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Via Electronic Filing

April 14, 2020

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

**Subject: Constantine Hydroelectric Project (FERC No. 10661)
Initial Study Report
Virtual Webex Meeting Scheduled for April 23, 2020**

Dear Secretary Bose:

Indiana Michigan Power Company (I&M), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the 1.2 megawatt Constantine Hydroelectric Project (Project) (FERC Project No. 10661). The Project is located along the St. Joseph River in St. Joseph County, Michigan.

I&M operates and maintains the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on September 30, 2023. I&M is pursuing a subsequent license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (CFR) Part 5.

I&M has conducted studies as provided in the March 15, 2019 Revised Study Plan (RSP) and approved in the Commission's April 9, 2019 Study Plan Determination (SPD) for the Project. In accordance with 18 CFR § 5.15, I&M is hereby filing the Initial Study Report (ISR) with the Commission. The ISR describes I&M's overall progress in implementing the study plan and schedule, summarizes available data, and describes any variances from the study plan and schedule approved by the Commission. Concurrent with this filing, the ISR is being made available to stakeholders on the Project's public relicensing website at www.aephydro.com/HydroPlant/Constantine.

The Commission's regulations at 18 C.F.R. § 5.15(c) require I&M to hold an ISR Meeting with participants and FERC staff within 15 days of filing the ISR. Accordingly, I&M will hold an ISR Meeting (via Webex) from 9 AM to 4 PM on April 23, 2020.

To allow for adequate planning, I&M respectfully requests that those planning on joining the ISR Webex Meeting RSVP by emailing Jon Magalski at jmmagalski@aep.com on or before close of business April 21, 2020.

Constantine Hydroelectric Project (FERC No. 10661)
Initial Study Report
April 14, 2020
Page 2 of 3

If there are any questions regarding this filing, please do not hesitate to contact me at (614) 716-2240 or jmmagalski@aep.com.

Sincerely,

A handwritten signature in black ink, reading "Jonathan M. Magalski". The signature is written in a cursive style with a large, stylized initial "J".

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Initial Study Report

Constantine Hydroelectric Project
(FERC No. 10661)

April 14, 2020

Prepared by:



Prepared for:



An **AEP** Company

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List of Acronyms

ADCP	Acoustic Doppler Current Profiler
AEP	American Electric Power Company
APE	Area of Potential Effects
BEHI	Bank Erosion Hazard Index
C.F.R.	Code of Federal Regulations
Commonwealth	Commonwealth Heritage Group
cm/s	centimeters per second
DLA	Draft License Application
DO	dissolved oxygen
ERL	Effect Range Low
ERM	Effect Range Median
FERC	Federal Energy Regulatory Commission (or Commission)
fps	feet per second
GIS	Geographic Information System
GPS	global positioning system
GLEC	Great Lakes Environmental Center, LLC
ILP	Integrated Licensing Process
I&M	Indiana Michigan Power Company
ISR	Initial Study Report
LRSS	Lower Reservoir
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NA	not applicable
NOI	Notice of Intent
NWI	National Wetland Inventory
PAD	Pre-Application Document
PEL	Probable Effect Level
Project	Constantine Hydroelectric Project
PSP	Proposed Study Plan
RSP	Revised Study Plan
SD1	Scoping Document 1
SD2	Scoping Document 2
SHPO	State Historic Preservation Office
SPD	Study Plan Determination
SQG	sediment quality guidelines
TEL	Threshold Effect Levels
YES	Young Energy Services

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1 Introduction and Background

1.1 Introduction

Indiana Michigan Power Company (I&M), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the 1.2-megawatt Constantine Hydroelectric Project (Project) (FERC No. 10661).

I&M operates and maintains the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on September 30, 2023. I&M is pursuing a subsequent license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (C.F.R.) Part 5.

In accordance with 18 C.F.R. § 5.15, I&M has initiated studies and information gathering activities as provided in the study plan and schedule approved by the Commission. This Initial Study Report (ISR) describes the Licensee's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule.

The Commission's regulations at 18 C.F.R. § 5.15(c) require I&M to hold a meeting with participants and FERC staff within 15 days of filing the ISR. Accordingly, **I&M will hold an ISR Meeting via Webex from 9 AM to 4 PM on April 23, 2020. An agenda for the ISR Meeting is presented in Error! Reference source not found. to this ISR.**

To allow for adequate planning, I&M respectfully requests that those planning on joining the ISR Webex Meeting RSVP by emailing Jon Magalski at jmmagalski@aep.com on or before close of business April 21, 2020.

1.2 Background

The Project is located along the St. Joseph River in St. Joseph County, Michigan. On June 4, 2018, I&M initiated the ILP by filing a Pre-Application Document (PAD) and Notice of Intent (NOI) with the Commission. Major ILP milestones to-date are presented in Table 1.2-1. Major ILP Milestones Completed.

Table 1.2-1 Major ILP Milestones Completed

Date	Milestone
06/04/2018	PAD and NOI Filed
07/25/2018	Scoping Document 1 (SD1) Issued by FERC
08/28-8/29/2018	FERC Agency and Public Scoping Meetings Conducted
08/28/2018	Project Site Visit Held
11/13/2018	Scoping Document 2 (SD2) Issued by FERC
11/16/2018	Proposed Study Plan (PSP) Filed
12/11/2018	PSP Meeting Conducted

Date	Milestone
03/15/2019	Revised Study Plan (RSP) Filed
04/09/2019	FERC Issued Study Plan Determination (SPD)
04/14/2020	Initial Study Report (ISR) Filed

I&M has continued consultation with stakeholders regarding approved studies as required by the Commission's SPD. In accordance with the schedule presented in the RSP, I&M has also provided stakeholders with Quarterly ILP Study Progress Reports that include a description of study activities conducted during the previous quarter, activities expected to occur in the next quarter, and identified variances from the approved study plan.¹

1.3 Study Plan Implementation

On April 9, 2019, the Commission issued a SPD for the Project. The SPD directed I&M to conduct 8 studies:

1. Botanical Resources Study
2. Shoreline Stability Assessment
3. Water Quality Study
4. Fisheries Survey
5. Mussel Survey
6. Wetlands Study
7. Recreation Study
8. Cultural Resources Study

I&M initiated the approved studies in accordance with the schedule and methods described in the RSP and SPD. Section 2 of this ISR describes I&M's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule.² All of the studies have been completed and technical study reports are attached as appendices to this ISR.

1.4 Proposals to Modify Ongoing Studies or for New Studies

At this time, I&M is not proposing any modifications to the studies approved in the Commission's April 9, 2019 SPD or any new studies. As described above, I&M will hold an ISR Meeting via Webex on April 23, 2020. I&M will file an ISR Meeting Summary with the Commission within 15 days of the ISR Meeting (on or before May 8, 2020).

¹ To date, Quarterly ILP Study Progress Reports were filed with the Commission and distributed to the Project's mailing list on July 9, 2019, October 9, 2019, January 9, 2020 and April 9, 2020.

² I&M notes that stakeholders have also previously been made aware of certain variances from the study plan and schedule in the Quarterly ILP Study Progress Reports.

After review of the ISR Meeting Summary, stakeholders may file disagreements with the meeting summary, request modifications to studies, or request new studies.

Disagreements with the ISR Meeting Summary and any requests to amend the study plan to include new or modified studies must be filed with the Commission no later than 30 days after the filing of the ISR Meeting Summary (on or before June 7, 2020). In requesting modifications to studies or new studies, stakeholders must take into account the following criteria:

- *Criteria for Modification of Approved Study (18 C.F.R. 5.15(d)).* Any proposal to modify a study must be accompanied by a showing of good cause why the proposal should be approved, and must include, as appropriate to the facts of the case, a demonstration that:
 - (1) Approved studies were not conducted as provided for in the approved study plan; or
 - (2) The study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way.
- *Criteria for New Study (18 C.F.R. 5.15(e)).* Any proposal for new information gathering or studies must be accompanied by a showing of good cause why the proposal should be approved, and must include, as appropriate to the facts of the case, a statement explaining:
 - (1) Any material changes in the law or regulations applicable to the information request;
 - (2) Why the goals and objectives of any approved study could not be met with the approved study methodology;
 - (3) Why the request was not made earlier;
 - (4) Significant changes in the project proposal or that significant new information material to the study objectives has become available; and
 - (5) Why the new study request satisfies the study criteria in 18 C.F.R. § 5.9(b).

I&M will have 30 days to respond to any disagreements or requests to amend the study plan (July 7, 2020). The Commission's Director of the Office of Energy Projects will resolve any disagreement and amend the approved study plan, as appropriate, within 30 days of the due date for I&M's response (no later than August 6, 2020).

2 Status and Summaries of Studies

This section describes I&M's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule. Study methods and available study results are summarized for each of the 8 studies approved in the Commission's SPD.

2.1 Botanical Resources Study

2.1.1 Study Status

I&M has completed the Botanical Resources Study in accordance with the RSP and the Commission's SPD. The technical report including the results of the Botanical Resources Study is included as Appendix B to this ISR.

2.1.2 Summary of Study Methods and Results

In accordance with the Commission's SPD, I&M conducted a Botanical Resources Study. Great Lakes Environmental Center, LLC (GLEC) led the Botanical Resources Study and performed desktop mapping of vegetation in the Project area using existing aerial imagery along with field surveys to document rare, threatened and endangered (RTE) and invasive plant species present in the Project study area.

The Project's FERC-approved Project boundary was surveyed and locations of RTE and invasive species were mapped and photographed. The approximate density and area of coverage was documented for observed invasive species. General observations were also noted regarding habitat and site conditions, including type, density, and quality. GLEC ground-truthed the information presented in the cover type base maps that were developed using existing aerial imagery. Cover type maps were updated as necessary based on field verification and the results of the RTE and invasive species field surveys. Additionally, GLEC searched for and documented the presence of any wild rice beds.

The botanical resources of the Constantine Project boundary were inventoried in August and September of 2019. Specific attention was given to the discovery of state and federal RTE species, such as wild rice, American water willow (*Justicia americana*) and eastern prairie fringed orchid (*Platanthera leucophaea*), as well as the presence and abundance of invasive plant species, such as, Eurasian watermilfoil (*Myriophyllum spicatum*), purple loosestrife (*Lythrum salicaria*), Carolina fanwort (*Cabomba caroliniana*) and crispy pondweed (*Potamogeton crispus*).

Principal habitat types were described as a result of the inventory and consisted primarily of a mixture of floodplain forested communities, residential areas and scrub/shrub and emergent wetlands.

Results were compared to historical inventories from the Michigan Natural Features Inventory, previous assessments and historical (pre-reservoir) maps. Notable differences were noted between the southern, midsection and northern reaches of the Project. A diverse community of a total of 159 native and non-native plant species were identified in the 2019 assessment (presented in Section 5.3 in Table 2 of the Botanical Resources Study Report). American water willow was documented during the inventory, whereas other RTE plants species (i.e., wild rice and eastern prairie fringed orchid) were absent from the Project boundary.

Twenty-three non-native plants were discovered in the inventory, including Siberian elm (*Ulmus pumila*), narrow leaf cattail (*Typha angustifolia*), bittersweet nightshade (*Solanum dulcamara*), broad-leaved dock (*Rumex obtusifolius*), multiflora rose (*Rosa multiflora*), locust, crispy pondweed, Canada bluegrass (*Poa compressa*), reed canary grass (*Phalaris arundinaceae*), Eurasian watermilfoil, forget-me-not (*Myosotis scorpioides*),

white mulberry (*Morus alba*), yellow sweet clover (*Melilotus officinalis*), purple loosestrife, moneywort (*Lysimachia nummularia*), amur honey suckle (*Lonicera maackii*), common pivot (*Ligustrum vulgare*), Dame's rocket (*Hesperis matronalis*), ground ivy (*Glechoma hederacea*), autumn olive (*Elaeagnus umbellata*), oriental bittersweet (*Celastrus orbiculatus*), northern catalpa (*Catalpa speciosa*), Carolina fanwort and velvetleaf (*Abutilon theophrasti*). The Constantine PAD outlined four species; Carolina fanwort, purple loosestrife, Eurasian watermilfoil, and crispy pondweed from the above list as non-native, special concern species. Locations of these invasive plants were recorded in the field during the Botanical Resources Survey and referenced 2019 map data from the annual Constantine Invasive Species Survey conducted by GLEC for I&M (GLEC 2019). The locations of these invasive plant species are presented in Figure 2.1-1. The remaining non-native/invasive species of concern were found to be much less abundant.

Purple loosestrife abundance was noted as a specific threat to the existing wetlands, particularly in the northern sections of the Project boundary. Eurasian watermilfoil was also noted as becoming more abundant than previously noted in the other assessments. Both purple loosestrife and Eurasian watermilfoil have the greatest potential to significantly alter the native habitats in the wetland and off-shore aquatic communities in the Project area.

Based on this assessment and the annual invasive species assessments, it continues to appear that in general, the light and heavy infestations within the Project boundary continue to increase including the Eurasian watermilfoil. The overall assessment of the botanical resources at the Constantine Project remains similar to that described in the PAD and the 1993 assessment (FERC 1993).

2.1.3 Variances from FERC-Approved Study Plan

The actual Botanical Resources Survey and study methods applied some interpretations of and minor variances from the method details outlined in Section 6 Botanical Resources Study of the March 15, 2019 RSP. Under Task 6.6.1 Desktop Mapping of Vegetation, the RSP indicates that I&M “will obtain high-resolution aerial imagery to characterize the vegetation in the Project area, to the extent practical.” For this study, the research biologists and Geographic Information System (GIS) specialists utilized standard satellite imagery provided by Google Earth and ESRI ArcMap streaming services for feature interpretation. No other “special” high resolution imagery was obtained or utilized for the study.

Existing information regarding botanical resources in the Project area, presented in Section 5.5 of the PAD, classifies the vegetation as a “mixed hardwood community of predominantly oak, with some ash, beech, hickory, maple, cottonwood, and aspen” and falling within the Beech-Maple Association of Eastern Deciduous Forest (I&M 1988, Bailey 1978). For this study, the classification and description scheme developed by the Michigan Natural Features Inventory was used to update and further expound upon the forest cover types (Kost et al. 2007). Preliminary descriptions of the Project area state that along its lower third, the reservoir is largely within pre-existing river banks and is bordered by a fringe of trees, while along the upper two-thirds of the reservoir the river often covers more extensive (up to 1,200 feet) widths of lowland areas (I&M 1988). Upon

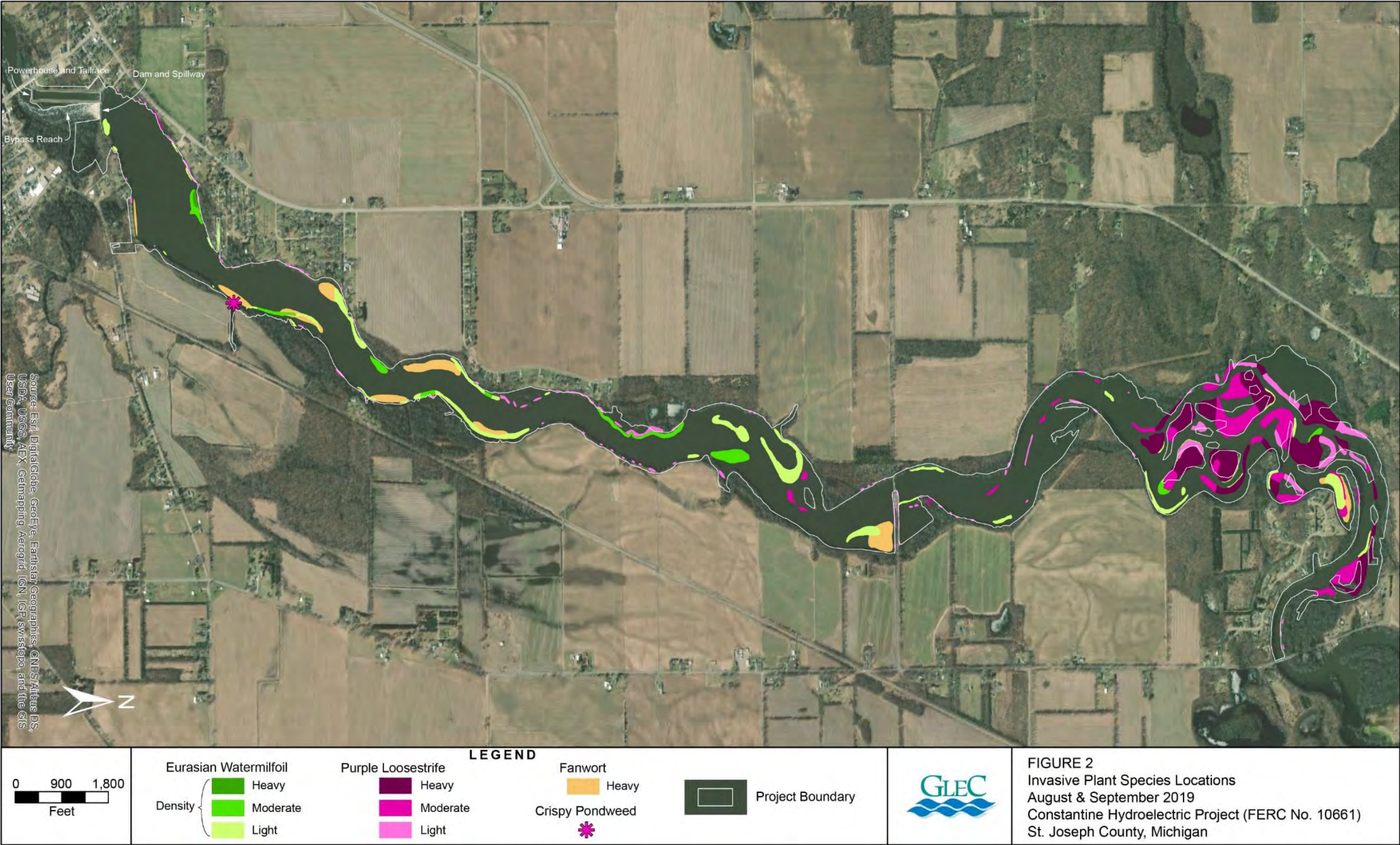


Figure 1.1-1. Invasive Plant Species Locations

the completion of Meander surveys and a full species list, this study determined that this fringe of trees within the lower third, to half, of the reservoir is more specifically classified as floodplain forest and the lowland areas within the upper reaches of the reservoir are primarily forested and emergent wetlands, dominated by willow (*Salix* spp.) and silver maple trees.

2.2 Shoreline Stability Assessment

2.2.1 Study Status

I&M has completed the Shoreline Stability Assessment in accordance with the RSP and the Commission's SPD. The technical report including the results of the Shoreline Stability Assessment is included as Appendix C to this ISR.

2.2.2 Summary of Study Methods and Results

In accordance with the Commission's SPD, I&M conducted a Shoreline Stability Assessment of the Project's reservoir and downstream areas. This study consisted of a literature review and field survey, which was led by GLEC.

Prior to conducting field surveys, a literature review was performed to review any existing information on geology and soils in the study area that may be useful to assess bank composition and erosion potential in the study area.

Observations for the 2019 Shoreline Stability Assessment of the reservoir and bypass reach were made June 2-4 and September 24-27, 2019. Assessed sites were located at various points along the shoreline within the reservoir and bypass reach. Sites were labeled according to their location in the bypass reach or the reservoir. During the June survey event, 57 sites were evaluated, and the results are listed in Table 2 in Section 8 of Shoreline Stability Assessment Report. Of the 57 sites evaluated, 12 were located in the bypass reach and 45 were located in the reservoir. During the September survey event, 31 sites were evaluated, and the results are listed in Table 3 in the Shoreline Stability Assessment Report. Of the 31 sites evaluated, 8 were located in the bypass reach and 23 were located in the reservoir. Examples of the assessed locations are provided in Figures 2-20 in Section 7 of the Shoreline Stability Assessment Report.

In summary, primary observations and conclusions from the Shoreline Stability Assessment are:

- In June, modified Bank Erosion Hazard Index (BEHI) scores in the Project area ranged from Very Low to Moderate at 57 individual sites. In the bypass reach, sites were scored as; 5 Very Low, 1 Low, 3 Moderate, and 3 not applicable (NA). In the reservoir area, sites were scored as; 2 Very Low, 20 Low, 12 Moderate, and 11 NA.
- In September, BEHI scores in the Project area ranged from Low to Moderate at 39 sites. In the bypass reach, sites scored as; 5 Low, 2 Moderate, and 1 NA. In the reservoir area, sites were scored as; 19 Low and 12 Moderate.

- Based on observations used to calculate the modified BEHI, three areas may require additional assessment to confirm and possibly mitigate potential future erosion hazards within the Project:
 - 1) Site BA03 located at the downstream end of the Project. This site has an area of erosion located against concrete at the base of the bridge extending under the overhanging vegetation. This erosion area is likely caused by current hitting the bank from the tailrace.
 - 2) Site BA16 located at the upstream end of the bypass reach. This isolated point has no vegetation and soil is actively falling into the bypass reach.
 - 3) In the reservoir, the area from site SJR05 to SJR12. This area is located in a more riverine section of the Project along an outside bend in the river channel. This area has had the riparian vegetation removed for home construction and maintained turf grass lawns.

2.2.3 Variances from FERC-Approved Study Plan

The Shoreline Stability Assessment was conducted in full conformance with the Commission's SPD.

2.3 Water Quality Study

2.3.1 Study Status

I&M has completed the Water Quality Study in accordance with the RSP and the Commission's SPD. The technical report including the results of the Water Quality Study is included as Appendix D to this ISR.

2.3.2 Summary of Study Methods and Results

In accordance with the study plan approved in the Commission's SPD, I&M conducted a Water Quality Study in the Project's reservoir, bypass reach and downstream area.

GLEC led the Water Quality Study and monitored water quality at five locations (reservoir, power canal, tailrace and two locations in the bypass reach) as shown in Figure 2.3-1. Calibrated Onset® HOBO U26 dissolved oxygen (DO) Data Loggers set to record water temperature and DO at 15-minute intervals were deployed at the five monitoring locations for continuous *in situ* measurements. Discrete multi-parameter water quality measurements of temperature, DO, pH, and specific conductance were also collected at the monitoring locations using a calibrated YSI ProDSS water quality meter.

Continuous water temperature and DO measurements were recorded from May 1, 2019 through October 31, 2019. Discrete multi-parameter water quality measurements were collected at each of the five monitoring locations on a monthly basis from May through October.

Additionally, GLEC conducted sediment contaminant sampling along three transects in the Project reservoir (Figure 2.3-1). Although FERC's SPD did not require I&M to perform

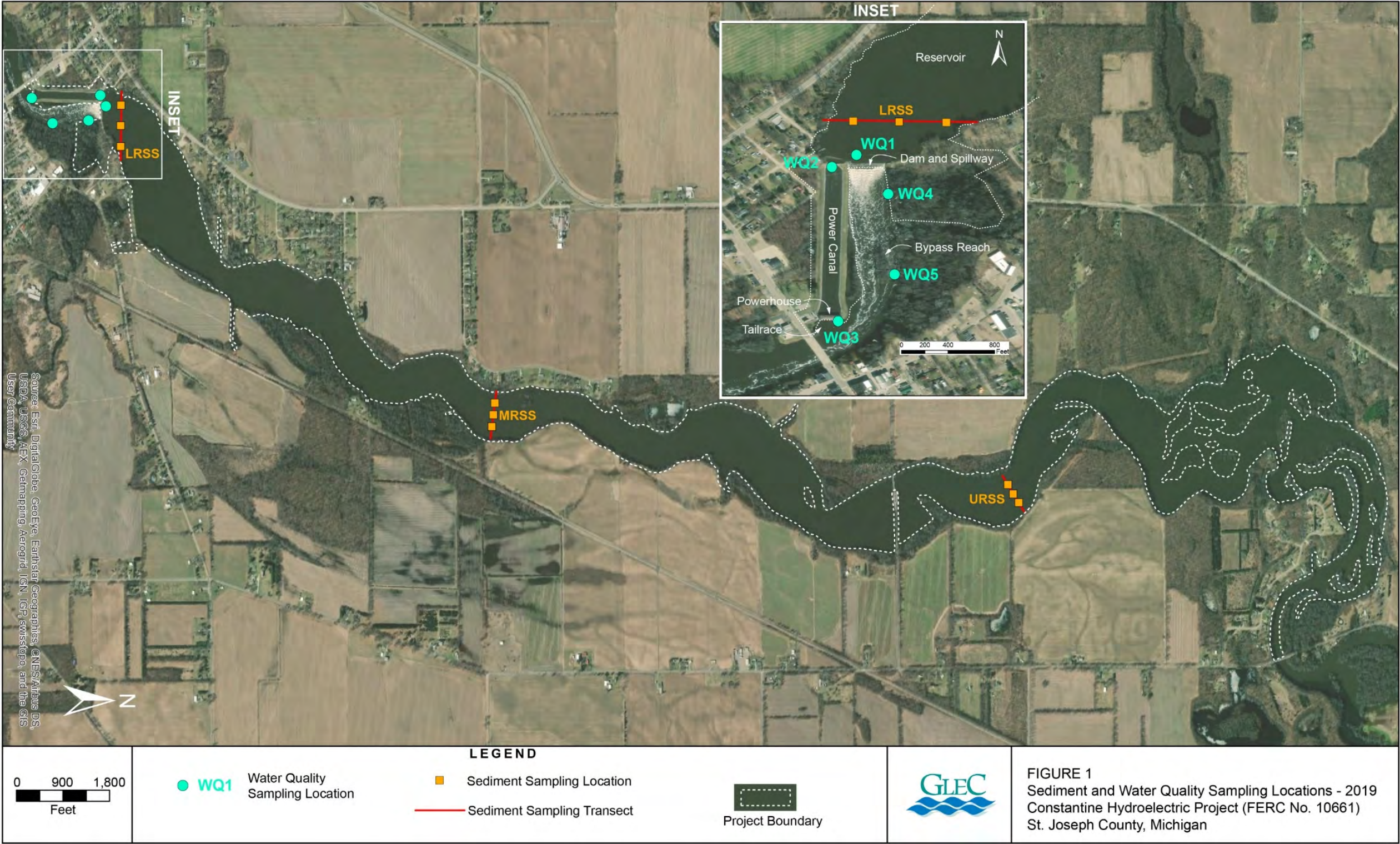


Figure 2.3-1. Water Quality Monitoring and Sediment Sampling Locations

sediment contaminant sampling, based on I&M's experience at other projects (i.e., Mottville Project) and the resource agencies' interest in these data, I&M agreed to conduct the sampling and provide this information to resource agencies.

In general, the DO and water temperature plots demonstrate a typical diurnal fluctuation that is reflective of day and night respiration (dissolved oxygen) and the relatively rapid change in water temperature due to changes in air temperature. However, there were several instances when this pattern was interrupted possibly due to meter malfunctioning, meter desiccation (temporarily out of the water) or vandalism. Specifically;

- the mid-June and mid-July DO data for the tailrace,
- rapidly declining DO and temperature data in late August for the bypass reach upstream of the Fawn River,
- the rapid decline and then increase in water temperature mid- to late September in the tailrace, and
- spikes in DO to levels greater than saturation in late September in the bypass reach upstream of the Fawn River.

In each instance the anomalies were investigated by reviewing the field conditions, maintenance and calibration logs and the data from the secondary data logger (if available) to determine the problem.

Primary observations from the Water Quality Study include:

- DO readings fell within state threshold limits for the entire duration of the study in both the reservoir and power canal. Water temperature readings were below the monthly maximum threshold limits in the reservoir, power canal, tailrace, and the bypass reach upstream of the Fawn River.
- The monthly water temperature threshold was exceeded on October 1 and 2, 2019 in the bypass reach downstream of the Fawn River for 26 consecutive instantaneous measurements. However, 14 of the 26 measurements were above the threshold by only 0.2°C, which is within the accuracy range of the temperature probe. It's possible that water temperature at this location may be heavily influenced by warm water coming from the Fawn River rather than exceedances only attributable to influences in the St. Joseph River.
- In the tailrace, instantaneous DO readings as well as the daily average DO were below state thresholds on July 16, 2019. Due to probe damage and malfunction as listed in Section 5.1 of the Water Quality Study Report (Appendix D), only one logger was recording in the tailrace in July and so there was not a second set of data to verify these low readings. DO values recorded at all other water quality monitoring stations were above the thresholds on this day.
- Instantaneous DO readings below the state threshold were recorded on August 7, 18, and 19, 2019 in the bypass reach downstream of the Fawn River. The daily average DO fell below the threshold on July 21, 2019 and August 19, 2019 for this location.

In the bypass reach upstream of the Fawn River, instantaneous DO values below the threshold were recorded on eight days in August and ten days in September. For five of those days in August and five in September, the daily average DO also fell below the state threshold. During the data download event on August 29, 2019, the field crew observed that no significant river flow was present in the bypass reach due to the fact that the water surface elevation at that time was below the top surface of the control structure. The DO data suggests that this diversion of water to the power canal began somewhere between August 14 and August 20, 2019. On August 20, 2019, both the instantaneous DO threshold of 4.0 milligrams per liter (mg/L) and the daily average threshold of 5.0 mg/L were exceeded in the bypass reach upstream of the Fawn River. These exceedances persisted on and off through September 25, 2019. During the fish collection event on September 26-28, 2019, conducted as part of the Fisheries Survey for the Project relicensing, the field crew noted that the water surface elevation at that time was again below the top surface of the control structure. Heavy rain was observed during the fish collection event and the DO data shows that concentrations rose shortly after that. The majority of the DO exceedances observed during the Water Quality Study correspond to water diversion out of the bypass reach and into the power canal.

Sediment Chemistry

Sediment analysis results were compared to published sediment quality guidelines (SQG) (MacDonald et al. 2000, Ingersoll et al. 2002, GeoEngineer 2015, and WDNR 2003) to determine the relative risk to aquatic life and human health. Relative risk to aquatic life was determined by comparing the sediment analysis to Probable Effect Levels (PEL), Threshold Effect Levels (TEL), Effect Range Median (ERM) and Effect Range Low (ERL). Sediment concentrations of various contaminants that exceed the SQG may adversely affect aquatic life. Total PCB and mercury were also assessed, but those chemicals are likely to have a greater effect on human health than aquatic life and are also discussed in the fish tissue results section of the Fisheries Survey study report.

With the exception of mercury, lead and arsenic, each analyte concentration in the Constantine reservoir sediments were measured at concentrations less than the most restrictive SQG (TEL). Sediment chemistry is typically affected by agricultural runoff within the basin and is not considered to be the result of Project operations.

Mercury

The sediment mercury concentration in the Lower Reservoir (LRSS) duplicate sample slightly exceeded the TEL (0.17 milligrams per kilogram [mg/kg]) at 0.19 mg/kg in the duplicate sample. Mercury was measured at 0.16 mg/kg in the other sample. These concentrations were less than the other three SQG values. Mercury concentrations at or below the TEL are unlikely to cause adverse effects to aquatic life.

Lead

Lead concentrations in the LRSS duplicate sample were equal to the TEL and ERL SQG at 35 mg/kg. Lead concentrations in the other LRSS sample and in the other two reservoir locations (middle reservoir and upper reservoir) were all less than any

of the SQGs used. Lead concentrations at or below the TEL and ERL are unlikely to cause adverse effects to aquatic life.

Arsenic

Arsenic concentrations in the LRSS samples exceeded the PEL (17 mg/kg). The LRSS lead concentration was measured at 28.8 mg/kg. Arsenic levels at this concentration may cause adverse effects to aquatic life.

With the above noted exceptions, the contaminants measured in the Constantine reservoir are not likely to have an adverse effect on aquatic life or human health. Mercury and lead concentrations were measured at or near the TEL and ERL which would indicate a very low risk to aquatic life. Arsenic concentrations in the LRSS were measured at concentrations that may adversely affect aquatic life, but were at concentrations less than the median effects level (85 mg/kg). Site specific conditions (e.g., total organic carbon, pH, biotic ligands) will affect the bioavailability and are likely to lessen the effect of arsenic at these concentrations. Consequently, this concentration of arsenic in sediment is likely not a great concern to aquatic life in the sediment. Finally, it is unclear whether the elevated concentrations, especially arsenic, in the sediments are naturally occurring or are from anthropogenic sources.

2.3.3 Variances from FERC-Approved Study Plan

The Water Quality Study was conducted in full conformance with the RSP, with the exception of the following variances:

- On or around May 21, 2019, it is suspected that both loggers in the tailrace were pushed up onto the concrete ledge due to upwelling. The primary logger was damaged during this action and quit recording on May 21 while the secondary logger continued to record data from what could have been a position above the water. Because of the damage to the primary logger, data from the secondary logger was used for the month of May. The primary logger was replaced on May 30, 2019.
- Both the primary and secondary continuous temperature and DO loggers were discovered to be missing from the bypass reach upstream of the Fawn River during the monthly download on August 1, 2019. No data exists for that location for June 27 to August 1, 2019. A new primary logger was placed at the site on August 1, 2019. A secondary logger was added the following month. The data collected during this time period from the other water quality monitoring stations suggests that no major adverse events occurred between June 27 and August 1, 2019.
- The Commission's SPD did not require that I&M conduct the sediment contaminant sampling component. However, based on I&M's experience at other projects on the St. Joseph River, I&M decided to proceed with the data collection and analysis.

2.4 Fisheries Survey

2.4.1 Study Status

I&M has completed the Fisheries Survey in accordance with the RSP and the Commission's SPD. The technical report including the results of the Fisheries Survey is included as Appendix E to this ISR.

2.4.2 Summary of Study Methods and Results

In accordance with the study plan approved in the Commission's SPD, I&M conducted a Fisheries Survey in the Project's reservoir and bypass reach³. This study was led by GLEC and was designed to collect a comprehensive baseline for existing fishery resources in the vicinity of the Project and collect information to compare to the previous entrainment and impingement study that was conducted for the Project.

Prior to conducting field surveys, GLEC obtained the required scientific collector's permit from the Michigan Department of Natural Resources (MDNR). GLEC conducted two sampling events during daylight hours in the late spring/early summer (May-June) and the late summer/early fall (August-September) of 2019. Fish sampling was conducted using boat electrofishing and fyke nets.

Both near-shore (shallow) and mid-channel (deep) habitats were sampled to characterize fish communities and life stages that use these different habitat types. Supporting data was recorded at each sampling location, including: (1) location (Global Positioning System [GPS]); (2) sampling gear type; (3) mesohabitat; (4) representative photographs; (5) time and date; (6) weather; (7) general descriptions of depth, flows, and substrate; and (8) cover type and estimated percentage of cover. In addition to this supporting data, GLEC collected discrete water quality measurements of water temperature, DO, pH and specific conductance at each sampling location. A secchi disk reading was also taken at each sampling site.

As part of the Fisheries Survey, GLEC measured the average approach velocities 1-foot in front of the existing trashrack structure. Measurements were collected at the Project's maximum and efficient generation rates using an Acoustic Doppler Current Profiler (ADCP).

Additionally, GLEC collected fish tissue samples from ten Largemouth Bass (*Micropterus salmoides*) (resident predator fish) and ten Shorthead Redhorse (*Moxostoma macrolepidotum*) in the Project reservoir that were analyzed for mercury and PCBs. Contaminants that affect fish in the St. Joseph River often come from agricultural runoff and other local sources of pollution within the basin. Any potential contaminants present in fish in the Project area are not considered to be the result of Project operations. Although FERC's SPD did not require I&M to perform fish tissue sampling, based on

³ The RSP included the Project's power canal. However, during the field season there were concerns regarding safety and access to the power canal for effective sampling due to lack of boat access and that the canal is too deep and swift to use other sampling methods safely. GLEC consulted with MDNR's Fisheries Division, Southern Lake Michigan Management Unit regarding the potential for eliminating sampling in the power canal. Brian Gunderman, the Unit Manager, notified GLEC that the nearby collections in the Project's reservoir and bypass reach, along with the relocation collections in the power canal conducted during maintenance work in the spring of 2019 (unrelated to the relicensing), made collections in the power canal by GLEC unnecessary.

I&M's experience at other projects (i.e., Mottville Project) and the resource agencies' interest in these data, I&M agreed to conduct the sampling and provide this information to resource agencies. The results of the fish tissue sampling have not been received from the lab at the time the ISR was submitted. The Fisheries Survey Report will be supplemented with this information when available.

Fish Community Baseline Survey Compared to Historical Community Data

During fish collections in June and September of 2019 GLEC documented a diverse and abundant fish community. The 2,343 fish representing 46 species are equal in species richness to collections made in the area in the historical record. The June and September fish sampling collected the same or more species than historical sampling records as shown in Table 2.4-1. It appears that the community has not changed significantly since the last major survey.

Species collected in the past, but missing from this year's collections included Brook (*Lampetra planeri*) and Silver Lamprey (*Ichthyomyzon unicuspis*), Central Stoneroller (*Campostoma anomalum*), Common Shiner (*Luxilus cornutus*), Creek Chub (*Semotilus atromaculatus*), Fathead Minnow (*Pimephales promelas*), Spotted Gar (*Lepisosteus oculatus*), and Stonecat (*Noturus flavus*). During the 2019 fish collection, six species were collected that were not seen in past records including: Brown Bullhead (*Ameiurus nebulosus*), Emerald Shiner (*Notropis atherinoides*), Flathead Catfish, Northern Sunfish (*Lepomis peltastes*), Pirate Perch (*Aphredoderus sayanus*), and White Crappie (*Pomoxis annularis*). Most species collected remain the same from the last broad survey completed by AEP in 1990-1991.

Table 2.4-1 Comparison of Fish Species Collected Near the Constantine Project in Various Surveys

Common Name	Shepherd 1975	AEP 1991	MDNR 1998	Cardno 2019	GLEC 2019
American Brook Lamprey		X			
Black Crappie	X	X	X	X	X
Black Redhorse		X			X
Blackside Darter		X		X	X
Bluegill	X	X	X	X	X
Bluntnose Minnow	X	X			X
Bowfin		X	X		X
Brook Silverside		X	X	X	X
Brown Bullhead					X
Central Stoneroller		X			
Channel Catfish		X	X	X	X
Chestnut Lamprey		X			X
Common Carp	X	X	X		X

Common Name	Shepherd 1975	AEP 1991	MDNR 1998	Cardno 2019	GLEC 2019
Common Shiner	X	X		X	
Creek Chub		X			
Emerald Shiner					X
Fathead Minnow		X			
Flathead Catfish					X
Gizzard Shad					X
Golden Redhorse		X		X	X
Golden Shiner	X	X			X
Grass Pickerel		X			X
Greater Redhorse		X			X
Green Sunfish	X	X		X	X
Greenside Darter				X	X
Johnny Darter		X		X	X
Largemouth Bass	X	X	X	X	X
Logperch	X	X	X	X	X
Longear Sunfish		X			
Longnose Gar	X	X	X		X
Mimic Shiner		X		X	X
Northern Hogsucker	X	X			X
Northern Pike	X	X	X		X
Northern Sunfish					X
Pirate Perch					X
Pumpkinseed	X	X	X		X
Rainbow Darter		X		X	X
River Redhorse		X			X
Redhorse Sp.			X		
Rock Bass	X	X	X	X	X
Rosyface Shiner		X			
Sand Shiner		X			X
Shorthead Redhorse		X		X	X
Silver Lamprey		X			
Silver Redhorse		X			X
Smallmouth Bass	X	X	X	X	X

Common Name	Shepherd 1975	AEP 1991	MDNR 1998	Cardno 2019	GLEC 2019
Spotfin Shiner	X	X			X
Spotted Gar	X				
Spotted Sucker	X	X	X		X
Stonecat				X	
Striped Shiner		X			X
Walleye		X	X	X	X
Warmouth	X	X			X
White Crappie					X
White Sucker	X	X	X		X
Yellow Bullhead	X	X		X	X
Yellow Perch		X	X	X	X

Intake Velocities for Fish Impingement and Entrainment Potential

The intake velocities recorded at two locations within the power canal were similar to those reported in the entrainment survey completed in 1991 (AEP 1991). As reported in the PAD, during original licensing in 1988, velocities were measured as 1.8 feet per second (fps) through the trackracks and 1.3 fps at the face of the trackracks (I&M 2018). This is very similar to average velocities measured in the power canal by the ADCP sensors in June, 2019 of 1.57 fps (47.9 centimeters per second [cm/s]) just downstream of the headgate structure (Transect 1) and 1.33 fps (40.5 cm/s) upstream of the trashracks (Transect 2). This supports the assumption made in the PAD that velocities would likely remain unchanged as there have been no change to Project operations or modification of significant Project features.

Table 2.4-2 is a comparison of published swim speeds for several freshwater fish that include the species collected during the 2019 Constantine assessment. Entrainment susceptibility may be judged in part by the ability of a fish to swim against the current upstream of the powerhouse. The average swim speeds reported are very similar to the measured water velocity in the power canal, whereas the published maximum or burst swim speeds often exceed the velocity measurements in the power canal.

Table 2.4-2 Experimental Observations of Prolonged Swimming Speeds Grouped by Genus

Family	Genus	Number Fish Tested	Average of Minimum Swim Speed	Average of Swim Speed	Average of Maximum Swim Speed	Unit of Swim Speed
<i>Catostomidae</i>	<i>Catostomus</i>	4		48.7		cm/s

Family	Genus	Number Fish Tested	Average of Minimum Swim Speed	Average of Swim Speed	Average of Maximum Swim Speed	Unit of Swim Speed
<i>Centrarchidae</i>	<i>Lepomis</i>	5		30.0		cm/s
<i>Centrarchidae</i>	<i>Micropterus</i>	11	50.0 ¹	43.0 ²	118.0 ¹	cm/s
<i>Cyprinidae</i>	<i>Campostoma</i>	1	27.9	39.9	53.6	cm/s
<i>Cyprinidae</i>	<i>Cyprinus</i>	2	64.9	98.1	131.0	cm/s
<i>Cyprinidae</i>	<i>Notemigonus</i>	1	30.9		71.3	cm/s
<i>Cyprinidae</i>	<i>Notropis</i>	4		33.5		cm/s
<i>Esocidae</i>	<i>Esox</i>	2	19.0		47.4	cm/s
<i>Percidae</i>	<i>Etheostoma</i>	3	14.3	29.6	42.1	cm/s
<i>Percidae</i>	<i>Sander</i>	9	36.5	31.0	90.5	cm/s
<i>Petromyzontidae</i>	<i>Lampetra</i>	4	15.2	62.8	45.7	cm/s
¹ Minimum and Maximum Speed from <i>Micropterus dolomieu</i>						
² Average Speed from <i>Micropterus salmoides</i>						

Source: FishXing Version 3.0 Beta, 2006.

Fish entrainment is also affected by the downstream migration or movement of fish and the downstream drift of larval and juvenile fish. No estimates of fish entrainment were completed with this study.

2.4.3 Variances from FERC-Approved Study Plan

Visual estimates of the water clarity were made by recording the depth at which a Secchi disk disappeared at fish collection sites, recorded to the nearest tenth of a meter. However, at some fish collection locations the current was too swift to accurately measure transparency using a Secchi disk, these locations were marked as Secchi depth NA.

During the measurement of intake velocities in the power canal interference to the surveying unit was encountered while trying to record measurements 1-foot upstream of the Project's trashracks as specified in the RSP. In order to record useable measurements, the velocity profile transect for this location was shifted slightly upstream in the power canal to the point where interference was alleviated and velocities could be successfully recorded.

The Project's power canal was initially included in the fish sampling study area pursuant to the RSP, but there were concerns regarding safety and access to the power canal for effective sampling due to lack of boat access and that the canal is too deep and swift to use other sampling methods safely. The power canal was excluded from the sampling area based on communication with MDNR staff from the Fisheries Division in the Southern Lake Michigan Unit, who agreed that the stranded fish survey of the power

canal in spring 2019 provided sufficient data to predict the species present (McCauley, personal communication, July 10-11, 2019). No additional fish collections were made in the power canal during this survey.

During collection of fish tissue samples field staff were unable to collect enough individuals of either of the preferred bottom-feeding species identified in the RSP, Common Carp or Channel Catfish. Field staff substituted (10) Shorthead Redhorse to represent the bottom feeder fish species.

2.5 Mussel Survey

2.5.1 Study Status

I&M has completed the Mussel Survey in accordance with the RSP and the Commission's SPD. The technical report including the results of the Mussel Survey is included as Appendix F to this ISR.

2.5.2 Summary of Study Methods and Results

In accordance with the study plan approved in the Commission's SPD, I&M conducted a Mussel Survey in the Project's reservoir, bypass reach and downstream of the powerhouse.

EnviroScience, Inc. (EnviroScience) led the Mussel Survey, and prior to conducting field surveys, obtained the appropriate required scientific collector's permit from the MDNR. EnviroScience conducted mussel surveys in August of 2019. Surveys were conducted according to MDNR's Michigan Freshwater Mussel Survey Protocols and Relocation Procedures⁴.

A qualitative mussel survey was conducted at two sites in the reservoir, one site in the bypass reach, and one site downstream of the Project's powerhouse (including multiple sub-reaches). Mussel survey locations are depicted in Figure 2.5-1. Basic habitat information such as substrate type (e.g., gravel, cobble, boulder), water depth, habitat type (e.g., riffle, run, pool), cover type (e.g., woody debris), stream width, and qualitative water velocity was recorded at each sampling location. Representative photographs were also taken of each species. Additionally, water quality data, including water temperature, DO, pH, and specific conductance were collected from representative locations in the survey areas during the mussel survey.

Mussel assemblage in the Project study area was similar to historic records near the area as presented in Table 4 of the Mussel Survey Report (Appendix F). Nineteen (19) species have been documented in this portion of the St. Joseph River and 12 were observed live in this study. Species observed in this study and not documented downstream by Wesley and Duffy (1999) included the Mapleleaf (*Quadrula quadrula*), Lilliput (*Toxolasma parvum*), and Paper Pondshell (*Utterbackia imbecillis*). Conversely, species observed pre-1999 and not recorded in this study included Cylindrical Papershell (*Anodontoidea ferrussacianus*), Purple Wartyback (*Cyclonaias tuberculata*), Ohio Pigtoe

⁴ Michigan Freshwater Mussel Survey Protocols and Relocation Procedures, 2018 is available at <https://www.fws.gov/midwest/eastlansing/te/pdf/MIFreshwaterMusselSurveyProtocolsRelocationProceduresFeb2018.pdf>.

(*Pleuorbema cordatum*), and Rainbow (*Villosa iris*). An undetectable, and not very diverse, mussel community may occupy the region upstream of the dam. Only six species were reported by Wesley and Duffy (1999) near Three Rivers, Michigan. A study performed near the dam headrace in 2019, associated with a separate project, collected 11 species. Species collected in that survey were like those observed at Sites 2 and 3 in this study, except for Round Pigtoe (live; *Pleurobema sintoxia*) and live Purple Wartyback.

No federally listed mussel species were detected within the Project area. An undetectable mussel community may occupy the region upstream of the dam, and mussel scarcity is likely due to a lack of habitat and unstable conditions in Sites 1 and 4. There appears to be a stable, recruiting mussel community below the dam that has likely persisted for several years based on the diversity and abundances observed in this survey and historical records. The mussels observed would likely not be affected by continued operation assuming relicensing would not alter the existing hydraulics.

2.5.3 Variances from FERC-Approved Study Plan

The Mussel Survey was conducted in full conformance with the Commission's SPD.

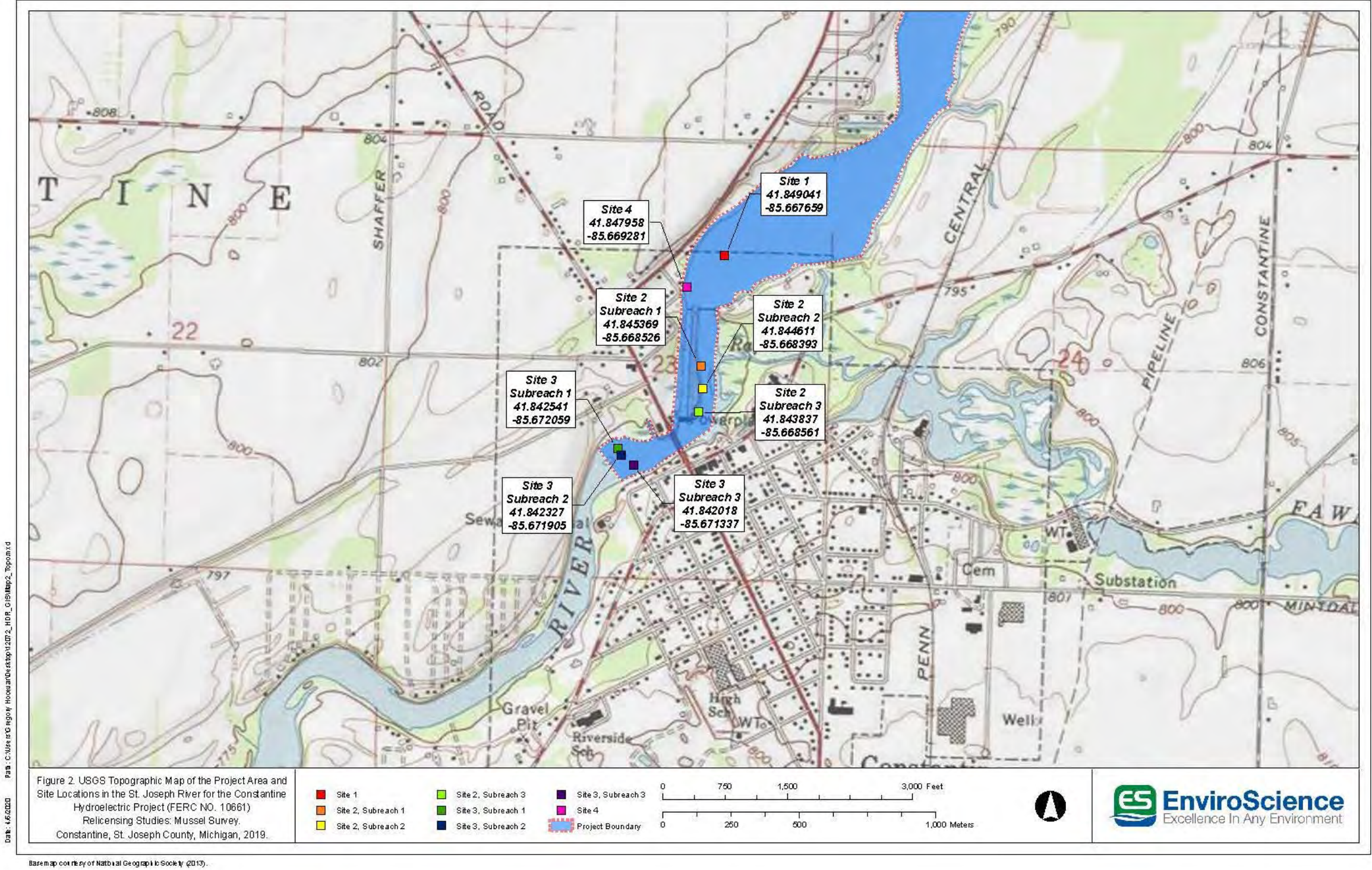


Figure 3.5-1. Mussel Survey Locations

2.6 Wetlands Study

2.6.1 Study Status

I&M has completed the Wetlands Study in accordance with the RSP and the Commission's SPD. The technical report including the results of the Wetlands Study is included as Appendix G to this ISR.

2.6.2 Summary of Study Methods and Results

In accordance with the study plan approved in the Commission's SPD, I&M conducted a Wetlands Study to document all wetlands located within and adjacent to the Project boundary that may potentially be impacted due to continued Project operations.

GLEC led the Wetlands Study, and prior to conducting field surveys, developed base maps in GIS of wetland cover types in the Project study area using source data from National Wetlands Inventory (NWI) and Michigan Department of Environmental Quality (MDEQ) wetland databases. The base maps include riparian and wetland vegetation throughout the study area. Wetlands are generally classified into four classification groups according to Cowardin et al. (1979): Palustrine Emergent, Palustrine Scrub-Shrub, Palustrine Forested, and Open Water.

On August 14, 15, and 16, 2019, two field biologists surveyed the wetland complexes in the Constantine reservoir, bypass reach and tailrace areas within the Project boundary. The purpose of the survey was to verify the wetland map features in the Project NWI wetland map that was provided in the PAD. The survey was conducted by boat and walking nearshore areas over the length of the Project. Observations were recorded at 48 stations generally adjacent to or overlying the NWI wetlands features within the Project boundary. Observations of wetland habitats near the Project boundary were recorded at 8 stations (14, 24, 25, 37, 38, 39, 40), not immediately adjacent to or overlying NWI map clipped features and are provided in Figure 2.6-1. The Wetlands Study was coincidental with the Botanical Resources Study, and field survey notes (Section 7 of the Wetlands Study Report) describe the vegetative cover, species composition, and wetland classifications which imply successional stage - including degree of inundation (e.g., seasonally flooded, permanently flooded) for each station, based upon information obtained from this study as well as the annual Constantine Invasive Species Survey conducted by GLEC for I&M (GLEC 2019). Any changes in wetland type or characteristics to the existing NWI classification were noted when relevant. Coordinate positions were recorded with a Global Positioning System (GPS) device at 40 of the 48 stations and marked on a large-scale field map for the remaining 8 stations. As prescribed by the RSP, delineations/field measurements were not conducted to verify the size or extent of the wetland features.

Wetlands are generally defined as those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions. The Constantine Project area is in the Beach-Maple Association of the Eastern Deciduous Forest Province (Bailey 1978). Dominant vegetation in the Project area is a mixed hardwood community consisting of oak, ash, beach, hickory, maple, cottonwood, and aspen. Plant species of the aquatic

wetland community include American white waterlily (*Nymphaea odorata*), Eurasian watermilfoil, and crispy pondweed. Arrow arum is a dominant species in the emergent wetland class. Cattails are a minor component of the wetland plant community in the Constantine reservoir.

The classification of wetlands and the acreages observed in this study vary very little from the results from previous assessments described in the PAD. The most notable change documented was the reclassification of the island between the tailrace and bypass reach from PEM1C Freshwater Emergent Wetland to PFO1C Forested Shrub Wetland. This change was made due to the ground-truthing and identification of a discrepancy in the NWI wetland map.

Total wetland acreage strictly within the Project boundary was estimated to remain at approximately 35.8 acres across five NWI categories that fall under the system/class categories palustrine forested and palustrine scrub-shrub wetland habitats. The majority of the Project wetland area (20.8 acres) is classified as: PF01Ch Palustrine, Forested, Broad Leaved Deciduous, Seasonally Flooded, and Diked/Impounded. These observations are consistent with the information presented in the PAD.

Modifications to existing NWI wetlands map classifications were attributable to invasive species competition; purple loosestrife overwhelming the scrub-shrub communities in the modified zones. Modifications are described for each station in Section 7 of the Wetlands Study, which is included in Appendix G of this ISR. As noted in the RSP and PAD, the Constantine Project is operated as run-of-river and has little effect on reservoir levels that could potentially impact wetlands within the Project boundary.

1.1.1 Variances from FERC-Approved Study Plan

Actual wetlands survey and study methods applied some interpretations of and minor variances from the method details outlined in Section 11 Wetlands Study of the March 15, 2019 RSP. Section 11 subsections variously describe wetlands of concern and the study area as “wetlands within or adjacent to the Project boundary”, “wetlands in the Project boundary”, and “wetland cover types in the Project study area”. The survey and mapping tasks prescribed in the RSP were followed to address wetlands within the FERC Project boundary as it appears on the approved Exhibit G maps, since only areas within the Project boundary are relevant to Project operations. Wetland areas adjacent to (i.e., outside) the Project boundary were referenced in some areas to support and verify observations, but were not re-classified or studied to update wetland features relating to the Project. The Task 1 Desktop Mapping approach in the RSP suggests source data could include soil maps and maps from NWI and MDEQ. As mentioned in Section 4.1 above, it was determined that the best source data for wetlands in the study area was the U.S. Fish and Wildlife Service NWI wetlands map already used in the PAD to produce the Project NWI wetlands map layer.

Soil maps were not used in the wetlands survey or post-survey mapping exercises. Field notes and the Summary and Discussion section above discuss soil regimes in the study area. However, there is no doubt that the soils are hydric and either somewhat “dried” due to low river conditions, or wet depending on the size of the wetland adjacent to the Project boundary or juxtaposition of the riverine habitat.

Task 2 Field Verification of Wetland Maps in the RSP prescribes that any map change recommendations include species composition, successional stage, and extent of

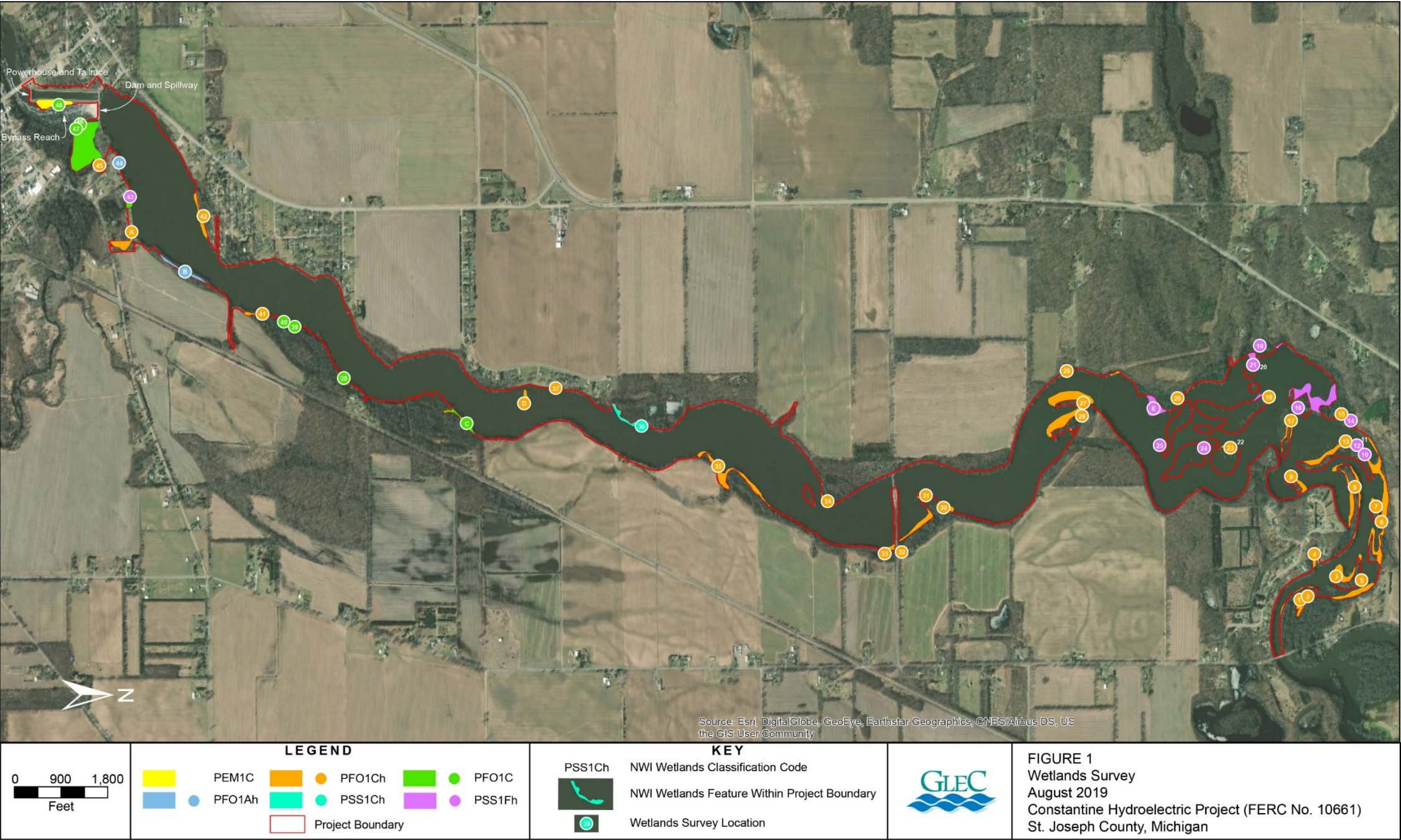


Figure 4.6-1. Wetlands Survey Map

shoreline. Where changes to Project NWI wetland features were recommended, field measurements were not taken to verify extent of shoreline where the feature was re-classified.

2.7 Recreation Study

2.7.1 Study Status

I&M has completed the Recreation Study in accordance with the RSP and the Commission's SPD. The technical report including the results of the Recreation Study is included as Appendix H to this ISR.

2.7.2 Summary of Study Methods and Results

In accordance with the study plan approved in the Commission's SPD, I&M conducted a Recreation Study to assess the adequacy of existing public access and recreational facilities to meet current and future recreation needs.

Young Energy Services (YES) performed a field inventory to document existing formal and informal recreation facilities in the Project area (within and adjacent to the Project boundary). YES recorded the following information for each of the inventoried recreation areas:

- (1) A description of the type and location of existing recreation facilities;
- (2) The type of recreation provided (boat access, angler access, picnicking, etc.);
- (3) Length and footing materials of any trails;
- (4) Existing facilities, signage, and sanitation;
- (5) The type of vehicular access and parking (if any);
- (6) Suitability of facilities to provide recreational opportunities and access for persons with disabilities (i.e., compliance with current Americans with Disabilities Act standards for accessible design); and
- (7) Photographic documentation of recreation facilities and GPS location.

In combination with the facility inventory, YES performed a qualitative assessment of the condition of the recreation facilities. The recreation amenities available at each recreation facility were rated using the following criteria: (N) Needs replacement (broken or missing components, or non-functional); (R) Needs repair (structural damage or otherwise in obvious disrepair); (M) Needs maintenance (ongoing maintenance issue, primarily cleaning); and (G) Good condition (functional and well-maintained).

YES collected visitor use data at the FERC-approved recreation sites, formal non-Project recreation sites, and other informal recreation sites through a combination of in-person surveys, field reconnaissance, and photographic documentation. Recreation visitor use data was collected from May through September of 2019. Surveys were conducted from 8:00 AM until 6:00 PM according to the schedule presented in Table 2.7-1.

Table 2.7-1 Visitor Use Survey Schedule

Month	Survey and Reconnaissance
May	<ul style="list-style-type: none"> One weekend day (Memorial Day Weekend) One randomly selected weekday
June	<ul style="list-style-type: none"> One weekend day that coincides with the Father's Day boat race¹ One randomly selected weekday
July	<ul style="list-style-type: none"> One weekend day One randomly selected weekday
August	<ul style="list-style-type: none"> One weekend day One randomly selected weekday
September	<ul style="list-style-type: none"> One weekend day (Labor Day Weekend) One randomly selected weekday

¹ The Michigan Hydroplane Racing Association typically holds an annual boat race on the St. Joseph River in Constantine on or about Father's Day weekend. To the extent practicable, I&M will attempt to collect visitor use data during one weekend race day. However, the boat race has been cancelled or postponed in previous years due to permitting issues, weather events, or other circumstances. If the boat race is postponed in 2019, I&M will attempt to reschedule a weekend survey day to accommodate the rescheduled boat race.

The actual dates that field reconnaissance took place in 2019 were as follows:

- May 22 and 27 (Memorial Day)
- June 15, 16 (Father's Day) and 28
- July 1 and 21 (Boat Race)
- August 15 and 25
- September 27 and 29

A team of two technicians rotated between the recreation sites in random order and conducting interviews with willing participants. Technicians also recorded relevant conditions, including observed recreational activities, estimated number of vehicles, and number of recreational users. General information regarding date, time, and weather conditions was also recorded. A total of 21 recreation surveys were completed in the field.

In addition to the personal interviews, I&M developed an online version of the interview questions for respondents to provide survey responses electronically. The online survey was available from May 1 through September 30, 2019. A notice of the online survey was posted to AEP's relicensing website and signs were posted at each of the Project's recreation facilities notifying recreationists of how to complete the online survey. A total of seven surveys were completed online during the study period.

The existing recreation facilities, both Project and Non-Project, are well maintained and utilized by the public. Overall, the public is pleased with the recreation facilities provided by I&M, St. Joseph County, and the Village of Constantine. The cooperative effort of I&M and local governments has resulted in recreation facilities that not only meet the goals and objectives of the relevant recreation plans but contribute to the economies of the

area. This is evidenced by individuals from outside of St. Joseph County visiting to boat on the Constantine Project reservoir, canoe/kayak the St. Joseph River, and fish the river and reservoir. According to the comments received, the existing facilities contribute to the enjoyment of all participating in those activities.

The primary recreation activities for the Constantine Project observed are fishing by boat, bank fishing, fishing from the tailwater fishing access platform located adjacent to the powerhouse, and pleasure boating. Results from the in-person and online surveys, provided below in Table 2.7-2, substantiate those observations.

Table 2.7-2 Activities Participated in by Survey Respondents

	Bank Fishing	Boat Fishing	Pleasure Boating	Canoe/ Kayak	Picnic	Swim	Sight-Seeing	Hunt	View Wildlife	Other
Number	5	5	6	1	0	0	1	0	0	0
Percent	27.8	27.8	33.3	5.6	0	0	5.6	0	0	0

Those surveyed indicated that the overall experience had recreating at the Constantine Project was totally acceptable. Table 2.7-3 presents the results of the surveys relative to rating the overall experience of the respondents.

Table 2.7-3 Overall Experience of Survey Respondents

	Totally Unacceptable	Unacceptable	Neutral	Acceptable	Totally Acceptable
Safety			1 (4.8%)		20 (95.2%)
Enjoyment				1 (4.8%)	20 (95.2%)
Crowding	1 (4.8%)			2 (10.5%)	17 (89.5%)
Overall Experience				1 (5.9%)	16 (94.1%)

Overall, survey respondents appear to be very satisfied with the existing recreation facilities in the Project area. Suggested improvements for each of the existing Project recreation sites are detailed in Section 2.3.1 of the Recreation Study Report included in Appendix H of this ISR. The recommended improvements primarily reflect the need for signage improvements, identifying Americans with Disabilities-accessible parking areas, and improvements to vegetation management. The Project recreation site with the most suggested improvements is the canoe portage below the Project spillway. Suggested improvements include: better signage, upgraded walking surface, and increasing the trail width.

2.7.3 Variances from FERC-Approved Study Plan

The Recreation Study was conducted in full conformance with the Commission's SPD.

2.8 Cultural Resources Study

2.8.1 Study Status

I&M has completed the Cultural Resources Study in accordance with the RSP and the Commission's SPD. The technical reports including the results of the Cultural Resources Study are included as Appendix I to this ISR, and are being filed with FERC as privileged.

2.8.2 Summary of Study Methods and Results

By notice dated July 25, 2018, FERC designated I&M as its non-federal representative for purposes of conducting informal consultation pursuant to Section 106 of the National Historic Preservation Act (Section 106).⁵ Pursuant to 36 C.F.R. § 800.4(a)(1) and the approved Cultural Resources Study Plan, I&M consulted with the Michigan State Historic Preservation Office (SHPO), Forest County Potawatomi Community, Pokagon Band of Potawatomi Indians, and Nottawaseppi Huron Band of the Potawatomi Tribes regarding Project's Area of Potential Effects (APE). By letter dated March 5, 2019, I&M proposed to define the APE for this undertaking as:

The APE for the Constantine Project includes lands within the FERC-approved Project boundary. The APE also includes lands outside of the Project boundary where Project operations, Project-related recreation activities, or other enhancements may cause changes in the character or use of historic properties, if any such properties exist.

I&M received a response from the Forest County Potawatomi on March 7, 2019, concurring with the general APE as defined by I&M, but noted that field surveys should be conducted in order to adequately determine the potential impact of hydro operations on cultural and historic properties. I&M did not receive a response from the Michigan SHPO or other Tribes.

I&M retained Commonwealth Heritage Group (Commonwealth) to conduct the cultural resources studies at the Project. Commonwealth conducted: (1) records and literature review, (2) architecture history/field investigations, and (3) archaeological field investigations.

Background research to identify previously recorded above-ground resources was conducted in July 2019, prior to field survey. Research was conducted at the Michigan SHPO in Lansing, Michigan, and by utilizing online resources including the National Park Service database. Background investigations revealed that there were no previously recorded historic properties in the APE. The cultural resources field survey for above-ground resources was completed in July 2019.

Commonwealth surveyed all above-ground properties over 50 years of age in the APE. As a result of this survey, one property, the Constantine Hydroelectric Plant, was identified as retaining historic integrity. Further investigation of the complex, including the powerhouse, headgates, power canal and earthen embankments, dam and spillway,

⁵ 54 U.S.C. § 306108

substation, and machine shop led Commonwealth to recommend the property as eligible for listing in the National Register of Historic Places.

Commonwealth conducted an archaeology survey on July 22 through July 24, 2019, in accordance with the guidelines established by the U.S. Secretary of the Interior and acceptable to the Michigan SHPO. The topographic relief from the water surface to the maximum height of the bank in any portion of the Project's APE is limited, heavily vegetated, and most of the adjacent properties are privately owned. Thus, Commonwealth archaeologists found accessing and inspecting the riverbanks by canoe to be the most efficient method for visual inspection.

No previously unrecorded archaeological sites were identified during the survey. Commonwealth found no historic properties to be affected by the proposed continued operation of the Project. Based on the results of the Cultural Resources Study, I&M will consult with federally-recognized Indian Tribes to develop and conduct an inventory of properties of traditional religious and cultural importance (often referred to as "traditional cultural properties") within the APE and will provide the Commission with an inventory report in conjunction with the DLA filing.

2.8.3 Variances from FERC-Approved Study Plan

The Cultural Resources Study was conducted in full conformance with the Commission's SPD.

3 Upcoming ILP Milestones and Study Reporting

Table 2.8-1 presents upcoming ILP milestones.

Table 2.8-1 Upcoming Major ILP Milestones

Date	Milestone
4/23/2020	ISR Meeting
5/8/2020	File ISR Meeting Summary
6/7/2020	Stakeholders file disagreements with ISR Meeting Summary and/or requests for modified/new studies
7/7/2020	I&M files response to disagreements with ISR Meeting Summary and/or requests for modified/new studies
8/6/2020	FERC Director of the Office of Energy Projects makes a determination on disputes/amendments to the approved study plan
3/1/2021 – 9/30/2021	Conduct Second Year of Studies (if necessary)
4/14/2021	File Updated Study Report (USR), if necessary
4/23/2021	USR Report Meeting
5/8/2021	File USR Meeting Summary

Date	Milestone
5/3/2021	File Draft License Application (DLA)
8/1/2021	Comments on DLA Due
9/30/2021	File Final License Application

4 Notice of Intent to File Draft License Application

As required by 18 CFR § 5.16(c), I&M hereby advises the Commission of its intent to file a Draft License Application, which will include the contents of a license application, rather than a Preliminary Licensing Proposal. The draft license application will be filed no later than May 3, 2021.

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Appendix A. ISR Meeting Agenda

Agenda

Project: Constantine Hydroelectric Project (FERC No. 10661)

Subject: Initial Study Report Meeting

Date: Thursday, April 23, 2020

Location: Webex (Virtual Meeting)

9:00 a.m. – 9:10 a.m.	Welcome and Introduction
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9:10 a.m. – 9:50 a.m.	Botanical Resources Study
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9:50 a.m. – 10:30 a.m.	Shoreline Stability Assessment
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10:30 a.m. – 11:10 a.m.	Water Quality Study
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11:10 a.m. – 11:20 a.m.	Break
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11:20 a.m. – 12:00 p.m.	Fisheries Survey
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12:00 p.m. – 12:40 p.m.	Mussel Survey
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12:40 p.m. – 1:30 p.m.	Lunch
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1:30 p.m. – 2:10 p.m.	Wetlands Study
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2:10 p.m. – 2:50 p.m.	Recreation Study
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2:50 p.m. – 3:30 p.m.	Cultural Resources Study
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3:30 p.m. – 4:00 p.m.	Discussion and Questions
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Appendix B. Botanical Resources Study

Botanical Resources Study
Report

Constantine Project (FERC
No. 10661)
March 31, 2020

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1. Project Introduction and Background

Indiana Michigan Power Company (I&M), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 1.2 megawatt Constantine Hydroelectric Project (Project) (FERC Project No. 10661). The Project is located along the St. Joseph River in the Village of Constantine in St. Joseph County, Michigan.

I&M operates and maintains the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on September 30, 2023. I&M is pursuing a subsequent license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR § 5.15, I&M has conducted studies as provided in the March 15, 2019 Revised Study Plan (RSP) and schedule approved in the Commission's April 9, 2019 Study Plan Determination (SPD) for the Project. This report describes the methods and results of the Botanical Resources Study conducted in support of preparing an application for a subsequent license for the Project.

Existing relevant and reasonably available information pertinent to the scope of the RSP including botanical resources in the Project area was included in the Pre-Application Document (PAD) (I&M 2018) Sections 5.5 Wildlife and Botanical Resources, 5.6 Wetlands, Littoral, and Riparian Habitat, and 5.7 Rare, Threatened and Endangered (RTE) Species. The Constantine reservoir lies within Southwest Michigan's Beech-Maple Association of Eastern Deciduous Forest Province (Bailey 1978). Historic vegetation maps of the area (circa 1800) show the forest types as Mixed Hardwood Swamp, Oak-Hickory Forest, Black Oak Barrens, and Mixed Oak Savanna (Corner et al. 1995). Current vegetation in the general area is primarily floodplain forested, scrub/shrub and emergent wetlands (Kost et al. 2007). The area surrounding the Constantine reservoir is largely agricultural. Along its lower third, the reservoir is largely within pre-existing river banks and is bordered by a fringe of trees, while along the upper two-thirds of the reservoir the river often covers more extensive (up to 1,200 feet) widths of lowland areas (I&M 1988). Prior to this study, limited information was available regarding botanical resources in the Project area.

2. Study Goals and Objectives

In accordance with I&M's RSP and the Commission's SPD for the Project, the goal of the Botanical Resources Study was to document botanical resources within the Project boundary. The specific objectives of this study were as follows:

- Describe vegetation types within the Project boundary;
- Document historic and/or current presence of wild rice beds;
- Identify and map any RTE plant species, specifically the federally-threatened eastern prairie fringed orchid and the state-threatened water willow; and
- Document the presence, abundance, and location of invasive plant species.

3. Study Area

The study area for the Botanical Resources Study is the FERC Project boundary, defined by the Constantine Project boundary map as provided in Appendix C of the PAD. The ArcGIS shapefile P-10661 Project Boundary Data 05-13-2016 ('Project Boundary' in Figures 1, 2, and 3) was used to guide field investigations, conduct Geographic Information System (GIS) analyses, and create map figures for this report.

4. Methodology

Pursuant to the RSP, the Botanical Resources Study included a field survey and inventory of botanical resources within the Constantine Project boundary during the period from August 15 to September 18, 2019. The survey was undertaken by contractor botanist field biologist from the Constantine dam located at Race Street, north to the Constantine Road Bridge. The survey was completed using a combination of satellite image interpretation and the Meander Search technique to maximize coverage of habitats and the location of RTE and invasive species (Nelson, 1987). Field biologists surveyed for the target plant species of interest list provided in the RSP (Table 1). Additionally, field biologists documented other notable species within the Project boundary. Vegetation and land cover were mapped and classified using Global Positioning System (GPS) technology and satellite imagery in the field. A comprehensive plant inventory list (Table 2) was created in addition to the species of interest list prescribed by the RSP. Population locations of species of interest such as *Justicia americana* (American water willow), *Lythrum salicaria* (purple loosestrife), *Myriophyllum spicatum* (Eurasian watermilfoil), and *Cabomba caroliniana* (Carolina fanwort) were plotted in the field with a GPS device, converted into GIS features and included in report map figures describing Rare, Threatened or Endangered Species, Invasive Plant Species, and Vegetation and Land Cover.

4.1. Desktop Mapping of Vegetation

A series of three map themes were developed to organize and map the botanical survey field data into six GIS feature layers presented on three map deliverables:

- Rare, Threatened or Endangered Species Locations (Figure 1)
- Invasive Plant Species Locations (Figure 2)
- Vegetation and Land Cover (Figure 3)

Satellite imagery base maps were used both in the field and in post-survey GIS processing to reference field collected GPS data. Imagery used for field work was current streaming Google Earth imagery for the Project area, while post processing work and map production utilized current ESRI ArcGIS streaming base map imagery. RTE species field data were comprised of GPS point coordinates for American water willow that describe discrete locations (smaller area centroid) or larger extents using beginning and ending point coordinates (polylines with point ends) and are displayed in Figure 1.

For the invasive plant species map layers, the field botanist used maps from the 2018 Constantine Invasive Species Survey (Great Lakes Environmental Center [GLEC] 2018) to check and update the

extents of purple loosestrife and Eurasian watermilfoil (*Myriophyllum spicatum*), the principal invasive species found in the Project area. Field notes and drawings were applied to the 2018 loosestrife and watermilfoil polygons which were then updated post-survey in ArcMap. In addition to updating the extents of loosestrife and watermilfoil, one incidence of crispy pondweed (*Potamogeton crispus*) was plotted and mapped and polygons describing beds of Carolina fanwort were drawn in the field over Google Earth imagery and edited post-survey in ArcMap using streaming imagery as a reference layer. No other invasive species of interest were detected or mapped.

For the vegetation and land cover map layer, polygons for emergent wetlands, forested wetlands, floodplain forested, residential, and scrub/shrub wetland features were drawn in the field over Google Earth imagery and edited post-survey in ArcMap using streaming imagery as a reference layer.

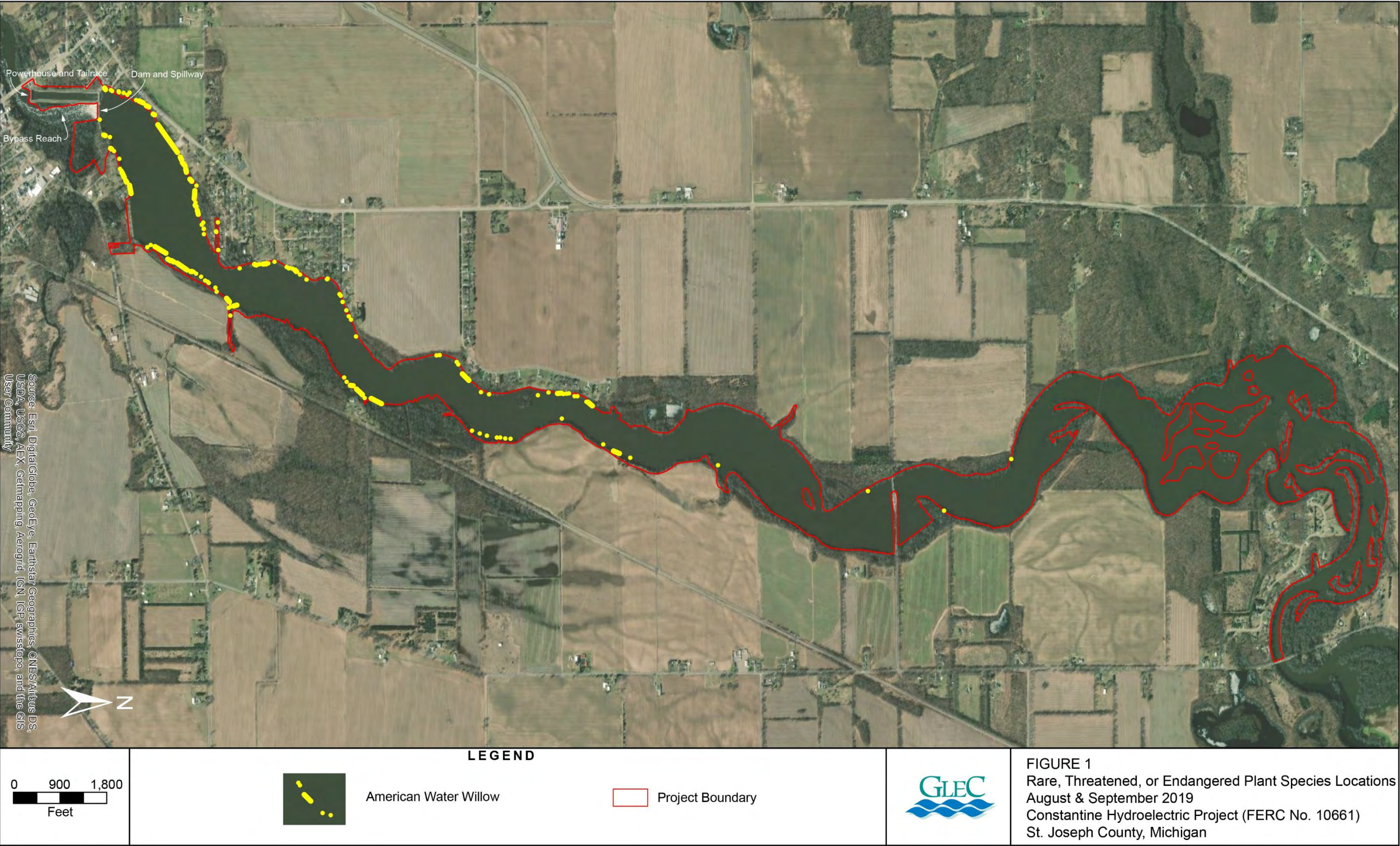


Figure 1. Rare, Threatened or Endangered Species Locations

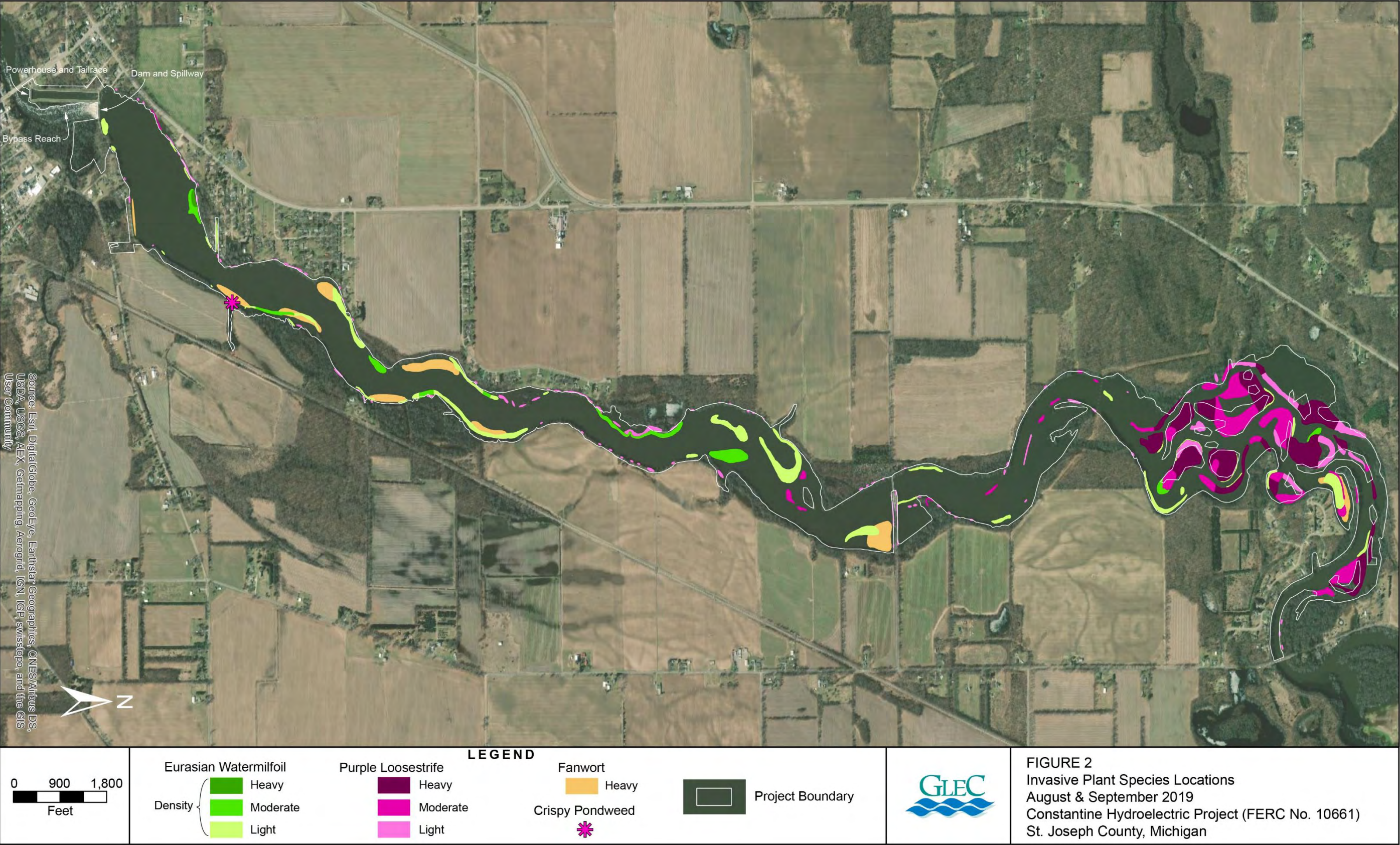


Figure 2. Invasive Plant Species Locations

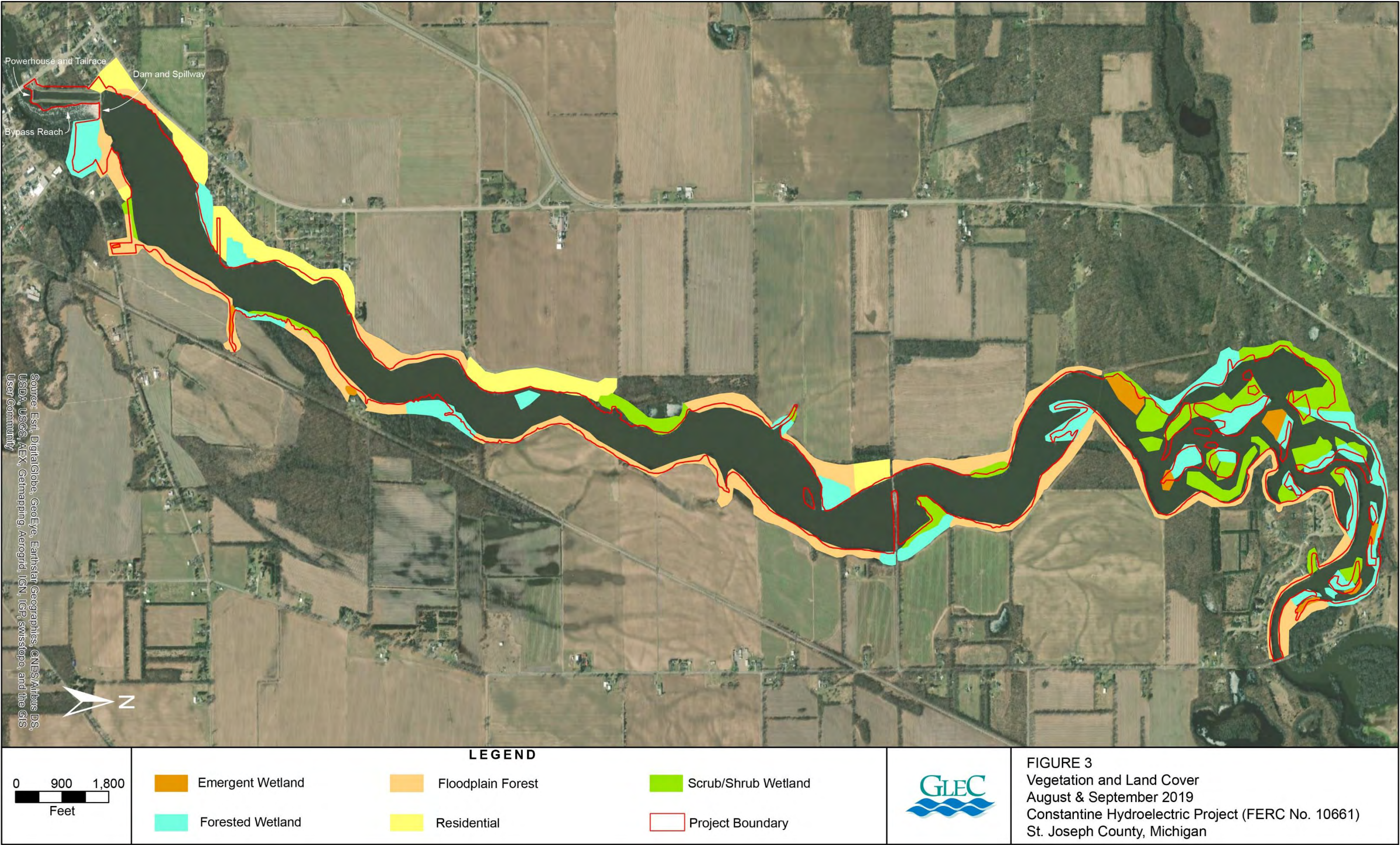


Figure 3. Vegetation and Land Cover

4.2. Develop Plant Species List

In consultation with resource agencies and stakeholders, a list of target plant species of interest to detect and map during the field survey was developed along with the characterization of other botanical resources (other species, vegetative cover, habitats and forest types). These species of interest were either invasive nuisance species or RTE species. The species of interest were provided in the RSP in Table 6.1 and are listed in Table 1 below along with their respective status.

Table 1. Plant Species of Interest

Common Name	Scientific Name	Status
Eastern Prairie Fringed Orchid	<i>Platanthera leucophaea</i>	Federally threatened
Water Willow	<i>Justicia americana</i>	State Threatened, S2 Rank
Purple Loosestrife	<i>Lythrum salicaria</i>	Non-native/Invasive
Eurasian Watermilfoil	<i>Myriophyllum spicatum</i>	Non-native/Invasive
Japanese Knotweed	<i>Fallopia japonica</i>	Non-native/Invasive
European Frogbit	<i>Hydrocharis morsus-ranae</i>	Non-native/Invasive
Starry Stonewort	<i>Nitellopsis obtusa</i>	
Curly-Leaf Pondweed	<i>Potamogeton crispus</i>	
Pond Water-Starwort	<i>Callitriche stagnalis</i>	
Common Reed	<i>Phragmites australis</i>	
Carolina Fanwort	<i>Cabomba caroliniana</i>	Non-native/Invasive

Survey findings regarding these species of interest are provided in Section 5.0 Study Results, along with survey results of an expanded list of all native, non-native and RTE species observed during the Botanical Resources Survey.

4.3. Survey for RTE and Invasive Plant Species and Field Verification of Vegetation Cover Types

The field botanist for the Project conducted field surveys in August and September of 2019 to document RTE and invasive plant species, based on the target species list provided in Table 1. RTE and invasive species were mapped using GPS coordinates to define discrete species population locations and to define the beginning and end points of larger population extents in the case of American water willow. For Carolina fanwort populations, polygons were drawn in the field using Google Earth imagery and density attributes was noted as “dense” for all fanwort beds. For purple loosestrife and Eurasian watermilfoil, 2018 Constantine Invasive Species Survey maps (GLEC 2018) were used as a reference to update population extents in the Project boundary. The special interest species list was checked during the survey. In addition to the special species list, the field botanist surveyed and recorded the presence of all species present in the Project boundary (see Table 2 in Section 5.0 Study Results)

The Botanical Resources Survey included general observations regarding habitat, vegetative cover, forest types, and land cover. Narrative descriptions and map polygons were created in the field to describe vegetation and land cover for the entire Project boundary area classified as either emergent wetlands, forested wetlands, floodplain forested, residential, or scrub/shrub wetlands.

Photographs of select species and shoreline habitats were taken per the RSP and are provided in Section 7.0. The RSP also required documenting the presence of any wild rice beds. No wild rice beds were identified within or adjacent to the Project boundary.

5. Study Results

5.1. General Description of Project Botanical Resources

Aquatic vegetation, occurring throughout the entirety of the reservoir, is dominated by coontail (*Ceratophyllum demersum*). Plant lists are associated with each polygon on the Vegetation and Land Cover map (Figure 3). Historic county data show that wild rice beds have existed in similar habitats as the Constantine reservoir within St. Joseph County in the past, however none were found during this survey (M.R. Penskar, et al. 2000).

Directly east of the Constantine dam lies a diverse mixed hardwood community, which drops into forested wetland to the south. The overstory of this hilly floodplain forest consists of three species of maple, with oak, basswood, cottonwood, elm, ash, walnut and northern catalpa (*Catalpa speciosa*) associates. The mid/understory is dominated by spice bush (*Lindera benzoin*) and buttonbush (*Cephalanthus occidentalis*), mixed with white mulberry (*Morus alba*), honeysuckle and black raspberry (*rubus occidentalis*). The understory dominants include Virginia wildrye (*Elymus virginicus*), asters, vervain, American germander (*Teucrium canadense*), bedstraw, New York fern (*Thelypteris noveboracensis*), sensitive fern (*Onoclea sensibilis*) and wild ginger (*Asarum canadense*). The low pockets of forested wetland in the southern portion have a similar overstory, with green ash (*Fraxinus pennsylvanica*), silver maple (*Acer saccharinum*), swamp white oak (*Quercus bicolor*) and black walnut (*Juglans nigra*) dominating. Understory species in this southern section including sensitive fern, interrupted fern (*Osmunda claytoniana*), southern blue flag (*Iris virginica*), false nettle (*Bohmeria cylindrica*) and meadow rue (*Thalictrum daisycarpum*). Small embedded scrub/shrub and emergent wetlands in this area are composed of buttonbush, southern blue flag, watercress, sensitive fern and Canada clearweed (*Pilea pumila*) (Figure 3).

The southern and mid-section of the Project area is a mixture of floodplain forested, residential, and small inlets of scrub/shrub and emergent wetlands. The majority of the reservoir is lined with broadleaf arrowhead (*Sagittaria latifolia*), which then transitions into green arrow arum (*Peltandra virginica*) in the northern sections of the reservoir. Lizard's tail (*Saururus cernuus*) and two species of *Persecaria* (*P. amphibia* and *P. hydropiperoides*) are also dominant along the reservoir shoreline. Offshore species, primarily in coves and inlets, include variegated pond-lily (*Nuphar variegata*) and American white waterlily (*Nymphaea odorata*), with some large sections of large-leaf cattail (*Typha latifolia*), and a few populations of narrow-leaf cattail (*Typha angustifolia*). Numerous populations of the state-threatened water willow line the southern and mid-section of the Project area of the reservoir (Figure 1). Nearshore aquatic species occur throughout the entirety of the reservoir. Primary aquatic species include coontail, Carolina fanwort, Eurasian watermilfoil, sago pondweed (*Stuckenia pectinata*), common waterweed (*Elodea canadensis*), tape-grass (*Vallisneria americana*), and pondweed (*Potamogeton berchtoldii*).

The northern reaches of the reservoir (north of Withers Road Bridge) are dominated by floodplain forested and forested wetland. Scrub/shrub wetlands and emergent wetlands are also present in this section of the reservoir. Silver maple and various species of willow dominate the canopy. The understory is primarily

buttonbush, swamp loosestrife (*Decodon verticillatus*) and purple loosestrife. The islands in the northern reaches are dominated by purple loosestrife (Figure 2).

No wild-rice (*Zizania aquatica*), beds were found within the Project boundary at the time of the survey. Additionally, the federally-threatened eastern prairie fringed orchid (*Platanthera leucophaea*) was also not observed during the assessment.

5.2. Species of Interest

Justicia americana, American water willow (State Threatened, S2 Rank)

American water willow is a native willow of special concern in Michigan. Populations of the American water willow are located along both the eastern and western shorelines of the reservoir from the Constantine dam, northward approximately two-thirds of the length of the Project area. Populations begin to dwindle when purple loosestrife increases, in the northern reaches of the reservoir. All populations of *Justicia* were mapped using GPS technology (Figure 2).

Cabomba caroliniana, Carolina fanwort (Non-native/Invasive)

Carolina fanwort is present throughout the length of the Project area in varying densities. This species is commonly associated with coontail and is present in dense populations along much of the shoreline. The largest populations were documented during the survey and shown in Figure 1.

Lythrum salicaria, Purple loosestrife (Non-native/Invasive)

Purple loosestrife was documented at a total of 150 locations in the Constantine reservoir in 2019 (GLEC 2019). The majority of these infestations were characterized by a single plant or a few scattered plants. However, there were 29 documented instances of moderate purple loosestrife infestations and 16 heavy purple loosestrife infestations, characterized by nearly pure stands of purple loosestrife.

Historical purple loosestrife infestations in the Constantine reservoir indicate that light infestations consistently increased between 1998 and 2017, with a significant reduction in light infestations in 2018, and the number of light purple loosestrife infestations remained nearly constant between 2018 and 2019. Moderate infestations have remained relatively stable between 1998 and 2018, however in 2019 there were more moderate purple loosestrife infestations than observed during previous assessments (GLEC 2019).

Purple loosestrife populations in 2019 are similar to 2018 surveys and range from light/moderate in the southern reaches of the Project area to dense in the northern sections of the Project area, throughout the islands and shoreline (Figure 2).

Myriophyllum spicatum, Eurasian watermilfoil (Non-native/Invasive)

A total of 49 Eurasian watermilfoil infestations were observed in the Constantine reservoir in 2019 (GLEC 2019). Most of these infestations were characterized by a single plant or a few scattered plants, but there were nine instances of moderate infestations and one instance characterized by dense plants crowding out native vegetation. Where not choking out native vegetation, Eurasian watermilfoil was often mixed with coontail, pondweeds and Carolina fanwort.

Excluding year-to-year variability, light infestations of Eurasian watermilfoil in the Constantine reservoir have increased since 1998 (GLEC 2019). Eurasian watermilfoil populations were significantly larger than those found in 2018 than 2019, and span the length of the reservoir, increasing in density within the northern reaches of the reservoir (Figure 2).

Zizania aquatica, Southern wild-rice (State Threatened, S2S3 Rank)

There was no presence of wild rice throughout the Project boundary. Historic county data show that wild rice beds may have been present in the area in the past (M.R. Penskar, et al. 2000).

Potamogeton crispus, Crispy pondweed (Non-native/Invasive)

Crispy pondweed was found in one location along the southeastern shoreline on the reservoir (Figure 2). The presence of this invasive species may be more widespread throughout the reservoir, requiring further investigation.

5.3. Vegetation, Land Cover, Forest Types and Habitat Descriptions

Floodplain Forest:

Floodplain forest exists throughout the majority of the Project boundary. The overstory tree species composition changes slightly moving from the south to the northern reaches of the reservoir boundary, therefore this cover type is described in additional detail. Digital polygons of the cover type map have associated attribute data showing the dominant species in each region of floodplain forest (Figure 1). Much of this forest type's edge is lined with populations of the state-threatened American waterwillow.

East of the Constantine dam, the Floodplain forest canopy consists of a diverse overstory of various maples (*Acer saccharum*, *Acer saccharinum*, and *Acer negundo*), oak (*Quercus macrocarpa*), basswood (*Tilia Americana*), cottonwood (*Populus deltoides*), elm (*Ulmus Americana*), ash (*Fraxinus americana*, *Fraxinus pennsylvanica*), hickory (*Carya ovata*), walnut (*Juglans nigra*), redbud (*Cercis canadensis*) and Catalpa (*Catalpa speciosa*). The mid and understory of this floodplain forest is dominated by the woody shrubs buttonbush, blackberry (*Rubus alleghaniensis*) and honeysuckle (*Lonicera spp.*) as well as mulberry. The understory/herbaceous layer is composed primarily of the following herbs, grasses and forbes: Virginia wildrye, aster (*Symphyotrichum lateriflorum*), vervain (*Verbena urticifolia*), Missouri ironweed (*Veronica missurica*), bedstraw (*Galium triflorum*), moneywort (*Lysimachia nummularia*), ferns (*Thelypteris noveboracensis*, *Osmunda claytoniana*), ginger (*Asarum canadense*) and woodsorrel (*Oxalis dillenii*).

The southwestern shoreline of the Project area, is still dominated by oak species, as mapped circa 1800 as Mixed Oak Savanna (Corner et al. 1995). Canopy species include white oak (*Quercus alba*), bur oak (*Quercus macrocarpa*), red oak (*Quercus rubra*) and pin oak (*Quercus palustris*). Other canopy species include silver maple, elm (*Ulmus americana*), and willow (*Salix petiolaris*). The mid/understory of this floodplain forest is primarily composed of buttonbush, purple loosestrife, broadleaf arrowhead, lizard's tail and waterwillow.

The mid-section of the reservoir shoreline, up to the Withers Road Bridge, has a forest canopy dominated by silver maple, elm, sycamore (*Plantanus occidentalis*), ash (*Fraxinus americana*, *Fraxinus nigra*), willow (*Salix petiolaris*, *Salix nigra*) and black oak (*Quercus nigra*), with mulberry, pin oak, basswood (*Tilia americana*), walnut (*Juglans nigra*), hickory (*Carya cordiformis*) and sugar maple (*Acer saccharum*) intermixed. Occasional

red cedar (*Juniperus virginiana*) and honey locust (*Gleditsia triacanthos*) are also present along these sections. This floodplain forest mid/understory is dominated by broadleaf arrowhead, lizard's tail and waterwillow.

North of the Withers Road Bridge, the floodplain forest canopy is dominated by silver maple and willow (*Salix petiolaris*, *Salix nigra*), merging into significant areas of forested wetland. Other canopy species include basswood (*Tilia americana*), mulberry, hickory (*Carya cordiformis*), cottonwood (*Populus deltoides*), green and black ash (*Fraxinus pennsylvanica* and *F. nigra*), elm (*Ulmus americana*), and honey locust. The mid-story/shrub layer of this section is primarily rose (*Rosa multiflora*), privet (*Ligustrum vulgare*), buttonbush and loosestrife (*Lythrum salicaria*, *Decodon verticillatus*). Understory species include false nettle, riverbank grape (*Vitis riparia*), avens (*Geum canadense*), wild yam (*Dioscorea villosa*), black currant (*Ribes americanum*), cardinal flower (*Lobelia cardinalis*), aster (*Symphyotrichum lateriflora*), Virginia wildrye and bluegrass (*Poa compressa*).

Forested Wetland:

Forested wetland areas within the Project boundary have a canopy dominated primarily by silver maple and willow trees (*Salix nigra*). Other canopy dominants are green ash, elm and red oak, with Tulip tree (*Liriodendron tulipifera*) and alder (*Alnus incana*) also common. The woody shrub/mid-story layer is composed of willow (*Salix petiolaris*), dogwoods (*Cornus racemosa*, *C. foemina*), buttonbush, spicebush (*Lindera benzoin*), and loosestrife (*Lythrum salicaria*, *Decodon verticillatus*). Understory plants include southern blue flag, water parsnip (*Sium suave*), meadow rue, crowfoot (*Ranunculus flabellaris*) and sensitive fern and multiple sedge and grass species (*Carex gracilima*, *Carex vulpinoidea*, *Carex gracilima*, *Cyperus strigosus*, *Leersia virginica*). Low pockets of forested wetland in the south near the dam include canopy species of pin oak and black walnut, whereas forested wetland in the northern reaches of the Project boundary are primarily silver maple, willow and ash dominated.

Scrub/Shrub Wetland:

Scrub/shrub wetlands are dominant in the northern reaches of the Project boundary and less common to the south. These wetlands are composed of buttonbush, loosestrife (*Decodon verticillatus*, *Lythrum salicaria*), willow (*Salix petiolaris* and *Salix sericea*), with understory plants of smartweed (*Persicaria amphibia*), water-pepper (*Persicaria hydropiperoides*), southern blue flag, watercress (*Nasturtium officinale*), sensitive fern and clearweed (*Pilea pumila*). Grasses and sedges are dominated by Virginia wildrye with sedges, *Carex gracilima* and *C. vulpinoidea*.

Emergent Wetland:

Emergent wetlands occur within pockets of forested wetland, inside of reservoir inlets, and along much of the northern shoreline of the Project boundary. Some of these areas to the north are being overtaken by purple loosestrife. The majority of the reservoir is lined with broadleaf arrowhead, which then transitions into green arrow arum in the northern sections of the reservoir. Dominant species of emergent wetlands include cattail (*Typha latifolia* (with some small pockets of *Typha angustifolia*), arrowhead, green arrow arum, smartweed (*Persicaria amphibia*), water-pepper, jewelweed (*Impatiens capensis*), false nettle, pickerelweed (*Pontedaria cordata*), variegated pond-lily (*Nuphar variegata*), American white waterlily (*Nymphaea odorata*), lizard's tail, and Virginia wildrye.

Less common species include sensitive fern (*Onoclea sensibilis*), water parsnip (*Sium suave*), goldenrod (*Solidago rugosa*), aster (*Symphyotrichum puniceum*), nightshade (*Solanum dulcamara*), clearweed (*Pilea pumila*), watercress (*Nasturtium officinale*), southern blue flag, meadow rue, and duckweed (*Lemna trisulcata*).

Aquatic Vegetation:

Nearshore submerged/aquatic species occur throughout the entirety of the reservoir. Coontail occurs throughout the entire reservoir in high densities. This is followed by fanwort, which is very common. Highest densities of this non-native invasive species are mapped (Figure 2). Eurasian watermilfoil, is fairly common within the Project boundary (Figure 2). Other common aquatic species include pondweed (*Potamogeton berchtoldii*, *Stuckenia pectinate*), common waterweed (*Elodea canadensis*), and tape-grass. Crispy pondweed, also a non-native invasive species, was found in one location within the reservoir and but would require intensive further investigation to map its full extent.

Residential:

Residential areas throughout the Project boundary are mostly partially forested, but some of these areas have been cleared into manicured lawns. Canopy trees include cottonwood (*Populus deltoides*), maples (*Acer saccharum*, *Acer saccharinum*) and willow (*Salix nigra*). The shrub/mid-story layer is a mixture of native and non-native plants, including purple loosestrife, multiflora rose (*Rosa multiflora*) and dogwood (*Cornus sericia*). The herbaceous layer is made up of American water willow, Joe-pye weed (*Eutrochium maculatum*), lizard's tail, goldenrod, riverbank grape (*Vitis riparia*), *Bidens trichosperma*, jewelweed (*Impatiens capensis*), mint (*Mentha canadensis*), milkweed (*Asclepias syriaca*), false nettle, moneywort (*Lysimachia nummularia*) and Virginia wildrye, shining flat-sedge (*Cyperus bipartitus*) and white beaks-edge (*Rhynchospora alba*). Common dodder (*Cuscuta gronovii*) was also found growing amongst much of the American water willow.

Table 2. List of Species at Constantine Reservoir, August-September 2019

Scientific Name	Common Name	Status
<i>Abutilon theophrasti</i>	Velvetleaf	Non-native
<i>Acalypha rhomboidea</i>	Common copperleaf	Native
<i>Acer negundo</i>	Boxelder maple	Native
<i>Acer saccharinum</i>	Silver maple	Native
<i>Acer saccharum</i>	Sugar maple	Native
<i>Alnus incana</i>	Speckled alder	Native
<i>Ambrosia artemisiifolia</i>	Common ragweed	Native
<i>Amphicarpaea bracteata</i>	Hog peanut	Native
<i>Asarum canadense</i>	Canadian wild ginger	Native
<i>Asclepias incarnata</i>	Swamp milkweed	Native
<i>Asclepias syriaca</i>	Common milkweed	Native
<i>Asimina triloba</i>	Common pawpaw	Native
<i>Asplenium platyneuron</i>	Ebony spleenwort	Native
<i>Bidens cernua</i>	Nodding beggarticks	Native
<i>Bidens frondosa</i>	Devil's beggarticks	Native
<i>Bidens trichosperma</i>	Marsh Tickseed	Native
<i>Boehmeria cylindrica</i>	False nettle	Native
<i>Cabomba caroliniana</i>	Carolina fanwort	Non-native
<i>Carex gracillima</i>	Sedge	Native
<i>Carex vulpinoidea</i>	Fox sedge	Native
<i>Carya glabra</i>	Pignut hickory	Native
<i>Carya cordiformis</i>	Bitternut hickory	Native

Scientific Name	Common Name	Status
<i>Catalpa speciosa</i>	Northern catalpa	Non-native
<i>Celastrus orbiculatus</i>	Oriental bittersweet	Non-native
<i>Cephalanthus occidentalis</i>	Buttonbush	Native
<i>Ceratophyllum demersum</i>	Coontail	Native
<i>Cercis canadensis</i>	Eastern redbud	Native
<i>Cicuta bulbifera</i>	Water hemlock	Native
<i>Cicuta maculata</i>	Water hemlock	Native
<i>Clematis virginica</i>	Virgin's bower	Native
<i>Cornus amomum</i>	Silky dogwood	Native
<i>Cornus foemina</i>	Gray dogwood	Native
<i>Cornus sericea</i>	Red osier dogwood	Native
<i>Cuscuta gronovii</i>	Common dodder	Native
<i>Cyperus bipartitus</i>	Shining flatsedge	Native
<i>Cyperus strigosus</i>	Long scaled nut sedge	Native
<i>Decodon verticillatus</i>	Swamp loosestrife	Native
<i>Dioscorea villosa</i>	Wild yam	Native
<i>Elaeagnus umbellata</i>	Autumn olive	Non-native
<i>Elodea canadensis</i>	Common waterweed	Native
<i>Elymus virginicus</i>	Virginia wildrye	Native
<i>Equisetum arvense</i>	Field horsetail	Native
<i>Erigeron annuus</i>	Annual fleabane	Native
<i>Erigeron strigosus</i>	Daisy fleabane	Native
<i>Eutrochium maculatum</i>	Spotted Joe-pye weed	Native
<i>Fraxinus americana</i>	White ash	Native
<i>Fraxinus nigra</i>	Black ash	Native
<i>Fraxinus pennsylvanica</i>	Green ash	Native
<i>Galium triflorum</i>	Fragrant bedstraw	Native
<i>Geum canadense</i>	White avens	Native
<i>Glechoma hederacea</i>	Ground-ivy	Non-native
<i>Gleditsia triacanthos</i>	Honey locust	Native
<i>Hesperis matronalis</i>	Dame's rocket	Non-native
<i>Hydrocotyle americana</i>	American Water-pennywort	Native
<i>Hypericum ascyron</i>	Great St. John's wort	Native
<i>Impatiens capensis</i>	Common jewelweed	Native
<i>Iris virginica</i>	Southern blue flag	Native
<i>Juniperus virginiana</i>	Red-cedar	Native
<i>Juglans nigra</i>	Eastern black walnut	Native
<i>Justicia americana</i>	American water willow	Native, S2
<i>Leersia oryzoides</i>	Cut grass	Native
<i>Leersia virginica</i>	White grass	Native
<i>Lemna turionifera</i>	Red duckweed	Native
<i>Ligustrum vulgare</i>	Common privet	Non-native
<i>Lindera benzoin</i>	Northern spicebush	Native
<i>Liriodendron tulipifera</i>	Tulip tree	Native
<i>Lobelia cardinalis</i>	Cardinal flower	Native

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Scientific Name	Common Name	Status
<i>Lobelia siphilitica</i>	Great blue lobelia	Native
<i>Lonicera maackii</i>	Amur honeysuckle	Non-native
<i>Lonicera spp.</i>	Honeysuckle	*
<i>Lycopus americanus</i>	Common water horehound	Native
<i>Lysimachia ciliata</i>	Fringed loosestrife	Native
<i>Lysimachia nummularia</i>	Moneywort	Non-native
<i>Lythrum salicaria</i>	Purple loosestrife	Non-native
<i>Lysimachia thysiflora</i>	Tufted loosestrife	Native
<i>Melilotus officinalis</i>	Yellow sweet clover	Non-native
<i>Mentha canadensis</i>	American corn mint	Native
<i>Morus alba</i>	White mulberry	Non-native
<i>Myosotis scorpioides</i>	Forget-me-not	Non-native
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	Non-native
<i>Nasturtium officinale</i>	Watercress	Native
<i>Nuphar variegata</i>	Variegated pond-lily	Native
<i>Nymphaea odorata</i>	American white waterlily	Native
<i>Oenothera biennis</i>	Common evening-primrose	Native
<i>Onoclea sensibilis</i>	Sensitive fern	Native
<i>Osmunda claytonii</i>	Interrupted fern	Native
<i>Oxalis dillenii</i>	Common yellow wood sorrel	Native
<i>Peltandra virginica</i>	Green arrow arum	Native
<i>Persicaria hydropiperoides</i>	Water-pepper	Native
<i>Persicaria amphibia</i>	Water smartweed	Native
<i>Persicaria robustior</i>	Stout smartweed	Native
<i>Persicaria sagittata</i>	Arrow-leaved tearthumb	Native
<i>Persicaria virginiana</i>	American jumpseed	Native
<i>Phalaris arundinaceae</i>	Reed canary grass	Non-native
<i>Physostegia virginiana</i>	False dragonhead	Native
<i>Phytolacca americana</i>	American pokeweed	Native
<i>Pilea pumila</i>	Canada clearweed	Native
<i>Platanus occidentalis</i>	American sycamore	Native
<i>Poa compressa</i>	Canada bluegrass	Non-native
<i>Poa spp.</i>	Meadow-grass	*
<i>Podophyllum peltatum</i>	Mayapple	Native
<i>Polystichum acrostichoides</i>	Christmas fern	Native
<i>Pontederia cordata</i>	Pickerelweed	Native
<i>Populus deltoides</i>	Eastern cottonwood	Native
<i>Populus grandidentata</i>	Bigtooth aspen	Native
<i>Potamogeton berchtoldii</i>	Pondweed	Native
<i>Potamogeton crispus</i>	Crispy pondweed	Non-native
<i>Quercus alba</i>	White oak	Native
<i>Quercus bicolor</i>	Swamp white oak	Native
<i>Quercus macrocarpa</i>	Bur oak	Native
<i>Quercus palustris</i>	Pin oak	Native
<i>Quercus rubra</i>	Northern red oak	Native

Scientific Name	Common Name	Status
<i>Quercus velutina</i>	Black oak	Native
<i>Ranunculus flabellaris</i>	Yellow water crowfoot	Native
<i>Rhynchospora alba</i>	White beak-sedge	Native
<i>Ribes americanum</i>	Wild black currant	Native
<i>Ribes cynosbati</i>	Prickly gooseberry	Native
<i>Robinia spp.</i>	Locust	Non-native
<i>Rosa multiflora</i>	Multiflora rose	Non-native
<i>Rubus occidentalis</i>	Black raspberry	Native
<i>Rumex obtusifolius</i>	Broad-leaved dock	Non-native
<i>Rumex verticillatus</i>	Swamp dock	Native
<i>Sagittaria latifolia</i>	Broadleaf arrowhead	Native
<i>Salix sericea</i>	Silky willow	Native
<i>Salix petiolaris</i>	Slender willow	Native
<i>Salix nigra</i>	Black willow	Native
<i>Sambucus canadensis</i>	American black elderberry	Native
<i>Sanicula trifoliata</i>	Black snakeroot	Native
<i>Sassafras albidum</i>	Sassafras	Native
<i>Saururus cernuus</i>	Lizard's tail	Native
<i>Scutellaria lateriflora</i>	Side-flowering skullcap	Native
<i>Sium suave</i>	Water parsnip	Native
<i>Smilax ecirrata</i>	Upright carrion flower	Native
<i>Solanum dulcamara</i>	Bittersweet nightshade	Non-native
<i>Solidago rugosa</i>	Rough-leaved goldenrod	Native
<i>Sparganium spp.</i>	Bur-reed	Native
<i>Stachys tenuifolia</i>	Smooth hedgenettle	Native
<i>Stuckenia pectinata</i>	Sago pondweed	Native
<i>Symphotrichum lateriflorum</i>	Calico aster	Native
<i>Symphotrichum puniceum</i>	Swamp aster	Native
<i>Symplocarpus foetidus</i>	Eastern skunk cabbage	Native
<i>Teucrium canadense</i>	American germander	Native
<i>Thalictrum dasycarpum</i>	Purple meadow rue	Native
<i>Thelypteris noveboracensis</i>	New York fern	Native
<i>Tilia americana</i>	Basswood	Native
<i>Toxicodendron vernix</i>	Poison sumac	Native
<i>Toxicodendron radicans</i>	Poison ivy	Native
<i>Typha angustifolia</i>	Narrow-leaved cattail	Non-native
<i>Typha latifolia</i>	Broadleaf cattail	Native
<i>Ulmus americana</i>	American elm	Native
<i>Ulmus pumila</i>	Siberian elm	Non-native
<i>Urtica dioica</i>	Stinging nettle	Native
<i>Vallisneria americana</i>	Tape-grass	Native
<i>Verbena hastata</i>	Blue vervain	Native
<i>Verbena urticifolia</i>	White vervain	Native
<i>Vernonia missurica</i>	Missouri ironweed	Native
<i>Viburnum lentago</i>	Nannyberry	Native

Scientific Name	Common Name	Status
<i>Viola spp.</i>	Violet	*
<i>Vitis riparia</i>	Riverbank grape	Native

*Not enough material for ID

6. Summary and Discussion

The botanical resources of the Constantine Hydroelectric Project boundary were inventoried in August and September 2019. Specific attention was given to the discovery of state and federal RTE species, such as wild rice, water willow and eastern prairie fringed orchid, as well as the presence and abundance of invasive plant species, such as, Eurasian watermilfoil, purple loosestrife, Carolina fanwort and crispy pondweed.

Principal habitat types were described as a result of the inventory and consisted primarily of a mixture of floodplain forested communities, residential areas and scrub/shrub and emergent wetlands.

Results were compared to historical inventories from the Michigan Natural Features Inventory, previous assessments and historical (pre-reservoir) maps. Notable differences were noted between the southern, midsection and northern reaches of the Project. A diverse community of a total of 159 native and non-native plant species were identified in the 2019 assessment (Table 2). American water willow was documented during the inventory, whereas other RTE plants species (i.e., wild rice and eastern prairie fringed orchid) were absent from the Project boundary.

Twenty-three non-native plants were discovered in the inventory, including Iberian elm, narrow leaf cattail, bittersweet nightshade, broad-leaved dock, multiflora rose, locust, crispy pondweed, Canada bluegrass, reed canary grass, Eurasian watermilfoil, forget-me-not, white mulberry, yellow sweet clover, purple loosestrife, moneywort, amur honey suckle, common pivot, Dame's rocket, ground ivy, autumn olive, oriental bittersweet, northern catalpa, Carolina fanwort and velvet leaf. The Constantine PAD outlined four species; Carolina fanwort, purple loosestrife, Eurasian watermilfoil, and crispy pondweed from the above list as non-native, special concern species. Locations of these invasive plants were recorded in the field during the Botanical Resources Survey and referenced 2019 map data from the annual Constantine Invasive Species Survey conducted by GLEC for I&M (GLEC 2019). The locations of these invasive plant species are presented in Figure 2. The remaining non-native/invasive species of concern were found to be much less abundant.

Purple loosestrife abundance was noted as a specific threat to the existing wetlands, particularly in the northern sections of the Project boundary. Eurasian watermilfoil was also noted as becoming more abundant than previously noted in the other assessments. Both purple loosestrife and Eurasian watermilfoil have the greatest potential to significantly alter the native habitats in the wetland and off-shore aquatic communities in the Project area.

Based on this assessment and the annual invasive species assessments, it continues to appear that in general, the light and heavy infestations within the Project boundary continue to increase including the Eurasian watermilfoil. The overall assessment of the botanical resources at the Constantine Project remains similar to that described in the PAD and the 1993 assessment (FERC 1993).

6.1. Variances from FERC-Approved Study Plan

The actual Botanical Resources Survey and study methods applied some interpretations of and minor variances from the method details outlined in Section 6 Botanical Resources Study of the March 15, 2019 RSP. Under Task 6.6.1 Desktop Mapping of Vegetation, the RSP indicates that I&M “will obtain high-resolution aerial imagery to characterize the vegetation in the Project area, to the extent practical.” For this study, the research biologists and GIS specialists utilized standard satellite imagery provided by Google Earth and ESRI ArcMap streaming services for feature interpretation. No other “special” high resolution imagery was obtained or utilized for the study.

Existing information regarding botanical resources in the Project area, presented in Section 5.5 of the PAD, classifies the vegetation as a “mixed hardwood community of predominantly oak, with some ash, beech, hickory, maple, cottonwood, and aspen” and falling within the Beech-Maple Association of Eastern Deciduous Forest (I&M 1988, Bailey 1978). For this study, the classification and description scheme developed by the Michigan Natural Features Inventory was used to update and further expound upon the forest cover types (Kost et al. 2007). Preliminary descriptions of the Project area state that along its lower third, the reservoir is largely within pre-existing river banks and is bordered by a fringe of trees, while along the upper two-thirds of the reservoir the river often covers more extensive (up to 1,200 feet) widths of lowland areas (I&M 1988). Upon the completion of Meander surveys and a full species list, this study determined that this fringe of trees within the lower third, to half, of the reservoir is more specifically classified as floodplain forest and the lowland areas within the upper reaches of the reservoir are primarily forested and emergent wetlands, dominated by willow (*Salix spp.*) and silver maple trees (Figure 3).

7. Botanical Survey Photographs



Scrub-shrub islands in the northern reaches, typically lined with bull lily, American white lily, and green arrow arum (*Peltandra virginica*)



Dense fanwort population



Water-willow in residential area



Typical size water-willow population



Shoreline showing coontail in water, water-willow along shoreline, floodplain forest on banks



Bull lily nearshore with scrub-shrub wetland along shoreline



Water-willow and lizard's tail - common throughout the southern reaches of the reservoir



Aquatic coontail - found throughout the entirety of the reservoir



Pocket of emergent wetland along southeast project boundary



One of many small inlets along shoreline



Justica americana - American water-willow



Justica americana - American water-willow



Justica americana - American water-willow

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Appendix C. Shoreline Stability Assessment

Shoreline Stability Assessment Report

Constantine Project (FERC No. 10661)
March 31, 2020

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1. Project Introduction and Background

Indiana Michigan Power Company (I&M), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 1.2 megawatt Constantine Hydroelectric Project (Project) (FERC No. 10661). The Project is located along the St. Joseph River in the Village of Constantine in St. Joseph County, Michigan.

I&M operates and maintains the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on September 30, 2023. I&M is pursuing a subsequent license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR § 5.15, I&M has conducted studies as provided in the March 15, 2019 Revised Study Plan (RSP) and schedule approved in the Commission's April 9, 2019 Study Plan Determination (SPD) for the Project. This report describes the methods and results of the Shoreline Stability Assessment Study conducted in support of preparing an application for a subsequent license for the Project.

During the preparation of the Pre-Application Document (PAD), I&M proposed to conduct a Shoreline Stability Assessment Study at the Project to identify sites of erosion or shoreline instability. Comments on the PAD were received from Michigan Department of Natural Resources (MDNR) related to geology and soil resources, specifically related to potential erosion as a result of Project operations. In their comments on the November 16, 2018 Proposed Study Plan (PSP), FERC suggested additional requirements for the study, which have been incorporated into Section 7.6.2 of the RSP and performed as part of the 2019 study.

Shoreline erosion is a common concern at hydroelectric projects. While the Project's run-of-river mode of operation provides protection against erosion, I&M recognizes that aspects of the Project's geological setting may contribute to the potential for shoreline erosion. Additionally, private shoreline activities may also contribute to shoreline erosion and instability.

2. Study Goals and Objectives

In accordance with I&M's RSP and the Commission's SPD for the Project, the goal of the Shoreline Stability Assessment Study was to identify sites of erosion and shoreline stability in the Project area. The specific objectives of this study were as follows:

- Survey the Project's reservoir, bypass reach and tailrace area to characterize the shoreline, with the focus on erosion or shoreline instability;
- Inventory, map, and document any areas of erosion or shoreline instability;
- Develop a scoring system to identify areas that have a potential to erode at unnaturally high rates; and
- Prioritize any areas where remedial action or further assessment may be needed.

3. Study Area

The study area for the Shoreline Stability Assessment Study is the Project's reservoir, from the Constantine Road bridge downstream to the dam, bypass reach and tailrace area downstream of the powerhouse to the Business Route 131 Bridge (Figure 1). The reservoir embankment is approximately 650 feet long. The dike has a maximum height of approximately 20 feet and is constructed of sand. In 2014, the top of the embankment was raised to elevation 790. The downstream side of the embankment was reshaped to the present slope in 1987 and 2004. In 2004, sheet piles were installed on the downstream right end of the embankment (the length of the line of sheeting was 150 feet). The side slopes are about 2:1, horizontal to vertical (estimated in the field) on the upstream side and 2:1, horizontal to vertical, to nearly flat (flush with native ground) on the downstream side (I&M 2018).

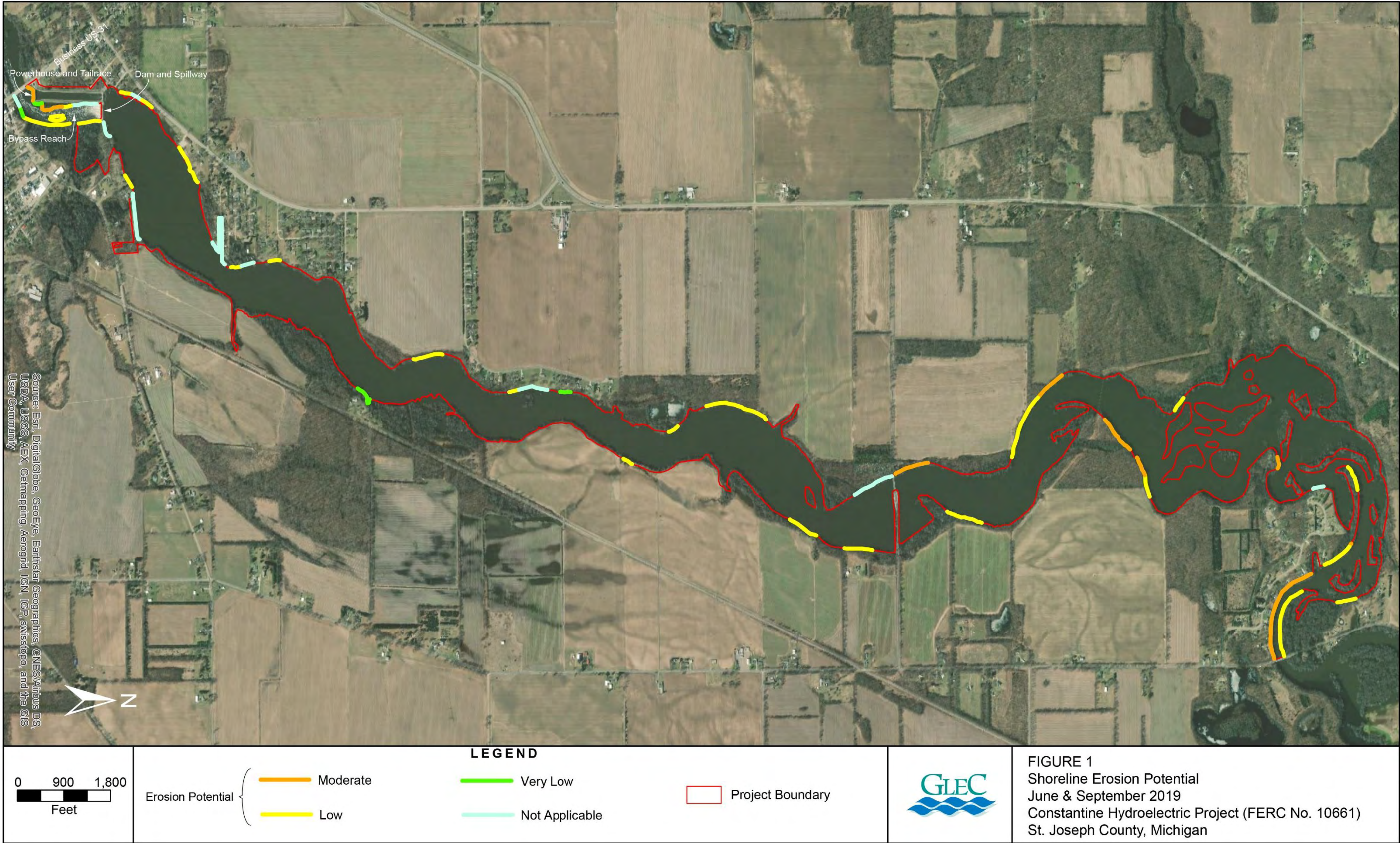


Figure 1. Shoreline Erosion Potential

4. Methodology

4.1. Literature Review

Great Lakes Environmental Center (GLEC) reviewed existing information on soils in the study area including soil survey maps and geologic maps as provided in Pre-Application Document (PAD) (I&M 2018) in Sections 5.2 Geology and 5.6 Wetlands, Littoral, and Riparian Habitat as well as the USDA soil survey of St. Joseph County (United States Department of Agriculture [USDA] 1983). Existing information was combined with information collected through field observations and field measurements to assess bank composition and erosion potential in the Project study area.

4.2. Shoreline Survey

Field surveys were conducted on June 2-4 and September 24-27, 2019 to characterize the shoreline of the Project's reservoir from the Constantine Road Bridge downstream to the US 131 Business Route Bridge in Constantine, Michigan. GLEC conducted the shoreline survey when the St. Joseph River was at a normal flow rate for June and September. Additionally, GLEC obtained hourly flow data from the U.S. Geological Survey (USGS) gage on the St. Joseph River at Mottville, Michigan (gage no. 04099000) (Appendix C) and a record of the daily maximum and minimum water surface elevations in the Constantine reservoir during the shoreline survey.

GLEC used the modified Bank Erosion Hazard Index (BEHI) method proposed by David Rosgen (Rosgen 2001) as the Standard Operating Procedure for assessing bank erosion and estimating erosion potential at the Project (Appendix A). For each area assessed, observations of vegetative cover, quantity of material, height, and slope of bank, existing erosion control mechanisms, soil or rock type, composition, and thickness of various bank materials or strata, and other relevant data were recorded on standardized field forms (Appendix B). Other factors contributing to bank erosion in the study area were identified and recorded. A Global Positioning System (GPS) was used to locate each of the assessed areas and representative photographs were taken at each location and are provided as figures in Section 7 of this report. A thematic map describing the erosion potential of the assessed areas is provided in Figure 1.

4.2.1. Modified Bank Erosion Hazard Index

The modified BEHI procedure consists of four observational metrics. A brief description of each metric is provided below. Point values for these metrics (Table 1) were assigned after a sufficient length of the river channel was examined (at least 200 feet), so that representative conditions were identified. Conditions on both banks were assessed, and scored independently.

Table 1. Metric Scores for the Modified BEHI used for the 2019 AEP Constantine Hydroelectric Project Shoreline Stability Study.

BEHI Category	Root Depth Values	Root Depth Scores	Root Density (%)	Root Density Scores	Surface Protection (Avg. %)	Surface Protection Scores	Bank Angle (degrees)	Bank Angle Scores	Total Score, by Category
Very low	90-100	1.45	80-100	1.45	80-100	1.45	0-20	1.45	≤ 5.8
Low	50-89	2.95	55-79	2.95	55-79	2.95	21-60	2.95	5.8 – 11.8
Moderate	30-49	4.95	30-54	4.95	30-54	4.95	61-80	4.95	11.9 – 19.8
High	15-29	6.95	15-29	6.95	15-29	6.95	81-90	6.95	19.9 – 27.8
Very high	5-14	8.5	5-14	8.5	10-14	8.5	91-119	8.5	27.9 – 34.0
Extreme	< 5	10	< 5	10	< 10	10	> 119	10	34.1 – 40

Ratio of root depth to bank height. Root depth is the ratio of the average plant root depth to the bank height, expressed as a percent (e.g., roots extending 2' into a 4' tall bank = 0.50).

Root density. Root density, expressed as a percent, is the proportion of the stream bank surface covered (and protected) by plant roots (e.g., a bank whose slope is half covered with roots = 50%).

Surface protection. Surface protection is the percentage of the stream bank covered (and therefore protected) by plant roots, downed logs and branches, rocks, etc. In many streams in southern Michigan, surface protection and root density are synonymous.

Bank angle. Bank angle is the angle of the bank from the waterline at base flow to the top of the bank, as opposed to benches that are higher on the floodplain. Bank angles greater than 90 degrees occur on undercut banks. Bank angle can be measured with a clinometer, though given the broad bank angle categories (Table 1), visual estimates are generally sufficient. Bank angle is perhaps the metric most often estimated incorrectly.

It is important to note that the BEHI procedure was originally developed for un-impounded rivers and streams, and BEHI scoring is confounded by hardened (armored) shorelines (e.g., rip rap, concrete, pilings etc.). Consequently, any field observation must take that into consideration and best professional judgment was exercised in this instance to account for that on the field data sheets.

4.2.2. Index Scoring and Interpretation

A draft field sheet for recording observations for the modified BEHI procedure is provided in Appendix A. Overall scores for the modified BEHI are calculated by summing the scores for each individual metric using the values in Table 1. The overall BEHI score corresponds to an erosion hazard category. Score categories are based on a scale from 5.8 to 40; a score of 5.8 or below is rated as Very Low, 5.9 to 11.8 is rated as Low, 11.9 to 19.8 is rated as Moderate, 19.9 to 27.8 is rated as High, 27.9 to 34.0 is rated as Very High, and a score greater than 34.0 is rated as Extreme. It should be noted that the overall BEHI scores and categories were created by Rosgen's work in the Rocky Mountain States, and in the future, these may be modified for conditions in Michigan.

4.2.3. Index Quality Control

Due to the subjective nature of this procedure, BEHI metric scores were verified by review of the photographs taken at each assessed site. The review was conducted by a GLEC senior field biologist familiar with the Project site. Several sites within the Project were visited in June and again in September to assess the precision of observations recorded. The senior field biologist was on the Project site during the September assessment. Several assessed sites were located in high traffic areas. According to the method outlined in Appendix A, shoreline areas located in high traffic areas such as parks, livestock crossings, highly landscaped lawns, etc. are not representative of average conditions and should be avoided unless they are the specific focus of the study. In the instances where sites were located in these high traffic areas, values for each metric were recorded, but score categories were not calculated and recorded as NA (Not Applicable). NA sites were also the result of complete armoring of the bank near the dam and powerhouse and/or extensive landscaping near homes and in parks.

5. Study Results

Observations for the 2019 Shoreline Stability Assessment of the reservoir and bypass reach were made during the June 2-4 and September 24-27, 2019 sampling events. Assessed sites were located at various points along the shoreline within the reservoir and bypass reach. Sites were labeled according to their location in the bypass reach or the reservoir. During the June sampling event, 57 sites were evaluated, and the results are listed in Table 2 in **Section 8** of this report. Of the 57 sites evaluated, 12 were located in the bypass reach and 45 were located in the reservoir. During the September sampling event, 31 sites were evaluated, and the results are listed in Table 3. Of the 31 sites evaluated, 8 were located in the bypass reach and 23 were located in the reservoir. Examples of the assessed locations are given in Figures 2-20 in **Section 7** of this study report.

5.1. Bypass Reach

5.1.1. June Assessment

Twelve individual sites were assessed during the June sampling event in the bypass reach (Table 2). BEHI scores ranged from Very Low to Moderate in applicable sites in this area. Three sites were listed as NA due to shoreline armoring. Figure 2 shows the complete armoring of the shoreline at site BA02.

Three bypass reach sites did show some limited signs of erosion and scored in the Moderate category. Site BA03 showed an area of erosion against the Business Route 131 Bridge at the downstream end of the assessment area (Figure 3). The increase in slope and a decrease in plant root density places site BA03 in the Moderate category. Sites BA05 and BA06 scored in the Moderate category due to the increased slope of the bank in this area and the decrease in surface protection of the bank at the water surface (Figures 4 and 5). The remaining sites were assessed as Very Low to Low due to the shallow bank angle, and increased surface protection and root density at these locations (Figures 6 and 7).

5.1.2. September Assessment

Eight sites were assessed during the September sampling event in the bypass reach (Table 3). BEHI scores ranged from Low to Moderate in applicable sites. Four sites were revisited, BA05 and BA06 were

assessed as a single site. The BEHI score categories remained relatively unchanged with the exception of BA10 and BA11. The score categories changed from Very Low to Low most likely due to a drop in the water levels during this sampling period. The tailrace water surface elevations were 0.8-0.9 feet lower than the June assessment period. The lower water levels likely contributed to the increase in surface protection and root density scores resulting in a slightly higher total score.

One localized spot of erosion was observed in September in the bypass reach. Figure 8 shows one localized erosion area of concern near the dam. The lack of vegetation above the steel bulkhead and concrete are allowing for increased erosion in this localized area. This site was not observed in June due to the higher water levels (Table 4) and current velocity in the bypass reach. The lower water levels in September allowed for access to the entire bypass reach up to the dam.

5.2. Reservoir Area

5.2.1. June Assessment

A total of 45 individual reservoir sites were assessed during the June sampling event. Sites were located from the Constantine Road Bridge downstream to the dam. BEHI scores ranged from Very Low to Moderate in applicable sites. Eleven sites were set aside as NA due to the high degree of armoring along the banks or the presence of intensive landscaping in the areas near homes (Table 2). An example of shoreline armoring within the reservoir from site SJR45 is shown in Figure 9, and an example of intensive landscaping from SJR17 is shown in Figure 10.

An area along the left descending bank downstream of the Constantine Road Bridge scored in the Moderate erosion category. Sites SJR05 through SJR12 are located in a more riverine section of the Project. These sites are located along an outside bend with homes located within 100 feet of the shoreline. The steep slope of the bank, removal of some riparian vegetation for lawns, and the increased current velocity along the outside bend, place this section in the Moderate erosion category. Figures 11 and 12 show the steep slopes and addition of homes along this 1,600 foot section of shoreline. Moderate erosion was also present at sites SJR15 and SJR21-23. An increase in the bank angle and a decrease in root density resulted in the higher scores at these sites. Figures 13 and 14 show examples of the increased slope and reduced root density at these locations.

The remainder of the applicable reservoir sites assessed in June scored in the Low or Very Low category. The decrease in the bank angle and increase in root density and surface protection reduce the risk of erosion at these locations. Sites SJR27 (Figure 15) and SJR39 (Figure 16) are developed with buildings and lawns, but a decreased risk of erosion.

5.2.2. September Assessment

A total of 31 reservoir sites were assessed during the September sampling visit. The BEHI scores ranged from Low to Moderate at all 31 locations. The number of sites revisited in September totaled 19. Several of the 19 sites revisited were grouped together and given an individual score. Sites grouped together are noted in Table 3. The revisited sites yielded the same results as the June sampling. Moderate erosion was again noted from SJR05V2-SJR12V2 and SJR19V2-SJR20V2. Site SJR15V2 had a slight change in score from Moderate to Low. This score change likely is the result of grouping this site with two sites that scored low in June SJR13 and SJR14. Two additional sites were scored as Moderate in September. Site

SJR49 (Figure 17) and SJR53 (Figure 18) scored in the Moderate category due to their bank angle. The remaining 19 sites scored in the low category. Figures 19 and 20 show adequate surface protection, root depth, and root density along with less steep bank angles to score in the Low erosion risk category.

5.3. Revisited Sites

During the September sampling visit, 19 sites that were assessed in June were revisited. Four sites were located in the bypass reach and 15 were located in the reservoir. The 15 reservoir sites were primarily located at the upstream portion of the Project area near the Constantine Road Bridge. Score categories remained the same between visits at 16 of the 19 sites. Two sites in the bypass reach BA05 and BA06, changed in score from the Very Low category to Low, and one site in the reservoir changed from Moderate to Low. The slight change in category was likely the result of changing water levels in the bypass reach. Water levels were lower during the September sampling visit by 0.8-0.9 feet on each sampling day (Table 4). The slight change in the reservoir at site SJR15 was likely due to grouping this site along with SJR13 and SJR14. Grouping these sites changed the bank angle score resulting in a category change to Low.

6. Summary and Discussion

In summary, primary observations and conclusions from the Shoreline Stability Study are:

- In June, modified BEHI scores in the Project area ranged from Very Low to Moderate at 57 individual sites. In the bypass reach, sites were scored as; 5 Very Low, 1 Low, 3 Moderate, and 3 NA. In the reservoir area, sites were scored as; 2 Very Low, 20 Low, 12 Moderate, and 11 NA.
- In September, BEHI scores in the Project area ranged from Low to Moderate at 39 sites. In the bypass reach, sites scored as; 5 Low, 2 Moderate, and 1 NA. In the reservoir area, sites were scored as; 19 Low and 12 Moderate.
- Based on observations used to calculate the modified BEHI, three areas may require additional assessment to confirm and possibly mitigate potential future erosion hazards within the Project:
 - 1) Site BA03 located at the downstream end of the Project. This site has an area of erosion located against concrete at the base of the bridge extending under the overhanging vegetation. This erosion area is likely caused by current hitting the bank from the tailrace.
 - 2) Site BA16 located at the upstream end of the bypass reach. This isolated point has no vegetation and soil is actively falling into the bypass reach.
 - 3) In the reservoir, the area from site SJR05 to SJR12. This area is located in a more riverine section of the Project along an outside bend in the river channel. This area has had the riparian vegetation removed for home construction and maintained turf grass lawns.

6.1. Variances from FERC-Approved Study Plan

There were no variations from the study approach, methods, and reporting requirements as prescribed in the March 15, 2019 RSP for the Shoreline Stability Assessment Study (RSP Section 7).

7. Shoreline Survey Photographs - AEP Constantine Project Area 2019



Figure 2. Site BA02: Example of shoreline armoring in the bypass reach area.



Figure 3. Site BA03: Area of Moderate erosion located at the Business Route US-131 Bridge.



Figure 4. Site BA05: Moderate erosion near the water surface.



Figure 5. Site BA06: Moderate erosion near the water surface.



Figure 6. Site BA10:Very Low erosion category.



Figure 7. Site BA12:Very Low erosion category.



Figure 8. Area of localized very high erosion risk in the bypass reach area



Figure 9. Site SJR45: Example of shoreline armoring.



Figure 10. Site SJR17: An example of intensive landscaping along the shoreline within the reservoir area.



Figure 11. Site SJR09: Erosion along outside bend with roof of home in the background.



Figure 12. Site SJR10: Moderate erosion located along outside bend of river with home in background.



Figure 13. Site SJR15: Moderate erosion associated with an increase in bank angle.



Figure 14. Site SJR18: Moderate erosion associated with an increase in bank angle and a decrease in root density.



Figure 15. Site SJR27: Developed site along reservoir with Low erosion.



Figure 16. Site SJR39: Shoreline along VFW Hall.



Figure 17. Site SJR49: Moderate erosion category present due to an increase in bank angle.



Figure 18. Site SJR53: Moderate erosion only due to the bank angle.



Figure 19. Site SJR02V2: Low erosion score category with low bank angle and adequate surface protection across site.



Figure 20. Site SJR55: Low erosion score category.

8. Tables

Table 2. Modified Bank Erosion Hazard Index Scores for the Assessed Locations within the AEP Constantine Hydroelectric Project Area – Data Collected June 2-4, 2019.

Site ID	Root Depth Score	Root Density Score	Surface Protection Score	Bank Angle Score	Total Score	Score Category
Bypass Area						
BA01	1.45	1.45	1.45	1.45	5.80	Very Low
BA02	2.95	2.95	1.45	6.95	14.30	NA
BA03	2.95	8.50	1.45	2.95	15.85	Moderate
BA04	1.45	1.45	1.45	1.45	5.80	Very Low
BA05	1.45	2.95	6.95	6.95	18.30	Moderate
BA06	1.45	2.95	6.95	6.95	18.30	Moderate
BA07	1.45	1.45	1.45	2.95	7.30	Low
BA08	10.00	10.00	1.45	4.95	26.40	NA
BA09	10.00	10.00	1.45	4.95	26.40	NA
BA10	1.45	1.45	1.45	1.45	5.80	Very Low
BA11	1.45	1.45	1.45	1.45	5.80	Very Low
BA12	1.45	1.45	1.45	1.45	5.80	Very Low
Reservoir Area						
SJR01	1.45	2.95	2.95	1.45	8.80	Low
SJR02	1.45	4.95	2.95	1.45	10.80	Low
SJR03	1.45	2.95	2.95	2.95	10.30	Low
SJR04	1.45	2.95	2.95	2.95	10.30	Low
SJR05	1.45	2.95	2.95	4.95	12.30	Moderate
SJR06	1.45	4.95	1.45	4.95	12.80	Moderate
SJR07	1.45	2.95	2.95	4.95	12.30	Moderate
SJR08	1.45	4.95	1.45	4.95	12.80	Moderate
SJR09	1.45	4.95	2.95	6.95	16.30	Moderate
SJR10	1.45	2.95	2.95	6.95	14.30	Moderate
SJR11	1.45	4.95	2.95	6.95	16.30	Moderate
SJR12	1.45	4.95	2.95	6.95	16.30	Moderate
SJR13	1.45	2.95	1.45	4.95	10.80	Low
SJR14	1.45	2.95	1.45	4.95	10.80	Low
SJR15	1.45	2.95	2.95	4.95	12.30	Moderate
SJR16	1.45	2.95	4.95	1.45	10.80	Low
SJR17	1.45	8.50	1.45	4.95	16.35	NA
SJR18	2.95	4.95	2.95	4.95	15.80	Moderate
SJR19	1.45	4.95	2.95	4.95	14.30	Moderate
SJR20	1.45	4.95	4.95	2.95	14.30	Moderate
SJR21	10.00	10.00	1.45	4.95	26.40	NA

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SJR22	1.45	8.50	1.45	2.95	14.35	NA
SJR23	1.45	2.95	1.45	2.95	8.80	NA
SJR24	1.45	2.95	2.95	1.45	8.80	Low
SJR25	1.45	1.45	1.45	2.95	7.30	Low
SJR26	1.45	2.95	1.45	2.95	8.80	Low
SJR27	1.45	1.45	1.45	2.95	7.30	Low
SJR28	1.45	1.45	1.45	1.45	5.80	Very Low
SJR29	1.45	1.45	1.45	6.95	11.30	NA
SJR30	1.45	2.95	1.45	1.45	7.30	Low
SJR31	1.45	1.45	1.45	1.45	5.80	Very Low
SJR32	1.45	1.45	1.45	2.95	7.30	Low
SJR33	1.45	1.45	1.45	1.45	5.80	NA
SJR34	1.45	1.45	1.45	2.95	7.30	Low
SJR35	1.45	2.95	2.95	2.95	10.30	NA
SJR36	1.45	2.95	1.45	2.95	8.80	NA
SJR37	1.45	2.95	1.45	2.95	8.80	NA
SJR38	1.45	2.95	1.45	1.45	7.30	Low
SJR39	1.45	1.45	2.95	2.95	8.80	Low
SJR40	1.45	1.45	2.95	2.95	8.80	Low
SJR41	1.45	2.95	2.95	2.95	10.30	Low
SJR42	1.45	2.95	1.45	2.95	8.80	NA
SJR43	1.45	1.45	1.45	2.95	7.30	Low
SJR44	1.45	2.95	1.45	2.95	8.80	Low
SJR45	2.95	2.95	1.45	2.95	10.30	NA

NA – Not applicable due to a high degree of armoring along bank within assessment site.

Table 3. Modified Bank Erosion Hazard Index Scores for the Assessed Locations within the AEP Constantine Hydroelectric Project Area– Data Collected September 24-27, 2019.

Site ID	Root Depth Score	Root Density Score	Surface Protection Score	Bank Angle Score	Total Score	Score Category
Bypass Area						
BA05V2 ^a	1.45	4.95	4.95	2.95	14.30	Moderate
BA06V2 ^a	1.45	4.95	4.95	2.95	14.3	Moderate
BA10V2	1.45	2.95	2.95	2.95	10.30	Low
BA11V2	1.45	2.95	1.45	2.95	8.80	Low
BA13	1.45	2.95	4.95	1.45	10.80	Low
BA14	1.45	2.95	2.95	2.95	10.30	Low
BA15	1.45	2.95	2.95	2.95	10.30	Low
BA16	10.00	8.50	10.00	4.95	33.45	NA

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Reservoir Area						
SJR01V2 ^b	2.95	2.95	2.95	1.45	10.30	Low
SJR02V2 ^b	1.45	2.95	2.95	1.45	8.80	Low
SJR03V2 ^b	1.45	2.95	2.95	1.45	8.80	Low
SJR05V2 ^c	4.95	4.95	4.95	4.95	19.80	Moderate
SJR06V2 ^c	4.95	4.95	4.95	4.95	19.80	Moderate
SJR07V2 ^c	4.95	4.95	4.95	4.95	19.80	Moderate
SJR08V2 ^c	4.95	4.95	4.95	4.95	19.80	Moderate
SJR09V2 ^c	4.95	4.95	4.95	4.95	19.80	Moderate
SJR10V2 ^c	4.95	4.95	4.95	4.95	19.80	Moderate
SJR11V2 ^d	1.45	4.95	6.95	4.95	18.30	Moderate
SJR12V2 ^d	1.45	4.95	6.95	4.95	18.30	Moderate
SJR13V2 ^e	2.95	2.95	2.95	2.95	11.80	Low
SJR14V2 ^e	2.95	2.95	2.95	2.95	11.80	Low
SJR15V2 ^e	2.95	2.95	2.95	2.95	11.80	Low
SJR16V2	1.45	2.95	2.95	1.45	8.80	Low
SJR19V2	2.95	4.95	2.95	2.95	13.80	Moderate
SJR20V2	2.95	4.95	2.95	2.95	13.80	Moderate
SJR24V2 ^f	1.45	2.95	2.95	2.95	10.30	Low
SJR25V2 ^f	1.45	2.95	2.95	2.95	10.30	Low
SJR46	1.45	2.95	2.95	2.95	10.30	Low
SJR47	1.45	1.45	1.45	2.95	7.30	Low
SJR48	2.95	2.95	2.95	2.95	11.80	Low
SJR49	2.95	2.95	2.95	4.95	13.80	Moderate
SJR50	2.95	2.95	2.95	2.95	11.80	Low
SJR51	2.95	2.95	2.95	2.95	11.80	Low
SJR52	1.45	2.95	2.95	2.95	10.30	Low
SJR53	1.45	2.95	2.95	4.95	12.30	Moderate
SJR54	1.45	2.95	2.95	2.95	10.30	Low
SJR55	1.45	2.95	2.95	2.95	10.30	Low
SJR56	1.45	2.95	2.95	2.95	10.30	Low
SJR57	1.45	2.95	2.95	2.95	10.30	Low

a, b, c, d, e, f – Combined as individual sites during the September Assessment

NA - Not applicable due to a high degree of armoring along bank within assessment site.

Table 4. Water surface elevations at the Constantine Project during the Shoreline Stability Assessment (June and September 2019).

Date	Forebay Elevation (ft)			Raceway Elevation (ft)			Tailwater Elevation (ft)		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
6/2/2019	783.3	783.3	783.3	783.3	783.3	783.3	772.2	772.2	772.3
6/3/2019	783.2	783.2	783.3	783.2	783.2	783.3	772.2	772.1	772.2
6/4/2019	783.2	783.2	783.2	783.2	783.2	783.3	772.1	772.1	772.2
9/24/2019	782.9	782.9	782.9	782.9	782.9	782.9	771.3	771.3	771.4
9/25/2019	782.9	782.9	782.9	782.9	782.9	782.9	771.3	771.2	771.4
9/26/2019	782.9	782.9	782.9	782.9	782.9	782.9	771.3	771.2	771.3
9/27/2019	782.9	782.9	783.0	782.9	782.9	782.9	771.3	771.2	771.5

9. References

Indiana Michigan Power Company (I&M). 2018. Constantine Hydroelectric Project (FERC No. 10661). Notice of Intent and Pre-Application Document. Federal Energy Regulatory Commission, Washington, D.C. June 4, 2018.

Rosgen, D.L. 2001. A Practical Method of Computing Streambank Erosion Rate. Proceedings of the Seventh Federal Interagency Sedimentation Conference, Vol. 2, pp. II - 9-15, March 25-29, 2001, Reno, NV.

Appendix A. Rosgen SOP

STANDARD OPERATING PROCEDURE

ASSESSING BANK EROSION POTENTIAL USING ROSGEN'S BANK EROSION HAZARD INDEX (BEHI)

1.0 Overview

While stream bank erosion is a natural process that occurs in every watershed, excessive erosion has serious adverse consequences for the physical and biological function of rivers. Eroding stream banks can be a major source of sediment to a stream (up to 80% of the annual load; Simon and Thorne, 1996), and human activities such as urbanization or dam construction can accelerate bank erosion rates by more than an order of magnitude. It is often difficult, however, to distinguish between stream banks that are eroding at a natural rate from those that are or have the potential to erode at unnaturally high rates due to altered watershed hydrology or sediment loads. The Bank Erosion Hazard Index (BEHI), created by Dave Rosgen of Wildland Hydrology, Inc. (Rosgen, 2001), is one of several procedures for assessing stream bank erosion condition and potential. It assigns point values to several aspects of bank condition and provides an overall score that can be used to inventory stream bank condition over large areas, prioritize eroding banks for remedial actions, etc. This standard operating procedure (SOP) describes two versions of the BEHI technique.

2.0 Procedure

Below are descriptions of two BEHI procedures. The first describes the complete BEHI procedure created by Rosgen, including identification of bankfull width. The second describes a modified BEHI procedure, which does not require identification of bankfull width. The modified BEHI procedure is intended for use by workers who lack experience in identifying bankfull indicators, including volunteer monitors. Correctly identifying appropriate bankfull indicators requires considerable experience, and is the most subjective step in the original BEHI procedure.

In truth, both procedures described below are 'modified', in that the step of calculating BEHI scores has been simplified such that there is only a single score for each metric, rather than the range of possible scores provided in Rosgen's original paper. This simplification is intended to remove some unnecessary subjectivity from the field observations, without overly reducing the utility of the procedure.

A. Complete BEHI Procedure

The complete BEHI procedure consists of five metrics; four observational and one requiring some measurements. They are:

1. Ratio of bank height to bankfull height
2. Ratio of root depth to bank height

3. Root density, in percent
4. Bank angle, in degrees
5. Surface protection, in percent

Brief descriptions of each metric are provided below.

Point values for these metrics (Table 1) should only be assigned after a sufficient length of the stream channel (the 'stream reach') has been examined (at least 100'; 2 to 3 meander lengths is preferable), so that representative conditions are identified. Conditions on both banks should be assessed, and scored separately if they are consistently different. See Section 4 for further advice on where to make – and not make – the observations.

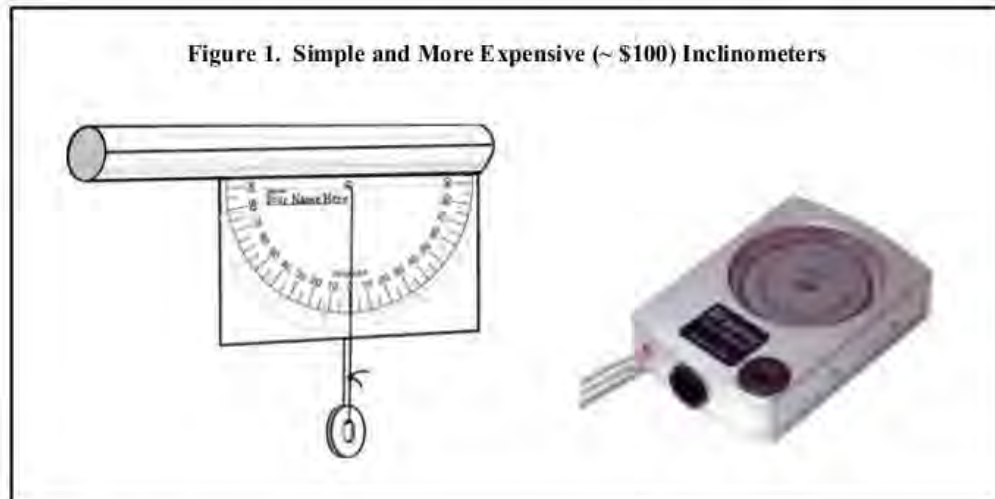
Ratio of bank height to bankfull height. This is the most challenging of the BEHI metrics, as it requires accurate identification of bankfull indicators. A full discussion of different bankfull indicators is beyond the scope of this SOP, but it is thoroughly discussed in Williams (1978), and a useful free video is available from the U.S. Forest Service (2003). Common bankfull indicators in stable southern Michigan streams include top of bank, top of point bars, and other changes in channel slope. Vegetative indicators are seldom useful in southern Michigan streams. Bankfull indicators in unstable streams (i.e., incising or aggrading streams) can be more difficult to identify, but are usually less than top of bank.

Ratio of root depth to bank height. Root depth is the ratio of the average plant root depth to the bank height, expressed as a percent (e.g., roots extending 2' into a 4' tall bank = 0.50.)

Root density. Root density, expressed as a percent, is the proportion of the stream bank surface covered (and protected) by plant roots (e.g., a bank whose slope is half covered with roots = 50%).

Surface protection. Surface protection is the percentage of the stream bank covered (and therefore protected) by plant roots, downed logs and branches, rocks, etc. In many streams in southern Michigan, surface protection and root density are synonymous.

Bank angle. Bank angle is the angle of the "lower bank" – the bank from the waterline at base flow to the top of the bank, as opposed to benches that are higher on the floodplain. Bank angles great than 90° occur on undercut banks. Bank angle can be measured with an inclinometer (Figure 1), though given the broad bank angle categories (Table 1), visual estimates are generally sufficient. Bank angle is perhaps the metric most often estimated incorrectly.



B. Modified BEHI Procedure

If the field staff lack experience with identifying bank full indicators, it is recommended that the bank height/bankfull height ratio metric be dropped from the BEHI calculation, leaving four metrics:

1. Ratio of root depth to bank height
2. Root density, in percent
3. Surface protection, in percent
4. Bank angle, in degrees

Observations for these metrics are made as described in Section 2A, and the overall BEHI score is calculated using Table 2.

3.0 Data Calculation and Interpretation

A draft field sheet for recording observations for the modified BEHI procedure is in Appendix 1. Overall scores for the Complete BEHI are calculated by summing the scores for each individual metric using the values in Table 1, and scores for the Modified BEHI are similarly calculated using the values in Table 2. The overall BEHI score corresponds to an erosion hazard category. It should be noted that the overall BEHI scores and categories were created by Rosgen's work in the Rocky Mountain states, and in the future these may be modified for conditions in Michigan. Illustrated examples from southern Michigan streams are in Appendix 2.

BEHI scores have several potential uses, including ranking multiple stations for further study or remedial actions (Figure 2).

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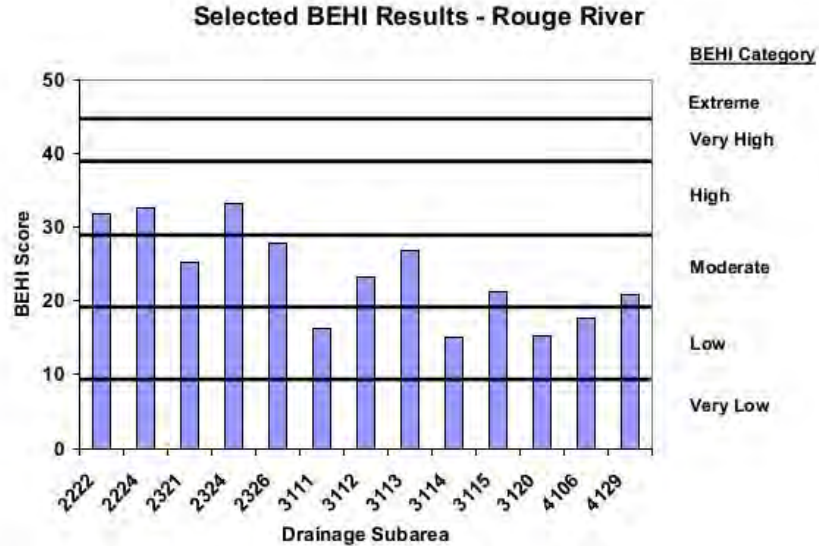
Table 1. Scores for the Complete BEHI.

BEHI Category	Bank Height/ Bankfull Height	BH/BFH Score	Root Depth (% of BFH)	Root Depth Score	Root Density (%)	Root Density Score	Surface Protection (Avg. %)	Surface Protection Score	Bank Angle (degrees)	Bank Angle Score	Total Score, by Category
Very low	1.0-1.1	1.45	90-100	1.45	80-100	1.45	80-100	1.45	0-20	1.45	≤ 7.25
Low	1.11-1.19	2.95	50-89	2.95	55-79	2.95	55-79	2.95	21-60	2.95	7.26 – 14.75
Moderate	1.2-1.5	4.95	30-49	4.95	30-54	4.95	30-54	4.95	61-80	4.95	14.76 – 24.75
High	1.6-2.0	6.95	15-29	6.95	15-29	6.95	15-29	6.95	81-90	6.95	24.76 – 34.75
Very high	2.1-2.8	8.5	5-14	8.5	5-14	8.5	10-14	8.5	91-119	8.5	34.76 – 42.50
Extreme	>2.8	10	< 5	10	< 5	10	< 10	10	> 119	10	42.51 - 50

Table 2. Scores for the Modified BEHI.

BEHI Category	Root Depth Values	Root Depth Scores	Root Density (%)	Root Density Scores	Surface Protection (Avg. %)	Surface Protection Scores	Bank Angle (degrees)	Bank Angle Scores	Total Score, by Category
Very low	90-100	1.45	80-100	1.45	80-100	1.45	0-20	1.45	≤ 5.8
Low	50-89	2.95	55-79	2.95	55-79	2.95	21-60	2.95	5.9 – 11.8
Moderate	30-49	4.95	30-54	4.95	30-54	4.95	61-80	4.95	11.9 – 19.8
High	15-29	6.95	15-29	6.95	15-29	6.95	81-90	6.95	19.9 – 27.8
Very high	5-14	8.5	5-14	8.5	10-14	8.5	91-119	8.5	27.9 – 34.0
Extreme	< 5	10	< 5	10	< 10	10	> 119	10	34.1 - 40

Figure 2. BEHI Score Example



4.0 Quality Control Issues

(1) Accuracy: Accuracy as traditionally defined is difficult to assess for this largely subjective, observational procedure. When performed by volunteers, however, the accuracy of their observations can be maximized by training from others more experienced in river morphology studies, and verified by spot-checks of their work by the trainers.

(2) Precision: Precision as traditionally defined is also difficult to assess for this largely subjective, observational procedure. Spot-checks within a few weeks of volunteer observations can be used to assess precision as well as accuracy.

(3) Reference reaches: In addition to the erosion hazard categories generated by this procedure, it can also be useful to make these observations at reference reaches — stream reaches in portions of the same watershed, or an adjacent watershed, that are believed to be (relatively) undisturbed by urban development, stream channelization, etc. A good document describing how to choose and document conditions at a reference site is the U.S. Forest Service report by Harrelson, et al. (1994). Alternatively, contact the author of this SOP for advice on selecting a representative reference reach. In general, reference reaches are best established in the same watershed as the stream reach of interest, in a stream of the same size (e.g., same stream order, or baseflow wetted width) and with similar soil type and channel slope.

(4) Stream reach selection (Representativeness): Selection of specific stream reaches for BEHI observations will depend on the objectives of the study, but a few general rules apply:

- Stream bank conditions are naturally variable even in stable streams, and to characterize a stream reach it is recommended that at least 200' of the stream reach be viewed before the BEHI observations are made.
- Stream banks adjacent to riffle areas tend to be the most stable section of a stream channel, while banks in meander bends tend to have the highest erosion rates – even in geomorphically stable streams.
- Stream banks in 'high traffic' areas (parks, livestock crossings, etc.) are not representative of average conditions and should be avoided – unless they are the specific focus of the study.

While volunteers can collect large amounts of useful BEHI data with adequate training and supervision, experience has shown that they are prone to overemphasizing small, atypical bank erosion "hot spots," even when asked to score more representative banks.

5.0 References

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Shoreline Stability Assessment Report
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Modified Bank Erosion Hazard Index (BEHI) Field Form

Date: _____ Personnel: _____

Location: _____

(Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	10-14	91-119
< 5	< 5	< 10	> 119

Comments: _____

Date: _____ Personnel: _____

Location: _____

(Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	10-14	91-119
< 5	< 5	< 10	> 119

Comments: _____

Date: _____ Personnel: _____

Location: _____

(Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	10-14	91-119
< 5	< 5	< 10	> 119

Comments: _____

Appendix 2. Examples of Different Bank Conditions in Southern Michigan Streams

Figure A. Tributary, Kalamazoo River watershed



Bank Height/Bankfull Height $\approx 1.0-1.1$

Root Depth/Bank Height $\approx 0.9-1.0$

Root Density $\approx 80-100\%$

Bank Angle $\approx 0-20^\circ$?

Surface Protection $\approx 80-100\%$

BEHI Score = 7.25 (Very low)

Figure B. Kalamazoo River



Bank Height/Bankfull Height $\approx 1.0-1.1$

Root Depth/Bank Height $\approx 0.9-1.0$

Root Density $\approx 30-54\%$, not counting sod slump

Bank Angle $\approx 81-90^\circ$

Surface Protection $\approx 30-54\%$

BEHI Score = 19.75 (Moderate)

Note sod slumping into channel – a sure indication of an unstable bank, presumably because streamside vegetation = mowed grass, not woody vegetation. Otherwise the channel is in pretty good shape.

Figure C. Rouge River



Bank Height/Bankfull Height $\approx 1.0-1.1$
(assuming top of bank = bankfull)

Root Depth/Bank Height $\approx 0.9-1.0$

Root Density $\approx 5-14\%$

Bank Angle $\approx 81-90^\circ$

Surface Protection $\approx 10-14\%$

BEHI Score = 26.85 (High)

Interesting site – roots extend to waterline, but are so few that they provide minimal bank protection. Also, this site is downstream from a dam, where erosion is usually atypically high due to “hungry water” created by the impoundment.

Figure D. Hagar Creek , Ottawa County



Bank Height/Bankfull Height $\approx > 2.8$

Root Depth/Bank Height $\approx 0.3-0.49$ at best

Root Density $\approx 5-14\%$

Bank Angle $\approx 81-90^\circ$

Surface Protection $\approx 10-14\%$

BEHI Score = 38.9 (Very high)

Appendix B. Field Form

Shoreline Stability Assessment Report
Constantine Project (FERC No. 10661)

Modified Bank Erosion Hazard Index (BEHI) Field Form

Date: _____ Personnel: _____

Location: _____

(Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	10-14	91-119
< 5	< 5	< 10	> 119

Comments: _____

Date: _____ Personnel: _____

Location: _____

(Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	10-14	91-119
< 5	< 5	< 10	> 119

Comments: _____

Date: _____ Personnel: _____

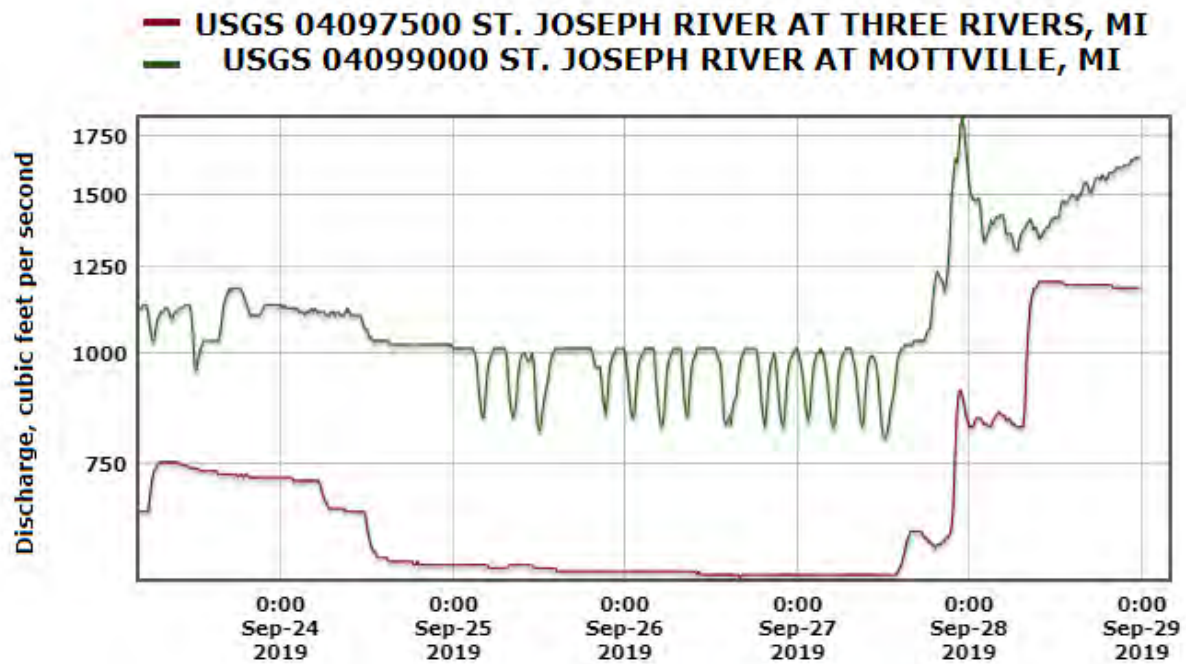
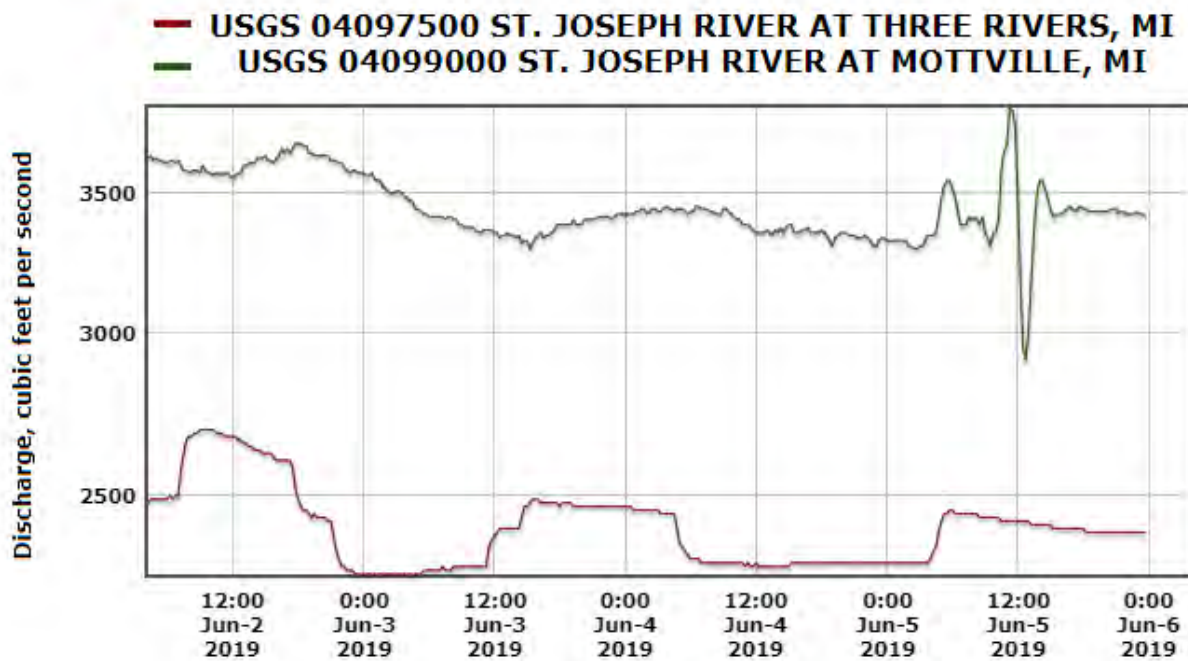
Location: _____

(Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	10-14	91-119
< 5	< 5	< 10	> 119

Comments: _____

Appendix C. Flow Graphs



Appendix D. Water Quality Study

Water Quality Study Report

Constantine Project (FERC No. 10661)
March 31, 2020

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1. Project Introduction and Background

Indiana Michigan Power Company (I&M), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 1.2 megawatt(MW) Constantine Hydroelectric Project (Project) (FERC Project No. 10661).The Project is located along the St. Joseph River in the Village of Constantine in St. Joseph County, Michigan.

I&M operates and maintains the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on September 30, 2023. I&M is pursuing a subsequent license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR § 5.15, I&M has conducted studies as provided in the March 15, 2019 Revised Study Plan (RSP) and schedule approved in the Commission's April 9, 2019 Study Plan Determination (SPD) for the Project. This report describes the methods and results of the Water Quality Study conducted in support of preparing an application for a subsequent license for the Project.

Existing relevant and reasonably available information regarding water quality in the Project area was presented in Section 5.3 of the Pre-Application Document (PAD) (I&M 2018). The PAD included historical water quality data collected in support of the existing license. Historical data show that the Project waters meet the state standards regarding water temperature and dissolved oxygen (DO), and that Project operations appear to have little to no effect on water quality in the St. Joseph River.

1.1. Applicable Water Quality Standards

Water quality standards for Project waters are regulated by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) under delegated authority from the U.S. Environmental Protection Agency (USEPA). The water quality standards applicable to the St. Joseph River are provided in the State of Michigan's Part 4 Rules, Water Quality Standards (of Part 3, Water Resources Protection, of Act 451 of 1994). Michigan's Part 4 Water Quality Standards require that all designated uses of the receiving water be protected (Michigan Department of Environmental Quality (MDEQ, 2016). Designated uses are defined in R 323.1100 and include at a minimum: agriculture, navigation, industrial water supply, warmwater fishery, other indigenous aquatic life and wildlife, fish consumption, and partial body contact recreation. Additional designated uses may be applied to specific waters. The St. Joseph River has no additional designation (i.e., trout stream or public water supply). Table 1 summarizes the numeric and qualitative water quality standards for pH, DO, and water temperature in the St. Joseph River.

Table 1: Water Quality Standards for the St. Joseph River, Michigan.

Michigan Rule	Parameter	Warmwater Standards																																							
Rule 53	pH	The hydrogen ion concentration expressed as pH shall be maintained within the range of 6.5 to 9.0 S.U. in all surface waters of the state, except for those waters where the background pH lies outside the range of 6.5 to 9.0 S.U.																																							
Rule 64	Dissolved Oxygen	...the dissolved oxygen shall not be lowered below a minimum of 4 milligrams per liter, or below 5 milligrams per liter as a daily average, at the design flow during the warm weather season...																																							
Rule 75	Temperature	<div>Rivers, streams, and impoundments naturally capable of supporting warmwater fish shall not receive a heat load which would warm the receiving water at the edge of the mixing zone to temperatures greater than the following monthly maximum temperatures:</div> <table><tr><th>Month</th><th>J</th><th>F</th><th>M</th><th>A</th><th>M</th><th>J</th><th>J</th><th>A</th><th>S</th><th>O</th><th>N</th><th>D</th></tr><tr><td>°F</td><td>50</td><td>50</td><td>55</td><td>65</td><td>75</td><td>85</td><td>85</td><td>85</td><td>85</td><td>70</td><td>60</td><td>50</td></tr><tr><td>°C</td><td>10.0</td><td>10.0</td><td>12.8</td><td>18.3</td><td>23.9</td><td>29.4</td><td>29.4</td><td>29.4</td><td>29.4</td><td>21.1</td><td>15.6</td><td>10.0</td></tr></table>	Month	J	F	M	A	M	J	J	A	S	O	N	D	°F	50	50	55	65	75	85	85	85	85	70	60	50	°C	10.0	10.0	12.8	18.3	23.9	29.4	29.4	29.4	29.4	21.1	15.6	10.0
Month	J	F	M	A	M	J	J	A	S	O	N	D																													
°F	50	50	55	65	75	85	85	85	85	70	60	50																													
°C	10.0	10.0	12.8	18.3	23.9	29.4	29.4	29.4	29.4	21.1	15.6	10.0																													

Source: MDEQ 2016.

2. Study Goals and Objectives

In accordance with I&M's RSP and the Commission's SPD for the Project, the goal of the Water Quality Study was to determine the effects of continued Project operation on water quality, including DO concentrations and water temperature in the Project reservoir and in the St. Joseph River downstream from the Project (i.e., Project bypass reach and tailrace). The goals and objectives of this study were as follows:

- Gather existing and relevant baseline water quality data to determine compliance with state water quality standards.
- Analyze sediment in the Project reservoir to determine the concentration of select contaminants potentially present in sediment.

Methodologies for the collection and analysis of water quality and sediment data are detailed in this report. Results presented in this report characterize water quality and conditions within the reservoir, the power canal, the bypass reach, and the tailrace in three categories: 1) Continuous DO and temperature monitoring, 2) Discrete multi-parameter water quality sampling, and 3) Sediment contaminant sampling and analysis from the Project reservoir.

3. Study Area

The study area for the Water Quality Study is the FERC Project boundary, the bypass reach, and the river reach downstream to the US 131 Business Route Bridge (Figure 1). In total, five water quality monitoring stations (reservoir, power canal, tailrace, bypass reach upstream of the Fawn River, and bypass reach downstream of the Fawn River) were established and monitored for approximately six months in 2019. Sediment sampling was conducted along three transects in the reservoir (lower, middle, and upper reservoir) on September 25, 2019.

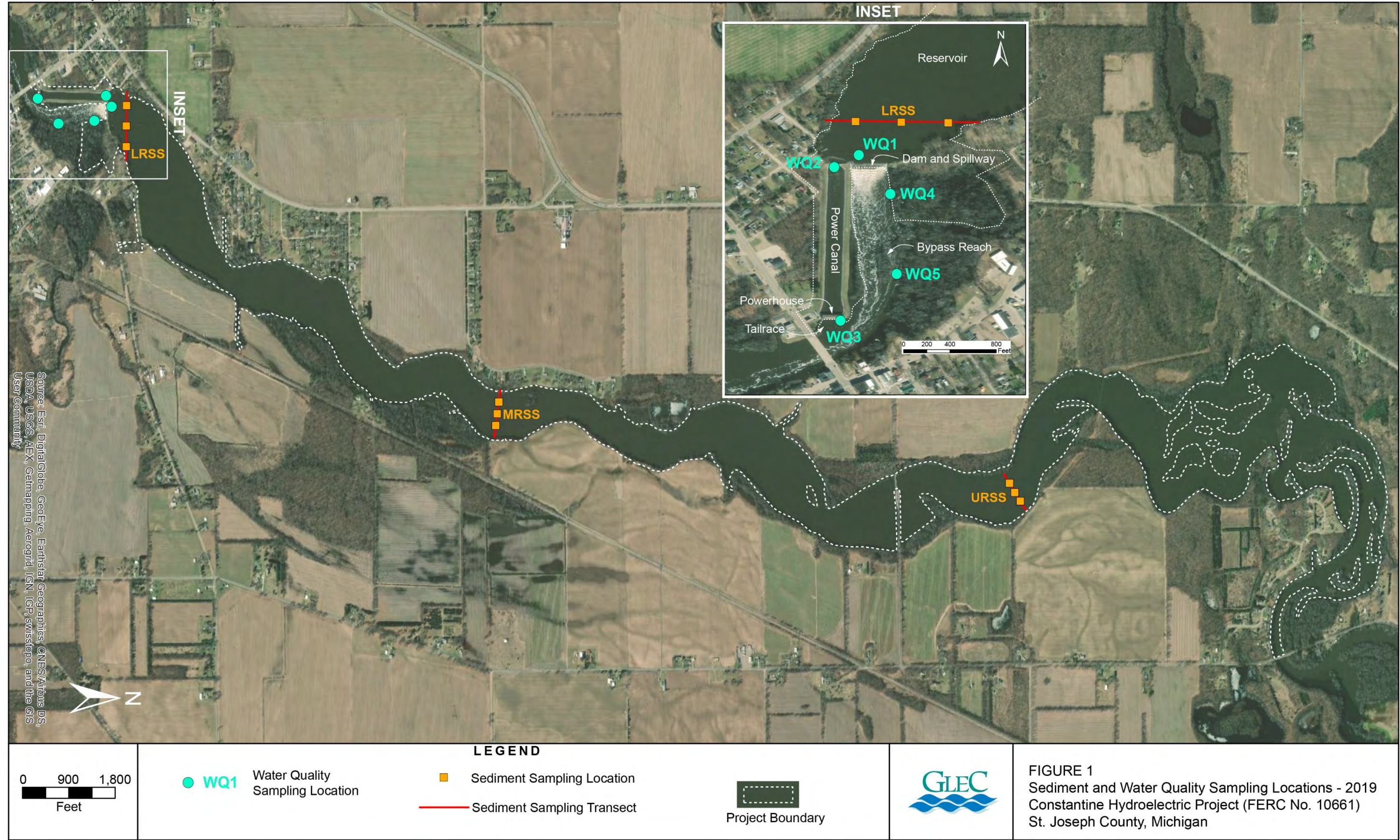


Figure 1: Water Quality Monitoring and Sediment Sampling Stations at the Constantine Hydroelectric Project, 2019.

4. Methodology

The Water Quality Study was conducted pursuant to the Commission's SPD at predetermined locations in the Project reservoir and in the St. Joseph River downstream from the Project. All water quality monitoring stations were geo-referenced using a Global Positioning System (GPS). Great Lakes Environmental Center (GLEC) collected discrete and continuous seasonal water quality data of the physical and chemical state of surface water in the study area as described in greater detail below.

4.1. Continuous Temperature and DO Monitoring and Discrete Multi-parameter Water Quality Measurements

The three components of the field data collection were conducted in accordance with the methods provided in the approved RSP. Duplicate combined water temperature and DO data loggers were set to record water temperature and DO at 1-hour intervals from May 1 through October 31, 2019. Calibrated Onset® HOBO U26 DO/Temperature Loggers were deployed at the five water quality monitoring stations for continuous *in situ* measurements (Figure 1). At all locations, a primary data logger and a secondary data logger were installed. The loggers were suspended in the water column approximately one meter below the surface on a steel cable attached to various stationary objects above the water's surface (trees, fencing, etc.). Both data loggers at station WQ4 in the bypass reach upstream of the Fawn River were discovered to be missing on August 1, 2019. Consequently, the data loggers were lost sometime between June 27 and August 1, 2019. Therefore no data was collected for that location during that time period. GLEC took corrective action, and replaced the loggers with a new primary logger. Additional discussion of other periods of low DO measurements and equipment malfunction is presented in Section 5.

Field staff downloaded data from loggers at each monitoring station directly onto a laptop computer. During each visit, all equipment was checked for operation, calibration, battery life, and any necessary adjustments to the instrument were made based on manufacturer's specifications. Each logger was also cleaned and the cable, housing, and other installation materials were visually inspected for damage and repaired or replaced as necessary.

Discrete multi-parameter water quality measurements of temperature, DO concentration, pH, and specific conductance were also collected at the monitoring stations using a calibrated YSI ProDSS® multi-parameter probe. These data collections occurred monthly and concurrent with deployment and downloads of the continuous data loggers, starting May 1 and ending October 31, 2019, in accordance with the schedule listed in Table 2.

Table 2: 2019 Water Quality Sampling and Data Download Schedule

Data Type	4/29	5/1	5/13	5/30	6/27	8/1	8/29	9/30	10/31
Continuous DO/Temperature	NA	Deploy ¹	x	x	x	x	x	x	X Retrieve
Discrete Multi-parameter	x	NA	x	x	x	x	x	x	x

Note:

NA = Not applicable, no data collected.

¹ = Continuous data collection began on May 1, 2019.

X = Data collection and/or data download.

4.2. Sediment Contaminant Sampling

Three transects were established in the reservoir: Lower Reservoir (LRSS), Middle Reservoir (MRSS), and Upper Reservoir (URSS). Along each transect, three sediment samples were collected on September 25, 2019 and composited for shipment and analysis. The Lower Reservoir transect was sampled in duplicate. Sediment sampling transects and locations are shown in Figure 1 above. The composited sediment samples were analyzed for the following parameters:

- Total PCBs
- Mercury
- Percent Moisture
- Oil and Grease
- Total Phosphorus
- Total Organic Carbon
- Metals: Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver, and Zinc

Sediment samples were collected and processed following the methodologies outlined in *EPA-823-B-01-002 – Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses*. Samples were shipped to Pace Analytical Laboratory for analysis.

4.3. Data Analysis and Processing

Upon completion of the field data collection effort, all data was checked for errors and omissions. For monitoring stations utilizing primary and secondary data loggers, data were preferentially reported and analyzed from the primary data logger at each station with a few exceptions. In those instances when anomalies were identified with the data, data from the second data logger was reviewed to address the anomaly. Instream flow data (e.g., U.S. Geological Survey gauging stations) and Constantine Project operational data (i.e., MW production converted to discharge) were also reviewed to understand the data. Verified data is presented as tables and/or plots to illustrate the information. Descriptive statistics (e.g., minimum, maximum, mean, median) were calculated to further characterize the data.

4.4. Equipment Calibration and Quality Assurance

The field measurement equipment used during this study included the following:

- Onset HOBO Model U26 DO/Temperature Loggers were used to monitor continuous temperature and DO. The water temperature sensor is accurate to ± 0.2 degrees Celsius ($^{\circ}\text{C}$). Prior to deployment, each data logger was fitted with a new RDO Basic Sensor and anti-fouling cap. The DO sensor has a seven month use life and is accurate to ± 0.2 mg/L.
- A YSI ProDSS multi-parameter water quality meter was outfitted with temperature, specific conductance, pH, and DO sensors. It was used to collect discrete multi-parameter water quality data. The unit was also used to collect water quality parameters prior to deployment of data loggers. The accuracy of the YSI's sensor array as specified by the manufacturer is presented in Table 3.

Table 3: YSI ProDSS Sensor Specifications

Sensor	Accuracy
Temperature	$\pm 0.2^{\circ}\text{C}$
DO	0 to 20 mg/L: ± 0.1 mg/L or 1% of reading, whichever is greater
Specific conductance	0 to 100 mS/cm: $\pm 0.5\%$ of reading or 0.001 mS/cm, whichever is greater
pH	± 0.2 pH units

Prior to the first deployment, units were calibrated in the GLEC laboratory and then field calibrated on-site per the manufacturer instructions. Data loggers were also field calibrated according to manufacturer instructions prior to each subsequent deployment. Prior to each day's instantaneous sample collection, the YSI ProDSS was checked against a suite of standards, and adjustments were made to the calibration according to manufacturer instructions.

A Quality Assurance Project Plan (QAPP) was developed by GLEC. Throughout the study, the designated Quality Assurance Officer was responsible for monitoring and verifying implementation of the quality assurance and quality control procedures. Additionally, the Quality Assurance Officer reviewed the study's intermediate and final products and worked with the Project Leader to ensure consistency and adherence to the plan.

5. Study Results

Water quality characteristics and conditions in the reservoir, power canal, tailrace, and bypass reach during the 2019 study period are detailed in this section. Several water quality plots are presented in the appendices to this report. Appendix A presents time series plots for the continuous temperature and DO at all monitoring stations on a monthly basis to illustrate temperature and DO along the longitudinal profile of the study reach. Monthly time periods were selected to better illustrate diurnal patterns and magnitudes of change at each monitoring station under varying flow conditions.

The continuous data logger plots provided in Appendix B present DO and temperature data collected at individual monitoring stations during the 6-month study period on a monthly basis. Monthly time periods were selected to better illustrate diurnal patterns and magnitudes of change at each monitoring station under varying flow conditions.

Discrete multi-parameter data provided in Appendix C includes time series plots for each water quality parameter and allows for comparison of water quality conditions across monitoring stations.

5.1. Continuous Dissolved Oxygen and Temperature Monitoring

The range, mean, and median of temperature and DO readings collected during continuous monitoring in the study area is presented in Table 4 below, and monthly plots are provided in Appendix B for each station. Water temperatures between stations had consistent daily and seasonal patterns, and ranged from a minimum of 8.78°C at the bypass reach downstream of the Fawn River on October 31, 2019 to a maximum of 29.20°C in the power canal on July 20, 2019. The bypass reach upstream and downstream of the Fawn River generally had lower water temperatures than the reservoir, power canal, and tailrace.

With the exception of the bypass reach downstream of the Fawn River, water temperatures recorded at all monitoring stations were below the month-by-month state regulatory thresholds outlined in Section 1.1. Beginning on October 1 and ending on October 2, 2019, temperatures above 21.1°C were recorded in the bypass reach downstream of the Fawn River for 26 consecutive hours. The temperature readings during this time ranged from 21.12°C to 21.48°C. Fourteen of the 26 readings were within 0.2°C (temperature probe accuracy is $\pm 0.2^\circ\text{C}$) of the state threshold.

DO ranged from a minimum of 1.06 mg/L at the bypass reach upstream of the Fawn River on August 21, 2019 to a maximum of 15.48 mg/L on September 23, 2019 also at the bypass reach upstream of the Fawn River. This lowest fluctuation in DO corresponds to the dates when it was suspected that water was not flowing over the water control structure upstream of the bypass reach. The highest fluctuation in DO (15.48 mg/L) is an anomaly and likely due to an equipment malfunction since the value is much greater than the saturation value for DO at those temperatures.

The tailrace and bypass reach upstream and downstream of the Fawn River experienced instantaneous DO concentrations below the state threshold of 4.0 mg/L. On July 16, 2019, DO in the tailrace fell below 4.0 mg/L for multiple hours between 07:00 and 13:00. The bypass reach upstream of the Fawn River experienced a total of eight days in August and ten days in September where instantaneous DO readings were below 4.0 mg/L. The bypass reach downstream of the Fawn River experienced three days in August where the instantaneous DO concentration dropped below the state threshold.

DO concentrations dropped below the daily average threshold of 5.0 mg/L at three locations. The daily average DO in the tailrace dropped below 5.0 mg/L on July 16, 2019 with an average reading of 4.61 mg/L. The bypass reach downstream of the Fawn River experienced two days where DO was below the daily average threshold: July 21, 2019 (average DO was 4.87 mg/L) and August 19, 2019 (average DO was 4.99 mg/L). The bypass reach upstream of the Fawn River had

10 days on which the DO fell below the daily average threshold: August 20, 21, 27, 28, and 29, with average DO values of 3.79, 2.28, 3.16, 2.44, and 4.26 mg/L, respectively and September 16, 17, 18, 19, and 20, with average DO values of 4.23, 3.86, 4.03, 4.18, and 4.91 mg/L, respectively.

Table 4: Range of Continuous Temperature and DO Readings from May 1 to October 31, 2019

Monitoring Station	Temperature (°C)				DO (mg/L)			
	Max	Min	Mean	Median	Max	Min	Mean	Median
WQ1 - Reservoir	28.66	9.00	20.52	21.36	11.43	4.43	8.09	7.99
WQ2 - Power Canal	29.20	9.20	20.72	21.52	13.30	5.11	8.56	8.54
WQ3 - Tailrace	28.82	9.20	20.61	21.47	11.84	2.73	8.50	8.49
WQ4 - Bypass Reach Upstream of the Fawn River	26.60	9.14	18.52	19.20	15.48	1.06	8.25	8.40
WQ5 - Bypass Reach Downstream of the Fawn River	29.06	8.78	20.29	21.21	10.45	2.34	7.14	6.98

During the course of the study, several anomalies were noted with the instrumentation. Below is a list of those anomalies and how they affected data collection. These instances are also listed below the corresponding plots in Appendices A and B.

1. On or around May 21, 2019, it is suspected that both loggers in the tailrace were pushed up onto the concrete ledge due to upwelling. The primary logger was damaged during this action and quit recording on May 21 while the secondary logger continued to record data from what could have been a position above the water. Because of the damage to the primary logger, data from the secondary logger was used for the month of May. The primary logger was replaced on May 30, 2019.
2. Tailrace logger data had two instances where the DO readings were suspect. These instances were from June 12-21, 2019 and from July 14-19, 2019. These were possibly due to turbulence or shock from upwelling at this location. No secondary logger data was available for comparison due to a malfunction with the secondary logger.
3. The secondary logger in the bypass reach upstream of the Fawn River did not record data from May 30 through June 27, 2019. Data from the primary logger was used for May 30 through June 27, 2019.
4. Both loggers located in the bypass reach upstream of the Fawn River were discovered to be missing on August 1, 2019. No data exists for that location for June 27 through August 1, 2019.
5. During the visit on August 29, 2019, nearly all of the water from the reservoir was being routed through the power canal. There was little to no flow through the bypass reach during that visit. The exact date that this process began is unknown, but it is believed that it began somewhere between August 14 and 20, 2019. The data from both locations in the bypass reach show large drops in DO in mid- to late August. During the visit on September 30, 2019, water was once again flowing through the bypass reach.
6. The secondary logger in the tailrace was not working from September 30 through October 31, 2019. Data from the primary logger was used for that month.

7. The secondary logger data was used for the bypass reach downstream of the Fawn River from August 29 to September 30, 2019. The plot for the primary logger data showed an odd section of low DO data during that time.
8. For the month of August, data from the primary logger at the bypass reach downstream of the Fawn River was used with the exception of August 17 at 11:00 through August 22, 2019 at 11:00. Data from the secondary logger was used for that time period due to oddly low DO readings observed with the primary data.
9. From August 1 to August 29, 2019, data from the secondary logger was used for the power canal.

5.2. Discrete Multi-parameter Water Quality Sampling

Water temperature, DO concentration, specific conductance, and pH were collected at the monitoring stations during eight sampling events, as summarized in Table 5 below and detailed in Appendix C. Water quality sampling was conducted approximately 1.0 meter below the water's surface at each monitoring station. Water temperature, pH values, and DO concentrations recorded during *in situ*, discrete sampling events all fell below the state thresholds for temperature, pH, and DO.

On average, water temperatures were lowest in the bypass reach downstream of the Fawn River (17.3°C). The lowest recorded *in situ* water temperature was 8.7°C at the bypass reach downstream of the Fawn River on October 31, 2019. The highest temperature (24.3°C) was also recorded at the bypass reach downstream of the Fawn River on June 27, 2019.

With the exception of the October 31, 2019 *in situ* measurement, the bypass reach downstream of the Fawn River consistently had the lowest measured DO concentration among monitoring sites as well as the lowest average DO concentration (8.01 mg/L). The average DO concentration was highest in the bypass reach upstream of the Fawn River (8.89 mg/L). The highest measured *in situ* DO concentration (10.81 mg/L) occurred in the power canal on April 29, 2019.

Specific conductance was, on average, highest in the bypass reach downstream of the Fawn River (529 µS/cm). Average specific conductance values for the other four monitoring sites ranged from 508 to 509 µS/cm. The highest discrete specific conductance value was recorded on August 1, 2019 in the bypass reach downstream of the Fawn River and was 555 µS/cm. The lowest discrete value was recorded on September 30, 2019 in the bypass reach upstream of the Fawn River (475 µS/cm).

Average pH was lowest in the bypass reach downstream of the Fawn River (7.74) and highest in the bypass reach upstream of the Fawn River (8.01). The lowest *in situ* pH was recorded in the bypass reach downstream of the Fawn River on May 30, 2019 (7.42) and the highest *in situ* pH (8.29) was recorded in both the power canal and the bypass reach upstream of the Fawn River on April 29, 2019.

Table 5: 2019 Discrete Multi-parameter Water Quality Results

Temperature (°C)									
Monitoring Station	4/29	5/13	5/30	6/27	8/1	8/29	9/30	10/31	Mean
WQ1 - Reservoir	12.4	12.6	21.2	23.9	23.7	21.6	17.7	9.2	17.8
WQ2 - Power Canal	12.3	12.5	21.0	24.0	23.8	21.5	17.7	9.2	17.8
WQ3 - Tailrace	12.0	12.5	21.0	24.1	24.1	21.5	17.8	9.2	17.8
WQ4 - Bypass Reach Upstream of the Fawn River	12.4	12.5	21.0	24.1	23.8	20.2	17.8	9.2	17.6
WQ5 - Bypass Reach Downstream of the Fawn River	11.4	12.3	21.0	24.3	23.1	19.9	17.5	8.7	17.3
Dissolved Oxygen (mg/L)									
Monitoring Station	4/29	5/13	5/30	6/27	8/1	8/29	9/30	10/31	Mean
WQ1 - Reservoir	10.46	9.51	7.79	7.06	8.23	8.58	7.15	9.70	8.56
WQ2 - Power Canal	10.81	9.62	7.53	7.20	8.15	8.57	7.23	9.72	8.60
WQ3 - Tailrace	10.46	9.55	7.68	7.40	8.47	8.54	7.61	10.20	8.74
WQ4 - Bypass Reach Upstream of the Fawn River	10.61	10.01	8.19	7.85	8.47	7.77	8.68	9.50	8.89
WQ5 - Bypass Reach Downstream of the Fawn River	10.11	8.67	6.82	6.75	7.13	7.07	7.05	10.50	8.01
Specific Conductance(µS/cm)									
Monitoring Station	4/29	5/13	5/30	6/27	8/1	8/29	9/30	10/31	Mean
WQ1 - Reservoir	530	494	509	501	536	498	476	522	508
WQ2 - Power Canal	528	496	509	501	536	498	476	524	509
WQ3 - Tailrace	529	495	508	501	535	498	477	523	508
WQ4 - Bypass Reach Upstream of the Fawn River	528	494	507	500	535	513	475	523	509
WQ5 - Bypass Reach Downstream of the Fawn River	518	521	524	527	555	546	523	521	529
pH Value									
Monitoring Station	4/29	5/13	5/30	6/27	8/1	8/29	9/30	10/31	Mean
WQ1 - Reservoir	8.26	7.95	7.47	7.73	8.07	7.86	8.03	7.92	7.91
WQ2 - Power Canal	8.29	7.86	7.65	7.67	7.79	7.94	7.88	7.86	7.87
WQ3 - Tailrace	8.26	7.94	7.69	7.82	8.10	7.94	8.03	8.04	7.98
WQ4 - Bypass Reach Upstream of the Fawn River	8.29	7.98	7.79	7.97	8.10	7.87	7.94	8.11	8.01
WQ5 - Bypass Reach Downstream of the Fawn River	8.07	7.68	7.42	7.56	7.79	7.70	7.76	7.95	7.74

5.3. Sediment Sampling

Pace Analytical Laboratory conducted the analysis on the Constantine reservoir sediment samples collected on September 25, 2019. A summary of the results is listed in Table 6 below and the full report from Pace Analytical is presented in Appendix D. The results are reported on a “dry weight” basis and are adjusted for percent moisture, sample size and any dilutions.

Table 6: Summary of Sediment Results for the Constantine Reservoir, Collected September 25, 2019

Analyte (Method)	Units	LRSS: Lower Reservoir Sediment Sample	LRSSD: Lower Reservoir Sediment Sample Duplicate	MRSS: Middle Reservoir Sediment Sample	URSS: Upper Reservoir Sediment Sample
		(MDL)	(MDL)	(MDL)	(MDL)
PCB, Total (EPA 8082)	ug/kg	<110 (110)	<111 (111)	<94.0 (94.0)	<155 (155)
Mercury (EPA 7471)	mg/kg	0.16 (0.043)	0.19 (0.044)	0.13 (0.035)	0.12 ¹ (0.060)
Percent Moisture (ASTM 02974-87)	%	77.2 (0.10)	77.6 (0.10)	73.4 (0.10)	83.8 (0.10)
Oil and Grease (EPA 9071)	mg/kg	1,900¹ (1,810)	<1,720 (1,720)	2,120 ¹ (1,540)	2,800 ¹ (2,480)
Total Phosphorus EPA 365.4)	mg/kg	830 (77.0)	828 (63.2)	808 (59.7)	1,190 (109)
Mean Total Organic Carbon (EPA 9060)	mg/kg	98,200 (7,560)	103,000 (9,030)	82,100 (9920)	131,000 (15,700)
Total Metals (EPA 6010)					
Arsenic	mg/kg	28.8 (6.2)	23.9 (6.1)	18.7 (5.1)	30.2 (8.6)
Cadmium	mg/kg	0.78 ¹ (0.57)	0.93 ¹ (0.56)	<0.47 (0.47)	<0.78 (0.78)
Chromium	mg/kg	16.4 (1.2)	17.0 (1.2)	13.4 (0.98)	20.3 (1.6)
Copper	mg/kg	24.2 (1.2)	26.4 (1.2)	22.6 (0.97)	24.5 (1.6)
Lead	mg/kg	30 (2.5)	35.0 (2.5)	24.4 (2.1)	29.4 (3.5)
Nickel	mg/kg	11.2 (1.1)	12.3 (1.1)	9.3 (0.93)	14.8 (1.6)
Selenium	mg/kg	<5.6 (5.6)	<5.5 (5.5)	<4.6 (4.6)	<7.7 (7.7)
Silver	mg/kg	<1.3 (1.3)	<1.3 (1.3)	<1.1 (1.1)	<1.8 (1.8)
Zinc	mg/kg	93.2 (5.1)	104 (5.0)	84.2 (4.2)	87.8 (7.0)

MDL = Adjusted Method Detection Limit.

¹Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

6. Summary and Discussion

In general, the DO and water temperature plots demonstrate a typical diurnal fluctuation that is reflective of day and night respiration (dissolved oxygen) and the relatively rapid change in water temperature due to changes in air temperature. However, there were several instances when this pattern was interrupted possibly due to meter malfunctioning, meter desiccation (temporarily out of the water) or vandalism. Specifically;

- the mid-June and mid-July DO data for the tailrace,
- rapidly declining DO and temperature data in late August for the bypass reach upstream of the Fawn River,
- the rapid decline and then increase in water temperature mid- to late September in the tailrace, and
- spikes in DO to levels greater than saturation in late September in the bypass reach upstream of the Fawn River.

In each instance the anomalies were investigated by reviewing the field conditions, maintenance and calibration logs and the data from the secondary data logger (if available) to determine the problem.

Primary observations from the Water Quality Study include:

- DO readings fell within state threshold limits for the entire duration of the study in both the reservoir and power canal. Water temperature readings were below the monthly maximum threshold limits in the reservoir, power canal, tailrace, and the bypass reach upstream of the Fawn River.
- The monthly water temperature threshold was exceeded on October 1 and 2, 2019 in the bypass reach downstream of the Fawn River for 26 consecutive instantaneous measurements. However, 14 of the 26 measurements were above the threshold by only 0.2°C, which is within the accuracy range of the temperature probe. It's possible that water temperature at this location may be heavily influenced by warm water coming from the Fawn River rather than exceedances only attributable to influences in the St. Joseph River.
- In the tailrace, instantaneous DO readings as well as the daily average DO were below state thresholds on July 16, 2019. Due to probe damage and malfunction as listed in Section 5.1, only one logger was recording in the tailrace in July and so there was not a second set of data to verify these low readings. DO values recorded at all other water quality monitoring stations were above the thresholds on this day.

- Instantaneous DO readings below the state threshold were recorded on August 7, 18, and 19, 2019 in the bypass reach downstream of the Fawn River. The daily average DO fell below the threshold on July 21, 2019 and August 19, 2019 for this location.

In the bypass reach upstream of the Fawn River, instantaneous DO values below the threshold were recorded on eight days in August and ten days in September. For five of those days in August and five in September, the daily average DO also fell below the state threshold. During the data download event on August 29, 2019, the field crew observed that no significant river flow was present in the bypass reach due to the fact that the water surface elevation at that time was below the top surface of the control structure. The DO data suggests that this diversion of water to the power canal began somewhere between August 14 and August 20, 2019. On August 20, 2019, both the instantaneous DO threshold of 4.0 mg/L and the daily average threshold of 5.0 mg/L were exceeded in the bypass reach upstream of the Fawn River. These exceedances persisted on and off through September 25, 2019. During the fish collection event on September 26-28, 2019, conducted as part of the Fisheries Survey for the Project relicensing, the field crew noted that the water surface elevation at that time was again below the top surface of the control structure. Heavy rain was observed during the fish collection event and the DO data shows that concentrations rose shortly after that. The majority of the DO exceedances observed during the Water Quality Study correspond to water diversion out of the bypass reach and into the power canal.

Sediment Chemistry

Sediment analysis results were compared to published sediment quality guidelines (SQG) (MacDonald et al. 2000, Ingersoll et al. 2002, GeoEngineer 2015, and WDNR 2003) to determine the relative risk to aquatic life and human health. Relative risk to aquatic life was determined by comparing the sediment analysis to Probable Effect Levels (PEL), Threshold Effect Levels (TEL), Effect Range Median (ERM) and Effect Range Low (ERL). Sediment concentrations of various contaminants that exceed the SQG may adversely affect aquatic life. Total PCB and mercury were also assessed, but those chemicals are likely to have a greater effect on human health than aquatic life and are also discussed in the fish tissue results section of the Fisheries Survey study report.

With the exception of mercury, lead and arsenic, each analyte concentration in the Constantine reservoir sediments were measured at concentrations less than the most restrictive SQG (TEL).

Mercury

The sediment mercury concentration in the LRSS duplicate sample slightly exceeded the TEL (0.17 mg/kg) at 0.19 mg/kg in the duplicate sample. Mercury was measured at 0.16 mg/kg in the other sample. These concentrations were less than the other three SQG values. Mercury concentrations at or below the TEL are unlikely to cause adverse effects to aquatic life.

Lead

Lead concentrations in the LRSS duplicate sample were equal to the TEL and ERL SQG at 35 mg/kg. Lead concentrations in the other LRSS sample and in the other two reservoir locations (middle reservoir and upper reservoir) were all less than any of the SQGs used. Lead concentrations at or below the TEL and ERL are unlikely to cause adverse effects to aquatic life.

Arsenic

Arsenic concentrations in the LRSS samples exceeded the PEL (17 mg/kg). The LRSS lead concentration was measured at 28.8 mg/kg. Arsenic levels at this concentration would likely cause adverse effects to aquatic life.

With the above noted exceptions, the contaminants measured in the Constantine reservoir are not likely to have an adverse effect on aquatic life or human health. Mercury and lead concentrations were measured at or near the TEL and ERL which would indicate a very low risk to aquatic life. Arsenic concentrations in the LRSS were measured at concentrations that may adversely affect aquatic life, but were at concentrations less than the median effects level (85 mg/kg). Site specific conditions (e.g., total organic carbon, pH, biotic ligands) will affect the bioavailability and are likely to lessen the effect of arsenic at these concentrations. Consequently, this concentration of arsenic in sediment is likely not a great concern to aquatic life in the sediment.

6.1. Variances from FERC-Approved Study Plan

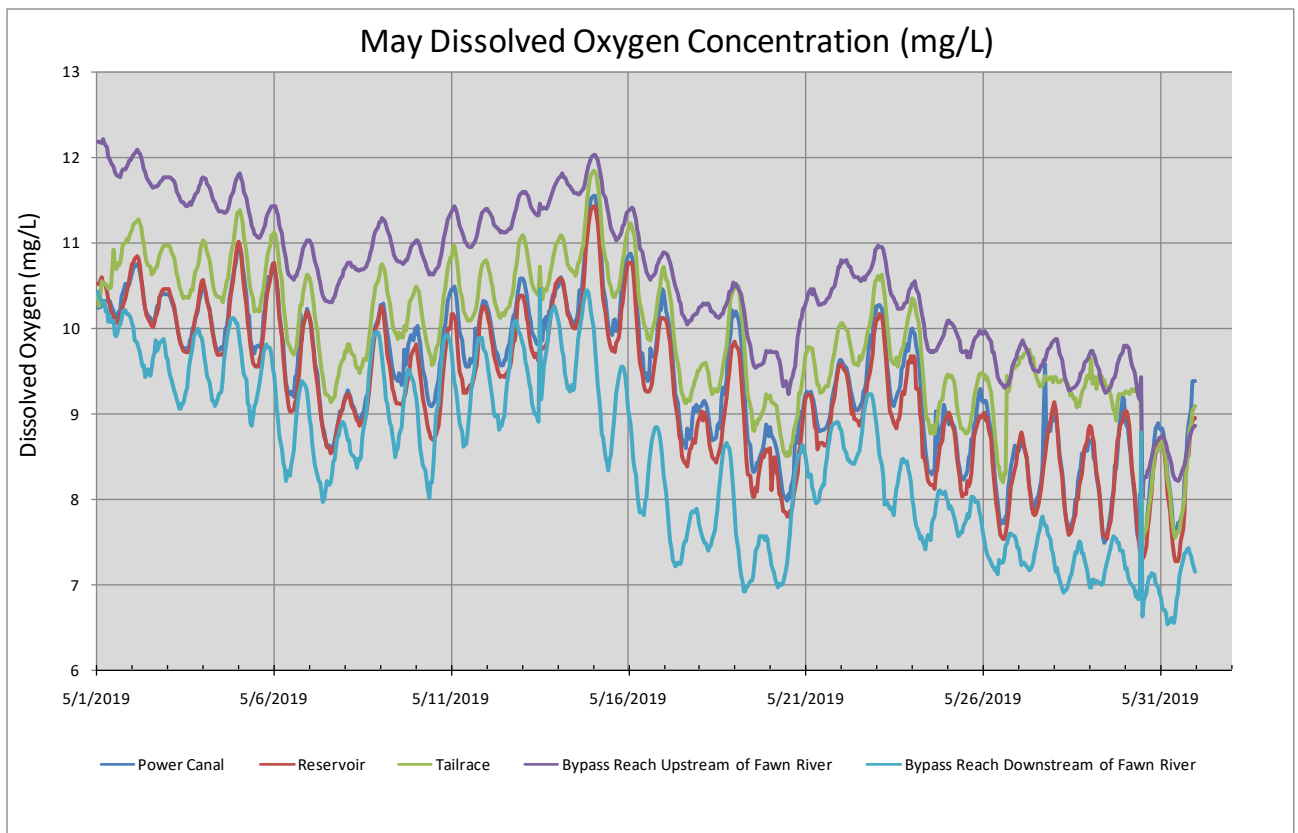
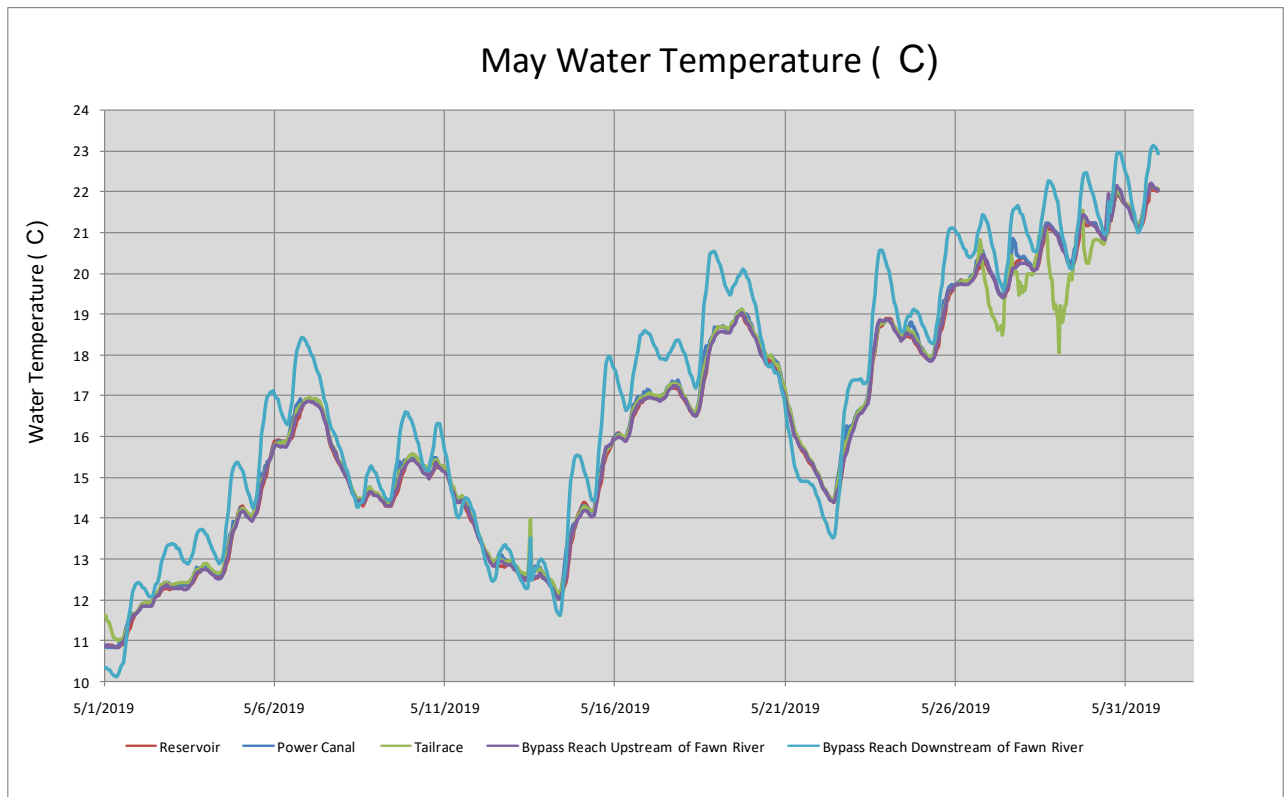
The Water Quality Study was conducted in full conformance with the RSP, with the exception of the following variances:

- On or around May 21, 2019, it is suspected that both loggers in the tailrace were pushed up onto the concrete ledge due to upwelling. The primary logger was damaged during this action and quit recording on May 21 while the secondary logger continued to record data from what could have been a position above the water. Because of the damage to the primary logger, data from the secondary logger was used for the month of May. The primary logger was replaced on May 30, 2019.
- Both the primary and secondary continuous temperature and DO loggers were discovered to be missing from the bypass reach upstream of the Fawn River during the monthly download on August 1, 2019. No data exists for that location for June 27 to August 1, 2019. A new primary logger was placed at the site on August 1, 2019. A secondary logger was added the following month. The data collected during this time period from the other water quality monitoring stations suggests that no major adverse events occurred between June 27 and August 1, 2019.
- The Commission's SPD recommended that I&M modify the Water Quality Study to remove the sediment contaminant sampling component. However, based on I&M's experience at other projects on the St. Joseph River, I&M decided to proceed with the data collection and analysis.

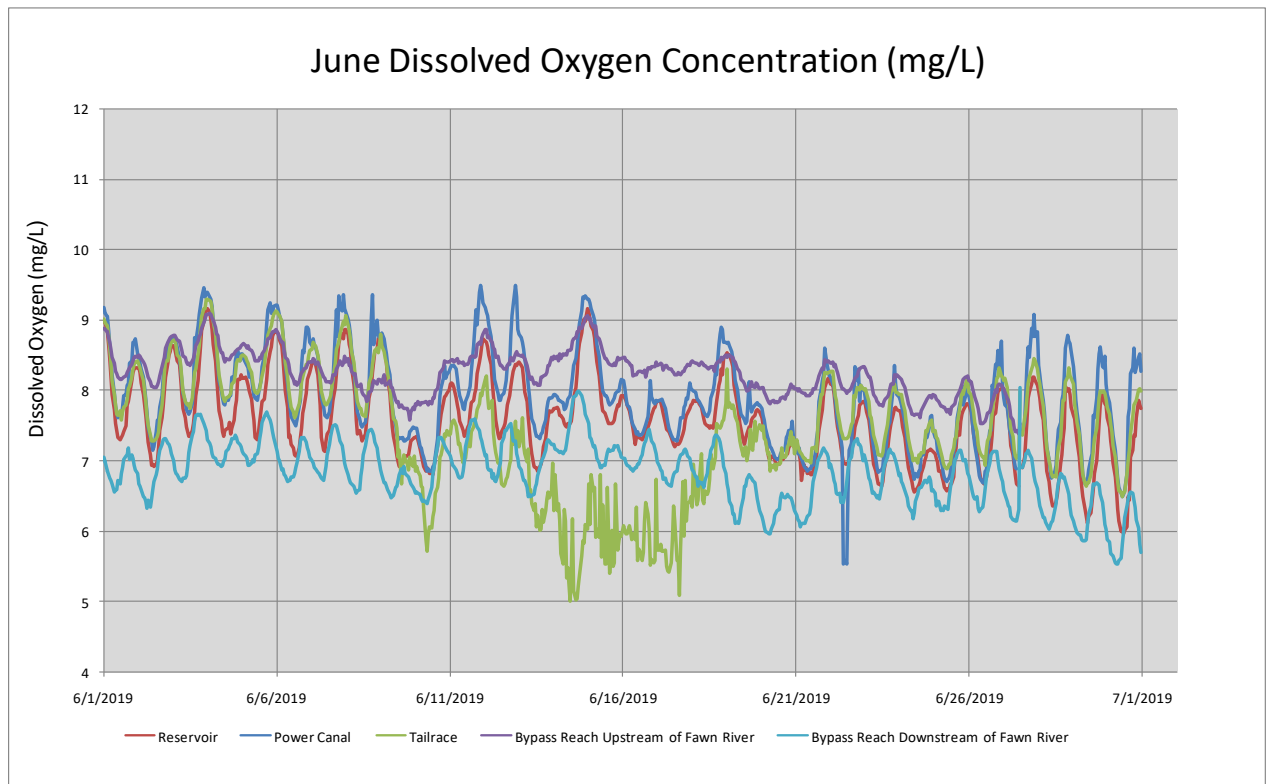
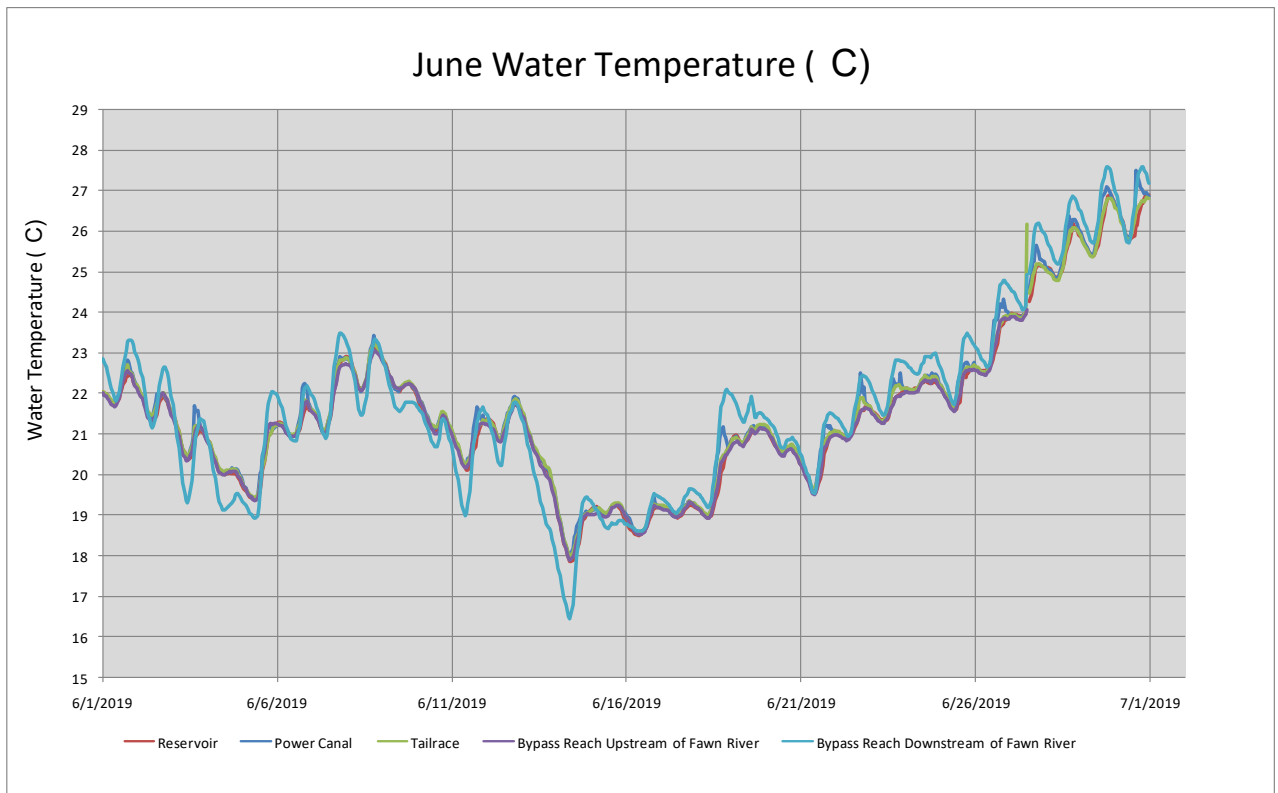
7. References

- GeoEngineer. 2015. Sediment Quality Guidelines (SQGs): A Review and Their Use in Practice. <https://www.geoengineer.org/education/web-class-projects/cee-549-geoenvironmental-engineering-fall-2015/assignments/sediment-quality-guidelines-sqgs-a-review-and-their-use-in-practice>
- Indiana Michigan Power (I&M). 2018. Constantine Hydroelectric Project (FERC No. 10661). Notice of Intent and Pre-Application Document. Federal Energy Regulatory Commission, Washington, D.C. June 4, 2018.
- Indiana Michigan Power (I&M). 2019. Constantine Hydroelectric Project (FERC No. 10661). Filing of Revised Study Plan for Relicensing Studies. Federal Energy Regulatory Commission, Washington, D.C. March 15, 2019
- Ingersoll, Christopher G., Wenning, Richard J. 2002. "Use of Sediment Quality Guidelines and Related Tools for the Assessment of Contaminated Sediments: Executive Summary of a SETAC Pellston Workshop". Society of Environmental Toxicology and Chemistry.
- MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxicol. 39:20- 31.
- Michigan Department of Environmental Quality (MDEQ). 2016. Water Bureau. Water Resources Protection. January 13, 2006. Part 4 Water Quality Standards. www.michigan.gov/documents/deg/wrd-rules-part4_521508_7.pdf
- Wisconsin Department of Natural Resources (WDNR). 2003. "Consensus-Based Sediment Quality Guidelines: Recommendations for Use & Application." Contaminated Sediment Standing Team.

Appendix A
Combined Continuous Water Temperature and Dissolved Oxygen
Plots



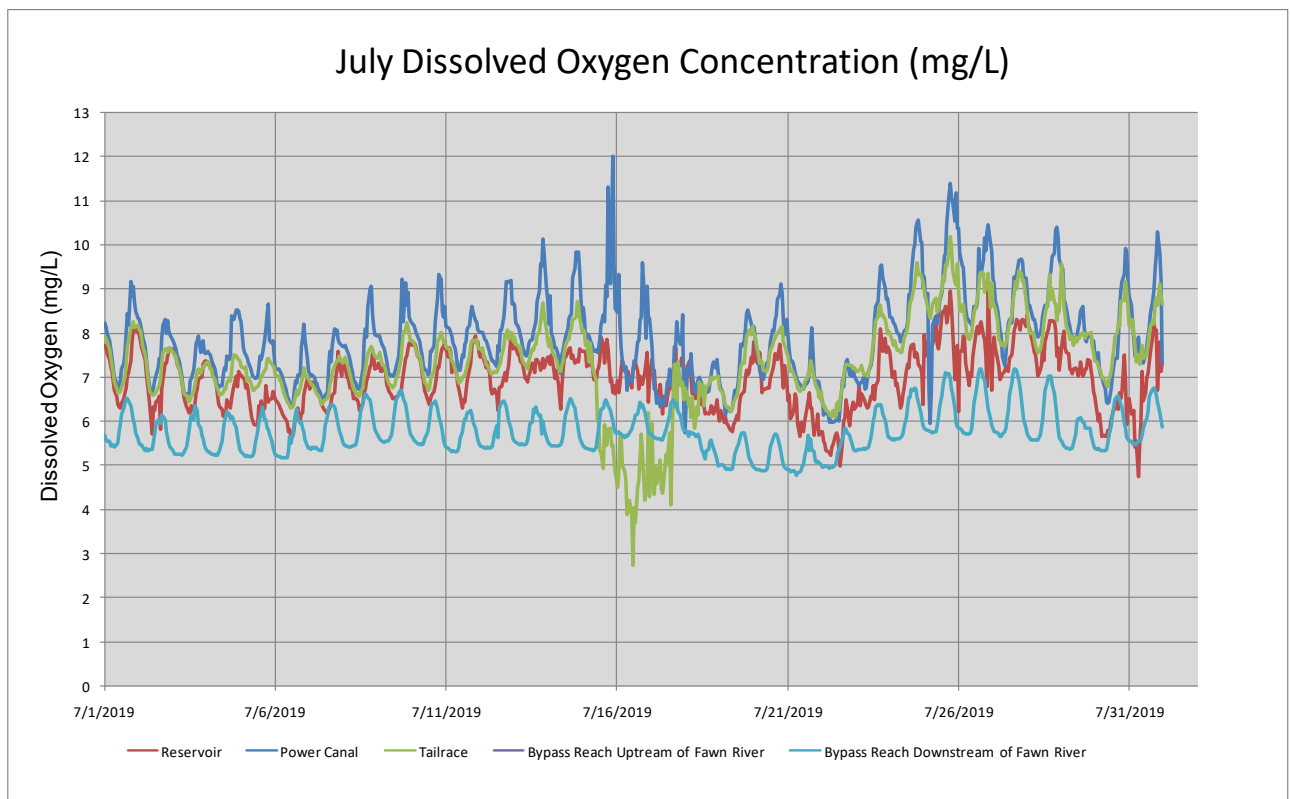
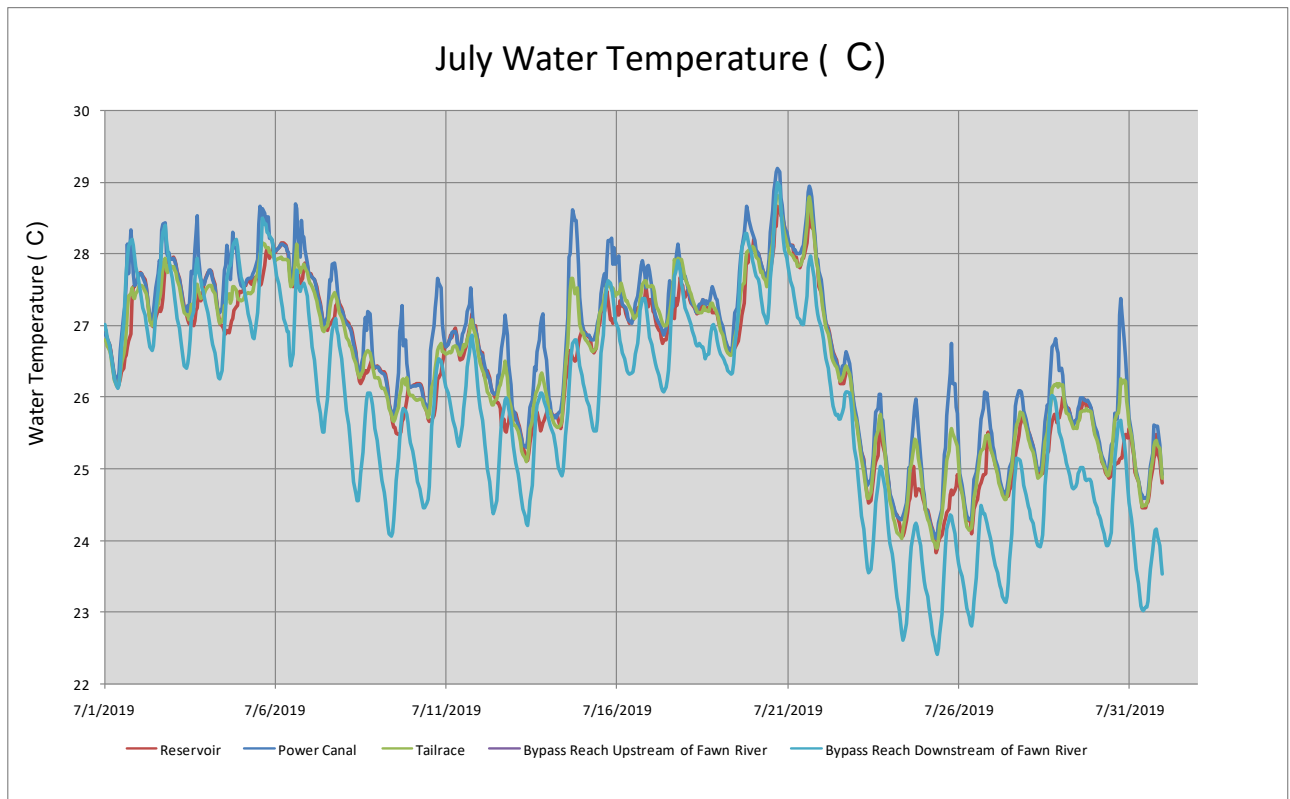
*On or around May 21, 2019, both loggers in the tailrace were pushed up onto the concrete ledge due to upwelling. The primary logger was damaged during this action and quit recording on May 21 while the secondary logger continued to record data from above the water. Because of the damage to the primary logger, data from the secondary logger was used for May 1 to May 21, 2019. The primary logger was replaced on May 30, 2019.



*Tailrace logger data had two instances where the DO readings were suspect. These instances were from June 12-21, 2019 and from July 14-19, 2019. These were possibly due to turbulence or shock from upwelling at this location. No secondary logger data was available for comparison due to a malfunction with the secondary logger.

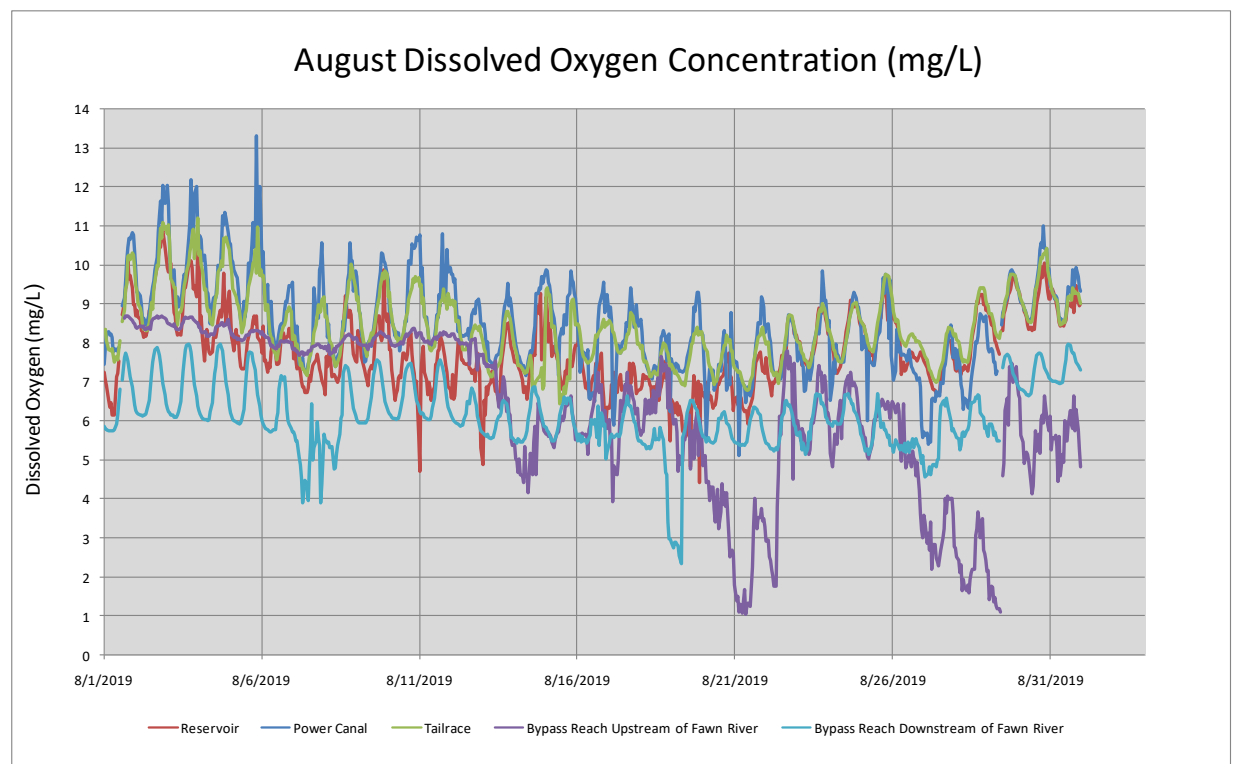
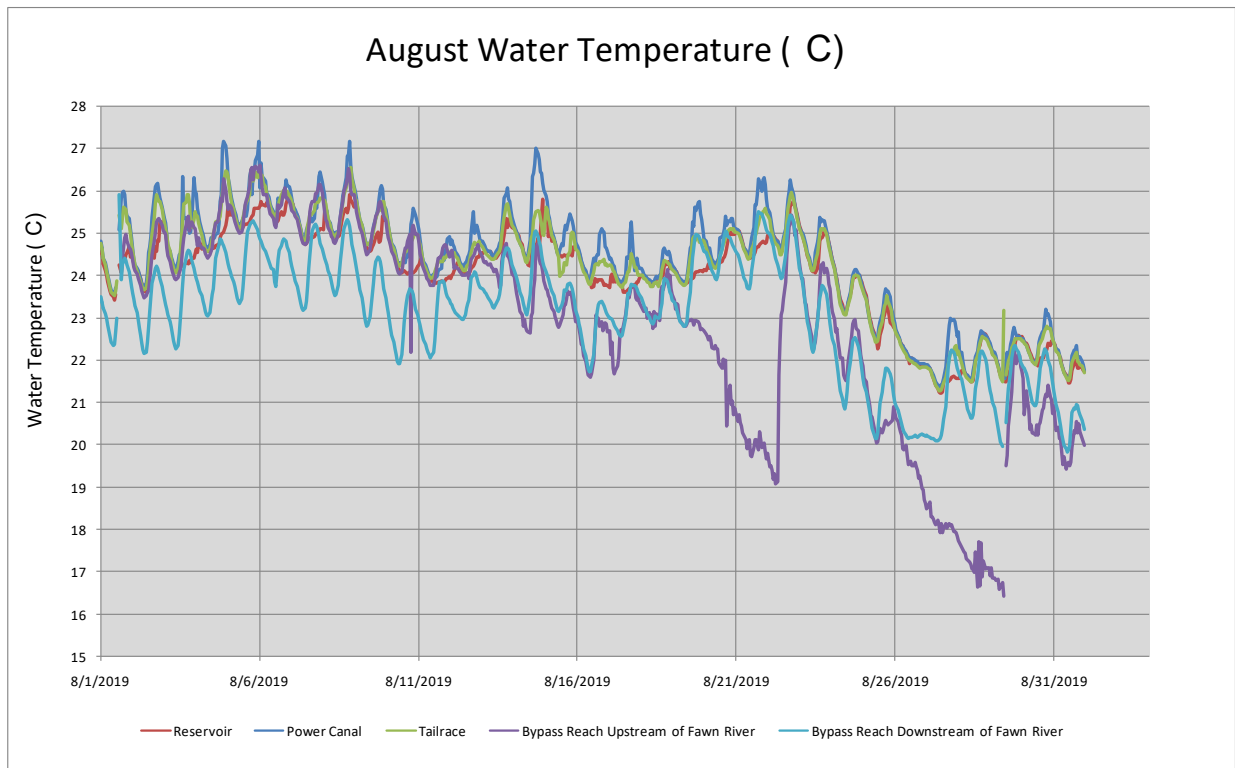
*The secondary logger in the bypass reach upstream of the Fawn River did not record data from May 30 through June 27, 2019. Data from the primary logger was used for May 30 through June 27, 2019.

*Both loggers located in the bypass reach upstream of the Fawn River were discovered to be missing on August 1, 2019. No data exists for that location for June 27 through August 1, 2019.



*Both loggers located in the bypass reach upstream of the Fawn River were discovered to be missing on August 1, 2019. No data exists for that location for June 27 through August 1, 2019.

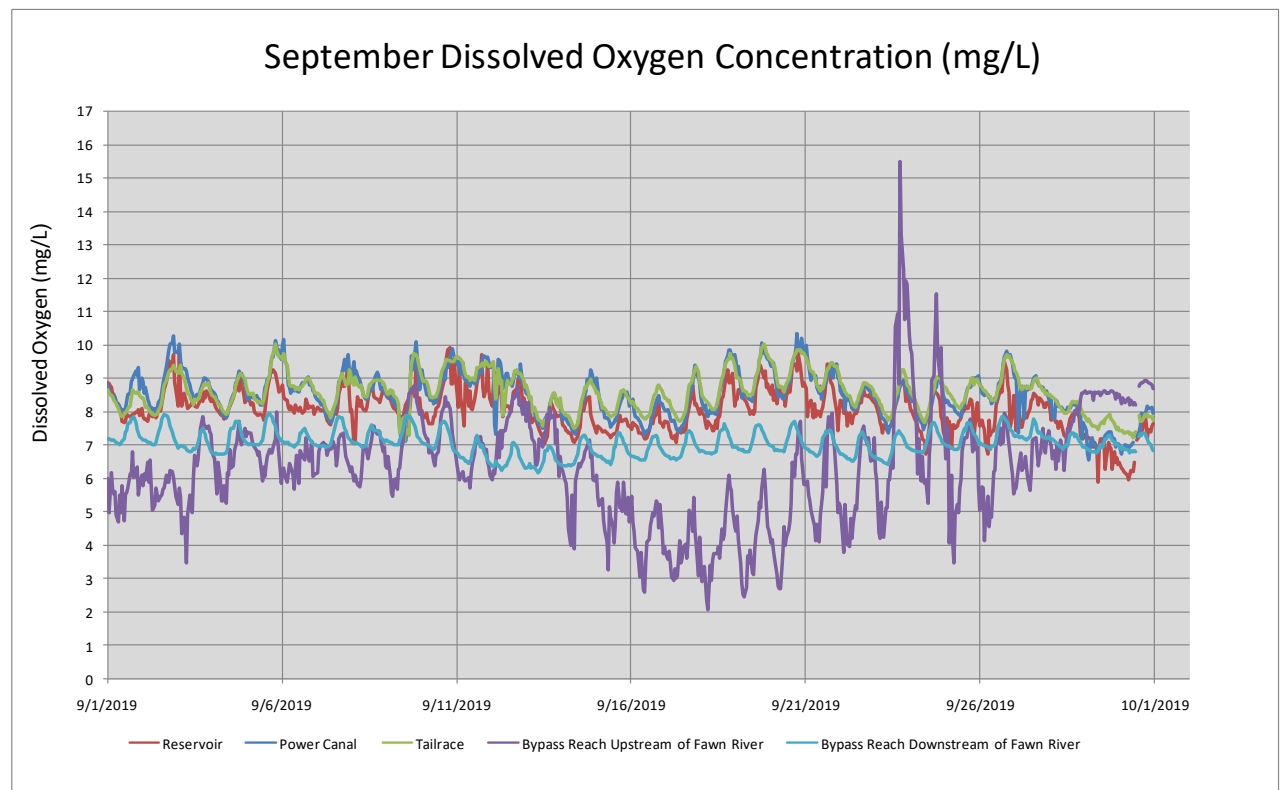
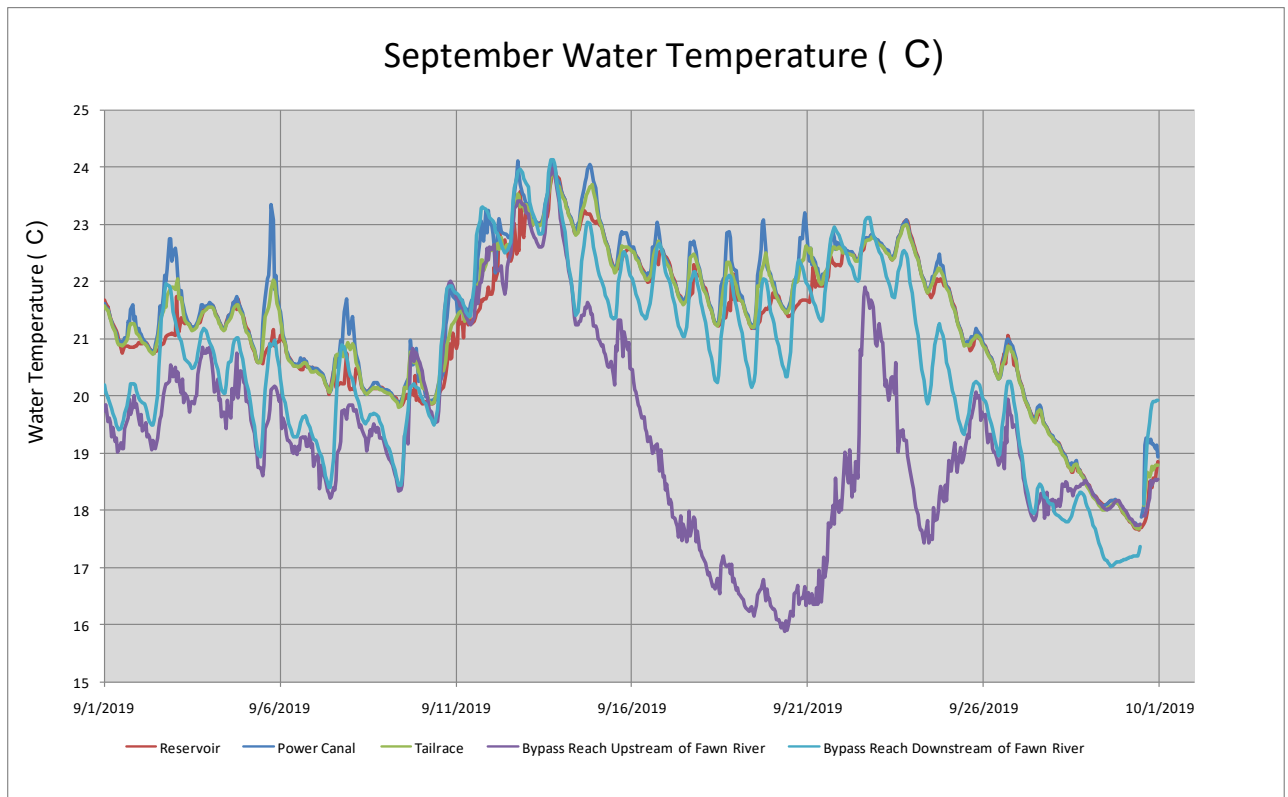
*Tailrace logger data had two instances where the DO readings were suspect. These instances were from June 12-21, 2019 and from July 14-19, 2019. These were possibly due to turbulence or shock from upwelling at this location. No secondary logger data was available for comparison due to a malfunction with the secondary logger.



*During the visit on August 29, 2019, nearly all of the water from the reservoir was being routed through the power canal. There was little to no flow through the bypass reach during that visit. The exact date that this process began is unknown, but it is believed that it began somewhere between August 14 and 20, 2019. The data from both locations in the bypass reach show large drops in DO in mid- to late August. During the visit on September 30, 2019, water was once again flowing through the bypass reach.

*For the month of August, data from the primary logger in the bypass reach downstream of the Fawn River was used with the exception of August 17 at 11:00 through August 22, 2019 at 11:00. Data from the secondary logger was used for that time period due to oddly low DO readings observed with the primary data.

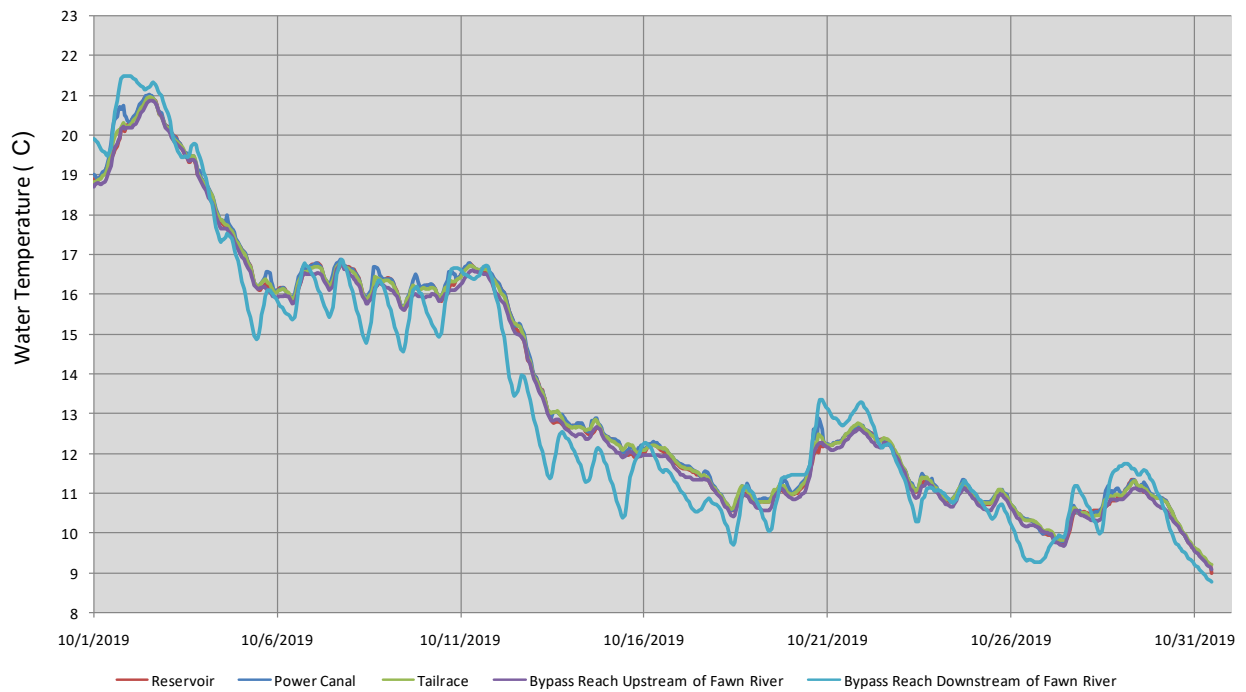
*From August 1 to August 29, 2019, data from the secondary logger was used for the power canal.



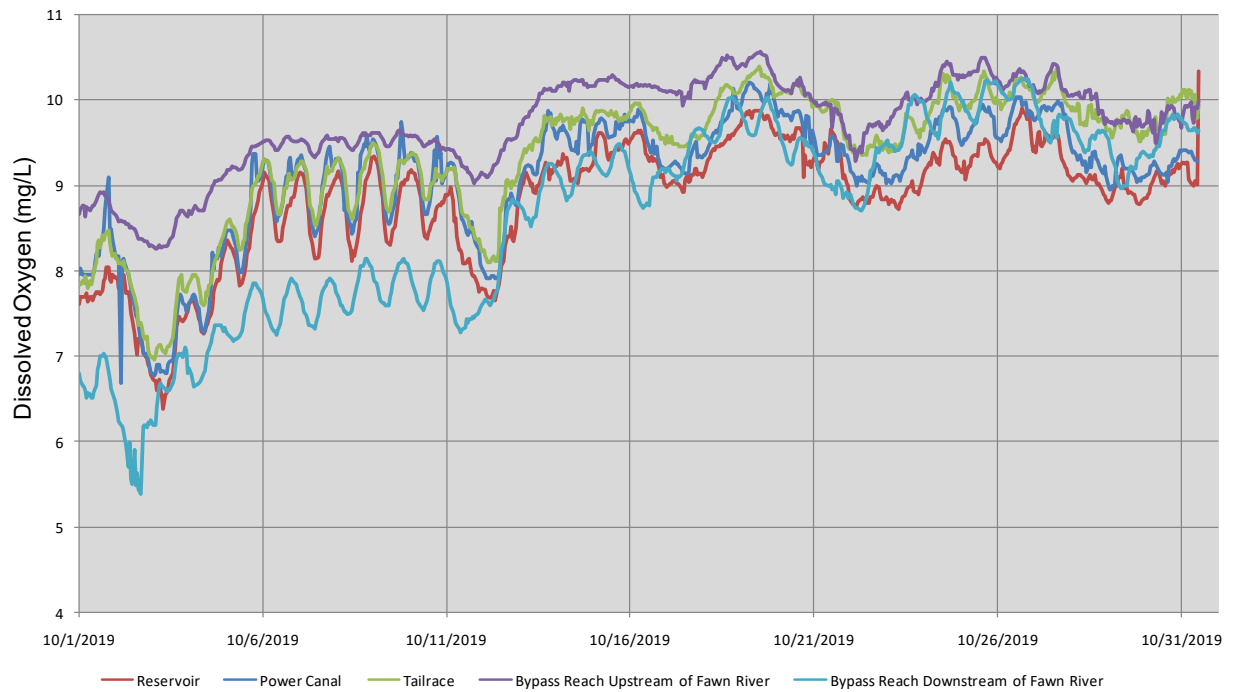
*During the visit on August 29, 2019, nearly all of the water from the reservoir was being routed through the power canal. There was little to no flow through the bypass reach during that visit. The exact date that this process began is unknown, but it is believed that it began somewhere between August 14 and 20, 2019. The data from both locations in the bypass reach show large drops in DO in mid- to late August. During the visit on September 30, 2019, water was once again flowing through the bypass reach.

*The secondary logger data was used for the bypass reach downstream of the Fawn River from August 29 to September 30, 2019. The plot for the primary logger data showed an odd section of low DO during that time.

October Water Temperature (C)



October Dissolved Oxygen Concentration (mg/L)



*The secondary logger in the tailrace was not working from September 30 through October 31, 2019. Data from the primary logger was used for that month.

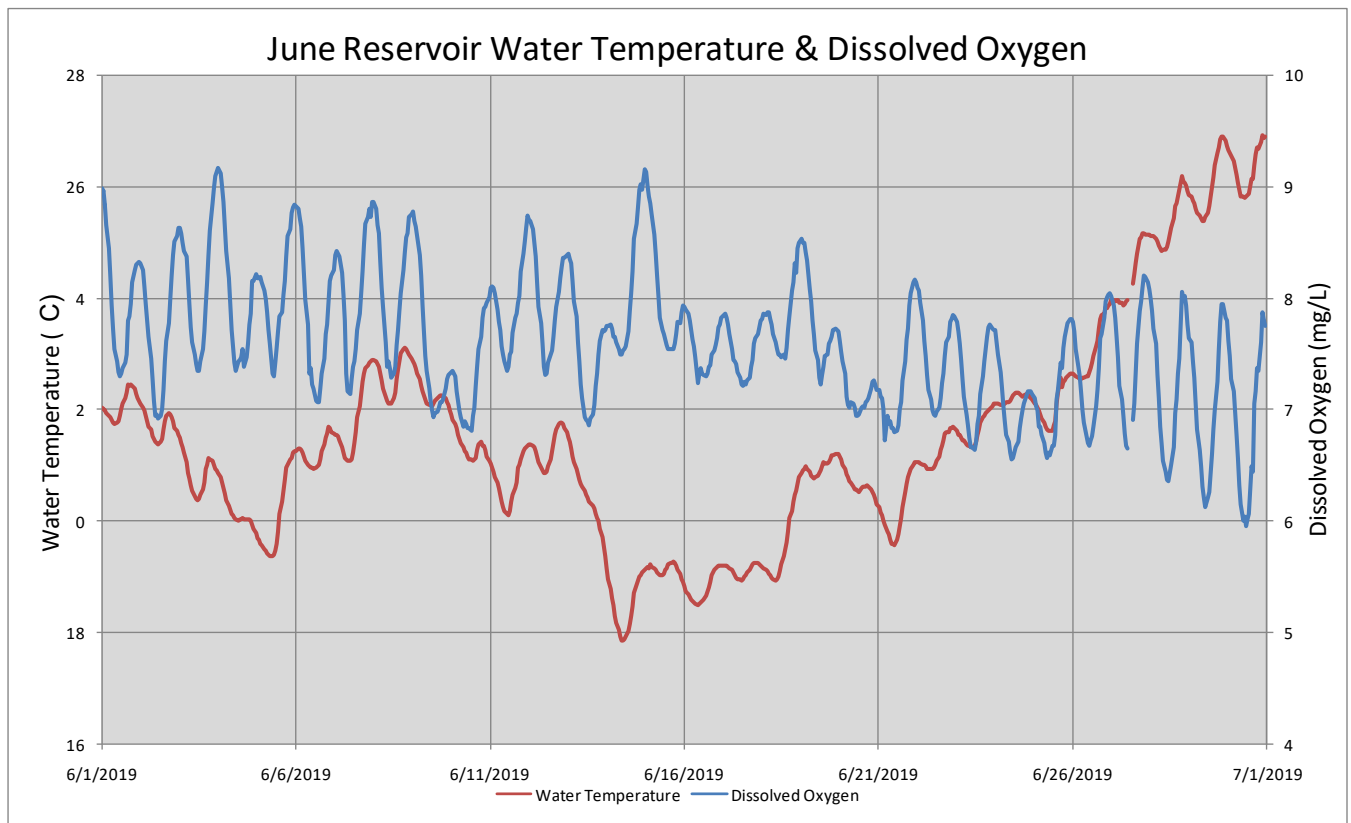
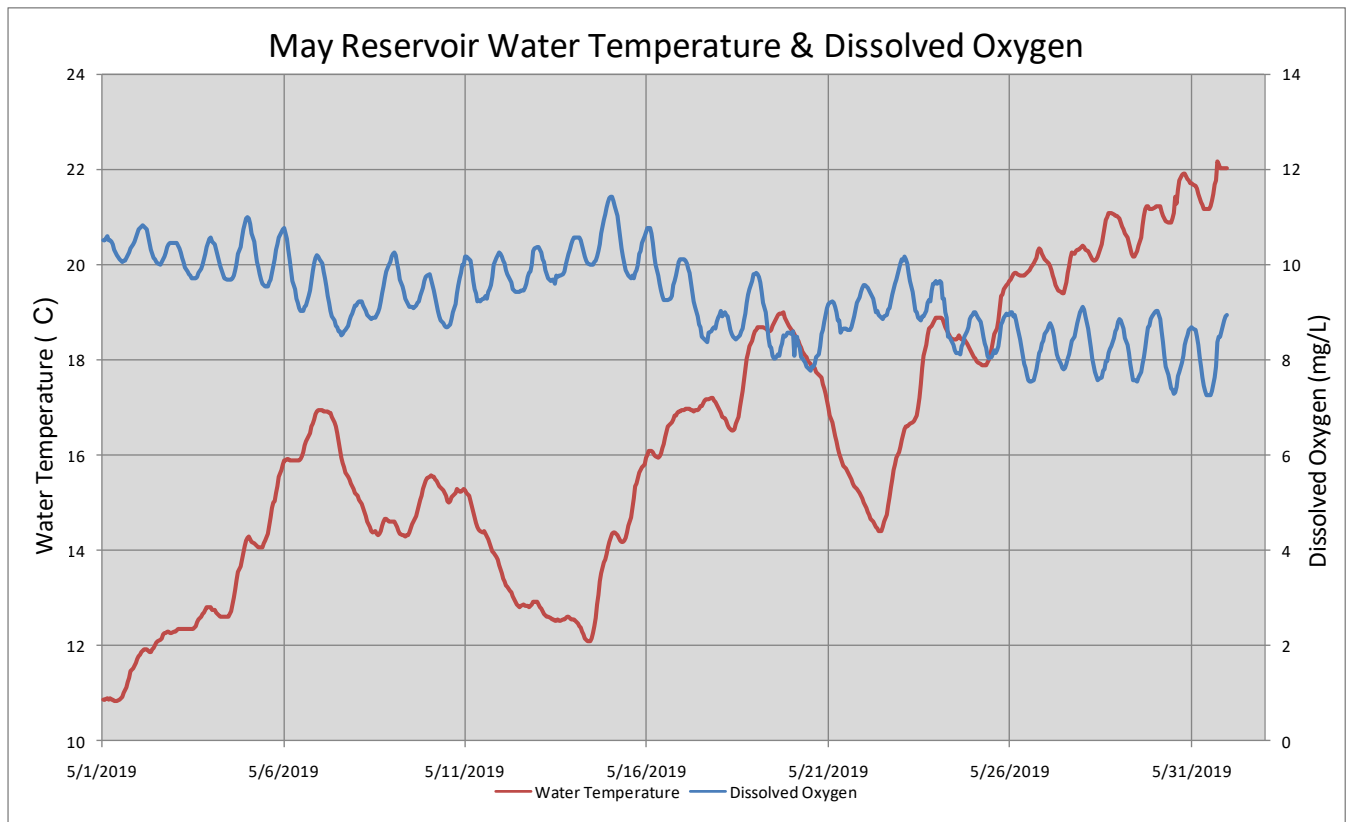
Appendix B

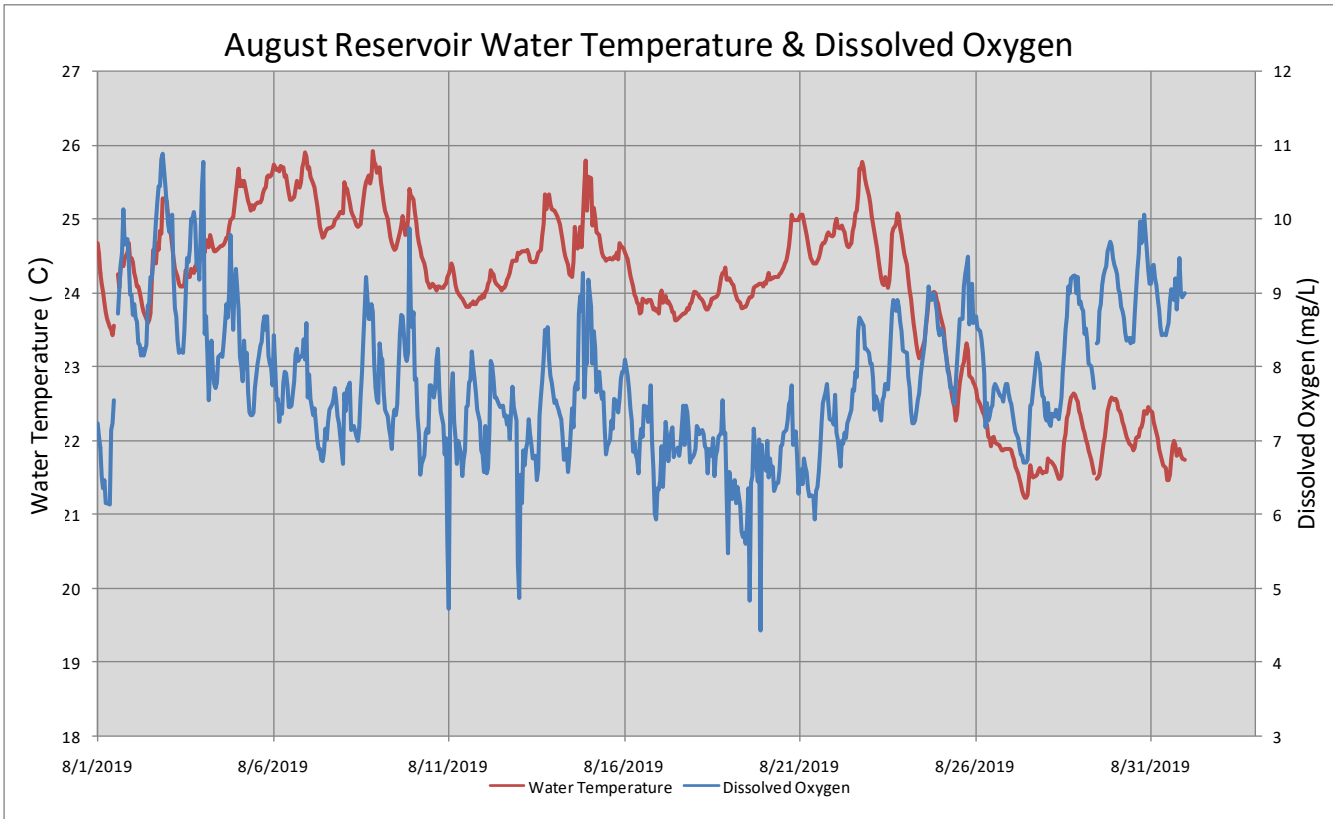
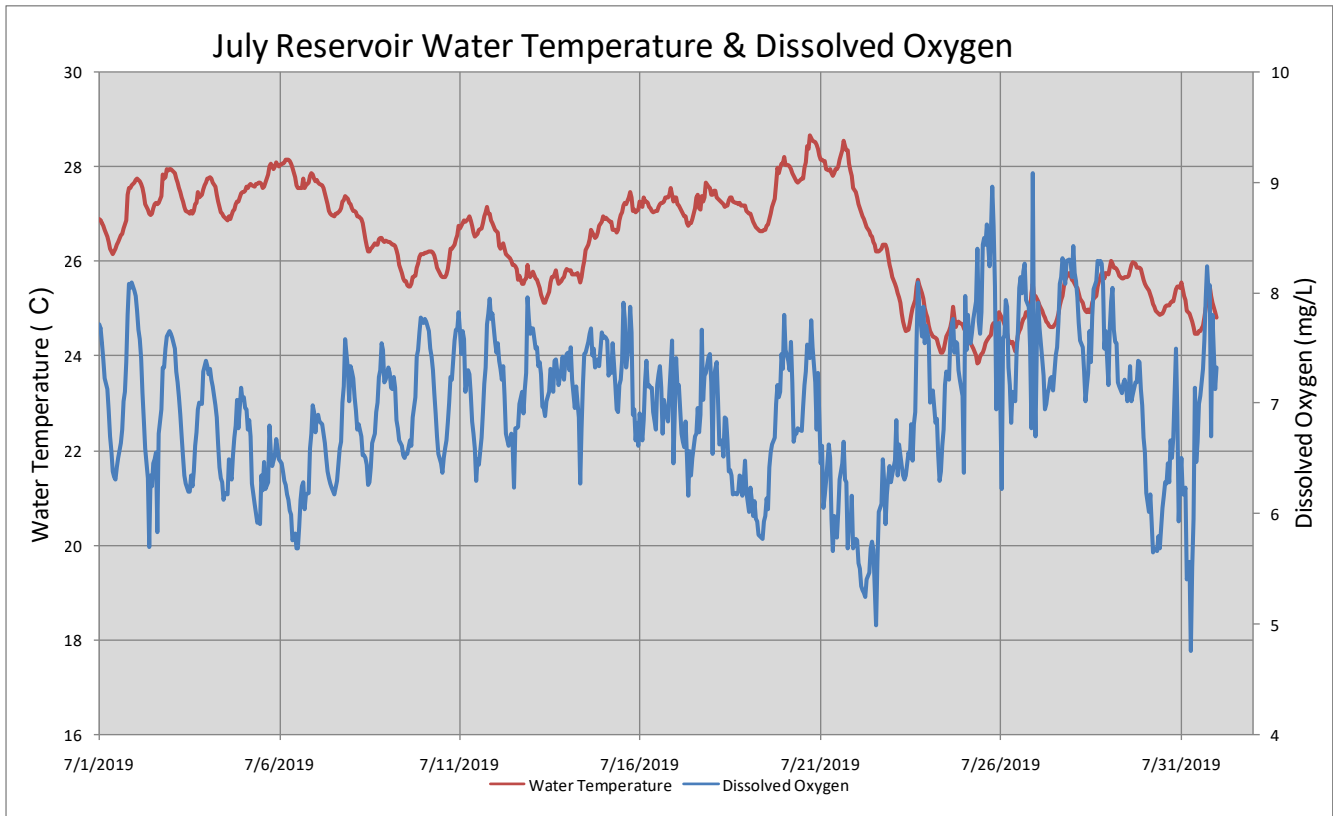
Continuous Water Temperature and Dissolved Oxygen Plots by
Monitoring Stations:

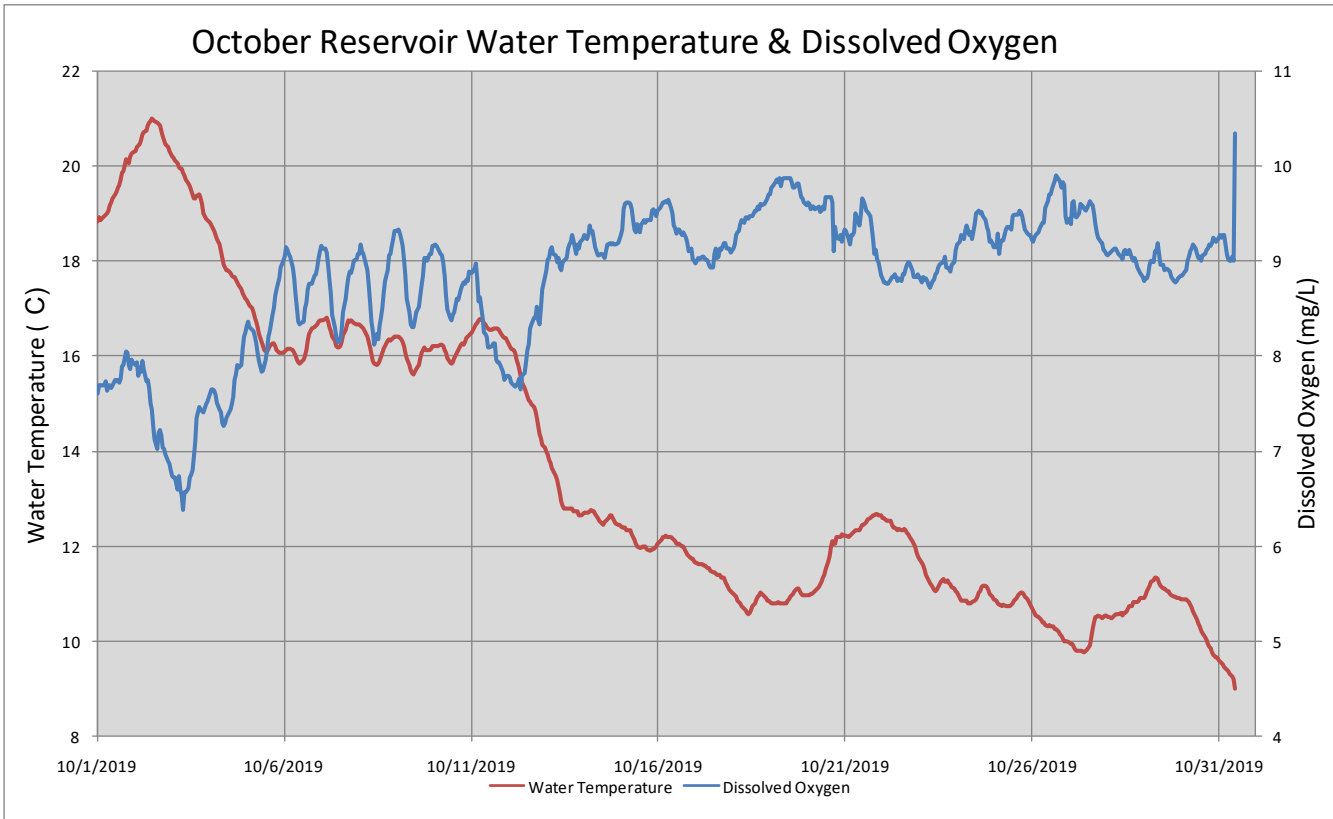
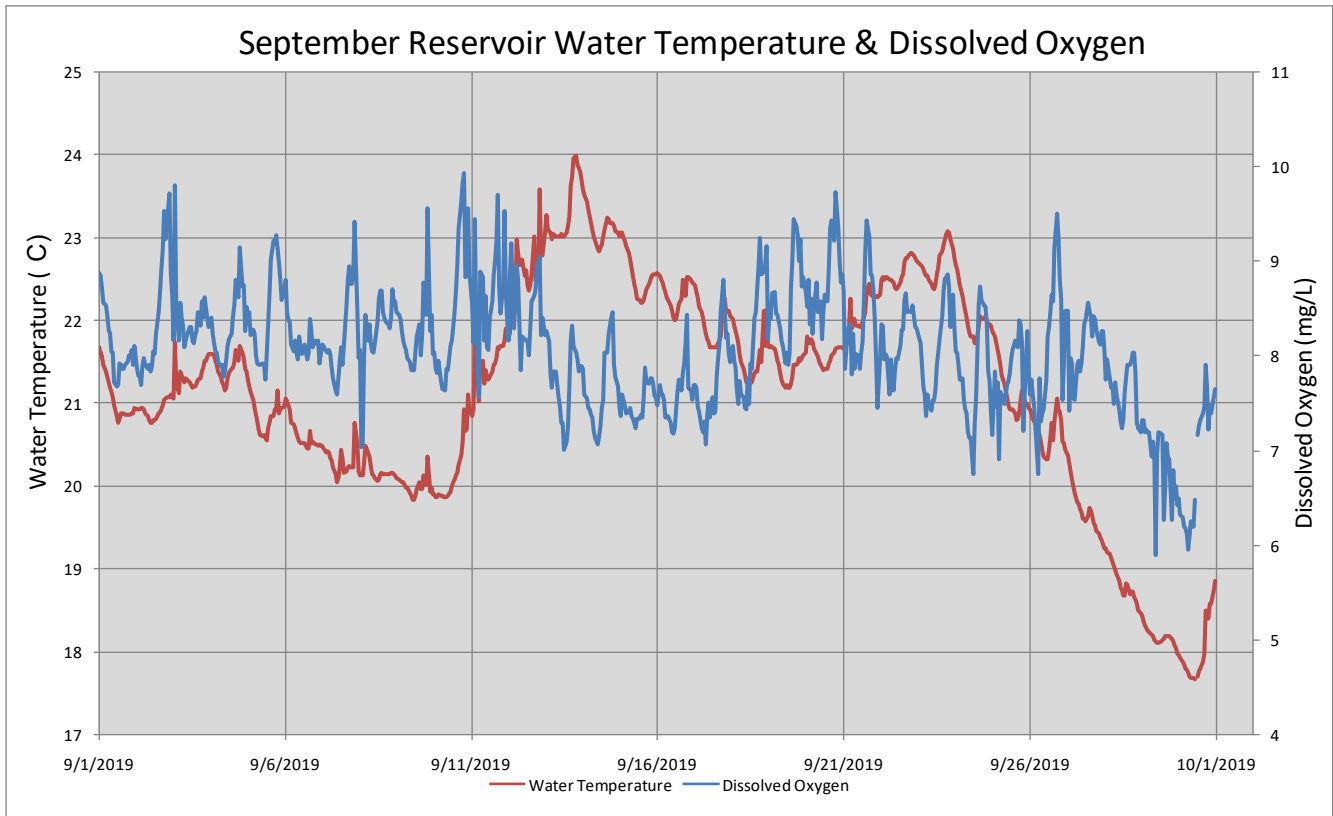
- Reservoir
- Power Canal
- Tailrace
- Bypass Reach Upstream of the Fawn River
- Bypass Reach Downstream of the Fawn River

Continuous Water Temperature and Dissolved Oxygen Plots

- Reservoir



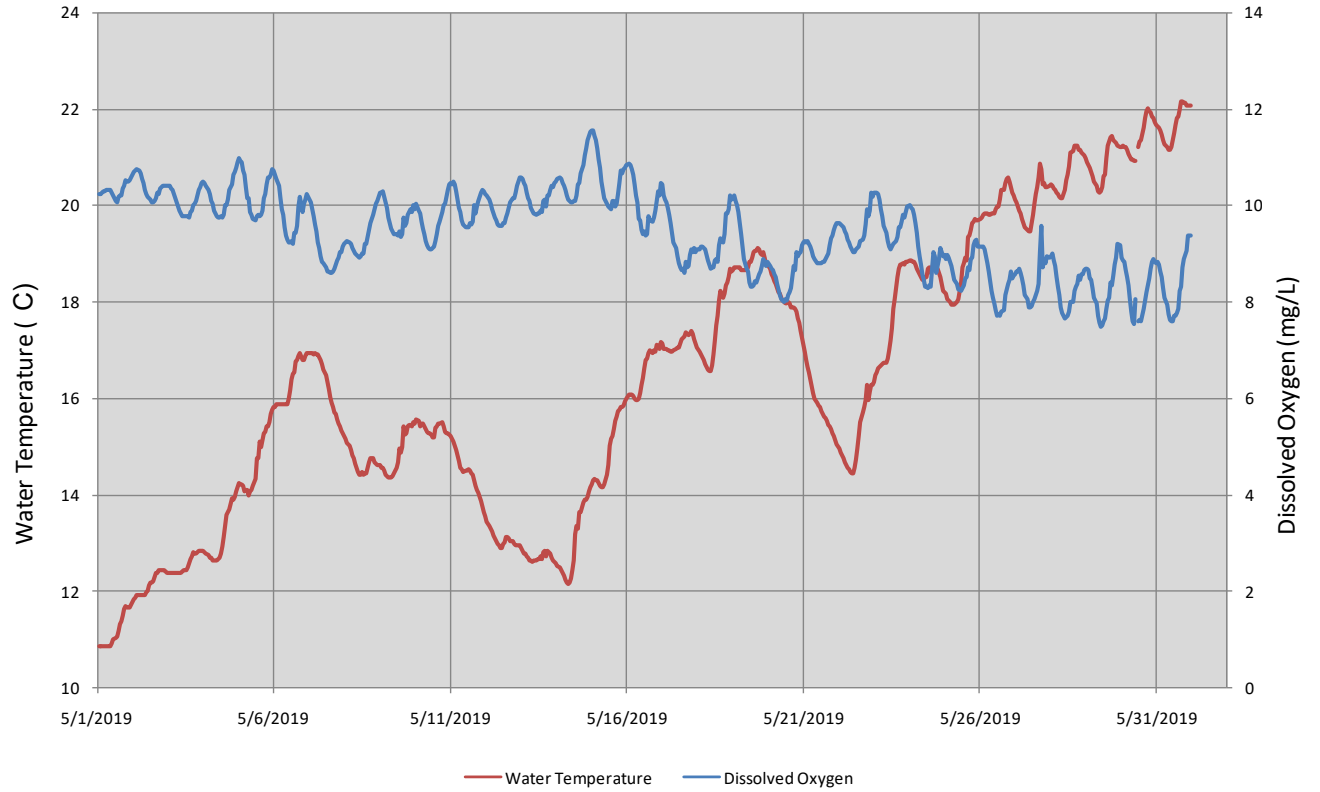




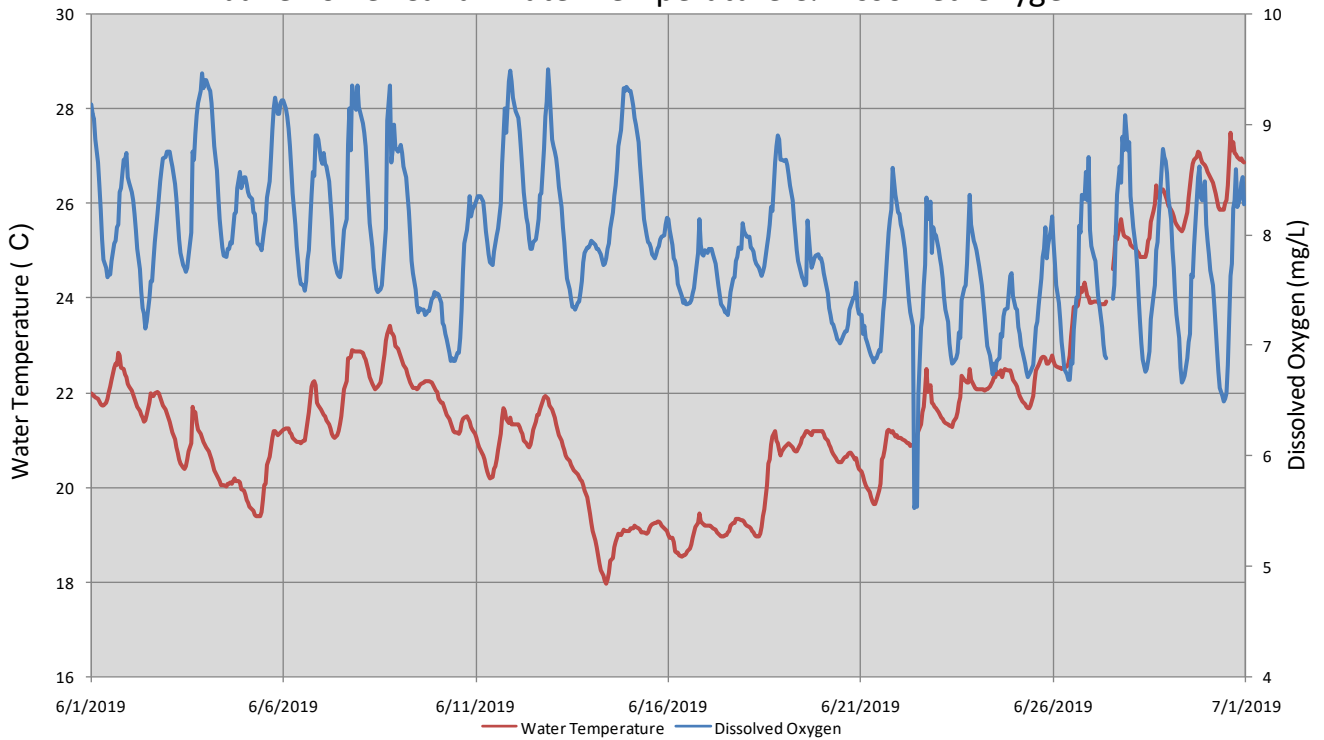
Continuous Water Temperature and Dissolved Oxygen Plots

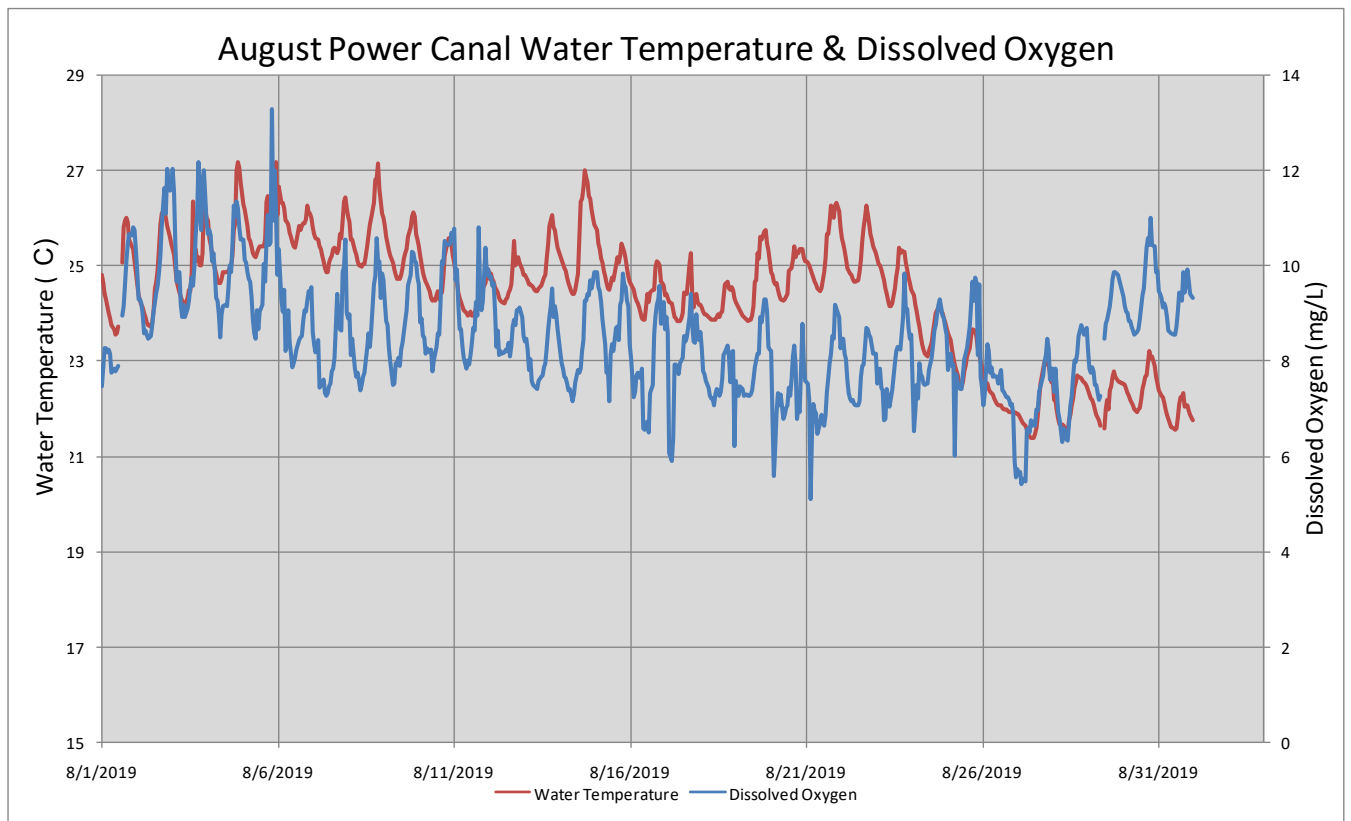
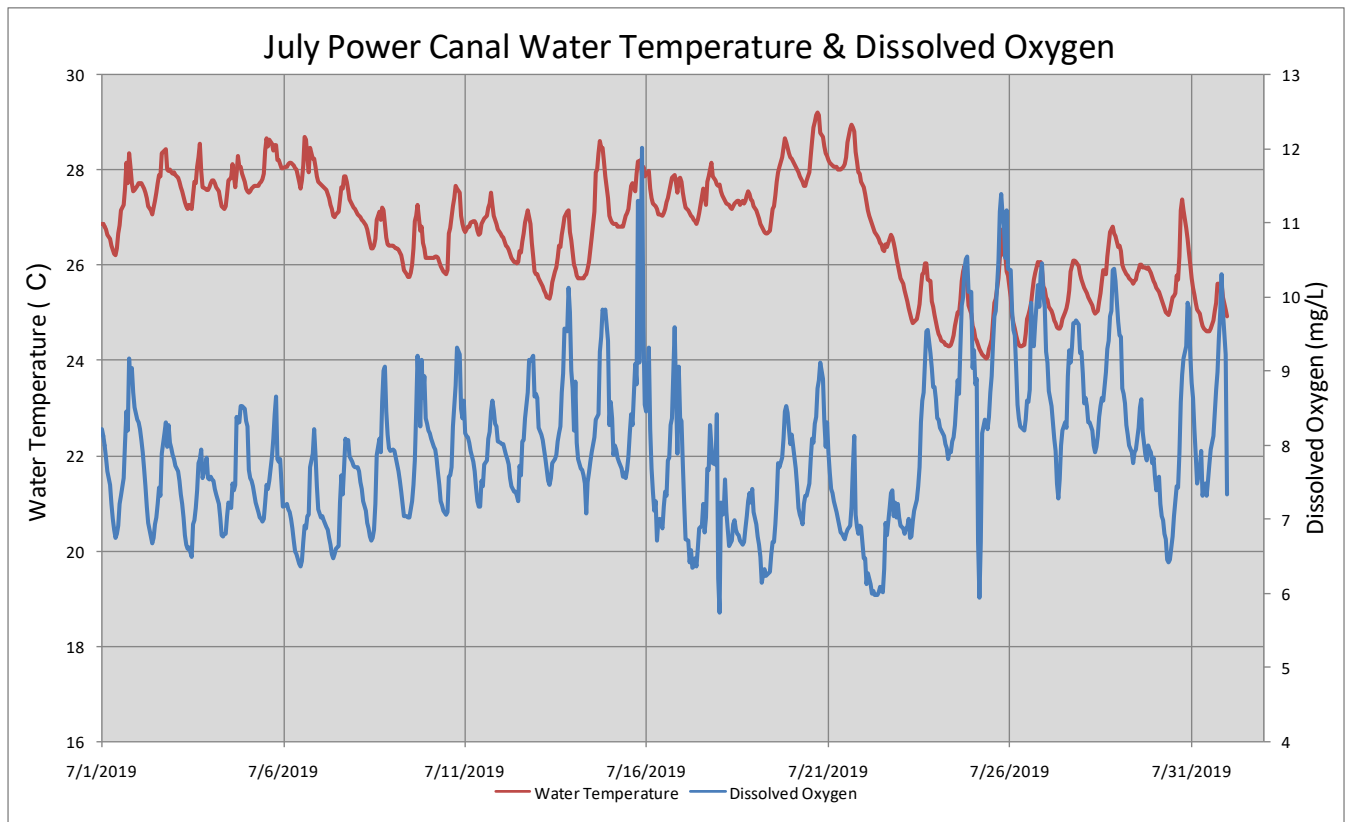
- Power Canal

May Power Canal Water Temperature & Dissolved Oxygen



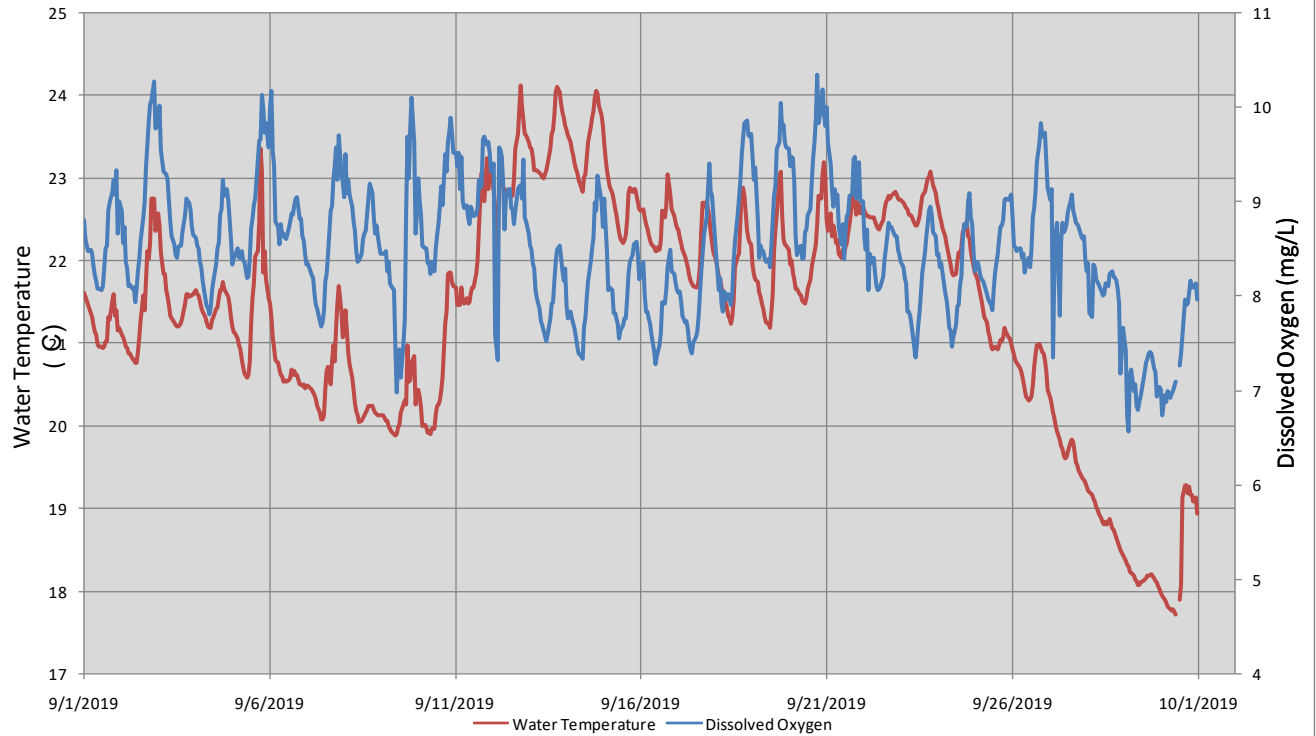
June Power Canal Water Temperature & Dissolved Oxygen



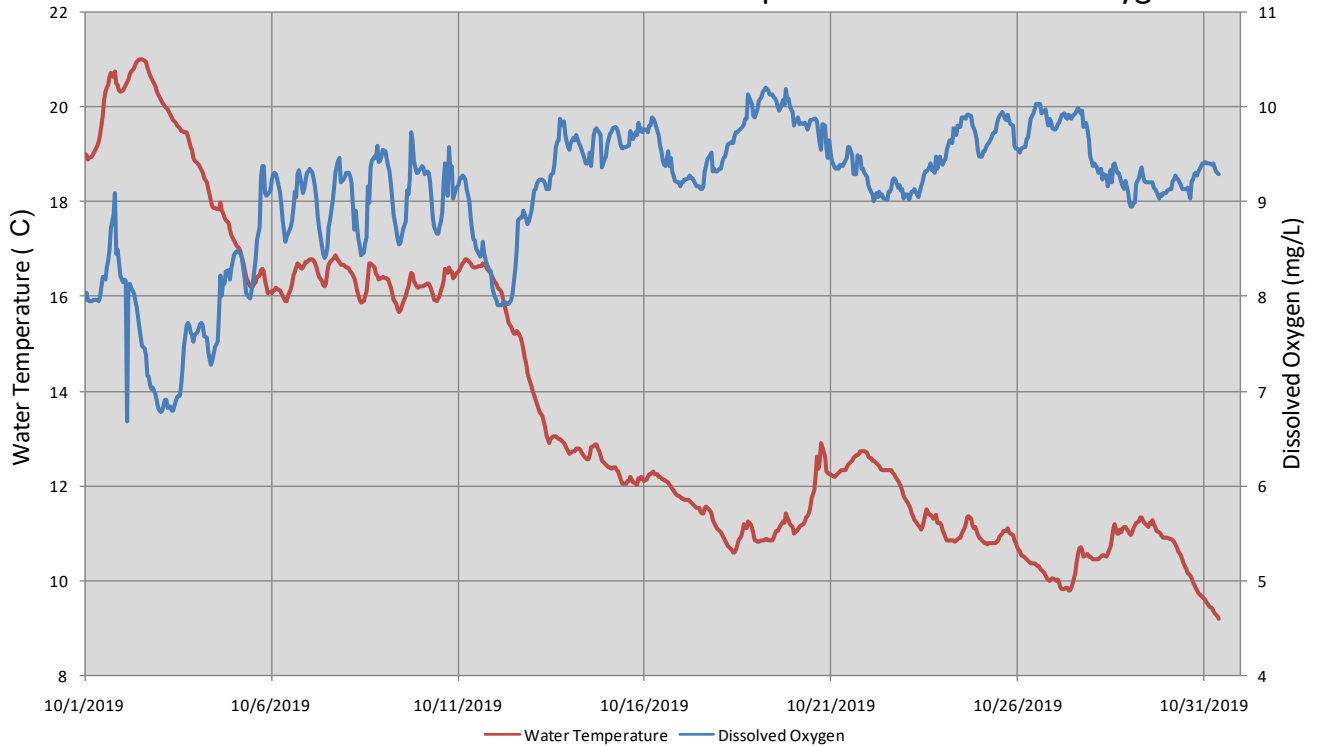


*From August 1 to August 29, 2019, data from the secondary logger was used for the power canal.

September Power Canal Water Temperature & Dissolved Oxygen

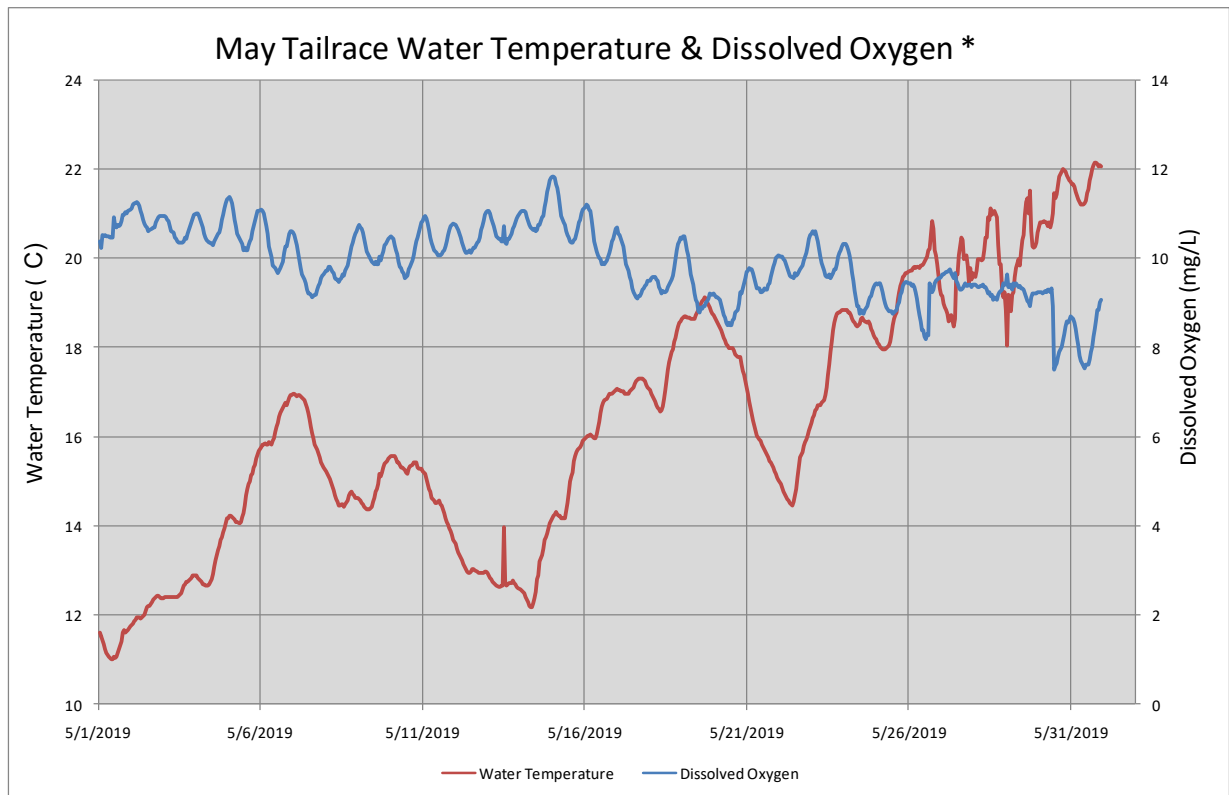


October Power Canal Water Temperature & Dissolved Oxygen

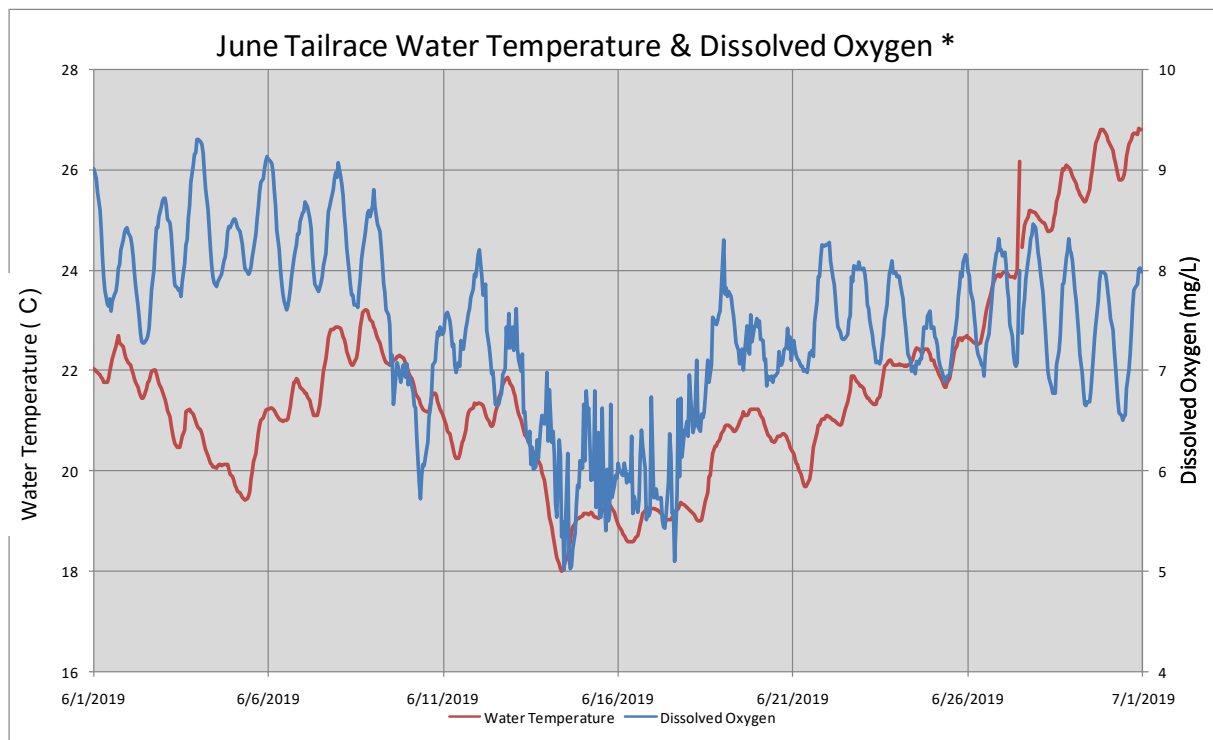


Continuous Water Temperature and Dissolved Oxygen Plots

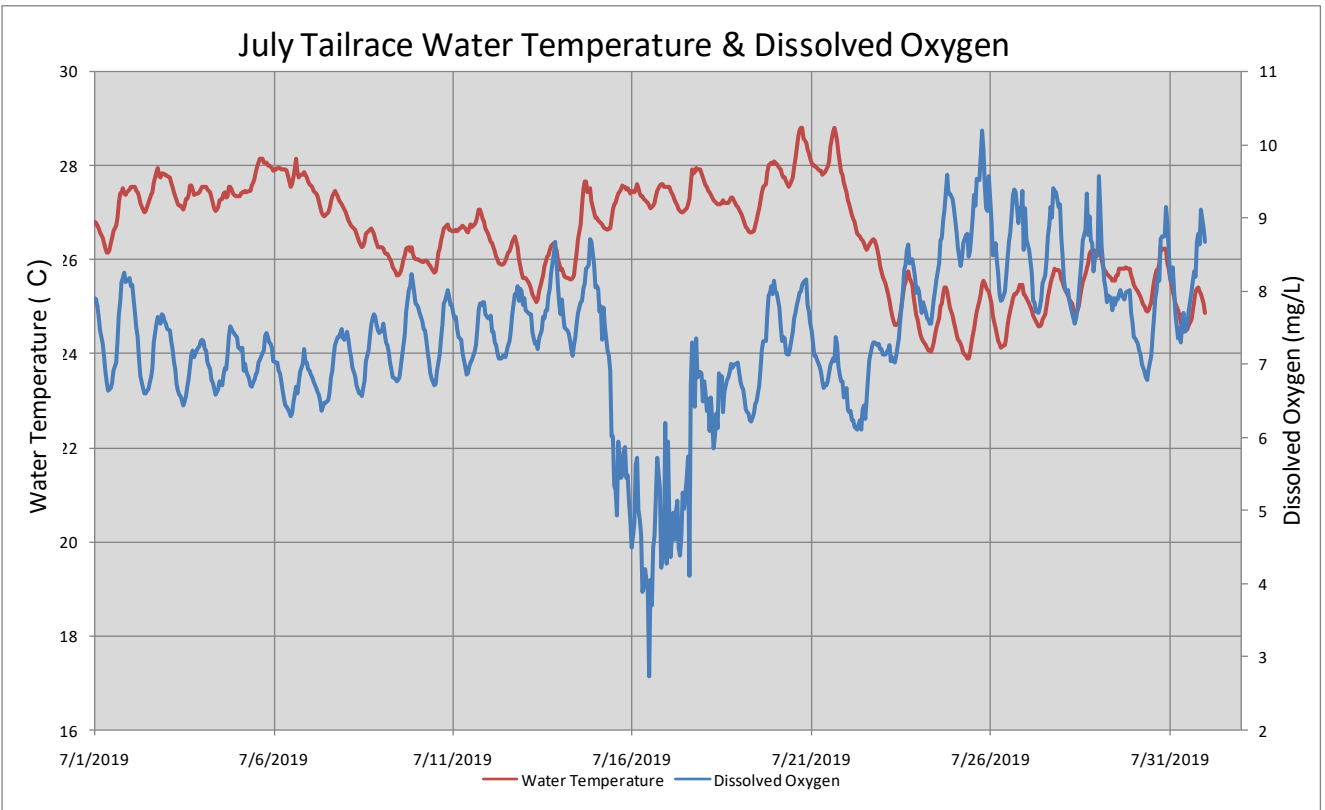
- Tailrace



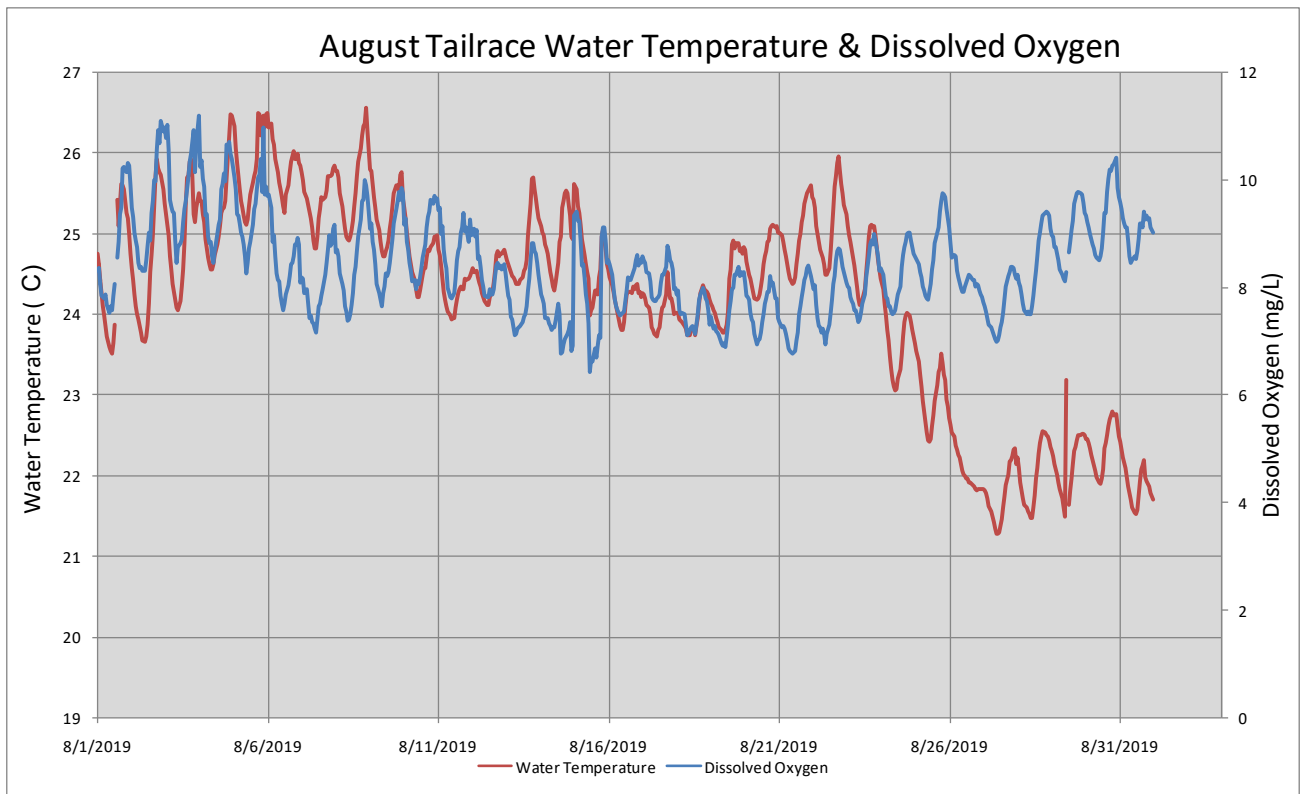
*On or around May 21, 2019, it is suspected that both loggers in the tailrace were pushed up onto the concrete ledge due to upwelling. The primary logger was damaged during this action and quit recording on May 21 while the secondary logger continued to record data from what could have been a position above the water. Because of the damage to the primary logger, data from the secondary logger was used for the month of May. The primary logger was replaced on May 30, 2019.

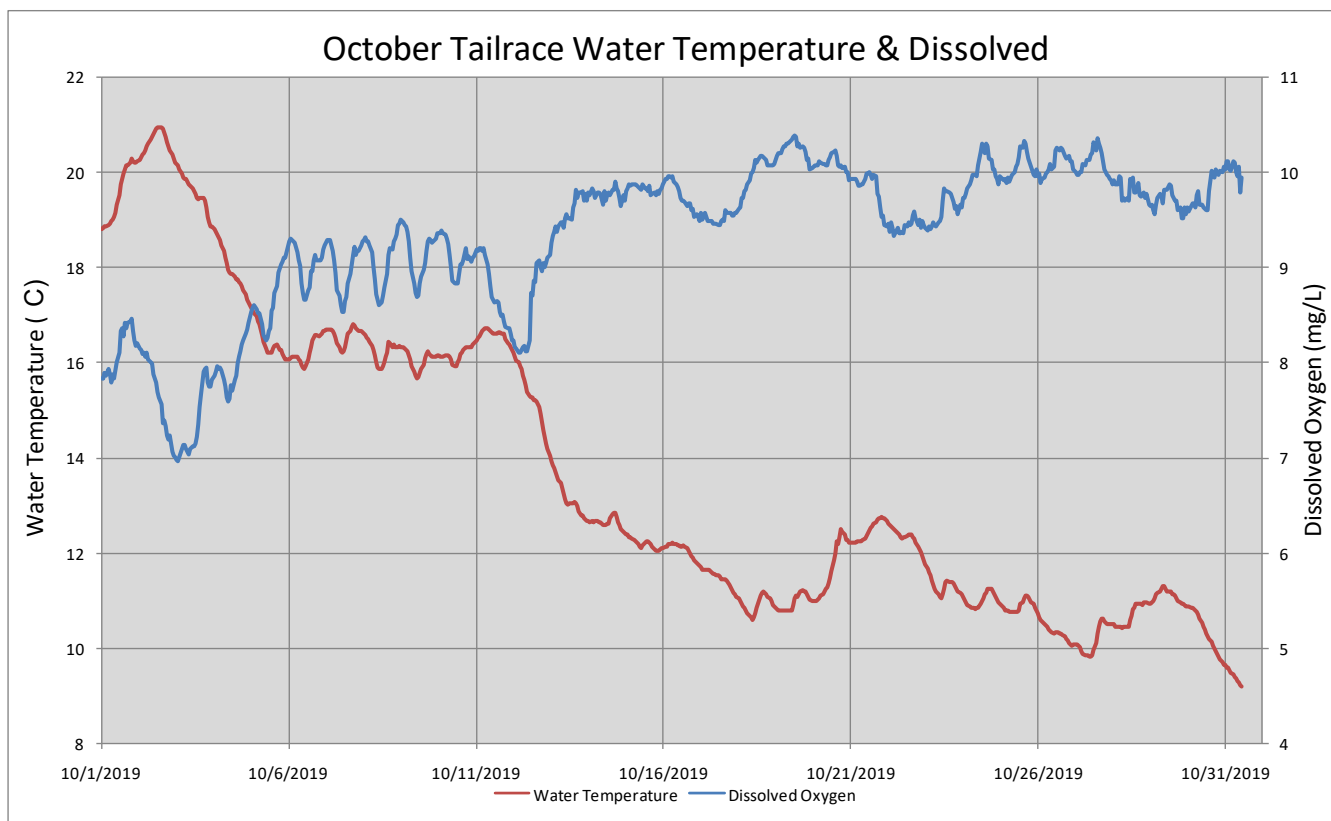
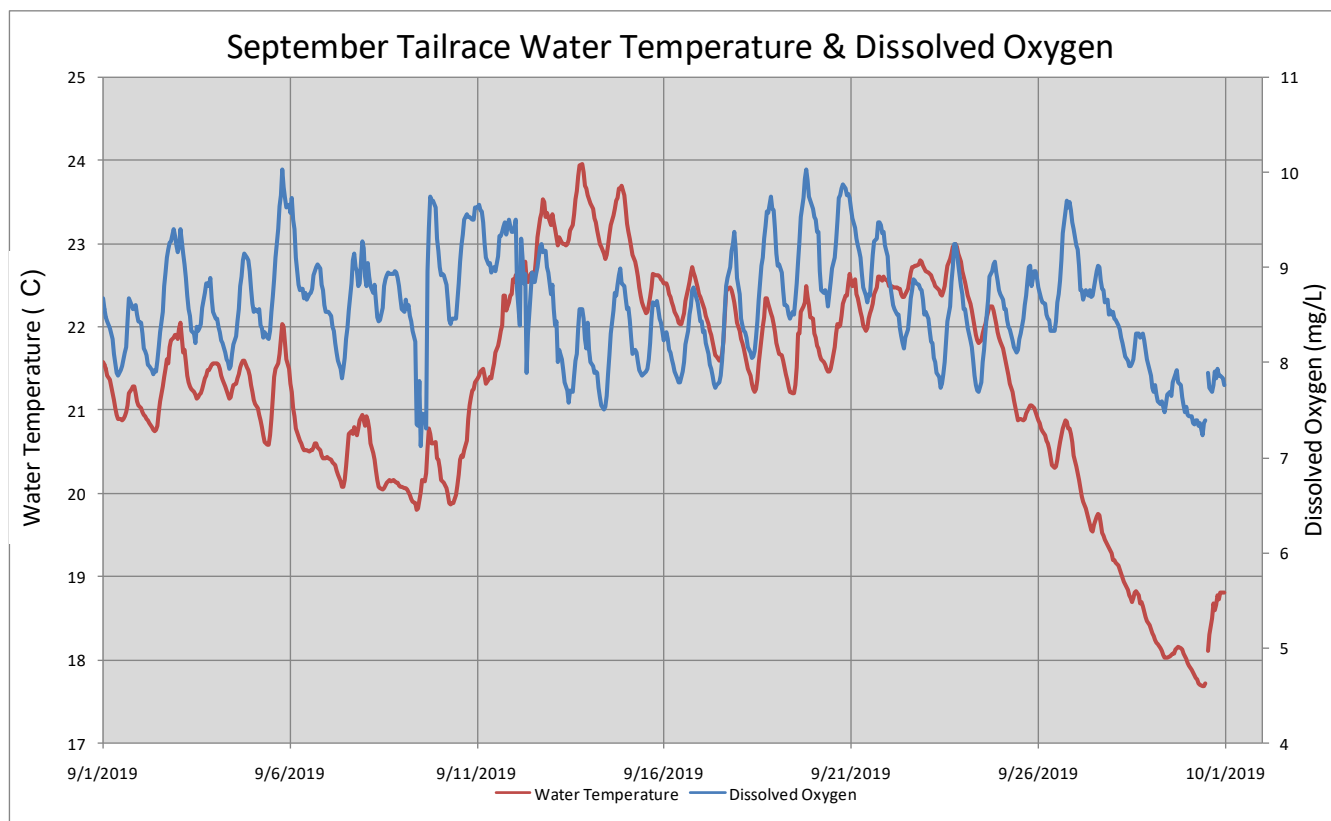


*Tailrace logger data had two instances where the DO readings were suspect. These instances were from June 12-21, 2019 and from July 14-19, 2019. These were possibly due to turbulence or shock from upwelling at this location. No secondary logger data was available for comparison due to a malfunction with the secondary logger.



*Tailrace logger data had two instances where the DO readings were suspect. These instances were from June 12-21, 2019 and from July 14-19, 2019. These were possibly due to turbulence or shock from upwelling at this location. No secondary logger data was available for comparison due to a malfunction with the secondary logger.

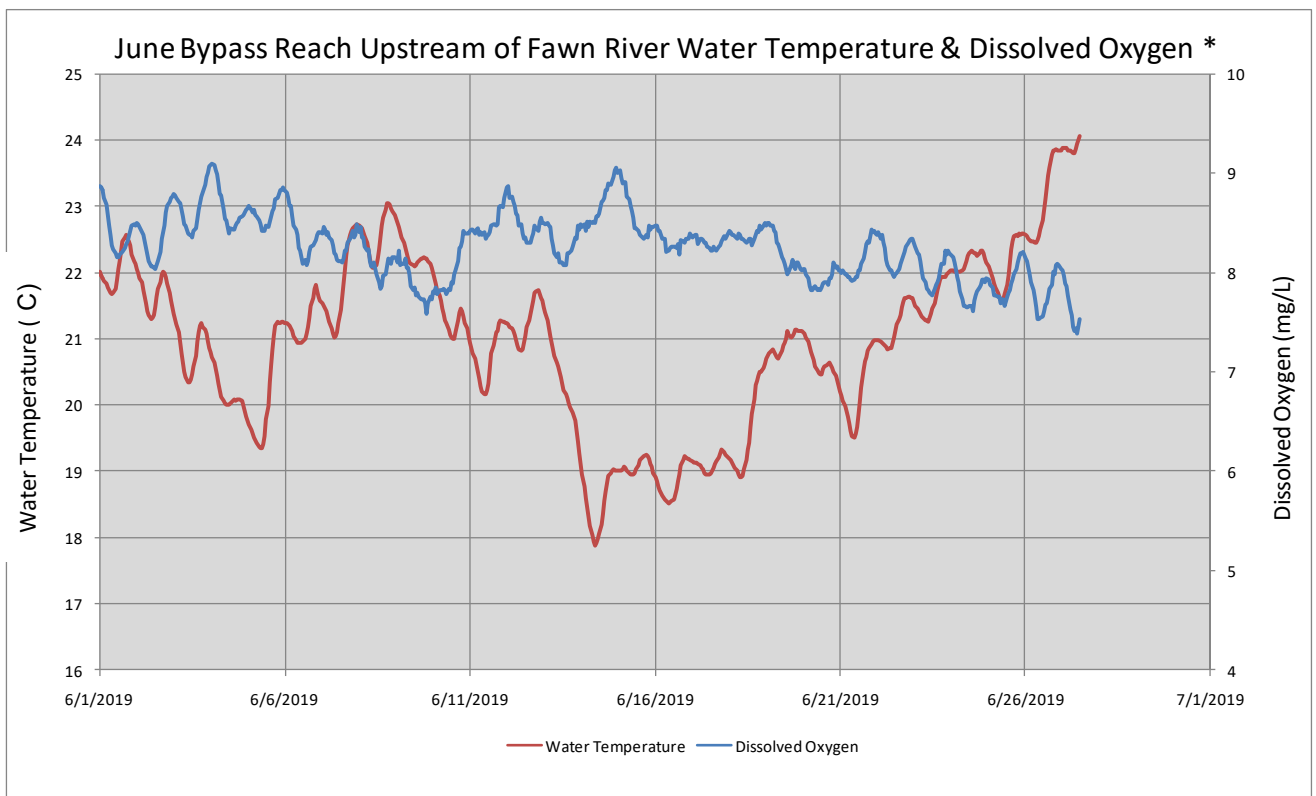
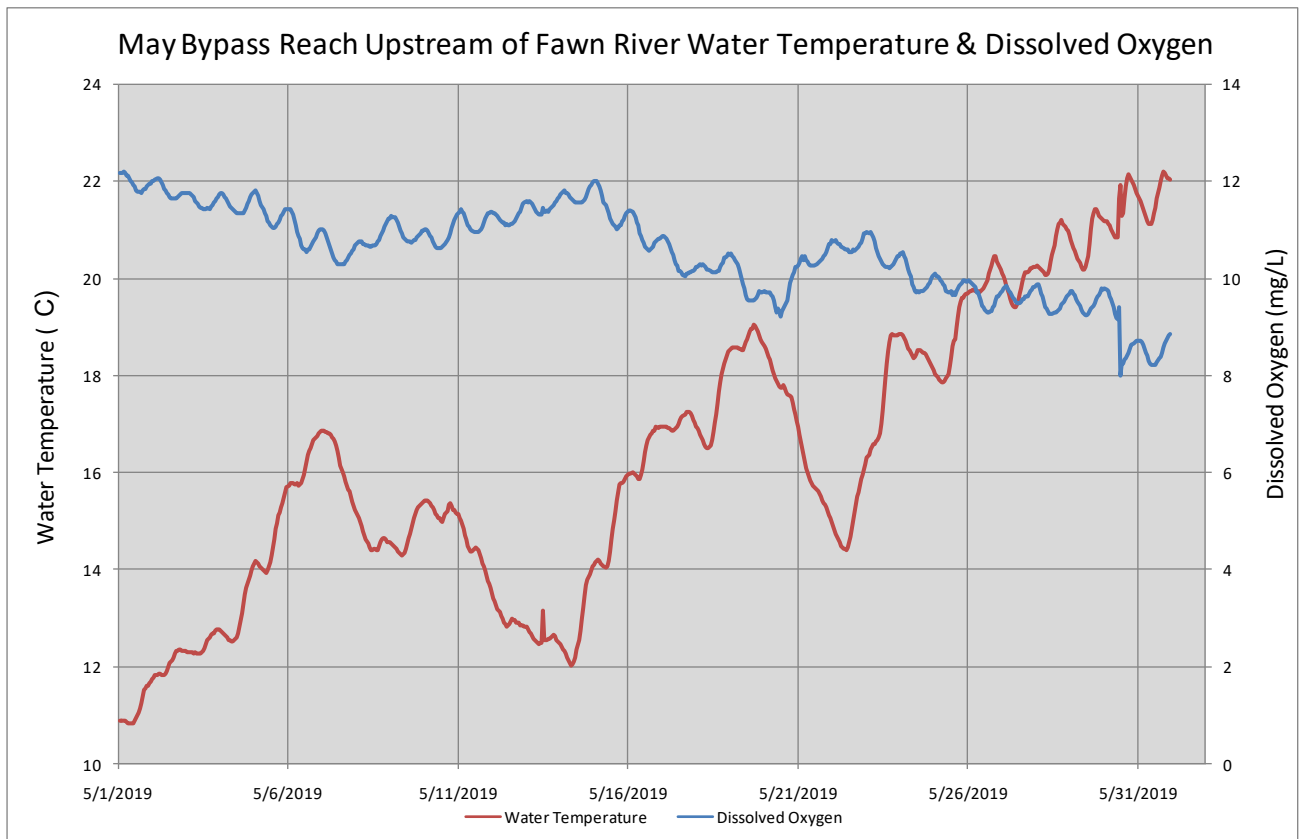




*The secondary logger in the tailrace was not working from September 30 through October 31, 2019. Data from the primary logger was used for that month.

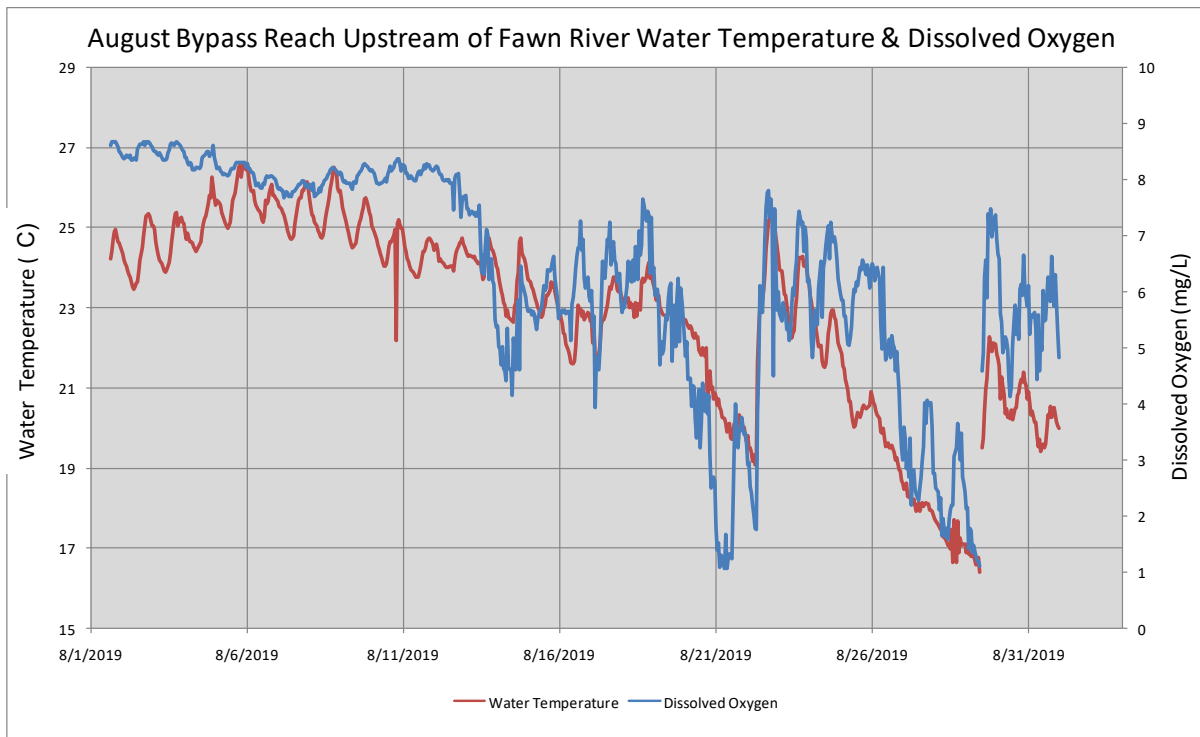
Continuous Water Temperature and Dissolved Oxygen Plots

- Bypass Reach Upstream of the Fawn River

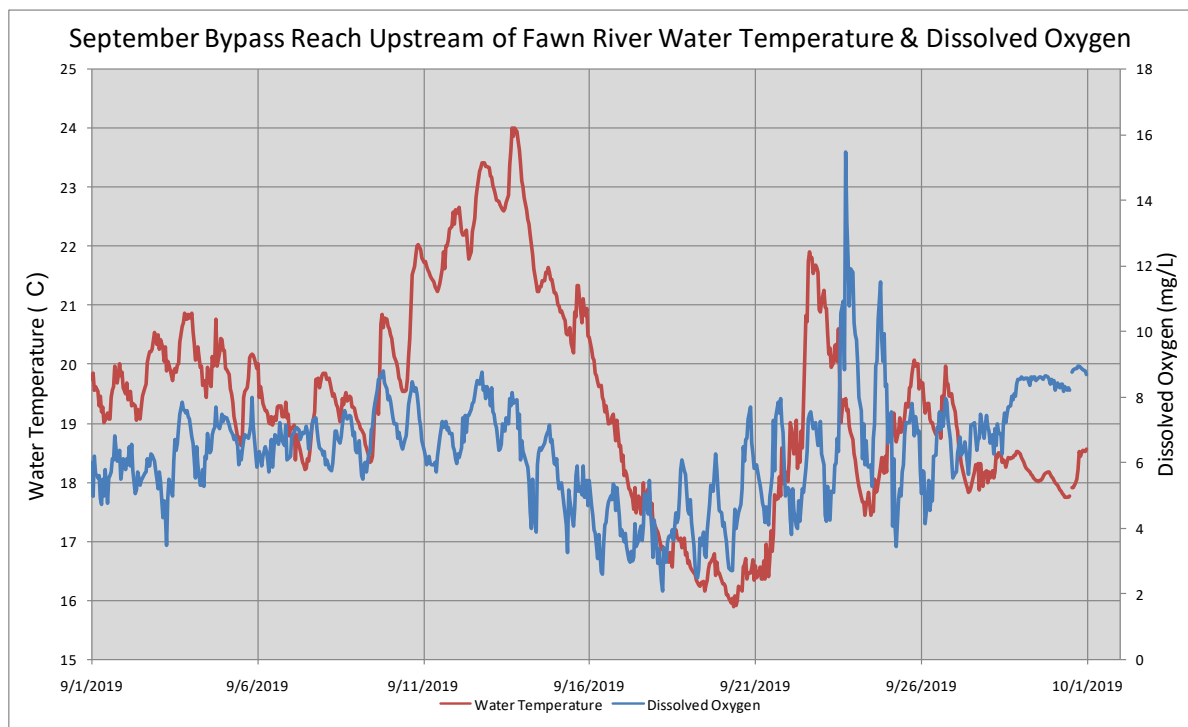


*The secondary logger in the bypass reach upstream of the Fawn River did not record data from May 30 through June 27, 2019. Data from the primary logger was used for May 30 through June 27, 2019.

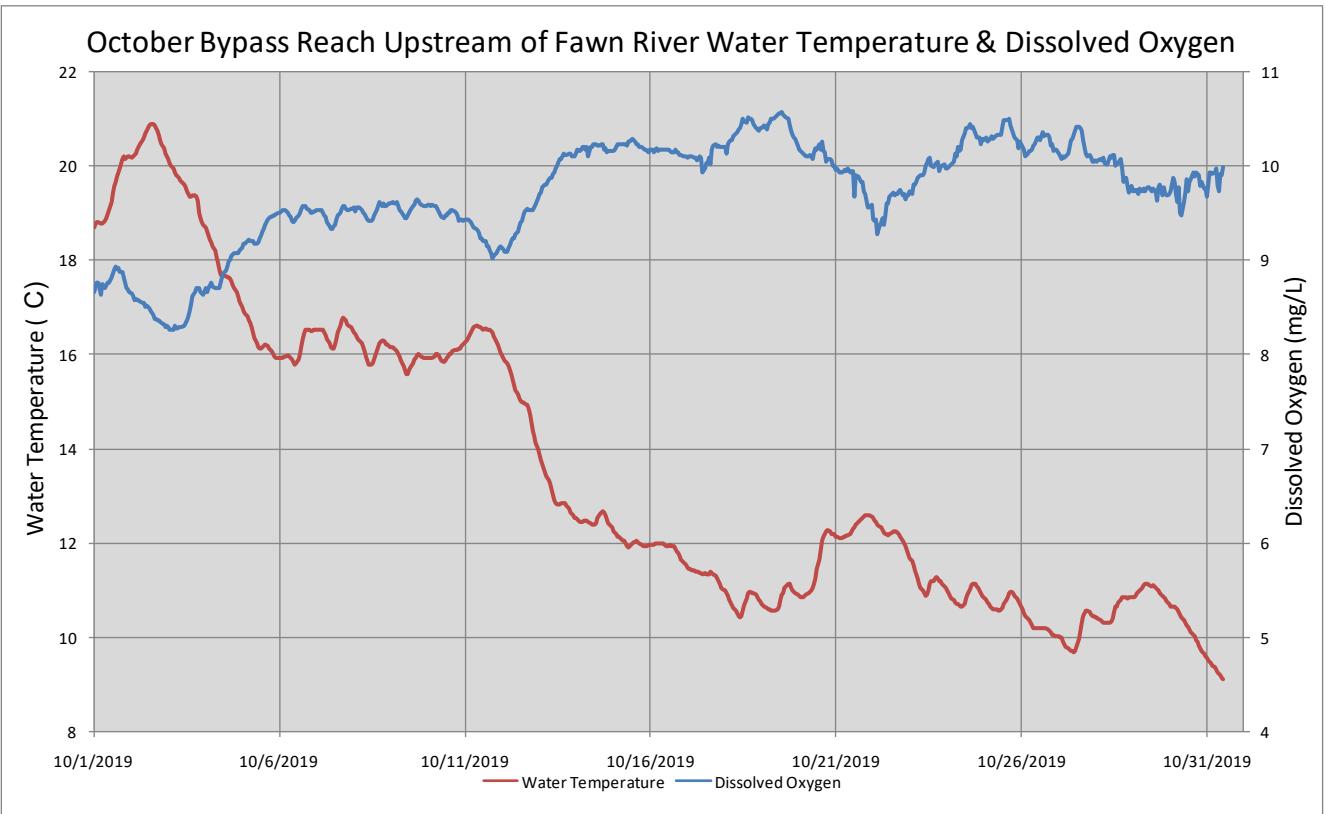
*Both loggers located in the bypass reach upstream of the Fawn River were discovered to be missing on August 1, 2019. No data exists for that location for June 27 through August 1, 2019.



*During the visit on August 29, 2019, nearly all of the water from the reservoir was being routed through the power canal. There was little to no flow through the bypass reach during that visit. The exact date that this process began is unknown, but it is believed that it began somewhere between August 14 and 20, 2019. The data from both locations in the bypass reach show large drops in DO in mid- to late August. During the visit on September 30, 2019, water was once again flowing through the bypass reach.



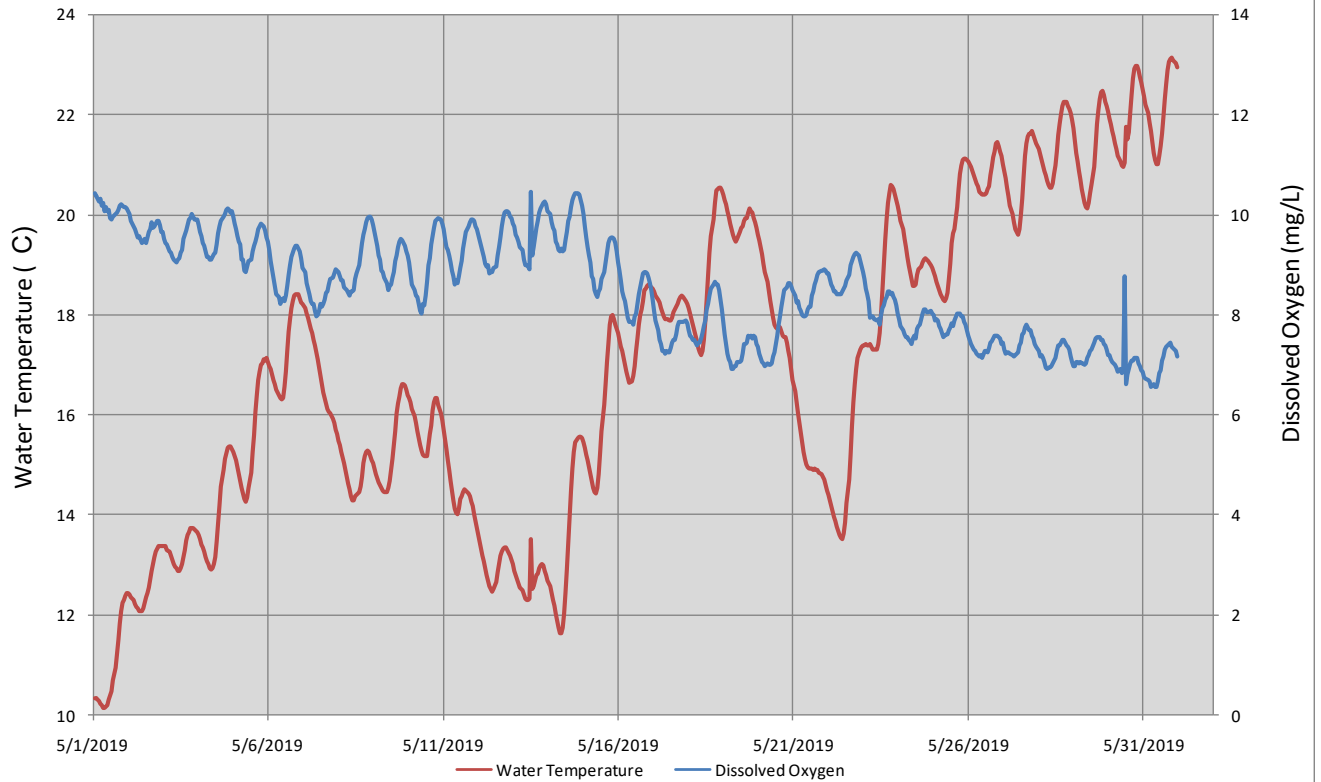
*During the visit on August 29, 2019, nearly all of the water from the reservoir was being routed through the power canal. There was little to no flow through the bypass reach during that visit. The exact date that this process began is unknown, but it is believed that it began somewhere between August 14 and 20, 2019. The data from both locations in the bypass reach show large drops in DO in mid- to late August. During the visit on September 30, 2019, water was once again flowing through the bypass reach.



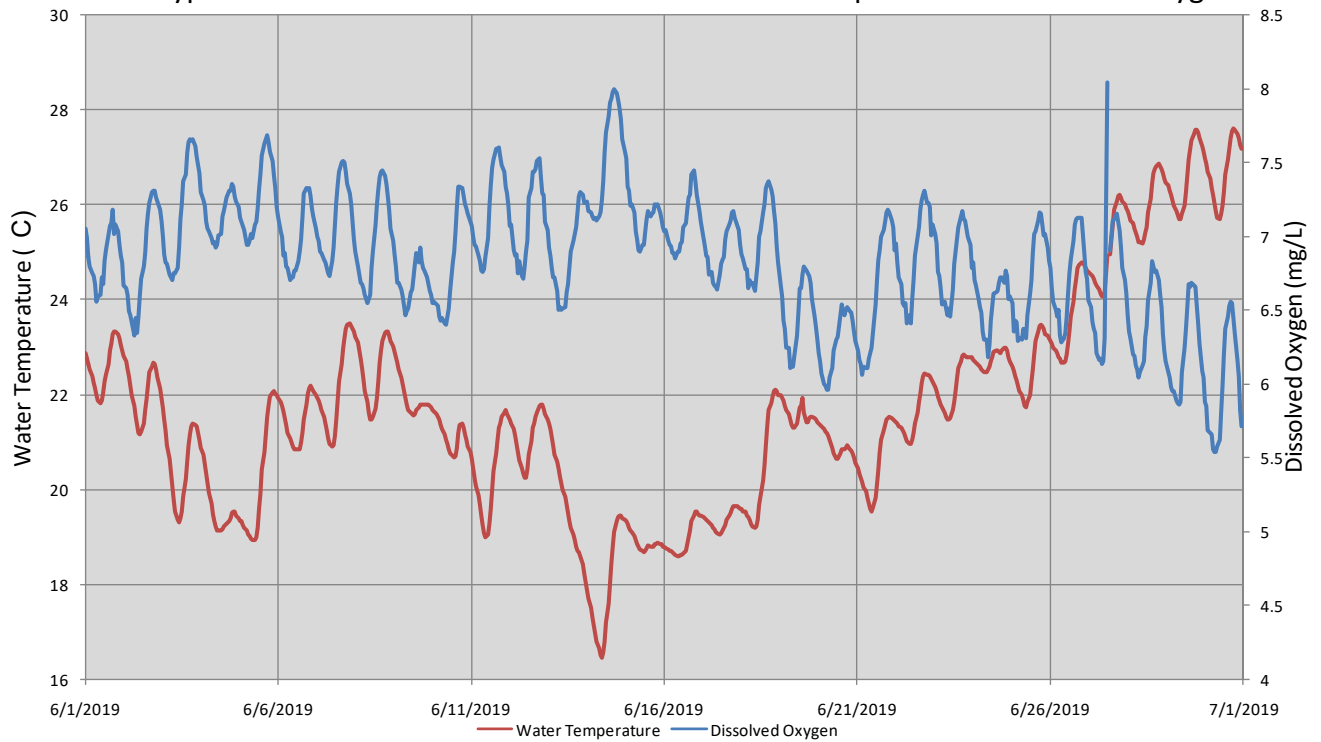
Continuous Water Temperature and Dissolved Oxygen Plots

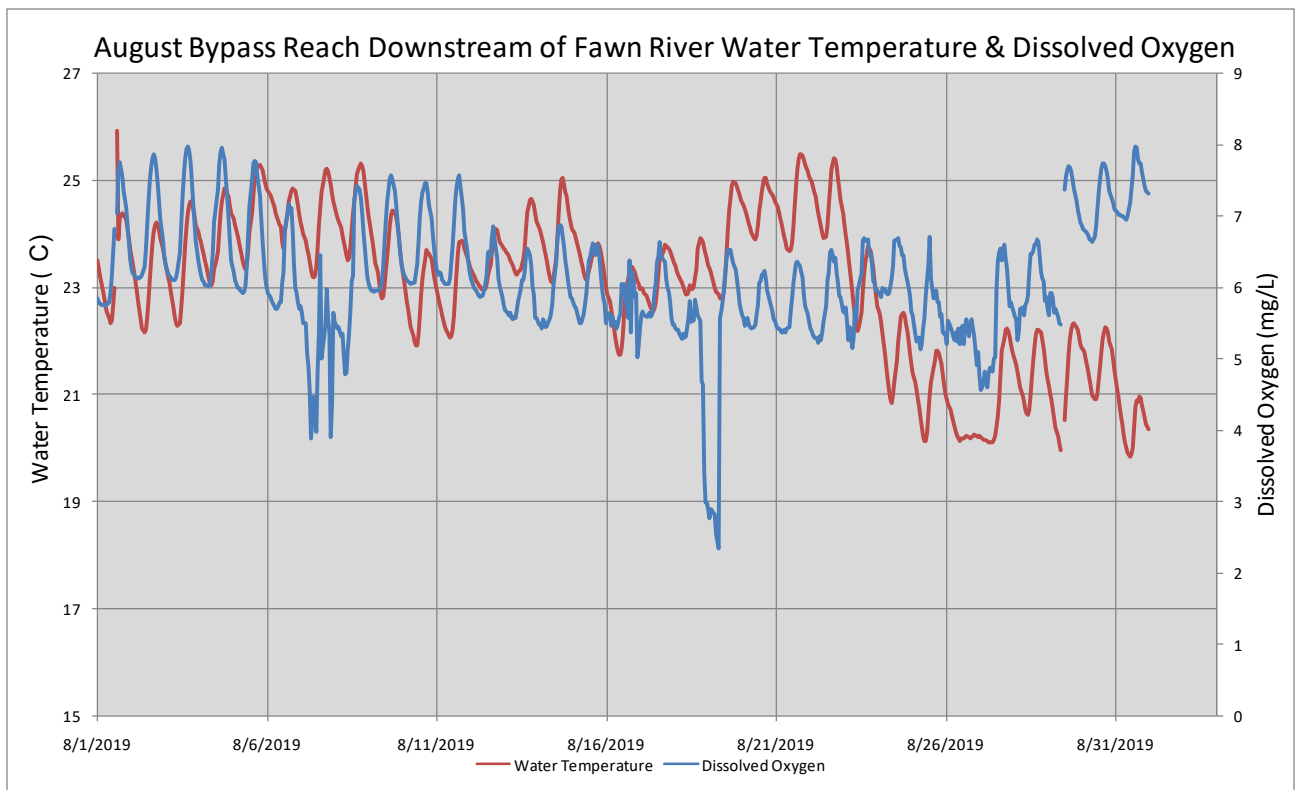
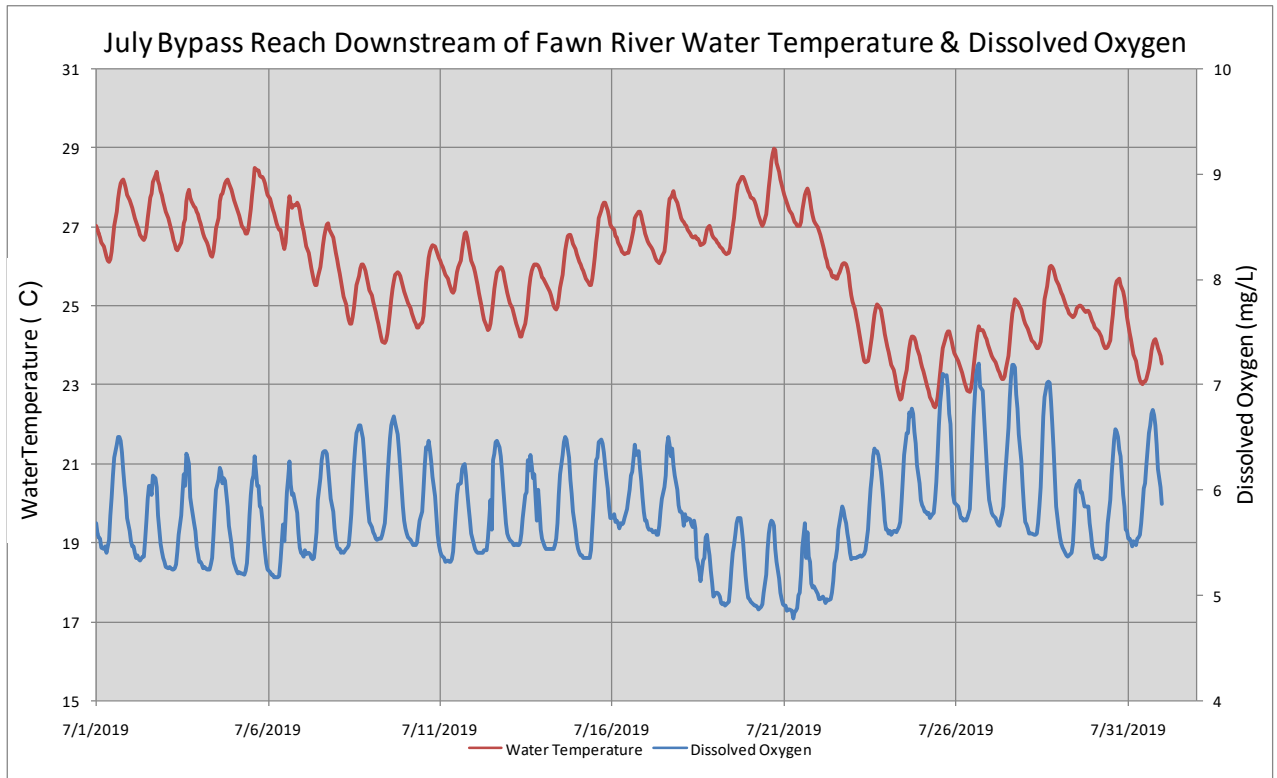
- Bypass Reach Downstream of the Fawn River

May Bypass Reach Downstream of Fawn River Water Temperature & Dissolved Oxygen



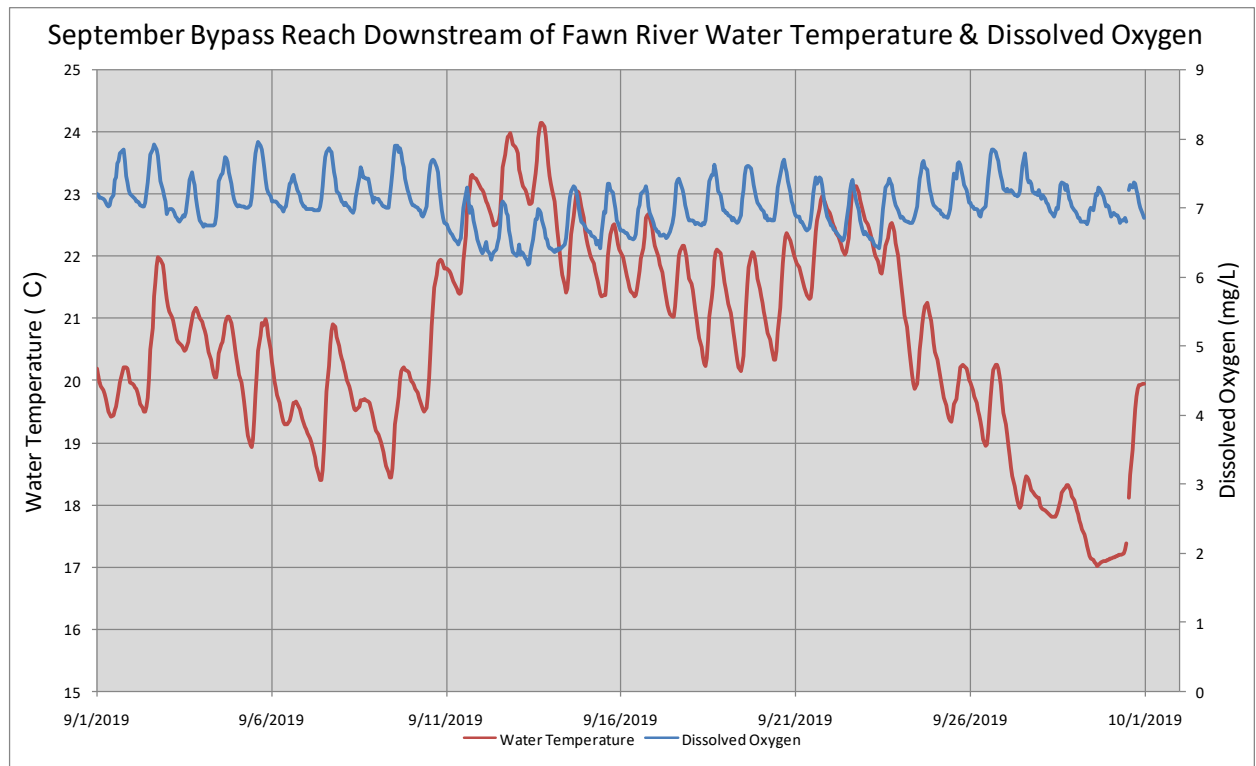
June Bypass Reach Downstream of Fawn River Water Temperature & Dissolved Oxygen





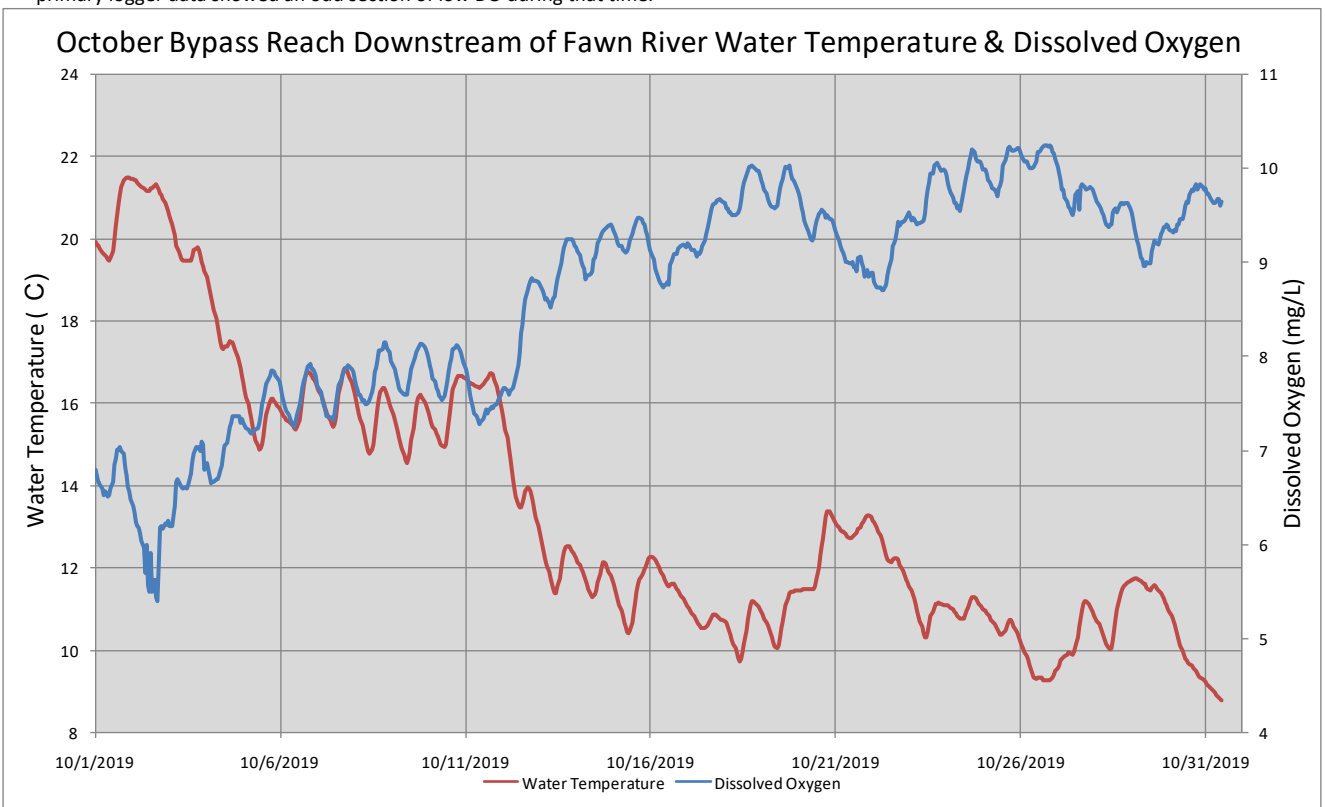
*During the visit on August 29, 2019, nearly all of the water from the reservoir was being routed through the power canal. There was little to no flow through the bypass reach during that visit. The exact date that this process began is unknown, but it is believed that it began somewhere between August 14 and 20, 2019. The data from both locations in the bypass reach show large drops in DO in mid- to late August. During the visit on September 30, 2019, water was once again flowing through the bypass reach.

*For the month of August, data from the primary logger in the bypass reach downstream of the Fawn River was used with the exception of August 17 at 11:00 through August 22, 2019 at 11:00. Data from the secondary logger was used for that time period due to oddly low DO readings observed with the primary data.



*During the visit on August 29, 2019, nearly all of the water from the reservoir was being routed through the power canal. There was little to no flow through the bypass reach during that visit. The exact date that this process began is unknown, but it is believed that it began somewhere between August 14 and 20, 2019. The data from both locations in the bypass reach show large drops in DO in mid- to late August. During the visit on September 30, 2019, water was once again flowing through the bypass reach.

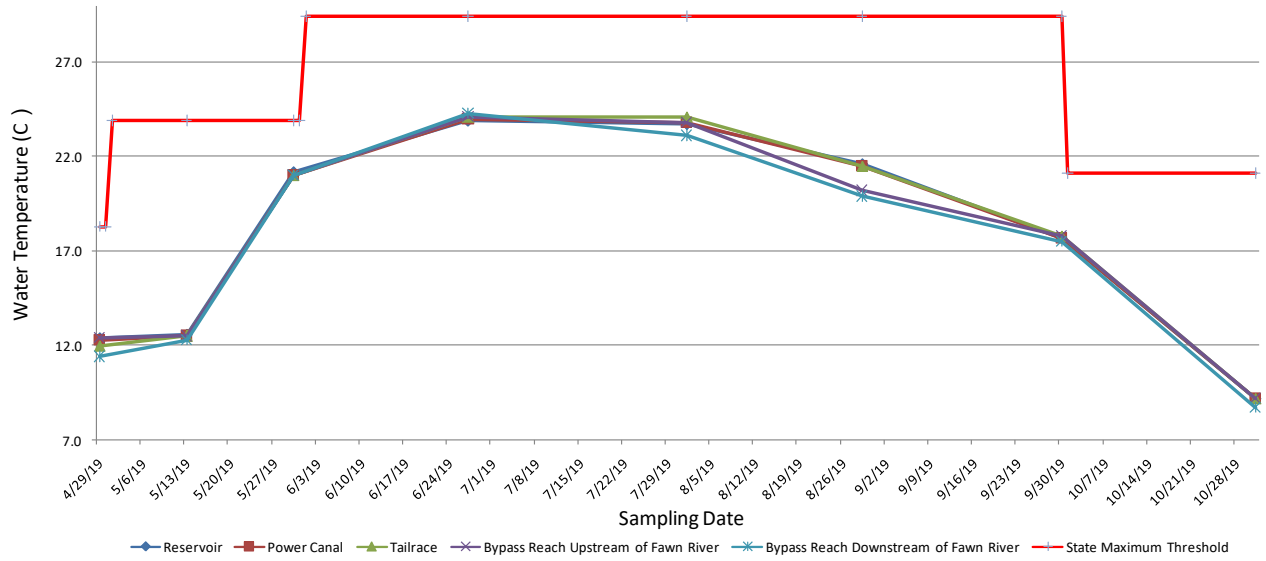
*The secondary logger data was used for the bypass reach downstream of the Fawn River from August 29 to September 30, 2019. The plot for the primary logger data showed an odd section of low DO during that time.



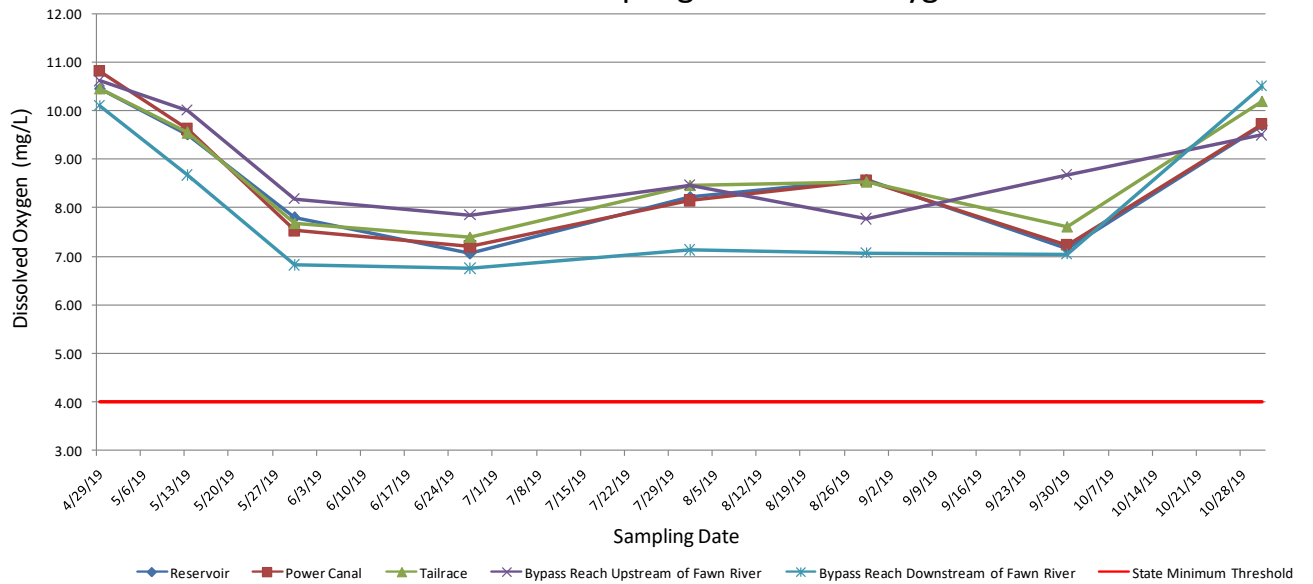
Appendix C

Discrete Multi-parameter Water Quality Plots

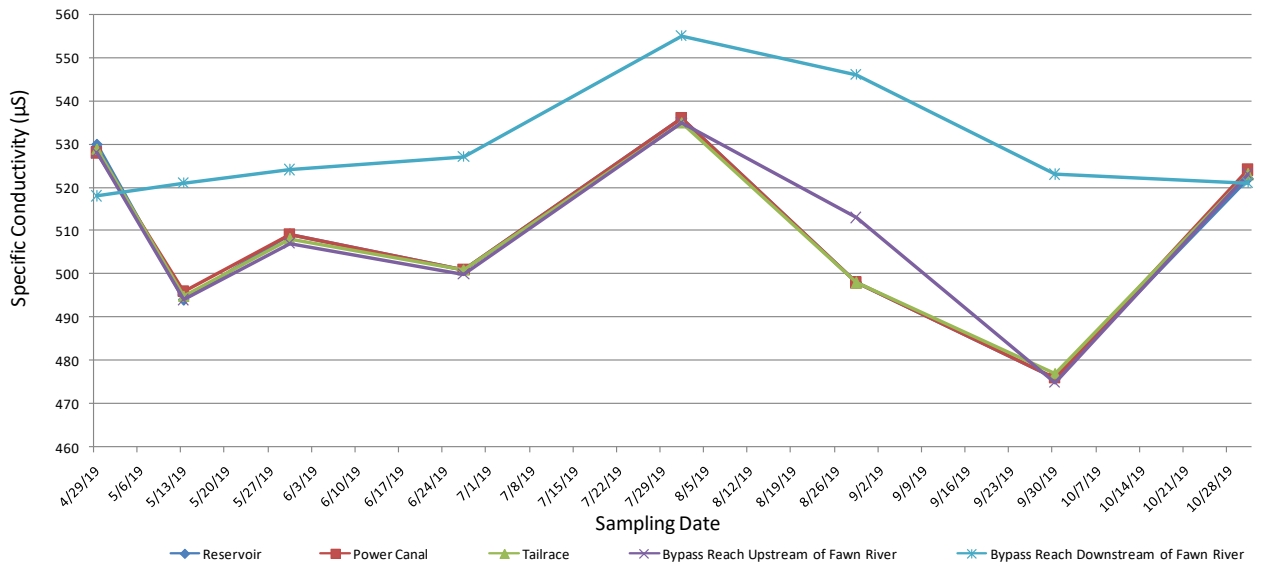
2019 Discrete Sampling- Water Temperature



2019 Discrete Sampling- Dissolved Oxygen



2019 Discrete Sampling- Specific Conductivity



2019 Discrete Sampling- pH



Appendix D
Sediment Results from Pace Analytical Laboratory



Pace Analytical Services, LLC
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

February 27, 2020

Michelle VanDenBrand
Great Lakes Environmental Center
739 Hastings Street
Traverse City, MI 49686

RE: Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

Dear Michelle VanDenBrand:

Enclosed are the analytical results for sample(s) received by the laboratory on October 01, 2019. 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.

Report revised to include Arsenic analysis.

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

Sincerely,

Tod Noltemeyer
tod.noltemeyer@pacelabs.com
(920)469-2436
Project Manager

Enclosures

cc: Dennis McCauley, Great Lakes Environmental Center, Inc.



REPORT OF LABORATORY ANALYSIS

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



Pace Analytical Services, LLC
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

CERTIFICATIONS

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

Pace Analytical Services Minneapolis

AZLA Certification #: 2926.01
Alabama Certification #: 40770
Alaska Contaminated Sites Certification #: 17-009
Alaska DW Certification #: MN00064
Arizona Certification #: AZ0014
Arkansas DW Certification #: MN00064
Arkansas WW Certification #: 88-0680
California Certification #: 2929
CNMI Saipan Certification #: MP0003
Colorado Certification #: MN00064
Connecticut Certification #: PH-0256
EPA Region 8+Wyoming DW Certification #: via MN 027-053-137
Florida Certification #: E87605
Georgia Certification #: 959
Guam EPA Certification #: MN00064
Hawaii Certification #: MN00064
Idaho Certification #: MN00064
Illinois Certification #: 200011
Indiana Certification #: C-MN-01
Iowa Certification #: 368
Kansas Certification #: E-10167
Kentucky DW Certification #: 90062
Kentucky WW Certification #: 90062
Louisiana DEQ Certification #: 03086
Louisiana DW Certification #: MN00064
Maine Certification #: MN00064
Maryland Certification #: 322
Massachusetts Certification #: M-MN064
Massachusetts DWP Certification #: via MN 027-053-137
Michigan Certification #: 9909
Minnesota Certification #: 027-053-137

Minnesota Dept of Ag Certification #: via MN 027-053-137
Minnesota Petrofund Certification #: 1240
Mississippi Certification #: MN00064
Missouri Certification #: 10100
Montana Certification #: CERT0092
Nebraska Certification #: NE-OS-18-06
Nevada Certification #: MN00064
New Hampshire Certification #: 2081
New Jersey Certification #: MN002
New York Certification #: 11647
North Carolina DW Certification #: 27700
North Carolina WW Certification #: 530
North Dakota Certification #: R-036
Ohio DW Certification #: 41244
Ohio VAP Certification #: CL101
Oklahoma Certification #: 9507
Oregon Primary Certification #: MN300001
Oregon Secondary Certification #: MN200001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification #: MN00064
South Carolina Certification #: 74003001
Tennessee Certification #: TN02818
Texas Certification #: T104704192
Utah Certification #: MN00064
Vermont Certification #: VT-027053137
Virginia Certification #: 460163
Washington Certification #: C486
West Virginia DEP Certification #: 382
West Virginia DW Certification #: 9952 C
Wisconsin Certification #: 999407970
Wyoming UST Certification #: via AZLA 2926.01

Pace Analytical Services Green Bay

1241 Bellevue Street, Green Bay, WI 54302
Florida/NELAP Certification #: E87948
Illinois Certification #: 200050
Kentucky UST Certification #: 82
Louisiana Certification #: 04168
Minnesota Certification #: 055-999-334
New York Certification #: 12064
North Dakota Certification #: R-150

Virginia VELAP ID: 460263
South Carolina Certification #: 83006001
Texas Certification #: T104704529-14-1
Wisconsin Certification #: 405132750
Wisconsin DATCP Certification #: 105-444
USDA Soil Permit #: P330-16-00157
Federal Fish & Wildlife Permit #: LE51774A-0

REPORT OF LABORATORY ANALYSIS

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SAMPLE SUMMARY

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

Lab ID	Sample ID	Matrix	Date Collected	Date Received
40196278001	LRSS	Solid	09/25/19 13:45	10/01/19 09:30
40196278002	LRSSD	Solid	09/25/19 13:45	10/01/19 09:30
40196278003	MRSS	Solid	09/25/19 15:00	10/01/19 09:30
40196278004	URSS	Solid	09/25/19 16:10	10/01/19 09:30

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SAMPLE ANALYTE COUNT

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
40196278001	LRSS	EPA 8082	BLM	10	PASI-G
		EPA 6010	TXW	9	PASI-G
		EPA 7471	AJT	1	PASI-G
		ASTM D2974-87	PCG	1	PASI-G
		EPA 9071	JER	1	PASI-M
		EPA 365.4	DAW	1	PASI-G
		EPA 9060	TJJ	6	PASI-G
		EPA 8082	BLM	10	PASI-G
		EPA 6010	TXW	9	PASI-G
40196278002	LRSSD	EPA 7471	AJT	1	PASI-G
		ASTM D2974-87	PCG	1	PASI-G
		EPA 9071	JER	1	PASI-M
		EPA 365.4	DAW	1	PASI-G
		EPA 9060	TJJ	6	PASI-G
		EPA 8082	BLM	10	PASI-G
		EPA 6010	TXW	9	PASI-G
		EPA 7471	AJT	1	PASI-G
		ASTM D2974-87	PCG	1	PASI-G
40196278003	MRSS	EPA 9071	JER	1	PASI-M
		EPA 365.4	DAW	1	PASI-G
		EPA 9060	TJJ	6	PASI-G
		EPA 8082	BLM	10	PASI-G
		EPA 6010	TXW	9	PASI-G
		EPA 7471	AJT	1	PASI-G
		ASTM D2974-87	PCG	1	PASI-G
		EPA 9071	JER	1	PASI-M
		EPA 365.4	DAW	1	PASI-G
40196278004	URSS	EPA 9060	TJJ	6	PASI-G
		EPA 8082	BLM	10	PASI-G
		EPA 6010	TXW	9	PASI-G
		EPA 7471	AJT	1	PASI-G
		ASTM D2974-87	AH	1	PASI-G
		EPA 9071	JER	1	PASI-M
		EPA 365.4	DAW	1	PASI-G
		EPA 9060	TJJ	6	PASI-G
		EPA 8082	BLM	10	PASI-G

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PROJECT NARRATIVE

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

Method: EPA 8082
Description: 8082 GCS PCB
Client: Great Lakes Environmental Center
Date: February 27, 2020

General Information:

4 samples were analyzed for EPA 8082. All samples were received in acceptable condition with any exceptions noted below or on the chain-of-custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:

The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:

The samples were prepared in accordance with EPA 3541 with any exceptions noted below.

Initial Calibrations (Including MS Tune as applicable):

All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:

All criteria were within method requirements with any exceptions noted below.

Surrogates:

All surrogates were within QC limits with any exceptions noted below.

QC Batch: 337743

S0: Surrogate recovery outside laboratory control limits.

- LCS (Lab ID: 1961714)
 - Decachlorobiphenyl (S)
- MS (Lab ID: 1961715)
 - Decachlorobiphenyl (S)
- MSD (Lab ID: 1961716)
 - Decachlorobiphenyl (S)

S3: Surrogate recovery exceeded laboratory control limits. Analyte presence below reporting limits in associated sample.

- BLANK (Lab ID: 1961713)
 - Decachlorobiphenyl (S)

Method Blank:

All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:

All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:

All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

Method: EPA 6010
Description: 6010 MET ICP
Client: Great Lakes Environmental Center
Date: February 27, 2020

General Information:

4 samples were analyzed for EPA 6010. All samples were received in acceptable condition with any exceptions noted below or on the chain-of-custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:

The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:

The samples were prepared in accordance with EPA 3050 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):

All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:

All criteria were within method requirements with any exceptions noted below.

Method Blank:

All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:

All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:

All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

Method: EPA 7471
Description: 7471 Mercury
Client: Great Lakes Environmental Center
Date: February 27, 2020

General Information:

4 samples were analyzed for EPA 7471. All samples were received in acceptable condition with any exceptions noted below or on the chain-of-custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:

The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:

The samples were prepared in accordance with EPA 7471 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):

All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:

All criteria were within method requirements with any exceptions noted below.

Method Blank:

All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:

All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:

All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

Method: EPA 9071
Description: 9071 Oil and Grease, Soxhlet
Client: Great Lakes Environmental Center
Date: February 27, 2020

General Information:

4 samples were analyzed for EPA 9071. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:

The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:

The samples were prepared in accordance with EPA 9071B with any exceptions noted below.

Method Blank:

All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:

All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:

All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: 636672

A matrix spike and/or matrix spike duplicate (MS/MSD) were performed on the following sample(s): 70106716002

M1: Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

- MS (Lab ID: 3431462)
- Oil and Grease

Duplicate Sample:

All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

Method: EPA 365.4
Description: 365.4 Total Phosphorus
Client: Great Lakes Environmental Center
Date: February 27, 2020

General Information:

4 samples were analyzed for EPA 365.4. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:

The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:

The samples were prepared in accordance with EPA 365.4 with any exceptions noted below.

Method Blank:

All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:

All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:

All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

Method: EPA 9060
Description: Total Organic Carbon Quad
Client: Great Lakes Environmental Center
Date: February 27, 2020

General Information:

4 samples were analyzed for EPA 9060. All samples were received in acceptable condition with any exceptions noted below or on the chain-of-custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:

The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:

All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:

All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:

All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

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ANALYTICAL RESULTS

Project: HDR/AEP-CONSTANTINE

Pace Project No.: 40196278

Sample: LRSS Lab ID: 40196278001 Collected: 09/25/19 13:45 Received: 10/01/19 09:30 Matrix: Solid

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

Parameters	Results	Units	POL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS PCB Analytical Method: EPA 8082 Preparation Method: EPA 3541									
PCB-1016 (Aroclor 1016)	<110	ug/kg	219	110	1	10/16/19 16:49	10/18/19 14:31	12674-11-2	
PCB-1221 (Aroclor 1221)	<110	ug/kg	219	110	1	10/16/19 16:49	10/18/19 14:31	11104-28-2	
PCB-1232 (Aroclor 1232)	<110	ug/kg	219	110	1	10/16/19 16:49	10/18/19 14:31	11141-16-5	
PCB-1242 (Aroclor 1242)	<110	ug/kg	219	110	1	10/16/19 16:49	10/18/19 14:31	53469-21-9	
PCB-1248 (Aroclor 1248)	<110	ug/kg	219	110	1	10/16/19 16:49	10/18/19 14:31	12672-29-6	
PCB-1254 (Aroclor 1254)	<110	ug/kg	219	110	1	10/16/19 16:49	10/18/19 14:31	11097-69-1	
PCB-1260 (Aroclor 1260)	<110	ug/kg	219	110	1	10/16/19 16:49	10/18/19 14:31	11096-82-5	
PCB, Total	<110	ug/kg	219	110	1	10/16/19 16:49	10/18/19 14:31	1336-36-3	
Surrogates									
Tetrachloro-m-xylene (S)	87	%	57-115		1	10/16/19 16:49	10/18/19 14:31	877-09-8	
Decachlorobiphenyl (S)	73	%	47-97		1	10/16/19 16:49	10/18/19 14:31	2051-24-3	
6010 MET ICP Analytical Method: EPA 6010 Preparation Method: EPA 3050									
Arsenic	28.8	mg/kg	20.7	6.2	1	10/04/19 07:25	10/07/19 11:57	7440-38-2	
Cadmium	0.78J	mg/kg	2.1	0.57	1	10/04/19 07:25	10/07/19 11:57	7440-43-9	
Chromium	16.4	mg/kg	4.2	1.2	1	10/04/19 07:25	10/07/19 11:57	7440-47-3	
Copper	24.2	mg/kg	4.2	1.2	1	10/04/19 07:25	10/07/19 11:57	7440-50-8	
Lead	30.0	mg/kg	8.5	2.5	1	10/04/19 07:25	10/07/19 11:57	7439-92-1	
Nickel	11.2	mg/kg	4.2	1.1	1	10/04/19 07:25	10/07/19 11:57	7440-02-0	
Selenium	<5.6	mg/kg	18.5	5.6	1	10/04/19 07:25	10/07/19 11:57	7782-49-2	
Silver	<1.3	mg/kg	4.2	1.3	1	10/04/19 07:25	10/07/19 11:57	7440-22-4	
Zinc	93.2	mg/kg	17.0	5.1	1	10/04/19 07:25	10/07/19 11:57	7440-66-6	
7471 Mercury Analytical Method: EPA 7471 Preparation Method: EPA 7471									
Mercury	0.16	mg/kg	0.14	0.043	1	10/10/19 09:50	10/11/19 10:52	7439-97-6	
Percent Moisture Analytical Method: ASTM D2974-87									
Percent Moisture	77.2	%	0.10	0.10	1		10/02/19 18:59		
9071 Oil and Grease, Soxhlet Analytical Method: EPA 9071 Preparation Method: EPA 9071B									
Oil and Grease	1900J	mg/kg	7290	1810	1	10/08/19 08:36	10/08/19 14:56		
365.4 Total Phosphorus Analytical Method: EPA 365.4 Preparation Method: EPA 365.4									
Phosphorus	830	mg/kg	154	77.0	1	10/08/19 09:10	10/08/19 13:45	7723-14-0	
Total Organic Carbon Quad Analytical Method: EPA 9060									
Total Organic Carbon	93700	mg/kg	25500	7660	1		10/09/19 06:03	7440-44-0	
Total Organic Carbon	99100	mg/kg	25600	7680	1		10/09/19 06:09	7440-44-0	
Total Organic Carbon	99100	mg/kg	25200	7570	1		10/09/19 06:15	7440-44-0	
Total Organic Carbon	101000	mg/kg	24400	7330	1		10/09/19 06:21	7440-44-0	
Mean Total Organic Carbon	98200	mg/kg	25200	7560	1		10/09/19 06:03	7440-44-0	
Surrogates									
RSD%	3.2	%			1		10/09/19 06:03		

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Date: 02/27/2020 11:42 AM

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ANALYTICAL RESULTS

Project: HDR/AEP-CONSTANTINE

Pace Project No.: 40196278

Sample: LRSSD Lab ID: 40196278002 Collected: 09/25/19 13:45 Received: 10/01/19 09:30 Matrix: Solid

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

Parameters	Results	Units	POL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS PCB Analytical Method: EPA 8082 Preparation Method: EPA 3541									
PCB-1016 (Aroclor 1016)	<111	ug/kg	223	111	1	10/16/19 16:49	10/18/19 14:49	12674-11-2	
PCB-1221 (Aroclor 1221)	<111	ug/kg	223	111	1	10/16/19 16:49	10/18/19 14:49	11104-28-2	
PCB-1232 (Aroclor 1232)	<111	ug/kg	223	111	1	10/16/19 16:49	10/18/19 14:49	11141-16-5	
PCB-1242 (Aroclor 1242)	<111	ug/kg	223	111	1	10/16/19 16:49	10/18/19 14:49	53469-21-9	
PCB-1248 (Aroclor 1248)	<111	ug/kg	223	111	1	10/16/19 16:49	10/18/19 14:49	12672-29-6	
PCB-1254 (Aroclor 1254)	<111	ug/kg	223	111	1	10/16/19 16:49	10/18/19 14:49	11097-69-1	
PCB-1260 (Aroclor 1260)	<111	ug/kg	223	111	1	10/16/19 16:49	10/18/19 14:49	11096-82-5	
PCB, Total	<111	ug/kg	223	111	1	10/16/19 16:49	10/18/19 14:49	1336-36-3	
Surrogates									
Tetrachloro-m-xylene (S)	85	%	57-115		1	10/16/19 16:49	10/18/19 14:49	877-09-8	
Decachlorobiphenyl (S)	72	%	47-97		1	10/16/19 16:49	10/18/19 14:49	2051-24-3	
6010 MET ICP Analytical Method: EPA 6010 Preparation Method: EPA 3050									
Arsenic	23.9	mg/kg	20.4	6.1	1	10/04/19 07:25	10/07/19 12:00	7440-38-2	
Cadmium	0.93J	mg/kg	2.1	0.56	1	10/04/19 07:25	10/07/19 12:00	7440-43-9	
Chromium	17.0	mg/kg	4.2	1.2	1	10/04/19 07:25	10/07/19 12:00	7440-47-3	
Copper	26.4	mg/kg	4.2	1.2	1	10/04/19 07:25	10/07/19 12:00	7440-50-8	
Lead	35.0	mg/kg	8.4	2.5	1	10/04/19 07:25	10/07/19 12:00	7439-92-1	
Nickel	12.3	mg/kg	4.2	1.1	1	10/04/19 07:25	10/07/19 12:00	7440-02-0	
Selenium	<5.5	mg/kg	18.2	5.5	1	10/04/19 07:25	10/07/19 12:00	7782-49-2	
Silver	<1.3	mg/kg	4.2	1.3	1	10/04/19 07:25	10/07/19 12:00	7440-22-4	
Zinc	104	mg/kg	16.7	5.0	1	10/04/19 07:25	10/07/19 12:00	7440-66-6	
7471 Mercury Analytical Method: EPA 7471 Preparation Method: EPA 7471									
Mercury	0.19	mg/kg	0.15	0.044	1	10/10/19 09:50	10/11/19 10:54	7439-97-6	
Percent Moisture Analytical Method: ASTM D2974-87									
Percent Moisture	77.6	%	0.10	0.10	1		10/02/19 18:59		
9071 Oil and Grease, Soxhlet Analytical Method: EPA 9071 Preparation Method: EPA 9071B									
Oil and Grease	<1720	mg/kg	6960	1720	1	10/10/19 08:35	10/10/19 14:50		
365.4 Total Phosphorus Analytical Method: EPA 365.4 Preparation Method: EPA 365.4									
Phosphorus	828	mg/kg	126	63.2	1	10/08/19 09:10	10/08/19 13:46	7723-14-0	
Total Organic Carbon Quad Analytical Method: EPA 9060									
Total Organic Carbon	100000	mg/kg	29800	8930	1		10/09/19 07:12	7440-44-0	
Total Organic Carbon	97200	mg/kg	30000	9010	1		10/09/19 07:17	7440-44-0	
Total Organic Carbon	106000	mg/kg	30200	9060	1		10/09/19 07:23	7440-44-0	
Total Organic Carbon	107000	mg/kg	30500	9140	1		10/09/19 07:29	7440-44-0	
Mean Total Organic Carbon	103000	mg/kg	30100	9030	1		10/09/19 07:12	7440-44-0	
Surrogates									
RSD%	4.5	%			1		10/09/19 07:12		

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ANALYTICAL RESULTS

Project: HDR/AEP-CONSTANTINE

Pace Project No.: 40196278

Sample: MRSS Lab ID: 40196278003 Collected: 09/25/19 15:00 Received: 10/01/19 09:30 Matrix: Solid

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

Parameters	Results	Units	POL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS PCB Analytical Method: EPA 8082 Preparation Method: EPA 3541									
PCB-1016 (Aroclor 1016)	<94.0	ug/kg	188	94.0	1	10/16/19 16:49	10/18/19 15:07	12674-11-2	
PCB-1221 (Aroclor 1221)	<94.0	ug/kg	188	94.0	1	10/16/19 16:49	10/18/19 15:07	11104-28-2	
PCB-1232 (Aroclor 1232)	<94.0	ug/kg	188	94.0	1	10/16/19 16:49	10/18/19 15:07	11141-16-5	
PCB-1242 (Aroclor 1242)	<94.0	ug/kg	188	94.0	1	10/16/19 16:49	10/18/19 15:07	53469-21-9	
PCB-1248 (Aroclor 1248)	<94.0	ug/kg	188	94.0	1	10/16/19 16:49	10/18/19 15:07	12672-29-6	
PCB-1254 (Aroclor 1254)	<94.0	ug/kg	188	94.0	1	10/16/19 16:49	10/18/19 15:07	11097-69-1	
PCB-1260 (Aroclor 1260)	<94.0	ug/kg	188	94.0	1	10/16/19 16:49	10/18/19 15:07	11096-82-5	
PCB, Total	<94.0	ug/kg	188	94.0	1	10/16/19 16:49	10/18/19 15:07	1336-36-3	
Surrogates									
Tetrachloro-m-xylene (S)	83	%	57-115		1	10/16/19 16:49	10/18/19 15:07	877-09-8	
Decachlorobiphenyl (S)	73	%	47-97		1	10/16/19 16:49	10/18/19 15:07	2051-24-3	
6010 MET ICP Analytical Method: EPA 6010 Preparation Method: EPA 3050									
Arsenic	18.7	mg/kg	17.1	5.1	1	10/04/19 07:25	10/07/19 12:07	7440-38-2	
Cadmium	<0.47	mg/kg	1.8	0.47	1	10/04/19 07:25	10/07/19 12:07	7440-43-9	
Chromium	13.4	mg/kg	3.5	0.98	1	10/04/19 07:25	10/07/19 12:07	7440-47-3	
Copper	22.6	mg/kg	3.5	0.97	1	10/04/19 07:25	10/07/19 12:07	7440-50-8	
Lead	24.4	mg/kg	7.0	2.1	1	10/04/19 07:25	10/07/19 12:07	7439-92-1	
Nickel	9.3	mg/kg	3.5	0.93	1	10/04/19 07:25	10/07/19 12:07	7440-02-0	
Selenium	<4.6	mg/kg	15.3	4.6	1	10/04/19 07:25	10/07/19 12:07	7782-49-2	
Silver	<1.1	mg/kg	3.5	1.1	1	10/04/19 07:25	10/07/19 12:07	7440-22-4	
Zinc	84.2	mg/kg	14.0	4.2	1	10/04/19 07:25	10/07/19 12:07	7440-66-6	
7471 Mercury Analytical Method: EPA 7471 Preparation Method: EPA 7471									
Mercury	0.13	mg/kg	0.12	0.035	1	10/10/19 09:50	10/11/19 11:01	7439-97-6	
Percent Moisture Analytical Method: ASTM D2974-87									
Percent Moisture	73.4	%	0.10	0.10	1		10/02/19 18:59		
9071 Oil and Grease, Soxhlet Analytical Method: EPA 9071 Preparation Method: EPA 9071B									
Oil and Grease	2120J	mg/kg	6230	1540	1	10/10/19 08:35	10/10/19 14:50		
365.4 Total Phosphorus Analytical Method: EPA 365.4 Preparation Method: EPA 365.4									
Phosphorus	808	mg/kg	119	59.7	1	10/08/19 09:10	10/08/19 13:46	7723-14-0	
Total Organic Carbon Quad Analytical Method: EPA 9060									
Total Organic Carbon	77100	mg/kg	33400	10000	1		10/09/19 07:36	7440-44-0	
Total Organic Carbon	77200	mg/kg	33000	9910	1		10/09/19 07:42	7440-44-0	
Total Organic Carbon	90900	mg/kg	33800	10100	1		10/09/19 07:47	7440-44-0	
Total Organic Carbon	83200	mg/kg	32100	9620	1		10/09/19 07:53	7440-44-0	
Mean Total Organic Carbon	82100	mg/kg	33100	9920	1		10/09/19 07:36	7440-44-0	
Surrogates									
RSD%	7.9	%			1		10/09/19 07:36		

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ANALYTICAL RESULTS

Project: HDR/AEP-CONSTANTINE

Pace Project No.: 40196278

Sample: URSS Lab ID: 40196278004 Collected: 09/25/19 16:10 Received: 10/01/19 09:30 Matrix: Solid

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

Parameters	Results	Units	POL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS PCB Analytical Method: EPA 8082 Preparation Method: EPA 3541									
PCB-1016 (Aroclor 1016)	<155	ug/kg	310	155	1	10/16/19 16:49	10/18/19 15:25	12674-11-2	
PCB-1221 (Aroclor 1221)	<155	ug/kg	310	155	1	10/16/19 16:49	10/18/19 15:25	11104-28-2	
PCB-1232 (Aroclor 1232)	<155	ug/kg	310	155	1	10/16/19 16:49	10/18/19 15:25	11141-16-5	
PCB-1242 (Aroclor 1242)	<155	ug/kg	310	155	1	10/16/19 16:49	10/18/19 15:25	53469-21-9	
PCB-1248 (Aroclor 1248)	<155	ug/kg	310	155	1	10/16/19 16:49	10/18/19 15:25	12672-29-6	
PCB-1254 (Aroclor 1254)	<155	ug/kg	310	155	1	10/16/19 16:49	10/18/19 15:25	11097-69-1	
PCB-1260 (Aroclor 1260)	<155	ug/kg	310	155	1	10/16/19 16:49	10/18/19 15:25	11096-82-5	
PCB, Total	<155	ug/kg	310	155	1	10/16/19 16:49	10/18/19 15:25	1336-36-3	
Surrogates									
Tetrachloro-m-xylene (S)	87	%	57-115		1	10/16/19 16:49	10/18/19 15:25	877-09-8	
Decachlorobiphenyl (S)	74	%	47-97		1	10/16/19 16:49	10/18/19 15:25	2051-24-3	
6010 MET ICP Analytical Method: EPA 6010 Preparation Method: EPA 3050									
Arsenic	30.2	mg/kg	28.6	8.6	1	10/04/19 07:25	10/07/19 12:09	7440-38-2	
Cadmium	<0.78	mg/kg	2.9	0.78	1	10/04/19 07:25	10/07/19 12:09	7440-43-9	
Chromium	20.3	mg/kg	5.9	1.6	1	10/04/19 07:25	10/07/19 12:09	7440-47-3	
Copper	24.5	mg/kg	5.9	1.6	1	10/04/19 07:25	10/07/19 12:09	7440-50-8	
Lead	29.4	mg/kg	11.7	3.5	1	10/04/19 07:25	10/07/19 12:09	7439-92-1	
Nickel	14.8	mg/kg	5.9	1.6	1	10/04/19 07:25	10/07/19 12:09	7440-02-0	
Selenium	<7.7	mg/kg	25.6	7.7	1	10/04/19 07:25	10/07/19 12:09	7782-49-2	
Silver	<1.8	mg/kg	5.9	1.8	1	10/04/19 07:25	10/07/19 12:09	7440-22-4	
Zinc	87.8	mg/kg	23.5	7.0	1	10/04/19 07:25	10/07/19 12:09	7440-66-6	
7471 Mercury Analytical Method: EPA 7471 Preparation Method: EPA 7471									
Mercury	0.12J	mg/kg	0.20	0.060	1	10/10/19 09:50	10/11/19 11:04	7439-97-6	
Percent Moisture Analytical Method: ASTM D2974-87									
Percent Moisture	83.8	%	0.10	0.10	1		10/02/19 19:40		
9071 Oil and Grease, Soxhlet Analytical Method: EPA 9071 Preparation Method: EPA 9071B									
Oil and Grease	2800J	mg/kg	10000	2480	1	10/10/19 08:35	10/10/19 14:50		
365.4 Total Phosphorus Analytical Method: EPA 365.4 Preparation Method: EPA 365.4									
Phosphorus	1190	mg/kg	218	109	1	10/08/19 09:10	10/08/19 13:47	7723-14-0	
Total Organic Carbon Quad Analytical Method: EPA 9060									
Total Organic Carbon	129000	mg/kg	52600	15800	1		10/09/19 07:58	7440-44-0	
Total Organic Carbon	123000	mg/kg	53900	16200	1		10/09/19 08:04	7440-44-0	
Total Organic Carbon	151000	mg/kg	50600	15200	1		10/09/19 08:10	7440-44-0	
Total Organic Carbon	122000	mg/kg	52400	15700	1		10/09/19 08:17	7440-44-0	
Mean Total Organic Carbon	131000	mg/kg	52400	15700	1		10/09/19 07:58	7440-44-0	
Surrogates									
RSD%	10.4	%			1		10/09/19 07:58		

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QUALITY CONTROL DATA

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

QC Batch: 336911 Analysis Method: EPA 7471
QC Batch Method: EPA 7471 Analysis Description: 7471 Mercury
Associated Lab Samples: 40196278001, 40196278002, 40196278003, 40196278004

METHOD BLANK: 1956727 Matrix: Solid
Associated Lab Samples: 40196278001, 40196278002, 40196278003, 40196278004

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Mercury	mg/kg	<0.010	0.035	0.010	10/11/19 10:15	

LABORATORY CONTROL SAMPLE: 1956728

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mercury	mg/kg	0.83	0.83	100	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1956729 1956730

Parameter	Units	40196244001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mercury	mg/kg	0.013J	1	1	1.0	1.0	100	100	85-115	1	20	

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QUALITY CONTROL DATA

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

QC Batch: 336056 Analysis Method: EPA 6010
QC Batch Method: EPA 3050 Analysis Description: 6010 MET
Associated Lab Samples: 40196278001, 40196278002, 40196278003, 40196278004

METHOD BLANK: 1951234 Matrix: Solid
Associated Lab Samples: 40196278001, 40196278002, 40196278003, 40196278004

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Arsenic	mg/kg	<1.5	4.9	1.5	10/07/19 11:09	
Cadmium	mg/kg	<0.13	0.50	0.13	10/07/19 11:09	
Chromium	mg/kg	<0.28	1.0	0.28	10/07/19 11:09	
Copper	mg/kg	0.30J	1.0	0.28	10/07/19 11:09	
Lead	mg/kg	<0.60	2.0	0.60	10/07/19 11:09	
Nickel	mg/kg	<0.26	1.0	0.26	10/07/19 11:09	
Selenium	mg/kg	<1.3	4.4	1.3	10/07/19 11:09	
Silver	mg/kg	<0.31	1.0	0.31	10/07/19 11:09	
Zinc	mg/kg	<1.2	4.0	1.2	10/07/19 11:09	

LABORATORY CONTROL SAMPLE: 1951235

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Arsenic	mg/kg	50	48.2	96	80-120	
Cadmium	mg/kg	50	50.2	100	80-120	
Chromium	mg/kg	50	49.8	100	80-120	
Copper	mg/kg	50	49.5	99	80-120	
Lead	mg/kg	50	50.6	101	80-120	
Nickel	mg/kg	50	51.6	103	80-120	
Selenium	mg/kg	50	51.0	102	80-120	
Silver	mg/kg	25	24.6	98	80-120	
Zinc	mg/kg	50	50.1	100	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1951236 1951237

Parameter	Units	40195979001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic	mg/kg	<1.6	54.9	55.1	49.2	49.4	90	90	75-125	0	20	
Cadmium	mg/kg	<0.15	54.9	55.1	50.5	51.1	92	93	75-125	1	20	
Chromium	mg/kg	6.0	54.9	55.1	56.0	58.1	91	95	75-125	4	20	
Copper	mg/kg	7.0	54.9	55.1	57.5	58.7	92	94	75-125	2	20	
Lead	mg/kg	6.3	54.9	55.1	55.8	55.7	90	90	75-125	0	20	
Nickel	mg/kg	5.4	54.9	55.1	57.1	56.8	94	93	75-125	0	20	
Selenium	mg/kg	<1.4	54.9	55.1	45.7	46.9	83	85	75-125	3	20	
Silver	mg/kg	<0.34	27.4	27.6	25.8	26.1	92	94	75-125	2	20	
Zinc	mg/kg	34.1	54.9	55.1	86.1	86.6	95	95	75-125	1	20	

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QUALITY CONTROL DATA

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

QC Batch: 337743 Analysis Method: EPA 8082
QC Batch Method: EPA 3541 Analysis Description: 8082 GCS PCB
Associated Lab Samples: 40196278001, 40196278002, 40196278003, 40196278004

METHOD BLANK: 1961713 Matrix: Solid
Associated Lab Samples: 40196278001, 40196278002, 40196278003, 40196278004

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
PCB-1016 (Aroclor 1016)	ug/kg	<25.0	50.0	25.0	10/18/19 13:00	
PCB-1221 (Aroclor 1221)	ug/kg	<25.0	50.0	25.0	10/18/19 13:00	
PCB-1232 (Aroclor 1232)	ug/kg	<25.0	50.0	25.0	10/18/19 13:00	
PCB-1242 (Aroclor 1242)	ug/kg	<25.0	50.0	25.0	10/18/19 13:00	
PCB-1248 (Aroclor 1248)	ug/kg	<25.0	50.0	25.0	10/18/19 13:00	
PCB-1254 (Aroclor 1254)	ug/kg	<25.0	50.0	25.0	10/18/19 13:00	
PCB-1260 (Aroclor 1260)	ug/kg	<25.0	50.0	25.0	10/18/19 13:00	
Decachlorobiphenyl (S)	%	101	47-97		10/18/19 13:00	S3
Tetrachloro-m-xylene (S)	%	98	57-115		10/18/19 13:00	

LABORATORY CONTROL SAMPLE: 1961714

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
PCB-1016 (Aroclor 1016)	ug/kg		<25.0			
PCB-1221 (Aroclor 1221)	ug/kg		<25.0			
PCB-1232 (Aroclor 1232)	ug/kg		<25.0			
PCB-1242 (Aroclor 1242)	ug/kg		<25.0			
PCB-1248 (Aroclor 1248)	ug/kg		<25.0			
PCB-1254 (Aroclor 1254)	ug/kg		<25.0			
PCB-1260 (Aroclor 1260)	ug/kg	500	450	90	64-115	
Decachlorobiphenyl (S)	%			99	47-97	S0
Tetrachloro-m-xylene (S)	%			98	57-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1961715 1961716

Parameter	Units	40197113007 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	<0.029 mg/kg			<28.9	<29.1					20	
PCB-1221 (Aroclor 1221)	ug/kg	<0.029 mg/kg			<28.9	<29.1					20	
PCB-1232 (Aroclor 1232)	ug/kg	<0.029 mg/kg			<28.9	<29.1					20	
PCB-1242 (Aroclor 1242)	ug/kg	<0.029 mg/kg			<28.9	<29.1					20	
PCB-1248 (Aroclor 1248)	ug/kg	<0.029 mg/kg			<28.9	<29.1					20	
PCB-1254 (Aroclor 1254)	ug/kg	<0.029 mg/kg			<28.9	<29.1					20	

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QUALITY CONTROL DATA

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1961715 1961716												
Parameter	Units	40197113007 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max. RPD	Qual
PCB-1260 (Aroclor 1260)	ug/kg	<0.029 mg/kg	578	581	527	531	91	91	49-115	1	20	
Decachlorobiphenyl (S)	%						101	101	47-97			SD
Tetrachloro-m-xylene (S)	%						99	102	57-115			

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QUALITY CONTROL DATA

Project: HDR/AEP-CONSTANTINE

Pace Project No.: 40196278

QC Batch: 336151

Analysis Method: ASTM D2974-87

QC Batch Method: ASTM D2974-87

Analysis Description: Dry Weight/Percent Moisture

Associated Lab Samples: 40196278001, 40196278002, 40196278003

SAMPLE DUPLICATE: 1951880

Parameter	Units	40195521006 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	18.9	19.5	3	10	

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QUALITY CONTROL DATA

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

QC Batch:	336158	Analysis Method:	ASTM D2974-87
QC Batch Method:	ASTM D2974-87	Analysis Description:	Dry Weight/Percent Moisture
Associated Lab Samples:	40196278004		

SAMPLE DUPLICATE: 1951895

Parameter	Units	40195307029 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	20.9	21.6	3	10	

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QUALITY CONTROL DATA

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

QC Batch:	636672	Analysis Method:	EPA 9071
QC Batch Method:	EPA 9071B	Analysis Description:	9071 SOX, Oil and Grease
Associated Lab Samples:	40196278001		

METHOD BLANK: 3431459 Matrix: Solid
Associated Lab Samples: 40196278001

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Oil and Grease	mg/kg	65.0J	250	61.9	10/09/19 14:56	

LABORATORY CONTROL SAMPLE & LCSD: 3431460

		3431461								
Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
Oil and Grease	mg/kg	2000	2020	1940	101	97	78-114	4	18	

MATRIX SPIKE SAMPLE: 3431462

		70106716002								
Parameter	Units	Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers			
Oil and Grease	mg/kg	1330	7950	16900	196	78-114	M1			

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QUALITY CONTROL DATA

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

QC Batch: 637228 Analysis Method: EPA 9071
QC Batch Method: EPA 9071B Analysis Description: 9071 SOX, Oil and Grease
Associated Lab Samples: 40196278002, 40196278003, 40196278004

METHOD BLANK: 3434448 Matrix: Solid

Associated Lab Samples: 40196278002, 40196278003, 40196278004

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Oil and Grease	mg/kg	<61.9	250	61.9	10/10/19 14:50	

LABORATORY CONTROL SAMPLE: 3434449

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Oil and Grease	mg/kg	2000	1990	100	78-114	

MATRIX SPIKE SAMPLE: 3434450

Parameter	Units	40196278002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Oil and Grease	mg/kg	<1720	55900	57500	101	78-114	

SAMPLE DUPLICATE: 3434451

Parameter	Units	40196278003 Result	Dup Result	RPD	Max RPD	Qualifiers
Oil and Grease	mg/kg	2120J	<1530		18	

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QUALITY CONTROL DATA

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

QC Batch: 336646 Analysis Method: EPA 365.4
QC Batch Method: EPA 365.4 Analysis Description: 365.4 Total Phosphorus
Associated Lab Samples: 40196278001, 40196278002, 40196278003, 40196278004

METHOD BLANK: 1955199 Matrix: Solid
Associated Lab Samples: 40196278001, 40196278002, 40196278003, 40196278004

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Phosphorus	mg/kg	<20.0	40.0	20.0	10/08/19 13:38	

LABORATORY CONTROL SAMPLE: 1955200

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Phosphorus	mg/kg	500	490	98	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1955201 1955202

Parameter	Units	40196404003 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Phosphorus	mg/kg	17800	65000	65600	86600	94400	106	117	80-120	9	20	

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QUALITY CONTROL DATA

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

QC Batch: 336757 Analysis Method: EPA 9060
QC Batch Method: EPA 9060 Analysis Description: 9060 TOC Average
Associated Lab Samples: 40196278001, 40196278002, 40196278003, 40196278004

METHOD BLANK: 1955841 Matrix: Solid
Associated Lab Samples: 40196278001, 40196278002, 40196278003, 40196278004

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Mean Total Organic Carbon	mg/kg	<194	647	194	10/09/19 04:50	

LABORATORY CONTROL SAMPLE: 1955842

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mean Total Organic Carbon	mg/kg	120000	121000	101	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1955843 1955844

Parameter	Units	40196278001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mean Total Organic Carbon	mg/kg	98200	233000	231000	327000	326000	98	99	50-150	0	30	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1955845 1955846

Parameter	Units	40196606001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mean Total Organic Carbon	mg/kg	364000	817000	821000	1230000	1200000	106	102	50-150	2	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.

REPORT OF LABORATORY ANALYSIS

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QUALIFIERS

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

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.

LABORATORIES

PASI-G Pace Analytical Services - Green Bay
PASI-M Pace Analytical Services - Minneapolis

ANALYTE QUALIFIERS

M1 Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.
S0 Surrogate recovery outside laboratory control limits.
S3 Surrogate recovery exceeded laboratory control limits. Analyte presence below reporting limits in associated sample.

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: HDR/AEP-CONSTANTINE
Pace Project No.: 40196278

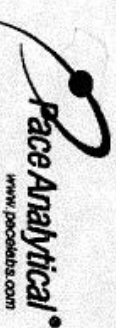
Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
40196278001	LRSS	EPA 3541	337743	EPA 8082	337745
40196278002	LRSSD	EPA 3541	337743	EPA 8082	337745
40196278003	MRSS	EPA 3541	337743	EPA 8082	337745
40196278004	URSS	EPA 3541	337743	EPA 8082	337745
40196278001	LRSS	EPA 3050	336056	EPA 6010	336536
40196278002	LRSSD	EPA 3050	336056	EPA 6010	336536
40196278003	MRSS	EPA 3050	336056	EPA 6010	336536
40196278004	URSS	EPA 3050	336056	EPA 6010	336536
40196278001	LRSS	EPA 7471	336911	EPA 7471	336972
40196278002	LRSSD	EPA 7471	336911	EPA 7471	336972
40196278003	MRSS	EPA 7471	336911	EPA 7471	336972
40196278004	URSS	EPA 7471	336911	EPA 7471	336972
40196278001	LRSS	ASTM D2974-87	336151		
40196278002	LRSSD	ASTM D2974-87	336151		
40196278003	MRSS	ASTM D2974-87	336151		
40196278004	URSS	ASTM D2974-87	336158		
40196278001	LRSS	EPA 9071 B	636672	EPA 9071	636987
40196278002	LRSSD	EPA 9071 B	637228	EPA 9071	637501
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40196278004	URSS	EPA 9071 B	637228	EPA 9071	637501
40196278001	LRSS	EPA 365.4	336646	EPA 365.4	336677
40196278002	LRSSD	EPA 365.4	336646	EPA 365.4	336677
40196278003	MRSS	EPA 365.4	336646	EPA 365.4	336677
40196278004	URSS	EPA 365.4	336646	EPA 365.4	336677
40196278001	LRSS	EPA 9060	336757		
40196278001	LRSS	EPA 9060	336758		
40196278002	LRSSD	EPA 9060	336757		
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40196278004	URSS	EPA 9060	336758		

REPORT OF LABORATORY ANALYSIS

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(Please Print Clearly)

Company Name: **GLEC**
Branch/Location: **Traverse City, MI**
Project Contact: **Dennis McCauley**
Phone: **231-941-2230**
Project Number:
Project Name: **HDR/AEP, Constraint**
Project State: **MI**
Sampled By (Print): **Craig Davis**
Sampled By (Sign): **Craig Davis**
PO #:



UPPER MIDWEST REGION
MN: 612-607-1700 WI: 920-469-2436

Page 1 of 1
401916228
Page 27 of 29

CHAIN OF CUSTODY

Matrix Codes
A-Air B-HCL C-H2SO4 D-HNO3 E-D Water F-Methanol G-NaOH
H-Sodium Bisulfite Solution I-Sodium Thiosulfate J-Other

FILTERED?
(YES/NO)
PRESERVATION
(CODE)

Data Package Options
(billable)
☐ EPA Level III
☐ EPA Level IV
☐ On your sample (billable)
☐ NOT needed on your sample
Matrix Codes
A = Air B = Biotin C = Charcoal D = Oil E = Soil F = Sludge G = Water H = Drinking Water I = Ground Water J = Surface Water K = Waste Water L = Wipe
Regulatory Program:

Analyses Requested	Y/N	Pick Letter
Metals, Phosphorus, PCBs, TOC, Moisture	N	A
Oil & Grease	N	A

Quote #: 440336
Mail To Contact: Dennis McCauley
Mail To Company: GLEC
Mail To Address: 739 Hastings St
Traverse City, MI 49686
Invoice To Contact: Amelia Howard
Invoice To Company: GLEC
Invoice To Address: 739 Hastings St
Traverse City, MI 49686
Invoice To Phone: 231-941-2230
CLIENT COMMENTS
LAB COMMENTS (Lab Use Only)
Profile #

001	L RSS	001	9/25	1345	Sed		X												
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003	L RSS	002	9/25	1345	"		X												
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006	L RSS	003	9/25	1500	"			X											
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Only 1 per sample available

Client Name: GLEC

Sample Preservation Receipt Form

Project # 409628All containers needing preservation have been checked and noted below: ☒ Yes ☐ No ☒ N/A

Lab Lot# of pH paper:

Lab Std #ID of preservation (if pH adjusted):

Initial when completed:

Date/Time:

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1241 Bellevue Street, Suite 905
Green Bay, WI 54302
Page 28

Pace Lab #	Glass	Plastic	Vials	Jars	General	VOA Vials (>6mm) *	H2SO4 pH \leq	NaOH+Zn Act pH \geq 9	NaOH pH \geq 12	HNO3 pH \leq	pH after adjusted	Volume (mL)
001	AG1U	BP1U	DG9A	JGFU	SP5T							2.5 / 5 / 10
002	AG1H	BP2N	DG9T	WGFU	ZPLC							2.5 / 5 / 10
003	AG4S	BP2Z	VG9U	WPFU	GN							2.5 / 5 / 10
004	AG4U	BP3U	VG9H									2.5 / 5 / 10
005	AG5U	BP3B	VG9M									2.5 / 5 / 10
006	AG2S	BP3N	VG9D									2.5 / 5 / 10
007	BG3U	BP3S										2.5 / 5 / 10
008												2.5 / 5 / 10
009												2.5 / 5 / 10
010												2.5 / 5 / 10
011												2.5 / 5 / 10
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018												2.5 / 5 / 10
019												2.5 / 5 / 10
020												2.5 / 5 / 10

Exceptions to preservation check: VOA, Coliform, TOC, O&G, MI DRO, Phenolics, Other: 578 10/1/17Headspace in VOA Vials (>6mm): ☒ Yes ☐ No ☒ N/A *If yes look in headspace column

AG1U	1 liter amber glass	BP1U	1 liter plastic unpres	DG9A	40 mL amber ascorbic	JGFU	4 oz amber jar unpres
AG1H	1 liter amber glass HCL	BP2N	500 mL plastic HNO3	DG9T	40 mL amber Na Thio	WGFU	4 oz clear jar unpres
AG4S	125 mL amber glass H2SO4	BP2Z	500 mL plastic NaOH, Znact	VG9U	40 mL clear vial unpres	WPFU	4 oz plastic jar unpres
AG4U	120 mL amber glass unpres	BP3U	250 mL plastic unpres	VG9H	40 mL clear vial HCL		
AG5U	100 mL amber glass unpres	BP3B	250 mL plastic NaOH	VG9M	40 mL clear vial MeOH		
AG2S	500 mL amber glass H2SO4	BP3N	250 mL plastic HNO3	VG9D	40 mL clear vial DI	SP5T	120 mL plastic Na Thiosulfate
BG3U	250 mL clear glass unpres	BP3S	250 mL plastic H2SO4			ZPLC	ziploc bag
						GN	

Appendix E. Fisheries Study

Fisheries Survey Report

Constantine Project (FERC No. 10661)
March 31, 2020

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1. Project Introduction and Background

Indiana Michigan Power Company (I&M), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the 1.2-megawatt Constantine Hydroelectric Project (Project) (FERC No. 10661). The Project is located along the St. Joseph River in St. Joseph County, Michigan.

I&M operates and maintains the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on September 30, 2023. I&M is pursuing a subsequent license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR § 5.15, I&M has conducted studies as provided in the March 15, 2019 Revised Study Plan (RSP) and schedule approved in the Commission's April 9, 2019 Study Plan Determination (SPD) for the Project. This report describes the methods and results of the Fisheries Survey conducted in support of preparing an application for a subsequent license for the Project.

Existing relevant and reasonably available information regarding the fish community in the Project vicinity was summarized in Section 5.4 of the Pre-Application Document (PAD) (I&M 2018). The St. Joseph River is characterized as a warmwater stream (I&M 1988), and the middle reach (from Mendon, Michigan to Elkhart, Indiana) of the St. Joseph River is managed for Channel Catfish (*Ictalurus punctatus*), Smallmouth Bass (*Micropterus dolomieu*), and Walleye (*Sander vitreus*) (Wesley and Duffy 1999). Historically, the Michigan Department of Natural Resources (MDNR) has stocked Walleye and Channel Catfish in this reach of the St. Joseph River (Wesley and Duffy 1999). Over the past eleven years (2006 to 2016) nearly 275,000 Walleye (just over an inch long) have been stocked in the river in St. Joseph County. Stocking occurred in 2006, 2012, 2014, and 2016 (MDNR 2017). Channel Catfish have not been stocked in this area of the river since 1999 (MDNR 2017).

In the summer of 1972, the MDNR conducted a fish survey along the St. Joseph River using electrofishing and fyke nets. Fifty-two sampling locations were established along the mainstem of the river from its headwaters to the mouth. One segment included from below the dam in Three Rivers, Michigan, to the Constantine dam and another segment included from Constantine dam to the Mottville dam (Shepherd 1975, as cited in I&M 1988). Twenty-two taxa were collected in the segments upstream and downstream of the Constantine dam (Table 1). Although abundance data were not available from this study, Wesley and Duffy (1999) summarized the Shepherd (1975) survey and indicated Bluegill (*Lepomis macrochirus*), Black Crappie (*Pomoxis nigromaculatus*), and Smallmouth Bass were the most abundant sport fish collected. Redhorse (*Moxostoma spp.*), Spotted Sucker (*Minytrema melanops*), Longnose Gar (*Lepisosteus osseus*), and Golden Shiner (*Notemigonus crysoleucas*) were also abundant (Shepherd 1975, as cited in I&M 1988; Wesley and Duffy 1999).

Table 1. Fish Species Collected During Previous Studies from Two Study Reaches of the St. Joseph River

Common Name	Scientific Name	Three Rivers Dam to Constantine Dam	Constantine Dam to Mottville Dam
Black Crappie*	<i>Pomoxis nigromaculatus</i>	X	X
Bluegill*	<i>Lepomis macrochirus</i>	X	X
Bluntnose Minnow	<i>Pimephales notatus</i>		X
Common Carp	<i>Cyprinus carpio</i>	X	X
Common Shiner	<i>Luxilus cornutus</i>	X	
Golden Shiner	<i>Notemigonus crysoleucas</i>		X
Green Sunfish*	<i>Lepomis cyanellus</i>		X
Northern Hogsucker	<i>Hypentelium nigricans</i>		X
Largemouth Bass*	<i>Micropterus salmoides</i>	X	X
Logperch	<i>Percina caprodes</i>	X	X
Longnose Gar	<i>Lepisosteus osseus</i>	X	X
Northern Pike*	<i>Esox lucius</i>	X	X
Pumpkinseed*	<i>Lepomis gibbosus</i>	X	X
Redhorse	<i>Moxostoma spp.</i>	X	X
Rock Bass*	<i>Ambloplites rupestris</i>	X	X
Smallmouth Bass*	<i>Micropterus dolomieu</i>	X	X
Spotfin Shiner	<i>Cyprinella spiloptera</i>		X
Spotted Gar	<i>Lepisosteus oculatus</i>		X
Spotted Sucker	<i>Minytrema melanops</i>	X	X
Warmouth Bass*	<i>Lepomis gulosus</i>		X
White Sucker	<i>Catostomus commersonii</i>	X	X
Yellow Bullhead	<i>Ameiurus natalis</i>	X	

*Identified as game fish, X indicates fish present.

Source: Shepherd 1975, as cited in I&M 1988.

From April 1990 through January 1991, a fish entrainment and riverine community study was conducted at the Project. Annual estimates of entrainment and associated mortality were calculated for the Project. The survey calculated an annual entrainment rate by extrapolating the results of a single-turbine tailrace netting survey conducted at the Constantine Project. Mortality estimates were calculated using mortality rates from the entrainment mortality study completed at the Buchanan Hydroelectric Project (FERC Project 2551), which shares a nearly identical operating head and turbine placement relative to tailwater elevation (AEP 1991). The Constantine fish entrainment study also compiled comprehensive fish community data through seining, netting, and electrofishing in the Project's reservoir and the bypass reach. The study concluded that entrainment mortality was relatively low with annual fish losses calculated at 7,751 fish. In the community assessment around the Project, 8,752 fish of 46 species were collected. The study found that the fish community was "diverse and the populations are abundant in the St. Joseph River near the Constantine Project" (AEP 1991).

In 1998, the MDNR conducted a general survey to evaluate the fish community and the Walleye stocking program upstream of the Constantine dam using electrofishing, trap nets, and gill nets in June and July (MDNR 1998). Nineteen species were collected during the survey (Table 2). Bluegill, Black Crappie, Channel Catfish, Walleye, and Smallmouth Bass were identified as the primary sport fish.

Table 2. MDNR Fish Community and Walleye Survey Upstream of the Constantine Dam in June and July 1998

Common Name	Scientific Name	Number	Relative Abundance* (%)
Black Crappie	<i>Pomoxis nigromaculatus</i>	45	7.1
Bluegill	<i>Lepomis macrochirus</i>	296	46.7
Bowfin	<i>Amia calva</i>	1	0.2
Bullhead catfishes	(family) <i>Ictaluridae</i>	2	0.3
Common Carp	<i>Cyprinus carpio</i>	18	2.8
Channel Catfish	<i>Ictalurus punctatus</i>	29	4.6
White Sucker	<i>Catostomus commersonii</i>	3	0.5
Hybrid sunfish	<i>Lepomis sp.</i>	4	0.6
Largemouth Bass	<i>Micropterus salmoides</i>	13	2.1
Longnose Gar	<i>Lepisosteus osseus</i>	16	2.5
Logperch	<i>Percina caprodes</i>	2	0.3
Northern Pike	<i>Esox lucius</i>	1	0.2
Pumpkinseed	<i>Lepomis gibbosus</i>	9	1.4
Redhorse	<i>Moxostoma spp.</i>	95	15
Rock Bass	<i>Ambloplites rupestris</i>	4	0.6
Smallmouth Bass	<i>Micropterus dolomieu</i>	34	5.4
Spotted Sucker	<i>Minytrema melanops</i>	44	6.9
Walleye	<i>Sander vitreus</i>	14	2.2
Yellow Perch	<i>Perca flavescens</i>	4	0.6
TOTAL		634	100

*As Percent of Total Fish Collected

Source: MDNR 1998.

In March 2019, fish collections and relocations were made by electrofishing in the Project's power canal (Table 3). These collections took place during drawdown for scheduled maintenance work, unrelated to these relicensing proceedings.

Table 3. Number of Live Fish Relocated from Project Area

Common Name	Scientific Name	Collection Date		Total
		3/28/2019	3/29/2019	
Rock Bass	<i>Ambloplites rupestris</i>	9	18	27
Yellow Bullhead	<i>Ameiurus natalis</i>	18	17	35
Greenside Darter	<i>Etheostoma blennioides</i>	-	3	3
Rainbow Darter	<i>Etheostoma caeruleum</i>	69	174	243
Johnny Darter	<i>Etheostoma nigrum</i>	14	16	30
Northern Hogsucker	<i>Hypentelium nigricans</i>	3	1	4
Channel Catfish	<i>Ictalurus punctatus</i>	-	9	9
Brook Silverside	<i>Labidesthes sicculus</i>	3	-	3
Green Sunfish	<i>Lepomis cyanellus</i>	1	-	1
Bluegill	<i>Lepomis macrochirus</i>	9	7	16
Common Shiner	<i>Luxilus cornutus</i>	1	3	4
Smallmouth Bass	<i>Micropterus dolomieu</i>	186	139	325
Largemouth Bass	<i>Micropterus salmoides</i>	1	1	2
Golden Redhorse	<i>Moxostoma erythrurum</i>	10	7	17
Shorthead Redhorse	<i>Moxostoma macrolepidotum</i>	2	-	2
Stonecat	<i>Noturus flavus</i>	-	1	1
Yellow Perch	<i>Perca flavescens</i>	3	3	6
Logperch	<i>Percina caprodes</i>	70	99	169
Blackside Darter	<i>Percina maculate</i>	3	17	20
Black Crappie	<i>Poxomis nigromaculatus</i>	-	1	1
Walleye	<i>Sander vitrus</i>	12	-	12
Total Individuals		414	516	930
Total Species		17	17	21

Source: Cardno 2019.

A diverse fish community of twenty-one species were collected and relocated. Primary game fish like those identified during the MDNR 1998 survey were present: Black Crappie, Bluegill, Channel Catfish, Smallmouth Bass, and Walleye.

2. Study Goals and Objectives

In accordance with I&M's RSP and the Commission's SPD for the Project, the goal of the Fisheries Survey was to collect baseline fisheries data in the Project area. The specific goals and objectives of this study were as follows:

- Collect a comprehensive baseline for existing fishery resources in the vicinity of the Project.
- Compare current fisheries data to historical fisheries data to determine any significant changes to fish species composition.
- Analyze tissue samples for mercury and PCB concentrations.
- Confirm intake velocities for fish impingement and entrainment potential.

3. Study Area

3.1. Fish Collections

The study area for fish community sampling consisted of locations throughout the Project's reservoir and bypass reach. The Project's power canal was initially included in the study area but was excluded based on communication with MDNR staff from the Fisheries Division in the Southern Lake Michigan Unit, who agreed that the stranded fish survey of the power canal in spring 2019 provided sufficient data to predict the species present (McCauley, personal communication, July 10-11, 2019).

Pursuant to the approved RSP, fish collections were made in the Project's reservoir and bypass reach sections in both near-shore (shallow) and mid-channel (deep) habitats; and in all available types of fish cover found within these zones to accurately characterize the fish community in the area of the Constantine Project. Collection areas were categorized as open-water, shoreline, backwater, macrophyte beds, and the bypass reach. Figure 1 shows the location of 33 collections completed in the reservoir and bypass reach.

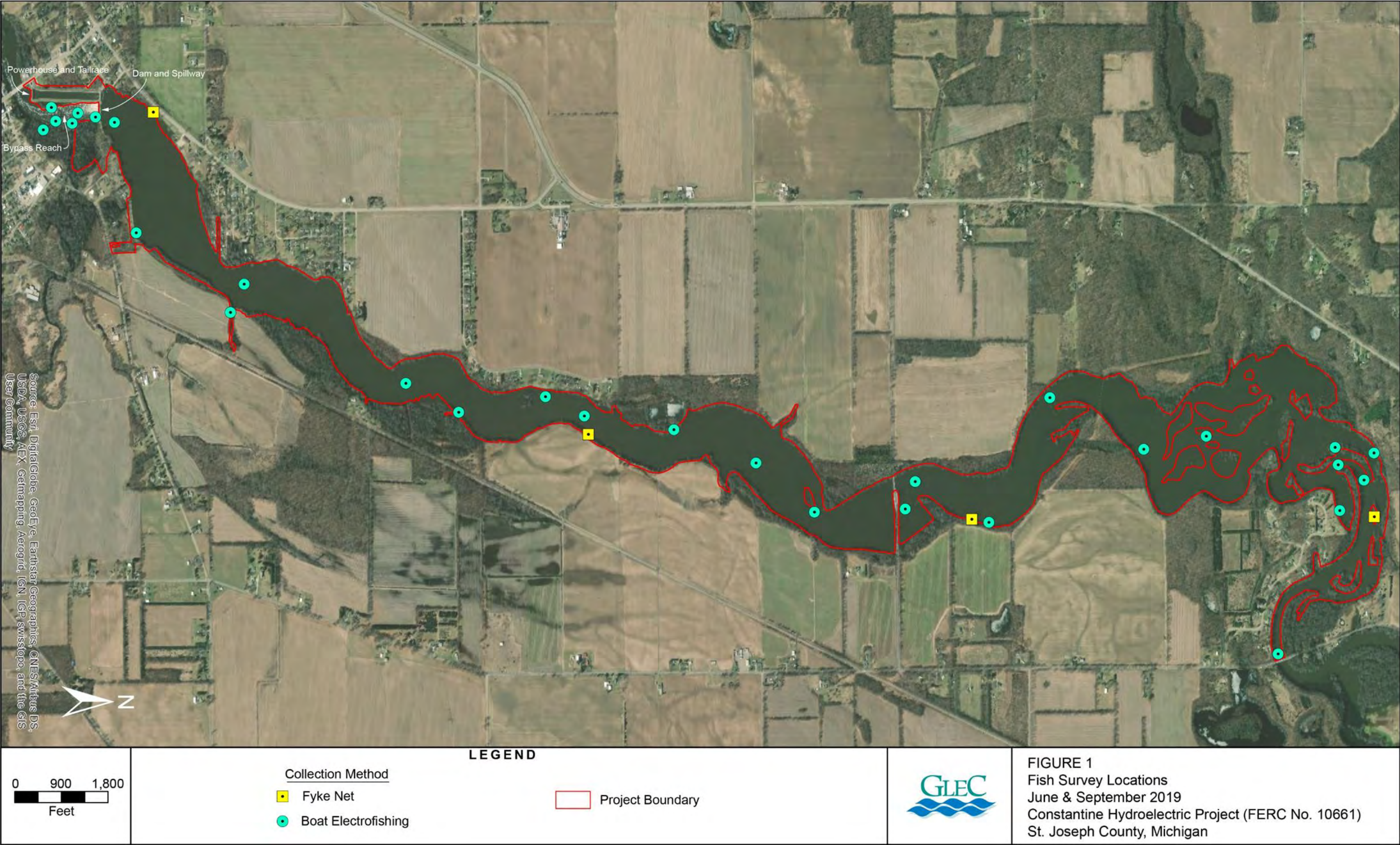


Figure 1. Fish Survey Locations

The location of each collection area was geo-referenced using a handheld Global Positioning System (GPS) unit. The habitat type, fish cover percentage and type, water depth, water current speed, and substrate type were noted. Table 12 in Section 7 contains all collection area locations and details.

3.2.Intake Velocities

In order to confirm intake velocities at the Project, a survey was conducted at two locations within the Project's power canal (see Figure 2).



Figure 2. Velocity Transects

The velocity transects were located downstream of the power canal headgates (Transect 1) and upstream of the powerhouse (Transect 2), geolocation of each transect is provided in Table 4.

Table 4. Coordinates for the Transect End-points for Current Velocity Sampling

Transect	Right Bank	Left Bank
Transect 1	41.84716, -85.66943	41.84710, -85.66908
Transect 2	41.84413, -85.66953	41.84415, -85.66902

4. Methodology

4.1. Fish Collections

4.1.1. Fyke Nets

Four fyke nets (trap nets) were set in locations spread over the length of the Project's reservoir (Figure 1). The fyke nets consisted of a single 50-foot lead net running to a 4-foot by 6-foot rectangular net frame with one-half inch mesh. Each net was set in the afternoon and retrieved the following morning on two consecutive days during the September sampling. The nets were set in relatively shallow, near-shore habitat with the lead net running perpendicular to shore to guide fish swimming parallel to shore into the trap end.

4.1.2. Electrofishing

Electrofishing was conducted via a 16-foot boat with a direct current (DC) electrofisher. The electrofisher was controlled by a Smith-Root 5.0 gas powered pulsator (GPP) running to a boom-mounted array and powered by a 5,000-watt generator. Output was set at each site according to conditions but was generally at 60 pulses per second and power limited to produce 5-6 amps. Each collection location was electrofished thoroughly for between 10-15 minutes, recorded in seconds for catch per unit effort (CPUE) calculation, and traveling a distance approximately 100-250 meters (m) depending on the density of the fish cover and until the operators felt confident that all habitats present had been adequately sampled. CPUE is calculated as individuals captured per hour.

4.2. Fish Processing

4.2.1. Fish Enumeration

Collected fish were held in a live well until the end of the transect when they were counted and identified to species. After enumeration, fish were released near the point of capture. Individual fish were measured to the nearest millimeter (mm) and weighed to the nearest gram. When more than 30 individuals of a single species were collected, those excess fish were only counted and a minimum and maximum length was recorded. For very small fish, individuals were batch weighed in order to register a valid weight on the scale.

4.2.2. Fish Tissue

Per the RSP, fish tissue samples were obtained from ten (10) legal size Largemouth Bass (*Micropterus salmoides*) (resident predator fish) and ten (10) Shorthead Redhorse (bottom feeder fish) that were representative of the sizes that may be consumed by anglers. The ten Largemouth Bass were divided into two size groups and analyzed separately. Specimens for tissue samples were collected and processed following the methodologies outlined in EPA 823-B-00-007 – Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories Volume 1 Fish Sampling and Analysis Third Edition (Appendix A). Collected tissue for analysis was skinless filet, the most conservative method (U.S. Environmental Protection Agency 2000). Methods used for analysis conformed to requirements stated in EPA 823-B-00-007. Fish tissue samples were analyzed for PCB Aroclors by EPA Method 8082, for PCB Congeners by EPA Method 1668, and for total mercury by EPA Method 7473. (Table 5).

Table 5. Fish Contaminant Parameters, Units and Maximum Required Detection Levels for Tissue Samples Collected from the AEP/Constantine Hydroelectric Plant Reservoir

Parameter	Reporting Units	Detection Level
Mercury	mg/kg	0.010
PCBs (Aroclors 1242, 1248, 1254 and 1260)	mg/kg	0.025
Total PCBs	mg/kg	0.025

(Placeholder pending lab results, confirm and update based on lab report)

4.3. Supporting Data

4.3.1. In-situ Water Quality

Discrete multi-parameter water quality measurements of temperature, dissolved oxygen (DO) concentration, pH, and specific conductance were collected at the fish sampling locations using a calibrated YSI ProDSS® multi-parameter sonde. Visual estimates of the water clarity were made by recording the depth at which a Secchi disk disappeared at fish collection sites, recorded to the nearest tenth of a meter. However, at some fish collection locations the current was too swift to accurately measure using a Secchi disk, these locations were marked as Secchi depth N/A.

4.3.2. Intake Velocities

Measurements were collected to determine the average approach velocity of water in the power canal and entering the Project's trashrack structure. Interference to the surveying unit was encountered while trying to record measurements 1-foot upstream of the Project's trashracks. In order to record useable measurements, the velocity profile transect for this location was shifted slightly upstream in the power canal.

Each velocity profile event consisted of bank-to-bank transects using an acoustic doppler current profiler (ADCP). A total of six velocity transect measurements were completed during June 12th, 2019, three at each transect location. A M9 RiverSurveyor ADCP system and hydroboard were used, designed to measure river discharge, 3-dimensional water velocity, and bathymetry. The RiverSurveyor Power and Communication Module (PCM) contains a differential GPS and 2.4 gigahertz (GHz) Bluetooth radio. The

ADCP utilizes a nine-beam system with two sets of four profiling beams (each set having its own frequency) and one vertical beam (see Figure 3).

The ADCP has two sets of velocity measurement transducers, both in a Janus configuration – four 3.0-megahertz (MHz) transducers and four 1.0-MHz transducers. The M9 RiverSurveyor has a velocity profiling range of up to 40 m and a discharge measurement range of 80 m (when referencing GPS and the vertical beam).

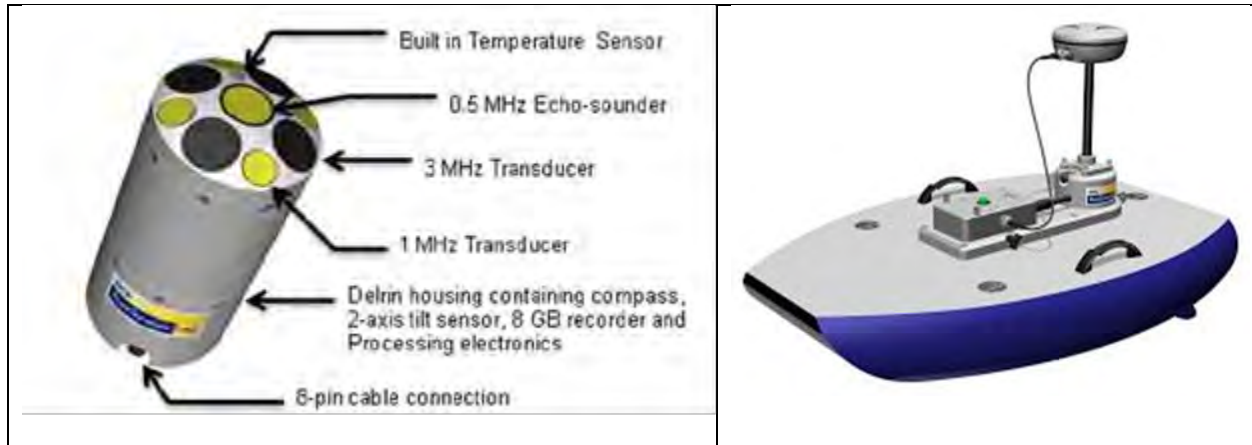


Figure 3. M9 RiverSurveyor Features and HydroBoard

With respect to bathymetry, the vertical acoustic beam, operating at 500 kilohertz (kHz), provides direct measurements below the instrument in the same manner as a single beam echo sounder. The four velocity beams, operating at 1000 kHz, each measure an additional depth and are projected at a 25-degree angle from the vertical axis. When the water depth gets shallow (approximately less than 5 m), the four 3000 kHz beams measure the bottom depth in place of the 1000 kHz beams. The M9 RiverSurveyor system test and compass calibration were successfully completed each day consistent with Great Lakes Environmental Center, Inc.'s (GLEC) Standard Operating Procedure (Appendix D).

5. Study Results

5.1. Fish Collections

5.1.1. Fish Community Baseline Survey

Field staff collected 2,343 individuals representing 46 species during the June and September fish sampling. Table 6 shows the total number of individuals of each species and where they were captured.

Table 6. Species Captured by Fyke Net or Electrofishing in the Constantine Project's Reservoir and Bypass Reach During All Sampling Events

<i>Family Common Name</i>	<i>Species Common Name</i>	<i>Scientific Name</i>	<i>Bypass Reach</i>	<i>Reservoir</i>	<i>Total</i>	<i>Relative Abundance</i>
<i>Bowfins</i>	Bowfin	<i>Amia calva</i>	288	14	302	12.90%
<i>Bullhead Catfishes</i>	Brown Bullhead	<i>Ameiurus nebulosus</i>		4	4	0.20%
	Channel Catfish	<i>Ictalurus punctatus</i>	2		2	0.10%

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	Flathead Catfish	<i>Pylodictis olivaris</i>	1	1	0.00%	
	Yellow Bullhead	<i>Ameiurus natalis</i>	2	11	13	0.60%
Carp & Minnows	Bluntnose Minnow	<i>Pimephales notatus</i>	8	221	229	9.80%
	Common Carp	<i>Cyprinus carpio</i>	7	13	20	0.90%
	Emerald Shiner	<i>Notropis atherinoides</i>	1	16	17	0.70%
	Golden Shiner	<i>Notemigonus crysoleucas</i>		21	21	0.90%
	Mimic Shiner	<i>Notropis volucellus</i>	92	143	235	10.00%
	Sand Shiner	<i>Notropis stramineus</i>	6		6	0.30%
	Spotfin Shiner	<i>Cyprinella spiloptera</i>	18	36	54	2.30%
	Striped Shiner	<i>Luxilus chrysocephalus</i>		8	8	0.30%
Gars	Longnose Gar	<i>Lepisosteus osseus</i>	3	1	4	0.20%
Herrings & Shads	Gizzard Shad	<i>Dorosoma cepedianum</i>		37	37	1.60%
Lampreys	Chestnut Lamprey	<i>Ichthyomyzon castaneus</i>	1	1	2	0.10%
Perches	Blackside Darter	<i>Percina maculata</i>	3	1	4	0.20%
	Greenside Darter	<i>Etheostoma blennioides</i>	1		1	0.00%
	Johnny Darter	<i>Etheostoma nigrum</i>		1	1	0.00%
	Logperch	<i>Percina caprodes</i>	2	16	18	0.80%
	Pirate Perch	<i>Aphredoderus sayanus</i>		2	2	0.10%
	Rainbow Darter	<i>Etheostoma caeruleum</i>	2		2	0.10%
	Walleye	<i>Sander vitreus</i>	2		2	0.10%
	Yellow Perch	<i>Perca flavescens</i>	5	11	16	0.70%
Pikes & Pickerels	Grass Pickerel	<i>Esox americanus vermiculatus</i>		8	8	0.30%
	Northern Pike	<i>Esox lucius</i>	3	1	4	0.20%
Silversides	Brook Silverside	<i>Labidesthes sicculus</i>	4	15	19	0.80%
Suckers	Black Redhorse	<i>Moxostoma duquesnei</i>		2	2	0.10%
	Golden Redhorse	<i>Moxostoma erythrurum</i>	11	65	76	3.20%
	Greater Redhorse	<i>Moxostoma valenciennesi</i>		13	13	0.60%
	Northern Hogsucker	<i>Hypentelium nigricans</i>		1	1	0.00%
	River Redhorse	<i>Moxostoma carinatum</i>		2	2	0.10%
	Shorthead Redhorse	<i>Moxostoma macrolepidotum</i>	20	38	58	2.50%
	Silver Redhorse	<i>Moxostoma anisurum</i>	2	13	15	0.60%
	Spotted Sucker	<i>Minytrema melanops</i>		63	63	2.70%
	White Sucker	<i>Catostomus commersonii</i>	1	3	4	0.20%
Sunfishes	Black Crappie	<i>Pomoxis nigromaculatus</i>	1	15	16	0.70%
	Bluegill	<i>Lepomis macrochirus</i>	99	632	731	31.20%
	Green Sunfish	<i>Lepomis cyanellus</i>	7	2	9	0.40%
	Largemouth Bass	<i>Micropterus salmoides</i>	16	87	103	4.40%
	Northern Sunfish	<i>Lepomis peltastes</i>	14	1	15	0.60%
	Pumpkinseed	<i>Lepomis gibbosus</i>	11	42	53	2.30%
	Rock Bass	<i>Ambloplites rupestris</i>	35	38	73	3.10%

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	Smallmouth Bass	<i>Micropterus dolomieu</i>	43	23	66	2.80%
	Warmouth	<i>Lepomis gulosus</i>	8	2	10	0.40%
	White Crappie	<i>Pomoxis annularis</i>		1	1	0.00%
Totals	(Species: 46)		718	1625	2343	

Bluegill, Bowfin (*Amia calva*), Mimic Shiner (*Notropis volucellus*), Largemouth Bass, Golden Redhorse (*Moxostoma erythrurum*), and Rock Bass (*Ambloplites rupestris*) were the most abundant species collected and represent approximately 75 percent of all individuals captured. Some species captured were collected in sparse numbers with 17 species represented by less than five individuals, and five species with only a single individual caught. In total 1,625 fish were captured in the reservoir compared to 718 in the bypass reach.

Flathead Catfish (*Pylodictis olivaris*) was the only species caught only in the fyke net and not while electrofishing. Fyke nets were set in the Project's reservoir and had a CPUE of 1.88 fish per hour or approximately 45 fish per 24-hours on average.

Table 7 shows the CPUE for electrofishing collections in the reservoir and the bypass reach with the spillway tailwater excluded. During the September sampling, Bowfin were congregated at the base of the bypass spillway in great numbers, they represented half of all individuals caught in that area. When the catch from this area was included in the CPUE aggregate the overall bypass reach showed an increase in CPUE with 359 fish per hour and an individual CPUE in the spillway tailwater of 1,045 fish per hour. Excluding the spillway tailwater area and fyke nets, the CPUE in each area of the Project were relatively similar with 218 fish per hour in the spillway and 240 in the reservoir.

Table 7. Catch Per Unit Effort for Electrofishing in the Constantine Project's Reservoir and Bypass Reach in Total and by Habitat Type (Excludes Bypass Spillway Tailwater)

Area	Habitat	CPUE (ind/hr)
Bypass Reach		218
	Backwater	172
	Bypass Mid-Channel	73
	River Mouth	248
	Shoreline	342
Reservoir		240
	Backwater	286
	Macrophyte Bed	399
	Open Water	96
	Shoreline	449
Total		235

* Individual fish collected per hour.

5.1.2. Fish Tissue

During fish collections in September, field crews collected (10) Largemouth Bass and (10) Shorthead Redhorse for fish tissue analysis via boat electrofishing. After four days of collections, five Largemouth

Bass were included at less than the legal size (355.6 mm) because ten individuals of legal size were not collected; those five individuals ranged in size from 295-315 mm. Five Largemouth Bass greater than 360 mm were also collected for analysis. Field staff were unable to collect enough individuals of either of the preferred species, Common Carp or Channel Catfish, and substituted (10) Shorthead Redhorse to represent the bottom feeder fish species; those individuals ranged in size from 423-562 mm.

<insert fish tissue results from Pace Labs when available>

5.2.Supporting Data

5.2.1. In-situ Water Quality

The complete in-situ water quality data are presented in Appendix C, and the minimum, maximum, and average values are listed below in Table 8.

Table 8. Minimum, Maximum, and Average Values for In-situ Water Quality at Fish Collection Sites in June and September

	pH		Dissolved Oxygen (mg/L)		Specific Conductance (μS/cm)		Surface Temperature (°C)		Secchi Disk Depth (m)		Depth (m)	
	June	Sept	June	Sept	June	Sept	June	Sept	June	Sept	June	Sept
Minimum	7.61	7.88	6.05	7.28	486	504	19.5	17.6	0.80	0.50	0.7	0.5
Maximum	8.13	8.24	9.00	9.55	546	611	21.9	22.7	1.10	2.00	4.5	3.7
Average	7.98	8.12	7.95	8.17	510	521	20.3	20.2	0.95	1.30	1.9	2.0

5.2.2. Intake Velocities

The results of the ADCP velocity survey are shown below in Table 9. The average current velocity for Transect 1 and 2 was 1.57 feet per second (ft/s) and 1.33 ft/s respectively.

Table 9. Summary Results from Six ADCP Transects in the Project's Power Canal

Transect Number	File Reference	Direction	Start Date	Start Time	Transect Width ft	Transect Area ft ²	Mean River Velocity ft/s	Boat Speed ft/s	Left Q cfs	Right Q cfs	Total Q cfs	Average Current Velocity ft/s	Average Transect Q cfs
Transect 1	4851	left bank to right bank	6/12/2019	9:48:52 AM	96.5	772.1	1.579	0.601	0.76	0.00	1219.4	1.57	1,218.9
	5937	left bank to right bank	6/12/2019	9:59:39 AM	95.2	777.8	1.576	0.690	0.43	0.00	1226.0		
	3534	right bank to left bank	6/12/2019	10:35:33 AM	94.1	774.2	1.565	0.523	0.61	0.26	1211.3		
Transect 2	3009	right bank to left bank	6/12/2019	11:30:05 AM	109.2	936.0	1.328	0.650	0.53	0.62	1243.3	1.33	1,234.8
	5620	left bank to right bank	6/12/2019	11:56:14 AM	108.0	933.3	1.316	0.662	0.14	0.51	1228.4		
	0921	left bank to right bank	6/12/2019	12:09:15 PM	101.5	906.2	1.36	0.870	0.06	0.00	1232.8		

The average flow rate in Transects 1 and 2 was 1,218.9 cubic feet per second (cfs) and 1,234.8 cfs, respectively, during the study.

6. Summary and Discussion

6.1. Fish Community

6.1.1. Fish Community Baseline Survey Compared to Historical Community Data

During fish collections in June and September 2019 GLEC documented a diverse and abundant fish community. The 2,343 fish representing 46 species are equal in species richness to collections made in the area in the historical record. The June and September fish sampling collected the same or more species than historical sampling records as described in the introduction (Table 10). It appears that the community has not changed significantly since the last major survey.

Species collected in the past, but missing from this year's collections included Brook (*Lampetra planeri*) and Silver Lamprey (*Ichthyomyzon unicuspis*), Central Stoneroller (*Campostoma anomalum*), Common Shiner (*Luxilus cornutus*), Creek Chub (*Semotilus atromaculatus*), Fathead Minnow (*Pimephales promelas*), Spotted Gar (*Lepisosteus oculatus*), and Stonecat (*Noturus flavus*). During the 2019 fish collection, six species were collected that were not seen in past records including: Brown Bullhead (*Ameiurus nebulosus*), Emerald Shiner (*Notropis atherinoides*), Flathead Catfish, Northern Sunfish (*Lepomis peltastes*), Pirate Perch (*Aphredoderus sayanus*), and White Crappie (*Pomoxis annularis*). Most species collected remain the same from the last broad survey completed by AEP in 1990-1991.

Table 10. Comparison of Fish Species Collected Near the Constantine Project in Various Surveys

Common Name	Shepherd 1975	AEP 1991	MDNR 1998	Cardno 2019	GLEC 2019
American Brook Lamprey		X			
Black Crappie	X	X	X	X	X
Black Redhorse		X			X
Blackside Darter		X		X	X
Bluegill	X	X	X	X	X
Bluntnose Minnow	X	X			X
Bowfin		X	X		X
Brook Silverside		X	X	X	X
Brown Bullhead					X
Central Stoneroller		X			
Channel Catfish		X	X	X	X
Chestnut Lamprey		X			X
Common Carp	X	X	X		X
Common Shiner	X	X		X	
Creek Chub		X			
Emerald Shiner					X
Fathead Minnow		X			
Flathead Catfish					X
Gizzard Shad					X
Golden Redhorse		X		X	X
Golden Shiner	X	X			X
Grass Pickerel		X			X
Greater Redhorse		X			X
Green Sunfish	X	X		X	X

Greenside Darter				X	X
Johnny Darter		X		X	X
Largemouth Bass	X	X	X	X	X
Logperch	X	X	X	X	X
Longear Sunfish		X			
Longnose Gar	X	X	X		X
Mimic Shiner		X		X	X
Northern Hogsucker	X	X			X
Northern Pike	X	X	X		X
Northern Sunfish					X
Pirate Perch					X
Pumpkinseed	X	X	X		X
Rainbow Darter		X		X	X
River Redhorse		X			X
Redhorse Sp.			X		
Rock Bass	X	X	X	X	X
Rosyface Shiner		X			
Sand Shiner		X			X
Shorthead Redhorse		X		X	X
Silver Lamprey		X			
Silver Redhorse		X			X
Smallmouth Bass	X	X	X	X	X
Spotfin Shiner	X	X			X
Spotted Gar	X				
Spotted Sucker	X	X	X		X
Stonecat				X	
Striped Shiner		X			X
Walleye		X	X	X	X
Warmouth	X	X			X
White Crappie					X
White Sucker	X	X	X		X
Yellow Bullhead	X	X		X	X
Yellow Perch		X	X	X	X

6.1.2. Fish Tissue

<insert fish tissue analysis when results are available>

6.1.3. Intake Velocities for Fish Impingement and Entrainment Potential

The intake velocities recorded at two locations within the power canal were similar to those reported in the entrainment survey completed in 1991 (AEP 1991). As reported in the PAD, during original licensing in 1988 velocities were measured as 1.8 feet per second (fps) through the trackracks and 1.3 fps at the face of the trackracks (I&M 2018). This is very similar to average velocities measured in the power canal by the ADCP sensors in June, 2019 of 1.57 fps (47.9 centimeters per second [cm/s]) just downstream of the headgate structure (Transect 1) and 1.33 fps (40.5 cm/s) upstream of the trashracks (Transect 2). This supports the assumption made in the PAD that velocities would likely remain unchanged as there have been no change to Project operations or modification of significant Project features.

Table 11 is a comparison of published swim speeds for several freshwater fish that include the species collected during the 2019 Constantine assessment. Entrainment susceptibility may be judged in part by the ability of a fish to swim against the current upstream of the powerhouse. The average swim speeds reported are very similar to the measured water velocity in the power canal, whereas the published maximum or burst swim speeds often exceed the velocity measurements in the power canal.

Table 11. Experimental Observations of Prolonged Swimming Speeds Grouped by Genus

Family	Genus	Number Fish Tested	Average of Minimum Swim Speed	Average of Swim Speed	Average of Maximum Swim Speed	Unit of Swim Speed
<i>Catostomidae</i>	<i>Catostomus</i>	4		48.7		cm/s
<i>Centrarchidae</i>	<i>Lepomis</i>	5		30.0		cm/s
<i>Centrarchidae</i>	<i>Micropterus</i>	11	50.0 ¹	43.0 ²	118.0 ¹	cm/s
<i>Cyprinidae</i>	<i>Campostoma</i>	1	27.9	39.9	53.6	cm/s
<i>Cyprinidae</i>	<i>Cyprinus</i>	2	64.9	98.1	131.0	cm/s
<i>Cyprinidae</i>	<i>Notemigonus</i>	1	30.9		71.3	cm/s
<i>Cyprinidae</i>	<i>Notropis</i>	4		33.5		cm/s
<i>Esocidae</i>	<i>Esox</i>	2	19.0		47.4	cm/s
<i>Percidae</i>	<i>Etheostoma</i>	3	14.3	29.6	42.1	cm/s
<i>Percidae</i>	<i>Sander</i>	9	36.5	31.0	90.5	cm/s
<i>Petromyzontidae</i>	<i>Lampetra</i>	4	15.2	62.8	45.7	cm/s
¹ Minimum and Maximum Speed from <i>Micropterus dolomieu</i>						
² Average Speed from <i>Micropterus salmoides</i>						

Source: FishXing Version 3.0 Beta, 2006.

Fish entrainment is also affected by the downstream migration or movement of fish and the downstream drift of larval and juvenile fish. No estimates of fish entrainment were completed with this study.

6.2. Variances from FERC-Approved Study Plan

Visual estimates of the water clarity were made by recording the depth at which a Secchi disk disappeared at fish collection sites, recorded to the nearest tenth of a meter. However, at some fish collection locations the current was too swift to accurately measure transparency using a Secchi disk, these locations were marked as Secchi-depth N/A.

During the measurement of intake velocities in the power canal interference to the surveying unit was encountered while trying to record measurements 1-foot upstream of the Project's trashracks as specified in the RSP. In order to record useable measurements, the velocity profile transect for this location was shifted slightly upstream in the power canal to the point where interference was alleviated and velocities could be successfully recorded.

The Project's power canal was initially included in the study area pursuant to the RSP but was excluded based on communication with MDNR staff from the Fisheries Division in the Southern Lake Michigan Unit, who agreed that the stranded fish survey of the power canal in spring 2019 provided sufficient

data to predict the species present (McCauley, personal communication, July 10-11, 2019). No additional fish collections were made in the power canal during this survey.

During collection of fish tissue samples field staff were unable to collect enough individuals of either of the preferred bottom-feeding species identified in the RSP, Common Carp or Channel Catfish. Field staff substituted (10) Shorthead Redhorse to represent the bottom feeder fish species.

6.3. Agency Correspondence and/or Consultation

Email communication (Appendix E) between Dennis McCauley of GLEC and MDNR's Fisheries Division, Southern Lake Michigan Management Unit, was initiated to confirm exclusion of the Project's power canal from fish collection efforts. Brian Gunderman, the Unit Manager, replied that the nearby collections in the Project's reservoir and bypass reach, along with the relocation collections in the power canal during maintenance work in spring of 2019 (unrelated to FERC relicensing), made collections by GLEC unnecessary (McCauley 2019).

7. Field Location Notes

Table 12. Sampling Locations and Dates in the Constantine Project's Reservoir and Bypass Reach

Sampling ID	Date	Latitude	Longitude	Substrate	Meso-habitat Type
BPBD-F	09/27/19	41.84700	-85.66810	gravel	Shoreline, Open water
BPBW1-S	06/02/19	41.84489	-85.66789	silt	Backwater
BPBW2-S	06/02/19	41.84423	-85.66743	silt	Backwater
BPMC-F	09/27/19	41.84666	-85.66832	gravel	Open water
BPMC-S	06/02/19	41.84606	-85.66832	gravel	Open water
BPRM-S	06/02/19	41.84576	-85.66778	sand	River mouth
BPSL-F	09/27/19	41.84627	-85.66885	rip rap	Shoreline
BPSL-S	06/02/19	41.84466	-85.66862	gravel/cobble	Shoreline
BW1-S	06/03/19	41.91281	-85.64729	silt	Backwater
BW2-S	06/04/19	41.88982	-85.64738	silt	Backwater
BW3-S	06/04/19	41.85413	-85.65778	silt	Backwater
BW4-F	09/26/19	41.91461	-85.65034	silt	Backwater
FKN1-F	09/24/19	41.91463	-85.64696	silt	Shoreline
FKN1-F2	09/25/19	41.91463	-85.64696	silt	Shoreline
FKN2-F	09/24/19	41.89335	-85.64684	silt	Shoreline
FKN2-F2	09/25/19	41.89335	-85.64684	silt	Shoreline
FKN3-F	09/24/19	41.87306	-85.65133	sand	Shoreline
FKN3-F2	09/25/19	41.87306	-85.65133	sand	Shoreline
FKN4-F	09/24/19	41.85005	-85.66837	sand	Shoreline
FKN4-F2	09/25/19	41.85005	-85.66837	sand	Shoreline
MB1-S	06/03/19	41.91272	-85.64971	sand	Macrophyte bed
MB2-S	06/04/19	41.88502	-85.64721	sand/silt	Macrophyte bed
MB3-S	06/04/19	41.87080	-85.65331	gravel	Macrophyte bed
MB4-F	09/26/19	41.91256	-85.65064	silt	Macrophyte bed
MB5-F	09/26/19	41.90244	-85.65054	silt	Macrophyte bed
OW10-F	09/26/19	41.90954	-85.63972	silt	Open water
OW10-S	06/03/19	41.90954	-85.63972	gravel	Open water
OW1-F	09/24/19	41.84805	-85.66791	silt	Open water
OW1-S	06/03/19	41.84800	-85.66783	silt	Open water
OW2-F	09/24/19	41.85486	-85.65927	silt	Open water
OW2-S	06/03/19	41.85486	-85.65927	silt	Open water
OW3-F	09/25/19	41.86342	-85.65402	silt	Open water
OW3-S	06/03/19	41.86342	-85.65402	sand/silt	Open water
OW4-F	09/25/19	41.87286	-85.65230	silt	Open water
OW4-S	06/03/19	41.87286	-85.65230	sand/silt	Open water
OW5-F	09/25/19	41.88193	-85.64982	silt	Open water
OW5-S	06/03/19	41.88193	-85.64982	sand	Open water
OW6-S	06/03/19	41.89036	-85.64883	sand	Open water
OW7-S	06/03/19	41.89747	-85.65327	sand	Open water
OW8-S	06/03/19	41.90574	-85.65122	silt	Open water
OW9-F	09/26/19	41.91408	-85.64891	silt	Open water
OW9-S	06/03/19	41.91408	-85.64891	sand	Open water
SL1-S	06/04/19	41.89425	-85.64667	silt	Shoreline
SL2-S	06/04/19	41.87759	-85.65158	sand	Shoreline
SL3-F	09/24/19	41.84916	-85.66199	small boulders	Shoreline
SL3-S	06/04/19	41.84916	-85.66199	small boulders	Shoreline
SL4-F	09/25/19	41.86620	-85.65250	silt	Shoreline

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Appendix A. Guidance for Fish Advisories

United States
Environmental Protection
Agency

Office of Water
(4305)

EPA 823-B-00-007
November 2000

**EPA Guidance for Assessing
Chemical Contaminant
Data for Use in Fish
Advisories**

**Volume 1
Fish Sampling and Analysis
Third Edition**



Appendix B. Fish Tissue

<insert Fish Tissue lab results when available>

Appendix C. In-situ Water Quality Values

June In-situ Water Quality Values

Sampling ID	pH	Dissolved Oxygen (mg/L)	Sp. Cond. (μS/cm)	Surface Temp. (°C)	Secchi Disk Depth (m)	Depth (m)
BPBW1-S	7.74	7.24	532	21.9	n/a	2.1
BPBW2-S	7.61	6.05	546	20.5	0.90	0.8
BPMC-S	8.00	8.13	494	21.4	n/a	1.9
BPSL-S	8.01	8.31	494	21.7	n/a	2.0
BPRM-S	7.75	7.04	537	21.6	n/a	1.1
BW1-S	8.08	8.97	513	20.6	n/a	0.7
BW2-S	7.74	8.19	486	19.8	0.80	0.8
BW3-S	8.04	7.90	503	19.5	n/a	1.0
MB1-S	8.04	8.40	514	20.6	n/a	0.7
MB2-S	8.01	7.67	506	19.6	1.00	1.4
MB3-S	8.05	8.00	507	19.8	1.00	1.5
OW1-S	7.93	7.40	506	20.2	1.00	n/a
OW2-S	8.05	7.46	506	20.0	0.90	n/a
OW3-S	8.05	7.50	507	20.0	1.00	n/a
OW4-S	8.10	7.60	507	20.0	1.00	4.5
OW5-S	8.04	7.81	507	19.9	0.95	2.6
OW6-S	8.06	8.13	508	20.0	n/a	3.4
OW7-S	8.03	8.53	509	20.1	n/a	3.7
OW8-S	8.00	8.73	509	20.1	n/a	2.1
OW9-S	8.13	8.90	510	20.3	n/a	2.4
OW10-S	8.09	9.00	513	20.4	n/a	3.7
SL1-S	7.87	7.60	506	19.6	1.10	1.4
SL2-S	8.00	7.80	506	19.6	0.80	0.8
SL3-S	8.05	8.52	502	20.1	0.90	1.4
Minimum	7.61	6.05	486	19.5	0.80	0.7
Maximum	8.13	9.00	546	21.9	1.10	4.5
Average	7.98	7.95	509	20.	0.95	1.9

Fisheries Survey Report
Constantine Project (FERC No. 10661)

September In-situ Water Quality Values

Sampling ID	pH	Dissolved Oxygen (mg/L)	Sp. Cond. (μS/cm)	Surface Temp. (°C)	Secchi Disk Depth (m)	Depth (m)
BPBD-F	8.04	7.75	551	18.0	1.5	2.1
BPMC-F	7.88	7.47	585	17.6	1.25	3.0
BPSL-F	7.91	7.59	582	17.6	0.5	0.5
BW4-F	8.23	8.35	512	19.6	0.8	0.8
FKN1-F	8.05	7.45	511	20.0	1.25	1.8
FKN1-F2	7.94	7.52	511	19.4	1.25	1.8
FKN2-F	8.09	7.28	509	20.5	1.25	1.9
FKN2-F2	8.07	7.69	512	19.9	1.25	1.9
FKN3-F	8.09	7.84	508	21.2	1.25	2.7
FKN3-F2	8.10	8.41	510	20.2	1.25	2.7
FKN4-F	8.14	8.30	506	22.6	1.25	1.6
FKN4-F2	8.14	8.33	507	20.6	1.25	1.6
MB4-F	8.16	8.01	513	19.4	1.25	1.3
MB5-F	8.24	8.97	510	20.0	1.25	2.3
OW1-F	8.16	8.48	506	22.2	2	3.0
OW2-F	8.24	9.55	505	22.6	2	2.0
OW3-F	8.15	8.52	508	20.4	1.25	1.4
OW4-F	8.19	8.86	510	20.5	1.4	3.1
OW5-F	8.16	8.53	511	20.3	1.5	3.7
OW9-F	8.18	7.71	511	19.3	1.3	1.3
OW10-F	8.14	7.58	611	19.2	1.5	2.3
SL3-F	8.20	9.08	504	22.7	1.25	1.5
SL4-F	8.15	8.74	510	20.4	1.25	1.3
Minimum	7.88	7.28	504	17.6	0.50	0.5
Maximum	8.24	9.55	611	22.7	2.00	3.7
Average	8.12	8.17	521	20.1	1.30	1.9

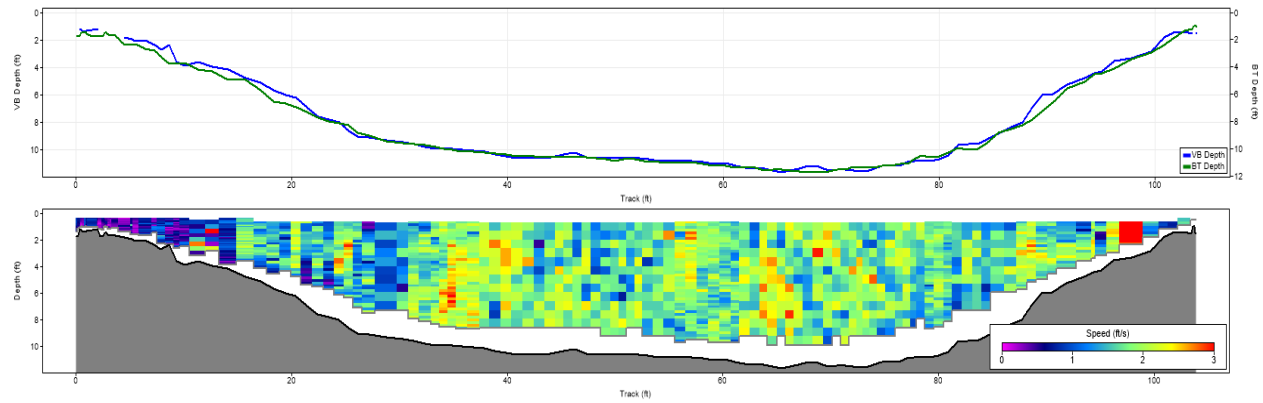
Appendix D. Acoustic Doppler Current Profiler

Fisheries Survey Report

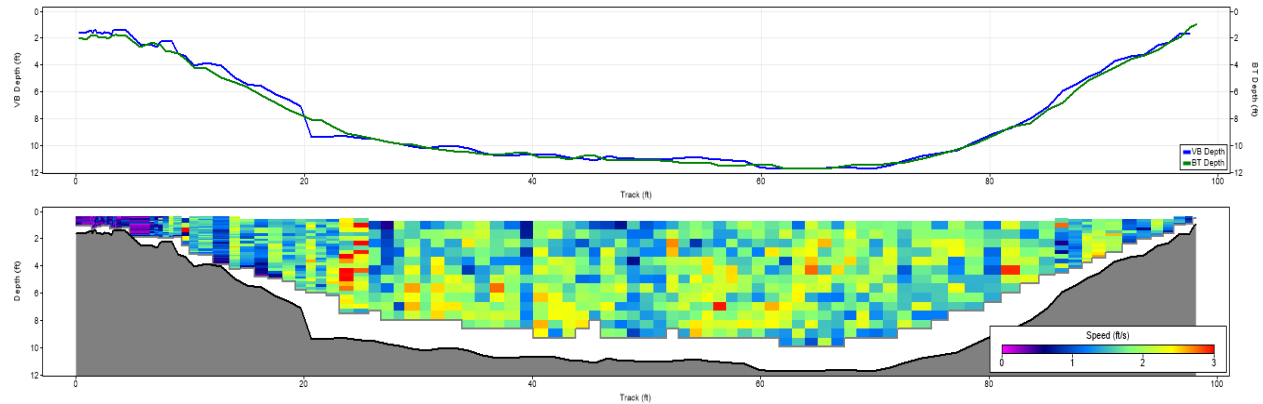
Constantine Project (FERC No. 10661)

File	File Reference	Direction	Left Bank Distance ft	Right Bank Distance ft	Start Date	Start Time	Duration minutes	Track Length ft	DMG ft	Transect Width ft	Transect Area ft²	Mean River Velocity ft/s	Boat Speed ft/s	Left Q cfs	Right Q cfs	Total Q cfs
20190612094851r.rivr	4851	left bank to right bank	2.0	2.0	6/12/2019	9:48:52 AM	0:02:54	104.5	92.5	96.5	772.1	1.579	0.601	0.76	0.00	1219.4
20190612095937r.rivr	5937	left bank to right bank	2.0	2.0	6/12/2019	9:59:39 AM	0:02:25	100.0	91.2	95.2	777.8	1.576	0.690	0.43	0.00	1226.0
20190612103534r.rivr	3534	right bank to left bank	2.0	2.0	6/12/2019	10:35:33 AM	0:03:27	108.3	90.1	94.1	774.2	1.565	0.523	0.61	0.26	1211.3
						Mean	0:02:55	104.27	91.28	95.28	774.70	1.573	0.604	0.6	0.09	1,218.87
						Std Dev	0:00:25	3.39	0.98	0.981	2.337	0.006	0.068	0.13	0.12	6.00
						COV	0	0.033	0.011	0.01	0.003	0.004	0.113	0.221	1.414	0.01

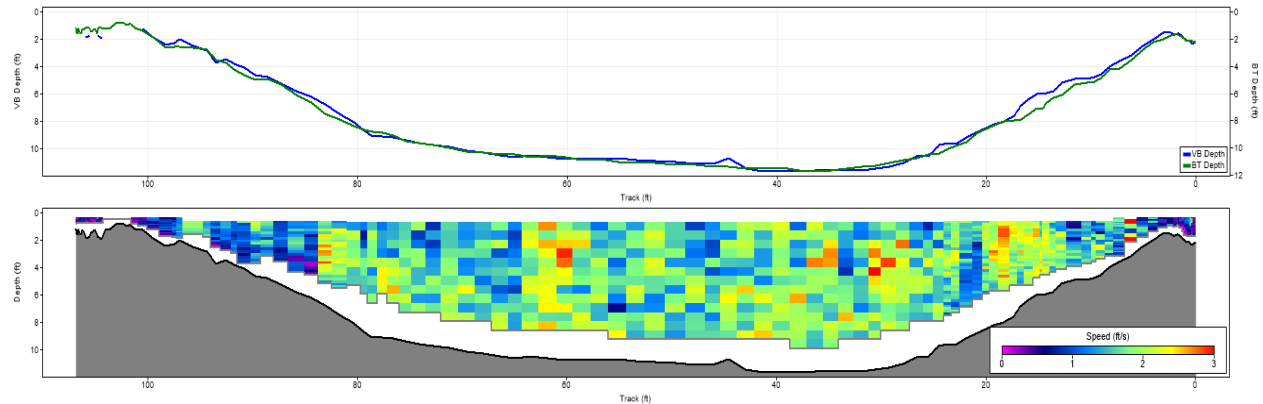
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File Reference: 5937



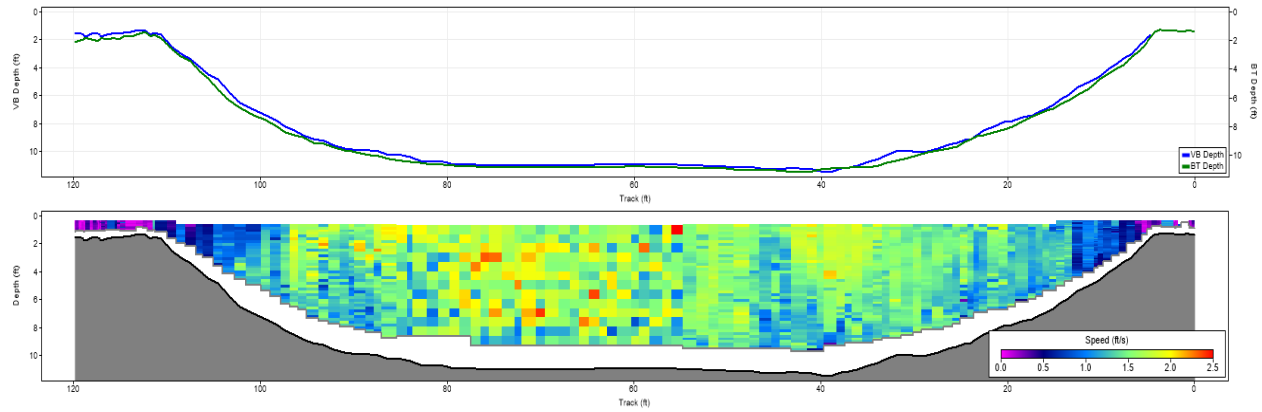
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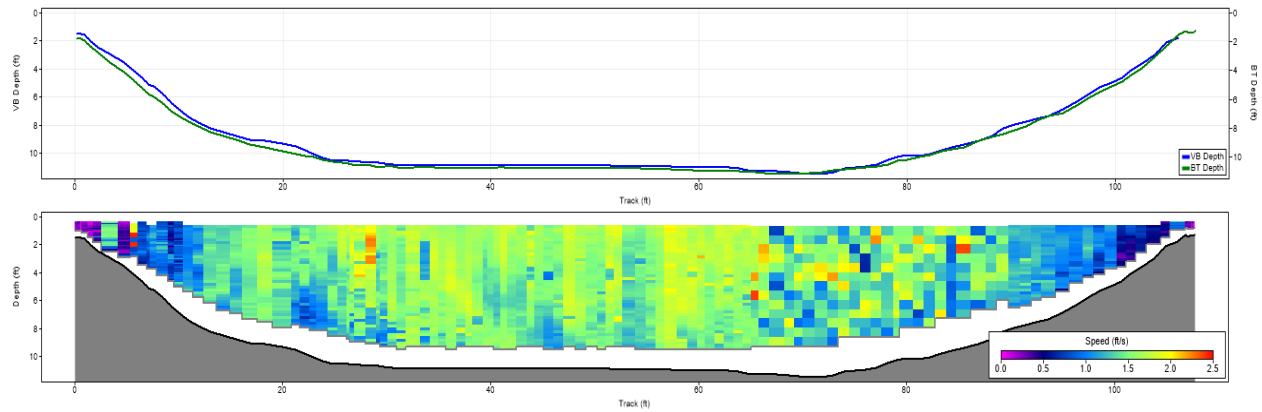
Fisheries Survey Report Constantine Project (FERC No. 10661)

File	File Reference	Direction	Left Bank Distance ft	Right Bank Distance ft	Start Date	Start Time	Duration minutes	Track Length ft	DMG ft	Transect Width ft	Transect Area ft²	Mean River Velocity ft/s	Boat Speed ft/s	Left Q cfs	Right Q cfs	Total Q cfs
20190612113009r.rivr	3009	right bank to left bank	3.0	3.0	6/12/2019	11:30:05 AM	0:03:12	124.9	103.2	109.2	936.0	1.328	0.650	0.53	0.62	1243.3
20190612115620r.rivr	5620	left bank to right bank	3.0	3.0	6/12/2019	11:56:14 AM	0:02:46	109.9	102.0	108.0	933.3	1.316	0.662	0.14	0.51	1228.4
20190612120921r.rivr	0921	left bank to right bank	3.0	3.0	6/12/2019	12:09:15 PM	0:02:12	114.9	95.5	101.5	906.2	1.36	0.870	0.06	0.00	1232.8
						Mean	0:02:43	116.54	100.23	106.23	925.18	1.335	0.728	0.24	0.38	1,234.84
						Std Dev	0:00:25	6.22	3.37	3.369	13.47	0.019	0.101	0.21	0.27	6.23
						COV	0	0.053	0.034	0.032	0.015	0.014	0.139	0.848	0.716	0.01

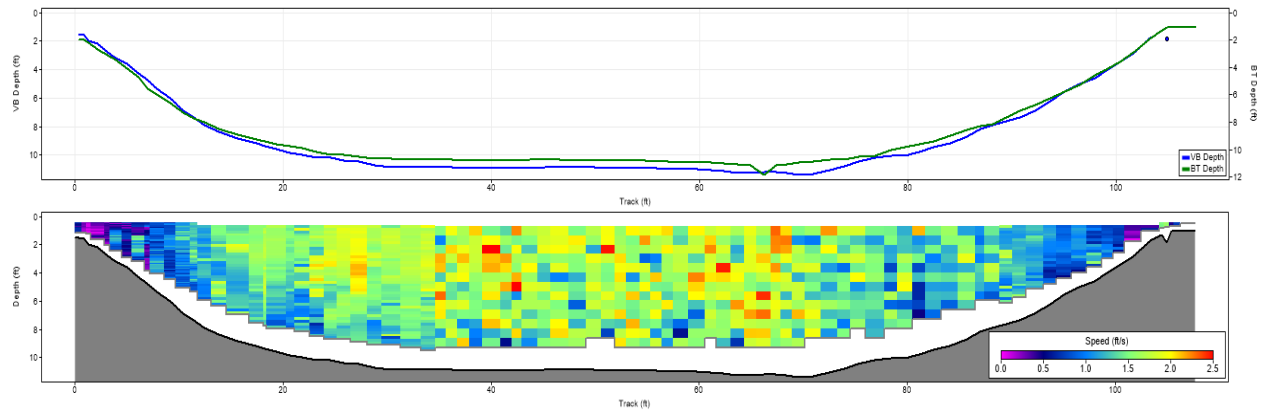
File Reference: 3009



File Reference: 5620



File Reference: 0921



Appendix E. Agency Correspondence

Fisheries Survey Report
Constantine Project (FERC No. 10661)

From: **Gunderman, Brian (DNR)** <GundermanB@michigan.gov>
Date: Thu, Jul 11, 2019 at 11:18 AM
Subject: RE: Constantine Hydropower Project: Power Canal Fisheries Assessment
To: Dennis McCauley <dmccauley@glec.com>
Cc: Diana, Matthew (DNR) <DianaM@michigan.gov>, Thiamkeelakul, Kesiree (DNR) <ThiamkeelakulK@michigan.gov>
Kruger, Kyle (DNR) <KRUGERK@michigan.gov>

Hi Dennis,

Thank you for providing the map and report! It is not necessary to conduct electrofishing or netting in the power canal. The stranded fish survey and the electrofishing in the impoundment are sufficient to determine which species are likely to be present in the power canal.

Brian Gunderman
Southern Lake Michigan Unit Manager
Michigan Department of Natural Resources – Fisheries Division
621 N. 10th Street
Plainwell, MI 49080
Phone: (269)204-7009
Fax: (269)685-1362

From: Dennis McCauley <dmccauley@glec.com>
Sent: Wednesday, July 10, 2019 3:11 PM
To: Gunderman, Brian (DNR) <GundermanB@michigan.gov>
Cc: Quiggle, Robert <Robert.Quiggle@hdrinc.com>
Subject: Constantine Hydropower Project: Power Canal Fisheries Assessment

Hello Brian: Thank you for speaking with me today regarding the level of effort necessary to assess the fisheries in the AEP Constantine Hydroelectric Power Canal project (FERC No.: 10661). Great Lakes Environmental Center, Inc. (GLEC) is tasked with assisting HDR Engineering and AEP with the completion of the fisheries tasks outlined for the project relicensing studies. We have determined that the only way to effectively fish the power canal would be electrofishing but that would require us to crane the equipment into the canal. We would welcome your input into this. We completed electrofishing in the impoundment and the by-pass channel (June 2019). I have attached a map showing the electrofishing locations. In that effort we collected 36 species of fish.

In April of this year, another contractor completed a stranded fish and mussel assessment within the power canal (report attached) and they observed 21 species of fish, which, with the exception of the greenside darter, rainbow darter, johnny darter, brook silverside, common shiner and stonecat, overlapped with the species collected in the impoundment and by-pass channel. That report also shows good pictures of the de-watered power canal for your reference.

I'll look forward to hearing back from you regarding WDNR's expectations for fishing the Power Canal. If you have any questions, or require additional information, please let me know. Thank you. Dennis

—
Dennis J. McCauley
President/Senior Environmental Scientist
Great Lakes Environmental Center, Inc.
Phone: 231/941-2230
Cell: [REDACTED]
FAX: 231/941-2240
www.glec.com

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Appendix F. Mussel Survey

FRESHWATER MUSSEL SURVEY FOR THE CONSTANTINE HYDROELECTRIC PROJECT (FERC No. 10661)

Prepared for:



1304 Buckley Road, Suite 202
Syracuse, New York 13212-4311

and

Indiana Michigan Power Company (I&M)
a unit of

American Electric Power



ES Project No.: 12072

Date: 4/14/2020

Prepared by:



EnviroScience
Excellence In Any Environment

5070 Stow Rd.
Stow, OH 44224
800-940-4025

www.EnviroScienceInc.com

Freshwater Mussel Survey for the
Constantine Hydroelectric project
(FERC No. 10661)

Document Date: 4/14/2020
ES Project No.: 12072

Prepared for:

Mr. Robert Quiggle
Regulatory and Environmental Section Manager
HDR

Authorization for Release

The analyses, opinions, and conclusions in this document are based entirely on EnviroScience's unbiased, professional judgement. EnviroScience's compensation is not in any way contingent on any action or event resulting from this study.

The undersigned attest, to the best of their knowledge, that this document and the information contained herein is accurate and conforms to EnviroScience's internal Quality Assurance standards.



Philip Mathias
Malacologist | Field Supervisor



Ryan Schwegman
Marine Services Practice Area Manager

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ACKNOWLEDGEMENTS

Funding for the project was provided by American Electric Power and Indiana Michigan Power Company (I&M) through a contract with HDR, Inc. Mr. Robert Quiggle was the point of contact for HDR, Inc. Mr. Jonathan Magalski was the project manager and environmental coordinator for American Electric Power (AEP). Mr. Dustin Zirkle (AEP) was the Diving Program Manager and Ryan Stough (AEP / I&M) was the onsite dive inspector. The EnviroScience, Inc. staff who completed the work and reporting include the following. The project manager was Mr. Ryan Schwegman. Mr. Philip Mathias was the field supervisor, malacologist, and authored the mussel survey report. Mr. Patrick Evankovich served as the designated dive supervisor. EnviroScience divers participating on the survey were Mr. Layne Levine, Mr. Matthew Villanueva, and Mr. Jeremy Zucker. Technical review was completed by Mr. Schwegman, and Ms. Kristen Schmidt. Mr. Greg Zimmerman assisted with project coordination and reviewed the report for quality control. Mr. Gregory Hocesvar created GIS mapping.

1.0 INTRODUCTION

Indiana Michigan Power Company (I&M), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 1,200-kilowatt (kW) Constantine Hydroelectric Project (FERC Project No. 10661) (Project), located on the St. Joseph River in the Village of Constantine in St. Joseph County, Michigan (Latitude 41.847265, Longitude -85.668484; Township 7S, Range 12W, Section 23). The Project is in the process of Federal Energy Regulatory Commission (FERC) relicensing, and as part of the Proposed Study Plan (PSP), prepared by AEP and HDR, Inc. (HDR), a mussel survey was proposed. HDR requested that EnviroScience provide a proposal to complete the mussel survey task of the PSP. The results of the mussel survey would help determine the effects of project operation on mussel habitat.

The existing license for the Project was issued by FERC for a 30-year term, with an effective date of October 20, 1993 and expiration date of September 30, 2023. The I&M is pursuing a new license for the Project pursuant to the FERC's Integrated Licensing Process (ILP) described in 18 Code of Federal Regulations (CFR) Part 5. The I&M filed a Pre-Application Document and associated Notice of Intent with the Commission on June 4, 2018 to initiate the ILP. Pursuant to the FERC's regulations in 18 CFR §5.11, I&M developed a Proposed Study Plan (PSP) for the Project that was filed with the FERC on November 16, 2018. The I&M held a PSP Meeting on December 11, 2018 for the purpose of clarifying the PSP, explaining any initial information gathering needs, and addressing any outstanding issues associated with the PSP. I&M filed the Revised Study Plan (RSP) per the FERC Study Plan Determination (SPD) dated April 9, 2019, which approved eight studies, including a mussel survey.

1.1 BACKGROUND

Continued Project operation could affect (negatively or positively) freshwater mussel resources within and/or adjacent to the Project area, which includes the Project reservoir, bypassed reach, and immediately downstream of the U.S. Route (US) 131 Business Route Bridge (Figure 1; HDR, 2018). Of the 44 mussel species found in Michigan, 19 (43%) are listed as either endangered or threatened pursuant to the Endangered Species Act of the State of Michigan, Part 365 of PA 451 1994, Michigan Natural Resources and Environmental Protection Act (MDNR, 2009). To adhere to the FERC relicensing requirements, the mussel survey was performed to describe potential Project effects to mussels.

The St. Joseph River at this location has a drainage area of 4,740 square kilometers (km²; 1,830 square miles [mi²]), and drains into Lake Michigan in Berrien County, Michigan. The Project location is surrounded by residential, commercial, forest, and park/lawn land use types. The 2019 Michigan Mussel Survey Protocol (Protocol) classified the Project reach of the St. Joseph River as a "Group 2 Stream" (Hanshue et al., 2019). Group 2 Streams are defined as streams where state threatened and/or endangered mussels are known or are expected to occur and historically supported federally listed mussel species.

This study was conducted in accordance with the PSP, SPD, and the Protocol. The results of the survey will aid in determining any potential effects (positive or negative) from continued operation imposed on the mussel community within the Project area. Study results may be utilized to develop protection, mitigation, and enhancement (PM&E) measures warranted under a new FERC license.

2.0 METHODS

Survey methods were developed to provide adequate data in order to assess potential effects that this Project may have on the existing mussel community. No instream work stream is anticipated as a result of Project relicensing; therefore, no new direct impacts are anticipated. The survey methods were coordinated between AEP, I&M, HDR, EnviroScience, and MDNR. The PSP called for qualitative surveys at four locations: two locations within the reservoir, one location in the bypass reach, and one location downstream of the Project's powerhouse. The bypass reach had been recently dredged; therefore, any mussel community (if present) was not likely representative of existing conditions. An alternative location downstream of the bypass reach was selected and approved by MDNR, AEP, I&M, and HDR. The Sites surveyed are listed below and depicted in Figure 2.

- Site 1 was upstream of the dam within the reservoir at Latitude 41.849041, Longitude -85.667659.
- Site 2 was downstream of the dam at the confluence of the Fawn River with St. Joseph River. Per the SPD recommendations, one survey site was to be upstream of the Fawn River confluence and the other site in the bypassed reach downstream of the confluence. Due to safety considerations (turbulent river conditions precluding safe diving conditions), accessibility, and cursory review of available mussel habitat in the area upstream of the Fawn River confluence, this area was precluded from the survey. A location near to the confluence was surveyed and was deemed more appropriate based on the survey objectives. Three sub-reaches were evaluated:
 - Sub-reach 1 at Latitude 41.849041, Longitude -85.667659
 - Sub-reach 2 at Latitude 41.844611, Longitude -85.668393
 - Sub-reach 3 at Latitude 41.843837, Longitude -85.668561
- Site 3 was downstream of the bypass reach. Three sub-reaches were evaluated:
 - Sub-reach 1 at Latitude 41.842541, Longitude -85.672059
 - Sub-reach 2 at Latitude 41.842327, Longitude -85.671905
 - Sub-reach 3 at Latitude 41.842018, Longitude -85.671337
- Site 4 was upstream of the dam within the reservoir at Latitude 41.847958, Longitude -85.669281

Final approval of survey methods from MDNR was required due to the possibility of state threatened and endangered species presence in the Project area. The mussel survey study plan was approved by MDNR on July 10, 2019 per the issuance of a Project Scientific Collection Permit. The approved survey methods and Project Scientific Collection Permit are provided in Appendix A.

2.1 MUSSEL SURVEY

Mussel surveys were performed following the semi-quantitative guidelines described in Section V of the Protocol (Hanshue et al., 2019). Visual-tactile timed search methods were used to determine mussel presence. The objective of the surveys was to collect enough data to generate species richness curves.

General habitat data, including substrate composition using the Wentworth Scale (% observed of silt, sand, gravel, etc.), were reported by divers prior to initiating searches to allow the team malacologist to assess the suitability of mussel habitat. Overall, 30 sub-reach searches were surveyed at each site, and each sub-reach was searched for 10 minutes for a total of five work-

person-hours per site. Searching entailed divers sweeping away silt and debris and probing the substrate to detect burrowed mussels. Diving utilized surface-supplied air and tethered hardhat diving methods. Surface-supplied air diving facilitated a high level of safety and data collection oversight using two-way communication with top-side support.

The survey team also recorded general site observations and water chemistry each day of the survey. Habitat information such as water depth, habitat type (e.g., riffle, run, pool), cover type (e.g., woody debris), stream width, and qualitative water velocity were noted. Water chemistry parameters (Dissolved Oxygen [% and mg/L], Specific Conductivity [μ S/cm], pH, and flow [ft/s]) were collected morning, mid-day, and in the evening with a Yellow Springs Instruments (YSI) Professional Plus multiparameter instrument that was calibrated the evening prior to use.

2.2 MUSSEL HANDLING

All live mussels were identified, counted, and sexed (dimorphic species only) during the survey. Dead shells were scored as either fresh dead (lustrous nacre, dead <1yr), weathered dead (dull or chalky nacre, dead one to many years), or subfossil (heavily weathered and fragmented, dead many years to many decades) and noted as present. Live mussels were kept cool and moist in shade and were not out of the water for more than five minutes during processing. All live mussels were returned to the area of their collection. Shell lengths of each live mussel were recorded to represent population age structure. Digital images of each species (one of their valves and a closeup of each species dorsal view [umbo]) were taken with a metered scale. Taxonomy nomenclature followed Williams et al. (2017).

2.3 QUALITY CONTROL PROCEDURES

Several measures of quality control were implemented to ensure thorough mussel collection, consistent habitat assessment by divers, and accurate species identification by malacologists. The field staff working on this Project were highly experience in performing freshwater mussel surveys. The field supervisor (Mr. Philip Mathias) has extensive experience (more than 10 years) identifying and handling mussels and directly supervised and actively participated in all survey operations for this project. A copy of Mr. Mathias' scientific collector permits is included in Appendix A. EnviroScience divers were all individually trained and experienced (more than 50 hours) in mussel sampling using both visual and tactile means.

3.0 RESULTS

The EnviroScience field team conducted the survey between August 20 and August 21, 2019. River conditions were appropriate for mussel surveys with an average water temperature of 25 degrees Celsius (77 degrees Fahrenheit) and excellent water clarity. Water visibility averaged 182 centimeters (cm) (72 inches [in]) upstream of the dam and 305cm (120in) below the dam in the flowing habitat areas.

3.1 MUSSEL SURVEY RESULTS

No evidence (live or recently dead) of federally listed threatened or endangered species was observed. The state endangered Lilliput (*Toxolasma parvum*) was found alive in Site 2 sub-reach 2 and the state threatened Purple Wartyback (*Cyclonaias tuberculata*) was found as dead shell in Site 2 sub-reach1 (Table 1). Mussels were generally common, but not densely aggregated in the surveyed reaches. Habitat suitability did not appear to be a limiting factor for mussel colonization, nor did Project operation appear to be negatively effecting mussel distribution.

Overall, a total of 394 mussels representing 12 live species were detected and an additional four species were detected as shells only (Table 1). All live mussels were collected below the dam. The Plain Pocketbook (*Lampsilis cardium*) was the dominant species (total number [n] 111) representing 27.5% of all individuals collected). The Ellipse (*Venustaconcha ellipsiformis*; n=82) and Mucket (*Actinonaias ligamentina*; n=74) were subdominant representing 20.8% and 18.8% of all individuals collected, respectively. The Ellipse is designated as a state special concern species; no legal protection is afforded to special concern species in Michigan. One additional special concern species was collected (Elktoe [*Alasmidonta marginata*]). A summary of mussels observed by site and sub-reach is provided in Table 2. Water chemistry data can be found in Table 3. Mussel shell lengths are presented as histograms in Appendix B. Digital images of representative specimens and general site photos can be found in Appendix C.

Species Richness curves for the two sites where live mussels were detected are provided in Appendix D. Species richness data collected from Site 2 indicated an additional 300 individuals would be required to detect an additional species. Species richness data from Site 3 indicated another 127 individuals would be needed to detect an additional species.

3.1.1 Above the Dam/Sites 1 and 4

No live mussels were found above the dam. Divers collected weathered dead shell of individuals in the reaches surveyed upstream of the dam, and no evidence of living mussels was detected. The three species observed as dead shell were Paper Pondshell (*Utterbackia imbecillis*), Giant Floater (*Pyganodon grandis*), and Spike (*Eurynia dilatata*) (Table 2).

Habitat conditions were not ideal for mussel colonization upstream of the dam. Generally, suitable mussel habitat is that where heterogeneous substrate is present in moderately flowing conditions, and the substrate is free of silt. Mussel habitat (substrate) closer to the dam (upstream survey extent; Sites 1 and 4) varied from that in the downstream survey extent. The upstream portion was dominated by fine substrates of silt, mud, clay, and woody debris. There was noticeable anoxia (lack of dissolved oxygen) in the substrates throughout the upstream portion as decomposition gas coupled with blackened substrates were prevalent.

3.1.2 Below the Dam Sites 2 and 3

Mussels were more common along the right descending bank in the downstream sites and appeared concentrated to the thalweg of the river. Mussel distribution in riverine systems often corresponds with the channel of flow and thalweg. Total abundance within Site 2 Sub-reach 1, Sub-reach 2, and Sub-reach 3 was 29, 39, and 102, respectively (Table 2). Catch-per-unit-effort (CPUE) was highest at Site 2 Sub-reach 3 (20.4 mussels per hour). Site 3 overall had the most mussels observed and abundance was 33, 75, and 116, in Sub-reach 1, Sub-reach 2, and Sub-reach 3, respectively.

Below the dam had ideal substrate to support a diverse mussel community. Substrates were 75% gravel and 25% sand below the dam (Site 2 sub-reaches), while further downstream of the dam (Site 3 sub-reaches) was 50% sand and 50% gravel.

4.0 DISCUSSION

Many factors influence mussel community persistence in the St. Joseph River, and some may be directly and indirectly related to Project operation. The information available regarding specific and cumulative impacts to mussels from hydroelectric dams is relatively understudied and difficult to conclude as a sole contributing factor to decline or loss of species. Direct impacts affecting

mussel persistence include the loss of riverine mussel habitat through the construction and operation of dams. Dams are one of the “single most important factors” to the decline in North American mussel fauna (Haag, 2012). Conversely, Layzer and Scott (2006) identified the tailwaters of dams as beneficial to mussel communities citing increased aeration in tailwaters provides suitable habitat conditions and promotes mussel colonization.

Direct effects from high-volume discharges and abrupt shifts in operation (e.g., reducing or increasing operation capacity resulting in altered river flows downstream) may result in fluctuating water levels and instable riverbed substrates. Inconsistent and variable water velocity can expose boulders, bedrock, and result in depositional shifting sand, which is inhospitable to most freshwater mussels (Neck and Howells, 1994). Similarly, dam operation can change patterns of sedimentation, scour, and alter the ability of particulate matter (food source for mussels) to be transported throughout the stream (Baxter, 1977; Petts, 1980; Ward & Stanford, 1987; Ligon et al., 1995).

Indirect effects of continued operation on mussel life history, reproduction, and habitat may be the most influential to mussel community persistence. Disruptions in mussel reproductivity and shifts in habitat are often attributed to acute or chronic declines in an assemblage over time. For example, because mussels temporarily parasitize and require a fish host, dams can limit fish passage and consequently mussel dispersal (Watters, 1996). As river habitat fluctuates, fish species composition can also shift influencing host availability for the resident mussel community. Often dam tailwaters exhibit fluctuating water temperatures during discharge or release, which can affect spawning and recruitment success of resident mussels.

Mussel assemblage in the Project study area was similar to historic records near the area as presented in Table 4. Nineteen (19) species have been documented in this portion of the St. Joseph River and 12 were observed live in this study. Species observed in this study and not documented downstream by Wesley and Duffy (1999) included the Mapleleaf (*Quadrula quadrula*), Lilliput, and Paper Pondshell. Conversely, species observed pre-1999 and not recorded in this study included Cylindrical Papershell (*Anodontoidea ferrussacianus*), Purple Wartyback (*Cyclonaias tuberculata*), Ohio Pigtoe (*Pleurobema cordatum*), and Rainbow (*Villosa iris*). An undetectable, and not very diverse, mussel community may occupy the region upstream of the dam. Only six species were reported by Wesley and Diff (1999) near Three Rivers, Michigan. A study performed near the dam head race in 2019, associated with a separate project, collected 11 species. Species collected in that survey were like those observed at Sites 2 and 3 in this study, except for Round Pigtoe (live; *Pleurobema sintoxia*) and live Purple Wartyback.

Based on the mussel distribution and habitat conditions observed in this survey, it is likely that Project operation in this part of the St. Joseph River supports the theory presented in Layzer and Scott (2006). Habitat appears to be the limiting factor for mussel colonization at Sites 1 and 4. A small disconnected concentration of mussels was observed downstream where suitable habitat was more prevalent. Reproductivity and recolonization through recruitment may be limited due to fish passage or slowed but some continuity of stable substrate exists despite fluctuating tailwaters. Recommendations for developing PM&E measures were not part of this scope.

5.0 CONCLUSIONS

No federally listed mussel species were detected within the Project area. An undetectable mussel community may occupy the region upstream of the dam, and mussel scarcity is likely to due to a

lack of habitat and unstable conditions in Sites 1 and 4. There appears to be a stable, recruiting mussel community below the dam that has likely persisted for several years based on the diversity and abundances observed in this survey and historical records. The mussels observed would likely not be affected by continued operation assuming relicensing would not alter the existing hydraulics. The results from this survey can be used to assist the FERC as well as MDNR as they evaluate the relicensing of continued operations at I&M Constantine Hydroelectric Project and implementation of any PM&E measures for the Project.

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Tables

Table 1. Status, Numbers, Relative Abundance, and Minimum, Maximum, and Mean Shell Length of the Total Freshwater Mussels collected from the Constantine Hydroelectric Project (FERC NO. 10661) Relicensing Studies: Mussel Survey. Constantine, St. Joseph County, Michigan, 2019.

Species	Common Name	Federal Status ¹	MI Status ¹	Condition ²			Rel. Ab. (%)	Shell Length (mm)			Sex (No. Live)	
				Live	FD	D		Min.	Max.	Mean	Female	Male
<i>Actinonaias ligamentina</i>	Mucket			74		1	18.8%	85.0	147.0	114.1		
<i>Alasmodonta marginata</i>	Elktoe		SC	30			7.6%	34.0	82.0	64.8		
<i>Cyclonaias pustulosa</i>	Pimpleback			20			5.1%	51.0	84.0	66.2		
<i>Cyclonaias tuberculata</i>	Purple Wartyback		T			1						
<i>Eurynia dilatata</i>	Spike			10		2	2.5%	70.0	122.0	90.8		
<i>Fusconaia flava</i>	Wabash Pigtoe			3			0.8%	38.0	92.0	70.0		
<i>Lampsilis cardium</i>	Plain Pocketbook			111		1	28.2%	47.0	122.0	91.0	40	71
<i>Lampsilis siliquoidea</i>	Fatmucket					1						
<i>Lasmigona costata</i>	Flutedshell		SC	19		1	4.8%	80.0	137.0	108.8		
<i>Pleurobema sintoxia</i>	Round Pigtoe		SC			1						
<i>Pyganodon grandis</i>	Giant Floater					6						
<i>Quadrula quadrula</i>	Mapleleaf			2			0.5%	80.0	83.0	81.5		
<i>Strophitus undulatus</i>	Creeper			32			8.1%	40.0	98.0	81.0		
<i>Toxolasma parvum</i>	Lilliput		E	1			0.3%		26.0			
<i>Utterbackia imbecillis</i>	Paper Pondshell		SC	10		5	2.5%	35.0	87.0	59.5		
<i>Venustaconcha ellipsiformis</i>	Ellipse		SC	82		1	20.8%	40.0	77.0	61.0		
Total				394		20	100.0%					
No. of Species				12		10						

¹ E = Endangered; SC = Special Concern; T = Threatened

² FD=fresh dead shell, D=includes weathered dead and subfossil shells

Table 2. Michigan Status, Numbers, Relative Abundance, Minimum, Maximum, and Mean Shell Length, Sex of Live Sexually Dimorphic Species for Each Site and Subreach that Freshwater Mussels were collected from the Constantine Hydroelectric Project (FERC NO. 10661) Relicensing Studies: Mussel Survey. Constantine, St. Joseph County, Michigan, 2019.

Site	Scientific Name	Common Name	MI Status ¹	Live	WD	Length (mm)			Sex (No. Live)	
						Min.	Max.	Mean	Female	Male
Site 1, Upstream of Dam (41.849041, -85.667659)										
	<i>Pyganodon grandis</i>	Giant Floater	SC		5	73.0	132.0	92.4		
	<i>Utterbackia imbecillis</i>	Paper Pondshell			4	71.0	87.0	82.0		
	Total				0	9				
	CPUE			0.0						
	No. Species			0	2					
Site 4, Upstream of Dam (41.847958, -85.669281)										
	<i>Eurynia dilatata</i>	Spike	SC		1	85	85	85.0		
	<i>Pyganodon grandis</i>	Giant Floater			1	125	125	125.0		
	<i>Utterbackia imbecillis</i>	Paper Pondshell			1	76	76	76.0		
	Totals			0	3					
	CPUE			0.0						
	No. Species			0	3					
Site 2, SubReach 1, Below Dam (41.845369, -85.668526)										
	<i>Actinonaias ligamentina</i>	Mucket	T	5		105	129	118.2		
	<i>Cyclonaias pustulosa</i>	Pimpleback			1		77			
	<i>Cyclonaias tuberculata</i>	Purple Wartyback			1		77			
	<i>Eurynia dilatata</i>	Spike		1			120			
	<i>Fusconaia flava</i>	Wabash Pigtoe		1			38			
	<i>Lampsilis cardium</i>	Plain Pocketbook		11		83	109	97.0	5	6
	<i>Lampsilis siliquoidea</i>	Fatmucket			1		122			
	<i>Lasmigona costata</i>	Flutedshell	SC	3	1	92	134	116.8		
	<i>Pleurobema sintoxia</i>	Round Pigtoe	SC		1		82			
	<i>Quadrula quadrula</i>	Mapleleaf		2		80	83	81.5		
	<i>Strophitus undulatus</i>	Creeper		2		68	94	81.0		
	<i>Utterbackia imbecillis</i>	Paper Pondshell	SC	2		46	58	52.0		
	<i>Venustaconcha ellipsiformis</i>	Ellipse	SC	1	1	61	61	61.0		
	Total			29	5					
	CPUE			5.8						
	No. Species			10	5					
Site 2, SubReach 2, Below Dam (41.844611, -85.668393)										
	<i>Actinonaias ligamentina</i>	Mucket	SC	8	1	85	147	112.4		
	<i>Alasmidonta marginata</i>	Elktoe			3		66	77	70.7	

Table 2. Michigan Status, Numbers, Relative Abundance, Minimum, Maximum, and Mean Shell Length, Sex of Live Sexually Dimorphic Species for Each Site and Subreach that Freshwater Mussels were collected from the Constantine Hydroelectric Project (FERC NO. 10661) Relicensing Studies: Mussel Survey. Constantine, St. Joseph County, Michigan, 2019.

Site	Scientific Name	Common Name	MI Status ¹	Live	WD	Length (mm)			Sex (No. Live)	
						Min.	Max.	Mean	Female	Male
Site 2, SubReach 2, Below Dam (41.844611, -85.668393) (Cont'd)										
	<i>Cyclonaias pustulosa</i>	Pimpleback		4		56	80	68.0		
	<i>Eurynia dilatata</i>	Spike			1					
	<i>Lampsilis cardium</i>	Plain Pocketbook		14	1	79	112	96.0	7	7
	<i>Lasmigona costata</i>	Flutedshell	SC	3		102	118	110.7		
	<i>Strophitus undulatus</i>	Creeper		1		98	98	98.0		
	<i>Toxolasma parvum</i>	Lilliput	E	1		26	26	26.0		
	<i>Utterbackia imbecillis</i>	Paper Pondshell	SC	1		64	64	64.0		
	<i>Venustaconcha ellipsiformis</i>	Ellipse	SC	4		60	64	63.0		
	Total			39	3					
	CPUE			7.8						
	No. Species:			9	3					
Site 2, SubReach 3, Below Dam (41.843837, -85.668561)										
	<i>Actinonaias ligamentina</i>	Mucket		34		93	129	110.97		
	<i>Cyclonaias pustulosa</i>	Pimpleback		6		61	72	65.167		
	<i>Eurynia dilatata</i>	Spike		3		70	122	88.667		
	<i>Lampsilis cardium</i>	Plain Pocketbook		40		66	122	95.5	9	31
	<i>Lasmigona costata</i>	Flutedshell	SC	4		94	113	108		
	<i>Strophitus undulatus</i>	Creeper		5		78	91	86.6		
	<i>Venustaconcha ellipsiformis</i>	Ellipse	SC	10		54	67	61.2		
	Total			102	0					
	CPUE			20.4						
	No. Species			7	0					
Site 3, SubReach 1, Below Dam (41.842541, -85.672059)										
	<i>Actinonaias ligamentina</i>	Mucket		3		99	109	103.33		
	<i>Alasmodonta marginata</i>	Elktoe	SC	1		60	60	60		
	<i>Cyclonaias pustulosa</i>	Pimpleback		2		54	59	56.5		
	<i>Eurynia dilatata</i>	Spike		1		95	95	95		
	<i>Fusconaia flava</i>	Wabash Pigtoe		1		92	92	92		
	<i>Lampsilis cardium</i>	Plain Pocketbook		13		73	111	90.538	4	9
	<i>Lasmigona costata</i>	Flutedshell	SC	2		81	122	101.5		
	<i>Strophitus undulatus</i>	Creeper		2		76	87	81.5		
	<i>Utterbackia imbecillis</i>	Paper Pondshell	SC	2		35	60	47.5		

Table 2. Michigan Status, Numbers, Relative Abundance, Minimum, Maximum, and Mean Shell Length, Sex of Live Sexually Dimorphic Species for Each Site and Subreach that Freshwater Mussels were collected from the Constantine Hydroelectric Project (FERC NO. 10661) Relicensing Studies: Mussel Survey. Constantine, St. Joseph County, Michigan, 2019.

Site	Scientific Name	Common Name	MI Status ¹	Live	WD	Length (mm)			Sex (No. Live)	
						Min.	Max.	Mean	Female	Male
Site 3, SubReach 1, Below Dam (41.842541, -85.672059) (Cont'd)										
	<i>Venustaconcha ellipsiformis</i>	Ellipse	SC	6		55	65	61		
	Totals			33	0					
	CPUE			6.6						
	No. Species			10	0					
Site 3, SubReach 2, Below Dam (41.842327, -85.671905)										
	<i>Actinonaias ligamentina</i>	Mucket		5		104	147	121		
	<i>Alasmidonta marginata</i>	Elktoe	SC	6		57	75	64.833		
	<i>Cyclonaias pustulosa</i>	Pimpleback		4		51	84	66		
	<i>Eurynia dilatata</i>	Spike		1		82	82	82		
	<i>Fusconaia flava</i>	Wabash Pigtoe		1		80	80	80		
	<i>Lampsilis cardium</i>	Plain Pocketbook		25		47	101	80.04	12	13
	<i>Lasmigona costata</i>	Flutedshell	SC	4		82	137	106.75		
	<i>Strophitus undulatus</i>	Creeper		6		75	94	84.5		
	<i>Utterbackia imbecillis</i>	Paper Pondshell	SC	2		44	50	47		
	<i>Venustaconcha ellipsiformis</i>	Ellipse	SC	21		50	77	62.714		
	Totals			75	0					
	CPUE			15.0						
	No. Species			10	0					
Site 3, SubReach 3, Below Dam (41.842018, -85.671337)										
	<i>Actinonaias ligamentina</i>	Mucket		19		100	141	120		
	<i>Alasmidonta marginata</i>	Elktoe	SC	20		34	82	64.2		
	<i>Cyclonaias pustulosa</i>	Pimpleback		3		63	72	69		
	<i>Eurynia dilatata</i>	Spike		4		75	115	88.75		
	<i>Lampsilis cardium</i>	Plain Pocketbook		8		52	125	86.875	3	5
	<i>Lasmigona costata</i>	Flutedshell	SC	3		80	130	105		
	<i>Strophitus undulatus</i>	Creeper		16		40	93	76.813		
	<i>Utterbackia imbecillis</i>	Paper Pondshell	SC	3		35	54	44		
	<i>Venustaconcha ellipsiformis</i>	Ellipse	SC	40		40	71	59.875		
	Totals			116	0					
	CPUE			23.2						
	No. Species			9	0					

¹ E = Endangered; SC = Special Concern; T = Threatened
CPUE = Catch per Unit Effort (number live per hour)

Table 3. Data Collected from the YSI Above (Sites 1 and 4) and Below (Sites 2 & 3) the Dam for the Constantine Hydroelectric Project for FERC Relicensing. St. Joseph River, St. Joseph County, Michigan, 2019.

Site	Latitude	Longitude	Date	Time (24h)	Temp (°C)	Pressure		DO (mg/L)	Spec.		
						(mmHg)	DO (%)		Conductivity (µS/cm)	pH	Flow
Sites 1 & 4	41.847631	-85.669427	8/21/2019	7:15	24.3	740	79	6.6	0.493	9.38	0.1 ft/s
Sites 1 & 4	41.847631	-85.669427	8/21/2019	16:40	25.2	739.1	112	9.2	0.492	8.65	0.1 ft/s
Site 2	41.844625	-85.668431	8/21/2019	9:03	23.4	741.2	63	5.3	0.530	8.87	0.5 ft/s
Site 3	41.842536	-85.672006	8/21/2019	13:08	24.7	739.4	83	6.9	0.495	8.71	0.5 ft/s

Table 4. Live Mussel Records from within the Vicinity of the Constantine Hydroelectric Project, Constantine, Michigan

Scientific Name	Common Name	EnviroScience (2019)	Cardno (2019)	Wesley & Duffy (1999)	
		This Study Constantine, MI	Dam Head Race Constantine, MI	Upstream Three Rivers, MI	Downstream Mottville, MI
<i>Actinonaias ligamentina</i>	Mucket	X	X		X
<i>Alasmodonta marginata</i>	Elktoe	X	X	X	X
<i>Anodontoides ferussacianus</i>	Cylindric Papershell				X
<i>Cyclonaias pustulosa</i>	Pimpleback	X	X		
<i>Cyclonaias tuberculata</i>	Purple Wartyback		X		X
<i>Eurynia [Elliptio] dilatata</i>	Spike	X	X	X	X
<i>Fusconaia flava</i>	Wabash Pigtoe	X	X	X	X
<i>Lampsilis cardium</i>	Plain Pocketbook	X	X		X
<i>Lampsilis siliquioidea</i>	Fatmucket				
<i>Lasmigona costata</i>	Flutedshell	X	X		X
<i>Pleurobema sintoxia</i>	Round Pigtoe		X		
<i>Pleurobema cordatum</i>	Ohio Pigtoe				X
<i>Pyganodon grandis</i>	Giant Floater			X	
<i>Quadrula quadrula</i>	Mapleleaf	X			
<i>Strophitus undulatus</i>	Creeper	X	X	X	X
<i>Toxolasma parvum</i>	Lilliput	X			
<i>Utterbackia imbecillis</i>	Paper Pondshell	X	X		
<i>Venusta concha ellipsiformis</i>	Ellipse	X		X	X
<i>Villosa iris</i>	Rainbow				X
Total Species		12	11	6	12

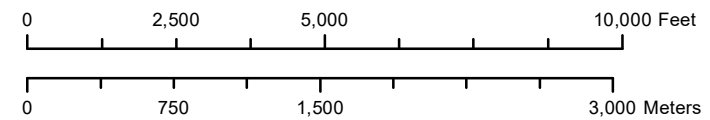
X denotes species observed; Additional information for Constantine was from Cardno (2019), while the data from Three Rivers and Mottville, Michigan was been documented in several reports (Van der Schalie 1930, Horvath et al. 1994, Sherman 1997, and Fisher 1998) and is summarized in Wesley and Duffy (1999). Species nomenclature follow Williams et al. (2017).

Figures



Figure 1. Project Location
Map for the Constantine
Hydroelectric Project (FERC NO. 10661).

 Project Boundary



Date: 4/6/2020 Path: C:\Users\Gregory Hovevan\Desktop\12072_HDR_GISMap2_Topo.mxd

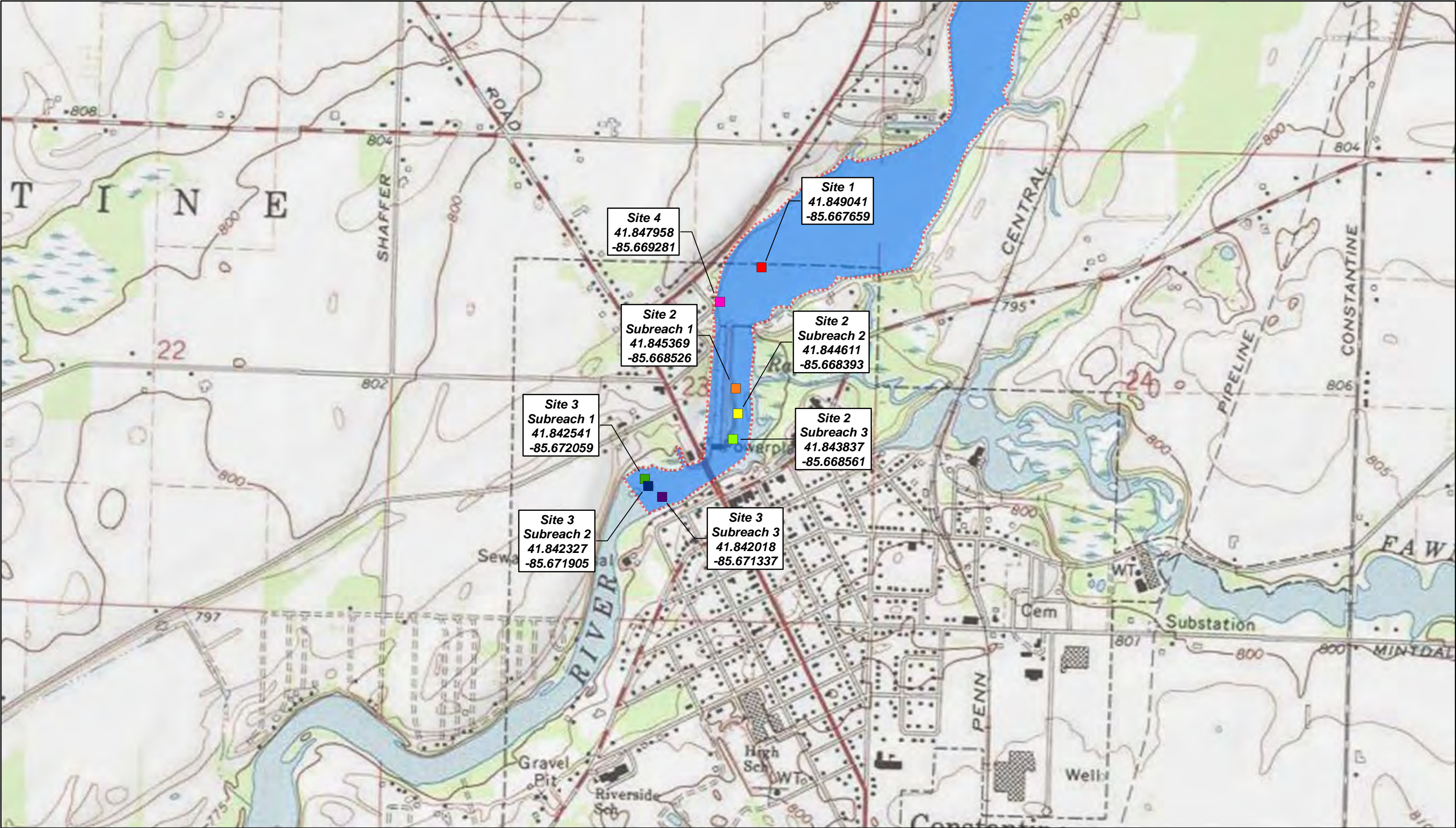
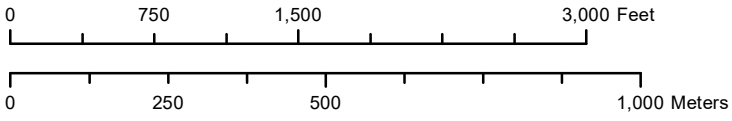


Figure 2. USGS Topographic Map of the Project Area and Site Locations in the St. Joseph River for the Constantine Hydroelectric Project (FERC NO. 10661)
Relicensing Studies: Mussel Survey.
Constantine, St. Joseph County, Michigan, 2019.

- | | | |
|----------------------|----------------------|----------------------|
| ■ Site 1 | ■ Site 2, Subreach 3 | ■ Site 3, Subreach 3 |
| ■ Site 2, Subreach 1 | ■ Site 3, Subreach 1 | ■ Site 4 |
| ■ Site 2, Subreach 2 | ■ Site 3, Subreach 2 | ■ Project Boundary |

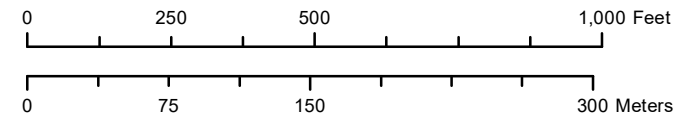


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Date: 4/6/2020



Figure 2. Number of Live Mussels Observed at Each Site and SubReach in the St. Joseph River for the Constantine Hydroelectric Project FERC Relicensing. Constantine, St. Joseph County, MI, 2019.

Survey Area Reach (20m x 50m)
Project Boundary



Appendix A

Agency Correspondence and MDNR Scientific Collecting Permits

PERMIT PROPOSAL:

CONSTANTINE HYDROELECTRIC
PROJECT (FERC NO. 10661)

Relicensing Studies: Mussel Survey

Prepared for:

HDR

1304 Buckley Road, Suite 202
Syracuse, New York 13212-4311

and

**Indiana Michigan Power
Company (I&M)**, a unit of

American Electric Power (AEP)

ES Project No.: 12072
Date: 6/4/2019



Prepared by:



5070 Stow Rd.
Stow, OH 44224
800-940-4025

www.EnviroScienceInc.com

1.0 INTRODUCTION

Indiana Michigan Power Company (I&M), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 1,200-kilowatt (kW) Constantine Hydroelectric Project (Project) (FERC Project No. 10661), located on the St. Joseph River in the Village of Constantine in St. Joseph County, Michigan (41.847265, -85.668484) and is in the process of FERC relicensing. A mussel survey was proposed as part of the Proposed Study Plan (PSP) prepared by AEP and HDR. Subsequently, HDR requested that EnviroScience provide a proposal to complete the mussel survey task. The results of the mussel survey would help to determine the effects of project operation on habitat for the mussels.

2.0 SCOPE OF WORK

MUSSEL SURVEY

Chapter 10 of the Proposed Study Plan outlines the general goals and requirements for the mussel survey. EnviroScience proposes the following methods to assess the mussel assemblage at the Constantine Hydroelectric Project:

- No impacts to the stream will occur, therefore no relocation will be necessary.
- The work will be semi-quantitative in nature following Section V of the Michigan Freshwater Mussel Survey Protocols and Relocation Procedures (Hanshue et al. 2018; the Protocol).
- The field survey will be completed between June 1st and October 15th.
- Methods will utilize a quantitative “timed search survey” as defined by the Protocol to develop species richness curves for each location.
- These surveys will be completed at four locations (two in the reservoir, one in the bypass reach, one downstream of the dam) with suitable habitat for mussels.
 - A minimum of 30 sub-reach searches will be completed at each site. Each sub-reach search will be 10 minutes in length for a total of 5-hrs of search time, per site.
 - Additional time searches will be completed, if required to provide ample data to develop a species richness curve.
- Due to the anticipated depths within many sections of the project area, diving is anticipated. All diving and underwater operations will comply with the AEP Corporate Underwater Diving Policy (12/04/2018 Rev. #2) or the most recent standard.
- Mussels will be processed per the PSP and Section V of the protocol Protocol and carefully returned to the location of their collection.
- Habitat and qualitative flow data will also be collected at each site per the PSP, as well as water quality at the beginning and end of each day.

REPORTING

A mussel survey study report will be completed following the reporting guidelines in the Protocol and provided for HDR to include in their final report or EnviroScience will provide HDR the report language in an MS Word template file with appendices and attachments. The report will include the project elements requested in the PSP as well as representative photos and GIS-based mapping of mussel resources. Data will be submitted to the MDNR as required by the terms of the scientific collector’s permits and Protocol.



GRETCHEN WHITMER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
LANSING



DANIEL EICHINGER
DIRECTOR

Date Issued: 6/12/2019

SCIENTIFIC COLLECTOR'S PERMIT
Mollusk

Under the provisions of Part 487, Act 451, P.A. 1994, as amended, being section 324.48735, permission is hereby granted to:

Name: Philip Thomas Mathias

Driver's License No.: ST472685 OH

Address: EnviroScience, Inc.
5070 Stow Rd
Stow, MI 44224

to take, catch, or kill and possess the aquatic species from the waters and land within the jurisdiction of this state, as specified below in the special provisions section. This permit limits the take of aquatic species to the **minimum** number needed.

Prior to field activities occurring on any stream, public lake or public lands under this permit, the permittee **must notify** the local fish biologist or Fisheries Division supervisor of the Management Unit where collections will occur. This contact must be made at least 48 hours prior to commencing field work and during normal business hours Monday-Friday between 8 a.m. and 5 p.m. If a set work schedule has been established for the field season, providing a copy to the unit may alleviate the need for additional contacts with a single unit. It is also strongly recommended that the permittee notify the District Law Supervisor for the county where the permit is being used. Failure to notify the law supervisor may result in the disruption of field work. Both of these contacts can be initiated by calling the appropriate operational service center (map and phone numbers provided).

Any survey or sampling gear that is authorized by this permit and left on public lands or waters of the state unattended by the permittee must be clearly marked with either the permittee's name or organized affiliation. Failure to properly attach and display ownership, may result in unattended gear being removed by the DNR.

SPECIAL PROVISIONS: Permittees are authorized for general survey purposes to collect, identify, enumerate and release freshwater mussels at the collection area listed below. The permittee is to collect, handle, process and release mussels in accordance with the Michigan Freshwater Mussel Survey Protocol and Relocation Procedures (Hanshue et. al 2018). All activities authorized under this permit are to be non-lethal and the lethal collection or permanent removal of live mussels from the wild is prohibited. Additionally, if the permittee encounters any mussel listed in Michigan as special concern, threatened, or endangered, it is to be immediately released upon identification with as little further handling as possible.

All equipment coming in contact with water including: boat hulls, boat trailers, buckets, waders, nets, etc. must be visually inspected and cleaned by hand picking any attached plants, sediments, or other debris. This should be done immediately upon leaving the water body being worked on.

Due to the high number of mussel species in Michigan listed as state threatened or endangered it is suggested that the permittee preemptively check with the state T&E permit coordinator, Casey Reitz, about whether any additional permitting is necessary or desired for this particular study. Casey can be reached at 517-284-6210 reitzc@michigan.gov

Permitted collection area: In the upstream and downstream vicinity of the Constantine Hydroelectric Project on the St. Joseph River in St. Joseph County within the Lake Michigan Basin.

Permitted collection gear: by hand; scuba;

A copy of all reports and scientific papers using organisms collected with this permit shall be provided to DNR, Fisheries Division in addition to a Collector's Report form.

GENERAL PROVISIONS: This permit must be in permittee's possession during collection and must be made available upon request of any Department representative. Collection is limited to species not threatened or endangered. This permit is not transferable. This permit does not provide any authorization to circumvent any federal, state, or local laws and ordinances, including, but not limited to restricted entrance to refuges or other areas closed to the public without written permission of the land administrator. For a complete list of provisions, see Guidelines for Holders of Cultural or Scientific Collector's Permits.

In addition to this permit, separate DNR Public Land Use permits are required from:

- 1) Parks and Recreation Division for activities in State Parks and Recreation Areas and at the state boat launches;**
- 2) Wildlife Division for activities in State Game Areas; and**
- 3) Forest Resources Division for activities in State Forests**

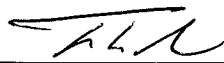
Public Land Use Permit applications can be obtained online at:

http://www.michigan.gov/dnr/0,16077,7-153-30301_31154_35728---,00.html

Permittees are also advised to contact the US Forest Service and National Park Service about any permit requirements for activities occurring in Michigan's National Forests and National Parks, respectively.

Any violation of the conditions of this permit may result in revocation of this permit and misdemeanor penalties of imprisonment for not more than 90 days or a fine of not more than \$500 or all of the above. Unless revoked, this permit **expires on 12/31/2019**.

By



James L. Dexter, Chief
Fisheries Division



cc: Fisheries Division
Southern Lake Michigan Management Unit
Threatened and Endangered Species Unit, Wildlife Division



GRETCHEN WHITMER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
LANSING



DANIEL EICHINGER
DIRECTOR

AMENDMENT TO
SCIENTIFIC COLLECTOR'S PERMIT
Mollusk

Amendment Issued: 6/25/2019
Date Permit Issued: 6/12/2019

Under the provisions of Part 487, Act 451, P.A. 1994, as amended, being section 324.48735, permission is hereby granted to:

Name: Philip Thomas Mathias

Driver's License No.: ST472685 OH

Address: EnviroScience, Inc.
5070 Stow Rd
Stow, OH 44224

to take, catch, or kill and possess the aquatic species from the waters and land within the jurisdiction of this state, as specified below in the special provisions section. This permit limits the take of aquatic species to the **minimum** number needed.

Prior to field activities occurring on any stream, public lake or public lands under this permit, the permittee **must notify** the local fish biologist or Fisheries Division supervisor of the Management Unit where collections will occur. This contact must be made at least 48 hours prior to commencing field work and during normal business hours Monday-Friday between 8 a.m. and 5 p.m. If a set work schedule has been established for the field season, providing a copy to the unit may alleviate the need for additional contacts with a single unit. It is also strongly recommended that the permittee notify the District Law Supervisor for the county where the permit is being used. Failure to notify the law supervisor may result in the disruption of field work. Both of these contacts can be initiated by calling the appropriate operational service center (map and phone numbers provided).

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SPECIAL PROVISIONS: Permittees are authorized for general survey purposes to collect, identify, enumerate and release freshwater mussels at the collection area listed below. The permittee is to collect, handle, process and release mussels in accordance with the Michigan Freshwater Mussel Survey Protocol and Relocation Procedures (Hanshue et. al 2018). All activities authorized under this permit are to be non-lethal and the lethal collection or permanent removal of live mussels from the wild is prohibited. Additionally, if the permittee encounters any mussel listed in Michigan as special concern, threatened, or endangered, it is to be immediately released upon identification with as little further handling as possible.

All equipment coming in contact with water including: boat hulls, boat trailers, buckets, waders, nets, etc. must be visually inspected and cleaned by hand picking any attached plants, sediments, or other debris. This should be done immediately upon leaving the water body being worked on.

Michigan Department of Natural Resources
Fisheries Division
Collector's Permit

Due to the high number of mussel species in Michigan listed as state threatened or endangered it is suggested that the permittee preemptively check with the state T&E permit coordinator, Casey Reitz, about whether any additional permitting is necessary or desired for this particular study. Casey can be reached at 517-284-6210 reitzc@michigan.gov

Permitted collection area: In the upstream and downstream vicinity of the Constantine Hydroelectric Project on the St. Joseph River in St. Joseph County within the Lake Michigan Basin.

Permitted collection gear: by hand; scuba;

A copy of all reports and scientific papers using organisms collected with this permit shall be provided to DNR, Fisheries Division in addition to a Collector's Report form.

GENERAL PROVISIONS: This permit must be in permittee's possession during collection and must be made available upon request of any Department representative. Collection is limited to species not threatened or endangered. This permit is not transferable. This permit does not provide any authorization to circumvent any federal, state, or local laws and ordinances, including, but not limited to restricted entrance to refuges or other areas closed to the public without written permission of the land administrator. For a complete list of provisions, see Guidelines for Holders of Cultural or Scientific Collector's Permits.

In addition to this permit, separate DNR Public Land Use permits are required from:



- 1) Parks and Recreation Division for activities in State Parks and Recreation Areas and at the state boat launches;
- 2) Wildlife Division for activities in State Game Areas; and
- 3) Forest Resources Division for activities in State Forests

Public Land Use Permit applications can be obtained online at:

http://www.michigan.gov/dnr/0,16077,7-153-30301_31154_35728---,00.html

Permittees are also advised to contact the US Forest Service and National Park Service about any permit requirements for activities occurring in Michigan's National Forests and National Parks, respectively.

Any violation of the conditions of this permit may result in revocation of this permit and misdemeanor penalties of imprisonment for not more than 90 days or a fine of not more than \$500 or all of the above. Unless revoked, this permit **expires on 12/31/2019**.

By  
James L. Dexter, Chief
Fisheries Division

cc: Fisheries Division
Southern Lake Michigan Management Unit
Threatened and Endangered Species Unit, Wildlife Division



GRETCHEN WHITMER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
LANSING



DANIEL EICHINGER
DIRECTOR

July 10, 2019

Mr. Phillip Mathias
EnviroScience, Inc.
5070 Stow Rd.
Stow, OH 44224

Dear Mr. Mathias:

This letter is an official attachment to your Threatened and Endangered Species Permit (**TE 182**). Your permit is issued in the *Consultant* category only. Your permit expires on **March 31, 2022**. Renewal information will be sent in December of 2021.

Authorization:

To conduct the scientific activities listed under special conditions on the threatened/endangered species listed below. All activities are subject to the standard permit conditions within this letter.

- This permit authorizes capture, temporary possession and relocation of state listed Threatened or Endangered species of **Mussels** in St. Joseph County.
- Propagation of brood stock and release of mussels to same watersheds is permitted.
- Relocation efforts must comply with the Michigan DNR Standards for Freshwater Mussel Protocol.
- Any salvageable mussel shells may be placed into an appropriate archiving facility at the University of Michigan Museum of Zoology or other appropriate institution.
- Subpermittees: None

Mollusks

- Requires a scientific collector permit from the DNR's Fish Division. Permitted is the collection and temporary holding of mussels. Sampling must be done in a manner that minimizes the amount of time taken from the water and risk to the mussels. The consultant must have written approval from the Fisheries Division Management Unit Supervisor for each project prior to surveying and moving mussels from the project site. The consultant must complete reports for each project within 60 days and submit them to the Fisheries Division Management Unit Supervisor and Scott Hanshue with the DNR's Fisheries Division. The consultant must follow the most recent Michigan Freshwater Mussel Survey Protocols and Relocation Procedures document, including guidelines for monitoring and reporting.

Standard Permit Conditions

- A. All specimens authorized for collection under this Permit shall be deposited in the collection of an approved public educational or research institution prior to Permit expiration.

- B. None of the specimens collected shall become part of a private collection or private property.
- C. This permit does not allow or grant the right of trespass. Projects shall not take place on any private or public lands without permission from the owner or administrator of such lands.
- D. This permit does not provide authorization to circumvent any federal, state, or local laws and ordinances.
- E. Additionally, federal permits may be required for activities affecting federally listed threatened or endangered species and/or migratory birds. Contact the U. S. Fish and Wildlife Service at 2651 Coolidge Road, East Lansing, MI 48823.
- F. The activities covered under this Permit are not transferable to another person unless specifically authorized.
- G. Unless otherwise noted, within 10 days of the expiration of this Permit, the holder is required to file a report detailing the locations of any threatened and endangered species encountered and the number and disposition of specimens handled. Annual reports for multi-year permits are due at the end of each calendar year.
- H. A person conducting any activities authorized by this permit shall carry a copy of this permit and shall produce a copy of this permit upon request of a Department of Natural Resources employee or law enforcement officer.

All permits require and annual report unless indicated otherwise. You can use the enclosed report form and submit forms via email to reitzc@michigan.gov. In addition, please report any new occurrences of threatened and endangered species as soon as possible instead of waiting until the end of the year. This will allow new data to be incorporated into the Michigan Natural Features Inventory database sooner, thus ensuring greater protection for these species and their habitats.

Thank you for helping protect our threatened and endangered species. Feel free to contact me with any questions or concerns.

Sincerely,



Casey M. Reitz, Permit Specialist
DNR-Wildlife Division
Phone: 517-284-6210
Fax: 517-335-6604
reitzc@michigan.gov
www.michigan.gov/wildlifepermits

**APPLICATION FOR A THREATENED/ENDANGERED
SPECIES PERMIT**


By the authority of Part 365, Endangered Species Protection, of the Natural Resource and Environmental Protection Act, Act 451 of 1994, and the rules established thereunder, submittal is required to be considered for a permit.

INSTRUCTIONS: Please type or print all information except the signature and mail with attachments to the Wildlife Division. Federal permits may be required for federally listed or migratory species.

APPLICANT INFORMATION AND PERMIT TYPE

<input checked="" type="checkbox"/> New Permit <input type="checkbox"/> Renewal Permit		If Renewal, Permit Number: _____	
<input checked="" type="checkbox"/> Consultant (provide credentials)	<input type="checkbox"/> Education or Scientific	<input type="checkbox"/> Development	<input type="checkbox"/> Live Animal Programs/Salvage
Name of Applicant (Last, First, Middle) Mathias, Philip, Thomas		Applicant's Title (If applicable) Malacologist	
Name of Organization EnviroScience, Inc.		Subpermittee	
Address 5070 Stow Rd			
City, State, ZIP Code Stow, OH 44224			
Telephone 330-688-0111		E-Mail Address pmathias@enviroscienceinc.com	

SPECIES INFORMATION

Species (Scientific or common names) T&E mussels. See attached species list.	
Location (Be specific. Include Michigan county(ies)) St. Joseph County: above and below the dam located here: 41.847265, -85.668484	
Time period requested (Usually one calendar year) 06/01/2019 to 10/15/2019	
Number of plants and/or animals to be handled, collected, relocated, etc. As encountered as this is a preliminary survey	
Name and location of public institution where authorized specimens will be placed Mussels will be returned to their point of collection.	
Purpose of project and justification for study, collection, or relocating species (Attach applicable proposals or plans) Indiana Michigan Power Company (I&M), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 1,200-kilowatt (kW) Constantine Hydroelectric Project (Project) (FERC Project No. 10661), located on the St. Joseph River in the Village of Constantine in St. Joseph County, Michigan and is in the process of FERC relicensing. A mussel survey was proposed as part of the Proposed Study Plan (PSP) prepared by AEP and HDR. The results of the mussel survey would help to determine the effects of project operation on habitat for the mussels.	
Proposed methods to mitigate impacts of projects (Attached applicable proposals or plans) Methods will follow "Hanshue, S., J. Rathbun, P. Badra, J. Bettaso, B. Hosler, J. Pruden, and J. Grabarkiewicz. 2018. Michigan Freshwater Mussel Survey Protocols and Relocation Procedures." Further methods are described in the attached survey proposal.	
Signature of Applicant 	Date 06/04/2019

Mail completed application and attachments to:

Wildlife Division
Department of Natural Resources
PO Box 30444
Lansing, MI 48909-7944

Permit #: TE 182
Issued: 7/10/19
Expired: 3/31/22



**THREATENED / ENDANGERED SPECIES REPORT**

This information is required by the authority of Part 365, Endangered Species Protection, of the Natural Resources and Environmental Protection Act, Act 451 of 1994, and the Rules established thereunder.

REQUIREMENTS: As a holder of a Threatened/Endangered Species Permit, you are required to complete this report **even** if you did not collect, observe, or relocate any listed species. Failure to report may result in loss of permit renewal. Where applicable, copies of complete specimen labels or reports may be substituted in lieu of completing this form if you provide information on the form that is not included on the label or in the report.

INSTRUCTIONS: Complete one form for each site and for each species at a site. Mail all report information to the Michigan DNR, Wildlife Division, (address on Page 2), **within 10 days of the permit expiration date or by December 31**, for each year of a multi-year permit.

PERMITTEE INFORMATION

Permittee's Name (Last, First, Middle)	Name of Organization or Business (if applicable)	
Address	Permit Number	
City, State, ZIP	Telephone ()	Email

SPECIES INFORMATION

☐ I did not collect, observe, or relocate any threatened or endangered species during the period covered by my permit. (Sign and date page 2.)

☐ I collected, observed, or relocated the species listed below.

Species: (Scientific and common names)

OBSERVATION DATE	LOCATION (Legal description or UTM coordinates)			
	County	Town	Range	Section 1/4

Detailed Directions to Site: Include directions from nearest town or road. Draw or attach a map indicating the exact location of the observation, collection, and/or relocation site (photocopies of USGS topographic maps preferred).

POPULATION DATA

Number of Individuals:	Observed	Collected	Captured/Relocated
Phenology (plants):	Percent Flowering	Percent Fruiting	Apparent Vigor
Animal Population Age Structure:	Number of Adults	Number of Juveniles	
Evidence of Reproduction:			

RELOCATION DATA (IF APPLICABLE)

Survival of Relocated Specimens:	Number Relocated	Number Surviving	Percent Surviving
----------------------------------	------------------	------------------	-------------------

HABITAT DATA

Extent of Habitat:	<input type="checkbox"/> Acres <input type="checkbox"/> Sq. Meters	Percent Occupied by Species
No. of Acres, Sq., Meters, etc.		
Associated Species: (List 6 plant species in order of dominance, beginning with overstory if present.)		
Microhabitat Description: (soils, topography, etc.)		

CONSERVATION DATA

OVERALL SITE QUALITY:	<input type="checkbox"/> Excellent	<input type="checkbox"/> Good	<input type="checkbox"/> Fair	<input type="checkbox"/> Poor
Threats or Need for Protection: (Immediate? Long Term?)				
Other Information Needs: (Survey, Monitoring, etc.)				
Institution Where Specimens Were Deposited: (If collected or salvaged)			Voucher/Collection Number:	
Comments, Additional Information and Recommendations: (Attach sheets, reports, or photographs as appropriate)				

Permittee's Signature

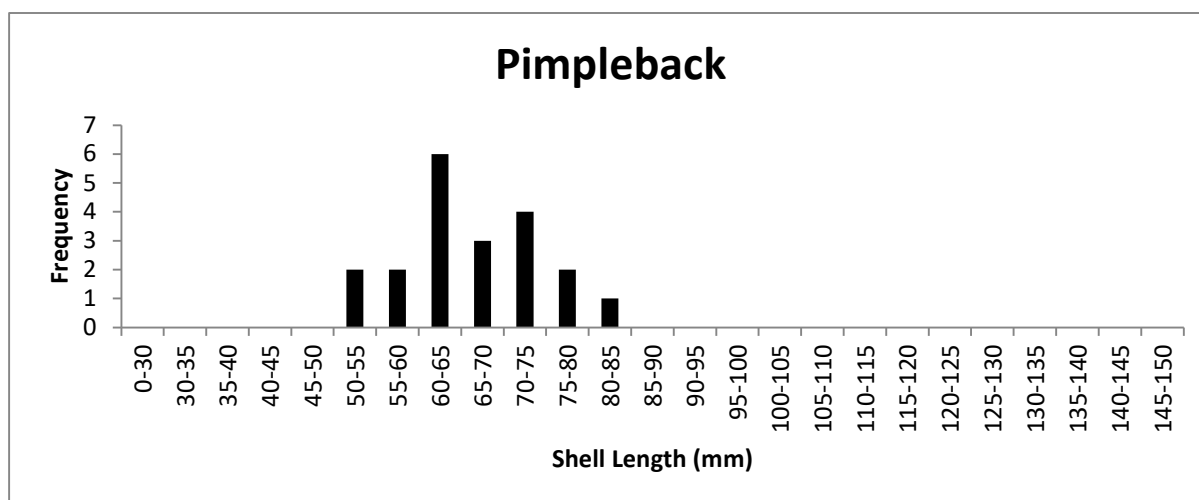
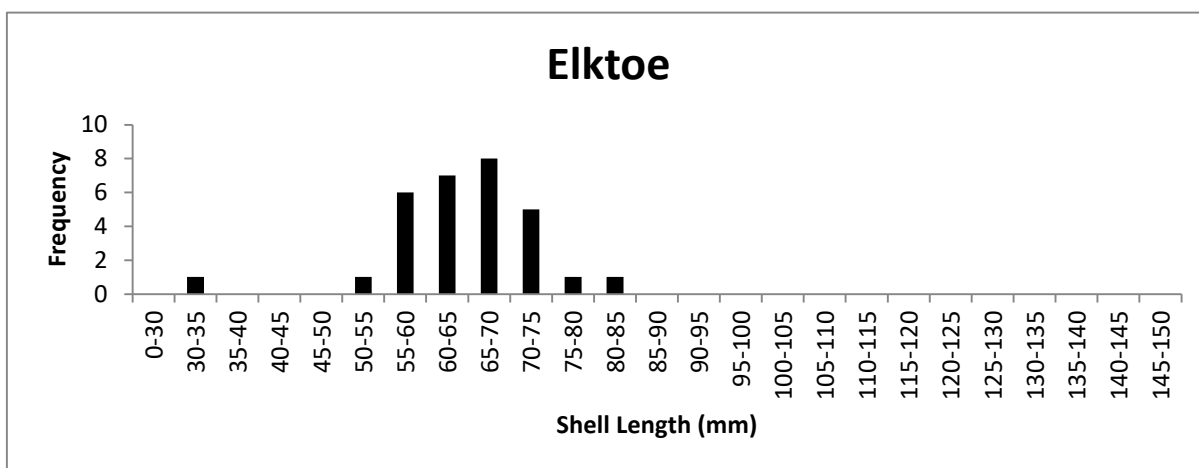
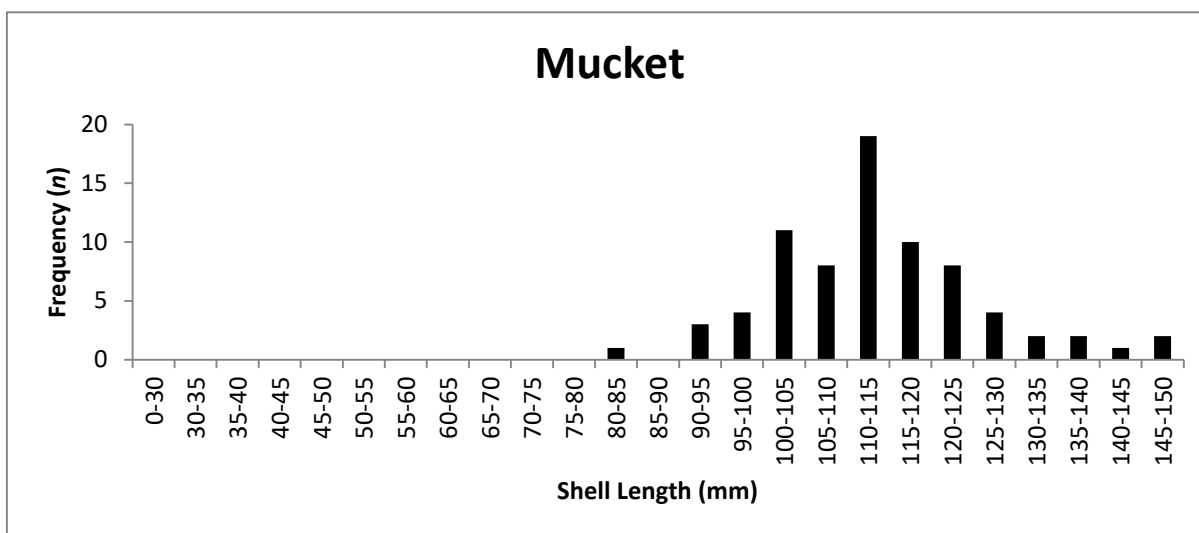
Date

Mail completed application with attachments to :**WILDLIFE DIVISION – PERMIT SPECIALSIT
MICHIGAN DEPARTMENT OF NATURAL RESOURCES
PO BOX 30444, LANSING MI 48909-7944
FAX: 517-335-6604 or reitzc@michigan.gov**

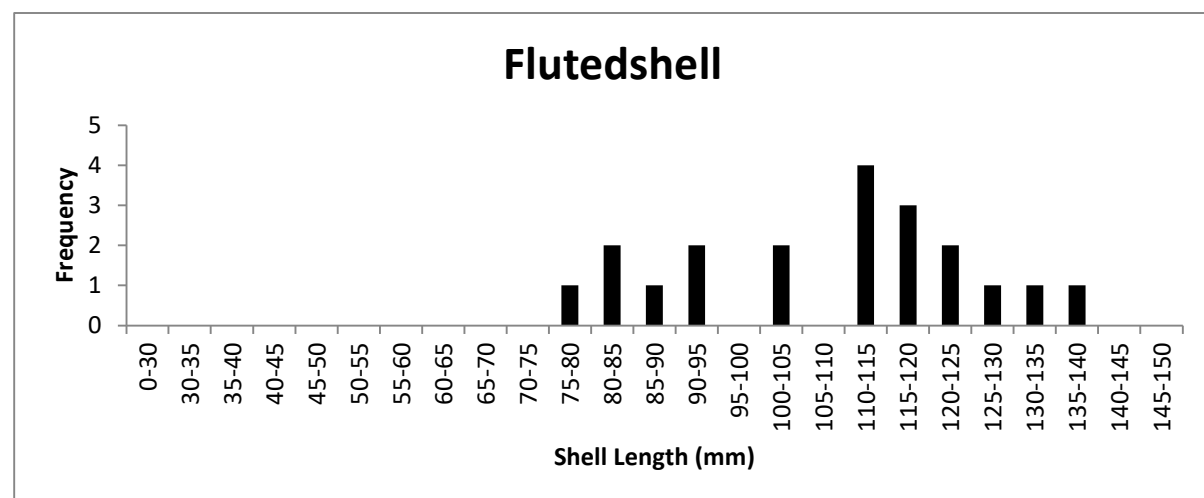
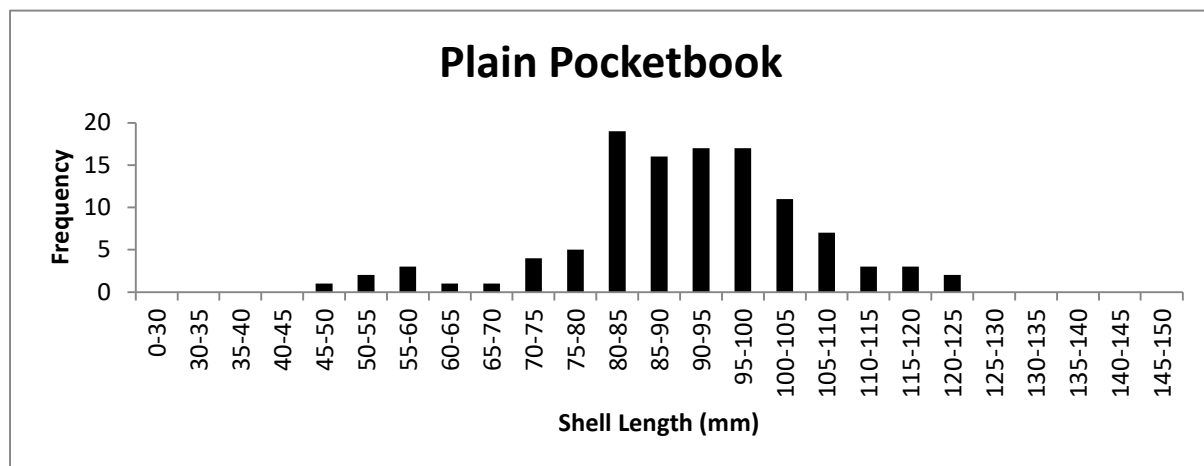
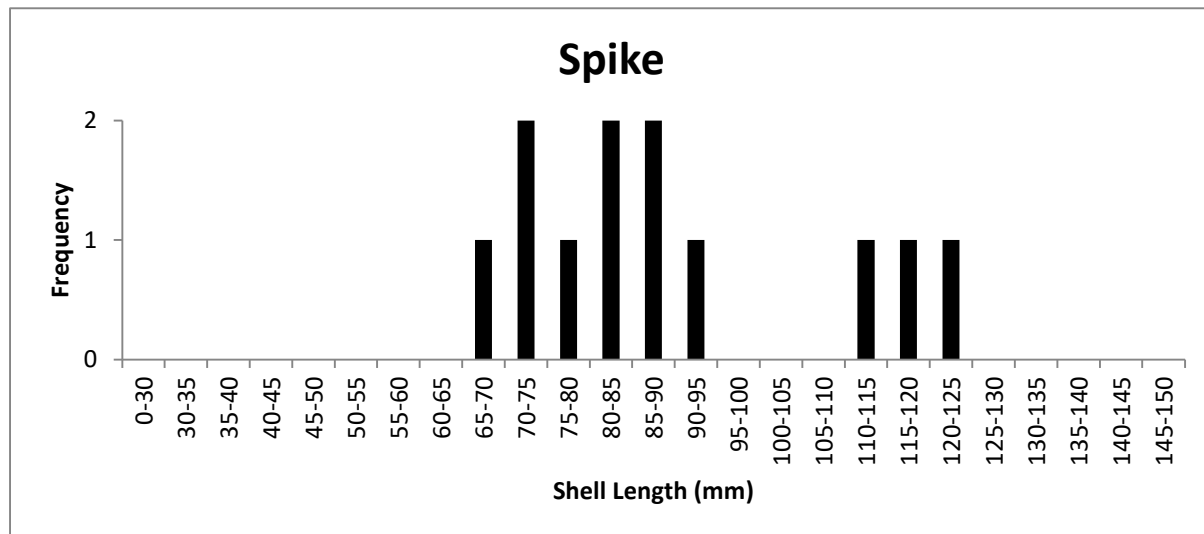
Appendix B

Shell Length Histograms

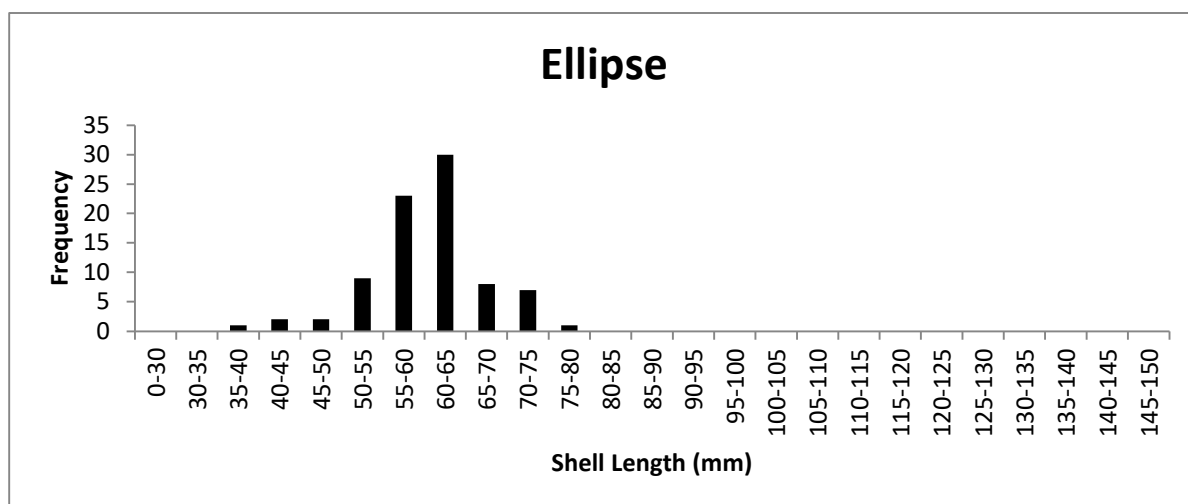
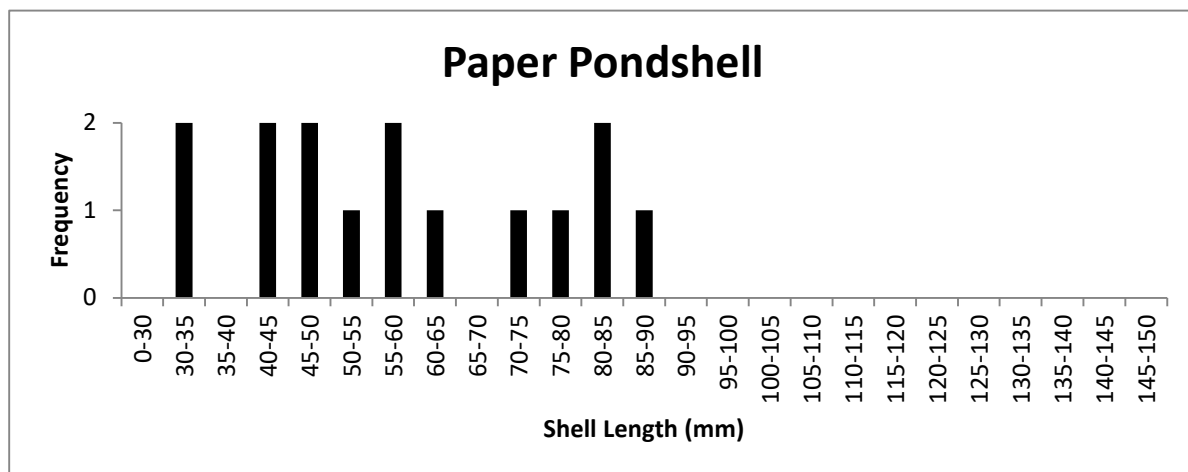
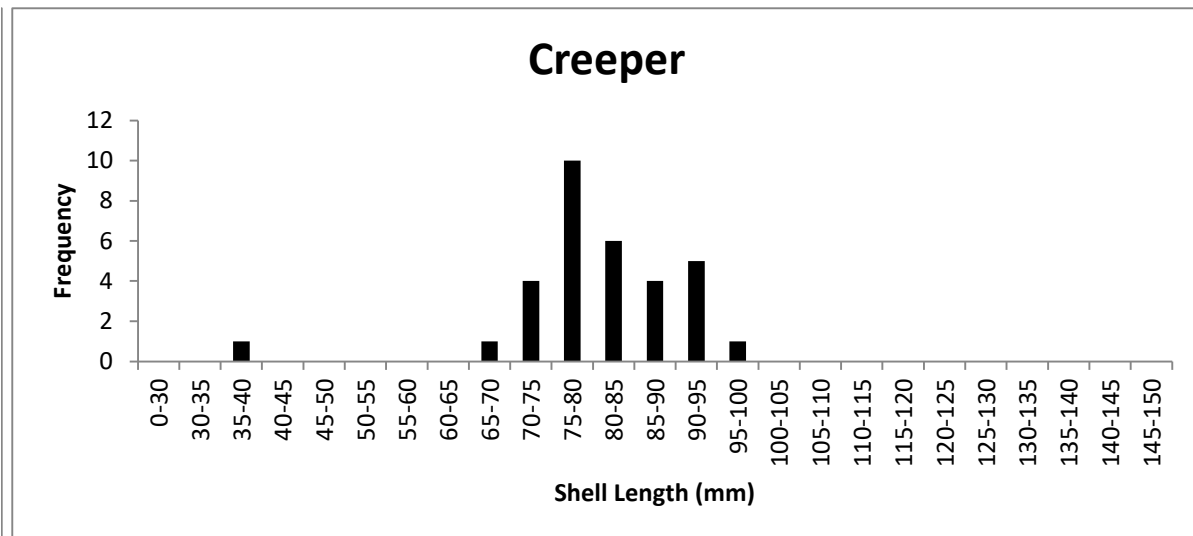
Appendix B. Length Frequency Histograms of Live Mussels ($n=3$) Collected from the Constantine Hydroelectric Project (FERC NO. 10661) Relicensing Studies: Mussel Survey. Constantine, St. Joseph County, Michigan, 2019.



Appendix B. Length Frequency Histograms of Live Mussels ($n=3$) Collected from the Constantine Hydroelectric Project (FERC NO. 10661) Relicensing Studies: Mussel Survey. Constantine, St. Joseph County, Michigan, 2019.



Appendix B. Length Frequency Histograms of Live Mussels ($n \geq 3$) Collected from the Constantine Hydroelectric Project (FERC NO. 10661) Relicensing Studies: Mussel Survey. Constantine, St. Joseph County, Michigan, 2019.



Appendix C

Digital Image Log

Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 1 and 2. Mucket (*Actinonaias ligamentina*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 3 and 4. Elktoe (*Alasmodonta marginata*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 5 and 6. Pimpleback (*Cyclonaias [Quadrula] pustulosa*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 7 and 8. Purple Wartyback (*Cyclonaias tuberculata*); right valve (top), umbo (bottom)



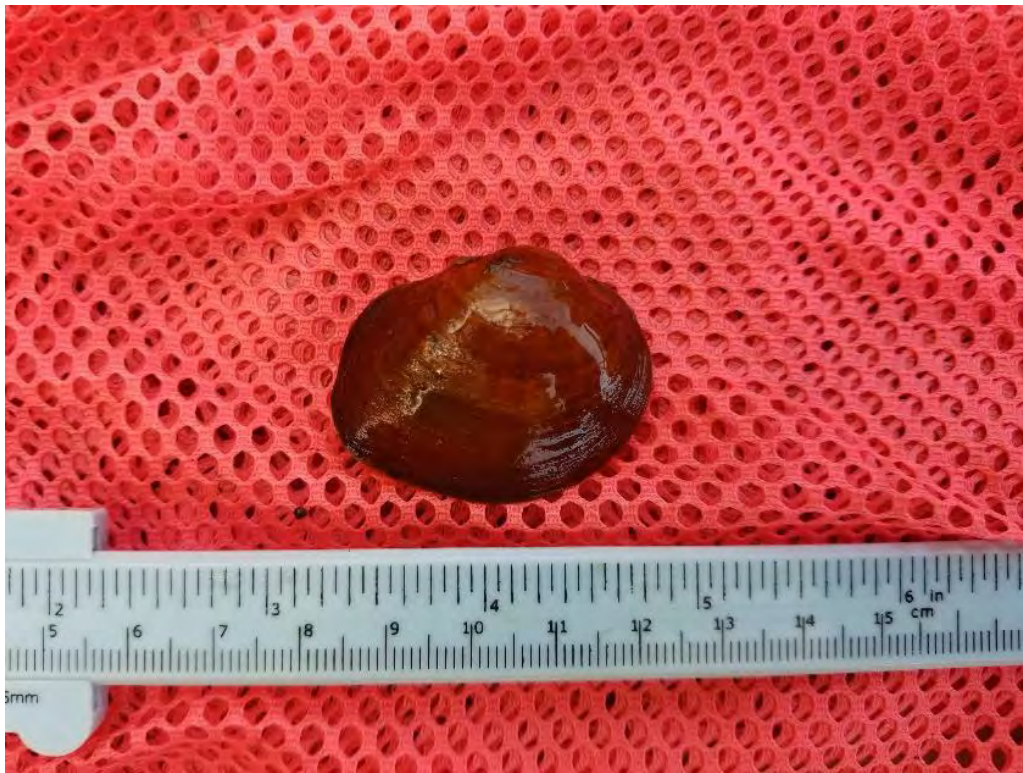
Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 9 and 10. Spike (*Eurynia dilatata*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 11 and 12. Wabash Pigtoe (*Fusconaia flava*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 13 and 14. Plain Pocketbook Female (*Lampsilis cardium*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 15 and 16. Plain Pocketbook Male (*Lampsilis cardium*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 17 and 18. Fatmucket (*Lampsilis siliquoidea*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 19 and 20. Flutedshell (*Lasmigona costata*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 21 and 22. Round Pigtoe (*Pleurobema sintoxia*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 23 and 24. Giant Floater (*Pyganodon grandis*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 25 and 26. Mapleleaf (*Quadrula quadrula*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 27 and 28. Creeper (*Strophitus undulatus*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 29 and 30. Lilliput (*Toxolasma parvum*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 31 and 32. Paper Pondshell (*Utterbackia imbecillis*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Images 33 and 34. Ellipse (*Venustaconcha ellipsiformis*); right valve (top), umbo (bottom)



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Image 35. Site 1, Sub-reach 1 Looking Downstream



Digital Image 36. Site 1, Sub-reach 1 Looking Upstream



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019

Digital Image 37. Site 4, Sub-reach 1 Looking Downstream



Digital Image 38. Site 4, Sub-reach 1 Looking Upstream



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019
Digital Image 39. Substrate near Site 1.



Digital Image 40. Upstream Portion of Site 2 Looking Upstream



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019
Digital Image 41. Upstream Portion of Site 2 Looking Downstream



Digital Image 42. Upstream Portion Site 2, Substrate



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019
Digital Image 43. Downstream Site 2, Looking Downstream



Digital Image 44. Downstream Site 2. Looking Upstream



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019
Digital Image 45. Downstream Portion of Site 2, Substrate



Digital Image 46. Upstream Portion of Site 3, Looking Downstream



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019
Digital Image 47. Upstream Portion Site 3, Looking Upstream



Digital Image 48. Downstream Portion of Site 3, Looking Downstream



Freshwater Mussel Survey for the Constantine Hydroelectric Project (FERC No. 10661)
HDR, Inc. and American Electric Power
Photographed August 21, 2019
Digital Image 49. Portion of Site 3, Looking Upstream



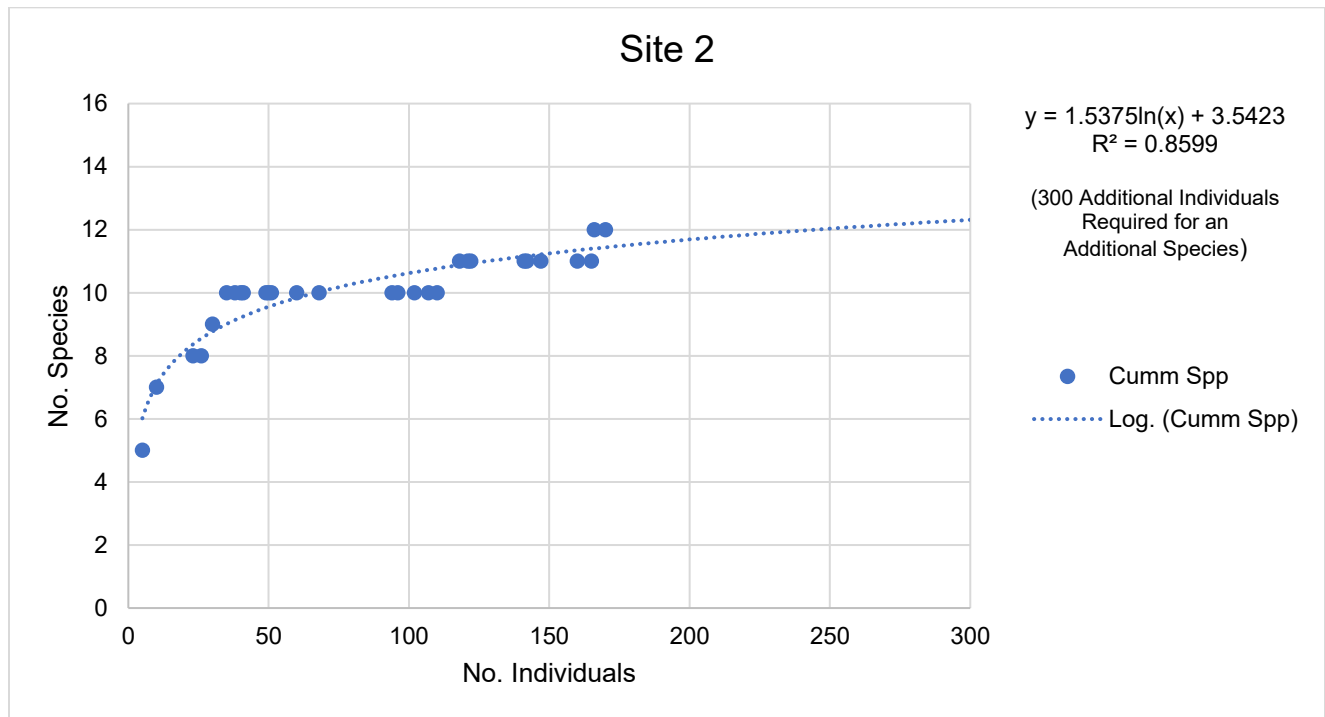
Digital Image 50. Site 3, Substrate



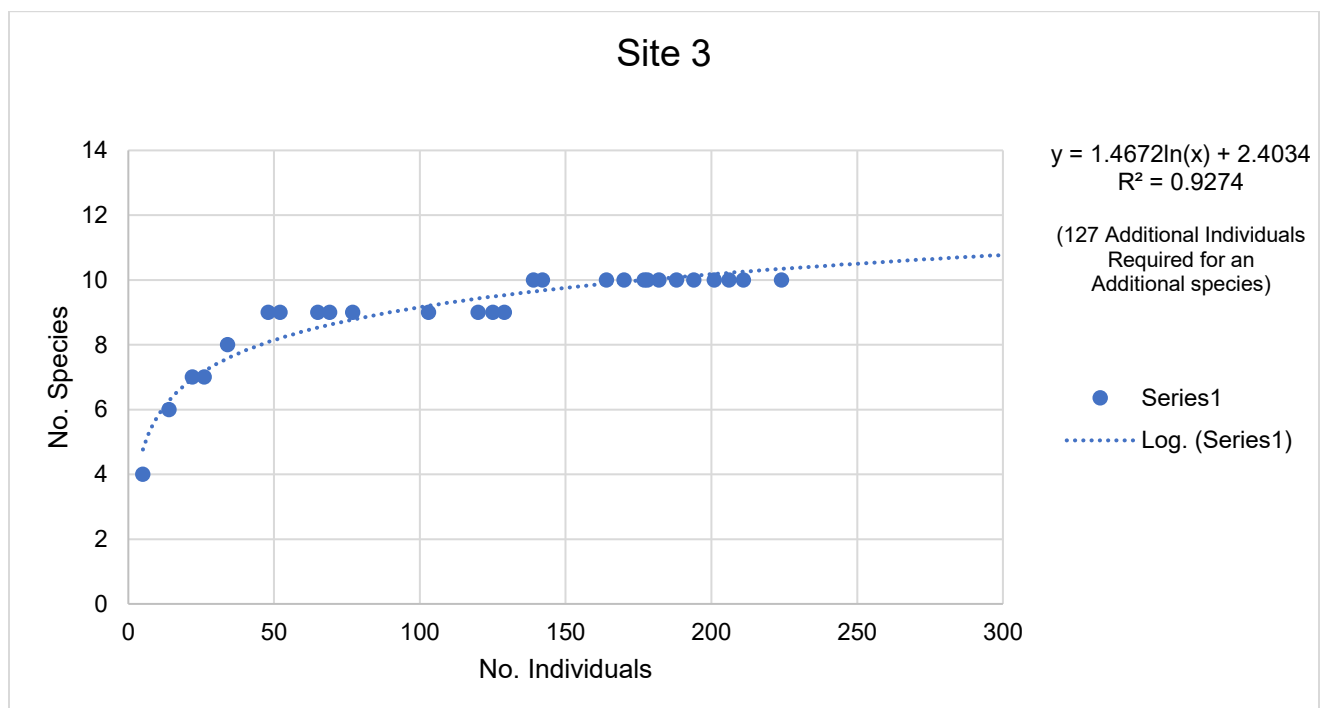
Appendix D

Species Richness Curves

Species richness curve within Site 2 of the Project area, St. Joseph River, Michigan, 2019.



Species richness curve within Site 3 of the Project area, St. Joseph River, Michigan, 2019.



Appendix G. Wetlands Study

Wetlands Study Report

Constantine Project (FERC No. 10661)
March 31, 2020

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1. Project Introduction and Background

Indiana Michigan Power Company (I&M), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 1.2-megawatt Constantine Hydroelectric Project (Project) (FERC Project No. 10661). The Project located along the St. Joseph River in the Village of Constantine in St. Joseph County, Michigan.

I&M operates and maintains the Project under a license from the Federal Energy Regulatory Commission (FERC or Commission). The Project's existing license expires on September 30, 2023. I&M is pursuing a subsequent license for the Project using the Commission's Integrated Licensing Process (ILP) as defined in 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR § 5.15, I&M has conducted studies as provided in the March 15, 2019 Revised Study Plan (RSP) and schedule approved in the Commission's April 9, 2019 Study Plan Determination (SPD) for the Project. This report describes the methods and results of the Wetlands Study conducted in support of preparing an application for a subsequent license for the Project.

The State of Michigan administers Section 404 of the federal Clean Water Act regulating wetlands in most areas of the State through the Michigan Department of Environment, Great Lakes and Energy (EGLE). The U.S. Army Corps of Engineers (USACE) retains jurisdiction over traditionally navigable waters including the Great Lakes and connecting channels and wetlands directly adjacent to these waters. Wetlands are generally defined as those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions. The United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) classification system (Cowardin 1979) defines wetlands as:

...lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominately hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some point during the growing season of the year.

Existing relevant and reasonably available information pertinent to the scope of the RSP including wetlands and riparian habitat in the Project area was included in the Pre-Application Document (PAD) (I&M 2018) in Section 5.6 Wetlands, Littoral, and Riparian Habitat. Sub-section 5.6.3 Wetland, Riparian Zone, and Littoral Maps, provides a map of wetlands within the Project boundary and a summary table of acreage by USFWS NWI category within the Project boundary. The Project wetland Geographic Information System (GIS) map features were used to calculate total wetland acreage for each wetland feature within the Project boundary. Total wetland acreage within the Project boundary was calculated as 35.8 acres across six NWI categories that fall under the system/class categories palustrine emergent, palustrine forested, and palustrine scrub-shrub wetland habitats (Cowardin 1979). The majority of the

Project wetland area (20.8 acres) is classified as: PF01Ch Palustrine, Forested, Broad Leaved Deciduous, Seasonally Flooded, and Diked/Impounded. The Project wetland map included in the PAD was developed through GIS editing (clipping) of the USFWS NWI wetlands polygon layer against the Constantine Project boundary polygon.

Section 5.6 of the PAD also includes background information on wetland and riparian vegetation. The Project area is in the Beach-Maple Association of the Eastern Deciduous Forest Province (Bailey 1978). Dominant vegetation in the Project area is a mixed hardwood community consisting of oak, ash, beach, hickory, maple, cottonwood, and aspen. Willow species dominate the plant community in the scrub-shrub areas and maple, sycamore, and cottonwood dominate the forested wetlands. Other species of the palustrine forested areas include ash, sumac, walnut, and oaks. Plant species of the aquatic bed community include American white waterlily (*Nymphaea odorata*), Eurasian watermilfoil (*Myriophyllum spicatum*), and crispy pondweed (*Potamogeton crispus*). Green arrow arum (*Peltandra virginica*) is a dominant species in the emergent wetland class. Cattails are a minor component of the wetland plant community in the Constantine reservoir (FERC 1993a).

2. Study Goals and Objectives

In accordance with I&M's RSP and the Commission SPD for the Project, the general goal of the Wetlands Study was to conduct a field survey of wetland and riparian areas within the Project boundary to characterize habitats, vegetation and verify/update existing wetlands map data. The specific goals and objectives of this study were as follows:

- Use NWI and Michigan Department of Environmental Quality (MDEQ) Wetland Maps to identify, display, and describe the current composition of wetland communities within and adjacent to the study area.
- Use the NWI and MDEQ Wetland Maps to develop a GIS database on the extent, classification, and plant community structure of wetland habitats within and adjacent to the study area.
- Confirm NWI wetland classifications of previously documented wetlands based on field observations and assess any necessary map change recommendations.
- Via the GIS data, estimate the total acres of wetlands and cover type habitats that currently exist within the study area.
- Provide the necessary baseline data to support determination of potential Project effects.

Applied methods and variances from the RSP study methods are described in the following sections, along with survey data and discussion of study results.

3. Study Area

The study area for the Wetlands Study is the FERC Project boundary as detailed on the map provided in Appendix C of the PAD. The ArcGIS shapefile P-10661 Project Boundary Data 05-13-2016 (see Figure 1) was used to guide field investigations, conduct GIS analyses, and create map figures for this report.

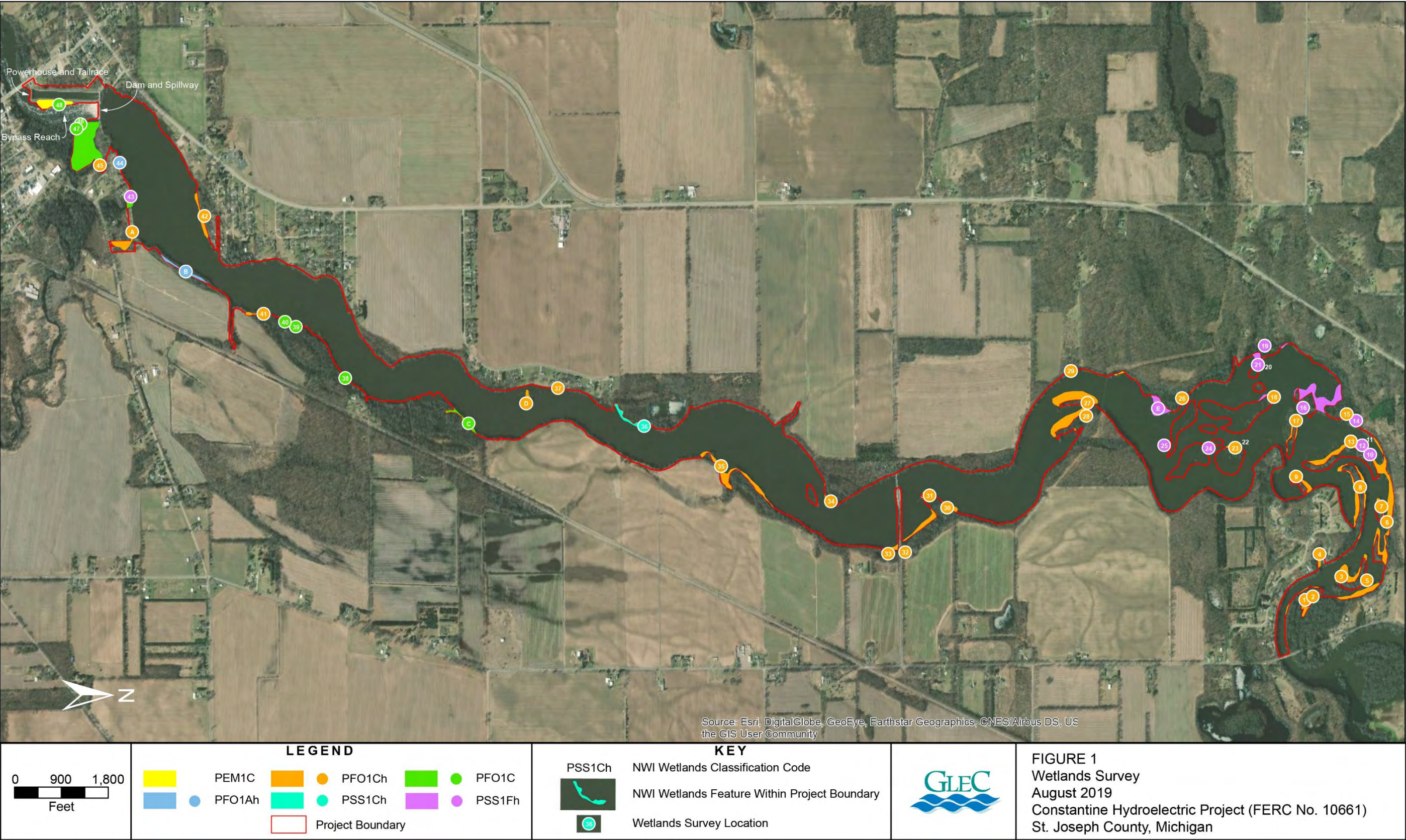


Figure 1. Wetland Survey Map

4. Methodology

The Wetlands Study was conducted pursuant to the approved March 15, 2019 RSP with some modifications. A field survey of wetlands and riparian vegetation was conducted by a certified wetlands biologist on August 14, 15, and 16, 2019. The survey involved verifying and noting any changes to the characteristics and extent of the NWI wetland features within the Project boundary. Field data included habitat descriptions at 48 positions throughout the length of the Project area. Pursuant to the RSP, formal wetland delineations were not conducted. Wetland delineations, according to the 1987 USACE Wetland Delineation Manual, involve collecting soil core samples, identifying and formally mapping wetland vegetation, and documenting hydrologic characteristics. There were only slight variations in observed wetland feature classifications and extents compared to the Project NWI wetlands map. Consistent with the RSP, field measurements (i.e., delineations) to quantify changes to the NWI wetland feature areas were not conducted; changes to NWI map features are noted in the Summary and Discussion and Field Survey Notes sections below. After the field survey, numbered field survey positions and accompanying note attributes were converted into map point features (Figure 1). Survey notes describing wetland and riparian vegetation characteristics are provided in Section 7. Field survey notes with corresponding station numbers are displayed on Figure 1.

Operated as run-of-river, this Project will have little effect on reservoir levels that would, if varied, potentially impact wetlands associated with the Project. The study methods proposed by I&M and outlined below are used commonly during FERC relicensing studies and provided adequate information to assess potential impacts to wetlands related to Project operations.

4.1.Desktop Mapping/Distribution of Wetland and Riparian Vegetation

The RSP called for the development of a GIS base map of wetland cover types in the Project study area using the best available data from state and/or federal agencies (i.e., USFWS, MDEQ). For the Project area, it was determined that the best available map data was the USFWS NWI digital wetland map polygons, available for download as undated ESRI shapefile polygons from the USFWS NWI website. The State of Michigan offers the same NWI wetland layer for download through its GIS Open Data website. The Project study area wetland map was developed through GIS editing (clipping) of the USFWS NWI wetlands polygon layer against the Constantine Project boundary polygon. The resulting shapefile *wetn_mi_20170808_NWI_Wetlands_Clip* – heretofore referred to as “Project NWI Wetlands Map” - was utilized to describe wetland area by classification, guide the wetlands and riparian vegetation field survey, and provide a base reference layer for Figure 1. The Project wetland GIS map features were used to calculate total wetland acreage for each wetland feature within the Project boundary and summarized in the PAD in Table 5.6-1 National Wetlands Inventory Classification System and Estimated Acreage. Total wetland acreage within the Project boundary was calculated as 35.8 acres across six NWI categories that fall under the system/class categories palustrine emergent, palustrine forested, and palustrine scrub-shrub wetland habitats (Cowardin 1979). The majority of the Project wetland area (20.8

acres) is classified as: PF01Ch Palustrine, Forested, Broad Leaved Deciduous, Seasonally Flooded, and Diked/Impounded.

Table 1. National Wetlands Inventory Classification System and Estimated Acreage (PAD Table 5.6-1).

Wetland Code	System	Class	Subclass	Regime	Qualifier	Estimated Acres
PEM1C	Palustrine	Emergent	Persistent	Seasonally Flooded	None	1.4
PFO1Ah	Palustrine	Forested	Broad-Leaved Deciduous	Temporary Flooded	Diked/ Impounded	0.5
PFO1C	Palustrine	Forested	Broad-Leaved Deciduous	Seasonally Flooded	Diked/ Impounded	7.6
PFO1Ch	Palustrine	Forested	Broad-Leaved Deciduous	Seasonally Flooded	Diked/ Impounded	20.8
PSS1Ch	Palustrine	Scrub-Shrub	Broad-Leaved Deciduous	Seasonally Flooded	Diked/ Impounded	0.8
PSS1Fh	Palustrine	Scrub-Shrub	Broad-Leaved Deciduous	Semi permanently Flooded	Diked/ Impounded	4.7

4.2. Field Survey Verification of Wetland Maps

On August 14, 15, and 16, 2019, two contractor field biologists surveyed the wetland complexes in the Constantine reservoir, bypass reach and tailrace areas within the Project boundary. The purpose of the survey was to verify the wetland map features in the Project NWI wetland map described in Section 4.1. The survey was conducted by boat and walking near shore areas over the length of the Project.

Observations were recorded at 48 stations generally adjacent to or overlying the NWI wetlands features within the Project boundary. Observations of wetland habitats near the Project boundary were recorded at 8 stations (14,24,25,37,38,39,40), not immediately adjacent to or overlying NWI map clipped features and are provided in Figure 1 and the Field Survey Notes section to support overall study findings. The Wetlands Study was coincidental with the Botanical Resources Study, and field survey notes (Section 7) describe the vegetative cover, species composition, and wetland classifications which imply successional stage - including degree of inundation (e.g., seasonally flooded, permanently flooded) for each station, based upon information obtained from this study as well as the annual Constantine Invasive Species Survey conducted by GLEC for I&M (GLEC 2019 Invasive Species Survey). Any changes in wetland type or characteristics to the existing NWI classification were noted when relevant. Coordinate positions were recorded with a Global Positioning System (GPS) device at 40 of the 48 stations and marked on a large-scale field map for the remaining 8 stations. As prescribed by the RSP, delineations/field measurements were not conducted to verify the size or extent of the wetland features. The field notes appear in Section 7 Field Survey Notes.

4.3. Field Survey Data Analysis and Mapping

The field notes and coordinate data from the August survey were reviewed and edited by the field biologist and GIS analyst. A total of 48 ESRI ArcGIS point features were created from GPS coordinates and field map markings that include the confirmed or modified wetland classification attribute (stations

1 through 48). Six of the survey stations had duplicate paired coordinates for essentially duplicate observations as the survey meandered through the northern end of the reservoir (stations 11 and 12; 20 and 21; 22 and 23). Notes for these duplicate locations can serve as an ad hoc quality check as they confirm the same observed wetland classification for each pair. As part of post-survey processing, an additional five observation points were created using ArcGIS aerial imagery base map (stations A through E) to correspond with overlaid NWI polygons that had not been formally field-verified. Wetland classifications were applied to these additional five stations through image analysis and verification by field biologists. The 53 observation survey points were then labeled with numbers and overlaid on an aerial image base map and the existing Project NWI wetlands layer. The NWI wetlands polygons and survey point map layers were color coded with the same classification color theme to visually identify where wetland classifications were confirmed or where updates were made (Figure 1).

5. Study Results

5.1. Wetlands Coverage and Description

The wetlands mapping and field survey exercises determined that the wetland coverages described by the Project NWI wetland map and summarized by classification and acreage in Table 1 generally fit the same description with a few exceptions. The most notable modification was the reclassification of the island between the tailrace and bypass reach from PEM1C Freshwater Emergent Wetland to PFO1C Forested Shrub Wetland, likely an example where a field investigation (i.e., ground-truthing) provided more accurate information than interpreting an image (i.e., remote sensing). This difference is further explained in the survey notes for station 48 and is visually evident in Figure 1. The observed change to the classification of the island at station 48 is the most significant change to the existing NWI wetlands (within the Project boundary) from the survey findings. Allowing for the change to the island classification, the category PEM1C would be removed and the summary of wetlands acreage by classification provided in Table 1 would change to the following in Table 2:

Table 2. National Wetlands Inventory Classification System and Estimated Acreage from August 2019 Survey.

Wetland Code	System	Class	Subclass	Regime	Qualifier	Estimated Acres
PFO1Ah	Palustrine	Forested	Broad-Leaved Deciduous	Temporary Flooded	Diked/ Impounded	0.5
PFO1C	Palustrine	Forested	Broad-Leaved Deciduous	Seasonally Flooded	Diked/ Impounded	9.0
PFO1Ch	Palustrine	Forested	Broad-Leaved Deciduous	Seasonally Flooded	Diked/ Impounded	20.8
PSS1Ch	Palustrine	Scrub-Shrub	Broad-Leaved Deciduous	Seasonally Flooded	Diked/ Impounded	0.8
PSS1Fh	Palustrine	Scrub-Shrub	Broad-Leaved Deciduous	Semi permanently Flooded	Diked/ Impounded	4.7

The wetlands survey did produce some other observed changes to the Project NWI wetlands map coverage data. There are no estimates of changes to acreage by classification types since field measurements (i.e., delineations) were not conducted. It can be stated that the observed changes – other than the island mentioned above – were relatively minor and do not significantly affect the mix of wetland types or introduce new wetland types not already described within the Project boundary. Table 3 provides a summary where station observations differed from the Project NWI wetlands map classification for the station area. Notes for each station are provided in Section 7 Field Survey Notes.

Table 3. Survey Stations with Different Classification versus Underlying NWI Map Data.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
10	PSS1Fh	PFO1Ch
11	PSS1Fh	PFO1Ch
12	PSS1Fh	PFO1Ch
18	PFO1Ch	PSS1Fh
43	PSS1Fh	PFO1Ch
45	PFO1Ch	PFO1C
48	PFO1C	PEM1C

6. Summary and Discussion

Wetlands are generally defined as those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions. The Constantine Project area is in the Beach-Maple Association of the Eastern Deciduous Forest Province (Bailey 1978). Dominant vegetation in the Project area is a mixed hardwood community consisting of oak, ash, beach, hickory, maple, cottonwood, and aspen. Plant species of the aquatic wetland community include American white waterlily, Eurasian watermilfoil, and crispy pondweed. Arrow arum is a dominant species in the emergent wetland class. Cattails are a minor component of the wetland plant community in the Constantine reservoir.

The classification of wetlands and the acreages observed in this study vary very little from the results from previous assessments described in the PAD. The most notable change documented was the reclassification of the island between the tailrace and bypass reach from PEM1C Freshwater Emergent Wetland to PFO1C Forested Shrub Wetland. This change was made due to the ground-truthing and identification of a discrepancy in the NWI wetland map.

Total wetland acreage strictly within the Project boundary was estimated to remain at approximately 35.8 acres across five NWI categories that fall under the system/class categories palustrine forested and palustrine scrub-shrub wetland habitats. The majority of the Project wetland area (20.8 acres) is classified as: PFO1Ch Palustrine, Forested, Broad Leaved Deciduous, Seasonally Flooded, and Diked/Impounded. These observations are consistent with the information presented in the PAD.

Modifications to existing NWI wetlands map classifications were attributable to invasive species competition; purple loosestrife (*Lythrum salicaria*) overwhelming the scrub-shrub communities in the modified zones. Modifications are described in Section 7 Field Survey Notes for each station. As noted in the RSP and PAD, the Constantine Project is operated as run-of-river and has little effect on reservoir levels that could potentially impact wetlands within the Project boundary.

6.1. Variances from FERC-Approved Study Plan

Actual wetlands survey and study methods applied some interpretations of and minor variances from the method details outlined in Section 11 Wetlands Study of the March 15, 2019 RSP. Section 11 subsections variously describe wetlands of concern and the study area as “wetlands within or adjacent to the Project boundary”, “wetlands in the Project boundary”, and “wetland cover types in the Project study area”. The survey and mapping tasks prescribed in the RSP were followed to address wetlands within the official permit Project boundary, since only areas within the Project boundary are relevant to Project operations and licensing requirements. Wetland areas adjacent to (i.e., outside) the Project boundary were referenced in some areas to support and verify observations, but were not re-classified or studied to update wetland features relating to the Project. The Task 1 Desktop Mapping approach in the RSP suggests source data could include soil maps and maps from NWI and MDEQ. As mentioned in Section 4.1 above, it was determined that the best source data for wetlands in the study area was the USFWS NWI wetlands map already used in the PAD to produce the Project NWI Wetlands map layer.

Soil maps were not used in the wetlands survey or post-survey mapping exercises. Field notes and the Summary and Discussion section above discuss soil regimes in the study area. However, there is no doubt that the soils are hydric and either somewhat “dried” due to low river conditions, or wet depending on the size of the wetland adjacent to the Project boundary or juxtaposition of the riverine habitat.

Task 2 Field Verification of Wetland Maps in the RSP prescribes that any map change recommendations include species composition, successional stage, and extent of shoreline. Where changes to Project NWI wetland features were recommended, field measurements were not taken to verify extent of shoreline where the feature was re-classified.

7. Field Survey Notes

The following section provides the field survey notes recorded at each observation station by the field biologists who conducted the wetlands survey on August 14, 15, and 16, 2019. Each station is labeled on Figure 1 for reference. The station notes describe vegetative cover supporting the classification noted as “Observed Wetlands Class” in the station note header. The “Project NWI Wetlands Map Class” in each note header is the wetland classification of the adjacent or underlying wetland feature in the Project NWI wetland map, also exhibited in Figure 1 for visual comparison. Explanations are provided in each note where the observed wetlands classifications did not agree with the NWI map data or did not correspond to a nearby NWI map feature.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
1	PFO1Ch	PFO1Ch

Overstory of silver maple (*Acer saccharinum*), catalpa, and willow. Ground cover lizard's tail (*Saururus cernuus*), purple loosestrife, pond lily, and buttonbush (*Cephalanthus occidentalis*). Currently inundated 10yR2/1; muck soil.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
2	PFO1Ch	PFO1Ch

Overstory of silver maple, lizard's tail, and pond lily. Currently inundated 10yR2/1; muck soil.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
3	PFO1Ch	PFO1Ch

Overstory of elm, hickory, and silver maple. Ground cover lizard's tail purple loosestrife, Joe-pye weed (*Eutrochium maculatum*), and buttonbush.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
4	PFO1Ch	PFO1Ch

Overstory of willow tree. Understory of small willow, arrowhead, purple loosestrife, goldenrod (*Solidago rugosa*), Joe-pye weed, and buttonbush.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
5	PFO1Ch	PFO1Ch

Overstory of silver maple. Understory of willow, smartweed (*Persicaria amphibia*), button bush, and lizard's tail.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
6	PFO1Ch	PFO1Ch

Overstory of silver maple. Understory of arrowhead and lizard's tail.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
7	PFO1Ch	PFO1Ch

Overstory of willow and silver maple. Understory of lizard's tail, gray dogwood (*Cornus foemina*), purple loosestrife, elm, green ash (*Fraxinus pennsylvanica*), and cardinal flower (*Lobelia cardinalis*).

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
8	PFO1Ch	PFO1Ch

Overstory of silver maple, green ash, and willow. Understory of arrowhead, Joe-pye weed, purple loosestrife, false nettle (*Bohmeria cylindrica*), buttonbush, elm, vervain (*Verbena urticifolia*), and skullcap.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
9	PFO1Ch	PFO1Ch

Overstory of silver maple and elm. Understory of lizard's tail, cardinal flower, arrowhead, black ash (*Fraxinus nigra*) false nettle, small elm, American corn mint (*Mentha canadensis*), smartweed and buttonbush.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
10	PSS1Fh	PFO1Ch

Stations 10- 12 concern three islands closely grouped at the north end of the Project. Observations were taken from the boat only since heavy muck prohibited safe foot travel. This complex of islands exhibited some of the adjacent NWI polygon classification PFO1Ch along the eastern edges with silver maple overstory, but the majority of the island habitats appeared to be more representative of PSS1Fh with arrowhead, lily along the edge, smartweed, lizard's tail, buttonbush, pussy willow (*Salix discolor*), and purple loosestrife. It was evident that emergent purple loosestrife is outcompeting the scrub-shrub community.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
11	PSS1Fh	PFO1Ch

Stations 10- 12 concern three islands closely grouped at the north end of the Project. Observations were taken from the boat only since heavy muck prohibited safe foot travel. This complex of islands exhibited some of the adjacent NWI polygon classification PFO1Ch along the eastern edges with silver maple overstory, but the majority of the island habitats appeared to be more representative of PSS1Fh with arrowhead, lily along the edge, smartweed, lizard's tail, buttonbush, pussy willow, and purple loosestrife. It was evident that emergent purple loosestrife is outcompeting the scrub-shrub community. Station 11 is a duplicate observation location to station 12 (same GPS coordinates).

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
12	PSS1Fh	PFO1Ch

Stations 10- 12 concern three islands closely grouped at the north end of the Project. Observations were taken from the boat only since heavy muck prohibited safe foot travel. This complex of islands exhibited some of the adjacent NWI classification PFO1Ch along the eastern edges with silver maple overstory, but the most of the island areas appeared to be predominantly representative of PSS1Fh with arrowhead, lily along the edges, smartweed, lizard's tail, buttonbush, pussy willow, and purple loosestrife. It was evident that emergent purple loosestrife is outcompeting the scrub-shrub community. Station 12 is a duplicate observation location to station 11 (same GPS coordinates).

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
13	PFO1Ch	PFO1Ch

Overstory of silver maple. Understory of gray dogwood, buttonbush, multiflora rose, arrowhead, lizard's tail, and purple loosestrife on the margins.

Station	Observed Wetlands Class	Project NWI Wetlands Map Class
14	PSS1Fh	NA

Cattail, gray dogwood, curly dock (*Rumex crispus*), swamp loosestrife (*Decodon verticillatus*), buttonbush, cutgrass (*Leersia oryzoides*), elm <4" DBH, and purple loosestrife. Still scrub-shrub. Note: this station position is slightly outside the Project boundary and there is no NWI feature next to this station in either the Project NWI map or surrounding area NWI map, but the observation and classification is consistent with other stations in the general area.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
15	PFO1Ch	NA

Overstory of chinquapin oak (*Quercus muehlenbergii*), swamp white oak (*Quercus bicolor*), silver maple, hickory, and green ash. Understory of small green ash, false nettle, cutgrass, gray dogwood, arrowhead, and buttonbush. Note: this station position is slightly outside the Project boundary and there is no NWI feature next to this station in the Project NWI map, but the station is adjacent to a surrounding area NWI wetland map feature classified PFO1Ch, to the observation is consistent with existing NWI data.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
16	PSS1Fh	PSS1Fh

Overstory of mature silver maple along the eastern edge of the island. Understory of dense purple loosestrife, buttonbush, and pussy willow.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
17	PFO1Ch	PFO1Ch

Overstory of silver maple. Understory of purple loosestrife, arrowhead, cardinal flower, grape, gray dogwood, multiflora rose, cattail, common loosestrife, and buttonbush. Half forested/half emergent.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
18	PFO1Ch	PSS1Fh

The Project NWI map polygon underlying station 18 is classified as PSS1Fh. The field biologist determined that this area was more indicative of wetland classification PFO1Ch: Palustrine, Forested, Broad-leaved Deciduous, Seasonally Flooded, Impounded wetland. The vegetative cover description is given as overstory of silver maple and willow. Understory of buttonbush, green ash, arrowhead, purple loosestrife, swamp milkweed (*Asclepias incarnata*), and common cattail (*Typha latifolia*).

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
19	PSS1Fh	PSS1Fh

Wetland area dominated by purple loosestrife with native arrowhead, lizard's tail, buttonbush, and willow being suppressed.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
20	PSS1Fh	PSS1Fh

Overstory of silver maple and willow. Understory of common cattail, arrowhead, gray dogwood, buttonbush, small maple, and small willow being out competed by purple loosestrife. Visited twice - duplicate station position to station 21 (same GPS coordinates).

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
21	PSS1Fh	PSS1Fh

Majority is purple loosestrife outcompeting smartweed (*Persicaria amphibia*), arrowhead, buttonbush, small silver maple, and gray dogwood. Visited twice - duplicate station position to station 20 (same GPS coordinates).

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
22	PFO1Ch	PFO1Ch

Small island. Overstory of silver maple, willow, and elm. Understory of small willow bush, buttonbush, curly dock, arrowhead, American corn mint, and multiflora rose. Purple loosestrife is outcompeting the scrub-shrub component of the wetlands on the east side. Visited twice - duplicate station position to station 23 (same GPS coordinates).

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
23	PFO1Ch	PFO1Ch

Small acreage <1 acre. Overstory of willow and silver maple, surrounded by purple loosestrife, with some cattail, arrowhead, and lily. Purple loosestrife is outcompeting native vegetation. Visited twice - duplicate station position to station 22 (same GPS coordinates).

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
24	PSS1Fh	PSS1Fh

Channel Islands. Purple loosestrife, arrowhead, small willow, smartweed, and swamp loosestrife. Purple loosestrife is outcompeting the scrub-shrub plant community. This station is not immediately adjacent to a Project NWI map feature but is consistent with the underlying wetland feature classification in the general NWI wetland map.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
25	PSS1Fh	PSS1Fh

Channel Islands. Purple loosestrife, arrowhead, small willow, smartweed, and swamp loosestrife. Purple loosestrife is outcompeting the scrub-shrub plant community. This station is not immediately adjacent to a Project NWI map feature but is consistent with the underlying wetland feature classification in the general NWI wetland map.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
26	PFO1Ch	PFO1Ch

Overstory of swamp white oak, basswood, red maple (*Acer rubrum*), small elm. Understory of buttonbush, lizard's tail, small black ash, cutgrass, skunk cabbage (*Symplocarpus foetidus*), and sensitive fern (*Onoclea sensibilis*).

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
27	PFO1Ch	PFO1Ch

Overstory of silver maple, hickory, black oak (*Quercus velutina*) on fringe, and willow, up to 22" DBH. Understory of gray dogwood, cutgrass, buttonbush, and arrowhead.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
28	PFO1Ch	PFO1Ch

Overstory of silver maple, black oak, willow, white oak on the fringe. Small amount of narrowleaf cattail (*Typha angustifolia*). Buttonbush, arrowhead, false nettle, lizard's tail, cutgrass, and small narrowleaf cattail.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
29	PFO1Ch	PFO1Ch

(No field note descriptions for this station)

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
30	PFO1Ch	PFO1Ch

Overstory of silver maple and elm. Understory of cutgrass, arrowhead, elderberry, smartweed, water willow, buttonbush, and false nettle.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
31	PFO1Ch	PFO1Ch

Overstory of silver maple and willow. Understory of arrowhead, purple loosestrife, cutgrass, cardinal flower, and buttonbush.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
32	PFO1Ch	PFO1Ch

Overstory of silver maple, elm, willow, and sycamore. Understory of cottonwood, smartweed, jewelweed (*Impatiens capensis*), red osier dogwood (*Cornus sericea*), buttonbush, gray dogwood, wild tomato (*Solanum habrochaites*), and purple loosestrife.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
33	PFO1Ch	PFO1Ch

(No field note descriptions for this station)

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
34	PFO1Ch	PFO1Ch

Overstory of silver maple, white oak, basswood, and hickory. Understory of black ash, box elder (*Acer negundo*), cardinal flower, false nettle, buttonbush, gray dogwood, cutgrass, arrowhead, lizard's tail, and purple loosestrife.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
35	PFO1Ch	PFO1Ch

Overstory of silver maple and willow. Understory of gray dogwood, buttonbush, swamp loosestrife, arrowhead, lizard's tail, and purple loosestrife.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
36	PFO1C	PFO1C

Scrub-shrub, willow, buttonbush, ash, swamp loosestrife, arrowhead, pickerelweed (*Pontederia cordata*), common cattail, bindweed, peachleaf willow (*Salix amygdaloides*).

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
37	PFO1Ch	NA

Station 37 is a shoreline observation point not adjacent to a Project NWI map or general NWI map feature, but is consistent with the nearest Project NWI map island feature just south of this location.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
38	PFO1C	NA

Overstory of willow, elm, red cedar, and basswood. Understory of buttonbush, lizard's tail, arrowhead, cardinal flower, and cutgrass.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
39	PFO1C	NA

Overstory of silver maple, swamp white oak, and sycamore. Under-story of buttonbush, spicebush (*Lindera benzoin*), false nettle, stag horn fern, arrowhead, and lizard's tail. Station 39 is on the same shoreline about 200 meters north of the nearest Project NWI wetland feature and adjacent to a general NWI wetland feature classified as PFO1Ch, so in this respect does not agree with the NWI map data.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
40	PFO1C	NA

Overstory of swamp white oak and silver maple. Understory of buttonbush, spicebush, cutgrass, water parsnip (*Sium suave*), lizard's tail, and arrowhead. Station 39 is on the same shoreline about 130 meters north of the nearest Project NWI wetland feature and adjacent to a general NWI wetland feature classified as PFO1Ch, so in this respect does not agree with the NWI map data.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
41	PFO1Ch	PFO1Ch

Overstory of chinquapin oak, silver maple, and elm. Understory of buttonbush, sensitive fern, arrowhead, gray dogwood, lizard's tail, and spicebush.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
42	PFO1Ch	PFO1Ch

Overstory of silver maple. Understory of buttonbush, lizard's tail, cardinal flower, and cutgrass.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
43	PSS1Fh	PFO1Ch

A portion of station 43 is not forested due to power line maintenance and residential construction. The field biologist determined that this recent activity combined with general observations makes this area more indicative of a PSS1Fh classification versus the NWI map data PFO1Ch classification. Fringed loosestrife (*Lysimachia ciliata*), purple loosestrife, lizard's tail, buttonbush, and narrowleaf cattail. Vegetative cover at the site was characterized as fringed loosestrife, purple loosestrife, lizard's tail, buttonbush, and narrowleaf cattail, which supports a reclassification to PSS1Fh within the observed area.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
44	PFO1Ah	NA

Overstory of silver maple, mulberry, and American elm (*Ulmus americana*). Understory of lizard's tail, arrowhead, and pickerelweed. Station 44 is not on or adjacent to a Project NWI or general NWI map feature.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
45	PFO1Ch	PFO1C

Station 45 is described as a very narrow strip of muck soil inundated by water. This classification is not consistent with the adjacent significant map feature in both the Project NWI and general NWI maps and nearby stations 46 and 47 classified as PFO1C, suggesting that this is a small distinct area.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
46	PFO1C	PFO1C

Overstory of silver maple, soft maple (*Acer saccharinum*), water willow, and chinquapin oak. Understory of elm saplings, green ash saplings, spicebush, cutgrass, and false nettle.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
47	PFO1C	PFO1C

Downstream from the dam on the junction of Fawn River and St. Joseph River. Overstory of silver maple, chinquapin oak, and elm. Understory of spicebush, green ash saplings, gray dogwood, false nettle, and purple loosestrife.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
48	PFO1C	PEM1C

This is the island in the St. Joseph River downstream of the dam in the tailrace just east of the power canal. The field biologist determined that this feature should be classified as PFO1C (Forested Shrub Wetland) instead of the NWI PEM1C (Freshwater Emergent Wetland) – classification. This change is the most significant modification to the base NWI data from the wetlands survey, eliminating the PEM1C category from the Project NWI wetlands map inventory and adding 1.4 acres to the PFO1C category in the overall wetlands acreage summary table (Table 2). The site was unapproachable to land the boat due to low water and too deep to wade, but was easily observed from the boat. Vegetative cover is described as: overstory of silver maple and cottonwood. Understory of gray dogwood, water willow, arrowhead, and purple loosestrife observed from east shore.

In order to remain consistent with the study approach, an additional five observation check stations (A through E) were created after the field survey in ArcMap by referencing aerial imagery and wetland features in the Project NWI wetlands map that had not been formally field verified. Both field biologists who conducted the wetlands and botanical resources survey confirmed through memory and imagery interpretation that all five added check stations match the underlying NWI classifications.

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
A	PFO1Ch	PFO1Ch

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
B	PFO1Ah	PFO1Ah

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
C	PFO1C	PFO1C

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
D	PFO1Ch	PFO1Ch

Station	Observed Wetlands Classification	Project NWI Wetlands Map Class
E	PSS1Fh	PSS1Fh

8. References

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- Indiana Michigan Power Company (I&M). 2018. Constantine Hydroelectric Project (FERC No. 10661). Notice of Intent and Pre-Application Document. Federal Energy Regulatory Commission, Washington, D.C. June 4, 2018.
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Appendix H. Recreation Study

Indiana Michigan Power Company

Constantine Hydroelectric Project (P-10661)

Recreation Study



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BACKGROUND

Indiana Michigan Power Company (I&M), a unit of American Electric Power (AEP), is the Licensee, owner and operator of the run-of-river Constantine Hydroelectric Project (FERC No. 10661) (Project or Constantine Project) located on the St. Joseph River at Constantine, Michigan. The current license for the Project was issued by the Federal Energy Regulatory Commission (FERC or Commission) with an effective date of October 1, 1993. The license term of the Project is thirty years and the expiration date for the license is September 30, 2023. Accordingly, I&M is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

I&M filed the Notice of Intent (NOI) and Pre-Application Document (PAD) with the Commission on June 4, 2018 to initiate the ILP. The PAD provides a description of the Project and summarizes the existing, relevant, and reasonably available information to assist the Commission, resource agencies, Indian Tribes, non-governmental organizations (NGOs), and other stakeholders in identifying issues, determining information needs, and preparing study requests. In the PAD, I&M stated its intention to conduct a study to assess recreational opportunities and potential improvements at the Project.

The National Environmental Policy Act of 1969 (NEPA), the Commission's regulations, and other applicable statutes require the Commission to independently evaluate the environmental effects of issuing a subsequent license for the Project and to consider reasonable alternatives to relicensing. At this time, the Commission has expressed its intent to prepare an Environmental Assessment (EA) that describes and evaluates the site-specific and cumulative potential effects (if any) of issuing a subsequent license, as well as potential alternatives to relicensing. The EA is supported by a scoping process to identify issues, concerns, and opportunities for resource enhancements associated with the proposed action. Accordingly, the Commission issued Scoping Document 1 (SD1) for the Project on July 25, 2018. SD1 was intended to advise resource agencies, Indian Tribes, NGOs, and other stakeholders as to the proposed scope of the EA and to seek additional information pertinent to the Commission's analysis. One of the resources the FERC determined should be analyzed was the existing public access, recreational facilities, and their ability to meet current and future recreation needs for the Project.

SD1 was followed by Scoping Meetings held August 28 and 29, 2018 in Constantine, Michigan. During these meetings, FERC staff presented information regarding the ILP and details regarding the study scoping process and how to request a relicensing study, including the Commission's study criteria. In addition, FERC staff solicited comments regarding the scope of issues and analyses for the EA. Pursuant to 8 CFR §5.8(d), a public site visit of the Project was

conducted on August 28, 2018. Resource agencies, Indian Tribes, and other interested parties were afforded a 60-day period to request studies and provide comments on the PAD and SD1. The comment period was initiated with the Commission's July 25, 2018 notice and concluded on October 2, 2018.

FERC issued Scoping Document 2 (SD2) on November 13, 2018 to provide information on the proposed action and alternatives, the environmental analysis process FERC staff will follow to prepare the EA, and a revised list of issues to be addressed in the EA. In SD2, FERC again identified the need to assess recreation resources at the Project.

In accordance with 18 CFR §5.11, I&M developed a Proposed Study Plan (PSP) for the Project that was filed with the Commission and made available to stakeholders on November 16, 2018. The purpose of the PSP was to present the studies and study methods proposed by I&M and to address the comments and study requests submitted by resource agencies and other stakeholders. In the PSP, I&M proposed to conduct a Recreation Study to collect information regarding current recreation use levels and the condition of the existing formal and informal recreation facilities in the Project area.

Pursuant to 18 CFR §5.11(e), I&M held a PSP Meeting on December 11, 2018, for the purpose of clarifying the PSP, explaining any initial information gathering needs, and addressing any outstanding issues associated with the PSP. The meeting was held in Lansing, Michigan, and attended by representatives from FERC, the U.S. Fish and Wildlife Service, Michigan Department of Natural Resources, Michigan Department of Environmental Quality, and Young Energy Services (YES). During the PSP Meeting, I&M presented the basis for the studies as described in the PSP.

Resource agencies and stakeholders were afforded 90 days from the date of the PSP filing (i.e., until February 14, 2018) to provide comments on the PSP or to request additional studies. In developing the Revised Study Plan (RSP) for the Project, I&M carefully evaluated and considered agency and stakeholder comments and study requests filed in response to the PAD, SD1, SD2, PSP and discussed during the PSP Meeting. In accordance with 18 CFR § 5.13, I&M filed the RSP with the Commission on March 15, 2019. On April 9, 2019, the Commission issued a Study Plan Determination for the Project. The SPD approved I&M's proposed Recreation Study without modification.

This Recreation Study has been prepared under the requirements of the April 9, 2019 Study Plan Determination by YES, the subcontractor to perform the work.

1.0 STUDY AREA

The study area includes the Project boundary and recreational facilities adjacent to the Project boundary. The Project boundary, as shown on the Exhibit G drawings that are a part of the Project's existing license, extends upstream from just below the faces of the Project powerhouse and spillway located in the Village of Constantine, Michigan off N. Washington Road to Constantine Road in Lockport Township essentially following the limits of the Project reservoir at normal pool elevation 789.2 ft. NGVD. At the normal pool elevation, the reservoir for the Project has a surface area of 608 acres and the associated shoreline encompasses approximately 12 miles. For those recreation facilities provided and maintained by I&M under the requirements of the existing Project license, the Project boundary was extended under Order Approving Revised Exhibit G Drawing issued September 21, 1999 by FERC to include those areas.

Several recreational facilities for the Project have been provided by the Licensee in accordance with Articles 411 and 412 of the existing license as well as Order Approving Recreational Facilities issued July 25, 1995 and Order Approving Building Removal Plan Including Tailwater Fishing Facility issued April 5, 1995. The facilities provided by I&M and identified as Project recreation sites provide the public free access to the Project reservoir as well as to the St. Joseph River below the Project's powerhouse and spillway. Those facilities include: (1) a boat launch on the Project reservoir; (2) a reservoir fishing access site; (3) a tailwater fishing access platform; and (4) a canoe portage around the east abutment of the Project spillway. Exhibits R-1 through R-3 of the Project license (see Appendix E) present as-built drawings of the Project Recreation Facilities. Each of the described facilities is located within the Project boundary and is operated and maintained by I&M.

In addition to the recreational facilities provided by I&M, there are community parks outside of the Project boundary identified as Non-Project recreation sites that provide access to the St. Joseph River below the Project spillway. The community parks that are provided, maintained, and operated by the Village of Constantine (Village) are identified as Shelby Park and Riverview Park. Both are located along the east side of the St. Joseph within the Village and provide public access to the river at no cost.

The American Legion (Post 223) maintains a boat launch upstream of the Project spillway along the western shoreline of the Project reservoir with access directly off U.S. Business Route 131. This location is also identified as a Non-Project recreation site. Use of the facility is limited to American Legion members. Each summer, hydroplane and runabout boat races are held by the U.S. Title Series Championship Racing Association. Boats in the competition are launched from the American Legion site.

Of the 12 miles of Project reservoir shoreline, approximately 2.5% is safely accessible to the general public by land travel without trespassing on private property. The majority of the area abutting the Project reservoir consists of agricultural lands with limited land within the Project boundary. Private development along the reservoir is limited in scope.

2.0 RECREATION STUDY OBJECTIVES AND METHODOLOGIES

The objectives for the Recreation Study include collecting information regarding current recreation use levels and the condition of the existing recreation facilities in the Project area. This information is gathered in order to: (1) characterize current recreation use of the Project area; (2) estimate future demand for public recreation use at the Project; (3) assess the condition of the existing recreation facilities in the Project area and identify any need for improvements; and (4) evaluate potential impacts of the Project on existing Project recreation facilities and improvements. YES staff performing necessary work included Dr. James Lewis, Ph.D. and Frank Simms, PE. Both have extensive experience in recreational studies related to licensing and relicensing of hydroelectric projects and are familiar with the Constantine Project and associated recreation facilities.

2.1 Current Use of Recreation Facilities

Visitor use data at the Project and Non-Project recreation sites was collected by Dr. Lewis and his assistant including in-person surveys, field reconnaissance, and photo documentation. Field reconnaissance and in-person surveys were conducted during the prime recreation season from May 2019 through September 2019. Surveys were performed at the sites in compliance with the Visitor Use Survey Schedule contained in Section 12.6.2 of the RSP which is presented below in Table 2.1.1.

Table 2.1.1: Survey and Reconnaissance Schedule	
May	One weekend day (Memorial Day weekend)
	One randomly selected weekday
June	One weekend day to coincide with the Father's Day boat race
	One randomly selected weekday
July	One weekend day
	One randomly selected weekday
August	One weekend day
	One randomly selected weekend day
September	One weekend day (Labor Day weekend)
	One randomly selected weekday

Regarding the referenced Father's Day boat race, the Michigan Hydroplane Racing Association typically holds an annual boat race on the St. Joseph River at Constantine on or about Father's Day.

During their visits to the recreation sites, Dr. Lewis and his assistant rotated between the recreation sites spending a minimum of half an hour at each conducting interviews, making observations of ongoing activities, and recording the number of vehicles in parking areas associated with each facility. In addition, general information regarding date, time and weather conditions was recorded. Individuals interviewed at the recreation sites were asked to complete a questionnaire designed to collect certain information including:

- General user information
- Resident/visitor
- Purpose and duration of visit
- Distance traveled
- Day use/overnight lodging
- History of visiting the site or area
- Types of recreational activities participated in or planned during visit
- Other recreational sites visited or intended to be visited during their visit
- General satisfaction with recreational opportunities and facilities including recommendations for improvements
- Effects of Project operations on recreation use and access
- Accessibility of facilities

Each of the individuals approached to complete a survey on site were presented the option of completing the survey online. Information on how to access the online questionnaire was provided by Dr. Lewis and his assistant. In addition, the same information in the form of a windshield flyer was placed on each vehicle parked in areas associated with the recreational facilities. A total of fifty flyers were placed on vehicle windshields during the study period. I&M also posted signs at each recreational site directing those desiring to complete a questionnaire online. The questionnaire is contained in Appendix B of this study as is a copy of the referenced windshield flyer.

The actual dates that field reconnaissance took place in 2019 were as follows:

- May 22 and 27 (Memorial Day)
- June 15, 16 (Father's Day) and 28
- July 1 and 21 (Boat Race)
- August 15 and 25
- September 27 and 29

Twenty-one site surveys were completed in the field. In addition, seven surveys were completed online. The results of the surveys are summarized in Appendix D. From the information obtained, individuals utilizing the formal Project and Non-Project recreation facilities are day visitors primarily coming from within 30 miles of the Constantine Project. This is true for holidays, weekend days, and typical weekdays. There were a limited number of individuals who traveled extended distances. For example, one individual that completed a survey was from the Upper Peninsula in Michigan, therefore travelling approximately 600 miles each way to enjoy the recreation opportunities afforded at the Project. Additionally, other individuals surveyed indicated that they had travelled approximately 200 miles and 150 miles respectively.

Based upon the results of the surveys along with observations made in the field, the majority of the individuals utilizing the recreation sites are individual users who are fishing. Many of those fish on the reservoir. They come early in the morning, launch from the Constantine Project boat launch, and spend the day on the reservoir. The Tailwater Fishing Access provided by I&M immediately downstream of the Project powerhouse is also a popular site. There was not a significant amount of canoeing or kayaking observed. Users of the recreation sites are predominantly males with an average age of fifty years according to the survey information collected at the sites and online.

Visitors were typically noted recreating during days Dr. Lewis and his assistant visited the Project. However, there were scheduled field observation days during which no one was observed visiting any of the recreation sites. In a number of those instances, this was due weather conditions such as rain, fog, and/or temperatures. This was the case for Labor Day which started out with light rain and fog.

The Project-related facilities are utilized year-round with most use occurring during the prime recreation months of May through September. Respondents to the surveys noted that most utilized more than one recreation site during their visits. Observations made by Dr. Lewis are included in the Monthly Progress Reports included in Appendix F.

In 2019, two boat races were held at the American Legion site. The Father's Day race referenced earlier took place that weekend. Attendance was sparse due to weather conditions. On July 21st, the U.S. Title Series Boat Races occurred attracting a large number of boat racing fans. Weather conditions were favorable, and the event was well-attended.

The boat races at the Project typically attract a large number of visitors to the Constantine area. Many of the visitors are local residents but, as evidenced by the various out-of-state license plates, there are a significant number of individuals who travel extensively to enjoy the races. During the races in July, license plates from the below listed states were noticed:

- Florida (5)
- New York (1)
- Indiana (3)

- Iowa (10)
- Illinois (6)
- Connecticut (1)
- Ohio (1)
- Wisconsin (1)
- South Carolina (1)

In addition to the number of license plates from states outside of Michigan listed above, thirty vehicles with license plates from Michigan were observed.

On February 19, 2015 I&M filed the “Licensed Hydropower Development Recreation Report – FERC Form 80” (FERC Form 80 Report) for the Constantine Hydroelectric Project. The report presented detailed information regarding the usage of the Project recreation facilities provided and operated by I&M including capacity utilization. From that report, the following estimates of capacity utilization are provided:

- | | |
|---------------------|-----|
| • Boat Launch Areas | 48% |
| • Portages | 5% |
| • Tailwater Fishing | 44% |
| • Reservoir Fishing | 9% |
| • Picnic Areas | 6% |

Estimates of capacity utilization for the boat launch areas represent an average of the Project reservoir boat launch and American Legion boat launch. The individual capacity utilization for the Project boat launch was estimated at 46% while capacity utilization estimates for the American Legion boat launch were approximately 50%.

The conclusion of the FERC Form 80 Report was that the use of each of the individual Project recreation sites was relatively low with less than 20,000 recreation days per year and that the existing Project facilities provide sufficient access.

The results of the site surveys along with the observations made during field visits completed for this study appear to verify the findings of the FERC Form 80 Report. Activity observed at the Project facilities demonstrate that Project recreation facilities provide sufficient access to the Project reservoir and the St. Joseph River.

Usage of the Non-Project recreation facilities provided by the Village of Constantine noted during the field surveys show that those facilities also provide adequate access to the public for recreation purposes. During the site surveys at no time was full use of the facilities observed. As with the Project facilities, the Non-Project facilities had little to no usage during the visits by YES staff. Comments provided for the surveys, both in the field and online, note public satisfaction with the Project and Non-Project facilities.

The very low usage of the canoe portage for the Project identified in the FERC Form 80 Report was verified not only by field observations and survey results but also through conversation with the operators of Liquid Therapy Canoe and Kayak Rental located in nearby Three Rivers, Michigan (Liquid Therapy). Liquid Therapy rents an average of 10 canoes/kayaks daily during the recreation season. The public boat launch adjacent to the facilities owned by Liquid Therapy provides access to the St. Joseph River just upstream of the Project boundary for the Constantine Project. The facilities available to the public at that location include a concrete ramp and ample parking. The travel time from the canoe and kayak livery to the spillway powerhouse for the Constantine Project is approximately four hours. The operators for Liquid Theory note that most rentals from their livery travel approximately two hours to the take-out provided by St. Joseph County at Withers Road, which is near the mid-point for the Constantine Project reservoir. The access at Withers Road consists of wooden steps that allow canoeists/kayakers to get out of the water to the parking area along the road.

Those who do elect to continue further downstream take their canoes or kayaks out of the water at the boat launch provided by I&M on the reservoir at the Constantine Project. This is also true for canoeists or kayakers other than those who rent from Liquid Therapy. The overall result is that canoeing/kayaking beyond the spillway for the Constantine Project is very infrequent; thus the portage is not utilized extensively.

2.2 Future Use of Recreation Facilities

As part of the development of the St. Joseph County, Michigan Parks and Recreation Five-Year Plan 2019-2023 (PRFYP), input was obtained from the general public regarding main recreation interests of those visiting parks in St. Joseph County. On the top of the list was running/walking/hiking followed by canoeing/kayaking. Within the Michigan Statewide Comprehensive Outdoor Recreation Plan 2018-2022 (SCORP), those same recreational preferences are also high on the list of top outdoor recreation activities.

According to the St. Joseph County PRFYP, St. Joseph County (County) has more navigable waterways than any other county in the State of Michigan. The goal of St. Joseph County Parks and Recreation is to highlight those natural resources as a means of attracting people to the County along with promoting and funding development of water-based recreation with facilities that complement canoe trails with access points. The State of Michigan in its 2018-2022 SCORP also emphasizes the importance of water based-recreation by pointing out the need to ensure access to water-based recreation through the development of water trails and increasing access for canoes, kayaking, and fishing.

The above described goals are further emphasized by the 2015 completion of the Water Trail Master Plan for St. Joseph County. Through a public input process and extensive resource inventory study, specific needs to meet those goals were identified and include:

- Appropriate distribution of access points

- Hierarchy of services and quality of access
- Water trail route priorities and types
- Consistent signage and promotion

Regarding the appropriate distribution of access points, it is stated within the Water Trail Master Plan that there should be a second access point one to two hours downstream of any canoe/kayak put-in. In addition, reference is made to a maximum spacing of four hours between sites having amenities such as restrooms and parking. When including the access at Withers Road, the current distribution of access points from the boat ramp in Three Rivers through the Constantine Project meets the described goals.

In 2016, The Village of Constantine prepared its five-year Parks and Recreation Plan. In that plan, the Village identifies the need for restroom facilities at I&Ms Tailwater Fishing Access. The need for restroom facilities at the Tailwater Fishing Access was stated numerous times by those interviewed. As with the master plans described for St. Joseph County and the State of Michigan, the importance of water-based recreation in the area is emphasized. As part of its plans, the Village identifies the desire to extend the existing boardwalk at Riverview Park onto I&M property upstream of the park and containing the portage around the spillway for the Constantine Project. It is stated in the plan that the Village understands that such an extension would require an agreement with I&M to utilize the property.

Although the recreation facilities at and near the Constantine Project are utilized by individuals from various locations outside the Village of Constantine and St. Joseph County, it is clear that the majority of the use comes from local residents. It is also clearly understood that participation in outdoor recreation activities has grown over the past few years and is anticipated to continue to grow. Most of that growth would be expected to be related to population growth for the Village and County.

According to census information, populations for the Village and County have been stagnant if not somewhat negative over the last 10 years. The population for St. Joseph County for the period of 2010 through 2017 is estimated to have decreased from 61,283 to 60,819 (approximately -0.8%) while the Village of Constantine's population is estimated to have gone down from 2,076 in 2010 2,047 in 2016 (approx. -1.4%). Large gains in growth are not currently anticipated for the future. The completion of the U.S. Route 131 bypass, which redirected traffic from going through the Village of Constantine, has apparently contributed to recreationists bypassing the Village. This is according to comments provided during the field observations. With these considerations, it is believed that the existing Project and Non-Project recreation sites referenced in this study should meet the recreation needs for the Project now and into the future.

As noted earlier, private development along the Project reservoir is limited. Therefore, private use does not contribute significantly to recreation activity at the Project and is not expected to do so in the future.

2.3 Recreation Facility Inventory and Condition Assessments

Field inventories and condition assessments were made of recreation facilities within and adjacent to the Project boundary in accordance with Section 12.6.1 of the Revised Study Plan for the Constantine Hydroelectric Project filed March 15, 2019 by I&M and approved by in the SPD for the Constantine Project issued by FERC on April 9, 2019. This includes those Project Recreation Facilities provided and maintained by I&M and the Non-Project Recreation Facilities provided by others. Information recorded includes:

- A description of the type and location of existing recreation facilities.
- The type of recreation provided.
- Length and footing materials of any trails.
- Existing facilities, signage, and sanitation.
- The type of vehicular access and parking (if any).
- Suitability of facilities to provide recreational opportunities and access for persons with disabilities.
- Photographic documentation of recreation facilities.
- Qualitative assessments of the condition of the recreation facilities.

The type, location, and condition of the existing recreation facilities were noted during the field reconnaissance that occurred on July 16 and 17, 2019 as well as during the days that survey information was gathered as described in Section 2.1 of this study. Qualitative assessments made of the Project recreation amenities were recorded on the Facilities and Condition Forms provided in Appendix C of this report.

Utilizing the Facilities and Condition Form, the recreation amenities were rated using the following criteria: (N) Needs replacement; (R) Needs repair; (M) Needs maintenance; and (G) Good condition. In each case, an explanation of the rating was provided. Field personnel for the qualitative assessments made included Dr. Lewis and Mr. Simms, who are familiar with the Project recreation facilities. Photographs of the recreation facilities taken during the field reconnaissance are contained in Appendix C of this report as well as in the monthly progress reports provided in Appendix F.

The following subsection summarizes the recreation amenities inventory and condition assessments for the Project Recreation Facilities.

2.3.1 Project Recreation Facilities

2.3.1.1 Tailwater Fishing Access

The tailwater fishing platform is located immediately downstream of the Project powerhouse along the west shoreline of the St. Joseph River. It is a wooden structure that is ramped to allow access for the general public as well as individuals with special needs. Handrails are provided along the access ramps which have a maximum slope of less than five percent.

Approximately 45 lineal feet of the platform is available for fishing. Handrails are provided at two heights. Four sections of the handrails have a height of 42 inches to support individuals who stand and fish. Three sections have a height of 34 inches to allow individuals to fish while sitting including while in a wheelchair. The elevation of the wood deck from which fishing takes place is approximately 4.75 feet above the normal tailwater elevation of 771.5 feet NGVD. Between each handrail section, a vertical clear space of 6.5 inches is provided so that fish caught can be brought to the individual catching the fish without having to raise it above the handrail.

Near the tailwater fishing platform is a paved parking area that can accommodate eight vehicles. The parking area is within the Village of Constantine's Rotary Park maintained by the Village. Individuals parking in the provided area need to traverse a distance of approximately 200 feet to the fishing platform on a paved sidewalk along U.S. Business Route 131 which connects to a 42 inch-wide paved asphalt walkway. The asphalt walkway has a maximum slope of five percent. Exhibits R-2 and R-3 of the Project License are provided in Appendix E and present details related to the tailwater fishing platform.

The Tailwater Fishing Platform is in good condition. The platform appears to be sound and requiring just normal maintenance. The associated grounds are well maintained with the grass mowed and nearly no litter. During the July 16 and 17 site visit, it was noticed that the light on the powerhouse just above the platform was damaged and not working. It should be replaced or repaired. In addition, the asphalt ramp to the platform should be resurfaced and the contact point at the platform repaired to eliminate the gap between the surface of the paved path and the platform.

There are no trash receptacles. They were provided earlier when the platform was constructed. However, the trash receptacles actually attracted more household trash and litter than the current situation. Individuals surveyed about the lack of trash receptacles stated that they understood the reasons for not providing them and believed that the cleanliness of the site improved after they were removed.

Signage providing direction to the parking area needs to be improved. Individuals traveling north on U.S. Business Route 131 cannot see the directional sign to the parking area since it is obscured by the information sign placed in front of it by the Village. Signs required by the FERC giving notice to the Project number and where additional information regarding recreation opportunities may be found are prominently displayed and visible to the public. The safety sign

at the head of the asphalt ramp to the platform has aged and is faded. Replacement of that sign is suggested.

The surface of the parking area at Rotary Park is in good condition as is the surrounding grounds. However, there is no sign designating a parking space for handicap use. A designated parking slot should be provided and signed appropriately. One item raised by the public utilizing the tailwater fishing platform is the lack of sanitary facilities. The nearest public facility is the porta-john provided by I&M approximately one-third of a mile from the tailwater fishing platform at I&M's reservoir boat launch.

2.3.1.2 Reservoir Boat Launch

The reservoir boat launch provided, operated, and maintained by I&M is located adjacent to the west abutment for the Project spillway at the intersection of Garden Street and Race Street in the Village of Constantine. Facilities provided include: (1) 15 foot-wide concrete boat ramp with a slope of 13%; (2) paved parking providing spaces for 10 vehicles as well as four spaces for vehicles with trailers; (3) floating platform approximately 24.25 feet long and 12.33 feet wide allowing for access to boats utilizing the adjacent boat ramp and for reservoir fishing; (4) ramp/access bridge from the parking area to the floating platform having a maximum slope of 8%; and (5) ADA-accessible portable porta-john. The deck for the floating platform is 22 inches above the surface elevation for the Project reservoir. To allow access to boats utilizing the boat ramp, the adjacent side of the platform is open. The remaining three sides of the floating platform have handrails that are set at different heights and separated by 9-inch gaps to allow for fishing by those with special needs as well as others. Details for the boat launch are shown in Exhibits R-1 and R-2 provided in Appendix E.

The boat launch provided by I&M on the Project reservoir is in good condition requiring normal maintenance and some minor repairs. The grounds and parking area are well maintained. During the July 16 and 17 inventory, it was noted that sections of the privacy fencing adjacent to the entrance to the parking area have failed or were in need of repair or replacement. Since that time, the fencing has been replaced. Within the parking area, there are no parking spaces designated for handicap use only. Such designation should be provided adjacent to the boat ramp.

Other maintenance that should be considered includes trimming vegetation that was impeding access to the bridge connecting the parking area to the floating platform adjacent to the boat ramp. Vegetation blocking view of the safety warning site adjacent to the boat ramp was also observed. On the floating platform, one section of handrail (third from the upstream end) was loose and needed to be tightened. In addition, the bumpers along the open portion of the floating platform need to be replaced since some sections are gone while those remaining are in poor condition. One survey respondent suggested that bank fishing opportunities be expanded at the boat launch area. The amount of property owned by I&M along the reservoir constrains the length of shoreline available for bank fishing. Therefore, this is not a recommendation of this study.

2.3.1.3 Reservoir Fishing Access and Canoe Portage

Located at the east abutment area for the Project spillway is a take-out for individuals canoeing or kayaking the Project reservoir. From the take-out, recreationists can proceed to the canoe portage steps that provide a route for portaging down the east abutment. Parallel to the steps is a wood trough that those handling kayaks or canoes can use to assist with traversing the abutment embankment. The steps are constructed of a wood frame with compacted stone fill. There are a total of 19 steps each having a width of six feet, a depth of 2.5 feet, and a height of five inches. At the end of the steps is a trail with a crushed stone surface averaging 1.5 feet in width that follows along the St. Joseph River and leads to the portage put-in located approximately 300 feet downstream of the Project spillway. The total length of the portage from take-out to put-in is 560 feet.

Adjacent to the portage take-out, the abutment embankment is open to the public allowing for bank fishing at the reservoir. In this area, an ADA-accessible porta-john and picnic table is provided. There is no parking area available at the portage/reservoir bank fishing site. Individuals can park vehicles in the vicinity of the intersection of nearby Hull Street and Wells Street. A locked gate closes the area off to vehicle access but does allow for the public to access the area by foot. Approximately three vehicles can utilize the available street parking area. The distance from the street parking area to the bank fishing area is approximately 600 feet.

The canoe portage is in poor condition and needs repairs as well as improved maintenance. A portion of the take-out for the canoe portage along the Project reservoir is covered by vegetation which needs to be cleared to allow unobstructed removal of canoes and kayaks from the reservoir. There is no signage upstream of the portage take-out directing individuals to where they can get of the reservoir surface to bypass the Project spillway. In addition, once out of the water there is no signage provided to direct recreationists to the portage trail. Therefore, signage improvements are recommended.

Along the spillway abutment area, a handicap accessible picnic table and porta-john are provided. The grounds in this area are well-maintained and kept clear of debris and litter. An informational sign regarding the Project facilities and capabilities is provided at the upper end of the stairs leading down the embankment to the portage path. The sign has faded and needs updating or replacement.

The stairs leading down the embankment are in good condition but do require some minor repair. In particular, the compacted stone fill has settled and needs to be replenished to bring the steps up to original level. The trail below the steps is in very poor condition and needs significant work.

Comments received regarding the canoe portage highlight concerns that the portage trail is very close to the river and individuals utilizing the portage for canoeing or kayaking can enter the established safety zone downstream of the Project spillway. Signs stating that the portage put-

in is approximately 300 feet downstream of the spillway and that entering the river closer than that point presents a safety hazard could be beneficial.

Vegetation overhanging the trail should be removed in order to allow unimpeded access along the trail. Additionally, the trail should be widened, and a crushed stone walking surface considered. At the put-in downstream of the Project spillway, improvements should be made to provide those utilizing the put-in a stable area to put their canoes/kayaks into the St. Joseph River to continue downstream. A sign noting the location of the put-in should also be provided.

2.3.2 Non-Project Recreation Facilities

2.3.2.1 Riverview Park

Riverview Park is a community park located along the east side of the St. Joseph River extending downstream of the Project spillway from the canoe portage put-in. There are two distinct areas at Riverview Park which are connected by a raised boardwalk constructed of wood. The most upstream area includes: (1) parking for six vehicles of which one is designated for handicap use; (2) a covered picnic area; (3) a playground; (4) park benches; and (5) a porta-john. Parking is also available along E. Water Street. Facilities provided at the most downstream area include: (1) a concrete single lane boat launch; (2) a floating platform to allow access to boats utilizing the adjacent boat ramp as well as for fishing; (3) tables with seats that are ADA acceptable; and (4) parking for six to eight vehicles as well as three to four vehicles with trailers.

Riverview Park is a well-maintained recreation site. The grounds are well-kept with no noticeable litter, grasses cut, and facilities maintained in good condition. High water in 2018 caused significant damage to the boardwalk connecting both areas of the park, making it impossible to utilize. The Village is planning to repair and replace the damaged portions of the boardwalk as funds become available. Use of the other facilities provided at Riverview Park is not impeded by not having the boardwalk available. The floating access platform adjacent to the boat ramp does tend to move slightly. The Village may want to consider improving the security of the platform. Improvements to the banks at the boat launch were made after the July 16 and 17 inventories and condition assessments.

2.3.2.2 Shelby Park

At the northeast corner of the intersection of N. Washington Street and E. Water Street in the Village of Constantine is Shelby Park, a community park approximately one acre in area and abutting the shoreline for the St. Joseph River directly across from the powerhouse for the Constantine Hydroelectric Project. Facilities at the park consist primarily of paved walkways, benches, a covered gazebo sitting area, and tables with attached seating. The tables and seats are accessible to those with special needs.

Along the St. Joseph River, handrails are provided to allow fishing from a concrete platform approximately 135 feet in length. The handrail sections are set at different heights and separated allowing visitors including those with special needs to sit while fishing.

The facilities at Shelby Park are in very good condition. One feature noticed at Shelby Park and the other Village parks is the provision of signs identifying different types of trees.

2.3.2.3 Rotary Park

As described previously for the Tailwater Fishing Access provided by I&M, Rotary Park is a community park that provides parking for that facility. At one time, the park had a playground area that was removed. There are no other facilities at Rotary Park.

As with the other Village parks, the condition of Rotary Park is very good. As noted for I&M's Tailwater Fishing Access, one of the parking spaces should be designated as available for handicap use only and appropriate signage provided. Rotary Park could also be considered as a potential location for a porta-john or other sanitary facility to accommodate individuals utilizing the Tailwater Fishing Access if deemed necessary.

2.3.2.4 American Legion Boat Launch

Approximately one-quarter mile upstream of the Project spillway along the western shoreline of the Project reservoir is a boat launch which is owned and operated by American Legion Post 223. Individuals utilizing the boat launch, consisting of a concrete boat ramp and movable access platform, include members of the Legion and guests. There is also a clubhouse for members. The shoreline is open to the reservoir allowing for fishing by members. The American Legion Boat Launch is used as the access point for boats participating in the hydroplane and runabout boat races held annually at the American Legion. There is extensive parking provided for members and guests during races.

The facilities at the American Legion Boat Launch are kept in very good condition.

2.4 Potential Impacts of the Project on Existing Project Recreation Facilities and Improvements

The results of the Recreation Study indicate that the existing recreation facilities, both Project and Non-Project, meet the current and foreseeable future recreation needs of the public. The facilities are mostly well maintained and are in line with the goals and objectives of the recreation plans for the State of Michigan, St. Joseph County, and the Village of Constantine. Therefore, other than improvements to the canoe portage trail as discussed in Section 2.3.1.3 and maintenance of the existing recreation facilities, there are no changes and/or additions suggested. There are no anticipated changes to Project operations or facilities that would have impacts on existing Project recreation facilities and proposed improvements.

In the 2016 Village of Constantine Parks & Recreation Plan, the Village identifies the goal and objective to extend the existing boardwalk at the east end of Riverview Park. The extension would be constructed on property owned by I&M and could potentially connect with the existing canoe portage trail. The extension of the boardwalk should not be a requirement of the new license for the Constantine Hydroelectric Project. However, I&M may want to consider a cooperative effort with the Village of Constantine if approached in the future.

Under the requirements of the current license for the Project, I&M was required to file in accordance with 18 C.F.R. § 8.11 a recreation report every six years that provided an update on recreation facilities at that project and an assessment of whether the existing facilities would meet the recreation needs of the Project for the following six years. The report was to be prepared in consultation with the appropriate agencies, local governments, and non-governmental organizations (NGOs). The FERC order issued December 12, 2018 eliminated the need for the preparation and filing of the recreation report required under 18 C.F.R. § 18.11 for the Constantine Project. Recreation needs at hydroelectric projects change over time since they are subject to changes in population, the types of recreation desired, along with other reasons. The reports were an effective tool in being able to determine the need for improvements to recreation facilities at Projects as well as the elimination of facilities that were no longer effective in meeting the recreation needs for the Project area. They also provided a mechanism for Project licensees to keep in touch with the recreation needs by consulting with the appropriate agencies, local governments, and NGOs. I&M has a good working relationship with the Village of Constantine and St. Joseph County. That working relationship should be maintained including keeping all parties apprised of changes in recreation needs at the Constantine Hydroelectric Project in the absence of the previously required recreation reports.

3.0 SUMMARY

The existing recreation facilities, both Project and Non-Project, are well maintained and utilized by the public. Overall, the public is pleased with the recreation facilities provided by I&M, St. Joseph County, and the Village of Constantine. The cooperative effort of I&M and local governments has resulted in recreation facilities that not only meet the goals and objectives of the relevant recreation plans but contribute to the economies of the area. This is evidenced by individuals from outside of St. Joseph County visiting to boat on the Constantine Project Reservoir, canoe/kayak the St. Joseph River, and fish the river and reservoir. According to the comments received, the existing facilities contribute to the enjoyment of all participating in those activities.

The primary recreation activities for the Constantine Project observed are fishing by boat, bank fishing, fishing from the Tailwater Fishing Access platform located at the face of the

powerhouse, and pleasure boating. Results from the site and online surveys, provided below in Table 3.1, substantiate those observations.

Table 3.1: Activities Participated in by Survey Respondents

	Bank Fishing	Boat Fishing	Pleasure Boating	Canoe/ Kayak	Picnic	Swim	Sight-Seeing	Hunt	View Wildlife	Other
Number	5	5	6	1	0	0	1	0	0	0
Percent	27.8	27.8	33.3	5.6	0	0	5.6	0	0	0

Those surveyed indicated that the overall experience had recreating at the Constantine Project was totally acceptable. Table 3.2 presents the results of the surveys relative to rating the overall experience of the respondents.

Table 3.2: Overall Experience of Survey Respondents

	Totally Unacceptable	Unacceptable	Neutral	Acceptable	Totally Acceptable
Safety (Number/Percent)			1 (4.8%)		20 (95.2%)
Enjoyment (Number/Percent)				1 (4.8%)	20 (95.2%)
Crowding (Number/Percent)	1			2 (10.5%)	17 (89.5%)
Overall Experience (Number/Percent)				1 (5.9%)	16 (94.1%)

Based upon the results of the observations made by this study, there are no additions or reductions to Project recreation facilities recommended. For each of the existing Project recreation sites, suggested improvements are noted in Section 2.3.1. These primarily reflect the need for signage improvements, identifying slots at the parking areas as being for use by handicapped individuals only, and improvements to vegetation management. Of the Project recreation sites, the canoe portage below the Project spillway requires the most work. As noted in Section 2.3.1, the portage trail in particular needs to be improved including signage, the walking surface, and trail width.

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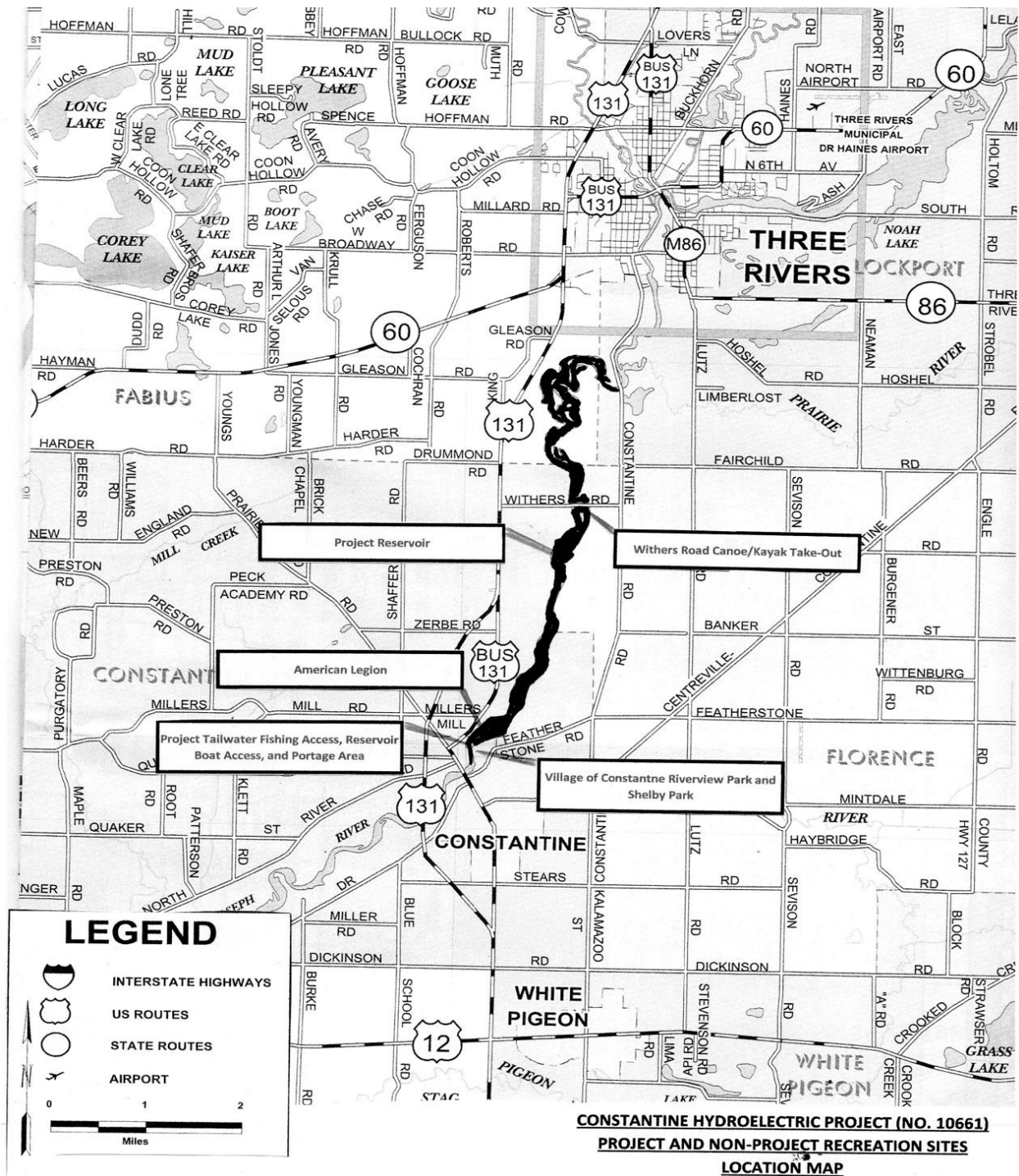
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Location Map of Recreation Areas in Vicinity of Constantine Hydroelectric Project
(Note: Map from Constantine Hydroelectric Project Pre-Application Document – Figure 5.8.11)

**CONSTANTINE HYDROELECTRIC PROJECT (FERC NO. 10661)
RECREATION STUDY**

Appendix –A: Facility Inventory and Condition Assessment Form

Content:

- **Blank Recreation Facility Inventory and Condition Assessment Form**

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Constantine Hydroelectric Project (FERC No. 10661)

Location:
Date:
Surveyor:
Photo Number(s):

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane			N / R / M / G	
Fishing Platform			N / R / M / G	
Portage (put-in/take-out)			N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)			N / R / M / G	
Picnic Table			N / R / M / G	
Restroom			N / R / M / G	
Trash Receptacles			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: _____ Standard: _____ ADA: _____ Double (trailer): _____ Other: _____				Condition N / R / M / G
	Surface Type: Asphalt Concrete Gravel Other: _____				
Signs	#	Size	Material	Condition	Comments
FERC Project			wood / metal / other	N / R / M / G	
Facility ID			wood / metal / other	N / R / M / G	
Regulations			wood / metal / other	N / R / M / G	
Directional			wood / metal / other	N / R / M / G	
Interpretive			wood / metal / other	N / R / M / G	

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES:

Note the age of the facilities (if known) as well as any signs of overuse.

CONSTANTINE HYDROELECTRIC PROJECT (FERC NO. 10661)
RECREATION STUDY

Appendix – B: Recreation Site Survey Questionnaire

Content:

- Blank Recreation Site Survey Questionnaire (Pages 1 through 4)
- Windshield Flyer

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ON-SITE/IN-PERSON RECREATION INTERVIEW
Constantine Hydroelectric Project (FERC No. 10661)
Recreation Site Survey Questionnaire

Indiana Michigan Power Company (I&M) is the licensee, owner, and operator of the 1.2 megawatt (MW) Constantine Hydroelectric Project (Project or Constantine Project) which is licensed by the Federal Energy Regulatory Commission (FERC). The three FERC-approved recreation facilities associated with the Project are located immediately upstream and downstream of the Project. The current operating license for the Project was issued on October 20, 1993, and expires on September 30, 2023. I&M must file its application with FERC for a new license no later than September 30, 2021. As part of the relicensing process, I&M is conducting studies on environmental resources to enable FERC to prepare an environmental document. The purpose of this survey is to collect information about use of the Project's three FERC-approved recreation facilities.

Interview Location:	Constantine Boat Launch <input type="checkbox"/> Constantine Tailwater Fishing Access <input type="checkbox"/> Constantine Portage and Reservoir Fishing Access <input type="checkbox"/> Riverview Park <input type="checkbox"/> Riverview Park Boat Launch <input type="checkbox"/> Shelby Park <input type="checkbox"/> American Legion Boat Launch <input type="checkbox"/> Other <input type="checkbox"/>		
Home Zip Code: _____	Date: _____		
Age: _____	Time: _____		
Are you:	Male <input type="checkbox"/>	Female <input type="checkbox"/>	Prefer not to answer <input type="checkbox"/>
Interviewer: _____			

Q-1. Regarding the Constantine Project area, do you consider yourself: **(Please circle one)**

1. A regular visitor to this area (3 or more times per year)
2. An occasional visitor (1-2 times per year)
3. An infrequent visitor (Less than 1 time per year)
4. This is my first visit

Q-2. On this trip to the Constantine Project area, when did you arrive?

Arrival Date	Arrival Time
____/____/____	_____AM/PM

When do you expect to leave the Constantine Project area?

Departure Date	Departure Time
____/____/____	_____AM/PM

Q-3. During the last 12 months (including this trip), which month(s) did you visit the Constantine Project area?
(Please select all that apply)

Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐

- ☐ Constantine Boat Launch
- ☐ Constantine Tailwater Fishing Access
- ☐ Constantine Portage and Reservoir Fishing Access
- ☐ Riverview Park
- ☐ Riverview Park Boat Launch
- ☐ Shelby Park
- ☐ American Legion Boat Launch
- ☐ None of the above
- ☐ Other (Please list)

A. _____ miles

1. Yes 2. No

1. RV/Auto/Tent Campground
2. Motel/hotel
3. Bed and Breakfast
4. Vacation or rental home
5. Other (Please specify: _____)

A. _____ people

1. Individual
2. Adult group (over 21)
3. Youth group (under 21)
4. Family (with children)
5. Mixed group (families and friends of various ages)

1. Bank fishing	5. Picnicking	8. Hunting
2. Boat fishing	6. Swimming	9. Wildlife viewing

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3. Pleasure boating	7. Sight-seeing	10. Other (please describe)
4. Canoeing/kayaking		

Q-11. Of the activities you circled in Q-10 above, what is the primary activity that you participated in, or expect to participate in, on this visit? (Please write in the corresponding number **from above**)

A. Primary activity # _____

Q-12. If you specified that boating or fishing is the primary activity you participated in please rate the following:

	Totally Unacceptable	Unacceptable	Neutral	Acceptable	Totally Acceptable
Safety	1	2	3	4	5
Enjoyment	1	2	3	4	5
Crowding	1	2	3	4	5
Overall Experience	1	2	3	4	5

Q-13. If you participated in recreational activities in the Constantine Project area today or in the past, please rate the following:

	Constantine Boat Launch	Constantine Tailrace Fishing Access	Constantine Portage and Reservoir Fishing Access	Riverview Park
Accessibility				
Parking				
Crowding				
Safety				
Condition of Recreation Facilities				
Available Facilities				
Overall Experience				

	Riverview Park Boat Launch	Shelby Park	American Legion Boat Launch	Other
Accessibility				
Parking				
Crowding				
Safety				
Condition of Recreation Facilities				
Available Facilities				
Overall Experience				

Q-14. Please tell us what type(s) of recreation enhancements you believe are needed and at what specific location(s) at the Constantine Project.

1. Type of recreation enhancement: _____

Location(s): _____

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2. Type of recreation enhancement: _____

Location(s): _____

Q-15. Please share any other comments that you have regarding recreation near the Constantine Project: _____

Thank you for completing the Recreation Survey!

Web Survey – Windshield Flyer

The following information was provided to those not completing the Recreation Site Survey Questionnaire in the field:

“I & M (Indiana Michigan Power) is conducting a Recreation Study as part of the relicensing of the Constantine Hydroelectric Project FERC No. 10661

Please participate in the Recreation Study by visiting the website below to take a brief online survey intended to gather information about recreational use at the Constantine Hydroelectric Project.

You can follow either link to get to the survey:

www.aephydro.com/HydroPlant/Constantine (click on The
Recreation Survey Link

Or go straight to this link:

https://hdrinc.co1.qualtrics.com/jfe/form/SV_by1FPypkLuQRT9z

Thank you!”

CONSTANTINE HYDROELECTRIC PROJECT (NO. 10661)
RECREATION STUDY

Appendix – C: Recreation Facility Inventories and Condition Assessments

Content:

- **Reservoir Boat Launch (Project Recreation Site)**
- **Tailwater Fishing Access (Project Recreation Site)**
- **Reservoir Fishing Access and Canoe Portage (Project Recreation Site)**
- **Riverview Park Playground Area and Boat Launch (Non-Project Recreation Site)**
- **Shelby Park (Non-Project Recreation Site)**
- **American Legion (Non-Project Recreation Site)**
- **Withers Road Canoe/Kayak Take-Out (Informal Recreation Site)**



**CONSTANTINE HYDROELECTRIC PROJECT NO. 10661
RESERVOIR BOAT LAUNCH
(PROJECT RECREATION SITE)**

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Constantine Hydroelectric Project (FERC No. 10661)

Location:	Reservoir Boat Launch (41.84742; -85.66965)
Date: July 16 & 17, 2019	Surveyor: F. Simms/J. Lewis
Photo Number(s):	Photos Attached

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane	1	Yes	N / R / M / <u>G</u>	Notes Attached
Fishing Platform	1	Yes	N / R / M / <u>G</u>	.Notes Attached
Portage (put-in/take-out)			N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)			N / R / M / G	
Picnic Table			N / R / M / G	
Restroom	1	Yes	N / R / M / <u>G</u>	Notes Attached
Trash Receptacles	1		N / R / <u>M</u> / G	
Other			N / R / M / G	

PARKING	Total Spaces: <u>14</u> Standard: <u>10</u> ADA: <u> </u> Double (trailer): <u>4</u> Other: <u> </u>				Condition
	Surface Type: <u>Asphalt</u> Concrete Gravel Other: <u> </u>				N / R / M / <u>G</u>
Signs	#	Size	Material	Condition	Comments
FERC Project	1		wood / <u>metal</u> / other	N / R / M / <u>G</u>	
Facility ID			wood / metal / other	N / R / M / G	
Regulations	1		wood / <u>metal</u> / other	N / R / <u>M</u> / G	Obscured by vegetation.
Directional	1		wood / <u>metal</u> / other	N / R / M / <u>G</u>	
Interpretive			wood / metal / other	N / R / M / G	

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES:

Note the age of the facilities (if known) as well as any signs of overuse.

Estimated age of facilities: 22 years

Notes from Constantine Project Boat Launch
Inventory and Condition Assessment - July 16 and 17, 2019

- Parking area asphalt paved and in good condition. Some maintenance needed to eliminate potholes.
- Parking is provided for ten vehicles and four vehicles with trailers. There is no designated handicap parking.
- FERC information sign located at gated entrance.
- No sign directing users directly to entrance. One directional sign located along U.S. Business Route 131 which can be seen by traffic heading north.
- Warning signs located at entrance to boat ramp obscured by vegetative growth.
- ADA rated sanitary facility provided at parking area.
- Sections of wood privacy fence at parking entrance missing and/or collapsing (Repairs made since inventory completed).
- Boat ramp, single lane, constructed of concrete.
- Boat barrier located upstream of project spillway and headrace in good condition.
- Floating platform adjacent to boat ramp and associated access bridging from parking area in good condition. Both the floating platform and access bridging allow for handicap access. The wood surface of the floating platform was noticed to be somewhat slippery due to early morning dew.
- Access along access bridging partially blocked by overgrowth of vegetation.
- A number of the boat bumpers along the floating platform are either missing or in poor condition and should be replaced.
- One handrail section along the floating platform is loose and needs to be repaired.
- Security lights provided for the parking area and boat ramp.
- Overall, the boat launch area is maintained in good condition.
- In conversation with owner of property located directly across from entrance to boat launch area, he stated that there have been very little if any disturbances by anyone utilizing the facilities.



Bridge to Floating Platform (41.84752, -85.66959)



Boat Ramp, Bridging, and Floating Platform (41.84749, -85.66968)



Boat Barrier Upstream of Spillway and Headgates (41.847538, -85.669586)



FERC Sign at Boat Launch (41.847439,-85.670059)



Collapsed Section of Privacy Fence at Entrance to Parking Area (41.84751, -85.66998)



Replaced Section of Fencing at Parking Area Entrance



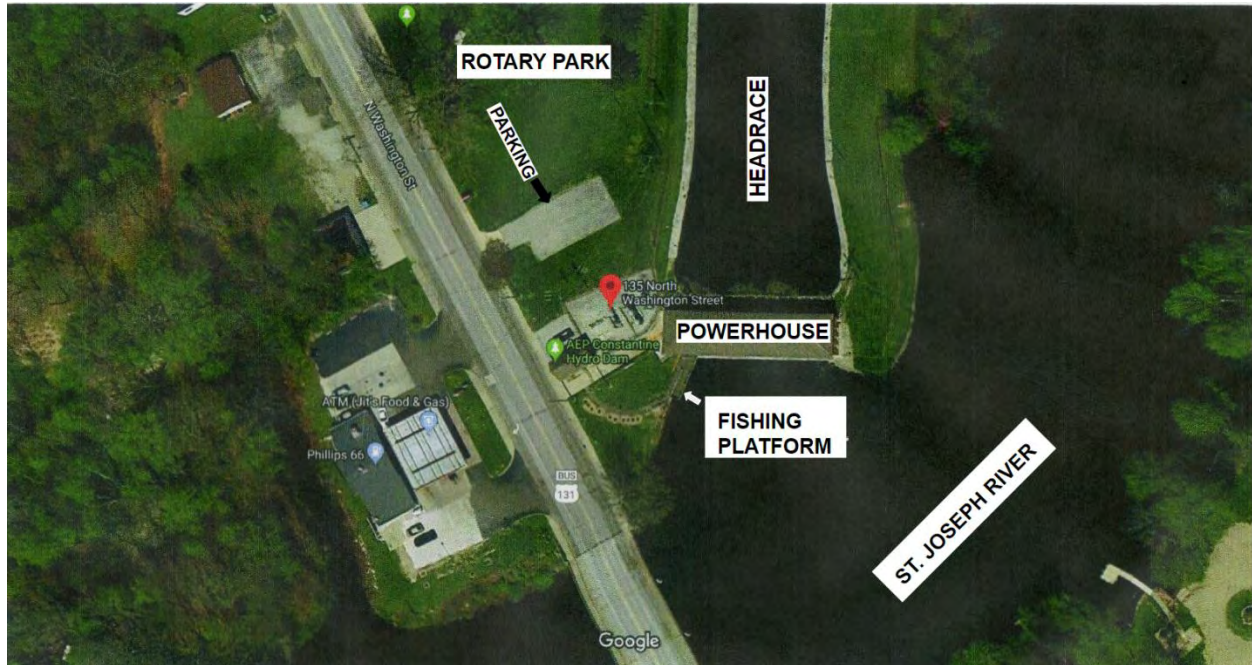
ADA Sanitary Facility at Boat Launch Parking Area (41.84745, -85.66971)



Warning Sign at Boat Ramp - Obscured by Vegetation (41.84741, -85.66976)



Looking North on U.S. Business Route 131 at Directional Sign to Boat Access
(41.8454, -85.67132)



**CONSTANTINE HYDROELECTRIC PROJECT NO. 10661
TAILWATER FISHING ACCESS
(PROJECT RECREATION SITE)**

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Constantine Hydroelectric Project (FERC No.10661)

Location:	Tailwater Fishing Access (41.84359; -85.66949)
Date: July 16 & 17, 2019	Surveyor: F. Simms/J. Lewis
Photo Number(s):	Photos Attached

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane			N / R / M / G	
Fishing Platform	1	Yes	N / R / M / G	Notes Attached
Portage (put-in/take-out)			N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)			N / R / M / G	
Picnic Table			N / R / M / G	
Restroom			N / R / M / G	
Trash Receptacles			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: <u>8</u> Standard: <u>8</u> ADA: <u> </u> Double (trailer): <u> </u> Other: <u> </u>				Condition
	Surface Type: Asphalt Concrete Gravel Other: <u> </u>				
Signs	#	Size	Material	Condition	Comments
FERC Project	2		wood / metal / other	N / R / M / G	
Facility ID	1		wood / metal / other	N / R / M / G	
Regulations	1		wood / metal / other	N / R / M / G	Fading – Hard to Read
Directional	2		wood / metal / other	N / R / M / G	Sign on Bus. Rt. 131-N Obscured
Interpretive			wood / metal / other	N / R / M / G	

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES:

Note the age of the facilities (if known) as well as any signs of overuse.

- Estimated age of facilities 22 years.
- Parking spaces provided at Village of Constantine Rotary Park adjacent to Tailwater Fishing Platform area.

**Notes from Constantine Project Tailwater Fishing Access
Inventory and Condition Assessment - July 16 and 17, 2019**

- Parking area at Rotary Park is asphalt paved and provides parking for eight vehicles. The parking lot is in good condition and well maintained. There is no designated handicap parking.
- The view of the sign located along northbound Business Route 131 cannot be seen by traffic due to Village of Constantine information sign blocking the line of sight. The directional sign along southbound Business Route 131 is visible and in good shape.
- Parking available for I&M employees only adjacent to former plant operator building at entrance gate to substation. FERC information sign provided at substation fence visible from parking area. FERC information sign also provided so as to be seen from tailwater fishing access platform.
- Walking distance from Rotary Park to tailwater access platform measured at approximately 200 lineal feet along sidewalk adjacent to U.S. Business Route 131. ADA curb cuts provided at driveways.
- Walkway from sidewalk to tailwater fishing access structure asphalt paved. Slope and width of pathway allow for handicap access. The walkway is in good shape but needs maintenance particularly at point where asphalt meets the wood access platform.
- No sanitary facility provided.
- Directional sign to tailwater access platform in good shape and easy to see. However, safety warning sign at the head of the asphalt walkway has faded and needs to be replaced.
- Wooden site identification sign in poor shape but readable.
- Light and window above tailwater fishing platform broken. Apparently the result of vandalism.
- No trash receptacle provided.
- The tailwater fishing platform is of wood construction and is in good condition. Handrails, platform slopes, and railings along river downstream of powerhouse allow for handicap access.
- Overall, the tailwater fishing access is in good condition and well maintained.



Downstream Face of Constantine Project Powerhouse Showing Tailwater Fishing Access Platform (41.843357,-85.669823)



Tailwater Fishing Access – Parking Area at Village Rotary Park (41.84372, -85.67007)



FERC Information Sign Along Substation Fence as Seen from Rotary Park Parking Area
(41.8438, -85.66999)



FERC Information Sign as Seen From Tailwater Fishing Access (41.8436, -85.66962)



Village Information Sign Along U.S. Business Route 131 – North Blocking Directional Sign for Tailwater Access Parking (41.8438, -85.67017)



Tailwater Park Identification Sign (41.84349, -85.66992)



Asphalt Walkway Meets Tailwater Fishing Platform (41.84353, -85.66986)



Paved Walkway to Tailwater Fishing Platform (41.84355, -85.66992)



Sidewalk from Rotary Park to Tailwater Fishing Access (41.84372, -85.67003)



Tailwater Fishing Access Platform (41.84366, -85.66955)



Broken Light and Window at Powerhouse Above Tailwater Fishing Access Platform
(41.8436, -85.6696)



Warning Sign at Head of Paved Access to Tailwater Fishing Access Platform
(41.84352, -85.66973)



**CONSTANTINE HYDROELECTRIC PROJECT NO. 10661
RESERVOIR FISHING ACCESS AND CANOE PORTAGE
(PROJECT RECREATION SITE)**

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Constantine Hydroelectric Project (FERC No.10661)

Location:	Reservoir Fishing Access & Portage (41.847431; -85.66949)
Date: July 16 & 17, 2019	Surveyor: F. Simms/J. Lewis
Photo Number(s):	Photos Attached

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane			N / R / M / G	
Fishing Platform			N / R / M / G	
Portage (put-in/take-out)	1 ea.	No	N / R / M / G	Notes Attached
Portage Trail/Walking Trail (include length and footing materials)	1	No	N / R / M / G	Notes Attached – Length = 560 L.F.
Picnic Table	1	Yes	N / R / M / G	
Restroom	1	Yes	N / R / M / G	
Trash Receptacles			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: _____ Standard: _____ ADA: _____ Double (trailer): _____ Other: _____					Condition N / R / M / G
	Surface Type: Asphalt Concrete Gravel Other: _____					
Signs	#	Size	Material	Condition	Comments	
FERC Project			wood / metal / other	N / R / M / G		
Facility ID			wood / metal / other	N / R / M / G		
Regulations			wood / metal / other	N / R / M / G		
Directional			wood / metal / other	N / R / M / G		
Interpretive	1		wood / metal / other	N / R / M / G	Notes Attached	

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES:

Note the age of the facilities (if known) as well as any signs of overuse.

Estimated age of facilities 22 years

**Notes from Constantine Project Canoe Portage and Fishing Access Area
Inventory and Condition Assessment - July 16 and 17, 2019**

- Take-out at reservoir, located immediately upstream of the spillway boat barrier, is in poor condition. Vegetation blocks access. Gravel surfaces below and above water need to be re-established.
- Signs providing direction for following the portage not provided. No sign observed providing identification of canoe take-out at reservoir.
- ADA sanitary facility provided near the take-out as is an ADA picnic table.
- The total length of portage from take-out along the reservoir to the put-in point downstream of the Constantine Project spillway was measured at 560 lineal feet.
- The portage route from the take-out along the top of the embankment is wide and flat. The walking surface is primarily grassed with some crushed stone. The upper area is well maintained and well kept.
- Eighteen steps are provided to allow access from the top of the portage embankment to the downstream portion of the portage. Steps are 6 ft. wide X 2.5 ft. deep X 5 in. high. Each has timber framing around crushed stone fill. The crush stone has settled in most of the step areas and should be replenished. To assist with carrying canoes and/or kayaks, a “v-shaped” timber trough is provided adjacent to the steps.
- No trash receptacles are provided.
- The sign at the head of the steps providing information about the Constantine Project is in poor shape and needs to be replaced.
- The portage path downstream of the steps is approximately 18 inches wide having a gravel surface. This section of the portage is in very poor condition with vegetation overgrowth along a major portion of its length. The small bridge over a drainage swale requires those utilizing the portage to take a high step to get onto the bridge as well as getting off. Sections of the portage path downstream of the steps are immediately adjacent to the river and pose some difficulty in following the path.
- The portage put-in is located adjacent to the warning buoys below the Project spillway delineating the limit for boaters travelling upstream. The put-in is in poor condition and is in need of upgrading.
- There is no parking provided. There is unofficial parking along Hull Street nearby for three vehicles. However, vehicles are kept from entering the site by a locked gate. Individuals desiring to access the canoe take-out and fishing access area is along an existing dirt and gravel road utilized for maintenance purposes. The distance from the gate to the portage take-out and fishing access is approximately 600 lineal feet.



Canoe Portage Take-out at the Reservoir (41.84743, -85.66718)



Canoe Portage and Access for Fishing Along Embankment (41.847431,-85.667175)



Maintenance Road from Hull Street to Canoe Take-out and Access for Fishing
(41.84768, -85.66583)



Picnic Table at Portage Take-out and Fishing Access Area (41.847305,-85.667480)



Project Information Sign at Canoe Portage (41.847260,-85.667488)



ADA Porta-John at Portage Take-out and Fishing Access Area (41.84751, -85.66711)



Portage Steps and V-Trough (41.847103,-85.667786)



Portage Downstream of Steps Including Bridge Over Swale (41.84711, -85.66778)



Portage Between Bridge Over Swale and Put-in (41.84671, -85.66776)



Portage Put-in Downstream of Spillway at Warning Buoy (41.84644, -85.66781)



Warning Buoys Downstream of Spillway at Portage Put-in (41.84646, -85.66781)



**CONSTANTINE HYDROELECTRIC PROJECT NO. 10661
RIVERVIEW PARK PLAYGROUND AREA AND BOAT LAUNCH
(NON-PROJECT RECREATION SITE)**

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Constantine Hydroelectric Project (FERC No.10661)

Location:	Riverview Park – Playground Area (41.84396; -85.66581)
Date: July 16 & 17, 2019	Surveyor: F. Simms/J. Lewis
Photo Number(s):	Photos Attached

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane			N / R / M / G	
Fishing Platform			N / R / M / G	
Portage (put-in/take-out)			N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)	1	Yes	N / R / M / G	Notes Attached – Wood Boardwalk
Picnic Table			N / R / M / G	
Restroom	1	No	N / R / M / G	
Trash Receptacles			N / R / M / G	
Other		Yes	N / R / M / G	Playground, Basketball Court, Picnic Shelter – Notes

PARKING	Total Spaces: <u>4</u> Standard: <u>3</u> ADA: <u>1</u> Double (trailer): _____ Other: _____				Condition
	Surface Type: <u>Asphalt</u> Concrete Gravel Other: _____				N / R / M / G
Signs	#	Size	Material	Condition	Comments
FERC Project	N/A		wood / metal / other	N / R / M / G	Non-Project Facility
Facility ID	1		<u>wood</u> / metal / other	N / R / M / G	
Regulations	1		wood / <u>metal</u> / other	N / R / M / G	
Directional			wood / metal / other	N / R / M / G	
Interpretive			wood / metal / other	N / R / M / G	

N – Needs replacement (broken or missing components, or non-functional)
R – Needs repair (structural damage or otherwise in obvious disrepair)
M – Needs maintenance (ongoing maintenance issue, primarily cleaning)
G – Good condition (functional and well-maintained)
If a facility is given a rating of “N”, “R”, or “M”, provide specific details.

ADDITIONAL COMMENTS/NOTES:

Note the age of the facilities (if known) as well as any signs of overuse.

- Notes Attached
- Age of Facilities Unknown.

Notes from Village of Constantine Riverview Park Playground Area
Inventory and Condition Assessment - July 16 and 17, 2019

- Facilities at park consist primarily of playground, basketball court, and picnic shelter.
- Paved parking provided for five vehicles. One parking space of the five is designated for handicap only.
- Wood raised boardwalk along river that connects with similar boardwalk at downstream boat launch area. Boardwalk was constructed for handicap accessibility but is currently not usable due to extensive damage caused by high river flows in 2018.
- Porta-John provided. Not ADA.
- Park and facilities in very good condition. The entire park is well maintained and kept.
- Information signs provided regarding types of trees.



Playground at Riverview Park (41.84396, -85.66581)



Boardwalk at Connecting Point for Playground Area (41.844395,-85.665932)



Riverview Park Boardwalk Damage (41.84421, -85.66796)



Riverview Park Boardwalk Damage (41.844105,-85.666832)

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Constantine Hydroelectric Project (FERC No.10661)

Location:	Riverview Park – Boat Launch (41.84289; -85.66784)
Date: July 16 & 17, 2019	Surveyor: F. Simms/J. Lewis
Photo Number(s):	Photos Attached

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane	1	Yes	N / R / M / G	Notes Attached
Fishing Platform	1	Yes	N / R / M / G	Notes Attached
Portage (put-in/take-out)			N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)	1	Yes	N / R / M / G	Notes Attached – Wood Boardwalk
Picnic Table	2	Yes	N / R / M / G	Notes Attached
Restroom			N / R / M / G	
Trash Receptacles			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: 10-14 _____ Standard: 6-10 _____ ADA: 4 _____ Double (trailer): _____ Other: _____					Condition
	Surface Type: Asphalt Concrete Gravel Other: __Dirt_____					N / R / M / G
Signs	#	Size	Material	Condition	Comments	
FERC Project	N/A		wood / metal / other	N / R / M / G	Non-Project Facility	
Facility ID	1		wood / metal / other	N / R / M / G		
Regulations			wood / metal / other	N / R / M / G		
Directional			wood / metal / other	N / R / M / G		
Interpretive			wood / metal / other	N / R / M / G		

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES:

Note the age of the facilities (if known) as well as any signs of overuse.

- Notes Attached
- Age of facilities unknown

Notes from Village of Constantine Riverview Park Boat Launch Area
Inventory and Condition Assessment - July 16 and 17, 2019

- Single lane concrete paved boat launch with adjacent 12 ft. X 18 ft. floating access platform.
- Floating platform connected to park area by 35 ft. long access bridge.
- Floating platform and access bridge provide for handicap accessibility.
- Dirt and gravel parking and turnaround provided for six to ten vehicles and three to four vehicles with trailers.
- Two ADA tables with seats each provided along with a number of standard benches.
- Information signs provided identifying tree types.
- Boat launch area connected to playground area by wood boardwalk. Damage to boardwalk precludes use at the present time including fishing platform constructed as part of boardwalk. Total length of boardwalk from the boat launch area to playground approximately 600 lineal feet.
- Area well maintained and kept.



Access to boardwalk from boat launch parking area (41.84326, -85.66784)



Boat launch turnaround and parking area (41.84289, -85.66784)



Boat launch at Riverview Park (41.84308, -85.66821)



Tables and seating at boat launch area (41.842892,-85.667831)



Improvement at Boat Launch since July 16 and 17 Inventory



View of Improvements at Riverview Park Boat Launch



CONSTANTINE HYDROELECTRIC PROJECT NO. 10661
SHELBY PARK
(NON-PROJECT RECREATION SITE)

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Constantine Hydroelectric Project (FERC No.10661)

Location:	Shelby Park (41.84244; -85.66909)
Date: July 16 & 17, 2019	Surveyor: F. Simms/J. Lewis
Photo Number(s):	Photos Attached

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane			N / R / M / G	
Fishing Platform	1	Yes	N / R / M / G	Length along St. Joseph River = 135 L.F. Concrete surface.
Portage (put-in/take-out)			N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)			N / R / M / G	
Picnic Table	5	Yes	N / R / M / G	Notes Attached
Restroom			N / R / M / G	
Trash Receptacles			N / R / M / G	
Park Benches	6		N / R / M / G	Notes Attached

PARKING	Total Spaces: _____ Standard: _____ ADA: _____ Double (trailer): _____ Other: _____					Condition
	Surface Type: Asphalt Concrete Gravel Other: _____					N / R / M / G
Signs	#	Size	Material	Condition	Comments	
FERC Project	N/A		wood / metal / other	N / R / M / G	Non-Project Facility	
Facility ID	1		wood / metal / other	N / R / M / G		
Regulations			wood / metal / other	N / R / M / G		
Directional			wood / metal / other	N / R / M / G		
Interpretive			wood / metal / other	N / R / M / G		

N – Needs replacement (broken or missing components, or non-functional)
R – Needs repair (structural damage or otherwise in obvious disrepair)
M – Needs maintenance (ongoing maintenance issue, primarily cleaning)
G – Good condition (functional and well-maintained)
If a facility is given a rating of “N”, “R”, or “M”, provide specific details.

ADDITIONAL COMMENTS/NOTES:

Note the age of the facilities (if known) as well as any signs of overuse.

- Notes Attached.
- Age of facilities unknown.

Notes from Village of Constantine Shelby Park
Inventory and Condition Assessment - July 16 and 17, 2019

- Park and facilities very well maintained and in good condition. Entire park has paved walkways and is handicap accessible.
- Numerous facilities for sitting including three tables with benches, two picnic tables, and six benches.
- One covered sitting area with four benches.
- Paved area along the St. Joseph River with handrails allowing for fishing for its entire length measured at 135 lineal feet.
- Park has lighting provided.
- One active water fountain provided.
- Information signs describing types of trees.
- Bike racks provided at park entrance.



View of park looking into nearby Constantine commercial area (41.842796,-85.668900)



Covered sitting area and water fountain (41.842903,-85.668816)



Paved fishing area along river (41.842670,-85.669014)



Park identification sign along U.S. Business Route 131 (41.842407,-85.669128)



**CONSTANTINE HYDROELECTRIC PROJECT NO. 10661
AMERICAN LEGION BOAT LAUNCH
(NON-PROJECT RECREATION SITE)**

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Constantine Hydroelectric Project (FERC No.10661)

Location:	American Legion Recreation Facility (41.850980; -85.666892)
Date: August 2019	Surveyor: J. Lewis
Photo Number(s):	Photos Attached

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane	1	No	N / R / M / G	Movable boat dock provided on as-needed basis including boat races.
Fishing Platform			N / R / M / G	Fishing access available along shoreline.
Portage (put-in/take-out)			N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)			N / R / M / G	
Picnic Table			N / R / M / G	
Restroom			N / R / M / G	Restrooms available to members. Facilities provided by American Legion for boat races.
Trash Receptacles			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: _____ Standard: _____ ADA: _____ Double (trailer): _____ Other: (See notes)					Condition
	Surface Type: Asphalt Concrete Gravel Other: _____					N / R / M / G
Signs	#	Size	Material	Condition	Comments	
FERC Project			wood / metal / other	N / R / M / G		
Facility ID			wood / metal / other	N / R / M / G		
Regulations			wood / metal / other	N / R / M / G	See notes.	
Directional			wood / metal / other	N / R / M / G		
Interpretive			wood / metal / other	N / R / M / G		

N – Needs replacement (broken or missing components, or non-functional)
R – Needs repair (structural damage or otherwise in obvious disrepair)
M – Needs maintenance (ongoing maintenance issue, primarily cleaning)
G – Good condition (functional and well-maintained)
If a facility is given a rating of “N”, “R”, or “M”, provide specific details.

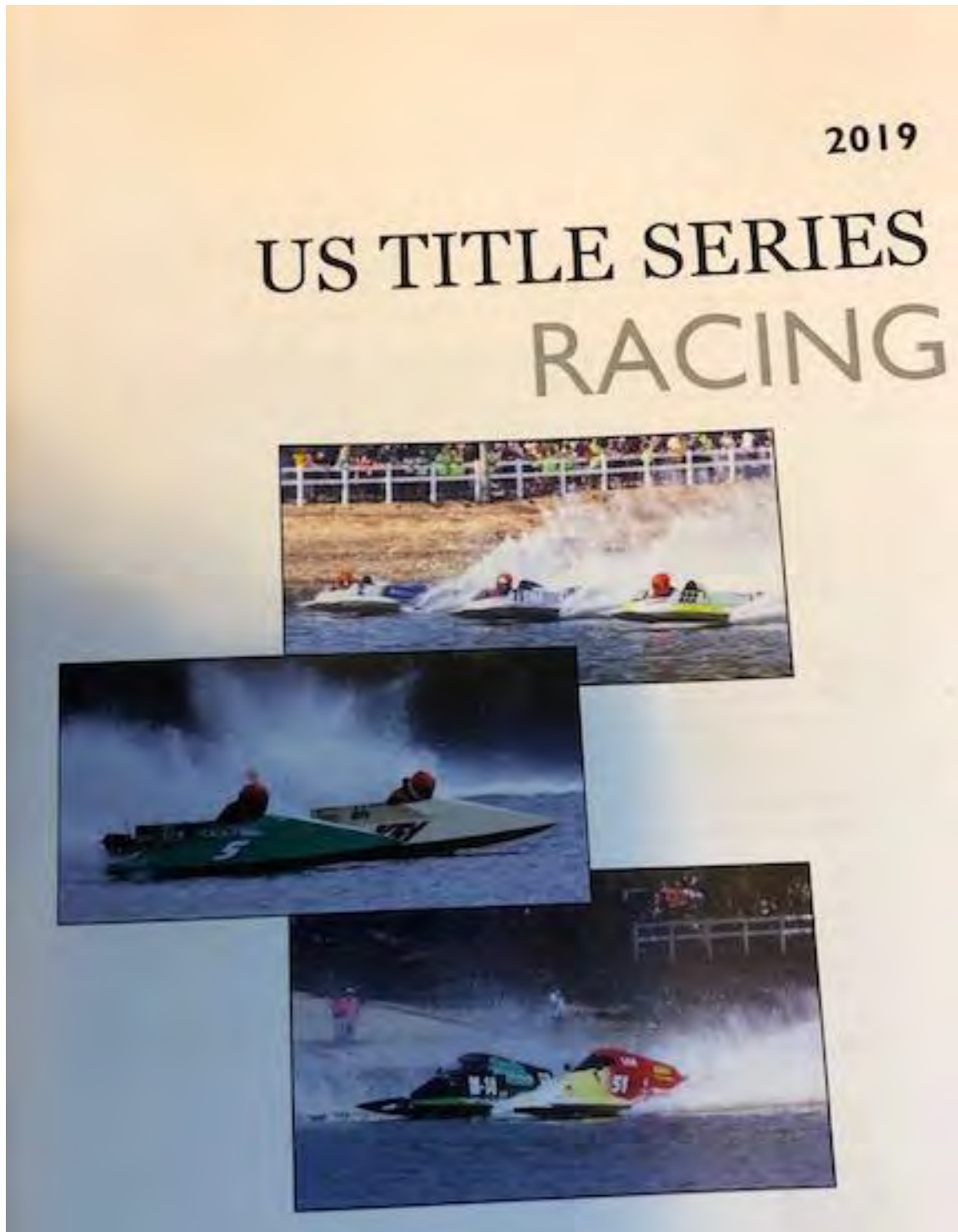
ADDITIONAL COMMENTS/NOTES:

Note the age of the facilities (if known) as well as any signs of overuse.

- Gravel parking areas provided. Number of vehicles that can be accommodated undetermined.
- Parking allowed on grass areas during races.
- Signs posted noting that permits from American Legion required for use of facilities.



American Legion Boat Races – Father's Day Weekend – June 2019



Program from U.S. Title Series Boat Racing – July 21, 2019



Two classes of boats for U.S. Title Series Boat Racing – July 21, 2019



Pit area during July 21 boat races.



Participant parking area.



Boat racing on Constantine Project Reservoir.



Competitor trailer.



Spectators at July 21 boat races.



Sign at American Legion Boat Launch



Movable boat dock for American Legion boat launch.



American Legion boat ramp.



Shoreline along Project Reservoir at American Legion boat launch.



**CONSTANTINE HYDROELECTRIC PROJECT NO. 10661
WITHERS ROAD CANOE/KAYAK TAKE-OUT
(INFORMAL RECREATION SITE)**

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Constantine Hydroelectric Project (FERC No.10661)

Location:	Withers Road Canoe/Kayak Take-Out (41.9206; -85.65649)
Date: July 16 & 17, 2019	Surveyor: F. Simms/J. Lewis
Photo Number(s):	Photos Attached

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane			N / R / M / G	
Fishing Platform			N / R / M / G	
Portage (put-in/take-out)	1	No	N / R / M / G	Notes Attached
Portage Trail/Walking Trail (include length and footing materials)			N / R / M / G	
Picnic Table			N / R / M / G	
Restroom			N / R / M / G	
Trash Receptacles			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: 8-10 _____ Standard: 8-10 _____ ADA: _____ Double (trailer): _____ Other: _____				Condition N / R / M / G
	Surface Type: Asphalt Concrete Gravel Other: _____				
Signs	#	Size	Material	Condition	Comments
FERC Project	N/A		wood / metal / other	N / R / M / G	Non- Project Informal Recreation Site
Facility ID			wood / metal / other	N / R / M / G	
Regulations			wood / metal / other	N / R / M / G	
Directional			wood / metal / other	N / R / M / G	
Interpretive			wood / metal / other	N / R / M / G	

N – Needs replacement (broken or missing components, or non-functional)
R – Needs repair (structural damage or otherwise in obvious disrepair)
M – Needs maintenance (ongoing maintenance issue, primarily cleaning)
G – Good condition (functional and well-maintained)
If a facility is given a rating of “N”, “R”, or “M”, provide specific details.

ADDITIONAL COMMENTS/NOTES:

Note the age of the facilities (if known) as well as any signs of overuse.

- Informal recreation site maintained by St. Joseph County.
- Notes Attached.

**Notes from Withers Road Canoe/Kayak Take-Out
Inventory and Condition Assessment - July 16 and 17, 2019**

- Withers Road Take-out is approximately at the mid-point for the Constantine Project Reservoir. The distances to the boat launch on the St. Joseph River at Three Rivers, Michigan and to the boat launch for the Constantine Hydroelectric Project are approximately equal at three miles.
- Access consists of wood frame steps with crushed stone walking surface. There are a total of five steps leading to a landing. Each step is 12 ft. wide X 2.25 ft. deep X 5 inches high.
- Parking is available for three to five vehicles along the road berm on each side of Withers Road.
- Parking area surface is gravel.
- Picnic table and trash container on site.
- Access maintained by St. Joseph County.



Canoe/Kayak take-out area along north side of Withers Road
(41.920227,-85.671257)



Canoe/Kayak Take-out looking upstream (41.92423, -85.65424)



Access drive and parking for take-out (41.889317,-85.648170)

**CONSTANTINE HYDROELECTRIC PROJECT (FERC NO. 10661)
RECREATION STUDY**

Appendix –D: Recreation Site Survey Questionnaire Results

Content:

- **Combined Online and On-Site /In-Person Recreation Survey Results**
- **Recreation Study: Online Recreation Survey Results Questions Nos. Q1 Through Q12**
- **Recreation Study: Online Recreation Survey Results Questions Nos. Q-13 Through Q15**
- **Recreation Study: On-Site/In-person Recreation Interview Results Questions Nos. Q-1 Through Q-12**
- **Recreation Study: On-Site/In-Person Recreation Interview Results Questions Nos. Q-13 Through Q-15**

CONSTANTINE HYDROELECTRIC PROJECT (FERC No. 10661)
COMBINED ON-LINE AND ON-SITE/IN-PERSON RECREATION SURVEY RESULTS

Q-1: Regarding the Constantine Project area, do you consider yourself: (1) a regular visitor to the area; (2) an occasional visitor; (3) an infrequent visitor; or (4) is this your first visit?

Visitor Type	Regular	Occasional	Infrequent	First Visit
Number	16	6	1	4
Percentage	59.3	22.2	3.7	14.8

Q-2: On this trip to the Constantine Project area, when did you arrive? When do you expect to leave the Constantine Project area? (See interview results summaries)

Q-3: During the last 12 months (including this trip), which month(s) did you visit the Constantine Project area?

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Number	2	3	8	10	19	18	13	12	10	8	4	3
Percentage	8.0	12.0	32.0	40.0	76.0	72.0	52.0	48.0	40.00	32.0	16.0	12.0

Q-4: Which of the following recreation areas at or near the Constantine Project did you visit for recreation during the past 12 months? Constantine Boat Launch (CBL); Constantine Tailwater Fishing Access (CTFA); Constantine Portage and Reservoir Fishing Access (CPORT); Riverview Park (RP); Riverview Park Boat Launch (RPBL); Shelby Park (SP); American Legion Boat Launch (ALBL); None of the above (NOA); or Other.

Site	CBL	CTFA	CPORT	RP	RPBL	SP	ALBL	NOA	Other
*Number	16	15	17	13	10	10	10	0	0

*Includes 10 visitors indicating use of all facilities during visit.

Q-5: About how many miles did you travel to get to the Constantine Project area? Average = 99.1 (See interview results summaries).

Q-6: Are you staying overnight in the Constantine Project area (not including at you own home) on this trip?

Answer	Yes	No
Number	8	19
Percentage	29.6	70.4

Q-7: If you answered yes to Q-6, at what type of accommodations will you be staying?

Accommodation	RV/Auto/Tent	Motel/Hotel	B&B	Vac. or Rental Home	Other
Number	5	2			1

Q-8: How many people (including you) are in your group? Average = 2.04 (See interview results summaries)

Q-9: Which of the following best describes your group during this trip?

Group Type	Individual	Adult Group (Over 21)	Youth Group (Under 21)	Family (with children)	Mixed Group
Number	6	12	1	1	1
Percentage	28.5	57.1	4.8	4.8	4.8

Q-10: On this trip to the Constantine Project area, in which of the following activities have you or do you expect to participate?

Activity	Bank Fishing	Boat Fishing	Pleasure Boating	Canoe/Kayak	Picnic	Swim	Sight-Seeing	Hunt	View Wildlife	Other
Number	6	5	6	2	0	0	1	0	1	0
Percent	28.6	23.8	28.6	9.5	0	0	4.8	0	4.8	0

Q-11: Of the activities you circled in Q-10 above, what is the primary activity that you participated in, or expect to participate in on this visit?

Activity	Bank Fishing	Boat Fishing	Pleasure Boating	Canoe/Kayak	Picnic	Swim	Sight-Seeing	Hunt	View Wildlife	Other
Number	5	5	6	1	0	0	1	0	0	0
Percent	27.8	27.8	33.3	5.6	0	0	5.6	0	0	0

Q-12: If you specified boating or fishing in the primary activity you participated in please rate the following:

Number (Percent)	Totally Unacceptable	Unacceptable	Neutral	Acceptable	Totally Acceptable
Safety			1 (4.8%)		20 (95.2%)
Enjoyment				1 (4.8%)	20 (95.2%)
Crowding	1			2 (10.5%)	17 (89.5%)
Overall Experience				1 (5.9%)	16 (94.1%)

Q-13: If you participated in recreational activities in the Constantine Project area today or in the past, please rate the following: Constantine Boat Launch (CBL); Constantine Tailwater Fishing Access (CTFA); Constantine Portage and Reservoir Fishing Access (CPORT); Riverview Park (RP); Riverview Park Boat Launch (RPBL); Shelby Park (SP); American Legion Boat Launch (ALBL); or Other.

	Accessibility	Parking	Crowding	Safety	Condition of Facilities	Available Facilities	Overall Experience
CBL	4.0	4.3	4.8	3.7	3.7	4.5	4.5
CTFA	4.5	4.0	3.5	3.0	4.0	3.0	3.8
CPORT	3.0	3.0	4.0	4.0	3.0	3.0	3.0
RP	4.5	4.5	4.5	4.0	4.0	4.0	4.0
RPBL							
SP							
ALBL	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Other							

Q-14: Please tell us what type(s) of recreation enhancements you believe are needed and at what specific location(s) at the Constantine Project. (See interview results summaries)

Q-15: Please share any other comments that you have regarding recreation near the Constantine Project. (See interview results summaries)

CONSTANTINE HYDROELECTRIC PROJECT (FERC No. 10661)
RECREATION STUDY: ON-LINE RECREATION SURVEY RESULTS

QUESTIONS NOS. Q-1 THROUGH Q-12

					Site Survey Question Number											Q12				
Survey No.	Home	Date	Age	Gender	Q1	Q2 date	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Safety	Enjoyment	Crowding	Experience	
1	Middlebury, Indiana	27-May-19	63	Male	1	5/27/19	5,7	CBL	15	2		1	1	2		3	4	5	4	
2	Chesterton, Indiana	4-Jun-19	67	Male	1	6/1/19	5,6	CBL	90	2		2	2	2						
3	Paw Paw, Indiana	17-Jun-19	31	Male	1	6/16/19	3,4,5,6,7,8,9,10	CBL	35	2	2	2	2	2,4		5	5	5	5	
4	White Pigeon, Michigan	14-Jun-19	26	Male	1	6/14/19	3,4,5,6	CBL,CTFA,CPORT	5	2										
5	Three Rivers, Michigan	28-Jul-19	56	Male	1	7/24/19	4,5,6,7,8,9,10	CBL,CPORT	7	2		1	1	2,7,9						
6	St. Marys, Ohio	26-Jul-19	33	Male	1	7/3/19	3,4,5,6,7,8	CBL,CTFA,CPORT,RP	150	1	5	1	2	1						
7	Sidney, Ohio	20-Aug-19	66	Male	1	8/15/19	3,4,8	CPORT	185	2										
Average			48.86						69.57			1.40				4.00	4.50	5.00	4.50	

Legend:

CTFA = Tailwater Fishing Area

RP = Riverview Park

CPORT = Canoe Portage

CBL = Reservoir Boat Launch

All = All Sites

Note: Question numbers and responses refer to the "Recreation Site Survey Questionnaire" for the Constantine Project (See Appendix B).

CONSTANTINE HYDROELECTRIC PROJECT (FERC No. 10661)

RECREATION STUDY: ON-LINE RECREATION SURVEY RESULTS - QUESTIONS Q-13 THROUGH Q-15

QUESTION NO. Q-13: If you participated in recreational activities in the Constantine Project, please rate the following.

	Constantine Boat Launch	Constantine Tailrace Fishing Access	Constantine Portage and Reservoir Fishing Access	Riverview Park
Accessibility	3,5,4	4	3	4
Parking	5,4,4	3	3	4
Crowding	5,5,5,4	3	5,3	4
Safety	3,4,4	4	4	3
Condition of Recreation Facilities	3,4,4	4	3	3
Available Facilities	4,5	3	3	3
Overall Experience	5,4	3	3	3

	Riverview Park Boat Launch	Shelby Park	American Legion Boat Launch	Other
Accessibility				
Parking				
Crowding				
Safety				
Condition of Recreation Facilities				
Available Facilities				
Overall Experience				

QUESTIONS NOS. Q-14 AND Q-15 (Combined Responses)

Question No. Q-14: Please tell us what type of recreation enhancements you believe are needed and at what specific location(s) at the Constantine Project.

Question No. Q-15: Please share any other comments that you have regarding recreation near the Constantine Project.

Survey No. 1: Trash receptacles needed at all sites. Have used Constantine Boat Launch for years. Floating dock at Constantine Boat Launch getting worn and tired from weather and use.

Fence at Constantine Boat Launch has sections broken and grass needs mowing. (Note: Fence has been replaced since visit.)

Survey No. 2: No comments.

Survey No. 3: Something should be provided to mark the drop and shallow sides of the lake/river at least up to Withers Road.

Survey No. 4: No comments.

Survey No. 5: More parking needed at Constantine Boat Launch. Floating dock needs upkeep. More walleye should be planted at Project.

Fish at Project probably more than other people and take grandchildren along. We troll for walleye and pike, and view wildlife.

Cannot express enough how this has to continue for all. What a great place. Anything I can do to help would be pleasure.

Survey No. 6: Need more access area for bank fishing at Constantine Boat Launch. Additional bank fishing should also be provided elsewhere at Project.

Survey No. 7: No comments.

Notes: Question numbers and responses refer to the "Recreation Site Survey Questionnaire" for the Constantine Project (See Appendix-B).

Ratings are based on a scale of "1 to 5" with "5" being the highest.

Survey Nos. are also those listed for Questions Q-1 through Q-12.

CONSTANTINE HYDROELECTRIC PROJECT (FERC No. 10661)

RECREATION STUDY: ON-SITE/IN-PERSON RECREATION INTERVIEW RESULTS

QUESTIONS NOS. Q-1 THROUGH Q-12

Survey No.	Site Visited	Home	Date	Age	Gender	Site Survey Question Number										Q12				
						Q1	Q2 (Arrive/Leave)	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Safety	Enjoyment	Crowding	Experience
1	CTFA	Constantine, Michigan	29-May-19	42	Female	3		6,7,8	CTFA	0.25	2		3	4	1	1	5	5	5	5
2	CTFA	Constantine, Michigan	27-May-19	20	Female	1	5-27/5-27	5,6,7,8,9,10	CTFA, CPORT, RP	0.5	2		2	2	1	1	5	5	4	5
3	CTFA	Three Rivers, Michigan	27-May-19	51	Male	1	5-27/5-27	5,9,10	CPORT	9	2		4	3	2	2	5	5	5	5
4	RP	Sherwood, Michigan	1-Jul-19	34	Female	2	7-1/7-1	6,7,8	RP		2		6	2	4	4	5	5	5	5
5	RP	Constantine, Michigan	27-May-19	61	Male	1		ALL 12	RP		2		4							
6	ALL	Wetmore, Michigan	20-Jul-19	61	Male	4	7-20/7-21	6	ALL	95	1	1	2	2	3	3,7	5	5	5	5
7	ALL	New Lothrop, Michigan	20-Jul-19	64	Male	2	7-20/7-20	5	ALL	200	1	2	2				5	5	5	5
8	ALL	Ft. Wayne, Indiana	20-Jul-19	64	Male	4	7-20/7-21	6	ALL	95	1	1	2	2	3	3	5	5	5	5
9	CTFA	Jones, Michigan	17-Jul-19	63	Male	2	7-17/7-17	2,3,4,5,6,7,8,9,10,11,12	CTFA	14	2		3	1			5	5	5	5
10	CPORT	Constantine, Michigan	27-May-19	29	Male	1		4,5,6,7,8,9	CPORT	2	2		1	1	1	1	5	5	5	5
11	CTFA	Sturgis, Michigan	27-May-19	22	Male	1	5-27/5-27	4,5,6,7,8,9	CTFA	70	2		1	1	1	1	5	5	1	5
12	CTFA	Constantine, Michigan	27-May-19	65	Male	1	5-27/5-27	3,4,5,6,7,8,9,10,11	CTFA	1	2		1	1	1	1	5	5	4	5
13	ALL	Elkhart, Indiana	16-Jun-19	52	Male	2	6-15/6-16	5	ALL	41	1	1	6	2	3	3	5	5	5	5
14	ALL	Camden, Indiana	16-Jun-19	20	Male	2	6-15/6-16	5	ALL	50	1	1	6	2	3	3	5	5	5	5
15	ALL	Schoolcraft, Michigan	15-Jun-19	75	Male	1		ALL 12	ALL	15	2		2	2	3	3	5	5	5	5
16	ALL	Schoolcraft, Michigan	15-Jun-19	35	Male	2	6-15/6-16	6	ALL	140	1	1	5	5	3	3	5	5	5	5
17	ALL	Paw Paw, Michigan	16-Jun-19	72	Male	4	6-16/6-16	5	ALL	40	2		3	2			5	5	5	
18	ALL	Bentley, Michigan	15-Jun-19	41	Male	1	6-15/6-22	5,6	ALL	1200	1	2	8	2			5	5	5	
19	ALL	White Pigeon, Michigan	15-Jun-19	71	Male	4	6-15/6-15		ALL	8	2						5	5		
20	CTFA	Sturgis, Michigan	15-Jun-19	61	Male	1	6-15/6-15		CTFA	10	2						5	5	5	
Average				50.15						110.60			2.44				5.00	5.00	4.17	5.00

Legend:

CTFA = Tailwater Fishing Area
RP = Riverview Park
CPORT = Canoe Portage
CBL=Reservoir Boat Launch
All = All Sites

Note : Question numbers and responses refer to the "Recreation Site Survey Questionnaire" for the Constantine Project (See Appendix-B).

CONSTANTINE HYDROELECTRIC PROJECT (FERC No. 10661)

RECREATION STUDY: ON-SITE/IN-PERSON RECREATION INTERVIEW RESULTS - QUESTIONS Q-13 THROUGH Q-15

QUESTION NO. Q-13: If you participated in recreational activities in the Constantine Project, please rate the following.

	Constantine Boat Launch	Constantine Tailrace Fishing Access	Constantine Portage and Reservoir Fishing Access	Riverview Park
Accessibility		5		5
Parking		5		5
Crowding		4		5
Safety		2		5
Condition of Recreation Facilities		4		5
Available Facilities				5
Overall Experience		4-5		5

	Riverview Park Boat Launch	Shelby Park	American Legion Boat Launch	Other
Accessibility			5,5,5,5,5	
Parking			5,5,5,5,5	
Crowding			5,5,5,5,5	
Safety			5,5,5,5,5	
Condition of Recreation Facilities			5,5,5,5,5	
Available Facilities			5,5,5,5,5	
Overall Experience			5,5,5,5,5	

QUESTIONS NOS. Q-14 AND Q-15 (Combined Responses)

Question No. Q-14: Please tell us what type of recreation enhancements you believe are needed and at what specific location(s) at the Constantine Project.

Question No. Q-15: Please share any other comments that you have regarding recreation near the Constantine Project.

- Survey No. 1: More docks. Repair boardwalk at Riverview Park
- Survey No. 2: Repair boardwalk at Riverview Park. Provide porta-potty and trash receptacles at Riverview Park Boat Launch. Overall, enjoy facilities and return often.
- Survey No. 3: Facilities are great. Trash receptacles should be considered. Overall, enjoy all facilities and return often.
- Survey No. 4: Kayak or canoe launch at Riverview Park.
- Survey No. 5: Swimming hole needed. Facilities are well maintained.
- Survey No. 6: Shrubbery appears to be too large along water at American Legion boat launch site.
- Survey No. 7: Beach area should be provided.
- Survey No. 8: No comments.
- Survey No. 9: Fish ladder suggested. Always accept facilities as provided.
- Survey No. 10: Portage trail needs to be cleared.
- Survey No. 11: Lighting at Tailwater Fishing Access gets shot out. Need more parking.
- Survey No. 12: Need porta-potty and trash receptacle at Tailwater Fishing Access. Existing rip-rap along reservoir embankment a good idea.
- Survey No. 13: Update bleachers and pavillion at American Legion boat launch.
- Survey No. 14: Nothing needs to be changed. Enjoy boat races at American Legion.
- Survey No. 15: Enhancements to pavillion at American Legion. Blowing leaves in river not acceptable.
- Survey No. 16: Stadium seating at American Legion. Overall, good place to come back to.
- Survey No. 17: Walleye should be stocked in reservoir. Want more boat races.
- Survey No. 18: Pit area at American Legion needs grass.
- Survey No. 19: No comments.
- Survey No. 20: More organizations to utilize the waterway. Sailing an example.

Notes: Question numbers and responses refer to the "Recreation Site Survey Questionnaire" for the Constantine Project (See Appendix-B).

Ratings are based on a scale of "1 to 5" with "5" being the highest.

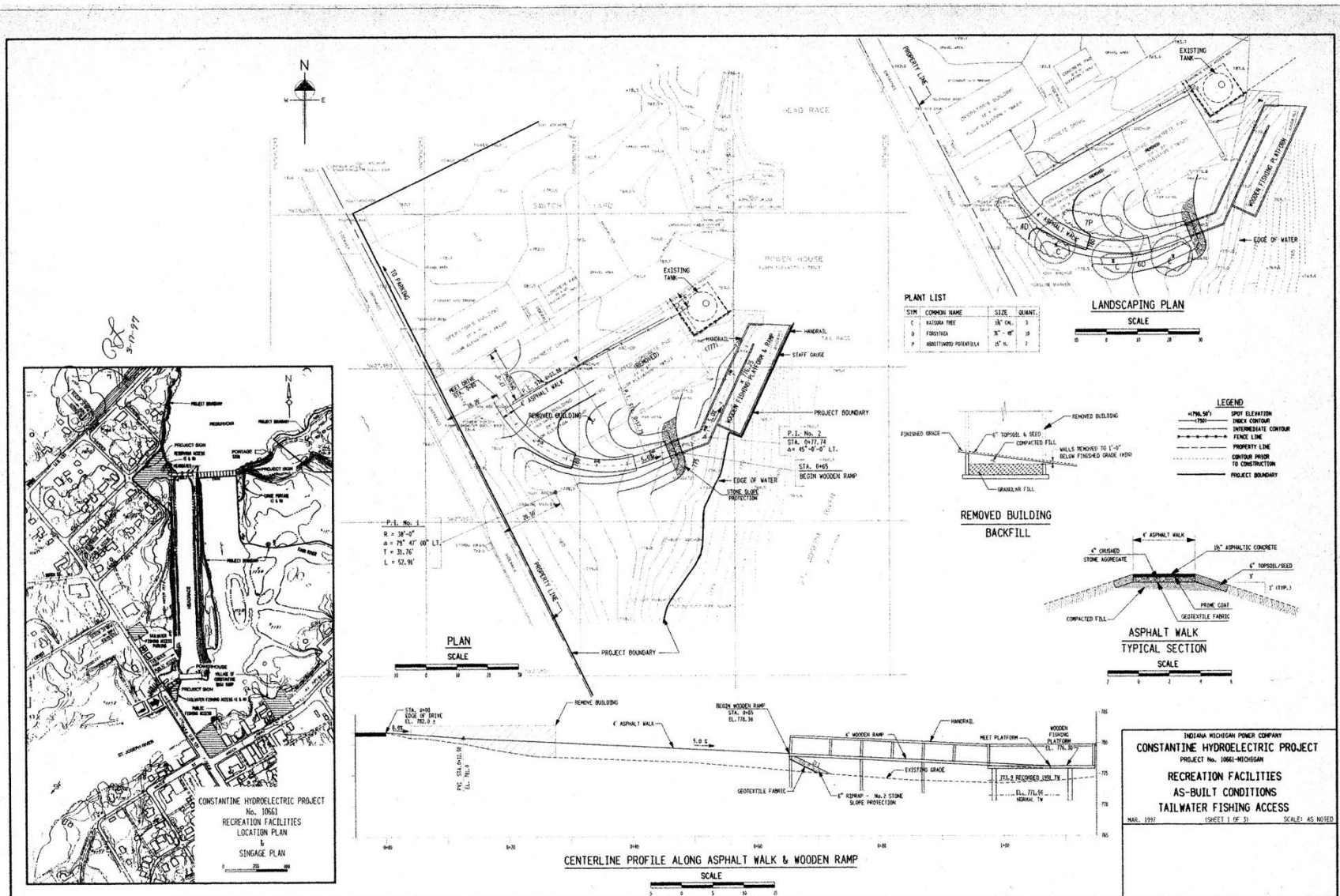
Survey Nos. are also those listed for Questions Q-1 through Q-12.

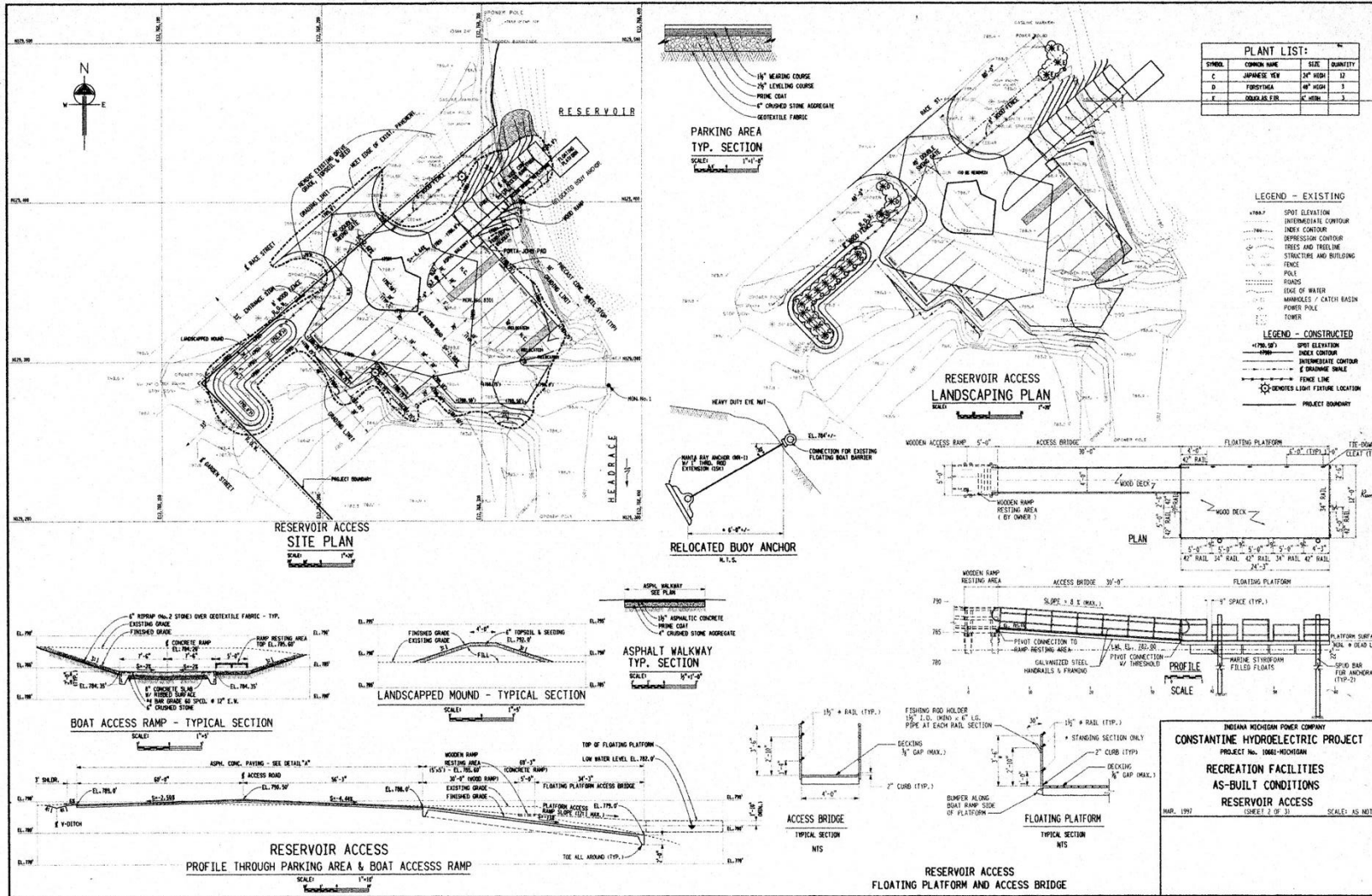
**CONSTANTINE HYDROELECTRIC PROJECT (FERC NO. 10661)
RECREATION STUDY**

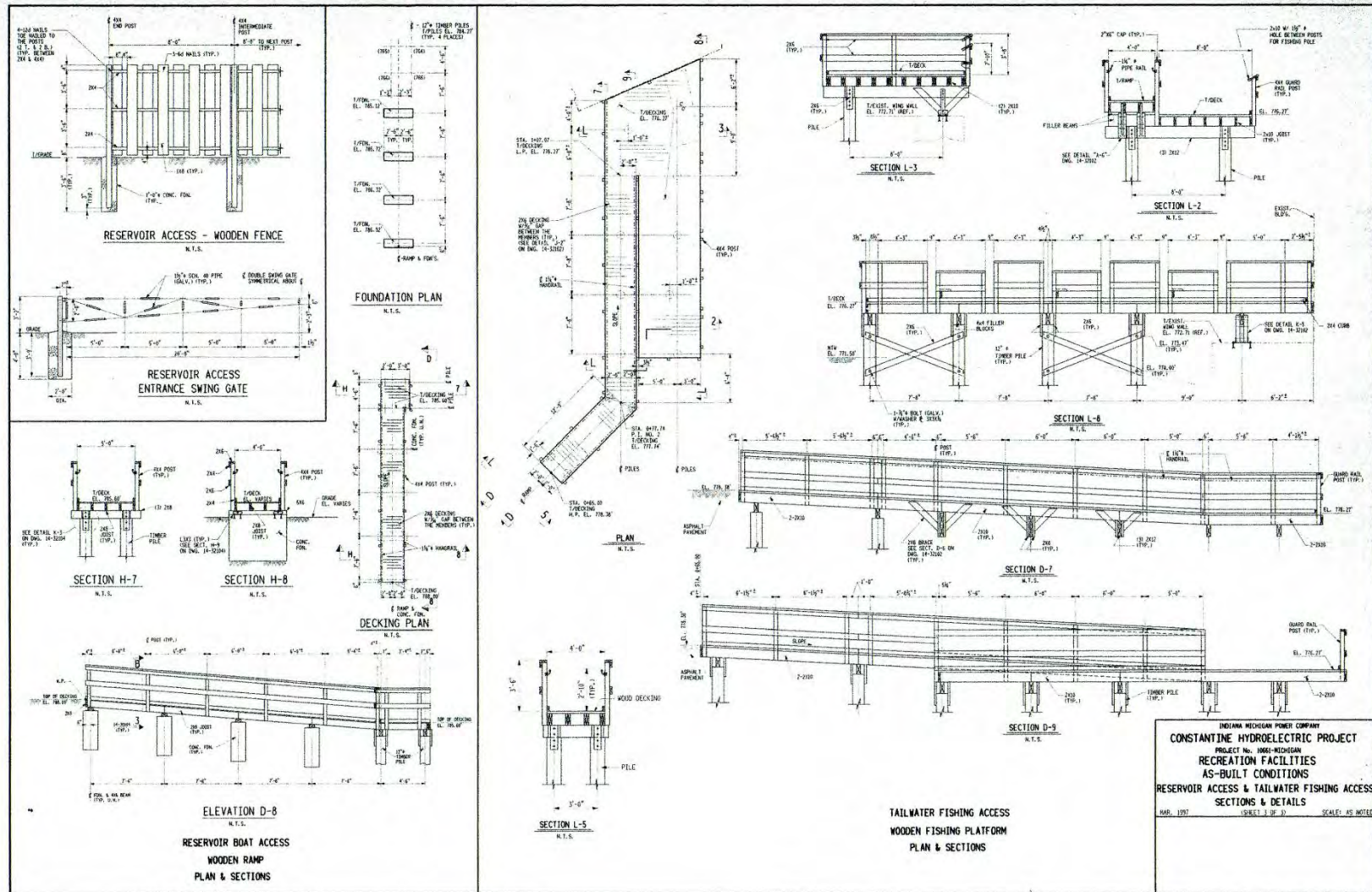
Appendix – E: Exhibit R Drawings

Content:

- **Sheet 1 of 3: Recreation Facilities As-Built Conditions Tailwater Fishing Access**
- **Sheet 2 of 3: Recreation Facilities As-Built Conditions Reservoir Access**
- **Sheet 3 of 3: Recreation Facilities As-Built Conditions Reservoir Access & Tailwater Fishing Access Sections & Details**







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**CONSTANTINE HYDROELECTRIC PROJECT (FERC NO. 10661)
RECREATION STUDY**

Appendix – F: Monthly Progress Reports

Content:

- **Progress Report No. 1 – May 2019**
- **Progress Report No. 2 – June 2019**
- **Progress Report No. 3 – July 2019**
- **Progress Report No. 4 – August 2019**
- **Progress Report No. 5 – September, 2019**

CONSTANTINE HYDROELECTRIC PROJECT (P-10661)
RECREATION STUDY – PROGRESS REPORT NO. 1
Progress through MAY 31, 2019

Introduction:

Progress Report No.1 presents the work completed by Young Energy Services (YES) through May 31, 2019 for the Constantine Hydroelectric Project (Project) Recreation Study. Included are reports by YES staff and Jim Lewis and assistant presenting the field activities accomplished during the referenced time period.

Summary:

As noted in the field reports, YES staff commenced field survey activities on Wednesday, May 22, 2019, which represents the one randomly selected weekday required under the approved Recreation Study Plan. Field surveys were then also performed on Monday, May 27, 2019 in accordance with the schedule established for the Recreation Study for the Memorial Day weekend. Weather conditions had impacts on recreation at the Project both days. However, YES staff was able to gather information for the greater part of each day at the Project and non-Project facilities identified for the Recreation Study where field information is to be obtained. The information obtained included interviews with individuals utilizing the recreation facilities resulting in the completion of ten to twelve interview/survey forms created by Indiana Michigan Power Company (I&M) for the Recreation Study.

In order to capture as many comments regarding the recreation facilities and recreation use within and around the Project as possible, YES staff created flyers that direct those individuals that YES staff were either not able to interview or did not desire to complete the survey in the field to the online survey established by HDR for I&M. To capture recreationists who were boating on the Project reservoir during the time YES staff were on site, flyers were placed on the windshields of vehicles parked at the Project and non-Project recreation facilities. A copy of the flyer is attached as part of this report.

Recreation Report-Constantine Hydroelectric Project-May 22, 2019

Time and Weather:

We had to delay our start time as we had storms and rain that lasted until about 11:00am. Arrived at 11:30am, temperature was 55° and by 12:30, it was about 70°.

Boat/Launch Lane:

Very little use in the morning. By the afternoon there was one truck with a boat trailer. Boat was not visible on the reservoir. Put a request on the windshield of the truck to complete the online visitor survey. Very little use of the area, probably due to the weather that day. (See Facility inventory for pictures). Facility Coordinates: Latitude 41.847630, Longitude -85.669464

Fishing Platform:

Again, very little use, but we were lucky to catch a fisherman about 11:00am, an 80-year-old man with two fishing lines. We were able to interview him. He was from Constantine, spends quite a bit of time fishing in the tailwater area. Says the fishing is not as good as it used to be, but he feels very safe and loves the area and very happy that it is available. Did comment that when the dock was put in at the boat launch it ruined the fishing because access to the area inside of the buoy was limited.

Portage Area:

Portage area is in very good condition. No one there all day, and I have noticed (even in prior study) that this area is not utilized. Picnic table is fair, and ADA accessible, but the trail to the picnic table is not ADA accessible. Walking trail to the canoe portage is in good shape. Facility Coordinates: Latitude 41.8473222, Longitude -85.667848

Restrooms:

Restrooms at the Canoe Portage area, as well as the Boat Launch, are in fair condition.

Trash Receptacles:

There are no trash receptacles

Constantine Riverview Park (Not I&M responsibility)

This park is maintained by the village and has a fishing dock, picnic tables and further up on shore there is a playground area. Again, few people there. One couple stopped for a few minutes to eat lunch. However, one young man (29) came to fish. Says he comes to the area almost every day to throw in a line and absolutely loves the fishing. Later in the evening he fishes from a boat. Likes the entire area and would like to see the dock at Riverview Park fixed. It is not very stable and depending on the water level is often underwater.



Boat Launch: Wood and metal are in good shape. Restroom in the background is in fair shape. Parking lot is in very good shape. May need some trimming of vegetation.



Tailwater Fishing: Wood and metal are in good shape. Needs a trash receptacle (although fisherman pointed out that if they put a receptacle here, people tend to dump their household trash).



Portage Area: Area is in very good shape and well maintained. Restroom is fair. Trail is in good shape; picnic table is fair.



Riverview Park: Park is in very good shape. Picnic tables and benches. Dock is in fair shape, however not very stable and tends to get covered according to water table.

Recreation Report-Constantine Hydroelectric Project-May 27, (Memorial Day) 2019

Time and Weather:

Again, due to rain and storms, we had to delay start time as we had storms and rain that lasted until about 9:00am. Arrived at 10:00am, temperature was 63° and by 12:30, it was about 70°.

Boat/Launch:

When we arrived, there were already 5 cars with boat trailers in the boat launch. I could not see any boats on the reservoir. We put paper requests on each car and decided to stay for a while to see if the boats came in. Nothing for a long time. Surprising for the weather, there were a lot of boats, but as the weather got nicer, I could see why people were on the reservoir. I was told that in order to interview those people (fisherman), I would have to be there at 5:00-5:30am or after it gets dark.

Constantine Riverview Park (Not I&M responsibility):

This park is maintained by the village and has a fishing dock, picnic tables and further up on shore there is a playground area. On a day like today (even though the weather was fair), this is a very popular area. Throughout the day, the park was primarily used as pass-through as many people parked there in the morning for the Memorial Day Parade. I did ask several families as they came to their cars what they thought about the park and all were very positive. This is a very clean park area that is well utilized, and the consensus is that the dock needs to be updated.

Tailwater Fishing Platform:

When I first got to the parking area for the Tailwater Fishing Platform I was very excited because there were 10 cars. I figured I would be able to get a lot of opinions. We were coming from the Boat Launch, so we couldn't see the platform. Again, it was a parking area for the Memorial Day Parade. Everyone that came got in their cars and left. We decided to run over to Riverview Park and look for people. We then returned to the Tailwater fishing platform and found 2 people fishing. A young man (29) and an older man (76). We surveyed them and asked them all the questions and talked with them about the site. Both love it there and fish all the time. The older man said that he came there almost every day. Three important comments: Trash cans, light on the building (see photos) and why isn't there a Porta-John when there is one every other site? I told them I would pass on the comments. Almost everyone comments on the porta-john and lack of a trash can. Many regulars have said that people tend to bring household trash and even steal the trash can. It would also appear that there is no level surface around the tailwater for a Porta-John. Later that afternoon, we saw more people at the Tailwater Fishing Area and went over again. It was the older man's family who came out to fish with him. The day had become very nice and it was a nice family activity. We interviewed his

son and daughter-in-law and their comments included a porta-john and a question about building the dock out further into the river.

Shelby Park:

There is not very much action in the park, but when I went in, there was a man with his grandchildren, and I asked him if he would allow me to ask him some questions (survey). He said gladly. He was born and has lived all his life in Constantine. He really enjoys the river, although the majority of the times he just goes to various sites (mainly Shelby and Riverview parks) to sit and relax. However, as I was talking to him I told him about coming to the boat races, and he happens to be the man in charge of the boat races on Father's Day. He gave me his number and told me to feel free to call him and to see him at the boat races where he would put me in contact with people to talk about the Constantine Site. I also have permission from the American Legion to be on its property during the Boat Races and ask people questions.

Portage Area:

Again, the Portage area is in very good condition. I ran into several fishermen and had them fill out the survey. One man was there with his family and grandchildren, fishing. We talked a great deal about the area, and he said that the community members were very lucky to have the site. There is a concern that someone is actually living at the Portage Site (you can see the fire pit in the photos).

The portage trail is in very poor condition. I spoke with 2 fisherman who we just coming up from the trail. It is in pretty poor shape (probably due to the rain). There is a great deal of trash (see photo) and the bridge along the trail seems to be dangerous because of the step up and down. I think that the area can be improved. If this in fact is a trail to bring a canoe or kayak through to the river, that would be difficult.

Finally, as you can see in the photos, signage at the portage is in pretty poor condition. The sign that tells about the hydro plant is old and should be replaced.

Restrooms:

Restrooms at the Canoe Portage area, as well as the Boat Launch are in fair condition.

Trash Receptacles:

There are no trash receptacles, and this topic was mentioned by almost everyone who was interviewed. One person pointed out that the trash receptacles are often stolen or used by people to dispose of household trash which makes it difficult to put trash receptacles at the sites. They are, however, the #1 topic mentioned.

Locations:

I did take screen shots of the phone GPS. Here are the various locations:

Latitude	Latitude	Latitude	Latitude	Latitude
41.846464	41.842586	41.847554	41.847376	41.842586
Longitude	Longitude	Longitude	Longitude	Longitude
-85.667793	-85.667869	-85.670328	-85.667372	-85.667869
Accuracy: 475	Accuracy: 1.81	Accuracy: 1.01	Accuracy: 1.01	Accuracy: 1.81
GPS Odometer	Try the full version	Radius on map	Radius on map	Try the full version

Canoe
Portage

Riverview
Park

Boat
Launch

Bank
Fishing

Riverview
Park

Boat Launch-No new pictures of the boat launch

Riverview Park:



There are a lot of teenagers and younger kids who like to use Riverview Park for fishing and wading.

Tailwater Fishing:



Tailwater Fishing

One of the people fishing says that he has replaced the light by himself several times and that people shoot it out. Fisherman like to fish after dark and a light would help.

Shelby Park:



Park is nice, well cared for, and is in very good shape. Signage needs work.

Portage Area:



It seems like the sign should be replaced.



You can see a fire pit (recent) and there are some signs that a person is staying there.



Step up or down from bridge can be very dangerous.



Trash (bottles and glass) left along the portage trail.

Information About Accessing Online Survey

The following information is placed on windshields of vehicles at the parking areas for the recreation facilities and provided to individuals not wanting to fill out the forms at the sites:

“I & M (Indiana Michigan Power) is conducting a Recreation Study as part of the relicensing of the Constantine Hydroelectric Project FERC No. 10661

Please participate in the Recreation Study by visiting the website below to take a brief online survey intended to gather information about recreational use at the Constantine Hydroelectric Project.

You can follow either link to get to the survey:

www.aephydro.com/HydroPlant/Constantine (click on The
Recreation Survey Link

Or go straight to this link:

https://hdrinc.co1.qualtrics.com/jfe/form/SV_by1FPypkLuQRT9z

Thank you!”

CONSTANTINE HYDROELECTRIC PROJECT (P-10661)
RECREATION STUDY – PROGRESS REPORT NO. 2
Progress: June 1 through June 30, 2019

Introduction:

Progress Report No. 2 presents the work completed and observations made by Young Energy Services (YES) related to the Constantine Hydroelectric Project (Project) Recreation Study for the period June 1 through June 30, 2019. Included are reports by YES staff, Jim Lewis and assistant, presenting the field activities accomplished during the referenced time period.

Summary:

YES staff was in the field during the Father's Day weekend (June 15 and 16) to observe activities during the scheduled boat races. As noted in the attached field report, weather had a definite impact on the boat races resulting in minimal participation by the public. YES staff also went to the recreation sites for the Constantine Project on June 28. Again, weather had an impact on recreation activities. In general, usage of the recreation facilities, both those provided by I&M and the Village of Constantine, was similar to that recorded in the month of May. Comments by the public interviewed reflected satisfaction with and appreciation for the facilities that exist.

YES staff was informed of professional hydroplane races on the river scheduled for mid-July. YES staff plans to be on-site during the races to interview spectators and observe activities.

Recreation Report-Constantine Hydroelectric Project-June 2019

June 2019 was a very strange weather month in Michigan. The usual average temperature in June is between 70° and 80°. The temperature was below average almost every day for the first 20 days of June, and most days when the temperature was average, it rained. Kalamazoo experienced a lot of rain during the first half of June (<https://wwmt.com/news/local/mother-nature-might-be-confused-kalamazoo-2019-has-seen-more-precipitation-than-seattle>). In fact, according to the National Weather Service, the Southwestern Michigan region averages about 2.7 inches of rain in June. In June 2019, Southwest Michigan had over five inches of rain. (There is not a weather station for Constantine, this is based on St. Joseph County).

We spent three days in Constantine in June. The boat races (see photos) happen the weekend of Father's Day. Instead of going only on Father's Day, we went the entire weekend (Saturday and Sunday). On both days the high temperature was approximately 65°, cloudy and overcast. Because of the weather, there were not many spectators, but we interviewed those who were there. If you look at two of the pictures, you can see that one of the popular places to watch the boat races is the Portage area. However, because of the weather, no one was there.

We also spent another day in Constantine, although again the weather was not very good and found perhaps one or two people to interview.

Boat Launch, Riverview Park, Tailwater Fishing, Shelby Park, and the Portage are all as reported in the May report. There was not a lot of use the first part of June. Interestingly, when we ask people about the area, most of them would not add anything to the area and really enjoy the opportunities presented on the river. Many of those interviewed expressed that they are aware of the fact that I&M Power provides some of the recreation facilities in the area and are happy with those that are provided.

There was one comment from people at the boat races. Apparently, there was some type of situation with the Department of Natural Resources in regard to the races and I was told that the races last year were canceled.

In mid-July, there are professional hydroplane races on the river, and we plan to be there to interview spectators. We have been told there are very powerful boats and usually a very large crowd.



Photos from boat races at Constantine Project during Father's Day Weekend

CONSTANTINE HYDROELECTRIC PROJECT (P-10661)
RECREATION STUDY – PROGRESS REPORT NO. 3
Progress: July 1 through July 31, 2019

Introduction:

Progress Report No.3 presents the work completed and observations made by Young Energy Services (YES) related to the Constantine Hydroelectric Project (Project) Recreation Study for the period July 1 through July 31, 2019. Included are reports by YES staff, Jim Lewis and assistant, presenting the field activities accomplished during the referenced time period.

Summary:

As noted in the attached field report, YES staff was at the Project on three separate days in July. Activities during those days were varied ranging from: (1) surveys and interviews on July 1 accomplished similarly as in previous months; (2) inventories and condition assessments of Project and Non-Project recreation facilities on July 17; and (3) attendance at the U.S. Title Series Boat Racing held July 21 by the American Legion. In general, use of the Project and Non-Project facilities was similar to that recorded in previous months. The exception was on July 21 when the boat races occurred. Comments provided by the public interviewed reflected satisfaction with and appreciation for the existing facilities.

Regarding the inventories and condition assessments, most Project and Non-Project recreation facilities were found to be in good condition with only minor maintenance work needed. Exceptions were the canoe portage around the spillway for the Project and the boardwalks at Riverview Park which were damaged during high river flows.

Recreation Report-Constantine Hydroelectric Project-July 2019

The weather at the beginning of July appeared to be a repeat of June. It was cool, overcast, and rainy. However, as the month progressed, we finally got into Michigan weather and even into several very hot and humid days.

There were three trips to Constantine in July. The first was completed by myself and my student (Brandon) on July 1. It was a sunny but cool, so we did not know what to expect. We got down there about 11:00 am (the main road to Constantine, Highway 131 was under construction, so it took us a while to get there). We checked all of the spots and spent the most time at the Tailwater Fishing Area and the Canoe Portage. There is nothing to report from that day because there were no cars in any of the parking areas, and no one fishing or utilizing the river.

The second trip to Constantine was with Frank Simms on July 17th. We spent time at all the areas where Frank completed maintenance reports on the Boat Launch, which is in pretty good shape. There was one car parked there, but I could not see a boat on the lake, so I left a flyer on the windshield. We spent time at the Tailwater fishing area where we saw two men fishing, one of the men with his grandchildren. I took advantage of meeting the men and interviewed one of them. While we were there, one of the men caught several fish, one which was approximately 17-inch small mouth (see photo). Again, Frank conducted measurements and we talked with the men for a while. We went to the Canoe Portage and again Frank took measurements. We walked down the portage trail. As I reported earlier, the trail is not in the greatest shape, and needs work. It would be very difficult to portage canoes or kayaks, through that trail. Frank and I also took a walk on the boardwalk through Riverview Park, most of which has been destroyed by flooding. I know that they had severe flooding in the Spring, and we were able to discuss the flooding with a man who was exercising his dog. The water was powerful and high enough to move several sections of the boardwalk. He said that he had heard that it was going to be repaired but didn't know when.

Our final day in Constantine in July (me and Brandon) was July 21st. We did a run through of all the areas but saw no cars or people. However, July 21st was the U.S. Title Series Boat Racing. We spent a great deal of time at the American Legion Post, site of the racing. We were lucky enough to talk to several people in the crowd, and then spend time walking through the competitor pit areas and even talk to some of the competitors. July 21st was a beautiful, sunny day and a perfect day for racing. Most of the people who attend the races come only for the races, but like the area (usually come each year). All of them were very complimentary of the area, the river (reservoir), the competition, and the community.

Interestingly, when we interview people and ask them the final question on the interview sheet pertaining to what they would add to make the river a better place, almost no one would add or change a thing. Brandon and I spent time watching the race (this was a higher class of boats

then the June races and much faster) and walking through the areas observing license plates. On the following pages you will see pictures of the area, several boats on the course and other pictures of the pit area.

Automobile Count:

We conducted an automobile count at the Boat Races. This is what we found:

50 Cars

Michigan Plates: 21

Out of State Plates

Florida 5

New York 1

Indiana 3

Iowa 10

Illinois 6

Connecticut 1

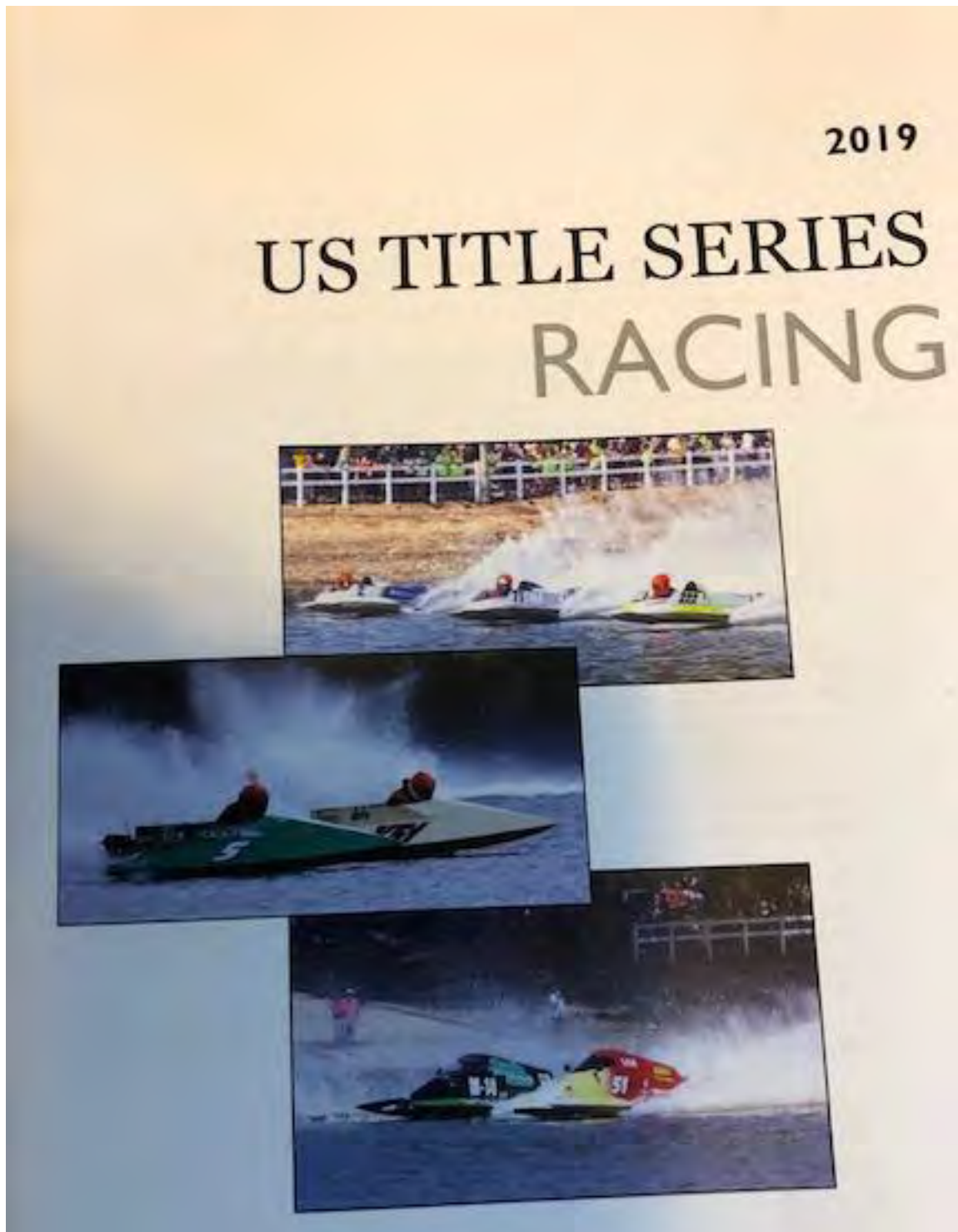
Ohio 1

Wisconsin 1

South Carolina 1



July 17th, Constantine Tailwater Fishing, 17.5-inch small mouth bass.



This is the program for the weekend of racing at Constantine. There are 2-3 weekends of racing, the highest class of boat races July 19-21.



Two of the boat classes. Both of these are lower classes because they do not have enclosed cockpits





This is a picture of the pits from outside the fence.



This is the parking for competitors who come from all over the Midwest.



One of the boats racing on the course.



Better picture of a higher class of boat.



This is probably the largest participant in the racing. They had about 4 boats from different classes. We had a chance to discuss the races with one of their crew chiefs.



Some of the viewers. It was a very nice day for racing.

CONSTANTINE HYDROELECTRIC PROJECT (P-10661)
RECREATION STUDY – PROGRESS REPORT NO. 4
Progress: August 1 through August 31, 2019

Introduction:

Progress Report No.4 presents the work completed and observations made by Young Energy Services (YES) related to the Constantine Hydroelectric Project (Project) Recreation Study for the period August 1 through August 31, 2019. Included is the report by YES staff, Jim Lewis and assistant, presenting the field activities accomplished during the referenced time period.

Summary:

YES staff was at the Project for two days in August observing activities at the Project and Non-Project recreation sites. Use of the sites was similar to that recorded for the previous months. Of note was the number of vehicles observed at Village of Constantine's Riverview Park. It was also observed that the fencing at the entrance to the Project Reservoir Boat Access which had been noted during the inventory and condition assessments in July as having sections failing was replaced. As for the bridge section in front of the headgate structure shown in the field report photographs attached, it is utilized as a log boom to keep larger floating debris from entering the Project headrace.

Recreation Report-Constantine Hydroelectric Project-August 2019

There were two trips to Constantine in August. The first was completed by myself and my student (Brandon) on August 15th. Temperature wise it was warm, but it was an overcast day. We checked all of the spots and spent the most time at the boat launch speaking with a fisherman about the area. There is very little to report from that day because there were no cars in any of the parking areas, and no one fishing or utilizing the river except for the one person we talked with. In the photos you will notice one picture that is a concern at the entrance to the Portage area. Everyone walks around the gate since it is locked and on one side there is a wire that is about head high that can easily cut a person walking. We also noted that the fence on the side yard of the boat launch was being rebuilt.

The second trip to Constantine was on August 25th. We spent time at all the areas and ran into quite a few people fishing at the canoe portage area. That is sort of unusual because we rarely saw people there fishing. It was interesting because one group of young men had never been fishing there and were anxious to fish. The minute they threw in their lines, one person immediately caught a fish. We interviewed all of them and there was another couple who told me that he comes fishing on the at least three times a week. He points out that about a year ago AEP did construction on the dam and left a walkway in that seems to have ruined the fishing from the boat launch. He has no idea why the walkway was left in, and I told him that I would take pictures and see if we could find an answer. We also found that there were about 7-8 trucks parked at Riverview Park that day (it was a Sunday). No one was there, so I am assuming that they launched some type of boat or kayaks for a day on the river. Seven of the license plates were Michigan, the eighth was from Texas.



Fishermen asked about this bridge. It was put in for construction about a year ago and has created some problems for fishing. Why is it still there?



This is actually wire that is about the height of one's head. It is also sharp. It was a fence to prevent people from walking around the gate, but it is now just pieces of the fence left over.



New fence at the boat launch. (It is now complete.)



Fishermen want to know if this can be cleared to allow more fishing at the portage site. (it is at the bottom of the stairs).



The clearing (in the previous picture,) would be to the left of this fisherman.

CONSTANTINE HYDROELECTRIC PROJECT (P-10661)
RECREATION STUDY – PROGRESS REPORT NO. 5
Progress: September 1 through September 30, 2019

Introduction:

Progress Report No. 5 presents the work completed and observations made by Young Energy Services (YES) related to the Constantine Hydroelectric Project (Project) Recreation Study for the period September 1 through September 30, 2019. Included is the report by YES staff, Jim Lewis and assistant, presenting the field activities accomplished during the referenced time period.

Summary:

As noted in the attached summary of field activities, YES staff was at the Project on September 27 and 29. For one of those days (September 29), weather conditions were such that recreation activities at the Project were non-existent. On the 27th, recreation activities were observed as were improvements made by the Village of Constantine at Riverview Park and by I&M at the Reservoir Boat Launch. Inclement weather precluded recreation activities taking place during the weekend days for the Labor Day holiday.

The observations made during the month of September represent the conclusion of field work for the Recreation Study. Information collected during interviews of individuals at the Project and Non-Project related recreation facilities is being reviewed and assembled along with the condition inventories and assessments. The surveys submitted electronically by recreationists will need to be obtained in order to be incorporated into the Recreation Study Report to be prepared by YES for the Constantine Hydroelectric Project.

Recreation Report-Constantine Hydroelectric Project-September-2019

There were two trips to Constantine in September. The first was Friday, September 27th. It was cool and overcast that day and there was not a lot going on. The first thing that I did was to go to the American Legion and check out the condition of the boat launch and shoreline. The Legion has a very nice boat launch and the shoreline is accessible in a lot of places. Anyone can use the shoreline if they purchase a permit from the Legion. I have no idea how many permits they sell because I have never observed anyone using the area by the Legion.

From there I went to the boat launch. There were two trucks with boat trailers at the boat launch. I put flyers on the windshields directing them to the web site. They have also put up a new fence along the property (City or AEP..see photo). After that I checked all of the spots. It was interesting because I was at Riverview Park and as I drove up I noticed people launching a boat with electronic equipment on it. I went to the area and took pictures and they came in to speak with me. They were from GLEC in Traverse City, a firm that is doing a fish count for HDR. We talked for a little while about the area and then I noticed that at Riverview the boat launch has been improved with new retaining walls and gravel (see photo's). They have done a great job fixing it up. (Another photo from across the river shows all the gravel). Aside from that there were very few people around, but I did notice someone fishing near the dam. I went over to the tailwater fishing area and noticed that the fisherman was someone who I had interviewed on a previous trip. We sat and talked about the river and fishing and as I have said, a lot of people are very content with the fishing in the area. One observation that I did make was the silt buildup by the boat launch which is probably the result of the lowering of the river.

I planned to go on Sunday, September 29th and got there and it poured. Of course, there were not boats on the river and there was no fishing. The storm started Friday, let up for a while at Saturday, and started again Saturday night. By Sunday afternoon, Constantine had received about 2 inches of rain.

American Legion Boat Launch

Latitude: 41.850980

Longitude: -85.666892



Permit Sign at American Legion Boat Launch



Movable Dock at American Legion (used for boat races)



Boat Launch at the American Legion



Shoreline at the American Legion



Completed fence at I&M Reservoir Boat Launch



Silt at the I&M Boat Launch



Side of the boat launch at Riverview Park



Improvements at Riverview Park

Appendix I. Cultural Resources Study
(filed as privileged)