Memorandum

CH2M HILL, Inc.
9191 S. Jamaica Street
Englewood, CO 80112-5946

Subject: **Bathymetric Survey Investigation Work Plan**

Project Name: Velsicol Chemical Corporation/Pine River Superfund Site

Attention: Tom Alcamo/U.S. Environmental Protection Agency (EPA)

From: CH2M HILL, Inc. (CH2M)

Date: February 16, 2022

DCN: GLAES-R5-21F0106-02004

CH2M has prepared this investigation work plan for EPA to describe the methods, procedures, and rationale for the completion of topographic and hydrographic surveying along and within the Pine River at the Velsicol Chemical Corporation/Pine River Superfund Site (site) located in St. Louis, Michigan. The bathymetric survey described in this technical memorandum is necessary to support the remedial design (RD) of the downgradient vertical barrier as described in the June 22, 2012, Record of Decision. This work is being performed under Great Lakes Architect and Engineering Services II Contract 68HE0519D0007, Task Order Number 68HE0521F0106.

1. Site Description

The site (National Superfund Database Identification Number MID00722439) encompasses approximately 100 acres in St. Louis, Michigan, and includes the Former Plant Site (FPS) and a residential area referenced as the adjacent or nearby properties (ANP). The lead agency for the remedial investigation (RI)/feasibility study (FS) was the Michigan Department of Environment, Great Lakes, and Energy. EPA is the lead agency for the ongoing RD and remedial action (RA) efforts for the site.

A chemical manufacturing plant formerly occupied the FPS from the mid-1930s until it was demolished in 1978. Industrial operations at the plant, which included manufacturing of pesticides and fire retardants, resulted in widespread contamination on the FPS. In 1982, the Velsicol Chemical Corporation entered into an administrative order on consent with the United States and the State of Michigan. Pursuant to the administrative order on consent, the Velsicol Chemical Corporation constructed a containment system for the FPS, which included the installation of a low-permeability cap and a 2-foot-thick low-permeability slurry wall around the entire 52-acre FPS.

The FPS is fenced and is bordered on the south and east by the ANP, with Washington Avenue (M-46) along the southern edge. Watson Street and North Street mark the eastern edge, and the Pine River and Mill Pond form the western and northern boundaries. The ANP spans approximately 12 blocks and is primarily composed of residential properties that lie south and east of the former plant boundary. A small number of commercial properties are also located south of the FPS, along M-46 and East Washington Avenue.

The site consists of four operable units (OUs), as shown on Figure 1. The OUs are described as follows:

- OU1—FPS and ANP, for which RD and RA activities are in progress
- OU2—Pine River and Mill Pond sediment adjacent and upstream from the St. Louis hydroelectric dam, for which RA activities were completed in 2006
- OU3—Pine River sediments stretching from the St. Louis hydroelectric dam to approximately 1.25 miles downstream of the dam, for which RI activities are ongoing
- OU4—Pine River sediments stretching from approximately 1.25 miles downstream of the St. Louis hydroelectric dam to the confluence of the Pine, Chippewa, and Tittabawassee rivers, for which RI activities are ongoing

The survey activities described in this technical memorandum will occur within the Pine River, and the results will be used for remedial component design for OU1.

2. Objectives

As described in the Record of Decision, a vertical barrier will be installed around the entire perimeter of the FPS as part of the overall site remedy to decrease the potential for dissolved-phase contaminants in the Shallow Unit to discharge to the Pine River. A conceptual alignment of the downgradient portion of the vertical barrier was illustrated in the FS (Weston, 2011) and shows construction of the vertical barrier downgradient of the existing site slurry wall, within the Pine River. As described in the FS, fill will be placed in the area between the existing ground surface and downgradient vertical barrier and overlain with an engineered cap. The topography of the riverbank and riverbed are not well-documented; therefore, the purpose of the topographic and bathymetric surveying outlined in this investigation work plan is to provide documentation of these features to support future RDs.

3. Field Activities

Bathymetric survey field activities will be performed by Seaworks of Benton Harbor, Michigan. Seaworks will perform all technical aspects of the fieldwork under full-time oversight by CH2M.

The survey area consists of the stretch of the Pine River from the M-46 bridge crossing downstream to the Mill Street bridge crossing and the adjacent riverbank area located along the FPS (Figure 2). Boat access to this stretch of river is limited by the low bridge clearances at the M-46 and Mill Street bridges. Therefore, the subcontractor will use a drone vessel (Z-Boat 1800-RP) to complete the hydrographic survey. The drone will be controlled remotely by a crew who will follow and monitor the vessel from a small boat. Both vessels will be launched from Leppien Park just south of the M-46 bridge, as the vertical clearance at this location is sufficient to allow passage of both vessels into the survey area.

The following subsections provide technical details of the work are. Additional detail can be found in the subcontractor technical proposal (Seaworks Group, LLC, 2022) provided in Attachment 1.

3.1 Survey Control and Benchmarks

Prior to beginning the survey, the subcontractor will establish a minimum of two control points. The subcontractor will conduct survey equipment quality assurance/quality control checks twice daily (prior to commencing and after the completion of daily field surveying activities) by checking the accuracy of Global Positioning System (GPS) equipment at a minimum of one control point with established survey control. The subcontractor will use a previously georeferenced monument or historical marker located in the vicinity of the project reach as one of the control points.

Figure 2 shows previously established survey control points. The existing survey control will be reused for surveying activities, if practicable. If the existing survey control points are no longer usable, the subcontractor will establish new local control points.

3.2 Multibeam Bathymetric Survey and High-resolution Side-scan Imaging

The subcontractor will perform a multibeam bathymetry survey with side-scan imagery within the area shown on Figure 2. The surveying extent will extend 500 feet upstream and downstream of extents shown on Figure 2. This task is required to produce a confident digital terrain model (DTM) of the current sediment conditions through multibeam hydrographic surveying techniques. Side-scan sonar imaging will be conducted to identify riverbed structures, locations of debris and surface utilities, and shoreline characteristics.

The subcontractor will conduct the multibeam survey and side-scan imaging with 200 percent acoustic coverage (100 percent overlap) of transects. If drastic changes are noticed in the sediment terrain or conditions, additional transects will be surveyed to enhance the sediment DTM surface and side-scan imaging in these areas. The subcontractor will conduct survey tasks as close to shore as feasible without endangering safety or damaging equipment. Side-scan imagery resolution will be collected at a resolution of 6 inches or finer to identify structures along the shoreline, as well as exposed objects within the riverbed. As part of equipment calibration procedures, manual water depth measurements will be collected prior to commencing the survey to verify echo-sounder readings used for the survey or associated multibeam quality assurance/quality control procedures.

In areas within the proposed survey boundary where shallow water or obstructions (for example, aquatic vegetation) inhibit multibeam bathymetry surveying techniques, a single-beam echo-sounder of similar frequency will be deployed. Use of static survey shots of water elevation and water depth will be completed as required within a normalized grid pattern. The grid pattern spacing will be approved by CH2M in consultation with the subcontractor prior to implementation to ensure that the data density provides adequate resolution of the sediment surface and any unique slope break features to meet project objectives.

3.3 Underwater Magnetometer Survey

Magnetometer surveying will be performed within the limits, as shown on Figure 2. The survey will be conducted using electronic equipment aboard a survey vessel and will extend as close to shore as feasible without endangering safety or damaging equipment. Surveys shall be conducted with a cesium or Oberhausen magnetometer with a sensitivity of 1.0 gamma or less. Transect spacing will be no greater than 25 feet, with data sampling collected at intervals of 1 second or less. Magnetometer equipment will be towed above the river bottom and at a distance no less than 1.5 times the towing vessel length to minimize signal interference by the vessel itself.

3.4 Topographic Survey

The subcontractor will perform a topographic survey of the east and south shorelines (that is, those along the FPS) along the bathymetric survey area shown on Figure 2 for integration into bathymetric survey data. This survey data will also be used in future design work for the FPS containment system, including the installation of a vertical barrier wall and construction of an engineered cap. At a minimum, the top and toe of defined banks, as well as any significant natural slope breaks, will be surveyed to appropriately capture adequate resolution of river geomorphic features, slope breaks, and upland contours such that the survey results generate a seamless transition when mapping elevation contours from water to land.

The subcontractor will conduct Total Station and GPS field surveys as necessary to generate topographic and planimetric base mapping of the designated survey area. The objective for this task is the delivery of a planimetric and topographic mapping DTM with a scale of 1 inch = 20 feet and 0.5-foot contour interval specifications.

3.5 Field Documentation

The Field Team Leader or designee(s) will record information pertinent to field activities in a field logbook. The following information will be included:

- Heading including date, project name, specific task, client, and physical location
- Site conditions, health and safety tailgate topics, and quality tailgate topics
- Names, titles, and organization of personnel onsite, names and titles of visitors, and times of visits
- Field observations, time of specific activities, details on surveying activities performed, references to field forms used or type of document generated, and lists and descriptions of photographs taken to document field activities
- Specific problems, including equipment malfunctions and their resolutions
- Unexpected or adverse field conditions that may inhibit the field team's ability to perform the day's activity or that may affect the accuracy of the data collected
- Decontamination

Additional information may be recorded at the discretion of the logbook user. Erroneous markings will be crossed out with a single line and initialed and dated by the author.

3.5.1 Standard Field Data Forms

Standard forms will be completed in the field, as applicable, in addition to the field logbooks.
The following standard field data forms will be completed as necessary and are included in Attachment 2:

- U.S. EPA Great Lakes National Program Office (GLNPO) Locational Data Checklist and Metadata Recording Form. All survey data collected for Great Lakes National Program Office projects require this form to be completed. The requirement applies to CH2M and any subcontractors that will be collecting locational data (that is, point data, hydrographic, topographic). The form must be completed for each GPS unit used. The CH2M Field Team Leader will ensure this form is completed by the subcontractor for each GPS unit that is used.
- Photo log.

The field forms ensure necessary data are recorded consistently throughout the field task. No blank spaces will appear on completed forms. If information requested is not applicable, the space will be marked with a dashed line or marked “N/A.”

Field personnel will submit field forms daily to the Project Manager/Assistant Project Manager, who will review the data sheets to ensure all necessary information has been recorded. Completed and reviewed field forms will be filed onsite in a project-specific file.

At the conclusion of the event, scanned copies of all field records and photos also will be uploaded to a specified location on the project’s Microsoft Teams site.

4. Decontamination

The subcontractor will be responsible for providing appropriate decontamination tools, equipment, solutions, containers, and supplies. All vessels, equipment, and appurtenances will be decontaminated prior to arrival at the site. If equipment exhibits obvious signs of potential contamination from another site (for example, sediment and aquatic vegetation), work will not commence until the equipment has been cleaned. The subcontractor will decontaminate all their equipment, vessels, and vehicles. Vessels will be free of sediment, aquatic vegetation, and bilge water before leaving the site.

5. Health and Safety

CH2M and its subcontractors will abide by U.S. Occupational Safety and Health Administration regulations and the site-specific health and safety plan (HASP; CH2M, 2021). The HASP will be kept onsite during all field activities, and a copy will be maintained in the project files. Prior to onsite field activities, CH2M field personnel and subcontractor personnel will conduct a field chartering meeting in which the scope of work and site- and task-specific hazards are reviewed.

5.1 Personal Protective Equipment

Personal protective equipment must be worn by field personnel at all times when actual or potential hazards exist. All field personnel will refer to and follow procedures outlined in the HASP (CH2M, 2021). Fieldwork for this investigation will be performed in Modified Level D:

- Work clothes or cotton overalls
- Personal flotation device when working on or near water
- Safety-toe, chemical-resistant boots, or safety-toe leatherwork boots with outer rubber boot covers
- Surgical-style nitrile gloves (if handling contaminated media or equipment that has come into contact with contaminated media)
- Hardhat (if working within in situ thermal treatment areas that are being decommissioned)
- Safety glasses with side-shield protection

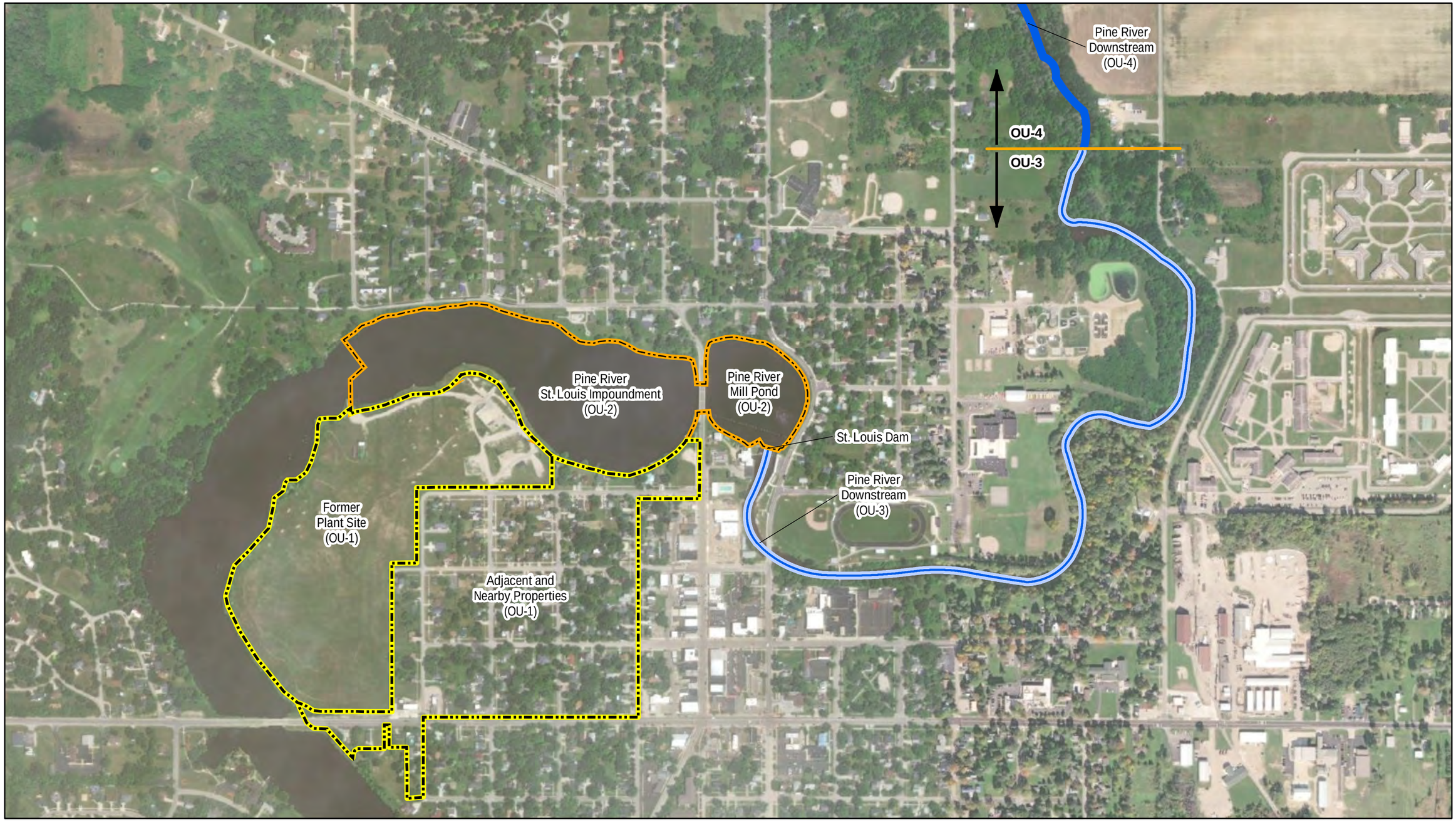
6. References

CH2M HILL, Inc. (CH2M). 2021. *Health and Safety Plan, Velsicol Chemical Corporation Superfund Site, Former Plant Site Remedial Design, St. Louis, Michigan.* September.

Seaworks Group, LLC. 2022. *Technical Proposal – Velsicol Chemical Superfund Site, St. Louis, Michigan, Remedial Design.* January.

Weston Solutions of Michigan, Inc. (Weston). 2011. *Feasibility Study Operable Unit One, Velsicol Chemical Corporation Superfund Site, St. Louis, Gratiot County, Michigan*. November.

Figures



Legend

- FORMER PLANT SITE AND ADJACENT AND NEARBY PROPERTIES (OU1)
- PINE RIVER - ST LOUIS IMPOUNDMENT (OU2)
- PINE RIVER (OU3)
- PINE RIVER (OU4)

N

0 600 1,200

Feet

FIGURE 1
Study Areas and Operable Units
Velsicol Chemical Corporation Superfund Site
St. Louis, Michigan

Document Path - MKE - \\Hercules: \\dc1vs01\GISProj\E\EPA\Velsicol_SuperfundSite\Reports\2021\QAPP\MapFiles\Figure01_Study Areas and Operable Units.mxd User Name: mpetersh Date: 8/27/2021 Time: 3:47:13 PM

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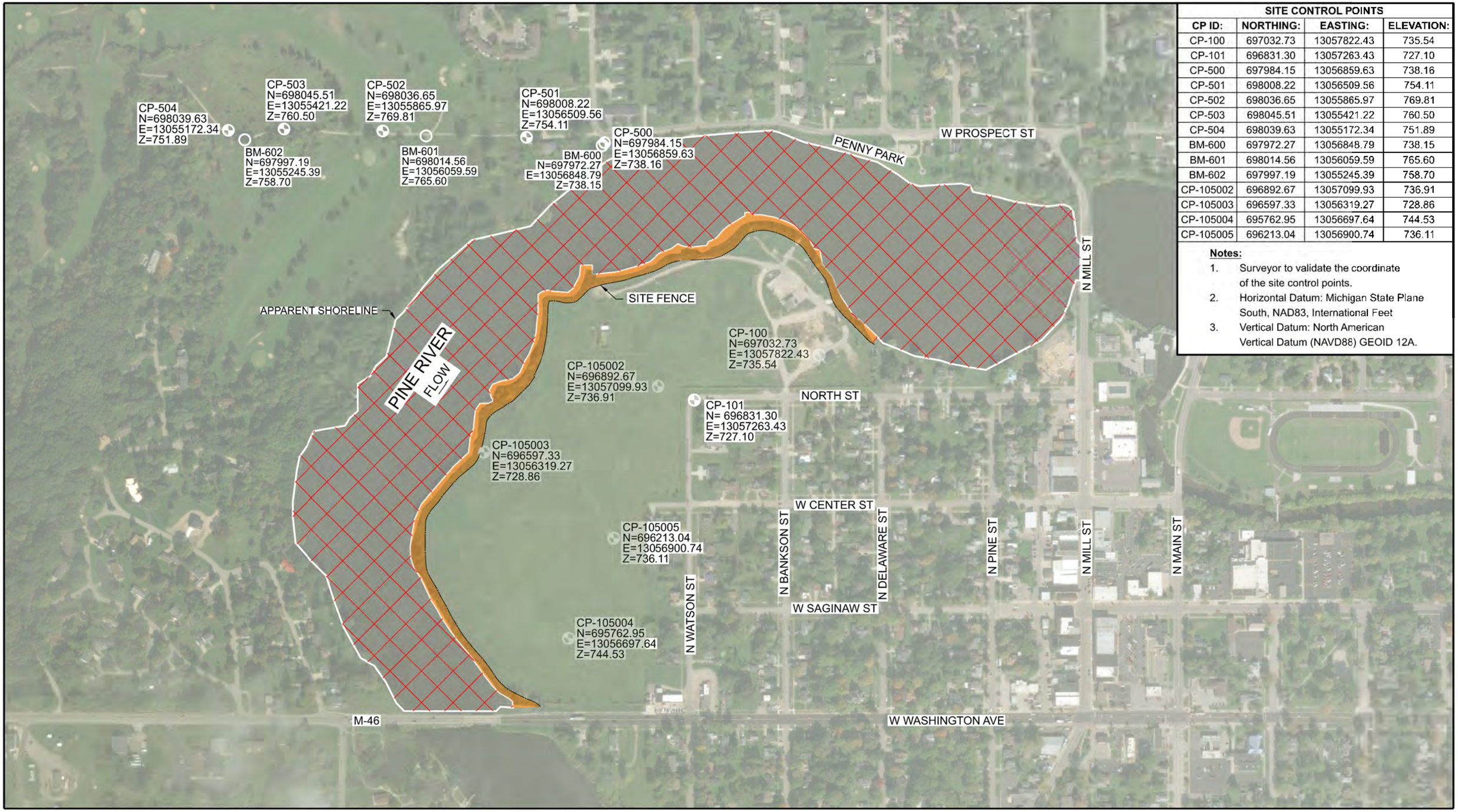


SITE CONTROL POINTS			
CP ID:	NORTHING:	EASTING:	ELEVATION:
CP-100	697032.73	13057822.43	735.54
CP-101	696831.30	13057263.43	727.10
CP-500	697984.15	13056859.63	738.16
CP-501	698008.22	13056509.56	754.11
CP-502	698036.65	13055865.97	769.81
CP-503	698045.51	13055421.22	760.50
CP-504	698039.63	13055172.34	751.89
BM-600	697972.27	13056848.79	738.15
BM-601	698014.56	13056059.59	765.60
BM-602	697997.19	13055245.39	758.70
CP-105002	696892.67	13057099.93	736.91
CP-105003	696597.33	13056319.27	728.86
CP-105004	695762.95	13056697.64	744.53
CP-105005	696213.04	13056900.74	736.11

Notes:

1. Surveyor to validate the coordinate of the site control points.
2. Horizontal Datum: Michigan State Plane South, NAD83, International Feet
3. Vertical Datum: North American Vertical Datum (NAVD88) GEOID 12A.

Legend:

- Control Point
- Benchmark
- Bathymetric Survey Area
- Topographic Survey Area Between Shoreline and Existing FPS Fence

N

0 200 400 600

Scale In Feet

Figure 2. Topographic and Hydrographic Survey Area
Velsicol Chemical Corporation Superfund Site
St. Louis, Michigan

ch2m:

Attachment 1
Subcontractor Technical Proposal

Technical Proposal for:

Velsicol Superfund Site
Pine River, St. Louis, MI
BATHYMETRIC & TOPOGRAPHIC INVESTIGATION

Prepared for:

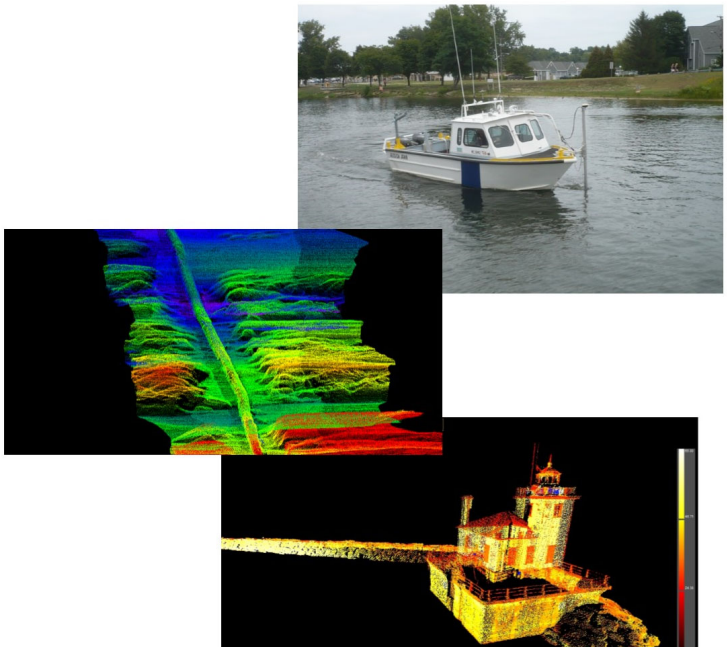
JACOBS®

1999 Bryan St., Suite 1200
Dallas, TX 75201

Prepared By:

SEAWORKS GROUP, LLC

185 E. Main St., Suite 414, Benton Harbor, MI 49022 269-277-3005



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HUBZone
Historically Underutilized Business Zone
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Phone: 269-277-3005
Email: chris@seaworksgroup.com

TABLE OF CONTENTS

1.1 Project Overview

Seaworks is tasked with performing a hydrographic investigation along the Pine River in St. Louis, MI. This investigation is to include the area along the Velsicol Chemical Plant Superfund Site . The purpose of the survey is to assess site conditions to assist in the design of a vertical barrier. This investigation is to include a multibeam bathymetric survey, magnetometer survey, high resolution side scan sonar, and shoreside topographic survey. The survey area will encompass the outlined river area from the M-46 overpass to the N. Mill St. bridge. Project water depths are expected to vary between approximately 2' to 18' in this area of the river.

Survey data will be collected by Seaworks between during a 1-week period in March 2022.

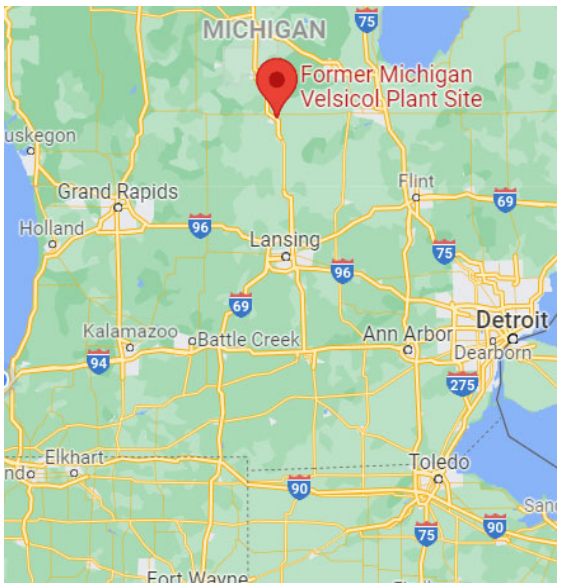


Figure 1.1 – Project Location

Figure 1.2 – Survey Area (Green)

1.2 Company Profile & Experience

Seaworks is the best-equipped and most highly qualified hydrographic firm in the Great Lakes region. We are the only regional business in our category that is **focused specifically on marine operations**, and one of the few hydrographic operations that is led by a National Society of Professional Surveyors/Hydrographic Society of America **(NSPS/THSOA) Certified Hydrographer**.

Our investment in dedicated survey vessels, high-resolution multibeam systems, vessel-mounted LiDAR scanners, and precision positioning systems is unmatched in the region. Supporting marine environmental Engineers and Contractors is one of Seaworks' primary specialties, having worked on **numerous large-scale remediations of similar size and complexity** in the past. Through this experience we have a proven track record of delivering on our technical, Health & Safety, and QA/QC responsibilities.

Please review the attached Statement of Qualifications package for further detail.

2.0 Datums & Control

2.1 Project Datums

Horizontal

Datum: Michigan State Plane Coordinate System, South Zone (2113), 1983 North American Datum
Units: International Ft.

Vertical

Datum: North American Vertical Datum of 1988
Units: International Ft.
Geoid: Continental US (CONUS) 2018

2.2 Survey Control

Site control points will be established using RTK GPS equipment and corrections from the Michigan DOT VRS network. Before establishing any control, a check will be performed against a nearby NGS benchmark to confirm equipment accuracy. The provided points that were previously established will be investigated and confirmed if possible.

At the prescribed location 2-3 permanent control points will be set. One will be used for RTK base station setups, one will be used for pre and post-survey QC checks, and one will be set near the water as a reference for water level measurements.

During hydrographic survey activities, a Trimble SPS base station will be set on an appropriate control point and pre and post-survey QC checks will be performed on secondary points using a Trimble R8 rover. All QC points will be confirmed to check in within 0.10' horizontally and vertically.

Figure 2.1 – Typical Base Station Setup

Phone: 269-277-3005
Email: chris@seaworksgroup.com

3.0 Equipment

3.1 Survey Vessels

Z-Boat 1800-RP

The Z-Boat 1800-RP is a small, remote-controlled, "drone" survey vessel that can be equipped with most of the same survey technologies as Seaworks' large survey vessels. It's portability and compact size make it ideal for shallow-water surveying, difficult to access areas, and protected waters of any depth. Seaworks' boat has a "ruggedized package" upgrade which features a single lifting eye, a dual-GPS/GNSS antenna mount frame, and an interchangeable sensor mount well.

Figure 3.1 – Z-Boat

Specifications

- Length: 6'
- Width: 3'
- Height: 3'
- Survey/max speed: 3/8kts
- Boat weight: 85lbs
- Payload capacity: 65lbs

3.2 Multibeam Sonar

R2Sonic 2020

The R2Sonic 2020 multibeam sonar system scans underwater features using a high-resolution swath of 256 beams with beam widths of 2° across-track and 2° along-track (2° x 2° system). The system can be operated in either equidistant or equal-angle operating modes, with a swath coverage angle of up to 130°. The sonar operates at user-selectable frequencies between 200kHz and 450kHz.

Figure 3.2 – R2Sonic 2020

A continuous sound velocity profile is normally measured by velocity probe casts and then corrected for within the processing software.

Sonar Equipment & Accessories

- Multibeam Echosounder: R2Sonic 2020
- SV Profiler: Teledyne Odom Digibar Pro

Phone: 269-277-3005
Email: chris@seaworksgroup.com

3.3 Sidescan Sonar

Edgetech 4125

The Edgetech 4125 side-scan sonar is a 600/1,600Khz dual simultaneous frequency system designed for high-resolution search and mapping applications. The dual frequencies provide a combination of long range search capability and ultra high resolution images for detail and detection of very small objects.

The 4125 system utilizes Edgetech's Full Spectrum CHIRP technology, which provides higher resolution imagery at ranges up to 50% greater than comparable systems. The system has an operating ranges of 120m @ 600Khz and 35m @ 1,600Khz. It has a horizontal beam width of 0.20° and an across-track resolution of 0.6cm.

Figure 3.3 – Edgetech 4125

The sonar towfish is typically towed behind the survey vessel at an optimal altitude above the bottom to maximize detection and image quality. In shallow waters it is deployed from the side of the vessel using an outrigger davit.

3.4 Positioning & Orientation System

Applanix POS MV 120

Horizontal and vertical positioning will be accomplished using an Applanix POS MV 120 Position & Orientation system. The POS MV 120 package uses RTK (Real Time Kinematic) GPS technology which is capable of receiving both L1 & L2 frequencies as well as the GLONASS satellites. Equipment is capable of achieving positioning accuracies of up to +/-0.10', both horizontally and vertically. The RTK positioning equipment is be capable of rapid update rates >5Hz, allowing it to be used for real-time heave compensation.

Figure 3.4 – POS MV 120

A two-antenna "moving baseline RTK" system is used by the POS to provide high-accuracy heading in addition to vessel position. Heading sensing equipment is capable of maintaining at least +/-0.10° heading accuracy under most conditions.

The final component of the system is a precision motion sensor which is used for vessel pitch and roll corrections. The sensor was calibrated/zeroed with the vessel at rest, and then mounting offsets were determined by a patch test performed prior to mobilization. Motion sensing equipment is capable of angular measurement accuracy of at least +/-0.04°.

Phone: 269-277-3005
Email: chris@seaworksgroup.com

3.5 Magnetometer Equipment

Geometrics G-882

The Geometrics G-882 Cesium Vapor Marine Magnetometer is used to locate ferrous objects by detecting distortions they create in the earth's magnetic field. The magnetometer's sensitivity is better than 1.0 gamma and sampling intervals are as low as 1hz. This translates to detection capabilities varying from >30m for 1 ton of steel to 10m for 30lb of steel.

Figure 3.5 – Geometrics G-882

The magnetometer is typically towed behind the survey vessel at a distance where readings are not affected by metal on the vessel itself. In deeper water it is towed beneath the surface, in shallower water it is towed on the surface by attaching it to floats.

4.0 Personnel

Chris Ebner, P.E. (MI & IL) will be the Project Manager and Lead Hydrographer for the operation. Chris is a Hydrographer certified by the Hydrographic Society of America and the National Society of Professional Surveyors (THSOA/NSPS) with 14 years of experience in hydrographic surveying.

Wade Whitfield and Ed Lopez will be the Project Surveyors for field data collection and processing. Wade and Ed have relevant education backgrounds, work experience, and extensive hands-on experience using the hydrographic systems described above.

5.0 Procedures

5.1 Mobilization & Launch

The Z-boat will be transported to site by trailer along with the Jon boat. Both of these will be deployed from Leppien Park just south of M-46 bridge. Bases upon information from the SOW both of these vessels should have clearance to pass under this bridge.

5.2 Calibrations & Checks

Immediately prior to multibeam and side-scan surveys, a sound velocity profile will be measured using the Digibar Pro. The Digibar cast records velocities throughout the water column at 1' increments, which are applied to sonar data during collection and processing. Additionally, sound velocity at the sonar head is measured and applied in real-time using the head-mounted AML MicroX probe. A new Digibar cast will be performed approximately every two hours, or any time the vessel moves to a new survey area.

Pre and post-survey water level checks are performed by comparing RTK GPS elevation outputs from the POS MV to water level shots from the Trimble RTK GPS Rover.

Bar checks for the Survey Vessel are performed regularly, by measuring returns off an aluminum plate held at a known depth below the sonar head. This is done to confirm the sonar head draft value as well as provide a documented physical check against Seaworks' electronic soundings.

Multibeam patch tests for the Survey Vessel are performed regularly in order to measure and confirm sensor mounting offsets. This is done by running survey lines in a predetermined pattern over a recognizable object such as a slope or pipeline. The data is then processed using a software routine to compute the pitch, roll, and heading angular offsets.

5.3 Field Procedures

Topographic River Bank Survey

After QC points check in with the RTK Pole setup the data will be collected on approximate 50' spaced transects. These transects will capture top and toe of slope along with significant slope breaks. This procedure will be used along the designated riverbank area. Data will be collected in the from as close to the hydrographic survey limits as possible, up the bank to the existing fence line. Site features of interest will also be mapped. Topographic survey will be overseen by a Professional Land Surveyor licensed in Michigan.

Multibeam Hydrographic Survey

After initial checks and calibrations, bathymetry lines will be run parallel to the river centerline at line spacings of 10' - 30'. Survey line spacing will be selected in order to provide complete bottom coverage by the multibeam swath at varying water depths. 100% overlap (200% coverage) is desired between passes in order to maximize density and provide redundant data for QC purposes. However this may not be possible in very shallow conditions due to narrow swath width.

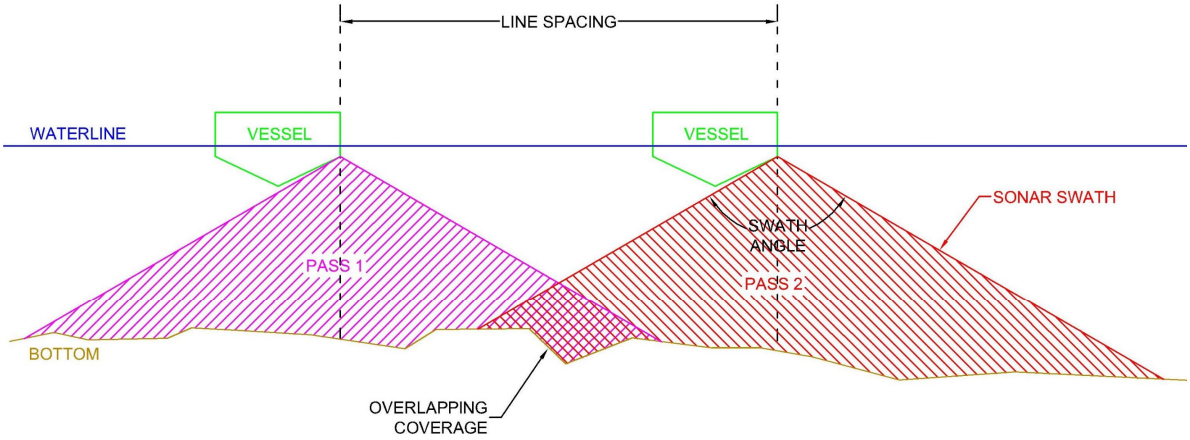


Figure 5.1 – Multibeam Swath Diagram (General)

Multibeam data can generally be collected to water depths of as little as 3-4' and within 10-20' of banks. It is assumed that additional coverage in very shallow water will be achieved using a single-beam Z-Boat

drone. The Z-Boat can generally collect data in 1.5-2' depths. From the extents of the Z-boat to fence line, topographic pole shots will be used to complete bank/upland survey.

Sonar operating parameters - Bathymetry

- Sonar Frequency: 400Khz
- Swath Angle: 120°, increased to 140° in shallow water
- Sonar Mode
  - Equi-Distant Beams
  - Down/Bathy/Normal
- Survey Speed: 3.5-4.0Kts

Side-Scan Sonar Survey

The side-scan sonar will be hung directly over the side of the Jon Boat in the shallow areas and potentially towed at an optimal altitude in the slightly deeper areas. Optimal coverage obtaining 200% overlap will be achieved using a minimum line spacing of 40'. This will ensure there is redundant data for QC purposes, and that no objects of interest will be lost within the nadir gap directly beneath the towfish. Survey line orientation will be parallel to the river centerline. A minimal survey speed will be used for optimal data density and resolution.

Side-scan sonar operating parameters:

- Sonar Frequency: 1,600Khz
- Coverage Width: 25m
- Survey Speed: 3.0Kts
- Tow Cable Length: 0-10m (dependent upon depth)
- Average Altitude: 2-5m

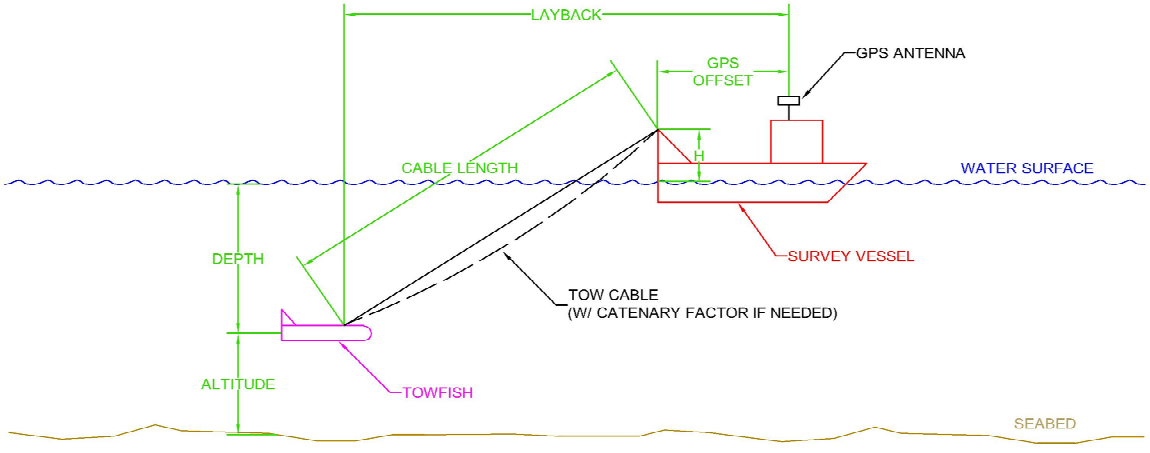


Figure 5.2 – Towed Sonar Layback

Magnetometer Survey

During the magnetometer phase, the magnetometer will be towed approximately 30' behind the survey vessel. This distance has been selected to minimize interference from the vessel itself, while still maintaining control to maneuver the vessel along banks and obstacles. Along banks and shallow water, the magnetometer will be towed on the surface by attaching it to foam floats. In deeper water it may be towed below the surface if needed to maintain an optimal altitude. Survey line orientation will be perpendicular to the river centerline with line spacing of no greater than 25'. The line spacing was selected to maximize coverage and minimize any chance of missing small targets between lines. (Same line spacing as specified in SOW)

Magnetometer operating parameters:

- Line Spacing: 25'
- Survey Speed: 3.5Kts
- Tow Cable Length: 30' (will be adjusted as-needed to maintain altitude)
- Average Altitude: 6-18'

Figure 5.3 – Proposed 25' Transect Magnetometer Survey Lines

5.4 Processing & Deliverables

Following data collection, survey data will be processed using the Hypack/Hysweep 2020 software package. Raw data will be pre-filtered, then manually cleaned of unsuitable data and sonar noise. Positioning and motion sensing corrections will be applied, then data will be saved in Hypack Edited Data format for additional post-processing.

Data will be exported in a non-reduced point cloud .XYZ format, as well as 3x3' XYZ grid files reduced using Average sounding selection. The XYZ grid will be used in Hypack's TIN utility to generate contour and geotiff files for inclusion in bathymetric plots.

Side scan data will be reviewed in Chesapeake Technology SonarWiz. The water column will be digitized and positioning and heading smoothing will be applied. Time Varied Gain (TVG) values will be adjusted as needed for the best visual appearance. Items of interest will be manually identified and measured, and a target database will be generated. Finally, individual side-scan passes will be georeferenced and mosaicked into a 0.5' resolution Geotiff image, using Overlay and Average filter methods.

Magnetometer data will be processed using Hypack 2020 Single-Beam editor. Data will be converted to XYGamma format and processed in the TIN utility to generate a contour drawing showing deviations from background gamma values. Debris objects will be identified and cross-referenced with side-scan data to assist with target identification.

Seaworks will provide deliverables to the client bases upon the expectations outlines in Section 3.5 of the SOW provided.

6.0 Project Schedule

Due to the presence of aquatic vegetation, it is strongly recommended that work take place during the March-April 2022 timeframe when vegetation will be minimal.

The survey is expected to require about 1 week on site.

Advance notice to proceed is always appreciated in order to minimize potential scheduling conflicts.

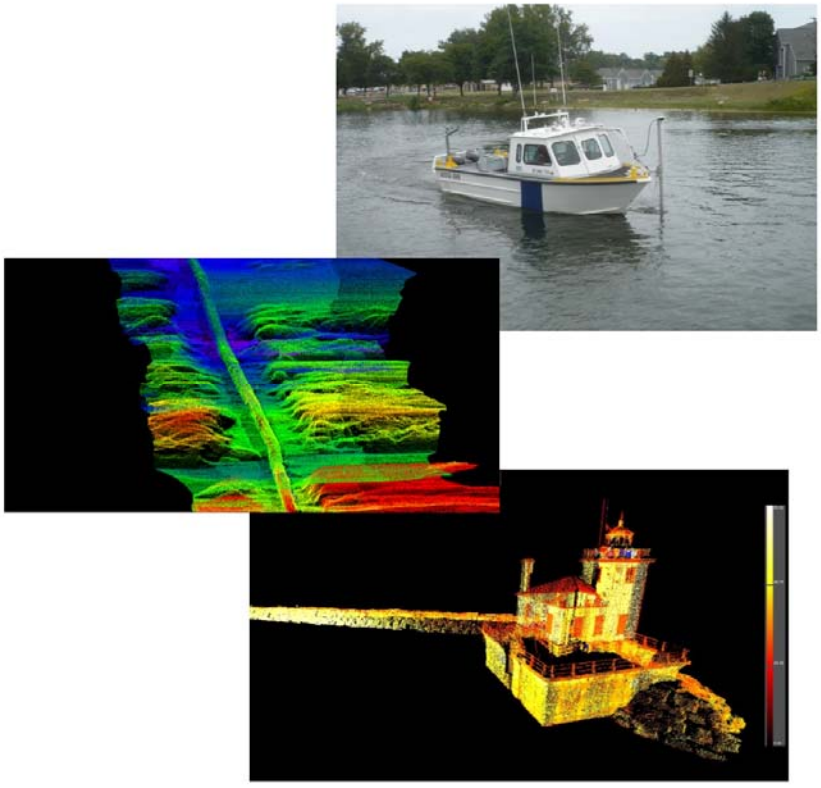
Statement of Qualifications for

HYDROGRAPHIC SURVEYING

Prepared By:

SEAWORKS GROUP, LLC

Benton Harbor, MI
269-277-3005
www.seaworksgroup.com



seaworks
HYDROGRAPHIC • GEOPHYSICAL • ENVIRONMENTAL

HUBZone
Historically Underutilized Business Zone
CERTIFIED

Phone: 269-277-3005
Email: chris@seaworksgroup.com

Personnel Qualifications

Seaworks professionals have a passion for hydrography, having performed numerous surveys throughout the Great Lakes, inland rivers, and US coastal regions. The company is managed by a licensed Professional Engineer, and all hydrographic surveys are **supervised by a National Society of Professional Surveyors/Hydrographic Society of America (NSPS/THSOA) Certified Hydrographer**. Seaworks personnel have extensive multibeam surveying experience and have an excellent working knowledge of the EM1110-1-1003 USACE Hydrographic Survey Manual.

Seaworks specializes in technically challenging, logistically complex survey operations and continues to develop a solid track record of exceeding client expectations on marine projects throughout the US. We have had the privilege of supporting a wide variety of marine works including dredge operations, breakwater construction, environmental remediation, marina planning, and salvage operations.

Health & Safety

Seaworks' most basic core value is the health & safety of our employees, clients, subcontractors, and the public. This value is ingrained in everything we do, including our health & safety program, commitment to employee education & training, and employee accountability standards.

H&S Program Highlights

- Task-specific AHA program
- Strict task-specific PPE policies
- Commitment to a drug-free workplace
- Vehicle safety policy
- Employee/subcontractor accountability

MANAGER'S COMMITMENT STATEMENT

Seaworks management will:

1. **Be accessible and listen to employees**
2. **Be fair and consistent in enforcement of policies**
3. **Empower employees to speak up about safety**
4. **Make Health & Safety expectations clear**
5. **Protect our marine environment**

Employee training & certifications

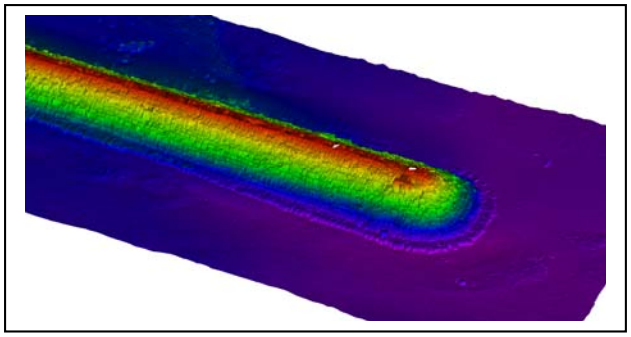
- OSHA 30hr
- OSHA HAZWOPER
- NASBLA Approved Boater Safety Education
- CPR/1st Aid/AED

All of Seaworks vessels and equipment undergo weekly internal inspections to ensure that they meet the most stringent US Coast Guard and US Army Corps of Engineers standards.

Phone: 269-277-3005
Email: chris@seaworksgroup.com

Representative Projects

Cleveland East Breakwater Repair



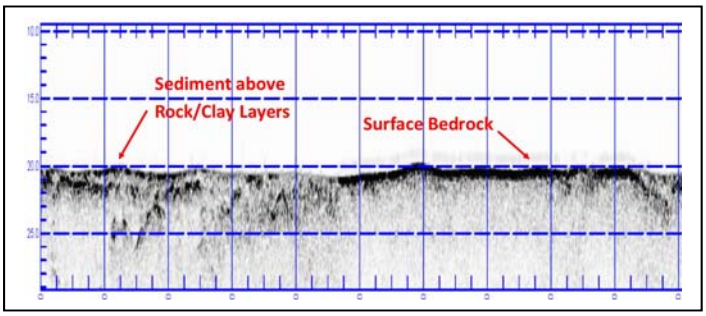
Location: Cleveland, OH
Client: Great Lakes Dock & Materials
USACE Buffalo District
Date: October 2014 – November 2016

Technologies: Multibeam Sonar
Vessel-based LiDAR Scanner

Project Summary:

Seaworks was employed by Great Lakes Dock & Materials and the USACE Buffalo District to perform multibeam and LiDAR surveys for the USACE Cleveland East Breakwater Repair Project. Seaworks used a multibeam sonar and a vessel mounted LiDAR scanner to collect high-resolution point cloud data both above and below the waterline. This dataset was used to generate a Placement Plan submittal for the installation of precast, interlocking Dolosse blocks as well as layers of bedding and armor stone. Once the Placement Plan was approved by the USACE Buffalo District, it was used during the placement of the blocks while Seaworks continued to perform progress and post-surveys as work progressed.

Calumet Harbor Rock Removal, Chicago, IL



Location: Chicago, IL
Client: Roen Salvage Company
USACE Chicago District
Date: May 2017

Technologies: Multibeam Sonar
Sub-Bottom Profiler

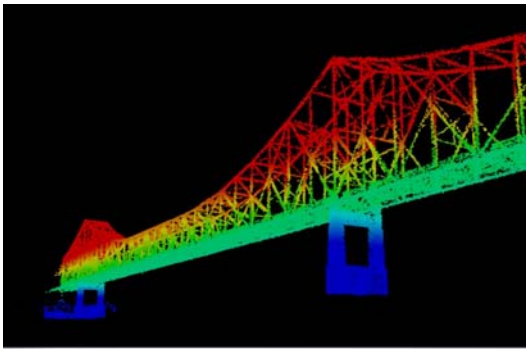
Project Summary:

Seaworks was employed by Roen Salvage Co. and the USACE Chicago District to perform surface and sub-bottom bathymetric surveys of a rock dredging area using multibeam sonar and a sub-bottom profiler. The survey area consisted of a 1,000' x 1,000' dredge cell with known areas of bedrock at and below the surface. Seaworks deployed a high-resolution multibeam system and CHIRP sub-bottom profiler, recording data simultaneously along a 25' grid pattern throughout the cell. This data was used by Seaworks to generate high-resolution multibeam point grid representing the surface bathymetry, as well as isopatch drawings of the underlying bedrock and sediment overburden. A final report with volume computations was developed to guide drilling and blasting operations for the rock removal work.

Phone: 269-277-3005
Email: chris@seaworksgroup.com

Representative Projects (Continued)

LiDAR & PICREPS Surveys, St. Louis, MO



Location: Mississippi River, IL & MO
Client: Thouvenot, Wade, & Moerchen (TWM)
USACE St. Louis District
Date: March-April 2017

Technologies: Vessel-based LiDAR Scanner

Project Summary:

Seaworks was employed by Thouvenot, Wade, & Moerchen (TWM) and the USACE St. Louis District to perform mobile LiDAR scans of 30 bridges throughout the St. Louis District boundaries, including the Mississippi, Illinois, and Kaskaskia Rivers. Using a high-resolution Renishaw mobile LiDAR, Seaworks scanned the bridges, piers, abutments, lights, and fenders, generating a detailed point cloud of each bridge, which was then used by TWM to generate detailed profile drawings for addition to the USACE's navigation charts. Although the project was logistically challenging, with bridges scattered over 400 river miles, Seaworks was able to collect the data in only two weeks because of the efficiency of the vessel-based LiDAR.

Buffalo River Area of Concern As-Built Surveys

Location: Buffalo River, Buffalo, NY
Client: Anchor QEA
Date: June-July 2017

Techologies: Multibeam Sonar
Single-beam Sonar
Portable Z-Boat Drone

Project Summary:

Seaworks was tasked by Anchor QEA with performing As-Built surveys for several phases of the Buffalo River Area of Concern restoration project. Seaworks first performed high-resolution multibeam surveys over the entire 8 mile length, including a 2 mile offshoot known as the City Ship Canal. A portable Z-Boat drone was then transported to several shallow-water Habitat Restoration areas on board Seaworks' survey vessel, the Mary Rose. The Z-Boat was launched from the larger vessel using a small davit winch, and was then used to collect single-beam data in shallow locations with difficult access. Topographic data was also collected along the banks of the Habitat Restoration areas using RTK GPS rovers and a conventional total station. Finally, data was processed and complied into a series of bathymetric plots and a detailed final report.

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Equipment

At Seaworks, we take a great deal of pride in our equipment. Equipment is regularly inspected, maintained, and calibrated, with an appropriate inventory of spare parts on hand. All of this ensures that we are prepared to respond to customers' needs reliably, and above all, safely.

Seaworks operates various types of sonar equipment including dual-frequency side scans and high-resolution multibeam systems. We are able to scan the bottom in incredible detail, making these the ultimate technologies for underwater inspection, object location, and as-built surveys.

Additionally, Seaworks is one of only a few companies operating combination mobile LiDAR/multibeam sonar equipped survey vessels, generating a high-resolution point cloud above and below the waterline simultaneously. Using a laser module scanning at a rate of 36,000 points per second at 2" accuracy, Seaworks efficiently collects high-resolution bank and structure data, which is often more cost-effective than a conventional topo survey crew.

Vessels

24' Jessica Jean, 25' Mary Rose, 30' Karen J

- Heavily built aluminum construction
- 3000W generator
- Twin 4-stroke outboards

Teledyne Oceanscience Z-Boat drone

Sonar & Scanning Equipment

- Echotrac CV200 dual-frequency echosounder
- Echotrac CV100 dual-frequency echosounder
- R2Sonic 2022 multibeam echosounder
- R2Sonic 2020 dual-head multibeam echosounder
- Edgetech 4125 dual-frequency side scan sonar
- Renishaw SLM mobile LiDAR system

Positioning & Motion Sensing Equipment

- Applanix POS-MV Wavemaster (2)
- Hemisphere Vector VS330 RTK heading & positioning system
- Trimble SPS & R8 base & rover packages

Attachment 2
Field Data Forms

U.S. EPA Great Lakes National Program Office
Locational Data Checklist and Metadata Recording Form

This document accompanies *GLNPO's Great Lakes Legacy Act Data Reporting Standard* , Version 1.0, March 2010, which provides detailed data reporting guidance for project data including required electronic data deliverables (EDD). In addition to the EDD and project field forms, project participants are required to complete this checklist at the end of each sampling event. Copies of completed forms should be submitted to the GLNPO Project Lead.

Contact Information

Contact Name: _____ Phone Number: _____

Affiliation: _____ E-mail Address: _____

Study Information

Project Title: _____

Site Name: _____

Sampling Start Date: _____ Sampling Stop Date: _____

Preparation Activities (please confirm each activity in the boxes to the right)

1. Sampling staff are trained in GPS Field Data Collection and have familiarized themselves with the GPS unit used for this project (certified training recommended). ☐

2. Determined window of satellite availability. http://www.trimble.com/planningsoftware_ts.asp ☐

3. Established at least two control points for both vertical and horizontal accuracy. ☐
   For assistance locating control points visit http://www.ngs.noaa.gov/cgi-bin/datasheet.prl or http://www.geocaching.com/mark/. This may not be feasible if the GPS unit is mounted to a vessel. *

4. Located 3 reference points. * ☐

Data Collection Activities (please confirm each activity in the boxes to the right)

1. GPS unit was configured to collect data only when the following requirements were met:
   a. A minimum of four satellites ☐
   b. Position dilution of precision (PDOP)<=6 ☐
   c. Satellite elevation >=15° above the horizon ☐
   d. A minimum signal-to-noise ratio (refer to GPS user manual for recommendation) ☐

2. Collected point data based on the nearest base station's logging interval. ☐

3. Collected point data for a period of at least 1 minute per location. ☐

4. Reported locational data in WGS 84 or NAD 83 (please specify_____). ☐

Please provide an explanation if a box was not checked for any of the responses above and specify deviations (include sample IDs if applicable):

_____

_____

_____

*Collect these points on at least the first day of sampling. Collecting on each sampling day is recommended. Record on page 2.

GPS Unit Specifications

GPS Brand and model number: _____

Model accuracy: _____

Data Processing

Which of the following best describes any data correction that may have been performed:

☐ real-time correction - specify type _____ ☐ post processed differential correction - provide base station id and location _____

☐ no correction ☐ other, please specify _____

Quality Information

Describe any difficulties in collecting locational data: _____

_____

List final post-processed accuracy of the data: _____

Data Collector:

Confirm required information has been provided.

_____ _____

Signature Date

GLNPO Project Lead:

Confirm required information has been provided.

_____ _____

Signature Date

U.S. EPA Great Lakes National Program Office
GPS Daily Check

Collect these data on at least the first day of sampling. Collecting on each sampling day is recommended.

Project Title: _____

Date: _____

Horizontal Control Point 1

Benchmark ID: _____ Time: _____

Established Latitude: _____ Measured Latitude: _____

Established Longitude: _____ Measured Longitude: _____

Displacement (include UOM): _____

Horizontal Control Point 2

Benchmark ID: _____ Time: _____

Established Latitude: _____ Measured Latitude: _____

Established Longitude: _____ Measured Longitude: _____

Displacement (include UOM): _____

Vertical Control Point 1

Benchmark ID: _____ Time: _____

Established Elevation: _____ Measured Elevation: _____

Displacement (include UOM): _____

Vertical Control Point 2

Benchmark ID: _____ Time: _____

Established Elevation: _____ Measured Elevation: _____

Displacement (include UOM): _____

Reference Point 1

Time: _____

Physical/Locational description: _____

Measured Latitude: _____ Measured Longitude: _____

Reference Point 2

Time: _____

Physical/Locational description: _____

Measured Latitude: _____ Measured Longitude: _____

Reference Point 3

Time: _____

Physical/Locational description: _____

Measured Latitude: _____ Measured Longitude: _____

ch2m

PHOTOGRAPH RECORD FILE INDEX

ROLL NO: _____

PERIOD FROM: _____ TO _____ 20 ___

PROJECT: Velsicol - NAPL/DBCP Areas 1 and 2 PROJECT NO: 478783

PREPARED BY: _____

Picture Number	Photograph Description/Location	Date	Daily Log Number