COLEMAN ENGINEERING CO.

Civil Engineering • Environmental Engineering
Geotechnical Engineering • Land Surveying • Test Drilling
Construction Quality Control • Materials Laboratory Testing

Principals:
John R. Garske
James J. Strigel
Michael L. DesRosier

April 17, 2000

Mr. Cliff Clark
Department of Environmental Quality
1990 U. S. 41 South
P. O. Box 190
Marquette, Michigan 49855

RE: Category N Baseline Environmental Assessment
Former Power Station and Copper Ore Processing Facility
Lake Linden (Torch Lake Township), Michigan

Dear Mr. Clark:

On behalf of Meninc, Incorporated, Coleman Engineering Company is pleased to submit this Baseline Environmental Assessment for the Former Power Station in Lake Linden, Michigan.

If you have any questions concerning this report, please feel free to contact me at this office.

Sincerely,

COLEMAN ENGINEERING COMPANY

(FOR JPP)

John P. Polich
Director of Environmental Services

JPP/JTH/kh
Enclosure
cc: Mr. Alan Bennett - Law Weathers & Richardson w/enclosure
Mr. Louis Meneguzzo – w/enclosure

F:/data/99009/catnbea/deqltr4-17-00

635 Industrial Park Drive - P.O. Box 607
Iron Mountain, Michigan 49801
(906) 774-3440
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Ironwood, Michigan 49938
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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION

FOR DEQ USE ONLY
BEA Disclosure # BOO-00154-MI

DISCLOSURE OF A BASELINE ENVIRONMENTAL ASSESSMENT
(FORM EQP4446(REV.3/99))

(Under the authority of Part 201, 1994 Act 451, as amended, and the Rules promulgated thereunder)

DO NOT use this form for requesting a Baseline Environmental Assessment ("BEA") adequacy determination, OR if the property is not a facility, OR if the BEA was complete before the effective date of the BEA rules. *Please answer the following questions as completely as possible.*

Name and address of submitter (individual or legal entity):*
Meninc, Incorporated
204 Calumet Street
Lake Linden, Michigan 49945

Status relative to the property:

	Former	Current	Prospective
Owner*	☐	☒	☐
Operator*	☐	☐	☐

Address/location of property where BEA was conducted:
Former Power Station
M-26
Lake Linden, Michigan 49945

County: Houghton

Provide the property tax identification number(s) or, if applicable, the ward and item number(s) for the property identified in the BEA. Required pursuant to Rule 907.
31-014-306-004-00 and 31-014-307-004-00

Contact person: Mr. Louis Meneguzzo Telephone #: 906-296-0526

If the address of the person seeking liability protection above is different from the address that should be used to correspond with the contact person, please provide the contact person's address:

Check the appropriate response to each of the following questions.

	YES	NO
1. Is it known that the source of contamination at the property is primarily from any of the following?		
• **A leaking underground storage tank (UST) regulated under Part 213, 1994 PA 451, as amended.**	☐	☒
• **A licensed landfill or solid waste management facility.**	☐	☒
• **A licensed hazardous waste treatment, storage, or disposal facility.**	☐	☒
• **Oil and gas development related activities.**	☐	☒

The source of the release that resulted in this property becoming a "facility" will determine which DEQ division will maintain a file regarding this BEA.

2. Based on the Part 201 Rules, this BEA is a:

Category N	☒
Category D	☐
Category S	☐

	YES	NO
3. Is the property at which the BEA was conducted a "facility"* as defined by Section 20101? If the answer to this question is NO, do not submit the BEA to the DEQ.	☒	☐

4. **Was the BEA conducted* prior to or within 45 days after the date of purchase*, occupancy, or foreclosure of the property, whichever is earliest, and completed* not more than 15 days after the date required by Section 20126(1)(c) or Rule 299.5903(8)?** If the answer to either portion of this question is no, you are ineligible for an exemption from liability based on the BEA. YES ☒ NO ☐

5. **Is the BEA being disclosed to the DEQ no later than 8 months after the earliest of the date of purchase, occupancy, or foreclosure?** All disclosures pursuant to Rule 919(3) must be submitted to the DEQ no later than 8 months after the earliest of the date of purchase, occupancy, or foreclosure. YES ☒ NO ☐

6. **Are any USTs or abandoned or discarded containers identified in the BEA?** If yes, this information must be provided on Form EQP4476. YES ☒ NO ☐

7. **Does this BEA rely on an isolation zone or an engineering control that requires an affidavit pursuant to Rule 299.5909(3) or 299.5909(4)?** If yes, a completed affidavit, Form EQP4479, must be attached or the BEA will not be considered complete. YES ☐ NO ☒

With my signature below, I certify that the enclosed BEA and all related materials are complete and accurate to the best of my knowledge and belief. I understand that intentionally submitting false information to the DEQ is a felony and may result in fines up to $25,000 for each violation.

Signature of Submitter: _____ 3-31-00
(Person legally authorized to bind the person seeking liability protection) Date

Name (Typed or Printed) Louis J. Meneguzzo

Title President, Meninc Incorporated

BASELINE ENVIRONMENTAL ASSESSMENT
Conducted Pursuant to Section 20126(1)(c)
Of 1994 PA 451, Part 201 as amended,
And the Rules promulgated pursuant thereunder

For

FORMER POWER STATION AND
COPPER ORE PROCESSING FACILITIES
TORCH LAKE TOWNSHIP
HOUGHTON COUNTY, MICHIGAN

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ATTACHMENTS

I. IDENTIFICATION OF AUTHOR AND DATE BEA WAS CONDUCTED AND DATE BEA WAS COMPLETED

The Baseline Environmental Assessment (BEA) was compiled by Mr. John P. Polich of Coleman Engineering Company (CEC), Iron Mountain, Michigan. The BEA was conducted on February 3, 2000. The BEA was completed on March 30, 2000.

II. INTRODUCTION

Meninc, Incorporated has retained CEC to perform a Category N BEA of the former Calumet and Hecla Consolidated Copper Company copper ore processing facility. The subject property is located in part of the Southeast Quarter of Section 6 and part of the Northeast Quarter of Section 7, Township 32 North, Range 32 West, Torch Lake Township, Houghton County, Michigan. More specifically, the subject property is located immediately south of the Village of Lake Linden, Michigan. The total acreage of the subject property is approximately 14 acres, which fronts upon Torch Lake. A property description can be found in section III. A.; site location maps can be found in Attachment A.

The BEA was conducted pursuant to Section 20126(1)(c) of 1994 PA 451, Part 201, as amended.

A Phase I Environmental Site Assessment (ESA) was performed on the subject property in July 1999 by CEC. The Phase I ESA revealed that historical operations at the subject site included a coal fired, electric power generating plant and copper ore milling and concentrating facilities.

The site is part of the former Calumet and Hecla Mining Company (later known as Calumet & Hecla Consolidated Copper Company and referred to as C&H in this report) ore processing and tailing sands reclamation facility. The facility at Lake Linden was first established in 1868 as a "stamp mill" where copper ore from C&H mines in Calumet was refined. The Lake Linden facility operated for 100 years until 1968 when all copper mining and processing facilities in the Keweenaw ceased operations. During the one hundred years of operations, the processes and facilities changed greatly, processing hundreds of millions of tons of copper ore and tailing sands and producing millions of tons of copper.

The Phase I ESA Report which contains Sanborn maps of the facility through the years. An early Sandborn map (1900) displays the facility's buildings including two stamp mills (the "Calumet" and the "Hecla"), a boiler house, sand wheelhouses, pump house, offices and shop buildings. At this facility, ore was crushed in the stamp mills and copper was separated in shaker/wash table processes. The refined copper was sent for further refinement to the smelter

facility at Hubble, Michigan, approximately 1 mile south of the Lake Linden facility. The waste tailings or "stamp sands" were discharged to Torch Lake. Although the processes used at the stamp mills were improved over time, it remained basically a physical crushing/separating/sorting process.

During the early 1900's the process changed enormously. Electricity on a large scale was introduced to the facility with the construction of a power plant in approximately 1905. However, the greatest change was the development of new ore refinement technology in the early 1900's. The new technology lead to the reprocessing of the stamp sands which had been dumped into Torch Lake for the previous 50 years. The reprocessing of stamp sands was called, "reclamation", and began around 1915 at the Lake Linden facility

The new refinement processes for the purpose of reclamation include ball mills, flotation and leaching. With the introduction of the reclamation process around 1915, the Lake Linden facility was greatly expanded with the construction of two regrinder plants (#1 & #2), a flotation plant, leaching plant and a distillation plant. There were also two dredges that operated in Torch Lake dredging the stamp sands which had been disposed of earlier. The facility continued to operate until 1968, utilizing the boiler plant, powerhouse, regrinder plants, flotation plant, leaching plant and distillation plant at Lake Linden. The Hecla stamp mill was closed down in 1927 and the Calumet stamp mill was closed shortly after World War II.

The refining processes at the facility are briefly described as follows. After ore (either stamp sands or mined ore) had been processed in the regrinder plants the pulverized result was separated for further processing by either floatation or leaching. The flotation and leaching processes were more complex than the previous stamp mill process and involved use of various chemical compounds. Floatation is a process in which heavy metals can be activated to float. The basic elements for this process are water, fatty oil and agitation to introduce air thereby creating a froth. At this point a very fine slurry of copper ore is added to the mixture in a floatation tank. The fine copper adheres to the frothed foam of the fatty oils and is skimmed off to be sent to the smelter for final processing. The compounds used as frothing agents include fuel oil, pine oil, creosote, coal tar and its distillates and later potassium or sodium xanthate.

Leaching is the process of converting metallic copper into a soluble oxidized leachate; the leachate was then distilled to retrieve copper oxide solids. The processes started in the leaching plant where ore from the regrinder plant was placed in leaching tanks containing a leaching solution (cupric ammonium carbonate). The leaching solution was processed to a copper rich solution (which went to the distillation plant) and a copper poor solution which was recycled back into the leaching tank. In the leaching plant, the treated tailings underwent a

steaming process to recover ammonia which was recycled back into the leachate. The copper rich leachate solution was transferred to the distillation plant where it was distilled. The result of this process was copper oxide compounds which were used in paints, fertilizers and other products. The leachate condensate was recycled back to the leaching plant.

The regrinder plants, floatation plant and leaching plant were all located to the north of the subject property on adjacent property which currently is owned by the Houghton County Historical Society. The ruins of the distillation plant, boiler plant and the Hecla stamp mill, as well as the still standing power plant, are located on the subject property. There were numerous railroad spurs, pipelines and launders which traversed the property for transporting raw materials or waste products.

The power plant building, which remains on the site bears a notice on one its doors identifying the structure as, "Condemned as Dangerous and Unsafe".

After the shut down in 1968, C&H was dissolved in approximately 1970. Universal Oil Products (UOP) acquired the holdings of C&H, including the subject property. It is not known what UOP did to the property but it was not an active copper processing facility. It is reported in USEPA documents that in 1972 a storage tank in the leaching plant spilled 27,000 gallons of cupric ammonium carbonate which discharged into Torch Lake. In 1975, Mr. Rudolph G. Kump of Calumet, Michigan purchased the property from UOP. Mr. Kump salvaged iron piping and construction materials from the site.

The mine tailings or stamp sands have been documented to have high concentrations of metals which has lead to the designation of the area as a "Superfund" site by the U.S. Environmental Protection Agency (EPA). Exposed tailings are considered as "Operational Unit #1" of the Superfund site. The remedy which the EPA and the Natural Resource Conservation Service (NRCS) has developed is erosion stabilization and capping of tailings exposed to the environment.

The USEPA has identified as Torch Lake Superfund Site Operational Unit #1 (OU#1), deposits of surface tailings in the primary study area which is the west shore of Torch Lake. Portions of the subject site have been determined by USEPA to meet this definition.

As a result of the Phase I ESA efforts, several Recognized Environmental Conditions (RECs) were identified. A copy of the Phase I ESA has been included with this BEA as Attachment B "Phase I Environmental Site Assessment Former Calumet & Hecla Power Plant Site, Torch Lake Township, Houghton County, Michigan"

A Phase II ESA of the subject property was performed in January 1999. The Phase II ESA concentrated on areas of the site which were known to have coal ash and cinders exposed at the surface. The results of the Phase II ESA conclude that soils at the site are impacted with metals. Additional soil sampling was completed on the site on February 3, 2000. The findings of the Phase II ESA and the additional sampling and analysis further show that there is metals impact on the subject property at levels exceeding Michigan Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended, Part 201 Residential Cleanup Criteria. In that metals impact exceeding applicable NREPA criteria has been identified, the subject property can be classified as a "Facility" per NREPA Part 201. The Phase II ESA report can be found as an Appendix to the Phase I ESA Report in Attachment B of this Baseline Environmental Assessment.

Meninc Incorporated acquired the site on February 16, 2000. A previous owner, Mr. Rudolf Kump, had completed several years of salvage operations on the property. Prior to Mr. Kump the property was owned by a series of corporate owners including Universal Oil Products Corporation and the Calumet and Hecla Consolidated Copper Company. Universal Oil Products Corporation reportedly may have conducted some salvage operations on the property. The Calumet and Hecla Consolidated Copper Company operated the power plant and copper ore milling and processing facilities beginning in the mid nineteenth century through the mid 1960's.

A Category N BEA has been selected because Meninc, Incorporated does not intend to use any hazardous substances at the subject property. At this time Meninc Incorporated is proposing to develop waterfront residential housing on the subject site.

III. PROPERTY DESCRIPTION AND INTENDED HAZARDOUS SUBSTANCE USE

A. LEGAL DESCRIPTION OF PROPERTY

The subject property is located along State Highway M-26 in the Township of Torch Lake, Houghton County, Michigan. More specifically, the subject property is located immediately south of the Village of Lake Linden, Michigan. The total acreage of the subject property is approximately 14 acres, which fronts upon Torch Lake. Site location maps and a scaled site drawing can be found in Attachment A.

The legal property description is as follows:

A parcel of land being part of Government Lot One of Section Seven, and part of Government Lot Four of Section Six, Township 55 North, Range 32 West, Torch Lake Township, Houghton County, Michigan, described as follows:

Commencing at the South ¼ corner of Section Six, Township 55 North, Range 32 West, thence North 59 degrees, 23 minutes, 30 seconds East 67.94 feet to the centerline of Highway M-26, which is the Point of Beginning; thence North 14 degrees, 56 minutes 10 seconds East 144.46 feet along the centerline of M-26; thence along the centerline of M-26 on a curve to the right 388.41 feet, which curve has a radius of 1910.08 feet and a chord length of 387.73 feet and bearing North 20 degrees, 45 minutes, 40 seconds East, said point being on the southerly boundary of a parcel previously conveyed to the Houghton County Historical Society; thence South 72 degrees, 00 minutes, 50 seconds East 187.41 feet along the boundary of the Houghton County Historical Society property; thence North 17 degrees, 59 minutes, 10 seconds East 100.00 feet along the boundary of the Houghton County Historical Society property; thence South 72 degrees, 00 minutes, 50 seconds East 528.13 feet along the boundary of the Houghton County Historical Society property to a meander corner on the shore of Torch Lake; thence along the shore of Torch Lake on a meander line bearing South 36 degrees, 05 minutes, 30 seconds West 773.86 feet; thence along the shore of Torch Lake on a meander line bearing South 43 degrees, 38 minutes, 30 seconds West 277.74 feet to a meander corner; thence North 69 degrees, 28 minutes, 30 seconds West 388.16 feet to the centerline of Highway M-26; thence along the centerline of M-26 on a curve to the left 338.74 feet, which curve has a radius of 1432.69 feet and a chord length of 337.97 feet and bearing North 21 degrees, 42 minutes, 35 seconds East, said point also being the Point of Beginning, the above-described parcel containing 14.12 acres, more or less, and it being expressly understood and intended that the above-described land extends to the water's edge of Torch Lake.

B. PROPERTY TAX IDENTIFICATION NUMBER

The Houghton County Property Tax Identification Numbers for the subject site are 31 –014-306-004-00 (north portion) and 31-014-306-004-00 (south portion).

T. ON Sheet be 307

C. PHOTOGRAPHS

Photographs of the subject property are included in Attachment C. Photographs of the site are also included in the Phase I ESA presented in Attachment A.

D. INTENDED HAZARDOUS SUBSTANCE USE

There will be no significant hazardous substance use at the subject property. At this time Meninc, Incorporated intends to redevelop the property for residential use.

IV. KNOWN CONTAMINATION

A. HAZARDOUS SUBSTANCES ON SITE

The following hazardous substances have been identified on site. Results of a Phase II ESA completed in January, 1999 indicate that there are concentrations of metals in surface soils on the site which exceed Michigan Natural Resources and Environmental Protection Act (NREPA) Part 201 Residential Cleanup Criteria. In addition one soil sample was collected from the northern portion of the site on February 3, 2000. Result of analyses performed on that sample also exceeds NREPA Part 201 Residential Cleanup Criteria for metals. Soil sample analysis results are summarized in Table I below. Soil sample locations are shown on Figure 4, which is contained in Attachment A. Laboratory analysis reports for samples 1 through 6 can be found in Attachment D.

TABLE I
Soil Sample Analysis Results

Sample ID/ Metal	CAS #	1	2	3	4	5	6	Statewide Default Back--ground Level[1]	NREPA Part 201 Direct Contact[2]
Date Collected		Jan. 13, 1999	Jan. 13, 1999	Jan. 13, 1999	Jan. 13, 1999	Jan. 13, 1999	Feb. 3, 2000		
Arsenic	7440382	18.5	12.4	26.6	17.2	16.6	7.3	5.8	6.6
Barium	7440393	93.6	56.8	323.8	96.1	144.0	733	75.0	30,000
Cadmium	7440439	0.12	0.26	0.31	0.40	0.21	2	1.2	420
Chromium	16065831	ND	ND	ND	19.6	ND	62	18.0	630,000
Copper	7440508	387	510	2,040	8,850	151	18,700	32.0	16,000
Lead	7439921	58.7	55.9	115	145	50.0	519	21.0	400
Mercury	7439976	ND	ND	ND	ND	ND	0.10	0.13	130
Selenium	7782492	2.5	1.3	1.4	0.9	0.9	0.7	0.14	2,100
Silver	7440224	0.25	0.37	0.27	1.94	0.32	3	1.0	2,000
Zinc	7440666	29.2	57.6	178	194	27.9	228	47.0	140,000

- All units in milligrams per kilograms (mg/kg)
- Shaded areas in exceedance of the Soil Default Statewide Background Clean Up Criteria
- ND concentration below method detection limit

1 – Michigan PA 451 Part 201 Statewide Default Background per Operational Memo #18, dated May 28, 1999.
2 – Michigan PA 451 Part 201 Residential and Commercial I Direct Contact criteria per Operational Memo #18, dated May 28, 1999

B. KNOWN CONTAMINATION SUMMARY

The results of soil sample analysis indicate that soil at the subject property has been impacted at levels exceeding applicable *Residential and Commercial I, Part 201, Generic Cleanup Criteria and Screening Levels,* MDEQ Operational Memorandum No 18, NREPA, 1994 PA 451, Part 201, as amended. In completing the Phase II ESA field sampling effort, areas which were known to have surface deposits of ash were focused upon. Sample analysis results are considered to be reflective of those areas sampled. There are, however, several different materials exposed on the surface of the site, including stamp sands. General observations regarding the location of various surface features is presented in Attachment A, Figure 5. Because of the documented metals impact, the subject property can been classified as a "*Facility*" per NREPA, 1994 PA 451, Part 201, as amended.

C. ABANDONED CONTAINERS

Several abandoned containers have been found on the subject property. The abandoned containers that have been identified consist of steel drums in two general locations on the property. One drum was observed to be floating in the water, which is present within the basement of the former power plant building (see Attachment C, photo #7). Several other drums most of which are crushed and all of which are rusted, were observed among partially buried debris found on the east portion of the site near the shore of Torch Lake (see Attachment C, photo # 11). For personnel safety reasons, the drum located within the basement of the former power plant building can not be accessed. The drums observed among the partially buried debris in the east portion of the site have been determined to be empty. Form EQP 4476, "Notice Regarding Discarded or Abandoned Containers" has been completed for the intact drums observed, and can be found in Attachment E. The locations of the discarded and abandoned drums are displayed on Figure 5, which can be found in Attachment A.

No evidence of aboveground or underground storage tanks has been observed on the subject property.

V. LIKELIHOOD OF OTHER CONTAMINATION

The site has a history of use as a heavy industrial facility. As such there are certain risks of the presence other heretofore undiscovered contaminants. Historical site information and the Phase I ESA (see Attachment B) suggest that there is the potential for environmental impact at the following locations:

- Torch Lake Superfund Site- The U.S. Environmental Protection Agency (EPA) has identified the primary contaminant sources in surface tailings in the study area on the west shore of Torch Lake as Torch Lake Superfund Site Operational Unit #1 (OU#1). The mine tailings or stamp sands have been documented to have elevated concentrations of metals. Portions of the subject site meet this definition and have been included by USEPA in OU#1.

- Coal Ash- The presence of the coal ash has been documented in a Phase I ESA to be present in a number of areas on the site, some of which were sampled and some of which were not. The coal ash may be a source of metals impact.

- Drums inside of building - The contents of the drum observed inside the power plant building at the site are unknown. The drum is presumed to represent a material threat of a release of a hazardous substance.

- Refractory brick - The refractory brick, much of which is disintegrating in the power plant building, may contain elevated levels of metals. This material may pose a threat of a release of a hazardous substance.

- Water in basement of the building - There is a large volume of water in the lower level of the power plant building. This water may contain elevated concentrations of metals or other compounds used in the building. The presence of the water may obscure, by submergence, evidence of the presence of hazardous materials.

- There is potential for polychlorinated biphenols (PCB) laden switch gear within power house in general and also in the overhead cranes. In addition, there is evidence of an electric power transmission substation having been on the property, which could also have been a source of PCB.

- Still House & Filter House Operations - The distillation and filtering processes can produce hazardous by-products. It is not known what by-products were generated at the site or how by-products were disposed of.

- Flotation and Leaching Process Chemicals - Numerous chemicals were used in the floatation and leaching processes.

- Boiler Treatment Chemicals- Boiler treatment chemicals used in the boiler plant and power plant may have been released to the environment.

- Improper disposal of general wastes over the years - The disposal practices of waste at the facility is not completely known. There are several areas on the property, which are covered with debris (including coal ash and stamp sands) exceeding 10 feet in depth. It is not known what materials may have been included with the debris.

- Copper Concentrate Bags – There is a pile of copper concentrate product bags that appeared to have residue in them. There may be a residual of metals associated with the bags.

- Tunnel-Portions of a brick lined tunnel were found adjacent to the foundation of the former boiler house. Because of concerns regarding personnel safety, the interior of the tunnel could not be inspected. There may be hazardous materials in the inaccessible portions of the tunnel.

- Leachate Spill - A spill of 27,000 gallons of cupric ammonium carbonate reportedly occurred on the property immediately north of the subject parcel and was discharged into Torch Lake in 1972, presumably from the leaching plant. This spill may have affected the subject site.

- Disposal of a large quantity of waste material directly into Torch Lake apparently took place for nearly a century. This disposal practice would presently be considered a violation of the existing regulations. There may be residues of disposed compound in various areas of the site.

VI. CONCLUSIONS

Meninc, Incorporated will have no significant hazardous substance use at the subject property. No significant hazardous substance use at the subject property by Meninc, Incorporated will serve as the means of distinguishing old releases of hazardous substances from new releases of hazardous substances.

VII. REFERENCES

Listed below are documents utilized to aid in the completion of this BEA. Data presentation, summaries and conclusions presented in this BEA should not be considered apart from respective documents.

- "Environmental Remediation," Part 201 of 1994 Public Act 451, as amended.

- "Instructions for Preparing and Disclosing Baseline Environmental Assessments and Section 7a Compliance Analysis to the Michigan

Department of Environmental Quality and for Requesting Optional Determinations," dated March 11, 1999.

- "Standard Practice for Environmental Assessments: Phase I Environmental Site Assessment Process," American Society for Testing and Materials, Designation: E 1527-97.

- Phase I Environmental Site Assessment, Former Calumet & Hecla Power Plant Site Torch Lake Township, Houghton County, Michigan.

- Benedict, C. Harry, "Lake Superior Milling Practices", Michigan College of Mining and Technology, 1955.

VIII. ATTACHMENTS

Attachment A Site Location Maps
- Figure 1 Regional Location Map
- Figure 2 Site Location Map
- Figure 3 Site Map
- Figure 4 Sample Location Map
- Figure 5 Location of Impact

Attachment B Phase I Environmental Site Assessment

Attachment C Photographs

Attachment D Laboratory Analysis Reports

Attachment E Form EQP4476

IX. LIMITATIONS

No environmental assessment can wholly eliminate uncertainty regarding the environmental condition of the site. There is a point at which the cost of information gathered and/or time required to gather it outweighs the usefulness of the information and, in fact, may be a material detriment to the orderly completion of transactions. A balance between the competing goals of reasonable and practical environmental site assessments and the reduction in unknown conditions resulting from additional information has been attempted.

ATTACHMENT A

SITE LOCATION MAPS

REGIONAL LOCATION MAP
BASELINE ENVIRONMENTAL ASSESSMENT
FORMER POWER STATION AND
COPPER ORE PROCESSING FACILITIES
TORCH LAKE TOWNSHIP
HOUGHTON COUNTY, MICHIGAN

FIGURE 1

COLEMAN ENGINEERING COMPANY
635 CIRCLE DRIVE
IRON MOUNTAIN, MICHIGAN 49801

DATE 3/22/00
JOB NO 99009
CADD FILE 99009-01-D

Source:
USGS Quadrangle map

NORTH

SCALE: 1"=1000'

SITE LOCATION MAP
BASELINE ENVIRONMENTAL ASSESSMENT
FORMER POWER STATION AND
COPPER ORE PROCESSING FACILITIES
TORCH LAKE TOWNSHIP
HOUGHTON COUNTY, MICHIGAN

COLEMAN ENGINEERING COMPANY
635 CIRCLE DRIVE
IRON MOUNTAIN, MICHIGAN 49801

FIGURE 2

DATE 3/22/00
JOB NO 99009
CADD FILE 99009-02-D

ATTACHMENT B

PHASE I ENVIRONMENTAL SITE ASSESSMENT

PHASE I ENVIRONMENTAL SITE ASSESSMENT
FORMER CALUMET & HECLA POWER PLANT SITE
TORCH LAKE TOWNSHIP, MICHIGAN

Prepared by:

COLEMAN ENGINEERING COMPANY
635 Industrial Park Drive
P.O. Box 607
Iron Mountain, MI 49801

PROJECT #E-99009

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APPENDICES

PHASE I ENVIRONMENTAL SITE ASSESSMENT
Former Calumet & Hecla Power Plant Site
Torch Lake Township, Michigan

I. INTRODUCTION

Coleman Engineering Company has been retained by Mr. Louis Meneguzzo of Lake Linden, Michigan, to conduct a Phase I Environmental Site Assessment (ESA) in accordance with the American Society for Testing and Materials (ASTM) Designation: E 1527-97 "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process" for an approximately 14 acre parcel located in Torch Lake Township, Houghton County, Michigan.

A. EXECUTIVE SUMMARY

Research methods employed in performing the Phase I Environmental Site Assessment (Phase I ESA) of the subject property consisted of obtaining file information regarding the site area from federal and state regulatory agencies through the use of a specialized environmental database search firm. Research methods also included an in-house state regulatory agency database search, telephone discussions with persons who are familiar with the history of the site, and to some extent, local agencies. Due to the nature of the subject property historic aerial photos, Sanborn Maps and United States Environmental Protection Agency (USEPA) documents were review as part of the research efforts. As a final effort, a site reconnaissance walkover was conducted. The Phase I ESA performed for the subject property has revealed much evidence of recognized environmental conditions (REC's) in connection with the subject property. The REC's are listed below:

- Torch Lake Superfund Site - As the USEPA has identified the Torch Lake Superfund Site Operational Unit #1 (OU#1) as primary contaminant sources in surface tailings in the primary study area on the west shore of Torch Lake. Portions of the subject site may meet this definition. The presence of the Torch Lake Superfund site can be considered an REC.

- Coal Ash - The presence of the coal ash has been documented in a Phase II ESA in January 1999, to have metals concentrations which exceed the Michigan Department of Environmental Quality (MDEQ) Default Type A (Statewide Default Background Levels) Clean Up Criteria. The complete extent of the coal ash is not known. Investigations to determine the degree and extent of impact may be appropriate before performing any remedial action. The Phase II ESA report can be found in Appendix E of this report.

- Mine Tailings - The mine tailings or stamp sands have been documented to have high concentrations of metals which has designated the area to be listed as a "Superfund" site by the USEPA. Exposed tailings are considered as "Operational Unit #1" of the Superfund site. The remedy which the EPA and the Natural Resource Conservation Service (NRCS) has developed is erosion stabilization and capping of tailings exposed to the environment.

- Drums in and outside of building - The contents of the drums observed at the site are unknown, the drums are presumed to represent a material threat of a release of a hazardous substance. The contents of the drums should be identified and then disposed of properly.

- Refractory brick - The refractory brick, much of which is disintegrating in the building, may contain high levels of metals. This material may pose a threat of a release of a hazardous substance.

- Water in basement of the building - There is a large volume of water in the lower level of the building. This water may contain high concentrations of metals or other compounds used in the building. This material may pose a threat of a release of a hazardous substance. The water, which has accumulated within the basement, should be sampled for appropriate parameters. (This should be considered a REC until investigative efforts indicate there is no threat to the environment.)
  At a minimum, this water should be characterized and disposed of properly.

- Polychlorinated biphenyl (PCB) laden equipment - There is potential for PCB laden switch gear within power house in general and also in the overhead cranes - Further research and investigation should be performed to determine if there is a need for any remedial action.

- Still House & Filter House Operations - The distillation and filtering processes can produce hazardous by-products. It is not known what products were generated at the site or how products were disposed of. The processes should be researched further and sampling around these facilities may be appropriate. This should be considered a REC until investigative efforts indicate there is no threat to the environment.

- Uninspected tunnel – A tunnel was discovered near the still house during the site walk over. The tunnel was not inspected due to safety reasons. This tunnel should be considered a REC until a complete inspection can be preformed.

- Excavations - The purpose of the several excavations around the power plant building is unknown. The excavations may have been used as waste disposal areas and should be researched further. This should be considered a REC until investigative efforts indicate there is no threat to the environment.

- Floatation and Leaching Process Chemicals - Numerous chemicals were used in the floatation and leaching processes. Further research to understand these processes should be performed. Sampling around the facilities may be appropriate. This should also be considered a REC until investigative efforts indicate there is no threat to the environment.

- Boiler Treatment Chemicals - Treatment chemicals used in the boiler plant and power plant may have been released to the environment. Further investigation of this may be appropriate. This should also be considered a REC until investigative efforts indicate there is no threat to the environment.

- Flooded Basement - The flooded lower level of the power plant prevented inspection of that area and therefore is considered a REC. An inspection of the lower level should be performed after the water is removed.

- Improper disposal of general wastes - The disposal practices of waste at the facility is not completely known. There are several areas on the property which have several feet of debris (including coal ash and stamp sands) exceeding 10 feet in depth, piled in haphazard manner. It is not known what materials may have been included with the debris. This should be considered a REC until investigative efforts indicate there is no threat to the environment. Further research on waste disposal practices and a subsurface investigation of these areas may be appropriate.

- Copper Concentrate Bags - The pile of copper concentrate that appeared to have residue in them should be considered a REC as they may be releasing hazardous material into the environment.

- Leachate Spill - A spill of 27,000 gallons of cupric ammonium carbonate was discharged into Torch Lake in 1972, presumably from the leaching plant. This should be considered a REC until investigative efforts indicate there is no threat to the environment.

- Discharge to Torch Lake - Disposal of a large quantity of waste material directly into Torch Lake apparently took place for nearly a century. Because this disposal practice would presently be considered a violation of

the existing regulations it should be considered a REC until investigative efforts indicate there is no threat to the environment.

There are environmental issues and conditions in connection with the subject property that are outside of the scope of ASTM Designation: E 1527-97. Although non-scope considerations are not required by this practice to demonstrate appropriate inquiry, there may be standards or protocols for assessment of potential hazards and conditions associated with non-scope conditions developed by government entities, professional organizations, or other private entities.

Assorted Debris - There are numerous piles of debris on the site most of which appear to be demolition waste. This material should be cleaned up.

Radon - Radon is a known carcinogen that can be present in the environment. Further investigation of this may be appropriate.

Asbestos - Asbestos is a known carcinogen and was used as a building material during the era of the power plant construction. Further investigation of this may be appropriate.

Lead Paint - Lead paint is a known health hazard and was widely used during the era of the power plants lifetime. Further investigation of this may be appropriate.

Residual Coal – Residual coal was found to be present within a coal silo on the property. The quantity of residual coal is unknown, however, it should be recovered and either recycled as fuel or properly disposed of.

Condemned Building- The building which remains on the site bears a notice on one its doors identifying the structure as Condemned as Dangerous and Unsafe. The building should be properly razed and the material disposed if in an acceptable manner.

B. SCOPE OF THE PHASE I ESA PROCESS

The scope of the Phase I ESA Process as set forth in ASTM Designation: E1527-97, is to define good commercial and customary practice in the United States of America for conducting an environmental site assessment of a parcel of commercial real estate with respect to the range of contaminants within the scope of the Comprehensive Environmental Compensation and Liability Act (CERCLA) and petroleum products. As such, this practice is intended to permit a buyer of a property to satisfy one (1) of the requirements to qualify for the innocent landowner defense to CERCLA liability.

The goal of the processes established by this practice is to identify REC's. The term REC means the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property. The term "hazardous substances" or "petroleum products", include those even under conditions in compliance with laws. The term is not intended to include *de minimus* conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate regulatory agencies.

Information needed for completion of a Phase I ESA may be provided by a number of parties including third-party vendors, present owners and operators of the property, regulatory agencies, neighbors, past employees, etc. Prior assessments may also contain usable information. A Phase I ESA does not include any testing or sampling of materials.

Limitations of a Phase I ESA are predicated by the scope of services. The Scope of Services for the Phase I ESA focused on the following:

- Regulatory agency file search. The purpose of this review is to help determine the potential for hazardous substances on the property and within a reasonable "Search Distance" of the property as a result of either past or present activities; and if such substances are present, to assess if conditions suggest that such materials have the potential to affect the property. File searches are as follows:

  - Federal and State regulatory agency files were reviewed both through an in-house record search and through the use of a specialized environmental database search firm. The information included, but was not limited to, CERCLA, National Priorities List (NPL), Resource Conservation and Recovery Act (RCRA), the State List of Environmental Contamination Sites, Leaking Underground Storage Tanks (LUSTs) Lists, and Underground Storage Tank (UST) Lists.

- Limited interviews with persons having specific knowledge of the subject property. The goal of the interviews was to assess if conditions suggest that hazardous substances are present on or have the potential to affect the property.

- A site reconnaissance of the subject property. The goal of the site reconnaissance is to assess if conditions suggest that hazardous substances are present on or have the potential to affect the property.

- Investigation of adjoining properties, limited to a review of the possible existence of regulated substances through information supplied by regulatory agency databases. General observations as to the existence of visually evident REC's on adjoining properties were also performed during the site reconnaissance.

- Sanborn Maps and aerial photos were reviewed as a historic review of changes on the property and note any potential REC's on the property.

- The completion of a report describing the investigation methods, findings and conclusions.

C. LIMITATIONS OF ASSESSMENT

The scope of the proposed investigation was specifically limited from consideration of asbestos containing materials, radon, lead-based paints, lead in drinking water, potable water well tests, septic tank/drainfield tests, pesticides, and wetlands. The scope of the proposed investigation did not include preparation of a title abstract, nor has one been received to be reviewed as a source document for this report.

There are other limitations inherent to environmental site assessments. When dealing with natural conditions, and especially natural conditions that are hidden from view, even the most accomplished investigator can only deal in probabilities. Environmental conditions are also affected by time due to the mobility of contaminants, change in state and other characteristics of materials.

No environmental site assessment can wholly eliminate uncertainty regarding the environmental condition of the site. A Phase I ESA is intended to reduce, but not eliminate, uncertainty regarding the environmental condition of the subject property. A Phase I ESA also does not mean an exhaustive assessment of a clean property. There is a point at which the cost of information gathered and/or the time required to gather it outweighs the usefulness of the information and, in fact, may be a material detriment to the orderly completion of transactions. A balance between the competing goals of reasonable and practical environmental site assessments and the reduction in

unknown conditions resulting from additional information has been attempted. Additional limitations can be found in Appendix G.

D. SPECIAL TERMS AND CONDITIONS

This report is intended solely for use by Mr. Louis Meneguzzo of Lake Linden, Michigan. Coleman Engineering Company expressly disassociates itself from any use of this document or the information included herein, except as authorized. All information related to or provided by private sources is confidential. The identification of private sources shall not be interpreted as authorization or permission by Coleman Engineering Company for contact with such sources.

II. PROPERTY DESCRIPTION

A. LOCATION AND PROPERTY DESCRIPTION

The subject property is located in part of the Southeast Quarter of Section 6 and part of the Northeast Quarter of Section 7, Township 32 North, Range 32 West, Torch Lake Township, Houghton County, Michigan. More specifically, the subject property is located immediately south of the Village of Lake Linden, Michigan. The total acreage of the subject property is approximately 14 acres, which fronts upon Torch Lake. The site is part of the former Calumet and Hecla Consolidated Copper Company Lake Linden copper ore processing facility. A property description can be found in Appendix B; site maps can be found in Appendix A.

B. SITE CHARACTERISTICS

The site is located on the Keweenaw Peninsula, which is on the southern Margin of the Lake Superior Basin. The major stratigraphic units in the site area include the Portage Lake Lava Series, the Copper Harbor Conglomerate, the Nonesuch Shale, Freda Sandstone and the Jacobsville Sandstone. The Portage Lake Lava Series is a result of Late Precambrian volcanic activity. This rock unit is composed of a succession of more than two hundred lava flows recognized as tholeiitic flood basalts. Conglomerate and sandstone beds are deposited throughout the basalt flows. After volcanic activity ceased, sediment deposition occurred resulting in the overlying sedimentary units mentioned above. The area was also affected by metamorphic and or hydrothermal activity in which large amounts of copper were concentrated in the lava flow and interbedded conglomerate units. The area was the scene of an enormous mining boom during the last half of the nineteenth century. Copper mining continued in the area until 1968.

The geologic activity in the region resulted in the formation of the Keweenaw Peninsula. The Keweenaw Peninsula trends in a southwest to northeast orientation, is approximately 50 miles long and 20 miles wide. The peninsula rises hundreds of feet above the surrounding Lake Superior. The approximate elevation of Lake Superior is 602 feet above mean sea level (ft msl) as is Torch Lake. The site lies on a lowland on the east side of the Keweenaw fault. Elevation at the site is approximately 620 ft msl. The land surface east of the site rises dramatically to the central plateau of the peninsula with an approximate elevation of 1200 ft msl.

Soils in the area are of glacial origin. The last glacial activity was the Wisconsinian Stage of glaciation which occurred approximately 10,000 years before present. The surficial geology is a complex of ground moraine, end moraine, outwash areas and lake deposits. The soils on the Keweenaw Peninsula are generally thin, however due to the wide variety of glacial formations in the area there is also a wide variety of soil types. Soils on the site are of anthropogenic origin, generally either stamp sands or coal ash. Bedrock underlying the site is the Precambrian Jacobsville Sandstone. Depth to bedrock is not known.

Hydrogeology in the area consists of glacial overburden and bedrock aquifers. Approximately half of the wells in Houghton and Keweenaw Counties utilize glacial aquifers and half utilize bedrock aquifers. The quality and quantity of groundwater is extremely variable in both glacial overburden and bedrock formations. However, in most locations in the area wells suitable for domestic use can be drilled successfully.

Electrical service is provided by Upper Peninsula Power Company, gas service is provided by Michigan Consolidated Gas Company, and telephone service is provided by Ameritech. Sewer and water service is provided by the Lake Linden Water Authority although outside the Village of Lake Linden limits water service is provided by the Northern Michigan Water Company.

C. HISTORICAL OVERVIEW

The site is part of the former Calumet and Hecla Mining Company (later known as Calumet & Hecla Consolidated Copper Company and referred to as C&H in this report) ore processing and tailing sands reclamation facility. The facility at Lake Linden was first established in 1868 as a "stamp mill" where copper ore from C&H mines in Calumet was refined. The Lake Linden facility operated for 100 years until 1968 when all copper mining and processing facilities in the Keweenaw ceased operations. During the 100 years of operations the processes and facilities changed greatly, processing

hundreds of millions of tons of copper ore and tailing sands while producing millions of tons of copper.

Appendix C contains Sanborn maps of the facility through the years. An early Sandborn map (1900) displays the facility's buildings including two (2) stamp mills, the "Calumet" and the "Hecla", a boiler house, sand wheelhouses, pump house, offices and shop buildings. At this facility ore was crushed in the stamp mills and copper was refined in shaker/wash table processes. The refined copper was sent for further refinement to the smelter facility at Hubble, Michigan, approximately 1 mile south of the Lake Linden facility. The waste tailings or "stamp sands" were discharged to Torch Lake. Although the processes used at the stamp mills were improved over time, it remained basically a physical crushing/separating/sorting process.

During the early 1900's the facility changed enormously. Electricity on a large scale was introduced to the facility with the construction of a power plant in approximately 1905. However, the greatest change was the development of new ore refinement technology in the early 1900's. The new technology lead to the reprocessing of the stamp sands which had been dumped into Torch Lake for the previous 50 years. The reprocessing of stamp sands was called reclamation and began around 1915 at the Lake Linden facility.

The new refinement processes for the purpose of reclamation include ball mills, flotation and leaching. With the introduction of the reclamation process around 1915, the Lake Linden facility was greatly expanded with the construction of two (2) regrinder plants (#1&#2), a flotation plant, leaching plant and a distillation plant. There were also two (2) dredges that operated in Torch Lake dredging the stamp sands. The facility continued to operate until 1968 utilizing the boiler plant, powerhouse, regrinder plants, flotation plant, leaching plant and distillation plant at Lake Linden. The Hecla stamp mill was closed down in 1927 and the Calumet stamp mill was closed shortly after World War II.

The refining processes at the facility are briefly described as follows. After ore (either stamp sands or mined ore) had been processed in the regrinder plants, the pulverized result was separated for further processing by either floatation or leaching. The flotation and leaching processes were more complex than the previous stamp mill process and involved use of various chemical compounds. Floatation is a process in which heavy metals can be activated to float. The basic elements for this process are water, fatty oil and agitation to introduce air thereby creating a froth. At this point a very fine slurry of copper ore is added to the mixture in a floatation tank. The fine copper adheres to the frothed foam of the fatty oils and is skimmed off to be

sent to the smelter for final processing. The compounds used as frothing agents include fuel oil, pine oil, creosote, coal tar and its distillates and later potassium or sodium xanthate. Leaching is the process of converting metallic copper into a soluble oxidized leachate; the leachate was distilled to retrieve copper oxide solids. The processes started in the leaching plant where ore from the regrinder plant was placed in leaching tanks containing a leaching solution (cupric ammonium carbonate). The leaching solution was processed to a copper rich solution (which went to the distillation plant) and a copper poor solution which was recycled back into the leaching tank. In the leaching plant the treated tailings underwent a steaming process to recover ammonia which was recycled back into the leachate. The copper rich leachate solution was transferred to the distillation plant where it was distilled. The result of this process was copper oxide compounds which were used in paints, fertilizers and other products. The leachate condensate was recycled back to the leaching plant.

The regrinder plants, floatation plant and leaching plant were all located on adjacent property to the north of the subject property which currently is owned by the Houghton County Historical Society. The ruins of the distillation plant, boiler plant and the Hecla stamp mill as well as the still standing power plant are located on the subject property. There were numerous railroad spurs, pipelines and launders which traversed the property for transporting raw materials or waste products.

The processes and the Lake Linden facility itself changed over the 100 years of operation, at one time employing up to 2000 people. For a detailed account of the procedures occurring on the site a reference titled "Lake Superior Milling Practices" by C. Harry Benedict provides detailed descriptions of processes used. This book was use as a reference in the brief overview given above.

D. TORCH LAKE SUPERFUND SITE

In 1968 C&H shut down all of its operations in the Keweenaw and Universal Oil Products (UOP) acquired the holdings of C&H including the Lake Linden processing facility. It is not known what UOP did to the property but it was not an active copper processing facility. It is reported in USEPA documents that in 1972 a storage tank in the leaching plant (located on the parcel immediately north of the subject site) spilled 27,000 gallons of cupric ammonium carbonate which discharged into Torch Lake. In 1975 Mr. Rudolph G. Kump of Calumet, Michigan purchased the property from UOP. Mr. Kump salvaged structural steel and construction materials from the site.

In 1983 the Michigan Department of Public Health (MDPH) issued an advisory against the consumption of sauger and walleye from Torch Lake due to the high incidence of fish tumors noted on fish studies in the lake conducted in the 1970' and early 1980's. In 1984 the USEPA proposed listing Torch Lake on the NPL of toxic waste sites. Torch Lake was officially placed on the NPL in 1988 making it a "Superfund" site. The Torch Lake Superfund Site included many former copper processing facilities which were located on the western shore of Torch Lake. The subject property is included in what is identified as Area 1 of Operation Unit (OU) #1. The USEPA identified abandoned drums and the stamp sands as hazards to the environment and would become the focus of investigation and remediation.

Mr. Rudolph Kump was named as a potentially responsible party (PRP) by the USEPA in early 1991. The USEPA recognized UOP, Quincy Mining Company and Quincy Development Company as the primary PRP's and removed Mr. Kump from the list of PRP's according to a May 2, 1991 correspondence from the USEPA. However as Mr. Kump owned the property, he was included in an Administrative Order on by Consent (AOC) issued by the USEPA. The AOC was for investigation/remediation of drums. Mr. Kump also entered into an agreement with other PRP's whereby UOP/Quincy Mining/Quincy Development would be responsible for costs incurred by the drum investigation and remediation. It is also believed Mr. Kump was included in a second AOC for the remediation of stamp sands by means of vegetative cover. However, no documentation indicating that the second AOC was executed has been made available. Copies of USEPA correspondence, the drum AOC and the agreement with the other PRP's are included in Appendix G.

A work plan for the drum clean up prepared in July of 1991 by Geraghty &Miller, Inc., environmental consultants for the PRP's, specifically notes the subject property as Area 1 of OU #1. The work plan states there were approximately 15 drums that were located of a steep loose brick embankment along the shoreline. The work plan can be found in Appendix H. The remediation (recovery) of the drums had been performed in 1991 and 1992. Apparently the drums on the subject property had been removed as part of the remedial activities. In the summer of 1999 the first major remedial action of stamp sands is occurring in the Torch Lake OU #1. Approximately 120 acres of exposed stamps at the far north end of Torch Lake is being stabilized and covered with topsoil and seeded with a vegetative cover. This work is being supervised by the NRCS. There is funding available for further remediation of areas in OU #1 where there areis exposed stamp sands.

E. SANBORN MAPS AND AERIAL PHOTOGRAPHS

As part of the property historic research, Sanborn Maps of the site were obtained and can be found in Appendix C of this report. Sanborn Maps were maps, generally of industrial facilities, used by insurance companies for fire insurance purposes. The subject property was included on has Sanborn Maps from 1900, 1908, 1917, 1928, 1935 and 1954. A review of these maps displays the changes at the former C&H Lake Linden ore processing facility. The following is a summary of the buildings found on the maps in chronological order.

1900 Map displays the "Hecla" and the Calumet" stamp mills, pump houses, wheel houses, a boiler house (later to be called the still house) and several small out buildings. The "Hecla" stamp mill, a pump house, a wheel house and the boiler house are on the subject property.

1908 Map displays the buildings mentioned above as well as a boiler house, power house, concentrating mill, an old power house and a machine shop. The old boiler house, now called the still house, apparently was expanded with an addition. The power house, boiler house and still house are on the subject property

1917 Map displays the aforementioned buildings plus regrinder plant #2, leaching plant and a warehouse. The concentrating mill in the 1908 Map is called regrinder plant #1; the building previously called the old boiler house is called the still house. The buildings on the subject property have not changed.

1928 Map displays all buildings previously listed with the addition of a flotation plant (which is not on the subject property).

1935 Map displays the buildings listed above although there is a notation that the "Hecla" stamp mill is not in use.

1954 Map shows all buildings from previous maps however the "Hecla" stamp mill and regrinder plant #1 are removed. There is a notation of a steam tunnel running north/south along the west side of the former "Hecla" stamp mill location, which is on the subject property.

It should be noted that the locations of railroad sidings, launders and smaller buildings had changed over the years. The shoreline of Torch Lake had also changed over the years with the addition or removal of stamp sands.

There are historic aerial photographs included in the Environmental Data Resource Inc. (EDR) report, Appendix C. The photos are from 1954, 19063,

1983 and 1993 which show the former C&H facility. The photos vary in quality and scale and therefore vary in legibility. The 1954 photo displays the same buildings as the 1954 Sanborn Map. The 1963 photo shows that the "Calumet" stamp mill, regrinder plant #2 and the flotation plant have been demolished, although the foundations are still visible. The power house, boiler house, leachate plant, still house and several smaller buildings are still standing. The 1983 photo shows that the power house is the only large building left on the site however many foundations are visible. The 1993 photo also displays only the power house and foundations.

III. GOVERNMENT AGENCY AND PRIVATE SOURCE DOCUMENTATION

A. FEDERAL GOVERNMENT

Federal regulatory agencies were not directly contacted for file information. A private search firm, EDR, specializing in database searches, was utilized. The firm accessed the USEPA database acquisitions for ASTM Designation: 1527-97 standard search distances surrounding the site. The pertinent USEPA databases searched included, but were not limited to: the NPL; the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS); the Resource Conservation and Recovery Information System (RCRIS); the Toxic Release Inventory (TRI); and the Toxic Substances Control Act (TSCA) Inventory.

The database report displays federally listed sites in both text format and on a digitized site map. The search areas are performed according to the ASTM Designation: E 1527-97 search distance criteria. The search distances vary by the database being searched.

The EDR federal database search identified the property as being within 1/8 mile of a site on the NPL and CERCLIS. The site is identified as the Torch Lake Superfund Site, OU #1. The Torch Lake Superfund Site is a result of mine tailings being discharged into the lake from the numerous copper ore processing facilities located on the west shore of the lake which operated from 1868 to1968. OU #1 refers to any area where the tailings are exposed to erosion by wind or water, and since the site does have exposed stamp sands it can be considered part of OU #1. The EDR report includes a description of the site's history and its current status.

Due to variations in government reported site addresses and locations, some sites that may be within the ASTM search criteria may not be reported. These discrepancies are caused by a site not providing a complete street address, by filing a partial street address or by filing only a

post office box number. The EDR report identified a number of unmappable sites, denoted as "orphan sites". None of the listed orphan sites appear to be positioned in an area that is likely to be an environmental detriment the subject property. Details of the identified orphan sites are located on pages 3 and 13 of the attached EDR report entitled "The EDR-Radius Map", located in Appendix C.

Mr. Steve Padovani, USEPA Region 5, was contacted and interviewed as part of this Torch Lake Superfund OU #1. Mr. Padovani is the Torch Lake Superfund Site Project Manager for the USEPA. Mr. Padovani was asked to comment on the current status of the project. Mr. Padovani said that the remedial investigation and feasibility study (RI/FS) of the site has been complete for several years. The RI/FS found no immediate danger to human health from the tailings which had been discharged into Torch Lake. The areas of concern identified were areas of tailings which are susceptible to wind and/or water erosion. The remedial action plan calls for stabilization and covering of these areas with topsoil and revegetating. The remedial actions were to start this summer (1999). Mr. Padovani said that the NRCS which is part of the U.S. Department of Agriculture (USDA) is the engineering/design/contract administration organization for the remedial action. The USEPA's future activities include site monitoring and project administration; at this point in time the USEPA's role is very limited

Mr. Gary Aho, USDA-NRCS, Hancock, Michigan, was interviewed as he is the NRCS's project manager for the Torch Lake Remedial Action. Mr. Aho said that his department is performing the engineering design of the remedial action, developing contract documents, receiving and awarding contracts as well as project oversight and administration. The first major remedial construction activities are scheduled to occur this summer at the Lake Linden waste water treatment facility which had been constructed on stamp sand at the northern tip of Torch Lake. Mr. Aho asked exactly where the subject property is located. Mr. Aho was provided with a copy of a map of the facility and indicated he thought there are stamp sands present on the property most notably on the north end along the shoreline of Torch Lake.

B. STATE GOVERNMENT

State regulatory agency files were also reviewed through the use of EDR. EDR searched a number of the MDEQ data bases, including but not limited to the LUST list; the UST Facility list; the State Hazardous Waste Sites (SHWS) list; and the Solid Waste Facilities/Landfill (LF) sites database.

The EDR database search identified one (1) state regulatory agency search match located within the ASTM Designation: E 1527-97 search radius criteria.

One (1) LUST site is within the 0.50 mile search radius. The subject property was not identified in any of the state databases searched.

Details of the aforementioned state database search matches are located on page 2 of the attached EDR report entitled "The EDR-Radius Map" located in the Appendix C.

Due to variations in government reported site addresses and locations, some sites that may be within the ASTM search criteria may not be reported. These discrepancies are caused by a site not providing a complete street address, by filing a partial street address or by filing only a post office box number. The EDR report identified a number of unmappable sites, denoted as "orphan sites". None of the listed orphan sites appear to be positioned in an area that is likely to be an environmental detriment the subject property. Details of the identified orphan sites are located on page 13 of the attached EDR report entitled "The EDR-Radius Map", located in the Appendix C.

Please note that fuel oil tanks are excluded from the public list by State Statute.

C. COUNTY AND LOCAL GOVERNMENT

Mr. Jim Reahlt, Torch Lake Township Supervisor, was contacted about the property. Mr. Rheault was asked if he was aware of any complaints, fires or other issues with respect to the property. Mr. Rheault said he knew of no complaints or fires however he is fairly young (30 years old) and his knowledge of the area's history is limited. He was aware that part of the former C&H property was given to the Houghton County Historical Society who in turn gave a portion of the property to the Village of Lake Linden to develop into a park and marina. This parcel was developed in the late 1980's. Mr. Rheault also said the Town contacted the Houghton County Building Inspectors office who inspected and then condemned the power plant building. Mr. Rheault added that the Township does not have any zoning ordinances.

D. PRIVATE SOURCES

Knowledgeable Persons

Mr. Rudolf Kump of Calumet, the current owner of the property, was interviewed for this report. Mr. Kump stated he purchased the property in 1975 from UOP (which had been C&H) and the property was in the same general condition it is today. After C&H ceased operations, Ishpeming Steel was contracted by either C&H or UOP to salvage the steel buildings left on the property. Mr. Kump said he purchased the property to use the power plant building for a welding and metal fabrication facility when it was rumored a new mining venture was going to develop some of the old C&H mines in the area and a large welding facility may be needed. The mining ventures never materialized and the property basically sat untouched all these years. However, Mr. Kump said he did salvage a small amount of steel piping off the site and someone had approached him on using the site for a wood chipping operation. A berm had been constructed around the northwest corner of the property in anticipation of the wood chipping operation but the potential facility was never constructed. I asked Mr. Kump about the water in the lower level of the power plant building, he said the water had been there although it had apparently had been pumped out numerous times prior to his purchase of the property and he had pumped it out a few times. I asked him what was in the lower level, he said not much, most piping had been removed for scrap and he couldn't recall anything specific. I also asked Mr. Kump about the piles of unused cooper concentrate bags and rusting (empty) barrels east of the former stamp mill near the pump house. He said that the salvage company (Ishpeming Steel) had free rein when they worked there and they most likely dumped those items in that area. Finally I asked Mr. Kump about the USEPA Torch Lake site, Mr. Kump said in the early 1990's he had a great deal of contact with the USEPA, a Mr. Peter Felitti in particular. Mr. Kump said that UOP had taken responsibility for the costs of any clean up in the past and he had no communication with UOP or USEPA for quite a while.

Mr. Louis Meneguzzo is longtime resident of Lake Linden and resides approximately 200 feet south of the subject property. Mr. Meneguzzo's memory of the property is limited to the time period after the processing facility ceased operations, primarily since Mr. Kump's ownership of the property (1975). Mr. Meneguzzo said that the property has remained relatively unchanged since the plant shutdown and various salvaging operations occurred in the 1970's. He also said Mr. Kump leased the property to an unnamed person who had plans of developing a wood chipping plant. An earthen berm was constructed along the north and west boundaries of the property. The chipping plant was never developed, however, the berm remains.

Mr. Red Dulong, Mr. Bob Limbeck and Mr. Paul Myers were former employees C&H and worked at the Lake Linden facility at one time or another. Mr. Dulong was an electrician from 1942 to 1968. Mr. Limbeck was a pipefitter from 1944 to 1968. Both these gentleman often worked at the power plant or boiler plant when they were in operation performing maintenance tasks. Mr. Myers was a switchboard operator from 1954 to 1968 and worked at the power plant. A group discussion was conducted with these gentlemen on May 25, 1999 near the subject site.

The discussion began with the job each man had performed and the duties and locations of the job. Mr. Dulong and Mr. Limbeck were maintenance type workers and performed tasks all over the Lake Linden facility as well as the smelter facility in Hubble and the Ahmeek reclamation plant in Tamarack City. Both these facilities are located 1 to 2 miles south of Lake Linden and were owned and operated by C&H. Both men had worked in the power plant or boiler plant often during their years of employment. As an electrical switchboard operator, Mr. Myers job was at the power plant.

A discussion of the facilities general operations was pursued. The description of the reclamation process the men gave started with the two dredges sending tailings to a shoreline pumping plant which sent the tailings to one of two (2) regrinder plants, the processed material then went to either the flotation plant, the leaching plant or the smelter in Hubble. Processed material from the flotation plant either went to the leaching plant or the smelter in Hubble, the waste tailings went back out into the lake. Processed material from the leachate went to the still house. At the still house the leachate was distilled and copper oxides were produced. Waste was transferred back to the leachate plant. The description of the operation given by the men followed the description in Section II. C. of this report.

Mr. Dulong said that when he started work in 1942 the Calumet stamp mill was still in operation but was shut down in 1944. The Hecla stamp mill had been dismantled years prior to his employment at C&H. (The Hecla was the first stamp mill on Torch Lake.) All three (3) men said that the reclamation process continued until 1968 but ore from the mines was also processed at Lake Linden, however during their tenure, most of the ore went to the Ahmeek mill in Tamarack City.

The facility at Lake Linden consisted of two (2) dredges, one (1) dredging sand discharged from the Hecla mill and one (1) dredging sand from the Calumet mill, the flotation plant, the leaching plant, the distillation plant (known as the still house), the pump house, the idle Calumet stamp mill and several small shop buildings, offices and the dispensary.

Mr. Myers was asked about the power house facility. He said there were three (3) turbine generators powered by steam from the boiler plant and one (1) high pressure boiler in the power house that could also power the turbine generators. This boiler was fired by coal and/or natural gas. The steam from this boiler was tied into the boiler plant and could be utilized for other operations at the facility. The boilers in the boiler plant were all coal fired. Coal was transported to the boiler house and power plant by rail from the coal docks which was located 1/4 mile south of the power plant. Coal for the power plant boiler was stored in a silo which still stands, and coal for the boilers was brought in as necessary by rail, there were no coal stockpiles or other storage there. Mr. Limbeck said the coal ash from the boilers dropped into a launder which discharged its slurry to the ground surface south of the boiler plant. The coal ash is very evident in this area and may be up to 30 feet thick.

Mr. Myers said that numerous compounds were used in the operation of the power plant (i.e. lubricants, boiler compounds) but they were generally consumed in the operation and there was very little waste. Mr. Limbeck said waste generated from operation of the facility either went out into the lake with the tailings waste or was incinerated in the boilers. Both Mr. Myers and Mr. Dulong agreed with Mr. Limbeck on this point. Mr. Limbeck was asked what sort of waste went into the boilers to which he said anything that fit through the doors. This included household waste from the managers' homes, all containers from products used in the operation and all the day to day garbage generated by the entire facility. Mr. Limbeck said that once a year the hospital in Hancock would bring waste there to be incinerated. All the gentlemen agreed the boilers at Lake Linden were the hottest around. Mr. Dulong was asked about oil from transformers. Specifically what happened to used transformer oil. Mr. Dulong said used oil was given out to employees who would spread it on gravel camp roads to keep dust down. Mr. Limbeck added that men would line up with jugs to receive the free oil.

IV. SITE RECONNAISSANCE

The site reconnaissance serves several purposes. It allows the investigator to gain first-hand knowledge of the property. Only by a site reconnaissance can the investigator observe the property for signs of environmental concern such as stained soil/buildings or stressed vegetation. A site walkover also allows the investigator to correlate historical record information with current site conditions and may provide for identification of items requiring further investigation.

Coleman Engineering Company conducted walkover site reconnaissance on May 24 and 25, 1999. The walkovers included observations of current use and

indications of prior use of the subject property and adjoining properties, observation of the subject property's and adjoining property's possible land issues, observation of subject property's boundary lines, and a search for visual evidence of REC's at the subject property, and to a limited extent, adjoining properties.

Subject Property Site Reconnaissance

The property is located immediately south of Lake Linden, Michigan, in Torch Lake Township of Houghton County and is bordered by Michigan State Highway 26 to the west and Torch Lake to the east. The Houghton County Historical Society Museum is immediately north of the property and a residential area lies to the south. The property is approximately 14 acres; an earthen berm borders a portion of the western and northern boundaries. Site maps are included in Appendix A.

As previously described, the property is part of the former C&H copper ore processing facility. The only building remaining on the property is the former C&H power plant, however there are foundation ruins from the former Hecla stamp mill, the boiler plant, the still house and pump house as well as other smaller unidentified ruins. The power plant building is approximately 250 feet long, 75 feet wide and 60 feet in height, and has reportedly not been in use since 1968. The building is of steel frame construction with metal siding. There is a concrete floor with many openings to a lower level. Portions of the roof have collapsed and all windows are broken out. The building is in very poor repair and has been condemned. For the most part the building is empty.

Equipment and machinery have been taken out of the building with the exception of two (2) bridge cranes. The motors and controls have been removed from the cranes. There are several piles of debris in the building consisting of piping and scrap metal. At the south end of the building are the remnants of a boiler where tons of fire brick and refractory cement remain. Also at the south end of the building is an approximately 4 foot diameter steel smokestack which extends through the roof. The lower portion of the stack is coated with presumed asbestos containing insulation. There is a coal silo outside of the building at the southeast end. Shoots from the coal silo enter the building near the former boiler location. Coal was noted at the end of the shoot inside the building, indicating that the silo may still contain coal. It was also noted that the entire lower level of the building was flooded with 4 to 5 feet of water, several 55-gallon drums were observed floating on the water. The water had an apparent greenish tint and there were areas with surface scum.

The area immediately surrounding the building was inspected. Paint chips, pieces of roofing and siding were noted. The roofing material and the siding from the

coal silo may contain asbestos; the paint may be lead based. There is a pile of scrap metal at the northeast end of the building. There is a large pile of wooden pallets on the east side of the building. Several pits, approximately 10 to 12 feet in depth and 15 to 20 feet square at the surface, which had been previously excavated next to the foundation were observed along the east side of the building; the purpose of these excavation is not known. One of these pits, near the coal tower, exposed red stamp sands. On the west side of the building is an area where there are several power poles where there may have been electrical transformers.

After inspecting the former power plant building, the rest of the property was walked over. The most notable ruin is the foundation of the former Hecla stamp mill. The foundation is over 600 feet long and approximately 100 feet wide and trends north/south on the east side of the property. It is of stone and concrete construction and numerous walls, pits and pillars are present. There are also many pipes extending out of the foundation. The southeastern end of the foundation drops 15 to 25 feet to Torch Lake; the slope is of concrete and rock rubble presumably part of the building. The shoreline is armored with 15 feet to 25 feet (vertical) of rock/concrete rubble to the base of the brick ruins of the former pump house and Hecla stamp mill. South of the former pump house, several partially buried 55-gallon drums were found on the ground surface. The drums were in an extremely rusted condition and did not appear to contain anything. Near the drums there was a large pile (10 feet x 5 feet x 4 feet high) of paper bags labeled, "Copper Concentrate 100 lbs." The bags may have been new when placed there but are highly weathered where exposed. A closer inspection indicated that there may be residue of copper compounds in the bags. Immediately west of the south end of the Hecla stamp mill ruins there is 20 to 30 feet (vertical) of rubble and debris piled down the slope near the lake. Most of the debris appears to be metal or wood construction demolition material however the exact volume and nature of this debris is unknown.

East of the power plant, between the power plant building and the stamp mill ruins, are the ruins of the former boiler plant, which is approximately 200 feet long and 100 feet wide trending in a north/south orientation. The ruins are a large concrete slab and two (2) large concrete structures approximately 12 feet in height and 20 feet in diameter. These structures are assumed to be the bases for the boiler plant smokestacks. Near the most easterly stack base an opening of a large (approximately10 feet high x15 feet wide) tunnel was noted. The tunnel was not entered during the walkover. On the concrete slab of the boiler house was a large pile of what appeared to be new refractory brick and scrap metal.

North of the boiler house ruins are the still house ruins. This ruin consists of a concrete slab approximately 200 feet long by 75 feet wide oriented north/south. There are three (3) concrete pillars (approximately 4 feet diameter and 10 feet in

height) on the north end of the ruin. There are railroad tracks set into the concrete at the south side of the ruin.

Immediately west of the still house ruin is a partially buried concrete trough approximately 4 feet wide 3 feet in height and 100 feet long in a north/south orientation. It is believed this trough is a former "launder" which transported water (wastewater). Next to this trough is a partially uncovered stone footing or foundation approximately 25 feet wide and 50 feet long. This building is identified as a filter house on the 1917 Sanborn Map.

Along highway M-26 in front of the power plant is a concrete launder for storm water. The launder crosses the highway at the north end of the power plant, traverses south in front of the power plant then turns east where the concrete launder ends and an open stream travels for 200 to 300 feet where it discharges to Torch Lake. The stream is the approximate southern boundary of the property. The source of the launder is not known, but it is off of the subject site. Surface drainage on the site is generally toward Torch Lake (east) of toward the stream at the south end of the property.

The areas of the property that are not covered by the power plant building or concrete ruins are covered by coal ash or stamp sands. The only exception to this is the northwest corner of the property where there appears to be native soil at the ground surface. There is very little vegetation on the property, what is present is primarily small shrubs or small aspen trees. The shrubs and trees are limited to the southeast corner and northeast corner of the property. As noted in Section III.D. of this report, waste including ash from the boilers in the boiler house and power plant were dropped into a launder and dumped south of the power plant and boiler house. This ash was noted there and observation at the stream at the south boundary indicate the ash may be 20 to 30 feet thick. Stamp sands can also be found on the site, most notably along the shore of Torch Lake at the north end of the property.

Adjoining Properties

The adjoining properties, defined as any real property or properties the border of which is contiguous or partially contiguous with that of the subject property, or that would be contiguous or partially contiguous with that of the subject property but for a street, road, or other public thoroughfare separating them, were observed during the site reconnaissance. The adjoining properties are summarized by general direction from the subject property:

North: The property to the north of the site is owned by the Houghton County Historical Society and is home to the Society's Museum. The property is also part of the former C&H facilities. There are several buildings on the property

utilized for museum displays. There are outdoor displays of mining equipment on the north end of the museum grounds. The only ruin that is left is believed to be the Calumet stamp mill. The Village of Lake Linden also owns a portion of the former C&H property which has been developed into a park and marina.

South: To the south of the subject property is a residential home and garage. The home appears to be of recent construction.

West: Michigan State Highway M-26 is on the west side of the subject property. Property across the highway is privately owned but not developed as a very steep slope of several hundred feet rises up from the west side of the highway.

East: To the east of the subject property is Torch Lake.

V. CONCLUSIONS

Coleman Engineering Company has performed a Phase I ESA in conformance with the scope and limitations of ASTM Designation: E 1527-97 "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process" for the 14 acre parcel located south of the Village of Lake Linden in Torch Lake Township, Houghton County, Michigan. This Phase I ESA has revealed evidence of REC's in connection with the above-described property as follows:

- Torch Lake Superfund Site - As the USEPA has determined that any area with stamp sands exposed to the environment part of the Torch Lake Superfund Site OU #1 portions of the site fall within this definition.

- Coal Ash - The presence of the coal ash has been documented in a Phase II ESA in January, 1999, to have metals concentrations which exceed the MDEQ Default Type A Clean Up Criteria and therefore is considered a REC. The complete extent of the coal ash is not known. Investigations to determine the degree and extent of impact may be appropriate before performing any remedial action. The Phase II ESA report can be found in Appendix E of this report.

- Mine Tailings - The mine tailings or stamp sands have been documented to have high concentrations of metals which has designated the area to be listed as a "Superfund" site by the USEPA. Exposed tailings are considered as "Operational Unit #1" of the Superfund site and therefore are also considered an REC. The remedy which the EPA and NRCS has developed is erosion stabilization and capping of tailings exposed to the environment.

- Drums in and outside of building - The contents of the drums observed at the site are unknown known, the drums are presumed to represent a material threat of a release of a hazardous substance and there for are considered a REC. The contents of the drums should be identified and then disposed of properly.

- Refractory brick - The refractory brick, much of which is disintegrating in the building, may contain high levels of metals. This material may pose a threat of a release of a hazardous substance therefor should be considered an REC.

- Water in basement of the building - There is a large volume of water in the lower level of the building. This water may contain high concentrations of metals or other compounds used in the building. This material may pose a threat of a release of a hazardous substance therefor should be considered an REC. The water, which has accumulated within the basement, should be sampled for appropriate parameters. At a minimum, this water should be characterized and disposed of properly.

- Potential for PCB laden switch gear power house in general also OH cranes - As there were many electrical switching devices, transformers and motors which may have contained oils which contained PCB's. Further research and investigation should be performed to determine if there is a need for any remedial action. This should also be considered an REC until investigative efforts indicate there is no threat to the environment.

- Still House & Filter House Operations - The distillation and filtering processes can produce hazardous by-products. It is not known what products were generated at the site or how products were disposed of. The processes should be researched further and sampling around these facilities may be appropriate. This should also be considered an REC until investigative efforts indicate there is no threat to the environment.

- Excavations - The purpose of the several excavations around the power plant building is unknown. The excavations may have been used as waste disposal areas and should be researched further. This should also be considered an REC until investigative efforts indicate there is no threat to the environment.

- Floatation and Leaching Process Chemicals - Numerous chemicals were used in the floatation and leaching processes. Further research to understand these processes should be performed. Sampling around the facilities may be appropriate. This should also be considered an REC until investigative efforts indicate there is no threat to the environment.

- Boiler Treatment Chemicals - Boiler treatment chemicals used in the boiler plant and power plant may have been released to the environment. Further investigation of this may be appropriate. This should also be considered an REC until investigative efforts indicate there is no threat to the environment.

- Flooded Basement - The flooded lower level of the power plant prevented inspection of that area and therefore is considered a REC. An inspection should be performed when the water is removed.

- Improper disposal of general wastes over the years - The disposal practices of waste at the C&H facility is not completely known. There are several areas on the property which have tens of feet of debris (including coal ash and stamp sands) piled in haphazard manner. It is not known what materials may have been included with the debris. Further research on waste disposal practices and a subsurface investigation of these areas may be appropriate.

- Copper Concentrate bags - The pile of copper concentrate that appeared to have residue in them can be considered an REC as they may be releasing hazardous material into the environment.

- Leachate Spill - A spill of 27,000 gallons of cupric ammonium carbonate was discharged into Torch Lake in 1972 presumably from the leaching plant. This could be considered an REC.

In summation, the subject property was once part of an enormous copper ore processing facility which operated for 100 years. The property is also the last portion of the former facility which has not undergone some type of site development. The era during which the facility operated lacked any significant environmental regulations and general waste disposal practices were very basic. After the facility closed salvage operations continued for an unknown time period, using unknown methods. An inspection of the property indicates many REC's that were easily found, it is unknown what may lie within the piles of debris or areas of coal ash or stamp sands.

There are environmental issues or conditions in connection with the subject property that are outside of the scope of ASTM Designation: E 1527-97. Although non-scope considerations are not required by this practice to demonstrate appropriate inquiry, there may be standards or protocols for assessment of potential hazards and conditions associated with non-scope conditions developed by government entities, professional organizations, or other private entities.

The following is a list of non-scope issues or conditions associated with the subject property that should be noted and assessed. No implication is intended as

to the relative importance of inquiry into such non-scope considerations, and this list of non-scope considerations is not intended to be all inclusive.

Assorted Debris - There are numerous piles of debris on the site most of which appear to be demolition waste. This material should be cleaned up.

Radon - Radon is a known carcinogen that can be present in the environment. Further investigation of this may be appropriate.

Asbestos - Asbestos is a known carcinogen and was used as a building material during the era of the power plant construction. Further investigation of this may be appropriate.

Lead Paint - Lead paint is a known health hazard and was widely used during the era of the power plants lifetime. Further investigation of this may be appropriate.

Residual Coal – Residual coal was found to be present within a coal silo on the property. The quantity of residual coal is unknown, however, it should be recovered and either recycled as fuel or properly disposed of.

Condemned Building- The building which remains on the site bears a notice on one its doors identifying the structure as Condemned as Dangerous and Unsafe. The building should be properly razed and the material disposed if in an acceptable manner.

No efforts have been expended to investigate the potential for offsite third party impacts. Further investigation of the identified topics of concern may require site sampling and analysis. These activities are all beyond the defined scope of this investigation. The client may, however, wish to undertake these activities. Only the client, however, is capable of determining the relevancy of information presented and the need to pursue items of concern further.

APPENDIX A

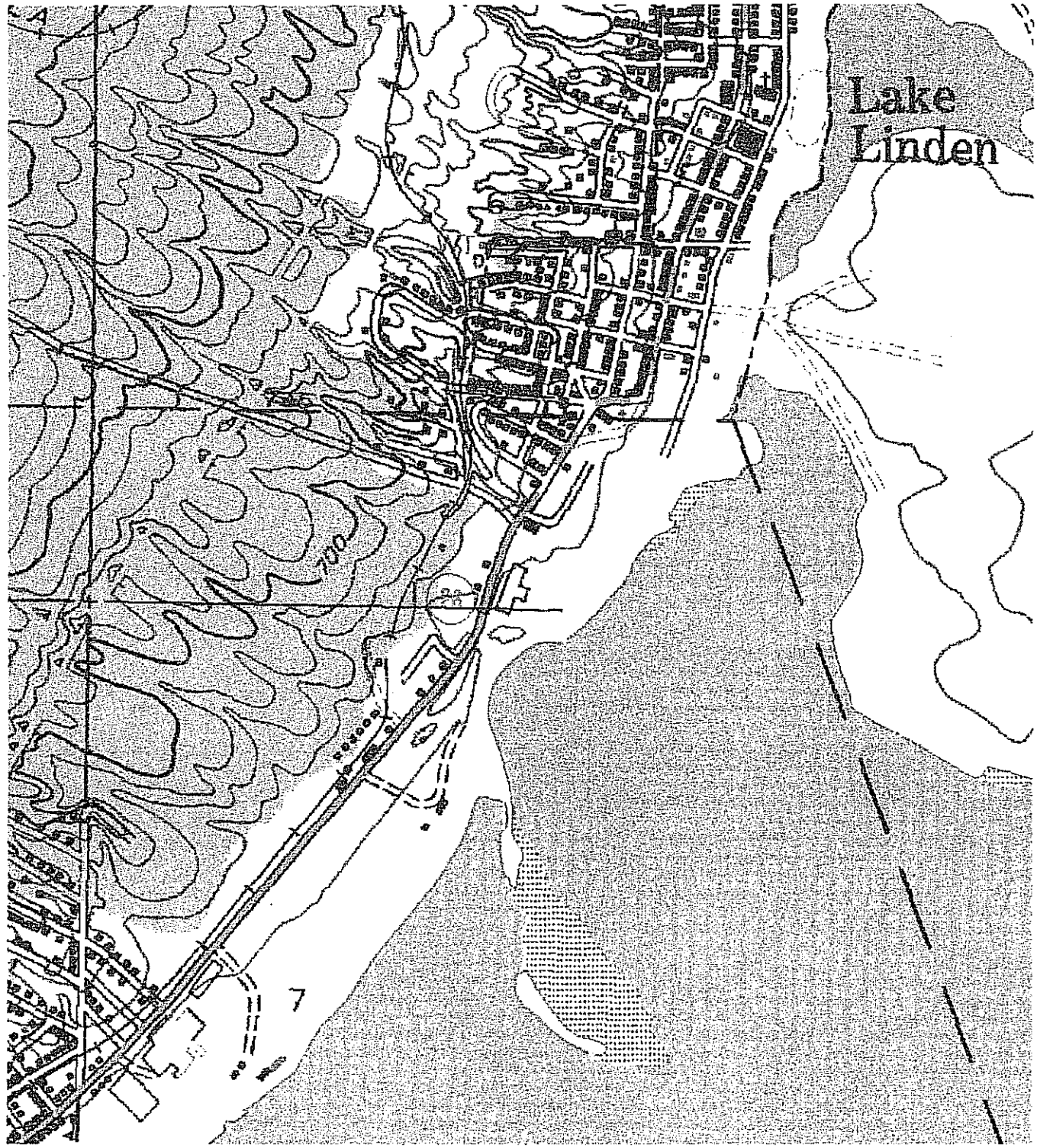
SITE LOCATION MAPS

PROJECT LOCATION MAP
PHASE I ESA
LOUIS MENEGUZZO
LAKE LINDEN, MICHIGAN

COLEMAN ENGINEERING COMPANY
CONSULTING ENGINEERS & LAND SURVEYORS
IRON MOUNTAIN, MICHIGAN

FIGURE 1

DATE: JUNE 14, 1999
JOB NO: 99009-C
CAD FILE: 99009-MW

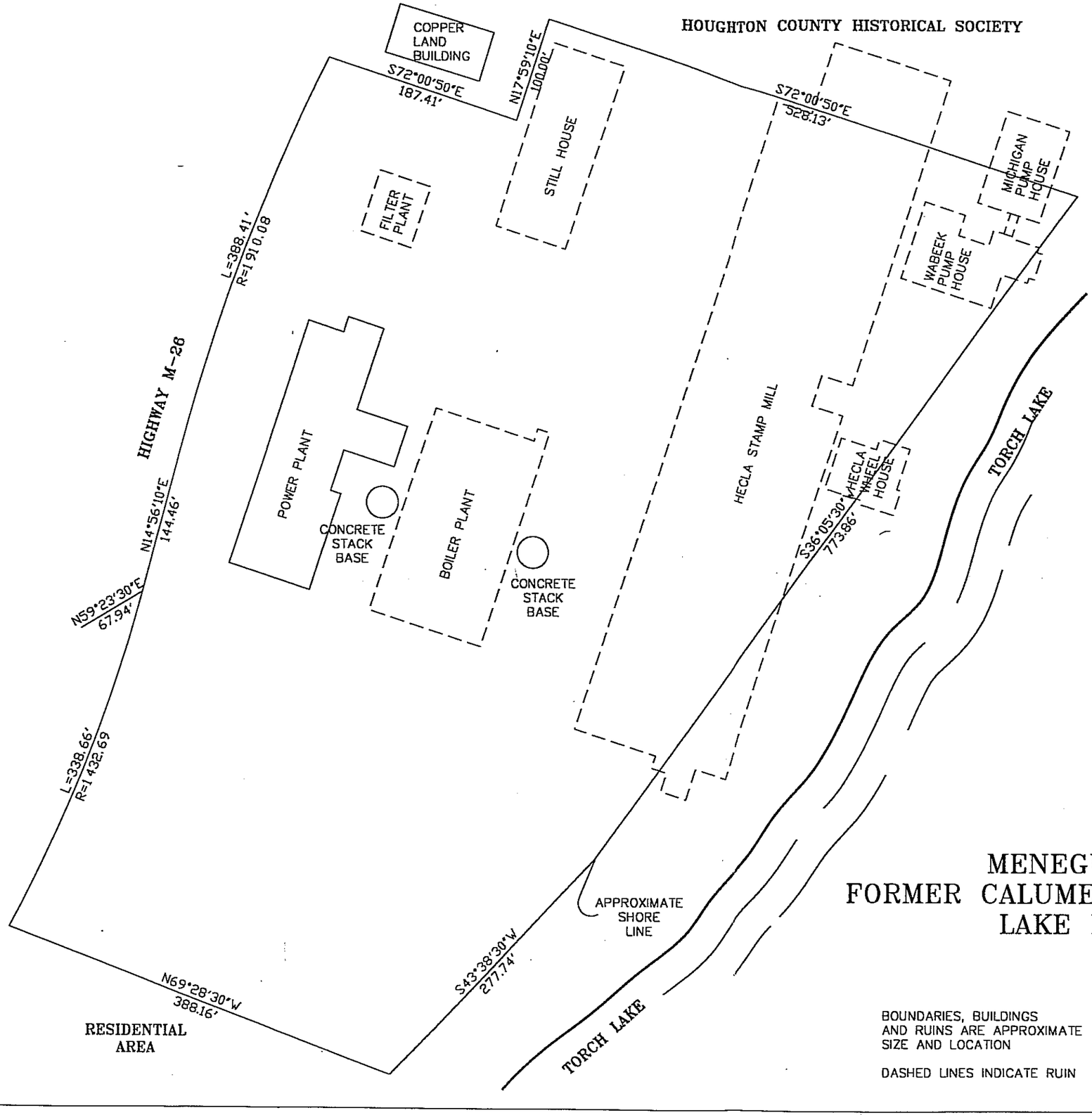


PROPERTY LOCATION MAP
FORMER CALUMET HECLA POWER STATION
PHASE I ENVIRONMENTAL SITE ASSESSMENT
LAKE LINDEN, MICHIGAN

HOUGHTON COUNTY HISTORICAL SOCIETY

NORTH

SCALE: 1"=100'



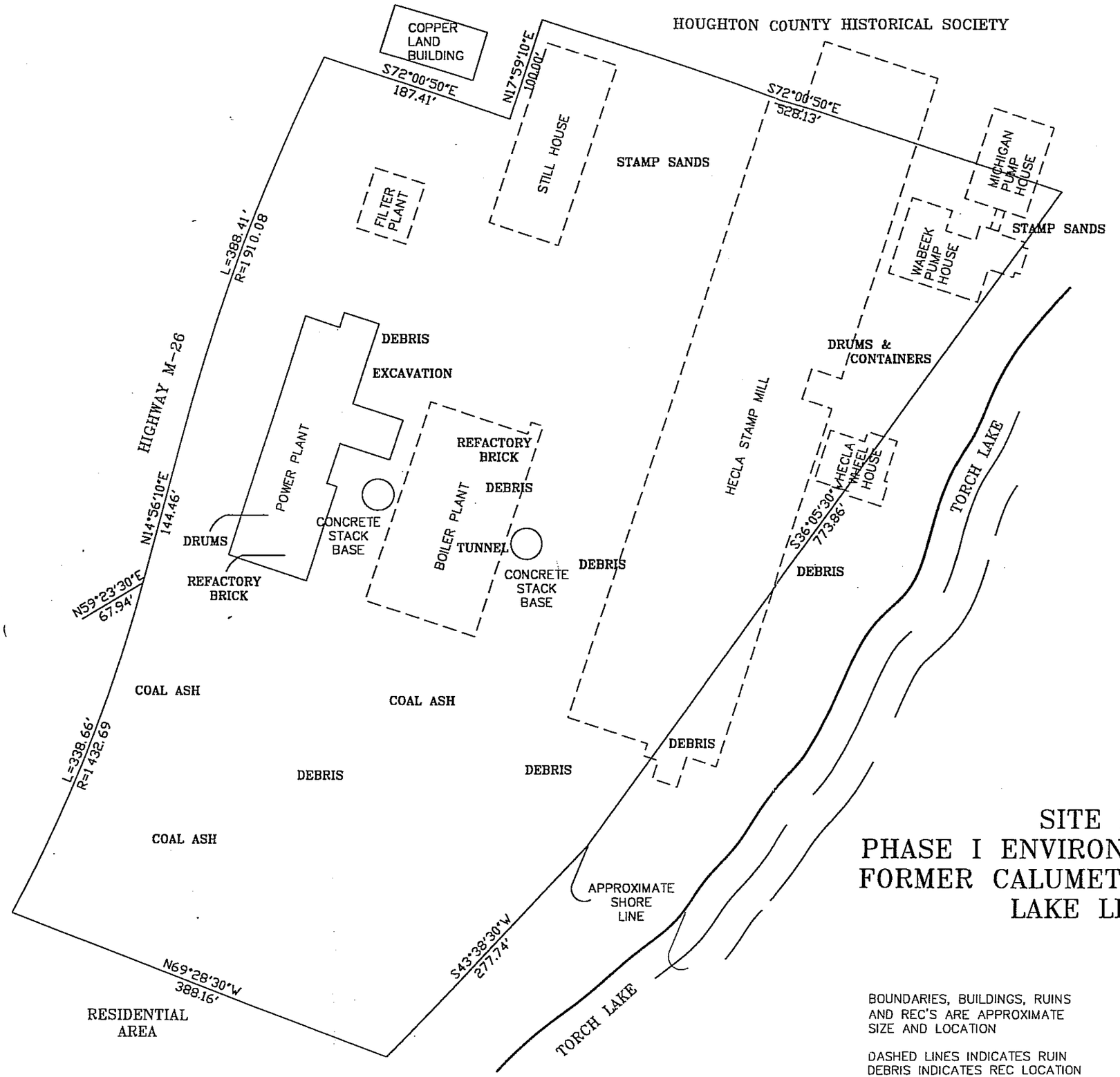
SITE MAP
MENEGUZZO PHASE I ESA
FORMER CALUMET & HECLA POWER STATION
LAKE LINDEN, MICHIGAN
FIGURE 3

BOUNDARIES, BUILDINGS AND RUINS ARE APPROXIMATE SIZE AND LOCATION

DASHED LINES INDICATE RUIN

COLEMAN ENGINEERING COMPANY
635 INDUSTRIAL PARK DRIVE
IRON MOUNTAIN, MICHIGAN 49801

DATE 06/08/99
JOB NO 99009
CADD FILE 99009



SITE FEATURES MAP
PHASE I ENVIRONMENTAL SITE ASSESSMENT
FORMER CALUMET & HECLA POWER STATION
LAKE LINDEN, MICHIGAN
FIGURE 4

BOUNDARIES, BUILDINGS, RUINS AND REC'S ARE APPROXIMATE SIZE AND LOCATION

DASHED LINES INDICATES RUIN
DEBRIS INDICATES REC LOCATION

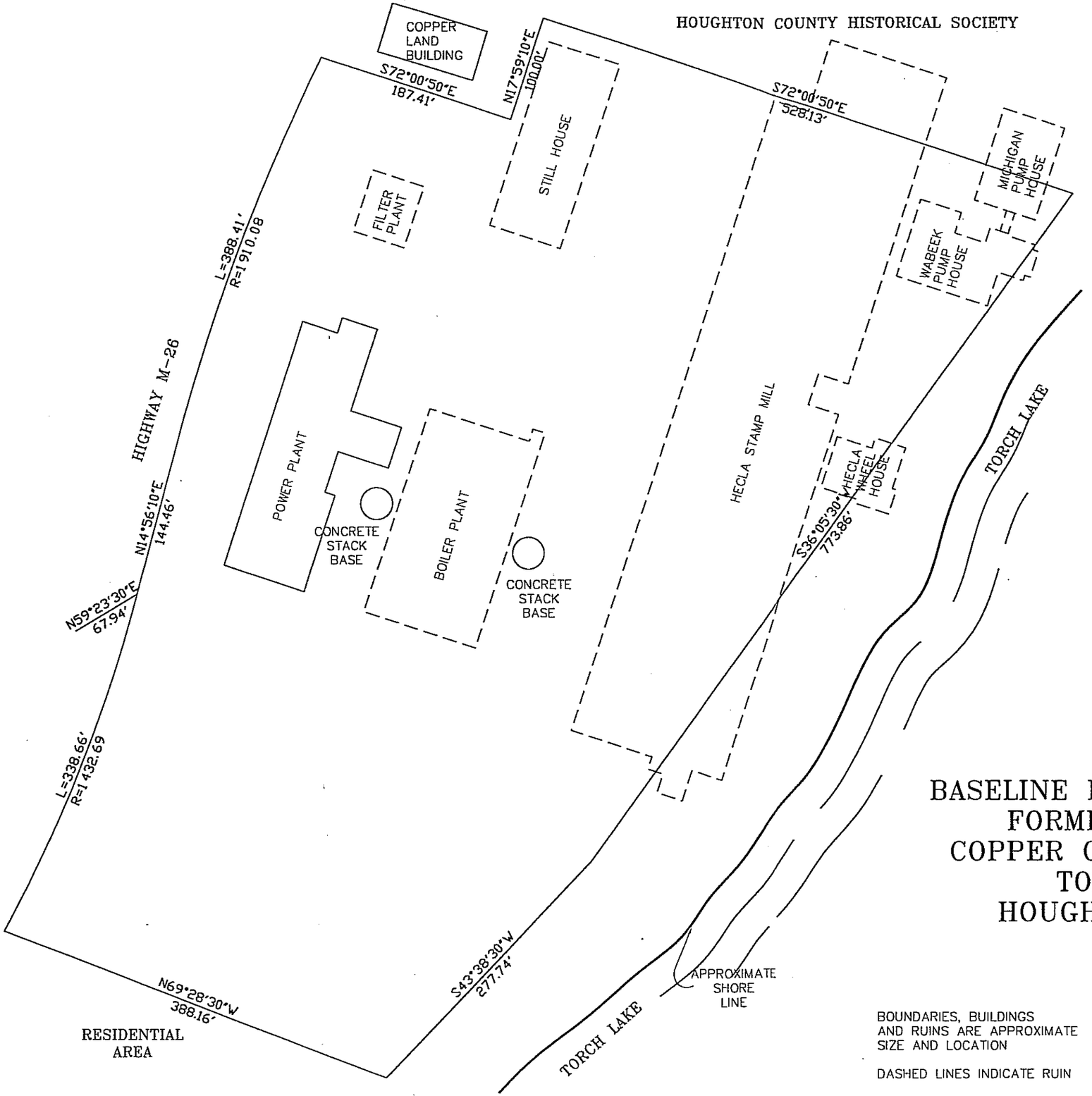
COLEMAN ENGINEERING COMPANY
635 INDUSTRIAL PARK DRIVE
IRON MOUNTAIN, MICHIGAN 49801

DATE 06/08/99
JOB NO 99009
CADD FILE 99009

HOUGHTON COUNTY HISTORICAL SOCIETY

NORTH

SCALE: 1"=100'



SITE MAP
BASELINE ENVIRONMENTAL ASSESSMENT
FORMER POWER STATION AND
COPPER ORE PROCESSING FACILITIES
TORCH LAKE TOWNSHIP
HOUGHTON COUNTY, MICHIGAN

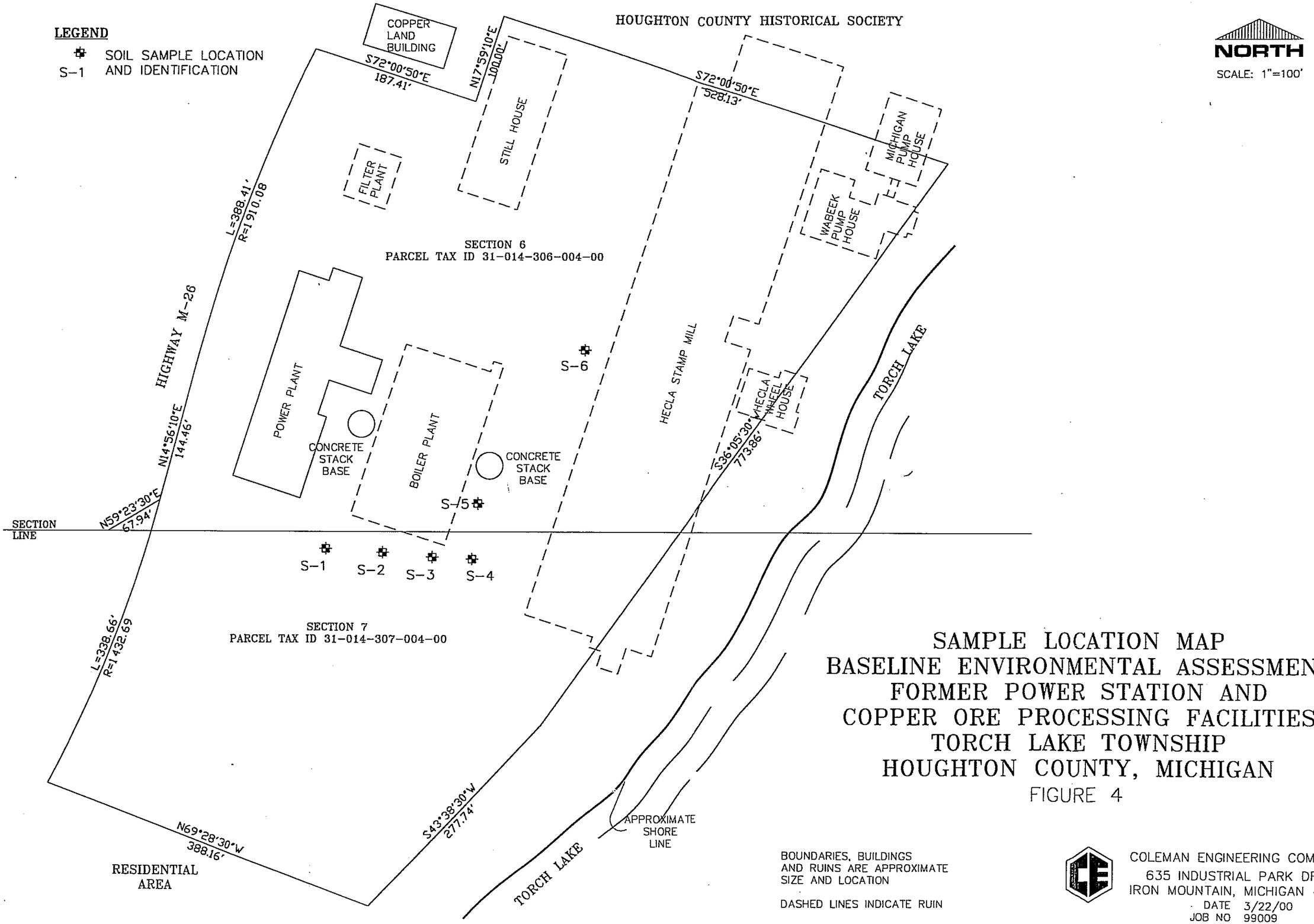
FIGURE 3

BOUNDARIES, BUILDINGS AND RUINS ARE APPROXIMATE SIZE AND LOCATION

DASHED LINES INDICATE RUIN

COLEMAN ENGINEERING COMPANY
635 INDUSTRIAL PARK DRIVE
IRON MOUNTAIN, MICHIGAN 49801

DATE 3/22/00
JOB NO 99009
CADD FILE 99009-03-D



SAMPLE LOCATION MAP
BASELINE ENVIRONMENTAL ASSESSMENT
FORMER POWER STATION AND
COPPER ORE PROCESSING FACILITIES
TORCH LAKE TOWNSHIP
HOUGHTON COUNTY, MICHIGAN

FIGURE 4

BOUNDARIES, BUILDINGS AND RUINS ARE APPROXIMATE SIZE AND LOCATION

DASHED LINES INDICATE RUIN

COLEMAN ENGINEERING COMPANY
635 INDUSTRIAL PARK DRIVE
IRON MOUNTAIN, MICHIGAN 49801

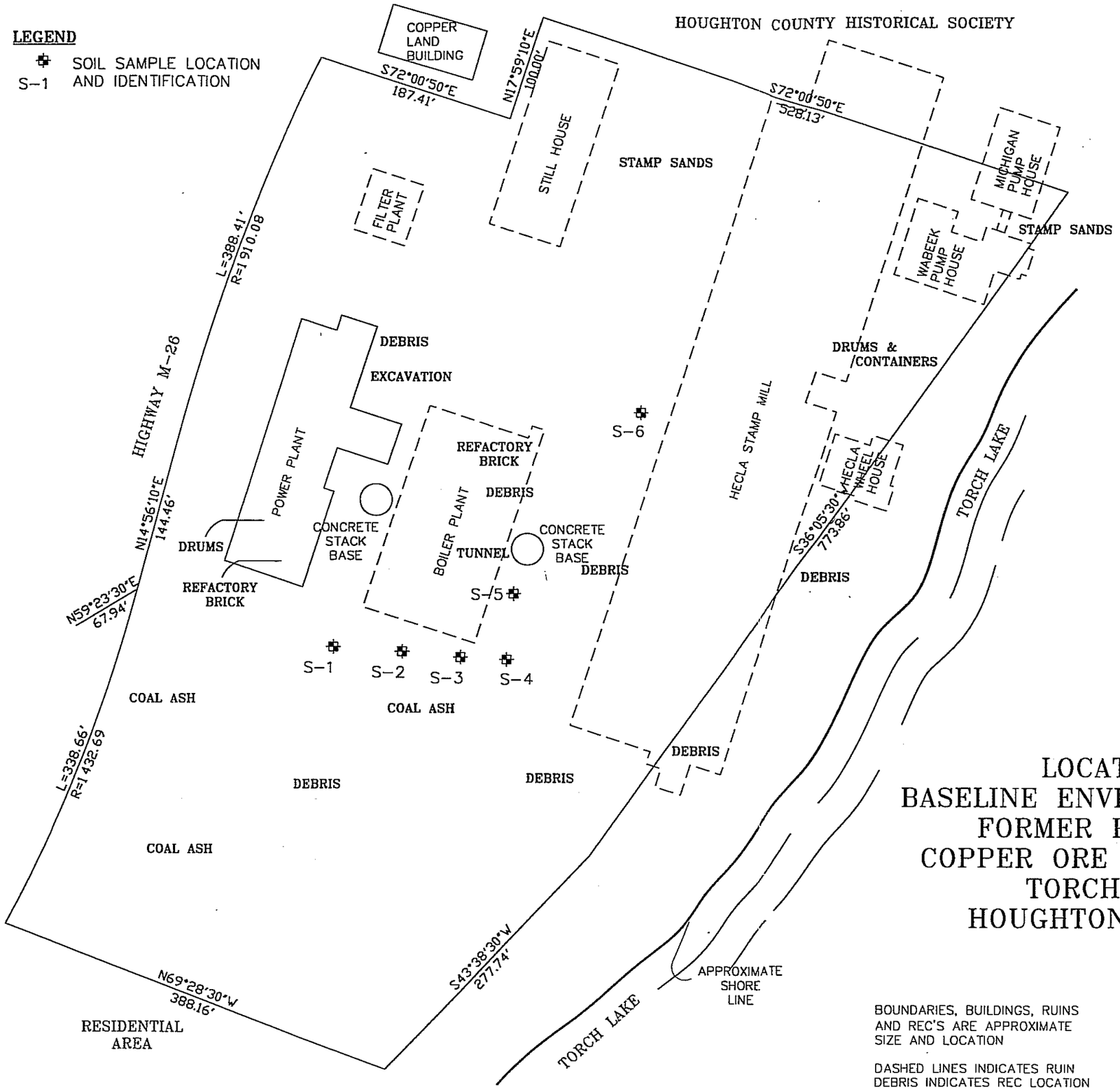
DATE 3/22/00
JOB NO 99009
CADD FILE 99009-04-D

LEGEND

⊕ SOIL SAMPLE LOCATION
S–1 AND IDENTIFICATION

NORTH

SCALE: 1"=100'



LOCATION OF IMPACT
BASELINE ENVIRONMENTAL ASSESSMENT
FORMER POWER STATION AND
COPPER ORE PROCESSING FACILITIES
TORCH LAKE TOWNSHIP
HOUGHTON COUNTY, MICHIGAN

FIGURE 5

BOUNDARIES, BUILDINGS, RUINS AND REC'S ARE APPROXIMATE SIZE AND LOCATION

DASHED LINES INDICATES RUIN
DEBRIS INDICATES REC LOCATION

COLEMAN ENGINEERING COMPANY
635 INDUSTRIAL PARK DRIVE
IRON MOUNTAIN, MICHIGAN 49801

DATE 3/22/00
JOB NO 99009
CADD FILE 99009-05-D

APPENDIX B

PROPERTY DESCRIPTION

PROJECT DESCRIPTION

A parcel of land being part of Government Lot One of Section Seven, and part of Government Lot four of Section Six, Township 55 North, Range 32 West, Torch Lake Township, Houghton County, Michigan, described as follows:

Commencing at the South ¼ corner of Section Six, Township 55 North, Range 32 West, thence North 59 degrees, 23 minutes, 30 seconds East 67.94 feet to the centerline of Highway M-26, which is the Point of Beginning; thence North 14 degrees, 56 minutes, 10 seconds East 144.46 feet along the centerline of M-26; thence along the centerline of M-26 on a curve to the right 388.41 feet, which curve has a radius of 1910.08 feet and a chord length of 387.73 feet and bearing North 20 degrees, 45 minutes, 40 seconds East, said point being on the southerly boundary of a parcel previously conveyed to the Houghton County Historical Society; thence South 72 degrees, 00 minutes, 50 seconds East 187.41 feet along the boundary of the Houghton County Historical Society property; thence North 17 degrees, 59 minutes, 10 seconds East 100.00 feet along the boundary of the Houghton County Historical Society property; thence South 72 degrees, 00 minutes, 50 seconds East 520.13 feet along the boundary of the Houghton County Historical Society property to a meander corner on the shore of Torch Lake; thence along the shore of Torch Lake on a meander line bearing South 36 degrees, 05 minutes, 30 seconds West 773.86 feet; thence along the shore of Torch Lake on a meander line bearing South 43 degrees, 38 minutes, 30 seconds West 277.74 feet to a meander corner, thence North 69 degrees, 28 minutes, 30 seconds West 388.16 feet to the centerline of Highway M-26; thence along the centerline of M-26 on a curve to the left 338.74 feet, which curve has a radius of 1432.69 feet and a chord length of 337.97 feet and bearing North 21 degrees, 42 minutes, 35 seconds East, said point also being the Point of Beginning, the above-described parcel containing 14.12 acres, more or less and it being expressly understood and intended that the above described land extends to the waters edge of Torch Lake.

APPENDIX C

EDR REPORT

- AIR PHOTOS

- SANBORN MAPS

Environmental Data Resources, Inc.
an edr company

"Linking Technology with Tradition"

Sanborn™ Map Report

Ship to:

John Hunt
Coleman Engineering Co.
635 Industrial Drive
Iron Mountain, MI 49801

Order Date: 5/4/1999 **Completion Date:** 05/05/1999

Inquiry #: 365738.4s

P.O. #: E99009B

Site Name: Meneguzzo Phase I

Address: Lake Linden

City/State: Lake Linden, MI 49945

Cross Streets:

1023217BJR 906-774-3440

Based on client-supplied information, fire insurance maps for the following years were identified

1900 - 1 - map
1908 - 1 - map
1917 - 2 maps
1928 - 1 - map
1935 - 1 - map
1954 - 1 - map

Total Maps: 7

Limited Permission to Photocopy

Coleman Engineering Co. (the client) is permitted to make up to THREE photocopies of this Sanborn Map transmittal and each fire insurance map accompanying this report solely for the limited use of its customer. No one other than the client is authorized to make copies. Upon request made directly to an EDR Account Executive, the client may be permitted to make a limited number of additional photocopies. This permission is conditioned upon compliance by the client, its customer and their agents with EDR's copyright policy; a copy of which is available upon request.

The EDR-Radius Map
with GeoCheck®

Meneguzzo Phase I
Lake Linden
Lake Linden, MI 49945

Inquiry Number: 365738.3s

May 04, 1999

Environmental Data Resources, Inc.
an edr company

The Source For Environmental Risk Management Data

3530 Post Road
Southport, Connecticut 06490

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

TABLE OF CONTENTS

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR). The report meets the government records search requirements of ASTM Standard Practice for Environmental Site Assessments, E 1527-97. Search distances are per ASTM standard or custom distances requested by the user.

The address of the subject property for which the search was intended is:

LAKE LINDEN
LAKE LINDEN, MI 49945

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the subject property or within the ASTM E 1527-97 search radius around the subject property for the following Databases:

Delisted NPL:	NPL Deletions
RCRIS-TSD:	Resource Conservation and Recovery Information System
SHWS:	State Haz. Waste
CERC-NFRAP:	Comprehensive Environmental Response, Compensation, and Liability Information System
CORRACTS:	Corrective Action Report
SWF/LF:	Solid Waste Facilities Database
UST:	Underground Storage Tank Facility List
AST:	Aboveground Tanks
RAATS:	RCRA Administrative Action Tracking System
RCRIS-SQG:	Resource Conservation and Recovery Information System
RCRIS-LQG:	Resource Conservation and Recovery Information System
HMIRS:	Hazardous Materials Information Reporting System
PADS:	PCB Activity Database System
ERNS:	Emergency Response Notification System
FINDS:	Facility Index System/Facility Identification Initiative Program Summary Report
TRIS:	Toxic Chemical Release Inventory System
NPL Lien:	NPL Liens
TSCA:	Toxic Substances Control Act
MLTS:	Material Licensing Tracking System
CONSENT:	Superfund (CERCLA) Consent Decrees
Coal Gas:	Former Manufactured gas (Coal Gas) Sites.

Unmapped (orphan) sites are not considered in the foregoing analysis.

Search Results:

Search results for the subject property and the search radius, are listed below:

Subject Property:

The subject property was not listed in any of the databases searched by EDR.

EXECUTIVE SUMMARY

Surrounding Properties:

Elevations have been determined from the USGS 1 degree Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. EDR's definition of a site with an elevation equal to the subject property includes a tolerance of -10 feet. Sites with an elevation equal to or higher than the subject property have been differentiated below from sites with an elevation lower than the subject property (by more than 10 feet). Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

NPL: Also known as Superfund, the National Priority List database is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund program. The source of this database is the U.S. EPA.

A review of the NPL list, as provided by EDR, and dated 01/19/1999 has revealed that there is 1 NPL site within approximately 1 mile of the subject property.

Equal/Higher Elevation	Address	Dist / Dir	Map ID	Page
TORCH LAKE	*STE RTE 26 N OF QUINCY*	*0 - 1/8*	*0*	*9*

CERCLIS: The Comprehensive Environmental Response, Compensation and Liability Information System contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).
CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

A review of the CERCLIS list, as provided by EDR, and dated 11/10/1998 has revealed that there is 1 CERCLIS site within approximately 0.5 miles of the subject property.

Equal/Higher Elevation	Address	Dist / Dir	Map ID	Page
TORCH LAKE	*STE RTE 26 N OF QUINCY*	*0 - 1/8*	*0*	*9*

LUST: The Leaking Underground Storage Tank Incident Reports contain an inventory of reported leaking underground storage tank incidents. The data come from the Department of Environmental Quality's Leaking Underground Storage Tank (LUST) Database.

A review of the LUST list, as provided by EDR, and dated 11/01/1998 has revealed that there is 1 LUST site within approximately 0.5 miles of the subject property.

Equal/Higher Elevation	Address	Dist / Dir	Map ID	Page
VILLAGE OF LAKE LINDEN	*401 CALUMET ST*	*1/4 - 1/2 NNE*	*1*	*11*

RODS: Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid the cleanup.

A review of the ROD list, as provided by EDR, has revealed that there is 1 ROD site within approximately 1 mile of the subject property.

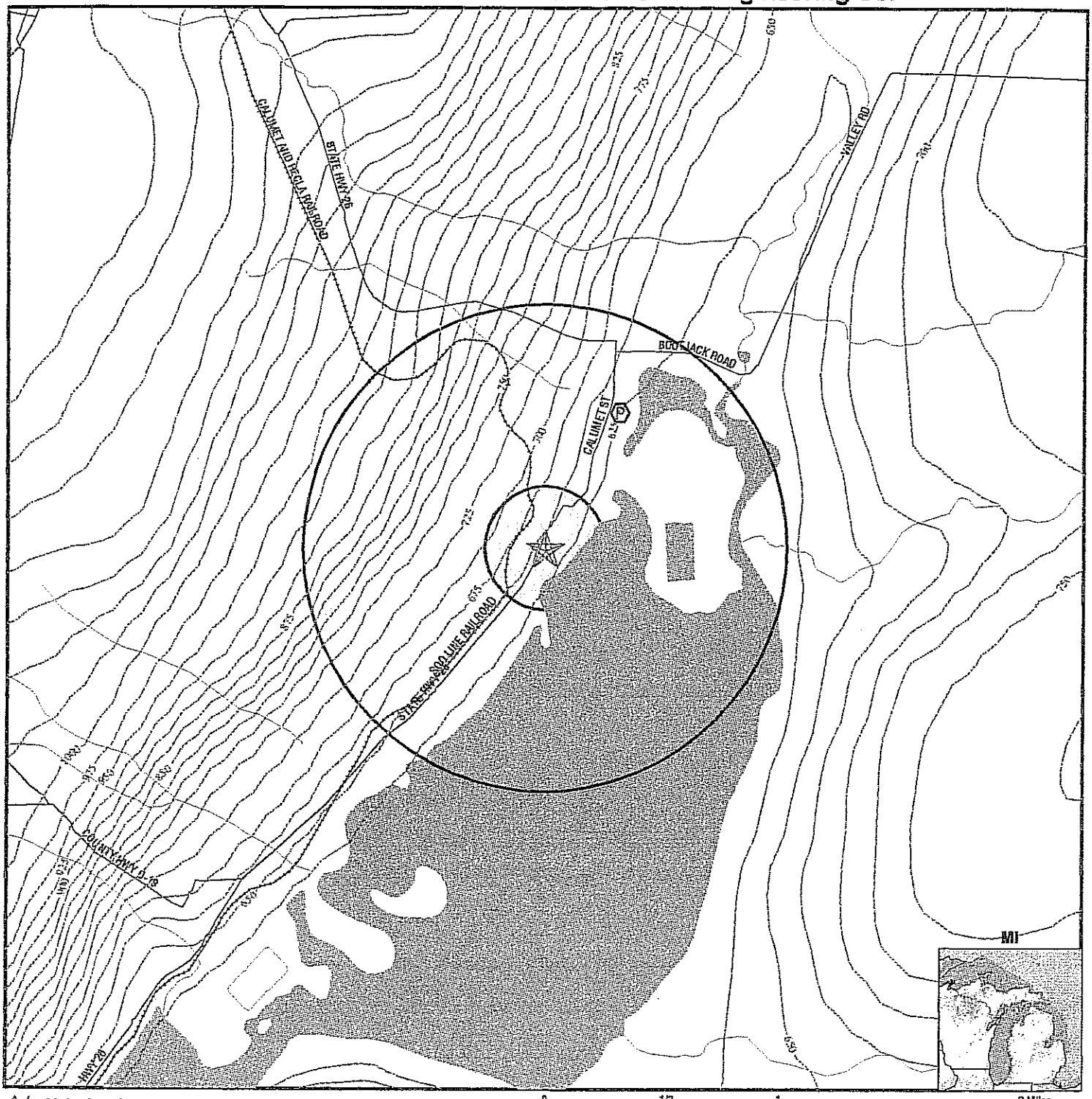
Equal/Higher Elevation	Address	Dist / Dir	Map ID	Page
TORCH LAKE	*STE RTE 26 N OF QUINCY*	*0 - 1/8*	*0*	*9*

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped:

Site Name	Database(s)
VACANT LOTS	UST,LUST
GAY BAR	UST
SAWMILL	UST

TOPOGRAPHIC MAP - 365738.3s - Coleman Engineering Co.



- Major Roads
- Contour Lines
- Waterways
- Earthquake epicenter, Richter 5 or greater
- (F) Closest Federal Well in quadrant
- [S] Closest State Well in quadrant
- (P) Closest Public Water Supply Well
- (HD) Closest Hydrogeological Data
- Oil, gas or related wells

TARGET PROPERTY:	Meneguzzo Phase I	CUSTOMER:	Coleman Engineering Co.
ADDRESS:	Lake Linden	CONTACT:	John Hunt
CITY/STATE/ZIP:	Lake Linden MI 49945	INQUIRY #:	365738.3s
LAT/LONG:	47.1861 / 88.4135	DATE:	May 04, 1999 4:59 pm

GEOCHECK VERSION 2.1
SUMMARY

TARGET PROPERTY COORDINATES

Latitude (North):	47.186119 - 47° 11' 10.0"
Longitude (West):	88.413490 - 88° 24' 48.6"
Universal Transverse Mercator:	Zone 16
UTM X (Meters):	392909.8
UTM Y (Meters):	5226598.0

USGS TOPOGRAPHIC MAP ASSOCIATED WITH THIS SITE

Target Property:	2447088-B4 LAURIUM, MI

GEOLOGIC AGE IDENTIFICATION†

Geologic Code:	Z
Era:	Precambrian
System:	Precambrian
Series:	Z Sedimentary rocks

ROCK STRATIGRAPHIC UNIT†

Category:	Stratified Sequence

GROUNDWATER FLOW INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, including well data collected on nearby properties, regional groundwater flow information (from deep aquifers), or surface topography.‡

AQUIFLOW™** Search Radius: 2.000 Miles

MAP ID	DISTANCE FROM TP	DIRECTION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported			

General Topographic Gradient at Target Property: General ESE
General Hydrogeologic Gradient at Target Property: No hydrogeologic data available.
Site-Specific Hydrogeological Data*:

Search Radius:	2.0 miles
Status:	Not found

FEDERAL DATABASE WELL INFORMATION

WELL QUADRANT	DISTANCE FROM TP	LITHOLOGY	DEPTH TO WATER TABLE
NO WELLS FOUND			

STATE WATER WELL INFORMATION

WELL QUADRANT	DISTANCE FROM TP	DEPTH FEET
NO WELLS FOUND		

STATE OIL/GAS WELL INFORMATION

PERMIT #	DISTANCE FROM TP
NO WELLS FOUND	

† Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).
‡ U.S. EPA Ground Water Handbook, Vol I: Ground Water and Contamination, Office of Research and development EPA/625/6-90/016a,Chapter 4, page 78, September 1990.
** EDR AQUIFLOW™ information System of hydrogeologically determined groundwater flow directions at specific locations. See the date pages at the end of this report for a complete description.

GEOCHECK VERSION 2.1
SUMMARY

PUBLIC WATER SUPPLY SYSTEM INFORMATION

Searched by Nearest PWS.
NOTE: PWS System location is not always the same as well location.

PWS Name: DREAMLAND HOTEL
BOOTJACK ROAD
LAKE LINDEN, MI 49945
Location Relative to TP: 1/2 - 1 Mile North
PWS currently has or has had major violation(s): No

AREA RADON INFORMATION

EPA Radon Zone for HOUGHTON County: 2

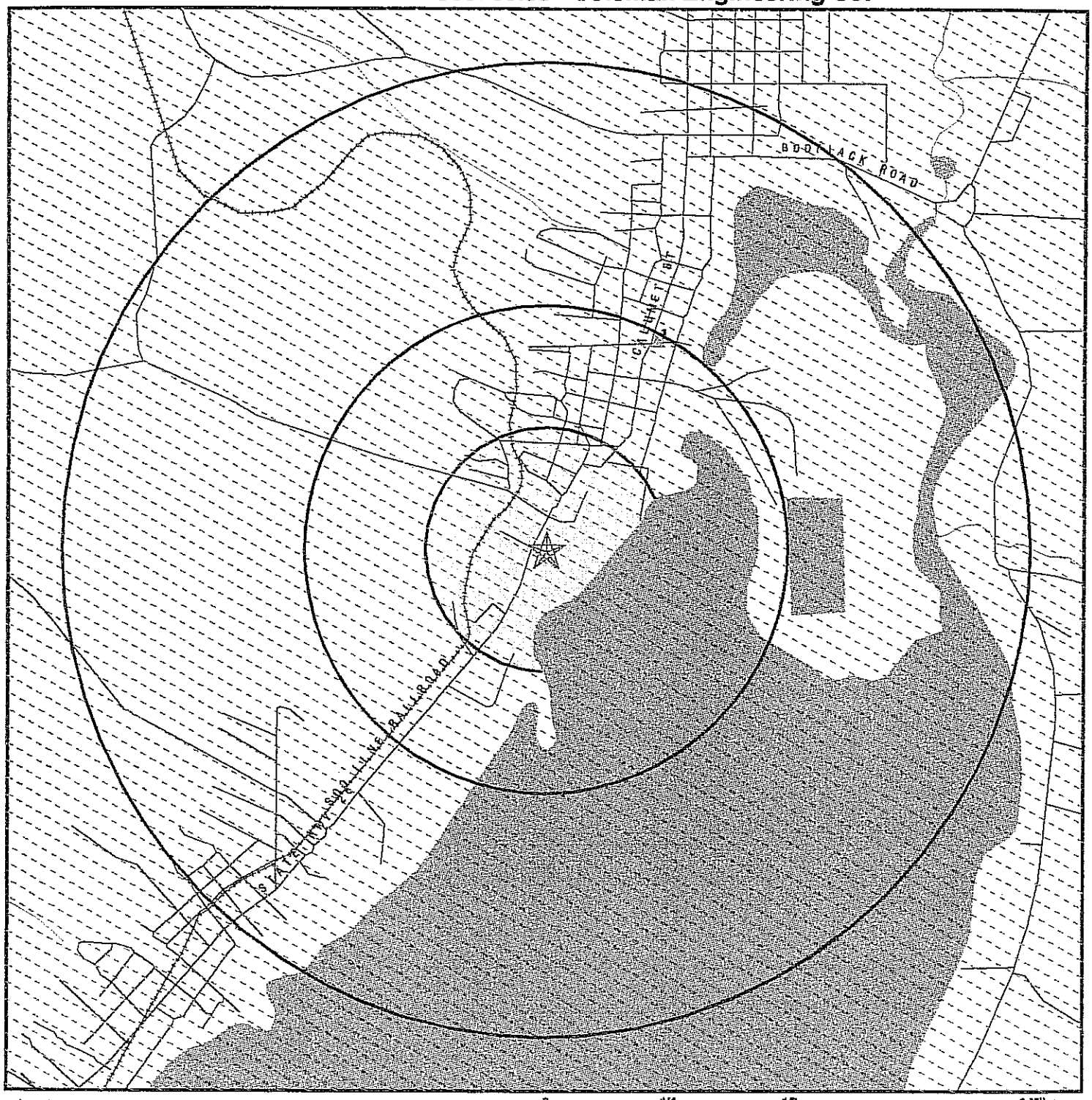
Note: Zone 1 indoor average level > 4 pCi/L
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Zip Code: 49945

Number of sites tested: 2

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	Not Reported	Not Reported	Not Reported	Not Reported
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	0.450 pCi/L	100%	0%	0%

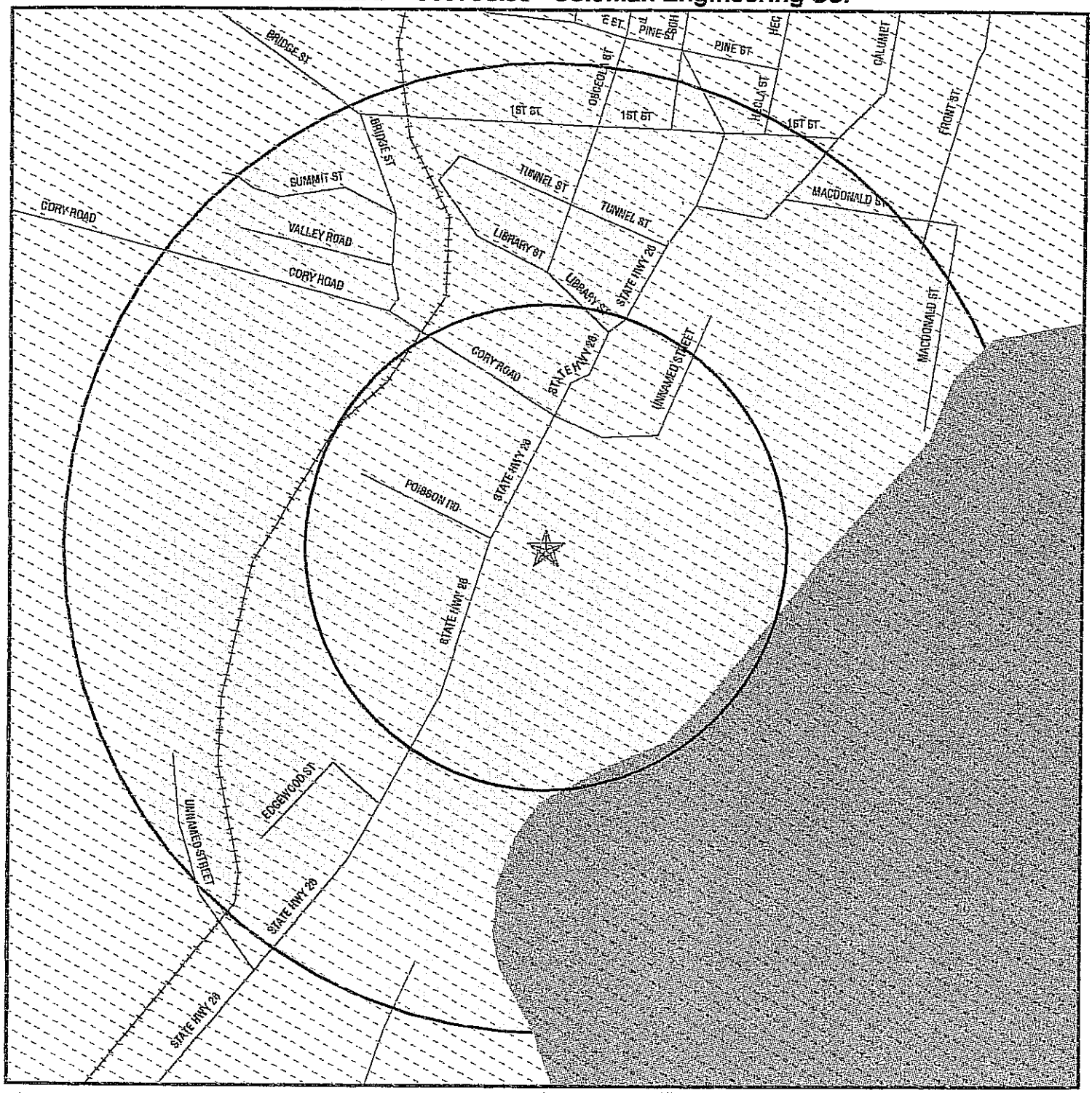
OVERVIEW MAP - 365738.3s - Coleman Engineering Co.



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Coal Gasification Sites (if requested)
- National Priority List Sites
- Landfill Sites
- Power transmission lines
- Oil & Gas pipelines

TARGET PROPERTY:	Meneguzzo Phase I	CUSTOMER:	Coleman Engineering Co.
ADDRESS:	Lake Linden	CONTACT:	John Hunt
CITY/STATE/ZIP:	Lake Linden MI 49945	INQUIRY #:	365738.3s
LAT/LONG:	47.1861 / 88.4135	DATE:	May 04, 1999 4:54 pm

DETAIL MAP - 365738.3s - Coleman Engineering Co.



0 1/16 1/8 1/4 Miles

- ☆ Target Property
- △ Sites at elevations higher than or equal to the target property
- ◇ Sites at elevations lower than the target property
- Coal Gasification Sites (if requested)
- Sensitive Receptors
- National Priority List Sites
- Landfill Sites
- Power transmission lines
- Oil & Gas pipelines

N

TARGET PROPERTY:	Meneguzzo Phase I	CUSTOMER:	Coleman Engineering Co.
ADDRESS:	Lake Linden	CONTACT:	John Hunt
CITY/STATE/ZIP:	Lake Linden MI 49945	INQUIRY #:	365738.3s
LAT/LONG:	47.1861 / 88.4135	DATE:	May 04, 1999 4:56 pm

MAP FINDINGS SUMMARY SHOWING ALL SITES

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
NPL		1.000	1	0	0	0	NR	1
Delisted NPL		TP	NR	NR	NR	NR	NR	0
RCRIS-TSD		0.500	0	0	0	NR	NR	0
State Haz. Waste		1.000	0	0	0	0	NR	0
CERCLIS		0.500	1	0	0	NR	NR	1
CERC-NFRAP		TP	NR	NR	NR	NR	NR	0
CORRACTS		1.000	0	0	0	0	NR	0
State Landfill		0.500	0	0	0	NR	NR	0
LUST		0.500	0	0	1	NR	NR	1
UST		0.250	0	0	NR	NR	NR	0
AST		TP	NR	NR	NR	NR	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
RCRIS Sm. Quan. Gen.		0.250	0	0	NR	NR	NR	0
RCRIS Lg. Quan. Gen.		0.250	0	0	NR	NR	NR	0
HMIRS		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
ERNS		TP	NR	NR	NR	NR	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
NPL Liens		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
ROD		1.000	1	0	0	0	NR	1
CONSENT		1.000	0	0	0	0	NR	0
Coal Gas		1.000	0	0	0	0	NR	0

TP = Target Property

NR = Not Requested at this Search Distance

* Sites may be listed in more than one database

MAP FINDINGS SUMMARY SHOWING
ONLY SITES HIGHER THAN OR THE SAME ELEVATION AS TP

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
NPL		1.000	1	0	0	0	NR	1
Delisted NPL		TP	NR	NR	NR	NR	NR	0
RCRIS-TSD		0.500	0	0	0	NR	NR	0
State Haz. Waste		1.000	0	0	0	0	NR	0
CERCLIS		0.500	1	0	0	NR	NR	1
CERC-NFRAP		TP	NR	NR	NR	NR	NR	0
CORRACTS		1.000	0	0	0	0	NR	0
State Landfill		0.500	0	0	0	NR	NR	0
LUST		0.500	0	0	1	NR	NR	1
UST		0.250	0	0	NR	NR	NR	0
AST		TP	NR	NR	NR	NR	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
RCRIS Sm. Quan. Gen.		0.250	0	0	NR	NR	NR	0
RCRIS Lg. Quan. Gen.		0.250	0	0	NR	NR	NR	0
HMIRS		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
ERNS		TP	NR	NR	NR	NR	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
NPL Liens		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
ROD		1.000	1	0	0	0	NR	1
CONSENT		1.000	0	0	0	0	NR	0
Coal Gas		1.000	0	0	0	0	NR	0

TP = Target Property

NR = Not Requested at this Search Distance

* Sites may be listed in more than one database

Coal Gas Site Search: No site was found in a search of Real Property Scan's ENVIROHAZ database.

NPL TORCH LAKE
Region STE RTE 26 N OF QUINCY MILLS
HUBBELL, MI 49934

CERCLIS 1000169512
NPL MID980901946
ROD

< 1/8
1

CERCLIS Classification Data:

Site Incident Category:	Not reported	Federal Facility:	Not a Federal Facility
Ownership Status:	Mixed Ownership	NPL Status:	Currently on the Final NPL
Contact:	GRACE CO	Contact Tel:	(312) 353-6779
Contact:	NOLA HICKS	Contact Tel:	(312) 886-7949
Contact:	JOSEPH MALEK	Contact Tel:	Not reported
Contact:	STEVEN PADOVANI	Contact Tel:	(312) 353-6755
Contact:	JANET PFUNDHELLER	Contact Tel:	(312) 353-5821
Contact:	JATINDER SINGH	Contact Tel:	(312) 353-6756

Site Description: The 2,700-acre Torch Lake Superfund site is located on the Keweenaw Penninsula in Houghton County, MI. The site includes Torch Lake, the west shore of Torch Lake, the northern portion of Portage Lake, the Portage Lake Canal, Keweenaw Waterway, the N orth Entry to Lake Superior, Boston Pond, Calumet Lake, and other areas associated with the Keweenaw Basin. Stampsand piles and slag piles/beach deposited along the western shore of Torch Lake, Northern Portage Lake, Keweenaw Waterway, Lake Superior , Boston Road, and Calumet Lake are also included as part of the site. Several small communities are located on the west shore of Torch Lake. Wetlands are located on the east portion of the Lake Linden stampsand pile, on the eastern edge of the Hub bell stampsend pile, around Boston Pond, and the eastern shore of Torch Lake. Torch Lake was the site of copper milling and smelting operations between 1868-1968. The site is currently inactive. Torch Lake was the site of copper milling and smelti ng facilities and operations for over 100 years. Between 1868 and 1968, approximately 200 million tons of stampsands were dumped into Torch Lake. In the 1970s, environmental concern developed regarding the century-long deposition of stampsands 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. An RI/FS was performed in November 1988. In July, 1991, EPA and six companies and individuals entered into an Administrative Order on Consent, whereb y the companies and individuals agreed to sample and remove drums located on the shore and lake bottom. EPA determined that a full-blown FS was not necessary for Operable Unit 2 (OU2). Instead, EPA produced a Remedy Position Paper which presents th e results of the efforts undertaken by EPA to evaluate the remedial options for OU2. The Remedy Position Paper, which will serve as the Focused Feasibility Study for OU2, describes the operative site conditions and various potential remedial measure s, assesses the feasibility considering the conditions, documents EPA's position regarding the measures which have been considered, and describes the Proposed Plan for OU2.

CERCLIS Assessment History:

Assessment:	DISCOVERY	Completed:	19840101
Assessment:	PRELIMINARY ASSESSMENT	Completed:	19840101
Assessment:	HRS PACKAGE	Completed:	19840801

Score

TORCH LAKE (Continued) 1000169512

Assessment:	SITE INSPECTION	Completed:	19840801
Assessment:	PROPOSAL TO NPL	Completed:	19841015
Assessment:	NPL RP SEARCH	Completed:	19850930
Assessment:	FINAL LISTING ON NPL	Completed:	19860610
Assessment:	RI/FS NEGOTIATIONS	Completed:	19880928.
Assessment:	NPL RP SEARCH	Completed:	19890306
Assessment:	REMOVAL ASSESSMENT	Completed:	19900921
Assessment:	UNILATERAL ADMIN ORDER	Completed:	19910501
Assessment:	ADMIN ORDER ON CONSENT	Completed:	19910730
Assessment:	ECOLOGICAL RISK ASSESSMENT	Completed:	19920315
Assessment:	PRP REMOVAL	Completed:	19920330
Assessment:	REMOVAL ASSESSMENT	Completed:	19920710
Assessment:	COMBINED RI/FS	Completed:	19920930
Assessment:	RECORD OF DECISION	Completed:	19920930
Assessment:	COMBINED RI/FS	Completed:	19940331
Assessment:	RECORD OF DECISION	Completed:	19940331
Assessment:	RD/RA NEGOTIATIONS	Completed:	19940928
Assessment:	NPL RP SEARCH	Completed:	19950929
Assessment:	RD/RA NEGOTIATIONS	Completed:	19960501
Assessment:	CONSENT DECREE	Completed:	19960501
Assessment:	ADMIN ORDER ON CONSENT	Completed:	19970110
Assessment:	COST RECVRY DECSN DOCMT-NO SUE	Completed:	19970325
Assessment:	CONSENT DECREE	Completed:	19971024
Assessment:	REMEDIAL DESIGN	Completed:	19980910
Assessment:	ADMINISTRATIVE RECORDS	Completed:	Not reported
Assessment:	FIVE YEAR REMEDY ASSESSMENT	Completed:	Not reported
Assessment:	TECHNICAL ASSISTANCE	Completed:	Not reported
Assessment:	TREATABILITY STUDY	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	MANAGEMENT ASSISTANCE	Completed:	Not reported
Assessment:	HUMAN HEALTH RISK ASSESSMENT	Completed:	Not reported
Assessment:	ADMINISTRATIVE RECORDS	Completed:	Not reported
Assessment:	REMEDIAL COMMUNITY RELATIONS	Completed:	Not reported

CERCLIS Site Status:
Not reported

CERCLIS Alias Name(s):
TORCH LAKE

TORCH LAKE (Continued) 1000169512

NPL:

ID:	05MI091
Date Listed:	6/10/86 (FINAL)
EPA/ID:	MID980901946
Haz. Rank Score:	46.72
Status:	LISTED ON NPL
Rank:	268
Group:	6
Ownership:	Private
Permit:	Not reported.
Site Activities:	Spill.
Site Activities:	Leaking Containers
Site Condition:	Damage of Flora/Fauna.
Site Condition:	Contamination of Soil
Waste Type:	Metals
Waste Type:	Mine Tailings

Contaminant:	Media Affected:
COPPER AND COMPOUNDS, NOS (CU)	Surface Water
ZINC AND COMPOUNDS, NOS (ZN)	Not reported
NICKEL AND COMPOUNDS, NOS (NI)	Not reported
CHROMIUM AND COMPOUNDS, NOS (CR)	Not reported
AMMONIA	Surface Water
LEAD (PB)	Not reported

Distance to nearest Population:	Not reported
Population within a 1 Mile Radius:	Not reported
Population within a 2 Mile Radius:	Not reported
Population within a 4 Mile Radius:	Not reported
Vertical Distance to Aquifer:	Less than 21 Feet
Ground Water Use:	Used as Drinking Water, Alternative Source not Available
Distance to nearest Surface Water:	Greater than 2 Miles

ROD:
Full-text of USEPA Record of Decision(s) is available from EDR.

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1 NNE 1/4-1/2 2558 Higher VILLAGE OF LAKE LINDEN
401 CALUMET ST
LAKE LINDEN, MI 49945

UST U000254389
LUST N/A

LUST:

Facility ID:	0-000353
Status:	OPEN

UST:

Facility ID:	0-000353
Tank ID:	1
Owner:	VILLAGE OF LAKE LINDEN
Owner Address:	401 CALUMET STREET LAKE LINDEN, MI 49945
Product:	Gasoline
Capacity:	1,000
Tank Age:	24
Tank Material:	Bare Steel
Tank Status:	Remv
Piping Material:	Galvanized Steel
Piping Type:	Not reported
Contact:	SUSAN A HARALSON

VILLAGE OF LAKE LINDEN (Continued) U000254389

Contact Phone: (906) 296-9911
Release Detection:
Tank: Not reported
Pipe: Not reported

Facility ID: 0-000353
Tank ID: 2
Owner: VILLAGE OF LAKE LINDEN
Owner Address: 401 CALUMET STREET
LAKE LINDEN, MI 49945
Product: Diesel
Capacity: 500
Tank Age: 24
Tank Material: Bare Steel
Tank Status: Remv
Piping Material: Galvanized Steel
Piping Type: Not reported
Contact: SUSAN A HARALSON
Contact Phone: (906) 296-9911
Release Detection:
Tank: Not reported
Pipe: Not reported

Facility ID: 0-000353
Tank ID: 3
Owner: VILLAGE OF LAKE LINDEN
Owner Address: 401 CALUMET STREET
LAKE LINDEN, MI 49945
Product: Gasoline
Capacity: 500
Tank Age: 20
Tank Material: Bare Steel
Tank Status: Remv
Piping Material: Galvanized Steel
Piping Type: Not reported
Contact: SUSAN A HARALSON
Contact Phone: (906) 296-9911
Release Detection:
Tank: Not reported
Pipe: Not reported

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)	Facility ID
GAY	U003321525	GAY BAR	101 LAKE	49945	UST	0-009175
LAKE LINDEN	U003325674	VACANT LOTS	100 BLOCK OF CALUMET	49945	UST, LUST	0-035575
LAKE LINDEN	U003321307	SAWMILL	HWY M-26	49945	UST	0-008438

GEOCHECK VERSION 2.1
PUBLIC WATER SUPPLY SYSTEM INFORMATION

Searched by Nearest PWS.

PWS SUMMARY:

PWS ID:	MI3120049	PWS Status:	Active	Distance from TP:	1/2 - 1 Mile
Date Initiated:	Not Reported	Date Deactivated:	Not Reported	Dir relative to TP:	North
PWS Name:	DREAMLAND HOTEL BOOTJACK ROAD LAKE LINDEN, MI 49945				
Addressee / Facility:	Not Reported				
Facility Latitude:	47 11 39		Facility Longitude:	088 24 25	
City Served:	Not Reported				
Treatment Class:	Untreated		Population Served:	Under 101 Persons	

PWS currently has or has had major violation(s): No

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Elapsed ASTM days: Provides confirmation that this EDR report meets or exceeds the 90-day updating requirement of the ASTM standard.

FEDERAL ASTM RECORDS:

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System
Source: EPA
Telephone: 703-413-0223
CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 11/10/98
Date Made Active at EDR: 01/29/99
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 12/29/98
Elapsed ASTM days: 31
Date of Last EDR Contact: 03/03/99

ERNS: Emergency Response Notification System
Source: EPA/NTIS
Telephone: 202-260-2342
Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 12/31/98
Date Made Active at EDR: 01/18/99
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 01/13/99
Elapsed ASTM days: 5
Date of Last EDR Contact: 01/04/99

NPL: National Priority List
Source: EPA
Telephone: 703-603-8852
National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC).

Date of Government Version: 01/19/99
Date Made Active at EDR: 02/19/99
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 02/08/99
Elapsed ASTM days: 11
Date of Last EDR Contact: 02/08/99

RCRIS: Resource Conservation and Recovery Information System
Source: EPA/NTIS
Telephone: 800-424-9346
Resource Conservation and Recovery Information System. RCRIS includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA).

Date of Government Version: 01/04/99
Date Made Active at EDR: 02/24/99
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 02/04/99
Elapsed ASTM days: 20
Date of Last EDR Contact: 03/31/99

CORRACTS: Corrective Action Report
Source: EPA
Telephone: 800-424-9346
CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 12/01/98
Date Made Active at EDR: 01/29/99
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 12/28/98
Elapsed ASTM days: 32
Date of Last EDR Contact: 03/16/99

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

FEDERAL NON-ASTM RECORDS:

BRS: Biennial Reporting System
Source: EPA/NTIS
Telephone: 800-424-9346
The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/95
Database Release Frequency: Biennially

Date of Last EDR Contact: 03/25/99
Date of Next Scheduled EDR Contact: 06/21/99

CONSENT: Superfund (CERCLA) Consent Decrees
Source: EPA Regional Offices
Telephone: Varies
Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: Varies
Database Release Frequency: Varies

Date of Last EDR Contact: Varies
Date of Next Scheduled EDR Contact: N/A

FINDS: Facility Index System/Facility Identification Initiative Program Summary Report
Source: EPA/NTIS
Telephone: N/A
Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 01/08/99
Database Release Frequency: Quarterly

Date of Last EDR Contact: 04/16/99
Date of Next Scheduled EDR Contact: 07/12/99

HMIRS: Hazardous Materials Information Reporting System
Source: U.S. Department of Transportation
Telephone: 202-366-4526
Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 12/31/97
Database Release Frequency: Annually

Date of Last EDR Contact: 03/24/99
Date of Next Scheduled EDR Contact: 04/26/99

MLTS: Material Licensing Tracking System
Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 12/08/98
Database Release Frequency: Quarterly

Date of Last EDR Contact: 03/02/99
Date of Next Scheduled EDR Contact: 05/31/99

NPL LIENS: Federal Superfund Liens
Source: EPA
Telephone: 205-564-4267
Federal Superfund Liens. Under the authority granted the USEPA by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner receives notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/91
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 02/22/98
Date of Next Scheduled EDR Contact: 05/24/99

PADS: PCB Activity Database System
Source: EPA
Telephone: 202-260-3936
PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 09/22/97
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 03/05/99
Date of Next Scheduled EDR Contact: 05/17/99

RAATS: RCRA Administrative Action Tracking System
Source: EPA
Telephone: 202-564-4104
RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/95
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 03/15/99
Date of Next Scheduled EDR Contact: 06/14/99

ROD: Records Of Decision
Source: NTIS
Telephone: 703-416-0223
Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 03/31/95
Database Release Frequency: Annually

Date of Last EDR Contact: 04/19/99
Date of Next Scheduled EDR Contact: 07/19/99

TRIS: Toxic Chemical Release Inventory System
Source: EPA/NTIS
Telephone: 202-260-1531
Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/95
Database Release Frequency: Annually

Date of Last EDR Contact: 04/01/99
Date of Next Scheduled EDR Contact: 06/28/99

TSCA: Toxic Substances Control Act
Source: EPA
Telephone: 202-260-1444
Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/94
Database Release Frequency: Every 4 Years

Date of Last EDR Contact: 04/26/99
Date of Next Scheduled EDR Contact: 07/26/99

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

STATE OF MICHIGAN ASTM RECORDS:

LUST: Leaking Underground Storage Tank Sites
Source: Department of Environmental Quality
Telephone: 517-335-3075
Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 11/01/98
Date Made Active at EDR: 01/15/99
Database Release Frequency: Annually

Date of Data Arrival at EDR: 12/14/98
Elapsed ASTM days: 32
Date of Last EDR Contact: 03/18/99

SHWS: Contaminated Sites
Source: Department of Environmental Quality
Telephone: 517-373-9540
State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 12/09/98
Date Made Active at EDR: 04/01/99
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 03/01/99
Elapsed ASTM days: 31
Date of Last EDR Contact: 03/01/99

LF: Solid Waste Facilities Database
Source: Department of Environmental Quality
Telephone: 517-335-4035
Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 12/01/98
Date Made Active at EDR: 03/01/99
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 02/01/99
Elapsed ASTM days: 28
Date of Last EDR Contact: 01/22/99

UST: Underground Storage Tank Facility List
Source: Department of Environmental Quality
Telephone: 517-373-8168
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 11/01/98
Date Made Active at EDR: 03/23/99
Database Release Frequency: Annually

Date of Data Arrival at EDR: 02/23/99
Elapsed ASTM days: 28
Date of Last EDR Contact: 03/10/99

STATE OF MICHIGAN NON-ASTM RECORDS:

AST: Aboveground Tanks
Source: Department of Environmental Quality
Telephone: 517-373-8168
Registered Aboveground Storage Tanks.

Date of Government Version: 11/01/98
Database Release Frequency: Annually

Date of Last EDR Contact: 01/07/99
Date of Next Scheduled EDR Contact: 04/26/99

Historical and Other Database(s)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

Former Manufactured Gas (Coal Gas) Sites: The existence and location of Coal Gas sites is provided exclusively to EDR by Real Property Scan, Inc. For a technical description of the types of hazards which may be found at such sites, contact your EDR customer service representative.

Disclaimer Provided by Real Property Scan, Inc.

The information contained in this report has predominantly been obtained from publicly available sources produced by entities other than Real Property Scan. While reasonable steps have been taken to insure the accuracy of this report, Real Property Scan does not guarantee the accuracy of this report. Any liability on the part of Real Property Scan is strictly limited to a refund of the amount paid. No claim is made for the actual existence of toxins at any site. This report does not constitute a legal opinion.

DELISTED NPL: NPL Deletions
Source: EPA
Telephone: 703-603-8769
The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 01/19/99
Date Made Active at EDR: 02/19/99
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 02/08/99
Elapsed ASTM days: 11
Date of Last EDR Contact: 02/08/99

NFRAP: No Further Remedial Action Planned
Source: EPA
Telephone: 703-413-0223
As of February 1995, CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) have been removed from CERCLIS. NFRAP sites may be sites where, following an initial investigation, no contamination was found, contamination was removed quickly without the need for the site to be placed on the NPL, or the contamination was not serious enough to require Federal Superfund action or NPL consideration. EPA has removed approximately 25,000 NFRAP sites to lift the unintended barriers to the redevelopment of these properties and has archived them as historical records so EPA does not needlessly repeat the investigations in the future. This policy change is part of the EPA's Brownfields Redevelopment Program to help cities, states, private investors and affected citizens to promote economic redevelopment of unproductive urban sites.

Date of Government Version: 11/10/98
Date Made Active at EDR: 01/29/99
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 12/29/98
Elapsed ASTM days: 31
Date of Last EDR Contact: 03/03/99

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-260-2805
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-260-2805
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SWDIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Area Radon Information: The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones: Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

Oil/Gas Pipelines/Electrical Transmission Lines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines and electrical transmission lines.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

USGS Water Wells: In November 1971 the United States Geological Survey (USGS) implemented a national water resource information tracking system. This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on more than 900,000 wells, springs, and other sources of groundwater.

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1998 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in March 1997 from the U.S. Fish and Wildlife Service.

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Water Dams: National Inventory of Dams
Source: Federal Emergency Management Agency
Telephone: 202-646-2801
National computer database of more than 74,000 dams maintained by the Federal Emergency Management Agency.

Michigan Public and Private Water Wells
Source: Michigan Department of Natural Resources
Locations of verified municipal and private water well sites compiled from Michigan Department of Public Health, Water Well and Pump Records. Available in the following MI counties: Calhoun, Eaton, Genesee, Ingham, Jackson, Kalamazoo, Kent, Midland, Muskegon, Oakland, Ottawaw, Saginaw, St. Clair, Washtenaw.

Michigan Oil and Gas Wells
Source: Michigan Department of Natural Resources
Locations of oil and gas wells are compiled from permit records on file at the Geological Survey Division (GSD), Michigan Department of Natural Resources.

The EDR-Aerial Photography Print Service

Meneguzzo Phase I
Lake Linden
Lake Linden, MI 49945

May 9, 1999

Inquiry Number: 365738-5

The Source For Environmental Risk Management Data

3530 Post Road
Southport, Connecticut 06490

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802

Environmental Data Resources, Inc.
Aerial Photography Print Service

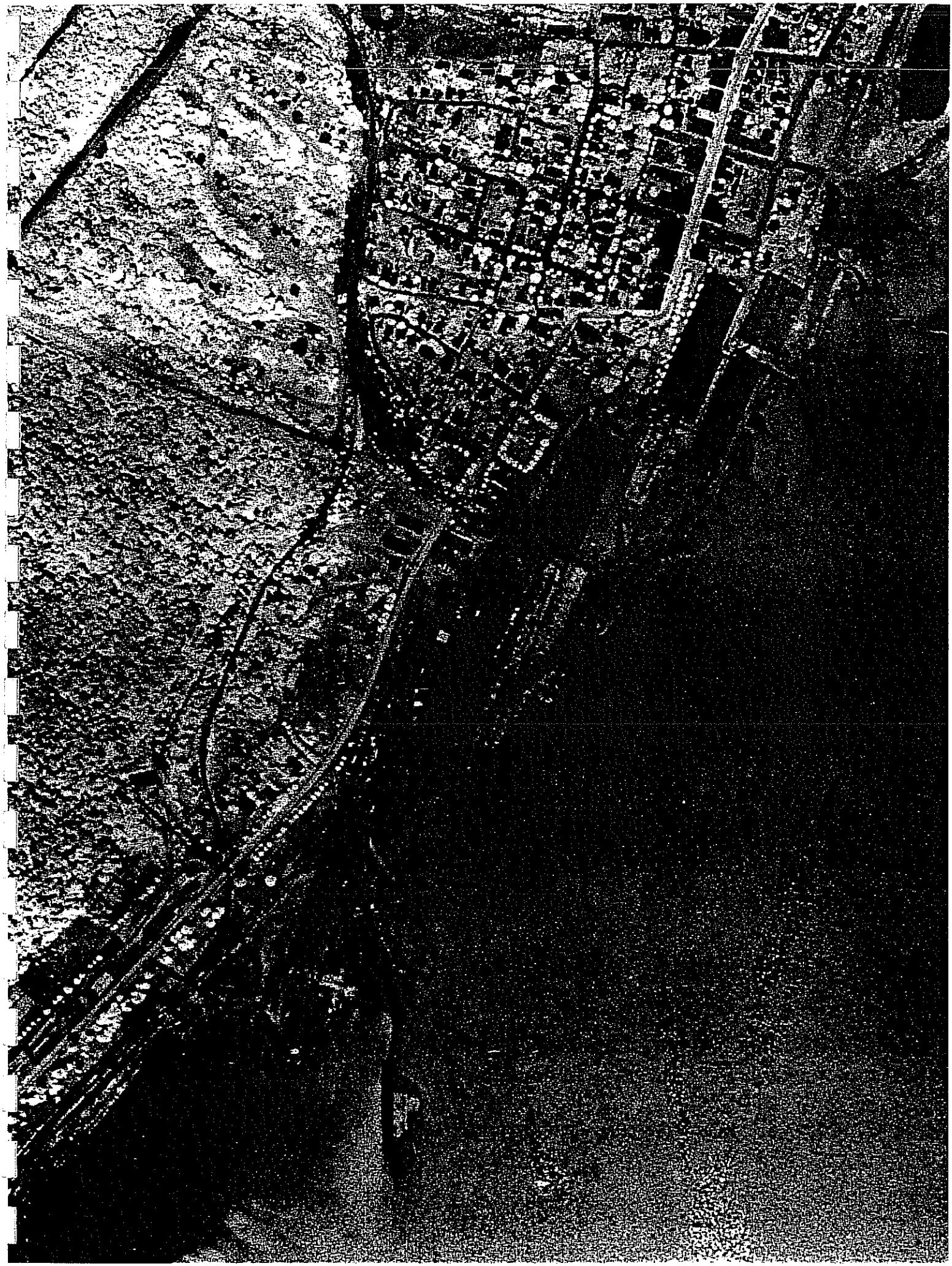
Environmental Data Resources, Inc.'s (EDR) Aerial Photography Print Service is a screening tool designed to assist professionals in evaluating potential liability on a target property resulting from past activities. ASTM E 1527-97, Section 7.3 on Historical Use Information, identifies the prior use requirements for a Phase I environmental site assessment. The ASTM standard requires a review of *reasonably ascertainable standard historical sources. Reasonably ascertainable means information that is publicly available, obtainable from a source with reasonable time and cost constraints, and practically reviewable.*

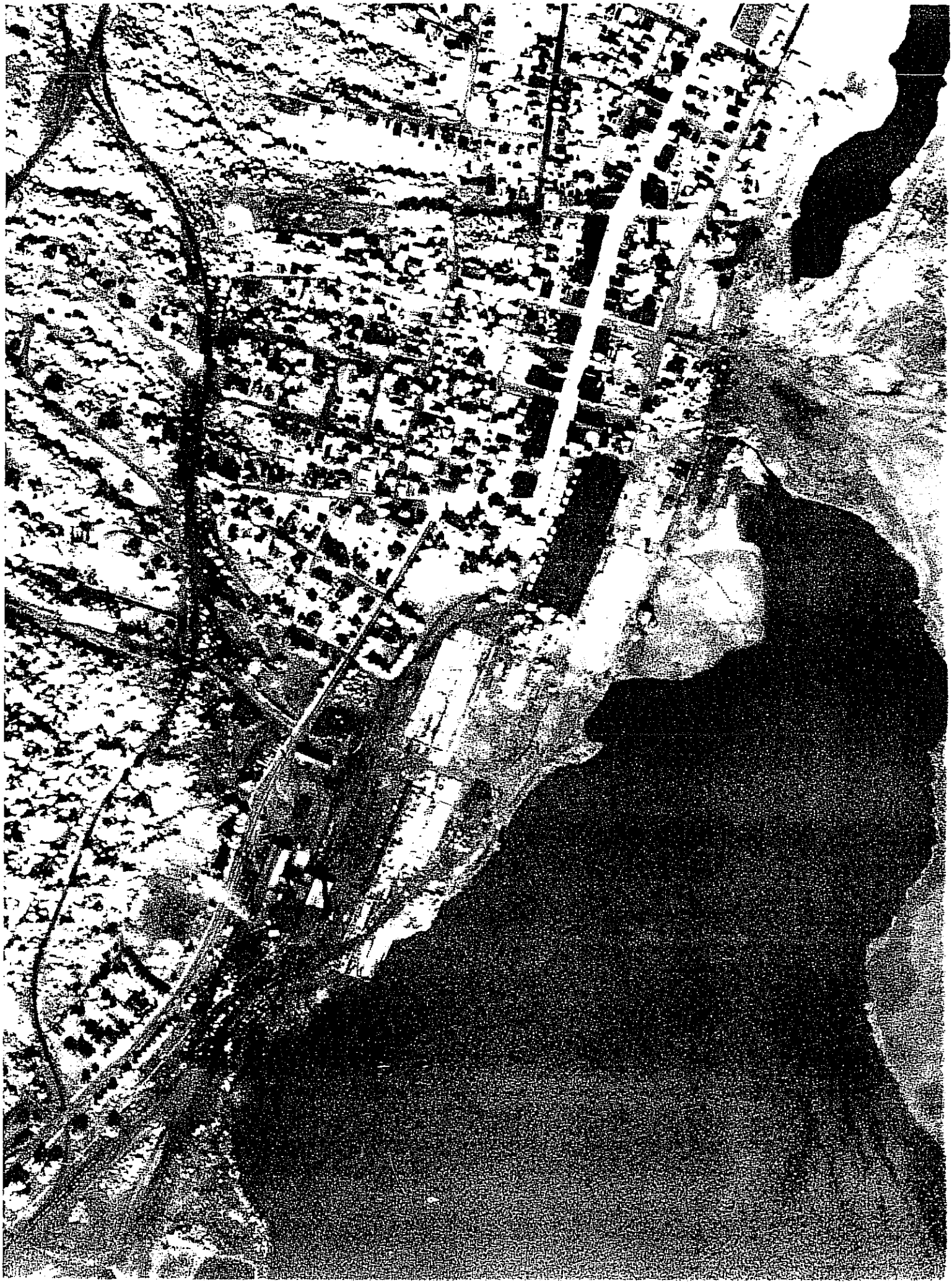
To meet the prior use requirements of ASTM E 1527-97, Section 7.3.2, the following *standard historical sources* may be used: aerial photographs, fire insurance maps, property tax files, land title records (although these cannot be the sole historical source consulted), topographic maps, city directories, building department records, or zoning/land use records. ASTM E 1527-97 requires *"All obvious uses of the property shall be identified from the present, back to the property's obvious first developed use, or back to 1940, whichever is earlier. This task requires reviewing only as many of the standard historical sources as are necessary, and that are reasonably ascertainable and likely to be useful."* (ASTM E 1527-97, Section 7.3.2, page 11.)

Aerial Photographs

Aerial photographs are a valuable historical resource for documenting past land use and can be particularly helpful when other historical sources (such as city directories or fire insurance maps) are not reasonably ascertainable. The EDR Aerial Photograph Print Service includes a search of local aerial photograph collections flown by public and private agencies for the state of Michigan. EDR's professional field-based researchers provide digitally reproduced historical aerial photographs at ten year intervals.

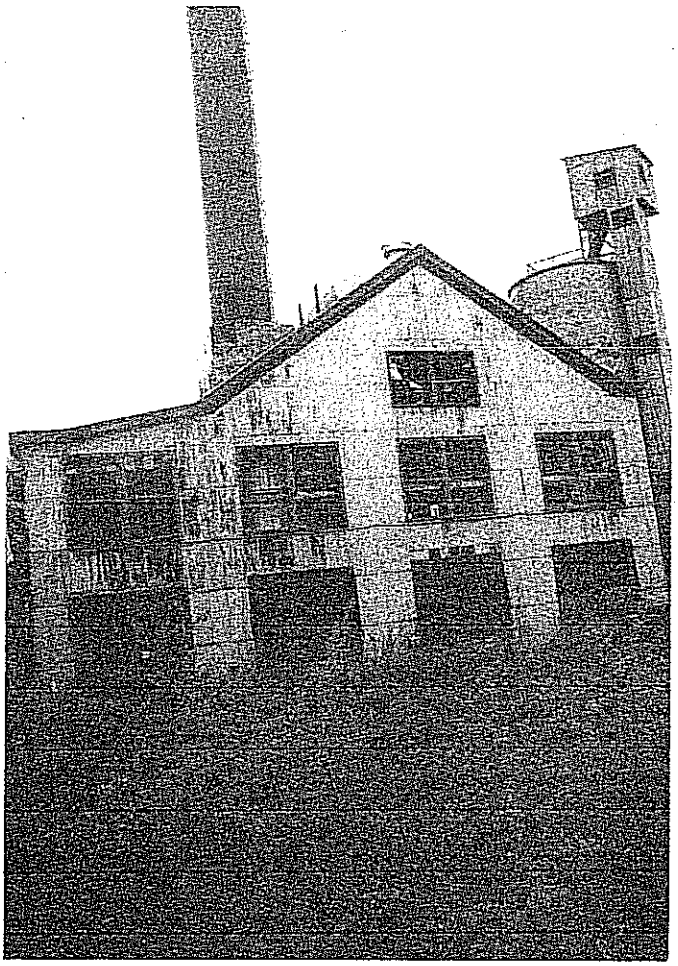
Please call Environmental Data Resources, Inc. Nationwide Customer Service at
1-800-352-0050 (8am-8pm ET)
with questions or comments about your report.
Thank you for your business!



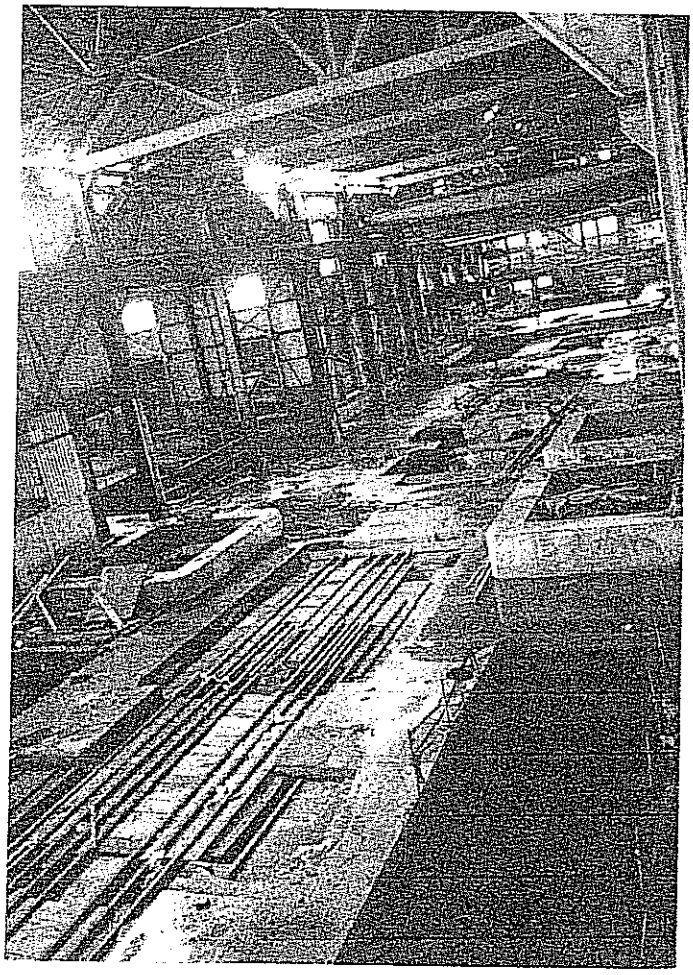


APPENDIX D

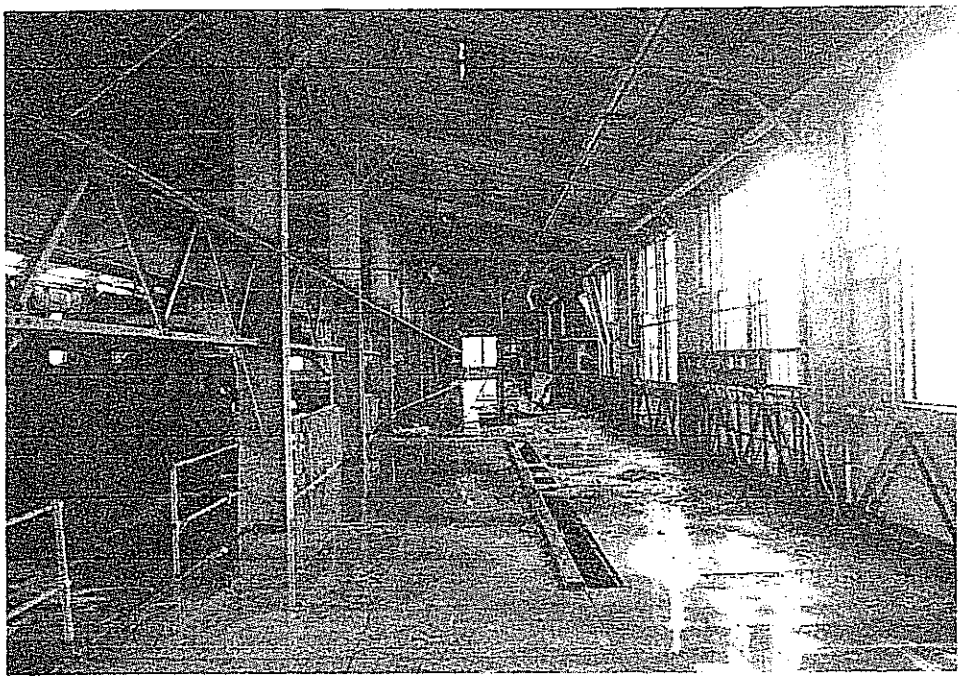
PHOTOS



SOUTH SIDE OF POWER PLANT BUILDING

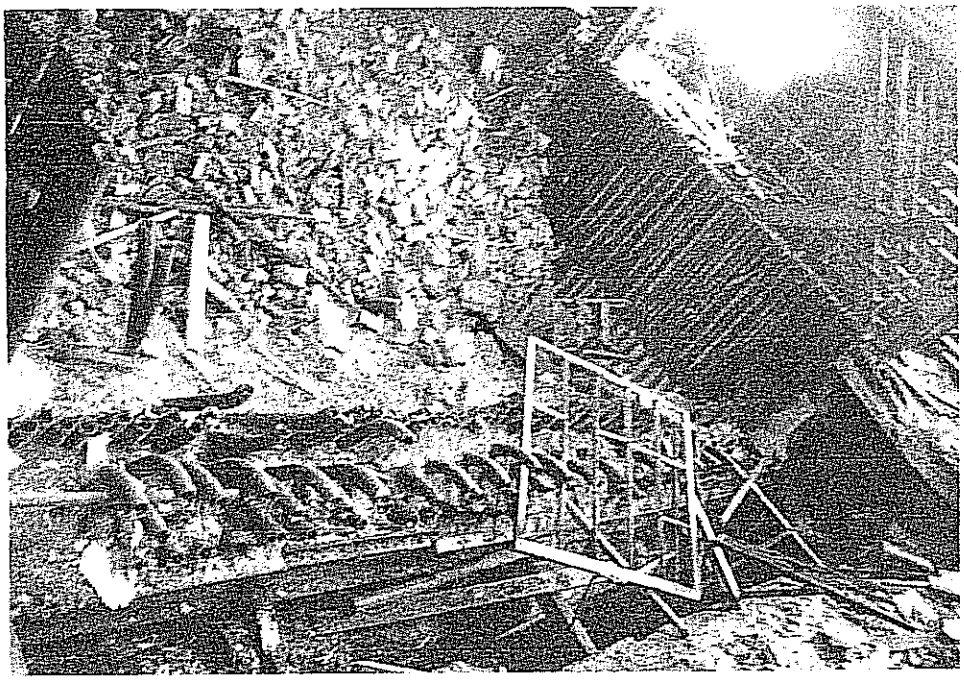


MAIN FLOOR OF POWER PLANT

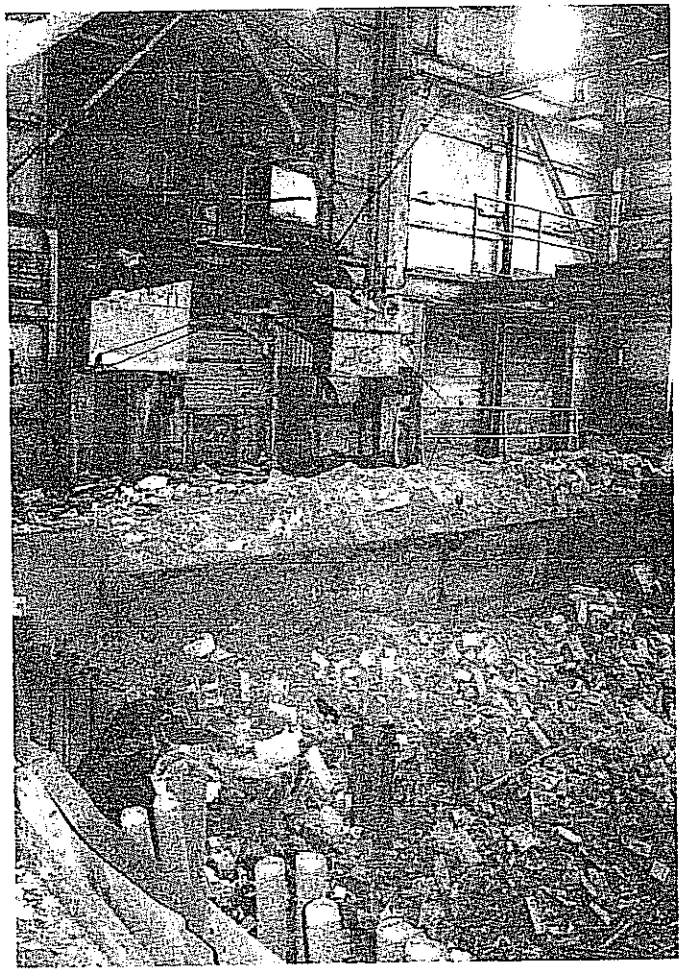


UPPER DECK OF POWER PLANT BUILDING

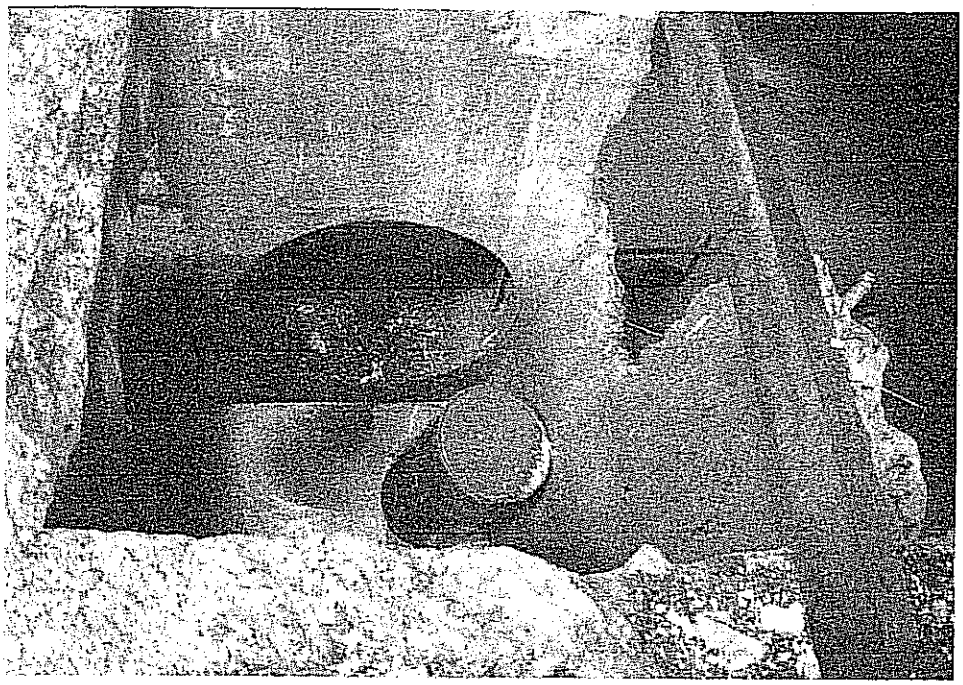
FLOODED LOWER LEVEL OF POWER PLANT BUILDING



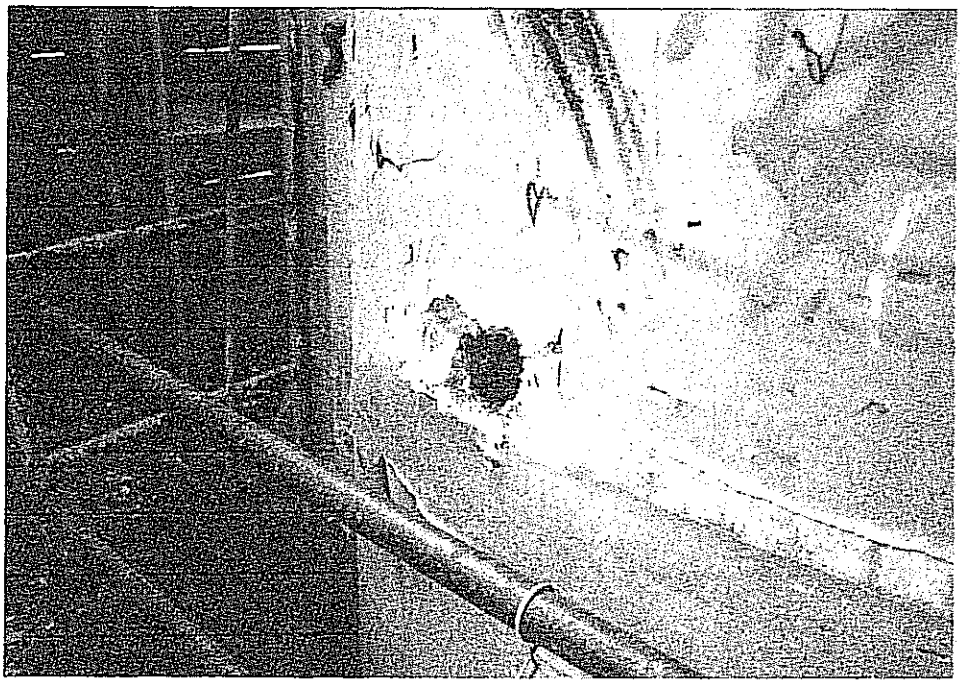
DISMANTLED BOILER IN POWER PLANT BUILDING



DISMANTLED BOILER AND
COAL SHOOTS IN POWER PLANT

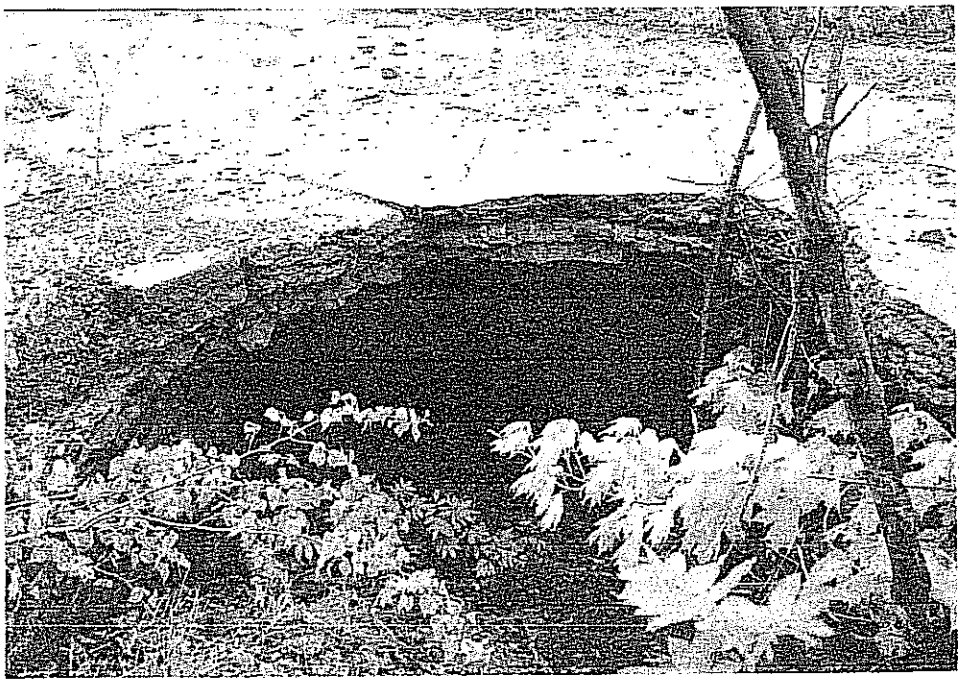


DRUMS IN FLOODED LOWER LEVEL OF POWER PLANT BUILDING



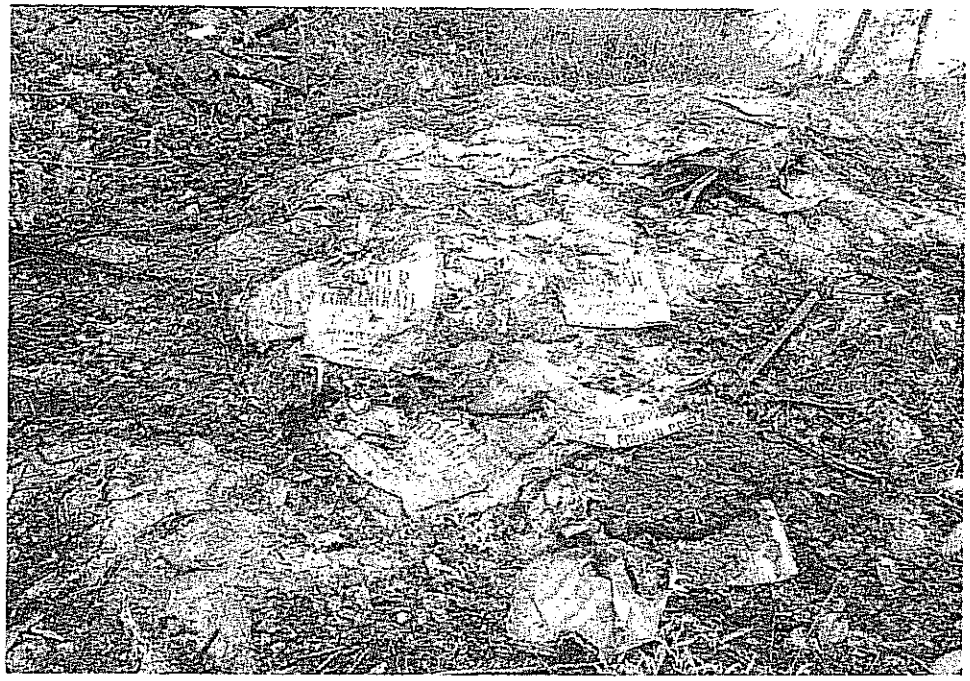
POSSIBLE ASBESTOS CONTAINING INSULATION AROUND SMOKE STACK SOUTH END OF POWER PLANT BUILDING

DEBRIS PILE ON BOILER PLANT RUINS BOILER PLANT BUILDING IN BACKGROUND - LEFT



TUNNEL ENTRANCE UNDER BOILER PLANT RUINS

PARTIALLY BURIED DRUMS AND OTHER DEBRIS - EAST CENTRAL PORTION OF THE PROPERTY



PILE OF COPPER CONCENTRATE BAGS AND OTHER DEBRIS - EAST CENTRAL PORTION OF THE PROPERTY

APPENDIX E

PHASE II ENVIRONMENTAL SITE ASSESSMENT

COLEMAN ENGINEERING CO.

Civil Engineering • Environmental Engineering
Geotechnical Engineering • Land Surveying • Test Drilling
Construction Quality Control • Materials Laboratory Testing

Principals:
John R. Garske
James J. Strigel
Michael L. DesRosier

January 22, 1999

Mr. Louis Meneguzzo
M-26 Box 294
Lake Linden, Michigan 49945

Re: Former Calumet Hecla Power Plant
Lake Linden, Michigan
Phase II Environmental Site Assessment (ESA)

Dear Mr. Meneguzzo:

This letter serves to document the procedures and findings of a Phase II ESA conducted at the above referenced property.

Introduction

The subject property was the location of a Calumet and Hecla Mining Company coal fired power plant. Local history of the subject property indicated an area with a potential recognized environmental condition (REC). To further investigate the area which has been identified as having a potential REC, a Phase II ESA was performed. The REC being investigated was identified as a result of the presence of a large volume of apparent coal ash which remains on the site. A Phase I ESA was not performed prior to preparation of this report. The term REC generally means the presence or likely presence of any hazardous substances or petroleum product on a property under conditions that indicate an existing release, past release or material threat of release into structures on the property, onto the ground, or into groundwater or surface water of the property.

The following area at the subject property was identified as having a potential REC:

- **Ash Dump Area**

  The facility had been a coal fired power generation plant which had been constructed and utilized by the Calumet and Hecla Mining Company. Coal Ash (bottom ash) was dumped over several acres on the site mainly to the south and east of the power plant building. The extent of the ash dump area is unknown as there was 3-4 feet of snow on the ground at the time of Phase II ESA field work. Ash can contain elevated levels of metals which is the basis of an REC concern at this site.

635 Industrial Park Drive - P.O. Box 607
Iron Mountain, Michigan 49801
(906) 774-3440
FAX: (906) 774-7776

Office Also Located At:
205 N. Harrison Street
Ironwood, Michigan 49938
(906) 932-5048
FAX: (906) 932-3213

- **Phase II Procedures**

On Wednesday, January 13, 1999, Mr. John Hunt of Coleman Engineering Company (CEC) performed sampling at the site. Weather conditions were severe; temperature of approximately +3°F (daytime high), windy, cloudy with occasional snow showers. There was approximately 3 to 4 feet of snow on the ground. Mr. Louis Meneguzzo pointed out the area of potential REC concern to Mr. Hunt. MJO Excavating of Hancock, Michigan was on site to provide bulldozing services. A pathway was cleared to the area of concern and five (5) sampling locations were chosen. Using the bulldozer, the sampling locations were cleared and the soil/ash excavated to a depth of 1-2 feet below ground surface (BGS). There was approximately 4-6 inches of frost at each sampling location. At each sampling location soil conditions consisted of black/brown granular material of cinders, slag, rock, sand, wood coal and miscellaneous debris. A sample was retrieved from each location from approximately 1 to 2 feet BGS. The five (5) samples were transported to White Water and Associates Laboratories in Amasa, Michigan.

Laboratory analyses are summarized below in Table 1.

Table 1
Soil Sample Analysis Results

Sample ID/ Metal	1	2	3	4	5	Default Type A Clean-up[1] Criteria
Arsenic	18.5	12.4	26.6	17.2	16.6	5.8
Barium	93.6	56.8	323.8	96.1	144.0	75.0
Cadmium	0.12	0.26	0.31	0.40	0.21	1.2
Chromium	ND	ND	ND	19.6	ND	18.0
Copper	387	510	2040	8850	151	32.0
Lead	58.7	55.9	115	145	50.0	21.0
Mercury	ND	ND	ND	ND	ND	0.13
Selenium	2.5	1.3	1.4	0.9	0.9	0.14
Silver	0.25	0.37	0.27	1.94	0.32	1.0
Zinc	29.2	57.6	178	194	27.9	47.0

- All units in milligrams per kilograms (mg/kg)
- Shaded areas in exceedance of the Default Type A Soil Clean Up Criteria
- ND concentration below method detection limit
1 – Michigan PA 451 Part 201 Default Type A Clean Up Criteria per MERA Operational Memo #15

A review of the analysis results indicates numerous exceedances of the Michigan PA 451 Part 201 Default Type A Cleanup Criteria. All samples were in exceedance of arsenic, copper, lead and selenium. Several samples were also in exceedance of chromium, silver and zinc.

- **Conclusion**

The purpose of this Phase II ESA was to confirm if a REC exists at this site. The result of the Phase II ESA indicates that a REC does exist at the site. Laboratory analysis results from samples collected at the site exceed Default Type A Cleanup Criteria and therefore the site meets the definition of a "Facility" under Michigan Public Act 451 of 1995 as amended.

The total extent of impact has not been defined however the sample locations are spaced over an area of approximately one acre, it therefore is assumed that the impacted area is greater than one acre in size.

- **Limitations**

There are limitations inherent to the environmental investigation process. No environmental investigation can wholly eliminate uncertainty regarding actual environmental conditions of the subject study area(s). This is because when dealing with existing conditions that are hidden from view, affected by time, changes in state and other limitations, it would require a substantial level of financial and technical effort in order to remove all of the uncertainty associated with a site evaluation.

It must be understood that the laboratory results and the conclusions drawn from the results have inherent limitations and uncertainty. The limitations and uncertainty exist when site samples are collected and laboratory analyzed for the purpose of representing existing site conditions. Although special care is taken in the field to assure adequate sampling, the laboratory analytical results of those samples are most representative of the exact location of where the samples were collected. The results, however, are used as a basis for demonstrating existing conditions, when in fact the overall actual conditions may be different. Additional limitations can be found attached.

This report was prepared solely for use by Mr. Louis Meneguzzo. CEC expressly disassociates itself from any use of this document for information included herein, except by Mr. Louis Meneguzzo.

Should you have any questions or require additional information, please feel free to contact this office at your earliest convenience.

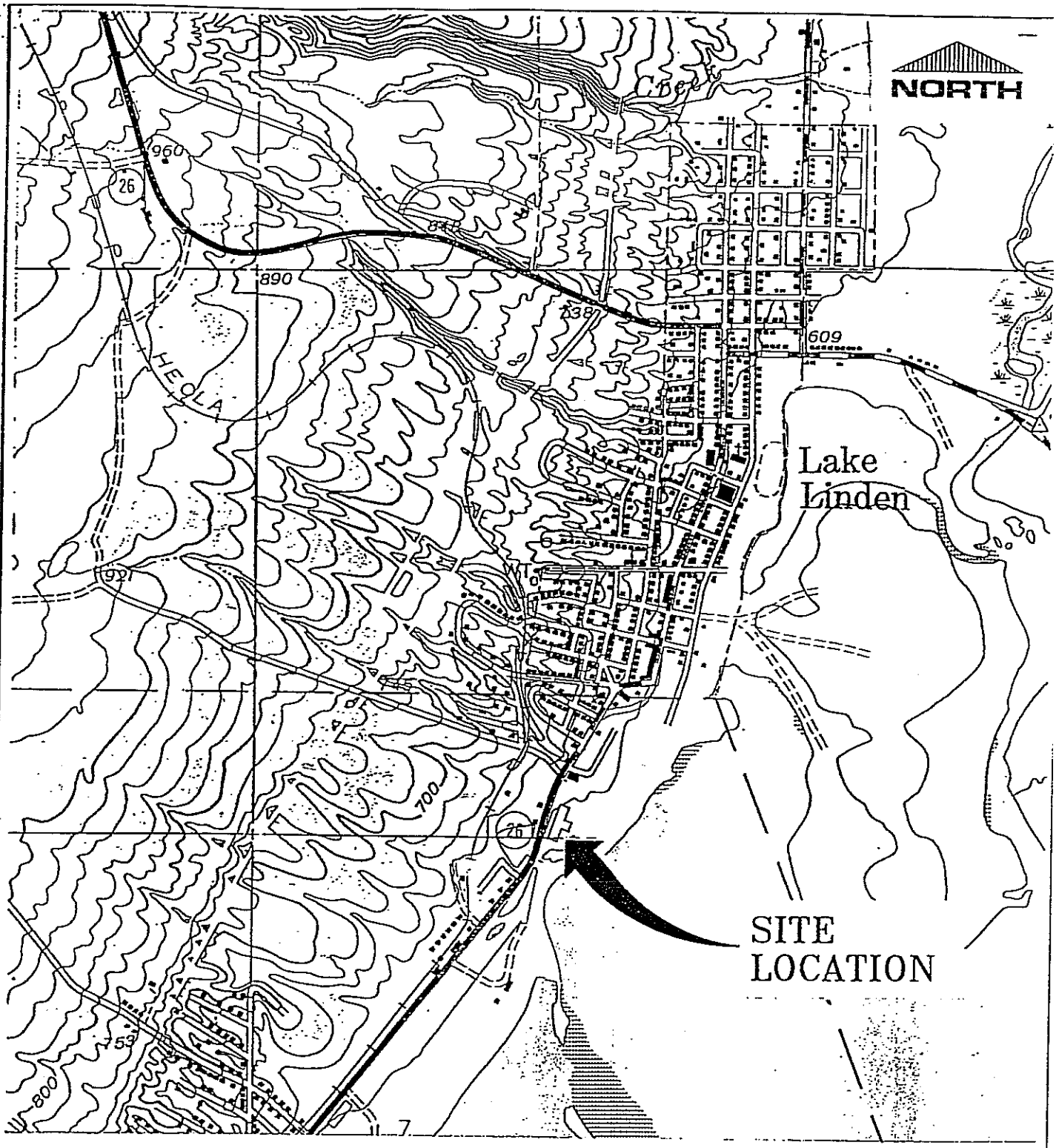
Sincerely,

COLEMAN ENGINEERING COMPANY

John T. Hunt, P.G.
Hydrogeologist

JTH/kh
CEC # E-99009

FIGURES



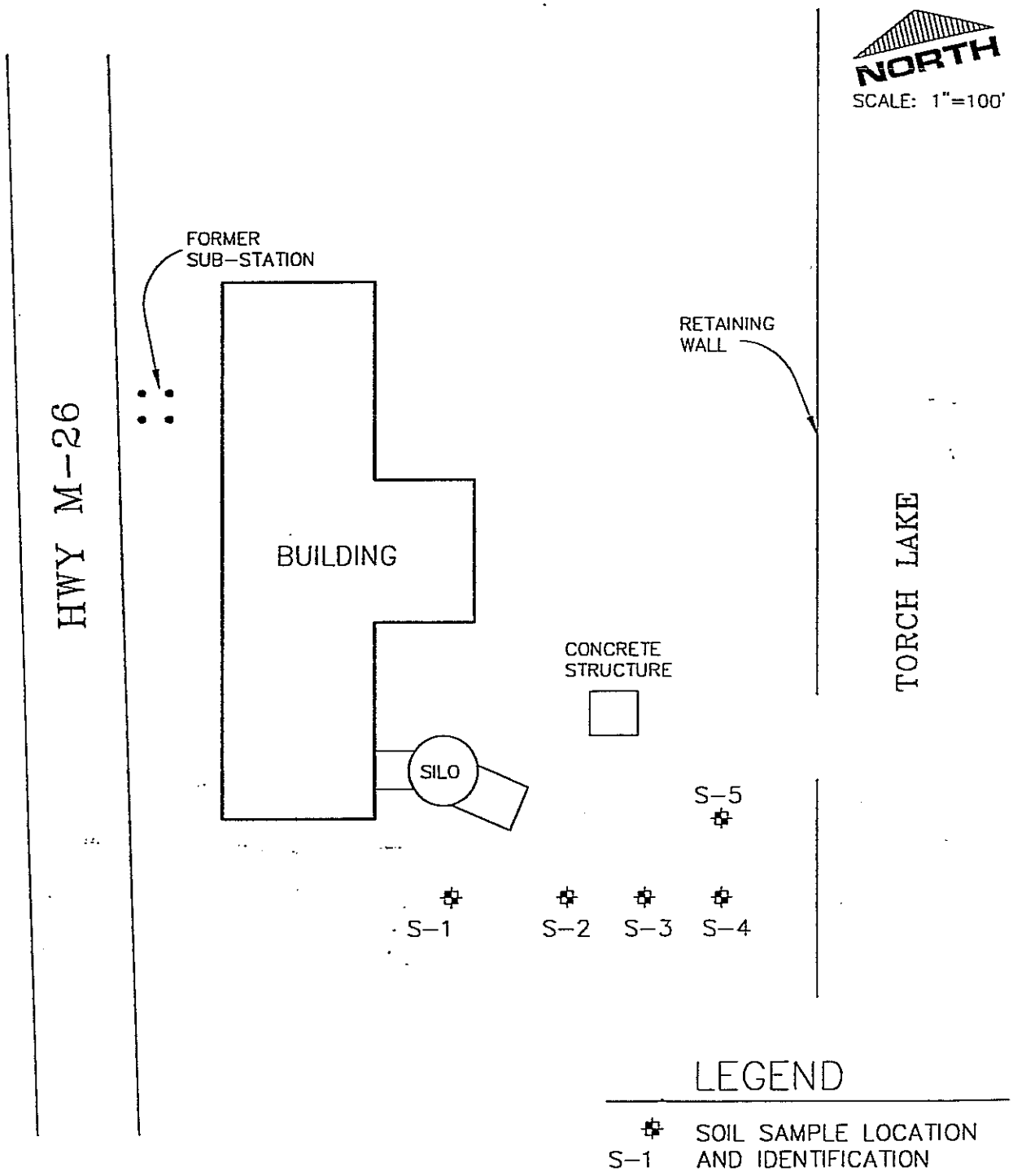
1 MILE

SITE LOCATION MAP
PHASE II ESA
LOUIS MENEGUZZO
LAKE LINDEN, MICHIGAN

LAURIUM, MICH.
N4707.5—W8822.5/7.5
1946
PHOTOREVISED 1975

COLEMAN ENGINEERING COMPANY
635 INDUSTRIAL PARK DRIVE
IRON MOUNTAIN, MICHIGAN 49801

DATE 01/18/99
JOB NO 99009
CADD FILE 99009-WIW



LEGEND

S-1 — SOIL SAMPLE LOCATION AND IDENTIFICATION

SITE MAP
PHASE II ENVIRONMENTAL SITE ASSESSMENT
LOUIS MENEGUZZO
LAKE LINDEN, MICHIGAN

COLEMAN ENGINEERING COMPANY
635 INDUSTRIAL PARK DRIVE
IRON MOUNTAIN, MICHIGAN 49801

DATE 01/18/99
JOB NO 99009
CADD FILE 99009-01

LABORATORY REPORT

ANALYTICAL REPORT

ECOLOGICAL CONSULTING AND
ENVIRONMENTAL LABORATORY SERVICES

WHITE WATER ASSOCIATES, INC.

Cover Page

All analyses performed according to EPA Methods (EPA-600/4-79/020, March 1983 or SW-846, Third Edition). Sample chain-of-custody form(s) attached.

Client:	Coleman Engineering - Iron M	**WWA Job #:**	10964
Project:	C&H Meneguzzo	**Sample Matrix:**	solid
Date Received:	1/13/1999	**Date Reported:**	1/21/1999

Sample Number	Client Sample ID	Date Sampled
10964-01	1	01/13/99
10964-02	2	01/13/99
10964-03	3	01/13/99
10964-04	4	01/13/99
10964-05	5	01/13/99

Comments (if any):

I certify that the data contained in this Final Report has been generated and reviewed in accordance with approved methods and White Water Associates Standard Operating Procedures. Exceptions, if any, are discussed in the accompanying sample narrative. Release of this Final Report is authorized by White Water Associates management, as is verified by the following signature.

Approved By: Bette J. Neuro

Post-It™ brand fax transmittal memo 7671 | # of pages ▸ 4

To John Hunt	From Bette
Co. Coleman	Co. White Water
Dept.	Phone #
Fax #	Fax #

ANALYTICAL REPORT

ECOLOGICAL CONSULTING AND
ENVIRONMENTAL LABORATORY SERVICES

WHITE WATER ASSOCIATES, INC.

Client:	Coleman Engineering - Iron Mo	**WWA Job #:**	10964
Project:	C&H Meneguzzo	**Sample Matrix:**	solid
Date Received:	1/13/1999		

Michigan Metals

Parameter	Sample 10964-01 1	Sample 10964-02 2	Sample 10964-03 3	Sample 10964-04 4	Date Analyzed	Method	Units	RL
Arsenic (s)	18.5	12.4	26.6	17.2	1/15/1999	7060	mg/kg	1
Barium (s)	93.6	56.8	323.8	96.1	1/19/1999	7080	mg/kg	0.1
Cadmium (s)	0.12	0.68	0.31	0.40	1/14/1999	7130	mg/kg	0.05
Chromium (s)	ND	ND	ND	19.6	1/15/1999	7190	mg/kg	0.2
Copper (s)	387	510	2040	8850	1/15/1999	7210	mg/kg	0.2
Lead (s)	58.7	55.9	115	145	1/15/1999	7420	mg/kg	0.2
Mercury (s)	ND	ND	ND	ND	1/14/1999	7471	mg/kg	0.04
Selenium (s)	2.5	1.3	1.4	0.9	1/15/1999	7740	mg/kg	0.2
Silver (s)	0.25	0.37	0.27	1.94	1/16/1999	7760	mg/kg	0.025
Zinc (s)	29.2	57.6	178	194	1/14/1999	7950	mg/kg	1

RL = Reporting Limit
ND = Not Detected
NR = Not Requested

ppm = mg/l (liquid) or mg/kg (solid)
ppb = ug/l (liquid) or ug/kg (solid)

429 River Lane • P.O. Box 27 • Amasa, Michigan 49903 • Phone (906) 822-7373 • FAX (906) 822-7977

ANALYTICAL REPORT

ECOLOGICAL CONSULTING AND
ENVIRONMENTAL LABORATORY SERVICES

WHITE WATER ASSOCIATES, INC.

Client:	Coleman Engineering - Iron Mo	WWA Job #:	10964
Project:	C&H Meneguzzo	Sample Matrix:	solid
Date Received:	1/13/1999		

Michigan Metals

Parameter	Sample 10964-05 5	Date Analyzed	Method	Units	RL
Arsenic (s)	16.6	1/15/1999	7060	mg/kg	1
Barium (s)	144.0	1/19/1999	7080	mg/kg	0.1
Cadmium (s)	0.21	1/14/1999	7130	mg/kg	0.05
Chromium (s)	ND	1/15/1999	7190	mg/kg	0.2
Copper (s)	151	1/15/1999	7210	mg/kg	0.2
Lead (s)	50.0	1/15/1999	7420	mg/kg	0.2
Mercury (s)	ND	1/14/1999	7471	mg/kg	0.04
Selenium (s)	0.9	1/15/1999	7740	mg/kg	0.2
Silver (s)	0.32	1/16/1999	7760	mg/kg	0.025
Zinc (s)	27.9	1/14/1999	7950	mg/kg	1

RL = Reporting Limit
ND = Not Detected
NR = Not Requested

ppm = mg/l (liquid) or mg/kg (solid)
ppb = ug/l (liquid) or ug/kg (solid)

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CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

10964

J.O.N. C&H MENEGUZZO

SAMPLER'S SIGNATURE: John Hunt

CLIENT NAME: COLEMAN ENG

ADDRESS: IRON MT

PHONE #: 774 3440

SAMPLE LOCATION	SAMPLE I.D.#	TIME	DATE	SAMPLE TYPE: GRAB	SAMPLE TYPE: COMPOSITE	NO. OF CONTAINERS	ANALYSIS TYPE REQUESTED: 10 METALS	REMARKS:
	1	1:15P	1-13	X		1	1	
	2	1:30	"	"		"	1	
	3	1:45	"	"		"	1	
	4	2:00	"	"		"	1	
	5	2:15	"	"		"	1	

Customer retain pink, send white and yellow with samples. Original (white) will be returned with report.

RELINQUISHED BY	DATE	TIME	RECEIVED BY	RELINQUISHED BY	DATE	TIME	RECEIVED BY
John Hunt	1-13	5:00P					

RELINQUISHED BY	DATE	TIME	RECEIVED BY LABORATORY	DATE	TIME	REMARKS:
				1/13/95		

429 River Lane, P.O. Box 27
Amasa, Michigan 49903
Phone (906) 822-7373, Fax -7977

ADDITIONAL LIMITATIONS

LIMITATIONS
FOR
PHASE I & II ENVIRONMENTAL SITE ASSESSMENT REPORTS

1. In preparation of this report, Coleman Engineering Company (CEC) has relied on certain information provided by the parties reference herein. Although there may have been some degree of overlap in the information provided by these various sources, we did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this site review.

2. Our conclusions regarding the site are based on observations of existing site conditions, our interpretation of available site history and site usage information. The findings are relevant to the dates of our site visit and should not be relied upon to represent conditions or information available at other dates. The findings and conclusions must be considered probabilities based on professional judgment concerning the significance of the limited data gathered during the course of the site review. Conclusions regarding the condition of the site do not represent a warranty that all areas within the site are of the same quality as may be inferred from observable site conditions and readily available site history and limited exploration program carried out as part of this review. Should additional information on environmental conditions at the site which is not contained in this report be obtained, such information should be brought to CEC's attention. We will evaluate such information and, on the basis of our evaluation, may modify the conclusions stated in the report.

3. Observations were made of the site and of structures on the site as indicated within the report. Where access to portions of the site or to structures on the site was unavailable or limited, CEC renders no opinion as to the presence of hazardous material or to the presence of indirect evidence relating to hazardous material in that portion of the site or structure. In addition, CEC renders no opinion as to the presence of hazardous material or to the presence of indirect evidence relating to hazardous material where direct observation of interior walls, floor, or ceiling of a structure on the site was obstructed by objects or coverings on or over these surfaces.

4. CEC did not perform testing or analyses to determine the presence or concentration of asbestos, lead-based paints, or radon or other naturally occurring materials, nor did it include an evaluation of latent conditions at the site or in the environment at the site.

5. No specific attempt was made to check the compliance of present or past owners or operators of the site with federal, state, or local laws and regulations, environmental or otherwise.

6. The conclusions and recommendations contained in this report are based in part upon the data obtained from a limited number of soil and groundwater samples obtained from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until further exploration. If various or other latent conditions then appear evident, it will be necessary to re-evaluate the conclusions and recommendations of this report.

7. Water level observations have been made in the borings and/or monitoring wells at the times and under the conditions stated on the boring logs. However, it must be noted that fluctuations in the level of groundwater may occur due to variations in rainfall and other factors different from those prevailing at the time measurements were made.

8. Where quantitative laboratory testing has been conducted by an outside laboratory, CEC has relied upon data provided, and has not conducted an independent evaluation of the reliability of these data.

9. The conclusions and recommendations contained in this report are based in part upon various types of chemical data and are continent upon their validity. These data have been reviewed and interpretations made in this report. It should be noted that variations in the types and concentrations of contaminants and variations in their flow paths may occur due to seasonal water table fluctuations, past disposal practices, the passage of time, and other factors. Should additional chemical data become available in the future, these data should be reviewed by CEC and the conclusions and recommendations presented herein modified accordingly.

10. Chemical analyses have been performed for specific parameters during the course of this site review, as described in the text. However, it should be noted that additional chemical constituents not searched for during the current study may be present in soil and/or groundwater at the site.

11. This report has been prepared for, and is intended for the exclusive use of Mr. Louis Meneguzzo. The contents of this report should not be relied upon by any other party without the express written consent of CEC. However, CEC acknowledges that the report may be conveyed to the owner and lending institution associated with the prospective sale and/or lease of the site.

BASELINE SITE ASSESMENT

INTRODUCTION

Background

In 1995, amendments to Part 201 of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended, substantially modified provisions of the law regarding liability for the cleanup of environmental contamination. Section 26(1)(c) provides certain liability protections to a person who becomes an owner or operator of contaminated property on or after June 5, 1995 (the effective date of the amendments), if, among other things, that person conducts a Baseline Environmental Assessment (BEA). The purpose of a BEA is to gather sufficient information about the property being transferred to allow a new release to be distinguished for existing contamination. Section 29a allows a person to petition the Department of Environmental Quality (DEQ) for a determination that their BEA satisfies the requirements for the liability exemption. The relevant provisions of Part 201 are described in more detail below. Throughout this document references to Section numbers of Part 201 omit the initial "201."

Authority

The DEQ is issuing these revised interim instructions dated January 22, 1996, to facilitate implementation of Sections 26(1)(c) and 29a of Part 201 of NREPA. This package includes instructions for the preparation of BEAs, and the forms which must be used for disclosure of a BEA to the DEQ. The DEQ will, as required by Section 26(8), establish formal guidelines under the Administrative Procedures Act (1969 PA 306) to define minimum technical standards for BEAs. Until those formal guidelines are in place, persons may rely upon interim instructions and guidance from the DEQ for preparation of BEAs. Section 29a specifies that petitions for BEA review and related DEQ determinations must be submitted on a form provided by the DEQ. The required forms are included in this package. See instructions on pages A-i and B-i to determine which forms are required for your disclosure. The instructions and forms in this package are subject to revision.

Important Provisions of the Law

Some of the most important provisions of Part 201 related to BEAs are reviewed here to assist the reader in understanding the interim instructions and guidance. This summary does not substitute for a careful reading of the law. Persons preparing BEAs should be thoroughly familiar with Part 201.

"Facility" is an important term under Part 201. The definition from Section 1(1)(*l*) is:

> *"Facility" means any area, place, or property where a hazardous substance in excess of the concentrations which satisfy the requirements of Sections 20120a(1)(a) or (17) has been released, deposited, disposed of, or otherwise comes to be located. Facility does not include any area, place, or property at which response activities have been completed which satisfy the cleanup criteria for the residential category provided for in Sections 20120a(1)(a) and (17).*

(b) Exercise due care by undertaking response activity necessary to mitigate unacceptable exposure to hazardous substances and allow for the intended use of the facility in a manner that protects the public health and safety.
(c) Take reasonable precautions against the reasonably foreseeable acts or omissions of a third party and the consequences that foreseeably could result from those acts or omissions.

The person submitting a BEA under Section 29a may also, in conjunction with the exemption petition, request a determination that the proposed use of the property satisfies the requirements of Section 7a. Pages 10 through 13 of these instructions contain guidance to be used in preparing a request for a DEQ determination regarding compliance with Section 7a.

Timing and Modifications

In order to meet the criteria for an exemption from liability under Section 26(1)(c) of the NREPA, a BEA must be conducted prior to or within 45 days after the earliest of purchase, occupancy or foreclosure. These Instructions allow the person preparing the BEA to elect a limited scope for the investigation if knowledge about future hazardous substance use at the property can be relied upon, in part, to distinguish existing contamination from a subsequent release. No specific provision is made in Part 201 for amendments to a BEA after the 45 day period specified in Section 26(1)(c). This is true both with regard to curing any deficiencies that may be identified through DEQ review of the BEA pursuant to Section 29a, and with regard to changes that may be necessitated by the use of additional hazardous substances at the property in the future (i.e., in addition to those which were considered when a limited-scope BEA was performed). However, the DEQ has developed procedures to be followed by persons wishing to submit supplemental information regarding a property. See Appendix D for procedures for submitting information to:

1. correct deficiencies in a BEA (page D-2)
2. supplement the record with information about facility conditions (page D-1), and
3. complete a Section 7a Compliance Analysis including a Plan for Response Activity if necessary (page D-3).

CAUTION

Before petitioning the DEQ for a determination of adequacy on a BEA, petitioners should carefully consider the consequences of conducting an inadequate BEA and receiving a negative determination. If the timing of the petition and determination do not provide an opportunity for the petitioner to correct deficiencies in the BEA, then the petitioner may be taking on liability for the existing contamination. For example, if a new purchaser submits a petition to the DEQ 38 days after purchase, has already started

INSTRUCTIONS FOR BASELINE ENVIRONMENTAL ASSESSMENTS

Interim Minimum Technical Standards for Baseline Environmental Assessments Conducted Under Section 20126(1)(c) of 1994 PA 451, as amended

Purpose of Baseline Environmental Assessments

The purpose of a Baseline Environmental Assessment (BEA) is stated in the definition in Section 1(1)(d):

> *"Baseline environmental assessment" means an evaluation of environmental conditions which exist at a facility at the time of purchase, occupancy, or foreclosure that reasonably defines the existing conditions and circumstance at the facility so that in the event of a subsequent release, there is a means of distinguishing the new release from existing contamination. (Emphasis added).*

Being able to distinguish "new releases" from "existing contamination" is a function of what has already been released, and what might be released in the future. If the nature of and potential for future releases are very clearly characterized and/or limited, there may be little need for extensive data characterizing current contamination in order to appropriately conclude that new releases could be distinguished. Conversely, if the nature of and potential for new releases are not characterized or limited, a great deal of information to characterize and quantify existing contamination may be needed. Therefore, BEAs of limited scope may be performed taking into account specific future uses of the property and uses of hazardous substances at the property. These instructions relate to definition of conditions at the property being transferred, which may not include the entire facility. Where the facility is larger than the property, describing conditions at the property rather than the facility is sufficient.

Parties petitioning for a BEA determination (based upon completion of an adequate BEA) should recognize that data of a different scope and purpose will routinely be needed for determinations of compliance with "due care" obligations of Section 7a. While requiring some of the same type of information included in typical BEAs, Section 7a compliance determinations may require more extensive data and interpretations.

Minimum Technical Standards

The following describes typically expected and generally necessary elements of BEAs. Although the elements specified here will routinely be acceptable, a greater degree of evaluation and documentation will often be in the interest of potential new owners and operators, particularly for assessing compliance with Section 7a obligations. Such parties are encouraged to develop the additional information and include it in reports to the department. Concise, well organized reports will facilitate agency reviews and issuance of

of past property use may be used, in part, to direct the sampling activities. For this degree of characterization, the specific contaminant distribution and extent do not need to be known and specified.

A. IV. An assessment and conclusions as to the likelihood that other hazardous substances are also present on the subject property. This assessment should be based on a thorough evaluation of all previous uses of the facility. With special emphasis on hazardous substance use in commercial and industrial applications. An ASTM #1527 Phase I Environmental Site Assessment or equivalent alternate assessment method is acceptable.

A.V. A specific statement that there will be no significant hazardous substance use at the property, and that this is a basis for being able to distinguish existing contamination from a new release.

Category B

B. **Additional characterization requirements (beyond those stated in Category A) for BEAs performed where a specified new use of the property includes significant hazardous substance use, <u>but different</u> substances from those known or likely to be facility contaminants:**

B. I. Hazardous substances which will be used at the property in significant quantities are to be identified. (See definition of significant hazardous substance use on Page 2.)

B. II. No additional characterization needed, beyond that specified in A. II.

B. III. No additional characterization needed, beyond that specified in A. III.

B. IV. A demonstration will need to be made that the hazardous substances specified in B. I. are not already present as facility contaminants. The conclusions of the A. IV. assessment may in some cases be sufficient to meet this requirement, particularly if it is clear there is no reason to think hazardous substances of the type to be used have ever been present at the property. However, if the assessment indicates it is likely that they have, data is needed to make this demonstration.

B.V. **(This item is required for BEAs that are submitted with a Petition pursuant to Section 29a and is optional for BEAs only disclosed pursuant to Section 26(1)(c).)** An explanation should be presented that describes how the body of information in the BEA can be used, and why it is sufficient, to distinguish potential contamination due to new releases anywhere on the property from contamination that existed at the time of the BEA.

anywhere on the property from contamination that existed at the time of the BEA.

Additional Approaches

Additional approaches that provide a basis to distinguish potential new hazardous substance releases from existing contamination may be presented in conjunction with the types of information detailed for Categories B and C above, or in lieu of some of this information. Such proposals may be based upon one or both of the following alternative approaches.

1. Engineered controls and/or features that provide a verifiable means of assuring that any release that occurs in the future will be spatially separated from existing contaminated media, will be detected, and will be responded to in a timely manner so as to prevent commingling with the existing contamination. All such proposals still should supply, as a minimum, the information described for Category A above. A description of any engineering controls that will be used must be included.

2. Due to cost or timing constraints, a person may prefer not to sample for a specific hazardous substance that will be used in the future on the property. In these circumstances, the DEQ may accept a statement in the petitioner's affidavit that if (insert specific hazardous substances) are found in concentrations requiring response activity after the BEA is complete, the petitioner acknowledge that he/she shall not assert the BEA as a defense to liability for undertaking the necessary response activities.

BEA Format

The BEA should be titled, and its contents organized as follows:

Baseline Environmental Assessment
Conducted Pursuant to Section 20126(1)(c)
of 1994 PA 451, Part 201, as amended

1. **Introduction** explains general circumstances of the property with regard to past and intended activities, and in particular, identify which of the three categories specified in the Interim Technical Standards, (A, B, or C), is the basis upon which the BEA was conducted.

2. **Property Description & Intended Hazardous Substance Use** BEA element A. I., and as appropriate, B. I., or C.I. or description of specific features and controls of an alternative proposal as described in the previous section "Additional Approaches".

3. **Known Contamination** BEA elements A. II. and A. III. and, as appropriate, C. II. and C. III.

form to submit a BEA satisfies Section 26(1)(c) obligations (it is not necessary to submit both forms nor the BEA two times). Each person (individual or other entity who is seeking a determination on a BEA) must submit a separate Petition and fee with the BEA. An exception to this requirement will be made for joint owners of property as tenants in common or joint tenants as long as the petitioners will be conducting the same activities on the property. In this case, only one petition and petition fee will be necessary.

Services Covered by BEA Review Fee

A fee of $750 is required for all BEA Petitions submitted for DEQ review pursuant to Section 29a. No fee is required to accompany a BEA disclosed pursuant to Section 26(1)(c)(ii). The following services are covered by payment of the fee for BEA Petition review. This section describes only the covered services and does not address the required timing of submittals to the DEQ. See Appendix D for discussion of submittal deadlines.

1. Review of and determination regarding the initial BEA and other required materials.

2. One review of and determination regarding adequacy of revisions to the BEA or other required materials if the initial determination identifies any deficiencies in the BEA or other Petition documents.

3. Review of and determination regarding the initial Section 7a Compliance Analysis if the petitioner exercises their option to seek a determination of compliance with Section 7a requirements, and a Plan for Response Activity (PRA), if one is proposed with the Section 7a Compliance Analysis to assure compliance with Section 7a.

4. One review of and determination regarding a revised Section 7a Compliance Analysis (and PRA, if relevant) if one is prepared in response to deficiencies identified in the initial determination.

If additional iterations of the BEA or Section 7a Compliance Analysis/PRA are submitted for DEQ determination(s), they must be accompanied by an additional $750 fee. Submittals beyond the first revisions (as described above) which are not accompanied by the fee will not receive determinations. Such submittals may be retained in DEQ files.

INTERIM MINIMUM TECHNICAL STANDARDS FOR SECTION 26(1)(c) BEAs

Summary Chart

(see text for full explanations & details)

CIRCUMSTANCES OF FUTURE PROPERTY USE FOR WHICH BEA IS PERFORMED	CHARACTERIZATIONS BY BEA				
	I. Of Subject Property	II. Of Known Contaminants Identities and Quantities	III. Of Known Contaminants Distribution and Fate	IV. Of Likelihood of Unknown Contamination	V. Summary Rationale
Category A. Basic characterizations for ***ALL BEA's***, including those for properties at which there will be no hazardous substance use.	Legal property description plus scaled map/survey.	Names & concentrations of hazardous substances known to be present in excess of the residential cleanup standard.	Identification of the environmental media & general locations at which the known hazardous substances are present on the subject property.	An assessment and conclusions as to the likelihood that other hazardous substances are also present on the subject property.	Include specific statement that there will be no significant hazardous substance use..
Category B. ***ADDITIONAL*** characterizations for properties which will use different hazardous substances from those known or likely to already be present at the facility.	Identification of the hazardous substances which will be used on the property in the future.	No additional characterization needed beyond A.II.	No additional characterization needed beyond A.III.	A demonstration that the hazardous substances which will be used at the property have not already been released to the environment at this location.	Explain how new releases would be distinguished from existing contamination.
Category C. ***ADDITIONAL*** characterizations for properties which will use the same hazardous substances as are already known or likely to be present as facility contaminants; OR for properties at which any hazardous substance might be used as no limit on future use is identified.	No additional characterization needed beyond A.I. and B.1.	Quantification of the amount of known contamination on the property for hazardous substances to be used or not excluded from potential use.	Delineation of the extent and projected fate of the known property contaminants.	Investigation to confirm the presence and extent of likely contaminants.	Explain how new releases would be distinguished from existing contamination.

Note: Different or additional characterizations and reporting will routinely be needed to determine compliance with Section 7a obligations..

APPENDIX F

EPA RI/FS

EPA Contract No.: 68-W8-0093
Work Assignment No.: 02-5LS8
Donohue Project No.: 20011

VOLUME 1

FINAL REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT I

TORCH LAKE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
HOUGHTON COUNTY, MICHIGAN

NOVEMBER 1990

Prepared for:

U.S. Environmental Protection Agency
Emergency and Remedial Response Branch
Region V
230 South Dearborn Street
Chicago, Illinois 60604

FINAL REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT I
TORCH LAKE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
HOUGHTON COUNTY, MICHIGAN

NOVEMBER 1990

Lorraine S. Ransome 12-21-90

Lorraine S. Ransome, Ph.D. Date
Site Manager
Donohue & Associates, Inc.

Roman M. Gau/L&R 12-31-90

Roman M. Gau, P.E. Date
ARCS Project Manager
Donohue & Associates, Inc.

Michael L. Crosser 12/31/90

Michael L. Crosser Date
Technical Services/Quality Assurance Manager
Donohue & Associates, Inc.

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VOLUME 2

ARCS/R/TORCHLRI/AA1

EXECUTIVE SUMMARY

Donohue & Associates, Inc. (Donohue) is submitting this Remedial Investigation (RI) Report for Operable Unit I for the Torch Lake Superfund Site. This RI Report is submitted to the U.S. Environmental Protection Agency (EPA) in response to Work Assignment No. 02-5LS8 under EPA Region V ARCS Contract No. 68-W8-0093.

The Torch Lake Superfund Site is located on the Keweenaw Peninsula in Houghton County, Michigan. Torch Lake is tributary to the Keweenaw Waterway which flows to Lake Superior. Torch Lake is located in Michigan's copper mining district, and for over 100 years the lake was the site of milling and smelting facilities, a repository for copper mining and milling wastes, and part of the waterway used for transportation to support the mining industry. Over 5 million tons of native copper were produced from this area, and at least 200 million tons of tailings were dumped into Torch Lake.

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 water or sediments, toxic discharges, and fish abnormalities prompted many investigations into long- and short-term impacts attributed to mine waste disposal. The Torch Lake Superfund Site is on the EPA National Priorities List for funding under CERCLA, and Torch Lake is on the Act 307 Michigan Sites of Environmental Contamination Priority List. The International Joint Commission Water Quality Board designated Torch Lake as a Great Lakes Area of Concern.

A federal-lead Remedial Investigation/ Feasibility Study (RI/FS) was initiated in October 1988. The Torch Lake RI/FS will be conducted using three operable units (OU). This report summarizes the RI performed for OU I which includes primary contaminant sources in surface tailings in the primary study area, on the western shore of Torch Lake. The OU I RI was performed to collect and evaluate data to assess the physical characteristics of OU I, the type and extent of contamination of OU I, environmental and human health risks associated with OU I, and the need for and methods to remediate OU I. Activities documented in this report include waste characterization of OU I tailings and drums, characterization of fugitive dust emissions, air exposure modeling, limited characterization of soil, and assessment of human health impacts.

Geophysical surveys to detect buried drums and sampling and analysis of exposed drums on the surface of OU I tailings were performed. Surface and subsurface samples of OU I tailings, slime, and slag were collected and analyzed for radiation, semivolatile organic compounds, inorganic compounds, and physical properties. Limited soil sampling and air sampling were performed to evaluate the potential for transport of airborne particulates from tailings to residential yards.

Geophysical anomalies were recorded which may indicate the possible presence of buried drums. The analysis of waste contents of surface drums did not indicate that immediate removal of the drums was necessary.

No radiation readings above background were measured for OU I tailings. The compounds detected in OU I surface and subsurface tailings included bis(2-ethylhexyl)phthalate, polycyclic aromatic hydrocarbon (PAH) compounds, and inorganic compounds. The concentration and distribution of metals appeared similar among surface and subsurface tailings and slime materials. Slag material exhibited higher concentrations of arsenic, chromium, copper, and lead. Neither the semivolatile organic nor inorganic compound levels measured in OU I tailings are dramatically higher than those found in naturally-occurring soils. In general, organic compound levels were orders of magnitude higher in soil samples than in tailings samples. Metal levels were generally similar in soil samples and tailings samples.

The fate and transport of OU I organic chemicals of potential concern (PAHs) are determined primarily by sorption and complexation mechanisms. The fate and transport of OU I inorganic chemicals of potential concern (metals) are determined primarily by oxidation, precipitation, sorption, ion exchange, and complexation/chelation mechanisms. These mechanisms tend to limit the mobility of the PAHs and metals measured in OU I tailings.

A baseline risk assessment for OU I tailings was conducted to analyze the potential adverse health effects (both current and future) resulting from exposures to hazardous substances in OU I tailings. Eighteen compounds were selected as chemicals of potential concern, and more than twelve exposure scenarios were evaluated. The risks of cancer from lifetime exposure to chemicals of potential concern at Torch Lake OU I were evaluated. Based on currently available toxicological data on the chemicals of potential concern for OU I, noncarcinogenic effects were also evaluated for subchronic or chronic exposures.

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

Donohue & Associates, Inc. (Donohue) is submitting this Remedial Investigation (RI) Report for Operable Unit I (OU I) for the Torch Lake Superfund Site. This RI Report is submitted to the U.S. Environmental Protection Agency (EPA) in response to Work Assignment No. 02-5LS8 under Region V ARCS Contract No. 68-W8-0093.

The rationale and scope of work for the Torch Lake Remedial Investigation/ Feasibility Study (RI/FS) is described in the Torch Lake RI/FS Final Work Plan (Revision 1) (Donohue, 1989a). The Torch Lake RI/FS will be conducted as three operable units. OU I includes the primary contaminant sources of surface tailings and drum contents in the primary study area, on the western shore of Torch Lake. This OU has been identified as possibly requiring separate and earlier remediation than other media, from a human risk perspective. OU II includes other potentially contaminated media in the primary study area. These comprise soil, air, surface water, and Torch Lakes's submerged tailings, sediment, groundwater, and biota. OU III includes other tailings contaminant sources in the mid-Keweenaw Peninsula, including the North Entry, the northern portion of Portage Lake, and tributary areas.

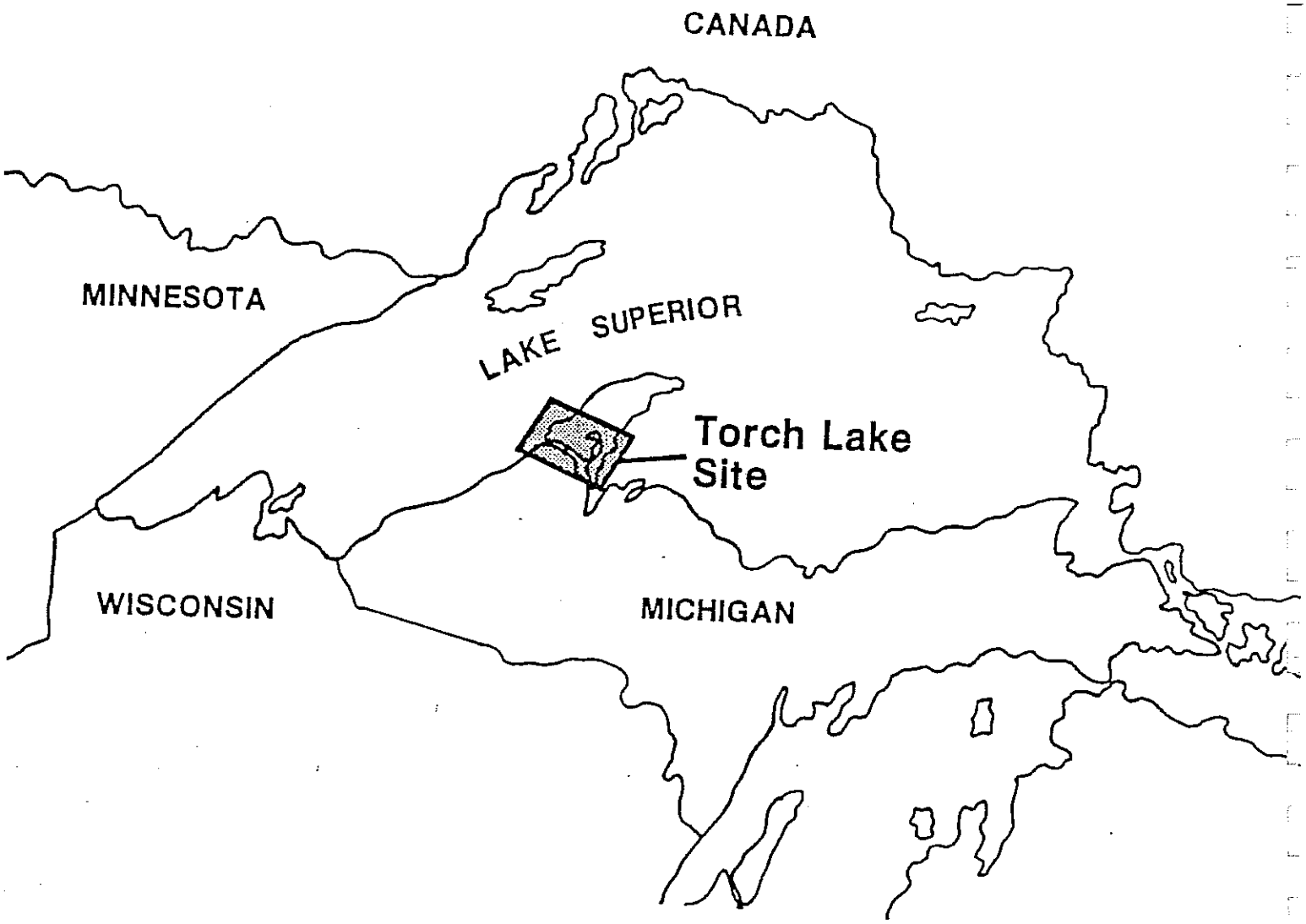
This report summarizes the RI performed for OU I which includes primary contaminant sources in surface tailings on the western shore of Torch Lake. The RI was performed to collect and evaluate data to supplement existing data and form the basis for assessing: (1) physical characteristics of OU I, (2) type and extent of contamination of OU I, (3) environmental and human health risks associated with OU I, and (4) the need for and methods to remediate OU I. Activities documented in this report include waste characterization of OU I tailings and drums, characterization of dust emissions, air pathway exposure modeling, limited characterization of soil, and assessment of human health impact.

This introductory chapter presents site background and history, a summary of the RI/FS Work Plan rationale and approach including the division of the site into three operable units, and the organization of the remaining chapters of the RI Report for OU I.

1.2 SITE BACKGROUND

1.2.1 Site Location and Description

The location of the Torch Lake Superfund Site is shown on Figure 1-1. It is located on the Keweenaw Peninsula in Houghton County, Michigan, at 47°N latitude, 88°W longitude. Torch Lake is tributary to Portage Lake, which is part of the Keweenaw Waterway that flows to Lake Superior. Torch Lake is about 14 mi by water from Lake Superior. Torch Lake has a surface area of 2,717 acres, a mean depth of 56 ft, a maximum depth of 115 ft, and a volume of 5.2×10^9 ft^3. The Trap Rock River and several small creeks discharge into



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SITE LOCATION MAP

TORCH LAKE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
HOUGHTON COUNTY, MICHIGAN

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FIGURE 1-1

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Torch Lake. Its watershed is approximately 77 mi^2. The watershed is forested with second-growth northern hardwoods, and supports a few dairy and potato farms. Only a small percentage of the watershed is residential or commercial. The communities of Lake Linden (pop. 1181), Hubbell (pop. 1278), and Mason are located on the west side of 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 (Michigan Department of Natural Resources, 1987).

1.2.2 Site History and Response Actions

The following sections describe industrial history, environmental problems and studies, regulatory actions, and response actions pertaining to the Torch Lake Superfund Site.

1.2.2.1 Industrial History

Torch Lake is located in Michigan's copper mining district. For 100 years, the lake was the site of milling and smelting facilities, a repository for copper mining and milling wastes, and a part of the waterway used for transportation to support the industry. PRC Engineering, Michigan Technological University (MTU) (Rose, W.I., et al, 1986), and MDNR (Michigan Department of Natural Resources, 1987), have compiled chronologies of Torch Lake's copper industry. The following summary of the chronology is relevant to the types of hazardous materials potentially impacting the environment.

Deposits of native (elemental) copper are found in a belt extending from the tip of the Keweenaw Peninsula southwest over a distance of 100 miles. Copper mined in the region was native copper, found as a metal. Copper mining operations had begun on the Keweenaw Peninsula by the 1860s. 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" or "stampsands", were discarded with mill processing water, typically by pumping into the lake or waterway. The milling process was not efficient, and copper was lost in the discarded tailings.

Mining output, milling activity, and tailings production peaked in the Torch Lake area in the early 1900s to 1920. Mining company records from this time describe how mill tailings were pumped out into Torch Lake and deposited on property around Torch Lake. All of the mills were located on the west shore of the lake.

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. A flotation process made it economically feasible to recover copper from old tailings in

Torch Lake and was used for reclamation at Torch Lake mills by 1917. The flotation process involved agitating ore, water, oil, and chemicals to produce a froth that would support copper-bearing particles. During the 1920s, chemical reagents were used to further increase the efficiency of the flotation process. The chemical reagents included lime, pyridine oil, coal-tar creosotes, wood creosote, pine oil, and xanthates. These were used in various combinations depending on the ore and process water. After leaching or flotation at reclamation plants, chemically treated tailings were returned to the lake, resulting in increased turbidity.

During the 1920s, mining activities decreased, whereas tailings processing per mine increased over the previous decade. 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. The last mill closed in 1968.

Over 5 million tons of native copper were produced from this area, and more than half of this was processed along the shores of Torch Lake from the 1860s until 1968. Between 1868 and 1968 at least 200 million tons of tailings were dumped into Torch Lake, filling at least 20 percent of the lake's original volume. These deposits resulted in drastic changes to the shoreline.

In the early 1970s, exploratory research was conducted in the Centennial Mine, resulting in a dewatering discharge into Slaughterhouse Creek, a Trap Rock River tributary. A small copper recovery plant continues to operate in Hubbell, and discharges non-contact cooling water into Torch Lake (Science Applications International Corp., 1986).

1.2.2.2 History of Environmental Problems and Studies

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 water or sediments, toxic discharges, and fish abnormalities prompted many investigations into long- and short-term impacts attributable to mine-waste disposal.

The academic and regulatory communities have produced an extensive amount of data, research, scientific literature, and reports regarding Torch Lake's complex environmental problems (Michigan Department of Natural Resources, 1987; Rose, W.I., et al., 1986; Warburton, 1986; Michigan Water Resources Commission, 1973; Wright et al., 1973; Black et al., 1982; U.S. EPA, 1987; Spence, 1988a).

In 1972, cupric ammonium carbonate leaching liquor was discharged into the north end of Torch Lake from storage vats at the Lake Linden Leaching Plant. The Michigan Water Resources Commission (MWRC) investigated the spill (MWRC, 1973) and reported that discoloration of several acres of lake bottom indicated previous discharges. No deleterious effects to surface water quality, algae, fish, or benthic macroinvertebrates were detected three months after the discharge. To assess effects from the spill, MWRC compared results from its 1972 investigation to data from a 1970 MWRC investigation. Except for

chloride and copper, 15 water quality parameters surveyed were within ranges commonly encountered in Michigan lakes of this type. Chloride concentrations had decreased because of the termination of mine dewatering and the effect of natural lake flushing. Dissolved copper concentrations remained high, similar to 1970 levels. Heavy metal concentrations in Torch Lake sediments were within ranges measured at 28 background locations in Michigan, except for elevated levels of arsenic, chromium, zinc, and copper. Plant and benthic invertebrate analyses did not indicate changes in water quality. Copper concentrations in Torch Lake fish were found to be less that those measured in 1970. Mercury was found in fish in 1972, but this was attributed to the use of analytical techniques that were more sensitive than those previously available.

MTU researchers also examined the alteration of Torch Lake water quality after the 1972 discharges (Wright et al., 1973). The cupric ammonium carbonate spills were cited as factors in temporary water quality changes, namely the depletion of oxygen through the conversion of ammonia to nitrate, elevated copper levels, increased pH, and increased carbonate alkalinity. Bioassays suggested that portions of the lake were toxic to a macroinvertebrate amphipod specie.

A diverse fish population has occupied Torch Lake and supported productive food and sport fishing. Although game fish biomass has remained constant, changes in the dominant larger predator species, from sauger to walleye and northern pike, and lack of sauger reproduction and juveniles have been reported. Impacts to dominant fish predator species may have been due to lake chemistry or turbidity/habitat changes. In 1973, abnormalities and lesions in Torch Lake sauger and walleye were documented by an MTU graduate student and reported to the MDNR. Subsequent pathological research was conducted in 1979, 1980, and 1982, and indicated that these two species from Torch Lake were commonly affected with three types of neoplasms including hepatomas, dermal fibromas, and gelatinous masses. No virus particles were observed, and the livers were found to be frequently atrophic. Pug-headedness in perch has also been observed at an incidence of greater than 1 percent, which is significant for fish.

Benthic communities have been reduced in areas of copper tailings, and bioassays have shown the tailings to be toxic (MDNR, 1987).

MTU researchers, under contract with the MDNR, have conducted numerous studies to determine possible impacts of copper mining wastes on the environment of the Torch Lake area. Five studies are discussed in the 1986 Project Completion Report (Leddy, 1986) and are summarized here.

A four-month tumor induction study was conducted in the laboratory to examine the effect on fish liver histology following static exposure to creosote and xanthate flotation agents in the presence of Torch Lake sediments. Causal relationships with liver abnormalities or tumor occurrence were not concluded.

The environmental fate of xanthates and creosotes was examined using library and laboratory studies. Xanthate fate was studied by following the degradation of pure compounds in the laboratory. The rate and mechanism of degradation was related to pH, and it was concluded that xanthates would not be expected to persist in the environment beyond one year. Torch Lake sediment extracts were analyzed for ten typical creosote polycyclic aromatic hydrocarbon (PAH) components. Eight of these compounds were not detectable in the sediment extracts. Chrysene and benzo[a]pyrene were detectable, but the sources could not be determined. Airborne particulates from fuel combustion as well as mining pollutants may have contributed to the PAH content of Torch Lake sediment.

A study regarding tumor incidence and parasite surveys of perch, walleye, and sauger from Torch Lake reported that parasite species and tumors were observed in the three fish species, and abnormalities were observed in perch, but no direct relationship between parasites and tumors was found.

In a study of heavy metals in Torch Lake sediments and mining wastes, sediment, tailings, and airborne dust samples were analyzed for metals and mineral composition. It was concluded that though the sediments were enriched with arsenic, chromium, copper, lead, tin, and zinc, Torch Lake water is not directly contaminated with heavy metals, and though winds stir up dust from stampsands, it is unlikely that airborne heavy metals represent a serious human health problem. The chromium, lead, tin, and zinc enrichment of sediments in the vicinity of Hubbell is anomalous in reference to local mineral deposits, and is attributed to contamination from electrical debris and associated slag at the reclamation plant near Hubbell.

The copper budget for Torch Lake was calculated with the hydrologic budget to determine the amount and sources of copper entering Torch Lake. Over 96 percent of the copper input is from surface runoff, 3 percent is from precipitation, and less than 1 percent is from groundwater. Copper loss occurs by outflow through Portage Lake. Considering external factors only, the budget indicates an annual net loss of dissolved copper. However, no significant changes in copper concentrations have occurred in the past 14 years. It was therefore concluded that internal processes (precipitation, complexation, dissolution, adsorption, and diffusion in sediment pore water) control dissolved copper concentrations.

In 1988, MTU researchers conducted a magnetometry investigation of a small area of stampsands. The investigation indicated the presence of buried metallic objects near an area where many barrels are rumored to have been buried (Spence, 1988b).

In 1988, MDNR collected 455 fish, including 18 species, from Torch Lake and Portage Lake (Michigan Department of Natural Resources, 1989). No sauger were captured, and this rarity was attributed to the fact that turbidity in the waters has decreased. No suspicious growths were observed, either externally or internally, during fish collection or liver preparation. Livers from 32 walleye and bullheads were analyzed. One walleye from Portage Lake had abnormal liver cell development, but this was not confirmed as a tumor. The

other 31 livers were normal. The MDNR report compared these data to previous studies and concluded that these data strongly suggest that liver tumor inducing agents above background concentrations no longer exist in the Torch Lake - Portage Lake fishery. Low contaminant levels in fish flesh further suggest reconsideration of the fish consumption advisory.

In 1988, the Agency for Toxic Substances and Disease Registry (ATSDR) released its Preliminary Health Assessment for Torch Lake (MDPH, 1988). Site background, previous investigations, site visit, potentially contaminated media, potential environmental and human exposure pathways, and demographics were evaluated and discussed.

Based on the information reviewed, it was concluded that the site is of potential public health concern because of possible exposure to presently unknown etiologic agents at levels that may result in adverse health effects over time. Although Torch Lake is polluted with copper and other contaminants, no known health effects were linked to the problem. The incidence of cancer deaths over the period 1970-1981 was cited as at or below the state average for age-adjusted cancer mortality except for stomach cancer. Stomach cancer in the locale was linked with the predominantly Scandinavian descent of the population.

The ATSDR report recommended additional investigations regarding: (1) rumors about dumping of chemicals and barrels into the lake; (2) contents of barrels found in and around the lake; (3) private well sampling and analysis; (4) fish population reproduction and tumor incidence; (5) causative agent of fish tumors; (6) human health risk from fish consumption. The ATSDR report also recommended cleanup of abandoned buildings and industrial scrap materials which constitute physical hazards on the shoreline of Torch Lake.

The ATSDR concluded that although there is currently a potential for human exposure to contaminants, there are no indications in the review conducted for the ATSDR Health Assessment that human exposure is actually occurring at the present time or has occurred in the past. Therefore the site is not being considered for followup health studies at this time. ATSDR will reevaluate the site for followup if data become available suggesting human exposure is occurring or has occurred.

In 1989, the Bureau of Mines (U.S. Department of Interior, 1990) performed laboratory evaluations of tailings and water samples from Torch Lake to determine the potential for metals to adversely affect Torch Lake. In general, metal concentrations of leachates from Torch Lake tailings samples were concluded to be extremely low when compared to tailings at over 30 other sites. Bureau of Mines results indicated that very little metal is being released from the Torch Lake tailings.

1.2.2.3 History of Regulatory Actions

Because of the incidence of fish tumors, in 1983 the Michigan Department of Public Health (MDPH) announced an advisory against the consumption of Torch Lake sauger and walleye. Although no human health effects were associated

with fish consumption, MDPH issued the advisory as a preventive measure until the causative factors of fish tumors and the potential risks to humans could be identified. The advisory is still in effect.

In 1984, the Hazard Ranking System was applied by EPA to score the Torch Lake Superfund Site. The site was defined as Torch Lake, the northern end of Portage Lake, and the North Entry to Lake Superior, because at these locations copper concentrations were significantly above background values. The background samples were obtained from the southern end of Portage Lake and the South Entry.

In 1985, the U.S. EPA initiated a responsible party search for the Torch Lake waste disposal site. Three potentially responsible parties (PRPs) were identified and issued notice letters. In August 1988, negotiations with these three PRPs were concluded. In June 1988, the Torch Lake Superfund Site was placed on the U.S. EPA National Priority List (NPL) for funding under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). A federal-lead RI/FS was initiated at the site in October 1988.

Torch Lake is on the Act 307 Michigan Sites of Environmental Contamination Priority List. In 1985, MTU researchers were awarded funds from the MDNR through Act 307 to study fish tumor problems in Torch Lake.

In 1983, the International Joint Commission Water Quality Board designated Torch Lake as a Great Lakes Area of Concern (AOC). An AOC is defined as an area with known impairment of a designated use. The AOC is confined to Torch Lake and its shores on the basis of the fish consumption advisory, tumor frequency, metal-contaminated sediments and their impact on biota, and the history of mining waste disposal. In 1985, the State of Michigan designated Torch Lake as a Category 2 AOC based on the information base available and programs underway. In the case of the Torch Lake AOC, the causative factors were unknown and an investigation was underway. The site can be removed from the AOC list when evidence is presented that the designated uses have been restored.

The MDNR completed a Remedial Action Plan (RAP) for Torch Lake in 1987. The primary goal of the RAP was stated as the removal of the fish consumption advisory "on the basis of its issuance". The objectives of the RAP were to assemble and summarize all existing data, identify impaired designated uses, identify problem sources, identify data gaps, propose further investigations, and propose alternatives to restore designated uses.

The impaired uses of Torch Lake were identified as: (1) fish consumption because of the MDPH advisory affecting sport fishery for sauger and walleye, and (2) the reduced benthic macroinvertebrate community in locations where mine tailings have been deposited. In the RAP, the MDNR recommended that the AOC be reclassified because: external fish tumors have been associated with viral infections; fish tumors are common in Great Lakes populations; all other fish in the community did not exhibit abnormal growths and can be used for food; the fish move freely to Portage Lake and Lake Superior; although not aesthetically pleasing, tumors from fish do not transmit cancer to humans; bioassays of Torch Lake sediment and water have been negative for mutagenic activity; tumor-inducing agents have not been identified in Torch Lake.

In September 1988, the State of Michigan issued a letter of assurance to enable the EPA to conduct an RI/FS for the Torch Lake Superfund Site. This letter recommended continuation of MTU's previous studies.

1.2.2.4 History of Response Actions

Attempts to establish vegetation on stampsand deposits on the shorelines of Torch Lake have been conducted since the 1960s (Leddy, 1986, and Science Applications International Corp., 1986). The objectives of stampsand vegetation include stabilizing the shoreline and reducing airborne particulates. The Portage Lake Water and Sewage Authority has spray-irrigated sewage sludge on tailings to promote vegetation at the southwest end of the lake.

The Village of Lake Linden has been developing recreational facilities with a bathing beach, camping area, park, and boat ramps at the north end of Torch Lake.

In Hubbell and Lake Linden, debris around the smelters and from the shoreline has been removed.

Proposed actions include restocking and monitoring sauger or walleye in Torch Lake, monitoring Torch Lake water and fish tissue, and natural transportation and burial of copper-enriched sediments in Torch Lake (MDNR, 1987). MTU researchers disagreed with MDNR's restocking proposal, monitoring plan, funding level, and natural sedimentation processes proposal, and proposed other research to identify alternatives for remedial action. In the 1987 RAP, the MDNR stated that other remedial actions for the fish consumption impairment cannot be proposed since causes of fish tumors have not been determined; other remedial actions for the contaminated sediment problem have not been proposed because of the expanse and volume of the sediments. Other reviewers oppose the restocking plan because it would encourage fishing and consumption, and because it may not be logistically possible.

Wastewater treatment is being upgraded in the surrounding communities.

1.3 INITIAL SITE EVALUATION AND DESIGNATION OF OPERABLE UNITS

A detailed initial evaluation of the site is contained in the Final Work Plan (Revision 1) (Donohue, 1989a).

1.3.1 Types and Volume of Waste Present

The types and approximate amounts of waste present in OU I and the potential contaminants associated with each are summarized in Table 1-1. Copper ore tailings are present in and around Torch Lake and at other locations on the Keweenaw Peninsula in tremendous quantities. The estimated total of 200 million tons of ore tailings which were discharged into the lake can be divided into two categories. The first includes tailings resulting from the stamping/gravimetric separation process. Contaminants of concern in tailings from this process include copper, arsenic, chromium, lead, and zinc. The second category includes tailings reprocessed using the flotation process. The flotation process used lime, pyridine oil, coal tar creosotes, wood creosote, pine oil, and xanthates.

TABLE 1-1

TYPES AND VOLUMES OF WASTE PRESENT
OPERABLE UNIT I
TORCH LAKE SITE

Houghton County, Michigan

Waste Type	Amount	Potential Contaminants	Comments
Copper ore tailings from stamping/gravimetric separation process	10^8 tons	Copper Arsenic Chromium Lead Zinc	Twenty percent of pre-1868 lake volume filled with tailing
Copper ore tailings reprocessed using flotation process	10^8 tons	Copper Arsenic Chromium Lead Zinc Creosote Coal Tar Derivatives Xanthates	
Drummed material in tailings piles	Unknown; some drums visible	Unknown	Rumor that some drums could contain explosives
Debris from electrical material reclamation	10^3-10^5 tons	PCB Asbestos Metals	Mixed in with tailings along shore

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Drums are present in the tailings and submerged in Torch Lake. The presence of exposed drums has been confirmed visually. The presence of buried and submerged drums has been indicated by geophysical investigations conducted by EPA Technical Support Unit and Emergency Response Team personnel. A brief geophysics survey conducted by researchers at MTU also showed an anomaly which may indicate additional buried drums (Spence, 1988b). The nature of the material disposed of in drums is not documented. Because explosives were used in large quantities during mining operations, and because workers, angry over local area strikes were rumored to have put explosives in drums, one or more drums could contain explosives.

Debris associated with an electrical materials copper reclamation facility is mixed with tailings over a portion of the site. Some scrap material was burned, and some was disposed near the facility. The contaminants of concern associated with electrical material reclamation include PCBs, metals, and asbestos.

1.3.2 Potential Migration Pathways

Contaminant sources and potential migration pathways are shown on Figure 1-2, the Conceptual Site Model. Primary contaminant sources include (1) tailings with associated debris and flotation chemicals, (2) drums in the tailings, (3) drums in Torch Lake, and (4) industrial chemicals. Industrial chemicals are included as a possible contaminant source because of a reported discharge of leaching liquor directly to the lake (MWRC, 1973).

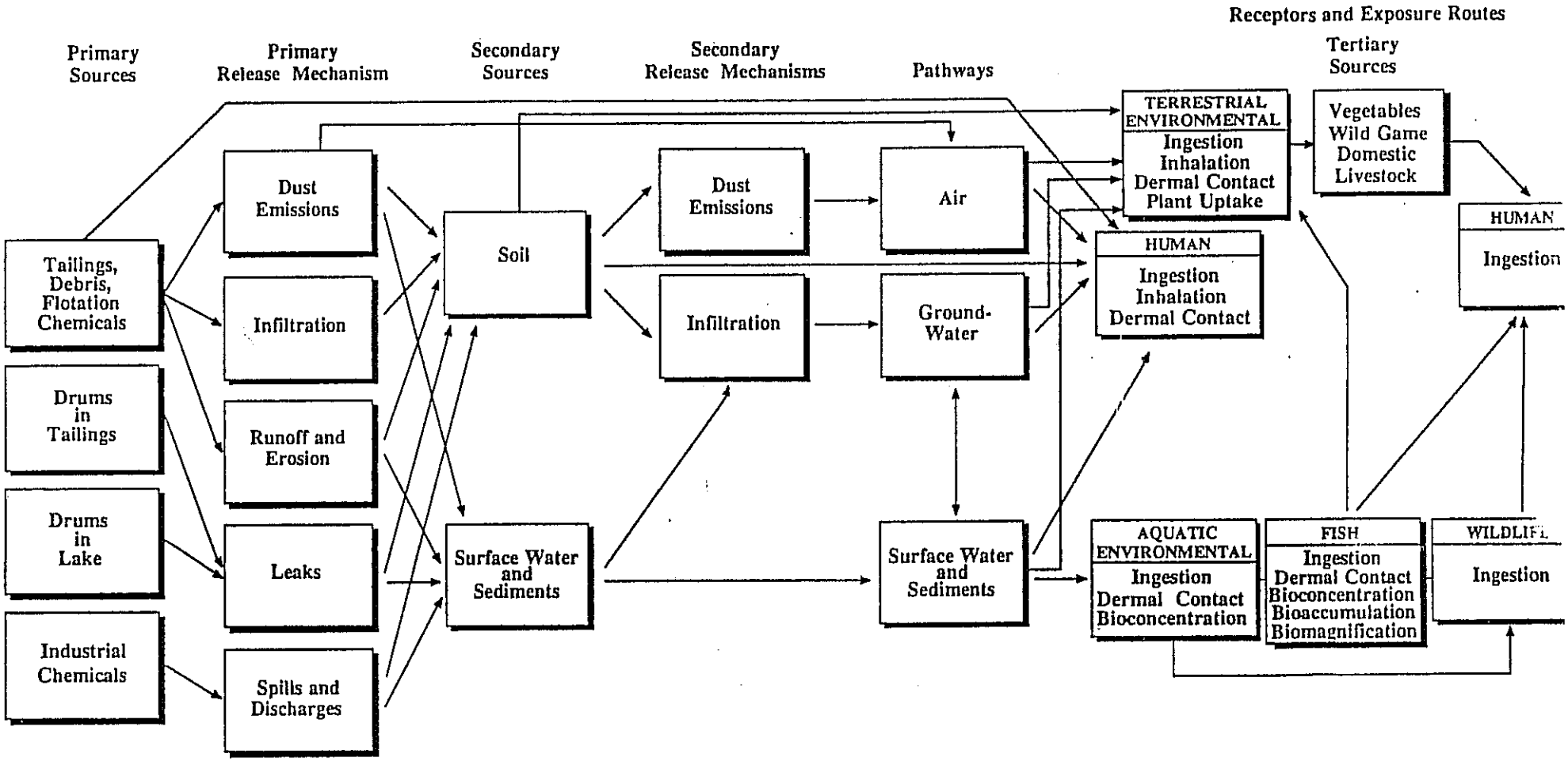
Primary release mechanisms include dust emissions, infiltration, runoff, and erosion from tailings; leaks from drums in the tailings and in the lake; and spills and discharges of industrial chemicals. These release mechanisms result in secondary contaminant sources including contaminated soil, surface water, and sediments. Secondary release mechanisms include dust emissions and infiltration from soil, and infiltration through sediments.

Potential contaminant transport pathways to receptors include air for dust emissions, groundwater flow to water supplies, and surface water and sediments.

Receptors include humans via ingestion, inhalation, and dermal contact, and terrestrial and aquatic environmental species through ingestion, inhalation, and direct contact. Through bioaccumulation, fish and other fauna can serve as sources to both human and environmental receptors through ingestion.

1.3.3 Identification of Operable Units

The Hazard Ranking System scoring package defined the Torch Lake Superfund Site to include Torch Lake, the North Entry (to Lake Superior), and the northern portion of Portage Lake, where copper concentrations are significantly above the background established by the southern portion of Portage Lake and the South Entry. This area is shown on Figure 1-3.



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CONCEPTUAL SITE MODEL
TORCH LAKE
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
HOUGHTON COUNTY, MICHIGAN FIGURE 1-2

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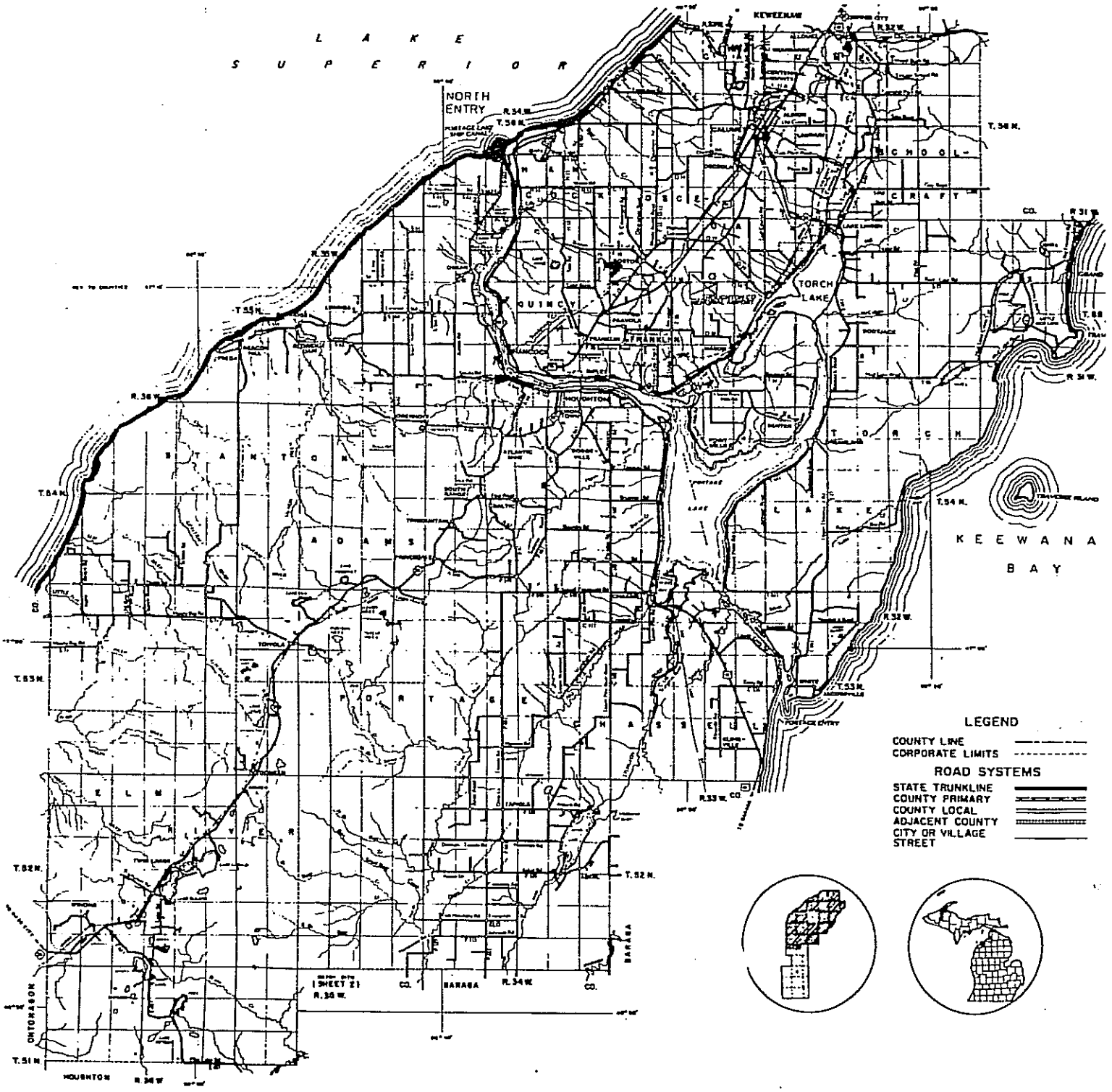
8:Ora Charts:Figure 3-1



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TORCH LAKE SITE

TORCH LAKE

REMEDIAL INVESTIGATION / FEASIBILITY STUDY

HOUGHTON COUNTY, MICHIGAN

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FIGURE 1-3

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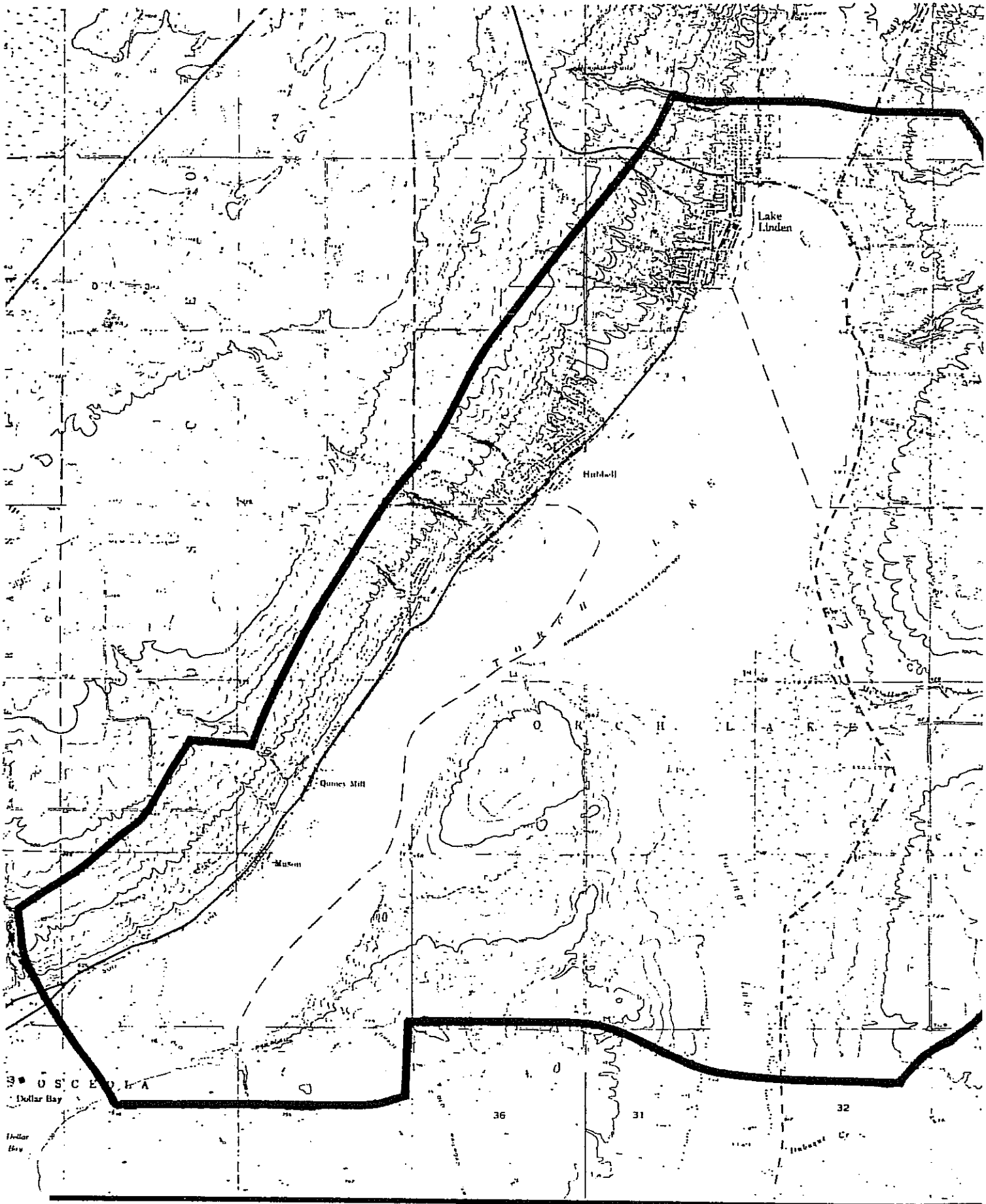
During project scoping meetings, representatives from EPA, Donohue, MDNR, the U.S. Fish and Wild Life Service, and the Bureau of Mines reached consensus that operable units (OU) will be defined for the site for the following reasons:

- The Torch Lake Site as defined in the Hazard Ranking System is large and complex.
- The most important waste sources and the receptors are in close proximity over a relatively small portion of the site.
- Remediation of contaminant sources, if necessary, will be expedited by completing the RI/FS and ROD for the tailings adjacent to the lake.
- Information obtained from a relatively small portion of the site, containing serious sources and important receptors, can be used to determine the need for additional information throughout the rest of the site and to help develop and focus the scope of work for collecting additional information.
- There is a substantial amount of background information available for the site as a whole that must be reviewed. In addition there are ongoing studies concerning the site as a whole that, when completed, will help determine the scope for the remaining work. This background information can be reviewed while work proceeds on the smaller area.

The primary study area includes Torch Lake and its surrounding shore. The boundaries of the primary study area, shown on Figure 1-4, are the Keweenaw Fault line along the northwest side of the lake, Hammell Creek to the north, the topographic ridge line on the east, and a line extending from Gooseneck Creek in the southwest corner of Torch Lake eastward along Upper Point Mills Road and Baulman Road to the eastern boundary on the south. Included in this area are the towns of Lake Linden, Hubbell, and Mason on the west side of Torch Lake. The primary study area was delineated because the environmental problems here are more readily defined, and focusing on this area will provide earlier information on potential remedial action alternatives. This approach will prevent delays in remedial action for Torch Lake and will provide background information for planning for the remainder of the site.

OU I includes the primary contaminant sources of surface tailings and drum contents in the primary study area, on the western shore of Torch Lake. This OU has been identified as possibly requiring separate and earlier remediation than other media, from a human risk perspective.

OU II includes other potentially contaminated media in the primary study area. These comprise soil, air, surface water, and Torch Lakes's submerged tailings, sediment, groundwater, and biota.



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JUNE 1989

PRIMARY STUDY AREA

TORCH LAKE

REMEDIAL INVESTIGATION / FEASIBILITY STUDY

HOUGHTON COUNTY, MICHIGAN

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OU III includes other tailings contaminant sources in the mid-Keweenaw Peninsula, including the North Entry, the northern portion of Portage Lake, and tributary areas.

OU II or III may be divided into additional operable units if data indicate that separate study and remediation will be most effective. OU III may be integrated with OU I for later stages of the RI/FS if evaluations performed in early RI/FS tasks indicate that this is appropriate.

1.4 OPERABLE UNIT I ACTIVITIES AND ORGANIZATION OF REPORT

Remedial investigation activities associated with OU I were conducted to evaluate the elements of the Conceptual Site Model highlighted on Figure 1-5. Specific activities included waste characterization of OU I tailings, geophysical investigations for drums in OU I tailings, sampling of drums that were accessible from the surface, characterization of dust emissions from OU I tailings, characterization of soil in the immediate vicinity of receptors, air pathway exposure modeling, and assessment of human health impacts. Waste characterization activities included investigation of parameters needed to evaluate potential remedial actions.

Chapters 2 through 6 of this RI Report for OU I present details of the OU I study area investigation, and discussions of the physical characteristics of the study area, the nature and extent of OU I contamination, contaminant fate and transport, and the OU I baseline risk assessment. In general, results and conclusions from OU I RI activities are discussed and integrated in the text of the Report, while media-specific data and evaluations are presented in Technical Memoranda. Chapter 7 presents conclusions and discussion of uncertainties. Technical Memoranda are included in Appendix A. The Baseline Risk Assessment Report for OU I is presented in Appendix B (found in Volume 2 of this report).

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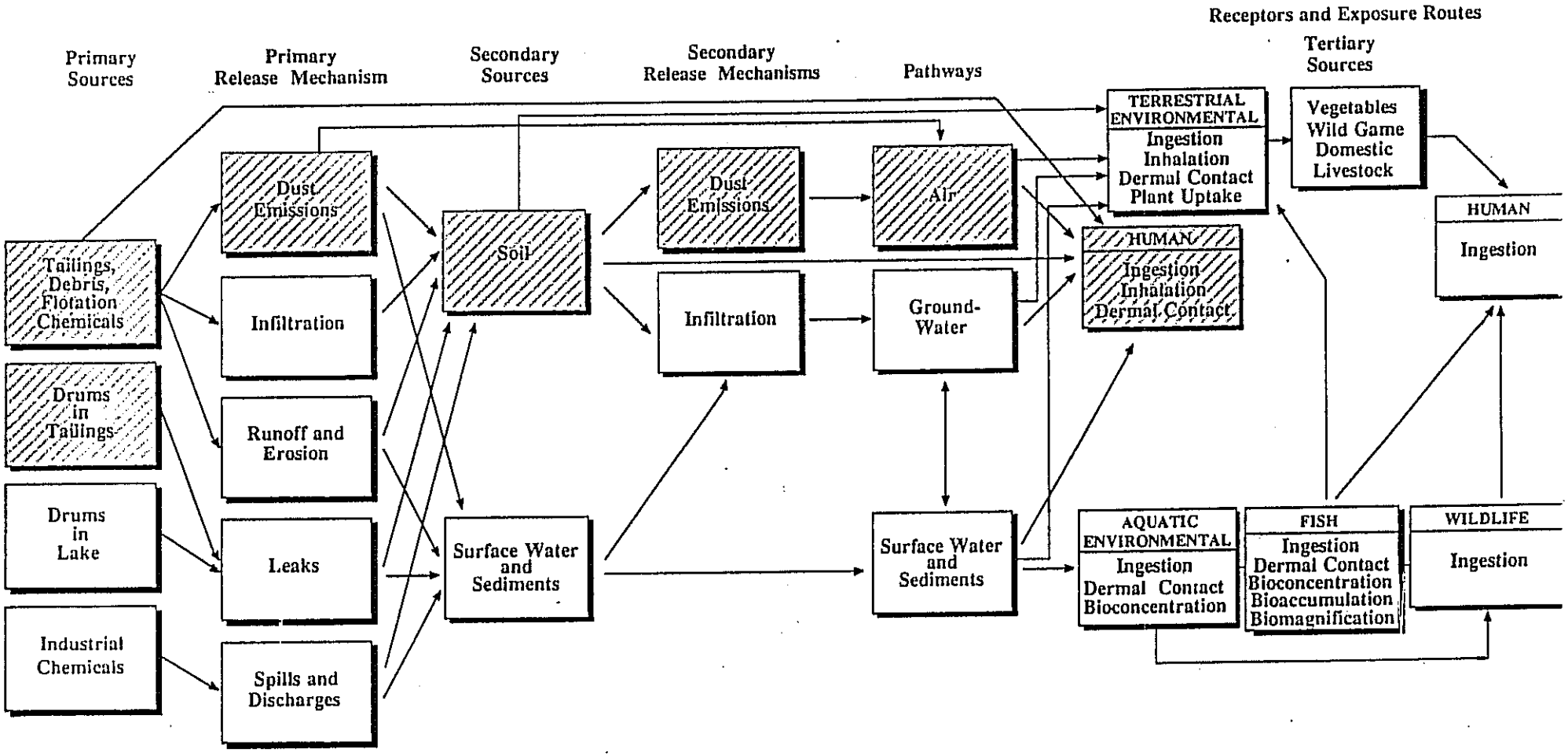

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CONCEPTUAL SITE MODEL – OUI RI
TORCH LAKE
REMEDIAL INVESTIGATION / FEASIBILITY STUDY
HOUGHTON COUNTY, MICHIGAN FIGURE 1-5

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8.Dra Charts/Figure 1-1

2.0 STUDY AREA INVESTIGATION

This chapter describes field activities and physical and chemical monitoring associated with site and waste characterization of OU I. The remedial investigation for OU I included a review of the mining archives at Michigan Technological University (MTU), field reconnaissance, drum investigation including geophysical surveys for locating drums, drum sampling to determine drum contents, surface tailings sampling, subsurface tailings sampling, soil sampling in the immediate vicinity of human receptors, and air sampling and meteorological monitoring. This chapter summarizes these activities which are discussed in more detail in the referenced Technical Memoranda (Appendix A).

2.1 MICHIGAN TECHNOLOGICAL UNIVERSITY ARCHIVE SEARCH AND FIELD RECONNAISSANCE OF TAILINGS

Donohue conducted a search of mining company records at the MTU archives to better understand the industrial activities that impacted the Torch Lake Superfund Site and OU I in particular. Information obtained in the archive search and from field reconnaissance is presented in Technical Memorandum Number 1 (TM 1) in Appendix A. Information documented in TM 1 was used to divide the OU I tailings along the west side of the lake into sectors based on homogeneity of tailings type and source. Nine sectors were identified for separate sampling.

General locations of these sectors are shown in Figure 2-1. Surface features and past and present land use in the vicinity of OU I are discussed further in TM 1 and Chapter 3 of this report.

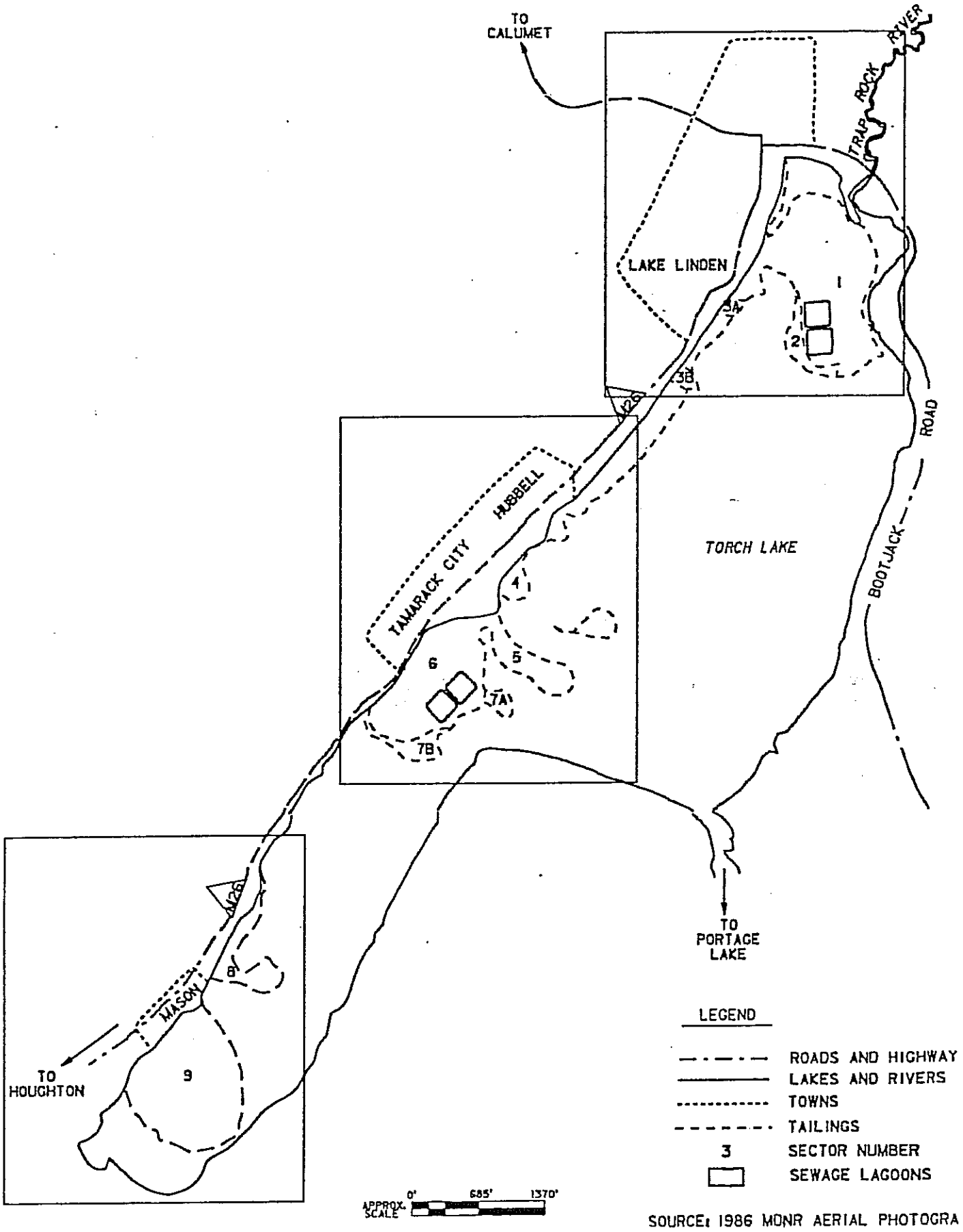
2.2 DRUM INVESTIGATION

Geophysical surveys to detect buried and submerged drums and sampling and analysis of exposed drums on the surface of OU I tailings were performed in 1989 to locate buried drums and characterize drum contents. Additional drum investigation activities are planned for 1990.

2.2.1 Geophysical Investigations

Geophysical survey activities for OU I are discussed in detail in TM 2 (Appendix A). Geophysical survey activities were conducted by Donohue, Region V EPA Technical Support Unit, and Great Lakes National Program Office (GLNPO) staff. The purpose of the geophysical investigations was to delineate suspected drum disposal areas within OU I tailings piles and off-shore in Torch Lake. Magnetometry and ground penetrating radar (GPR) investigations were conducted on OU I tailings piles to locate buried drums. GPR and sub-bottom profile (seismic) investigations were conducted in Torch Lake to locate submerged drums.

As described in TM 2, magnetometer and GPR surveys were conducted at the Centerline Apartments area in Lake Linden, the stampmill site in Tamarack City, and the sewage settlement pond site. Reference baseline and a 100- by 50-foot grid were surveyed at each location. Survey grid markers labeled with



Donohue

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OPERABLE UNIT I TAILINGS SECTORS

TORCH LAKE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
HOUGHTON COUNTY, MICHIGAN

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Engineers Architects Scientists

FIGURE

north and east grid coordinates were placed along the survey lines. Details concerning the geophysical survey investigations are explained in TM 2. Results are discussed in Section 4.1.1.

The marine GPR system consisted of recording equipment and a GPR antennae. The location of the boat was determined with Loran C Navigation and marked on a strip chart recorder. The marine GPR was not effective in locating submerged drums because the depth of water penetration was limited to approximately 20 feet.

The subbottom profiler system consisted of recording equipment with a seismic source and receiver. The location of the boat during this survey was determined with Loran C Navigation and marked on a strip chart recorder. The subbottom profiler mapped several near-shore areas and conducted several transects across the lake, both north-south and east-west. Technical difficulties terminated the survey without a complete coverage of the lake as proposed in the Final Work Plan.

2.2.2 Drum Sampling

In June 1989, EPA Technical Assistance Team (TAT) sampling personnel collected samples from eight surface drums and five surface soil locations along the northern and western shoreline of Torch Lake. Drum and soil samples collected, the matrix of each sample, and the analytical parameters analyzed for each sample are summarized in Table 2-1. Details of the sampling program, including maps showing general sample locations, are presented in TM 3 (Appendix A).

2.3 TAILINGS SAMPLING

2.3.1 Introduction

Tailings in OU I were sampled and analyzed to characterize their potential as a contaminant source, for risk assessment purposes, and to provide data needed to evaluate remedial action alternatives.

Tailing samples were collected from all nine sectors delineated in TM 1. Approximate sampling locations are shown on Figures 2-2, 2-3, and 2-4. Survey locations of sampling points are presented in TM 4. Samples were collected from the surface (0- to 6-inch) and subsurface (0- to 3-foot) depths. Sampling procedures for surface tailings and subsurface tailings are reported in TM 4 and TM 5, respectively. Details of tailings sampling procedures are also presented in the RI/FS Field Sampling Plan (Revision 1) (Donohue, 1989b). Deviations from procedures described in the Field Sampling Plan are recorded in TM 4 and TM 5. Also included in TM 4 is a summary of visual descriptions for each sector.

In addition to tailings sample collection activities, field monitoring for alpha/beta/gamma radiation was completed using a Monitor 4 detector. Measurements were recorded for composite subsamples. Tailings samples were

TABLE 2-1

TAT DRUM AND SOIL SAMPLES
TORCH LAKE, HUBBELL, MI
JUNE 21, 1989

Sample Number	Location	Matrix	Analytical Parameters
S-57	Lake Linden-Drum #1	Solid	RCRA*
S-58	Lake Linden-Drum #2	Solid	VOA/ABN/PEST/ PCB/EP Tox Metals/ Total Metals/Cyanide
S-59	Lake Linden-Drum #3	Solid	VOA/ABN/PEST/ PCB/EP Tox Metals/ Total Metals/Cyanide
S-60	Lake Linden-Roofing Debris	Solid	Asbestos
S-61	Hubbell-Drum #1	Solid	VOA/ABN/PEST/ PCB/EP Tox Metals/ Total Metals/Cyanide
S-62	Hubbell-Drum #2	Solid	VOA/ABN/PEST/ PCB/EP Tox Metals/ Total Metals/Cyanide
S-63	Hubbell-Soil #1	Soil	PEST/PCB
S-64	Hubbell-Soil #2	Soil	PEST/PCB
S-65	Lake Linden-Tailings	Solid	RCRA*
S-66	Mason-Drum #1	Liquid	VOA/ABN/PEST/ PCB/EP Tox Metals/ Total Metals/Cyanide
S-67	Mason-Drum #2	Solid	VOA/ABN/PEST/ PCB/EP Tox Metals/ Total Metals/Cyanide
S-68	Mason-Soil	Soil	VOA/ABN/PEST/ PCB/EP Tox Metals/ Total Metals/Cyanide

TABLE 2-1
(Continued)

TAT DRUM AND SOIL SAMPLES
TORCH LAKE, HUBBELL, MI
JUNE 21, 1989

Sample Number	Location	Matrix	Analytical Parameters
S-69	Mason-Drum #3	Liquid	VOA/ABN/PEST/ PCB/EP Tox Metals/ Total Metals/Cyanide
S-70	Background-East Soil	Soil	VOA/ABN/PEST/PCB Total Metals/Cyanide

* RCRA parameters include EP Toxicity Metals/Total and Reactive Cyanide/Total and Reactive Sulfide/pH/Flashpoint

Table Source: TAT Report 2/28/90
See TM 3

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analyzed for inorganic and semivolatile organic compounds, which comprise all compounds on EPA's Target Compound List with the exception of cyanide, as well as for the physical parameters of moisture content, grain size distribution, Atterberg Limits, and cation exchange capacity (TM 8).

2.3.2 Surface Samples

Surface tailings samples were collected to assess risk by exposure from dermal contact and inhalation of fugitive dust. A total of 58 surface tailings sample composites were collected from the 0- to 6-inch depth at a density of one composite sample per 10 acres. As described in TM 4, the surface tailing sampling and decontamination procedures were conducted in accordance with the Torch Lake RI/FS Field Sampling Plan, Quality Assurance Project Plan, and Health and Safety Plan (Donohue, 1989 b,c,d). Descriptions of texture, Munsell color, vegetation, debris, and special features were recorded. Samples were collected from areas that contained tailings. Grab samples were obtained from "slime" deposits (very fine grain size material), crushed slag, and the slag pile to further characterize these materials.

2.3.3 Subsurface Samples

Subsurface tailings samples were collected to obtain data necessary to evaluate remedial action alternatives, particularly stabilization and dust control by vegetation. Twelve subsurface tailings composite samples were collected from the 0- to 3-foot depth at a density of one sample per 20 acres. Procedures used and observations recorded during collection of subsurface tailings samples are presented in TM 5.

A total of 23 subsurface excavations were conducted during the sampling program. Prior to intrusive work, excavation locations were checked for buried metallic objects with a metal detector. Radiation measurements were taken from composite samples at each location. Each excavation was also screened with an HNu photoionization detector upon completion of the excavation. Photographs were taken at each sample location.

Subsurface conditions encountered at Sector 3 prevented excavation to 3 feet. Construction debris and gravel sized slag allowed digging with a shovel to only 2 feet below grade. Therefore, the composite sample was collected from a depth of 0 to 2 feet at this location.

Observations during subsurface tailings sampling at Sector 8 suggested that the two sampling locations were located in tailings materials derived from different sources. Although both areas consisted of amygdaloidal basalt tailings, the sample collected at Location 2 was coarser-grained with a lower percentage of fine-grained tailings than the sample from Location 4. Therefore, separate samples and decontamination procedures were conducted at both locations.

2.4 SOIL SAMPLING

Limited soil sampling was performed to obtain preliminary information regarding whether air-borne particulate materials are being transported from OU I tailings sources to residential yards in the primary study area. Soil samples were collected from nine residential yards in Lake Linden, Hubbell, Tamarack City, and Mason, as well as from the Lake Linden football field. Each sample was composited from four subsamples collected from the 0- to 4-inch depth. Sample locations and procedures are described in detail in TM 6. Soil samples were analyzed for semivolatile organic and inorganic compounds.

Ten composite soil samples were collected, each comprised of four subsamples representing the corners of the property sampled. Samples were collected using an 18-inch, 3/4-inch diameter silt probe driven to a depth of 0 to 4 inches. Samples were analyzed for Routine Analytical Services (RAS) inorganic compounds and extractable compounds.

In general, the soil cores obtained consisted of various hues of grayish- and brownish-brown, dry to damp silty sand. In most cases, a 1- to 2-inch root zone and darker topsoil was evident. Although signs of contamination were not apparent, traces of tailings and/or slag were noted. Descriptions were recorded on soils data forms.

Additional details of the soil sampling and sample handling procedures are recorded in TM 6 (Appendix A). Deviations from the Field Sampling Plan (Donohue, 1989b), are documented in TM 6.

Additional soil samples were also collected by EPA TAT personnel, and these procedures and results are reported in TM 3.

2.5 AIR SAMPLING

Ambient air samples were collected at Torch Lake to provide data to support an air pathway analysis as a component of the baseline risk assessment for OU I. Air monitoring and modeling data were obtained to characterize the airborne transport of fugitive dust from tailings, and to estimate emission rates and concentrations of air contaminants to assess actual or potential receptor exposure to air contaminants.

Michigan Department of Natural Resources (MDNR) personnel conducted the Torch Lake air sampling program according to the procedures described in the Torch Lake RI/FS Field Sampling Plan (Donohue, 1989b) and the Quality Assurance Project Plan (Donohue, 1989c). Four sampling locations were selected based upon wind and population profiles to monitor likely exposure points, emissions sources, and background conditions. Total suspended particulate (TSP) high volume samplers were operated over a 1-month period from August 14 to September 13, 1989. Samples were collected for 24-hour periods every other day, resulting in collection of 62 filters of TSP, including five field blanks and five duplicates. Filters were analyzed for TSP at EPA's Region V Central

Regional Laboratory. The two samples with the highest TSP from each sampler and the highest TSP from the duplicate sampler were analyzed for 26 metals including arsenic, chromium, copper, nickel, lead, and zinc.

Further details concerning the air sampling and meteorological monitoring program are provided in TM 7 (Appendix A). TM 7 includes MDNR's documented report.

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3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

The physical and cultural setting of the Torch Lake Superfund Site, including the regional climate, soils, physiography, surface hydrology, geology, hydrogeology, and population and land use, are described in the RI/FS Work Plan (Donohue, 1989a). This chapter presents background information, field observations, and the results of field and laboratory investigations which were conducted to determine physical characteristics of OU I tailings. The following sections describe regional and OU I surface features, and geotechnical properties of OU I tailings.

3.1 SURFACE FEATURES

3.1.1 Regional Surface Features

Surface features of the Torch Lake region are a reflection of soil types, topography, drainage, geology, and historic mining practices.

3.1.1.1 Soils

Soils in the area are primarily sandy loams, loams, and silt loams developed from parent material consisting of glacial till or Jacobsville Sandstone. The soils of the region are predominantly Spodosols characterized as moderately well- to well-drained with corresponding moderate permeability. Tailings piles in the region are another significant "soil" type. Tailings material ranges from pebbles to coarse sand and fine silt.

3.1.1.2 Topography and Drainage

The linear-shaped Torch Lake follows the margin of the Keweenaw Fault in a northeast-southwest orientation. The topography and drainage of the area reflect differences in bedrock lithologies and relative resistance to erosion from Pleistocene glaciation. To the west of Torch Lake, the topography is steep, with relief ranging from 600 to 1,200 feet within 3 miles of the lake. To the east, relief is considerably less, and elevations are lower, ranging from approximately 600 to 800 feet MSL (mean sea level).

Streamflow to Torch Lake occurs from four major sources including the Trap Rock River, Dover Creek, McCallum Creek, and Sawmill Creek. Numerous smaller second and third order tributary streams enter from across the Keweenaw Fault along the northwest margin of Torch Lake. Drainage patterns in the region are controlled largely by bedrock type and follow along faults and fractures in the Precambrian bedrock. The numerous lakes and wetlands and low drainage density in the eastern portion of the Torch Lake drainage basin are characteristic of a recently glaciated landscape.

3.1.1.3 Geology

The surficial geology of the Torch Lake area is composed of bedrock outcrop overlain by glacial drift in some areas. The Portage Lake Lava Series and

Jacobsville Sandstone occur along the northwest margin of Torch Lake. Immediately adjacent to Torch Lake, bedrock crops out in large areas beneath a thin cover of glacial drift. The Portage Lake Lava Series consists of basalt and andesitic lava flows with interbedded conglomerates and sandstones. The Jacobsville Sandstone is a light red to bleached white, fine- to coarse-grained feldspathic sandstone.

3.1.1.4 Historic Mining Practices

In addition to the tailings piles, abandoned mine works including stamp mills and smelters are a prominent surface feature throughout the region. The tailings were often processed near a waterway. Therefore, many of the shorelines of the lakes and rivers of the region are dotted with the ruins of former stamp mills and smelters. The greatest concentration of these ruins is along the western shore of Torch Lake.

3.1.2 Tailings Surface Features

The western shore of Torch Lake is lined with tailings piles and the associated stamp mill and smelter ruins attributable to past copper mining practices. This section provides detailed descriptions of surface features of OU I tailings, which are themselves the prominent surface feature in the primary study area. OU I tailings were divided into nine sectors as shown on Figure 2-1 based on information obtained in a search of MTU archives and field reconnaissance work as reported in TM 1.

In the following sections, each sector is described in detail. Surface feature physical and locational information for all sectors are summarized in Table 3-1, and additional descriptive information is provided in TM 1 and TM 4 (Appendix A).

3.1.2.1 Sector 1

Sector 1 (Figure 2-2) encompasses approximately 110 acres of red conglomerate tailings. The tailings consist of primarily dusky red to reddish brown, fine, and medium silty sand. In addition to being one of the largest tailings piles along the west shoreline of Torch Lake, Sector 1 exhibits the greatest relief of any of the sectors. Relief in the north-central portion of the sector is on the order of 20 to 30 feet. As is the case with many of the sectors, Sector 1 has little or no relief along its perimeter. Vegetation is sparse except along the northern perimeter adjacent to the Trap Rock River and in those areas where vegetation has been actively encouraged through the addition of topsoil and planting of pine trees. Vegetation is primarily confined to an area surrounding the sewage ponds and public campground. Areas of stressed vegetation are also evident. Surface features unique to Sector 1 include an abandoned landfill and associated miscellaneous surface debris, sewage ponds, a public beach, campground, and park. Sampling and analysis to characterize the abandoned landfill or the sewage ponds were not within the scope of the field activities conducted for the OU I remedial investigation. Slime patches consisting of broken chips resembling weathered shale and dry powder-like fine clayey silt are apparent at the surface. Slime is the mining engineering term for the fine-grained material produced during the copper reclamation process.

TABLE 3–1

TORCH LAKE RI
TAILINGS SECTOR SUMMARY

PHYSICAL CHARACTERISTICS	SECTORS											
	1	2	3 A	3 B	4	5	6	7 A	7 B	8	9	Slag Pile
Red Conglomerate Tailings	X				X			X	X			
Black Amygdaloid Tailings		X	X	X		X	X			X	X	
Slime Deposits	X				X	X	X		X	X	X	
Crushed Slag		X	X	X	X					X		X
Coal Present				X						X		
Reprocessed by leaching	X						X					
Reprocessed by flotation	X	X				X	X			X		
Grain Size (F, M, C)*	F–M	F–C	F–C	F–C	F–M	F–M	F–M	F–C	F–C	F–C	F–M	F–C
Drums on Surface				X	X		X			X		X
Topsoil Addition/Revegetation	X	X					X				X	
Miscellaneous industrial debris	X		X	X	X	X				X	X	X
Railroad ties/timbers	X		X	X	X	X				X	X	
Vegetation												
Sparse	X		X	X	X	X	X	X	X	X		X
Heavy	X	X					X				X	
Surface Area (acres)												
<10		X	X	X	X							X
10 to 25								X	X			
25 to 50						X				X		
>50	X						X				X	
Wetlands						X	X					
Sewage sludge applied							X				X	
LOCATIONAL & CULTURAL CHARACTERISTICS												
Near Lake Linden	X	X	X	X								
Near Hubbel					X							X
Near Tamarack City					X	X	X	X	X			
Near Mason										X	X	
Accessible to public	X	X	X	X	X	X	X	X	X	X		X
Sewage ponds present (fenced)	X						X					
Active sewage sludge application											X	
Abandoned landfill present	X				X						X	
Near public beach	X	X										
Near public campground/park	X	X										
Near copper reclamation plant												X
Near former smelter stacks												X
Monitoring wells present	X						X			X	X	
Near former leaching plant	X	X					X	X	X			
Near former stamp mill	X	X	X	X	X	X	X	X	X	X	X	
Near boat landing/dock			X		X							
Near railroad right–of–way							X			X		
Near industry												X
Near homes, apartments	X			X	X					X		X
Near schools	X	X										
Near sewage ponds		X						X	X			

*F = Fine–grained
M = Medium–grained
C = Coarse–grained

3.1.2.2 Sector 2

Approximately 8 acres of black amygdaloid tailings comprise Sector 2. Sector 2 tailings form a narrow band partially encircling the Lake Linden sewage ponds to the southwest (Figure 2-2). These darker amygdaloid tailings are contiguous to the red conglomerate tailings of Sector 1 both to the north and to the east. Sector 2 is characterized by low relief, moderate to heavy vegetation in places, and by its proximity to the sewage ponds and campground of Sector 1. Vegetation has been enhanced with topsoil addition and pine tree plantings. Crushed slag is intermixed with the coarse amygdaloid tailings of Sector 2.

3.1.2.3 Sector 3

Sector 3 (Figure 2-2) consists of a northern subsector (3A) and a southern subsector (3B) for a total of approximately 6 acres. Subsector 3A consists of minor amounts of black amygdaloid tailings with large amounts of slag, brick, and rubble. The extensive debris of the Calumet and Hecla Stamp Mill site is observed with areas of sparse vegetation. Subsector 3B is also black amygdaloid tailings with lesser amounts of crushed slag and coal. Surface debris includes railroad ties, timbers, wood pilings, and drums. Subsector 3B is moderately to heavily vegetated. Sector 3 is characterized by little or no relief.

3.1.2.4 Sector 4

Sector 4 (Figure 2-3) encompasses nearly 10 acres of red conglomerate tailings attributable to the Ahmeek Mill. This sparsely vegetated sector exhibits little or no relief. Significant amounts of surface debris are present including timbers, scrap metal, and drums. It appears that Sector 4 has been used as a dump site. Crushed slag is apparent on the tailings, as are patches of slime.

3.1.2.5 Sector 5

The 36 acres which comprise Sector 5 (Figure 2-3) consist of dark brown to very dark gray amygdaloid tailings ranging from very fine to medium silty sand. Sector 5 tailings are sparsely vegetated with little or no relief. Surface debris consisting of timbers is concentrated along a northwest/southeast trending line. Many of these timbers presumably formed the support structure for tailings discharge pipes. A wetland area is present to the northwest of the sector. Slime patches are more abundant and generally thicker in Sector 5 than in any other sector. The pinkish gray slime patches tend to be slightly elevated in relation to the surrounding tailings because the slime is more resistant to aeolian erosion.

3.1.2.6 Sector 6

Approximately 54 acres of black amygdaloid tailings comprise Sector 6 (Figure 2-3). With the exception of tailings type, Sector 6 is similar to Sector 1 in that it displays considerable relief, has been actively

revegetated, and contains sewage ponds. The greatest relief is present along the northwest perimeter of the sector. A 15- to 20-foot deep ravine parallels the railroad grade and Highway M-26, coincident with the former Torch Lake shoreline. This ravine area is a wetland, and numerous drums are piled on the sideslopes in the southern portion. Wetlands also occur to the north of Sector 6. Vegetation is heaviest in an area surrounding the sewage ponds. The sparsest vegetation occurs in the northeast portion of sector. Timbers represent the dominant surface debris. Sewage sludge has been applied on the surface of Sector 6. In some portions of the sector, there is evidence of mixing between black amygdaloid and red conglomerate tailings. Patches of slime are also present.

3.1.2.7 Sector 7

Sector 7 (Figure 2-3) consists of two separate subsectors (7A and 7B) contiguous with Sector 6. Total area of Sector 7 is approximately 21 acres. Sector 7 is characterized by little or no relief, red conglomerate tailings, and sparse vegetation. Surface debris consists primarily of timbers. A prominent northeast-southwest trending line of timbers is present on subsector 7B. These timbers were likely support structures for discharge pipes. Slime deposits are apparent in subsector 7B, but not in subsector 7A.

3:1.2.8 Sector 8

Sector 8 (Figure 2-4) is an irregular-shaped area comprised of 42 acres in a narrow band along the Torch Lake shoreline. Sector 8 consists of black amygdaloid tailings with crushed slag and coal. The northern portion of the sector encompasses an area formerly occupied by a coal dock. Small tailings piles and considerable amounts of debris and buildings ruins characterize the northern portion of the sector. Surface debris includes drums, scrap metal, and timbers. That portion of Sector 8, best described as a large hook-shaped spit, displays uniform finer-grained tailings, notably lacking in vegetation. The topography ranges from flat to undulating reflective of gully erosion caused by surface erosion. Slime deposits are quite extensive in the sector.

3.1.2.9 Sector 9

Sector 9 (Figure 2-4) is the largest tailings sector, incorporating approximately 155 acres of black amygdaloid tailings. The tailings are similar to those of Sector 8, however Sector 9 lacks the crushed slag and coal. Slime deposits are prevalent in Sector 9. Sector 9 displays moderate to heavy vegetation which has been encouraged through the addition of topsoil and active sewage sludge application. The central portion of the sector is characterized by higher relief which grades to a nearly level tailings/lake interface. Hummocky and undulating topography has been accentuated by dune formation and human disturbances associated with the land application of sewage sludge. The central portion of the sector has also been the site of solid waste dumping. Surface debris consists of drums, miscellaneous industrial debris, and timbers.

3.1.2.10 Slag

A prominent area of slag is located adjacent to, and south of, the Peninsula Reclamation Plant (Figure 2-3). An area adjacent to the reclamation plant consists of crushed slag. The slag structure is amorphous and massive. The area is unvegetated with scattered timbers and building debris. The slag pile south of the reclamation plant consists of angular, amorphous slag fragments ranging in size from sand to boulders. Portions of the slag pile exhibit flow features which suggests deposition as a molten material. Total area of the slag is less than 10 acres.

3.2 GEOTECHNICAL PROPERTIES OF TAILINGS

Selected surface and subsurface tailings samples were analyzed for geotechnical parameters, including moisture content, specific gravity, grain size distribution, Atterberg limits, water holding capacity, and cation exchange capacity. These data are presented in TM 8. The color or source of the tailings is not related to the geotechnical properties of the samples collected.

3.2.1 Surface Tailings

The red conglomerate and black amygdaloid tailings have similar grain size characteristics. Based on the Unified Soil Classification System (USCS), the tailings are predominantly silty sands and poorly graded sands with silt. The greatest percentage of the tailings material lies within the sand size range. The coarsest material is located in Sector 3, which reflects a disproportionate amount of crushed slag, building debris, and other fill material. Table 2 in TM 8 presents a summary of the grain size data for the surface tailings samples. Plots of grain size data reveal skewed distributions for samples from Sectors 3 and 8 compared to other sectors.

The tailings are nonplastic and unamenable to measurement of Atterberg limits. Moisture content displays the greatest variability of the geotechnical parameters, ranging from 2.2 to 32.7%. A direct correlation exists between tailings moisture content and vegetation density. The most heavily vegetated tailings exhibit the greatest moisture content. Water holding capacity ranges from 21.8% to 42.5%. Cation exchange capacity of surface tailings samples ranged from 4.7 to 18.1 meq/100 g. Slime material CEC was 9.3 meq/100 g. A summary of the surface geotechnical results is presented in TM 8.

3.2.2 Subsurface Tailings

The grain size data for the subsurface tailings samples are similar to that of the surface samples. The USCS classification is primarily silty sand and poorly graded sands with silt. The coarsest material in the subsurface is in Sector 3, where nearly 40% of the material lies in the gravel size range. This again reflects the building debris, slag, and fill material which is not present in other sectors. Table 4 in TM 8 presents a summary of the grain size distribution data for the subsurface tailings samples.

The subsurface tailings are nonplastic and exhibit variation in moisture content consistent with the surface samples. Moisture content ranges from 4.8 to 27.1%. No direct relationship appears to exist between the moisture content of subsurface samples and vegetation density because subsurface samples are predominantly moist due to position in the soil profile. Water holding capacity ranges from 17.3 to 43.1%. Cation exchange capacity of subsurface tailings ranged from 5.0 to 16.8 meq/100 g. A summary of the shallow subsurface geotechnical results is presented in TM 8.

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4.0 NATURE AND EXTENT OF CONTAMINATION

This chapter presents the results of OU I site and waste characterization for both natural chemical components and contaminant compounds, for the media sampled in OU I RI field investigation activities. These media include drums, OU I tailings, soil, and air. This chapter emphasizes the chemicals of potential concern for this site which were identified in data evaluation performed for the Baseline Risk Assessment (Appendix B).

4.1 DRUMS

The 1989 drum investigation included both a geophysical survey to attempt to define the extent and location of drums buried in OU I tailings, and sampling and analysis of surface drums to determine the nature of their contents. RI activities related to identifying the nature and extent of drum wastes will continue in 1990 when additional exposed, buried, and submerged drums will be staged and sampled. Therefore, this report presents the results of initial activities only. Evaluation of the nature and extent, fate and transport characteristics, or risk associated with drum-related contamination will be performed and presented after additional drum investigation activities are conducted.

4.1.1 Geophysical Survey

The results of the geophysical survey of OU I tailings are discussed in detail in TM 2 and in TM 9. The ground penetrating radar data from the three tailings sites investigated were difficult to interpret because of the complex appearance of the signal reflection. This was attributed to the extensive metallic debris in OU I tailings fill areas. Also, radar target data did not correspond to magnetic data.

The radar record from the Stampmill Site indicated radar targets that may include buried drums or other cylindrical metallic objects. The Stampmill Site radar targets did not correspond to magnetic anomalies indicating that the buried objects are non-ferrous (not iron or steel). Only a few radar targets were recorded at the Centerline Apartments Site, and these did not correspond to the magnetic anomalies. This indicates that these targets are also non-ferrous materials. The non-magnetic radar targets may be attributable to large boulders of copper which did not go through crushers in the stampmills, and were often thrown into the tailings piles.

Radar targets were not found at the Stampmill and Centerville Apartments Sites at the locations of magnetic anomalies, suggesting that (1) scrap iron or steel may also be found at these locations, or (2) the magnetic anomalies are outside of the spacing of the radar lines.

The radar targets at the Sewage Pond Site did correspond to magnetic anomalies. These targets have the best chance to be buried drums. However, not all magnetic anomalies were associated with radar targets.

Test pit excavations are required to verify whether the radar targets or magnetic anomalies represent buried drums. Test pit excavations and drum sampling are scheduled for 1990.

4.1.2 Analysis of Surface Drum Contents

As discussed in Section 2.2.2, EPA TAT personnel sampled the contents of eight drums found exposed at various locations on the surface of OU I tailings. The analytical data reported in TM 3 indicate that for seven of the drums, the concentration of hazardous constituents was very low as measured by the EP toxicity test. None of the drum waste material sampled is considered hazardous based on RCRA characteristics of EP toxicity. PCBs and pesticides were not found above method detection limits in any drum. In general, only traces of volatile and semivolatile organic compounds were found. One overturned and leaking drum from a Hubbell sampling location contained 4,000 ppm of trichloroethylene (TCE). It is suspected that this drum is not related to past site operations, but rather to a recent unauthorized disposal.

The TAT assessment did not indicate that immediate removal of the drums was necessary.

4.2 TAILINGS

Radiation readings above background were not measured for any tailings sample (TM 4).

Analytical chemistry data for OU I tailings samples are presented and discussed in TM 10. A summary of the ranges in concentration of chemicals of potential concern measured in surface and subsurface tailings samples is shown in Table 4-1. This table also presents naturally occurring, native soil concentrations. The data and discussion in TM 10 provide the following conclusions regarding the distribution of chemicals in OU I tailings.

Detectable amounts of semivolatile organic compounds were measured in surface (0 to 6 inch) tailings samples in all sectors. Bis(2-ethylhexyl)phthalate (BEHP) was the most widespread, and was measured in all sectors except Sectors 4, 7, and 9. The highest concentrations and the largest number of semivolatile organic compounds were measured in Sectors 3 and 8. Fifteen base/neutral extractable compounds, primarily polycyclic aromatic hydrocarbons, were detected in Sectors 3 and 8. The highest concentrations of semivolatile organic compounds measured were for benzo(b)fluoranthene or benzo(k)fluoranthene in Sector 8.

Semivolatile organic compounds were also measured in subsurface tailings samples taken from the 0 to 3 foot depth in all sectors except Sectors 4 and 9. The largest number of subsurface semivolatile organic compounds and the highest concentrations were also found in Sectors 3 and 8.

The distributions and concentrations of semivolatile organic compounds were similar for surface and subsurface tailings samples. Sectors 3 and 8, where semivolatile organic compounds were detected, were the same sectors where

TABLE 4-1

SUMMARY OF CHEMICALS OF POTENTIAL CONCERN
DETECTED IN OPERABLE UNIT I TAILINGS
TORCH LAKE RI/FS
AUGUST, 1989

	Range of Concentrations, mg/kg		Native Soil Concentrations, mg/kg
	Surface Tailings	Subsurface Tailings	
Organic Compounds			
bis(2-Ethylhexyl) phthalate	0.038J - 1.2	0.11 - 1.1U	150 - 925
PAHs			
Naphthalene	0.050J - 0.44U	0.08J - 0.43U	1 - 5
2-Methylnaphthalene	0.069J - 0.44U	0.12J - 0.43U	
Acenaphthylene	0.037J - 0.44U	0.35U - 0.43U	
Phenanthrene	0.049J - 0.44U	0.073J - 0.43U	
Fluoranthene	0.039J - 0.44U	0.048J - 0.43U	0 - 0.04
Pyrene	0.047J - 0.44U	0.06J - 0.43U	0 - 0.015
Benzo(a)anthracene	0.054J - 0.44U	0.022J - 0.43U	0 - 0.01
Chrysene	0.046J - 0.44U	0.025J - 0.43U	0 - 5
Benzo(b)fluoranthene	0.057J - 0.56	0.066J - 0.43U	0 - 0.03
Benzo(k)fluoranthene	0.067J - 0.56	0.066J - 0.43U	0 - 0.015
Benzo(a)pyrene	0.048J - 0.44U	0.02J - 0.43U	0 - 8
Indeno(1,2,3-cd) pyrene	0.091J - 0.44U	0.140J - 0.43U	0 - 0.015
Dibenzo(a,h) anthracene	0.044J - 0.44U	0.066J - 0.43U	
Benzo(g,h,i) perylene	0.099J - 0.44U	0.160J - 0.43U	0 - 0.02
Inorganic Compounds			
Aluminum	5,190 - 37,200	5,410 - 27,200	10,000 - 300,000
Antimony	3.4U - 11.7	3.5 - 7.3	
Arsenic	0.37U - 8.3	0.47 - 14.4	1.0 - 40
Barium	5.5 - 135	5.1 - 68	100 - 3,500
Beryllium	0.18U - 1.7	0.18U - 1.0	0.1 - 40
Boron	N/A	N/A	
Chromium	10.7 - 46.3	13.6 - 42.7	5.0 - 3,000
Cobalt	5.4 - 52.6	8.5 - 32.8	1.0 - 40
Copper	72.3 - 3,020	699 - 5,540	2.0 - 100
Lead	1.5 - 104	0.38U - 82.8	2.0 - 200
Manganese	103 - 1,080	217 - 703	100 - 4,000

TABLE 4-1

SUMMARY OF CHEMICALS OF POTENTIAL CONCERN
DETECTED IN OPERABLE UNIT I TAILINGS
TORCH LAKE RI/FS
AUGUST, 1989
(continued)

	Range of Concentrations, mg/kg		Native Soil Concentrations, mg/kg
	Surface Tailings	Subsurface Tailings	
Mercury	0.08U - 1.1	0.09U - 0.24	0.01 - 0.08
Nickel	12.6 - 57.3	20.2 - 115	5.0 - 1,000
Silver	1.5U - 8.2	1.5U - 22.8	0.1 - 5.0
Titanium	N/A	N/A	1,000 - 10,000
Vanadium	19.2 - 159	25.5 - 121	20 - 500

Notes:

- U indicates compound was not detected and the numerical value indicates the contract required quantitation limit, adjusted for dilution and percent moisture (organics) or the instrument detection limit (inorganics).
- N/A indicates chemical not analyzed for in this medium.
- J indicates this value is estimated.
- PAH denotes polycyclic aromatic hydrocarbon compounds.
- Source of naturally occurring native soil concentrations is Dragun (1988).

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railroad ties, tar roofing, or coal debris were documented in the field sampling logs (see Table 3-1). Sectors 3 and 8 were the only sectors where the presence of coal at sampling locations was documented. All of the semi-volatile polycyclic aromatic hydrocarbon chemicals of potential concern are documented as being derived from coal, coal-tar, wood preservative sludge, or petroleum sources (Verschueren, 1983).

Inorganic compounds of potential concern including chromium, cobalt, copper, lead, nickel, and vanadium were found in most sectors at varying concentrations.

Arsenic was found in Sectors 1, 3, 5, 6, and 7. Arsenic was found in subsurface samples for Sectors 3 and 6. Arsenic levels in slag samples exceeded typical native soil levels. Mercury was detected in all samples from Sectors 3 and 8 at concentrations exceeding typical soils.

The concentration and distribution of metals appeared to be similar in the surface and subsurface samples. For inorganic constituents, the majority of the subsurface tailings concentrations are within or below the range of concentrations found at the surface.

In general, copper concentrations measured in tailings are elevated above the range generally found in soils. This is expected because of the occurrence of native copper in the Keweenaw Peninsula.

Slime material, the fine-grained tailings material deposited in layers in the tailings, contained higher concentrations of chromium than tailings samples. The concentrations of other inorganic compounds such as arsenic, copper, and lead are similar in slime samples and tailings samples.

Slag material, produced by smelting high copper concentrate produced in the stamping and flotation processes, exhibited higher concentrations of arsenic, chromium, copper, and lead than the concentrations measured in the tailings samples.

In summary, neither organic nor inorganic compound levels measured in OU I tailings are dramatically higher than those found in naturally-occurring soils.

4.3 SOILS

Soil chemistry analytical results are presented and discussed in TM 11. Ten composite residential soil samples were collected and analyzed during OU I RI activities to assess contaminant distribution from tailings sources. The results are discussed here although neither complete characterization of Torch Lake Superfund Site soils nor assessment of risk attributable to soils was within the scope of OU I RI activities. A summary of the ranges of chemicals of potential concern measured in soil samples and naturally occurring soil concentrations are shown in Table 4-2.

TABLE 4-2

SUMMARY OF CHEMICALS OF POTENTIAL CONCERN
DETECTED IN SOIL SAMPLES
TORCH LAKE RI/FS
AUGUST, 1989

	Range of Concentrations, mg/kg	Native Soil Concentrations, mg/kg
Organic Compounds		
bis(2-Ethylhexyl) phthalate	0.800 - 3.8	150 - 925
PAHs		
Naphthalene	U - 0.071J	1 - 5
2-Methylnaphthalene	U - 0.054J	
Acenaphthylene	U - 0.13J	
Phenanthrene	0.049J - 1.900	
Fluoranthene	U - 0.092J	0 - 0.04
Pyrene	0.045J - 2.600	0 - 0.015
Benzo(a)anthracene	U - 1.500	0 - 0.01
Chrysene	U - 1.600	0 - 5
Benzo(b)fluoranthene	U - 1.500	0 - 0.03
Benzo(k)fluoranthene	U - 0.670	0 - 0.015
Benzo(a)pyrene	U - 1.600	0 - 8
Indeno(1,2,3-cd)pyrene	U - 0.630	0 - 0.015
Dibenzo(a,h)anthracene	U - 0.290J	
Benzo(g,h,i)perylene	U - 0.670J	0 - 0.02
Inorganic Compounds		
Aluminum	3,140 - 7,600	10,000 - 300,000
Antimony	U	
Arsenic	U - 7.00	1.0 - 40
Barium	U - 101.00	100 - 3,500
Beryllium	U	0.1 - 40
Boron	U	
Chromium	5.90 - 20.10	5.0 - 3,000
Cobalt	U	1.0 - 40
Copper	58.30 - 459.0	2.0 - 100
Lead	6.10 - 329.0	2.0 - 200
Manganese	91.40 - 357.0	100 - 4,000

TABLE 4-2

SUMMARY OF CHEMICALS OF POTENTIAL CONCERN
DETECTED IN SOIL SAMPLES
TORCH LAKE RI/FS
AUGUST, 1989
(continued)

	Range of Concentrations, mg/kg	Native Soil Concentrations, mg/kg
Mercury	0 - 0.47	0.01 - 0.08
Nickel	0 - 33.70	5.0 - 1,000
Silver	1.5U	0.1 - 5.0
Titanium	U	1,000 - 10,000
Vanadium	11.40 - 26.30	20 - 500

Notes:

- U indicates compound was not detected and the numerical value indicates the contract required quantitation limit, adjusted for dilution and percent moisture (organics) or the instrument detection limit (inorganics).
- N/A indicates chemical not analyzed for in this medium.
- J indicates this value is estimated.
- PAH denotes polycyclic aromatic hydrocarbon compounds.
- Source of naturally occurring native soil concentrations is Dragun (1988).

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Semivolatile organic compounds were measured in most of the ten soil samples. Base/neutral extractable and TIC hydrocarbons were the most widely distributed. Semivolatile organic compounds detected at levels higher than naturally-occurring levels in soils include: fluoranthene, pyrene, benzo(a) anthracene, benzo(b) fluoranthene, benzo(k) fluoranthene, indeno (1,2,3-cd) pyrene, and benzo(g,h,i) perylene.

Inorganic compounds of potential concern, including chromium, copper, lead, nickel, and vanadium were measured in most of the soil samples. Copper, lead, and mercury were detected at concentrations exceeding native soil concentrations. The measured copper concentrations were higher than typical native soil levels for all soil samples except for that from the football field. High concentrations of lead and mercury were measured in one soil sample from Lake Linden. The sampling team did not observe anything that might explain the high lead and mercury concentration in this sample. High mercury levels were also measured in four samples from Lake Linden and Mason. Arsenic was measured in 8 of 11 soil samples, at levels typical of naturally occurring soils.

EPA Technical Assistance Team (TAT) personnel also collected soil samples during a Torch Lake Site Assessment (TM 3). Three samples from locations of suspected contamination in Hubbell and Mason and a background soil sample from the east side of Torch Lake were analyzed for volatile and semivolatile organic compounds, EP toxicity metals, total metals, and cyanide. Methylene chloride, phenanthrene, fluoranthene, pyrene, chrysene, and di-n-octyl phthalate were detected from a soil sample collected directly underneath a drum. No pesticides or PCBs were detected. EP toxicity metals concentrations were below maximum concentrations (40 CFR 261). All of the metals detected were within the typical concentration ranges of metals in soils.

The inorganic compounds measured in the ten residential soil samples collected for the RI field investigation (TM 11) are generally an order of magnitude higher than concentrations measured in the TAT background soil sample collected from the east side of Torch Lake (TM 3).

4.4 COMPARISON OF TAILINGS AND SOIL CHEMISTRY

In general, semivolatile organic compound levels were orders of magnitude higher in soil samples than in tailings samples. Arsenic, chromium, and copper concentrations are generally similar in soil samples and tailings samples. The highest level of lead measured was detected in a soil sample.

For both tailings and soil samples, contaminant compounds were distributed in a non-homogeneous manner. There was no pattern of distribution which suggested impact of tailings-derived compounds to residential soils. The sporadic distribution, the lack of geographical proximity, and the concentrations measured suggest that detected compounds are unrelated between these media.

4.5 AIR

The results of the air-monitoring program conducted by MDNR are provided in TM 7. The air samplers installed on the west side of Torch Lake received higher levels of total suspended particulate material than the sampler on the east side of the lake which was farther from the OU I tailings.

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5.0 CONTAMINANT FATE AND TRANSPORT

This chapter addresses potential routes of contaminant migration and contaminant persistence and mobility for chemicals of potential concern in OU I tailings.

5.1 POTENTIAL ROUTES OF MIGRATION

The remedial investigation and risk assessment for Operable Unit I address the potential routes of migration highlighted in Figure 1-5. Contaminant migration from OU I tailings could occur by generation of particulate material, or by infiltration, runoff, or erosion. Contaminant migration could also occur from secondary sources such as soil.

Particulate generation may occur when fugitive dust is generated by wind erosion of exposed tailings. Vehicular travel over contaminated tailings also creates dust and may be a source of airborne contaminants. Evaluation of the air exposure pathway was conducted by emissions and air modeling as part of the Baseline Risk Assessment (Chapter 6 and Appendix B).

Quantification of other migration pathways was not part of the scope of this investigation. Contaminant infiltration from OU I tailings will be addressed by collection and analysis of groundwater samples from beneath OU I tailings during the OU II RI, and by leaching tests conducted by the Bureau of Mines. Contaminant runoff and erosion will also be addressed after collection of surface water and sediment samples in the OU II RI. The potential for contaminant migration from drums in OU I tailings will be addressed after additional investigations to locate and sample drums to determine the nature and extent of drum-derived contamination.

The significance of contaminant migration by infiltration, runoff, or erosion routes is limited by the persistence and mobility of the contaminant types detected in OU I tailings. Contaminant persistence and mobility are discussed below for OU I chemicals of potential concern.

5.2 CONTAMINANT PERSISTENCE AND MOBILITY

There are several mechanisms that can affect contaminant fate and transport in the environment. These include transformation mechanisms (such as biotransformation, hydrolysis, oxidation, and precipitation); phase change mechanisms (such as volatilization, sorption, ion exchange, and dissolution); and transport mechanisms (such as advection, diffusion, complexation/ chelation, and particle-facilitated transport). These mechanisms can cause loss, movement, change, or retardation of contaminants in the environment. The potential for these mechanisms to contribute to contaminant fate or transport in OU I tailings is determined by the chemical and physical properties of the tailings and of the compounds of interest. The chemicals of potential concern identified for OU I tailings include primarily polycyclic aromatic hydrocarbons (PAHs) and inorganic compounds. The fate and transport characteristics of these classes of compounds are discussed in the following sections.

5.2.1 Organic Chemicals of Potential Concern

The organic chemicals of potential concern are shown in Table 5-1. All 15 compounds are categorized as semivolatile organic compounds. Fourteen are polynuclear aromatic hydrocarbons and one is a phthalate. Important physical properties of these semivolatile organic compounds are also listed in Table 5-1. In general, all of the semivolatile organic compounds listed have low water solubility, large octanol-water partition coefficients, and very low vapor pressures. These properties result in relatively low mobility in a groundwater/soil environment. These organic compounds tend to adsorb fairly strongly to solid materials and remain relatively immobile. The exceptions are the naphthalene compounds, which have relative high water solubility and high vapor pressure, and would be relatively mobile.

Biotransformation for polynuclear aromatic hydrocarbons has been noted in aerobic environments. Nonhalogenated semivolatile compounds may be susceptible to biotransformation. However, with the environmental conditions present in the tailings at Torch Lake, biodegradation is expected to be slow and complete oxidation to harmless products cannot be assured.

Hydrolysis is the chemical transformation of a compound through reaction with water. Organic compounds recognized as resistant to hydrolysis include PAHs (Lyman, 1981).

Oxidation can alter the toxicity of an original compound. Chemical oxidation of organic compounds can be catalyzed in soils, clays, and minerals by iron, manganese, aluminum, and adsorbed oxygen at ambient temperature and pressure. However this process is very dependent on oxygen state.

Volatilization is the movement of a contaminant from a solid or liquid phase into the gas phase. This reduces the concentration of the compound in the original phase and increases it in the gas phase. Compounds may volatilize from the surface of contaminated solid matrices, migrate upward through the vadose zone, and be released to the atmosphere at the ground surface.

The potential for volatilization can be evaluated using the Henry's Law Constant (HLC). Compounds with HLCs greater than or equal to 10^{-3} atmospheres-meter^3/mole are classified as high volatility compounds, compounds with HLCs from 3×10^{-7} to 10^{-3} are classified as moderate volatility, and compounds with HLCs less than 3×10^{-7} are classified as low volatility (Lyman, 1981). The chemicals of potential concern for OU I tailings are thus classified as having only low to moderate volatility (Table 5-1).

Many organic compounds sorb to soil through a partitioning process between the soil and the liquid or gas phases. Many hazardous organic compounds are hydrophobic compounds that preferentially partition out of the liquid phase. In the natural environment, partitioning occurs to a preferred phase such as organic material in the soil. This partitioning, or sorption, reduces the mobility of the organic compounds, and affects other fate mechanisms such as volatilization, hydrolysis, and biodegration by reducing the amount of contaminant available to these processes. Polynuclear aromatic hydrocarbons and

TABLE 5-1

Physical and Chemical Characteristics
of Organic Chemicals of Potential Concern

	Water Solubility mg/l @ 25°C	Log of Kow	Log of Vapor Pressure mm @ 25°C	Henry's Law Constant $atm-m^3$ /mol
bis(2-ethylhexyl)phthalate	0.40	4.2	-6.7	No data
Naphthalene	30	3.3	-0.63	No data
2-Methylnaphthalene	24.6	4.1	No data	No data
Acenaphthylene	3.9	4.07	-1.8	9.20E-5
Phenanthrene	1.29	4.5	-3.16	1.59E-4
Fluoranthene	0.26	5.2	-5.3	6.46E-6
Pyrene	0.16	5.0	-6.2	5.04E-6
Benzo(a)anthracene	0.014	5.9	-6.9	1.16E-6
Chrysene	0.006	5.6	-8.2	1.05E-6
Benzo(b)fluoranthene	0.014	6.06	-6.30	1.19E-5
Benzo(k)fluoranthene	0.00055	6.9	-10.0	3.94E-5
Benzo(a)pyrene	0.00038	6.0	-8.3	1.55E-6
Indeno(1,2,3-cd)pyrene	0.0062	7.7	-10.0	6.86E-8
Dibenz(a,h)anthracene	0.0005	6.5	-10.0	7.33E-8
Benzo(g,h,i)perylene	0.00026	7.1	-10.0	5.34E-8

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bis(2-ethylhexyl)phthalate are not mobile in most soil-water systems because they bind onto organic macromolecules which are extensively adsorbed onto soil surfaces due to van der Waals forces (Dragun, 1988).

2.2 Inorganic Chemicals of Potential Concern

Inorganic chemicals of potential concern and relevant chemical properties are listed in Table 5-2. The inorganic compounds are primarily metals and include aluminum, antimony, arsenic, barium, beryllium, boron, chromium, cobalt, copper, lead, manganese, mercury, nickel, silver, titanium, and vanadium.

Barium and beryllium are Group II elements which form relatively insoluble silicates, carbonates, sulfates, and phosphates. Titanium is a Group III element whose most abundant chemical form is titanium dioxide, an inert material. Boron is a Group III element that has a very complicated chemistry. Many anionic boron species are soluble and mobile in the environment. Lead is a Group IV metal that forms relatively insoluble sulfides and sulfates. Lead generally forms cationic species that are well-attenuated by cation exchange sites in natural soil materials. Antimony and arsenic are Group V elements that generally form anionic species, especially in basic environments. These anionic species are not attenuated by cation exchange sites in natural soils. They are, however, well precipitated by iron in soils.

The remainder of the elements identified as inorganic chemicals of potential concern are transition metal elements that can form complexes with both organic and inorganic ligands. Frequently, these complexes are soluble and mobilize metals in the environment if the ligands are present in significant concentration. Chromium in the +6 oxidation state can also form an anionic species which can be quite mobile in the environment because of lack of attenuation by cation exchange sites in natural soils.

Sorption of metals and other inorganic ionic species can be referred to as ion exchange. The cationic chemicals of potential concern can exchange onto the tailings mineral surfaces displacing naturally occurring cations such as calcium, magnesium, and sodium. The surface and subsurface tailings exhibit moderate cation exchange capacity values of 4.7 to 18.1 meq/100 g, which are typical of sandy loam to loam soil types, and indicate that ion exchange or sorption may be a factor reducing mobility of cationic species. The potential for retention of metals by sorption to tailings mineral surfaces is supported by the relatively similar distribution of metals measured at different depths in OU I tailings.

Sorption of anionic species by ion exchange will not occur to the same extent because the mineral surfaces are negatively charged. Few minerals have readily exchangeable anions. Therefore, the chemicals of potential concern which are present as anionic species are potentially more mobile.

Precipitation is the formation of a solid from components in aqueous solutions. Precipitation may be a significant fate mechanism for metals under the reducing and oxidation-reduction conditions in OU I tailings, reducing metal mobility.

TABLE 5-2

Chemical Characteristics of
Inorganic Chemicals of
Potential Concern

	Periodic Table Group	Characteristics
Aluminum	III	
Antimony	V	Anionic species in basic medium.
Arsenic	V	Anionic species in basic medium.
Barium	II	Relatively insoluble silicates, carbonates, sulfates.
Beryllium	II	Relatively insoluble silicates, carbonates, sulfates.
Boron	III	Complicated chemistry, many soluble species.
Chromium	Transition	Anionic species in the oxidation state, soluble complexes.
Cobalt	Transition	Soluble complexes, ion exchange to soil.
Copper	Transition	Soluble complexes, ion exchange to soil.
Lead	IV	Low solubility, some soluble complexes, ion exchange to soil.
Manganese	Transition	Soluble complexes, ion exchange to soil.
Mercury	Transition	Soluble complexes, ion exchange to soil.
Nickel	Transition	Soluble complexes, ion exchange to soil.
Silver	Transition	Soluble complexes, ion exchange to soil.
Titanium	III	Low solubility oxide is primary form.
Vanadium	Transition	Soluble complexes, ion exchange to soil.

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Dowdy and Volk (1983) reviewed research data related to metal transport. In soil materials, metals occur on exchange sites, are incorporated into or on the surface of crystalline or noncrystalline inorganic precipitates, are incorporated into organic compounds, and are present in solution. Heavy metals are sparingly soluble, and occur predominantly in a sorbed state or as part of insoluble inorganic or organic compounds. Movement of metals in natural soils is generally considered minimal because of low solubilities. Metal movement could occur by diffusion as free ion or complexed forms, by mass flow, or by particle facilitated transport through open channels. Metal diffusion generally occurs over only relatively short distances, so that mass flow is the principle mechanism by which metals move distances. Metal movement with water requires that the metal be in the soluble phase or associated with mobile particulates. Matrix specific parameters such as pH, sorption sites, ionic strength, and ligands affect the concentration of metals in solution. Metals are often chelated or complexed with organic materials. The chelated compounds may be more soluble than inorganic precipitates. Metal movement will most likely occur for sandy, acid, low organic matter soils which receive high rainfall. Even under these conditions, however, the extent of metal movement will be limited. Most movement will occur through open channels where the soil has little opportunity for metal attenuation.

Studies regarding dissolution and leaching of compounds through OU I tailings have been initiated by the Bureau of Mines (U.S. Department of the Interior, 1990). The Bureau of Mines performed laboratory evaluations of tailings and water samples from Torch Lake to determine the potential for metals to adversely affect Torch Lake. Partial digestion assays for 32 elements, column leach, and slurry leach tests were performed to evaluate contaminant release potential from tailings. Element concentrations were compared to maximum contamination levels (MCLs) specified in the National Drinking Water Standards.

Surface and submerged tailings samples had nearly the same composition as determined by the partial digestion assay. The metal release characteristics were very similar for both types of tailings as revealed by the column leach tests. The sensitivity of tailings to further oxidation reactions that release metals was evaluated and indicated very little increase in metals with the possible exception of iron. Further studies were proposed to evaluate possible effects which remedial action processes may have in promoting metal release and leaching following oxidation if submerged tailings are exposed to air.

In general, metal concentrations in leachates from Torch Lake tailings samples were concluded to be extremely low when compared to tailings at over 30 other sites. This was attributed to the Torch Lake tailings being highly oxidized and originating from a non-sulfide ore body. Bureau of Mines results indicated that very little metal is being released from the Torch Lake tailings. Leachates occasionally contained copper, iron, and manganese at concentrations above drinking water standards.

Transport of the inorganic compounds from the tailings materials through the soils and to the groundwater system will be evaluated in work associated with OU II. The potential for transport will be measured directly by installing wells through the tailings into the groundwater that is in contact with the tailings. The inorganic compounds of potential concern plus indicator chemicals will be measured to allow calculation of speciation of the chemicals of concern. Once the speciation is known, transport relative to groundwater flow can be determined.

5.3 SUMMARY

The fate and transport of the OU I organic chemicals of potential concern (PAHs) are determined primarily by volatilization, sorption, and complexation mechanisms. The fate and transport of OU I inorganic chemicals of potential concern (metals) are determined primarily by oxidation, precipitation, sorption, ion exchange, and complexation/chelation mechanisms. These mechanisms (other than complexation and chelation) tend to limit the mobility of the PAHs and metals measured in OU I tailings. Based on the physical and chemical properties of the compounds measured in OU I tailings and on the physical and chemical properties of the tailings themselves, organic and cationic and anionic inorganic species measured will exhibit only moderate mobility in the tailing matrix.

Water is generally responsible for the mobility of compounds in soil systems. However the rate of contaminant migration depends on transformation, fixation, and adsorption reactions which remove and immobilize compounds from migrating water. Advection, diffusion, and other transport mechanisms which are related to groundwater characteristics will be addressed when groundwater flow and chemical characteristics are evaluated after installation and sampling of monitoring wells through the tailings. Results from these activities will be evaluated and presented in the RI report for OU II.

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6.0 BASELINE RISK ASSESSMENT

The baseline risk assessment for Operable Unit I tailings is an analysis of the potential adverse health effects (both current and future) resulting from exposures to hazardous substances in tailings along the western shore of Torch Lake. By definition, a baseline risk assessment is limited to conditions under the no-action alternative, that is in the absence of any remedial actions to control or mitigate releases. The results of this baseline risk assessment will be used to:

- Document both the magnitude and causes of risk at Torch Lake, OU I.
- Aid in determining if remedial actions may be necessary to mitigate unacceptable health risks.

The methods used in this risk assessment were developed by the U.S. EPA specifically for evaluations of risk at hazardous waste sites (U.S. EPA 1989a). Overall, these methods are intentionally conservative. This means that the estimates of risk calculated in this report are likely to be somewhat higher than the true risk.

The Baseline Risk Assessment Report for OU I is presented in its entirety in Appendix B (Volume 2 of this report).

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7.0 SUMMARY AND CONCLUSIONS

7.1 SUMMARY

The remedial investigation for Operable Unit I was conducted to determine the nature and extent of contamination in tailings in the primary study area and to assess potential adverse health effects resulting from releases of hazardous substances from OU I tailings. The data and evaluations performed in this remedial investigation will also aid in determining if remedial actions may be necessary to mitigate unacceptable site-related health risks and to support the selection of remedial action alternatives.

Activities documented in this report include waste characterization of OU I tailings and drums, characterization of fugitive dust emissions, air exposure modeling, limited characterization of soil, and assessment of human health impacts.

Geophysical surveys to detect buried drums and sampling and analysis of exposed drums on the surface of OU I tailings were performed. Geophysical anomalies were recorded which may indicate the presence of buried drums. The analysis of waste contents of surface drums did not indicate that immediate removal of the drums was necessary.

Surface and subsurface samples of OU I tailings, slime, and slag were collected and analyzed for radiation, semivolatile organic and inorganic compounds, and physical properties. No radiation readings above background were measured for OU I tailings. The compounds detected in OU I surface and subsurface tailings included bis(2-ethylhexyl)phthalate, polycyclic aromatic hydrocarbon compounds, and inorganic compounds. The concentration and distribution of compounds appeared similar among surface tailings, subsurface tailings, and slime materials. Slag materials exhibited higher concentrations of arsenic, chromium, copper and lead. Neither the semivolatile organic nor inorganic compound levels measured in OU I tailings are dramatically higher than those found in naturally-occurring soils.

Limited soil sampling and air sampling were performed to evaluate the potential for transport of airborne particulates from tailings to residential yards. In general, organic compound levels were orders of magnitude higher in soil samples than in tailings samples. Metal levels are generally similar in soil samples and tailings samples.

The fate and transport of OU I organic chemicals of potential concern (PAHs) are determined primarily by sorption and complexation mechanisms. The fate and transport of OU I inorganic chemicals of potential concern (metals) are determined primarily by oxidation, precipitation, sorption, ion exchange, and complexation/chelation mechanisms. These mechanisms tend to limit the mobility of the PAHs and metals measured in OU I tailings.

The baseline risk assessment for OU I tailings was conducted to analyze the potential adverse health effects (both current and future) resulting from exposures to hazardous substances in OU I tailings. Results of the baseline risk assessment for OU I are presented in Appendix B (Volume 2 of this report). The calculated risks derived for this OU should be considered approximate based on uncertainties inherent to risk assessment procedures, and are likely to overestimate actual risk.

7.2 UNCERTAINTIES

For the remedial investigation at any site, there is residual uncertainty inherent to sampling and analysis procedures used, evaluations performed, and assumptions made. The primary uncertainty related to the OU I remedial investigation pertains to the issue of data sufficiency.

To determine the nature and extent of contamination of OU I tailings, 58 surface and 12 subsurface composite samples were collected to represent approximately 450 acres of surface tailings in the primary study area. The horizontal extent of contamination was assessed by using a stratified systematic design to ensure collection and compositing of samples from strata homogeneous in tailings type, source, and processing history. Composite samples were collected at each sampling location to adequately represent tailings variability. The vertical extent of contamination was assessed to the depths selected as appropriate for the homogeneity of the matrix, the mobilities of the suspected contaminants, the exposure scenarios, and the remedial action alternatives. Additional samples to be collected in 1990 from borings during the installation of monitoring wells will allow further assessment of the vertical homogeneity of OU I tailings and the vertical extent of contamination.

The number of samples collected to represent OU I tailings was determined based on the sources, types, and processing of tailings as determined by mining company records archives review and site reconnaissance. Homogeneous sectors were sampled at a density of one sample per 10 acres of surface tailings or one sample per 20 acres of subsurface tailings. This sampling density was selected based on the homogeneity of the tailings and on the compositing performed to ensure sampling to reflect variability at each sampling location. The number of samples collected provided adequate distribution at the 95% significance level based on a conservative first approximation of 65% coefficient of variation, 20% error (U.S. EPA, 1983).

The results of the OU I tailings characterization investigations indicate that the nature and the extent of tailings contamination (elevated concentrations of chemicals of potential concern) are not homogeneous across sectors, and contamination is therefore not attributable to the tailings themselves. With this type of contaminant distribution, even significantly increasing the sampling density will not proportionally increase the probability of finding contamination.

Based on the sampling density employed, isolated or "hot spot" contamination may not have been sampled. Again, even significantly increasing the sampling density will not adequately allow for detecting hot spot contamination in roughly 450 acres of tailings.

The sampling design employed and the analytical physical and chemical characterization results, coupled with the extensive archives search and reconnaissance performed, indicate that the OU I tailings are generally homogeneous especially compared to natural soils. The residual uncertainty associated with sampling adequacy is therefore less than might be expected at other Superfund sites with the same sampling density applied to natural soils. Therefore, no further sampling to characterize OU I tailings is recommended at this time.

7.3 CONCLUSIONS

The sampling performed to characterize the OU I tailings is adequate based on the homogeneity of the parameters measured, the distribution of contaminant compounds, and the relatively low levels of contaminants found. While hot spot contamination may exist, it is not attributable to tailings composition, and could not be reliably located or predicted using any reasonable sampling program.

Four potential sources of physical heterogeneity may provide visual evidence to suspect hot spot contamination. Slime or slag deposits have been characterized during this RI. Slime materials did not exhibit significant heterogeneity in chemical or physical properties related to contaminant composition or transport. Slag materials exhibit elevated levels of inorganic contaminant compounds, however, the amorphous massive structure of these materials do not contribute risk using reasonable exposure scenarios. Debris and drum deposits also may provide visual indication of potential hot spot contamination. The levels of contamination associated with the most prominent OU I debris such as timbers were assessed during the RI activities and baseline risk assessment addressed in this report. The levels of contamination and risk associated with drums will be addressed after excavation and sampling of buried drums in 1990.

The results of the OU I remedial investigation activities conducted thus far can be compared to the Conceptual Site Model presented in Figure 1-5. Contaminant migration from primary tailings sources via the dust emissions release mechanism through the air pathway to human receptors was evaluated. Human exposure by ingestion, inhalation, and dermal contact was considered. The calculated risks for the OU I tailings are not so severe (based on the one in one million risk criteria) to indicate that this source area presents a health hazard requiring accelerated remediation. However, this does not imply that the OU I tailings do not pose a threat. The infiltration, runoff, and erosion release mechanisms have not been evaluated, could contribute to significant risk, and remedial control would then be considered.

Additional studies and data collection activities, related to OU I primary contaminant sources, which are recommended and planned include:

- Assessment of contaminant infiltration potential by collection of groundwater samples from monitoring wells underneath OU I tailings and collection of borings through tailings
- Assessment of contaminant infiltration and leaching by Bureau of Mines leaching studies
- Assessment of runoff and erosion from OU I tailings by collection and analysis of surface water and sediment samples
- Assessment of nature and extent of contamination from drums by excavation and sampling of drums.

The results from these OU I investigations will be integrated with those from Operable Units II and III to assess composite risk for the Torch Lake Superfund Site.

Based on the relatively low levels of contamination measured and on the relatively low levels of risk calculated for OU I tailings, EPA will evaluate whether accelerated treatability and feasibility studies specific to this source medium are warranted at this time.

ARCS/R/TORCHLRI/AA4

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APPENDIX A

TECHNICAL MEMORANDA

TM 1 MTU Archive Search and Field Reconnaissance of Torch Lake Tailings
TM 2 Geophysical Investigation
TM 3 TAT Drum Sampling, Soil Sampling, Water Sampling, and Data Assessment
TM 4 Surface Tailings Sampling
TM 5 Subsurface Tailings Sampling
TM 6 Phase 1 Soil Sampling
TM 7 Air Monitoring
TM 8 Geotechnical Analysis of Surface and Subsurface Tailings
TM 9 Ground Penetrating Radar Survey
TM 10 Tailings Chemical Analysis for Operable Unit 1
TM 11 Soil Chemical Analysis

TECHNICAL MEMORANDUM NUMBER 1

DATE: July 28, 1989

TO: Lorrie Ransome
Site Manager
Torch Lake Superfund Site

FROM: Jeffrey D. Maletzke
Hydrogeologist

SUBJECT: EPA Region V ARCS Contract No. 68-W8-0093
EPA Work Assignment No. 02-5LS8
Donohue Project No. 20011
Torch Lake RI/FS

Michigan Technological University Archive Search
and Field Reconnaissance of Torch Lake Tailings
Torch Lake Superfund Site
Houghton County, Michigan

On July 17 to July 21, 1989, Donohue conducted a search of mining company records in the Michigan Technological University (MTU) archives. In addition, field reconnaissance was conducted to examine the nature and extent of the tailings along the western shore of Torch Lake. The information obtained through these activities is summarized in this memo. A discussion of the types and sources of tailings along the western shore of Torch Lake is included. Based upon this information, these tailings were assigned to sectors which reflect homogeneity of tailings type and source. The area of each sector, and the number of samples and their locations within each sector were mapped on air photos. A bibliography of the most useful references obtained from MTU is also included.

Schedule

Monday (7/17): Travel to Houghton, Michigan.
Donohue personnel begin archive search at MTU.

Tuesday (7/18): Continue archive search at MTU.

Wednesday (7/19): Complete archive search at MTU.
Conduct field reconnaissance of northernmost tailings at Lake Linden.

Thursday (7/20): Complete field reconnaissance of tailings along the entire length of Torch Lake's western shore.

Friday (7/21): Consolidate findings, review for data gaps.
Depart Houghton, Michigan, travel to Sheboygan, Wisconsin.

General

The history of copper mining in this region and subsequent deposition of tailings in Torch Lake, spans a period of approximately 100 years, from the late 1860's to the late 1960's. The copper mined was found in conglomerate and amygdaloid forms. Conglomerate is formed by compaction and cementation of river-deposited gravel, with copper in interstitial spaces. Amygdaloid is derived when vesicles formed in cooling lava become filled with copper.

Once mined, the ore was transported to mills along the western shore of Torch Lake (Figure 1) where the ore was crushed (or stamped). The copper and crushed rock were separated by gravimetric sorting in which the difference in specific gravity between the copper and the crushed rock permitted the copper to be concentrated and extracted. The waste sands (tailings) produced from these operations were discarded, typically by pumping into Torch Lake. Values equal to one-fourth of the total copper were lost in the waste sands.

Beginning about 1916, spurred by war time economy and advances, in metallurgy, the tailings were dredged from the lake, screened, recrushed, and gravity separated at one of three reclamation plants. From oldest to youngest these plants included the Calumet and Hecla (1916), the Tamarack (1925), and the Quincy (1943) (Figure 1). At these plants, an ammonia leaching process was used to recover copper from conglomerate tailings, and a flotation process was used to extract copper from both conglomerate and amygdaloid tailings.

The leaching process involved the dissolution of metallic copper in a cupric ammonium solution containing an excess of ammonium carbonate. With the copper dissolved as either cuprous or cupric ammonium carbonate, steam distillation was employed to cool and condense the carbon dioxide and ammonia, thereby facilitating recovery of the copper. Leaching accounted for 40 percent of the copper reclaimed from the original stamp sands.

The flotation process involved agitation of ore, water, oil, and chemicals to produce a froth, supporting copper-bearing particles. Typical reagents consisted of 50 percent coal tar, 15 percent pyridine oil, 20 percent coal tar creosote, and 15 percent wood creosote. In 1926, xanthates were introduced. Prior to the use of xanthates, only conglomerate tailings were treated by flotation. Approximately 0.05 pounds of potassium and sodium xanthate were used per ton of ore in combination with 0.15 pounds of pine oil per ton of ore. Pine oil contained wood creosote. Flotation accounted for 10 percent of the copper reclaimed in the original stamp sands.

After reclamation, the chemically treated tailings were returned to Torch Lake. The present location and extent of the tailings presumably reflects the final placement after processing by the respective reclamation plants.

The following discussion stems directly from maps and descriptions found in the MTU archives, as well as from field reconnaissance. During field reconnaissance the location and extent of the tailings, as well as other notable features, were mapped on air photos (Figures 2 through 6). Tailings were then assigned to sectors as indicated on the air photos and Figure 7. Each sector

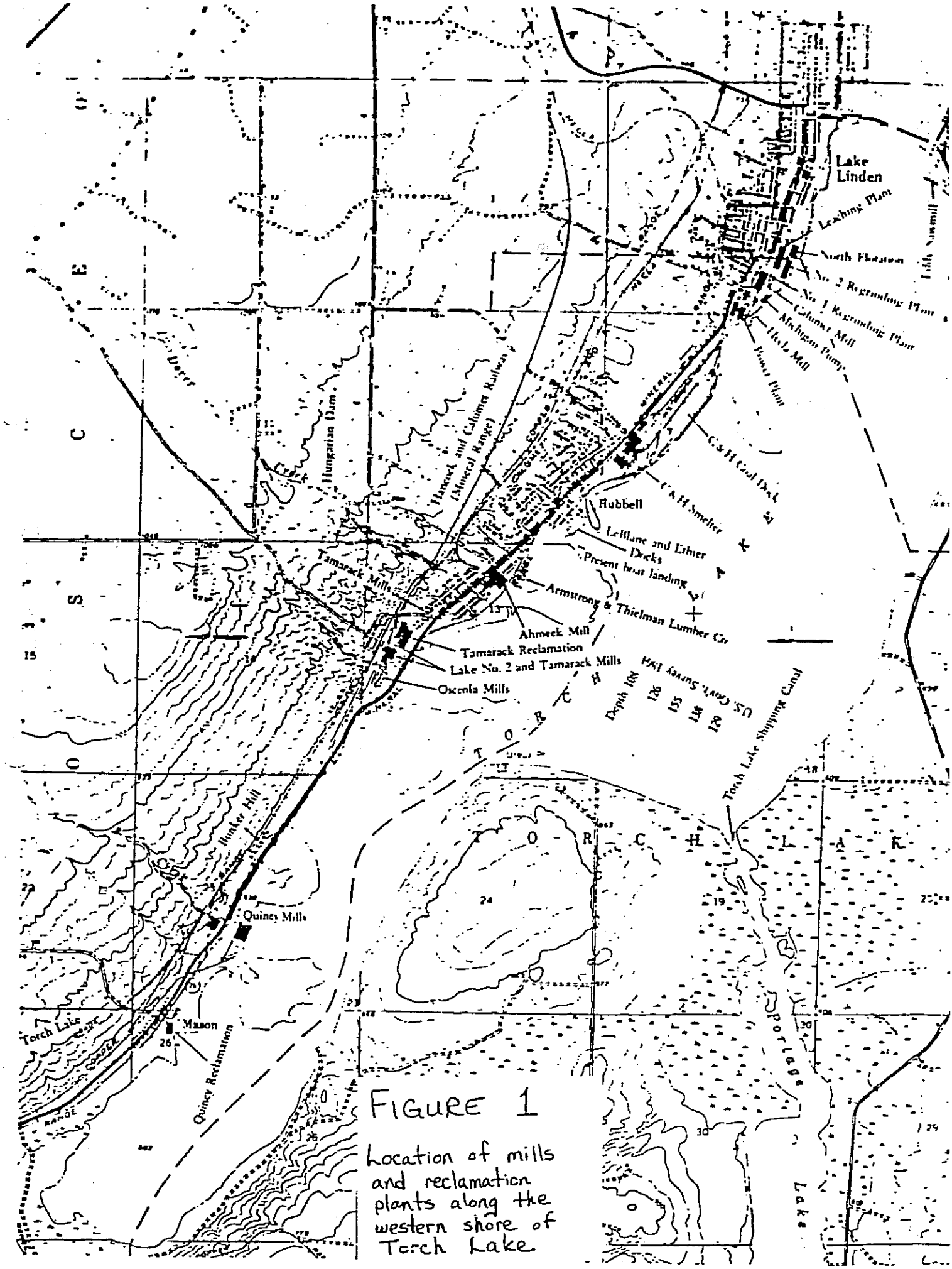


FIGURE 1

Location of mills and reclamation plants along the western shore of Torch Lake

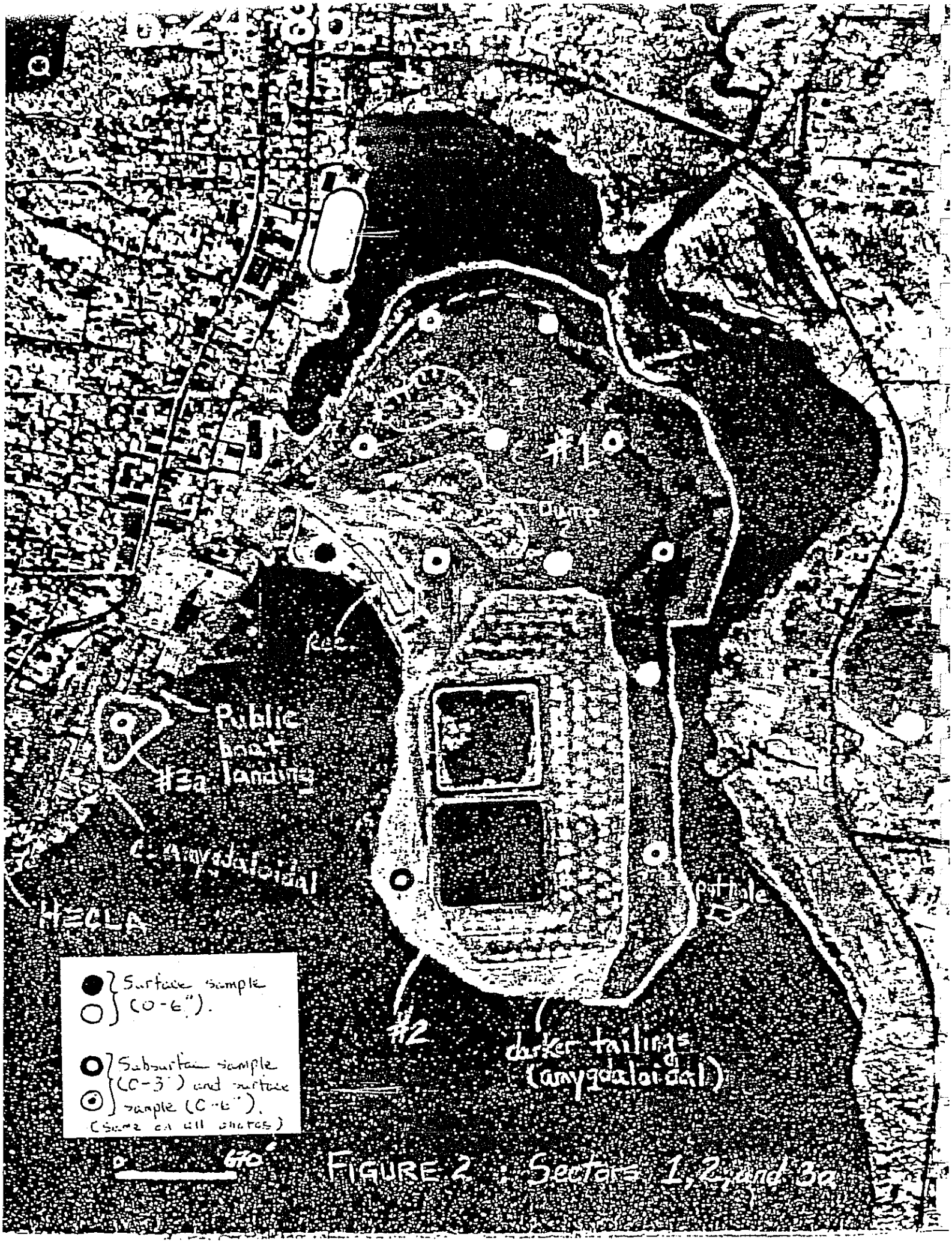


FIGURE 2 : Sector 1, 2, and 3a

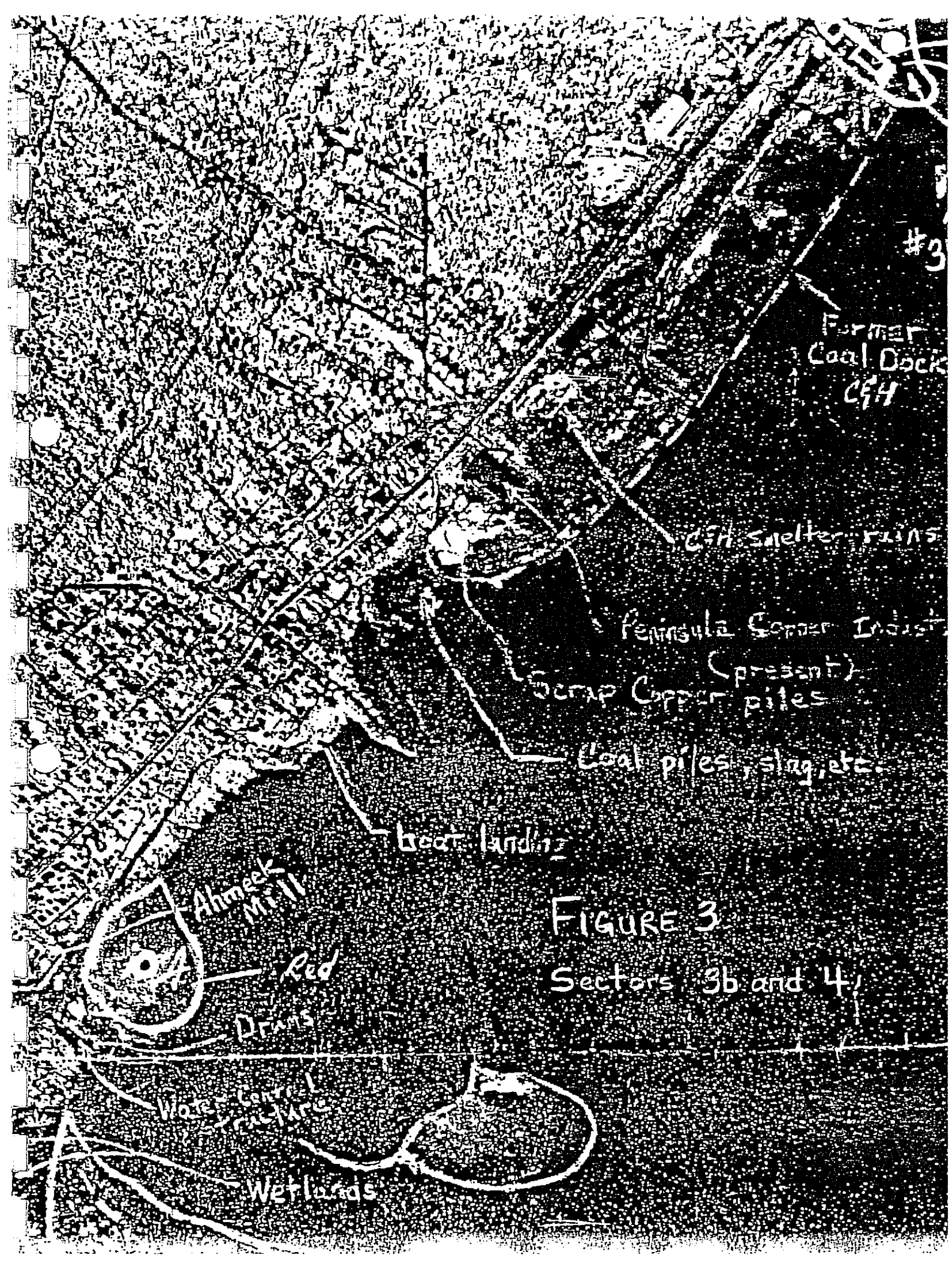
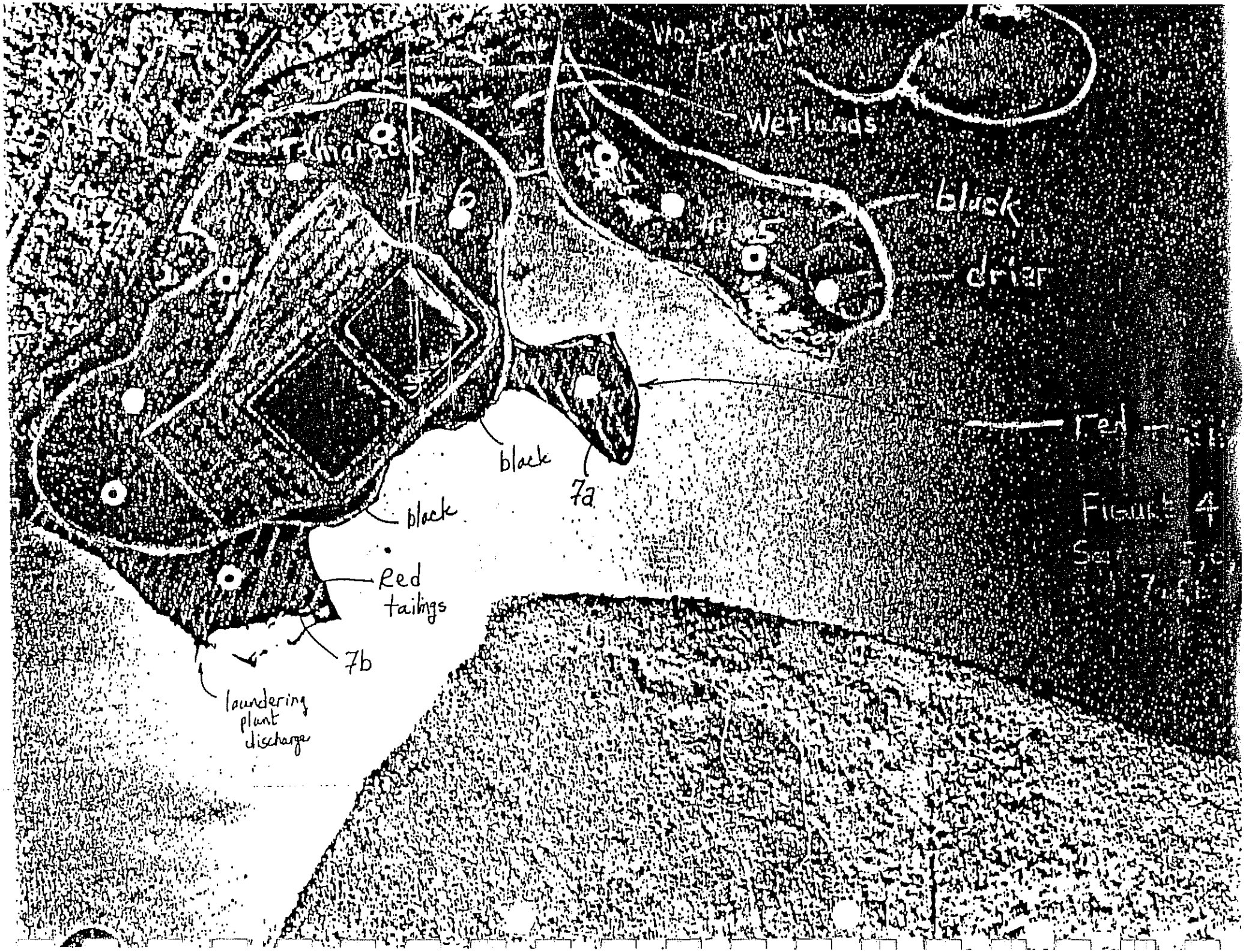


FIGURE 3

Sectors 3b and 4


Wetlands
black
dried
red mud
black
7a
black
red
tailings
7b
laundering
plant
discharge