970324

Phase I Field Investigation Report

Morrow Dam
700 East Michigan Avenue Consumers Power Drive
Comstock Township, Michigan

STS Hydropower, LLC

Project number: 60644031

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1. Introduction

1.1 Project Background

In October 2019, an inspection of the Morrow Dam spillway gates concluded that the gates were significantly deteriorated and in need of immediate repair. Following the inspection, a controlled drawdown of the reservoir was initiated to relieve pressure on the gates and eliminate the risk of uncontrolled flooding, which would have posed a considerable public health and safety risk to downstream communities. Although the drawdown for repairs was expected to continue for four months, a detailed inspection conducted after the reservoir was lowered indicated that a full replacement of the gates was necessary. Replacement of the spillway gates was completed in December 2020. Reservoir refill operations commenced soon thereafter, and the reservoir was returned to its normal operating elevation on January 12, 2021.

Following the initial drawdown, the Michigan Department of Environmental, Great Lakes, and Energy (EGLE) received reports of increased turbidity and fine sediment deposits downstream of the dam. STS Hydropower, LLC (STS) received Violation Notices citing increased downstream turbidity and sediment deposition, issued by EGLE on July 8, 2020 and September 16, 2020. The violation notices require STS to develop a plan to assess the volume, location, depth and composition of sediments downstream that passed through the Morrow Lake Dam during the drawdown and to sample these sediments for polychlorinated biphenyls (PCBs), metals and total petroleum hydrocarbons (TPHs). STS responded to the Violation Notices and agreed to study downstream sediments to determine the quantity and characteristics of sediments that passed through the Morrow Lake Dam during the drawdown.

AECOM drafted a field investigation work plan that presented a phased sampling approach to obtain the above requested data (AECOM 2020). This first phase of sediment collection (i.e., vibracoring and grab sampling) was implemented between December 2, 2020 to December 7, 2020. Additionally, the field investigation included procedures for delineation of fine sediment deposits previously identified downstream of Morrow Lake Dam (approximately eight river miles of probing) as well as a bathymetric survey downstream of Morrow Lake Dam from the tailrace of the Dam to the railroad bridge at Lottie Avenue (approximately seven river miles). The bathymetric survey was conducted between October 27, 2020 and December 3, 2020 by Seaworks Group, LLC (Seaworks) and results are provided in **Appendix A**.

1.2 Purpose

The purpose of this report is to present the findings of the Phase I Field Investigation. The Phase I Field Investigation was conducted to:

- Gather bathymetric and topographic data of the Kalamazoo River from Morrow Lake Dam to the Lottie Ave. railroad bridge crossing (approximately seven miles downstream of Morrow Lake Dam).
- Delineate deposited sediment (location and volume) using tile rod probes from Morrow Lake Dam downstream to the railroad bridge and downstream of the superfund site operating units (OUs) (approximately eight river miles of probing);
- Sample sediment to physically characterize the material tentatively identified as post-drawdown sediment;
- Analyze post-drawdown sediment for targeted chemical constituents (i.e., PCBs, polycyclic aromatic hydrocarbons (PAHs), metals, and TPH); and
- Compare downstream sediment deposition area characteristics (Morrow Lake Dam to Lottie Ave. railroad bridge crossing) to upstream sediment.

2. Phase I Field Investigation Plan

AECOM proposed a phased approach for the identification, collection and characterization of sediment that passed through the Morrow Lake Dam during the drawdown. As discussed in **Section 1.2** above, the Phase I field investigation was conducted to gather bathymetric and topographic data, further delineate deposited sediment, characterize deposited sediment both physically and chemically, and compare the characteristics of deposited downstream sediment to upstream source materials. An overview of the completed Phase I Field Investigation activities is provided as **Figure 1**.

Results of this Phase I sampling event will be used to refine additional sediment sampling plans and methods, identify data gaps, and evaluate feasibility of future sediment management alternatives and designs. Additionally, dewatering treatability tests will be performed after receipt and evaluation of Phase I results to evaluate feasibility and efficacy of ex situ sediment management alternatives including but not limited to gravity/stacking, passive and mechanical dewatering, solidification/stabilization and potential water treatment of the resulting filtrate.

2.1 Target Analysis

The following chemical and geotechnical analyses were identified for vibracore and grab samples:

- PCBs as Aroclors – Kalamazoo River SOP (United States Environmental Protection Agency (US EPA)) SW-846 Method 8082A (as described in Superfund Quality Assurance Project Plans (QAPPs)).
- Total PCBs by congeners (US EPA Method 1668A) - as recommended by EGLE;
- Polycyclic aromatic hydrocarbons (PAHs) (US EPA Method 8270 SIM - grab samples only;
- Total petroleum hydrocarbons – Diesel Range Organics (TPH-DRO) (US EPA SW-846 Method 8015D Modified);
- Michigan 10 metals (US EPA SW-846 Method 6010/7471) – upstream samples only;
- Grain size analysis with hydrometer and sieve (ASTM D422);
- Moisture content (ASTM D2216);
- Specific gravity (ASTM D854);
- Total organic carbon (TOC) (ASTM D2974), and
- Atterberg limits (ASTM D4318).

The following table (**Table 1**) displays the number of proposed sample locations, if they were collected upstream or downstream of Morrow Lake Dam, the matrix and sample type, the analysis proposed by location and the number of quality assurance, quality control (QAQC) samples to be collected.

Table 1. Sample Matrix and Analytical Parameters

Location	Number of Locations	Matrix	Type	Analysis		QA/QC
Upstream	3	Sediment	Grab	• PCB (8082A) • PCB (M1668A) • TPH (8015M)	• PAHs (8270 SIM) • MI metals (6010D) • Geotechnical	Field Duplicate (1) MS/MSD (1/1)
Upstream - DMA	1	Sediment	Grab	• PCB (8082A) • PCB (M1668A) • MI metals (6010D)	• Geotechnical	
Upstream	1	Sediment	Reference / Background - Grab	• PCB (8082A) • PCB (M1668A) • TPH (8015M)	• PAHs (8270 SIM) • MI metals (6010D) • Geotechnical	
Upstream	1	Sediment	Core	• PCB (8082A) • PCB (M1668A) • TPH (8015M)	• MI metals (6010D) • Geotechnical (1 composite/core)	Field Duplicate (1) MS/MSD (1/1)
Upstream	2	Sediment	Core	Frozen		Field Duplicate (2) MS/MSD (1/1)
Downstream	11	Sediment	Grab	• PCB (8082A) • PCB (M1668A) • TPH (8015M)	• PAHs (8270 SIM) • Geotechnical	Field Duplicate (1) MS/MSD (1/1)
Downstream	4	Sediment	Core	• PCB (8082A) • TPH (8015M)	• Geotechnical (1 composite/core)	Field Duplicate (1) MS/MSD (1/1)
Downstream	7	Sediment	Core	Frozen		Field Duplicate (7) MS/MSD (3/3)

3. Methodology

The following sections describe the field procedures and methods used during sample collection, transportation, logging, and processing. Photographs of field activities taken during the Phase I investigation are included as **Appendix B.**

3.1 Sediment Sampling

In collaboration with SWAT Consulting Inc. (SWAT), surficial sediment grab samples and cores were collected from December 2, 2020 through December 5, 2020 at 16 targeted areas, both upstream (5 target areas) and downstream (11 target areas) of the Morrow Lake Dam (**Figure 2**). Upstream areas were used to assess background and post-drawdown conditions. Downstream areas were previously identified and targeted as high priority deposition areas. Field personnel navigated to the targeted locations utilizing a Trimble Yuma Global Positioning System (GPS) unit. Final sample locations were adjusted in the field based on field conditions and then GPS coordinates were collected from the actual sample locations. Samples were collected in accordance with the QAPP developed by other consulting companies for the downstream Superfund sites (Amec Foster Wheeler 2016a) and (GEI 2020a). All grab samples and sediment cores were collected and subsequently transported to the GEI Consultants (GEI) processing facility in Plainwell, Michigan.

3.1.1 Grab Sample Collection Procedure

Surficial sediment (0 to 6 inches below surface) was collected by AECOM and SWAT using a petite ponar, clamshell dredge sampler. At each sample location the ponar was lowered to the river bottom where a tripping mechanism would activate, allowing the sampler to clamp shut, grabbing a surface sediment sample. The device was brought to the surface where the collected material was emptied into a 2-gallon High Density Polyethylene (HDPE) bucket. This process was repeated until the desired sample volume was collected. Additional sediment sample volume was collected from each location in 5-gallon HDPE buckets to be used for future treatability testing. All grab samples were collected utilizing this procedure except for the “Upstream-DMA” location (WCDMACS001, formerly USCCG005). Sediment was collected from the dredged material staging area (DMA) in place of an in-river sample due to the proposed location’s close proximity to the dam.

3.1.2 Vibracore Sample Collection Procedure

Sediment cores were collected by AECOM and SWAT utilizing a portable vibracore mounted on a flat bottom sampling boat or an air boat, depending on constraints to sample location access and other site conditions.

The following procedure was used for vibracore collection:

1. The sampling boat was initially positioned and anchored using spud poles over pre-determined sample locations. Actual sample locations were dependent upon river conditions (i.e., flow and water depth) and safe access at the time of sample collection. Final sample locations were recorded using a Trimble Yuma GPS unit.
2. A 3-inch diameter Lexan vibracore tube was positioned over the moon pool opening of the boat. A pipe was locked into the vibrating head. The vibrating head was turned on and the agitator was guided in a downward vertical motion into the sediment to collect the core. Core tubes were advanced a least one foot past the target depth or to refusal to limit washout. This process was repeated at any location where recovery was estimated to be less than 80 percent. Up to three additional cores were attempted within a 15-foot radius of each target core sample location.
3. The vibracore tube was slowly advanced back to the surface keeping the core as vertical as possible. The core was capped with a rubber stopper and secured with electrical tape to prevent loss of the sediment sample.

4. The collar of the vibracore head around the pipe was unhooked and the core was labeled on the cap with total depth, orientation, attempt number and core location identification.
5. Total sediment recovery was recorded along with any visual observations of the core. Additional measurements taken included water depth, depth of sediment to refusal, and water quality characteristics (e.g. temperature, dissolved oxygen, conductivity and turbidity).
6. Cores were stored vertically on the boat and continued to be stored vertically after they were brought to shore. Cores were transported in an upright position to the GEI processing facility in a vehicle equipped with a core storage rack.

The following table (**Table 2**) displays a summary of the cores collected, their status, and the water quality characteristics at each core location.

Table 2. Core Collection Summary

				Water Quality Characteristics			
Location ID	Status	Water Depth (feet)	Number of Cores Collected	Temperature (ºC)	Dissolved Oxygen (%)	Conductivity (µS/cm)	Turbidity (NTUs)
USCCC002	Frozen	0.2	3	**	**	**	**
USCCC003	Frozen	0.9	4	3.338	106.2	648	3.74
USCCC004	Sampled	0.0	4	**	**	**	**
DSRBC001	Frozen	0.8	4	4.839	116.2	632	7.00
DSLBC002	Sampled	0.7	4	3.269	107.2	640	5.98
DSLBC003	Frozen	0.5	2	5.423	118.6	631	8.84
DSLBC004	Sampled	1.7	2	3.034	101.4	653	5.42
DSCCC005	Frozen	0.1	2	**	**	**	**
DSRBC006	Frozen	0.5	2	3.723	106.1	623	3.90
DSLBC007	Frozen	0.8	2	5.203	117.1	644	4.96
DSRBC008	Sampled	0.1	4	**	**	**	**
DSLBC009	Frozen	0.0	4	**	**	**	**
DSRBC010	Frozen	0.6	4	3.372	99.4	648	3.74
DSRBC011	Sampled	0.0	4	**	**	**	**

Notes:
** Water quality parameters could not be collected due to low water levels or dry conditions.
ºC = Degree Celsius
% = Percent
NTUs = Nephelometric Turbidity Units
µS/cm = microsiemens per centimeter

3.1.3 Upstream Sampling

Vibracore and surficial sediment grab samples were collected at five target areas upstream of Morrow Lake Dam (**Figure 2**). Sediment was collected at one upstream core location (USCCC004) and four upstream grab locations (USRBG001, USCCG002, USCCG003 and USCCG004). In addition, sediment cores collected at two locations (USCCC002 and USCCC003) were stored in a portable freezer staged at the GEI facility where they will be kept for future analysis, if warranted.

During dam repairs, any material encountered during the repair was dredged and placed in a dredged material staging area (DMA) south of Morrow Lake Dam. One composite sample consisting of 18 aliquots collected at varying depths was collected from the DMA (**WCDMACS001**). Discussion about the sample is included in this section.

3.1.4 Downstream Sampling

Vibracore and surficial sediment grab samples were collected at 11 target areas downstream of Morrow Lake Dam (**Figure 2**). Grab samples were collected at 11 locations (DSRBG001, DSLBG002, DSLBG003, DSLBG004, DSRBG005, DSRBG006, DSLBG007, DSRBG008, DSLBG009, DSRBG010, and DSRBG011) and sediment cores were collected at 11 locations (DSRBC001, DSLBC002, DSLBC003, DSLBC004, DSRBC005, DSRBC006, DSLBC007, DSRBC008, DSLBC009, DSRBC010, and DSRBC011). All cores collected at downstream locations, except four locations (DSLBC002, DSLBC004, DSRBC008 and DSRBC011), were stored in a portable freezer staged at the GEI facility where they will be kept for future analysis, if warranted.

3.2 Sediment Logging and Processing

After sediment samples were collected from each location, the material was transported to the GEI processing facility in Plainwell, Michigan where samples were logged, processed and subsequently containerized for geotechnical and chemical analysis or preservation in the onsite freezer.

3.2.1 Sediment Logging

Upon arrival at the processing facility, all grab samples were placed in cold storage (refrigerator) until processed. Cores were grouped by sample location and kept in an upright position. Any observed sediment settling was noted. If a core had excess water, the team decanted the core by drilling one hole in the side of the core just above the uppermost sediment deposit as well as one hole in the top of the core cap. All water decanted from the cores was containerized for future disposal.

If a core was not going to be logged and processed immediately, the core was kept in an upright position in cold storage at the facility. Cores that were ready to be logged and processed were transferred to the core cutting area and placed horizontal on the core cutting table. Cores were cut lengthwise on opposite sides using sheers or an electric saw. Once the core was cut length wise on both sides, the core was separated into two halves. The two halves were laid side by side on the core logging table and a photograph was taken with a white board indicating the core identification number, drive length, recovery length, date, time, and top/bottom of the core. Once opened and photographed, the core was visually logged using the Unified Soil Classification System (USCS). Grab samples were also logged using the USCS. Attributes such as color, odor, and/or organic material were noted. Geophysical logs were generated for all cores and grab samples logged during the Phase I Field Investigation event. All logs, including the Photographic log, are provided in **Appendix B**.

3.2.2 Core Sample Processing

Cores from the same sample location were laid side-by-side on the processing table, top to bottom, to align similar horizons and determine sample intervals. Sample intervals were determined by the team based on individual core characteristics. Following determination of the sample intervals, material was separated within the core at the interval lines using unused paint sticks. Material within the same interval was transferred into a new aluminum pan for homogenization.

Wearing clean nitrile gloves, the corresponding interval from each core was mixed until visibly homogenous. Following initial homogenization, the material was homogenized further, according to the US EPA quartering procedure. The sample material was divided into equal quarters, mixing each quarter individually. After each quarter was thoroughly mixed, the quarters were then mixed into two halves. The halves were homogenized again, before mixing the two halves to create one homogenized sample of material. This procedure was repeated until the material was adequately homogenized as per the processing team.

The material was simultaneously added to all sample containers (regular, duplicates, matrix spikes and matrix spike duplicates (MS/MSD), and splits) one spoonful at a time until no material was remaining, or until all sample jars were filled. This procedure was repeated for all sample intervals. Any remaining sediment from each interval at a single sample location was comingled into a single 2-gallon HDPE bucket for geotechnical analysis. A new pair of nitrile gloves, aluminum pans, and miscellaneous sampling equipment was used for each interval. Used sampling equipment and supplies, including used cores and polyethylene sheeting, were collected and double bagged by AECOM personnel for disposal by US EPA personnel.

3.2.3 Grab Sample Processing

For grab samples, sample identification was confirmed at the processing table and excess water in the sampling bucket was decanted. Grab samples were logged using USCS prior to being emptied into new aluminum pans for processing. Using clean nitrile gloves and unused sampling supplies, grab samples were homogenized using the US EPA quartering procedure described above (**Section 3.2.2**). The material was simultaneously added to all sample containers (regular, duplicates, MS/MSDs, and splits) one spoonful at a time until no material was remaining, or until all sample jars were filled. Any remaining sediment was kept for geotechnical analysis. This procedure was repeated for all grab samples.

3.3 Sample Handling, Transport, and Custody

Sample handling in the field conformed to appropriate sample custody procedures. Field custody procedures included proper sample identification, chain-of-custody (COC) forms, and packaging and shipping procedures. Identification labels were attached to all sample containers before the sampling process began in order to ensure proper sample identification. Each label included the sample location, date and time sampled, initials of the sampler, and analysis to be performed. All samples were kept in cold storage at the GEI processing facility until they were packaged in a cooler and either shipped or hand delivered to the appropriate laboratory. Geotechnical samples were hand delivered to Materials Testing Consultants Inc. (Materials Testing) in Grand Rapids, Michigan. Processed core and grab samples for chemical analysis were placed in coolers with wet ice (less than 4 degrees Celsius) and bubble wrapped to prevent breakage during transport. The coolers and a COC form were shipped overnight via Federal Express to Pace Environmental Sciences Laboratory (Pace Laboratory) in Green Bay, Wisconsin.

3.4 Waste Management

Any waste generated during the Phase I event was containerized by AECOM personnel and disposed of by US EPA personnel at a licensed waste disposal facility. Excess river water collected during the decanting process was collected in 5-gallon HDPE buckets. Spent sampling equipment and supplies including used cores, polyethylene sheeting, nitrile gloves, aluminum pans, and other miscellaneous materials were collected in heavyweight garbage bags and double bagged by AECOM personnel for disposal by US EPA personnel.

3.5 Sediment Delineation and Bathymetric Survey

Sediment delineation was conducted in association with in-stream sediment collection locations at the 11 high-priority depositional areas downstream of Morrow Lake Dam. In addition to delineation of the targeted sediment sampling locations, tile rod probing delineated the post-drawdown sediment deposition

areas from approximately the King Highway Landfill OU (RM 72.5) downstream to Crown Vantage Landfill (RM 68.5). Sediment probing was performed by AECOM and SWAT on December 2 to 5, 2020.

Data collected during delineation included GPS location, water depth to top of sediment, and sediment thickness to refusal. Using an AMS ¾" tile probe with 4' extensions, the probe was advanced from an anchored boat to refusal. Refusal was defined as the depth by which manual advancement of the probe ended. Sub-surface material encountered at refusal varied from compacted sand to cobble. Visual observations of sediment deposits assisted in identifying and probing potential depositional sediment boundaries within the river. Areas which contained depositional sediments were probed to identify the point of winnowing sediment thickness as well as the greatest thickness. This data was imported into a GIS layer and extrapolated along the winnowing margin to create a boundary line. Edge of water data from the Seaworks 2020 bathymetric survey data were used to bound the shoreline conditions of the sediment deposits.

Refer to **Section 5.1** and **Table 5** for a discussion of the sediment probing results. Refer to **Figure 3** for Field Delineated Sediment Probing Areas.

Seaworks performed a bathymetric survey on the Kalamazoo River, downstream of the Morrow Lake Dam between the Dam's tailrace and the railroad crossing at Lottie Avenue. A bathymetric survey volume estimation of the 2020 bathymetric survey (post-drawdown) in comparison to the 2018 bathymetric survey (pre-drawdown) is provided below in **Section 5.2**.

4. Laboratory Results

The following sections describe the chemical and geotechnical results of the sediment samples collected during the Phase I event. The results of the chemical analysis are presented in **Table 3** and the laboratory analytical reports are provided in **Appendix C.** All detected analytes are also included for each sample location on **Figure 2**. Geotechnical results are presented in **Table 4** and the laboratory geotechnical report is provided in **Appendix C**. The analytical results of the split samples collected by EGLE and the US EPA will be incorporated into **Table 3** in the future and the summary reports from the agencies will be provided in **Appendix D** and **Appendix E,** respectively.

4.1 Chemical Properties

The sediment results (**Table 3**) shows tabulated analytical results for all of the sediment samples collected by AECOM during the Phase I event. A total of 30 sediment parent samples, four duplicate samples, and four MS/MSDs were collected by AECOM and submitted to Pace Laboratory for chemical analysis. In addition, split samples were collected by the EGLE and the US EPA at limited locations. EGLE collected a total of 7 split samples (USCCG002(0.0-0.5)-EGLE01, USCCC004(1.0-2.0)-EGLE01, DSRBG001(0.0-0.5)-EGLE01, DSLBC002(1.3-2.9)-EGLE01, DSLBC004(1.3-2.6)-EGLE01, DSCCG005(0.0-0.5)-EGLE01, and WCDMACS001-EGLE01) and the US EPA collected a total of six split samples (USRBG001(0.0-0.5)-SP01, DSLBC002(0-1.3)-SP01, DSLBG003(0.0-0.5)-SP01, DSLBG003(0.0-0.5)-SP02, DSLBG007(0.0-0.5)-SP01, and DSRBC008(0.0-1.25)-SP01). Results of the split samples collected by EGLE and the US EPA will be incorporated into this report at a future date and will not be discussed further in this report.

Analytical results were reported down to the Method Detection Limit (MDL). Any result not detected was reported as less than (<) the samples' MDL. Results that were detected above the MDL but below their reporting limit was given a "J" qualifier. Results with a "J" qualifier should be considered estimated.

Michigan 10 metals were detected in all eight of the parent samples collected from upstream of Morrow Lake Dam. Metals were not analyzed in samples collected from downstream of Morrow Lake Dam. PCB-Aroclors were detected in 26 of the 30 parent samples collected with total concentrations ranging from 22.7 to 926 micrograms per kilogram (µg/kg). PCB-Congeners were detected in all 19 parent sediment samples collected with total concentrations ranging from 9.03 to 216 µg/kg. PAHs were detected in all 15 of the parent samples collected. TPH-DRO was detected in all 29 of the parent samples collected and with detections ranging from 14.7 milligrams per kilogram (mg/kg) to 78.9 mg/kg.

4.2 Geotechnical Properties

Geotechnical results for sediment samples collected during the Phase I event are summarized in **Table 4**. A total of 21 sediment samples were submitted to Materials Testing for geotechnical analysis. Out of 21 geotechnical samples submitted, 15 were surficial grab samples and six were vibracore samples, aliquots collected, composited and homogenized from each core horizon.

Six samples were determined to be non-plastic (USRBG001, USCCG002, DSRBG006, DSLBC002-GEO, DSLBC004-GEO, and DSRBC008-GEO). Sediment was organic clay or organic silt (USCS classification) with an organic content ranging from 13.9 to 22.3%.

4.3 Data Quality Assurance/Quality Control

Four blind duplicate samples (Dup-1, Dup-2, Dup-3, and Dup-4) were collected at four locations during the Phase I event. Duplicates were collected from DSLBC002(0-1.3), DSLBG002(0.0-0.5), USCCG002(0.0-0.5) and USCCC004(2.0-3.0), respectively. MS/MSD samples were collected from DSRBG001(0.0-0.5), USCCG003(0.0-0.5), USCCC004(1.0-2.0), and DSLBC004(0.0-1.3).

The duplicate and MS/MSD samples were submitted to the laboratory with their parent samples. These QA/QC samples were also analyzed for the same parameters as the parent sample. The results from the

analysis of the blind duplicate samples are included in **Table 3** and in the laboratory analytical reports in **Appendix C.** The results of the MS/MSD samples are included in the laboratory analytical reports in **Appendix C.**

A data quality review was conducted by AECOM data reviewers and an AECOM chemist. The analytical results for the duplicate samples (Dup-1 through Dup-4) were found to be consistent with those of the parent samples, DSLBC002(0-1.3), DSLBG002(0.0-0.5), USCCG002(0.0-0.5) and USCCC004(2.0-3.0), respectively, with the exception of PAHs in sample DSLBG002(0.0-0.5) and its field duplicate Dup-2. The results are usable for project objectives with an unknown direction of bias.

The analytical results for the MS/MSD samples (DSRBG001(0.0-0.5), USCCG003(0.0-0.5), USCCC004(1.0-2.0), and DSLBC004(0.0-1.3)) were found to be within acceptable recovery limits for all analytes except PAHs, TPH-DRO, and PCB congeners. The percent recovered for most of the PAHs in the MS and MSD analysis of samples DSRBG001(0.0-0.5) and USCCG003(0.0-0.5) were below criteria. The results are usable for project objectives but may be biased low. The percent recovered for TPH-DRO in the MSD analysis of sample USCCG003(0.0-0.5) was below criteria; the result is usable for project objectives but may be biased low.

The percent recovered was above criteria for several PCB congeners in the MS and MSD analyses of samples DSRBG001 (0.0-0.5) and USCCC004(1.0-2.0) the results are usable for project objectives but may be biased high. Precision criteria were also not met for some PCB congeners in the MS/MSD analysis of sample USCCC004(1.0-2.0); results are usable with an unknown direction of bias.

The percent recovered was outside criteria for several PCB congeners in the MS and MSD analyses of sample USCCG003(0.0-0.5). Precision criteria were also not met for some PCB congeners in the MS/MSD analysis. Based on both high and low recoveries and precision outside criteria, the results are usable for project objectives but may be biased.

Results for PCB4 (2,2'-Dichlorobiphenyl) in samples USRBG001(0.0-0.5), USCCC004(1.0-2.0), and DSLBG009(0.0-0.5); and for PCB11 (3,3'-Dichlorobiphenyl) in several sediment samples collected December 3 through 5, 2020 may be biased high due to laboratory method blank contamination.

5. Volumetric Analysis

5.1 Sediment Delineation

The findings of the sediment delineation indicate variable sediment thickness and extent exist throughout the survey area. Within the river segment of the Phase I sediment sample locations, 10 sediment deposits were identified, delineated and mapped (**Figure 3**). These areas varied in thickness from approximately 2.2 feet to 10.1 feet. The surface area ranged from approximately 1,532 square feet to 65,726 square feet. Estimated sediment volumes were conservatively calculated by assigning the greatest thickness observed within each of the depositional areas. Estimated sediment volumes ranged from 237 to 17,811 cubic yards. The estimated volume of each of these 10 depositional areas is summarized in **Table 5**.

Within the 4-mile reach from RM 72.5 to RM 68.5 variability in sediment thickness and extent was observed. Twenty-seven depositional areas were identified, probed and mapped. Each area was generally confined to the margin of the riverbanks (**Figure 3**). A portion of the survey areas was only observed from a distance via boat as the braided channels near RM 72.5 caused navigational and access challenges. The sediment delineation effort extended approximately 2/3 of a mile downstream of the 2020 Seaworks bathymetric survey (**Appendix A**), limiting delineation of the edge of water boundary in this reach of the river. Based on the observations from this area, it was identified that depositional sediments exist, but it is not known to what extent and thickness as noted in **Figure 3**.

5.2 Bathymetric Survey

This section discusses and presents results of a comparison of the sediment depositional differences between the 2018 pre-drawdown bathymetric survey (Spicer Consulting LLC, 2018) and the 2020 post-drawdown bathymetric survey (**Appendix A**). Specifically, this analysis examines the survey differences in the surveys of the third river segment “Extent of 2018 Bathymetric Data” described below. However, it is helpful to first define and provide a brief discussion of available survey information from four discrete river segments when considering the downstream fate and transport of sediment from upstream:

1. **Morrow Lake:**
   Enbridge conducted a single-beam bathymetric survey of Morrow Lake in September 2010. This data was used to create 0.5-foot contours.

2. **Morrow Lake Dam to Upstream Limit of 2018 Bathymetric Data (i.e., Homer Stryker Ball Park):**
   STS retained Seaworks to conduct multi-beam and LiDAR survey with the intent to capture below/above water sediment features. Hydrographic surveying in the main river took place during Fall 2020, between October 27th and November 8th. Aerial LiDAR surveying was conducted on November 12th. Oxbow hydrographic surveys took place December 1st-3rd.

   As discussed in **Section 5.1**, vertical probing of identifiable sediment deposition was also conducted by AECOM and SWAT in December 2020 in this river segment in coordination with collection of sediment cores.

3. **Extent of 2018 Bathymetric Data (i.e., Homer Stryker Ball Park to Railroad (RR) Bridge by Lottie Ave.)**
   Wood Group retained Spicer Consulting Limited to conduct a multi-beam survey of this river segment in 2018. This data was processed to generate 1-foot contours.

   STS retained Seaworks to conduct a multi-beam and LiDAR survey with the intent to capture below/above water sediment features. Hydrographic surveying in the main river took place during Fall 2020, between October 27th and November 8th. Aerial LiDAR surveying was conducted on November 12th. Oxbow hydrographic surveys took place December 1st-3rd.

   In addition, as discussed in **Section 5.1**, vertical probing of identifiable sediment deposition was also conducted by AECOM and SWAT in this river segment in coordination with sediment core locations.

4. **Downstream of Survey Extent (i.e., RR Bridge by Lottie Ave.)**
   Both the 2018 and 2020 bathymetric surveys terminated at the RR Bridge by Lottie Ave. However, the vertical probing of identifiable sediment deposition, discussed above, continued downstream another 2/3rd of a mile from the RR Bridge by Lottie Ave.

   Note: There is a FEMA Flood Insurance Study (FIS) of the Kalamazoo River from Morrow Lake downstream to around Mosel Avenue Bridge at the Township of Kalamazoo boundary. Most of the survey used for this model was from 1979 with a section updated in 1994. The hydrologic and hydraulic work was performed around 1992.

When considering the bathymetric data available for river segment three “Extent of 2018 Bathymetric Data”, the existence of two overlapping data sets permit the opportunity to conduct an analysis aimed at quantifying the location (spatial extent) and amount (depositional volume) of post-drawdown sediment deposits that have occurred since the time of the first survey (Spicer Consulting LLC 2018). Given the relative proximity in time between these two data sets and the fact that they bracket pre- and post-drawdown conditions, such an analysis provides a straightforward means to understanding the potential fate and transport of sediment that may have passed through the Morrow Lake Dam during the drawdown that occurred between October 31, 2019 and December 9, 2020.

This analysis was conducted in ArcGIS and involved a raster analysis that analyzed the differences between the two data sets. This difference results in an elevation difference for each raster pixel. The raster pixel size was set at 1-foot by 1-foot and corresponded to the size of the existing 2018 dataset. These elevation differences were subsequently plotted and visually inspected to identify and group areas of deposition, see **Figure 4**. This figure shows the current depositional locations and increases in sediment accumulation that has occurred since the 2018 bathymetric survey. Dark blue represents areas where erosion has occurred and/or deposition was less than 1-foot.

The following assumptions were made as part of this analysis:

- Deposition was grouped into areas by visual observation and identified by areas with deposition greater than or equal to 1-foot. Polygons (shown in yellow on **Figure 4** and **Table 6**) are identified depositional area groups.
- The 2018 and 2020 bathymetry rasters were clipped with each of the depositional area group polygons and the ArcGIS cut-fill tool used to calculate the volume of deposition for each area.

The size of raster pixel used will influence the calculated volume. This analysis uses a 1-foot by 1-foot raster pixel which is anticipated to be within the accuracy supported by the underlying bathymetric data sets.

5.3 Methods Comparison

A comparison between the methods of sediment deposition analysis presented in **Sections 5.1** and **5.2** show that there are at least two points of consideration as discussed below.

1. In general, volume estimates based upon probing were found to over calculate the volume by three to four times the calculations based upon a comparison between the two multi-beam surveys taken in close proximity to pre- and post-drawdown of Morrow Lake Dam.
2. Probing is highly dependent upon human judgment to identify areas of deposition and is less accurate than other data collection methods. A direct comparison between areas highlighted in **Figure 3** to those in **Figure 4** identifies areas of sediment deposition that were present during 2018 survey conditions – namely pre-drawdown sediment from upstream.

Given the challenges of using probing data to calculate depositional sediment volumes, it was not used for areas where more accurate methods could be used. However, where overlapping bathymetric datasets do not exist (i.e., between Morrow Lake Dam and the Ballpark) probing data does provide an order-of-magnitude assessment for location and to a much lesser extent volume.

It is also important to note that both **Figure 3** and **Figure 4** represent a snapshot in time. Rivers are dynamic, and sediment fate and transport are an ongoing process. As spring flows are seen in the river, there is a potential for sediment currently deposited in these areas to be mobilized. Use of a hydrodynamic model will help provide further insight to these processes. The hydrodynamic model will also help define the potential for sediment moving past the downstream extent.

6. Conclusions and Recommendations

The Phase I Field Investigation for the collection and characterization of sediments that passed through the Morrow Lake Dam during the drawdown has been completed and consisted of the following activities:

- Characterization of deposited sediments by collection of core and grab samples at locations upstream and downstream of Morrow Lake Dam;
- Analysis of chemical constituents from core and grab sediment samples;
- Analysis of geotechnical physical parameters of sediment grab samples;
- Delineation of deposited sediment thickness by hand tile rod probing; and
- Collection of bathymetric survey data downstream of Morrow Lake Dam to the railroad at Lottie Avenue.

Sediment collection and tile rod probing was conducted from December 2, 2020 until December 7, 2020 and included analysis of total PCBs as Aroclors and total PCBs by congeners, PAHs, Michigan 10 metals and TPH-DRO. Most analyses were performed using US EPA Test Methods for Evaluating Solid Waste: Physical/Chemical Methods (SW-846), other than total PCBs by congeners and percent moisture which do not fall under this program. Geotechnical testing was conducted using the appropriate ASTM test methods. All data, test results, and volumes are provided on **Figures 1** through **4** and **Tables 2** through **6** and should be referenced as required.

Chemical analysis indicates PCBs, PAHs, and TPH-DRO were measured in both upstream and downstream samples. PCB concentrations are below the action level for the area (1.0 mg/kg) (AMEC 2016b; GEI 2020b). Based on analytical results of this Phase I investigation, analysis of frozen sediment core samples and additional constituents-of-concern delineation of downstream sediment are not recommended.

Geotechnical physical properties of the surficial material showed primarily organic silt and clay (> 70%) and greater than 14% organic content at both upstream and downstream locations. Although the number of samples was limited in this Phase I investigation, by using geotechnical properties (i.e., particle size distribution and organic matter content) it may be possible to identify sediment that may have passed through the Morrow Lake Dam during the gate replacement from Morrow Lake to downstream of the Morrow Lake Dam. However, as previously indicated in the baseline evaluation of the 2018 Spicer bathymetric survey, depositional material with similar geotechnical properties was already present (prior to gate replacement activities) in many of these sample locations previously identified as sediment sinks and/or traps. Therefore, it may be difficult to delineate when sediment deposition occurred based on geotechnical properties alone and bathymetric survey data is not available for all river reaches downstream of the Morrow Lake Dam to provide a “snapshot” of pre-drawdown conditions.

The Phase II approach should focus on completing hydrodynamic modeling and sediment transport assessment within the reaches of the river sampled in Phase I. This data can be used to estimate the volume of sediment to be managed within this reach. Delineation processes and procedures developed in Phase I (e.g., probing and grab sampling) will be streamlined in Phase II to delineate additional depositional areas further downstream of the Phase I targets. Phase II should also include treatability testing for in situ and ex situ sediment management and may include a preliminary alternative analysis for identification, prioritization and management of sediment deposition. As part of this preliminary alternative analysis, an assessment may be performed to identify beneficial uses for the sediment or other storage options within the watershed. Some examples of this include:

- Areas that require shoreline enhancement or improvements;
- Shoreline or littoral zone restoration;
- Habitat and/or wetland creation and/or improvement; or
- Other living shoreline applications.

7. References

AECOM (2020). Morrow Dam Phase I Field Investigation Work Plan. December 2020.

AMEC Foster Wheeler Environment & Infrastructure, Inc. (AMEC) (2016a). Multi-Area Quality Assurance Project Plan – Revision 1, Addendum 1, Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site, Operable Unit 5. Prepared for Georgia-Pacific LLC. February 2016.

AMEC (2016b). Otsego Township Dam Area; Time Critical Removal Action. Draft Field Sampling Plan. Prepared for US Environmental Protection Agency Region 5. Georgia Pacific LLC, Weyerhaeuser Company, International Paper Company. June 2016.

GEI (2020a). Multi-Area Quality Assurance Project Plan, Revision 0: OU5 Allied Paper/Portage Creek/Kalamazoo River Superfund Site. Prepared for Kalamazoo River Areas 2, 3, and 4 Remediation LLC. April 2020 (submitted).

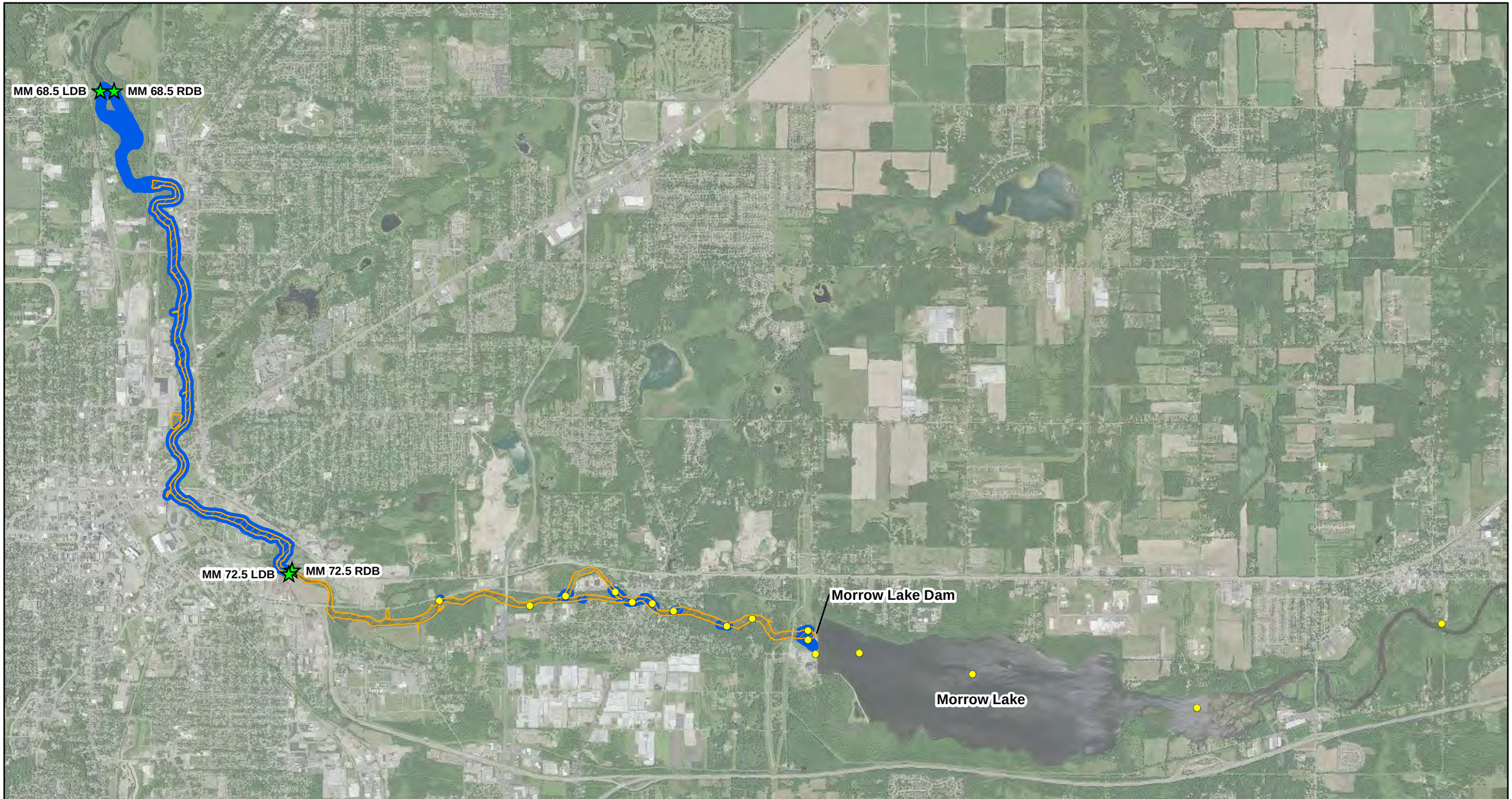
GEI (2020b). Pre-Design Investigation Field Sampling Plan, OU5 Area 4 Time Critical Removal Action Allied Paper/Portage Creek/Kalamazoo River Superfund Site. Prepared for Kalamazoo River Areas 2, 3, and 4 Remediation LLC. June 2020 (submitted).

Spicer Consulting LLC (2018). Bathymetric Survey of Kalamazoo River. October 2018.

US EPA (2005). Intergovernmental Data Quality Task Force. Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 1: UFP-QAPP Manual. Version 1, March 2005. Publication Numbers: USEPA: EPA-505-B-04-900A, Department of Defense: STIC ADA427785. March.

US EPA (2020). Approval for a Time-Critical Removal Action at the Trowbridge Dam Area of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site, Allegan County, Michigan (EPA ID MID006007306). April 2020.

Figures



AECOM

Project: 60644031

Prepared: 2/8/2021

Map Location

Legend
Phase 1 Surveys

- December 2020 Sediment Sampling Location
- December 2020 Probing Survey Area
- 2020 Bathymetry Survey Area
- River Mile Marker

N

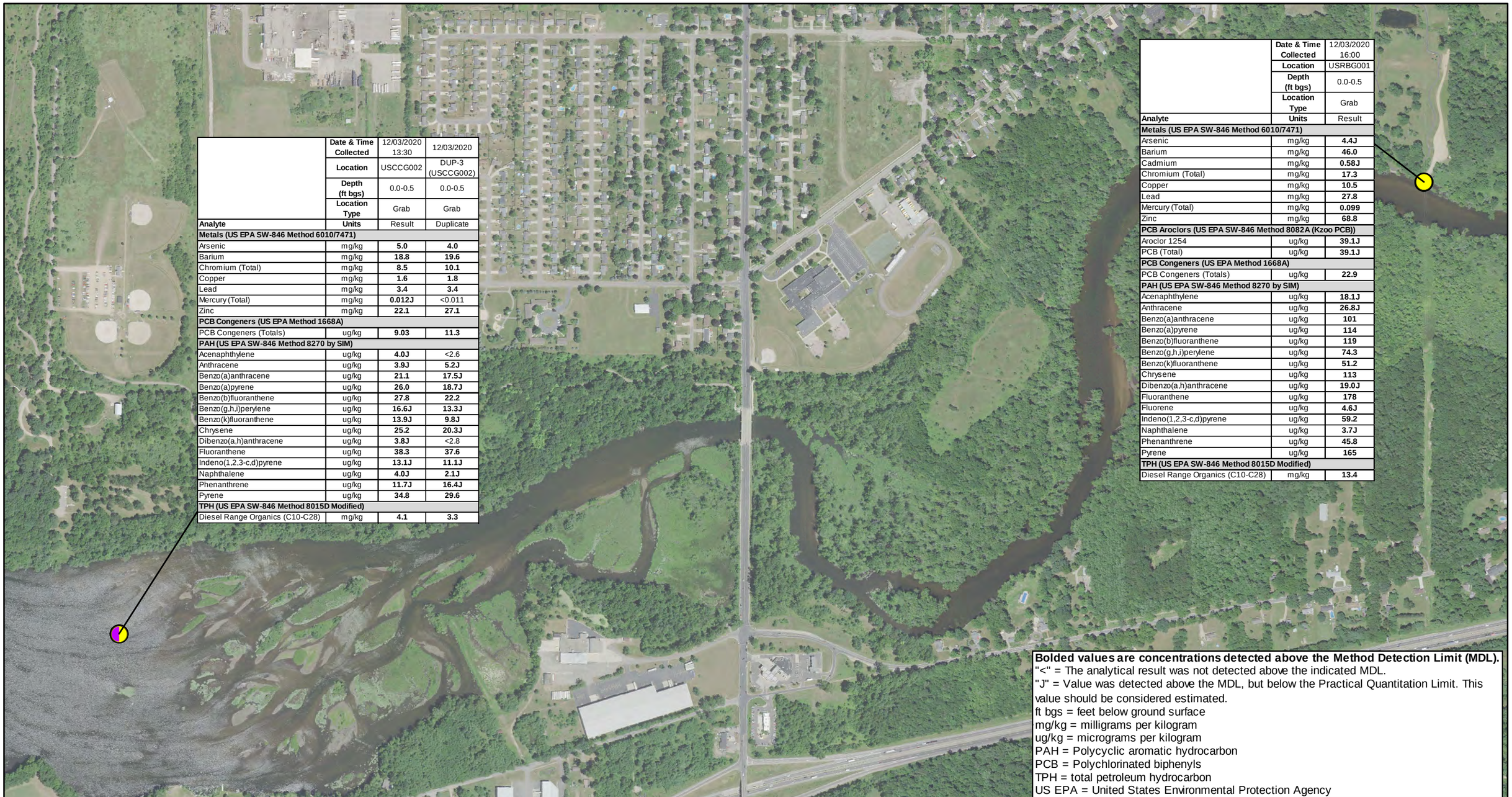
0 1,700 3,400 6,800 Feet

FIGURE 1
PHASE I FIELD INVESTIGATION
OVERVIEW

EAGLE CREEK RE MORROW DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Figure1_Phase1_Overview.mxd

Aerial: November 12, 2020 over 2018 NAIP Imagery



	Date & Time Collected	12/03/2020 13:30	12/03/2020
	Location	USCCG002	DUP-3 (USCCG002)
	Depth (ft bgs)	0.0-0.5	0.0-0.5
	Location Type	Grab	Grab
Analyte	**Units**	Result	Duplicate
Metals (US EPA SW-846 Method 6010/7471)			
Arsenic	mg/kg	**5.0**	**4.0**
Barium	mg/kg	**18.8**	**19.6**
Chromium (Total)	mg/kg	**8.5**	**10.1**
Copper	mg/kg	**1.6**	**1.8**
Lead	mg/kg	**3.4**	**3.4**
Mercury (Total)	mg/kg	**0.012J**	<0.011
Zinc	mg/kg	**22.1**	**27.1**
PCB Congeners (US EPA Method 1668A)			
PCB Congeners (Totals)	ug/kg	**9.03**	**11.3**
PAH (US EPA SW-846 Method 8270 by SIM)			
Acenaphthylene	ug/kg	**4.0J**	<2.6
Anthracene	ug/kg	**3.9J**	**5.2J**
Benzo(a)anthracene	ug/kg	**21.1**	**17.5J**
Benzo(a)pyrene	ug/kg	**26.0**	**18.7J**
Benzo(b)fluoranthene	ug/kg	**27.8**	**22.2**
Benzo(g,h,i)perylene	ug/kg	**16.6J**	**13.3J**
Benzo(k)fluoranthene	ug/kg	**13.9J**	**9.8J**
Chrysene	ug/kg	**25.2**	**20.3J**
Dibenzo(a,h)anthracene	ug/kg	**3.8J**	<2.8
Fluoranthene	ug/kg	**38.3**	**37.6**
Indeno(1,2,3-c,d)pyrene	ug/kg	**13.1J**	**11.1J**
Naphthalene	ug/kg	**4.0J**	**2.1J**
Phenanthrene	ug/kg	**11.7J**	**16.4J**
Pyrene	ug/kg	**34.8**	**29.6**
TPH (US EPA SW-846 Method 8015D Modified)			
Diesel Range Organics (C10-C28)	mg/kg	**4.1**	**3.3**

	Date & Time Collected	12/03/2020 16:00
	Location	USRBG001
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
Metals (US EPA SW-846 Method 6010/7471)		
Arsenic	mg/kg	**4.4J**
Barium	mg/kg	**46.0**
Cadmium	mg/kg	**0.58J**
Chromium (Total)	mg/kg	**17.3**
Copper	mg/kg	**10.5**
Lead	mg/kg	**27.8**
Mercury (Total)	mg/kg	**0.099**
Zinc	mg/kg	**68.8**
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1254	ug/kg	**39.1J**
PCB (Total)	ug/kg	**39.1J**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**22.9**
PAH (US EPA SW-846 Method 8270 by SIM)		
Acenaphthylene	ug/kg	**18.1J**
Anthracene	ug/kg	**26.8J**
Benzo(a)anthracene	ug/kg	**101**
Benzo(a)pyrene	ug/kg	**114**
Benzo(b)fluoranthene	ug/kg	**119**
Benzo(g,h,i)perylene	ug/kg	**74.3**
Benzo(k)fluoranthene	ug/kg	**51.2**
Chrysene	ug/kg	**113**
Dibenzo(a,h)anthracene	ug/kg	**19.0J**
Fluoranthene	ug/kg	**178**
Fluorene	ug/kg	**4.6J**
Indeno(1,2,3-c,d)pyrene	ug/kg	**59.2**
Naphthalene	ug/kg	**3.7J**
Phenanthrene	ug/kg	**45.8**
Pyrene	ug/kg	**165**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**13.4**

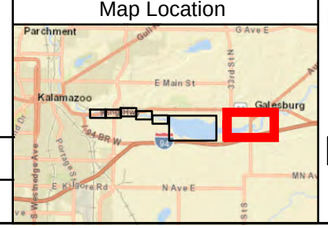
Bolded values are concentrations detected above the Method Detection Limit (MDL).
"<" = The analytical result was not detected above the indicated MDL.
"J" = Value was detected above the MDL, but below the Practical Quantitation Limit. This value should be considered estimated.
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyls
TPH = total petroleum hydrocarbon
US EPA = United States Environmental Protection Agency

AECOM

Project: 60644031

Prepared: 1/28/2021

Map Location



Legend

- Sediment Grab & Analyzed Sediment Core Samping Location (5 locations)
- Sediment Grab & Frozen Sediment Core Sampling Location (9 locations)
- Sediment Grab Sampling Location (2 locations)
- Sediment Containment & Sediment Sack

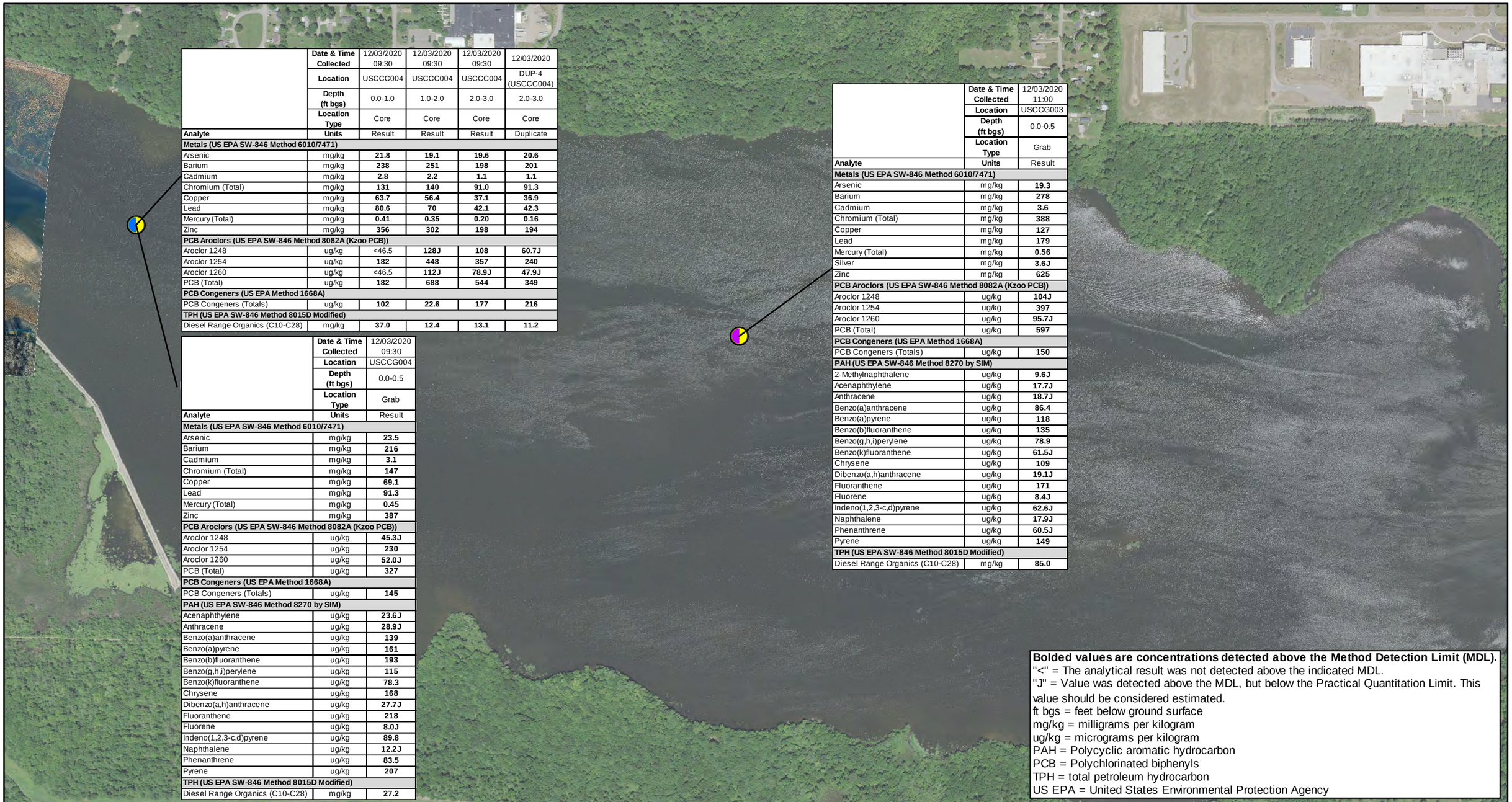
N

0 300 600 1,200 Feet

FIGURE 2
SEDIMENT SAMPLE LOCATIONS & ANALYTICAL DETECTIONS
SHEET 1 OF 7

STS MORROW LAKE DAM

Aerial: November 12, 2020 over 2018 NAIP Imagery



	Date & Time Collected	12/03/2020 09:30	12/03/2020 09:30	12/03/2020 09:30	12/03/2020
	Location	USCCC004	USCCC004	USCCC004	DUP-4 (USCCC004)
	Depth (ft bgs)	0.0-1.0	1.0-2.0	2.0-3.0	2.0-3.0
	Location Type	Core	Core	Core	Core
Analyte	**Units**	Result	Result	Result	Duplicate
Metals (US EPA SW-846 Method 6010/7471)					
Arsenic	mg/kg	**21.8**	**19.1**	**19.6**	**20.6**
Barium	mg/kg	**238**	**251**	**198**	**201**
Cadmium	mg/kg	**2.8**	**2.2**	**1.1**	**1.1**
Chromium (Total)	mg/kg	**131**	**140**	**91.0**	**91.3**
Copper	mg/kg	**63.7**	**56.4**	**37.1**	**36.9**
Lead	mg/kg	**80.6**	**70**	**42.1**	**42.3**
Mercury (Total)	mg/kg	**0.41**	**0.35**	**0.20**	**0.16**
Zinc	mg/kg	**356**	**302**	**198**	**194**
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))					
Aroclor 1248	ug/kg	<46.5	**128J**	**108**	**60.7J**
Aroclor 1254	ug/kg	**182**	**448**	**357**	**240**
Aroclor 1260	ug/kg	<46.5	**112J**	**78.9J**	**47.9J**
PCB (Total)	ug/kg	**182**	**688**	**544**	**349**
PCB Congeners (US EPA Method 1668A)					
PCB Congeners (Totals)	ug/kg	**102**	**22.6**	**177**	**216**
TPH (US EPA SW-846 Method 8015D Modified)					
Diesel Range Organics (C10-C28)	mg/kg	**37.0**	**12.4**	**13.1**	**11.2**

	Date & Time Collected	12/03/2020 09:30
	Location	USCCG004
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
Metals (US EPA SW-846 Method 6010/7471)		
Arsenic	mg/kg	**23.5**
Barium	mg/kg	**216**
Cadmium	mg/kg	**3.1**
Chromium (Total)	mg/kg	**147**
Copper	mg/kg	**69.1**
Lead	mg/kg	**91.3**
Mercury (Total)	mg/kg	**0.45**
Zinc	mg/kg	**387**
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1248	ug/kg	**45.3J**
Aroclor 1254	ug/kg	**230**
Aroclor 1260	ug/kg	**52.0J**
PCB (Total)	ug/kg	**327**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**145**
PAH (US EPA SW-846 Method 8270 by SIM)		
Acenaphthylene	ug/kg	**23.6J**
Anthracene	ug/kg	**28.9J**
Benzo(a)anthracene	ug/kg	**139**
Benzo(a)pyrene	ug/kg	**161**
Benzo(b)fluoranthene	ug/kg	**193**
Benzo(g,h,i)perylene	ug/kg	**115**
Benzo(k)fluoranthene	ug/kg	**78.3**
Chrysene	ug/kg	**168**
Dibenzo(a,h)anthracene	ug/kg	**27.7J**
Fluoranthene	ug/kg	**218**
Fluorene	ug/kg	**8.0J**
Indeno(1,2,3-c,d)pyrene	ug/kg	**89.8**
Naphthalene	ug/kg	**12.2J**
Phenanthrene	ug/kg	**83.5**
Pyrene	ug/kg	**207**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**27.2**

	Date & Time Collected	12/03/2020 11:00
	Location	USCCG003
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
Metals (US EPA SW-846 Method 6010/7471)		
Arsenic	mg/kg	**19.3**
Barium	mg/kg	**278**
Cadmium	mg/kg	**3.6**
Chromium (Total)	mg/kg	**388**
Copper	mg/kg	**127**
Lead	mg/kg	**179**
Mercury (Total)	mg/kg	**0.56**
Silver	mg/kg	**3.6J**
Zinc	mg/kg	**625**
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1248	ug/kg	**104J**
Aroclor 1254	ug/kg	**397**
Aroclor 1260	ug/kg	**95.7J**
PCB (Total)	ug/kg	**597**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**150**
PAH (US EPA SW-846 Method 8270 by SIM)		
2-Methylnaphthalene	ug/kg	**9.6J**
Acenaphthylene	ug/kg	**17.7J**
Anthracene	ug/kg	**18.7J**
Benzo(a)anthracene	ug/kg	**86.4**
Benzo(a)pyrene	ug/kg	**118**
Benzo(b)fluoranthene	ug/kg	**135**
Benzo(g,h,i)perylene	ug/kg	**78.9**
Benzo(k)fluoranthene	ug/kg	**61.5J**
Chrysene	ug/kg	**109**
Dibenzo(a,h)anthracene	ug/kg	**19.1J**
Fluoranthene	ug/kg	**171**
Fluorene	ug/kg	**8.4J**
Indeno(1,2,3-c,d)pyrene	ug/kg	**62.6J**
Naphthalene	ug/kg	**17.9J**
Phenanthrene	ug/kg	**60.5J**
Pyrene	ug/kg	**149**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**85.0**

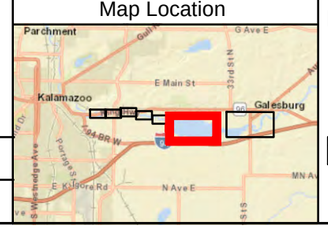
Bolded values are concentrations detected above the Method Detection Limit (MDL).
"<" = The analytical result was not detected above the indicated MDL.
"J" = Value was detected above the MDL, but below the Practical Quantitation Limit. This value should be considered estimated.
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyls
TPH = total petroleum hydrocarbon
US EPA = United States Environmental Protection Agency

AECOM

Project: 60644031

Prepared: 1/28/2021

Map Location



Legend

- Sediment Grab & Analyzed Sediment Core Samping Location (5 locations)
- Sediment Grab & Frozen Sediment Core Sampling Location (9 locations)
- Sediment Grab Sampling Location (2 locations)
- Sediment Containment & Sediment Sack

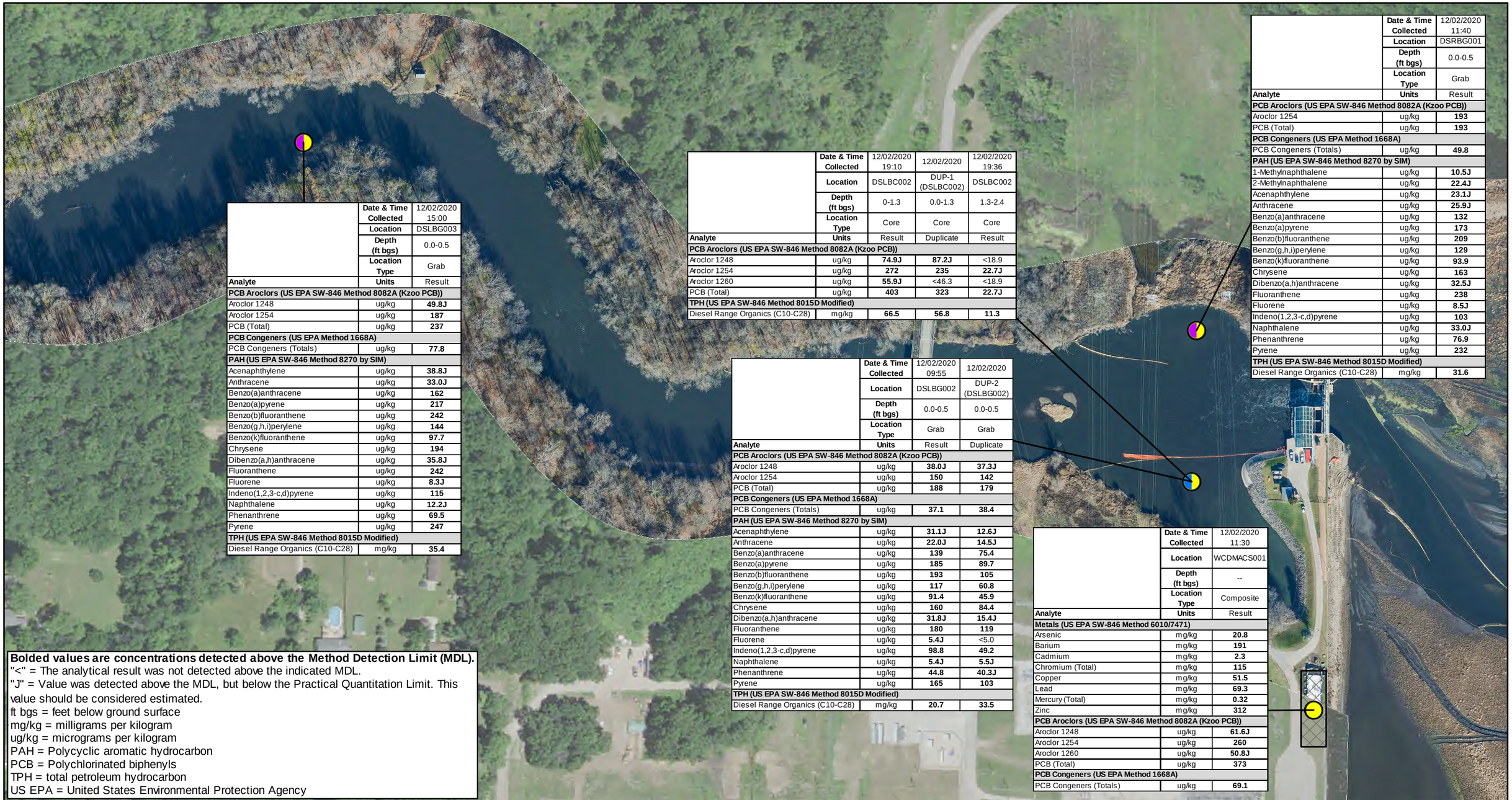
N

0 300 600 1,200 Feet

FIGURE 2
SEDIMENT SAMPLE LOCATIONS & ANALYTICAL DETECTIONS
SHEET 2 OF 7

STS MORROW LAKE DAM

Aerial: November 12, 2020 over 2018 NAIP Imagery



	Date & Time Collected	12/02/2020 15:00
	Location	DSLBG003
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1248	ug/kg	**49.8J**
Aroclor 1254	ug/kg	**187**
PCB (Total)	ug/kg	**237**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**77.8**
PAH (US EPA SW-846 Method 8270 by SIM)		
Acenaphthylene	ug/kg	**38.8J**
Anthracene	ug/kg	**33.0J**
Benzo(a)anthracene	ug/kg	**162**
Benzo(a)pyrene	ug/kg	**217**
Benzo(b)fluoranthene	ug/kg	**242**
Benzo(g,h,i)perylene	ug/kg	**144**
Benzo(k)fluoranthene	ug/kg	**97.7**
Chrysene	ug/kg	**194**
Dibenzo(a,h)anthracene	ug/kg	**35.8J**
Fluoranthene	ug/kg	**242**
Fluorene	ug/kg	**8.3J**
Indeno(1,2,3-c,d)pyrene	ug/kg	**115**
Naphthalene	ug/kg	**12.2J**
Phenanthrene	ug/kg	**69.5**
Pyrene	ug/kg	**247**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**35.4**

	Date & Time Collected	12/02/2020 19:10	12/02/2020	12/02/2020 19:36
	Location	DSLBC002	DUP-1 (DSLBC002)	DSLBC002
	Depth (ft bgs)	0-1.3	0.0-1.3	1.3-2.4
	Location Type	Core	Core	Core
Analyte	**Units**	Result	Duplicate	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))				
Aroclor 1248	ug/kg	**74.9J**	**87.2J**	<18.9
Aroclor 1254	ug/kg	**272**	**235**	**22.7J**
Aroclor 1260	ug/kg	**55.9J**	<46.3	<18.9
PCB (Total)	ug/kg	**403**	**323**	**22.7J**
TPH (US EPA SW-846 Method 8015D Modified)				
Diesel Range Organics (C10-C28)	mg/kg	**66.5**	**56.8**	**11.3**

	Date & Time Collected	12/02/2020 09:55	12/02/2020
	Location	DSLBG002	DUP-2 (DSLBG002)
	Depth (ft bgs)	0.0-0.5	0.0-0.5
	Location Type	Grab	Grab
Analyte	**Units**	Result	Duplicate
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))			
Aroclor 1248	ug/kg	**38.0J**	**37.3J**
Aroclor 1254	ug/kg	**150**	**142**
PCB (Total)	ug/kg	**188**	**179**
PCB Congeners (US EPA Method 1668A)			
PCB Congeners (Totals)	ug/kg	**37.1**	**38.4**
PAH (US EPA SW-846 Method 8270 by SIM)			
Acenaphthylene	ug/kg	**31.1J**	**12.6J**
Anthracene	ug/kg	**22.0J**	**14.5J**
Benzo(a)anthracene	ug/kg	**139**	**75.4**
Benzo(a)pyrene	ug/kg	**185**	**89.7**
Benzo(b)fluoranthene	ug/kg	**193**	**105**
Benzo(g,h,i)perylene	ug/kg	**117**	**60.8**
Benzo(k)fluoranthene	ug/kg	**91.4**	**45.9**
Chrysene	ug/kg	**160**	**84.4**
Dibenzo(a,h)anthracene	ug/kg	**31.8J**	**15.4J**
Fluoranthene	ug/kg	**180**	**119**
Fluorene	ug/kg	**5.4J**	<5.0
Indeno(1,2,3-c,d)pyrene	ug/kg	**98.8**	**49.2**
Naphthalene	ug/kg	**5.4J**	**5.5J**
Phenanthrene	ug/kg	**44.8**	**40.3J**
Pyrene	ug/kg	**165**	**103**
TPH (US EPA SW-846 Method 8015D Modified)			
Diesel Range Organics (C10-C28)	mg/kg	**20.7**	**33.5**

	Date & Time Collected	12/02/2020 11:40
	Location	DSRBG001
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1254	ug/kg	**193**
PCB (Total)	ug/kg	**193**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**49.8**
PAH (US EPA SW-846 Method 8270 by SIM)		
1-Methylnaphthalene	ug/kg	**10.5J**
2-Methylnaphthalene	ug/kg	**22.4J**
Acenaphthylene	ug/kg	**23.1J**
Anthracene	ug/kg	**25.9J**
Benzo(a)anthracene	ug/kg	**132**
Benzo(a)pyrene	ug/kg	**173**
Benzo(b)fluoranthene	ug/kg	**209**
Benzo(g,h,i)perylene	ug/kg	**129**
Benzo(k)fluoranthene	ug/kg	**93.9**
Chrysene	ug/kg	**163**
Dibenzo(a,h)anthracene	ug/kg	**32.5J**
Fluoranthene	ug/kg	**238**
Fluorene	ug/kg	**8.5J**
Indeno(1,2,3-c,d)pyrene	ug/kg	**103**
Naphthalene	ug/kg	**33.0J**
Phenanthrene	ug/kg	**76.9**
Pyrene	ug/kg	**232**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**31.6**

	Date & Time Collected	12/02/2020 11:30
	Location	WCDMACS001
	Depth (ft bgs)	--
	Location Type	Composite
Analyte	**Units**	Result
Metals (US EPA SW-846 Method 6010/7471)		
Arsenic	mg/kg	**20.8**
Barium	mg/kg	**191**
Cadmium	mg/kg	**2.3**
Chromium (Total)	mg/kg	**115**
Copper	mg/kg	**51.5**
Lead	mg/kg	**69.3**
Mercury (Total)	mg/kg	**0.32**
Zinc	mg/kg	**312**
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1248	ug/kg	**61.6J**
Aroclor 1254	ug/kg	**260**
Aroclor 1260	ug/kg	**50.8J**
PCB (Total)	ug/kg	**373**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**69.1**

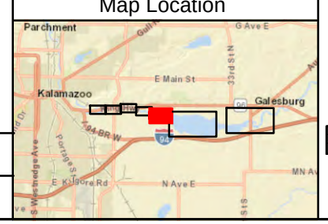
Bolded values are concentrations detected above the Method Detection Limit (MDL).
"<" = The analytical result was not detected above the indicated MDL.
"J" = Value was detected above the MDL, but below the Practical Quantitation Limit. This value should be considered estimated.
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyls
TPH = total petroleum hydrocarbon
US EPA = United States Environmental Protection Agency

AECOM

Project: 60644031

Prepared: 1/29/2021

Map Location



Legend

- Sediment Grab & Analyzed Sediment Core Samping Location (5 locations)
- Sediment Grab & Frozen Sediment Core Sampling Location (9 locations)
- Sediment Grab Sampling Location (2 locations)
- Sediment Containment & Sediment Sack

*Sample WCDMACS001 is a composite sample consisting of multiple aliquiots collected from the dredged material generated during the Morrow Dam gate repairs in late 2020.

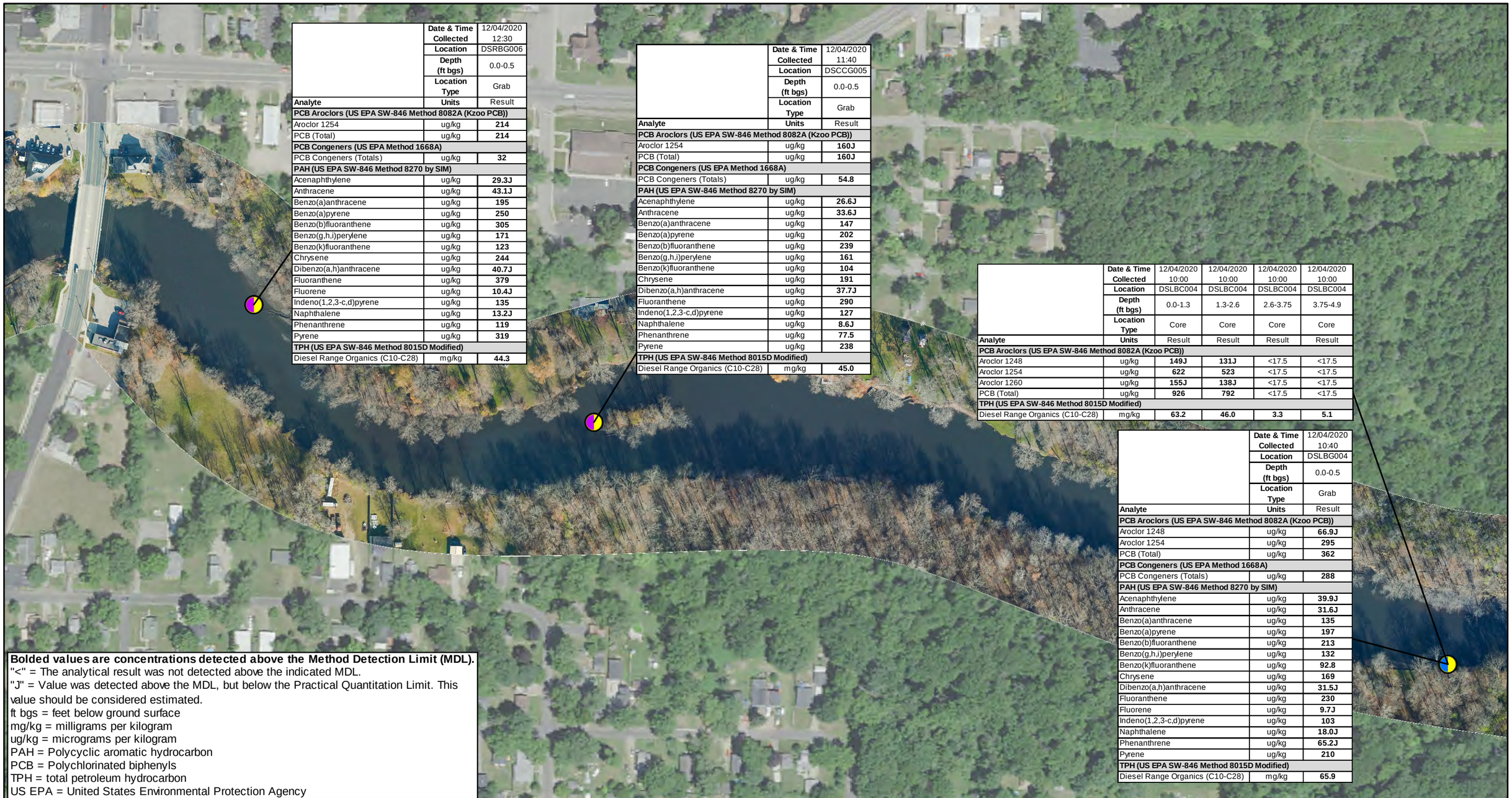
N

0 100 200 400 Feet

FIGURE 2
SEDIMENT SAMPLE LOCATIONS & ANALYTICAL DETECTIONS
SHEET 3 OF 7

STS MORROW LAKE DAM

Aerial: November 12, 2020 over 2018 NAIP Imagery



	Date & Time Collected	12/04/2020 12:30
	Location	DSRBG006
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1254	ug/kg	**214**
PCB (Total)	ug/kg	**214**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**32**
PAH (US EPA SW-846 Method 8270 by SIM)		
Acenaphthylene	ug/kg	**29.3J**
Anthracene	ug/kg	**43.1J**
Benzo(a)anthracene	ug/kg	**195**
Benzo(a)pyrene	ug/kg	**250**
Benzo(b)fluoranthene	ug/kg	**305**
Benzo(g,h,i)perylene	ug/kg	**171**
Benzo(k)fluoranthene	ug/kg	**123**
Chrysene	ug/kg	**244**
Dibenzo(a,h)anthracene	ug/kg	**40.7J**
Fluoranthene	ug/kg	**379**
Fluorene	ug/kg	**10.4J**
Indeno(1,2,3-c,d)pyrene	ug/kg	**135**
Naphthalene	ug/kg	**13.2J**
Phenanthrene	ug/kg	**119**
Pyrene	ug/kg	**319**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**44.3**

	Date & Time Collected	12/04/2020 11:40
	Location	DSCCG005
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1254	ug/kg	**160J**
PCB (Total)	ug/kg	**160J**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**54.8**
PAH (US EPA SW-846 Method 8270 by SIM)		
Acenaphthylene	ug/kg	**26.6J**
Anthracene	ug/kg	**33.6J**
Benzo(a)anthracene	ug/kg	**147**
Benzo(a)pyrene	ug/kg	**202**
Benzo(b)fluoranthene	ug/kg	**239**
Benzo(g,h,i)perylene	ug/kg	**161**
Benzo(k)fluoranthene	ug/kg	**104**
Chrysene	ug/kg	**191**
Dibenzo(a,h)anthracene	ug/kg	**37.7J**
Fluoranthene	ug/kg	**290**
Indeno(1,2,3-c,d)pyrene	ug/kg	**127**
Naphthalene	ug/kg	**8.6J**
Phenanthrene	ug/kg	**77.5**
Pyrene	ug/kg	**238**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**45.0**

	Date & Time Collected	12/04/2020 10:00	12/04/2020 10:00	12/04/2020 10:00	12/04/2020 10:00
	Location	DSLBC004	DSLBC004	DSLBC004	DSLBC004
	Depth (ft bgs)	0.0-1.3	1.3-2.6	2.6-3.75	3.75-4.9
	Location Type	Core	Core	Core	Core
Analyte	**Units**	Result	Result	Result	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))					
Aroclor 1248	ug/kg	**149J**	**131J**	<17.5	<17.5
Aroclor 1254	ug/kg	**622**	**523**	<17.5	<17.5
Aroclor 1260	ug/kg	**155J**	**138J**	<17.5	<17.5
PCB (Total)	ug/kg	**926**	**792**	<17.5	<17.5
TPH (US EPA SW-846 Method 8015D Modified)					
Diesel Range Organics (C10-C28)	mg/kg	**63.2**	**46.0**	**3.3**	**5.1**

	Date & Time Collected	12/04/2020 10:40
	Location	DSLBG004
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1248	ug/kg	**66.9J**
Aroclor 1254	ug/kg	**295**
PCB (Total)	ug/kg	**362**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**288**
PAH (US EPA SW-846 Method 8270 by SIM)		
Acenaphthylene	ug/kg	**39.9J**
Anthracene	ug/kg	**31.6J**
Benzo(a)anthracene	ug/kg	**135**
Benzo(a)pyrene	ug/kg	**197**
Benzo(b)fluoranthene	ug/kg	**213**
Benzo(g,h,i)perylene	ug/kg	**132**
Benzo(k)fluoranthene	ug/kg	**92.8**
Chrysene	ug/kg	**169**
Dibenzo(a,h)anthracene	ug/kg	**31.5J**
Fluoranthene	ug/kg	**230**
Fluorene	ug/kg	**9.7J**
Indeno(1,2,3-c,d)pyrene	ug/kg	**103**
Naphthalene	ug/kg	**18.0J**
Phenanthrene	ug/kg	**65.2J**
Pyrene	ug/kg	**210**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**65.9**

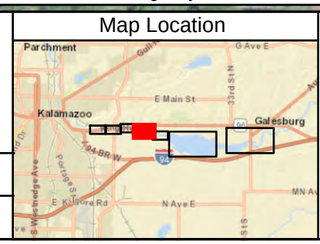
Bolded values are concentrations detected above the Method Detection Limit (MDL).
"<" = The analytical result was not detected above the indicated MDL.
"J" = Value was detected above the MDL, but below the Practical Quantitation Limit. This value should be considered estimated.
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyls
TPH = total petroleum hydrocarbon
US EPA = United States Environmental Protection Agency

AECOM

Project: 60644031

Prepared: 1/28/2021

Map Location



Legend

- Sediment Grab & Analyzed Sediment Core Samping Location (5 locations)
- Sediment Grab & Frozen Sediment Core Sampling Location (9 locations)
- Sediment Grab Sampling Location (2 locations)
- Sediment Containment & Sediment Sack

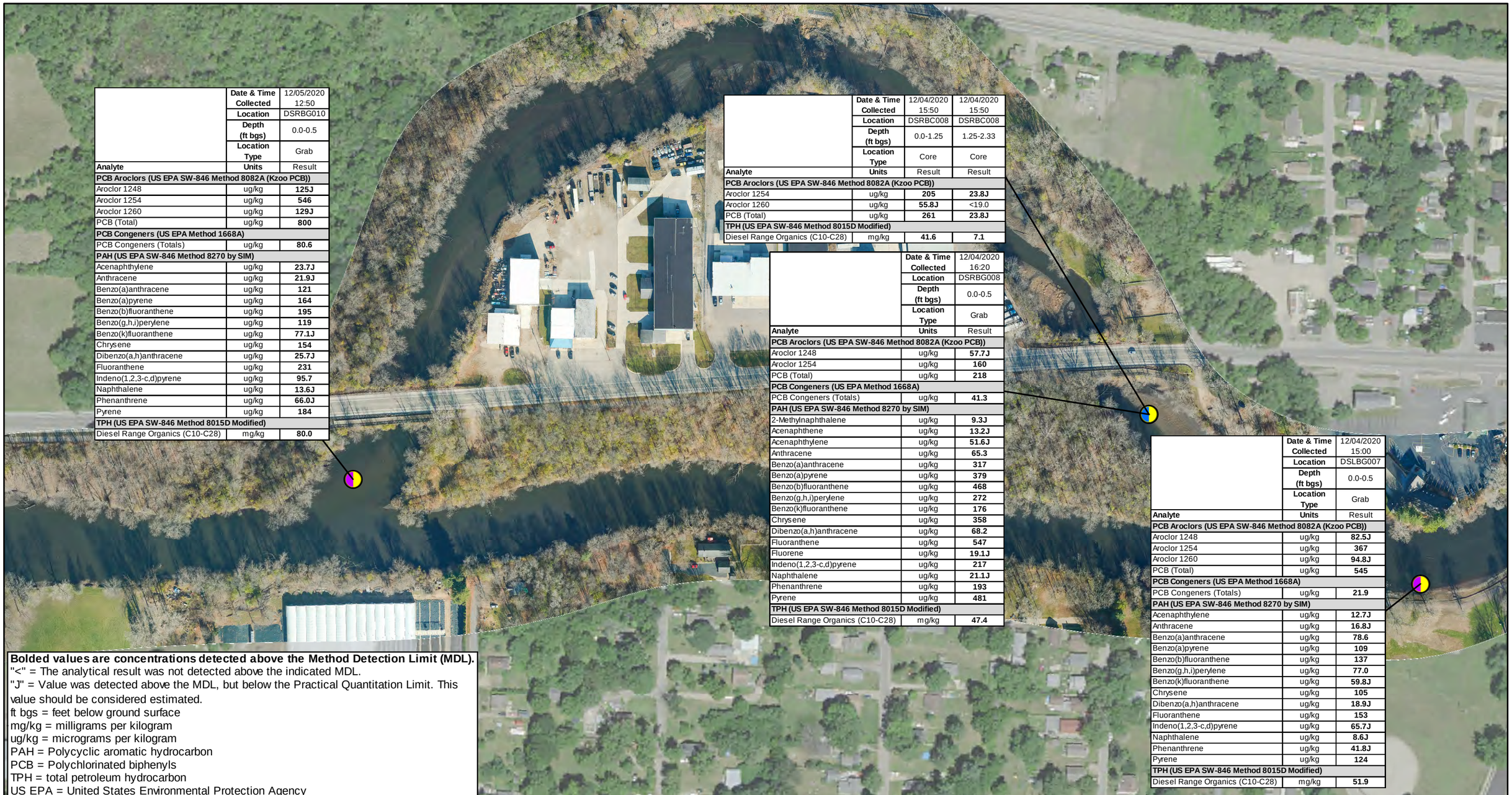
N

0 100 200 400 Feet

FIGURE 2
SEDIMENT SAMPLE LOCATIONS & ANALYTICAL DETECTIONS
SHEET 4 OF 7

STS MORROW LAKE DAM

Aerial: November 12, 2020 over 2018 NAIP Imagery



	Date & Time Collected	12/05/2020 12:50
	Location	DSRBG010
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1248	ug/kg	**125J**
Aroclor 1254	ug/kg	**546**
Aroclor 1260	ug/kg	**129J**
PCB (Total)	ug/kg	**800**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**80.6**
PAH (US EPA SW-846 Method 8270 by SIM)		
Acenaphthylene	ug/kg	**23.7J**
Anthracene	ug/kg	**21.9J**
Benzo(a)anthracene	ug/kg	**121**
Benzo(a)pyrene	ug/kg	**164**
Benzo(b)fluoranthene	ug/kg	**195**
Benzo(g,h,i)perylene	ug/kg	**119**
Benzo(k)fluoranthene	ug/kg	**77.1J**
Chrysene	ug/kg	**154**
Dibenzo(a,h)anthracene	ug/kg	**25.7J**
Fluoranthene	ug/kg	**231**
Indeno(1,2,3-c,d)pyrene	ug/kg	**95.7**
Naphthalene	ug/kg	**13.6J**
Phenanthrene	ug/kg	**66.0J**
Pyrene	ug/kg	**184**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**80.0**

	Date & Time Collected	12/04/2020 15:50	12/04/2020 15:50
	Location	DSRBC008	DSRBC008
	Depth (ft bgs)	0.0-1.25	1.25-2.33
	Location Type	Core	Core
Analyte	**Units**	Result	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))			
Aroclor 1254	ug/kg	**205**	**23.8J**
Aroclor 1260	ug/kg	**55.8J**	<19.0
PCB (Total)	ug/kg	**261**	**23.8J**
TPH (US EPA SW-846 Method 8015D Modified)			
Diesel Range Organics (C10-C28)	mg/kg	**41.6**	**7.1**

	Date & Time Collected	12/04/2020 16:20
	Location	DSRBG008
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1248	ug/kg	**57.7J**
Aroclor 1254	ug/kg	**160**
PCB (Total)	ug/kg	**218**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**41.3**
PAH (US EPA SW-846 Method 8270 by SIM)		
2-Methylnaphthalene	ug/kg	**9.3J**
Acenaphthene	ug/kg	**13.2J**
Acenaphthylene	ug/kg	**51.6J**
Anthracene	ug/kg	**65.3**
Benzo(a)anthracene	ug/kg	**317**
Benzo(a)pyrene	ug/kg	**379**
Benzo(b)fluoranthene	ug/kg	**468**
Benzo(g,h,i)perylene	ug/kg	**272**
Benzo(k)fluoranthene	ug/kg	**176**
Chrysene	ug/kg	**358**
Dibenzo(a,h)anthracene	ug/kg	**68.2**
Fluoranthene	ug/kg	**547**
Fluorene	ug/kg	**19.1J**
Indeno(1,2,3-c,d)pyrene	ug/kg	**217**
Naphthalene	ug/kg	**21.1J**
Phenanthrene	ug/kg	**193**
Pyrene	ug/kg	**481**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**47.4**

	Date & Time Collected	12/04/2020 15:00
	Location	DSLBG007
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1248	ug/kg	**82.5J**
Aroclor 1254	ug/kg	**367**
Aroclor 1260	ug/kg	**94.8J**
PCB (Total)	ug/kg	**545**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**21.9**
PAH (US EPA SW-846 Method 8270 by SIM)		
Acenaphthylene	ug/kg	**12.7J**
Anthracene	ug/kg	**16.8J**
Benzo(a)anthracene	ug/kg	**78.6**
Benzo(a)pyrene	ug/kg	**109**
Benzo(b)fluoranthene	ug/kg	**137**
Benzo(g,h,i)perylene	ug/kg	**77.0**
Benzo(k)fluoranthene	ug/kg	**59.8J**
Chrysene	ug/kg	**105**
Dibenzo(a,h)anthracene	ug/kg	**18.9J**
Fluoranthene	ug/kg	**153**
Indeno(1,2,3-c,d)pyrene	ug/kg	**65.7J**
Naphthalene	ug/kg	**8.6J**
Phenanthrene	ug/kg	**41.8J**
Pyrene	ug/kg	**124**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**51.9**

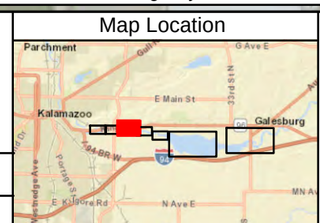
Bolded values are concentrations detected above the Method Detection Limit (MDL).
"<" = The analytical result was not detected above the indicated MDL.
"J" = Value was detected above the MDL, but below the Practical Quantitation Limit. This value should be considered estimated.
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyls
TPH = total petroleum hydrocarbon
US EPA = United States Environmental Protection Agency

AECOM

Project: 60644031

Prepared: 1/28/2021

Map Location



Legend

- Sediment Grab & Analyzed Sediment Core Samping Location (5 locations)
- Sediment Grab & Frozen Sediment Core Sampling Location (9 locations)
- Sediment Grab Sampling Location (2 locations)
- Sediment Containment & Sediment Sack

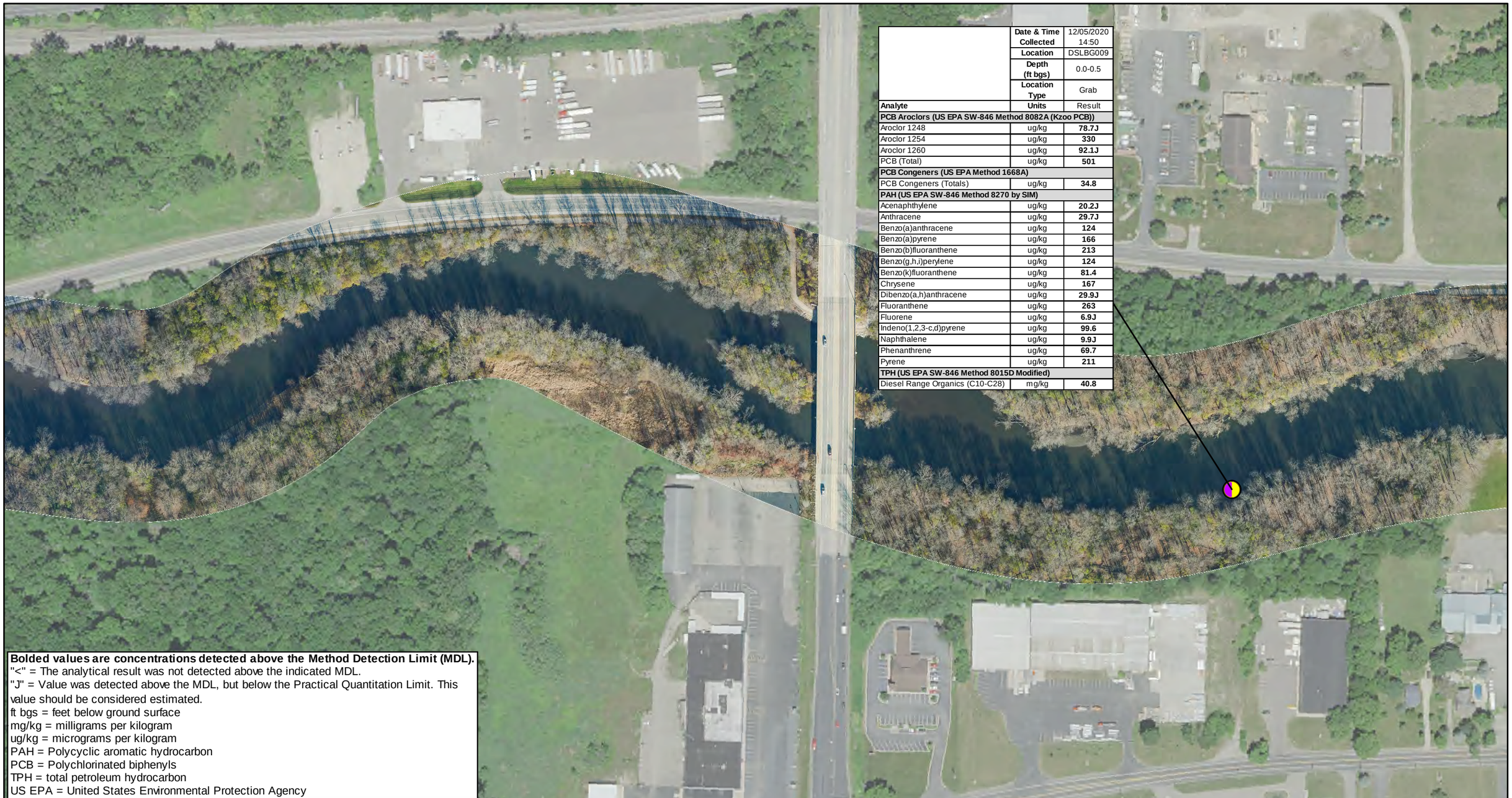
N

0 100 200 400 Feet

FIGURE 2
SEDIMENT SAMPLE LOCATIONS & ANALYTICAL DETECTIONS
SHEET 5 OF 7

STS MORROW LAKE DAM

Aerial: November 12, 2020 over 2018 NAIP Imagery



	Date & Time Collected	12/05/2020 14:50
	Location	DSLBG009
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1248	ug/kg	**78.7J**
Aroclor 1254	ug/kg	**330**
Aroclor 1260	ug/kg	**92.1J**
PCB (Total)	ug/kg	**501**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**34.8**
PAH (US EPA SW-846 Method 8270 by SIM)		
Acenaphthylene	ug/kg	**20.2J**
Anthracene	ug/kg	**29.7J**
Benzo(a)anthracene	ug/kg	**124**
Benzo(a)pyrene	ug/kg	**166**
Benzo(b)fluoranthene	ug/kg	**213**
Benzo(g,h,i)perylene	ug/kg	**124**
Benzo(k)fluoranthene	ug/kg	**81.4**
Chrysene	ug/kg	**167**
Dibenzo(a,h)anthracene	ug/kg	**29.9J**
Fluoranthene	ug/kg	**263**
Fluorene	ug/kg	**6.9J**
Indeno(1,2,3-c,d)pyrene	ug/kg	**99.6**
Naphthalene	ug/kg	**9.9J**
Phenanthrene	ug/kg	**69.7**
Pyrene	ug/kg	**211**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**40.8**

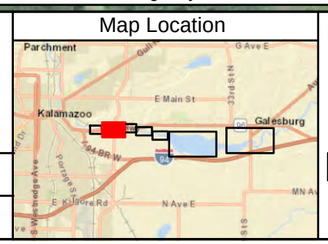
Bolded values are concentrations detected above the Method Detection Limit (MDL).
"<" = The analytical result was not detected above the indicated MDL.
"J" = Value was detected above the MDL, but below the Practical Quantitation Limit. This value should be considered estimated.
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyls
TPH = total petroleum hydrocarbon
US EPA = United States Environmental Protection Agency

AECOM

Project: 60644031

Prepared: 1/28/2021

Map Location



Legend

- Sediment Grab & Analyzed Sediment Core Samping Location (5 locations)
- Sediment Grab & Frozen Sediment Core Sampling Location (9 locations)
- Sediment Grab Sampling Location (2 locations)
- Sediment Containment & Sediment Sack

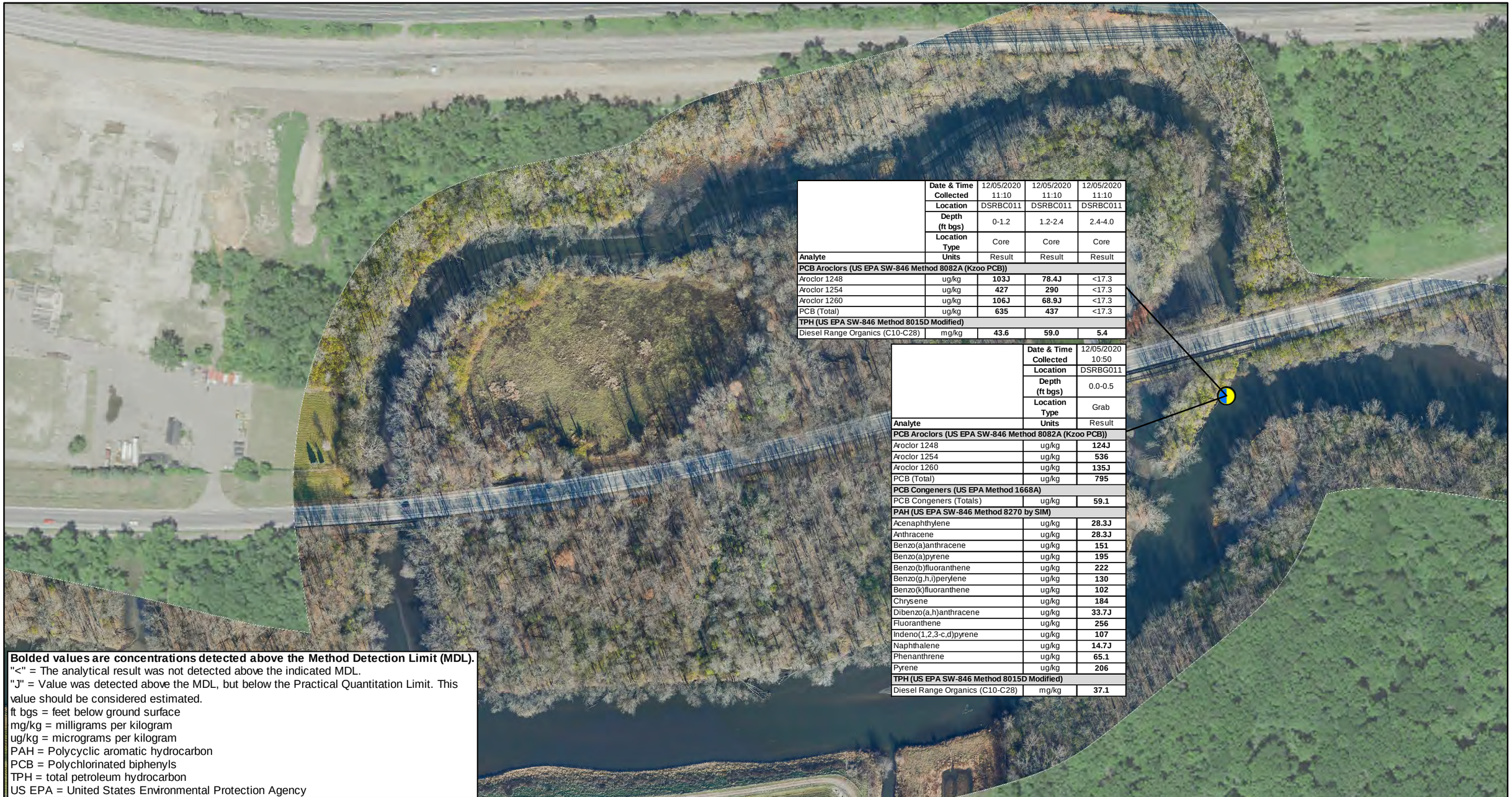
N

0 100 200 400 Feet

FIGURE 2
SEDIMENT SAMPLE LOCATIONS & ANALYTICAL DETECTIONS
SHEET 6 OF 7

STS MORROW LAKE DAM

Aerial: November 12, 2020 over 2018 NAIP Imagery



	Date & Time Collected	12/05/2020 11:10	12/05/2020 11:10	12/05/2020 11:10
	Location	DSRBC011	DSRBC011	DSRBC011
	Depth (ft bgs)	0-1.2	1.2-2.4	2.4-4.0
	Location Type	Core	Core	Core
Analyte	**Units**	Result	Result	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))				
Aroclor 1248	ug/kg	**103J**	**78.4J**	<17.3
Aroclor 1254	ug/kg	**427**	**290**	<17.3
Aroclor 1260	ug/kg	**106J**	**68.9J**	<17.3
PCB (Total)	ug/kg	**635**	**437**	<17.3
TPH (US EPA SW-846 Method 8015D Modified)				
Diesel Range Organics (C10-C28)	mg/kg	**43.6**	**59.0**	**5.4**

	Date & Time Collected	12/05/2020 10:50
	Location	DSRBG011
	Depth (ft bgs)	0.0-0.5
	Location Type	Grab
Analyte	**Units**	Result
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))		
Aroclor 1248	ug/kg	**124J**
Aroclor 1254	ug/kg	**536**
Aroclor 1260	ug/kg	**135J**
PCB (Total)	ug/kg	**795**
PCB Congeners (US EPA Method 1668A)		
PCB Congeners (Totals)	ug/kg	**59.1**
PAH (US EPA SW-846 Method 8270 by SIM)		
Acenaphthylene	ug/kg	**28.3J**
Anthracene	ug/kg	**28.3J**
Benzo(a)anthracene	ug/kg	**151**
Benzo(a)pyrene	ug/kg	**195**
Benzo(b)fluoranthene	ug/kg	**222**
Benzo(g,h,i)perylene	ug/kg	**130**
Benzo(k)fluoranthene	ug/kg	**102**
Chrysene	ug/kg	**184**
Dibenzo(a,h)anthracene	ug/kg	**33.7J**
Fluoranthene	ug/kg	**256**
Indeno(1,2,3-c,d)pyrene	ug/kg	**107**
Naphthalene	ug/kg	**14.7J**
Phenanthrene	ug/kg	**65.1**
Pyrene	ug/kg	**206**
TPH (US EPA SW-846 Method 8015D Modified)		
Diesel Range Organics (C10-C28)	mg/kg	**37.1**

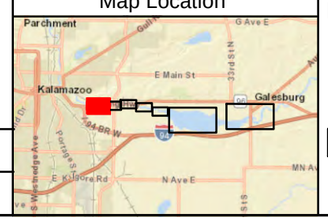
Bolded values are concentrations detected above the Method Detection Limit (MDL).
"<" = The analytical result was not detected above the indicated MDL.
"J" = Value was detected above the MDL, but below the Practical Quantitation Limit. This value should be considered estimated.
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyls
TPH = total petroleum hydrocarbon
US EPA = United States Environmental Protection Agency

AECOM

Project: 60644031

Prepared: 1/28/2021

Map Location



Legend

- Sediment Grab & Analyzed Sediment Core Samping Location (5 locations)
- Sediment Grab & Frozen Sediment Core Sampling Location (9 locations)
- Sediment Grab Sampling Location (2 locations)
- Sediment Containment & Sediment Sack

N

0 100 200 400 Feet

FIGURE 2
SEDIMENT SAMPLE LOCATIONS & ANALYTICAL DETECTIONS
SHEET 7 OF 7

STS MORROW LAKE DAM

Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location

Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Area ID
Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 1 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

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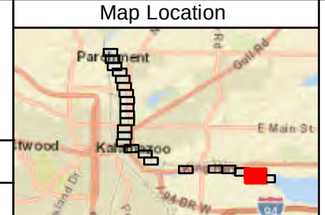
AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Area ID
Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 2 OF 23

STS MORROW LAKE DAM

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Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location

Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Area ID
Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 3 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location

Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Area ID
Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 4 OF 23

STS MORROW LAKE DAM

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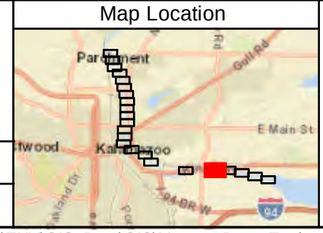
Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Area ID
Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 5 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location

Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Area ID
Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 6 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

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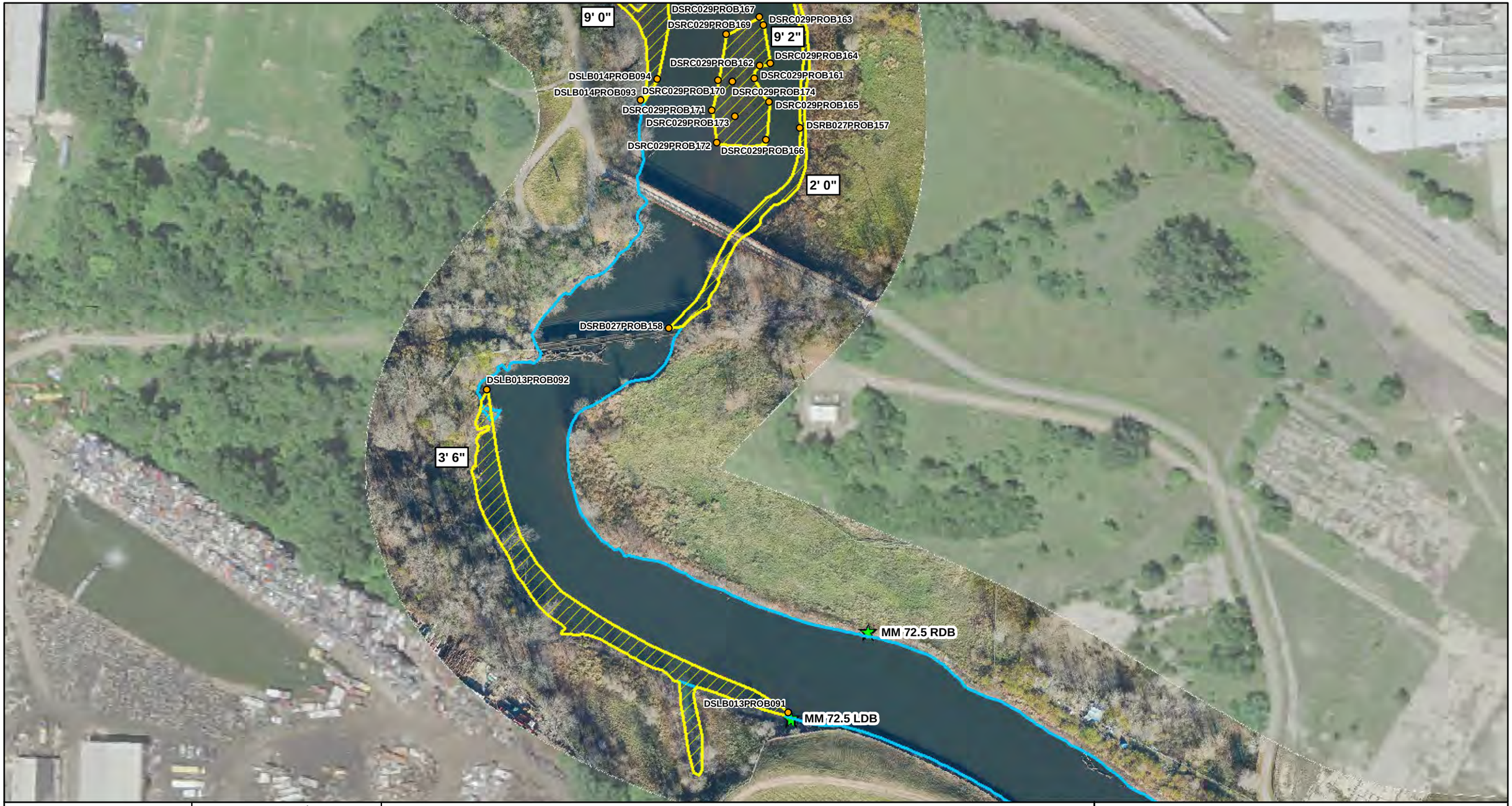
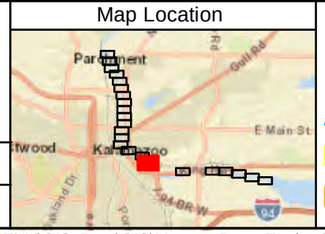


AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 7 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

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AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location

Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 8 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

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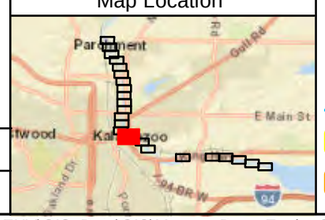
AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 9 OF 23

STS MORROW LAKE DAM

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AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location

Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 10 OF 23

STS MORROW LAKE DAM

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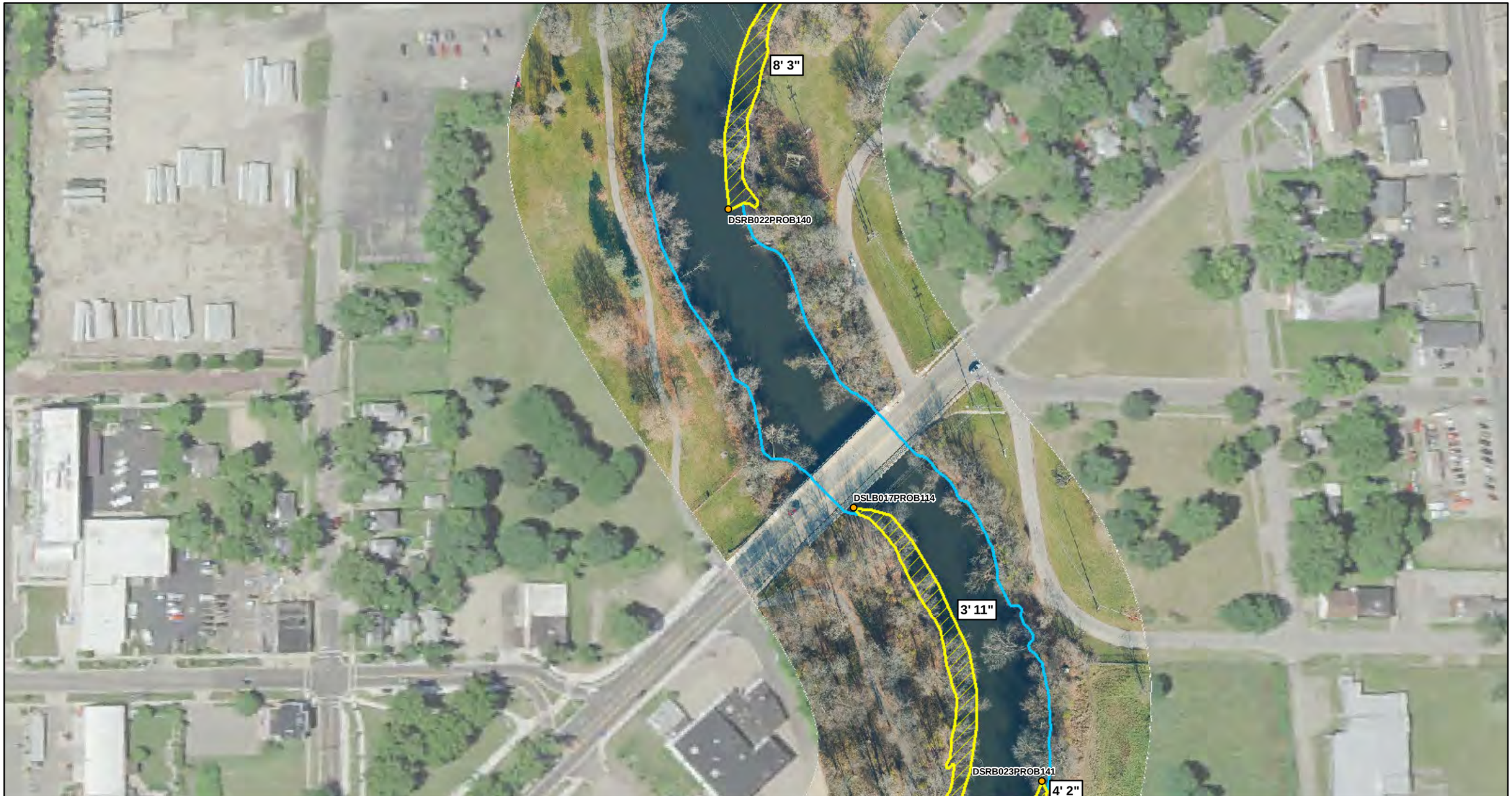

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location

Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 11 OF 23

STS MORROW LAKE DAM

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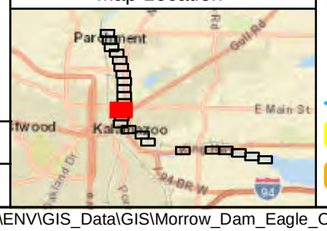
Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 12 OF 23

STS MORROW LAKE DAM

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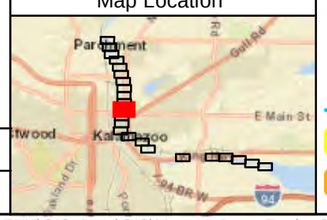
Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

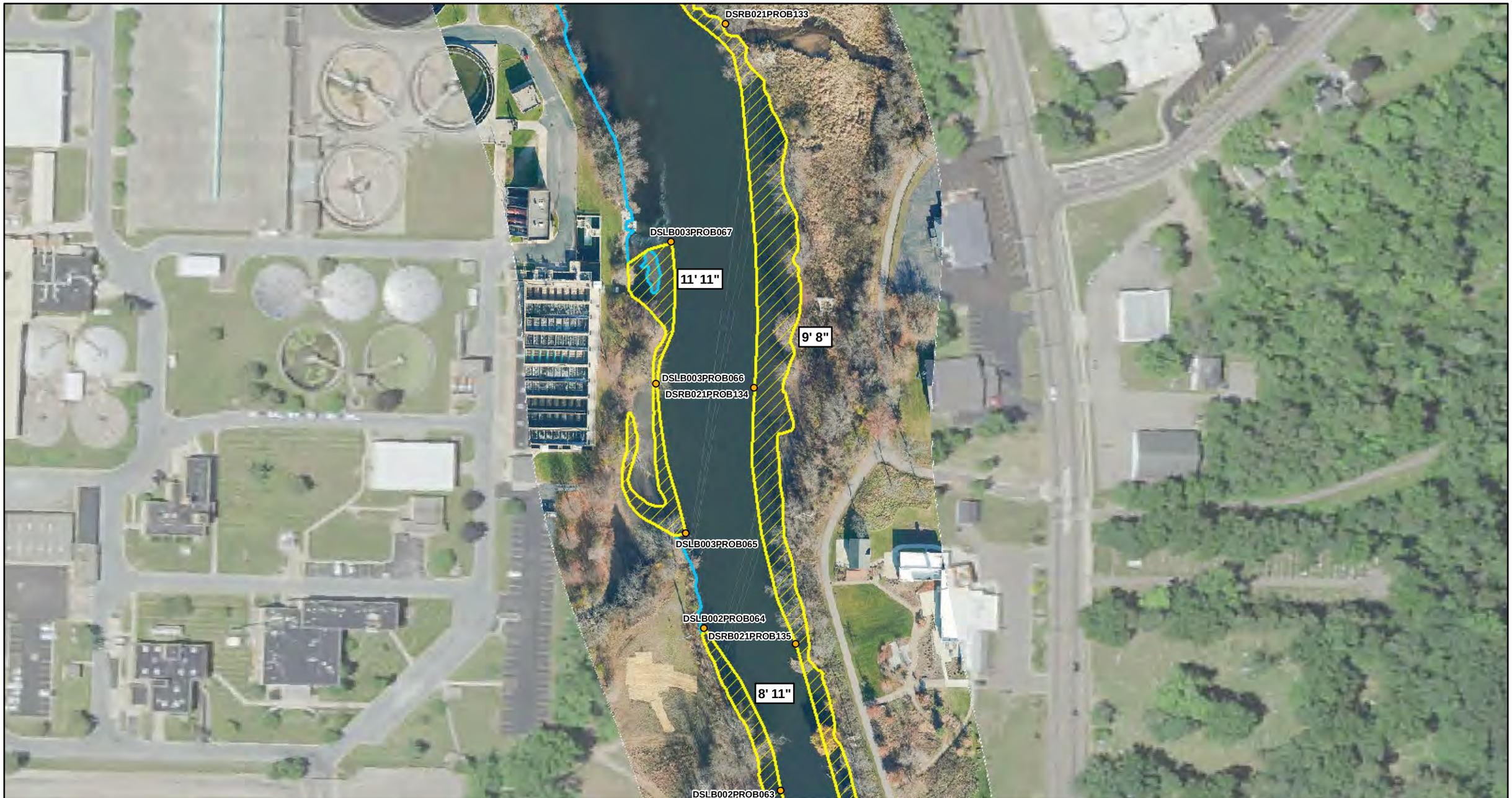
0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 13 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

Aerial: November 12, 2020 over 2018 NAIP Imagery



AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location

Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 14 OF 23

STS MORROW LAKE DAM

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Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location

Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 15 OF 23

STS MORROW LAKE DAM

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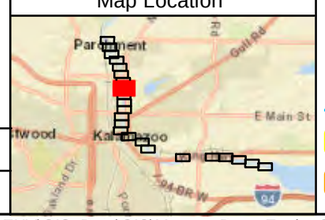
AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 16 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

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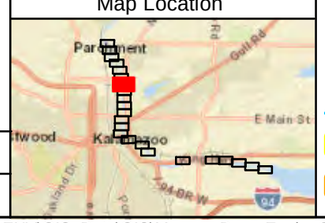
AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 17 OF 23

STS MORROW LAKE DAM

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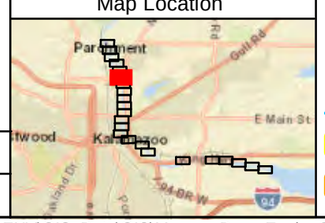
Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 18 OF 23

STS MORROW LAKE DAM

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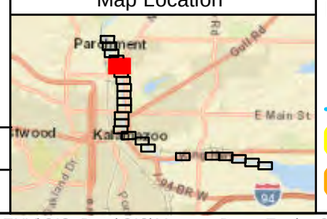
Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 19 OF 23

STS MORROW LAKE DAM

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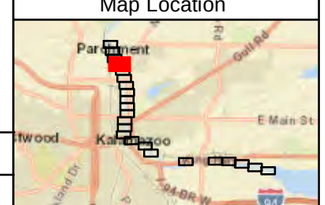
Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 20 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

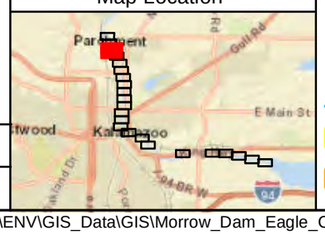
Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 21 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

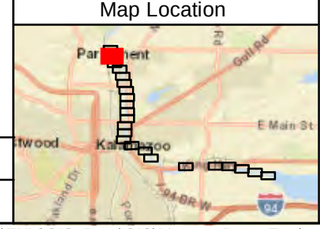
Aerial: November 12, 2020 over 2018 NAIP Imagery

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

- Probing GPS Data
- River Mile Marker
- Seaworks Shoreline
- Field Delineated Sediment Areas
- Area visually observed to contain sediment deposits, but unable to be accessed by boat

Maximum Sediment Thickness Measured (feet/inches)

Note: Sediment depositional areas downstream of Area A-10 are not given an area number as those deposits were too variable to delineate.

N

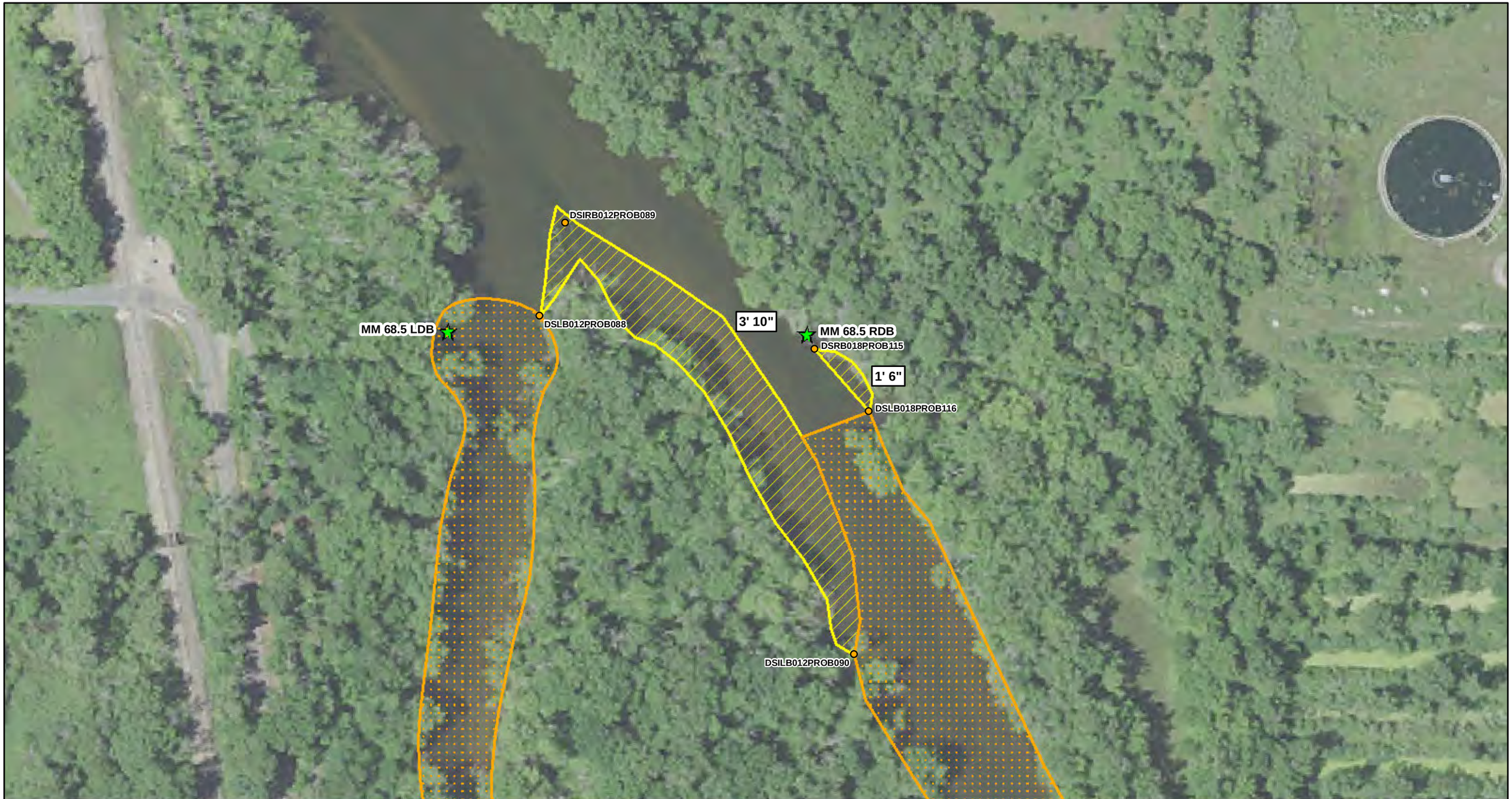
0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 22 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

Aerial: November 12, 2020 over 2018 NAIP Imagery



AECOM

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Prepared: 1/25/2021

Map Location

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- Probing GPS Data
- River Mile Marker
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N

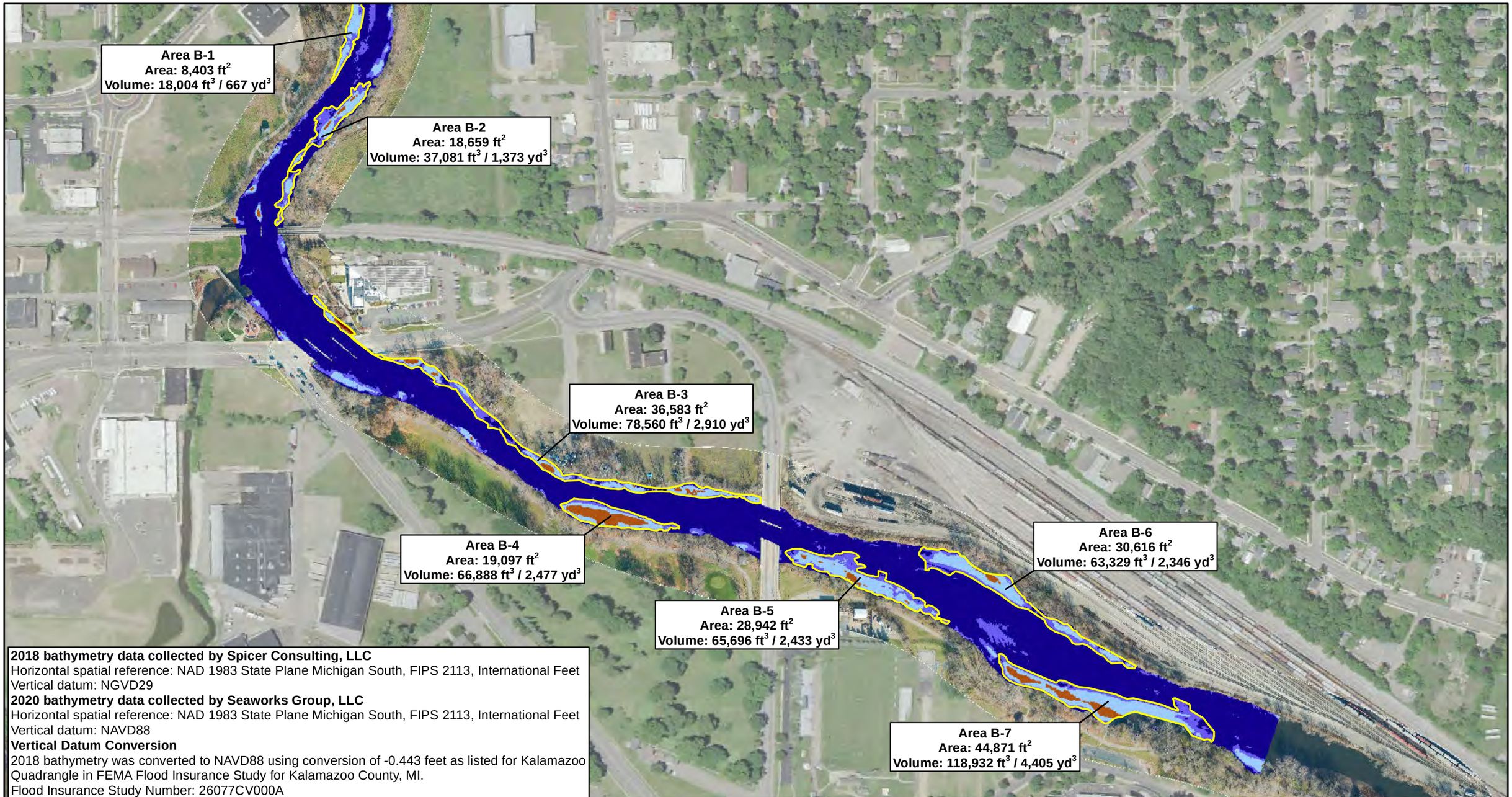
0 62.5 125 250 Feet

FIGURE 3
FIELD DELINEATED SEDIMENT AREAS
SHEET 23 OF 23

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig2_Probing_Field_Data.mxd

Aerial: November 12, 2020 over 2018 NAIP Imagery



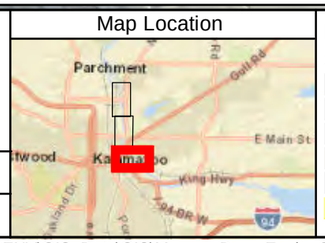
2018 bathymetry data collected by Spicer Consulting, LLC
Horizontal spatial reference: NAD 1983 State Plane Michigan South, FIPS 2113, International Feet
Vertical datum: NGVD29
2020 bathymetry data collected by Seaworks Group, LLC
Horizontal spatial reference: NAD 1983 State Plane Michigan South, FIPS 2113, International Feet
Vertical datum: NAVD88
Vertical Datum Conversion
2018 bathymetry was converted to NAVD88 using conversion of -0.443 feet as listed for Kalamazoo Quadrangle in FEMA Flood Insurance Study for Kalamazoo County, MI.
Flood Insurance Study Number: 26077CV000A

AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

Sediment Deposition from 2018 to 2020 in feet
- Deposition less than 1 foot
- 1 - 2 feet
- 2 - 4 feet
- 4 - 8 feet
- 8 - 12.9 feet
- Target Area

Area ID
Area in square feet (ft^2)
Volume in cubic feet (ft^3) and cubic yards (yd^3)

N

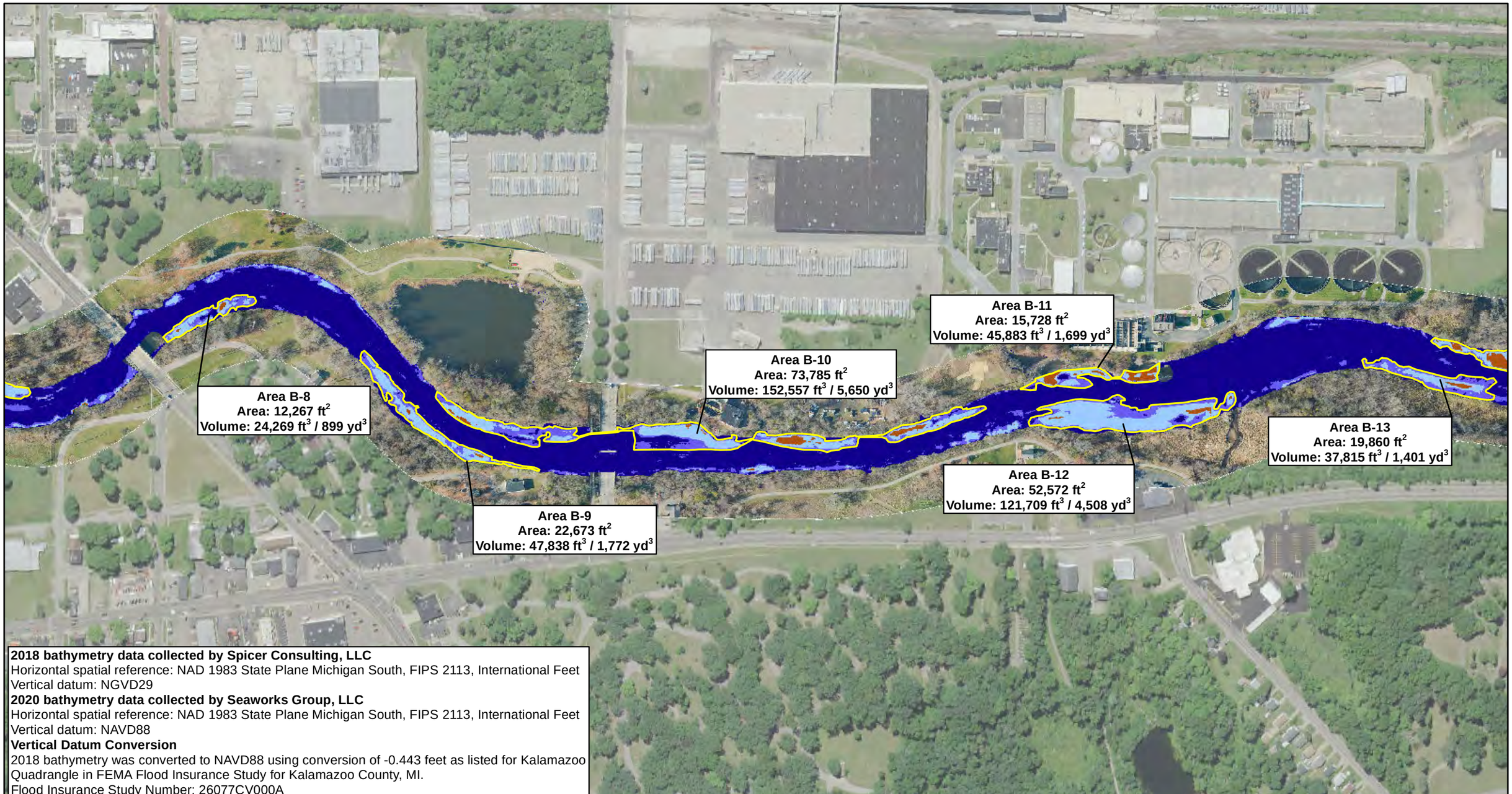
0 150 300 600 Feet

FIGURE 4
SEDIMENT BATHYMETRY
SHEET 1 OF 3

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig3_Bathymetry_Difference.mxd

Aerial: November 12, 2020 over 2018 NAIP Imagery



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Vertical datum: NGVD29
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Horizontal spatial reference: NAD 1983 State Plane Michigan South, FIPS 2113, International Feet
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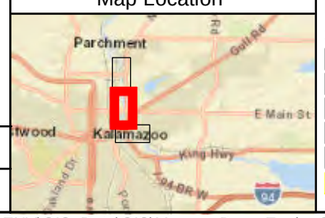
AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location



Legend

Sediment Deposition from 2018 to 2020 in feet
- Deposition less than 1 foot
- 1 - 2 feet
- 2 - 4 feet
- 4 - 8 feet
- 8 - 12.9 feet
- Target Area

Area ID
Area in square feet (ft^2)
Volume in cubic feet (ft^3) and cubic yards (yd^3)

N

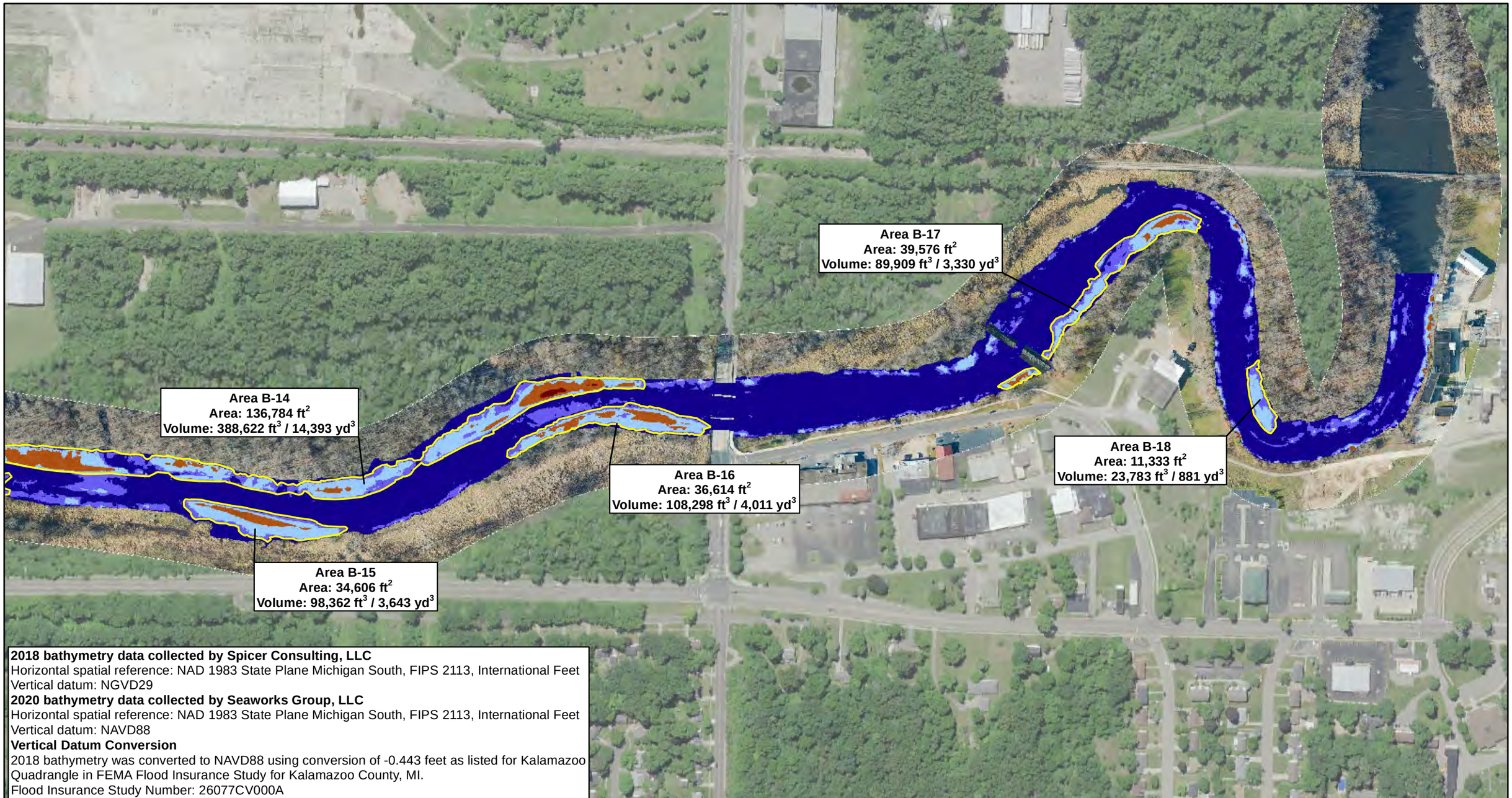
0 150 300 600 Feet

FIGURE 4
SEDIMENT BATHYMETRY
SHEET 2 OF 3

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig3_Bathymetry_Difference.mxd

Aerial: November 12, 2020 over 2018 NAIP Imagery



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Horizontal spatial reference: NAD 1983 State Plane Michigan South, FIPS 2113, International Feet
Vertical datum: NGVD29
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AECOM

Project: 60644031

Prepared: 1/25/2021

Map Location

Legend

Sediment Deposition from 2018 to 2020 in feet
- Deposition less than 1 foot
- 1 - 2 feet
- 2 - 4 feet
- 4 - 8 feet
- 8 - 12.9 feet
- Target Area

Area ID
Area in square feet (ft^2)
Volume in cubic feet (ft^3) and cubic yards (yd^3)

N

0 150 300 600 Feet

FIGURE 4
SEDIMENT BATHYMETRY
SHEET 3 OF 3

STS MORROW LAKE DAM

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Morrow_Dam_Eagle_Creek\MXDs\Fig3_Bathymetry_Difference.mxd

Aerial: November 12, 2020 over 2018 NAIP Imagery

Tables

Table 3 - Sediment Analytical Results
STS Hydropower/Eagle Creek RE
Morrow Lake Dam

	Date & Time Collected	12/03/2020 16:00	12/03/2020 13:30	12/03/2020	12/03/2020 11:00	12/03/2020 09:30	12/03/2020 09:30	12/03/2020 09:30	12/03/2020 09:30	12/03/2020	12/02/2020 11:30	12/02/2020 11:40	12/02/2020 09:55	12/02/2020	12/02/2020 19:10	12/02/2020	12/02/2020 19:36	12/02/2020 15:00
	Location	USRBG001	USCCG002	DUP-3 (USCCG002)	USCCG003	USCCG004	USCCC004	USCCC004	USCCC004	DUP-4 (USCCC004)	WCDMACS001	DSRBG001	DSLBG002	DUP-2 (DSLBG002)	DSLBC002	DUP-1 (DSLBC002)	DSLBC002	DSLBG003
	Depth (ft bgs)	0.0-0.5	0.0-0.5	0.0-0.5	0.0-0.5	0.0-0.5	0.0-1.0	1.0-2.0	2.0-3.0	2.0-3.0	--	0.0-0.5	0.0-0.5	0.0-0.5	0-1.3	0-1.3	1.3-2.4	0.0-0.5
	Location Type	Grab	Grab	Grab	Grab	Grab	Core	Core	Core	Core	Composite	Grab	Grab	Grab	Core	Core	Core	Grab
Analyte	**Units**	Result	Result	Duplicate	Result	Result	Result	Result	Result	Duplicate	Result	Result	Result	Duplicate	Result	Duplicate	Result	Result
Metals (US EPA SW-846 Method 6010/7471)																		
Arsenic	mg/kg	**4.4J**	**5.0**	**4.0**	**19.3**	**23.5**	**21.8**	**19.1**	**19.6**	**20.6**	**20.8**	NS	NS	NS	NS	NS	NS	NS
Barium	mg/kg	**46.0**	**18.8**	**19.6**	**278**	**216**	**238**	**251**	**198**	**201**	**191**	NS	NS	NS	NS	NS	NS	NS
Cadmium	mg/kg	**0.58J**	<0.16	<0.16	**3.6**	**3.1**	**2.8**	**2.2**	**1.1**	**1.1**	**2.3**	NS	NS	NS	NS	NS	NS	NS
Chromium (Total)	mg/kg	**17.3**	**8.5**	**10.1**	**388**	**147**	**131**	**140**	**91.0**	**91.3**	**115**	NS	NS	NS	NS	NS	NS	NS
Copper	mg/kg	**10.5**	**1.6**	**1.8**	**127**	**69.1**	**63.7**	**56.4**	**37.1**	**36.9**	**51.5**	NS	NS	NS	NS	NS	NS	NS
Lead	mg/kg	**27.8**	**3.4**	**3.4**	**179**	**91.3**	**80.6**	**70**	**42.1**	**42.3**	**69.3**	NS	NS	NS	NS	NS	NS	NS
Mercury (Total)	mg/kg	**0.099**	**0.012J**	<0.011	**0.56**	**0.45**	**0.41**	**0.35**	**0.20**	**0.16**	**0.32**	NS	NS	NS	NS	NS	NS	NS
Selenium	mg/kg	<2.7	<1.6	<1.6	<5.1	<3.9	<3.8	<3.7	<2.7	<2.7	<3.3	NS	NS	NS	NS	NS	NS	NS
Silver	mg/kg	<0.63	<0.38	<0.37	**3.6J**	<0.91	<0.90	<0.87	<0.64	<0.63	<0.78	NS	NS	NS	NS	NS	NS	NS
Zinc	mg/kg	**68.8**	**22.1**	**27.1**	**625**	**387**	**356**	**302**	**198**	**194**	**312**	NS	NS	NS	NS	NS	NS	NS
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))																		
Aroclor 1016	ug/kg	<31.0	<18.1	<18.0	<57.6	<45.1	<46.5	<42.4	<30.8	<30.4	<40.0	<53.5	<34.7	<36.5	<45.0	<46.3	<18.9	<46.8
Aroclor 1221	ug/kg	<31.0	<18.1	<18.0	<57.6	<45.1	<46.5	<42.2	<30.8	<30.4	<40.0	<53.5	<34.7	<36.5	<45.0	<46.3	<18.9	<46.8
Aroclor 1232	ug/kg	<31.0	<18.1	<18.0	<57.6	<45.1	<46.5	<42.2	<30.8	<30.4	<40.0	<53.5	<34.7	<36.5	<45.0	<46.3	<18.9	<46.8
Aroclor 1242	ug/kg	<31.0	<18.1	<18.0	<57.6	<45.1	<46.5	<42.2	<30.8	<30.4	<40.0	<53.5	<34.7	<36.5	<45.0	<46.3	<18.9	<46.8
Aroclor 1248	ug/kg	<31.0	<18.1	<18.0	**104J**	**45.3J**	<46.5	**128J**	**108**	**60.7J**	**61.6J**	<53.5	**38.0J**	**37.3J**	**74.9J**	**87.2J**	<18.9	**49.8J**
Aroclor 1254	ug/kg	**39.1J**	<18.1	<18.0	**397**	**230**	**182**	**448**	**357**	**240**	**260**	**193**	**150**	**142**	**272**	**235**	**22.7J**	**187**
Aroclor 1260	ug/kg	<31.0	<18.1	<18.0	**95.7J**	**52.0J**	<46.5	**112J**	**78.9J**	**47.9J**	**50.8J**	<53.3	<34.7	<36.5	**55.9J**	<46.3	<18.9	<46.8
PCB (Total)	ug/kg	**39.1J**	<18.1	<18.0	**597**	**327**	**182**	**688**	**544**	**349**	**373**	**193**	**188**	**179**	**403**	**323**	**22.7J**	**237**
PCB Congeners (US EPA Method 1668A)																		
PCB Congeners (Totals)	ug/kg	**22.9**	**9.03**	**11.3**	**150**	**145**	**102**	**22.6**	**177**	**216**	**69.1**	**49.8**	**37.1**	**38.4**	NS	NS	NS	**77.8**
PAH (US EPA SW-846 Method 8270 by SIM)																		
1-Methylnaphthalene	ug/kg	<5.1	<3.0	<3.0	<9.5	<7.5	NS	NS	NS	NS	NS	**10.5J**	<5.7	<6.0	NS	NS	NS	<7.7
2-Methylnaphthalene	ug/kg	<5.1	<3.0	<3.0	**9.6J**	<7.5	NS	NS	NS	NS	NS	**22.4J**	<5.7	<6.0	NS	NS	NS	<7.7
Acenaphthene	ug/kg	<4.5	<2.7	<2.6	<8.4	<6.6	NS	NS	NS	NS	NS	<7.8	<5.1	<5.4	NS	NS	NS	<6.9
Acenaphthylene	ug/kg	**18.1J**	**4.0J**	<2.6	**17.7J**	**23.6J**	NS	NS	NS	NS	NS	**23.1J**	**31.1J**	**12.6J**	NS	NS	NS	**38.8J**
Anthracene	ug/kg	**26.8J**	**3.9J**	**5.2J**	**18.7J**	**28.9J**	NS	NS	NS	NS	NS	**25.9J**	**22.0J**	**14.5J**	NS	NS	NS	**33.0J**
Benzo(a)anthracene	ug/kg	**101**	**21.1**	**17.5J**	**86.4**	**139**	NS	NS	NS	NS	NS	**132**	**139**	**75.4**	NS	NS	NS	**162**
Benzo(a)pyrene	ug/kg	**114**	**26.0**	**18.7J**	**118**	**161**	NS	NS	NS	NS	NS	**173**	**185**	**89.7**	NS	NS	NS	**217**
Benzo(b)fluoranthene	ug/kg	**119**	**27.8**	**22.2**	**135**	**193**	NS	NS	NS	NS	NS	**209**	**193**	**105**	NS	NS	NS	**242**
Benzo(g,h,i)perylene	ug/kg	**74.3**	**16.6J**	**13.3J**	**78.9**	**115**	NS	NS	NS	NS	NS	**129**	**117**	**60.8**	NS	NS	NS	**144**
Benzo(k)fluoranthene	ug/kg	**51.2**	**13.9J**	**9.8J**	**61.5J**	**78.3**	NS	NS	NS	NS	NS	**93.9**	**91.4**	**45.9**	NS	NS	NS	**97.7**
Chrysene	ug/kg	**113**	**25.2**	**20.3J**	**109**	**168**	NS	NS	NS	NS	NS	**163**	**160**	**84.4**	NS	NS	NS	**194**
Dibenzo(a,h)anthracene	ug/kg	**19.0J**	**3.8J**	<2.8	**19.1J**	**27.7J**	NS	NS	NS	NS	NS	**32.5J**	**31.8J**	**15.4J**	NS	NS	NS	**35.8J**
Fluoranthene	ug/kg	**178**	**38.3**	**37.6**	**171**	**218**	NS	NS	NS	NS	NS	**238**	**180**	**119**	NS	NS	NS	**242**
Fluorene	ug/kg	**4.6J**	<2.5	<2.4	**8.4J**	**8.0J**	NS	NS	NS	NS	NS	**8.5J**	**5.4J**	<5.0	NS	NS	NS	**8.3J**
Indeno(1,2,3-c,d)pyrene	ug/kg	**59.2**	**13.1J**	**11.1J**	**62.6J**	**89.8**	NS	NS	NS	NS	NS	**103**	**98.8**	**49.2**	NS	NS	NS	**115**
Naphthalene	ug/kg	**3.7J**	**4.0J**	**2.1J**	**17.9J**	**12.2J**	NS	NS	NS	NS	NS	**33.0J**	**5.4J**	**5.5J**	NS	NS	NS	**12.2J**
Phenanthrene	ug/kg	**45.8**	**11.7J**	**16.4J**	**60.5J**	**83.5**	NS	NS	NS	NS	NS	**76.9**	**44.8**	**40.3J**	NS	NS	NS	**69.5**
Pyrene	ug/kg	**165**	**34.8**	**29.6**	**149**	**207**	NS	NS	NS	NS	NS	**232**	**165**	**103**	NS	NS	NS	**247**
TPH (US EPA SW-846 Method 8015D Modified)																		
Diesel Range Organics (C10-C28)	mg/kg	**13.4**	**4.1**	**3.3**	**85.0**	**27.2**	**37.0**	**12.4**	**13.1**	**11.2**	NS	**31.6**	**20.7**	**33.5**	**66.5**	**56.8**	**11.3**	**35.4**
Solids (ASTM D2974-87)																		
Moisture, percent	%	**52.3**	**18.4**	**17.7**	**74.3**	**67.3**	**68.3**	**65.1**	**52.1**	**51.4**	**63.1**	**72.3**	**57.4**	**59.6**	**67.2**	**68.2**	**21.6**	**68.4**

Table 3 - Sediment Analytical Results
STS Hydropower/Eagle Creek RE
Morrow Lake Dam

	Date & Time Collected	12/04/2020 10:00	12/04/2020 10:00	12/04/2020 10:00	12/04/2020 10:00	12/04/2020 10:40	12/04/2020 11:40	12/04/2020 12:30	12/04/2020 15:00	12/04/2020 15:50	12/04/2020 15:50	12/04/2020 16:20	12/05/2020 14:50	12/05/2020 12:50	12/05/2020 10:50	12/05/2020 11:10	12/05/2020 11:10	12/05/2020 11:10
	Location	DSLBC004	DSLBC004	DSLBC004	DSLBC004	DSLBG004	DSCCG005	DSRBG006	DSLBG007	DSRBC008	DSRBC008	DSRBG008	DSLBG009	DSRBG010	DSRBG011	DSRBC011	DSRBC011	DSRBC011
	Depth (ft bgs)	0.0-1.3	1.3-2.6	2.6-3.75	3.75-4.9	0.0-0.5	0.0-0.5	0.0-0.5	0.0-0.5	0.0-1.25	1.25-2.33	0.0-0.5	0.0-0.5	0.0-0.5	0.0-0.5	0-1.2	1.2-2.4	2.4-4.0
	Location Type	Core	Core	Core	Core	Grab	Grab	Grab	Grab	Core	Core	Grab	Grab	Grab	Grab	Core	Core	Core
Analyte	**Units**	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
Metals (US EPA SW-846 Method 6010/7471)																		
Arsenic	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Barium	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cadmium	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chromium (Total)	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Copper	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Lead	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mercury (Total)	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Selenium	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Silver	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Zinc	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PCB Aroclors (US EPA SW-846 Method 8082A (Kzoo PCB))																		
Aroclor 1016	ug/kg	<58.2	<50.2	<17.5	<17.5	<63.5	<57.4	<50.8	<58.9	<49.8	<19.0	<46.4	<48.3	<70.1	<52.9	<52.7	<49.2	<17.3
Aroclor 1221	ug/kg	<58.2	<50.2	<17.5	<17.5	<63.5	<57.4	<50.8	<58.9	<49.8	<19.0	<46.4	<48.3	<70.1	<52.9	<52.7	<49.2	<17.3
Aroclor 1232	ug/kg	<58.2	<50.2	<17.5	<17.5	<63.5	<57.4	<50.8	<58.9	<49.8	<19.0	<46.4	<48.3	<70.1	<52.9	<52.7	<49.2	<17.3
Aroclor 1242	ug/kg	<58.2	<50.2	<17.5	<17.5	<63.5	<57.4	<50.8	<58.9	<49.8	<19.0	<46.4	<48.3	<70.1	<52.9	<52.7	<49.2	<17.3
Aroclor 1248	ug/kg	**149J**	**131J**	<17.5	<17.5	**66.9J**	<57.4	<50.8	**82.5J**	<49.8	<19.0	**57.7J**	**78.7J**	**125J**	**124J**	**103J**	**78.4J**	<17.3
Aroclor 1254	ug/kg	**622**	**523**	<17.5	<17.5	**295**	**160J**	**214**	**367**	**205**	**23.8J**	**160**	**330**	**546**	**536**	**427**	**290**	<17.3
Aroclor 1260	ug/kg	**155J**	**138J**	<17.5	<17.5	<63.5	<57.4	<50.8	**94.8J**	**55.8J**	<19.0	<46.4	**92.1J**	**129J**	**135J**	**106J**	**68.9J**	<17.3
PCB (Total)	ug/kg	**926**	**792**	<17.5	<17.5	**362**	**160J**	**214**	**545**	**261**	**23.8J**	**218**	**501**	**800**	**795**	**635**	**437**	<17.3
PCB Congeners (US EPA Method 1668A)																		
PCB Congeners (Totals)	ug/kg	NS	NS	NS	NS	**288**	**54.8**	**32**	**21.9**	NS	NS	**41.3**	**34.8**	**80.6**	**59.1**	NS	NS	NS
PAH (US EPA SW-846 Method 8270 by SIM)																		
1-Methylnaphthalene	ug/kg	NS	NS	NS	NS	<10.5	<9.5	<8.4	<9.7	NS	NS	<7.7	<8.0	<11.5	<8.7	NS	NS	NS
2-Methylnaphthalene	ug/kg	NS	NS	NS	NS	<10.5	<9.5	<8.4	<9.8	NS	NS	**9.3J**	<8.0	<11.6	<8.7	NS	NS	NS
Acenaphthene	ug/kg	NS	NS	NS	NS	<9.3	<8.4	<7.5	<8.6	NS	NS	**13.2J**	<7.1	<10.3	<7.8	NS	NS	NS
Acenaphthylene	ug/kg	NS	NS	NS	NS	**39.9J**	**26.6J**	**29.3J**	**12.7J**	NS	NS	**51.6J**	**20.2J**	**23.7J**	**28.3J**	NS	NS	NS
Anthracene	ug/kg	NS	NS	NS	NS	**31.6J**	**33.6J**	**43.1J**	**16.8J**	NS	NS	**65.3**	**29.7J**	**21.9J**	**28.3J**	NS	NS	NS
Benzo(a)anthracene	ug/kg	NS	NS	NS	NS	**135**	**147**	**195**	**78.6**	NS	NS	**317**	**124**	**121**	**151**	NS	NS	NS
Benzo(a)pyrene	ug/kg	NS	NS	NS	NS	**197**	**202**	**250**	**109**	NS	NS	**379**	**166**	**164**	**195**	NS	NS	NS
Benzo(b)fluoranthene	ug/kg	NS	NS	NS	NS	**213**	**239**	**305**	**137**	NS	NS	**468**	**213**	**195**	**222**	NS	NS	NS
Benzo(g,h,i)perylene	ug/kg	NS	NS	NS	NS	**132**	**161**	**171**	**77.0**	NS	NS	**272**	**124**	**119**	**130**	NS	NS	NS
Benzo(k)fluoranthene	ug/kg	NS	NS	NS	NS	**92.8**	**104**	**123**	**59.8J**	NS	NS	**176**	**81.4**	**77.1J**	**102**	NS	NS	NS
Chrysene	ug/kg	NS	NS	NS	NS	**169**	**191**	**244**	**105**	NS	NS	**358**	**167**	**154**	**184**	NS	NS	NS
Dibenzo(a,h)anthracene	ug/kg	NS	NS	NS	NS	**31.5J**	**37.7J**	**40.7J**	**18.9J**	NS	NS	**68.2**	**29.9J**	**25.7J**	**33.7J**	NS	NS	NS
Fluoranthene	ug/kg	NS	NS	NS	NS	**230**	**290**	**379**	**153**	NS	NS	**547**	**263**	**231**	**256**	NS	NS	NS
Fluorene	ug/kg	NS	NS	NS	NS	**9.7J**	<7.8	**10.4J**	<8.0	NS	NS	**19.1J**	**6.9J**	<9.5	<7.2	NS	NS	NS
Indeno(1,2,3-c,d)pyrene	ug/kg	NS	NS	NS	NS	**103**	**127**	**135**	**65.7J**	NS	NS	**217**	**99.6**	**95.7**	**107**	NS	NS	NS
Naphthalene	ug/kg	NS	NS	NS	NS	**18.0J**	**8.6J**	**13.2J**	**8.6J**	NS	NS	**21.1J**	**9.9J**	**13.6J**	**14.7J**	NS	NS	NS
Phenanthrene	ug/kg	NS	NS	NS	NS	**65.2J**	**77.5**	**119**	**41.8J**	NS	NS	**193**	**69.7**	**66.0J**	**65.1**	NS	NS	NS
Pyrene	ug/kg	NS	NS	NS	NS	**210**	**238**	**319**	**124**	NS	NS	**481**	**211**	**184**	**206**	NS	NS	NS
TPH (US EPA SW-846 Method 8015D Modified)																		
Diesel Range Organics (C10-C28)	mg/kg	**63.2**	**46.0**	**3.3**	**5.1**	**65.9**	**45.0**	**44.3**	**51.9**	**41.6**	**7.1**	**47.4**	**40.8**	**80.0**	**37.1**	**43.6**	**59.0**	**5.4**
Solids (ASTM D2974-87)																		
Moisture, percent	%	**74.6**	**70.6**	**15.4**	**15.5**	**76.8**	**74.2**	**71.0**	**75.0**	**70.3**	**22.4**	**68.1**	**69.5**	**78.9**	**72.1**	**72.0**	**70.0**	**14.7**

Table 3 - Sediment Analytical Results
STS Hydropower/Eagle Creek RE
Morrow Lake Dam

Sediment Footnotes:
Bolded values are concentrations detected above the Method Detection Limit (MDL).
"<" = The analytical result was not detected above the indicated MDL.
"J" = Value was detected above the MDL, but below the Practical Quantitation Limit. This value should be considered estimated.
--- = not completed/not analyzed
% = Percent
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram
NA = not applicable
NS = Not Sampled
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyls
TPH = total petroleum hydrocarbon
US EPA = United States Environmental Protection Agency
ASTM = American Society for Testing and Materials

Table 4 - Geotechnical Results
STS Hydropower/Eagle Creek RE
Morrow Lake Dam

			Sample	WCDMACS001	USRBG001	USCCG002	USCCG003	USCCG004	USCCC004-GEO	DSRBG001	DSLBG002	DSLBG003	DSLBG004	DSCCG005
			Date	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020
Parameter			Units	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
SAMPLE DEPTH			ft bgs	COMPOSITE	0.0-0.5	0.0-0.5	0.0-0.5	0.0-0.5	COMPOSITE	0.0-0.5	0.0-0.5	0.0-0.5	0.0-0.5	0.0-0.5
SAMPLE DESCRIPTION (USCS)			--	OH	SM	SP	OH	OH	OH	OH	OH	OH	OH	OH
ORGANIC CONTENT (ASTM D2974)			%	18.9	7.0	0.6	19.6	22.3	14.6	17.6	8.3	16.9	20.0	19.4
NATURAL MOISTURE CONTENT (ASTM D2216)			%	180.1	112.3	23.0	298.0	203.4	147.6	287.0	134.4	245.6	320.5	267.3
SPECIFIC GRAVITY (ASTM D854)			--	2.417	2.581	2.626	2.424	2.351	2.492	2.45	2.551	2.398	2.456	2.419
PASSING #200 SIEVE (ASTM D422)			%	69.3	18.6	2.0	83.1	83.9	63.3	82.3	39	68.5	84.2	71.6
Grain Size (ASTM D422)	% +3"	--	mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	% Gravel	Coarse	mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Fine	mm	0.0	0.4	0.7	0.0	0.0	0.0	0.0	0.1	0.1	0.0	4.2
	% Sand	Coarse	mm	0.0	0.5	4.6	0.0	0.0	0.1	0.0	0.0	0.0	0.0	1.1
		Medium	mm	4.2	6.9	38.6	2.5	2.8	3.6	0.9	2.9	1.7	0.9	3.2
		Fine	mm	26.5	73.6	54.1	14.4	13.3	33.0	16.8	58.0	29.7	14.9	19.9
	% Fines	Silt	mm	54.9	12.3	0.2	70.0	73.7	49.0	74.2	31.0	60.6	74.0	64.1
		Clay	mm	14.4	6.3	1.8	13.1	10.2	14.3	8.1	8.0	7.9	10.2	7.5
ATTERBERG LIMITS (ASTM D4318)		LL	--	100	--	--	112	127	78	107	56	92	115	110
		PL	--	70	NP	NP	81	89	55	75	44	68	77	81
		PI	--	30	--	--	31	38	23	32	12	24	38	29
Particle Size Distribution (ASTM D422)		85%	mm	0.1603	0.3152	0.9671	0.0885	0.0803	0.2354	0.0829	0.1948	0.1425	0.0777	0.1424
		60%	mm	0.0581	0.1975	0.4508	0.0263	0.0351	0.0589	0.0409	0.1292	0.0611	0.0357	0.0571
		50%	mm	0.0452	0.1722	0.3920	0.0208	0.0255	0.0289	0.0303	0.1033	0.0488	0.0241	0.0460
		30%	mm	0.0145	0.1175	0.3081	0.0123	0.0130	0.0131	0.0164	0.0377	0.0192	0.0119	0.0226
		15%	mm	0.0052	0.0573	0.2474	0.0058	0.0066	0.0053	0.0082	0.0129	0.0089	0.0061	0.0096
		10%	mm	0.0036	0.0213	0.2185	0.0039	0.0049	0.0034	0.0059	0.0071	0.0059	0.0050	0.0063
		CC	--	1.00	3.28	0.96	1.48	0.99	0.86	1.11	1.54	1.03	0.80	1.41
		Cu	--	16.01	9.27	2.06	6.70	7.15	17.37	6.90	18.09	10.43	7.20	9.00

Notes:

PSD stands = "Particle Size Distribution"
"--" = Not Applicable or Not Available
ft = feet; in. = inches; min. = minute; ft bgs = feet below ground surface.
mm = millimeters
% = percentage
USCS = Unified Soil Classification System
ASTM = American Society for Testing and Materials
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index (LL-PL)
NP = Non-Plastic
CC = Coefficient of Curvature
Cu - Coeffiecnt of Uniformity
GS = Specific Gravity of Soil
D85 = Size corresponding to 85% finer on the cumulative particle-size distribution curve reported in mm
OH = Organic clay, organic silt
SM = Silty sand
SP = Poorly graded sand
MH = Elastic silt

Table 4 - Geotechnical Results
STS Hydropower/Eagle Creek RE
Morrow Lake Dam

			Sample	DSRBG006	DSLBG007	DSRBG008	DSLBG009	DSRBG010	DSRBG011	DSLBC002-GEO	DSLBC004-GEO	DSRBC008-GEO	DSRBC011-GEO
			Date	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020	12/2/2020
Parameter			Units	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
SAMPLE DEPTH			ft bgs	0.0-0.5	0.0-0.5	0.0-0.5	0.0-0.5	0.0-0.5	0.0-0.5	COMPOSITE	COMPOSITE	COMPOSITE	COMPOSITE
SAMPLE DESCRIPTION (USCS)			--	OH	OH	OH	OH	OH	OH	SP-SM	SM	SM	MH
ORGANIC CONTENT (ASTM D2974)			%	14.0	20.4	17.2	13.9	20.1	16.2	4.2	4.7	4.8	8.9
NATURAL MOISTURE CONTENT (ASTM D2216)			%	212.0	302.9	246.9	212.5	353.4	258.0	48.8	70.8	61.2	78.3
SPECIFIC GRAVITY (ASTM D854)			--	2.478	2.418	2.368	2.417	2.385	2.414	2.636	2.616	2.628	2.509
PASSING #200 SIEVE (ASTM D422)			%	63.4	81.2	64.5	76.4	83.6	79.3	7.2	21.5	10.9	19.4
Grain Size (ASTM D422)	% +3"	--	mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	% Gravel	Coarse	mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9
		Fine	mm	0.1	0.1	0.9	0.0	0.0	0.0	7.3	9.6	12.1	32.3
	% Sand	Coarse	mm	0.1	0.0	2.4	0.0	0.0	0.0	11.7	3.4	11.8	7.0
		Medium	mm	1.9	2.0	6.8	0.7	2.1	1.0	50.1	22.8	27.6	20.2
		Fine	mm	34.5	16.7	25.4	22.9	14.3	19.7	23.7	42.7	37.6	16.2
	% Fines	Silt	mm	57.2	71.1	58.4	65.6	72.9	71.2	4.7	16.0	7.7	15.0
		Clay	mm	6.2	10.1	6.1	10.8	10.7	8.1	2.5	5.5	3.2	4.4
ATTERBERG LIMITS (ASTM D4318)		LL	--	--	117	106	99	122	106	--	--	--	58
		PL	--	NP	67	84	68	81	73	NP	NP	NP	43
		PI	--	--	50	22	31	41	33	--	--	--	15
Particle Size Distribution (ASTM D422)		85%	mm	0.1694	0.0914	0.2133	0.1007	0.0826	0.0966	2.5704	1.5220	3.8784	13.2815
		60%	mm	0.0676	0.0364	0.0671	0.0505	0.0274	0.0352	0.8680	0.3924	0.7197	3.5891
		50%	mm	0.0492	0.0260	0.0535	0.0382	0.0208	0.0265	0.6704	0.3329	0.4489	0.9471
		30%	mm	0.0258	0.0142	0.0283	0.0159	0.0128	0.0151	0.4151	0.2234	0.2438	0.3120
		15%	mm	0.0122	0.0074	0.0117	0.0070	0.0070	0.0083	0.2535	0.0287	0.1529	0.0328
		10%	mm	0.0082	0.0049	0.0086	0.0047	0.0048	0.0059	0.1414	0.0134	0.0608	0.0136
		CC	--	1.20	1.13	1.39	1.07	1.25	1.10	1.40	9.50	1.36	1.99
		Cu	--	8.23	7.35	7.82	10.74	5.76	6.00	6.14	29.29	11.84	263.59

Notes:

PSD stands = "Particle Size Distribution"
"--" = Not Applicable or Not Available
ft = feet; in. = inches; min. = minute; ft bgs = feet below ground surfac
mm = millimeters
% = percentage
USCS = Unified Soil Classification System
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LL = Liquid Limit
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NP = Non-Plastic
CC = Coefficient of Curvature
Cu - Coeffiecnt of Uniformity
GS = Specific Gravity of Soil
D85 = Size corresponding to 85% finer on the cumulative particle-size
OH = Organic clay, organic silt
SM = Silty sand
SP = Poorly graded sand
MH = Elastic silt

Table 5 - Sediment Probing Results
STS Hydropower/Eagle Creek RE
Morrow Lake Dam

Location	Sediment Thickness (ft)	Sediment Area (sq.ft)	Sediment Volume (cu.ft)	Sediment Volume (cu.yd)
Area A-1	6.42	65,267	419,014	15,519
Area A-2	10.08	47,709	480,905	17,811
Area A-3	2.08	5,918	12,310	456
Area A-4	3.75	6,806	25,522	945
Area A-5	4.00	23,973	95,890	3,551
Area A-6	8.75	12,727	111,365	4,125
Area A-7	2.17	43,972	95,419	3,534
Area A-8	4.17	1,532	6,389	237
Area A-9	7.42	32,846	243,719	9,027
Area A-10	5.42	2,042	11,066	410

Notes:
cu. = cubic
ft = feet
sq. = square
yd = yard

Table 6 - Volumetric Analysis Results
STS Hydropower/Eagle Creek RE
Morrow Lake Dam

Location	Sediment Thickness (ft)	Sediment Area (sq.ft)	Sediment Volume (cu.ft)	Sediment Volume (cu.yd)
Area B-1	2.14	8,403	18,004	667
Area B-2	2.00	18,569	37,081	1,373
Area B-3	2.15	36,583	78,560	2,910
Area B-4	3.50	19,097	66,888	2,477
Area B-5	2.27	28,942	65,696	2,433
Area B-6	2.07	30,616	63,329	2,346
Area B-7	2.65	44,871	118,932	4,405
Area B-8	1.98	12,267	24,269	899
Area B-9	2.11	22,673	47,838	1,772
Area B-10	2.07	73,785	152,557	5,650
Area B-11	2.92	15,728	45,883	1,699
Area B-12	2.32	52,572	121,709	4,508
Area B-13	1.90	19,860	37,815	1,401
Area B-14	2.84	136,784	388,622	14,393
Area B-15	2.84	34,606	98,362	3,643
Area B-16	2.96	36,614	108,298	4,011
Area B-17	2.27	39,576	89,909	3,330
Area B-18	2.10	11,333	23,783	881

Notes:
cu. = cubic
ft = feet
sq. = square
yd = yard