Characterization of the Fenholloway River Near the Former Foley Cellulose Discharge, Taylor County June 18, 2019 - June 16, 2022

Division of Environmental Assessment and Restoration
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Executive Summary

Department of Environmental Protection's (DEP) Aquatic Ecology and Quality Assurance Section and Biology Program staff performed a study to evaluate and document the response of the Fenholloway River's biological communities to effluent modifications and outfall relocation at the Georgia Pacific Foley Cellulose facility. Foley Cellulose was a dissolving kraft pulp mill located in Taylor County, Florida that discharged into the Fenholloway River, a blackwater stream that originates in the San Pedro Bay swamp and flows into the Gulf of Mexico. The effluent treatment modifications started in 2018 and were completed in March 2019. The facility continued discharging to the Fenholloway River from the original outfall through December 2020, when the outfall was moved from the freshwater portion of the river to further downstream nearer to the estuary.

DEP monitored environmental conditions and collected samples semiannually for water quality parameters, qualitative and quantitative macroinvertebrate, and quantitative algal analyses near the original outfall from June 2019 to June 2022. Results from an upstream control site, a near-field test site (Test Site 1) and a far-field test site (Test Site 2) were compared to each other and to historical data to determine if the facility's modifications and outfall relocation resulted in improvements in the receiving waters.

The Study findings are:

- Dissolved oxygen, specific conductance and total ammonia met the Class III Freshwater Criteria after outfall relocation.
- Total phosphorus and total nitrogen concentrations were reduced after effluent improvements and removal but stayed near or above their respective criteria throughout the study.
- Prior to relocation, the elevated specific conductance of the effluent is believed to have contributed to the failing Stream Condition Index (SCI) scores and lower macroinvertebrate diversity scores at the test sites. Upgrades to the facility's wastewater processing lowered the effluent's specific conductance to levels that complied with Class III Freshwater Criteria, and the SCI consistently passed at Test Site 1 near US 19 starting in December 2020. This suggests the macroinvertebrate community recovered very quickly after the outfall was removed from the freshwater portion of the river.
- After the effluent modifications in 2019, downstream Hester-Dendy diversity scores were typically higher at the test sites compared to the control site, demonstrating remarkable recovery of the macroinvertebrate community. Downstream diversity scores continued to show improvements after the outfall relocation.
- DEP is interested in continuing to periodically perform SCIs in the Fenholloway River to evaluate if the river continues to support a healthy and well-balanced flora and fauna. The segment of the river that previously received effluent will remain on DEP's Impaired Waters list until there are sufficient passing data to meet delisting criteria.

Introduction and Purpose

Georgia Pacific's Foley Cellulose facility is a dissolving kraft pulp mill located in Taylor County, Florida. The facility discharges into the Fenholloway River, a blackwater stream that originates in the San Pedro Bay swamp and flows into the Gulf of Mexico. In 1947, the Fenholloway River was designated by the State of Florida as a Class V industrial use river. In 1988, the facility began modifications to its effluent treatment to reduce its chemical discharge (Preserving the Fenholloway). After determining that Class III Freshwater Criteria were attainable, the Florida Environmental Regulation Commission voted to reclassify the Fenholloway River from Class V industrial to Class III Freshwater fishable-swimmable, (Paulic et. al. 1996); this reclassification was effective December 31, 1997.

In 1998, the US Environmental Protection Agency (EPA) conducted an ecological risk assessment comprised of screening assays of Fenholloway sediments to determine potential toxicity of dioxins, furans, Polycyclic Aromatic Hydrocarbons (PAHs) and Polychlorinated Biphenyls (PCBs) on aquatic life (piscivorous birds, fish, and mammals) (EPA 1998). EPA also measured sediment total organic carbon (TOC) and grain size. The study found elevated levels of toxic compounds based on the screening assays but concluded that the potential exposures were below the level that may cause potential adverse effects. In 2003, EPA determined that in order for the river to meet Class III Freshwater Criteria, relocation of the outfall would be necessary (Preserving the Fenholloway).

In 2000, as part of the National Pollutant Discharge Elimination System (NPDES) permit program, the Florida Department of Environmental Protection (DEP) conducted a Fifth Year Inspection (FYI5) Biological Assessment to evaluate water quality and biological effects of the effluent discharged from the facility into the Fenholloway River. In 2006, DEP conducted a FYI5 with additional sites sampled in anticipation of an outfall relocation. From 2002 to 2018, DEP conducted five Abbreviated Fifth Year Inspection (FYI3) Effluent Quality Assessments. (FYI reports are available at DEP Biological and Audit Report Search.)

The facility's discharge location was a canal that entered the Fenholloway River approximately 40 km upstream from the Gulf of Mexico, in Waterbody ID (WBID) 3473B (**Figure 1**). WBID 3473B is on the Florida 303(d) list of impaired waters for dissolved oxygen (DO), specific conductance, total phosphorus (TP), and total ammonia per the Impaired Waters Rule (IWR), Chapter 62-303, Florida Administrative Code (F.A.C.). See Appendix A for a table of WBID 3473B impairments and IWR planning period, verified period, and delisting thresholds.

In 2018, DEP's Division of Environmental Assessment and Restoration (DEAR) was made aware that, in addition to effluent treatment modifications, the Foley outfall was going to be moved from the freshwater portion of the Fenholloway River to nearer to the estuary. Monitoring in the estuary was already occurring. Rarely is there an opportunity to conduct an in-stream, before-and-after point source outfall removal study. Prior to this project, effluent water chemistry was regularly tested through 2018, but the most recent DEP instream sampling events were in 2006.

The Foley Cellulose facility completed effluent treatment modifications in March 2019 but continued discharging to the Fenholloway River from the original outfall through December 2020. In December 2020, the outfall was relocated to the tidal portion of the Fenholloway River at mile marker 1.5, approximately 25 km downstream of the facility. A more complete history and description of the facility's changes and associated timeline can be found on the webpage Preserving the Fenholloway. The purpose of this project was to document changes to the Fenholloway River's biological health by evaluating in-stream conditions after the Foley Cellulose facility completed the effluent treatment modifications and relocated the outfall further downstream.

Background

Previous Sampling Sites

DEP's FYIs used a variety of sampling sites. In 2000, the Control Site was located approximately 10 km upstream of the discharge canal and the Test Site was located at CR 361A, approximately 5 km downstream of the discharge canal (DEP 2001). For the 2006 FYI5, three additional sites were established much closer to the outfall to collect baseline data for the eventual relocation of the outfall (DEP 2007). The original control site was renamed Control Site 1 and a new control site, Control Site 2, was established in the Fenholloway River approximately 50 m upstream of the confluence with the discharge canal. Test Site 1 was established in the discharge canal approximately 50 meters upstream of the confluence with the river. Test Site 2 was established in the Fenholloway River approximately 50 meters downstream of the discharge canal. (**Figure 2**).

Previous Water Chemistry Results

The results of the seven DEP FYI inspections consistently showed lower DO and higher specific conductance in the effluent and in the river below the discharge canal, as compared to upstream control sites. The algal growth potential (AGP) of the effluent, along with chemical analyses of the effluent and receiving waters, showed higher nutrient levels in all effluent and test site samples, as compared to control site samples. Based on the salinity of the effluent sample, AGPs were analyzed using either a freshwater algal species, *Pseudokirchneriella subcapitata* (formerly *Selenastrum capricornutum*), or a marine algal species, *Dunaliella tertiolecta* (Miller, et. al. 1978). AGPs for all sites were often above the problem threshold for both freshwater (5 mg dry wt/L) and marine receiving waters (10 mg dry wt/L) (Raschke and Schultz 1987). Un-ionized ammonia values calculated for the effluent and test site samples were typically higher than values calculated for control site samples and exceeded the Class III Freshwater Criterion that was in effect prior to 7/24/2017 (Subsection 62-302.530(3)-, F.A.C., prior to 2/17/2016) on several occasions. Several effluent bioassays were either acutely or chronically toxic to test organisms; however, the toxicity never exceeded permit limits or interim permit limits set in Administrative Order (AO) 011-NED. In FYI3 2018, a suite of organic pesticides was included for which 2,4,6-trichlorophenol was detected above the practical quantitation limit (PQL) and 2,4-dichlorophenol, fluoranthene and pyrene were detected between the method detection limit (MDL) and PQL **(Table 1)**.

Table 1. Summary of Fifth Year Inspections, 2000 to 2018. Table shows impaired parameters and analytes, indicators for nutrient enrichment and toxicity, and detected organic pesticides. A dash (-) indicates sample/measurement was not collected. FW – Freshwater, SA – Salinity adjusted, NOEC – No observed effect concentration for growth/reproduction, LOEC – lowest observed effect concentration for survival, IC25 – inhibition concentration at which there is a 25% reduction in toxicity, LC50 – lethal concentration at which there is 50% mortality, *C. leedsi - Cyprinella leedsi, P. promelas - Pimephales promelas, M. beryllina - Menidia beryllina, C. dubia - Ceriodaphnia dubia, A. bahia- Americamysis bahia.* Results highlighted in yellow exceed the permit limit and/or the Class III Criteria (Freshwater and 2018 Marine) effective at the time of sampling.

	FYI5 (2000)			**FYI3 (2002)**	**FYI5 (2006)**					**FYI3 (2009)**	**FYI3 (2011)**	**FYI3 (2012)**	**FYI3 (2018)**
Analyte (units)	Effluent	Control Site	Test Site	Effluent	Effluent	Control Site 1	Control Site 2	Test Site 1	Test Site 2	Effluent	Effluent	Effluent	Effluent
Dissolved Oxygen (mg/L)	2.9	7.2	1.8	-	3.4	7.9	5.7	7.2	6.7	3.0	4.8	2.8	3.8
Specific Conductance (µmhos/cm)	2,244[1] e	341	2,160 e	-	2,800[1] e	52	136	2,770 e	2,473 e	2,348[1] e	2,664[1] e	2,282[1] e	2,323[1] e
Ortho-Phosphate (mg P/L)	1.3	0.10	1.5	0.78	1.5	0.041	0.081	1.7	1.6	0.96	1.4	1.6	1.0 Q
Total Phosphorus (mg P/L)	2.2	0.17	2.2	1.2	2.2	0.061	0.095	2.1	2.1	1.4 A	1.9 Y	2.0	1.8 e
Total Ammonia (mg N/L)	4.6	0.05	4.6	5.0	4.6	0.06	0.15	4.6	4.1	0.2	4 Y	3.1	3.3
Un-ionized Ammonia (mg NH3/L)	0.03 c e	0.00 c	0.01 c	0.043 c e	0.05 c e	< 0.02 c	< 0.02 c	0.05 c e	0.04 c e	≤ 0.02 c	≤ 0.02 c	0.10 c e	< 0.02 c
Nitrate+Nitrite (mg N/L)	0.02	0.05	0.13	0.004 U	1.0	0.020 U	0.004 U	1.2	1.0	0.005 I	0.17 Y	0.004 I	0.019
Total Kjeldahl Nitrogen (mg N/L)	7.8	0.76	7.3	6.0	8.3	1.9	1.8	8.6	8.4	7.1	7.5 Y	5.9	8.4
Organic Nitrogen (mg N/L)	3.2 c	0.70 c	2.7 c	-	3.7 c	1.8 c	1.6 c	4.0 c	4.3 c	6.9 c	3.5 c	2.8 c	5.1 c
Total Nitrogen (mg N/L)	7.8 c	0.80 c	7.4 c	-	9.3 c	1.9 c	1.8 c	9.8 c	9.4 c	7.1 c	7.7 c	5.9 c	8.4 c
2,4,6-trichlorophenol (µg/L)	-	-	-	-	-	-	-	-	-	-	-	-	0.25
2,4-dichlorophenol (µg/L)	-	-	-	-	-	-	-	-	-	-	-	-	0.072 I
Fluoranthene (µg/L)	-	-	-	-	-	-	-	-	-	-	-	-	0.034 IJ
Pyrene (µg/L)	-	-		-	-	-	-	-	-	-	-	-	0.095 IJ

	FYI5 (2000)			**FYI3 (2002)**	**FYI5 (2006)**					**FYI3 (2009)**	**FYI3 (2011)**	**FYI3 (2012)**	**FYI3 (2018)**
Analyte (units)	Effluent	Control Site	Test Site	Effluent	Effluent	Control Site 1	Control Site 2	Test Site 1	Test Site 2	Effluent	Effluent	Effluent	Effluent
Algal Growth Potential: (mg dry wt/L)	58.4 e (FW)	8.20 e (FW)	67.7 e (FW)	-	199 e (FW)	1.90 A (FW)	8.10 e (FW)	175 e (FW)	191 e (FW)	110 e (FW)	9.17 (FW)	123 A e (SA)	108 e (SA)
Bioassay: vertebrate (growth/survival)	> 100% NOEC *C. leedsi*	-	-	No Result[2]	LC50 = >100% *C. leedsi*	-	-	-	-	LOEC = 100% *P. promelas*	IC25 = 100% *P. promelas*	IC25 = 27.3%[4] *M. beryllina*	LC50 = ≥ 100%[5] *M. beryllina*
Bioassay: invertebrate (reproduction/growth/ survival)	> 100% NOEC *C. dubia*	-	-	> 100% NOEC *C. dubia*	LC50 < 100%[3] e *C. dubia*	-	-	-	-	LOEC = 100% e *C. dubia*	IC25 = 52.8 % e *C. dubia*	IC25 = 54.3%[4] e *A. bahia*	LC50 = ≥ 100%[5] *A. bahia*

e - Value exceeds the Class III Criteria or permit limits
c - Value is calculated
A - Value reported is the mean of two or more determinations
Q - Sample held beyond normal holding time
U - Material analyzed for but not detected; value reported is the method detection limit
Y - Improper preservation
1 - Within interim permit limits (AO 011-NED, 4,000 µmhos/cm).
2 - Control failure in *C. leedsi* bioassay; test invalidated.
3 - There was 95% mortality in 100% effluent, which is greater than permit limit of 50% mortality.
4 - Within proposed permit limits (IC25 ≥ 25%)
5 - Within interim permit limits (AO 011-NED, LC50 ≥ 100%).

Previous Algal Community Results

Both FYI5s showed differences in the algal communities between control and test sites. Periphyton was sampled by periphytometers (quantitative) in 2000 and a natural substrate method (qualitative) in 2006. In 2000, the Control Site periphyton community was dominated by diatoms (98%) and although diatoms were present (44%) at the Test Site near CR 361A, blue-green algae were dominant (56%). Compared to the Control Site, the Test Site had fewer taxa and less diversity (DEP 2001). The data represented an imbalance of the natural populations of aquatic flora that did not meet Paragraph 62-302.530(48)(b), F.A.C. The FYI5 2006 data showed similar declines in periphyton communities at Test Sites 1 and 2, which were upstream of US 19 closer to the confluence. Samples from Control Site 1 and Test Site 1 were both dominated by diatoms; however, there were fewer algal units in the Test Site 1 sample (DEP 2007).

Previous Quantitative Macroinvertebrate Results

In FYI5 2000, the Test Site showed a decline in macroinvertebrate communities compared to the Control Site in terms of the number of taxa; the Florida Index; number of Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa; and diversity scores. The Shannon-Weaver diversity was 83.9% less at the Test Site (0.56) than at the Control Site (3.47). Similarly, in FYI5 2006, the Shannon-Weaver diversity scores were 2.98 at Control Site 2, 0.96 at Test Site 1, and 1.6 at Test Site 2, representing a reduction of 81.2% and 46.3%, respectively. These numbers are indicative of a loss of biological integrity and an imbalance in the aquatic fauna (Paragraph 62-302.530(10)(a) and Paragraph 62-302.530(48)(b), F.A.C.) and represent conditions favorable for the dominance of nuisance taxa (Subsection 62-302.530(47), F.A.C.).

Previous Qualitative Macroinvertebrate Results

The Stream Condition Index (SCI) is a biological assessment procedure that measures the degree to which flowing fresh waters support a healthy, well-balanced biological community, as indicated by benthic macroinvertebrates. It should be noted that the SCI, a multi-metric, qualitative tool for assessing macroinvertebrate stream health, has undergone multiple revisions over the course of this project. The revision names roughly correlate to the year in which they took effect: SCI_1992, SCI_2004, and most recently, the SCI_2012. For this report, it is not necessary to understand the nuances of each revision, but it is important to know that it is not appropriate to compare SCI versions through time as the thresholds changed substantially amongst the versions. For example, a site with score of 29 in the 1992 version is considered "excellent" while a score of 29 represents a failing score in the 2012 version. **Table 2** shows SCI scores calculated with the appropriate version for that year. With that understanding, in FYI 2000, the SCI_1992 score of 29 placed the Control Site in the "Excellent" category while the Test Site, with a score of 11, was considered "Severely Degraded." In FYI5 2006, the SCI_2004 score placed Control Site 1 (52) in the "Fair" category and although Control Site 2 (39) was considered "Poor," it ranked higher than Test Site 1 and Test Site 2 (5 and 3, respectively), both of which fell into the "Very Poor" category.

Table 2. Summary of Fifth Year Inspection Biological Communities, 2000 and 2006. A dash (-) indicates sample/measurement was not collected.

Metric	FYI5 2000		FYI5 2006			
	Control Site	Test Site	Control Site 1	Control Site 2	Test Site 1	Test Site 2
Periphyton						
# Total Taxa	17	4	28	-	19	-
% Diatoms	97.5	44.4	99.4	-	81.8	-
% Blue-green	1.0	55.6	0.32	-	18.2	-
Quantitative Macroinvertebrates (Hester-Dendy samplers)						
# Taxa	22	6	- [6]	19	8	18
% Dominant Taxon	25.3	89.9	- [6]	23.4	77.3	49.4
Shannon-Weaver diversity	3.5	0.56 e	- [6]	3.0	0.96	1.6
Qualitative Macroinvertebrates (SCI)						
# Taxa	37	2	20	27	10	9
% Dominant Taxon	11.0	52.0	77.2	49.5	80.2	70.4
SCI_1992	29	11	-	-	-	-
SCI_2004	-	-	52	39	5	3

e - Value exceeds the Class III Criteria or permit limits

6 - Hester-Dendy samplers not recovered.

Study Sites

For this study, a single control site and two test sites were established to monitor the river as the facility completed modifications and relocated the outfall. The Control Site was established upstream of US 27, approximately 10 km upstream of the discharge canal. A near-field test site, Test Site 1, was established upstream of US 19 and approximately 50 meters below the discharge canal. A far-field site, Test Site 2, was established approximately 4 km downstream of the discharge canal, just upstream of CR 361A. All monitoring locations are shown in **Figure 2.**

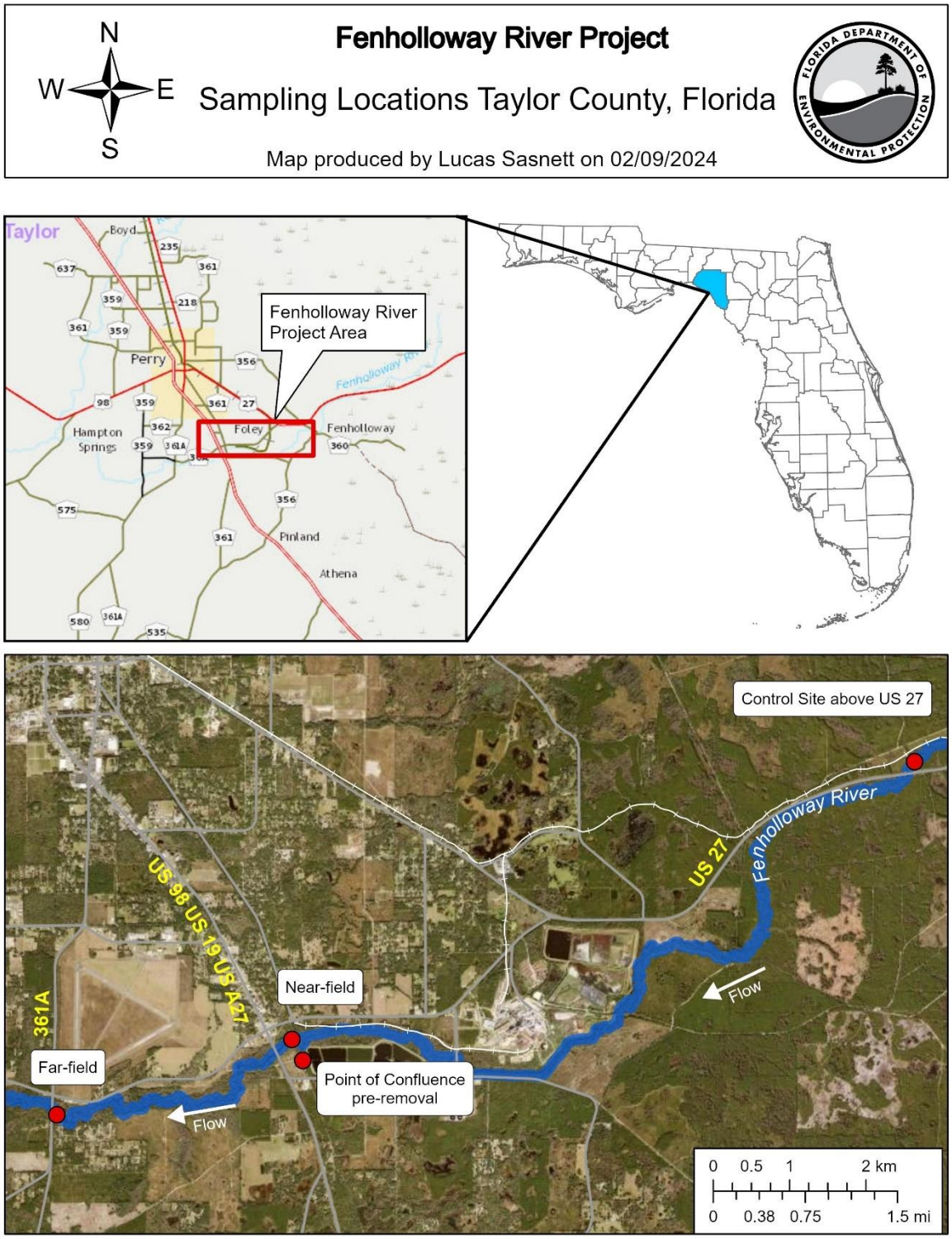


Figure 1. Map of facility and in-stream sampling locations

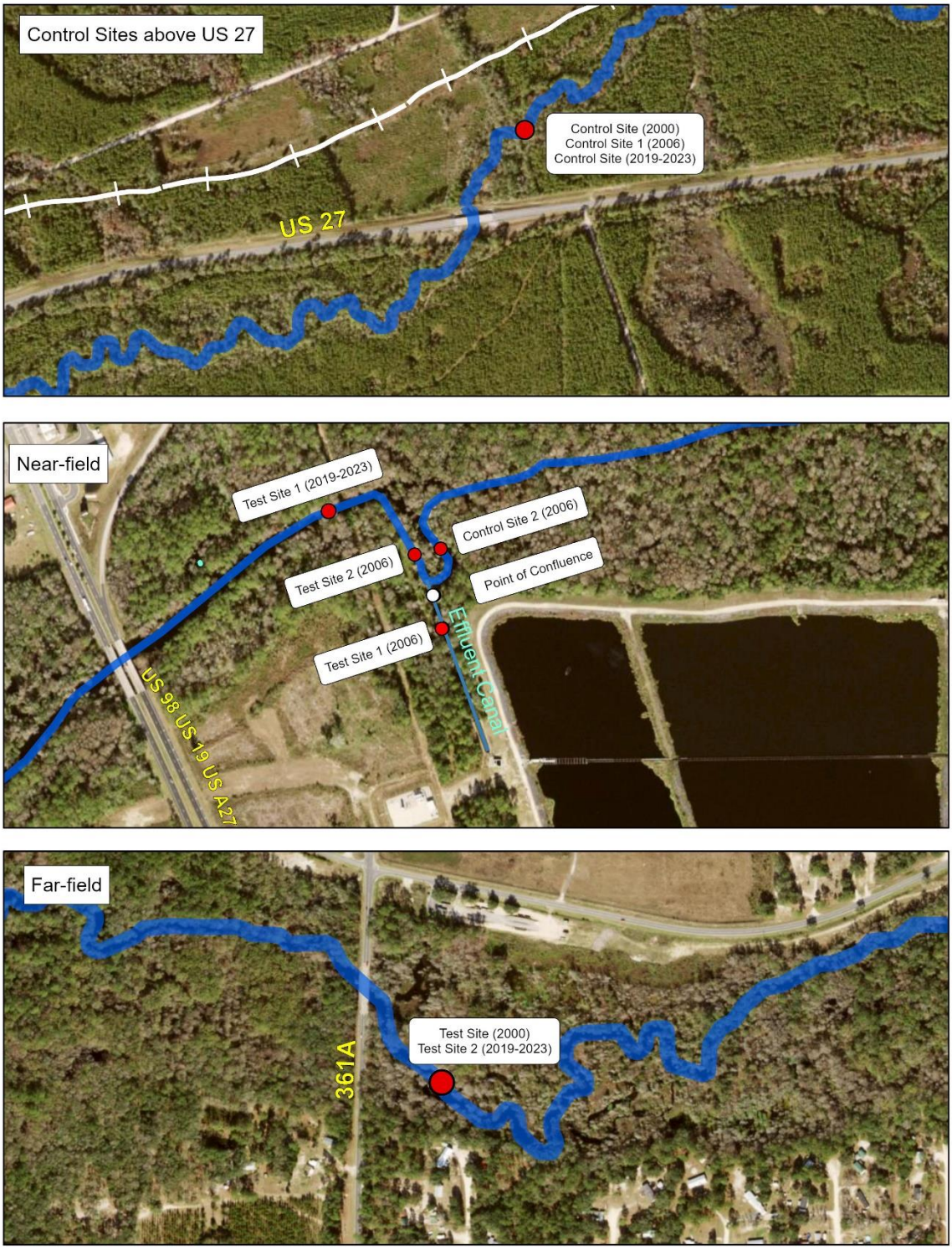


Figure 2. Previous and current study sampling locations for Fenholloway River Project

Methods

Two sampling events per year, at least three months apart, were planned for 2018 through 2022 after which, DEP would determine if the river had sufficiently recovered or if further sampling would be needed. Each sampling event would include measured water quality parameters, water quality samples, qualitative and quantitative macroinvertebrate samples and quantitative algal samples. During each sampling event, photos would be taken at a set location at each site to monitor water levels and changes over time. Additional field observations would be recorded.

On September 12, 2018, DEP visited several previously sampled sites along the Fenholloway River to deploy Hester-Dendy samplers and periphytometers. The water levels were elevated above the normal high-water mark making it impossible to see the channel or banks, and deployment was aborted. Once water levels receded and stabilized, DEP established the access points and study sites for future sampling events. Henceforth, a series of United States Geological Survey (USGS) water level gauges on the Fenholloway River were consulted throughout the study (https://waterdata.usgs.gov/nwis/rt) to determine when conditions were appropriate for biological monitoring (Appendix B). Conditions were first considered appropriate for sampling about 10 months after the September 2018 visit.

DEP monitored environmental conditions near the original outfall from June 2019 to June 2022 and compared the results to historical data to determine if the facility's modifications and outfall relocation resulted in improvements in the receiving waters. Appendix C shows a complete list of sampling trips and the samples collected on each occasion.

Water quality parameters of DO, pH, specific conductance and temperature were measured using a multiprobe meter. Water quality samples were collected using the direct grab technique. Analytes were selected based on those detected in previous FYI reports as well as to provide information relevant to aquatic life use in the Fenholloway River. Refer to Appendix D for a list of analytes sampled and the corresponding DEP SOP or Lab Method.

Macroinvertebrates were collected using the SCI method and Hester-Dendy artificial substrates. For the SCI, productive habitat in a 100 m stretch was sampled using 20 sweeps with a D-framed dip net. Samples are typically collected in the top 0.5 m of the water's surface (the arm length of an average sampler). For this reason, it is imperative that the habitat in this top 0.5 m be fully inundated allowing organisms to colonize available habitats and be reachable prior to sampling. The SCI is composed of ten metrics that quantitatively describe stream community structure and function and is dimensionless, with scores between 0 and 100. A balanced faunal community is achieved if the average score of at least two temporally independent (greater than 3 months apart) SCIs is 40 or higher, with neither of the two most recent SCI scores less than 35 (Section 62-303.430(2), F.A.C.).

The Hester-Dendy multi-plate sampler is a commonly used tool for macroinvertebrate collection in flowing systems. One advantage of this sampling device is that it provides a fixed sampling area in systems with differing and/or limited amounts of natural habitats. The standardized sampling area allows

for the comparison of quantitative measurements of macroinvertebrate community health such as the Shannon-Weaver Diversity Index. Disadvantages of these devices are the risk of being tampered with or becoming stranded when water levels change significantly after being deployed, both of which occurred during this study. During this study, four Hester-Dendy multi-plate samplers (condos) were attached to a floating PVC frame and suspended in the water column for 28 days at each sampling location (**Figure 3**).

The Hester-Dendy floating PVC frame provides an excellent opportunity to sample algae by periphytometer. For algal collections, glass microscope slides were scuffed with sandpaper to facilitate periphyton attachment. A periphytometer consists of eight slides placed in a plastic slide-tray. Each periphytometer was suspended in the water column for 28 days at each sampling location.

All samples were collected by staff from DEAR's Aquatic Ecology and Quality Assurance Section and Biology Program and analyzed at the DEP Laboratory in Tallahassee (DOH certification # E31780). All bioassessments were conducted by staff who have demonstrated required proficiency in the methods. All field and laboratory methods followed DEP Standard Operating Procedures (see https://floridadep.gov/dear/quality-assurance/content/dep-sops and https://floridadep.gov/dear/florida-dep-laboratory/content/dep-laboratory-quality-assurance-manual-and-sops for details) and met DEP quality assurance/quality control standards (see https://floridadep.gov/dear/quality-assurance).



Figure 3. Figure 3. Hester-Dendy in the field. From left to right: Hester-Dendy deployed at Test Site 1, close-up of Hester-Dendy deployed at Test Site 1, and retrieval of a multi-plate sampler from the Control Site.

Results and Discussion

Challenges

Sampling was scheduled to begin in 2018; however, the first sampling event was not completed until July 2019, when water levels were appropriate for biological sampling. Over the ensuing three years, seven sampling events were completed. The Fenholloway River's frequent water level fluctuations and dark tannic color (**Figure 4**) made it difficult or impossible to perform the biological assessments on several occasions. At other times, vandalism and receding water levels resulted in the Hester-Dendy samplers and periphytometers being exposed to air (**Figure 5**), rendering them unusable.



Figure 4. Water level fluctuation at Test Site 1. On left, 4/20/2021 (gauge height 12.2 ft); On right, 6/16/2022 (gauge height 9.5 ft). Note the exposed banks during the 6/16/2022 visit.



Figure 5. A Hester-Dendy sampler stranded on the bank after the water level receded while deployed at Test Site 1 (6/16/2022).

Test Site 2 upstream of CR 361A was located behind private property and along the landing path to a nearby airport. In March 2020, approximately 20 m of the left bank was sprayed with herbicide to increase visibility for airplanes. Vegetation on the left bank died off and slowly began to recover by the last sampling trip, 6/16/2022. Also in March 2020, approximately 30 m of the right bank became disturbed by the construction of an outbuilding by the owner of the private property. The disturbance increased as the building progressed but never extended beyond the original 30 m stretch. Habitat Assessment scores were reduced because of riparian zone disturbances.

Sampling was delayed twice due to inclement weather and heavy rainfall from back-to-back tropical systems in August and September of both 2020 and 2021. Water levels were above appropriate sampling conditions for more than a month. On other occasions, water levels were lower than typical. In many cases, the lower water levels made habitats more accessible for sampling; however, on 6/16/2022, roots that provide good, productive habitat for macroinvertebrates were exposed rendering them unable to be sampled.

During the 1/21/2021 sampling trip, an alligator longer than 13 feet was observed at Test Site 2. As a result, neither the water quality samples, nor the SCI were collected on that date. For the 5/19/2021 sampling visit, an extension pole was used to collect water quality samples from the riverbank at Test Site 2. After reviewing the data collected to-date for Test Site 2 and considering sampler safety, it was decided to discontinue sampling at this site for the remainder of the study.

Physical Characterizations and Field Chemical Parameters

Physical site characterizations, including canopy cover, riparian buffer zones, channelization, water odors and sediment odors were recorded. Parameters DO, pH, specific conductance, temperature and sample depth were measured during every water quality site visit, except on 11/2/2020 when the meter was forgotten (Appendix E).

While seasons affected the amount of canopy cover, each sampling location generally ranked in a similar order. The Control Site had the most canopy cover (heavily shaded), Test Site 2 had the least (lightly shaded/open) and Test Site 1 typically fell in between (moderately shaded). The typical width at the Control Site ranged from 3 m to 6 m whereas the typical width at both test sites ranged from 7 m to 15 m. The differences in stream width could explain the differences in canopy cover. The canopy cover at Test Site 2 was also reduced due to disturbances within the first 30 m of both the left and right riparian zones.

There are no impoundments along the Fenholloway River. The river has a natural channel for nearly its entire length. At Test Site 1 near US 19, some channelization was observed however, the river was mostly recovered. The remains of an old railroad bridge near Test Site 1 explain why that portion of the river was modified. Fifty meters downstream of the discharge canal, temperature differences could be felt between the river's natural water and the discharge water, indicating a noticeable volume of water entering the river from the canal. The plume from the discharge canal may have also impacted the river's channel.

Chemical/petroleum water odors were noted at Test Site 1 on 10/9/2019 and at both test sites on 7/16/2019, 2/12/2020 and 3/11/2020. Chemical/petroleum sediment odors were noted at Test Site 1 on 10/9/2019 and 3/11/2020 and at Test Site 2 on 6/18/2019, 7/16/2019, 2/12/2020 and 3/11/2020. All odors were observed as "Normal" after 3/11/2020, approximately 3 months after the outfall was relocated.

The Fenholloway River falls within the Big Bend Bioregion, for which the daily average DO saturation shall not be below 34 percent in more than 10 percent of the values (Paragraph 62-302.533(1)(a), F.A.C.). San Pedro Bay swamp is the headwaters for the Fenholloway River, and wetlands are naturally low in DO. Prior to the relocation of the outfall in December 2020, the measured DO was greater than 34 % saturation at the Control Site, Test Site 1, and Test Site 2 (**Figure 6**). The lowest measured DO (43.3 %) was at the Control Site on 10/9/2019. The lowest measured DO values in the study occurred at the Control Site and Test Site 1 on 6/16/2022. The Control Site DO measured 33% saturation, just below the Big Bend Bioregion threshold, and the Test Site 1 DO measured 37.6 % saturation, just above the Big Bend Bioregion threshold. The naturally low DO of the wetland source water combined with the low water level may account for the lower measured DO levels on 6/16/2022. Without the effluent point source, the river could potentially see new seasonal low DOs under low water conditions.

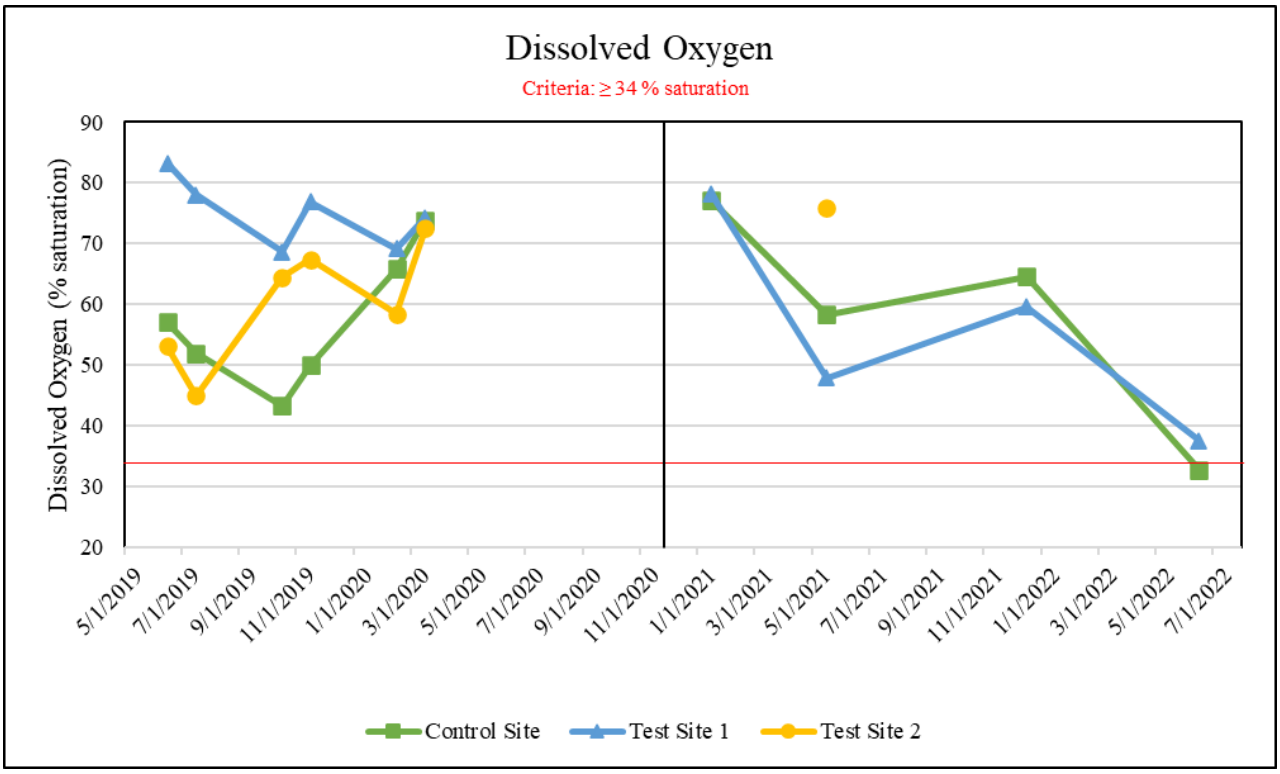


Figure 6. Measured dissolved oxygen compared to the Class III Freshwater Criterion (red line); vertical black line denotes outfall relocation completed (December 2020).

The pH Class III Freshwater Criterion is based on the natural background of a waterbody. As a blackwater stream, the Fenholloway River has a naturally low pH, typically less than 6.0 SU (**Table 3**); therefore, the pH of the river shall not vary more than one unit above the natural background (Paragraph 62-302.530(52)(c), F.A.C). This study considers the pH of the Control Site a reasonable surrogate for the natural background of the river. For every sampling event with pH measurements, Test Site 1 and Test Site 2 exceeded 1 SU unit above the natural background of the water, except for the 6/16/2022 sampling event when the Control Site had a higher-than-average pH (6.6 SU) and Test Site 1 was just less than 1 SU above it (7.5 SU).

Table 3. pH (SU) measurements for each monitoring location and date. The Control Site measurements are considered natural background measurements. All Test Site 1 and Test Site 2 values are greater than 1 SU above the Control Site (highlighted in yellow) except Test Site 1, 6/16/2022.

Sampling Dates	Control Site	Test Site 1	Test Site 2
6/18/2019	4.0	7.3	7.1
7/16/2019	3.8	6.8	7.0
10/9/2019	5.8	7.5	7.6
11/6/2019	5.5	7.5	7.6
2/12/2020	5.0	7.5	7.6
3/11/2020	4.0	6.7	7.3
11/2/2020	-	-	-
1/21/2021	3.7	6.9	-
5/19/2021	5.5	6.9	7.4
12/20/2021	4.2	6.4	-
6/16/2022	6.6	7.5	-

During the 2000 and 2006 FYI5 events, specific conductance downstream of the discharge canal exceeded the Class III Freshwater Criterion of ≤ 1,275 µmhos/cm (Subsection 62-302.530(22), F.A.C.) on several occasions; however, interim permit limits allowed a maximum of 4,000 µmhos/cm in the effluent (AO 011-NED). During the first year of this study before the December 2020 outfall relocation, specific conductance exceeded the freshwater limit at Test Site 1 and Test Site 2 (**Figure 7**). After the outfall was relocated, specific conductance values measured less than 500 µmhos/cm and there were no additional exceedances.

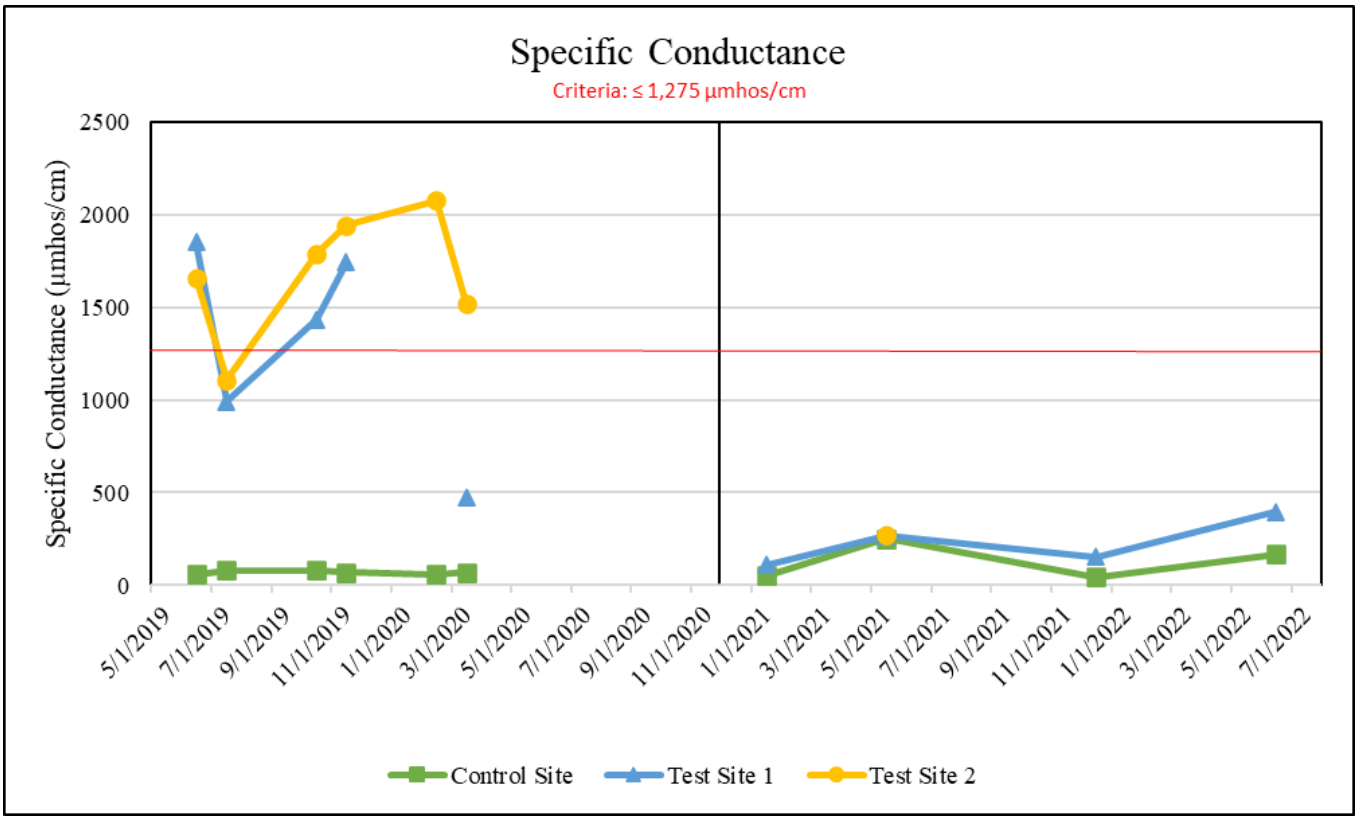


Figure 7. Measured specific conductance compared to the Class III Freshwater Criterion (red line); vertical black line denotes outfall relocation completed (December 2020).

Water Chemistry

Prior to 2013, total phosphorus (TP), total nitrogen (TN), and chlorophyll *a* Class III Water Quality Criteria were based on single sample results; however, in 2013, DEP implemented the Numeric Nutrient Criteria for streams (NNC) for which the water quality thresholds for TP, TN, and chlorophyll *a* are based on annual geometric means (AGM). The Fenholloway River falls within the Panhandle East Nutrient Watershed Region for NNC. For this region, the nutrient thresholds, expressed as AGM, are 0.18 mg/L TP and 1.03 mg/L TN (Paragraph 62-302.531(2)(c), F.A.C.). Thresholds are not to be exceeded more than once in any three calendar-year period.

During the FYI events from 2000 to 2012, effluent sample TP measured between 1.2 mg/L and 2.2 mg/L. When in-stream TP samples were collected, test site values (2.1 and 2.2 mg/L) were very similar to the effluent values (2.2 mg/L) whereas control site values were much lower (0.061 to 0.17 mg/L) (**Table 1**). Furthermore, the FYI3 2018 effluent sample TP was 1.8 mg/L. During the current study, the highest measured TP (0.51 mg/L) was in the 7/16/2019 Test Site 2 sample (**Figure 8**). By December 2020, TP levels measured in the Control Site, Test Site 1 and Test Site 2 samples were all below the regional NNC threshold of 0.18 mg/L. While there was fluctuation in TP levels, overall TP levels downstream of the

facility after effluent modifications and outfall relocation were consistently lower than those detected in the FYIs and close to or lower than NNC for the Panhandle East Nutrient Watershed Region. Additional nutrient sampling may be needed to meet data sufficiency requirements to calculate and assess attainment of the stream nutrient standard.

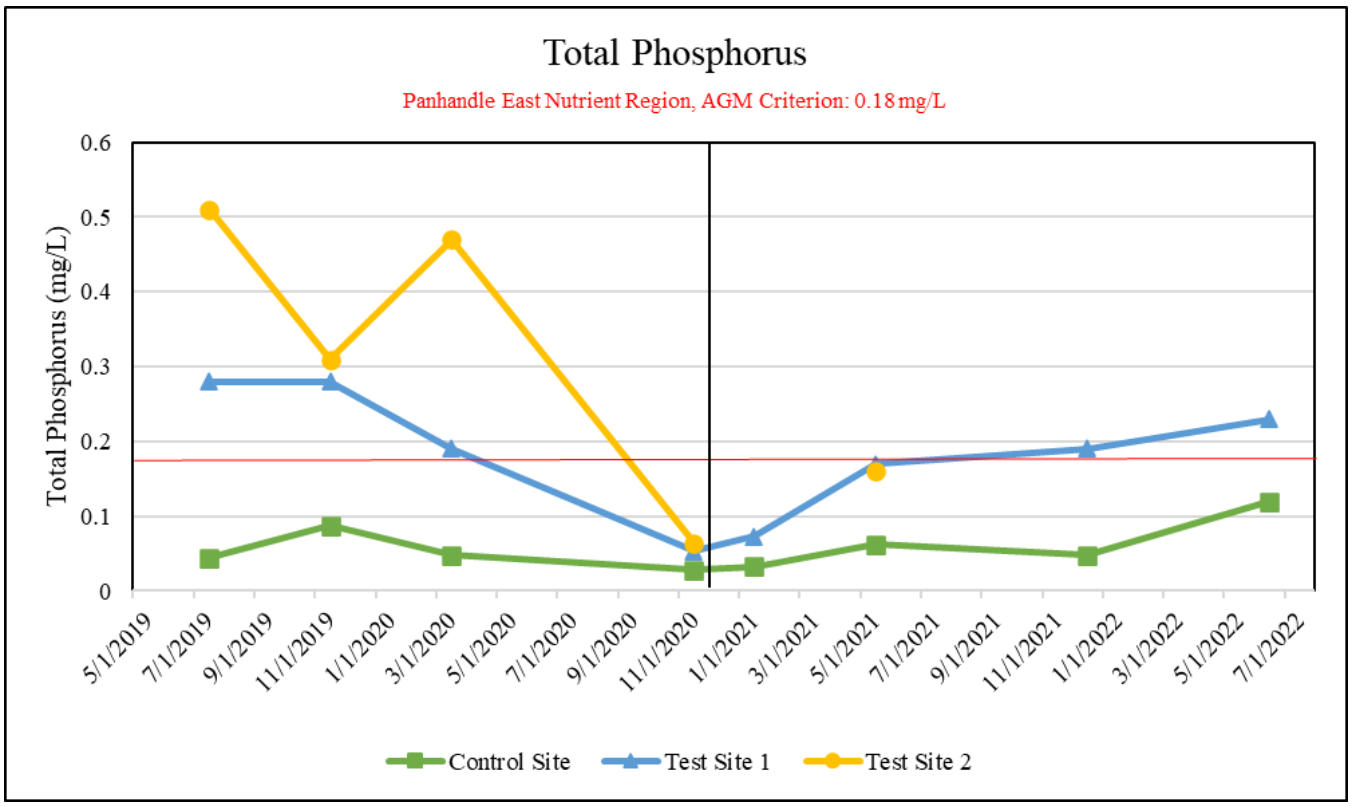


Figure 8. Measured total phosphorus compared to the Class III Freshwater Criterion (red line); vertical black line denotes outfall relocation completed (December 2020).

Calculated TN values showed a similar pattern to the TP results in FYI events from 2000 to 2012. Effluent calculated TN ranged between 5.9 mg/L and 9.4 mg/L and test site values mirrored the effluent levels whereas control site values were much lower (0.8 to 1.9 mg/L) (**Table 1**). From July 2019 to December 2020, single-sample calculated TN levels from the Control Site, Test Site 1 and Test Site 2 were all above the TN threshold (1.03 mg/L as AGM) for the Panhandle East Nutrient Watershed Region (Paragraph 62-302.531(2)(c), F.A.C.) (**Figure 9**). After the December 2020 outfall relocation, single-sample calculated TN levels remained at or above the NNC threshold for TN; however, concentrations were generally below those before December 2020. TN at Test Site 1 on 5/19/2021 and 6/16/2022 were below the regional NNC threshold for TN. TN levels at the Control Site were consistently higher than TN levels at both test sites, before and after outfall relocation, which suggests that TN exceedances at the test sites were likely not related to the discharge. Additional nutrient sampling may be needed to meet data sufficiency requirements to calculate and assess attainment of the stream nutrient standard.

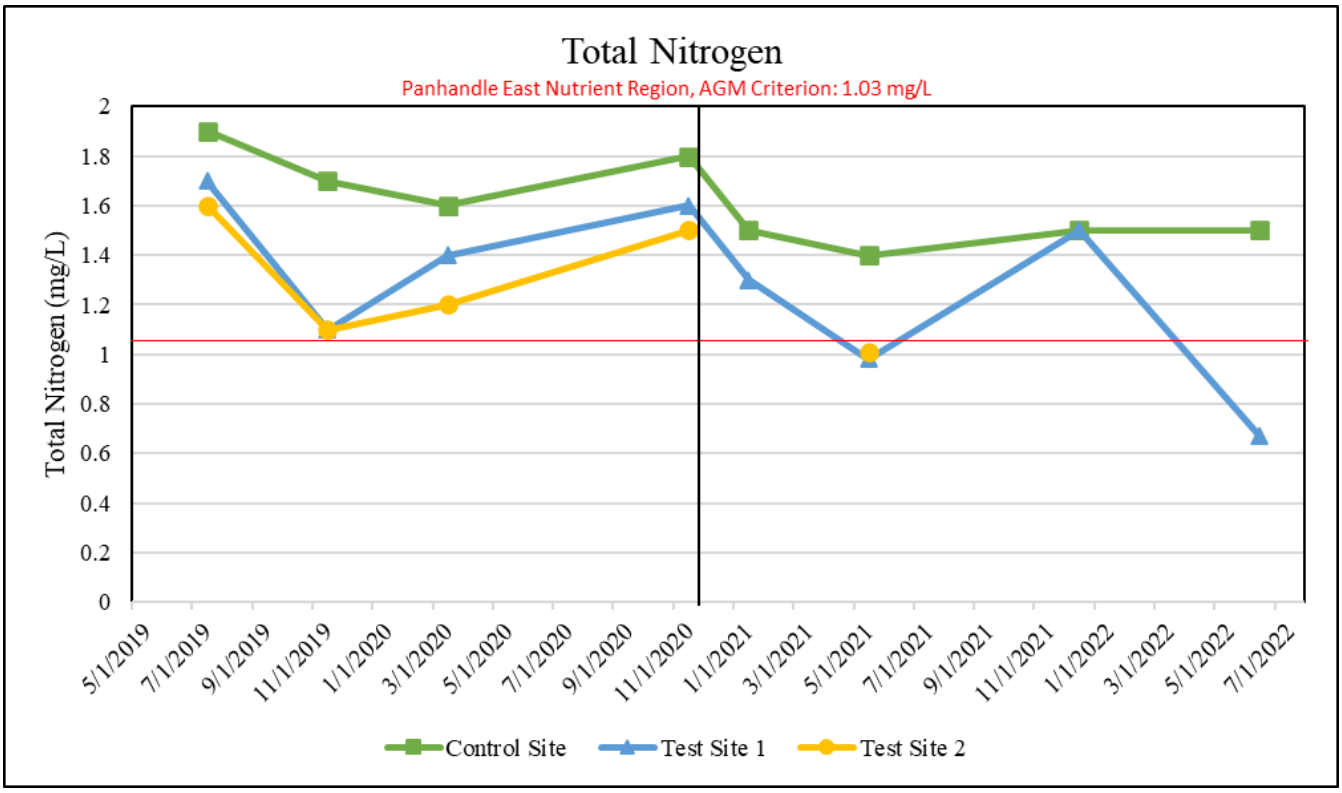


Figure 9. Measured total nitrogen compared to the Class III Freshwater Criterion (red line); vertical black line denotes outfall relocation completed (December 2020).

The Class III Freshwater Criterion for total ammonia is temperature and pH dependent (Subsection 62-302.530(3), F.A.C.). Temperature and pH measurements were not taken on 11/2/2020; therefore, the total ammonia criterion was unable to be calculated for that site visit (Appendices E, F). Total ammonia never exceeded the criterion for dates with temperature and pH measurement data. Metals also complied with Class III Freshwater Criteria (Appendix G).

In the March 2018 FYI3, four common pulp mill organic chemical byproducts were detected in the effluent sample (**Table 1**). In the fall of 2018, Foley replaced four sets of black liquor evaporators with new evaporators. Evaporators remove water from pulping chemicals to concentrate them, therefore reducing the amount of chemicals that get discharged into the receiving waterbody. Water chemistry sampling for this study commenced after the new evaporators were installed. The only organic constituent analyzed was 2,4,6-trichlorophenol. It was detected in Test Site 1 and Test Site 2 samples on 7/16/2019 (0.20 µg/L and 0.12 I µg/L, respectively) and on 11/6/2019 (0.11 I µg/L, for both sites) (Appendix H). The Class III Freshwater Criterion for 2,4,6-trichlorophenol is less than or equal to 6.5 µg/L annual average (Subparagraph 62-302.530(53)(c)4, F.A.C.). During this study, 2,4,6-trichlorophenol was detected but never exceeded its water quality criterion, and after 11/6/2019, it was no longer detected in water chemistry samples.

Periphyton

Excessive periphyton growth or nuisance periphyton can be indicative of nutrient enrichment. Previous FYI5s used periphytometers (2000) and natural substrate methods (2006) to assess and compare algal growth at the control and test sites; periphytometers were used in this study (Appendix I). Control site samples were dominated by diatoms in previous studies and in five out of seven samples in the current study (**Table 4**). For the other two samples in this study, the Control Site was dominated by blue-green algae (77%, 3/11/2020) or green algae (80%, 11/2/2020). The 6/16/2022 event was a bit of an outlier, with very few wet and diatom taxa collected at the Control Site compared to the other visits.

Similar to FYI5 2000 results, the periphyton community on 7/16/2019 at Test Site 2 near CR 361A was split between diatoms (47%) and blue-green algae (50%) but was dominated by blue-green algae. The remaining three samples collected at Test Site 2 were dominated by diatoms, which is similar to results for this location from FYI5 2006. For safety reasons, Test Site 2 periphyton samples were not collected after 11/2/2020. At Test Site 1 near US 19 and closer to the confluence of the discharge canal, the periphyton community was dominated by blue green algae for both visits in 2019 but diatoms after that (11/2/2020 and 5/19/2021). Unfortunately, periphytometers were either vandalized or exposed on the bank due to low water for the 3/11/2020, 12/20/2021, and 6/16/2022 visits.

The dominant diatom genus was often *Eunotia*. This genus is widely distributed and diverse in species. It is a benthic, epiphytic, epilithic taxon that, in general, prefers acidic waters with phosphorus and low conductivity. Species within *Eunotia* show a range of tolerance to nutrient concentrations and organic contaminants (Wehr and Sheath, 2003). *Gomphonema* is also a naviculoid diatom and was dominant in two test site samples. It shares many of the same ecological characteristics as *Eunotia* regarding geographic distribution and diversity. With low pH wetland headwaters and specific conductance reduced to less than 500 µmhos/cm after the outfall relocation, it is not surprising that *Eunotia* sp. was commonly the dominant taxon in the Fenholloway River periphytometer samples.

Table 4. Quantitative periphyton results. Observed classes reported.

Metric	**7/16/2019**			**11/6/2019**			**3/11/2020**		**11/2/2020**			**5/19/2021**		**12/20/2021**	**6/16/2022**
	Control Site	Test Site 1	Test Site 2	Control Site	Test Site 1	Test Site 2	Control Site	Test Site 2	Control Site	Test Site 1	Test Site 2	Control Site	Test Site 1	Control Site	Control Site
% Blue-green	23	70	50	23	86	4.0	77	17	3.2	11	3.9	33	17	2.6	0.33
% Green	0	0.95	3.0	0.58	1.9	1.6	0	0	80	4.5	21	0	0	1.7	0
% Euglenophytes	0	0	0	0	0	0	0	0	0	0	0.32	0	0	0	0
% Diatoms	76	28	47	77	12	94	23	83	17	85	75	67	83	96	100
# Wet Taxa	7	10	11	8	7	7	4	6	8	4	11	3	3	5	2
Dominant Wet Taxon	*Anabaena* sp.	*Pseudanabaena* sp.	*Chamaesiphon* sp.	*Pseudanabaena* sp.	*Pseudanabaena* sp.	*Pseudanabaena* sp.	*Pseudanabaena mucicola*	*Pseudanabaena* sp.	*Coccomonas* sp.	*Pseudanabaena* sp.	*Oedogonium* sp.	*Pseudanabaena mucicola* sp.	*Pseudanabaena* sp.	*Fortiea bossei*	*Anabaena* sp.
# Diatom Taxa	33	51	22	17	30	22	13	21	18	22	19	36	14	30	4
Dominant Diatom Taxon	*Eunotia* sp.	*Eunotia* sp.	*Achnanthidium exiguum*	*Eunotia* sp.	*Gomphonema* sp.	*Nitzschia* sp.	*Eunotia* sp.	*Gomphonema parvulum*	*Eunotia* sp.	*Eunotia* sp.	*Eunotia* sp.	*Eunotia* sp.	*Eunotia* sp.	*Eunotia* sp.	*Eunotia* sp.

Macroinvertebrates

Stream Condition Index

SCI scores for all sampling locations and dates are shown in **Figure 10.** The water level at the Control Site was above the reachable zone for sampling on 6/18/2019 and thus, no sample was collected. The Control Site consistently scored in the "Exceptional" category (>64) for all five subsequent sampling events. The far-field downstream Test Site 2 was sampled three times prior to the December 2020 outfall relocation and failed the SCI each time (scores 17, 16, and 12). Test Site 2 was not sampled after the outfall relocation due to safety precautions. Test Site 1 failed the initial sampling event (score 20), passed the second (score 47), and failed the third (score 10). The second sampling event had twice as many total taxa (35 vs 18) and several additional sensitive taxa (five vs one) compared to the first or third event (Appendix J). The underlying cause for the increased taxa diversity or number of sensitive taxa resulting in a higher score during the second sampling event is unclear since all three events were prior to the December 2020 outfall relocation. After the outfall relocation, all Test Site 1 scores (61, 68, and 68) passed and were comparable to the Control Site scores. It is notable that Test Site 1 achieved this level of recovery, especially the high scores on the last two sampling events, given the SCI score was 10 only a year earlier. This difference in SCI scores suggests the macroinvertebrate community recovered very quickly after the outfall was removed from the freshwater portion of the river in December 2020. Average SCI scores for the Control Site, Test Site 1 and Test Site 2 over the study period, were 72 (n=5), 51 (n=6), and 14 (n=3), respectively.

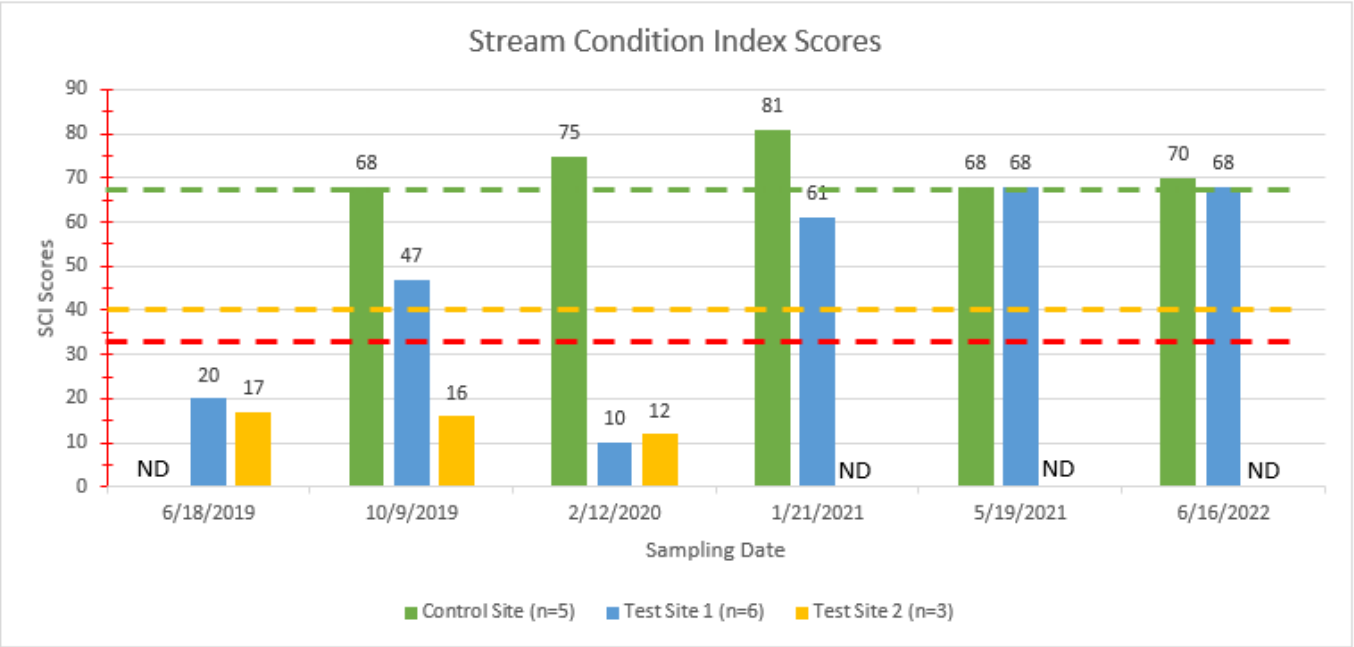


Figure 10. SCI scores for sampling locations on the Fenholloway River from June 2019 to June 2022. Green, yellow, and red dashed lines represent the exceptional threshold, the average impairment threshold, and single sample impairment threshold, respectively. "ND" indicates dates for which no samples were collected.

Hester-Dendy

The Biological Health criterion (Paragraph 62-302.530(10)(a), F.A.C.) states that the Shannon-Weaver Diversity Index must not be reduced to less than 75% of background (control) site levels. The higher and Control Site-comparable SCI scores obtained at Test Site 1 after outfall removal has been interpreted as remarkable recovery in the macroinvertebrate community. The Hester-Dendy diversity calculations show a similar pattern, only in this case, the improvement in scores occurred after the initial upgrades were completed (March 2019, **Figure 11**) rather than after the outfall had been completely removed from the freshwater portion of the river. **Figure 11** shows the average Hester-Dendy diversity scores on an annual basis between 2000 and 2022; scores from 2000 and 2006 are all prior to the facility upgrades. These earlier downstream, near- and far-field scores are clearly lower than the upstream, control site scores, but by 2019, Test Site 1 (near field) scores are greater than the Control Site scores for the duration of this study (2019-2022) (**Tables 5**, **6**, and **7**). See taxa list in Appendix K.

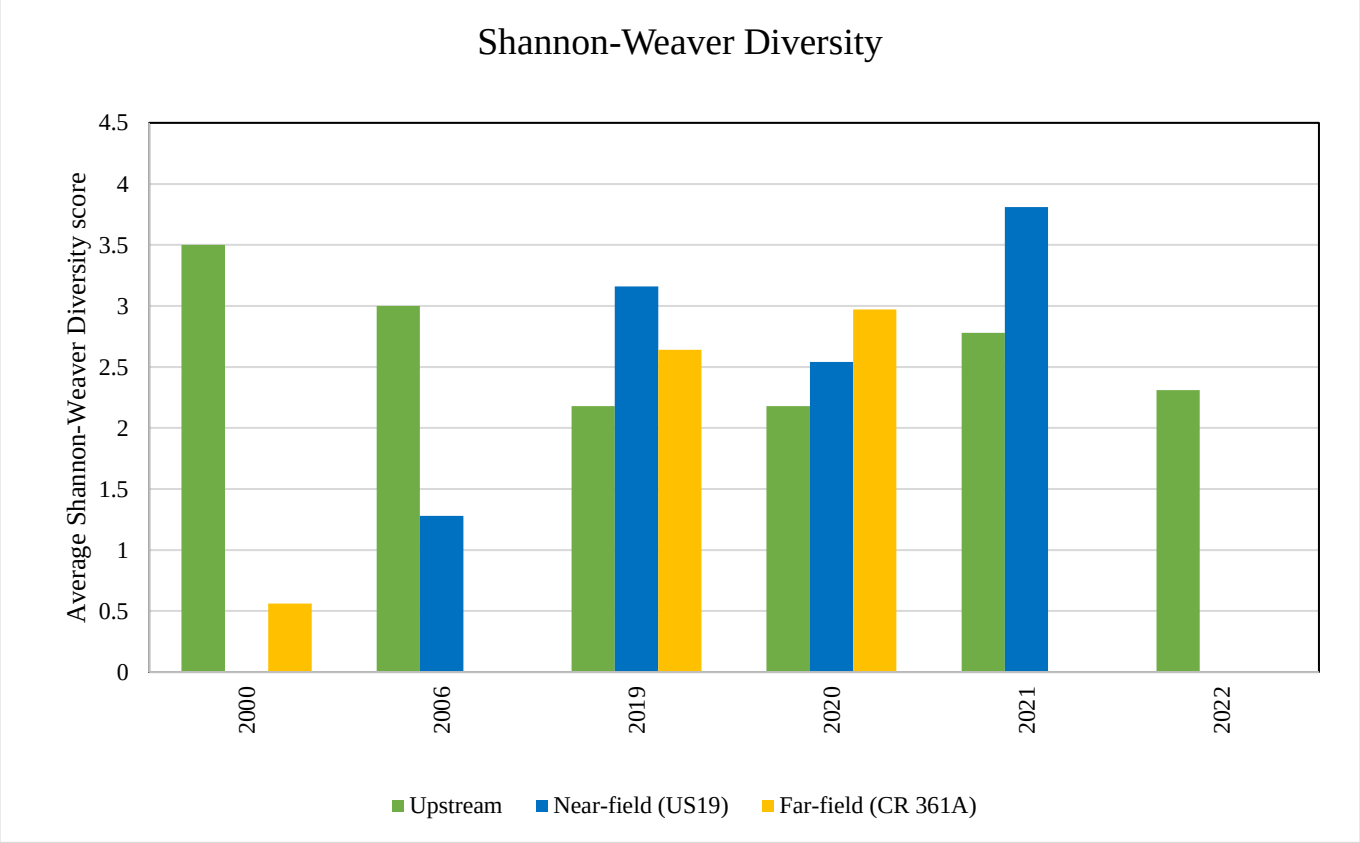


Figure 11. Average annual results of the Shannon-Weaver Diversity Index values for sampling locations on the Fenholloway River from 2000 through 2022.

Table 5. Control Site Hester-Dendy Results

Control Site	7/16/2019	11/06/2019	3/11/2020	11/02/2020	5/19/2021	12/20/2021	6/16/2022
Shannon-Weaver Diversity	2.23	2.13	2.01	2.34	2.74	2.81	2.31
Number of Taxa	20	15	9	24	14	14	23
Number of EPT Taxa	3	1	3	6	4	2	3
Percent Dominant Taxon	58	64	58	57	25	42	58
Dominant Taxon Name	*Simulium slossonae*	*Stenonema* sp.	*Simulium* sp.	*Hydropsyche* sp.	*Simulium* sp.	*Simulium* sp.	*Stenonema* sp.
Number of Individuals (counted)	530	294 *	193 *	1,601	1,211	280 *	349
Number of Individuals (#/m^2)	1,052	585	511	3,177	2,404	557	651

* Diversity scores calculated with < 300 individuals have the potential for negative bias (lower scores compared to sites with more individuals) (Lande 1996).

Table 6. Test Site 1 Hester-Dendy Results. A dash (-) indicates sample/measurement was not collected.

Test Site 1	7/16/2019	11/06/2019	3/11/2020	11/02/2020	5/19/2021	12/20/2021	6/16/2022
Shannon-Weaver Diversity	3.61	2.71	-	2.54	3.81	-	-
Number of Taxa	34	25	-	19	29	-	-
Number of EPT Taxa	5	4	-	6	5	-	-
Percent Dominant Taxon	24	48	-	37	31	-	-
Dominant Taxon Name	*Ancyronyx variegatus*	*Polypedilum scalaenum* grp.	-	*Stenonema* sp.	*Stenonema* sp.	-	-
Number of Individuals (counted)	596	855	-	789	190 *	-	-
Number of Individuals (#/m^2)	1,185	1,697	-	1,566	379	-	-

* Diversity scores calculated with < 300 individuals have the potential for negative bias (lower scores compared to sites with more individuals) (Lande 1996).

Table 7. Test Site 2 Hester-Dendy Results. A dash (-) indicates sample/measurement was not collected.

Test Site 2	7/16/2019	11/06/2019	3/11/2020	11/02/2020	5/19/2021	12/20/2021	6/16/2022
Shannon-Weaver Diversity	2.74	2.54	2.60	3.34	-	-	-
Number of Taxa	19	16	19	34	-	-	-
Number of EPT Taxa	3	3	2	6	-	-	-
Percent Dominant Taxon	39	40	35	37	-	-	-
Dominant Taxon Name	*Hydropsyche* sp.	*Polypedilum scalaenum* grp.	*Rheocricotopus robacki*	*Hydropsyche rossi*	-	-	-
Number of Individuals (counted)	1,696	1,700	559	1,975	-	-	-
Number of Individuals (#/m^2)	3,365	3,373	1,445	3,110	-	-	-

Conclusions

For fifty-one years, the Fenholloway River was Florida's only Class V industrial use river. In 1998, the river was re-classified as a Class III fishable-swimmable waterbody. Georgia-Pacific's Foley Cellulose dissolving kraft pulp mill, which discharged into the Fenholloway River, completed plant modifications in March 2019 and the relocation of its outfall in December 2020.

At the commencement of this study, this portion of the Fenholloway River was listed on the Florida 303(d) impaired list for DO, specific conductance, total ammonia, and total phosphorus. Although the DO, specific conductance, and total ammonia met the Class III Freshwater Criteria for these parameters after outfall relocation, the river will remain on the Impaired Waters List until there is sufficient passing data to meet delisting criteria (Appendix A). Total phosphorus and total nitrogen continued to stay near or above their respective criteria throughout the study and the river will likewise stay on the Impaired Waters List for nutrients until there is sufficient passing data to meet delisting criteria.

This project recorded the recovery of the Fenholloway River's biological communities by evaluating the environmental conditions after the Foley Cellulose plant completed effluent modifications and while and after the outfall was relocated further downstream. Prior to relocation, the elevated specific conductance is believed to have contributed to the failing SCI and lower diversity scores at the test sites. After upgrades to the effluent lowered specific conductance to levels that complied with Class III Freshwater Criteria and with the ultimate relocation of the outfall, the SCI consistently passed at Test Site 1 near US 19 since December 2020. The two most recent samples achieved "Exceptional" SCI scores which is remarkable given that two years prior, the scores were in the single digits. After the initial upgrades were made to the effluent quality, diversity measures were typically higher at the test sites compared to the control site. DEP will periodically perform SCIs in the Fenholloway River to evaluate whether the river continues to support a healthy and well-balanced flora and fauna.

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Appendix A. Summary of WBID 3473B impairments and IWR planning period, verified period and delisting thresholds, as of 11/9/2022

WBID	Waterbody Name	Waterbody Type	Waterbody Class	1998 303(d) Parameter of Concern	Parameters Assessed Using the Impaired Surface Waters Rule (IWR)	Criterion Concentration or Threshold Not Met	Previous Summary Assessment Category	Preliminary IWR Run 64 Current Assessment Category	Preliminary IWR Run 64 Integrated Report Category Summary Assessment	Preliminary IWR Run 64 Summary Assessment Status	Planning Period Assessment Data	Verified Period Assessment Data	Delisting or 303(d) List Removal Threshold
3473B	Fenholloway River below Buckeye Pulp Mill	Stream	3F		Biology	Average score of at least two temporally independent SCI scores ≥ 40; or either of the two most recent SCI scores ≥ 35; or if there are only two SCI scores and there is less than or equal to a 20 point difference.	4d	3c	4d	Study List	SCI (n=5) Mean 1 (16), Mean 2 (47)	SCI (n=8) WBID Mean (31) Mean 1 (68), Mean 2 (61)	303(d) List Removal Threshold: Average score of at least two temporally independent SCI scores ≥ 40, and neither of the two most recent SCI scores < 35; if there are only two SCI scores, there is ≤ 20 point difference (no longer meets 62-303.430, F.A.C.).
3473B	Fenholloway River below Buckeye Pulp Mill	Stream	3F		Nutrients (Total Nitrogen)	AGM ≤ 1.03 mg/L	4d	4d	4d	Study List	AGM 2016 (4.93 mg/L) 2017 (2.52 mg/L)	AGM 2016 (4.93 mg/L) 2017 (2.52 mg/L) 2020 (1.18 mg/L) 2021 (0.71 mg/L)	303(d) List Removal Threshold: Not more than one exceedance in the most recent three consecutive year period (no longer meets 62-303.390(2)(e), F.A.C.).

WBID	Waterbody Name	Waterbody Type	Waterbody Class	1998 303(d) Parameter of Concern	Parameters Assessed Using the Impaired Surface Waters Rule (IWR)	Criterion Concentration or Threshold Not Met	Previous Summary Assessment Category	Preliminary IWR Run 64 Current Assessment Category	Preliminary IWR Run 64 Integrated Report Category Summary Assessment	Preliminary IWR Run 64 Summary Assessment Status	Planning Period Assessment Data	Verified Period Assessment Data	Delisting or 303(d) List Removal Threshold
3473B	Fenholloway River below Buckeye Pulp Mill	Stream	3F		Nutrients (Total Phosphorus)	AGM ≤ 0.18 mg/L	4d	2	2	Not Impaired	AGM 2016 (1.24 mg/L) 2017 (0.55 mg/L)	AGM 2016 (1.24 mg/L) 2017 (0.55 mg/L) 2020 (0.18 mg/L) 2021 (0.12 mg/L)	303(d) List Removal Threshold: Not more than one exceedance in the most recent three consecutive year period (no longer meets 62-303.390(2)(e), F.A.C.).
3473B	Fenholloway River below Buckeye Pulp Mill	Stream	3F		Specific Conductance	Shall not be increased more than 50% above background or to 1275 µmhos/cm, whichever is greater.	5	5	5	Impaired	9/14	7/26	Delisting Threshold: Number of samples that do not meet applicable criterion is less than or equal to the number listed in Table 4 for the given sample size, with a minimum sample size of 30 (table starts at 0 exceedances for a sample size of 30-37); (per 62-303.720(2)(a)(1), F.A.C.).
3473B	Fenholloway River below Buckeye Pulp Mill	Stream	3F		Total Ammonia	see FS 62-302.530(7)	5	2	5	Impaired	6/14	4/26	Delisting Threshold: Number of samples that do not meet applicable

WBID	Waterbody Name	Waterbody Type	Waterbody Class	1998 303(d) Parameter of Concern	Parameters Assessed Using the Impaired Surface Waters Rule (IWR)	Criterion Concentration or Threshold Not Met	Previous Summary Assessment Category	Preliminary IWR Run 64 Current Assessment Category	Preliminary IWR Run 64 Integrated Report Category Summary Assessment	Preliminary IWR Run 64 Summary Assessment Status	Planning Period Assessment Data	Verified Period Assessment Data	Delisting or 303(d) List Removal Threshold
													criterion is less than or equal to the number listed in Table 4 for the given sample size, with a minimum sample size of 30 (table starts at 0 exceedances for a sample size of 30-37); (per 62-303.720(2)(a)(1), F.A.C.).
3473B	Fenholloway River below Buckeye Pulp Mill	Stream	3F	Dissolved Oxygen	Dissolved Oxygen (Percent Saturation)	≥ 34 %	5	4d	4d	Study List	11/14	10/26	Delisting Threshold: Number of samples that do not meet applicable criterion is less than or equal to the number listed in Table 4 for the given sample size, with a minimum sample size of 30 (table starts at 0 exceedances for a sample size of 30-37); (per 62-303.720(2)(a)(1), F.A.C.).

WBID	Waterbody Name	Waterbody Type	Waterbody Class	1998 303(d) Parameter of Concern	Parameters Assessed Using the Impaired Surface Waters Rule (IWR)	Criterion Concentration or Threshold Not Met	Previous Summary Assessment Category	Preliminary IWR Run 64 Current Assessment Category	Preliminary IWR Run 64 Integrated Report Category Summary Assessment	Preliminary IWR Run 64 Summary Assessment Status	Planning Period Assessment Data	Verified Period Assessment Data	Delisting or 303(d) List Removal Threshold
3473B	Fenholloway River below Buckeye Pulp Mill	Stream	3F	Biochemical Oxygen Demand	Dissolved Oxygen (Percent Saturation)	≥ 34 %	5	4d	4d	Study List	11/14	10/26	Delisting Threshold: Number of samples that do not meet applicable criterion is less than or equal to the number listed in Table 4 for the given sample size, with a minimum sample size of 30 (table starts at 0 exceedances for a sample size of 30-37); (per 62-303.720(2)(a)(1), F.A.C.).

Appendix B. USGS Water Level Gauge IDs, locations, and appropriate water levels for sampling.

Sampling Location	USGS Monitoring Location (Gauge ID)	Gauge Location on Fenholloway River	Appropriate Water Level for Sampling (ft)
Control Site	02324400	Bridge at US 27	< 5
Test Site 1	02324500	Bridge at US 19	< 12
Test Site 2	02325000	Bridge at Hampton Springs Road	< 14

Appendix C. Sampling trips, samples collected, and bioassessments performed

Sampling Event #	Date	Phys-Chem	HA	Water Quality	SCI	Hester-Dendy (collection)	Periphyton
1	6/18/19	C, T1, T2	T1, T2	-	T1, T2	-	-
1	7/16/19	C, T1, T2	-	C, T1, T2	-	C, T1, T2	C, T1, T2
2	10/9/19	C, T1	C, T1, T2	-	C, T1, T2	-	-
2	11/6/19	-	-	C, T1, T2	-	C, T1, T2	C, T1, T2
3	2/12/20	C, T1, T2	C, T1, T2	-	C, T1, T2	-	-
3	3/11/20	C, T1, T2	-	C, T1, T2	-	C, T2	C, T2
4	10/26/20	-	-	-	-	-	-
4	11/2/20	-	-	C, T1, T2	-	C, T1, T2	C, T1, T2
4	1/21/21	C, T1	C, T1	C, T1	C, T1	-	-
5	4/21/21	-	-	-	-	-	-
5	5/19/21	-	C, T1	C, T1, T2	C, T1	C, T1	C, T1
6	11/22/21	-	-	-	-	-	-
6	12/20/21	-	-	C, T1	-	C	C
7	5/19/22	-	-	-	-	-	-
7	6/16/22	C, T1	C, T1	C, T1	C, T1	C, T1	C

Sampling events and collected parameters. C – Control, T1 – Test Site 1, T2 – Test Site 2.

Appendix D. Analytes collected twice per year at control and test sites

Endpoint	Indicators	DEP SOP or Lab Method
Biological Communities	Hester-Dendy Samplers	FS 7430
	Stream Condition Index	SCI 1000
	Periphytometers	FS 7210
	Habitat Assessment	FT 1300
Water Quality	Color	SM 2120 B
	Turbidity	EPA 180.1
	Alkalinity	SM 2320 B
	Total Suspended Solids	SM 2540 D
	Total Kjeldahl Nitrogen	EPA 351.2
	Ammonia as N	EPA 350.1
	Nitrate+nitrite	EPA 353.2
	Total Phosphorus	EPA 365.1
	Chlorophyll *a*	SM 10200 H
	C-BOD, 5-day	SM 5210 B
	Aluminum, Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver	EPA 200.8
	Calcium, Iron, Magnesium, Potassium, Sodium, Zinc	EPA 200.7
	Chloroform	EPA 5035A
	2,4,5-Trichlorophenol	EPA 8270
Physical Parameters	Temperature	FT 1400
	pH	FT 1100
	Dissolved Oxygen	FT 1500
	Specific Conductance	FT 1200
	Secchi Depth	FT 1700

Appendix E. Field measurement results and Class III Freshwater Criteria

Sampling Event 1

Parameter	Units	Class III Criteria	Control Site 6/18/2019	Control Site 7/16/2019	Test Site 1 6/18/2019	Test Site 1 7/16/2019	Test Site 2 6/18/2019	Test Site 2 7/16/2019
Sample Depth	m	-	-	0.1	0.2	0.1	0.2	0.1
Temperature	C	-	24.4	26.8	28.9	28.9	27.8	29
pH[1]	SU	6.0 - 8.5	4.0	3.78	7.3 e	6.8 e	7.1 e	7.0 e
Specific Conductance	µmhos/cm	≤ 1,275	58.2	82	1,850 e	992	1,659 e	1,106
Salinity	ppt	-	-	0 c	0.9 c	0.5 c	0.8 c	0.5 c
Dissolved Oxygen	% saturation	≥ 34	57.1	52	83.3	78	53.1	45
Dissolved Oxygen	mg/L	-	4.76	4.14	6.37	5.94	4.15	3.46

Sampling Event 2

Parameter	Units	Class III Criteria	Control Site 10/9/2019	Control Site 11/6/2019	Test Site 1 10/9/2019	Test Site 1 11/6/2019	Test Site 2 10/9/2019	Test Site 2 11/6/2019
Sample Depth	m	-	0.2	0.3	0.3	0.3	0.1	0.2
Temperature	C	-	23.3	19.5	25.5	23.9	25.8	23.9
pH[1]	SU	6.0 - 8.5	5.8	5.52	7.5 e	7.5 e	7.6 e	7.6 e
Specific Conductance	µmhos/cm	≤ 1,275	83	70.5	1,435 e	1,741 e	1,787 e	1,942 e
Salinity	ppt	-	0 c	0 c	0.7 c	0.9 c	0.9 c	1 c
Dissolved Oxygen	% saturation	≥ 34	43.3	50	68.7	76.9	64.5	67.4
Dissolved Oxygen	mg/L	-	3.65	-	5.58	-	-	-

Sampling Event 3

Parameter	Units	Class III Criteria	Control Site 2/12/2020	Control Site 3/11/2020	Test Site 1 2/12/2020	Test Site 1 3/11/2020	Test Site 2 2/12/2020	Test Site 2 3/11/2020
Sample Depth	m	-	0.1	0.1	0.1	0.1	0.1	0.1
Temperature	C	-	17.6	17	22.2	19	22.9	20.82
pH[1]	SU	6.0 - 8.5	5.04	3.97	7.5 e	6.7 e	7.6 e	7.3 e
Specific Conductance	µmhos/cm	≤ 1,275	59.5	71	15.32	476.6	2,075	1,519 e
Salinity	ppt	-	0 c	0 c	0 c	0.3 c	0 c	0.8 c
Dissolved Oxygen	% saturation	≥ 34	65.8	73.9	69.2	74.3	58.4	72.5
Dissolved Oxygen	mg/L	-	6.26	7.14	5.94	6.89	4.98	6.46

Sampling Event 4

Parameter	Units	Class III Criteria	Control Site 10/26/2020 No meter	Control Site 11/2/2020 No meter	Control Site 1/21/2021	Test Site 1 10/26/2020 No meter	Test Site 1 11/2/2020 No meter	Test Site 1 1/21/2021	Test Site 2 10/26/2020 No meter	Test Site 2 11/2/2020 No meter
Sample Depth	m	-	-	-	0.2	-	-	0.2	-	-
Temperature	C	-	-	-	11.4	-	-	12.8	-	-
pH[1]	SU	6.0 - 8.5	-	-	3.71	-	-	6.9 e	-	-
Specific Conductance	µmhos/cm	≤ 1,275	-	-	53	-	-	110	-	-
Salinity	ppt	-	-	-	0 c	-	-	0.1 c	-	-
Dissolved Oxygen	% saturation	≥ 34	-	-	77.1	-	-	78.1	-	-
Dissolved Oxygen	mg/L	-	-	-	-	-	-	-	-	-

Sampling Event 5: Field Parameters not measured during Hester-Dendy deployment, 4/21/2021

Parameter	Units	Class III Criteria	Control Site 4/21/2021	Control Site 5/19/2021	Test Site 1 4/21/2021	Test Site 1 5/19/2021	Test Site 2 4/21/2021	Test Site 2 5/19/2021
Sample Depth	m	-	-	0.8	-	1.0	-	0.3
Temperature	C	-	-	21.3	-	21.6	-	21.9
pH[1]	SU	6.0 - 8.5	-	5.5	-	6.9 e	-	7.4 e
Specific Conductance	µmhos/cm	≤ 1,275	-	251.2	-	266.2	-	272.8
Salinity	ppt	-	-	0.13 c	-	0.14 c	-	0.1 c
Dissolved Oxygen	% saturation	≥ 34	-	58.3	-	47.9	-	75.8
Dissolved Oxygen	mg/L	-	-	5.17	-	4.22	-	6.64

Sampling Event 6: Field Parameters not measured during Hester-Dendy deployment, 11/22/2021

Parameter	Units	Class III Criteria	Control Site 11/22/2021	Control Site 12/20/2021	Test Site 1 11/22/2021	Test Site 1 12/20/2021
Sample Depth	m	-	-	0.1	-	0.1
Temperature	C	-	-	18.9	-	19.2
pH[1]	SU	6.0 - 8.5	-	4.2	-	6.4 e
Specific Conductance	µmhos/cm	≤ 1,275	-	46.9	-	154.4
Salinity	ppt	-	-	0 c	-	0.1 c
Dissolved Oxygen	% saturation	≥ 34	-	64.6	-	59.6
Dissolved Oxygen	mg/L	-	-	-	-	-

Sampling Event 7: Field Parameters not measured during Hester-Dendy deployment, 5/19/2022

Parameter	Units	Class III Criteria	Control Site 5/19/2022	Control Site 6/16/2022	Test Site 1 5/19/2022	Test Site 1 6/16/2022
Sample Depth	m	-	-	0.1	-	0.1
Temperature	C	-	-	25.7	-	25
pH[1]	SU	6.0 - 8.5	-	6.6	-	7.5
Specific Conductance	µmhos/cm	≤ 1,275	-	168.5	-	397.8
Salinity	ppt	-	-	0.1 c	-	0.2 c
Dissolved Oxygen	% saturation	≥ 34	-	32.75	-	37.6
Dissolved Oxygen	mg/L	-	-	2.67	-	-

A dash (-) indicates sample/measurement was not collected or criterion/limit does not exist.
e - Value exceeds the Class III Water Quality Criteria
c - Value is calculated
1 - pH shall not vary more than one unit above natural background of predominantly fresh waters, 62-302.530 F.A.C.

Appendix F. Analytical water chemistry data and Class III Freshwater Criteria

Sampling date: 7/16/2019

Analyte	Units	Class III Criteria	Control Site	Test Site 1	Test Site 2
Total Phosphorus	mg P/L	≤ 0.12 g	0.044	0.28	0.51
Total Ammonia	mg N/L	-	0.04	0.11	0.065
TAN criteria	mg N/L	-	3.43 c	2.81 c	2.79 c
Un-ionized Ammonia (calculated salinity)	mg N/L	-	< 0.02 c	< 0.02 c	< 0.02 c
Nitrate and Nitrite	mg N/L	-	0.004 U	0.011	0.1
Total Kjeldahl Nitrogen	mg N/L	-	1.9	1.7	1.5
Organic Nitrogen	mg N/L	-	1.9 c	1.6 c	1.4 c
Total Nitrogen	mg N/L	≤ 1.54 g	1.9 c	1.7 c	1.6 c
Chlorophyll *a* - Corrected (Water)	µg/L	< 3.2	2.8 U	4.1 U	2.1 U
Phaeophytin (Water)	µg/L	-	3.0 U	4.5 U	2.2 U
Chlorophyll *a* - Corrected (Periphyton)	µg/L	-	0.24 U	0.75 I	6.3 A
Phaeophytin (Periphyton)	µg/L	-	0.19 U	0.41 U	0.41 U
CBOD, 5 day, N - inhibited	mg/L	-	0.97 I	2.8	3.1 A
Hardness	mg CaCO3/L	-	13.5 c	54.3 c	92.1 c
Total Suspended Solids	mg/L	-	3 I	4 IA	3 I
Turbidity	NTU	≤ 29 t	2.1	4.3	2.6
Color (true)	PCU	-	1000	990	930
Alkalinity	mg CaCO3/L	≥ 20	0.65 U	86	111

Sampling date: 11/6/2019

Analyte	Units	Class III Criteria	Control Site	Test Site 1	Test Site 2
Total Phosphorus	mg P/L	≤ 0.12 g	0.087	0.28	0.31
Total Ammonia	mg N/L	-	0.11	0.068	0.045
TAN criteria	mg N/L	-	5.5 c	2.64 c	2.42 c
Un-ionized Ammonia (calculated salinity)	mg N/L	-	< 0.02 c	< 0.02 c	< 0.02 c
Nitrate and Nitrite	mg N/L	-	0.1	0.07	0.062
Total Kjeldahl Nitrogen	mg N/L	-	1.6	1	1
Organic Nitrogen	mg N/L	-	1.5 c	0.9 c	1 c
Total Nitrogen	mg N/L	≤ 1.54 g	1.7 c	1.1 c	1.1 c
Chlorophyll *a* - Corrected (Water)	µg/L	< 3.2	1.6 U	0.92 U	1.0 U
Phaeophytin (Water)	µg/L	-	1.8 U	1.0 U	1.1 U
Chlorophyll *a* - Corrected (Periphyton)	µg/L	-	0.44 I	0.61 U	6.3 AJ
Phaeophytin (Periphyton)	µg/L	-	0.14 I	0.48 U	1.9 I
CBOD, 5 day, N - inhibited	mg/L	-	33	29	6.4
Hardness	mg CaCO3/L	-	50.1 c	204 c	229 c
Total Suspended Solids	mg/L	-	3 I	6 I	7 I
Turbidity	NTU	≤ 29 t	16 A	5.7	5.2
Color (true)	PCU	-	890 A	550	540
Alkalinity	mg CaCO3/L	≥ 20	20	194	203

Sampling date: 3/11/2020

Analyte	Units	Class III Criteria	Control Site	Test Site 1	Test Site 2
Total Phosphorus	mg P/L	≤ 0.12 g	0.048	0.19	0.47
Total Ammonia	mg N/L	-	0.048	0.08	0.094
TAN criteria	mg N/L	-	6.46 c	5.44 c	3.79 c
Un-ionized Ammonia (calculated salinity)	mg N/L	-	< 0.02 c	< 0.02 c	< 0.02 c
Nitrate and Nitrite	mg N/L	-	0.004 I	0.024	0.049
Total Kjeldahl Nitrogen	mg N/L	-	1.6	1.4	1.2
Organic Nitrogen	mg N/L	-	1.6 c	1.3 c	1.1 c
Total Nitrogen	mg N/L	≤ 1.54 g	1.6 c	1.4 c	1.2 c
Chlorophyll *a* - Corrected (Water)	µg/L	< 3.2	0.89 U	0.89 U	1.8 U
Phaeophytin (Water)	µg/L	-	0.98 U	0.98 U	2.0 U
Chlorophyll *a* - Corrected (Periphyton)	µg/L	-	0.052 U	-	6.4 A
Phaeophytin (Periphyton)	µg/L	-	0.041 U	-	0.43 I
CBOD, 5 day, N - inhibited	mg/L	-	2.3 V	3.2 V	3.6 V
Hardness	mg CaCO3/L	-	18.8 c	86.8 c	175 c
Total Suspended Solids	mg/L	-	2 I	3 I	6 I
Turbidity	NTU	≤ 29 t	8.1 A	4	4.2
Color (true)	PCU	-	910	820	800
Alkalinity	mg CaCO3/L	≥ 20	0.65 U	65	140

Sampling date: 11/2/2020

Analyte	Units	Class III Criteria	Control Site	Test Site 1	Test Site 2
Total Phosphorus	mg P/L	≤ 0.12 g	0.028	0.053	0.064
Total Ammonia	mg N/L	-	0.033	0.042	0.036
TAN criteria	mg N/L	-	-	-	-
Un-ionized Ammonia (calculated salinity)	mg N/L	-	-	-	-
Nitrate and Nitrite	mg N/L	-	0.004 U	0.006 I	0.011
Total Kjeldahl Nitrogen	mg N/L	-	1.8	1.6	1.5
Organic Nitrogen	mg N/L	-	1.8 c	1.6 c	1.5 c
Total Nitrogen	mg N/L	≤ 1.54 g	1.8 c	1.6 c	1.5 c
Chlorophyll *a* - Corrected (Water)	µg/L	< 3.2	1.6 U	1.6 U	1.6 U
Phaeophytin (Water)	µg/L	-	1.8 U	1.8 U	1.8 U
Chlorophyll *a* - Corrected (Periphyton)	µg/L	-	0.25 U	3.2	13
Phaeophytin (Periphyton)	µg/L	-	0.20 U	0.082 U	0.59 I
CBOD, 5 day, N - inhibited	mg/L	-	2.0 U	2.0 U	2.0 U
Hardness	mg CaCO3/L	-	9.2 c	23.8 c	24 c
Total Suspended Solids	mg/L	-	2 I	2 I	2 I
Turbidity	NTU	≤ 29 t	1.4	1.4	1.6
Color (true)	PCU	-	810	780	790
Alkalinity	mg CaCO3/L	≥ 20	0.65 U	4.3	2.9

Sampling date: 1/21/2021

Analyte	Units	Class III Criteria	Control Site	Test Site 1	Test Site 2
Total Phosphorus	mg P/L	≤ 0.12 g	0.033	0.073	-
Total Ammonia	mg N/L	-	0.066	0.096	-
TAN criteria	mg N/L	-	9.26 c	7.79 c	-
Un-ionized Ammonia (calculated salinity)	mg N/L	-	< 0.02 c	< 0.02 c	-
Nitrate and Nitrite	mg N/L	-	0.004 U	0.019	-
Total Kjeldahl Nitrogen	mg N/L	-	1.5	1.3	-
Organic Nitrogen	mg N/L	-	1.4 c	1.2 c	-
Total Nitrogen	mg N/L	≤ 1.54 g	1.5 c	1.3 c	-
Chlorophyll *a* - Corrected (Water)	µg/L	< 3.2	0.82 U	0.82 U	-
Phaeophytin (Water)	µg/L	-	0.90 U	0.90 U	-
Chlorophyll *a* - Corrected (Periphyton)	µg/L	-	-	-	-
Phaeophytin (Periphyton)	µg/L	-	-	-	-
CBOD, 5 day, N - inhibited	mg/L	-	2.0	7.8 A	-
Hardness	mg CaCO3/L	-	18.2 c	58.7 c	-
Total Suspended Solids	mg/L	-	2 I	2 IA	-
Turbidity	NTU	≤ 29 t	2.6	1.8	-
Color (true)	PCU	-	810	700	-
Alkalinity	mg CaCO3/L	≥ 20	0.65 U	36	-

Sampling date: 5/19/2021

Analyte	Units	Class III Criteria	Control Site	Test Site 1	Test Site 2
Total Phosphorus	mg P/L	≤ 0.12 g	0.062	0.17	0.16
Total Ammonia	mg N/L	-	0.1	0.15	0.1
TAN criteria	mg N/L	-	4.89 c	4.45 c	3.21 c
Un-ionized Ammonia (calculated salinity)	mg N/L	-	< 0.02 c	< 0.02 c	< 0.02 c
Nitrate and Nitrite	mg N/L	-	0.007 I	0.076	0.16
Total Kjeldahl Nitrogen	mg N/L	-	1.4	0.9	0.85
Organic Nitrogen	mg N/L	-	1.3 c	0.75 c	0.75 c
Total Nitrogen	mg N/L	≤ 1.54 g	1.4 c	0.98 c	1.01 c
Chlorophyll *a* - Corrected (Water)	µg/L	< 3.2	0.82 U	0.82 U	0.86 I
Phaeophytin (Water)	µg/L	-	1.0 I	0.90 U	0.90 U
Chlorophyll *a* - Corrected (Periphyton)	µg/L	-	0.070 U	0.42 U	-
Phaeophytin (Periphyton)	µg/L	-	0.069 I	0.33 U	-
CBOD, 5 day, N - inhibited	mg/L	-	2.0 U	2.0 U	2.0 U
Hardness	mg CaCO3/L	-	46.3 c	135 c	122 c
Total Suspended Solids	mg/L	-	3 I	4 I	3 I
Turbidity	NTU	≤ 29 t	2.1	2.6	1.8
Color (true)	PCU	-	870	470	470
Alkalinity	mg CaCO3/L	≥ 20	15	108	108

Sampling date: 12/20/2021

Analyte	Units	Class III Criteria	Control Site	Test Site 1
Total Phosphorus	mg P/L	≤ 0.12 g	0.048	0.19
Total Ammonia	mg N/L	-	0.12	0.11
TAN criteria	mg N/L	-	5.71 c	5.6 c
Un-ionized Ammonia (calculated salinity)	mg N/L	-	< 0.02 c	< 0.02 c
Nitrate and Nitrite	mg N/L	-	0.004 U	0.048
Total Kjeldahl Nitrogen	mg N/L	-	1.5	1.5
Organic Nitrogen	mg N/L	-	1.4 c	1.4 c
Total Nitrogen	mg N/L	≤ 1.54 g	1.5 c	1.5 c
Chlorophyll *a* - Corrected (Water)	µg/L	< 3.2	0.83 I	1.6 I
Phaeophytin (Water)	µg/L	-	0.90 U	1.6 U
Chlorophyll *a* - Corrected (Periphyton)	µg/L	-	0.93 A	-
Phaeophytin (Periphyton)	µg/L	-	0.16 U	-
CBOD, 5 day, N - inhibited	mg/L	-	2.0 U	2.0 U
Hardness	mg CaCO3/L	-	23.4 c	72.3 c
Total Suspended Solids	mg/L	-	2 I	2 I
Turbidity	NTU	≤ 29 t	2.6	2.3
Color (true)	PCU	-	800	630
Alkalinity	mg CaCO3/L	≥ 20	0.65 U	61

Sampling date: 6/16/2022

Analyte	Units	Class III Criteria	Control Site	Test Site 1
Total Phosphorus	mg P/L	≤ 0.12 g	0.12	0.23
Total Ammonia	mg N/L	-	0.058	0.14
TAN criteria	mg N/L	-	3.6 c	2.48 c
Un-ionized Ammonia (calculated salinity)	mg N/L	-	< 0.02 c	< 0.02 c
Nitrate and Nitrite	mg N/L	-	0.18	0.12
Total Kjeldahl Nitrogen	mg N/L	-	1.3	0.55
Organic Nitrogen	mg N/L	-	1.2 c	0.41 c
Total Nitrogen	mg N/L	≤ 1.54 g	1.5 c	0.67 c
Chlorophyll *a* - Corrected (Water)	µg/L	< 3.2	1.5 U	3.6 e
Phaeophytin (Water)	µg/L	-	1.6 U	1.1 U
Chlorophyll *a* - Corrected (Periphyton)	µg/L	-	23.0 A	-
Phaeophytin (Periphyton)	µg/L	-	0.61 I	-
CBOD, 5 day, N - inhibited	mg/L	-	-	-
Hardness	mg CaCO3/L	-	81.7 c	166 c
Total Suspended Solids	mg/L	-	3 I	2 IA
Turbidity	NTU	≤ 29 t	2	1.6
Color (true)	PCU	-	730	150
Alkalinity	mg CaCO3/L	≥ 20	61	171

A dash (-) indicates sample/measurement was not collected or criterion/limit does not exist.
e - Value exceeds the Class III Freshwater Quality Criteria
c - Value is calculated
g - Value expressed as an annual geometric mean
t - Shall not exceed 29 NTUs above background
A - Value reported is the mean of two or more determinations
I - The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
J - Estimated value
U - Material analyzed for but not detected; value reported is the method detection limit
V - Analyte was detected in both sample and method blank

Appendix G. Analytical metals data and Class III Freshwater Quality Criteria

Sampling date: 7/16/2019

Analyte	Units	Control Site Class III Criteria	Control Site	Test Site 1 Class III Criteria	Test Site 1	Test Site 2 Class III Criteria	Test Site 2
Hardness	mg CaCO3/L	-	13.5 c	-	54.3 c	-	92.1 c
Aluminum	µg/L	-	590	-	491	-	393
Arsenic	µg/L	≤ 50	0.5	≤ 50	0.51	≤ 50	0.49
Cadmium	µg/L	≤ 0.097 b	0.020 U	≤ 0.172 b	0.038 I	≤ 0.255 b	0.056 I
Calcium	mg/L	-	3.24	-	12.2	-	19.9
Chromium, Total [1]	µg/L	≤ 27.7 b	0.66 I	≤ 52.3 b	1.1 I	≤ 80.6 b	1.5 I
Copper	µg/L	≤ 2.85 b	0.40 U	≤ 5.54 b	0.99	≤ 8.7 b	1.67
Iron	µg/L	≤ 1,000	640	≤ 1,000	520	≤ 1,000	440
Lead	µg/L	≤ 0.545 b	0.41	≤ 1.46 b	0.37 I	≤ 2.87 b	0.29 I
Magnesium	mg/L	-	1.32	-	5.79	-	10.3
Nickel	µg/L	≤ 16.1 b	0.50 U	≤ 31.1 b	1.1 I	≤ 48.7 b	1.7 I
Potassium	mg/L	-	0.30 U	-	1.2 I	-	2.4
Selenium	µg/L	≤ 5.0	0.29 I	≤ 5.0	0.20 U	≤ 5.0	0.23 I
Silver	µg/L	≤ 0.07	0.010 U	≤ 0.07	0.011 I	≤ 0.07	0.019 I
Sodium	mg/L	-	2.4	-	89.7	-	196
Zinc	µg/L	≤ 37 b	5.0 U	≤ 71.4 b	5.0 U	≤ 112 b	6.7 I

Sampling date: 11/6/2019

Analyte	Units	Control Site Class III Criteria	Control Site	Test Site 1 Class III Criteria	Test Site 1	Test Site 2 Class III Criteria	Test Site 2
Hardness	mg CaCO3/L	-	50.1 c	-	204 c	-	229 c
Aluminum	µg/L	-	659	-	265	-	297
Arsenic	µg/L	≤ 50	0.44	≤ 50	0.51	≤ 50	0.35
Cadmium	µg/L	≤ 0.162 b	0.020 U	≤ 0.459 b	0.048 I	≤ 0.501 b	0.066 I
Calcium	mg/L	-	13.8	-	49.7	-	55.6
Chromium, Total [1]	µg/L	≤ 48.9 b	0.94 I	≤ 155 b	2.1	≤ 170 b	3.8
Copper	µg/L	≤ 5.17 b	0.40 U	≤ 17.2 b	2.09	≤ 19 b	2.88
Iron	µg/L	≤ 1,000	580	≤ 1,000	360	≤ 1,000	270
Lead	µg/L	≤ 1.32 b	0.38 I	≤ 7.88 b	0.22 I	≤ 9.16 b	0.26 I
Magnesium	mg/L	-	3.79	-	19.4	-	22
Nickel	µg/L	≤ 29.1 b	0.77 I	≤ 95.3 b	2.3	≤ 105 b	4
Potassium	mg/L	-	0.30 U	-	4.9	-	6.1
Selenium	µg/L	≤ 5.0	0.21 I	≤ 5.0	0.20 U	≤ 5.0	0.20 U
Silver	µg/L	≤ 0.07	0.013 I	≤ 0.07	0.025 I	≤ 0.07	0.037 I
Sodium	mg/L	-	3	-	275	-	367
Zinc	µg/L	≤ 66.7 b	5.0 U	≤ 219 b	6.0 I	≤ 242 b	8.3 I

Sampling date: 3/11/2020

Analyte	Units	Control Site Class III Criteria	Control Site	Test Site 1 Class III Criteria	Test Site 1	Test Site 2 Class III Criteria	Test Site 2
Hardness	mg CaCO3/L	-	18.8 c	-	86.8 c	-	175 c
Aluminum	µg/L	-	760	-	514	-	489
Arsenic	µg/L	≤ 50	0.39	≤ 50	0.47	≤ 50	0.42
Cadmium	µg/L	≤ 0.097 b	0.020 U	≤ 0.244 b	0.033 I	≤ 0.409 b	0.047 I
Calcium	mg/L	-	4.76	-	22	-	45.3
Chromium, Total [1]	µg/L	≤ 27.7 b	0.91 I	≤ 76.8 b	1.5 I	≤ 136 b	3.2
Copper	µg/L	≤ 2.85 b	0.40 U	≤ 8.27 b	0.75 I	≤ 15 b	1.76
Iron	µg/L	≤ 1,000	460	≤ 1,000	440	≤ 1,000	360
Lead	µg/L	≤ 0.545 b	0.45	≤ 2.66 b	0.32 I	≤ 6.48 b	0.26 I
Magnesium	mg/L	-	1.67	-	7.74	-	15
Nickel	µg/L	≤ 16.1 b	0.50 U	≤ 46.3 b	1.1 I	≤ 83.7 b	2.6
Potassium	mg/L	-	0.30 U	-	0.91 I	-	2.8
Selenium	µg/L	≤ 5.0	0.20 U	≤ 5.0	0.20 U	≤ 5.0	0.20 U
Silver	µg/L	≤ 0.07	0.010 U	≤ 0.07	0.010 U	≤ 0.07	0.023 I
Sodium	mg/L	-	2.6	-	81.8	-	275
Zinc	µg/L	≤ 37 b	5.0 U	≤ 106 b	5.0 U	≤ 192 b	11 I

Sampling date: 11/2/2020

Analyte	Units	Control Site Class III Criteria	Control Site	Test Site 1 Class III Criteria	Test Site 1	Test Site 2 Class III Criteria	Test Site 2
Hardness	mg CaCO3/L	-	9.2 c	-	23.8 c	-	24 c
Aluminum	µg/L	-	446	-	444	-	483
Arsenic	µg/L	≤ 50	0.36	≤ 50	0.41	≤ 50	0.41
Cadmium	µg/L	≤ 0.1 b	0.020 U	≤ 0.097 b	0.020 U	≤ 0.097 b	0.022 I
Calcium	mg/L	-	2.17	-	5.81	-	5.93
Chromium, Total [1]	µg/L	≤ 28 b	0.56 I	≤ 27.7 b	0.62 I	≤ 27.7 b	0.74 I
Copper	µg/L	≤ 2.9 b	0.40 U	≤ 2.85 b	0.40 U	≤ 2.85 b	0.40 U
Iron	µg/L	≤ 1,000	520	≤ 1,000	500	≤ 1,000	580
Lead	µg/L	≤ 0.54 b	0.36 I	≤ 0.545 b	0.32 I	≤ 0.545 b	0.38 I
Magnesium	mg/L	-	0.92	-	2.26	-	2.23
Nickel	µg/L	≤ 16 b	0.59 I	≤ 16.1 b	0.50 U	≤ 16.1 b	0.50 U
Potassium	mg/L	-	0.30 U	-	0.30 U	-	0.30 U
Selenium	µg/L	≤ 5.0	0.20 U	≤ 5.0	0.20 U	≤ 5.0	0.20 U
Silver	µg/L	≤ 0.07	0.010 U	≤ 0.07	0.010 U	≤ 0.07	0.010 U
Sodium	mg/L	-	2.3	-	3.2	-	4.2
Zinc	µg/L	≤ 37 b	5.0 U	≤ 37 b	5.0 U	≤ 37 b	5.0 U

Sampling date: 1/21/2021

Analyte	Units	Control Site Class III Criteria	Control Site	Test Site 1 Class III Criteria	Test Site 1
Hardness	mg CaCO3/L	-	18.2 c	-	58.7 c
Aluminum	µg/L	-	419	-	311
Arsenic	µg/L	≤ 50	0.26	≤ 50	0.36
Cadmium	µg/L	≤ 0.097 b	0.020 U	≤ 0.182 b	0.020 U
Calcium	mg/L	-	4.73	-	14.7
Chromium, Total [1]	µg/L	≤ 27.7 b	0.66 I	≤ 55.7 b	0.63 I
Copper	µg/L	≤ 2.85 b	0.40 U	≤ 5.91 b	0.40 U
Iron	µg/L	≤ 1,000	480	≤ 1,000	480
Lead	µg/L	≤ 0.545 b	0.30 I	≤ 1.61 b	0.22 I
Magnesium	mg/L	-	1.56	-	5.33
Nickel	µg/L	≤ 16.1 b	0.50 U	≤ 33.2 b	0.50 U
Potassium	mg/L	-	0.30 U	-	0.30 U
Selenium	µg/L	≤ 5.0	0.20 U	≤ 5.0	0.20 U
Silver	µg/L	≤ 0.07	0.010 U	≤ 0.07	0.010 U
Sodium	mg/L	-	2.5	-	7.0
Zinc	µg/L	≤ 37 b	5.0 U	≤ 76.2 b	5.0 U

Sampling date: 5/19/2021

Analyte	Units	Control Site Class III Criteria	Control Site	Test Site 1 Class III Criteria	Test Site 1	Test Site 2 Class III Criteria	Test Site 2
Hardness	mg CaCO3/L	-	46.3 c	-	135 c	-	122 c
Aluminum	µg/L	-	410	-	220	-	199
Arsenic	µg/L	≤ 50	0.29	≤ 50	0.74	≤ 50	0.67
Cadmium	µg/L	≤ 0.153 b	0.020 U	≤ 0.338 b	0.020 U	≤ 0.314 b	0.020 U
Calcium	mg/L	-	12.9	-	34.1	-	31.1
Chromium, Total [1]	µg/L	≤ 45.9 b	0.67 I	≤ 110 b	0.72 I	≤ 102 b	0.89 I
Copper	µg/L	≤ 4.83 b	0.40 U	≤ 12.1 b	0.40 U	≤ 11.1 b	0.40 U
Iron	µg/L	≤ 1,000	630	≤ 1,000	650	≤ 1,000	560
Lead	µg/L	≤ 1.19 b	0.30 I	≤ 4.66 b	0.20 U	≤ 4.1 b	0.20 U
Magnesium	mg/L	-	3.43	-	12.1	-	10.8
Nickel	µg/L	≤ 27.2 b	0.50 U	≤ 67.2 b	0.50 U	≤ 61.8 b	0.50 U
Potassium	mg/L	-	0.30 U	-	0.41 I	-	0.43 I
Selenium	µg/L	≤ 5.0	0.20 U	≤ 5.0	0.20 U	≤ 5.0	0.20 U
Silver	µg/L	≤ 0.07	0.010 U	≤ 0.07	0.010 U	≤ 0.07	0.010 U
Sodium	mg/L	-	3	-	15.6	-	18
Zinc	µg/L	≤ 62.4 b	5.0 U	≤ 154 b	5.0 U	≤ 142 b	5.0 U

Sampling date: 12/20/2021

Analyte	Units	Control Site Class III Criteria	Control Site	Test Site 1 Class III Criteria	Test Site 1
Hardness	mg CaCO3/L	-	23.4 c	-	72.3 c
Aluminum	µg/L	-	499	-	353
Arsenic	µg/L	≤ 50	0.33	≤ 50	0.59
Cadmium	µg/L	≤ 0.097 b	0.020 U	≤ 0.213 b	0.020 U
Calcium	mg/L	-	6.25	-	18.2
Chromium, Total [1]	µg/L	≤ 27.7 b	0.68 I	≤ 66.1 b	0.75 I
Copper	µg/L	≤ 2.85 b	0.40 U	≤ 7.07 b	0.40 U
Iron	µg/L	≤ 1,000	540	≤ 1,000	550
Lead	µg/L	≤ 0.545 b	0.32 I	≤ 2.11 b	0.20 I
Magnesium	mg/L	-	1.89	-	6.53
Nickel	µg/L	≤ 16.1 b	0.50 U	≤ 39.7 b	0.50 U
Potassium	mg/L	-	0.30 U	-	0.30 U
Selenium	µg/L	≤ 5.0	0.20 U	≤ 5.0	0.20 U
Silver	µg/L	≤ 0.07	0.010 U	≤ 0.07	0.010 U
Sodium	mg/L	-	2.4		8.7
Zinc	µg/L	≤ 37 b	5.0 U	≤ 91.1 b	5.0 U

Sampling date: 6/16/2022

Analyte	Units	Control Site Class III Criteria	Control Site	Test Site 1 Class III Criteria	Test Site 1
Hardness	mg CaCO3/L	-	81.7 c	-	166 c
Aluminum	µg/L	-	353	-	55
Arsenic	µg/L	≤ 50	0.38	≤ 50	1.31
Cadmium	µg/L	≤ 0.233 b	0.020 U	≤ 0.395 b	0.020 U
Calcium	mg/L	-	23.4	-	41.9
Chromium, Total [1]	µg/L	≤ 73 b	0.89 I	≤ 131 b	0.60 I
Copper	µg/L	≤ 7.85 b	0.40 U	≤ 14.4 b	0.40 U
Iron	µg/L	≤ 1,000	460	≤ 1,000	680
Lead	µg/L	≤ 2.46 b	0.24 I	≤ 6.08 b	0.20 U
Magnesium	mg/L	-	5.64	-	15
Nickel	µg/L	≤ 43.9 b	0.50 U	≤ 80.3 b	0.50 U
Potassium	mg/L	-	0.30 U	-	0.54 I
Selenium	µg/L	≤ 5.0	0.20 U	≤ 5.0	0.20 U
Silver	µg/L	≤ 0.07	0.010 U	≤ 0.07	0.010 U
Sodium	mg/L	-	2.4	-	20
Zinc	µg/L	≤ 101 b	5.0 U	≤ 184 b	5.0 U

A dash (-) indicates sample/measurement was not collected or criterion/limit does not exist.
b - Value is calculated based on hardness, (62-302.530(3))
c - Value is calculated
I - The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
U - Material analyzed for but not detected; value reported is the method detection limit
1 - Class III Freshwater Quality Criterion (62-302.530(19)(a), F.A.C.) is for chromium-III

Appendix H. Analytical data for 2,4,6-Trichlorophenol

Date	Units	Control Site	Test Site 1	Test Site 2
7/16/2019	µg/L	0.052 U	0.20	0.12 I
11/6/2019	µg/L	0.055 U	0.11 I	0.11 I
3/11/2020	µg/L	0.050 U	0.051 U	0.050 U
11/2/2020	µg/L	0.052 U	0.052 U	0.052 U
1/21/2021	µg/L	0.052 U	0.049 U	-
5/19/2021	µg/L	0.048 U	0.047 U	0.047 U
12/20/2021	µg/L	0.048 U	0.048 U	-

A dash (-) indicates sample/measurement was not collected.
U - Material analyzed for but not detected; value reported is the method detection limit
I - The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit

Appendix I. Periphyton taxa list

Taxa	Control Site 7/16/2019	Test Site 1 7/16/2019	Test Site 2 7/16/2019	Control Site 11/6/2019	Test Site 1 11/6/2019	Test Site 2 11/6/2019	Control Site 3/11/2020	Test Site 2 3/11/2020	Control Site 11/2/2020	Test Site 1 11/2/2020	Test Site 2 11/2/2020	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 12/20/2021	Control Site 6/16/2022
Bacillariophyceae	**473**	**434**	**500**	**491**	**458**	**499**	**109**	**500**	**135**	**494**	**496**	**62**	**366**	**496**	**500**
Achnanthales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Achnanthes rupestoides	-	-	-	-	3	-	-	5	-	2	-	-	8	-	-
Achnanthidium exiguum	12	9	202	-	7	11	-	4	-	-	6	-	4	-	-
Achnanthidium minutissimum	1	1	11	-	33	-	-	-	-	-	-	-	6	-	-
Cocconeis fluviatilis	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
Cocconeis placentula	2	2	3	-	2	-	-	-	-	-	1	-	-	-	-
Karayevia clevei	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
Lemnicola hungarica	-	5	27	-	1	2	-	34	-	-	1	-	8	-	-
Planothidium apiculatum	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Planothidium delicatulum	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-
Planothidium frequentissimum	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Planothidium lanceolatum	-	-	10	-	-	-	-	4	-	-	-	-	4	-	-
Planothidium rostratum	-	-	6	-	6	-	-	-	-	-	-	-	-	-	-
Bacillariales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bacillaria sp.	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-
Bacillaria paxillifer	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-
Nitzschia sp.	1	12	12	117	29	145	2	14	8	10	12	14	8	54	-
Nitzschia acicularis	2	3	-	-	4	-	-	-	2	-	-	-	-	-	-
Nitzschia amphibia	-	3	6	7	9	13	-	-	-	-	-	-	-	5	-
Nitzschia amphibia frauenfeldii	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Nitzschia gracilis	2	1	-	18	-	-	2	4	-	-	-	6	-	-	-
Nitzschia intermedia	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia nana	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-
Nitzschia palea	18	29	-	68	-	8	-	4	-	-	-	-	5	42	-

Taxa	Control Site 7/16/2019	Test Site 1 7/16/2019	Test Site 2 7/16/2019	Control Site 11/6/2019	Test Site 1 11/6/2019	Test Site 2 11/6/2019	Control Site 3/11/2020	Test Site 2 3/11/2020	Control Site 11/2/2020	Test Site 1 11/2/2020	Test Site 2 11/2/2020	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 12/20/2021	Control Site 6/16/2022
Nitzschia palea debilis	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-
Nitzschia sigma	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Cymbellales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Encyonema minutum	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Encyonema neomesianum	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-
Encyonema silesiacum	-	-	4	-	-	-	-	2	-	-	-	-	-	-	-
Gomphonema sp.	2	10	18	-	111	93	-	-	-	4	-	2	12	-	-
Gomphonema affine	-	25	9	-	47	8	-	4	-	-	-	-	3	-	-
Gomphonema augur	-	-	14	-	4	4	-	-	-	-	-	-	-	-	-
Gomphonema gracile	-	-	-	3	33	15	-	14	-	4	-	-	4	-	-
Gomphonema grovei	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gomphonema hebridense	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-
Gomphonema minutum	4	5	-	-	53	25	-	38	-	-	-	-	-	-	-
Gomphonema parvulum	-	21	59	9	25	41	-	155	-	2	6	-	25	2	-
Placoneis elginensis	-	10	-	2	-	-	-	-	-	-	-	-	4	-	-
Placoneis gastrum	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Eunotiales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eunotia sp.	270	126	28	221	23	8	45	-	121	280	311	19	82	104	488
Eunotia bilunaris	7	4	-	4	-	-	-	-	2	11	-	-	10	84	4
Eunotia camelus	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Eunotia carolina	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Eunotia flexuosa	-	15	6	-	6	-	7	2	7	32	4	-	6	18	-
Eunotia formica	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eunotia incisa	2	18	-	13	-	-	7	-	38	53	47	6	-	14	6
Eunotia monodon	-	-	-	-	-	-	-	-	-	-	-	2	26	-	-
Eunotia naegelii	-	-	-	-	-	-	-	-	-	-	-	-	5	11	-
Eunotia paludosa	30	2	-	5	-	-	25	-	23	8	-	2	-	24	-
Eunotia pectinalis	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Taxa	Control Site 7/16/2019	Test Site 1 7/16/2019	Test Site 2 7/16/2019	Control Site 11/6/2019	Test Site 1 11/6/2019	Test Site 2 11/6/2019	Control Site 3/11/2020	Test Site 2 3/11/2020	Control Site 11/2/2020	Test Site 1 11/2/2020	Test Site 2 11/2/2020	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 12/20/2021	Control Site 6/16/2022
Eunotia pectinalis undulata	-	-	-	-	-	-	-	-	-	18	49	-	-	-	-
Eunotia praerupta	6	-	-	-	-	-	-	-	-	41	-	-	-	-	-
Eunotia rhomboidea	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Eunotia zygodon	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Naviculales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brachysira brebissonii	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Caloneis sp.	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Capartogramma crucicula	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Craticula sp.	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Craticula cuspidata	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Diadesmis confervacea	44	15	-	-	-	-	1	-	19	2	6	2	1	-	-
Diploneis sp.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Frustulia sp.	-	-	-	-	-	-	3	-	12	-	-	1	-	2	-
Frustulia crassinervia	5	8	-	-	-	-	-	-	-	-	-	-	-	-	-
Frustulia rhomboides	9	-	-	-	-	-	-	-	-	-	33	-	4	-	-
Hippodonta capitata	-	-	-	-	-	4	-	116	-	-	-	-	6	-	-
Hippodonta hungarica	2	12	3	-	-	6	-	38	-	-	2	-	-	-	-
Mayamaea atomus	-	-	-	-	4	-	-	-	-	8	4	-	-	-	-
Navicula sp.	-	7	3	-	12	35	-	21	-	4	-	-	22	-	-
Navicula cryptocephala	-	8	2	-	7	7	-	-	-	-	2	-	6	-	-
Navicula cryptotenella	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Navicula kotschyi	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula minima	6	6	73	-	6	1	-	2	-	-	-	-	23	-	2
Navicula radiosa	-	2	-	-	6	2	-	16	-	-	-	-	-	-	-
Navicula rostellata	-	-	-	-	-	54	-	-	-	-	-	-	-	-	-
Navicula trivialis	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Neidium sp.	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Neidium densestriatum	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Taxa	Control Site 7/16/2019	Test Site 1 7/16/2019	Test Site 2 7/16/2019	Control Site 11/6/2019	Test Site 1 11/6/2019	Test Site 2 11/6/2019	Control Site 3/11/2020	Test Site 2 3/11/2020	Control Site 11/2/2020	Test Site 1 11/2/2020	Test Site 2 11/2/2020	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 12/20/2021	Control Site 6/16/2022
Nupela neotropica	-	3	-	-	1	-	2	-	-	8	-	-	42	-	-
Pinnularia sp.	32	39	2	10	23	7	14	14	13	4	6	5	16	32	-
Sellaphora laevissima	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-
Sellaphora pupula	2	5	-	3	-	-	-	-	2	-	-	-	11	-	-
Stauroneis phoenicenteron	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Thalassiophysales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphora sp.	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Amphora veneta	-	3	-	4	1	-	-	-	-	1	-	-	-	-	-
Chlorophyceae	-	**2**	**9**	**1**	**3**	**5**	-	-	**100**	**5**	**65**	-	-	**5**	-
Chaetophorales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Draparnaldia sp.	-	-	-	-	-	-	-	-	-	-	22	-	-	-	-
Stigeoclonium sp.	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
Chlorococcales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorella sp.	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-
Dictyosphaerium ehrenbergianum	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Dictyosphaerium pulchellum	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Golenkinia radiata	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-
Kirchneriella sp.	-	-	2	-	-	-	-	-	-	1	-	-	-	-	-
Oedogoniales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oedogonium sp.	-	-	-	-	-	-	-	-	-	-	34	-	-	-	-
Ulotrichales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planctonema lauterbornii	-	-	-	-	3	4	-	-	-	-	-	-	-	-	-
Volvocales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlamydomonas sp.	-	-	-	-	-	-	-	-	-	4	4	-	-	-	-
Coccomonas sp.	-	-	-	-	-	-	-	-	88	-	-	-	-	-	-
Zygnematales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Closterium sp.	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-
Mougeotia sp.	-	-	-	-	-	-	-	-	-	-	3	-	-	5	-

Taxa	Control Site 7/16/2019	Test Site 1 7/16/2019	Test Site 2 7/16/2019	Control Site 11/6/2019	Test Site 1 11/6/2019	Test Site 2 11/6/2019	Control Site 3/11/2020	Test Site 2 3/11/2020	Control Site 11/2/2020	Test Site 1 11/2/2020	Test Site 2 11/2/2020	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 12/20/2021	Control Site 6/16/2022
Coscinodiscophyceae	**14**	**51**	**-**	**7**	**37**	**-**	**4**	**-**	**43**	**2**	**2**	**2**	**27**	**4**	**-**
Aulacoseirales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aulacoseira granulata	12	48	-	7	37	-	3	-	43	2	2	2	16	4	-
Melosirales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melosira sp.	2	3	-	-	-	-	1	-	-	-	-	-	11	-	-
Cryptophyceae	-	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
Cryptomonadales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chroomonas sp.	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanophyceae	**15**	**146**	**151**	**39**	**133**	**12**	**59**	**51**	**4**	**12**	**12**	**13**	**23**	**8**	**1**
Chamaesiphonales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chamaesiphon sp.	-	-	93	-	-	-	-	-	-	-	-	-	-	-	-
Chroococcales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aphanocapsa delicatissima	-	-	-	4	-	-	-	-	1	-	-	-	-	-	-
Aphanothece microspora	-	-	-	3	-	-	-	-	1	-	-	-	-	-	-
Bacularia sp.	-	-	-	7	-	-	5	-	-	-	-	-	-	-	-
Merismopedia tenuissima	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Merismopedia warmingiana	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-
Snowella sp.	1	2	-	2	-	-	-	-	-	-	-	-	-	-	-
Nostocales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anabaena sp.	6	-	-	1	7	3	-	3	-	-	2	-	-	-	1
Calothrix sp.	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Cylindrospermopsis raciborskii	-	11	16	-	-	-	-	-	-	-	-	-	-	-	-
Cylindrospermum sp.	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Fortiea bossei	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-
Gloeotrichia sp.	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Oscillatoriales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jaaginema gracile	-	19	12	-	22	-	-	-	-	-	1	-	-	-	-
Lyngbya sp.	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-

Taxa	Control Site 7/16/2019	Test Site 1 7/16/2019	Test Site 2 7/16/2019	Control Site 11/6/2019	Test Site 1 11/6/2019	Test Site 2 11/6/2019	Control Site 3/11/2020	Test Site 2 3/11/2020	Control Site 11/2/2020	Test Site 1 11/2/2020	Test Site 2 11/2/2020	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 12/20/2021	Control Site 6/16/2022
Oscillatoria sp.	-	-	1	-	-	-	-	-	-	-	2	6	3	-	-
Planktolyngbya lacustris	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Planktolyngbya limnetica	-	43	9	-	36	-	-	1	-	-	-	-	-	-	-
Planktothrix agardhii	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Pseudanabaena sp.	3	70	17	22	66	6	9	29	1	12	-	-	20	1	-
Pseudanabaena mucicola	1	-	-	-	-	-	45	-	-	-	-	7	-	1	-
Schizothrix calcicola	-	-	-	-	-	-	-	17	-	-	-	-	-	-	-
Spirulina major sp.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Euglenophyceae	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**
Euglenales	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Phacus sp.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Fragilariophyceae	**8**	**9**	**-**	**2**	**-**	**-**	**-**	**-**	**13**	**3**	**-**	**-**	**-**	**-**	**-**
Fragilariales	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Fragilaria berolinensis	-	2	-	2	-	-	-	-	2	-	-	-	-	-	-
Fragilariforma bicapitata	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudostaurosira brevistriata	-	6	-	-	-	-	-	-	-	3	-	-	-	-	-
Staurosira construens	2	-	-	-	-	-	-	-	4	-	-	-	-	-	-
Staurosirella pinnata	6	-	-	-	-	-	-	-	3	-	-	-	-	-	-
Synedra ulna	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-
Mediophyceae	**5**	**7**	**1**	**-**	**5**	**1**	**-**	**-**	**6**	**2**	**2**	**2**	**7**	**-**	**-**
Thalassiosirales	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Cyclostephanos invisitatus	-	1	-	-	-	-	-	-	2	-	-	-	-	-	-
Cyclotella meneghiniana	2	2	-	-	2	1	-	-	4	-	-	2	4	-	-
Stephanodiscus sp.	3	4	1	-	3	-	-	-	-	2	2	-	3	-	-

Appendix J. Stream Condition Index (SCI) taxa list

Taxa	Test Site 1 6/18/2019	Test Site 2 6/18/2019	Control Site 10/9/2019	Test Site 1 10/9/2019	Test Site 2 10/9/2019	Control Site 2/12/2020	Test Site 1 2/12/2020	Test Site 2 2/12/2020	Control Site 1/21/2021	Test Site 1 1/21/2021	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 6/16/2022	Test Site 1 6/16/2022
Acariformes	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Arrenurus sp.	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Amphipoda	**135**	**174**	**-**	**52**	**222**	**-**	**144**	**221**	**-**	**9**	**-**	**55**	**-**	**21**
Crangonyx sp.	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Hyalella azteca	135	174	-	52	222	-	144	221	-	9	-	54	-	21
Basommatophora	**16**	**29**	**2**	**24**	**2**	**7**	**17**	**4**	**1**	**27**	**1**	**20**	**-**	**16**
Ancylidae	-	6	2	4	1	7	3	3	1	-	1	6	-	1
Laevapex sp.	-	14	-	-	-	-	-	-	-	-	-	-	-	-
Lymnaea columella	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Lymnaeidae	-	-	-	-	-	-	-	-	-	3	-	-	-	-
Menetus sp.	-	2	-	-	-	-	-	1	-	-	-	1	-	1
Physa sp.	16	7	-	20	1	-	14	-	-	24	-	12	-	14
Coleoptera	**6**	**-**	**26**	**34**	**1**	**46**	**1**	**1**	**19**	**9**	**17**	**37**	**33**	**40**
Ancyronyx variegatus	4	-	6	17	-	11	-	-	6	1	2	12	2	6
Berosus sp.	-	-	-	-	-	1	-	-	-	-	-	-	1	-
Curculionidae	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Dineutus sp.	-	-	-	-	-	1	-	1	-	1	-	-	1	1
Dubiraphia vittata	1	-	4	8	-	10	1	-	3	3	-	19	2	24
Hydrocanthus sp.	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Hydrovatus sp.	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydrovatus platycornis	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Microcylloepus pusillus	-	-	8	-	-	8	-	-	3	-	7	1	14	-
Noteridae	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Peltodytes sp.	-	-	-	-	-	-	-	-	-	1	-	-	-	2

Taxa	Test Site 1 6/18/2019	Test Site 2 6/18/2019	Control Site 10/9/2019	Test Site 1 10/9/2019	Test Site 2 10/9/2019	Control Site 2/12/2020	Test Site 1 2/12/2020	Test Site 2 2/12/2020	Control Site 1/21/2021	Test Site 1 1/21/2021	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 6/16/2022	Test Site 1 6/16/2022
Scirtes sp.	-	-	-	-	-	2	-	-	-	-	-	3	-	1
Stenelmis sp.	-	-	8	6	-	13	-	-	7	3	8	1	13	4
Decapoda	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Cambaridae	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Diptera	**32**	**40**	**87**	**103**	**46**	**106**	**34**	**43**	**127**	**117**	**118**	**81**	**77**	**116**
Ablabesmyia (karelia) grp.	-	-	-	-	-	-	1	-	-	1	-	-	-	-
Ablabesmyia mallochi	-	-	16	4	-	3	2	-	6	24	1	9	1	-
Ablabesmyia rhamphe grp.	24	7	2	73	4	7	13	1	-	4	3	5	2	5
Atrichopogon sp.	-	-	1	-	-	-	-	2	-	-	-	-	-	-
Ceratopogonidae	1	-	-	4	-	2	2	-	1	1	-	1	-	5
Chironomus sp.	2	-	-	-	-	1	3	-	-	2	-	1	-	1
Cladotanytarsus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Cladotanytarsus cf. daviesi	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Clinotanypus sp.	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Corynoneura sp.	-	-	-	-	-	-	-	-	-	3	-	-	-	-
Cryptochironomus sp.	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Cryptotendipes sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Dicrotendipes sp.	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Dicrotendipes lucifer	1	11	-	-	6	-	-	4	-	-	-	-	-	-
Dicrotendipes modestus	-	-	-	-	-	-	-	-	-	-	-	-	-	25
Dicrotendipes neomodestus	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Empididae	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Ephydridae	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Goeldichironomus sp.	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Goeldichironomus cf. natans	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Goeldichironomus holoprasinus	1	-	-	-	-	-	-	-	-	1	-	-	-	1
Hemerodromia sp.	-	-	1	-	-	3	-	-	18	1	17	3	19	5
Kribiodorum perpulchrum	-	-	-	-	-	1	-	-	-	-	-	-	-	-

Taxa	Test Site 1 6/18/2019	Test Site 2 6/18/2019	Control Site 10/9/2019	Test Site 1 10/9/2019	Test Site 2 10/9/2019	Control Site 2/12/2020	Test Site 1 2/12/2020	Test Site 2 2/12/2020	Control Site 1/21/2021	Test Site 1 1/21/2021	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 6/16/2022	Test Site 1 6/16/2022
Labrundinia becki	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Labrundinia johannseni	-	-	-	1	-	-	-	-	-	1	-	-	-	-
Labrundinia pilosella	-	-	-	2	1	1	-	2	-	4	-	-	-	-
Labrundinia virescens	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Larsia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Microtendipes pedellus grp.	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Nilothauma sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Parachironomus sp.	-	-	-	1	5	-	-	-	-	-	-	-	-	-
Pentaneura inconspicua	-	-	-	-	-	-	1	11	-	-	-	-	-	-
Phaenopsectra sp.	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Polypedilum beckae	-	-	-	-	6	-	-	-	-	-	-	-	-	-
Polypedilum flavum	-	-	7	1	-	3	-	-	3	7	4	15	12	18
Polypedilum illinoense grp.	2	16	-	3	8	-	9	18	2	-	-	1	-	4
Polypedilum scalaenum grp.	-	2	-	2	10	-	-	-	-	1	-	1	3	7
Pseudosmittia sp.	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Psychodidae	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Rheocricotopus robacki	-	-	-	-	-	-	-	-	-	-	-	1	4	1
Rheotanytarsus exiguus grp.	-	-	28	-	-	7	-	-	38	2	52	8	16	10
Rheotanytarsus pellucidus	-	-	-	-	-	-	-	-	-	-	-	1	-	2
Roederiodes sp.	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Simulium sp.	-	-	-	-	-	8	-	-	35	4	11	5	12	-
Simulium slossonae	-	-	15	-	-	-	-	-	-	-	-	-	-	-
Stenochironomus sp.	-	2	2	1	-	26	1	4	5	2	7	12	1	1
Stictochironomus sp.	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Stratiomyidae	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Tanypus sp.	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Tanytarsus sp.	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Tanytarsus messersmithi	-	-	-	-	-	-	-	-	-	-	-	1	-	-

Taxa	Test Site 1 6/18/2019	Test Site 2 6/18/2019	Control Site 10/9/2019	Test Site 1 10/9/2019	Test Site 2 10/9/2019	Control Site 2/12/2020	Test Site 1 2/12/2020	Test Site 2 2/12/2020	Control Site 1/21/2021	Test Site 1 1/21/2021	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 6/16/2022	Test Site 1 6/16/2022
Tanytarsus sepp	-	-	-	-	-	-	-	-	-	-	-	-	-	10
Tanytarsus sp. d epler	-	-	2	4	-	5	-	-	3	37	6	-	1	-
Tanytarsus sp. f epler	1	-	-	2	-	-	-	-	-	2	-	-	-	3
Tanytarsus sp. g epler complex	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Tanytarsus sp. l epler 2014	-	-	-	-	-	-	-	-	-	4	-	-	-	-
Tanytarsus sp. l epler complex	-	-	-	-	-	3	-	-	1	5	-	4	-	1
Tanytarsus sp. n epler	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Tanytarsus sp. t epler	-	-	-	-	-	-	-	-	-	1	-	1	-	1
Thienemannimyia grp.	-	-	11	1	1	7	-	-	15	5	17	3	3	4
Tribelos fuscicornis	-	-	-	1	-	21	-	-	-	-	-	-	1	1
Tribelos jucundum	-	-	-	1	-	4	-	-	-	3	-	3	-	1
Tvetenia tshernovskii	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Xenochironomus xenolabis	-	-	2	-	-	-	-	-	-	-	-	-	-	2
Ephemeroptera	**-**	**-**	**18**	**4**	**-**	**38**	**-**	**-**	**26**	**14**	**32**	**8**	**78**	**8**
Caenis sp.	-	-	-	3	-	-	-	-	-	2	-	1	-	2
Callibaetis sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Heptageniidae	-	-	-	-	-	15	-	-	-	-	-	-	-	-
Leptophlebiidae	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Maccaffertium sp.	-	-	18	1	-	23	-	-	25	12	32	7	-	-
Stenonema sp.	-	-	-	-	-	-	-	-	-	-	-	-	78	5
Haplotaxida	**61**	**20**	**1**	**10**	**4**	**4**	**77**	**1**	**6**	**57**	**1**	**19**	**4**	**11**
Aulodrilus pigueti	1	-	-	3	-	-	17	-	-	2	-	8	-	-
Bratislavia unidentata	2	2	-	-	-	-	6	-	-	-	-	-	-	-
Dero sp.	-	-	-	-	-	-	6	-	-	-	-	-	-	1
Dero digitata complex	53	-	-	2	-	-	-	-	-	30	-	-	-	-
Dero lodeni	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Dero vaga	-	1	-	1	-	-	-	-	-	-	-	3	-	-
Enchytraeidae	-	-	-	-	-	-	-	-	1	-	-	-	1	-

Taxa	Test Site 1 6/18/2019	Test Site 2 6/18/2019	Control Site 10/9/2019	Test Site 1 10/9/2019	Test Site 2 10/9/2019	Control Site 2/12/2020	Test Site 1 2/12/2020	Test Site 2 2/12/2020	Control Site 1/21/2021	Test Site 1 1/21/2021	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 6/16/2022	Test Site 1 6/16/2022
Haemonais waldvogeli	4	15	-	4	2	-	-	-	-	-	-	-	-	-
Limnodrilus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Limnodrilus hoffmeisteri	-	-	-	-	-	-	1	-	-	12	-	4	-	-
Naididae	-	-	-	-	-	-	-	1	-	-	1	-	-	-
Nais communis complex	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Nais(animal)	-	-	-	-	-	-	36	-	-	-	-	-	-	-
Pristina sp.	-	-	-	-	-	-	11	-	-	-	-	4	1	-
Pristina longidentata	-	-	-	-	-	-	-	-	-	7	-	-	-	-
Pristina longisoma	-	-	-	-	-	-	-	-	-	6	-	-	-	-
Tubificidae	-	1	1	-	2	4	-	-	5	-	-	-	2	7
Heteroptera	**1**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**1**	**-**	**-**	**1**	**-**
Mesovelia sp.	-	-	-	-	1	-	1	-	-	-	-	-	-	-
Pelocoris sp.	-	-	-	-	-	-	1	-	-	1	-	-	-	-
Pleidae	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Ranatra sp.	-	-	-	-	1	-	1	-	-	-	-	-	-	-
Ranatra buenoi	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Hoplonemertea	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
Prostoma sp.	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Isopoda	**-**	**-**	**93**	**-**	**-**	**5**	**-**	**-**	**45**	**-**	**56**	**-**	**3**	**-**
Caecidotea	-	-	93	-	-	5	-	-	45	-	56	-	3	-
Lepidoptera	**-**	**1**	**-**	**-**	**1**	**-**	**3**	**-**	**-**	**1**	**-**	**1**	**-**	**1**
Crambidae	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Lepidoptera	-	-	-	-	-	-	3	-	-	-	-	1	-	-
Petrophila sp.	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Synclita sp.	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Lumbriculida	**-**	**-**	**1**	**-**	**-**	**10**	**-**	**-**	**1**	**-**	**-**	**2**	**3**	**-**
Eclipidrilus sp.	-	-	1	-	-	-	-	-	1	-	-	2	-	-
Eclipidrilus palustris	-	-	-	-	-	10	-	-	-	-	-	-	2	-

Taxa	Test Site 1 6/18/2019	Test Site 2 6/18/2019	Control Site 10/9/2019	Test Site 1 10/9/2019	Test Site 2 10/9/2019	Control Site 2/12/2020	Test Site 1 2/12/2020	Test Site 2 2/12/2020	Control Site 1/21/2021	Test Site 1 1/21/2021	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 6/16/2022	Test Site 1 6/16/2022
Lumbriculus variegatus	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Megaloptera	**-**	**-**	**1**	**-**	**-**	**2**	**-**	**-**	**2**	**-**	**2**	**-**	**18**	**1**
Climacia areolaris	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Corydalus cornutus	-	-	1	-	-	2	-	-	2	-	2	-	16	1
Odonata	**41**	**3**	**18**	**30**	**3**	**28**	**17**	**7**	**7**	**20**	**8**	**32**	**3**	**28**
Aeshnidae	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Argia sp.	-	-	7	3	-	21	-	-	6	2	5	-	-	-
Boyeria vinosa	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Brachymesia gravida	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Coenagrionidae	-	1	-	-	2	-	-	-	-	-	-	-	-	-
Enallagma sp.	22	1	4	7	-	3	17	4	-	11	1	19	-	23
Enallagma coecum	-	-	-	-	-	-	-	3	-	-	-	-	-	-
Epicordulia princeps regina	-	-	-	-	-	-	-	-	-	-	-	7	-	-
Epitheca sp.	-	-	-	-	-	-	-	-	-	-	-	-	3	-
Gomphidae	-	-	-	-	-	1	-	-	-	1	-	-	-	-
Gomphus exilis	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Ischnura sp.	-	-	-	-	-	-	-	-	-	1	-	2	-	5
Libellula sp.	-	-	-	1	1	-	-	-	-	2	-	4	-	-
Libellulidae	-	1	-	-	-	-	-	-	-	3	-	-	-	-
Macromia sp.	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Nasiaeschna pentacantha	1	-	-	2	-	-	-	-	-	-	-	-	-	-
Nehalennia sp.	-	-	-	6	-	-	-	-	-	-	-	-	-	-
Neurocordulia sp.	-	-	7	4	-	1	-	-	-	-	-	-	-	-
Neurocordulia alabamensis	-	-	-	3	-	-	-	-	1	-	1	-	-	-
Tetragoneuria sp.	17	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetragoneuria sepia	-	-	-	3	-	-	-	-	-	-	-	-	-	-
Rhynchobdellida	**-**	**-**	**-**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**5**	**-**	**-**
Helobdella stagnalis complex	-	-	-	-	-	-	-	-	-	-	-	1	-	-

Taxa	Test Site 1 6/18/2019	Test Site 2 6/18/2019	Control Site 10/9/2019	Test Site 1 10/9/2019	Test Site 2 10/9/2019	Control Site 2/12/2020	Test Site 1 2/12/2020	Test Site 2 2/12/2020	Control Site 1/21/2021	Test Site 1 1/21/2021	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 6/16/2022	Test Site 1 6/16/2022
Helobdella triserialis	-	-	-	-	-	-	-	-	-	-	-	4	-	-
Placobdella ornata	-	-	-	1	-	-	2	-	-	-	-	-	-	-
Trichoptera	**1**	**24**	**56**	**27**	**19**	**52**	**1**	**17**	**68**	**41**	**51**	**53**	**71**	**47**
Cheumatopsyche sp.	-	5	3	-	3	-	-	-	12	-	2	1	4	1
Chimarrav	-	-	1	2	-	-	-	-	4	-	-	3	1	7
Hydropsyche sp.	-	-	12	4	15	4	-	16	40	2	30	20	45	5
Hydropsyche rossi	-	15	-	-	-	-	-	-	-	-	-	-	-	-
Hydroptila sp.	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Molanna blenda	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Molanna tryphena	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Nectopsyche sp.	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Oecetis sp.	1	-	-	-	1	-	-	-	-	-	-	-	-	-
Oecetis georgia	-	-	33	-	-	36	-	-	8	16	17	14	15	29
Oecetis nocturna	-	4	-	6	-	-	-	1	-	8	-	1	-	-
Oecetis sp. e floyd	-	-	-	1	-	-	1	-	-	-	-	5	-	-
Oxyethira sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Polycentropus sp.	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Pycnopsyche sp.	-	-	-	-	-	-	-	-	3	-	-	-	-	-
Triaenodes sp.	-	-	-	-	-	-	-	-	1	-	-	-	2	-
Triaenodes ignitus	-	-	-	-	-	-	-	-	-	-	-	2	3	-
Triaenodes perna/helo	-	-	5	12	-	7	-	-	-	15	2	7	-	4
Veneroida	**-**	**-**	**-**	**1**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**12**
Sphaeriidae(mollusca)	-	-	-	1	-	3	-	-	-	-	-	1	-	12
Phyla	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bivalvia	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Hirudinea	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Platyhelminthes	-	-	-	-	2	-	-	-	-	-	-	-	-	-

Appendix K. Hester-Dendy taxa list

Taxa	Control Site 7/16/2019	Test Site 1 7/16/2019	Test Site 2 7/16/2019	Control Site 11/6/2019	Test Site 1 11/6/2019	Test Site 2 11/6/2019	Control Site 3/11/2020	Test Site 2 3/11/2020	Control Site 11/2/2020	Test Site 1 11/2/2020	Test Site 2 11/2/2020	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 12/20/2021	Control Site 6/16/2022
Amphipoda	**-**	**7**	**85**	**1**	**43**	**318**	**-**	**101**	**22**	**-**	**56**	**-**	**2**	**-**	**-**
Hyalella azteca	-	7	85	1	43	318	-	101	22	-	56	-	2	-	-
Basommatophora	**-**	**123**	**49**	**1**	**2**	**1**	**-**	**3**	**-**	**1**	**-**	**-**	**6**	**-**	**-**
Ancylidae	-	1	47	1	1	1	-	2	-	1	-	-	-	-	-
Menetus sp.	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-
Physa sp.	-	114	2	-	1	-	-	1	-	-	-	-	6	-	-
Coleoptera	**10**	**175**	**2**	**-**	**4**	**-**	**-**	**-**	**1**	**4**	**-**	**-**	**5**	**-**	**39**
Ancyronyx variegatus	5	144	-	-	3	-	-	-	1	1	-	-	5	-	34
Dineutus sp.	-	27	2	-	-	-	-	-	-	-	-	-	-	-	1
Microcylloepus pusillus	5	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Stenelmis sp.	-	3	-	-	1	-	-	-	-	3	-	-	-	-	3
Tropisternus blatchleyi	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Decapoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
Cambaridae	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Diptera	**408**	**246**	**612**	**84**	**762**	**1049**	**151**	**343**	**494**	**203**	**935**	**930**	**100**	**211**	**42**
Ablabesmyia mallochi	-	-	-	-	3	-	-	-	-	-	-	-	15	-	1
Ablabesmyia rhamphe grp.	-	87	5	-	138	3	-	1	-	-	5	-	8	-	-
Atrichopogon sp.	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Ceratopogonidae	-	4	-	-	3	-	-	-	-	-	-	-	-	-	-
Chironomidae	3	5	22	2	63	67	-	63	17	8	52	-	-	2	1
Chironomus sp.	-	-	-	-	16	-	-	-	-	-	-	-	-	-	-
Corynoneura sp.	-	-	-	9	-	-	-	-	-	-	2	6	3	-	1
Corynoneura sp. c epler	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-
Cricotopus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Cricotopus bicinctus	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Dicrotendipes sp.	-	1	42	-	3	14	-	2	-	-	-	-	-	-	-

Taxa	Control Site 7/16/2019	Test Site 1 7/16/2019	Test Site 2 7/16/2019	Control Site 11/6/2019	Test Site 1 11/6/2019	Test Site 2 11/6/2019	Control Site 3/11/2020	Test Site 2 3/11/2020	Control Site 11/2/2020	Test Site 1 11/2/2020	Test Site 2 11/2/2020	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 12/20/2021	Control Site 6/16/2022
Dicrotendipes lucifer	-	-	213	-	22	43	-	1	-	-	-	-	-	-	-
Dicrotendipes modestus	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Dicrotendipes simpsoni	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-
Goeldichironomus carus	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Goeldichironomus cf. natans	-	1	-	-	-	4	-	-	-	-	-	-	-	-	-
Hemerodromia sp.	6	-	-	-	-	-	-	6	16	-	11	26	10	19	4
Kiefferulus sp.	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Labrundinia sp.	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
Labrundinia becki	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-
Labrundinia pilosella	-	1	-	1	6	-	-	-	-	-	2	-	1	-	-
Nanocladius sp.	-	2	16	-	-	-	-	1	-	-	1	-	1	-	-
Palpomyia/bezzia grp.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Parachironomus sp.	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-
Parachironomus carinatus	-	-	4	-	-	2	-	-	-	-	-	-	-	-	-
Pentaneura inconspicua	-	1	90	1	43	199	-	47	11	2	169	-	-	-	-
Polypedilum sp.	-	2	-	-	-	-	-	-	1	1	-	-	-	-	-
Polypedilum beckae	-	-	-	-	8	27	-	-	-	-	-	-	-	-	-
Polypedilum fallax	-	4	-	-	-	-	-	1	-	3	4	-	7	-	4
Polypedilum flavum	32	-	4	-	-	4	19	-	224	63	52	50	-	16	3
Polypedilum illinoense grp.	2	20	85	-	27	34	-	56	6	-	-	-	-	-	-
Polypedilum scalaenum grp.	-	7	113	1	377	642	-	2	-	-	116	-	5	-	4
Rheocricotopus robacki	-	-	1	-	-	-	-	158	11	1	141	-	-	-	-
Rheocricotopus tuberculatus	-	-	-	-	-	-	-	-	-	-	-	3	-	2	-
Rheotanytarsus exiguus grp.	14	1	-	11	1	-	7	-	106	52	18	289	1	24	1
Rheotanytarsus pellucidus	-	-	-	-	-	-	-	-	9	2	164	-	-	-	-
Simulium sp.	14	2	-	16	-	-	112	3	37	61	-	308	-	117	17
Simulium slossonae	296	-	-	-	-	-	-	-	40	-	-	-	-	-	-
Stenochironomus sp.	-	17	16	-	-	-	-	-	-	-	10	-	1	-	-

Taxa	Control Site 7/16/2019	Test Site 1 7/16/2019	Test Site 2 7/16/2019	Control Site 11/6/2019	Test Site 1 11/6/2019	Test Site 2 11/6/2019	Control Site 3/11/2020	Test Site 2 3/11/2020	Control Site 11/2/2020	Test Site 1 11/2/2020	Test Site 2 11/2/2020	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 12/20/2021	Control Site 6/16/2022
Tanytarsus sp.	-	-	-	-	-	-	-	-	-	-	3	-	1	-	-
Tanytarsus buckleyi	2	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Tanytarsus messersmithi	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Tanytarsus sepp	-	2	-	-	-	-	-	-	-	-	9	-	-	-	-
Tanytarsus sp. alpha	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-
Tanytarsus sp. d epler	6	-	-	3	-	-	-	-	-	-	4	-	1	4	-
Tanytarsus sp. f epler	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-
Tanytarsus sp. l epler 2014	1	5	-	-	-	-	-	-	-	-	34	-	2	-	-
Tanytarsus sp. l epler complex	2	4	-	-	-	-	-	-	1	-	117	-	-	-	-
Thienemanniella sp.	19	-	-	-	-	-	4	-	5	2	3	238	-	-	1
Thienemanniella lobapodema	6	-	-	20	-	-	-	-	2	-	1	-	-	6	-
Thienemanniella xena	-	-	-	-	-	-	6	-	4	1	2	-	-	16	-
Thienemannimyia grp.	2	1	-	7	10	-	3	-	4	7	-	10	4	4	4
Tribelos fuscicornis	1	61	1	13	40	6	-	-	-	-	-	-	22	-	1
Tribelos jucundum	-	10	-	-	-	-	-	-	-	-	-	-	2	-	-
Ephemeroptera	**2**	**21**	**-**	**188**	**2**	**-**	**29**	**-**	**27**	**292**	**11**	**69**	**62**	**27**	**201**
Heptageniidae	-	11	-	23	-	-	2	-	1	86	5	-	12	17	31
Maccaffertium sp.	2	9	-	165	2	-	27	-	25	206	2	69	47	10	-
Stenacron sp.	-	1	-	-	-	-	-	-	1	-	4	-	3	-	-
Stenonema sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	170
Haplotaxida	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**1**	**-**	**46**	**-**	**-**	**-**	**-**
Bratislavia unidentata	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-
Nais communis complex	-	-	-	-	-	-	-	1	1	-	46	-	-	-	-
Heteroptera	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Abedus immaculatus	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
Hydroida	**-**	**4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hydra sp.	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Isopoda	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**3**

Taxa	Control Site 7/16/2019	Test Site 1 7/16/2019	Test Site 2 7/16/2019	Control Site 11/6/2019	Test Site 1 11/6/2019	Test Site 2 11/6/2019	Control Site 3/11/2020	Test Site 2 3/11/2020	Control Site 11/2/2020	Test Site 1 11/2/2020	Test Site 2 11/2/2020	Control Site 5/19/2021	Test Site 1 5/19/2021	Control Site 12/20/2021	Control Site 6/16/2022
Caecidotea sp.	-	-	-	-	-	-	-	-	1	-	-	-	-	1	3
Megaloptera	**43**	**-**	**6**	**8**	**-**	**-**	**10**	**-**	**6**	**4**	**1**	**15**	**-**	**5**	**14**
Corydalidae	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Corydalus cornutus	43	-	5	8	-	-	10	-	6	4	1	15	-	5	14
Odonata	**1**	**-**	**-**	**12**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**9**	**-**	**4**
Argia sp.	-	-	-	12	-	-	-	-	-	-	-	-	-	-	2
Argia tibialis	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-
Boyeria vinosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Enallagma sp.	-	-	-	-	-	-	-	-	1	-	1	-	2	-	1
Neurocordulia alabamensis	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Rhynchobdellida	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Gloiobdella elongata	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Trichoptera	**66**	**20**	**942**	**-**	**41**	**330**	**3**	**110**	**1048**	**285**	**925**	**196**	**5**	**36**	**46**
Cernotina sp.	-	1	-	-	22	1	-	-	-	-	-	-	-	-	-
Cheumatopsyche sp.	1	3	249	-	-	96	-	5	78	1	14	21	-	-	-
Chimarra sp.	-	-	2	-	1	-	1	-	50	220	135	4	-	-	-
Cyrnellus fraternus	-	-	-	-	-	-	-	-	8	14	40	-	1	-	-
Hydropsyche sp.	51	10	569	-	13	188	1	79	898	42	660	171	-	36	44
Hydropsyche decalda	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydropsyche rossi	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-
Hydropsychidae	4	6	122	-	-	45	1	26	14	7	60	-	-	-	-
Oecetis sp.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Oecetis georgia	-	-	-	-	-	-	-	-	-	-	-	-	3	-	1
Polycentropodidae	-	-	-	-	5	-	-	-	-	-	7	-	-	-	-
Triaenodes sp.	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Trichoptera	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Veneroida	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
Sphaeriidae(mollusca)	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-