FINAL CLOSE OUT REPORT

Arrowhead Refinery Co. Superfund Site
Hermantown, Minnesota

March 16, 2021

I. Introduction

This Final Close Out Report documents that the U.S. Environmental Protection Agency (EPA) has determined, in accordance with Close Out Procedures for National Priorities List Sites (OSWER Directive 9320.2-22, May 2011), that all appropriate response actions at the Arrowhead Refinery Co. Superfund Site have been successfully implemented in accordance with EPA's 1986 Record of Decision (ROD) and subsequent 1994 Amendment to the Record of Decision (AROD) modifications.

II. Summary of Site Conditions

Site Background

The Site is located in Hermantown, St. Louis County, Minnesota, eight miles northwest of the City of Duluth (Figure 1). The legal parcel boundaries are set forth in a 1995 Consent Decree that implemented the remedial actions at the Site. The Site is approximately ten acres and is located adjacent to Miller Trunk Highway, also known as U.S. Route 53 or U.S. Highway 53. The original Site facilities were constructed on a filled-in white cedar swamp. The adjacent wetlands are ecologically sensitive with no known endangered species at or near the Site. Surface water across the Site flowed southwest and discharged via a culvert under Highway 53 to a marshy area that joins Rocky Run Creek, a tributary of the Midway River. The Midway River ultimately discharges into the St. Louis River, which empties into Lake Superior. The Site is located in a rural area, with some nearby residential and commercial development. More populated areas are within a few miles. The current zoning and land use for the Site is designated as commercial/industrial. The land uses for the areas surrounding the Site are residential to the south and east sides of the Site and commercial/industrial to the north and west.

Land use at the Site was industrial/commercial prior to 1945. The principal activity at the Site was re-refining of used oil, which occurred from 1945 until operations ceased in 1977. Re-refining of used oil at the Site produced three waste streams: acid sludge, filter cake and process wastewater. On-site disposal of these wastes resulted in a two-acre acid sludge lagoon, a filter cake disposal area, oil-saturated wetland peat, and contaminated sediments, soils, and groundwater. The Site's source materials (including sludge, filter cake and oil-saturated peat) have been excavated, and the sediments and soils have been remediated to a restricted commercial/industrial level and covered with imported topsoil. At the time of the Remedial Investigation (RI), the only buildings on the Site were a former auto body shop and warehouse used by Gopher Oil (see Figure 2). Building demolition was conducted during Phase II of the Remedial Investigation. Currently, the only existing building on the Site is an office/warehouse used by a medical equipment rental company off Highway 53.

Summary of Remedial Action Required by ROD and AROD

The 1986 ROD set forth the following selected remedies:

- Excavation and on-site incineration of 4,600 cubic yards of sludge and 20,500 cubic yards of contaminated soils and sediments.
- A groundwater pump and treat system designed to restore the aquifer and control contaminant migration over a 20-50 year period.
- Extension of a nearby municipal water system to replace those private water supplies most likely to be affected by groundwater contamination from the Arrowhead Site.
- Proper abandonment in accordance with state well codes of individual wells formerly used as drinking water supplies.

The 1994 AROD set forth the following selected remedial actions:

- Excavation of sludge and filter cake using a visually contaminated standard; total volume approximately 4,600 – 6,100 cubic yards.
- On-site treatment of sludge and filter cake by chemical disassociation (re-refining) of the toxic compounds within the sludge/filter cake matrix to produce a saleable "off-specification" fuel and to recover lead in a smelting operation or to stabilize and place in a permitted RCRA Subtitle D facility.
- Excavation of visually-contaminated soils and sediments, followed by placement of soils and sediments in a permitted RCRA Subtitle D facility.
- Change groundwater remedy from 1986 ROD as follows: operation and maintenance of the groundwater extraction and treatment system until groundwater at the site perimeter meets Maximum Contamination Limits (MCLs).

Remedial Actions

Contaminated media at the Site included the source material (including sludge, filter cake and oil-saturated peat), soils, sediments, and groundwater. A complete list of contaminants of concern (COCs) can be found in Table 2 in the attachments. The 1986 RI Report included a public health evaluation. The RI determined that remedial actions (RAs) were required for the source material, soil, sediments, and groundwater for the following reasons (CH2M Hill, 1986a).

- The acid sludge lagoon was found to contain polynuclear aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and heavy metals (primarily lead). The lagoon acted as a potential source for future soil and water impacts and possible air impacts, as well as a direct contact threat in the form of acid burns and direct exposure to the contaminants listed above. In addition, the lagoon was causing obvious environmental damage including trapping birds in the tarry substance.

- Leaching of contaminants from the wastewater ditch and the sludge lagoon into groundwater caused groundwater beneath the Site to exceed federal drinking water standards and criteria, including the then current and proposed MCLs. Specifically, carcinogenic PAHs in some groundwater samples exceeded the 10^{-6} excess lifetime cancer risk (1 in 1,000,000). Concentrations of non-carcinogens including cadmium, lead, and manganese were elevated and potentially posed health risks.

- Soil concentrations were elevated such that estimated soil exposure exceeded lifetime cancer risks for both commercial and residential use. Elevated soil concentrations were primarily located in the process area. Estimated intakes of some non-carcinogens (e.g. lead, cadmium, xylene, and barium) also exceeded the acceptable intake criteria.

There was potential for impact to downgradient off-site private wells from contaminated groundwater migrating across the Site property boundary and Highway 53. Estimated arrival times to two private wells south of Highway 53 was between 15 and 40 years. Future use of these private wells without remedial action at the Site would have exposed residents to contaminant concentrations resulting in a cancer risk exceeding the upper end of EPA's generally acceptable risk (1 in 10,000).

The potentially responsible parties (PRPs), represented by the Arrowhead Refinery Assessment Group (ARAG), Minnesota Pollution Control Agency (MPCA), and EPA signed a mixed work Consent Decree that was entered by the court in 1995. The Consent Decree sets forth respective roles for implementation of the 1994 AROD (USDC, 1995). In general, the responsibilities were set forth as follows: ARAG was required to excavate and treat all source material; EPA was listed as responsible for excavating and disposing of visibly contaminated soils and sediments, and stabilizing and disposing of source material residuals; and MPCA was responsible for operating and maintaining the groundwater extraction system, and performing long-term groundwater monitoring.

Source Material Remedial Action

ARAG performed the source material remedial action in accordance with the 1994 AROD and the 1995 Consent Decree. ARAG contracted with 7-7, Inc. to excavate the sludge lagoon, the filter cake disposal area, and oil-saturated peats, and perform re-refinement of the oil recovered from source materials (7-7, Inc., 1997) as specified in the 1994 AROD. EPA performed stabilization and disposal of all source material remedial activities as specified in the Consent Decree.

The 1994 AROD specifically required that all visibly contaminated source material be excavated, liquefied, neutralized, and homogenized with diluent and neutralizing agents on-site in the areas of the sludge lagoon, the process area, and the wastewater ditch. The material was then to be conditioned with a precipitating agent, clarified, and the decant liquid was to be offered for sale as off-specification fuel. The solids were to be filtered, dried, and stabilized for disposal off-site in a Resource Conservation and Recovery Act Subtitle D landfill (EPA, 1994).

ARAG initiated Source Material RA in June 1995. Barr Engineering served as the main contractor to ARAG. Barr executed a subcontract with 7-7, Inc., which conducted the RA. Between June 1995 and July 1996, a total of 7,025.8 tons of source material was processed, yielding 1,105,349 gallons of off-spec fuel product. Additionally, 5,334 cu. yds. of hazardous debris and 843 tons of non-hazardous debris were shipped off-site for disposal. An inspection meeting was held on June 14, 1996 with the Remedial Project Manager (RPM), CH2M Hill, ARAG, and MPCA to detail remaining Source Material activities needed for remedial action completion, including confirmatory sampling, final grading and seeding, and submittal of a final survey. All remaining actions were completed by October 1996.

Stabilization and disposal of residuals generated by the Source Material RA commenced under an EPA contract with CH2M Hill on August 9, 1995 and was completed on May 30, 1996. CH2M Hill executed a subcontract with GNB, Inc. to conduct this phase of the work. A total of 4,834 tons of residuals were received by GNB, stabilized and/or disposed of off-site. A total of 532 tons did not require stabilization prior to disposal. Excavation and disposal of contaminated soils and sediments commenced under the same work assignment on June 6, 1996 and was completed on October 30, 1996. A total of 24,327 tons were excavated and disposed off-site. A final inspection was conducted on October 8, 1996 with the RPM, CH2M Hill, ARAG, and MPCA to detail remaining activities needed for remedial action completion, including final surveying of topsoil, and seeding, and demobilization of equipment and supporting utilities.

Upon completion of each phase of excavation for the different source areas, a visual verification was conducted to ensure that no source material remained and that no organic contamination was present. If there was a question about whether discoloration was present, a sample was collected for Toxicity Characteristic Leaching Procedure (TCLP) testing for lead or for carcinogenic PAH analysis. Five such samples were collected, and none of them contained concentrations indicating source material was present. In addition, EPA's contractor, CH2M Hill, collected composite confirmation samples on roughly 70-foot centers for lead analysis. None of these confirmation samples exceeded the cleanup standard of 500 mg/kg (CH2M Hill, 1996a).

The hazardous and non-hazardous debris were transported to Subtitle C and D landfills in Fort Wayne, Indiana, and Rosemont, Minnesota, respectively (7-7, Inc., 1997).

CH2M Hill performed lead stabilization and oversaw disposal of excavated source material residuals (CH2M Hill, 1996a). A total of 4,072 tons of source materials was stabilized using a proprietary chemical lead stabilizing agent. The 4,072 tons and an additional 532 tons of material that did not require stabilization were disposed in off-site Subtitle D landfills.

Contaminated Soil and Sediment Remedial Action

In accordance with the 1994 AROD and the 1995 Consent Decree, EPA performed the contaminated soil and sediment remedial action. CH2M Hill excavated 32,000 tons of visibly stained soil and sediment, of which 24,000 tons were nonhazardous, and 8,000 tons tested chemically hazardous. The hazardous soil and sediment were treated on-site using the same proprietary chemical lead-stabilizing agent used on the source material residuals (CH2M Hill, 1996a). Confirmation sampling of the stabilized soil and sediment was performed to confirm a TCLP-lead concentration of less than 5 milligram per liter (mg/L). All soil and sediment were disposed at a Subtitle D landfill.

During excavation of visibly stained soil and sediment, CH2M Hill collected composite confirmation samples on roughly 70-foot centers. None of the confirmation samples exceeded the cleanup level of 500 mg/kg of lead. No additional excavation was triggered (CH2M Hill, 1996a). In general, visibly contaminated soils were underlain by a blue-gray clay layer which appears to have acted as a vertical barrier to downward contaminant migration.

Groundwater Remedial Action

In accordance with the 1986 ROD and the 1990 Unilateral Administrative Order, the PRP group constructed an extension of the Hermantown water main, starting at the corner of Lavaque Bypass (formerly Ugstad Road) and Highway 53 and extending westward for 3,300 feet. Construction was completed in 1990, and 13 residences and businesses were connected to the water main. Following connection to Hermantown city water, 13 private wells previously in use at the residences were sealed.

In accordance with the 1986 ROD, EPA completed construction of the Site groundwater extraction and treatment system in June 1993. The system consisted of an interceptor trench and French Drain system approximately 850 feet long and 25 feet deep (Bay West, 2009). Groundwater was pumped from the trench from four manholes with sumps and discharged to the Western Lake Superior Sanitary District (WLSSD) sanitary system. The MPCA signed an allocation agreement with the WLSSD to discharge wastewater to the treatment plant under allotted discharge limits. The maximum flow volume discharge allowed was 1.5 million gallons per month. Remediation system monitoring was performed on a weekly basis to obtain flow totalizer readings and pump operation data. Monthly reports of system operation results were submitted to the WLSSD. The system discharge was sampled and analytical results were reported to the WLSSD on a quarterly basis to ensure that WLSSD discharge standards were met.

In accordance with the 1995 Consent Decree, MPCA took over long-term operation and maintenance of the groundwater extraction system in 1996. The purpose of the groundwater extraction system was to prevent contaminated groundwater from migrating beyond the southern Site boundary.

The WLSSD requested the groundwater extraction system be turned off on March 22, 2007 to allow for testing and repairs to be made on the forced sewer main in the area. In April 2007, MPCA approved the Trial Groundwater Extraction System Shut Down Report. As a result, the system remained off and the trial system shutdown monitoring was initiated. At the time that the groundwater extraction system was shutdown, the 1994 AROD cleanup criteria appeared to have been met since concentrations at the Site perimeter were below federal MCLs or applicable Minnesota Department of Health (MDH) Health-Based Values (HBVs), and point of compliance monitoring wells for surface water runoff located at the southern boundary of the Site also had concentrations of contaminants less than the applicable Class 2B chronic concentrations. Fourteen groundwater monitoring events have been performed since that time. In June 2013, MPCA concluded that the groundwater concentrations were below acceptable risk criteria in the compliance monitoring wells and approved the sealing of the remaining monitoring wells associated with the Site. In June 2013, Bay West, the MPCA's contractor, oversaw the abandonment of the remaining 12 monitoring wells and decommissioning of the groundwater extraction trench system along with manholes and control house associated with the Site.

Site Cleanup and Restoration

During source material, soil, and sediment excavation and treatment, additional Site activities were performed, consisting of: abandonment of four monitoring well clusters (comprising 16

monitoring wells) inside the excavation footprints; disposing of 161 55-gallon waste drums associated with prior Site investigations; disposing of 56 55-gallon waste drums and pails from the Gopher Oil building; discharging decontamination water, groundwater, and stormwater generated during the remedial activities to the WLSSD sanitary sewer; disposing of a buried open-top railroad car containing oil-saturated sands; disposing of one underground storage tank; demolition of two buildings used as auto body shops and removal of associated above ground storage tanks, debris, and oil-stained soil (CH2M Hill, 1996a).

At the conclusion of excavation work, a total of 48,050 tons of imported backfill were placed on the Site, compacted, graded, overlain with 4 to 6 inches of topsoil, seeded with grasses, mulched, and fertilized. A final Site grade was constructed, sloping slightly to the southwest (CH2M Hill, 1996a).

The Site is currently being used for commercial purposes with a medical equipment rental company office at the Site. The remainder of the Site is an open, overgrown field, with a drainage ditch north of the office building.

In summary, all remedial actions required by the ROD and AROD for the Site are complete. The source material remedy was completed from April 1995 through December 1996. 46,000 tons of waste were sent off-site for off-site use and disposal. The contaminated soils and sediments remedy was completed from January to November of 1996. 24,783 tons of contaminated soil and sediment were sent off-site for disposal. Construction of the Hermantown water main was completed in 1990, and 13 residences and businesses were connected to the water main. Construction of the groundwater extraction and treatment system was completed in June 1993. This system operated until 2007, when MPCA initiated a trial shutdown period. No concentration rebound occurred in the monitoring wells, and in 2011 MPCA decommissioned the groundwater extraction and treatment system. Because groundwater concentrations continued to meet Applicable or Relevant and Appropriate Requirements (ARARs) and remained below acceptable risk criteria, MPCA discontinued groundwater monitoring in 2013 and properly abandoned the monitoring wells.

Institutional Controls

The 1994 AROD required institutional controls (ICs) to ensure the protectiveness of the remedial actions. The AROD states: “Place deed restrictions on-site to ensure that the Site remains zoned for commercial/industrial development only.” ICs are non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for exposure to contamination and that protect the integrity of the remedy. ICs are required to assure the long-term protectiveness for any areas which do not allow for unlimited use and unrestricted exposure (UU/UE) due to potential residual contamination two feet below ground surface (bgs). Table 1 below summarizes ICs for restricted areas at the Site.

Table 1: Summary of Planned and/or Implemented ICs

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
On-Site Groundwater	Yes	Yes	Entire site (PID Nos. 395-0010-00820, 395-0010-00822, 395-0010-00854 and 395-0010-00853)	Restrict installation of groundwater wells and groundwater use.	Commercial/ industrial zoning (complete) Consent Decree, Access Agreements, Mailed Notices (complete) Affidavit, General Information on File with County (complete) Environmental Covenant and Easement (executed 2/19/2021)
On-Site Soils	Yes	Yes	Entire site (PID Nos. 395-0010-00820, 395-0010-00822, 395-0010-00854 and 395-0010-00853)	Restrict residential use of on-site property. Prohibit disturbance of soils.	Commercial/ industrial zoning (complete) Consent Decree, Access Agreements, Mailed Notices (complete) Affidavit, General Information on File with County (complete) Environmental Covenant and Easement (executed 02/19/2021)

Status of Access Restrictions and ICs: MPCA and the property owner have signed an EPA approved Environmental Covenant and Easement (ECA) for the Site, and the ECA was recorded with St. Louis County on February 19, 2021. The ECA prohibits disturbance of soils and use of groundwater wells at the Site. A map showing the area in which the ICs and the EC applies is included as Figure 3.

Current Compliance: The Site is currently in compliance with proposed use restrictions. During its last Site inspection in May 2017, EPA did not observe any groundwater wells installed at the Site. The soil has not been disturbed. The property is being used for commercial purposes in accordance with current zoning designation.

Long Term Stewardship: MPCA is currently operating under a 2013 Long-Term Stewardship (LTS) Plan (Bay West, 2013). The LTS Plan for this Site includes two ICs. Development at the Site is currently controlled through zoning to C1 Commercial and Light Industrial businesses which aligns with the industrial clean-up criteria used at the Site. Notification to future property

owners is controlled through an affidavit and copy of the Consent Decree recorded with the property deed. The Site is managed through the MPCA's performance of bi-annual inspections and an annual advisory mailing to local government agencies and adjacent properties. In combination with the EC, these ICs limit the potential risk to human health and the environment.

III. Monitoring Results

MPCA performed regular groundwater monitoring sampling events beginning in 1996 when it took over the Site from the PRP group. Groundwater analytical results indicated that starting in April 2004 the concentrations of VOCs in groundwater were below corresponding MCLs, Health Risk Limits (HRLs), and HBVs, with the exception of 1,4-dioxane at MPCA-4B and MPCA-5B, and vinyl chloride at MW-14A. In addition, starting in April 2004, dissolved arsenic concentrations were below corresponding MCLs, HRLs, and HBVs in all wells except at MPCA-4B and MPCA-5B (Bay West, 2007).

The groundwater remedial action was supplemented by performing an updated receptor survey in 2004 (Bay West, 2005). The updated receptor survey investigated residential properties 1,500 feet from the Site boundaries to the west, south, and east. A total of 10 off-site private water supply wells were identified during the survey. Of the 10 residential water wells, 9 are cross-gradient to upgradient of the Site. Of these 9 wells, the well at 5298 Miller Trunk Highway is closest to the Site at 750 feet southeast of the groundwater extraction system control house. However, a meeting with the homeowner revealed that the well had been abandoned since 2006. The only well located downgradient to cross-gradient of the Site, at 4463 Ugstad Road, serves one residence and a nine-unit mobile home community. This well was considered more likely to receive groundwater that was historically captured by the groundwater extraction system than the other nine wells identified in the survey. Although sampling of monitoring wells between the Site and this residential well did not indicate that contaminants of concern had migrated beyond the interceptor trench, this well was included in the sampling plan for performance monitoring associated with the 2007 Trial Groundwater Extraction System Shut-Down (Bay West, 2009).

All contaminant concentrations sampled in 2013 were below the ARARs and to be considered (TBC) criteria listed in the 1986 ROD and 1994 AROD; however, two wells had concentrations above more recent screening levels (MDH HRLs). MW10-A had concentrations exceeding the 2013 MDH HRL for 1,4-dioxane (3.5 µg/L), but below the then current HBV of 30 µg/L. This well is off-Site across Highway 53, on the shoulder of the highway. Downstream wells were non-detect for 1,4-dioxane for all sampling events spanning 2008 through 2013, and groundwater flows toward a wetland. Therefore, there is no complete exposure pathway and no increased human health risk. Future exposure is not a concern. Monitoring Well MPCA-3S had concentration exceedances of the MDH HBV for Diesel Range Organics (200 µg/L). This well is on-Site and not a human health concern due to the current institutional controls in place at the Site.

IV. ATTAINMENT OF GROUNDWATER RESTORATION CLEANUP LEVELS

In June 2013, MPCA concluded that the groundwater concentrations were below acceptable risk criteria in the perimeter monitoring wells and approved the sealing of the remaining monitoring

wells associated with the Site (on-site and across Highway 53 at the trailer home park). See Section III. Monitoring Results for discussion of groundwater criteria that were met.

V. SUMMARY OF OPERATION AND MAINTENANCE REQUIRED

MPCA is currently operating under a 2013 LTS Plan (Bay West, 2013). The LTS Plan for this Site includes two ICs. IC#1includes an interview with the owner and a Site inspection in May and November of each year. IC#2 will include drafting and mailing/emailing advisories to entities associated with the Site through ownership, proximity, or regulatory oversight. Development at the Site is currently controlled through zoning to C1 Commercial and Light Industrial businesses which aligns with the industrial clean-up criteria used at the Site. Notification to future property owners is controlled through an affidavit and consent decree recorded with the property deed. The ICs listed above are being implemented by MPCA. In combination, these ICs are designed to limit the potential risk to human health or the environment.

VI. DEMONSTRATION OF CLEANUP ACTIVITY QUALITY ASSURANCE AND QUALITY CONTROL

There were four performance standards for each RA, and numerous construction quality control measures that were implemented during each RA. These are described below.

A. Standard No. 1-Removal of Visibly Contaminated Soil Containing Lead Greater than 500 ppm

1. Source Material RA

EPA's contractor, CH2M Hill, collected soil verification samples from the bottom of the sludge lagoon once ARAG's contractors, 7-7, Inc. and Barr Engineering, informed EPA that all the source material from an area of the lagoon had been removed. The excavated area was temporarily bermed off from adjacent contaminated areas until analytical results were obtained that indicated the soil lead content was less than 500 ppm. If the lead result was greater than 500 ppm, CH2M HILL excavated 1 foot of soil from the entire area represented by the sample and collected a subsequent sample in the same location. 7-7, Inc. was allowed to backfill once the soil underlying the former sludge lagoon met the 500 ppm lead cleanup level.

The Cleanup Verification Plan, included in the Remedial Design (RD), required that verification samples be located on 70-foot centers in a grid pattern. Because of the impracticality of excavating the viscous sludge material within a grid pattern, CH2M HILL collected verification samples in areas roughly 70 feet square as they were excavated by 7-7, Inc. Each sample was a composite of soil collected from the four corners of an imaginary square placed around each sample point. The average remaining lead content of the soils underlying the former sludge lagoon is 56 ppm.

If it was ambiguous to CH2M Hill and 7-7, Inc./Barr field whether material was source material, a sample was collected for TCLP lead, or carcinogenic PAH (cPAH) analysis. Five samples were collected for such classification purposes. Analytical results indicated that the materials in

question were not source material; i.e., TCLP- lead results were less than 5 mg/L, cPAHs were less than 57 ppm, and individual cPAHs were less than 5.7 ppm.

2. Contaminated Soils and Sediments RA

CH2M Hill, on behalf of EPA, collected verification soil samples from the bottom of excavations and from sidewalls when all visibly contaminated soil had been removed. The samples were collected within a grid pattern established on 70-foot intervals. As during the sludge lagoon verification sampling, each sample was collected as a composite sample, with soil collected from the four corners of an imaginary square around each sample point at 1 foot from the center.

Residual lead in the soil was found to be relatively low, with an average concentration of 45 ppm. No additional excavation was triggered during the Soils/Sediments RA as all soil verification samples were below the 500 ppm cleanup standard. In general, visibly contaminated soils were underlain by a blue gray clay layer, which appears to have acted as a barrier to further contaminant migration.

B. Standard No. 2 - Hazardous Material Management Criteria

1. Source Material RA

Benchtop and pilot test studies conducted during the remedial design indicated that the residuals generated in the Source Material RA would be characteristically hazardous for lead, as TCLP results for lead exceeded the RCRA hazardous waste classification of 5 mg/L. Thus, all residuals received from 7-7, Inc. were managed as hazardous material, unless occasional sampling (every 50 tons of residuals initially, subsequently relaxed to every 250 tons) demonstrated that a load was not characteristically hazardous.

Hazardous residuals were stabilized on-site by mechanically mixing the residuals with a proprietary chemical additive from GNB Environmental Services, Inc. of St. Paul, Minnesota. Once mixing was complete and the lead was essentially bound up during the stabilization process, a representative sample was analyzed for TCLP lead to determine if the soil had been successfully treated. If the TCLP lead sample result was less than the 5.0 mg/L RCRA criterion, the soil was no longer characteristically hazardous for lead and was disposed in a Subtitle D landfill. If the post-stabilized sample was greater than the 5.0 mg/L RCRA criterion, the pile of residuals represented by that sample was treated again, and resampled, until the pile met the TCLP lead criterion for Subtitle D disposal.

A post-stabilization sample was analyzed for every 60 tons of treated residuals.

2. Contaminated Soils and Sediment RA

The mobilization activities conducted by CH2M Hill, on behalf of EPA, for the Soils and Sediments RA included establishing a grid system over the construction area. To gain landfill acceptance of the contaminated soils and sediment, surficial and subsurface soil samples were collected from seven areas within the grid cells. The soil samples were analyzed for VOCs and TCLP lead. Based on a TCLP lead sample result of 10 mg/L in a sample collected near the sludge lagoon, additional sampling was conducted in that area to define the extent of soils deemed characteristically hazardous due to lead.

Roughly 8,000 tons of soil were classified as hazardous based on the TCLP lead sampling. The soil was stabilized on-site and disposed in a Subtitle D landfill with the nonhazardous soil once post-stabilization testing verified that the soil was no longer characteristically hazardous for lead.

C. Standard No. 3 - Water Discharge Standards

Decontamination water, groundwater, and stormwater generated or encountered during the RA was collected and sampled prior to discharge to WLSSD. During the Source Material RA, water samples were collected at the frequency specified in the Table 1.

During the Soils and Sediments RA, CH2M HILL requested from and was given permission by WLSSD to relax the frequency of sampling for rainwater collected in the on-site wastewater ditch, or in an open excavation area, if the initial sample from that area was below the criteria, and the soil within the ditch or excavation was not disturbed. Sample results indicated that pretreatment of the water was not required to meet the WLSSD discharge standards listed below, and the water was discharged into the groundwater extraction system force main. Sample results were forwarded to WLSSD as they were received from the laboratory, and the water discharge pumping log was forwarded regularly to the MPCA.

Table 1: WLSSD Discharge Requirements and Sampling Frequency

Compounds	Test Method	Discharge Standard
VOCs	MDH 465E	Sum of all analytes shall be less than 10 mg/L
PAHs	EPA 610	All individual analytes shall be less than 3 mg/L
PCBs	EPA 608	Less than 0.2 µg/L
BETX	EPA 8020	Sum of all analytes shall be less than 10 mg/L All individual analytes shall be less than 3 mg/L
DRO, GRO	Wis DNR Modified	Both less than 100 ppm
Lead	EPA 7420	Less than 3 mg/L
Mercury	EPA 245.1	Less than 0.0003 mg/L
Compounds	**Sampling and Analysis Frequency**	
BETX*, DRO, GRO, Lead	Every 25,000 gallons for the first 100,000 gallons, then every 50,000 gallons	
VOCs, PAHs, PCBs,	Every 100,000 gallons	

*Would not be performed every 100,000 gallons because it would duplicate the VOCs analysis.

**Benzene, Ethylbenzene, Toluene and Xylenes (BTEX), Diesel Range Organics (DRO), Gasoline Range Organics (GRO)

D. Standard No. 4-Fenceline Air Quality Standard

A total estimated carcinogenic risk of 1×10^{-4} and a noncarcinogenic hazard index of 1 for inhalation at the Site fenceline were established as limits for air emissions. Air monitoring conducted by CH2M Hill during the three Remedial Actions showed that the overall risk at the fenceline did not exceed these criteria. The air monitoring activities and results are

described in the Source Material Remedial Action Air Monitoring Report (CH2M Hill, 1996a).

E. Construction Quality Control

The Construction Quality Control Plan and technical specifications prepared during the soils and sediments remedial design, set additional criteria and standards to be met in the subsequent remedial action. The major requirements and a description of how they were met are set forth in Table 2.

Table 2: Construction Quality Control Plan Technical Specifications

Criteria	Achievement	Results
Subtitle D landfill, min. 2'-thick clay liner	Lake Area Landfill-Phase I Elk River Landfill-Phase II	Landfill certification letters and waste acceptance letters in Appendix E of Soils OU Remedial Action Completion Report (RACR) (CH2M Hill 1996a)
Verify buildings asbestos-free prior to demolition and disposal	Samples collected by certified asbestos inspector	No asbestos detected, results in Appendix F of Soils OU RACR (CH2M Hill 1996a)
Backfill Material contain < 100 ppm lead, < 1 ppm cPAHs, < 10 ppm GRO/PVOC Standard Proctor Compaction	Samples below criteria for lead, cPAHs, and GRO/PVOC Met specification	Results in Appendix G of Soils OU RACR (CH2M Hill 1996a)
Topsoil particle size analysis	Met specifications	Results in Appendix H of Soils OU RACR (CH2M Hill 1996a)

The QA/QC program utilized through the Source Material and the Soils and Sediments RAs were sufficiently rigorous and were adequately complied with to enable EPA and the State to determine that analytical results reported are accurate to the degree needed to assure satisfactory execution of each RA, consistent with the amended ROD and RD plans and specifications.

VII. FIVE-YEAR REVIEW

FYRs were completed in 1997, 2002, 2007, 2012, and 2017. The protectiveness statement in the 2017 FYR concluded that "conditions at the Site are currently protective of human health and the environment because there is no evidence of exposure or complete exposure pathways at the Site. However, in order for the remedy to be protective in the long-term, the remaining Environmental Covenant and Easement should be signed and recorded. EPA and MPCA are currently working with the landowner to achieve implementation of this IC. Because the Site has not achieved UU/UE, FYRs will continue at the Site."

The ERC was signed in February 2021, thereby achieving the implementation of the IC specified in the 2017 FYR.

VIII. SITE COMPLETION CRITERIA

The Site meets all site completion requirements specified in OSWER Directive 9320.2-22, Close Out Procedures for National Priorities List Sites. All RAOs and associated cleanup goals for the Site have been met and are consistent with Agency policy and guidance. Cleanup actions specified in the ROD and AROD for the Site have been implemented and the Site meets acceptable risk levels for all media and exposure pathways. The implemented ICs and LTS actions required at the Site are consistent with Agency policy and guidance. Therefore, EPA has determined that no further Superfund response is necessary at the Site to protect human health and the environment.

IX. BIBLIOGRAPHY

7-7, Inc., 1997, Completion of Remedial Action Report, Completion of Work Report for the Arrowhead Refinery Site, May 21 (7-7, 1997).

American Engineering Testing, Inc., 2006, Development Response Action Plan, Former Arrowhead Refinery Site, State Hwy 53 and Ugstad Road, Hermantown, Minnesota, July 12 (AET, 2006).

American Engineering Testing, Inc., 2008, Storm Water Pollution Prevention Plan – Response to Non-Compliant Issues, Former Arrowhead Refinery Site, State Hwy 53 and Ugstad Road, Hermantown, Minnesota, June 16 (AET, 2008).

Bay West, Inc., 2005, Updated Receptor Survey, Arrowhead Refinery Superfund Site, Hermantown, Minnesota, January 11 (Bay West, 2005).

Bay West, Inc., 2007, Trial Ground Water Extraction System Shut Down Report, Former Arrowhead Refinery, Hermantown, Minnesota, April (Bay West, 2007).

Bay West, Inc., 2009, 2008 Annual Monitoring Report and Trial Groundwater Extraction System Shutdown Evaluation Report, Arrowhead Refinery, Hermantown, Minnesota, June (Bay West, 2009).

Bay West, Inc., 2010, 2009 Annual Monitoring Report and Additional Direct Push Groundwater Investigation Report, Arrowhead Refinery, Hermantown, Minnesota, June (Bay West, 2010a).

Bay West, Inc., 2010, Institutional Control Evaluation, Former Arrowhead Refinery, Hermantown, Minnesota, August 13 (Bay West, 2010b).

Bay West, Inc., 2012, 2010-2011 Annual Report, Arrowhead Refinery, Hermantown, Minnesota, April (Bay West, 2012).

Bay West, Inc., 2013, Long-Term Stewardship Plan, Arrowhead Refinery, Hermantown, Minnesota, May (Bay West, 2013).

Bay West, Inc., 2014, 2013 Site Inspection Summary Report Prepared as Part of the Long-Term Stewardship Plan, Arrowhead Refinery, Hermantown, Minnesota, March (Bay West, 2014).

CH2M Hill, 1986, Remedial Investigation Report, Arrowhead Refinery Site, Hermantown, Minnesota, August 25 (CH2M Hill, 1986).

CH2M Hill, 1988, Field Design Investigation, Arrowhead Refinery Site, Hermantown, Minnesota (CH2M Hill, 1988).

CH2M Hill, 1996, Phase I Residuals Phase II Contaminated Soils and Sediments Remedial Action Closure Report, Arrowhead Refinery Site, Hermantown, Minnesota, November (CH2M Hill, 1996a).

CH2M Hill, 1996, Source Material Remedial Action Ambient Air Monitoring Final Report, Arrowhead Refinery Site, Hermantown, Minnesota, November (CH2M Hill, 1996b).

Minnesota Pollution Control Agency, 2007, Third Five-Year Review Report for Arrowhead Refinery Site, Hermantown, St. Louis County, Minnesota, September 27 (MPCA, 2007).

U.S. District Court, District of Minnesota, Fifth Division, 1995, Civil Action No. 5-89-CV-202, Consent Decree, March 9 (USDC, 1995).

U.S. EPA, 1994, Amendment to the Record of Decision Declaration, Arrowhead Refinery Superfund Site, St. Louis County, Hermantown, Minnesota (US EPA, 1994).

U.S. EPA, 1996, Superfund Preliminary Closeout Report (Long Term Remedial Action), Arrowhead Refinery Company Superfund Site, Hermantown, Minnesota, December (EPA, 1996).

U.S. EPA, 2017, Fifth Five-Year Review Report for Arrowhead Refinery Site, Hermantown, St. Louis County, Minnesota, August 15 (EPA, 2017).

Approved by:

3/16/2021

X 

Douglas Ballotti, Director
Superfund & Emergency Management Division
Signed by: DOUGLAS BALLOTTI

ATTACHMENTS

Table 2 – List of COCs

Figure 1 – Site Location Map

Figure 2 – Site Contamination Map

Figure 3 – UECA EC Site Map

Table 2

Table 2A

COMPARISON OF GROUNDWATER CONCENTRA STANDARDS, CRITERIA, AND GUIDELINES
ARROWHEAD REFINERY SITE

Chemical Name	Maximum Reported Concentration ug/l	Safe Drinking Water Act Interim Maximum Contaminant Limit (MCL) ug/l	Safe Drinking Water Act Proposed Maximum Contaminant Limit (MCL) ug/l	Safe Drinking Water Act Secondary Maximum Contaminant Limit (MCL) ug/l	Safe Drinking Water Act Recommended Maximum Contaminant Limit (RMCL) ug/l	Clean Water Act Water Quality Criteria (AWQC) for Human Health Adjusted for Drinking Water Only (ug/l)		Safe Drinking Water Act Health Advisories - (ug/l)				
								1 day		10 day		Chronic		Lifetime
						Toxicity Protection	Cancer Risk @ 10[-6]	10-kg Child	70-kg Adult	10-kg Child	70-kg Adult	10-kg Child	70-kg Adult	70-kg Adult
Arsenic	877	50			50P		0.0025	50		50		50	50	50
Barium	660	1,000			1,500P									1,000
Benzene	82		5		0F		0.67	233		233				
Beryllium	33						0.0039							
Bis(2-ethylhexyl)Phthalate	66					21,000								
Cadmium	222	10			5P	10		43		8		5	18	18
Chromium	290	50			120P			1,400		1,400		240	840	170
Copper	523			1,000	1,300P	1,000								
Cyanide	41					200		220		220		220	750	750
Dibutylphthalate	10	•				44,000								
1,2-Dichloroethane	7		5		0F		0.94	240		240		240	2,600	
1,1-Dichloroethene.	25		7		7F		0.0033	1,000		1,000		1,000	3,500	350
Trans-1,2-Dichloroethene	3,500				70P			2,720		1,000		1,000	3,500	350
2,4-Dimethylphenol	300					400								
Dimethylphthalate	38					350,000								
Di-n-butyl Phthalate	10					44,000								
Ethyl benzene	57				680P	2,400		21,000		2,100				3,400
Iron	3,800,000			300										
Lead	722	50			20P	50						10	10	10
Manganese	84,000			50										
Mercury	0.22	2			3P	10								5.5
Methylene Chloride	42						0.19	13,300		1,500				1,750
4-Methylphenol	400					0.10								
Nickel	1,280					15.4				1,000				350
Phenol	400					3,500								
Pyrene	10						•							
Silver	266	50				50								
Toluene	300				2,000P	15,000		18,000		6,000				10,800
Trichloroethene	650		5		0F		2.8							
Vinyl Chloride	720		1		0F		2	2,600		2,600		13	46	
Xylenes	230				440P			12,000		7,000		78,000	27,300	2,200
Zinc	295,000			5,000		5,000								

[a]The Ambient Water Quality Criteria lists 0.0031 ug/l as the criterion for all polynuclear aromatic hydrocarbons (PAH's).
P = Proposed
F = Final

GLT576/5

Table 2B

SOIL (SEDIMENT) CONCENTRATIONS AT WHICH CRITERIA OR RISKS COULD BE MET AT THE ARROWHEAD SITE

Chemicals	Concentrations in mg/kg Based on Potency Derived Cancer Risks at 10^{-4} Risk levels based on a LASI[a] of 0.013	10^{-4} Risk levels based on a LASI[a] of 0.00029	10^{-5} Risk levels based on a LASI[a] of 0.013	10^{-5} Risk levels based on a LASI[a] of 0.00029	10^{-7} Risk levels based on a LASI[a] of 0.013	10^{-7} Risk levels based on a LASI[a] of 0.00029	Concentrations in mg/kg Which Exceed the AIC for 10-kg Child at Soil Ingestion Rates of 0.1 g/day	1.0 g/day	10.0 g/day	Concentrations in mg/kg Which Exceed the AIC for 70-kg Adult at Soil Ingestion Rates of 0.1 g/day
Benzene	170	7,700	1.7	77	0.17	7.7				
Benzo(a)pyrene	0.6	30	0.006	0.3	0.0006	0.03				
Carbon Tetrachloride	57	2,700	0.57	27	0.057	2.7				
Chloroform	116	8,000	1.1	50	0.11	5.0				
Tetrachloroethene	150	6,800	1.5	68	0.15	6.8				
1,1,2-Trichloroethane	130	6,100	1.3	61	0.13	6.1				
Trichloroethene	680	32,000	6.8	320	0.68	32				
Barium							5,100	510	51	35,700
2-Butanone							4,600	460	46	32,200
Cadmium							29	2.9	0.29	200
Carbon Disulfide							11,000	1,100	110	77,000
Chlorobenzene							2,700	270	27	18,900
Chromium							500	50	5	3,500
Copper							3,700	370	37	25,900
Cyanide							2,000	200	20	14,000
1,1-Dichloroethane							12,000	1,200	120	84,000
Ethyl benzene							9,700	970	97	67,900
Lead							140	14	1.4	980
Manganese							22,000	2,200	220	154,000
Mercury							28	2.8	0.28	200
Nickel							10,000	1,000	100	70,000
Toluene							29,000	2,900	290	200,000
Xylene							1,000	100	10	7,000
Zinc							21,000	2,100	210	147,000

[a]Based on lifetime average soil ingestion (LASI) of 0.013 and 0.00029 g/kg body weight/day for a 70-year lifetime. Includes a correction to account for climatic limits on exposure.

AIC = Acceptable intake chronic. The 10 g soil/day represents the intake of a "pica child," the extreme intake situation. The 0.1 and 1.0 g soil/day intakes are probably more representative of young children.

GLT566/17

Figure 1

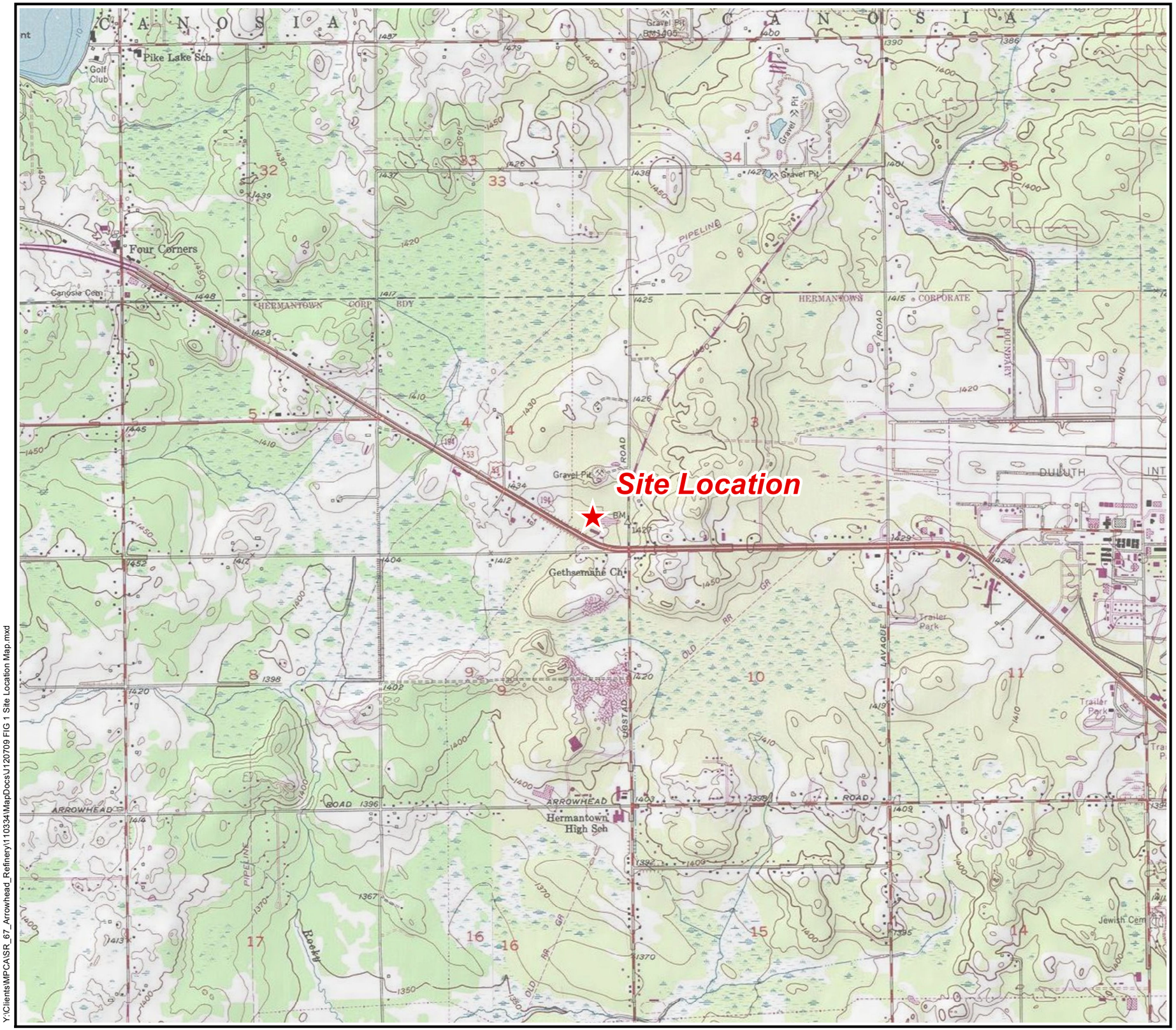


Figure 1

Site Location Map

Arrowhead Refinery
Hermantown, MN

Map Projection: NAD 1983 UTM Zone 15 North

0 2,000 4,000 Feet
0 610 1,220 Meters

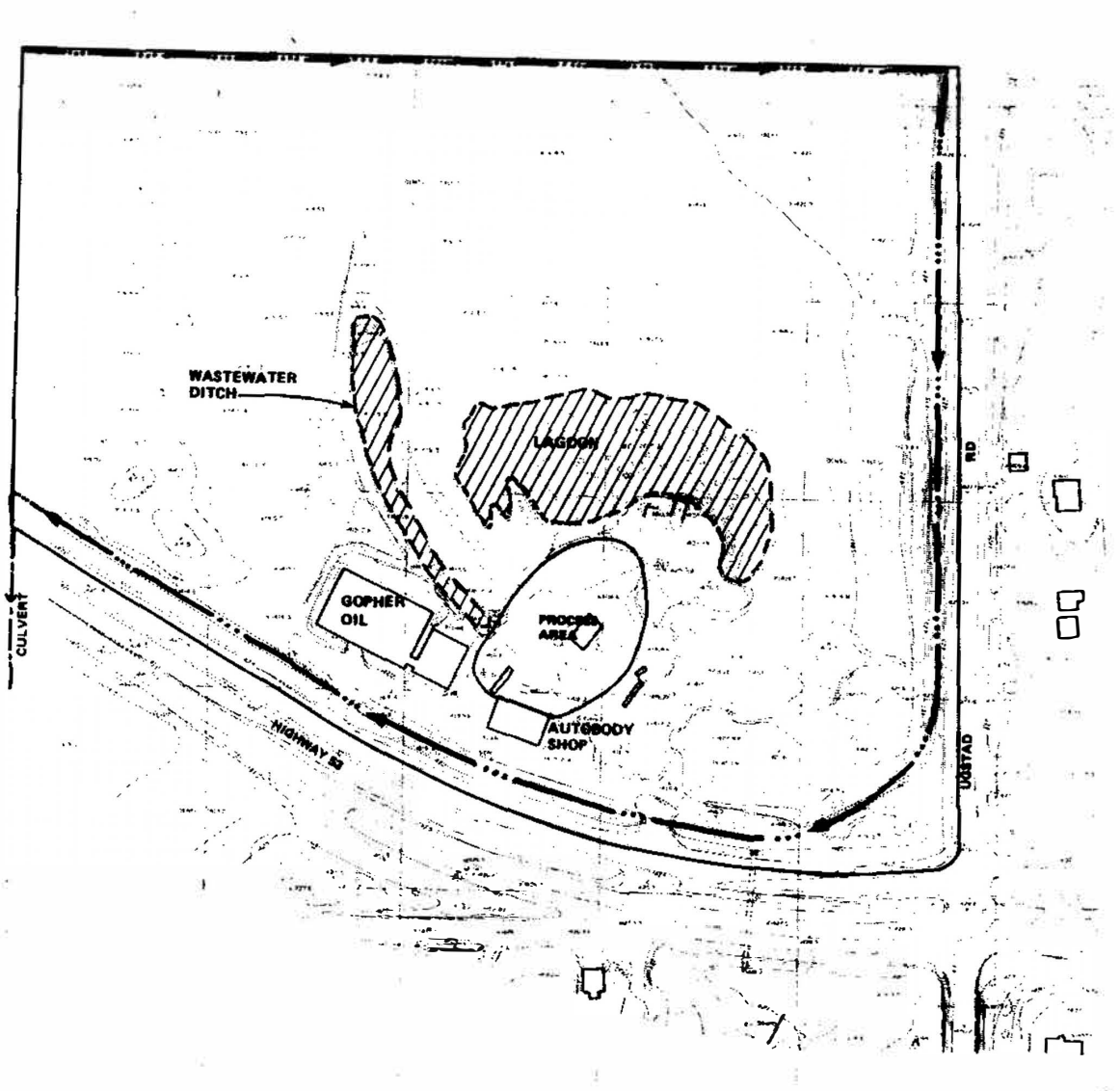
★ Site Location

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: SG Date Drawn/Revised: 5/13/2013 Project No. J120709

Y:\Clients\MPCA\SR_67_Arrowhead_Refinery\110334\MapDocs\J120709 FIG 1 Site Location Map.mxd

Figure 2



LEGEND

EPA DITCH

SITE BOUNDARY

NOTE: Arrows indicate direction of flow.

FIGURE 2
SITE MAP
ARROWHEAD REFINERY RI

Figure 3

Figure 3: Environmental Covenant map