A Watershed Report created by the Bureau of Water Quality in support of the Clean Water Act.

APPLE-ASHWAUBENON-DUCK TARGETED WATERSHED ASSESSMENT: A WATER QUALITY PLAN TO RESTORE WISCONSIN WATERSHEDS 2018

Duck Creek (LF05); Apple and Ashwaubenon (LF02)
HUC: 0403020404 & 0403020401
Monitored 2015

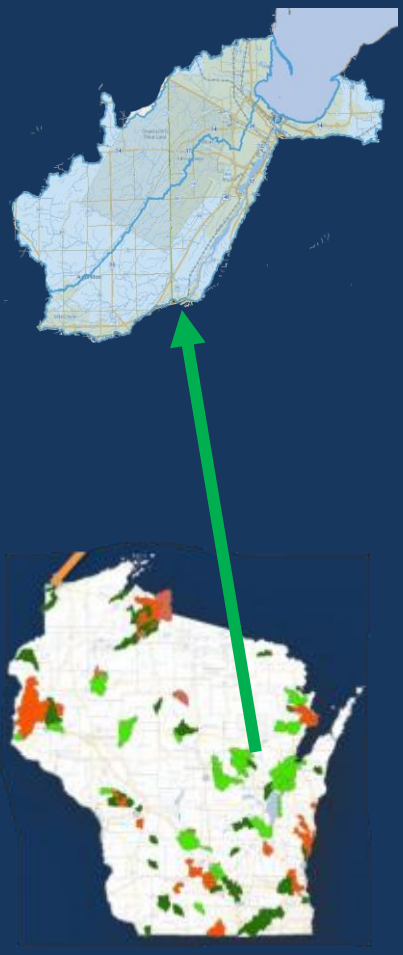


Photo caption, July 2015

Photo by Andrew Hudak, East District Water Quality Biologist
Wisconsin Department of Natural Resources

*To learn more about this area, see this **Wisconsin TWA Project Online**!*

***Find** more about waters, watersheds and projects on Explore Wisconsin's Waters Online !*

WISCONSIN DEPT. OF NATURAL RESOURCES

EGAD # 3200-2018-35
Water Quality Bureau, Wisconsin DNR

Contents

Figures

Tables

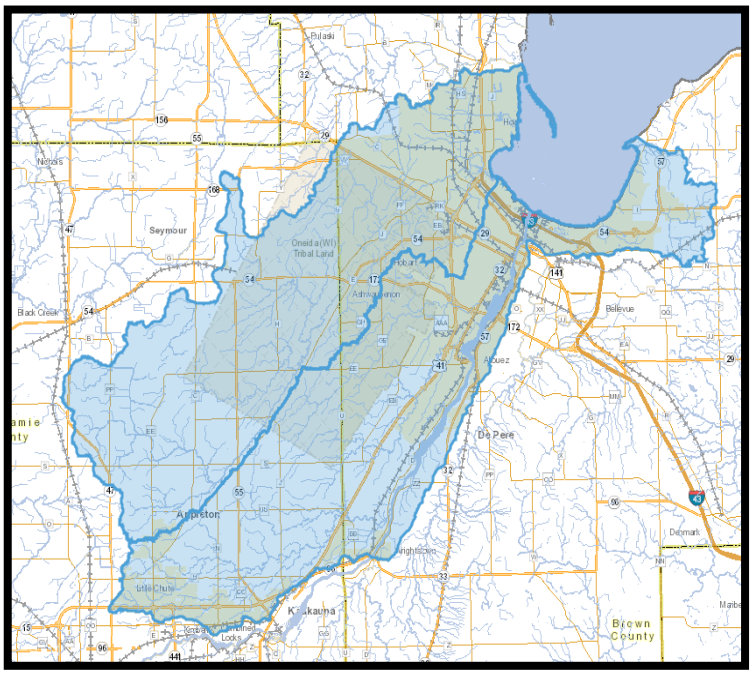
Unnamed Tributary at Farrell Road. 2015. Photo by Andrew Hudak, Water Quality Biologist, East District

Targeted Watershed Assessment Summary

In 2015, DNR Biologists conducted water quality surveys throughout the Duck, Apple, and Ashwaubenon Creek watersheds. Survey sites were selected on the intention to re-survey original watershed inventory sites, focus near structural BMP installations, and spaced to collect general water quality information to provide a contemporary assessment of water quality conditions. sites within the Apple-Ashwaubenon-Duck-West Plum TWA to evaluate current water quality conditions compared to original surveys conducted in 1996. Additionally, hard structural BMP's installed in the watershed under the Priority Watershed Project were evaluated.

Evaluation surveys included fish, macroinvertebrate, diatoms, continuous temperature, water chemistry and habitat surveys to calculate and compare instream nutrient concentrations and Index of biological integrity (IBI) scores between survey years. Water chemistry samples including total phosphorus (TP), Dissolved Ortho-Phosphorous (DOP), and total suspended sediment (TSS) were collected between May and October by volunteers with the Lower Fox River Tributary project. An additional three sites were selected at significant sub-watershed pour points located within the Apple-Ashwaubenon-Duck Creek watershed.

Figure 1: Duck- Apple-Ashwaubenon Creek TWA project location



About the Watershed

Streams throughout the Duck, Apple, and Ashwaubenon Creek watershed continue to display instream impacts from nutrient and sediment contributions originating from non-point source pollution in the watershed. A more thorough evaluation of the aquatic life within streams was conducted during the recent surveys and although nutrient concentrations continue to clearly exceed state standards, aquatic life within these streams is generally in fair to good condition with a few occurrences of poor or excellent conditions.

Duck-Apple-Ashwaubenon Creek Priority Watershed Project

The Duck, Apple, and Ashwaubenon Creek watershed was designated a priority watershed in 1995 to reduce non-point pollution loads and to improve water quality of streams in the watershed. There were 1,095 landowners that were eligible for cost sharing efforts during the time of plan eligibility 1995-2010. During this time, 549 cost-share agreements were signed in the project. The project was successful in implementing a multitude of BMPs (Appendix A). A focus for this study effort was to evaluate effectiveness of BMP installation under the agreements signed during the DAA priority watershed project.

Water Quality

Overall water quality and stream habitat is rated poor to good in the Apple and Ashwaubenon Watershed, with documented problems of sedimentation and phosphorus. Like the Duck Creek Watershed, sediment and phosphorus loading from upland agricultural fields are the major sources of nonpoint pollution. Increasing demand in residential development has also spawned sources of pollution from these sources' suburban sources. There are seven CAFOs located in the in the watershed and other nearby CAFO's may have agricultural lands in their nutrient management plans that lie within this watershed. There are no municipal or industrial point source dischargers and eight municipalities with MS4 permits that are within the Apple and Ashwaubenon Creek watersheds.

Management Priorities

Focus efforts to continue to reduce non-point source impacts in the Duck, Apple, Ashwaubenon Creek watersheds. Efforts should focus on continuing to improve landowner understanding of soils health principles and implementing fundamental practices. Additional focus should be devoted to improving stream buffer widths and quality in the watershed while maintaining adequate tillage setbacks. Manure management and application practices should continue to evolve with the implementation of soil health principles. Attention should be given to support best management practices to address the significant nutrient loss occurring through tile lines.

Recommendations

- Conduct additional monitoring in cooperation with the Oneida Tribe in Trout Creek and the UNT to Trout Creek to assess remnant Brook Trout population.
- Conduct additional monitoring in Thornberry Creek and the UNT to Thornberry Creek to assess remnant Brook Trout population.
- Conduct additional chemical and biological monitoring in Trout Creek to consider removing from the impaired water list for total phosphorus and total suspended solids.
- Support the development, implementation, and post implementation monitoring for a 9-Key Element Plan in coordination with Brown and Outagamie County in the Upper Duck and Apple Creek Watershed.

Wisconsin Water Quality Monitoring and Planning

This report was created under the state's Water Quality Management Planning and Water Resources Monitoring programs. The WQM Plan reflects the Water Resources Monitoring Strategy 2015-2020, the state's WisCALM 2018 Assessment procedures, and the 2018 Water Quality Management Program goals and priorities. Completion of this document Areawide Water Quality Management Planning milestones under the Clean Water Act, Section 208. Condition information and resource management recommendations support and guide program priorities for the plan area.

This plan is hereby approved by the Wisconsin DNR as a formal update to the Lower Fox River Water Quality Management Plan and Wisconsin's Statewide Areawide Water Quality Management Plan. WDNR Secretary Meyer will forward this plan to USEPA for Section 208 certification.

_____ _____
Andrew Hudak, East District Water Quality Biologist Date

_____ _____
Marsha Burzynski, District Water Resources Supervisor Date

_____ _____
Greg Searle, Water Quality Bureau Field Operations Director Date

_____ _____
Timothy Asplund, Water Quality Bureau Monitoring Section Chief Date

Basin/Watershed Partners

- Brown County LCD
- Outagamie County LCD
- Oneida Tribe
- Fox-Wolf Watershed Alliance
- UW-Green Bay (UW-GB)
- Fox Valley Technical College
- Northeast Wisconsin (NEW) Water
- U.S. Geological Survey (USGS)
- Natural Resources Conservation Service (NRCS)

Report Acknowledgements

- Andrew Hudak, Primary Author and Investigator, Eastern District, Wisconsin DNR
- Victoria Ziegler, Program Support, Water Quality Bureau, Wisconsin DNR
- Lisa Helmuth, Program Coordinator, Water Quality Bureau, Wisconsin DNR

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Abbreviations

BMP: Best Management Practice. A practice that is determined effective and practicable (including technological, economic, and institutional considerations) in preventing or reducing pollution generated from nonpoint sources to a level compatible with water quality goals.

Brown County LCD. Brown County Land and Water Conservation Department -- a branch of the county government charged with Developing and implementing programs and plans for conservation of soil and water by County In Wisconsin.

CAFO. Concentrated animal feeding operation. In animal husbandry, a concentrated animal feeding operation (CAFO), as defined by the United States Department of Agriculture (USDA), is an intensive animal feeding operation (AFO) in which over 1000 animal units are confined for over 45 days a year.

DATCP: Wisconsin Department of Agriculture, Trade and Consumer Protection – the state agency in partnership with DNR responsible for a variety of land and water related programs.

DNR. Wisconsin Department of Natural Resources is an agency of the State of Wisconsin created to preserve, protect, manage, and maintain natural resources.

END: Endangered Species - Wisconsin species designated as rare or unique due to proximity to the farthest extent of their natural range or due to anthropogenic deleterious impacts on the landscape or both.

ERW: Exceptional Resource Water- Wisconsin's designation under state water quality standards to waters with exceptional quality and which may be provided a higher level of protection through various programs and processes.

FHMD: Fisheries and Habitat Management Database – or Fish Database – the state's repository for fish taxonomy and auto-calculated metrics involving fish assemblage condition and related.

FVTC. Fox Valley Technical College. This is a local area college serving the greater Green Bay Fox Valley region.

FIBI: **Fish Index of biological integrity (Fish IBI).** An Index of Biological Integrity (IBI) is a scientific tool used to identify and classify water pollution problems. An IBI associates anthropogenic influences on a water body with biological activity in the water and is formulated using data developed from biosurveys. In Wisconsin, Fish IBIs are created for each type of natural community in the state's stream system.

Fox-Wolf Watershed Alliance. The Fox-Wolf Watershed Alliance is working to protect, restore and sustain the water resources of Wisconsin's Fox-Wolf River Basin.

HUC: **Hydrologic Unit Code.** A code or sequence of numbers that identify one of a number of nested and interlocked hydrologic catchments delineated by a consortium of agencies including USGS, USFS, and Wisconsin DNR.

MIBI: **Macroinvertebrate Index of biological integrity.** In Wisconsin, the MIBI, or macroinvertebrate Index of biological integrity, was developed specifically to assess Wisconsin's macroinvertebrate community (see also Fish IBI).

Monitoring Seq. No.: Monitoring Sequence Number refers to a unique identification code generated by the Surface Water Integrated Monitoring System (SWIMS), which holds much of the state's water quality monitoring data.

MDM: Maximum Daily Averages – maximum daily average is a calculated metric that may be used for temperature, dissolved oxygen and related chemistry parameters to characterize water condition.

NC: Natural Community. A system of categorizing water based on inherent physical, hydrologic, and biological components. Streams and Lakes have uniquely derived systems that result in specific natural community designations for each lake and river segment in the state. These designations dictate the appropriate assessment tools which improves the condition result, reflecting detailed nuances reflecting the modeling and analysis work foundational to the assessment systems.

mg/L: milligrams per liter - a volumetric measure typically used in chemistry analysis characterizations.

NEW Water: Northeast Wisconsin Water. an advocacy group operating in the northeast portion of the state for the restoration of the Wolf upper Fox in lower Fox basins.

NOAA: National Oceanic and Atmospheric Administration – a federal agency responsible for water / aquatic related activities involve the open waters, seas and Great Lakes.

ND: No detection – a term used typically in analytical settings to identify when a parameter or chemical constituent was not present at levels higher than the limit of detection.

NRCS: USDA Natural Resources Conservation Service -- formerly known as the Soil Conservation Service, the federal agency providing local support and land management outreach work with landowners and partners such as state agencies.

Outagamie County LCD - Outagamie County land and water conservation Department.

ORW: Outstanding Resource Water- Wisconsin's designation under state water quality standards to waters with outstanding quality and which may be provided a higher level of protection through various programs and processes.

SC: Species of Special Concern- species designated as special concern due to proximity to the farthest extent of their natural range or due to anthropogenic deleterious impacts on the landscape, or both.

SWIMS ID.: Surface Water Integrated Monitoring System (SWIMS) identification number is the unique monitoring station identification number for the location of monitoring data.

TDP: Total Dissolved Phosphorus – an analyzed chemistry parameter collected in aquatic systems positively correlated with excess productivity and eutrophication in Wisconsin waters.

TMDL: Total Maximum Daily Load – a technical report required for impaired waters Clean Water Act. TMDLs identify sources, sinks and impairments associated with the pollutant causing documented impairments.

TP: Total Phosphorus - an analyzed chemical parameter collected in aquatic systems frequently positively correlated with excess productivity and eutrophication in many of Wisconsin's waters.

TWA: Targeted Watershed Assessment. A monitoring study design centered on catchments or watersheds that uses a blend of geometric study design and targeted site selection to gather baseline data and additional collection work for unique and site-specific concerns for complex environmental questions including effectiveness monitoring of management actions, evaluation surveys for site specific criteria or permits, protection projects, and generalized watershed planning studies.

TSS: Total suspended solids – an analyzed physical parameter collected in aquatic systems that is frequently positively correlated with excess productivity, reduced water clarity, reduced dissolved oxygen and degraded biological communities.

TWA: **Targeted Watershed Assessment.** A statewide study design involving a rotating watershed approach to gathering of baseline monitoring data with specialized targeted assessments for unique and site-specific concerns, such as effectiveness monitoring of management actions.

UWGB. University of Wisconsin Green Bay. One of the University of Wisconsin system campuses comma and active research and analysis partner with the Wisconsin Department of natural resources that actively pursues the causes of, tools for, and restoration of Total phosphorus and suspended solids which are pollutants of concern in the upper Fox Wolf and Lower Fox basins.

USGS. United States Geological Survey. This federal agency is charged with researching and documenting critical resources throughout the United States period the USGS actively monitors and develops condition reports for ambient and trend water, sediment, soil, and geological resources in the Fox River Basins.

WATERS ID.: The Waterbody Assessment, Tracking, and Electronic Reporting System Identification Code. The WATERS ID is a unique numerical sequence number assigned by the WATERS system, also known as "Assessment Unit ID code." This code is used to identify unique stream segments or lakes assessed and stored in the WATERS system.

WBIC: **Water Body Identification Code.** WDNR's unique identification codes assigned to water features in the state. The lines and information allow the user to execute spatial and tabular queries about the data, make maps, and perform flow analysis and network traces.

WSLH: Wisconsin State Laboratory of Hygiene– the state's certified laboratory that provides a wide range of analytical services including toxicology, chemistry, and data sharing.

WQC: Water quality criteria – a component of Wisconsin's water quality standards that provide numerical endpoints for specific chemical, physical, and biological constituents.

Water Quality Plan Goals

The overall goal of this plan is to improve and protect water quality in the basin. This Targeted Watershed Assessment monitoring project provided substantial data to analyze current conditions and to make recommendations for future management actions in the area. This plan is designed to present monitoring study results, identify issues or concerns in the area found during the project and to make recommendations to improve or protect water quality consistent with Clean Water Act guidelines and state water quality standards.

Resources Overview

Location and Size

Duck-Apple-Ashwaubenon Creek TWA project is located within two primary watersheds: Duck Creek (LF05) and Apple and Ashwaubenon (LF02). In the nested HUC System (see Figure 1), the project includes: Duck Creek Watershed (LF05) is 152 square miles with 62% located in Outagamie County and 38% in Brown County.

Approximately one-half of the watershed lies within the Oneida tribal boundaries; however, only a small portion of the land is under tribal ownership. One concentrated animal feeding operation is in the watershed; however, other nearby CAFOs may have agricultural lands in their nutrient management plans that lie within this watershed. A continuing trend in agriculture in the region has been the increase of field tile installation to increase production and improve yields in the watershed. There are two municipal point source discharges within the watershed from the *Freedom Sanitary District* discharging and *Oneida WWTF* to Duck Creek. One industrial point source discharger is in the watershed and four municipalities permitted under the Municipal Separate Storm Sewer permit (MS4).

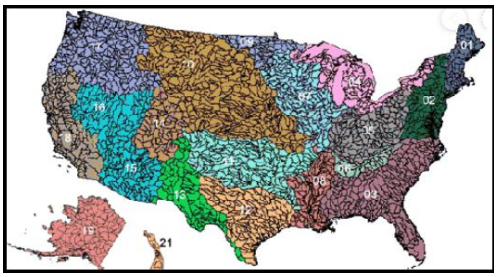
The Apple and Ashwaubenon Creek Watershed (LF02) is 113 mi^2 with 60% within Outagamie County and 40% in Brown County. Approximately 25% of the watershed lies within the Oneida Tribal boundaries; however, only a small portion of the land is under tribal ownership. There are 171 miles of named and unnamed streams in the watershed, all of which empty into the Fox River. Many intermittent tributaries discharge to Apple and Ashwaubenon Creeks and carry sediment and nutrients during runoff events. The headwaters are often dry in summer and agricultural setback and best management practices in relation to these are often lacking. With increasing demand for residential development, several stormwater ponds have been constructed online to these small headwater tributaries.

Hydrologic Unit Codes (HUCs)

HUC is an acronym for Hydrologic Unit Codes. HUCs identify drainage basins in the United States in a nested arrangement from largest (Regions) to smallest (Cataloging Units). A drainage basin is an area or region of land that catches precipitation that falls within that area and funnels it to a particular creek, stream, river until the water drains into an ocean. A drainage divide is the division between adjacent drainage basins.

Just as a creek or stream drains into a larger river, a drainage basin is nearly always part of a larger drainage basin. Drainage basins come in all shapes and sizes, with some only covering an area of a few acres while others are thousands of square miles across. Drainage basins cross artificial boundaries such as county, state, and international borders. The term watershed is often used in place of drainage basin.

The United States Geological Survey hierarchical system of "watersheds" which are called hydrologic units. Each unit assigned a unique Hydrologic Unit Code (HUC). As of 2020 there are six levels in the hierarchy, represented by hydrologic unit codes from 2 to 12 digits long, called regions, subregions, basins, subbasins, watersheds, and subwatersheds.



Courtesy of Idaho Department of Natural Resources.

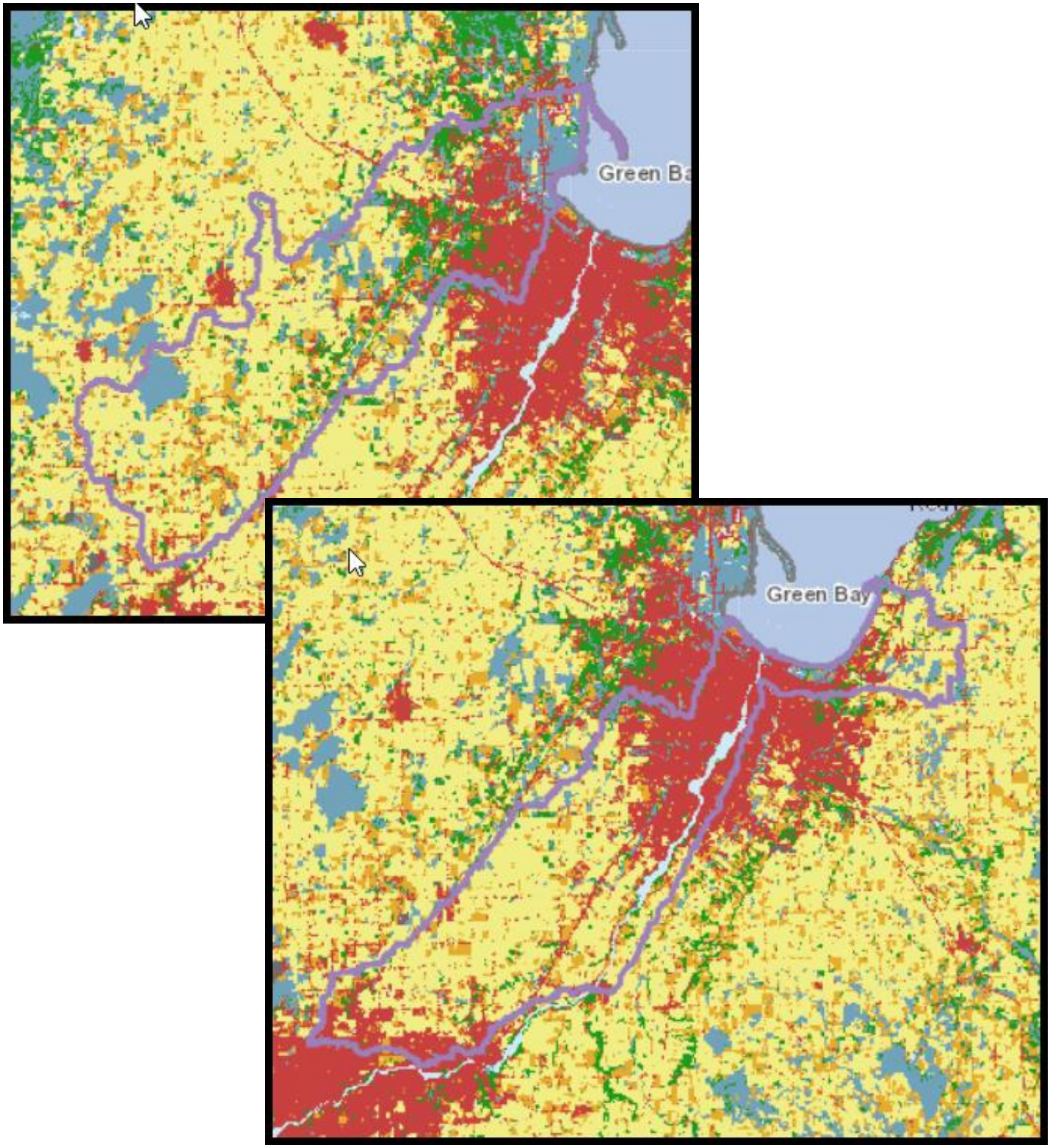
Population and Land Use

Land use in the Duck Creek Watershed (LF05) is predominately agricultural in the upstream portions with growing residential use in and near the Green Bay Metropolitan area. Land use in the Apple and Ashwaubenon Watershed (LF02) is primarily agriculture and residential, though industrial areas do exist in the urban areas of Green Bay and the north side of Appleton. Analysis of land use by watershed from WisLand2 (2016) indicates that **.....(Idk)**

Figure 2. Land Use in LR02 Watershed

Figure 3. Land Use in LR05 Watershed

Figure 4. Land use (Wiscland2 2016) in the Duck-Apple-Ashwaubenon Creek (DAA) TWA Project



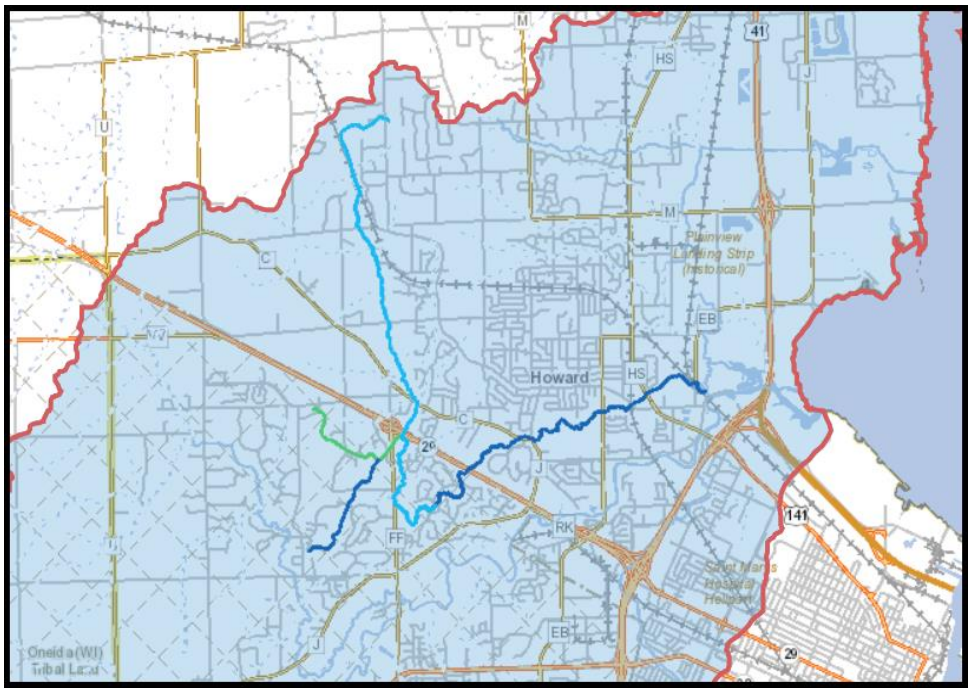
Trout Waters

DNR uses three categories to classify the different types of trout streams throughout Wisconsin. High quality trout waters (Class I) that have sufficient natural reproduction to sustain populations of wild trout, at or near carrying capacity. Consequently, streams in this category require no stocking of hatchery trout. Class II streams may have some natural reproduction, but not enough to utilize available food and space. Therefore, stocking is required to maintain a desirable sport fishery. Class III are marginal trout habitat with no natural reproduction occurring. Although currently Trout Creek and the Unnamed Tributary to Trout Creek at Shady Lane are unclassified trout waters, these streams have been documented to support a natural reproducing Brook Trout. Up until 2011, 3-year classes of trout have been captured in these two waterways following stocking and habitat improvements by the Oneida Nation. No trout were captured in 2015, and it is unclear at this time the fate of Brook Trout within these streams.

Table 1. Trout Waters in the Duck Creek (LF05) Watershed.
There are no classified trout waters in the Apple and Ashwaubenon watershed (LF02).

Watershed	Waterbody Name	WBIC	Start Mile	End Mile	Trout Class
LF05	Lancaster Creek	410000	0	4.61	CLASS III
LF05	Lancaster Creek	410000	4.61	10.9	CLASS II
LF05	Thornberry Creek	410050	0	1.43	CLASS I
LF05	Creek 13-4	3000354	0	1.35	CLASS III
LF05	Trout Creek	410200	0	12.77	Unclassified
LF05	Unnamed	5016644	0	1.04	Unclassified

Figure 5. Trout waters in the Duck Creek (LF05) Watershed.



Impaired Waters

Every two years, Section 303(d) of the Clean Water Act requires states to publish a list of all waters that do not meet water quality standards. The list, also known as the Impaired Waters List, is updated to reflect waters that are newly added or removed based on new information. Impaired waters in this watershed are impaired for historical discharges, mine tailings, and runoff issues. The listed impaired waters in these watersheds result from nonpoint sources, atmospheric deposition, and livestock (grazing or feeding). Pollutants include total phosphorus, PCBs, mercury, total suspended solids.

Table 2. Impaired Waters in the DAA TWA Project.

Watershed	Local Name	WBIC	Start Mile	End Mile (acres)	Pollutant	Impairment	303 Status	Sources
LF01	Ashwaubenon Creek Ashwaubenon Creek	122200	0	14.15	Total Phosphorus	Low DO	TMDL Approved	*Livestock (Grazing or Feeding Operations), Site Clearance (Land Development or Redevelopment) Animal Feeding Operations (NPS), Nonpoint Source (Rural or Urban), Discharges MS4s, Non-Irrigated crop production, post-development erosion and sedimentation*
		122200	0	14.15	Sediment/Total Suspended Solids	Degraded Habitat	TMDL Approved	
LF01	Apple Creek	124100	0	3.99	Total Phosphorus	Low DO	TMDL Approved	*Site Clearance (Land Development or Redevelopment), Livestock (Grazing or Feeding Operations), Channelization, Non-Point Source (Rural or Urban), Discharges from Municipal Separate Storm Sewer Systems (MS4), Loss of Riparian Habitat, Post-development Erosion and Sedimentation*
		124100	0	3.99	Sediment/Total Suspended Solids	Elevated Water Temperature, Degraded Habitat	TMDL Approved	
LF02		124100	3.99	23.88	Total Phosphorus	Low DO	TMDL Approved	
		124100	3.99	23.88	Sediment/Total Suspended Solids	Elevated Water Temperature, Degraded Habitat	TMDL Approved	
LF02	Dutchman Creek	121600	0	4.04	Total Phosphorus	Low DO, Degraded Biological Community	TMDL Approved	*Site Clearance (Land Development or Redevelopment), Livestock (Grazing or Feeding Operations), Animal Feeding Operations (NPS), Non-Point Source (Rural or Urban), Discharges from Municipal Separate Storm Sewer Systems (MS4), Non-irrigated Crop Production, Post-development Erosion and Sedimentation*
		121600	0	4.04	Ammonia (Unionized) - Toxin	Chronic Aquatic Toxicity	303d Listed	
		121600	4.06	16.03	Ammonia (Unionized) - Toxin	Chronic Aquatic Toxicity	Water Delisted	
		121600	16.05	17.97	Ammonia (Unionized) - Toxin	Chronic Aquatic Toxicity	303d Listed	
		121600	16.05	17.97	Total Phosphorus	Low DO	TMDL Approved	
LF02	Lower Fox River (DePere Dam to Middle Appleton Dam)	117900	7.39	32.18	Total Phosphorus	Low DO	TMDL Approved	*Industrial Point Source Discharge, Contaminated Sediments, Non-Point Source (Rural or Urban), Discharges from Municipal Separate Storm Sewer Systems (MS4)*
		117900	7.39	32.18	PCBs	Contaminated Fish Tissue	EAP Project	
LF05	Duck Creek	409700	0	4.96	Total Phosphorus	Low DO	TMDL Approved	*Non-Point Source (Rural or Urban), Atmospheric Deposition - Toxics*
		409700	0	4.96	Sediment/Total Suspended Solids	Degraded Habitat	TMDL Approved	
		409700	0	4.96	Mercury	Contaminated Fish Tissue	303d Listed	
		409700	4.96	25.69	Total Phosphorus	Low DO	Pollutant Removed	*Non-Point Source (Rural or Urban)*
		409700	4.96	25.69	Sediment/Total Suspended Solids	Low DO, Degraded Habitat	Pollutant Removed	
		409700	25.69	32.9	Total Phosphorus	Low DO	TMDL Approved	*Non-Point Source (Rural or Urban), Atmospheric Deposition – Toxics*
	Duck Creek	409700	25.69	32.9	Sediment/Total Suspended Solids	Degraded Habitat	TMDL Approved	
		409700	25.69	32.9	Mercury	Contaminated Fish Tissue	303d Listed	
LF05	Trout Creek	410200	0	12.77	Total Phosphorus	Sediment/Total Suspended Solids	Pollutant Removed	*Sediment/Total Suspended Solids*
LF05		410200	0	12.77	Sediment/Total Suspended Solids	Sediment/Total Suspended Solids	Pollutant Removed	

Watershed	Local Name	WBIC	Start Mile	End Mile (acres)	Pollutant	Impairment	303 Status	Sources
LF05	Green Bay (Inner Bay, AOC)	70			Total Phosphorus	Low DO	TMDL Approved	*Contaminated Sediments, Discharges from Municipal Separate Storm Sewer Systems (MS4)*
		70			PCBs	Contaminated Fish Tissue, Contaminated Sediment	303d Listed	
		70			Sediment/Total Suspended Solids	Degraded Habitat	TMDL Approved	
	Green Bay (GL Shoreline)	70			PCBs	Contaminated Fish Tissue	303d Listed	

Monitoring Project

Purpose

Eastern District staff conducted an evaluation of water quality conditions within the Duck-Apple-Ashwaubenon Creek watersheds in accordance with the Clean Water Act Section 319 evaluation monitoring project guidance. These watersheds are contained within Brown and Outagamie Counties. In the 1996 the Duck, Apple, and Ashwaubenon Creek Priority Watershed Plan was approved for nonpoint source control activities. To adequately evaluate the success of best management practices installed in these watersheds, a detailed and intensive pre- and post- monitoring schedule should have been developed to collect adequate information that could demonstrate in-stream water quality improvements. The initial watershed inventory was adequate to identify stressors and impairments but was broad in nature. To focus on the effectiveness of installed best management practices, new monitoring stations were selected near those practices that would provide a contemporary condition assessment of stream reaches that correlate with upland best management practices.

As part of a larger effort in the Duck-Apple-Ashwaubenon Targeted Watershed Assessment, forty-four (44) habitat and water quality sites were evaluated to document current condition and determine if the 1996 priority watershed project objectives were met. This project is a collaborative effort between DNR district staff, DNR central office, county staff, the Oneida Nation, UW-GB, and Fox Valley Technical College to determine an effective approach to assess water quality improvements within the watersheds that can be attributed to installation of conservation practices installed in the watershed.

Site Selection and Study Design

The targeted watershed approach study design was used for this project. The major focal point for this design was to target sub-watershed pour points and main tributary locations. In addition, a focused site selection effort was used to evaluate hard structural BMP's that have been installed in the watershed under the Priority Watershed Project. Areas of known BMP installations were provided by the County partners to aid in efforts of site selection. Sites were selected so data was not biased toward stream order or natural community; but were targeted based on access and the desire to have a representative station in a particular reach. Sites with historical data that could provide pre- and post- BMP implementation comparisons were targeted and often times fell within the desired locations applicable for the TWA design (Table 3, Figure 6).

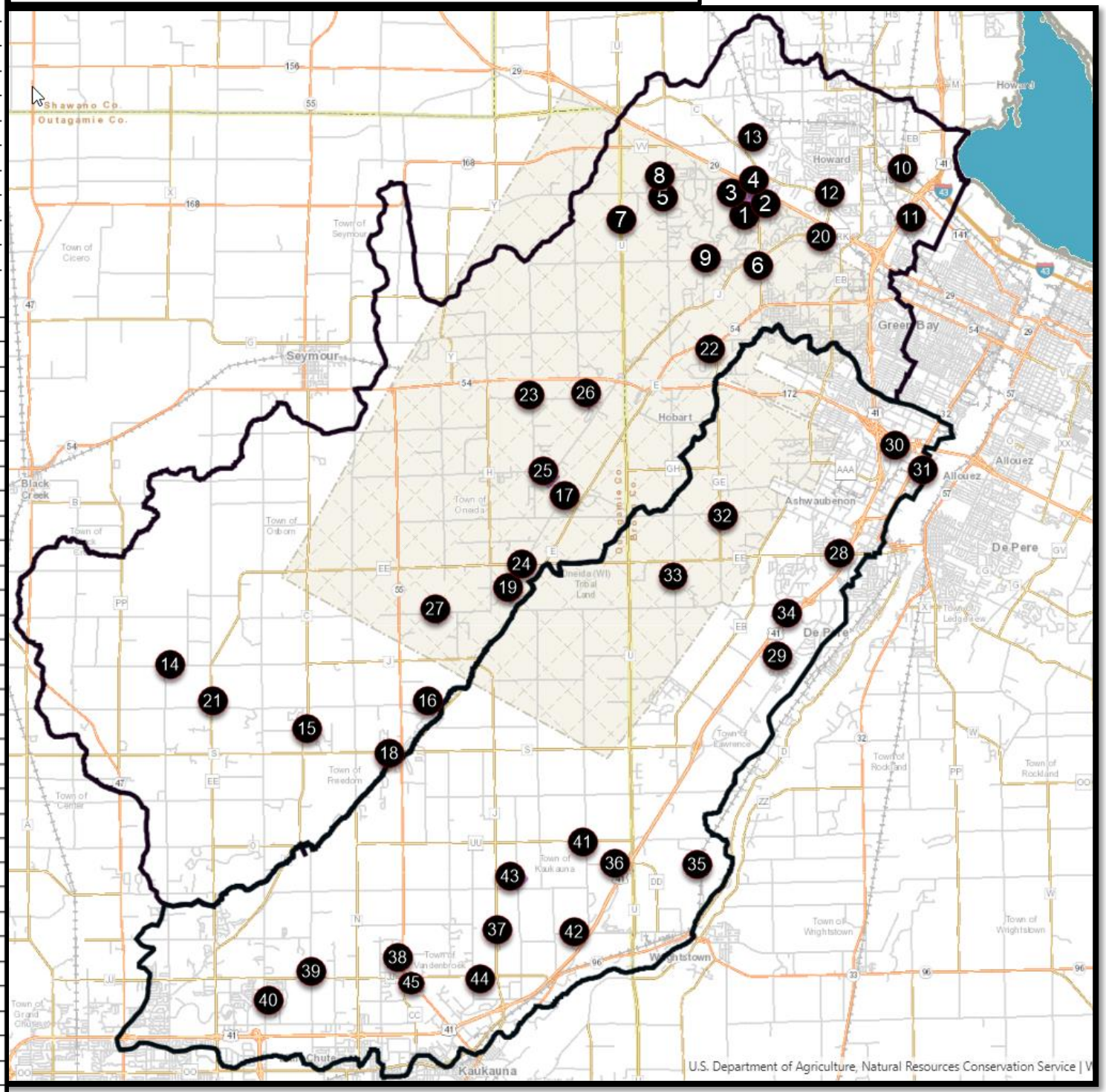
Table 3. Monitoring Stations in the DAA TWA Project.

Map Site	Station	Station Name	AU	Fish	Habitat	Macro	Diatoms	Water Chem (TP, DOP, TSS)	Temp
1	10043684	UNT to Thornberry Creek - Hill Drive	903760	X	X	X			X
2	10008261	Lancaster Creek - Navajo Trail	903720	X	X				X
3	10008267	Thornberry Creek - Forest Drive	903740	X	X				X
4	10043700	Thornberry Creek - CTH FF	903740	X	X	X			X
5	10008254	Trout Creek - Overland Road	10853	X	X				X
6	53037	Trout Creek - CTH FF	10853	X	X			TP	
7	453281	Trout Creek - CTH U	10853	X	X	X			X
8	10044071	UNT to Trout Creek - Shady Drive	6853719	X	X	X			
9	53694	Trout Creek-Trout Creek Drive	10853	X	X				X
10	10034510	Lancaster-Lakeview Drive	903700	X	X	X		TP, DOP, TSS	
11	10034514	Beaver Dam Creek- Memorial Drive	10852	X	X	X		TP	
12	10015722	Lancaster Creek - Shawano Ave	903700	X	X				

Map Site	Station	Station Name	AU	Fish	Habitat	Macro	Diatoms	Water Chem (TP, DOP, TSS)	Temp
13	10008262	Lancaster Creek - Evergreen Drive	903720	X	X	X			X
14	10044062	Duck Creek - Krueger Road	3884932	X	X	X			
15	10043984	Duck Creek - CTH C	10851	X	X				
16	453006	Duck Creek - Center Valley Road	10851	X	X				X
17	453255	Duck Creek - Seminary Rd	1487955	X	X	X			X
18	10020717	Duck Creek - CTH S	10851	X	X	X		TP	
19	10020873	Duck Creek - Tip Road	1487955	X	X	X			X
20	10038644	Duck Creek-Pamperin Park	10850	X	X	X	X	TP, DOP, TSS	
21	10015591	Duck Creek - CTH EE	3884932	X	X	X			
22	10044061	Silver Creek -STH 54	3994450	X	X	X			
23	10044060	UNT to Duck Creek - Old Seymour Road	6853613	X	X	X			
24	10043928	UNT to Duck Creek - Lambie Road	6853539	X	X	X			
25	10043935	UNT to Duck Creek - Ranch Road	6853613	X	X	X			
26	10044059	UNT to Duck Creek - Old Seymour Road	6853687	X	X	X			
27	10043929	UNT to Duck Creek - Ray Road	6853571	X	X	X			
28	10016502	Ashwaubenon Creek - Grant Street	10834	X	X	X	X	TP, DOP, TSS	X
29	10007874	Ashwaubenon Creek- Creamery Road	10834	X	X	X			
30	10015851	Dutchmans Creek - Oneida Street	10832	X	X	X	X	TP, DOP, TSS	X
31	53696	Dutchmans Creek- Cyrus Lane	10833					TP	
32	10043905	Dutchman Creek - Pine Tree Road	10833	X	X	X			X
33	10043897	Dutchman Creek - Overland Rd	10833	X	X				
34	10043793	Hemlock Creek - Sand Acres Drive	10835	X	X	X			
35	53684	Apple Creek - Rosin Road	313933	X	X	X	X	TP, DOP, TSS	X
36	10044012	Apple Creek - Garrity Road	10839	X	X	X			
37	10020830	Apple Creek CTH J	10839	X	X	X		TP	
38	453256	Apple Creek - STH 55	10839	X	X	X			
39	10044064	Apple Creek - Holland Road	10839	X	X	X			X
40	10044065	Apple Creek - French Road	10839	X	X				
41	10044070	UNT to Apple Creek - McCabe Road	5690705	X	X	X			
42	10044069	UNT to Apple Creek - Wrightstown Road	5690673	X	X	X			
43	10044068	UNT to Apple Creek - Farrell Road	5690705	X	X	X			
44	10044067	UNT to Apple Creek - CTH JJ	5690638	X	X	X			
45	10044066	UNT to Apple Creek - STH 55	5690601	X	X	X			

Map Site	Station	Station Name
1	10043684	UNT to Thornberry Creek - Hill Drive
2	10008261	Lancaster Creek - Navajo Trail
3	10008267	Thornberry Creek - Forest Drive
4	10043700	Thornberry Creek - CTH FF
5	10008254	Trout Creek - Overland Road
6	53037	Trout Creek - CTH FF
7	453281	Trout Creek - CTH U
8	10044071	UNT to Trout Creek - Shady Drive
9	53694	Trout Creek-Trout Creek Drive
10	10034510	Lancaster-Lakeview Drive
11	10034514	Beaver Dam Creek- Memorial Drive
12	10015722	Lancaster Creek - Shawano Ave
13	10008262	Lancaster Creek - Evergreen Drive
14	10044062	Duck Creek - Krueger Road
15	10043984	Duck Creek - CTH C
16	453006	Duck Creek - Center Valley Road
17	453255	Duck Creek - Seminary Rd
18	10020717	Duck Creek - CTH S
19	10020873	Duck Creek - Tip Road
20	10038644	Duck Creek-Pamperin Park
21	10015591	Duck Creek - CTH EE
22	10044061	Silver Creek -STH 54
23	10044060	UNT to Duck Creek - Old Seymour Road
24	10043928	UNT to Duck Creek - Lambie Road
25	10043935	UNT to Duck Creek - Ranch Road
26	10044059	UNT to Duck Creek - Old Seymour Road
27	10043929	UNT to Duck Creek - Ray Road
28	10016502	Ashwaubenon Creek - Grant Street
29	10007874	Ashwaubenon Creek- Creamery Road
30	10015851	Dutchmans Creek - Oneida Street
31	53696	Dutchmans Creek- Cyrus Lane
32	10043905	Dutchman Creek - Pine Tree Road
33	10043897	Dutchman Creek - Overland Rd
34	10043793	Hemlock Creek - Sand Acres Drive
35	53684	Apple Creek - Rosin Road
36	10044012	Apple Creek - Garrity Road
37	10020830	Apple Creek CTH J
38	453256	Apple Creek - STH 55
39	10044064	Apple Creek - Holland Road
40	10044065	Apple Creek - French Road
41	10044070	UNT to Apple Creek - McCabe Road
42	10044069	UNT to Apple Creek - Wrightstown Road
43	10044068	UNT to Apple Creek - Farrell Road
44	10044067	UNT to Apple Creek - CTH JJ
45	10044066	UNT to Apple Creek - STH 55

Figure 6. Monitoring Stations in the Duck-Apple-Ashwaubenon Creek (DAA) TWA Project



Methods, Equipment and Quality Assurance

Collection of water chemistry samples, continuous water temperatures, quantitative habitat, fish, and aquatic macroinvertebrates used standard DNR data collection methods and samples were sent to certified laboratories in the state for specific analysis. No specific in-field duplicates, replicates or blanks were collected for the study; however quality assurance sampling procedures were used in the collection and preservation of samples for all parameters.

Fish Assemblage

The fisheries assemblage was determined by a quantitative survey involving electroshocking a section of stream with a minimum station length of 35 times the mean stream width (Lyons, 1992). All fish were collected, identified, and counted. All gamefish were measured for length. All other DNR sampling protocols were used to assess the fish community for purposes of calculating the index of biotic integrity. DNR staff entered the fish data into the DNR Fisheries Database.

Habitat Evaluation

Habitat was evaluated throughout each fish survey station. Quantitative habitat survey station lengths were 35 times the mean stream width of the survey station. Following the determination of station length, the station was divided into 12 transects. At each transect, substrate, sedimentation, erosion, water depth, and riparian land use data were collected. DNR staff entered the quantitative habitat data into the DNR Fisheries and Habitat Management Database (FHMD).

Macroinvertebrate Evaluation

All sites were sampled using the DNR Guidelines for Collecting Macroinvertebrate Samples from Wadable Streams (2000). A D-shaped kick net with 600-micron mesh was used at all sites by standing upstream from the net and placing it firmly on the stream bed while digging into the substrate with the heel or toe to free the macroinvertebrates from the substrate. Riffles were targeted at each of the sites, but if none were present then overhanging vegetation, woody debris, or other vegetation would be sampled. For a representative sample of the aquatic macroinvertebrate community, a minimum of 100 aquatic macroinvertebrates collected in each sample was targeted. The aquatic macroinvertebrates were preserved in a 70-80% ethanol solution inside quart “Mason” jars. If necessary, multiple “Mason” jars were used per sample depending upon how much sediment and organic material was collected with the aquatic macroinvertebrates. Within the next 24 hours, the samples were re-preserved with another 70-80% ethanol solution. Samples were taken to the University of Wisconsin-Stevens Point Aquatic Entomology Laboratory (UWSP AEL) for lowest possible taxonomic identification. Staff at the UWSP AEL entered the data into the SWIMS database upon final taxonomic identification.

Water Chemistry Sampling

Water chemistry samples were collected by water action volunteers associated with the Lower Fox River Citizen Monitoring project funded through a GLRI-AOC grant managed by Fox Valley Technical College. Sample locations were selected at specific pour point locations within the Duck-Apple-Ashwaubenon Creek Watersheds. Standard DNR grab sampling methods were used to collect Total Phosphorous, Total Suspended Solids, and Dissolved Ortho-Phosphorous during the growing season in 2015 (Table 4). All samples were shipped to Wisconsin State Laboratory of Hygiene (WISLOH) for analysis. The WISLOH entered all sample analysis data into the Surface Water Integrated Monitoring System (SWIMS) database.

Continuous Temperature

Onset continuous temperature loggers were placed in 16 sites in 2015 and collected water temperature readings at 1-hour intervals to ascertain daily maximum average temperatures throughout the summer, approximately May through October.

Diatom Sampling

Diatom samples were collected at four sites following the diatom sampling in wadeable streams protocol. This provided the calculation of a Diatom Phosphorous Index with an inferred Total Phosphorous concentration for the waterway.

Study Results

Total Phosphorus, Dissolved Ortho-Phosphorous, Total Suspended Solids

All inorganic chemistry samples were sent to the WISLOH in Madison for analysis. Nine of the ten streams segments sampled in this project had an average TP concentration (mg/L) exceeding the NR 102 water quality criteria (WQC) for streams of 0.075 mg/L (Table 4). Wisconsin’s assessment methodology[1] requires a parametric statistical approach to assess stream TP data against the applicable water quality criterion found in NR 102. This approach involves the calculation of a 90% confidence limit around the median of a TP sample dataset. If the ***lower 90% confidence limit (LCL)*** exceeds the criterion for TP, then that segment (assessment unit) is considered exceeding the criterion. The LCLs were calculated for each stream TP samples (Table 4). Seven of the stream stations calculated LCLs exceeded the water quality criterion for TP (Figure 7). Dissolved Ortho-Phosphorous and Total Suspended Solids samples were collected at five stations. A few sample events were missed at these locations so a completed monthly comparison cannot be shown. Dissolved Ortho-Phosphorous was extremely high in Apple, Dutchmans, and Ashwaubenon Creeks even though only half the sampling months were represented. Dissolved Ortho- Phosphorous represents on average 50-75% of the overall Total Phosphorous concentrations observed. Growing season averages for Total Suspended Solids were near the general Lower Fox River TMDL target goal of 20 mg/L with the exception of Ashwaubenon Creek which was four times greater.

[1] *Consolidated Assessment and Listing Methodology (WisCALM 2018)*

Table 4. Total Phosphorous (mg/L) in the DAA TWA Project, 2015.

Swims Station	Waterbody Name	May	June	July	Aug.	Sept.	Oct.	Mean	Median	Lower 90% Median	Upper 90% Median
53684	Apple Cr - Rosin Rd	0.34	0.268	0.354	0.278	0.199	0.224	0.277	0.273	0.237	0.311
10020830	Apple Cr-CTH J	0.358	0.252	0.33	0.215	0.207	0.249	0.269	0.251	0.23	0.301
10015851	Dutchman's Cr- Oneida St	0.547	0.231	0.306	-	-	-	0.361	0.306	0.21	0.545
53696	Dutchman - Cyprus	0.177	0.305	0.626	1.32	0.591	0.309	0.555	0.427	0.293	0.687
10016502	Ashwaubenon Cr - Grant St	0.513	0.435	0.472	0.226	0.258	0.259	0.361	0.336	0.275	0.425
10034510	Lancaster Cr-Lakeview Dr	0.0538	0.086	0.128	-	-	-	0.089	0.086	0.052	0.135
10038644	Duck Cr-Pamperin Park	0.094	0.314	0.172	0.122	0.159	0.0967	0.160	0.139	0.111	0.191
10020717	Duck Creek-CTH S	0.95	0.223	0.44	0.406	0.224	0.248	0.415	0.317	0.255	0.503
10041583	Trout Creek-CTH FF	0.0351	0.302	0.138	0.0766	0.0976	0.055	0.117	0.086	0.058	0.144
10034514	Beaver Dam Creek - Memorial	0.075	0.0611	0.078	0.044	0.0495	0.138	0.074	0.068	0.054	0.088

Table 5. Total Suspended Solids (mg/L) in the DAA TWA Project, 2015.

Swims Station	Waterbody Name	May	June	July	August	September	October	Mean
53684	Apple Creek - Rosin Rd	61	4.4	11.4	17.4	8.75	7.8	18.5
10015851	Dutchman's Creek - Oneida St	75.3	15	153	-	-	-	81.1
10016502	Ashwaubenon Creek - Grant St	-	26.7	17.3	20.6	17.2	19.45	20.3
10034510	Lancaster Creek-Lakeview Dr	11.3	18	31	-	-	-	20.1
10038644	Duck Creek-Pamperin Park	7.2	61.6	13.4	11.7	11.3	4.75	18.3

Table 6. Dissolved Ortho-Phosphorus (mg/L) in the DAA TWA Project, 2015.

Swims Station	Waterbody Name	May	June	July	August	September	October	Mean
53684	Apple Creek - Rosin Rd	0.160	0.180	0.270	0.201	0.139	0.182	0.189
10015851	Dutchman's Creek - Oneida St	0.084	0.176	0.193	-	-	-	0.151
10016502	Ashwaubenon Creek - Grant St	-	0.221	0.306	0.128	0.126	0.203	0.197
10034510	Lancaster Creek-Lakeview Dr	0.018	0.043	0.064	-	-	-	0.042
10038644	Duck Creek-Pamperin Park	0.043	0.141	0.091	0.074	0.111	0.047	0.084

Figure 7. Station TP mg/l concentrations and TP standard (75 ug/l) in the DAA TWA Project.

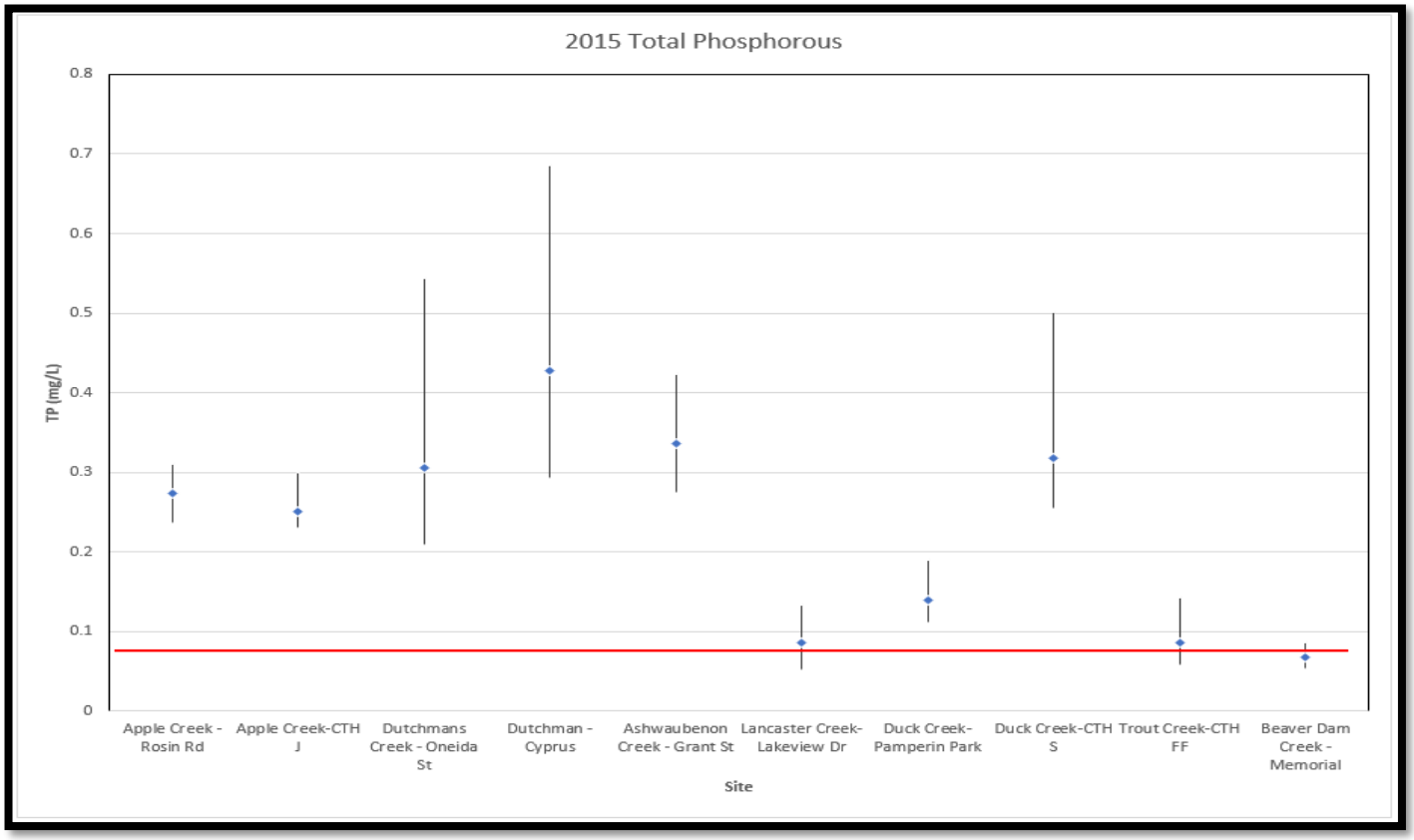


Figure 8. Ashwaubenon Creek at Grant TP, DOP, and TSS concentrations in the DAA TWA Project.

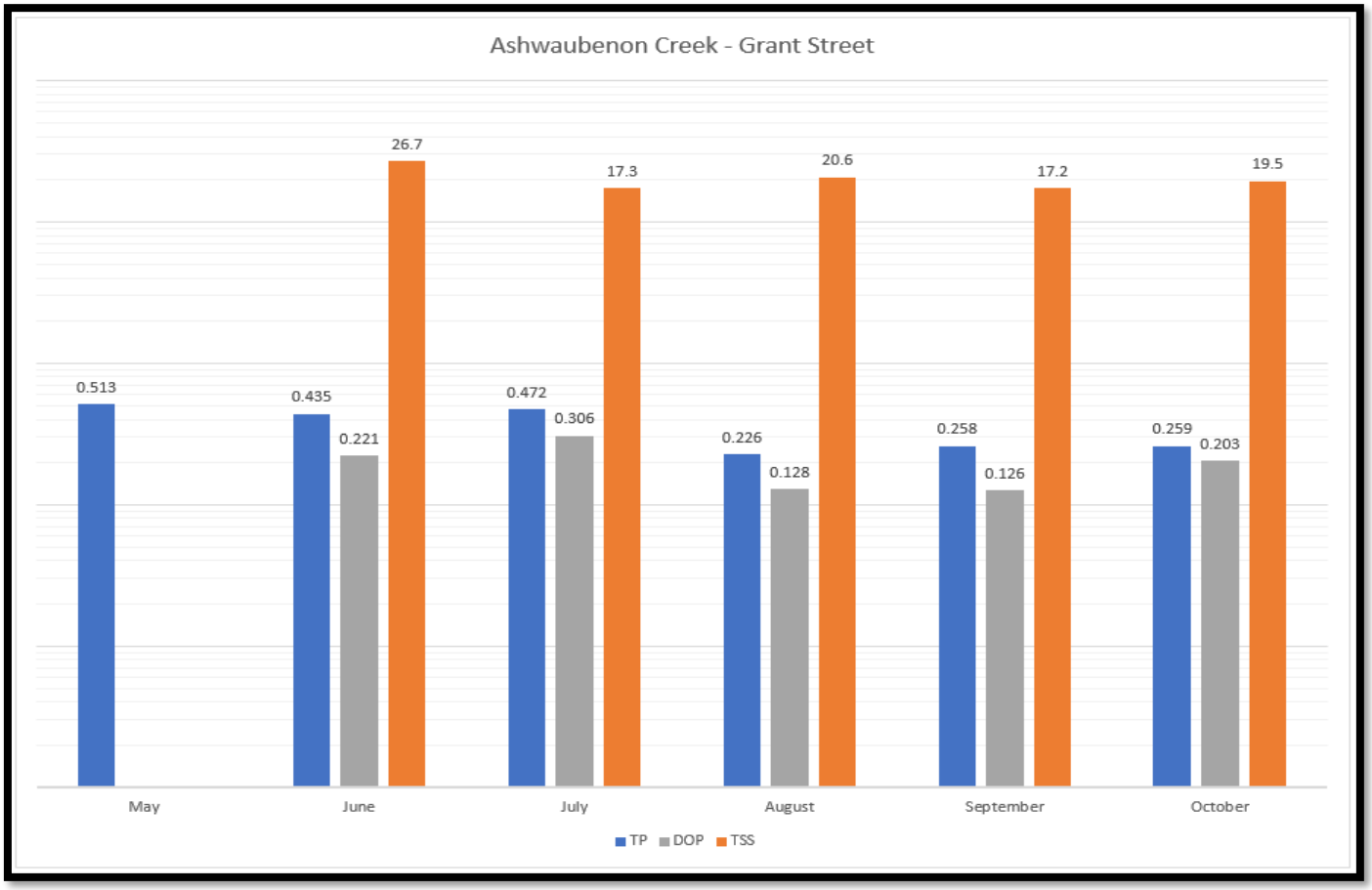


Figure 9. Dutchman's Creek at Oneida Street TP, DOP, and TSS concentrations in the DAA TWA Project.

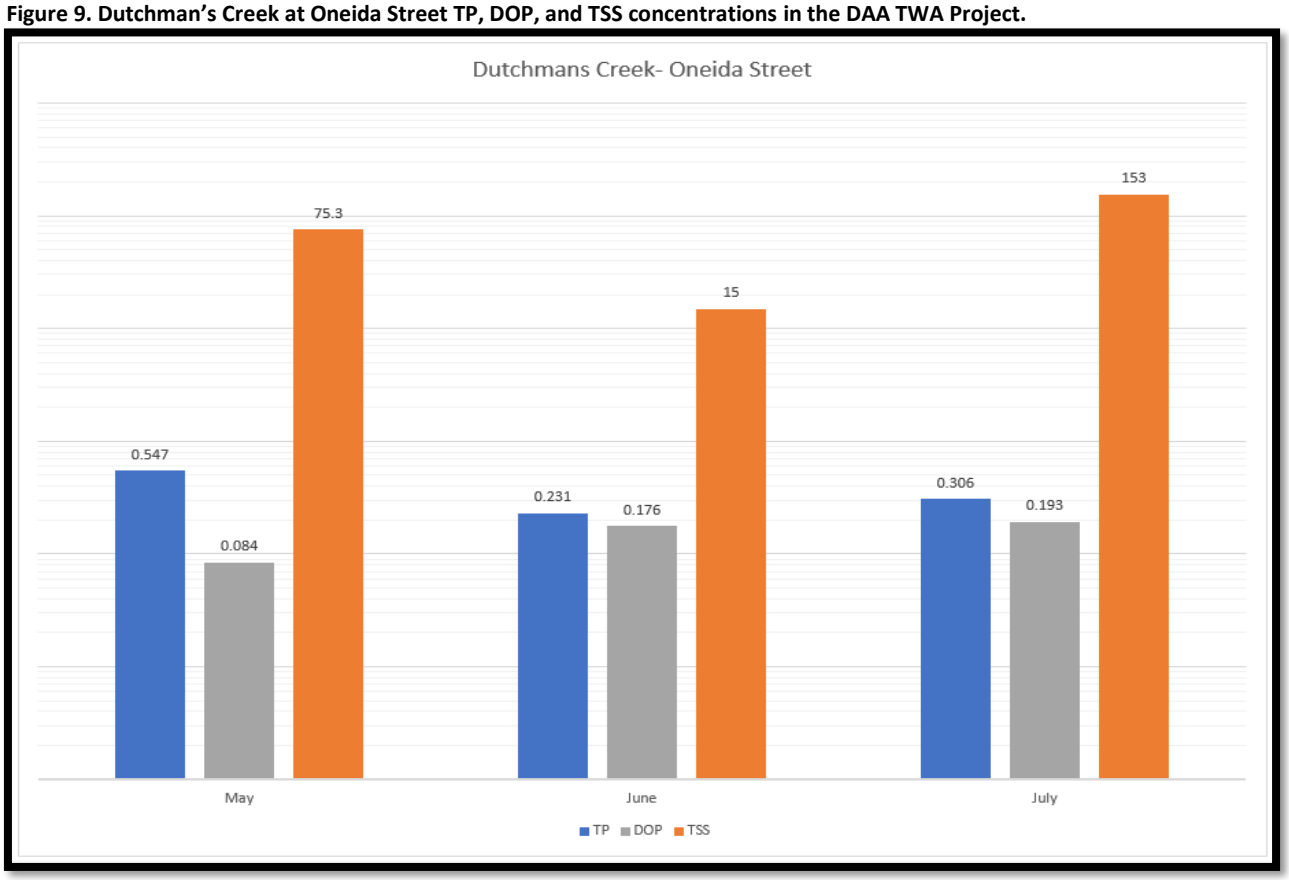


Figure 10. Apple Creek at Rosin Road TP, DOP, and TSS concentrations in the DAA TWA Project.

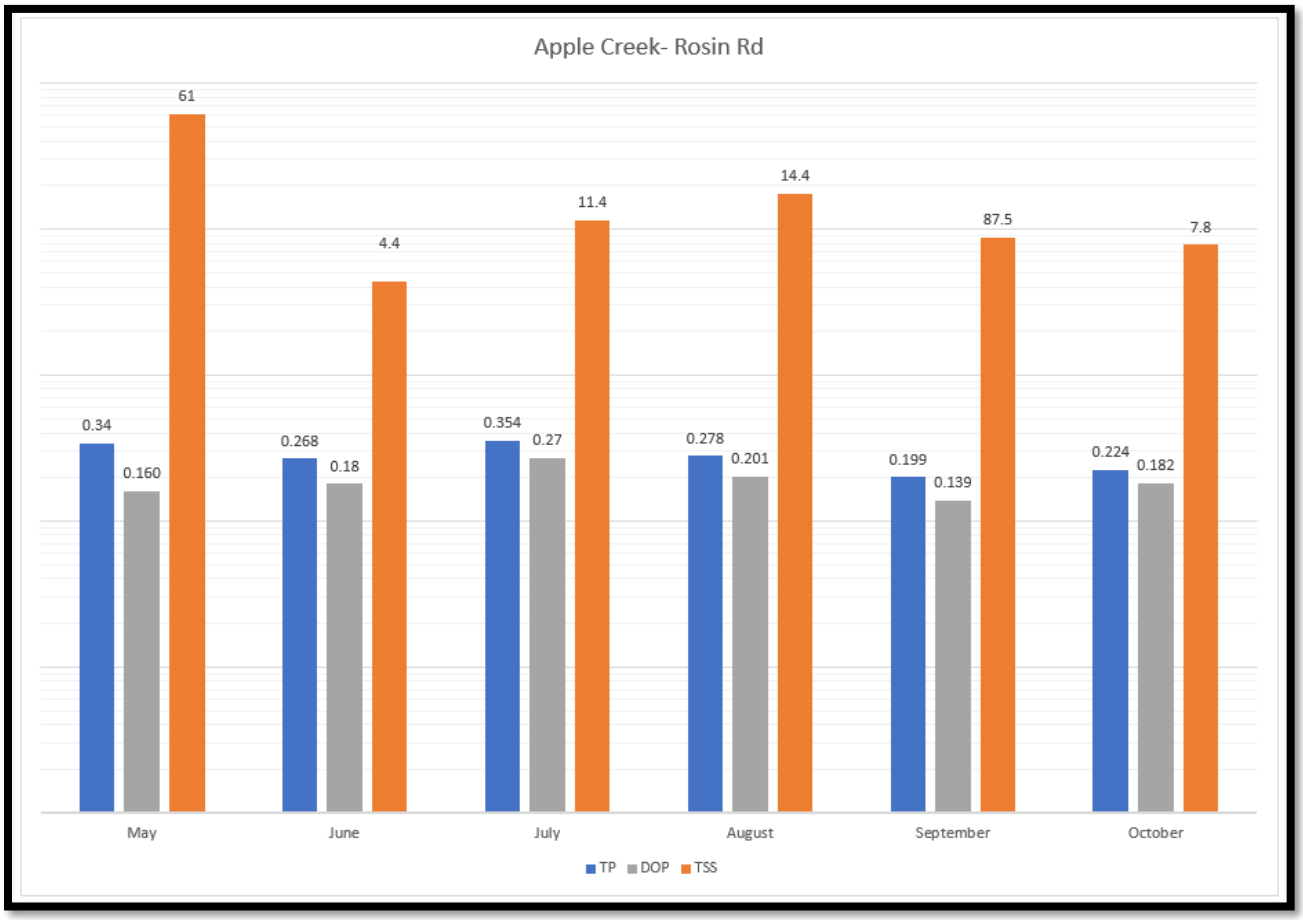


Figure 11. Lancaster Creek at Lakeview Drive TP, DOP, and TSS concentrations in the DAA TWA Project.

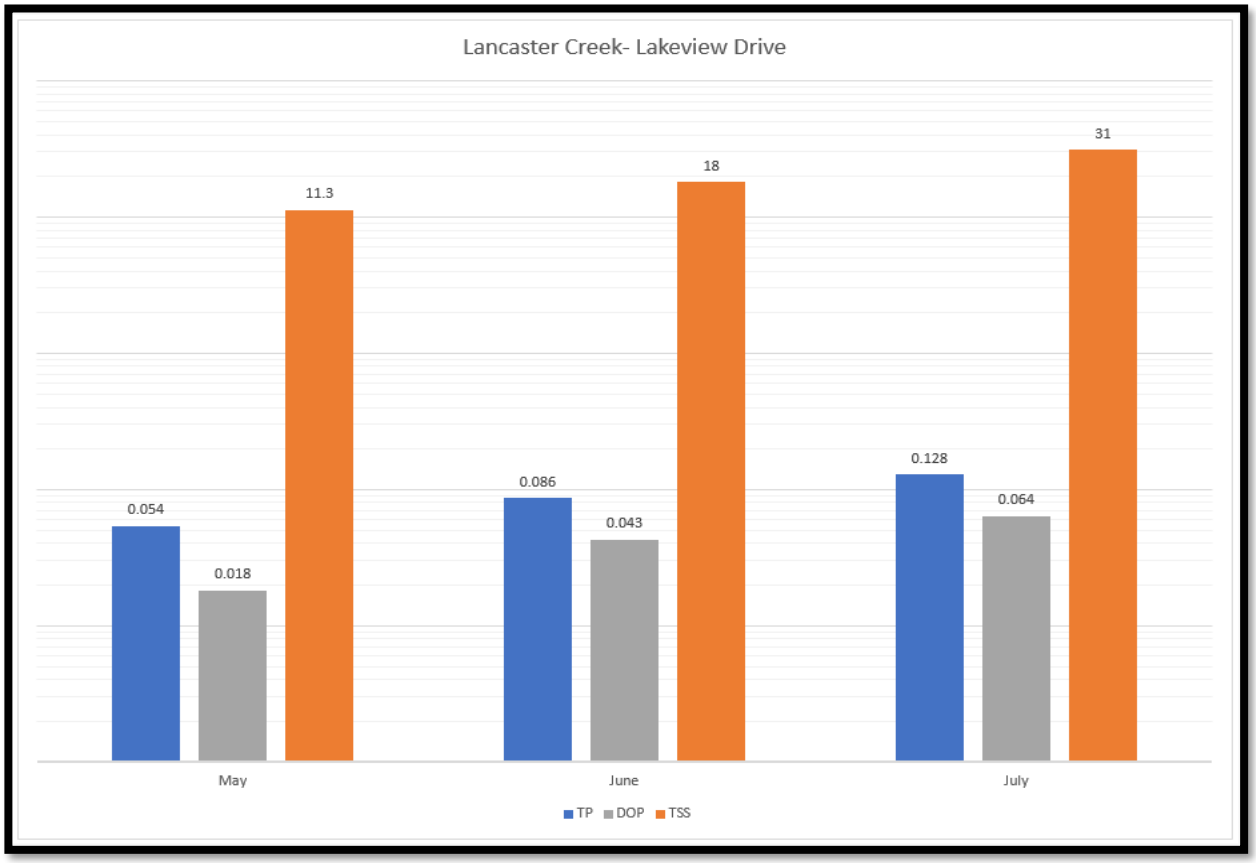
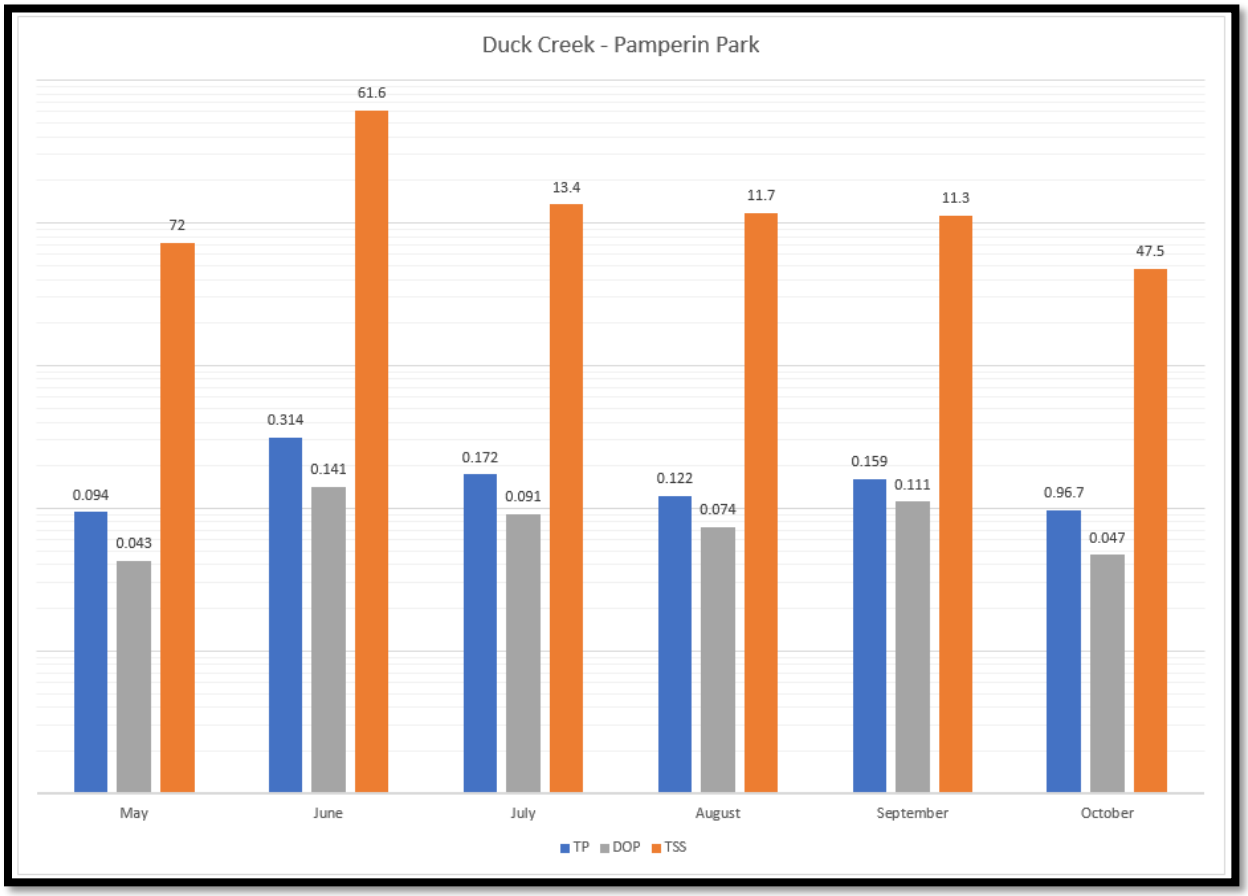


Figure 12. Duck Creek at Pamperin Park TP, DOP, and TSS concentrations in the DAA TWA Project.



Continuous Water Temperature

Continuous water temperature loggers were placed at 16 sites in the watershed to record 1-hour intervals to assess water temperatures to compared to modeled natural community thermal regime. The datasets are compared to daily max temperatures for impairment decisions. See Figure 13 below and Appendix C for Continuous Temperature graphics.

Table 7. Continuous Water Temperature Stations

Map Site	Station	Station Name	WBIC	AU
1	10043684	UNT to Thornberry Creek - Hill Drive	3000354	903760
2	10008261	Lancaster Creek - Navajo Trail	410000	903720
3	10008267	Thornberry Creek - Forest Drive	410050	903740
4	10043700	Thornberry Creek - CTH FF	410050	903740
5	10008254	Trout Creek - Overland Road	410200	10853
6	53694	Trout Creek-Trout Creek Drive	410200	10853
7	453281	Trout Creek - CTH U	410200	10853
13	10008262	Lancaster Creek - Evergreen Drive	410000	903720
16	453006	Duck Creek - Center Valley Road	409700	10851
17	453255	Duck Creek - Seminary Rd	409700	1487955
19	10020873	Duck Creek - Tip Road	409700	1487955
28	10016502	Ashwaubenon Creek - Grant Street	122200	10834
30	10015851	Dutchman's Creek - Oneida Street	121600	10832
32	10043905	Dutchman Creek - Pine Tree Road	121600	10833
35	53684	Apple Creek - Rosin Road	124100	313933
39	10044064	Apple Creek - Holland Road	124100	10839

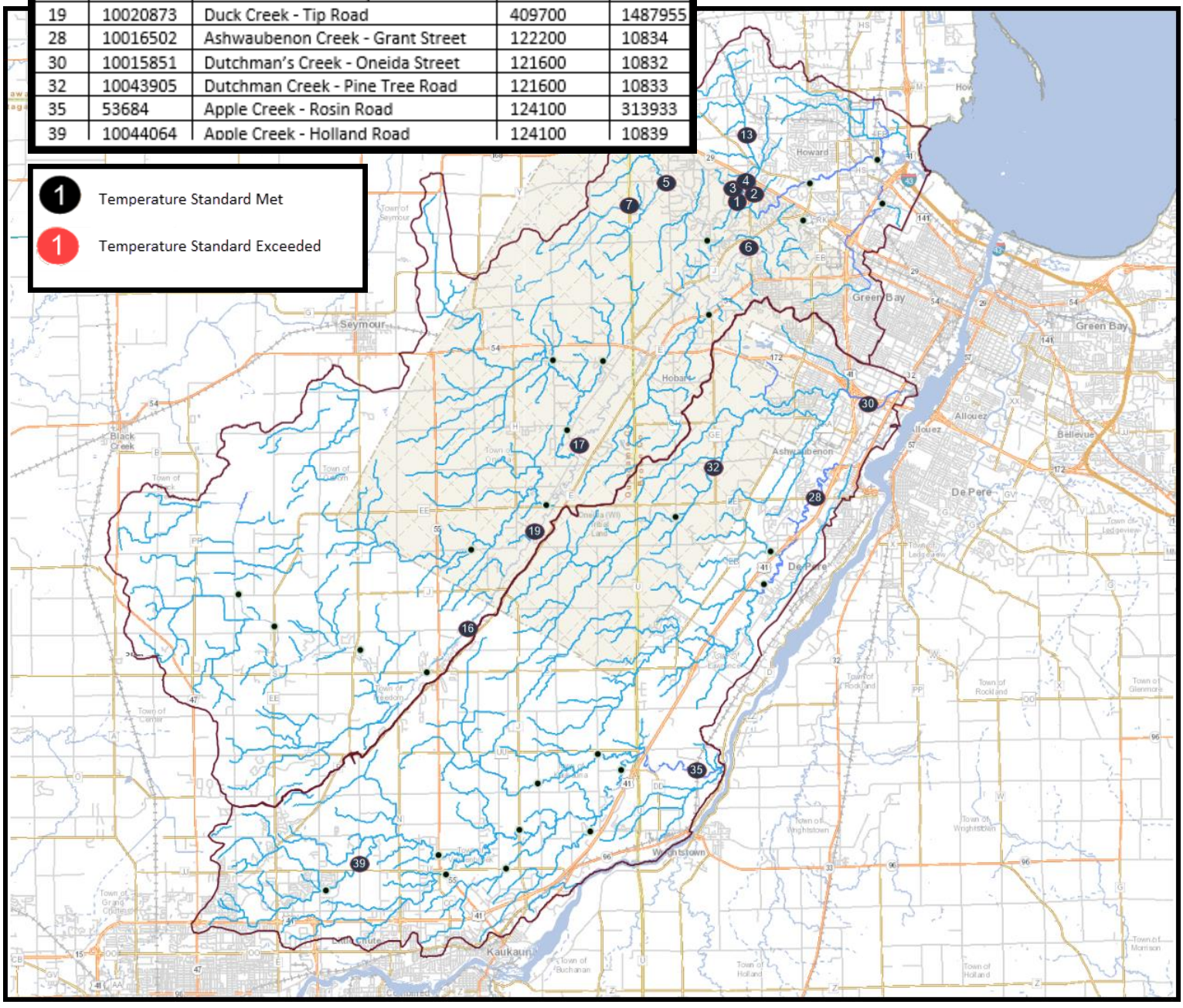


Figure 13. Continuous Temperature Data and WisCALM Thresholds (2018) in the DAA TWA Project.

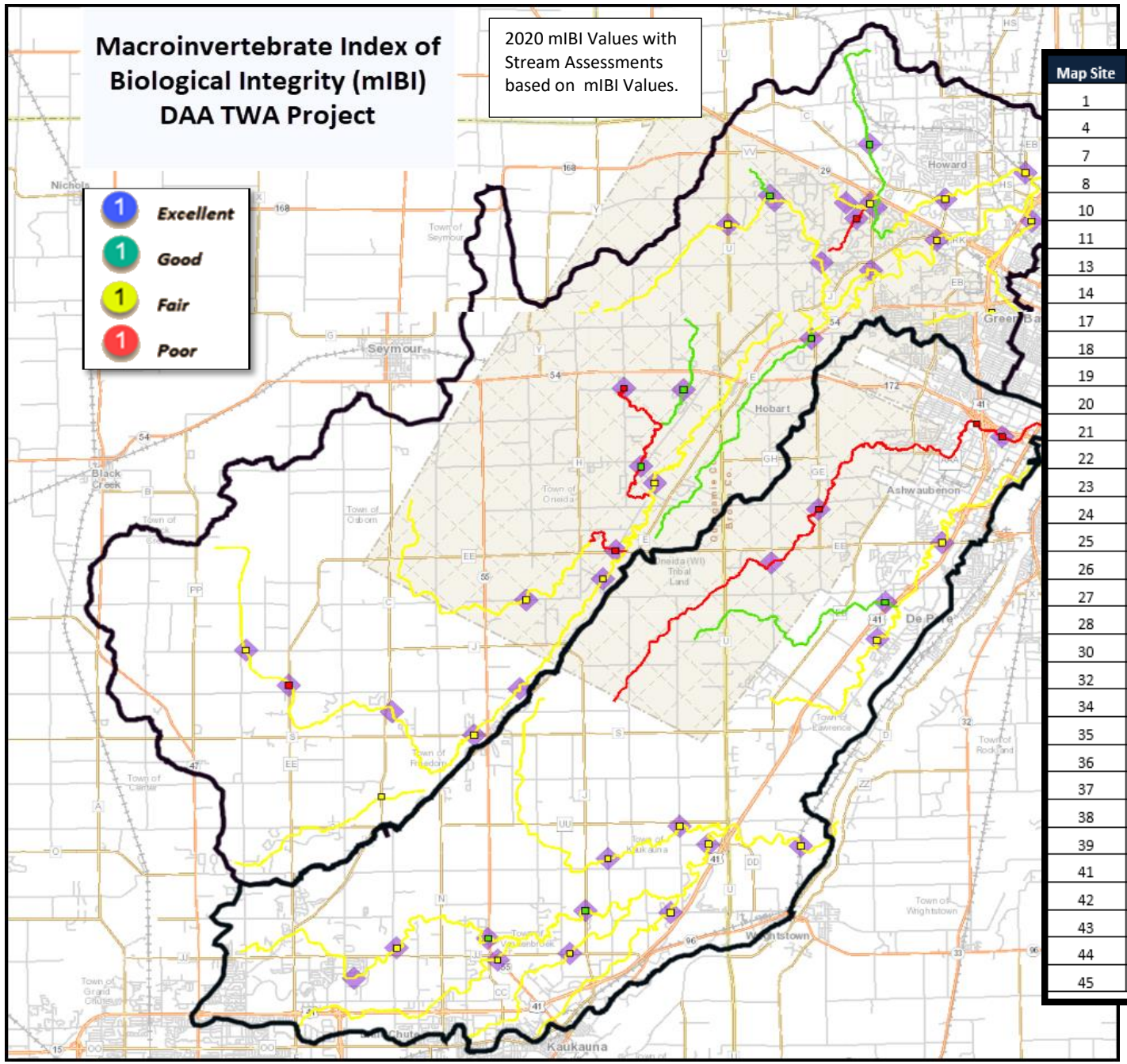
Macroinvertebrate Assessment

In fall 2015, macroinvertebrate samples were collected from 34 streams to calculate macroinvertebrate Index of Biotic integrity (MIBI) values. Some aquatic macroinvertebrate species are tolerant of environmental degradation, some moderately tolerant, and others intolerant. Based on representative macroinvertebrate samples collected and their associated tolerance to environmental degradation, the MIBI was calculated to indicate stream conditions (Table 7, Figure 9). MIBI scores range from -1.03 to 6.5. Of the 34 samples analyzed, 6 rated poor and 10 rated less than 4.0 which is on the lower side of fair.

Table 8. Macroinvertebrate Condition Values in the DAA Watershed.

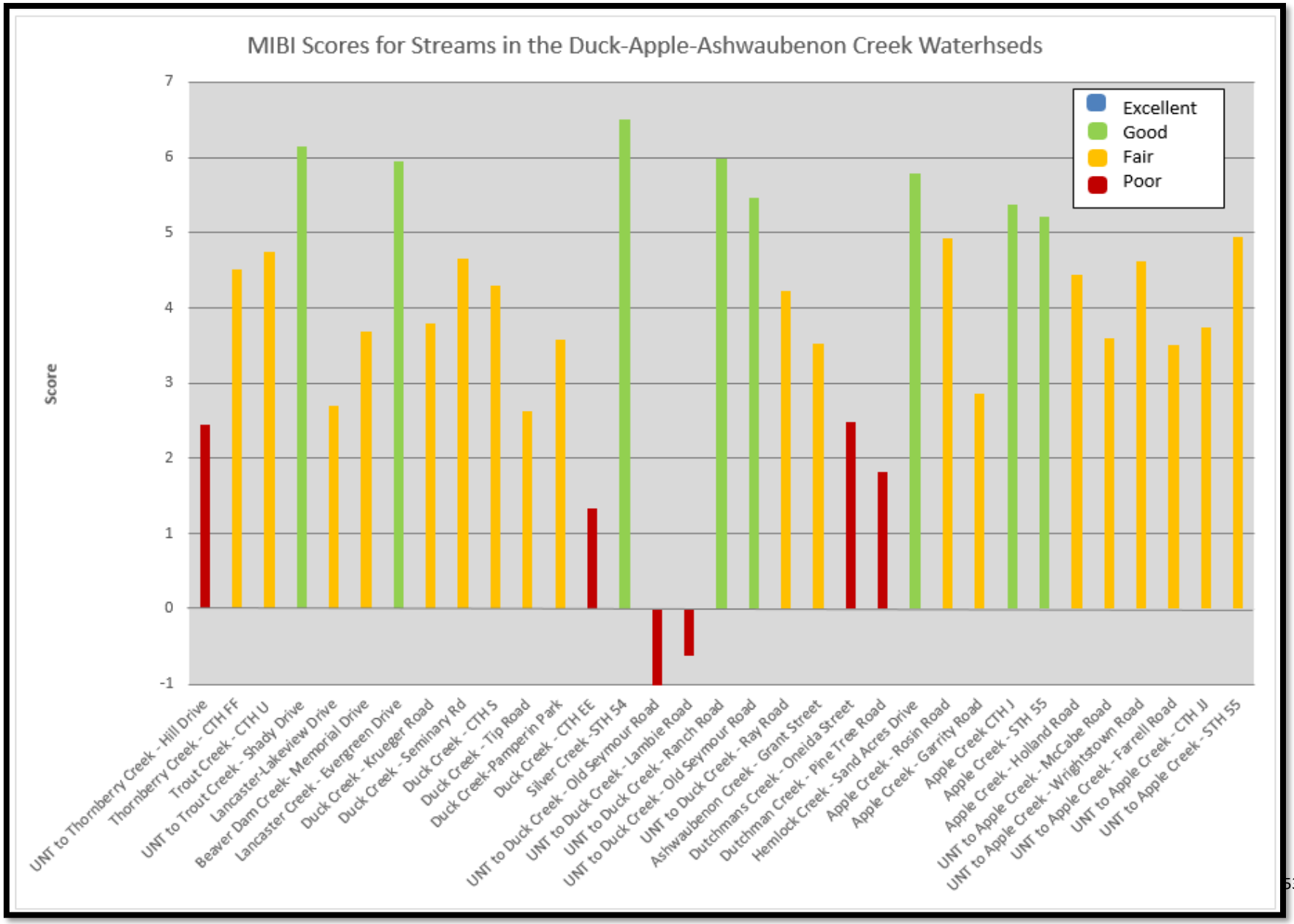
Map Site	Station	Station Name	Waterbody Name	WBIC	Value	Rating
1	10043684	UNT to Thornberry Creek - Hill Drive	Unnamed	3000354	2.45	Poor
4	10043700	Thornberry Creek - CTH FF	Thornberry Creek	410050	4.52	Fair
7	453281	Trout Creek - CTH U	Trout Creek	410200	4.75	Fair
8	10044071	UNT to Trout Creek - Shady Drive	Unnamed	5016644	6.15	Good
10	10034510	Lancaster-Lakeview Drive	Lancaster Creek	410000	2.7	Fair
11	10034514	Beaver Dam Creek- Memorial Drive	Beaver Dam Creek	410100	3.68	Fair
13	10008262	Lancaster Creek - Evergreen Drive	Lancaster Creek	410000	5.95	Good
14	10044062	Duck Creek - Krueger Road	Duck Creek	409700	3.79	Fair
17	453255	Duck Creek - Seminary Rd	Duck Creek	409700	4.65	Fair
18	10020717	Duck Creek - CTH S	Duck Creek	409700	4.29	Fair
19	10020873	Duck Creek - Tip Road	Duck Creek	409700	2.62	Fair
20	10038644	Duck Creek-Pamperin Park	Duck Creek	409700	3.58	Fair
21	10015591	Duck Creek - CTH EE	Duck Creek	409700	1.33	Poor
22	10044061	Silver Creek -STH 54	Silver Creek	5018670	6.5	Good
23	10044060	UNT to Duck Creek - Old Seymour Road	Unnamed	5018352	-1.03	Poor
24	10043928	UNT to Duck Creek - Lambie Road	Unnamed	5018448	-0.629	Poor
25	10043935	UNT to Duck Creek - Ranch Road	Unnamed	5018352	5.99	Good
26	10044059	UNT to Duck Creek - Old Seymour Road	Unnamed	5017444	5.46	Good
27	10043929	UNT to Duck Creek - Ray Road	Unnamed	5018448	4.22	Fair
28	10016502	Ashwaubenon Creek - Grant Street	Ashwaubenon Creek	122200	3.53	Fair
30	10015851	Dutchman's Creek - Oneida Street	Dutchman's Creek	121600	2.49	Poor
32	10043905	Dutchman Creek - Pine Tree Road	Dutchman's Creek	121600	1.82	Poor
34	10043793	Hemlock Creek - Sand Acres Drive	Hemlock	122600	5.78	Good
35	53684	Apple Creek - Rosin Road	Apple Creek	124100	4.93	Fair
36	10044012	Apple Creek - Garrity Road	Apple Creek	124100	2.86	Fair
37	10020830	Apple Creek CTH J	Apple Creek	124100	5.38	Good
38	453256	Apple Creek - STH 55	Apple Creek	124100	5.21	Good
39	10044064	Apple Creek - Holland Road	Apple Creek	124100	4.45	Fair
41	10044070	UNT to Apple Creek - McCabe Road	Unnamed	124600	3.6	Fair
42	10044069	UNT to Apple Creek - Wrightstown Road	Unnamed	124700	4.62	Fair
43	10044068	UNT to Apple Creek - Farrell Road	Unnamed	124600	3.5	Fair
44	10044067	UNT to Apple Creek - CTH JJ	Unnamed	124800	3.75	Fair
45	10044066	UNT to Apple Creek - STH 55	Unnamed	125000	4.94	Fair

Figure 14. Macroinvertebrate Stations and Condition Values in the DAA TWA Project.



Map Site	Station	Station Name
1	10043684	UNT to Thornberry Creek - Hill Drive
4	10043700	Thornberry Creek - CTH FF
7	453281	Trout Creek - CTH U
8	10044071	UNT to Trout Creek - Shady Drive
10	10034510	Lancaster-Lakeview Drive
11	10034514	Beaver Dam Creek- Memorial Drive
13	10008262	Lancaster Creek - Evergreen Drive
14	10044062	Duck Creek - Krueger Road
17	453255	Duck Creek - Seminary Rd
18	10020717	Duck Creek - CTH S
19	10020873	Duck Creek - Tip Road
20	10038644	Duck Creek-Pamperin Park
21	10015591	Duck Creek - CTH EE
22	10044061	Silver Creek -STH 54
23	10044060	UNT to Duck Creek - Old Seymour Road
24	10043928	UNT to Duck Creek - Lambie Road
25	10043935	UNT to Duck Creek - Ranch Road
26	10044059	UNT to Duck Creek - Old Seymour Road
27	10043929	UNT to Duck Creek - Ray Road
28	10016502	Ashwaubenon Creek - Grant Street
30	10015851	Dutchman's Creek - Oneida Street
32	10043905	Dutchman Creek - Pine Tree Road
34	10043793	Hemlock Creek - Sand Acres Drive
35	53684	Apple Creek - Rosin Road
36	10044012	Apple Creek - Garrity Road
37	10020830	Apple Creek CTH J
38	453256	Apple Creek - STH 55
39	10044064	Apple Creek - Holland Road
41	10044070	UNT to Apple Creek - McCabe Road
42	10044069	UNT to Apple Creek - Wrightstown Road
43	10044068	UNT to Apple Creek - Farrell Road
44	10044067	UNT to Apple Creek - CTH JJ
45	10044066	UNT to Apple Creek - STH 55

Figure 15. Duck-Apple-Ashwaubenon Creek in the DAA TWA Project.



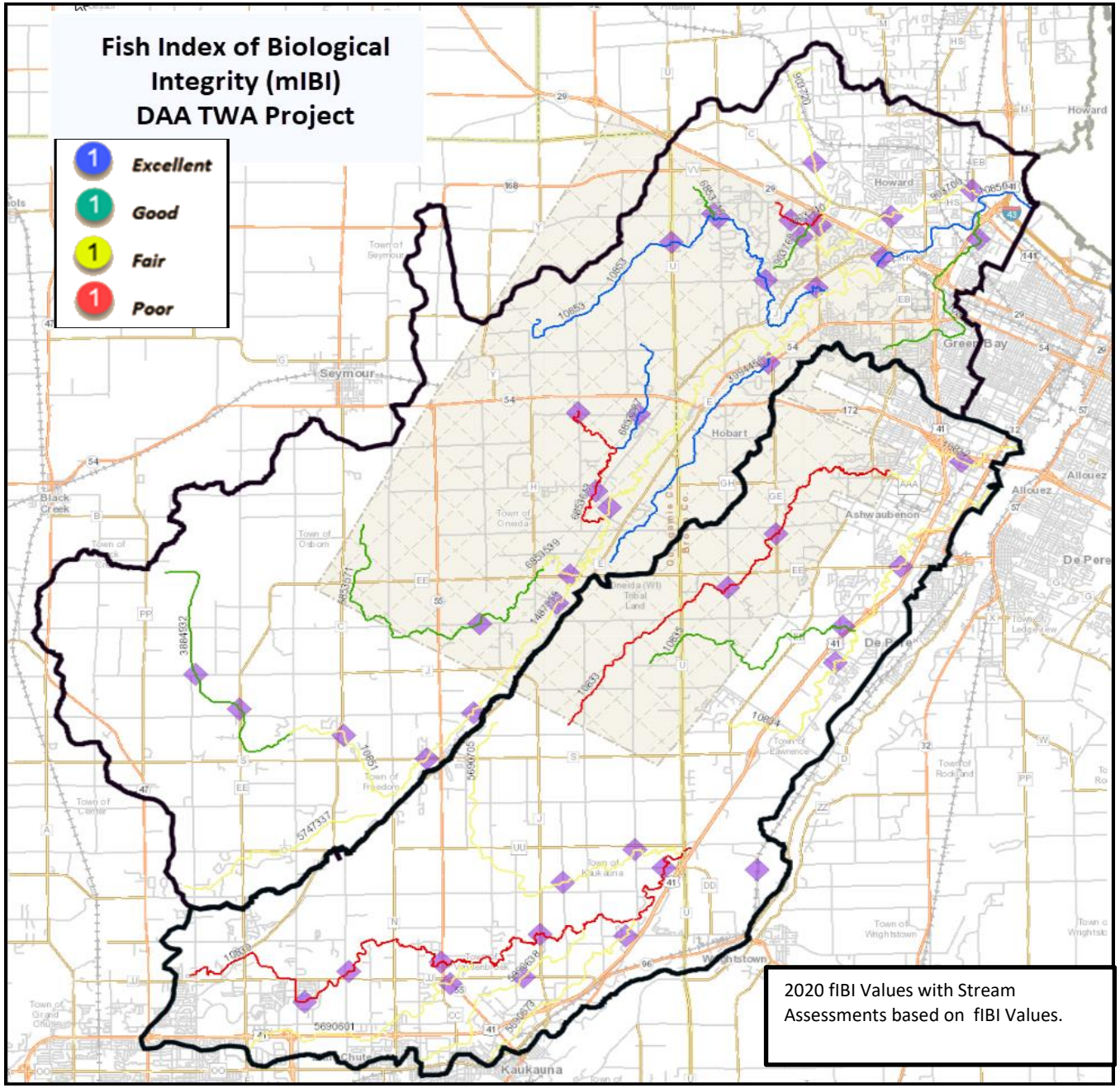
Fish Assessments

Fish surveys were completed on 44 stream sites between May and September in 2015. Some fish species are tolerant of environmental degradation, some species are moderately tolerant, and some others are intolerant. Based upon the representative fish collected during the survey and their associated tolerance to environmental degradation, a Fish Index of Biotic Integrity (FIBI) was calculated to indicate the water quality of the streams in the Duck-Apple-Ashwaubenon Creek Watershed. The FIBI scores ranged from 0 to 100. Of the 44 fish surveys, 4 had a condition of poor, 19 had a condition of fair, 14 had a condition of good, and 7 had a condition of excellent. (Table 6 Figure 16)

Table 9. Fish IBI Condition Values in the DAA TWA Project.

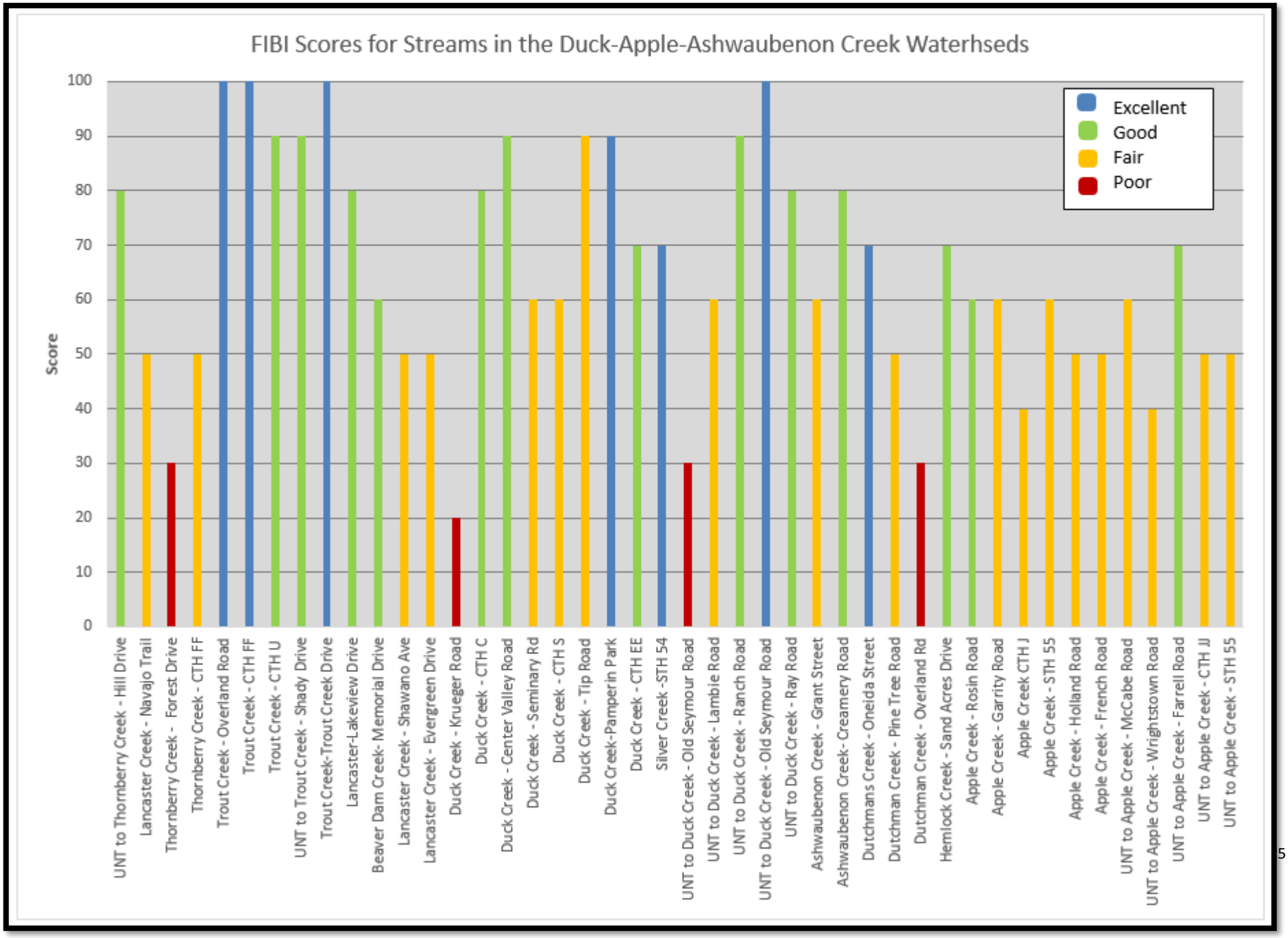
Station	Map Site #	WBIC	Waterbody Name	Station Name	Score	Rating	Verf. Natural Community
10015851		121600	Dutchman's Cr	Dutchman's Creek - Oneida Street	70	Excellent	CWMS
10043905		121600	Dutchman's Cr	Dutchman Creek - Pine Tree Road	50	Fair	CWHW
10043897		121600	Dutchman's Cr	Dutchman Creek - Overland Rd	30	Poor	CCHW
10016502		122200	Ashwaubenon Cr	Ashwaubenon Creek - Grant Street	60	Fair	CWHW
10007874		122200	Ashwaubenon Cr	Ashwaubenon Creek- Creamery Road	80	Good	CWHW
10043793		122600	Hemlock	Hemlock Creek - Sand Acres Drive	70	Good	CWHW
53684		124100	Apple Creek	Apple Creek - Rosin Road	60	Good	CWMS
10044012		124100	Apple Creek	Apple Creek - Garrity Road	60	Fair	CWHW
10020830		124100	Apple Creek	Apple Creek CTH J	40	Fair	CWMS
453256		124100	Apple Creek	Apple Creek - STH 55	60	Fair	CWHW
10044064		124100	Apple Creek	Apple Creek - Holland Road	50	Fair	CWHW
10044065		124100	Apple Creek	Apple Creek - French Road	50	Fair	WHW
10044070		124600	Unnamed	UNT to Apple Creek - McCabe Road	60	Fair	CWHW
10044068		124600	Unnamed	UNT to Apple Creek - Farrell Road	70	Good	CWHW
10044069		124700	Unnamed	UNT to Apple Creek - Wrightstown Road	40	Fair	CWHW
10044067		124800	Unnamed	UNT to Apple Creek - CTH JJ	50	Fair	CCHW
10044066		125000	Unnamed	UNT to Apple Creek - STH 55	50	Fair	CWHW
10044062		409700	Duck Creek	Duck Creek - Krueger Road	20	Poor	CWHW
10043984		409700	Duck Creek	Duck Creek - CTH C	80	Good	CWHW
453006		409700	Duck Creek	Duck Creek - Center Valley Road	90	Good	CWHW
453255		409700	Duck Creek	Duck Creek - Seminary Rd	60	Fair	CWHW
10020717		409700	Duck Creek	Duck Creek - CTH S	60	Fair	CWHW
10020873		409700	Duck Creek	Duck Creek - Tip Road	90	Good	CWHW
10038644		409700	Duck Creek	Duck Creek-Pamperin Park	90	Excellent	CWMS
10015591		409700	Duck Creek	Duck Creek - CTH EE	70	Good	CWHW
10008261		410000	Lancaster Creek	Lancaster Creek - Navajo Trail	50	Fair	CWHW
10034510		410000	Lancaster Cr	Lancaster-Lakeview Drive	80	Good	CWMS
10015722		410000	Lancaster Cr	Lancaster Creek - Shawano Ave	50	Fair	CCHW
10008262		410000	Lancaster Cr	Lancaster Creek - Evergreen Drive	50	Fair	CCHW
10008267		410050	Thornberry Cr	Thornberry Creek - Forest Drive	30	Poor	CCHW
10043700		410050	Thornberry Cr	Thornberry Creek - CTH FF	50	Fair	CWHW
10034514		410100	Beaver Dam Cr	Beaver Dam Creek- Memorial Drive	60	Good	CWMS
10008254		410200	Trout Creek	Trout Creek - Overland Road	100	Excellent	CWHW
53037		410200	Trout Creek	Trout Creek - CTH FF	100	Excellent	CWHW
453281		410200	Trout Creek	Trout Creek - CTH U	90	Good	CWHW
53694		410200	Trout Creek	Trout Creek-Trout Creek Drive	100	Excellent	CWHW
10043684		3000354	Unnamed	UNT to Thornberry Cr - Hill Drive	80	Good	CWHW
10044071		5016644	Unnamed	UNT to Trout Creek - Shady Drive	90	Good	CWHW
10044059		5017444	Unnamed	UNT to Duck Creek - Old Seymour Road	100	Excellent	CWHW
10044060		5018352	Unnamed	UNT to Duck Creek - Old Seymour Road	30	Poor	CWHW
10043935		5018352	Unnamed	UNT to Duck Creek - Ranch Road	90	Good	CWHW
10043928		5018448	Unnamed	UNT to Duck Creek - Lambie Road	60	Fair	CCHW
10043929		5018448	Unnamed	UNT to Duck Creek - Ray Road	80	Good	CWHW
44061		5018670	Silver Creek	Silver Creek -STH 54	70	Excellent	CWMS

Figure 16. Fish IBI Condition Values in the DAA TWA Project.



Map Site	Station	Station Name
1	10043684	UNT to Thornberry Creek - Hill Drive
2	10008261	Lancaster Creek - Navajo Trail
3	10008267	Thornberry Creek - Forest Drive
4	10043700	Thornberry Creek - CTH FF
5	10008254	Trout Creek - Overland Road
6	53037	Trout Creek - CTH FF
7	453281	Trout Creek - CTH U
8	10044071	UNT to Trout Creek - Shady Drive
9	53694	Trout Creek-Trout Creek Drive
10	10034510	Lancaster-Lakeview Drive
11	10034514	Beaver Dam Creek- Memorial Drive
12	10015722	Lancaster Creek - Shawano Ave
13	10008262	Lancaster Creek - Evergreen Drive
14	10044062	Duck Creek - Krueger Road
15	10043984	Duck Creek - CTH C
16	453006	Duck Creek - Center Valley Road
17	453255	Duck Creek - Seminary Rd
18	10020717	Duck Creek - CTH S
19	10020873	Duck Creek - Tip Road
20	10038644	Duck Creek-Pamperin Park
21	10015591	Duck Creek - CTH EE
22	10044061	Silver Creek -STH 54
23	10044060	UNT to Duck Creek - Old Seymour Road
24	10043928	UNT to Duck Creek - Lambie Road
25	10043935	UNT to Duck Creek - Ranch Road
26	10044059	UNT to Duck Creek - Old Seymour Road
27	10043929	UNT to Duck Creek - Ray Road
28	10016502	Ashwaubenon Creek - Grant Street
29	10007874	Ashwaubenon Creek- Creamery Road
30	10015851	Dutchmans Creek - Oneida Street
31	53696	Dutchmans Creek- Cyrus Lane
32	10043905	Dutchman Creek - Pine Tree Road
33	10043897	Dutchman Creek - Overland Rd
34	10043793	Hemlock Creek - Sand Acres Drive
35	53684	Apple Creek - Rosin Road
36	10044012	Apple Creek - Garrity Road
37	10020830	Apple Creek CTH J
38	453256	Apple Creek - STH 55
39	10044064	Apple Creek - Holland Road
40	10044065	Apple Creek - French Road
41	10044070	UNT to Apple Creek - McCabe Road
42	10044069	UNT to Apple Creek - Wrightstown Road
43	10044068	UNT to Apple Creek - Farrell Road
44	10044067	UNT to Apple Creek - CTH JJ
45	10044066	UNT to Apple Creek - STH 55

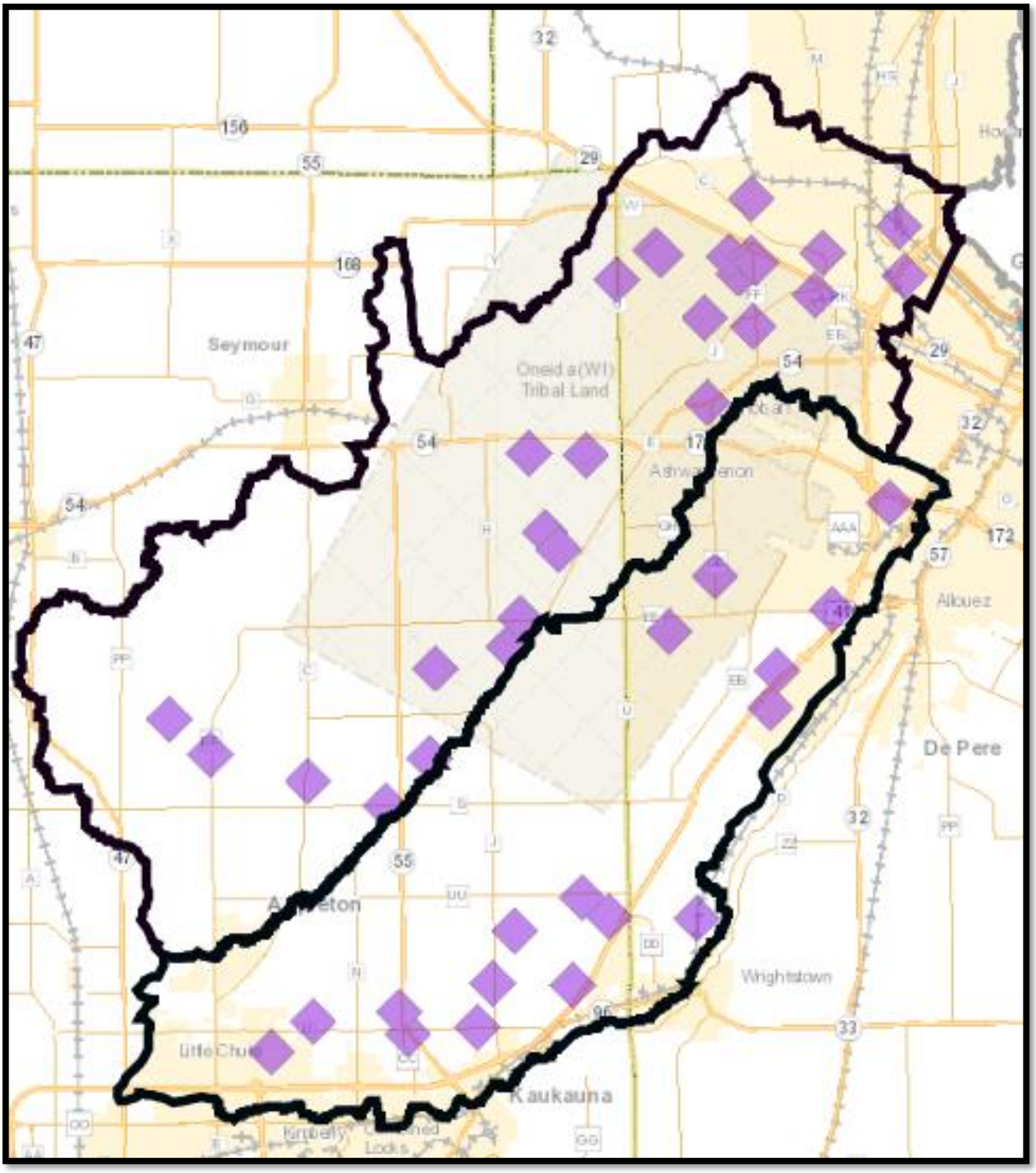
Figure 17. Fish IBI Condition Values Graph in the DAA TWA Project.



Habitat Assessments

Quantitative habitat assessments evaluate a representative stream reach (35 X Mean Stream Width) for the quantity and quality of habitat for fish and compare the habitat to reference streams in Wisconsin. Based upon the assessment data collected during the 2015 surveys, a habitat rating was calculated for 39 small streams less than 10m wide and five large streams greater than 10 m wide. (Table 8, Figure 11). The habitat rating scores were relatively similar for all streams and half scored in the fair range and half scored in the good range.

Figure 18. Habitat Condition Values in the DAA TWA Project.



Habitat Assessment

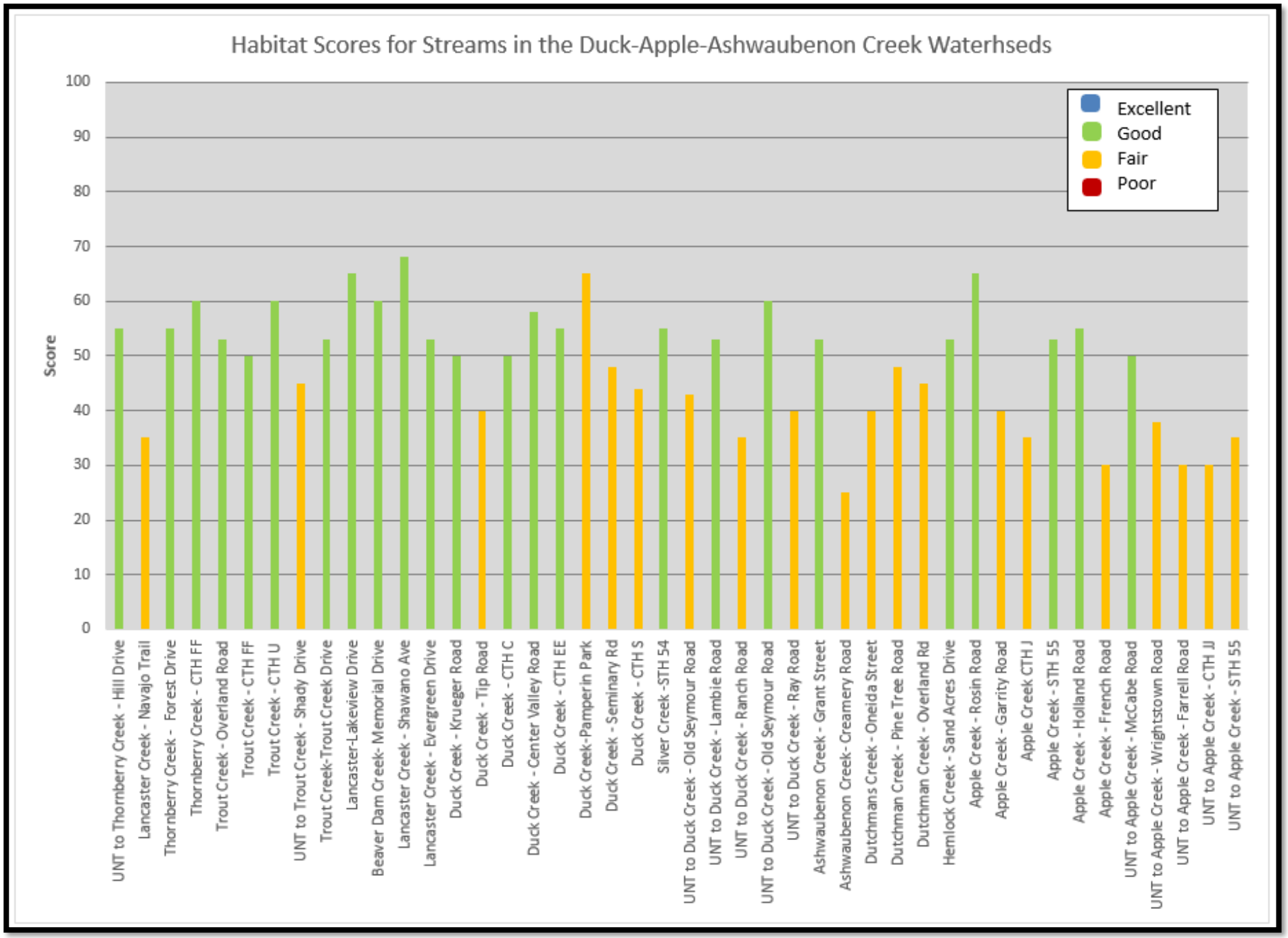
Table 10. Habitat Condition Values in the DAA TWA Project.

Waterbody Name	WBIC	Station	Station Name	AU	MSW (m)	Buffer Score	Erosion Score	Pool Score	W:D Score	Riff:Riff Score	Bend:Bend Score	Fine Sed Score	Fish Cover Score	Small Score	Small Rating
Unnamed	3000354	10043684	UNT to Thornberry Creek - Hill Drive	903760	2	10	15	0	10	0	15	5	0	55	Good
Lancaster Creek	410000	10008261	Lancaster Creek - Navajo Trail	903720	3	10	5	0	10	0	10	0	0	35	Fair
Thronberry Creek	410050	10008267	Thornberry Creek - Forest Drive	903740	3	10	15	0	10	15	10	5	0	55	Good
Thronberry Creek	410050	10043700	Thornberry Creek - CTH FF	903740	2	10	15	0	10	15	10	0	10	60	Good
Trout Creek	410200	10008254	Trout Creek - Overland Road	10853	3	15	5	3	10	15	0	0	5	53	Good
Trout Creek	410200	53037	Trout Creek - CTH FF	10853	5	15	10	0	5	15	15	5	0	50	Good
Trout Creek	410200	453281	Trout Creek - CTH U	10853	2	10	15	0	10	0	0	10	15	60	Good
Unnamed	5016644	10044071	UNT to Trout Creek - Shady Drive	6853719	3	15	5	0	10	15	10	0	0	45	Fair
Trout Creek	410200	53694	Trout Creek-Trout Creek Drive	10853	6	15	5	3	10	15	10	5	0	53	Good
Lancaster Creek	410000	10034510	Lancaster-Lakeview Drive	903700	6	10	10	0	10	15	0	5	15	65	Good
Lancaster Creek	410000	10015722	Lancaster Creek - Shawano Ave	903700	4	10	10	3	10	10	15	5	15	68	Good
Lancaster Creek	410000	10008262	Lancaster Creek - Evergreen Drive	903720	3	15	10	3	10	0	15	0	0	53	Good
Beaver Dam Creek	410100	10034514	Beaver Dam Creek- Memorial Drive	10852	5.5	10	5	10	10	0	15	5	5	60	Good
Duck Creek	409700	10044062	Duck Creek - Krueger Road	3884932	3.5	10	15	0	10	0	0	0	15	50	Good
Duck Creek	409700	10043984	Duck Creek - CTH C	10851	7	10	15	0	0	15	0	10	0	50	Good
Duck Creek	409700	453006	Duck Creek - Center Valley Road	10851	6	10	15	3	5	15	15	5	5	58	Good
Duck Creek	409700	10015591	Duck Creek - CTH EE	3884932	4	10	15	0	10	0	0	5	15	55	Good
Silver Creek	5018670	10044061	Silver Creek -STH 54	3994450	3	15	10	0	10	15	15	5	0	55	Good
Unnamed	5018352	10044060	UNT to Duck Creek - Old Seymour Road	6853613	2.5	15	10	3	10	5	5	0	0	43	Fair
Unnamed	5018448	10043928	UNT to Duck Creek - Lambie Road	6853539	3	10	10	3	10	15	0	5	0	53	Good
Unnamed	5018352	10043935	UNT to Duck Creek - Ranch Road	6853613	5	15	5	0	5	0	10	0	0	35	Fair
Unnamed	5017444	10044059	UNT to Duck Creek - Old Seymour Road	6853687	2.5	15	15	0	10	0	0	5	15	60	Good

Waterbody Name	WBIC	Station	Station Name	AU	MSW (m)	Buffer Score	Erosion Score	Pool Score	W:D Score	Riff:Riff Score	Bend:Bend Score	Fine Sed Score	Fish Cover Score	Small Score	Small Rating
Unnamed	5018448	10043929	UNT to Duck Creek - Ray Road	6853571	3	15	5	0	5	0	15	0	0	40	Fair
Ashwaubenon Creek	122200	10016502	Ashwaubenon Creek - Grant Street	10834	6	15	5	3	5	15	5	0	10	53	Good
Ashwaubenon Creek	122200	10007874	Ashwaubenon Creek- Creamery Road	10834	6	10	5	0	5	5	0	0	0	25	Fair
Dutchmans Creek	121600	10015851	Dutchmans Creek - Oneida Street	10832	8	15	5	0	10	0	0	0	10	40	Fair
Dutchmans Creek	121600	10043905	Dutchman Creek - Pine Tree Road	10833	3	15	10	3	10	0	10	0	0	48	Fair
Dutchmans Creek	121600	10043897	Dutchman Creek - Overland Rd	10833	3	15	15	0	10	0	0	5	0	45	Fair
Hemlock	122600	10043793	Hemlock Creek - Sand Acres Drive	10835	4	10	10	3	10	15	15	5	0	53	Good
Apple Creek	124100	10044012	Apple Creek - Garrity Road	10839	7	10	5	0	5	15	15	5	0	40	Fair
Apple Creek	124100	10020830	Apple Creek CTH J	10839	7	10	5	0	5	5	15	0	0	35	Fair
Apple Creek	124100	453256	Apple Creek - STH 55	10839	1	15	5	3	10	0	15	5	0	53	Good
Apple Creek	124100	10044064	Apple Creek - Holland Road	10839	5	10	15	0	10	15	0	0	5	55	Good
Apple Creek	124100	10044065	Apple Creek - French Road	10839	6	15	15	0	0	0	0	0	0	30	Fair
Unnamed	124600	10044070	UNT to Apple Creek - McCabe Road	5690705	3	10	10	0	10	15	0	5	0	50	Good
Unnamed	124700	10044069	UNT to Apple Creek - Wrightstown Road	5690673	3	10	5	3	10	10	10	0	0	38	Fair
Unnamed	124600	10044068	UNT to Apple Creek - Farrell Road	5690705	3	5	10	0	10	0	5	0	0	30	Fair
Unnamed	124800	10044067	UNT to Apple Creek - CTH JJ	5690638	2	10	10	0	10	0	0	0	0	30	Fair
Unnamed	125000	10044066	UNT to Apple Creek - STH 55	5690601	3	10	10	0	10	0	0	5	0	35	Fair

Waterbody Name	WBIC	Station	Station Name	AU	MSW (m)	Bank Stab	Riff:Riff Score	Bend:Bend Score	Fish Cover	Rocky Sub	Max Thal Score	Large Score	Large Rating
Apple Creek	124100	53684	Apple Creek - Rosin Road	313933	10	12	12	0	8	25	8	65	Good
Duck Creek	409700	453255	Duck Creek - Seminary Rd	1487955	10.5	12	12	0	8	16	0	48	Fair
Duck Creek	409700	10020873	Duck Creek - Tip Road	1487955	12	12	12	8	0	16	0	40	Fair
Duck Creek	409700	10038644	Duck Creek-Pamperin Park	10850	19	12	12	12	8	25	8	65	Fair
Duck Creek	409700	10020717	Duck Creek - CTH S	10851	13	12	0	8	8	0	16	44	Fair

Figure 19. Habitat Condition Values Graph in the DAA TWA Project.



Discussion of Results

The two main focal points for this watershed report are to provide a contemporary condition assessment of the streams within the Duck-Apple-Ashwaubenon Creek watersheds and to provide an assessment of influences to water quality conditions following the completion of the Priority Watershed Project within the watershed.

Overall River and Stream Health

In general, streams within the Duck-Apple-Ashwaubenon Creek watersheds continue to suffer from impacts associated with non-point sources of pollution and urbanization that influence the chemical, physical, and biological composition these aquatic communities.
All but two stream segments surveyed in the Duck-Apple-Ashwaubenon Creek watershed in 2015 were modeled to be cool-warm or cool-cold transitional headwater streams (Lyons, 2008). The department has developed a methodology to determine whether the modeled natural community is accurate based on the fishery assemblage and climate conditions (Lyons, 2013). The modeled natural community was accurate about 62% of the time. When the methodology was applied, streams may have been more accurately reflected as cool-warm headwater streams while an additional seven streams had sufficient flow and size to be considered main-stem rather than headwater stream. During the summer season of 2015 air temperatures and precipitation were considered within the normal weather pattern and influences on the fish natural community should have be negligible.

Environmental degradation can sometimes explain the discrepancy between the modelled and actual community where there is a lack of intolerant species and a dominance of tolerant ones. For the streams surveyed only five contained tolerant fish communities that prevented a new natural community classification from being proposed. For all the newly proposed natural community changes, seven changes required an alternative IBI to be calculated. With the application of the new IBI all seven sites improved in both score and rating. For all other changes in natural community between cool-cold, cool-warm, and warm headwater streams, the proposed change did not alter the IBI that was applied and thus scores and ratings stayed with the original under the original score and rating as assigned by the small stream IBI.

Species diversity throughout the Duck-Apple-Ashwaubenon Creek watersheds included 36 different fish species captured in 2015. Species diversity at sites near the confluence of the Fox River and Lake Michigan were much greater than sites further up in the watershed. Sites near these larger bodies of water, regardless of the natural community, displayed the greatest diversity of species which may have artificially inflated fish IBI scores. Survey sites located outside of this area of influence largely expressed watershed characteristics on fish community assemblage and may more accurately reflect fish IBI scores and water quality conditions.
The most dominant fish species as far as percent of total catch (24%) was the Creek Chub and was found during 41 of the 44 surveys (n=41). Other species that comprised a high percentage of the total catch include Brook Stickleback (13%, n=34), Johnny Darter (12%, n=42), Central Mudminnow (10%, n=31), White Sucker (9% n=36), and Common Shiner (6% n=22). Species that were frequently captured in surveys but did not constitute a sizable percentage of the total catch included Fathead Minnow (n=34) and Green Sunfish (n=32).
Only three species intolerant to environmental degradation were captured during surveys at 10 sites (Rock Bass n=5, Redside Dace n=4, and Northern Brook Lamprey Ammocoete n=1) and collectively comprised only 1.3% of the total catch. The spatial distribution of these species was isolated in Duck Creek, Trout Creek, Lancaster Creek, and an UNT to Trout Creek. Except for Duck Creek, water quality in these tributaries are less influenced by non-point source pollution and habitat degradation.

When comparing the F-IBI scores throughout the Duck-Apple-Ashwaubenon Creek Watersheds, stations located near the headwaters typically have depressed scores and as one progresses downstream towards the confluence of larger waterbodies, the scores improve. It is also important to note that scores in the Trout and Lancaster sub-watershed areas of Lower Duck Creek generally score better than other sub-watersheds in Upper and Middle Duck, Apple, Dutchman's and Ashwaubenon Creek watersheds. To fully understand habitat impacts on the F-IBI scores, it is necessary to look more closely at the individual metrics that make up the overall habitat scores.

Habitat scores are generally consistent throughout the entire DAA watershed and scores range from fair to good. Habitat scores throughout the watersheds were depressed by extensive fines, lack of pool habitat, and absence of cover for fish. Bank erosion is also a factor affecting localized areas within the watersheds. Generally, the riparian corridors are intact throughout the watershed with a few limited exceptions in the headwater areas of streams where agriculture productions encroach within the stream corridor. The Apple Creek watershed generally has the lowest habitat scores and based on observations is the most impacted by hydrologic modifications and historic agricultural practices.

Nutrient and sediment contributions to surface water continue to adversely affect water quality and is considered one of the most critical issue in the watershed. There is a sizable percentage of cropland that is drained via subsurface tile lines through an extensive drainage network. Grazing practices appear to be on the decline however high intensity dairy production is increasing and most crop rotations throughout the watershed are in dairy rotations. These cropping practices can directly influence instream nutrient and sediment concentrations. Total Phosphorous, Total Suspended Solids, and Dissolved Orth-phosphorous samples were collected at ten locations throughout the watershed and seven of the sites continue to be impaired by TP and all other sites had at minimum one TSS monthly sample that exceeded the standard identified in the Lower Fox TMDL of 20 mg/l TSS. It is evident the impact extensive tile drainage systems are having on instream concentrations of Dissolved Ortho-Phosphorous entering surface waters. At the sites that are impaired by TP, DOP comprises 60-65% of the TP

concentrations. At these concentrations, the proportion of DOP exceeds the listing criteria for TP as a whole. It is apparent that in any effort to reduce TP concentrations in the streams within the DAA, a significant emphasis must be placed on reducing the contribution of DOP.

The Macroinvertebrate IBI data did not show a consistent or expected theme related to other water quality conditions. 25% of the stream sites were within the fair to good range, 25% were in the poor to fairly poor range, and 50% were in the mid fair range. A few randomized sites that one would expect to have depressed scores such as Apple Creek at CTH J were rated as Good while other sites on Apple upstream and downstream rated as fair to fairly poor. When sites were combined within their respected assessment units, scores generally fell within the fair range throughout the watershed.

It can be generally summarized that throughout the DAA Creek watershed, non-point source impacts have a far greater influence on headwater stream conditions and as one travels downstream these influences transition to impacts from urbanization. The quality of assessments in the downstream areas may also be buffered by the proximity to larger waterways. This trend may indicate that although significant efforts have been made since the late 1990's to install conservation practices, additional practices to protect headwaters areas of these stream may provide improvements to the overall health of these aquatic ecosystems.

Priority Watershed Plan BMP effectiveness on Instream Water Quality Discussion

The Department of Natural Resources prepared a Surface Water Appraisal Report in April of 1996 to summarize existing conditions of the DAA Creek watershed. This appraisal was used to aid in the development of goals and objectives for each sub-watershed. The appraisal report was not designed to be a comprehensive document of water quality but did provide a small snapshot of the overall conditions of streams within each sub-watershed. At that time, methods to collect water quality and assess conditions while valid, have been revised and adapted over time to better achieve rapid assessment of water quality. During 2015, the monitoring strategy was developed to provide insight into instream water quality changes that may be correlated to structural BMP installation or cropping practices implemented under the priority watershed plan in 1997. The locations of structural BMPs in Brown and Outagamie County are presented below (See Figure 17).

Duck Creek

- Burma Swamp- US- Poor Aquatic Life Conditions US STH 55- soft sediment Low Flow
- Fish Creek- -Mid Duck + Silver
- Trout Creek-
- Lancaster- DS Duck + Lan

Apple Creek

- Appleton- US to STH 55
- Freedom- DS to Fox

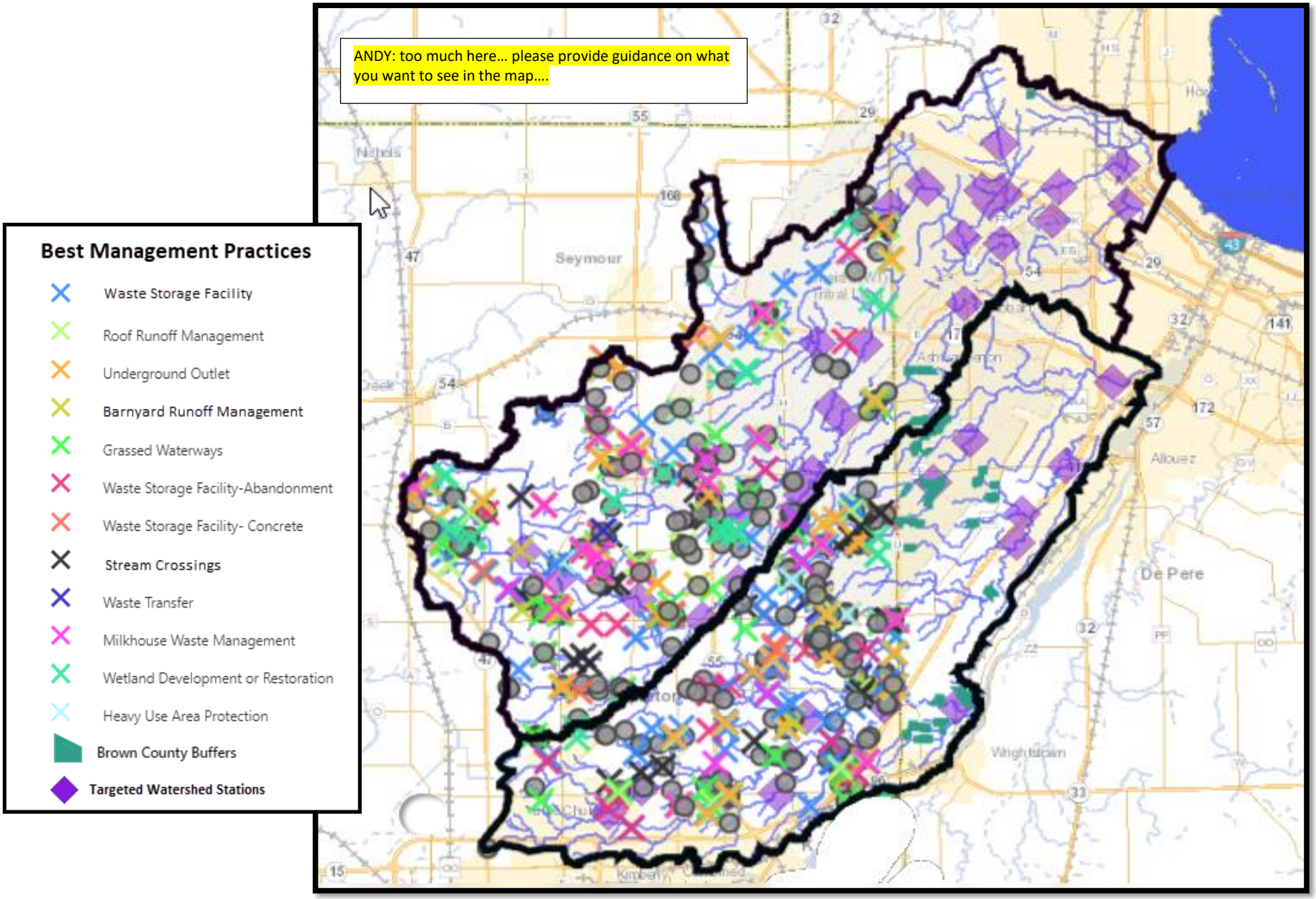
Ashwaubenon Creek

- Hemlock Creek-

Dutchmans Creek

- Dutchman's Creek

Figure 20. Best Management Practices and Stations in the DAA TWA Project.



Conclusion & Recommendations

Overall water quality and stream habitat in the Apple Ashwaubenon Duck Creek Targeted Watershed Assessment study area are rated poor to good, with documented problems of sedimentation, phosphorus, excess algae, and heavy metals (Beaver Dam Creek). Sedimentation and phosphorus from upland agricultural fields are the major sources of nonpoint pollution in the watershed. Upland areas account for well over 80 percent of the overall load to local waters. Eroding streambanks and improperly managed livestock operations are also contributors.

In addition, land use changes in riparian and upland areas, in concert with the destruction of nearly 70% of the area's historical wetlands, have led to the `flashy' characteristics exhibited by area streams. The following management priorities and associated recommendations for DNR, partners and the public reflect the study findings and are consistent with and support the Lower Fox TMDL as well as the area's Nine Key Element plan.

Lower Fox TMDL Project Goals

The study area is the most downstream portion of the Lower Fox River Basin TMDL. Below are the primary restoration goals for the river, tributary streams, and Lower Green Bay .

- Reduce excess algal growth. Aesthetic reasons aside, reducing blue-green algae will reduce the risks associated with algal toxins to recreational users of the river and bay. In addition, a decrease in algal cover will also increase light penetration into deeper waters of the bay.
- Increase water clarity in Lower Green Bay. Achieving an average Secchi2 depth measurement of at least 1.14 meters will allow photosynthesis to occur at deeper levels in the bay, as well as improve conditions for recreational activities such as swimming.
- Increase growth of beneficial submerged aquatic vegetation in Lower Green Bay. This will help reduce the re-suspension of sediment particles from the bottom of the bay up into the water column, which will increase water clarity.
- Increase dissolved oxygen levels. This will better support aquatic life in the tributary streams and main stem of the Lower Fox River.
- Restore degraded habitat. This will better support aquatic life.

Management Priorities from the TWA Study

- Reduce non-point source impacts in the Duck, Apple, Ashwaubenon Creek watersheds.
- Improve landowner understanding of soils health principles and implementing fundamental practices.
- Improve stream buffer widths and quality in the watershed while maintaining adequate tillage setbacks.
- Manure management and application practices should continue to evolve with the implementation of soil health principles.
- Support best management practices to address the significant nutrient loss occurring through tile lines.

Recommendations

- Conduct additional monitoring in cooperation with the Oneida Tribe in Trout Creek and the UNT to Trout Creek to assess remnant Brook Trout population.
- Conduct additional monitoring in Thornberry Creek and the UNT to Thornberry Creek to assess remnant Brook Trout population.
- Conduct additional chemical and biological monitoring in Trout Creek to consider removing from the impaired water list for total phosphorus and total suspended solids.
- Support the development, implementation, and post implementation monitoring for a 9-Key Element Plan in coordination with Brown and Outagamie County in the Upper Duck and Apple Creek Watershed.

Ideas for Watershed Residents

Riparian Corridor Condition Management
Do you live near or adjacent to a waterway in the Lower Fox River? Riparian corridor management can help improve water quality conditions.

- Contact a local forester or consider enrolling in the managed forest program to enhance the riparian corridor condition and water quality.
- DNR Forestry Resources
  - Managed Forest Land Program
  - Brown County
  - Outagamie County

Land & Animal Management Cover crops are essentially fall deer food plots, helping to stem soil loss and provide food for overwintering species.

- DNR Deer Management Resources
  - Wisconsin Deer Management
  - Quality Deer Management
  - Animal Manure Management

Monitoring Learn more, get Involved! *Are you interested in Water Quality? See resources to learn more.*

- Monitoring Programs
- Water Action Volunteers
- Natural Resource Education (UWEX)
- Lower Fox Total Maximum Daily Load (TMDL)
- Lower Fox Citizen Monitoring Network
- Waterway and Wetland Permits

Adopt Good Infiltration Practices *Infiltration best practices can make a big difference in our watersheds.*

- *Rain barrels, rain gardens, down spout level spreader, planting native vegetation.*
- Storm drain stenciling, supporting leaf collection, reducing fertilizer and salt use and
- *Practicing good animal waste management*.

Preserving Soil Health Maintaining soil health is a great way to protect water quality. Use of conservation tillage, no till farming, and planting cover crops can make a big difference. For more information check out:

- UW Extension Conservation Training
- Wisconsin Farmer-Led Watershed Councils
- NRCS Soils Health Days.

Erosion Control and Stabilization. Keeping soil secure on the landscape, even during new construction, protects water quality. Using bank stabilization measures and seasonal timing of land work will reduce sediment and phosphorus delivery to watershed streams and bays.

Appendix A: Priority Watershed Plan (1994) Installed BMPs

INSTALLED BMP'S (Based on CSA Data)					
Amount	Unit	Best Management Practice (BMP)	BMP Code	Cost-Share Expenditures	Funding Type
3,500	Feet	Field Diversions	C3	$10,788.05	Bonding
14.5	Acres	Grassed Waterways	C5	$39,849.14	Bonding
34	No.	Barnyard Runoff Management	L1	$533,065.39	Bonding
33	No.	Roof Runoff Management	L1R	$77,360.09	Bonding
29	No.	Manure Storage Facilities	L2	$701,799.84	Bonding
225.5	Acres	Intensive Grazing Management	L5	$21,860.46	Bonding
22	No.	Milking Center Waste Control Systems	L6	$27,954.78	Bonding
13	No.	Animal Waste Storage Abandonment	L7	$79,792.66	Bonding
31.9	Acres	Critical Area Stabilization	M1	$22,876.89	Bonding
5	No.	Grade Stabilization Structures	M2	$27,540.78	Bonding
2	No.	Pesticide Mgt. – Spill Control Facility	M6S	$46,521.10	Bonding
1.0	Acres	Wetland Restoration	M7	$2,256.94	Bonding
201	No.	Well Abandonment	M9	$92,659.97	Bonding
744	Feet	Stream Crossing (12 crossings)	MC	$17,591.50	Bonding
2,805	Feet	Streambank Rip-Rapping	MR	$32,163.46	Bonding
2	No.	Waste Transfer - Feed Leachate Runoff System	R33	$9,109.04	Bonding
36.5	Feet	Special Infield Buffers (15 year O&M)	S10	$16,852.60	Bonding
5.2	Acres	Riparian Buffers	MU	$208.22	Bonding
76,208	Acres	High Residue Management – 30% Residue	C7	$924,515.64	Cropping
15,292	Acres	High Residue Management – 15% Residue	C7B	$94,977.06	Cropping
210	Acres	Cropland Protection Cover	C10	$3,678.50	Cropping
28,229.9	Acres	Nutrient Management	M5	$44,474.12	Cropping
35,247.7	Acres	Pesticide Management	M6	$56,723.86	Cropping
TOTAL COST-SHARE EXPENDITURES (All Funds) = $2,884,620.09					

Appendix B: References

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Guidelines for Assessing Fish Communities of Wadeable Streams in Wisconsin

Guidelines for Qualitative Physical Habitat Evaluation of Wadeable Streams
Guidelines for Evaluating Habitat of Wadeable Streams Revised June 2002 (Quantitative Habitat)
Guidelines for Collecting Macroinvertebrate Samples in Wadeable Streams
Guidelines and Procedures for Surface Water Grab Sampling (Dec. 2005 Version 3)
Guidelines and Standard Procedures for Continuous Temperature Monitoring Wisconsin DNR May 2004 (Version 1)
Diatom Collections for Calculation of the Diatom Nutrient Index (DNI), WQ Monitoring 2016 SOP v2.3 01

Appendix C: Stream Narratives

Apple Creek (WBIC 124100)
Apple Creek is a 24-mile long cool-warm headwater stream originating in Outagamie County. Extensive hydrologic modification have occurred in the upper portions of the watershed including relocations, ditching, straightening, and the construction of online storm water ponds. As Apple Creek approaches the Fox River, it converts to a mainstem stream supporting a more diverse fish assemblage.

Apple Creek, a 24-mile creek, is usually dry except for scattered pools near road crossings and toward the mouth of the river where it drains into the Fox River. Bottom materials are silt, rubble and gravel, with few boulders. Similar to many streams in Brown County, Apple Creek is plagued by erosion. Cattle pasturing along streambanks and hills have caused heavy erosion and no vegetation. nonpoint source pollution, point source pollution and urban stormwater runoff cause sedimentation and low dissolved oxygen levels, which contribute to poor water quality.

Summary data from 2018 assessments of Apple Creek, miles 0-3.99, showed continued impairment by phosphorus; new total phosphorus sample data overwhelmingly exceeded 2018 WisCALM listing criteria for the Fish and Aquatic Life use, however, available biological data did not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category). The Macroinvertebrates indicate fairly poor water quality. The 2018 assessments also showed impairment by temperature; new temperature sample data exceeded 2018 WisCALM listing criteria for Fish and Aquatic Life.

Ashwaubenon Creek (WBIC 122200)
Ashwaubenon Creek, a 15-mile sluggish, hard water stream flowing through agricultural and residential Brown County. Bottom materials consist of rubble, gravel and silt. In the agricultural portion of the stream the stream banks and hills are bare and erosion heavy due to cattle pasturing. In the residential area the stream is filled with litter a debris. The 2018 assessments of Ashwaubenon Creek showed continued impairment by phosphorus; new total phosphorus sample data overwhelmingly exceeded 2018 WisCALM listing criteria for the Fish and Aquatic Life use, however, available biological data did not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category). Based on the most updated information, no change in existing impaired waters listing is needed.

Watershed (LF02) Narratives

Dutchman Creek (WBIC 121600)
Dutchman Creek, a 17-mile stream, has been ditched and the course altered to accommodate residential and commercial developments beginning in the area (HWY 41 & 172 and near Oneida Street). During mid-summer low flow conditions, most of Dutchman Creek and all of its tributaries dry up. Bottom materials consist mainly of soft sediments. Riffle areas are rare and there seems to be little scouring of the stream bottom. Streambanks are generally in poor condition and buffering is limited or absent. Crops and livestock dominate the riparian zone in the upper reaches while residential, commercial and industrial land uses are dominate near the mouth. Stream habitat assessment surveys indicate poor habitat and dissolved oxygen measurements showed several violations of the state standard (5 mg/l).

Ashwaubenon Creek (WBIC 122200)
Ashwaubenon Creek, a 15-mile sluggish, hard water stream flowing through agricultural and residential Brown County. Bottom materials consist of rubble, gravel and silt. In the agricultural portion of the stream the stream banks and hills are bare and erosion heavy due to cattle pasturing. In the residential area the stream is filled with litter and debris. Nonpoint source pollution, point source pollution and urban stormwater runoff singly or in combination cause sedimentation, low dissolved oxygen levels, all of which contribute to poor water quality. Dissolved oxygen and temperature were monitored to document swings in DO due to external factors like rain or plants. Violation of the 5 mg/l state DO standard occurred often. Low or no stream flow during critical summer months also plays a major role in limiting aquatic life in the watershed (Johnson 1996).

The 2018 assessments of Ashwaubenon Creek showed continued impairment by phosphorus; new total phosphorus sample data overwhelmingly exceeded 2018 WisCALM listing criteria for the Fish and Aquatic Life use, however, available biological data did not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category).

Hemlock Creek (WBIC 122600)
Hemlock Creek, a 7-mile stream, is impacted by low flow during the summer months. Streambanks are generally in poor condition and buffering is limited or absent. Crops and livestock dominate the riparian zones (Johnson 1996).

North Branch Ashwaubenon Creek (WBIC 123200)
North Branch Ashwaubenon Creek, in the Apple and Ashwaubenon Creeks Watershed, is a 7.50-mile river that falls in Brown and Outagamie Counties. This river is managed for fishing and swimming and is currently not considered impaired.

South Branch Ashwaubenon Creek (WBIC 123400)
South Branch Ashwaubenon Creek, in the Apple and Ashwaubenon Creeks Watershed, is a 6.24-mile river that falls in Brown and Outagamie Counties. This river is managed for fishing and swimming and is currently not considered impaired.

Apple Creek (WBIC 124100)
Apple Creek, a 24-mile creek, is usually dry except for scattered pools near road crossings and toward the mouth of the river where it drains into the Fox River. Bottom materials are silt, rubble and gravel, with few boulders. The 2018 assessments of Apple Creek (miles 0-3.99) showed continued impairment by phosphorus; new total phosphorus sample data overwhelmingly exceeded 2018 WisCALM listing criteria for the Fish and Aquatic Life use, however, available biological data did not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category). Based on the most updated information, no change in existing impaired waters listing is needed. The 2018 assessments showed continued impairment by temperature; new temperature sample data exceeded 2018 WisCALM listing criteria for the Fish and Aquatic Life use. Based on the most updated information, no change in existing impaired waters listing is needed.

Watershed (LF05) Narratives

Duck Creek (WBIC 409700)
Overview 02/01/1999 Duck Creek is a 42-mile hard water stream that originates in Burma Swamp, located in central Outagamie County, and winds northeast until it empties into the bay of Green Bay, just north of the city of Green Bay. The drainage area of the Duck Creek Watershed encompasses 152 square miles with land use in the upper portion being primarily agricultural and the lower portion being predominantly residential and urban. A Fisheries and Habitat Evaluation Assessment Plan (FHEAP) was designed for Duck Creek by the U.S. Fish and Wildlife Service, WDNR and the Oneida Tribe of Indians.

This project provided information on the habitat and fish community of the Duck Creek Watershed. Sampling included fish collection and identification, population estimates and habitat evaluations. A final report will be available sometime this year (1998). The resident fishery consists primarily of panfish, bullheads and northern pike while seasonal runs of salmon, yellow perch, northern pike, walleye and suckers occur. A species of special concern, the redside dace, is present in a portion of Duck Creek. Most of Duck Creek is classified as a warm water sport fishery with the exception of the upper reaches which are classified as warm water forage fishery. Duck Creek is impacted by a multitude of negative landuse practices: Streambank buffers are rare, livestock and cropping occur right up to the streambank and ditching is prevalent. The result is erosion causing turbid water, warmer water temperatures, lower dissolved oxygen levels, stream flashiness and dramatic water fluctuation including periods of ponding and no flow (Johnson 1996 & 1998). The Water Resources Division of the U.S. Geological Survey, in cooperation with local, State and Federal agencies, obtains a large amount of data pertaining to the water resources of Wisconsin each year (Holmstrom 1995).

A gauging station is located on Duck Creek on the right bank upstream from the HWY FF Road bridge, near Howard. The station has been in service since April 1988. The type of data being collected include: chemical, discharge, sediment, and water temperature. Please refer to the U.S. Geological Survey Water Resource Data Wisconsin Water Year 1996 for specific data. The USGS also has a National Water Quality Assessment (NAWQA) station located on Duck Creek at Seminary Road. This station began collecting samples in March 1993. Parameters which were collected include: pesticides, macroinvertebrates, sediments, algae, habitat evaluations were conducted, caddisfly and fish tissue analysis was performed and vegetation plot surveys were completed (Johnson 1996).

The 2018 assessments of Duck Creek (miles 0-4.96) showed continued impairment by phosphorus; new total phosphorus sample data exceeded 2018 WisCALM listing criteria for the Fish and Aquatic Life use, however, available biological data did not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category). Based on the most updated information, no change in existing impaired waters listing is needed.

The 2018 assessments of Duck Creek (miles 25.69-32.9) showed continued impairment by phosphorus; new total phosphorus sample data overwhelmingly exceeded 2018 WisCALM listing criteria for the Fish and Aquatic Life use, however, available biological data did not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category). Based on the most updated information, no change in existing impaired waters listing is needed.

Lancaster Creek (WBIC 410000)
Lancaster Creek (WBIC 410000) from Indian Trail to headwaters was assessed during the 2018 listing cycle; new biological (fish Index of Biotic Integrity (IBI) scores) and temperature sample data were clearly below 2018 WisCALM listing thresholds for the Fish and Aquatic Life use. This water is meeting this designated use and is not considered impaired.

Thornberry Creek (WBIC 410050)

Overview 10/17/2011 Thornberry Creek, in the Duck Creek Watershed, is a 1.43 mile river that falls in Brown County. This river is a Class I Trout Water under the Fisheries Program. This river is managed for fishing and swimming and is currently not considered impaired.

Beaver Dam Creek (WBIC 410100)

Beaver Dam Creek is a small, shallow stream originating Southwest High School and meanders its way north 4 miles to eventually drain into the Duck Creek near Velp Avenue. The stream is very flashy and carries a considerable sediment load. Substrate is made up of gravel, cobble and some soft sediments. The stream has a "fair" habitat rating below Memorial Drive. Macroinvertebrates collected there in October 1994 rated water quality as "poor", in April 1995 water quality was rated as "fairly poor". Oxygen levels recorded in August and September 1995 never fell below 6 mg/l. This stream has a history of fish kills occurring every 2-3 years since the 1970's. they have been caused by ammonia spills, discharges of blood (very high BOD) from a rendering plant and other, mostly industrial practices. Fish kills are not normally severe in Beaver Dam Creek because there are not many resident fish present and most of the fish that are there can migrate downstream to Duck Creek and Green Bay. No fish surveys were conducted during the priority watershed appraisal monitoring, though it is presumed that any fish species living in Duck Creek can travel up Beaver Dam Creek (Johnson 1996).

Trout Creek (WBIC 410200)

Trout Creek is an 8-mile hard water stream that is a tributary to Duck Creek. Trout Creek is classified as a warm water sport fishery. Trout Creek drains 19.5 square miles of land, of which 74% is agricultural. The lower and mainstem reach have relatively steep topography, are well buffered by woodlands and have few nonpoint source impacts. The headwaters originate in areas with more gentle topography, poor buffering and significant nonpoint source impacts. Habitat evaluations conducted in 1995 ranked the creek from "poor" to "fair". HBI values taken at Western Drive indicated "good" water quality. Dissolved oxygen (D.O.) readings taken during the summer of 1995 showed significant diurnal D.O. swings with several violations of the 5 mg/l state standard. Water chemistry results from the spring of 1995 depicted very high amounts of suspended solids. The upper reaches of Trout Creek would greatly benefit from nonpoint source controls (Johnson 1996).

Appendix D: Fish Assemblage Results

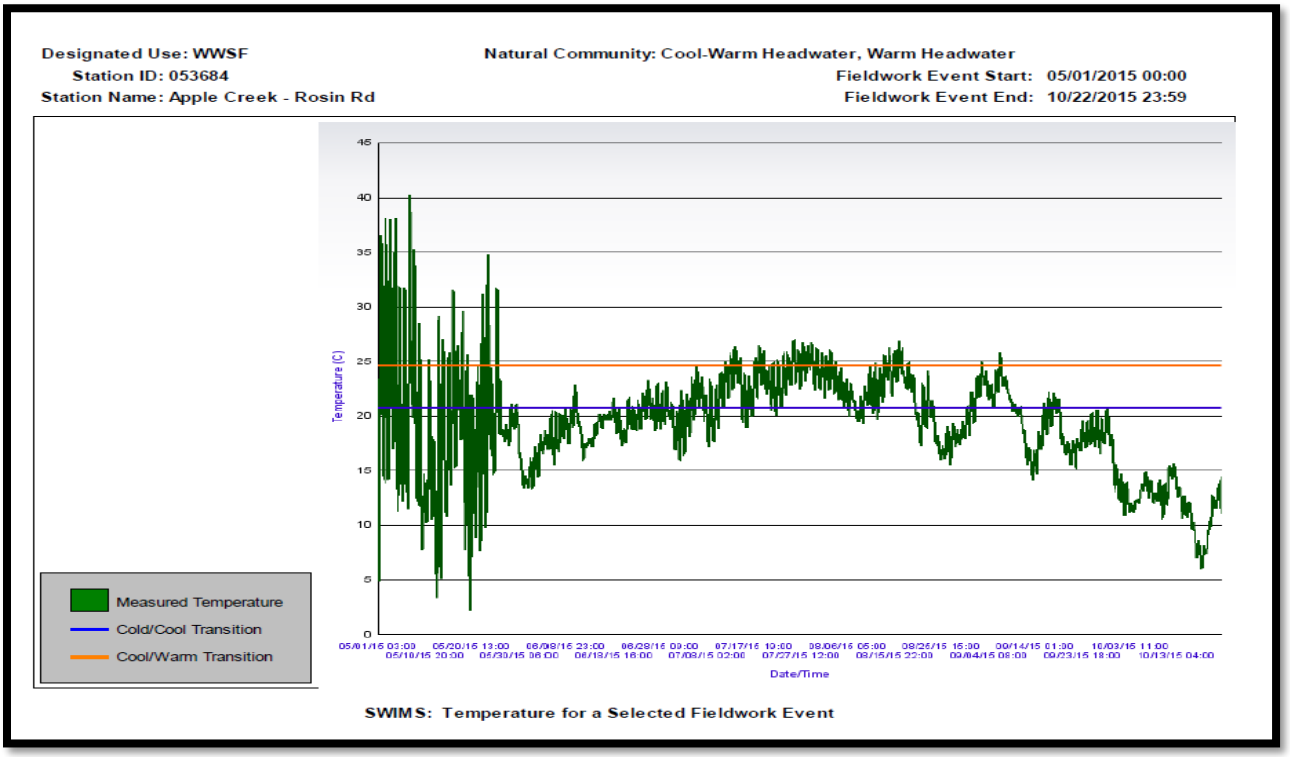
Stream - Site	Apple Creek Rosin Road	UNT to Apple Creek McCabe Road	UNT to Apple Creek Farrell Road	Apple Creek Garrity Road	Apple Creek STH 55	Apple Creek Holland Road	Apple Creek French Road	UNT to Apple Creek STH 55	UNT to Apple Creek Wrightstown Road	UNT to Apple Creek CTH JJ	Apple Creek CTH J	
Stream Order	4	3	3	4	3	3	3	3	2	2	4	
Mean Stream Width	10	3.0	3	7	7	5	6	3.00	3	2.00	7	
Station Length	400	105	105	245	245	175	210	105	105	105	245	
Nat. Comm. Classification	CWHW	CWHW	CWHW	CWHW	CWHW	CWHW	CWHW	CWHW	CWHW	CCHW	CWHW	
Verified Nat. Comm.	CWMS	CWHW	CWHW	CWHW	CWHW	CWHW	WHW	CWHW	CWHW	CCHW	CWMS	
Fish Species												Total
Black Bullhead				1	1			4				6
Black Crappie	5											5
Bluegill					1							1
Bluntnose Minnow	181			16	36	7	1	2			39	282
Brook Stickleback		34	338				2	3	42	76	10	505
Common Shiner	221			53	47	1	3	8			35	368
Common Carp					1		16	1			1	19
Creek Chub	531	9	12	462	119	17		12	11	19	269	1461
Fathead Minnow	17	14	47	4	12	28	18	3		26	33	202
Gizzard Shad	57			2								59
Green Sunfish	102	2	10	30	123	14	19	15	1	10	32	358
Johnny Darter	44	31	80	225	54	17	7	2	24	2	302	788
Largemouth Bass	2			3	8	4	31				2	50
Pumpkinseed	1											1
Round Goby	78			30							3	111
Shorthead Redhorse	11			4								15
Spotfin Shiner	10											10
White Sucker	176	32	18	101	65	6		3		1	134	536
Yellow Perch					1							1
Totals	1436	122	505	931	468	94	97	53	78	134	860	4778
# species	14	6	6	12	12	8	8	10	4	6	11	
19 species												
IBI Score												
Coldwater	-	-	-	-	-	-	-	-	-	-	-	
Coolwater (CC)	-	-	-	-	-	-	-	-	-	-	-	
Coolwater (CW)	G 60	-	-	-	-	-	-	-	-	-	F 40	
Warmwater	-	-	-	-	-	-	-	-	-	-	-	
Small Stream	F 60	F 60	G 70	F 60	F 60	F 50	F 50	F 50	F 40	F 50	G 70	

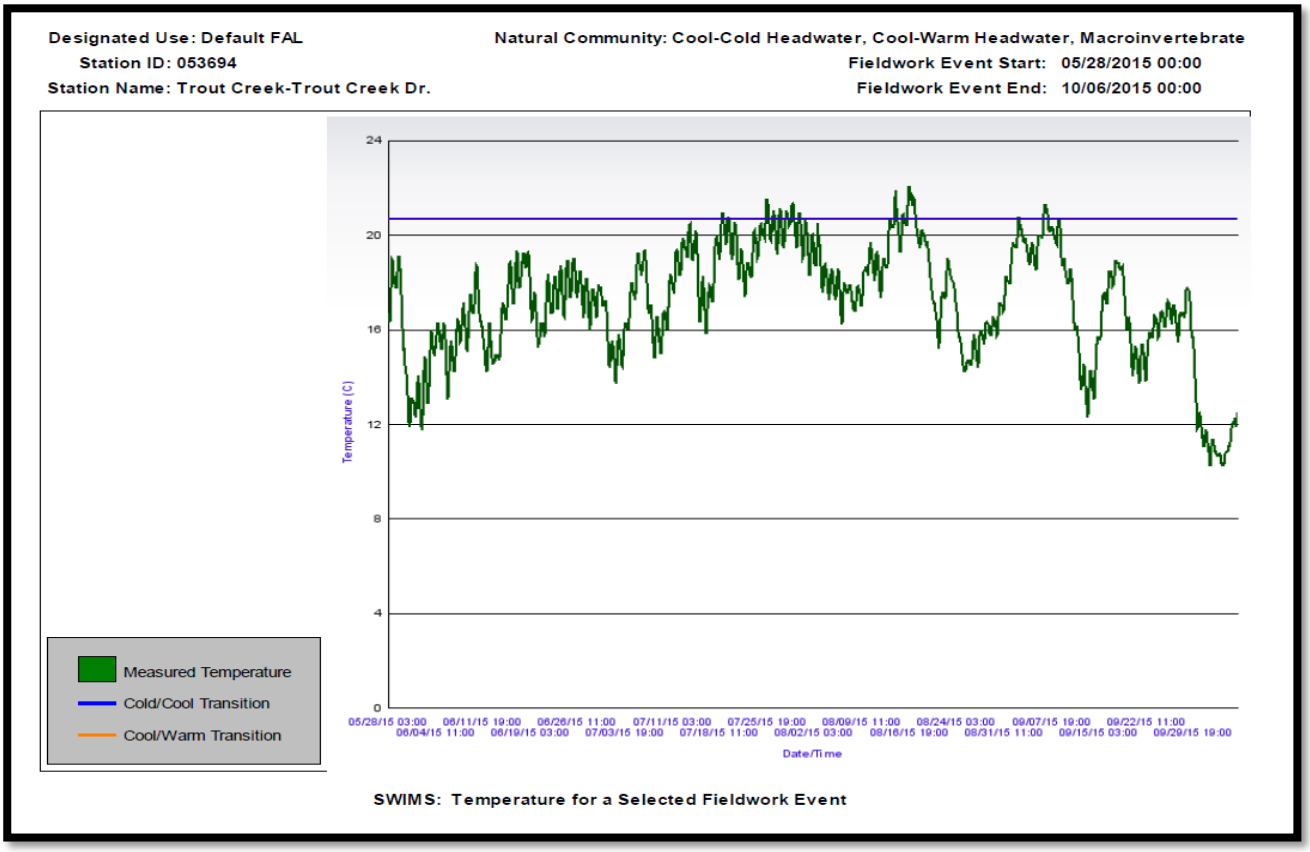
Stream - Site	Duck Creek CTH S	UNT (silver Creek) to Duck Creek STH 54	Duck Creek CTH C	Duck Creek Tip Road	Duck Creek CTH EE	UNT to Duck Creek Lambie Road	Duck Creek Pamperin Park	UNT to Duck Creek Ranch Road	Duck Creek Krueger Road	UNT to Duck Creek Old Seymour Road	Duck Creek Center Valley Road	UNT to Duck Creek Ray Road	Duck Creek Seminary Road	UNT to Duck Creek (E) Old Seymour Road	
Stream Order	4	2	4	4	4	4	5	3	3	3	4	3	5	2	
Mean Stream Width	13	3.0	7	10	4	4	19	4.00	3.5	3.00	6	3	12	3.0	
Station Length	400	105	245	350	140	140	400	140	125	105	210	105	400	105	
Nat. Comm. Classification	CWHW	CCHW	CWHW	CWHW	CWHW	CCHW	CWHW	CWHW	CWHW	CWHW	CWHW	MAC	CWHW	MAC	
V. Nat. Comm. Classification	CWHW	CWMS	CWHW	CWHW	CWHW	CCHW	CWMS	CWHW	CWHW	CWHW	CWHW	MAC	CWHW	MAC	
Fish Species															Total
Black Bullhead	4										2				6
Black Crappie							1								1
W. Blacknose Dace		16	30	15			3	17			69	3	19	2	174
Blackside Darter			18	4			12						11		45
Bluntnose Minnow		1		2			83				4				90
Brook Stickleback	36	42	169	3	54	132	2	30		178	2	204	3	150	1005
Central Mudminnow	145	6	56	19	618	25	4	73	11	32	53	38	21	45	1146
Common Shiner	7			34			342		1		56		11		451
Common Carp	27														27
Creek Chub	2	30	11	79	3	9	130	80	1	2	134	1	99	73	654
Emerald Shiner							47								47
Fathead Minnow	3	7		1	1	4	23	11			8	5		19	82
Gizzard Shad							55								55
Golden Redhorse					2										2
Golden Shiner	6														6
Green Sunfish	12		2			6	1	10			1	2	6	1	41
Johnny Darter	5	57	107	16	1	42	46	54		5	30	15	33	6	417
Largemouth Bass							2								2
Logperch							62						4		66
Longnose Dace		65	16				156				69		23		329
Northern Pike	1						1								2
Northern Redbelly Dace														1	1
Pearl Dace				5	1			20			26	4	33	47	136
Pumpkinseed	2														2
Redside Dace				2											2
Rock Bass		38					22				2				62
Round Goby							206								206
Smallmouth Bass							2								2
Walleye							1								1
White Sucker	165	8	33	18	5	5	88	39	2	2	26	7	38	4	440
Yellow Perch							57								57
Totals	415	270	442	198	685	223	1346	334	15	219	482	279	301	348	5557
# species	13	10	9	12	8	7	23	9	4	5	14	9	12	10	
31 species															
IBI Score															
Coolwater (CC)	-	E 70	-	-	-	-	-	-	-	-	-	-	-	-	
Coolwater (CW)	-	-	-	-	-	-	E 90	-	-	-	-	-	-	-	
Small Stream	F 60	-	G 80	G 90	G 70	F 60	-	G 90	P 20	P 30	G 90	G 80	F 60	E 100	

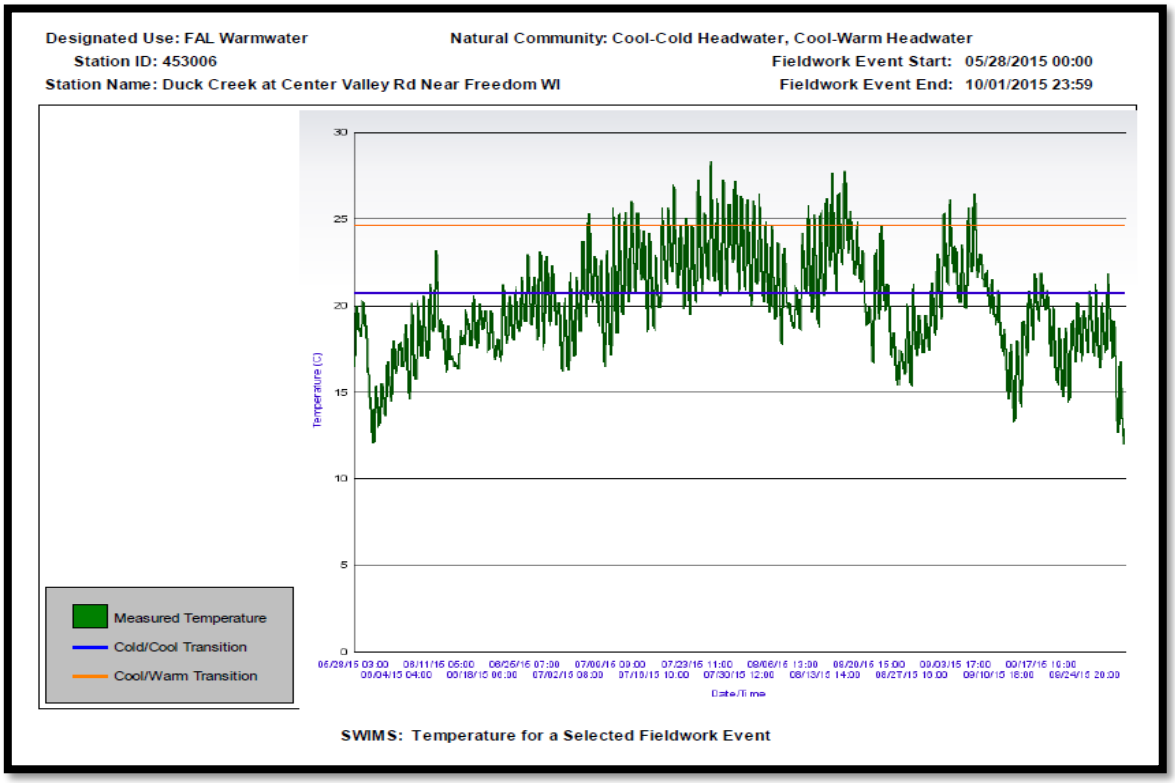
Stream - Site	Beaver Dam Creek Memorial Drive	Trout Creek CTH FF	Trout Creek Trout Creek Road	Trout Creek Overland Road	Trout Creek CTH U	UNT to Trout Creek Shady Lane	Lancaster Creek Lakeview	Lancaster Creek Navajo Trail	Thornberry Creek Centennial Blvd/ CTH FF	Thornberry Creek Forest Road	UNT to Thornberry Hill Road	Lancaster Creek Shawano Ave	Lancaster Creek Evergreen Dr	
Stream Order	2	3	3	3	2	2	3	3	2	1	1	3	2	
Mean Stream Width	5.5	5	6	3.5	2	3.00	5	3.00	3	2	2	3	3	
Station Length	190	175	210	130	105	105	175	105	105	105	105	105	105	
Nat. Comm. Classification	CWHW	CWHW	CWHW	CCHW	CCHW	CCHW	CCHW	CCHW	CCHW	CCHW	CWHW	CCHW	CCHW	
V. Nat. Comm. Classification	CWMS	CWHW	CWHW	CWHW	CWHW	CWHW	CWMS	CWHW	CWHW	CCHW	CWHW	CCHW	CCHW	
Fish Species														Total
Black Bullhead	1		1			1								3
W. Blacknose Dace		25			17							1	1	44
Blackside Darter	1	8	1											10
Bluntnose Minnow	13													13
Brook Stickleback	1	13	38	6	5	21			1	40	47			172
Burbot							4							4
Central Mudminnow	4	14	65	22	36	16		2	2	1	43		2	207
Common Shiner	39	3	3				2	1				4		52
Creek Chub	39	216	448	19	18	2	12	56	67		17	42	114	1050
Fathead Minnow	13		3		1			3	23	6	22	16	24	111
Gizzard Shad	1													1
Green Sunfish	20	2	9	1			17	4	3			16	1	73
Johnny Darter	7	61	67	12	1	2	7	17	15	1	21	9	4	224
Lamprey Ammocytes									2					2
Largemouth Bass			4				1							5
Logperch	1						2					5		8
Longnose Dace		139	142	15		5		11	2			2		316
Northern Pike							14							14
Northern Redbelly Dace			4		9	1					7			21
Pearl Dace		1	14	8	34	21							6	84
Pumpkinseed							1							1
Redside Dace		24	85	3										112
Rock Bass	7						6							13
Round Goby	10						32					1		43
White Sucker	32	22	46	4			25	9	5			3	9	155
Yellow Perch	8						56							64
Totals	197	528	930	90	121	69	179	103	120	48	157	99	161	2802
# species	16	12	15	9	8	8	13	8	9	4	6	10	8	
26 species														
IBI Score														
Coolwater (CC)	-	-	-	-	-	-	-	-	-	-	-			
Coolwater (CW)	G 60	-	-	-	-	-	E 70	-	-	-	-			
Small Stream	-	E 100	E 100	E 100	G 90	G 90	-	F 50	F 50	P 30	G 80	F 50	F 50	

Stream - Site	Ashwaubenon Creek Grant Road	Hemlock Creek Sand Acres Drive	Ashwaubenon Creek Creamery Road	Dutchman Creek Oneida Street	Dutchman Creek Overland Road	Dutchman Creek Pine Tree Hill Road	
Stream Order	4	3	3	3	3	3	
Mean Stream Width	6	4.0	6	8	3	2.5	
Station Length	210	140	210	280	105	105	
Nat. Comm. Classification	CWHW	CCHW	CWHW	CWHW	CCHW	CCHW	
Ver Nat. Comm. Classification	CWHW	CWMS	CWHW	CWMS	CCHW	CWHW	
Fish Species							Total
Black Bullhead	18	8	42	1			69
Black Crappie	1						1
Bluegill			1				1
Brook Stickleback		16	49	2	77	93	237
Central Mudminnow	1	4	52	35	14	2	108
Common Shiner	1		5	5			11
Common Carp			1				1
Creek Chub	86	33	230	55		9	413
Emerald Shiner				36			36
Fathead Minnow	1	16	226		1	4	248
Gizzard Shad			1	3			4
Golden Shiner			1				1
Green Sunfish	1		2	7			10
Johnny Darter	19	68	141	35		36	299
Largemouth Bass	1		2	1			4
Logperch				6			6
Northern Pike	4			2			6
Round Goby	7			164			171
Spotfin Shiner				2			2
White Sucker	35	5	139	32			211
Yellow Perch	3	1		60			64
Totals	178	151	892	446	92	144	1903
# species	13	8	14	16	3	5	
21 species							
IBI Score							
Coldwater	-	-	-	-	-	-	
Coolwater (CC)	-	-	-	-	-	-	
Coolwater (CW)	-	G 50	-	E 70	-	-	
Warmwater	-	-	-	-	-	-	
Small Stream	F 60	G 70	G 80	-	P 30	F 50	

Appendix E: Temperature Graphs



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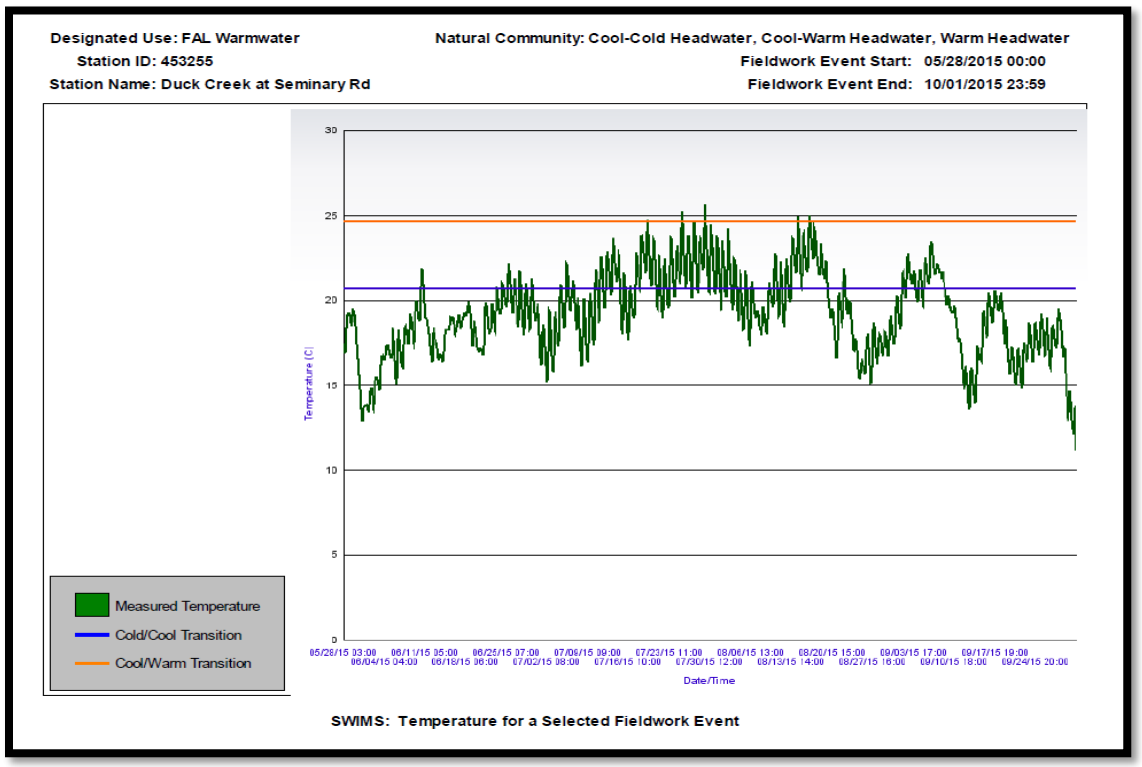
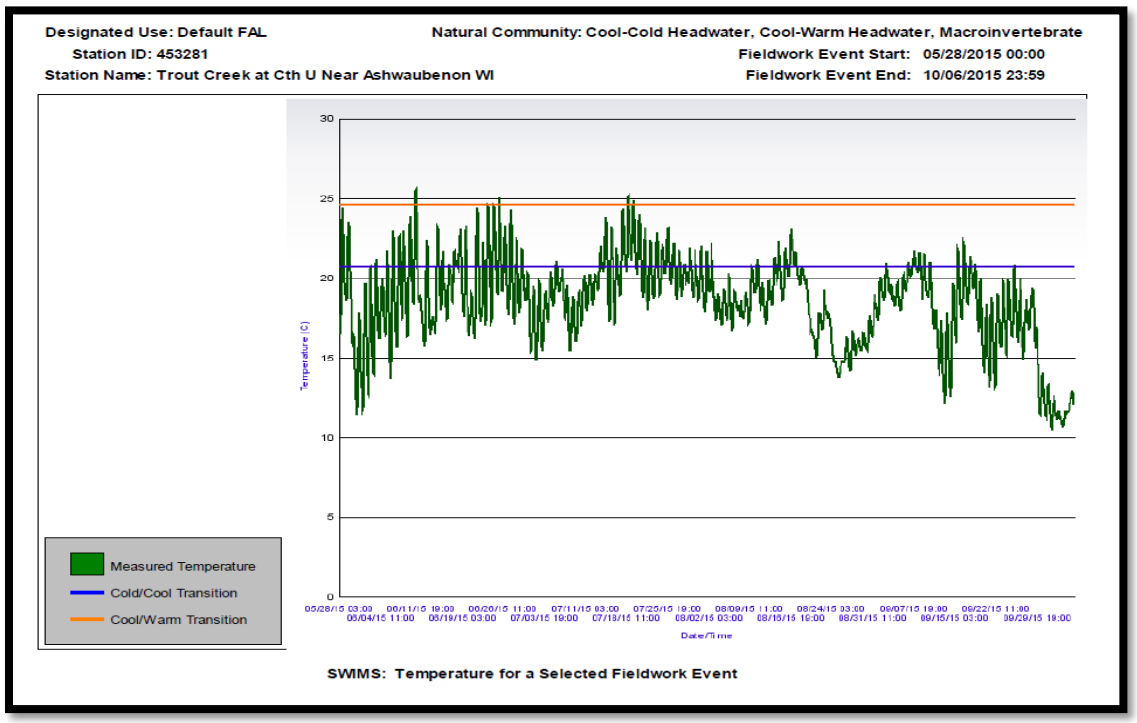
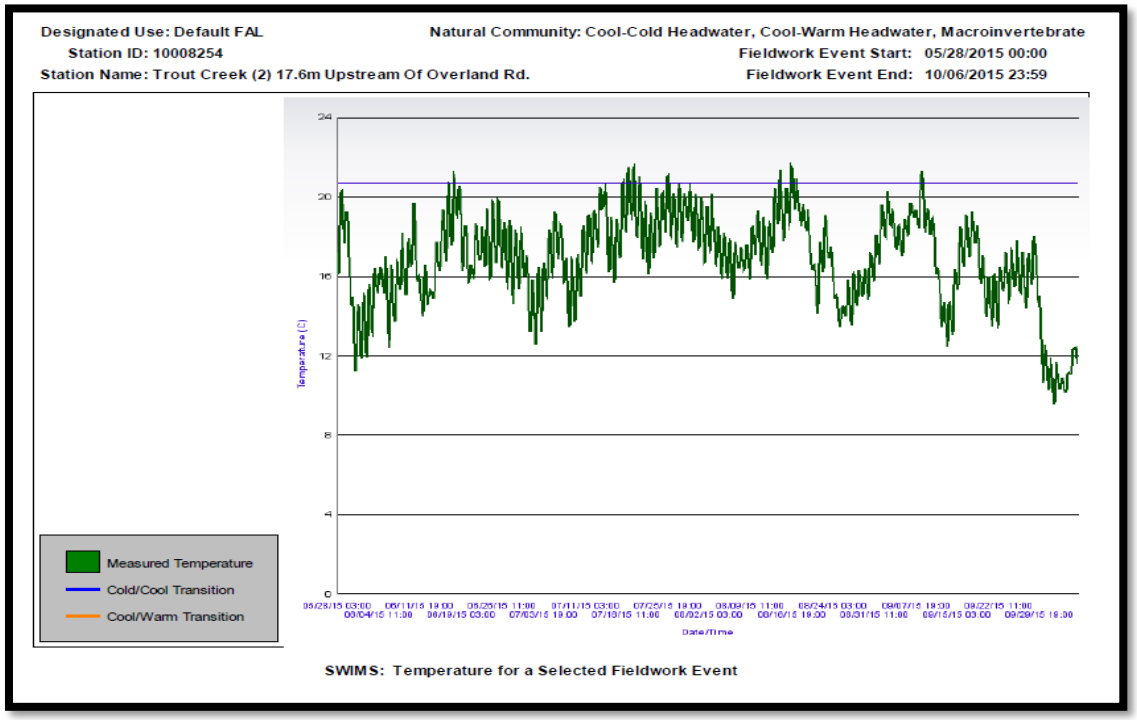
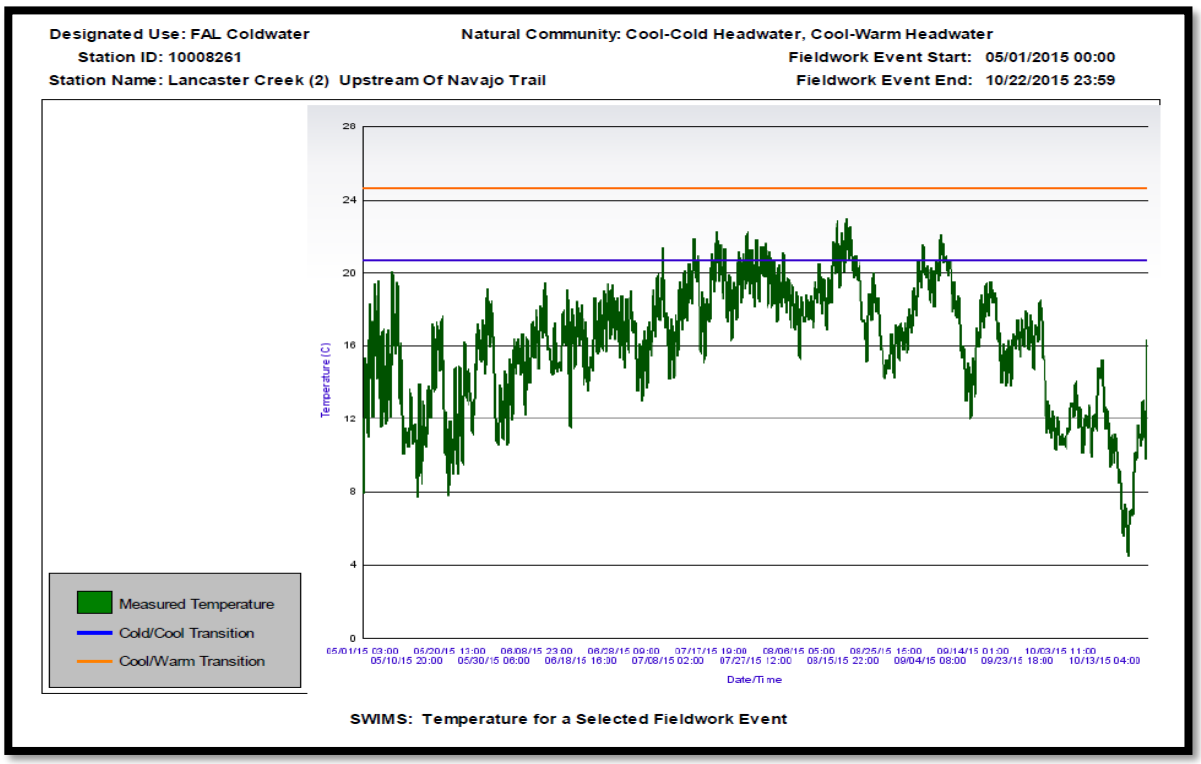
Natural Community: Cool-Cold Headwater, Cool-Warm Headwater
Station ID: 453006
Fieldwork Event Start: 05/28/2015 00:00
Station Name: Duck Creek at Center Valley Rd Near Freedom WI
Fieldwork Event End: 10/01/2015 23:59
Temperature (C)
Date/Time
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
SWIMS: Temperature for a Selected Fieldwork Event

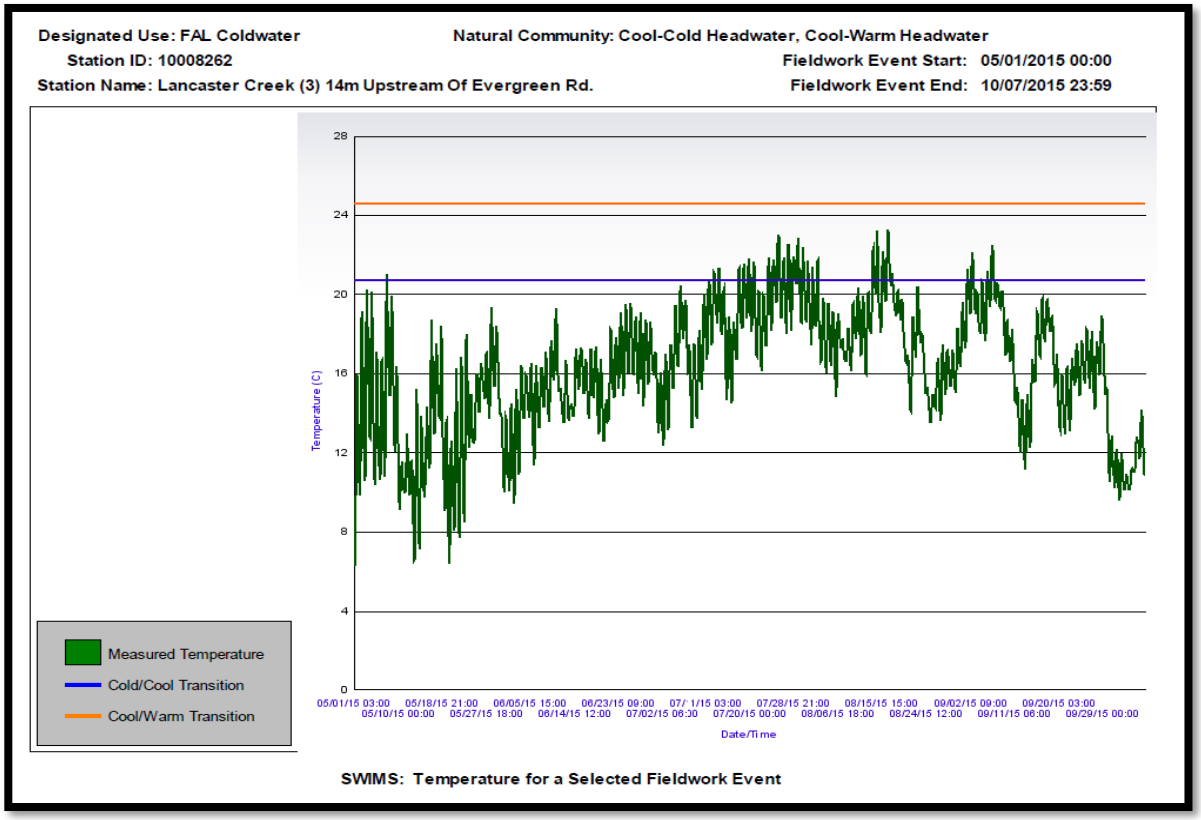

Designated Use: FAL Warmwater
Natural Community: Cool-Cold Headwater, Cool-Warm Headwater, Warm Headwater
Station ID: 453255
Fieldwork Event Start: 05/28/2015 00:00
Station Name: Duck Creek at Seminary Rd
Fieldwork Event End: 10/01/2015 23:59
Temperature (C)
Date/Time
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
SWIMS: Temperature for a Selected Fieldwork Event


Designated Use: Default FAL
Natural Community: Cool-Cold Headwater, Cool-Warm Headwater, Macroinvertebrate
Station ID: 453281
Fieldwork Event Start: 05/28/2015 00:00
Station Name: Trout Creek at Cth U Near Ashwaubenon WI
Fieldwork Event End: 10/06/2015 23:59
Temperature (C)
Date/Time
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
SWIMS: Temperature for a Selected Fieldwork Event

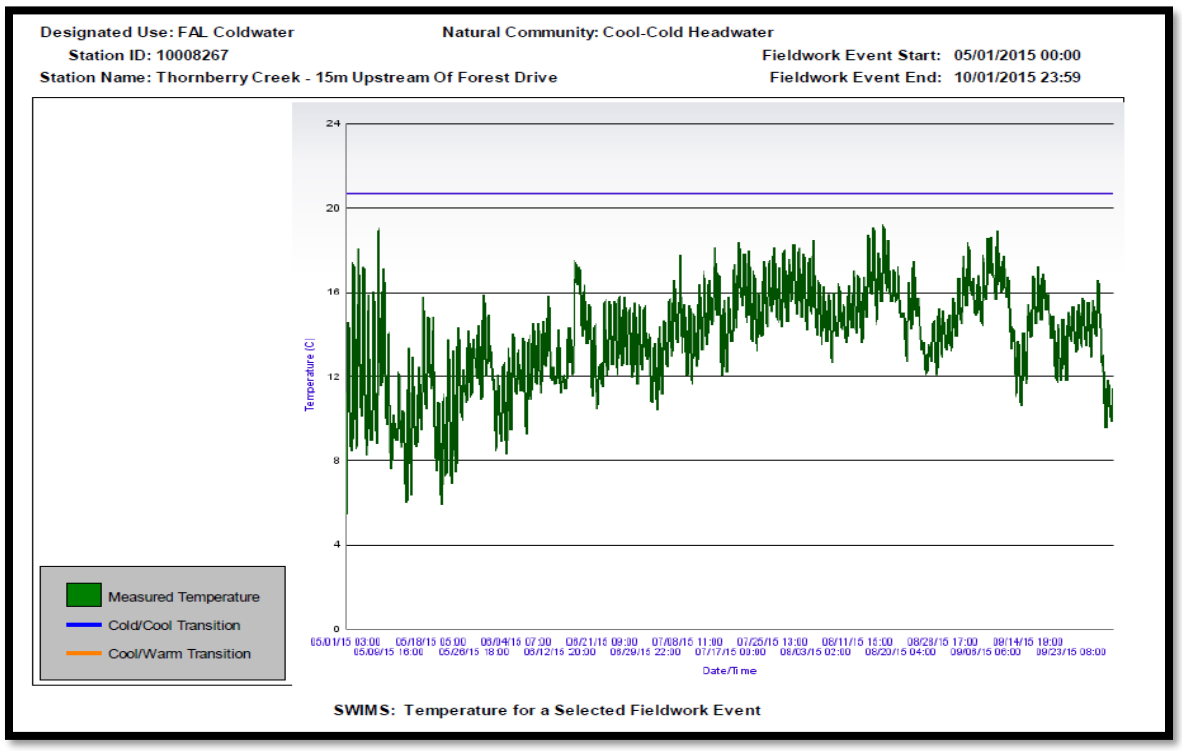

Designated Use: Default FAL
Natural Community: Cool-Cold Headwater, Cool-Warm Headwater, Macroinvertebrate
Station ID: 10008254
Fieldwork Event Start: 05/28/2015 00:00
Station Name: Trout Creek (2) 17.6m Upstream Of Overland Rd.
Fieldwork Event End: 10/06/2015 23:59
Temperature (C)
Date/Time
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
SWIMS: Temperature for a Selected Fieldwork Event

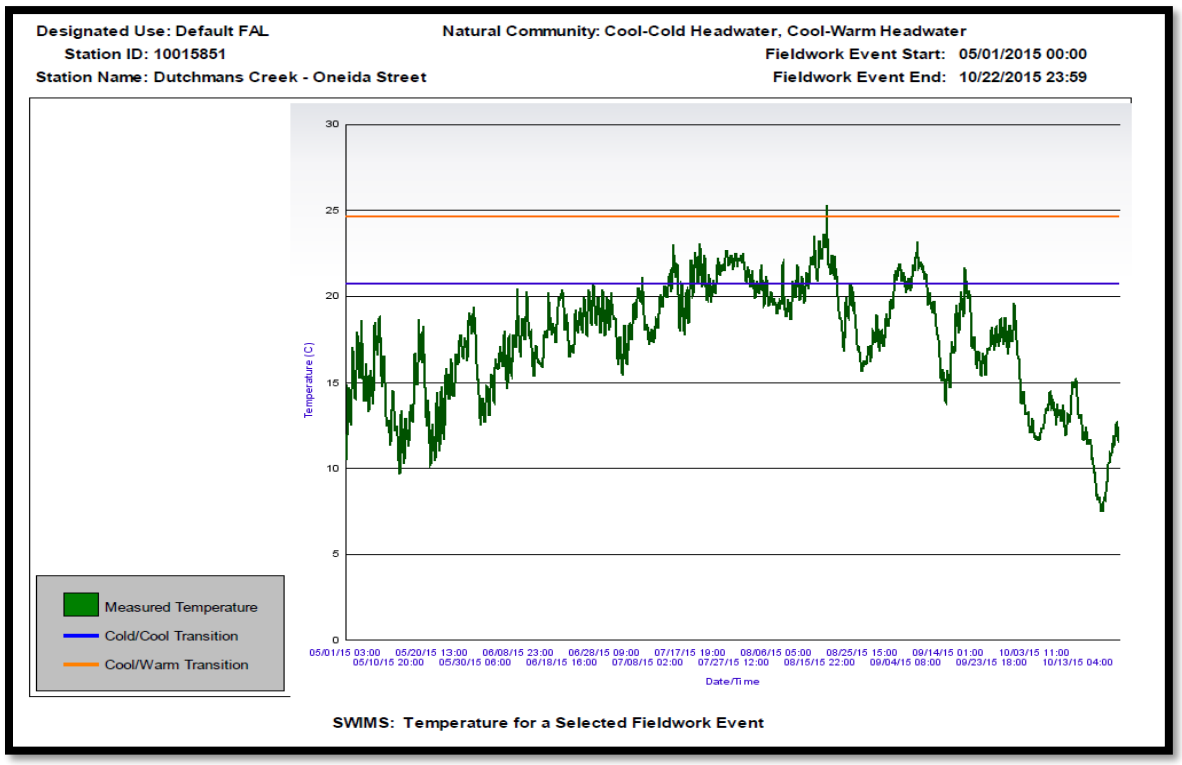


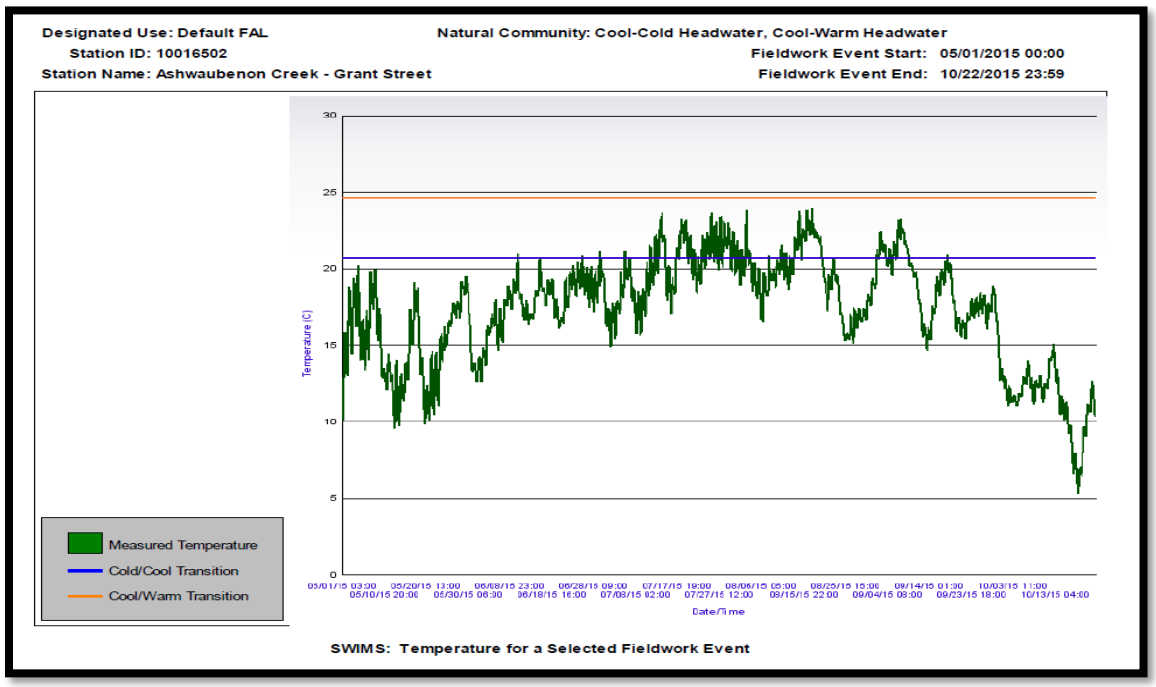
SWIMS: Temperature for a Selected Fieldwork Event

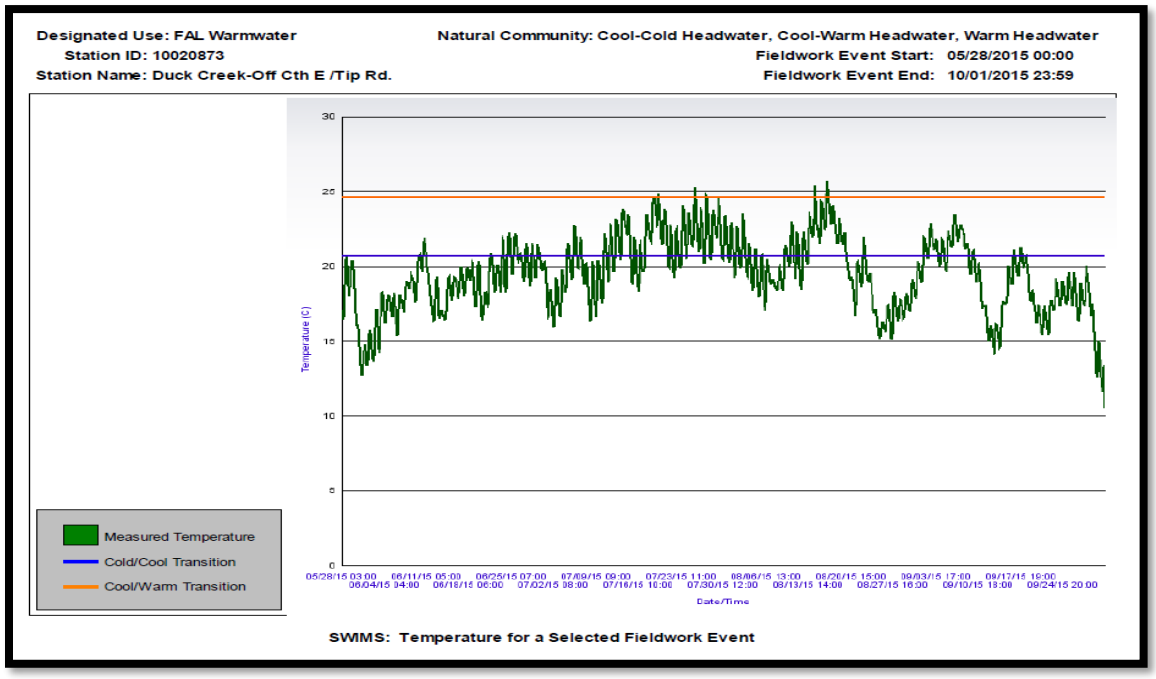


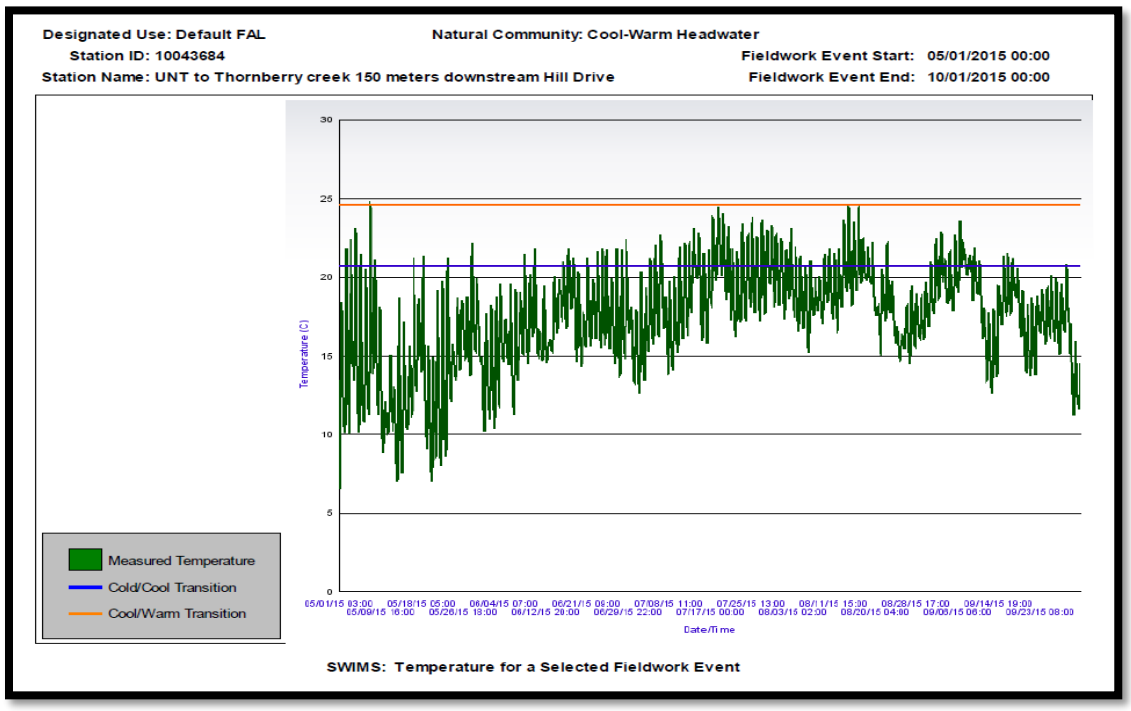
SWIMS: Temperature for a Selected Fieldwork Event

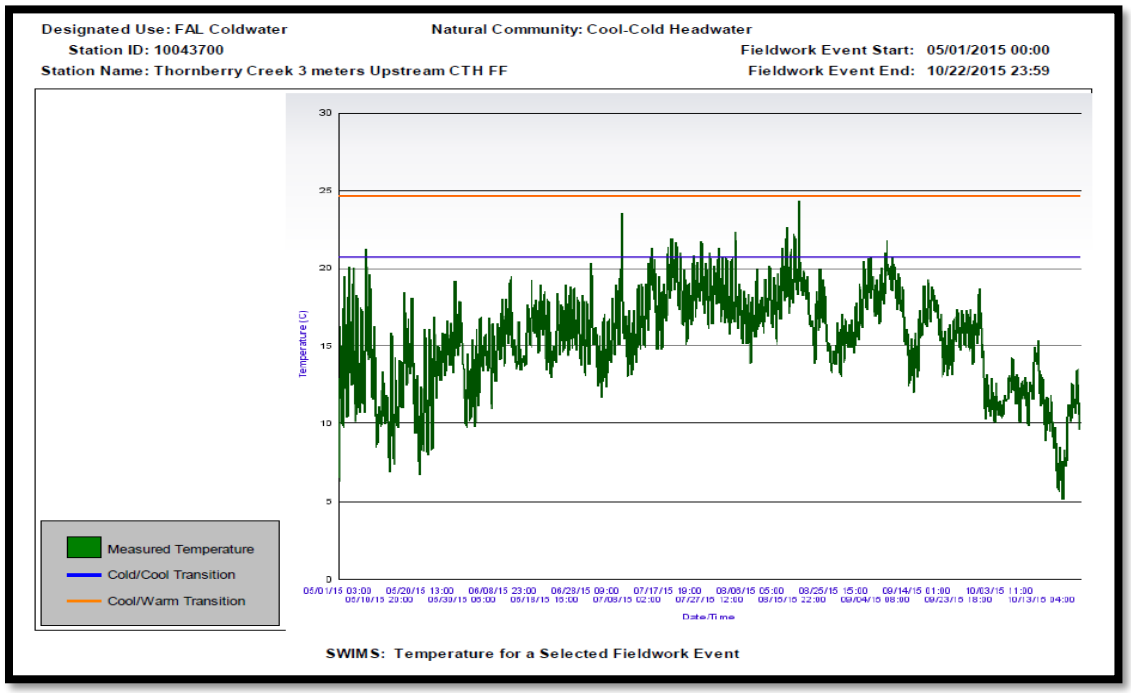

Designated Use: FAL Coldwater
Natural Community: Cool-Cold Headwater
Station ID: 10008267
Fieldwork Event Start: 05/01/2015 00:00
Station Name: Thornberry Creek - 15m Upstream Of Forest Drive
Fieldwork Event End: 10/01/2015 23:59
Temperature (C)
Date/Time
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
SWIMS: Temperature for a Selected Fieldwork Event

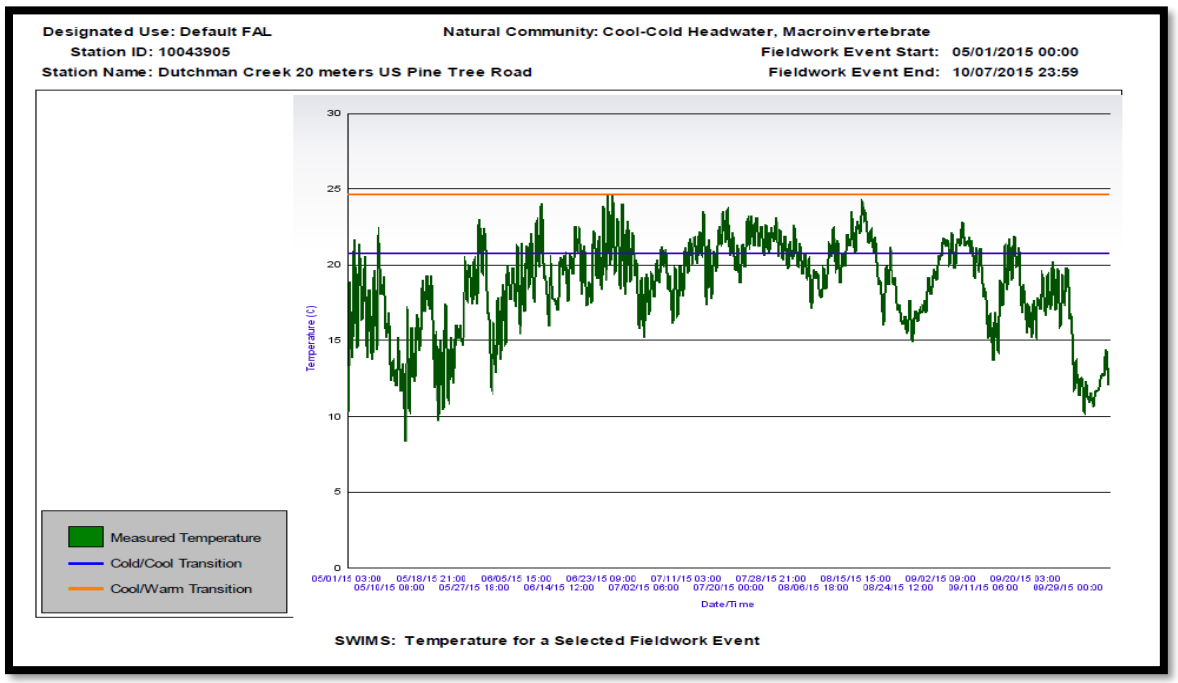

Designated Use: Default FAL
Natural Community: Cool-Cold Headwater, Cool-Warm Headwater
Station ID: 10015851
Fieldwork Event Start: 05/01/2015 00:00
Station Name: Dutchmans Creek - Oneida Street
Fieldwork Event End: 10/22/2015 23:59
Temperature (C)
Date/Time
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
SWIMS: Temperature for a Selected Fieldwork Event

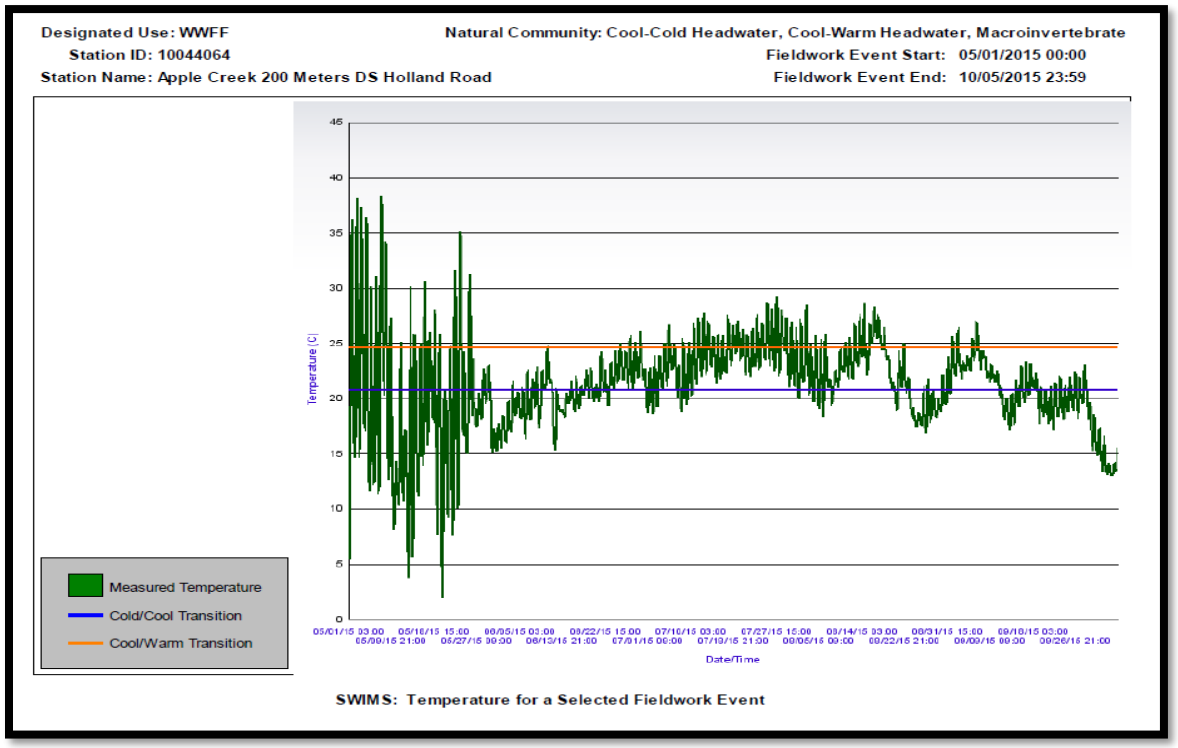

Designated Use: Default FAL
Natural Community: Cool-Cold Headwater, Cool-Warm Headwater
Station ID: 10016502
Fieldwork Event Start: 05/01/2015 00:00
Station Name: Ashwaubenon Creek - Grant Street
Fieldwork Event End: 10/22/2015 23:59
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
Temperature (C)
Date/Time
SWIMS: Temperature for a Selected Fieldwork Event


Designated Use: FAL Warmwater
Natural Community: Cool-Cold Headwater, Cool-Warm Headwater, Warm Headwater
Station ID: 10020873
Fieldwork Event Start: 05/28/2015 00:00
Station Name: Duck Creek-Off Cth E /Tip Rd.
Fieldwork Event End: 10/01/2015 23:59
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
Temperature (C)
Date/Time
SWIMS: Temperature for a Selected Fieldwork Event


Designated Use: Default FAL
Natural Community: Cool-Warm Headwater
Station ID: 10043684
Fieldwork Event Start: 05/01/2015 00:00
Station Name: UNT to Thornberry creek 150 meters downstream Hill Drive
Fieldwork Event End: 10/01/2015 00:00
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
Temperature (C)
Date/Time
SWIMS: Temperature for a Selected Fieldwork Event


Designated Use: FAL Coldwater
Natural Community: Cool-Cold Headwater
Station ID: 10043700
Fieldwork Event Start: 05/01/2015 00:00
Station Name: Thornberry Creek 3 meters Upstream CTH FF
Fieldwork Event End: 10/22/2015 23:59
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
Temperature (C)
Date/Time
SWIMS: Temperature for a Selected Fieldwork Event


Designated Use: Default FAL
Natural Community: Cool-Cold Headwater, Macroinvertebrate
Station ID: 10043905
Fieldwork Event Start: 05/01/2015 00:00
Station Name: Dutchman Creek 20 meters US Pine Tree Road
Fieldwork Event End: 10/07/2015 23:59
Temperature (C)
Date/Time
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
SWIMS: Temperature for a Selected Fieldwork Event


Designated Use: WWFF
Natural Community: Cool-Cold Headwater, Cool-Warm Headwater, Macroinvertebrate
Station ID: 10044064
Fieldwork Event Start: 05/01/2015 00:00
Station Name: Apple Creek 200 Meters DS Holland Road
Fieldwork Event End: 10/05/2015 23:59
Temperature (C)
Date/Time
Measured Temperature
Cold/Cool Transition
Cool/Warm Transition
SWIMS: Temperature for a Selected Fieldwork Event

Appendix F: Water Quality Standards Assessment Table[1]

Water-shed	WBIC	Waterbody Name	Start Mile	End Mile	Current Use	Attain-able Use	Supporting Use	Designated Use	Impairment	Sources	Assess-ment	Impaired Water Status
LF02	117900	Lower Fox River (Depere Dam To Middle Appleton Dam)	7.39	32.18	WWSF	WWSF	Not Supporting	Default FAL	Contaminated Fish Tissue, Low DO	Industrial Point Source Discharge, Contaminated Sediments, Non-Point Source (Rural or Urban), Discharges from Municipal Separate Storm Sewer Systems (MS4)	Monitored	EAP Project, TMDL Approved
LF02	121600	Dutchman Creek	0	4.04	WWFF	WWSF	Not Supporting	Default FAL	Chronic Aquatic Toxicity, Low DO, Degraded Biological Community	Site Clearance (Land Development or Redevelopment), Livestock (Grazing or Feeding Operations), Industrial Point Source Discharge, Animal Feeding Operations (NPS), Non-Point Source (Rural or Urban), Discharges from Municipal Separate Storm Sewer Systems (MS4), Non-irrigated Crop Production, Post-development Erosion and Sedimentation	Monitored	303d Listed, TMDL Approved
LF02	121600	Dutchman Creek	4.06	16.03	WWFF	WWSF	Not Assessed	Default FAL	Chronic Aquatic Toxicity, Degraded Habitat	Site Clearance (Land Development or Redevelopment), Livestock (Grazing or Feeding Operations), Animal Feeding Operations (NPS), Non-Point Source (Rural or Urban), Discharges from Municipal Separate Storm Sewer Systems (MS4), Non-irrigated Crop Production, Post-development Erosion and Sedimentation	Monitored	Water Delisted
LF02	121600	Dutchman Creek	16.05	17.97	WWFF	WWSF	Not Supporting	Default FAL	Chronic Aquatic Toxicity, Low DO	Site Clearance (Land Development or Redevelopment), Livestock (Grazing or Feeding Operations), Industrial Point Source Discharge, Animal Feeding Operations (NPS), Non-Point Source (Rural or Urban), Discharges from Municipal Separate Storm Sewer Systems (MS4), Non-irrigated Crop Production, Post-development Erosion and Sedimentation	Monitored	303d Listed, TMDL Approved
LF02	122200	Ashwaubenon Creek	0	14.15	WWSF	WWSF	Not Supporting	Default FAL	Low DO, Degraded Habitat	Livestock (Grazing or Feeding Operations), Site Clearance (Land Development or Redevelopment), Animal Feeding Operations (NPS), Non-Point Source (Rural or Urban), Discharges from Municipal Separate Storm Sewer Systems (MS4), Non-irrigated Crop Production, Post-development Erosion and Sedimentation	Monitored	TMDL Approved

Water-shed	WBIC	Waterbody Name	Start Mile	End Mile	Current Use	Attain-able Use	Supporting Use	Designated Use	Impairment	Sources	Assess-ment	Impaired Water Status
LF02	124100	Apple Creek	0	3.99	WWSF	WWSF	Not Supporting	WWSF	Low DO, Elevated Water Temperature, Degraded Habitat	Non-Point Source (Rural or Urban)	Monitored	TMDL Approved
LF02	124100	Apple Creek	3.99	23.88	WWFF	WWFF	Not Supporting	WWFF	Low DO, Elevated Water Temperature, Degraded Habitat	Site Clearance (Land Development or Redevelopment), Livestock (Grazing or Feeding Operations), Channelization, Non-Point Source (Rural or Urban), Loss of Riparian Habitat, Discharges from Municipal Separate Storm Sewer Systems (MS4), Post-development Erosion and Sedimentation	Monitored	TMDL Approved
LF05	70	Green Bay (Inner Bay, Aoc)	0	13867.36	WWSF	WWSF	Not Supporting	Default FAL	Low DO, Degraded Habitat, Contaminated Sediment	Contaminated Sediments, Discharges from Municipal Separate Storm Sewer Systems (MS4)	Monitored	TMDL Approved, 303d Listed
LF05	70	Green Bay (Gl Shoreline)	0	8.94	WWSF	WWSF	Supporting	Default FAL	NA	NA	Monitored	303d Listed
LF05	93	Peats Lake	0	248.08	FAL	FAL	Not Assessed	Default FAL	NA	NA	No Assessment on File	NA
LF05	409700	Duck Creek	0	4.96	WWSF	WWSF	Not Supporting	Default FAL	Low DO, Degraded Habitat	Non-Point Source (Rural or Urban)	Monitored	TMDL Approved, 303d Listed
LF05	409700	Duck Creek	4.96	25.69	WWFF	WWSF	Not Assessed	FAL Warmwater	Low DO, Degraded Habitat	Non-Point Source (Rural or Urban)	Monitored	Pollutant Removed
LF05	409700	Duck Creek	25.69	32.9	WWFF	WWSF	Not Supporting	FAL Warmwater	Low DO, Degraded Habitat	Non-Point Source (Rural or Urban)	Monitored	TMDL Approved, 303d Listed
LF05	409700	Duck Creek	32.9	39.46	FAL	FAL	Supporting	Default FAL	NA	NA	Monitored	NA
LF05	410000	Lancaster Creek	0	4.61	Class III Trout	FAL	Fully Supporting	Default FAL	NA	NA	Monitored	NA
LF05	410000	Lancaster Creek	4.61	10.9	Cold (Class II Trout)	Cold (Class II Trout)	Fully Supporting	FAL Coldwater	NA	NA	Monitored	NA
LF05	410050	Thornberry Creek	0	1.43	Cold (Class I Trout)	Cold (Class I Trout)	Not Assessed	FAL Coldwater	NA	NA	No Assessment on File	NA
LF05	410100	Beaver Dam Creek	0	5.79	FAL	WWFF	Supporting	Default FAL	NA	NA	No Assessment on File	NA

Water-shed	WBIC	Waterbody Name	Start Mile	End Mile	Current Use	Attain-able Use	Supporting Use	Designated Use	Impairment	Sources	Assess-ment	Impaired Water Status
LF05	410100	Beaver Dam Creek	4	5.79	FAL	FAL	Not Assessed	Default FAL	NA	NA	Not Assessed	NA
LF05	410200	Trout Creek	0	12.77	WWFF	WWSF	Not Assessed	Default FAL	Sediment/Total Suspended Solids	NA	Monitored	Pollutant Removed
LF05	5018448	Unnamed Trib to Duck Creek	1.59	10.97	FAL	FAL	Supporting	Default FAL	NA	NA	Monitored	NA
LF05	5018670	Local Water	0	6.61	FAL	FAL	Supporting	Default FAL	NA	NA	Monitored	NA

[1]This table reflects the condition of waters in the study area watershed. This table data is stored in the Water Assessment Tracking and Electronic Reporting System (WATERS) and is updated on an ongoing basis via monitoring data and assessment calculations.

The following definitions apply:

- Current Use – current condition of water based on monitoring data.
- Attainable Use – "ecological potential" of water based on water type, natural community, lack of human-induced disturbances.
- Supporting Use – decision on whether the water's current condition is supporting its designated use under "water quality standards".
- Designated Use – the water's classified use under NR102, Wisconsin Water Quality Standards, for Fish and Aquatic Life.
- Assessment – field indicates what type of data or information supports the decisions in the table (current, attainable, and supporting attainable).