FRIENDS OF THE DETROIT RIVER

SUGAR ISLAND HABITAT RESTORATION FEASIBILITY & CONCEPT DESIGN

January 2019

SMITHGROUP HRM LimnoTech

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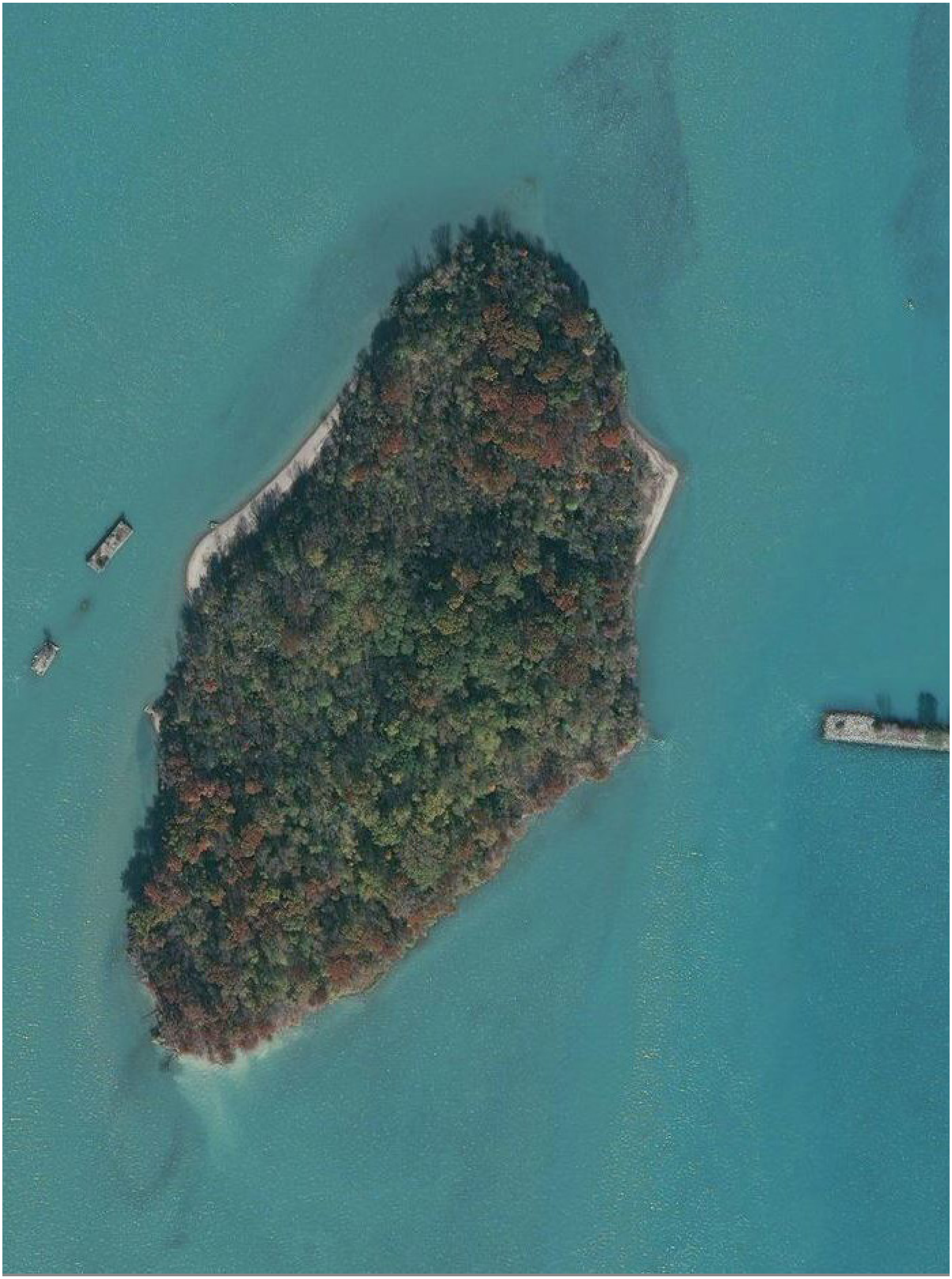
FRIENDS of the DETROIT RIVER

NOAA Great Lakes RESTORATION

U.S. FISH & WILDLIFE SERVICE

P. A. C.



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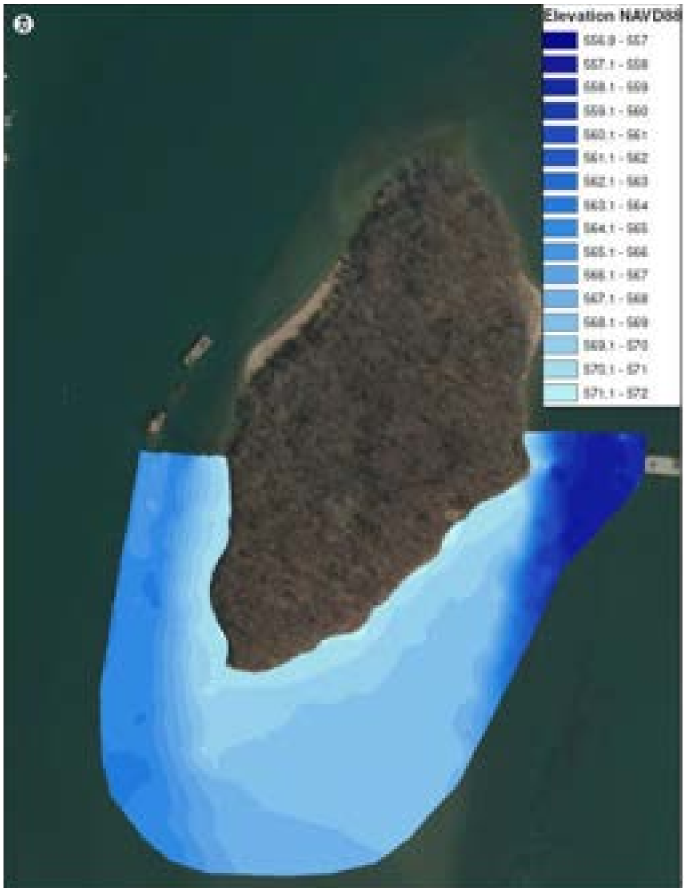
EXECUTIVE SUMMARY

Approximately 28-acres in size, Sugar Island has rebounded from several decades of recreational park use to a densely vegetated state, making previous human-introduced uses almost unnoticeable. However, the island sits at the outlet of the Detroit River into Lake Erie, rendering it susceptible to high wave and wind action from the south. Since the early 1900s, it is estimated that Sugar Island, particularly during cycles when river levels are at or exceed ordinary high water elevations, has lost over 6 acres of upland to shoreline erosion.

Through a Great Lakes Restoration Initiative grant funded by the National Oceanic and Atmospheric Administration, the Friends of the Detroit River, in partnership with the U.S. Fish and Wildlife Service, selected the SmithGroup design team to explore the ecological value and feasibility in controlling shoreline erosion and simultaneously enhance fish and wildlife habitat within and adjacent to the Island.

The SmithGroup team, including LimnoTech, Herpetological Resource and Management, experienced avian specialist Allen Chartier, and fisheries biologist James Diana, performed extensive field assessments including botanical, avian, fish, and herpetological studies to evaluate the extent and quality of existing habitat on and surrounding Sugar Island. Detailed summaries of the field studies and assessments are included in the report appendices.



BATHYMETRIC SURVEY PLAN

Bathymetric survey, supplemented with land survey of the existing cliff faces, indicated an approximately 20-acre shallow water area surrounding the southern tip of the island. The near vertical cliff faces around the west side are typically 6- to -8 feet in height above water level, increasing to 10- to-12 feet in height around the southern end and east side. Water depth within the study area currently approaches 6 feet but is reduced to 2 feet or less during low water datum and significantly reduces fisheries habitat without grade manipulation and enhanced substrate conditions. Off-shore soils samples indicated that existing soils are typically fine sand with the west side being more medium sand. Bluff and subsurface samples were typically fine silt/clay materials. Chemical analysis of selected samples did not reveal any unacceptable levels of contaminants.

The SmithGroup team developed both a hydrodynamic model and wind-wave model to understand the existing riverine conditions that could be contributing to continued loss of shoreline. The analysis indicated that current conditions have very low energy near the south end of the island with higher velocities around the western shoreline and further increased velocities within the adjacent deeper channels on both sides of the island. The maximum wind-driven wave heights modeled at the south shore were 4- to 5-feet in height. The results of the existing condition modeling indicated that the U.S. Army Corps of Engineers cross-dike from the Livingston Channel does not appear to be a major contributing factor for shoreline erosion; rather higher than average water levels coupled with high waves resulting from long southerly fetches creates erosive conditions along the exposed southern face of the island.

An understanding of the presence of existing fish and wildlife was needed in order to develop design solutions that could protect the island from further erosion while enhancing habitat opportunities.

The fisheries field investigations indicated that while a relatively low abundance of fish was documented compared to other adjacent areas in the Detroit River, the shallow area south of the island that is currently marginal fish habitat could be improved considerably to create a protected zone offering greater opportunity to capture the mainly juvenile and young game fish present within enhanced spawning and nursery habitats.

Consequently, various off-shore and near-shore restoration measures were explored that could break the wave energy from the south and deflect higher currents along the west side of the island. An option of extending a groyne from the western face of the island connecting to the concrete remains of the former boat docks was modeled but determined to increase current in the main western channel on the east edge of Meso Island, thus not deemed to be a viable solution.

EXISTING SOUTH FACE OF SUGAR ISLAND

The preferred concept plan consists of a series of curvilinear and overlapping, off-shore revetment structures surrounding the 20-acre shallow area off the southern end of the island, combined with grade manipulations to expand habitat functions during periods of low water datum. The revetment structures are proposed at a top elevation of 578.0, which is 1 foot above the 100-year flood elevation. The top of the structures vary in width and would consist of vegetation suitable to attract additional habitat use. The existing eastern tip of the island across from the U.S. Army Corps of Engineers cross-dike would be supplemented with additional armor stone allowing for the creation of protected habitat zone immediately south along the shoreline. On the west side, a new small groyne is similarly proposed that would reduce velocities immediately adjacent to the shoreline, but not adversely increase velocities in the main westerly channel. The existing shoreline would be restored with riprap slope up to elevation 578.0 and planted with additional vegetation to further stabilize the slope. At the water’s edge, a variable width emergent wetland shelf would be created that has approximately 2 feet of water depth during high water levels and would become an exposed mud flat during low water periods. The river side edge of the shelf would be protected with additional riprap. Some portions of the south-easterly cliff face would be left in existing condition as the vertical sand cliff face provides another type of habitat for certain wildlife. This cliff face is centered within the area protected by off-shore structures such that it would not typically be exposed to erosive conditions. A deeper water channel is proposed to be excavated adjacent to the south-easterly face of the island to create a greater variety of fish habitats within the protected zone.

The off-shore structures would have openings to allow for fish passage and current flushing, but would be appropriately designed to reduce wave energy to maximum 1- to 2-foot waves. The modeling of currents and waves within the vicinity of Sugar Island was primarily focused on the potential to cause shoreline erosion and scouring of the sediment bed. Modeling the resultant shear stresses caused by the wave energy transfer to the sediment bed and currents allowed the SmithGroup team to focus on developing remediation strategies that could reduce these forces within acceptable levels. The resultant concept design reflects an understanding of how waves and currents interact throughout the study area. The design team designed structural features to break waves and reduce exposure of nearshore aquatic areas to high currents from the Detroit River. The proposed design also minimizes impacts of the project on other parts of the Detroit River, including affecting water currents outside the project area or causing erosion in other parts of the system. Further assessment of the chosen design's fine-scale hydrodynamic and sediment transport environment will occur in the subsequent design stages of the next project. .

The concept provides a protected 20-acre zone for fish and wildlife that can be enhanced with numerous other habitat structures. Submerged woody debris and aggregate beds would be placed throughout the restoration area to provide cover for fish and fish spawning opportunities. Existing fallen trees would be placed along the restored shoreline to further diversify wildlife habitats and supplemented with snake hibernaculums, sand nesting areas, and mud-puppy structures.

To enhance the upland habitat, an invasive species eradication plan should be implemented and supplemented with additional new plantings in an effort to restore the island to a wet-mesic flatwoods. These upland improvements would greatly diversify the native botanical species while improving avian habitats as well, particularly with the addition of native fruit-bearing vegetation. As one of the many islands along the Detroit River, Sugar Island provides a much needed place to rest and forage along this vital migratory corridor. The observed avian species were rich in diversity with 141 total species documented that included five species listed as Special Concern and five species listed as Threatened.

Sugar Island represents a unique opportunity at the mouth of the Detroit River as it enters Lake Erie. It currently provides habitat for a multitude of botanical and wildlife species based on it's own resilient ability to restore from decades of recreational use. The island however has exhibited significant loss of habitat due to high water and wave action. This study, including intial river modeling, has concluded that an aesthetically engineered solution is feasible to protect the island from further erosive forces while providing an opportunity to significantly increase the vital fish and wildlife habitats in the region to aid in removing in the Detroit River as an Area of Concern.

SOUTH SHORELINE HABITAT RESTORATION CONCEPT

OPINION OF COSTS

SOUTH SHORELINE & AQUATIC HABITAT RESTORATION

Opinion of Probable Construction Costs (with 15% contingency) = $8,050,000

Estimated Preliminary & Final Engineering Design Fees = $550,000-$650,000

Estimated Construction Engineering Fees = $160,000-$240,000

TOTAL Estimated Construction Costs = $8,760,000-$8,940,000

ISLAND UPLAND HABITAT RESTORATION

Opinion of Probable Construction Costs (with 15% contingency) = $2,128,000

Estimated Preliminary & Final Engineering Design Fees = $130,000-$170,000

Estimated Construction Engineering Fees = $42,000-$64,000

TOTAL Estimated Construction Costs = $2,300,000-$2,362,000

Refer to itemized opinion of probable construction costs included in Appendix G. The following assumptions apply:

- Costs are based on 2018 dollars without escalation to future years.
- The construction costs are based upon the preferred concept design and as such reflects the current level of design detail and the estimate reflects a general magnitude of cost.
- The removal of contaminated/hazardous soils and materials, underground obstructions, and other unknown conditions may exist within the project limits and as such are not included.

APPENDIX A

MODEL DEVELOPMENT AND ANALYSES MEMO

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Water | Scientists
Environment | Engineers

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Memorandum

From: Dan Rucinski
Ed Verhamme
Cathy Whiting
To: Emily McKinnon

Date: December 5, 2018
Project: SUGARIS
CC:

SUBJECT: **Sugar Island Restoration– Model Development and Analyses**

Introduction

LimnoTech has been tasked with simulating transport dynamics in the Detroit River, focused on the Sugar Island area, to aide in assessment of the hydrologic impacts of coastal restoration efforts near the shores of the island. This has been accomplished by development of a fine-scale hydrodynamic model, as well as a wind-driven wave model. The hydrodynamic model has been developed in the FVCOM framework, while the SWAN model was used to simulate wind-driven waves. Multiple proposed alternatives were modeled in this effort, including hypothetical groyne additions, as well as construction of islands and barriers on the southern side of the island.

The purpose of this memo is to summarize the development of the models and as well to document the model simulations.

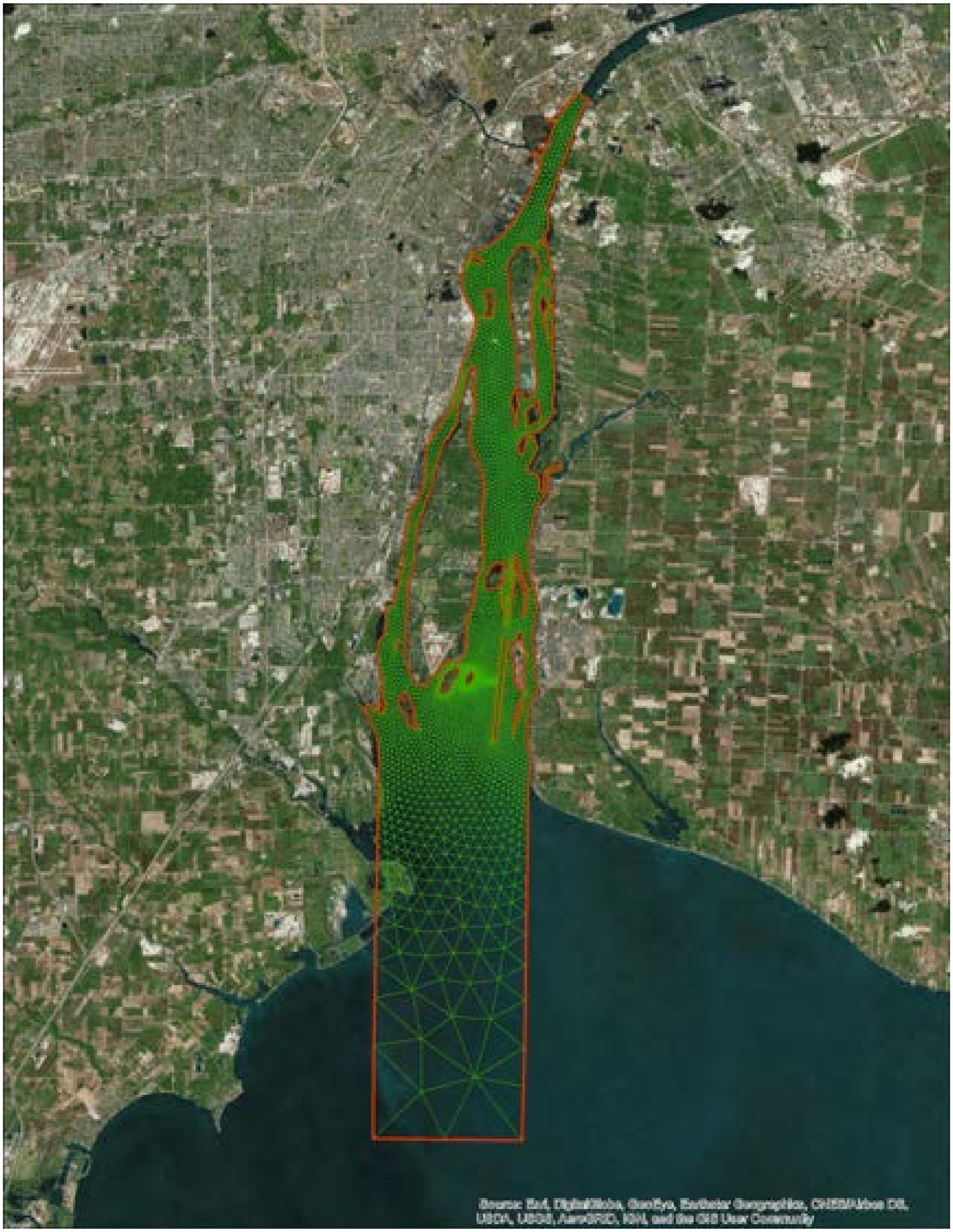
Hydrodynamic Model Background

The Finite Volume Community Ocean Model (FVCOM) is a three-dimensional fully coupled ice-ocean-wave-sediment-ecosystem model that operates on an unstructured grid. The model was originally developed and is widely used, to simulate hydrodynamics in coastal ocean regions; however it has recently gained popularity for use in large lakes. Because the model was developed for coastal ocean regions where tidal fluctuations are significant, FVCOM is capable of simulating wetting and drying of areas that are not continuously under water, an important feature for this project. The source code was developed by researchers at the University of Massachusetts-Dartmouth and the Woods Hole Oceanographic Institute (Chen et al. 2003).

Hydrodynamic Model Development

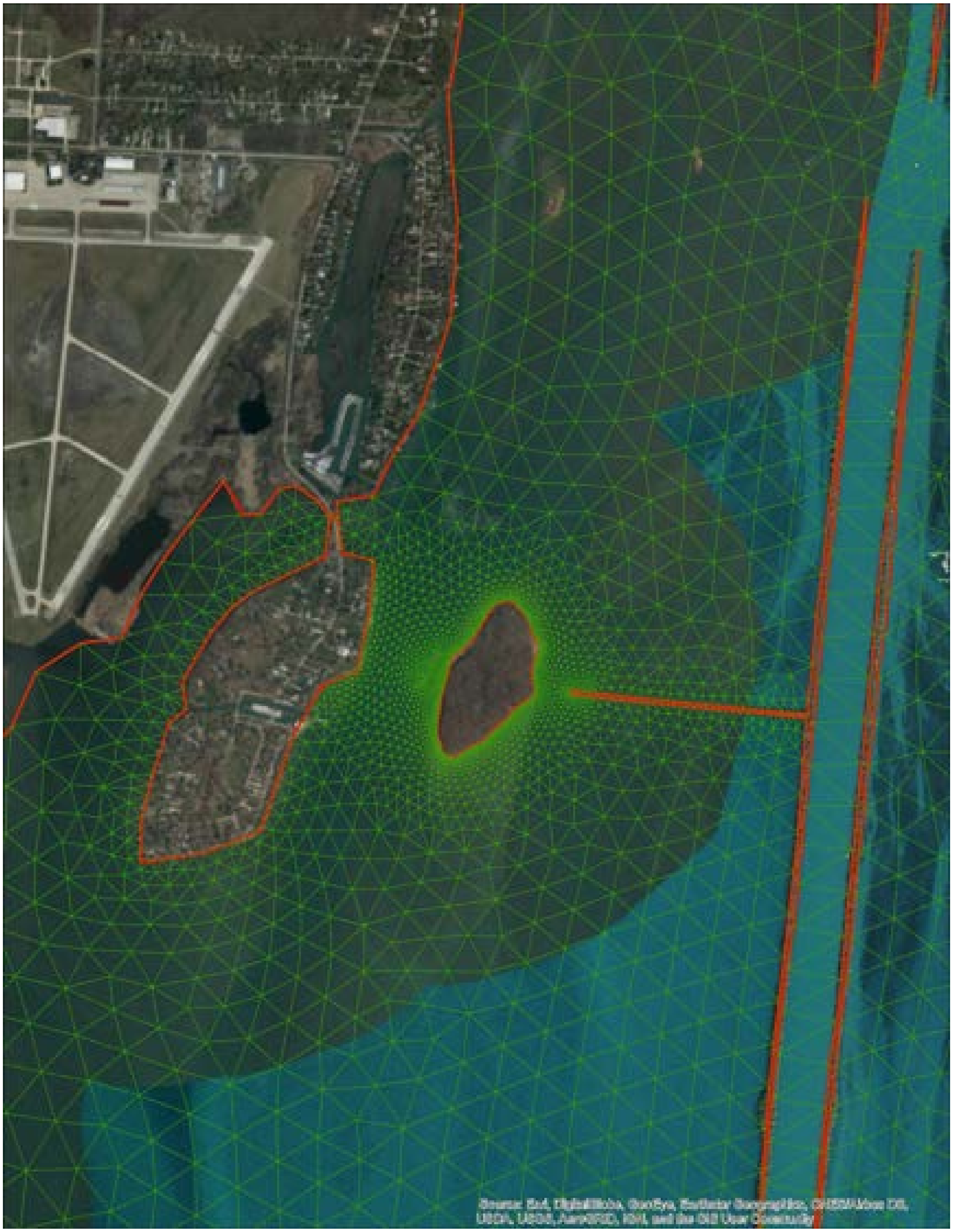
Grid Development

LimnoTech developed the model computational grid using the SMS software package (www.aquaveo.com). FVCOM uses an unstructured grid, otherwise knowns as a flexible mesh, consisting of triangular cells and nodes corresponding to the vertices of each cell. This framework allows the grid to be highly variable in spatial resolution with very small cells in focus areas and larger cells in open water regions. The computation grid extends from the Fort Wayne water level gauge to the confluence of the Detroit River and Lake Erie. The smallest cells are located along the southern shore of Sugar Island and are on the order of 30 m^2, while the largest cells are approximately 6.77 km^2. The final computational grid consists of 9,571 triangular cells and 5,523 nodes, and is shown in Figure 1. The vertical resolution was set to simulate two vertical layers representing an equal fraction of the water column. Figure 2 shows the model resolution near the project area.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 1: Model computation grid.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 2: Model computation grid near Sugar Island project area.

Bathymetry

FVCOM requires bathymetric information at each cell and node. The baseline condition bathymetry dataset was developed using a combination of data sources to most accurately represent the Detroit River and the project area. LimnoTech combined data from NOAA and recent sounding surveys to develop an elevation surface in ArcMap GIS. LimnoTech also conducted a bathymetry survey on the southern side of the project area, and those data were used and superseded any existing data that overlapped.

Atmospheric Forcings

FVCOM requires high resolution (hourly or finer temporal resolution) atmospheric data to simulate the heat balance in the system. These inputs consist of solar radiation, atmospheric pressure, air temperature, humidity, cloud cover and wind speed and direction. These values were obtained from the Climate Forecast System Reanalysis (CFSR) model and were interpolated over the computational grid.

Boundary Conditions

The model grid represents the Detroit River from Fort Wayne to Lake Erie. Water level boundary conditions were used at both the upstream and downstream boundaries. These boundary conditions are set at each of the nodes along the boundaries, and used water level elevation data from the corresponding National Ocean Service water level gauges.

Hydrodynamic Simulations and Results

Two separate model simulations were performed, representing: 1) current conditions and 2) a hypothetical condition with a constructed groyne on the northwest side of the island. The only difference between these simulations is the bathymetry information. That is, for the simulation of a constructed groyne, the bathymetry was adjusted to be above the water level (thus restricting flow) along the nodes representing the groyne location. Each simulation consists of a 7 week period, representing May 1 – June 20, 2017.

Example model output, representing a single point in time, is shown in Figures 3 and 4. Example point-in-time vertically averaged velocity fields are shown near the project area for the baseline condition (Figure 3) and the hypothetical groyne condition (Figure 4). The groyne location is shown as the red line in Figure 4. The magnitude of the velocity is indicated by the color of the arrows.

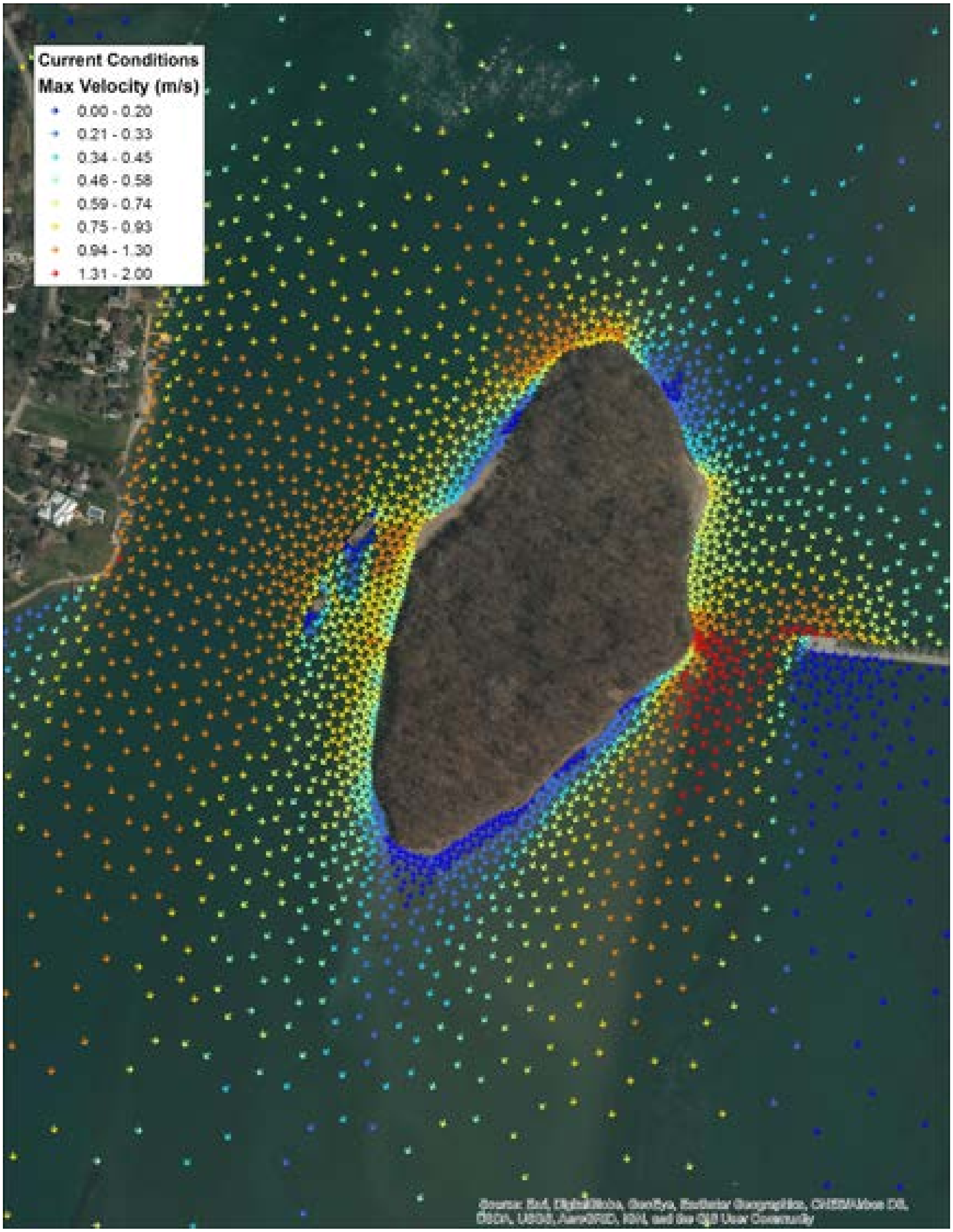
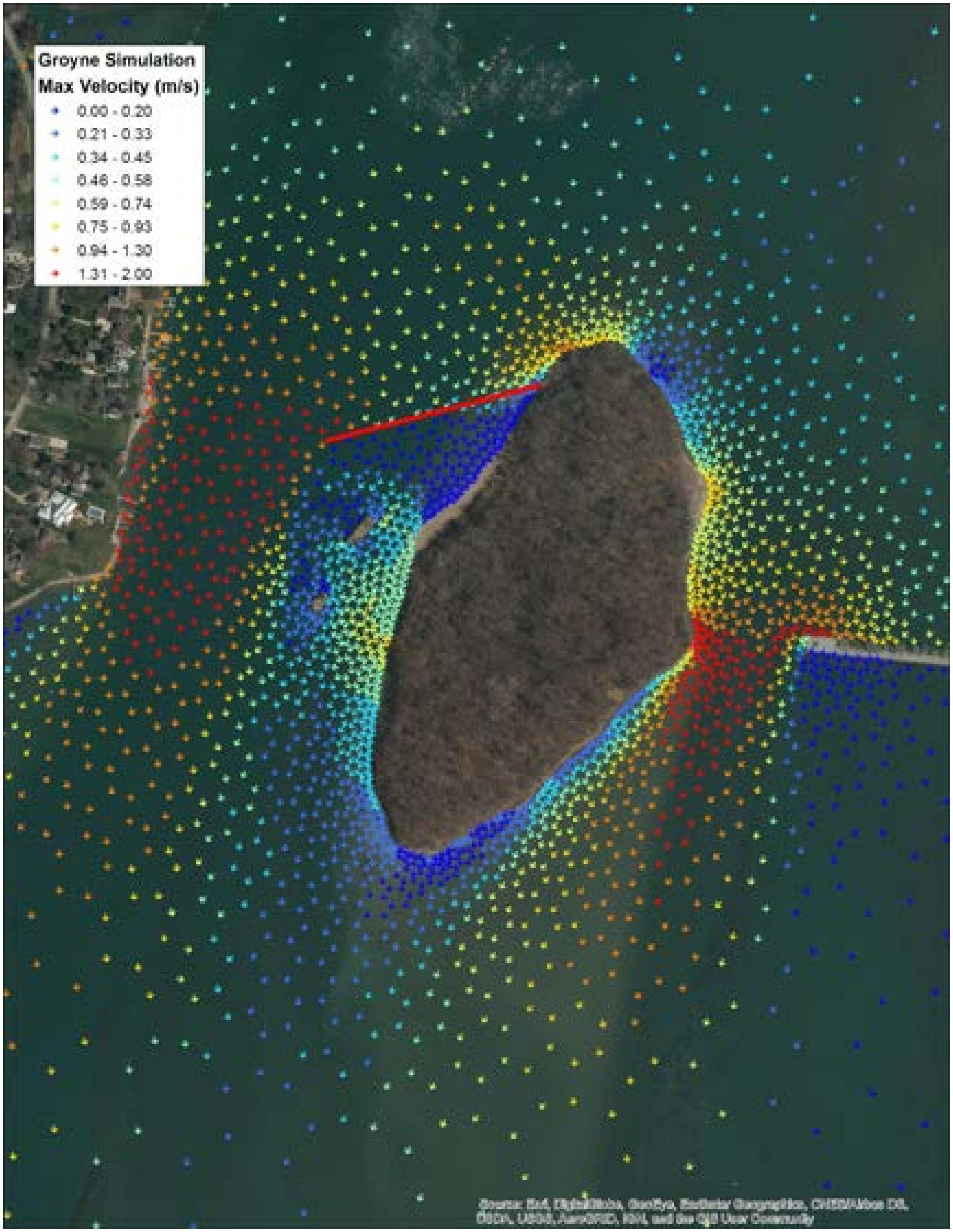


Figure 3: Simulated velocity fields under current conditions on 5/1/2017 near Sugar Island.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 4: Simulated velocity fields under hypothetical groyne scenario on 5/7/2017 near Sugar Island.

The FVCOM model indicates that under current conditions, there is a very low energy zone near the south side of the island, with higher velocities along the east and west sides of the island. Under the hypothetical groyne scenario, the groyne did reduce the velocities on the western shore, however, it also increased energy along the eastern shore of Meso Island.

Wind Wave Model Background

Simulating WAves Nearshore (SWAN) is a third-generation wind wave model, developed at Delft University of Technology, which computes random, short-crested wind-generated waves in coastal regions and inland waters (Booij et al. 1999). SWAN accounts for wave propagation in time and space, shoaling, refraction, frequency shifting, three- and four-wave interactions, whitecapping, bottom friction and depth-induced breaking, and dissipation. The main inputs required to run SWAN are bathymetry and wind conditions.

Wind Wave Model Development and Applications

The wind-wave model domain was expanded to include all of the Western Basin of Lake Erie. This was done to allow the fetch, or the length of the open water in the direction of the waves, to be maximized to produce a conservative, “worst-case” wave condition. The model mesh for the SWAN simulation is shown in Figure 5.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 5: Wind-driven wave model (SWAN) mesh domain.

A wind analysis was initially performed to determine the dominant wind directions and speed in the system. Hourly wind data from the Toledo Light House #2 station (2005-2018) were used to create a wind-rose (Figure 6).

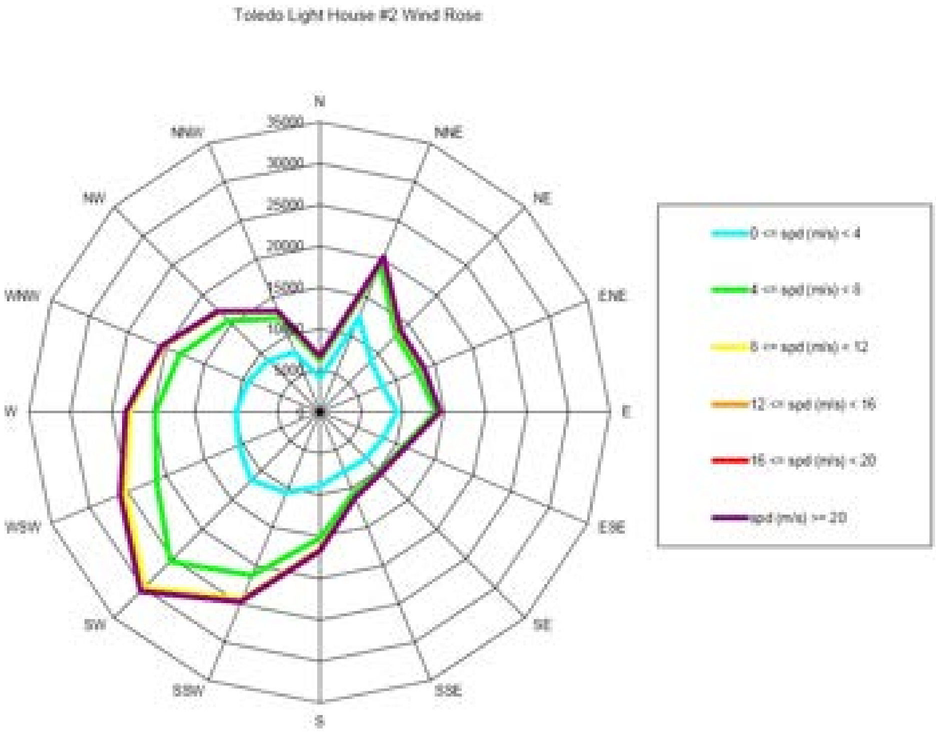


Figure 6: Wind-rose of data from Toledo Light House #2 station.

These data indicate that the winds are primarily from the southwest, with maximum wind speeds of 45 mph. Because winds from the southwest are at an angle to Sugar Island that would prevent them from creating maximum wave heights on the island's shores, we modeled a wind from true south to represent a worst case condition. The model was run for several wind-speed conditions to assess the sensitivity of wave height near Sugar Island in response to wind speed. A response curve was developed (Figure 7) showing the relationship of maximum wind speed to wave height on the southern end of the island. To be conservative in the analysis, a wind speed of 50 mph was used to assess the wave height response.

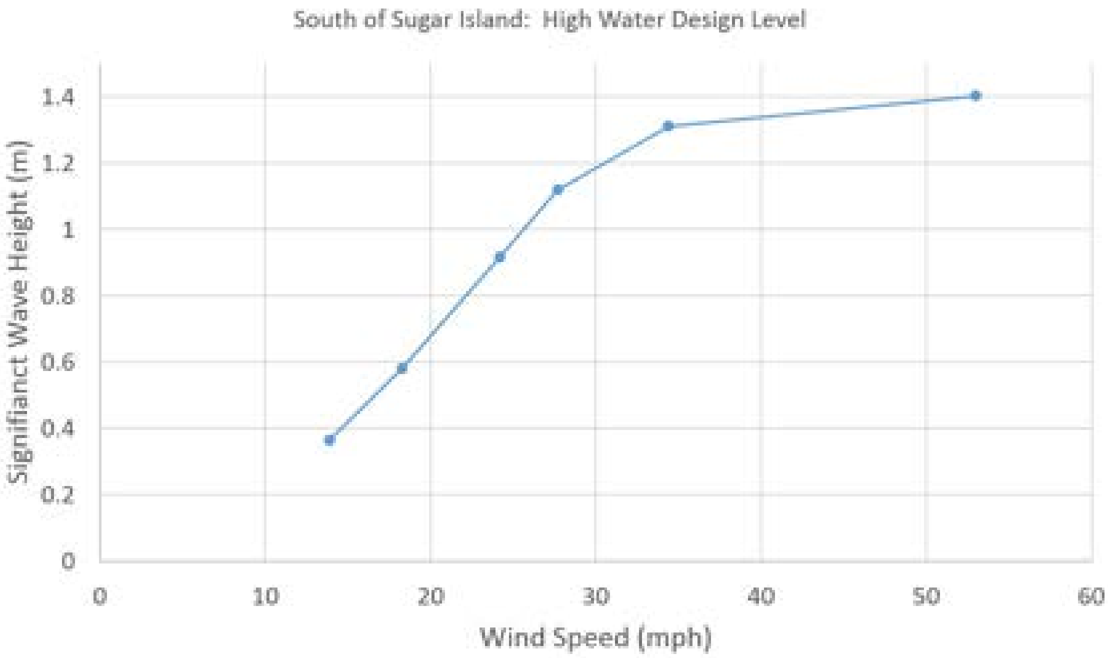


Figure 7: Wave height response to wind conditions on southern side of Sugar Island.

Additionally, wind-driven waves are a function of water depth, with deeper waters allowing larger waves. Again, to be conservative, a high water level from the 68-year record at the NOAA National Ocean Service Gibraltar gauge was used. This corresponded to the maximum monthly value plus the maximum monthly surge, or 579.59 feet referenced to the IGLD datum.

Two final model simulations were performed to represent: 1) current (baseline) conditions and 2) proposed design conditions. The only difference in these scenarios is the bathymetric data was adjusted in the design condition to represent the proposed islands and obstructions on the southern side of Sugar Island. These simulations are defined below.

1. Current:
    - Bathymetry: current
    - Wind speed: 50 mph
    - Wind direction: towards north (90 degrees)
    - Water level: 579.59 ft (IGLD)
2. Design:
    - Bathymetry: proposed design on southern side of island
    - Wind speed: 50 mph
    - Wind direction: towards north (90 degrees)
    - Water level: 579.59 feet (IGLD)

The simulated significant wave height (m) is shown for each of these simulations in Figures 8 and 9, respectively. In general, the simulated waves are approximately 4 to 5 feet on the southern shore under the current condition scenario. The design scenario provides islands and obstructions south of Sugar Island that break the waves and create a low energy area near the southern shore with wave heights reduced to 1 to 2 feet.

Design Assessment

As described above, LimnoTech modeled the wave and current environment in the vicinity of Sugar Island. LimnoTech also separately sampled the bottom sediments in the vicinity of the Sugar Island. The sediment results, combined with the wave and current conditions formed a conceptual understanding of the dynamic environment around the island, which was then used by the Smith Group team to develop preliminary design concepts for restoration work. Model results provided bounding conditions for the design team of the mean and extreme wave heights and currents that might impact the shoreline and bottom sediments.

While this project did not develop a complete sediment transport model, it did determine the shear stresses that are induced during high wave and current events. As evidenced by the eroding bluff on the south side of Sugar Island and visible sediment resuspension during field visits, the existing in-place sediments are not adequate protection against further erosion. The Smith Group team designed structural features to break waves and reduce exposure of nearshore aquatic areas to high currents from the Detroit River. The proposed design also minimizes impacts of the project on other parts of the Detroit River, including affecting water currents outside the project area or causing erosion in other parts of the system. Further assessment of the chosen design's fine-scale hydrodynamic and sediment transport environment will occur in the subsequent design stages of the next project.

To date, the LimnoTech & Smith Group team has shown that a restoration project on the south side of Sugar Island can significantly reduce erosion of the south face, provide for a protected aquatic habitat environment, and minimize negative impacts to other areas outside of the proposed project area.

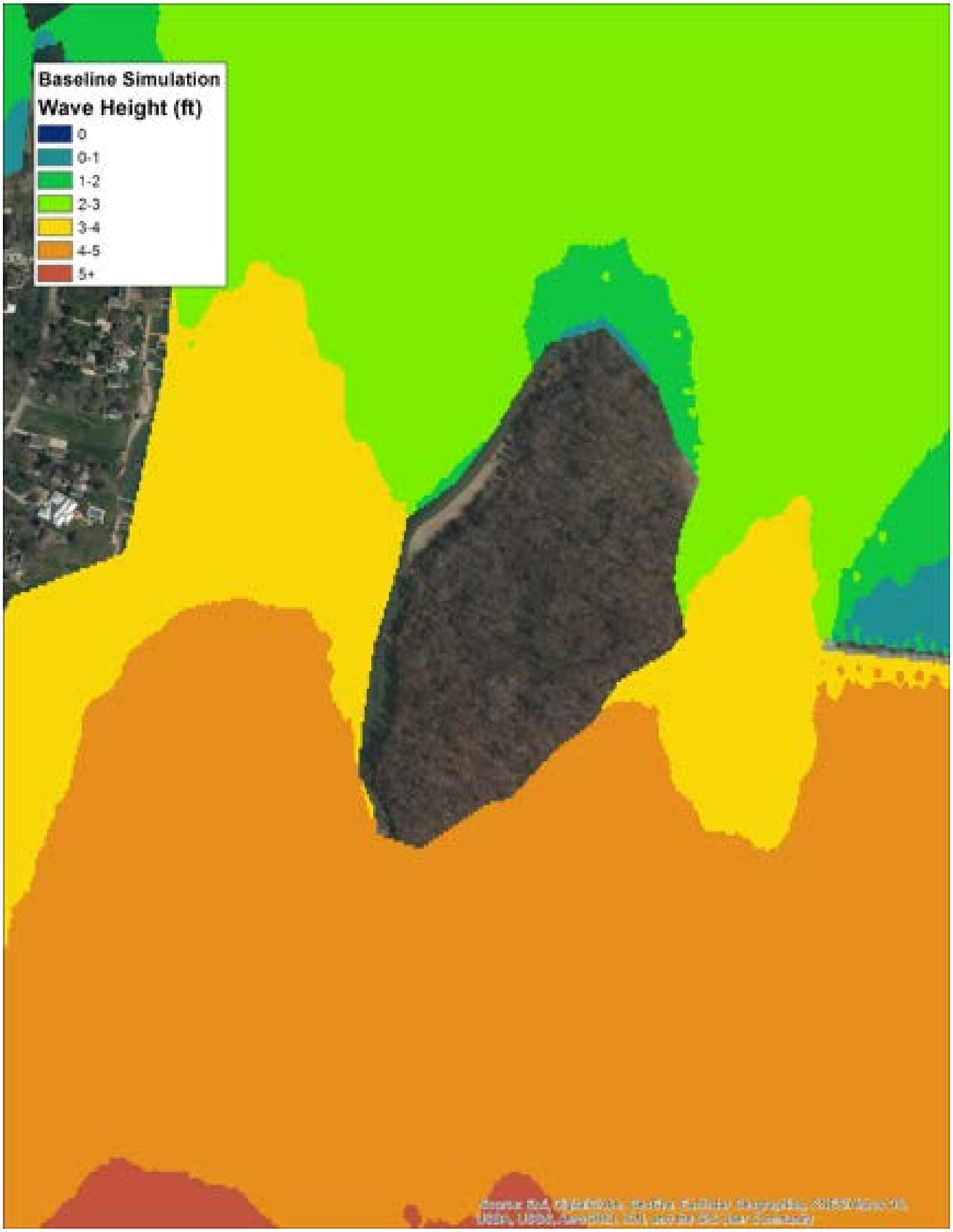


Figure 8: Simulated wave height near project area under current conditions.

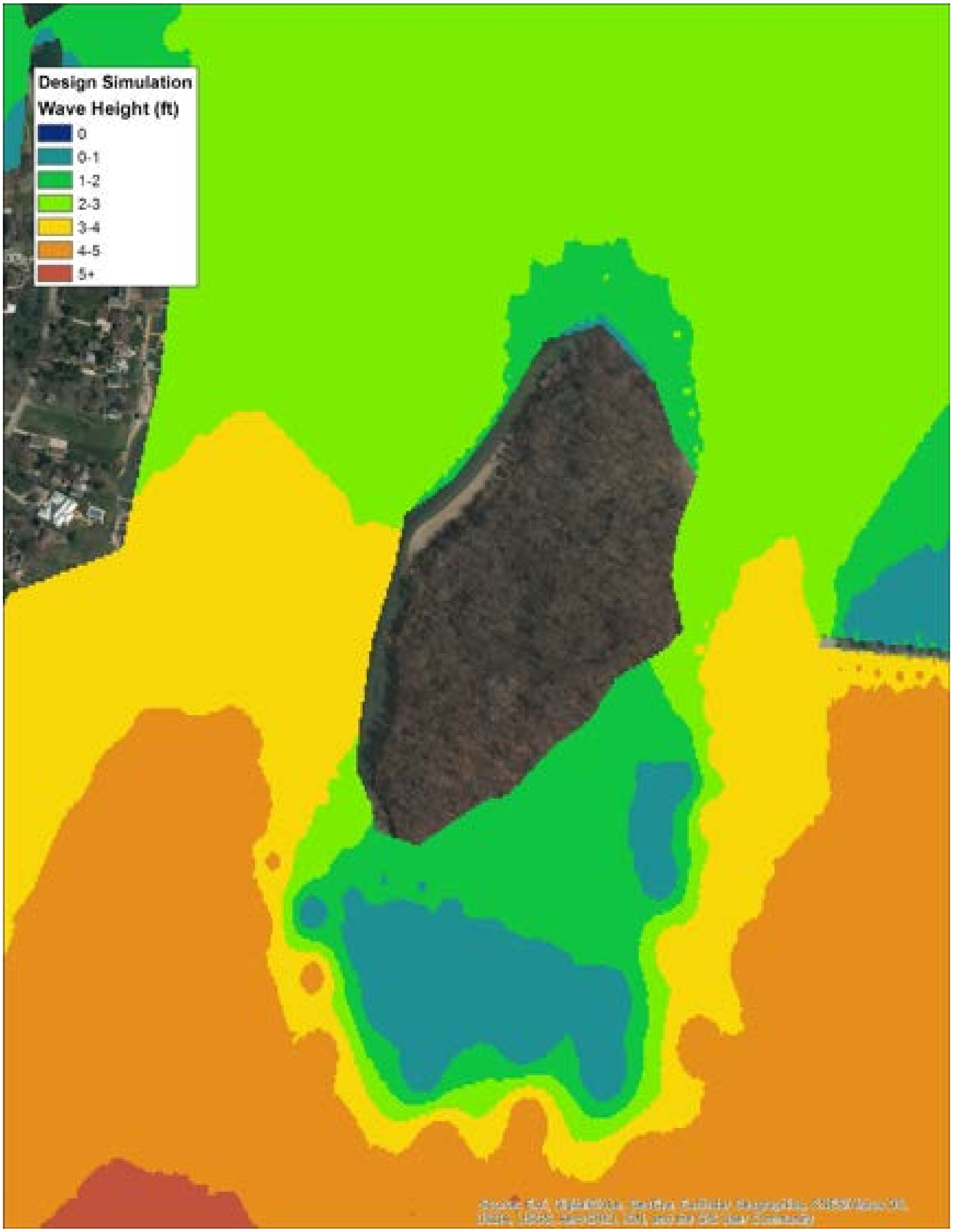


Figure 9: Simulated wave height near project area under proposed deign conditions.

References

Booij, N., R.C. Ris and L.H. Holthuijsen, 1999, A third-generation wave model for coastal regions, Part I, Model description and validation, J. Geophys. Res. C4, 104, 7649-7666.

Chen, C. H. Liu, R. C. Beardsley, 2003. An unstructured, finite-volume, three-dimensional, primitive equation ocean model: application to coastal ocean and estuaries. J. Atm. &Oceanic Tech., 20, 159-186.

APPENDIX B

BATHYMETRY AND SEDIMENT SAMPLING RESULTS

Sugar Island – Bathymetry and Sediment Sampling Results

December 5, 2018

LimnoTech

Water | Scientists
Environment | Engineers

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INTRODUCTION

LimnoTech has conducted various field activities in the Detroit River near Sugar Island, as part of the Sugar Island Habitat Restoration Project for the Friends of the Detroit River. A bathymetric survey, surface sediment sampling, and sediment coring were conducted in May, June and July 2018. The work was conducted in accordance with the Quality Assurance Project Plan dated March, 2018. This report describes the collection methods, locations, analyses and results for the field work conducted in 2018.

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BATHYMETRIC SURVEY

The bathymetric survey of the south side of Sugar Island was conducted on May 16, 2018. Field procedures were performed in accordance with US Army Corps of Engineers (USACOE) EM 1110-2-1003, Hydrographic Surveying standard, November 2013. The survey was performed using a single beam sonar (200 kHz transducer) and high precision GPS system using HYPACK 2017 software. Horizontal survey control was maintained using a Trimble AgGPS+ with DGPS corrections. Survey transects were placed approximately 150 feet apart, oriented perpendicular to the island, and extended approximately 400 feet to 600 feet offshore on the southern portion of the island. A benchmark set on the island by SmithGroupJJR was used to measure the relationship between the known elevation of the benchmark and the water surface. Survey data were logged at a minimum of 1Hz, then post-processed to remove outliers, and then converted to 1 foot bathymetric contours of the survey area. Vessel pitch and roll were measured and compensated for in post-processing.

Weather conditions were generally favorable for performing the survey. Wind and water surface conditions where good for the first three hours of the survey, with the wind turning to the SE and picking up around 1400. This caused some small surface waves. The Detroit River has a NOAA tide gage located at Gibraltar, MI (Station #9044020) approximately two miles west of the survey location. Water surface elevation data was downloaded and used for post processing the raw depth files. The water surface fluctuated approximately +/- 0.4 foot over the course of the survey.

Vessel squat/draft and instrument latency was measured at the survey location or determined pre-survey and corrected for in post-processing. The echosounder was calibrated at the start of the survey by bar check procedure and verified at the close of the survey. No deviation in calibration was detected. Calibration was successful to <0.1 foot. Since the survey was conducted in shallow water, no sound velocity profile data was required.

The field data was downloaded and processed to remove soundings received from abnormal floating debris, weeds and other false returns. The data were then processed using the water elevation established from the land based benchmark. Adjacent Great Lakes tide gauge water level information was downloaded for the same time period of the bathymetric survey and correlated to the site based on proximity, thus providing a sound comparison of the water elevation measured and used in the bathymetric survey. This information was then imported to ARCGIS for surface creation.

The results of the bathymetric survey are shown in Figure 1.

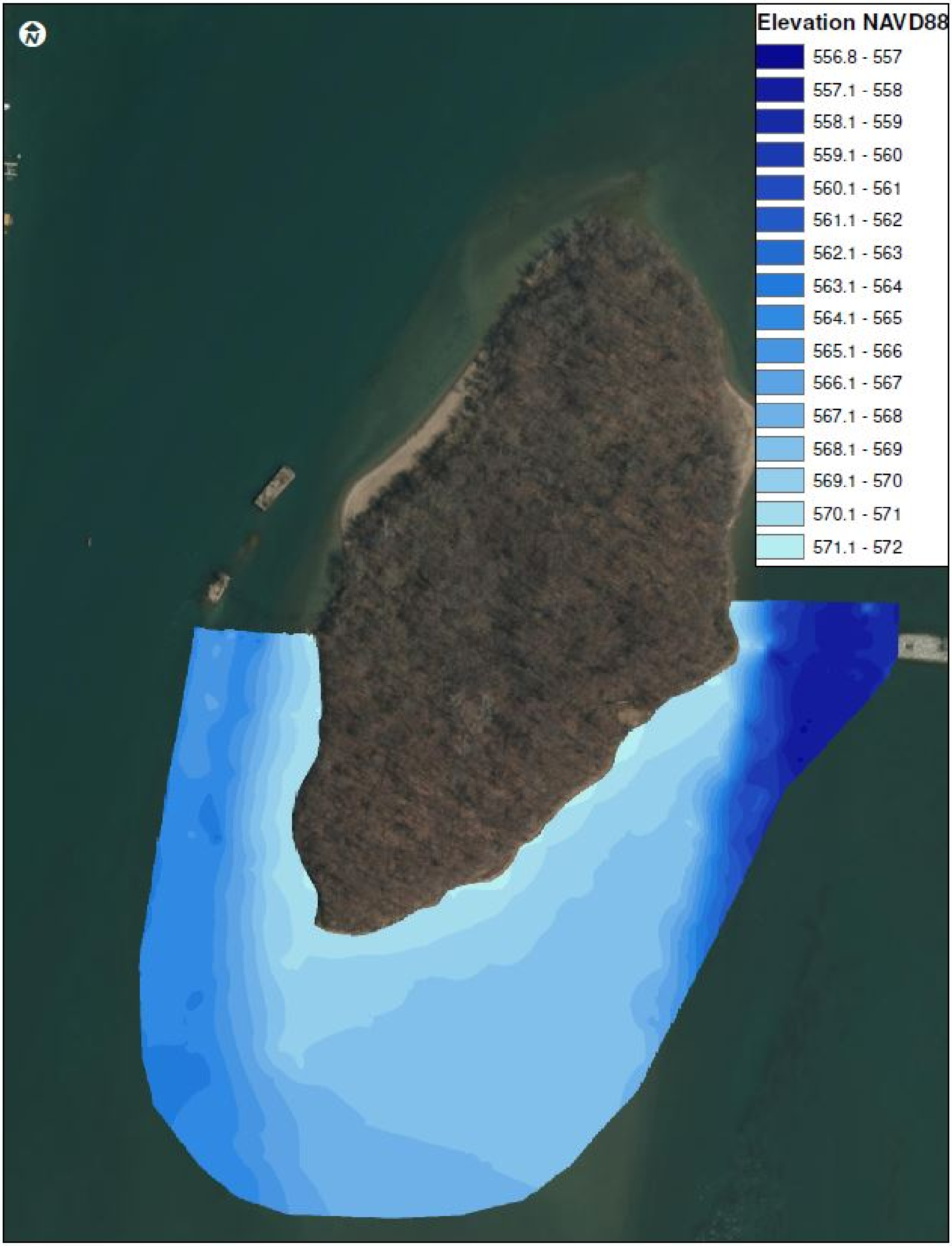

Figure 1. Bathymetric Survey Results

A sophisticated river current meter (Sontek River Survey System) was also used to provide direct measurements of velocity and flow at critical locations around the island, particularly on the east side, where velocities were expected to be high. This data can be used to independently verify model performance and make direct measurements of bottom velocities and even estimate any sediment bed load movement. The data are summarized in Table 1.

Table 1. Velocity Measurements

Transect	Date	Average Velocity (ft/sec)	Discharge (cfs)	Maximum Depth (feet)
East Side Channel	6/1/18	2.08	11,284	19.8
West Side Channel	6/1/18	1.99	31,599	22.4

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SEDIMENT SAMPLE LOCATIONS

Sediment sampling was conducted on June 1, 2018 and July 18, 2018 at the locations described in Table 2 and shown in Figures 2 and 3. Prior to collecting the surface sediment samples, a side-scan sonar survey was conducted to identify any unusual objects below or to the right/left of the survey transects. Underwater video was also used to view bottom conditions in the sampling locations.

Table 2. Surface Sediment Sample Locations.

Station ID	Waterbody	Longitude	Latitude
Sugar-1	Detroit River	-83.146068	42.091701
Sugar-2	Detroit River	-83.146552	42.08999
Sugar-3	Detroit River	-83.146672	42.088737
Sugar-4	Sugar Island Bank	-83.146091	42.088955
Sugar-5	Detroit River	-83.144858	42.088624
Sugar-6	Detroit River	-83.143254	42.089573
VIB-1	Detroit River	-83.146239	42.089961
VIB-2	Detroit River	-83.146203	42.088933
VIB-3	Detroit River	-83.145045	42.088921
VIB-4	Detroit River	-83.143523	42.089747
VIB-5	Detroit River	-83.142779	42.089357
VIB-6	Detroit River	-83.14461	42.08796
VIB-7	Detroit River	-83.146168	42.087908
VIB-8	Detroit River	-83.146563	42.088752
VIB-9	Detroit River	-83.146593	42.089939

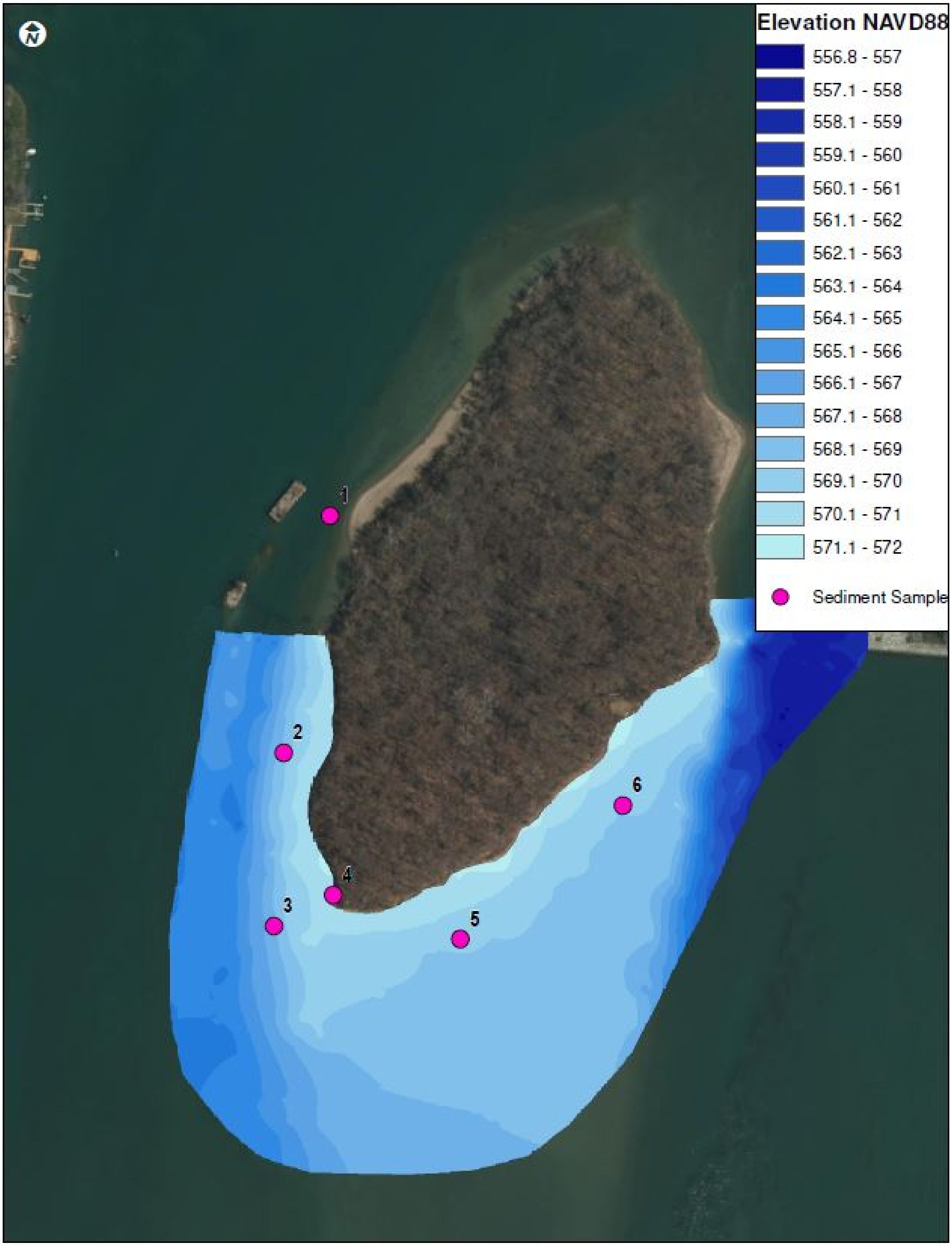

Figure 2. Surface Sediment Sample Location Map

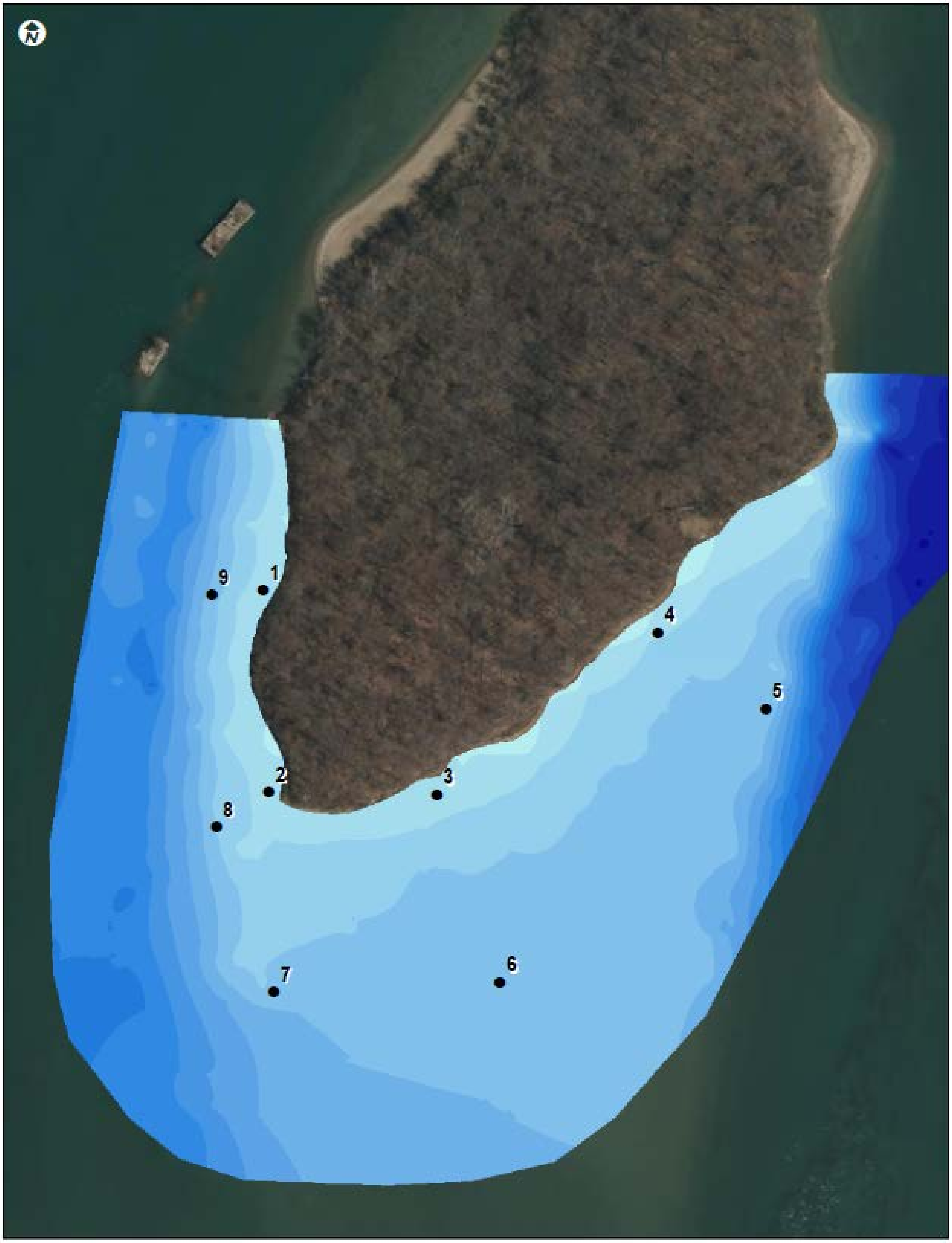

Figure 3. Vibracore Sediment Sample Location Map

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4

SAMPLING METHODS

4.1 Sampling Schedule

The surface sediment sampling was conducted on June 1, 2018 in accordance with the Quality Assurance Project Plan (QAPP). The sediment coring was conducted on July 18, 2018. Prior to initiation of field activities, SmithGroupJJR and the US Fish and Wildlife Service at Grosse Ile, MI were notified.

4.2 Sample Collection

Surface sediment samples were collected at the stations (Sugar-1 to Sugar-6) shown in Figure 2. The surface sediment samples were collected with a petite ponar according to the Standard Operating Procedure (SOP) provided in the QAPP. The ponar sampler was manually deployed and retrieved. The procedure includes deploying the sampler off of the edge of the boat, retrieving the sampler to the boat deck, decanting water at the top of the sampler, and emptying the sediment into a decontaminated stainless-steel bowl. The sediment was homogenized using a stainless steel spoon. Notes of field observations were recorded describing the sample characteristics, and digital photographs were taken to document visual sediment characteristics. Sediment was then transferred directly into laboratory-approved, labeled sample containers onboard the vessel. A sample of bank material was also collected (Sugar-4). These samples were analyzed for the parameters listed in Table 3.

Sediment cores were collected on July 18, 2018 using vibracore technology provided by Affiliated Researchers, according to the SOP provided in Appendix A. Sediment cores were collected at the stations (VIB-1 to VIB-9) shown in Figure 3. The vibracoring system consisted of the vibracore head with internal vibrator motor, 4-inch-diameter dedicated core tube, underwater electrical cable connecting the surface platform to the vibracore head, and a control box. Vibracore technology uses a combination of vibration and gravity to advance the core tube through the soft sediment.

The vibration created by the vibracore head displaces the sediment around the outside of the core sampler allowing the core tube to penetrate the sediment column. The estimated depth of core penetration into the sediments was measured and recorded. Care was taken when removing the core tube in order to prevent the loss of collected sediment. Once the core bottom reached the water surface, the bottom of the core was securely capped and taped if necessary. Once the core tube was removed from the vibracore head, the top of the core tube was secured in the same manner. Sediment was then transferred from the cores into laboratory-approved, labeled sample containers. These samples were analyzed for the parameters listed in Table 3.

4.3 Sample Analysis

The sediment samples were delivered in iced coolers under Chain-of-Custody (COC) for laboratory analysis as detailed in Table 3.

Pace Analytical Laboratories in Grand Rapids, MI conducted the contaminant analyses. The laboratory supplied all the sample containers and coolers in accordance with the analytical method requirements. Materials Testing Consultants in Grand Rapids, MI conducted the grain size analyses.

Table 3. Sediment Sample Analytical Parameters

Station	Grain Size	PCBs	Metals	VOCs	SVOCs
Sugar-1					
Sugar-2	X				
Sugar-3	X	X	X	X	X
Sugar-3a (4-8”)	X				
Sugar-4	X				
Sugar-5					
Sugar-6	X	X	X	X	X
VIB-1		X	X	X	X
VIB-2					
VIB-3	X				
VIB-4					
VIB-5					
VIB-6	X	X	X	X	X
VIB-7					
VIB-8					
VIB-9					

5

STUDY RESULTS

The sediment quality data are summarized in Appendix B. The laboratory reports are included in Appendix C. The chain of custodies and field notes are included in Appendix D.

5.1 Surface Sediment Results

5.1.1 Sugar-1

The Sugar-1 location was in the middle of the channel between the old pier/dock and the sand beach. The water depth was approximately 10 feet, with swift currents. Due to the thin layer of surficial sediment only Ponar grab samples were collected. Approximately six Ponar grabs were required to fill one-third of a gallon zip lock bag.

Probe Depth: 16 inches (likely hard clay below sand/gravel surface layer)

5.1.2 Sugar-2

The Sugar-2 location had a water depth of approximately 5 feet. The river bottom had a very sandy/gravel surface. Due to the thin layer of surficial sediment only Ponar grab samples were collected. Several Ponar grabs (mostly sand) were required to fill one-third of a gallon zip lock bag.

Probe Depth: 36 inches (likely hard clay below a surface sand layer)

5.1.3 Sugar-3

The Sugar-3 location had a water depth of approximately 5 feet. The Ponar only grabbed some surficial organic/sand/clay mix. A hand push corer was used to try to sample clay material.

Probe Depth: 48 inches (likely all hard clay with some sand at surface)

5.1.4 Sugar-4

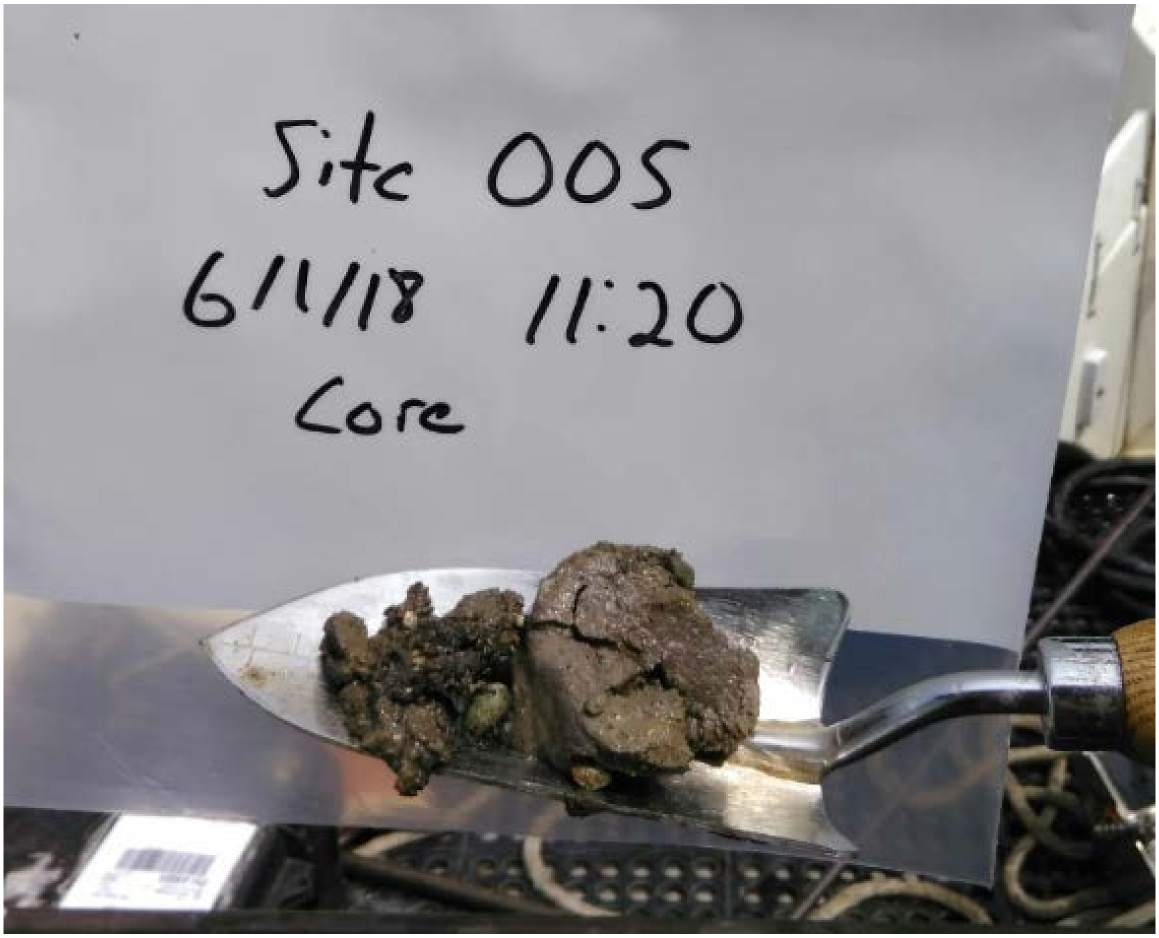
The Sugar-4 sample was collected from the cliff face on the south side of island. The collected material was very dry, dense material. There were visible signs of erosion actively happening. The cliff face crumbled with a shovel and broke by hand. The cliff face height above the current water elevation is 8 feet.

Probe Depth: 0 inches. Not able to probe at all.

5.1.5 Sugar-5

The Sugar-5 location had a water depth of approximately 4 feet. There was no sample recovery with the Ponar. A hand core device was used to get a small scoop of surface material.

Probe Depth: 0 inches. Very hard bottom. Not able to probe at all. Likely same material as cliff face.



5.1.6 Sugar-6

The water depth at location Sugar-6 was approximately 4 to 5 feet. The currents in this area were very calm (likely in an eddy area). The surface sediment layer consisted of 6 inches of very organic material. Samples were easily collected with the Ponar.

Probe Depth: 7 inches. Could easily probe into surface organics/silt, but very hard below that.

5.2 Sediment Core Results

At each sampling station the sediment was initially probed to determine the soft sediment depth. The finding were similar to those found during the surface sediment sampling – the soft sediments are minimal on the south side of Sugar Island. At two locations on the south side of the island (VIB-2 and VIB-7) there was no soft sediment and no sediment core could be collected. The core recovery with the vibracore at the other seven locations ranged from 0.5 feet to 1.9 feet with the exception of VIB-9 on the west side of the island, where a 4.7 feet core was recovered. The sediment cores are summarized in Table 4.

The sediments were generally tan/gray silty clay with sand.

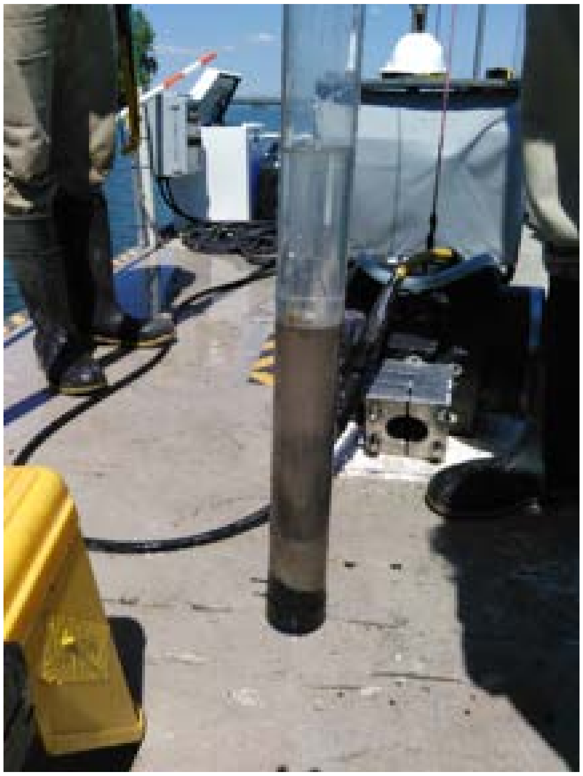
Table 4. Sediment Core Summary

Station	Location	Water Depth (feet)	Core Recovery (feet)
VIB-1	Nearshore-west side	---	0.5
VIB-2	Nearshore-southwest side	3.2	No recovery
VIB-3	Nearshore-southeast side	3.5	0.6
VIB-4	Nearshore-east side	4.3	1.0
VIB-5	Offshore-east side	5.3	0.7
VIB-6	Offshore-southeast side	5.4	1.0
VIB-7	Offshore-south side	---	No recovery
VIB-8	Offshore-southwest side	4.6	1.9
VIB-9	Offshore-west side	5.7	4.7

Vibracore Device

Site VIB-1

Site VIB-3



Site VIB-5

Site VIB-6

Site VIB-8

Site VIB-9

5.3 Laboratory Analysis

The results of the contaminant analysis are provided in Appendix B. The results show that PCBs, volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) were not detected in either of the two surface sediment samples or two sediment core samples submitted for analysis.

Metals were present in all four samples with manganese concentrations being the highest. Mercury was not detected any of the four samples. All detected concentrations were below the probable effect concentration (PEC).

The results of the grain size analyses are provided in Table 5 and shown in Figure 4. The surficial sediment collected at locations Sugar-2, Sugar-3, and Sugar-6 show the majority of the material collected is fine sand, with the exception of Sugar-2 which had more medium sand. The samples collected from the bank area (Sugar-4), from 4 to 8 inches deep (Sugar-3a) and the two sediment cores (VIB-3 and VIB-6) showed that fine materials (silt and clay) dominated.

Table 5. Sediment Sample Grain Size Analysis Results

		% Gravel		% Sand			% Fines	
Station	Depth	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
Sugar-2	Surface	0.0	2.7	0.6	68.4	22.9	4.3	1.1
Sugar-3	Surface	1.6	6.0	1.3	7.5	75.1	5.6	2.9
Sugar-3.2	4-8 in	0.0	0.0	0.0	3.3	16.7	42.9	37.1
Sugar-4	Bank	0.0	2.2	1.0	7.5	17.6	40.8	30.0
Sugar-6	Surface	0.7	7.0	1.1	24.2	54.6	9.1	3.3
VIB-3	0-12 in	0.0	5.9	4.7	8.8	16.9	33.2	30.5
VIB-6	0-10.8 in	1.1	7.2	5.1	14.2	21.2	27.0	24.2

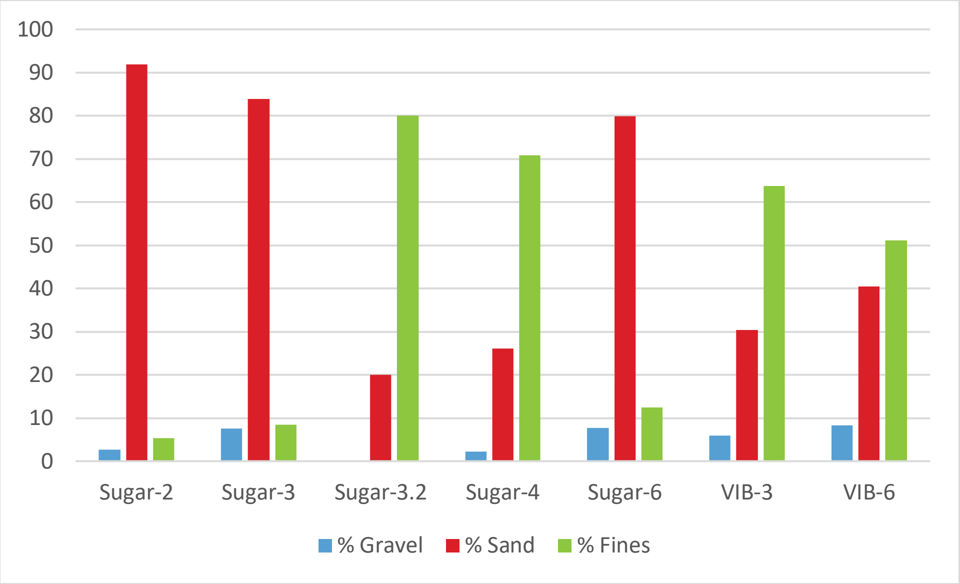


Figure 4. Sediment Sample Grain Size Comparison.

Appendix A
Vibracore SOP

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I. INTRODUCTION

The general procedures to be used in obtaining sediment samples from rivers, creeks, ponds and impoundments are presented in this standard operating procedure (SOP). A hand-held dredge will be the primary equipment used to collect surface sediment samples. Lexan tubing will be the primary equipment used to collect sediment cores. The tubing may be replaced with a calibrated rod for sediment depth/thickness probing. If sufficient penetration cannot be achieved using Lexan tubing (perhaps because of the presence of cobbles, bedrock or other hard consolidated material), a suitable sediment corer may be substituted where necessary and practicable. The core tubing will be inserted down into the sediments in a straight and vertical manner to provide a representative cross-section sample.

II. MATERIALS

The following materials, as required, will be available during sediment sampling:

- Personal protective equipment as required by the Health and Safety Plan;
- Cleaning equipment as required in the Work Plan;
- Boat;
- Aluminum foil;
- Aluminum or stainless steel tray;
- Electrical or duct tape;
- Lexan tubing with end caps;
- Push rod for extracting core from tubing;
- Sediment corer (e.g, KB-corer, standard split-spoon)
- Hand-held dredge with rope(e.g, Ponar Sampler);
- Calibrated rod for sediment depth/thickness measurement;
- Liners for core sampling devices (e.g., brass, stainless steel, Teflon, plastic).
- Sampling device extension rods, handle, or hammer-driver;
- Stainless steel spatula, lab spoon, or equivalent (new wooden tongue depressors may also be used)Handsaw and/or knife;
- Appropriate sample containers and forms;
- Insulated coolers with cold packs or ice;
- Field log.

A. Procedures for Lexan Tube Sampling

The following procedures will be employed to collect sediment core samples:

1. Don personal protective equipment as required by the Health and Safety Plan.

2. Lower the Lexan tube until it just reaches the top of the sediment and measure and record the depth of the water.

3. Push the Lexan tube into the sediment by hand until refusal. Measure the depth of sediment. If the procedure is being performed solely to determine sediment depth (probing), a calibrated rod may be used in place of the Lexan tube. If the procedure is being performed to collect samples for physical observation or laboratory analysis, continue with the next step.

4. It may be desirable to drive the tube down several more inches, measuring the distance, to obtain a “plug” of consolidated material at the bottom of

the core and prevent the loose sediment from escaping.

5. Add water from the surface water body into the top of the tube until it is full and place the cap securely over the tube end.

6. Slowly pull the tube from the sediment, twisting it slightly as it is removed.

7. If the sediment sample is solely for the purpose of descriptive physical characterization, it may be removed from the water/core, described and disposed of at the sampling location. If the sediment sample is to be transported to another location for processing, proceed with the next step.

8. Before the tube is fully removed from the water, place a cap on the bottom end while still submerged.

8. Keeping the tube upright, dry the bottom end of the tube and seal the cap with tape.

9. Keeping the tube upright, transport the core sample to the shore and use a handsaw to cut the tube approximately one inch above the sediment.

10. Re-cap the cut end of the tube, seal the cap with electrical tape and mark this end as “TOP”.

11. If the core is to be stored or transported from the sampling site, dry the tube and affix a completed sample label on the tube, including sample ID, date and time.

11. If the core is to be photographed, fill out and include the attached Photograph Form in the picture.

12. If the core is to be submitted for laboratory analysis, place the core sample in a cooler with ice.

13. Sediment cores for laboratory analysis will be extruded from the Lexan tubing onto an aluminum or stainless steel tray or onto aluminum foil. Cores will be sectioned into the required depth-proportioned increments based on the ratio of the measured sediment depth to the recovered sediment depth to account for sample compression or expansion during collection. Each increment will be individually packaged. Cores may be frozen to facilitate sectioning when sediment is extremely loose.

14. Record all appropriate information (e.g., sample description, date, time, analyses) in the field log.

15. Label, handle, pack, and ship the samples consistent with the procedures in the Standard Operating Procedure for Shipping and Handling of Samples.

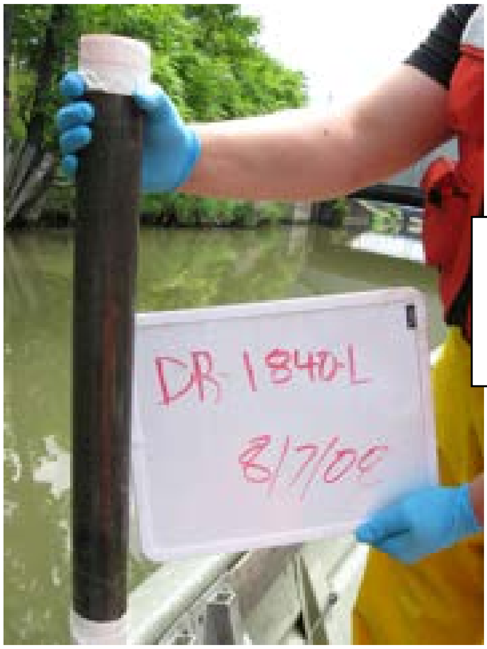

Photo 1: Collected sediment core.

B. Procedures for Sediment Probing

The calibration rod will be used to probe sediment depths along a sediment characterization transect as follows:

1. Don personal protective equipment as required by the Health and Safety Plan.
2. Push the rod into the sediment by hand until refusal.
3. Measure the depth of sediment.
4. Measurements of location, depth, and time will be recorded in the field log.

C. Procedures for Hand-Held Dredge Sampling

1. Don personal protective equipment as required by the Health and Safety Plan.
2. Drop the opened dredge from boat, making sure that the end of the rope is maintained at all times inside the boat.
3. Once the dredge has been allowed to settle into the bottom sediments, a hard pull on the rope will enclose the sediments inside the dredge.
4. Retrieve the dredge into the boat and open to allow sediments to empy onto a tray.
5. Record all appropriate information (e.g., sample description, date, time, analyses) in the field log.
6. If the sample is to be submitted for laboratory analysis, label, handle, pack, and ship the samples consistent with the procedures in the Standard Operating Procedure for Shipping and Handling of Samples.

III. SURVEY

A field survey control program will be conducted, if required, using standard instrument survey techniques to document the sampling location.

IV. EQUIPMENT CLEANING

Equipment cleaning will be performed at the beginning of the sampling event and between each separate sampling location as described in Standard Operating Procedure for Cleaning Equipment.

V. DISPOSAL METHODS

All water generated during cleaning procedures will be collected and contained on site for determination of appropriate treatment/disposal methods.

Personal protective equipment, such as gloves, disposable clothing, and the disposable equipment resulting from personnel cleaning procedures and sampling and handling activities will be placed in plastic bags. These bags may be transferred into appropriately labeled 55-gallon drums for appropriate disposal as necessary.

Sediments removed from the sampling location will be placed in sealed 55-gallon steel drums or roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine appropriate disposal methods.

Sediment Sampling/Probing Log

Samplers: Date: Weather:

Date	Time	Location	Total Core Depth	Depth of Water	Sediment Penetration Depth	Sediment Recovery Length	Sample ID	Increment	Visual Description

Comments:

Sediment Sample Photo ID Sheet

⇧

This End Top

Sample ID

Location

Transect:

Position:

Depth of Water (ft)

Total Length of Core (ft)

Core Interval (ft)

Samplers

Date

Time

Appendix B
Contaminant Data

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SUGAR ISLAND - SEDIMENT SAMPLE RESULTS

Parameter	Method	Units	Sugar-3 *6/1/18*	Sugar-6 *6/1/18*	VIB-1 *7/18/18*	VIB-6 *7/18/18*	PEC
PCB-1016	EPA 8082	ug/kg	<48.9	<43.8	<41.9	<41.3	
PCB-1211		ug/kg	<48.9	<43.8	<41.9	<41.3	
PCB-1232		ug/kg	<48.9	<43.8	<41.9	<41.3	
PCB-1242		ug/kg	<48.9	<43.8	<41.9	<41.3	
PCB-1248		ug/kg	<48.9	<43.8	<41.9	<41.3	
PCB-1254		ug/kg	<48.9	<43.8	<41.9	<41.3	
PCB-1260		ug/kg	<48.9	<43.8	<41.9	<41.3	
Total PCB		ug/kg					676
Aluminum	EPA 6010C	mg/kg	12,700	3,810	9,500	8,140	
Calcium		mg/kg	28,200	10,000	123,000	97,100	
Iron		mg/kg	11,400	868	17,800	22,600	
Magnesium		mg/kg	6,300	1,220	16,200	16,800	
Potassium		mg/kg	1,670	905	2,500	2,020	
Sodium		mg/kg	98.3	143	18,100	207	
Antimony	EPA 6020A	ug/kg	<139	<134	<119	<125	
Arsenic		ug/kg	4,490	3,840	7,420	4,150	33,000
Barium		ug/kg	97,300	14,700	97,400	49,100	
Beryllium		ug/kg	798	<668	421	400	
Cadmium		ug/kg	223	96	135	70.8	4,980
Chromium		ug/kg	24,300	6,460	15,400	13,900	111,000
Cobalt		ug/kg	7,270	3,870	9,610	7,870	
Copper		ug/kg	25,500	5,800	19,500	14,400	149,000
Lead		ug/kg	11,000	5,240	9,370	8,180	128,000
Manganese		ug/kg	122,000	222,000	636,000	449,000	
Nickel		ug/kg	22,500	8,140	24,700	18,800	48,600
Selenium		ug/kg	6,430	2,680	3,720	3,210	
Silver		ug/kg	<69.3	<66.8	<59.7	<62.4	
Thallium		ug/kg	373	<334	381	<312	
Vanadium		ug/kg	36,900	12,300	21,400	18,600	
Zinc		ug/kg	62,800	20,700	49,700	40,400	459,000
Mercury	EPA 7471	ug/kg	<70.3	<68.3	<62.3	<58.8	486
Acenaphthene	EPA 8270C	ug/kg	<251	<233	<21.7	<21	
Acenaphthylene		ug/kg	<251	<233	<21.7	<21	
Anthracene		ug/kg	<251	<233	<21.7	<21	845
Benzo(a)anthracene		ug/kg	<251	<233	<21.7	<105	1050
Benzo(a)pyrene		ug/kg	<251	<233	<21.7	**29**	1450
Benzo(b)fluoranthene		ug/kg	<251	<233	<21.7	**29.7**	
Benzo(g,h,i)perylene		ug/kg	<487	<452	<42.1	<40.8	
Benzo(k)fluoranthene		ug/kg	<251	<233	<21.7	<21	
4-Bromophenylphenyl ether		ug/kg	<251	<233	<21.7	<21	
Butylbenzylphthalate		ug/kg	<487	<452	<42.1	<204	
Carbazole		ug/kg	<2510	<2330	<217	<210	
4-Chloro-3-methylphenol		ug/kg	<251	<233	<21.7	<21	
bi(2-Chloroethoxy)methane		ug/kg	<251	<233	<21.7	<21	
bis(2-Chloroethoxy)ether		ug/kg	<251	<233	<21.7	<21	
bi(2-Chloroisopropyl)ether		ug/kg	<251	<233	<21.7	<21	
2-Chloronaphthalene		ug/kg	<251	<233	<21.7	<21	
2-Chlorophenol		ug/kg	<251	<233	<21.7	<21	
4-Chlorophenylphenyl ether		ug/kg	<251	<233	<21.7	<21	
Chrysene		ug/kg	<251	<233	<21.7	<105	1290
Dibenz(a,h)anthracene		ug/kg	<487	<452	<42.1	<40.8	
Dibenzofuran		ug/kg	<251	<233	<21.7	<21	
1,2-Dichlorobenzene		ug/kg	<251	<233	<21.7	<21	
1,3-Dichlorobenzene		ug/kg	<251	<233	<21.7	<21	
1,4-Dichlorobenzene		ug/kg	<251	<233	<21.7	<21	
2,4-Dichlorophenol		ug/kg	<487	<452	<42.1	<40.8	
Diethylphthalate		ug/kg	<251	<233	<21.7	<21	
2,4-Dimethylphenol		ug/kg	<2510	<2330	<217	<210	
Dimethylphthalate		ug/kg	<251	<233	<21.7	<21	
Di-n-butylphthalate		ug/kg	<989	<918	**191**	<82.9	
4,6-Dinitro-2-methylphenol		ug/kg	<2510	<2330	<217	<210	
2,4-Dinitrophenol		ug/kg	<2510	<2330	<217	<210	
2,4-Dinitrotoluene		ug/kg	<487	<452	<42.1	<40.8	
2,6-Dinitrotoluene		ug/kg	<251	<233	<21.7	<21	
Di-n-octylphthalate		ug/kg	<251	<233	<21.7	<105	
bis(2-Ethylhexyl)phthalate		ug/kg	<487	<452	<42.1	<204	
1,2-Diphenylhydrazine		ug/kg	<251	<233	<21.7	<21	
Fluoranthene		ug/kg	<251	<233	<21.7	**44.5**	2,230
Fluorene		ug/kg	<487	<452	<42.1	<40.8	536
Hexachloro-1,3-butadiene		ug/kg	<251	<233	<21.7	<21	
Hexachlorobenzene		ug/kg	<251	<233	<21.7	<21	
Hexachlorocyclopentadiene		ug/kg	<251	<233	<21.7	<21	
Hexachloroethane		ug/kg	<251	<233	<21.7	<21	
Indeno(1,2,3-cd)pyrene		ug/kg	<487	<452	<42.1	<40.8	
Isophorone		ug/kg	<251	<233	<21.7	<21	
2-Methylnapthalene		ug/kg	<251	<233	<21.7	<21	
2-Methylphenol(o Cresol)		ug/kg	<251	<233	<21.7	<21	
3&4-Methylphenol(m&p Cresol)		ug/kg	<502	<466	<43.4	<42.1	
Naphthalene		ug/kg	<251	<233	<21.7	<21	561
2-Nitroaniline		ug/kg	<251	<233	<21.7	<21	
3-Nitroaniline		ug/kg	<4870	<4520	<421	<408	
4-Nitroaniline		ug/kg	<4870	<4520	<421	<408	
Nitrobenzene		ug/kg	<251	<233	<21.7	<21	
2-Nitrophenol		ug/kg	<251	<233	<21.7	<21	

Parameter	Method	Units	Sugar-3 *6/1/18*	Sugar-6 *6/1/18*	VIB-1 *7/18/18*	VIB-6 *7/18/18*	PEC
4-Nitrophenol		ug/kg	<9890	<9180	<854	<829	
N-Nitrosodiumethylamine	EPA 8270C	ug/kg	<487	<452	<42.1	<40.8	
N-Nitro-di-n-propylamine		ug/kg	<251	<233	<21.7	<21	
N-Nitrosodiphenylamine		ug/kg	<251	<233	<21.7	<21	
Pentachlorophenol		ug/kg	<487	<452	<42.1	<40.8	
Phenanthrene		ug/kg	<251	<233	<21.7	<21	1170
Phenol		ug/kg	<2510	<2330	<217	<210	
Pyrene		ug/kg	<251	<233	<21.7	<105	1520
1,2,4-Trichlorobenzene		ug/kg	<251	<233	<21.7	<21	
2,4,5-Trichlorophenol		ug/kg	<251	<233	<21.7	<21	
2,4,6-Trichlorophenol		ug/kg	<251	<233	<21.7	<21	
Acetone	EPA 8260B	ug/kg	<1140	<1040	<1000	<887	
Acrylonitrile		ug/kg	<381	<346	<333	<296	
tert-Amylmethyl ether		ug/kg	<381	<346	<333	<296	
Benzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Bromobenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Bromochloromethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
Bromodichloromethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
Bromoform		ug/kg	<76.2	<69.1	<66.7	<59.1	
Bromomethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
2-Butanone		ug/kg	<3810	<3460	<3330	<2960	
ter-Butyl Alcohol		ug/kg	<3810	<3460	<3330	<2960	
n-Butylbenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
sec-Butylbenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
tert-Butylbenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Carbon disulfide		ug/kg	<381	<346	<333	<296	
Carbon tetrachloride		ug/kg	<76.2	<69.1	<66.7	<59.1	
Chlorobenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Chloroethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
Chloroform		ug/kg	<76.2	<69.1	<66.7	<59.1	
Chloromethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
Cyclohexane		ug/kg	<3810	<3460	<3330	<2960	
1,2-Dibromo-3-chloropropane		ug/kg	<381	<346	<333	<296	
Dibromochloromethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,2-Dibromomethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
Dibromomethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,2-Dichlorobenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,3-Dichlorobenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,4-Dichlorobenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
trans-1,4-Dichloro-2-butene		ug/kg	<381	<346	<333	<296	
Dichlorofluoromethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,1-Dichloroethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,2-Dichloroethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,1-Dichloroethene		ug/kg	<76.2	<69.1	<66.7	<59.1	
cis-1,2-Dichloroethene		ug/kg	<76.2	<69.1	<66.7	<59.1	
trans-1,3-Dichloroethene		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,2-Dichloropropane		ug/kg	<76.2	<69.1	<66.7	<59.1	
cis-1,3-Dichloropropene		ug/kg	<76.2	<69.1	<66.7	<59.1	
trans-1,3-Dichloropropene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Diethyl ether		ug/kg	<76.2	<69.1	<66.7	<59.1	
Diisopropyl ether		ug/kg	<381	<346	<333	<296	
Ethylbenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Ethyl-tert-butyl ether		ug/kg	<381	<346	<66.7	<296	
Hexachloroethane		ug/kg	<381	<346	<3330	<296	
2-Hexanone		ug/kg	<3810	<3460	<333	<2960	
Iodomethane		ug/kg	<381	<346	<66.7	<296	
Isopropylbenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Methylene chloride		ug/kg	<76.2	<69.1	<333	<59.1	
2-Methylnapthalene	EPA 8260B	ug/kg	<381	<346	<333	<296	
4-Methyl-2-pentanone		ug/kg	<381	<346	<3330	<2960	
Methyl-tert-butyl ether		ug/kg	<3810	<3460	<66.7	<59.1	
Naphthalene		ug/kg	<76.2	<69.1	<333	<296	
n-Propylbenzene		ug/kg	<381	<346	<66.7	<59.1	
Styrene		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,1,1,2-Tetrachloroethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,1,2,2-Tetrachloroethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
Tetrachloroethene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Tetrahydrofuran		ug/kg	<76.2	<346	<66.7	<296	
Toluene		ug/kg	<381	<69.1	<66.7	<59.1	
1,2,3-Trichlorobenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,2,4-Trichlorobenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,1,1-Trichloroethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,1,2-Trichloroethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
Trichloroethene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Trichloroethene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Trichlorofluoromethane		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,2,3-Trichloropropane		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,2,3-Trimethylbenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,2,4-Trimethylbenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
1,3,5-Trimethylbenzene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Vinyl Chloride		ug/kg	<76.2	<69.1	<66.7	<59.1	
m&p-Xylene		ug/kg	<152	<138	<133	<118	
o-Xylene		ug/kg	<76.2	<69.1	<66.7	<59.1	
Percent moisture	SM2540	%	33.7	27.7	21.9	21.0	

Appendix C
Laboratory Reports

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Pace Analytical Services, LLC
5560 Corporate Exchange Ct. SE
Grand Rapids, MI 49512
(616)975-4500

June 19, 2018

Robert Betz
LimnoTech
501 Avis Drive
Ann Arbor, MI 48108

RE: Project: Sediment Sampling
Pace Project No.: 4613112

Dear Robert Betz:

Enclosed are the analytical results for sample(s) received by the laboratory on June 06, 2018. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

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

Sincerely,

Jennifer L Rice

Jennifer Rice
jennifer.rice@pacelabs.com
(616)975-4500
Project Manager

Enclosures

CERTIFICATIONS

Project:	Sediment Sampling
Pace Project No.:	4613112

Grand Rapids Certification ID's

5560 Corporate Exchange Ct SE, Grand Rapids, MI 49512
Minnesota Department of Health, Certificate #1385941
Arkansas Department of Environmental Quality, Certificate #17-046-0
Georgia Environmental Protection Division, Stipulation
Illinois Environmental Protection Agency, Certificate #004325
Michigan Department of Environmental Quality, Laboratory #0034
New York State Department of Health, Serial #57971 and 57972
North Carolina Division of Water Resources, Certificate #659
Virginia Department of General Services, Certificate #9028
Wisconsin Department of Natural Resources, Laboratory #999472650
U.S. Department of Agriculture Permit to Receive Soil, Permit #P330-17-00278

SAMPLE SUMMARY

Project: Sediment Sampling
Pace Project No.: 4613112

Lab ID	Sample ID	Matrix	Date Collected	Date Received
4613112001	**SITE 3**	Solid	06/01/18 10:30	06/06/18 08:20
4613112002	**SITE 6**	Solid	06/01/18 13:20	06/06/18 08:20

SAMPLE ANALYTE COUNT

Project: Sediment Sampling
Pace Project No.: 4613112

Lab ID	Sample ID	Method	Analysts	Analytes Reported
4613112001	**SITE 3**	EPA 8082A	CAC	9
		EPA 6010C	KLV	6
		EPA 6020A	DSC, DWJ	16
		EPA 7471B	DSC	1
		EPA 8270C	JLB	70
		EPA 8260B	DLV	76
		SM 2540 G-11/3550	NS1	1
4613112002	**SITE 6**	EPA 8082A	CAC	9
		EPA 6010C	KLV	6
		EPA 6020A	DSC, DWJ	16
		EPA 7471B	DSC	1
		EPA 8270C	JLB	70
		EPA 8260B	DLV	76
		SM 2540 G-11/3550	NS1	1

ANALYTICAL RESULTS

Project:	Sediment Sampling
Pace Project No.:	4613112

Sample: SITE 3 **Lab ID: 4613112001** Collected: 06/01/18 10:30 Received: 06/06/18 08:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS Solids ASE	Analytical Method: EPA 8082A Preparation Method: EPA 3545A							
PCB-1016 (Aroclor 1016)	**<48.9**	ug/kg	48.9	1	06/11/18 16:19	06/13/18 14:49	12674-11-2	
PCB-1221 (Aroclor 1221)	**<48.9**	ug/kg	48.9	1	06/11/18 16:19	06/13/18 14:49	11104-28-2	
PCB-1232 (Aroclor 1232)	**<48.9**	ug/kg	48.9	1	06/11/18 16:19	06/13/18 14:49	11141-16-5	
PCB-1242 (Aroclor 1242)	**<48.9**	ug/kg	48.9	1	06/11/18 16:19	06/13/18 14:49	53469-21-9	
PCB-1248 (Aroclor 1248)	**<48.9**	ug/kg	48.9	1	06/11/18 16:19	06/13/18 14:49	12672-29-6	
PCB-1254 (Aroclor 1254)	**<48.9**	ug/kg	48.9	1	06/11/18 16:19	06/13/18 14:49	11097-69-1	
PCB-1260 (Aroclor 1260)	**<48.9**	ug/kg	48.9	1	06/11/18 16:19	06/13/18 14:49	11096-82-5	
Surrogates								
Decachlorobiphenyl (S)	52	%.	45-135	1	06/11/18 16:19	06/13/18 14:49	2051-24-3	
Tetrachloro-m-xylene (S)	53	%.	56-123	1	06/11/18 16:19	06/13/18 14:49	877-09-8	S0
6010C MET ICP	Analytical Method: EPA 6010C Preparation Method: EPA 3050B							
Aluminum	**12700000**	ug/kg	14400	1	06/12/18 07:50	06/13/18 10:39	7429-90-5	
Calcium	**28200000**	ug/kg	72000	1	06/12/18 07:50	06/13/18 10:39	7440-70-2	
Iron	**11400000**	ug/kg	7200	1	06/12/18 07:50	06/13/18 10:39	7439-89-6	
Magnesium	**6300000**	ug/kg	72000	1	06/12/18 07:50	06/13/18 10:39	7439-95-4	
Potassium	**1670000**	ug/kg	72000	1	06/12/18 07:50	06/13/18 10:39	7440-09-7	
Sodium	**98300**	ug/kg	72000	1	06/12/18 07:50	06/13/18 10:39	7440-23-5	
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050B							
Antimony	**<139**	ug/kg	139	1	06/11/18 07:35	06/14/18 16:50	7440-36-0	
Arsenic	**4490**	ug/kg	693	5	06/11/18 07:35	06/13/18 16:02	7440-38-2	
Barium	**97300**	ug/kg	3470	25	06/11/18 07:35	06/15/18 08:57	7440-39-3	
Beryllium	**798**	ug/kg	693	5	06/11/18 07:35	06/13/18 16:02	7440-41-7	1l
Cadmium	**223**	ug/kg	69.3	1	06/11/18 07:35	06/14/18 16:50	7440-43-9	
Chromium	**24300**	ug/kg	693	5	06/11/18 07:35	06/13/18 16:02	7440-47-3	
Cobalt	**7270**	ug/kg	693	5	06/11/18 07:35	06/13/18 16:02	7440-48-4	
Copper	**25500**	ug/kg	693	5	06/11/18 07:35	06/13/18 16:02	7440-50-8	
Lead	**11000**	ug/kg	693	5	06/11/18 07:35	06/13/18 16:02	7439-92-1	
Manganese	**122000**	ug/kg	3470	25	06/11/18 07:35	06/14/18 16:47	7439-96-5	
Nickel	**22500**	ug/kg	693	5	06/11/18 07:35	06/13/18 16:02	7440-02-0	
Selenium	**6430**	ug/kg	139	1	06/11/18 07:35	06/14/18 16:50	7782-49-2	
Silver	**<69.3**	ug/kg	69.3	1	06/11/18 07:35	06/14/18 16:50	7440-22-4	
Thallium	**373**	ug/kg	347	5	06/11/18 07:35	06/13/18 16:02	7440-28-0	1l
Vanadium	**36900**	ug/kg	3470	25	06/11/18 07:35	06/14/18 16:47	7440-62-2	
Zinc	**62800**	ug/kg	34700	25	06/11/18 07:35	06/14/18 16:47	7440-66-6	
7471 Mercury	Analytical Method: EPA 7471B Preparation Method: EPA 7471B							
Mercury	**<70.3**	ug/kg	70.3	1	06/07/18 10:46	06/08/18 09:17	7439-97-6	
8270C MSSV Solid	Analytical Method: EPA 8270C Preparation Method: EPA 3550C							
Acenaphthene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	83-32-9	
Acenaphthylene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	208-96-8	
Anthracene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	120-12-7	
Benzo(a)anthracene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	56-55-3	

ANALYTICAL RESULTS

Project: Sediment Sampling
Pace Project No.: 4613112

Sample: SITE 3 **Lab ID: 4613112001** Collected: 06/01/18 10:30 Received: 06/06/18 08:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

8270C MSSV Solid Analytical Method: EPA 8270C Preparation Method: EPA 3550C

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Benzo(a)pyrene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	50-32-8	
Benzo(b)fluoranthene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	205-99-2	
Benzo(g,h,i)perylene	**<487**	ug/kg	487	10	06/11/18 08:40	06/18/18 16:37	191-24-2	M6
Benzo(k)fluoranthene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	207-08-9	
4-Bromophenylphenyl ether	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	101-55-3	
Butylbenzylphthalate	**<487**	ug/kg	487	10	06/11/18 08:40	06/18/18 16:37	85-68-7	
Carbazole	**<2510**	ug/kg	2510	10	06/11/18 08:40	06/18/18 16:37	86-74-8	
4-Chloro-3-methylphenol	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	59-50-7	
bis(2-Chloroethoxy)methane	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	111-91-1	
bis(2-Chloroethyl) ether	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	111-44-4	
bis(2-Chloroisopropyl) ether	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	108-60-1	
2-Chloronaphthalene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	91-58-7	
2-Chlorophenol	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	95-57-8	
4-Chlorophenylphenyl ether	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	7005-72-3	
Chrysene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	218-01-9	
Dibenz(a,h)anthracene	**<487**	ug/kg	487	10	06/11/18 08:40	06/18/18 16:37	53-70-3	M6
Dibenzofuran	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	132-64-9	
1,2-Dichlorobenzene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	95-50-1	
1,3-Dichlorobenzene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	541-73-1	
1,4-Dichlorobenzene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	106-46-7	
2,4-Dichlorophenol	**<487**	ug/kg	487	10	06/11/18 08:40	06/18/18 16:37	120-83-2	
Diethylphthalate	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	84-66-2	
2,4-Dimethylphenol	**<2510**	ug/kg	2510	10	06/11/18 08:40	06/18/18 16:37	105-67-9	
Dimethylphthalate	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	131-11-3	
Di-n-butylphthalate	**<989**	ug/kg	989	10	06/11/18 08:40	06/18/18 16:37	84-74-2	
4,6-Dinitro-2-methylphenol	**<2510**	ug/kg	2510	10	06/11/18 08:40	06/18/18 16:37	534-52-1	M6
2,4-Dinitrophenol	**<2510**	ug/kg	2510	10	06/11/18 08:40	06/18/18 16:37	51-28-5	L1,M6
2,4-Dinitrotoluene	**<487**	ug/kg	487	10	06/11/18 08:40	06/18/18 16:37	121-14-2	
2,6-Dinitrotoluene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	606-20-2	
Di-n-octylphthalate	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	117-84-0	
1,2-Diphenylhydrazine	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	122-66-7	
bis(2-Ethylhexyl)phthalate	**<487**	ug/kg	487	10	06/11/18 08:40	06/18/18 16:37	117-81-7	
Fluoranthene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	206-44-0	
Fluorene	**<487**	ug/kg	487	10	06/11/18 08:40	06/18/18 16:37	86-73-7	
Hexachloro-1,3-butadiene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	87-68-3	
Hexachlorobenzene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	118-74-1	
Hexachlorocyclopentadiene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	77-47-4	
Hexachloroethane	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	67-72-1	
Indeno(1,2,3-cd)pyrene	**<487**	ug/kg	487	10	06/11/18 08:40	06/18/18 16:37	193-39-5	
Isophorone	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	78-59-1	
2-Methylnaphthalene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	91-57-6	
2-Methylphenol(o-Cresol)	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	95-48-7	
3&4-Methylphenol(m&p Cresol)	**<502**	ug/kg	502	10	06/11/18 08:40	06/18/18 16:37		
Naphthalene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	91-20-3	
2-Nitroaniline	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	88-74-4	
3-Nitroaniline	**<4870**	ug/kg	4870	10	06/11/18 08:40	06/18/18 16:37	99-09-2	M6

ANALYTICAL RESULTS

Project: Sediment Sampling
Pace Project No.: 4613112

Sample: SITE 3 **Lab ID: 4613112001** Collected: 06/01/18 10:30 Received: 06/06/18 08:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8270C MSSV Solid	Analytical Method: EPA 8270C Preparation Method: EPA 3550C							
4-Nitroaniline	**<4870**	ug/kg	4870	10	06/11/18 08:40	06/18/18 16:37	100-01-6	M6
Nitrobenzene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	98-95-3	
2-Nitrophenol	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	88-75-5	
4-Nitrophenol	**<9890**	ug/kg	9890	10	06/11/18 08:40	06/18/18 16:37	100-02-7	
N-Nitrosodimethylamine	**<487**	ug/kg	487	10	06/11/18 08:40	06/18/18 16:37	62-75-9	
N-Nitroso-di-n-propylamine	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	621-64-7	
N-Nitrosodiphenylamine	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	86-30-6	
Pentachlorophenol	**<487**	ug/kg	487	10	06/11/18 08:40	06/18/18 16:37	87-86-5	
Phenanthrene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	85-01-8	
Phenol	**<2510**	ug/kg	2510	10	06/11/18 08:40	06/18/18 16:37	108-95-2	ED
Pyrene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	129-00-0	
1,2,4-Trichlorobenzene	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	120-82-1	
2,4,5-Trichlorophenol	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	95-95-4	
2,4,6-Trichlorophenol	**<251**	ug/kg	251	10	06/11/18 08:40	06/18/18 16:37	88-06-2	
Surrogates								
Nitrobenzene-d5 (S)	62	%.	33-131	10	06/11/18 08:40	06/18/18 16:37	4165-60-0	
2-Fluorobiphenyl (S)	64	%.	46-122	10	06/11/18 08:40	06/18/18 16:37	321-60-8	
o-Terphenyl (S)	69	%.	20-155	10	06/11/18 08:40	06/18/18 16:37	84-15-1	
Phenol-d6 (S)	65	%.	30-115	10	06/11/18 08:40	06/18/18 16:37	13127-88-3	
2-Fluorophenol (S)	65	%.	33-113	10	06/11/18 08:40	06/18/18 16:37	367-12-4	
2,4,6-Tribromophenol (S)	61	%.	12-124	10	06/11/18 08:40	06/18/18 16:37	118-79-6	
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B Preparation Method: EPA 5035A							
Acetone	**<1140**	ug/kg	1140	1	06/13/18 12:00	06/13/18 17:45	67-64-1	
Acrylonitrile	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	107-13-1	
tert-Amylmethyl ether	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	994-05-8	
Benzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	71-43-2	
Bromobenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	108-86-1	
Bromochloromethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	74-97-5	
Bromodichloromethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	75-27-4	
Bromoform	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	75-25-2	
Bromomethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	74-83-9	
2-Butanone (MEK)	**<3810**	ug/kg	3810	1	06/13/18 12:00	06/13/18 17:45	78-93-3	
tert-Butyl Alcohol	**<3810**	ug/kg	3810	1	06/13/18 12:00	06/13/18 17:45	75-65-0	
n-Butylbenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	104-51-8	
sec-Butylbenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	135-98-8	
tert-Butylbenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	98-06-6	
Carbon disulfide	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	75-15-0	
Carbon tetrachloride	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	56-23-5	
Chlorobenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	108-90-7	
Chloroethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	75-00-3	
Chloroform	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	67-66-3	
Chloromethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	74-87-3	
Cyclohexane	**<3810**	ug/kg	3810	1	06/13/18 12:00	06/13/18 17:45	110-82-7	
1,2-Dibromo-3-chloropropane	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	96-12-8	
Dibromochloromethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	124-48-1	

ANALYTICAL RESULTS

Project: Sediment Sampling
Pace Project No.: 4613112

Sample: SITE 3 **Lab ID: 4613112001** Collected: 06/01/18 10:30 Received: 06/06/18 08:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B Preparation Method: EPA 5035A							
1,2-Dibromoethane (EDB)	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	106-93-4	
Dibromomethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	74-95-3	
1,2-Dichlorobenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	95-50-1	
1,3-Dichlorobenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	541-73-1	
1,4-Dichlorobenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	106-46-7	
trans-1,4-Dichloro-2-butene	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	110-57-6	
Dichlorodifluoromethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	75-71-8	
1,1-Dichloroethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	75-34-3	
1,2-Dichloroethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	107-06-2	
1,1-Dichloroethene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	75-35-4	
cis-1,2-Dichloroethene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	156-59-2	
trans-1,2-Dichloroethene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	156-60-5	
1,2-Dichloropropane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	78-87-5	
cis-1,3-Dichloropropene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	10061-01-5	
trans-1,3-Dichloropropene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	10061-02-6	
Diethyl ether (Ethyl ether)	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	60-29-7	
Diisopropyl ether	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	108-20-3	
Ethylbenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	100-41-4	
Ethyl-tert-butyl ether	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	637-92-3	
Hexachloroethane	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	67-72-1	
2-Hexanone	**<3810**	ug/kg	3810	1	06/13/18 12:00	06/13/18 17:45	591-78-6	
Iodomethane	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	74-88-4	
Isopropylbenzene (Cumene)	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	98-82-8	
p-Isopropyltoluene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	99-87-6	
Methylene Chloride	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	75-09-2	
2-Methylnaphthalene	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	91-57-6	N2
4-Methyl-2-pentanone (MIBK)	**<3810**	ug/kg	3810	1	06/13/18 12:00	06/13/18 17:45	108-10-1	
Methyl-tert-butyl ether	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	1634-04-4	
Naphthalene	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	91-20-3	
n-Propylbenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	103-65-1	
Styrene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	100-42-5	
1,1,1,2-Tetrachloroethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	630-20-6	
1,1,2,2-Tetrachloroethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	79-34-5	
Tetrachloroethene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	127-18-4	
Tetrahydrofuran	**<381**	ug/kg	381	1	06/13/18 12:00	06/13/18 17:45	109-99-9	
Toluene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	108-88-3	
1,2,3-Trichlorobenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	87-61-6	
1,2,4-Trichlorobenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	120-82-1	
1,1,1-Trichloroethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	71-55-6	
1,1,2-Trichloroethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	79-00-5	
Trichloroethene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	79-01-6	
Trichlorofluoromethane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	75-69-4	
1,2,3-Trichloropropane	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	96-18-4	
1,2,3-Trimethylbenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	526-73-8	
1,2,4-Trimethylbenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	95-63-6	
1,3,5-Trimethylbenzene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	108-67-8	

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ANALYTICAL RESULTS

Project: Sediment Sampling
Pace Project No.: 4613112

Sample: SITE 3 **Lab ID: 4613112001** Collected: 06/01/18 10:30 Received: 06/06/18 08:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B Preparation Method: EPA 5035A							
Vinyl chloride	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	75-01-4	
m&p-Xylene	**<152**	ug/kg	152	1	06/13/18 12:00	06/13/18 17:45	179601-23-1	
o-Xylene	**<76.2**	ug/kg	76.2	1	06/13/18 12:00	06/13/18 17:45	95-47-6	
Surrogates								
Dibromofluoromethane (S)	93	%.	75-123	1	06/13/18 12:00	06/13/18 17:45	1868-53-7	
Toluene-d8 (S)	99	%.	85-113	1	06/13/18 12:00	06/13/18 17:45	2037-26-5	
4-Bromofluorobenzene (S)	97	%.	81-117	1	06/13/18 12:00	06/13/18 17:45	460-00-4	
1,2-Dichloroethane-d4 (S)	100	%.	83-116	1	06/13/18 12:00	06/13/18 17:45	17060-07-0	
Percent Moisture	Analytical Method: SM 2540 G-11/3550							
Percent Moisture	**33.7**	%	0.10	1		06/11/18 14:58		

ANALYTICAL RESULTS

Project: Sediment Sampling
Pace Project No.: 4613112

Sample: SITE 6 **Lab ID: 4613112002** Collected: 06/01/18 13:20 Received: 06/06/18 08:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS Solids ASE	Analytical Method: EPA 8082A Preparation Method: EPA 3545A							
PCB-1016 (Aroclor 1016)	**<43.8**	ug/kg	43.8	1	06/11/18 16:19	06/13/18 15:19	12674-11-2	
PCB-1221 (Aroclor 1221)	**<43.8**	ug/kg	43.8	1	06/11/18 16:19	06/13/18 15:19	11104-28-2	
PCB-1232 (Aroclor 1232)	**<43.8**	ug/kg	43.8	1	06/11/18 16:19	06/13/18 15:19	11141-16-5	
PCB-1242 (Aroclor 1242)	**<43.8**	ug/kg	43.8	1	06/11/18 16:19	06/13/18 15:19	53469-21-9	
PCB-1248 (Aroclor 1248)	**<43.8**	ug/kg	43.8	1	06/11/18 16:19	06/13/18 15:19	12672-29-6	
PCB-1254 (Aroclor 1254)	**<43.8**	ug/kg	43.8	1	06/11/18 16:19	06/13/18 15:19	11097-69-1	
PCB-1260 (Aroclor 1260)	**<43.8**	ug/kg	43.8	1	06/11/18 16:19	06/13/18 15:19	11096-82-5	
Surrogates								
Decachlorobiphenyl (S)	71	%.	45-135	1	06/11/18 16:19	06/13/18 15:19	2051-24-3	
Tetrachloro-m-xylene (S)	80	%.	56-123	1	06/11/18 16:19	06/13/18 15:19	877-09-8	
6010C MET ICP	Analytical Method: EPA 6010C Preparation Method: EPA 3050B							
Aluminum	**3810000**	ug/kg	63000	5	06/12/18 07:50	06/13/18 11:31	7429-90-5	D3
Calcium	**100000000**	ug/kg	315000	5	06/12/18 07:50	06/13/18 11:31	7440-70-2	D3
Iron	**8680000**	ug/kg	31500	5	06/12/18 07:50	06/13/18 11:31	7439-89-6	D3
Magnesium	**12200000**	ug/kg	63000	1	06/12/18 07:50	06/13/18 10:44	7439-95-4	
Potassium	**905000**	ug/kg	63000	1	06/12/18 07:50	06/13/18 10:44	7440-09-7	
Sodium	**143000**	ug/kg	63000	1	06/12/18 07:50	06/13/18 10:44	7440-23-5	
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050B							
Antimony	**<134**	ug/kg	134	1	06/11/18 07:35	06/14/18 17:07	7440-36-0	
Arsenic	**3840**	ug/kg	668	5	06/11/18 07:35	06/13/18 16:13	7440-38-2	
Barium	**14700**	ug/kg	668	5	06/11/18 07:35	06/13/18 16:13	7440-39-3	
Beryllium	**<668**	ug/kg	668	5	06/11/18 07:35	06/13/18 16:13	7440-41-7	1l
Cadmium	**96.0**	ug/kg	66.8	1	06/11/18 07:35	06/14/18 17:07	7440-43-9	
Chromium	**6460**	ug/kg	668	5	06/11/18 07:35	06/13/18 16:13	7440-47-3	
Cobalt	**3870**	ug/kg	668	5	06/11/18 07:35	06/13/18 16:13	7440-48-4	
Copper	**5800**	ug/kg	668	5	06/11/18 07:35	06/13/18 16:13	7440-50-8	
Lead	**5240**	ug/kg	668	5	06/11/18 07:35	06/13/18 16:13	7439-92-1	
Manganese	**222000**	ug/kg	6680	50	06/11/18 07:35	06/14/18 17:04	7439-96-5	
Nickel	**8140**	ug/kg	668	5	06/11/18 07:35	06/13/18 16:13	7440-02-0	
Selenium	**2680**	ug/kg	134	1	06/11/18 07:35	06/14/18 17:07	7782-49-2	
Silver	**<66.8**	ug/kg	66.8	1	06/11/18 07:35	06/14/18 17:07	7440-22-4	
Thallium	**<334**	ug/kg	334	5	06/11/18 07:35	06/13/18 16:13	7440-28-0	1l
Vanadium	**12300**	ug/kg	668	5	06/11/18 07:35	06/13/18 16:13	7440-62-2	
Zinc	**20700**	ug/kg	6680	5	06/11/18 07:35	06/14/18 14:58	7440-66-6	
7471 Mercury	Analytical Method: EPA 7471B Preparation Method: EPA 7471B							
Mercury	**<68.3**	ug/kg	68.3	1	06/07/18 10:46	06/08/18 09:22	7439-97-6	
8270C MSSV Solid	Analytical Method: EPA 8270C Preparation Method: EPA 3550C							
Acenaphthene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	83-32-9	
Acenaphthylene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	208-96-8	
Anthracene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	120-12-7	
Benzo(a)anthracene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	56-55-3	

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ANALYTICAL RESULTS

Project: Sediment Sampling
Pace Project No.: 4613112

Sample: SITE 6 **Lab ID: 4613112002** Collected: 06/01/18 13:20 Received: 06/06/18 08:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

8270C MSSV Solid Analytical Method: EPA 8270C Preparation Method: EPA 3550C

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Benzo(a)pyrene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	50-32-8	
Benzo(b)fluoranthene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	205-99-2	
Benzo(g,h,i)perylene	**<452**	ug/kg	452	10	06/11/18 08:40	06/18/18 18:26	191-24-2	
Benzo(k)fluoranthene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	207-08-9	
4-Bromophenylphenyl ether	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	101-55-3	
Butylbenzylphthalate	**<452**	ug/kg	452	10	06/11/18 08:40	06/18/18 18:26	85-68-7	
Carbazole	**<2330**	ug/kg	2330	10	06/11/18 08:40	06/18/18 18:26	86-74-8	
4-Chloro-3-methylphenol	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	59-50-7	
bis(2-Chloroethoxy)methane	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	111-91-1	
bis(2-Chloroethyl) ether	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	111-44-4	
bis(2-Chloroisopropyl) ether	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	108-60-1	
2-Chloronaphthalene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	91-58-7	
2-Chlorophenol	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	95-57-8	
4-Chlorophenylphenyl ether	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	7005-72-3	
Chrysene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	218-01-9	
Dibenz(a,h)anthracene	**<452**	ug/kg	452	10	06/11/18 08:40	06/18/18 18:26	53-70-3	
Dibenzofuran	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	132-64-9	
1,2-Dichlorobenzene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	95-50-1	
1,3-Dichlorobenzene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	541-73-1	
1,4-Dichlorobenzene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	106-46-7	
2,4-Dichlorophenol	**<452**	ug/kg	452	10	06/11/18 08:40	06/18/18 18:26	120-83-2	
Diethylphthalate	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	84-66-2	
2,4-Dimethylphenol	**<2330**	ug/kg	2330	10	06/11/18 08:40	06/18/18 18:26	105-67-9	
Dimethylphthalate	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	131-11-3	
Di-n-butylphthalate	**<918**	ug/kg	918	10	06/11/18 08:40	06/18/18 18:26	84-74-2	
4,6-Dinitro-2-methylphenol	**<2330**	ug/kg	2330	10	06/11/18 08:40	06/18/18 18:26	534-52-1	
2,4-Dinitrophenol	**<2330**	ug/kg	2330	10	06/11/18 08:40	06/18/18 18:26	51-28-5	L1
2,4-Dinitrotoluene	**<452**	ug/kg	452	10	06/11/18 08:40	06/18/18 18:26	121-14-2	
2,6-Dinitrotoluene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	606-20-2	
Di-n-octylphthalate	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	117-84-0	
1,2-Diphenylhydrazine	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	122-66-7	
bis(2-Ethylhexyl)phthalate	**<452**	ug/kg	452	10	06/11/18 08:40	06/18/18 18:26	117-81-7	
Fluoranthene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	206-44-0	
Fluorene	**<452**	ug/kg	452	10	06/11/18 08:40	06/18/18 18:26	86-73-7	
Hexachloro-1,3-butadiene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	87-68-3	
Hexachlorobenzene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	118-74-1	
Hexachlorocyclopentadiene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	77-47-4	
Hexachloroethane	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	67-72-1	
Indeno(1,2,3-cd)pyrene	**<452**	ug/kg	452	10	06/11/18 08:40	06/18/18 18:26	193-39-5	
Isophorone	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	78-59-1	
2-Methylnaphthalene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	91-57-6	
2-Methylphenol(o-Cresol)	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	95-48-7	
3&4-Methylphenol(m&p Cresol)	**<466**	ug/kg	466	10	06/11/18 08:40	06/18/18 18:26		
Naphthalene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	91-20-3	
2-Nitroaniline	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	88-74-4	
3-Nitroaniline	**<4520**	ug/kg	4520	10	06/11/18 08:40	06/18/18 18:26	99-09-2	

ANALYTICAL RESULTS

Project: Sediment Sampling
Pace Project No.: 4613112

Sample: SITE 6 **Lab ID: 4613112002** Collected: 06/01/18 13:20 Received: 06/06/18 08:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8270C MSSV Solid	Analytical Method: EPA 8270C Preparation Method: EPA 3550C							
4-Nitroaniline	**<4520**	ug/kg	4520	10	06/11/18 08:40	06/18/18 18:26	100-01-6	
Nitrobenzene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	98-95-3	
2-Nitrophenol	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	88-75-5	
4-Nitrophenol	**<9180**	ug/kg	9180	10	06/11/18 08:40	06/18/18 18:26	100-02-7	
N-Nitrosodimethylamine	**<452**	ug/kg	452	10	06/11/18 08:40	06/18/18 18:26	62-75-9	
N-Nitroso-di-n-propylamine	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	621-64-7	
N-Nitrosodiphenylamine	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	86-30-6	
Pentachlorophenol	**<452**	ug/kg	452	10	06/11/18 08:40	06/18/18 18:26	87-86-5	
Phenanthrene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	85-01-8	
Phenol	**<2330**	ug/kg	2330	10	06/11/18 08:40	06/18/18 18:26	108-95-2	ED
Pyrene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	129-00-0	
1,2,4-Trichlorobenzene	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	120-82-1	
2,4,5-Trichlorophenol	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	95-95-4	
2,4,6-Trichlorophenol	**<233**	ug/kg	233	10	06/11/18 08:40	06/18/18 18:26	88-06-2	
Surrogates								
Nitrobenzene-d5 (S)	46	%.	33-131	10	06/11/18 08:40	06/18/18 18:26	4165-60-0	
2-Fluorobiphenyl (S)	52	%.	46-122	10	06/11/18 08:40	06/18/18 18:26	321-60-8	
o-Terphenyl (S)	61	%.	20-155	10	06/11/18 08:40	06/18/18 18:26	84-15-1	
Phenol-d6 (S)	51	%.	30-115	10	06/11/18 08:40	06/18/18 18:26	13127-88-3	
2-Fluorophenol (S)	51	%.	33-113	10	06/11/18 08:40	06/18/18 18:26	367-12-4	
2,4,6-Tribromophenol (S)	56	%.	12-124	10	06/11/18 08:40	06/18/18 18:26	118-79-6	
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B Preparation Method: EPA 5035A							
Acetone	**<1040**	ug/kg	1040	1	06/13/18 12:00	06/13/18 18:09	67-64-1	
Acrylonitrile	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	107-13-1	
tert-Amylmethyl ether	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	994-05-8	
Benzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	71-43-2	
Bromobenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	108-86-1	
Bromochloromethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	74-97-5	
Bromodichloromethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	75-27-4	
Bromoform	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	75-25-2	
Bromomethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	74-83-9	
2-Butanone (MEK)	**<3460**	ug/kg	3460	1	06/13/18 12:00	06/13/18 18:09	78-93-3	
tert-Butyl Alcohol	**<3460**	ug/kg	3460	1	06/13/18 12:00	06/13/18 18:09	75-65-0	
n-Butylbenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	104-51-8	
sec-Butylbenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	135-98-8	
tert-Butylbenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	98-06-6	
Carbon disulfide	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	75-15-0	
Carbon tetrachloride	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	56-23-5	
Chlorobenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	108-90-7	
Chloroethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	75-00-3	
Chloroform	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	67-66-3	
Chloromethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	74-87-3	
Cyclohexane	**<3460**	ug/kg	3460	1	06/13/18 12:00	06/13/18 18:09	110-82-7	
1,2-Dibromo-3-chloropropane	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	96-12-8	
Dibromochloromethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	124-48-1	

ANALYTICAL RESULTS

Project: Sediment Sampling
Pace Project No.: 4613112

Sample: SITE 6 **Lab ID: 4613112002** Collected: 06/01/18 13:20 Received: 06/06/18 08:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B Preparation Method: EPA 5035A							
1,2-Dibromoethane (EDB)	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	106-93-4	
Dibromomethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	74-95-3	
1,2-Dichlorobenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	95-50-1	
1,3-Dichlorobenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	541-73-1	
1,4-Dichlorobenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	106-46-7	
trans-1,4-Dichloro-2-butene	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	110-57-6	
Dichlorodifluoromethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	75-71-8	
1,1-Dichloroethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	75-34-3	
1,2-Dichloroethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	107-06-2	
1,1-Dichloroethene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	75-35-4	
cis-1,2-Dichloroethene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	156-59-2	
trans-1,2-Dichloroethene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	156-60-5	
1,2-Dichloropropane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	78-87-5	
cis-1,3-Dichloropropene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	10061-01-5	
trans-1,3-Dichloropropene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	10061-02-6	
Diethyl ether (Ethyl ether)	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	60-29-7	
Diisopropyl ether	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	108-20-3	
Ethylbenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	100-41-4	
Ethyl-tert-butyl ether	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	637-92-3	
Hexachloroethane	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	67-72-1	
2-Hexanone	**<3460**	ug/kg	3460	1	06/13/18 12:00	06/13/18 18:09	591-78-6	
Iodomethane	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	74-88-4	
Isopropylbenzene (Cumene)	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	98-82-8	
p-Isopropyltoluene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	99-87-6	
Methylene Chloride	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	75-09-2	
2-Methylnaphthalene	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	91-57-6	N2
4-Methyl-2-pentanone (MIBK)	**<3460**	ug/kg	3460	1	06/13/18 12:00	06/13/18 18:09	108-10-1	
Methyl-tert-butyl ether	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	1634-04-4	
Naphthalene	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	91-20-3	
n-Propylbenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	103-65-1	
Styrene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	100-42-5	
1,1,1,2-Tetrachloroethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	630-20-6	
1,1,2,2-Tetrachloroethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	79-34-5	
Tetrachloroethene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	127-18-4	
Tetrahydrofuran	**<346**	ug/kg	346	1	06/13/18 12:00	06/13/18 18:09	109-99-9	
Toluene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	108-88-3	
1,2,3-Trichlorobenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	87-61-6	
1,2,4-Trichlorobenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	120-82-1	
1,1,1-Trichloroethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	71-55-6	
1,1,2-Trichloroethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	79-00-5	
Trichloroethene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	79-01-6	
Trichlorofluoromethane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	75-69-4	
1,2,3-Trichloropropane	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	96-18-4	
1,2,3-Trimethylbenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	526-73-8	
1,2,4-Trimethylbenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	95-63-6	
1,3,5-Trimethylbenzene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	108-67-8	

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ANALYTICAL RESULTS

Project: Sediment Sampling
Pace Project No.: 4613112

Sample: SITE 6 **Lab ID: 4613112002** Collected: 06/01/18 13:20 Received: 06/06/18 08:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B Preparation Method: EPA 5035A							
Vinyl chloride	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	75-01-4	
m&p-Xylene	**<138**	ug/kg	138	1	06/13/18 12:00	06/13/18 18:09	179601-23-1	
o-Xylene	**<69.1**	ug/kg	69.1	1	06/13/18 12:00	06/13/18 18:09	95-47-6	
Surrogates								
Dibromofluoromethane (S)	93	%.	75-123	1	06/13/18 12:00	06/13/18 18:09	1868-53-7	
Toluene-d8 (S)	99	%.	85-113	1	06/13/18 12:00	06/13/18 18:09	2037-26-5	
4-Bromofluorobenzene (S)	96	%.	81-117	1	06/13/18 12:00	06/13/18 18:09	460-00-4	
1,2-Dichloroethane-d4 (S)	101	%.	83-116	1	06/13/18 12:00	06/13/18 18:09	17060-07-0	
Percent Moisture	Analytical Method: SM 2540 G-11/3550							
Percent Moisture	**27.7**	%	0.10	1		06/11/18 15:00		

QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

QC Batch: 25190
QC Batch Method: EPA 7471B
Analysis Method: EPA 7471B
Analysis Description: 7471 Mercury
Associated Lab Samples: 4613112001, 4613112002

METHOD BLANK: 100973
Matrix: Solid
Associated Lab Samples: 4613112001, 4613112002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Mercury	ug/kg	<48.9	48.9	06/08/18 08:44	

LABORATORY CONTROL SAMPLE: 100974

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mercury	ug/kg	319	294	92	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 100975 100976

Parameter	Units	4613165016 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mercury	ug/kg	0.015J mg/kg	331	328	298	283	85	82	80-120	5	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

QC Batch: 25417
QC Batch Method: EPA 3050B
Analysis Method: EPA 6010C
Analysis Description: 6010 MET
Associated Lab Samples: 4613112001, 4613112002

METHOD BLANK: 101970
Matrix: Solid
Associated Lab Samples: 4613112001, 4613112002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Aluminum	ug/kg	<9830	9830	06/13/18 10:08	
Calcium	ug/kg	<49100	49100	06/13/18 10:08	
Iron	ug/kg	<4910	4910	06/13/18 10:08	
Magnesium	ug/kg	<49100	49100	06/13/18 10:08	
Potassium	ug/kg	<49100	49100	06/13/18 10:08	
Sodium	ug/kg	<49100	49100	06/13/18 10:08	

LABORATORY CONTROL SAMPLE: 101971

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Aluminum	ug/kg	91700	89000	97	80-120	
Calcium	ug/kg	917000	872000	95	80-120	
Iron	ug/kg	18300	17400	95	80-120	
Magnesium	ug/kg	917000	880000	96	80-120	
Potassium	ug/kg	917000	908000	99	80-120	
Sodium	ug/kg	917000	910000	99	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 101972 101973

Parameter	Units	4612454005 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Aluminum	ug/kg	60100 mg/kg	95800	92600	83700000	53400000	24600	-7260	75-125	44	20	M1,R1
Calcium	ug/kg	<249 mg/kg	958000	926000	944000	964000	88	93	75-125	2	20	
Iron	ug/kg	28300 mg/kg	19200	18500	24200000	27400000	-21400	-4880	75-125	12	20	M1
Magnesium	ug/kg	<249 mg/kg	958000	926000	605000	763000	62	81	75-125	23	20	M1,R1
Potassium	ug/kg	120000 mg/kg	958000	926000	134000000	103000000	1460	-1920	75-125	27	20	E,M1,R1
Sodium	ug/kg	853 mg/kg	958000	926000	1840000	1680000	103	89	75-125	9	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

QC Batch: 25298
Analysis Method: EPA 6020A
QC Batch Method: EPA 3050B
Analysis Description: 6020A MET
Associated Lab Samples: 4613112001, 4613112002

METHOD BLANK: 101416
Matrix: Solid
Associated Lab Samples: 4613112001, 4613112002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Antimony	ug/kg	<93.1	93.1	06/14/18 11:04	
Arsenic	ug/kg	<93.1	93.1	06/13/18 14:44	
Barium	ug/kg	<93.1	93.1	06/13/18 14:44	
Beryllium	ug/kg	<93.1	93.1	06/13/18 14:44	
Cadmium	ug/kg	<46.6	46.6	06/13/18 14:44	
Chromium	ug/kg	<93.1	93.1	06/13/18 14:44	
Cobalt	ug/kg	<93.1	93.1	06/13/18 14:44	
Copper	ug/kg	<93.1	93.1	06/13/18 14:44	
Lead	ug/kg	<93.1	93.1	06/13/18 14:44	
Manganese	ug/kg	<93.1	93.1	06/13/18 14:44	
Nickel	ug/kg	<93.1	93.1	06/13/18 14:44	
Selenium	ug/kg	<93.1	93.1	06/13/18 14:44	
Silver	ug/kg	<46.6	46.6	06/13/18 14:44	
Thallium	ug/kg	<46.6	46.6	06/13/18 14:44	
Vanadium	ug/kg	<93.1	93.1	06/13/18 14:44	
Zinc	ug/kg	<931	931	06/14/18 14:38	

LABORATORY CONTROL SAMPLE: 101417

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Antimony	ug/kg	1930	2050	107	80-120	
Arsenic	ug/kg	1930	1990	103	80-120	
Barium	ug/kg	1930	1900	99	80-120	
Beryllium	ug/kg	1930	1870	97	80-120	
Cadmium	ug/kg	1930	1890	98	80-120	
Chromium	ug/kg	1930	2000	104	80-120	
Cobalt	ug/kg	1930	1990	103	80-120	
Copper	ug/kg	1930	1980	103	80-120	
Lead	ug/kg	1930	1980	103	80-120	
Manganese	ug/kg	1930	2010	104	80-120	
Nickel	ug/kg	1930	1980	103	80-120	
Selenium	ug/kg	1930	1910	99	80-120	
Silver	ug/kg	1930	1910	99	80-120	
Thallium	ug/kg	1930	1960	102	80-120	
Vanadium	ug/kg	1930	1990	103	80-120	
Zinc	ug/kg	1930	2150	111	80-120	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project:	Sediment Sampling
Pace Project No.:	4613112

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 101418 101419

Parameter	Units	4612634016 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic	ug/kg	1.3 mg/kg	2040	2040	4030	5550	132	206	75-125	32	20	M1,R1
Barium	ug/kg	4.8 mg/kg	2040	2040	10800	5660	292	40	75-125	63	20	M1,R1
Beryllium	ug/kg	ND	2040	2040	1640	1620	78	77	75-125	1	20	
Cadmium	ug/kg	0.48 mg/kg	2040	2040	2010	2040	75	77	75-125	2	20	
Chromium	ug/kg	1.9 mg/kg	2040	2040	4030	3720	103	88	75-125	8	20	
Cobalt	ug/kg	0.87 mg/kg	2040	2040	3110	3050	109	107	75-125	2	20	
Copper	ug/kg	2.2 mg/kg	2040	2040	4550	4650	114	119	75-125	2	20	
Lead	ug/kg	2.0 mg/kg	2040	2040	4960	119000	145	5740	75-125	184	20	E,M1,R1
Manganese	ug/kg	151 mg/kg	2040	2040	258000	145000	5230	-271	75-125	56	20	E,M1,R1
Nickel	ug/kg	4.0 mg/kg	2040	2040	6660	5690	131	84	75-125	16	20	M1
Selenium	ug/kg	0.34J mg/kg	2040	2040	2350	2360	98	99	75-125	1	20	
Silver	ug/kg	ND	2040	2040	1890	1910	92	93	75-125	1	20	
Thallium	ug/kg	0.42 mg/kg	2040	2040	2310	2470	92	101	75-125	7	20	
Vanadium	ug/kg	3.0 mg/kg	2040	2040	4150	3970	56	46	75-125	5	20	M1
Zinc	ug/kg	129 mg/kg	2040	2040	10000	9040	-5830	-5880	75-125	10	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 101420 101421

Parameter	Units	4612872016 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic	ug/kg	1.5 mg/kg	2060	2110	3560	3090	102	77	75-125	14	20	
Barium	ug/kg	12.4 mg/kg	2060	2110	14500	10700	103	-79	75-125	30	20	M1,R1
Beryllium	ug/kg	0.053J mg/kg	2060	2110	1930	1900	91	88	75-125	1	20	
Cadmium	ug/kg	0.084J mg/kg	2060	2110	2300	1960	107	89	75-125	16	20	
Chromium	ug/kg	1.5 mg/kg	2060	2110	3680	3250	106	83	75-125	12	20	
Cobalt	ug/kg	1.1 mg/kg	2060	2110	2950	2720	89	76	75-125	8	20	
Copper	ug/kg	2.5 mg/kg	2060	2110	3910	3680	70	58	75-125	6	20	M1
Lead	ug/kg	4.0 mg/kg	2060	2110	5140	4700	54	31	75-125	9	20	M1
Manganese	ug/kg	229 mg/kg	2060	2110	178000	147000	-2440	-3880	75-125	19	20	E,M1
Nickel	ug/kg	6.0 mg/kg	2060	2110	5410	5380	-29	-30	75-125	1	20	M1
Selenium	ug/kg	0.36J mg/kg	2060	2110	2260	2130	93	84	75-125	6	20	
Silver	ug/kg	0.0078J mg/kg	2060	2110	2090	1870	101	89	75-125	11	20	
Thallium	ug/kg	0.58 mg/kg	2060	2110	2650	2230	100	78	75-125	17	20	
Vanadium	ug/kg	1.6 mg/kg	2060	2110	3770	3430	108	89	75-125	9	20	
Zinc	ug/kg	19.2 mg/kg	2060	2110	44200	12100	1220	-334	75-125	114	20	E,M1,R1

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 101422 101423

Parameter	Units	4613165016 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Antimony	ug/kg	0.020J mg/kg	1960	1980	174	185	8	8	75-125	6	20	M1
Arsenic	ug/kg	3.2 mg/kg	1960	1980	5290	5530	106	117	75-125	4	20	
Barium	ug/kg	55.2 mg/kg	1960	1980	23000	16500	-1640	-1960	75-125	33	20	M1,R1
Beryllium	ug/kg	0.12J mg/kg	1960	1980	1750	1840	83	87	75-125	5	20	
Cadmium	ug/kg	0.15 mg/kg	1960	1980	2130	2540	101	121	75-125	18	20	
Chromium	ug/kg	3.0 mg/kg	1960	1980	4200	4840	59	91	75-125	14	20	M1
Cobalt	ug/kg	2.5 mg/kg	1960	1980	3640	3600	58	56	75-125	1	20	M1
Copper	ug/kg	5.9 mg/kg	1960	1980	5790	6170	-6	14	75-125	6	20	M1
Lead	ug/kg	5.7 mg/kg	1960	1980	6590	6530	47	44	75-125	1	20	M1
Manganese	ug/kg	240 mg/kg	1960	1980	336000	253000	4920	656	75-125	28	20	E,M1, R1
Nickel	ug/kg	12.0 mg/kg	1960	1980	7960	8740	-208	-167	75-125	9	20	M1
Selenium	ug/kg	0.37J mg/kg	1960	1980	2090	2140	88	90	75-125	2	20	
Silver	ug/kg	0.010J mg/kg	1960	1980	1820	1880	92	95	75-125	3	20	
Thallium	ug/kg	0.59 mg/kg	1960	1980	2790	2800	112	112	75-125	0	20	
Vanadium	ug/kg	3.9 mg/kg	1960	1980	4830	5500	45	79	75-125	13	20	M1
Zinc	ug/kg	54.8 mg/kg	1960	1980	65500	501000	548	22600	75-125	154	20	E,M1, R1

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

QC Batch: 25644
Analysis Method: EPA 8260B
QC Batch Method: EPA 5035A
Analysis Description: 8260B MSV 5035A Med Level
Associated Lab Samples: 4613112001, 4613112002

METHOD BLANK: 102905
Matrix: Solid
Associated Lab Samples: 4613112001, 4613112002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,1,1,2-Tetrachloroethane	ug/kg	<50.0	50.0	06/13/18 16:32	
1,1,1-Trichloroethane	ug/kg	<50.0	50.0	06/13/18 16:32	
1,1,2,2-Tetrachloroethane	ug/kg	<50.0	50.0	06/13/18 16:32	
1,1,2-Trichloroethane	ug/kg	<50.0	50.0	06/13/18 16:32	
1,1-Dichloroethane	ug/kg	<50.0	50.0	06/13/18 16:32	
1,1-Dichloroethene	ug/kg	<50.0	50.0	06/13/18 16:32	
1,2,3-Trichlorobenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
1,2,3-Trichloropropane	ug/kg	<50.0	50.0	06/13/18 16:32	
1,2,3-Trimethylbenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
1,2,4-Trichlorobenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
1,2,4-Trimethylbenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
1,2-Dibromo-3-chloropropane	ug/kg	<250	250	06/13/18 16:32	
1,2-Dibromoethane (EDB)	ug/kg	<50.0	50.0	06/13/18 16:32	
1,2-Dichlorobenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
1,2-Dichloroethane	ug/kg	<50.0	50.0	06/13/18 16:32	
1,2-Dichloropropane	ug/kg	<50.0	50.0	06/13/18 16:32	
1,3,5-Trimethylbenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
1,3-Dichlorobenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
1,4-Dichlorobenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
2-Butanone (MEK)	ug/kg	<2500	2500	06/13/18 16:32	
2-Hexanone	ug/kg	<2500	2500	06/13/18 16:32	
2-Methylnaphthalene	ug/kg	<250	250	06/13/18 16:32	N2
4-Methyl-2-pentanone (MIBK)	ug/kg	<2500	2500	06/13/18 16:32	
Acetone	ug/kg	<750	750	06/13/18 16:32	
Acrylonitrile	ug/kg	<250	250	06/13/18 16:32	
Benzene	ug/kg	<50.0	50.0	06/13/18 16:32	
Bromobenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
Bromochloromethane	ug/kg	<50.0	50.0	06/13/18 16:32	
Bromodichloromethane	ug/kg	<50.0	50.0	06/13/18 16:32	
Bromoform	ug/kg	<50.0	50.0	06/13/18 16:32	
Bromomethane	ug/kg	<50.0	50.0	06/13/18 16:32	
Carbon disulfide	ug/kg	<250	250	06/13/18 16:32	
Carbon tetrachloride	ug/kg	<50.0	50.0	06/13/18 16:32	
Chlorobenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
Chloroethane	ug/kg	<50.0	50.0	06/13/18 16:32	
Chloroform	ug/kg	<50.0	50.0	06/13/18 16:32	
Chloromethane	ug/kg	<50.0	50.0	06/13/18 16:32	
cis-1,2-Dichloroethene	ug/kg	<50.0	50.0	06/13/18 16:32	
cis-1,3-Dichloropropene	ug/kg	<50.0	50.0	06/13/18 16:32	
Cyclohexane	ug/kg	<2500	2500	06/13/18 16:32	
Dibromochloromethane	ug/kg	<50.0	50.0	06/13/18 16:32	

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

METHOD BLANK: 102905 Matrix: Solid
Associated Lab Samples: 4613112001, 4613112002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Dibromomethane	ug/kg	<50.0	50.0	06/13/18 16:32	
Dichlorodifluoromethane	ug/kg	<50.0	50.0	06/13/18 16:32	
Diethyl ether (Ethyl ether)	ug/kg	<50.0	50.0	06/13/18 16:32	
Diisopropyl ether	ug/kg	<250	250	06/13/18 16:32	
Ethyl-tert-butyl ether	ug/kg	<250	250	06/13/18 16:32	
Ethylbenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
Hexachloroethane	ug/kg	<250	250	06/13/18 16:32	
Iodomethane	ug/kg	<250	250	06/13/18 16:32	
Isopropylbenzene (Cumene)	ug/kg	<50.0	50.0	06/13/18 16:32	
m&p-Xylene	ug/kg	<100	100	06/13/18 16:32	
Methyl-tert-butyl ether	ug/kg	<50.0	50.0	06/13/18 16:32	
Methylene Chloride	ug/kg	<250	250	06/13/18 16:32	
n-Butylbenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
n-Propylbenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
Naphthalene	ug/kg	<250	250	06/13/18 16:32	
o-Xylene	ug/kg	<50.0	50.0	06/13/18 16:32	
p-Isopropyltoluene	ug/kg	<50.0	50.0	06/13/18 16:32	
sec-Butylbenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
Styrene	ug/kg	<50.0	50.0	06/13/18 16:32	
tert-Amylmethyl ether	ug/kg	<250	250	06/13/18 16:32	
tert-Butyl Alcohol	ug/kg	<2500	2500	06/13/18 16:32	
tert-Butylbenzene	ug/kg	<50.0	50.0	06/13/18 16:32	
Tetrachloroethene	ug/kg	<50.0	50.0	06/13/18 16:32	
Tetrahydrofuran	ug/kg	<250	250	06/13/18 16:32	
Toluene	ug/kg	<50.0	50.0	06/13/18 16:32	
trans-1,2-Dichloroethene	ug/kg	<50.0	50.0	06/13/18 16:32	
trans-1,3-Dichloropropene	ug/kg	<50.0	50.0	06/13/18 16:32	
trans-1,4-Dichloro-2-butene	ug/kg	<250	250	06/13/18 16:32	
Trichloroethene	ug/kg	<50.0	50.0	06/13/18 16:32	
Trichlorofluoromethane	ug/kg	<50.0	50.0	06/13/18 16:32	
Vinyl chloride	ug/kg	<50.0	50.0	06/13/18 16:32	
1,2-Dichloroethane-d4 (S)	%.	98	83-116	06/13/18 16:32	
4-Bromofluorobenzene (S)	%.	96	81-117	06/13/18 16:32	
Dibromofluoromethane (S)	%.	96	75-123	06/13/18 16:32	
Toluene-d8 (S)	%.	99	85-113	06/13/18 16:32	

METHOD BLANK: 103493 Matrix: Solid
Associated Lab Samples: 4613112001, 4613112002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,1,1,2-Tetrachloroethane	ug/kg	<50.0	50.0	06/14/18 13:58	
1,1,1-Trichloroethane	ug/kg	<50.0	50.0	06/14/18 13:58	
1,1,2,2-Tetrachloroethane	ug/kg	<50.0	50.0	06/14/18 13:58	

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

METHOD BLANK: 103493 Matrix: Solid

Associated Lab Samples: 4613112001, 4613112002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,1,2-Trichloroethane	ug/kg	<50.0	50.0	06/14/18 13:58	
1,1-Dichloroethane	ug/kg	<50.0	50.0	06/14/18 13:58	
1,1-Dichloroethene	ug/kg	<50.0	50.0	06/14/18 13:58	
1,2,3-Trichlorobenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
1,2,3-Trichloropropane	ug/kg	<50.0	50.0	06/14/18 13:58	
1,2,4-Trichlorobenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
1,2,4-Trimethylbenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
1,2-Dibromo-3-chloropropane	ug/kg	<250	250	06/14/18 13:58	
1,2-Dibromoethane (EDB)	ug/kg	<50.0	50.0	06/14/18 13:58	
1,2-Dichlorobenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
1,2-Dichloroethane	ug/kg	<50.0	50.0	06/14/18 13:58	
1,2-Dichloropropane	ug/kg	<50.0	50.0	06/14/18 13:58	
1,3,5-Trimethylbenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
1,3-Dichlorobenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
1,4-Dichlorobenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
2-Butanone (MEK)	ug/kg	<2500	2500	06/14/18 13:58	
2-Hexanone	ug/kg	<2500	2500	06/14/18 13:58	
2-Methylnaphthalene	ug/kg	<250	250	06/14/18 13:58	N2
4-Methyl-2-pentanone (MIBK)	ug/kg	<2500	2500	06/14/18 13:58	
Acetone	ug/kg	<750	750	06/14/18 13:58	
Acrylonitrile	ug/kg	<250	250	06/14/18 13:58	
Benzene	ug/kg	<50.0	50.0	06/14/18 13:58	
Bromobenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
Bromochloromethane	ug/kg	<50.0	50.0	06/14/18 13:58	
Bromodichloromethane	ug/kg	<50.0	50.0	06/14/18 13:58	
Bromoform	ug/kg	<50.0	50.0	06/14/18 13:58	
Bromomethane	ug/kg	<50.0	50.0	06/14/18 13:58	
Carbon disulfide	ug/kg	<250	250	06/14/18 13:58	
Carbon tetrachloride	ug/kg	<50.0	50.0	06/14/18 13:58	
Chlorobenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
Chloroethane	ug/kg	<50.0	50.0	06/14/18 13:58	
Chloroform	ug/kg	<50.0	50.0	06/14/18 13:58	
Chloromethane	ug/kg	<50.0	50.0	06/14/18 13:58	
cis-1,2-Dichloroethene	ug/kg	<50.0	50.0	06/14/18 13:58	
cis-1,3-Dichloropropene	ug/kg	<50.0	50.0	06/14/18 13:58	
Cyclohexane	ug/kg	<2500	2500	06/14/18 13:58	
Dibromochloromethane	ug/kg	<50.0	50.0	06/14/18 13:58	
Dibromomethane	ug/kg	<50.0	50.0	06/14/18 13:58	
Dichlorodifluoromethane	ug/kg	<50.0	50.0	06/14/18 13:58	
Diethyl ether (Ethyl ether)	ug/kg	<50.0	50.0	06/14/18 13:58	
Ethylbenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
Hexachloroethane	ug/kg	<250	250	06/14/18 13:58	
Iodomethane	ug/kg	<250	250	06/14/18 13:58	
Isopropylbenzene (Cumene)	ug/kg	<50.0	50.0	06/14/18 13:58	
m&p-Xylene	ug/kg	<100	100	06/14/18 13:58	

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

METHOD BLANK: 103493 Matrix: Solid
Associated Lab Samples: 4613112001, 4613112002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Methyl-tert-butyl ether	ug/kg	<50.0	50.0	06/14/18 13:58	
Methylene Chloride	ug/kg	<250	250	06/14/18 13:58	
n-Butylbenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
n-Propylbenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
Naphthalene	ug/kg	<250	250	06/14/18 13:58	
o-Xylene	ug/kg	<50.0	50.0	06/14/18 13:58	
p-Isopropyltoluene	ug/kg	<50.0	50.0	06/14/18 13:58	
sec-Butylbenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
Styrene	ug/kg	<50.0	50.0	06/14/18 13:58	
tert-Butylbenzene	ug/kg	<50.0	50.0	06/14/18 13:58	
Tetrachloroethene	ug/kg	<50.0	50.0	06/14/18 13:58	
Tetrahydrofuran	ug/kg	<250	250	06/14/18 13:58	
Toluene	ug/kg	<50.0	50.0	06/14/18 13:58	
trans-1,2-Dichloroethene	ug/kg	<50.0	50.0	06/14/18 13:58	
trans-1,3-Dichloropropene	ug/kg	<50.0	50.0	06/14/18 13:58	
trans-1,4-Dichloro-2-butene	ug/kg	<250	250	06/14/18 13:58	
Trichloroethene	ug/kg	<50.0	50.0	06/14/18 13:58	
Trichlorofluoromethane	ug/kg	<50.0	50.0	06/14/18 13:58	
Vinyl chloride	ug/kg	<50.0	50.0	06/14/18 13:58	
1,2-Dichloroethane-d4 (S)	%.	101	83-116	06/14/18 13:58	
4-Bromofluorobenzene (S)	%.	97	81-117	06/14/18 13:58	
Dibromofluoromethane (S)	%.	92	75-123	06/14/18 13:58	
Toluene-d8 (S)	%.	98	85-113	06/14/18 13:58	

LABORATORY CONTROL SAMPLE: 102906

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1,1,2-Tetrachloroethane	ug/kg	2000	1940	97	83-116	
1,1,1-Trichloroethane	ug/kg	2000	1910	96	84-121	
1,1,2,2-Tetrachloroethane	ug/kg	2000	1810	90	75-125	
1,1,2-Trichloroethane	ug/kg	2000	1930	97	85-120	
1,1-Dichloroethane	ug/kg	2000	1790	89	81-121	
1,1-Dichloroethene	ug/kg	2000	1800	90	80-121	
1,2,3-Trichlorobenzene	ug/kg	2000	1940	97	66-129	
1,2,3-Trichloropropane	ug/kg	2000	1960	98	73-125	
1,2,3-Trimethylbenzene	ug/kg	2000	2260	113	70-130	
1,2,4-Trichlorobenzene	ug/kg	2000	1910	95	66-133	
1,2,4-Trimethylbenzene	ug/kg	2000	1890	94	85-118	
1,2-Dibromo-3-chloropropane	ug/kg	2000	1640	82	51-132	
1,2-Dibromoethane (EDB)	ug/kg	2000	1980	99	81-118	
1,2-Dichlorobenzene	ug/kg	2000	1860	93	82-124	
1,2-Dichloroethane	ug/kg	2000	1830	92	82-119	
1,2-Dichloropropane	ug/kg	2000	1820	91	80-122	
1,3,5-Trimethylbenzene	ug/kg	2000	1870	93	85-119	

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

LABORATORY CONTROL SAMPLE: 102906

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,3-Dichlorobenzene	ug/kg	2000	1790	89	85-119	
1,4-Dichlorobenzene	ug/kg	2000	1830	91	85-119	
2-Butanone (MEK)	ug/kg	2000	<2500	99	68-130	
2-Hexanone	ug/kg	2000	<2500	110	63-131	
2-Methylnaphthalene	ug/kg	2000	1770	88	42-131	N2
4-Methyl-2-pentanone (MIBK)	ug/kg	2000	<2500	106	68-133	
Acetone	ug/kg	2000	2170	108	64-130	
Acrylonitrile	ug/kg	2000	1780	89	69-132	
Benzene	ug/kg	2000	1850	92	85-118	
Bromobenzene	ug/kg	2000	1840	92	89-116	
Bromochloromethane	ug/kg	2000	1840	92	81-121	
Bromodichloromethane	ug/kg	2000	2050	103	80-123	
Bromoform	ug/kg	2000	1950	98	58-128	
Bromomethane	ug/kg	2000	1810	90	57-139	
Carbon disulfide	ug/kg	2000	2060	103	65-138	
Carbon tetrachloride	ug/kg	2000	1950	98	76-125	
Chlorobenzene	ug/kg	2000	1840	92	86-114	
Chloroethane	ug/kg	2000	1880	94	76-123	
Chloroform	ug/kg	2000	1860	93	86-118	
Chloromethane	ug/kg	2000	1680	84	73-123	
cis-1,2-Dichloroethene	ug/kg	2000	1880	94	85-118	
cis-1,3-Dichloropropene	ug/kg	2000	2030	102	79-121	
Cyclohexane	ug/kg	2000	<2500	91	79-122	
Dibromochloromethane	ug/kg	2000	1810	91	72-119	
Dibromomethane	ug/kg	2000	1920	96	83-117	
Dichlorodifluoromethane	ug/kg	2000	1720	86	68-135	
Diethyl ether (Ethyl ether)	ug/kg	2000	1790	89	78-118	
Diisopropyl ether	ug/kg	2000	2360	118	70-130	
Ethyl-tert-butyl ether	ug/kg	2000	2090	104	70-130	
Ethylbenzene	ug/kg	2000	1910	95	84-116	
Hexachloroethane	ug/kg	2000	1970	99	70-122	
Iodomethane	ug/kg	2000	1840	92	47-150	
Isopropylbenzene (Cumene)	ug/kg	2000	1760	88	82-125	
m&p-Xylene	ug/kg	4000	3790	95	84-118	
Methyl-tert-butyl ether	ug/kg	4000	3760	94	81-119	
Methylene Chloride	ug/kg	2000	1740	87	78-123	
n-Butylbenzene	ug/kg	2000	1790	90	75-125	
n-Propylbenzene	ug/kg	2000	1860	93	85-121	
Naphthalene	ug/kg	2000	1740	87	53-133	
o-Xylene	ug/kg	2000	1880	94	85-115	
p-Isopropyltoluene	ug/kg	2000	1820	91	82-122	
sec-Butylbenzene	ug/kg	2000	1800	90	84-121	
Styrene	ug/kg	2000	1960	98	79-115	
tert-Amylmethyl ether	ug/kg	2000	1890	94	70-130	
tert-Butyl Alcohol	ug/kg	10000	8430	84	70-130	
tert-Butylbenzene	ug/kg	2000	1840	92	86-121	
Tetrachloroethene	ug/kg	2000	1900	95	85-116	

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QUALITY CONTROL DATA

Project:	Sediment Sampling
Pace Project No.:	4613112

LABORATORY CONTROL SAMPLE: 102906

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Tetrahydrofuran	ug/kg	2000	1900	95	62-126	
Toluene	ug/kg	2000	1890	95	86-120	
trans-1,2-Dichloroethene	ug/kg	2000	1820	91	85-117	
trans-1,3-Dichloropropene	ug/kg	2000	1930	97	73-125	
trans-1,4-Dichloro-2-butene	ug/kg	2000	1880	94	67-130	
Trichloroethene	ug/kg	2000	1860	93	83-125	
Trichlorofluoromethane	ug/kg	2000	1810	91	82-123	
Vinyl chloride	ug/kg	2000	1730	86	77-124	
1,2-Dichloroethane-d4 (S)	%.			98	83-116	
4-Bromofluorobenzene (S)	%.			100	81-117	
Dibromofluoromethane (S)	%.			101	75-123	
Toluene-d8 (S)	%.			99	85-113	

LABORATORY CONTROL SAMPLE: 103494

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1,1,2-Tetrachloroethane	ug/kg	2000	2000	100	83-116	
1,1,1-Trichloroethane	ug/kg	2000	1870	94	84-121	
1,1,2,2-Tetrachloroethane	ug/kg	2000	1910	96	75-125	
1,1,2-Trichloroethane	ug/kg	2000	1890	95	85-120	
1,1-Dichloroethane	ug/kg	2000	1840	92	81-121	
1,1-Dichloroethene	ug/kg	2000	1930	97	80-121	
1,2,3-Trichlorobenzene	ug/kg	2000	1890	94	66-129	
1,2,3-Trichloropropane	ug/kg	2000	2010	100	73-125	
1,2,4-Trichlorobenzene	ug/kg	2000	1880	94	66-133	
1,2,4-Trimethylbenzene	ug/kg	2000	1850	93	85-118	
1,2-Dibromo-3-chloropropane	ug/kg	2000	1850	92	51-132	
1,2-Dibromoethane (EDB)	ug/kg	2000	2050	102	81-118	
1,2-Dichlorobenzene	ug/kg	2000	1920	96	82-124	
1,2-Dichloroethane	ug/kg	2000	2000	100	82-119	
1,2-Dichloropropane	ug/kg	2000	1890	94	80-122	
1,3,5-Trimethylbenzene	ug/kg	2000	1890	95	85-119	
1,3-Dichlorobenzene	ug/kg	2000	1900	95	85-119	
1,4-Dichlorobenzene	ug/kg	2000	1940	97	85-119	
2-Butanone (MEK)	ug/kg	2000	<2500	94	68-130	
2-Hexanone	ug/kg	2000	<2500	102	63-131	
2-Methylnaphthalene	ug/kg	2000	1960	98	42-131	N2
4-Methyl-2-pentanone (MIBK)	ug/kg	2000	<2500	95	68-133	
Acetone	ug/kg	2000	1880	94	64-130	
Acrylonitrile	ug/kg	2000	1940	97	69-132	
Benzene	ug/kg	2000	1840	92	85-118	
Bromobenzene	ug/kg	2000	1940	97	89-116	
Bromochloromethane	ug/kg	2000	1950	98	81-121	
Bromodichloromethane	ug/kg	2000	2010	100	80-123	
Bromoform	ug/kg	2000	1770	88	58-128	

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

LABORATORY CONTROL SAMPLE: 103494

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Bromomethane	ug/kg	2000	2000	100	57-139	
Carbon disulfide	ug/kg	2000	1840	92	65-138	
Carbon tetrachloride	ug/kg	2000	1920	96	76-125	
Chlorobenzene	ug/kg	2000	1890	94	86-114	
Chloroethane	ug/kg	2000	1800	90	76-123	
Chloroform	ug/kg	2000	1910	96	86-118	
Chloromethane	ug/kg	2000	1940	97	73-123	
cis-1,2-Dichloroethene	ug/kg	2000	1870	93	85-118	
cis-1,3-Dichloropropene	ug/kg	2000	2020	101	79-121	
Cyclohexane	ug/kg	2000	<2500	95	79-122	
Dibromochloromethane	ug/kg	2000	2020	101	72-119	
Dibromomethane	ug/kg	2000	1970	98	83-117	
Dichlorodifluoromethane	ug/kg	2000	1820	91	68-135	
Diethyl ether (Ethyl ether)	ug/kg	2000	1890	94	78-118	
Ethylbenzene	ug/kg	2000	1850	92	84-116	
Hexachloroethane	ug/kg	2000	2050	103	70-122	
Iodomethane	ug/kg	2000	2090	104	47-150	
Isopropylbenzene (Cumene)	ug/kg	2000	1880	94	82-125	
m&p-Xylene	ug/kg	4000	3680	92	84-118	
Methyl-tert-butyl ether	ug/kg	2000	1900	95	81-119	
Methylene Chloride	ug/kg	2000	1870	93	78-123	
n-Butylbenzene	ug/kg	2000	1900	95	75-125	
n-Propylbenzene	ug/kg	2000	1890	95	85-121	
Naphthalene	ug/kg	2000	1980	99	53-133	
o-Xylene	ug/kg	2000	1900	95	85-115	
p-Isopropyltoluene	ug/kg	2000	1870	94	82-122	
sec-Butylbenzene	ug/kg	2000	1870	94	84-121	
Styrene	ug/kg	2000	1990	99	79-115	
tert-Butylbenzene	ug/kg	2000	1880	94	86-121	
Tetrachloroethene	ug/kg	2000	1810	91	85-116	
Tetrahydrofuran	ug/kg	2000	1810	91	62-126	
Toluene	ug/kg	2000	1940	97	86-120	
trans-1,2-Dichloroethene	ug/kg	2000	1830	92	85-117	
trans-1,3-Dichloropropene	ug/kg	2000	2010	101	73-125	
trans-1,4-Dichloro-2-butene	ug/kg	2000	1810	90	67-130	
Trichloroethene	ug/kg	2000	1900	95	83-125	
Trichlorofluoromethane	ug/kg	2000	1800	90	82-123	
Vinyl chloride	ug/kg	2000	1840	92	77-124	
1,2-Dichloroethane-d4 (S)	%.			104	83-116	
4-Bromofluorobenzene (S)	%.			100	81-117	
Dibromofluoromethane (S)	%.			102	75-123	
Toluene-d8 (S)	%.			101	85-113	

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 103177 103178

Parameter	Units	4613209001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1,1,1,2-Tetrachloroethane	ug/kg	ND	2320	2320	2240	2320	97	100	82-116	4	10	
1,1,1-Trichloroethane	ug/kg	ND	2320	2320	2210	2340	95	101	84-126	5	9	
1,1,2,2-Tetrachloroethane	ug/kg	ND	2320	2320	2220	2240	96	97	64-122	1	14	
1,1,2-Trichloroethane	ug/kg	ND	2320	2320	2270	2360	98	102	81-124	4	8	
1,1-Dichloroethane	ug/kg	ND	2320	2320	2150	2250	93	97	85-127	4	9	
1,1-Dichloroethene	ug/kg	ND	2320	2320	2140	2220	92	96	81-135	4	11	
1,2,3-Trichlorobenzene	ug/kg	ND	2320	2320	2360	2430	102	105	77-126	3	16	
1,2,3-Trichloropropane	ug/kg	ND	2320	2320	2310	2410	100	104	69-114	4	14	
1,2,3-Trimethylbenzene	ug/kg				2150	2220				3	20	
1,2,4-Trichlorobenzene	ug/kg	ND	2320	2320	2330	2430	100	104	76-131	4	11	
1,2,4-Trimethylbenzene	ug/kg	ND	2320	2320	2230	2300	96	99	79-114	3	11	
1,2-Dibromo-3-chloropropane	ug/kg	ND	2320	2320	2020	2060	87	89	69-125	2	11	
1,2-Dibromoethane (EDB)	ug/kg	ND	2320	2320	2310	2380	100	103	72-124	3	11	
1,2-Dichlorobenzene	ug/kg	ND	2320	2320	2220	2290	96	99	85-121	3	10	
1,2-Dichloroethane	ug/kg	ND	2320	2320	2250	2270	97	98	82-125	1	8	
1,2-Dichloropropane	ug/kg	ND	2320	2320	2240	2290	97	99	78-132	2	11	
1,3,5-Trimethylbenzene	ug/kg	ND	2320	2320	2170	2240	94	96	83-112	3	12	
1,3-Dichlorobenzene	ug/kg	ND	2320	2320	2110	2230	91	96	86-116	6	8	
1,4-Dichlorobenzene	ug/kg	ND	2320	2320	2120	2240	91	97	87-115	5	9	
2-Butanone (MEK)	ug/kg	ND	2320	2320	<2900	<2900	94	94	49-152		16	
2-Hexanone	ug/kg	ND	2320	2320	<2900	<2900	107	107	49-135		16	
2-Methylnaphthalene	ug/kg	ND	2320	2320	2890	2690	123	114	45-130	7	23	N2
4-Methyl-2-pentanone (MIBK)	ug/kg	ND	2320	2320	<2900	<2900	105	109	60-134		17	
Acetone	ug/kg	ND	2320	2320	2370	2390	96	97	56-144	1	18	
Acrylonitrile	ug/kg	ND	2320	2320	2290	2360	99	102	67-136	3	15	
Benzene	ug/kg	ND	2320	2320	2180	2240	94	97	85-125	3	9	
Bromobenzene	ug/kg	ND	2320	2320	2160	2260	93	97	82-115	5	11	
Bromochloromethane	ug/kg	ND	2320	2320	2180	2210	94	95	85-126	2	10	
Bromodichloromethane	ug/kg	ND	2320	2320	2210	2360	95	102	78-124	7	9	
Bromoform	ug/kg	ND	2320	2320	2170	2250	93	97	75-118	4	11	
Bromomethane	ug/kg	ND	2320	2320	2150	2270	93	98	70-135	5	24	
Carbon disulfide	ug/kg	ND	2320	2320	1900	2010	82	87	45-108	5	21	
Carbon tetrachloride	ug/kg	ND	2320	2320	2190	2320	94	100	71-130	6	14	
Chlorobenzene	ug/kg	ND	2320	2320	2170	2260	93	98	86-118	4	11	
Chloroethane	ug/kg	ND	2320	2320	2290	2410	99	104	32-136	5	21	
Chloroform	ug/kg	ND	2320	2320	2190	2250	95	97	86-126	2	7	
Chloromethane	ug/kg	ND	2320	2320	2020	2180	86	93	70-142	8	15	
cis-1,2-Dichloroethene	ug/kg	ND	2320	2320	2210	2290	95	99	88-125	4	9	
cis-1,3-Dichloropropene	ug/kg	ND	2320	2320	2230	2330	96	100	70-124	4	10	
Cyclohexane	ug/kg	ND	2320	2320	<2900	<2900	95	101	72-135		11	
Dibromochloromethane	ug/kg	ND	2320	2320	1940	2060	84	89	57-121	6	12	
Dibromomethane	ug/kg	ND	2320	2320	2290	2390	99	103	86-119	4	7	
Dichlorodifluoromethane	ug/kg	ND	2320	2320	2060	2350	89	102	65-133	13	12	R1
Diethyl ether (Ethyl ether)	ug/kg	ND	2320	2320	2190	2260	94	98	71-131	3	9	

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 103177 103178

Parameter	Units	4613209001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Diisopropyl ether	ug/kg				2640	2700				2	40	
Ethyl-tert-butyl ether	ug/kg				2330	2400				3	20	
Ethylbenzene	ug/kg	ND	2320	2320	2180	2320	94	100	80-122	6	10	
Hexachloroethane	ug/kg	ND	2320	2320	2040	2310	88	100	81-117	12	11	R1
Iodomethane	ug/kg	ND	2320	2320	1930	2060	83	89	63-158	6	28	
Isopropylbenzene (Cumene)	ug/kg	ND	2320	2320	2170	2240	94	96	84-120	3	9	
m&p-Xylene	ug/kg	ND	4630	4630	4390	4600	95	99	77-128	5	10	
Methyl-tert-butyl ether	ug/kg	ND	4630	4630	4490	4610	97	99	63-134	3	11	
Methylene Chloride	ug/kg	ND	2320	2320	2180	2230	93	95	78-139	3	9	
n-Butylbenzene	ug/kg	ND	2320	2320	2160	2240	93	96	71-122	4	12	
n-Propylbenzene	ug/kg	ND	2320	2320	2180	2290	94	99	73-124	5	8	
Naphthalene	ug/kg	ND	2320	2320	2350	2330	101	101	67-119	1	15	
o-Xylene	ug/kg	ND	2320	2320	2250	2330	97	100	83-121	3	9	
p-Isopropyltoluene	ug/kg	ND	2320	2320	2150	2230	93	96	82-116	4	13	
sec-Butylbenzene	ug/kg	ND	2320	2320	2160	2260	93	97	84-117	4	10	
Styrene	ug/kg	ND	2320	2320	2300	2370	99	102	80-117	3	10	
tert-Amylmethyl ether	ug/kg				2160	2220				2	30	
tert-Butyl Alcohol	ug/kg				9640	9880				2	40	
tert-Butylbenzene	ug/kg	ND	2320	2320	2150	2270	93	98	84-118	6	12	
Tetrachloroethene	ug/kg	ND	2320	2320	2120	2200	92	95	74-130	3	11	
Tetrahydrofuran	ug/kg	ND	2320	2320	2320	2390	100	103	45-135	3	16	
Toluene	ug/kg	ND	2320	2320	2190	2290	95	99	81-128	4	10	
trans-1,2-Dichloroethene	ug/kg	ND	2320	2320	2190	2260	94	97	81-135	3	10	
trans-1,3-Dichloropropene	ug/kg	ND	2320	2320	2260	2350	97	101	63-122	4	9	
trans-1,4-Dichloro-2-butene	ug/kg	ND	2320	2320	2200	2200	95	95	44-118	0	10	
Trichloroethene	ug/kg	ND	2320	2320	2210	2280	95	98	90-130	3	12	
Trichlorofluoromethane	ug/kg	ND	2320	2320	2210	2320	96	100	50-155	4	13	
Vinyl chloride	ug/kg	ND	2320	2320	2160	2310	93	100	63-148	7	11	
1,2-Dichloroethane-d4 (S)	%.						99	100	83-116			
4-Bromofluorobenzene (S)	%.						101	103	81-117			
Dibromofluoromethane (S)	%.						99	103	75-123			
Toluene-d8 (S)	%.						102	101	85-113			

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

QC Batch: 25441
QC Batch Method: EPA 3545A
Analysis Method: EPA 8082A
Analysis Description: 8082A GCS PCB
Associated Lab Samples: 4613112001, 4613112002

METHOD BLANK: 102049
Matrix: Solid
Associated Lab Samples: 4613112001, 4613112002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
PCB-1016 (Aroclor 1016)	ug/kg	<33.0	33.0	06/13/18 14:19	
PCB-1221 (Aroclor 1221)	ug/kg	<33.0	33.0	06/13/18 14:19	
PCB-1232 (Aroclor 1232)	ug/kg	<33.0	33.0	06/13/18 14:19	
PCB-1242 (Aroclor 1242)	ug/kg	<33.0	33.0	06/13/18 14:19	
PCB-1248 (Aroclor 1248)	ug/kg	<33.0	33.0	06/13/18 14:19	
PCB-1254 (Aroclor 1254)	ug/kg	<33.0	33.0	06/13/18 14:19	
PCB-1260 (Aroclor 1260)	ug/kg	<33.0	33.0	06/13/18 14:19	
Decachlorobiphenyl (S)	%.	85	45-135	06/13/18 14:19	
Tetrachloro-m-xylene (S)	%.	95	56-123	06/13/18 14:19	

LABORATORY CONTROL SAMPLE: 102050

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
PCB-1016 (Aroclor 1016)	ug/kg	200	169	85	68-129	
PCB-1260 (Aroclor 1260)	ug/kg	200	172	86	60-140	
Decachlorobiphenyl (S)	%.			73	45-135	
Tetrachloro-m-xylene (S)	%.			83	56-123	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 102051 102052

Parameter	Units	4613112001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
PCB-1016 (Aroclor 1016)	ug/kg	<48.9	297	291	257	236	87	81	49-128	9	30	
PCB-1260 (Aroclor 1260)	ug/kg	<48.9	297	291	258	237	87	81	48-138	9	30	
Decachlorobiphenyl (S)	%.						75	71	45-135			
Tetrachloro-m-xylene (S)	%.						84	77	56-123			

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

QC Batch: 25366
Analysis Method: EPA 8270C
QC Batch Method: EPA 3550C
Analysis Description: 8270C Solid MSSV
Associated Lab Samples: 4613112001, 4613112002

METHOD BLANK: 101826
Matrix: Solid
Associated Lab Samples: 4613112001, 4613112002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,2,4-Trichlorobenzene	ug/kg	<17.0	17.0	06/12/18 15:30	
1,2-Dichlorobenzene	ug/kg	<17.0	17.0	06/12/18 15:30	
1,2-Diphenylhydrazine	ug/kg	<17.0	17.0	06/12/18 15:30	
1,3-Dichlorobenzene	ug/kg	<17.0	17.0	06/12/18 15:30	
1,4-Dichlorobenzene	ug/kg	<17.0	17.0	06/12/18 15:30	
2,4,5-Trichlorophenol	ug/kg	<17.0	17.0	06/12/18 15:30	
2,4,6-Trichlorophenol	ug/kg	<17.0	17.0	06/12/18 15:30	
2,4-Dichlorophenol	ug/kg	<33.0	33.0	06/12/18 15:30	
2,4-Dimethylphenol	ug/kg	<170	170	06/12/18 15:30	
2,4-Dinitrophenol	ug/kg	<170	170	06/12/18 15:30	
2,4-Dinitrotoluene	ug/kg	<33.0	33.0	06/12/18 15:30	
2,6-Dinitrotoluene	ug/kg	<17.0	17.0	06/12/18 15:30	
2-Chloronaphthalene	ug/kg	<17.0	17.0	06/12/18 15:30	
2-Chlorophenol	ug/kg	<17.0	17.0	06/12/18 15:30	
2-Methylnaphthalene	ug/kg	<17.0	17.0	06/12/18 15:30	
2-Methylphenol(o-Cresol)	ug/kg	<17.0	17.0	06/12/18 15:30	
2-Nitroaniline	ug/kg	<17.0	17.0	06/18/18 09:04	
2-Nitrophenol	ug/kg	<17.0	17.0	06/12/18 15:30	
3&4-Methylphenol(m&p Cresol)	ug/kg	<34.0	34.0	06/12/18 15:30	
3-Nitroaniline	ug/kg	<330	330	06/18/18 09:04	
4,6-Dinitro-2-methylphenol	ug/kg	<170	170	06/12/18 15:30	
4-Bromophenylphenyl ether	ug/kg	<17.0	17.0	06/12/18 15:30	
4-Chloro-3-methylphenol	ug/kg	<17.0	17.0	06/12/18 15:30	
4-Chlorophenylphenyl ether	ug/kg	<17.0	17.0	06/12/18 15:30	
4-Nitroaniline	ug/kg	<330	330	06/18/18 09:04	
4-Nitrophenol	ug/kg	<670	670	06/12/18 15:30	
Acenaphthene	ug/kg	<17.0	17.0	06/12/18 15:30	
Acenaphthylene	ug/kg	<17.0	17.0	06/12/18 15:30	
Anthracene	ug/kg	<17.0	17.0	06/12/18 15:30	
Benzo(a)anthracene	ug/kg	<17.0	17.0	06/12/18 15:30	
Benzo(a)pyrene	ug/kg	<17.0	17.0	06/12/18 15:30	
Benzo(b)fluoranthene	ug/kg	<17.0	17.0	06/12/18 15:30	
Benzo(g,h,i)perylene	ug/kg	<33.0	33.0	06/12/18 15:30	
Benzo(k)fluoranthene	ug/kg	<17.0	17.0	06/12/18 15:30	
bis(2-Chloroethoxy)methane	ug/kg	<17.0	17.0	06/12/18 15:30	
bis(2-Chloroethyl) ether	ug/kg	<17.0	17.0	06/12/18 15:30	
bis(2-Chloroisopropyl) ether	ug/kg	<17.0	17.0	06/12/18 15:30	
bis(2-Ethylhexyl)phthalate	ug/kg	<33.0	33.0	06/12/18 15:30	
Butylbenzylphthalate	ug/kg	<33.0	33.0	06/12/18 15:30	
Carbazole	ug/kg	<170	170	06/12/18 15:30	
Chrysene	ug/kg	<17.0	17.0	06/12/18 15:30	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

METHOD BLANK: 101826 Matrix: Solid
Associated Lab Samples: 4613112001, 4613112002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Di-n-butylphthalate	ug/kg	<67.0	67.0	06/12/18 15:30	
Di-n-octylphthalate	ug/kg	<17.0	17.0	06/18/18 09:04	
Dibenz(a,h)anthracene	ug/kg	<33.0	33.0	06/12/18 15:30	
Dibenzofuran	ug/kg	<17.0	17.0	06/12/18 15:30	
Diethylphthalate	ug/kg	<17.0	17.0	06/12/18 15:30	
Dimethylphthalate	ug/kg	<17.0	17.0	06/12/18 15:30	
Fluoranthene	ug/kg	<17.0	17.0	06/12/18 15:30	
Fluorene	ug/kg	<33.0	33.0	06/12/18 15:30	
Hexachloro-1,3-butadiene	ug/kg	<17.0	17.0	06/12/18 15:30	
Hexachlorobenzene	ug/kg	<17.0	17.0	06/12/18 15:30	
Hexachlorocyclopentadiene	ug/kg	<17.0	17.0	06/12/18 15:30	
Hexachloroethane	ug/kg	<17.0	17.0	06/12/18 15:30	
Indeno(1,2,3-cd)pyrene	ug/kg	<33.0	33.0	06/12/18 15:30	
Isophorone	ug/kg	<17.0	17.0	06/12/18 15:30	
N-Nitroso-di-n-propylamine	ug/kg	<17.0	17.0	06/12/18 15:30	
N-Nitrosodimethylamine	ug/kg	<33.0	33.0	06/12/18 15:30	
N-Nitrosodiphenylamine	ug/kg	<17.0	17.0	06/12/18 15:30	
Naphthalene	ug/kg	<17.0	17.0	06/12/18 15:30	
Nitrobenzene	ug/kg	<17.0	17.0	06/12/18 15:30	
Pentachlorophenol	ug/kg	<33.0	33.0	06/18/18 09:04	
Phenanthrene	ug/kg	<17.0	17.0	06/12/18 15:30	
Phenol	ug/kg	<170	170	06/12/18 15:30	
Pyrene	ug/kg	<17.0	17.0	06/12/18 15:30	
2,4,6-Tribromophenol (S)	%.	105	12-124	06/12/18 15:30	
2-Fluorobiphenyl (S)	%.	110	46-122	06/12/18 15:30	
2-Fluorophenol (S)	%.	102	33-113	06/12/18 15:30	
Nitrobenzene-d5 (S)	%.	111	33-131	06/12/18 15:30	
o-Terphenyl (S)	%.	111	20-155	06/12/18 15:30	
Phenol-d6 (S)	%.	103	30-115	06/12/18 15:30	

LABORATORY CONTROL SAMPLE: 101827

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,2,4-Trichlorobenzene	ug/kg	333	311	93	51-110	
1,2-Dichlorobenzene	ug/kg	333	299	90	63-115	
1,2-Diphenylhydrazine	ug/kg	333	306	92	68-125	
1,3-Dichlorobenzene	ug/kg	333	300	90	54-113	
1,4-Dichlorobenzene	ug/kg	333	288	86	61-111	
2,4,5-Trichlorophenol	ug/kg	333	352	105	61-126	
2,4,6-Trichlorophenol	ug/kg	333	347	104	45-128	
2,4-Dichlorophenol	ug/kg	333	326	98	50-128	
2,4-Dimethylphenol	ug/kg	333	304	91	40-122	
2,4-Dinitrophenol	ug/kg	333	437	131	25-105	L1
2,4-Dinitrotoluene	ug/kg	333	325	97	51-128	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

LABORATORY CONTROL SAMPLE: 101827

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
2,6-Dinitrotoluene	ug/kg	333	316	95	61-119	
2-Chloronaphthalene	ug/kg	333	328	98	67-111	
2-Chlorophenol	ug/kg	333	304	91	62-118	
2-Methylnaphthalene	ug/kg	333	319	96	56-124	
2-Methylphenol(o-Cresol)	ug/kg	333	289	87	58-113	
2-Nitroaniline	ug/kg	333	290	87	63-122	
2-Nitrophenol	ug/kg	333	303	91	55-115	
3&4-Methylphenol(m&p Cresol)	ug/kg	333	302	91	47-158	
3-Nitroaniline	ug/kg	333	<330	43	19-86	
4,6-Dinitro-2-methylphenol	ug/kg	333	374	112	26-136	
4-Bromophenylphenyl ether	ug/kg	333	342	103	61-124	
4-Chloro-3-methylphenol	ug/kg	333	328	98	57-124	
4-Chlorophenylphenyl ether	ug/kg	333	316	95	62-114	
4-Nitroaniline	ug/kg	333	<330	61	26-125	
4-Nitrophenol	ug/kg	333	<670	97	36-131	
Acenaphthene	ug/kg	333	334	100	55-113	
Acenaphthylene	ug/kg	333	344	103	56-138	
Anthracene	ug/kg	333	328	98	63-134	
Benzo(a)anthracene	ug/kg	333	362	109	53-142	
Benzo(a)pyrene	ug/kg	333	311	93	54-136	
Benzo(b)fluoranthene	ug/kg	333	306	92	49-146	
Benzo(g,h,i)perylene	ug/kg	333	195	58	47-141	
Benzo(k)fluoranthene	ug/kg	333	330	99	56-136	
bis(2-Chloroethoxy)methane	ug/kg	333	287	86	57-121	
bis(2-Chloroethyl) ether	ug/kg	333	286	86	54-112	
bis(2-Chloroisopropyl) ether	ug/kg	333	262	79	62-116	
bis(2-Ethylhexyl)phthalate	ug/kg	333	355	107	50-140	
Butylbenzylphthalate	ug/kg	333	329	99	51-145	
Carbazole	ug/kg	333	346	104	76-126	
Chrysene	ug/kg	333	343	103	66-137	
Di-n-butylphthalate	ug/kg	333	344	103	65-140	
Di-n-octylphthalate	ug/kg	333	400	120	63-132	
Dibenz(a,h)anthracene	ug/kg	333	245	74	52-142	
Dibenzofuran	ug/kg	333	312	94	65-119	
Diethylphthalate	ug/kg	333	336	101	59-128	
Dimethylphthalate	ug/kg	333	327	98	66-122	
Fluoranthene	ug/kg	333	311	93	66-140	
Fluorene	ug/kg	333	325	97	60-131	
Hexachloro-1,3-butadiene	ug/kg	333	313	94	56-128	
Hexachlorobenzene	ug/kg	333	329	99	34-141	
Hexachlorocyclopentadiene	ug/kg	333	291	87	34-124	
Hexachloroethane	ug/kg	333	283	85	60-111	
Indeno(1,2,3-cd)pyrene	ug/kg	333	230	69	53-135	
Isophorone	ug/kg	333	240	72	55-127	
N-Nitroso-di-n-propylamine	ug/kg	333	298	89	48-127	
N-Nitrosodimethylamine	ug/kg	333	267	80	27-152	
N-Nitrosodiphenylamine	ug/kg	333	334	100	33-109	

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

LABORATORY CONTROL SAMPLE: 101827

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Naphthalene	ug/kg	333	320	96	52-128	
Nitrobenzene	ug/kg	333	315	95	56-109	
Pentachlorophenol	ug/kg	333	306	92	19-117	
Phenanthrene	ug/kg	333	321	96	58-134	
Phenol	ug/kg	333	291	87	53-120	
Pyrene	ug/kg	333	294	88	60-132	
2,4,6-Tribromophenol (S)	%.			101	12-124	
2-Fluorobiphenyl (S)	%.			104	46-122	
2-Fluorophenol (S)	%.			101	33-113	
Nitrobenzene-d5 (S)	%.			107	33-131	
o-Terphenyl (S)	%.			105	20-155	
Phenol-d6 (S)	%.			100	30-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 101828 101829

Parameter	Units	4613112001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1,2,4-Trichlorobenzene	ug/kg	<251	498	495	417	375	84	76	44-111	11	40	
1,2-Dichlorobenzene	ug/kg	<251	498	495	427	394	86	80	49-115	8	40	
1,2-Diphenylhydrazine	ug/kg	<251	498	495	423	410	85	83	57-135	3	40	
1,3-Dichlorobenzene	ug/kg	<251	498	495	413	354	83	72	39-129	15	40	
1,4-Dichlorobenzene	ug/kg	<251	498	495	423	365	85	74	36-110	15	40	
2,4,5-Trichlorophenol	ug/kg	<251	498	495	432	355	87	72	25-151	20	40	
2,4,6-Trichlorophenol	ug/kg	<251	498	495	410	393	82	79	10-159	4	40	
2,4-Dichlorophenol	ug/kg	<487	498	495	<493	<489	73	68	38-131		40	
2,4-Dimethylphenol	ug/kg	<2510	498	495	<2540	<2520	61	61	22-136		40	
2,4-Dinitrophenol	ug/kg	<2510	498	495	<2540	<2520	0	0	1-138		40	M6
2,4-Dinitrotoluene	ug/kg	<487	498	495	502	<489	101	91	28-136		40	
2,6-Dinitrotoluene	ug/kg	<251	498	495	364	336	73	68	22-156	8	40	
2-Chloronaphthalene	ug/kg	<251	498	495	433	413	87	84	42-138	5	40	
2-Chlorophenol	ug/kg	<251	498	495	446	393	90	80	25-154	13	40	
2-Methylnaphthalene	ug/kg	<251	498	495	425	389	85	79	42-130	9	40	
2-Methylphenol(o-Cresol)	ug/kg	<251	498	495	363	353	73	71	45-113	3	40	
2-Nitroaniline	ug/kg	<251	498	495	637	611	128	124	48-140	4	40	
2-Nitrophenol	ug/kg	<251	498	495	368	360	74	73	11-147	2	40	
3&4-Methylphenol(m&p Cresol)	ug/kg	<502	498	495	<508	<504	75	72	29-164		40	
3-Nitroaniline	ug/kg	<4870	498	495	<4930	<4890	131	133	4-94		40	M6
4,6-Dinitro-2-methylphenol	ug/kg	<2510	498	495	<2540	<2520	152	149	10-114		40	M6
4-Bromophenylphenyl ether	ug/kg	<251	498	495	427	407	86	82	47-139	5	40	
4-Chloro-3-methylphenol	ug/kg	<251	498	495	323	309	65	62	18-143	5	40	
4-Chlorophenylphenyl ether	ug/kg	<251	498	495	414	390	83	79	34-136	6	40	
4-Nitroaniline	ug/kg	<4870	498	495	<4930	<4890	141	146	11-115		40	M6
4-Nitrophenol	ug/kg	<9890	498	495	<10000	<9930	85	53	10-163		40	
Acenaphthene	ug/kg	<251	498	495	443	406	89	82	52-110	9	40	

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QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 101828 101829

Parameter	Units	4613112001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Acenaphthylene	ug/kg	<251	498	495	425	399	85	81	52-139	6	40	
Anthracene	ug/kg	<251	498	495	415	365	83	74	48-138	13	40	
Benzo(a)anthracene	ug/kg	<251	498	495	441	410	89	83	48-134	7	40	
Benzo(a)pyrene	ug/kg	<251	498	495	400	382	75	72	36-129	5	40	
Benzo(b)fluoranthene	ug/kg	<251	498	495	378	409	76	83	44-141	8	40	
Benzo(g,h,i)perylene	ug/kg	<487	498	495	<493	<489	33	36	36-146		40	M6
Benzo(k)fluoranthene	ug/kg	<251	498	495	446	446	90	90	44-134	0	40	
bis(2-Chloroethoxy)methane	ug/kg	<251	498	495	367	341	74	69	38-144	7	40	
bis(2-Chloroethyl) ether	ug/kg	<251	498	495	448	375	90	76	43-129	18	40	
bis(2-Chloroisopropyl) ether	ug/kg	<251	498	495	436	386	88	78	48-133	12	40	
bis(2-Ethylhexyl)phthalate	ug/kg	<487	498	495	518	525	104	106	43-148	1	40	
Butylbenzylphthalate	ug/kg	<487	498	495	514	<489	103	94	43-143		40	
Carbazole	ug/kg	<2510	498	495	<2540	<2520	92	89	34-167		40	
Chrysene	ug/kg	<251	498	495	465	422	93	85	45-143	10	40	
Di-n-butylphthalate	ug/kg	<989	498	495	<1000	<993	88	90	15-184		40	
Di-n-octylphthalate	ug/kg	<251	498	495	499	476	100	96	50-154	5	40	
Dibenz(a,h)anthracene	ug/kg	<487	498	495	<493	<489	40	35	38-149		40	M6
Dibenzofuran	ug/kg	<251	498	495	428	399	86	81	51-136	7	40	
Diethylphthalate	ug/kg	<251	498	495	420	409	84	83	43-139	3	40	
Dimethylphthalate	ug/kg	<251	498	495	365	353	73	71	50-138	3	40	
Fluoranthene	ug/kg	<251	498	495	418	394	84	80	34-140	6	40	
Fluorene	ug/kg	<487	498	495	<493	<489	90	85	49-127		40	
Hexachloro-1,3-butadiene	ug/kg	<251	498	495	420	373	84	75	47-127	12	40	
Hexachlorobenzene	ug/kg	<251	498	495	448	392	90	79	49-134	13	40	
Hexachlorocyclopentadiene	ug/kg	<251	498	495	<254	<252	23	15	1-118		40	
Hexachloroethane	ug/kg	<251	498	495	413	324	83	66	33-137	24	40	
Indeno(1,2,3-cd)pyrene	ug/kg	<487	498	495	<493	<489	38	38	31-128		40	
Isophorone	ug/kg	<251	498	495	264	<252	53	50	24-147		40	
N-Nitroso-di-n-propylamine	ug/kg	<251	498	495	352	333	71	67	41-123	6	40	
N-Nitrosodimethylamine	ug/kg	<487	498	495	<493	<489	75	80	18-135		40	
N-Nitrosodiphenylamine	ug/kg	<251	498	495	420	408	84	82	35-100	3	40	
Naphthalene	ug/kg	<251	498	495	458	413	92	84	32-138	10	40	
Nitrobenzene	ug/kg	<251	498	495	434	387	87	78	37-142	11	40	
Pentachlorophenol	ug/kg	<487	498	495	496	<489	100	95	15-129		40	
Phenanthrene	ug/kg	<251	498	495	433	423	87	86	39-134	2	40	
Phenol	ug/kg	<2510	498	495	<2540	<2520	82	74	23-140		40	
Pyrene	ug/kg	<251	498	495	452	437	91	88	39-145	4	40	
2,4,6-Tribromophenol (S)	%.						68	68	12-124			
2-Fluorobiphenyl (S)	%.						71	69	46-122			
2-Fluorophenol (S)	%.						74	67	33-113			
Nitrobenzene-d5 (S)	%.						66	60	33-131			
o-Terphenyl (S)	%.						71	70	20-155			
Phenol-d6 (S)	%.						70	66	30-115			

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sediment Sampling
Pace Project No.: 4613112

QC Batch: 25380
Analysis Method: SM 2540 G-11/3550
QC Batch Method: SM 2540 G-11/3550
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 4613112001, 4613112002

SAMPLE DUPLICATE: 101858

Parameter	Units	4613089002 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	16.7	15.7	7	20	

SAMPLE DUPLICATE: 101859

Parameter	Units	4613165016 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	4.5	3.8	16	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project:	Sediment Sampling
Pace Project No.:	4613112

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

ANALYTE QUALIFIERS

1I	Due to sample matrix-related Internal Standard failure, the sample was reanalyzed at dilution. The RL for this analyte has been elevated.
D3	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
E	Analyte concentration exceeded the calibration range. The reported result is estimated.
ED	Due to the extract's physical characteristics, the analysis was performed at dilution.
L1	Analyte recovery in the laboratory control sample (LCS) was above QC limits. Results for this analyte in associated samples may be biased high.
M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.
M6	Matrix spike and Matrix spike duplicate recovery not evaluated against control limits due to sample dilution.
N2	The lab does not hold NELAC/TNI accreditation for this parameter.
R1	RPD value was outside control limits.
S0	Surrogate recovery outside laboratory control limits.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Sediment Sampling
Pace Project No.: 4613112

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
4613112001	**SITE 3**	EPA 3545A	25441	EPA 8082A	25601
4613112002	**SITE 6**	EPA 3545A	25441	EPA 8082A	25601
4613112001	**SITE 3**	EPA 3050B	25417	EPA 6010C	25637
4613112002	**SITE 6**	EPA 3050B	25417	EPA 6010C	25637
4613112001	**SITE 3**	EPA 3050B	25298	EPA 6020A	25598
4613112002	**SITE 6**	EPA 3050B	25298	EPA 6020A	25598
4613112001	**SITE 3**	EPA 7471B	25190	EPA 7471B	25277
4613112002	**SITE 6**	EPA 7471B	25190	EPA 7471B	25277
4613112001	**SITE 3**	EPA 3550C	25366	EPA 8270C	25483
4613112002	**SITE 6**	EPA 3550C	25366	EPA 8270C	25483
4613112001	**SITE 3**	EPA 5035A	25644	EPA 8260B	25708
4613112002	**SITE 6**	EPA 5035A	25644	EPA 8260B	25708
4613112001	**SITE 3**	SM 2540 G-11/3550	25380		
4613112002	**SITE 6**	SM 2540 G-11/3550	25380		

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WO#: 4613112

4613112

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page : 1 Of 1

ecti
equ

ompany: LimnoTech
ddress: 501 Avis Drive
nn Arbor, MI 48108
mail: bbetz@limno.com
hone: (734)332-1200 Fax
equested Due Date:

nformation:
Report To: Robert Betz
Copy To:
Purchase Order #:
Project Name: Sediment Sampling
Project #:

Section C
Invoice Information:
Attention: CATHY WHITING
Company Name: LIMNOTECH
Address: 501 AVIS DR · ANN ARBOR, MI . 48108
Pace Quote:
Pace Project Manager: jennifer.rice@pacelabs.com,
Pace Profile #: 1675

Regulatory Agency

State / Location

MATRIX	CODE
Drinking Water	DW
Water	WT
Waste Water	WW
Product	P
Soil/Solid	SL
Oil	OL
Wipe	WP
Air	AR
Other	OT
Tissue	TS

SAMPLE ID
One Character per box.
(A-Z, 0-9 / , -)
Sample Ids must be unique

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED START DATE	COLLECTED START TIME	COLLECTED END DATE	COLLECTED END TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H2SO4	HNO3	HCl	NaOH	Na2S2O3	Methanol	Other	Analyses Test Y/N	Requested Analysis Filtered (Y/N): SVOC, PCB, TAL (23) Metal	VOC	Residual Chlorine (Y/N)	45-3
1	SITE3	SL	G	6/1/18	10:30				2	X									X	X		
2	SITE6	SL	G	6/1/18	13:20				2	X									X	X		
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
11																						
12																						

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
					6/6/18	0820				

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: CATHY WHITING
SIGNATURE of SAMPLER: Cathy Whiting
DATE Signed: 6/5/18

TEMP in C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLE RECEIVING / LOG-IN CHECKLIST

Pace Analytical®

Client: Limno Tech

Work Order #: 4613112

Receipt Record Page/Line #: 45-3

Recorded by (initials/date): 6/6/18

☒ Cooler
☐ Box
☐ Other______

Qty Received: 1

Thermometer Used:
☒ IR Gun (#202)
☐ Digital Thermometer (#54)
☐ IR Gun (#402)

Cooler #: Blue   Time: 0851

Custody Seals:
- ☒ None
- ☐ Present / Intact
- ☐ Present / Not Intact

Coolant Type:
- ☐ Loose Ice
- ☒ Bagged Ice
- ☐ Blue Ice
- ☐ None

Coolant Location:
Dispersed / Top / [✓ Middle] / Bottom

Temp Blank Present: ☐ Yes ☒ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1	5.6		5.6
Sample 2	4.7		4.7
Sample 3	4.8		4.8

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler #:   Time:

Custody Seals:
- ☐ None
- ☐ Present / Intact
- ☐ Present / Not Intact

Coolant Type:
- ☐ Loose Ice
- ☐ Bagged Ice
- ☐ Blue Ice
- ☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler #:   Time:

Custody Seals:
- ☐ None
- ☐ Present / Intact
- ☐ Present / Not Intact

Coolant Type:
- ☐ Loose Ice
- ☐ Bagged Ice
- ☐ Blue Ice
- ☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler #:   Time:

Custody Seals:
- ☐ None
- ☐ Present / Intact
- ☐ Present / Not Intact

Coolant Type:
- ☐ Loose Ice
- ☐ Bagged Ice
- ☐ Blue Ice
- ☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

If any shaded areas checked, complete Sample Receiving Non-Conformance

Paperwork Received

Yes	No	
☒	☐	Chain of Custody record(s)? If No, Initiated By ______
☒		Received for Lab Signed/Date/Time?
☐	☒	USDA Soil Documents?
☐	☒	Sampling / Field Forms?
☐	☒	Other ______

COC Information

☒ Pace COC ☐ Other______

COC ID Numbers:

Check COC for Accuracy

Yes	No	
☒	☐	Analysis Requested?
☒	☐	Sample ID matches COC?
☒	☐	Sample Date and Time matches COC?
☒	☐	All containers indicated are received?

Sample Condition Summary

N/A	Yes	No	
	☐	☒	Broken containers/lids?
	☐	☒	Missing or incomplete labels?
	☐	☒	Illegible information on labels?
	☐	☒	Low volume received?
	☐	☒	Inappropriate or non-Pace containers received?
☐	☐	☒	VOC vials have headspace?
	☐	☒	Extra sample locations?
	☐	☒	Containers not listed on COC?

Check Sample Preservation

N/A	Yes	No	
	☐	☒	Temperature Blank **OR** average sample temperature, ≥6° C?
☒	☐	☐	If "Yes" was thermal preservation required?
☒	☐	☐	If "Yes" were ALL samples collected the same day as receipt?
☒	☐		Completed Sample Preservation Verification Form?
☒	☐	☐	Samples chemically preserved correctly?
☒	☐		If "No", add wire tag and fill out Non-Conformance Form?
☒	☐		Received unpreserved Terracore kit?
			If "Yes" unpreserved vials must be frozen

Work Order Not Logged In with Short Hold / Rush

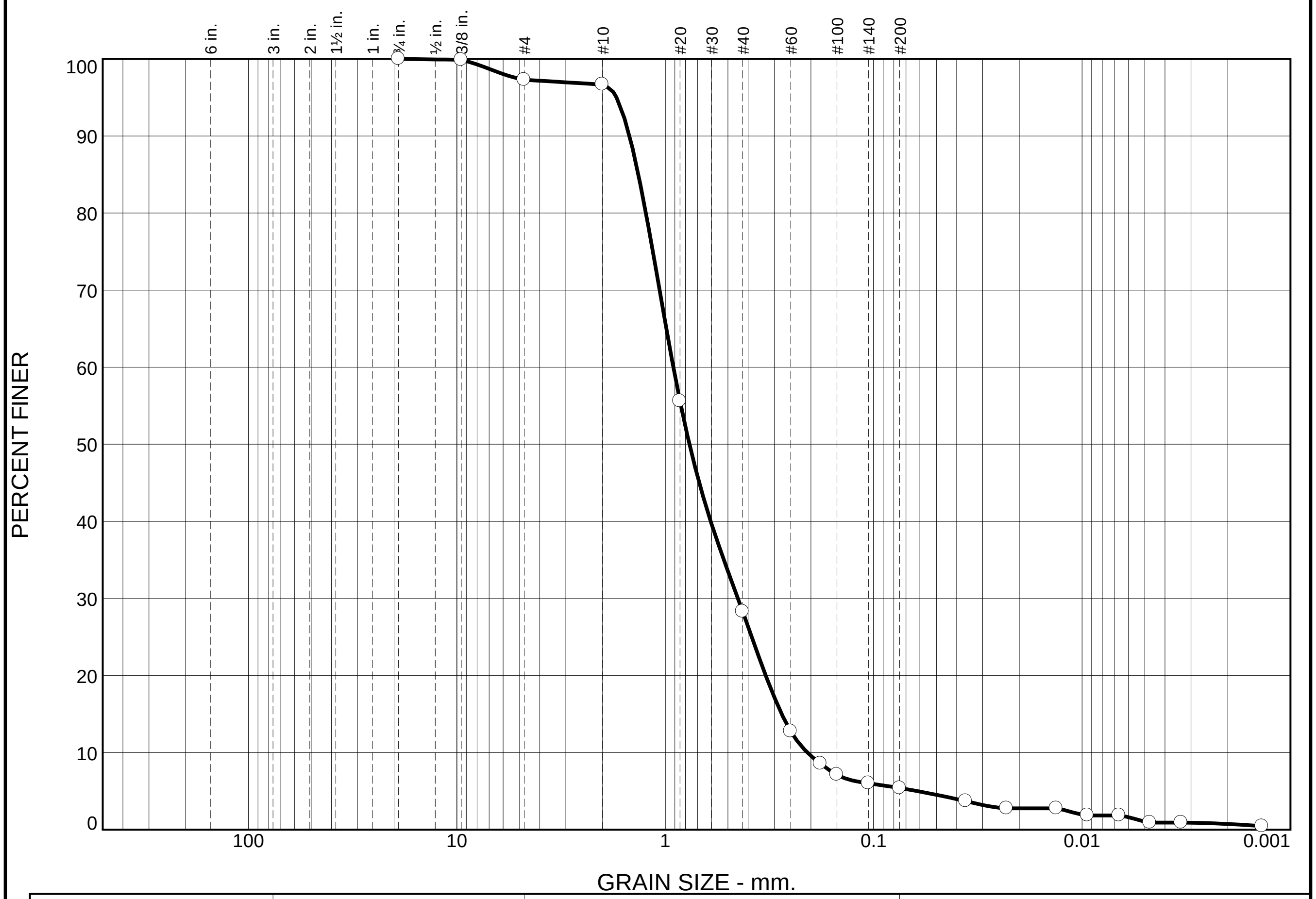
☐ Copies of COC To Lab Areas

Notes

Yes	No	
☒	☐	Were all samples logged into Epic?
☒	☐	Were all samples labelled?
☒	☐	Were samples placed on scan locations?

Initial / Date : 6/6/18

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	2.7	0.6	68.4	22.9	4.3	1.1

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.3469	0.9141	0.7655	0.4481	0.2763	0.2078	1.06	4.40

Material Description	USCS	AASHTO
○ Brown Poorly Graded Sand with Silt	SP-SM	

Project No. 181186 **Client:** LimnoTech, LTI

Project: Sugar Island

○ **Location:** Site 2, 6/1/18 at 10:14 **Sample Number:** 147863

Remarks:

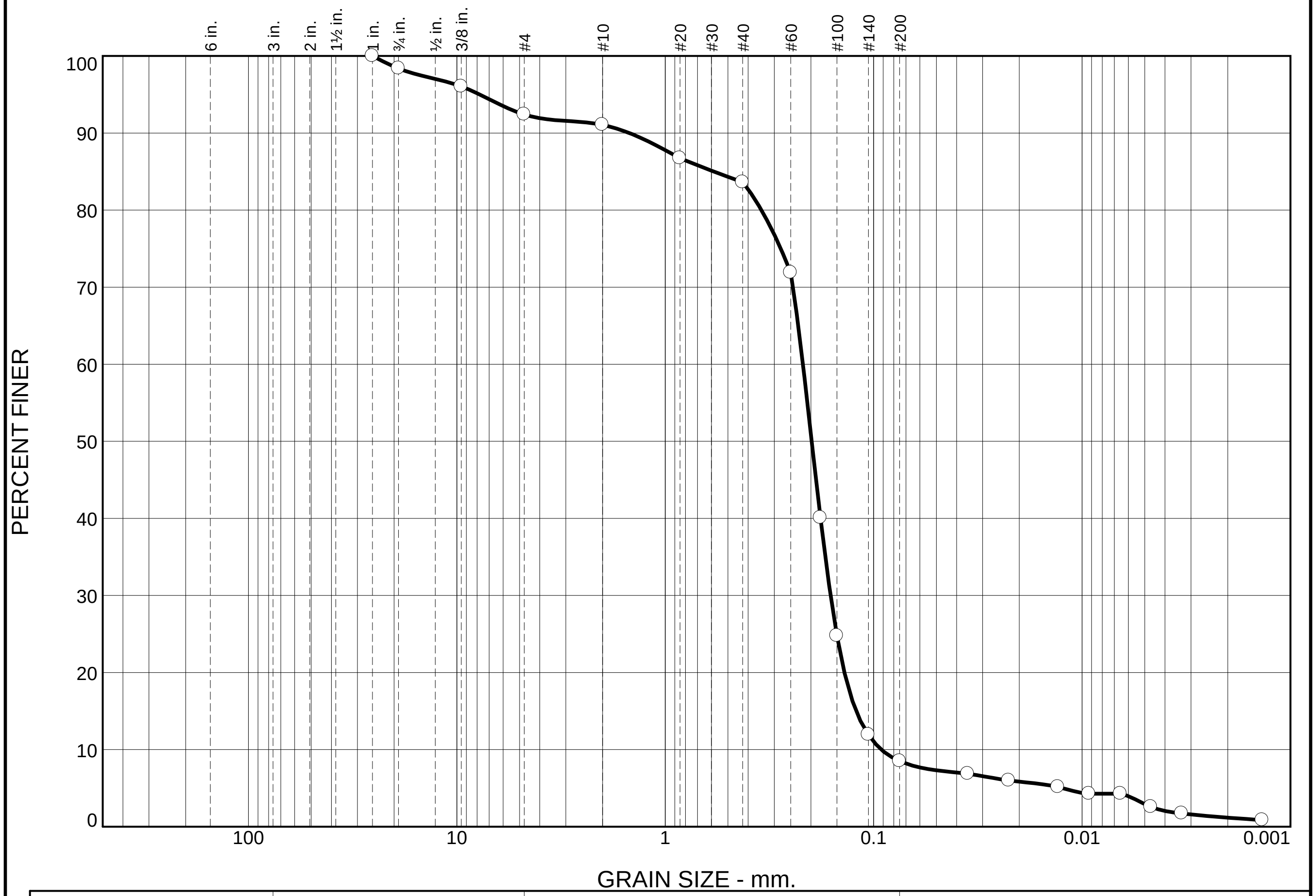
○Fines visually classified

MATERIALS TESTING CONSULTANTS, INC.

Grand Rapids, MI

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	1.6	6.0	1.3	7.5	75.1	5.6	2.9

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.5840	0.2183	0.1982	0.1610	0.1213	0.0919	1.29	2.38

Material Description	USCS	AASHTO
○ Brown Poorly Graded Sand with Silt	SP-SM	

Project No. 181186 **Client:** LimnoTech, LTI

Project: Sugar Island

○ **Location:** Site 3.1, 6/1/18 at 10:30 **Sample Number:** 147864

MATERIALS TESTING CONSULTANTS, INC.

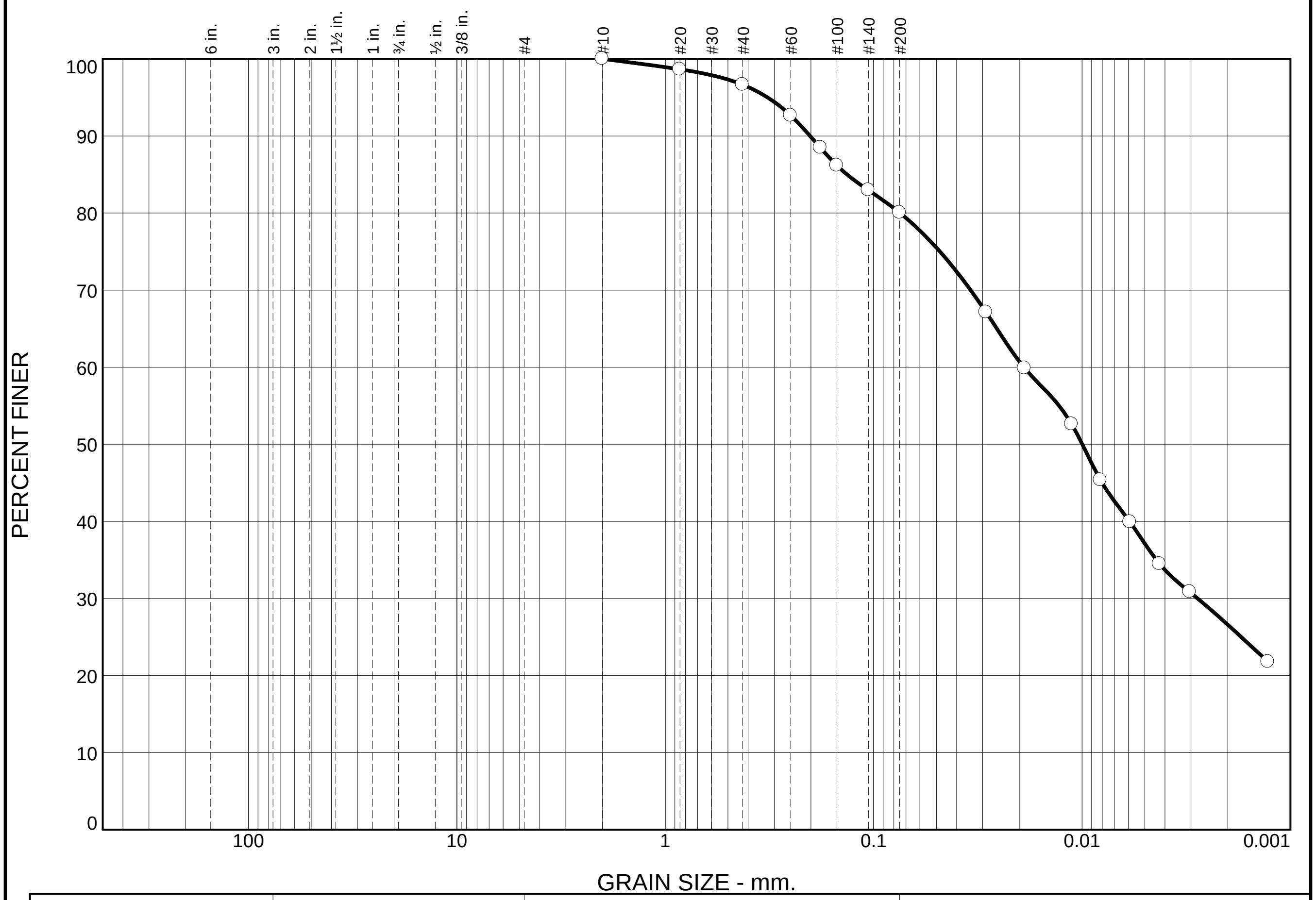
Grand Rapids, MI

Remarks:

○Fines visually classified

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	3.3	16.7	42.9	37.1

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1342	0.0190	0.0100	0.0028				

Material Description	USCS	AASHTO
○ Dark Brown Silty Clay with Sand	CL-ML	

Project No. 181186 **Client:** LimnoTech, LTI
Project: Sugar Island

○ **Location:** Site 3.2, 6/1/18 at 10:30 **Sample Number:** 147865

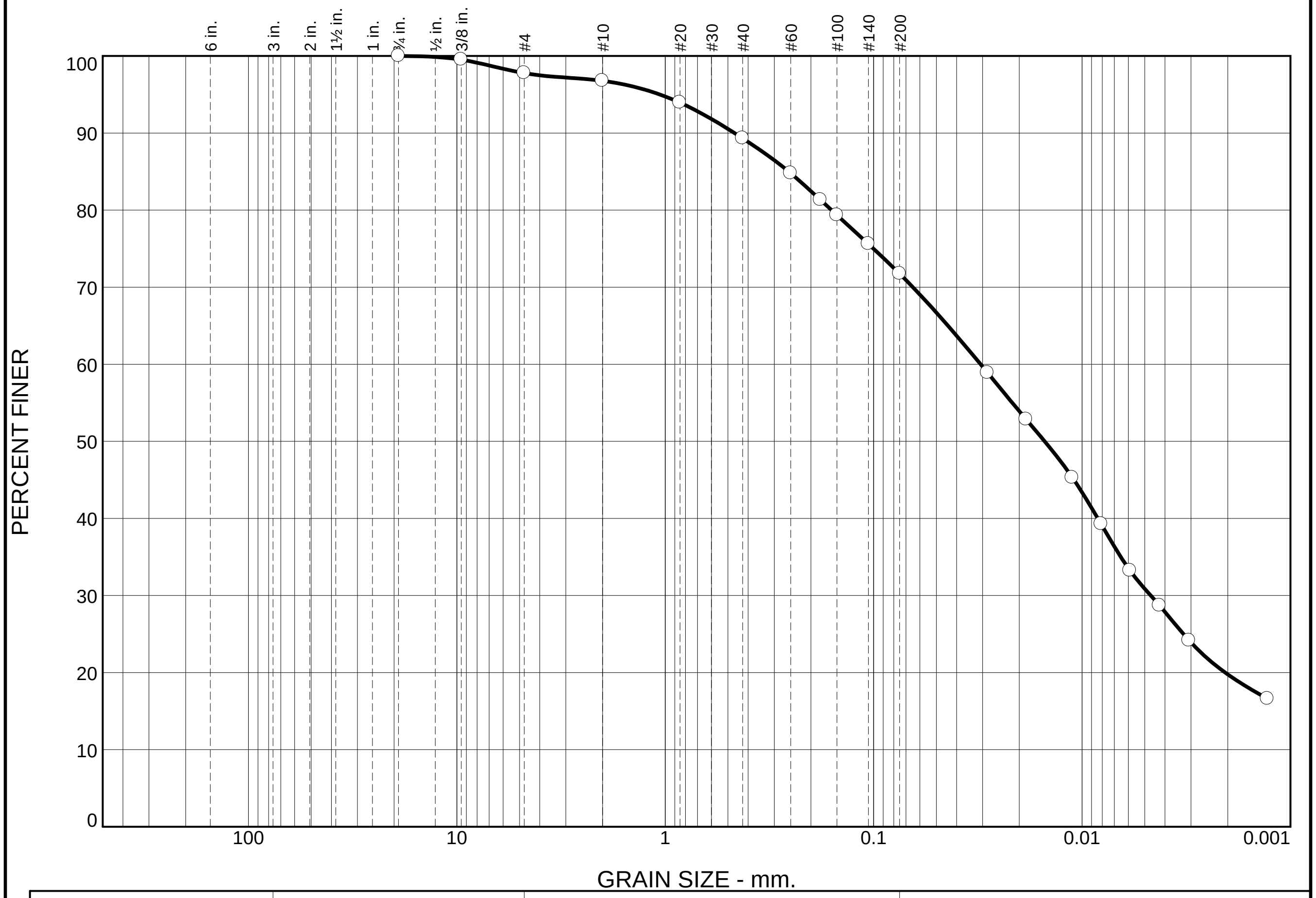
Remarks:
○Fines visually classified

MATERIALS TESTING CONSULTANTS, INC.

Grand Rapids, MI

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	2.2	1.0	7.5	17.6	40.8	30.9

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2556	0.0307	0.0151	0.0047				

Material Description	USCS	AASHTO
○ Light Brown Silty Clay with Sand	CL-ML	

Project No. 181186 **Client:** LimnoTech, LTI

Project: Sugar Island

○ **Location:** Site 4, 6/1/18 at 11:00 **Sample Number:** 147866

Remarks:

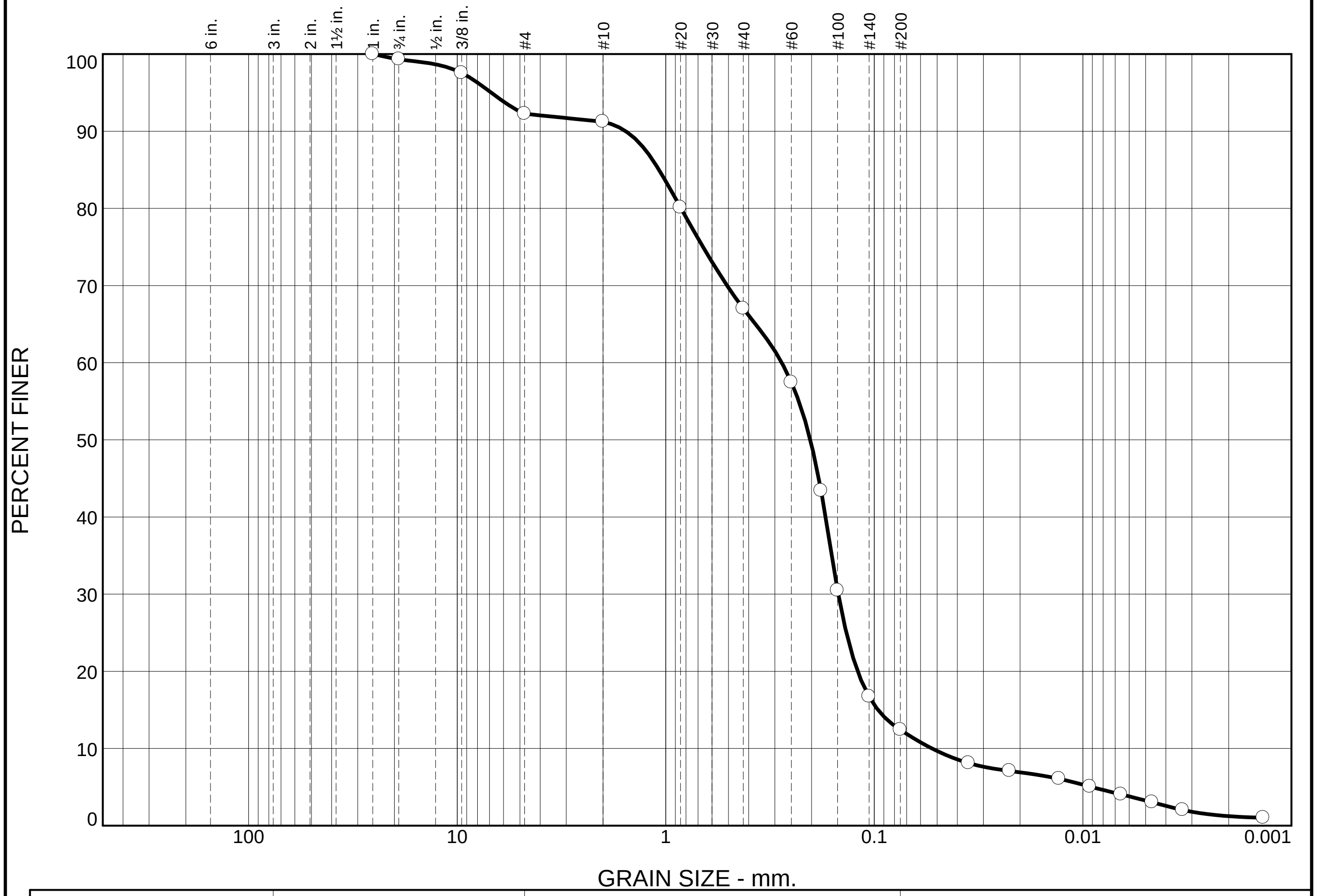
○Fines visually classified

MATERIALS TESTING CONSULTANTS, INC.

Grand Rapids, MI

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.7	7.0	1.1	24.2	54.6	9.1	3.3

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.0775	0.2780	0.2026	0.1489	0.0961	0.0529	1.51	5.25

Material Description	USCS	AASHTO
○ Light Brown Silty Sand	SM	

Project No. 181186 **Client:** LimnoTech, LTI

Project: Sugar Island

○ **Location:** Site 6, 6/1/18 at 13:20 **Sample Number:** 147867

MATERIALS TESTING CONSULTANTS, INC.

Grand Rapids, MI

Remarks:

○Fines visually classified

Figure

Pace Analytical Services, LLC
5560 Corporate Exchange Ct. SE
Grand Rapids, MI 49512
(616)975-4500

July 31, 2018

Robert Betz
LimnoTech
501 Avis Drive
Ann Arbor, MI 48108

RE: Project: Sugar Island
Pace Project No.: 4615231

Dear Robert Betz:

Enclosed are the analytical results for sample(s) received by the laboratory on July 21, 2018. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

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

Sincerely,

Melanie S Booms

Melanie Booms
melanie.booms@pacelabs.com
(616)975-4500
Project Manager

Enclosures

CERTIFICATIONS

Project:	Sugar Island
Pace Project No.:	4615231

Grand Rapids Certification ID's

5560 Corporate Exchange Ct SE, Grand Rapids, MI 49512
Minnesota Department of Health, Certificate #1385941
Arkansas Department of Environmental Quality, Certificate #18-046-0
Georgia Environmental Protection Division, Stipulation
Illinois Environmental Protection Agency, Certificate #004325
Michigan Department of Environmental Quality, Laboratory #0034
New York State Department of Health, Serial #57971 and 57972
North Carolina Division of Water Resources, Certificate #659
Virginia Department of General Services, Certificate #9780
Wisconsin Department of Natural Resources, Laboratory #999472650
U.S. Department of Agriculture Permit to Receive Soil, Permit #P330-17-00278

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SAMPLE SUMMARY

Project: Sugar Island
Pace Project No.: 4615231

Lab ID	Sample ID	Matrix	Date Collected	Date Received
4615231001	**VIB-1**	Solid	07/18/18 09:15	07/21/18 10:20

SAMPLE ANALYTE COUNT

Project: Sugar Island
Pace Project No.: 4615231

Lab ID	Sample ID	Method	Analysts	Analytes Reported
4615231001	**VIB-1**	EPA 8082A	MSZ	9
		EPA 6010C	KLV	6
		EPA 6020A	DWJ	16
		EPA 7471B	DWJ	1
		EPA 8270C	JHB	70
		EPA 8260B	DLV	76
		SM 2540 G-11/3550	NS1	1

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ANALYTICAL RESULTS

Project:	Sugar Island
Pace Project No.:	4615231

Sample: VIB-1 **Lab ID: 4615231001** Collected: 07/18/18 09:15 Received: 07/21/18 10:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS Solids ASE	Analytical Method: EPA 8082A Preparation Method: EPA 3545A							
PCB-1016 (Aroclor 1016)	**<41.9**	ug/kg	41.9	1	07/23/18 07:57	07/23/18 22:16	12674-11-2	
PCB-1221 (Aroclor 1221)	**<41.9**	ug/kg	41.9	1	07/23/18 07:57	07/23/18 22:16	11104-28-2	
PCB-1232 (Aroclor 1232)	**<41.9**	ug/kg	41.9	1	07/23/18 07:57	07/23/18 22:16	11141-16-5	
PCB-1242 (Aroclor 1242)	**<41.9**	ug/kg	41.9	1	07/23/18 07:57	07/23/18 22:16	53469-21-9	
PCB-1248 (Aroclor 1248)	**<41.9**	ug/kg	41.9	1	07/23/18 07:57	07/23/18 22:16	12672-29-6	
PCB-1254 (Aroclor 1254)	**<41.9**	ug/kg	41.9	1	07/23/18 07:57	07/23/18 22:16	11097-69-1	
PCB-1260 (Aroclor 1260)	**<41.9**	ug/kg	41.9	1	07/23/18 07:57	07/23/18 22:16	11096-82-5	
Surrogates								
Decachlorobiphenyl (S)	96	%.	45-135	1	07/23/18 07:57	07/23/18 22:16	2051-24-3	
Tetrachloro-m-xylene (S)	97	%.	56-123	1	07/23/18 07:57	07/23/18 22:16	877-09-8	
6010C MET ICP	Analytical Method: EPA 6010C Preparation Method: EPA 3050B							
Aluminum	**9500000**	ug/kg	62000	5	07/24/18 06:53	07/25/18 11:02	7429-90-5	D3
Calcium	**123000000**	ug/kg	310000	5	07/24/18 06:53	07/25/18 11:02	7440-70-2	
Iron	**17800000**	ug/kg	632000	100	07/26/18 07:28	07/27/18 08:26	7439-89-6	
Magnesium	**16200000**	ug/kg	62000	1	07/24/18 06:53	07/25/18 10:31	7439-95-4	
Potassium	**2500000**	ug/kg	62000	1	07/24/18 06:53	07/25/18 10:31	7440-09-7	
Sodium	**181000**	ug/kg	62000	1	07/24/18 06:53	07/25/18 10:31	7440-23-5	
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050B							
Antimony	**<119**	ug/kg	119	1	07/24/18 06:53	07/25/18 14:54	7440-36-0	
Arsenic	**7420**	ug/kg	597	5	07/24/18 06:53	07/25/18 12:43	7440-38-2	
Barium	**97400**	ug/kg	2980	25	07/24/18 06:53	07/25/18 14:51	7440-39-3	
Beryllium	**421**	ug/kg	119	1	07/24/18 06:53	07/25/18 14:54	7440-41-7	
Cadmium	**135**	ug/kg	59.7	1	07/24/18 06:53	07/25/18 14:54	7440-43-9	
Chromium	**15400**	ug/kg	597	5	07/24/18 06:53	07/25/18 12:43	7440-47-3	
Cobalt	**9610**	ug/kg	597	5	07/24/18 06:53	07/25/18 12:43	7440-48-4	
Copper	**19500**	ug/kg	597	5	07/24/18 06:53	07/25/18 12:43	7440-50-8	
Lead	**9370**	ug/kg	597	5	07/24/18 06:53	07/25/18 12:43	7439-92-1	
Manganese	**636000**	ug/kg	29800	250	07/24/18 06:53	07/25/18 14:43	7439-96-5	
Nickel	**24700**	ug/kg	597	5	07/24/18 06:53	07/25/18 12:43	7440-02-0	
Selenium	**3720**	ug/kg	597	5	07/24/18 06:53	07/25/18 12:43	7782-49-2	
Silver	**<59.7**	ug/kg	59.7	1	07/24/18 06:53	07/25/18 14:54	7440-22-4	
Thallium	**381**	ug/kg	298	5	07/24/18 06:53	07/25/18 12:43	7440-28-0	2l
Vanadium	**21400**	ug/kg	597	5	07/24/18 06:53	07/25/18 12:43	7440-62-2	
Zinc	**49700**	ug/kg	29800	25	07/24/18 06:53	07/25/18 14:51	7440-66-6	
7471 Mercury	Analytical Method: EPA 7471B Preparation Method: EPA 7471B							
Mercury	**<62.3**	ug/kg	62.3	1	07/24/18 10:08	07/25/18 09:35	7439-97-6	
8270C MSSV Solid	Analytical Method: EPA 8270C Preparation Method: EPA 3550C							
Acenaphthene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	83-32-9	
Acenaphthylene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	208-96-8	
Anthracene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	120-12-7	
Benzo(a)anthracene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	56-55-3	

ANALYTICAL RESULTS

Project: Sugar Island
Pace Project No.: 4615231

Sample: VIB-1 **Lab ID: 4615231001** Collected: 07/18/18 09:15 Received: 07/21/18 10:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

8270C MSSV Solid Analytical Method: EPA 8270C Preparation Method: EPA 3550C

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Benzo(a)pyrene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	50-32-8	
Benzo(b)fluoranthene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	205-99-2	
Benzo(g,h,i)perylene	**<42.1**	ug/kg	42.1	1	07/25/18 07:00	07/27/18 16:41	191-24-2	
Benzo(k)fluoranthene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	207-08-9	
4-Bromophenylphenyl ether	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	101-55-3	
Butylbenzylphthalate	**<42.1**	ug/kg	42.1	1	07/25/18 07:00	07/27/18 16:41	85-68-7	
Carbazole	**<217**	ug/kg	217	1	07/25/18 07:00	07/27/18 16:41	86-74-8	
4-Chloro-3-methylphenol	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	59-50-7	
bis(2-Chloroethoxy)methane	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	111-91-1	
bis(2-Chloroethyl) ether	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	111-44-4	
bis(2-Chloroisopropyl) ether	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	108-60-1	
2-Chloronaphthalene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	91-58-7	
2-Chlorophenol	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	95-57-8	
4-Chlorophenylphenyl ether	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	7005-72-3	
Chrysene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	218-01-9	
Dibenz(a,h)anthracene	**<42.1**	ug/kg	42.1	1	07/25/18 07:00	07/27/18 16:41	53-70-3	
Dibenzofuran	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	132-64-9	
1,2-Dichlorobenzene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	95-50-1	
1,3-Dichlorobenzene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	541-73-1	
1,4-Dichlorobenzene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	106-46-7	
2,4-Dichlorophenol	**<42.1**	ug/kg	42.1	1	07/25/18 07:00	07/27/18 16:41	120-83-2	
Diethylphthalate	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	84-66-2	
2,4-Dimethylphenol	**<217**	ug/kg	217	1	07/25/18 07:00	07/27/18 16:41	105-67-9	
Dimethylphthalate	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	131-11-3	
Di-n-butylphthalate	**191**	ug/kg	85.4	1	07/25/18 07:00	07/27/18 16:41	84-74-2	
4,6-Dinitro-2-methylphenol	**<217**	ug/kg	217	1	07/25/18 07:00	07/27/18 16:41	534-52-1	
2,4-Dinitrophenol	**<217**	ug/kg	217	1	07/25/18 07:00	07/27/18 16:41	51-28-5	
2,4-Dinitrotoluene	**<42.1**	ug/kg	42.1	1	07/25/18 07:00	07/27/18 16:41	121-14-2	
2,6-Dinitrotoluene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	606-20-2	
Di-n-octylphthalate	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	117-84-0	
1,2-Diphenylhydrazine	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	122-66-7	
bis(2-Ethylhexyl)phthalate	**<42.1**	ug/kg	42.1	1	07/25/18 07:00	07/27/18 16:41	117-81-7	
Fluoranthene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	206-44-0	
Fluorene	**<42.1**	ug/kg	42.1	1	07/25/18 07:00	07/27/18 16:41	86-73-7	
Hexachloro-1,3-butadiene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	87-68-3	
Hexachlorobenzene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	118-74-1	
Hexachlorocyclopentadiene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	77-47-4	
Hexachloroethane	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	67-72-1	
Indeno(1,2,3-cd)pyrene	**<42.1**	ug/kg	42.1	1	07/25/18 07:00	07/27/18 16:41	193-39-5	
Isophorone	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	78-59-1	
2-Methylnaphthalene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	91-57-6	
2-Methylphenol(o-Cresol)	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	95-48-7	
3&4-Methylphenol(m&p Cresol)	**<43.4**	ug/kg	43.4	1	07/25/18 07:00	07/27/18 16:41		
Naphthalene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	91-20-3	
2-Nitroaniline	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	88-74-4	
3-Nitroaniline	**<421**	ug/kg	421	1	07/25/18 07:00	07/27/18 16:41	99-09-2	

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ANALYTICAL RESULTS

Project: Sugar Island
Pace Project No.: 4615231

Sample: VIB-1 **Lab ID: 4615231001** Collected: 07/18/18 09:15 Received: 07/21/18 10:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8270C MSSV Solid	Analytical Method: EPA 8270C Preparation Method: EPA 3550C							
4-Nitroaniline	**<421**	ug/kg	421	1	07/25/18 07:00	07/27/18 16:41	100-01-6	
Nitrobenzene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	98-95-3	
2-Nitrophenol	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	88-75-5	
4-Nitrophenol	**<854**	ug/kg	854	1	07/25/18 07:00	07/27/18 16:41	100-02-7	
N-Nitrosodimethylamine	**<42.1**	ug/kg	42.1	1	07/25/18 07:00	07/27/18 16:41	62-75-9	
N-Nitroso-di-n-propylamine	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	621-64-7	
N-Nitrosodiphenylamine	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	86-30-6	
Pentachlorophenol	**<42.1**	ug/kg	42.1	1	07/25/18 07:00	07/27/18 16:41	87-86-5	
Phenanthrene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	85-01-8	
Phenol	**<217**	ug/kg	217	1	07/25/18 07:00	07/27/18 16:41	108-95-2	
Pyrene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	129-00-0	
1,2,4-Trichlorobenzene	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	120-82-1	
2,4,5-Trichlorophenol	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	95-95-4	
2,4,6-Trichlorophenol	**<21.7**	ug/kg	21.7	1	07/25/18 07:00	07/27/18 16:41	88-06-2	
Surrogates								
Nitrobenzene-d5 (S)	59	%.	33-131	1	07/25/18 07:00	07/27/18 16:41	4165-60-0	
2-Fluorobiphenyl (S)	62	%.	46-122	1	07/25/18 07:00	07/27/18 16:41	321-60-8	
o-Terphenyl (S)	69	%.	20-155	1	07/25/18 07:00	07/27/18 16:41	84-15-1	
Phenol-d6 (S)	59	%.	30-115	1	07/25/18 07:00	07/27/18 16:41	13127-88-3	
2-Fluorophenol (S)	65	%.	33-113	1	07/25/18 07:00	07/27/18 16:41	367-12-4	
2,4,6-Tribromophenol (S)	53	%.	12-124	1	07/25/18 07:00	07/27/18 16:41	118-79-6	
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B Preparation Method: EPA 5035A							
Acetone	**<1000**	ug/kg	1000	1	07/23/18 12:00	07/23/18 21:41	67-64-1	
Acrylonitrile	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	107-13-1	
tert-Amylmethyl ether	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	994-05-8	
Benzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	71-43-2	
Bromobenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	108-86-1	
Bromochloromethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	74-97-5	
Bromodichloromethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	75-27-4	
Bromoform	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	75-25-2	
Bromomethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	74-83-9	
2-Butanone (MEK)	**<3330**	ug/kg	3330	1	07/23/18 12:00	07/23/18 21:41	78-93-3	
tert-Butyl Alcohol	**<3330**	ug/kg	3330	1	07/23/18 12:00	07/23/18 21:41	75-65-0	
n-Butylbenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	104-51-8	
sec-Butylbenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	135-98-8	
tert-Butylbenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	98-06-6	
Carbon disulfide	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	75-15-0	
Carbon tetrachloride	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	56-23-5	
Chlorobenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	108-90-7	
Chloroethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	75-00-3	
Chloroform	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	67-66-3	
Chloromethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	74-87-3	
Cyclohexane	**<3330**	ug/kg	3330	1	07/23/18 12:00	07/23/18 21:41	110-82-7	
1,2-Dibromo-3-chloropropane	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	96-12-8	
Dibromochloromethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	124-48-1	

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ANALYTICAL RESULTS

Project: Sugar Island
Pace Project No.: 4615231

Sample: VIB-1 **Lab ID: 4615231001** Collected: 07/18/18 09:15 Received: 07/21/18 10:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B Preparation Method: EPA 5035A							
1,2-Dibromoethane (EDB)	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	106-93-4	
Dibromomethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	74-95-3	
1,2-Dichlorobenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	95-50-1	
1,3-Dichlorobenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	541-73-1	
1,4-Dichlorobenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	106-46-7	
trans-1,4-Dichloro-2-butene	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	110-57-6	
Dichlorodifluoromethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	75-71-8	
1,1-Dichloroethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	75-34-3	
1,2-Dichloroethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	107-06-2	
1,1-Dichloroethene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	75-35-4	
cis-1,2-Dichloroethene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	156-59-2	
trans-1,2-Dichloroethene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	156-60-5	
1,2-Dichloropropane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	78-87-5	
cis-1,3-Dichloropropene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	10061-01-5	
trans-1,3-Dichloropropene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	10061-02-6	
Diethyl ether (Ethyl ether)	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	60-29-7	
Diisopropyl ether	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	108-20-3	
Ethylbenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	100-41-4	
Ethyl-tert-butyl ether	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	637-92-3	
Hexachloroethane	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	67-72-1	
2-Hexanone	**<3330**	ug/kg	3330	1	07/23/18 12:00	07/23/18 21:41	591-78-6	
Iodomethane	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	74-88-4	
Isopropylbenzene (Cumene)	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	98-82-8	
p-Isopropyltoluene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	99-87-6	
Methylene Chloride	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	75-09-2	
2-Methylnaphthalene	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	91-57-6	N2
4-Methyl-2-pentanone (MIBK)	**<3330**	ug/kg	3330	1	07/23/18 12:00	07/23/18 21:41	108-10-1	
Methyl-tert-butyl ether	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	1634-04-4	
Naphthalene	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	91-20-3	
n-Propylbenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	103-65-1	
Styrene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	100-42-5	
1,1,1,2-Tetrachloroethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	630-20-6	
1,1,2,2-Tetrachloroethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	79-34-5	
Tetrachloroethene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	127-18-4	
Tetrahydrofuran	**<333**	ug/kg	333	1	07/23/18 12:00	07/23/18 21:41	109-99-9	
Toluene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	108-88-3	
1,2,3-Trichlorobenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	87-61-6	
1,2,4-Trichlorobenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	120-82-1	
1,1,1-Trichloroethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	71-55-6	
1,1,2-Trichloroethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	79-00-5	
Trichloroethene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	79-01-6	
Trichlorofluoromethane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	75-69-4	
1,2,3-Trichloropropane	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	96-18-4	
1,2,3-Trimethylbenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	526-73-8	
1,2,4-Trimethylbenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	95-63-6	
1,3,5-Trimethylbenzene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	108-67-8	

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ANALYTICAL RESULTS

Project: Sugar Island
Pace Project No.: 4615231

Sample: VIB-1 **Lab ID: 4615231001** Collected: 07/18/18 09:15 Received: 07/21/18 10:20 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B Preparation Method: EPA 5035A							
Vinyl chloride	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	75-01-4	
m&p-Xylene	**<133**	ug/kg	133	1	07/23/18 12:00	07/23/18 21:41	179601-23-1	
o-Xylene	**<66.7**	ug/kg	66.7	1	07/23/18 12:00	07/23/18 21:41	95-47-6	
Surrogates								
Dibromofluoromethane (S)	97	%.	75-123	1	07/23/18 12:00	07/23/18 21:41	1868-53-7	
Toluene-d8 (S)	96	%.	85-113	1	07/23/18 12:00	07/23/18 21:41	2037-26-5	
4-Bromofluorobenzene (S)	95	%.	81-117	1	07/23/18 12:00	07/23/18 21:41	460-00-4	
1,2-Dichloroethane-d4 (S)	99	%.	83-116	1	07/23/18 12:00	07/23/18 21:41	17060-07-0	
Percent Moisture	Analytical Method: SM 2540 G-11/3550							
Percent Moisture	**21.9**	%	0.10	1		07/24/18 19:22		

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

QC Batch: 28792
QC Batch Method: EPA 7471B
Analysis Method: EPA 7471B
Analysis Description: 7471 Mercury
Associated Lab Samples: 4615231001

METHOD BLANK: 115103
Matrix: Solid
Associated Lab Samples: 4615231001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Mercury	ug/kg	<46.1	46.1	07/25/18 08:19	

LABORATORY CONTROL SAMPLE: 115104

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mercury	ug/kg	311	274	88	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115105 115106

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mercury	ug/kg	<58.8	409	390	375	368	88	90	80-120	2	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

QC Batch: 28681
QC Batch Method: EPA 3050B
Analysis Method: EPA 6010C
Analysis Description: 6010 MET
Associated Lab Samples: 4615231001

METHOD BLANK: 114764 Matrix: Solid
Associated Lab Samples: 4615231001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Aluminum	ug/kg	<9710	9710	07/25/18 10:03	
Calcium	ug/kg	<48600	48600	07/25/18 10:03	
Magnesium	ug/kg	<48600	48600	07/25/18 10:03	
Potassium	ug/kg	<48600	48600	07/25/18 10:03	
Sodium	ug/kg	<48600	48600	07/25/18 10:03	

LABORATORY CONTROL SAMPLE: 114765

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Aluminum	ug/kg	94700	112000	118	80-120	
Calcium	ug/kg	947000	965000	102	80-120	
Magnesium	ug/kg	947000	977000	103	80-120	
Potassium	ug/kg	947000	960000	101	80-120	
Sodium	ug/kg	947000	982000	104	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 114766 114767

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Aluminum	ug/kg	8140000	122000	119000	10200000	12700000	1660	3850	75-125	22	20	M1,R1
Calcium	ug/kg	97100000	1220000	1190000	95600000	112000000	-119	1280	75-125	16	20	M1
Magnesium	ug/kg	16800000	1220000	1190000	16700000	18600000	-9	148	75-125	11	20	M1
Potassium	ug/kg	2020000	1220000	1190000	4100000	5250000	171	271	75-125	24	20	M1,R1
Sodium	ug/kg	207000	1220000	1190000	1560000	1550000	111	112	75-125	1	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

QC Batch: 28971
Analysis Method: EPA 6010C
QC Batch Method: EPA 3050B
Analysis Description: 6010 MET
Associated Lab Samples: 4615231001

METHOD BLANK: 115813
Matrix: Solid
Associated Lab Samples: 4615231001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Iron	ug/kg	<4620	4620	07/27/18 08:12	

LABORATORY CONTROL SAMPLE: 115814

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Iron	ug/kg	18800	17500	93	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115815 115816

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Iron	ug/kg	22600000	24900	24500	21500000	21500000	-4610	-4630	75-125	0	20	M6

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

QC Batch: 28682
QC Batch Method: EPA 3050B
Analysis Method: EPA 6020A
Analysis Description: 6020A MET
Associated Lab Samples: 4615231001

METHOD BLANK: 114768
Matrix: Solid
Associated Lab Samples: 4615231001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Antimony	ug/kg	<97.2	97.2	07/25/18 12:24	
Arsenic	ug/kg	<97.2	97.2	07/25/18 12:24	
Barium	ug/kg	<97.2	97.2	07/25/18 12:24	
Beryllium	ug/kg	<97.2	97.2	07/25/18 12:24	
Cadmium	ug/kg	<48.6	48.6	07/25/18 12:24	
Chromium	ug/kg	<97.2	97.2	07/25/18 12:24	
Cobalt	ug/kg	<97.2	97.2	07/25/18 12:24	
Copper	ug/kg	<97.2	97.2	07/25/18 12:24	
Lead	ug/kg	<97.2	97.2	07/25/18 12:24	
Manganese	ug/kg	<97.2	97.2	07/25/18 12:24	
Nickel	ug/kg	<97.2	97.2	07/25/18 12:24	
Selenium	ug/kg	<97.2	97.2	07/25/18 12:24	
Silver	ug/kg	<48.6	48.6	07/25/18 12:24	
Thallium	ug/kg	<48.6	48.6	07/25/18 12:24	
Vanadium	ug/kg	<97.2	97.2	07/25/18 12:24	
Zinc	ug/kg	<972	972	07/25/18 12:24	

LABORATORY CONTROL SAMPLE: 114769

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Antimony	ug/kg	1900	1840	97	80-120	
Arsenic	ug/kg	1900	1810	95	80-120	
Barium	ug/kg	1900	1800	95	80-120	
Beryllium	ug/kg	1900	1600	84	80-120	
Cadmium	ug/kg	1900	1700	90	80-120	
Chromium	ug/kg	1900	1960	103	80-120	
Cobalt	ug/kg	1900	1960	103	80-120	
Copper	ug/kg	1900	1910	101	80-120	
Lead	ug/kg	1900	1910	101	80-120	
Manganese	ug/kg	1900	2020	106	80-120	
Nickel	ug/kg	1900	1920	101	80-120	
Selenium	ug/kg	1900	1590	84	80-120	
Silver	ug/kg	1900	1830	97	80-120	
Thallium	ug/kg	1900	1890	100	80-120	
Vanadium	ug/kg	1900	1910	101	80-120	
Zinc	ug/kg	1900	1850	98	80-120	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 114770 114771

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Antimony	ug/kg	<125	2510	2480	<126	<124	4	4	75-125		20	M1
Arsenic	ug/kg	4150	2510	2480	8300	6650	166	101	75-125	22	20	M1,R1
Barium	ug/kg	49100	2510	2480	53300	65900	165	679	75-125	21	20	E,M1, R1
Beryllium	ug/kg	400	2510	2480	2450	2610	82	89	75-125	6	20	
Cadmium	ug/kg	70.8	2510	2480	2470	2510	96	98	75-125	1	20	
Chromium	ug/kg	13900	2510	2480	15500	18300	66	177	75-125	16	20	M1
Cobalt	ug/kg	7870	2510	2480	10700	10800	113	118	75-125	1	20	
Copper	ug/kg	14400	2510	2480	19600	18900	207	182	75-125	4	20	M1
Lead	ug/kg	8180	2510	2480	11300	11300	125	124	75-125	0	20	
Manganese	ug/kg	449000	2510	2480	537000	528000	3510	3190	75-125	2	20	E,M1
Nickel	ug/kg	18800	2510	2480	20700	21300	79	102	75-125	3	20	
Selenium	ug/kg	3210	2510	2480	5940	5860	109	107	75-125	1	20	
Silver	ug/kg	<62.4	2510	2480	2090	2180	82	87	75-125	4	20	
Thallium	ug/kg	<312	2510	2480	2710	2680	101	102	75-125	1	20	
Vanadium	ug/kg	18600	2510	2480	22700	24600	162	242	75-125	8	20	M1
Zinc	ug/kg	40400	2510	2480	57400	48900	679	345	75-125	16	20	E,M1

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

QC Batch: 28699
Analysis Method: EPA 8260B
QC Batch Method: EPA 5035A
Analysis Description: 8260B MSV 5035A Med Level
Associated Lab Samples: 4615231001

METHOD BLANK: 114822
Matrix: Solid
Associated Lab Samples: 4615231001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,1,1,2-Tetrachloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,1,1-Trichloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,1,2,2-Tetrachloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,1,2-Trichloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,1-Dichloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,1-Dichloroethene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2,3-Trichlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2,3-Trichloropropane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2,3-Trimethylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2,4-Trichlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2,4-Trimethylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2-Dibromo-3-chloropropane	ug/kg	<250	250	07/23/18 17:13	
1,2-Dibromoethane (EDB)	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2-Dichlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2-Dichloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2-Dichloropropane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,3,5-Trimethylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,3-Dichlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,4-Dichlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
2-Butanone (MEK)	ug/kg	<2500	2500	07/23/18 17:13	
2-Hexanone	ug/kg	<2500	2500	07/23/18 17:13	
2-Methylnaphthalene	ug/kg	<250	250	07/23/18 17:13	N2
4-Methyl-2-pentanone (MIBK)	ug/kg	<2500	2500	07/23/18 17:13	
Acetone	ug/kg	<750	750	07/23/18 17:13	
Acrylonitrile	ug/kg	<250	250	07/23/18 17:13	
Benzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Bromobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Bromochloromethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Bromodichloromethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Bromoform	ug/kg	<50.0	50.0	07/23/18 17:13	
Bromomethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Carbon disulfide	ug/kg	<250	250	07/23/18 17:13	
Carbon tetrachloride	ug/kg	<50.0	50.0	07/23/18 17:13	
Chlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Chloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Chloroform	ug/kg	<50.0	50.0	07/23/18 17:13	
Chloromethane	ug/kg	<50.0	50.0	07/23/18 17:13	
cis-1,2-Dichloroethene	ug/kg	<50.0	50.0	07/23/18 17:13	
cis-1,3-Dichloropropene	ug/kg	<50.0	50.0	07/23/18 17:13	
Cyclohexane	ug/kg	<2500	2500	07/23/18 17:13	
Dibromochloromethane	ug/kg	<50.0	50.0	07/23/18 17:13	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

METHOD BLANK: 114822 Matrix: Solid

Associated Lab Samples: 4615231001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Dibromomethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Dichlorodifluoromethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Diethyl ether (Ethyl ether)	ug/kg	<50.0	50.0	07/23/18 17:13	
Diisopropyl ether	ug/kg	<250	250	07/23/18 17:13	
Ethyl-tert-butyl ether	ug/kg	<250	250	07/23/18 17:13	
Ethylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Hexachloroethane	ug/kg	<250	250	07/23/18 17:13	
Iodomethane	ug/kg	<250	250	07/23/18 17:13	
Isopropylbenzene (Cumene)	ug/kg	<50.0	50.0	07/23/18 17:13	
m&p-Xylene	ug/kg	<100	100	07/23/18 17:13	
Methyl-tert-butyl ether	ug/kg	<50.0	50.0	07/23/18 17:13	
Methylene Chloride	ug/kg	<250	250	07/23/18 17:13	
n-Butylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
n-Propylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Naphthalene	ug/kg	<250	250	07/23/18 17:13	
o-Xylene	ug/kg	<50.0	50.0	07/23/18 17:13	
p-Isopropyltoluene	ug/kg	<50.0	50.0	07/23/18 17:13	
sec-Butylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Styrene	ug/kg	<50.0	50.0	07/23/18 17:13	
tert-Amylmethyl ether	ug/kg	<250	250	07/23/18 17:13	
tert-Butyl Alcohol	ug/kg	<2500	2500	07/23/18 17:13	
tert-Butylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Tetrachloroethene	ug/kg	<50.0	50.0	07/23/18 17:13	
Tetrahydrofuran	ug/kg	<250	250	07/23/18 17:13	
Toluene	ug/kg	<50.0	50.0	07/23/18 17:13	
trans-1,2-Dichloroethene	ug/kg	<50.0	50.0	07/23/18 17:13	
trans-1,3-Dichloropropene	ug/kg	<50.0	50.0	07/23/18 17:13	
trans-1,4-Dichloro-2-butene	ug/kg	<250	250	07/23/18 17:13	
Trichloroethene	ug/kg	<50.0	50.0	07/23/18 17:13	
Trichlorofluoromethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Vinyl chloride	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2-Dichloroethane-d4 (S)	%.	101	83-116	07/23/18 17:13	
4-Bromofluorobenzene (S)	%.	96	81-117	07/23/18 17:13	
Dibromofluoromethane (S)	%.	94	75-123	07/23/18 17:13	
Toluene-d8 (S)	%.	96	85-113	07/23/18 17:13	

LABORATORY CONTROL SAMPLE: 114823

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1,1,2-Tetrachloroethane	ug/kg	2000	2060	103	83-116	
1,1,1-Trichloroethane	ug/kg	2000	2050	102	84-121	
1,1,2,2-Tetrachloroethane	ug/kg	2000	1970	98	75-125	
1,1,2-Trichloroethane	ug/kg	2000	2010	101	85-120	
1,1-Dichloroethane	ug/kg	2000	2060	103	81-121	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

LABORATORY CONTROL SAMPLE: 114823

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1-Dichloroethene	ug/kg	2000	1980	99	80-121	
1,2,3-Trichlorobenzene	ug/kg	2000	2170	109	66-129	
1,2,3-Trichloropropane	ug/kg	2000	2130	107	73-125	
1,2,3-Trimethylbenzene	ug/kg	2000	1930	96	70-130	
1,2,4-Trichlorobenzene	ug/kg	2000	2120	106	66-133	
1,2,4-Trimethylbenzene	ug/kg	2000	2060	103	85-118	
1,2-Dibromo-3-chloropropane	ug/kg	2000	1800	90	51-132	
1,2-Dibromoethane (EDB)	ug/kg	2000	2080	104	81-118	
1,2-Dichlorobenzene	ug/kg	2000	1970	99	82-124	
1,2-Dichloroethane	ug/kg	2000	2010	101	82-119	
1,2-Dichloropropane	ug/kg	2000	2000	100	80-122	
1,3,5-Trimethylbenzene	ug/kg	2000	2080	104	85-119	
1,3-Dichlorobenzene	ug/kg	2000	2030	101	85-119	
1,4-Dichlorobenzene	ug/kg	2000	1960	98	85-119	
2-Butanone (MEK)	ug/kg	2000	<2500	108	68-130	
2-Hexanone	ug/kg	2000	<2500	101	63-131	
2-Methylnaphthalene	ug/kg	2000	1850	92	42-131	N2
4-Methyl-2-pentanone (MIBK)	ug/kg	2000	<2500	106	68-133	
Acetone	ug/kg	2000	2080	104	64-130	
Acrylonitrile	ug/kg	2000	2040	102	69-132	
Benzene	ug/kg	2000	2020	101	85-118	
Bromobenzene	ug/kg	2000	1960	98	89-116	
Bromochloromethane	ug/kg	2000	2080	104	81-121	
Bromodichloromethane	ug/kg	2000	1980	99	80-123	
Bromoform	ug/kg	2000	2140	107	58-128	
Bromomethane	ug/kg	2000	1990	99	57-139	
Carbon disulfide	ug/kg	2000	1810	91	65-138	
Carbon tetrachloride	ug/kg	2000	2070	104	76-125	
Chlorobenzene	ug/kg	2000	2010	100	86-114	
Chloroethane	ug/kg	2000	2080	104	76-123	
Chloroform	ug/kg	2000	1920	96	86-118	
Chloromethane	ug/kg	2000	2240	112	73-123	
cis-1,2-Dichloroethene	ug/kg	2000	2130	106	85-118	
cis-1,3-Dichloropropene	ug/kg	2000	2060	103	79-121	
Cyclohexane	ug/kg	2000	<2500	102	79-122	
Dibromochloromethane	ug/kg	2000	2150	107	72-119	
Dibromomethane	ug/kg	2000	2010	101	83-117	
Dichlorodifluoromethane	ug/kg	2000	2420	121	68-135	
Diethyl ether (Ethyl ether)	ug/kg	2000	1980	99	78-118	
Diisopropyl ether	ug/kg	2000	1860	93	70-130	
Ethyl-tert-butyl ether	ug/kg	2000	1900	95	70-130	
Ethylbenzene	ug/kg	2000	2060	103	84-116	
Hexachloroethane	ug/kg	2000	1990	100	70-122	
Iodomethane	ug/kg	2000	1660	83	47-150	
Isopropylbenzene (Cumene)	ug/kg	2000	2060	103	82-125	
m&p-Xylene	ug/kg	4000	4160	104	84-118	
Methyl-tert-butyl ether	ug/kg	4000	4060	101	81-119	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

LABORATORY CONTROL SAMPLE: 114823

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Methylene Chloride	ug/kg	2000	1890	94	78-123	
n-Butylbenzene	ug/kg	2000	2050	103	75-125	
n-Propylbenzene	ug/kg	2000	2010	100	85-121	
Naphthalene	ug/kg	2000	1840	92	53-133	
o-Xylene	ug/kg	2000	2010	101	85-115	
p-Isopropyltoluene	ug/kg	2000	2010	101	82-122	
sec-Butylbenzene	ug/kg	2000	2040	102	84-121	
Styrene	ug/kg	2000	2140	107	79-115	
tert-Amylmethyl ether	ug/kg	2000	1940	97	70-130	
tert-Butyl Alcohol	ug/kg	10000	9430	94	70-130	
tert-Butylbenzene	ug/kg	2000	2030	102	86-121	
Tetrachloroethene	ug/kg	2000	2020	101	85-116	
Tetrahydrofuran	ug/kg	2000	1960	98	62-126	
Toluene	ug/kg	2000	1990	99	86-120	
trans-1,2-Dichloroethene	ug/kg	2000	2030	101	85-117	
trans-1,3-Dichloropropene	ug/kg	2000	2130	107	73-125	
trans-1,4-Dichloro-2-butene	ug/kg	2000	2020	101	67-130	
Trichloroethene	ug/kg	2000	1970	98	83-125	
Trichlorofluoromethane	ug/kg	2000	2020	101	82-123	
Vinyl chloride	ug/kg	2000	2300	115	77-124	
1,2-Dichloroethane-d4 (S)	%.			102	83-116	
4-Bromofluorobenzene (S)	%.			103	81-117	
Dibromofluoromethane (S)	%.			102	75-123	
Toluene-d8 (S)	%.			100	85-113	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115053 115054

Parameter	Units	4615021001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1,1,1,2-Tetrachloroethane	ug/kg	0.060 U mg/kg	2390	2390	2240	2250	94	94	82-116	1	10	
1,1,1-Trichloroethane	ug/kg	0.060 U mg/kg	2390	2390	2200	2390	92	100	84-126	8	9	
1,1,2,2-Tetrachloroethane	ug/kg	0.060 U mg/kg	2390	2390	2130	2150	89	90	64-122	1	14	
1,1,2-Trichloroethane	ug/kg	0.060 U mg/kg	2390	2390	2280	2360	95	99	81-124	4	8	
1,1-Dichloroethane	ug/kg	0.060 U mg/kg	2390	2390	2290	2410	96	101	85-127	5	9	
1,1-Dichloroethene	ug/kg	0.060 U mg/kg	2390	2390	2160	2360	91	99	81-135	9	11	
1,2,3-Trichlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2420	2430	101	102	77-126	0	16	
1,2,3-Trichloropropane	ug/kg	0.060 U mg/kg	2390	2390	2250	2290	94	96	69-114	2	14	
1,2,3-Trimethylbenzene	ug/kg	0.060 U mg/kg	2390	2390	1930	1950	81	82	70-130	1	20	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115053 115054

Parameter	Units	4615021001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1,2,4-Trichlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2450	2450	102	102	76-131	0	11	
1,2,4-Trimethylbenzene	ug/kg	0.020J mg/kg	2390	2390	2310	2330	96	97	79-114	1	11	
1,2-Dibromo-3-chloropropane	ug/kg	0.30 U mg/kg	2390	2390	1870	1940	78	81	69-125	4	11	
1,2-Dibromoethane (EDB)	ug/kg	0.060 U mg/kg	2390	2390	2240	2280	94	95	72-124	2	11	
1,2-Dichlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2200	2240	92	94	85-121	2	10	
1,2-Dichloroethane	ug/kg	0.060 U mg/kg	2390	2390	2290	2390	96	100	82-125	4	8	
1,2-Dichloropropane	ug/kg	0.060 U mg/kg	2390	2390	2200	2340	92	98	78-132	6	11	
1,3,5-Trimethylbenzene	ug/kg	0.060 U mg/kg	2390	2390	2290	2350	96	98	83-112	3	12	
1,3-Dichlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2240	2250	94	94	86-116	1	8	
1,4-Dichlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2160	2200	90	92	87-115	2	9	
2-Butanone (MEK)	ug/kg	3.0 U mg/kg	2390	2390	<2990	<2990	104	108	49-152		16	
2-Hexanone	ug/kg	3.0 U mg/kg	2390	2390	<2990	<2990	93	96	49-135		16	
2-Methylnaphthalene	ug/kg	0.13J mg/kg	2390	2390	2230	2290	88	90	45-130	3	23	N2
4-Methyl-2-pentanone (MIBK)	ug/kg	3.0 U mg/kg	2390	2390	<2990	<2990	102	105	60-134		17	
Acetone	ug/kg	0.10J mg/kg	2390	2390	2400	2450	96	98	56-144	2	18	
Acrylonitrile	ug/kg	0.30 U mg/kg	2390	2390	2270	2380	95	100	67-136	5	15	
Benzene	ug/kg	0.060 U mg/kg	2390	2390	2270	2380	95	100	85-125	5	9	
Bromobenzene	ug/kg	0.060 U mg/kg	2390	2390	2230	2250	93	94	82-115	1	11	
Bromochloromethane	ug/kg	0.060 U mg/kg	2390	2390	2380	2620	100	110	85-126	9	10	
Bromodichloromethane	ug/kg	0.060 U mg/kg	2390	2390	2100	2250	88	94	78-124	7	9	
Bromoform	ug/kg	0.060 U mg/kg	2390	2390	2110	2130	88	89	75-118	1	11	
Bromomethane	ug/kg	0.060 U mg/kg	2390	2390	2200	2370	92	99	70-135	7	24	
Carbon disulfide	ug/kg	0.30 U mg/kg	2390	2390	1940	2270	81	95	45-108	16	21	
Carbon tetrachloride	ug/kg	0.060 U mg/kg	2390	2390	2160	2370	90	99	71-130	9	14	
Chlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2240	2310	94	97	86-118	3	11	
Chloroethane	ug/kg	0.060 U mg/kg	2390	2390	2140	2640	90	111	32-136	21	21	
Chloroform	ug/kg	0.060 U mg/kg	2390	2390	2310	2430	97	101	86-126	5	7	

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QUALITY CONTROL DATA

Project:	Sugar Island
Pace Project No.:	4615231

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115053 115054

Parameter	Units	4615021001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloromethane	ug/kg	0.060 U mg/kg	2390	2390	2550	2660	107	111	70-142	4	15	
cis-1,2-Dichloroethene	ug/kg	0.060 U mg/kg	2390	2390	2420	2440	101	102	88-125	1	9	
cis-1,3-Dichloropropene	ug/kg	0.060 U mg/kg	2390	2390	2120	2270	89	95	70-124	7	10	
Cyclohexane	ug/kg	0.027J mg/kg	2390	2390	<2990	<2990	96	101	72-135		11	
Dibromochloromethane	ug/kg	0.060 U mg/kg	2390	2390	2150	2250	90	94	57-121	4	12	
Dibromomethane	ug/kg	0.060 U mg/kg	2390	2390	2220	2320	93	97	86-119	4	7	
Dichlorodifluoromethane	ug/kg	0.060 U mg/kg	2390	2390	2820	3030	118	127	65-133	7	12	
Diethyl ether (Ethyl ether)	ug/kg	0.060 U mg/kg	2390	2390	2210	2280	93	95	71-131	3	9	
Diisopropyl ether	ug/kg	0.30 U mg/kg	2390	2390	2130	2210	89	92	65-135	4	40	
Ethyl-tert-butyl ether	ug/kg	0.30 U mg/kg	2390	2390	2160	2270	90	95	70-130	5	20	
Ethylbenzene	ug/kg	0.013J mg/kg	2390	2390	2310	2330	96	97	80-122	1	10	
Hexachloroethane	ug/kg	0.30 U mg/kg	2390	2390	1970	2010	83	84	81-117	2	11	
Iodomethane	ug/kg	0.30 U mg/kg	2390	2390	2240	2500	94	104	63-158	11	28	
Isopropylbenzene (Cumene)	ug/kg	0.060 U mg/kg	2390	2390	2270	2360	95	99	84-120	4	9	
m&p-Xylene	ug/kg	0.040J mg/kg	4780	4780	4580	4760	95	99	77-128	4	10	
Methyl-tert-butyl ether	ug/kg	0.060 U mg/kg	4780	4780	4510	4730	94	99	63-134	5	11	
Methylene Chloride	ug/kg	0.30 U mg/kg	2390	2390	1990	2190	83	91	78-139	9	9	
n-Butylbenzene	ug/kg	0.060 U mg/kg	2390	2390	2250	2300	94	96	71-122	2	12	
n-Propylbenzene	ug/kg	0.060 U mg/kg	2390	2390	2240	2320	94	97	73-124	3	8	
Naphthalene	ug/kg	0.28J mg/kg	2390	2390	2190	2230	80	82	67-119	2	15	
o-Xylene	ug/kg	0.015J mg/kg	2390	2390	2330	2360	97	98	83-121	1	9	
p-Isopropyltoluene	ug/kg	0.060 U mg/kg	2390	2390	2230	2260	93	94	82-116	1	13	
sec-Butylbenzene	ug/kg	0.060 U mg/kg	2390	2390	2260	2290	95	96	84-117	1	10	
Styrene	ug/kg	0.060 U mg/kg	2390	2390	2380	2450	99	102	80-117	3	10	
tert-Amylmethyl ether	ug/kg	0.30 U mg/kg	2390	2390	2290	2370	96	99	70-130	3	30	
tert-Butyl Alcohol	ug/kg	3.0 U mg/kg	12000	12000	11000	11200	92	93	68-100	2	40	
tert-Butylbenzene	ug/kg	0.060 U mg/kg	2390	2390	2250	2310	94	97	84-118	3	12	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115053 115054

Parameter	Units	4615021001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Tetrachloroethene	ug/kg	0.060 U mg/kg	2390	2390	2280	2300	95	96	74-130	1	11	
Tetrahydrofuran	ug/kg	0.30 U mg/kg	2390	2390	2210	2260	92	95	45-135	2	16	
Toluene	ug/kg	0.060 U mg/kg	2390	2390	2240	2330	94	98	81-128	4	10	
trans-1,2-Dichloroethene	ug/kg	0.060 U mg/kg	2390	2390	2250	2320	94	97	81-135	3	10	
trans-1,3-Dichloropropene	ug/kg	0.060 U mg/kg	2390	2390	2180	2280	91	95	63-122	4	9	
trans-1,4-Dichloro-2-butene	ug/kg	0.30 U mg/kg	2390	2390	2080	1960	87	82	44-118	6	10	
Trichloroethene	ug/kg	0.060 U mg/kg	2390	2390	2180	2280	91	95	90-130	5	12	
Trichlorofluoromethane	ug/kg	0.060 U mg/kg	2390	2390	2360	2480	99	104	50-155	5	13	
Vinyl chloride	ug/kg	0.060 U mg/kg	2390	2390	2640	2760	110	115	63-148	5	11	
1,2-Dichloroethane-d4 (S)	%.						98	98	83-116			
4-Bromofluorobenzene (S)	%.						102	102	81-117			
Dibromofluoromethane (S)	%.						98	100	75-123			
Toluene-d8 (S)	%.						101	102	85-113			

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

QC Batch: 28656
Analysis Method: EPA 8082A
QC Batch Method: EPA 3545A
Analysis Description: 8082A GCS PCB
Associated Lab Samples: 4615231001

METHOD BLANK: 114722
Matrix: Solid
Associated Lab Samples: 4615231001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
PCB-1016 (Aroclor 1016)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1221 (Aroclor 1221)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1232 (Aroclor 1232)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1242 (Aroclor 1242)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1248 (Aroclor 1248)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1254 (Aroclor 1254)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1260 (Aroclor 1260)	ug/kg	<33.0	33.0	07/23/18 19:46	
Decachlorobiphenyl (S)	%.	94	45-135	07/23/18 19:46	
Tetrachloro-m-xylene (S)	%.	87	56-123	07/23/18 19:46	

LABORATORY CONTROL SAMPLE: 114723

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
PCB-1016 (Aroclor 1016)	ug/kg	200	163	81	68-129	
PCB-1260 (Aroclor 1260)	ug/kg	200	167	83	60-140	
Decachlorobiphenyl (S)	%.			84	45-135	
Tetrachloro-m-xylene (S)	%.			83	56-123	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 114724 114725

Parameter	Units	4615120001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
PCB-1016 (Aroclor 1016)	ug/kg	<0.033 mg/kg	201	198	180	188	90	95	49-128	4	30	
PCB-1260 (Aroclor 1260)	ug/kg	<0.033 mg/kg	201	198	182	190	90	96	48-138	4	30	
Decachlorobiphenyl (S)	%.						87	90	45-135			
Tetrachloro-m-xylene (S)	%.						92	96	56-123			

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

QC Batch: 28882 Analysis Method: EPA 8270C
QC Batch Method: EPA 3550C Analysis Description: 8270C Solid MSSV
Associated Lab Samples: 4615231001

METHOD BLANK: 115461 Matrix: Solid
Associated Lab Samples: 4615231001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,2,4-Trichlorobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
1,2-Dichlorobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
1,2-Diphenylhydrazine	ug/kg	<17.0	17.0	07/27/18 10:14	
1,3-Dichlorobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
1,4-Dichlorobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
2,4,5-Trichlorophenol	ug/kg	<17.0	17.0	07/27/18 10:14	
2,4,6-Trichlorophenol	ug/kg	<17.0	17.0	07/27/18 10:14	
2,4-Dichlorophenol	ug/kg	<33.0	33.0	07/27/18 10:14	
2,4-Dimethylphenol	ug/kg	<170	170	07/27/18 10:14	
2,4-Dinitrophenol	ug/kg	<170	170	07/27/18 10:14	
2,4-Dinitrotoluene	ug/kg	<33.0	33.0	07/27/18 10:14	
2,6-Dinitrotoluene	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Chloronaphthalene	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Chlorophenol	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Methylnaphthalene	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Methylphenol(o-Cresol)	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Nitroaniline	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Nitrophenol	ug/kg	<17.0	17.0	07/27/18 10:14	
3&4-Methylphenol(m&p Cresol)	ug/kg	<34.0	34.0	07/27/18 10:14	
3-Nitroaniline	ug/kg	<330	330	07/27/18 10:14	
4,6-Dinitro-2-methylphenol	ug/kg	<170	170	07/27/18 10:14	
4-Bromophenylphenyl ether	ug/kg	<17.0	17.0	07/27/18 10:14	
4-Chloro-3-methylphenol	ug/kg	<17.0	17.0	07/27/18 10:14	
4-Chlorophenylphenyl ether	ug/kg	<17.0	17.0	07/27/18 10:14	
4-Nitroaniline	ug/kg	<330	330	07/27/18 10:14	
4-Nitrophenol	ug/kg	<670	670	07/27/18 10:14	
Acenaphthene	ug/kg	<17.0	17.0	07/27/18 10:14	
Acenaphthylene	ug/kg	<17.0	17.0	07/27/18 10:14	
Anthracene	ug/kg	<17.0	17.0	07/27/18 10:14	
Benzo(a)anthracene	ug/kg	<17.0	17.0	07/27/18 10:14	
Benzo(a)pyrene	ug/kg	<17.0	17.0	07/27/18 10:14	
Benzo(b)fluoranthene	ug/kg	<17.0	17.0	07/27/18 10:14	
Benzo(g,h,i)perylene	ug/kg	<33.0	33.0	07/27/18 10:14	
Benzo(k)fluoranthene	ug/kg	<17.0	17.0	07/27/18 10:14	
bis(2-Chloroethoxy)methane	ug/kg	<17.0	17.0	07/27/18 10:14	
bis(2-Chloroethyl) ether	ug/kg	<17.0	17.0	07/27/18 10:14	
bis(2-Chloroisopropyl) ether	ug/kg	<17.0	17.0	07/27/18 10:14	
bis(2-Ethylhexyl)phthalate	ug/kg	<33.0	33.0	07/27/18 10:14	
Butylbenzylphthalate	ug/kg	<33.0	33.0	07/27/18 10:14	
Carbazole	ug/kg	<170	170	07/27/18 10:14	
Chrysene	ug/kg	<17.0	17.0	07/27/18 10:14	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

METHOD BLANK: 115461 Matrix: Solid

Associated Lab Samples: 4615231001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Di-n-butylphthalate	ug/kg	<67.0	67.0	07/27/18 10:14	
Di-n-octylphthalate	ug/kg	<17.0	17.0	07/27/18 10:14	
Dibenz(a,h)anthracene	ug/kg	<33.0	33.0	07/27/18 10:14	
Dibenzofuran	ug/kg	<17.0	17.0	07/27/18 10:14	
Diethylphthalate	ug/kg	<17.0	17.0	07/27/18 10:14	
Dimethylphthalate	ug/kg	<17.0	17.0	07/27/18 10:14	
Fluoranthene	ug/kg	<17.0	17.0	07/27/18 10:14	
Fluorene	ug/kg	<33.0	33.0	07/27/18 10:14	
Hexachloro-1,3-butadiene	ug/kg	<17.0	17.0	07/27/18 10:14	
Hexachlorobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
Hexachlorocyclopentadiene	ug/kg	<17.0	17.0	07/27/18 10:14	
Hexachloroethane	ug/kg	<17.0	17.0	07/27/18 10:14	
Indeno(1,2,3-cd)pyrene	ug/kg	<33.0	33.0	07/27/18 10:14	
Isophorone	ug/kg	<17.0	17.0	07/27/18 10:14	
N-Nitroso-di-n-propylamine	ug/kg	<17.0	17.0	07/27/18 10:14	
N-Nitrosodimethylamine	ug/kg	<33.0	33.0	07/27/18 10:14	
N-Nitrosodiphenylamine	ug/kg	<17.0	17.0	07/27/18 10:14	
Naphthalene	ug/kg	<17.0	17.0	07/27/18 10:14	
Nitrobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
Pentachlorophenol	ug/kg	<33.0	33.0	07/27/18 10:14	
Phenanthrene	ug/kg	<17.0	17.0	07/27/18 10:14	
Phenol	ug/kg	<170	170	07/27/18 10:14	
Pyrene	ug/kg	<17.0	17.0	07/27/18 10:14	
2,4,6-Tribromophenol (S)	%.	50	12-124	07/27/18 10:14	
2-Fluorobiphenyl (S)	%.	65	46-122	07/27/18 10:14	
2-Fluorophenol (S)	%.	67	33-113	07/27/18 10:14	
Nitrobenzene-d5 (S)	%.	60	33-131	07/27/18 10:14	
o-Terphenyl (S)	%.	71	20-155	07/27/18 10:14	
Phenol-d6 (S)	%.	63	30-115	07/27/18 10:14	

LABORATORY CONTROL SAMPLE: 115462

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,2,4-Trichlorobenzene	ug/kg	333	233	70	51-110	
1,2-Dichlorobenzene	ug/kg	333	228	69	63-115	
1,2-Diphenylhydrazine	ug/kg	333	290	87	68-125	
1,3-Dichlorobenzene	ug/kg	333	234	70	54-113	
1,4-Dichlorobenzene	ug/kg	333	212	64	61-111	
2,4,5-Trichlorophenol	ug/kg	333	213	64	61-126	
2,4,6-Trichlorophenol	ug/kg	333	233	70	45-128	
2,4-Dichlorophenol	ug/kg	333	198	59	50-128	
2,4-Dimethylphenol	ug/kg	333	<170	51	40-122	
2,4-Dinitrophenol	ug/kg	333	313	94	25-105	
2,4-Dinitrotoluene	ug/kg	333	239	72	51-128	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

LABORATORY CONTROL SAMPLE: 115462

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
2,6-Dinitrotoluene	ug/kg	333	247	74	61-119	
2-Chloronaphthalene	ug/kg	333	253	76	67-111	
2-Chlorophenol	ug/kg	333	235	70	62-118	
2-Methylnaphthalene	ug/kg	333	239	72	56-124	
2-Methylphenol(o-Cresol)	ug/kg	333	196	59	58-113	
2-Nitroaniline	ug/kg	333	238	71	63-122	
2-Nitrophenol	ug/kg	333	249	75	55-115	
3&4-Methylphenol(m&p Cresol)	ug/kg	333	190	57	47-158	
3-Nitroaniline	ug/kg	333	<330	38	19-86	
4,6-Dinitro-2-methylphenol	ug/kg	333	348	104	26-136	
4-Bromophenylphenyl ether	ug/kg	333	267	80	61-124	
4-Chloro-3-methylphenol	ug/kg	333	213	64	57-124	
4-Chlorophenylphenyl ether	ug/kg	333	249	75	62-114	
4-Nitroaniline	ug/kg	333	<330	56	26-125	
4-Nitrophenol	ug/kg	333	<670	75	36-131	
Acenaphthene	ug/kg	333	263	79	55-113	
Acenaphthylene	ug/kg	333	272	81	56-138	
Anthracene	ug/kg	333	270	81	63-134	
Benzo(a)anthracene	ug/kg	333	293	88	53-142	
Benzo(a)pyrene	ug/kg	333	257	77	54-136	
Benzo(b)fluoranthene	ug/kg	333	243	73	49-146	
Benzo(g,h,i)perylene	ug/kg	333	264	79	47-141	
Benzo(k)fluoranthene	ug/kg	333	239	72	56-136	
bis(2-Chloroethoxy)methane	ug/kg	333	223	67	57-121	
bis(2-Chloroethyl) ether	ug/kg	333	221	66	54-112	
bis(2-Chloroisopropyl) ether	ug/kg	333	264	79	62-116	
bis(2-Ethylhexyl)phthalate	ug/kg	333	297	89	50-140	
Butylbenzylphthalate	ug/kg	333	315	94	51-145	
Carbazole	ug/kg	333	290	87	76-126	
Chrysene	ug/kg	333	272	82	66-137	
Di-n-butylphthalate	ug/kg	333	299	90	65-140	
Di-n-octylphthalate	ug/kg	333	312	94	63-132	
Dibenz(a,h)anthracene	ug/kg	333	273	82	52-142	
Dibenzofuran	ug/kg	333	246	74	65-119	
Diethylphthalate	ug/kg	333	249	75	59-128	
Dimethylphthalate	ug/kg	333	246	74	66-122	
Fluoranthene	ug/kg	333	279	84	66-140	
Fluorene	ug/kg	333	263	79	60-131	
Hexachloro-1,3-butadiene	ug/kg	333	228	68	56-128	
Hexachlorobenzene	ug/kg	333	270	81	34-141	
Hexachlorocyclopentadiene	ug/kg	333	207	62	34-124	
Hexachloroethane	ug/kg	333	221	66	60-111	
Indeno(1,2,3-cd)pyrene	ug/kg	333	258	77	53-135	
Isophorone	ug/kg	333	195	59	55-127	
N-Nitroso-di-n-propylamine	ug/kg	333	238	71	48-127	
N-Nitrosodimethylamine	ug/kg	333	240	72	27-152	
N-Nitrosodiphenylamine	ug/kg	333	267	80	33-109	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

LABORATORY CONTROL SAMPLE: 115462

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Naphthalene	ug/kg	333	252	76	52-128	
Nitrobenzene	ug/kg	333	246	74	56-109	
Pentachlorophenol	ug/kg	333	259	78	19-117	
Phenanthrene	ug/kg	333	263	79	58-134	
Phenol	ug/kg	333	212	64	53-120	
Pyrene	ug/kg	333	288	86	60-132	
2,4,6-Tribromophenol (S)	%.			55	12-124	
2-Fluorobiphenyl (S)	%.			62	46-122	
2-Fluorophenol (S)	%.			63	33-113	
Nitrobenzene-d5 (S)	%.			59	33-131	
o-Terphenyl (S)	%.			66	20-155	
Phenol-d6 (S)	%.			56	30-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115463 115464

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1,2,4-Trichlorobenzene	ug/kg	<21.0	416	411	262	295	63	72	44-111	12	40	
1,2-Dichlorobenzene	ug/kg	<21.0	416	411	216	276	52	67	49-115	25	40	
1,2-Diphenylhydrazine	ug/kg	<21.0	416	411	396	367	94	89	57-135	7	40	
1,3-Dichlorobenzene	ug/kg	<21.0	416	411	189	252	45	61	39-129	29	40	
1,4-Dichlorobenzene	ug/kg	<21.0	416	411	198	263	47	64	36-110	28	40	
2,4,5-Trichlorophenol	ug/kg	<21.0	416	411	279	273	67	67	25-151	2	40	
2,4,6-Trichlorophenol	ug/kg	<21.0	416	411	417	388	100	94	10-159	7	40	
2,4-Dichlorophenol	ug/kg	<40.8	416	411	301	292	72	71	38-131	3	40	
2,4-Dimethylphenol	ug/kg	<210	416	411	271	262	64	63	22-136	4	40	
2,4-Dinitrophenol	ug/kg	<210	416	411	222	<210	53	44	1-138		40	
2,4-Dinitrotoluene	ug/kg	<40.8	416	411	308	267	71	62	28-136	14	40	
2,6-Dinitrotoluene	ug/kg	<21.0	416	411	308	303	71	71	22-156	2	40	
2-Chloronaphthalene	ug/kg	<21.0	416	411	347	348	83	85	42-138	0	40	
2-Chlorophenol	ug/kg	<21.0	416	411	300	302	72	73	25-154	1	40	
2-Methylnaphthalene	ug/kg	<21.0	416	411	299	308	71	74	42-130	3	40	
2-Methylphenol(o-Cresol)	ug/kg	<21.0	416	411	272	263	65	64	45-113	3	40	
2-Nitroaniline	ug/kg	<21.0	416	411	345	333	80	78	48-140	4	40	
2-Nitrophenol	ug/kg	<21.0	416	411	333	323	79	77	11-147	3	40	
3&4-Methylphenol(m&p Cresol)	ug/kg	<42.1	416	411	276	263	66	64	29-164	5	40	
3-Nitroaniline	ug/kg	<408	416	411	<413	<407	56	68	4-94		40	
4,6-Dinitro-2-methylphenol	ug/kg	<210	416	411	349	268	74	56	10-114	26	40	
4-Bromophenylphenyl ether	ug/kg	<21.0	416	411	432	413	104	101	47-139	4	40	
4-Chloro-3-methylphenol	ug/kg	<21.0	416	411	325	317	77	76	18-143	2	40	
4-Chlorophenylphenyl ether	ug/kg	<21.0	416	411	349	338	84	82	34-136	3	40	
4-Nitroaniline	ug/kg	<408	416	411	<413	<407	34	39	11-115		40	
4-Nitrophenol	ug/kg	<829	416	411	<838	<826	76	73	10-163		40	
Acenaphthene	ug/kg	<21.0	416	411	370	362	88	87	52-110	2	40	

QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115463 115464

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Acenaphthylene	ug/kg	<21.0	416	411	374	366	89	88	52-139	2	40	
Anthracene	ug/kg	<21.0	416	411	362	354	84	83	48-138	2	40	
Benzo(a)anthracene	ug/kg	<105	416	411	375	369	83	83	48-134	2	40	1l
Benzo(a)pyrene	ug/kg	29.0	416	411	349	352	77	79	36-129	1	40	1l
Benzo(b)fluoranthene	ug/kg	29.7	416	411	350	378	77	85	44-141	8	40	1l
Benzo(g,h,i)perylene	ug/kg	<40.8	416	411	303	284	69	65	36-146	6	40	1l
Benzo(k)fluoranthene	ug/kg	<21.0	416	411	285	294	65	68	44-134	3	40	1l
bis(2-Chloroethoxy)methane	ug/kg	<21.0	416	411	296	297	70	72	38-144	0	40	
bis(2-Chloroethyl) ether	ug/kg	<21.0	416	411	282	291	68	71	43-129	3	40	
bis(2-Chloroisopropyl) ether	ug/kg	<21.0	416	411	277	304	67	74	48-133	9	40	
bis(2-Ethylhexyl)phthalate	ug/kg	<204	416	411	444	414	91	85	43-148	7	40	1l
Butylbenzylphthalate	ug/kg	<204	416	411	439	401	105	98	43-143	9	40	1l
Carbazole	ug/kg	<210	416	411	330	326	79	79	34-167	1	40	
Chrysene	ug/kg	<105	416	411	367	354	78	76	45-143	4	40	1l
Di-n-butylphthalate	ug/kg	<82.9	416	411	368	374	80	83	15-184	2	40	
Di-n-octylphthalate	ug/kg	<105	416	411	477	440	114	107	50-154	8	40	1l
Dibenz(a,h)anthracene	ug/kg	<40.8	416	411	333	322	76	75	38-149	4	40	1l
Dibenzofuran	ug/kg	<21.0	416	411	346	338	82	81	51-136	2	40	
Diethylphthalate	ug/kg	<21.0	416	411	333	334	79	80	43-139	0	40	
Dimethylphthalate	ug/kg	<21.0	416	411	265	252	62	60	50-138	5	40	
Fluoranthene	ug/kg	44.5	416	411	344	344	72	73	34-140	0	40	
Fluorene	ug/kg	<40.8	416	411	366	314	86	75	49-127	15	40	
Hexachloro-1,3-butadiene	ug/kg	<21.0	416	411	217	280	52	68	47-127	25	40	
Hexachlorobenzene	ug/kg	<21.0	416	411	443	420	106	102	49-134	5	40	
Hexachlorocyclopentadiene	ug/kg	<21.0	416	411	<21.3	<21.0	0	0	1-118		40	M1
Hexachloroethane	ug/kg	<21.0	416	411	107	127	26	31	33-137	17	40	M1
Indeno(1,2,3-cd)pyrene	ug/kg	<40.8	416	411	335	287	76	65	31-128	15	40	1l
Isophorone	ug/kg	<21.0	416	411	244	241	58	58	24-147	1	40	
N-Nitroso-di-n-propylamine	ug/kg	<21.0	416	411	289	301	69	73	41-123	4	40	
N-Nitrosodimethylamine	ug/kg	<40.8	416	411	279	306	67	74	18-135	9	40	
N-Nitrosodiphenylamine	ug/kg	<21.0	416	411	468	330	111	79	35-100	35	40	M1
Naphthalene	ug/kg	<21.0	416	411	301	323	72	78	32-138	7	40	
Nitrobenzene	ug/kg	<21.0	416	411	308	313	74	76	37-142	2	40	
Pentachlorophenol	ug/kg	<40.8	416	411	229	236	55	57	15-129	3	40	
Phenanthrene	ug/kg	<21.0	416	411	364	332	84	77	39-134	9	40	
Phenol	ug/kg	<210	416	411	349	457	72	100	23-140	27	40	
Pyrene	ug/kg	<105	416	411	455	462	92	95	39-145	2	40	1l
2,4,6-Tribromophenol (S)	%.						49	47	12-124			
2-Fluorobiphenyl (S)	%.						67	66	46-122			
2-Fluorophenol (S)	%.						67	64	33-113			
Nitrobenzene-d5 (S)	%.						63	63	33-131			
o-Terphenyl (S)	%.						70	67	20-155			
Phenol-d6 (S)	%.						58	58	30-115			

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615231

QC Batch: 28809
QC Batch Method: SM 2540 G-11/3550
Analysis Method: SM 2540 G-11/3550
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 4615231001

SAMPLE DUPLICATE: 115175

Parameter	Units	4615201001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	21.0	20.6	2	20	

SAMPLE DUPLICATE: 115176

Parameter	Units	4615138031 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	0.10 U	<0.10		20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project: Sugar Island
Pace Project No.: 4615231

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

ANALYTE QUALIFIERS

1l	Due to sample matrix related internal standard failure, this sample was analyzed at a dilution. The RL for this analyte has been elevated.
2l	Due to sample matrix-related internal standard failure, the sample was reanalyzed at dilution. The RL for this analyte has been elevated.
D3	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
E	Analyte concentration exceeded the calibration range. The reported result is estimated.
M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.
M6	Matrix spike and Matrix spike duplicate recovery not evaluated against control limits due to sample dilution.
N2	The lab does not hold NELAC/TNI accreditation for this parameter.
R1	RPD value was outside control limits.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Sugar Island
Pace Project No.: 4615231

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
4615231001	**VIB-1**	EPA 3545A	28656	EPA 8082A	28744
4615231001	**VIB-1**	EPA 3050B	28681	EPA 6010C	28906
4615231001	**VIB-1**	EPA 3050B	28971	EPA 6010C	29125
4615231001	**VIB-1**	EPA 3050B	28682	EPA 6020A	28937
4615231001	**VIB-1**	EPA 7471B	28792	EPA 7471B	28885
4615231001	**VIB-1**	EPA 3550C	28882	EPA 8270C	28988
4615231001	**VIB-1**	EPA 5035A	28699	EPA 8260B	28771
4615231001	**VIB-1**	SM 2540 G-11/3550	28809		

WO#:4615231

4615231

C.

Check originating office

☐ **Corporate Office**
501 Avis Drive
Ann Arbor, MI 48108
Phone (734) 332-1200
Fax (734) 332-1212

☐ **Kalamazoo Field Office**
2980 Business One Drive
Kalamazoo, MI 49048
Phone (269) 226-0190
Fax (269) 226-0192

CHAIN OF CUSTODY RECORD

PROJ. NO.:

PROJECT NAME: SUGAR ISLAND

SAMPLERS: (Signature) BETZ

7-3

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	Sample Matrix	# of Containers	PCB SVOC TAL metals	VOC					REMARKS
	7/10/18	9:15		X	VIB-1	sed	2	X	X					

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)
Cathy Whiting	7/20	16:00	

Relinquished by: (Signature)	DATE	TIME	Received by: (Signature)

Relinquished by: (Signature)	DATE	TIME	Received for Laboratory by: (Signature)

LABORATORY SENT TO: PACE ANALYTICAL

LABORATORY CONTACT: JENNIFER RICE

SHIPPING CARRIER: FED EX

TRACKING NUMBER:

DATE	TIME	Requested Turnaround Time:

SAMPLE RECEIVING / LOG-IN CHECKLIST

Pace Analytical®

Client: Limno Tech
Work Order #: 4615C31
Receipt Record Page/Line #: 7-3

Recorded by (initials/date): PS 7/21/18

☒ Cooler
☐ Box
☐ Other________

Qty Received: 1

Thermometer Used:
☒ IR Gun (#202)
☐ Digital Thermometer (#54)
☐ IR Gun (#402)

Cooler #: Blu
Time: 1051

Custody Seals:
☒ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☒ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
[✓ Dispersed] / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☒ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1	3.4		3.4
Sample 2	3.0		3.0
Sample 3			

When above 6 °C take a
3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler #:
Time:

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a
3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler #:
Time:

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a
3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler #:
Time:

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a
3 Sample Average °C:

☐ VOC Trip Blank received?

If any shaded areas checked, complete Sample Receiving Non-Conformance

Paperwork Received

Yes	No	
☒	☐	Chain of Custody record(s)? If No, Initiated By ________
☒		Received for Lab Signed/Date/Time?
☐	☒	USDA Soil Documents?
☐	☒	Sampling / Field Forms?
☐	☒	Other ________

COC Information

☒ Pace COC ☐ Other________

COC ID Numbers:

Check COC for Accuracy

Yes	No	
☒	☐	Analysis Requested?
☒	☐	Sample ID matches COC?
☒	☐	Sample Date and Time matches COC?
☒	☐	All containers indicated are received?

Sample Condition Summary

N/A	Yes	No	
	☐	☒	Broken containers/lids?
	☐	☒	Missing or incomplete labels?
	☐	☒	Illegible information on labels?
	☐	☒	Low volume received?
	☐	☒	Inappropriate or non-Pace containers received?
☐	☐	☒	VOC vials have headspace?
	☐	☒	Extra sample locations?
	☐	☒	Containers not listed on COC?

Check Sample Preservation

N/A	Yes	No	
	☐	☒	Temperature Blank **OR** average sample temperature, ≥6° C?
☒	☐	☐	If "Yes" was thermal preservation required?
☒	☐	☐	If "Yes" were ALL samples collected the same day as receipt?
☒	☐		Completed Sample Preservation Verification Form?
☒	☐	☐	Samples chemically preserved correctly?
☒	☐		If "No", add wire tag and fill out Non-Conformance Form?
☒	☐		Received unpreserved Terracore kit?
			If "Yes" unpreserved vials must be frozen

Work Order Not Logged In with Short Hold / Rush

☐ Copies of COC To Lab Areas

Notes

Yes	No	
☒	☐	Were all samples logged into Epic?
☒	☐	Were all samples labelled?
☒	☐	Were samples placed on scan locations?

Initial / Date : PS 7/21/18

Pace Analytical Services, LLC
5560 Corporate Exchange Ct. SE
Grand Rapids, MI 49512
(616)975-4500

July 31, 2018

Robert Betz
LimnoTech
501 Avis Drive
Ann Arbor, MI 48108

RE: Project: Sugar Island
Pace Project No.: 4615201

Dear Robert Betz:

Enclosed are the analytical results for sample(s) received by the laboratory on July 20, 2018. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

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

Sincerely,

Melanie S Booms

Melanie Booms
melanie.booms@pacelabs.com
(616)975-4500
Project Manager

Enclosures

CERTIFICATIONS

Project:	Sugar Island
Pace Project No.:	4615201

Grand Rapids Certification ID's

5560 Corporate Exchange Ct SE, Grand Rapids, MI 49512
Minnesota Department of Health, Certificate #1385941
Arkansas Department of Environmental Quality, Certificate #18-046-0
Georgia Environmental Protection Division, Stipulation
Illinois Environmental Protection Agency, Certificate #004325
Michigan Department of Environmental Quality, Laboratory #0034
New York State Department of Health, Serial #57971 and 57972
North Carolina Division of Water Resources, Certificate #659
Virginia Department of General Services, Certificate #9780
Wisconsin Department of Natural Resources, Laboratory #999472650
U.S. Department of Agriculture Permit to Receive Soil, Permit #P330-17-00278

SAMPLE SUMMARY

Project: Sugar Island
Pace Project No.: 4615201

Lab ID	Sample ID	Matrix	Date Collected	Date Received
4615201001	**VIB-6**	Solid	07/18/18 13:15	07/20/18 08:30

This report shall not be reproduced, except in full,
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SAMPLE ANALYTE COUNT

Project: Sugar Island
Pace Project No.: 4615201

Lab ID	Sample ID	Method	Analysts	Analytes Reported
4615201001	**VIB-6**	EPA 8082A	MSZ	9
		EPA 6010C	KLV	6
		EPA 6020A	DWJ	16
		EPA 7471B	DWJ	1
		EPA 8270C	JHB	70
		EPA 8260B	DLV	76
		SM 2540 G-11/3550	NS1	1

ANALYTICAL RESULTS

Project:	Sugar Island
Pace Project No.:	4615201

Sample: VIB-6 **Lab ID: 4615201001** Collected: 07/18/18 13:15 Received: 07/20/18 08:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS Solids ASE	Analytical Method: EPA 8082A Preparation Method: EPA 3545A							
PCB-1016 (Aroclor 1016)	**<41.3**	ug/kg	41.3	1	07/23/18 07:57	07/23/18 21:16	12674-11-2	
PCB-1221 (Aroclor 1221)	**<41.3**	ug/kg	41.3	1	07/23/18 07:57	07/23/18 21:16	11104-28-2	
PCB-1232 (Aroclor 1232)	**<41.3**	ug/kg	41.3	1	07/23/18 07:57	07/23/18 21:16	11141-16-5	
PCB-1242 (Aroclor 1242)	**<41.3**	ug/kg	41.3	1	07/23/18 07:57	07/23/18 21:16	53469-21-9	
PCB-1248 (Aroclor 1248)	**<41.3**	ug/kg	41.3	1	07/23/18 07:57	07/23/18 21:16	12672-29-6	
PCB-1254 (Aroclor 1254)	**<41.3**	ug/kg	41.3	1	07/23/18 07:57	07/23/18 21:16	11097-69-1	
PCB-1260 (Aroclor 1260)	**<41.3**	ug/kg	41.3	1	07/23/18 07:57	07/23/18 21:16	11096-82-5	
Surrogates								
Decachlorobiphenyl (S)	87	%.	45-135	1	07/23/18 07:57	07/23/18 21:16	2051-24-3	
Tetrachloro-m-xylene (S)	88	%.	56-123	1	07/23/18 07:57	07/23/18 21:16	877-09-8	
6010C MET ICP	Analytical Method: EPA 6010C Preparation Method: EPA 3050B							
Aluminum	**8140000**	ug/kg	58700	5	07/24/18 06:53	07/25/18 10:36	7429-90-5	D3,M1, R1
Calcium	**97100000**	ug/kg	294000	5	07/24/18 06:53	07/25/18 10:36	7440-70-2	M1
Iron	**22600000**	ug/kg	616000	100	07/26/18 07:28	07/27/18 08:16	7439-89-6	M6
Magnesium	**16800000**	ug/kg	58700	1	07/24/18 06:53	07/25/18 10:07	7439-95-4	M1
Potassium	**2020000**	ug/kg	58700	1	07/24/18 06:53	07/25/18 10:07	7440-09-7	M1,R1
Sodium	**207000**	ug/kg	58700	1	07/24/18 06:53	07/25/18 10:07	7440-23-5	
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050B							
Antimony	**<125**	ug/kg	125	1	07/24/18 06:53	07/25/18 14:01	7440-36-0	M1
Arsenic	**4150**	ug/kg	624	5	07/24/18 06:53	07/25/18 12:30	7440-38-2	M1,R1
Barium	**49100**	ug/kg	3120	25	07/24/18 06:53	07/25/18 13:53	7440-39-3	M1,R1
Beryllium	**400**	ug/kg	125	1	07/24/18 06:53	07/25/18 14:01	7440-41-7	
Cadmium	**70.8**	ug/kg	62.4	1	07/24/18 06:53	07/25/18 14:01	7440-43-9	
Chromium	**13900**	ug/kg	624	5	07/24/18 06:53	07/25/18 12:30	7440-47-3	M1
Cobalt	**7870**	ug/kg	624	5	07/24/18 06:53	07/25/18 12:30	7440-48-4	
Copper	**14400**	ug/kg	624	5	07/24/18 06:53	07/25/18 12:30	7440-50-8	M1
Lead	**8180**	ug/kg	624	5	07/24/18 06:53	07/25/18 12:30	7439-92-1	
Manganese	**449000**	ug/kg	31200	250	07/24/18 06:53	07/25/18 13:45	7439-96-5	M1
Nickel	**18800**	ug/kg	624	5	07/24/18 06:53	07/25/18 12:30	7440-02-0	
Selenium	**3210**	ug/kg	624	5	07/24/18 06:53	07/25/18 12:30	7782-49-2	
Silver	**<62.4**	ug/kg	62.4	1	07/24/18 06:53	07/25/18 14:01	7440-22-4	
Thallium	**<312**	ug/kg	312	5	07/24/18 06:53	07/25/18 12:30	7440-28-0	2l
Vanadium	**18600**	ug/kg	624	5	07/24/18 06:53	07/25/18 12:30	7440-62-2	M1
Zinc	**40400**	ug/kg	31200	25	07/24/18 06:53	07/25/18 13:53	7440-66-6	M1
7471 Mercury	Analytical Method: EPA 7471B Preparation Method: EPA 7471B							
Mercury	**<58.8**	ug/kg	58.8	1	07/24/18 10:08	07/25/18 08:29	7439-97-6	
8270C MSSV Solid	Analytical Method: EPA 8270C Preparation Method: EPA 3550C							
Acenaphthene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	83-32-9	
Acenaphthylene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	208-96-8	
Anthracene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	120-12-7	
Benzo(a)anthracene	**<105**	ug/kg	105	5	07/25/18 07:00	07/27/18 13:45	56-55-3	1l

ANALYTICAL RESULTS

Project: Sugar Island
Pace Project No.: 4615201

Sample: VIB-6 **Lab ID: 4615201001** Collected: 07/18/18 13:15 Received: 07/20/18 08:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8270C MSSV Solid	Analytical Method: EPA 8270C Preparation Method: EPA 3550C							
Benzo(a)pyrene	**29.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	50-32-8	
Benzo(b)fluoranthene	**29.7**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	205-99-2	
Benzo(g,h,i)perylene	**<40.8**	ug/kg	40.8	1	07/25/18 07:00	07/27/18 16:06	191-24-2	
Benzo(k)fluoranthene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	207-08-9	
4-Bromophenylphenyl ether	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	101-55-3	
Butylbenzylphthalate	**<204**	ug/kg	204	5	07/25/18 07:00	07/27/18 13:45	85-68-7	1l
Carbazole	**<210**	ug/kg	210	1	07/25/18 07:00	07/27/18 16:06	86-74-8	
4-Chloro-3-methylphenol	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	59-50-7	
bis(2-Chloroethoxy)methane	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	111-91-1	
bis(2-Chloroethyl) ether	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	111-44-4	
bis(2-Chloroisopropyl) ether	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	108-60-1	
2-Chloronaphthalene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	91-58-7	
2-Chlorophenol	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	95-57-8	
4-Chlorophenylphenyl ether	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	7005-72-3	
Chrysene	**<105**	ug/kg	105	5	07/25/18 07:00	07/27/18 13:45	218-01-9	1l
Dibenz(a,h)anthracene	**<40.8**	ug/kg	40.8	1	07/25/18 07:00	07/27/18 16:06	53-70-3	
Dibenzofuran	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	132-64-9	
1,2-Dichlorobenzene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	95-50-1	
1,3-Dichlorobenzene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	541-73-1	
1,4-Dichlorobenzene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	106-46-7	
2,4-Dichlorophenol	**<40.8**	ug/kg	40.8	1	07/25/18 07:00	07/27/18 16:06	120-83-2	
Diethylphthalate	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	84-66-2	
2,4-Dimethylphenol	**<210**	ug/kg	210	1	07/25/18 07:00	07/27/18 16:06	105-67-9	
Dimethylphthalate	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	131-11-3	
Di-n-butylphthalate	**<82.9**	ug/kg	82.9	1	07/25/18 07:00	07/27/18 16:06	84-74-2	
4,6-Dinitro-2-methylphenol	**<210**	ug/kg	210	1	07/25/18 07:00	07/27/18 16:06	534-52-1	
2,4-Dinitrophenol	**<210**	ug/kg	210	1	07/25/18 07:00	07/27/18 16:06	51-28-5	
2,4-Dinitrotoluene	**<40.8**	ug/kg	40.8	1	07/25/18 07:00	07/27/18 16:06	121-14-2	
2,6-Dinitrotoluene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	606-20-2	
Di-n-octylphthalate	**<105**	ug/kg	105	5	07/25/18 07:00	07/27/18 13:45	117-84-0	1l
1,2-Diphenylhydrazine	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	122-66-7	
bis(2-Ethylhexyl)phthalate	**<204**	ug/kg	204	5	07/25/18 07:00	07/27/18 13:45	117-81-7	1l
Fluoranthene	**44.5**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	206-44-0	
Fluorene	**<40.8**	ug/kg	40.8	1	07/25/18 07:00	07/27/18 16:06	86-73-7	
Hexachloro-1,3-butadiene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	87-68-3	
Hexachlorobenzene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	118-74-1	
Hexachlorocyclopentadiene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	77-47-4	M1
Hexachloroethane	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	67-72-1	M1
Indeno(1,2,3-cd)pyrene	**<40.8**	ug/kg	40.8	1	07/25/18 07:00	07/27/18 16:06	193-39-5	
Isophorone	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	78-59-1	
2-Methylnaphthalene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	91-57-6	
2-Methylphenol(o-Cresol)	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	95-48-7	
3&4-Methylphenol(m&p Cresol)	**<42.1**	ug/kg	42.1	1	07/25/18 07:00	07/27/18 16:06		
Naphthalene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	91-20-3	
2-Nitroaniline	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	88-74-4	
3-Nitroaniline	**<408**	ug/kg	408	1	07/25/18 07:00	07/27/18 16:06	99-09-2	

ANALYTICAL RESULTS

Project: Sugar Island
Pace Project No.: 4615201

Sample: VIB-6 **Lab ID: 4615201001** Collected: 07/18/18 13:15 Received: 07/20/18 08:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8270C MSSV Solid	Analytical Method: EPA 8270C Preparation Method: EPA 3550C							
4-Nitroaniline	**<408**	ug/kg	408	1	07/25/18 07:00	07/27/18 16:06	100-01-6	
Nitrobenzene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	98-95-3	
2-Nitrophenol	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	88-75-5	
4-Nitrophenol	**<829**	ug/kg	829	1	07/25/18 07:00	07/27/18 16:06	100-02-7	
N-Nitrosodimethylamine	**<40.8**	ug/kg	40.8	1	07/25/18 07:00	07/27/18 16:06	62-75-9	
N-Nitroso-di-n-propylamine	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	621-64-7	
N-Nitrosodiphenylamine	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	86-30-6	M1
Pentachlorophenol	**<40.8**	ug/kg	40.8	1	07/25/18 07:00	07/27/18 16:06	87-86-5	
Phenanthrene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	85-01-8	
Phenol	**<210**	ug/kg	210	1	07/25/18 07:00	07/27/18 16:06	108-95-2	
Pyrene	**<105**	ug/kg	105	5	07/25/18 07:00	07/27/18 13:45	129-00-0	
1,2,4-Trichlorobenzene	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	120-82-1	
2,4,5-Trichlorophenol	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	95-95-4	
2,4,6-Trichlorophenol	**<21.0**	ug/kg	21.0	1	07/25/18 07:00	07/27/18 16:06	88-06-2	
Surrogates								
Nitrobenzene-d5 (S)	64	%.	33-131	1	07/25/18 07:00	07/27/18 16:06	4165-60-0	
2-Fluorobiphenyl (S)	61	%.	46-122	1	07/25/18 07:00	07/27/18 16:06	321-60-8	
o-Terphenyl (S)	66	%.	20-155	1	07/25/18 07:00	07/27/18 16:06	84-15-1	
Phenol-d6 (S)	68	%.	30-115	1	07/25/18 07:00	07/27/18 16:06	13127-88-3	
2-Fluorophenol (S)	74	%.	33-113	1	07/25/18 07:00	07/27/18 16:06	367-12-4	
2,4,6-Tribromophenol (S)	44	%.	12-124	1	07/25/18 07:00	07/27/18 16:06	118-79-6	
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B Preparation Method: EPA 5035A							
Acetone	**<887**	ug/kg	887	1	07/23/18 12:00	07/23/18 21:17	67-64-1	
Acrylonitrile	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	107-13-1	
tert-Amylmethyl ether	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	994-05-8	
Benzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	71-43-2	
Bromobenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	108-86-1	
Bromochloromethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	74-97-5	
Bromodichloromethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	75-27-4	
Bromoform	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	75-25-2	
Bromomethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	74-83-9	
2-Butanone (MEK)	**<2960**	ug/kg	2960	1	07/23/18 12:00	07/23/18 21:17	78-93-3	
tert-Butyl Alcohol	**<2960**	ug/kg	2960	1	07/23/18 12:00	07/23/18 21:17	75-65-0	
n-Butylbenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	104-51-8	
sec-Butylbenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	135-98-8	
tert-Butylbenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	98-06-6	
Carbon disulfide	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	75-15-0	
Carbon tetrachloride	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	56-23-5	
Chlorobenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	108-90-7	
Chloroethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	75-00-3	
Chloroform	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	67-66-3	
Chloromethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	74-87-3	
Cyclohexane	**<2960**	ug/kg	2960	1	07/23/18 12:00	07/23/18 21:17	110-82-7	
1,2-Dibromo-3-chloropropane	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	96-12-8	
Dibromochloromethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	124-48-1	

ANALYTICAL RESULTS

Project: Sugar Island
Pace Project No.: 4615201

Sample: VIB-6 **Lab ID: 4615201001** Collected: 07/18/18 13:15 Received: 07/20/18 08:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B		Preparation Method: EPA 5035A					
1,2-Dibromoethane (EDB)	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	106-93-4	
Dibromomethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	74-95-3	
1,2-Dichlorobenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	95-50-1	
1,3-Dichlorobenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	541-73-1	
1,4-Dichlorobenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	106-46-7	
trans-1,4-Dichloro-2-butene	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	110-57-6	
Dichlorodifluoromethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	75-71-8	
1,1-Dichloroethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	75-34-3	
1,2-Dichloroethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	107-06-2	
1,1-Dichloroethene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	75-35-4	
cis-1,2-Dichloroethene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	156-59-2	
trans-1,2-Dichloroethene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	156-60-5	
1,2-Dichloropropane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	78-87-5	
cis-1,3-Dichloropropene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	10061-01-5	
trans-1,3-Dichloropropene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	10061-02-6	
Diethyl ether (Ethyl ether)	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	60-29-7	
Diisopropyl ether	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	108-20-3	
Ethylbenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	100-41-4	
Ethyl-tert-butyl ether	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	637-92-3	
Hexachloroethane	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	67-72-1	
2-Hexanone	**<2960**	ug/kg	2960	1	07/23/18 12:00	07/23/18 21:17	591-78-6	
Iodomethane	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	74-88-4	
Isopropylbenzene (Cumene)	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	98-82-8	
p-Isopropyltoluene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	99-87-6	
Methylene Chloride	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	75-09-2	
2-Methylnaphthalene	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	91-57-6	N2
4-Methyl-2-pentanone (MIBK)	**<2960**	ug/kg	2960	1	07/23/18 12:00	07/23/18 21:17	108-10-1	
Methyl-tert-butyl ether	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	1634-04-4	
Naphthalene	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	91-20-3	
n-Propylbenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	103-65-1	
Styrene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	100-42-5	
1,1,1,2-Tetrachloroethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	630-20-6	
1,1,2,2-Tetrachloroethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	79-34-5	
Tetrachloroethene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	127-18-4	
Tetrahydrofuran	**<296**	ug/kg	296	1	07/23/18 12:00	07/23/18 21:17	109-99-9	
Toluene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	108-88-3	
1,2,3-Trichlorobenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	87-61-6	
1,2,4-Trichlorobenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	120-82-1	
1,1,1-Trichloroethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	71-55-6	
1,1,2-Trichloroethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	79-00-5	
Trichloroethene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	79-01-6	
Trichlorofluoromethane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	75-69-4	
1,2,3-Trichloropropane	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	96-18-4	
1,2,3-Trimethylbenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	526-73-8	
1,2,4-Trimethylbenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	95-63-6	
1,3,5-Trimethylbenzene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	108-67-8	

ANALYTICAL RESULTS

Project: Sugar Island
Pace Project No.: 4615201

Sample: VIB-6 **Lab ID: 4615201001** Collected: 07/18/18 13:15 Received: 07/20/18 08:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260B MSV 5035A Med Level	Analytical Method: EPA 8260B Preparation Method: EPA 5035A							
Vinyl chloride	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	75-01-4	
m&p-Xylene	**<118**	ug/kg	118	1	07/23/18 12:00	07/23/18 21:17	179601-23-1	
o-Xylene	**<59.1**	ug/kg	59.1	1	07/23/18 12:00	07/23/18 21:17	95-47-6	
Surrogates								
Dibromofluoromethane (S)	96	%.	75-123	1	07/23/18 12:00	07/23/18 21:17	1868-53-7	
Toluene-d8 (S)	97	%.	85-113	1	07/23/18 12:00	07/23/18 21:17	2037-26-5	
4-Bromofluorobenzene (S)	95	%.	81-117	1	07/23/18 12:00	07/23/18 21:17	460-00-4	
1,2-Dichloroethane-d4 (S)	101	%.	83-116	1	07/23/18 12:00	07/23/18 21:17	17060-07-0	
Percent Moisture	Analytical Method: SM 2540 G-11/3550							
Percent Moisture	**21.0**	%	0.10	1		07/24/18 19:13		

QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

QC Batch: 28792
QC Batch Method: EPA 7471B
Analysis Method: EPA 7471B
Analysis Description: 7471 Mercury
Associated Lab Samples: 4615201001

METHOD BLANK: 115103
Matrix: Solid
Associated Lab Samples: 4615201001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Mercury	ug/kg	<46.1	46.1	07/25/18 08:19	

LABORATORY CONTROL SAMPLE: 115104

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mercury	ug/kg	311	274	88	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115105 115106

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mercury	ug/kg	<58.8	409	390	375	368	88	90	80-120	2	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

QC Batch: 28681
QC Batch Method: EPA 3050B
Analysis Method: EPA 6010C
Analysis Description: 6010 MET
Associated Lab Samples: 4615201001

METHOD BLANK: 114764
Matrix: Solid
Associated Lab Samples: 4615201001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Aluminum	ug/kg	<9710	9710	07/25/18 10:03	
Calcium	ug/kg	<48600	48600	07/25/18 10:03	
Magnesium	ug/kg	<48600	48600	07/25/18 10:03	
Potassium	ug/kg	<48600	48600	07/25/18 10:03	
Sodium	ug/kg	<48600	48600	07/25/18 10:03	

LABORATORY CONTROL SAMPLE: 114765

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Aluminum	ug/kg	94700	112000	118	80-120	
Calcium	ug/kg	947000	965000	102	80-120	
Magnesium	ug/kg	947000	977000	103	80-120	
Potassium	ug/kg	947000	960000	101	80-120	
Sodium	ug/kg	947000	982000	104	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 114766 114767

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Aluminum	ug/kg	8140000	122000	119000	10200000	12700000	1660	3850	75-125	22	20	M1,R1
Calcium	ug/kg	97100000	1220000	1190000	95600000	112000000	-119	1280	75-125	16	20	M1
Magnesium	ug/kg	16800000	1220000	1190000	16700000	18600000	-9	148	75-125	11	20	M1
Potassium	ug/kg	2020000	1220000	1190000	4100000	5250000	171	271	75-125	24	20	M1,R1
Sodium	ug/kg	207000	1220000	1190000	1560000	1550000	111	112	75-125	1	20	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

QC Batch: 28971
QC Batch Method: EPA 3050B
Analysis Method: EPA 6010C
Analysis Description: 6010 MET
Associated Lab Samples: 4615201001

METHOD BLANK: 115813
Matrix: Solid
Associated Lab Samples: 4615201001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Iron	ug/kg	<4620	4620	07/27/18 08:12	

LABORATORY CONTROL SAMPLE: 115814

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Iron	ug/kg	18800	17500	93	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115815 115816

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Iron	ug/kg	22600000	24900	24500	21500000	21500000	-4610	-4630	75-125	0	20	M6

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

QC Batch: 28682
Analysis Method: EPA 6020A
QC Batch Method: EPA 3050B
Analysis Description: 6020A MET
Associated Lab Samples: 4615201001

METHOD BLANK: 114768
Matrix: Solid
Associated Lab Samples: 4615201001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Antimony	ug/kg	<97.2	97.2	07/25/18 12:24	
Arsenic	ug/kg	<97.2	97.2	07/25/18 12:24	
Barium	ug/kg	<97.2	97.2	07/25/18 12:24	
Beryllium	ug/kg	<97.2	97.2	07/25/18 12:24	
Cadmium	ug/kg	<48.6	48.6	07/25/18 12:24	
Chromium	ug/kg	<97.2	97.2	07/25/18 12:24	
Cobalt	ug/kg	<97.2	97.2	07/25/18 12:24	
Copper	ug/kg	<97.2	97.2	07/25/18 12:24	
Lead	ug/kg	<97.2	97.2	07/25/18 12:24	
Manganese	ug/kg	<97.2	97.2	07/25/18 12:24	
Nickel	ug/kg	<97.2	97.2	07/25/18 12:24	
Selenium	ug/kg	<97.2	97.2	07/25/18 12:24	
Silver	ug/kg	<48.6	48.6	07/25/18 12:24	
Thallium	ug/kg	<48.6	48.6	07/25/18 12:24	
Vanadium	ug/kg	<97.2	97.2	07/25/18 12:24	
Zinc	ug/kg	<972	972	07/25/18 12:24	

LABORATORY CONTROL SAMPLE: 114769

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Antimony	ug/kg	1900	1840	97	80-120	
Arsenic	ug/kg	1900	1810	95	80-120	
Barium	ug/kg	1900	1800	95	80-120	
Beryllium	ug/kg	1900	1600	84	80-120	
Cadmium	ug/kg	1900	1700	90	80-120	
Chromium	ug/kg	1900	1960	103	80-120	
Cobalt	ug/kg	1900	1960	103	80-120	
Copper	ug/kg	1900	1910	101	80-120	
Lead	ug/kg	1900	1910	101	80-120	
Manganese	ug/kg	1900	2020	106	80-120	
Nickel	ug/kg	1900	1920	101	80-120	
Selenium	ug/kg	1900	1590	84	80-120	
Silver	ug/kg	1900	1830	97	80-120	
Thallium	ug/kg	1900	1890	100	80-120	
Vanadium	ug/kg	1900	1910	101	80-120	
Zinc	ug/kg	1900	1850	98	80-120	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 114770 114771

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Antimony	ug/kg	<125	2510	2480	<126	<124	4	4	75-125		20	M1
Arsenic	ug/kg	4150	2510	2480	8300	6650	166	101	75-125	22	20	M1,R1
Barium	ug/kg	49100	2510	2480	53300	65900	165	679	75-125	21	20	E,M1, R1
Beryllium	ug/kg	400	2510	2480	2450	2610	82	89	75-125	6	20	
Cadmium	ug/kg	70.8	2510	2480	2470	2510	96	98	75-125	1	20	
Chromium	ug/kg	13900	2510	2480	15500	18300	66	177	75-125	16	20	M1
Cobalt	ug/kg	7870	2510	2480	10700	10800	113	118	75-125	1	20	
Copper	ug/kg	14400	2510	2480	19600	18900	207	182	75-125	4	20	M1
Lead	ug/kg	8180	2510	2480	11300	11300	125	124	75-125	0	20	
Manganese	ug/kg	449000	2510	2480	537000	528000	3510	3190	75-125	2	20	E,M1
Nickel	ug/kg	18800	2510	2480	20700	21300	79	102	75-125	3	20	
Selenium	ug/kg	3210	2510	2480	5940	5860	109	107	75-125	1	20	
Silver	ug/kg	<62.4	2510	2480	2090	2180	82	87	75-125	4	20	
Thallium	ug/kg	<312	2510	2480	2710	2680	101	102	75-125	1	20	
Vanadium	ug/kg	18600	2510	2480	22700	24600	162	242	75-125	8	20	M1
Zinc	ug/kg	40400	2510	2480	57400	48900	679	345	75-125	16	20	E,M1

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

QC Batch: 28699
Analysis Method: EPA 8260B
QC Batch Method: EPA 5035A
Analysis Description: 8260B MSV 5035A Med Level
Associated Lab Samples: 4615201001

METHOD BLANK: 114822
Matrix: Solid
Associated Lab Samples: 4615201001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,1,1,2-Tetrachloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,1,1-Trichloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,1,2,2-Tetrachloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,1,2-Trichloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,1-Dichloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,1-Dichloroethene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2,3-Trichlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2,3-Trichloropropane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2,3-Trimethylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2,4-Trichlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2,4-Trimethylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2-Dibromo-3-chloropropane	ug/kg	<250	250	07/23/18 17:13	
1,2-Dibromoethane (EDB)	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2-Dichlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2-Dichloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2-Dichloropropane	ug/kg	<50.0	50.0	07/23/18 17:13	
1,3,5-Trimethylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,3-Dichlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
1,4-Dichlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
2-Butanone (MEK)	ug/kg	<2500	2500	07/23/18 17:13	
2-Hexanone	ug/kg	<2500	2500	07/23/18 17:13	
2-Methylnaphthalene	ug/kg	<250	250	07/23/18 17:13	N2
4-Methyl-2-pentanone (MIBK)	ug/kg	<2500	2500	07/23/18 17:13	
Acetone	ug/kg	<750	750	07/23/18 17:13	
Acrylonitrile	ug/kg	<250	250	07/23/18 17:13	
Benzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Bromobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Bromochloromethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Bromodichloromethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Bromoform	ug/kg	<50.0	50.0	07/23/18 17:13	
Bromomethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Carbon disulfide	ug/kg	<250	250	07/23/18 17:13	
Carbon tetrachloride	ug/kg	<50.0	50.0	07/23/18 17:13	
Chlorobenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Chloroethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Chloroform	ug/kg	<50.0	50.0	07/23/18 17:13	
Chloromethane	ug/kg	<50.0	50.0	07/23/18 17:13	
cis-1,2-Dichloroethene	ug/kg	<50.0	50.0	07/23/18 17:13	
cis-1,3-Dichloropropene	ug/kg	<50.0	50.0	07/23/18 17:13	
Cyclohexane	ug/kg	<2500	2500	07/23/18 17:13	
Dibromochloromethane	ug/kg	<50.0	50.0	07/23/18 17:13	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

METHOD BLANK: 114822 Matrix: Solid
Associated Lab Samples: 4615201001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Dibromomethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Dichlorodifluoromethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Diethyl ether (Ethyl ether)	ug/kg	<50.0	50.0	07/23/18 17:13	
Diisopropyl ether	ug/kg	<250	250	07/23/18 17:13	
Ethyl-tert-butyl ether	ug/kg	<250	250	07/23/18 17:13	
Ethylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Hexachloroethane	ug/kg	<250	250	07/23/18 17:13	
Iodomethane	ug/kg	<250	250	07/23/18 17:13	
Isopropylbenzene (Cumene)	ug/kg	<50.0	50.0	07/23/18 17:13	
m&p-Xylene	ug/kg	<100	100	07/23/18 17:13	
Methyl-tert-butyl ether	ug/kg	<50.0	50.0	07/23/18 17:13	
Methylene Chloride	ug/kg	<250	250	07/23/18 17:13	
n-Butylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
n-Propylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Naphthalene	ug/kg	<250	250	07/23/18 17:13	
o-Xylene	ug/kg	<50.0	50.0	07/23/18 17:13	
p-Isopropyltoluene	ug/kg	<50.0	50.0	07/23/18 17:13	
sec-Butylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Styrene	ug/kg	<50.0	50.0	07/23/18 17:13	
tert-Amylmethyl ether	ug/kg	<250	250	07/23/18 17:13	
tert-Butyl Alcohol	ug/kg	<2500	2500	07/23/18 17:13	
tert-Butylbenzene	ug/kg	<50.0	50.0	07/23/18 17:13	
Tetrachloroethene	ug/kg	<50.0	50.0	07/23/18 17:13	
Tetrahydrofuran	ug/kg	<250	250	07/23/18 17:13	
Toluene	ug/kg	<50.0	50.0	07/23/18 17:13	
trans-1,2-Dichloroethene	ug/kg	<50.0	50.0	07/23/18 17:13	
trans-1,3-Dichloropropene	ug/kg	<50.0	50.0	07/23/18 17:13	
trans-1,4-Dichloro-2-butene	ug/kg	<250	250	07/23/18 17:13	
Trichloroethene	ug/kg	<50.0	50.0	07/23/18 17:13	
Trichlorofluoromethane	ug/kg	<50.0	50.0	07/23/18 17:13	
Vinyl chloride	ug/kg	<50.0	50.0	07/23/18 17:13	
1,2-Dichloroethane-d4 (S)	%.	101	83-116	07/23/18 17:13	
4-Bromofluorobenzene (S)	%.	96	81-117	07/23/18 17:13	
Dibromofluoromethane (S)	%.	94	75-123	07/23/18 17:13	
Toluene-d8 (S)	%.	96	85-113	07/23/18 17:13	

LABORATORY CONTROL SAMPLE: 114823

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1,1,2-Tetrachloroethane	ug/kg	2000	2060	103	83-116	
1,1,1-Trichloroethane	ug/kg	2000	2050	102	84-121	
1,1,2,2-Tetrachloroethane	ug/kg	2000	1970	98	75-125	
1,1,2-Trichloroethane	ug/kg	2000	2010	101	85-120	
1,1-Dichloroethane	ug/kg	2000	2060	103	81-121	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

LABORATORY CONTROL SAMPLE: 114823

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1-Dichloroethene	ug/kg	2000	1980	99	80-121	
1,2,3-Trichlorobenzene	ug/kg	2000	2170	109	66-129	
1,2,3-Trichloropropane	ug/kg	2000	2130	107	73-125	
1,2,3-Trimethylbenzene	ug/kg	2000	1930	96	70-130	
1,2,4-Trichlorobenzene	ug/kg	2000	2120	106	66-133	
1,2,4-Trimethylbenzene	ug/kg	2000	2060	103	85-118	
1,2-Dibromo-3-chloropropane	ug/kg	2000	1800	90	51-132	
1,2-Dibromoethane (EDB)	ug/kg	2000	2080	104	81-118	
1,2-Dichlorobenzene	ug/kg	2000	1970	99	82-124	
1,2-Dichloroethane	ug/kg	2000	2010	101	82-119	
1,2-Dichloropropane	ug/kg	2000	2000	100	80-122	
1,3,5-Trimethylbenzene	ug/kg	2000	2080	104	85-119	
1,3-Dichlorobenzene	ug/kg	2000	2030	101	85-119	
1,4-Dichlorobenzene	ug/kg	2000	1960	98	85-119	
2-Butanone (MEK)	ug/kg	2000	<2500	108	68-130	
2-Hexanone	ug/kg	2000	<2500	101	63-131	
2-Methylnaphthalene	ug/kg	2000	1850	92	42-131	N2
4-Methyl-2-pentanone (MIBK)	ug/kg	2000	<2500	106	68-133	
Acetone	ug/kg	2000	2080	104	64-130	
Acrylonitrile	ug/kg	2000	2040	102	69-132	
Benzene	ug/kg	2000	2020	101	85-118	
Bromobenzene	ug/kg	2000	1960	98	89-116	
Bromochloromethane	ug/kg	2000	2080	104	81-121	
Bromodichloromethane	ug/kg	2000	1980	99	80-123	
Bromoform	ug/kg	2000	2140	107	58-128	
Bromomethane	ug/kg	2000	1990	99	57-139	
Carbon disulfide	ug/kg	2000	1810	91	65-138	
Carbon tetrachloride	ug/kg	2000	2070	104	76-125	
Chlorobenzene	ug/kg	2000	2010	100	86-114	
Chloroethane	ug/kg	2000	2080	104	76-123	
Chloroform	ug/kg	2000	1920	96	86-118	
Chloromethane	ug/kg	2000	2240	112	73-123	
cis-1,2-Dichloroethene	ug/kg	2000	2130	106	85-118	
cis-1,3-Dichloropropene	ug/kg	2000	2060	103	79-121	
Cyclohexane	ug/kg	2000	<2500	102	79-122	
Dibromochloromethane	ug/kg	2000	2150	107	72-119	
Dibromomethane	ug/kg	2000	2010	101	83-117	
Dichlorodifluoromethane	ug/kg	2000	2420	121	68-135	
Diethyl ether (Ethyl ether)	ug/kg	2000	1980	99	78-118	
Diisopropyl ether	ug/kg	2000	1860	93	70-130	
Ethyl-tert-butyl ether	ug/kg	2000	1900	95	70-130	
Ethylbenzene	ug/kg	2000	2060	103	84-116	
Hexachloroethane	ug/kg	2000	1990	100	70-122	
Iodomethane	ug/kg	2000	1660	83	47-150	
Isopropylbenzene (Cumene)	ug/kg	2000	2060	103	82-125	
m&p-Xylene	ug/kg	4000	4160	104	84-118	
Methyl-tert-butyl ether	ug/kg	4000	4060	101	81-119	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

LABORATORY CONTROL SAMPLE: 114823

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Methylene Chloride	ug/kg	2000	1890	94	78-123	
n-Butylbenzene	ug/kg	2000	2050	103	75-125	
n-Propylbenzene	ug/kg	2000	2010	100	85-121	
Naphthalene	ug/kg	2000	1840	92	53-133	
o-Xylene	ug/kg	2000	2010	101	85-115	
p-Isopropyltoluene	ug/kg	2000	2010	101	82-122	
sec-Butylbenzene	ug/kg	2000	2040	102	84-121	
Styrene	ug/kg	2000	2140	107	79-115	
tert-Amylmethyl ether	ug/kg	2000	1940	97	70-130	
tert-Butyl Alcohol	ug/kg	10000	9430	94	70-130	
tert-Butylbenzene	ug/kg	2000	2030	102	86-121	
Tetrachloroethene	ug/kg	2000	2020	101	85-116	
Tetrahydrofuran	ug/kg	2000	1960	98	62-126	
Toluene	ug/kg	2000	1990	99	86-120	
trans-1,2-Dichloroethene	ug/kg	2000	2030	101	85-117	
trans-1,3-Dichloropropene	ug/kg	2000	2130	107	73-125	
trans-1,4-Dichloro-2-butene	ug/kg	2000	2020	101	67-130	
Trichloroethene	ug/kg	2000	1970	98	83-125	
Trichlorofluoromethane	ug/kg	2000	2020	101	82-123	
Vinyl chloride	ug/kg	2000	2300	115	77-124	
1,2-Dichloroethane-d4 (S)	%.			102	83-116	
4-Bromofluorobenzene (S)	%.			103	81-117	
Dibromofluoromethane (S)	%.			102	75-123	
Toluene-d8 (S)	%.			100	85-113	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115053 115054

Parameter	Units	4615021001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1,1,1,2-Tetrachloroethane	ug/kg	0.060 U mg/kg	2390	2390	2240	2250	94	94	82-116	1	10	
1,1,1-Trichloroethane	ug/kg	0.060 U mg/kg	2390	2390	2200	2390	92	100	84-126	8	9	
1,1,2,2-Tetrachloroethane	ug/kg	0.060 U mg/kg	2390	2390	2130	2150	89	90	64-122	1	14	
1,1,2-Trichloroethane	ug/kg	0.060 U mg/kg	2390	2390	2280	2360	95	99	81-124	4	8	
1,1-Dichloroethane	ug/kg	0.060 U mg/kg	2390	2390	2290	2410	96	101	85-127	5	9	
1,1-Dichloroethene	ug/kg	0.060 U mg/kg	2390	2390	2160	2360	91	99	81-135	9	11	
1,2,3-Trichlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2420	2430	101	102	77-126	0	16	
1,2,3-Trichloropropane	ug/kg	0.060 U mg/kg	2390	2390	2250	2290	94	96	69-114	2	14	
1,2,3-Trimethylbenzene	ug/kg	0.060 U mg/kg	2390	2390	1930	1950	81	82	70-130	1	20	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115053 115054

Parameter	Units	4615021001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1,2,4-Trichlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2450	2450	102	102	76-131	0	11	
1,2,4-Trimethylbenzene	ug/kg	0.020J mg/kg	2390	2390	2310	2330	96	97	79-114	1	11	
1,2-Dibromo-3-chloropropane	ug/kg	0.30 U mg/kg	2390	2390	1870	1940	78	81	69-125	4	11	
1,2-Dibromoethane (EDB)	ug/kg	0.060 U mg/kg	2390	2390	2240	2280	94	95	72-124	2	11	
1,2-Dichlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2200	2240	92	94	85-121	2	10	
1,2-Dichloroethane	ug/kg	0.060 U mg/kg	2390	2390	2290	2390	96	100	82-125	4	8	
1,2-Dichloropropane	ug/kg	0.060 U mg/kg	2390	2390	2200	2340	92	98	78-132	6	11	
1,3,5-Trimethylbenzene	ug/kg	0.060 U mg/kg	2390	2390	2290	2350	96	98	83-112	3	12	
1,3-Dichlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2240	2250	94	94	86-116	1	8	
1,4-Dichlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2160	2200	90	92	87-115	2	9	
2-Butanone (MEK)	ug/kg	3.0 U mg/kg	2390	2390	<2990	<2990	104	108	49-152		16	
2-Hexanone	ug/kg	3.0 U mg/kg	2390	2390	<2990	<2990	93	96	49-135		16	
2-Methylnaphthalene	ug/kg	0.13J mg/kg	2390	2390	2230	2290	88	90	45-130	3	23	N2
4-Methyl-2-pentanone (MIBK)	ug/kg	3.0 U mg/kg	2390	2390	<2990	<2990	102	105	60-134		17	
Acetone	ug/kg	0.10J mg/kg	2390	2390	2400	2450	96	98	56-144	2	18	
Acrylonitrile	ug/kg	0.30 U mg/kg	2390	2390	2270	2380	95	100	67-136	5	15	
Benzene	ug/kg	0.060 U mg/kg	2390	2390	2270	2380	95	100	85-125	5	9	
Bromobenzene	ug/kg	0.060 U mg/kg	2390	2390	2230	2250	93	94	82-115	1	11	
Bromochloromethane	ug/kg	0.060 U mg/kg	2390	2390	2380	2620	100	110	85-126	9	10	
Bromodichloromethane	ug/kg	0.060 U mg/kg	2390	2390	2100	2250	88	94	78-124	7	9	
Bromoform	ug/kg	0.060 U mg/kg	2390	2390	2110	2130	88	89	75-118	1	11	
Bromomethane	ug/kg	0.060 U mg/kg	2390	2390	2200	2370	92	99	70-135	7	24	
Carbon disulfide	ug/kg	0.30 U mg/kg	2390	2390	1940	2270	81	95	45-108	16	21	
Carbon tetrachloride	ug/kg	0.060 U mg/kg	2390	2390	2160	2370	90	99	71-130	9	14	
Chlorobenzene	ug/kg	0.060 U mg/kg	2390	2390	2240	2310	94	97	86-118	3	11	
Chloroethane	ug/kg	0.060 U mg/kg	2390	2390	2140	2640	90	111	32-136	21	21	
Chloroform	ug/kg	0.060 U mg/kg	2390	2390	2310	2430	97	101	86-126	5	7	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115053 115054

Parameter	Units	4615021001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloromethane	ug/kg	0.060 U mg/kg	2390	2390	2550	2660	107	111	70-142	4	15	
cis-1,2-Dichloroethene	ug/kg	0.060 U mg/kg	2390	2390	2420	2440	101	102	88-125	1	9	
cis-1,3-Dichloropropene	ug/kg	0.060 U mg/kg	2390	2390	2120	2270	89	95	70-124	7	10	
Cyclohexane	ug/kg	0.027J mg/kg	2390	2390	<2990	<2990	96	101	72-135		11	
Dibromochloromethane	ug/kg	0.060 U mg/kg	2390	2390	2150	2250	90	94	57-121	4	12	
Dibromomethane	ug/kg	0.060 U mg/kg	2390	2390	2220	2320	93	97	86-119	4	7	
Dichlorodifluoromethane	ug/kg	0.060 U mg/kg	2390	2390	2820	3030	118	127	65-133	7	12	
Diethyl ether (Ethyl ether)	ug/kg	0.060 U mg/kg	2390	2390	2210	2280	93	95	71-131	3	9	
Diisopropyl ether	ug/kg	0.30 U mg/kg	2390	2390	2130	2210	89	92	65-135	4	40	
Ethyl-tert-butyl ether	ug/kg	0.30 U mg/kg	2390	2390	2160	2270	90	95	70-130	5	20	
Ethylbenzene	ug/kg	0.013J mg/kg	2390	2390	2310	2330	96	97	80-122	1	10	
Hexachloroethane	ug/kg	0.30 U mg/kg	2390	2390	1970	2010	83	84	81-117	2	11	
Iodomethane	ug/kg	0.30 U mg/kg	2390	2390	2240	2500	94	104	63-158	11	28	
Isopropylbenzene (Cumene)	ug/kg	0.060 U mg/kg	2390	2390	2270	2360	95	99	84-120	4	9	
m&p-Xylene	ug/kg	0.040J mg/kg	4780	4780	4580	4760	95	99	77-128	4	10	
Methyl-tert-butyl ether	ug/kg	0.060 U mg/kg	4780	4780	4510	4730	94	99	63-134	5	11	
Methylene Chloride	ug/kg	0.30 U mg/kg	2390	2390	1990	2190	83	91	78-139	9	9	
n-Butylbenzene	ug/kg	0.060 U mg/kg	2390	2390	2250	2300	94	96	71-122	2	12	
n-Propylbenzene	ug/kg	0.060 U mg/kg	2390	2390	2240	2320	94	97	73-124	3	8	
Naphthalene	ug/kg	0.28J mg/kg	2390	2390	2190	2230	80	82	67-119	2	15	
o-Xylene	ug/kg	0.015J mg/kg	2390	2390	2330	2360	97	98	83-121	1	9	
p-Isopropyltoluene	ug/kg	0.060 U mg/kg	2390	2390	2230	2260	93	94	82-116	1	13	
sec-Butylbenzene	ug/kg	0.060 U mg/kg	2390	2390	2260	2290	95	96	84-117	1	10	
Styrene	ug/kg	0.060 U mg/kg	2390	2390	2380	2450	99	102	80-117	3	10	
tert-Amylmethyl ether	ug/kg	0.30 U mg/kg	2390	2390	2290	2370	96	99	70-130	3	30	
tert-Butyl Alcohol	ug/kg	3.0 U mg/kg	12000	12000	11000	11200	92	93	68-100	2	40	
tert-Butylbenzene	ug/kg	0.060 U mg/kg	2390	2390	2250	2310	94	97	84-118	3	12	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115053 115054

Parameter	Units	4615021001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Tetrachloroethene	ug/kg	0.060 U mg/kg	2390	2390	2280	2300	95	96	74-130	1	11	
Tetrahydrofuran	ug/kg	0.30 U mg/kg	2390	2390	2210	2260	92	95	45-135	2	16	
Toluene	ug/kg	0.060 U mg/kg	2390	2390	2240	2330	94	98	81-128	4	10	
trans-1,2-Dichloroethene	ug/kg	0.060 U mg/kg	2390	2390	2250	2320	94	97	81-135	3	10	
trans-1,3-Dichloropropene	ug/kg	0.060 U mg/kg	2390	2390	2180	2280	91	95	63-122	4	9	
trans-1,4-Dichloro-2-butene	ug/kg	0.30 U mg/kg	2390	2390	2080	1960	87	82	44-118	6	10	
Trichloroethene	ug/kg	0.060 U mg/kg	2390	2390	2180	2280	91	95	90-130	5	12	
Trichlorofluoromethane	ug/kg	0.060 U mg/kg	2390	2390	2360	2480	99	104	50-155	5	13	
Vinyl chloride	ug/kg	0.060 U mg/kg	2390	2390	2640	2760	110	115	63-148	5	11	
1,2-Dichloroethane-d4 (S)	%.						98	98	83-116			
4-Bromofluorobenzene (S)	%.						102	102	81-117			
Dibromofluoromethane (S)	%.						98	100	75-123			
Toluene-d8 (S)	%.						101	102	85-113			

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

QC Batch: 28656
QC Batch Method: EPA 3545A
Analysis Method: EPA 8082A
Analysis Description: 8082A GCS PCB
Associated Lab Samples: 4615201001

METHOD BLANK: 114722
Matrix: Solid
Associated Lab Samples: 4615201001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
PCB-1016 (Aroclor 1016)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1221 (Aroclor 1221)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1232 (Aroclor 1232)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1242 (Aroclor 1242)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1248 (Aroclor 1248)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1254 (Aroclor 1254)	ug/kg	<33.0	33.0	07/23/18 19:46	
PCB-1260 (Aroclor 1260)	ug/kg	<33.0	33.0	07/23/18 19:46	
Decachlorobiphenyl (S)	%.	94	45-135	07/23/18 19:46	
Tetrachloro-m-xylene (S)	%.	87	56-123	07/23/18 19:46	

LABORATORY CONTROL SAMPLE: 114723

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
PCB-1016 (Aroclor 1016)	ug/kg	200	163	81	68-129	
PCB-1260 (Aroclor 1260)	ug/kg	200	167	83	60-140	
Decachlorobiphenyl (S)	%.			84	45-135	
Tetrachloro-m-xylene (S)	%.			83	56-123	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 114724 114725

Parameter	Units	4615120001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
PCB-1016 (Aroclor 1016)	ug/kg	<0.033 mg/kg	201	198	180	188	90	95	49-128	4	30	
PCB-1260 (Aroclor 1260)	ug/kg	<0.033 mg/kg	201	198	182	190	90	96	48-138	4	30	
Decachlorobiphenyl (S)	%.						87	90	45-135			
Tetrachloro-m-xylene (S)	%.						92	96	56-123			

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

QC Batch: 28882
QC Batch Method: EPA 3550C
Analysis Method: EPA 8270C
Analysis Description: 8270C Solid MSSV
Associated Lab Samples: 4615201001

METHOD BLANK: 115461
Matrix: Solid
Associated Lab Samples: 4615201001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,2,4-Trichlorobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
1,2-Dichlorobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
1,2-Diphenylhydrazine	ug/kg	<17.0	17.0	07/27/18 10:14	
1,3-Dichlorobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
1,4-Dichlorobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
2,4,5-Trichlorophenol	ug/kg	<17.0	17.0	07/27/18 10:14	
2,4,6-Trichlorophenol	ug/kg	<17.0	17.0	07/27/18 10:14	
2,4-Dichlorophenol	ug/kg	<33.0	33.0	07/27/18 10:14	
2,4-Dimethylphenol	ug/kg	<170	170	07/27/18 10:14	
2,4-Dinitrophenol	ug/kg	<170	170	07/27/18 10:14	
2,4-Dinitrotoluene	ug/kg	<33.0	33.0	07/27/18 10:14	
2,6-Dinitrotoluene	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Chloronaphthalene	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Chlorophenol	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Methylnaphthalene	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Methylphenol(o-Cresol)	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Nitroaniline	ug/kg	<17.0	17.0	07/27/18 10:14	
2-Nitrophenol	ug/kg	<17.0	17.0	07/27/18 10:14	
3&4-Methylphenol(m&p Cresol)	ug/kg	<34.0	34.0	07/27/18 10:14	
3-Nitroaniline	ug/kg	<330	330	07/27/18 10:14	
4,6-Dinitro-2-methylphenol	ug/kg	<170	170	07/27/18 10:14	
4-Bromophenylphenyl ether	ug/kg	<17.0	17.0	07/27/18 10:14	
4-Chloro-3-methylphenol	ug/kg	<17.0	17.0	07/27/18 10:14	
4-Chlorophenylphenyl ether	ug/kg	<17.0	17.0	07/27/18 10:14	
4-Nitroaniline	ug/kg	<330	330	07/27/18 10:14	
4-Nitrophenol	ug/kg	<670	670	07/27/18 10:14	
Acenaphthene	ug/kg	<17.0	17.0	07/27/18 10:14	
Acenaphthylene	ug/kg	<17.0	17.0	07/27/18 10:14	
Anthracene	ug/kg	<17.0	17.0	07/27/18 10:14	
Benzo(a)anthracene	ug/kg	<17.0	17.0	07/27/18 10:14	
Benzo(a)pyrene	ug/kg	<17.0	17.0	07/27/18 10:14	
Benzo(b)fluoranthene	ug/kg	<17.0	17.0	07/27/18 10:14	
Benzo(g,h,i)perylene	ug/kg	<33.0	33.0	07/27/18 10:14	
Benzo(k)fluoranthene	ug/kg	<17.0	17.0	07/27/18 10:14	
bis(2-Chloroethoxy)methane	ug/kg	<17.0	17.0	07/27/18 10:14	
bis(2-Chloroethyl) ether	ug/kg	<17.0	17.0	07/27/18 10:14	
bis(2-Chloroisopropyl) ether	ug/kg	<17.0	17.0	07/27/18 10:14	
bis(2-Ethylhexyl)phthalate	ug/kg	<33.0	33.0	07/27/18 10:14	
Butylbenzylphthalate	ug/kg	<33.0	33.0	07/27/18 10:14	
Carbazole	ug/kg	<170	170	07/27/18 10:14	
Chrysene	ug/kg	<17.0	17.0	07/27/18 10:14	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

METHOD BLANK: 115461 Matrix: Solid

Associated Lab Samples: 4615201001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Di-n-butylphthalate	ug/kg	<67.0	67.0	07/27/18 10:14	
Di-n-octylphthalate	ug/kg	<17.0	17.0	07/27/18 10:14	
Dibenz(a,h)anthracene	ug/kg	<33.0	33.0	07/27/18 10:14	
Dibenzofuran	ug/kg	<17.0	17.0	07/27/18 10:14	
Diethylphthalate	ug/kg	<17.0	17.0	07/27/18 10:14	
Dimethylphthalate	ug/kg	<17.0	17.0	07/27/18 10:14	
Fluoranthene	ug/kg	<17.0	17.0	07/27/18 10:14	
Fluorene	ug/kg	<33.0	33.0	07/27/18 10:14	
Hexachloro-1,3-butadiene	ug/kg	<17.0	17.0	07/27/18 10:14	
Hexachlorobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
Hexachlorocyclopentadiene	ug/kg	<17.0	17.0	07/27/18 10:14	
Hexachloroethane	ug/kg	<17.0	17.0	07/27/18 10:14	
Indeno(1,2,3-cd)pyrene	ug/kg	<33.0	33.0	07/27/18 10:14	
Isophorone	ug/kg	<17.0	17.0	07/27/18 10:14	
N-Nitroso-di-n-propylamine	ug/kg	<17.0	17.0	07/27/18 10:14	
N-Nitrosodimethylamine	ug/kg	<33.0	33.0	07/27/18 10:14	
N-Nitrosodiphenylamine	ug/kg	<17.0	17.0	07/27/18 10:14	
Naphthalene	ug/kg	<17.0	17.0	07/27/18 10:14	
Nitrobenzene	ug/kg	<17.0	17.0	07/27/18 10:14	
Pentachlorophenol	ug/kg	<33.0	33.0	07/27/18 10:14	
Phenanthrene	ug/kg	<17.0	17.0	07/27/18 10:14	
Phenol	ug/kg	<170	170	07/27/18 10:14	
Pyrene	ug/kg	<17.0	17.0	07/27/18 10:14	
2,4,6-Tribromophenol (S)	%.	50	12-124	07/27/18 10:14	
2-Fluorobiphenyl (S)	%.	65	46-122	07/27/18 10:14	
2-Fluorophenol (S)	%.	67	33-113	07/27/18 10:14	
Nitrobenzene-d5 (S)	%.	60	33-131	07/27/18 10:14	
o-Terphenyl (S)	%.	71	20-155	07/27/18 10:14	
Phenol-d6 (S)	%.	63	30-115	07/27/18 10:14	

LABORATORY CONTROL SAMPLE: 115462

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,2,4-Trichlorobenzene	ug/kg	333	233	70	51-110	
1,2-Dichlorobenzene	ug/kg	333	228	69	63-115	
1,2-Diphenylhydrazine	ug/kg	333	290	87	68-125	
1,3-Dichlorobenzene	ug/kg	333	234	70	54-113	
1,4-Dichlorobenzene	ug/kg	333	212	64	61-111	
2,4,5-Trichlorophenol	ug/kg	333	213	64	61-126	
2,4,6-Trichlorophenol	ug/kg	333	233	70	45-128	
2,4-Dichlorophenol	ug/kg	333	198	59	50-128	
2,4-Dimethylphenol	ug/kg	333	<170	51	40-122	
2,4-Dinitrophenol	ug/kg	333	313	94	25-105	
2,4-Dinitrotoluene	ug/kg	333	239	72	51-128	

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QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

LABORATORY CONTROL SAMPLE: 115462

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
2,6-Dinitrotoluene	ug/kg	333	247	74	61-119	
2-Chloronaphthalene	ug/kg	333	253	76	67-111	
2-Chlorophenol	ug/kg	333	235	70	62-118	
2-Methylnaphthalene	ug/kg	333	239	72	56-124	
2-Methylphenol(o-Cresol)	ug/kg	333	196	59	58-113	
2-Nitroaniline	ug/kg	333	238	71	63-122	
2-Nitrophenol	ug/kg	333	249	75	55-115	
3&4-Methylphenol(m&p Cresol)	ug/kg	333	190	57	47-158	
3-Nitroaniline	ug/kg	333	<330	38	19-86	
4,6-Dinitro-2-methylphenol	ug/kg	333	348	104	26-136	
4-Bromophenylphenyl ether	ug/kg	333	267	80	61-124	
4-Chloro-3-methylphenol	ug/kg	333	213	64	57-124	
4-Chlorophenylphenyl ether	ug/kg	333	249	75	62-114	
4-Nitroaniline	ug/kg	333	<330	56	26-125	
4-Nitrophenol	ug/kg	333	<670	75	36-131	
Acenaphthene	ug/kg	333	263	79	55-113	
Acenaphthylene	ug/kg	333	272	81	56-138	
Anthracene	ug/kg	333	270	81	63-134	
Benzo(a)anthracene	ug/kg	333	293	88	53-142	
Benzo(a)pyrene	ug/kg	333	257	77	54-136	
Benzo(b)fluoranthene	ug/kg	333	243	73	49-146	
Benzo(g,h,i)perylene	ug/kg	333	264	79	47-141	
Benzo(k)fluoranthene	ug/kg	333	239	72	56-136	
bis(2-Chloroethoxy)methane	ug/kg	333	223	67	57-121	
bis(2-Chloroethyl) ether	ug/kg	333	221	66	54-112	
bis(2-Chloroisopropyl) ether	ug/kg	333	264	79	62-116	
bis(2-Ethylhexyl)phthalate	ug/kg	333	297	89	50-140	
Butylbenzylphthalate	ug/kg	333	315	94	51-145	
Carbazole	ug/kg	333	290	87	76-126	
Chrysene	ug/kg	333	272	82	66-137	
Di-n-butylphthalate	ug/kg	333	299	90	65-140	
Di-n-octylphthalate	ug/kg	333	312	94	63-132	
Dibenz(a,h)anthracene	ug/kg	333	273	82	52-142	
Dibenzofuran	ug/kg	333	246	74	65-119	
Diethylphthalate	ug/kg	333	249	75	59-128	
Dimethylphthalate	ug/kg	333	246	74	66-122	
Fluoranthene	ug/kg	333	279	84	66-140	
Fluorene	ug/kg	333	263	79	60-131	
Hexachloro-1,3-butadiene	ug/kg	333	228	68	56-128	
Hexachlorobenzene	ug/kg	333	270	81	34-141	
Hexachlorocyclopentadiene	ug/kg	333	207	62	34-124	
Hexachloroethane	ug/kg	333	221	66	60-111	
Indeno(1,2,3-cd)pyrene	ug/kg	333	258	77	53-135	
Isophorone	ug/kg	333	195	59	55-127	
N-Nitroso-di-n-propylamine	ug/kg	333	238	71	48-127	
N-Nitrosodimethylamine	ug/kg	333	240	72	27-152	
N-Nitrosodiphenylamine	ug/kg	333	267	80	33-109	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

LABORATORY CONTROL SAMPLE: 115462

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Naphthalene	ug/kg	333	252	76	52-128	
Nitrobenzene	ug/kg	333	246	74	56-109	
Pentachlorophenol	ug/kg	333	259	78	19-117	
Phenanthrene	ug/kg	333	263	79	58-134	
Phenol	ug/kg	333	212	64	53-120	
Pyrene	ug/kg	333	288	86	60-132	
2,4,6-Tribromophenol (S)	%.			55	12-124	
2-Fluorobiphenyl (S)	%.			62	46-122	
2-Fluorophenol (S)	%.			63	33-113	
Nitrobenzene-d5 (S)	%.			59	33-131	
o-Terphenyl (S)	%.			66	20-155	
Phenol-d6 (S)	%.			56	30-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115463 115464

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1,2,4-Trichlorobenzene	ug/kg	<21.0	416	411	262	295	63	72	44-111	12	40	
1,2-Dichlorobenzene	ug/kg	<21.0	416	411	216	276	52	67	49-115	25	40	
1,2-Diphenylhydrazine	ug/kg	<21.0	416	411	396	367	94	89	57-135	7	40	
1,3-Dichlorobenzene	ug/kg	<21.0	416	411	189	252	45	61	39-129	29	40	
1,4-Dichlorobenzene	ug/kg	<21.0	416	411	198	263	47	64	36-110	28	40	
2,4,5-Trichlorophenol	ug/kg	<21.0	416	411	279	273	67	67	25-151	2	40	
2,4,6-Trichlorophenol	ug/kg	<21.0	416	411	417	388	100	94	10-159	7	40	
2,4-Dichlorophenol	ug/kg	<40.8	416	411	301	292	72	71	38-131	3	40	
2,4-Dimethylphenol	ug/kg	<210	416	411	271	262	64	63	22-136	4	40	
2,4-Dinitrophenol	ug/kg	<210	416	411	222	<210	53	44	1-138		40	
2,4-Dinitrotoluene	ug/kg	<40.8	416	411	308	267	71	62	28-136	14	40	
2,6-Dinitrotoluene	ug/kg	<21.0	416	411	308	303	71	71	22-156	2	40	
2-Chloronaphthalene	ug/kg	<21.0	416	411	347	348	83	85	42-138	0	40	
2-Chlorophenol	ug/kg	<21.0	416	411	300	302	72	73	25-154	1	40	
2-Methylnaphthalene	ug/kg	<21.0	416	411	299	308	71	74	42-130	3	40	
2-Methylphenol(o-Cresol)	ug/kg	<21.0	416	411	272	263	65	64	45-113	3	40	
2-Nitroaniline	ug/kg	<21.0	416	411	345	333	80	78	48-140	4	40	
2-Nitrophenol	ug/kg	<21.0	416	411	333	323	79	77	11-147	3	40	
3&4-Methylphenol(m&p Cresol)	ug/kg	<42.1	416	411	276	263	66	64	29-164	5	40	
3-Nitroaniline	ug/kg	<408	416	411	<413	<407	56	68	4-94		40	
4,6-Dinitro-2-methylphenol	ug/kg	<210	416	411	349	268	74	56	10-114	26	40	
4-Bromophenylphenyl ether	ug/kg	<21.0	416	411	432	413	104	101	47-139	4	40	
4-Chloro-3-methylphenol	ug/kg	<21.0	416	411	325	317	77	76	18-143	2	40	
4-Chlorophenylphenyl ether	ug/kg	<21.0	416	411	349	338	84	82	34-136	3	40	
4-Nitroaniline	ug/kg	<408	416	411	<413	<407	34	39	11-115		40	
4-Nitrophenol	ug/kg	<829	416	411	<838	<826	76	73	10-163		40	
Acenaphthene	ug/kg	<21.0	416	411	370	362	88	87	52-110	2	40	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 115463 115464

Parameter	Units	4615201001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Acenaphthylene	ug/kg	<21.0	416	411	374	366	89	88	52-139	2	40	
Anthracene	ug/kg	<21.0	416	411	362	354	84	83	48-138	2	40	
Benzo(a)anthracene	ug/kg	<105	416	411	375	369	83	83	48-134	2	40	1l
Benzo(a)pyrene	ug/kg	29.0	416	411	349	352	77	79	36-129	1	40	1l
Benzo(b)fluoranthene	ug/kg	29.7	416	411	350	378	77	85	44-141	8	40	1l
Benzo(g,h,i)perylene	ug/kg	<40.8	416	411	303	284	69	65	36-146	6	40	1l
Benzo(k)fluoranthene	ug/kg	<21.0	416	411	285	294	65	68	44-134	3	40	1l
bis(2-Chloroethoxy)methane	ug/kg	<21.0	416	411	296	297	70	72	38-144	0	40	
bis(2-Chloroethyl) ether	ug/kg	<21.0	416	411	282	291	68	71	43-129	3	40	
bis(2-Chloroisopropyl) ether	ug/kg	<21.0	416	411	277	304	67	74	48-133	9	40	
bis(2-Ethylhexyl)phthalate	ug/kg	<204	416	411	444	414	91	85	43-148	7	40	1l
Butylbenzylphthalate	ug/kg	<204	416	411	439	401	105	98	43-143	9	40	1l
Carbazole	ug/kg	<210	416	411	330	326	79	79	34-167	1	40	
Chrysene	ug/kg	<105	416	411	367	354	78	76	45-143	4	40	1l
Di-n-butylphthalate	ug/kg	<82.9	416	411	368	374	80	83	15-184	2	40	
Di-n-octylphthalate	ug/kg	<105	416	411	477	440	114	107	50-154	8	40	1l
Dibenz(a,h)anthracene	ug/kg	<40.8	416	411	333	322	76	75	38-149	4	40	1l
Dibenzofuran	ug/kg	<21.0	416	411	346	338	82	81	51-136	2	40	
Diethylphthalate	ug/kg	<21.0	416	411	333	334	79	80	43-139	0	40	
Dimethylphthalate	ug/kg	<21.0	416	411	265	252	62	60	50-138	5	40	
Fluoranthene	ug/kg	44.5	416	411	344	344	72	73	34-140	0	40	
Fluorene	ug/kg	<40.8	416	411	366	314	86	75	49-127	15	40	
Hexachloro-1,3-butadiene	ug/kg	<21.0	416	411	217	280	52	68	47-127	25	40	
Hexachlorobenzene	ug/kg	<21.0	416	411	443	420	106	102	49-134	5	40	
Hexachlorocyclopentadiene	ug/kg	<21.0	416	411	<21.3	<21.0	0	0	1-118		40	M1
Hexachloroethane	ug/kg	<21.0	416	411	107	127	26	31	33-137	17	40	M1
Indeno(1,2,3-cd)pyrene	ug/kg	<40.8	416	411	335	287	76	65	31-128	15	40	1l
Isophorone	ug/kg	<21.0	416	411	244	241	58	58	24-147	1	40	
N-Nitroso-di-n-propylamine	ug/kg	<21.0	416	411	289	301	69	73	41-123	4	40	
N-Nitrosodimethylamine	ug/kg	<40.8	416	411	279	306	67	74	18-135	9	40	
N-Nitrosodiphenylamine	ug/kg	<21.0	416	411	468	330	111	79	35-100	35	40	M1
Naphthalene	ug/kg	<21.0	416	411	301	323	72	78	32-138	7	40	
Nitrobenzene	ug/kg	<21.0	416	411	308	313	74	76	37-142	2	40	
Pentachlorophenol	ug/kg	<40.8	416	411	229	236	55	57	15-129	3	40	
Phenanthrene	ug/kg	<21.0	416	411	364	332	84	77	39-134	9	40	
Phenol	ug/kg	<210	416	411	349	457	72	100	23-140	27	40	
Pyrene	ug/kg	<105	416	411	455	462	92	95	39-145	2	40	1l
2,4,6-Tribromophenol (S)	%.						49	47	12-124			
2-Fluorobiphenyl (S)	%.						67	66	46-122			
2-Fluorophenol (S)	%.						67	64	33-113			
Nitrobenzene-d5 (S)	%.						63	63	33-131			
o-Terphenyl (S)	%.						70	67	20-155			
Phenol-d6 (S)	%.						58	58	30-115			

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: Sugar Island
Pace Project No.: 4615201

QC Batch: 28809
Analysis Method: SM 2540 G-11/3550
QC Batch Method: SM 2540 G-11/3550
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 4615201001

SAMPLE DUPLICATE: 115175

Parameter	Units	4615201001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	21.0	20.6	2	20	

SAMPLE DUPLICATE: 115176

Parameter	Units	4615138031 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	0.10 U	<0.10		20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project:	Sugar Island
Pace Project No.:	4615201

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

ANALYTE QUALIFIERS

1I	Due to sample matrix related internal standard failure, this sample was analyzed at a dilution. The RL for this analyte has been elevated.
2I	Due to sample matrix-related internal standard failure, the sample was reanalyzed at dilution. The RL for this analyte has been elevated.
D3	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
E	Analyte concentration exceeded the calibration range. The reported result is estimated.
M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.
M6	Matrix spike and Matrix spike duplicate recovery not evaluated against control limits due to sample dilution.
N2	The lab does not hold NELAC/TNI accreditation for this parameter.
R1	RPD value was outside control limits.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Sugar Island
Pace Project No.: 4615201

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
4615201001	**VIB-6**	EPA 3545A	28656	EPA 8082A	28744
4615201001	**VIB-6**	EPA 3050B	28681	EPA 6010C	28906
4615201001	**VIB-6**	EPA 3050B	28971	EPA 6010C	29125
4615201001	**VIB-6**	EPA 3050B	28682	EPA 6020A	28937
4615201001	**VIB-6**	EPA 7471B	28792	EPA 7471B	28885
4615201001	**VIB-6**	EPA 3550C	28882	EPA 8270C	28988
4615201001	**VIB-6**	EPA 5035A	28699	EPA 8260B	28771
4615201001	**VIB-6**	SM 2540 G-11/3550	28809		

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

WO#: 4615201

4615201

Inc.

Check originating office

☐ **Corporate Office**
501 Avis Drive
Ann Arbor, MI 48108
Phone (734) 332-1200
Fax (734) 332-1212

☐ **Kalamazoo Field Office**
2980 Business One Drive
Kalamazoo, MI 49048
Phone (269) 226-0190
Fax (269) 226-0192

CHAIN OF CUSTODY RECORD

PROJ. NO.:

PROJECT NAME: SUGAR ISLAND

SAMPLERS: (Signature) BETZ

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	Sample Matrix	# of Containers	SVOC, PCB, TAL (23) metals	VOC					REMARKS
	7/18/18	9:15		X	VIB-1	Sed	2	X	X					
	7/18/18	13:15		X	VIB-6	SED	2	X	X					

Relinquished by: (Signature) Cathy Whiting DATE 7/19/18 TIME 18:30

Received by: (Signature)

Relinquished by: (Signature) DATE TIME

Received by: (Signature)

Relinquished by: (Signature) DATE TIME

Received for Laboratory by: (Signature)

LABORATORY SENT TO: PACE

LABORATORY CONTACT: JENNIFER RICE

SHIPPING CARRIER: FED EX

TRACKING NUMBER:

DATE 7/20 TIME 0830

Requested Turnaround Time: 2 WEEK

SAMPLE RECEIVING / LOG-IN CHECKLIST

Pace Analytical®

Client: LTI

Work Order #: 461520l

Receipt Record Page/Line #: 6-23

001

Recorded by (initials/date): IB 7/20/18

☒ Cooler
☐ Box
☐ Other____

Qty Received: 1

Thermometer Used:
☐ IR Gun (#202)
☐ Digital Thermometer (#54)
☒ IR Gun (#402)

Cooler #: — Time: 1146

Custody Seals:
☒ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☒ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
[✓ Dispersed] / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☒ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank	/	/	/
Sample 1	9.5		9.5
Sample 2	11.0		11.0
Sample 3	/		/

When above 6 °C take a 3 Sample Average °C: 10.2

☐ VOC Trip Blank received?

Cooler #: Time:

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler #: Time:

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler #: Time:

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

If any shaded areas checked, complete Sample Receiving Non-Conformance

Paperwork Received

Yes	No	
☒	☐	Chain of Custody record(s)? If No, Initiated By ________
☒		Received for Lab Signed/Date/Time?
☐	☒	USDA Soil Documents?
☐	☒	Sampling / Field Forms?
☐	☒	Other ________

COC Information

☐ Pace COC ☒ Other LTI

COC ID Numbers:

19678

Check COC for Accuracy

Yes	No	
☒	☐	Analysis Requested?
☒	☐	Sample ID matches COC?
☒	☐	Sample Date and Time matches COC?
☐	☒	All containers indicated are received?

Sample Condition Summary

N/A	Yes	No	
	☐	☒	Broken containers/lids?
	☐	☒	Missing or incomplete labels?
	☐	☒	Illegible information on labels?
	☐	☒	Low volume received?
	☐	☒	Inappropriate or non-Pace containers received?
☒	☐	☐	VOC vials have headspace?
	☐	☒	Extra sample locations?
	☐	☒	Containers not listed on COC?

Check Sample Preservation

N/A	Yes	No	
	☒	☐	Temperature Blank **OR** average sample temperature, ≥6° C?
☐	☒	☐	If "Yes" was thermal preservation required?
☐	☐	☒	If "Yes" were ALL samples collected the same day as receipt?
☒	☐		Completed Sample Preservation Verification Form?
☒	☐	☐	Samples chemically preserved correctly?
☒	☐		If "No", add wire tag and fill out Non-Conformance Form?
☒	☐		Received unpreserved Terracore kit?
			If "Yes" unpreserved vials must be frozen

Work Order Not Logged In with Short Hold / Rush

☐ Copies of COC To Lab Areas

Notes

Yes	No	
☒	☐	Were all samples logged into Epic?
☒	☐	Were all samples labelled?
☒	☐	Were samples placed on scan locations?

Initial / Date : IB 7/20/18

Pace Analytical®

SAMPLE RECEIVING NON-CONFORMANCE REPORT

Client LTI
Receipt Log # 6-23
Completed By (initials/date) IB 7/20/18
Work Order # 4615201
Project Chemist

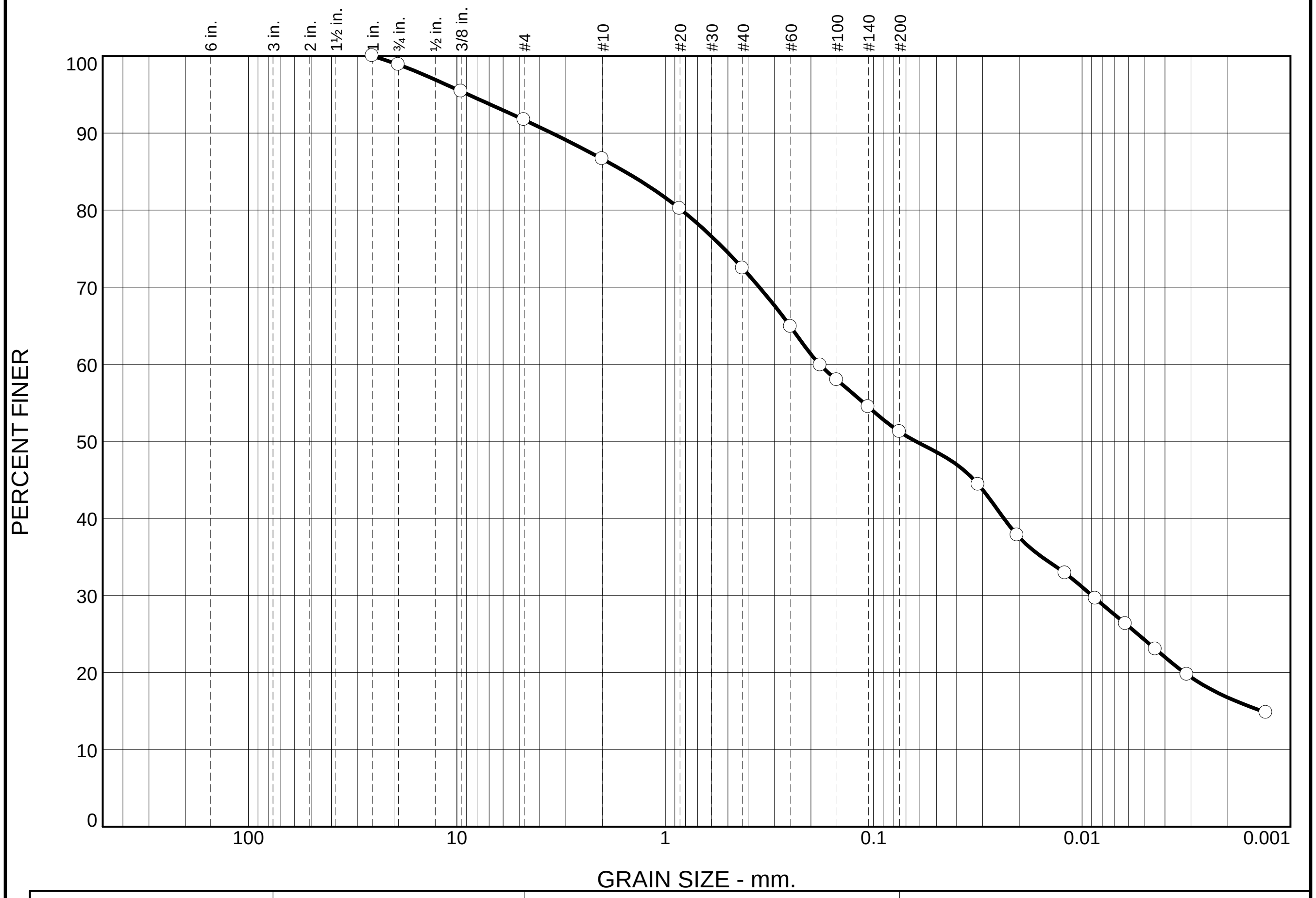
List non-conformance issues associated with this work order in the chart below/left. Identify discrepancies between the COC and sample tags in the chart below/right. Add comments as needed.

		Type of Problem										COC					Sample Tag					
COC ID #	Line #	Discrepancy	Missing Container	Broken Container	Label Missing / Incomplete	Label Illegible	Low Volume	Inappropriate Container	Headspace	Not Listed on COC	Preservation	Sample Field ID	Date Sampled	Time Sampled	Container Type	Qty	Sample Field ID	Date Sampled	Time Sampled	Container Type	Qty	Line Item Comments
19678	X										X											THERM
	1		X									VIB-1	7/18/18	0915	X	X	X	X	X	X	X	MISSING SAMPLE

General Comments:

Project Chemist (initials/date)

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	1.1	7.2	5.1	14.2	21.2	27.0	24.2

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.5622	0.1820	0.0627	0.0090	0.0014			

Material Description	USCS	AASHTO
○ Gray Silty Clay with Sand	CL-ML	

Project No. 181186 **Client:** LimnoTech, LTI

Project: Sugar Island

○ **Location:** VIB-6 **Sample Number:** 148970

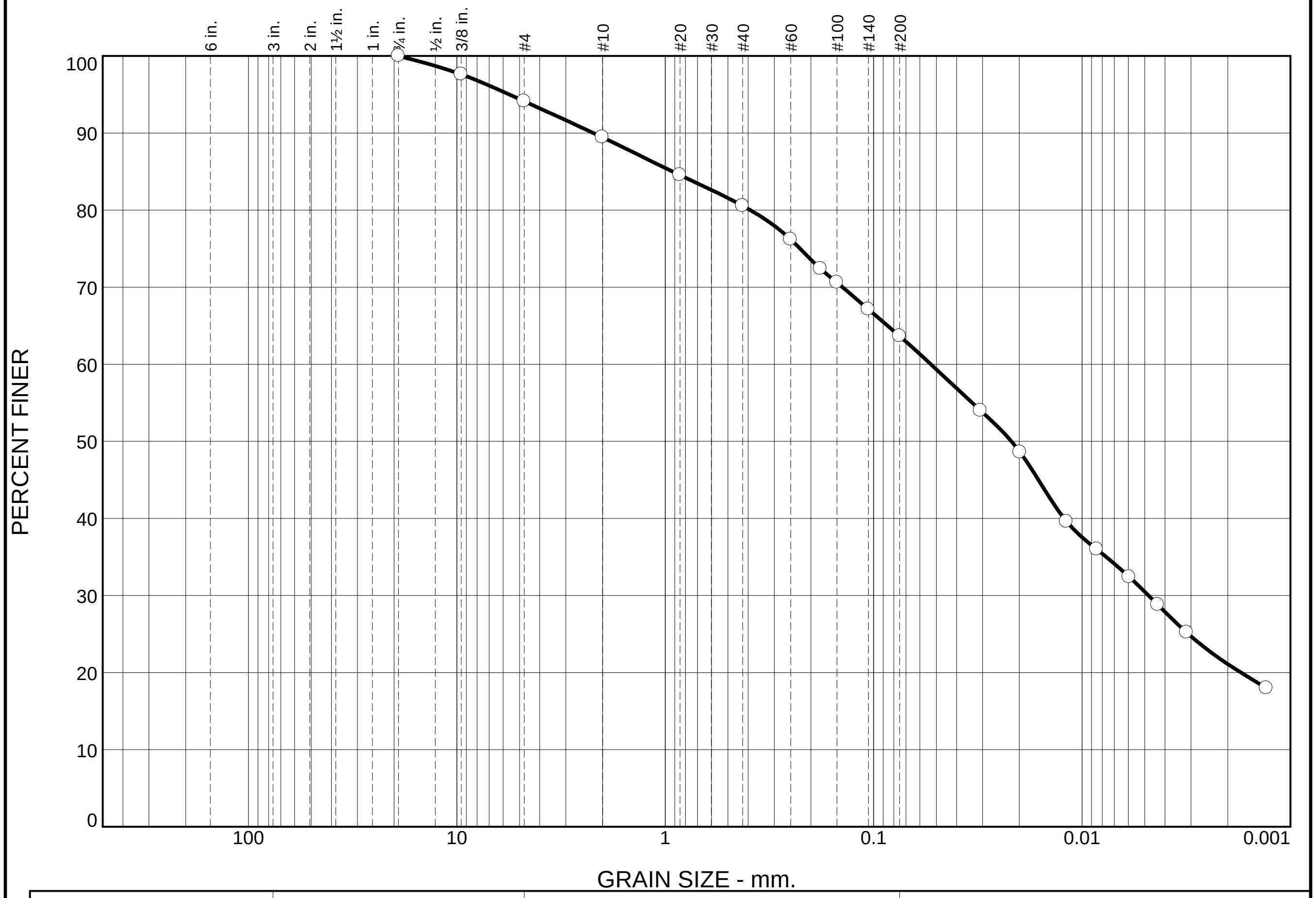
Remarks:

MATERIALS TESTING CONSULTANTS, INC.

Grand Rapids, MI

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	5.9	4.7	8.8	16.9	33.2	30.5

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.9216	0.0531	0.0218	0.0048				

Material Description	USCS	AASHTO
○ Gray Silty Clay with Sand	CL-ML	

Project No. 181186 **Client:** LimnoTech, LTI
Project: Sugar Island

○ **Location:** VIB-3 **Sample Number:** 148971

MATERIALS TESTING CONSULTANTS, INC.

Grand Rapids, MI

Remarks:

Figure

Appendix D
Field Notes and Chain of Custody

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Location ____________ Date ____________

Project / Client ____________

Location ____________ Date 5/16/18

Project / Client SUGAR IS - BATHY

0700 C. O'Brien + R. Betz @ AA
load up equip + drive to
Lk Erie Metro Park

(0830 - 930) - Replace gas tank - hole
developed + fuel leak

0945 at Metro park load + launch
1030 Head out to Sugar IS.
1115 At Sugar IS. survey site BM
elev. BM7 = 586.998' NAVD88

+BS	-FS	elev	
+0.62		587.618	BM/HI
	- 13.06	574.558	H_2O surf.
+0.62		587.618	BM/HI
	- 13.06	574.558	H_2O surf. - check

1200 single beam set up - check
bottom conditions for weed growth

Rite in the Rain

1215 Bar check, draft = 0.7'

Set	read	SVEL
3	2.98	4764
5	4.95	
10	9.97	
15	14.99	4788
13	12.99	
10	9.97	
7	6.95	
5	4.95	
3	2.98	4783 ft/s

lead line check ≈ 17.55'
sounder read ≈ 17.60

1430 * wind SE, chop + white cap *

1550 Close survey - could not find deeper area
very choppy conditions + high flow

~~bar set~~	~~bar read~~
3	3.01
7	6.98
10	9.97
12	12.00

draft = 0.70'

1640 close elev. survey @ BM1 = 586.998'

+BS	-FS	elev	
1.31'			BM/HI
	-14.0'	574.308'	H_2O surf.
+1.31'			
	-14.0'		H_2O surf. check

* choppy H_2O surf. near bar - estimate H_2O surf. * - water level is dropping ← Use Gibraltar gage ht.

1730 back at launch
1930 back in AA - demob

Rite in the Rain

Field Notes

June 1, 2018. Ed Verhamme Gerg Cutrell.

Weather: Dead Calm. 70 deg. Partly Cloudy

7:30 – left dock

8:05 – Arrived at island

8:10 – Set up adcp

8:20 – Started saving lowrance

8:20 – Placed flashing light on top of boat

8:30 to 8:45 : Pulled adcp from rock split to island and back on east side of island. Approximately 11,300 cfs

9:20 to 9:40 ADCP transect from west side of island . approximately 31,500 cfs. Saw a BALD EAGLE. Turkeys.

9:50 – Site 001 16" into sediment with probe between dock and island on west side. 3 ponar

10:14 – Site 002 36" probe depth. 4 Ponar. Very sandy coarse sediment

10:30 – Site 003 48" probe depth. 10 Ponar. Tried surficial core ..~ 8".. got very hard mud…put in two bags (core top and core bottom.

11:00 – collect bank sample on SW side of island.

11:20 – Site 005. Hard compact sand/clay. Core could only penetrate a few inches. Probed ~2".

11:30 – Break for lunch

12:00 – ROV at beach on west side

12:30 – ROV at site 3

13:20 – Site 6. 7" probe depth..about 5" is softer…2" seems to be hard clay. PONAR.

13:38 – ROV at site 6

1400 – head back to dock

2:10 – Arrived at dock

LTI-Limno-Tech, Inc.
Environmental Engineering

Check originating office

☐ **Corporate Office**
501 Avis Drive
Ann Arbor, MI 48108
Phone (734) 332-1200
Fax (734) 332-1212

☐ **Kalamazoo Field Office**
2980 Business One Drive
Kalamazoo, MI 49048
Phone (269) 226-0190
Fax (269) 226-0192

CHAIN OF CUSTODY RECORD

PROJ. NO.

PROJECT NAME SUGAR ISLAND

SAMPLERS: *(Signature)* EV / GC

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	Sample Matrix	# of Containers	GRAINSIZE						REMARKS
SITE 2	6/1/18	10:14		X		SED	1	X						
SITE 3-1		10:30		X	PONAR		1	X						
SITE 3-2		10:30		X	TUBE		1	X						
SITE 4		11:00		X			1	X						
SITE 6		13:20		X			1	X						

Relinquished by: *(Signature)*	DATE	TIME	Received by: *(Signature)*
Cathy Whiting	6/5/18	10:30	
Relinquished by: *(Signature)*	**DATE**	**TIME**	**Received by:** *(Signature)*
Relinquished by: *(Signature)*	**DATE**	**TIME**	**Received for Laboratory by:** *(Signature)*

LABORATORY SENT TO: MTC
LABORATORY CONTACT: DAN ELLIOTT
SHIPPING CARRIER: FED EX
TRACKING NUMBER:

DATE	TIME	Requested Turnaround Time:

Location Sugar Island Date 7/18/2018

Project / Client SUGARIS Sediment Sampling

RTB

0900 Met Affiliated Researchers w/ pontoon boat at Ford Yacht Club on Gross Ile
Shannon Remick, Jeff + Chance
☎ 989-859-0749
Met w/ Dave of FYC - yard mgr to open boat launch on Trenton Channel

AR sets up GPS + RTK at boat launch area

- Safety brief - slips, trips, falls, boat envrmt

0830 Launch + depart for Sugar Island
** see note about coords next page

At site 1 - probe around for sediments - only ~ 1" of soft seds

0915 Pull vibracore, get ~ 6" recovery tan seds w/ rock or mussel
Water Elv. = 573.524'
Marked location w/ Trimble Collector.
1 core for visual characterizing

Plan
Geotech samples at 2, 3 + 6, if possible
visual characterization cores at 1-9

Location Date 7/18/2018

Project / Client SUGARIS

** Coordinates Note
S Wade originally sent sed. locs as lat/long
AR received as state plane coords but Jeff thinks they are Central MI instead of S MI coords. Called S Wade + he emailed the correct S. MI state plane coords, gave to Jeff to compare with what he is using.

Jeff said we were w/in 7 ft of the shot he took using COORD system

Site 9 1 core for visual characterizing

0945 5.7' water depth
collect vibracore
9.9', total push below water surface
→ 4.7' core recovered
dk brown/gray seds
573.592' water Elv.

Location
Date 7/18/2018
Project / Client SUGARIS

Site 2 S. end of Sugar Island
initial loc was very rocky
moved ~20' to E
Still very hardpan bottom
we will not collect a geotech
core here because would
need at least 27" recovery

- * 1st core attempt only penetrated
0.1 foot (~1") No recovery
- * 2nd attempt: penetrate ~6"
no recovery

* no core catcher used

- 3rd attempt using core catcher in
end of core tube - core held
~ 4" sed. but not long enough to cap
no recovery
- 4th attempt - no recovery

water depth = 3.2'
no soft seds present
Ø water elev 573.766

Location
Date 7/19/2019
Project / Client SUGARIS

1030 **At Site 8**
water depth 4.6'
sed thick 6' below water surface
8 vibracore
total depth pushed ≈ 6.6"
core recovery ≈ 1.9'

8A Vibracore duplicate using
a clean core tube (paper
wrapped)
6.7' total depth of push
2.4' recovery

Water depth = see above
" elev. 573.768
GeoTech = 8,8A = 4' Lenght
Note: Called Cathy W when at
Site 2 to advise of no recovery
She texted alternative locations
for geotechnical if we
encounter recovery problems
- Try Geotech at 3+6 then 7,8 + 9
in that order

Location ______ Date 7/18/19

Project / Client SOLARIS

1100 At Site 7

original location is hardpan/
no vibracorable
moved ~20 ft to west
still not able to probe into sediments

water elv 573.[illegible] ~~see Rodo~~

Attempt vibracore 2X
No recovery
~ a little sediment was initially cored but would not stay in tube when pulled up

Ø

Location ______ Date 7/18/2019

Project / Client SOLARIS

1122 At site 6

water depth 5.4'
sed probe 6' = 0.6' sed thickness

1127 pull vibracore

- 1st; total push = 6.3' below water surface
  recovery = 1'
- 6A total push = 6.5'
  recovery = 0.9'
- 6B total = 6.5'
  recov = 1.1'

pulled 3 cores - total of 3' seds
all from top 1' of bottom

water elv. 573.817'
Geotech 6, 6A, 6B = 3' length
1150 leave to shuttle cores back to truck + resupply

Location

Date 7/18/2018

Project / Client SUGARIS

1315 **At Site 3**

Probing around boat for sed thickness
3.5' water depth
0.4' sed thickness via probing

Vibracore
● 3 0.6' recovery
unsure of total push

● 3A push 4.4'
sed 0.9' recovered

● 3B sed recov. 0.7' clay + rock
not an ideal core space
around clayey lump

● 3C sed recov = 0.8'

Geotain 3, 3A, 3C = 2.3' length

Location

Date 7/18/2018

Project / Client SUGARIS

1410 **At Site 4**
located by observation - No GPS
water depth = 4.3'
Vibracore
total depth = 5.4'
recovery = 1'

No cellular or GPS service
here on phone or
Trimble CTD100

AR Had to replace bolt in vibracore

1455 **At Site 5**
Located by observation - No GPS

Vibracore
~~total depth =~~
~~recovery =~~
water depth = 5.3
sed probe thickness = 0.7
Core push = 6.6' below water
Recov. Core len = 1.4'

Location ______ Date 7/18/2019

Project / Client SUGARIS

~1515 Site 10 = ~60' S of 7

Attempt to obtain core in vicinity of site 7

vibracore ✗

push length ~ 7.5 below water

recovery core len = 1'

1536 – water depth = 6.8'

water elev ~ 574.277

1540 Head back to marina

Location ______ Date ______

Project / Client ______

WO#: 4615201

4615201

Inc.

Check originating office

☐ **Corporate Office**
501 Avis Drive
Ann Arbor, MI 48108
Phone (734) 332-1200
Fax (734) 332-1212

☐ **Kalamazoo Field Office**
2980 Business One Drive
Kalamazoo, MI 49048
Phone (269) 226-0190
Fax (269) 226-0192

CHAIN OF CUSTODY RECORD

PROJ. NO.:

PROJECT NAME: SUGAR ISLAND

SAMPLERS: (Signature) BETZ

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	Sample Matrix	# of Containers	SVOC, PCB, TA(23) metals	VOC					REMARKS
	7/18/18	9:15		X	VIB-1	Sed	2	X	X					
	7/18/18	13:15		X	VIB-6	SED	2	X	X					

Relinquished by: (Signature) Cathy Whiting
DATE 7/19/18 TIME 18:30
Received by: (Signature)

Relinquished by: (Signature)
DATE TIME
Received by: (Signature)

Relinquished by: (Signature)
DATE TIME
Received for Laboratory by: (Signature)

LABORATORY SENT TO: PACE
LABORATORY CONTACT: JENNIFER RICE
SHIPPING CARRIER: FED EX
TRACKING NUMBER:

DATE 7/20 TIME 0830
Requested Turnaround Time: 2 WEEK

SAMPLE RECEIVING / LOG-IN CHECKLIST

Pace Analytical®

Client LTI

Receipt Record Page/Line # 6-23

Work Order # 461520I

001

Recorded by (initials/date) IB 7/20/18

☑ Cooler
☐ Box
☐ Other____

Qty Received 1

Thermometer Used
☐ IR Gun (#202)
☐ Digital Thermometer (#54)
☑ IR Gun (#402)

Cooler # — Time 1146

Custody Seals:
☑ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☑ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
[✓ Dispersed] / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☑ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank	/	/	/
Sample 1	9.5		9.5
Sample 2	11.0		11.0
Sample 3	/		/

When above 6 °C take a 3 Sample Average °C: 10.2

☐ VOC Trip Blank received?

Cooler # Time

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler # Time

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler # Time

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

If any shaded areas checked, complete Sample Receiving Non-Conformance

Paperwork Received

Yes	No	
☑	☐	Chain of Custody record(s)? If No, Initiated By ________
☑		Received for Lab Signed/Date/Time?
☐	☑	USDA Soil Documents?
☐	☑	Sampling / Field Forms?
☐	☑	Other ________

COC Information

☐ Pace COC ☑ Other LTI

COC ID Numbers:

19678

Check COC for Accuracy

Yes	No	
☑	☐	Analysis Requested?
☑	☐	Sample ID matches COC?
☑	☐	Sample Date and Time matches COC?
☐	☑	All containers indicated are received?

Sample Condition Summary

N/A	Yes	No	
	☐	☑	Broken containers/lids?
	☐	☑	Missing or incomplete labels?
	☐	☑	Illegible information on labels?
	☐	☑	Low volume received?
	☐	☑	Inappropriate or non-Pace containers received?
☑	☐	☐	VOC vials have headspace?
	☐	☑	Extra sample locations?
	☐	☑	Containers not listed on COC?

Check Sample Preservation

N/A	Yes	No	
	☑	☐	Temperature Blank **OR** average sample temperature, ≥6° C?
☐	☑	☐	If "Yes" was thermal preservation required?
☐	☐	☑	If "Yes" were ALL samples collected the same day as receipt?
☑	☐		Completed Sample Preservation Verification Form?
☑	☐	☐	Samples chemically preserved correctly?
☑	☐		If "No", add wire tag and fill out Non-Conformance Form?
☑	☐		Received unpreserved Terracore kit?
			If "Yes" unpreserved vials must be frozen

Work Order Not Logged In with Short Hold / Rush

☐ Copies of COC To Lab Areas

Notes

Yes	No	
☑	☐	Were all samples logged into Epic?
☑	☐	Were all samples labelled?
☑	☐	Were samples placed on scan locations?

Initial / Date : IB 7/20/18

Pace Analytical®

SAMPLE RECEIVING NON-CONFORMANCE REPORT

Client: LTI

Receipt Log #: 6-23

Completed By (initials/date): IB 7/20/18

Work Order #: 4615201

Project Chemist:

List non-conformance issues associated with this work order in the chart below/left. Identify discrepancies between the COC and sample tags in the chart below/right. Add comments as needed.

COC ID #	Line #	Type of Problem										COC					Sample Tag					Line Item Comments
		Discrepancy	Missing Container	Broken Container	Label Missing / Incomplete	Label Illegible	Low Volume	Inappropriate Container	Headspace	Not Listed on COC	Preservation	Sample Field ID	Date Sampled	Time Sampled	Container Type	Qty	Sample Field ID	Date Sampled	Time Sampled	Container Type	Qty	
19678	X										X											THERM
	1		X									VIB-1	7/18/18	0915	X	X	X	X	X	X	X	MISSING SAMPLE

General Comments:

Project Chemist (initials/date)

WO#:4613112

4613112

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page : 1 Of 1

ecti

equ

ompany: LimnoTech
ddress: 501 Avis Drive
nn Arbor, MI 48108
mail: bbetz@limno.com
hone: (734)332-1200 Fax
equested Due Date:

nformation:
Report To: Robert Betz
Copy To:
Purchase Order #:
Project Name: Sediment Sampling
Project #:

Section C
Invoice Information:
Attention: CATHY WHITING
Company Name: LIMNOTECH
Address: 501 AVIS DR. ANN ARBOR, MI. 48108
Pace Quote:
Pace Project Manager: jennifer.rice@pacelabs.com,
Pace Profile #: 1675

Regulatory Agency

State / Location

MATRIX	CODE
Drinking Water	DW
Water	WT
Waste Water	WW
Product	P
Soil/Solid	SL
Oil	OL
Wipe	WP
Air	AR
Other	OT
Tissue	TS

SAMPLE ID
One Character per box.
(A-Z, 0-9 / , -)
Sample Ids must be unique

				COLLECTED						Preservatives									Requested Analysis Filtered (Y/N)													
				START		END												Y/N														
ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	DATE	TIME	DATE	TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H2SO4	HNO3	HCl	NaOH	Na2S2O3	Methanol	Other	Analyses Test	SVOC, PCB, TAL (23) Metals	VOC											Residual Chlorine (Y/N)	45-3
1	SITE 3	SL	G	6/1/18	10:30				2	X									X	X												
2	SITE 6	SL	G	6/1/18	13:20				2	X									X	X												
3																																
4																																
5																																
6																																
7																																
8																																
9																																
10																																
11																																
12																																

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
					6/6/18	0820				

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: CATHY WHITING
SIGNATURE of SAMPLER: Cathy Whiting
DATE Signed: 6/5/18

TEMP in C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLE RECEIVING / LOG-IN CHECKLIST

Pace Analytical®

Client: Limno Tech

Work Order #: 4613112

Receipt Record Page/Line #: 45-3

Recorded by (initials/date): RS 6/6/18

☑ Cooler
☐ Box
☐ Other______

Qty Received: 1

Thermometer Used:
☑ IR Gun (#202)
☐ Digital Thermometer (#54)
☐ IR Gun (#402)

Cooler #: Blue Time: 0851

Custody Seals:
☑ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☑ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / [✓ Middle] / Bottom

Temp Blank Present: ☐ Yes ☑ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1	5.6		5.6
Sample 2	4.7		4.7
Sample 3	4.8		4.8

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler #: Time:

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler #: Time:

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

Cooler #: Time:

Custody Seals:
☐ None
☐ Present / Intact
☐ Present / Not Intact

Coolant Type:
☐ Loose Ice
☐ Bagged Ice
☐ Blue Ice
☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is:
☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

When above 6 °C take a 3 Sample Average °C:

☐ VOC Trip Blank received?

If any shaded areas checked, complete Sample Receiving Non-Conformance

Paperwork Received

Yes	No	
☑	☐	Chain of Custody record(s)? If No, Initiated By ______
☑		Received for Lab Signed/Date/Time?
☐	☑	USDA Soil Documents?
☐	☑	Sampling / Field Forms?
☐	☑	Other ______

COC Information

☑ Pace COC ☐ Other______

COC ID Numbers:

Check COC for Accuracy

Yes	No	
☑	☐	Analysis Requested?
☑	☐	Sample ID matches COC?
☑	☐	Sample Date and Time matches COC?
☑	☐	All containers indicated are received?

Sample Condition Summary

N/A	Yes	No	
	☐	☑	Broken containers/lids?
	☐	☑	Missing or incomplete labels?
	☐	☑	Illegible information on labels?
	☐	☑	Low volume received?
	☐	☑	Inappropriate or non-Pace containers received?
☐	☐	☑	VOC vials have headspace?
	☐	☑	Extra sample locations?
	☐	☑	Containers not listed on COC?

Check Sample Preservation

N/A	Yes	No	
	☐	☑	Temperature Blank **OR** average sample temperature, ≥6° C?
☑	☐	☐	If "Yes" was thermal preservation required?
☑	☐	☐	If "Yes" were ALL samples collected the same day as receipt?
☑	☐		Completed Sample Preservation Verification Form?
☑	☐	☐	Samples chemically preserved correctly?
☑	☐		If "No", add wire tag and fill out Non-Conformance Form?
☑	☐		Received unpreserved Terracore kit?
			If "Yes" unpreserved vials must be frozen

Work Order Not Logged In with Short Hold / Rush

☐ Copies of COC To Lab Areas

Notes

Yes	No	
☑	☐	Were all samples logged into Epic?
☑	☐	Were all samples labelled?
☑	☐	Were samples placed on scan locations?

Initial / Date : RS 6/6/18

LTI-Limno-Tech, Inc.
Environmental Engineering

Gave COC to Chris who hand off to MTC on 7/23

Check originating

☐ **Corporate Office**
501 Avis Drive
Ann Arbor, MI 48108
Phone (734) 332-1200
Fax (734) 332-1212

☐ **Kalamazoo Fie**
2980 Business One D
Kalamazoo, MI 49048
Phone (269) 226-0190
Fax (269) 226-0192

CHAIN OF CUSTODY RECORD

PROJ. NO.

PROJECT NAME SUGAR ISLAND

SAMPLERS: *(Signature)* BETZ

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	Sample Matrix	# of Containers	UNIT WEIGHT	DIRECT SHEAR	TRIAXIAL CU	UNCONFINED COMP.	GRAIN SIZE		REMARKS
	7/18/18	11:27		X	VIB-6	SED	3	X	X	X	X	X		
	7/18/18	8:15		X	VIB-3	SED	3	X	X	X	X	X		

Relinquished by: *(Signature)* **DATE** **TIME** **Received by:** *(Signature)*

Relinquished by: *(Signature)* **DATE** **TIME** **Received by:** *(Signature)*

Relinquished by: *(Signature)* **DATE** **TIME** **Received for Laboratory by:** *(Signature)*

LABORATORY SENT TO:

LABORATORY CONTACT:

SHIPPING CARRIER:

TRACKING NUMBER:

DATE **TIME** **Requested Turnaround Time:**

APPENDIX C

BOTANICAL ASSESSMENT

FRIENDS OF THE DETROIT RIVER

SUGAR ISLAND HABITAT RESTORATION

Botanical Assessment

SMITHGROUP

September 2018

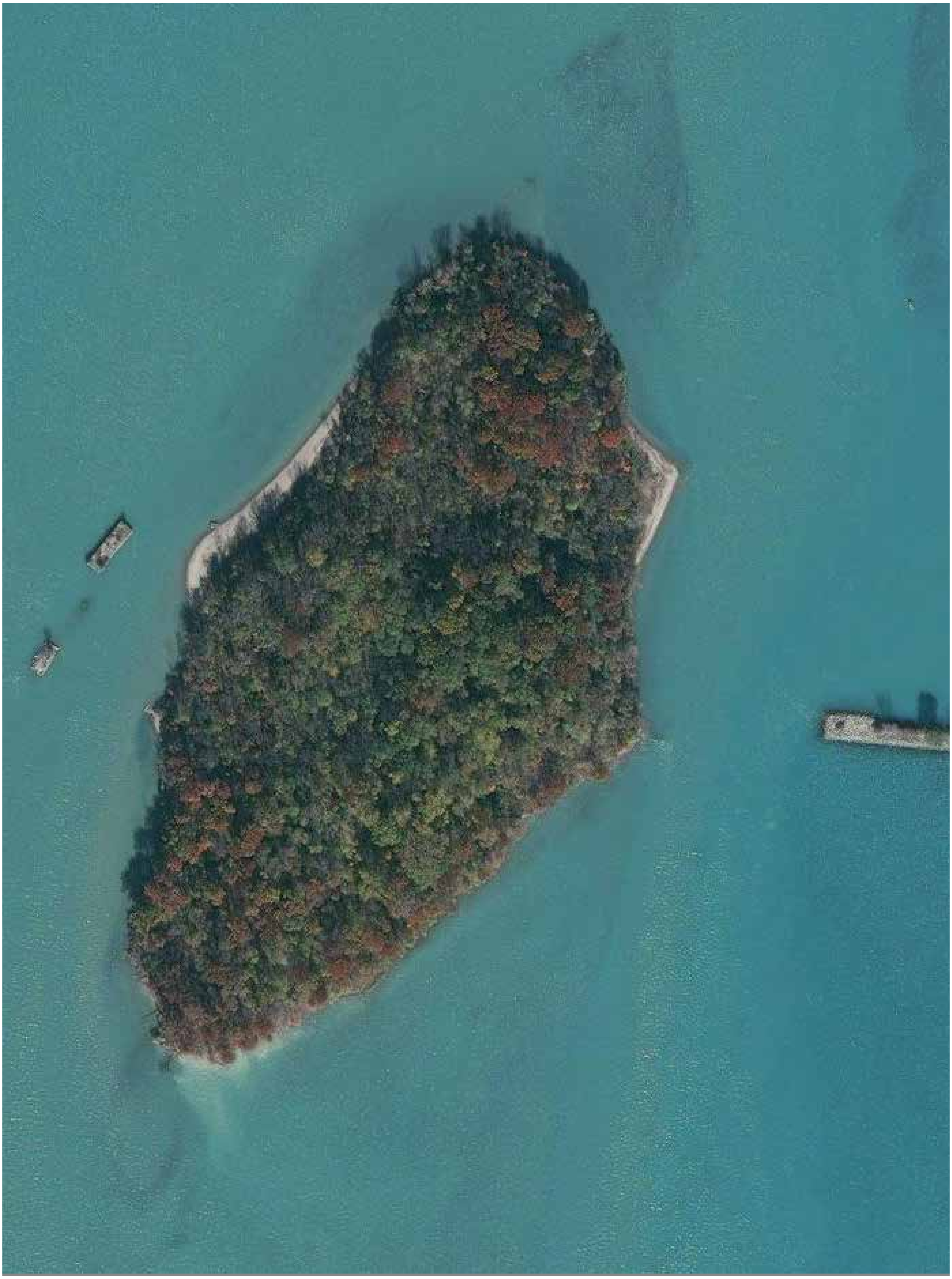


TABLE OF CONTENTS

INTRODUCTION

As part of the Baseline Biological Survey for Sugar Island (Island), a botanical assessment was performed to inventory the native and non-native terrestrial and aquatic plant species. Visits to the Island to assess terrestrial species occurred in May, June, and August of 2018.

It should be noted that based on literature research and observed remnant structures, the Island and near-shore areas have been heavily altered from its natural state. Taking into account the types of land uses that previously existed on the Island, it is evident that many trees were removed, new plantings (such as lawns) added, and grade modifications performed, to the extent that verification of pre-settlement conditions of the Island may never be fully verified. What we can say is that the Island has been very resilient and over the period since the Island uses have changed, nature has rebounded to the extent that vegetation is dense and diverse and previous human-introduced uses are almost unnoticeable.

Based on the identification of numerous plants typically found in wet-mesic flatwoods communities, as well as the Natural Resources Conservation Service (NRCS) soil survey classification description and the position of the Island in the Maumee Lake Plain subsection, Sugar Island can be classified today as a wet-mesic flatwoods community. Previous environmental investigations have already made this claim, which current site surveys have confirmed. This community is characterized by poorly to somewhat poorly drained forests dominated by a mixture of lowland and upland hardwoods; the type of woodlands is based primarily on the presence and depth of sand deposits and clay layers. They are characterized by a patchy mosaic of uplands mixed with depressions containing an impervious subsurface clay layer that causes seasonal inundation and ponding. Surface flow and precipitation in the form of both rain and snow provide this community with most of its water. Small, shallow vernal pools in spring become desiccated during late summer/fall, and plants in this community have adapted to these conditions. Wet-mesic flatwoods are ranked S2 (imperiled in the state) and G2G3 (globally imperiled/globally very rare and local).

The near-shore area around the Island (up to 10 feet deep) is also included under this assessment. Dense beds of macrophytes were observed in several locations along all sides of the Island but the 15- to 20-acre study area adjacent to the south tip of the Island is mostly void of macrophytes or stunted in growth where found, suggesting that the swift cross currents and absence of an organic soil layer contributes to this condition.

METHODS

Time-meander surveys were conducted across the entire Island to document presence and relative abundance of the species, although dense shrub cover made using this method difficult.

Macrophyte beds around the Island were reviewed from the Friends of the Detroit River (FDR) boat. The beds were easily visible from the surface and when not, a garden rake was used to pull plants to the surface for identification.

Researched resources included:

- A hardcopy wetland delineation map created in January 2004 and printed on a base map containing topographic elevations and contours (Appendix A).
- The Michigan Natural Features Inventory (MNFI) Wet-mesic Flatwoods Community Abstract (Appendix B).
- The NRCS/ United States Department of Agriculture (USDA) Soil Survey of Sugar Island and vicinities completed in October 2017 (Appendix C).
- The United States Fish and Wildlife Service (USFWS) Draft Environmental Assessment of February 6, 2013, "Additional Public Use of Sugar Island Unit, Detroit River International Wildlife Refuge."
- Historic black and white DTE aerial photography from 1949, 1952, and 1967 (Appendix E, Photos 1 – 3).
- Historic photographs and postcards, from the Internet (Appendix E, Photos 4 – 14).
- Topographic survey prepared by SmithGroup.

RESULTS

OVERALL

Figure 1 shows a graphic representation of generalized plant communities on the Island. The Island is predominantly upland by nature, as well as containing wetland areas that are large enough to be mappable, with dozens of smaller micro-wetlands occurring in numerous depressions. The plants within all these regimes are fairly consistent across the site; however, there are certain areas on the Island that have slightly different plant palettes and therefore bear mentioning. Generally, the plant species found on the Island closely match the list of upland and wetland plants typically found in a wet-mesic flatwoods with the exception of the invasive species. Macrophyte beds in the near-shore areas of the river were comprised of both native and non-native species and provide excellent cover for juvenile fish species.

It is difficult to ascertain how much influence previous man-made structures and underground drainage pipes have had on the topography and plant communities. Aerial photography from DTE dated 1949 (Photo 1) shows the dance pavilion and ramps still in existence, but in 1952 (Photo 2) the ramps are gone. In 1954 the dance pavilion burned to the ground. It is difficult today to find any sign of the dance pavilion location although a short rock wall that probably bordered the walkway from the boat ramp was found. There was another smaller building on the south side of the dance pavilion – use unknown – and a baseball diamond on the north side. These areas were lacking mature trees at that time and appeared to be mostly turf. There are large silver maples (*Acer saccharinum)* now scattered throughout these areas but since this species tends to grow quickly they cannot be precisely determined to be from the same time period as the resort's heyday. The baseball diamond is presumed to be the large open area north of the dance pavilion seen in historic aerial photos and is now mostly wetland (Wetland D in the report) and is lacking mature trees. Portions of an arcing swale that was probably used to drain the baseball diamond was located farther north of Wetland D and is part of Wetland A. Picnic grounds were located on the east side of the dance pavilion and historic postcards show large trees preserved for this area, presumably to provide shade. The 1949 aerial photo also shows large trees on this side as well as just north of the dance pavilion. Historic postcards show large grassy areas across most of the Island.

Shrub and ground cover diversity is typically low in wet mesic flatwoods because of the few number of plants that can withstand regular flood-drought cycles, as well as the dense overstory canopy. This could explain why the aggressive common privet (*Ligustrum vulgare*) was able to become the primary understory plant on the Island: it tolerates a wide range of environmental conditions from full sun to forest understories, and from sandy, to loamy, to clay soils. Birds and wildlife do get the benefit of eating the fruit but that distributes the plant even further because the seeds pass unharmed. Privet also colonizes via root sprouts. The abundance of privet could explain the reason why the Island is lacking a more diverse shrub understory, since only one shrub (gray dogwood, *Cornus foemina*) of the typical 13 shrub species listed as found in this community were observed.

FIGURE 1. PLANT COMMUNITY ASSESSMENT

Across the site, dominant overstory and understory plants can be succinctly categorized as hackberry, red oak, silver maple, common privet, and jumpseed.

Two plants merit special mention because they are listed species and are included in the MNFI's "Rare Plants Associated with Wet-Mesic Flatwoods." The first is wahoo (*Euonymus purpurea*), a state-listed Special Concern shrub/small tree. At least one 15-foot +/- tall tree was found on the eastern bluff across from the cross-vein. The second important species is red mulberry (*Morus rubra*), found a short distance inland on the southeast side of the Island, although the positive identification of this state-listed Threatened tree was not 100%. The sample taken appeared to have mostly red mulberry identifying characteristics (growing in dense shade, dull green leaf surfaces, sharply toothed leaf edges, less prominent main vein on leaf underside, and some immature buds appear to be characteristic of red mulberry), but also one to two white mulberry characteristics (hairs on main veins on leaf undersides and some immature buds appear to be characteristic of white mulberry). Literature claims that these trees will hybridize, so until buds can be reviewed, a positive identification is not yet available.

SOILS

The NRCS surveyed the Island's soils in October 2017 (Appendix C), reporting that most of the Island is made up of Blount loam with a small hammer head-shaped area on the west side/central portion consisting of Pewamo loam. Pewamo loam, occurring in depressions on till-floored lake plains, is a hydric soil and previous wetland mapping from 2004 confirms that a large wetland system is located in this portion of the Island. Pewamo loam is poorly draining with a depth to water table of 0 inches and a soil profile consisting of 0 to 10 inches loam, 10 to 60 inches silty clay loam. Blount loam, formed in till and located on "wave-worked till plains" and till plains, is somewhat poorly draining with a depth to water table of 6 to 12 inches and a soil profile consisting of 0 to 9 inches loam, 9 to 27 inches clay, and 27 to 80 inches clay loam. Scattered large and small wetlands have been identified across this soil type in the 2004 wetland survey. Pewamo is a minor component of Blount soils, likely occurring in these depressions.


JUMPSEED (PERSICARIA VIRGINIANA) DOMINATES MUCH OF THE SITE

The soil survey occurred many years after human disturbance created the resort that once occupied the site. With structures including a large dance pavilion, restaurant, baseball diamond, and roller coaster, it is difficult to determine which soils and landforms are original to the Island, but site investigations still confirm overall presence of a wet-mesic flatwoods community. It is unlikely that soils were transported to the Island, but grade manipulation would have occurred to improve drainage and create level surfaces for outdoor recreation.

A seasonal high-water table was also observed across the southern half of the Island in May, but was mostly absent in June. This observation suggests that the soil classification is correct with sand lenses serving as the conduit for the seepage that were observed in several locations, mid-way up the bluffs surrounding the Island perimeter. While some bank failure and falling trees are associated with this seepage line, this does not appear to be the only reason for the excessive bank failure; other reasons may include high water levels in the river, wave action and, to a limited degree, currents.

UPLAND AREAS

The canopy layer is dominated by oaks (*Quercus rubra, Q. alba, Q. macrocarpa*), hickories (*Carya ovata, C. cordiformis, C. glabra*), black cherry (*Prunus serotina*), black walnut (*Juglans nigra*), hackberry (*Celtis occidentalis*), slippery elm (*Ulmus rubra*), and occasionally mulberry (*Morus alba*), American linden (*Tilia americana*), and Norway maple (*Acer platanoides*). Understory consists of canopy saplings and a few hawthorn (*Crataegus spp.*), occasional ironwood (*Ostrya virginiana*) and common buckthorn (*Rhamnus cathartica*). The shrub layer is completely dominated by common privet but other plant species include honeysuckle (*Lonicera spp.*), multiflora rose (*Rosa multiflora*), black raspberry (*Rubus occidentalis*), and gray dogwood (*Cornus foemina*). The groundplain is more diversely native and is dominated by shade tolerant species like jumpseed (*Persicaria virginiana*), white avens (*Geum canadense*), poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*), riverbank grape (*Vitis riparia*), and seedlings of linden, ash, and buckthorn. Wintercreeper (*Euonymus fortunei*) is a major invasive dominant groundcover of the Island's upland areas.

48-INCH DBH WHITE OAK ON NORTH SIDE OF ISLAND

A small grove of sugar maples (*Acer saccharum*) is located on the southeast side of the Island along the eroded bluff, just south of the open grassy area and extends inland for only a short distance. None of the trees is much larger than 12-inch diameter at breast height (DBH), some are saplings, and there are only approximately a dozen trees. Two are falling into the Detroit River.

An interesting feature of the upland areas of the Island, particularly the drier sections in the center and north where most of the oaks are located, is the size and condition of the canopy trees. One white oak on the north side was measured at 48-inch DBH and other red oaks in this area are almost as large, but appear to be in decline. It is not yet clear whether this decline is due to age of the trees combined with the growth environment or as a result of the historical land uses (grade manipulation, soil compaction, and changed site hydrology). White oaks are especially susceptible to urban impacts that cause compaction, reduction of mycorrhizal associations, and removal of understory organic litter. Red oaks live an average of 200 years, white oaks an average of 300 years. However, oaks 70 to 90 years of age, especially red oaks, are most vulnerable to oak decline. Oak decline is a cascading series of events that can cause oaks to deteriorate over time, generally starting with an environmental stress such as drought or early season frost damage, or by soil compaction. Drought and compaction causes mortality of rootlets in the upper 12 inches of soil, plus, if trees defoliate too heavily, they need to convert root-stored starch into sugar to support continued metabolism, which in turn weakens resources and trees begin to decline. Adventive fungi and/or pests may invade the tree which impairs movement of water and nutrients, resulting in crown die-back. Over-mature trees do not have the capacity to rebound with the return of normal environmental conditions because the tree demands more resources than it possesses. It is beyond the scope of this assessment to determine specifically what may have caused these trees to decline, but a list of area droughts includes a 7-year drought in the 1930's, another 7-year drought in the 1960's, the worst drought on record in 1988, and now 2016, 2017, and 2018 have been drought years. Fortunately, the dead and dying trees provide excellent habitat for many cavity-dwelling birds and other wildlife has been observed by Allen Chartier, the project avian expert.

BLUFF EDGES

The tops of the bluffs surrounding the perimeters of the Island, approximately 25-feet +/- wide, contained a slightly different plant palette than the rest of the site, particularly along the heavily eroded, south-facing

DEAD TREE CAVITY IS HABITAT FOR MANY BIRD SPECIES

SPRING BEAUTY (CLAYTONIA VIRGINICA) ON UPLAND BLUFF

CUTLEAF TOOTHWORT (CARDAMINE CONCETENATA) IS THICK ON SOME UPLAND BLUFFS

EAST SIDE OPEN GRASSY BLUFF IN JUNE

SOUTH POINT CAMPSITE/DUCK BLIND

bluff. In some places the population of privet does not begin until approximately 25-feet +/- from the bluff edge, which apparently allows native species to flourish in these largely upland, better lit environments. Plants here included gray dogwood, masses of spring beauty (*Claytonia virginica*), white trout lily (*Erythronium albidum*), and cutleaf toothwort (*Cardamine concatenate*), with occasional Solomon's seal (*Polygoatum biflorum*) and heart-leaf aster (*Symphyotrichum urophyllum*). In one small bluff edge on the lower west side of the Island was a grassy area unlike any other on the Island. In this area the groundplain was dominated by path rush (*Juncus tenuis*) and crested sedge (*Carex cristatella*) with smaller populations of spotted touch-me-not (*Impatiens capensis*), jumpseed, and tiny silver maple seedlings. It is unclear at this point what caused this wet plant community, but a ~24-inch DBH shagbark hickory and a ~8 to 1-inch DBH American linden, both upland species, had recently collapsed into the water from the bluff edge at this same point.

Canopy trees species are typical of those found in upland areas of the Island, and also common privet, honeysuckle, jumpseed, poison ivy, white avens, Virginia creeper, etc.

Another top of bluff area that differs from the rest occurs on the east side of the Island, just south of where the cross-dike stretches toward the Island. This larger grassy area extends approximately ~50-feet inward from the shoreline and is completely devoid of overstory trees and shrubs with the exception of a few small gray dogwood and shining sumac (*Rhus glabra*, which was not found anywhere else on the Island). The grassy opening was dominated by smooth brome (*Bromus inermis*) and Canada bluegrass (*Poa compressa*), scattered with wood reed grass (*Cinna arundinacea*), and bordered on the western edge by giant reed (*Phragmites* *australis*). Scattered in the grasses were poison ivy and black raspberry, and toward the bluff edge black medic (*Medicago lupulina*) and white clover (*Trifolium repens*) formed the groundplain. Historic photos do not show this area to have housed any special attractions. But shortly before the June site visit a huge multi-trunk hackberry had slid into the water leaving behind an exposed sand deposit at the edge of this open grassy area where a ground seep was previously observed in May. The sandy soil would explain the ability for the smooth sumac to grow here.

The south point of the Island is an obvious favorite spot for camping, picnicking, and campfires due to the presence of plywood platforms and other man-made materials; and with people comes a high concentration of invasive species – several of which are not found anywhere else on the Island. Dominant plants at this point included bull thistle (*Circium vulgare*), common mullein (*Verbascum thapsis*), Queen Anne's lace (*Daucus carota*), garlic mustard (*Alliaria petiolata*), orchard grass (*Dactylis glomerata*), Canada bluegrass (*Poa compressa*), annual bedstraw (*Galium aparine*), Canada thistle (*Cirsium arvense*), and honeysuckle, along with spring beauty, cutleaf toothwort, and trout lily.

WETLANDS

During the 2004 wetland survey (Appendix A) many wetlands were flagged but then later determined not to be wetlands by the Michigan Department of Environmental Quality (MDEQ) staff. The misperception is understandable – the wetlands tend to be dominated by Facultative plants like hackberry, gray dogwood, jumpseed, poison ivy, and path rush. The truly "wet" wetlands contain populations of American elm canopy trees and elm seedlings, silver maple (*Acer saccharinum*), green ash seedlings (*Fraxinus pennsylvanica*), glossy buckthorn seedlings (*Rhamnus*

TYPICAL WETLAND ON SUGAR ISLAND, WITH SEDGES, JUMPSEED, SPOTTED TOUCH-ME-NOT, VIRGINIA CREEPER, AND HACKBERRY SAPLINGS

THIS WETLAND IS DOMINATED BY FALSE NETTLE (BOEHMERIA CYLINDRICA)

WETLAND D EARLY IN THE SEASON

SOUTHEAST SHELF IN EARLY SPRING

SILVERWEED (POTENTILLA ANSWERINA) DOMINATES A LARGE PORTION OF THE EAST BEACH

frangula), American cranberrybush (*Viburnum opulus*), white grass (*Leersia virginica*), fowl manna grass (*Glyceria striata*), false nettle (*Boehmeria cylindrica*), and spotted touch-me-not. A few sensitive ferns (*Onoclea sensibilis*) were found in Wetland D. Elm and ash likely played a bigger role in canopy composition before introduction of Dutch elm disease and the emerald ash borer. Many of these wetlands are shallow, small vernal pools and thus have bare soil for the remainder of the season with sparse vegetative cover.

The south-central portion of the Island tends to have higher concentrations of large caliper silver maples as well as American elm, slippery elm, hackberry, etc. but this area has not been identified as wetland.

The 2004 wetland survey identified Wetland A as an unnatural, narrow, half-circular shape that appeared to be man-made. The June site visit revealed a shallow swale, hard to continually track, that contained mostly Facultative species. Close investigation of the 1949 aerial fly-over photography reveals an open, non-treed area that is ringed by the swale on the north; likely the baseball diamond and the swale that was used to help drain the area.

BEACHES/WATERLINE SHELVES

On exposed shelves such as those found on the south, southwest, and southeast sides, trees that used to be above the water line during lower water levels are now in water and include cottonwood, hickory, American linden, and American elm. Shrub layers include overstory tree saplings, redtwig dogwood (*Cornus sericea*), and sandbar willow and other willow species (*Salix exigua*); groundcover is mostly giant reed. A large linear bed of an emergent plant species – threesquare (*Schoenoplectus pungens*) – is growing in the seasonally submerged shoreline along the south side of the Island, partially protecting the shoreline from wave action and providing cover for aquatic species. This is an ideal condition to have and design options will explore the expansion of this condition.

The northeast beach contains both open sand and wet swale. The open area is dominated by a carpet of silverweed (*Potentilla anserina*) but other scattered populations include evening primrose (*Oenothera biennis*), riverbank grape (*Vitis riparia*), common milkweed (*Asclepias syriaca*), scouring rush (*Equisetum* *hyemale*), blue vervain (*Verbena hastata*), poison ivy, and numerous non-native individuals like Queen Anne's lace (*Daucus carota*), Canada thistle, and bindweed (*Convolvulus arvensis*). The swale contained Siberian elm (*Ulmus pumila*), cottonwood (*Populus deltoides*), redtwig dogwood, cattail (*Typha spp.*), threesquare, Phragmites, and blue flag iris (*Iris virginica*). The wetland component of this beach would be regulated under Natural Resources and Environmental Protection Act (NREPA) 1994 PA 451 Part 303, Wetlands Protection (while the shorelines would be protected under Part 301, Inland Lakes and Streams).

The large west beach has open sandy areas with an herbaceous upland fringe on the edge of the woods, and a large wet swale. The upland fringe mainly contains common milkweed, riverbank grape, staghorn sumac (*Rhus typhina*), and sandbar willows.

The large sandy wet swale on the western beach has a much more diverse herbaceous palette than the northeast beach swale, with a majority of the plants being native in origin except for small populations of purple loosestrife (*Lythrum salicaria*), Phragmites, flowering rush (*Butomus umbellatus*), and a few other non-native but less invasive wetland plants. The swale was dominated by common water horehound (*Lycopus americanus*) and sandbar willow, along with other wet meadow-type plants such as blue vervain, nutsedge (*Cyperus esculentus*), soft-stemmed rush (*Juncus effusus*), Torrey's rush (*Juncus torreyi*), wild mint (*Mentha canadensis*), boneset (*Eupatorium perfoliatum*), softstem bulrush (*Schoenoplectus tabernaemontani*), cottonwood seedlings and silver maple seedlings. The sandy ridge between the swale and the Detroit River contained other upland invasive species like Canada thistle, black locust saplings (*Robinia pseudoacacia*), sowthistle (*Sonchus arvensis*), and curly dock (*Rumex crispus*) mixed in with the sandbar willows. The wetland component of this beach would also be regulated under Part 303.

NATIVE HERBACEOUS GROUNDCOVER IN WET SWALE ON WEST BEACH

AQUATIC AREAS

Investigations via boat revealed healthy, thick aquatic beds on the north, east, and west sides of the Island. Dominant plants in these areas were pondweed (*Potamogeton crispus*) and wild celery (*Vallisneria americana*), with lesser beds of Eurasian milfoil (*Myriophyllum spicatum*) and common waterweed (*Elodea canadensis*) , muskweed (*Chara spp.*), and coontail (*Certophyllum demersum*).

The southeast and southwest sides of the Island contained similar plants, but they were found in linear beds that followed current-induced ridges. On the south side itself little to no aquatic plants were found, likely due to currents and erosion of the Island.

The 15- to 20-acre study area adjacent to the south point of the Island is mostly void of vegetation. Cross currents and a gravel bottom in 3- to 6-feet water depth is the common characteristic in this area with little to no macrophytic vegetation.

WINTERCREEPER CLIMBING A HACKBERRY ON THE ISLAND; MULTIFLORA ROSE NEARBY

INVASIVE SPECIES

Invasive, non-native species found on the site and their typical locale include, in alphabetical order by scientific name:

- Norway maple (*Acer platanoides*) – upland areas
- Garlic mustard (*Alliaria petiolata*) – tops of bluffs and scattered in wetlands and upland areas
- Barberry (*Berberis vulgaris*) – sparse; bluff edges
- Winter creeper (*Euonymus fortunei*) – upland areas
- Common privet (*Ligustrum vulgare*) – everywhere except within wetlands
- Honeysuckle (*Lonicera spp.*) – everywhere except within wetlands
- Purple loosestrife (*Lythrum salicaria*) – wetter areas, beaches
- White mulberry (*Morus alba*) – upland areas, bluff edges
- Phragmites (*Phragmites australis*) – shelves and the eastern open grassy area
- Common buckthorn (*Rhamnus cathartica*) - everywhere
- Glossy buckthorn (*Rhamnus frangula*) – wetter areas
- Jetbead (*Rhodotypos scandens*) – sparse; bluff edge
- Multiflora rose (*Rosa multiflora*) – upland areas and wetland edges
- Cool season grasses (*bluegrass spp., smooth brome, orchard grass*) – upland areas and bluffs

Common privet is likely the largest threat on the Island to plant diversity, affecting the shrub layer by outcompeting natives for light and nutrients, and the herbaceous layer by shading. Privet is dense across the Island although there is a small area near the south point and one near the north point where the population thins out. They are also only present in wetlands as small seedlings. Honeysuckle species are close seconds to common privet regarding density of population, with winter creeper being the major threat to the groundplain.

Unfortunately, the most populous invasive plants also provide berries for birds and other wildlife. Privet, white mulberry, both buckthorn species, honeysuckle, multiflora rose, jetbead, and wintercreeper could have been introduced to the Island by a combination of their use as ornamental landscape plantings or by bird droppings. Since they all produce berries favored by birds, their persistence on the Island is not surprising. Any eradication of these species should be compensated with plantings of mature berry-bearing plants favored by (migratory) birds.

RECOMMENDATIONS

The management of Sugar Island for biological purposes can be divided into 3 categories: control of invasive species, management of hydrology to restore original wet-mesic flatwood conditions, and introduction of replacement native wet-mesic flatwood plants that will also benefit migratory birds and fish.

The MNFI has written a detailed management plan for wet-mesic flatwood communities in the "Wet-mesic Flatwoods Community Abstract" which includes several actions, such as invasive species eradication, protection of hydrologic degradation, protection of large-diameter rotting logs and standing dead wood, control of deer populations, and regeneration of oak species.

One of the MNFI's recommendations for management of wet-mesic flatwoods is to protect the downed and decomposing trees because they provide an environment conducive to oak regeneration and germination of other plant species. Many of these trees can be categorized as habitat features since trunk decay and cavities provide habitat for a variety of birds and small mammals while also providing an opening in the canopy below. However, one of the strategies to offset oak decline is to remove older/dying trees to reduce or delay fungal diseases and pest attacks. Also, overcrowding of mature trees adds stress to the trees by exacerbating moisture stress during drought. This is a contradiction that should be considered when finalizing management strategies.

INVASIVE SPECIES CONTROL

Control of invasive species on the Island could be a daunting task since the understory is dominated by non-native invasive species, so priority should be placed on certain plants and carried out over multiple years. Privet, honeysuckle, and multiflora rose are probably the biggest threat because of their large populations on the Island, but also because their fruit is so heavily favored and, therefore, widely spread by migrating birds. To add to the complexity of this topic, the removal of these species will also result in the loss of important food and shelter for the Island bird population. We suggest the following:

- Develop a comprehensive management plan for invasive species to eradicate existing invasives. The plan should include a phased removal combined with native plantings as noted below.
- The management plan should focus on a 5-year eradication and planting program.
- Once complete, annual inspections and spot treatments to eradicate seed bank species and other plants that colonize the Island on an annual basis in perpetuity.

White mulberry should also be higher on the list for eradication because if there are red mulberry present on the Island, white mulberries are hybridizing with them and thus impairing reproduction of the pure species.

Woody invasive species on the Island could be best controlled during the winter, as long as there is still access to the Island, by a basal bark treatment of an oil-based triclopyr herbicide. Cut stumps can be treated with triclopyr or a 2,4-D + 2,4-DP-based herbicide and is most effective in the fall. Herbicides labeled to control privet include glyphosate, triclopyr, imazapyr, metsulfuron, fosamine ammonium, 2,4-D + 2,4-DP, and mixtures of some of these herbicides.

Control of these species should not involve any soil disturbance which could expose invasive species seeds to conditions favorable for germination.

Prevention of human presence on the Island would aid in reduction of introduced weed species.

MANAGEMENT OF HYDROLOGY

Historically, development of the recreation components included grade manipulation and storm drainage systems to make the Island more useable for recreation. Today, the evidence of these changes is hard to notice except for the remnant foundations and eroded areas at discharge points of the storm drains. The identification of all drainage pipes is not part of the project deliverables but an attempt to document these points of discharge revealed five or six locations. There may be more, but the density of invasive understory species made additional identification difficult. The observed pipes are either 4-inch or 6-inch diameter and mostly constructed of clay. Over time the clay sections separate, tree roots and soil fill the pipes, and eventually flow is blocked or significantly reduced, which is the condition currently observed. Tracing the lines back from their discharge points did not reveal any additional structures but they most likely are still present but are concealed by leaf litter.

The reestablishment of trees across the Island would result in root disturbances to many of these high quality native trees, so the recommendation for restoration of site hydrology should be limited to:

- Removing only those drainage systems that will not cause root damage.

ONE OF MANY OLD DRAIN PIPES FOUND BELOW BLUFF EDGES

- Where root damage is unavoidable, hand-dig to expose the pipe and remove a 3-foot section, plug with concrete, and backfill,

Existing topography should remain as it exists today since there is no clear indication of historical topography with which to compare.

Any change in hydrology should avoid disturbance to soils which could expose invasive species seeds to conditions favorable for germination.

RESTORATION OF NATIVE PLANTS

The eradication of non-native, invasive, berry-bearing plants could have an impact on birds already using the Island for food, habitat, and migration, and thus the Island should be repopulated with mature, native, berry-bearing plants shortly after the eradication or installed in phases as suggested above. However, there is a delicate balance between providing beneficial berries for birds while adhering to the wet-mesic flatwoods plant palette; the most beneficial berry-bearing plants may not be typically found in this community.

Research has shown that non-native plant fruit is less beneficial to migrating birds than native species' fruit, yet birds tend to favor these plants over native berries; as one researcher put it, they will "choose the candy bar over the burger." Migrating birds need fruit that are both rich in antioxidants and high in calories. Certain native species have more beneficial fruit than other species, including dogwoods, spicebush, and arrowwood viburnum. Appendix F lists the top berry-bearing plants most often recommended for bird consumption and whether they are typically found in a wet-mesic flatwoods, as well as whether they are currently found on Sugar Island. From this table, a recommended list of berry-bearing woody plants was developed that will not only replace the eradicated, non-native, berry-bearing, invasive plant species but will help restore the wet-mesic wetland:

- Chokeberry (*Aronia prunitolia*)
- Winterberry (*Ilex verticillata*, both femalse and male pollinator)
- Spicebush (*Lindera benzoin*)
- Red mulberry (*Morus rubra*)
- Oak species (*chinkapin oak [Q. muehlenbergii]*, swamp white oak [*Q. bicolor*], pin oak [*Q. palustris*])
- Elderberry (*Sambucus canadensis*)
- Nannyberry (*Viburnum lentago*)
- Blackhaw (*V. prunifolium*)
- Downy arrowwood (*V. rafinesquianum*)

Granted, not all wet-mesic flatwoods will contain each plant typically found in this community because the success of the individual's survival depends on soils and hydrologic regimes of their locations.

A list of berry-bearing woody species that already exist on the Island but should be planted to help fill the gaps left by eradicated non-native woody species includes:

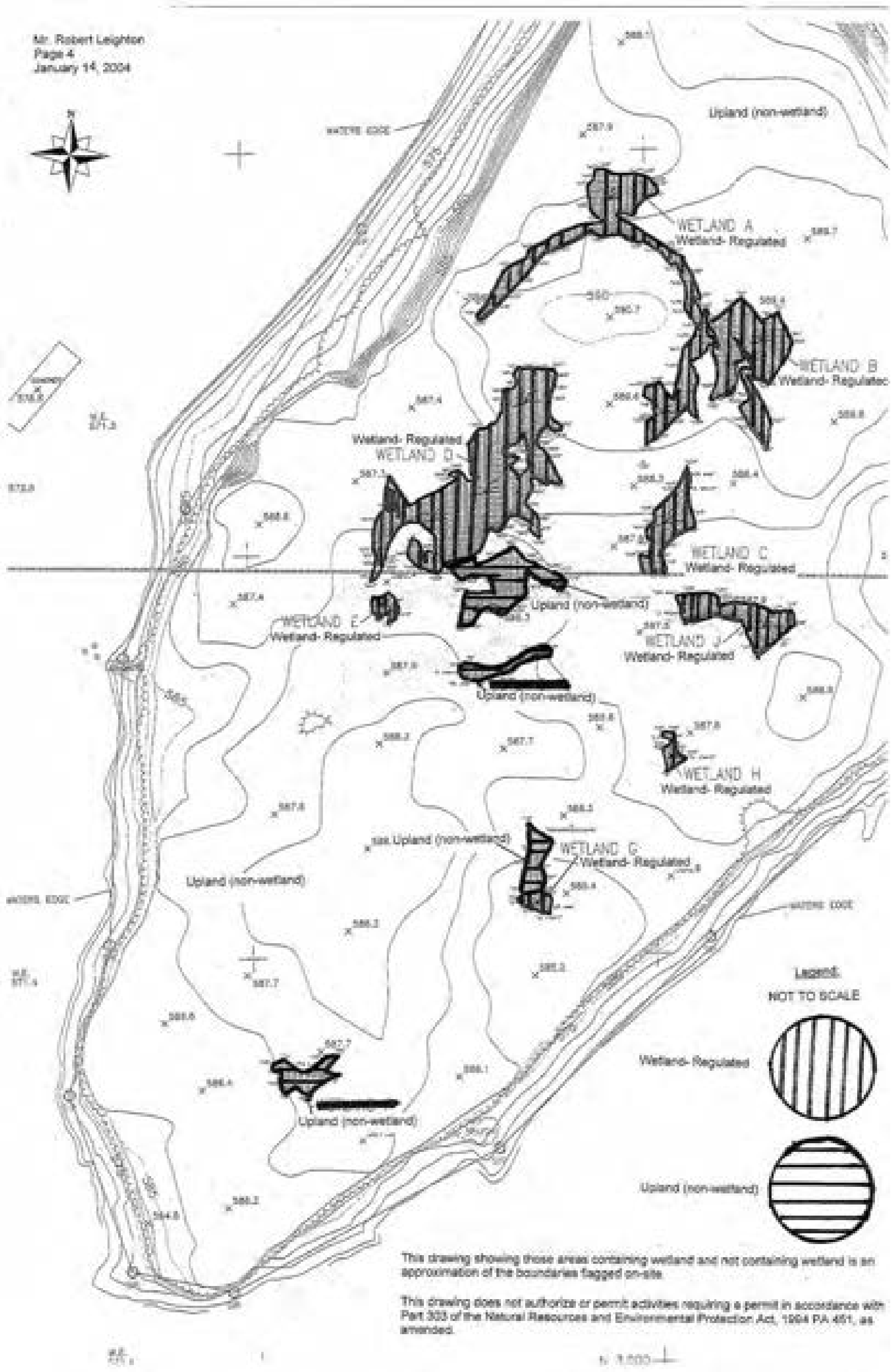
- Red osier dogwood (*Cornus sericea*)
- Rough-leaved dogwood (*C. drummondii*)
- Gray dogwood (*C. foemina*)
- Wahoo (*Euonymus atropurpurea*)
- Virginia creeper (*Parthenocissus quinquefolia*)
- Oak species (*Quercus rubra, Q. alba*)

Other species not included on highly-favored berry lists but are typically found in wet-mesic flatwoods and that could be used to restore this community while still benefiting birds are:

- Black gum (*Nyssa sylvatica*)
- Choke cherry (*Prunus virginiana*)
- Wild black current (*Ribes americanum*)

APPENDIX A

ROBERT LEIGHTON WETLAND DELINEATION MAP-JANUARY 2004



Mr. Robert Leighton
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January 14, 2004

This drawing showing those areas containing wetland and not containing wetland is an approximation of the boundaries flagged on-site.

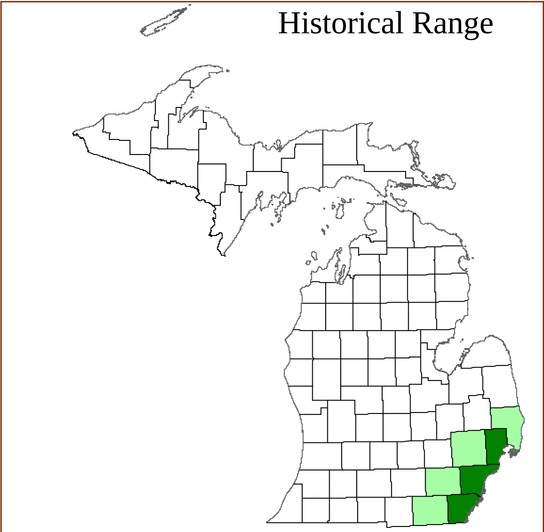
This drawing does not authorize or permit activities requiring a permit in accordance with Part 303 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

APPENDIX B

MICHIGAN NATURAL FEATURES INVENTORY WET-MESIC FLATWOODS COMMUNITY ABSTRACT

Wet-mesic Flatwoods Community Abstract

Photo by Suzan L. Campbell

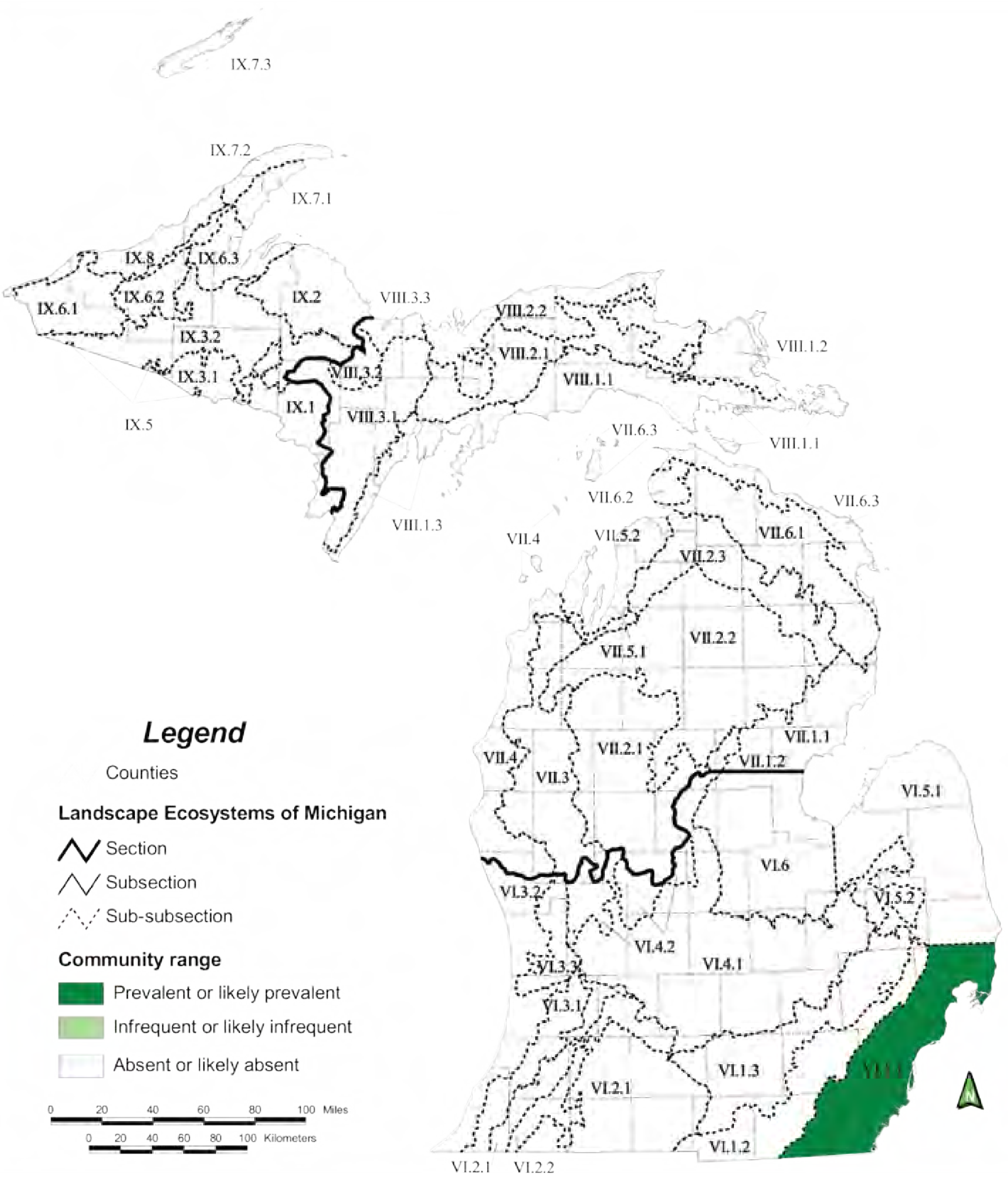


Overview: Wet-mesic flatwoods is a somewhat poorly drained to poorly drained forest on mineral soils dominated by a mixture of lowland and upland hardwoods. The community occurs exclusively on glacial lakeplain in southeastern Lower Michigan, where an impermeable clay layer in the soil profile contributes to poor internal drainage. Seasonal hydrologic fluctuations and windthrow are important natural disturbances that influence community structure, species composition, and successional trajectory of wet-mesic flatwoods.

Global and State Rank: G2G3/S2

Range: Flatwoods communities characterized by relatively flat topography, slowly permeable to impermeable subsurface soil layers, and seasonal hydrologic fluctuation occur scattered throughout the eastern United States (NatureServe 2009). In the Great Lakes region, flatwoods communities on poorly drained glacial lakeplains and flat to undulating till plains are distributed in Michigan, Ohio, Indiana, Illinois, Pennsylvania, and Ontario, Canada (Fike 1999, Faber-Langendoen 2001, NatureServe 2009). In Michigan, wet-mesic flatwoods is restricted to relatively flat glacial lakeplain in southeastern Lower Michigan in the Maumee Lake Plain ecological Sub-subsection (Albert 1995, Kost et al. 2007, Albert et al. 2008).

Rank Justification: The acreage of wet-mesic flatwoods present in Michigan circa 1800 is difficult to determine because the community type has characteristics that overlap those of several of the forest types mapped based on General Land Office (GLO) survey notes, primarily hardwood swamp and beech-sugar maple forest (Comer et al. 1995a, Kost et al. 2007). Analysis of GLO survey notes reveals that lowland forest dominated by hardwoods covered approximately 570,000 ha (1,400,000 ac) of southern Lower Michigan circa 1800 (Comer et al. 1995a). These stands were characterized by mixed hardwoods (490,000 ha or 1,200,000 ac), black ash (77,000 ha or 190,000 ac), elm (5,300 ha or 13,000 ac), and silver maple-red maple (4,000 ha or 10,000 ac). The majority of lowland forest acreage in southern Lower Michigan was associated with stream and river floodplains, and is classified as floodplain forest (Tepley et al. 2004, Kost et al. 2007). Extensive stands of lowland hardwoods not associated with stream floodplains were concentrated on poorly drained lakeplain in Wayne, Lenawee, Saginaw, St. Clair, Huron, Monroe, Sanilac, and Macomb Counties (Comer et al. 1995a). These stands were characterized by southern hardwood swamp on very poorly drained soils, and wet-mesic flatwoods on somewhat poorly to poorly drained soils. Wet-mesic flatwoods also likely occupied portions of the lakeplain characterized as mesic southern forest (i.e., beech-sugar maple forest) on the circa 1800 vegetation map (Comer et al. 1995a). Forests classified as hardwood swamp



Ecoregional map of Michigan (Albert 1995) depicting historical distribution of wet-mesic flatwoods (Albert et al. 2008) and beech-sugar maple forest comprised a significant proportion of the lakeplain in the early 1800s, covering > 60% of the land surface in Lenawee, Macomb, Monroe, St. Clair, and Wayne counties (Comer et al. 1995a). An additional natural community that may be successionally related to wet-mesic flatwoods, lakeplain oak openings, covered significant acreage in Monroe (13%) and Wayne (5%) counties on sand lakeplain prone to frequent fires (Comer et al. 1995a, Kost et al. 2007). The historic prevalence of hardwood swamp, beech-sugar maple forest, and lakeplain oak openings in southeastern Lower Michigan suggests wet-mesic flatwoods was common at the time of the GLO surveys.

Conversion of the southeastern Michigan glacial lakeplain for agricultural production accelerated in the early 1800s and resulted in the loss and degradation of wet-mesic flatwoods. Extensive drainage networks created to expand agriculture lowered regional water tables and reduced wet-mesic flatwoods to small, isolated woodlots (Comer et al. 1995b, Knopp 1999). This development led to the reduction of wetland acreage in southeastern Lower Michigan by 80-90%, the highest percentage loss of wetlands among all regions of the state (Comer et al. 1995b). Despite the significant loss of wetlands statewide and in southeastern Lower Michigan, MIRIS data (MDNR 1978) indicate that approximately 500,000 ha (1,200,000 ac) of lowland hardwood forest occurred in southern Lower Michigan in the 1970s. This figure includes 28,000 ha (69,000 ac) in the Maumee Lake Plain ecological Sub-subsection. The portion of this acreage represented by wet-mesic flatwoods cannot be determined because wet-mesic flatwoods does not correspond closely to any of the MIRIS cover type classifications. More recent data indicate 340,000 ha (840,000 ac) of lowland deciduous forest exists at present in the southern Lower Peninsula, including 17,000 ha (42,000 ac) in the Maumee Lake Plain (MDNR 2001). Again, the portion of this acreage characterized by wet-mesic flatwoods cannot be determined with precision due to broad cover type classification and resolution of the spectral data. However, the majority of lowland forest in the ecoregion is comprised of fragmented, degraded woodlots that do not closely approximate undisturbed conditions. Some areas of wet-mesic flatwoods may be classified as upland deciduous forest in the MIRIS and IFMAP land cover classifications due to the community's naturally variable canopy composition (MDNR 1978, MDNR 2001).

Currently, six occurrences of wet-mesic flatwoods are documented from Michigan, located in Macomb, Wayne, and Monroe counties. These occurrences range in size from 3 ha (7 ac) to 35 ac (87 ac), totaling approximately 96 ha (240 ac) (MNFI 2010). Only two occurrences are estimated to be of good to fair viability (BC-rank), with the remaining occurrences estimated to be of fair or fair to poor viability (C- to CD-rank). All of these sites are isolated woodlots in agricultural or urban landscapes, degraded by landscape-scale fragmentation and hydrologic alteration (MNFI 2010). Additional disturbances that have reduced viability of remnant wet-mesic flatwoods over the past century include the introduction of non-native pests and pathogens (e.g., elm blight and emerald ash borer), invasive plants, and excessive deer herbivory, which have significantly altered community structure, species composition, and successional trajectory (Barnes 1976, Rooney and Waller 2003, McCullough and Katovich 2004). For these reasons, the community is considered imperiled in the state (Kost et al. 2007).

Physiographic Context: The Michigan range of wet-mesic flatwoods is in southeastern Lower Michigan, in the Maumee Lake Plain Sub-subsection within the Washtenaw Subsection (Albert 1995). This region has the longest growing season in the state, ranging from 160 to 170 days, averaging 163 days (Comer et al. 1995b, Barnes and Wagner 2004). The daily maximum temperature in July ranges from 28° to 29° C (82° to 85° F), the daily minimum temperature in January ranges from -10° to -7° C (14° to 19° F), and the annual average temperature is 9.3° C (48.7° F). Mean annual total precipitation is 820 mm (32 in), with average seasonal snowfall less than 100 cm (40 in) (Eichenlaub et al. 1990, Albert 1995, Barnes and Wagner 2004, MSU Climatology Office 2008).

Wet-mesic flatwoods occurs exclusively in the Maumee Lake Plain Sub-subsection in southeastern Lower Michigan (Kost et al. 2007, MNFI 2010). This Sub-subsection is characterized by a broad, flat clay lakeplain containing broad channels of lacustrine sand that support low beach ridges and small dunes (Albert 1995). Portions of the lakeplain with thick clay deposits near the surface are characterized by nearly level topography. In these areas, differences in elevation of as little as 30 cm separate "upland flats" from low, wet areas and depressions, and vernal pools were historically common (Knopp 1999). Areas of the lakeplain characterized by deep sand deposits are better-drained and more topographically diverse, with development of beach ridges and low dunes on the otherwise level surface. Areas of the lakeplain characterized by a relatively thin sand veneer over clay are distributed throughout the clay plain, and exhibit variable topography with level plains and low ridges (Knopp 1999). Wet-mesic flatwoods is concentrated on the clay and sand/clay lakeplain, where impermeable subsurface layers and low stream density impedes drainage and causes seasonal ponding (Albert et al. 1986, Comer et al. 1995b). In these areas, wet-mesic flatwoods occupies a topographic position between very poorly drained southern hardwood swamp in the wettest depressions and mesic southern forest where slope and stream density permit favorable drainage. The community may also occur scattered within sand lakeplain, where seasonal desiccation, fire, and beaver activity historically favored the development of prairie and savanna (i.e., lakeplain oak openings, lakeplain wet-mesic prairie, lakeplain wet prairie, and mesic sand prairie) rather than forest communities. On the wettest sites, wet-mesic flatwoods may also be associated with emergent marsh and Great Lakes marsh (Kost et al. 2007).

Photo by Steve A. Thomas

Slight changes in elevation are associated with significant differences in soil surface moisture and plant species composition.

Wet-mesic flatwoods occurs on seasonally wet, poorly aerated mineral soils on clay and sand/clay lakeplain that become desiccated during the late growing season and fall (Knopp 1999, Lee 2005). The water table seasonally or periodically drops well below the ground surface, permitting decomposition of organic matter on the forest floor. Seasonal water level fluctuations lead to mottling of the mineral soil layers. Soils on clay and sand/clay lakeplain contain a significant sand fraction in the upper layers, and tend to be medium acid (pH= 5.6-6.0) to slightly acid (pH= 6.1-6.5) at the surface, although pH may be greater in sites with high clay content in the upper layers. Clay fraction and alkalinity increase with depth; soils are typically mildly alkaline (pH= 7.4-7.8) to moderately alkaline (pH= 7.9-8.4) 1 m below the surface (Knopp 1999). Soils on the sand lakeplain are characterized by very high sand fractions at all depths and pH ranging from strongly acid (pH= 5.1-5.5) at the surface to neutral (pH= 6.6-7.3) at greater depth. The neutral to alkaline subsurface layers across the lakeplain are derived from calcareous Mississippian, Devonian, and Silurian marine and near-shore bedrock parent material (Comer et al. 1995b).

Natural Processes: The primary natural processes affecting development, structure, and successional trajectory of wet-mesic flatwoods are seasonal hydrologic fluctuations and small-scale windthrow. Wet-mesic flatwoods occupies seasonally wet depressions or mosaics of upland rises and depressions that are characterized by an impervious subsurface clay layer that causes seasonal inundation and ponding (Novitzki 1979, Brinson 1993, NatureServe 2009). The community receives most of its water from overland flow and precipitation (rain and snow) and loses water through evapotranspiration. Species composition in wet-mesic flatwoods is regulated by winter and spring inundation followed by soil desiccation in late summer and fall, when the water level drops well below the soil surface (Bryant 1963, Knopp 1999, Lee 2005). Several tree species adapted to flood-drought cycles are characteristic of wet-mesic flatwoods, including silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), and eastern cottonwood (*Populus deltoides*) (Barnes and Wagner 2004). These and other flood-tolerant species exhibit a number of adaptations to inundation, rapid changes in water level, and low oxygen availability during the growing season, including hypertrophied lenticels (gas-exchanging pores), shallow roots, adventitious roots, absence of seed dormancy, rapid growth, and stomatal closure during periods of root submergence (Hosner 1960, Hosner and Boyce 1962, Kozlowski and Pallardy 2002, Barnes and Wagner 2004, Lee 2005, Weber et al. 2007). Species that are less tolerant of flood-drought cycles, such as black ash (*Fraxinus nigra*) and conifers, are rare or absent in wet-mesic flatwoods (Lee 2005). Shrub and ground layer species richness and cover is relatively low due to regular flood-drought cycles and canopy closure (Hall and Harcombe 1998, NatureServe 2009). Many shrub and ground layer species occur on hummocks above the zone of inundation.

Small-scale windthrow is a characteristic disturbance in wet-mesic flatwoods that influences community composition and structure by creating canopy gaps that are suitable for the colonization and growth of light-dependent tree seedlings and saplings, shrubs, and herbs. Windthrow also tips and uproots trees, creating pit-and-mound topography that provides suitable microhabitats for a diversity of plant species (Christensen et al. 1959, Paratley and Fahey 1986, Vivian-Smith 1997). Some species preferentially colonize hummocks and decaying logs, whereas other species colonize depressions between root hummocks and other low, wet areas within the forest (Paratley and Fahey 1986, Anderson and Leopold 2002). The historic frequency of extensive windthrows and their influence on successional turnover of wet-mesic flatwoods is less well understood. Large-scale windthrows in the Maumee Lake Plain were noted by the GLO surveyors only in the extreme northern portion of the sub-subsection, where lowland forests occurred on flat clay plains (Comer et al. 1995b). Fire, thunderstorms, ice events, and other natural disturbances likely influenced the frequency and severity of historic windthrows in wet-mesic flatwoods.

The importance of oaks (*Quercus* spp.) and other disturbance-dependent tree species in wet-mesic flatwoods suggests a role for historic wildfires in the development and persistence of the community. However, the role of fire in wet-mesic flatwoods is unclear. GLO surveyors made few references to fire in the Maumee Lake Plain, and the domination of the clay lakeplain by closed-canopy forests suggests fires were infrequent and/or of low severity (Comer et al. 1995b). Wet-mesic flatwoods associated with fire-dependent systems (e.g., lakeplain oak openings) likely burned more frequently than occurrences adjacent to or surrounded by fire-resistant systems (e.g., mesic southern forest). Historically, where wet-mesic flatwoods bordered lakeplain prairies and lakeplain oak openings, surface fire likely spread through portions of the community when standing water was absent.

Beaver (*Castor canadensis*) activity in the lakeplain was likely concentrated in wetland systems in the lowest topographic positions, such as emergent marsh, lakeplain wet prairie, lakeplain oak openings, and southern hardwood swamp. Although wet-mesic flatwoods occupies a higher topographic position than these wetland communities, the community historically occurred in large wetland complexes that were significantly influenced by this ecosystem engineer. Occurrences of wet-mesic flatwoods in the immediate vicinity of streams and large marsh and wet prairie complexes were likely susceptible to beaver-induced successional turnover. Beaver increase plant species richness at the landscape scale by creating novel habitat patches with variability in light availability, soil moisture, and nutrient availability (Wright et al. 2002).

Vegetation Description: Wet-mesic flatwoods is a closed-canopy deciduous forest characterized by a canopy layer consisting of several lowland and upland tree species and variable species composition within the understory, shrub, and ground layers. Conifers are absent. The species listed below are derived from NatureServe (2009), Kost and O’Connor (2003), Kost et al. (2006), Knopp (1999), Waldron (1997), Farwell (1901), and occurrences of the community tracked by MNFI (2010). Agricultural and urban development and widespread hydrologic disruption on the Maumee Lake Plain have reduced wet-mesic flatwoods to small, isolated remnants that likely do not represent the range of natural variation exhibited by the community circa 1800. Therefore, vegetative composition and dominance should be considered in the context of disturbance history and site-specific edaphic and hydrologic characteristics.

Tree species composition in any particular stand is regulated by topographic position, hydroperiod, soil characteristics, and other site-specific factors. Characteristic species include red oak (*Quercus rubra*), basswood (*Tilia americana*), beech (*Fagus grandifolia*), white oak (*Q. alba*), bur oak (*Q. macrocarpa*), chinquapin oak (*Q. muehlenbergii*), Shumard’s oak (*Q. shumardii*, state special concern), black maple (*Acer nigrum*), bitternut hickory (*Carya cordiformis*), shellbark hickory (*C. laciniosa*), shagbark hickory (*C. ovata*), and white ash (*Fraxinus americana*). Wet-mesic flatwoods lacks the dominance of beech and sugar maple (*Acer saccharum*) that characterizes mesic southern forest, although both species may occur scattered in the canopy. Elevated, sandy beach ridges on the otherwise relatively level lakeplain support black oak (*Quercus velutina*), black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), black gum (*Nyssa sylvatica*), and other species characteristic of coarse-textured, well-drained soils. Historically, American chestnut (*Castanea dentata*) may have been a component of these beach ridges and other relatively well-drained, acidic portions of the lakeplain (Barnes and Wagner 2004). Seasonally wet depressions support several lowland hardwoods, including pin oak (*Quercus palustris*), swamp white oak (*Q. bicolor*), American elm (*Ulmus americana*), silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), pumpkin ash (*F. profunda*, state threatened), red maple (*Acer rubrum*), cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), and tulip poplar (*Liriodendron tulipifera*). American elm was an important canopy tree prior to the introduction and spread of elm blight, but now primarily occurs in the understory, where it may be the dominant tree species (Barnes 1976, Knopp 1999). Other characteristic understory trees include saplings of canopy tree species, musclewood (*Carpinus caroliniana*), choke cherry (*Prunus virginiana*), and ironwood (*Ostrya virginiana*). Wet-mesic flatwoods often occurs as a mosaic of upland rises and low depressions, resulting in mixed canopy composition (Comer et al. 1995b, Waldron 1997, Knopp 1999, NatureServe 2009).

Shrub cover varies by landform and site-specific conditions. The tall shrub layer is characterized by buttonbush (*Cephalanthus occidentalis*), rough-leaved dogwood (*Cornus drummondii*), gray dogwood (*C. foemina*), Michigan holly (*Ilex verticillata*), spicebush (*Lindera benzoin*), wild black currant (*Ribes americanum*), elderberry (*Sambucus canadensis*), maple-leaved arrow-wood (*V. acerifolium*), nannyberry (*V. lentago*), downy arrow-wood (*V. rafinesquianum*), and prickly-ash (*Zanthoxylum americanum*). Low shrubs are sparse except on relatively well-drained beach ridges and dunes, which may support black chokeberry (*Aronia prunifolia*), wintergreen (*Gaultheria procumbens*), low sweet blueberry (*Vaccinium angustifolium*), and blueberry (*V. pallidum*) (Knopp 1999).

Seasonal inundation results in patchy cover of ground layer species; ground cover may be low in sites that experience frequent flooding. The woody vines Virginia creeper (*Parthenocissus quinquefolia*), poison-ivy (*Toxicodendron radicans*), and riverbank grape (*Vitis riparia*) may dominate this layer. Seedlings of canopy trees, particularly maples and ashes, may carpet the ground layer. Characteristic herbs include hog-peanut (*Amphicarpaea bracteata*), jack-in-the-pulpit (*Arisaema triphyllum*), false nettle (*Boehmeria cylindrica*), pink spring cress (*Cardamine douglassii*), sedges (*Carex grayi*, *C. intumescens*, *C. lacustris*, *C. lupulina*, *C. muskingumensis*, *C. radiata*), water hemlock (*Cicuta maculata*), enchanter's nightshade (*Circaea lutetiana*), cut-leaved toothwort (*Dentaria laciniata*), wild yam (*Dioscorea villosa*), spinulose woodfern (*Dryopteris carthusiana*), white trout lily (*Erythronium albidum*), yellow trout lily (*E. americanum*), wild geranium (*Geranium maculatum*), fowl manna grass (*Glyceria striata*), round-lobed hepatica (*Hepatica americana*), southern blue flag (*Iris virginica*), white grass (*Leersia virginica*), common water horehound (*Lycopus americanus*), ostrich fern (*Matteuccia struthiopteris*), moon seed (*Menispermum canadense*), sensitive fern (*Onoclea sensibilis*), clearweed (*Pilea pumila*), mayapple (*Podophyllum peltatum*), Solomon-seal

Photo by Suzan L. Campbell

Better-drained portions of wet-mesic flatwoods may support a luxuriant spring flora.

(*Polygonatum biflorum*), downy Solomon seal (*P. pubescens*), jumpseed (*Polygonum virginianum*), Christmas fern (*Polystichum acrostichoides*), bloodroot (*Sanguinaria canadensis*), blue-stemmed goldenrod (*Solidago caesia*), broad-leaved goldenrod (*S. flexicaulis*), false spikenard (*Smilacina racemosa*), starry false Solomon-seal (*S. stellata*), and common trillium (*Trillium grandiflorum*).

Rare Plants Associated with Wet-mesic Flatwoods (E, Endangered; T, Threatened; SC, species of special concern).

Scientific Name	Common Name	State Status
Aristolochia serpentaria	Virginia snakeroot	T
Carex lupuliformis	false hop sedge	T
Carex seorsa	sedge	T
Carex squarrosa	squarrose sedge	SC
Castanea dentata	American chestnut	E
Cuscuta polygonorum	knotweed dodder	SC
Euonymus atropurpurea	wahoo	SC
Euphorbia commutata	tinted spurge	T
Fraxinus profunda	pumpkin ash	T
Galearis spectabilis	showy orchis	T
Hydrastis canadensis	goldenseal	T
Jeffersonia diphylla	twinleaf	SC
Lactuca floridana	woodland lettuce	T
Lactuca pulchella	blue lettuce	X
Lycopus virginicus	Virginia water-horehound	T
Morus rubra	red mulberry	T
Panax quinquefolius	ginseng	T
Plantago cordata	heart-leaved plantain	E
Populus heterophylla	swamp or black cottonwood	E
Quercus shumardii	Shumard's oak	SC
Smilax herbacea	smooth carrion-flower	SC
Valerianella umbilicata	corn salad	T
Viburnum prunifolium	black haw	SC

Rare Animals Associated with Wet-mesic Flatwoods (E, Endangered; T, Threatened; SC, species of special concern; LE, Federally Endangered; LT, Federally Threatened).

Scientific Name	Common Name	State Status
Acronicta falcula	corylus dagger moth	SC
Ambystoma opacum	marbled salamander	E
Ambystoma texanum	smallmouth salamander	E
Basilodes pepita	gold moth	SC
Buteo lineatus	red-shouldered hawk	T
Catocala illecta	Magdalen underwing	SC
Clemmys guttata	spotted turtle	T
Clonophis kirtlandii	Kirtland's snake	E
Emydoidea blandingii	Blanding's turtle	SC
Euphyes dukesi	Dukes' skipper	T
Gomphus quadricolor	rapids clubtail	SC
Haliaeetus leucocephalus	bald eagle	SC
Heterocampa subrotata	small heterocampa	SC
Heteropacha rileyana	Riley's lappet moth	SC
Incisalia henrici	Henry's elfin	T
Myotis sodalis	Indiana bat	E; LE
Nerodia erythrogaster neglecta	copperbelly watersnake	E; LT
Nycticorax nycticorax	black-crowned night-heron	SC
Pandion haliaetus	osprey	SC
Papaipema cerina	golden borer	SC
Papaipema speciosissima	regal fern borer	SC
Protonotaria citrea	prothonotary warbler	SC
Seiurus motacilla	Louisiana waterthrush	T
Sistrurus c. catenatus	eastern massasauga	SC
Terrapene c. carolina	eastern box turtle	SC

Photo by Joshua G. Cohen

Shumard's oak (*Quercus shumardii*; foreground) is associated with several other deciduous trees in the canopy of a remnant wet-mesic flatwoods in Macomb County.

Noteworthy Animal Species: The emerald ash borer (EAB, *Agrilus planipennis*), an invasive beetle native to eastern Asia, was first noted in North America in 2002 in southeastern Lower Michigan and has since been discovered elsewhere in Michigan and the Midwestern and eastern United States and adjacent Canadian provinces (Haack et al. 2002, USDA APHIS 2010). The larvae of this species feed on cambial tissue in the inner bark of ash trees, causing mortality of the host tree within three years (Haack et al. 2002). All species of ash in Michigan are considered hosts or potential hosts, and EAB has caused mortality of millions of ash trees since its introduction to southeastern Lower Michigan (McCullough and Katovich 2004, MacFarlane and Meyer 2005). This invasive beetle is likely to have a significant impact on wet-mesic flatwoods, as black ash, green ash, pumpkin ash, and white ash all occur in this community. Wet-mesic flatwoods structure has already been altered by the near-elimination of American chestnut and mature American elms by non-native fungal pathogens (Barnes 1976, Barnes and Wagner 2004).

Vernal pools are abundant in wet-mesic flatwoods and serve as breeding ponds for aquatic invertebrates and amphibians. Today, these isolated forest stands are often completely surrounded by agriculture, old fields, and urban developments, and therefore provide critical habitat for cavity nesters (e.g., owls), canopy-dwelling species, and interior forest obligates, including neotropical migrant birds such as black-throated green warbler (*Dendroica virens*), scarlet tanager (*Piranga olivacea*), and ovenbird (*Seiurus aurocapillus*).

Conservation and Biodiversity Management: Wet-mesic flatwoods has been reduced to small, disturbed remnant woodlots throughout the Maumee Lake Plain. The Maumee Lake Plain is the most developed ecological Sub-subsection in Michigan, and extensive drainage networks have altered hydrology at the landscape scale (Comer et al. 1995b). Conservation and management of wet-mesic flatwoods is hindered by landscape alteration and fragmentation, site-specific land-use history, and private ownership (Knopp 1999). A few occurrences of wet-mesic flatwoods are located in the Huron-Clinton Metroparks System (Kost and O'Connor 2003, Kost et al. 2006). Conservation and management of these and other remnants should focus on protection and/or restoration of the hydrological regime, reduction of landscape fragmentation, detection, control, and monitoring of invasive plants, animals, and pathogens, protection of downed and decomposing wood, reduction of deer browse pressure, and promotion of oak regeneration.

Protection of hydrology is critical to maintaining the integrity of wet-mesic flatwoods. Although drainage networks have altered hydrology at the landscape scale, much of the Maumee Lake Plain remains poorly drained or saturated from January to May (Knopp 1999). Protection from further hydrologic degradation is essential for the maintenance of processes that support persistence of wet-mesic flatwoods remnants. Several measures can be taken to protect the integrity of wet-mesic flatwoods hydrology. A relatively wide upland buffer zone can be established in developed areas to prevent run-off of polluted surface water. Within remnant stands, construction of new drainage ditches should be avoided, as should new road construction and stream maintenance projects (e.g., dredging, straightening, and removal of fallen wood). Hydrologic restoration projects can focus on removal of drain tiles and prevention of erosion along ditches. Although the drainage network in the Maumee Lake Plain has irreversibly altered hydrologic processes at the landscape scale, the characteristic natural processes of seasonal pooling of water followed by summer desiccation still occurs away from the immediate vicinity of ditches and drainage tiles.

Landscape fragmentation has reduced wet-mesic flatwoods occurrences to isolated stands surrounded by agriculture or urban development (Knopp 1999, Lee 2005, MNFI 2010). Fragmentation has a number of detrimental effects on biodiversity conservation, including the introduction of non-native predators, competitors, diseases, and parasites, reduction or elimination of dispersal corridors, disruption of ecosystem processes, and removal of key resources (Marzluff and Ewing 2001). The impacts of fragmentation can be reduced by establishing habitat linkages among remnant stands and management of the surrounding landscape to more closely approximate the conditions within the isolated stands (Marzluff and Ewing 2001). Research on wetland birds suggests that many species favor wetland tracts in a matrix of upland forest, rather than isolated wetland tracts, regardless of size (Riffell et al. 2006). Though restoration of these conditions is not possible in particularly urbanized landscapes, conservation efforts for isolated wet-mesic flatwoods tracts in agricultural landscapes should focus on improving the suitability of adjacent land for native species. Restoring connectivity between isolated forest patches by either replanting forest, especially oak species, or allowing old fields to succeed to forest will aid species dispersal and reduce edge effects.

Invasive plant species are a significant threat to wet-mesic flatwoods. Invasive species monitoring and removal efforts should be implemented in existing remnants of wet-mesic flatwoods. Species of particular concern include garlic mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii*), ground ivy (*Glechoma hederacea*), Dame's rocket (*Hesperis matronalis*), common privet (*Ligustrum vulgare*), honeysuckles (i.e., *Lonicera japonica*, *L. maackii*, *L. morrowii*, and *L.* x *bella*), moneywort (*Lysimachia nummularia*), white mulberry (*Morus alba*), reed canary grass (*Phalaris arundinacea*), reed (*Phragmites australis*), common buckthorn (*Rhamnus cathartica*), glossy buckthorn (*R. frangula*), and multiflora rose (*Rosa multiflora*) (Kost et al. 2007). Fragmentation and isolation of wet-mesic flatwoods occurrences by residential, commercial, and industrial development threatens this natural community type by restricting dispersal of native species and increasing the propagule pressure of commonly planted non-native trees, shrubs, and herbs. Monitoring and removal of invasive species should focus on those species that threaten to alter community composition, structure, and function (e.g., glossy buckthorn and multiflora rose). Management activities should avoid disturbances to soil and hydrology, which often leads to the establishment and spread of invasive plant species, especially in urban settings where invasive plants are well established.

Control of emerald ash borer is currently limited to prevention of human introduction of this species to new locations through banning transport of infected firewood or living trees. Research on parasitoids and fungal pathogens that may serve as potential biological controls of this species in North America is ongoing (Liu et al. 2003, Liu and Bauer 2006). Forest stands throughout the entire range of wet-mesic flatwoods are vulnerable to invasion by EAB, and the lack of a successful control strategy at this time emphasizes the importance of preventing its introduction to new sites. Evidence from the previous die-off of American elm suggests that shrub density may increase following the mortality of canopy ash trees (Dunn 1986). Invasive species, including reed, may also establish in the canopy gaps created by ash-kill (Cohen 2009).

Protection of large-diameter rotting logs and dead standing wood is important for the preservation of structural diversity and suitable substrate for the germination and establishment of several plant species (Paratley and Fahey 1986, McGee 2001, Anderson and Leopold 2002). Downed and standing dead wood also provides habitat for decomposers, invertebrates, birds, and small mammals (Marzluff and Ewing 2001). In addition to protection of the existing downed and dead wood in wet-mesic flatwoods stands, maintenance of mature and over-mature canopy trees ensures continued recruitment of large-diameter coarse woody debris.

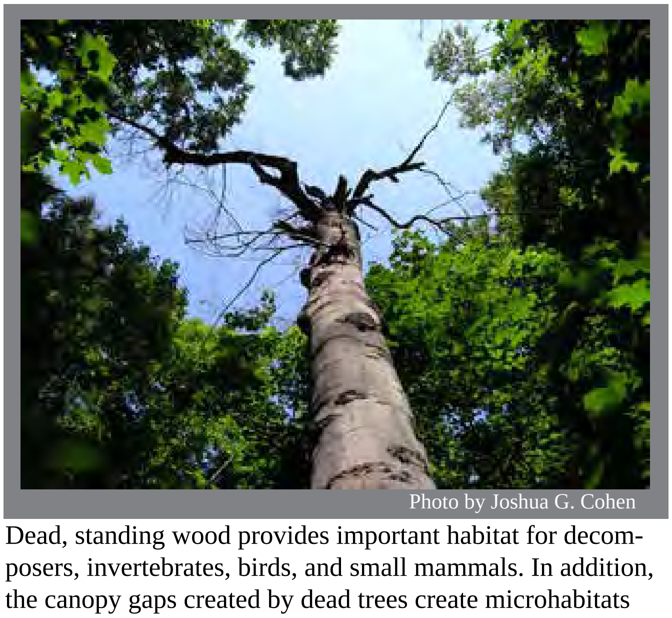


Photo by Joshua G. Cohen

Dead, standing wood provides important habitat for decomposers, invertebrates, birds, and small mammals. In addition, the canopy gaps created by dead trees create microhabitats suitable for the colonization and growth of light-dependent tree seedlings and saplings, shrubs, and herbs.

High density of white-tailed deer (*Odocoileus virginianus*) has led to significant browse pressure on tree seedlings, shrubs, and herbs throughout much of the eastern United States and adjacent Canadian provinces, altering structure and composition of all strata and producing a cascade of effects (e.g., detrimental impacts to pollinators of affected plant species) (McShea and Rappole 1992, Balgooyen and Waller 1995, Waller and Alverson 1997, Augustine and Frelich 1998, Rooney and Waller 2003, Kraft et al. 2004). Reduction of deer densities at the landscape scale will promote recovery of tree seedling, shrub, and herb populations. In areas where reducing the number of deer is not feasible, or in small, isolated stands of high-quality wet-mesic flatwoods, deer exclosures should be considered in order to promote tree regeneration and recruitment, in addition to recovery of impacted shrub and ground layer species.

Oak regeneration in wet-mesic flatwoods remnants appears to be poor (Kost and O’Connor 2003, Kost et al. 2006). Fire suppression, landscape fragmentation and development, deer browse, and mesophytic invasion may be contributing to the lack of oak regeneration in these stands (see Lee and Kost [2008] for a review of the ecological factors associated with oak regeneration in Lower Michigan). Historically, fire may have interacted with large-scale windthrow to create suitable conditions for the regeneration of oak species across the Maumee Lake Plain. In order to maintain a significant oak component in remnant wet-mesic flatwoods, a variety of management techniques should be considered, including the reduction of deer densities, construction and placement of deer exclosures, application of prescribed fire, and planting acorns and oak seedlings in suitable open areas adjacent to remnant forests that are suitable for colonization by oak species. Management for oak regeneration on mesic and wet-mesic soils may be especially difficult due to the lack of fuels for conducting prescribed fires and interspecific competition from germinating tree seedlings, resprouts, and shrubs (Iverson et al. 2008).

Research Needs: The distribution of wet-mesic flatwoods in the heavily developed Maumee Lake Plain as isolated, disturbed fragments limits our understanding of its original vegetative composition, structure, edaphic characteristics, and spatial configuration. Past disturbances and the relative scarcity of land in public ownership may be responsible for the lack of ecological studies of the system (Knopp 1999). A systematic survey for wet-mesic flatwoods in Michigan, including the collection of plot data, is necessary to assess the statewide conservation status of this natural community type.

Relatively undisturbed wet-mesic flatwoods remnants provide an opportunity to study the impacts of microtopography and soil texture on the distribution of plant species and vegetative associations. This research will inform and improve classification of wet-mesic flatwoods, and allow for better differentiation of the community type from similar hardwood-dominated communities that occur on slightly higher, better-drained soils (e.g., mesic southern forest), and lower, more poorly drained soils (e.g., southern hardwood swamp). An improved understanding of the spatial distribution of wet-mesic flatwoods will also aid classification, and will facilitate more accurate mapping of remnant occurrences.

Research on the distribution of wet-mesic flatwoods in Michigan is necessary to determine if the community or a similar community occurs elsewhere in Michigan, chiefly in the Sandusky Lake Plain, Saginaw Bay Lake Plain, and/or Southern Lake Michigan Lake Plain Ecological Sub-subsections (Albert 1995). The Sandusky and Saginaw Bay Lake Plains were historically characterized by extensive tracts of upland and lowland forest dominated by a mixture of hardwoods and conifers (Comer et al. 1995a). No occurrences of wet-mesic flatwoods have been documented in the Southern Lake Michigan Lake Plain Sub-subsection, but flatwoods communities are documented in the Indiana and Illinois portions of the Lake Michigan lakeplain (NatureServe 2009), and may potentially occur in Berrien County or elsewhere in southwestern Lower Michigan. Surveys are also needed to determine if the community occurs on other landforms where the impervious subsurface clay layers and level topography characteristics of glacial lakeplain are more locally distributed.

The natural disturbance regime that influences community structure, species composition, and successional trajectory of wet-mesic flatwoods is incompletely understood. For example, the natural fire regime of the community is poorly understood. At the time of the GLO surveys in the early 1800s, closed-canopy forests dominated the clay and sand/clay lakeplain, and fires were infrequently recorded (Comer et al. 1995b). However, some occurrences of wet-mesic flatwoods may represent fire-suppressed lakeplain oak openings, particularly on sandy soils that historically supported savanna and prairie communities (Comer et al. 1995b, Kost et al. 2007, NatureServe 2009). The ecological factors associated with successful oak regeneration in wet-mesic flatwoods merit further study and elucidation. The role and importance of beaver in shaping succession of wet-mesic flatwoods also warrants further research. Systematic inventory and long-term studies of wet-mesic flatwoods may result in a better understanding of these and other disturbance factors influencing the vegetation and structure of the community.


Photo by Joshua G. Cohen

The historic frequency and intensity of fires set by lightning (above) and humans in landscapes dominated by wet-mesic flatwoods warrants investigation.

Similar Communities: *Southern hardwood swamp* is an ash- or maple-dominated lowland forest on poorly drained to very poorly drained mineral or organic soils (Kost et al. 2007, Slaughter 2009). *Northern hardwood swamp* is an ash- or maple-dominated lowland forest that occurs north of the climatic tension zone (Weber et al. 2007). *Mesic southern forest* is a beech- and sugar maple–dominated upland forest that occupies a higher topographic position than wet-mesic flatwoods (Cohen 2004). *Lakeplain oak openings* is a fire-dependent savanna community on xeric or hydric soils, concentrated on sand lakeplain (Cohen 2001). *Floodplain forest* is a lowland forest impacted by over-the-bank flooding and cycles of erosion and deposition associated with streams of third order or greater (Tepley et al. 2004).

Other Classifications:

Michigan Natural Features Inventory Land Cover Mapping Code: 4148 (Oak [Pin oak, Swamp white oak] [Pin Oak Depression]); 4121 (Mesic Southern Forest); 414 (Hardwood Swamp [Lowland Hardwoods])

MNFI circa 1800 Vegetation: Beech – Sugar Maple Forest; Mixed Hardwood Swamp

Michigan Resource Information Systems (MIRIS): 414 (Lowland Hardwood); 412 (Central Hardwood)

Michigan Department of Natural Resources (MDNR): E – Swamp Hardwoods; M – Northern Hardwoods

MDNR IFMAP (MDNR 2001): Lowland Deciduous Forest; Northern Hardwood Association; Mixed Upland Deciduous

NatureServe U.S. National Vegetation Classification and International Classification of Ecological Communities (Faber-Langendoen 2001, NatureServe 2009):

CODE; ALLIANCE; ASSOCIATION; COMMON NAME

I.B.2.N.e; *Quercus palustris – (Quercus bicolor)* Seasonally Flooded Forest Alliance; *Quercus palustris – Quercus bicolor – Acer rubrum* Flatwoods Forest; Northern (Great Lakes) Flatwoods

I.B.2.N.e; *Quercus palustris – (Quercus bicolor)* Seasonally Flooded Forest Alliance; *Quercus palustris – Quercus bicolor – Nyssa sylvatica – Acer rubrum* Sand Flatwoods Forest; Pin Oak – Swamp White Oak Sand Flatwoods

I.B.2.N.a; *Fagus grandifolia – Quercus* spp. – *Acer* spp. Forest Alliance; *Fagus grandifolia – Acer saccharum – Quercus bicolor – Acer rubrum* Flatwoods Forest; Beech – Hardwoods Till Plain Flatwoods

Other states and Canadian provinces (natural community types with the strongest similarity to Michigan wet-mesic flatwoods indicated in *italics*)**:**

IL:	*Northern flatwoods* (White and Madany 1978)
IN:	*Boreal flatwoods* (Jacquart et al. 2002)
ON:	*Fresh – moist oak – maple – hickory deciduous forest ecosite*; *Oak mineral deciduous swamp ecosite*; Fresh – moist sugar maple deciduous forest ecosite*;* Fresh – moist lowland deciduous forest ecosite (Lee et al. 1998)
OH:	*Maple – ash – oak swamp* (Schneider and Cochrane 1998)
PA:	*Great Lakes region lakeplain palustrine forest* (Fike 1999)

APPENDIX C

USDA/NRCS SOIL SURVEY

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Wayne County, Michigan

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map (Sugar Island Soil Survey)

Map Scale: 1:5,120 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- □ Area of Interest (AOI)

Soils
- □ Soil Map Unit Polygons
- Soil Map Unit Lines
- ■ Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- ◇ Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- ◎ Miscellaneous Water
- ○ Perennial Water
- ∨ Rock Outcrop
- + Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- △ Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Wayne County, Michigan
Survey Area Data: Version 3, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Mar 4, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (Sugar Island Soil Survey)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BfA	Blount loam, Erie-Huron Lake Plain, 0 to 2 percent slopes	23.2	16.2%
Pe	Pewamo loam	4.6	3.2%
W	Water	115.3	80.4%
Totals for Area of Interest		**143.4**	**100.0%**

Map Unit Descriptions (Sugar Island Soil Survey)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Wayne County, Michigan

BfA—Blount loam, Erie-Huron Lake Plain, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2wb29
Elevation: 540 to 850 feet
Mean annual precipitation: 28 to 38 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Blount and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blount

Setting

Landform: Wave-worked till plains, nearshore zones (relict)
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Moderately fine-textured lodgment till

Typical profile

Ap - 0 to 9 inches: loam
Bt - 9 to 27 inches: clay
BC - 27 to 37 inches: clay loam
Cd - 37 to 80 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 19 to 49 inches to densic material
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)
Depth to water table: About 6 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 35 percent
Salinity, maximum in profile: Nonsaline (0.0 to 1.0 mmhos/cm)
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Pewamo

Percent of map unit: 7 percent
Landform: Wave-worked till plains, nearshore zones (relict)
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Microfeatures of landform position: Open depressions
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Hydric soil rating: Yes

Metamora

Percent of map unit: 5 percent
Landform: Wave-worked till plains, nearshore zones (relict)
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Microfeatures of landform position: Rises
Down-slope shape: Linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Selfridge

Percent of map unit: 3 percent
Landform: Wave-worked till plains, nearshore zones (relict)
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Microfeatures of landform position: Rises
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Pe—Pewamo loam

Map Unit Setting

National map unit symbol: 6bkv
Elevation: 570 to 720 feet
Mean annual precipitation: 28 to 34 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Pewamo and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pewamo

Setting

Landform: Depressions on till-floored lake plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy till

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 36 inches: silty clay loam
H3 - 36 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 30 percent
Available water storage in profile: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Blount

Percent of map unit: 4 percent
Landform: Flats on till-floored lake plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Corunna

Percent of map unit: 3 percent
Landform: Depressions on till-floored lake plains, depressions on lake plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Metamora

Percent of map unit: 3 percent
Landform: Drainageways on till-floored lake plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Convex

Hydric soil rating: No

W—Water

Map Unit Setting

National map unit symbol: 6bl8
Elevation: 570 to 720 feet
Mean annual precipitation: 28 to 34 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Not prime farmland

Minor Components

Water

Percent of map unit: 100 percent
Hydric soil rating: Unranked

APPENDIX D

HISTORIC SITE PHOTOGRAPHS

PHOTO 1. 1949 DTE AERIAL PHOTOGRAPH

PHOTO 2. 1952 DTE AERIAL PHOTOGRAPH

PHOTO 3. 1967 DTE AERIAL PHOTOGRAPH

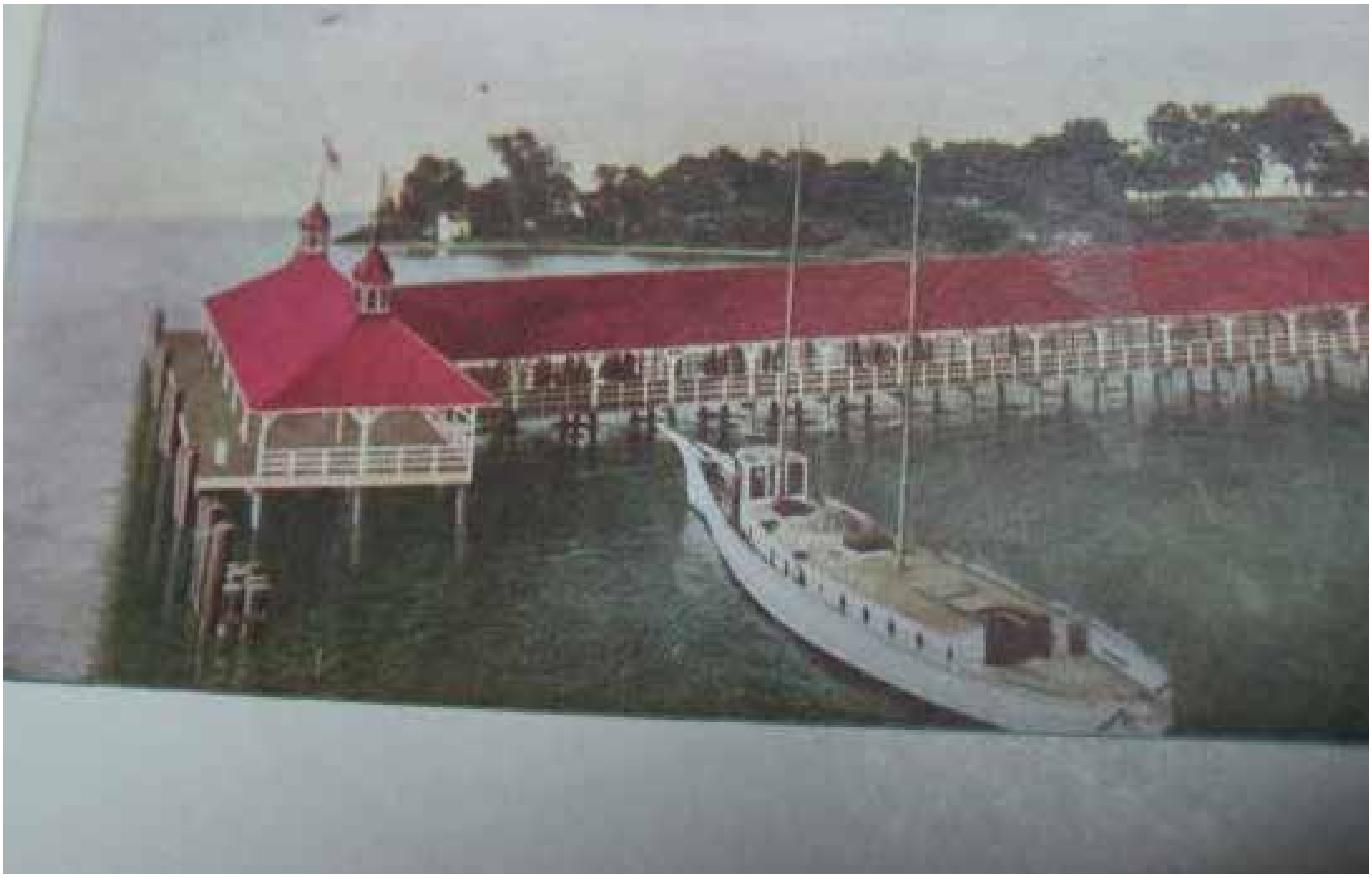

PHOTO 4. SUGAR ISLAND NORTH DOCK

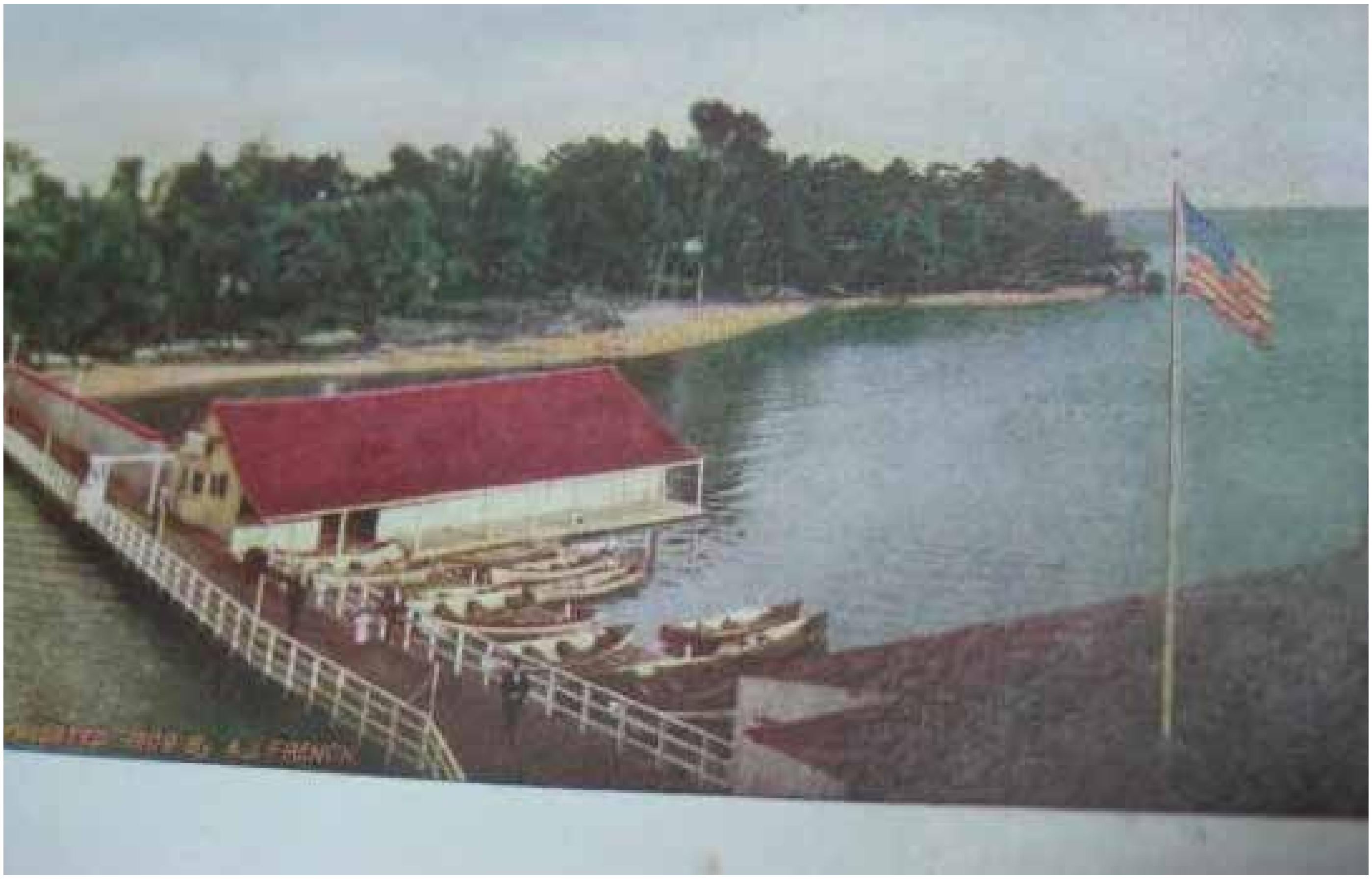

PHOTO 5. SUGAR ISLAND SOUTH DOCK WITH BOAT HOUSE

PHOTO 6. SUGAR ISLAND NORTH DOCK

PHOTO 7. SUGAR ISLAND DANCE PAVILION

PHOTO 8. SUGAR ISLAND PICNIC AREA ON EAST SIDE OF DANCE PAVILION; DANCE PAVILION IN CENTER WITH ADDITIONAL BUILDING ON LEFT (SOUTH SIDE)

PHOTO 9. SUGAR ISLAND PICNIC AREA ON EAST SIDE OF DANCE PAVILION

PHOTO 10. BALL DIAMOND ON NORTH SIDE OF DANCE PAVILION, SUGAR ISLAND

PHOTO 11. SWING ON SUGAR ISLAND, PROBABLY WEST SIDE SINCE BOAT RAMP APPEARS TO BE IN BACKGROUND

PHOTO 12. ROLLER COASTER ON WEST SIDE OF SUGAR ISLAND

PHOTO 13. WEST SIDE OF SUGAR ISLAND AS SEEN FROM THE DETROIT RIVER

PHOTO 14. WEST SIDE OF SUGAR ISLAND AS SEEN FROM HICKORY ISLAND

APPENDIX E

SUGAR ISLAND PLANT LIST

BOTANICAL NAME	COMMON NAME	WL INDICATOR	NATIVE?
GENERAL AREAS			
Acer platanoides	Norway maple	UPL	N
Acer saccharinum	Silver maple	FACW	Y
Acer saccharum	Sugar maple	FACU	Y
Carya cordiformis	Bitternut hickory	FAC	Y
Carya glabra	Pignut hickory	FACU	Y
Carya laciniosa	Shellbark hickory	FACW	Y
Carya ovata	Shagbark hickory	FACU	Y
Celtis occidentalis	Hackberry	FAC	Y
Juglens nigra	Black walnut	FACU	Y
Morus alba	White mulberry	FACU	N
Morus rubra	Red mulberry	FACU	Y
Populus deltoides	Cottonwood	FAC	Y
Prunus avium	Sweet cherry	UPL	N
Prunus serotina	Black cherry	FACU	Y
Quercus alba	White oak	FACU	Y
Quercus bicolor	Swamp white oak	FACW	Y
Quercus macrocarpa	Bur oak	FACU	Y
Quercus rubra	Red oak	FACU	Y
Tilia americana	American linden	FACU	Y
Ulmus americana	American elm	FACW	Y
Ulmus rubra	Slippery elm	FAC	Y
Cornus drummondii	Rough-leaved dogwood	FAC	Y
Cornus foemina	Gray dogwood	FAC	Y
Crataegus spp.	Hawthorn spp.		
Euonymus atropurpurea	Wahoo	FACU	Y
Ligustrum vulgare	Common privet	FACU	N
Lonicera spp.	Honeysuckle spp.		N
Ostrya virginiana	Ironwood	FACU	Y
Rhamnus cathartica	Common buckthorn	FAC	N
Rhamnus frangula (Frangula alnus)	Glossy buckthorn	FAC	N
Rosa multiflora	Multiflora rose	FACU	N
Rubus occidentalis	Black raspberry	UPL	Y
Alliaria petiolata	Garlic mustard	FACU	N
Arisaema triphyllum	Jack-in-the-pulpit	FAC	Y
Berberis vulgaris	Common barberry	FACU	N
Carex blanda	Woodland sedge	FAC	Y

BOTANICAL NAME	COMMON NAME	WL INDICATOR	NATIVE?
GENERAL AREAS (CONTINUED...)			
Carex rosea	Curly-styled woodland sedge	UPL	Y
Elymus virginicus	Virginia wild rye	FACW	Y
Euonymus fortunei	Wintercreeper	UPL	N
Geum canadense	White avens	FAC	Y
Glyceria striata	Fowl manna grass	OBL	Y
Impatiens capensis	Touch-me-not	FACW	Y
Fraxinus pensylvanica (seedlings)	Green ash	FACW	Y
Leersia virginica	White grass	FACW	Y
Lonicera reticulata?	Grape honeysuckle	UPL	N
Parthnocissus quinquefolia	Virginia creeper	FACU	Y
Persicaria virginiana (Polygonum virginianum)	Jumpseed	FAC	Y
Poa compressa	Canada bluegrass	FACU	N
Ranunculus abortivus	Small-flowered buttercup	FAC	Y
Rhamnus cathartica (seedlings)	Common buckthorn	FAC	N
Rhodotypos scandens	Black jetbead	UPL	N
Solanum ducamara	Annual nightshade	FAC	N
Taraxicum officinale	Dandelion	FACU	N
Tilia americana (seedlings)	American linden	FACU	Y
Toxicodendron radicans	Poison ivy	FAC	Y
Vitis riparia	River grape	FAC	Y
TOPS OF BLUFFS GROUNDPLAIN			
Ligustrum vulgare	Common privet	FACU	N
Lonicera spp.	Honeysuckle spp.		N
Alliaria petiolata	Garlic mustard	FACU	N
Claytonia virginica	Spring beauty	FACU	Y
Cardamine concatenata (Dentaria laciniata)	Cutleaf toothwort	FACU	Y
Erythronium albidum	White trout lily	FACU	Y
Galium aparine	Annual bedstraw	FACU	Y
Geum canadense	White avens	FAC	Y
Impatiens capensis	Touch-me-not	FACW	Y
Juncus tenuis	Path rush	FAC	Y
Persicaria virginiana (Polygonum virginianum)	Jumpseed	FAC	Y
Poa compressa	Canada bluegrass	FACU	N
Polygonatum biflorum	Solomon seal	FACU	Y
Ranunculus abortivus	Small-flowered buttercup	FAC	Y
Symphyotrichum urophyllum (A. sagittifolium)	Arrow-leaved aster	UPL	Y
Toxicodendron radicans	Poison ivy	FAC	Y

BOTANICAL NAME	COMMON NAME	WL INDICATOR	NATIVE?
BLUFF SOUTH POINT			
Acer saccharinum	Silver maple	FACW	Y
Carya cordiformis	Bitternut hickory	FAC	Y
Celtis occidentalis	Hackberry	FAC	Y
Prunus serotina	Black cherry	FACU	Y
Quercus rubra	Red oak	FACU	Y
Ulmus americana	American elm	FACW	Y
Ulmus rubra	Slippery elm	FAC	Y
Lonicera spp.	Honeysuckle spp.		N
Ligustrum vulgare	Common privet	FACU	N
Alliaria petiolata	Garlic mustard	FACU	N
Cardamine concatenata (Dentaria laciniata)	Cutleaf toothwort	FACU	Y
Carex spp.	Sedge spp.		
Circium arvense	Canada thistle	FACU	N
Circium vulgare	Bull thistle	FACU	N
Claytonia virginica	Spring beauty	FACU	Y
Dactylis glomerata	Orchard grass	FACU	N
Daucus carota	Queen Anne’s lace	UPL	N
Erigeron philadelphicus	‘Philadelphia fleabane	FAC	Y
Erythronium albidum	White trout lily	FACU	Y
Galium aparine	Annual bedstraw	FACU	Y
Glyceria striata	Fowl manna grass	OBL	Y
Impatiens capensis	Touch-me-not	FACW	Y
Poa compressa	Canada bluegrass	FACU	N
Rubus occidentalis	Black raspberry	UPL	Y
Solidago spp.	Goldenrod species		
Symphyotrichum urophyllum (A. sagittifolium)	Arrow-leaved aster	UPL	Y
Taraxicum officinale	Dandelion	FACU	N
Verbascum thapsus	Common mullein	UPL	N
WETLANDS			
Acer saccharinum	Silver maple	FACW	Y
Celtis occidentalis	Hackberry	FAC	Y
Quercus bicolor	Swamp white oak	FACW	Y
Quercus macrocarpa	Bur oak	FACU	Y
Ulmus americana	American elm	FACW	Y
Cornus foemina	Gray dogwood	FAC	Y
Fraxinus pensylvanica seedlings	Green ash	FACW	Y

BOTANICAL NAME	COMMON NAME	WL INDICATOR	NATIVE?
WETLANDS (CONTINUED...)			
Rhamnus frangula	Glossy buckthorn	FAC	N
Viburnum opulus	American highbush cranberry	FACW	Y
Boehmeria cylindrica	False nettle	OBL	Y
Carex brunnescens	Brownish sedge	FACW	Y
Duchesnea indica (Potentilla indica)	Mock strawberry	FACU	N
Geum canadense	White avens	FAC	Y
Glyceria striata	Fowl manna grass	OBL	Y
Impatiens capensis	Touch-me-not	FACW	Y
Juncus tenuis	Path rush	FAC	Y
Leersia virginica	White grass	FACW	Y
Onoclea sensibilis	Sensitive fern	FACW	Y
Parthenocissus quinquefolia	Virginia creeper	FACU	Y
Persicaria maculosa (Polygonum persicaria)	Lady's-thumb	FAC	N
Persicaria virginiana (Polygonum virginianum)	Jumpseed	FAC	Y
Thelypteris palustris	Marsh fern	FACW	Y
Toxicodendron radicans	Poison ivy	FAC	Y
Vitis riparia	Riverbank grape	FAC	Y
GRASSY BLUFF EAST SIDE			
Bromus inermis	Smooth brome	UPL	N
Cinna arundinacea	Wood reedgrass	FACW	Y
Conium maculatum	Poison hemlock	FACW	N
Erigeron philadelphicus	'Philadelphia fleabane	FAC	Y
Medicago lupulina	Black medic	FACU	N
Phalaris arundinacea	Reed canary grass	FACW	Y
Phragmites australis	Giant reed	FACW	N
Rhus glabra	Smooth sumac	UPL	Y
Rubus occidentalis	Black raspberry	UPL	Y
Solidago spp.	Goldenrod		
Toxicodendron radicans	Poison ivy	FAC	Y
Trifolium repens	White clover	FACU	N
BEACHES/SHELVES			
Acer negundo	Box elder	FAC	Y
Catalpa speciosa	Northern catalpa	FACU	N
Morus alba	White mulberry	FACU	N
Populus deltoides	Cottonwood	FAC	Y
Robinia pseudoacacia	Black locust	FACU	N

BOTANICAL NAME	COMMON NAME	WL INDICATOR	NATIVE?
BEACHES/SHELVES (CONTINUED…)			
Ulmus americana	American elm	FACW	Y
Ulmus pumila	Siberian elm	FACU	N
Cornus sericea	Redtwig dogwood	FACW	Y
Rhus typhina	Staghorn sumac	FACU	Y
Salix exigua	Sandbar willow	FACW	Y
Artemesia vulgaris	Mugwort	UPL	N
Asclepias syriaca	Common milkweed	UPL	Y
Circium arvense	Canada thistle	FACU	N
Convolvulus arvensis	Field bindweed	UPL	N
Daucus carota	Queen Anne's lace	UPL	N
Equisetum hyemale	Scouring rush	FAC	Y
Erigeron philadelphicus	'Philadelphia fleabane	FAC	Y
Iris virginica	Blue flag iris	OBL	Y
Lycopus americanus	Water horehound	OBL	Y
Lythrum salicaria	Purple loosestrife	OBL	N
Mirabilis nyctaginea	Wild four o'clock	UPL	N
Oenothera biennis	Evening primrose	FACU	Y
Phragmites australis	Giant reed	FACW	N
Potentilla anserina	Silverweed	FACW	Y
Schoenoplectus pungens	Three-square	OBL	Y
Setaria glauca	Yellow foxtail	FAC	N
Solidago altissima	Tall goldenrod	FACU	Y
Sonchus arvensis	Sowthistle	FACU	N
Toxicodendron radicans	Poison ivy	FAC	Y
Tragopogon praetensis	Common goatsbeard	UPL	N
Typha spp.	Cattail	OBL	Y/N
Verbena hastata	Blue vervain	FACW	Y
Vitis riparia	Riverbank grape	FAC	Y
WEST BEACH SWALE			
Acer saccharinum seedlings	Silver maple	FACW	Y
Populus deltoides	Cottonwood	FAC	Y
Rhamnus frangula seedlings	Glossy buckthorn	FAC	N
Robinia pseudoacacia	Black locust	FACU	N
Cornus foemina	Gray dogwood	FAC	Y
Salix exigua	Sandbar willow	FACW	Y
Alisma plantago-aquatica	Common water plantain	OBL	Y

BOTANICAL NAME	COMMON NAME	WL INDICATOR	NATIVE?
WEST BEACH SWALE (CONTINUED...)			
Bidens frondosa	Common beggar-ticks	FACW	Y
Butomus umbellatus	Flowering rush	OBL	N
Carex bebbii	Bebb’s sedge	OBL	Y
Cinna arundinacea	Wood reedgrass	FACW	Y
Cyperus bipartitus (C. rivularis)	Brook nut sedge	FACW	Y
Cyperus esculentus	Yellow nutsedge	FACW	Y
Echinochloa crus-galli	Barnyard grass	FAC	N
Epilobium hirsutum	Great hairy willowherb	FACW	N
Eupatorium perfoliatum	Boneset	FACW	Y
Helenium autumnale	Sneezeweed	FACW	Y
Juncus effusus	Soft-stemmed rush	OBL	Y
Juncus torreyi	Torrey’s rush	FACW	Y
Lycopus americanus	Water horehound	OBL	Y
Lycopus asper	Rough water horehound	OBL	N
Lythrum salicaria	Purple loosestrife	OBL	N
Mentha canadensis	Wild mint	FACW	Y
Mimulus ringens	Monkey-flower	OBL	Y
Phragmites australis	Giant reed	FACW	N
Persicaria lapathifolia (Polygonum l.)	Nodding smartweed	FACW	Y
Persicaria maculosa (Polygonum persicaria)	Lady’s-thumb	FAC	N
Rumex crispus	Curly dock	FAC	N
Sagittaria latifolia	Arrowhead	OBL	Y
Schoenoplectus pungens	Threesquare	OBL	Y
Schoenoplectus tabernaemontani	Softstem bulrush	OBL	Y
Scirpus pendulus	Bulrush	OBL	Y
Scuttelaria lateriflora	Mad-dog skullcap	OBL	Y
Verbena hastata	Blue vervain	FACW	Y
NORTH END			
Carya ovata	Shagbark hickory	FACU	Y
Carya cordiformis	Bitternut hickory	FAC	Y
Catalpa speciosa	Catalpa	FACU	N
Celtis occidentalis	Hackberry	FAC	Y
Morus alba	White mulberry	FACU	N
Juglens nigra	Black walnut	FACU	Y
Prunus serotina	Black cherry	FACU	Y
Quercus alba	White oak	FACU	Y

BOTANICAL NAME	COMMON NAME	WL INDICATOR	NATIVE?
NORTH END (CONTINUED...)			
Quercus rubra	Red oak	FACU	Y
Cornus foemina	Gray dogwood	FAC	Y
Crataegus spp.	Hawthorn spp.		
Ligustrum vulgare	Common privet	FACU	N
Lonicera spp.	Honeysuckle sp.		N
Rhamnus cathartica	Common buckthorn	FAC	N
Rosa multiflora	Multiflora rose	FACU	N
Rubus occidentalis	Black raspberry	UPL	Y
Allium canadense	Wild garlic	FACU	Y
Carex blanda	Woodland sedge	FAC	Y
Claytonia virginica	Spring beauty	FACU	Y
Erythronium albidum	White trout lily	FACU	Y
Euonymus fortunei	Wintercreeper	UPL	N
Erigeron annuus	Daisy fleabane	FACU	Y
Geum canadense	White avens	FAC	Y
Parthnocissus quinquefolia	Virginia creeper	FACU	Y
Persicaria virginiana (Polygonum virginianum)	Jumpseed	FAC	Y
Toxicodendron radicans	Poison ivy	FAC	Y
Vitis riparia	Riverbank grape	FAC	Y
AQUATIC BEDS			
Elodea canadensis	Common waterweed	OBL	Y
Eurasian milfoil	Myriophyllum spicatum	OBL	N
Potamogeton crispus	Pondweed	OBL	N
Vallisneria americana	Water celery	OBL	Y
Chara spp.	Muskweed	OBL	Y
Certophyllum demersum	Coontail	OBL	Y

APPENDIX F

FAVORED BERRY-BEARING PLANTS

LATIN NAME	COMMON NAME	FOUND ON SUGAR ISLAND?	FOUND IN WET-MESIC FLATWOODS	HYDROLOGIC PREFERENCE
Amelanchier spp	Serviceberry/Juneberry	No	No	
Aronia prunifolia	Black chokeberry	No	Yes	Shady moist or mesic understory
Celtis occidentalis	Hackberry	Yes	Yes	Mesic overstory
Cornus florida	Flowering dogwood	No	No	
Cornus sericea	Red osier dogwood	Yes	Yes	Shorelines, swales, wetlands
Cornus drummondii	Rough-leaved dogwood	Yes	Yes	Shorelines, swales, wetlands
Crataegus spp	Hawthorn spp.	Yes	No	
Ilex verticillata	Winterberry	No	Yes	Shady moist or mesic understory
Juniperus virginiana	Eastern red cedar	No	No	
Lindera benzoin	Spicebush	No	Yes	Shady moist or mesic understory
Morus rubra	Red mulberry	Yes	Yes	Mesic understory
Myrica pensylvanica	Northern bayberry	No	No	
Parthenocissus quinquefolia	Virginia creeper	Yes	Yes	Ubiquitous

LATIN NAME	COMMON NAME	FOUND ON SUGAR ISLAND?	FOUND IN WET-MESIC FLATWOODS	HYDROLOGIC PREFERENCE
Phytolacca americana	Pokeweed	No	No	
Quercus spp	Oak spp.	Yes	Yes	Depends on species
Rhus typhina	Staghorn sumac	Yes	No	
Rubus occidentalis	Black raspberry	Yes	No	
Salix spp	Willow sp.	Yes	No	
Sambucus canadensis	Elderberry	No	Yes	Shady or sunny moist or mesic
Toxicodendron radicans	Poison ivy	Yes	Yes	
Viburnum dentatum	Arrowwood viburnum	No	No	
Viburnum lentago	Nannyberry	No	Yes	Shady moist or mesic understory
Viburnum prunifolium	Black haw	No	Yes	Mesic understory
Viburnum rafinesquianum	Downy arrowwood	No	Yes	Shady upland
Vitis riparia	Riverbank grape	Yes	Yes	

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APPENDIX D

FISHERIES ASSESSMENT

FISH POPULATION STUDIES IN THE VICINITY OF SUGAR ISLAND, DETROIT RIVER, MICHIGAN, DURING 2018

by
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October 29, 2018

Introduction

This study was conducted as a pre-survey of the fish community prior to restoration activities on Sugar Island. The survey area was the entire island. Sampling was conducted on four consecutive nights, using standard gear for nearshore fish assessment, during the spring and fall. Weather was clear at the time of sampling with westerly and southerly winds from 5-15 mph. Sampling proceeded with no major difficulties. Timing of the spring sampling coincided with white bass spawning, as well as peak inshore migrations for many forage fishes and small game fishes. Typically, the largest inshore catches are taken in spring. Fall sampling was targeted on young game fish that might use the area for a nursery, although similar methods were used.

Methods

Sampling for the fish community in the vicinity of the restoration project near Sugar Island was conducted in May and September 2018. Sampling extended over five days, with nets initially set on May 20, then retrieved on May 21-24 when sampling was completed. The dates of September sampling were from September 16 to 20. The initial plan was to set pairs of hoop nets, minnow trap gangs, and to electroshock at two distinct locations on each side of the island. However, this was a fairly small area, and that much sampling could not be completed due to lack of space and currents that rolled the nets. As a result, hoop nets and minnow traps were set singly, approximately every 100 yards on both sides of the island, for a total of 7 hoop nets and 7 minnow gangs in spring and 8 hoop nets and 8 minnow gangs in fall. Electroshocking was conducted around the entire island, between the shore and five-foot depth, in both seasons.

In physical characteristics, the area is strongly affected by waves and currents, with winds from the south causing waves and erosion along the southern shoreline, while currents from the main river as well as back currents along the shore causing much erosion on the western shoreline. As a result, the aquatic habitat appears to be open sand, gravel, and clay. There are some fallen trees and logs in the nearshore area, but no evident aquatic vegetation in spring. By the fall, some bulrush habitat had emerged on the eastern shoreline, and a large amount of *Vallisineria* (water celery) was found in the areas about 3-6 feet in depth along the western shoreline, in the main current. The currents on the western side of the island affected the nets, as the lead or pot anchors were often displaced by currents, causing reduced fishing effectiveness at times. However, no such surge problem occurred with minnow traps or electroshocking in this area.

During each season, four hoop nets were set over a period of two nights on the eastern shoreline of the island, and four minnow trap gangs with five baited minnow traps each were set over the same two-night period. Following this, we set three hoop nets and three gangs of minnow traps on the western shoreline for two nights in spring, and four of each of these nets in fall. Finally, electrofishing was conducted throughout the entire study area, from nearshore to a depth of approximately five feet (Tables 1 and 3).

Results

The region mainly has fairly poor fish habitat with relatively low abundances of fish, estimated by all sampling methods used. Our total fish collections resulted in 2,100 fish taken by all methods combined over both seasons. In the spring, the area was dominated by minnows, with the dominant species being emerald shiner (43% of the total composition of fish species clearly identified, Table 2). Rock bass, blacknose shiner, and spottail shiner were other common species, representing between 10-20% of the total collection. Fishes from 16 species were collected overall in this season.

Most fish collected were either minnows or small game fish. Sampling in May prevented collection of young-of-year fish, which would not recruit to the gear for most species until fall. However, many fish collected were juveniles born the previous year. The rock bass population represented all age classes of fish in the area, while yellow perch were mainly intermediate in size, and white bass were all adults in their spawning migration.

Length information was collected on all game species taken in spring to evaluate size distribution (Tables 2 and 4). Most game species represented a narrow size range, identified mainly as juvenile fish. A 20-inch pike was collected, and the longest yellow perch and rock bass were of an adult size acceptable to anglers.

The species abundance and composition changed abruptly in the fall. Minnows were relatively rare at this time, while a number of young game fish were collected (Table 3). Overall, even fewer fish were taken in the fall (392), but more species were present (18). Most fish collected were again juveniles or small bodied species, and the number taken was very low for the amount of effort applied.

We have conducted previous collections in the Detroit River system at different sites, mostly downstream in the Trenton Channel, as well as at Belle Isle. Percent composition of different fish species for these collections is shown in Figure 1, as is the composition of different species in the current collection. The overall abundance was more even across the main species for the average Detroit River data and at Sugar Island compared to Belle Isle, while the fish community at Sugar Island and Belle Isle was much more dominated by minnows and less by game fish species compared to average Detroit River sites.

Most of the fish in spring were taken by one hoop on the east shoreline, which took a very large school of small minnows (1-2 inches). That haul produced over 1,200 fish. The large number of fish and the small size of individuals prevented us from identifying all individuals to species; however, an analysis of approximately 100 individuals indicated the fish were dominated by emerald shiner. In comparison to that haul, all other sampling attempts had low productivity.

Catch-per-unit effort was considerably lower than other sampling conducted in the Detroit River. A typical catch-per-unit effort for the same combination of nets in nearshore habitats for the river was approximately 60 fish*net^{-1}*hour^{-1}. The catch-per-unit effort on the present study was approximately five fish/hour. The low catch rate was consistent across all gear types, as relatively few fish were taken in any sampling technique, except the one hoop net haul. This area appears to have a depauperate fish fauna, with relatively few species of game fishes (especially Centrarchids) compared to other locations and relatively low abundance of individuals.

Discussion

The overall sampling of the region around Sugar Island indicates low abundance of mainly juvenile fish, and of those, predominantly minnows in the spring with young game fishes being more common in the fall. The catch-per-unit effort was considerably lower than other sites throughout the Detroit River. The area has limited habitat that could serve as a nursery for juvenile fishes and, as a result, has a very limited juvenile fish population. Adult fishes are also relatively uncommon, with only a few yellow perch, northern pike, and white bass as representatives taken as adult sized game fishes. This is a marginal fish habitat that could be improved considerably by restoration.

Typically juvenile fish of many species inhabit areas of submersed and emergent vegetation, where they have refuge from predation from larger fishes. We intentionally sampled the bulrush habitat on the eastern shoreline of the island in an attempt to determine if the fish were using this habitat, but catch was very low there. There was an increased catch in the submersed *Vallisineria* beds on the western side of the island, which may demonstrate the value of that habitat for juvenile fish. While it appears the lack of vegetation limits the fish habitat near the island, abundance of juvenile fish is also limited by the lack of spawning habitat and adult populations of fish using that area for spawning.

Table 1. Sampling methods and durations for fish sampling, May 20-24, 2018 near Sugar Island, Detroit River.

Net Type	**Number**	**Set Time**	**Pull time**	**Number of Fish**	**Number of Species**
Hoop	1	5/20 15:30	5/21 10:40	0	0
Hoop	2	5/20 15:40	5/21 10:48	15	4
Hoop	3	5/20 15:50	5/21 11:01	25	3
Hoop	4	5/20 16:00	5/21 11:13	21	6
Hoop	1	5/21 10:40	5/22 10:38	1	1
Hoop	2	5/21 10:48	5/22 10:49	1250	5
Hoop	3	5/21 11:01	5/22 11:30	14	2
Hoop	4	5/21 11:13	5/22 11:44	6	3
Minnow	1	5/20 16:10	5/21 11:28	2	2
Minnow	2	5/20 16:20	5/21 11:40	0	0
Minnow	3	5/20 16:30	5/21 11:44	1	1
Minnow	4	5/20 16:40	5/21 11:51	3	1
Minnow	1	5/21 11:28	5/22 12:04	4	1
Minnow	2	5/21 11:40	5/22 12:27	2	2
Minnow	3	5/21 11:44	5/22 12:34	4	3
Minnow	4	5/21 11:51	5/22 13:15	7	3
Hoop	5	5/22 11:10	5/23 11:06	47	4
Hoop	6	5/22 11:20	5/23 11:41	10	0
Hoop	7	5/22 11:56	5/23 12:10	7	1
Hoop	5	5/23 11:06	5/24 9:53	14	3
Hoop	6	5/23 11:41	5/24 10:06	25	4
Hoop	7	5/23 12:10	5/24 10:17	6	5
Minnow	5	5/22 12:12	5/23 11:06	45	4
Minnow	6	5/22 12:25	5/23 11:41	68	5
Minnow	7	5/22 12:45	5/23 12:10	0	0
Minnow	5	5/23 11:06	5/24 10:28	22	6
Minnow	6	5/23 11:41	5/24 10:46	87	4
Minnow	7	5/23 12:10	5/24 11:05	0	0
Electrofish*	1	5/21 12:17	5/22 13:39	43	8

*49 total minutes shocked

Table 2. Fish collection data from sampling, May 20-24, 2018 near Sugar Island, Detroit River.

Species	**Common Name**	**Total Collected**	**Length Range**	**Mean Length**
	UNID small minnows*	1102		
Notropis atherinoides	Emerald shiner	240		
Ambloplites rupestris	Rock bass	104	1.5-9.5 in	5.79 in
Rhinichthys atratulus	Blacknose dace	75		
Notropis hudsonius	Spottail shiner	69		
Nocomis biguttatus	Hornyhead chub	49		
Perca flavescens	Yellow perch	33	3.25-9.25 in	6.02 in
Morone chrysops	White bass	10	8-16.5 in	13.54 in
Notropis stramineus	Sand shiner	10		
Neogobius melanostomus	Round goby	5		
Ameiurus nebulosus	Brown bullhead	2		
Luxilus cornutus	Common shiner	2		
Esox lucius	Northern pike	1	20 in	20 in
Moxostoma erythrurum	Golden redhorse	1		
Osmerus mordax	Rainbow smelt	1		
Percopsis omiscomaycus	Trout-perch	1		
Lepomis gibbosus	Pumpkinseed	1	6 in	6 in
TOTAL	**16**	**1708**		

*All of these were collected in one hoop net. They were small (1-2 inches each) and difficult to identify, most were likely emerald shiner.

Table 3. Sampling methods and durations for fish sampling, September 16-20, 2018 near Sugar Island, Detroit River.

Net Type	Number	Set Time	Pull time	Number of Fish	Number of Species
Hoop	1	9/16 16:17	9/17 10:58	5	2
Hoop	2	9/16 16:25	9/17 11:04	1	1
Hoop	3	9/16 16:37	9/17 11:07	3	1
Hoop	4	9/16 16:47	9/17 11:14	21	6
Hoop	1	9/17 10:58	9/18 11:31	2	2
Hoop	2	9/17 11:04	9/18 12:05	6	2
Hoop	3	9/17 11:07	9/18 12:23	0	0
Hoop	4	9/17 11:14	9/18 12:28	8	6
Minnow	1	9/16 16:56	9/17 11:45	1	1
Minnow	2	9/16 17:05	9/17 11:53	7	1
Minnow	3	9/16 17:08	9/17 11:59	8	2
Minnow	4	9/16 17:14	9/17 12:10	2	1
Minnow	1	9/17 11:45	9/18 13:30	15	2
Minnow	2	9/17 11:53	9/18 13:36	22	1
Minnow	3	9/17 11:59	9/18 13:41	7	7
Minnow	4	9/17 12:10	9/18 13:46	8	2
Hoop	5	9/18 12:20	9/19 10:36	3	1
Hoop	6	9/18 13:12	9/19 10:28	7	2
Hoop	7	9/18 12:43	9/19 10:12	4	2
Hoop	8	9/18 12:58	9/19 10:22	0	0
Hoop	5	9/19 10:36	9/20 9:10	3	2
Hoop	6	9/19 10:28	9/20 9:20	5	1
Hoop	7	xx	xx	0	0
Hoop	8	9/19 10:22	9/20 9:36	3	2
Minnow	5	9/18 14:10	9/19 11:06	32	3
Minnow	6	9/18 14:05	9/19 10:54	25	2
Minnow	7	9/18 13:55	9/19 11:29	30	5
Minnow	8	9/18 14:01	9/19 11:15	30	5
Minnow	5	9/19 11:06	9/20 8:56	41	5
Minnow	6	9/19 10:54	9/20 8:51	8	3
Minnow	7	9/19 11:29	9/20 8:29	40	4
Minnow	8	9/19 11:15	9/20 8:42	17	4
Electrofish*	1	9/17 10:42	9/18 14:35	36	9

*52 total minutes shocked
xx = not reset due to currents

Table 4. Fish collection data from sampling, September 16-20, 2018 near Sugar Island, Detroit River.

Species	**Common Name**	**Total Collected**	**Length Range**	**Mean Length**
Neogobius melanostomus	Round goby	190		
Nocomis biguttatus	Hornyhead chub	66		
Ambloplites rupestris	Rock bass	33	1.75 – 8 in	2.75 in
Notropis hudsonius	Spottail shiner	24		
Dorosoma cepedianum	Gizzard shad	16		
Micropterus salmoides	Largemouth bass	13	2.5 – 5.6 in	4.2 in
Micropterus dolomeiu	Smallmouth bass	11	2.75 – 6 in	4.0 in
Perca flavescens	Yellow perch	10	2.75 – 8 in	4.7 in
Percina caprodes	Logperch	9		
Cyprinus carpio	Common carp	4		
Morone chrysops	White bass	3	2.75 – 3 in	2.8 in
Amia calva	Bowfin	3		
Notropis atherinoides	Emerald shiner	2		
Notropis stramineus	Sand shiner	2		
Catostomus commersoni	White Sucker	2		
Rhinichthys atratulus	Blacknose dace	1		
Ameiurus melas	Black bullhead	1		
Sander vitreus	Walleye	1	5 in	5 in
TOTAL	**18**	**392**		

Figure 1. Species composition of fish collected in the Detroit River in previous studies, compared to the composition of fish sampled in this analysis.

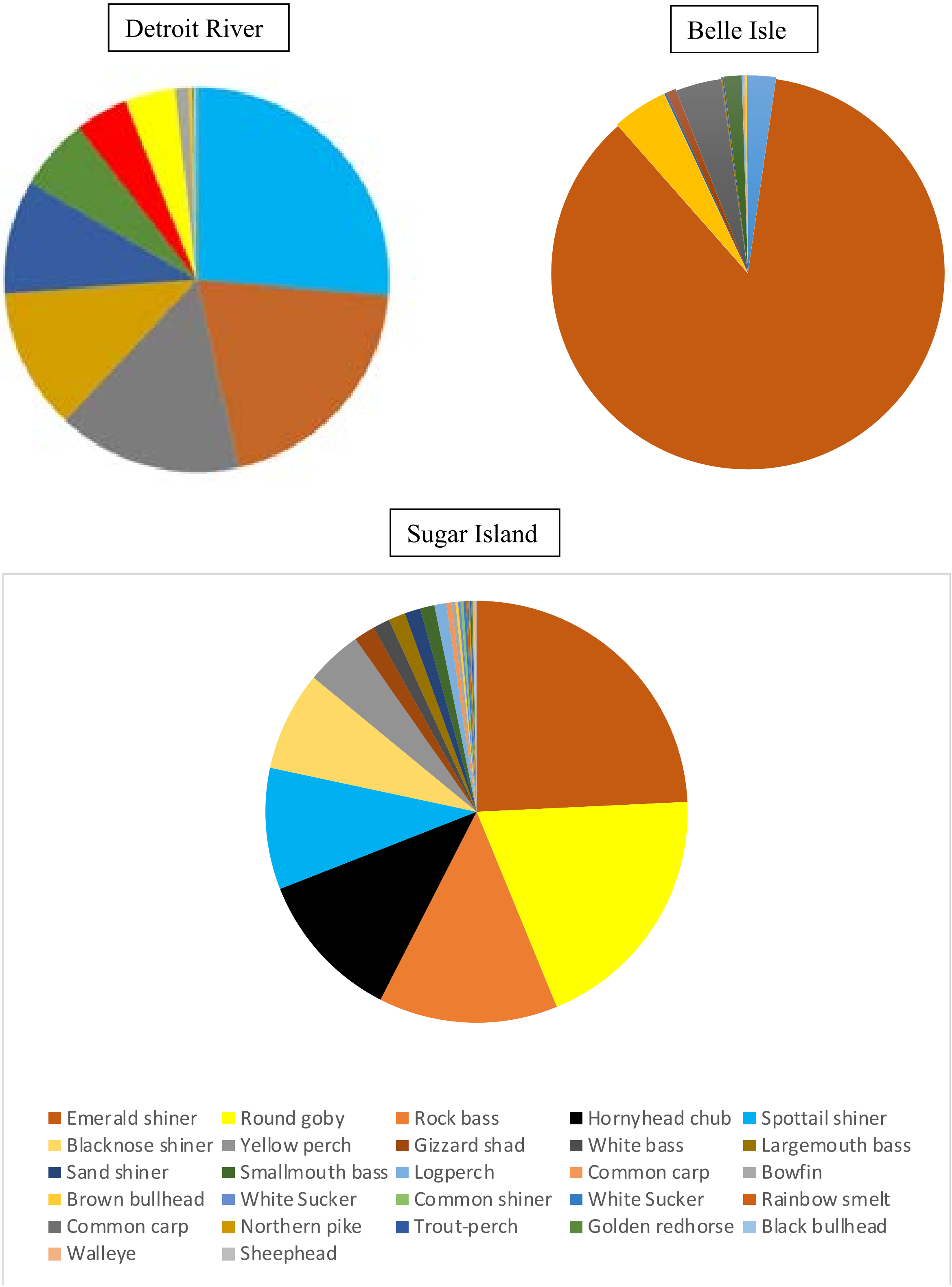
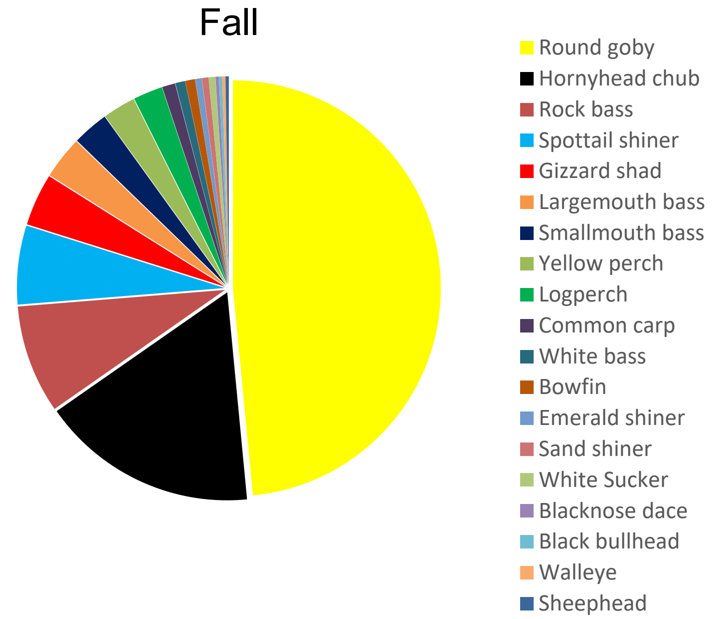
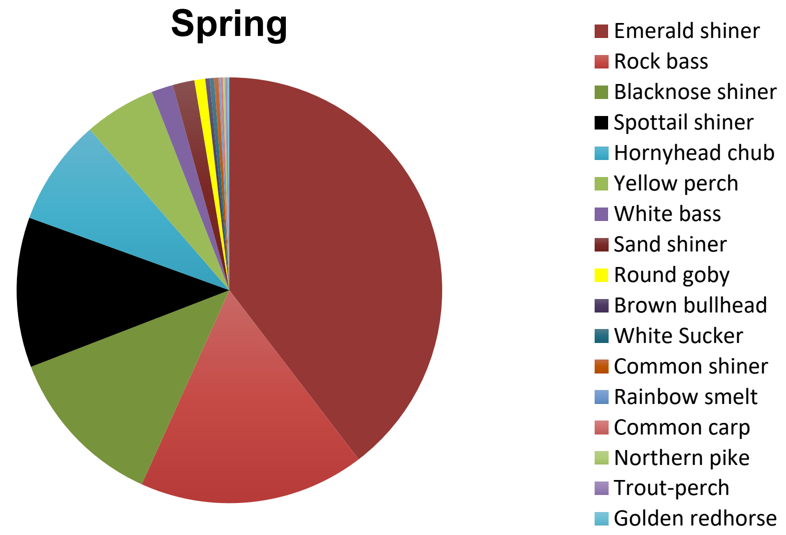


Figure 2. Species composition of fish collected at Sugar Island in Spring and Fall, 2018.





APPENDIX E

HERPETOFAUNA ASSESSMENT

Sugar Island Habitat Restoration:

Herpetofauna Assessment Final Report

October 2018

Prepared For:
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Prepared By:
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Suggested Citation: *Herpetological Resource and Management. 2018. Sugar Island Habitat Restoration: Herpetofauna Assessment Final Report. Herpetological Resource and Management Technical Report. Chelsea, MI. 24 pp.*

Contents

Executive Summary

In 2018 Herpetological Resource and Management (HRM) was contracted by SmithGroupJJR (SGJJR) as part of a grant from the Friends of the Detroit River with funding provided by the National Oceanic and Atmospheric Administration (NOAA) to conduct a baseline study and evaluate the potential for habitat restoration opportunities targeting amphibians and reptiles (herpetofauna) and birds (avifauna) on Sugar Island in the Detroit River. Habitat conditions on the island have degraded due to several factors including shoreline erosion and invasive vegetation. Herpetofauna surveys were conducted between April and July 2018. Results of the assessments are intended to assist in guiding restoration actions to be taken on the island as well as to help evaluate the success of restoration efforts.

Significant findings from 2018 herpetofauna assessments included:

- A total of eight amphibian and reptile species were recorded including Bullfrog (*Rana [Lithobates] catesbeiana*), Green Frog (*Rana [Lithobates] clamitans melanota*), Mudpuppy (*Necturus maculosus maculosus*), Butler's Garter Snake (*Thamnophis butleri*), Eastern Garter Snake (*Thamnophis sirtalis sirtalis*), Eastern Snapping Turtle (*Chelydra serpentina serpentina*), Midland Painted Turtle (*Chrysemys picta marginata*) and Northern Map Turtle (*Graptemys geographica*).
- Two herpetofauna species listed as Special Concern in Michigan were documented including Mudpuppy (*Necturus maculosus*) and Butler's Garter Snake (*Thamnophis butleri*).
- Based on observed habitat conditions during pre-restoration assessments and known species ranges, an additional 12 herpetofauna may occur on Sugar Island including one State Threatened species, the Eastern Fox Snake (*Pantherophis gloydi*).
- A number of opportunities for improving habitat conditions on Sugar Island for herpetofauna were identified including protecting critical habitats such as vernal pools and open grassland communities, and supplementing important features targeting amphibians and reptiles.
- Locations were identified where the addition of woody debris, basking locations, nesting structures, and hibernacula would be beneficial for improving overall habitat quality to herpetofauna on the island.

The restoration of Sugar Island will likely increase the number of wildlife species present and increase the abundance of its already present species. This project will also contribute to restoring lost habitats and degraded fish and wildlife populations within the Detroit River. These actions will help address measures needed for the removal of Beneficial Use Impairments and ultimately delisting this region as an Area of Concern.

Introduction

The Detroit River is one of 43 sites designated as an Area of Concern (AOC) under the 1987 Great Lakes Water Quality Agreement. Over a century of development has degraded this important channel that connects Lake St. Clair and the Upper Great Lakes to Lake Erie. As a result, a significant portion of the historical coastal marsh and riparian habitats along the Detroit River have been eliminated (United States Environmental Protection Agency 1996). A number of islands located throughout the river currently provide critical habitat resources for resident and migratory fish and wildlife; however, the integrity of these areas is threatened by several factors such as severe erosion and invasive plant communities. As part of the AOC listing, loss of fish and wildlife habitat is identified as one of several Beneficial Use Impairments (BUIs). Within recent years, several groups and agencies from both United States and Canada have directed efforts toward conducting restoration that will contribute to the removal of BUIs on the Detroit River and aid in the overall delisting as an AOC.

In 2018 Herpetological Resource and Management (HRM) was contracted by SmithGroupJJR (SGJJR) as part of a grant from the Friends of the Detroit River with funding provided by the National Oceanic and Atmospheric Administration (NOAA) to conduct a baseline study and evaluate the potential for habitat restoration opportunities targeting amphibians and reptiles (herpetofauna) and birds (avifauna) on Sugar Island in the Detroit River. Results of the assessments are intended to assist in guiding restoration actions to be taken on the island as well as to help evaluate the success of restoration efforts. Overall species presence, represented age class, spatial distribution, and relative abundance can be important tools in identifying the need for, and success of, habitat restoration (Cooperrider, Boyd et al. 1986; Saulović, Biočanin et al. 2007; Guilfoyle 2010). The contents of this report include the results of HRM's herpetofauna assessments.

Site Description

Sugar Island is an uninhabited 30-acre island located in the lower reach of the Detroit River approximately three miles upstream from the mouth of the river as it enters Lake Erie. Pre-settlement natural community of the island has been classified as a beach-maple-red oak complex. The island was historically used as an entertainment attraction and between the 1880s and 1950s included buildings, amusement rides, and an enlarged dock for ferry boats. After closing to the public, the island was commonly used by local visitors for exploring or hunting for several decades. In 2012, Sugar Island was purchased by the U.S. Fish and Wildlife Service and included in the Detroit River International Wildlife Refuge. The west shoreline of the island remains available for public use between Memorial Day and Labor Day and hunting is permitted in accordance with refuge and State of Michigan guidelines.

In its current condition, Sugar Island is classified as a wet-mesic flatwoods community. This community type is known for poorly drained forests that support a mixture of lowland and upland hardwoods that include a mosaic of upland areas with seasonally inundated depressions. The canopy layer of Sugar Island is dominated by oaks (*Quercus* spp.), hickories (*Carya* spp.), black cherry (*Prunus serotina*), black walnut (*Juglans nigra*), hackberry (*Celtis occidentalis*), and slippery elm (*Ulmus rubra*), with less abundant species including mulberry (*Morus alba*), American linden (*Tilia americana*), and Norway maple (*Acer platanoides*) (Photo 1). The understory includes some canopy saplings but is dominated by dense growth of invasive plant species primarily composed of common privet (*Ligustrum vulgare*), as well as common buckthorn (*Rhamnus cathartica*), honeysuckle (*Lonicera* spp.), multiflora rose (*Rosa multiflora*), and Japanese barberry (*Berberis thunbergii*). Within interior portion of the island, several pockets of ephemeral forested wetland are present including vernal pools (Photos 2-3). A small open grassland exists along the southeastern border (Photo 4). Sandy beaches are present on the eastern and western borders (Photo 5). Portions of the sandy beaches contain ridge swale landscape features with coastal wetland vegetation present in the swale habitat.

Erosion from the wave action has severely affected a majority of the island's shore with the southern end experiencing the heaviest wave action causing several large trees to erode off (Photos 6-7). Nearshore habitat lacks aquatic vegetation and is dominated by open sand, gravel, and clay. Cover in these areas is limited to trees that have fallen into the river as a result of erosion activity.

Methods

To determine herpetofauna species that may currently occur on the island, a historical review was conducted utilizing records from United States Fish and Wildlife Service (USFWS), Michigan Natural Features Inventory (MNFI), and the Michigan Herp Atlas Project.

HRM conducted herpetofaunal surveys and habitat assessments between April and June, 2018 during optimal weather conditions by teams of two to three biologists trained in the identification of herpetofauna. Methods to detect herpetofauna included visual encounters, examination of cover objects, and trapping. These sampling techniques were used to determine species presence, spatial distribution, and habitat use of amphibians and reptiles on the island. Surveys for Mudpuppies were conducted using baited traps completely submerged along the eastern and western near shore areas (Map 1, Photo 8). Terrestrial sampling including aural and time-constrained meander ground searches which included the investigation of potential basking and nesting areas, as well as turning over natural and acritical cover (logs, boards, debris, etc.) to detect herpetofauna present.

Results

Based on a historical review of Sugar Island, two species, Mudpuppy (*Necturus maculosus maculosus*) and Eastern Fox Snake (*Pantherophis gloydi*) have been previously recorded. Both species were detected from within the Detroit River, adjacent to the island. An additional 11 species have been detected on Grosse Ile directly west of Sugar Island. These species include, Northern Spring

Peeper (*Pseudacris crucifer crucifer*), Bullfrog (*Rana [Lithobates] catesbeiana*), Green Frog (*Rana [Lithobates] clamitans melanota*), Northern Leopard Frog (*Rana [Lithobates] pipiens*), Western (Midland) Chrous Frog (*Pseudacris triseriata*), Red-backed Salamander (*Plethodon cinereus*), Eastern Garter Snake (*Thamnophis sirtalis sirtalis*), Eastern Snapping Turtle (*Chelydra serpentina serpentina*), Midland Painted Turtle (*Chrysemys picta marginata*), Northern Map Turtle (*Graptemys geographica*), and Red-eared Slider (*Trachemys scripta elegans*).

During HRM's herpetofaunal surveys, a total of eight species were observed including two amphibians and four reptiles (Table 1). Species detected were, Bullfrog, Green Frog (Photo 9), Mudpuppy (Photo 10), Butler's Garter Snake (*Thamnophis butleri*) (Photo 11), Eastern Garter Snake (Photo 12), Eastern Snapping Turtle, Midland Painted Turtle (Photo 13), and Northern Map Turtle (Photo 14).

Based on observed habitat conditions during pre-restoration assessments and known species ranges, an additional 12 herpetofauna may occur on Sugar Island. These species include Eastern American Toad (*Bufo [Anaxyrus] americanus americanus*), Gray Treefrog (*Hyla chrysoscelis/versicolor*), Northern Spring Peeper, Western (Midland) Chorus Frog, Wood Frog (*Rana [Lithobates] sylvatica*), Red-spotted Newt (*Notophthalmus viridescens*), Red-backed Salamander, Northern Water Snake (*Nerodia sipedon sipedon*), Northern Brown Snake (*Storeria dekayi dekayi*), Northern Red-bellied Snake (*Storeria occipitomaculata occipitomaculata*), Northern Ribbon Snake (*Thamnophis sauritus septentrionalis*), and Eastern Spiny Softshell Turtle (*Apalone spinifera spinifera*).

Discussion and Recommendations

HRM documented eight amphibian and reptile species during 2018 assessments of Sugar Island. While this species richness can be considered moderate, the proximity of Sugar Island to adjacent habitats on the river presents a high likelihood of additional species colonizing the island. Of the eight herpetofauna observed in 2018, two species, Mudpuppy and Butler's Garter Snake are listed as Special Concern in Michigan and afforded protection by the Michigan Department of Natural Resources (MDNR) under the Fisheries Directors Order 224.16.

Mudpuppies are obligate hosts to the State of Michigan endangered salamander mussel (*Simpsonais ambigua*), making them an integral component of their aquatic ecosystems. They are also known as important predators of invasive round gobies (Beattie, Whiles et al. 2017; Stapleton, Mifsud et al. 2018). Habitat for this species within near shore areas of the island appears to be currently very limited. Observations were limited to juvenile animals. Prior to historic dredging activities, the Detroit River supported large expanses of limestone with fractures and crevices, which allowed Mudpuppies and numerous game and nongame fish species to utilize these habitats. Supplementing offshore areas surrounding Sugar Island with large, flat rock surfaces will improve opportunities for this aquatic salamander as well as several species of fish and other aquatic wildlife (Photo 15).

Butler's Garter Snakes are declining throughout Michigan and their total range (Harding and Mifsud 2017). The species prefers wet meadows, prairies, pond and lake borders, and other moist grassy communities. Habitats suitable for Butler's Garter Snake on Sugar Island is limited and threatened due to the presence of several invasive plants. Efforts should be placed on reducing or eliminating these invasive species to maintain quality of habitat for Butler's Garter Snake. This rare reptile species responds well to habitat restoration and is an important indicator species of ecosystem health.

Multiple age classes of herpetofauna were documented in 2018 including a hatchling Midland Painted Turtle. Within this region as well as throughout the state, turtle species face substantial threats including, limited nesting habitat as a result of shoreline armoring and high nest predation by mesopredators particularly raccoons (Harding and Mifsud 2017). The documentation of successful nesting on Sugar Island is significant. The location of the nest and proximity to water demonstrates the need for improved habitat and restoration. The turtle which likely recently emerged from its nest (Painted Turtles overwinter in nests and emerge in spring) was in the grassy meadow on the south eastern portion of the island near an active erosion area and steep drop off. Future management should include the creation of additional turtle nesting habitat and when possible, implementing measures to protect against nest predation (Photo 16).

Although not observed during preliminary assessments, Eastern Fox Snakes have been recently documented within the Detroit River directly adjacent to Sugar Island. Known for their strong swimming capabilities, there is high potential for them to occur on Sugar Island. The entire range of this State Threatened species lies within Great Lakes coastal marshes from the Saginaw Bay of Lake Huron south to northern Lake Erie. Eastern Fox Snakes have declined significantly within the Detroit River largely due to the widespread loss of coastal wetland habitat (Harding and Mifsud 2017). Restoration of Sugar Island will benefit local populations by providing valuable resources and refugia.

Habitat features important for the healthy, diverse herpetofauna populations were observed across the island during HRM's assessments. There is abundant woody debris within the uplands from downed trees (Photo 17). These structures provide an important source of cover to amphibians and reptiles for thermoregulation and refugia. They also serve as habitat for macroinvertebrates that are important prey items for herpetofauna. Restoration activities should focus on maintaining woody debris in upland habitats and supplementing in portions where it is more limited. Along the shoreline, downed trees that have fallen into the river are currently providing critical basking locations. Numerous turtles were observed using these sites along the southern end of the island. Maintaining these or similar basking structures within the river is important for providing this critical thermal regulatory habitat feature.

Several vernal pools were documented within the forested habitat, a feature that is typical to wet-mesic flatwood communities (Photo 18). These seasonally inundated, wetlands that may or may not hold water year round are particularly sensitive to disturbance (Thomas, Lee et al. 2010). Several salamander and frog species require vernal pools for breeding and larval phases and the associated uplands for foraging during adult life stages. Numerous herpetofauna species will also utilize vernal pools as foraging grounds during early spring. Drain tiles are present on the eastern border of Sugar Island and appear to be transporting a significant amount of water from the interior habitats. Removing these structures would likely help to maintain standing water within forested habitat and protect critical vernal pool habitat. Excavating these pools and recontouring them to a depth sufficient to supporting a greater diversity of vernal pool dependent wildlife is also strongly recommended (Photo 19). This fishless aquatic breeding habitat is a limiting factor for increased diversity of herpetofauna on the island.

Herpetofauna on Sugar Island would benefit from the creation of hibernacula structures to provide shelter during winter months. Hibernacula are typically several feet below grade and can be prepared by excavating a pit to at least 4-6 feet and placing rocks, logs, riprap, and other materials to create interstitial gaps (Photos 20-21). Once filled, the pit is covered with soil with only small openings remaining for entrance. Remnants of concrete foundations from buildings once established on the island may provide materials to create these structures and can save project costs by eliminating the need for moving the material off site (Mifsud 2014). Multiple locations have been identified for these structures, which have been proven to be effective on other island restoration projects (Map 3).

Additional sensitive wetland habitats that should be considered as part of the restoration include coastal marsh and ridge swale complex. These habitats were observed along the sandy shorelines on the western and eastern edges of the island. Naturally occurring in coastal areas, these communities are significant for their high concentration of biodiversity in a relatively small area. Creating similar structure along Sugar Island may provide breeding and development sites for several amphibians, habitat for migratory Arctic-breeding shorebirds, as well as for food sources that several herpetofauna and birds rely on including aquatic macroinvertebrates.

Multiple pockets of high quality forested habitat are present on Sugar Island, located in the central and east central portions of the island. However, the majority of interior forest understory is dominated by invasive vegetation in several portions including multi-flora rose, Japanese barberry (*Berberis thunbergii*), and common privet (Photo 22). These plants shade the ground and interfere with the thermoregulatory behavior of herpetofauna and reduce the suitability of these areas as basking sites for snakes or nesting sites for turtles.

One stand of invasive common reed (*Phragmites australis australis*) was observed on the south eastern border of the island (Photo 23). When growing in dense stands, this plant dominates wetland communities and restricts movements of herpetofauna between aquatic and terrestrial habitat, eliminates suitable basking sites, and cools the water which can slow the growth of amphibian eggs and larvae. These monocultures also provide limited avian habitat. Given the relatively limited presence of this plant on the island, it should be removed before further establishing and reducing the quality of coastal habitat.

Conclusion

The Detroit River historically contained abundant coastal marsh and riparian habitats that have been eliminated or degraded over the last century. The river's islands represent a significant proportion of the remaining habitat available within this AOC region. Baseline herpetofauna surveys of Sugar Island in 2018 resulted in the detection of eight amphibian and reptile species, including some known to be declining in Michigan. Based on habitat conditions and nearby occurrences, the island may support several additional species not detected in 2018 as well. Restoring and maintaining critical habitat resources including woody debris, vernal pools, and open grassland communities while incorporating other habitat opportunities such as hibernacula, nesting areas, will greatly benefit this island and the corridor. Efforts should also include removal of drain tile and control of invasive plant species. Sugar Island represents an important source of refugia for a diversity of wildlife known to occur in the region. Restoration of this location will be a valuable step toward the removal of the loss of fish and wildlife habitat BUI and overall goal of delisting the Detroit River as an AOC.

Maps

Map 1. Trapping locations used during Mudpuppy sampling on Sugar Island during 2018 assessments.

Map 2. Amphibian and reptile species and locations observed during Sugar Island herpetofaunal assessments.

Map 3. Recommendations for habitat restoration targeting amphibians and reptiles on Sugar Island.

Tables

Table 1. Amphibians and reptiles observed on Sugar Island by HRM during herpetofaunal assessments.
*Detected through fish sampling conducted simultaneously with HRM's assessments.

Sugar Island Herpetofauna			
Common Name	*Scientific Name*	*Observed*	*Potential*
Eastern American Toad	*Bufo [Anaxyrus] americanus americanus*		X
Gray Treefrog	*Hyla versicolor/chryscocelis*		X
Northern Spring Peeper	*Pseudacris crucifer crucifer*		X
Western (Midland) Chorus Frog	*Pseudacris triseriata*		X
Bullfrog	*Rana [Lithobates] catesbeiana*	X	
Green Frog	*Rana [Lithobates] clamitans melanota*	X	
Wood Frog	*Rana [Lithobates] sylvatica*		X
Mudpuppy*	*Necturus maculosus maculosus*	X	
Red-spotted Newt	*Notophthalmus viridescens*		X
Eastern Red-backed Salamander	*Plethodon cinereus*		X
Northern Water Snake	*Nerodia sipedon sipedon*		X
Eastern Fox Snake	*Pantherophis gloydi*		X
Northern Brown Snake	*Storeria dekayi dekayi*		X
Northern Red-bellied Snake	*Storeria occipitomaculata occipitomaculata*		X
Butler's Garter Snake	*Thamnophis butleri*	X	
Northern Ribbon Snake	*Thamnophis sauritus septentrionalis*		X
Eastern Garter Snake	*Thamnophis sirtalis sirtalis*	X	
Eastern Spiny Softshell Turtle	*Apalone spinifera spinifera*		X
Eastern Snapping Turtle	*Chelydra serpentina serpentina*	X	
Midland Painted Turtle	*Chrysemys picta marginata*	X	
Northern Map Turtle	*Graptemys geographica*	X	

Photos

Photo 1. Wet-mesic flatwoods habitat within Sugar Island.

Photo 2. Forested wetland habitat on Sugar Island.

Photo 3. Pocket of ephemeral forested wetland habitat on Sugar Island.

Photo 4. Open grassland habitat on the south eastern side of Sugar Island.

Photo 5. Sandy shoreline with coastal marsh vegetation on the eastern side of Sugar Island.

Photo 6. Severe erosion on the southern end of Sugar Island.

Photo 7. Numerous trees eroding off the southeastern side of Sugar Island.

Photo 8. Metal minnow trap used for conducting Mudpuppy surveys on Sugar Island.

Photo 9. Adult Green Frog observed during HRM's assessments.

Photo 10. Juvenile Mudpuppy captured by fish biologists during HRM's assessments.

Photo 11. Butler's Garter Snake observed in open grassland habitat on Sugar Island.

Photo 12. Eastern Garter Snake observed in forested habitat on Sugar Island.

Photo 13. Hatchling Midland Painted Turtle found on Sugar Island.

Photo 14. Northern Map Turtles basking on trees along the southern end of Sugar Island.

Photo 15. Example of concrete materials used to make Mudpuppy habitat structures.

Photo.16 Evidence of predated turtle nests observed during HRM's assessments.

Photo 17. Abundant sources of woody debris and tree snags observed on Sugar Island.

Photo 18. Vernal pool habitat that is critical for several wildlife groups on Sugar Island.

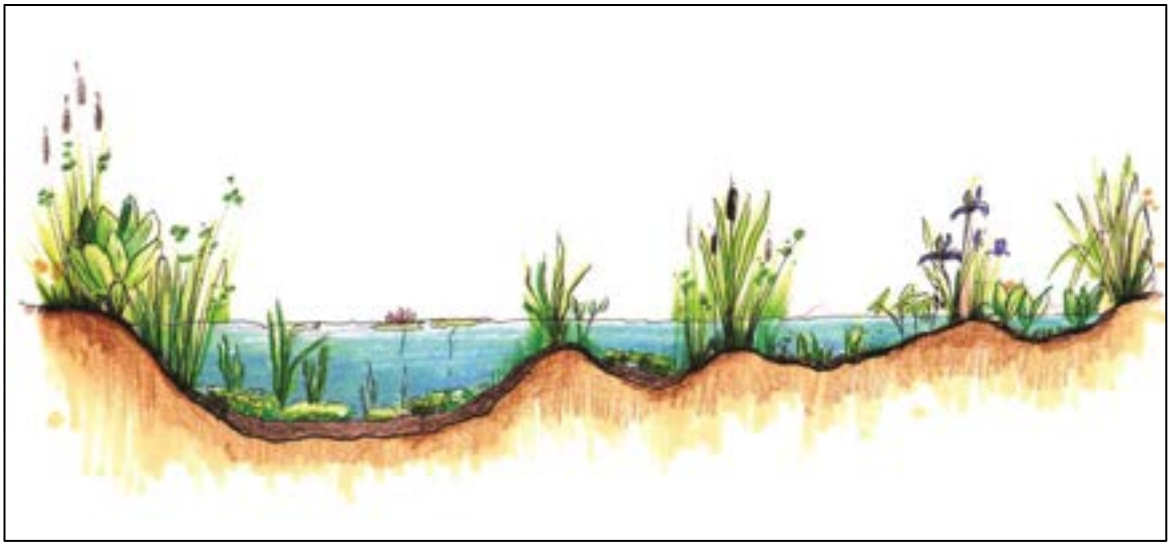

Photo 19. Design example of vernal pool construction, with multiple depths to provide a variety of microhabitats. Figure Credit: Michigan Amphibian and Reptile Best Management Practices Manual (Mifsud 2014).

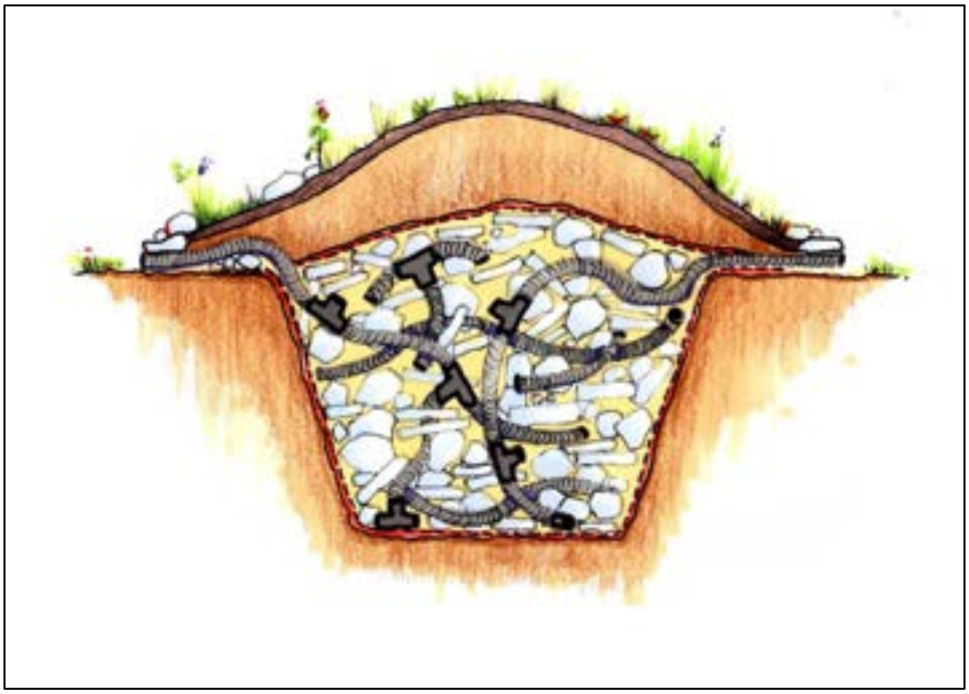

Photo 20. Design example of a reptile hibernaculum for providing overwintering habitat. Figure Credit: Michigan Amphibian and Reptile Best Management Practices Manual (Mifsud 2014).

Photo 21. Example of hibernacula constructed from materials left on site including nesting habitat on top that may be utilized by numerous wildlife species.

Photo 22. Invasive vegetation dominating portions of interior forested habitat on Sugar Island.

Photo 23. Small pocket of *Phragmites* within open grassland habitat on the southeastern side of Sugar Island that should be eradicated before further establishing.

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APPENDIX F

AVIAN ASSESSMENT

Sugar Island Habitat Restoration:

Avian Assessment Final Report

October 2018

Prepared For:
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Suggested Citation: *Herpetological Resource and Management. 2018. Sugar Island Habitat Restoration: Avian Assessment Spring Interim Report. Herpetological Resource and Management Technical Report. Chelsea, MI. 35 pp.*

Cover Photo Credit: Allen Chartier

Contents

Executive Summary

In 2018 Herpetological Resource and Management (HRM) was contracted by SmithGroupJJR (SGJJR) as part of a grant from the Friends of the Detroit River with funding provided by the National Oceanic and Atmospheric Administration (NOAA) to conduct a baseline study and evaluate the potential for habitat restoration opportunities targeting amphibians and reptiles (herpetofauna) and birds (avifauna) on Sugar Island in the Detroit River. HRM contracted with Allen Chartier to conduct the avian surveys associated with the island assessment. Habitat conditions on the island have degraded due to several factors including shoreline erosion and invasive vegetation. Wildlife inventory assessments were conducted between April and October 2018. Results of the assessments are intended to assist in guiding restoration actions to be taken on the island as well as to help evaluate the success of restoration efforts.

Significant findings from 2018 avian assessments efforts included:

- A total of 141 bird species were documented including 104 species on and/or using resources on the island, 44 flying non-stop over the island, and 28 species detected in the Detroit River within 400 meters of the island.
- Some level of breeding evidence (possible, probable, or confirmed) was observed for 43 species.
- Several rare species were documented including five listed as Special Concern in Michigan (Bald Eagle (*Haliaeetus leucocephalus*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Black-crowned Night Heron (*Nycticorax nycticorax*), Osprey (*Pandion haliaetus*), and Golden-winged Warbler (*Vermivora chrysoptera*), and five are listed as Threatened (Merlin (*Falco columbarius*), Common Loon (*Gavia immer*), Caspian Tern (*Hydroprogne caspia*), Forster's Tern (*Sterna forsteri*), and Common Tern (*Sterna hirundo*).
- Opportunities for improving breeding habitat for birds on Sugar Island include maintaining dead wood and snags on the landscape for primary and secondary cavity nesters and removal of invasive shrubs for ground nesters.
- Removal of invasive shrub species from interior habitat on Sugar Island should be followed by the addition of native fruit bearing species to provide critical resources to migrant and resident bird species.

The restoration of Sugar Island will likely increase the number of wildlife species present and increase the abundance of its already present species. This project will also contribute to restoring lost habitats and degraded fish and wildlife populations within the Detroit River. These actions will help address measures needed for the removal of Beneficial Use Impairments and ultimately delisting this region as an Area of Concern.

Introduction

The Detroit River is one of 43 sites designated as an Area of Concern (AOC) under the 1987 Great Lakes Water Quality Agreement. Over a century of development has degraded this important channel that connects Lake St. Clair and the Upper Great Lakes to Lake Erie. As a result, a significant portion of the historical coastal marsh and riparian habitats along the Detroit River have been eliminated (United States Environmental Protection Agency 1996). A number of islands located throughout the river currently provide critical habitat resources for resident and migratory fish and wildlife; however, the integrity of these areas is threatened by several factors such as severe erosion and invasive plant communities. As part of the AOC listing, loss of fish and wildlife habitat is identified as one of several Beneficial Use Impairments (BUIs). Within recent years, several groups and agencies from both United States and Canada have directed efforts toward conducting restoration that will contribute to the removal of BUIs on the Detroit River and aid in the overall delisting as an AOC.

In 2018 Herpetological Resource and Management (HRM) was contracted by SmithGroupJJR (SGJJR) as part of a grant from the Friends of the Detroit River with funding provided by the National Oceanic and Atmospheric Administration (NOAA) to conduct a baseline study and evaluate the potential for habitat restoration opportunities targeting amphibians and reptiles (herpetofauna) and birds (avifauna) on Sugar Island in the Detroit River. HRM contracted Allen Chartier, an expert of avifauna along the St. Clair to Detroit River system (SCDRS) to conduct the avian surveys. Results of the assessments are intended to assist in guiding restoration actions to be taken on the island as well as to help evaluate the success of restoration efforts. Overall species presence, represented age class, spatial distribution, and relative abundance can be important tools in identifying the need for, and success of, habitat restoration (Cooperrider, Boyd et al. 1986; Saulović, Biočanin et al. 2007). The contents of this report focus on the results of the avian assessments conducted by Allen Chartier.

Site Description

Sugar Island is an uninhabited 30-acre island located in the lower reach of the Detroit River approximately three miles upstream from the mouth of the river as it enters Lake Erie. Pre-settlement natural community of the island has been classified as a beach-maple-red oak complex. The island was historically used as an entertainment attraction and between the 1880s and 1950s included buildings, amusement rides, and an enlarged dock for ferry boats. After closing to the public, the island was commonly used by local visitors for exploring or hunting for several decades. In 2012, Sugar Island was purchased by the U.S. Fish and Wildlife Service and included in the Detroit River International Wildlife Refuge. The west shoreline of the island remains available for public use between Memorial Day and Labor Day and hunting is permitted in accordance with refuge and State of Michigan guidelines.

In its current condition, Sugar Island is classified as a wet-mesic flatwoods community. This community type is known for poorly drained forests that support a mixture of lowland and upland hardwoods that include a mosaic of upland areas with seasonally inundated depressions (Slaughter, Cohen et al. 2010). The canopy layer of Sugar Island is dominated by oaks (*Quercus* spp.), hickories (*Carya* spp.), black cherry (*Prunus serotina*), black walnut (*Juglans nigra*), hackberry (*Celtis occidentalis*), and slippery elm (*Ulmus rubra*), with less abundant species including mulberry (*Morus alba*), American linden (*Tilia americana*), and Norway maple (*Acer platanoides*) (Photo 1). The understory includes some canopy saplings but is dominated by dense growth of invasive plant species primarily composed of common privet .(*Ligustrum vulgare*), as well as common buckthorn (*Rhamnus cathartica*) honeysuckle (*Lonicera* spp.), multiflora rose (*Rosa multiflora*). Within interior portion of the island, several pockets of ephemeral forested wetland are present including vernal pools (Photos 2-3). A small open grassland exists along the southeastern border (Photo 4). Sandy beaches are present on the eastern and western borders (Photo 5). Portions of the sandy beaches contain ridge swale landscape features with coastal wetland vegetation present in the swale habitat.

Erosion has severely affected a majority of the island's shore with the southern end experiencing the heaviest wave action causing several large trees to erode off (Photos 6-7). Nearshore habitat lacks aquatic vegetation and is dominated by open sand, gravel, and clay. Cover in these areas is limited to trees that have fallen into the river as a result of erosion activity.

Methods

Avian surveys were conducted over 12 days between April and October, 2018. The objective was to capture both spring migration and autumn migration patterns and breeding season. Surveys were conducted at or shortly after sunrise using area search method. Due to dense invasive vegetation, more standardized transect counts were not employed. Time constrained ground searches were performed by traversing as much area of the island allowable in the time available. All birds observed or heard were recorded and their location in relation to the island (on island, in river, flying over) was noted. This method was used to assess diversity by evaluating species richness, community composition, and relative abundance. Information on avian observed reproductive activity was also recorded.

Results

A total of 141 species were detected (Table 1). This included 104 species resting on the island and/or using resources on the island, 44 flying non-stop over the island, and 28 species detected in the Detroit River within 400 meters of the island (Photos 8-33). Some level of breeding evidence (possible, probable, or confirmed) was observed for 43 species. Table 1 provides a complete list of species detected, and their status on Sugar Island.

Discussion and Recommendations

Over the five survey days conducted during spring migration, a total of 113 species were detected, some of which are likely year-round residents on the island. A total of 109 species were observed during the remaining seven surveys performed between August and October. Typically, bird migration is faster in spring than it is in autumn, as birds travel rapidly northward to establish breeding territories and begin breeding as soon as conditions allow. In autumn migration is more protracted, beginning as early as late July for some songbirds, typically the longer-distance Neotropical migrants, and not commencing until mid-October or later for species that over-winter in the Great Lakes region. As a result, species composition and abundance at any given site typically changes on a daily basis. Birds may stop over for several days before continuing their migrations. Duration of occupancy depends on how far the birds had flown (i.e., how much of their fat reserves they used) that night until they were forced to stop. Birds stopped early in their flights may not stay more than a day before continuing their migration. Due to the unpredictable nature of flight patterns, the frequency of surveys performed at a given location can influence the observed species richness. The presence, and especially absence, of bird species on Sugar Island during 2018 surveys are as likely to be correlated with random weather events as any other factor.

Of the 141 bird species documented during spring migration, five are listed as Special Concern including Bald Eagle (*Haliaeetus leucocephalus*) (Photo 14), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Black-crowned Night Heron (*Nycticorax nycticorax*), Osprey (*Pandion haliaetus*), and Golden-winged Warbler (*Vermivora chrysoptera*), and five are listed as threatened including Merlin (*Falco columbarius*), Common Loon (*Gavia immer*) (Photo 15), Caspian Tern (*Hydroprogne caspia*), Forster's Tern (*Sterna forsteri*), and Common Tern (*Sterna hirundo*) (Photo 16). Birds listed as Threatened in Michigan are protected by the MDNR Wildlife Division. In addition to these more rare species, Sugar Island provides critical migratory stopover habitat for a substantial number of birds known to utilize the region. The Detroit River is part of a globally important breeding area for two hundred migratory species and restoring Sugar Island will benefit a number of these birds.

Breeding evidence was observed for 43 species throughout the course of avian assessments (22 Confirmed, 15 Probable, 6 Possible). While the breeding season is generally considered to occur during the "summer" months, some species begin nesting quite early, such as Great Horned Owls (*Bubo virginianus*) in early February, Mourning Doves (*Zenaida macroura*) in March, and Black-capped Chickadees (*Poecile atricapillus*) and Tufted Titmice (*Baeolophus bicolor*) in mid-April. The peak of nest building and feeding of young does occur during June and July, but often the best time to confirm nesting status is by observing adults feeding fledged young, which is often most easily accomplished during August. During the single surveys conducted during June and July, effort was concentrated on locating nests, or observing behavior that allowed some level of breeding evidence to be obtained.

Primary and secondary cavity nesters, those that rely on the presence of dead wood and standing snags to successfully nest, were recorded as being prevalent among the breeding species on Sugar Island. Wood Duck (*Aix sponsa*), Eastern Screech-Owl (*Megascops asio*), Great Horned Owl, woodpeckers, nuthatches, chickadees, titmice, wrens, and Tree Swallows (*Tachycineta bicolor*) were all recorded on Sugar Island in 2018 and depend on this landscape feature. Numerous introduced/invasive European Starlings (*Sturnus vulgaris*) were also observed. This species often out-competes native species for these cavities (mainly excavated by the woodpeckers). Any management of the island should ensure that this abundant and important resource remains available (Photo 34). A few breeding species were recorded flying across the Detroit River west to Grosse Ile, suggesting a shortage of some nesting resources on the island.

Breeding habitat on Sugar Island for bird species that prefer to nest on or near the ground is currently limited due to the density of invasive shrubby species. Removal of these plants, and replacement with a more varied native flora including spring ephemeral wildflowers, could improve the cover available for more breeding species.

Sugar Island supports several ephemeral wetlands within the interior habitats (Photo 35). These seasonally inundated wetlands are typical to wet-mesic flatwood communities, may or may not hold water year around, and are particularly sensitive to disturbance. This natural community type on Sugar Island appears to support healthy populations of important food sources for birds within the study area. Many spring migrant songbirds along shorelines depend on the hatch of midges (order Diptera, family Chironomidae), which provides them with the resources to gain weight (and fat) to continue migrating. These hatches typically occur during May, and during the two surveys on Sugar Island in that month, midges were abundant. Midges depend on clean water to live and reproduce, and for this the standing water on Sugar Island might be as important as the adjacent Detroit River. Drain tiles are present on the eastern border of Sugar Island and appear to be transporting a significant amount of water from the interior habitats. Removing these structures would likely help to maintain standing water within forested habitat and protect this critical habitat.

During autumn migration surveys, several migrant insectivores were detected between August and September; however, fewer frugivores were recorded in October than expected. The more prolonged autumn migration begins mainly in early August, with strict insectivores departing earliest. Later, species that transition from being summer insectivores to winter frugivores (mainly in the tropics) pass through during September and early October and will utilize fruit resources where they are available. Later migrants that pass through during October and early November are dependent on fruit resources as well as seeds and grains, with the exception of kinglets (*Regulus* sp.) and Brown Creepers (*Certhia americana*), which are year-round insectivores.

The majority of the understory in the interior of Sugar Island is privet, and its fruit was abundant beginning in mid-September with ripe berries observed by early October (Photo 36). Preliminary observations indicate that migrants do not use Privet much during autumn migration, perhaps because they ripen too late in the season. This fruit is likely utilized mainly by winter resident and permanent resident species. Massive removal of privet is encouraged and is not likely to have a significant negative effect on autumn migrant songbirds on Sugar Island.

Honeysuckle was noted as another dominant invasive species on Sugar Island in 2018 (Photo 37). Unlike Privet, the massive removal of honeysuckle from the island may have significant impacts on the abundance of migrant bird species. At other Detroit River locations (e.g., Belle Isle), large scale removal of honeysuckle without the prompt replacement with native fruit sources has significantly reduced the number of some autumn migrant and winter resident songbirds there. There was very little honeysuckle in fruit on Sugar Island, confined mainly to the northwestern and northeastern shorelines. Honeysuckles in the north-central part of the island did not appear to fruit this autumn. Native sources of fruit appeared to be limited to scattered dogwood (*Cornus* sp.) around the island, and Poison-Ivy (*Toxicodendron radicans*) and grapevines (*Vitis* sp.), which were scattered all over the island and were observed being consumed by migrant birds. A few prickly vines (*Rubus* sp.) were also on the island, but none were observed in fruit. Encouraging native fruit sources on Sugar Island will benefit autumn migrant songbirds.

Conclusion

The Detroit River represents a vital migratory corridor for hundreds of bird species that rely on its numerous islands to rest and forage in order to successfully complete their journey. Avian surveys conducted on Sugar Island in 2018 resulted in the documentation of 141 bird species, which likely represents only a portion of the total species richness supported at this site. Included in the total count were five Special Concern and five Threatened species. Evidence of breeding activity was recorded for 43 different species and opportunities identified that may improve breeding conditions included maintaining dead snags and removal of invasive shrubs. In addition to invasive species removal, supplementing Sugar Island with native fruit bearing vegetation is recommended in order to maintain adequate food sources for migrant birds. The restoration of Sugar Island will be a valuable step toward the removal of the loss of fish and wildlife habitat BUI and help ultimately delist the Detroit River as an Area of Concern.

Tables

Table 1. Birds observed on Sugar Island during 2018surveys including locations and breeding status. (Breeding status codes and descriptions provided below)

Species	**On Island**	**Flyover**	**In River**	**Spring**	**Summer**	**Autumn**	**Breeding Status**
Canada Goose *Branta canadensis*	x	x	x	x	x	x	CO-FL
Mute Swan *Cygnus olor*			x	x	x	x	
Wood Duck *Aix sponsa*	x		x	x	x		PO-P
Mallard *Anas platyrhynchos*	x		x	x	x	x	CO-FL
Canvasback *Aythya valisineria*			x	x			
Greater Scaup *Aythya marila*			x	x			
Lesser Scaup *Aythya affinis*			x	x			
White-winged Scoter *Melanitta fusca*			x	x			
Bufflehead *Bucephala albeola*			x	x			
Common Goldeneye *Bucephala clangula*			x	x			
Hooded Merganser *Lophodytes cucullatus*			x	x			
Common Merganser *Mergus merganser*			x	x			
Red-breasted Merganser *Mergus serrator*			x	x			

Table 1. (cont.)

Species	**On Island**	**Flyover**	**In River**	**Spring**	**Summer**	**Autumn**	**Breeding Status**
Ruddy Duck *Oxyura jamaicensis*			x	x			
Wild Turkey *Meleagris gallopavo*	x			x	x	x	PO-X
Common Loon *Gavia immer*			x	x			
Horned Grebe *Podiceps auritus*			x	x			
Double-crested Cormorant *Phalacrocorax auritus*	x	x	x	x	x	x	
Great Blue Heron *Ardea herodias*	x	x		x	x	x	
Great Egret *Ardea alba*		x			x	x	
Black-crowned Night-Heron *Nycticorax nycticorax*		x				x	
Turkey Vulture *Cathartes aura*		x		x		x	
Osprey *Pandion haliaetus*		x		x		x	
Bald Eagle *Haliaeetus leucocephalus*	x	x		x		x	
Sharp-shinned Hawk *Accipiter striatus*	x	x				x	
Cooper's Hawk *Accipiter cooperii*		x				x	
Broad-winged Hawk *Buteo platypterus*	x	x				x	

Table 1. (cont.)

Species	**On Island**	**Flyover**	**In River**	**Spring**	**Summer**	**Autumn**	**Breeding Status**
Red-tailed Hawk *Buteo jamaicensis*		x				x	
Merlin *Falco columbarius*	x					x	
Killdeer *Charadrius vociferus*		x		x	x	x	
Spotted Sandpiper *Actitis macularius*	x			x	x	x	PR-P
Whimbrel *Numenius phaeopus*		x		x			
Bonaparte's Gull *Chroicocephalus philadelphia*			x	x		x	
Ring-billed Gull *Larus delawarensis*		x	x	x	x	x	
Herring Gull *Larus argentatus*		x	x	x	x	x	
Caspian Tern *Hydroprogne caspia*		x	x	x	x	x	
Common Tern *Sterna hirundo*		x	x	x	x	x	
Forster's Tern *Sterna forsteri*		x	x	x	x	x	
Rock Pigeon *Columba livia*		x		x			
Mourning Dove *Zenaida macroura*	x	x		x	x	x	PO-#
Eastern Screech-Owl *Megascops asio*	x			x			PO-X
Great Horned Owl *Bubo virginianus*	x			x			CO-NY

Table 1. (cont.)

Species	**On Island**	**Flyover**	**In River**	**Spring**	**Summer**	**Autumn**	**Breeding Status**
Chimney Swift *Chaetura pelagica*		x		x	x	x	
Ruby-throated Hummingbird *Archilochus colubris*	x					x	
Belted Kingfisher *Megaceryle alcyon*	x	x		x	x	x	PO-X
Red-headed Woodpecker *Melanerpes erythrocephalus*	x			x			
Red-bellied Woodpecker *Melanerpes carolinus*	x			x	x	x	PR-C
Yellow-bellied Sapsucker *Sphyrapicus varius*	x			x			
Downy Woodpecker *Picoides pubescens*	x			x	x	x	CO-FY
Hairy Woodpecker *Picoides villosus*	x			x	x	x	PR-P
Northern Flicker *Colaptes auratus*	x			x	x	x	CO-FL
Eastern Wood-Pewee *Contopus virens*	x			x	x	x	CO-FY
Yellow-bellied Flycatcher *Empidonax flaviventris*	x					x	
Willow Flycatcher *Empidonax traillii*	x			x			
Least Flycatcher *Empidonax minimus*	x			x		x	
Eastern Phoebe *Sayornis phoebe*	x			x			

Table 1. (cont.)

Species	**On Island**	**Flyover**	**In River**	**Spring**	**Summer**	**Autumn**	**Breeding Status**
Great Crested Flycatcher *Myiarchus crinitus*	x			x	x		PR-S
Eastern Kingbird *Tyrannus tyrannus*	x			x	x	x	CO-FY
Blue-headed Vireo *Vireo solitarius*	x					x	
Warbling Vireo *Vireo gilvus*	x			x	x	x	PR-S
Philadelphia Vireo *Vireo philadelphicus*	x					x	
Red-eyed Vireo *Vireo olivaceus*	x			x	x	x	PR-S
Blue Jay *Cyanocitta cristata*	x	x		x	x	x	CO-FY
American Crow *Corvus brachyrhynchos*		x				x	
Horned Lark *Eremophila alpestris*		x				x	
Purple Martin *Progne subis*		x		x	x	x	
Tree Swallow *Tachycineta bicolor*	x	x	x	x	x	x	CO-NB
N. Rough-winged Swallow *Stelgidopteryx serripennis*	x	x	x	x	x	x	PR-N
Bank Swallow *Riparia riparia*		x	x	x	x	x	
Cliff Swallow *Petrochelidon pyrrhonota*	x	x		x		x	
Barn Swallow *Hirundo rustica*	x	x	x	x	x	x	

Table 1. (cont.)

Species	**On Island**	**Flyover**	**In River**	**Spring**	**Summer**	**Autumn**	**Breeding Status**
Black-capped Chickadee *Poecile atricapillus*	x			x	x	x	CO-FY
Tufted Titmouse *Baeolophus bicolor*	x			x	x	x	CO-FY
Red-breasted Nuthatch *Sitta canadensis*	x					x	
White-breasted Nuthatch *Sitta carolinensis*	x			x	x	x	PR-T
Brown Creeper *Certhia americana*	x			x		x	
Carolina Wren *Thryothorus ludovicianus*	x			x	x	x	CO-FY
House Wren *Troglodytes aedon*	x			x	x	x	CO-FY
Winter Wren *Troglodytes hiemalis*	x			x		x	
Blue-gray Gnatcatcher *Polioptila caerulea*	x			x	x		PR-S
Golden-crowned Kinglet *Regulus satrapa*	x			x		x	
Ruby-crowned Kinglet *Regulus calendula*	x			x		x	
Veery *Catharus fuscescens*	x					x	
Gray-cheeked Thrush *Catharus minimus*	x			x		x	
Swainson's Thrush *Catharus ustulatus*	x			x		x	
Hermit Thrush *Catharus guttatus*	x			x		x	

Table 1. (cont.)

Species	**On Island**	**Flyover**	**In River**	**Spring**	**Summer**	**Autumn**	**Breeding Status**
Wood Thrush *Hylocichla mustelina*	x			x		x	
American Robin *Turdus migratorius*	x	x		x	x	x	CO-FY
Gray Catbird *Dumetella carolinensis*	x			x	x	x	PR-S
European Starling *Sturnus vulgaris*	x	x		x	x	x	CO-FY
American Pipit *Anthus rubescens*		x				x	
Cedar Waxwing *Bombycilla cedrorum*	x	x		x	x	x	CO-FY
Lapland Longspur *Calcarius lapponicus*		x				x	
Ovenbird *Seiurus aurocapilla*	x			x	x	x	PR-S
Northern Waterthrush *Parkesia noveboracensis*	x					x	
Golden-winged Warbler *Vermivora chrysoptera*	x			x			
Black-and-white Warbler *Mniotilta varia*	x			x			
Tennessee Warbler *Oreothlypis peregrina*	x			x		x	
Orange-crowned Warbler *Oreothlypis celata*	x					x	
Nashville Warbler *Oreothlypis ruficapilla*	x			x		x	
Connecticut Warbler *Oporornis agilis*	x					x	

Table 1. (cont.)

Species	**On Island**	**Flyover**	**In River**	**Spring**	**Summer**	**Autumn**	**Breeding Status**
Mourning Warbler *Geothlypis philadelphia*	x			x			
Common Yellowthroat *Geothlypis trichas*	x			x		x	
American Redstart *Setophaga ruticilla*	x			x		x	
Cape May Warbler *Setophaga tigrina*	x			x		x	
Northern Parula *Setophaga americana*	x			x		x	
Magnolia Warbler *Setophaga magnolia*	x			x		x	
Bay-breasted Warbler *Setophaga castanea*	x			x		x	
Yellow Warbler *Setophaga petechia*	x			x	x	x	CO-FY
Chestnut-sided Warbler *Setophaga pensylvanica*	x			x		x	
Blackpoll Warbler *Setophaga striata*	x			x		x	
Black-throated Blue Warbler *Setophaga caerulescens*	x					x	
Palm Warbler *Setophaga palmarum*	x					x	
Pine Warbler *Setophaga pinus*	x					x	
Yellow-rumped Warbler *Setophaga coronata*	x	x		x		x	
Black-throated Green Warbler *Setophaga virens*	x			x		x	

Table 1. (cont.)

Species	**On Island**	**Flyover**	**In River**	**Spring**	**Summer**	**Autumn**	**Breeding Status**
Wilson’s Warbler *Cardellina pusilla*	x			x		x	
Canada Warbler *Cardellina canadensis*	x			x			
American Tree Sparrow *Spizelloides arborea*	x			x			
Fox Sparrow *Passerella iliaca*	x			x			
Song Sparrow *Melospiza melodia*	x			x	x	x	CO-FY
Lincoln’s Sparrow *Melospiza lincolnii*	x					x	
White-throated Sparrow *Zonotrichia albicollis*	x			x		x	
White-crowned Sparrow *Zonotrichia leucophrys*	x					x	
Dark-eyed Junco *Junco hyemalis*	x			x		x	
Scarlet Tanager *Piranga olivacea*	x					x	
Northern Cardinal *Cardinalis cardinalis*	x			x	x	x	CO-FL
Rose-breasted Grosbeak *Pheucticus ludovicianus*	x			x		x	
Indigo Bunting *Passerina cyanea*	x			x			
Red-winged Blackbird *Agelaius phoeniceus*	x	x		x	x	x	CO-FY
Rusty Blackbird *Euphagus carolinus*	x			x		x	

Table 1. (cont.)

Species	**On Island**	**Flyover**	**In River**	**Spring**	**Summer**	**Autumn**	**Breeding Status**
Common Grackle *Quiscalus quiscula*	x	x		x	x	x	CO-FY
Brown-headed Cowbird *Molothrus ater*	x			x	x	x	PR-C
Orchard Oriole *Icterus spurius*	x			x	x		PR-S
Baltimore Oriole *Icterus galbula*	x			x	x	x	CO-FY
Purple Finch *Haemorhous purpureus*		x				x	
House Finch *Haemorhous mexicanus*	x	x		x	x	x	PR-P
Pine Siskin *Spinus pinus*		x				x	
American Goldfinch *Spinus tristis*	x	x		x	x	x	PR-P
House Sparrow *Passer domesticus*	x			x	x	x	PO-#

Breeding Status Code Descriptions

PO:Possible
# = Species observed in suitable nesting habitat during its breeding season.
X = singing male present in suitable nesting habitat during its breeding season

PR: Probable
S = Singing male present at same location on at least two dates at least 7 days apart, or multiple (5 or more) singing males on the same date during the breeding season.
P = Pair observed in suitable nesting habitat during breeding season.
T = Territorial behavioral (chasing individuals of the same species)
C = Courtship behavior or copulation
N = Visiting probable nest site
A = Agitated behavior or anxiety calls from adult
B = Nest building by wrens or excavation of holes by woodpeckers,

CO:Confirmed
NB = Nest building by all except woodpeckers and wrens.
PE = Physiological evidence of breeding or brooding based on bird in-hand.
DD = Distraction display or injury feigning
UN = Unused nest or eggshells found
FL = Recently fledged young (of altricial species) incapable of sustained flight, or downy young (of precocial species) restricted to the natal area by dependence on adults or limited mobility.
ON = Occupied nest - adults entering or leaving nest site in circumstances indicating occupied nest (includes high nests or nest-holes, the contents of which cannot be seen) or adult incubating or brooding.
FY = Adult(s) with food for young (carrying food) or feeding young
FS = Adult carrying fecal sac.
NE = Nest with eggs.
NY = Nest with young seen or heard.

Photos

Photo 1. Wet-mesic flatwoods habitat within Sugar Island.

Photo 2. Forested wetland habitat on Sugar Island.

Photo 3. Pocket of ephemeral forested wetland habitat on Sugar Island.

Photo 4. Open grassland habitat on the south eastern side of Sugar Island.

Photo 5. Sandy shoreline with coastal marsh vegetation on the eastern side of Sugar Island.

Photo 6. Severe erosion on the southern end of Sugar Island.

Photo 7. Numerous trees eroding off the southeastern side of Sugar Island.

Photo 8. Red-breasted Merganser pair observed in the Detroit River.

Photo 9. Wild Turkey observed perched in a tree on Sugar Island.

Photo 10. Common Loon recorded from the Detroit River during spring migration surveys.

Photo 11. Horned Grebe observed in the Detroit River.

Photo 12. Double-crested Cormorant observed flying over Sugar Island.

Photo 13. Bald Eagle observed flying over Sugar Island.

Photo 14. Cooper's Hawk recorded during autumn migration surveys.

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Photo 15. Merlin observed perched on Sugar Island.

Photo 16. Spotted Sandpiper recorded flying along the west beach where they were observed throughout the summer.

Photo 17. Common Tern observed flying over the Detroit River adjacent to Sugar Island. (there is a nesting colony on the northwestern side of Grosse Ile).

Photo 18. Great Horned Owl nest observed on Sugar Island during spring migration surveys.

Photo 19. Evidence of Woodpecker breeding activity observed on Sugar Island.

Photo 20. Yellow-bellied Sapsucker observed on Sugar Island during spring

2018 assessments.

Photo 21. Eastern Kingbird observed on Sugar Island.

Photo 22. Warbling Vireo observed foraging insects on Sugar Island.

Photo 23. Philadelphia Vireo recorded on Sugar Island in 2018.

Photo 24. Blue Jay observed flying over Sugar Island during 2018 assessments.

Photo 25. Barn Swallow observed resting on the shoreline of Sugar Island in 2018.

Photo 26. Tree Swallow recorded at a nest during 2018 assessments on Sugar Island.

Photo 27. Tufted Titmouse recorded in forested habitat on Sugar Island.

Photo 28. Golden-crowned Kinglet observed on Sugar Island.

Photo 29. Carolina Wren observed singing on Sugar Island in 2018.

Photo 30. American Robin observed on a nest during 2018 assessments on Sugar Island.

Photo 31. Black and White Warbler observed foraging for insects on tree bark in forested habitat on Sugar Island.

Photo 32. Yellow-rumped Warbler observed feeding on Poison-Ivy berries in fall migration.

Photo 33. Baltimore Oriole observed in forested habitat on Sugar Island.

Photo 34. Ephemeral wetland community on Sugar Island that provides habitat to important bird prey sources including midges.

Photo 35. Privet berries were abundant on Sugar Island but do not appear to be heavily foraged on by migratory bird species.

Photo 36. Honeysuckle berries provide important food source to migratory birds on Sugar Island and should be replaced with native fruit bearing shrubs if removed from the landscape.

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APPENDIX G

ITEMIZED OPINION OF PROBABLE CONSTRUCTION COSTS

SUGAR ISLAND HABITAT RESTORATION - DETROIT RIVER AREA OF CONCERN

SMITHGROUP

Wayne County, Michigan

OPINION OF PROBABLE CONSTRUCTION COST - FEASIBILITY STUDY

SGJJR PROJ. NO.: 10626.000
11-Dec-18

SOUTH SHORELINE & AQUATIC HABITAT RESTORATION

Item Description	Comments	Units	Unit Price	Qty. Subtotal	Cost Subtotal
GENERAL					
Construction Staking/Record Drawings	Contractor to self perform	Day	$1,200.00	12	$14,400.00
Permitting	SESC, Obtained by Contractor	LS	$5,000.00	1	$5,000.00
Mobilization, Max. _	4% of Construction	LS	$268,432.00	1	$268,432.00
					$287,832.00
SITE PREPARATION, EROSION CONTROL AND DEMOLITION					
Stage Large Woody Debris	Includes cutting potential hazards	Day	$2,200.00	7	$15,400.00
Turbidity Curtain	Reuse as work progresses	Ft	$15.00	1,000	$15,000.00
Silt Fence		Ft	$3.00	2,200	$6,600.00
					$37,000.00
MATERIAL PLACEMENT, EARTHWORK, & HABITAT STRUCTURES					
Earthwork, Cut and Fill	All spoils to be re-used on site	Cyd	$25.00	31,000	$775,000.00
Shape Shoreline Eroded Slope for Shoreline Stabiliation	General grading and shaping along shoreline	LS	$100,000.00	1	$100,000.00
Topsoil- Off-Site, 5.60 acres (could be site subsoil amended)	6" deep for breakwater structures and shoreline	Cyd	$25.00	4,600	$115,000.00
Brekawater Structures: Armor Stone	1,500 - 2,500 lbs stones, 3'thick	Ton	$100.00	21,000	$2,100,000.00
Breakwater Structures: Core Stone	100 - 300 lbs stones	Ton	$90.00	26,000	$2,340,000.00
Shoreline Stabilization (Heavy Riprap)	2' thick	Ton	$60.00	7,000	$420,000.00
Submerged Rock Ledge (Heavy Riprap)	Continuous along mud flat perimeter	Ton	$60.00	2,500	$150,000.00
Rock Spawning Reef: 4"-8" Limestone, Deep Water - 2 Locations	Placed 18" deep	Ton	$60.00	2,400	$144,000.00
Peastone, Aggregate, Warm Water Spawning - 5 locations	Placed 12" layer, 75' x 50' Each	Cyd	$60.00	700	$42,000.00
Submerged Spawning Structures	Anchored Brrush Piles	EA	$3,000.00	12	$36,000.00
Turtle Nesting Mounds and Ramps - 2 locations	Placed 18" deep - Off-site	Cyd	$50.00	200	$10,000.00
Rock Mound, 4" - 8" dia riprap	20' dia base x 8' high mounds (125 tons each)	EA	$8,000.00	3	$24,000.00
Hibernacula	Incl. underdrain, stone, excavation, backfilll	EA	$12,000.00	2	$24,000.00
Mudpuppy Structures	Flat stone or concrete debris	EA	$2,000.00	15	$30,000.00
Basking Logs	Individual trees or logs	EA	$700.00	35	$24,500.00
Large Woody Debris Structures	Set onto grade	EA	$2,500.00	20	$50,000.00
Non-woven Geotextile Fabric	Under all stone placement	SY	$4.00	35,000	$140,000.00
					$6,524,500.00
LANDSCAPING					
Native Seed Mix	Hand broadcast	acre	$3,500.00	5.6	$19,600.00
Mud Flat Plantings, 2.3 acres- Plugs/Root Stock	Planted 24 in. O.C. over 50% of area	Ea	$4.00	15,000	$60,000.00
Tree Plantings: 3 Acres, Islands and 50% shoreline above riprap	14" - 1/2" caliper, 200 trees/acre	Ea	$20.00	600	$12,000.00
Straw-Coconut, Erosion Control Blanket, Bio-degradable	Shoreline and upland areas	SY	$2.00	8,000	$16,000.00
Double Coconut, Erosion Control Blanket, Bio-degradable	Wavebreaks	SY	$2.90	9,000	$26,100.00
Maintenance + Warranty, First Season	1 year, Watering, Cultivating, Invasives ±17% plants	LS	$15,600.00	1	$15,600.00
					$149,300.00

$279,945.28

Notes / Assumptions:

1 Costs are based on 2018 dollars without escalation to future years unless otherwise noted.

2 The construction costs are based upon the preferred design of the Feasibility Study and as such reflects the current level of design detail and the estimate reflects a general magnitude of cost.

3 The estimate includes construction costs only and does not include the entire project costs for such items as construction observations, review/permitting, testing, general administration costs, and design/engineering fees.

4 The removal of contaminated/hazardous soils and materials, underground obstructions, and other unknown conditions may exist within the project limits and as such are not included.

Const. Sub-total	**$6,998,632**
15% Contingency	$1,049,795
ESTIMATED TOTAL CONSTRUCTION COST	**$8,048,427**

ISLAND UPLAND HABITAT RESTORATION

Item Description	Comments	Units	Unit Price	Qty. Subtotal	Cost Subtotal
GENERAL					
Construction Staking/Record Drawings	Contractor to self perform	Day	$1,200.00	4	$4,800.00
Permitting	SESC, Obtained by Contractor	LS	$5,000.00	1	$5,000.00
Mobilization, Max. _	4% of Construction	LS	$70,782.00	1	$70,782.00
					$80,582.00
SITE PREPARATION, EROSION CONTROL AND DEMOLITION					
Break Drain Tiles and Remove		LFt	$5.00	5,000	$25,000.00
Remove All Concrete Rubble, Debris and Miscelaneous Structures and Foundations	Off-site disposal	LS	$200,000.00	1	$200,000.00
Silt Fence		Ft	$3.00	5,500	$16,500.00
					$241,500.00
MATERIAL PLACEMENT, EARTHWORK, & HABITAT STRUCTURES					
Vernal Pools (6 total)	average size: 10,000 SF				
Earthwork	3-4' deep	Cyd	$20.00	5,400	$108,000.00
Woody Debris	Logs and trees 15 /pool	EA	$25.00	90	$2,250.00
Native Seeding	Buffer and Pool	Acre	$4,000.00	6	$24,000.00
Hibernacula	Incl. underdrain, stone, excavation, backflill	EA	$12,000.00	3	$36,000.00
Invasive Species Eradication and Understory Plantings	30 Acres, - 3-Year Eradication Program				
Year 1: 10 Acres					
Eradication - Mechanical	1/3 of Island	Acre	$15,000.00	10	$150,000.00
Eradication - Herbicide	same area as mechanical	Acre	$10,000.00	10	$100,000.00
Plantings - Understory	400 shrubs/understory trees/acre	EA	$25.00	4,000	$100,000.00
Seeding		Acre	$4,000.00	3	$12,000.00
Maintenance/Warranty		Acre	$5,000.00	10	$50,000.00
Year 2: 10 Acres					
Eradication - Mechanical	1/3 of Island	Acre	$16,000.00	10	$160,000.00
Eradication - Herbicide	same area as mechanical	Acre	$11,000.00	10	$110,000.00
Plantings - Understory	400 shrubs/understory trees/acre	EA	$30.00	4,000	$120,000.00
Seeding		Acre	$4,200.00	3	$12,600.00
Maintenance/Warranty		Acre	$4,000.00	10	$40,000.00
Year 2: 10 Acres					
Eradication - Mechanical	1/3 of Island	Acre	$17,000.00	10	$170,000.00
Eradication - Herbicide	same area as mechanical	Acre	$12,000.00	10	$120,000.00
Plantings - Understory	400 shrubs/understory trees/acre	EA	$35.00	4,000	$140,000.00
Seeding		Acre	$4,400.00	3	$13,200.00
Maintenance/Warranty		Acre	$6,000.00	10	$60,000.00
					$1,528,050.00

Const. Sub-total	**$1,850,132**
15% Contingency	$277,520
ESTIMATED TOTAL CONSTRUCTION COST	**$2,127,652**

Notes / Assumptions:

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APPENDIX H

CONCEPTUAL DRAWINGS

ACCORDING TO THE US ARMY CORPS OF ENGINEERS, THE FOLLOWING WATER DATUMS/ELEVATIONS APPLY FOR THE DETROIT RIVER AT GIBRALTAR, MICHIGAN:

DATUM/ELEVATION	IGLD 1985	NAVD 1988
LOW-WATER DATUM (LWD)	569.4 FT.	569.67 FT.
ORDINARY HIGH-WATER MARK (OHWM)	573.5 FT.	573.77 FT.

ILLUSTRATION SHOWN USING NAVD 1988 DATUM
SOURCE:
https://www.lre.usace.army.mil/Missions/Great-Lakes-Information/Links/Ordinary-High-Water-Mark-and-Low-Water-Datum

(SEE CONVERSION IN NOTE 2 ABOVE FOR NAVD 1988 INFORMATION)

SUGAR ISLAND HABITAT RESTORATION

DETROIT RIVER AREA OF CONCERN
WAYNE COUNTY, MICHIGAN (42.0898˚ N, 83.1436˚ W)

JANUARY 11, 2019
PN: 10626.000

SMITHGROUP

LimnoTech

SUGAR ISLAND HABITAT RESTORATION

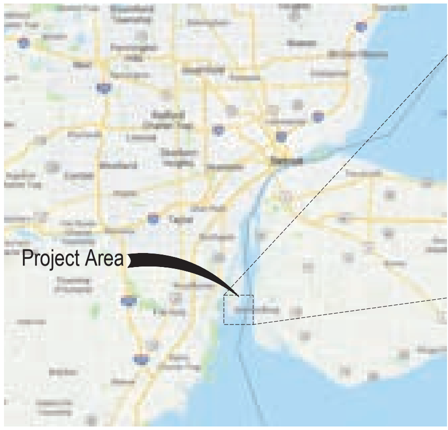
GROSSE ILE TOWNSHIP, WAYNE COUNTY, MICHIGAN

CONCEPT DESIGN

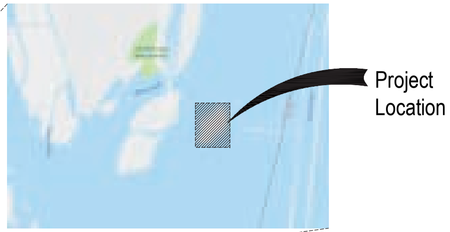
January 11, 2019

SmithGroup Project Number: 10626

DRAWING INDEX	
SHEET INDEX	SHEET TITLE
COVER	COVER SHEET
CV-100	TOPOGRAPHIC SURVEY
CS-100	CONCEPTUAL PLAN RESTORATION



PROJECT VICINITY MAP
NOT TO SCALE



PROJECT LOCATION MAP
NOT TO SCALE

Prepared for:

20600 EUREKA ROAD, SUITE 250
TAYLOR, MI 48180

Prepared by:

SMITHGROUP

201 DEPOT STREET
SECOND FLOOR
ANN ARBOR, MI 48104
734.662.4457
www.smithgroup.com

Design Team:

HERPTELOGICAL RESOURCE & MANAGEMENT
P.O. BOX 110
CHELSEA, MI 48118
517.522.3524

LIMNOTECH
BATHYMETRIC SURVEYING
501 AVIS DRIVE, #1
ANN ARBOR, MI 48108
734.332.1200

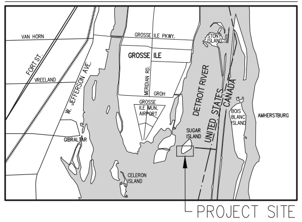
Project Partners:

TOPOGRAPHIC SURVEY

OF SHORELINE OF SOUTHERN PORTION OF SUGAR ISLAND, IN THE
DETROIT RIVER, GROSSE ILE TOWNSHIP, WAYNE COUNTY, MICHIGAN

VICINITY SKETCH -
GROSSE ILE TOWNSHIP, MICHIGAN

NTS



BENCHMARK

SITE BENCHMARK
CUT "X" IN TOP NORTHWEST CORNER OF CONCRETE STEP.

NORTHING = 217,941.79
EASTING = 13,454,802.69
ELEVATION = 587.00 FEET (NAVD88)

CONTROL POINT TABLE

Point No.	Northing	Easting	Elevation	Description
202	217625.46	13454678.46	580.31	CP SGJJR CAP REBAR
208	217348.68	13454647.67	578.56	CP SGJJR CAP REBAR
222	217533.00	13455429.40	586.84	CP SGJJR CAP REBAR
226	217755.47	13455629.83	584.65	CP SGJJR CAP REBAR

NOTES

1. HORIZONTAL DATUM IS ACCORDING TO MICHIGAN STATE PLANE GRID COORDINATES, SOUTH ZONE (2113), GEOID 2012A, INTERNATIONAL FEET AS LINEAR UNIT OF MEASURE.
2. VERTICAL DATUM IS ACCORDING TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), WITH BENCHMARKS LISTED HEREON. TO CONVERT FROM NAVD88 TO INTERNATIONAL GREAT LAKES DATUM OF 1985 (IGLD85) USE THE FOLLOWING CONVERSION:

   NAVD88 – 0.27 FEET = IGLD85
3. SMITHGROUPJJR PERFORMED A TOPOGRAPHIC SURVEY UTILIZING DATA COLLECTED WITH GLOBAL POSITIONING RECEIVERS REFERENCING THE MICHIGAN CONTINUOUSLY OPERATING REFERENCE NETWORK FOR SITE CONTROL. ELECTRONIC TOTAL STATIONS WERE ALSO USED FOR SURVEY DATA COLLECTION.
4. LIMNOTECH PERFORMED A BATHYMETRIC SURVEY ON MAY 16, 2018. EQUIPMENT UTILIZED INCLUDED A RESON NAVISOUND 110 ECHOSOUNDER WITH 200 KHZ TRANSDUCER, TRIMBLE DGPS AGGPS 132 (SUBMETER) FOR POSITIONING AND HONEYWELL HMR 3000 MOTION REFERENCE UNIT. CONTOURS PROVIDED FROM LIMNOTECH WERE MERGED WITH SMITHGROUPJJR UPLAND SURVEY IN PREPARATION OF THIS COMBINED SURVEY.
5. THIS SURVEY DOES NOT CONSTITUTE A TITLE SEARCH BY THE SURVEYOR. ALL INFORMATION REGARDING LAND BOUNDARY, EASEMENTS, RIGHTS–OF–WAY, AND OTHER INFORMATION THAT MAY AFFECT TITLE WAS GAINED FROM AVAILABLE TAX RECORDS AND/OR RECORDED LEGAL DOCUMENTS FOR ADJOINING PARCELS
6. MISS–DIG DESIGN TICKET B081791810 WAS ISSUED FOR THIS PROJECT. AS OF THE DATE OF THIS SURVEY, THE FOLLOWING ENTITIES WERE LISTED AS POSSIBLE UTILITY OWNERS AND MAPS HAVE BEEN REQUESTED ACCORDINGLY:
   - AT&T (TELECOM) – [RESPONSE CONCLUDED 'NO UTILITIES IN WORK AREA']
   - DETROIT EDISON (ELECTRIC) – [MAP RECEIVED]
   - CHARTER COMMUNICATIONS (TELECOM) – [NO RESPONSE]
7. UNDERGROUND UTILITY LOCATIONS WERE DERIVED FROM ACTUAL MEASUREMENTS ON VISIBLE UTILITIES, MISS DIG FLAGS/MARKINGS, AND/OR AVAILABLE RECORDS. THEY SHOULD NOT BE INTERPRETED TO BE EXACT LOCATIONS, NOR SHOULD THEY IT BE ASSUMED THAT THEY ARE THE ONLY UNDERGROUND UTILITIES IN THE AREA.
8. SUBSURFACE AND ENVIRONMENTAL CONDITIONS WERE NOT EXAMINED AND ARE NOT CONSIDERED A PART OF THIS SURVEY. NO STATEMENT IS MADE CONCERNING THE EXISTENCE OF UNDERGROUND OR OVERHEAD CONTAINERS OR FACILITIES THAT MAY AFFECT THE USE AND OR DEVELOPMENT OF THIS SITE.
9. ADDITIONAL SPOT ELEVATIONS MAY BE CONTAINED IN THE PROJECT DATABASE, AND ALTHOUGH NOT APPEARING IN THE RECORD PLAN DOCUMENT DUE TO SCALE AND VISIBILITY, WERE UTILIZED IN THE DIGITAL TERRAIN MODEL FOR CREATION OF THE ONE–FOOT CONTOURS. THE ADDITIONAL SPOT ELEVATION DATA IS AVAILABLE FOR FUTURE DESIGN ANALYSIS, BEING LOCATED ON A FROZEN LAYER WITHIN THE PROJECT DATABASE.

FLOODPLAIN NOTE

PORTIONS OF THE SUGAR ISLAND SHORELINE LIE IN THE FOLLOWING FLOOD ZONES:

- SPECIAL FLOOD HAZARD AREA ZONE AE: AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD – BASE FLOOD ELEVATIONS DETERMINED.
  BASE FLOOD ELEVATION = 577.0 FEET (NAVD 1988 DATUM)
- OTHER FLOOD AREA ZONE X (SHADED): AREAS OF 0.2% ANNUAL CHANCE FLOOD.
  BASE FLOOD ELEVATION ELEVATION = 577.6 (NAVD 1988 DATUM)

FLOOD ZONES AND BASE FLOOD ELEVATIONS FOR THE DETROIT RIVER WERE DERIVED FROM FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOOD INSURANCE RATE MAP (FIRM) NO. 26163C, PANEL 535, FOR WAYNE COUNTY, MICHIGAN, EFFECTIVE DATE FEBRUARY 2, 2012 AND FEMA FLOOD INSURANCE STUDY FOR WAYNE COUNTY, MICHIGAN, VOLUMES 26163CV001A & 26161CV003A, EFFECTIVE DATE FEBRUARY 2, 2012.

THE ABOVE BASE FLOOD ELEVATIONS HAVE NOT BEEN PLOTTED ON THIS SURVEY DUE TO SCALE LIMITATIONS. UN–SURVEYED PORTIONS OF THE SUGAR ISLAND MAY LIE IN OTHER FLOOD ZONES.

ADDITIONAL WATER INFORMATION

ACCORDING TO THE US ARMY CORPS OF ENGINEERS, THE FOLLOWING WATER DATUMS/ELEVATIONS APPLY FOR THE DETROIT RIVER AT GIBRALTAR, MICHIGAN:

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SOURCE:
https://www.lre.usace.army.mil/Missions/Great–Lakes–Information/Links/Ordinary–High–Water–Mark–and–Low–Water–Datum/
(SEE CONVERSION IN NOTE 2 ABOVE FOR NAVD 1988 INFORMATION)

SURVEY LEGEND

BM A	BENCHMARK	⊙	TREE – DECIDUOUS
CP 1	CONTROL POINT		STORM PIPE (END OF PIPE UNKNOWN)
○ F	FOUND IRON BAR OR PIPE		SIGN
+ 700.00	SPOT ELEVATION	699	TOPOGRAPHIC CONTOUR
PT. DESC.	MISC. POINT		BRUSHLINE/WOODED LIMITS
	CENTERLINE OF SWALE		EDGE OF WATER

CERTIFICATE

THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH LOCAL AND STATE JURISDICTIONAL REQUIREMENTS REGULATING MAPPING STANDARDS. THE UNDERSIGNED STATES THAT PROPER FIELD PROCEDURES, INSTRUMENTATION AND ADEQUATE STAFF WERE EMPLOYED TO ACHIEVE THE RESULTS INDICATED HEREIN.

SMITHGROUPJJR, INC.

CHARLES A. LANGOLF, PS 56210
PROFESSIONAL SURVEYOR
STATE OF MICHIGAN
charles.langolf@smithgroupjjr.com

SUGAR ISLAND
HABITAT RESTORATION

DETROIT, MICHIGAN

Owner:
FRIENDS OF THE
DETROIT RIVER
20600 EUREKA ROAD, SUITE 250
TAYLOR, MI 48180

SMITHGROUPJJR

201 DEPOT STREET
SECOND FLOOR
ANN ARBOR, MI 48104
734.662.4457
www.smithgroupjjr.com

LIMNOTECH
BATHYMETRIC SURVEYING
501 AVIS DRIVE, #1
ANN ARBOR, MI 48108
734.332.1200

ISSUED FOR	REV	DATE
CLIENT ISSUE	0	7/17/2018
CLIENT ISSUE	1	7/19/2018

SEALS AND SIGNATURES

NOT FOR CONSTRUCTION

KEY PLAN

DRAWING TITLE
TOPOGRAPHIC SURVEY

NOT TO SCALE. REDUCED PAGE SIZE FOR REPORT.

1" = 60'
SCALE

10626
PROJECT NUMBER

CV-100
DRAWING NUMBER

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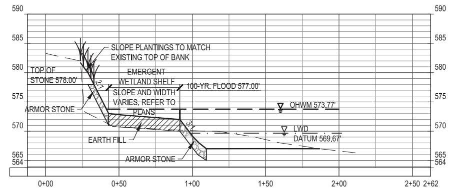
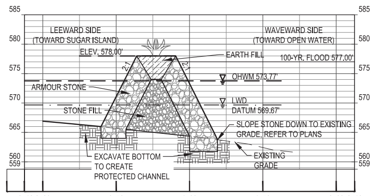


① CROSS SECTION A-A

HORIZ SCALE: 1" = 40'
VERT SCALE: 1" = 4'



② CROSS SECTION B-B

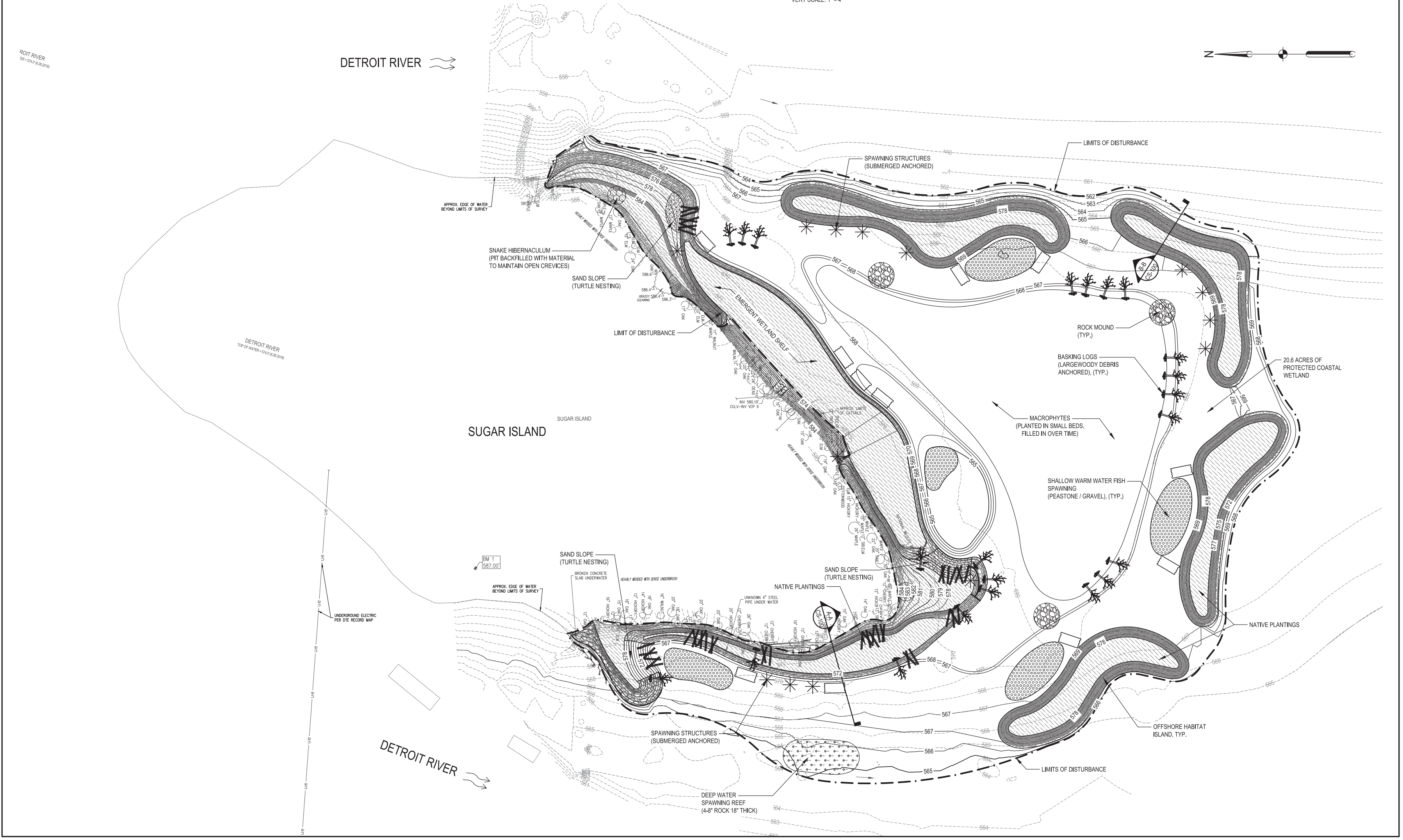
HORIZ SCALE: 1" = 40'
VERT SCALE: 1" = 4'

PROPOSED HABITAT RESTORATION VALUES
- 2,700 FT OF PROPOSED SHORELINE RESTORATION (AS MEASURED AT THE OHWM)
- 20.6 ACRES OF PROTECTED COASTAL WETLAND (AS MEASURED AT THE OHWM)

DATUM ELEVATIONS	
DATUM / ELEVATION	NAVD 1988
LOW WATER DATUM (LWD)	569.67 FT.
ORDINARY HIGH WATER MARK (OHWM)	573.77 FT.
100 - YEAR FLOODPLAIN	577.00 FT.

LEGEND

✳	SPAWNING STRUCTURES (SUBMERGED ANCHORS)
▨	NATIVE PLANTINGS
	BASKING LOGS (LARGE WOODY DEBRIS ANCHORED)
☐	MUD PUPPY STRUCTURE
— · —	LIMITS OF DISTURBANCE



SUGAR ISLAND
HABITAT RESTORATION

DETROIT, MICHIGAN

Owner:
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20600 EUREKA ROAD, SUITE 250
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201 DEPOT STREET
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ANN ARBOR, MI 48104
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www.smithgroup.com

ISSUED FOR	REV	DATE
PRELIMINARY DESIGN	1	1/11/2019

SEALS AND SIGNATURES

NOT FOR CONSTRUCTION

KEY PLAN

DRAWING TITLE
CONCEPTUAL PLAN
RESTORATION
NOT TO SCALE. REDUCED PAGE SIZE FOR REPORT.
0' 50' 100' 200'
SCALE: 1" = 100'

SCALE

PROJECT NUMBER
10626

DRAWING NUMBER
CS-100

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Design a Better Future

SMITHGROUP

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201 Depot Street
2nd Floor
Ann Arbor, MI 48104