# Shiawassee River Qualitative Assessment: Davis Lake to Mill Pond Dam

Davisburg, Oakland County, Michigan

January 19, 2022





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		Date	19 January 2022

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# 1 Introduction

# 1.1 Project Purpose

Springfield Charter Township (SCT), in partnership with Oakland County Parks and Recreation (OCPR) and North Oakland Headwaters Land Conservancy (NOHLC), contracted Cardno to complete a qualitative assessment of the biological community and stream habitat associated with the reach of the Shiawassee River from the inlet of Davis Lake, upstream to the Mill Pond Dam at Davisburg Road. Additionally, a survey of the aquatic plant community and baseline water quality sampling was completed in Davis Lake. The current assessment is similar in scope to the study completed in 2019 which assessed the Shiawassee River from the outlet of Davis Lake to Long Lake. Standard survey protocols were used during the assessment and sampling locations documented to allow for future sampling efforts as desired. The data collected during this study can be used as baseline community data for fish, macroinvertebrates, mussels, available instream and surrounding riparian habitat in the Shiawassee River and the aquatic plant community in Davis Lake. Results of the various assessments are used to qualitatively describe the biological integrity and habitat quality in the project area. A general discussion of the results is presented in the report and general recommendations for follow-up assessment efforts provided.

# 1.2 Project Location

The sampling area is located on a combination of SCT, NOHLC and OCPR property immediately north and east of the Town of Davisburg, Oakland County Michigan. Specifically, the Shiawassee River was assessed between Davis Lake and Davisburg Road with a total stream length of approximately 2,075 ft (Figure 1). The Shiawassee River in this location is considered to be in the headwaters of the drainage as the sampling reach is located approximately 1.8 miles downstream from the start of the drainage which begins at Shiawassee Lake.



Figure 1. Project location map.

# 2 Assessment Methods

# 2.1 Methods Introduction and Sampling Reaches

A goal of this study was to utilize standardized sampling protocols so future assessments could replicate efforts as needed to track the various biological communities and habitat features over time. Survey protocols used for this study included the Michigan Surface Water Assessment Section (SWAS) Procedure 51 (MDEQ, 2008) for fish, macroinvertebrates and habitat, the Michigan Freshwater Mussel Survey Protocols (MDNR, 2021) and the Michigan Department of Environmental Quality's (MDEQ) Procedures for Aquatic Vegetation Surveys (MDEQ, 2005). The project area was separated into three distinct reaches referred to as Reach 1, Reach 2 and Reach 3 (Figure 2). Reach 1 is the most downstream portion of the project area and extends from the westside of Eaton Road to Davis Lake and is approximately 700 ft in length. Reach 2 is located to the east of Eaton Road and continues southeast to the railroad tracks for a length of 1,300 ft. Reach 3 is located from the south side of the railroad tracks to the outfall of the Mill Pond Dam, just north of Davisburg Road and is 125 ft in length.

Fish, macroinvertebrates and habitat were sampled on August 10-11, 2021 at one location within each of the designated reaches (Figure 2). Sampling locations were selected based on available habitat within each of the reaches and worked to sample various habitat types as available (ex. riffle, pool, run, glide, undercut banks, aquatic vegetation, and woody debris). Due to the reduced length of Reach 3, the entire length of the area was sampled. Reach 1 was composed primarily of pool, glide and run habitat, with abundant aquatic vegetation and some undercut banks. Reach 2 had a variety of riffle, run, pool and glide habitats with a moderate amount of woody debris, and reduced amounts of aquatic vegetation and undercut banks. Reach 3 was composed of riffle habitat in the downstream 100 ft and then pool habitat at the upstream extent where the dam outfall structure was located. Mussel survey efforts were completed following fish and macroinvertebrate sampling on August 10-11, 2021 and occurred within the areas shown in Figure 2.

Prior to sampling activities Cardno staff member Thomas Estrem acquired the necessary Michigan collection permits. These include a state Scientific Collectors permit and state Threatened and Endangered Species permit. Copies of the permits can be found in Appendix A.



Figure 2. Procedure 51 sampling reaches and mussel reconnaissance extents, Oakland County, Michigan.

# 2.2 Procedure 51 Sampling: Fish, Macroinvertebrates and Habitat

#### 2.2.1 <u>Fish</u>

Fish were sampled utilizing a Smith Root LR-24 backpack electrofishing unit. Electrofishing efforts were completed within the areas shown in Figure 2 and sampled in an upstream manner. The stream length sample in Reach 1 was 300 ft, Reach 2 350 ft and Reach 3 125 ft. Due to a low number of fish collected during the sampling effort, Reach 1 was fished through twice and a total effort of 45 minutes was spent actively working to collect fish. Reach 3 due to the reduced length of the survey area was fished through multiple times and total of 45 minutes was spent sampling. Fish collected during sampling efforts were identified to species, length group recorded and any abnormalities noted. Fish community data was analyzed using the Procedure 51 fish assessment metrics to develop an overall rating of the sampled communities.

#### 2.2.2 <u>Macroinvertebrates</u>

Macroinvertebrate sampling consisted of 20 minutes of active collection effort within each sampling reach by two people for a total effort of 40 person minutes. Collections were made using triangular or d-shaped dip nets and all habitat types were sampled (ex. aquatic vegetation, bottom of rocks, undercut banks, woody-debris, run and pool habitats). Due to a generally low number of organisms present, subsampling of available individuals was not necessary and therefore all organisms were retained for identification and enumeration. All organisms collected were identified to family level and analyzed using the Procedure 51 macroinvertebrate metrics to develop an overall rating of the sampled communities.

#### 2.2.3 <u>Habitat</u>

Procedure 51 habitat assessment for glide/pool streams were completed within Reach 1 and Reach 2 while the riffle/run streams assessment was completed in Reach 3. To assess habitat features, two times the length of the fish/macroinvertebrate reaches were investigated. Of the 10 metrics used for assessment, seven are the same for both glide/pool and riffle/run, while three are different depending on assessment type. These variations in assessment metrics is described in more detail in Section 3.3. Habitat assessments included instream habitat, channel morphology, bank structural features and riparian vegetation. Habitat data was analyzed using the Procedure 51 assessment metrics to develop an overall rating of the available habitat.

#### 2.3 Mussel Reconnaissance Survey

Qualitative mussel sampling was completed using both visual and excavation techniques. The goal of the mussel sampling effort was to develop a species list of the site rather than a determination of species densities. Two persons utilizing snorkeling gear searched the entire channel working in an upstream direction. Visual observations of siphoning mussels were the primary method to locate individuals; however, random 0.5 square meter excavations of the streambed were completed to assist in mussel collections. A total of four person hours were spent actively searching for mussels within the specified search reaches (Figure 2). All mussels collected were identified to species, representative species photos taken and returned to the streambed in the location collected. A tally of the number of individuals was not collected and only a species list was documented.

#### 2.4 Water Chemistry Sampling

#### 2.4.1 Shiawassee River

General water chemistry sampling was completed on August 11, 2021 in conjunction with Procedure 51 sampling efforts. Water chemistry was sampled at Eaton Road and is considered representative for Reaches 1 and 2. Reach 3 was sampled at the pedestrian bridge. Parameters sampled included: water temperature, conductivity, pH, dissolved oxygen (% and mg/L) and turbidity.

#### 2.4.2 Davis Lake

General water chemistry within Davis Lake was sampled on August 9, 2021 in conjunction with the Davis Lake aquatic plant survey. Sampling was completed at a point in the middle of the lake as shown in Figure 3. Parameters assessed from the surface of the water column include pH, conductivity, transparency (secchi disk) and turbidity. Additionally, a dissolved oxygen (% and mg/L) and temperature profile of the water column was sampled at one-meter intervals.

#### 2.5 Aquatic Plant Survey

The aquatic plant survey of Davis Lake was conducted on August 9, 2021 utilizing the survey procedures detailed in the MDEQ's Procedures for Aquatic Vegetation Surveys. Fourteen aquatic vegetation assessment sites (AVAS) were established on approximately 200 ft intervals along the shoreline. Each AVAS began within the shallow emergent vegetation of the littoral zone and extended perpendicular to the shoreline into the lake. A drag rake was used to determine the identity and density of the deeper submerged vegetation, as well as finding the end of the AVAS when the submerged vegetation was no longer found. A complete list of the herbaceous species and charophytes (stoneworts) encountered during the survey along each AVAS was kept and assigned a numeric value ranging from one through 37.

Each numeric value was used to compile an inventory of the species encountered at each AVAS and assigned a letter relating to the percent cover range shown below.

- A) Found: Coverage less than two percent of the total AVAS surface area
- B) Sparse: Coverage from two through 20 percent of the total AVAS surface area
- C) Common: Coverage from 21 to 60 percent of the total AVAS surface area
- D) Dense: Coverage greater than 60 percent of the total AVAS surface area

An example of this notation from the survey using *Elodea canadensis* (common waterweed) is 1B, which meant that common waterweed had a density of two through 20 percent within the specific AVAS sampled. This method was replicated throughout each of the 14 AVAS sampled to determine the cumulative coverage of each species throughout Davis Lake. This data was processed following the MDEQ procedure.



Figure 3. Davis Lake aquatic plant survey map.

# 3 Results

# 3.1 Fish

Results of fish sampling efforts are displayed in Tables 1-3. In general, fish abundance (number of individuals collected) was low with 23 individuals collected in Reach 1 and 62 individuals collected in both Reach 2 and 3. Fish species assemblages were similar between sampling sites. Reach 3 had the most species collected at 10, followed by Reach 2 with nine and Reach 1 with seven (Tables 1-3). All species collected are common to the region and are not listed by State or Federal agencies. Species collected at all sites include rock bass, yellow bullhead, bluegill, warmouth and largemouth bass. Species collected at two sites include pumpkinseed sunfish, longear sunfish and common shiner. Species collected at only one site include grass pickerel (Reach 1), lake chubsucker (Reach 2), black bullhead (Reach 3) and green sunfish (Reach 3). In general, rock bass was the most abundant species collected within the project area, followed by bluegill, yellow bullhead and largemouth bass. Common shiner was locally abundant at reach two. Reach 3 was only location with a sucker species collected (lake chubsucker). No darter species were collected within any of the reaches despite suitable habitat such as riffles at Reach 2 and 3. Fish sampling datasheets are available in Appendix B and some representative species photos are available in Appendix C.

Species	Common Name	# Collected	Relative Abundance
Ambloplites rupestris	Rock Bass	8	34.8%
Ameiurus natalis	Yellow Bullhead	3	13.0%
Esox americanus vermiculatus	Grass Pickerel	1	4.3%
Lepomis gibbosus	Pumpkinseed Sunfish	1	4.3%
Lepomis gulosus	Warmouth	1	4.3%
Lepomis macrochirus	Bluegill	3	13.0%
Micropterus salmoides	Largemouth Bass	6	26.1%
Tot	23	100.0%	

Table 1. Reach	l fish	sampling	results,	August	10,	2021.
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#### Table 2. Reach 2 fish sampling results, August 10, 2021.

Species	Common Name	# Collected	Relative Abundance
Ambloplites rupestris	Rock Bass	8	12.9%
Ameiurus natalis	Yellow Bullhead	2	3.2%
Erimyzon sucetta	Lake Chubsucker	1	1.6%
Lepomis macrochirus	Bluegill	9	14.5%
Lepomis gulosus	Warmouth	1	1.6%
Lepomis megalotis	Longear Sunfish	7	11.3%
Luxilus cornutus	Common Shiner	29	46.8%
Micropterus salmoides	Largemouth Bass	3	4.8%
Semotilus atromaculatus	Creek Chub	2	3.2%
Tot	tal	62	100.0%

Species	Common Name	# Collected	Relative Abundance
Ambloplites rupestris	Rock Bass	19	30.6%
Ameiurus natalis	Yellow Bullhead	9	14.5%
Ameiurus melas	Black Bullhead	1	1.6%
Lepomis cyanellus	Green Sunfish	2	3.2%
Lepomis gibbosus	Pumpkinseed Sunfish	7	11.3%
Lepomis gulosus	Warmouth	2	3.2%
Lepomis macrochirus	Bluegill	18	29.0%
Lepomis megalotis	Longear Sunfish	2	3.2%
Luxilus cornutus	Common Shiner	1	1.6%
Micropterus salmoides	Largemouth Bass	1	1.6%
Το	Total		

#### Table 3. Reach 3 fish sampling results, August 11, 2021.

Procedure 51 fish community assessment scoring is displayed in Table 4. For metric scoring interpretation reference the following designations are defined:

- +1 = community is performing better than the average conditions found at an excellent site;
- 0 = community is performing between the average condition and minus two standard deviations from the average condition found at an excellent site;
- -1 = community is performing outside of two standard deviations from the average conditions found at the excellent site.

Overall site scores of +5 or higher are classified as excellent and scores of -5 or lower being classified as poor. Acceptable sites, are scored between excellent and poor in the range of +4 to -4. A site with a positive score of +4 or less is tending toward excellent. A site with a negative score of -1 to -4 is tending toward poor. Scores of 0 are considered neutral. It is important to note when less than 50 individuals are collected at a site, that site is automatically classified as poor, which happened to be the situation during the sampling effort at Reach 1.

Reach 2 had the highest score at +3 and Reach 1 and 3 each had a score of -1. A score of +3 at Reach 3 is rated as acceptable and tending towards excellent. A score of -1 at Reach 1 and 3 is rated as acceptable but tending towards poor. Reach 1 though is automatically designated a rating of Poor due to the collection of less than 50 individuals. Reach 2 achieved a higher score than the other two reaches primarily because it received scores of +1 in % insectivore and % simple lithophilic spawners metric. This occurred due to the increase in number common shiners collected in Reach 2. Metrics which received +1 scores at all sites included number of sunfish taxa, % tolerant individuals and % piscivore individuals. Metrics which received -1 scores at all sites included number of darter taxa, number of sucker taxa and number of intolerant taxa.

Fish Metric	Reach 1	Reach 2	Reach 3	Reach 1 Metric Score	Reach 2 Metric Score	Reach 3 Metric Score	
Total Taxa	7	9	10	0	0	0	
Darter Taxa	0	0	0	-1	-1	-1	
Sunfish Taxa	4	4	6	1	1	1	
Sucker Taxa	0	1	0	-1	-1	-1	
Intolerant Taxa	1	1	1	-1	-1	-1	
% Tolerant	13.0	6.5	17.7	1	1	1	
% Omnivore	13.0	6.5	16.1	1	1	0	
% Insectivore	17.4	74.2	48.4	-1	1	0	
% Piscivore	65.2	17.7	32.3	1	1	1	
% Simple Lithophilic Spawners	0	46.8	1.6	-1	1	-1	
			Total Score	-1	3	-1	
	Poor*	Acceptable (Tending toward excellent)	Acceptable (Tending toward poor)				
*Less than 50 individuals collected so automatically classified as poor: Reach 1 had 23 individuals.							

#### Table 4. Procedure 51 fish metric scoring results.

# 3.2 Macroinvertebrates

Results of the macroinvertebrate sampling are displayed in Tables 5-7. Reach 1 had the greatest number of families collected at 14, followed by Reach 2 with nine and Reach 3 with four. Overall, the total number of families identified between both sites was 16. Total number of EPT taxa (Ephemeroptera-mayflies, Plecoptera-stoneflies, and Trichoptera-caddisflies), which are generally indicative of high water quality, was seven (two Ephemeroptera and five Trichoptera). No stonefly families (Plecoptera) were collected. Dominant taxa's in Reach 1 were Amphipoda, Isopoda and Chironomidae. These taxa were only the most abundant in Reach 1 compared to the other reaches and is suggested to be correlated with slower water currents and increased density of aquatic vegetation present in Reach 1. Reach 1 had the greatest diversity of Ephemeroptera and Trichoptera with six taxa collected (Table 5). Reach 2 dominant taxa were Chironomidae, followed by Hydropsychidae and Elmidae. Reach 3 was dominated by the Hydropsychidae taxa. Macroinvertebrate field and laboratory datasheets are provided in Appendix B.

Phylum	Class	Order	Family	# Individuals
Arthropoda	Malacostraca	Amphipoda		31
Arthropoda	Malacostraca	Isopoda		37
Arthropoda	Insecta	Ephemeroptera	Baetidae	1
Arthropoda	Insecta	Ephemeroptera	Siphlonuridae	1
Arthropoda	Insecta	Odonata	Aeshnidae	2
Arthropoda	Insecta	Hemiptera	Naucoridae	1
Arthropoda	Insecta	Trichoptera	Calamoceratidae	1
Arthropoda	Insecta	Trichoptera	Hydropsychidae	7
Arthropoda	Insecta	Trichoptera	Limnephilidae	1
Arthropoda	Insecta	Trichoptera	Polycentropidae	8
Arthropoda	Insecta	Coleoptera	Elmidae	4
Arthropoda	Insecta	Diptera	Chironomidae	31
Arthropoda	Insecta	Diptera	Simuliidae	4
Arthropoda	Insecta	Diptera	Nymphomyiidae	1
			Total Individuals	130

Table 5. Reach 1 macroinvertebrate sampling results, August 10, 2021.

Phylum	Class	Order	Family	# Individuals
Arthropoda	Malacostraca	Amphipoda		2
Arthropoda	Malacostraca	Isopoda		3
Arthropoda	Insecta	Trichoptera	Hydropsychidae	17
Arthropoda	Insecta	Trichoptera	Philopotamidae	5
Arthropoda	Insecta	Trichoptera	Polycentropodidae	2
Arthropoda	Insecta	Coleoptera	Elmidae	15
Arthropoda	Insecta	Diptera	Chironomidae	19
Arthropoda	Insecta	Diptera	Simuliidae	1
Arthropoda	Insecta	Diptera	Tipulidae	4
			Total Individuals	68

Table 6. Reach 2 macroinvertebrate sampling results. August 10, 2021.

Table 7. Reach 3 macroinvertebrate sampling results, August 11, 2021.

				#
Phylum	Class	Order	Family	Individuals
Arthropoda	Insecta	Trichoptera	Hydropsychidae	90
Arthropoda	Insecta	Trichoptera	Philopotamidae	3
Arthropoda	Insecta	Coleoptera	Elmidae	10
Arthropoda	Insecta	Diptera	Simuliidae	3
			Total Individuals	106

Procedure 51 macroinvertebrate metric scoring results are displayed in Table 8. Metric scoring interpretations are the same as that discussed for fish in Section 3.1. All three reaches had a score of -2 which is considered acceptable but tending toward poor. Scoring metrics receiving scores of -1 at all sites include number of stonefly taxa and percent mayfly individuals. Percent surface dependent was the only metric receiving a +1 at all sites. Number of caddisfly taxa was the only metric with a score or 0 at all sites.

Invertebrate Metric	Reach 1	Reach 2	Reach 3	Reach 1 Metric Score	Reach 2 Metric Score	Reach 2 Metric Score
Total Taxa	14	9	4	0	-1	-1
Mayfly Taxa	2	0	0	0	-1	-1
Caddisfly Taxa	4	3	2	0	0	0
Stonefly Taxa	0	0	0	-1	-1	-1
% Mayfly	1.5	0	0	-1	-1	-1
% Caddisfly	13.1	35.3	87.7	0	1	1
% Dominance	28.5	27.9	84.9	0	0	-1
% Isopod, Snail, Leech	28.5	4.4	0	-1	0	1
% Surface Dependent	0.8	0	0	1	1	1
			Total Score	-2	-2	-2
				Acceptable	Acceptable	Acceptable
		Ad	jective Rating	(Tending toward	(Tending toward	(Tending toward
				poor)	poor)	poor)

# 3.3 Habitat

Table 9 displays the results of the Procedure 51 habitat assessments. Reach 1 and Reach 2 were each assessed using the glide/pool metrics while Reach 3 was assessed with riffle/run metrics. As stated in Section 2.2.3, seven of the 10 metrics used for assessment are the same between glide/pool and riffle/run designations, while three are specific to either glide/pool or riffle/run. Reach 2 had the highest score with 154 and was the only reach with an "excellent" designation. Reach 1 had a score of 150 and Reach 2 a score of 149, which are both assigned a "good" rating. Three metrics received a rating below excellent or good in Reach 3 and included velocity/depth variability, channel alteration and riparian vegetation zone width. Velocity/depth variability was assigned a marginal rating because there was not a diversity of riffle/run habitats present and the primary flow was fast and shallow. Reach 3 is the only reach with significant channel alteration and a reduced riparian vegetation width which resulted in marginal scores. Reach 2 had two metrics receive a rating of below excellent or good and included pool variability and channel sinuosity. In Reach 2 shallow pools (<3 ft) were prevalent causing the metric to be assigned a marginal rating and sinuosity was less than 2 which is assigned a marginal rating. Reach 1 had two metrics score below excellent or good which included pool variability and channel sinuosity. Pool variability was assigned poor due to a lack of deep pools and channel sinuosity was considered poor due to the straight pattern of the channel. Overall habitat ratings are high due to the relatively unaltered stream channel profile, pattern and dimension (Reach 1 and 2), high guality/wide riparian areas (Reach 1 and 2), stable streambanks, vegetation cover and maintained flow status. Procedure 51 habitat assessment datasheets are available in Appendix B and representative sites photos available in Appendix C.

			Reach 1 (Glide/Pool-GP)		Reach 2 (Glide/Pool-GP)		Reach 3 (Riffle/Run- RR)	
Habitat Parameter		Max Score	Score	Condition Category	Score	Condition Category	Score	Condition Category
1. Epifaunal Substrate/Available Cover		20	14	Good	16	Excellent	14	Good
2. Pool Substrate Characterization (GP) or Embeddedness (RR)		20	15	Good	16	Excellent	16	Excellent
3. Pool Variability (GP) or Velocity/Depth Combinations (RR)		20	5	Poor	9	Marginal	9	Marginal
4. Sediment Deposition	on	20	13	Good	15	Good	18	Excellent
5a. Channel Flow Status- Maintained Flow Volume		10	10	Excellent	9	Excellent	10	Excellent
5b. Channel Flow Status- Flashiness		10	10	Excellent	9	Excellent	10	Excellent
6. Channel Alteration		20	20	Excellent	20	Excellent	10	Marginal
7. Channel Sinuosity (GP) or Frequency of Riffles (RR)		20	5	Poor	6	Marginal	18	Excellent
	LB	10	9	Excellent	9	Excellent	10	Excellent
8. Bank Stability	RB	10	9	Excellent	9	Excellent	10	Excellent
	LB	10	10	Excellent	10	Excellent	9	Excellent
9. Vegetative Protection	RB	10	10	Excellent	10	Excellent	9	Excellent
10. Riparian Vegetative	LB	10	10	Excellent	10	Excellent	3	Marginal
Zone Width	RB	10	10	Excellent	10	Excellent	3	Marginal
Total Score and Classification 200			150	Good	158	Excellent	149	Good
				Excellent				
Scoring Interpretation				Good				105-154
		•			Margina			56-104
		Poor				<56		

#### Table 9. Procedure 51 habitat assessment results.

# 3.4 Mussels

Results of the mussel reconnaissance survey efforts are displayed in Table 10. A total of three live mussel species were encountered during survey efforts. Live mussels were observed in Reach 1 and 2 but none in Reach 3. Reach 3 receives increased velocities from the dam outlet structure and is composed of a significant amount of cobble substrate which limits mussel establishment. The most abundant species present in Reach 1 was rainbow (*Villosa iris*) while plain pocketbook (*Lampsilis cardium*) was the most abundant in Reach 2. Giant floater (*Pyganodon grandis*) was only observed alive in Reach 1; however, weathered dead shells were collected in Reach 2. Cylindrical Papershell (*Anodontoides ferussacianus*) was not collected alive and a weathered dead shell was collected in Reach 1. All species encountered are common to the region however rainbow is listed as a species of special concern by the State. Overall, the mussel community appeared to be healthy but not overly abundant due to only moderate numbers of individuals observed in Reach 1 and 2. Reach 3 does not support a mussel community but is limited by suitable substrate rather than poor water quality. Representative mussel species photos are available in Appendix C.

Species	Reach 1	Reach 2
Anodontoides ferussacianus	S	
Lampsilis cardium	А	A*
Pyganodon grandis	A	S
Villosa iris	A*	А
SC=Special Concern	A = Alive; S (*) = mos species	= Shell Only; t common in Reach

Table 10. Reach 1 and Reach 2 mussel reconnaissance surve	ey results, August 10, 2021
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#### 3.5 Water Chemistry

#### 3.5.1 Shiawassee River

Water chemistry parameters collected during the sampling effort are displayed in Tables 11 and 12. All parameters analyzed are typical for the region and are acceptable for biological function of a diverse group of aquatic biota.

# Table 11. Water chemistry parameters collected on August 11, 2021 at Eaton Road for Reach 1 and Reach 2.

Reach 1 and 2 Water Quality 8/11/2021						
Water Temperature (F)	78.5					
Dissolved Oxygen	97.1%					
Dissolved Oxygen	7.57 mg/L					
pН	7.35					
Conductivity (µS)	659					
Turbidity (NTU)	2.6					

Reach 3 Water Quality 8/11/2021						
Water Temperature (F)	76.4					
	86.1%					
Dissolved Oxygen	6.85 mg/L					
pН	7.08					
Conductivity (µS)	688					
Turbidity (NTU)	3.05					

Table 12. Water chemistry parameters collected on August 11, 2021 in Reach 3 near DavisburgRoad.

#### 3.5.2 Davis Lake

Results of the Davis Lake water chemistry sampling indicate the water column becomes thermally stratified during the summer as shown in Figure 4. Below 10 ft the concentration of dissolved oxygen decreases rapidly and reduces to below the concentration suitable for fish habitation. Dissolved oxygen concentrations below 4 mg/L are not suitable for sustained fish habitation and therefore limit available fish habitat during the warmer summer months with a stratified water column. Water clarity (transparency) was high as the measured secchi disk reading was 16.5 ft (Table 13). All other parameters measured were typical for the region and suggest Davis Lake as good water quality.





Table 13. Davis Lake waler chemistry parameters conected on August 3, 202	Table 1	3. Davis	Lake water	chemistry	parameters	collected on	August 9,	2021
---	---------	----------	------------	-----------	------------	--------------	-----------	------

Davis Lake Water Quality 8/9/2021						
pН	7.52					
Conductivity (µS)	691					
Turbidity (NTU)	1.05					
Transparency - Secchi Disk (ft)	16.5					

# 3.6 Aquatic Plant Survey

Davis Lake is approximately 9.0 acres, of which nearly 4.0 acres is within the surveyed littoral zone. The survey of the littoral zone documented 37 species that largely consisted of herbaceous emergent and submerged vegetation. The emergent vegetation within the shallow areas of the littoral zone was dominated by *Cyperaceae* (sedges) with a 28 percent cumulative coverage, namely *Schoenoplectus* species (bulrushes). Both submerged and free-floating aquatic plants were growing within the emergent vegetation, which resulted in the shallow water areas being fully vegetated. The most represented shallow submerged species was an unidentified *Chara* species (stonewort), which had greater than 60 percent density in 13 of the AVAS and a cumulative coverage of 77 percent.

The width of the shallow emergent sections of each AVAS, on average, was near half of the entire sampled length of the AVAS. As the shallow emergent vegetation dominance diminished, the submerged vegetation became dominant. The dominant submerged vegetation was *Nitellopsis obtusa* (starry stonewort, 52 percent) and *Myriophyllum heterophyllum* (various-leaved water milfoil, 42 percent). Additional submerged vegetation could be found within these two dominant species, though their respective cumulative coverage was significantly lower. The invasive starry stonewort was found in ten of the 14 AVAS, and was predominantly located in the deepest sections of the littoral zone. When it was found on the drag rake, it was normally the only species represented in the deepest areas prior to the limnetic zone and end of each AVAS.

While starry stonewort was dominant in the deeper water, water milfoil was dominant in the shallow areas beyond the emergent vegetation edge. Starry stonewort could be found intermixed with the water milfoil, but it was significantly less dominant in many cases. Including starry stonewort, non-native and invasive species account for 59 percent of the cumulative coverage total. Due to the stratification of layers of vegetation, the cumulative coverage total was 259 percent. Native herbaceous species accounted for 123 percent of this total. Other invasive species such as *Lythrum salicaria* (purple loosestrife) and *Phragmites australis* (common reed) had some lower densities in portions of the littoral zone, but were more prevalent outside of the survey area.

Overall, the dominant native species consisted of sedges, water milfoil, and Nuphar advena (yellow pond lily). Yellow pond lily was found throughout the littoral zone, but was best represented at the eastern portion of Davis Lake where the Shiawassee River enters the lake. Based on a visual estimation, all of the native species present account for approximately 90 percent of the relative cover of the littoral zone. The diversity of the native vegetation in the littoral zone, and beyond Davis Lake, is extensive and well-established adding to its apparent resiliency against the invasive species that are present. Data collected during the aquatic plant survey is available Appendix D.

# 4 Discussion and Recommendations

Results of the various biological community assessments for fish, macroinvertebrates and mussels indicate the overall diversity of species is not high within the three reaches sampled. This is similar to what was sampled during the 2019 assessment downstream of Davis Lake. Fish communities were dominated by Centrarchidae species, sunfish and bass. The fish community sampled in 2019 downstream from Davis Lake was very similar to the current study results and the primary species not collected in 2021 is the rainbow darter. Habitat for rainbow darter was present in the sample reaches in 2021 and it was surprising that no individuals were collected. Presence of sunfish indicates suitable pool habitats are sustained throughout the year and an adequate aquatic insect communities is present to provide forage. Fish abundance however was low within the survey reaches and may be a function of relatively low sustained water levels (depths) and decreased variability of habitat types and reduced presence of deep pools (>3 ft). The close proximity of Davis Lake may also play a role in reduced fish abundance in the project reaches as fish can migrate between the lake and stream environment easily. Aquatic macroinvertebrate abundance is also suggested as low due to generally limited number of individuals collected. A reduced number of aquatic insects also may limit the ability to support a larger fish community assemblage. Substrates within Reach 1 and 2 were generally composed of smaller materials such as sand, and silt with an increase in gravel substrate in Reach 2. Riffle habitats are also not well defined in Reach 1 and 2 and therefore may limit aquatic species diversity. As discussed in the 2019 study, the presence of riffle habitats generally promotes the establishment of additional fish, macroinvertebrate and mussel species due to increased water velocities, generally associated larger substrates such as gravel and cobble, which offer increased areas for invertebrate attachment sites, spawning habitat and increased micro-habitats for invertebrates and small fish to habitat.

Water quality within the stream is suggested to be high due to the surrounding high quality wetland and upland riparian area and stable geomorphology of the stream observed within Reach 1 and 2. Reach 3 has a history of alteration and disturbance due to the proximity of the rail road, Davisburg Road and the Mill Pond Dam outlet structure. Water quality measurements taken during the survey do not suggest any limitations or negative effects to aquatic biota. The presence of an established mussel community within the project area is a good indication of adequate water quality and habitat stability. A variety of sizes were collected for each of the mussel species encountered indicating recruitment. One species of special concern was collected during the sampling efforts which include the rainbow mussel.

Habitat assessments documented suitable conditions within all three reaches. Reach 2 was classified as excellent while Reach 1 and 3 were assigned good designations. Habitat characteristics such as pool depth and channel sinuosity were poor or marginal for glide/pool assessments in Reach 1 and 2. Riffle velocity/depths and riparian vegetation width were poor or marginal in Reach 3. Habitat characteristics such as stable well-vegetated streambanks, wide/high quality riparian areas, a lack of channel alteration, a stable flow regime and reduced sedimentation characterize the available habitat along the project area.

Davis Lake aquatic plant survey documented a littoral zone area of approximately 4.0 acres or 44% of the surface area of Davis Lake. Thirty-seven species were documented in the littoral zone survey area. The shallow portions of the littoral zone were dominated by sedges and *Chara* species. Deeper portions of the littoral zone were dominated by various-leaved water milfoil and starry stonewort. Starry stonewort is an invasive species and know to occur upstream of the project area in the Mill Pond reservoir area. Overall, the dominant native species consisted of sedges, water milfoil and yellow pond lily. Based on visual estimation, all of the native species present account for approximately 90 percent of the relative cover of the littoral zone. Baseline water chemistry sampling in Davis Lake documented the stratification of the water column and indicated a rapid decrease in dissolved oxygen concentration from 10 to 15 ft. Dissolved oxygen concentrations below 10 ft are suggested to limit fish habitation as concentrations were below 4.0 mg/L. Water clarity was high with a secchi disk measurement of 16.5 ft.

Overall, the assessment completed for the current project provides a baseline set of data for future monitoring efforts and can be added to the data collected downstream in 2019. Recommendations/considerations for future assessments include the following:

- Implement fish and macroinvertebrate monitoring schedule to develop historical database of community structures. Suggest sampling every 3-5 years and including the three sites surveyed during this project, plus an additional site within Reach 2 farther upstream. If possible, complete two fish sampling events during the survey season (June 1-September 30), to understand if there is seasonal variability in fish community structure. Suggest one fish sampling event in early June and another in August or September.
- Continue to monitor mussel species assemblages to determine stability of community.
- Implement water quality monitoring schedule to develop historical database of measured parameters (yearly sampling if possible). Suggested parameters include, total phosphorus, soluble phosphorus, TKN, ammonia, nitrate, *E. coli*, total suspended solids (TSS), water temperature, dissolved oxygen, pH and conductivity.
- Fish community sampling within Davis and Long Lakes to understand community structure. Associated with fish sampling would be dissolved oxygen and temperature profiles within the lakes and epilimnion and hypolimnion water quality sampling for phosphorus and nitrogen. Additionally, complete secchi disk readings throughout the year to track water clarity.
- Implement an aquatic vegetation monitoring schedule within Davis Lake and any other lakes farther downstream to document and monitor trends in aquatic plant communities. Suggested monitoring frequency is every 3-5 years.

# 5 References

- MDNR. 2021. Michigan freshwater mussel survey protocols and relocation procedures.
- MDEQ. 2008. Qualitative biological and habitat survey protocols for wadeable streams and rivers. WB-SWAS-051.
- MDEQ. 2005. Department of Environmental Quality procedures for aquatic vegetation surveys.

Davisburg, Oakland County, Michigan

# APPENDIX

# SCIENTIFIC COLLECTORS PERMITS



# **SCIENTIFIC COLLECTOR'S PERMIT**

Issued under the authority of Public Act 451 of 1994, Part 487, as amended, section 324.48735.

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

First Name	Last Name						
Thomas	Estrem						
Co-Permittee	Co-Permittee						
Benjamin Long							
Institution/Affiliation							
Cardno							
Mailing Address							
708 Roosevelt Road, Walkerton, Indiana, 46574							
	First Name Thomas Co-Permittee Benjamin Long						

To survey, handle, take, catch, kill and/or possess 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 the species authorized 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 <u>and</u> 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 contacts can be initiated by calling the appropriate operational service center (map and phone numbers provided separately).

#### **SPECIAL PROVISIONS:**

<u>Project #1</u>: Permittees are authorized for general survey and relocation purposes in association with MDOT construction planned on the I-94 east and west bound bridges over the Kalamazoo River near the City of Battle Creek in Calhoun County to collect, identify, enumerate, and release all mollusk species. The permittees will follow the protocol specified in the document titled "Michigan Freshwater Mussel Survey Protocols and Relocation Procedures" (2021 V3). Relocation of mussels from the construction site to suitable areas immediately outside the area of impact is authorized following the MDOT/DNR mussel relocation plan approved by Fisheries Biologist Matt Diana for this project as outlined in the permit application.

<u>Project #2</u>: Permittees are authorized for general survey and relocation purposes in association with MDOT construction planned on the I-196 north and south bound bridges over the Kalamazoo River near the Town of Saugatuck in Allegan County to collect, identify, enumerate, and release all mollusk species. The permittees will follow the protocol specified in the document titled "Michigan Freshwater Mussel Survey Protocols and Relocation Procedures" (2021 V3). Relocation of mussels from the construction site to suitable areas immediately outside the area of impact is authorized following the MDOT/DNR mussel relocation plan approved by Fisheries Biologist Matt Diana for this project as outlined in the permit application.

<u>Project #3</u>: Permittees are authorized for general survey purposes in association with construction planned by the City of Lansing on six bridges over the Grand and Red Cedar rivers in Ingham County to collect, identify, enumerate, and release all mollusk species. The permittees will follow the protocol specified in the document titled "Michigan Freshwater Mussel Survey Protocols and Relocation Procedures" (2021 V3).

<u>Project #4</u>: Permittees are authorized for general survey purposes in association with efforts by Springfield Charter Township and Oakland County Parks to remove Mill Pond Dam to collect, identify, enumerate and release fish and mussel along a 2200 ft reach of the Shiawassee River from the inlet of Davis Lake to the outlet of the Mill Pond. The assessments are being completed to document stream biological and habitat conditions prior to the removal of the Mill Pond dam. Fish will be sampled within the project reach utilizing the Michigan Surface Water Assessment Section (SWAS) Procedure 51 (2008). Fish will be collected using electrofishing gear. Mussels will be assessed using the Michigan Freshwater Mussel Survey and Relocation Procedures (2021 V3) for reconnaissance survey. Mussels will be searched for within the project reach using snorkel gear with temporary collect by hand.

<u>Project #5</u>: Permittees are authorized for general survey and relocation purposes in association with MDOT construction planned on the Grand River at the I-96 Bridges in Eaton County to collect, identify, enumerate and release all mollusk species. Mussels will be relocated from approximately 5000 m2 of river bottom to a suitable location outside the project area (likely upstream) following the protocols specified in the Michigan Freshwater Mussel Survey Protocols and Relocation Procedures (2021 V3). The project is being completed for MDOT in advance of channel disturbance associated with planned construction on the I-96 northbound and southbound bridges.

<u>Project #6</u>: Permittees are authorized for general survey and relocation purposes in association with an Ottawa County Parks construction project on the Grand River at the Green Street Bridge in Ottawa County to collect, identify, enumerate and release all mollusk species. Mussels will be relocated from approximately 2000 m2 of river bottom to a suitable location outside the project area (likely upstream) following the protocols specified in the Michigan Freshwater Mussel Survey Protocols and Relocation Procedures (2021 V3). The project is completed for the Ottawa County Parks in advance of channel disturbance associated with construction on the Green Street Bridge.

No lethal collection of **fish or** mussels is authorized by this permit and no voucher specimens may be retained. Should a species listed in Michigan as special concern, threatened, or endangered be encountered while in the field, the permittees must release it outside the area of impact immediately upon identification with as little further handling as possible. Lists of the Michigan's **fish and** mollusk species as well as their respective health statuses can be found online at <u>www.michigan.gov/scientificcollectorspermit</u>

The collection or handling of any freshwater mussel, regardless of species, from a waterbody known to be inhabited by a state or federally listed mussel species requires, in addition to this permit, either a State of Michigan Threatened & Endangered Species Permit, a Federal T&E Permit or both. Please review Michigan's Mussel Map Viewer for waterbodies in Michigan with known T&E populations and prepare for your permitting needs accordingly at <a href="https://mnfi.anr.msu.edu/resources/michigan-mussels">https://mnfi.anr.msu.edu/resources/michigan-mussels</a>.

For State T&E permitting contact Casey Reitz at <u>reitzc@michigan.gov</u>. In addition to mussel work, Casey should be contacted if any other threatened or endangered species is encountered with the purpose of relocation.

For Federal T&E permitting please contact the regional US Fish and Wildlife Service Office in East Lansing, Michigan.

In response to the VHS virus and other aquatic invasive species in Michigan, the following is required:

- 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.
- 2) All equipment coming in contact with water and/or fish and/or specifically working with aquatic invertebrates including: boat hulls, boat trailers, buckets, waders, nets, etc. must be disinfected using a 1 cup of bleach to 10 gallons of water solution prior to moving the equipment to another waterbody. If long periods of time (week or longer) are anticipated in between sampling events, thorough drying of all equipment in the sun is an acceptable alternative to using the bleach solution.
  - a. A 20 min Virkon Aquatic bath can be substituted as a bleach alternative.
  - b. A 20 min 100% vinegar bath can be substituted as a bleach alternative.

For more information on VHS or invasive species, go to the Fisheries link on the Department of Natural Resources web site at: <u>http://www.michigan.gov/dnr</u>

#### Permitted collection area:

Project #1: The Kalamazoo River at the I-94 bridge crossing near the city of Battle Creek in Calhoun County within the Lake Michigan Basin.

Project #2: The Kalamazoo River at the 1-196 bridge crossing near the Town of Saugatuck in Allegan County within the Lake Michigan Basin.

Project #3: The Grand and Red Cedar rivers within the City of Lansing in Ingham County within the Lake Michigan Basin.

Project #4: The Shiawassee River in Oakland County from roughly the inlet of Davis Lake to the outlet of the Mill Pond within the Lake Huron Basin.

Project #5: The Grand River in Eaton County in the vicinity of the I-96 northbound and southbound bridges within the Lake Michigan Basin.

# Project #6: The Grand River in Ottawa County in the vicinity of the Green Street Bridge within the Lake Michigan Basin.

Permitted collection gear: by hand and hand/dip nets while wading and potentially with the aid of SCUBA or snorkeling equipment; **electrofishing**.

Completion of an annual report is required with this permit. It shall be provided to DNR, Fisheries Division using online Collector's Report Form at <u>www.michigan.gov/scientificcollectorspermit</u>.

**GENERAL PROVISIONS:** This permit must be in permittee's possession during collection in the field or the location where specimens are being held and must be made available upon request of any Department representative. Activities under this permit are limited to species not listed as threatened or endangered unless the permittee(s) is also in possession of the required Threatened and Endangered Species Permit from DNR Wildlife Division for state listed species as well as the proper permit(s) from the US Fish and Wildlife Service for federally listed species. 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.

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: <u>https://www.michigan.gov/dnr/0,4570,7-350-79136\_79262\_80436\_85611---,00.html</u>

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

All sampling gear that is deployed and left unattended in the field by persons permitted under this program must be clearly labeled with the name of the permittee's affiliation (university, zoo, consulting firm, agency, etc.) on the sampling gear itself or on at least one of the buoys or floats used to mark deployed gear that is submerged. Additionally, boats used to conduct permit activities must also be clearly marked on the sides of the vessel with the permittee's affiliation.

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.

FOR DNR USE ONLY						
Permit Number	Issue Date	Expiration Date				
FSCP06122021101929	06/16/2021	12/31/2021				
cc:						
SLMMU, SLHMU, Threatened & Endangered						
For, James L. Dexter, Chief, MDNR Fisheries Divis	For, James L. Dexter, Chief, MDNR Fisheries Division					
The h the						



**GRETCHEN WHITMER** 

GOVERNOR

Lansing



April 16, 2020

Mr. Thomas Estrem Cardno 708 Roosevelt Rd Walkerton, IN 46574

Dear Mr. Estrem:

This letter is an official attachment to your Threatened and Endangered Species Permit (**TE 235**). Your permit is issued in the *Consultant* category only. Your permit expires on **March 31**, **2023**. Renewal information will be sent in December of 2022.

### **Standard Consultant Conditions**

Plants

 Permitted is the survey of threatened plants for identification and documentation, for environmental impact analysis, and to provide new information on the distribution of listed plant species. Endangered species are not authorized for collection. Use photography or non-destructive collection techniques for documentation whenever feasible (and by limiting collections to leaves, flowers, or fruits). Surveys must be done in a manner that will not cause harm to the population or its habitat.

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.

Insects

• Handling of threatened and endangered insects is permitted when needed for identification and documentation. Surveys must not significantly reduce the size of the local population and must be done in a manner that will not cause harm to the population or its habitat. Use non-lethal survey and capture techniques such as carful capture and release or photography whenever possible.

Fish

• Listed fish species may be humanely captured for identification and released at the same site using standard non-lethal collection techniques. Dead specimens may be salvaged.

Birds

• Capture or collection of listed birds is not permitted. Use non-lethal techniques such as photography or recordings of songs when specific documentation is required.

Reptiles and Amphibians

• Threatened and endangered reptiles and amphibians may be humanely captured for identification and examination and released at the same site.

#### Mammals

• Rely on the use of sign or other observations to determine the presence of mammals to the extent possible. Small mammals (e.g., bats, shrews, and voles) may be live trapped when needed to determine their presence but must be released on site unharmed. Larger mammals may not be captured.

# **Standard Permit Conditions**

- 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.
- None of the specimens collected shall become part of a private collection or private property.
- 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.
- This permit does not provide authorization to circumvent any federal, state, or local laws and ordinances.
- 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.
- The activities covered under this Permit are not transferable to another person unless specifically authorized.
- 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.
- 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.

Subpermittees are those working under the direction of the permit holder.

All permits require and annual report unless indicated otherwise. You can use the enclosed report form and submit forms via email to <u>reitzc@michigan.gov</u>. 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,

Carsey 7 Reitz

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

Davisburg, Oakland County, Michigan

# APPENDIX



# **PROCEDURE 51 DATASHEETS**

Shiawassee River Appendix J (continued)

Gear: boat / ss / ops)

# Passes: ) 2 \*Warmouth

8/10/2021

Sampling Time: 45min # Probes Number of Anomalies: O Comments: Petromyzontidae (Lampreys) Sea lamprey (a/l) Silver lamprey (a/l) Northern brook lamprey (a/l) Chestnut lamprey (a/l) American brook lamprey (a/l) Lepisosteidae (Gars) \*Spotted gar \*Longnose gar Amiidae (Bowfins) \*Bowfin Clupeidae (Herrings) \*Alewife \*Gizzard shad Salmonidae (Salmon/Trout) \*Rainbow trout \*Brown trout \*Brook trout \*Coho \*Chinook Umbridae (Mudminnow) Central mudminnow Esocidae (Pike) \*Grass pike \*Northern pike \*Muskellunge Cyprinidae (Minnows and Carp) Central stoneroller Lake chub \*Goldfish \*Carp Bigeye chub \*Horneyhead chub \*River chub \*Creek chub \*Golden shiner Pugnose shiner Emerald shiner **Bigeye shiner** Ironcolor shiner \*Common shiner Central bigmouth shiner Blackchin shiner Blacknose shiner Spottail shiner Silver shiner Rosyface shiner Spotfin shiner Sand shiner Redfin shiner Mimic shiner

Bluntnose minnow	
Suckermouth minnow	
Silverjaw minnow	-
Northern redbelly dace	
Southern redbelly dace	
Finescale dace	
Blacknose dace	
Longnose dace	
Redside dace	
*Pearl dace	_
Cottidae (Sculpins)	
Mottled sculpin	
Slimy sculpin	
Catostomidae (Suckers)	
*Longnose sucker	
*White sucker	
*Creek chubsucker	
*Lake chubsucker	_
*Northern hog sucker	
*Spotted sucker	
*Silver redhorse	
*River redhorse	
*Black redhorse	
*Golden redhorse	
*Shorthead redhorse	
*Greater redhorse	_
Ictaluridae (Bullhead/Catfish)	
*Black bullhead	
*Brown bullhead	-
*Yellow bullhead	3
Stonecat	-
Tadpole madtom	-
Brindled madtom	
*Channel catfish	_
*Flathead catfish	_
Aphredoderidae (Pirate perch)	
Pirate perch	
Atherinidae (Silversides)	
Brook silverside	-
Cyprinodontidae (Topminnows	5)
Banded killifish	
Blackstripe topminnow	_
Gastarostaidas (Sticklahacks)	
Brook stickloback	
Threespine stickleback	
Parehisthuidae (Toma base)	
*M/bite base	
Multic parch	-
Contrarchidae (Susfiches)	-
*Pook base	2
KOCK Dass	
Green sumsti	_

\*Pumpkinseed

# Passes:	300 FT	length
*Warmouth	+	
*Orangespotted sunfish		
*Bluegill	3	
*Longear sunfish		
*White crappie		
*Black crappie		
*Largemouth bass	6	
*Smallmouth bass		
Percidae (Perch)		
N. sand darter		
Rainbow darter	Concerne of	
Iowa darter		
Greenside darter		
Fantail darter		
Orangethroat darter		
Johnny darter	1	
Blackside darter	1000	
Logperch	in the second second	
*Yellow perch		
*Walleye		
Percopsidae (Trout-perch)		
Trout-perch		
Anguillidae (Eels)		
*American eel		
Gadidae (Cod)		
*Burbot		
Sciaenidae (Drums)		
*Freshwater drum		
Cobitidae (Loaches)		
Oriental weatherfish		
Other family/species:		

\* = Measured length

Chapter 25A – GLEAS PROCEDURE #51 38

Brassy minnow

Fathead minnow

Species length (in)	Rack	Vellow	brass Pickerel	Rimptinsed	Warmouth	Buegill	Bass	In
1	16.31	6.6					0	1
2	e	N/		4		6	00	2
3		e			1			3
4	0 6	1		1	-			4
5	6.0		6	1	0		N 201 E2	5
6						1.1		6
7	0					0 6		7
8	e c	1				X	3	8
9	¢	1		1		1		9
10					·			10
11		1	1	- E		In the second second	1	11
12					1000	1		12
13		V	-		1	1		13
14								14
15		1	1					15
16		1						16
17	·		1	1	1			17
18		1.1			S		1	18
19		1			1			19
20								20
>20	1				1			>20

Appendix J (continued)

For individuals >20" record actual length

Species	
length (in)	In
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
>20	>20

Additional station comments Station Number: Reach 1 Length Sampled (ft): 300 Area Sampled (sq ft): 3,300

8/10/2021 Reach 2 Shiawassee River 8, Appendix J (continued)

325ft length # Passes: 1 Gear: boat / ss /(bps) Sampling Time: 45 min # Probes Number of Anomalies: Comments: \*Warmouth Petromyzontidae (Lampreys) Bluntnose minnow \*Orangespotted sunfish Suckermouth minnow Sea lamprey (a/l) Silverjaw minnow \*Bluegill Silver lamprey (a/l) Northern redbelly dace \*Longear sunfish Northern brook lamprey (a/l) Southern redbelly dace \*White crappie Chestnut lamprey (a/l) \*Black crappie Finescale dace American brook lamprey (a/l) \*Largemouth bass Blacknose dace Lepisosteidae (Gars) \*Smallmouth bass \*Spotted gar Longnose dace Redside dace Percidae (Perch) \*Longnose gar N. sand darter Amiidae (Bowfins) \*Pearl dace Rainbow darter Cottidae (Sculpins) \*Bowfin lowa darter Mottled sculpin Clupeidae (Herrings) Greenside darter \*Alewife Slimy sculpin Fantail darter Catostomidae (Suckers) \*Gizzard shad Orangethroat darter Salmonidae (Salmon/Trout) \*Longnose sucker \*White sucker Johnny darter \*Rainbow trout \*Creek chubsucker Blackside darter \*Brown trout Logperch \*Brook trout \*Lake chubsucker \*Yellow perch \*Coho \*Northern hog sucker \*Spotted sucker \*Walleye \*Chinook Percopsidae (Trout-perch) \*Silver redhorse Umbridae (Mudminnow) \*River redhorse Trout-perch Central mudminnow Anguillidae (Eels) \*Black redhorse Esocidae (Pike) \*American eel \*Golden redhorse \*Grass pike Gadidae (Cod) \*Shorthead redhorse \*Northern pike \*Greater redhorse \*Burbot \*Muskellunge Cyprinidae (Minnows and Carp) Ictaluridae (Bullhead/Catfish) Sciaenidae (Drums) \*Freshwater drum Central stoneroller \*Black bullhead Cobitidae (Loaches) \*Brown bullhead Lake chub Oriental weatherfish \*Yellow bullhead \*Goldfish Other family/species: Stonecat \*Carp Tadpole madtom Bigeye chub Brindled madtom \*Horneyhead chub \*Channel catfish \*River chub \*Flathead catfish \*Creek chub Aphredoderidae (Pirate perch) \*Golden shiner Pugnose shiner Pirate perch Atherinidae (Silversides) \* = Measured length Emerald shiner Brook silverside **Bigeye shiner** Cyprinodontidae (Topminnows) Ironcolor shiner 29 Banded killifish \*Common shiner Blackstripe topminnow Central bigmouth shiner Blackchin shiner Gasterosteidae (Sticklebacks) Blacknose shiner Brook stickleback Spottail shiner Threespine stickleback Silver shiner Rosyface shiner Perchicthyidae (Temp. bass) Spotfin shiner \*White bass \*White perch Sand shiner Centrarchidae (Sunfishes) Redfin shiner \*Rock bass Mimic shiner \*Green sunfish Brassy minnow \*Pumpkinseed

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Fathead minnow

$\begin{array}{c c c c c c c c c c c c c c c c c c c $	or and Sunfish	Shinne  	15455 	In 1 2 3 4 5 6 7 8
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	•	19 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9		4 5 6 7 8
5 4 4 6		99 97 9		5 6 7 8
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10			/	10
11				11
12			1	12
13				13
14			1	14
15				15
16				16
17				17
18			1	18
19				19
20	1. Sec	1		20
>20				>20
For individuals >20" record actual length				
Species (nex				
length (in) Chub				In
1			5	1
2				2

# Appendix J (continued)

Species	(reek	
length (in)	chub	In
1		1
2		2
3		3
4		4
5	0	5
6	e	6
7		7
8		8
9		9
10		10
11		11
12		12
13		13
14		14
15		15
16		16
17		17
18		18
19		19
20		20
>20		>20

Additional station comments Station Number: Reach a Length Sampled (ft): 325 Area Sampled (sq ft): 3575

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Shiawassee River Poach 3

8/11/2021 Appendix J (continued)

Gear: boat / ss / bps

Sampling Time: 45 min # Probes Number of Anomalies: Comments: Petromyzontidae (Lampreys) Sea lamprey (a/l) Silver lamprey (a/l) Northern brook lamprey (a/l) Chestnut lamprey (a/l) American brook lamprey (a/l) Lepisosteidae (Gars) \*Spotted gar \*Longnose gar Amiidae (Bowfins) \*Bowfin Clupeidae (Herrings) \*Alewife \*Gizzard shad Salmonidae (Salmon/Trout) \*Rainbow trout \*Brown trout \*Brook trout \*Coho \*Chinook Umbridae (Mudminnow) Central mudminnow Esocidae (Pike) \*Grass pike \*Northern pike \*Muskellunge Cyprinidae (Minnows and Carp) Central stoneroller Lake chub \*Goldfish \*Carp Bigeye chub \*Horneyhead chub \*River chub \*Creek chub \*Golden shiner Pugnose shiner Emerald shiner **Bigeye shiner** Ironcolor shiner \*Common shiner Central bigmouth shiner Blackchin shiner Blacknose shiner Spottail shiner Silver shiner Rosyface shiner Spotfin shiner Sand shiner **Redfin shiner** 

U	
Bluntnose minnow	
Suckermouth minnow	
Silveriaw minnow	
Northern redbelly dace	-
Southern redbelly dace	-
Finescale dace	_
Blacknose dace	
Longnose dace	
Redside dace	
*Pearl dace	
Cottidae (Sculpins)	
Mottled sculpin	
Slimy sculpin	
Catostomidae (Suckers)	
*Longnose sucker	
*White sucker	
*Crock chubsucker	
*Lake chubsucker	
*Northorn bog sucker	_
*Spotted sucker	
*Silver redbored	
Sliver redhorso	_
*Disclosed	-
Black rednorse	-
Golden rednorse	_
Shortnead rednorse	_
Greater rednorse	
Ictaluridae (Bullhead/Catrisi	1 1
Black builhead	-
*Brown bullhead	0
*Yellow bullhead	9
Stonecat	
Tadpole madtom	
Brindled madtom	
*Channel catfish	
*Flathead cattish	
Aphredoderidae (Pirate per	ch)
Pirate perch	-
Atherinidae (Silversides)	
Brook silverside	-
Cyprinodontidae (Topminno	ows)
Banded killifish	_
Blackstripe topminnow	
Gasterosteidae (Stickleback	(s)
Brook stickleback	
Threespine stickleback	
Perchicthyidae (Temp. bass	)
*White bass	
*White perch	
Centrarchidae (Sunfishes)	
*Rock bass	19
*Green sunfish	2
*Pumpkinseed	7

2 \*Warmouth \*Orangespotted sunfish 182 \*Bluegill \*Longear sunfish \*White crappie \*Black crappie \*Largemouth bass \*Smallmouth bass Percidae (Perch) N. sand darter Rainbow darter lowa darter Greenside darter Fantail darter Orangethroat darter Johnny darter Blackside darter Logperch \*Yellow perch \*Walleye Percopsidae (Trout-perch) Trout-perch Anguillidae (Eels) \*American eel Gadidae (Cod) \*Burbot Sciaenidae (Drums) \*Freshwater drum Cobitidae (Loaches) Oriental weatherfish Other family/species:

# Passes: multiple

ttoft length

#### \* = Measured length

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Mimic shiner Brassy minnow

Fathead minnow

Species	Reck	Vellera	Black	Green	Princking	Warmouth	Rugall	Longeer	
length (in)	Bass	Bullhood	Bullhast	Sunfish	1. 1		Discigni	Sunfish	In
1								-	1
2							1	-	2
3	66		1		e	40	6.	-	3
4	1.	19		6	e		4 8		4
5	L	10	1 - C	e	60		11		5
6	9.6	c °	11.		6			e	6
7			1				60	6	7
8	4	0							8
9									9
10	1	1 mm	6		the second second				10
11		-							11
12						1.27			12
13			1						13
14								2	14
15									15
16									16
17									17
18					1		-		18
19				-					19
20									20
>20									>20

Appendix J (continued)

For individuals >20" record actual length

Species	Common	Largemouth					· · · · · · · · · · · · · · · · · · ·
length (in)	Shiner	Bass		-			In
1	1.10.1			1			1
2					2	1	2
3				-			3
4				1			4
5			1				5
6	3						6
7					1		7
8				1	-		8
9	10				1	1	9
10				1	1 m	· · · · · · · · · · · · · · · · · · ·	10
11			1		1	1	· 11
12		e					12
13	1.000			-			13
14				1			14
15					1	1 m	. 15
16					1		16
17					0	1	17
18				1.0	Real Property lies		18
19		S	10 mm				19
20							20
>20		1		1		1 mar 1 m	>20

Additional station comments

Station Number: Beech 3 Length Sampled (ft): ++ 125 Area Sampled (sq ft): 1270

Chapter 25A – GLEAS PROCEDURE #51 37

#### Appendix J (continued)

BENTHIC		Hemiptera	
MACROINVERTEBRATES	1	Belostomatidae	-
<u> </u>		Corixidae	
Station Number: Keach	11	Gelastocoridae	
Time Sampled: 40 Der So	n mont	Serridae	
Area Sampled:		Mesoveliidae	
Comments:		Naucoridae	T
Common terres		Nepidae	
		Notonectidae	
		Pleidae	
PORIFERA		Saldidae	_
PLATVHELMINTHES		Veliidae	
Turbellaria		Megaloptera	
NEMATOMORPHA		Corvdalidae	
REVOZOA		Sialidae	
ANNELIDA		Neuroptera	
Hirudinea		Sisvridae	
Oligoshasta		Trichontera	
ABTURODODA		Brachycontridae	
Crusteese		Clossocomatidae	
Amphinada	31	Holioonsychidao	
Amphipoda		Hudropsychidae	
Decapoda	27	Hydropsychidae	
Isopoda		Hydropulidae	
Arachholdea		Lepidosiomalidae	
Hydracarina		Leptocendae	-
Insecta		Limnephilidae	
Ephemeroptera		Molannidae	
Ametropodidae		Odontoceridae	
Baetiscidae		Philopotamidae	
Baetidae		Phryganeidae	
Caenidae		Polycentropodidae	0
Ephemerellidae		Psychomylidae	
Ephemeridae		Rhyacophilidae	_
Heptageniidae	-	Sericostomatidae	
Isonychiidae		Uenoidae (Neophylax)	
Leptophlebiidae		Lepidoptera	
Metretopodidae		Noctuidae	
Polymitarcyidae		Pyralidae	
Potamanthidae	-	Coleoptera	
Siphlonuridae	1	Dryopidae	-
Tricorythidae	1	Dytiscidae	
Odonata		Elmidae	4
Anisoptera	~	Gyrinidae (a/l)	_
Aeshnidae	d	Haliplidae (a/l)	
Cordulegastridae		Heteroceridae	
Corduliidae		Hydraenidae	-
Gomphidae		Hydrophilidae	
Libellulidae		Lampyridae (a/l)	
Macomiidae		Noteridae (a/l)	
Zygoptera		Psephenidae(a/l)	
Calopterygidae		Ptilodactylidae (a/l)	1
Coenagrionidae	_	Scirtidae (a/l)	
Lestidae			
Plecoptera		Diptera	
Capniidae		Athericidae	
Chloroperlidae	-	Ceratopogonidae	
Leuctridae		Chaoboridae	1.0
Nemouridae		Chironomidae	31
Peltoperlidae		Culicidae	
Perlidae		Dixidae	
Periodidae		Dolichopodidae	_
Pteronarcvidae		Empididae	
Taeniontervoidae		Ephydridae	
i demoprei ygiude		-bud augus	

Muscidae	
Ptychopteridae	0
Psychodidae	
Sciomyzidae	1
Simuliidae	-
Stratiomvidae	
Svrohidae	-
Tabanidae	
Thaumaleidae	-
Tipulidae	-
MOLLUSCA	-
Gastropoda	
Ancylidae	
Bithyniidae	-
Hydrobiidae	-
Lympaeidae	-
Physidae	-
Planorhidae	-
Plauroparidaa	-
Pieurocendae	÷
Pomatiopsidae	+
Valvalidae	-
Viviparidae	-
Pelecypoda	
Dreissenidae	-
Pisidiidae	-
Sphaeriidae	-
Unionidae	-
La anoceratidae	i.
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### Appendix J (continued)

BENTHIC	н	emiptera		Muscidae
MACROINVERTEBRATES		Belostomatidae		Ptychopteridae
0 1	2	Corixidae		Psychodidae
Station Number: Keach	a	Gelastocoridae	100 m	Sciomyzidae
Time Sampled: 40 person	minutes	Gerridae		Simuliidae
Area Sampled:		Mesoveliidae		Stratiomyidae
Comments:		Naucoridae	_	Syrphidae
4 4 6 2 6 1 8 9 5 <del>-</del>		Nepidae		Tabanidae
		Notonectidae		Thaumaleidae
		Pleidae	-	Tipulidae
PORIFERA		Saldidae	1100	MOLLUSCA
DI ATVHEI MINTHES		Velijdae		Gastropoda
Turbollaria		Megaloptera		Ancylidae
NEWATOMODDUA		Convdalidae		Bithyniidae
NEMATOMORPHA		Colydaidae		Hydrobiidaa
BRYUZUA		Sialidae		Hydrobiidae
ANNELIDA		Neuroptera		Lymnaeidae
Hirudinea		Sisyridae		Physidae
Oligochaeta		Trichoptera		Planorbidae
ARTHROPODA		Brachycentridae		Pleuroceridae
Crustacea	~	Glossosomatidae		Pomatiopsidae
Amphipoda	d	Helicopsychidae		Valvatidae
Decapoda		Hydropsychidae	17	Viviparidae
Isopoda	3	Hydroptilidae		Pelecypoda
Arachnoidea		Lepidostomatidae		Dreissenidae
Hydracarina		Leptoceridae	_	Pisidiidae
Insecta		Limnephilidae		Sphaeriidae
Enhemerontera		Molannidae		Unionidae
Amotropodidoo		Odontoceridae		onionidao
Restingidas		Dhilopotomidoo	5	
Baetidae		Philopotalilidae	2	
Baelloae		Phryganeidae		
Caenidae		Polycentropodidae	_01_	
Ephemerellidae		Psychomylidae		
Ephemeridae		Rhyacophilidae		
Heptageniidae		Sericostomatidae		
Isonychiidae		Uenoidae (Neophylax)		
Leptophlebiidae		Lepidoptera		
Metretopodidae		Noctuidae		
Polymitarcyidae		Pyralidae		
Potamanthidae		Coleoptera		
Siphlonuridae		Dryopidae		
Tricorythidae		Dytiscidae		
Odonata		Elmidae	15	
Anisontera		Gyrinidae (a/l)	12	
Aoshpidao		Haliplidae (a/l)		
Cordulogastridaa		Hotorocoridao		
Cordulidae		Hudroopidoo		
Cordulidae		Hydraehilidaa	-	
Gomphidae		Hydrophilidae		
Libellulidae		Lampyridae (a/l)		
Macomiidae		Noteridae (a/l)		
Zygoptera		Psephenidae(a/l)		
Calopterygidae		Ptilodactylidae (a/l)		
Coenagrionidae		Scirtidae (a/l)		
Lestidae				
Plecoptera	D	iptera		
Capniidae		Athericidae	Contraction of the local division of the loc	
Chloroperlidae		Ceratopogonidae		
Leuctridae		Chaoboridae		
Nemouridae		Chironomidae	19	
Peltoperlidae		Culicidae		
Porlidao		Dividae		
Periodidae		Dolioboodidoo		
Pteroparavidaa		Empididao		
Teoplartonaide		Emploidae		
raeniopterygidae		Ephydridae		

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Muscidae

Ptychopteridae

Psychodidae Sciomyzidae Simuliidae

Stratiomyidae

Thaumaleidae Tipulidae

Tabanidae

Bithyniidae Hydrobiidae Lymnaeidae

Physidae Planorbidae

Pleuroceridae Pomatiopsidae Valvatidae

Dreissenidae

Sphaeriidae

#### Appendix J (continued)

BENTHIC	Hemiptera		Muscidae
MACROINVERTEBRATES	Belostomatidae		Ptychopte
0 0	Corixidae		Psychodid
Station Number: Keach 5	Gelastocoridae		Sciomyzid
Time Sampled: 40 person munutes	Gerridae		Simuliidae
Area Sampled:	Mesoveliidae		Stratiomyi
Comments:	Naucoridae		Syrphidae
	Nepidae		Tabanidae
	Notonectidae		Thaumale
	Pleidae		Tipulidae
PORIFERA	Saldidae	1000	MOLLUSCA
PLATYHELMINTHES	Veliidae		Gastropoda
Turbellaria	Megaloptera		Ancylidae
NEMATOMORPHA	Corvdalidae		Bithyniidae
BRYOZOA	Sialidae		Hydrobiidae
ANNELIDA	Neuroptera		Lymnaeidae
Hirudinea	Sisvridae		Physidae
Oligochaeta	Trichontera		Planorbidae
	Brachycentridae		Pleurocerid
Crustacea	Glossosomatidae		Pomationsi
Amphipoda	Helicopsychidae		Valvatidae
Ampinpoda	Hydropsychidae	an	Vivinaridae
Decapoda	Hydroptilidao	10	Pelecynoda
Arashpoides	Lopidostomatidae		Dreissenida
Arachiloidea	Leptooridae	1. <u></u> 7	Disidiidaa
	Limpophilidae		Sphaoriidae
Insecta	Malappidaa		Unionidao
Epnemeroptera	Molannidae		Unionidae
Ametropodidae	Dhilenstemidee	-	
Baetiscidae	Philopotamidae	2	
Baetidae	Phryganeidae		
Caenidae	Polycentropodidae		
Ephemerellidae	Psychomylidae	-	
Ephemeridae	Rhyacophilidae		
Heptageniidae	Sericostomatidae		
Isonychiidae	Uenoidae (Neophylax)		
Leptophlebiidae	Lepidoptera		
Metretopodidae	Noctuidae		
Polymitarcyidae	Pyralidae		
Potamanthidae	Coleoptera		
Siphlonuridae	Dryopidae		
Tricorythidae	Dytiscidae	-	
Odonata	Elmidae	10	
Anisoptera	Gyrinidae (a/l)		
Aeshnidae	Haliplidae (a/l)		
Cordulegastridae	Heteroceridae		
Corduliidae	Hydraenidae		
Gomphidae	Hydrophilidae		
Libellulidae	Lampyridae (a/l)		
Macomiidae	Noteridae (a/l)		
Zygoptera	Psephenidae(a/l)		
Calopterygidae	Ptilodactylidae (a/l)		
Coenagrionidae	Scirtidae (a/l)		
Lestidae			
Plecoptera	Diptera		
Capniidae	Athericidae	-	
Chloroperlidae	Ceratopogonidae	1000	
Leuctridae	Chaoboridae		
Nemouridae	Chironomidae		
Peltoperlidae	Culicidae		
Perlidae	Dixidae		
Perlodidae	Dolichopodidae		
Pteronarcvidae	Empididae		
Taenioptervoidae	Ephydridae		

Chapter 25A - GLEAS PROCEDURE #51

Reach I Shinwassee River

# HABITAT ASSESSMENT FIELD DATA SHEET - GLIDE/POOL STREAMS

Habitat	Condition Category						
Parameter	Excellent	Good	Marginal	Poor			
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and net transient)	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.			
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0			
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.			
SCORE	20 19 18 17 16	15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0			
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep nools present	Majority of pools large- deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small- shallow or pools absent.			
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0			
4. Sediment Deposition	Little or no enlargement of island or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.			
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0			
5a. Channel Flow Status - Maintained Flow Volume	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.			
SCORE	10 9	8 7 6	5 4 3	2 1 0			
5b. Channel Flow Status – Flashiness	Vegetation along the stream bank is complete nearly to the waters edge. Little or no evidence of frequent changes in discharge and/or frequent high water events that scours stream bank vegetation. Large woody debris (if present) stable and extending laterally across the stream channel.	Some evidence of bank scour approximately 4-8 inches above the waters surface. Large woody debris (if present) mostly stable and extending partially into the active stream channel.	Bank scour evidence 9-18 inches above the waters surface. Large woody debris (if present) tend to lay more against the stream bank rather than extending into the active channel.	Bank scour (>20 inches) along the stream channel. Large woody debris are generally absent from the active channel and/or may exist as woody debris jams along the stream bank above the active channel.			
SCORE	(10) 9	8 7 6	5 4 3	2 1 0			
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging (greater than past 20 yr) may be present, but recent channelization is not prosent. Channelization is continuous but not (>5 years). Embankments with mature trees and dominated by grass and shrubs.		Stream reach has been recently channelized (<5 years). OR Banks shored with gabion, rock, cement or bare earth. Instream habitat greatly altered or removed entirely. Bank vegetation moderately dense to absent.			
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0			

Habitat		Cond	tion Category				
Parameter	Excellent	Good	Marginal	Poor			
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. (Note: lack of sinuosity may be due to channelization)	Channel straight; waterway has been channelized for a long distance.			
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1 0			
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.			
SCORE (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0			
SCORE (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0			
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but 1 class of plants is not well- represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	am am as longer istraight increase the stream length 1 to 2 times longer than if it was in a straight line. (Note: tack of sinuosity may be due to channelization)       channelization a straight line. (Note: tack of sinuosity may be due to channelization)         12       11       10       9       8       7       6       5       4       3       2       1       0         e; areas of 60% of bank in reach has areas of erosion, high erosion potential during floods.       Unstable; many eroded areas; "raw" sections and bends; obvious bank soughing; 60-100% of bank has erosional scars.       6       5       4       3       2       1       0         6       5       4       3       2       1       0       0       100% of bank has         acces e       covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation; disruption obvious; patches of bare soil or closely cropped vegetation; disruption obvious; patches of bare soil or closely cropped vegetation; disruption obvious; patches of bare soil or closely cropped vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.       Vidth of riparian zone 10-75 feet; human activities have impacted zone a great deal.         12       0       10       10       10       10         14       10       10       2       1       0         16       5       4				
SCORE (LB)	Left Bank (10 9	8 7 6	5 4 3	2 1 0			
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >150 feet and dominated by native vegetation including trees, shrubs, or non-woody macrophytes or wetlands; vegetative disruption through grazing or moving minimal or not evident; almost all plants allowed to grow naturally. Human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted	Width of riparian zone 75- 150 feet; human activities have impacted zone only minimally.	Width of riparian zone 10- 75 feet; human activities have impacted zone a great deal.	Width of riparian zone <10 feet; little or no riparian vegetation due to human activities.			
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0			
SCORE (RB)	Right Bank (0) 9	8 7 6	5 4 3	2 1 0			

Total Score 150

Rech2

Shiawassee River

# HABITAT ASSESSMENT FIELD DATA SHEET - GLIDE/POOL STREAMS

Habitat	Condition Category					
Parameter	Excellent	Good	Marginal	Poor		
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.		
SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.		
SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large- deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small- shallow or pools absent.		
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	543210		
4. Sediment Deposition	Little or no enlargement of island or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.		
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
5a. Channel Flow Status - Maintained Flow Volume	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate is exposed	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.		
SCORE	10 (9)	8 7 6	5 4 3	2 1 0		
5b. Channel Flow Status – Flashiness	Vegetation along the stream bank is complete nearly to the waters edge. Little or no evidence of frequent changes in discharge and/or frequent high water events that scours stream bank vegetation. Large woody debris (if present) stable and extending laterally across the stream channel	Some evidence of bank scour approximately 4-8 inches above the waters surface. Large woody debris (if present) mostly stable and extending partially into the active stream channel.	Bank scour evidence 9-18 inches above the waters surface. Large woody debris (if present) tend to lay more against the stream bank rather than extending into the active channel.	Bank scour (>20 inches) along the stream channel Large woody debris are generally absent from the active channel and/or may exist as woody debris jams along the stream bank above the active channel.		
SCORE	10 (9)	8 7 6	5 4 3	2 1 0		
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging (greater than past 20 yr) may be present, but recent channelization is not present	Channelization is continuous but not recent (>5 years). Embankments without mature trees and dominated by grasses and shrubs.	Stream reach has been recently channelized (<5 years). OR Banks shored with gabion, rock, cement or bare earth. Instream habitat greatly altered or removed entirely. Bank vegetation moderately dense to absent		
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		

# Reach 2 Shiquassee River

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Appendix J (continued)

Habitat	Condition Category						
Parameter	Excellent	Good	Marginal	Poor			
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. (Note: lack of sinuosity may be due to channelization)	Channel straight; waterway has been channelized for a long distance.			
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0			
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.			
SCORE (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0			
SCORE (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0			
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream	streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	streambank surfaces covered by native vegetation, but 1 class of plants is not well- represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	surfaces covered by vegetation; disruption of streambank vegetation has been removed to 2 inches or less in average stubble height.			
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0			
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0			
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >150 feet and dominated by native vegetation including trees, shrubs, or non-woody macrophytes or wetlands; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. Human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 75- 150 feet; human activities have impacted zone only minimally.	Width of riparian zone 10- 75 feet; human activities have impacted zone a great deal.	Width of riparian zone <10 feet; little or no riparian vegetation due to human activities.			
SCORE (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0			
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0			

Total Score 158

Reach 3

Shiawassee River

# HABITAT ASSESSMENT FIELD DATA SHEET - RIFFLE/RUN STREAMS

Habitat	Condition Category						
Parameter	Excellent	Good	Marginal	Poor			
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale)	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.			
SCORE	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0			
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of piche space	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.			
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0			
3. Velocity/Depth Regime	All 4 velocity/depth regimes present (slow-deep, slow- shallow, fast-deep, fast- shallow). (Slow is <1.0 f/s, deep is >2 ft ).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast- shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).			
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0			
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.			
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0			
5a. Channel Flow Status - Maintained Flow Volume	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.			
SCORE	(10) 9	8 7 6	5 4 3	2 1 0			
5b. Channel Flow Status – Flashiness	Vegetation along the stream bank is complete nearly to the waters edge. Little or no evidence of frequent changes in discharge and/or frequent high water events that scour stream bank vegetation. Channel retention devices (if present) stable and extending laterally across the stream channel	Some evidence of bank scour approximately 4-8 inches above the waters surface. Channel retention devices (if present) mostly stable and extending partially into the active stream channel.	Bank scour evidence 9-18 inches above the waters surface. Channel retention devices (if present) tend to lay more against the stream bank rather than extending into the active channel.	Bank scour (>20 inches) along the stream channel. Channel retention devices are generally absent from the active channel and/or may exist as woody debris jams along the stream bank above the active channel.			
SCORE	(10) 9	8 7 6	5 4 3	2 1 0			

# Reach 3 Shinwassee

# Appendix J (continued)

Habitat		Condition Category							
Parameter	Excellent	Good		Marginal Channelization is continuous but not recent (>5 years). Embankments without mature trees and dominated by grasses and shrubs.		Poor			
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelizat present, usually in of bridge abutmen evidence of past channelization, i.e dredging (greater past 20 yr) may be present, but recer channelization is r present.	ion areas ts; than than t not			Stream reach has been recently channelized (<5 years). OR Banks shored with gabion, rock, cement or bare earth. Instream habitat greatly altered or removed entirely. Bank vegetation moderately dense to absent.			
SCORE	20 19 18 17 16	15 14 13 12	2 11	(10) 9	8	7 6	5 4 3 2 1 0		
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffl infrequent; distant between riffles div the width of the st between 7 to 15.	es ce ided by ream is	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.		Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.			
SCORE	20 19 (18) 17 16	15 14 13 13	2 11	10 9	8	76	5 4	3 2	1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable infrequent, small a erosion mostly he over. 5-30% of ba reach has areas o erosion.	; areas of aled ank in of	Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods.		Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars			
SCORE (LB)	Left Bank 10 9	8 7	6	5	4	3	2	1	0
SCORE (RB)	Right Bank (10) 9	8 7	6	5	4	3	2	1	0
9. Vegetative Protection (score each bank)	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally	70-90% of the stream bank surfaces covered by native vegetation, but 1 class of plants is not well- represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.		Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.					
SCORE (LB)	Left Bank 10 (9	8 7	6	5	4	3	2	1	0
SCORE (RB)	Right Bank 10 (9)	8 7	6	5	4	3	2	1	0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >150 feet and dominated by native vegetation including trees, shrubs, or non-woody macrophytes or wetlands; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. Human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone	Width of riparian zone 75- 150 feet; human activities have impacted zone only minimally. Width of riparian zone 10- 75 feet; human activities have impacted zone a great deal.		Width o <10 fee riparian human	f riparian t; little or vegetati activities.	zone no on due to			
SCORE (LB)	Left Bank 10 9	8 7	6	5	4	(3)	2	1	0
SCORE (RB)	Right Bank 10 9	8 7	6	5	4	(3)	2	1	0

Total Score 149

Davisburg, Oakland County, Michigan



# **REPRESENTATIVE PHOTOS**





Reach 1, facing downstream from pedestrian bridge, 8/11/2021



Davis Lake in SW corner facing NE, littoral zone example, 8/9/2021

Project Number: J192086800



Reach 3, facing upstream from pedestrian bridge, 8/11/2021



Davis Lake in NE corner facing E, littoral zone example, 8/9/2021

APPENDIX C Representative Photos Shiawassee River Qualitative Assessment Davis Lake to Mill Pond Dam Oakland County, Michigan





Grass pickerel collected from Reach 1, 8/10/2021



Lake chubsucker collected from Reach 2, 8/10/2021

![](_page_46_Picture_4.jpeg)

Rock bass collected from Reach 1, 8/10/2021

![](_page_46_Picture_6.jpeg)

Longear sunfish collected from Reach 2, 8/10/2021

![](_page_46_Picture_8.jpeg)

![](_page_46_Picture_9.jpeg)

Project Number: J192086800

![](_page_47_Picture_0.jpeg)

Live Rainbow collected 8/10/2021

![](_page_47_Picture_2.jpeg)

Live Plain Pocketbook collected 8/10/2021

![](_page_47_Picture_4.jpeg)

Weathered dead shell Cylindrical Papershell collected 8/10/2021

![](_page_47_Picture_6.jpeg)

Live Giant Floater collected 8/10/2021

APPENDIX C Representative Photos Shiawassee River Qualitative Assessment Davis Lake to Mill Pond Dam Oakland County, Michigan

![](_page_47_Picture_9.jpeg)

Project Number: J192086800

Davisburg, Oakland County, Michigan

# APPENDIX

![](_page_48_Picture_2.jpeg)

# DAVIS LAKE AQUATIC PLANT SURVEY DATA TABLES

![](_page_48_Picture_4.jpeg)

Lake Name: Davis Lake Survey Date: August 9, 2021 County: Oakland County, Michigan Practitioners: Adam Balzer and Tom Estrem Weather: ~80F, 0.5 to 1.0 hrs thunderstorms, partly cloudy after Duration: 6.0 hours survey time Total AVAS: 14 Water Color: Brown/tannin stained Transparency: Secchi disk to 4 meters, Turbidity 1.05 NTU

Occurance Per Density Code **Relative Density** Cumulative Coverage Number Species Percentage В A(1) D(80) Α С D B(10) C(40) Sum Elodea canadensis 5.3 Chara spp. 77.1 Nymphaea odorata 17.9 Schoenoplectus tabernaemontani 1.4 0 15.7 Schoenoplectus acutus Eleocharis palustris 5.7 Potamogeton nodosus 6.6 Myriophyllum heterophyllum 42.2 Lythrum salicaria 4.6 Phragmites australis 0.1 52.1 Nitellopsis obtusa 13 Spirodela polyrhiza 0 1.5 0.1 Galium tinctorium Utricularia vulgaris 6.1 Carex spp. (CXLASI, CXSTRI, No IDs) 2.3 0 0.1 Thelypteris palustris Epilobium coloratum 0.1 Cicuta bulbifera 0.3 1.7 Potamogeton crispus 0 Sagittaria latifolia 0.8 0.1 Leersia oryzoides 0 Najas flexilis 0.1 Lemna trisulca 0.3 0 Potamogeton zosteriformis 6.6 Typha angustifolia 0.7 Cyperus diandrus 0.2 Myriophyllum sibiricum 0.9 Sparganium sp. (likely S. eurycarpum) 0.9 Ceratophyllum demersum 3.6 0 Nuphar advena 1.4 Ludwigia palustris 3 0.1 0 0 0.2 Agalinis purpurea Eleocharis flavescens 1.4 0 0.7 Cyperus bipartitus Lobelia kalmii 0.1 Asclepias incarnata 0.1 Campanula aparinoides 0.1 

Density Codes

А

В

С

D

<2%

2-20%

21-60%

>60%