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DEPARTMENT OF ENVIRONMENTAL QUALITY
REMEDIATION AND REDEVELOPMENT DIVISION
CALUMET FIELD OFFICE
CALUMET, MICHIGAN

DRAFT
Technical Memorandum for:

Compilation and Interpretation of Key Historic Studies Abandoned Mining Wastes - Torch Lake non-Superfund Site – C&H Tamarack City Operations Area (Site ID # 31000098) Houghton County, Michigan

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INTRODUCTION

Weston Solutions of Michigan, Inc. (WESTON®) has prepared this Compilation and Interpretation of Key Historic Studies Technical Memorandum to document previous studies and investigations that will be used in the development of the *Draft Sampling and Analysis Plan for the Abandoned Mining Wastes Torch Lake Non-Superfund Site – Calumet and Hecla (C&H) Tamarack City Operations Area, Houghton County, Michigan (SAP)* to be prepared by WESTON.

The technical memorandum has been prepared in accordance with the *Scope of Work, Schedule, and Budget Estimate - Abandoned Mining Wastes – Torch Lake non-Superfund Site, C&H Lake Linden Operations Area, Houghton County Michigan, December 16, 2013* and the subsequent *Scope of Work, Schedule, and Budget Estimate for Modification 1 (July 2014)* prepared by WESTON in response to requests from the Michigan Department of Environmental Quality (MDEQ), Remediation and Redevelopment Division, under the Indefinite Scope, Indefinite Delivery (ISID) Professional Services contract between WESTON and the MDEQ (Contract No. 00477).

PROJECT OBJECTIVES

The Torch Lake Non-Superfund (NS) Site (Site) is characterized by the risks posed by chemical containers and residues historically discarded in or near Torch Lake. These concerns are distinct and separate from the risks historically addressed under the U.S. Environmental Protection Agency's (EPA's) Superfund program. The EPA defines the Torch Lake Superfund Site as the upper six inches of stamp sand and slag in certain areas of Houghton County and any soil cap and vegetative cover applied to such areas.

The remaining concerns at Torch Lake and the surrounding areas identified by the MDEQ include known or suspected impacts to groundwater, surface water, sediments, and upland media that were not addressed under the Superfund program. Environmental impacts that will be evaluated under the Site SAP include, but are not limited to the assessment of the following:

- Unidentified, significant in-lake and/or terrestrial sources of contamination including polychlorinated biphenyls (PCBs);
- Uncharacterized waste deposits, including more than 750 uncharacterized drums, reportedly, on the lake bottom;
- Bulk disposal areas, including stamp sand deposits, slag dumps, and landfills; and,
- Industrial ruins including coal storage areas, underground storage tanks (USTs), suspect asbestos containing materials (SACM), and any other waste materials identified in future investigations.

The risks posed to environmental media, sediment in particular, by these waste deposits and continuing sources of contamination contribute to the limited recovery of the Torch Lake ecosystem. As such, the investigation will be largely driven by documented observations of drum and/or other debris locations in the lake as well as consideration related to historic operations and detected PCB concentrations.

The objectives of the Torch Lake NS project are to support a comprehensive management approach that will guide MDEQ's decision making process in addressing risks present in the region. In 2014, these risks were identified and evaluated in the C&H Lake Linden Operations Area. The evaluation of these risks will continue in 2015 in the C&H Tamarack City Operations Area presented on **Figure 1**. The primary focus of this portion of the project is to ascertain the source, nature, and extent of contaminants (including PCBs) in all affected environmental media (soil, groundwater, surface water, waste materials, and sediments) within Torch Lake, including former industrial areas along the shoreline, summarized as follows:

- Ahmeek Stamp Mill Complex;
- Osceola Township Park;
- Tamarack Reclamation Plant Complex;
- Tamarack Stamp Mill Complex;
- Osceola Stamp Mill; and,
- Historic Municipal Dump.

The former industrial areas summarized above are presented on **Figure 2**.

SITE BACKGROUND

Hard rock mining operations were prevalent throughout Houghton and Keweenaw Counties for nearly a century, primarily spanning an era between the mid-1800's and the mid-1900's. As mining activities declined in the region, a majority of the mine holdings, including surface and underground operations were abandoned, scrapped, and remnants otherwise left in-place.

The Torch Lake NS Site includes properties remote from Torch Lake proper, such as the 270+ acre Centennial Mine just north of Calumet, the Michigan Smelter, Freda/Redridge, the Tamarack City industrial ruins, Mason- Quincy Mill & leach plant, and other areas congruent with the Torch Lake Superfund site where the response action has been limited to the application of the vegetative cover or eliminating the area from further consideration.

The vast distribution of these former mining operations throughout the region (spanning several townships, villages and cities in Houghton County along the Portage Canal, Lake Superior, Slaughterhouse Creek, and Torch Lake) required that operational areas of the mining companies be divided into geographic subsets, allowing for prioritization by geography/location and establishing a phased approach for assessing and addressing environmental concerns regionally.

The C&H Tamarack City Operations Geographic Area encompasses the former C&H Mining Company copper mining and processing operations in the vicinity of Tamarack City, Michigan. Industrialization of the C&H Tamarack City Operations Area was initiated with the construction

of several facilities between 1887 and 1908. These facilities included the construction and operation of the Osceola Stamp Mill, the Tamarack Stamp Mill, the Lake Stamp Mill No.2, and the Ahmeek Stamp Mill which were owned and operated by separate mining companies. Beginning in a timeframe around 1910, C&H gradually gained controlling interests in these operations. By the 1920s and 1930s milling operations ceased at several of the facilities while others, such as the Ahmeek Stamp Mill, were renovated or improved to meet the demands of the mining operations in the region. In a similar timeframe the Tamarack Reclamation Plant Complex was constructed for the processing of stamp sands recovered from Torch Lake (initially deposited in the lake as waste material by the aforementioned Osceola, Tamarack, Lake, and Ahmeek mills). Wastes generated by the operation of the reclamation plant, including re-grinded stamp sands, were discharged to Torch Lake for disposal. The C&H Tamarack City Operations Area and the conceptual geographic boundaries of each study area are presented on **Figure 2**.

SITE LOCATION AND DESCRIPTION

The C&H Tamarack City Operations Area consists of approximately 110 acres of land extending approximately three miles along the shoreline of Torch Lake. The geographic area also incorporates up to 187 different parcels with multiple property owners. Building on the organization of the Preliminary Assessment completed by the MDEQ in November 2012, the C&H Tamarack City Operations Area was divided into three smaller study areas based on the historical industrial operations in each area. The investigative areas and their respective former industrial sites are summarized as follows:

- Ahmeek Mill Processing Area
  - Ahmeek Stamp Mill Complex
    - Ahmeek Stamp Mill;
    - Ahmeek Pump House;
    - Ahmeek Power House;
    - Ahmeek Boiler House; and,
    - Observed SACM documented by the MDEQ
- Tamarack Processing Area
  - Tamarack Reclamation Plant Complex
    - Tamarack Regrinding Plant;
    - Tamarack Electric Substation;
    - Tamarack Floatation Plant;
    - Tamarack Leaching Plant; and,
    - Tamarack Classifying Plant.
  - Tamarack Stamp Mill Complex
    - Tamarack Stamp Mill No.1; and,
    - Lake Stamp Mill No.2 (Tamarack Stamp Mill No.2).
  - Osceola Stamp Mill.

- Tamarack Sands Area
  - Stamp Sand Deposit; and,
  - Historic Municipal Dump.

APPLICABLE REGULATORY CRITERIA

Evaluation of potential environmental and human health risks present in the C&H Tamarack City Operations Area requires that analytical results are uniformly compared to regulatory criteria. Previous investigations in the geographic area had specific goals and objectives that may have placed emphasis on evaluating specific locations, environmental media, or chemical analytes, intentionally narrowing the scope of each investigation. In addition, to the constraint of focused objectives, these investigations are also prone to common limiting factors such as funding, personnel, and equipment resources. As such, the findings of a given investigation are also limited, potentially providing a compartmentalized view of a larger, more prolific problem.

Similar to limitations identified above, the findings and interpretation of each investigation were also contingent upon the selected regulatory criteria utilized in the evaluation. Over the course of time, regulatory criteria are refined and subject to change, often including criteria revisions and new rule promulgation. As a result, regulatory criteria for a specific exposure pathway and environmental medium evaluated in 2002 may have been evaluated differently using the same regulatory criteria in 2013.

In support of developing a comprehensive approach for evaluating risks, the analytical results from previous investigations summarized herein were compiled and compared to the same regulatory criteria. Consistent with this approach, the same regulatory criteria will be used to evaluate the findings derived from implementation of the SAP. The following provides a summary of the regulatory criteria utilized for evaluating analytical results from surface soil, subsurface soil, groundwater, sediment, and surface water during interpretation of the identified key documents:

- Part 201 of Michigan's Natural Resources and Environmental Protection Act (NREPA), being Public Act (PA) 451 of 1994, as amended Residential and Non-Residential Cleanup Criteria for Response Activity (December 30, 2013).
  - Surface Soil;
  - Subsurface Soil; and,
  - Groundwater.
- EPA, Resource Conservation and Recovery Act (RCRA), Identification and Listing of Hazardous Waste Criteria (40 Code of Federal Regulations, Part 261, Subpart C).
  - Abandoned Containers; and,
  - Waste Materials.

- EPA, National Emission Standards for Hazardous Air Pollutants (NESHAP).
  - Suspect Asbestos Containing Materials (SACM).
- EPA, RCRA Ecological Screening Levels (ESL) (August 2003).
  - Surface Water; and,
  - Sediment.
- MDEQ – Rule 57 Water Quality Values, Surface Water Assessment Section (February 2014).
  - Surface Water.
- Sediment Quality Guidelines, Threshold Effect Concentrations (TECs) and Probable Effect Concentrations (PECs), MacDonald, et al, 2000.
  - Sediment.

The establishment of baseline criteria is critical to SAP development as well as the future assessment of findings related to the Site. It should be noted that the figures included in this technical memorandum have been prepared using the criteria summarized above; however the conclusions from each of the investigations summarized in the document narratives have not been modified, thus preserving the objectives and findings of the original documents.

SAP DEVELOPMENT

Screening and sample analytical data from previous investigations will be incorporated into the sample design. By doing so WESTON will be able to identify potential data gaps, while considering the recommendations in each document and available screening and analytical results for soil, groundwater, and sediment from the investigations.

As discussed in the preceding subsection, results derived from individual investigations limit interpretation, particularly as it relates to the presence of potential source areas, localized concentrations of contaminated media, and potential exposure routes. As such, analytical and screening results compiled from the key documents summarized in this document were also integrated into the project database. The result creates a more comprehensive look at the historical findings at the Site while also reducing the potential for redundant sampling activities. The historical analytical and screening results at the Site are presented on multiple figures summarized as follows:

- **Figure 1** Site Location Map
- **Figure 2** Geographic Area Map
- **Figure 3a** Soil Sample Location Map – Ahmeek Mill Processing Area

- **Figure 3b** Soil Sample Location Map – Ahmeek Mill Processing Area
- **Figure 4a** Soil Screening Location Map – Ahmeek Mill Processing Area
- **Figure 4b** Soil Screening Location Map – Ahmeek Mill Processing Area
- **Figure 5** Groundwater Sample Location Map – Ahmeek Mill Processing Area
- **Figure 6** Sediment Sample Location Map – Ahmeek Mill Processing Area
- **Figure 7a** Soil and Waste Sample Location Map – Tamarack Processing Area
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- **Figure 9** Groundwater Sample Location Map – Tamarack Processing Area
- **Figure 10** Soil Sample Location Map – Tamarack Sands Area
- **Figure 11** Soil Screening Location Map – Tamarack Sands Area
- **Figure 12** Sediment Sample Location Map – Tamarack Sands Area
- **Figure 13** PCB Congener Detections – SPMD and Fish Tissue Sampling Locations

The volume of analytical data derived from the historical documents and presented on the aforementioned figures required the use of graphical and analytical details to simplify the overall presentation of the data. With the exception of soil screening results presented on **Figure 4a**, **Figure 4b**, **Figure 8a, Figure 8b**, and **Figure 11**, the following graphics were used to present the analytical results:

- **Green Dots** – A sample location that is typically unlabeled to reduce overcrowding of the figure, these dots represent a sampling or screening result that was below the figure criteria. Green dots may be derived from any of the historical investigations.

- **Red Dots** – A sample location labeled with a callout box that lists the sample identification, the sample interval, and the sample date. These dots represent an exceedance of figure criteria, a summary of which is presented in the corresponding callout box.

- **Yellow Dot/Ring** – A sample location represented by a yellow dot indicates that it was analyzed for PCBs and no congeners were detected. A green or red sample location surrounded by a yellow ring, indicates the same; the sample was analyzed for PCBs and no congener was detected.

- **Light Blue Dot/Ring** – A sample location represented by a light blue dot means that it was analyzed for PCBs and at least one congener was detected (recall that if PCBs exceeded criteria the dot would be red). A green or red sample location surrounded by a blue ring, indicates the same; the sample was analyzed for PCBs and at least one congener was detected (if PCBs exceeded criteria they would be listed in the callout box)

KEY DOCUMENT REVIEW AND INTERPRETATION

This Section provides a summary of the key documents selected for review as well as a synopsis of the investigation and conclusions relevant to the development of the SAP.

KEY DOCUMENT IDENTIFICATION AND REVIEW

Numerous investigations have been conducted on and along the shoreline of Torch Lake with various purposes, often specific to a particular property or investigative focus. Although often referenced in individual reports, a comprehensive approach that consolidates the findings of these investigations has not been completed. In support of the development of the SAP for the Torch Lake NS Site key deliverables associated with the C&H Tamarack City Operations Area were selected to assist in the identification of historic areas of contamination or data gaps requiring further assessment. The following is a summary of the key documents reviewed during preparation of the SAP:

- *Baseline Environmental Assessment of Tamarack Stamp Mill in Osceola Township, Portions of Section 13, T55N, R33W, Osceola Township, Houghton County, Michigan – November 2001***.** Prepared by U.P. Engineers and Architects, Inc.

- *Brownfield Redevelopment Assessment Report for Tamarack City Stamp Mill, M-26 Highway, Hubbell, Michigan – December 2002.* Prepared by the MDEQ-RRD, Superfund Section, Pre-remedial Group, Site Evaluation Unit (Pre-remedial Group).

- *Draft Technical Memorandum for Tamarack City Stamp Mill Site Analytical Data Review and Evaluation – March 2005.* Prepared by WESTON.

- *Final Report, PCB Study Using Semipermeable Membrane Devices in Torch Lake, Houghton County – March 2006*. Prepared by the Great Lakes Environmental Center.

- *Summary Report for the Torch Lake Area Assessment, Torch Lake NPL Site and Surrounding Areas, Keweenaw Peninsula, Michigan – December 2007*. Prepared by WESTON.

- *PCB Concentrations in Walleye Collected from Torch Lake (Houghton County) and Lake Superior - June 2008*. Prepared by the MDEQ Water Bureau.

- *Aroclor Sediment Investigation, Torch Lake Area of Concern, Houghton County, Michigan – June 2009*. Prepared by the EPA Great Lakes National Program Office (GLNPO).

- *Draft Site Inspection Report for C&H Tamarack Operations, Hubbell, Michigan 49934 – March 2013.* Prepared by the MDEQ-RRD, Superfund Section, Pre-remedial Group.

- *Tamarack Area Facilities, Task 3 – Phase 2 Report, Historical Archive Research and Mapping from Hubbell Beach through Tamarack City, C&H Historic Properties of Torch Lake – October 2014.* Prepared by Michigan Technological University.

- *Removal Action Letter Report, Tamarack Stamp Mill, Osceola Township, Houghton County, Michigan – October 2014.* Prepared by Oneida Total Integrated Enterprises, Inc.

The following subsections summarize the findings of these investigations and the conclusions derived from the performance of each assessment.

Baseline Environmental Assessment of Tamarack Stamp Mill in Osceola Township, Portions of Section 13, T55N, R33W, Osceola Township, Houghton County, Michigan – November 2001

U.P. Engineers and Architects (UPEA) on behalf of Osceola Township conducted a Baseline Environmental Assessment (BEA) at the Ahmeek (Tamarack City) Stamp Mill (Subject Property) in 2001. *Note: The Ahmeek Stamp Mill was owned by the Ahmeek Mining Company and was used to process native copper ore from the Ahmeek Mine located in Keweenaw County.*

The BEA at the Subject Property located in Osceola Township, Michigan was conducted on 19 October 2001 and completed on 8 November 2001. The Subject Property was donated and purchased from Superior Crafts, Inc. Title to the Subject Property was acquired by Osceola Township on 10 September 2001. The purpose of the BEA was to investigate environmental conditions at the Subject Property in accordance with the requirements for a Category N BEA. The scope of work to prepare the Category N BEA included the general definition of possible contamination in surface soils on the Subject Property and conclusions as to the likelihood that other hazardous substances were also present. The BEA was conducted in general conformance with ASTM International (ASTM) Standard E 1527-2000, Phase I Environmental Site Assessment (ESA).

Historical research, sampling activities and the subsequent findings derived from the performance of the BEA are summarized in the following subsections.

Historical Documentation

UPEA conducted a review of Sanborn Fire Insurance maps and a drawing obtained from the University Archives and Historical Collections at Michigan Technological University (Michigan Tech) entitled "*The Native Copper Mining Era of the Keweenaw Copper Country, Lodes and Mining Locations, 1846-1968*" by Tauno Kilpela.

UPEA reported that the Ahmeek Stamp Mill began production in 1910. The 1908 fire insurance map indicated that four residential dwellings occupied the stamp mill footprint prior to its construction. The surrounding area consisted of residential dwellings as well, except for a lumber mill located on adjacent land to the south. The 1917 fire insurance map shows the Ahmeek Stamp Mill in place. A pump house with a steam turbine was present in the 5th Street right-of-way at the end of Spruce Street. The lumber mill was still present;

however, it was not in operation. A lumber warehouse and carpenter shop were present across the south ends of lots 7, 8, 9, and 10, of Block 5. The surrounding area was still residential. The 1928 Sanborn map shows a transformer house located to the southwest of the pump house noted in the 1917 map. This is located in Lot 7 of Block 10. The 1928 map, updated to 1935, shows the addition of a power house north of the pump house. A boiler house was also present farther to the southwest of the pump house. An apparent smoke stack was present adjacent to the boiler house at the southeast corner of Lot 9, Block 10. Two brick storage houses and an electric shop are present on Lots 3,4,5 and 10 of Block 5.

Soil Sampling

UPEA collected five soil samples on 19 October 2001 identified as: Stack, Concrete Floor, Door Jam, Track Turn, and SS Pile. The soil samples were collected via a hand auger and sampling spoon. Soil samples were collected with a stainless steel spoon from the top six inches of soil, where available. Samples collected from the concrete floor and door jam were collected from 0-3 inches (in) below ground surface, due to restricting layers (concrete). All soil samples had concentrations of chemicals of concern (COCs) that exceeded Part 201 Generic Residential Cleanup Criteria. The soil samples had chemical concentrations that exceeded Part 201 Generic Residential Direct Contact, Drinking Water Protection, and Groundwater/Surface Water Interface Protection Criteria.

Discarded or Abandoned Containers

There were no abandoned or discarded containers, above ground storage tanks, or underground storage tanks observed or reported on the Subject Property.

Known Contamination

Contaminated soils were identified at all sample locations, serving as the basis for concluding that the Subject Property is a "facility" as defined in Section 1 (1)(o) of Part 201 Environmental Remediation of the NREPA, 1994 PA 451, as amended.

Because all soil samples were collected from no more than 6-8 in below the existing ground surface, no specific subsurface conditions were investigated. No groundwater samples were collected on-site (groundwater analytical reports were not provided in the BEA).

Brownfield Redevelopment Assessment Report for Tamarack City Stamp Mill, M-26 Highway, Hubbell, Michigan – December 2002

The MDEQ Pre-Remedial Group through a cooperative agreement with the EPA conducted a Brownfield Redevelopment Assessment (BFRA) at the Tamarack City Stamp Mill (TCSM), described in the aforementioned BEA as the Ahmeek Stamp Mill, in June 2002. The BFRA included file and information searches, a reconnaissance inspection of the property, the collection of surficial soil, soil boring, and groundwater samples, and obtaining x-ray

fluorescence (XRF) readings of surface materials. Field activities were conducted between 4 and 5 June 2002 and resulted in the collection of the following:

- The collection of 25 surface soil samples (SS-1 through SS-25);
- The advancement of 10 soil borings (SB-1 through SB-10) and the collection of subsurface soil samples;
- The collection of XRF (soil screening) measurements from 71 locations; and,
- The collection of seven groundwater samples from six temporary monitoring wells.

Analysis of the samples detected the presence of contaminants at concentrations greater than the Generic Residential Cleanup Criteria of Part 201, Environmental Remediation, of the NREPA, 1994 PA 451, as amended. The following subsections summarize analytical results derived from the investigation.

Surface Soil Sampling

Twenty-five (25) surficial soil samples were collected and analyzed. Several semi-volatile organic compounds (SVOCs) exceeded Residential Criteria at five sample locations. These included benzo(a)pyrene, carbazole, fluoranthene, naphthalene, and phenanthrene. Five of the compounds were detected in SS-2; three at SS-1 and SS-18, and only carbazole at SS-3 and benzo(a)pyrene at SS-9. None of these exceeded Industrial Criteria. In addition, thirteen inorganics exceeded criteria. Arsenic, barium, chromium, cobalt, copper, cyanide, lead, manganese, mercury, nickel, selenium, silver, and zinc exceeded Residential Criteria. Some of these were detected at all the locations sampled, except at SS-21 and SS-22. Only arsenic and lead exceeded Industrial Criteria, and only at SS-1, SS-4, and SS-13. No volatile organic compounds (VOCs), pesticides, or PCBs were determined to exceed criteria.

Subsurface Soil Sampling

All samples were collected from the 4-8 feet (ft). core. Eight sample locations contained inorganic constituents that exceeded Residential Criteria, including chromium, cobalt, copper, mercury, selenium, silver, thallium, and zinc. No Industrial Criteria were exceeded. The most contaminated sample was reportedly SB-3. No VOCs, SVOCs, pesticides, or PCBs were determined to exceed criteria

Soil Screening

The MDEQ routinely collected two separate readings at soil screening locations using different radioactive sources. Some readings were collected in association with surficial soil samples, while others were independent readings of concrete and other hard surfaces. Where multiple readings were taken in association with a surficial soil sample, only the highest measured concentration was presented in the data summary tables.

Groundwater Sampling

All temporary monitoring well samples were collected utilizing teflon tubing and a peristaltic pump. Eight inorganics were determined to exceed Residential Criteria. These included barium, beryllium, copper, lead, manganese, mercury, selenium and vanadium. TMW-6 contained the most exceedances of inorganics. TMW-5 exceeded criteria for copper and selenium, while the rest of the locations only exceeded criteria for copper. No industrial Criteria were exceeded. No VOCs or SVOCs, pesticides or PCBs were determined to exceed criteria in groundwater sampled. Groundwater flow was determined to be to the south/southeast, towards Torch Lake.

Consistent with the 2001 findings by UPEA, the MDEQ determined that the property meets the definition of a facility. The MDEQ recommended that several issues be addressed before, or during the redevelopment of the TCSM property. These included 1.) the mitigation of direct contact and particulate soil inhalation risks in shallow soils and on some hard surfaces; 2.) an evaluation of the existing local ordinance that prohibits the drinking of groundwater at the TCSM; 3.) taking appropriate measures to address trip and fall safety concerns; and, 4.) taking actions to minimize further impacts to the groundwater that may exacerbate environmental effects in Torch Lake. In addition, any responsibilities that may be present under Part 201, such as due care (Section 20107a), should be considered.

Draft Technical Memorandum for Tamarack City Stamp Mill Site Analytical Data Review and Evaluation – March 2005

WESTON conducted an analytical data and file review for the TCSM property in March 2005. The review was used to assess the nature of chemical hazards in surficial soil to potentially be addressed during the interim response (IR) activities, and to evaluate additional Site investigation needs after the IR has been completed.

The documents used for the analytical data review were the BEA conducted by the UPEA and the BFRA conducted by the MDEQ. The analytical data was compared to current (2005) MDEQ Part 201 Residential and Commercial I Direct Contact Criteria (DCC) and Particulate Soil Inhalation Criteria (PSIC). The DCC and PSIC exposure pathways were contemplated during this data review as these were considered to be the most likely routes of exposure to future occupants/visitors to the Site. Specifically, these two exposure pathways were considered most relevant based on the following rationale:

- DCC – The anticipated future use of the property was assumed to be a historic park. Contact with surficial materials and structures by visitors was expected. If DCC issues existed, measures would be necessary to minimize contact.

- PSIC – The anticipated future use of the property was assumed to be a historic park, inhalation of surface particles was expected to be probable because the ground surface consisted of loose soils which could be easily airborne. If PSIC issues existed on-site, measures would be necessary to minimize exposure.

After reviewing the analytical data, it was evident that surface soils and standing structures were the main media of concern at the Site. This determination was based on contaminant concentrations at the surface above DC and PSI criteria. While limited XRF readings were collected for concrete rubble piles and standing structures, it did not appear that concrete surfaces had been sampled for laboratory analysis. Based on Site visits performed to date, the concrete rubble piles appear to meet the definition of "inert" according to Part 115, Solid Waste Management, of the NREPA, 1994 PA 451, as amended. However, not all of the concrete surfaces in the rubble piles were exposed to allow for visual inspection. Therefore, WESTON assumed the concrete rubble piles would be treated as "inert" material for the purposes of the IR unless newly exposed (during the IR) concrete surfaces within the rubble piles suggest otherwise due to the presence of surface coatings. If newly exposed concrete rubble surfaces suggest the material is "non-inert", sampling of the material should be performed and/or the material should be segregated from the "inert" material and either remain on site or be disposed of properly.

Final Report, PCB Study Using Semipermeable Membrane Devices (SPMD) in Torch Lake, Houghton County – March 2006

The MDEQ contracted Great Lakes Environmental Center, Inc. (GLEC) to conduct a contaminant concentration study using SPMDs in Torch Lake, Portage Lake, and the Keweenaw Waterway in Houghton County, and Huron Bay in Baraga County. The intent of the study was to collect data for comparison of PCB residues at the various sites to determine if Torch Lake was a source of PCBs.

SPMDs are passive samplers that can be used as an alternative to the collection and analysis of water samples. One advantage of SPMDs is that they isolate only the truly dissolved portion of these compounds from the water; compound that is adsorbed to particulates, and therefore not bioavailable, is excluded. SPMDs mimic the transfer of dissolved compounds across biological membranes (e.g., gills), effectively concentrating them and allowing the detection of compounds that may be present at concentrations below the analytical method detection level in water samples. At constant temperature and flow velocity, the amount of a particular compound absorbed by an SPMD is linearly proportional to the dissolved concentration of the compound in the water (Booij et al. 2003). The utility of SPMDs for monitoring aqueous residues of PCBs, as well as other low to moderate molecular weight nonpolar organic environmental contaminants, has been repeatedly demonstrated.

SPMDs were deployed at 10 locations (Sites 1-10) in Torch Lake, Portage Lake, and the Keweenaw Waterway in Houghton County, and Huron Bay in Baraga County. None of the SPMD locations were located within the C&H Tamarack City Operations Area. PCBs detected at Sites 2, 5, 7, 8, 9, and 10 were very similar in concentration, congener pattern, and number of congeners. Total PCB concentrations at these sites ranged from 22 to 26 micrograms per liter (µg/L) with nearly identical congeners being detected. Of the 13 to 16 congeners detected at these six sites, 12 were detected at all ten sites. Sites 2, 5, 7, 8, 9, and 10 were all located outside the main basin of Torch Lake.

- Site 2 was upstream of Torch Lake, in the Trap Rock River;

- Site 5 was in the southern basin of the lake, connected to the main basin by only a narrow strait, and partially fed by tributaries;
- Site 7 was located in Portage Lake;
- Sites 8 and 9 were in the Keweenaw waterway; and,
- Site 10 was in Lake Superior.

The MDEQ selected Sites 5 and 7 to determine whether the stamp sands or the old mill near Site 5, and the abandoned equipment near Site 7, were sources of PCBs; the results from this study suggest that there were not. Sites 8, 9, and 10 were chosen to demonstrate background levels of PCBs in the Keweenaw waterway and Lake Superior. The similarity of PCB results for these six sites suggests that PCBs at Sites 2, 5, and 7 were also at background levels.

In contrast, the remaining sites within Torch Lake (Sites 1, 3, 4, and 6) had elevated levels of PCBs, with the highest concentrations and the greatest number of congeners detected at Site 4. Sites 3 and 4 were selected because they were near potential PCB sources, which the results support. The fact that Site 1 (without stamp sands) had elevated levels of PCBs, and Site 5 (with stamp sands) had background levels of PCBs indicates that the stamp sands were not a source of PCBs. Site 6 was representative of the discharge from the lake. Overall, the results demonstrated that the surface water in the main basin of Torch Lake contains elevated levels of PCBs.

Summary Report for the Torch Lake Area Assessment, Torch Lake NPL Site and Surrounding Areas, Keweenaw Peninsula, Michigan – December 2007

In September 2007, the EPA at the request of the MDEQ, conducted assessment activities in the vicinity of Torch Lake. The focus of the assessment was on 17 Areas of Investigation (AOI) identified jointly by the EPA and the MDEQ that were impacted by historical copper mining operations in the Keweenaw Peninsula. The Torch Lake Area Assessment included portions of the Torch Lake NPL Site where stamp sands are the primary media of concern.

The primary project objectives of the Torch Lake Area Assessment were to evaluate imminent threats to human health, welfare and the environment, including the identification of areas for additional investigation. The geographical locations specific to Torch Lake, and pathways evaluated during the assessment were:

- Direct-contact hazards associated with exposed stamp sand and the potential presence of other mining-era related waste along the western shoreline of Torch Lake. At the time of the investigation, the evaluated area included recently exposed shoreline between the edge of the EPA-installed vegetative cover and the water's edge as a result of the significantly lower surface-water levels in Lake Superior and its contiguous water bodies. These previously shallow water areas had not been investigated; and,

- Limited evaluation of potential environmental concerns at abandoned mining-era related industrial buildings, ruins, and land areas proximal to the western shoreline of Torch Lake.

Targeted AOIs relevant to the C&H Tamarack City Operations Area of the Torch Lake NS Site included in the Torch Lake Area Assessment are summarized as follows:

- AOI 19 – Former C&H Leach Plant and Hubbell Stamp Sands;
- AOI 20 – Tamarack City Stamp Mill; and,
- AOI 27 – Drums on Lake Bottom.

A comprehensive assessment of all environmental hazards known to affect historical industrial properties and structures was not within the scope of the assessment; however, the EPA's report provided specific recommendations by AOI for further investigation, maintenance, and or no further action. The following presents the findings related to the aforementioned AOIs derived from the Torch Lake Area Assessment:

- Access was denied to the Former C&H Leach Plant which is currently an operating construction company storage yard. Based on MDEQ sampling at the site, it was recommended that additional investigation be completed to further assess the nature and extent of potential contamination in the vicinity of the complex.

- Surface soil was screened with an XRF unit at 18 locations on the Hubbell Stamp Sands and one sample was collected and submitted for verification via laboratory analysis (HUB-S1-13). Two locations that were screened with an XRF unit exhibited arsenic concentrations greater than Residential Direct Contact Criteria (HUBS1- 08 and HUB-S1-10).

- Identified hazards at the TCSM included the deposition of building debris, including massive concrete structures, metal debris, and rubble on the former mill floor and surrounding grade; the presence of household and solid wastes at various locations of the property; and surface soil samples collected from the site identified several locations where chemical concentrations exceeded Residential DCC and PSIC.

PCB Concentrations in Walleye Collected from Torch Lake (Houghton County) and Lake Superior - June 2008

Torch Lake, Houghton County, is currently listed as a Great Lakes Area of Concern by the EPA, in part because of elevated levels of PCBs in fish. The PCB concentrations in fish collected from Torch Lake have been consistently higher than in fish found in nearby surface water bodies. A fish consumption advisory due to elevated levels of PCBs was first issued for Torch Lake fish by the MDCH in 1998.

The Torch Lake watershed contains elevated levels of PCBs, but the question remained as to whether the watershed is the cause of elevated concentrations in fish. It had been postulated that the elevated concentrations of PCBs in fish caught in Torch Lake may actually represent

exposure to the contaminant in Lake Superior since PCBs are elevated in several species in Lake Superior, and there are no barriers to fish movement between the two water bodies. The elevated PCB concentration in Lake Superior fish is believed to be due primarily to atmospheric deposition.

Prior to this study, no walleye from Lake Superior in the vicinity of Torch Lake had been analyzed for chemical contamination. The goal of this study was to compare concentrations of total PCBs in walleye collected from Torch Lake (Houghton County) with concentrations in walleye collected from Portage Lake and Huron Bay, Lake Superior. The null hypothesis was that PCB concentrations within Torch Lake fish were no different than in fish collected from Portage Lake and nearby waters of Lake Superior. Walleye were collected from Huron Bay, Lake Superior, in April 2006 and from Torch Lake and Portage Lake in April 2007. In general, the study included the following findings:

- The length ranges of walleye collected from all three locations were equivalent.
- Total PCB and lipid-normalized total PCB concentrations in Torch Lake walleye collected in 2007 were equivalent to the concentrations in walleye collected in 2000.
- Total PCB and lipid-normalized total PCB concentrations in walleye collected from Torch Lake were higher than concentrations in walleye collected from Huron Bay, and the data suggest that walleye from the two areas represent distinct groups.
- Total PCB concentrations in Portage Lake walleye appear similar to the concentrations in walleye collected from Huron Bay, but the comparisons are weak due to a small Portage Lake sample.
- The MDCH fish consumption advisories for Torch Lake and Portage Lake walleye are unlikely to be relaxed based on the total PCB concentrations measured in the 2007 samples.

The higher total PCB concentrations and different congener composition in the Torch Lake walleye as compared to the Huron Bay walleye are consistent with the sediment and surface water studies indicating that there is a source of PCBs in the Torch Lake watershed. It seems likely that the walleye collected in Torch Lake are in the lake for extended periods of time and that the elevated concentrations of PCBs measured in those fish are a result of sources within the Torch Lake watershed over and above atmospheric inputs.

Aroclor Sediment Investigation Torch Lake Area of Concern, Houghton County, Michigan – GLNPO - 2009

The objective of this study was to evaluate surficial sediments throughout Torch Lake to determine if there are areas of higher PCB concentrations that might indicate a terrestrial and/or aquatic source of PCBs. The report summarizes the results of the 2008 sediment sampling event and provides some context for those results. In addition, the data evaluation presented

incorporated the results of the 2007 sampling efforts completed by the MDEQ and the EPA GLNPO.

Eighty surficial sediment samples, along with 9 duplicate samples were collected between 26 and 28 August 2008. All sample locations were randomly selected prior to mobilization of the EPA's research vessel, *Mudpuppy,* to the lake. The locations were reviewed and discussed with both MDEQ and the Torch Lake Public Advisory Council (TLPAC).

Of the eighty nine samples collected and analyzed, only two had detectable concentrations of PCBs, sample TL08-75 (90 micrograms per kilogram [µg/kg]) and TL08-76 (26 µg/kg). Both TL08-75 and TL08-76 were in the vicinity of the samples collected in 2007 that had detectable concentrations of PCBs in the top 1-2 inches of sediment. The 2007 data from this area ranged from a low of 130 µg/kg to 1,100 µg/kg (MDEQ 2008a). The 2007 sampling event did identify subsurface concentrations of PCBs ranging from 180 µg/kg to 8,900 µg/kg in samples ranging from 6 inches to 64 inches below the sediment surface. Combining the two data sets results in a detectable range of PCB concentrations from a low of 26 µg/kg to a high of 1,100 µg/kg.

Draft Site Inspection Report for C&H Tamarack Operations, Hubbell, Michigan 49934 – March 2013

Under the authority of a cooperative agreement between the MDEQ and the EPA, the MDEQ's Pre-Remedial Group conducted assessment activities in the C&H Tamarack City Operations Area in November 2012. The MDEQ completed the assessment activities under an approved work plan dated 2 November 2012. The Site Inspection (SI) field work was completed between 5 and 8 November 2012. The findings were documented in a draft report prepared by the MDEQ that details the completed investigative activities, analytical findings, and demographics for the C&H Tamarack City Operations Area.

The investigation was prompted by historical findings documenting that source areas exist and releases to the environment have occurred at the properties within the C&H Tamarack City Operations Area. The MDEQ concluded that the results from historical investigations demonstrated that soil and groundwater contamination pose risks to the surface waters of Torch Lake.

The scope and objectives of the SI were designed to meet the investigative requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 105 to provide sufficient data for National Priorities List (NPL) or No Further Remedial Action Planned (NFRAP) decisions and/or to support the need for time-critical or non-time-critical actions. The performance of the SI included interviews with local residents; reconnaissance inspections of the properties; installation of temporary groundwater monitoring wells; collection of soil, groundwater, surface water, and sediment samples; and documentation of Site conditions. Four migration pathways of concern were discussed in the report and included groundwater, surface water, soil, and air.

Soil

Analysis of the surficial soil samples revealed the presence of SVOCs, inorganic analytes, and PCB compounds as observed releases. The MDEQ concluded that all the samples collected during the SI contained contaminants at high enough concentrations to be considered observed releases. Analysis of the soil boring samples revealed the lack of any obvious waste.

The MDEQ utilized an XRF to screen surface soils during the implementation of the SI. XRF screening documented many areas where inorganic contaminant concentrations exceeded applicable criteria. XRF screening results were not used to determine observed releases as are the surficial soil samples that were analyzed at the laboratories. Instead, the XRF screening results were compared to appropriate direct contact and soil protection criteria to aid in the determination of the extent of surficial soil contamination.

Groundwater

Analysis of the groundwater monitoring well samples revealed the presence of arsenic, copper, iron, and manganese at concentrations significantly above background. Observed release samples were limited to samples TMW-02 and TMW-03, located in the vicinity of the former leach plant. No observed release was determined to be associated with sample TMW-05.

The MDEQ concluded that this contamination in the groundwater is attributable to the Site because arsenic and copper in particular were detected in high concentrations in contaminated soils and source areas. This contamination is documented to include much of the area that includes the remains of the three buildings that were part of the former reclamation plant.

Surface Water and Sediment

Surface water and sediment were not sampled during the SI. The reason for this is that Torch Lake Superfund Site stamp sands are located between the C&H Tamarack Operations Site *(as defined by MDEQ during the SI)* and Torch Lake. These stamp sand wastes, and any other wastes associated with the stamp sands, were generated at the C&H Tamarack Operations Site *(as defined by MDEQ during the SI)* and directly deposited into Torch Lake by C&H. The presence of these wastes in Torch Lake is documented evidence by direct observation of an observed release to the surface water pathway.

The MDEQ determined that contaminants are likely entering the lake from contaminated soil source areas and from waste piles on land, leaching through coarse-grained soils into groundwater, and discharging to the lake. The ground surface topography is sloped steeply towards Torch Lake and this also causes the groundwater gradient to be sloped similarly towards the lake. Groundwater contaminants, especially copper, have been documented in the shallow groundwater just northwest of M-26, where groundwater was also documented to be flowing towards Torch Lake. In addition, the MDEQ noted that past operations at the Site have been documented to deposit stamp sands and related wastes directly into Torch Lake. The presence of these wastes in Torch Lake adjacent to the Site is documentation by direct observation of an observed release to the surface water pathway.

Air

A release of potential contaminants to the air was not documented during the investigation of the Site; however, the MDEQ believes that potential releases to air exist. Significant surface waste and soil contamination have been documented making the surface soil subject to wind erosion potentially allowing particulates to become airborne and respirable.

Tamarack Area Facilities, Task 3 – Phase 2 Report, Historical Archive Research and Mapping from Hubbell Beach through Tamarack City, C&H Historic Properties of Torch Lake – October 2014

As a component to a broader scope of work, Michigan Tech provided background historical information associated with C&H's Tamarack City Operations. Geo-referenced Sanborn Fire Insurance Maps and structure coordinates were provided and incorporated into the project database. In addition to geo-referenced maps, Michigan Tech also provided archival blueprints for several of the facilities within the proposed investigation area. These references to historical structures and operations will be incorporated into the SAP, allowing the investigation to target specific operations and potential sources, minimizing the amount of approximation needed to located a given structure. Coordinates and/or structural and operational details related to the following structures were provided by Michigan Tech:

- Ahmeek Mill Facilities;
  - Ahmeek Stamp Mill;
  - Ahmeek Pump House;
  - Ahmeek Power House;
  - Ahmeek Transformer House; and,
  - Ahmeek Boiler House.
- Tamarack Reclamation Plant;
  - Tamarack Regrinding Plant;
  - Tamarack Electric Sub-station;
  - Tamarack Classifying Plant;
  - Tamarack Flotation Plant;
  - Tamarack Leaching Plant;
  - Lake Chemical Company; and,
  - Tamarack Stamp Mill.
- Lake Milling, Smelting, and Refining Company;
  - Stamp Mill No. 2.
- Osceola Stamp Mill; and,
- Mutual Water Light and Company Pump House.

Removal Action Letter Report, Tamarack Stamp Mill, Osceola Township, Houghton County, Michigan – October 2014. Prepared by Oneida Total Integrated Enterprises, Inc. (OTIE)

The MDEQ requested EPA assistance in addressing identified asbestos containing materials (ACM) at the TCSM as it posed a potential threat to nearby residents and users of the adjacent public park. In response to this request EPA performed a Site Assessment on 5 July 2013, 11 July 2013, and 10 September 2013. The Site Assessment included the collection of bulk samples to determine potential threats posed by conditions at the TCSM. Based on the results, six of the twelve samples were determined to contain asbestos. Site assessment samples D1-1, D2-1, D3-1, and D4-2 each showed results of 5-10 percent (%) Chrysotile. Sample P1 was determined to have 1-5% Chrysotile, while sample P4 had 10-15% Chrysotile. The analytical results from the Site Assessment and the existing Site conditions indicated a threat of release of hazardous substances to the environment and surrounding properties. As outlined in 40 Code of Federal Regulations (CFR) Section 300.415(b) (2), the TCSM Site met the criteria for a removal action.

The EPA and its contractors, mobilized to the Site in July 2014 to support the removal action. The removal included mobilization, waste sampling and characterization, hazardous and non-hazardous waste consolidation and disposal, health and safety air monitoring, decontamination, and demobilization.

During the week of 28 July 2014, EPA contractors cleared vegetation on the south side of the Site; established work zones; installed fencing along the north, east, and south ends of the Site to improve security and restrict access to the Site; and placed signage on the fence directing visitors to the EPA command post. All debris piles were thoroughly soaked with water using a hydraulic hose. Debris was gathered from inside the foundations and staged adjacent to the pillars. The interior and exterior areas of the foundations were then washed with water using a hydraulic hose. EPA contractors donned level C personal protective equipment (PPE) and removed debris piles from the southeast area of the Site along with the debris removed from the pillars using the Bobcat skid-steer loaders and staged the waste for later disposal. Once the debris was segregated and staged, clean off-site backfill material procured from a local vendor was delivered to the Site. The backfill was placed in the areas of formerly existing debris piles in the southeast portion of the Site and surrounding the pillars.

Large vegetation debris was consolidated into manageable pieces using a chipper/shredder and staged for disposal. ACM debris collected and staged during the removal action was loaded into a double-lined bed of a dump truck for disposal. On 7 August 2014 a total of 4 cubic yards (yd^3) of friable asbestos material was shipped to K&W Landfill in Ontonagon, Michigan for landfill disposal. Sampling locations were determined based on the wind direction and were relocated as the wind direction changed during removal activities. During the entirety of this removal action, at no time did particulate matter and fugitive dust levels exceeded applicable removal action levels. The EPA and their contractors demobilized from the Site on 14 August 2014.

During the removal action, EPA worked with the Osceola Township Supervisor and the National Park Service (NPS) to preserve the historical artifacts at the Site to the extent practicable. Milling

balls, tools, and drill bits were found during performance of the work and transferred to the NPS for preservation.

Correspondence, Narratives, and Analytical Results from Other Studies

In addition, to the findings of the investigations summarized above, WESTON also considered the results derived from other investigations that may have been provided in the form of correspondence or narrative accounts of the sampling events and partial data sets. This information, although not necessarily provided in a complete and final report format, was valuable nonetheless. The following subsections summarize correspondence considered as during SAP preparation.

MDEQ Tamarack City Asbestos Bag Observation - Fall 2014

During a preliminary walk-through of the Ahmeek Mill Processing Area the MDEQ observed a bag in the brush across the street from the basketball court and the Tamarack City Park/Playground. The bag was labeled as asbestos. The bag was photographed and the location recorded so that inspection/investigation of the area may be included in the development of the SAP.

Reported Tamarack City Municipal Dump - Fall 2014

While conducted interviews during the preparation of their historical documentation, Michigan Tech received and account of a historical municipal dump located in the northern portion of the Tamarack Sands Area. Additional inquiry determined that the "Old Tamarack City Dump is lake ward of Spruce Street between 2nd and 3rd Street in Tamarack City. Reportedly, evidence related to dumping in the area is easily identifiable and may include SACM." The approximate location of the historical municipal dump has been recorded so that inspection/investigation of the area may be included in the development of the SAP.

DATA INTERPRETATION AND LINES OF EVIDENCE

The investigative findings summarized in the preceding section individually provide relevant information related to various aspects of the health and long-term management of Torch Lake. The following subsections provide a summary of the how the specific findings will be incorporated into the *Draft Sampling and Analysis Plan for the Abandoned Mining Wastes, Calumet and Hecla (C&H) Tamarack City Operations Area, Torch Lake Non-Superfund Site, Houghton County, Michigan*.

BEA of Tamarack Stamp Mill in Osceola Township, Portions of Section 13, T55N, R33W, Osceola Township, Houghton County, Michigan – November 2001

Historical references, analytical results, and observations documented during the implementation of the BEA will be incorporated into the SAP. Although the sample coordinates were approximated the information provided by the investigation contributed to an understanding of the distribution of contaminants at the TCSM property. The analytical data generated during the

investigation will be used to evaluate the potential presence of terrestrial mining wastes that would be represented by elevated levels of inorganic contaminants.

Coordinates associated with the soil samples collected during the BEA were not provided; therefore, the sample locations were approximated based on the information provided in the BEA. Soil sample locations and the associated analytical results are depicted on **Figure 3a** and **Figure 3b**.

BFRA Report for Tamarack City Stamp Mill, M-26 Highway, Hubbell, Michigan – December 2002

Similar to the BEA, analytical results, and observations documented during the implementation of the BFRA will be incorporated into the SAP. The results of the assessment expanded upon the findings of the BEA, providing additional detail related to the distribution of contaminants in environmental media including subsurface soil and groundwater which were not evaluated as part of the BEA.

Surface and subsurface soil sample locations and the associated analytical results are depicted on **Figure 3a** and **Figure 3b**. Soil screening locations are depicted on **Figure 4a** and **Figure 4b**. Groundwater sample locations and the associated analytical results are depicted on **Figure 5.**

Final Report, PCB Study Using SPMD in Torch Lake, Houghton County – March 2006

Analytical results from the SPMD study will not be directly incorporated into the SAP for the Site. The analytical results were evaluated and compared to the analytical results from the other studies summarized herein. The SPMD results confirm the presence of PCBs in surface waters; however, the study was inconclusive in identifying a specific PCB source within Torch Lake. Further, concentrations of PCBs measured in the SPMD samples were consistent with historical data; demonstrating higher concentrations of PCB congeners in Torch Lake with the highest concentrations being measured in the vicinity of the Site. Analytical results for SPMD samples collected from Torch Lake are presented on **Figure 13**.

Draft Technical Memorandum for Tamarack City Stamp Mill Site Analytical Data Review and Evaluation – March 2005

As outlined in the preceding subsections, analytical results, and observations documented during the implementation of the BEA and the BFRA will be incorporated into the SAP. In addition, recommendations related to the IR and future response activities outlined in WESTON's technical memorandum will also be considered during preparation of the SAP. These recommendations relevant to the TCSM are summarized as follows:

- Collect samples of the surficial material of the standing structures (i.e. concrete and paint) for laboratory analysis of inorganics to verify the XRF readings of the surface materials that may pose a future inhalation/DC risk to occupants and/or visitors.

- Cap the exposed ground surfaces with clay, topsoil or other applicable material to reduce DC and PSI hazards to future Site visitors/area residents. Based on the BFRA and BEA sampling results, these areas are largely limited to the northern and eastern portions of the Site.

- Collect additional groundwater samples using low flow sampling procedures or grab samples with filtering to analyze metal concentrations that are representative of actual groundwater conditions.

Summary Report for the Torch Lake Area Assessment, Torch Lake NPL Site and Surrounding Areas, Keweenaw Peninsula, Michigan – December 2007

The Torch Lake Area Assessment will be used to evaluate surface soil conditions that might be indicative of mining wastes. The assessment included a substantial number of surface soil screening results, recorded using an x-ray fluorescence hand held analyzer, primarily within the Tamarack Sands study area. Soil sampling and soil screening locations derived from the C&H Tamarack City Operations Area during implementation of the Torch Lake Area Assessment presented on **Figure 10** and **Figure 11**, respectively. The analytical data generated during the investigation will be used to evaluate the potential presence of terrestrial mining wastes that would be represented by elevated levels of inorganic contaminants.

PCB Concentrations in Walleye Collected from Torch Lake (Houghton County) and Lake Superior - June 2008

Analytical results from this study will not be directly incorporated into the SAP for the Site. Concentrations of PCBs in fish collected from Torch Lake were considered evidence of an ongoing source of PCBs present in or along the shoreline of Torch Lake. Analytical results for fish tissue samples collected from Walleye taken from Torch Lake in 2000 and 2007 are summarized on **Figure 13**. (*Note: Sample coordinates for tissue samples were not reported, tissue samples were reported by water body only.)* Similarly, analytical results from fish tissue samples collected from northern pike and walleye from Torch Lake in 2013 will be incorporated into the project database once the results are publicly available.

The resulting offshore sampling program was developed with an emphasis in evaluating historical industrial operations at the Site. The investigative sampling locations were positioned to further evaluate environmental conditions along the lake bottom and shoreline of Torch Lake to determine whether contributing sources of PCB contamination may be present.

Aroclor Sediment Investigation Torch Lake Area of Concern, Houghton County, Michigan, EPA – GLNPO - 2009

Sediment analytical results summarized in this document were used to establish baseline conditions in the sediment of Torch Lake. The objective of the investigation, determining whether areas of elevated PCB concentrations may indicate a terrestrial and/or aquatic source of PCBs, tied directly to the objectives of the current investigative activities. The conclusions derived from the report supported the development of both terrestrial and offshore investigative

locations. Sample locations and contaminant concentrations presented on **Figure 6** and **Figure 12** were used to evaluate the presence of existing contamination and determine where data gaps may be present. In addition, land use was also considered to determine where potential unidentified terrestrial sources of contamination may be present or where potential exposure risks were greatest.

The resulting offshore sampling program will be developed to minimize the duplication of previous investigative activities, while also providing results that contribute to a comprehensive understanding of waste and contaminant distribution along the lake bottom.

Draft Site Inspection Report for C&H Tamarack Operations, Hubbell, Michigan 49934 – March 2013

The geographic areas established in the SAP will be generally based on the same geographic areas established during the Pre-Remedial Group's investigation. Specific boundaries, naming conventions, and areas will be modified to fully incorporate the goals and objectives established in the SAP, but the overall intent will be to maintain consistency with the previous investigation to allow for uniform discussion of results and impacts across the defined limits of the Site. The conceptual geographic boundaries of the Site are presented on **Figure 1**.

In addition to incorporating the SI's organizational structure, the analytical and screening results collected from soil and groundwater will also be incorporated into the sample design. Sample locations, screening locations, and contaminant concentrations presented on **Figure 7a** through **Figure 9** were used to evaluate the presence of existing contamination and determine where data gaps may be present.

Removal Action Letter Report, Tamarack Stamp Mill, Osceola Township, Houghton County, Michigan – October 2014. Prepared by OTIE

The removal action completed at the TCSM will be considered during the development of the SAP. Analytical results collected during the Site Assessment established the basis for the removal action, resulting in the removal of identified ACM. Analytical results generated during the course of the removal action included air monitoring and sampling which indicated that particulates were not leaving the limits of the work zone.

The removal action conducted at the Site resulted in the collection and disposal of asbestos contaminated media. Further, the removal action contributed to a comprehensive understanding of disposal practices at the end of mining era operations and the potential for waste distribution along the shoreline of Torch Lake in the vicinity of the former stamp mill.

MDEQ Tamarack City Asbestos Bag Observation - Fall 2014

The observation of the bag labeled asbestos in close proximity to the aforementioned removal action suggests that additional SACM may be present in the vicinity. Further, the observation of the bag confirms that disposal practices at the end of mining era operations created the potential for waste distribution along the shoreline of Torch Lake, and in particular, the vicinity of the

former stamp mill. The location of the bag was considered in the development of the SAP and will be incorporated into the physical inspection and inventory program described in the SAP.

Reported Tamarack City Municipal Dump - Fall 2014

The historical account documented by Michigan Tech related to the location of a historical municipal dump presents environmental concerns due to its close proximity to Torch Lake. The municipal dump is assumed to be present in the vicinity of stamp sands deposited in the Tamarack Sands Area, creating the potential for contaminants present in the waste deposit to leach to Torch Lake and impact surface water and sediment. Further, the reported presence of SACM in the area presents potential physical and inhalation hazards as well as additional insight related to the disposal practices at the end of mining era operations. The location of the historical municipal dump was considered in the development of the SAP and will be incorporated into the physical inspection and inventory and intrusive investigation programs described in the SAP.

CONCLUSIONS AND RECOMMENDATIONS

The evaluation and interpretation of analytical results and findings from previous key investigations was completed to create a baseline understanding of conditions within the C&H Tamarack City Operations Area. The incorporation of these findings into the SAP will minimize redundancies while also creating a more comprehensive approach for assessing potential environmental impacts across the C&H Tamarack City Operations Area and the Torch Lake NS Site.

CONCLUSIONS

The properties in the C&H Tamarack City Operations Area feature vacant land, historical and recreational parks, in mixed residential/non-residential areas within the village of Tamarack City and within the limits of Osceola Township. The contaminants attributable to the Site include SVOCs, PCBs, and inorganic contaminants. Concerns at Torch Lake and the surrounding areas identified by the MDEQ include known or suspected impacts to groundwater, surface water, sediments, and upland media that were not addressed under the Superfund program. Further, the analytical and screening results indicate that inorganic contaminants are present in environmental media in excess of Part 201 of Michigan's NREPA, being PA 451 of 1994, as amended Residential and Non-Residential Cleanup Criteria for Response Activity.

The analytical results from these key investigations will be used in the characterization of the within the Tamarack City Operations Area, but will also contribute to the horizontal and vertical placement of the proposed sampling locations in the conceptual study areas that will be defined in the SAP.

The activities, operations, and wastes related to the former industrial areas identified within the C&H Tamarack City Operations Area will be researched and documented. Terrestrial and underwater surveys will be conducted to identify potential drum and waste deposits. Representative sediment, surface water, groundwater, soil, and waste samples in the vicinity of

these previously uncharacterized debris and waste deposits will be collected and analyzed. Further, the sample intervals will be spaced horizontally and vertically to accurately characterize the extent of any identified contamination in the vicinity of the identified wastes.

RECOMMENDATIONS

The review and evaluation of the summarized reports will result in the preparation of a SAP that builds upon existing analytical results and focuses on potential environmental impacts, including the following:

- Unidentified, significant in-lake and/or terrestrial sources of contamination including PCBs;
- Uncharacterized waste deposits, including more than 750 uncharacterized drums, reportedly, on the lake bottom;
- Bulk disposal areas, including stamp sand deposits, slag dumps, and landfills; and,
- Industrial ruins including coal storage areas, USTs, SACM, and any other waste materials identified in future investigations.

The risks posed to environmental media, sediment in particular, by these waste deposits and continuing sources of contamination contribute to the limited recovery of the Torch Lake ecosystem. As such, the investigation will be largely driven by documented observations of drum and/or other debris locations in the lake as well as consideration related to historic operations and detected PCB concentrations.

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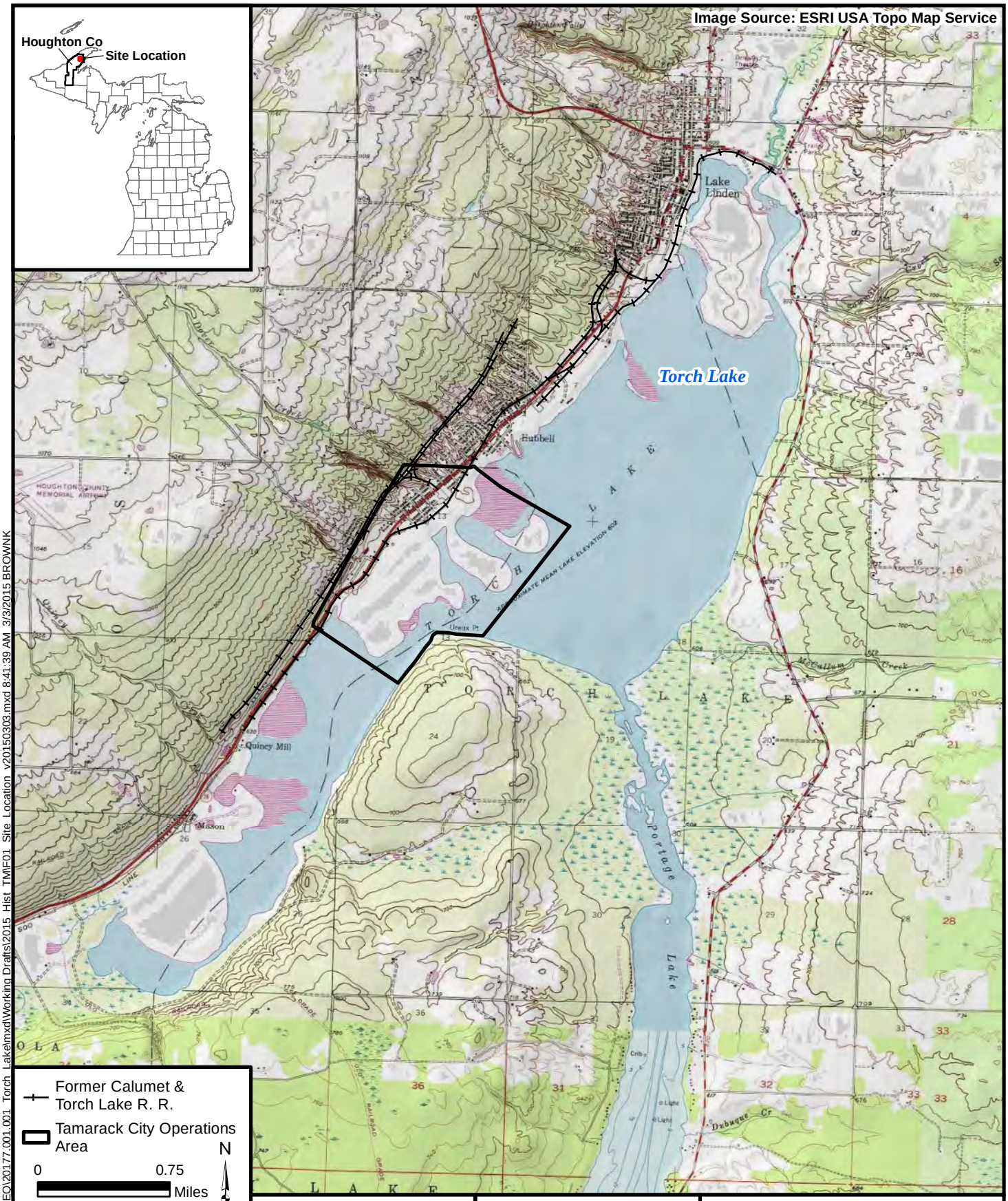
FIGURES



Source: Draft Site Inspection (SI) Report for C&H Lake Linden Operations, Lake Linden, Michigan, 49945 - March 2013. Prepared by the MDEQ-RRD Superfund Section, Pre-remedial Group, Site Evaluation Unit (Pre-remedial Group)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC.
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Figure 1
Site Location Map
Tamarack City Operations Area
Tamarack City, Houghton County, Michigan

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Image Source: ESRI World Imagery

Ahmeek Mill Processing Area
-Osceola Township Park
-Ahmeek Stamp Mill Complex

Tamarack Processing Area
-Tamarack Reclamation Plant Complex
-Tamarack Stamp Mill Complex
-Osceola Stamp Mill

Tamarack Sands Area
-Historic Municipal Dump

Ahmeek Stamp Mill
Ahmeek Boiler House
Ahmeek Pump House
Ahmeek Power House - Post 1930 update
Ahmeek Boiler House - Post 1930 update
Approximate Location of Observed Asbestos Bag
Alleged Historic Municipal Dump
Tamarack Electric Substation
Tamarack Regrinding Plant
Tamarack Classifying Plant
Tamarack Flotation Plant
Tamarack Leaching Plant
Tamarack Mill No.1
Lake Stamp Mill No. 2 (Tamarack Mill No. 2)
Osceola Stamp Mill
Mutual Water, Light and Power Pump House

Map Extent

Oneco Rd
Tamarack Hill Rd
Maple St
Spruce St
E 6th St
E 7th St
W 6th St
4th St
3rd St
2nd St
Conglomerate St
N Amygdaloid St
S Amygdaloid Rd
Red Metal Cir
Johnson Rd
Junction Rd
M-26
M-203
Red Barn Rd

- Identified Industrial Areas of Interest
- Soil and Vegitative Cap (from MDEQ GIS files)
- Estimated Cap Limits
- Mining Era Buildings and Structures
- Study Areas (DRAFT)
- Tamarack City Operations Geographic Area

Mining Era Buildings and Structures from:
- *Michigan Technical University Archive Research Phase II Report Addendum*

N
0 750 Ft
Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

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Figure 2
Geographic Area Map
C&H Tamarack City Operations Area
Tamarack City, Houghton County, Michigan

DRAFT

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Image Source: ESRI World Imagery

SS-15 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.42	CYANIDE	0.34		mg/kg	[2]
0-0.42	ARSENIC	5		mg/kg	[2,4,11]
0-0.42	COBALT	8.8		mg/kg	[2,4,11]
0-0.42	COPPER	596	J	mg/kg	[2]
0-0.42	IRON	23300		mg/kg	[4,11]
0-0.42	SELENIUM	1.6		mg/kg	[2]

SS-16 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.25	COBALT	6.4		mg/kg	[2,4,11]
0-0.25	COPPER	478	J	mg/kg	[2]

SS-17 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.42	CYANIDE	0.24		mg/kg	[2]
0-0.42	ALUMINUM	8890		mg/kg	[4,11]
0-0.42	ARSENIC	15.4		mg/kg	[2,4,10,11]
0-0.42	COBALT	9.3		mg/kg	[2,4,11]
0-0.42	COPPER	1020	J	mg/kg	[2]
0-0.42	IRON	18700		mg/kg	[4,11]
0-0.42	SELENIUM	2.6		mg/kg	[2]
0-0.42	ZINC	110		mg/kg	[2]

SB-5 06/04/02

Depth	Parameter	Result		Units	[Criteria]
1-3	ALUMINUM	7560		mg/kg	[4,11]
1-3	COBALT	7.6		mg/kg	[2,4,11]
1-3	COPPER	69.8	J	mg/kg	[2]

SS-18 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.33	CYANIDE	0.12		mg/kg	[2]
0-0.33	ALUMINUM	9080		mg/kg	[4,11]
0-0.33	ANTIMONY	1.3	J	mg/kg	[2]
0-0.33	ARSENIC	11.8		mg/kg	[2,4,10,11]
0-0.33	COBALT	14.6		mg/kg	[2,4,11]
0-0.33	COPPER	4980	J	mg/kg	[2]
0-0.33	IRON	58400		mg/kg	[4,11]
0-0.33	MAGNESIUM	9070		mg/kg	[4]
0-0.33	MANGANESE	895	J	mg/kg	[2,4,11]
0-0.33	MERCURY	0.39		mg/kg	[2]
0-0.33	NICKEL	47.6		mg/kg	[2]
0-0.33	SELENIUM	1.7		mg/kg	[2]
0-0.33	SILVER	1.1		mg/kg	[2]
0-0.33	ZINC	185		mg/kg	[2]
0-0.33	BENZO(A)PYRENE	4100		ug/kg	[10]
0-0.33	FLUORANTHENE	9800		ug/kg	[2]
0-0.33	PHENANTHRENE	7400		ug/kg	[2]

5 (SS Pile) 10/19/01

Depth	Parameter	Result	Units	[Criteria]
0-0	COPPER	1200	mg/kg	[2]
0-0	NICKEL	40	mg/kg	[2]
0-0	SELENIUM	0.5	mg/kg	[2]
0-0	ZINC	82	mg/kg	[2]

SS-14 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.42	ALUMINUM	7980		mg/kg	[4,11]
0-0.42	COBALT	10.2		mg/kg	[2,4,11]
0-0.42	COPPER	719	J	mg/kg	[2]
0-0.42	SELENIUM	1.3		mg/kg	[2]
0-0.42	ZINC	94.4		mg/kg	[2]

SB-4 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-2.5	CYANIDE	0.11		mg/kg	[2]
0-2.5	COBALT	3.9		mg/kg	[2,4,11]
0-2.5	COPPER	1390	J	mg/kg	[2]
0-2.5	ZINC	71.8	J	mg/kg	[2]

SB-6 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-2.33	ALUMINUM	7230		mg/kg	[4,11]
0-2.33	COBALT	7.7		mg/kg	[2,4,11]
0-2.33	COPPER	435	J	mg/kg	[2]
0-2.33	SELENIUM	0.66		mg/kg	[2]

SS-19 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.5	CYANIDE	0.22		mg/kg	[2]
0-0.5	ARSENIC	4.9		mg/kg	[2,4,11]
0-0.5	COBALT	7.6		mg/kg	[2,4,11]
0-0.5	COPPER	878	J	mg/kg	[2]
0-0.5	SELENIUM	1.2		mg/kg	[2]
0-0.5	ZINC	165		mg/kg	[2]

SS-11 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.42	ALUMINUM	7410		mg/kg	[4,11]
0-0.42	COBALT	9.4		mg/kg	[2,4,11]
0-0.42	COPPER	620	J	mg/kg	[2]
0-0.42	SELENIUM	0.59		mg/kg	[2]
0-0.42	ZINC	95.2		mg/kg	[2]

SS-13 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.33	ALUMINUM	9640		mg/kg	[4,11]
0-0.33	ANTIMONY	2.8	J	mg/kg	[2]
0-0.33	ARSENIC	16		mg/kg	[2,4,10,11]
0-0.33	BARIUM	157		mg/kg	[2]
0-0.33	COBALT	18.5		mg/kg	[2,4,11]
0-0.33	COPPER	9290	J	mg/kg	[2,4,11]
0-0.33	IRON	132000		mg/kg	[4,11]
0-0.33	LEAD	878	J	mg/kg	[4,10,11]
0-0.33	MAGNESIUM	11400		mg/kg	[4]
0-0.33	MANGANESE	1020	J	mg/kg	[2,4,11]
0-0.33	MERCURY	0.22		mg/kg	[2]
0-0.33	NICKEL	73.6		mg/kg	[2]
0-0.33	SELENIUM	2.4		mg/kg	[2]
0-0.33	SILVER	2.4		mg/kg	[2]
0-0.33	ZINC	372		mg/kg	[2]

SS-20 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.42	CYANIDE	0.13		mg/kg	[2]
0-0.42	COBALT	7.4		mg/kg	[2,4,11]
0-0.42	COPPER	789	J	mg/kg	[2]
0-0.42	SELENIUM	0.83		mg/kg	[2]
0-0.42	ZINC	63		mg/kg	[2]

SS-12 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.25	ALUMINUM	10400		mg/kg	[4,11]
0-0.25	ARSENIC	6.2		mg/kg	[2,4,11]
0-0.25	COBALT	17.9		mg/kg	[2,4,11]
0-0.25	COPPER	3340	J	mg/kg	[2]
0-0.25	IRON	14300		mg/kg	[4,11]
0-0.25	MAGNESIUM	12700		mg/kg	[4]
0-0.25	NICKEL	30.2		mg/kg	[2]
0-0.25	SELENIUM	0.48		mg/kg	[2]
0-0.25	ZINC	96.5		mg/kg	[2]

SB-3 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-2.5	ALUMINUM	9710		mg/kg	[4,11]
0-2.5	COBALT	15.6		mg/kg	[2,4,11]
0-2.5	COPPER	3600	J	mg/kg	[2]
0-2.5	IRON	13300	J	mg/kg	[4,11]
0-2.5	MAGNESIUM	13400		mg/kg	[4]
0-2.5	SILVER	1.9		mg/kg	[2]
0-2.5	THALLIUM	4.6		mg/kg	[2,4,11]
0-2.5	ZINC	67	J	mg/kg	[2]

SS-9 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.25	CYANIDE	0.15		mg/kg	[2]
0-0.25	ALUMINUM	8480		mg/kg	[4,11]
0-0.25	ARSENIC	14.2		mg/kg	[2,4,10,11]
0-0.25	COBALT	13.8		mg/kg	[2,4,11]
0-0.25	COPPER	8940	J	mg/kg	[2,4,11]
0-0.25	IRON	25500		mg/kg	[4,11]
0-0.25	MAGNESIUM	9090		mg/kg	[4]
0-0.25	MERCURY	0.17		mg/kg	[2]
0-0.25	NICKEL	71.6		mg/kg	[2]
0-0.25	SELENIUM	1		mg/kg	[2]
0-0.25	SILVER	3.3		mg/kg	[2]
0-0.25	ZINC	159		mg/kg	[2]
0-0.25	BENZO(A)PYRENE	2400	J	ug/kg	[10]

SS-23 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.25	ALUMINUM	7320		mg/kg	[4,11]
0-0.25	COBALT	7.2		mg/kg	[2,4,11]
0-0.25	COPPER	1380	J	mg/kg	[2]
0-0.25	IRON	12400	J	mg/kg	[4,11]

SS-22 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.5	COBALT	4.8		mg/kg	[2,4,11]
0-0.5	COPPER	242	J	mg/kg	[2]

SS-10 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.33	COBALT	7.7		mg/kg	[2,4,11]
0-0.33	COPPER	1280	J	mg/kg	[2]

SB-2 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0.5-2.5	COBALT	6.2		mg/kg	[2,4,11]
0.5-2.5	COPPER	165	J	mg/kg	[2]
0.5-2.5	MERCURY	0.25		mg/kg	[2]
0.5-2.5	SELENIUM	0.67		mg/kg	[2]

SS-25 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.5	ALUMINUM	10400		mg/kg	[4,11]
0-0.5	COBALT	9.7		mg/kg	[2,4,11]
0-0.5	COPPER	1450	J	mg/kg	[2]
0-0.5	MANGANESE	672		mg/kg	[2,4,11]
0-0.5	THALLIUM	1.8	J	mg/kg	[2]

SB-7 06/04/02

Depth	Parameter	Result	Units	[Criteria]
0-2	COBALT	1.9	mg/kg	[4]

SS-24 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.33	ALUMINUM	6910		mg/kg	[4,11]
0-0.33	COBALT	9.1		mg/kg	[2,4,11]
0-0.33	COPPER	1240	J	mg/kg	[2]
0-0.33	IRON	16500	J	mg/kg	[4,11]
0-0.33	SELENIUM	0.69		mg/kg	[2]
0-0.33	THALLIUM	1.5	J	mg/kg	[2]

3 (Door Jam) 10/19/01

Depth	Parameter	Result	Units	[Criteria]
0-0	ARSENIC	210	mg/kg	[2,4,10,11,17]
0-0	BARIUM	190	mg/kg	[2]
0-0	COPPER	240000	mg/kg	[2,4,9,10,11,16,17]
0-0	LEAD	700	mg/kg	[10]
0-0	MERCURY	0.16	mg/kg	[2]
0-0	NICKEL	48	mg/kg	[2]
0-0	SELENIUM	1.7	mg/kg	[2]
0-0	SILVER	38	mg/kg	[2,4,11]
0-0	ZINC	410	mg/kg	[2]
0-0	BENZO(A)PYRENE	9600	ug/kg	[16,17]
0-0	CARBAZOLE	2500	ug/kg	[2]
0-0	FLUORANTHENE	15000	ug/kg	[2]
0-0	PHENANTHRENE	10000	ug/kg	[2]

SS-21 06/04/02

Depth	Parameter	Result		Units	[Criteria]
0-0.5	COBALT	5.8		mg/kg	[2,4,11]
0-0.5	COPPER	856	J	mg/kg	[2]

4 (Track Turn) 10/19/01

Depth	Parameter	Result	Units	[Criteria]
0-0	ARSENIC	48	mg/kg	[2,4,10,11,17]
0-0	COPPER	35000	mg/kg	[2,4,10,11]
0-0	LEAD	430	mg/kg	[10]
0-0	MERCURY	0.25	mg/kg	[2]
0-0	NICKEL	69	mg/kg	[2]
0-0	SELENIUM	0.71	mg/kg	[2]
0-0	SILVER	7.5	mg/kg	[2,4]
0-0	ZINC	210	mg/kg	[2]
0-0	BENZO(A)PYRENE	2900	ug/kg	[10]
0-0	PHENANTHRENE	2500	ug/kg	[2]

MDEQ Part 201 Cleanup Criteria for Response Action
2=Groundwater Surface Water Interface Protection Criteria
3=Soil Saturation Concentration Screening Levels
4=Residential Drinking Water Protection Criteria
5=Residential Soil Volatilization to Indoor Air Inhalation Criteria (VSIC)
6=Residential Infinite Source Volatile Soil Inhalation Criteria
7=Residential Finite VSIC for 5 Meter Source Thickness
8=Residential Finite VSIC for 2 Meter Source Thickness
9=Residential Particulate Soil Inhalation Criteria
10=Residential Direct Contact Criteria
11=Nonresidential Drinking Water Protection Criteria
12=Nonresidential Soil Volatilization to Indoor Air Inhalation
13=Nonresidential Infinite Source Volatile Soil Inhalation Criteria
14=Nonresidential Finite VSIC for 5 Meter Source Thickness
15=Nonresidential Finite VSIC for 2 Meter Source Thickness
16=Nonresidential Particulate Soil Inhalation Criteria
17=Nonresidential Direct Contact Criteria

- Sampling locations with at least one exceedance
- Sampling locations with no exceedances
- Locations are included within a different geographical area boundary

Locations Analyzed for PCBs

- No Detections
- At Least One Detection
- Conceptual Site and Geographic Area Boundaries

Notes:
MG/KG = milligrams per kilogram
UG/KG = micrograms per kilogram
Sample depths shown in feet below ground surface.

N

0 350 Ft

Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC
P.O. Box 577
Houghton, MI 49931

Figure 3a
Soil Sample Location Map
Ahmeek Mill Processing Area
Tamarack City, Houghton County, Michigan

DRAFT

FILE: T:\GIS Projects\MDEQ\20177.001.001 Torch Lake\mxd\Working Drafts\2015 Hist TMF\F03A Ahmeek Soil DRAFTv 20150303.mxd 9:30:16 AM 3/3/2015 BROWNK

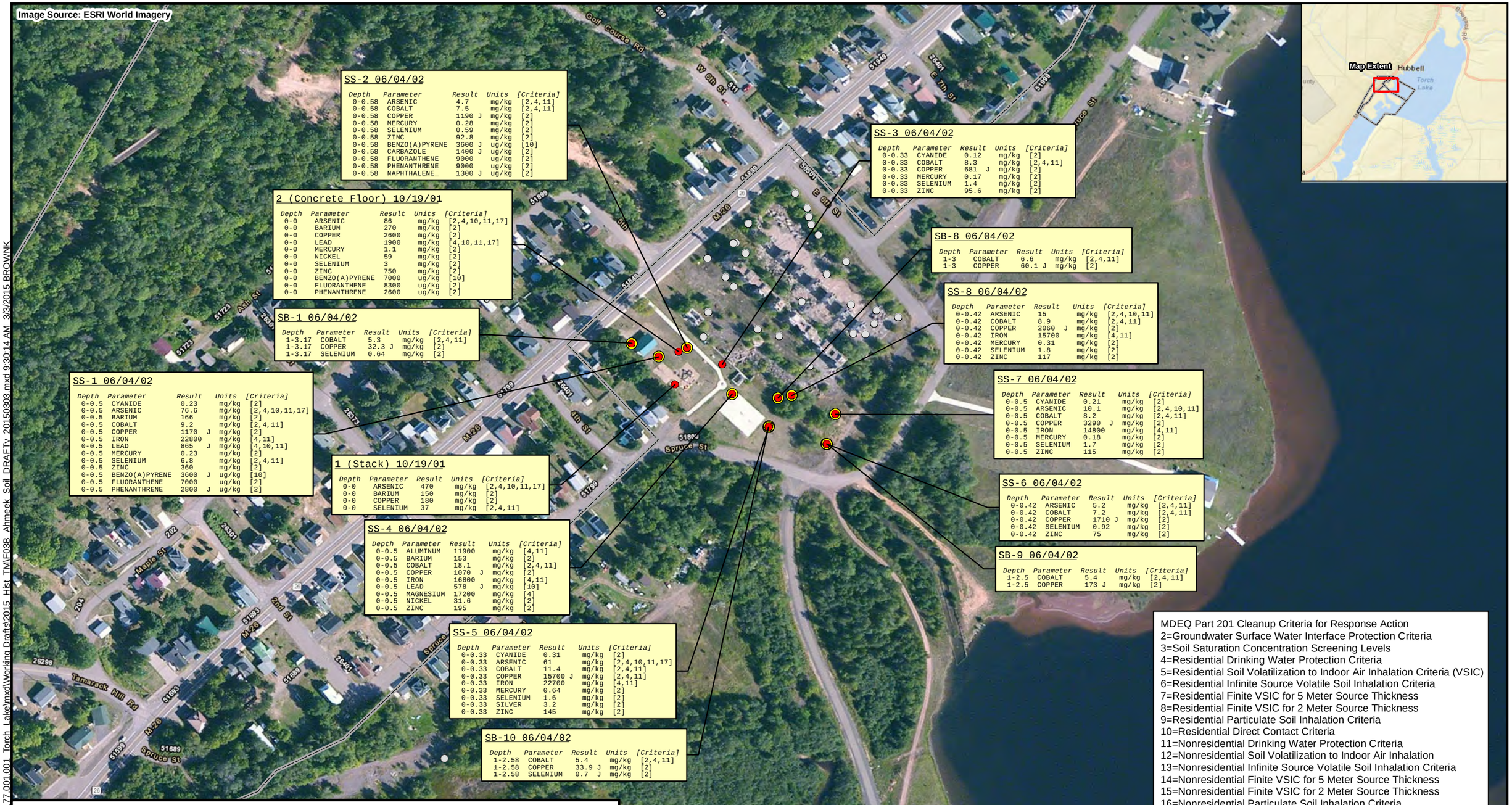
Image Source: ESRI World Imagery
Golf Course Rd
W 6th St
E 7th St
E 5th St
Ash St
Maple St
Spruce St
Tamarack Hill Rd
2nd St
4th St
M-26
Map Extent
Hubbell
Torch Lake
SS-2 06/04/02
Depth Parameter Result Units [Criteria]
0-0.58 ARSENIC 4.7 mg/kg [2,4,11]
0-0.58 COBALT 7.5 mg/kg [2,4,11]
0-0.58 COPPER 1190 J mg/kg [2]
0-0.58 MERCURY 0.28 mg/kg [2]
0-0.58 SELENIUM 0.59 mg/kg [2]
0-0.58 ZINC 92.8 mg/kg [2]
0-0.58 BENZO(A)PYRENE 3600 J ug/kg [10]
0-0.58 CARBAZOLE 1400 J ug/kg [2]
0-0.58 FLUORANTHENE 9000 ug/kg [2]
0-0.58 PHENANTHRENE 9000 ug/kg [2]
0-0.58 NAPHTHALENE_ 1300 J ug/kg [2]
SS-3 06/04/02
Depth Parameter Result Units [Criteria]
0-0.33 CYANIDE 0.12 mg/kg [2]
0-0.33 COBALT 8.3 mg/kg [2,4,11]
0-0.33 COPPER 681 J mg/kg [2]
0-0.33 MERCURY 0.17 mg/kg [2]
0-0.33 SELENIUM 1.4 mg/kg [2]
0-0.33 ZINC 95.6 mg/kg [2]
2 (Concrete Floor) 10/19/01
Depth Parameter Result Units [Criteria]
0-0 ARSENIC 86 mg/kg [2,4,10,11,17]
0-0 BARIUM 270 mg/kg [2]
0-0 COPPER 2600 mg/kg [2]
0-0 LEAD 1900 mg/kg [4,10,11,17]
0-0 MERCURY 1.1 mg/kg [2]
0-0 NICKEL 59 mg/kg [2]
0-0 SELENIUM 3 mg/kg [2]
0-0 ZINC 750 mg/kg [2]
0-0 BENZO(A)PYRENE 7000 ug/kg [10]
0-0 FLUORANTHENE 8300 ug/kg [2]
0-0 PHENANTHRENE 2600 ug/kg [2]
SB-8 06/04/02
Depth Parameter Result Units [Criteria]
1-3 COBALT 6.6 mg/kg [2,4,11]
1-3 COPPER 60.1 J mg/kg [2]
SB-1 06/04/02
Depth Parameter Result Units [Criteria]
1-3.17 COBALT 5.3 mg/kg [2,4,11]
1-3.17 COPPER 32.3 J mg/kg [2]
1-3.17 SELENIUM 0.64 mg/kg [2]
SS-8 06/04/02
Depth Parameter Result Units [Criteria]
0-0.42 ARSENIC 15 mg/kg [2,4,10,11]
0-0.42 COBALT 8.9 mg/kg [2,4,11]
0-0.42 COPPER 2060 J mg/kg [2]
0-0.42 IRON 15700 mg/kg [4,11]
0-0.42 MERCURY 0.31 mg/kg [2]
0-0.42 SELENIUM 1.8 mg/kg [2]
0-0.42 ZINC 117 mg/kg [2]
SS-1 06/04/02
Depth Parameter Result Units [Criteria]
0-0.5 CYANIDE 0.23 mg/kg [2]
0-0.5 ARSENIC 76.6 mg/kg [2,4,10,11,17]
0-0.5 BARIUM 166 mg/kg [2]
0-0.5 COBALT 9.2 mg/kg [2,4,11]
0-0.5 COPPER 1170 J mg/kg [2]
0-0.5 IRON 22800 mg/kg [4,11]
0-0.5 LEAD 865 J mg/kg [4,10,11]
0-0.5 MERCURY 0.23 mg/kg [2]
0-0.5 SELENIUM 6.8 mg/kg [2,4,11]
0-0.5 ZINC 360 mg/kg [2]
0-0.5 BENZO(A)PYRENE 3600 J ug/kg [10]
0-0.5 FLUORANTHENE 7000 ug/kg [2]
0-0.5 PHENANTHRENE 2800 J ug/kg [2]
SS-7 06/04/02
Depth Parameter Result Units [Criteria]
0-0.5 CYANIDE 0.21 mg/kg [2]
0-0.5 ARSENIC 10.1 mg/kg [2,4,10,11]
0-0.5 COBALT 8.2 mg/kg [2,4,11]
0-0.5 COPPER 3290 J mg/kg [2]
0-0.5 IRON 14800 mg/kg [4,11]
0-0.5 MERCURY 0.18 mg/kg [2]
0-0.5 SELENIUM 1.7 mg/kg [2]
0-0.5 ZINC 115 mg/kg [2]
1 (Stack) 10/19/01
Depth Parameter Result Units [Criteria]
0-0 ARSENIC 470 mg/kg [2,4,10,11,17]
0-0 BARIUM 150 mg/kg [2]
0-0 COPPER 180 mg/kg [2]
0-0 SELENIUM 37 mg/kg [2,4,11]
SS-6 06/04/02
Depth Parameter Result Units [Criteria]
0-0.42 ARSENIC 5.2 mg/kg [2,4,11]
0-0.42 COBALT 7.2 mg/kg [2,4,11]
0-0.42 COPPER 1710 J mg/kg [2]
0-0.42 SELENIUM 0.92 mg/kg [2]
0-0.42 ZINC 75 mg/kg [2]
SS-4 06/04/02
Depth Parameter Result Units [Criteria]
0-0.5 ALUMINUM 11900 mg/kg [4,11]
0-0.5 BARIUM 153 mg/kg [2]
0-0.5 COBALT 18.1 mg/kg [2,4,11]
0-0.5 COPPER 1070 J mg/kg [2]
0-0.5 IRON 16800 mg/kg [4,11]
0-0.5 LEAD 578 J mg/kg [10]
0-0.5 MAGNESIUM 17200 mg/kg [4]
0-0.5 NICKEL 31.6 mg/kg [2]
0-0.5 ZINC 195 mg/kg [2]
SB-9 06/04/02
Depth Parameter Result Units [Criteria]
1-2.5 COBALT 5.4 mg/kg [2,4,11]
1-2.5 COPPER 173 J mg/kg [2]
SS-5 06/04/02
Depth Parameter Result Units [Criteria]
0-0.33 CYANIDE 0.31 mg/kg [2]
0-0.33 ARSENIC 61 mg/kg [2,4,10,11,17]
0-0.33 COBALT 11.4 mg/kg [2,4,11]
0-0.33 COPPER 15700 J mg/kg [2,4,11]
0-0.33 IRON 22700 mg/kg [4,11]
0-0.33 MERCURY 0.64 mg/kg [2]
0-0.33 SELENIUM 1.6 mg/kg [2]
0-0.33 SILVER 3.2 mg/kg [2]
0-0.33 ZINC 145 mg/kg [2]
SB-10 06/04/02
Depth Parameter Result Units [Criteria]
1-2.58 COBALT 5.4 mg/kg [2,4,11]
1-2.58 COPPER 33.9 J mg/kg [2]
1-2.58 SELENIUM 0.7 J mg/kg [2]
MDEQ Part 201 Cleanup Criteria for Response Action
2=Groundwater Surface Water Interface Protection Criteria
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17=Nonresidential Direct Contact Criteria
Sampling locations with at least one exceedance
Sampling locations with no exceedances
Locations are included within a different geographical area boundary
Locations Analyzed for PCBs
No Detections
At Least One Detection
Conceptual Site and Geographic Area Boundaries
Notes:
MG/KG = milligrams per kilogram
UG/KG = micrograms per kilogram
Sample depths shown in feet below ground surface.
N
0
200
Ft
Coordinate System: MIGeoRef(m)
Prepared for:
Michigan Department of Environmental Quality
Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC
P.O. Box 577
Houghton, MI 49931
Figure 3b
Soil Sample Location Map
Ahmeek Mill Processing Area
Tamarack City, Houghton County, Michigan
DRAFT
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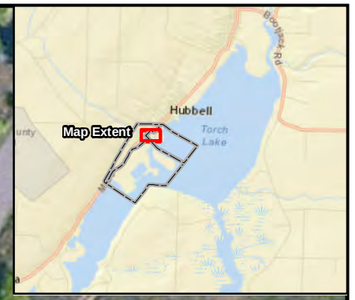
Image Source: ESRI World Imagery



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X-29
X-33
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X-37
X-6
X-31
X-2
X-36
X-5A
X-5B
X-5C
X-30
X-28
X-3
X-38
X-35
X-5
X-4
X-34
X-1
SS-4X

W 6th St
E 6th St
M-26
Maple St
Spruce St
4th St
51899
51800
51793
28441
28383
200
701

Locations Screened for Metals - At least one exceedance of:

- Residential Direct Contact Criteria
- Residential Particulate Soil Inhalation Criteria
- Non Residential Direct Contact Criteria
- Non Residential Particulate Soil Inhalation Criteria
- Screening locations with no exceedances
- Locations are included within a different geographical area boundary
- Conceptual Site and Geographic Area Boundaries

Xray Fluorescence screening results are from surface soils unless otherwise specified.

N

0 100 Ft

Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC
P.O. Box 577
Houghton, MI 49931

Figure 4a
Soil Screening Location Map
Ahmeek Mill Processing Area
Tamarack City, Houghton County, Michigan

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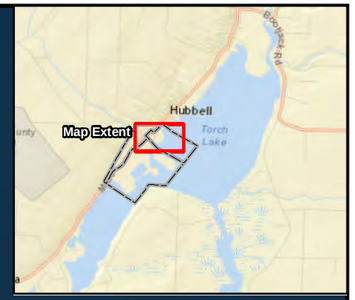

HB-2-2

HB-2-1

HUB-S1-13

Locations Screened for Metals - At least one exceedance of:

- Residential Direct Contact Criteria
- Residential Particulate Soil Inhalation Criteria
- Non Residential Direct Contact Criteria
- Non Residential Particulate Soil Inhalation Criteria

- Screening locations with no exceedances
- Locations are included within a different geographical area boundary
- Conceptual Site and Geographic Area Boundaries

Xray Fluorescence screening results are from surface soils unless otherwise specified.

N

0 250 Ft

Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC
P.O. Box 577
Houghton, MI 49931

Figure 4b
Soil Screening Location Map
Ahmeek Mill Processing Area
Tamarack City, Houghton County, Michigan

DRAFT

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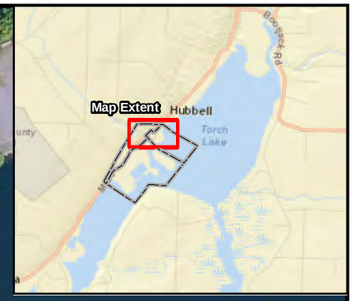

TMW-1 06/04/02

Parameter	Result		Units	[Criteria]
ALUMINUM	600	J	ug/l	[1,2]
COPPER	6		ug/l	[3]
IRON	1290		ug/l	[1,2]
MANGANESE	227		ug/l	[1,2]

TMW-2 06/04/02

Parameter	Result		Units	[Criteria]
ALUMINUM	348	J	ug/l	[1,2]
ALUMINUM (DUP)	447	J	ug/l	[1,2]
COPPER	21.7		ug/l	[3]
COPPER (DUP)	18		ug/l	[3]
IRON	3490		ug/l	[1,2]
IRON (DUP)	3650		ug/l	[1,2]
MANGANESE	120		ug/l	[1,2]
MANGANESE (DUP)	120		ug/l	[1,2]

TMW-3 06/04/02

Parameter	Result		Units	[Criteria]
ALUMINUM	355	J	ug/l	[1,2]
ANTIMONY	2.7		ug/l	[3]
COPPER	7.8		ug/l	[3]
IRON	2520		ug/l	[1,2]
MANGANESE	112		ug/l	[1,2]
VANADIUM	5.2		ug/l	[1]

TMW-4 06/04/02

Parameter	Result		Units	[Criteria]
ALUMINUM	813	J	ug/l	[1,2]
COPPER	6.3		ug/l	[3]
IRON	984		ug/l	[1,2]
MANGANESE	64.9		ug/l	[1,2]
VANADIUM	5.5		ug/l	[1]

TMW-5 06/04/02

Parameter	Result		Units	[Criteria]
ALUMINUM	3370	J	ug/l	[1,2]
COPPER	58.6		ug/l	[3]
IRON	2750		ug/l	[1,2]
MANGANESE	61.2		ug/l	[1,2]
SELENIUM	5.8	J	ug/l	[3]
VANADIUM	8.7		ug/l	[1]

TMW-6 06/04/02

Parameter	Result		Units	[Criteria]
ALUMINUM	4690	J	ug/l	[1,2]
BARIUM	257		ug/l	[3]
BERYLLIUM	0.56	J	ug/l	[3]
COPPER	358		ug/l	[3]
IRON	17400		ug/l	[1,2]
LEAD	6.3		ug/l	[1,2]
MANGANESE	338		ug/l	[1,2]
MERCURY	0.14		ug/l	[3]
VANADIUM	34.6		ug/l	[1,3]

MDEQ Part 201 Cleanup Criteria for Response Action
1=Residential Drinking Water Criteria
2=Nonresidential Drinking Water Criteria
3=Groundwater Surface Water Interface Criteria
4=Water Solubility
5=Residential Groundwater Vol to Indoor Air Inhalation
6=Nonresidential Groundwater Vol to Indoor Air Inhalation
7=Flammability and Explosivity Screening Level

- Sampling locations with at least one exceedance
- Sampling locations with no exceedances
- Locations are included within a different geographical area boundary

Locations Analyzed for PCBs

- No Detections
- At Least One Detection
- Conceptual Site and Geographic Area Boundaries

Notes:
MG/L = milligrams per liter
UG/L = micrograms per liter
[#-#] = screen intervals
bgs = below ground surface

N

0 250 Ft

Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC
P.O. Box 577
Houghton, MI 49931

Figure 5
Groundwater Sample Location Map
Ahmeek Mill Processing Area
Tamarck City, Houghton County, Michigan

DRAFT

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Sampling locations with at least one exceedance

Sampling locations with no exceedances

Locations are included within a different geographical area boundary

Locations Analyzed for PCBs

No Detections

At Least One Detection

Conceptual Site and Geographic Area Boundaries

N

0 375 Ft

Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC
P.O. Box 577
Houghton, MI 49931

Figure 6

Sediment Sample Location Map
Ahmeek Mill Processing Area
Tamarck City, Houghton County, Michigan

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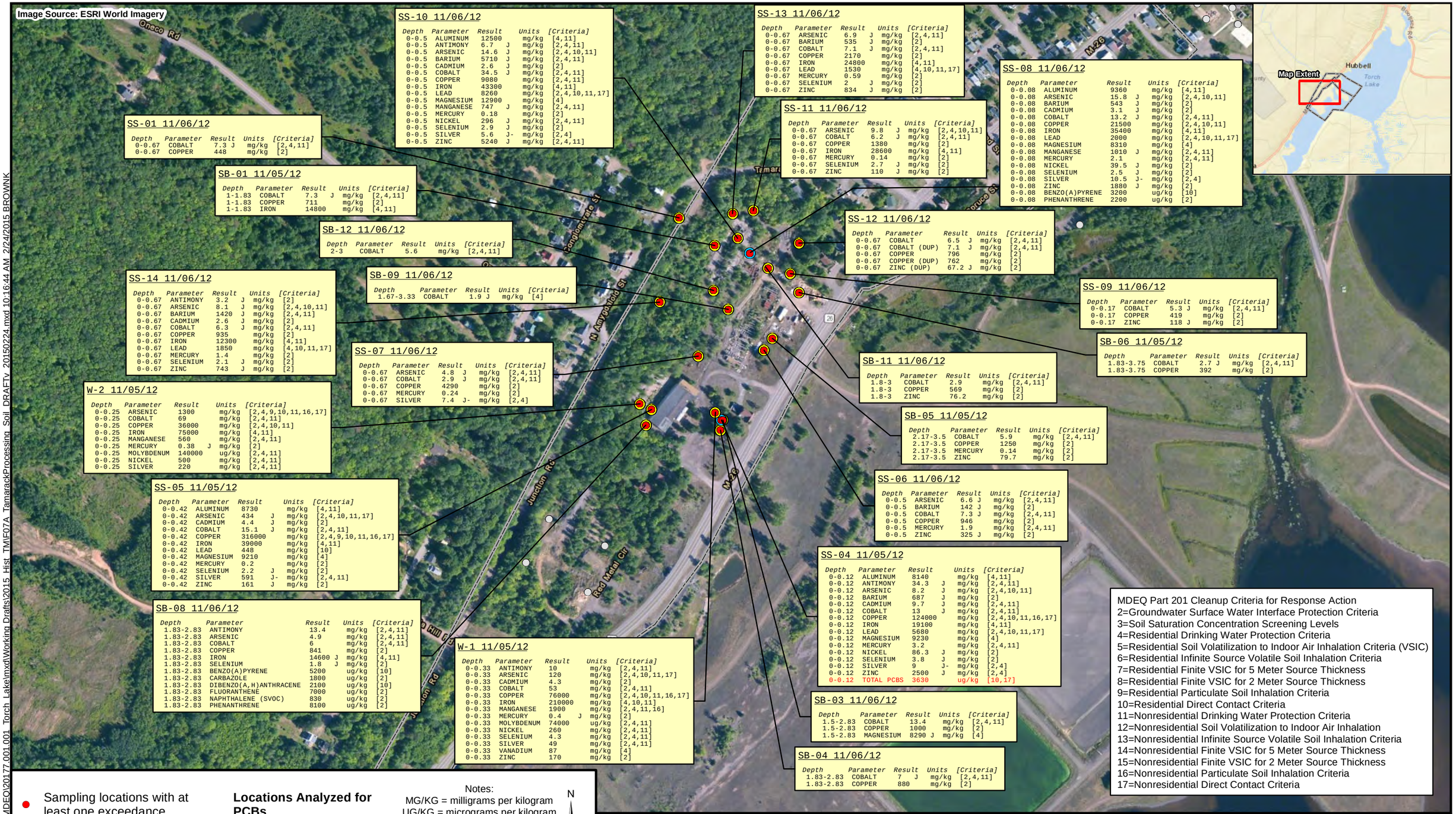

SS-10 11/06/12

Depth	Parameter	Result		Units	[Criteria]
0-0.5	ALUMINUM	12500		mg/kg	[4,11]
0-0.5	ANTIMONY	6.7	J	mg/kg	[2,4,11]
0-0.5	ARSENIC	14.6	J	mg/kg	[2,4,10,11]
0-0.5	BARIUM	5710	J	mg/kg	[2,4,11]
0-0.5	CADMIUM	2.6	J	mg/kg	[2]
0-0.5	COBALT	34.5	J	mg/kg	[2,4,11]
0-0.5	COPPER	9080		mg/kg	[2,4,11]
0-0.5	IRON	43300		mg/kg	[4,11]
0-0.5	LEAD	8260		mg/kg	[2,4,10,11,17]
0-0.5	MAGNESIUM	12900		mg/kg	[4]
0-0.5	MANGANESE	747	J	mg/kg	[2,4,11]
0-0.5	MERCURY	0.18		mg/kg	[2]
0-0.5	NICKEL	296	J	mg/kg	[2,4,11]
0-0.5	SELENIUM	2.9	J	mg/kg	[2]
0-0.5	SILVER	5.6	J-	mg/kg	[2,4]
0-0.5	ZINC	5240	J	mg/kg	[2,4,11]

SS-13 11/06/12

Depth	Parameter	Result		Units	[Criteria]
0-0.67	ARSENIC	6.9	J	mg/kg	[2,4,11]
0-0.67	BARIUM	535	J	mg/kg	[2]
0-0.67	COBALT	7.1	J	mg/kg	[2,4,11]
0-0.67	COPPER	2170		mg/kg	[2]
0-0.67	IRON	24800		mg/kg	[4,11]
0-0.67	LEAD	1530		mg/kg	[4,10,11,17]
0-0.67	MERCURY	0.59		mg/kg	[2]
0-0.67	SELENIUM	2	J	mg/kg	[2]
0-0.67	ZINC	834	J	mg/kg	[2]

SS-11 11/06/12

Depth	Parameter	Result		Units	[Criteria]
0-0.67	ARSENIC	9.8	J	mg/kg	[2,4,10,11]
0-0.67	COBALT	6.2	J	mg/kg	[2,4,11]
0-0.67	COPPER	1380		mg/kg	[2]
0-0.67	IRON	28600		mg/kg	[4,11]
0-0.67	MERCURY	0.14		mg/kg	[2]
0-0.67	SELENIUM	2.7	J	mg/kg	[2]
0-0.67	ZINC	110	J	mg/kg	[2]

SS-08 11/06/12

Depth	Parameter	Result		Units	[Criteria]
0-0.08	ALUMINUM	9360		mg/kg	[4,11]
0-0.08	ARSENIC	15.8	J	mg/kg	[2,4,10,11]
0-0.08	BARIUM	543	J	mg/kg	[2]
0-0.08	CADMIUM	3.1	J	mg/kg	[2]
0-0.08	COBALT	13.2	J	mg/kg	[2,4,11]
0-0.08	COPPER	21500		mg/kg	[2,4,10,11]
0-0.08	IRON	35400		mg/kg	[4,11]
0-0.08	LEAD	2000		mg/kg	[2,4,10,11,17]
0-0.08	MAGNESIUM	8310		mg/kg	[4]
0-0.08	MANGANESE	1010	J	mg/kg	[2,4,11]
0-0.08	MERCURY	2.1		mg/kg	[2,4,11]
0-0.08	NICKEL	39.5	J	mg/kg	[2]
0-0.08	SELENIUM	2.5	J	mg/kg	[2]
0-0.08	SILVER	10.5	J-	mg/kg	[2,4]
0-0.08	ZINC	1880	J	mg/kg	[2]
0-0.08	BENZO(A)PYRENE	3200		ug/kg	[10]
0-0.08	PHENANTHRENE	2200		ug/kg	[2]

SS-01 11/06/12

Depth	Parameter	Result		Units	[Criteria]
0-0.67	COBALT	7.3	J	mg/kg	[2,4,11]
0-0.67	COPPER	448		mg/kg	[2]

SB-01 11/05/12

Depth	Parameter	Result		Units	[Criteria]
1-1.83	COBALT	7.3	J	mg/kg	[2,4,11]
1-1.83	COPPER	711		mg/kg	[2]
1-1.83	IRON	14800		mg/kg	[4,11]

SB-12 11/06/12

Depth	Parameter	Result	Units	[Criteria]
2-3	COBALT	5.6	mg/kg	[2,4,11]

SS-12 11/06/12

Depth	Parameter	Result		Units	[Criteria]
0-0.67	COBALT	6.5	J	mg/kg	[2,4,11]
0-0.67	COBALT (DUP)	7.1	J	mg/kg	[2,4,11]
0-0.67	COPPER	796		mg/kg	[2]
0-0.67	COPPER (DUP)	762		mg/kg	[2]
0-0.67	ZINC (DUP)	67.2	J	mg/kg	[2]

SS-14 11/06/12

Depth	Parameter	Result		Units	[Criteria]
0-0.67	ANTIMONY	3.2	J	mg/kg	[2]
0-0.67	ARSENIC	8.1	J	mg/kg	[2,4,10,11]
0-0.67	BARIUM	1420	J	mg/kg	[2,4,11]
0-0.67	CADMIUM	2.6	J	mg/kg	[2]
0-0.67	COBALT	6.3	J	mg/kg	[2,4,11]
0-0.67	COPPER	935		mg/kg	[2]
0-0.67	IRON	12300		mg/kg	[4,11]
0-0.67	LEAD	1850		mg/kg	[4,10,11,17]
0-0.67	MERCURY	1.4		mg/kg	[2]
0-0.67	SELENIUM	2.1	J	mg/kg	[2]
0-0.67	ZINC	743	J	mg/kg	[2]

SB-09 11/06/12

Depth	Parameter	Result	Units	[Criteria]
1.67-3.33	COBALT	1.9 J	mg/kg	[4]

SS-09 11/06/12

Depth	Parameter	Result		Units	[Criteria]
0-0.17	COBALT	5.3	J	mg/kg	[2,4,11]
0-0.17	COPPER	419		mg/kg	[2]
0-0.17	ZINC	118	J	mg/kg	[2]

SS-07 11/06/12

Depth	Parameter	Result		Units	[Criteria]
0-0.67	ARSENIC	4.8	J	mg/kg	[2,4,11]
0-0.67	COBALT	2.9	J	mg/kg	[2,4,11]
0-0.67	COPPER	4290		mg/kg	[2]
0-0.67	MERCURY	0.24		mg/kg	[2]
0-0.67	SILVER	7.4	J-	mg/kg	[2,4]

SB-06 11/05/12

Depth	Parameter	Result	Units	[Criteria]
1.83-3.75	COBALT	2.7 J	mg/kg	[2,4,11]
1.83-3.75	COPPER	392	mg/kg	[2]

SB-11 11/06/12

Depth	Parameter	Result	Units	[Criteria]
1.8-3	COBALT	2.9	mg/kg	[2,4,11]
1.8-3	COPPER	569	mg/kg	[2]
1.8-3	ZINC	76.2	mg/kg	[2]

W-2 11/05/12

Depth	Parameter	Result		Units	[Criteria]
0-0.25	ARSENIC	1300		mg/kg	[2,4,9,10,11,16,17]
0-0.25	COBALT	69		mg/kg	[2,4,11]
0-0.25	COPPER	36000		mg/kg	[2,4,10,11]
0-0.25	IRON	75000		mg/kg	[4,11]
0-0.25	MANGANESE	560		mg/kg	[2,4,11]
0-0.25	MERCURY	0.38	J	mg/kg	[2]
0-0.25	MOLYBDENUM	140000		ug/kg	[2,4,11]
0-0.25	NICKEL	500		mg/kg	[2,4,11]
0-0.25	SILVER	220		mg/kg	[2,4,11]

SS-05 11/05/12

Depth	Parameter	Result		Units	[Criteria]
2.17-3.5	COBALT	5.9		mg/kg	[2,4,11]
2.17-3.5	COPPER	1250		mg/kg	[2]
2.17-3.5	MERCURY	0.14		mg/kg	[2]
2.17-3.5	ZINC	79.7		mg/kg	[2]

SS-06 11/06/12

Depth	Parameter	Result		Units	[Criteria]
0-0.5	ARSENIC	6.6	J	mg/kg	[2,4,11]
0-0.5	BARIUM	142	J	mg/kg	[2]
0-0.5	COBALT	7.3	J	mg/kg	[2,4,11]
0-0.5	COPPER	946		mg/kg	[2]
0-0.5	MERCURY	1.9		mg/kg	[2,4,11]
0-0.5	ZINC	325	J	mg/kg	[2]

SS-05 11/05/12

Depth	Parameter	Result		Units	[Criteria]
0-0.42	ALUMINUM	8730		mg/kg	[4,11]
0-0.42	ARSENIC	434	J	mg/kg	[2,4,10,11,17]
0-0.42	CADMIUM	4.4	J	mg/kg	[2]
0-0.42	COBALT	15.1	J	mg/kg	[2,4,11]
0-0.42	COPPER	316000		mg/kg	[2,4,9,10,11,16,17]
0-0.42	IRON	39000		mg/kg	[4,11]
0-0.42	LEAD	448		mg/kg	[10]
0-0.42	MAGNESIUM	9210		mg/kg	[4]
0-0.42	MERCURY	0.2		mg/kg	[2]
0-0.42	SELENIUM	2.2	J	mg/kg	[2]
0-0.42	SILVER	591	J-	mg/kg	[2,4,11]
0-0.42	ZINC	161	J	mg/kg	[2]

SS-04 11/05/12

Depth	Parameter	Result		Units	[Criteria]
0-0.12	ALUMINUM	8140		mg/kg	[4,11]
0-0.12	ANTIMONY	34.3	J	mg/kg	[2,4,11]
0-0.12	ARSENIC	8.2	J	mg/kg	[2,4,10,11]
0-0.12	BARIUM	687	J	mg/kg	[2]
0-0.12	CADMIUM	9.7	J	mg/kg	[2,4,11]
0-0.12	COBALT	13	J	mg/kg	[2,4,11]
0-0.12	COPPER	124000		mg/kg	[2,4,10,11,16,17]
0-0.12	IRON	19100		mg/kg	[4,11]
0-0.12	LEAD	5680		mg/kg	[2,4,10,11,17]
0-0.12	MAGNESIUM	9230		mg/kg	[4]
0-0.12	MERCURY	3.2		mg/kg	[2,4,11]
0-0.12	NICKEL	86.3	J	mg/kg	[2]
0-0.12	SELENIUM	3.8	J	mg/kg	[2]
0-0.12	SILVER	9	J-	mg/kg	[2,4]
0-0.12	ZINC	2500	J	mg/kg	[2,4]
0-0.12	TOTAL PCBS	3630		ug/kg	[10,17]

SB-08 11/06/12

Depth	Parameter	Result		Units	[Criteria]
1.83-2.83	ANTIMONY	13.4		mg/kg	[2,4,11]
1.83-2.83	ARSENIC	4.9		mg/kg	[2,4,11]
1.83-2.83	COBALT	6		mg/kg	[2,4,11]
1.83-2.83	COPPER	841		mg/kg	[2]
1.83-2.83	IRON	14600	J	mg/kg	[4,11]
1.83-2.83	SELENIUM	1.8	J	mg/kg	[2]
1.83-2.83	BENZO(A)PYRENE	5200		ug/kg	[10]
1.83-2.83	CARBAZOLE	1800		ug/kg	[2]
1.83-2.83	DIBENZO(A,H)ANTHRACENE	2100		ug/kg	[10]
1.83-2.83	FLUORANTHENE	7000		ug/kg	[2]
1.83-2.83	NAPHTHALENE (SVOC)	830		ug/kg	[2]
1.83-2.83	PHENANTHRENE	8100		ug/kg	[2]

W-1 11/05/12

Depth	Parameter	Result	Units	[Criteria]
0-0.33	ANTIMONY	10	mg/kg	[2,4,11]
0-0.33	ARSENIC	120	mg/kg	[2,4,10,11,17]
0-0.33	CADMIUM	4.3	mg/kg	[2]
0-0.33	COBALT	53	mg/kg	[2,4,11]
0-0.33	COPPER	76000	mg/kg	[2,4,10,11,16,17]
0-0.33	IRON	210000	mg/kg	[4,10,11]
0-0.33	MANGANESE	1900	mg/kg	[2,4,11,16]
0-0.33	MERCURY	0.4 J	mg/kg	[2]
0-0.33	MOLYBDENUM	74000	ug/kg	[2,4,11]
0-0.33	NICKEL	260	mg/kg	[2,4,11]
0-0.33	SELENIUM	4.3	mg/kg	[2,4,11]
0-0.33	SILVER	49	mg/kg	[2,4,11]
0-0.33	VANADIUM	87	mg/kg	[4]
0-0.33	ZINC	170	mg/kg	[2]

SB-03 11/06/12

Depth	Parameter	Result		Units	[Criteria]
1.5-2.83	COBALT	13.4		mg/kg	[2,4,11]
1.5-2.83	COPPER	1000		mg/kg	[2]
1.5-2.83	MAGNESIUM	8290	J	mg/kg	[4]

SB-04 11/06/12

Depth	Parameter	Result		Units	[Criteria]
1.83-2.83	COBALT	7	J	mg/kg	[2,4,11]
1.83-2.83	COPPER	880		mg/kg	[2]

MDEQ Part 201 Cleanup Criteria for Response Action
2=Groundwater Surface Water Interface Protection Criteria
3=Soil Saturation Concentration Screening Levels
4=Residential Drinking Water Protection Criteria
5=Residential Soil Volatilization to Indoor Air Inhalation Criteria (VSIC)
6=Residential Infinite Source Volatile Soil Inhalation Criteria
7=Residential Finite VSIC for 5 Meter Source Thickness
8=Residential Finite VSIC for 2 Meter Source Thickness
9=Residential Particulate Soil Inhalation Criteria
10=Residential Direct Contact Criteria
11=Nonresidential Drinking Water Protection Criteria
12=Nonresidential Soil Volatilization to Indoor Air Inhalation
13=Nonresidential Infinite Source Volatile Soil Inhalation Criteria
14=Nonresidential Finite VSIC for 5 Meter Source Thickness
15=Nonresidential Finite VSIC for 2 Meter Source Thickness
16=Nonresidential Particulate Soil Inhalation Criteria
17=Nonresidential Direct Contact Criteria

- Sampling locations with at least one exceedance
- Sampling locations with no exceedances
- Locations are included within a different geographical area boundary

Locations Analyzed for PCBs
- No Detections
- At Least One Detection
- Conceptual Site and Geographic Area Boundaries

Notes:
MG/KG = milligrams per kilogram
UG/KG = micrograms per kilogram
Sample depths shown in feet below ground surface.

N

0 350 Ft

Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC
P.O. Box 577
Houghton, MI 49931

Figure 7a
Soil and Waste Sample Location Map
Tamarack Processing Area
Tamarack City, Houghton County, Michigan

DRAFT

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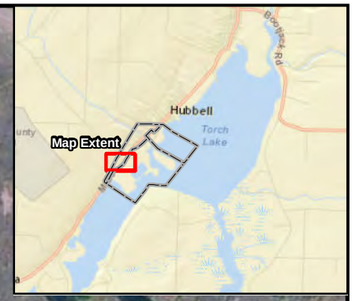
Image Source: ESRI World Imagery



SB-02 11/05/12

Depth	Parameter	Result	Units	[Criteria]
1.83-2.83	COBALT	7.1 J	mg/kg	[2,4,11]
1.83-2.83	COBALT (DUP)	6.4 J	mg/kg	[2,4,11]
1.83-2.83	COPPER	539	mg/kg	[2]
1.83-2.83	COPPER (DUP)	577	mg/kg	[2]

SS-02 11/05/12

Depth	Parameter	Result	Units	[Criteria]
0-0.75	ARSENIC	13.1 J	mg/kg	[2,4,10,11]
0-0.75	ARSENIC (DUP)	15.9 J	mg/kg	[2,4,10,11]
0-0.75	BARIUM (DUP)	139 J	mg/kg	[2]
0-0.75	COBALT	5.7 J	mg/kg	[2,4,11]
0-0.75	COBALT (DUP)	5.9 J	mg/kg	[2,4,11]
0-0.75	COPPER	511	mg/kg	[2]
0-0.75	COPPER (DUP)	528	mg/kg	[2]
0-0.75	IRON	13800	mg/kg	[4,11]
0-0.75	SELENIUM	6.1 J	mg/kg	[2,4,11]
0-0.75	SELENIUM (DUP)	8.2 J	mg/kg	[2,4,11]

SS-03 11/05/12

Depth	Parameter	Result	Units	[Criteria]
0-0.5	ALUMINUM	10400	mg/kg	[4,11]
0-0.5	ARSENIC	8.2 J	mg/kg	[2,4,10,11]
0-0.5	COBALT	14.5 J	mg/kg	[2,4,11]
0-0.5	COPPER	5180	mg/kg	[2]
0-0.5	IRON	21000	mg/kg	[4,11]
0-0.5	LEAD	504	mg/kg	[10]
0-0.5	MAGNESIUM	9130	mg/kg	[4]
0-0.5	MERCURY	0.38	mg/kg	[2]
0-0.5	NICKEL	31.9 J	mg/kg	[2]
0-0.5	SILVER	3.2 J-	mg/kg	[2]
0-0.5	ZINC	187 J	mg/kg	[2]
0-0.5	BENZO(A)PYRENE	4500	ug/kg	[10]
0-0.5	FLUORANTHENE	8900	ug/kg	[2]
0-0.5	PHENANTHRENE	9200	ug/kg	[2]

SB-10 11/05/12

Depth	Parameter	Result	Units	[Criteria]
0-1.83	COBALT	8.6	mg/kg	[2,4,11]
0-1.83	COPPER	605	mg/kg	[2]

MDEQ Part 201 Cleanup Criteria for Response Action
2=Groundwater Surface Water Interface Protection Criteria
3=Soil Saturation Concentration Screening Levels
4=Residential Drinking Water Protection Criteria
5=Residential Soil Volatilization to Indoor Air Inhalation Criteria (VSIC)
6=Residential Infinite Source Volatile Soil Inhalation Criteria
7=Residential Finite VSIC for 5 Meter Source Thickness
8=Residential Finite VSIC for 2 Meter Source Thickness
9=Residential Particulate Soil Inhalation Criteria
10=Residential Direct Contact Criteria
11=Nonresidential Drinking Water Protection Criteria
12=Nonresidential Soil Volatilization to Indoor Air Inhalation
13=Nonresidential Infinite Source Volatile Soil Inhalation Criteria
14=Nonresidential Finite VSIC for 5 Meter Source Thickness
15=Nonresidential Finite VSIC for 2 Meter Source Thickness
16=Nonresidential Particulate Soil Inhalation Criteria
17=Nonresidential Direct Contact Criteria

- Sampling locations with at least one exceedance
- Sampling locations with no exceedances
- Locations are included within a different geographical area boundary

Locations Analyzed for PCBs

- No Detections
- At Least One Detection
- Conceptual Site and Geographic Area Boundaries

Notes:
MG/KG = milligrams per kilogram
UG/KG = micrograms per kilogram
Sample depths shown in feet below ground surface.

N

0 150 Ft

Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC
P.O. Box 577
Houghton, MI 49931

Figure 7b
Soil and Waste Sample Location Map
Tamarack Processing Area
Tamarack City, Houghton County, Michigan

DRAFT

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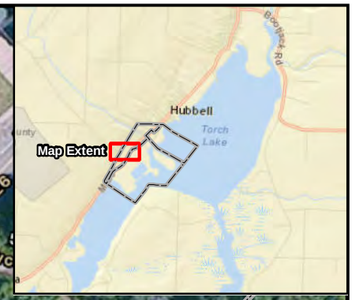
Image Source: ESRI World Imagery



Locations Screened for Metals - At least one exceedance of:

- Residential Direct Contact Criteria
- Residential Particulate Soil Inhalation Criteria
- Non Residential Direct Contact Criteria
- Non Residential Particulate Soil Inhalation Criteria

- Screening locations with no exceedances
- Locations are included within a different geographical area boundary
- Conceptual Site and Geographic Area Boundaries

Xray Fluorescence screening results are from surface soils unless otherwise specified.

N

0 150 Ft

Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC
P.O. Box 577
Houghton, MI 49931

Figure 8a

DRAFT

Soil Screening Location Map
Tamarack Processing Area
Tamarack City, Houghton County, Michigan

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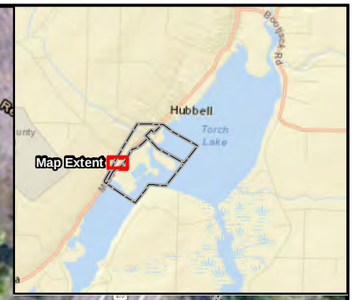

XRF19
XRF17
XRF18
XRF15
XRF16
XRF13
XRF14
XRF21
XRF37
XRF04
XRF20
XRF39
XRF05
XRF-64
XRF22
XRF36
XRF38
XRF12
XRF35
XRF34
XRF23
XRF11
XRF24
XRF25
XRF33
XRF-68
XRF27
XRF26
XRF10
XRF09
XRF06
XRF-66
XRF-67
XRF08
XRF-65
XRF28
XRF29
XRF07
XRF32
XRF31
XRF30

Junction Rd
Osceola Hill Rd
S Anvydahold Rd
Rod Metal Cir
M-26
51139
51459
20

Locations Screened for Metals - At least one exceedance of:

- Residential Direct Contact Criteria
- Residential Particulate Soil Inhalation Criteria
- Non Residential Direct Contact Criteria
- Non Residential Particulate Soil Inhalation Criteria
- Screening locations with no exceedances
- Locations are included within a different geographical area boundary
- Conceptual Site and Geographic Area Boundaries

Xray Fluorescence screening results are from surface soils unless otherwise specified.

N

0 100 Ft

Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC
P.O. Box 577
Houghton, MI 49931

Figure 8b
Soil Screening Location Map
Tamarack Processing Area
Tamarack City, Houghton County, Michigan

DRAFT

FILE: T:\GIS_Projects\MDEQ\20177.001.001_Torch_Lake\mxd\Working Drafts\2015_Hist_TMIF08B_TamarackProcessing_XRF_DRAFTv_20150224.mxd 12:53:30 PM 2/24/2015 BROWNK

Image Source: ESRI World Imagery

TMW-02 11/05/12

Parameter	Result	Units	[Criteria]
COPPER	8	ug/l	[3]
COPPER (DUP)	8.5	ug/l	[3]
IRON	6260	ug/l	[1,2]
IRON (DUP)	6490	ug/l	[1,2]
MANGANESE	1380	ug/l	[1,2,3]
MANGANESE (DUP)	1340	ug/l	[1,2,3]
VANADIUM	5.9	ug/l	[1]
VANADIUM (DUP)	5.9	ug/l	[1]

TMW-03 11/05/12

Parameter	Result	Units	[Criteria]
COPPER	12.6	ug/l	[3]
MANGANESE	420	ug/l	[1,2]

TMW-01 11/06/12

Parameter	Result	Units	[Criteria]
MANGANESE	114	ug/l	[1,2]

TMW-05

Map Extent

MDEQ Part 201 Cleanup Criteria for Response Action
1=Residential Drinking Water Criteria
2=Nonresidential Drinking Water Criteria
3=Groundwater Surface Water Interface Criteria
4=Water Solubility
5=Residential Groundwater Vol to Indoor Air Inhalation
6=Nonresidential Groundwater Vol to Indoor Air Inhalation
7=Flammability and Explosivity Screening Level

- Sampling locations with at least one exceedance
- Sampling locations with no exceedances
- Locations are included within a different geographical area boundary

Locations Analyzed for PCBs

- No Detections
- At Least One Detection
- Conceptual Site and Geographic Area Boundaries

Notes:
MG/L = milligrams per liter
UG/L = micrograms per liter
[#-#] = screen intervals
bgs = below ground surface

N

0 600 Ft

Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
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Houghton, MI 49931

Figure 9
Groundwater Sample Location Map
Tamarack Processing Area
Tamarack City, Houghton County, Michigan

DRAFT

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Image Source: ESRI World Imagery

Hub-S1-12 09/12/07

Depth	Parameter	Result	Units	[Criteria]
0-0	ALUMINUM	15000	mg/kg	[4,11]
0-0	ARSENIC	4.8	mg/kg	[2,4,11]
0-0	COBALT	21	mg/kg	[2,4,11]
0-0	COPPER	6000	mg/kg	[2,4,11]
0-0	LITHIUM	12	mg/kg	[2,4,11]
0-0	NICKEL	39	mg/kg	[2]
0-0	ZINC	95	mg/kg	[2]

- Sampling locations with at least one exceedance
- Sampling locations with no exceedances
- Locations are included within a different geographical area boundary

Locations Analyzed for PCBs

- No Detections
- At Least One Detection
- Conceptual Site and Geographic Area Boundaries

Notes:
MG/KG = milligrams per kilogram
UG/KG = micrograms per kilogram
Sample depths shown in feet below ground surface.

N

0 600 Ft

Coordinate System: MIGeoRef(m)

MDEQ Part 201 Cleanup Criteria for Response Action
2=Groundwater Surface Water Interface Protection Criteria
3=Soil Saturation Concentration Screening Levels
4=Residential Drinking Water Protection Criteria
5=Residential Soil Volatilization to Indoor Air Inhalation Criteria (VSIC)
6=Residential Infinite Source Volatile Soil Inhalation Criteria
7=Residential Finite VSIC for 5 Meter Source Thickness
8=Residential Finite VSIC for 2 Meter Source Thickness
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12=Nonresidential Soil Volatilization to Indoor Air Inhalation
13=Nonresidential Infinite Source Volatile Soil Inhalation Criteria
14=Nonresidential Finite VSIC for 5 Meter Source Thickness
15=Nonresidential Finite VSIC for 2 Meter Source Thickness
16=Nonresidential Particulate Soil Inhalation Criteria
17=Nonresidential Direct Contact Criteria

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
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Houghton, MI 49931

Figure 10

Soil Sample Location Map
Tamarack Sands Area
Tamarack City, Houghton County, Michigan

DRAFT

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Houghton, MI 49931

Figure 11
DRAFT
Soil Screening Location Map
Tamarack Sands Area
Tamarack City, Houghton County, Michigan

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Image Source: ESRI World Imagery

Oneco Rd
Conglomerate St
N Amygdaloid St
Tamarack Hill Rd
Maple St
2nd St
M-26
20
S Amygdaloid Rd
Junction Rd
Red Metal Cir
M-26
Junction Rd
M-26
26
M-26
Red Barn Rd

TL08-068
TL08-015
TL08-067
TL08-066
TL08-030

- Sampling locations with at least one exceedance
- Sampling locations with no exceedances
- Locations are included within a different geographical area boundary

Locations Analyzed for PCBs

- No Detections
- At Least One Detection
- Conceptual Site and Geographic Area Boundaries

N

0 625 Ft

Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
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Houghton, MI 49931

Figure 12
Sediment Sample Location Map
Ahmeek Processing Area
Tamarack City, Houghton County, Michigan

DRAFT

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Image Source: ESRI World Imagery

SPMD Site #8 11/17/05
Parameter Result
TOTAL PCBS 10

SPMD Site #3 11/18/05
Parameter Result
TOTAL PCBS 74

SPMD Site #2 11/18/05
Parameter Result
TOTAL PCBS 22

SPMD Site #4 11/18/05
Parameter Result
TOTAL PCBS 150

SPMD Site #5 11/18/05
Parameter Result
TOTAL PCBS 23

SPMD Site #7 11/18/05
Parameter Result
TOTAL PCBS 21

SPMD Site #1 11/18/05
Parameter Result
TOTAL PCBS 77

SPMD Site #6 11/18/05
Parameter Result
TOTAL PCBS 62

SPMD Site #9 11/17/05
Parameter Result
TOTAL PCBS 25

SPMD Site #10 11/18/05
Parameter Result
TOTAL PCBS 23

Map Extents

PCB Congener Data for Walleye in Torch Lake

Sample ID	Collection Date	Length (cm)	Weight (g)	TOTAL PCBC (ppm)
2000096-S10	5/3/2000	43.4	760	0.040
2000096-S11	5/3/2000	46	1000	0.030
2000096-S12	5/3/2000	46.7	900	0.036
2000096-S13	5/3/2000	47	940	0.020
2000096-S14	5/3/2000	47.8	980	0.046
2000096-S15	5/3/2000	52.1	1180	0.373
2000096-S16	5/3/2000	54.1	1480	0.183
2000096-S17	5/3/2000	55.9	1640	0.184
2000096-S18	5/3/2000	55.4	1930	0.039
2000096-S19	5/3/2000	54.1	1620	0.029
2007257-S21	4/25/2007	39.37	520	0.011
2007257-S22	4/25/2007	39.116	620	0.051
2007257-S23	4/25/2007	44.196	680	0.016
2007257-S24	4/25/2007	45.212	860	0.010
2007257-S25	4/25/2007	45.212	710	0.026
2007257-S26	4/25/2007	47.752	1060	0.125
2007257-S27	4/25/2007	50.038	900	0.021
2007257-S28	4/25/2007	52.832	1350	0.077
2007257-S29	4/25/2007	53.086	1180	0.052
2007257-S30	4/25/2007	54.61	1760	0.235
2007257-S31	4/25/2007	54.61	1710	0.039
2007257-S32	4/25/2007	57.912	1770	0.469
2007257-S33	4/25/2007	54.864	1550	0.212
2007257-S34	4/25/2007	58.928	1980	0.206
2007257-S35	4/25/2007	59.69	1920	0.176
2007257-S36	4/25/2007	60.198	1840	0.161
2007257-S37	4/25/2007	61.722	2180	0.271
2007257-S38	4/25/2007	61.722	2180	0.183
2007257-S39	4/25/2007	63.246	2100	0.346
2007257-S40	4/25/2007	63.246	2570	0.206

Sampling Location Type

- Semi-Permeable Membrane Device
- Fish
- Conceptual Site and Geographic Area Boundaries

Notes:
Fish sample location shown is a generalization
All SPMD results presented in ug/l
ug/l = micrograms per liter
PCBC = PCB Congeners

N
0 3 Miles
Coordinate System: MIGeoRef(m)

Prepared for:
Michigan Department of Environmental Quality

Prepared By:
WESTON SOLUTIONS of MICHIGAN, INC
P.O. Box 577
Houghton, MI 49931

Figure 13
PCB Congener Detections
SPMD and Fish Tissue Sampling Locations
Tamarack City, Houghton County, Michigan

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