported off-site for Alternative S4, landfill cells will have to be prepared in advance to receive the material.

7. Cost

For Alternative T2, a modified approach was adopted for present worth analysis. This alternative will require 5 years for implementation. Since contractors performing the remediation will require payment as services are rendered, the total capital expenditure was assumed to be received in five equal installments. The costs incurred in the second, third, fourth, and fifth years are adjusted to the base year by applying the appropriate present worth factor. Because the capital expenditure is distributed over 5 years, this approach for calculating present worth will result in a slightly lower present worth cost than would be obtained by assuming that all of the capital cost will be incurred at the end of 5 years. The O&M costs for Alternative T2 is expected to be incurred for only 10 years after which a full vegetative cover is anticipated to be established.

Alternative S4 is the most expensive and Alternative S1 is the least expensive.

See Section VII for detailed cost information of each alternative.

8. State Acceptance

The Michigan Department of Natural Resources (MDNR) concurs with the selected remedy.

9. Community Acceptance

The specific comments received and U.S. EPA's response are outlined in the attached Responsiveness Summary.

IX. THE SELECTED REMEDY

As provided in CERCLA and the NCP, and based upon the evaluation of the RI/FS and the nine criteria, the U.S. EPA, in consultation with the MDNR, has selected Alternative T2 for tailing piles in OU I and III, Alternative S3 for the Hubbell slag pile/beach and certain slag piles in OU I, and Alternative S1 for Quincy Smelter slag pile in OU III as the remedial action at the Torch Lake Site, Operable Units I and III.

These alternatives were selected for tailings and slag piles/beach located in OUs I and III of the Site based on the cancer risk to current and future residents from inhaling and ingesting certain tailings and slag piles/beach, the non-cancer risk from tailings and slag materials at certain tailing/slag piles in OU III, the adverse impact of the tailings on Torch Lake and other water bodies, the adverse impact of the tailing piles on the natural habitat surrounding Torch Lake, including the loss of wetlands, and the location of these contaminants in a Great Lake "Area of Concern". In addition, the selected alternatives provide the best balance of the nine evaluation criteria.

The major components of selected remedy include the following:

- Deed restrictions would be sought to control the use of tailing piles and slag piles/beach so that tailings and/or slag will not be left in a condition which will expose humans and animals to contaminants or increase the potential for run-off of contaminants into the lake;

- Removal of debris such as wood, empty drums, and other garbage in the tailing piles for off-site disposal in order to effectively implement the soil cover with vegetation;

- Soil cover with vegetation over OU I tailings in Lake Linden (124 acres), Hubbell/Tamarack City (121 acres), and Mason (197 acres). OU I tailings was estimated as 442 acres;

- Soil cover with vegetation over OU III tailings in Calumet Lake (location 2, 2 acres), Boston Pond (location 3, 65 acres), Michigan Smelter (location 5, 23 acres), Dollar Bay slag pile (location 8, 28 acres), and Grosse-Point (location 9 and 10, 157 acres). OU III tailings were estimated as 229 acres;

- Soil cover with vegetation over OU I slag pile/beach in Hubbell. OU I slag pile/beach was estimated as 9 acres;

- The Isle-Royale tailings in OU III will be excluded from the area to be covered with soil and vegetation under this ROD as follows:

    - The portion of Isle-Royale tailings which is being developed as a sewage treatment plant will be excluded from the area to be covered with soil and vegetation under this ROD. The part of this area to be covered by conventional sewage treatment tanks is approximately 12 acres. The remaining part, approximately 48 acres, will be covered with soil and vegetation by the Portage Lake Water and Sewage Authority as part of the sewage treatment facility development plan. If this area is not covered and vegetated within 5 years after the date that the final Remedial Design is submitted, then this area shall be subject to the requirements of this ROD. The completed sewage treatment facility will achieve the remedial objectives by reducing the release of contaminants into the air;

    - The portion of the Isle-Royale tailings which is designated to be developed as a residential area will be excluded from the area to be covered with soil and vegetation under this ROD. This area covers approximately 90 acres. However, if this area is not developed as a residential area within 5 years after the date that the final Remedial Design is submitted, then this area shall be subject to the requirements of this ROD;

    - The portion of the Isle-Royale tailings which is currently being used as source material to make cement blocks and as a finished block storage area for the Superior Block Company will be excluded from the area to be covered with soil and vegetation under this ROD. This area is estimated to be 60 acres. It is determined that the use of tailings as a storage area for cement blocks would somewhat achieve the remedial objectives by reducing the release of contaminants into the air. However, if any portion of the area is no longer to be used as a storage area, soil cover with vegetation must be implemented pursuant to this ROD. The owner and/or operator of Superior Block Co. must use dust control measures such as water spray during the operation of mining and other activities in order to reduce the release of dust into the air;

- The area designated by Houghton County Road Commission as source material to spread on the road during winter to provide traction for motor vehicles will be excluded from the area to be covered with soil and vegetation. This area is located in Grosse-Point and is estimated to be 46 acres. The tailing pile presents no unacceptable risk to human health. While this area is being utilized, the following procedures must be observed:

    - The area should be covered with enough soil to prevent the release of tailings to the air and lake;

- Excavation should stop at seven (7) feet above the water table (defined as the average of seasonal highs and lows over a two year period). This portion must subsequently be covered with soil or soil and vegetation;

- Once the entire area is excavated to seven (7) feet above the water table, it must be covered with soil and vegetation pursuant to this ROD;

• No action for the OU III slag pile located in the Quincy Smelter area (location 6, approximately 25 acres), based on the assumption that this area will be developed as part of a National Historic Park. If this area is not developed as a National Park in the future, deed restrictions will be sought to prevent the development of residences in the slag pile area;

• The North Entry (location 4), Redridge (location 11) and Freda (location 12) tailings are excluded from the area to be covered under this ROD. Locations 4, 11, and 12 are along the Lake Superior shore where pounding waves and water currents will likely retard or destroy any remedial actions. As a result, U.S. EPA currently believes it to be technically impracticable to implement the chosen remedy at these locations. However, the North Entry (location 4) and Freda (location 12) tailings, approximately 46 acres, shall be studied during Remedial Design. If U.S. EPA determines that any portion of these two areas is sufficiently unaffected by Lake Superior wave activity such that it can be effectively covered with soil and vegetated, then the unaffected area or areas shall be subject to the requirements of this ROD.

Estimated costs for implementing the selected remedies, based on an assumption of 442 acres of OU I tailings, 9 acres of OU I slag, and 290 acres of OU III tailings, are as follows:

Capital Costs:

Operable Unit I: $3,402,000
Operable Unit III: $2,890,000

Annual Maintenance Costs:

Operable Unit I: $ 51,000
Operable Unit III: $ 58,000

Present Net Worth:

Operable Unit I: $3,258,000
Operable Unit III: $2,868,000

Total Present Net Worth:

Operable Units I and III: $6,126,000

X. STATUTORY DETERMINATIONS

The selected remedy must satisfy the requirements of Section 121 of CERCLA to:

A. protect human health and environment;
B. comply with ARARs;
C. Be cost-effective;
D. Utilize permanent solutions and alternate treatment or resource recovery technologies to the maximum extent practicable; and,
E. Satisfy the preference for treatment as a principle element of the remedy or document in the ROD why the preference for treatment was not satisfied.

The implementation of the selected remedy at the Site satisfies the requirements of CERCLA as detailed below:

A. Protection of Human Health and the Environment

This selected remedy will provide adequate protection of human health and the environment through soil cover with vegetation.

Risk posed by contaminants in the tailings and slag piles/beach in OU I and in the few tailing/slag piles in OU III through direct contact and air inhalation will be reduced and controlled by soil cover and

vegetation over tailings and slag pile/beach. The North Entry (location 4) and Freda (location 12) tailings do present a non-cancer health risk based on current (location 12) and future (location 4) residential scenarios, however these areas are excluded from the area to be covered under this ROD. Locations 4 and 12 are situated along the Lake Superior shore where pounding waves and water currents will likely retard or destroy any remedial actions. As a result, U.S. EPA currently believes it to be technically impracticable to implement the chosen remedy at these locations. However, portions of locations 4 and 12 may be sufficiently unaffected by wave activity such that soil coverage and vegetation may be possible. Therefore, during Remedial Design, location 4 and location 12 will be studied so as to determine whether the residential scenario, and therefore remedial action under this ROD, is appropriate for any portion of either area. Obviously, areas which are subject to violent wave action could not be justifiably described as residential.

No unacceptable short-term risks will be caused by implementation of the remedy. Standard safety programs, such as monitoring, and use of protective equipment, should mitigate any short-term risks. Short-term risks include exposure of site workers and the community to dust particles, and to noise nuisance during implementation of the soil cover with vegetation. Ambient air monitoring would be conducted and appropriate safety measures would be taken if contaminants were emitted.

B. Compliance with ARARs

The selected Remedial Action for Operable Units I and III of the Site will comply with all Federal and more stringent State applicable or relevant and appropriate requirements.

U.S. EPA has determined that alternatives T2 and S3 comply with a Michigan Environmental Response Act 307 Type "C" cleanup. Under the MDNR's reading of Act 307, this ROD is to be considered an Act 307 interim remedy, as allowed by R 299.5509. U.S. EPA considers this remedy to be a final remedy for Operable Units I and III.

During implementation of Alternatives T2 and S3, air sampling will be performed to monitor potential release of contaminants into the air and dust control measures will be employed to meet compliance with CAA and Michigan Air Pollution Act 348.

Alternatives T2 and S3 shall be designed and implemented not to destroy, lose or injure the wetlands located at the Site in order to comply with Protection of Wetlands and Michigan Act 203.

The State has indicated that it believes the Michigan Solid Waste Act 641 (1979) to be an ARAR for this ROD. U.S. EPA does not concur with this assessment. First, U.S. EPA has determined that Act 641 is not applicable. Secondly, even if Act 641 may be relevant in that tailings and slag from copper mining may be considered a solid waste from an industrial process, U.S. EPA has determined that Act 641 is not appropriate in that an Act 641 cap is not well suited to this site due to the size and situation of the areas addressed by this ROD.

The following ARARs are associated with the selected remedy for this site:

Chemical Specific

- Clean Air Act (CAA) 40 CFR 50.1-6,8,9,11 and 12.
- Michigan Environmental Response act 307 (1982), MCL 299.601 R 299.5101
- Michigan Air Pollution Control Act 348 (1965) Part 2,3,9 and 10

Action Specific

- Clean Air Act (CAA), 40 CFR Parts 50, 51
- Federal Protection of Wetlands Act, 40 CFR 6, APP.A
- Michigan Act 203 (1974), Wetland Protection Act
- Michigan Shoreland Protection and Management Act 245 (1970)
- Michigan Act 347 (1972), Soil Erosion and Sedimentation Control Act, MCL 282.101 R 323.1701
- Michigan Act 348 (1965), Parts 2, 3, 9, and 10, Air Pollution Act

Location Specific

- Archaeological and Historic Preservation Act, 40 CFR 6.301(c)/16 USC 469
- National Historic Preservation act, 40 CFR 6.301(b)/16 USC 470
- Historic Sites, Buildings and Antiquities Act, 40 CFR 6.301(a)/16 USC 461-467
- Fish and Wildlife Coordination Act, 40 CFR 6.302(g)/16 USC 1531-1566
- Endangered Species Act, 50 CFR Parts 17 and 402/16 USC 1531-1543
- Protection of Wetlands, 40 CFR 6 (App. A)
- Michigan Endangered Species Act 203 (1974), MCL 299.221 R299.1021
- Michigan Wetland Protection Act 203 (1979), MCL 281.701 R281.921
- Michigan Shoreland Protection and Management act 245 (1970), MCL 281.641
- Michigan Soil Erosion and Sedimentation Control act 347 (1972), MCL 282.101 R323.1701

The following regulations are identified as to be considered (TBC) for this ROD:

- Occupational Safety and Health Act, 29 CFR 120
- Michigan Act 154, Rule 3301 (1974), Michigan Occupational Safety and Health Act.
- MCLA 257.722, Michigan Vehicle Code

C. Cost-Effectiveness

Cost-effectiveness compares the effectiveness of an alternative in proportion to its cost of providing its environmental benefits.

The selected remedy is cost-effective because it provides a high degree of overall effectiveness proportional to its costs. The estimated cost of the selected remedy is comparable with the other alternatives and assures a high degree of certainty that the remedy will be effective in the long-term due to the significant reduction of the risks due to the direct contact and air inhalation and of the release of contaminants into the environment.

D. Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy does not involve treatment technologies because any form of treatment for the tailings and slag piles/beach is not practicable or cost effective at this time. However, U.S. EPA believes and the State of Michigan concurs that the selected remedy represents the maximum extent to which permanent solutions can be utilized in a cost-effective manner for the remedial action at the Site. Soil cover with vegetation over tailings and slag pile/beach located at the Site will significantly reduce the risks posed through direct contact and air inhalation. The selected remedy would also reduce the release of tailings into the lakes through erosion, water infiltration, and air deposition. U.S. EPA has determined that the selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short-term effectiveness, implementability, cost and State and community acceptance.

E. Preference for Treatment as a Principal Element

The risks to human health and the environment associated with Operable Units I and III of the Site are presented by the contaminated tailings and slag pile/beach.

Although treatment was not found to be practical, the selected remedy addresses these risks by installing soil cover with vegetation over contaminated tailings and slag pile/beach. The groundwater, surface water, sediments, and associated biota at the Site will be addressed in an Operable Unit II ROD.

XI. DOCUMENTATION OF SIGNIFICANT CHANGES

After a careful review of the comments received from the public during the public comment period and public meeting, U.S. EPA has determined that the following areas should be excluded from the area to be covered with soil and vegetation under this ROD:

- The Isle-Royal tailings in OU III will be excluded as follows:

  - The portion of Isle-Royale tailings in OU III which is being developed as a sewage treatment plant. The part of this area to be covered by conventional sewage treatment tanks is approximately 12 acres. The remaining part, approximately 48 acres, will be covered with soil and vegetation by the Portage Lake Water and Sewage Authority as part of the sewage treatment facility development plan. However, if this area is not covered and vegetated within 5 years after the date that the final Remedial Design is submitted, then this area shall be subject to the requirements of this ROD;

  - The portion of the Isle-Royale tailings which is designated as an area to be developed as a residential area. This area covers approximately 90 acres. However, if this area is not developed as a residential area within 5 years after the date that the final Remedial Design is submitted, then this area shall be subject to the requirements of this ROD;

  - The portion of Isle-Royale tailings in OU III which is currently being used as source material to make cement blocks and as a finished block storage area for the Superior Block Company. This area covers approximately 60 acres. However, if any portion of the area is no longer to be used as a storage and source area, soil cover with vegetation must be implemented pursuant to this ROD. The owner and/or operator of Superior Block Co. must use dust control measures such as water spray during the operation of mining and other activities in order to reduce the release of dust into the air; and

- The portion of the Grosse-Point tailings which is currently being used by the Houghton County Road Commission as source material to spread on the road during winter to provide traction for motor vehicles.

This area covers approximately 46 acres. While this area is being utilized, the following procedures must be observed:

- The area should be covered with enough soil to prevent the release of tailings to the air and lake;

- Excavation should stop at seven (7) feet above the water table (defined as the average of seasonal highs and lows over a two year period). This portion must subsequently be covered with soil or soil and vegetation;

- Once the entire area is excavated to seven (7) feet above the water table, it must be covered with soil and vegetation pursuant to this ROD.

U.S. EPA has determined that the completed sewage treatment facility would achieve the remedial objectives by covering the tailings. The use of tailings as a cement block storage area would also somewhat achieve the remedial objectives by reducing the release of contaminants into the air. Therefore; U.S. EPA has determined to exclude the Isle-Royale tailings (as described above) from the area to be covered with soil and vegetation under this ROD. However, if the area is no longer used as a cement block storage area, soil cover with vegetation must be conducted under this ROD. The owner and/or operator of Superior Block Co. must use dust control measures such as water spray, during the operation of mining and other activities in order to reduce the release of dust into the air.

The City of Houghton has indicated that the City has a plan to develop approximately 90 acres of Isle-Royale tailings into a residential area. This plan includes covering tailings with 2 feet of soils. It is expected to implement this plan within 5 years. Since this plan is similar to the remedy under this ROD, U.S. EPA has determined to exclude this 90 acre tract from the area to be covered with soil and vegetation in order to allow the local township to implement their plan. However, if this plan is not implemented within 5 years after the date that the Remedial Design is submitted, then the soil cover with vegetation under this ROD must be implemented.

It is also determined that the use of tailings from the Grosse-Point tailing pile as road-friction material over such a large area, given the limited time period of exposure involved, would not cause significant adverse impact to humans and/or the environment. Tailings spread on a road during the wet

conditions of winter are unlikely to become airborne. Tailings would likely accumulate on the sides along the roads and become mixed with existing soil. In the Baseline Risk Assessment for OU III, the estimated cancer risks in the Isle-Royale area, like the Grosse-Point area, were approximately 1 X 10[-5]. This risk level is considered acceptable to humans. At Isle-Royale, tailings are excavated, vehicular traffic frequently resuspends the tailings, and the bare piles are subject to wind erosion. This activity results in acceptable risk at Isle-Royale. The mass of tailings expected to be taken from Grosse-Point and used in road spreading activities would be many orders of magnitude less than that from the Isle-Royale area. The risk to the environment from the tailings spread on the road would not be significant because the volume per area of tailings on the road would be small, and most of the tailings would settle near the road. Therefore, it is not expected that a large volume of tailings on the road would travel to water bodies and subsequently cause adverse effects to the environment. It is estimated that an additional 15 million dollars would be needed over the next ten years if the Houghton County Road Commission was required to find another source for road-friction material. Therefore, it is determined that the tailings in Grosse-Point can be used as road-friction material. However, the tailings area should be covered with enough soil to prevent the release of tailings into the air and the lake. Once any portion of the area has been excavated to a level seven feet above the water table (defined as the average of seasonal highs and lows over a two year period), excavation should cease, and that portion should either be covered with soil or covered with soil and vegetation. After completion of excavation of this entire area to a level seven feet above the water table, the area should be covered with soil and vegetation pursuant to this ROD.

The Proposed Plan excluded the slag/tailing pile located in the Dollar Bay area (Location 8) of OU III because of the nature of material and recent commerce activity. However, based on further assessment, it is determined that the slag/tailing pile is located outside of the commerce area and should be addressed under this ROD. Several homes are located around this slag/tailing pile and the non-cancer risk due to the ingestion of slag/tailing was considered as unacceptable. Partial regrading of this slag/tailing pile would be necessary to implement soil cover with vegetation. This slag/tailing pile covers approximately 28 acres.

The North Entry (location 4), Redridge (location 11) and Freda (location 12) tailings are excluded from the area to be covered under this ROD. Locations 4, 11, and 12 are along the Lake Superior shore where pounding waves and water currents will likely retard or destroy any remedial actions. As a result, U.S. EPA currently believes it to be technically impracticable to implement the chosen remedy at these locations. However, the North Entry (location 4) and Freda (location 12) tailings, approximately 46 acres, shall be studied during Remedial Design. If U.S. EPA determines that any portion of the two areas is sufficiently unaffected by Lake Superior wave activity such that it can be effectively covered with soil and vegetated, then the unaffected area or areas shall be subject to the requirements of this ROD.

Due to the these changes, the total areas in OU III to be addressed are approximately 229 acres. However, for the purposes of estimating the capital cost for OU III, this ROD uses 290 acres, due to the potential inclusion of the North Entry (location 4) tailings, and in an attempt to compensate for some uncertainty in acreage designation. The capital cost to implement Alternative T2 for OU III is approximately $2,890,000, and annual maintenance cost is $58,000. The present worth is approximately $2,868,000.

Index of Guidelines
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1985 Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites, EPA/600/8-85/002, Office of Health and Environmental Assessment, Washington, D.C.

1986 Superfund Public Health Evaluation Manual, NTIS PB87-183125

9/87 Superfund Exposure Assessment Manual, OSWER Directive #9285.5-1

1988 Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, Office of Emergency and Remedial Response

1/88 Preliminary Assessment Guidance, OSWER 9345 0-01 (OERR/HSCD) Final

1/83 Emergency Response Procedures for Control of Hazardous Substance Releases, EPA-600/D-84-023 (Rockwell International) Final

2/88 Superfund Removal Procedures, Revision # 3 OSWER #9360.0-038 (OSWER/OERR) Final

10/88 Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, OSWER #9355.3-01 (OSWER/OERR) Final

3/87 Data Quality Objectives for Remedial Response Activities: Development Process, OSWER #9355.0-7B (CDM Federal Programs Corp.) Final

6/84 Geophysical Techniques for Sensing Buried Wastes and Waste Migration, EPA-600/7-84/064 (Technos, Inc.) Final

2/88 Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses, (Viar and Co.) Draft

9/85 Practical Guide for Ground-Water Sampling, EPA/600/2-85/104 (Illinois St. Water Survey) Final

10/85 CERCLA Compliance with Other Environmental Statutes, OSWER #9234.0-2, Final

8/88 CERCLA Compliance with Other Laws Manual, OSWER #9234.1-01 Draft

9/86 Guidelines for Carcinogen Risk Assessment Federal Register, September 24, 1986. p.33922 (EPA) Final

9/86 Guidelines for Exposure Assessment Federal Register, September 24, 1986, p.34042. Final

Integrated Risk Information System (IRIS), Final

9/88 Public Health Risk Evaluation Database, Final

6/88 Community Relations in Superfund: A Handbook, OSWER #9230.0038, Final

11/87 Revised Procedures for Planning and Implementing Off-Site Response Actions, OSWER # 9834.11 (OWPE), Interim Final

12/90 Superfund Removal Procedures, Action Memorandum Guidance, EPA/540/P-90/004

1/90 Handbook on In Situ Treatment of hazardous Waste-Contaminated Soils, EPA/540/2-90/002

12/88 Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites, EPA/540/G-88/003

12/89 Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part A, Interim Final, EPA/504/1-89/002

12/86 Interim Guidance on Superfund Selection of Remedy, OSWER # 9355.0-19

4/91 Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions, OSWER Directive 9355.0-30

References specified in Remedial Investigation Reports for OU I, II and III, Risk Assessment Reports for OU I, II and III, Ecological Assessment Report, and Feasibility Study Report for OU I/III.