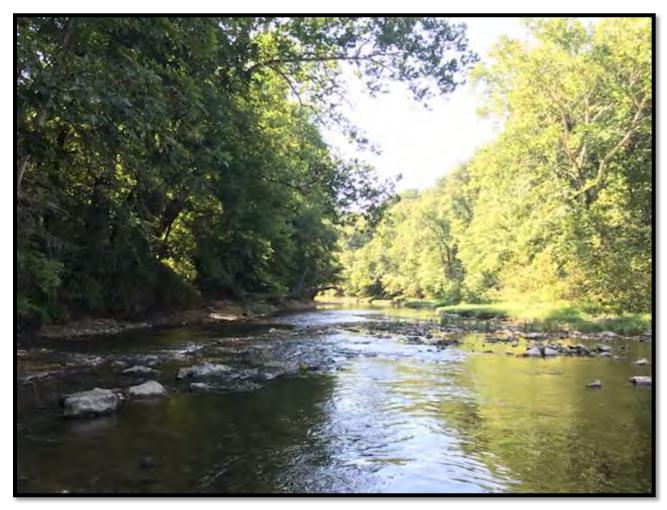
A Total Maximum Daily Load Report for the Vernon Fork Muscatatuck River Watershed



Final TMDL Report

August 29, 2022

Prepared for: U.S. Environmental Protection Agency Region 5 **Prepared by:** Indiana Department of Environmental Management

Table of Contents

Table of Contents	i
List of Figures	v
List of Tables	vii
Executive Summary	ix
1.0 INTRODUCTION	1
1.1 Water Quality Standards	4
1.1.1 <i>E. coli</i>	4
1.1.3 Biological Communities	5
1.2 Water Quality Targets	8
1.2.1 E. coli TMDLs	8
1.2.2 IBC and DO TMDLs	8
Total Phosphorus	8
Total Suspended Solids (TSS)	9
1.3 Listing Information	9
1.3.1 Understanding Subwatersheds and Assessment Units	9
1.3.2 Understanding 303(d) Listing Information	11
1.4 Water Quality Data	17
1.4.1 Water Quality Data	17
1.4.2 E. coli Data	20
1.4.3 Water Chemistry Data	23
1.4.4 Biological Data	26
2.0 DESCRIPTION OF THE WATERSHED AND SOURCE ASSESSMENT	29
2.1 Land Use	
2.1.1 Cropland	
2.1.2 Hay/Pastureland	
2.1.3 Confined Feeding Operations (CFOs) and Animal Feeding Operations (AFOs)	
2.2 Topography and Geology	
2.2.1 Karst Geology	
2.3 Soils	40
2.3.1 Soil Drainage	40

2.3.2 Septic Tank Absorption Field Suitability	
2.3.3 Soil Saturation and Wetlands	44
2.3.4 Soil Erodibility	55
2.3.5 Streambank Erosion	
2.4 Wildlife and Classified Lands	63
2.4.1 Wildlife	63
2.4.2 Classified Lands	64
2.5 Climate and Precipitation	66
2.6 Human Population	67
2.6.1 Onsite Sewage Disposal Systems	69
2.6.2 Urban Stormwater	72
2.7 Point Sources	73
2.7.1 Municipal Wastewater Treatment Plants (WWTPs)	73
Permit Compliance	77
2.7.2 Industrial Wastewater	
Quarry Operations	
Petroleum Product Terminals	
Permit Compliance	
2.7.3 Regulated Stormwater	
Construction Stormwater	
Industrial Stormwater	
Municipal Separate Storm Sewer Systems (MS4)	
2.8 Summary	91
3.0 TECHNICAL APPROACH	93
3.1 Load Duration Curves	93
3.2 Stream Flow Estimates	95
3.3 Margin of Safety (MOS)	
3.4 Future Growth Calculations	
4.0 LINKAGE ANALYSIS	
4.1 Pollutants of Concern	
4.1.1 <i>E. coli</i>	
4.1.2 Total Phosphorus	

4.1.3 Total Suspended Solids (TSS)	
4.2 Linkage Analysis by Subwatershed	105
4.2.1 Indian Creek	105
4.2.2 Sixmile Creek	
4.2.3 Storm Creek	117
4.2.4 Mutton Creek	
4.2.5 Polly Branch	
4.2.6 Grassy Creek	140
5.0 ALLOCATIONS	
5.1 Individual Allocations	
5.1.1 Approach for Calculating General Permit Waste Load Allocations	
5.2 Critical Conditions	
6.0 REASONABLE ASSURANCES/IMPLEMENTATION	155
6.1 Implementation Activity Options for Sources in the Vernon Fork Muscatatuck River Wate	rshed 155
6.2 Implementation Goals and Indicators	
6.3 Summary of Programs	
6.3.1 Federal Programs	
Clean Water Act Section 319(h) Grants	
Clean Water Action Section 205(j) Grants	
HUD Community Development Block Grant Program (CDBG)	
USDA Conservation Stewardship Program (CSP)	
USDA Conservation Reserve Program (CRP)	
USDA Conservation Reserve Enhancement Program (CREP) (Not currently available for	
watershed)	
USDA Environmental Quality Incentives Program (EQIP)	
USDA Farmable Wetlands Program (FWP)	161
USDA Conservation Technical Assistance (CTA)	
USDA Section 504 Home Repair Program	
USDA Watershed Surveys and Planning	
USDA Agricultural Conservation Easement Program (ACEP)	163
USDA Regional Conservation Partnership Program (RCPP)	164
USDA Healthy Forests Reserve Program (HFRP)	164

USDA Voluntary Public Access and Habitat Incentive Program (VPA-HIP)	
6.3.2 State Programs	
IDEM Point Source Control Program	
IDEM Nonpoint Source Control Program	
IDEM Hoosier Riverwatch Program	
ISDA Division of Soil Conservation	166
ISDA Clean Water Indiana (CWI) Program	166
ISDA INfield Advantage (INFA) Program	166
IDNR Lake and River Enhancement (LARE) Program	167
IFA State Revolving Fund (SRF) Loan Program	167
6.3.3 Local Programs	167
6.4 Implementation Programs by Source	
6.4.1 Point Source Programs	170
Municipal Wastewater Treatment Plants (WWTPs)	170
Industrial Wastewater	170
Construction Stormwater	170
Industrial Stormwater	171
Municipal Separate Storm Sewer Systems (MS4)	171
CAFOs	
Illegal straight pipes	
6.4.2 Nonpoint Sources Programs	
Cropland	
Pastures and Livestock Operations	174
CFOs	174
Streambank Erosion	
Onsite Wastewater Treatment Systems	
Wildlife/Domestic Pets	176
6.5 Potential Implementation Partners and Technical Assistance Resources	176
7.0 PUBLIC PARTICIPATION	179
References	
Appendices	

List of Figures

Figure 1: Location of the Vernon Fork Muscatatuck River Watershed
Figure 2: Subwatersheds (12-Digit HUCs) in the Vernon Fork Muscatatuck River Watershed
Figure 3: Location of Historical IDEM Sampling Sites in the Vernon Fork Muscatatuck River Watershed
Figure 4: Streams Listed on the 2020 Section 303(d) List of Impaired Waters in the Vernon Fork Muscatatuck River Watershed
Figure 5: 2020-2021 Sampling Locations for the Vernon Fork Muscatatuck River TMDL Study
Figure 5: 2020-2021 Sampling Locations for the Verion Fork Muscatatuck River TMDL Study
drainage areas for 2020 and 2021. Values over 125 MPN/100mL are not meeting the current water quality
standard for <i>E. coli</i>
Figure 7: Total phosphorus concentrations based on single sample maximum concentration (mg/L) and
sampling site drainage areas for 2020 and 2021. Values over 0.30 mg/L are not meeting the water quality
target value for total phosphorus
Figure 8: Total Suspended Solids concentrations based on single sample maximum concentration (mg/L)
and sampling site drainage areas for 2020 and 2021. Values over 30 mg/L are not meeting the water
quality target value for TSS
Figure 9: Streams to be listed on the Draft 2024 Section 303(d) List of Impaired Waters in the Vernon
Fork Muscatatuck River Watershed
Figure 10: Land use in the Vernon Fork Muscatatuck River Watershed
Figure 11: Cash Crop Acreage in the Vernon Fork Muscatatuck River Watershed
Figure 12: Grassland and Pastureland in the Vernon Fork Muscatatuck River Watershed with CFO
locations
Figure 13: Topography of the Vernon Fork Muscatatuck River Watershed. Digital Elevation Data (DEM)
was taken from the State of Indiana's Geographic Information Office (GIO)
Figure 14: Karst Features in the Vernon Fork Muscatatuck River Watershed
Figure 15: Hydrological Soil Groups in the Vernon Fork Muscatatuck River Watershed
Figure 16: Suitability of Soils for Septic Systems in the Vernon Fork Muscatatuck River Watershed44
Figure 17: Hydric Soils in the Vernon Fork Muscatatuck River Watershed
(https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/)
Figure 18: Location of Highly Erodible Lands (HEL) in the Vernon Fork Muscatatuck River Watershed 56
Figure 19: Location of Highly Elocatore Lands (HEL) in the Vernon Fork Muscatatuck River Watershed
Figure 20: Managed and Classified Lands within the Vernon Fork Muscatatuck River Watershed
Figure 22: Municipalities in the Vernon Fork Muscatatuck River Watershed
Figure 23: Municipal Wastewater Treatment Facilities Discharging within the Vernon Fork Muscatatuck
River Watershed
Figure 24: Quarry Facilities Discharging within the Vernon Fork Muscatatuck River Watershed
Figure 25: Petroleum Product Terminal Facilities Discharging within the Vernon Fork Muscatatuck River
Watershed
Figure 26: Industrial Stormwater Facilities Discharging within the Vernon Fork Muscatatuck River
Watershed

Figure 27: MS4 Boundaries in the Vernon Fork Muscatatuck River Watershed	91
Figure 28: Location of Surrogate Flow Gage in Vernon, IN	97
Figure 29: Average Daily Flow Estimate for the Vernon Fork Muscatatuck River Watershed for	data from
2012-2021	
Figure 30: Substrate + Bank Erosion/Riparian Zone Score in Relation to Fish Community IBI	Scores in
the Vernon Fork Muscatatuck River Watershed	
Figure 31: Substrate + Bank Erosion/Riparian Zone Score in Relation to Macroinvertebrate Con	nmunity
mIBI Scores in the Vernon Fork Muscatatuck River Watershed	
Figure 32: Sampling Stations in Indian Creek Subwatershed	
Figure 33: E. coli Load Duration Curve for Indian Creek Subwatershed	
Figure 34: Graph of Precipitation and E. coli Data for Indian Creek Subwatershed	
Figure 35: Sampling Stations in Sixmile Creek Subwatershed	114
Figure 36: E. coli Load Duration Curve for Sixmile Creek Subwatershed	115
Figure 37: Graph of Precipitation and E. coli Data for Sixmile Creek Subwatershed	115
Figure 38: Total Phosphorus Load Duration Curve for Sixmile Creek Subwatershed	
Figure 39: Graph of Precipitation and Total Phosphorus Data for Sixmile Creek Subwatershed	116
Figure 40: Sampling Stations in Storm Creek Subwatershed	
Figure 41: E. coli Load Duration Curve for Storm Creek Subwatershed	
Figure 42: Graph of Precipitation and E. coli Data at Storm Creek Subwatershed	
Figure 43: Total Suspended Solids Load Duration Curve for Storm Creek Subwatershed	
Figure 44: Graph of Precipitation and Total Suspended Solids Data for Storm Creek Subwatersh	ed 123
Figure 45: Total Phosphorus Load Duration Curve for Storm Creek Subwatershed	
Figure 46 :Graph of Precipitation and Total Phosphorus Data for Storm Creek Subwatershed	
Figure 47: Sampling Stations in Mutton Creek Subwatershed	
Figure 48: E. coli Load Duration Curve for Mutton Creek Subwatershed	
Figure 49: Graph of Precipitation and E. coli Data for Mutton Creek Subwatershed	131
Figure 50: Total Suspended Solids Load Duration Curve for Mutton Creek Subwatershed	
Figure 51: Graph of Precipitation and Total Suspended Solids Data for Mutton Creek Subwaters	hed 132
Figure 52: Total Phosphorus Load Duration Curve for Mutton Creek Subwatershed	
Figure 53: Graph of Precipitation and Total Suspended Solids Data for Mutton Creek Subwaters	hed 133
Figure 54: Sampling Stations in Polly Branch Subwatershed	
Figure 55: E. coli Load Duration Curve for Polly Branch Subwatershed	138
Figure 56: Graph of Precipitation and E. coli Data for Polly Branch Subwatershed	
Figure 57: Total Phosphorus Load Duration Curve for Polly Branch Subwatershed	139
Figure 58: Graph of Precipitation and Total Phosphorus Data for Polly Branch Subwatershed	139
Figure 59: Sampling Stations in Grassy Creek Subwatershed	145
Figure 60: E. coli Load Duration Curve for Grassy Creek Subwatershed	146
Figure 61: Graph of Precipitation and E. coli Data for Grassy Creek Subwatershed	146
Figure 62: Total Phosphorus Load Duration Curve for Grassy Creek Subwatershed	147
Figure 63: Graph of Precipitation and Total Phosphorus Data for Grassy Creek Subwatershed	147

List of Tables

Table 1: Critical Conditions for TMDL Parameters
Table 2: Vernon Fork Muscatatuck River Watershed Aquatic Life Use Support Criteria for Biological
Communities
Table 3: Target Values Used for Development of the Vernon Fork Muscatauck River Watershed TMDLs9
Table 4: Section 303(d) List Information for the Vernon Fork Muscatatuck River Watershed for 2020 and
2024
Table 5: Vernon Fork Muscatatuck River Watershed Sampling Site Information 19
Table 6: Summary of Pathogen Data in Vernon Fork Muscatatuck River Watershed by Subwatershed 20
Table 7: Summary of Chemistry Data in Vernon Fork Muscatatuck River Watershed for Nutrients, Total
Suspended Solids, and Dissolved Oxygen
Table 8: Biotic Integrity Scores in the Vernon Fork Muscatatuck River Watershed Identified During
August/September 2021 Sampling
Table 9: Vernon Fork Muscatatuck River Subwatershed Drainage Areas 29
Table 10: Land Use of the Vernon Fork Muscatatuck River Watershed 31
Table 11: Land Use in the Vernon Fork Muscatatuck River Subwatersheds
Table 12: Major Cash Crop Acreage in the Vernon Fork Muscatatuck River Watershed
Table 13: CFOs in the Vernon Fork Muscatatuck River Watershed 37
Table 14: Hydrologic Soil Groups 41
Table 15: Hydrologic Soil Groups in the Vernon Fork Muscatatuck River Subwatersheds
Table 16: Hydric Ratings for Map Units with Hydric Soils in the Vernon Fork Muscatatuck River
Watershed
Table 17: HEL/Potential HEL Acreage in the Vernon Fork Muscatatuck River Watershed57
Table 18: Tillage Transect Data for 2019 by County in the Vernon Fork Muscatatuck River Watershed. 62
Table 19: Bacteria Source Load by Species
Table 20: Managed Lands within the Vernon Fork Muscatatuck River Watershed
Table 21: Classified Lands within the Vernon Fork Muscatatuck River Watershed
Table 22: Population Data for Counties in Vernon Fork Muscatatuck River Watershed67
Table 23: Estimated Population in the Vernon Fork Muscatatuck River Watershed
Table 24: Rural and Urban Household Density in the Vernon Fork Muscatatuck River Subwatersheds71
Table 25: Unsewered residences/businesses reported by county in 2016-2017
Table 26: Municipal Wastewater Treatment Plant Facilities Discharging within the Vernon Fork
Muscatatuck River Watershed75
Table 27: Summary of Municipal Wastewater Treatment Plant Permit Compliance in the Vernon Fork
Muscatatuck River Watershed for the Five-Year Period of 2017-202177
Table 28: Quarry Facilities Discharging within the Vernon Fork Muscatatuck River Watershed 81
Table 29: Petroleum Product Terminal Facilities Discharging within the Vernon Fork Muscatatuck River
Watershed
Table 30: Summary of Industrial Wastewater Permit Compliance in the Vernon Fork Muscatatuck River
Watershed for the Five-Year Period of 2017-2021
Table 31: Average Annual Land Disturbance from Permitted Construction Activity in the Vernon Fork
Muscatatuck River Subwatersheds from 2017-2022

Executive Summary

The Vernon Fork Muscatatuck River watershed (HUC 0512020707) is located in southeastern Indiana and covers an area of approximately 212 square miles. Overall, it drains approximately 412 square miles. The watershed originates in Jennings County, its water flowing southwest into Jackson County, where it empties from the Muscatatuck River into the East Fork of the White River. Land use throughout the watershed is predominantly forested, with agricultural use being the second most abundant type.

The Clean Water Act (CWA) and U.S. Environmental Protection Agency (U.S. EPA) regulations require that states develop Total Maximum Daily Loads (TMDLs) for waters on the Section 303(d) List of Impaired Waters. A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs are composed of the sum of individual waste load allocations (WLAs) for regulated sources and load allocations (LAs) for sources that are not directly regulated. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this is defined by the equation:

$\mathsf{TMDL} = \sum \mathsf{WLAs} + \sum \mathsf{LAs} + \mathsf{MOS}$

This TMDL has been developed to address *E. coli*, biotic communities, and dissolved oxygen impairments in the Vernon Fork Muscatatuck River watershed, in accordance with the TMDL Program Priority Framework. Parameters chosen for TMDL development include *E. coli*, total suspended solids (TSS), and total phosphorus (TP). These parameters will be referred to cumulatively in this report as "pollutants."

The Vernon Fork Muscatatuck River watershed TMDL was prioritized to be completed at this time based on local interest in addressing water quality, the Indiana Department of Environmental Management (IDEM) interest in conducting baseline water quality monitoring for local planning, and a competitive Section 319 application from the local partners to develop a watershed management plan in conjunction with the IDEM sampling and TMDL development for streams impaired for *E. coli*, biological communities, and dissolved oxygen.

After IDEM identifies a waterbody as having an impairment and places the waterbody on Indiana's Section 303(d) List of Impaired Waters, IDEM implements a sampling plan to determine the extent and the magnitude of the impairment. The next task is to reassess each waterbody using new sampling data and to examine the watershed as a whole. The reassessment data help IDEM identify the area of concern for TMDL development. As a result of the reassessment of the Vernon Fork Muscatatuck River watershed, the pollutants and the impaired segments for which TMDLs were developed differ from those appearing on the 2022 Section 303(d) List because sampling performed by IDEM in 2020 and 2021 generated new water quality data that were not available at the time the 2022 Section 303(d) List was developed.

Both historical and recent data were used for the TMDL analysis. Surveys of the Vernon Fork Muscatatuck River watershed have been conducted as far back as 1992 with sampling on Crosley Lake. Fixed station monitoring has been conducted in the watershed since 1998. More extensive surveys of the watershed were conducted in 1993, 1997, 2002-2007, 2013, 2016, and 2017 by the probabilistic, targeted, and fish tissue monitoring programs in varying years. This includes two studies in cooperation with the U.S. Fish and Wildlife Service.

Sampling data were collected at 23 sampling sites from November 2020 to October 2021 by IDEM for the TMDL analysis. The data indicate that 20 of the sample sites violated one or more of the Indiana Water Quality Standards (327 IAC 2).

Potential sources of biotic impairment, *E. coli*, and low dissolved oxygen levels in the watershed include both regulated point sources and nonpoint sources. Point sources, including wastewater treatment plants (WWTPs), an industrial facility and quarry that discharge wastewater, stormwater permitted industrial facilities, construction activities, and an MS4 community are regulated through the National Pollutant Discharge Elimination System (NPDES). Nonpoint sources, such as unregulated urban stormwater, agricultural run-off, bank erosion, wildlife, confined feeding operations (CFOs), pasture animals with access to streams, and faulty/failing septic systems are all potential sources.

Determining the specific reasons for high *E. coli* counts in any given waterbody is challenging. There are many potential sources, and *E. coli* counts are inherently variable. Within the Vernon Fork Muscatatuck River watershed, subwatersheds with large areas of hay/pastureland, agriculture, forested land, and developed areas have the highest average *E. coli* counts. It is therefore possible that multiple sources are contributing to elevated *E. coli* levels. With large amounts of land being forested or in agricultural use throughout all of the subwatersheds, small unregulated farming operations that allow livestock to have direct access to streams, the land application of manure, and wildlife excrement could all contribute to high *E. coli* levels. Additionally, with many unsewered areas in the watershed, factors such as failing septic systems and illegal straight pipes are likely affecting *E. coli* levels in multiple subwatersheds, especially at lower flows when there is less dilution. Specific sources of *E. coli* to each impaired waterbody should be further evaluated during follow-up implementation activities.

Within the Vernon Fork Muscatatuck River watershed, certain subwatersheds had high total phosphorus loads and multiple low dissolved oxygen hits. It is possible that field run-off in these subwatersheds is contributing to elevated phosphorus loads, resulting in lower dissolved oxygen. However, other factors could also explain the correlation, such as upstream loading, failing septics, impeded or low flow, tillage practices, or point source contributions. Low dissolved oxygen levels can also be correlated to elevated levels of total suspended solids by reducing light availability to aquatic plants.

Various subwatersheds in the Vernon Fork Muscatatuck River watershed have impaired biotic communities. Biological communities include fish and aquatic macroinvertebrates, such as insects. These in-stream organisms are indicators of the cumulative effects of activities that

affect water quality conditions over time. An impaired biotic communities (IBC) listing on Indiana's 303(d) List suggests that one or more of the aquatic biological communities is unhealthy as determined by IDEM's monitoring data. IBC is not a source of impairment but a symptom of other sources. To address these impairments in the Vernon Fork Muscatatuck River watershed, high TSS and total phosphorus have been identified as pollutants for TMDL development.

An important step in the TMDL process is the allocation of the allowable loads to individual point sources, as well as sources that are not directly regulated. The Vernon Fork Muscatatuck River watershed TMDL includes these allocations, which are presented for each of the 12-digit hydrologic unit code (HUC) subwatersheds containing impairments.

There are four NPDES permitted facilities that discharge located in the Vernon Fork Muscatatuck River watershed. These facilities include two wastewater treatment facilities, a quarry operation, and an industrial facility. Of these facilities, two were found to be in violation of their permit limits for various parameters over the past five years. Although these NPDES facilities were found to be in violation of their permit limits, effluent from permitted facilities meets water quality standards and/or targets the majority of the time.

There are several types of documented and suspected nonpoint sources located in the Vernon Fork Muscatatuck River watershed, including unregulated livestock operations with direct access to streams, agricultural row crop land use, leaking or failing septic systems, straight pipes, wildlife and waterfowl, and bank erosion. Many of these sources are often found in subwatersheds with elevated levels of *E. coli*, TSS, and total phosphorus. Although Indiana does not have a permitting program for nonpoint sources, many nonpoint sources are addressed through voluntary programs intended to reduce pollutant loads, minimize flow, and improve water quality.

This TMDL report identifies which locations could most benefit from focus on implementation activities. These areas throughout the Vernon Fork Muscatatuck River watershed are referred to as critical conditions. The report also provides recommendations on the types of implementation activities, including best management practices (BMPs), that key implementation partners in the watershed can consider to achieve the pollutant load reductions calculated for each subwatershed. Table 1 presents potential critical areas which can be used to recommend BMPs identified as having a high likely degree of effectiveness to achieve the *E. coli*, TSS, and total phosphorus load reductions allocated to sources in each subwatershed. The critical condition for each TMDL is identified as the flow condition requiring the largest percent reduction based on a 90th percentile concentration of observed water quality data in each subwatershed and flow regime combination. A more detailed explanation of critical conditions can be found in Section 5.2.

			Cri	tical Conditio	n	
Parameter	Subwatershed (HUC)	High	Moist	Mid-Range	Dry	Low
	Indian Creek (051202070701)	94%	95%	21%	0%	0%
	Sixmile Creek (051202070702)	93%	83%	90%	92%	77%
	Storm Creek (051202070703)	95%	69%	76%	84%	94%
<i>E. coli</i> (counts/mL)	Mutton Creek (051202070704)	95%	90%	93%	92%	92%
	Polly Branch (051202070705)	95%	95%	85%	82%	86%
	Grassy Creek (051202070706)	95%	73%	72%	68%	75%
Total Phosphorus (mg/L)	Sixmile Creek (051202070702)		0%	25%	11%	14%
	Storm Creek (051202070703)	57%	0%	0%	0%	0%
	Mutton Creek (051202070704)	60%	0%	0%	0%	0%
	Polly Branch (051202070705)	0%	57%	0%	0%	0%
	Grassy Creek (051202070706)	48%	67%	0%	86%	86%
Total Suspended Solids (mg/L)	Storm Creek (051202070703)	87%	0%	0%	0%	0%
	Mutton Creek (051202070704)	88%	0%	0%	0%	0%

Table 1: Critical Conditions for TMDL Parameters

Note: -- represents no data collected in the flow regime

Public participation is an important and required component of the TMDL development process. The following public meetings and public comment periods have been held to further develop this project:

- A virtual public kickoff meeting was held in on October 27, 2020 to introduce the project and solicit public input. IDEM explained the TMDL process and presented initial information regarding the Vernon Fork Muscatatuck River watershed. Questions were answered from the public, and information was solicited from local stakeholders.
- On June 14 and 16, 2021, IDEM partnered with the Jennings County SWCD to host a TMDL public outreach event at the Jennings County Fair in North Vernon, Indiana. IDEM staff were on-site to explain the project and their processes for collecting water chemistry, fish, and macroinvertebrates. The details of the partnership between the Jennings County SWCD and IDEM were detailed as well.

- On March 16, 2022 a notice was posted to the IDEM TMDL Reports webpage and to the IDEM Public Notices webpage to inform stakeholders of new impairments discovered during the 2020-2021 watershed characterization study in the Vernon Fork Muscatatuck River watershed. The notice outlined the findings of the study and listed proposed additions/deletions to the 2024 303(d) List of Impaired Waters. Public comments were solicited through April 30, 2022. IDEM received no comments regarding the notice.
- A draft TMDL public meeting was held in the watershed at the Jennings County Public Library in North Vernon, Indiana on July 14, 2022 at 10:00 AM. The findings of the TMDL study were presented at the meeting, and the public had the opportunity to ask questions and provide information to be included in the final TMDL report. A public comment period begins July 15, 2022 through August 15, 2022.

1.0 INTRODUCTION

This section of the Total Maximum Daily Load (TMDL) provides an overview of the Vernon Fork Muscatatuck River watershed location and the regulatory requirements that have led to the development of this TMDL to address impairments in the watershed.

The Vernon Fork Muscatatuck River watershed TMDL was prioritized to be completed at this time based on local interest from the Jennings County Soil and Water Conservation District (SWCD) in addressing water quality, IDEM interest in conducting baseline water quality monitoring for local planning, and a competitive Section 319 application from the local partners to develop a watershed management plan in conjunction with the IDEM sampling and TMDL development for streams impaired for *E. coli*, biotic communities, and dissolved oxygen.

The Vernon Fork Muscatatuck River watershed (HUC0512020707), shown in Figure 1, is located in southeastern Indiana and covers an area of approximately 212 square miles. Overall, it drains approximately 412 square miles. The watershed originates in Jennings County, its water flowing southwest into Jackson County, where it empties from the Muscatatuck River into the East Fork of the White River, just south of Crothersville, Indiana. Land use throughout the watershed is predominantly forested, with agricultural hay/pasture use being the second most abundant type.

The Clean Water Act (CWA) and U.S. Environmental Protection Agency (U.S. EPA) regulations require that states develop TMDLs for waters on the Section 303(d) List of Impaired Waters. U.S. EPA defines a TMDL as the sum of the individual waste load allocations (WLA) for point sources and load allocations (LA) for nonpoint sources, and a margin of safety (MOS) that addresses the uncertainty in the analysis.

The overall goals and objectives of the TMDL study for the Vernon Fork Muscatatuck River watershed are to:

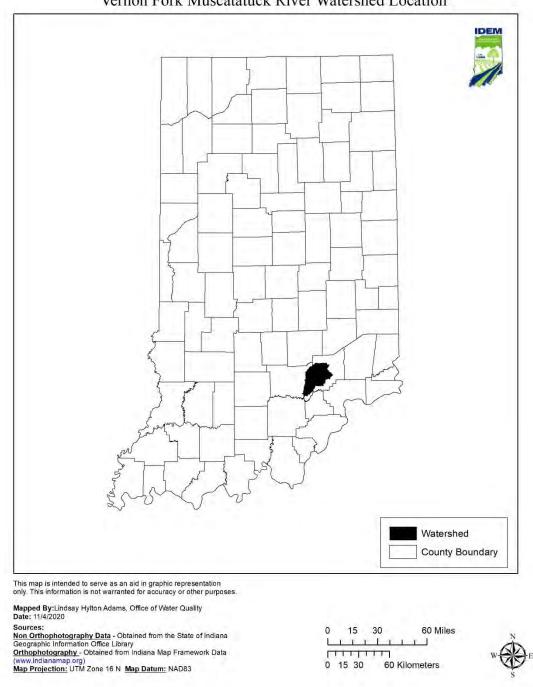
- Assess the water quality of the impaired waterbodies and identify key issues associated with the impairments and potential pollutant sources.
- Determine current loads of pollutants to the impaired waterbodies.
- Use the best available science and available data to determine the total maximum daily load the waterbodies can receive while fully supporting the designated use(s) that are impaired.
- If current loads exceed the maximum allowable loads, determine the load reduction that is needed.
- Inform and involve the public throughout the project to ensure that key concerns are addressed and the best available information is used.
- Identify critical flow conditions that watershed stakeholders can use to identify critical areas.



- Recommend activities for purposes of TMDL implementation.
- Submit a final TMDL report to the U.S. EPA for review and approval.

Watershed stakeholders and partners can use the final approved TMDL report to craft a watershed management plan (WMP) that meets both U.S. EPA's nine minimum elements under the CWA Section 319 Nonpoint Source Program, as well as the additional requirements under IDEM's WMP Checklist.





Vernon Fork Muscatatuck River Watershed Location





1.1 Water Quality Standards

Under the CWA, every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters. These standards represent a level of water quality that will support the CWA's goal of "swimmable/fishable" waters. Water quality standards consist of three different components:

- **Designated uses** reflect how the water can potentially be used by humans and how well it supports a biological community. Examples of designated uses include aquatic life support, drinking water supply, and full body contact recreation. Every waterbody in Indiana has a designated use or uses; however, not all uses apply to all waters. The Vernon Fork Muscatatuck River watershed TMDLs focus on protecting the designated aquatic life support and full body contact recreational uses of the waterbodies.
- Criteria express the condition of the water that is necessary to support the designated uses. Numeric criteria represent the concentration of a pollutant that can be in the water and still protect the designated use of the waterbody. Narrative criteria are the general water quality criteria ("free from...") that apply to all surface waters. Numeric criteria for *E. coli*, and narrative criteria for Impaired Biotic Communities (IBC) and Dissolved Oxygen were used as the basis of the Vernon Fork Muscatatuck River watershed TMDLs.
- **Antidegradation** policies provide protection of existing uses and extra protection for high-quality or unique waters.

The water quality standards in Indiana pertaining to *E. coli* and IBC ("the impairments") are described below.

<u>1.1.1 *E. coli*</u>

E. coli is an indicator of the possible presence of pathogenic organisms (e.g., enterococcal *E. coli*, viruses, and protozoa) which may cause human illness. The direct monitoring of these pathogens is difficult; therefore, *E. coli* is used as an indicator of potential fecal contamination. *E. coli* is a sub-group of fecal coliform; the presence of *E. coli* in a water sample indicates recent fecal contamination is likely. Concentrations are typically reported as the count of organisms in 100 milliliters of water (count/100 mL) or most probable number (MPN/100 mL) and may vary at a particular site depending on the baseline *E. coli* level already in the river, inputs from other sources, dilution due to precipitation events, and die-off or multiplication of the organism within the river water and sediments.

The numeric *E. coli* criteria associated with protecting the recreational use are described below.

"The criteria in this subsection are to be used to evaluate waters for full body contact recreational uses, to establish wastewater treatment requirements, and to establish effluent limits during the recreational season, which is defined as the months of April through October, inclusive. E. coli bacteria, shall not exceed one hundred twenty-five (125) per one hundred (100) milliliters as a geometric mean based on not less than five (5) samples equally spaced over a thirty (30) day period



nor exceed two hundred thirty-five (235) per one hundred (100) milliliters in any one (1) sample in a thirty (30) day period. . . However, a single sample shall be used for making beach notification and closure decisions." [Source: Indiana Administrative Code Title 327 Water Pollution Control Board. Article 2. Section 1-6(a).]

1.1.2 Nutrients

The term "nutrients" refers to the various forms of nitrogen and phosphorus found in a waterbody. Both nitrogen and phosphorus are necessary for aquatic life, and both elements are needed at some level in a waterbody to sustain life. The natural amount of nutrients in a waterbody varies depending on the type of system. A pristine mountain spring might have little to almost no nutrients, whereas a lowland, mature stream flowing through wetland areas might have naturally high nutrient concentrations. Streams draining larger areas are also expected to have higher nutrient concentrations.

Nutrients generally do not pose a direct threat to the designated uses of a waterbody. However, excess nutrients can cause an undesirable abundance of plant and algae growth through a process called eutrophication. Eutrophication can have many effects on a stream. One possible effect is low dissolved oxygen concentrations caused by excessive plant respiration and/or decay. Ammonia, which is toxic to fish at high concentrations, can be released from decaying organic matter when eutrophication occurs. For these reasons, excessive nutrients can result in the non-attainment of bio-criteria and impairment of the designated use.

Like most states, Indiana has not yet adopted numeric water quality criteria for nutrients. The relevant narrative criteria that apply to the TMDLs presented in this report state the following:

"All surface waters at all times and at all places, including waters within the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges that do any of the following:" [327 IAC 2-1-6. Sec. 6. (a)(1)]...

(a)re in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to such degree as to create a nuisance, be unsightly, or otherwise impair the designated uses." [327 IAC 2-1-6. Sec. 6. (a) (1)(D)]

(a)re in amounts sufficient to be acutely toxic to, or to otherwise severely injure or kill, aquatic life, other animals, plants, or humans." [327 IAC 2-1-6. Sec. 6. (a) (1)(E)]

1.1.3 Biological Communities

The water quality regulatory definition of a "well-balanced aquatic community" is "an aquatic community which is diverse in species composition, contains several different trophic levels, and is not composed mainly of strictly pollution tolerant species" [327 IAC 2-1-9(49)].

Impaired biotic communities (IBC) are not a source of impairment but a symptom of other sources. To address these impairments in the Vernon Fork Muscatatuck River watershed, TSS and TP have been identified as pollutants for TMDL development. IDEM has not yet adopted



numeric water quality criteria for total suspended solids (TSS) or Total Phosphorus (TP). The relevant narrative criteria that apply to the TMDLs presented in this report state the following:

"All surface waters at all times and at all places, including waters within the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges that do any of the following:" [327 IAC 2-1-6. Sec. 6. (a)(1)]...

(a)re in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to such degree as to create a nuisance, be unsightly, or otherwise impair the designated uses." [327 IAC 2-1-6. Sec. 6. (a) (1)(D)]

(a)re in amounts sufficient to be acutely toxic to, or to otherwise severely injure or kill, aquatic life, other animals, plants, or humans." [327 IAC 2-1-6. Sec. 6. (a) (1)(E)]

In addition, the narrative biological criterion [327 IAC 2-1-3(2)] states the following:

"All waters, except those designated as limited use, will be capable of supporting a well-balanced, warm water aquatic community."

Biological assessments for streams are based on the sampling and evaluation of either the fish communities, the benthic aquatic macroinvertebrate communities, or both. Indices of biotic integrity (IBI) for fish and macroinvertebrate (mIBI) assessment scores, or both, were calculated and compared to regionally calibrated models. In evaluating fish communities, streams rating as "poor" or worse are classified as non-supporting for aquatic life uses. For benthic aquatic macroinvertebrate communities, individual sites are compared to a statewide calibration at the lowest practical level of identification for Indiana. All sites at or above background for the calibration are considered to be supporting aquatic life uses. Those sites rated as moderately or severely impaired in the calibration are considered to be non-supporting. Waters with identified impairments to one or more biological communities are considered not supporting aquatic life use. The biological thresholds Indiana uses to make use attainment decisions are shown in Table 2 to provide greater context for understanding the range of biological conditions that is considered either fully supporting or impaired.

IDEM's aquatic life use assessments are never based solely on habitat evaluations. However, habitat evaluations are used as supporting information in conjunction with biological data to determine aquatic life use support. Such evaluations, which take into consideration a variety of habitat characteristics as well as stream size, help IDEM to determine the extent to which habitat conditions may be influencing the ability of biological communities to thrive. If habitat is determined to be driving a biotic community impairment (IBC) and no other pollutants that might be contributing to the impairment have been identified, the IBC may not be considered for inclusion on IDEM's 303(d) List of Impaired Waters (Category 5). In such cases, the waterbody is instead placed in Category 4C (non-pollutant causes) for the biological impairment.



Biotic Index Score and Associated Assessment Decision	Integrity Class	Corresponding Integrity Class Score	Attributes
F	ish community Index of Bio	otic Integrity (IBI) Scores (Ra	nge of possible scores is 0-60)
Fully Supporting	Excellent	53-60	Comparable to "least impacted" conditions, exceptional assemblage of species
IBI ≥ 36 Indicates Full Support	Good	45-52	Decreased species richness (intolerant species in particular), sensitive species present
	Fair	36-44	Intolerant and sensitive species absent, skewed trophic structure
Not Supporting	Poor	23-35	Many expected species absent or rare, tolerant species dominant
IBI < 36	Very Poor	12-22	At least one species present, tolerant species dominant
Indicates Impairment	No Organisms	0	No fish captured during sampling.
		rtebrate community Index of \B) Methods (Range of possi	Biotic Integrity (mIBI) Scores ible scores is 12-60)
5 4 0 4	Excellent	53-60	Comparable to "least impacted" conditions, exceptional assemblage of species
Fully Supporting mIBI ≥ 36 Indicates Full Support	Good	45-52	Decreased species richness (intolerant species in particular), sensitive species present
	Fair	36-44	Intolerant and sensitive species absent, skewed trophic structure
Not Supporting	Poor	23-35	Many expected species absent or rare, tolerant species dominant
Not Supporting mIBI < 36	Very Poor	13-22	At least one species present, tolerant species dominant
Indicates Impairment	No Organisms	12	No macroinvertebrates captured during sampling.

Table 2: Vernon Fork Muscatatuck River Watershed Aquatic Life Use Support Criteria for Biological Communities



1.2 Water Quality Targets

Target values are needed for the development of TMDLs because of the need to calculate allowable daily loads. For parameters that have numeric criteria, such as *E. coli*, the target equals the numeric criteria. For parameters that do not have numeric criteria, target values must be identified from some other source. The target values used to develop the Vernon Fork Muscatatuck River watershed TMDL are presented below.

1.2.1 *E. coli* TMDLs

The target value used for the Vernon Fork Muscatatuck River watershed TMDL was based on the 235 counts/100 mL single sample maximum component of the water quality standard (i.e., daily loading capacities were calculated by multiplying flows by 235 counts/100 mL). The U.S. EPA report, "An Approach for Using Load Duration Curves in the Development of TMDLs" describes how the monthly geometric mean (125 counts/100mL) is likely to be met when the single sample maximum value (235 counts/100mL) is used to develop the loading capacity (U.S. EPA, 2007). The process calculates the daily maximum bacteria value that is possible to observe and still attain the monthly geometric mean. If the single sample maximum is set as a never-to-be surpassed value then it becomes the maximum value that can be observed, and all other bacteria values would have to be less than the maximum.

1.2.2 IBC and DO TMDLs

The following sections describe the TMDL target values used for total phosphorus and TSS when developing IBC and DO TMDLs.

Total Phosphorus

Although Indiana has not yet adopted numeric water quality criteria for nutrients, IDEM has identified the following nutrient benchmarks that are used to assess potential nutrient impairments:

• Total phosphorus should not exceed 0.30 mg/L (U.S. EPA's nationwide 1986 Quality Criteria for Waters also known as the *Gold Book*).

The total phosphorus value (0.30 mg/L) was used as the TMDL target during the development of the Vernon Fork Muscatatuck River watershed TMDL. IDEM has determined that meeting this target will result in achieving the narrative biological criterion by improving water quality and promoting a well-balanced aquatic community. Phosphorus is interpreted as an average in the NPDES permits. A review of historic IDEM monitoring data indicates that when WWTPs were in compliance with their individual permit limit for phosphorus (1.0 mg/L), the in-stream target for phosphorus (0.30 mg/L) was typically met. As such, WWTPs were given WLAs based on a 1.0 mg/L permit limitation.



Total Suspended Solids (TSS)

Although Indiana has not yet adopted numeric water quality criteria for TSS, IDEM has identified a target value based on IDEM's NPDES permitting process. A target of 30.0 mg/L for TSS has been identified as a permit limit for NPDES facilities. A target value of 30.0 mg/L TSS was therefore used as the TSS TMDL target value to ensure consistency with IDEM's NPDES permitting process. IDEM has determined that meeting the TSS target will result in achieving the narrative biological criterion by improving water quality and promoting a well-balanced aquatic community.

Various subwatersheds in the Vernon Fork Muscatatuck River watershed have IBC impairments. Biological communities include fish and aquatic invertebrates, such as insects. These in-stream organisms are indicators of the cumulative effects of activities that affect water quality conditions over time. An IBC listing on Indiana's 303(d) List of Impaired Waters means that IDEM's monitoring data show one or both of the aquatic communities are not as healthy as they should be. IBC is not a source of impairment but a symptom of other sources. To address these impairments in the Vernon Fork Muscatatuck River watershed, TSS and TP have been identified as pollutants for TMDL development.

A few subwatersheds in the Vernon Fork Muscatatuck River watershed have dissolved oxygen impairments. Dissolved oxygen is not a source of impairment but a symptom of other sources. To address these impairments in the watershed, phosphorus and TSS, where applicable, have been identified as pollutants for TMDL development.

Table 3 reiterates the TMDL target values presented in Section 1.0. These are the target values IDEM uses to assess water quality data collected in the Vernon Fork Muscatatuck River watershed.

Table 3: Target Values Used for Development of the Vernon Fork Muscatatuck River Watershed TMDLs

Parameter	Target Value
Total Phosphorus	No value should exceed 0.30 mg/L
Total Suspended Solids	No value should exceed 30.0 mg/L
E. coli	No value should exceed 235 counts/100 mL (single sample maximum)

1.3 Listing Information

1.3.1 Understanding Subwatersheds and Assessment Units

This section presents information concerning IDEM's segmentation process as it applies to the Vernon Fork Muscatatuck River watershed. IDEM identifies this watershed and its tributaries using a watershed numbering system developed by United States Geological Survey (USGS), Natural Resource Conservation Service (NRCS), and the U.S. Water Resources Council referred to as hydrologic unit codes (HUCs). HUCs are a way of identifying watersheds in a nested arrangement from largest (i.e., those with shorter HUCs) to smallest (i.e., those with



longer HUCs) (IDEM, 2010). Figure 2 shows the 12-digit HUCs located in the Vernon Fork Muscatatuck River watershed.

Within each 12-digit HUC subwatershed, IDEM has identified several Assessment Unit IDs (AUIDs), which represent individual stream segments. Through the process of segmenting waterbodies into AUIDs, IDEM identifies streams reaches and stream networks that are representative for the purposes of assessment. In practice, this process leads to grouping tributary streams into smaller catchment basins of similar hydrology, land use, and other characteristics such that all tributaries within the catchment basin can be expected to have similar potential water quality impacts. Catchment basins, as defined by the aforementioned factors, are typically very small, which significantly reduces the variability in the water quality expected from one stream or stream reach to another. Given this, all tributaries within a catchment basin are assigned a single AUID. Grouping tributary systems into smaller catchment basins also allows for better characterization of the larger watershed and more localized recommendations for implementation activities. Variability within the larger watershed will be accounted for by the differing AUIDs assigned to the different catchment basins.

Table 4 and Table 9 contain the AUIDs in the subwatersheds of the Vernon Fork Muscatatuck River watershed and the associated drainage area. Subsequent sections of the TMDL report organize information by subwatershed (if applicable) and AUID.



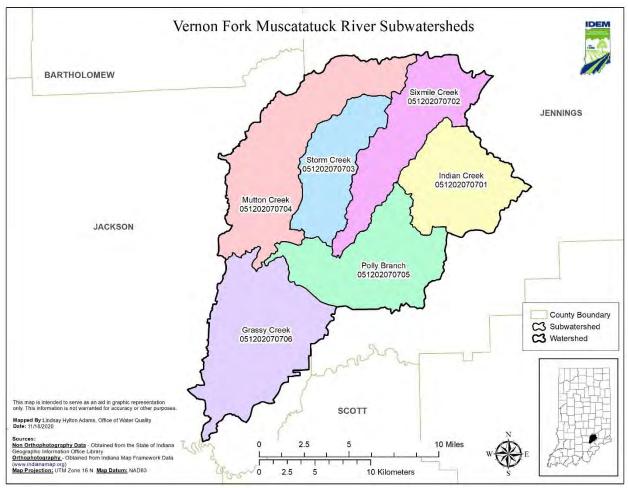


Figure 2: Subwatersheds (12-Digit HUCs) in the Vernon Fork Muscatatuck River Watershed

1.3.2 Understanding 303(d) Listing Information

There are a number of existing impairments in the Vernon Fork Muscatatuck River watershed from the approved 2022 303(d) List of Impaired Waters (

Table 4 and Figure 4). The listings and causes of impairment have been adjusted as a result of reassessment data collected at 23 sampling locations in the watershed. Within the Vernon Fork Muscatatuck River watershed, a total of 21 assessment unit IDs (AUIDs) will be cited as impaired for *E. coli*, 5 AUIDs cited as impaired for fish tissue (Mercury) impairments, 7 AUIDs cited as impaired for dissolved oxygen, and 8 AUIDs cited as impaired for IBC on Indiana's 2024 303(d) List of Impaired Waters (

Table 4 and Figure 9). These impaired segments account for approximately 243 miles.

Table 4 presents listing information for the Vernon Fork Muscatatuck River watershed, including a comparison of the updated listings with the 2022 listings and associated causes of impairments addressed by the TMDLs. The reassessment data used in updating the listings for



the watershed are available in Appendix A. Below is an inventory assessment of the available biological and chemistry data for the Vernon Fork Muscatatuck River watershed.

Table 4: Section 303(d) List Information for the Vernon Fork Muscatatuck River Watershed for
2022 and 2024

Name of Subwatershed	Current AUID	Length (mi)	2022 Section 303(d) Listed Impairment	Updated Impairments to be listed 2024 303(d)
	INW0771_02	7.02		E. coli
	INW0771_03	11.14	E. coli, Hg (FT)	E. coli, Hg (FT)
	INW0771_04	11.18	E. coli, Hg (FT)	E. coli, Hg (FT)
	INW0771_T1001	3.51		
	INW0771_T1001A	0.79		
Indian Creek	INW0771_T1001B	0.43		
051202070701	INW0771_T1002	6.38		
	INW0771_T1003	9.41		
	INW0771_T1004	5.70		
	INW0771_T1005	11.52		
	INW0771_T1006	3.30	E. coli, Hg (FT)	E. coli, Hg (FT)
	INW07P1041_00	0.70		
	INW0772_01A	13.95		E. coli, IBC, DO
	INW0772_03	1.35	IBC	E. coli, IBC
	INW0772_04	2.94		E. coli
	INW0772_05	11.73		E. coli
	INW0772_06	5.58		E. coli
	INW0772_T1001	6.88		
Sixmile Creek 051202070702	INW0772_T1003	3.16		
001202010102	INW0772_T1004	3.92		
	INW0772_T1005	4.84		
	INW0772_T1005A	0.41		
	INW07P1016_00	1.88		
	INW07P1071_00	0.28		
	INW07P1073_00	0.42		
	INW0773_01	22.82	IBC	E. coli
	INW0773_02	4.59	IBC, DO	IBC, DO
	INW0773_T1001	4.79		
	INW0773_T1002	4.68	IBC, DO	E. coli, IBC, DO
	INW0773_T1003	5.55		
Storm Creek 051202070703	INW0773_T1004	0.82		
	INW0773_T1005	4.85		
	INW0773_T1006	4.47		
	INW0773_T1007	0.62		
	INW0773_T1008	0.40		
	INW0773_T1009	0.18		
	INW07P1056_00	1.60		



Vernon Fork Muscatatuck River Watershed TMDL Report

Name of Subwatershed	Current AUID	Length (mi)	2022 Section 303(d) Listed Impairment	Updated Impairments to be listed 2024 303(d)
	INW07P1078_00	0.53		
	INW0773_T1010	1.11		
	INW0774_01	19.56	E. coli	E. coli
	INW0774_02	15.71	DO	E. coli, DO
	INW0774_03	7.06	E. coli, DO	E. coli, DO
	INW0774_T1001	3.29		
Mutton Creek 050202070704	INW0774_T1002	4.93		E. coli
000202010104	INW0774_T1003	11.31		E. coli
	INW0774_T1004	3.37		
	INW0774_T1005	12.77	IBC	E. coli, IBC
	INW0774_T1006	5.51		
	INW0775_01	17.83	DO, Hg (FT)	E. coli, Hg (FT)
	INW0775_01A	0.42		
	INW0775_01B	1.22		
	INW0775_02	4.74		
	INW0775_04	6.71		
Polly Branch	INW0775_05	12.26		
051202070705	INW0775_06	1.11		
	INW0775_T1001	4.96	Hg (FT)	Hg (FT)
	INW0775_T1002	4.18		
	INW0775_T1003	26.39	E. coli, IBC, DO	E. coli, IBC
	INW0775_T1004	10.22		
	INW0775_T1009	1.36		
	 INW0776_03	10.27		
	INW0776_04	0.35		
	INW0776_05	6.06	DO	DO
	 INW0776_06	4.70		
	INW0776_07	1.06		
	 INW0776_08	2.68		
	 INW0776_09	0.67		
	 INW0776_10	2.84		
	INW0776_T1005	3.84		
Grassy Creek	 INW0776_T1006	0.88		
051202070706	INW0776_T1007	1.74		
	 INW0776_T1008	6.41		
	 INW0776_T1009	11.85		E. coli, IBC, DO
	 INW0776_T1010	4.76		
	 INW0776_T1011	10.63		
	 INW0776_T1012	3.08		
		11.69		
	 INW0776_T1014	7.31		
	 INW0776_T1015	9.54		
	 INW0776_T1016	15.44		



Vernon Fork Muscatatuck River Watershed TMDL Report

Name of Subwatershed	Current AUID	Length (mi)	2022 Section 303(d) Listed Impairment	Updated Impairments to be listed 2024 303(d)
	INW0776_T1017	0.69		
	INW0776_T1018	2.58		
	INW0776_T1019	3.88		E. coli, IBC
	INW0776_T1020	3.01		
	INW0776_T1021	1.24		
	INW0776_T1022	0.42		
	INW0776_T1023	0.75		
	INW0776_T1024	1.96		
	INW0776_T1025	2.06		

Understanding

Table 4:

- Column 1: Name of Subwatershed (12-digit HUC). Shows the name of the subwatershed at the 12-digit HUC scale. The subwatershed found in this first column is the appropriate scale for what the IDEM's Watershed Management Plan (WMP) Checklist defines as a subwatershed for the purposes of watershed management planning.
- Column 2: Current AUID. Identifies the AUID given to waterbodies within the 12-digit HUC subwatershed for purposes of the 2022 Section 303(d) listing assessment process.
- Column 3: Length (mi). Provides the length in miles of the associated AUID.
- Column 4: 2022 Section 303(d) Listed Impairment. Identifies the cause of impairment associated with the 2022 Section 303(d) listing.
- Column 5: Updated Impairments to be listed on the 2024 303(d) List. Provides the updated causes of impairment if new data and information are available.



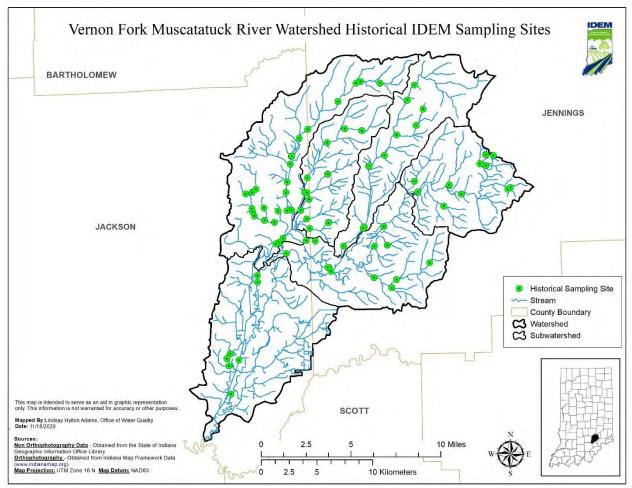


Figure 3: Location of Historical IDEM Sampling Sites in the Vernon Fork Muscatatuck River Watershed



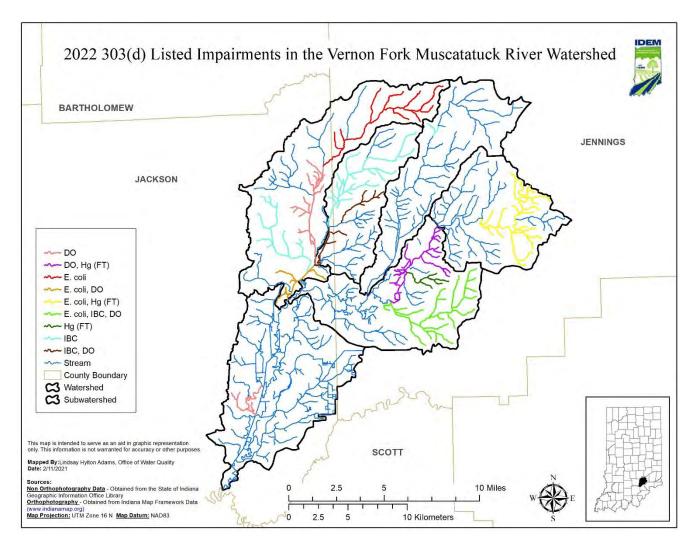


Figure 4: Streams Listed on the 2022 Section 303(d) List of Impaired Waters in the Vernon Fork Muscatatuck River Watershed



1.4 Water Quality Data

This section of the TMDL report contains a brief characterization of the Vernon Fork Muscatatuck River watershed water quality information that was collected in development of this TMDL. Understanding the natural and human factors affecting the watershed will assist in selecting and tailoring appropriate and feasible implementation activities to achieve water quality standards.

1.4.1 Water Quality Data

Data collected by IDEM from November 2020 through October 2021 were used for the TMDL analysis. Twenty-three sites were sampled for pathogens, water chemistry, and biological data in the Vernon Fork Muscatatuck River watershed. Table 5 and Figure 5 show the sampling site locations and information. Table 6 summarizes the pathogen data, and Table 7 summarizes the water chemistry data within the Vernon Fork Muscatatuck River watershed, in addition to the maximum concentrations at all impaired sites along with the reduction needed to meet the TMDL. Figures 6-8 below give a visual representation of pollutant concentration by site.

The percent reductions were calculated as follows:

% Reduction = $\frac{(\text{Observed Concentration - Target Value or WQS})}{\text{Observed Concentration}} \times 100$

Appendix A shows the individual sample results and summaries of all the water quality data for all 23 monitoring sites.



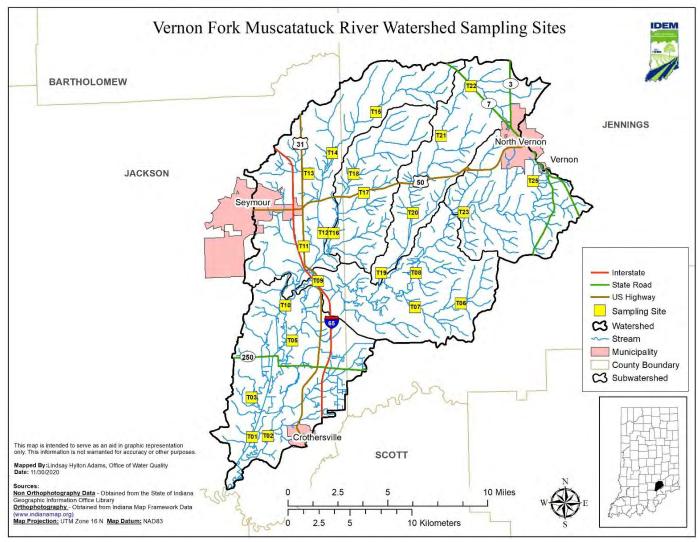


Figure 5: 2020-2021 Sampling Locations for the Vernon Fork Muscatatuck River TMDL Study



Site #	EPA Site ID	IDEM Station ID	Stream Name	Road Name	AUID
T01	21T-001	WEM090-0003	Rider Ditch	County Road 600 S	INW0776_T1022
T02	21T-002	WEM-07-0010	Grassy Creek	County Road 600 S	INW0776_T1019
Т03	21T-003	WEM090-0008	Vernon Fork Muscatatuck River	County Road 400 S	INW0776_05
T05	21T-005	WEM-07-0015	John McDonald Ditch	County Road 125 S	INW0776_T1009
T06	21T-006	WEM-07-0021	Tea Creek	County Road 650 S	INW0775_T1003
T07	21T-007	WEM070-0029	Tea Creek	County Road 650 W	INW0775_T1003
Т08	21T-008	WEM070-0039	Vernon Fork Muscatatuck River	County Road 500 S	INW0775_01
Т09	21T-009	WEM070-0020	Vernon Fork Muscatatuck River	US Hwy 31	INW0775_05
T10	21T-010	WEM090-0015	Vernon Fork Muscatatuck River	County Road E 50 N	INW0776_03
T11	21T-011	WEM080-0015	Sandy Branch	US Hwy 31	INW0774_T1005
T12	21T-012	WEM080-0014	Mutton Creek Ditch	County Road 400 N	INW0774_02
T13	21T-013	WEM-07-0016	Tributary of Mutton Creek	County Road 700 N	INW0774_T1003
T14	21T-014	WEM080-0027	Mutton Creek	County Road 800 N	INW0774_02
T15	21T-015	WEM080-0025	Mutton Creek	County Road 300 N	INW0774_01
T16	21T-016	WEM080-0013	Storm Creek Ditch	County Road 400 N	INW0773_02
T17	21T-017	WEM080-0005	Tributary to Richart Lake	County Road 900 W	INW0773_T1002
T18	21T-018	WEM-07-0014	Storm Creek	Base Road	INW0773_01
T19	21T-019	WEM-07-0017	Sixmile Creek	County Road 500 S	INW0772_06
T20	21T-020	WEM-07-0018	Sixmile Creek	County Road 200 S	INW0772_05
T21	21T-021	WEM-07-0019	Sixmile Creek	County Road 175 N	INW0772_04
T22	21T-022	WEM-07-0020	Sixmile Creek	State Road 7	INW0772_01A
T23	21T-023	WEM070-0036	Vernon Fork Muscatatuck River	County Road 400 W	INW0771_02
T25	21T-025	WEM070-0001	Vernon Fork Muscatatuck River	County Road 60 S	INW0771_03

Understanding Table 5:

- Column 1: Site #. Lists the site number that corresponds to the site location in Figure 5.
- Column 2: EPA Site ID. Provides the EPA assigned site number.
- Column 3: IDEM Station ID. Provides the IDEM assigned site number.
- Column 4: Stream Name. Identifies the stream name that the site is located on.
- Column 5: Road Name. Identifies the road name that the site is located on.
- Column 6: AUID. Identifies the AUID given to waterbodies within the 12-digit HUC subwatershed for purposes of the 2024 Section 303(d) listing assessment process.



<u>1.4.2 *E. coli* Data</u>

Tab	ole 6: Summary	/ of Pathogen Da	ita in Vernon For	k Muscatatuck F	River Wat	ershed by Subwate	ershed

Subwatershed	Site #	IDEM Station ID	AUID	Period of Record	Total Number	Percent of Samples Exceeding <i>E. coli</i> WQS (#/100 mL)		Geomean	<i>E. coli</i> Percent Reduction	Single Sample Maximum	<i>E. coli</i> Percent Reduction Based
					of Samples	125	235	(#/100 mL)	Based on Geomean (125/100mL)	(SSM) (#/100 mL)	on SSM (#/100 mL)
Indian Creek	T23	WEM070-0036	INW0771_02	4/12/21-10/12/21	10	50	30	151.74	17.62	2419.60	90.29
Indian Creek	T25	WEM070-0001	INW0771_03	4/12/21-10/12/21	10	40	30	141.34	11.56	2419.60	90.29
	T19	WEM-07-0017	INW0772_06	4/12/21-10/12/21	10	100	60	357.02	64.99	1046.20	77.54
Sixmile Creek	T20	WEM-07-0018	INW0772_05	4/12/21-10/12/21	10	90	90	484.04	74.18	727.00	67.68
Sixinile Creek	T21	WEM-07-0019	INW0772_04	4/12/21-10/12/21	10	80	40	186.89	33.12	313.00	24.92
	T22	WEM-07-0020	INW0772_01A	4/12/21-10/12/21	10	100	100	1730.5	92.78	2419.60	90.29
	T16	WEM080-0013	INW0773_02	4/13/21-10/13/21	10	40	10	59.94	NA	2419.60	90.29
Storm Creek	T17	WEM080-0005	INW0773_T1002	4/13/21-10/13/21	9	100	88.9	602.45	79.25	2419.60	90.29
	T18	WEM-07-0014	INW0773_01	4/13/21-10/13/21	10	100	80	493.11	74.65	2419.60	90.29
	T11	WEM080-0015	INW0774_T1005	4/13/21-10/13/21	10	90	70	435.7	71.31	2419.60	90.29
	T12	WEM080-0014	INW0774_02	4/13/21-10/13/21	10	80	50	166.4	24.88	2419.60	90.29
Mutton Creek	T13	WEM-07-0016	INW0774_T1003	4/13/21-10/13/21	10	90	70	460.2	72.84	2419.60	90.29
	T14	WEM080-0027	INW0774_02	4/12/21-10/12/21	10	90	90	1131.04	88.95	2419.60	90.29
	T15	WEM080-0025	INW0774_01	4/12/21-10/12/21	10	100	90	505.48	75.27	980.40	76.03
	T06	WEM-07-0021	INW0775_T1003	4/12/21-10/12/21	10	80	80	560.57	77.70	2419.60	90.29
Dolly Bronch	T07	WEM070-0029	INW0775_T1003	4/12/21-10/12/21	10	90	80	581.59	78.51	1986.30	88.17
Polly Branch	T08	WEM070-0039	INW0775_01	4/12/21-10/12/21	10	80	40	235.5	46.92	2419.60	90.29
	Т09	WEM070-0020	INW0775_05	4/13/21-10/13/21	10	70	40	83.77	NA	2419.60	90.29
Grassy Creek	T01	WEM090-0003	INW0776_T1022	4/13/21-10/13/21	10	70	40	107.48	NA	2419.60	90.29
	T02	WEM-07-0010	INW0776_T1019	4/13/21-10/13/21	10	70	50	244.37	48.85	2419.60	90.29
	T03	WEM090-0008	INW0776_05	4/13/21-10/13/21	10	80	50	183.88	32.02	2419.60	90.29
	T05	WEM-07-0015	INW0776_T1009	4/13/21-10/13/21	10	90	70	220.36	43.27	2419.60	90.29
	T10	WEM090-0015	INW0776_03	4/13/21-10/13/21	10	70	50	96.69	NA	2419.60	90.29



Understanding Table 6: Pathogen data for the Vernon Fork Muscatatuck River watershed indicated the following:

- Reductions of 90 percent or greater are needed to meet the TMDL target values for *E. coli* in Indian Creek.
- Reductions of 90 percent or greater are needed to meet the TMDL target values for *E. coli* in Sixmile Creek.
- Reductions of 90 percent or greater are needed to meet the TMDL target values for *E. coli* in Storm Creek.
- Reductions of 90 percent or greater are needed to meet the TMDL target values for *E. coli* in Mutton Creek.
- Reductions of 90 percent or greater are needed to meet the TMDL target values for *E. col*i in Polly Branch.
- Reductions of 90 percent or greater are needed to meet the TMDL target values for *E. coli* in Grassy Creek.



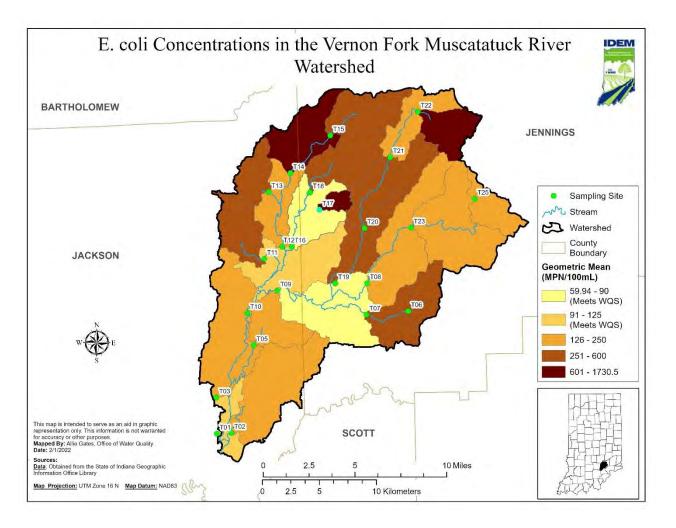


Figure 6: *E. coli* concentrations based on 5-week geometric mean (MPN/100mL) and sampling site drainage areas for 2020 and 2021. Values over 125 MPN/100mL are not meeting the current water quality standard for *E. coli*.



1.4.3 Water Chemistry Data

Table 7: Summary of Chemistry Data in Vernon Fork Muscatatuck River Watershed for Nutrients, Total Suspended Solids, and **Dissolved Oxygen**

Subwatershed	Site #	IDEM Station ID	AUID	Total Phosphorus Single Sample Maximum (mg/L)	Total Phosphorus % Reduction	Total Suspended Solids Single Sample Maximum (mg/L)	Total Suspended Solids % Reduction	Dissolved Oxygen Single Sample Minimum (mg/L)	Dissolved Oxygen % Below WQS
Indian Creek	T23	WEM070-0036	INW0771_02	0.49	38.8	60	50.0	6.85	NA
	T25	WEM070-0001	INW0771_03	0.35	14.3	101	70.3	6.54	NA
	T19	WEM-07-0017	INW0772_06	0.21	NA	28	NA	6.82	NA
0. 10 1	T20	WEM-07-0018	INW0772_05	0.37	18.9	14	NA	6.86	NA
Sixmile Creek	T21	WEM-07-0019	INW0772_04	0.5	40.0	15	NA	6.01	NA
	T22	WEM-07-0020	INW0772_01A	0.14	NA	13	NA	2.63	52.1
	T16	WEM080-0013	INW0773_02	0.67	55.2	240	87.5	0.18	2122.2
Storm Creek	T17	WEM080-0005	INW0773_T1002	0.4	25.0	120	75.0	0.36	1011.1
	T18	WEM-07-0014	INW0773_01	0.7	57.1	210	85.7	3.79	5.5
	T11	WEM080-0015	INW0774_T1005	0.34	11.8	95	68.4	5.64	NA
Mutter Creek	T12	WEM080-0014	INW0774_02	0.26	NA	92	67.4	0.46	769.6
Mutton Creek	T13	WEM-07-0016	INW0774_T1003	0.85	64.7	290	89.7	5.69	NA
	T14	WEM080-0027	INW0774_02	0.35	14.3	20	NA	4.78	NA
	T15	WEM080-0025	INW0774_01	0.087	NA	7.5	NA	4.46	NA
	T06	WEM-07-0021	INW0775_T1003	0.9	66.7	15	NA	4.59	NA
Delly Dreneb	T07	WEM070-0029	INW0775_T1003	0.67	55.2	19	NA	2.6	53.8
Polly Branch	T08	WEM070-0039	INW0775_01	0.47	36.2	54	44.4	4.67	NA
	T09	WEM070-0020	INW0775_05	0.36	16.7	100	70.0	4.35	NA
	T01	WEM090-0003	INW0776_T1022	0.37	18.9	140	78.6	4.76	NA
	T02	WEM-07-0010	INW0776_T1019	2.9	89.7	53	43.4	4.17	NA
Grassy Creek	T03	WEM090-0008	INW0776_05	1.1	72.7	42	28.6	0.35	1042.9
	T05	WEM-07-0015	INW0776_T1009	0.25	NA	54	44.4	1.56	156.4
	T10	WEM090-0015	INW0776_03	0.3	NA	93	67.7	4.19	NA



***Note:** This table summarizes all data collected. Any reduction shown that is not associated with a TMDL is for informational purposes only.

Understanding Table 7: Water chemistry data for the Vernon Fork Muscatatuck River watershed indicated the following:

- *Reductions of 39 percent or greater are needed to meet the TMDL target values for total phosphorus and 70 percent or greater for TSS in Indian Creek.
- Reductions of 40 percent or greater are needed to meet the TMDL target values for total phosphorus in Simile Creek.
- Reductions of 57 percent or greater are needed to meet the TMDL target values for total phosphorus and 88 percent or greater for TSS in Storm Creek.
- Reductions of 65 percent or greater are needed to meet the TMDL target values for total phosphorus and 90 percent or greater for TSS in Mutton Creek.
- *Reductions of 67 percent or greater are needed to meet the TMDL target values for total phosphorus and 70 percent or greater for TSS in Polly Branch.
- *Reductions of 90 percent or greater are needed to meet the TMDL target values for total phosphorus and 79 percent or greater for TSS in Grassy Creek.



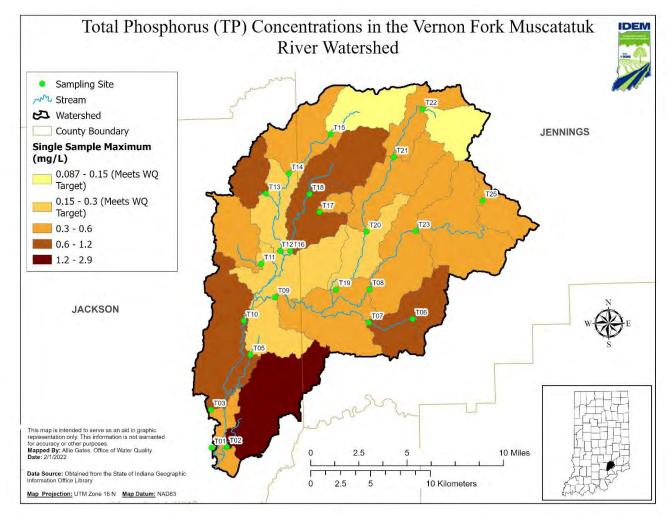


Figure 7: Total phosphorus concentrations based on single sample maximum concentration (mg/L) and sampling site drainage areas for 2020 and 2021. Values over 0.30 mg/L are not meeting the water quality target value for total phosphorus.



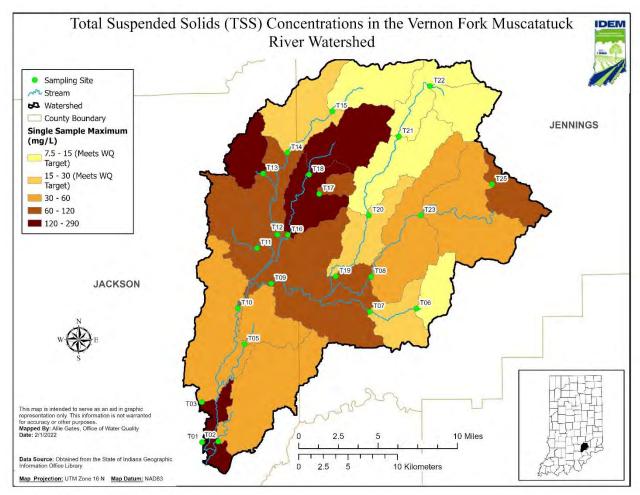


Figure 8: Total Suspended Solids concentrations based on single sample maximum concentration (mg/L) and sampling site drainage areas for 2020 and 2021. Values over 30 mg/L are not meeting the water quality target value for TSS.

1.4.4 Biological Data

Sampling performed by IDEM in August and September 2021 documented numerous biotic impairments in the Vernon Fork Muscatatuck River watershed as summarized in Table 8. Fish and macroinvertebrate community sampling took place at 21 sampling sites in the Vernon Fork Muscatatuck River watershed. Sampling data indicate that the overall biological integrity of the watershed was fair. Sampling resulted in 6 of the 21 sites failing established criteria for aquatic life use support for fish and/or macroinvertebrates.

Through the TMDL efforts, IDEM has identified several potential reasons for the impairments. TSS can reduce plants available for consumption by inhibiting growth of submerged aquatic plants, lower dissolved oxygen levels by reducing light penetration (which impairs algal growth), impair the ability of fish to see and catch food, increase stream temperature, clog fish gills



(which may decrease disease resistance), slow growth rates, and prevent the development of eggs and larvae. Total phosphorus can cause excessive plant production resulting in increased turbidity, decrease dissolved oxygen levels, and greater fluctuations in diurnal dissolved oxygen and pH levels, resulting in lower stream diversity. Attaining the TSS and total phosphorus target values shown in Table 3 will address the causes of IBC impairments.

							r		
Subwatershed	Stream Name	Site #	IDEM Station ID	Score	Integrity Class	QHEI	Score	Integrity Class	QHEI
		π		mIBI	mIBI	mIBI	IBI	IBI	IBI
	Vernon Fork Muscatatuck River	T23	WEM070-0036	42	Fair	62	52	Good	73
Indian Creek	Vernon Fork Muscatatuck River	T25	WEM070-0001	40	Fair	87	54	Excellent	80
	Sixmile Creek	T19	WEM-07-0017	44	Fair	44	46	Good	49
Sixmile Creek	Sixmile Creek	T20	WEM-07-0018	42	Fair	62	52	Good	62
OIXITILE OFCCK	Sixmile Creek	T21	WEM-07-0019	42	Fair	67	38	Fair	72
	Sixmile Creek	T22	WEM-07-0020	30	Poor	57	32	Poor	55
	Storm Creek Ditch	T16	WEM080-0013	34	Poor	44	32	Poor	46
Storm Creek	Tributary to Richart Lake	T17	WEM080-0005	32	Poor	56	20	Very Poor	49
	Storm Creek	T18	WEM-07-0014	38	Fair	53	42	Fair	61
	Sandy Branch	T11	WEM080-0015	ND	ND	ND	ND	ND	ND
	Mutton Creek Ditch	T12	WEM080-0014	36	Fair	49	38	Fair	47
Mutton Creek	Tributary of Mutton Creek	T13	WEM-07-0016	40	Fair	48	40	Fair	65
	Mutton Creek	T14	WEM080-0027	40	Fair	52	40	Fair	52
	Mutton Creek	T15	WEM080-0025	42	Fair	53	36	Fair	60
	Tea Creek	T06	WEM-07-0021	32	Poor	62	38	Fair	57
Polly Branch	Tea Creek	T07	WEM070-0029	42	Fair	46	38	Fair	49
	Vernon Fork Muscatatuck River	T08	WEM070-0039	40	Fair	55	48	Good	62
	Vernon Fork Muscatatuck River	T09	WEM070-0020	42	Fair	74	52	Good	70
	Rider Ditch	T01	WEM090-0003	38	Fair	43	50	Good	55
	Grassy Creek	T02	WEM-07-0010	32	Poor	46	38	Fair	51
Grassy Creek	Vernon Fork Muscatatuck River	T03	WEM090-0008	ND	ND	ND	ND	ND	ND
	John McDonald Ditch	T05	WEM-07-0015	34	Poor	42	28	Poor	29
	Vernon Fork Muscatatuck River	T10	WEM090-0015	44	Fair	42	46	Good	57

 Table 8: Biotic Integrity Scores in the Vernon Fork Muscatatuck River Watershed Identified

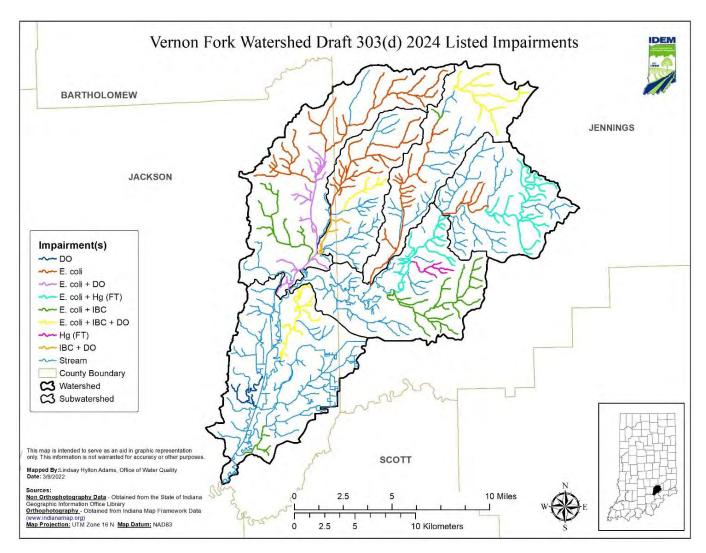
 During August/September 2021 Sampling



Notes: IBI = Index of Biotic Integrity for fish community, mIBI = Index of Biotic Integrity for macroinvertebrate community, QHEI = Qualitative Habitat Evaluation Index. QHEI Scores were calculated using IDEM's <u>Procedures for Completing the Qualitative Habitat Evaluation Index</u> <u>Technical Standard Operating Procedure</u> (IDEM, 2019).

ND= No Data

Figure 9: Streams to be listed on the Draft 2024 Section 303(d) List of Impaired Waters in the Vernon Fork Muscatatuck River Watershed





2.0 DESCRIPTION OF THE WATERSHED AND SOURCE ASSESSMENT

This section of the TMDL report contains a brief characterization of the Vernon Fork Muscatatuck River watershed to provide a better understanding of the historic and current conditions of the watershed that affect water quality and contribute to the impairments. Understanding the natural and human factors affecting the watershed will assist in selecting and tailoring appropriate and feasible implementation activities to achieve water quality standards.

As discussed in Section 1.3.1, the Vernon Fork Muscatatuck River watershed contains six 12digit HUC subwatersheds. Examining subwatersheds enables a closer examination of key factors that affect water quality. The subwatersheds include:

- Indian Creek (051202070701)
- Sixmile Creek (051202070702)
- Storm Creek (051202070703)
- Mutton Creek (051202070704)
- Polly Branch (051202070705)
- Grassy Creek (051202070706)

The following table contains the names of the six subwatersheds of the Vernon Fork Muscatatuck River watershed and their associated drainage area.

Name of Subwatershed	12-digit HUC	Area Within Watershed (sq. miles)	Percent of Watershed Area	Drainage Area (sq miles)	Percent of Total Drainage Area
Indian Creek	051202070701	29.24	13.79%	225.50	54.70%
Sixmile Creek	051202070702	31.00	14.62%	31.00	7.52%
Storm Creek	051202070703	23.28	10.97%	23.28	5.65%
Mutton Creek	051202070704	46.78	22.05%	70.06	16.99%
Polly Branch	051202070705	36.14	17.04%	292.66	70.99%
Grassy Creek	051202070706	45.68	21.54%	412.26	100.00%

Table 9: Vernon Fork Muscatatuck Rive	r Subwatershed Drainage Areas
Table 9. Vernon Fork Muscalaluck Rive	Subwatershed Drainage Areas

Understanding Table 9: Land area helps IDEM to define the pollutant load reductions needed for each AU in each 12-digit HUC subwatershed that comprises the Vernon Fork Muscatatuck River watershed. Information in each column is as follows:

- Column 1: Name of Subwatershed. Lists the name of the subwatersheds.
- Column 2: 12-digit HUC. Identifies the subwatershed's 12-digit HUC.



- Column 3: Area Within Watershed. Provides the area of each subwatershed within the overall watershed in square miles.
- Column 4: Percent of Watershed Area. Indicates the percent of land area of each subwatershed, providing a relative understanding of the portions of each subwatershed compared to the overall Vernon Fork Muscatatuck River watershed.
- Column 5: Drainage Area. Quantifies the area the specific subwatershed drains in square miles.
- Column 6: Percent of Total Drainage Area. Indicates the percent of the total drainage area, providing a relative understanding of the portion of the subwatershed in the overall Vernon Fork Muscatatuck River watershed.

IDEM bases load calculations on the drainage area for each of the 12-digit HUC subwatersheds. The information contained in this table is the foundation for the technical calculations found in Sections 3.0 and 4.0 of this report. This table will help watershed stakeholders look at the smaller subwatersheds within the Vernon Fork Muscatatuck River watershed and understand the smaller areas contributing to the impaired waterbody, helping to quantify the geographic scale that influences source characterization and areas for implementation.

The term "point source" refers to any discernible, confined and discrete conveyance, such as a pipe, ditch, channel, tunnel, or conduit, by which pollutants are transported to a waterbody. It also includes vessels or other floating craft from which pollutants are or may be discharged. By law, the term "point source" also includes: confined feeding operations (which are places where animals are confined and fed); and illicitly connected "straight pipe" discharges of household waste. Permitted point sources are regulated through the National Pollutant Discharge Elimination System (NPDES).

Nonpoint sources include all other categories not classified as point sources. In urban areas, nonpoint sources can include leaking or faulty septic systems, run-off from lawn fertilizer applications, pet waste, and other sources. In rural areas, nonpoint sources can include run-off from cropland, pastures and animal feeding operations, and inputs from streambank erosion, leaking, failing or straight-piped septic systems, and wildlife.

2.1 Land Use

Land use patterns provide important clues to the potential sources of impairments in a watershed. Land use information for the Vernon Fork Muscatatuck River watershed is available from the National Agricultural Statistics Service (NASS) cropland data layer. These data categorize the land use for each 30 meters by 30 meters parcel of land in the watershed based on satellite imagery from circa 2019. Figure 10 displays the spatial distribution of the land uses and the data are summarized in Table 10. Additionally, Table 11 displays the breakdown of land uses within each of the six subwatersheds.



Land use in the Vernon Fork Muscatatuck River watershed is primarily forested land, comprising 40 percent of the watershed. Approximately 24 percent of the land is in agricultural use. Corn and soybean crops are not typically associated with high *E. coli* loads, unless they have been fertilized with manure. Pasture/hay use also represents 24 percent of the watershed and could indicate the presence of animal feedlots, which can be significant sources of *E. coli*, TSS, and/or nutrients. The remaining land categories represent approximately 12 percent of the total land area.

The Vernon Fork Muscatatuck River watershed has a diverse network of streams. Tributaries include Mutton Creek, Sixmile Creek, Indian Creek, Storm Creek, Polly Branch, and Grassy Creek among others. Forested areas are more pronounced in the eastern portions of the watershed, especially throughout the Indian Creek subwatershed. The Muscatatuck National Wildlife Refuge, which encompasses portions of the Mutton Creek, Storm Creek, and Polly Branch subwatersheds, is also heavily forested with extensive wetlands that extend south into the Grassy Creek subwatershed. Urban areas consist of portions of the cities of Seymour and North Vernon, as well as the Town Vernon, in the northern portion of the watershed, along with the Town of Crothersville in the southern end. Waters drain to the Muscatatuck River and continue flowing southwest, where they eventually flow into the East Fork White River.

Many unique species call this watershed home. Various species of mollusks, including five which are federally endangered, can be found in the watershed and surrounding counties. The rare Popeye Shiner fish can also be found in this watershed, in addition to the Common Mudpuppy and Four-Toed Salamander, which are state species of special concern (IDNR, 2020). This fauna is dependent upon the health of the aquatic ecosystem. Additional information on state endangered, threatened, and rare species can be found on the DNR website (<u>DNR:</u> Nature Preserves: Endangered Plant and Animals (in.gov).

	Watershed			
Land Use	Ar			
	Acres	Square Miles	Percent	
Agricultural Land	32,818	51.28	24.14	
Developed Land	11,917	18.62	8.76	
Forested Land	54,127	84.57	39.82	
Hay/Pasture	32,619	50.97	24.00	
Open Water	1,287	2.01	0.95	
Shrub/Scrub	24	0.04	0.02	
Wetlands	3,152	4.93	2.32	
Total	135,941	212.41	100%	

Table 10: Land Use of the Vernon Fork Muscat	tatuck River Watershed
--	------------------------

Understanding Table 10: The predominant land use types in the Vernon Fork Muscatatuck River watershed can indicate potential sources of E. coli, TSS, and TP loadings. Different types of land uses are characterized by different types of hydrology. For example, developed lands are



characterized by impervious surfaces that increase the potential of stormwater events during high flow periods delivering E. coli, TSS, and nutrients to downstream streams and rivers. Forested land and wetlands allow water to infiltrate slowly thus reducing the risks of polluted water running off into waterbodies. In addition to differences in hydrology, land use types are associated with different types of activities that could contribute pollutants to the watershed. Understanding types of land uses will help identify the type of implementation approaches that watershed stakeholders can use to achieve E. coli, TSS, and TP load reductions.

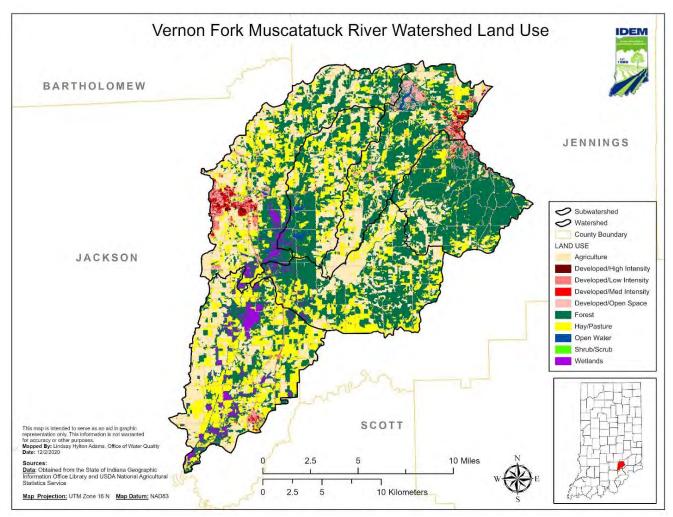


Figure 10: Land use in the Vernon Fork Muscatatuck River Watershed



	_	Land Use							
Subwatershed	Area	Agriculture	Developed	Forest	Hay/ Pasture	Open Water	Shrub/ Scrub	Wetlands	Total
la dian Ora di	Acres	2,107	1,612	12,823	2,025	163	4	7	18,739
Indian Creek (051202070701)	Sq. Mi.	3.29	2.52	20.04	3.16	0.25	0.01	0.01	29.28
(031202070701)	Percent	11%	9%	69%	11%	1%	0%	0%	100%
Civersile Oreals	Acres	4,977	2,767	7,859	3,992	280	11	10	19,896
Sixmile Creek (051202070702)	Sq. Mi.	7.78	4.32	12.28	6.24	0.44	0.02	0.01	31.09
(031202010102)	Percent	25%	14%	40%	20%	1%	0%	0%	100%
Otamia Orașali	Acres	3,486	735	6,594	3,657	288	2	169	14,930
Storm Creek (051202070703)	Sq. Mi.	5.45	1.15	10.30	5.71	0.45	0.00	0.26	23.33
(001202010100)	Percent	23%	5%	44%	25%	2%	0%	1%	100%
Mutton Creek	Acres	8,715	4,039	9,301	6,877	307	4	747	29,990
(051202070704)	Sq. Mi.	13.62	6.31	14.53	10.75	0.48	0.01	1.17	46.86
(00.2020/0/0/)	Percent	29%	13%	31%	23%	1%	0%	2%	100%
Delly Drench	Acres	5,239	1,010	10,701	5,834	120	2	282	23,190
Polly Branch (051202070705)	Sq. Mi.	8.19	1.58	16.72	9.12	0.19	0.00	0.44	36.23
(001202010100)	Percent	23%	4%	46%	25%	1%	0%	1%	100%
Crossy Crock	Acres	8,318	1,746	6,916	10,251	131	2	1,936	29,300
Grassy Creek (051202070706)	Sq. Mi.	13.00	2.73	10.81	16.02	0.20	0.00	3.02	45.78
(051202070706)	Percent	28%	6%	24%	35%	0%	0%	7%	100%

Table 11: Land Use in the Vernon Fork Muscatatuck River Subwatersheds

2.1.1 Cropland

Croplands can be a source of *E. coli*, sediments, and nutrients. Accumulation of nutrients and *E. coli* on cropland occurs from fertilization with chemical (e.g., anhydrous ammonia) fertilizers, manure fertilizers, inorganic fertilizers, wildlife excreta, irrigation water, and application of waste products from municipal and industrial wastewater treatment facilities. The majority of nutrient loading from cropland occurs from fertilization with commercial and manure fertilizers (Patwardhan, 1997). Use of manure for nitrogen supplementation often results in excessive phosphorus loads relative to crop requirements (Patwardhan, 1997). Data available from the National Agricultural Statistics Service (NASS) were downloaded to estimate crop acreage in the subwatersheds. The 2019 NASS statistics were used in the analysis as shown in

Table 12 and displayed in Figure 11 (USDA, 2019).



Subwatershed	Сгор	Total Acreage	% of Subwatershed Cash Crop Acreage
	Corn	1,089	52%
Indian Creek	Soybean	988	47%
(051202070701)	Winter Wheat/Soybeans	25	1%
	Total	2,102	100%
	Corn	1,684	34%
Oissesile, Ossale	Soybean	3,188	64%
Sixmile Creek (051202070702)	Winter Wheat/Soybeans	90	2%
(Total	4,962	100%
	Corn	957	27%
Storm Creek	Soybean	2,504	72%
(051202070703)	Winter Wheat/Soybeans	17	0%
(Total	3,478	100%
	Corn	2,529	29%
Mutton Creek	Soybean	5,825	67%
(051202070704)	Winter Wheat/Soybeans	344	4%
	Total	8,698	100%
	Corn	1,658	32%
Polly Branch	Soybean	3,515	67%
(051202070705)	Winter Wheat/Soybeans	58	1%
	Total	5,231	100%
	Corn	2,587	31%
Grassy Creek	Soybean	5,255	63%
(051202070706)	Winter Wheat/Soybeans	463	6%
	Total	8,305	100%

Table 12: Major Cash Crop Acreage in the Vernon Fork Muscatatuck River Watershed



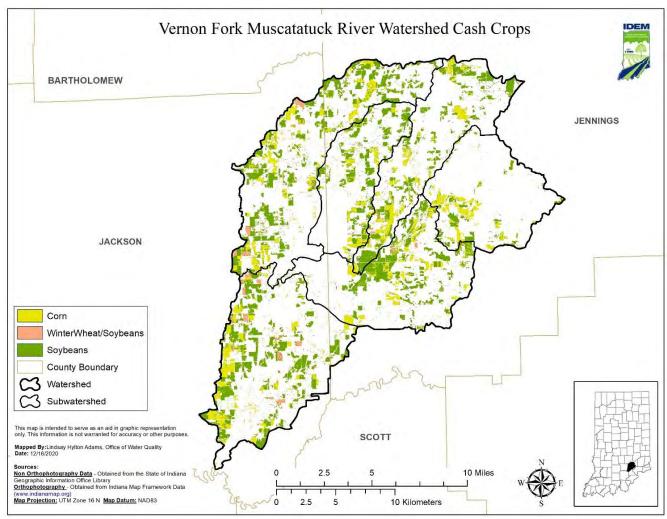


Figure 11: Cash Crop Acreage in the Vernon Fork Muscatatuck River Watershed

2.1.2 Hay/Pastureland

Run-off from pastures and livestock operations can be potential agricultural sources of *E. coli*, nutrients, and TSS. For example, animals grazing in pasturelands deposit manure directly upon the land surface and, even though a pasture may be relatively large and animal densities low, the manure will often be concentrated near the feeding and watering areas in the field. These areas can quickly become barren of plant cover, increasing the possibility of erosion and contaminated run-off during a storm event.

Livestock are potential source of *E. coli*, nutrients, and TSS to streams, particularly when direct access is unrestricted and/or where feeding structures are located adjacent to riparian areas. Watershed specific data are not available for livestock populations. The amount of hay/pastureland across the landscape can be used to as an indicator for potential areas of higher densities from livestock. Information on permitted livestock facilities within the Vernon Fork Muscatatuck River watershed are presented in Figure 12 and Table 13.



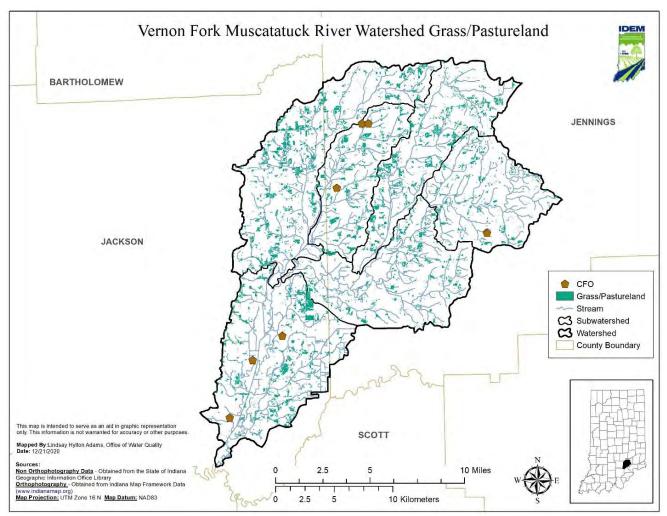


Figure 12: Grassland and Pastureland in the Vernon Fork Muscatatuck River Watershed with CFO locations

2.1.3 Confined Feeding Operations (CFOs) and Animal Feeding Operations (AFOs)

A CFO is an agricultural operation where animals are kept and raised in confined situations. It is a lot or facility (other than an aquatic animal production facility) where the following conditions are met:

- Animals have been, are, or will be stabled or confined and fed or maintained for a total of 45-days or more in any 12-month period.
- Crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over 50 percent of the lot or facility.
- The number of animals present meets the requirements for the state permitting action.

Feeding operations that are not classified as concentrated animal feeding operations (CAFOs) are known as confined feeding operations (CFOs) in Indiana. There are currently no CAFOs in



the Vernon Fork Muscatatuck River watershed. Non-CAFO animal feeding operations identified as CFOs by IDEM are considered nonpoint sources by U.S. EPA. Indiana's CFOs have state issued permits and are therefore categorized as nonpoint sources for the purposes of this TMDL. CFO permits are "no discharge" permits. Therefore, it is prohibited for these facilities to discharge to any water of the State.

The CFO regulations (327 IAC 19, 327 IAC 15-16) require that operations "not cause or contribute to an impairment of surface waters of the state." IDEM regulates these confined feeding operations under IAC 13-18-10, the Confined Feeding Control Law. The rules at 327 IAC 19, which implement the statute regulating confined feeding operations, were effective on July 1, 2012. The rule at 327 IAC 15-16, which regulates CAFOs and incorporates by reference the federal NPDES CAFO regulations, became effective on July 1, 2012. It should be noted that there are currently zero facilities in Indiana that have an NPDES permit under 327 IAC 15-16.

The animals raised in CFOs produce manure that is stored in pits, lagoons, tanks and other storage devices. The manure can then be applied to area fields as fertilizer. CFO owners can either apply manure to land they own or market and sell manure to other landowners per regulations outlined in 327 IAC 19-14. When stored and applied properly, this beneficial re-use of manure provides a natural source for crop nutrition. It also lessens the need for fuel and other natural resources that are used in the production of fertilizer.

However, CFOs can be a potential source of *E. coli* due to the following:

- Improper application of manure can contaminate surface or groundwater.
- Manure over-application or improper application can adversely impact soil productivity.

There are multiple AFOs (animal feeding operations) in the Vernon Fork Muscatatuck River watershed and seven permitted CFOs, as shown below in Table 13 and in Figure 12. Manure used for land application in the watershed may also originate from AFOs and CFOs in adjacent watersheds.

Subwatershed	CFO Permit ID	Operation Name	County	Animal Type and Permitted number
Indian Creek	4907	The Maschoffs LLC North Vernon	Jennings	Finishers: 115 Sows: 1,389
	6708	Rose Acre Farms Incorporated Spencer Breeder Farm	Jennings	Layers: 55,000
Storm Creek	1207	Rose Acre Farms Incorporated Woodacres Farm	Jennings	Layers: 275,000
	3571	Rose Acres Farms Incorporated Storm Creek Breeder Farm	Jennings	Layers: 48,000

Table 13: CFOs in the Vernon Fork Muscatatuck River Watershed



Subwatershed	CFO Permit ID	Operation Name	County	Animal Type and Permitted number
	6294	Jonathon Pollert	Jackson	Finishers: 4,400
Grassy Creek	884	Brenda Bobb Farm	Jackson	Finishers: 4,000
	6959	Kyle & Leah Broshears	Jackson	Finishers: 4,400

2.2 Topography and Geology

Topographic and geologic features of a watershed play a role in defining a watershed's drainage pattern. Figure 13 below displays the topography of the watershed. Information concerning the topography and geology within the Vernon Fork Muscatatuck River watershed is available from the Indiana Geological and Water Survey (IGWS). The Vernon Fork Muscatatuck River watershed originates in Jennings County, its water flowing southwest into Jackson County, where it empties from the Muscatatuck River into the East Fork of the White River. The Vernon Fork Muscatatuck River watershed is located in the Southern Hills and Lowlands physiographic region of the state, which is characterized by knolls and ridges, with gorges and ridges to the south. It is unique in Indiana by not having been covered by glacial till.

The entire bedrock surface of Indiana consists of sedimentary rocks. The major kinds of sedimentary rock in Indiana include limestone, dolomite, shale, sandstone, and siltstone. The northern two-thirds of Indiana are composed of glacial deposits containing groundwater. These glacial aquifers exist where sand and gravel bodies are present within clay-rich glacial till (sediment deposited by ice) or in alluvial, coastal, and glacial outwash deposits. Groundwater availability is much different in the southern unglaciated part of Indiana. There are few unconsolidated deposits above the bedrock surface, and the voids in bedrock (other than karst dissolution features) are seldom sufficiently interconnected to yield useful amounts of groundwater. Reservoirs in the state, such as Monroe Lake and Patoka Lake, are used for water supply in lieu of water wells in southern Indiana. The IGWS website contains information about the geology of Indiana (https://igws.indiana.edu/GroundWater).



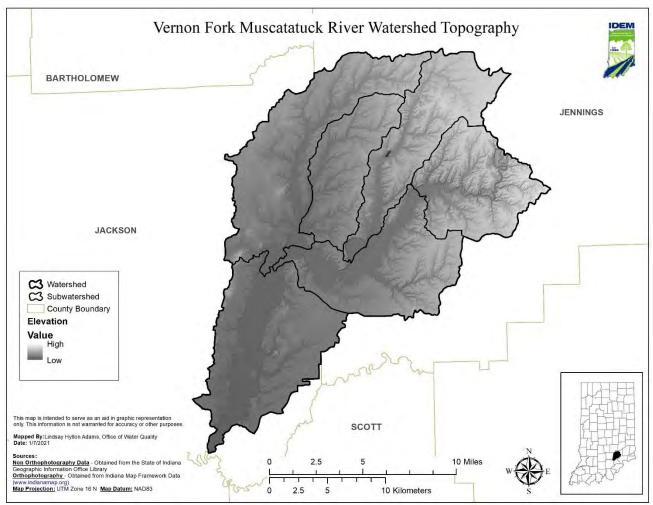


Figure 13: Topography of the Vernon Fork Muscatatuck River Watershed. Digital Elevation Data (DEM) was taken from the State of Indiana's Geographic Information Office (GIO).

2.2.1 Karst Geology

Karst regions are characterized by the presence of limestone or other soluble rocks, where drainage has been largely diverted into subsurface routes. The topography of such areas is dominated by sinkholes, sinking streams, large springs, and caves. Many subsurface drainage networks in this area are fed by surface streams that sink into caves or swallow holes. Activities that impact the surface water quality can thus be expected to affect groundwater as well. Due to the nature of conduit flow, impacts are likely to be ephemeral, and determination of exact directions of transport or affected conduits may be problematic in the absence of detailed dye-tracing studies. While the State of Indiana has performed dye-tracing studies in southern Indiana, none have been performed within the Vernon Fork Muscatatuck River watershed (Flemming et al., 1995). Figure 14 displays the location of the karst features of the watershed.



The Indiana Karst Conservancy is a 501(c)(3) non-profit organization dedicated to the preservation and conservation of Indiana's unique karst features. Unfortunately, many karst features are subject to incompatible or damaging uses. Most are on private land, occasionally with owners unaware of their significance or apathetic to their preservation. The IKC provides protection and awareness of karst features and the unique habitat they provide. For more information regarding the IKC, visit their website at http://www.ikc.caves.org/.

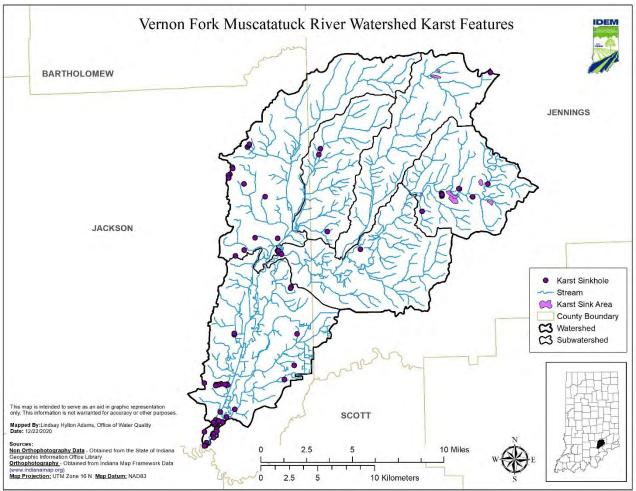


Figure 14: Karst Features in the Vernon Fork Muscatatuck River Watershed

2.3 Soils

There are different soil characteristics that can affect the health of the watershed. Some of these characteristics include soil drainage, septic tank suitability, soil saturation, and soil erodibility.

2.3.1 Soil Drainage

The hydrologic soil group classification is a means for categorizing soils by similar infiltration and run-off characteristics during periods of prolonged wetting. The NRCS has defined four hydrologic groups for soils, described in Table 14 (USDA, 2009). Data for the Vernon Fork



Muscatatuck River watershed were obtained from the USDA Soil Survey Geographic (SSURGO) database. Downloaded data were summarized based on the major hydrologic group in the surface layers of the map unit and are displayed below in Figure 15 and Table 15.

The majority of the watershed is covered by category D soils (73 percent), followed by category C soils (14 percent), category B soils (7 percent), and category A soils (2 percent). Category D soils have a high clay content and poor drainage. This means that regular flooding is likely in much of this watershed, which can transport pollutants across the landscape.

Of the soils identified as category D, 23 percent are specified as dual hydrologic group B/D and 70 percent are specified as dual hydrologic group C/D. Dual hydrologic groups are identified for certain wet soils that can be adequately drained. The first letter applies to the drained condition, and the second letter applies to the undrained, natural condition. Due to the watershed scale of this report, soils with dual hydrologic groups are classified as category D. However, a site-specific study should consider whether the site has been drained when soils with a dual hydrologic group are present.

Hydrologic Soils Group	Description					
A	Soils with high infiltrations rates. Usually deep, well drained sands or gravels. Little run-off.					
В	Soils with moderate infiltration rates. Usually moderately deep, moderately well drained soils.					
С	Soils with slow infiltration rates. Soils with finer textures and slow water movement.					
D	Soils with very slow infiltration rates. Soils with high clay content and poor drainage. High amounts of run-off.					

Table 14: Hydrologic Soil Groups

Understanding Table 14: Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. Soil infiltration rates can affect pollutant loading within a watershed. During high flows, areas with low soil infiltration capacity can flood and therefore discharge high pollutant loads to nearby waterways. In contrast, soils with high infiltration rates can slow the movement of pollutants to streams.



Vernon Fork Muscatatuck River Watershed TMDL Report

Subwatershed	Hydrologic Soil Group						
Subwatersneu	Α	В	С	D			
Indian Creek	0.1%	16.6%	33.4%	40.5%			
Sixmile Creek	0.0%	11.1%	14.5%	62.6%			
Storm Creek	0.1%	0.5%	12.1%	85.7%			
Mutton Creek	7.1%	3.0%	7.4%	77.6%			
Polly Branch	0.1%	8.9%	11.9%	78.4%			
Grassy Creek	0.2%	4.5%	3.9%	90.3%			

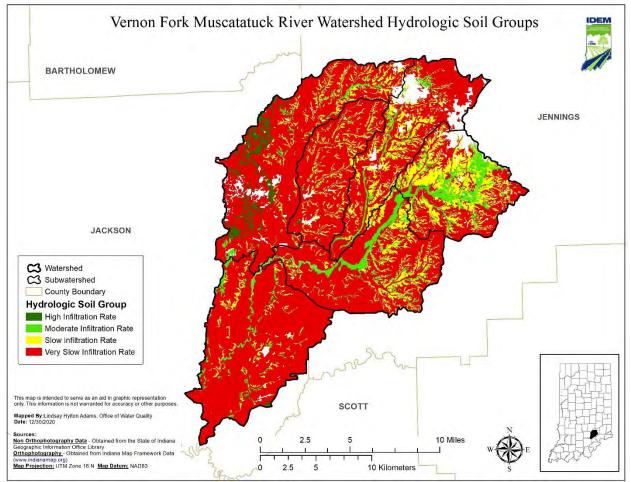


Figure 15: Hydrological Soil Groups in the Vernon Fork Muscatatuck River Watershed



2.3.2 Septic Tank Absorption Field Suitability

Septic systems require soil characteristics and geology that allow gradual seepage of wastewater into the surrounding soils. Seasonal high water tables, shallow compact till, and coarse soils present limitations for septic systems. Heavy clay soils require larger (and therefore more expensive) absorption fields; while sandier, well-drained soils are often suitable for smaller, more affordable gravity-flow trench systems. Hydrologic soil group A and B soils have good infiltration rates and have less risk for failing septic systems due to this factor. Group C and D soils have slow infiltration rates with finer textures and slow water movement. Table 15 illustrates the hydrologic soil groups for the Vernon Fork Muscatatuck River subwatersheds.

While system design can often overcome these limitations (i.e., perimeter drains, mound systems or pressure distribution), sometimes the soil characteristics prove to be unsuitable for any type of traditional septic system. Common soil type limitations which contribute to septic system failure are: seasonal water tables, compact glacial till, bedrock, coarse sand and gravel outwash, and fragipan. When these septic systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration), there can be adverse effects to surface waters due to *E. coli* and nutrients (Horsley and Witten, 1996). Refer to Section 2.6.1 for additional information regarding septic systems within the Vernon Fork Muscatatuck River watershed.

Figure 16 shows ratings that indicate the extent to which the soils are suitable for septic systems within the Vernon Fork Muscatatuck River watershed. Only that part of the soil between depths of 24 and 60 inches is evaluated for septic system suitability. The ratings are based on the soil properties that affect absorption of the effluent, construction, maintenance of the system, and public health.

Soils labeled "very limited" indicate that the soil has at least one feature that is unfavorable for septic systems. Approximately 95 percent of the Vernon Fork Muscatatuck River watershed is considered "very limited" in terms of soil suitability for septic systems. These limitations generally cannot be overcome without major soil reclamation or expensive installation designs. Approximately 4 percent of the soils within the Vernon Fork Muscatatuck River watershed are "not rated," meaning these soils have not been assigned a rating class because it is not industry standard to install a septic system in these geographic locations. Approximately 1 percent of the soils in the Vernon Fork Muscatatuck River watershed are designated "somewhat limited," meaning that the soil type is suitable for septic systems.



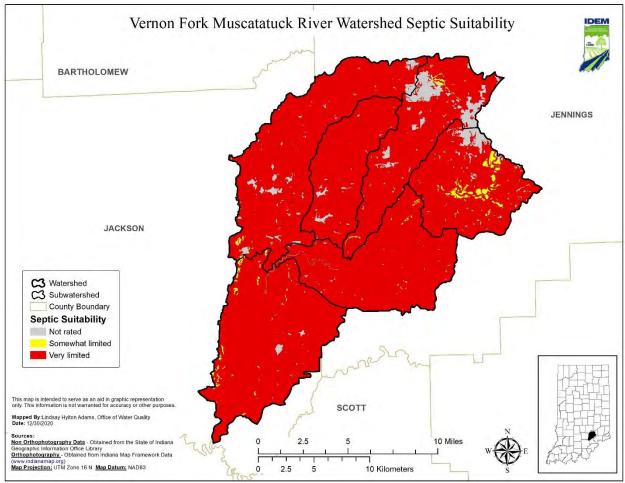


Figure 16: Suitability of Soils for Septic Systems in the Vernon Fork Muscatatuck River Watershed

2.3.3 Soil Saturation and Wetlands

Soils that remain saturated or inundated with water for a sufficient length of time become hydric through a series of chemical, physical, and biological processes. Once a soil takes on hydric characteristics, it retains those characteristics even after the soil is drained. Hydric soils have been identified in the Vernon Fork Muscatatuck River watershed and are important in consideration of wetland restoration activities. Approximately 63,712 acres, or 47 percent, of the Vernon Fork Muscatatuck River watershed area contains soils that are considered hydric or have hydric inclusions. Table 16 includes a list of each map unit within the Vernon Fork Muscatatuck River watershed with a hydric rating greater than 0. Hydric ratings indicate the percentage of the map unit that meets the criteria for hydric soils. For example, map units with a hydric rating of 95 or more have more significant coverage of hydric soils. Table 16 and Figure 17 display the hydric ratings for each map unit within the Vernon Fork Muscatatuck River



watershed. The Grassy Creek subwatershed appears to have the most significant hydric soil coverage in the watershed. However, a large portion of these soils have been drained for either agricultural production or urban development and would no longer support a wetland. The location of remaining hydric soils can be used to consider possible locations for wetland creation or enhancement. There are many components in addition to soil type that must be considered before moving forward with wetland design and creation.



Table 16: Hydric Ratings for Map Units with Hydric Soils in the Vernon Fork Muscatatuck River Watershed

Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
	AddA	Avonburg silt loam, 0 to 2 percent slopes	10	1,209
	AddB2	Avonburg silt loam, 2 to 4 percent slopes, eroded	10	56
	BbhA	Bartle silt loam, 0 to 2 percent slopes	10	37
	BgeAH	Birds silt loam, 0 to 1 percent slopes, frequently flooded, brief duration	90	4
	ClfA	Cobbsfork silt loam, 0 to 1 percent slopes	95	690
	DfnA	Dubois silt loam, 0 to 2 percent slopes	5	107
Indian Creek	HleAW	Holton silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	5	84
	PhaA	Peoga silt loam, 0 to 1 percent slopes	93	4
	StdAH	Stendal silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	3	18
	UfdA	Urban land-Cobbsfork-Avonburg complex, 0 to 2 percent slopes	17	299
	WaaAH	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	10	20
	WaaAW	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	10	3
	WnmA	Whitcomb silt loam, 0 to 2 percent slopes	3	3
		Total Acreage		2,535
	AddA	Avonburg silt loam, 0 to 2 percent slopes	10	1,531
	AddB2	Avonburg silt loam, 2 to 4 percent slopes, eroded	10	292
Sixmile Creek	BbhA	Bartle silt loam, 0 to 2 percent slopes	10	66
	BgeAH	Birds silt loam, 0 to 1 percent slopes, frequently flooded, brief duration	90	8
	BgeAHU	Birds silt loam, undrained, 0 to 1 percent slopes, frequently flooded, brief duration	95	4
	ClfA	Cobbsfork silt loam, 0 to 1 percent slopes	95	2,779
	DfnA	Dubois silt loam, 0 to 2 percent slopes	5	157



Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
	DfnB2	Dubois silt loam, 2 to 6 percent slopes, eroded	3	2
	HleAW	Holton silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	5	257
	PhaA	Peoga silt loam, 0 to 1 percent slopes	93	46
	PlpAH	Piopolis silty clay loam, 0 to 1 percent slopes, frequently flooded, brief duration	97	164
	StdAH	Stendal silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	3	212
	StdAQ	Stendal silt loam, 0 to 2 percent slopes, rarely flooded	5	119
	UfdA	Urban land-Cobbsfork-Avonburg complex, 0 to 2 percent slopes	17	767
	WaaAH	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	10	244
	WaaAW	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	10	20
	WnmA	Whitcomb silt loam, 0 to 2 percent slopes	3	80
	WooAQ	Wilhite silt loam, overwash, 0 to 1 percent slopes, rarely flooded	100	2
		Total Acreage		6,749
	AddA	Avonburg silt loam, 0 to 2 percent slopes	10	1,644
	AddB2	Avonburg silt loam, 2 to 4 percent slopes, eroded	10	131
	BbhA	Bartle silt loam, 0 to 2 percent slopes	10	29
	BgeAHU	Birds silt loam, undrained, 0 to 1 percent slopes, frequently flooded, brief duration	95	685
	ClfA	Cobbsfork silt loam, 0 to 1 percent slopes	95	1,276
Storm Creek	DfnA	Dubois silt loam, 0 to 2 percent slopes	5	1,685
	DfnB2	Dubois silt loam, 2 to 6 percent slopes, eroded	3	173
	HleAW	Holton silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	5	148
	PhaA	Peoga silt loam, 0 to 1 percent slopes	93	894
	StdAQ	Stendal silt loam, 0 to 2 percent slopes, rarely flooded	5	6
	UcvA	Udorthents-Aquents complex	5	25



Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
	WaaAH	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	10	207
	WaaAW	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	10	531
	WnmA	Whitcomb silt loam, 0 to 2 percent slopes	3	77
		Total Acreage		7,509
	AddA	Avonburg silt loam, 0 to 2 percent slopes	10	1,993
	AddB2	Avonburg silt loam, 2 to 4 percent slopes, eroded	10	315
	AzoA	Ayrshire fine sandy loam, sandy substratum, 0 to 2 percent slopes	5	2,258
	BbhA	Bartle silt loam, 0 to 2 percent slopes	10	186
	BgeAH	Birds silt loam, 0 to 1 percent slopes, frequently flooded, brief duration	90	541
	BgeAHU	Birds silt loam, undrained, 0 to 1 percent slopes, frequently flooded, brief duration	95	1,907
	BlfF	Bloomfield fine sand, 15 to 45 percent slopes	1	43
	ClfA	Cobbsfork silt loam, 0 to 1 percent slopes	95	1,941
	DfnA	Dubois silt loam, 0 to 2 percent slopes	5	1,551
Mutton Creek	DfnB2	Dubois silt loam, 2 to 6 percent slopes, eroded	3	434
	HIeAW	Holton silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	5	105
	LvIA	Lyles fine sandy loam, 0 to 1 percent slopes	95	1,640
	PhaA	Peoga silt loam, 0 to 1 percent slopes	93	768
	SIdAH	Shoals silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	4	183
	StdAQ	Stendal silt loam, 0 to 2 percent slopes, rarely flooded	5	45
	UcvA	Udorthents-Aquents complex	5	20
	UezA	Urban land-Ayrshire, sandy substratum, complex, 0 to 2 percent slopes	2	659
	UfdA	Urban land-Cobbsfork-Avonburg complex, 0 to 2 percent slopes	17	110
	UevA	Urban land-Dubois complex, 0 to 2 percent slopes	6	52



Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
	UevB	Urban land-Dubois complex, 2 to 6 percent slopes	2	7
	UlfA	Urban land-Lyles complex, 0 to 1 percent slopes	43	429
	UggA	Urban land-Peoga complex, 0 to 1 percent slopes	42	4
	UgmAQ	Urban land-Stendal complex, 0 to 2 percent slopes, rarely flooded	4	9
	WaaAH	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	10	778
	WaaAW	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	10	313
	WnmA	Whitcomb silt loam, 0 to 2 percent slopes	3	34
	WooAQ	Wilhite silt loam, overwash, 0 to 1 percent slopes, rarely flooded	100	5
	WolAHU	Wilhite silty clay, undrained, 0 to 1 percent slopes, frequently flooded, brief duration	100	32
	ZcaAH	Zipp silty clay, 0 to 1 percent slopes, frequently flooded, brief duration	95	2
		Total Acreage		16,363
	AddA	Avonburg silt loam, 0 to 2 percent slopes	10	1,626
	AddB2	Avonburg silt loam, 2 to 4 percent slopes, eroded	10	76
	BbhA	Bartle silt loam, 0 to 2 percent slopes	10	211
	BgeAH	Birds silt loam, 0 to 1 percent slopes, frequently flooded, brief duration	90	37
	BgeAHU	Birds silt loam, undrained, 0 to 1 percent slopes, frequently flooded, brief duration	95	538
Polly Branch	ClfA	Cobbsfork silt loam, 0 to 1 percent slopes	95	1,229
	DfnA	Dubois silt loam, 0 to 2 percent slopes	5	1,064
	DfnB2	Dubois silt loam, 2 to 6 percent slopes, eroded	3	162
	HIeAW	Holton silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	5	251
	PhaA	Peoga silt loam, 0 to 1 percent slopes	93	2,049
	PlpAH	Piopolis silty clay loam, 0 to 1 percent slopes, frequently flooded, brief duration	97	128



Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
	PlpAHU	Piopolis silty clay loam, undrained, 0 to 1 percent slopes, frequently flooded, brief duration	98	234
	StdAH	Stendal silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	2	1,104
	StdAQ	Stendal silt loam, 0 to 2 percent slopes, rarely flooded	2	21
	UcvA	Udorthents-Aquents complex	5	31
	WaaAH	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	10	1,095
	WaaAW	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	10	18
	WnmA	Whitcomb silt loam, 0 to 2 percent slopes	3	55
		Total Acreage		9,930
	BbhA	Bartle silt loam, 0 to 2 percent slopes	10	20
	BgeAH	Birds silt loam, 0 to 1 percent slopes, frequently flooded, brief duration	90	3,441
	BgeAHU	Birds silt loam, undrained, 0 to 1 percent slopes, frequently flooded, brief duration	95	2,234
	DfnA	Dubois silt loam, 0 to 2 percent slopes	5	3,905
	DfnB2	Dubois silt loam, 2 to 6 percent slopes, eroded	3	1,100
	MikA	McGary silty clay loam, 0 to 2 percent slopes	3	12
	PhaA	Peoga silt loam, 0 to 1 percent slopes	93	6,478
Grassy Creek	PlpAH	Piopolis silty clay loam, 0 to 1 percent slopes, frequently flooded, brief duration	97	53
	PlpAHU	Piopolis silty clay loam, undrained, 0 to 1 percent slopes, frequently flooded, brief duration	98	51
	StdAH	Stendal silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	2	1,008
	StdAQ	Stendal silt loam, 0 to 2 percent slopes, rarely flooded	2	167
	UcvA	Udorthents-Aquents complex	5	65
	UevA	Urban land-Dubois complex, 0 to 2 percent slopes	6	52
	UevB	Urban land-Dubois complex, 2 to 6 percent slopes	2	22
	UggA	Urban land-Peoga complex, 0 to 1 percent slopes	42	257



Subwatershed	Map Symbol	Map Unit Name	Hydric Rating	Map Unit Acreage
	WaaAH	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	10	1,494
	WaaAW	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	10	36
	WolAHU	Wilhite silty clay, undrained, 0 to 1 percent slopes, frequently flooded, brief duration	100	232
		Total Acreage		20,626

Understanding Table 16: Areas with the most acreage of hydric soils might contain opportunities for wetland restoration activities that could help address water quality impairments. The hydric rating indicates the percentage of the map unit with hydric soils. Map units with a hydric rating of 100 have 100% hydric soils.



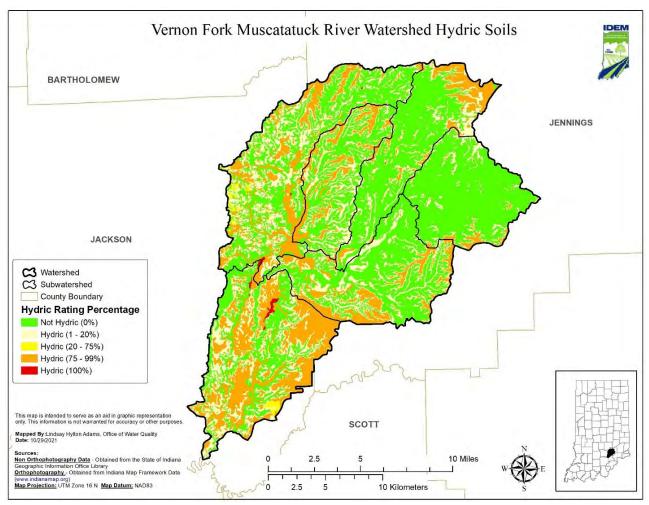


Figure 17: Hydric Soils in the Vernon Fork Muscatatuck River Watershed (<u>https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/</u>)

Nationally, since the late 1600s roughly 50 percent of the wetlands in the lower 48 states have been lost. Indiana has lost a large number of its wetlands, approximating over 80 percent (USGS, 1999). In the 1800s and 1900s millions of acres of wetlands were drained or converted into farms, cities, and roads. In the early 1700s, wetlands covered 25 percent of the total area of Indiana. That number has been greatly reduced. By the late 1980s, over 4.7 million acres of wetlands had been lost. Before the conversion of wetlands, there were over 5.6 million acres of wetlands in the state, wetlands such as bogs, fens, wet prairies, dune and swales, cypress swamps, marshes, and swamps. Wetlands now cover less than 4 percent of Indiana. (http://www.in.gov/idem/wetlands/importance-of-wetlands/)

Wetlands are home to wildlife. More than one-third (1/3) of America's threatened and endangered species live only in wetlands, which means they need them to survive. Over 200 species of birds rely on wetlands for feeding, nesting, foraging, and roosting. Wetlands provide



areas for recreation, education, and aesthetics. More than 98 million people hunt, fish, birdwatch, or photograph wildlife. Americans spend \$59.5 billion annually on these activities.

Wetland plants and soils naturally store and filter nutrients and sediments. Calm wetland waters, with their flat surface and flow characteristics, allow these materials to settle out of the water column, where plants in the wetland take up certain nutrients from the water. As a result, our lakes, rivers and streams are cleaner and our drinking water is safer. Constructed wetlands can even be used to clean wastewater, when properly designed. Wetlands also recharge our underground aquifers. Over 70 percent of Indiana residents rely on groundwater for part or all of their drinking water needs.

Wetlands protect our homes from floods. Like sponges, wetlands soak up and slowly release floodwaters. This lowers flood heights and slows the flow of water down rivers and streams. Wetlands also control erosion. Shorelines along rivers, lakes, and streams are protected by wetlands, which hold soil in place, absorb the energy of waves, and buffer strong currents.

Wetland areas act to buffer wide variations in flow conditions that result from storm events. They also allow water to infiltrate slowly thus reducing the risks of contaminated water run-off into waterbodies. Agencies such as the USGS and U.S. Fish and Wildlife Service (USFWS) estimate that Indiana has lost approximately 85 percent of the state's original wetlands. Currently, the Vernon Fork Muscatatuck River watershed contains approximately 20,088 acres of wetlands, or 14.80 percent of the total surface area. Additional information on wetlands can be found on the IDEM website: <u>http://www.in.gov/idem/wetlands/</u>.



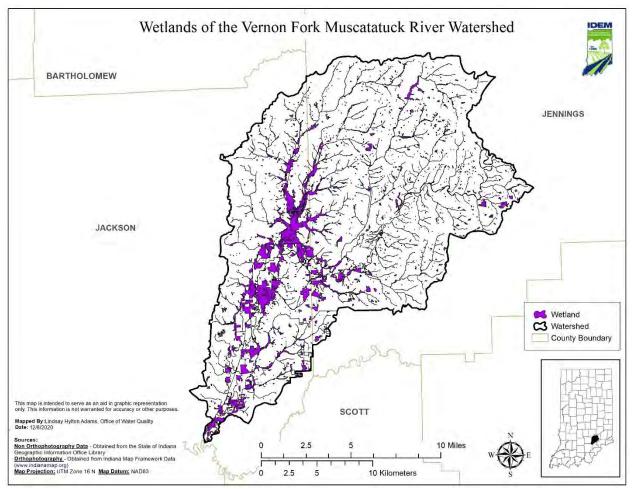


Figure 18: Location of Wetlands in the Vernon Fork Muscatatuck River Watershed

The USFWS has the responsibility for mapping wetlands in the United States. Those map products are currently held in the Fish and Wildlife Service Wetland Database (sometimes referred to as the National Wetlands Inventory or NWI). Figure 18 shows estimated locations of wetlands as defined by the USFWS's NWI. Wetland data for Indiana is available from the U.S. Fish and Wildlife Service's NWI at https://www.fws.gov/wetlands/data/Mapper.html. The NWI was not intended to produce maps that show exact wetland boundaries comparable to boundaries derived from ground soil surveys, and boundaries are generalized in most cases. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis. Therefore, the estimate of the current extent of wetlands in the Vernon Fork Muscatatuck River watershed from the NWI may not agree with those listed in Section 2.1. which are based upon the NASS Crop Data Layer (CDL) dataset. For more information on the wetland classification codes visit http://www.fws.gov/wetlands/Data/Wetland-Codes.html. The U.S. Fish and Wildlife Service uses data standards to increase the guality and compatibility of its data.



Changes to the natural drainage patterns of a watershed are referred to as hydromodifications. Historically, drain tiles have been used throughout Indiana to drain marsh or wetlands and make it either habitable or tillable for agricultural purposes. While tile drainage is understood to be pervasive – estimated at thousands of miles in Indiana – it is extremely challenging to quantify on a watershed basis because these tiles were established by varying authorities including County Courts, County Commissioners, or County Drainage Boards (http://indianacountysurveyors.org/directory.html).

In addition to tile drainage, regulated drains are another form of hydromodification. A regulated drain is a drain which was established through either a Circuit Court or Commissioners Court of the County prior to January 1, 1966 or by the County Drainage Board since that time. Regulated drains can be an open ditch, a tile drain, or a combination of both. The County Drainage Board can construct, maintain, reconstruct, or vacate a regulated drain.

2.3.4 Soil Erodibility

Although erosion is a natural process within stream ecosystems, excessive erosion negatively impacts the health of watersheds. Erosion increases sedimentation of the streambeds, which impacts the quality of habitat for fish and other organisms. Erosion also impacts water quality as it increases nutrients and decreases water clarity. As water flows over land and enters the stream as run-off, it carries pollutants and other nutrients that are attached to the sediment. Sediment suspended in the water blocks light needed by plants for photosynthesis and clogs respiratory surfaces of aquatic organisms.

The NRCS maintains a list of highly erodible lands (HEL) units for each county based upon the potential of soil units to erode from the land

(https://efotg.sc.egov.usda.gov/references/public/NE/HEL_Intro.pdf). HELs are especially susceptible to the erosional forces of wind and water. Wind erosion is common in flat areas where vegetation is sparse or where soil is loose, dry, and finely granulated. Wind erosion damages land and natural vegetation by removing productive topsoil from one place and depositing it in another. The classification for HELs is based upon an erodibility index for a soil, which is determined by dividing the potential average annual rate of erosion by the soil unit's soil loss tolerance (T) value, which is the maximum annual rate of erosion that could occur without causing a decline in long-term productivity. The soil types and acreages in the Vernon Fork Muscatatuck River watershed are listed in Table 17. HELs and potential HELs in the Vernon Fork Muscatatuck River watershed are mapped in Figure 19.

A total of 107,676 acres, or 79 percent, of the Vernon Fork Muscatatuck River watershed is considered highly erodible or potentially highly erodible. Rainfall surrounding the Vernon Fork Muscatatuck River watershed is moderately heavy with an annual average of 49.0 inches. This rainfall and climate data specific to the watershed is available from the Midwestern Regional Climate Center <u>https://mrcc.purdue.edu/</u>. Heavy rainfall increases flow rates within streams as the volume and velocity of water moving through the stream channels increases. Velocity of water also increases as streambank steepness increases.



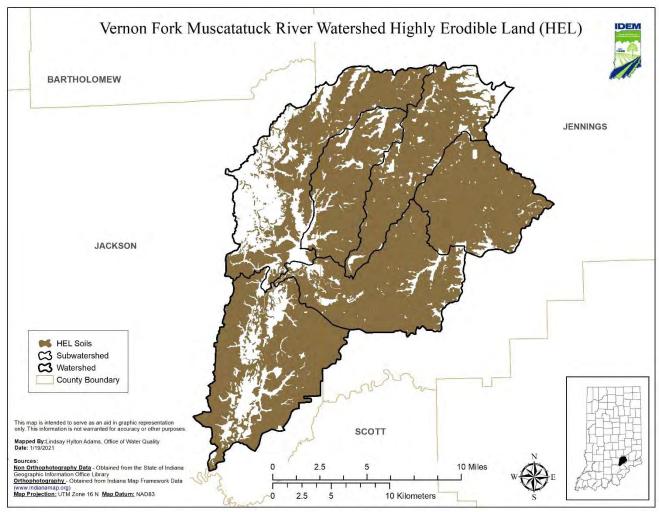


Figure 19: Location of Highly Erodible Lands (HEL) in the Vernon Fork Muscatatuck River Watershed



Map Symbol	HEL/Potential HEL Soil Types	Acres
AddA	Avonburg silt loam, 0 to 2 percent slopes	8,003
AddB2	Avonburg silt loam, 2 to 4 percent slopes, eroded	871
BbhA	Bartle silt loam, 0 to 2 percent slopes	548
BkeC2	Bloomfield-Alvin complex, 6 to 15 percent slopes, eroded	1,173
BlbB2	Blocher, soft black shale substratum-Jennings silt loams, 2 to 6 percent slopes, eroded	952
BlcC2	Blocher, soft black shale substratum-Jennings-Deputy silt loams, 6 to 12 percent slopes, eroded	1,286
BlcC3	Blocher, soft black shale substratum-Jennings-Deputy silt loams, 6 to 12 percent slopes, severely eroded	892
BlfF	Bloomfield fine sand, 15 to 45 percent slopes	43
BlgC2	Blocher-Cincinnati silt loams, 6 to 12 percent slopes, eroded	4,636
BlgC3	Blocher-Cincinnati silt loams, 6 to 12 percent slopes, severely eroded	1,978
BlkE2	Bonnell-Blocher-Hickory silt loams, 12 to 25 percent slopes, eroded	5,702
BnuD3	Bonnell-Hickory-Blocher complex, 12 to 25 percent slopes, severely eroded	1,059
BnxE2	Bonnell-Grayford silt loams, karst, hilly, eroded	4
BobE4	Bonnell-Hickory clay loams, 15 to 30 percent slopes, very severely eroded	66
BocD3	Bonnell silty clay loam, 10 to 18 percent slopes, severely eroded	104
CcaG	Caneyville-Rock outcrop complex, 25 to 60 percent slopes	639
CcbC2	Caneyville-Zenas silt loams, karst, rolling, eroded	101
CcgD2	Caneyville and Grayford silt loams, 12 to 25 percent slopes, eroded	179
CcgD3	Caneyville and Grayford silt loams, 12 to 25 percent slopes, severely eroded	88
CkkB2	Cincinnati silt loam, 2 to 6 percent slopes, eroded	5
CkkC2	Cincinnati silt loam, 6 to 12 percent slopes, eroded	170
CkkC3	Cincinnati silt loam, 6 to 12 percent slopes, severely eroded	34
CldB2	Cincinnati-Blocher silt loams, 2 to 6 percent slopes, eroded	818
CwaAQ	Cuba silt loam, 0 to 2 percent slopes, rarely flooded	73
DfnA	Dubois silt loam, 0 to 2 percent slopes	8,470
DfnB2	Dubois silt loam, 2 to 6 percent slopes, eroded	1,87 ⁻
DtwC2	Deputy silt loam, 6 to 15 percent slopes, eroded	1,776
DtzC3	Deputy-Trappist silty clay loams, 6 to 15 percent slopes, severely eroded	2,085
EesB2	Elkinsville-Millstone complex, 2 to 6 percent slopes, eroded	192
GmsF	Greybrook silt loam, 15 to 40 percent slopes	96
HccA	Haubstadt silt loam, 0 to 2 percent slopes	490
HccB2	Haubstadt silt loam, 2 to 6 percent slopes, eroded	7,524
HcgAH	Haymond silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	2,779
HcgAW	Haymond silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	198
HcpAP	Haymond silt loam, depression, 0 to 2 percent slopes, frequently ponded, very brief duration	11
HeeG	Hickory loam, 25 to 50 percent slopes	1,810
HheF	Hickory loam, 15 to 45 percent slopes	208
HizE2	Hickory-Grayford silt loams, 12 to 25 percent slopes, eroded	137

Table 17: HEL/Potential HEL Acreage in the Vernon Fork Muscatatuck River Watershed



Vernon Fork Muscatatuck River Watershed TMDL Report

Map Symbol	HEL/Potential HEL Soil Types	Acres
HizE3	Hickory-Grayford silt loams, 12 to 25 percent slopes, severely eroded	134
HleAW	Holton silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	844
McpC3	Markland silty clay loam, 6 to 12 percent slopes, severely eroded	7
MhyB2	Medora silt loam, 2 to 6 percent slopes, eroded	548
MhyC2	Medora silt loam, 6 to 12 percent slopes, eroded	525
MhyC3	Medora silt loam, 6 to 12 percent slopes, severely eroded	2
MikA	McGary silty clay loam, 0 to 2 percent slopes	12
NaaA	Nabb silt loam, 0 to 2 percent slopes	304
NaaB2	Nabb silt loam, 2 to 6 percent slopes, eroded	9,225
NehF	Negley loam, 18 to 35 percent slopes	270
NerD2	Negley silt loam, 12 to 18 percent slopes, eroded	478
OfaAW	Oldenburg silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	1,094
OmkC2	Otwell silt loam, 6 to 12 percent slopes, eroded	2,598
OmkC3	Otwell silt loam, 6 to 12 percent slopes, severely eroded	2,416
PbbB2	Parke silt loam, 2 to 6 percent slopes, eroded	285
PbbC2	Parke silt loam, 6 to 12 percent slopes, eroded	226
PcrA	Pekin silt loam, 0 to 2 percent slopes	6
PcrB2	Pekin silt loam, 2 to 6 percent slopes, eroded	1,297
PcrC2	Pekin silt loam, 6 to 12 percent slopes, eroded	470
PhaA	Peoga silt loam, 0 to 1 percent slopes	10,23
RptG	Rohan-Jessietown complex,25 to 60 percent slopes, rocky	255
RzfA	Ryker-Muscatatuck silt loams, terrace, 0 to 2 percent slopes	53
RzfB2	Ryker-Muscatatuck silt loams, terrace, 2 to 6 percent slopes, eroded	101
RzgB2	Ryker-Muscatatuck silt loams, karst, undulating, eroded	250
RzgC2	Ryker-Muscatatuck silt loams, karst, rolling, eroded	248
RzhC3	Ryker-Grayford-Muscatatuck complex, karst, rolling, severely eroded	178
SceA	Scottsburg silt loam, 0 to 2 percent slopes	50
ScfB2	Scottsburg-Deputy silt loams, 2 to 6 percent slopes, eroded	1,909
SfyB2	Shircliff silt loam, 2 to 6 percent slopes, eroded	11
StaAH	Steff silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	430
StaAQ	Steff silt loam, 0 to 2 percent slopes, rarely flooded	79
StdAH	Stendal silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	2,342
StdAQ	Stendal silt loam, 0 to 2 percent slopes, rarely flooded	359
SukC2	Stonehead silt loam, 4 to 12 percent slopes, eroded	3
ThbD4	Trappist silty clay loam, 6 to 18 percent slopes, very severely eroded	16
ThcD3	Trappist-Rohan complex, 12 to 25 percent slopes, severely eroded	202
ThdD2	Trappist-Rohan silt loams, 12 to 25 percent slopes, eroded	533
UdaB	Urban land-Deputy-Scottsburg complex, 2 to 15 percent slopes	967
UevA	Urban land-Dubois complex, 0 to 2 percent slopes	104
UevB	Urban land-Dubois complex, 2 to 6 percent slopes	29
UfaC	Urban land-Bloomfield-Alvin complex, 6 to 15 percent slopes	57



Map Symbol	HEL/Potential HEL Soil Types	Acres
UfcB	Urban land-Cincinnati-Nabb complex, 2 to 12 percent slopes	943
UfdA	Urban land-Cobbsfork-Avonburg complex, 0 to 2 percent slopes	1,176
UggA	Urban land-Peoga complex, 0 to 1 percent slopes	262
UghAQ	Urban land-Steff complex, 0 to 2 percent slopes, rarely flooded	3
UgmAQ	Urban land-Stendal complex, 0 to 2 percent slopes, rarely flooded	9
UlaB	Urban land-Parke-Medora complex, 2 to 6 percent slopes	26
UlbC	Urban land-Parke-Medora-Negley complex, 6 to 18 percent slopes	52
UloC	Urban land-Otwell complex, 6 to 12 percent slopes	29
UusB	Urban land-Haubstadt complex, 2 to 6 percent slopes	106
WaaAH	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	3,838
WaaAW	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	920
WnmA	Whitcomb silt loam, 0 to 2 percent slopes	249
WokAH	Wilbur silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	2,63
WokAW	Wilbur silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	182
WooAQ	Wilhite silt loam, overwash, 0 to 1 percent slopes, rarely flooded	7
WprAW	Wirt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	791
WpuAH	Wirt silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	59
ZnsB	Zenas silt loam, karst, undulating	165
AddA	Avonburg silt loam, 0 to 2 percent slopes	8,00
AddB2	Avonburg silt loam, 2 to 4 percent slopes, eroded	871
BbhA	Bartle silt loam, 0 to 2 percent slopes	548
BkeC2	Bloomfield-Alvin complex, 6 to 15 percent slopes, eroded	1,17
BlbB2	Blocher, soft black shale substratum-Jennings silt loams, 2 to 6 percent slopes, eroded	952
BlcC2	Blocher, soft black shale substratum-Jennings-Deputy silt loams, 6 to 12 percent slopes, eroded	1,28
BlcC3	Blocher, soft black shale substratum-Jennings-Deputy silt loams, 6 to 12 percent slopes, severely eroded	892
BIfF	Bloomfield fine sand, 15 to 45 percent slopes	43
BlgC2	Blocher-Cincinnati silt loams, 6 to 12 percent slopes, eroded	4,63
BlgC3	Blocher-Cincinnati silt loams, 6 to 12 percent slopes, severely eroded	1,97
BlkE2	Bonnell-Blocher-Hickory silt loams, 12 to 25 percent slopes, eroded	5,70
BnuD3	Bonnell-Hickory-Blocher complex, 12 to 25 percent slopes, severely eroded	1,05
BnxE2	Bonnell-Grayford silt loams, karst, hilly, eroded	4
BobE4	Bonnell-Hickory clay loams, 15 to 30 percent slopes, very severely eroded	66
BocD3	Bonnell silty clay loam, 10 to 18 percent slopes, severely eroded	104
CcaG	Caneyville-Rock outcrop complex, 25 to 60 percent slopes	639
CcbC2	Caneyville-Zenas silt loams, karst, rolling, eroded	101
CcgD2	Caneyville and Grayford silt loams, 12 to 25 percent slopes, eroded	
CcgD3	Caneyville and Grayford silt loams, 12 to 25 percent slopes, severely eroded	88
CkkB2	Cincinnati silt loam, 2 to 6 percent slopes, eroded	5
CkkC2	Cincinnati silt loam, 6 to 12 percent slopes, eroded	170



Map Symbol	HEL/Potential HEL Soil Types	
CkkC3	Cincinnati silt loam, 6 to 12 percent slopes, severely eroded	34
CldB2	Cincinnati-Blocher silt loams, 2 to 6 percent slopes, eroded	818
CwaAQ	Cuba silt loam, 0 to 2 percent slopes, rarely flooded	73
DfnA	Dubois silt loam, 0 to 2 percent slopes	8,470
DfnB2	Dubois silt loam, 2 to 6 percent slopes, eroded	1,871
DtwC2	Deputy silt loam, 6 to 15 percent slopes, eroded	1,776
DtzC3	Deputy-Trappist silty clay loams, 6 to 15 percent slopes, severely eroded	2,085
EesB2	Elkinsville-Millstone complex, 2 to 6 percent slopes, eroded	192
GmsF	Greybrook silt loam, 15 to 40 percent slopes	96
HccA	Haubstadt silt loam, 0 to 2 percent slopes	490
HccB2	Haubstadt silt loam, 2 to 6 percent slopes, eroded	7,524
HcgAH	Haymond silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	2,779
HcgAW	Haymond silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	198
НсрАР	Haymond silt loam, depression, 0 to 2 percent slopes, frequently ponded, very brief duration	11
HeeG	Hickory loam, 25 to 50 percent slopes	1,810
HheF	Hickory loam, 15 to 45 percent slopes	208
HizE2	Hickory-Grayford silt loams, 12 to 25 percent slopes, eroded	137
HizE3	Hickory-Grayford silt loams, 12 to 25 percent slopes, severely eroded	134
HIeAW	Holton silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	844
McpC3	Markland silty clay loam, 6 to 12 percent slopes, severely eroded	7
MhyB2	Medora silt loam, 2 to 6 percent slopes, eroded	548
MhyC2	Medora silt loam, 6 to 12 percent slopes, eroded	525
MhyC3	Medora silt loam, 6 to 12 percent slopes, severely eroded	2
MikA	McGary silty clay loam, 0 to 2 percent slopes	12
NaaA	Nabb silt loam, 0 to 2 percent slopes	304
NaaB2	Nabb silt loam, 2 to 6 percent slopes, eroded	9,22
NehF	Negley loam, 18 to 35 percent slopes	270
NerD2	Negley silt loam, 12 to 18 percent slopes, eroded	478
OfaAW	Oldenburg silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	1,094
OmkC2	Otwell silt loam, 6 to 12 percent slopes, eroded	2,59
OmkC3	Otwell silt loam, 6 to 12 percent slopes, severely eroded	2,41
PbbB2	Parke silt loam, 2 to 6 percent slopes, eroded	285
PbbC2	Parke silt loam, 6 to 12 percent slopes, eroded	226
PcrA	Pekin silt loam, 0 to 2 percent slopes	6
PcrB2	Pekin silt loam, 2 to 6 percent slopes, eroded	1,29
PcrC2	Pekin silt loam, 6 to 12 percent slopes, eroded	
PhaA	Peoga silt loam, 0 to 1 percent slopes	
RptG	Rohan-Jessietown complex,25 to 60 percent slopes, rocky	
RzfA	Ryker-Muscatatuck silt loams, terrace, 0 to 2 percent slopes	53
RzfB2	Ryker-Muscatatuck silt loams, terrace, 2 to 6 percent slopes, eroded	101



Map Symbol	HEL/Potential HEL Soil Types	Acres
RzgB2	Ryker-Muscatatuck silt loams, karst, undulating, eroded	250
RzgC2	Ryker-Muscatatuck silt loams, karst, rolling, eroded	248
RzhC3	Ryker-Grayford-Muscatatuck complex, karst, rolling, severely eroded	178
SceA	Scottsburg silt loam, 0 to 2 percent slopes	50
ScfB2	Scottsburg-Deputy silt loams, 2 to 6 percent slopes, eroded	1,909
SfyB2	Shircliff silt loam, 2 to 6 percent slopes, eroded	11
StaAH	Steff silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	430
StaAQ	Steff silt loam, 0 to 2 percent slopes, rarely flooded	79
StdAH	Stendal silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	2,342
StdAQ	Stendal silt loam, 0 to 2 percent slopes, rarely flooded	359
SukC2	Stonehead silt loam, 4 to 12 percent slopes, eroded	3
ThbD4	Trappist silty clay loam, 6 to 18 percent slopes, very severely eroded	16
ThcD3	Trappist-Rohan complex, 12 to 25 percent slopes, severely eroded	202
ThdD2	Trappist-Rohan silt loams, 12 to 25 percent slopes, eroded	533
UdaB	Urban land-Deputy-Scottsburg complex, 2 to 15 percent slopes	967
UevA	Urban land-Dubois complex, 0 to 2 percent slopes	104
UevB	Urban land-Dubois complex, 2 to 6 percent slopes	29
UfaC	Urban land-Bloomfield-Alvin complex, 6 to 15 percent slopes	57
UfcB	Urban land-Cincinnati-Nabb complex, 2 to 12 percent slopes	943
UfdA	Urban land-Cobbsfork-Avonburg complex, 0 to 2 percent slopes	1,176
UggA	Urban land-Peoga complex, 0 to 1 percent slopes	262
UghAQ	Urban land-Steff complex, 0 to 2 percent slopes, rarely flooded	3
UgmAQ	Urban land-Stendal complex, 0 to 2 percent slopes, rarely flooded	9
UlaB	Urban land-Parke-Medora complex, 2 to 6 percent slopes	26
UlbC	Urban land-Parke-Medora-Negley complex, 6 to 18 percent slopes	52
UloC	Urban land-Otwell complex, 6 to 12 percent slopes	29
UusB	Urban land-Haubstadt complex, 2 to 6 percent slopes	106
WaaAH	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	3,838
WaaAW	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	920
WnmA	Whitcomb silt loam, 0 to 2 percent slopes	249
WokAH	Wilbur silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	2,636
WokAW	Wilbur silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	182
WooAQ	Wilhite silt loam, overwash, 0 to 1 percent slopes, rarely flooded	7
WprAW	Wirt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	
WpuAH	Wirt silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	59
ZnsB	Zenas silt loam, karst, undulating	165
	Total	107,67

Understanding Table 17 and Figure 19: Areas with the most acreage of HEL might contribute to water quality impairments associated with excessive erosion, including IBC/TSS, and might contain opportunities for restoration to decrease erosion.



The Indiana State Department of Agriculture (ISDA) tracks trends in conservation and cropland through annual county tillage transects. Data collected through the tillage transect county data (found at https://secure.in.gov/isda/divisions/soil-conservation/cover-crop-and-tillage-transect-data/) can help determine adoption of conservation practices and estimate the average annual soil loss from Indiana's agricultural lands. The latest figures for the counties in the Vernon Fork Muscatatuck River watershed are shown in Table 18. Tillage practices captured in ISDA's tillage transect include living cover and no-till practices. According to ISDA, living cover includes living cover crops and cereal grains planted into cash crops using direct seeding or broadcast methods, and no-till is any direct seeding system including site preparation, with minimal soil disturbance (ISDA, 2019).

	Tillage Practice 2019				
County	Living	Cover	No-	till	
	Corn	Soybean	Corn	Soybean	
Jackson	7,929 ac 23%	18,540 ac 29%	39,601 ac 72%	56,086 ac 72%	
Jennings	1,047 ac 6%	9,675 ac 22%	13,583 ac 52%	38,297 ac 66%	

Table 18: Tillage Transect Data for 2019 by County in the Vernon Fork Muscatatuck River Watershed

Understanding Table 18: According to the table, in Jackson County no-till is predominant for corn, and also predominant for soybeans. In Jennings County, no-till is again predominant for corn, and also predominant for soybeans. Overall, no-till is utilized at a greater percentage than living cover in both counties, but the percentage of no till is greater in Jackson County.

2.3.5 Streambank Erosion

Streambank erosion is potentially a significant source of pollutants in the Vernon Fork Muscatatuck River watershed. Streambank erosion is a natural process but can be accelerated due to a variety of human activities including the following:

- Vegetation located adjacent to streams flowing through crop or pasture fields is often removed to promote drainage or cattle access to water. The loss of vegetation makes the streambanks more susceptible to erosion due to the loss of plant roots.
- Extensive areas of agricultural tiles promote much quicker delivery of rainfall into streams than would occur without subsurface drainage, which could potentially contribute to streambank erosion, due to high velocities and shear stress.
- The creation of impervious surfaces (e.g., streets, rooftops, driveways, parking lots) can also lead to rapid run-off of rainfall and higher stream velocities that might cause streambank erosion.



2.4 Wildlife and Classified Lands

2.4.1 Wildlife

The Indiana Department of Natural Resources (IDNR) is the primary entity responsible for monitoring wildlife populations and habitats throughout Indiana. Wildlife such as deer, waterfowl, raccoon, beaver, etc. can be sources of *E. coli* and nutrients. The animal habitat and proximity to surface waters are important factors that determine if animal waste can be transported to surface waters. Waterfowl and riparian mammals deposit waste directly into streams while other riparian species deposit waste in the floodplain, which can be transported to surface waters by runoff from precipitation events. Animal waste deposited in upland areas can also be transported to streams and rivers; however, due to the distance from uplands to surface streams, only larger precipitation events can sustain sufficient amounts of runoff to transport upland animal waste to surface waters.

Little information exists surrounding feces depositional patterns of wildlife, and a direct inventory of wildlife populations is generally not available. However, based on the *Bacteria Source Load Calculator*, developed by the Center for TMDL and Watershed Studies, bacteria production by animal type is estimated as well as their preferred habitat (<u>https://www.apps.bse.vt.edu/tmdl/</u>). Higher concentrations of wildlife in the habitats described in Table 19 could contribute *E. coli* and nutrients to the watershed, particularly during high flow conditions or flooding events.



Wildlife Type	<i>E. coli</i> Production Rate (cfu/day – animal)	Habitat
Deer	1.86 x 10 ⁸	Entire Watershed
Raccoon	2.65 x 10 ⁷	Low density on forests in rural areas; high density on forest near a permanent water source or near cropland
Muskrat	1.33 x 10 ⁷	Near ditch, medium sized stream, pond or lake edge
Goose	4.25 x 10 ⁸	Near main streams and impoundments
Duck	1.27 x 10 ⁹	Near main streams and impoundments
Beaver	2.00 x 10 ⁵	Near streams and impoundments in forest and pastures

Table 19: Bacteria Source Load by Species

2.4.2 Classified Lands

Managed lands, shown in Table 20, include natural and recreation areas which are owned or managed by the IDNR, federal agencies, local agencies, non-profit organizations, and conservation easements. Classified lands are public or private lands containing areas supporting growth of native or planted trees, native or planted grasses, wetlands, or other acceptable types of cover that have been set aside for managed production of timber, wildlife habitat, and watershed protection. Natural areas provide ideal habitat for wildlife. Some of the more common wildlife often found in natural areas include white-tailed deer, raccoon, muskrat, fowl, and beaver. While wildlife is known to contribute *E. coli* and nutrients to the surface waters, natural areas provide economic, ecological, and social benefits and should be preserved and protected. Management practices such as impervious surfaces reduction, native vegetation plantings, wetland creation, and riparian buffer maintenance will help in reducing stormwater run-off transporting pollutants to the streams. Table 20 and Figure 20 show the managed lands within the Vernon Fork Muscatatuck River watershed. Table 21 and Figure 20 show the classified lands within the watershed.



Unit Name	Manager	Area (acres)
Muscatatuck National Wildlife Refuge	U.S. Fish and Wildlife Service	7,655
Muscatatuck Acid Seep Spring Research Natural Area	U.S. Fish and Wildlife Service	120
Crosley Fish and Wildlife Area	DNR Fish and Wildlife	4,110
Frank Ratcliff Memorial Forest	Oak Heritage Conservancy	61
Tribbett's Woods Nature Preserve	Oak Heritage Conservancy	30
Total		11,976

Table 20: Managed Lands within the Vernon Fork Muscatatuck River Watershed

Table 21: Classified Lands within the Vernon Fork Muscatatuck River Watershed

Classified Lands		
Subwatershed	Area (acres)	
Indian Creek	1,514	
Sixmile Creek	889	
Storm Creek	319	
Mutton Creek	207	
Polly Branch	1,623	
Grassy Creek	1,368	
Total	5,920	



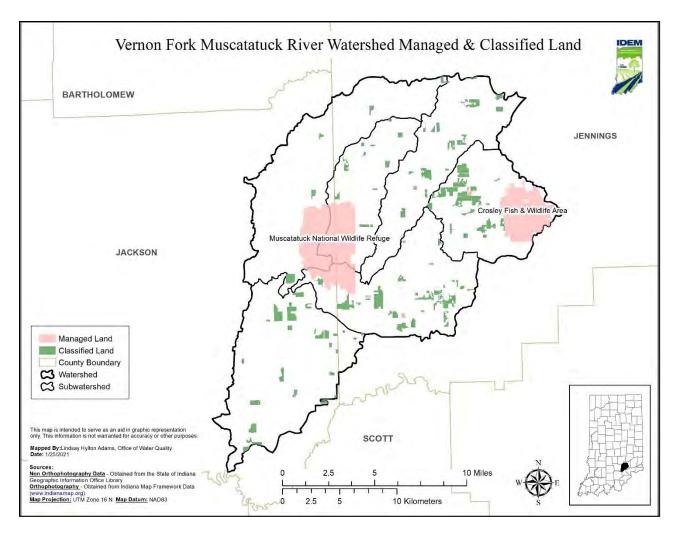


Figure 20: Managed and Classified Lands within the Vernon Fork Muscatatuck River Watershed

2.5 Climate and Precipitation

Climate varies in Indiana depending on latitude, topography, soil types, and lakes. Information on Indiana's climate is available through sources including the Midwestern Regional Climate Center (<u>https://mrcc.purdue.edu/</u>).

Climate data from Station USC00126435, located in North Vernon, IN, were used for climate analysis of the Vernon Fork Muscatatuck River watershed. Monthly data from 1938 to 2020 were available at the time of analysis. In general, the climate of the region is continental with hot, humid summers and cold winters. From 2011 to 2020, the average winter temperature in North Vernon was 38.0°F and the average summer temperature was 72.7°F. The average growing season (consecutive days with low temperatures greater than or equal to 32 degrees) is 186 days.

Examination of precipitation patterns is also a key component of watershed characterization because of the impact of run-off on water quality. From 2011-2020, the annual average



precipitation in North Vernon at Station USC00126435 was approximately 49.0 inches, including approximately 17.1 inches on average of total annual snowfall.

Rainfall intensity and timing affect watershed response to precipitation. This information is important in evaluating the effects of stormwater on the Vernon Fork Muscatatuck River watershed. Using data from USC00126435 during 2011-2020, 82 percent of the measurable precipitation events were low intensity (i.e., less than 0.2 inches), while 3 percent of the measurable precipitation events were greater than one inch.

According to the "Impacts of Climate Change for the State of Indiana" report developed by the Purdue Climate Change Research Center, Indiana will face a number of potential impacts if greenhouse gas concentrations continue to increase. The occurrence and duration of extreme heat events is likely to increase in Indiana while the occurrence of extreme cold events is likely to decrease (Diffenbaugh et al., 2005). Indiana could experience a significant reduction in extreme cold temperatures leading to warmer winters (Diffenbaugh et al., 2005). Total annual average precipitation is likely to increase, but there may be a shift in when the precipitation occurs. Winter and spring precipitation are projected to increase by 21 and 30 percent, respectively, by the end of the century, but summer precipitation may decline by 9 percent. Warmer and wetter winters may result in higher streamflow and increased flooding frequency. Total runoff is also projected to increase in total runoff occurring in the winter and spring (Purdue Climate Change Research Center, 2008).

Understanding when precipitation events occur helps in the linkage analysis in Section 4.0, which correlates flow conditions to pollutant concentrations and loads. Data indicates that the wet weather season in the Vernon Fork Muscatatuck River watershed currently occurs between the months of March and June.

2.6 Human Population

Counties with land located in the Vernon Fork Muscatatuck River watershed include Jackson and Jennings counties. Major government units with jurisdiction at least partially within the Vernon Fork Muscatatuck River watershed include North Vernon, Vernon, Seymour and Crothersville. U.S. Census data for each county during the past three decades are provided in Table 22 (U.S. Census Bureau, 2021).

County	2000	2010	2020
Jackson	41,335	42,376	46,428
Jennings	27,554	28,525	27,613

Table 22: Population Data for Counties in Vernon Fork Muscatatuck River Watershed

Understanding Table 22: Water quality is linked to population growth because a growing population often leads to more development, translating into more houses, roads, and infrastructure to support more people. The table provides information that shows how population has changed in each of the counties located in the Vernon Fork Muscatatuck River watershed



over time. In addition, understanding population trends can help watershed stakeholders to anticipate where pressures might increase in the future and where action in the Vernon Fork Muscatatuck River watershed could help prevent further water quality degradation.

Estimates of population within Vernon Fork Muscatatuck River watershed are based on 2020 US Census data and the percentage of census blocks in urban and rural areas (Table 23). Based on this analysis, the estimated population of the watershed is 39,565, with approximately 56 percent of the population classified as rural residents and 44 percent classified as urban residents. Figure 21 below indicates population density within the Vernon Fork Muscatatuck River watershed.

County	2020 Population	Total Estimated Urban Population	Total Estimated Rural Population	Percent of Total Watershed Population
Indian Creek	6,862	4,839	2,023	17.3%
Sixmile Creek	8,004	1,888	6,116	20.2%
Storm Creek	1,488	0	1,488	3.8%
Mutton Creek	17,549	9,180	8,369	44.4%
Polly Branch	1,676	0	1,676	4.2%
Grassy Greek	3,986	1,692	2,294	10.1%
Watershed Total	39,565	17,599	21,966	100.0%

Table 23: Estimated Population in the Vernon Fork Muscatatuck River Watershed

Understanding Table 23: Understanding where the greatest population is concentrated within the Vernon Fork Muscatatuck River watershed will help watershed stakeholders understand where different types of water quality pressures might currently exist. In general, watersheds with large urban populations are more likely to have problems associated with lots of impervious surfaces, poor riparian habitat, flashy stormwater flows, and large wastewater inputs. Alternatively, watersheds with mostly a non-urban population are more likely to suffer problems from failing septic systems, agricultural run-off, and other types of poor riparian habitat (e.g., channelized streams). Comparing the information in Table 22 with the information in Table 23 can provide an understanding of how population might change in the Vernon Fork Muscatatuck River watershed and which counties are experiencing the most growth and shifts in urban and non-urban population. Population change can serve as an indicator for changes in land uses. For example, growing populations might mean more development, resulting in increased impervious surfaces and more infrastructure (e.g., sanitary sewer and storm sewer). Declining population in areas of the Vernon Fork Muscatatuck River watershed might signify communities with under-utilized infrastructure and indicate opportunities to "rightsize" existing infrastructure and promote changes to land use that would benefit water quality (e.g., green infrastructure).



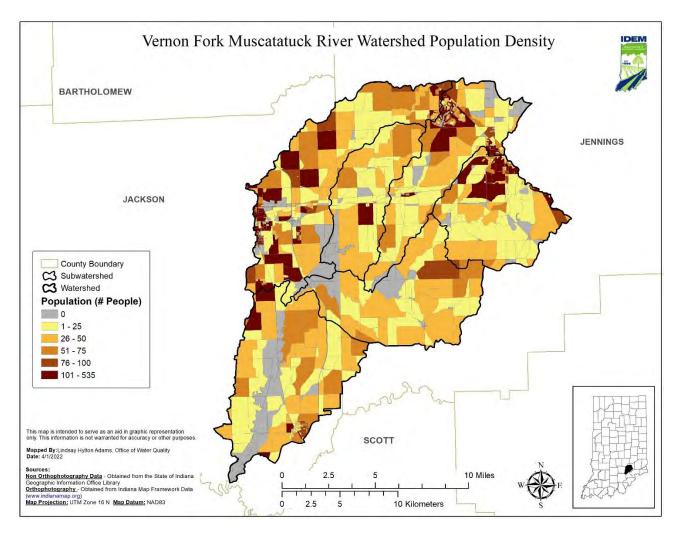


Figure 21: Population Density in the Vernon Fork Muscatatuck River Watershed

2.6.1 Onsite Sewage Disposal Systems

Onsite sewage disposal systems (i.e., septic systems) are underground wastewater treatment structures most commonly used in rural areas without centralized sewer systems. According to the U.S. EPA's SepticSmart Homeowners program, one in five U.S. homes has a septic system (U.S EPA, 2018). Local health departments regulate onsite residential sewage disposal systems via designated authority from the Indiana Department of Health (IDOH) (410 IAC 6-8.3). More than 800,000 onsite sewage disposal systems are currently used in Indiana. Local health departments issue more than 15,000 permits per year for new systems and about 6,000 permits for repairs (IDOH, 2020).

Septic systems typically consist of a septic tank to settle out and digest sewage solids, followed by a system of perforated piping to distribute the treated wastewater for absorption into the soil, also known as the drainfield. The septic tank holds the wastewater to allow for separation of solids, fats, oil, and grease. The septic tank also contains microorganisms that aid in breaking



down sludge and removing some contaminants from the wastewater. The drainfield allows for further removal of remaining contaminants through soil filtration.

Regular maintenance of septic systems, such as frequent inspections and pumping of the septic tank, is important to ensure the system is functioning safely and effectively. Septic systems that are properly designed and maintained should not serve as a source of contamination to surface waters. However, a septic system may fail if it is not properly installed or maintained, or if it is installed in an unsuitable soil type, as discussed in Section 2.3.2. A septic system that is not functioning properly may inadvertently contaminate groundwater and surface water due to elevated levels of nutrients and bacteria that can be found in untreated or inadequately treated household wastewater. A septic system is considered failing when the system exhibits one or more of the following:

- 1. The system refuses to accept sewage at the rate of design application, thereby interfering with the normal use of plumbing fixtures.
- 2. Effluent discharge exceeds the absorptive capacity of the soil, resulting in ponding, seepage, or other discharge of the effluent to the ground surface or to surface waters.
- 3. Effluent is discharged from the system causing contamination of a potable water supply, groundwater, or surface water.

The general sewage disposal requirements (410 IAC 6-8.3-52) in the residential onsite sewage systems rule state that:

- No person shall throw, run, drain, seep, or otherwise dispose into any of the surface waters or groundwaters of this state, or cause, permit, or suffer to be thrown, run, drained, allowed to seep, or otherwise disposed into such waters, any organic or inorganic matter from a dwelling or residential onsite sewage system that would cause or contribute to a health hazard or water pollution.
- The: (1) design; (2) construction; (3) installation; (4) location; (5) maintenance; and (6) operation; of residential onsite sewage systems shall comply with the provisions of this rule.

The violations and permit denial and revocation section (410 IAC 6-8.3-55) of the residential onsite sewage system rule states that:

- Should a residential onsite sewage system fail, the failure shall be corrected by the owner within the time limit set by the health officer.
- If any component of a residential onsite sewage system is found to be: (1) defective; (2) malfunctioning; or (3) in need of service; the health officer may require the repair, replacement, or service of that component. The repair, replacement, or service shall be conducted within the time limit set by the health officer.



• Any person found to be violating this rule may be served by the health officer with a written order stating the nature of the violation and providing a time limit for satisfactory correction thereof.

A comprehensive database of septic systems within the Vernon Fork Muscatatuck River watershed is not available; therefore, the rural population of each subwatershed was calculated to obtain a general representation of the number of systems. The U.S. Census provides the total number of people within a county as well as the total urban and rural population of the county. Subwatershed population is estimated by using the census block population found within each area. It is assumed that the numbers of septic systems in the subwatersheds are directly proportional to rural household density. An additional estimate of septic systems can be made using the 1990 US Census, as that is the last Census that inventoried how household wastewater is disposed. The rural households in the Vernon Fork Muscatatuck River subwatersheds are shown in Table 24, along with a calculated density (total rural households divided by total area). The rural household density can be used to compare the different subwatersheds within the Vernon Fork Muscatatuck River watersheds within the Vernon Fork Muscatatuck River 3020).

Subwatershed	Subwatershed Area (mi ²)	Households in Subwatershed	Urban Households	Rural Households	Rural Household Density (Houses/mi ²)	Urban Household Density (Houses/mi ²)
Indian Creek	29.24	2,911	2,124	787	26.9	72.6
Sixmile Creek	31.0	3,306	875	2,431	78.4	28.2
Storm Creek	23.28	608	0	608	26.1	0.0
Mutton Creek	46.78	7,138	3,705	3,433	73.4	79.2
Polly Branch	36.14	682	0	682	18.9	0.0
Grassy Creek	45.68	1,704	739	965	21.1	16.2

Table 24: Rural and Urban Household Density in the Vernon Fork Muscatatuck River Subwatersheds

A report by the Indiana Advisory Commission on Intergovernmental Relations (ACIR) surveyed county health department officials statewide from 2016 to 2017. Of the 444 unsewered communities reported statewide, the study was able to identify 192 of those communities where at least 25 percent of the individual wastewater treatment systems were failing. Unsewered communities were defined as "contiguous geographical areas containing at least 25 homes and/or businesses that are not served by sewers" (Palmer et. al, 2019). Table 25 reports unsewered communities by county relevant to the Vernon Fork Muscatatuck River watershed.



County	Unsewered Communities	Residences	Businesses
Jackson	1	166	13
Jennings	19	960	28

Table 25: Unsewered residences/businesses reported by county in 2016-2017.

2.6.2 Urban Stormwater

In areas not covered under the NPDES construction stormwater, industrial stormwater, or MS4 programs, as discussed in Section 2.7.3, stormwater run-off from developed areas is not regulated under a permit and is therefore a nonpoint source. Run-off from urban areas can carry a variety of pollutants originating from a variety of sources. Typically, urban sources of nutrients are fertilizer application to lawns and pet waste. Potential sources of *E. coli* in urban stormwater include pet waste, urban wildlife waste, homeless encampments, leaking sanitary sewers exfiltrating to storm drains, combined and sanitary sewer overflows, failing septic systems and more (Clary et al., 2014). Depending on the amount of developed, impervious land in a watershed, urban nonpoint source inputs can result in localized or widespread water quality degradation. The percent and distribution of developed land in the Vernon Fork Muscatatuck River watershed is discussed in Section 2.1. However, inputs from urban sources are difficult to quantify. Estimates can be made of residential areas that might receive fertilizer treatment. These estimates provide insight into the potential of urban nonpoint sources as important sources of nutrients, TSS, and *E. coli* in the Vernon Fork Muscatatuck River watershed.



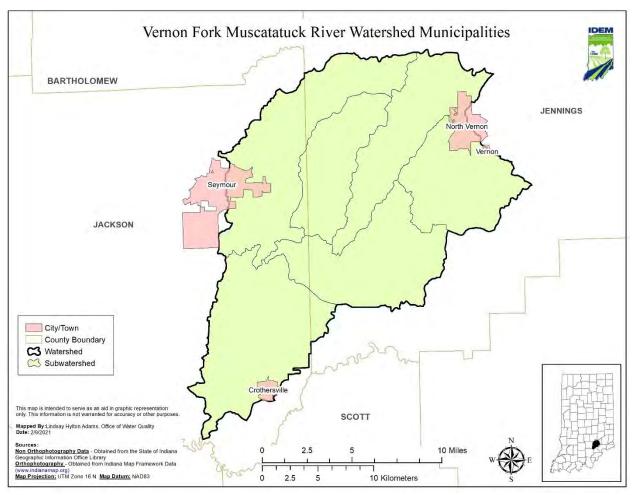


Figure 22: Municipalities in the Vernon Fork Muscatatuck River Watershed

2.7 Point Sources

This section summarizes the potential point sources of *E. coli*, TSS, and total phosphorus in the Vernon Fork Muscatatuck River watershed, as regulated through the National Pollutant Discharge Elimination System (NPDES) Program. As authorized by the CWA, the NPDES permit program controls water pollution by regulating facilities that discharge pollutants into waters of the United States. Point sources with NPDES permits within this watershed include wastewater treatment facilities, a quarry, industrial facilities, construction activity, and an MS4 community.

2.7.1 Municipal Wastewater Treatment Plants (WWTPs)

Municipal Wastewater Treatment Plants (WWTPs) that discharge wastewater through a point source to a surface water of the state are required to obtain a municipal NPDES wastewater permit. Some of the functions of a WWTP include sewage treatment and industrial waste treatment. Municipal wastewater facilities are required to disinfect their effluent for *E. coli* during



the recreational season (April 1 to October 31) in accordance with 327 IAC 5-10-6. WWTPs are critical for maintaining public sanitation and a healthy environment. However, WWTPs may discharge wastewater with elevated concentrations of pollutants into streams. Municipal wastewater permits include effluent limitations that are derived using water quality criteria developed to protect all designated and existing uses of the receiving water body and/or any more stringent technology-based limitations. There are two active WWTPs that discharge wastewater within the Vernon Fork Muscatatuck River watershed (Table 26 and Figure 23).

The Town of Crothersville WWTP (IN0022683) currently operates a Class II, 0.47 MGD oxidation ditch treatment facility consisting of a bar screen, a grit settling chamber, an influent flow meter, one oxidation ditch, three final clarifiers, ultraviolet light disinfection, post-aeration and an effluent flow meter. Sludge management includes two aerobic digesters as well as three sludge drying beds. Final solids are hauled off-site for landfill disposal. The collection system is comprised of combined sanitary and storm sewers with one Combined Sewer Overflow (CSO) location (002) and one Wet Weather Treatment Facility (WWTF) outfall (003). The facility has one outfall (001) that discharges to Nehrt Ditch. The receiving water has a seven-day, ten-year low flow ($Q_{7,10}$) of 0.0 cubic feet per second at the outfall location. The permittee accepts industrial flow from the following three industrial users: AISIN Chemical Indiana, LLC (INP000656 and INP000641) and AISIN Chemical Drivetrain, Inc. (INP000230). Industrial wastewater from AISIN Chemical Indiana, LLC (INP000641) makes up approximately 7% of the Crothersville WWTP's average annual flow.

Jennings Northwest Regional Utilities WWTP (IN0056049) currently operates a Class II, 0.352 MGD treatment facility consisting of screening, grit removal, a Multi-Stage Activated Biological Process (MSABP), a polishing pond, post aeration and ultraviolet light disinfection. There is an existing flow equalization basin which the permittee contends is not functional and cannot be used. The collection system is comprised of 100% separate sanitary sewers by design with no overflow or bypass points. The facility has one outfall (Outfall 002) that discharges to Six Mile Creek. The receiving water has a seven-day, ten-year low flow (Q7,10) of 0.0 cubic feet per second at the outfall location. There is no industrial flow to this wastewater treatment facility.

Effluent from these facilities are potential point sources of *E. coli*, total phosphorus, and TSS. As discussed in Section 1.2 Water Quality Targets, the TMDL target value for *E. coli* is the 235 counts/100 mL single sample maximum component of the water quality standard. The TMDL target value for total phosphorus is 0.3 mg/L or interpreted from current permit limits. These target values can be used to establish potential permit limits. Flows used to calculate pollutant loads from each treatment plant are estimated based on current flow data from data monitoring reports (DMR) or design flows from the facility permits when actual flow data is not available. Pollutant concentrations used to calculate wasteloads from each treatment plant are based on known technological limitations of the facilities.

The facilities' permit effluent limits for *E. coli* were used to determine *E. coli* wasteload allocations for each treatment plant. The effluent limit for *E. coli* is set at the 235 counts/100 mL single sample maximum component of the water quality standard. Neither facility currently has a



permit limit set for total phosphorus. As discussed in Section 1.2.2, treatment plants in compliance with a 1.0 mg/L total phosphorus permit limit typically meet the in-stream target for phosphorus (0.30 mg/L). Total phosphorus loadings from the Jennings Northwest Regional Utility were based upon using the design flow from the facility's permit and a 1.0 mg/L TP concentration. IDEM believes it is reasonable to expect that the issuance of and compliance with a 1.0 mg/L permit limit will result in the necessary reductions for meeting water quality targets in the Sixmile Creek subwatershed. Therefore, the recommended effluent limit for total phosphorus is set at 1.0 mg/L for Jennings Northwest Regional Utility WWTP.

TP loadings for the Town of Crothersville WWTP similarly were based upon using the average design flow for the facility and a 1.0 mg/L TP concentration at all flow regimes other than low flows. However, during low flows, additional total phosphorus reductions are necessary in the Grassy Creek subwatershed in order to remain within the TMDL. Therefore, for the Town of Crothersville WWTP, the TP concentration used for the total phosphorus WLA at the low flow regime is 0.8 mg/L. TP loadings at low flows from the Town of Crothersville WWTP were also based upon using the average reported flow for the facility, as reported in 2021 DMRs. The recommended effluent limit for total phosphorus is set at 1.0 mg/L for the Town of Crothersville WWTP. To better justify this limit, IDEM analyzed the reported effluent TP concentrations from eight Indiana WWTP facilities of similar capacity to Crothersville, with a 1.0 mg/L TP limit, and found an average monthly effluent TP concentration of 0.55 mg/L, over the past five years. It is therefore reasonable to expect that the facility's compliance with a 1.0 mg/L permit limit will in fact result in the necessary reductions for meeting the TP WLA, and water quality targets in the Grassy Creek subwatershed, even at low flows.

TSS was not found to be a pollutant of concern in either the Sixmile Creek or Grassy Creek subwatersheds, therefore, a TSS WLA was not developed for these facilities.

Table 26: Municipal Wastewater	I reatment Plant Facilities Discharging within the Vernon Fork
Muscatatuck River Watershed	

Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Average Design Flow (MGD)
Grassy Creek	Town of Crothersville WWTP	IN0022683	INW0776 T1018	Nehrt Ditch	0.47
Glassy Cleek			11010770_11018	Nenit Ditch	0.31*
Sixmile Creek	Jennings Northwest Regional Utility	IN0056049	INW0772_04	Six Mile Creek	0.35

* The 2021 average reported flow of 0.31 MGD for the Town of Crothersville WWTP is being used to represent discharge during low flow conditions.



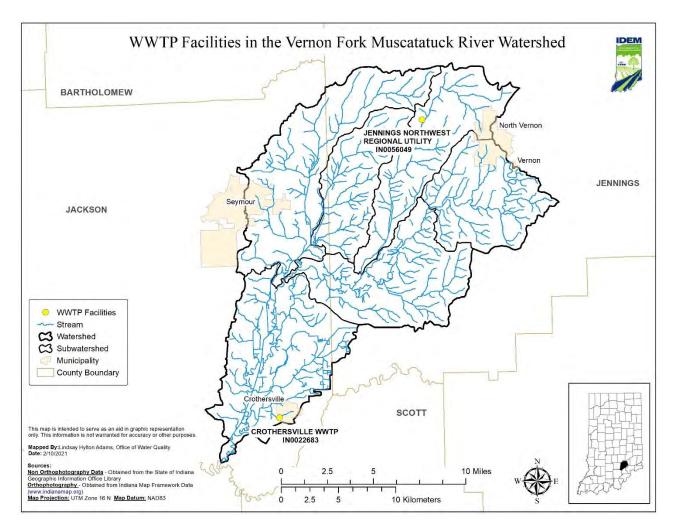


Figure 23: Municipal Wastewater Treatment Facilities Discharging within the Vernon Fork Muscatatuck River Watershed



Permit Compliance

Table 27: Summary of Municipal Wastewater Treatment Plant Permit Compliance in the Vernon Fork Muscatatuck River Watershedfor the Five-Year Period of 2017-2021.

	Facility	NPDES	•	Inspections for the		Water Quality Violations for the Last Five Years					
Subwatershed	Name	Permit Number	Stream	Last Five Years	Outfall	Month	Year	Parameter	Туре	Exceedance	
Grassy Creek	Town of Crothersville WWTP	IN0022683	Nehrt Ditch (Hominy Ditch)	Inspected by IDEM: 1/3/2017: Potential Problems 2/22/2018: Potential Problems 2/26/2020: Potential Problems	001 A	Aug. Aug. Aug. Aug. Nov. Nov. Nov. Aug. Aug.	2018 2018	TSS (mg/L) TSS (lb/d) TSS (lb/d) TSS (mg/L)	MO AVG MX WK AV MO AVG MX WK AVG DAILY MX MAX WK AV MO AVG MX WK AV MO AVG MX WK AV	460% 1013% 127% 350% 8% 13% 63% 134% 16% 97%	



Sixmile Creek	Jennings Northwest Regional Utility	IN0056049	Six Mile Creek	Inspected by IDEM: 3/21/2017: Violations Observed 11/28/2018: Violations Observed 2/2/2021: Violations Observed	002 A	Jan. Jan. Jan. Jan. Feb. Feb. Feb. Feb. March March March March May May May May May June July July July Nov. Nov. Jan. Jan. Jan. Feb. Feb. Karch March March March March May May May May June June July July Nov. Nov. Jan. Jan. Jan. Seb. March March March March March May May May June June June June June June June June	2017 2017 2017 2017 2017 2017 2017 2017	NH3-N (mg/L) NH3-N (lb/d) NH3-N (lb/d) NH3-N (mg/L) NH3-N (mg/L) NH3-N (lb/d) NH3-N (mg/L) NH3-N (mg/L) NH3-N (mg/L) NH3-N (lb/d) NH3-N (mg/L) NH3-N (lb/d) NH3-N (mg/L) NH3-N (mg/L)	. MO AVG MX WK AV MO AVG MX WK AV MX WK AV MO AVG MX WK AV	68% 107% 17% 23% 236% 255% 104% 21% 46% 59% 45% 158% 73% 41% 80% 14% 38% 69% 58% 75% 9% 76% 19% 594% 509% 263% 313% 450% 76% 271% 195% 26% 313% 450% 76% 31% 56% 67% 31% 81%
						March March June June June	2018 2018 2018	NH3-N (lb/d) NH3-N (lb/d) NH3-N (mg/L) NH3-N (mg/L) NH3-N (lb/d)	MO AVG MX WK AV MO AVG	56% 67% 31%
						June Nov. Jan. Jan.	2018 2019	NH3-N (lb/d) NH3-N (mg/L) NH3-N (mg/L) NH3-N (mg/L)	MA WK AV MO AVG MO AVG MX WK AV	260% 16% 25% 23%



		1	1					
				Jan.	2019	NH3-N (lb/d)	MO AVG	15%
				Jan.	2019	NH3-N (lb/d)	MX WK AV	79%
				Feb.	2019	NH3-N (mg/L)	MO AVG	13%
				Feb.	2019	NH3-N (mg/L)	MX WK AV	22%
				Feb.	2019	NH3-N (lb/d)	MO AVG	123%
				Feb.	2019	NH3-N (lb/d)	MX WK AV	143%
				March		NH3-N (mg/L)	MO AVG	36%
				March		NH3-N (mg/L)	MX WK AV	30%
				March		NH3-N (lb/d)	MO AVG	7%
				March	2019	NH3-N (lb/d)	MX WK AV	22%
				May	2019	NH3-N (mg/L)	MO AVG	9%
				May	2019	NH3-N (lb/d)	MO AVG	13%
				May	2019	NH3-N (lb/d)	MX WK AV	3%
				Nov.	2019	NH3-N (mg/L)	MX WK AV	78%
				Nov.	2019	NH3-N (lb/d)	MX WK AV	3%
				Dec.	2019	NH3-N (mg/L)	MO AVG	3%
				Dec.	2019	NH3-N (mg/L)	MX WK AV	11%
				Jan.	2020	NH3-N (mg/L)	MX WK AV	7%
				Feb.	2020	NH3-N (mg/L)	MO AVG	62%
				Feb.	2020	NH3-N (mg/L)	MX WK AV	59%
				Feb.	2020	NH3-N (lb/d)	MO AVG	48%
				Feb.	2020	NH3-N (lb/d)	MX WK AV	56%
				March	2020	NH3-N (mg/L)	MO AVG	128%
				March	2020	NH3-N (mg/L)	MX WK AV	229%
				March	2020	NH3-N (lb/d)	MO AVG	110%
				March	2020	NH3-N (lb/d)	MX WK AV	164%
				May	2020	NH3-N (mg/Ĺ)	MO AVG	21%
				May	2020	NH3-N (mg/L)	MX WK AV	142%
				May	2020	NH3-N (lb/d)	MX WK AV	37%
				June	2020	NH3-N (mg/Ĺ)	MX WK AV	5%
				Aug.	2020	NH3-N (mg/L)	MX WK AV	21%
				Oct.	2020	NH3-N (mg/L)	MO AVG	28%
				Oct.	2020	NH3-N (mg/L)	MX WK AV	23%
				Oct.	2020	NH3-N (lb/d)	MO AVG	51%
				Oct.	2020	NH3-N (lb/d)	MX WK AV	109%
				Nov.	2020	NH3-N (mg/L)	MO AVG	5%
				Nov.	2020	NH3-N (mg/L)	MX WK AV	133%
				Nov.	2020	NH3-N (lb/d)	MO AVG	8%
				Nov.	2020	NH3-N (lb/d)	MX WK AV	176%
				Feb.	2021	NH3-N (mg/Ĺ)	MO AVG	44%
				Feb.	2021	NH3-N (mg/L)	MX WK AV	118%
				Feb.	2021	NH3-N (lb/d)	MO AVG	39%
				Feb.	2021	NH3-N (lb/d)	MX WK AV	173%
L	1	1	I					



	Facility	NPDES		Inspections for the		Water	Quality	Violations for	the Last Five `	′ ears
Subwatershed	Name	Permit Number	Stream	Last Five Years	Outfall	Month	Year	Parameter	Туре	Exceedance
						March	2021	NH3-N (mg/L)	MO AVG	53%
						March	2021	NH3-N (mg/L)	MX WK AV	121%
						March	2021	NH3-N (lb/d)	MO AVG	22%
						March	2021	NH3-N (lb/d)	MX WK AV	95%
						April	2021	NH3-N (mg/Ĺ)	MX WK AV	4%
						April	2021	NH3-N (lb/d)	MX WK AV	135%
						May	2021	NH3-N (mg/L)	MX WK AV	27%
						June	2021	NH3-N (mg/L)	MO AVG	3%
						June	2021	NH3-N (mg/L)	MX WK AV	47%
						June	2021	NH3-N (lb/d)	MX WK AV	90%
						Sept.	2021	NH3-N (mg/L)	MO AVG	16%
						Sept.	2021	NH3-N (mg/L)	MX WK AV	181%
						Sept.	2021	NH3-N (lb/d)	MX WK AV	89%
						June	2017	E. coli	DAILY MX	21%
						June	2018	E. coli	DAILY MX	46%
						Sept.	2018	E. coli	DAILY MX	65%
						Aug.	2020	E. coli	DAILY MX	330%
						June	2020	pН	DAILY MX	1%
						May	2017	ŤSS	MO AVG	24%
						May	2017	TSS	MX WK AV	25%
						June	2018	TSS	MO AVG	17%
						June	2018	TSS	MX WK AV	79%



2.7.2 Industrial Wastewater

Industrial facilities that discharge wastewater through a point source to a surface water of the state are required to obtain an industrial NPDES wastewater permit. Industrial facilities typically generate wastewater through the production of a product. Wastewater discharges from these industrial sources may contain pollutants at levels that could affect the quality of receiving waters. Industrial wastewater permits include effluent limitations that are derived using water quality criteria developed to protect all designated and existing uses of the receiving water body and/or any more stringent technology-based limitations.

An industrial facility may be required to obtain an individual or a general industrial wastewater permit, depending on the activities that occur at the facility. An individual permit includes effluent limitations and operating requirements that are tailored to the specific activities of the facility. A general permit is a "one size fits all" type of activity-specific permit. General permit requirements were originally contained in Indiana Administrative Code (IAC) and set by Indiana's Environmental Rules Board through its formal rulemaking process. Unlike individual permits, general permits apply universally to all entities required to operate in accordance with the rule. However, IDEM is currently in the process of changing its approach to general permits from permit-by-rule to administrative general permits. There are currently two industrial facilities with industrial wastewater permits within the Vernon Fork Muscatatuck River watershed that are potential sources of TSS.

Quarry Operations

Wastewater discharges from Hanson Aggregates Hayden Quarry (ING490100) are regulated by the Sand, Gravel, Dimension Stone and Crushed Stone General Permit. This general permit addresses discharges of process wastewater and mine dewatering from facilities involved in sand, gravel, dimension stone, or crushed stone operations. This quarry contains one outfall which discharges into an unnamed ditch to Six Mile Creek. The facility has an average design flow of approximately 3.17 MGD (Outfall 001 with an average daily value of .141 and max. daily value of 3.168), with a TSS limit of 30 mg/l (daily max.). Effluent from this facility is a potential point source of TSS. However, this facility does not discharge within a subwatershed where TSS was identified as a pollutant of concern. Therefore, a WLA was not assigned to this facility for purposes of this TMDL report.

Table 00. Ouerm	y Facilities Dischargir	a within the Verne	n Carle Muse a tatuale	Diver Wetershed
Table za Ullam	v Facilines Discoaroir	ia wiinin ine verno		River vvalersneo
Tubio Lo. Quali	y i aomaoo bioonargii		In Fork maddatataok	

Subwatershed	Facility Name	Permit Number	Receiving Stream	Average Design Flow (MGD)	
Sixmile Creek	Hanson Aggregates Midwest- Hayden Quarry	ING490100	Unnamed Ditch to Six Mile Creek	3.17	



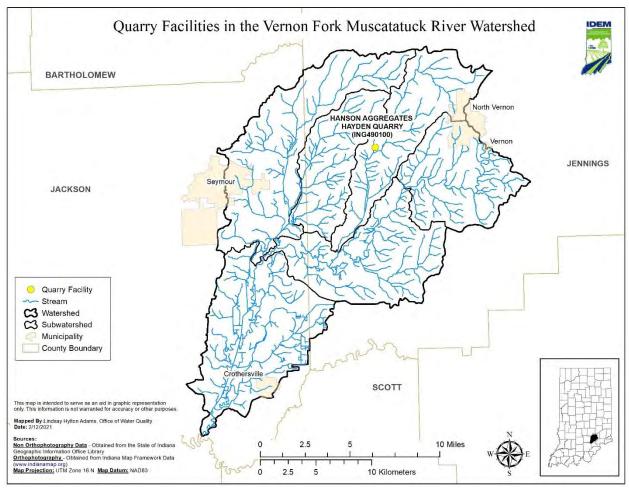


Figure 24: Quarry Facilities Discharging within the Vernon Fork Muscatatuck River Watershed

Petroleum Product Terminals

Wastewater discharges from HWRT Terminal-Seymour, LLC (ING340019) are regulated by the Petroleum Product Terminals General Permit. "Petroleum products terminals" refers to an area where petroleum products are supplied by pipeline or barge and where petroleum products are stored in above -ground tanks or are transferred to trucks for transport to other locations, or both. This general permit authorizes new and existing discharges described as follows from petroleum products terminals to surface waters of the State of Indiana: a) discharges of hydrostatic test waters from storage tanks and onsite pipelines which have been used for the storage and /or transfer or conveyance of crude oil or liquid petroleum hydrocarbons; b) discharges of stormwater runoff specifically from the diked containment areas of these storage tanks; and c) discharge of any accumulated solids or sludges from the tank bottoms. The permittee is required to properly remove and dispose of such solids in accordance with 327



IAC 5 -5 -2. This facility contains two outfalls which discharge non-process wastewater into Mutton Creek. The facility has an average discharge of approximately 0.072 MGD.

Effluent from this facility is potentially a point source of TSS. As discussed in Section 1.2, the TMDL target value for TSS is 30.0 mg/l or interpreted from current permit limits. This target value can be used to establish potential permit limits. Flows used to calculate sediment loads from this facility are estimated based on current flow data from data monitoring reports (DMR) or design flow from the facility permit when actual flow data is not available. Sediment concentrations used to calculate sediment loads from the facility are based on known technological limitations of the facility.

The facility's permit effluent limit for TSS is set at the NPDES limit of 45 mg/L daily maximum. Average design flow was determined from information reported by the facility during the permitting process. Discharges from this facility are not believed to be significant contributions of TSS in the watershed. Compliance with the current NPDES permit limit is consistent with the assumptions used to determine WLAs in the TMDL for protection of applicable water quality standards.

Subwatershed	Facility Name	Permit Number	Receiving Stream	Average Design Flow (MGD)
Mutton Creek	HWRT Terminal Seymour, LLC	ING340019	Mutton Creek	0.072

Table 29: Petroleum Product Terminal Facilities Discharging within the Vernon ForkMuscatatuck River Watershed



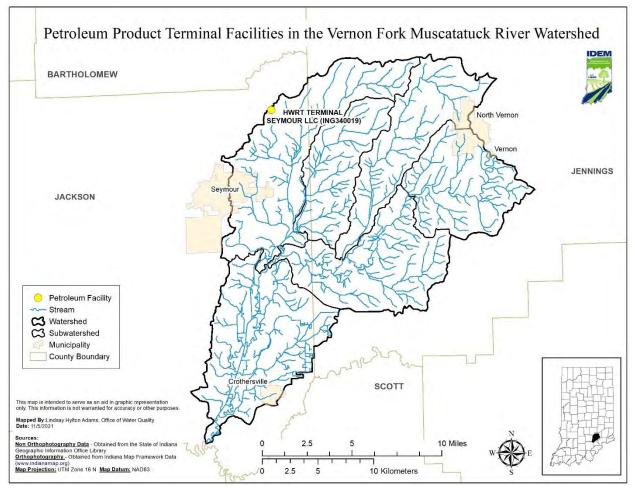


Figure 25: Petroleum Product Terminal Facilities Discharging within the Vernon Fork Muscatatuck River Watershed



Permit Compliance

Table 30: Summary of Industrial Wastewater Permit Compliance in the Vernon Fork Muscatatuck River Watershed for the Five-YearPeriod of 2017-2021

Cuburatarahad	Facility	NPDES	01	Inspections for the	Water Quality Violations for the Last Five Years					
Subwatershed	Name	Permit Number	Stream	Last Five Years	Outfall	Month	Year	Parameter	Туре	Exceedance
Sixmile Creek	Hanson Aggregates Midwest, Hayden Quarry	ING490100	Unnamed Ditch to Six Mile Creek	Inspected by IDEM: 5/15/2018: Satisfactory Conditions 1/28/2019: Satisfactory Conditions 11/14/2019: Satisfactory Conditions	NA	NA	NA	NA	NA	NA
Mutton Creek	HWRT Terminal Seymour, LLC	ING340019	Mutton Creek	Inspected by IDEM: 12/12/2018: Satisfactory Conditions	001	Feb.	2017	рН	Daily Max.	2%



2.7.3 Regulated Stormwater

Activities that discharge stormwater are typically regulated through NPDES stormwater general permits. The stormwater general permit requirements were originally contained in IAC and set by Indiana's Environmental Rules Board through its formal rulemaking process. General permits apply universally to all entities required to operate in accordance with the rule. However, IDEM is currently in the process of changing its approach to general permits from permit-by-rule to administrative general permits. The construction stormwater and municipal separate storm sewer system (MS4) administrative general permits have been finalized and are currently active. The industrial stormwater administrative general permit is also currently being developed.

Construction Stormwater

Stormwater run-off associated with construction activity is currently regulated under the administrative construction general permit (CGP). The CGP is a performance-based regulation designed to reduce pollutants that are associated with construction and/or land disturbing activities. In Indiana, most construction projects are administered through the general permit. The requirements of the permit apply to all persons who are involved in construction activity (which includes clearing, grading, excavation and other land disturbing activities) that results in the disturbance of one (1) acre or more of total land area. If the land disturbing activity results in the disturbance of less than one (1) acre of total land area but is part of a larger common plan of development or sale, the project is still subject to stormwater permitting.

The CGP requires the development and implementation of a construction plan that includes a stormwater pollution prevention plan (SWP3). The SWP3 outlines how erosion and sedimentation will be controlled on the project site to minimize the discharge of sediment off-site or to a water of the state. The SWP3 addresses other pollutants that may be associated with construction activity. This can include disposal of building materials, management of fueling operations, etc. The SWP3 should also address pollutants that will be associated with the post-construction land use. It is the responsibility of the project site owner to implement the SWP3. In addition, it is critical that the site is monitored during the construction process and in-field modifications are made to address the discharge of sediment and other pollutants from the project site. This may require modification of the SWP3 and field changes on the project site, as necessary, to prevent pollutants, including sediment, from leaving the project site.

If an adverse environmental impact from a project site is evident, IDEM may require the site to obtain an individual stormwater permit. An individual stormwater permit is typically required only if IDEM determines the discharge will significantly lower water quality. If an individual stormwater permit is required, notice will be given to the project site owner. An individual stormwater permit is a written document developed specifically for the project site.



The average annual land disturbance associated with construction sites permitted under the CGP are reported in Table 31. The estimated land disturbance was calculated for each subwatershed using data from permitted construction sites for the past five years.

Subwatershed	Estimated Annual Land Disturbance (Acres)				
Indian Creek	17				
Sixmile Creek	53				
Storm Creek	0				
Mutton Creek	242				
Polly Branch	4				
Grassy Creek	66				

Table 31: Average Annual Land Disturbance from Permitted Construction Activity in the VernonFork Muscatatuck River Subwatersheds from 2017-2022

Industrial Stormwater

Stormwater run-off associated with industrial activity is currently regulated under 327 IAC 15-6, which is commonly referred to as "Rule 6" or the industrial stormwater general permit. Compliance with the industrial stormwater general permit is required for facilities where activities of the industrial operation are exposed to stormwater and run-off is discharged though a point source to a waters of the state. The general permit applies to specific categories of industrial activities that must obtain permit coverage. Determination of applicable industrial activities is based on a facility's Standard Industrial Classification (SIC) Code(s) or facility activities included in the listed narrative descriptions within 327 IAC 15-6.

The industrial stormwater general permit requires the development and implementation of a stormwater pollution prevention plan (SWP3). The SWP3 must identify potential sources of pollution that may reasonably be expected to affect the quality of stormwater discharges exposed to industrial activity from the facility. Good housekeeping practices and stormwater control measures must be used in reducing the potential for pollutants to be exposed to stormwater, and the frequency of practices and maintenance requirements of measures requirements must be included in the SWP3. The SWP3 should also clearly identify the responsibilities of each stormwater pollution prevention team member. In addition, it is required that quarterly visual inspections of outdoor operations, measures, and outfalls are conducted as well as annual sampling of stormwater from applicable outfalls in order to determine if modifications of the SWP3 are necessary to prevent pollutants from discharging into a waters of the state.



Under certain circumstances, IDEM may require a facility to obtain an individual stormwater permit. An individual stormwater permit is required if a facility conducts an activity that falls under a regulated industrial activity category in which established effluent limitations have been set by the EPA. In addition, IDEM may determine that the general permit is not sufficient to protect water quality and an individual stormwater permit is required. If an individual stormwater permit is required, notice will be given to the industrial facility representative. An individual stormwater permit is a written document developed specifically for the facility.

There are a total of 21 industrial facilities with industrial stormwater general permits within the Vernon Fork Muscatatuck River watershed.

Subwatershed	Facility Name	Permit Number	Receiving Stream	Parcel Size (Acres)
Grassy Creek	MARMON RETAIL HOME IMPROVEMENT PRODUCTS	INRM01761	Nehrt Ditch	10.71
Grassy Creek	AISIN CHEMICAL INDIANA LLC	INRM00368	Nehrt Ditch	12.98
Grassy Creek	AISIN DRIVETRAIN INCORPORATED	INRM00890	Nehrt Ditch	13.13
Indian Creek	ERLER INDUSTRIES INCORPORATED	INRM00864	Indian Creek	2.99
Sixmile Creek	EBBING AUTO PARTS INC INRM00776 Sixmile Creek		17.19	
Sixmile Creek	PRODUCTS LLC		21.63	
Sixmile Creek	NOVOLEX CO LLC (HILEX POLY CO)	INRM00385	Sixmile Creek	6.60
Sixmile Creek	EBBING AUTO PARTS	INRM01730	Sixmile Creek	8.39
Sixmile Creek	MARTINREA INDUSTRIES INCORPORATED	INRM01269	Sixmile Creek	7.45
Sixmile Creek	NORTH VERNON INDUSTRY GROUP	INRM01500	Sixmile Creek	28.00
Sixmile Creek	GT INDUSTRIES, INC.	INRM02268	Sixmile Creek	25.04
Sixmile Creek	PACIFIC OCEAN CORPORATION	INRM02738	Sixmile Creek	7.39
Storm Creek	RIVER METALS RECYCLING	INRM02633	Unnamed tributary to Storm Creek	5.45
Mutton Creek	AISIN USA MANUFACTURING INCORPORATED	INRM02340	Sandy Branch	14.45
Mutton Creek	AISIN USA MANUFACTURING INCORPORATED	INRM00879	Sandy Branch	45.12
Mutton Creek	IRVING MATERIALS		Sandy Branch	4.07
Mutton Creek	THE ANDERSONS INRM02560 Sandy Branch		14.27	
Mutton Creek	SEYMOUR TUBING INCORPORATED	INRM00375	Sandy Branch	20.35

Table 32: Industrial Stormwater Facilities Discharging within the Vernon Fork Muscatatuck River Subwatersheds



Vernon Fork Muscatatuck River Watershed TMDL Report

ĺ	Mutton Creek	CUMMINS INCORPORATED - SEYMOUR ENGINE PLANT	INRM00922	Sandy Branch	27.96
	Mutton Creek	CUMMINS INC. SEYMOUR HHP BLOCK LINE FACILITY	INRM01872	Sandy Branch	3.51
	Mutton Creek	JACKSON COUNTY TRANSFER & RECYCLING STATION	INRM01239	Sandy Branch	2.34

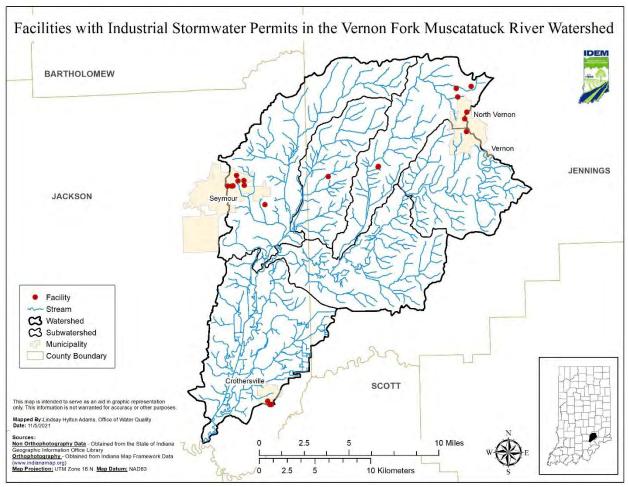


Figure 26: Industrial Stormwater Facilities Discharging within the Vernon Fork Muscatatuck River Watershed

Municipal Separate Storm Sewer Systems (MS4)

Stormwater run-off from certain types of urbanized areas are currently regulated under the administrative municipal storm sewer system (MS4) general permit. MS4s are defined as a conveyance or system of conveyances owned by a state, city, town, or other public entity that discharges to waters of the state and is designed or used for collecting or conveying stormwater. Regulated conveyance systems include roads with drains, municipal streets, catch basins, curbs, gutters, storm drains, piping, channels, ditches, tunnels, and conduits. It does not



include combined sewer overflows and publicly owned treatment works. There is currently one MS4 entity in the Vernon Fork Muscatatuck River watershed as shown in Table 33 and Figure 27.

The CWA requires stormwater discharges from certain types of urbanized areas to be permitted under the NPDES program. In 1990, Phase I of these requirements became effective, and municipalities with a population served by a MS4 of 100,000, or more were regulated. Under Phase I federal stormwater regulations, regulated MS4 entities were required to obtain individual permits. In 1999, Phase II became effective and any entity responsible for an MS4 conveyance, regardless of population size, could potentially be regulated. An individual NPDES permit is required when water quality standards are not being met under the general permit, a technology or regulatory change has occurred that causes the implementation of specific controls or limitations not expressed in the general permit, or a general permit is no longer appropriate based on permittee changes. If any of these situations occur, MS4 entities covered under this general permit rule may be required to terminate coverage and apply for an individual MS4 permit.

MS4 conveyances within urbanized areas have one of the greatest potentials for polluted stormwater run-off. The Federal Register Final Rule explains the reason as: "urbanization alters the natural infiltration capacity of the land and generates...pollutants...causing an increase in stormwater run-off volumes and pollutant loadings." Based on increased population and proportionally higher pollutant sources, urbanization results, "in a greater concentration of pollutants that can be mobilized by, or disposed into, stormwater discharges." MS4s can be significant sources of *E. coli*, nutrients, and sediment because they transport urban run-off that can be affected by pet waste, illicit sewer connections, failing septic systems, fertilizer, construction, and streambank erosion from hydrologic modifications.

Municipal boundaries and MS4 boundaries are not always the same but are often used to delineate the regulated MS4 area if a system map is not readily available. The MS4 WLAs are developed at High and Moist flow regimes; it is not expected that the MS4 will have non stormwater discharges. The MS4 operator shall develop a stormwater quality management plan (SWQMP) that includes a commitment to develop and implement a strategy to detect and eliminate illicit discharges to the MS4 conveyance.



Table 33: MS4 Communities in the Vernon Fork Muscatatuck River Watershed

Subwatershed	MS4 Community	Permit ID	Area in Drainage (Acres)	Percentage of Mutton Creek Subwatershed
Mutton Creek	City of Seymour	INR040082	1,879.16	6.28%

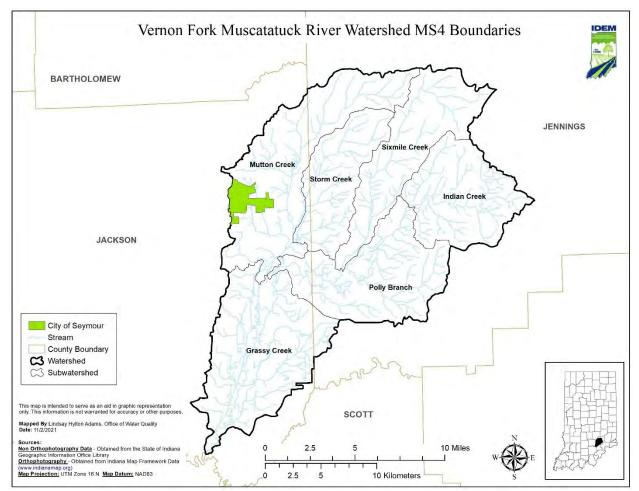


Figure 27: MS4 Boundaries in the Vernon Fork Muscatatuck River Watershed

2.8 Summary

The information presented in Section 1.0 helps to provide a better comprehensive understanding of the conditions and characteristics in the Vernon Fork Muscatatuck River watershed that, when coupled with the sources presented in Section 2.0, affect both water quality and water quantity. In summary, the predominant land uses in the Vernon Fork Muscatatuck River watershed of agriculture, hay/pasture and forested land serve as indicators as to the type of sources that are likely to contribute to water quality impairments in the watershed. Human population in the Vernon Fork Muscatatuck River watershed indicates where



more infrastructure-related pressures on water quality might exist. The subsections on topography and geology, as well as soils, provide information on the natural features that affect hydrology in the watershed. These features interact with land use activities and human population to create pressures on both water quality and quantity in the Vernon Fork Muscatatuck River watershed. Lastly, the subsection on climate and precipitation provides information on water quantity and the factors that influence flow, which ultimately affects the influence of stormwater on the watershed. Collectively, this information plays an important role in understanding the sources that contribute to water quality impairment during TMDL development and crafting the linkage analysis that connects the observed water quality impairment to what has caused that impairment.



3.0 TECHNICAL APPROACH

Previous sections of the report have provided a description of the Vernon Fork Muscatatuck River watershed and summarized the applicable water quality standards, water quality data, and identified the potential sources of *E. coli*, TSS, and total phosphorus for assessment units in each subwatershed. This section presents IDEM's technical approach for using water quality sampling data and flow data for each subwatershed as described in Section 4.0 to estimate the current allowable loads of *E. coli*, TSS, and total phosphorus in each subwatershed. This section focuses on describing the methodology and is helpful in understanding subsequent sections of the TMDL report.

3.1 Load Duration Curves

To determine allowable loads for the TMDL, IDEM uses a load duration curve approach. This approach helps to characterize water quality problems across flow conditions and provides a visual display that assists in determining whether loadings originate from point or nonpoint sources. Load duration curves present the frequency and magnitude of water quality violations in relation to the allowable loads, communicating the magnitude of the needed load reductions.

Developing a load duration curve is a multi-step process. To calculate the allowable loadings of a pollutant at different flow regimes, the load duration curve approach involves multiplying each flow by the TMDL target value or water quality standard and an appropriate conversion factor. The steps are as follows:

- A flow duration curve for the stream is developed by generating a flow frequency table and plotting the observed flows in order from highest (left portion of curve) to lowest (right portion of curve).
- The flow curve is translated into a load duration (or TMDL) curve. To accomplish this, each flow value is multiplied by the TMDL target value or water quality standard with the appropriate conversion factor and the resulting points are graphed. Conversion factors are used to convert the units of the target (e.g., #/100 mL for *E. coli*) to loads (e.g., MPN/day for *E. coli*) with the following factors used for this TMDL:
- *E. coli*: Flow (cfs) x TMDL Concentration Target (#/100mL) x Conversion Factor (24,465,758.4) = Load (MPN/day)
- Total Phosphorus and TSS: Flow (cfs) x TMDL Concentration Target (mg/L) x Conversion Factor (5.39) = Load (lb/day)
- To estimate existing loads, each water quality sample is converted to a load by multiplying the water quality sample concentration by the estimated daily flow on the day the sample was collected and the appropriate conversion factor. Then, the existing individual loads are plotted on the TMDL graph with the curve.
- Points plotting above the curve represent violations of the applicable water quality standard or exceedances of the applicable target and the daily allowable load. Those



points plotting below the curve represent compliance with standards and the daily allowable load.

• The area beneath the load duration curve is interpreted as the loading capacity of the stream. The difference between this area and the area representing the current loading conditions above the curve is the load that must be reduced to meet water quality standards.

The load duration curve approach can consider seasonal variation in TMDL development as required by the CWA and U.S. EPA's implementing regulations. Because the load duration curve approach establishes loads based on a representative flow regime, it inherently considers seasonal variations and critical conditions attributed to flow conditions.

The stream flows displayed on water quality or load duration curves may be grouped into various flow regimes to aid with interpretation of the load duration curves. The flow regimes are typically divided into the following five "hydrologic zones" (U.S. EPA, 2007):

- High Flows: Flows in this range represent flooding or near flooding stages of a stream.
 These flows are exceeded 0 10 percent of the time.
- Moist Conditions: Flows in this range are related to wet weather conditions. These flows are exceeded 10 – 40 percent of the time.
- Mid-Range Flows: Flows in this range represent median stream flow conditions. These flows are exceeded 40 60 percent of the time.
- Dry Conditions: Flows in this range are related to dry weather flows. These flows are exceeded 60 90 percent of the time.
- Low Flows: Flows in this range are seen in drought-like conditions. These flows are exceeded 90 100 percent of the time.

The load duration curve approach helps to identify the sources contributing to the impairment and to roughly differentiate between sources. Exceedances of the load duration curve at higher flows (0-40 percent ranges) are indicative of wet weather sources (e.g., nonpoint sources, regulated stormwater discharges). Exceedances of the load duration curve at lower flows (60 to 100 percent range) are indicative of point source sources (e.g., wastewater treatment facilities, livestock in the stream). Table 34 summarizes the general relationship between the five hydrologic zones and potentially contributing source areas (the table is not specific to any individual pollutant). For example, the table indicates that impacts from wastewater treatment plants are usually most pronounced during dry and low flow zones because there is less water in the stream to dilute their loads. In contrast, impacts from channel bank erosion is most pronounced during high flow zones because these are the periods during which stream velocities are high enough to cause erosion to occur.



	Duration Curve Zone					
Contributing Source Area	High (0%-10%)	Moist (10%-40%)	Mid-Range (40%-60%)	Dry (60%-90%)	Low (90%-100%)	
Wastewater treatment plants (point source)			L	М	н	
Livestock direct access to streams			L	М	Н	
Wildlife direct access to streams			L	М	Н	
Pasture management	Н	Н	М			
On-site wastewater systems/Unsewered areas	L	М	Н	Н	Н	
Riparian buffer areas	Н	Н	М	М		
Stormwater: Impervious	Н	Н	Н			
Stormwater: Upland	Н	Н	М			
Field drainage: Natural condition	Н	М				
Field drainage: Tile system	Н	Н	М	L		
Bank erosion	н	М	L			

Table 34: Relationship between Load Duration Curve Zones and Contributing Sources

Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low)

(Modified from An Approach for Using Load Duration Curves in the Development of TMDLs (U.S. EPA, 2007))

3.2 Stream Flow Estimates

Daily stream flows are necessary to implement the load duration curve approach. Load duration assessment locations in the Vernon Fork Muscatatuck River watershed were chosen based on the location of the impaired stream segments and the availability of water quality samples to estimate existing loads.

The USGS gage for the Vernon Fork Muscatatuck River at Vernon, IN (03369500) was used for the development of the *E. coli*, TSS, and total phosphorus load duration curve analysis for the Vernon Fork Muscatatuck River watershed TMDL. USGS gage 03369500 is located in Jennings County. Gage 03369500 drains approximately 198 sq. miles in the Muscatatuck (HUC 8: 05120207) watershed as shown in Figure 28.



Gage Location	Gage ID	Period of Record Used in Analysis
Vernon Fork Muscatatuck River at Vernon, Indiana	03369500	2012-2021

Since the load duration approach requires a stream flow time series for each site included in the analysis, stream flows were extrapolated from USGS gage 03369500 for each assessment location by using a multiplier based upon the ratio of the upstream drainage area for a given location to the drainage area of the Vernon Fork Muscatatuck River watershed.

Flows were estimated using the following equation:

$$Q \text{ungaged} = \frac{A \text{ungaged}}{A \text{gaged}} \times Q \text{gaged}$$

Where,

Qungaged:	Flow at the ungaged location
Q _{gaged} :	Flow at surrogate USGS gage station
A _{ungaged} :	Drainage area of the ungaged location
Agaged:	Drainage area of the gaged location

In this procedure, the drainage area of each of the load duration stations was divided by the drainage area of the surrogate USGS gage. The flows for each of the stations were then calculated by multiplying the flows at the surrogate gage by the drainage area ratios. Additional flows were added to certain locations to account for municipal wastewater treatment plants that discharge upstream and are not directly reflected in the load duration curve method.

Subwatershed	Drainage	ge Flow Duration Exceedance Interval Flows (cfs)				
	Area (sq. miles)	High (5%)	Moist (25%)	Mid-Range (50%)	Dry (75%)	Low (95%)
Indian Creek	225.50	1,439	281	93	24	4
Sixmile Creek	31.00	203	44	18	9	6
Storm Creek	23.28	149	29	10	2	0
Mutton Creek	70.06	447	87	29	8	1
Polly Branch	292.66	1,873	370	126	36	11
Grassy Creek	412.26	2,637	520	176	50	14

Table 36: Load Duration Curve Key Flow Percentile Estimates



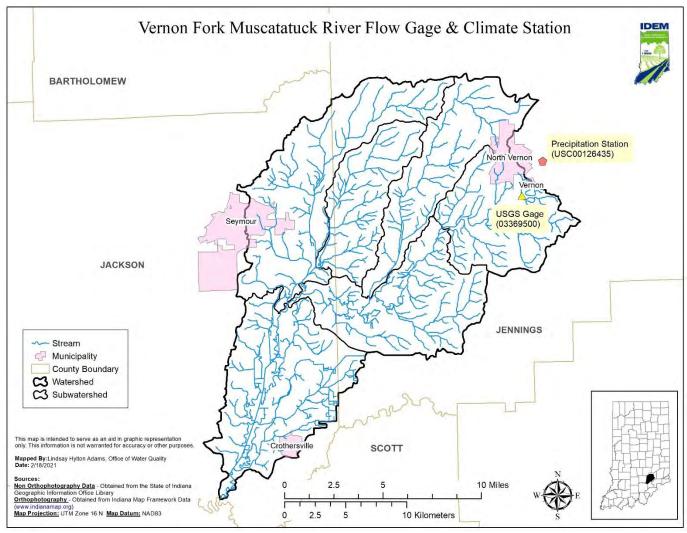


Figure 28: Location of Surrogate Flow Gage in Vernon, IN



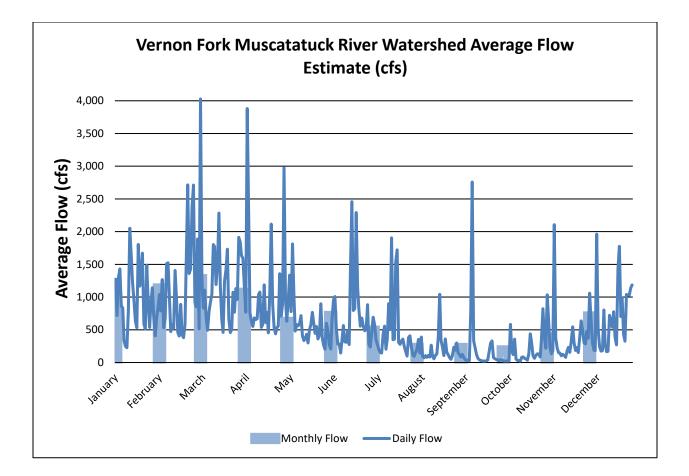


Figure 29: Average Daily Flow Estimate for the Vernon Fork Muscatatuck River Watershed for data from 2012-2021

3.3 Margin of Safety (MOS)

Section 303(d) of the Clean Water Act and U.S. EPA regulations at 40 CFR 130.7 require that "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numeric water quality standards with seasonal variations and a MOS which takes into account any lack of knowledge concerning the relationship between limitations and water quality." U.S. EPA guidance explains that the MOS may be implicit (i.e., incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e., expressed in the TMDL as loadings set aside for the MOS). This TMDL uses both an implicit and explicit MOS. An implicit MOS was used by applying a couple of conservative assumptions. A moderate explicit MOS has been applied by reserving 10% of the allowable load. Ten percent was considered an appropriate MOS based on the following considerations:

• The use of the load duration curve approach minimizes a great deal of uncertainty associated with the development of TMDLs because the calculation of the loading capacity is simply a function of flow multiplied by the target value. Most of the uncertainty



is therefore associated with the estimated flows in each assessed segment which were based on extrapolating flows from the nearest USGS gage.

- An additional implicit MOS for *E. coli* is included because the load duration analysis does not address die-off of pathogens.
- An additional implicit MOS for pollutants is realized in that when in compliance NPDES permitted sources are seldom discharging at their allowable limits.

3.4 Future Growth Calculations

Population trends indicate that this watershed has seen a slight increase in population over the past two decades (Table 23). Uncertainty regarding future populations and land use changes in the Vernon Fork Muscatatuck River watershed has led IDEM to choose to allocate 5% of the loading capacity to address increased bacteria and nutrient loads from future contributors.



4.0 LINKAGE ANALYSIS

A linkage analysis connects the observed water quality impairment to what has caused that impairment. An essential component of developing a TMDL is establishing a relationship between the source loadings and the resulting water quality. Potential point and nonpoint sources are inventoried in Section 2.0, and water quality data within the Vernon Fork Muscatatuck River watershed are discussed in Section 1.4. The purpose of this section is to evaluate which of the various potential sources is most likely to be contributing to the observed water quality impairments.

Load duration curves were created for each subwatershed in the Vernon Fork Muscatatuck River watershed that were sampled by IDEM in 2020 and 2021. The load duration curve method considers how stream flow conditions relate to a variety of pollutant loadings and their sources (point and nonpoint). Load duration curves illustrate water quality standard and target value violations during all flow ranges that occurred during sampling events. Section 3.0 summarizes the load duration curve approach.

To further investigate sources, water quality precipitation graphs have been created. Elevated levels of pollutants during rain events indicate contributions of pollutants due to run-off. The precipitation data was taken from a weather station in North Vernon, IN and managed by the Midwestern Regional Climate Center.

A linkage analysis for each subwatershed is included in this section. The analysis includes a summary of the subwatershed, including information regarding sampling sites, land use, NPDES facilities, MS4 communities, CSO communities, CFOs, and soil characteristics. A summary table of each subwatershed is also provided that includes the load allocations (LAs), wasteload allocations (WLAs), and margin of safety (MOS) values for pollutants of concern. Evaluating the load duration curves and precipitation graphs with consideration of these watershed characteristics allows for identification of potential point and nonpoint sources that are contributing to elevated concentrations of pollutants. Pollutants of concern for the Vernon Fork Muscatatuck River watershed identified by sampling data include *E. coli*, total phosphorus, and TSS.

4.1 Pollutants of Concern

<u>4.1.1 *E.* coli</u>

Establishing a linkage analysis for *E. coli* is challenging because there are so many potential sources, and *E. coli* counts have a high degree of variability. While it is difficult to perform a site-specific assessment of the causes of high *E. coli* for each location in a watershed, it is reasonable to expect that general patterns and trends can be used to provide some perspective on the most significant sources. Additional information is outlined in Section 1.1.1.

E. coli sources typically associated with high flow and moist conditions include failing onsite wastewater systems, urban stormwater/CSOs, run-off from agricultural areas, and bacterial re-



suspension from the streambed. *E. coli* sources typically associated with low flow conditions include a large number of homes on failing or illicitly connected septic systems that would provide a constant source. Elevated *E. coli* levels at low flow could also result from inadequate disinfection at wastewater treatment plants or animals with direct access to streams.

4.1.2 Total Phosphorus

Nutrients come in many forms, including nitrogen, phosphorus, ammonia, total Kjeldahl nitrogen (TKN), nitrite, and nitrate. Information presented in the water quality assessment describes nutrient conditions in the Vernon Fork Muscatatuck River watershed. Additional information is outlined in Sections 1.1.2 and 1.1.3.

Total phosphorus concentrations are naturally low in surface waters but high in rivers and streams located in agricultural and urban areas, or that receive wastewater discharges. High phosphorus levels in streams increase the growth of plants and algae, reducing the quality of the habitat, and causing low oxygen levels at night when the plants and algae are respiring but not photosynthesizing.

The load duration curves indicate that nonpoint sources as well as point sources may be contributing to the impairment. Nonpoint sources might include sediment-bound phosphorus that enters the river during erosional processes, as well as the run-off of storms over fertilized fields and residential areas. Septic systems might also be a potential source of phosphorus if the systems are failing and located adjacent to the streams.

4.1.3 Total Suspended Solids (TSS)

Developing a linkage analysis to address the connection between siltation and its effect on aquatic life uses often involves an evaluation of multiple factors. The interaction between erosion processes and hydrology is an important part of the assessment, with land use, riparian areas, and channel conditions being key considerations. Each can play a potential role in both creating and solving sediment problems. The sediment issues can occur when external inputs (e.g., sediment, run-off volume) to the stream become excessive, or when stream characteristics are altered so that it can no longer assimilate the loads, or a combination of both occur. Additional information is outlined in Section 1.1.3.

Sheet erosion is the detachment of soil particles by raindrop impact and their removal by water flowing overland as a sheet instead of in channels or rills. Rill erosion refers to the development of small, ephemeral concentrated flow paths, which function as both sediment source and sediment delivery systems for erosion on hillslopes. Sheet and rill erosion occurs more frequently in areas that lack or have sparse vegetation.

Bank and channel erosion refers to the wearing away of the banks of a stream or river. High rates of bank and channel erosion can often be associated with water flow and sediment dynamics being out of balance. This may result from land use activities that either alter flow regimes, adversely affect the floodplain and streamside riparian areas, or a combination of both.



Hydrology is a major driver for both sheet/rill and stream channel erosion. Bank and channel erosion are made worse when streams are straightened or channelized because channelization shortens overall stream lengths and results in increased velocities, bed and bank erosion, and sedimentation. Modified stream channels often have little habitat structure and variability necessary for diverse and abundant aquatic species. Channelization also disconnects streams from floodplain and riparian areas that are often converted to developed or agricultural lands.

Since monitoring began, TSS in the Vernon Fork Muscatatuck River watershed has sporadically exceeded the target. TSS tends to exceed target values in the spring and summer months, although data is incomplete or lacking for the winter months. High loads in the spring may be related to the plowing and planting of agricultural fields occurring during these months, increasing the opportunity for sheet and rill erosion. Further analysis pairing the TSS concentrations with flow conditions reveals elevated TSS concentrations during high flows and slightly lower concentrations during mid-range and lower flow conditions. Elevated TSS concentrations during high flows are consistent with significant loads coming from stream bank and gully erosion.

In addition to TSS, siltation within a stream may be analyzed by taking a closer look into the Qualitative Habitat Evaluation Index (QHEI) scores assigned to each sampling location. Habitat assessments were completed at each sampling site after both fish community and macroinvertebrate community sample collections using a slightly modified version of the Ohio Environmental Protection Agency (OHEPA) QHEI (OHEPA, 2006). The QHEI allows for a quantitative assessment of physical characteristics of the sampled stream. Each sampling site was assigned a QHEI score in relation to the habitat quality for both fish and macroinvertebrate communities. Completed QHEI forms for the Vernon Fork Muscatatuck River watershed are available in Appendix C.

The overall QHEI score is composed of a total of six metric scores. The six individual metrics include substrate, instream cover, channel morphology, bank erosion/riparian zone, pool/glide and riffle/run quality, and gradient. Of these metrics, the substrate metric is the most indicative of excessive siltation within a stream, while the bank erosion/riparian zone metric provides an explanation for excessive amounts of observed siltation. The substrate and bank erosion/riparian zone metric scores were analyzed for each sampling location throughout the watershed to determine if excessive siltation is linked to poor fish community IBI scores and macroinvertebrate community mIBI scores. Additional information regarding IBI and mIBI scores is available in Section 1.1.2.

Substrate and bank erosion/riparian zone metric scores were totaled and plotted against both fish community IBI scores and macroinvertebrate community mIBI scores (Figure 30 and Figure 31). Lower values for the substrate and bank erosion/riparian zone metrics indicate greater observed siltation within the stream and/or lower riparian and flood-plain quality. Lower IBI and mIBI scores indicate fewer individuals and/or low species diversity was observed within a stream. The R² value for the fish community analysis was approximately 0.91, and the R² value for the macroinvertebrate community was approximately 0.94. These values indicate a strong



positive correlation between excessive siltation and low IBI and mIBI scores. This analysis provides additional evidence that excessive siltation within a stream is linked to impaired biotic communities throughout the Vernon Fork Muscatatuck River watershed, in addition to elevated TSS monitoring data.



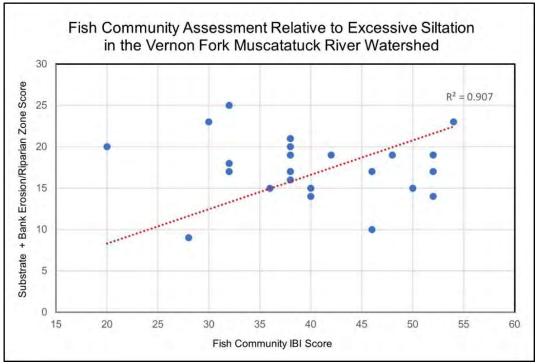


Figure 30: Substrate + Bank Erosion/Riparian Zone Score in Relation to Fish Community IBI Scores in the Vernon Fork Muscatatuck River Watershed

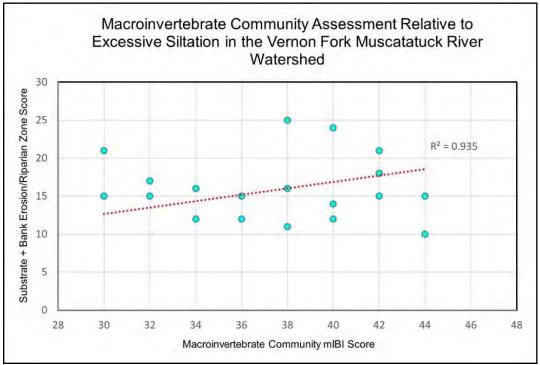


Figure 31: Substrate + Bank Erosion/Riparian Zone Score in Relation to Macroinvertebrate Community mIBI Scores in the Vernon Fork Muscatatuck River Watershed



4.2 Linkage Analysis by Subwatershed

The following sections discuss the load duration curves, precipitation graphs, water quality duration graphs, and linkage of sources to the water quality exceedances for each subwatershed. Load duration curves, precipitation graphs, and water quality duration graphs were created for each subwatershed.

4.2.1 Indian Creek

The Indian Creek subwatershed drains approximately 226 square miles, with an actual land area of around 29 square miles. The subwatershed receives approximately 196 square miles of upstream drainage and then drains southwest into the Vernon Fork Muscatatuck River in the Polly Branch subwatershed. The land use is primarily forested (69 percent), followed by hay/pasture (11 percent) and agriculture (11 percent). There is one NPDES permitted facility in the subwatershed, which is Erler Industries Incorporated (INRM00864). There are no MS4 permits in this subwatershed. Less than half of the subwatershed is rural, indicating many homes likely do not pump to on-site septic systems. Based on the septic suitability of the soil, the entire Vernon Fork Muscatatuck River watershed is very or somewhat limited. The landscape in this subwatershed is hilly and forested, with the small amount of agricultural land located in the southern portion. With its hilly nature, the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

The majority of this subwatershed is not identified as having hydric soil types in riparian zones. Areas with hydric soils could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With 11 percent of the land used for hay/pasture, a heavy presence of pasture animals is not expected. There is one permitted CFO in this subwatershed.

There are two monitoring sites located in this subwatershed. Sites T23 and T25 are both located on the Vernon Fork Muscatatuck River (Figure 32). In 2020 and 2021 this watershed was sampled 38 times between the two sites. Since T25 is also a regularly sampled IDEM Fixed Station site, 12 of those samples were collected as part of that program. The combined sampling resulted in both sites failing the water quality standards for *E. coli*. The *E. coli* geomean for site T23 was 151.74 MPN with 3/10 samples in exceedance of the single sample max; while site T25 had a geomean of 141.34 with 3/10 samples in exceedance of the single sample sample max. The *E. coli* water quality samples from sites T23 and T25 used to calculate the geomeans were taken on the same day for five consecutive weeks. High *E. coli* levels are reflective of wildlife population and leaking and failing septic systems.

The fish community IBI score for site T23 was 52 (good) and the QHEI was 73 (good). The macroinvertebrate community mIBI score was 42 (fair) and the QHEI was 62 (good). The fish community IBI score for site T25 was 54 (excellent) and the QHEI was 80 (good). The macroinvertebrate community mIBI score was 40 (fair) and the QHEI was 87 (good). Based on this data, neither site will be impaired for biotic communities.



Dissolved oxygen (DO) was not found to be below the water quality standard of 4.0 mg/L at either site.

There are approximately 71 miles of streams in the subwatershed. Based on IDEM data collected in 2020 and 2021, there will be 33 stream miles impaired for *E. coli*. These stream reaches will be listed on the 2024 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments. Table 37 provides a summary of the subwatershed, including listed stream reaches by AUID, drainage area, sampling sites, land use, and NPDES facilities, as well as LA, WLAs, and MOS values for *E. coli*.

Load duration curves (Figure 33), precipitation graphs (Figure 34: Graph of Precipitation and E. coli Data for Indian Creek Subwatershed), and water quality duration graphs (Appendix F) were created to further analyze potential sources in the subwatershed. Evaluating these graphs, with consideration of the watershed characteristics, allows for identification of potential point and nonpoint sources that are contributing to elevated E. coli concentrations. Elevated levels of pollutants during rain events can indicate streams are susceptible to high loads of *E. coli* due to run-off. The *E. coli* load duration curve shows the highest loadings during high flows and moist conditions. However, the precipitation graph illustrates that streams are at times in violation of the *E. coli* water guality standard even during drier conditions. This could indicate that point sources may also be contributing pollutants in addition to nonpoint sources. However, no permitted facilities that discharge *E. coli* are located within the subwatershed. Therefore, the majority of sources of E. coli in this subwatershed are likely nonpoint sources. Nonpoint sources may include small animal operations, wildlife, pasture animals with direct access to streams, land application of animal waste, straight pipes, streambank erosion, agricultural practices, and leaking and failing septic systems. See Section 6.1 and Table 47 for information pertaining to potentially suitable BMP selection for the Vernon Fork Muscatatuck River watershed.



		Indian Creek (05 ⁴	1202070701)				
Drainage Area			225.50 square m	iles			
Surface Area			29.24 square mi	iles			
Site # [IDEM Station ID]		T23 [WEN	1070-0036], T25 [\	VEM070-0001]			
Listed Segments [TMDL(s)]	INW0771_02 [<i>E. coli</i>]; INW0771_	03 [<i>E. coli</i>]; INW0 <i>coli</i>]	771_04 [<i>E. coli</i>]; INV	V0771_T1006 [<i>E.</i>		
Listed Impairments [TMDL(s)]		E. coli [E. coli]					
Land Use	Agricultural L	Agricultural Land: 11% Forested Land: 69% Developed Land: 9% Open Water: 1% Pasture/Hay: 11% Grassland/Shrubs: <1% Wetland: <1%					
NPDES Facilities		Erler Industries Inc (INRM00864)					
CAFOs		NA					
CFOs		The Maschoffs	s, LLC North Vern	on (Farm ID: 4907)			
	ТМ	DL <i>E. coli</i> Allocat	ions (MPN/day)				
Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%		
LA	9.12E+11	1.78E+11	5.89E+10	1.52E+10	2.72E+09		
WLA (Total)	0.00E+00	0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00					
MOS (10%)	1.07E+11	2.10E+10	6.92E+09	1.78E+09	3.20E+08		
Future Growth (5%)	5.36E+10	1.05E+10	3.46E+09	8.92E+08	1.60E+08		
Upstream Drainage Input (Muscatatuck River)	7.20E+12	1.41E+12	4.65E+11	1.20E+11	2.15E+10		
TMDL = LA+WLA+MOS	8.27E+12	1.62E+12	5.34E+11	1.38E+11	2.47E+10		

Table 37: Summary of Indian Creek Subwatershed Characteristics



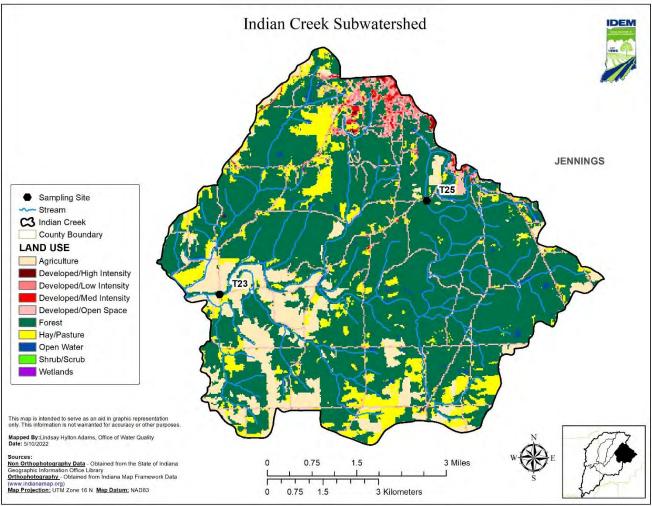


Figure 32: Sampling Stations in Indian Creek Subwatershed



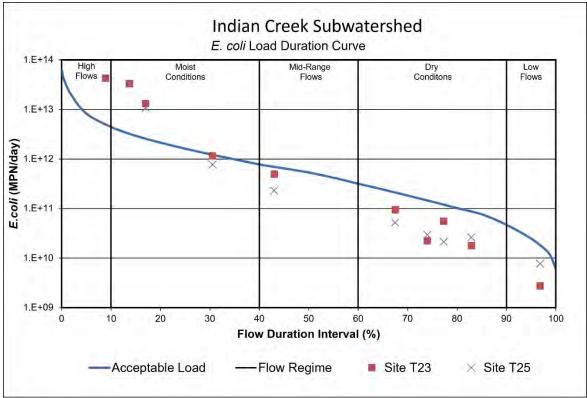


Figure 33: E. coli Load Duration Curve for Indian Creek Subwatershed.

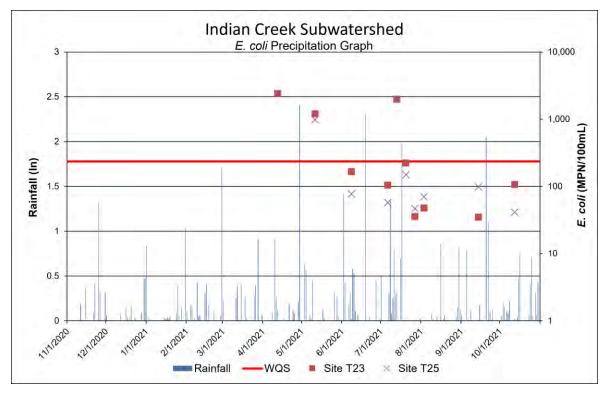


Figure 34: Graph of Precipitation and *E. coli* Data for Indian Creek Subwatershed



4.2.2 Sixmile Creek

The Sixmile Creek subwatershed drains approximately 31 square miles with an actual land area of approximately 31 square miles. The subwatershed drains southward into the Vernon Fork Muscatatuck River in the Polly Branch subwatershed. The land use is primarily forested (40 percent), followed by agriculture (25 percent) and hay/pastureland (20 percent). There are ten NPDES permitted dischargers in the subwatershed, including Jennings Northwest Regional Utility (IN0056049), Hanson Aggregates Midwest- Havden Quarry (ING490100), Ebbings Auto Parts Inc (INRM00776), Metaldyne Sinterforged Products LLC (INRM01513), Novolex Co LLC (INRM00385), Ebbing Auto Parts (INRM01730), Martinrea Industries Inc. (INRM01269), North Vernon Industry Group (INRM01500), GT Industries, Inc. (INRM02268), and Pacific Ocean Corp. (INRM02738). There are no MS4 permits in the subwatershed. The majority of the subwatershed is rural, indicating many homes pump to on-site septic systems. Based on the septic suitability of the soil, the entire Vernon Fork Muscatatuck River watershed is very or somewhat limited. Maintenance and inspection of septic systems in the area are important to ensure proper function and capacity. The landscape in this subwatershed is relatively hilly and forested, with urban area centered in the northern portion and pockets of agricultural land throughout. In some areas of the subwatershed there are limited riparian buffers remaining along the streambanks, due to agricultural practices. With its hilly nature, the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

The majority of this subwatershed is not identified as having hydric soil types in riparian zones. Areas with hydric soils could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With 20 percent of the land used for hay/pasture, a small presence of pasture animals is expected. There are no permitted CFOs in this subwatershed.

There are four monitoring sites located in this subwatershed. Sites T19, T20, T21 and T22 are all located on Sixmile Creek (Figure 35: Sampling Stations in Sixmile Creek Subwatershed). In 2020 and 2021 this watershed was sampled 47 times between the four sites, resulting in all four sites failing the water quality standards for *E. coli*. The *E. coli* geomean for site T19 was 357.02 MPN with 6/10 samples in exceedance of the single sample max. Site T20 had a geomean of 484.04 with 10/10 samples in exceedance of the single sample max. Site T21 had a geomean of 186.89 with 4/10 samples in exceedance of the single sample max. Site T22 had a geomean of 1730.5, the highest geomean score in the study, with 10/10 samples in exceedance of the single sample max. Site T22 had a geomean of 1730.5, the highest geomean score in the study, with 10/10 samples in exceedance of the single sample max. Site T22 had a geomean of 1730.5, the highest geomean score in the study, with 10/10 samples in exceedance of the single sample max. Site T22 had a geomean of 1730.5, the highest geomean score in the study, with 10/10 samples in exceedance of the single sample max. Site T22 had a geomean of 1730.5, the highest geomean score in the study, with 10/10 samples in exceedance of the single sample max. The *E. coli* water quality samples from these sites used to calculate the geomeans were taken on the same day for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration, land application of waste, wildlife, and leaking and failing septic systems.

The fish community IBI score for site T19 was 46 (good) and the QHEI was 49 (poor). The macro community mIBI score was 44 (fair) and the QHEI was 44 (poor). The fish community IBI score for site T20 was 52 (good) and the QHEI was 62 (good). The macro community mIBI



score was 42 (fair) and the QHEI was 62 (good). The fish community IBI score for site T21 was 38 (fair) and the QHEI was 72 (good). The macro community mIBI score was 42 (fair) and the QHEI was 67 (good). The fish community IBI score for site T22 was 32 (poor) and the QHEI was 74 (good). The macro community mIBI score was 30 (poor) and the QHEI was 57 (good). Based on this data, site T22 will be impaired for biotic communities.

Dissolved oxygen (DO) was found to be below the water quality standard of 4.0 mg/L on two occasions at site T22, ranging from 2.63 - 3.24 mg/L. Based on this data, site T22 will be listed as impaired for dissolved oxygen.

Evaluation of total phosphorus (TP) monitoring data indicate a linkage between elevated phosphorus levels and biotic community and dissolved oxygen impairments in the Sixmile Creek subwatershed. Total phosphorus concentrations ranged from 0.06 mg/L to 0.5 mg/L across 21 sampling events within the subwatershed and exceeded the target value five times. Given that the target value for total phosphorus was violated at multiple sites in the subwatershed, it is believed that a combination of high TP and low physical flows are likely the linkages to the biotic communities and dissolved oxygen impairments. Therefore, a TMDL for total phosphorus was developed for this subwatershed.

There are approximately 57 miles of streams in the subwatershed. Based on IDEM data collected in 2020 and 2021, there will be 36 stream miles impaired for *E. coli*, 15 miles impaired for biological communities, and 14 miles impaired for dissolved oxygen. These stream reaches will be listed on the 2024 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, and TP TMDLs were developed to address all impaired biotic community and dissolved oxygen impairments. Table 38 provides a summary of the subwatershed, including listed stream reaches by AUID, drainage area, sampling sites, land use, and NPDES facilities, as well as LA, WLAs, and MOS values for *E. coli* and TP.

Load duration curves (Figure 36 and Figure 38), precipitation graphs (Figure 37 and Figure 39), and water quality duration graphs (Appendix F) were created to further analyze potential sources in the subwatershed. Evaluating these graphs, with consideration of the watershed characteristics, allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* and TP concentrations. Elevated levels of pollutants during rain events can indicate streams are susceptible to high loads due to run-off. Based on the load duration curves, it can be concluded that the sources of pollutants in this watershed are likely both nonpoint and possibly point sources. The *E. coli* load duration curve for these sites shows that streams are susceptible to high loadings during rainfall events, as well as during drier conditions. The TP graphs show high loadings during midrange flows and drier conditions. These indicate point sources may also be contributing pollutants in addition to nonpoint sources.

There is one WWTP that discharges within the subwatershed, Jennings Northwest Regional Utility. This facility has had numerous permit violations in the past five years due to Ammonia, as well as *E. coli* and TSS (Table 26: Municipal Wastewater Treatment Plant Facilities Discharging within the Vernon Fork Muscatatuck River Watershed). The facility does not currently treat for or



have a permit limit for total phosphorus. Site T21 is located on the same segment as the facility's outfall. Due to three TP exceedances on this segment during sampling, combined with the facility's history of compliance issues, it is recommended that a TP limit be added to the permit at the next renewal. Total phosphorus loadings from the Jennings Northwest Regional Utility were based upon using the design flow for the facility, with loadings at all flow regimes calculated based upon using a 1.0 mg/L TP concentration. Based upon past analysis of Indiana WWTP facilities with phosphorus treatment and a 1.0 mg/L limit, IDEM believes it is reasonable to expect that, following the issuance of and compliance with a 1.0 mg/L permit limit, the Jennings Northwest Regional Utility can achieve the total phosphorus WLA given to them in this TMDL. Additionally, IDEM believes that a 1.0 mg/L permit limit will result in the TP reductions necessary for meeting in-stream water quality targets.

However, the majority of sources of *E. coli* and TP in this subwatershed are likely nonpoint sources. These may include leaking and failing septic systems, wildlife, small animal operations, pasture animals with direct access to streams, land application of animal waste, straight pipes, streambank erosion, and agricultural practices. See Section 6.1 and Table 47 for information pertaining to potentially suitable BMP selection for the Vernon Fork Muscatatuck River watershed.

Sixmile Creek (051202070702)				
Drainage Area	31.0 square miles			
Surface Area	31.0 square miles			
Site # [IDEM Station ID]	T19 [WEM-07-0017], T20 [WEM-07-0018], T21 [WEM-07-0019], T22 [WEM-07-0020]			
Listed Segments [TMDL(s)]	INW0772_01A [<i>E. coli</i> & TP]; INW0772_03 [<i>E. coli</i> & TP]; INW0772_04 [<i>E. coli</i>]; INW0772_05 [<i>E. coli</i>]; INW0772_06 [<i>E. coli</i>]			
Listed Impairments [TMDL(s)]	E. coli [E. coli], Impaired Biotic Communities [TP], Dissolved Oxygen [TP]			
Land Use	Agricultural Land: 25% Forested Land: 40% Developed Land: 14% Open Water: 1% Pasture/Hay: 20% Grassland/Shrubs: <1% Wetland: <1%			
NPDES Facilities	Jennings Northwest Regional Utility (IN0056049), Hanson Aggregates Midwest- Hayden Quarry (ING490100), Ebbings Auto Parts Inc (INRM00776), Metaldyne Sinterforged Products, LLC (INRM01513), Novolex Co, LLC (Hilex Poly Co) (INRM00385), Ebbing Auto Parts (INRM01730), Martinrea Industries Inc (INRM01269), North Vernon Industry Group (INRM01500), GT Industries Inc (INRM02268), Pacific Ocean Corporation (INRM02738)			
CAFOs	NA			
CFOs	NA			

Table 38: Summary of Sixmile Creek Subwatershed Characteristics



	ТМ	DL <i>E. coli</i> Allocat	ions (MPN/day)		
Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%
LA	9.90E+11	2.12E+11	8.59E+10	3.95E+10	2.64E+10
WLA (Total)	3.13E+09	3.13E+09	3.13E+09	3.13E+09	3.13E+09
MOS (10%)	1.17E+11	2.53E+10	1.05E+10	5.02E+09	3.47E+09
Future Growth (5%)	5.84E+10	1.27E+10	5.24E+09	2.51E+09	1.73E+09
TMDL = LA+WLA+MOS	1.17E+12	2.53E+11	1.05E+11	5.02E+10	3.47E+10
WLA (Individual)					
Jennings Northwest Regional Utility (IN0056049)	3.13E+09	3.13E+09	3.13E+09	3.13E+09	3.13E+09
	TMDL T	otal Phosphorus	Allocations (lbs/	day)	
Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%
LA	276.62	57.68	22.11	9.07	5.36
WLA	2.94	2.94	2.94	2.94	2.94
MOS (10%)	32.89	7.13	2.95	1.41	0.98
Future Growth (5%)	16.44	3.57	1.47	0.71	0.49
TMDL = LA+WLA+MOS	328.89	71.32	29.47	14.13	9.76
WLA (Individual)					



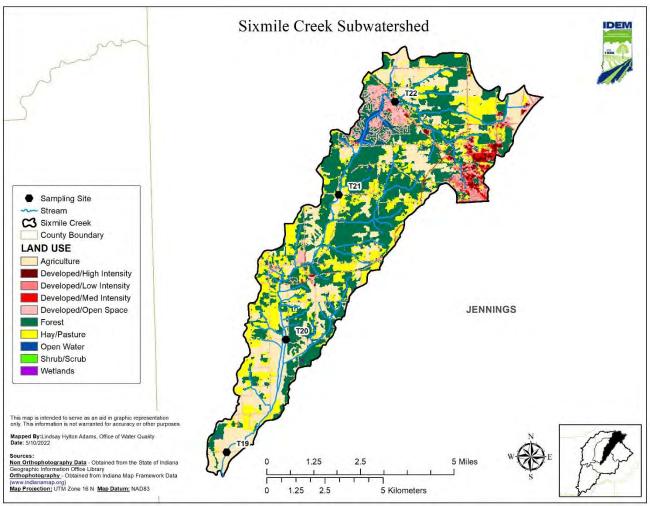


Figure 35: Sampling Stations in Sixmile Creek Subwatershed



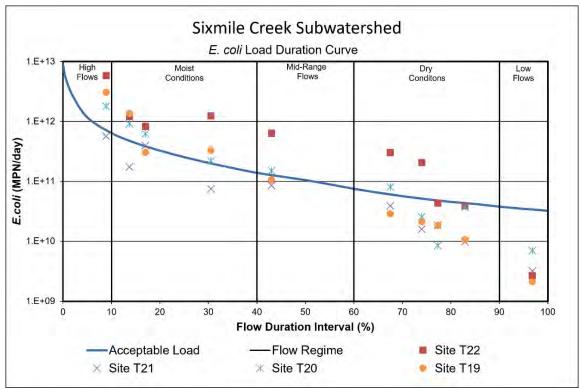


Figure 36: E. coli Load Duration Curve for Sixmile Creek Subwatershed

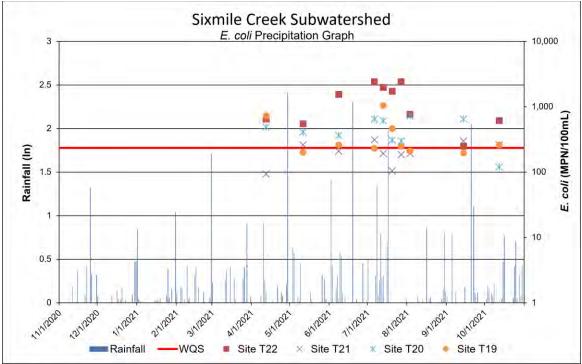


Figure 37: Graph of Precipitation and E. coli Data for Sixmile Creek Subwatershed



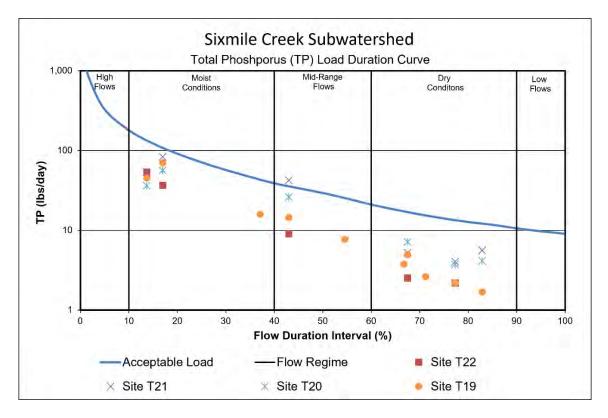


Figure 38: Total Phosphorus Load Duration Curve for Sixmile Creek Subwatershed

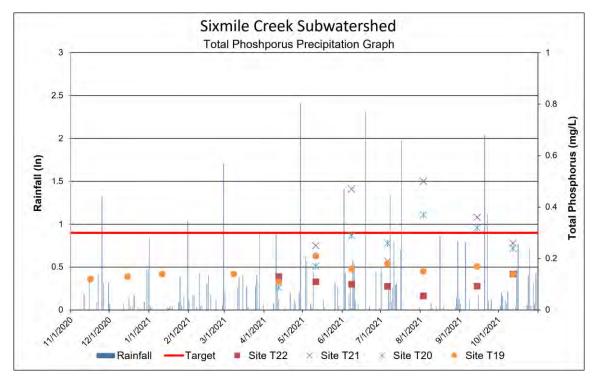


Figure 39: Graph of Precipitation and Total Phosphorus Data for Sixmile Creek Subwatershed



4.2.3 Storm Creek

The Storm Creek subwatershed drains approximately 23 square miles, with an actual land area of around 23 square miles. The subwatershed drains southwest into Mutton Creek in the Mutton Creek subwatershed. The land use is primarily forested (44 percent), followed by hay/pasture (25 percent) and agriculture (23 percent). There is one NPDES permitted facility in the subwatershed, which is River Metals Recycling (INRM02633). There are no MS4 permits in this subwatershed. The entire subwatershed is rural, indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, the entire Vernon Fork Muscatatuck River watershed is very or somewhat limited. Maintenance and inspection of septic systems in the area is important to ensure proper function and capacity. The landscape in this subwatershed is somewhat hilly and forested with agricultural land spread throughout. A large portion of the Muscatatuck National Wildlife Refuge is located in the southwest portion of the subwatershed, containing large amounts of forest, wetlands, and open water. In some areas of the subwatershed there are limited riparian buffers left along streambanks due to agricultural practices. With its hilly nature, the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

About half of this subwatershed is identified as having hydric soil types in riparian zones. Areas with hydric soils could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With 25 percent of the land used for hay/pasture, a moderate presence of pasture animals is expected. There are 3 permitted CFOs in this subwatershed.

There are three monitoring sites located in this subwatershed. Site T16 is located on Storm Creek Ditch, T17 is located on a tributary to Richart Lake, and T18 is located on Storm Creek (Figure 40). In 2020 and 2021, this watershed was sampled 35 times between the three sites resulting in two of the three sites failing the water quality standard for *E. coli*. The *E. coli* geomean for site T16 was 59.94 MPN with 1/10 samples in exceedance of the single sample max. Site T17 had a geomean of 602.45 with 8/9 samples in exceedance of the single sample max. Finally, site T18 had a geomean of 493.11 with 8/10 samples in exceedance of the single sample sample max. The *E. coli* water quality samples from sites T16, T17, and T18 used to calculate the geomeans were taken on the same day for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration, land application of waste, wildlife, and leaking and failing septic systems.

The fish community IBI score for site T16 was 32 (poor) and the QHEI was 46 (poor). The macro community mIBI score was 34 (poor) and the QHEI was 44 (poor). The fish community IBI score for site T17 was 20 (very poor) and the QHEI was 49 (poor). The macro community mIBI score was 32 (poor) and the QHEI was 56 (good). The fish community IBI score for site T18 was 42 (fair) and the QHEI was 61 (good). The macro community mIBI score was 38 (fair) and the QHEI was 53 (good). Based on this data, sites T16 and T17 will be impaired for biotic communities. However, the IBC impairment at site T16 was not determined to be pollutant-



driven due to the altered hydrology within the Muscatatuck National Wildlife Refuge, where the site is located, in addition to a log jam upstream of the site, which caused stagnation and wetland-like conditions.

Dissolved oxygen (DO) was found to be below the water quality standard of 4.0 mg/L on eight occasions at site T16 and on two occasions at site T17, ranging from 0.18 - 3.37 mg/L. Based on this data, both sites will be listed as impaired for dissolved oxygen. Again, given the characteristics described above at site T16, it was determined that stagnant flow in the system is likely contributing to the low DO levels found at the site.

TSS concentrations ranged from 2.2 mg/L to 240 mg/L across 24 sampling events within the subwatershed and exceeded the target value three times, all at sampling events that followed a heavy rain event. Given that the target value for TSS was violated following heavy precipitation throughout the subwatershed, a TSS TMDL was developed to address the dissolved oxygen and biotic communities impairments within the subwatershed.

Evaluation of total phosphorus monitoring data also indicate a linkage between elevated phosphorus levels and biotic communities and dissolved oxygen impairments in the Storm Creek subwatershed. Total phosphorus concentrations ranged from 0.062 mg/L to 0.7 mg/L across 24 sampling events within the subwatershed and exceeded the target value three times, again all following a heavy rain event. Given that the target value for total phosphorus was violated following heavy precipitation throughout the subwatershed, high total phosphorus is believed to be a potential linkage to the biotic communities and dissolved oxygen impairments, in addition to low physical flows. Therefore, a TMDL for total phosphorus was also developed for this subwatershed.

There are approximately 57 miles of streams in the subwatershed. Based on IDEM data collected in 2020 and 2021, there will be 28 stream miles impaired for *E. coli*, 9 miles impaired for biological communities, and 9 miles impaired for dissolved oxygen. These stream reaches will be listed on the 2024 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, and TSS and TP TMDLs were developed to address the biotic communities and dissolved oxygen impairments that are believed to be pollutant driven. Table 39 provides a summary of the subwatershed, including listed stream reaches by AUID, drainage area, sampling sites, land use, and NPDES facilities, as well as LA, WLAs, and MOS values for *E. coli*, TSS, and TP.

Load duration curves (Figure *41*, Figure *43*, Figure *45*), precipitation graphs (Figure 42, Figure 44, Figure 46), and water quality duration graphs (Appendix F) were created to further analyze potential sources in the subwatershed. Evaluating these graphs, with consideration of the watershed characteristics, allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli*, TSS, and TP concentrations. Elevated levels of pollutants during rain events can indicate streams are susceptible to high loads due to run-off. The *E. coli* graphs for these sites show that streams are susceptible to high loadings during rainfall events, as well as during dry conditions. The TSS graphs show high loadings only during high flows and



the TP graphs also show high loadings during high flow periods. There are no facilities in this watershed that discharge these pollutants. Therefore, the majority of sources of *E. coli*, TSS, and TP in this subwatershed are likely nonpoint sources, both rainfall-driven and not. These nonpoint sources may include small animal operations, wildlife, pasture animals with direct access to streams, land application of animal waste, straight pipes, streambank erosion, agricultural practices, and leaking and failing septic systems. See Section 6.1 and Table 47 for information pertaining to potentially suitable BMP selection for the Vernon Fork Muscatatuck River watershed.

Storm Creek (051202070703)						
Drainage Area			23.28 square mi	les		
Surface Area			23.28 square mi	les		
Site # [IDEM Station ID]	T1	6 [WEM080-0013]	, T17 [WEM080-0	005], T18 [WEM-07-	0014]	
Listed Segments [TMDL(s)]	INW0773_	_01 [<i>E. coli</i>]; INW0	773_02 [N/A]; INV	V0773_T1002 [<i>E. co</i> .	<i>li,</i> TP & TSS]	
Listed Impairments [TMDL(s)]	E. coli [E. coli]	, Impaired Biotic C	ommunities [TP &	TSS], Dissolved Ox	ygen [TP & TSS]	
Land Use	Agricultural L			veloped Land: 5% C bs: <1% Wetland: 19		
NPDES Facilities		River Metals Recycling (INRM02633)				
CAFOs	NA					
CFOs	Rose Acre Farms Inc. Spencer Breeder Farm (Farm ID: 6708), Rose Acre Farms Inc Woodacres Farm (Farm ID: 1207), Rose Acres Farms Inc Storm Creek Breeder Farm (Farm ID: 3571)					
	тм	DL <i>E. coli</i> Allocat	tions (MPN/day)			
Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%	
LA	7.26E+11	1.42E+11	4.69E+10	1.21E+10	2.16E+09	
WLA (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
MOS (10%)	8.54E+10	1.67E+10	5.51E+09	1.42E+09	2.55E+08	
Future Growth (5%)	4.27E+10	8.34E+09	2.76E+09	7.10E+08	1.27E+08	
TMDL = LA+WLA+MOS	8.54E+11	1.67E+11	5.51E+10	1.42E+10	2.55E+09	
			l			

Table 39: Summary of Storm Creek Subwatershed Characteristics



	IMDL Iotal	Suspended Soli	ds Allocations (I	bs/day)	
Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%
LA	20,423.78	3,988.58	1,318.69	339.58	60.91
WLA	7.47	1.46	0.00	0.00	0.00
MOS (10%)	2,403.68	469.42	155.14	39.95	7.17
Future Growth (5%)	1,201.84	234.71	77.57	19.98	3.58
TMDL = LA+WLA+MOS	24,036.76	4,694.16	1,551.40	399.50	71.65
WLA Individual					
Industrial Stormwater	7.47	1.46	0.00	0.00	0.00

TMDL Total Phosphorus Allocations (lbs/day)						
Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%	
LA	204.31	39.90	13.19	3.40	0.61	
WLA	0.00	0.00	0.00	0.00	0.00	
MOS (10%)	24.04	4.69	1.55	0.40	0.07	
Future Growth (5%)	12.02	2.35	0.78	0.20	0.04	
TMDL = LA+WLA+MOS	240.37	46.94	15.51	4.00	0.72	



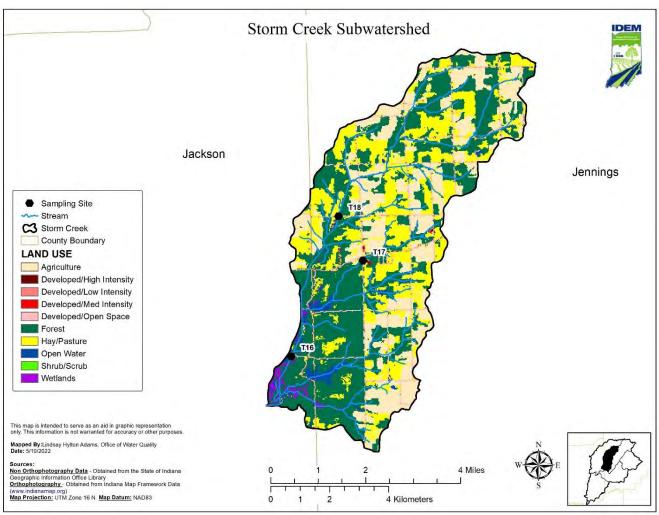


Figure 40: Sampling Stations in Storm Creek Subwatershed



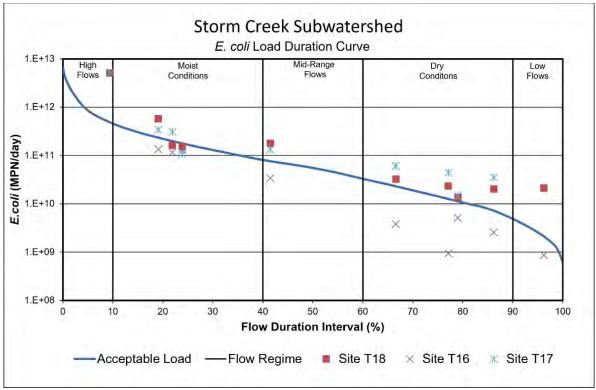


Figure 41: E. coli Load Duration Curve for Storm Creek Subwatershed

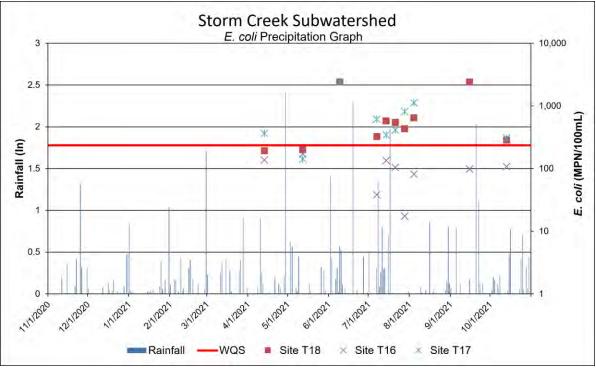
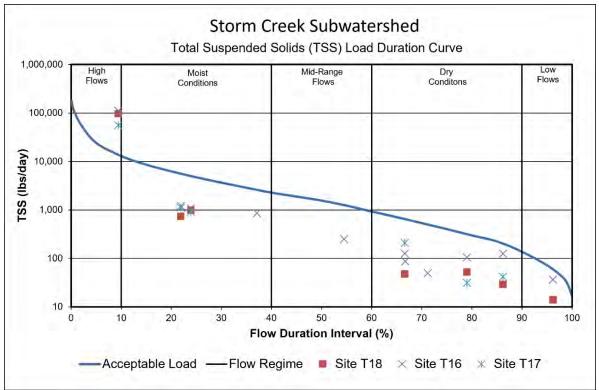
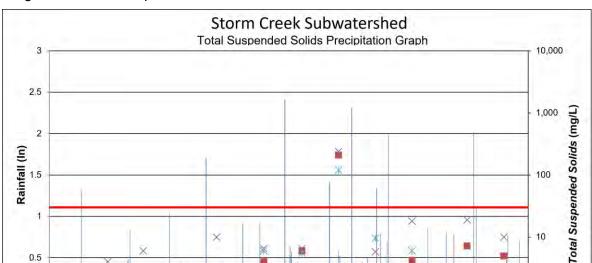


Figure 42: Graph of Precipitation and E. coli Data at Storm Creek Subwatershed







×

411/2021

Target

3112021

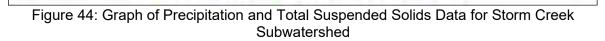
211/2021

Rainfall

11/2021

10

Figure 43: Total Suspended Solids Load Duration Curve for Storm Creek Subwatershed



Site T18

511/2021

6112021

11/12021

× Site T16

811/2021

011/2021

* Site T17

101/2021



0.5

0

11112020

121/2020

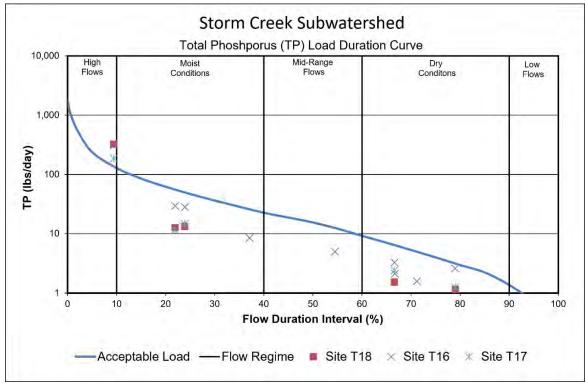


Figure 45: Total Phosphorus Load Duration Curve for Storm Creek Subwatershed

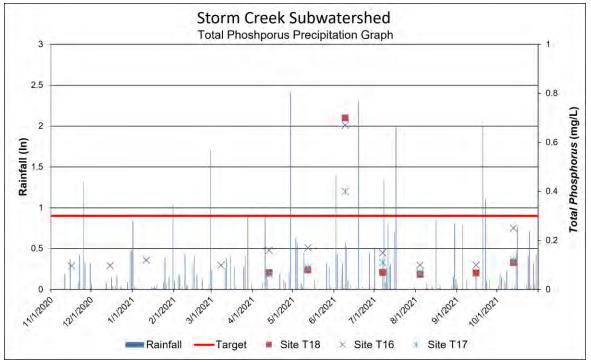


Figure 46 :Graph of Precipitation and Total Phosphorus Data for Storm Creek Subwatershed



4.2.4 Mutton Creek

The Mutton Creek subwatershed drains approximately 70 square miles, with an actual land area of around 47 square miles. The subwatershed drains southward into the Vernon Fork Muscatatuck River in the Grassy Creek subwatershed. The land use is primarily forested (31 percent), followed by agriculture (29 percent) and hay/pasture (23 percent). There are nine NPDES permitted facilities in the subwatershed, including HWRT Terminal Seymour, LLC (ING340019), Aisin USA Manufacturing Inc. (INRM02340 & INRM00879), Irving Materials Inc. (INRM02561), The Andersons Inc. (INRM02560), Seymour Tubing Inc. (INRM00375), Cummins Inc. Seymour Engine Plant (INRM00922), Cummins Inc. Seymour HHP Block Line Facility (INRM01872), Jackson Co. Transfer & Recycling Station (INRM01239). There is one MS4 permit in this subwatershed, which is for the City of Seymour (INR040082). Just under half of the subwatershed is rural, indicating many homes pump to on-site septic systems. Based on the septic suitability of the soil, the entire Vernon Fork Muscatatuck River watershed is very or somewhat limited. Maintenance and inspections of septic systems in the area are important to ensure proper function and capacity. The landscape in this subwatershed is relatively hilly, with nearly equal amounts of forested, hay/pasture, and agricultural land. The urban area is centered in the southwest portion. The southeast portion of the subwatershed contains the western half of the Muscatatuck National Wildlife Refuge, containing large areas of wetland and forest. In parts of the subwatershed, there are limited remaining riparian buffers left along stream banks, due to agricultural practices. The subwatershed does contain a fair amount of highly erodible soil types, which can be susceptible to sheet, rill, and isolated gully erosion, and can contribute to sediment loss from agricultural lands, as well as lands from the high gradient slopes.

About half of this subwatershed is identified as having hydric soil types in riparian zones. Areas with hydric soils could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With 23 percent of the land used for hay/pasture, a moderate presence of pasture animals is expected. There are no permitted CFOs in this subwatershed.

There are five monitoring sites located in this subwatershed. Site T11 is located on Sandy Branch, T12 is on Mutton Creek Ditch, T13 is on a tributary of Mutton Creek, and T14 and T15 are both located on Mutton Creek (Figure 47). In 2020 and 2021 this watershed was sampled 50 times between the five sites, resulting in all five sites failing the water quality standards for *E. coli*. The *E. coli* geomean for site T11 was 435.7 MPN with 7/10 samples in exceedance of the single sample max. Site T12 had a geomean of 166.4 with 5/10 samples in exceedance of the single sample max. Site T13 had a geomean of 460.2 with 7/10 samples in exceedance of the single sample max. Site T14 had a geomean of 1131.04 with 9/10 samples in exceedance of the single sample max. Lastly, site T15 had a geomean of 505.48 with 9/10 samples in exceedance of the single sample max. The *E. coli* water quality samples from these sites used to calculate the geomeans were taken on the same day for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration, land application of waste, wildlife, and leaking and failing septic systems.



Site T11 was not sampled for biology due to the presence of a beaver dam. The fish community IBI score for site T12 was 38 (fair) and the QHEI was 47 (poor). The macroinvertebrate community mIBI score was 36 (fair) and the QHEI was 49 (poor). The fish community IBI score for site T13 was 40 (fair) and the QHEI was 65 (good). The macroinvertebrate community mIBI score was 40 (fair) and the QHEI was 48 (poor). The fish community IBI score for site T14 was 40 (fair) and the QHEI was 61 (good). The macroinvertebrate community mIBI score was 40 (fair) and the QHEI was 61 (good). The macroinvertebrate community mIBI score was 40 (fair) and the QHEI was 52 (good). The fish community IBI score for site T15 was 36 (fair) and the QHEI was 52 (good). The fish community mIBI score was 42 (fair) and the QHEI was 53 (good). The macroinvertebrate community mIBI score was 42 (fair) and the QHEI was 53 (good). Based on this data, no sites would be impaired for biotic communities. However, site T11 has an existing biotic communities impairment that will continue since the site was not able to be sampled for biology.

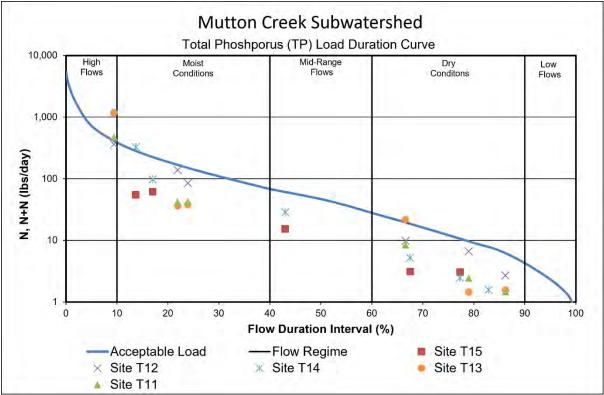
Dissolved oxygen (DO) was found to be below the water quality standard of 4.0 mg/L on six occasions at site T12, ranging from 0.46 - 3.25 mg/L. Based on this data, this site will be listed as impaired for dissolved oxygen. However, the DO impairment at T12 was not determined to be pollutant-driven due to the altered hydrology within the Muscatatuck National Wildlife Refuge, where the site is located, which caused stagnation and wetland-like conditions at the site.

TSS concentrations ranged from 2.4 mg/L to 290 mg/L across 35 sampling events within the subwatershed and exceeded the target value three times, all at sampling events that followed a heavy rain event. Given that the target value for TSS was violated following heavy precipitation throughout the subwatershed, a TSS TMDL was developed to address the biotic communities and existing dissolved oxygen impairment within the subwatershed.

Evaluation of total phosphorus monitoring data also indicate a linkage between elevated phosphorus levels and biotic communities and dissolved oxygen impairments in the Mutton Creek subwatershed. Total phosphorus concentrations ranged from 0.025 mg/L to 0.85 mg/L across 35 sampling events within the subwatershed and exceeded the target value on four occasions. Given that the target value for total phosphorus was violated throughout the subwatershed, a combination of high total phosphorus and low physical flows is believed to be a potential linkage to the biotic communities and dissolved oxygen impairments. Therefore, a TMDL for total phosphorus was also developed for this subwatershed.

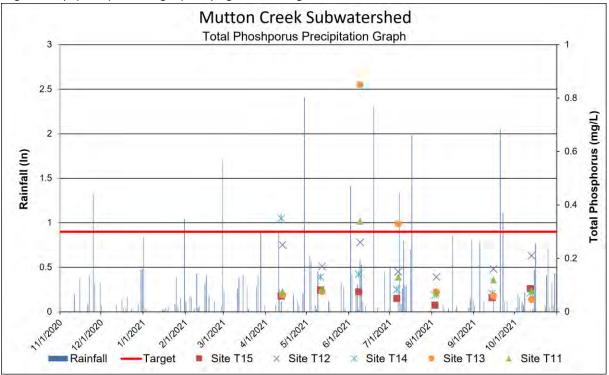
There are approximately 84 miles of stream in the subwatershed. Based on IDEM data collected in 2020 and 2021, there will be 71 stream miles impaired for *E. coli*, 13 miles impaired for biological communities, and 23 miles impaired for dissolved oxygen. These stream reaches will be listed on the 2024 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments, and TSS and TP TMDLs were developed to address all impaired biotic communities and DO impairments that are believed to be pollutant driven. Table 40 provides a summary of the Mutton Creek subwatershed, including listed stream reaches by AUID, drainage area, sampling sites, land use, and NPDES facilities, as well as LA, WLAs, and MOS values for *E. coli*, TSS, and TP.

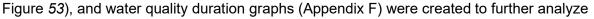




Load duration curves (Figure 48, Figure 50,









potential sources in the subwatershed. Evaluating these graphs, with consideration of the watershed characteristics, allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli*, TSS, and TP concentrations. Elevated levels of pollutants during rain events can indicate streams are susceptible to high loads due to run-off. The *E. coli* graphs for these sites show that streams are consistently susceptible to high loadings during high flows to dry conditions. The TSS graphs show high loadings only during high flows. TP graphs show high loadings during high flow periods as well as during drier conditions. Based on this information, the majority of sources of *E. coli*, TSS, and TP in this subwatershed are likely nonpoint sources, both rainfall-driven and not. These nonpoint sources may include leaking and failing septic systems, urban runoff, agricultural practices, small animal operations, wildlife, pasture animals with direct access to streams, land application of animal waste, straight pipes, and streambank erosion. See Section 6.1 and Table 47 for information pertaining to potentially suitable BMP selection for the Vernon Fork Muscatatuck River watershed.

Table 40: Summary of Mutton Creek Subwatershed Characteristics



	Mutto	on Creek (051202070704)				
Drainage Area	70.06 square miles						
Surface Area	46.78 square miles						
Site # [IDEM Station ID]	T11 [WEM080-0015], T12 [WEM080-0014], T13 [WEM-07-0016], T14 [WEM080-0027], T15 [WEM080-0025]						
Listed Segments [TMDL(s)]	INW0774_01 [<i>E. coli</i>]; INW0774_02 [<i>E. coli</i>]; INW0774_03 [<i>E. coli</i> , TP & TSS]; INW0774_T1002 [<i>E. coli</i>]; INW0774_T1003 [<i>E. coli</i>]; INW0774_T1005 [<i>E. coli</i> , TP & TSS]						
Listed Impairments [TMDL(s)]	<i>E. coli</i> [<i>E. coli</i>], Impaired Biotic Communities [TSS & TP], Dissolved Oxygen [TSS & TP]						
Land Use	Agricultural Land: 29% Forested Land: 31% Developed Land: 13% Open Water: 1% Pasture/Hay: 23% Grassland/Shrubs: <1% Wetland: 2%						
NPDES Facilities	City of Seymour MS4 (INR040082), HWRT Terminal Seymour, LLC (ING340019), Aisin USA Manufacturing Inc (INRM02340), Aisin USA Manufacturing Inc (INRM00879), Irving Materials Inc (INRM02561), The Andersons Inc (INRM02560), Seymour Tubing Inc (INRM00375), Cummins Inc- Seymour Engine Plant (INRM00922), Cummins Inc Seymour HHP Block Line Facility (INRM01872), Jackson County Transfer & Recycling Station (INRM01239)						
CAFOs	NA						
CFOs	NA						
	TMDL E	. coli Allocations (MPN/o	lay)				
Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%		
LA	1.37E+12	2.68E+11	9.47E+10	2.48E+10	4.89E+09		
WLA (Total)	9.16E+10	1.79E+10	0.00E+00	0.00E+00	0.00E+00		
MOS (10%)	1.72E+11	3.36E+10	1.11E+10	2.92E+09	5.76E+08		
Future Growth (5%)	8.58E+10	1.68E+10	5.57E+09	1.46E+09	2.88E+08		
Upstream Drainage Input (Storm Creek)	8.54E+11	1.67E+11	5.51E+10	1.42E+10	2.55E+09		
	8.54E+11 2.57E+12	1.67E+11 5.03E+11	5.51E+10 1.67E+11	1.42E+10 4.34E+10	2.55E+09 8.30E+09		
Input (Storm Creek) TMDL =							

TMDL Total Suspended Solids Allocations (lbs/day)



Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%
LA	37,954.70	7,403.49	2,638.13	670.65	110.67
WLA	3,116.19	629.61	27.03	27.03	27.03
MOS (10%)	4,831.87	945.07	313.55	82.08	16.20
Future Growth (5%)	2,415.94	472.54	156.77	41.04	8.10
Upstream Drainage Input (Storm Creek)	24,036.76	4,694.16	1,551.40	399.50	71.65
TMDL = LA+WLA+MOS	72,355.47	14,144.86	4,686.89	1,220.31	233.66
WLA (Individual)					
HWRT Terminal Seymour LLC (IN340019)	27.03	27.03	27.03	27.03	27.03
City of Seymour MS4 (INR040082)	2,576.15	502.51	0.00	0.00	0.00
Construction Stormwater	331.95	64.75	0.00	0.00	0.00
Industrial Stormwater	181.06	35.32	0.00	0.00	0.00

TMDL Total Phosphorus Allocations (lbs/day)

Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%		
LA	384.93	75.29	26.65	6.98	1.38		
WLA	25.78	5.04	0.00	0.00	0.00		
MOS (10%)	48.32	9.45	3.14	0.82	0.16		
Future Growth (5%)	24.16	4.73	1.57	0.41	0.08		
Upstream Drainage Input (Storm Creek)	240.37	46.94	15.51	4.00	0.72		
TMDL = LA+WLA+MOS	723.55	141.45	46.87	12.20	2.34		
WLA (Individual)							
City of Seymour MS4 (INR040082)	25.78	5.04	0.00	0.00	0.00		



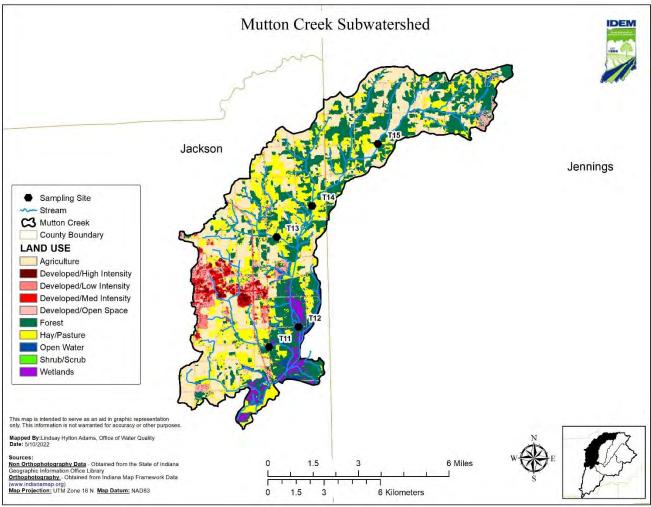


Figure 47: Sampling Stations in Mutton Creek Subwatershed



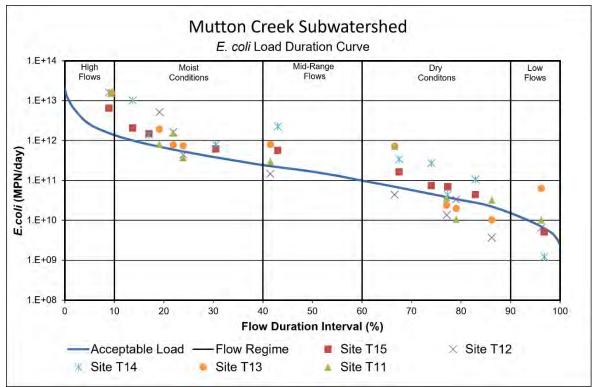


Figure 48: E. coli Load Duration Curve for Mutton Creek Subwatershed

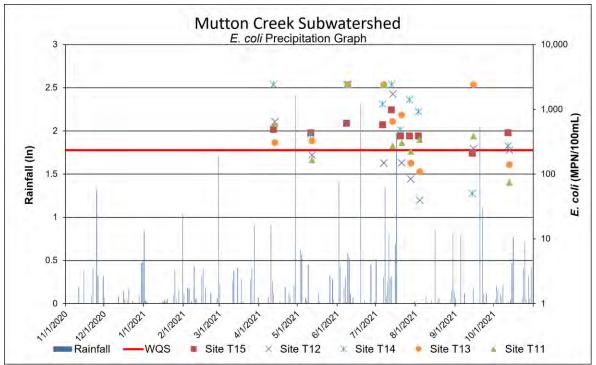


Figure 49: Graph of Precipitation and E. coli Data for Mutton Creek Subwatershed



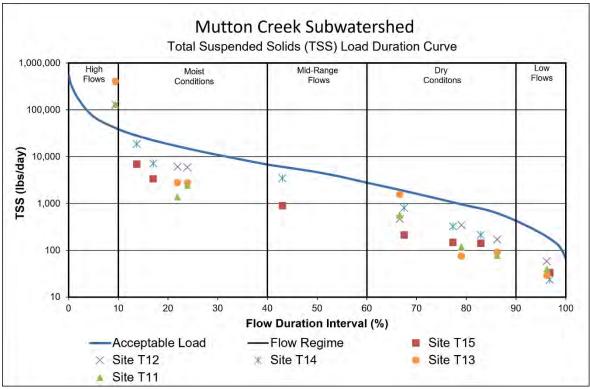


Figure 50: Total Suspended Solids Load Duration Curve for Mutton Creek Subwatershed

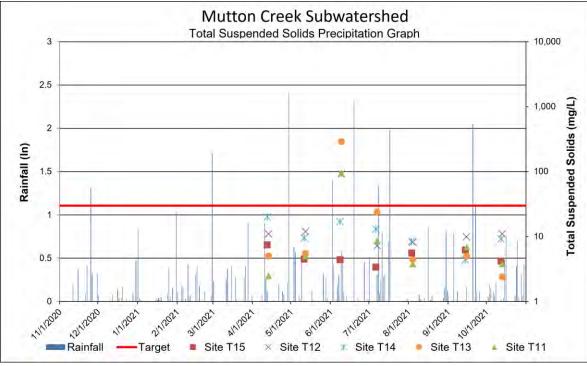


Figure 51: Graph of Precipitation and Total Suspended Solids Data for Mutton Creek Subwatershed



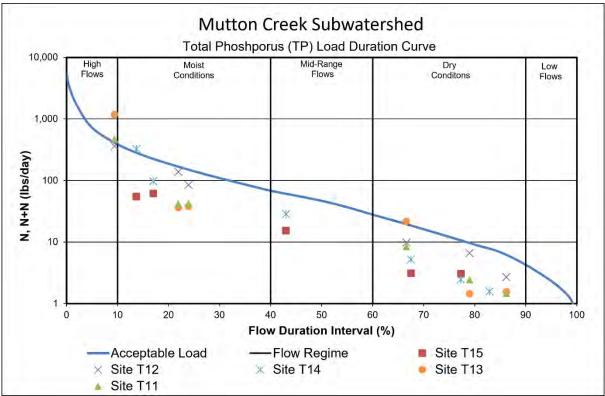


Figure 52: Total Phosphorus Load Duration Curve for Mutton Creek Subwatershed

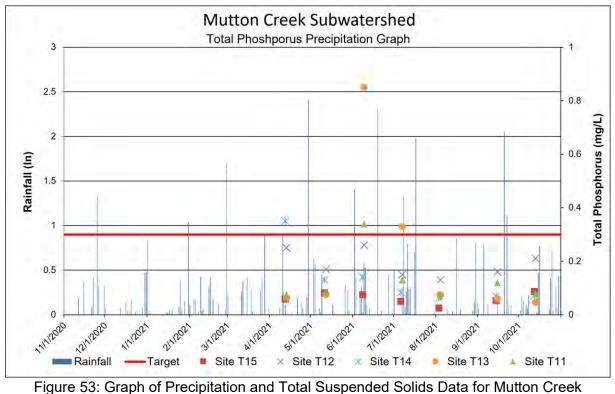


Figure 53: Graph of Precipitation and Total Suspended Solids Data for Mutton Creek Subwatershed



4.2.5 Polly Branch

The Polly Branch subwatershed drains approximately 293 square miles, with an actual land area of about 36 square miles. The subwatershed drains southwestward into the Vernon Fork Muscatatuck River in the Grassy Creek subwatershed. The land use is primarily forest (46 percent), followed by hay/pasture (25 percent) and agriculture (23 percent). There are no NPDES permitted facilities or MS4 permits in the subwatershed. The entire subwatershed is rural, indicating homes pump to on-site septic systems. Based on the septic suitability of the soil, the entire Vernon Fork Muscatatuck River watershed is very or somewhat limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in the area is relatively hilly and forested, with large pockets of hay/pasture and agricultural land spread throughout. The southwest portion contains the southern boundary of the Muscatatuck National Wildlife Refuge, with large amounts of forest and wetlands. In some areas of the subwatershed, there are limited riparian buffers left along the streambanks due to agricultural practices. With its hilly nature, the subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion and can contribute to sediment loss from agricultural lands, as well as lands from high gradient slopes.

About half of this subwatershed is identified as having hydric soil types in riparian zones. Areas with hydric soils could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With 25 percent of the land used for hay/pasture, a moderate presence of pasture animals is expected. There are no permitted CFOs in this subwatershed.

There are four monitoring sites located in this subwatershed. Sites T06 and T07 are located on Tea Creek. Sites T08 and T09 are located on the Vernon Fork Muscatatuck River (



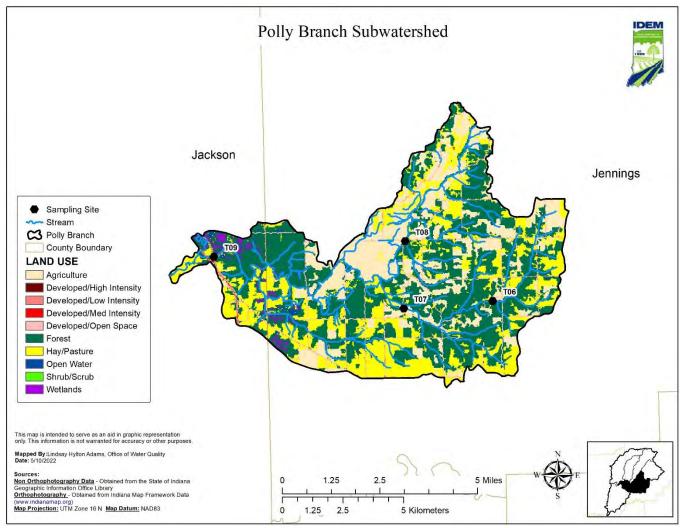


Figure *54*). In 2020 and 2021 this watershed was sampled 43 times between the four sites, resulting in three of the four sites failing the water quality standards for *E. coli*. The *E. coli* geomean for site T06 was 560.57 MPN with 8/10 samples in exceedance of the single sample max. Site T07 had a geomean of 581.59 with 8/10 samples in exceedance of the single sample max. Site T08 had a geomean of 235.5 with 4/10 samples in exceedance of the single sample max. Site T09 had a geomean of 83.77 with 4/10 samples in exceedance of the single sample max. The *E. coli* water quality samples from these sites used to calculate the geomeans were taken on the same day for five consecutive weeks. High *E. coli* levels are reflective of high animal concentration, land application of waste, wildlife, and leaking and failing septic systems.

The fish community IBI score for site T06 was 32 (poor) and the QHEI was 62 (good). The macroinvertebrate community mIBI score was 38 (fair) and the QHEI was 57 (good). The fish community IBI score for site T07 was 38 (fair) and the QHEI was 49 (poor). The macroinvertebrate community mIBI score was 42 (fair) and the QHEI was 46 (poor). The fish community IBI score for site T08 was 48 (good) and the QHEI was 62 (good). The macroinvertebrate community mIBI score was 40 (fair) and the QHEI was 62 (good). The fish community IBI score for site T08 was 48 (good) and the QHEI was 62 (good). The



community IBI score for site T09 was 52 (good) and the QHEI was 70 (good). The macroinvertebrate community mIBI score was 42 (fair) and the QHEI was 74 (good). Based on this data, site T06 will be impaired for biotic communities.

Evaluation of total phosphorus monitoring data indicate a linkage between elevated phosphorus levels and the biotic communities impairment in the Polly Branch subwatershed. Total phosphorus concentrations ranged from 0.034 mg/L to 0.9 mg/L across 35 sampling events within the subwatershed and exceeded the target value four times. Dissolved oxygen was only found to be below the water quality standard on one occasion, at site T07. Given that the target value for total phosphorus was violated throughout the subwatershed, high total phosphorus is believed to be a potential linkage to the biotic communities impairment. Therefore, a TMDL for total phosphorus was also developed for this subwatershed.

There are approximately 91 miles of streams in the subwatershed. Based on IDEM data collected in 2020 and 2021, there will be 44 stream miles impaired for *E. coli* and 26 miles impaired for biological communities. These stream reaches will be listed on the 2024 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments and TP TMDLs were developed to address all impaired biotic communities. Table 41 provides a summary of the Polly Branch subwatershed, including listed stream reaches by AUID, drainage area, sampling sites, land use, and NPDES facilities, as well as LA, WLAs, and MOS values for *E. coli* and TP.

Load duration curves (Figure 55 and Figure 57), precipitation graphs (Figure 56 and Figure 58), and water quality duration graphs (Appendix F) were created to further analyze potential sources in the subwatershed. Evaluating these graphs, with consideration of the watershed characteristics, allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* and TP concentrations. Elevated levels of pollutants during rain events can indicate streams are susceptible to high loads due to run-off. The *E. coli* graphs for these sites show that streams are consistently susceptible to high loadings, during rainfall events, as well as during dry conditions. The TP graphs show high loadings primarily during moist conditions. Since there are no facilities in this watershed that discharge these pollutants, the majority of sources of *E. coli* and TP in this subwatershed are likely nonpoint sources, both rainfall-driven and not. These nonpoint sources may include leaking and failing septic systems, agricultural practices, small animal operations, wildlife, pasture animals with direct access to streams, land application of animal waste, straight pipes, and streambank erosion. See Section 6.1 and Table 47 for information pertaining to potentially suitable BMP selection for the Vernon Fork Muscatatuck River watershed.



		Polly Branch (05 [,]	1202070705)										
Drainage Area		· •	292.66 square m	niles									
Surface Area			36.14 square m										
Site # [IDEM Station ID]	T06 [WEM-07	T06 [WEM-07-0021], T07 [WEM070-0029], T08 [WEM070-0039], T09 [WEM070-0020]											
Listed Segments [TMDL(s)]	INW0775_01 [<i>E. coli</i>]; INW0775_T1003 [<i>E. coli</i> & TP]												
Listed Impairments [TMDL(s)]		E. coli [E. coli], Impaired Biotic Communities, [TP]											
Land Use	Agricultural Land: 23% Forested Land: 46% Developed Land: 4% Open Water: 1% Pasture/Hay: 25% Grassland/Shrubs: <1% Wetland: 1%												
NPDES Facilities	NA												
CAFOs		NA											
CFOs			NA										
TMDL <i>E. coli</i> Allocations (MPN/day)													
Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	tions Flows Dry Condition		Low Flows 95%								
LA	1.13E+12	2.20E+11	7.28E+10	1.87E+10	3.36E+09								
WLA (Total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
MOS (10%)	1.33E+11	2.59E+10	8.56E+09	2.21E+09	3.95E+08								
Future Growth (5%)	6.63E+10	1.30E+10	4.28E+09	1.10E+09	1.98E+08								
Upstream Drainage Input (Indian Creek & Sixmile Creek)	9.44E+12	1.87E+12	6.39E+11	1.88E+11	5.94E+10								
TMDL = LA+WLA+MOS	1.08E+13	2.13E+12	7.24E+11	2.10E+11	6.33E+10								
	TN	IDL Total Phosph	norus (Ibs/day)										
Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%								
LA	317.35	61.98	20.48	5.27	0.95								
WLA	0.00	0.00	0.00	0.00	0.00								
MOS (10%)	37.34	7.29	2.41	0.62	0.11								
Future Growth (5%)	18.67	3.65	1.20	0.31	0.06								
Upstream Drainage Input (Indian Creek & Sixmile Creek)	2,657.19	526.02	179.75	52.83	16.71								
TMDL = LA+WLA+MOS	3,030.55	598.93	203.84	59.03	17.82								

Table 41: Summary of Polly Branch Subwatershed Characteristics



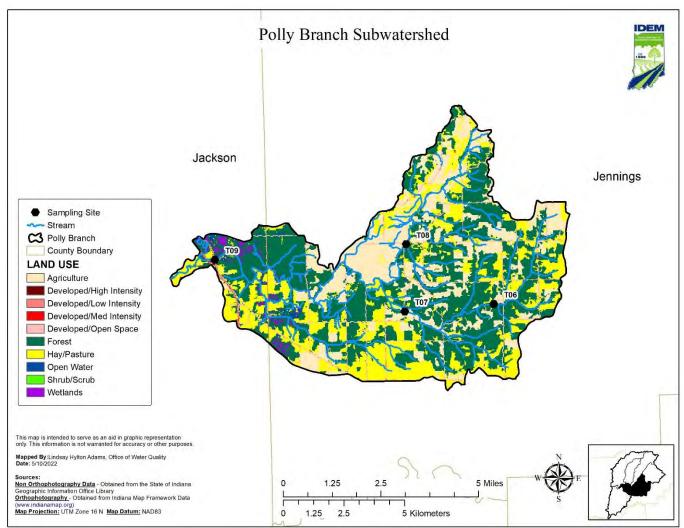


Figure 54: Sampling Stations in Polly Branch Subwatershed



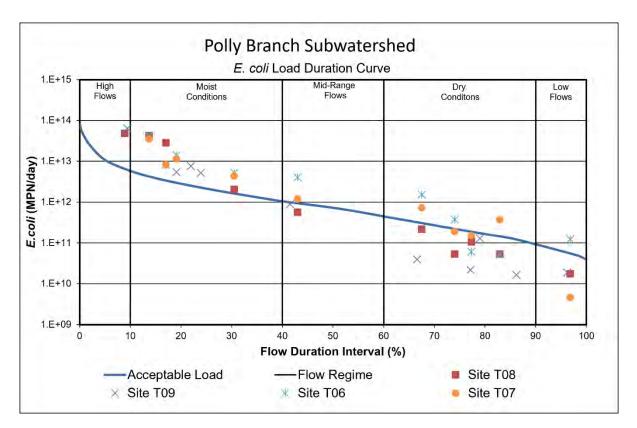


Figure 55: E. coli Load Duration Curve for Polly Branch Subwatershed

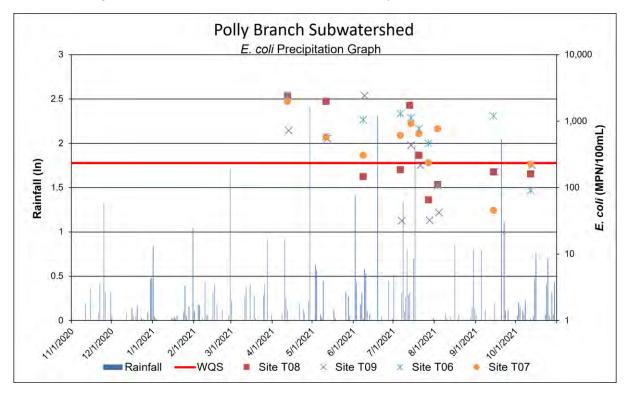


Figure 56: Graph of Precipitation and E. coli Data for Polly Branch Subwatershed



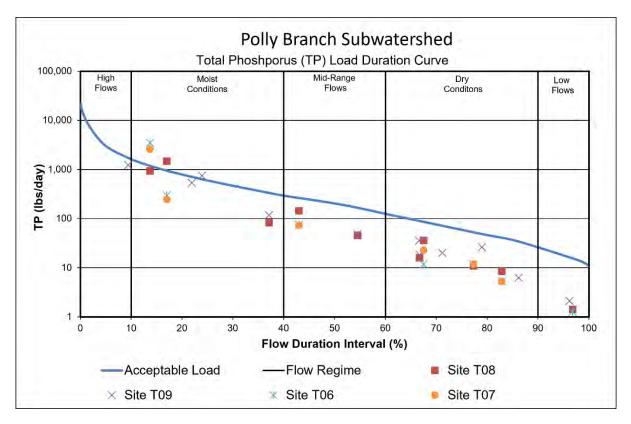


Figure 57: Total Phosphorus Load Duration Curve for Polly Branch Subwatershed

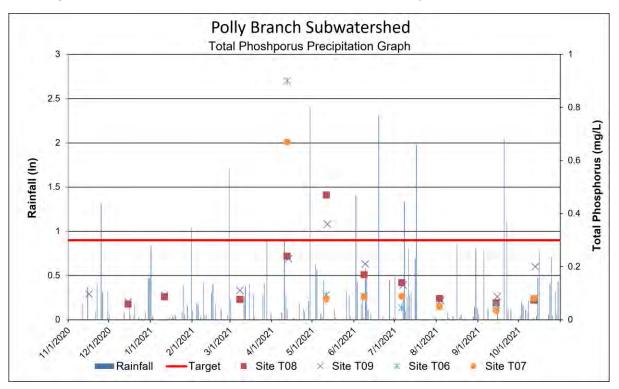


Figure 58: Graph of Precipitation and Total Phosphorus Data for Polly Branch Subwatershed



4.2.6 Grassy Creek

The Grassy Creek subwatershed drains approximately 412 square miles, with an actual land area of about 46 square miles. This subwatershed is the pour point for the watershed and drains southward into the Muscatatuck River, which continues to flow westward until its confluence with the East Fork White River. The land use is primarily hay/pasture (35 percent), followed by agriculture (28 percent) and forested land (24 percent). There are four NPDES permitted facilities in the subwatershed, including the Town of Crothersville WWTP (IN0022683). Marmon Retail Home Improvement Products (INRM01761), Aisin Chemical Indiana LLC (INRM00368), and Aisin Drivetrain Inc. (INRM00890). There are no MS4 permits in the subwatershed. Over half of the subwatershed is rural, indicating many homes pump to on-site septic systems. Based on the septic suitability of the soil, the entire Vernon Fork Muscatatuck River watershed is very or somewhat limited. Maintenance and inspections of septic systems in the area is important to ensure proper function and capacity. The landscape in this subwatershed is somewhat hilly and forested, with the majority being in hay/pasture or agricultural land. The small amount of urban area is centered in the southeastern portion of the subwatershed. There are pockets of wetland area spread throughout. In some parts of the subwatershed there are limited riparian buffers left along the stream banks due to agricultural practices. The subwatershed does contain significant amounts of highly erodible soil types. These soil types can be susceptible to sheet, rill, and isolated gully erosion, and can contribute to sediment loss from agricultural lands, as well as lands from the high gradient slopes.

Over half of this subwatershed is identified as having hydric soil types in riparian zones. Areas with hydric soils could be potential locations for wetland restoration or high functioning two-stage ditch implementation. With 35 percent of the land used for hay/pasture, a moderate presence of pasture animals is expected. There are 3 permitted CFOs in this subwatershed.

There are five monitoring sites located in this subwatershed. Site T01 is located on Rider Ditch, T02 is on Grassy Creek, T03 is on the Vernon Fork Muscatatuck River, T05 is on John McDonald Ditch, and site T10 is located on the Vernon Fork Muscatatuck River (Figure 59). In 2020 and 2021 this watershed was sampled 41 times between the five sites, resulting in three of the five sites failing the water quality standard for *E. coli*. However, one of those sites, site T03, continually exhibited a lack of flow and oxbow-like conditions throughout the duration of the study period. IDEM used best professional judgement to determine that this segment is no longer behaving as a stream and that assessing it as such would be misrepresentative of conditions that should be expected at the site. Therefore, the data from site T03 was not assessed nor incorporated into this report. The E. coli geomean for site T01 was 107.48 MPN with 4/10 samples in exceedance of the single sample max. Site T02 had a geomean of 244.37 with 5/10 samples in exceedance of the single sample max. Site T05 had a geomean of 220.36 with 7/10 samples in exceedance of the single sample max. Site T10 had a geomean of 96.69 with 5/10 samples in exceedance of the single sample max. The E. coli water quality samples from these sites used to calculate the geomeans were taken on the same day for five consecutive weeks. High E. coli levels are reflective of high animal concentration, land application of waste, wildlife, and leaking and failing septic systems.



The fish community IBI score for site T01 was 50 (good) and the QHEI was 55 (good). The macroinvertebrate community mIBI score was 38 (fair) and the QHEI was 43 (poor). The fish community IBI score for site T02 was 38 (fair) and the QHEI was 51 (good). The macroinvertebrate community mIBI score was 32 (poor) and the QHEI was 46 (poor). The fish community IBI score for site T05 was 28 (poor) and the QHEI was 29 (poor). The macroinvertebrate community mIBI score was 34 (poor) and the QHEI was 42 (poor). The fish community IBI score for site T10 was 46 (good) and the QHEI was 57 (good). The macroinvertebrate community mIBI score was 34 (poor) and the QHEI was 42 (poor). The fish community IBI score for site T10 was 46 (good) and the QHEI was 57 (good). The macroinvertebrate community mIBI score was 44 (fair) and the QHEI was 42 (poor). Based on this data, sites T02 and T05 will be impaired for biotic communities. However, the IBC impairment at site T05 was not determined to be pollutant-driven due to the recurring stagnation, low flow, and wetland-like conditions at the site. The impairment is likely habitat and flow-driven.

Dissolved oxygen (DO) was found to be below the water quality standard of 4.0 mg/L on five occasions at site T05, ranging from 1.56 - 3.53 mg/L. However, given the characteristics of the stream described above, it is again likely that the DO impairment is flow-driven. At site T02, DO was low, in the range of 4.0 - 5.0 mg/L, on five occasions throughout sampling.

Evaluation of total phosphorus monitoring data indicate a linkage between elevated phosphorus levels and biotic communities in the Grassy Creek subwatershed. Total phosphorus concentrations ranged from 0.044 mg/L to 2.9 mg/L across 36 sampling events within the subwatershed and exceeded the target value 9 times. While TSS exceeded the target value on occasion throughout the subwatershed, exceedances were minimal at the sites with impaired biotic communities. Given that the target value for total phosphorus was violated throughout the subwatershed, with very high concentrations at site T02, high total phosphorus is believed to be a potential linkage to the biotic communities impairments, in addition to low physical flows. Therefore, a TMDL for total phosphorus was developed for this subwatershed.

There are approximately 132 miles of stream in the subwatershed. Based on IDEM data collected in 2020 and 2021, there will be 16 stream miles impaired for *E. coli*, 16 miles impaired for biological communities, and 18 miles impaired for dissolved oxygen. These stream reaches will be listed on the 2024 303(d) List of Impaired Waters. Therefore, *E. coli* TMDLs were developed to address all *E. coli* impairments and TP TMDLs were developed to address impaired biotic communities that are believed to be pollutant driven. Table 42 provides a summary of the Grassy Creek subwatershed, including listed stream reaches by AUID, drainage area, sampling sites, land use, NPDES facilities, as well as LA, WLAs, and MOS values for *E. coli* and TP.

Load duration curves (Figure 60 and Figure 62), precipitation graphs (Figure 61 and Figure 63), and water quality duration graphs (Appendix F) were created to further analyze potential sources in the subwatershed. Evaluating these graphs, with consideration of the watershed characteristics, allows for identification of potential point and nonpoint sources that are contributing to elevated *E. coli* and TP concentrations. Elevated levels of pollutants during rain events can indicate streams are susceptible to high loads due to run-off. The *E. coli* load



duration curve for these sites shows that streams are consistently susceptible to high loadings during rainfall events, as well as during low flows. The TP graphs also show high loadings during high to low flow conditions. This indicates that point sources are likely contributing pollutants in addition to nonpoint sources.

There is one WWTP that discharges within the subwatershed, the Town of Crothersville WWTP. The facility does not currently treat for or have a permit limit for TP. Site T02 is located approximately two miles downstream of the facility. Due to TP exceedances at this site during every sampling event (up to 2.9 mg/L), it is recommended that a 1.0 mg/L permit limit is added to the permit at the next renewal. Total phosphorus loadings from the Town of Crothersville WWTP, except at low flows, were based upon using the design flow for the facility and a 1.0 mg/L concentration. However, at low flows, loadings were calculated using the 2021 reported average flow for the facility and a 0.8 mg/L TP concentration. The Town of Crothersville WWTP does not currently monitor for phosphorus output, to determine current levels of phosphorus treatment, so IDEM undertook an analysis of phosphorus effluent data from eight similarly sized WWTPs in the state of Indiana with a 1.0 mg/L TP limit. Based upon this additional analysis of five years of monitoring data, IDEM determined that these similar facilities discharged an average monthly TP concentration of 0.55 mg/L. IDEM believes it is therefore reasonable to expect that, following the issuance of and compliance with a 1.0 mg/L permit limit, the Town of Crothersville WWTP can achieve the total phosphorus WLA given to them in this TMDL, even at low flows. Additionally, IDEM believes that a 1.0 mg/L permit limit will result in the TP reductions necessary for meeting in-stream water quality targets.

The graphs for this subwatershed indicate that nonpoint sources, both rainfall-driven and not, are still a source of *E. coli* and TP. Nonpoint sources may include small animal operations, wildlife, pasture animals with direct access to streams, land application of animal waste, straight pipes, streambank erosion, agricultural practices, and leaking and failing septic systems. See Section 6.1 and Table 47 for information pertaining to potentially suitable BMP selection for the Vernon Fork Muscatatuck River watershed.



		Grassy Creek (05	1202070706)										
Drainage Area			412.26 square m	niles									
Surface Area		45.68 square miles											
Site # [IDEM Station ID]	T0 [.]	T01 [WEM090-0003], T02 [WEM-07-0010], T05 [WEM-07-0015], T10 [WEM090-0015]											
Listed Segments [TMDL(s)]	INW0776	INW0776_05 [N/A]; INW0776_T1009 [<i>E. coli</i>]; INW0776_T1019 [<i>E. coli</i> & TP]											
Listed Impairments [TMDL(s)]	E. coli [E. coli [E. coli], Impaired Biotic Communities [TP], Dissolved Oxygen [TP]											
Land Use	Agricultural L	Agricultural Land: 28% Forested Land: 24% Developed Land: 6% Open Water: 0% Pasture/Hay: 35% Grassland/Shrubs: <1% Wetland: 7%											
NPDES Facilities		Fown of Crothersville WWTP (IN0022683), Marmon Retail Home Improvement Products (INRM01761), Aisin Chemical Indiana, LLC (INRM00368), Aisin Drivetrain Inc (INRM00890)											
CAFOs		NA											
CFOs	Jonathon Pollert (Farm ID: 6294), Brenda Bobb Farm (Farm ID: 884), Kyle & Leah Broshears (Farm ID: 6959)												
TMDL <i>E. coli</i> Allocations (MPN/day)													
Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%								
LA	1.54E+12	3.01E+11	9.91E+10	2.51E+10	3.98E+09								
WLA	4.18E+09	4.18E+09	4.18E+09	4.18E+09	4.18E+09								
MOS (10%)	1.82E+11	3.59E+10	1.21E+10	3.44E+09	9.60E+08								
Future Growth (5%)	9.11E+10	1.80E+10	6.07E+09	1.72E+09	4.80E+08								
Upstream Drainage Input (Mutton Creek & Polly Branch)	1.33E+13	2.63E+12	8.91E+11	2.53E+11	7.16E+10								
TMDL = LA+WLA+MOS	1.52E+13	2.99E+12	1.01E+12	2.88E+11	8.12E+10								
WLA (Individual)													
Town of Crothersville	4.18E+09	4.18E+09	4.18E+09	4.18E+09	4.18E+09								
WWTP (IN0022683)													

Table 42: Summary of Grassy Creek Subwatershed Characteristics



TMDL Total Phosphorus Allocations (Ibs/day)												
Allocation Category Duration Interval (%)	High Flows 5%	Moist Conditions 25%	Mid-Range Flows 50%	Dry Conditions 75%	Low Flows 95%							
LA	431.86	81.99	25.14	4.30	0.23							
WLA	3.92	3.92	3.92	3.92	2.07							
MOS (10%)	51.27	10.11	3.42	0.97	0.27							
Future Growth (5%)	25.63	5.05	1.71	0.48	0.14							
Upstream Drainage Input (Mutton Creek & Polly Branch)	3,754.10	740.38	250.71	71.24	20.16							
TMDL = LA+WLA+MOS	4,266.78	841.45	284.90	80.91	22.86							
WLA (Individual)												
Town of Crothersville WWTP (IN0022683)	3.92	3.92	3.92	3.92	2.07**							
Outfall 002 (CSO)	0*	0*	0*	0*	0*							

*Note- The WLAs for the permitee are set to 0 for CSO discharges. This does not indicate the immediate prohibition of CSOs, but rather that another mechanism will address the CSOs. The mechanism that implements the CSO WLAs is the Long-Term Control Plan (LTCP) and the NPDES permit. The TMDL does not alter the ongoing activities and efforts of the existing LTCP. The permitee's originally approved LCTP has been fully implemented. Since it was determined that the permitee was not meeting the original LTCP level of control, they are now performing additional work under a CSO Compliance Plan (CP).

****Note-** Allocation is based upon an analysis of reported TP discharges from similar facilities with phosphorus treatment and using the 2021 average reported flow of 0.31 MGD for the Town of Crothersville WWTP, which is representative of discharge during low flow conditions.



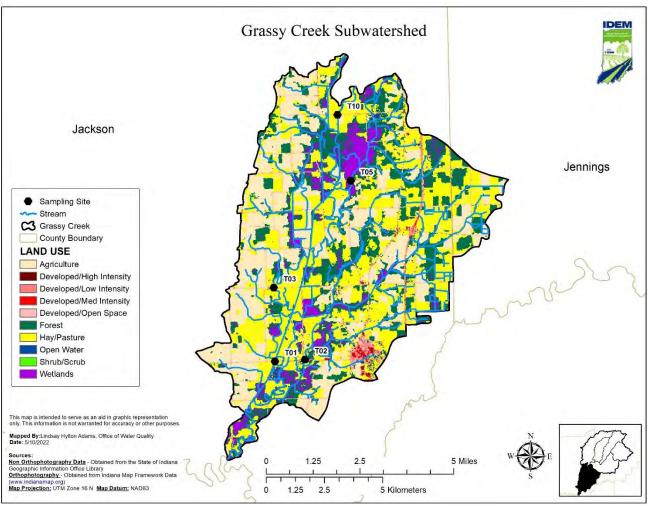


Figure 59: Sampling Stations in Grassy Creek Subwatershed



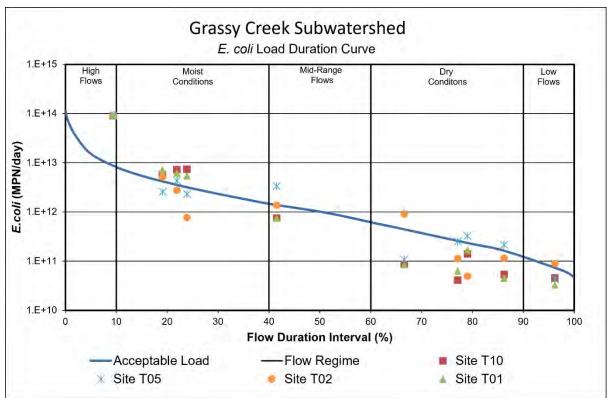


Figure 60: E. coli Load Duration Curve for Grassy Creek Subwatershed

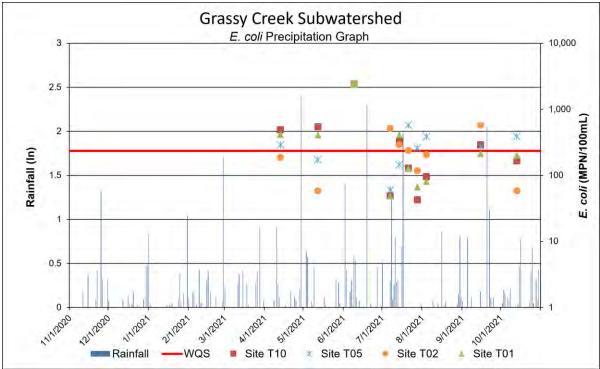


Figure 61: Graph of Precipitation and E. coli Data for Grassy Creek Subwatershed



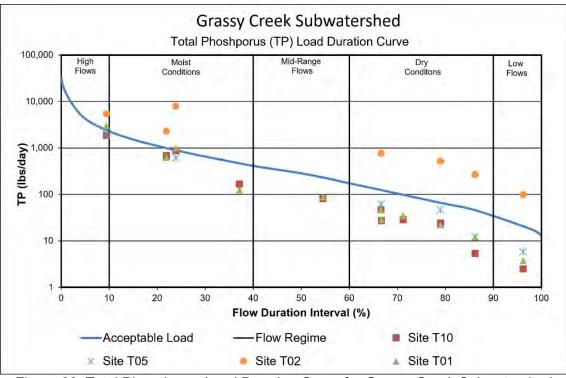


Figure 62: Total Phosphorus Load Duration Curve for Grassy Creek Subwatershed

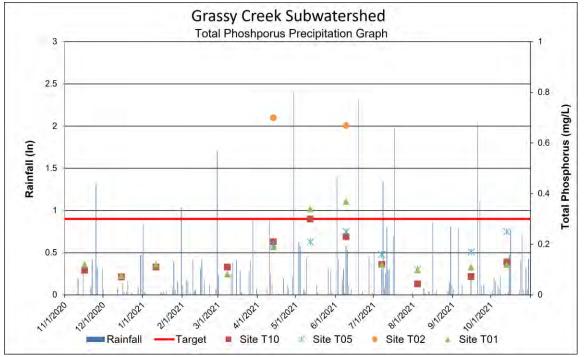


Figure 63: Graph of Precipitation and Total Phosphorus Data for Grassy Creek Subwatershed



5.0 ALLOCATIONS

A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs are composed of the sum of individual WLAs for regulated sources and LAs for sources not directly regulated by a permit. In addition, the TMDL must include a MOS, either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this is defined by the equation:

 $\mathsf{TMDL} = \sum \mathsf{WLAs} + \sum \mathsf{LAs} + \mathsf{MOS}$

5.1 Individual Allocations

This section presents the allowable pollutant loads and associated allocations for each of the subwatersheds and associated assessment units in the Vernon Fork Muscatatuck River watershed. Allocations were calculated for each 12-digit HUC (subwatershed). WLAs are typically calculated based on the design flow or estimated flow of the facility and the TMDL target or applicable permit limit. The following tables present the individual WLAs for NPDES facilities in the Vernon Fork Muscatatuck River watershed.



Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Flow Regime	Estimated Design Flow (MGD)	<i>E. coli</i> WLA (MPN/day)	NPDES Permit <i>E. coli</i> Limit	TSS WLA (lbs/day)	NPDES Permit TSS Limit	TP WLA (Ibs/day)	NPDES Permit TP Limit
Grassy Creek	Crothersville	IN0022683	INW0776 T1018	Nehrt Ditch	High - Dry	0.47	4.18E+09	235 MPN/100 mL Daily Max.	NA	NA	3.92	1.0 mg/L
	WWTP				Low	0.31 *	4.18E+09	235 MPN/100 mL Daily Max.	NA	NA	2.07 *	1.0 mg/L *
Mutton Creek	HWRT Terminal Seymour LLC	ING340019	NA	Mutton Creek	All	0.07	NA	NA	27.03	45 mg/L Daily Max.	NA	NA
Sixmile Creek	Jennings Northwest Regional Utility WWTP	IN0056049	INW0772_04	Six Mile Creek	All	0.35	3.13E+09	235 MPN/100 mL Daily Max.	NA	NA	2.94	1.0 mg/L

Table 43: Individual WLAs for NPDES Munici	nal and Industrial Facilities in the	Vernon Fork Muscatatuck River Watershed
	pai and muusulai i aciilites in the	

Understanding Table 43: The WLA for each NPDES permitted facility will be achieved through compliance with the facility's NPDES permit.

* This TMDL WLA at low flows is based upon using a 0.8 mg/L TP concentration, supported by an IDEM analysis of reported TP discharges from similar WWTP facilities with phosphorus treatment (see p.142 for further detail). It also uses the 2021 average reported flow of 0.31 MGD for the Town of Crothersville WWTP, which is representative of discharge during low flow conditions. The 0.8 mg/L TP value is not intended to be incorporated into the NPDES permit. Based on the aforementioned facilities analysis, IDEM believes that a 1.0 mg/L TP limit for this facility will result in TP discharges of 0.8 mg/L or less, accommodating the WLA at low flows.



5.1.1 Approach for Calculating General Permit Waste Load Allocations

A number of permittees in the Vernon Fork Muscatatuck River watershed have general rather than individual permits. An individual permit is site-specific and is developed to address discharges from a specific facility. A general permit is used to cover a category of similar discharges, rather than a specific site. IDEM may issue a general permit when there are several sources or activities involved in similar operations that may be adequately regulated with a standard set of conditions. Calculating WLAs for facilities with individual permits is straightforward; all the necessary information regarding allowable flows and effluent limits is contained within the permit. Calculating WLAs for facilities with general permits is more difficult because only limited information is available on historical flow and pollutant concentrations.

For example, some operations have general permits for treating run-off. Discharge is therefore related to precipitation events rather than a "design" flow as is available for WWTPs. Wasteload allocations for HWRT Terminal Seymour LLC (ING340019) were based on daily maximum and average daily flow values reported by the facility and their current permit limit. These allocations have varying limits based on dry and wet weather discharge flow rates. Individual WLAs for the facility are implemented through compliance with their NPDES permit.

Stormwater run-off associated with construction activity is currently regulated under the administrative construction general permit (CGP). The WLA for sites regulated under the construction stormwater general permit was determined based on the average annual land disturbance associated with total overall acreage for all sites in the subwatershed. The average annual land disturbance was calculated for each subwatershed using data from permitted constructions sites for the past five years.

Stormwater run-off from certain types of urbanized areas are currently regulated under the administrative municipal storm sewer system (MS4) general permit. The WLAs for MS4 communities were determined based on the overall area the MS4 has jurisdiction over in each subwatershed.

Subwatershee	MS4 Community	Permit ID	Drainade	Percentage of Subwatershed	High Flow Regime <i>E. coli</i> WLA (MPN/day)	•	•	Moist Flow Regime TSS WLA (mg/L)	•	Moist Flow Regime TP WLA (mg/L)
Mutton Creek	City of Seymour	INR040082	1879.16	6.28%	9.16E+10	1.79E+10	2576.15	502.51	25.78	5.04

Table 44: Individual WLAs for NPDES General Permit MS4 Communities in the Vernon Fork Muscatatuck River Watershed



5.2 Critical Conditions

The CWA requires that TMDLs take into account critical conditions for stream flow, loading, and water quality parameters as part of the analysis of loading capacity. The load duration curve approach helps to identify the sources contributing to the impairment and to roughly differentiate between sources.

Exceedances of the load duration curve at higher flows (0-40 percent ranges) are indicative of wet weather sources (e.g., nonpoint sources, regulated stormwater discharges). Exceedances of the load duration curve at lower flows (60 to 100 percent range) are indicative of point sources (e.g., wastewater treatment facilities, livestock in the stream). Table 45 summarizes the general relationship between the five hydrologic zones and potentially contributing sources (the table is not specific to any individual pollutant). Existing loading is calculated as the 90th percentile of measured *E. coli* concentrations under each hydrologic condition class multiplied by the flow at the middle of the flow exceedance percentile.

For example, in calculating the existing loading under dry conditions (flow exceedance percentile = 60-90 percent), the 75th percentile exceedance flow is *multiplied* by the 90th percentile of pollutant concentrations measured under 60-90th percentile flows. Through the load duration curve approach, it has been determined that load reductions for *E. coli*, TSS, and total phosphorus are needed for specific flow conditions. The critical conditions (the periods when the greatest reductions are required) vary by location and are summarized in



Table 46. After existing loading and percent reductions are calculated under each hydrologic condition class, the critical condition for each TMDL is identified as the flow condition requiring the largest percent reduction. For example, impacts from point sources are usually most pronounced during dry and low flow zones because there is less water in the stream to dilute their loads. In contrast, impacts from channel bank erosion is most pronounced during high flow zones because these are the periods during which stream velocities are high enough to cause erosion to occur. The table indicates that critical conditions for these pollutants, for most locations, occur during all flow regimes, and, therefore, implementation of controls should be targeted for these conditions.



	Duration Curve Zone										
Contributing Source Area	High (0%-10%)	Moist (10%-40%)	Mid-Range (40%-60%)	Dry (60%-90%)	Low (90%-100%)						
Wastewater treatment plants (point source)			L	М	н						
Livestock direct access to streams			L	М	Н						
Wildlife direct access to streams			L	М	Н						
Pasture management	Н	Н	М								
On-site wastewater systems/Unsewered areas	L	М	Н	Н	Н						
Riparian buffer areas	Н	Н	М	М							
Stormwater: Impervious	Н	н	Н								
Stormwater: Upland	н	н	М								
Field drainage: Natural condition	н	М									
Field drainage: Tile system	н	н	М	L							
Bank erosion	н	М	L								

Table 45: Relationship between Load Duration Curve Zones and Contributing Sources

Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low)

(Modified from *An Approach for Using Load Duration Curves in the Development of TMDLs (U.S. EPA, 2007))*



		Critical Condition									
Parameter	Subwatershed (HUC)	High	Moist	Mid-Range	Dry	Low					
	Indian Creek (051202070701)	94%	95%	21%	0%	0%					
	Sixmile Creek (051202070702)	93%	83%	90%	92%	77%					
E coli (counto/ml.)	Storm Creek (051202070703)	95%	69%	76%	84%	94%					
E. Con (Counts/ITL)	Mutton Creek (051202070704)	95%	90%	93%	92%	92%					
E. coli (counts/mL)Indian Creek (051202070701) Sixmile Creek (051202070702) Storm Creek (051202070703) Mutton Creek (051202070704) Polly Branch (051202070705) Grassy Creek (051202070706)Total Phosphorus (mg/L)Storm Creek (051202070704) 	Polly Branch (051202070705)	95%	95%	85%	82%	86%					
	Mutton Creek 95% 90% 93% 92 Mutton Creek 95% 95% 85% 82 Grassy Creek 95% 73% 72% 68 (051202070706) 95% 73% 72% 68 Sixmile Creek 0% 25% 11 Storm Creek 57% 0% 0% 0% Mutton Creek 57% 0% 0% 0%	68%	75%								
			0%	25%	11%	14%					
		57%	0%	0%	0%	0%					
Total Phosphorus (mg/L)		High Moist Mid-Range Dry Low 94% 95% 21% 0% 0% 93% 83% 90% 92% 77% 95% 69% 76% 84% 94% 95% 69% 76% 84% 94% 95% 90% 93% 92% 92% 95% 90% 93% 92% 92% 95% 90% 93% 92% 92% 95% 90% 93% 82% 86% 95% 73% 72% 68% 75% 95% 73% 72% 68% 75% 95% 73% 72% 68% 75% 95% 0% 0% 0% 0% 60% 0% 0% 0% 0% 95% 57% 0% 0% 0% 0% 57% 0% 0% 0% 0% 67% 0% <td>0%</td>	0%								
(051 Six (051 Sta (051 Sta (051 Sta (051 Mu (051 Pc (051 Grad (051 Six (051 Grad (051 Total Phosphorus (mg/L) Mu (051 Grad (051 Mu (051 Grad (051 Mu (051 Mu	Polly Branch (051202070705)	0%	57%	0%	0%	0%					
	Grassy Creek (051202070706)	48%	67%	0%	86%	86%					
Total Suspended Solids	Storm Creek (051202070703)	87%	0%	0%	0%	0%					
(mg/L)	Mutton Creek (051202070704)	88%	0%	0%	0%	0%					

Table 46: Critical Conditions for TMDL Parameters

Note: -- represents no data collected in the flow regime



Table 46 provide the foundation necessary to identify subwatersheds that are in need of the most significant pollutant reductions to achieve water quality standards in the Vernon Fork Muscatatuck River watershed. Using these two tables, along with the Linkage Analysis in Section 4.0, watershed organizations will gain a better understanding of which subwatersheds require the most pollutant load reductions. This can assist in future efforts to identify critical areas in the Vernon Fork Muscatatuck River watershed for implementation. The tables above focus on the information and data collected and analyzed through the TMDL development process for percent reduction purposes, whereas critical areas take into account other factors for consideration (e.g., political, social, economic) to help determine implementation feasibility that will affect progress toward pollutant load reductions and, ultimately, attainment of water quality standards. This information can be key to watershed organizations in the process of identifying and selecting critical areas and implementation activities for the purposes of watershed management plan development. IDEM recommends that watershed organizations take the percent reductions into consideration when selecting critical areas for purposes of watershed management planning. By also considering different flow regimes, watershed groups will be able to prioritize practices that give them the most efficient load reductions for each critical area that is chosen.



6.0 REASONABLE ASSURANCES/IMPLEMENTATION

This section of the Vernon Fork Muscatatuck River watershed TMDL focuses on implementation activities that have the potential to achieve the WLAs and LAs presented in previous sections. The focus of this section is to identify and select the most appropriate structural and non-structural best management practices (BMPs) and control technologies to reduce *E. coli*, TSS, and total phosphorus loads from sources throughout the Vernon Fork Muscatatuck River watershed, particularly in the critical areas identified in Section 5.2. This section also addresses the programs that are available to facilitate implementation of structural and non-structural BMPs to achieve the allocations, as well as current ongoing activities in the Vernon Fork Muscatatuck River watershed at the local level that will play a key role in successful TMDL implementation.

To select appropriate BMPs and control technologies, it is important to review the relevant sources in the Vernon Fork Muscatatuck River watershed.

Point Sources

- Wastewater treatment facilities
- Industrial facilities
- Regulated stormwater sources

Nonpoint Sources

- Leaking/failing onsite wastewater treatment systems
- Wildlife
- Cropland
- Pastures and livestock operations
- CFOs and AFOs
- Streambank erosion
- Urban nonpoint source run-off
- Illicitly connected straight pipe systems

6.1 Implementation Activity Options for Sources in the Vernon Fork Muscatatuck River Watershed

Keeping the list of significant sources in the Vernon Fork Muscatatuck River watershed in mind, it is possible to review the types of BMPs that are most appropriate for the pollutants and the source type.



Table 47 provides a list of implementation activities that are potentially suitable for the Vernon Fork Muscatatuck River watershed based on the pollutants and the types of sources. The implementation activities are a combination of structural and non-structural BMPs to achieve the assigned WLAs and LAs. IDEM recognizes that actions taken in any individual subwatershed may depend on a number of factors (including socioeconomic, political, and ecological factors). The recommendations in



Table 47 are not intended to be prescriptive. Any number or combination of implementation activities might contribute to water quality improvement, whether applied at sites where the actual impairment was noted or other locations where sources contribute indirectly to the water quality impairment.



Table 47: List of Potentially Suitable BMPs for the Vernon Fork Muscatatuck River Watershed

	Pollutant Point Sources Nonpoint Sources												
	P	Pollutant			ources								
Implementation Activities	Bacteria	Nutrients	Sediment	Municipal and Industrial Wastewater	Regulated Stormwater Sources	Illicitly Connected " Straight Pipe" Systems	Cropland	Pastures and Livestock Operations	CFOS	Streambank Erosion	Onsite Wastewater Treatment Systems	Wildlife/Domestic Pets	Urban NPS Run-off
Inspection and maintenance	Х	Х	Х	Х	Х						Х		
Outreach and education and training	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х
System replacement	Х	Х				Х					Х		
Conservation tillage/residue management	Х	Х	Х				Х						
Cover crops	Х	Х	Х				Х			Х			
Filter strips	Х	Х	Х		Х		Х	Х	Х	Х			
Grassed waterways	Х	Х	Х				Х		Х	Х			
Riparian forested/herbaceous buffers	Х	Х	Х				Х	Х	Х	Х		Х	Х
Manure handling, storage, treatment, and disposal	х	х					х		х				
Alternative watering systems	Х	Х	Х					Х	Х	Х			
Stream fencing (animal exclusion)	Х	Х	Х					Х		Х			
Prescribed grazing	Х	Х	Х					Х		Х			
Conservation easements	Х	Х	Х				Х			Х			
Two-stage ditches		Х	Х				Х	Х		Х			
Rain barrel		Х	Х		Х								Х
Rain garden		Х	Х		Х								Х
Bioretention					Х								Х
Porous pavement		Х	Х		Х								Х
Green roof					Х								Х
Stormwater planning and management	Х	Х	Х	Х	Х					Х	Х	Х	Х
Comprehensive Nutrient Management Plan	Х	Х					Х		Х				
Constructed Wetland	Х	Х	Х	Х		Х	Х					Х	Х
Critical Area Planting		Х	Х					Х		Х			
Drainage Water Management		Х					Х						
Nutrient Management Plan		Х					Х			Х			
Land Reconstruction of Mined Land			Х							Х			
Sediment Basin		Х	Х		Х		Х						Х
Pasture and Hay Planting	Х	Х	Х				Х	Х	Х	Х		Х	
Streambank and Shoreline Protection	Х	Х	Х				Х	Х	Х	Х		Х	
Conservation Crop Rotation		Х	Х				Х			Х			
Field Border	Х	Х	Х				Х	Х	Х			Х	



The information provided in Section 5.2 assisted in the development of Table 47, which provides a more refined suite of recommended implementation activities targeted to the critical flow condition identified in Section 5.2. Watershed stakeholders can use the implementation activities identified in Table 47 for each critical flow condition and select activities that are most feasible in the Vernon Fork Muscatatuck River watershed. This table can also help watershed stakeholders to identify implementation activities for critical areas that they select through the watershed management planning process.

6.2 Implementation Goals and Indicators

For each pollutant in the Vernon Fork Muscatatuck River watershed, IDEM has identified broad goal statements and indicators. This information is to help watershed stakeholders determine how to track implementation progress over time and also provide the information necessary to complete a watershed management plan.

E. coli Goal Statement: The waterbodies (or streams) in the Vernon Fork Muscatatuck River watershed should meet the 235 colonies/100 mL daily maximum TMDL target value.

E. coli Indicator: Water quality monitoring by IDEM will serve as the environmental indicator to determine progress toward the *E. coli* target value.

Total Phosphorus Goal Statement: The waterbodies (or streams) in the Vernon Fork Muscatatuck River watershed should meet the TMDL 0.30 mg/L total phosphorus target value.

Total Phosphorus Indicator: Water quality monitoring by IDEM will serve as the environmental indicator to determine progress toward the total phosphorus target value.

Total Suspended Solids Goal Statement: The waterbodies (or streams) in the Vernon Fork Muscatatuck River watershed should meet the TMDL 30 mg/L total suspended solids target value.

Total Suspended Solids Indicator: Water quality monitoring by IDEM will serve as the environmental indicator to determine progress toward the total suspended solids target value.

6.3 Summary of Programs

There are a number of federal, state, and local programs that either require or can assist with the implementation activities recommended for the Vernon Fork Muscatatuck River watershed. A description of these programs is provided in this section. The following section discusses how some of these programs relate to the various sources in the watershed.



6.3.1 Federal Programs

Clean Water Act Section 319(h) Grants

Section 319 of the federal Clean Water Act contains provisions for the control of nonpoint source pollution. The Section 319 program provides for various voluntary projects throughout the state to prevent water pollution and also provides for assessment and management plans related to waterbodies in Indiana impacted by NPS pollution. The Watershed Planning and Restoration Section within the Watershed Assessment and Planning Branch of the IDEM Office of Water Quality administers the Section 319 program for NPS-related projects.

U.S. EPA offers Clean Water Act Section 319(h) grant monies to the state on an annual basis. These grants must be used to fund projects that address nonpoint source pollution issues. Some projects which the Office of Water Quality has funded with this money in the past include developing and implementing Watershed Management Plans (WMPs), BMP demonstrations, data management, educational programs, modeling, stream restoration, and riparian buffer establishment. Projects are usually two to three years in length. Section 319(h) grants are intended to be used for project start-up, not as a continuous funding source. Units of government, nonprofit groups, and universities in the state that have expertise in nonpoint source pollution problems are invited to submit Section 319(h) proposals to the Office of Water Quality.

Clean Water Action Section 205(j) Grants

Section 205(j) provides for planning activities relating to the improvement of water quality from nonpoint and point sources by making funding available to municipal and county governments, regional planning commissions, and other public organizations. For-profit entities, non-profit organizations, private associations, universities, and individuals are not eligible for funding through Section 205(j). The CWA states that the grants are to be used for water quality management and planning, including, but not limited to:

- Identifying most cost effective and locally acceptable facility and nonpoint source measures to meet and maintain water quality standards;
- Developing an implementation plan to obtain state and local financial and regulatory commitments to implement measures developed under those plans;
- Determining the nature, extent, and cause of water quality problems in various areas of the state.

The Section 205(j) program provides for projects that gather and map information on nonpoint and point source water pollution, develop recommendations for increasing the involvement of environmental and civic organizations in watershed planning and implementation activities, and develop watershed management plans.



HUD Community Development Block Grant Program (CDBG)

The Community Development Block Grant Program (CDBG) is authorized under Title I of the Housing and Community Development (HCD) Act of 1974, as amended. The main objective of the CDBG program is to develop viable communities by helping to provide decent housing and suitable living environments and expanding economic opportunities principally for persons of low- and moderate-income. The U.S. Department of Housing and Urban Development (HUD) provides federal CDBG funds directly to Indiana annually, through the Office of Community and Rural Affairs (OCRA), which then provides funding to small, incorporated cities and towns with populations less than 50,000 and to non-urban counties.

CDBG regulations define eligible activities and the National Objectives that each activity must meet. OCRA is responsible for ensuring projects that receive funding in Indiana are in accordance with the National Objectives and eligible activities.

OCRA is required to develop a Consolidated Plan that describes needs, resources, priorities, and proposed activities to be undertaken. Indiana's Consolidated Plan includes four goals for prioritizing fund allocations. These goals include: expand and preserve affordable housing opportunities throughout the housing continuum, reduce homelessness and increase housing stability for special needs populations, promote livable communities and community revitalization through addressing unmet community development needs, and promote activities that enhance local economic development efforts. OCRA has funded a variety of projects, including sanitary sewer and water systems.

USDA Conservation Stewardship Program (CSP)

The Conservation Stewardship Program (CSP) helps landowners build on their existing conservation efforts while strengthening their operation. Whether they are looking to improve grazing conditions, increase crop yields, or develop wildlife habitat, NRCS can custom design a CSP plan to help them meet those goals. NRCS can help landowners schedule timely planting of cover crops, develop a grazing plan that will improve the forage base, implement no-till to reduce erosion or manage forested areas in a way that benefits wildlife habitat. If landowners are already taking steps to improve the condition of the land, chances are CSP can help them find new ways to meet their goals.

USDA Conservation Reserve Program (CRP)

NRCS provides technical assistance to landowners interested in participating in the Conservation Reserve Program (CRP) administered by the USDA Farm Service Agency. The Conservation Reserve Program reduces soil erosion, protects the nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost-share funding is provided to establish the vegetative cover practices.



<u>USDA Conservation Reserve Enhancement Program (CREP)</u> (*Not currently available for this watershed*)

NRCS provides technical assistance to landowners interested in participating in the Conservation Reserve Program administered by the USDA Farm Service Agency. The Conservation Reserve Enhancement Program (CREP), an offshoot of CRP, targets high-priority conservation concerns identified by a state, and federal funds are supplemented with non-federal funds to address those concerns. In exchange for removing environmentally sensitive land from production and establishing permanent resource conserving plant species, farmers and ranchers are paid an annual rental rate along with other federal and state incentives as applicable per each CREP agreement. Participation is voluntary, and the contract period is typically 10–15 years.

USDA Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with federal, state, and tribal environmental laws, and encourages environmental enhancement. The program is funded through the Commodity Credit Corporation. The purposes of the program are achieved through the implementation of a conservation plan, which includes structural, vegetative, and land management practices on eligible land. Five-to-ten-year contracts are made with eligible producers. Cost-share payments may be made to implement one or more eligible structural or vegetative practices, such as animal waste management facilities, terraces, filter strips, tree planting, and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices, such as nutrient management, pest management, and grazing land management. Fifty percent of the funding available for the program is targeted at natural resource concerns relating to livestock production. The program is carried out primarily in priority areas that may be watersheds, regions, or multi-state areas, and for significant statewide natural resource concerns that are outside of geographic priority areas.

USDA Farmable Wetlands Program (FWP)

NRCS provides technical assistance to landowners interested in participating in the Conservation Reserve Program administered by the USDA Farm Service Agency. The Farmable Wetlands Program (FWP) is designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. FWP is a voluntary program to restore up to one million acres of farmable wetlands and associated buffers. Participants must agree to restore the wetlands, establish plant cover, and to not use enrolled land for commercial purposes. Plant cover may include plants that are partially submerged or specific types of trees. By restoring farmable wetlands, FWP improves groundwater quality, helps trap and break down pollutants, prevents soil erosion, reduces downstream flood damage, and provides habitat for water birds and other wildlife. Wetlands can also be used to treat sewage and are found to be as effective as "high tech" methods. The Farm Service Agency runs the program through the



Conservation Reserve Program (CRP) with assistance from other government agencies and local conservation groups.

USDA Conservation Technical Assistance (CTA)

The purpose of the CTA program is to assist land users, communities, units of state and local government, and other Federal agencies in planning and implementing conservation systems. The purpose of conservation systems is to reduce erosion, improve soil and water quality, improve and conserve wetlands, enhance fish and wildlife habitat, improve air quality, improve pasture and range condition, reduce upstream flooding, and improve woodlands.

One objective of the program is to assist individual land users, communities, conservation districts, and other units of state and local government and federal agencies to meet their goals for resource stewardship and assist individuals in complying with state and local requirements. NRCS assistance to individuals is provided through conservation districts in accordance with the Memorandum of Understanding signed by the Secretary of Agriculture, the Governor of the State, and the conservation district. Assistance is provided to land users voluntarily applying conservation practices and to those who must comply with local or state laws and regulations.

Another objective is to provide assistance to agricultural producers to comply with the highly erodible land (HEL) and wetland (Swampbuster) provisions of the 1985 Food Security Act, as amended by the Food, Agriculture, Conservation and Trade Act of 1990 (16 U.S.C. 3801 et. seq.), the Federal Agriculture Improvement and Reform Act of 1996, and wetlands requirements of Section 404 of the Clean Water Act. NRCS makes HEL and wetland determinations and helps land users develop and implement conservation plans to comply with the law. The program also provides technical assistance to participants in USDA cost-share and conservation incentive programs.

NRCS collects, analyzes, interprets, displays, and disseminates information about the condition and trends of the Nation's soil and other natural resources so that people can make good decisions about resource use and about public policies for resource conservation. They also develop effective science-based technologies for natural resource assessment, management, and conservation.

USDA Section 504 Home Repair Program

USDA Rural Development administers the Section 504 Home Repair Program, or Single Family Housing Repair Loans and Grants. The Section 504 Home Repair Program provides loans to very low-income homeowners to repair, improve, or modernize their home and provides grants to elderly very low-income homeowners to remove health and safety hazards. The purpose of this program is to help families stay in their own home and keep their home in good repair. Applicants must live in a rural area below 50 percent of the area median income. Grant applicants must be age 62 or older and unable to repay a repair loan. Loans may be used to repair, improve, or modernize homes or to remove health and safety hazards. Grants must be used to remove health and safety hazards. For example, repairing a failed septic system may



be an applicable health and safety hazard. The maximum loan amount is \$20,000, and the maximum grant amount is \$7,500.

USDA Watershed Surveys and Planning

The Watershed and Flood Prevention Act, P.L. 83-566, August 4, 1954, (16 U.S.C. 1001-1008) authorized this program. Prior to fiscal year 1996, small watershed planning activities and the cooperative river basin surveys and investigations authorized by Section 6 of the Act were operated as separate programs. The 1996 appropriations act combined the activities into a single program entitled the Watershed Surveys and Planning program. Activities under both programs are continuing under this authority.

The purpose of the program is to assist federal, state, and local agencies and tribal governments to protect watersheds from damage caused by erosion, floodwater, and sediment and to conserve and develop water and land resources. Resource concerns addressed by the program include water quality, opportunities for water conservation, wetland and water storage capacity, agricultural drought problems, rural development, municipal and industrial water needs, upstream flood damages, and water needs for fish, wildlife, and forest-based industries.

Types of surveys and plans include watershed plans, river basin surveys and studies, flood hazard analyses, and floodplain management assistance. The focus of these plans is to identify solutions that use land treatment and non-structural measures to solve resource problems.

USDA Agricultural Conservation Easement Program (ACEP)

The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements component, NRCS helps American Indian tribes, state and local governments and nongovernmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect, and enhance enrolled wetlands.

Agricultural Land Easements protect the long-term viability of the nation's food supply by preventing conversion of productive working lands to non-agricultural uses. Land protected by agricultural land easements provides additional public benefits, including environmental quality, historic preservation, wildlife habitat, and protection of open space.

Wetland Reserve Easements provide habitat for fish and wildlife, including threatened and endangered species, improve water quality by filtering sediments and chemicals, reduce flooding, recharge groundwater, protect biological diversity, and provide opportunities for educational, scientific, and limited recreational activities.

NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land. In the case of working farms, the program helps farmers and ranchers keep their land in agriculture. The program also protects grazing uses and related conservation values by conserving grassland,



including rangeland, pastureland and shrubland. Eligible partners include American Indian tribes, state and local governments and non-governmental organizations that have farmland, rangeland, or grassland protection programs.

Under the Agricultural Land component, NRCS may contribute up to 50 percent of the fair market value of the agricultural land easement. Where NRCS determines that grasslands of special environmental significance will be protected, NRCS may contribute up to 75 percent of the fair market value of the agricultural land easement.

USDA Regional Conservation Partnership Program (RCPP)

The Regional Conservation Partnership Program (RCPP) encourages partners to join in efforts with producers to increase the restoration and sustainable use of soil, water, wildlife, and related natural resources on regional or watershed scales. Through the program, NRCS and its partners help producers install and maintain conservation activities in selected project areas. Partners leverage RCPP funding in project areas and report on the benefits achieved.

USDA Healthy Forests Reserve Program (HFRP)

The Healthy Forests Reserve Program (HFRP) helps landowners restore, enhance, and protect forestland resources on private lands through easements and financial assistance. HRFP aids the recovery of endangered and threatened species under the Endangered Species Act, improves plant and animal biodiversity, and enhances carbon sequestration.

HFRP provides landowners with 10-year restoration agreements and 30-year or permanent easements for specific conservation actions. For acreage owned by an Indian tribe, there is an additional enrollment option of a 30-year contract. Some landowners may avoid regulatory restrictions under the Endangered Species Act by restoring or improving habitat on their land for a specified period of time.

USDA Voluntary Public Access and Habitat Incentive Program (VPA-HIP)

The Voluntary Public Access and Habitat Incentive Program (VPA-HIP) is a competitive grants program that helps state and tribal governments increase public access to private lands for wildlife-dependent recreation, such as hunting, fishing, nature watching, or hiking.

State and tribal governments may submit proposals for VPA-HIP block grants from NRCS. These governments provide the funds to participating private landowners to initiate new or expand existing public access programs that enhance public access to areas previously unavailable for wildlife-dependent recreation. Nothing in VPA-HIP preempts liability laws that may apply to activities on any property related to grants made in these programs.



6.3.2 State Programs

IDEM Point Source Control Program

Point source pollution is regulated by several IDEM Office of Water Quality branches, including the Wastewater Compliance Branch, the Wastewater Permitting Branch, and the Surface Water, Operations, and Enforcement Branch. The Wastewater Permitting Branch issues NPDES and construction permits to sources that discharge wastewater to streams, lakes, and other waterbodies, including municipal wastewater treatment plants and industrial wastewater dischargers. The Stormwater Program, which is managed under the Surface Water, Operations, and Enforcement Branch, issues NPDES permits for stormwater discharges associated with industrial activities, active construction that results in a land disturbance of an acre or more, and municipal separate storm sewer systems (MS4). NPDES permits are issued in accordance with the Clean Water Act, federal laws, and state laws and regulations. The purpose of the NPDES permit is to control the point source discharge of pollutants into the waters of the state such that the quality of the water of the state is maintained in accordance with applicable water quality standards. The Wastewater Compliance Branch and Stormwater Program conduct inspections of facilities and projects with NPDES permits and review and evaluate compliance data to ensure permittees abide by the requirements of their permit. Control of discharges from point sources consistent with WLAs are implemented through the respective NPDES program.

IDEM Nonpoint Source Control Program

The state's Nonpoint Source Program, administered by the IDEM Office of Water Quality's Watershed Planning and Restoration Section, focuses on the assessment and prevention of nonpoint source water pollution. The program also provides for education and outreach to improve the way land is managed. Through the use of federal funding for the installation of BMPs, the development of watershed management plans, and the implementation of watershed restoration pollution prevention activities, the program reaches out to citizens so that land is managed in such a way that less pollution is generated.

Nonpoint source projects funded through the Office of Water Quality are a combination of local, regional, and statewide efforts sponsored by various public and not-for-profit organizations. The emphasis of these projects has been on the local, voluntary implementation of nonpoint source water pollution controls. The Watershed Planning and Restoration Section administers the Section 319 funding for nonpoint source-related projects, as well as Section 205(j) grants.

To award 319 grants, Watershed Planning and Restoration Section staff review proposals for minimum 319(h) eligibility criteria and rank each proposal. In their review, members consider such factors as: technical soundness; likelihood of achieving water quality results; strength of local partnerships; and competence/reliability of contracting agency. They then convene to discuss individual project merits and pool all rankings to arrive at final rankings for the projects. All proposals that rank above the funding target are included in the annual grant application to U.S. EPA, with U.S. EPA reserving the right to make final changes to the list. Actual funding depends on approval from U.S. EPA and yearly congressional appropriations.



Section 205(j) projects are administered through grant agreements that define the tasks, schedule, and budget for the project. IDEM project managers work closely with the project sponsors to help ensure that the project runs smoothly and the tasks of the grant agreement are fulfilled. Site visits are conducted at least quarterly to touch base on the project, provide guidance and technical assistance as needed, and to work with the grantee on any issues that arise to ensure a successful project closeout.

IDEM Hoosier Riverwatch Program

Hoosier Riverwatch (HRW) is a statewide volunteer stream water quality monitoring program administered by the IDEM Office of Water Quality, Watershed Assessment and Planning Branch. The mission of HRW is to involve the citizens of Indiana in becoming active stewards of Indiana's water resources and to increase public awareness of water quality issues and concerns. HRW accomplishes this through watershed education, hands-on training of volunteers, water monitoring, and clean-up activities. HRW collaborates with agencies and volunteers to educate local communities about the relationship between land use and water quality and to provide water quality information to citizens and governmental agencies working to protect Indiana's rivers and streams.

ISDA Division of Soil Conservation

The Indiana State Department of Agriculture (ISDA) Division of Soil Conservation's mission is to ensure the protection, wise use, and enhancement of Indiana's soil and water resources. The Division's employees are part of Indiana's Conservation Partnership, which includes the 92 soil and water conservation districts (SWCDs), the USDA Natural Resources Conservation Service, the Purdue University Cooperative Extension Service, IDEM, DNR, the USDA Farm Service Agency, and the State Soil Conservation Board. Working together, the partnership provides technical, educational, and financial assistance to citizens to solve erosion and sediment-related problems occurring on the land or impacting public waters.

ISDA Clean Water Indiana (CWI) Program

The ISDA Division of Soil Conservation administers the Clean Water Indiana (CWI) program under the direction of the State Soil Conservation Board. The CWI program provides financial assistance to landowners and conservation groups to support the implementation of conservation practices which will reduce nonpoint sources of water pollution through education, technical assistance, training, and cost sharing programs. The program is responsible for providing local matching funds, as well as competitive grants for sediment and nutrient reduction projects through Indiana's SWCDs.

ISDA INfield Advantage (INFA) Program

The ISDA Division of Soil Conservation administers Infield Advantage (INFA). INFA is a collaborative opportunity for farmers to collect and understand personalized, on-farm data to optimize their management practices. Participating farmers use precision agricultural tools and technologies, such as aerial imagery and the corn stalk nitrate test, to conduct research on their



own farms to determine nitrogen use efficiency in each field that they enroll. Peer to peer group discussions, local aggregated results, and collected data allow participants to make more informed decisions and implement personalized best management practices. INFA is available to farmers as a resource and a conduit to diverse on-farm research, innovative ideas, and technologies. INFA collaborates with local, regional, and national partners to help Indiana farmers improve their bottom line, adopt new management practices, protect natural resources, and benefit their surrounding communities.

IDNR Lake and River Enhancement (LARE) Program

The Lake and River Enhancement program is part of the Office of Private Lands in the Indiana Department of Natural Resources (IDNR), Division of Fish and Wildlife. The goal of the LARE program is to protect and enhance aquatic habitat for fish and wildlife and to ensure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities. This is accomplished through measures that reduce nonpoint source sediment and nutrient pollution of surface waters to a level that meets or surpasses state water quality standards. The LARE program provides technical and financial assistance to local entities for qualifying projects that improve and maintain water quality in public access lakes, rivers, and streams.

IFA State Revolving Fund (SRF) Loan Program

The SRF is a fixed rate, 20-year loan administered by the Indiana Finance Authority (IFA). The SRF provides low-interest loans to Indiana communities for projects that improve wastewater and drinking water infrastructure. The program's mission is to provide eligible entities with the lowest interest rates possible on the financing of such projects while protecting public health and the environment. SRF also funds nonpoint source projects that are tied to a wastewater loan. Any project where there is an existing pollution abatement need is eligible for SRF funding.

6.3.3 Local Programs

Jennings and Jackson counties are both active in obtaining funding and implementing projects in their respective watersheds to improve water quality. Programs taking place at the local level are key to successful TMDL implementation. Partners such as the Jennings and Jackson County SWCDs are instrumental to bringing grant funding into the Vernon Fork Muscatatuck River watershed to support local protection and restoration projects. This section provides a brief summary of the local programs taking place in the Vernon Fork Muscatatuck River watershed that will help to reduce pollutant loads, as well as provide ancillary benefits to the watershed.

Local groups also frequently conduct monitoring in watersheds with watershed management plans to engage the public through Hoosier Riverwatch volunteer monitoring events and through more formal monitoring efforts to determine if implementation activities have been successful in reducing nonpoint source pollutant loads. After best management practices are implemented by local groups, IDEM may also conduct performance monitoring at specific sites in the watershed through the Targeted Monitoring Program. Data collected through performance monitoring is



compared to water quality standards and targets, as discussed in Section 1.0, to determine if previously impaired waterbodies can be delisted from the Section 303(d) List of Impaired Waters.

Jennings County

Jennings County has received the following funding to improve water quality and conservation in 2020 and 2021 (ISDA 2022):

- Local: \$206,730
- Clean Water Indiana: \$20,000
- Conservation Reserve Program & Conservation Reserve Enhancement Program: \$505,612
- Conservation Stewardship Program: \$24,770
- Environmental Quality Incentives Program: \$402,859

Total: \$1,159,971

Jackson County

Jackson County has received the following funding to improve water quality and conservation in 2020 and 2021 (ISDA 2022):

- Local: \$144,948
- Clean Water Indiana: \$60,000
- Wildlife Habitat Cost-Share Program: \$667
- Conservation Reserve Program & Conservation Reserve Enhancement Program: \$1,164,373
- Agricultural Conservation Easement Program: \$1,160,093
- Conservation Stewardship Program: \$976,330
- Environmental Quality Incentives Program: \$515,286

Total: \$4,021,697

6.4 Implementation Programs by Source

Section 6.3 identified a number of federal, state, and local programs that can support implementation of the recommended management or restoration activities for the Vernon Fork Muscatatuck River watershed. Table 48 and the following sections identify which programs are relevant to the various sources in the watershed.



Source	IDEM NPDES program	Local agencies/programs	CWA 319(h) Grants	CWA 205(j) Grants	ISDA Division of Soil Conservation (INFA & CWI)	IDNR Division of Fish and Wildlife (LARE)	IFA State Revolving Fund (SRF) Loan Program)	HUD Community Development Block Grant Program (CDBG)	USDA Conservation Stewardship Program (CSP)	USDA Conservation Reserve Program (CRP)	USDA Conservation Technical Assistance (CTA)	USDA Environmental Quality Incentives Program (EQUIP)	USDA Farmable Wetlands Program	USDA Agricultural Conservation Easement Program (ACEP)	USDA Regional Conservation Partnership Program (RCPP)	USDA Healthy Forests Reserve Program (HFRP)	USDA Voluntary Public Access and Habitat Incentive Program (VPA-HIP)	USDA Watershed Surveys and Planning	USDA Wildlife Habitat Incentives Program (WHIP)	USDA Section 504 Program
Municipal & Industrial Wastewater	Х			х			Х													
Regulated Stormwater	х			х			х													
Illicitly Connected "Straight Pipe" Systems	х	х		x				х												
Cropland		х	х	х	х	х			х	х	х	х	х	Х	х	х	Х	х		
Pastures and Livestock Operations		х	х	х	х	х			х	х	х	х	х	х	х	х	х	х		
CFOs	х			х		х														
Streambank Erosion		Х	х	х	Х	х					х	х	х	Х	Х		Х	х		
Onsite Wastewater Treatment Systems		х		x			х	х												x
In-stream Habitat	х	Х	х			х													Х	
Wildlife/Domestic Pets		Х	х																	
Urban NPS Runoff		х	х																Х	х

Table 48: Summary of Programs Relevant to Sources in the Vernon Fork Muscatatuck River Watershed



6.4.1 Point Source Programs

Municipal Wastewater Treatment Plants (WWTPs)

Municipal Wastewater Treatment Plants (WWTPs) that discharge wastewater through a point source to a surface water of the state are required to obtain a municipal NPDES wastewater permit. Municipal wastewater permits include effluent limitations that are derived using water quality criteria developed to protect all designated and existing uses of the receiving water body and/or any more stringent technology-based limitations. The NPDES program provides IDEM the authority to ensure that recommended effluent limits are applied to the appropriate permit holders within the watershed.

Industrial Wastewater

Industrial facilities that discharge wastewater through a point source to a surface water of the state are required to obtain an industrial NPDES wastewater permit. Industrial wastewater permits include effluent limitations that are derived using water quality criteria developed to protect all designated and existing uses of the receiving water body and/or any more stringent technology-based limitations. The NPDES program provides IDEM the authority to ensure that recommended effluent limits are applied to the appropriate permit holders within the watershed.

Construction Stormwater

Stormwater run-off associated with construction activity is currently regulated under the construction general permit (CGP). The CGP requires the development and implementation of a construction plan that includes a stormwater pollution prevention plan (SWP3). The SWP3 outlines how erosion and sedimentation will be controlled on the project site to minimize the discharge of sediment off-site or to a water of the state. The primary pollutant of concern from active construction sites is sediment, or TSS. TSS TMDLs were developed to address impaired biotic communities in the Storm Creek and Mutton Creek subwatersheds. Identification of impaired waters with TMDLs, specifically those with TSS TMDLs, in the SWP3 is recommended to ensure adequate stormwater control measures are implemented to minimize discharges of sediment to impaired waters. It is assumed that permitted construction sites that are in compliance with the construction stormwater general permit meet the requirements of the TMDL. However, in order to ensure sediment-laden stormwater discharges from construction sites to impaired waters with TMDLs are minimized, implementation of additional measures may be considered, such as:

- Identify any waterbodies within the project site that have a U.S. EPA approved or established TMDL, including the name of the TMDL and pollutant(s) for which there is a TMDL.
- Increase self-monitoring in locations on the project site that discharge to impaired waters with TSS TMDLs.



- Improve construction sequencing to limit the amount of exposed soil at any given time as much as possible throughout the project.
- Increase frequency of stabilization of areas that are void of vegetative cover. When an area is left idle for seven days initiate stabilization. Stabilization includes permanent stabilization with structured armor, permanent seed mixes, or temporary seed mixes.
- Place signage or easily identifiable barriers, such as orange safety fencing, near impaired waters to alert construction crews of the sensitive resource.
- Increase the maintenance schedule of measures installed adjacent to impaired waters with TSS TMDLs to promote effective sediment removal.

Industrial Stormwater

Stormwater run-off associated with industrial activity is currently regulated under 327 IAC 15-6, which is commonly referred to as "Rule 6" or the industrial stormwater general permit. Facilities may also be required to obtain an individual stormwater permit as discussed in Section 2.7.3. There are a total of 21 industrial facilities with industrial stormwater general permits within the Vernon Fork Muscatatuck River watershed. The industrial stormwater general permit and individual stormwater permits require the development and implementation of a stormwater pollution prevention plan (SWP3). The SWP3 must identify potential sources of pollution that may reasonably be expected to affect the quality of stormwater discharges exposed to industrial activity from the facility. Good housekeeping practices and stormwater. It is assumed that permitted facilities that are in compliance with their permit meet the requirements of the TMDL. However, in order to ensure pollutant-laden stormwater discharges from permitted facilities to impaired waters with TMDLs are minimized, implementation of additional measures may be considered, such as:

- Identify U.S. EPA approved or established TMDLs, including the name of the TMDL and the pollutant(s) for which there is a TMDL, in the SWP3.
- Increase the frequency of visual inspections of stormwater management measures in locations that discharge to impaired waters with TMDLs beyond the quarterly requirement.
- Increase the frequency of monitoring at outfalls that discharge to impaired waters with TMDLs beyond the annual requirement.
- Increase the maintenance schedule of stormwater management measures installed adjacent to impaired waters with TMDLs to promote effective pollutant removal.

Municipal Separate Storm Sewer Systems (MS4)

Stormwater run-off from certain types of urbanized areas are required to obtain permit coverage under the MS4 general permit. According to the MS4 general permit, when a MS4 entity



determines that stormwater discharges from any part of its MS4 flows to a waterbody with a U.S. EPA approved TMDL, the MS4 must determine if the discharges have any pollutant(s) of concern relative to the TMDL. There is currently one MS4 entity in the Vernon Fork Muscatatuck River watershed, which is the City of Seymour (INR040082). The City of Seymour is located within the Mutton Creek subwatershed. The pollutants of concern for this subwatershed are E. coli, total phosphorus, and total suspended solids. The MS4 general permit states that "the MS4 entity must implement a program and update its SWQMP to incorporate appropriate stormwater management measures that will be implemented to reduce loadings of the pollutant(s) of concern and achieve the applicable WLA." Therefore, in order to achieve the WLA discussed in Section 5.1.1, the MS4 entity should take actions and implement BMPs that focus on the reduction of *E. coli*, total phosphorus, and TSS in stormwater. Domestic pets, urban wildlife, leaking sanitary sewers exfiltrating to storm drains, and failing septic systems are potential sources of E. coli in urban stormwater (Clary et al, 2014). Potential sources of phosphorus and sediment in urban stormwater also include fertilizer applied to lawns, plant and leaf litter, pet waste, soil particles, runoff from unregulated construction activities, and illicit discharges and connections. Table 47 includes a list of potentially suitable BMPs for implementation in the Vernon Fork Muscatatuck River watershed. Section 6.5 includes information regarding online resources available for estimating pollutant load reductions in order to optimize BMP selection. Additional implementation options for reducing *E. coli*, total phosphorus and TSS include, but are not limited to:

- Public outreach and education regarding proper septic system maintenance and replacement
- Detection and elimination of straight pipes and sanitary sewer pipes connected to storm sewer systems
- Public outreach and education regarding disposal of pet waste
- Public outreach and education regarding fertilizer application to domestic lawns
- Adoption and enforcement of pet waste ordinances
- Dry weather storm drain screening
- Installation of BMPs that increase detention of storm water run-off and reduce pollutant loading in stormwater run-off.
- Storm sewer maintenance
- Landscape modification to deter waterfowl near stormwater detention and retention ponds

<u>CAFOs</u>

CAFOs are point sources regulated through the NPDES Program. Indiana regulations for CAFOs can be found in 327 IAC 15-15 and federal regulations for all CAFOs can be found in 40 CFR Parts 9, 122, and 412. The Effluent Limitations Guidelines and New Source Performance



Standards for CAFOs require, in general, zero discharge from these areas and require proper design, construction, operation, and maintenance of the structures to contain all manure, litter, and process wastewater including the run-off and direct precipitation from a 25-year, 24-hour rainfall event. The NPDES general permit also requires that water quality standards shall not be exceeded in the event of an overflow from production areas. There are no CAFOs in the Vernon Fork Muscatatuck River watershed.

Examples of requirements for CAFO operators include

- weekly inspections of waste storage facilities
- develop a Soil Conservation Practice Plan for all manure application sites controlled by the CAFO
- develop a Stormwater Pollution Prevention Plan for the area immediately around the production barns
- submit an annual report to IDEM
- adjust land application rates based on nitrogen and phosphorus

Illegal straight pipes

Local health departments are responsible for locating and eliminating illicit discharges and illegal connections to the sewer system.

6.4.2 Nonpoint Sources Programs

Cropland

Nonpoint source pollution from cropland areas is typically reduced through the voluntary implementation of BMPs by private landowners. Programs available to support implementation of cropland BMPs, whether through cost-share or technical assistance and education, include:

- Clean Water Act Section 319(h) Grants
- Clean Water Act Section 205(j) Grants
- Indiana State Department of Agriculture Division of Soil Conservation/SWCDs (CWI & INFA)
- Indiana Department of Natural Resources Division of Fish and Wildlife (LARE)
- USDA Conservation Stewardship Program (CSP)
- USDA Conservation Reserve Program (CRP)
- USDA Conservation Reserve Enhancement Program (CREP)
- USDA Conservation Technical Assistance (CTA)
- USDA Environmental Quality Incentives Program (EQIP)



- USDA Farmable Wetlands Program
- USDA Agricultural Conservation Easement Program (ACEP)
- USDA Regional Conservation Partnership Program (RCPP)
- USDA Healthy Forests Reserve Program (HFRP)
- USDA Voluntary Public Access and Habitat Incentive Program (VPA-HIP)
- USDA Watershed Surveys and Planning

Pastures and Livestock Operations

Nonpoint source pollution from pasture and livestock areas is typically reduced through the voluntary implementation of BMPs by private landowners. Programs available to support implementation of pasture and grazing BMPs, whether through cost-share or technical assistance and education, include:

- Clean Water Act Section 319(h) Grants
- Clean Water Act Section 205(j) Grants
- Indiana State Department of Agriculture Division of Soil Conservation/SWCDs (CWI & INFA)
- Indiana Department of Natural Resources Division of Fish and Wildlife (LARE)
- USDA Conservation Stewardship Program (CSP)
- USDA Conservation Reserve Program (CRP)
- USDA Conservation Reserve Enhancement Program (CREP)
- USDA Conservation Technical Assistance (CTA)
- USDA Environmental Quality Incentives Program (EQIP)
- USDA Farmable Wetlands Program
- USDA Agricultural Conservation Easement Program (ACEP)
- USDA Regional Conservation Partnership Program (RCPP)
- USDA Healthy Forests Reserve Program (HFRP)
- USDA Voluntary Public Access and Habitat Incentive Program (VPA-HIP)
- USDA Watershed Surveys and Planning

<u>CFOs</u>

While CAFOs are regulated by federal law, CFOs are not. However, Indiana has CFO regulations 327 IAC 16 and 327 IAC 15 that require that operations manage manure, litter, and process wastewater in a manner that "does not cause or contribute to an impairment of surface



waters of the state." IDEM regulates CFOs under IC 13-18-10, the Confined Feeding Control Law. The rules at 327 IAC 16, which implement the statute regulating CFOs, were effective on March 10, 2002. IDEM's Office of Land Quality administers the regulatory program, which includes permitting, compliance monitoring, and enforcement activities.

Streambank Erosion

Streambank erosion can be the result of changes in the physical structure of the immediate bank from activities such as removal of riparian vegetation or frequent use by livestock, or it can be the result of increased flow volumes and velocities resulting from increased surface run-off throughout the upstream watershed. Therefore, streambank erosion might be addressed through BMPs and restoration targeted to the specific stream reach, and further degradation could be addressed through the use of BMPs implemented to address stormwater issues throughout the watershed. Programs available to support implementation of BMPs to address streambank erosion, whether through cost-share or technical assistance and education, include:

- Clean Water Act Section 319(h) Grants
- Clean Water Act Section 205(j) Grants
- Indiana State Department of Agriculture Division of Soil Conservation/SWCDs (CWI & INFA)
- Indiana Department of Natural Resources Division of Fish and Wildlife (LARE)
- USDA Conservation Technical Assistance (CTA)
- USDA Environmental Quality Incentives Program (EQIP)
- USDA Farmable Wetlands Program
- USDA Agricultural Conservation Easement Program (ACEP)
- USDA Regional Conservation Partnership Program (RCPP)
- USDA Voluntary Public Access and Habitat Incentive Program (VPA-HIP)
- USDA Watershed Surveys and Planning
- Mitigation Funds

Onsite Wastewater Treatment Systems

Local health departments and the Indiana Department of Health (IDOH) regulate septic systems through local ordinances and the Onsite Sewage Disposal Program (410 IAC 6-8.3). Regulations include constraints on the location and design of current septic systems in an effort to prevent system failures. The onsite sewage system rule also prohibits failing systems, requiring that no system will contaminate groundwater, and no system will discharge untreated effluent to the surface. Programs available to address issues related to failing onsite wastewater treatment systems within a community include:



- Clean Water Act Section 205(j) Grants
- IFA State Revolving Fund Loan Program
- HUD Community Development Block Grant Program (CDBG)
- USDA Section 504 Program

Wildlife/Domestic Pets

Addressing pollutant contributions from wildlife and domestic pets is typically done at the local level through education and outreach efforts. For wildlife, educational programs focus on proper maintenance of riparian areas and discouraging the public from feeding wildlife. For domestic pets, education programs focus on responsible pet waste maintenance (e.g., scoop the poop campaigns) coupled with local ordinances.

6.5 Potential Implementation Partners and Technical Assistance Resources

Agencies and organizations at the federal, state, and local levels will play a critical role in implementation to achieve the WLAs and LAs assigned under this TMDL. Table 49 identifies key potential implementation partners and the type of technical assistance they can provide to watershed stakeholders. IDEM has also compiled a matrix of public and private grants and other funding resources available to fund watershed implementation activities. The matrix is available on IDEM's website at http://www.in.gov/idem/nps/3439.htm.

Potential Implementation Partner	Funding Source
	Federal
USDA	Conservation Stewardship Program
USDA	Conservation Reserve Program
USDA	Conservation Technical Assistance (technical assistance only)
USDA	Environmental Quality Incentives Program
USDA	Farmable Wetlands Program
USDA	Agricultural Conservation Easement Program
USDA	Regional Conservation Partnership Program
USDA	Healthy Forests Reserve Program
USDA	Voluntary Public Access and Habitat Incentive Program
USDA	Watershed Surveys and Planning
USDA	Section 504 Home Repair Program
HUD	Community Development Block Grant Program

Table 49: Potential Implementation Partners in the Vernon Fork Muscatatuck River Watershed



Potential Implementation Partner	Funding Source
	State
ISDA	Division of Soil Conservation – Clean Water Indiana Program
ISDA	Division of Soil Conservation – INfield Advantage Program
IDNR	Division of Fish and Wildlife - Lake and River Enhancement program
IDEM	Clean Water Act Section 319(h) Grants
IDEM	Clean Water Act Section 205(j) Grants
	Local
Soil and Water Conservation Districts	Local funds
County Health Departments	Local funds

In addition, several tools are available to assist local watershed stakeholders with the estimation of pollutant load reductions from the implementation of various BMPs within the Vernon Fork Muscatatuck River watershed in order to optimize BMP selection. These tools include L-THIA LID, STEPL, the Region 5 Model, and the Indiana *E. coli* Calculator.

The Long-Term Hydrologic Impact Assessment (L-THIA) model is an online tool developed by Purdue University that estimates runoff, recharge, and pollutant loads for land use configurations based on precipitation data, soils, and land use data for an area. The L-THIA LID model is an enhancement to the original model, which can be used to simulate runoff and pollutant loads associated with low impact development (LID) practices at lot to watershed scales. The model can be used as a screening tool to evaluate the benefits of implementation of LID practices. LID practices included in the model include, but are not limited to, grass swales, rain barrel/cisterns, rain gardens, and porous pavement. The L-THIA LID tool is available online at https://engineering.purdue.edu/mapserve/LTHIA7/lthianew/lidIntro.php.

The Spreadsheet Tool for Estimating Pollutant Loads (STEPL) employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various BMPs. STEPL provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft Excel. It computes watershed surface runoff, nutrient loads, and sediment delivery based on land use distribution and management practices. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using known BMP efficiencies. The STEPL package can be downloaded at https://www.epa.gov/nps/spreadsheet-tool-estimating-pollutant-loads-stepl. Purdue University has also developed a web-based version of STEPL available at https://engineering.purdue.edu/mapserve/ldc/STEPL/?.

The Region 5 Model is a Microsoft Excel workbook that provides a gross estimate of sediment and nutrient load reductions from the implementation of agricultural and urban BMPs. The



model was developed by the U.S. EPA Region 5 and the Michigan Department of Environmental Quality. It does not estimate pollutant load reductions for dissolved constituents. The algorithms for non-urban BMPs are based on the Michigan Department of Environmental Quality's "Pollutants controlled: Calculation and documentation for Section 319 watersheds training manual". The algorithms for urban BMPs are based on the data and calculations developed by Illinois EPA. The Region 5 Model download and training materials can be found at <u>https://www.epa.gov/nps/region-5-model-estimating-pollutant-load-reductions</u>.

The Indiana *E. coli* Calculator (IEC) is a spreadsheet tool that estimates the *E. coli* contribution from multiple sources and calculates load reductions of BMP installations. The portions of the spreadsheet that calculate *E. coli* contributions are heavily based upon the U.S. EPA's Bacteria Indicator Tool (BIT). The BIT estimates the monthly accumulation rate of fecal coliform bacteria on four land uses (cropland, forest, built-up, and pastureland). The tool also estimates the direct input of fecal coliform bacteria to streams from grazing agricultural animals and failing septic systems. The IEC converts the fecal coliform values of the BIT to *E. coli* through a conversion equation based on Ohio water quality sampling results. The IEC is available in a condensed version as well as an expanded version. The IEC spreadsheet and user guide can be found at https://www.in.gov/idem/nps/watershed-toolkit/planning/.



7.0 PUBLIC PARTICIPATION

Public participation is an important and required component of the TMDL development process. The following public meetings were held in the watershed to discuss this project:

- A virtual public kickoff meeting was held in on October 27, 2020 to introduce the project and solicit public input. IDEM explained the TMDL process and presented initial information regarding the Vernon Fork Muscatatuck River watershed. Questions were answered from the public, and information was solicited from local stakeholders.
- On June 14 and 16, 2021, IDEM partnered with the Jennings County SWCD to host a TMDL public outreach event at the Jennings County Fair in North Vernon, Indiana. IDEM staff were on-site to explain the project and their processes for collecting water chemistry, fish, and macroinvertebrates. The details of the partnership between the Jennings County SWCD and IDEM were detailed as well.
- On March 16, 2022 a notice was posted to the IDEM TMDL Reports webpage and to the IDEM Public Notices webpage to inform stakeholders of new impairments discovered during the 2020-2021 watershed characterization study in the Vernon Fork Muscatatuck River watershed. The notice outlined the findings of the study and listed proposed additions/deletions to the 2024 303(d) List of Impaired Waters. Public comments were solicited through April 30, 2022. IDEM received no comments regarding the notice.
- A draft TMDL public meeting was held in the watershed at the Jennings County Public Library in North Vernon, Indiana on July 14, 2022 at 10:00 AM. The findings of the TMDL study were presented at the meeting and the public had the opportunity ask questions and provide information to be included in the final TMDL report. A public comment period begins July 15, 2022 through August 15, 2022.



References

- Bauers, C., Gosnell, M., Ooten, R., Bowman, J., et al. 2006. Acid Mine Drainage Abatement and Treatment (AMDAT) Plan for the Leading Creek Watershed. Columbus, Ohio: Ohio Environmental Protection Agency. Retrieved from: <u>https://www.epa.state.oh.us/portals/35/tmdl/Leading%20Creek%20AMDAT_final_5-12-06.pdf</u>
- Clary, J., Pechacek, L.D., Clark, S., et al. 2014. *Pathogens in Urban Stormwater Systems*. UWRRC Technical Committee Report. Retrieved from: <u>http://www.asce-</u>

pgh.org/Resources/EWRI/Pathogens%20Paper%20August%202014.pdf

- Diffenbaugh, N.S., Pal, J.S., Trapp, R.J., Giorgi, F. 2005. *Fine-Scale Processes Regulate the Response of Extreme Events to Global Climate Change*. Proceedings of the National Academy of Sciences of the United States of America, 102: 15774-15778.
- Flemming, A.H., Bonneau, P., Brown, S.E., et al. 1995. Open-File Report 95-7: Atlas of Hydrogeologic Terrains and Settings of Indiana, Final Report to the Office of the Indiana State Chemist, Contract No. E005349-95-0. Bloomington, Indiana: Indiana Geological Survey.
- Horsley and Witten, Inc. 1996. *Identification and Evaluation of Nutrient and Bacterial Loadings to Maquoit Bay, New Brunswick and Freeport, Maine*. Prepared by Horsley and Witten, Inc., Barnstable, MA for Casco Bay Estuary Project, Portland, ME.
- Indiana Department of Environmental Management (IDEM). 2010. Hydrologic Unit Codes: What Are They? Indianapolis, Indiana: Indiana Department of Environmental Management. Retrieved from: <u>https://www.in.gov/idem/nps/2422.htm</u>
- Indiana Department of Environmental Management (IDEM). 2019. Procedures for Completing the Qualitative Habitat Evaluation Index. B-003-OWQ-WAP-XX-19-T-R0. Watershed Planning and Assessment Branch, Office of Water Quality, Indiana Department of Environmental Management, Indianapolis, IN.
- Indiana State Department of Agriculture (ISDA). 2019. Cover Crop and Tillage Transect Data. Indianapolis, Indiana: Indiana State Department of Agriculture. Retrieved from: <u>https://secure.in.gov/isda/2383.htm</u>
- Indiana Department of Natural Resources (IDNR). 2017. List of Endangered, Threatened, and Rare Species by County. Indianapolis, Indiana: Indiana Department of Natural Resources. Retrieved from: <u>https://www.in.gov/dnr/naturepreserve/4666.htm</u>



- Indiana Department of Health (IDOH). 2020. Onsite Sewage Systems Program. Indianapolis, Indiana: Indiana State Department of Health. Retrieved from: <u>https://www.in.gov/health/eph/onsite-sewage-systems-program/</u>
- Palmer, J., Ridge, N., Caudill, G.D., Bryan, S. 2019. *More Than 11,000 Wastewater Failures Reported in Indiana's Unsewered Communities*, Issue 19-C08. Indianapolis, Indiana: Indiana Advisory Commission on Intergovernmental Relations. Retrieved from: <u>http://www.iacir.spea.iupui.edu/documents/RCAPbrief_Web.pdf</u>
- Patwardhan, A.S., Donlglan Jr, A.S. 1997. *Assessment of Nitrogen Loads to Aquatic Systems*. EPA-600-SR-95/173. U.S. Environmental Protection Agency, National Exposure Research Laboratory, Athens, GA.
- Purdue Climate Change Research Center. 2008. *Impacts of Climate Change for the State of Indiana*. West Lafayette, Indiana. Retrieved from: <u>https://ag.purdue.edu/indianaclimate/wp-</u> content/uploads/2018/12/ClimateImpactsIndiana 2008-Report.pdf
- U.S. Census Bureau. 2012. Indiana 2010: Summary Population and Housing Characteristics. Washington, DC: U.S. Department of Commerce. Retrieved from: <u>ftp://ftp2.census.gov/library/publications/2012/dec/cph-1-16.pdf</u>
- U.S. Department of Agriculture (USDA). 2019. National Agricultural Statistics Service Cropland Data Layer. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service. Retrieved from: <u>https://nassgeodata.gmu.edu/CropScape/</u>
- U.S. Department of Agriculture (USDA). 2009. *Hydrologic Soil Groups*. National Engineering Handbook. Washington, DC: U.S. Department of Agriculture, Natural Resources Conservation Service. Retrieved from: <u>https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=22526.wba</u>
- U.S. Environmental Protection Agency (U.S. EPA). 2018. SepticSmart Homeowners. Washington, DC: U.S. Environmental Protection Agency. Retrieved from: <u>https://www.epa.gov/septic/septicsmart-homeowners</u>
- U.S. Environmental Protection Agency (U.S. EPA). 2007. *An Approach for Using Load Duration Curves in the Development of TMDLs*. EPA-841-B-07-006. Washington, DC: U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds. Retrieved from: <u>https://www.epa.gov/tmdl/approach-using-load-duration-curves-</u> <u>development-tmdls</u>
- United States Geological Survey (USGS). 1999. *National Water Summary on Wetland Resources*. Washington, DC: United State Geological Survey. Retrieved from: <u>https://water.usgs.gov/nwsum/WSP2425/state_highlights_summary.html</u>



Appendices



APPENDIX A. WATER QUALITY DATA FOR THE VERNON FORK MUSCATATUCK RIVER WATERSHED TMDL

Subwatended	AUD	štream	IDEM Station ID Site	• e totation	Dute	% Saturation	Alkalinity (mg/L) Caldium (mg	(Noride (mg/t)	Californis (Total)	00 (mg/4) E. cali Harde	west (mg/k) Magn	ecium (mg/t) Ammo	ia Nitrogen, Nitrote-Nitrita	SH (SU)	Total Phosphorus Tes	atal Sugerded	fotal Solids (mg,K)	fotal Dissolved Solids	Specific Conductance	Sulfate (mg/L)	Temperature ("C) TEX	(mg/t) TOC (ugiti Turbidity (MTU	2020 303(d) tisting	Draft 2024 808(d) Listing Decklon	Petertial Sources
					*******	90.5 94.9	190	57 16 58 18		10.56 12.47		14 0.28 14 0.2	0.85	7.83	0.07 0.053	1.7 2	290 250	(mgt) 340 230	(maft) 396 432	24 23						E. col: Sewage discharges in unsewered areas + Widlife other than waterfowl + Livestock (grazing or feeding operations
	INW0771_02	Verrion Fork Muscatatuck Biver	WEM070-0036 T2	3 County Road 400 W		94.4 94.3 88 90.4 85 86 86.1 88.6 111.2 87.8 87.8	170	55 14 53 11 33 9.4 54 18 54 12 55 12	2419.6 2419.6 3419.6	20.55 12.47 13 11.78 9.55 1201.1 7.01 156.4 6.85 1504.6 7.46 1206.1 7.57 224.7 9 33.9 7.54 48 8.65 35 8.66 35 8.66 35	200	14 0.28 14 0.2 12 0.15 12 0.5 16 0.2 17 0.19 18 0.2 19 0.2 12 0.19 12 0.2 13 0.2 15 0.2	0.6	7.92 7.85 7.92 7.79 7.76 7.76 7.76 7.76 7.74 7.71 8.01 7.66	0.07 0.063 0.085 0.079 0.22 0.49 0.17 0.15	2 7 49 60 22 19 23	290 250 240 240 180 320 280 240	340 230 170 150 210 220 210	411 208 244 375 311 268 332 397 421.9	24 23 26 9.8 8.9 26 33 35 33 24 24	22.4 22.8 36.1	0.7 3. 0.54 2. 0.17 2. 0.99 7. 3.1 3 0.76 5. 0.48 3.	4.33 1 11.4 2 67 119 2 20.2 5 20 72.6 22.3 21 3 20.5	N/A	E. coli	
Indan Creek	INW0771_03	Vernen Folt Musicalatack River	VVEM078-0001 T2	5 County Road 60 5		00.5 94.9 94.9 94.4 80.4 80.1 80.1 80.1 80.1 80.1 80.1 80.1 80.1	140 120 45.5 1273 57.1 1274 45.1 1275 44.1 99 127.3 121 25.2 121 25.2 121 25.2 121 37.6 121 37.5 120 32 120 40 120 54 120 54 120 40	43 11 48 15 17 17 17 16 16 16 16 16 16 16 16 17 10 11 17 10 10 14 12 12 12 14	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	14.02 14.8 12.16 13.27 8.68 8.29 7.52 7.64 9.60 9.60 9.60 9.60 9.60 9.60 9.60 9.60 9.60 9.60 9.7 13.86 9.10 9.60 9.2	186 206 100 190 140	9.9 0.2 12 0.2 141 0.1 159 0.1 159 0.1 142 0.1 142 0.1 143 0.2 9.2 0.1 9.4 0.1 9.1 0.1 15.4 0.1 15.4 0.1 15.4 0.2 15.6 0.22 15.6 0.2 15.6 0.2 15.6 0.2 15.6 0.2 15.7 0.	0.4 12 13 14 0.3 2.7 2.9 13 14 0.5 13 12 0.7 13 16 46 14	7.83 7.99 7.925 7.925 7.927 7.76 7.77 7.77 8.07 7.77 8.07 8.25 8.07 7.75 8.25 8.07 7.9 7.9 8.25 8.07 7.9 8.04 8.07 7.9 7.9 7.9 8.04 8.04 7.9 8.05 8.05 7.9 8.05 8.05 7.90 8.05 8.05 7.90 8.05 8.05 7.90 8.05 8.05 7.90 7.90 8.05 7.90 8.05 7.90 7.90 8.05 7.90 8.05 7.90 7.90 7.90 7.90 8.05 7.90 7.90 7.90 7.90 7.90 7.90 7.90 7.90	0.085 0.041 0.041 0.041 0.081 0.081 0.085 0.085 0.235 0.156 0.156 0.041 0.041 0.041 0.041 0.15 0.16 0.15 0.16	#.8 7 10 10 10 10 10 10 10 10 10 10 10 10 10	330 340 244 234 235 235 237 238 300 272 237 237 237 237 237 237 237	170 221 229 200 100 100 100 100 100 100 100 200 200	306 432 432 432 348 353 313 313 322 468 325 468 325 457 457 457 457 457 457 457 457 457 45	12 20 24 26 26 13 30 30 30 30 30 30 22 26 9.4 9.2 29 44 20 20 20 20 20 20 20 20 20 20 20 20 20	22.1 4 2.5 0.5 6.8 10 21.2 21.2 21.4 24.9 28.7 28.9 9.8 2.8 13 12.8 0.8 22.4 22.5 22.1 22.5 22.5 22.9	0.45 2 0.57 3 0.44 4 0.4 3 0.1 3 0.1 1 0.5 3 0.5 2 1.3 6 1.3 5 0.7 5 0.6 2 1.3 6 0.7 5 0.6 2 1.3 6 0.7 5 0.7 5 0.6 2 1.3 6 1.3 7 0.7 5 0.6 2 1.3 6 1.3 7 0.7 5 0.7 5 0.6 2 1.3 6 1.3 7 0.7 5 0.6 2 1.3 6 1.3 7 0.7 5 0.7 5 0.7 5 0.7 5 0.7 5 0.7 5 0.7 5 0.7 1 0.7 2 1.2 7 0.1 2 0.1 2 0.2 2 0.2 4 0.2 4	2 7.35 1 24.8 8.65 5 31.7 7 3.77 2 34.9 7 232 2 235 2 235 2 34.9 7.87 8.52 6.54 103 103 103 5 4.6 61.1 12 5 4.2 4.2 5 4.2 5 4.2 5 4.2 5 4.2 5 4.2 5 4.2 5 5.75 5 7.75 5 7.75 5 7.75 5 7.75 5 7.75 5 7.75 5 7.75 5 7.75 7 7.75 7 7 7 7 7 7 7	E. col, Hg (FT)	E.col.7g(P)	E sik Senge debuga is unsensed som i Hilde aller for notebool
	INW0771_04 INW0771 T1001				AT/0.0417/0.017	94.4	150 50	15	2419.6	8.44 41.4	180	12 0.2	0.81	7.84	0.14	5	260	170	381.2	21	20.7 0	0.47 4	7 1.1	E. coli, Hg (FT)	E. col, Hg (FT)	
	INW0771_T1001A INW0771_T1001B INW0771_T1002																									
	INW0771_T1003 INW0771_T1004																									
	INW0771_T1005 INW0791041_00																							E. coli, Hg (FT)	E. col, Hg (FT)	
	INW0772_01A	Sientie Oreek	WEM-07-0020 T2	2 State Road 7		93.8 92 75.3 34.9 86.3 69.3 28.3 50.7 63.5 48.5 48.5 45.2	99 40 140 47 130 57 170 68 200 80	54 33 85 59 29	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	7.59 1986.3 6.42 1732.9		9.8 0.13 11 0.12 14 0.21 17 0.2 20 0.2	1.7	7.8 7.58 7.65 7.18 7.55 7.23 7.23 7.23 7.23 7.24 7.54 7.11 7.19	0.13 0.11 0.092 0.055 0.055 0.053	13 6.5 2.2 5	280 380 390 430 480	250 340 360 420 460 380	403 449 619 296 461 533 627 715 651	32 31 42 52 60	19	0.98 9. 0.87 6. 0.53 5. 0.32 3. 0.48 2. 0.75 4. 0.48 5.	9.55 2.69 4 5.86	N/A	E. col, IBC, DO	E. all legal sharps in user and anno Barran state and anno state and anno state anno state 20 San a report ann (bar find)
	INW0772 03				*******		200 73 190 72	49 27	2419.6			18 0.11 17 0.2	0.32			5 2.8	380	320	602	60 31	18.9 0	0.75 4. 0.48 5.		IIC	E. coli. IBC	E. col: Sewage discharges in unsewared areas
	100/0772_04	Sizele Creek	WEM-07-0019 72	1 County Road 175 N		96.4 93.9 69.8 71 83.5 76.3 75.2 74.9 84.4 77.5	91 33 92 34 120 49 89 34 90 29 97 31	35 28 42 21 13	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	9.88 93.4 9.45 261.3 6.27 209.8 6.01 313 7.05 193.5 6.52 194.5 6.55 195.5 7.15 6.65 193.5 7.15		7.8 0.12 7.7 0.17 11 0.21 8 0.2 7 0.2 8 0.2	1.4	E.03 7.93 7.61 7.65 7.56 7.56 7.61 7.66 7.79 7.61	0.13 0.25 0.47 0.19 0.5	15 15 4.4 5.8 5.8	190 290 280 210 290	200 250 210 200 260	362 331 521 245 23.1 250 271.3 276.7 792.4	28 22 30 29 15 15	54.2 0 15 0 20.6 0 23.8 0 23.8 0 23.1 0 22.4 0 23.1 0 22.4 0 23.1 0 22.4 0 23.1 0 23.2 0 23.0 0	0.92 6. 0.67 7. 0.88 7. 0.84 6.	1 16.4 7 18.7 5 6.21 1 7.56 21.2 16.8 7.59 2 8.29 10.2 8 9.9	N/A	E. col	E als Tenge febryen nurseend ena valdte der Rovandelat
Skrrile Creek	INW0772_05	Samle Greek	WEM-07-0018 T2	D County Read 200 S		95.4 92.9 62.8 71 83.5 76.3 75.2 84.4 100.8 84.4 100.8 81.4 100.8 81.4 100.8 81.2 91 95.3 82 92.9 80.1 100.7	97 37 90 35 98 39 120 48 120 53	16 18 32 27 33 28 28	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	8.09 613.1 7.93 307.6	120 140 170 190	8.7 0.12 9.5 0.17 12 0.23 14 0.2 9.1 0.2	1.2	E.03 7.93 7.65 7.56 7.56 7.61 7.66 7.61 7.69 7.61 8.11 E.07 7.79 7.61 8.11 E.07 7.79 7.94 7.88 7.79 7.94 7.79 7.94 7.79 7.93	0.35 0.088 0.17 0.29 0.25 0.37	5.2 12 13 8.4 8 9.6 24	230 330 200 180 330 290 360 270 270 500 240	260 160 160 270 220 320	362 331 321 289 246 21.1 271.3 270.7 322.4 334 355 420 455 266 420 455 265 330.4 332.2 331.9 332.2 331.9 332.2	26 29 35 36 76 31 31	23.5 22.5	0.79 6. 1.1 6. 0.59 5. 0.89 5. 0.65 6. 0.65 6. 0.66 5. 0.68 5. 0.68 5. 0.68 5. 0.68 5. 0.68 6. 0.57 5. 0.59 6. 0.59 6. 0.59 6. 0.59 6. 0.59 6. 0.68 5. 0.68	11.7 22 11.1 4 11.7	N/A	E. coli	E sell Sengerdinbegen in unserveral anna + kreistak (gening or fendre operations)
	19840772_06	Sientle Greek	WEM-07-0017 T1	9 County Read 500 S		102.7 105.5 94.7 94.4 105.8 105.8 102.1 113.4 90.4 95.8 84.8 105.9 102.6 118.4 118.4	110 43 120 44 110 43 120 47 120 47 120 52 120 52 120 45 120 47 120 47 120 47 120 45	20 19 17 17 28 30 27 31 24 20 20 21	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	10.35 13.01 13.33 13.15 10.07 727 10.83 201.4 7.03 200.3 8.8 231 7.68 1046.2 8.15 446.1	150 170 180 130 130 190 160	12 0.2 10 0.2 11 0.2 12 0.2 13 0.2 14 0.2 15 0.2 16 0.1 14 0.3 14 0.3 14 0.3 14 0.3 14 0.3 14 0.2 13 0.2 14 0.2 13 0.2 14 0.2 15 0.2 15 0.2 16 0.2 17 0.2 18 0.2 18 0.2 19 0.2 19 0.2 19 0.2 19 0.2 19 0.2 10 0.2	0.65 1.1 1.4 1.3 0.52 0.53 1.5 0.4	7.57 7.63 8.09 7.99 8.18 7.99 7.99 8.18 7.99 7.9 8.05 7.54 7.55 7.57 8.03 7.9 8.18 7.9 8.18 7.55 7.67 8.03 7.92	0.32 0.24 0.12 0.14 0.14 0.14 0.14 0.16 0.18 0.15 0.17 0.17	14 6.6 5.5 6.5 13 28 28 28 12 12 12 12 12	320 240 270 240 290 340 290 340 290 350 350	240 180 130 130 230 130 240 250 250 250 310 310	302.1 308.8 372 373 367 350 355 329 430 377 255 291 349 340 407 407 407	30 36 49 49 45 35 35 35 27 49 42 42 60 57	20.7 0 8.2 2.2 0 1.2 0 3.5 0 34.7 0 23 0 28.4 0 23.5 23.5 23.4	0.89 6. 0.63 6. 0.7 4. 0.33 3. 0.35 3. 0.6 3. 0.61 5. 0.91 6. 0.61 5. 0.91 6. 0.91	7 5.84 5 8.71 7 13.5 4 24.5 8 26.1 3 25.8 3 12.7 2 14.9 39.6 34.4 34.4	N/A	E. col	E alt Caffed and field question (MG) + using distance in summer dawn + wildle she than watched
	INW0772 T1001 INW0772_T1003 INW0772_T1004						120 45		Pilling	1.11 1.10.1	110		0.10	7.04					444.7							
	INW0772 T1004 INW0772 T1005 INW0772 T1005A																									
	INW07P3016_00 INW07P3071_00 INW07P3073_0P																									
	INW0773_01	Storm Creek	WEM-07-0014 T1	E Base Road		84 86.5 80.7 66.5 82.2 78.4 67.9 71 79 56.4	140 44 130 41 75 34 180 57 180 53 180 53	15 14 19 17 17 14 14 12	1553.1 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	8.8 193.5 9.53 201.4 7.27 2419.6 5.76 325.5 7.26 379.4 6.05 547.5 5.01 435.2 6.63 648.8 6.77 4.97 4.07 2419.6 3.79 285.1		12 0.13 11 0.15 9 0.28 15 0.2 13 0.2 14 0.2	0.81	7.85 7.94 7.34 7.51 7.6 7.34 7.37 7.43 7.6 7.5	0.059 0.05 0.7 0.07	4 6 210 2.2 4.2 7.2	170 270 450 270	180 270 190 290 280 280	355 345 272 429 354 350 394 414.8 311.3 414.8	22 29 29 28 25 25	21.5 21.2 22.2	0.58 6. 0.64 4. 1.8 3 0.27 3. 0.41 2. 0.55 3.	3 11.5 7 9.55 8 105 1 3.66 10.9 7.44 4.56 8 5.15 4.21 7 3.71	IEC	E. coli	 ask Carlinda annal Rading operation, (201) + arrange discharges in unaversited anna
	1100/0773_02	Storm Greek Ditch	WEM080-0013 T3	E County Road 400 N		84 86.5 86.5 86.5 86.5 86.5 7.1 7 9 7 9 7 9 7 9 7 9 7 9 7 9 7 8 8 8 7.6 8 8 7.7 8 8 8 7.6 8 8 7.7 8 8 8 7.7 8 7.8 7.8 7.8 7.8 7.8	180 51 160 45 140 47 90 30 82 30 110 33 94 29 75 29 140 42	12 15 9.5 10 13 12 12 12 12 12	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6		160 180 170 110 120 120 120 120 120 120	14 0.2 12 0.2 13 0.11 8.3 0.1 8 0.2 9.2 0.24 7.9 0.22 13 0.31 14 0.2 15 0.2 16 0.2 17 0.2 18 0.2 19 0.2 10 0.2 11 0.2	0.1 0.3 0.52 0.52 0.55 0.21 0.63 1.9 0.27	7.85 7.94 7.34 7.34 7.34 7.5 7.34 7.5 7.34 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5	0.058 0.11 0.056 0.058 0.12 0.059 0.15 0.17 0.67 0.15	5 4 6 10 6.5 6.5 240 5.8	320 350 250 340 270 160 170 140 240 510 240	280 180 250 200 98 150 200 170 260	355 345 272 429 354 354 354 414 311 311 311 311 301 414 417 355 111 305 125 252 303 305 265 247 269 310 331.5 3181 3181 3181 3181 3181 3181 3181 318	20 25 27 13 20 9.8 9.3	36.7 9.2 0 4.9 0 1.8 0 1.8 0 15.1 0 124 0 23.5 0 23.4 23.5 0 24.1 20.8 22.7 20.8 20.8	0.41 2 0.55 3 0.5 5 0.63 4 0.67 7 0.67 5 0.68 4 0.68 8 0.88 8 1.9 1 1.9 1 0.64 6	1 1.1.3 1 1.5 1 1.5 1 1.6 1	IBC, DO	IEC, DO	ité bara vinen Hegené 20 tatari anna (as Teologund)
Storn Creek					********	7 9.6 2.1	150 45	11	2419.6 2419.6	0.6 17.5 0.84 81.3 0.18	160	11 0.7 10 0.18		7.08 7.12 7.12	0.1	18	320 350 280	190 280	130 351.5 388.8	7.1	24.1 20.8 22.7	1.3 5	5.76 5 14.5 9.73			
	INW0773_T1001				*******	3.6 5.1	140 40 180 50	11 15	2419.6 2419.6	0.28 98.7 0.49 107.6	140 180	10 0.18 13 0.18	0.1	6.99 7.02	0.1 0.25	19 10	350 280	280 200	405.1 399.5	7.7	20.8 18.7	1.5 1 0.7 6	15.3	1		
	INW0773_T1002	Tributary to Richart Lake	WEMORE-CODS 71	7 County Road 900 W		84.2 85.6 81.1 53.5 81.8 81.1 59.4 51.2 4	110 46 120 40 51 23 160 60 170 54	36 30 18 36 32	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	7.2 344.8 7.16 410.6	180 160 84 230 210	15 0.11 14 0.13 6.5 0.26 19 0.2 18 0.2		7.74 7.76 7.37 7.39 7.5 7.37 7.35 7.4 7.33	0.052 0.059 0.4 0.11	6 5.5 120 9.6 6	240 360 370 430	260 330 170 460 510	457 423 309 533 302 412 501 523 543 543	45 41 13 58 46	21.5	0.71 7. 0.37 4. 1.3 1 0.37 4. 0.29 3.	14.5	IEC, DO	E. col., IBC, DO	E. oli Carlinda dend feeding quantum (PPI) + seage dichargen in universit anne + addite star darantefeal RE: Earns oferen RE: Earns oferen RE: Earns oferen RE: Earns of RE: E
	INW0773_T1003 INW0773 T1004				(read) (All)	<i>µ.</i> 9	220 64	53	2419.6	2.29 307.6			0.1	/.28	0.12	3	420) Set	619	be.	20.V (4.12			
	INW0773 T1005 INW0773_T1005 INW0773_T1005																									
	INW0773 T1005 INW0773 T1005																									
	INW07P3056_00 INW07P3078_00 INW0773_11030													t T												
					*******	94.2 101.7 74.2 61.1	100 34 110 37 140 58 130 47	11 14 23 15	2419.6 2419.6 2419.6 2419.6 2419.6	10.23 488.4 11.01 435.2 6.56 613.1 5.12 579.4	120 130 200 170	8.8 0.11 9 0.15 13 0.18 12 0.2	0.47 1.2 2.6 0.95	7.86 7.87 7.63 7.62	0.059 0.082 0.075 0.05	7.5 4.5 4.4 3.4	150 270 270 250	170 210 220 230	284 308 414 351	22 14 28 22	11.6 0 11.7 0 21.3 24 0	0.68 1 0.64 5. 0.6 4. 0.26 3	2 20 4 10.2 8 5.27 5.28			E. coli: Confined animal feeding operations (NPS) + sewage discharges in unsewered areas
					******	74.2 61.1	140 58 130 47	23 15	2419.6 2419.6	6.56 613.1 5.12 579.4	200	13 0.18 12 0.2	2.6 0.95	7.63 7.62	0.075 0.05	4.4 3.4	270 250	220 230	414 351	28 22	21.3 24 (0.6 4.	8 5.27 5.28			

	INW0774_01	Mutton Creek	WEM080-0025 T	County Road 300 N		83.9 89.6 62.7 71 54.3 60.6 49	150 150 160	51 47 57	12 7.9 13	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	7.78 980.4 7.97 387.3 5.36 387.3 6.52 387.3 4.77 5.32 209.8 4.46 435.2	180 170 200	12 13	0.2 0.2 0.2	0.9 0.1 0.18	.75 68 57 67 0.025 39 64 0.053 24 0.087	5.6 6.2 4.2	300 130 250	190 170 200	253 254 265 352 365.9 345.4 405.5	20 36 24	22 21.1 29.3 22.1 21.7 29.9	0.51 : 0.6 : 0.45	15.9 13.8 6.75 2.7 6.64 1.8 6.55 5 5.15	E. col	E. coli	
		Mutton Creek	WEM080-0014 T	12 County Road 400 N		59.3 70.1 72.7 31.6 64.1 56.6 39.2 28.3 16.3 5.4	100 110 150 150	34 34 41 50 47 40	18 17 22 23 18	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	6 648.8 7.32 196.8 6.48 2419.6 2.64 148.3 5.5 1732.9 4.87 150 3.25 84.2 2.51 39.3 1.4 0.46 248.1	120 120 150 180 170	9.8 9.6 12 14 13	0.23 0.19 0.35 0.16 0.2	0.71 1.1 2.8 2	42 0.25 65 0.17 64 0.26 59 0.15 59 527 54 522 0.13 52 54 52 53 54 52 53 53 53 53 53 53 53 53 53 53	11 12 92 7.2 8.2	170 270 420 120 360	180 220 200 320 210 210	294 318 340 303 304 372 387.9 405.5 362.8	36 15 36 36 12 12	34.6 13.3 21 24.6 22.9 22.8 24.8 21.1 23.4 20.8	0.32	LE 23.3 1.4 16.9 1.1 84 1.3 7.93 26.1 13.6 12.8 13.8 12.8	DO		E. eth check and whelp growthin (PF) + weap during in transmittation + within the there advised a variability 20. References (see Regi Regione)
Mutton Creek	1999.02	Mutton Greek	WEM080-0027 T	L4 County Road 800 N		92.3 70.1 72.7 31.6 64.1 56.6 22.2 21.3 16.3 5.4 16.7 84.1 84.1 84.1 84.1 84.1 16.7 72.6 5.3 84.1 84.1 16.7 75.5 55.3 82.5 83.5 84.2 84.5 84.5 84.5 84.5 84.5 84.5 84.5 84.5	150 93 200 130 150 150	42 32 33 50 47 45 45	12 15 15 23 26 12 12	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	6 648.8 7.12 126.8 6.44 2413.6 2.55 1712.9 4.37 150 3.5 1712.9 4.37 150 3.25 84.2 2.31 39.3 1.4 0.66 9.15 2433.6 6.42 440.6 6.52 2403.3 7.05 2420.3 7.05 2420.5 5.40 200.8 4.492 1413.6 5.49 201.8 5.49 201.8 5.49 5.49 5.49 5.49 5.49 5.49 5.49 5.49 5.49 5.42	180 120 120 180 170 170	13 9.3 9.3 14 14 14	0.2 0.28 0.12 0.27 0.2 0.2 0.2		221 236 2.16 236 2.12 25 25 25 25 25 25 25 25 25 25 25 25 25	11 20 9.5 17 13 8.4 4.4	280 180 300 250 250 250 250	180 180 240 210 240 250 250	372 387.9 405.5 384.1 274 295 374 241 241 241 340 340 360.7 373.8 391.8	9.1 18 29 25 17 12 4.1	54.6 13.3 21 24.6 22.9 22.8 24.8 24.8 24.8 21.1 23.4 20.8 11.6 23.3 21.2 24.5 22.2 24.5 22.2 24.5 22.2 24.5 22.2 24.5 22.2 24.5 22.7 23.5 22.7 23	0.53	18 23.3 54 16.9 7.1 84 13.3 7.61 13.6 26.1 13.6 12.8 12.8 8.05 12.8 10.5 10.5 12.6 10.2 19.5 13.1 19.9 14.8 52.5 19.6 15.8 9.6 15.8 9.62 10.4 10.4 4.55 11.7 10.4	DO	E. coli, DO	
	INW0774_03 INW0774 T1001 INW0774 T1002				AT/AAAT7/AAAT	59.7	150	50	15	2419.6	5.42 272.3	180	14	0.2	0.55	.12 0.07	9.2	240	210	391.6	22	20	0.55	.6 11.7	E. coli, DO	E. coli, DO	
	INW0774 T1002	Tributary of Mutton Creek	WEM-07-0016 TT	13 County Road 700 N		90 101.6 79.2 90.4 81.2 91.9 73.8 73.8 127.8 127.8 65.5 74	140 140 62 110	43 43 29 55	26 23 14 16	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	9.66 307.6 31.1 325.5 7.12 2419.6 7.8 2419.6 7.8 648.8 8.17 816.4 6.46 148.3 6.96 108.6 10.38 5.69 2419.6 7.29 140.1	180 160 100 140	14 13 7.5 11	0.16 0.21 0.67 0.2	1.7 2.2 2.7 1.7	.85 0.065 194 0.076 122 0.85 159 7.6 168 167 0.075 168 169 0.058	5 5.5 290 24 4.4	230 330 530 260	220 290 130 220	399 389 222 302 275 355 416 424.2 416.5 380	38 17 10 12 25	12.1 11.4 20.6 22.7 21 21.1 21.8 18.2 25.9 22.8		6.4 10.3 13 8.29 19 253 6 34.2 10.1 7.34 6.04 8.6 8.74 4.9 8.2 3.64 8.2 4.4	N/A	E. coli E. coli	E. tak Carlined animal fixeding operations (IPP) + sensign discharges in unservered areas
					********	71.5 127.8 65.5	170	44	19	2419.6 2419.6 2419.6	6.96 108.6 10.38 5.69 2419.6	180	15	0.2	0.18	.67 0.075 L04 .69 0.058 .38 0.046	4.4 5	340 390	260	424.2 416.5 380	13	18.2 25.9 22.8		1.6 1.74 4.9 1.2 1.64			
	INW0774 T1004	Sandy Branch	WEMORD-CO15 T	11 US Hwy 31		RL3 91.5 63.7 77.7 81.4 86.5 82 76.7 65	180 190 60 110	67 64 25 47	57 42 18 37	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	9.33 613.1 10 167 5.64 2419.6 7.18 272.3 7.74 307.6 7.27 224.7 7.16 344.8 5.69 387.3 6.16 74.9	240 230 85 170	18 17 5.6 12	0.2 0.27 0.36 0.2	0.51 1.2 0.59 0.58	.86 0.075 .94 0.085 .13 0.34 .72 0.13 .68 .78	2.5 5 95 8.6	290 420 320 320	310 370 110 350	475 557 206 350 498 576 642 642 644 647	26 27 7.6 38	12.8 12.3 21.3 23.4 21.5 20.8 21.2 18.7 22	0.55	1.5 6.11 2.9 6.54 3.8 81.9 3.7 8.96 1.7 8.96 11.9 4.34	IBC	E. col, IBC	E als Weerfaal
					********	76.7 65 61.9	230 230 230	84 81 78	55 57 55	2419.6 2419.6 2419.6	7.15 344.8 5.69 387.3 6.15 74.9	300 290 280	22 21 20	0.2 0.2 0.2	0.51 0.35 0.2	.88 0.071 .68 0.12 .68 0.078	1.8 7 1.8	560 620 440	500 480 380	646 647 656	34 32 29	18.7 22 17.1	0.38 0.61 0.85	1.3 4.31 2.8 5.53 1.3 6.55			
	INW0775_01	Verrion Fork Muscatatuck Biver	r WEM070-0039 TI	26 County Read 500 S		90.4 94 92.2 87.6 83 76.3 85 85.1 84.6 78 55.3 61.4 76.1	170 160 150 93 89 130 130	61 62 55 11 19 55 49	17 14 11 9.9 14 18 13	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	11.83 12.9 11.28 9.15 2419.6 9.41 1586.3 7.13 146.7 6.24 186 7.36 1732.9 7.42 307.6	210 210 180 120 180 180	15 14 12 7.8 6.3 11 10	0.2 0.18 0.18 0.31 0.24 0.2	1.7 1.6 1.6 0.64 1.4 4.1 1.8	.99 0.059 99 0.087 101 0.077 7.9 0.24 177 0.47 172 0.17 173 0.14 175	2.5 4 9 40 54 30 19	250 250 240 190 300 280	210 270 66 140 220 150 240	428 410 369 247 248 375 334 254 337	23 20 36 11 9.6 25 23 23	22.7	0.47 0.48 0.48 1.1 0.98 0.73 0.45	24 5.27 28 129 21 13.6 7.1 68.4 7.7 203 52 24.8 13 19.7 80.7 35.1	DD, Hg (FT)	E. col, Hg (FT)	E. all Sweep delayers in unaveral area - addle aller Then with that
	INW0775 01A INW0775 018 INW0775 02					84.6 78 35.3 68.4 76.1	180 140 150	61 45 51	11 8.8 16	2419.6 2419.6 2419.6 2419.6	6.97 65.7 6.77 111.2 4.67 5.74 172.3 6.81 160.7	220 150 180	16 10 12	0.2 0.2 0.2	0.67	.02 .64 0.08 7.5 .46 0.084 .35 0.074	23 10 6.8	330 330 270	250 150 200	408 439 476 329.1 393.4	22 10 24			17.8 2.3 20.3 11.6 1.3 11 1.9 9.21			
	INW0775 04				******	71.1	160	57	14		8.46	190	11	0.2	0.88	.62 0.097	4.3	120	270	400	23	9.1	0.66	11.1			
	INW0775_05	Vernon Fork Muscatatuck River	WEM070-0020 TI	29 US Hwy 31		73.3 87.2 90.7 87.4 81.6 85.1 74.1 54.5 73.8 70.8 59 59 51	160 170 150 94 96 92 150	80 61 53 54 55 55 52 52 50	17 14 12 15 15 15	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	8.46 11.19 12.52 10.68 5.52 727 8.83 547.5 6.40 21.8 6.41 4.51 4.52 6 1.45.2 6 218.7 4.51 4.52 5.58 218.7	190 210 210 170 120 120 130 170	14 11 7.7 7.5 8.6 11	0.2 0.17 0.13 0.19 0.15 0.23 0.2 0.2	0.88 1.4 1.9 1.4 0.55 1.3 3 0.92	102 0.097 101 0.067 174 0.093 175 0.11 175 0.21 168 0.35 132 0.21 145 0.13 126 132 13 13 13 13 13 13 13 13 13 13	4.3 3.5 5.5 16 41 44 100 21	120 260 250 250 250 250 250 300 300	270 170 230 150 150 240 170 250	400 415 388 355 257 275 285 353 266 339 405 426.7 337.4	20 22 38 32 31 35 34	9.1 4.7 2 6.7 34.5 31.8 21.9 26 23.1 23.7 23.9 22.9 22.9 22.9 23.3		11.3 11.5 11.5 11.5 12.6 12.4 12.9 13.7 14.2	N/A		
Poly Branch	INW0775 05				******	51 61	180 130 150	60 43 50	11 13 16	2419.6 2419.6	4.35 172.5 5.58 218.7	210 150 170	14 11 12	0.2 0.11 0.2	0.45 0.17 0.38	7.4 0.072 1.13 0.087 1.48 0.2	26 14 15	380 370 280	260 300 190	337.4 381.7	23 20 25	23.3 29.7	0.49 0.66 0.53	3 24 11 14.4 15 16.2			
	INW0775 05 INW0775 T1001 INW0775 T1002																								Hg (FT)	Hg (FT)	L. col: Confined animal feeding operations (NPS) + sewage discharges in unservered areas + withlife other than waterfood
		Tea Creek	WEM-07-0021 TI	26 County Road 650 S		102.9 100.8 91.1 120.5 96.9 104.8 94.1 122.1 123.4 123.4 123.4 123.4 123.4 123.4 123.4 123.4 123.4 123.4 123.4 123.4 123.4 123.5 124.8	82 140 150 170	29 41 57 57	13 15 26 12 8.2	2419.6 2419.6	10.66 2413.6 13.47 570.4 8.26 10.62.2 10 1299.7 8.44 1119.9 9.14 770.1 8.12 461.1 8.12 461.1 8.12 461.1 8.55 90.8 9.84 100.6 9.84 70.1 8.7 200.8 9.84 90.8 9.84 70.1 8.7 201.8 9.84 90.8 9.84 90.8 9.84 90.8 9.85 200.8 7.6 648.8 9.86 770.1 5.85 215.9 8.66 770.1 5.36 45.5 2.6 224.7	100 140 200 190	7.4 10 13 12	0.62 0.17 0.18 0.2	0.7 0.33 1 2 0.12	91 0.9 133 0.094 199 0.088 197 0.045 187 185 197 0.05 199 165 0.057	15 2.5 3 2.6 2	160 280 340 250 280	170 250 220 230	238 335 419 381 275 292 368 300.7 395.7 435	9.9 13 38 32 9	22.2 22.1 22.6		11 48.2 5 9.88 5 4.88 15 1.54 1.8 7.96 2.58 2.6 2.76 2.22 1.8 2.76	E. coli, IBC, DO		E die Lande sone weld gestion (sv.) - saag boogen e onwerd wat - sooe der terkeningen IEC Sone skinen
	INW0775_T1003					112.1 52.3 52.7 21.2 101.4 74.7 51.4	220 230 86 160 180 190	70 70 31 49 65 64	8.3 10 12 13 20 9.4	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	11.36 4.59 1203.3 5.5 50.8 9.88 1586.3 10.76 579.4 6.6 307.6 4.48 613.1 78 020.6	190 230 230 110 170 220 210	14 14 7.2 11 14 13	0.2 0.48 0.12 0.18 0.2	0.1	.29 0.05	4 5 2 4.8 6.8	390 110 150 300 340 280	280 210 180 280 230 280	196.7 435 471.5 238 379 442 418 310	11 8.8 10 15 18 13	22.5 21.8 29.4 12.7 13.5 21.4 24.2 21.8	0.67	2.22 1.8 2.76 1.8 2.39 1.8 47.1 1.2 10.1 1.4 7.8 1.5 9.28 1.4 7.8 1.5 9.28		E. col, IBC	
	INW0775 T1004	Tea Creek	WEM070-0029 TI	37 County Road 650 V		89.1 85.2 70.4 75.3 54 62.6 28.5	210 210 210	62 52	7.7 8.9 9.5	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	5.5 90.8 9.88 1986.3 10.76 579.4 6.6 307.6 4.46 613.1 7.8 548.8 5.05 235.9 6.68 770.1 4.54 5.38 2.6 224.7	230 210 200	14 14 13	0.2 0.2 0.2	0.25	.73 0.67 .88 0.078 7.7 0.087 .64 0.088 .64 .66 .65 .73 0.05 .47 .75 0.034 .23 0.081	5.2 1.6 1.4	320 380 280	260 240 150	471.5 238 379 442 418 319 376 447 454.4 467.7 459.4 467.7 429.7 420.8	13 6.6 6.6	29.4 22.7 33.5 21.4 24.2 21.8 20.9 23.7 23.7 23.1 23.6 22.9 29.9	0.33	5.8 2.39 18 47.1 1.2 10.1 1.4 7.8 5.5 9.28 1.4.8 9.84 8.31 2.2 9.14 4.58 1.3 3.64 4.55	E. col, HEC, DO		
-	INW0775_T1009				AT-04447-04444	75 85.7	160 160	55	16 17		8.66 11.05	190 210	13 14	0.13 0.14	0.5 1.2	.85 0.098 .89 0.071	6 3.5	300 270	260 170	394 413	19 25	9 4.5	0.59	1.6 13			
	INN0776_03	Verson Fork Muscalatuck River	r WEM090-0015 T	10 County Read If 50 h		75 85.7 89.3 89.1 82.7 82.9 70.8 60.5 67.6 61.8 61.6 61.6 51.3 55.8 40	160 160 140 95 93 100 150 180	51 47 34 32 39 51 51 57 44	16 14 15 17 15 13 13	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	0.00 11.05 12.43 10.73 8.43 488.4 8.55 547.5 6.16 2419.6 4.88 46.8 5.73 325.5 5.22 129.6 5.01 42.8 4.42 95.9 4.35 4.19	200 200 180 100 100 140 170 200 200	12 11 8.2 7.2 9.3 11 14	0.14 0.17 0.12 0.18 0.32 0.2 0.2 0.2	1.2 1.8 1.3 0.52 1.1 2.7 0.86 0.42 0.24	186 0.058 180 0.071 1.05 0.11 1.05 0.11 1.05 0.12 1.05 0.12 1.05 0.12 1.05 0.12 1.07 2.27 1.27 1.27 1.29 0.044 3.41 0.234	3.5 8.5 13 30 37 93 21 18	300 270 240 250 140 270 300 270 280 280	200 270 32 160 230 270 230 230 230 230	194 413 377 354 267 271 300 361 259 267 383 417.3 433.5 247.9	21 18 12 13 14 26 25	4.5 1.8 7.2 34.5 31.9 22.3 26.5 23.7 23.8 25.8 25.8 22.5 28.2 23.6	1.2 0 0.88	13 19 7.81 16 15.8 2.7 18.5 1.1 18.5 1.2 60.1 1.3 19.4 1.1 17.4 16.8 18.1 10.5 12.7 24.7 24.7 1.5 15.5	N/A		
	INW0775 04				*******	58.9	160	10	17			170	12	0.2	0.25	.00 0.13	12	150	180	282	19	13.4	1.2				Not assessing new data based on BPJ. Site is now an oxbow that no longer functions as a stream.
	19990776_05	Vernon Fork Muscatatuck River	r WEM090-0008 TI	County Read 400 S		54.7 48.5 52.9 4 57.8 48.8 0.16 5 4.5 5.6	100 100 35 160 160 180	35 38 17 44 43 41 48	15 17 10 28 27 36 34	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	5.65 410.6 5.06 201.4 4.61 2419.6 0.35 387.3 4.9 209.8 3.89 167 2 42.4 0.41 365.4 0.42 365.4 0.53 96	120 130 60 160 160 160 180	8.9 8.7 4.3 12 12 14 14	0.22 0.3 2.6 1.2 0.52 0.2 0.49	0.6 1.2 7.9 0.1 0.1 0.1	134 0.19 133 0.22 135 1.1 175 0.71 129 7 174 178 0.46 131 0.46 143 0.22 141 0.46	12 9.5 42 10 12 9	150 300 230 360 360 380 380 320	180 290 370 270 380 380 290 240	282 294 196 430 244 169 393 430.4 532 474.5	22 13 7.3 6.3 6 7.2 9.3	13.9 13.6 22 23.7 23.6 26.9 24.5 26.5 26.5 28.9 18.9 18.1		7.7 33.3 55 28.7 17 80.8 23 17.4 14.5 14.7 14.9 14.7 3.9 31.3 15 22.8 1.1 26.8	DO	Do	
	INW0776 05 INW0776 07 INW0776 08 INW0776 09 INW0776 10 INW0776 11005 INW0776 11005																										
	INW0775 09 INW0775 10 INW0775 T1075																										
	INW0776 T1006 INW0776 T1007 INW0776 T1008																										
Grassy Creek	INW0776_T1009	John McDenald Ditch	WEM-07-0015 TI	25 County Road 125 5		56.2 62.7 52.9 31.9 55.4 50.8 31.5 37.9 75.5	99 140 19 240 220	31 38 18 62 64	17 20 14 19 18	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	5.8 290.9 6.6 172.3 5.36 2419.6 2.76 60.9 4.87 145.5 4.46 579.4 2.71 261.3 1.53 387.3 6.17	110 140 61 220 230	7.8 10 4.3 16	0.13 0.23 0.44 0.2 0.2	0.052 0.21 2.3 0.45 0.38	1.32 0.2 7.5 0.21 0.03 0.25 5.52 0.16 1.17 7.1 1.33 0.1 7.6	9 5.5 54 2.8	180 290 230 360	190 330 330 270 230	267 356 156 454 219 236 453 495.4 520	6.2 20 7.5 34 28	13.4 13.1 20.8 23.3 21.8 22.8 22.7 19 23.5		15 37 19 15.8 11 92.1 15 6.37 24 19.7 7.71 12 6.87 4.4	N/A	E. col, IBC, DO	E. all control and locing sportnes (M) + arrange disclarges is unseened area + widdle other than without HE: Secons whereas HE: Secons whereas HE: Secons whereas the second seco

				********	32.1	230	67	16	2419.6	3.46 275	5 240	18	0.2	0.16	7.46	17 4.6	390	340	506	15	21.6	0.59	3.8	6.97			
				*******	16	240	67	22	2419.6	1 56 187	3 240	18	0.7	0.1	7.51	25 4	140	270	521	12	17.9	0.91	6.6	4 93			
NW0776 T1010					1	1	1											1									
eW0776 T1011																											
eW0775 T1012																											
W0775 T1013					-			-			-																
W0776 T1014																											
W0776 T1015																											
W0776 T1015					-			-			-																
W0776 T1017					-			-			-																
W0776 T1018																											
10770 11010				******	69.3	160	40	30	2419.6	7.06 184	180		0.23	0.32	7.61	1.7 12	250	270	495	11	34.6	1.2	11	25.5			E. col: Confined animal feedine operations (NPS)
				*******		160	52	49	2419.6	4.6 58.3		11	0.29	0.92	7.32	7 12	450	440	530	10	11.7	11	0.5	23.5			IBC: Source unknown
				*******	55	41	17	11	2419.6	4.85 2419		19	0.28	0.74	7.01	67 53	180	120	155	5.8	21.6	1.5	12	71.5			
				******		100			2419.6	6.27 517			0.2	17	7.85	1 1	710	590	#11	47	20.0	0.43	14	6.45			
				******		300	~		2419.6	5.02 290		20	0.2	4.7	7.27		100	380	289		22.7	0.43	2.0	19.8			
W0776_T1019	Grassy Creek	WEM-07-0010 TO	County Road 600	******					2419.6	4.17 238					7.16				226		23.9			19.3	N/A	E. coli, IBC	
				******					2419.6	4.81 117					7.59				776		21.3			6.61			
				*******		110	-		2419.6	6.52 206		37	0.2	1.9		2 7.4	740	750	886		18	0.26	2.1	9.1			
				******		340		30	2419.0	6.25	4 300		0.2	1.9	7.00		140	7.00	000		10	0.20		11.4			
				*******		110	-		2419.6	6.84 579			0.2	1.8	7.71	.9 2.4	820	500	907		19.5	0.55	2.6	4.22			
				*******		300			2410.6	4.89 58.0			0.2		7.00	14	630	500	803		18.3	0.54	10	4.33			
MAI0725 T1020				110011100111	1	1	1	1																			
					-																						
					77.2	160		15		1.00	190	11	0.11	0.53	7.94	12 41	300	250	101	10	9.7	0.44	45	11			
				*****		160	54	15 17		8.66 11.21	190 190	13	0.11	0.53		12 4.3	300 270	250 180	391 404	29 21	9.7 4.8	0.44	4.6	11 8.09			
				AT-0.417.0441	87.5	160 160 140	54	15 17		11.21	190 190	13 13 12	0.13		7.92 0	076 3.5	300 270 210	250 180 260	391 404 165	19 23 20	9.7 4.8 2		4.6 3				
				*****	87.5 92.2	160 160 140	54 55 50	15 17 15 14		11.21 12.78	190 190 170	13 13 12		1.2	7.92 C	076 3.5 12 11	300 270 210 210	250 180 260 86	391 404 365 340	29 23 20	9.7 4.8 2 7.7		4.6 3 3.8 1				
					87.5 92.2 88.6	160 160 140 120 00	54 55 59 45	15 17 15 14	2419.6	11.21 12.78 10.63	190 190 170 160	13 13 12 10	0.13	1.2 1.7 1.2	7.92 0 8.07 7.94 0	076 3.5 12 11 083 19	300 270 210 250	250 180 260 85 170	391 404 365 340 269	29 23 20 18	9.7 4.8 2 7.7		4.6 3 3.8 3 7.6	8.09 20			
					87.5 92.2 88.6 81.8	160 160 140 120 99	54 55 53 46 34	15 17 15 14 11	2419.6	11.21 12.78 10.63	190 170 160 120	13 13 12 10 8.3 7.7	0.13 0.15 0.14 0.2	1.2	7.92 0 8.07 7.94 0	076 3.5 12 11	300 270 250 250 180	250 180 260 85 170	191 404 365 340 269 263	29 23 20 18 11	9.7 4.8 2 7.7 34.9		4.6 3 3.8 3 7.6 7.2	8.09 20 24.8 50			
W0776 T1021					87.5 92.2 81.6 81.8 82.1	160 160 140 120 99 90 75	54 55 50 46 34 34 37	15 17 15 14 11 14	2419.6 2419.6 2419.6	11.21 12.78 10.63 8.27 410 8.38 410	190 170 160 120 6 120	13 13 12 10 8.3 7.7 7.6	0.13 0.15 0.14 0.2 0.21	1.2 1.7 1.2 0.51 1.2	7.92 0 8.07 7.94 0 7.67 7.67	076 3.5 112 11 083 19 19 37 14 44	270 210 250 180 350	180 260 85 170 300	404 365 340 269 263	23 20 18 11	4.8 2 7.7 14.9 14.4	0.65 0.64 0.55 1.1 1	4.6 3 3.8 3 7.6 7.2 7	8.09 20 24.8 50 67.8			
W0776 T1021	Rder Dtch	WEM090-0003 TO	1. County Road 600		87.5 92.2 81.6 81.8 82.1 67.7	160 160 140 120 99 90 75	54 55 50 46 34 34 34 32 31	15 17 15 14 11 14 10 15	2419.6 2419.6 2419.6 2419.6	11.21 12.78 10.63 8.27 410 8.38 410 5.88 2419	190 170 160 5 120 5 120 5 110	13 13 12 10 8.3 7.7 7.6 13	0.13 0.15 0.24 0.21 0.21 0.38	1.2 1.7 1.2 0.51 1.2 1.2 3.1	7.92 0 8.07 7.94 0 7.67 7.67 7.28	076 3.5 12 11 083 19	300 270 250 180 350 320 320	250 180 260 35 170 300 180 240	391 404 365 340 269 263 219 365	19 23 20 38 11 11 25 34	9.7 4.8 2 7.7 24.9 24.4 22.3 26.3		4.6 3 3.8 3 7.6 7.2 7 4	8.09 20 24.8 50 67.8 153	N/A		
WW0776 T1020	Rder Ditch	WEM090-0003 TO	1 Country Road 600		87.5 92.2 81.6 81.8 82.1 67.7 67.8	160 160 140 120 99 90 75 150	54 55 50 46 34 34 34 32 51	15 17 15 14 11 14 10 15	2419.6	11.21 12.78 10.63 8.27 410 5.88 410 5.88 2419 5.47 48.1	190 170 160 6 120 6 120 6 110 1 170	13 13 12 10 8.3 7.7 7.6 11	0.13 0.15 0.14 0.2 0.21	1.2 1.7 1.2 0.51 1.2	7.92 0 8.07 7.94 0 7.67 7.67 7.28	076 3.5 12 11 083 19 19 37 34 44 37 140	270 210 250 180 350 320	180 260 36 170 300 180	404 365 340 269 263 219 366	23 20 18 11	4.8 2 7.7 14.9 14.4	0.65 0.64 0.55 1.1 1 1	4.6 3 3.8 3 7.6 7.2 7 4	8.09 20 24.8 50 67.8	N/A		+
WW0776 T1021	Rder Ditch	WEM090-0003 TC	1 County Road 600		87.5 92.2 88.6 81.8 82.1 67.7 67.8 62.3	160 160 140 120 99 90 75 150	54 55 50 46 34 34 32 51	25 27 15 14 11 14 20 25	2419.6 2419.6	11.21 12.78 10.63 8.27 416 8.38 410 5.88 2419 5.47 461 5.85 410	190 170 160 6 120 6 110 1 170 6	13 13 12 10 8.3 7.7 7.6 11	0.13 0.15 0.24 0.21 0.21 0.38	1.2 1.7 1.2 0.51 1.2 1.2 3.1	7.92 0 8.07 7.94 0 7.67 7.67 7.28 7.65 7.41	076 3.5 12 11 083 19 19 37 34 44 37 140	270 210 250 180 350 320	180 260 36 170 300 180	404 365 340 269 263 219 366 252	23 20 18 11	4.8 2 7.7 14.9 14.4	0.65 0.64 0.55 1.1 1 1	4.6 3 3.8 3 7.6 7.2 7 4	8.09 20 24.8 50 67.8 153	N/A		
W0776 T1021	Rder Dtch	WEM090-0003 TO	1 County Road 600		87.5 92.2 88.6 81.8 82.1 67.7 67.8 62.3 52.7	160 160 140 120 99 90 75 150	54 55 50 46 34 34 34 31 51	35 17 15 14 11 14 20 25	2419.6 2419.6 2419.6	11.21 12.78 10.63 8.27 410 5.88 4200 5.47 461 5.85 410 4.96 131	190 170 160 6 120 6 110 1 170 6	13 13 12 10 8.3 7.7 7.6 11	0.13 0.15 0.24 0.21 0.21 0.38	1.2 1.7 1.2 0.51 1.2 1.2 3.1	7.92 0 8.07 7.94 0 7.67 7.67 7.65 7.41 7.24	076 3.5 12 11 083 19 19 37 34 44 37 140	270 210 250 180 350 320	180 260 36 170 300 180	404 365 340 269 263 219 366	23 20 18 11	4.8 2 7.7 14.9 14.4	0.65 0.64 0.55 1.1 1 1	4.6 3 3.8 3 7.6 7.2 7 4	8.09 20 24.8 50 67.8 153	N/A		
W0776 T1021	Rder Ditch	WEM090-0003 70	L County Road 600		87.5 92.2 88.6 81.8 82.1 67.7 67.8 62.3 52.7 60	160 160 140 120 99 90 75 150	54 55 50 46 34 34 32 51	15 17 15 14 10 15	2419.6 2419.6 2419.6 2419.6	11.21 12.78 10.63 8.27 414 5.88 410 5.88 2419 5.47 48 5.85 410 4.66 131 4.89 67	190 170 160 6 120 6 120 6 110 1 170 6 4	13 13 12 10 8.3 7.7 7.6 11	0.13 0.15 0.24 0.21 0.21 0.38	1.2 1.7 1.2 0.51 1.2 1.1 0.76	7.92 0 8.07 7.94 0 7.67 7.67 7.66 7.65 7.41 7.24 7.45	076 3.5 12 11 083 19 19 37 34 44 37 140	270 210 250 180 350 320	180 260 85 370 300 180 240	404 365 340 263 219 365 252 230 378	23 20 18 11	4.8 2 7.7 34.9 34.4 22.3 26.3 24 24 24.7	0.65 0.64 0.55 1.1 1.5 0.52	3 3.8 7.6 7.2 7 4	8.09 24.8 50 67.8 153 25.2 44 21.9 31.6	N/A		+
WW0776 T1021	Rder Dtch	WEM090-0003 TE	L County Road 600		87.5 92.2 81.6 81.8 82.1 67.7 67.8 02.3 50.7 60 50.2	160 160 160 140 120 99 90 75 150	54 56 50 46 34 34 32 51 51	15 17 15 14 10 15 15 12 13	2419.6 2419.6 2419.6	11.21 12.78 10.63 8.27 414 8.38 410 5.88 2419 5.47 48.1 5.85 410 4.96 167 5.15 81.1	190 170 160 6 120 6 120 6 110 1 170 6 4	13 13 12 10 8.3 7.7 7.6 11 14	0.13 0.15 0.24 0.21 0.21 0.38	1.2 1.7 1.2 0.51 1.2 1.2 3.1	7.92 0 8.07 7.94 0 7.67 7.67 7.65 7.41 7.24	076 3.5 12 11 083 19 19 37 34 44 37 140	270 210 250 180 350 320	180 260 36 170 300 180	404 365 340 269 263 219 365 252 230	23 20 18 11	4.8 2 7.7 34.9 34.4 22.3 26.3 24 24.7 25.9 22.4	0.65 0.64 0.55 1.1 1 1	4.6 3 3.8 3 7.6 7.2 7 4 3.6	8.09 20 24.8 50 67.8 153 25.2 44 21.9 31.6 28.8	N/A.		
WW0776 T1021	Rder Ditch	WEMORGOOD TO	1 County Road 600		87.5 92.2 81.6 81.8 82.1 67.7 67.8 62.3 52.7 60 52.2 53.4	160 160 160 120 99 90 75 150 170	54 56 50 64 34 34 34 32 51 51	15 17 15 14 11 14 20 25 25 13	2419.6 2419.6 2419.6 2419.6 2419.6	11.21 12.78 10.63 8.77 416 5.88 2419 5.47 410 5.88 410 4.66 131 4.66 131 4.89 67 5.15 81	190 170 160 6 120 6 120 6 120 6 4 1 270 8 4 200	13 13 12 20 8.3 7.7 7.6 11 24	0.13 0.15 0.14 0.2 0.38 0.2 0.2	1.2 1.7 1.2 0.51 1.2 1.1 0.76	7.92 0 8.07 7.94 0 7.67 7.28 7.65 7.28 7.66 7.41 7.41 7.46 7.56 7.56 7.56	076 3.5 112 11 053 19 129 37 34 44 37 140 112 33 11 36	270 230 180 350 320 300	180 260 35 170 300 180 240	404 365 340 269 263 366 252 230 376 411.6 435	23 20 18 11	4.8 2 7.7 34.9 34.4 22.3 26.3 24 24.7 25.9 22.4 25.9	0.65 0.64 0.55 1.1 1.5 0.52 0.44	3 3.8 3 7.6 7.2 7 4 3.6	8.09 20 24.8 50 67.8 25.2 44 21.9 31.6 28.8 21.7	N/A		
N0776 T1021	Ráer Ditch	WEM090-0003 TE	1 County Road 600		87.5 92.2 81.6 82.1 67.7 67.8 92.3 92.7 60 92.2 92.2 93.4 65.3	160 160 140 120 99 90 75 150 170	54 55 50 34 34 34 32 51 51 51	15 17 15 14 11 14 10 25 13 13 27 27	2419.6 2419.6 2419.6 2419.6	11.21 12.78 10.63 8.77 416 5.88 2419 5.47 410 5.88 410 4.66 131 4.66 131 4.89 67 5.15 81	190 170 160 6 120 6 120 6 110 4 170 6 4 4 200 2 150	13 13 12 10 8,3 7,7 7,6 11 11 24 12	0.13 0.15 0.24 0.21 0.21 0.38	1.2 1.7 0.51 1.2 3.1 0.76	7.92 0 8.07 7.94 0 7.67 7.67 7.65 7.41 7.24 7.45 7.56 7.56 7.56 7.56 7.43	076 3.5 12 11 083 19 19 37 34 44 37 140	270 210 250 180 350 320	180 260 85 370 300 180 240	404 365 340 269 263 239 366 252 230 376 411.6	23 20 18 11	4.8 2 7.7 34.9 34.4 22.3 26.3 24 24.7 25.9 22.4	0.65 0.64 0.55 1.1 1.5 0.52	3 3.8 7.6 7.2 7 4	8.09 20 24.8 50 67.8 153 25.2 44 21.9 31.6 28.8	N/A		
W0776_T1021	Rider Ditch	WEM090-0003 TE	1 County Road 600		87.5 92.2 81.6 82.1 67.7 67.8 92.3 92.7 60 92.2 92.2 93.4 65.3	160 160 140 120 99 90 75 150 170 170 130 150	54 55 50 46 34 34 34 32 51 57 44 47	25 25 27 25 24 21 26 20 25 23 23 23 27 22	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	11.21 12.78 10.63 8.27 416 8.38 420 5.87 2419 5.47 481 5.85 410 4.06 131 4.89 67 5.15 81 4.75 5.55 214	190 170 160 6 120 6 120 6 110 4 170 6 4 4 200 2 150	13 13 12 20 8.3 7.7 7.6 11 24 11 12	0.13 0.15 0.14 0.2 0.21 0.38 0.2 0.2 0.2	1.2 1.7 1.2 0.31 1.2 3.1 0.76 0.38	7.92 0 8.07 7.94 0 7.67 7.67 7.65 7.41 7.24 7.45 7.56 7.56 7.56 7.56 7.43	076 3.5 112 11 013 19 10 37 34 44 37 140 112 33 11 36 111 24	270 250 250 350 320 300 340	180 260 85 170 300 180 240 330	404 365 340 263 253 259 366 252 230 376 411.6 435 348.3	23 20 18 11	4.8 2 7.7 34.9 34.4 22.3 26.3 24 24.7 25.9 22.4 25.9 22.4 25.9 22.2	0.65 0.64 0.55 1.1 1 1.5 0.52 0.44 0.56	3 38 3 7.6 7.2 7 4 3.6 4.1	8.09 20 24.8 50 67.8 153 25.2 44 21.9 31.6 28.8 21.6 28.8 21.7 21.2	N/A		-
W0776 T1021	Rider Ditch	WEM090-0003 TC	1. County Pead 600		87.5 92.2 81.6 82.1 67.7 67.8 92.3 92.7 60 92.2 92.2 93.4 65.3	160 160 140 120 99 90 75 150 150	54 56 50 46 34 34 32 51 51 57 44 47	15 17 15 14 11 14 15 15 15 13 13 17 22	2419.6 2419.6 2419.6 2419.6 2419.6 2419.6	11.21 12.78 10.63 8.27 416 8.38 420 5.87 2419 5.47 481 5.85 410 4.06 131 4.89 67 5.15 81 4.75 5.55 214	190 170 160 6 120 6 120 6 110 1 170 6 4 4 200 2 150	13 13 10 8.3 7.7 7.6 11 24 12 12	0.13 0.15 0.14 0.2 0.21 0.38 0.2 0.2 0.2	1.2 1.7 1.2 0.31 1.2 3.1 0.75 0.38	7.92 0 8.07 7.94 0 7.67 7.67 7.65 7.41 7.24 7.45 7.56 7.56 7.56 7.56 7.43	076 3.5 112 11 013 19 10 37 34 44 37 140 112 33 11 36 111 24	270 250 250 350 320 300 340	180 260 85 170 300 180 240 330	404 365 340 263 253 259 366 252 230 376 411.6 435 348.3	23 20 18 11	4.8 2 7.7 34.9 34.4 22.3 26.3 24 24.7 25.9 22.4 25.9 22.4 25.9 22.2	0.65 0.64 0.55 1.1 1 1.5 0.52 0.44 0.56	3 38 3 7.6 7.2 7 4 3.6 4.1	8.09 20 24.8 50 67.8 153 25.2 44 21.9 31.6 28.8 21.6 28.8 21.7 21.2	N/A		

APPENDIX B. FISH AND MACROINVERTEBRATE COMMUNITY ASSESSMENT REPORTS



Site: Vernon Latitude: 38.	Muscatatuck Fork Muscatatud .793535 Eastern Corn Bel	Longitude:	.ocation: CR 600 \$ -85.884075	I	051202070900 ASNat Region: Area (sq.miles):	11A	LSite: Topo:		03 County: Jacks Segment: 83 t (ft/mile): 1.343	
Sample Inform	nation									
SampleNumber:	AB47653	Ev	entID: 21T001		s	ample MediumC	ollected:	Fish Commu	unity + Water + Mae	oro
SampleDate:	08/24/2021	5	SurveyCrewChief:	KAG	SampleT	ime: 09:45:00 A	M		HydroLabNum	ber: P5
WaterFlowType:	Pool	v	VaterAppearance:	Murky	SkyCon	ditions: 1 - Clea	ar		AirTemperature	e: 5 - 76-85
WindDirection:	27 - West (2	270 degrees)			WindStr	ength: 0 - Calm				
DissolvedO2 (mg/	/l): 4.76	pH: 7.	56 WaterTe	emp(°C): 25.9		SpecificConduct	ivity (µS/c	: m): 435	Turbidity (N	NTU): 21.7
SpecialNotes:										
ElectrofishingEqu	uipment:	Canoe	Voltag	je: 260		Avg.StreamV	Vidth(m):	15	DistanceFished	i (m): 225
SecondsFished:	2955		WaterDepthAvg (m): 1		WaterDepth	Max (m):	2.25	TimeAtSite	e: 03:00
BridgeInReach:		ReachRepr	esentative: 🗹	WhyRead	chNotRepresent	ative:				

Habitat Information

SpecialComments:

TotalScore (max100):	55	Substrate (max20):	Sco	ore	11	nstream icore (n	nCover nax20):	12	ChannelMor (max20):	pholog	yScore 9	
RiparianZoneBa Score(max10):	nkEre	osion	4	1	Pool/GI	ideQua	lityScore(m	ax12):	9 Riffle/I	RunQua	lityScore(max8):	4
GradientScore (max10):	6	%Poo	I:	45	%Riffle:	20	%Run:	35	%Glide:	0	CanopyCover PctOpen:	10%-<30%
SubjectiveRating	g:		Ae	sthe	eticRating:		NOTES:	"NEV	RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Inform	ation	Calib	oration Used: Eastern Corn Belt Plains			
	ctual	<u>Metric</u>			Actual	Metric	
Observ		<u>Score</u>			ervation	<u>Score</u>	
SpeciesCount:	26	5		%TolerantIndividuals:	10.92	5	
DarterSpeciesCount:	4	5		%OmnivoreIndividuals:	5.04	5	
SunfishSpeciesCount:	6	5		%InsectivoreIndividuals:	78.99	5	
SuckerSpeciesCount:	3	3		%CarnivoreIndividuals:	15.97	5	
SensitiveSpeciesCount:	8	3		Total # of Individuals (CPUE):	119	1	
				%SimpleLithophilicInd.:	21.01	3	
				%Ind.withDELT:	0	5	
Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending	S	tal IBI core bin 0	50				

Metrics can score a 0, 1, 3, or 5 depending on calibration.

(min 0, max 60)

Canoe w/MLES and boom

SampleNumber: AB47653

EventID: 21T001

LSite: WEM090-0003

County: Jackson

StreamName: Verr

Vernon Fork Muscatatuck River

LocationDescription: CR 600 South

Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bigeye Chub	1					
Black Buffalo	1					
Black Crappie	1					
Blackstripe Topminnow	1					
Bluegill	8					
Bluntnose Minnow	2					
Brook Silverside	5					
Bullhead Minnow	4					
Channel Catfish	1					
Common Carp	1					
Dusky Darter	3					
Eastern Sand Darter	1					
Golden Redhorse	14					
Green Sunfish	9					
Largemouth Bass	1					
Logperch	1					
Longear Sunfish	29					
Mississippi Silvery Minnow	2					
Mud Darter	1					
Northern Hog Sucker	3					
Redear Sunfish	2					
Redfin Pickerel	3					
Redfin Shiner	3					
Spotfin Shiner	8					
Spotted Bass	9					
Warmouth	5					



SubBasin: Musc	catatuck	14	digit HUC: 05120	207090020	LSite: WEM-07-007	10
Site: Grassy Cree	ek	Location: CR 600				County: Jackson
Latitude: 38.7940	048 Longitud	e: -85.869314	IASNat F	Region: 11A	Торо: Н-62	Segment: 76
Ecoregion: Easte	ern Corn Belt Plains		Drainage Area (sq	miles): 12.633	Gradien	t (ft/mile): 1.972
Sample Informatio	<u>on</u>					
SampleNumber:	AB47654	EventID: 21T002		Sample MediumCo	llected: Fish Commu	inity + Water + Macro
SampleDate: 08/2	24/2021	SurveyCrewChief: KA	AG s	SampleTime: 12:49:00 Pl	M	HydroLabNumber: P5
WaterFlowType:	Pool	WaterAppearance: Gr	reen	SkyConditions: 2 - Scatt	ered	AirTemperature: 6 - > 86
WindDirection: 2	27 - West (270 degrees)			WindStrength: 0 - Calm		
DissolvedO2 (mg/l):	6.25 pH :	7.85 WaterTemp	o(°C): 21	SpecificConductiv	/ity (µS/cm): 901	Turbidity (NTU): 22.5
SpecialNotes:						
ElectrofishingEquipme	ent: Canoe	Voltage:	190	Avg.StreamW	idth(m): 7	DistanceFished (m): 105
SecondsFished:	1623	WaterDepthAvg (m):	.7	WaterDepth	lax (m): 1	TimeAtSite: 01:45
BridgeInReach:		epresentative: 🗹	WhyReachNotRe	presentative:		
SpecialComments:	Canoe w/MLES	and boom				
Habitat Informatio	<u>on</u>					
	SubstrateScore 12 (max20):	InstreamCover 11 Score (max20):	ChannelMorph (max20):	ologyScore 8		
RiparianZoneBankEros Score(max10):	sion	GlideQualityScore(max12	. ,	nQualityScore(max8):	0	
GradientScore 4 (max10):	%Pool: 30 %Riffle	0 %Run: 0) %Glide:	70 CanopyCover PctOpen:	55%-<85%	
SubjectiveRating:	AestheticRatin	g: NOTES: "N	IEW RECORD"	· · · · · · · · · · · · · · · · · · ·		

Fish Community Index of Biotic Integrity (IBI)	nform	ation	Calik	ration Used: Eastern Corn Belt Plains		
<u>Ac</u>	ctual	<u>Metric</u>			Actual	Metric
<u>Observ</u>	<u>ation</u>	<u>Score</u>		<u>Obs</u>	<u>ervation</u>	<u>Score</u>
SpeciesCount:	13	5		%TolerantIndividuals:	15.56	5
Darter/Madtom/SculpinSpeciesCount:	0	1		%OmnivoreIndividuals:	12.22	5
%HeadwaterIndividuals:	0	1		%InsectivoreIndividuals:	52.22	5
MinnowSpeciesCount:	2	1		%PioneerIndividuals:	1.11	5
SensitiveSpeciesCount:	1	1		Total # of Individuals (CPUE):	90	1
				%SimpleLithophilicInd.:	27.78	3
				%Ind.withDELT:	0	5
Metrics are dependent on Ecoregion and Drainage Area.		al IBI core	38			

I otal IBI	30
Score	
(min 0,	
max 60)	

SampleNumber: AB47654	EventID: 21T002		LSite: WEN	<i>I</i> -07-0010	Cou	nty: Jackson
StreamName: Grassy Creek	Location					
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bluegill	8					
Creek Chub	1					
Flier	16					
Longear Sunfish	1					
Redear Sunfish	4					
Redfin Pickerel	20					
Spotted Bass	2					
Spotted Sucker	11					
Striped Shiner	3					
Warmouth	9					
Western Mosquitofish	2					
White Sucker	11					
Yellow Bullhead	2					



SubBasin:	Muscatatuck		14 digit HUC:	05120207090010	LSite: WEM-07-0	015
Site: John M	IcDonald Ditch	Location	CR 125 South			County: Jackson
Latitude: 38	.863035	Longitude: -85.845	590 I.	ASNat Region: 11A	Торо: H-62	Segment: 83
Ecoregion:	Eastern Corn Belf	t Plains	Drainage A	rea (sq.miles): 4.799	Gradie	nt (ft/mile): 2.349
Sample Inform	nation					
SampleNumber:	AB47657	EventID:	21T005	Sample MediumCo	ollected: Fish Comm	nunity + Water + Macro
SampleDate:	08/24/2021	SurveyC	rewChief: KAG	SampleTime: 02:55:00 P	M	HydroLabNumber: P5
WaterFlowType:	Stagnant	WaterAp	bearance: Sheen	SkyConditions: 2 - Scat	tered	AirTemperature: 6 - > 86
WindDirection:	27 - West (2	70 degrees)		WindStrength: 0 - Calm		
DissolvedO2 (mg	/l): 6.17	pH: 7.6	WaterTemp(°C): 25.5	SpecificConducti	vity (µS/cm): 520	Turbidity (NTU): 4.4
SpecialNotes:						
ElectrofishingEqu	uipment:	Backpack	Voltage: 200	Avg.StreamW	/idth(m): 4	DistanceFished (m): 60
SecondsFished:	815	Water	DepthAvg (m): .3	WaterDepthl	Max (m): .5	TimeAtSite: 01:10
BridgeInReach:		ReachRepresentati	ve: 🗹 WhyRead	hNotRepresentative:		
SpecialComment	s: M	LES backpack				

Habitat Information

(max100): ²⁹ (r	ubstrateScore nax20):	0	Instrea Score (nCover max20):	8	ChannelMor (max20):	rphologyS	core 4	
RiparianZoneBankErosi Score(max10):	on 9	Pool/C	GlideQu	alityScore(ma	ax12):	4 Riffle/	RunQualit	yScore(max8):	0
GradientScore 4 (max10):	%Pool: 0	%Riffle:	0	%Run:	0	%Glide:	100	CanopyCover PctOpen:	10%-<30%
SubjectiveRating:	Aesthe	eticRating	g:	NOTES:	"NEV	V RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Inform	<u>ation</u>	Calibration Used: Eastern Corn Belt Plains			
<u>A</u> Observ	<u>Metric</u> Score		Actual rvation	<u>Metric</u> Score		
SpeciesCount:	7	3	%TolerantIndividuals:	45.76	3	
Darter/Madtom/SculpinSpeciesCount:	0	1	%OmnivoreIndividuals:	6.78	5	
%HeadwaterIndividuals:	0	1	%InsectivoreIndividuals:	69.49	5	
MinnowSpeciesCount:	2	1	%PioneerIndividuals:	15.25	5	
SensitiveSpeciesCount:	0	1	Total # of Individuals (CPUE):	59	1	
			%SimpleLithophilicInd.:	0	1	
			%Ind.withDELT:	32.2	1	
Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending	S	al IBI core in 0.	28			

I otal IBI	20
Score	
(min 0,	
max 60)	

SampleNumber: AB47657	EventID: 21T005		LSite: WEM	1-07-0015	Cou	nty: Jackson
StreamName: John McDonald Di	itch Location	Description:	CR 125 South			
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Central Mudminnow	13					
Common Carp	4			1		
Golden Shiner	1					
Green Sunfish	9					
Largemouth Bass	3					
Pirate Perch	18				17	
Redfin Pickerel	11	1				



SubBasin:	Muscatatuck			14 digit HUC: 05120207070040 L	Site:	WEM-07-0021
Site: T	ea Creek	L	ocation:	50 South		County: Jennings
Latitude:	38.888319	Longitude:	-85.689068	IASNat Region: 11B T	оро:	H-40 Segment: 76
Ecoregion:	Eastern Corn Belt Pl	lains		Drainage Area (sq.miles): 4.617		Gradient (ft/mile): 20.301

Sample Information

SampleNumber:	AB47658	EventID: 21T006	Sample MediumCollected: Fish Co	ommunity + Water + Macro
SampleDate:	08/16/2021	SurveyCrewChief: CWY	SampleTime: 03:55:00 PM	HydroLabNumber: P5
WaterFlowType:	Pool	WaterAppearance: Clear	SkyConditions: 1 - Clear	AirTemperature: 5 - 76-85
WindDirection:	27 - West (270 degrees)		WindStrength: 0 - Calm	
DissolvedO2 (mg/l): 11.36 pH	: 7.99 WaterTemp(°C): 22.5	SpecificConductivity (µS/cm): 39	6.7 Turbidity (NTU): 2.22
SpecialNotes:	Becoming isolated pools			

ElectrofishingEquipment: Bac		Backpack Voltag	e: 250	Avg.StreamWidth(m):	5	DistanceFished (m): 75
SecondsFished:	593	WaterDepthAvg (r	m): .15	WaterDepthMax (m):	.35	TimeAtSite: 01:00
BridgeInReach:		ReachRepresentative: 🗹	WhyRe	eachNotRepresentative:		
SpecialComments:		Smithroot backpack				

Habitat Information

TotalScore (max100):	62	SubstrateSo (max20):	ore	18		mCover max20):	8	ChannelMor (max20):	rphology	Score 15	
RiparianZoneBa Score(max10):	InkEr	osion	7	Pool/G	ilideQu	alityScore(ma	ax12):	4 Riffle/	RunQuali	tyScore(max8):	0
GradientScore (max10):	10	%Pool:	10	%Riffle:	0	%Run:	90	%Glide:	0	CanopyCover PctOpen:	<10%- Closed
SubjectiveRatin	g:	Α	esth	eticRating	:	NOTES:	"NEV	RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Inform	Calibration Used: Eastern Corn Belt Plains			
<u>A</u> Observ	<u>ctual</u> ation	<u>Metric</u> Score	<u>A</u> Observ	<u>ctual</u> /ation	<u>Metric</u> Score
SpeciesCount:	9	3	%TolerantIndividuals:	50.44	1
Darter/Madtom/SculpinSpeciesCount:	3	5	%OmnivoreIndividuals:	15.04	5
%HeadwaterIndividuals:	4.87	1	%InsectivoreIndividuals:	20.8	1
MinnowSpeciesCount:	4	3	%PioneerIndividuals:	93.81	1
SensitiveSpeciesCount:	0	1	Total # of Individuals (CPUE):	226	5
			%SimpleLithophilicInd.:	6.64	1
			%Ind.withDELT:	0	5
Metrics are dependent on Ecoregion and Drainage Area.	S	al IBI core	32		

TOTAL IDI	52
Score	
(min 0,	
max 60)	

SampleNumber: AB47658	EventID: 21T006		LSite: WEN	1-07-0021	Cou	nty: Jennings
StreamName: Tea Creek	reek LocationDescription:		CR 650 South	CR 650 South		
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bluntnose Minnow	Minnow 33					
Central Stoneroller	63					
Creek Chub	80					
Fantail Darter	11					
Johnny Darter	16					
Largemouth Bass	2					
Orangethroat Darter	14					
Silverjaw Minnow	6					
White Sucker	1				Ī	



SubBasin	: Muscatatuck			14 digit HUC: 05120207070	040	LSite:	WEM070-0	029
Site:	Tea Creek	I	.ocation: C	650 West				County: Jennings
Latitude:	38.886045	Longitude:	-85.731305	IASNat Region	: 11B	Торо:	H-40	Segment: 83
Ecoregior	Eastern Corn Belt P	Plains		Drainage Area (sq.miles)	10.632		Gradie	nt (ft/mile): 2.676

Sample Information

SampleNumber:	AB47659	EventID: 21T007		Sample MediumCollected: Fisl	h Commu	nity + Water + Macro
SampleDate:	08/17/2021	SurveyCrewChief: CWY		SampleTime: 04:35:00 PM		HydroLabNumber: P5
WaterFlowType:	Pool	WaterAppearance: Clear		SkyConditions: 1 - Clear		AirTemperature: 5 - 76-85
WindDirection:	27 - West (270 degrees)			WindStrength: 0 - Calm		
DissolvedO2 (mg/l)	: 4.64 pH	: 7.47 WaterTemp(°C)	: 23.6	SpecificConductivity (µS/cm):	467.7	Turbidity (NTU): 4.58
SpecialNotes:	Becoming isolated pools					

ElectrofishingEquip	ment:	Backpack Vo	ltage: 2	250 Avg.Stre	reamWidth(m):	4	DistanceFished (m	i): 60
SecondsFished:	635	WaterDepthA	/g (m):	.3 WaterD	DepthMax (m):	1.5	TimeAtSite: (01:45
BridgeInReach:		ReachRepresentative: 🗹		WhyReachNotRepresentative:				
SpecialComments:		SR Backpack						

Habitat Information

(max100): 49	SubstrateScore (max20):	13 Instream Score (1	mCover max20):	11	ChannelMor (max20):	phologySo	ore 9	
RiparianZoneBankErc Score(max10):	sion 4	Pool/GlideQu	alityScore(ma	ax12):	8 Riffle/F	RunQuality	Score(max8):	0
GradientScore 4 (max10):	%Pool: 70	%Riffle: 0	%Run:	30	%Glide:	0	CanopyCover PctOpen:	>85%- Open
SubjectiveRating:	Aesthe	ticRating:	NOTES:	"NEV	/ RECORD"			

Fish Community Index of Biotic Integrity (IBI) Information				oration Used: Eastern Corn Belt Plains		
Actual Metric				<u>Actual</u>	Metric	
Observ		<u>Score</u>			ervation	<u>Score</u>
SpeciesCount:	19	5		%TolerantIndividuals:	29.79	3
Darter/Madtom/SculpinSpeciesCount:	2	3		%OmnivoreIndividuals:	13.48	5
%HeadwaterIndividuals:	2.84	1		%InsectivoreIndividuals:	72.34	5
MinnowSpeciesCount:	5	3		%PioneerIndividuals:	65.25	1
SensitiveSpeciesCount: 3		3		Total # of Individuals (CPUE):	141	3
				%SimpleLithophilicInd.:	9.22	1
				%Ind.withDELT:	0	5
Metrics are dependent on Ecoregion and Drainage Area.	S	al IBI core	38			

SampleNumber: AB47659	bleNumber: AB47659 EventID: 21T007			/070-0029	County: Jennings		
StreamName: Tea Creek	Location	Description:	CR 650 West	CR 650 West			
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies	
American Brook Lamprey	4						
Blackstripe Topminnow	1						
Bluegill	3						
Bluntnose Minnow	19						
Central Stoneroller	3						
Creek Chub	6						
Golden Redhorse	2						
Green Sunfish	13						
Johnny Darter	22						
Largemouth Bass	4						
Longear Sunfish	15						
Longnose Gar	1						
Orangethroat Darter	4						
Redfin Pickerel	2						
Silverjaw Minnow	25						
Spotted Sucker	3						
Striped Shiner	4						
Western Mosquitofish	7						
Yellow Bullhead	3						



SubBasin: Muscatatuc	k	14 digit HUC: 051202070700	30 LSite:	WEM070-0039
Site: Vernon Fork Musca	atatuck River Location: CR 500 S	South		County: Jennings
Latitude: 38.910992	Longitude: -85.730084	IASNat Region:	11A Topo:	H-40 Segment: 83
Ecoregion: Eastern Cor	n Belt Plains	Drainage Area (sq.miles):	234.158	Gradient (ft/mile): 1.678
Sample Information				
SampleNumber: AB47	660 EventID: 21T008	S	ample MediumCollected:	Fish Community + Water
SampleDate: 08/17/202	1 SurveyCrewChief:	CWY Sample	ime: 08:35:00 AM	HydroLabNumber: P5
WaterFlowType: Run	WaterAppearance:	Clear SkyCon	ditions: 1 - Clear	AirTemperature: 4 - 61-75
WindDirection: 27 - W	est (270 degrees)	WindStr	ength: 0 - Calm	
DissolvedO2 (mg/l): 4.	67 pH: 7.5 WaterTe	emp(°C): 23.9	SpecificConductivity (µS/c	m): 476 Turbidity (NTU): 11.6
SpecialNotes:				
ElectrofishingEquipment:	Canoe Voltag	je: 230	Avg.StreamWidth(m):	20 DistanceFished (m): 300
SecondsFished: 2680	WaterDepthAvg (m): .6	WaterDepthMax (m):	1.7 TimeAtSite: 03:00
BridgeInReach:	ReachRepresentative: 🗹	WhyReachNotRepresent	ative:	
SpecialComments:	also 21R164; canoe w/MLES			

Habitat Information

(max100): ⁶² (m	ubstrateScore 13 nax20):	InstreamCover Score (max20)	17	hannelMorphologySco max20):	ore 11	
RiparianZoneBankErosi Score(max10):	on 6 Poo	I/GlideQualitySc	ore(max12):	Riffle/RunQuality	Score(max8):	0
GradientScore 6 (max10):	%Pool: 40 %Riffl	e: 0 %R	Run: 60 %	% Glide: 0	CanopyCover PctOpen:	<10%- Closed
SubjectiveRating:	AestheticRati	ng: NOT	'ES: "NEW R	ECORD"		

Fish Community Index of Biotic Integrity (IBI) In	form	Calibration Used: Eastern Corn Belt Plains		
		<u>Metric</u> Score	<u>Actual</u> Observation	
SpeciesCount:	29	5	%TolerantIndividuals: 29.59	3
DarterSpeciesCount:	7	5	%OmnivoreIndividuals: 17.35	5
SunfishSpeciesCount:	4	5	%InsectivoreIndividuals: 78.57	5
SuckerSpeciesCount:	5	5	%CarnivoreIndividuals: 4.08	1
SensitiveSpeciesCount:	15	5	Total # of Individuals (CPUE): 294	3
			%SimpleLithophilicInd.: 19.39	1
			%Ind.withDELT: 0	5
Metrics are dependent on Ecoregion and Drainage Area.		al IBI core	48	

SampleNumber: AB47660

EventID: 21T008

3

LSite: WEM070-0039

County: Jennings

StreamName: Vernon

Vernon Fork Muscatatuck River

LocationDescription: CR 500 South

Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bigeye Chub	1					
Black Redhorse	4					
Blackstripe Topminnow	5					
Bluegill	5					
Bluntnose Minnow	51					
Brindled Madtom	6					
Channel Catfish	1					
Chestnut Lamprey	1					
Dusky Darter	17					
Eastern Sand Darter	3					
Golden Redhorse	7					
Green Sunfish	29					
Greenside Darter	5					
Longear Sunfish	100					
Mimic Shiner	2					
Mud Darter	2					
Northern Hog Sucker	5					
Orangethroat Darter	4					
Rainbow Darter	2					
Rock Bass	2					
Silver Redhorse	1					
Silver Shiner	1					
Slenderhead Darter	5					
Spotfin Shiner	7					
Spotted Bass	8					
Spotted Sucker	6					
Suckermouth Minnow	1					
Western Mosquitofish	7		Ī			
Yellow Bullhead	6					



	luscatatuck Fork Muscatatuck River	Location: US 31	14 digit HUC: 051	20207070070	LSite:	WEM070-0020	0 County: Jackson
Latitude: 38.9	006101 Lon	gitude: -85.821061	IASNa	t Region: 11A	Торо:	H-39	Segment: 83
Ecoregion: E	astern Corn Belt Plains		Drainage Area (sq.miles): 292.076		Gradient ((ft/mile): 1.458
Sample Informa SampleNumber:	ation AB47661	EventID: 21T009		Sample MediumCol	llected:	Fish Commun	ity + Water + Macro
SampleDate:	08/18/2021	SurveyCrewChief:	KAG	SampleTime: 09:00:00 AM	1		HydroLabNumber: P7
WaterFlowType:	Run	WaterAppearance:	Clear	SkyConditions: 2 - Scatte	ered		AirTemperature: 4 - 61-75
WindDirection:	18 - South (180 degr	ees)		WindStrength: 0 - Calm			
DissolvedO2 (mg/l): 4	pH: 7.33 WaterT	emp(°C): 24.3	SpecificConductiv	ity (µS/cr	n): 435	Turbidity (NTU): 15.1
SpecialNotes:	Riffle is riprap DS of br in run.	idge, live mussels seen at sit	te, crayfish appears to	be F. rusticus based on colora	ation seen	at site; readin	gs taken DS of bridge and riffle

ElectrofishingEquip	nent:	Canoe Volt	age: 360	Avg.StreamWidth(m):	11	DistanceFished (m): 165
SecondsFished:	3057	WaterDepthAvg	g (m): 1	WaterDepthMax (m):	2	TimeAtSite: 04:00
BridgeInReach:		ReachRepresentative: 🗹	WhyReachNo	Representative:		
SpecialComments:		Canoe w/MLES; DS of bridge				

Habitat Information

(max100): ⁷⁰ (m	bstrateScore ax20):	7 Instream Score (r		15	ChannelMorp (max20):	ohologySco	re 16	
RiparianZoneBankErosic Score(max10):	on 7 I	Pool/GlideQua	lityScore(ma	x12):	12 Riffle/R	unQualityS	core(max8):	7
GradientScore (max10):	%Pool: 40 %R	Riffle: 15	%Run:	45	%Glide:	0	CanopyCover PctOpen:	30%-<55%
SubjectiveRating:	Aesthetic	Rating:	NOTES:	"NEW	/ RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Inform	<u>ation</u>	Calib	ration Used: Eastern Corn Belt Plains		
<u>A</u>	ctual	Metric			Actual	Metric
<u>Observ</u>	ation	<u>Score</u>		<u>Obse</u>	ervation	<u>Score</u>
SpeciesCount:	38	5		%TolerantIndividuals:	21.08	5
DarterSpeciesCount:	9	5		%OmnivoreIndividuals:	7.97	5
SunfishSpeciesCount:	4	5		%InsectivoreIndividuals:	85.6	5
SuckerSpeciesCount:	3	3		%CarnivoreIndividuals:	6.17	3
SensitiveSpeciesCount:	16	5		Total # of Individuals (CPUE):	389	3
				%SimpleLithophilicInd.:	38.3	3
				%Ind.withDELT:	0	5
Metrics are dependent on Ecoregion and	Tot	al IBI	52			

Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.

Score

(min 0,

max 60)

SampleNumber: AB47661

EventID: 21T009

LSite: WEM070-0020

County: Jackson

StreamName: Verr

Vernon Fork Muscatatuck River

LocationDescription: US 31

Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bigeye Chub	99					
Black Redhorse	8					
Bluntnose Darter	1					
Bluntnose Minnow	31					
Brindled Madtom	5					
Brook Silverside	2					
Bullhead Minnow	32					
Central Mudminnow	1					
Channel Catfish	13					
Chestnut Lamprey	1					
Creek Chub	1					
Dusky Darter	1					
Eastern Sand Darter	2					
Emerald Shiner	1					
Flathead Catfish	2					
Golden Redhorse	2					
Green Sunfish	33					
Greenside Darter	8					
Harlequin Darter	4					
Largemouth Bass	3					
Logperch	2					
Longear Sunfish	14					
Longnose Gar	1					
Mud Darter	1					
Northern Hog Sucker	8					
Rainbow Darter	5					
Redfin Shiner	1					
Rock Bass	1					
Silverjaw Minnow	1					
Slenderhead Darter	2					
Smallmouth Bass	1				1	
Spotfin Shiner	56					
Spotted Bass	1				1	
Steelcolor Shiner	26				1	
Striped Shiner	1					
Suckermouth Minnow	15					
Warmouth	1				1	
Western Mosquitofish	2				1	



SubBasin: Muscatatuck	14 digit HUC: 05120	0207090010	LSite: WEM09	0-0015
Site: Vernon Fork Muscatatuck River Location: CR 50	North			County: Jackson
Latitude: 38.888570 Longitude: -85.851687	IASNat	Region: 11A	Торо: Н-39	Segment: 83
Ecoregion: Eastern Corn Belt Plains	Drainage Area (so	ı.miles): 364.501	Gra	dient (ft/mile): 1.458
Sample Information				
SampleNumber: AB47662 EventID: 21T010		Sample MediumCo	llected: Fish Co	mmunity + Water
SampleDate: 08/30/2021 SurveyCrewChief	: CWY	SampleTime: 10:49:00 A	M	HydroLabNumber: P5
WaterFlowType: Run WaterAppearance	: Murky	SkyConditions: 4 - Cloue	dy	AirTemperature: 5 - 76-85
WindDirection: 27 - West (270 degrees)		WindStrength: 0 - Calm		
DissolvedO2 (mg/l): 3.42 pH: 7.39 Water	Temp(°C): 26.5	SpecificConducti	vity (µS/cm): 437	7.5 Turbidity (NTU): 14.7
SpecialNotes:				
ElectrofishingEquipment: Canoe Volta	age: 272	Avg.StreamW	idth(m): 14	DistanceFished (m): 210
SecondsFished: 2880 WaterDepthAvg	(m): .75	WaterDepth	/lax (m): 1.5	TimeAtSite: 02:30
BridgeInReach: ReachRepresentative:	WhyReachNotR	epresentative:		
SpecialComments: Canoe w/Boom and Infinity Box				
Habitat Information				
TotalScore 57 SubstrateScore 13 InstreamCover	14 ChannelMorp (max20):	hologyScore 11		
TotalScore 57 SubstrateScore 13 InstreamCover (max100): 57 (max20): 13 Score (max20): RiparianZoneBankErosion 4 Rool/ClideQualityScore/m	¹⁴ (max20):		0	
TotalScore 57 SubstrateScore 13 InstreamCover (max100): 57 (max20): 13 Score (max20): RiparianZoneBankErosion 4 Pool/GlideQualityScore(m Score(max10): 6 GradientScore	14 (max20): nax12): 9 Riffle/Ru	unQualityScore(max8):		
TotalScore 57 SubstrateScore 13 InstreamCover (max100): 57 (max20): 13 Score (max20): RiparianZoneBankErosion 4 Pool/GlideQualityScore(max10):	¹⁴ (max20):	unQualityScore(max8):	0 55%-<85%	

Fish Community Index of Biotic Integrity (IBI) Info	orma	ation	Calibration Used: Eastern Corn Belt Plains		
Actu	ıal	Metric_		Actual	<u>Metric</u>
Observatio	on	<u>Score</u>	Obse	ervation	<u>Score</u>
SpeciesCount:	18	3	%TolerantIndividuals:	14.29	5
DarterSpeciesCount:	0	1	%OmnivoreIndividuals:	3.9	5
SunfishSpeciesCount:	4	5	%InsectivoreIndividuals:	85.71	5
SuckerSpeciesCount:	4	5	%CarnivoreIndividuals:	10.39	5
SensitiveSpeciesCount:	5	3	Total # of Individuals (CPUE):	77	1
			%SimpleLithophilicInd.:	36.36	3
			%Ind.withDELT:	0	5
Metrics are dependent on Ecoregion and	Tot	al IBI	46		

Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.

46

SampleNumber:	AB47662
---------------	---------

LSite: WEM090-0015

County: Jackson

StreamName: Vernon

Vernon Fork Muscatatuck River

LocationDescription: CR 50 North

Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Black Crappie	3					
Bluegill	2					
Bluntnose Minnow	1					
Brook Silverside	1					
Bullhead Minnow	10					
Channel Catfish	3					
Chestnut Lamprey	1					
Common Carp	1					
Freshwater Drum	2					
Gizzard Shad	1					
Golden Redhorse	9					
Green Sunfish	2					
Longear Sunfish	17					
Silver Redhorse	18					
Smallmouth Bass	1					
Smallmouth Buffalo	1					
Spotted Bass	3					
Spotted Sucker	1					



Latitude: 38.940733 Longitude: - Ecoregion: Eastern Corn Belt Plains		SNat Region: 11B Topo: H-39 a (sq.miles): 29.807 Grad	County: Jackson Segment: 83 dient (ft/mile): 2.112
Ecoregion: Eastern Corn Belt Plains			-
ample Information	Drainage Are	a (sq.miles): 29.807 Grad	dient (ft/mile): 2.112
•			
ampleNumber: AB47664 Ever			
•	ntID: 21T012	Sample MediumCollected: Fish Cor	mmunity + Water + Macro
SampleDate: 08/17/2021 Su	urveyCrewChief: KAG	SampleTime: 11:39:00 AM	HydroLabNumber: P7
VaterFlowType: Glide Wa	aterAppearance: Sheen	SkyConditions: 4 - Cloudy	AirTemperature: 5 - 76-85
VindDirection: 9 - East (90 degrees)		WindStrength: 0 - Calm	
DissolvedO2 (mg/l): 1.4 pH: 7.2	1 WaterTemp(°C): 23.4	SpecificConductivity (µS/cm): 405	5.5 Turbidity (NTU): 8.52
SpecialNotes:			
ElectrofishingEquipment: Canoe	Voltage: 250	Avg.StreamWidth(m): 10	DistanceFished (m): 150
5 1 1	WaterDepthAvg (m): 1	WaterDepthMax (m): 2	TimeAtSite: 03:00
		NotRepresentative:	
	; sheen on surface of water; canoe w	-	
max100): ⁴⁷ (max20): ⁷ Sco	ore (max20): ¹⁴ (max20):	AorphologyScore 4 Ie/RunQualityScore(max8): 0 90 CanopyCover 55%-<85% PctOpen: 55%-<85%	
SubjectiveRating: AestheticRating:	NOTES: "NEW RECORD	n	
Fish Community Index of Biotic Integrity (IBI		tion Used: Eastern Corn Belt Plains	
	<u>Actual Metric</u> rvation <u>Score</u>	<u>Actual</u> Observatio	
SpeciesCount:	13 3	%TolerantIndividuals: 19.44	
DarterSpeciesCount:	0 1	%OmnivoreIndividuals: 16.67	7 5
SunfishSpeciesCount:	5 5	%InsectivoreIndividuals: 44.44	4 3
SuckerSpeciesCount:	2 3	%CarnivoreIndividuals: 38.89) 3
SensitiveSpeciesCount:	1 1	Total # of Individuals (CPUE): 108	3 1
		%SimpleLithophilicInd.: 27.78	3 3
		%Ind.withDELT: (
Metrics are dependent on Ecoregion and	Total IBI 38 Score		-
Drainage Area.			
Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.	(min 0, max 60)		

SampleNumber: AB47664	EventID: 21T012		LSite: WEM	1080-0014	Cou	nty: Jackson
StreamName: Mutton Creek Dite	ch Location	Description:	CR 400 North			
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bluegill	22					
Bluntnose Minnow	1					
Bowfin	2					
Golden Shiner	2					
Green Sunfish	1					
Largemouth Bass	4					
Longear Sunfish	3					
Redear Sunfish	4					
Redfin Pickerel	16					
Spotted Sucker	13					
Warmouth	20					
Western Mosquitofish	3					
White Sucker	17					



SubBasin:	Muscatatuck		14 digit H	IUC: 051202070800	20 LSite:	WEM-07-0016	
Site: Tributa	ary of Mutton Creek	Location	n: CR 700 North			Co	unty: Jackson
Latitude: 38	3.983945	Longitude: -85.82	8548	IASNat Region:	11B Topo:	H-39 S	egment: 83
Ecoregion:	Eastern Corn Belt Pla	ains	Draina	ige Area (sq.miles):	5.117	Gradient (ft/r	mile): 11.518
Sample Inform	<u>nation</u>						
SampleNumber:	AB47665	EventID:	21T013	S	ample MediumCollected:	Fish Community -	+ Water + Macro
SampleDate:	08/16/2021	Survey	CrewChief: KAG	SampleT	ime: 02:53:00 PM	н	ydroLabNumber: P7
WaterFlowType:	Run	WaterA	pearance: Clear	SkyCon	ditions: 3 - Partly	Ai	rTemperature: 5 - 76-85
WindDirection:	27 - West (270	degrees)		WindStr	ength: 1 - Light		
DissolvedO2 (mg	j/l): 10.38	pH: 8.04	WaterTemp(°C):	25.9	SpecificConductivity (µS/c	:m): 416.5	Turbidity (NTU): 4.9
SpecialNotes:							
ElectrofishingEq	uipment: Ba	ackpack	Voltage: 200		Avg.StreamWidth(m):	3 Di s	stanceFished (m): 50
SecondsFished:	536	Water	DepthAvg (m): .25		WaterDepthMax (m):	.75	TimeAtSite: 01:00
BridgeInReach:		ReachRepresenta	tive: 🗹 🛛 Why	ReachNotRepresent	ative:		
SpecialComment	ts: MLE	S backpack					

Habitat Information

TotalScore (max100):	(max20):	11	eamCover e (max20):	16	ChannelMor (max20):	phologyS	core 12	
RiparianZoneBank Score(max10):	rosion 3	Pool/Glide	QualityScore(m	ax12):	9 Riffle/I	RunQualit	yScore(max8):	6
GradientScore 8 (max10):	% Pool: 30	%Riffle: 1	10 %Run:	60	%Glide:	0	CanopyCover PctOpen:	>85%- Open
SubjectiveRating:	Aesth	eticRating:	NOTES:	"NEV	RECORD"			

Fish Community Index of Biotic Integrity (IBI) I	nform	<u>ation</u>	Calib	ration Used: Eastern Corn Belt Plains		
<u>Ac</u> Observ	<u>ctual</u> ation	<u>Metric</u> Score		Obs	Actual ervation	<u>Metric</u> Score
SpeciesCount:	14	5		%TolerantIndividuals:	8.09	5
Darter/Madtom/SculpinSpeciesCount:	2	3		%OmnivoreIndividuals:	4.41	5
%HeadwaterIndividuals:	0	1		%InsectivoreIndividuals:	64.71	5
MinnowSpeciesCount:	4	3		%PioneerIndividuals:	33.82	3
SensitiveSpeciesCount:	1	1		Total # of Individuals (CPUE):	136	3
				%SimpleLithophilicInd.:	5.15	1
				%Ind.withDELT:	0	5
Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending	S	al IBI core in 0,	40			

on calibration.

SampleNumber:	AB47665
Sample Number.	AD41003

EventID: 21T013

LSite: WEM-07-0016

County: Jackson

StreamName: Tributary of Mutton Creek

n Creek

LocationDescription:

ion: CR 700 North

Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bluegill	10					
Bluntnose Minnow	1					
Central Stoneroller	31					
Creek Chub	2					
Green Sunfish	3					
Johnny Darter	6					
Largemouth Bass	2					
Longear Sunfish	64					
Orangethroat Darter	2					
Redear Sunfish	1					
Redfin Pickerel	7					
Silverjaw Minnow	1					
Western Mosquitofish	1					
White Sucker	5					



SubBasin: Muscatatuck	14 0	digit HUC: 051202070800	20 LSite:	WEM080-0027
Site: Mutton Creek	Location: CR 800 North	h		County: Jackson
Latitude: 38.998644 Longitud	e: -85.806382	IASNat Region:	11B Topo :	H-39 Segment: 83
Ecoregion: Eastern Corn Belt Plains	I	Drainage Area (sq.miles):	18.199	Gradient (ft/mile): 4.798
Sample Information				
SampleNumber: AB47666	EventID: 21T014	s	ample MediumCollected:	Fish Community + Water + Macro
SampleDate: 08/16/2021	SurveyCrewChief: KA	G SampleT	ime: 12:45:00 PM	HydroLabNumber: P7
WaterFlowType: Pool	WaterAppearance: Cle	ar SkyCon	ditions: 3 - Partly	AirTemperature: 5 - 76-85
WindDirection: 27 - West (270 degrees)		WindStr	ength: 1 - Light	
DissolvedO2 (mg/l): 4.84 pH:	7.4 WaterTemp	(°C): 23.7	SpecificConductivity (µS/c	m): 373.8 Turbidity (NTU): 10.4
SpecialNotes: Saw Ancyronyx and Enochro	us adults in sample, not pick	ed (not found during 15 min	ute pick).	
ElectrofishingEquipment: Backpack	Voltage:	200	Avg.StreamWidth(m):	7 DistanceFished (m): 105
SecondsFished: 1514	WaterDepthAvg (m):	.25	WaterDepthMax (m):	1.5 TimeAtSite: 01:30
BridgeInReach: ReachR	epresentative: 🗹	WhyReachNotRepresent	ative:	
SpecialComments: MLES backpack	K			

(max100): ⁶¹ (r	ubstrateScore nax20):	13	nstrean Score (n	nCover nax20):	16	ChannelMor (max20):	rphology	Score 14	
RiparianZoneBankEros Score(max10):	ion 3	Pool/Gl	lideQua	lityScore(ma	ax12):	9 Riffle/	RunQual	ityScore(max8):	0
GradientScore (max10):	% Pool: 30 %	%Riffle:	0	%Run:	70	%Glide:	0	CanopyCover PctOpen:	30%-<55%
SubjectiveRating:	Aesthet	icRating:		NOTES:	"NEV	RECORD"			

Fish Community Index of Biotic Integrity (IBI) I	Informa	ation	Cali	bration Used:		
<u>Ac</u>	ctual	Metric_			Actual	Metric_
Observ	<u>ation</u>	<u>Score</u>		<u>Obs</u>	ervation	<u>Score</u>
SpeciesCount:	17	5		%TolerantIndividuals:	6.59	5
Darter/Madtom/SculpinSpeciesCount:	1	1		%OmnivoreIndividuals:	4.4	5
%HeadwaterIndividuals:	0	1		%InsectivoreIndividuals:	91.94	5
MinnowSpeciesCount:	2	1		%PioneerIndividuals:	3.66	5
SensitiveSpeciesCount:	2	1		Total # of Individuals (CPUE):	273	5
				%SimpleLithophilicInd.:	6.96	1
				%Ind.withDELT:	0.73	3
Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.	So (m	al IBI core in 0, x 60)	38			

SampleNumber: AB47666	EventID: 21T014		LSite: WEM	1080-0027	Cou	nty: Jackson
StreamName: Mutton Creek	Location	Description:	CR 800 North			
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Black Crappie	1					
Blackstripe Topminnow	6					
Bluegill	45					
Bluntnose Minnow	3					
Brook Silverside	1					
Brown Bullhead	1					
Central Mudminnow	1					
Green Sunfish	2					
Johnny Darter	5					
Largemouth Bass	5					
Longear Sunfish	175	2				
Redear Sunfish	2					
Redfin Pickerel	4					
Striped Shiner	10					
Warmouth	1					
White Sucker	9					
Yellow Bullhead	2					



SubBasin: Muscatatuck	14	digit HUC: 051202070800	10 LSite:	WEM080-0025
Site: Mutton Creek	Location: CR 300 Nort	h		County: Jennings
Latitude: 39.027968	Longitude: -85.765410	IASNat Region:	11B Topo:	H-16 Segment: 83
Ecoregion: Eastern Corn Belt P	Plains	Drainage Area (sq.miles):	8.239	Gradient (ft/mile): 6.52
Sample Information				
SampleNumber: AB47667	EventID: 21T015	S	ample MediumCollected:	Fish Community + Water + Macro
SampleDate: 08/16/2021	SurveyCrewChief: KA	G SampleT	ime: 10:19:00 AM	HydroLabNumber: P7
WaterFlowType: Pool	WaterAppearance: Cle	ear SkyCone	ditions: 4 - Cloudy	AirTemperature: 4 - 61-75
WindDirection: 18 - South (18	30 degrees)	WindStr	ength: 1 - Light	
DissolvedO2 (mg/l): 4.77	pH: 7.39 WaterTemp	(° C): 22.1	SpecificConductivity (µS/c	m): 369.9 Turbidity (NTU): 6.89
SpecialNotes:				
ElectrofishingEquipment: B	Backpack Voltage:	200	Avg.StreamWidth(m):	6 DistanceFished (m): 90
SecondsFished: 1502	WaterDepthAvg (m):	.2	WaterDepthMax (m):	.75 TimeAtSite: 01:30
BridgeInReach:	ReachRepresentative: 🔽	WhyReachNotRepresent	ative:	
SpecialComments: MLE	ES backpack			

Habitat Information

(max100): ⁶⁰ (r	ubstrateScore ₁₁ nax20):	Instream Score (m		16	ChannelMor (max20):	phology	Score 15	
RiparianZoneBankEros Score(max10):	ion 4 Pool	l/GlideQual	ityScore(ma	ax12):	8 Riffle/I	RunQua	lityScore(max8):	0
GradientScore (max10):	%Pool: 40 %Riffle	e: 10	%Run:	50	%Glide:	0	CanopyCover PctOpen:	30%-<55%
SubjectiveRating:	AestheticRati	ng:	NOTES:	"NEV	/ RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Inform	<u>ation</u>	Calib	ration Used: Eastern Corn Belt Plains		
<u>A</u>	<u>ctual</u>	Metric			Actual	<u>Metric</u>
Observ	<u>ation</u>	<u>Score</u>		Obs	<u>ervation</u>	<u>Score</u>
SpeciesCount:	15	5		%TolerantIndividuals:	35.86	3
Darter/Madtom/SculpinSpeciesCount:	2	3		%OmnivoreIndividuals:	18.55	5
%HeadwaterIndividuals:	0	1		%InsectivoreIndividuals:	28.28	3
MinnowSpeciesCount:	5	3		%PioneerIndividuals:	74.96	1
SensitiveSpeciesCount:	1	1		Total # of Individuals (CPUE):	647	5
				%SimpleLithophilicInd.:	9.27	1
				%Ind.withDELT:	0	5
Metrics are dependent on Ecoregion and	Tot	al IBI	36			

Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.

Total IBI	36
Score	
(min 0,	
max 60)	

SampleNumber: AB47667	EventID: 21T015	LSite: WEM	1080-0025	County: Jennings					
StreamName: Mutton Creek	LocationDescription: CR 300 North								
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies			
Blackstripe Topminnow	2								
Bluegill	66								
Bluntnose Minnow	79								
Central Stoneroller	229								
Creek Chub	108								
Green Sunfish	2								
Johnny Darter	17								
Largemouth Bass	7								
Longear Sunfish	39								
Orangethroat Darter	19								
Redear Sunfish	1								
Redfin Shiner	4								
Silverjaw Minnow	31								
White Sucker	41								
Yellow Bullhead	2				T				



SubBasin:	: Muscatatu	ck		14 digit HUC: 051202070800	40	LSite:	WEM080-00	13
Site:	Storm Creek Ditcl	n L	ocation:	CR 400 North				County: Jackson
Latitude:	38.940553	Longitude:	-85.80592	28 IASNat Region:	11B	Торо:	H-39	Segment: 83
Ecoregion	: Eastern Co	orn Belt Plains		Drainage Area (sq.miles):	17.513		Gradient	: (ft/mile): 2.682
_								

Sample Information

SampleNumber:	AB47668	EventID: 2	21T016		Sample MediumCollected: Fis	h Community + Water + Macro	
SampleDate:	08/17/2021	SurveyCre	ewChief: KAG		SampleTime: 08:21:00 AM	HydroLabNumber: P7	
WaterFlowType:	Glide	WaterApp	earance: Sheen		SkyConditions: 4 - Cloudy	AirTemperature: 4 - 61-7	75
WindDirection:	9 - East (90 degrees)				WindStrength: 0 - Calm		
DissolvedO2 (mg/	l): 0.18 pl	I: 7.12	WaterTemp(°C):	22.7	SpecificConductivity (µS/cm):	388.8 Turbidity (NTU): 9.73	3
SpecialNotes:	Canoe site, entirely a dee	o canal, no kick					

ElectrofishingEquipr	nent:	Canoe	Voltage:	240	Avg.StreamWidth(m):	9	DistanceFished (m): 135
SecondsFished:	2494		WaterDepthAvg (m):	1	WaterDepthMax (m):	1.5	TimeAtSite: 03:00
BridgeInReach:		ReachRep	resentative: 🗹	WhyReachN	otRepresentative:		
SpecialComments:		canoe w/boom and	d MLES; sample collected	d DS of bridge of	due to log jam and excessive duckweed;	sheen o	on surface of water

TotalScore 46 (max100):	Substrate (max20):	Score	10		mCover max20):	12	ChannelMor (max20):	phologyS	icore 4	
RiparianZoneBankEr Score(max10):	osion	8	Pool/G	lideQu	alityScore(m	ax12):	8 Riffle/F	RunQualit	yScore(max8):	0
GradientScore 4 (max10):	%Poo	: 20	%Riffle:	0	%Run:	0	%Glide:	80	CanopyCover PctOpen:	55%-<85%
SubjectiveRating:		Aesth	eticRating:		NOTES:	"NEV	RECORD"			

Fish Community Index of Biotic Integrity (IBI) I	nform	<u>ation</u>	Calil	bration Used:		
	tual	<u>Metric</u>			Actual	Metric
Observa	<u>ation</u>	<u>Score</u>		Obs	ervation	<u>Score</u>
SpeciesCount:	8	3		%TolerantIndividuals:	3.45	5
Darter/Madtom/SculpinSpeciesCount:	0	1		%OmnivoreIndividuals:	0	5
%HeadwaterIndividuals:	0	1		%InsectivoreIndividuals:	34.48	3
MinnowSpeciesCount:	1	1		%PioneerIndividuals:	0	5
SensitiveSpeciesCount:	0	1		Total # of Individuals (CPUE):	29	1
				%SimpleLithophilicInd.:	3.45	1
				%Ind.withDELT:	0	5
Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.	S (m	al IBI core in 0, ax 60)	32			

SampleNumber: AB47668	EventID: 21T016		LSite: WEM	/080-0013	Cou	nty: Jackson
StreamName: Storm Creek Ditch	Location	LocationDescription:				
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bluegill	4					
Bowfin	1					
Flier	1					
Golden Shiner	1					
Redear Sunfish	3					
Redfin Pickerel	14					
Spotted Sucker	1					
Warmouth	4					



SubBasin	: Muscatatuck		14 digit HUC:	051202070800	40	LSite:	WEM080-0005	i	
Site:	Tributary to Richart Lake	Location:	CR 900 West				c	County: Jer	nnings
Latitude:	38.969530	Longitude: -85.7774	D2 IAS	SNat Region:	11B	Торо:	H-39	Segment:	83
Ecoregior	: Eastern Corn Belt Pl	ains	Drainage Are	ea (sq.miles):	1.529		Gradient (f	it/mile): 17.	.212

Sample Information

SampleNumber:	AB47669	EventID: 21T017		Sample MediumCollected: Fish	n Community + Water + Macro
SampleDate:	08/17/2021	SurveyCrewChief: KAG		SampleTime: 04:15:00 PM	HydroLabNumber: P7
WaterFlowType:	Pool	WaterAppearance: Clear		SkyConditions: 4 - Cloudy	AirTemperature: 6 - > 86
WindDirection:	27 - West (270 degrees)			WindStrength: 1 - Light	
DissolvedO2 (mg/l): 0.36 p ⊦	: 7.33 WaterTemp(°C):	22.3	SpecificConductivity (µS/cm):	543 Turbidity (NTU): 5.93
SpecialNotes:	Isolated pools				

ElectrofishingEquipment:		Backpack	Voltage:	200	Avg.StreamWidth(m):	4	DistanceFished (m): 60
SecondsFished:	562		WaterDepthAvg (m):	.1	WaterDepthMax (m):	.3	TimeAtSite: 01:00
BridgeInReach:			sentative: 🗹	WhyReach	NotRepresentative:		
SpecialComments:		isolated pools; MLES	S backpack				

Habitat Information

TotalScore (max100):	49	SubstrateSo (max20):	core	1.5		mCover max20):	8	ChannelMo (max20):	rphology	Score 10	
RiparianZoneBa Score(max10):	inkEr	osion	7	Pool/G	BlideQu	alityScore(m	ax12):	1 Riffle	/RunQuali	tyScore(max8):	0
GradientScore (max10):	10	%Pool:	90	%Riffle:	5	%Run:	5	%Glide:	0	CanopyCover PctOpen:	<10%- Closed
SubjectiveRatin	g:	Α	esth	eticRating	j:	NOTES:	"NEV	V RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Inform	Calibration Used:			
<u>A</u> Observ	<u>ctual</u> vation	<u>Metric</u> Score	Obs	Actual ervation	<u>Metric</u> Score
SpeciesCount:	5	3	%TolerantIndividuals:	98.75	1
Darter/Madtom/SculpinSpeciesCount:	0	1	%OmnivoreIndividuals:	12.5	1
%HeadwaterIndividuals:	0	1	%InsectivoreIndividuals:	18.75	1
MinnowSpeciesCount:	1	1	%PioneerIndividuals:	70	1
SensitiveSpeciesCount:	0	1	Total # of Individuals (CPUE):	80	3
			%SimpleLithophilicInd.:	12.5	1
			%Ind.withDELT:	0	5
Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending	S (m	al IBI core iin 0,	20		

on calibration.

20

SampleNumber:	AB47669	EventID:	21T017	LSite:	WEM080-0005	County:	Jennings

StreamName: Tributary to Richart Lake

LocationDescription: CR 900 West

Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bluegill	1					
Central Mudminnow	13					
Creek Chub	55					
Green Sunfish	1					
White Sucker	10					



SubBasin:	Muscatatuck		14 digit HUC:	05120207080030	LSite:	WEM-07-0014		
Site: Stor	rm Creek	Location:	Base Road			Cour	nty: Jennings	
Latitude:	38.983201	Longitude: -85.7867)9 I	ASNat Region: 11B	Торо:	H-39 Se	gment: 83	
Ecoregion:	Eastern Corn Belt	Plains	Drainage A	rea (sq.miles): 9.378		Gradient (ft/mi	ile): 4.073	
Sample Info	ormation							
SampleNumbe	er: AB47670	EventID: 2	1T018	Sample Med	iumCollected:	Fish Community +	Water + Macro	
SampleDate:	08/16/2021	SurveyCre	wChief: KAG	SampleTime: 04:3	9:00 PM	Hyd	droLabNumber: P7	7
WaterFlowTyp	e: Pool	WaterAppe	earance: Clear	SkyConditions: 2	- Scattered	AirT	Temperature: 5 - 76	3-85
WindDirection	: 27 - West (2	70 degrees)		WindStrength: 0 -	Calm			
DissolvedO2 (mg/l): 6.77	pH: 7.6	WaterTemp(°C): 22.6	SpecificCo	nductivity (µS/c	m): 311.3	Turbidity (NTU): 4.	.23
SpecialNotes:								
Electrofishing	Equipment:	Backpack	Voltage: 200	Avg.Str	eamWidth(m):	6 Dist	anceFished (m): 90	0
SecondsFishe	d: 1004	WaterDe	epthAvg (m): .5	Water	DepthMax (m):	1	TimeAtSite: 02:00	
BridgeInReach	n: 🗌	ReachRepresentativ	e: 🗹 WhyRead	hNotRepresentative:				

Habitat Information

SpecialComments:

TotalScore (max100):	61	SubstrateSo (max20):	core	14		nCover nax20):	15	ChannelMo (max20):	rphologySco	ore 11	
RiparianZoneB Score(max10):		osion	5	Pool/G	lideQua	alityScore(m	ax12):	10 Riffle/	RunQualityS	Score(max8):	0
GradientScore (max10):	6	%Pool:	40	%Riffle:	10	%Run:	50	%Glide:	0	CanopyCover PctOpen:	<10%- Closed
SubjectiveRatin	ng:	А	esth	eticRating:		NOTES:	"NEV	V RECORD"			

MLES backpack; 54.36% catch Longear Sunfish

Fish Community Index of Biotic Integrity (IBI)	Inform	Calil	pration Used: Eastern Corn Belt Plains			
<u>A</u> Observ	<u>Metric</u> Score		Obs	<u>Actual</u> ervation	<u>Metric</u> Score	
SpeciesCount:				%TolerantIndividuals:	18.79	5
Darter/Madtom/SculpinSpeciesCount:	3	5		%OmnivoreIndividuals:	3.36	5
%HeadwaterIndividuals:	0	1		%InsectivoreIndividuals:	85.91	5
MinnowSpeciesCount:	3	3		%PioneerIndividuals:	15.44	5
SensitiveSpeciesCount:	SensitiveSpeciesCount: 1			Total # of Individuals (CPUE):	149	3
				%SimpleLithophilicInd.:	6.71	1
				%Ind.withDELT:	0.67	3
Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.	S (m	tal IBI core nin 0, ax 60)	42			

SampleNumber: AB47670	EventID: 21T018		LSite: WEM	1-07-0014	Cou	nty: Jennings
StreamName: Storm Creek	Location	Description:	Base Road			
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Blackside Darter	1					
Bluegill	6					
Bluntnose Minnow	2					
Central Mudminnow	4					
Creek Chub	4					
Flier	4					
Green Sunfish	10					
Johnny Darter	1					
Largemouth Bass	1					1
Longear Sunfish	81					
Orangethroat Darter	6					
Pirate Perch	4				1	
Redfin Pickerel	8					
Redfin Shiner	5					
Warmouth	3					
Western Mosquitofish	1					
White Sucker	3					
Yellow Bullhead	5					



SubBasin:	Muscatatuck		14 digit HUC	: 05120207070060	LSite:	WEM-07-0017	
Site: Sixmi	ile Creek	Location	n: CR 500 South			Count	ty: Jennings
Latitude: 3	38.911153	Longitude: -85.76	2327	IASNat Region: 1	1A Topo:	H-39 Seg	ment: 83
Ecoregion:	Eastern Corn Bel	t Plains	Drainage	Area (sq.miles): 3	0.679	Gradient (ft/mile	e): 2.423
Sample Infor	<u>mation</u>						
SampleNumber	: AB47671	EventID:	21T019	San	ple MediumCollected:	Fish Community + V	√ater + Macro
SampleDate:	08/16/2021	Survey	CrewChief: CWY	SampleTim	e: 02:05:00 PM	Hyd	roLabNumber: P5
WaterFlowType	: Run	WaterA	pearance: Clear	SkyConditi	ons: 1 - Clear	AirTe	emperature: 5 - 76-85
WindDirection:	27 - West (2	270 degrees)		WindStren	gth: 1 - Light		
DissolvedO2 (m	ig/l): 8.44	pH: 7.9	WaterTemp(°C): 25	.2 Sp	ecificConductivity (µS/c	m): 340 T	urbidity (NTU): 14.4
SpecialNotes:							
ElectrofishingE	quipment:	Backpack	Voltage: 250		Avg.StreamWidth(m):	7 Dista	nceFished (m): 105
SecondsFished	: 849	Water	DepthAvg (m): .3		WaterDepthMax (m):	.75	FimeAtSite: 01:15
BridgeInReach:		ReachRepresenta	tive: 🗹 WhyRe	achNotRepresentati	ve:		
SpecialCommer	nts:	mithroot backpack					

(max100): ⁴⁹ (i	ubstrateScore nax20):	7 Instream Score (n		13	ChannelMorp (max20):	ohologySo	core 11	
RiparianZoneBankEros Score(max10):	ion 3	Pool/GlideQua	lityScore(ma	1x12):	9 Riffle/R	unQuality	Score(max8):	2
GradientScore 4 (max10):	% Pool: 25 %	%Riffle: 15	%Run:	60	%Glide:	0	CanopyCover PctOpen:	>85%- Open
SubjectiveRating:	Aestheti	icRating:	NOTES:	"NEV	/ RECORD"			

Fish Community Index of Biotic Integrity (IBI) Information				bration Used:		
Actual Metric					Actual	<u>Metric</u>
Observ	<u>ation</u>	<u>Score</u>		<u>Obs</u>	ervation	<u>Score</u>
SpeciesCount:	24	5		%TolerantIndividuals:	28.31	3
DarterSpeciesCount:	3	5		%OmnivoreIndividuals:	5.29	5
SunfishSpeciesCount:	4	5		%InsectivoreIndividuals:	87.83	5
SuckerSpeciesCount:	3	3		%CarnivoreIndividuals:	3.7	1
SensitiveSpeciesCount:	6	5		Total # of Individuals (CPUE):	378	5
				%SimpleLithophilicInd.:	7.14	1
				%Ind.withDELT:	0.26	3
Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.	So (m	al IBI core in 0, ix 60)	46			

SampleNumber: AB47671	EventID: 21T019		LSite: WEM	1-07-0017	County: Jennings		
StreamName: Sixmile Creek	StreamName: Sixmile Creek LocationDescription:						
Common Name	Individual Fish Count Deformiti		Eroded Fins	Lesions	Tumors	Multiple Anomalies	
Bigeye Chub	3						
Blackstripe Topminnow	1						
Bluegill	12				1		
Bluntnose Minnow	19						
Brindled Madtom	2						
Bullhead Minnow	2						
Central Stoneroller	12						
Channel Catfish	12						
Fantail Darter	1						
Golden Redhorse	1						
Green Sunfish	68						
Johnny Darter	5						
Largemouth Bass	1						
Longear Sunfish	109						
Mud Darter	8						
Northern Hog Sucker	7						
Rock Bass	1						
Silverjaw Minnow	21						
Spotfin Shiner	25						
Striped Shiner	13						
Suckermouth Minnow	2						
Western Mosquitofish	45						
White Sucker	1						
Yellow Bullhead	7						



SubBasin	: Muscatatuck			14 digit HUC: 05120207070060)	LSite:	WEM-07-001	8
Site:	Sixmile Creek	I	ocation:	CR 200 South				County: Jennings
Latitude:	38.954384	Longitude:	-85.73213	38 IASNat Region: 1	1A ·	Торо:	H-40	Segment: 83
Ecoregior	Eastern Corn Belt P	lains		Drainage Area (sq.miles): 2	24.444		Gradient	(ft/mile): 9.117

Sample Information

SampleNumber:	AB47672	EventID: 21T020	Sample MediumCollected: Fish Commu	nity + Water + Macro
SampleDate:	08/18/2021	SurveyCrewChief: CWY	SampleTime: 08:25:00 AM	HydroLabNumber: P5
WaterFlowType:	Pool	WaterAppearance: Clear	SkyConditions: 1 - Clear	AirTemperature: 4 - 61-75
WindDirection:	27 - West (270 degrees)		WindStrength: 0 - Calm	
DissolvedO2 (mg/l)	: 6.86 pH	: 7.76 WaterTemp(°C): 23	SpecificConductivity (µS/cm): 333.9	Turbidity (NTU): 9.26
SpecialNotes:	Photos taken of 2 Hageniu	s brevistylus, then released.		

ElectrofishingEquip	nent:	Backpack	Voltage:	250	Avg.StreamWidth(m):	9	DistanceFished (m): 135
SecondsFished:	998	,	WaterDepthAvg (m):	.3	WaterDepthMax (m):	.75	TimeAtSite: 01:30
BridgeInReach:		ReachRepres	sentative: 🗹	WhyReachN	lotRepresentative:		
SpecialComments:		Smithroot backpack					

Habitat Information

TotalScore 62 (max100):	SubstrateScore (max20):	14	streamCover ore (max20):	13	ChannelMor (max20):	phology	Score 11	
RiparianZoneBankEr Score(max10):	osion 3	Pool/Glid	leQualityScore(n	nax12):	7 Riffle/F	RunQual	ityScore(max8):	4
GradientScore 10 (max10):	%Pool: 60 %	%Riffle:	10 %Run:	30	%Glide:	0	CanopyCover PctOpen:	30%-<55%
SubjectiveRating:	Aesthet	ticRating:	NOTES:	"NEV	V RECORD"			

Fish Community Index of Biotic Integrity (IBI) Info	orma	Calibration Used:		
Actu	al	Actual	<u>Metric</u>	
Observatio	on	<u>Score</u>	Observation	<u>Score</u>
SpeciesCount: 2	23	5	%TolerantIndividuals: 12.32	5
DarterSpeciesCount:	5	5	%OmnivoreIndividuals: 12.32	5
SunfishSpeciesCount:	4	5	%InsectivoreIndividuals: 83.28	5
SuckerSpeciesCount:	4	5	%CarnivoreIndividuals: 2.35	1
SensitiveSpeciesCount:	8	5	Total # of Individuals (CPUE): 341	5
			%SimpleLithophilicInd.: 11.73	1
			%Ind.withDELT: 0	5
Metrics are dependent on Ecoregion and	Tot	al IBI	52	

Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.

Total IBI	52
Score	
(min 0,	
max 60)	

SampleNumber: AB47672	EventID: 21T020		LSite: WEM	1-07-0018	County: Jennings		
StreamName: Sixmile Creek	Location	Description:	CR 200 South				
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies	
Bigeye Chub	10						
Black Redhorse	1						
Blackside Darter	3						
Blackstripe Topminnow	1						
Bluegill	53						
Bluntnose Minnow	42						
Central Stoneroller	7						
Fantail Darter	6						
Golden Redhorse	4						
Greenside Darter	7						
Johnny Darter	4						
Largemouth Bass	3						
Logperch	2						
Longear Sunfish	161						
Northern Hog Sucker	7						
Redear Sunfish	1						
Redfin Pickerel	1						
Rock Bass	2						
Spotfin Shiner	10						
Spotted Bass	2						
Spotted Sucker	3						
Striped Shiner	10						
Tadpole Madtom	1		1				



SubBasin: N	<i>Auscatatuck</i>		14 digit HUC: 05	120207070050	LSite:	WEM-07-0019	
Site: Sixmile	Creek	Location: CR 175	North			(County: Jennings
Latitude: 39.0	010095 Longitud	de: -85.704976	IASI	Nat Region: 11	В Торо :	H-17	Segment: 83
Ecoregion: E	astern Corn Belt Plains		Drainage Area	(sq.miles): 13	.834	Gradient (ft/mile): 9.933
Sample Informa SampleNumber: SampleDate: WaterFlowType: WindDirection: DissolvedO2 (mg/l SpecialNotes:	AB47673 08/16/2021 Run 27 - West (270 degrees)	EventID: 21T021 SurveyCrewChief: WaterAppearance: 7.79 WaterTe		SampleTime SkyConditio WindStreng	ple MediumCollected: 12:02:00 PM ons: 3 - Partly th: 2 - Mod./Light cificConductivity (µS/c		ty + Water + Macro HydroLabNumber: P5 AirTemperature: 4 - 61-75 Turbidity (NTU): 10.2

ElectrofishingEquipr	nent:	Backpack	Voltage:	250	Avg.StreamWidth(m):	5	DistanceFished (m): 75
SecondsFished:	700	Wate	rDepthAvg (m):	.4	WaterDepthMax (m):	1	TimeAtSite: 01:00
BridgeInReach:		ReachRepresenta	ntive: 🗹	WhyRe	achNotRepresentative:		
SpecialComments:		Smithroot Backpack					

TotalScore (max100):	17	SubstrateSo (max20):	core	16	nstrean Score (n	nCover nax20):	12	ChannelMor (max20):	phologyS	core 15	
RiparianZoneBan Score(max10):	kEro	sion	5	Pool/G	lideQua	lityScore(m	ax12):	8 Riffle/I	RunQualit	yScore(max8):	6
GradientScore (max10):	10	%Pool:	30	%Riffle:	10	%Run:	60	%Glide:	0	CanopyCover PctOpen:	<10%- Closed
SubjectiveRating	:	Α	esth	eticRating		NOTES:	"NEV	V RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Inform	Calil	bration Used:			
<u>Ac</u>	Metric_			Actual	<u>Metric</u>	
Observ	ation	<u>Score</u>		<u>Obs</u>	ervation	<u>Score</u>
SpeciesCount:	16	5		%TolerantIndividuals:	33.09	3
Darter/Madtom/SculpinSpeciesCount:	4	5		%OmnivoreIndividuals:	12.23	5
%HeadwaterIndividuals:	1.44	1		%InsectivoreIndividuals:	58.27	5
MinnowSpeciesCount:	5	3		%PioneerIndividuals:	42.45	3
SensitiveSpeciesCount:	3	3		Total # of Individuals (CPUE):	139	3
				%SimpleLithophilicInd.:	15.83	1
				%Ind.withDELT:	1.44	1
Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.	Se (m	al IBI core in 0, ax 60)	38			

SampleNumber: AB47673	EventID: 21T021		LSite: WEM	<i>I</i> I-07-0019	Cou	nty: Jennings
StreamName: Sixmile Creek	Location	nDescription:	CR 175 North			
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bluegill	8					
Bluntnose Minnow	8					
Central Stoneroller	17			2		
Creek Chub	24					
Fantail Darter	2					
Green Sunfish	4					
Greenside Darter	9					
Johnny Darter	1					
Longear Sunfish	40					
Northern Hog Sucker	4					
Orangethroat Darter	5					
Spotfin Shiner	2					
Striped Shiner	4					
Western Mosquitofish	1					
White Sucker	9					
Yellow Bullhead	1				T	



SubBasin:	Muscatatuck			14 digit HUC: 05120207070	050	LSite:	WEM-07-	0020	
Site: Six	mile Creek	L	.ocation: C	R 415 North				County: Jennings	
Latitude:	39.045759	Longitude:	-85.676441	IASNat Region:	11B	Торо:	H-17	Segment: 83	
Ecoregion:	Eastern Corn Belt	Plains		Drainage Area (sq.miles):	8.944		Gradi	ent (ft/mile): 16.916	
Sample Info	ormation								

SampleNumber:	AB47674	EventID: 21T022	Sample MediumCollected: Fis	h Community + Water + Macro
SampleDate:	08/16/2021	SurveyCrewChief: CWY	SampleTime: 10:15:00 AM	HydroLabNumber: P5
WaterFlowType:	Pool	WaterAppearance: Clear	SkyConditions: 4 - Cloudy	AirTemperature: 4 - 61-75
WindDirection:	27 - West (270 degrees)		WindStrength: 0 - Calm	
DissolvedO2 (mg/l)): 5.15 pH	: 7.54 WaterTemp(°C):	20.1 SpecificConductivity (µS/cm):	715 Turbidity (NTU): 2.93
SpecialNotes:	Floating algal mats			

ElectrofishingEquip	ment:	Backpack	Voltage:	250	Avg.StreamWidth(m):	7	DistanceFished (m): 105
SecondsFished:	739	Water	DepthAvg (m):	.15	WaterDepthMax (m):	.8	TimeAtSite: 01:30
BridgeInReach:		ReachRepresentati	ve: 🗹	WhyReac	hNotRepresentative:		
SpecialComments:		half of reach backwater from	n reservoir, othe	er half becom	ning isolated pools; Smithroot backpack		

TotalScore (max100):	55	SubstrateSe (max20):	core	10		mCover max20):	9	ChannelMo (max20):	phology	Score 14	
RiparianZoneBa Score(max10):	ankEr	osion	7	Pool/0	GlideQu	alityScore(m	ax12):	5 Riffle/	RunQuali	tyScore(max8):	0
GradientScore (max10):	10	%Pool:	40	%Riffle:	0	%Run:	60	%Glide:	0	CanopyCover PctOpen:	<10%- Closed
SubjectiveRatin	g:	A	esth	eticRating	g:	NOTES:	"NEV	V RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Calib	oration Used: Eastern Corn Belt Plains				
Actual Metric					Actual	Metric_
Observ	vation	<u>Score</u>		<u>ervation</u>	<u>Score</u>	
SpeciesCount:	11	3		%TolerantIndividuals:	27.17	3
Darter/Madtom/SculpinSpeciesCount:	3	5		%OmnivoreIndividuals:	4.35	5
%HeadwaterIndividuals:	0	1		%InsectivoreIndividuals:	60.33	5
MinnowSpeciesCount:	3	3		%PioneerIndividuals:	89.67	1
SensitiveSpeciesCount:	1	1		Total # of Individuals (CPUE):	184	3
				%SimpleLithophilicInd.:	3.26	1
				%Ind.withDELT:	3.26	1
Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.	S (m	tal IBI core ain 0, ax 60)	32			

SampleNumber: AB47674	EventID: 21T022		LSite: WEN	1-07-0020	Cou	nty: Jennings
StreamName: Sixmile Creek	Location	Description:	CR 415 North			
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bluegill	8	3		2		
Bluntnose Minnow	8					
Central Stoneroller	48					
Creek Chub	14	1				
Green Sunfish	28					
Johnny Darter	61					
Largemouth Bass	3					
Longear Sunfish	5					
Orangethroat Darter	6					
Redear Sunfish	2		1			
Tadpole Madtom	1		1			



SubBasin:	Muscatatuck	14 digit HUC:	05120207070020	LSite:	WEM070-0036
Site: Ve	rnon Fork Muscatatuck River	Location: CR 400 West			County: Jennings
Latitude:	38.954294 Longit	ide: -85.684985	IASNat Region: 11A	Торо:	H-40 Segment: 83
Ecoregion:	Eastern Corn Belt Plains	Drainage A	Area (sq.miles): 218.283		Gradient (ft/mile): 1.437

Sample Information

SampleNumber:	AB47675	EventID: 21T023	Sample MediumCollected: Fish Commun	ity + Water + Macro
SampleDate:	08/18/2021	SurveyCrewChief: CWY	SampleTime: 10:17:00 AM	HydroLabNumber: P5
WaterFlowType:	Riffle	WaterAppearance: Clear	SkyConditions: 2 - Scattered	AirTemperature: 5 - 76-85
WindDirection:	27 - West (270 degrees)		WindStrength: 1 - Light	
DissolvedO2 (mg/): 6.85 pH:	7.67 WaterTemp(°C): 24.5	SpecificConductivity (µS/cm): 468.6	Turbidity (NTU): 8.81
SpecialNotes:	Photo taken of 1 Hagenius	brevistylus, then released		

ElectrofishingEquipr	nent:	Canoe	Voltage:	200	Avg.StreamWidth(m):	25	DistanceFished (m): 375
SecondsFished:	3071		WaterDepthAvg (m):	.5	WaterDepthMax (m):	2	TimeAtSite: 04:10
BridgeInReach:		ReachRepro	esentative: 🗹	WhyReachNotRep	presentative:		
SpecialComments:		Canoe w/Infinity box	k; portion of reach non-v	vadeable			

Habitat Information

(max100): ⁷³ (m	ubstrateScore ₁₅ nax20):	InstreamCover Score (max20):	16	ChannelMor (max20):	rphologyS	core 16	
RiparianZoneBankErosi Score(max10):	on 4 Poc	l/GlideQualityScore	e(max12):	11 Riffle/	RunQualit	yScore(max8):	5
GradientScore (max10):	%Pool: 40 %Riffl	e: 25 %Ru	n: 35	%Glide:	0	CanopyCover PctOpen:	55%-<85%
SubjectiveRating:	AestheticRat	ing: NOTES	S: "NEV	V RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Inform	Calibration Used: Eastern Corn Belt Plains			
<u>Actual Metric</u> <u>Observation</u> <u>Score</u>				Actual ervation	<u>Metric</u> Score
SpeciesCount:	31	5	%TolerantIndividuals:	7.96	5
DarterSpeciesCount:	6	5	%OmnivoreIndividuals:	6.92	5
SunfishSpeciesCount:	3	3	%InsectivoreIndividuals:	85.64	5
SuckerSpeciesCount:	5	5	%CarnivoreIndividuals:	3.39	1
SensitiveSpeciesCount:	16	5	Total # of Individuals (CPUE):	766	5
			%SimpleLithophilicInd.:	33.81	3
	<u> </u>		%Ind.withDELT:	0	5

Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.

Total IBI	52
Score	
(min 0,	
max 60)	

SampleNumber: AB47675

EventID: 21T023

LSite: WEM070-0036

County: Jennings

StreamName: Verno

Vernon Fork Muscatatuck River

LocationDescription: CR 400 West

Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bigeye Chub	121					
Black Redhorse	12					
Bluegill	3					
Bluntnose Minnow	53					
Brindled Madtom	2					
Brook Silverside	3					
Central Stoneroller	31					
Channel Catfish	6					
Chestnut Lamprey	1					
Dusky Darter	14					
Eastern Sand Darter	4					
Golden Redhorse	25					
Greenside Darter	46					
Johnny Darter	8					
Largemouth Bass	3					
Logperch	3					
Longear Sunfish	217					
Longnose Gar	1					
Northern Hog Sucker	33					
Rainbow Darter	22					
River Redhorse	1					
Rock Bass	9					
Silver Redhorse	1					
Silverjaw Minnow	3					
Smallmouth Bass	2					
Spotfin Shiner	106					
Spotted Bass	4		Ī			
Steelcolor Shiner	8					
Striped Shiner	5					
Suckermouth Minnow	18		Ì			
Yellow Bullhead	1		<u> </u>			



SubBasin:	Muscatatuck		14	digit HUC: 0512	20207070010	LSite:	WEM070-000)1
Site: Vernor	n Fork Muscatatuo	ck River L	ocation: CR 60 Sout	ı				County: Jennings
Latitude: 38	3.976361	Longitude:	-85.619826	IASNat	t Region: 11A	Торо:	H-41	Segment: 83
Ecoregion:	Eastern Corn Bel	t Plains		Drainage Area (s	q.miles): 197.56		Gradient	(ft/mile): 4.424
Sample Inform	nation							
SampleNumber:	AB47676	Ev	entID: 21T025		Sample Medium	nCollected:	Fish Commur	nity + Water + Macro
SampleDate:	08/17/2021	:	SurveyCrewChief: C	VY	SampleTime: 12:40:0	0 PM		HydroLabNumber: P5
WaterFlowType:	Riffle	v	VaterAppearance: Cl	ear	SkyConditions: 2 - S	Scattered		AirTemperature: 5 - 76-85
WindDirection:	27 - West (2	270 degrees)			WindStrength: 2 - Mo	od./Light		
DissolvedO2 (mg	g /l): 8.62	pH: 8.	35 WaterTemp	o(°C): 24.5	SpecificCondu	uctivity (µS/c	m): 466.8	Turbidity (NTU): 3.2
SpecialNotes:								
ElectrofishingEq	uipment:	Canoe	Voltage:	230	Avg.Strea	mWidth(m):	33	DistanceFished (m): 500
SecondsFished:	3388		WaterDepthAvg (m):	.4	WaterDep	pthMax (m):	1	TimeAtSite: 03:30
BridgeInReach:			resentative: 🗹	WhyReachNotl	Representative:			
SpecialComment	ts: c	anoe w/MLES						

Habitat Information

(max100): ⁸⁰ (m	iax20):	16 Instrea Score (nCover max20):	17	ChannelMor (max20):	phology	/Score 15	
RiparianZoneBankErosi Score(max10):	on 7 P	Pool/GlideQu	alityScore(ma	ax12):	9 Riffle/F	RunQua	lityScore(max8):	6
GradientScore 10 (max10):	%Pool: 30 %R	iffle: 30	%Run:	40	%Glide:	0	CanopyCover PctOpen:	55%-<85%
SubjectiveRating:	AestheticR	Rating:	NOTES:	"NEW	/ RECORD"			

Fish Community Index of Biotic Integrity (IBI) Info	orm	ation	Calibration Used:		
Actual Metric				Actual	Metric
<u>Observati</u> SpeciesCount:	<u>on</u> 28	<u>Score</u> 5	<u>ODs</u> %TolerantIndividuals:	ervation 4.46	<u>Score</u> 5
•			,	-	-
DarterSpeciesCount:	5	5	%OmnivoreIndividuals:	0.97	5
SunfishSpeciesCount:	5	5	%InsectivoreIndividuals:	92.44	5
SuckerSpeciesCount:	4	5	%CarnivoreIndividuals:	6.4	3
SensitiveSpeciesCount:	14	5	Total # of Individuals (CPUE):	516	5
			%SimpleLithophilicInd.:	18.99	1
			%Ind.withDELT:	0	5
Matrice are dependent on Ecorogian and	Tat		54		

Metrics are dependent on Ecoregion and Drainage Area. Metrics can score a 0, 1, 3, or 5 depending on calibration.

Total IBI	54
Score	
(min 0,	
max 60)	

SampleNumber: AB47676

EventID: 21T025

LSite: WEM070-0001

County: Jennings

StreamName: Ve

Vernon Fork Muscatatuck River

LocationDescription: CR 60 South

Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bigeye Chub	7					
Bigeye Shiner	10					
Black Bullhead	1					
Black Crappie	2					
Black Redhorse	19					
Bluegill	9					
Bluntnose Minnow	5					
Brindled Madtom	4					
Central Stoneroller	1					
Channel Catfish	1					
Golden Redhorse	19					
Green Sunfish	12					
Greenside Darter	40					
Johnny Darter	2					
Largemouth Bass	1					
Logperch	7					
Longear Sunfish	292					
Northern Hog Sucker	18					
Rainbow Darter	6					
Rock Bass	26					
Sand Shiner	1					
Slenderhead Darter	1					
Smallmouth Bass	3					
Spotfin Shiner	12					
Spotted Bass	2					
Spotted Sucker	1					
Striped Shiner	10					
Yellow Bullhead	4					



SubBasin:	Muscatatuck		14 digit l	HUC: 051202070800	30 LSite:	WEM-07-0014	
Site: Storn	n Creek	Locat	ion: Base Road			С	ounty: Jennings
Latitude: 3	38.983201	Longitude: -85.	786709	IASNat Region:	11B Topo:	H-39	Segment: 83
Ecoregion:	Eastern Corn Be	It Plains	Drain	age Area (sq.miles):	9.378	Gradient (f	t/mile): 4.073
Sample Infor	mation						
SampleNumber	: AB48036	Eventli): 21T018.5	S	ample MediumCollected:	Fish Community	y + Water
SampleDate:	09/09/2021	Surv	eyCrewChief: KAG	SampleT	ime: 09:35:00 AM		HydroLabNumber: P5
WaterFlowType	e: Pool	Wate	Appearance: Clear	SkyCon	ditions: 1 - Clear		AirTemperature: 4 - 61-75
WindDirection:	27 - West (270 degrees)		WindStr	ength: 0 - Calm		
DissolvedO2 (m	ng/l): 5.57	pH: 7.59	WaterTemp(°C):	18.6	SpecificConductivity (µS/c	:m): 407.6	Turbidity (NTU): 4.93
SpecialNotes:							
ElectrofishingE	quipment:	Backpack	Voltage: 200		Avg.StreamWidth(m):	6 E	DistanceFished (m): 90
SecondsFished	: 614	Wa	terDepthAvg (m): .25		WaterDepthMax (m):	.75	TimeAtSite: 01:00
BridgeInReach:		ReachRepreser	ntative: 🗹 🛛 Why	/ReachNotRepresent	ative:		
SpecialComme	nts:	ILES Backpack					

Habitat Information

(max100): 51 (n	ubstrateScore nax20):	13 Instream Score (I		8	ChannelMor (max20):	phology	Score 12	
RiparianZoneBankErosi Score(max10):	on 6	Pool/GlideQua	alityScore(max	x12):	6 Riffle/F	RunQuali	tyScore(max8):	0
GradientScore (max10):	%Pool: 30 %l	Riffle: 10	%Run:	60	%Glide:	0	CanopyCover PctOpen:	10%-<30%
SubjectiveRating:	Aesthetic	Rating:	NOTES:	"NEW	/ RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Inform	ation	Calibration Used:		
	<u>Actual</u> <u>Metric</u> Observation Score			Actual ervation	<u>Metric</u> Score
SpeciesCount:	15	5	%TolerantIndividuals:	19.49	5
Darter/Madtom/SculpinSpeciesCount:	2	3	%OmnivoreIndividuals:	3.39	5
%HeadwaterIndividuals:	0	1	%InsectivoreIndividuals:	92.37	5
MinnowSpeciesCount:	4	3	%PioneerIndividuals:	22.88	5
SensitiveSpeciesCount:	1	1	Total # of Individuals (CPUE):	118	3
			%SimpleLithophilicInd.:	4.24	1
			%Ind.withDELT:	2.54	1
Metrics are dependent on Ecoregion and Drainage Area.		tal IBI core	38		

Metrics can score a 0, 1, 3, or 5 depending on calibration.

30	2

SampleNumber: AB48036	EventID: 21T018.5		LSite: WEM	1-07-0014	Cou	nty: Jennings
StreamName: Storm Creek	Location	Description:	Base Road			
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Black Bullhead	1					
Bluegill	7					
Bluntnose Minnow	4					
Central Mudminnow	3					
Creek Chub	1					
Green Sunfish	12	1		1		
Johnny Darter	4					
Longear Sunfish	69					
Orangethroat Darter	5					
Pirate Perch	3					
Redfin Pickerel	3		1			
Redfin Shiner	2					
Silverjaw Minnow	1					
Warmouth	1					
Yellow Bullhead	2					



SubBasin:	Muscatatuck		14 digit HUC:	05120207080020	LSite: \	WEM080-0027		
Site: Muttor	n Creek	Locatio	n: CR 800 North			Cοι	Inty: Jackson	
Latitude: 3	8.998644	Longitude: -85.80	6382	ASNat Region: 11B	Topo: I	H-39 S	egment: 83	
Ecoregion:	Eastern Corn Bel	t Plains	Drainage A	Area (sq.miles): 18.199		Gradient (ft/n	nile): 4.798	
Sample Inform	<u>nation</u>							
SampleNumber:	AB48037	EventID:	21T014.5	Sample Mediu	mCollected:	Fish Community +	Water	
SampleDate:	08/30/2021	Survey	CrewChief: CWY	SampleTime: 01:05:0	00 PM	Ну	/droLabNumber:	P5
WaterFlowType:	Pool	WaterA	ppearance: Murky	SkyConditions: 7 - S	Shower	Air	Temperature: 4 -	61-75
WindDirection:	27 - West (2	270 degrees)		WindStrength: 1 - Li	ght			
DissolvedO2 (mg	g/l): 5.48	pH: 7.61	WaterTemp(°C): 25.1	SpecificCond	uctivity (µS/cm	a): 400.2	Turbidity (NTU):	28.8
SpecialNotes:								
ElectrofishingEc	uipment:	Backpack	Voltage: 200	Avg.Strea	mWidth(m):	7 Dis	tanceFished (m):	105
SecondsFished:	900	Wate	DepthAvg (m): .5	WaterDe	pthMax (m):	1.5	TimeAtSite: 01:	40
BridgeInReach:		ReachRepresenta	tive: 🗹 WhyRea	chNotRepresentative:				
SpecialCommen	ts: N	ILES Backpack; 60.42%	catch Longear Sunfish					

Habitat Information

(max100): ⁵² (r	ubstrateScore ₁₂ nax20):		mCover max20):	11	ChannelMor (max20):	phology	Score 11	
RiparianZoneBankEros Score(max10):	ion 3 Po	ol/GlideQu	alityScore(ma	ax12):	9 Riffle/	RunQual	lityScore(max8):	0
GradientScore (max10):	%Pool: 20 %Riff	i le: 0	%Run:	80	%Glide:	0	CanopyCover PctOpen:	55%-<85%
SubjectiveRating:	AestheticRa	ting:	NOTES:	"NEV	V RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Calib	ration Used: Eastern Corn Belt Plains				
<u>Actual</u> Observation		<u>Metric</u> Score		Obs	Actual ervation	<u>Metric</u> Score
SpeciesCount:	17	5		%TolerantIndividuals:	3.65	5
Darter/Madtom/SculpinSpeciesCount:	3	3		%OmnivoreIndividuals:	1.56	5
%HeadwaterIndividuals:	0	1		%InsectivoreIndividuals:	93.75	5
MinnowSpeciesCount:	3	1		%PioneerIndividuals:	3.65	5
SensitiveSpeciesCount:	2	1		Total # of Individuals (CPUE):	192	3
				%SimpleLithophilicInd.:	1.56	1
				%Ind.withDELT:	0	5
Metrics are dependent on Ecoregion and Drainage Area.		al IBI core	40			

Metrics can score a 0, 1, 3, or 5 depending on calibration.

TOTAL IDI	τv
Score	
(min 0,	
max 60)	
/	L

SampleNumber: AB48037	lumber: AB48037 EventID: 21T014.5				County: Jackson		
StreamName: Mutton Creek	Location	Description:	CR 800 North				
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies	
Blackstripe Topminnow	3						
Bluegill	50						
Bluntnose Minnow	2						
Brook Silverside	1						
Creek Chub	1						
Green Sunfish	1						
Johnny Darter	2						
Largemouth Bass	6						
Longear Sunfish	116						
Orangethroat Darter	1						
Redear Sunfish	1						
Redfin Pickerel	1						
Striped Shiner	1						
Tadpole Madtom	2						
Warmouth	1						
White Sucker	1						
Yellow Bullhead	2						



SubBasin: N	luscatatuck		14 di	git HUC: 051202070700	50 LSite:	WEM-07-0020	
Site: Sixmile C	Creek	Locatio	n: CR 415 North			Cor	unty: Jennings
Latitude: 39.0	45759	Longitude: -85.67	6441	IASNat Region:	11B Topo :	H-17 S	Segment: 83
Ecoregion: Ea	astern Corn Be	It Plains	Di	rainage Area (sq.miles):	8.944	Gradient (ft/r	mile): 16.916
Sample Informa	ation						
SampleNumber:	AB48619	EventID:	21T022.5	S	ample MediumCollected:	Fish Community -	+ Water
SampleDate:	09/09/2021	Survey	CrewChief: KAG	SampleT	ime: 11:00:00 AM	н	ydroLabNumber: P5
WaterFlowType:	Stagnant	WaterA	ppearance: Clear	r SkyCon	ditions: 1 - Clear	Ai	rTemperature: 4 - 61-75
WindDirection:	27 - West (2	270 degrees)		WindStr	ength: 0 - Calm		
DissolvedO2 (mg/l)	: 5.6	pH: 7.39	WaterTemp(°0	C): 17.5	SpecificConductivity (µS/c	:m): 550	Turbidity (NTU): 2.14
SpecialNotes:							
ElectrofishingEqui	pment:	Backpack	Voltage: 2	50	Avg.StreamWidth(m):	7 Dis	stanceFished (m): 105
SecondsFished:	791	Wate	rDepthAvg (m):	.1	WaterDepthMax (m):	.9	TimeAtSite: 01:00
BridgeInReach:		ReachRepresenta	tive: 🗹	WhyReachNotRepresent	ative:		
SpecialComments:	N	ILES Backpack					

Habitat Information

TotalScore 74 (max100):	SubstrateSco (max20):	re 16	Instream Score (n		15	ChannelMo (max20):	rphology	Score 13	
RiparianZoneBankE Score(max10):	rosion 7	Pool	/GlideQua	lityScore(m	ax12):	7 Riffle/	RunQual	ityScore(max8):	6
GradientScore 10 (max10):	%Pool:	20 %Riffle	: 10	%Run:	70	%Glide:	0	CanopyCover PctOpen:	10%-<30%
SubjectiveRating:	Aes	stheticRatin	ng:	NOTES:	"NEV	V RECORD"			

Fish Community Index of Biotic Integrity (IBI)	Informa	Calibration Used:			
	ctual	<u>Metric</u>		Actual	<u>Metric</u>
Observ	<u>ation</u>	<u>Score</u>	<u>Obs</u>	<u>ervation</u>	<u>Score</u>
SpeciesCount:	10	3	%TolerantIndividuals:	27.56	3
Darter/Madtom/SculpinSpeciesCount:	2	3	%OmnivoreIndividuals:	1.57	5
%HeadwaterIndividuals:	0	1	%InsectivoreIndividuals:	64.57	5
MinnowSpeciesCount:	3	3	%PioneerIndividuals:	76.38	1
SensitiveSpeciesCount:	1	1	Total # of Individuals (CPUE):	127	3
			%SimpleLithophilicInd.:	0.79	1
			%Ind.withDELT:	2.36	1
Metrics are dependent on Ecoregion and Drainage Area.	Sc	al IBI core	30		

Metrics can score a 0, 1, 3, or 5 depending on calibration.

Total IBI	30
Score	
(min 0,	
max 60)	

SampleNumber: AB48619	EventID: 21T022.5		LSite: WEN	<i>I</i> -07-0020	Cou	nty: Jennings
StreamName: Sixmile Creek	Location	Description:	CR 415 North			
Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bluegill	14					
Bluntnose Minnow	2					
Central Stoneroller	32					
Creek Chub	4					
Green Sunfish	23			2		
Johnny Darter	35					
Largemouth Bass	7		1			
Longear Sunfish	3					
Orangethroat Darter	1					
Yellow Bullhead	6					



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.								
Site Name	EPA ID	Macro Sam	ple Type	Sample #	¥	Macro Event #	Sample Date	County
WEM-07-0010	21T-002	MHA	4B	AB4765	4	210824702	8/24/21	Jackson
	Stream Name			Loca	tion		HUC 12	HUCTO14
G	rassy Creek			CR	600		051202070706	05120207090020
Northing	Eas	sting	Eco	region		Gradient	Drainage Area	QHEI Score
4294529.44	5981	92.59		55		1.972	12.633	46

TAXON	COUNT	NOTES	HBI
1220 (PLATYHELMINTHES)	1		Tolerance
1555 (Tubificinae with bifid	3		
chetae and hair)	5		
1234 (GLOSSIPHONIIDAE)	1		
1210 (BIVALVIA)	2	probably	
	-	Sphaerium	
1083 (Acari)	5	opilationality	4
1262 (AMPHIPODA)	2	imm. and dmg.	4
9068 (Gammarus)	13		6
9050 (Hyalella)	74		
3085 (Callibaetis fluctuans)	3		
9361 (Caenis Diminuta Gr.)	3		
1023 (AESHNIDAE)	2	imm.	3
3251 (Nasiaeschna	5		-
pentacantha)	-		
1027 (CORDULIIDAE)	2	imm.	3
3540 (lschnura)	2	no gills	9
1041 (CORIXIDAE)	14	nymphs, likely	5
· · · · · · · · · · · · · · · · · · ·		Trichocorixa	
7201 (Trichocorixa calva)	2	adult F	4
7230 (Neoplea striola)	2		
7207 (Belostoma)	5	nymphs	
1038 (GERRIDAÉ)	1	imm probably	
		Trepobates,	
		antennae odd	
7122 (Microvelia)	2	1 nymph, 1 dmg.	
		adult	
3604 (Peltodytes sexmaculatus)	1	adult	
7732 (Anopheles)	4		
9370 (Ceratopogon grp.)	1		8
8083 (Chironomini)	1		
9248 (Ablabesmyia Mallochi Gr.)	3		
8112 (Dicrotendipes)	5		6
8126 (Glyptotendipes)	1		6
9296 (Microtendipes Pedellus	1		
Gr.)			
8179 (Polypedilum)	1		
8235 (Paratanytarsus)	1		4
8241 (Tanytarsus)	3		4
9278 (Polypedilum Halterale Gr.)	1		
9241 (Polypedilum Illinoense	38		
Gr.)			

Туре	Value	<u>Metric</u> <u>Score</u>	Value
Total Taxa:	33	3	33
Total No. Individuals:	205	3	205
EPT Taxa:	2	1	2
% Orthocladiinae + Tanytarsini of Chironomidae:	7.27	5	7.27
% Non-insects excluding Astacidae:	49.27	1	49.27
Diptera Taxa:	12	3	12
% Intolerant (0-3):	1.95	1	1.95
% Tolerant (8-10):	1.46	5	1.46
% Predators FFG 1:	18.05	3	18.05
% Shredders + Scrapers FFG 1:	0.49	1	0.49
% Collector-Filterers FFG 1:	3.9	5	3.9
% Sprawlers:	0	1	0
mIBI Metric	: 32	Score:	

HBI	5.17
Shannon-Weaver Index	2.43
Shannon Equitability	0.69
% Dominant 3 Taxon	61.46
% Chironomidae	26.83



Residuals			
Identifier	Date	Count	%PSE



Narning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.								
Site Name	EPA ID	Macro Sam	ple Type	Sample #	Λ.	lacro Event #	Sample Date	County
WEM-07-0016	21T-013	MHA	٩B	AB47665	2	210816903	8/16/21	Jackson
	Stream Name			Locatio	on		HUC 12	HUCTO14
Tributar	y of Mutton Cr	eek		CR 700 N	lorth		051202070704	05120207080020
Northing	Eas	sting	Eco	region	Gı	radient	Drainage Area	QHEI Score
4315647.61	6014	62.41	Į	55	1	1.518	5.117	48

TAXON	COUNT	NOTES	HBI Tolerance
1220 (PLATYHELMINTHES)	1		TOIETAILCE
1552 (Tubificinae with bifid	1		
chetae and no hair chetae)			
1206 (PLANORBIDAE)	1	aperature broken	6
1090 (Physa)	4		8
2156 (Corbicula fluminea)	2		6
1083 (Acari)	2		4
1251 (ISOTOMIDAE)	2		
9366 (Baetis intercalaris	6	S21-024.3	3
complex)	_		-
3079 (Paracloeodes minutus)	15	S21-024.2	
3085 (Callibaetis fluctuans)	26		
9361 (Caenis Diminuta Gr.)	5		
1021 (GOMPHIDAE)	1	imm.	1
7026 (Calopteryx maculata)	2		
1026 (COENAGRIONIDAE)	1	likely Enallagma.	9
		imm.	
3540 (Ischnura)	4	imm. or no gills	9
3542 (Ischnura posita)	2		
3546 (Enallagma)	11	imm. or no gills	9
3549 (Enallagma divagans)	1		
3568 (Argia)	2	imm. or no gills	5
7122 (Microvelia)	1	adult female;	
		either M.	
		americana or M.	
		paludicola	
7128 (Microvelia hinei)	1	adult	
3600 (Peltodytes	1	adult female	
duodecimpunctatus)			
3851 (Berosus peregrinus)	2	adults	6
9216 (Tropisternus lateralis)	1	adult	
1096 (SCIRTIDAE)	2	larvae	5
7300 (Dubiraphia vittata)	2	adults (2M); Slide	
		S21-024.1 (PL =	
	_	265 um)	
7295 (Ancyronyx variegatus)	8	adults	4
7321 (Macronychus glabratus)	1	adult	3
1057 (HYDROPSYCHIDAE)	1	imm.	4
3432 (Cheumatopsyche)	6		3
3423 (Hydropsyche)	2	imm.	4
9154 (Hydropsyche venularis)	6		3
8980 (Hydropsyche betteni grp)	2		

Туре	Value	<u>Metric</u> <u>Score</u>
Total Taxa:	47	5
Total No. Individuals:	161	3
EPT Taxa:	9	5
% Orthocladiinae + Tanytarsini of Chironomidae:	8.82	5
% Non-insects excluding Astacidae:	6.83	5
Diptera Taxa:	14	5
% Intolerant (0-3):	12.42	1
% Tolerant (8-10):	13.66	3
% Predators FFG 1:	16.77	1
% Shredders + Scrapers FFG 1:	5.59	1
% Collector-Filterers FFG 1:	8.07	5
% Sprawlers:	1.24	1
mIBI Metric	40	

HBI	5.59
Shannon-Weaver Index	3.28
Shannon Equitability	0.85
% Dominant 3 Taxon	34.78
% Chironomidae	21.12



ΤΑΧΟΝ	COUNT	NOTES	HBI Tolerance
7732 (Anopheles)	1		
7984 (Procladius)	1		7
7926 (Tanypodinae)	1	1P	
9261 (Thienemannimyia Gr.)	2		
8023 (Cricotopus bicinctus)	1		7
8086 (Chironomus)	2		8
8099 (Cryptochironomus)	1		5
8104 (Cryptotendipes)	1		4
8112 (Dicrotendipes)	3		6
8162 (Paracladopelma)	5		7
8228 (Cladotanytarsus)	1		4
8241 (Tanytarsus)	1		4
9241 (Polypedilum Illinoense	15		
Gr.)			
9375 (Tipuloidea)	1		

Identifier	Date	Count	%PSE
JMB	9/30/2021	1	99.21



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.									
Site Name	EPA ID Macro Sample		Sample #	Macro Event #	Sample Date	County			
WEM070-0001	21T-025	MHAB	AB47676	210817701	8/17/21	Jennings			
	Stream Name		Location	1	HUC 12	HUCTO14			
Vernon Fo	ork Muscatatucl	k River	CR 60 South,	Vernon	051202070701	05120207070010			
Northing	Eas	sting Ec	oregion	Gradient	Drainage Area	QHEI Score			
4315059.3	6195	53.85	55	4.424	197.56	87			

TAXON	COUNT	NOTES	HBI	
			Tolerance	
1220 (PLATYHELMINTHES)	1			То
1430 (Isochaetides curvisetosus)	1			
2287 (Laevapex fuscus)	1	?		
2211 (Pleurocera)	13			
2337 (Truncatelloidea)	1		7	
2156 (Corbicula fluminea)	5		6	
2181 (Sphaerium)	8		6	e>
9031 (Lirceus)	1		8	
8996 (Faxonius)	1		4	
9016 (Faxonius sloanii)	1	form II male		
1017 (HEPTAGENIIDAE)	3		4	
9156 (Maccaffertium)	1	exiguum/pulchell um, J21-065.2		
7001 (Nixe inconspicua)	1	J21-065.1		
7011 (Acerpenna pygmaea)	3		2	%
9366 (Baetis intercalaris	31	J21-065.4-7	3	
complex)			-	
9347 (Procloeon viridoculare)	2	J21-065.3		
1018 (LEPTOPHLEBIIDAE)	1		2	
3109 (Isonychia)	4		2	
3099 (Hagenius brevistylus)	1	teeny tiny	1	
1025 (MACROMIIDAE)	1	small, probably	3	
	•	Macromia based	Ũ	
		on claws		
7046 (Epitheca princeps)	1			
3568 (Argia)	1	gill undeveloped,	5	
	•	tibialis?	Ũ	
7118 (Trepobates inermis)	1	male		
7116 (Metrobates hesperius)	1	male	1	
7122 (Microvelia)	1	nymph	1	
9290 (Gerridae (Gerrinae))	1	nymph		
9293 (Gerridae (Trepobatinae))	1	nymph,		
		Trepobates?		
3600 (Peltodytes	2			
duodecimpunctatus)	<u> </u>			
7293 (Psephenus herricki)	1		4	
7307 (Stenelmis)	10	lanvao	5	
7317 (Stenelmis sexlineata)	10	larvae	5	
· · · · ·		adults	A	
7295 (Ancyronyx variegatus)	3	adults	4 2	
3799 (Corydalus cornutus)				
1045 (PHILOPOTAMIDAE)	1	imm.	3	
3267 (Chimarra obscura)	33		4	

Туре	Value	_	<u>Metric</u> Score			
Total Taxa:	61		5			
otal No. Individuals:	325		5			
EPT Taxa:	14		5			
% Orthocladiinae + Tanytarsini of Chironomidae:	52.43		1			
% Non-insects xcluding Astacidae: Diptera Taxa: % Intolerant (0-3):	9.54		5			
	22	ſ	5			
	30.77	ſ	3			
% Tolerant (8-10):	1.54	ſ	5			
% Predators FFG 1:	5.23	ſ	1			
% Shredders + Scrapers FFG 1:	4.62		1			
Collector-Filterers FFG 1:	36.92	Ī	1			
% Sprawlers:	5.54		3			
mIBI Metric	mIBI Metric Score:					

HBI	3.87
Shannon-Weaver Index	3.3
Shannon Equitability	0.8
% Dominant 3 Taxon	35.69
% Chironomidae	31.69



TAXON	COUNT	NOTES	HBI
			Tolerance
3432 (Cheumatopsyche)	52		3
3419 (Hydropsyche Morosa Gr.)	11		
1054 (HYDROPTILIDAE)	1	imm.	4 2
8809 (Ochrotrichia)	1	? case bare,	2
		rounded valves,	
		not very	
7044 (Circulium)	4	compressed	5
7814 (Simulium)	4		-
7984 (Procladius)	7		7
7926 (Tanypodinae)	1		
8083 (Chironomini)	-		
9248 (Ablabesmyia Mallochi Gr.)	7		
9261 (Thienemannimyia Gr.)			
9354 (Stempellinella fimbriata)	31		0
8014 (Cardiocladius obscurus)	2		2
8017 (Corynoneura)	1 5	(12	4
9345 (Lopescladius)	5	(neomodestus?)	4
8074 (Thienemanniella)		1	4 8
8086 (Chironomus)	4	1 pupa	<u>8</u> 5
8099 (Cryptochironomus)	1	tulua 2 aidawaya	5 6
8112 (Dicrotendipes)		tylus? sideways	0
8179 (Polypedilum)	2		
8192 (Polypedilum flavum)	6	pupa: 1	
8202 (Saetheria)	3		4
9165 (Saetheria tylus)	6	Chironomus?	4
8228 (Cladotanytarsus)	ю		4
		Dicrotendipes? imm.	
8238 (Rheotanytarsus)	1	lobopodema?	3
8241 (Tanytarsus)	1	pupa	4
8397 (Hemerodromia)	1	μυμα	

Identifier	Date	Count	%PSE



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.									
Site Name	EPA ID	Macro Sam	ole Type	Sample #	Macro Event	# Sai	nple Date	County	
WEM090-0015	21T-010	MHA	В	AB46789	21082470	4 8	/24/21	Jackson	
	Stream Name			Location	1	нис	12	HUCTO14	
Vernon Fo	ork Muscatatuc	k River		CR 50 No	rth	0512020	070706	05120207090010	
Northing	Eas	sting	Eco	region	Gradient	Draina	age Area	QHEI Score	
4305037.95	5995	91.57	Į	55	1.458	364	4.501	42	

TAXON	COUNT	NOTES	HBI	Туре	Value	<u>Metric</u> Score
TAXON	COONT	NOTES	Tolerance	Total Taxa:	49	5
1220 (PLATYHELMINTHES)	1			Total No. Individuals:	383	5
1426 (Branchiura sowerbyi)	2		6	EPT Taxa:	4	1
1435 (Limnodrilus hoffmeisteri)	2		10		4	1
1421 (Aulodrilus pigueti)	1		7	% Orthocladiinae + Tanytarsini of	0	5
1522 (Pristinella jenkinae)	1	? head iffy	8	Chironomidae:	Ŭ	5
1552 (Tubificinae with bifid	11			% Non-insects	13.32	5
chetae and no hair chetae)				excluding Astacidae:		
1553 (Tubificinae with pectinate	1			Diptera Taxa:	14	5
chetae and hair chetae)				% Intolerant (0-3):	2.61	1
1555 (Tubificinae with bifid	1	(thin upper teeth)		9/ Telerent (9.40).	3.66	5
chetae and hair)	4			% Tolerant (8-10):		
1234 (GLOSSIPHONIIDAE)	1			% Predators FFG 1:	74.93	5
1233 (Erpobdellidae)	1		<u> </u>	% Shredders +	1.57	1
2181 (Sphaerium)	11		6	Scrapers FFG 1:		
1083 (Acari)	1		4	% Collector-Filterers FFG 1:	5.22	5
9050 (Hyalella)	17	famala	0	% Sprawlers:	0.78	1
9019 (Cambarus)	1	female	2	70 Oprawiers.	0.70	-
9016 (Faxonius sloanii)	1	form II male	2	mIBI Metric	Score:	44
3048 (Stenacron) 9361 (Caenis Diminuta Gr.)	3	not lotinonnio	3			
9361 (Caenis Diminuta Gr.)	5	not latipennis, probably				
		diminuta, one				
		with everted		S	upplemen	tal Metrics
		ovaries		-		
3259 (Pachydiplax longipennis)	1	oranoo			HBI	4.83
3282 (Plathemis lydia)	2		8			
3397 (Macromia)	3		2	Shannon-We	aver Index	2.12
3553 (Enallagma geminatum)	1			•••••••••		2.12
1041 (CORIXIDAE)	162	nymphs	5	Shannon F	Equitability	0.54
7201 (Trichocorixa calva)	102	f 48 m 54	4	ondinion 1	-quitability	0.04
7202 (Trichocorixa kanza)	6	f 5 m 1	4	% Domina	nt 3 Taxon	73.37
7183 (Palmacorixa)	1	probably nana?	5	78 Domina		13.31
		female		% Chi	ronomidae	7.83
7217 (Ranatra buenoi)	1			/6 CIII	ononnuae	7.05
7111 (Rheumatobates)	1	nymph				
3851 (Berosus peregrinus)	1		6			
3872 (Tropisternus)	1	larva				
1096 (SCIRTIDAE)	1		5			
3959 (Helichus lithophilus)	2					
7300 (Dubiraphia vittata)	1	J21-058.1 ~255				
		um aedaegus				
3911 (Hydrochus)	1	pseudosquamifer	5			



TAXON	COUNT	NOTES	HBI
			Tolerance
		?	
9154 (Hydropsyche venularis)	2	? smaller may be	3
		hard to id	
8923 (Nectopsyche diarina)	1		3
7830 (Atrichopogon)	1	?	5
9370 (Ceratopogon grp.)	1	tenuous	8
7929 (Clinotanypus pinguis)	1		8
7984 (Procladius)	1		7
9153 (Tribelos)	2	fuscicorne?	5
7926 (Tanypodinae)	1	pupa missing	
		thoracic horn?	
9248 (Ablabesmyia Mallochi Gr.)	1		
9284 (Tribelos jucundum)	2		
8086 (Chironomus)	6	2 pupa	8
8099 (Cryptochironomus)	1		5
8112 (Dicrotendipes)	4		6
8126 (Glyptotendipes)	9		6
8133 (Harnischia)	1		8
9241 (Polypedilum Illinoense	1		
Gr.)			

Identifier Date Count %PSE



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.									
Site Name	e EPA ID Macro Sample		le Type	Sample #	Macro Event	# Sample Date	County		
WEM080-0013	21T-016	MHAI	3	AB47668	210817901	8/17/21	Jackson		
	Stream Name			Location		HUC 12	HUCTO14		
Stor	rm Creek Ditch			CR 400 No	orth	051202070703	05120207080040		
Northing	Eas	ting	Eco	region	Gradient	Drainage Area	QHEI Score		
4310857.62	6034	84.81	į	55	2.682	17.513	44		

TAXON	COUNT	NOTES	HBI Tolerance	Tota
1220 (PLATYHELMINTHES)	2		Toteranoe	Total No. Indivi
1552 (Tubificinae with bifid	1			Total No. Indivi
chetae and no hair chetae)				EPT
1234 (GLOSSIPHONIIDAÉ)	2	one with many		% Orthocladi
· · · · ·		babies		Tanytars Chirono
1090 (Physa)	3		8	% Non-ir
1083 (Acari)	2		4	excluding Asta
9036 (Caecidotea)	1		8	Diptera
9050 (Hyalella)	25			% Intoleran
9056 (Crangonyx)	1		6	
3083 (Callibaetis floridanus)	4			% Tolerant
9361 (Caenis Diminuta Gr.)	5			% Predators
3259 (Pachydiplax longipennis)	1			% Shred
3305 (Erythemis simplicicollis)	1			Scrapers
3323 (Libellula pulchella)	1			% Collector-Fil
3331 (Sympetrum)	1		10	
3540 (Ischnura)	1	gills	9	% Spra
		undeveloped,		mIBI M
		probably posita		
3542 (Ischnura posita)	3			
3546 (Enallagma)	1	small, probably	9	
		divagans		
1041 (CORIXIDAE)	3	nymphs	5	
7201 (Trichocorixa calva)	5	4m 1f	4	
7230 (Neoplea striola)	8	7 adults 1 nymph		
7207 (Belostoma)	3	nymph		-
7216 (Ranatra)	2	imm.		Shan
7217 (Ranatra buenoi)	1			
7220 (Ranatra nigra)	2	4 h h a h	4	Sh
1037 (VELIIDAE)	1	this nymph		
		appears to be		%
		Platyvelia or Steinovelia		
		Steinovelia		
		stagnalis seems		
		most plausible		
		based on range		
7138 (Merragata)	1	micropterous		
· · · · · · · · · · · · · · · · · · ·		male, couldn't		
		remove genital		
		capsule		
3599 (Peltodytes dunavani)	1	? female		
3602 (Peltodytes muticus)	1	i	i	

Туре	<u>Value</u>	<u>Metric</u> Score
Total Taxa:	48	5
otal No. Individuals:	119	1
EPT Taxa:	2	1
% Orthocladiinae + Tanytarsini of Chironomidae:	5	5
% Non-insects excluding Astacidae:	31.09	3
Diptera Taxa:	13	3
% Intolerant (0-3):	0	1
% Tolerant (8-10):	7.56	5
% Predators FFG 1:	27.73	3
% Shredders + Scrapers FFG 1:	5.88	1
6 Collector-Filterers FFG 1:	6.72	5
% Sprawlers:	0	1
mIBI Metric	34	

НВІ	5.84
hannon-Weaver Index	3.36
Shannon Equitability	0.87
% Dominant 3 Taxon	32.77
% Chironomidae	16.81



TAXON	COUNT	NOTES	HBI
TAXON	COUNT	NOTES	Tolerance
2666 (Hygrotyc covi)	1	2	Tolerance
3666 (Hygrotus sayi)	1 2		<u> </u>
3789 (Liodessus flavicollis)	2	pattern odd, 2	6
		spots in front of elytra instead of	
		fascia	
3964 (Suphisellus)	1	larva	
3966 (S. bicolor bicolor)	1	bicolor subsp.???	
	1	adult	
1096 (SCIRTIDAE)	2	addit	5
3911 (Hydrochus)	1	female	5
3794 (Chauliodes pectinicornis)	1	? imm.	5
7732 (Anopheles)	1	: 01011.	
7780 (Culex)	5	some not 4th	
	Ŭ	instar, with	
		multiple tufts on	
		siphon	
7801 (Uranotaenia)	1	sapphirina?	
7929 (Clinotanypus pinguis)	1		8
7960 (Guttipelopia guttipennis)	1		
8086 (Chironomus)	1		8
8123 (Endochironomus)	1	(nigricans?)	6
8126 (Glyptotendipes)	1		6
9264 (Kiefferulus)	3		
8158 (Parachironomus	1		5
carinatus)			
8241 (Tanytarsus)	1		4
8180 (Polypedilum tritum)	4		
9241 (Polypedilum Illinoense	6	1 pupa	
Gr.)			

Identifier	Date	Count	%PSE
SEZ	10/25/2021	1	97.62



Warning: Macro Data i	s not finalized (stat	us is not "Appro	ved"); IBI so	ores may not be fin	al.		
Site Name	EPA ID	Macro Sam	ole Type	Sample #	Macro Event #	# Sample Date	County
WEM080-0014	21T-012	MHA	В	AB47664	210817902	8/17/21	Jackson
Stream Name Location						HUC 12	HUCTO14
Mutt	on Creek Ditch	า		CR 400 No	orth	051202070704	05120207080020
Northing	Eas	ting	Ecol	region	Gradient	Drainage Area	QHEI Score
4310866.62	6026	44.25	Ę	55	2.112	29.807	48

ΤΑΧΟΝ	COUNT	NOTES	HBI
			Tolerance
1220 (PLATYHELMINTHES)	1		
1507 (Nais variabilis)	1	?	10
1234 (GLOSSIPHONIIDAE)	3	one with juveniles	
9050 (Hyalella)	35		
3081 (Callibaetis)	4	floridanus? *some features of floridanus & fluctuans	6
9361 (Caenis Diminuta Gr.)	12		
3251 (Nasiaeschna pentacantha)	2		
7046 (Epitheca princeps)	1		
9315 (Epitheca (Tetragoneuria))	2	E. semiaquea?	
3540 (Ischnura)	1	imm. verticalis or prognata?	9
3542 (Ischnura posita)	3		
3546 (Enallagma)	1	imm. antennatum? divagans? germinatum?	9
3549 (Enallagma divagans)	3		
7230 (Neoplea striola)	1		
7207 (Belostoma)	6	nymphs	
7216 (Ranatra)	2	nymphs buenoi?	
7217 (Ranatra buenoi)	1		
7111 (Rheumatobates)	1	female	
7112 (Rheumatobates palosi)	1	male	
1037 (VELIIDAE)	1	Steinovelia stagnalis? nymph? mature	
7128 (Microvelia hinei)	1	male	
1096 (SCIRTIDAE)	5	larvae	5
7296 (Dubiraphia)	1	female ~2.5 mm probably vittata	5
1193 (CULICIDAE)	2	Uranotaenia sapphirina? or imm. Aedes, not 4th instar	8
7732 (Anopheles)	2		
7960 (Guttipelopia guttipennis)	1		
8083 (Chironomini)	1	? imm.	
8112 (Dicrotendipes)	3	some modestus/neomo	6

Туре	Value		<u>Metric</u> Score
Total Taxa:	34		3
Total No. Individuals:	108		1
EPT Taxa:	2		1
% Orthocladiinae + Tanytarsini of Chironomidae:	20		5
% Non-insects excluding Astacidae:	37.04		1
Diptera Taxa:	11		3
% Intolerant (0-3):	0		1
% Tolerant (8-10):	4.63		5
% Predators FFG 1:	25		3
% Shredders + Scrapers FFG 1:	6.48		1
% Collector-Filterers FFG 1:	6.48		5
% Sprawlers:	0.93		1
mIBI Metric	:	30	

HBI	6.09
Shannon-Weaver Index	2.79
Shannon Equitability	0.79
% Dominant 3 Taxon	49.07
% Chironomidae	13.89



TAXON	COUNT	NOTES	HBI
			Tolerance
		destus?	
8123 (Endochironomus)	2	nigricans? one	6
		maybe Tribelos?	
9296 (Microtendipes Pedellus	1		
Gr.)			
8241 (Tanytarsus)	3		4
8180 (Polypedilum tritum)	1		
9278 (Polypedilum Halterale Gr.)	1		
9241 (Polypedilum Illinoense	2		
Gr.)			

Identifier Date	Count	%PSE
-----------------	-------	------



Warning: Macro Data	is not finalized (stat	us is not "Approv	ved"); IBI so	cores may not be fin	al.		
Site Name	EPA ID	Macro Samp	le Type	Sample #	Macro Event	# Sample Date	County
WEM080-0014	21T-012	MHA	В	AB46802	210817903	8/17/21	Jackson
	Stream Name	HUC 12	HUCTO14				
Mutt	on Creek Ditch	1		CR 400 No	orth	051202070704	05120207080020
Northing	Eas	ting	Eco	region	Gradient	Drainage Area	QHEI Score
4310866.62	6026	44.25	Į	55	2.112	29.807	49

TAXON	COUNT	NOTES	HBI Tolerance
1220 (PLATYHELMINTHES)	3		
1485 (Chaetogaster diastrophus)	1		6
1234 (GLOSSIPHONIIDAE)	1		
1090 (Physa)	1		8
1083 (Acari)	3		4
9036 (Caecidotea)	3		8
9050 (Hyalella)	40		
1110 (EPHEMEROPTERA)	1	very imm. maybe caenis	
3081 (Callibaetis)	5	floridanus?	6
9361 (Caenis Diminuta Gr.)	14	some not latipennis?	
1120 (ANISOPTERA)	1	imm. corduliid or libellulid, etc.	
3251 (Nasiaeschna	3		
pentacantha)			
3080 (Phanogomphus	1	might be a little	
graslinellus)		immature	
3259 (Pachydiplax longipennis)	1		
7046 (Epitheca princeps)	1		
1026 (COENAGRIONIDAE)	1	imm.	9
3540 (Ischnura)	1	imm. prognata or posita	9
3542 (Ischnura posita)	3		
3549 (Enallagma divagans)	3		
3552 (Enallagma signatum)	1		
7230 (Neoplea striola)	3		
7207 (Belostoma)	4	nymph	
7217 (Ranatra buenoi)	2		
1037 (VELIIDAE)	1	very young nymph, maybe microvelia or steinovelia	
3600 (Peltodytes	1		
duodecimpunctatus)			
3602 (Peltodytes muticus)	1	? female, maybe sexmaculatus, median blotch poorly developed, punctures	
		confused?	_
1096 (SCIRTIDAE)	2		5
7300 (Dubiraphia vittata)	5	3m 2f J21-025.1	

Туре	Value	<u>Metric</u> <u>Score</u>
Total Taxa:	47	5
Total No. Individuals:	136	3
EPT Taxa:	3	1
% Orthocladiinae + Tanytarsini of Chironomidae:	20	5
% Non-insects excluding Astacidae:	38.24	1
Diptera Taxa:	18	5
% Intolerant (0-3):	0	1
% Tolerant (8-10):	6.62	5
% Predators FFG 1:	18.38	3
% Shredders + Scrapers FFG 1:	7.35	1
% Collector-Filterers FFG 1:	3.68	5
% Sprawlers:	2.21	1
mIBI Metric	Score:	36

HBI	6.15
Shannon-Weaver Index	3.08
Shannon Equitability	0.8
% Dominant 3 Taxon	43.38
% Chironomidae	18.38

2/9/2022 9:03:59 AM OWQ Biological Studies: MHAB Report, Page 1 of 2



TAXON	COUNT	NOTES	HBI
			Tolerance
		~280um	
		aedaegus	
3911 (Hydrochus)	1	female?	5
1193 (CULICIDAE)	1	imm. (very small)	8
7732 (Anopheles)	1		
7780 (Culex)	1		
9195 (Labrundinia neopilosella)	1		
7926 (Tanypodinae)	1	Fittkauimyia or	
		Psectrotanypus?	
		very imm.	
8083 (Chironomini)	1	imm.	
		Chironomus?	
9248 (Ablabesmyia Mallochi Gr.)	1		
9317 (Zavreliella marmorata)	1		
8017 (Corynoneura)	1		4
8047 (Nanocladius)	1	alternantherae?	5
8086 (Chironomus)	2		8
8112 (Dicrotendipes)	2	1 pupa both	6
		modestus/neomo	
		destus?	
8123 (Endochironomus)	5	subtendens?	6
9296 (Microtendipes Pedellus	1		
Gr.)			
8172 (Phaenopsectra)	1	flavipes?	7
8241 (Tanytarsus)	2		4
9278 (Polypedilum Halterale Gr.)	1		
9241 (Polypedilum Illinoense	4		
Gr.)			

Identifier Date Count	%PSE
-----------------------	------



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.									
Site Name	EPA ID	Macro Samp	le Type	Sample #	Macro Event	t #	Sample Date	County	
WEM070-0029	21T-007	MHAE	3	AB47659 210817702		2	8/17/21	Jennings	
	Stream Name			Location	1		HUC 12	HUCTO14	
	Tea Creek			CR 650 W	/est	05	1202070705	05120207070040	
Northing	Eas	ting	Eco	region	Gradient		Drainage Area	QHEI Score	
4304896.05	6100	36.43	Į	55	2.676		10.632	46	

ΤΑΧΟΝ	COUNT	NOTES	HBI
			Tolerance
1220 (PLATYHELMINTHES)	1		
1090 (Physa)	5		8
1083 (Acari)	4		4
9050 (Hyalella)	1		
9056 (Crangonyx)	1		6
8996 (Faxonius)	2	M Form II	4
3020 (Stenonema femoratum)	1		3
3081 (Callibaetis)	3	Slide S21-065.1; C. floridanus?	6
3130 (Paraleptophlebia)	4		3
9361 (Caenis Diminuta Gr.)	4		
3245 (Boyeria vinosa)	4		4
3448 (Somatochlora)	3	early instars	1
3534 (Calopteryx)	2	no gills, probably C. maculata	4
3546 (Enallagma)	2	no gills	9
3552 (Enallagma signatum)	2		
3568 (Argia)	1	no gills	5
1038 (GERRIDAE)	1	nymph; likely Trepobates	
7107 (Limnoporus canaliculatus)	1	adult	
7122 (Microvelia)	2	nymphs	
3600 (Peltodytes	3	adult F	
duodecimpunctatus)			
3772 (Copelatus glyphicus)	1	Adult F	
1096 (SCIRTIDAE)	4	L	5
7295 (Ancyronyx variegatus)	1	A	4
7732 (Anopheles)	1		
7984 (Procladius)	1		7
8083 (Chironomini)	1		
9248 (Ablabesmyia Mallochi Gr.)	8		
9250 (Ablabesmyia Rhamphae	1		
Gr.)			
9284 (Tribelos jucundum)	2		
8086 (Chironomus)	3		8
8112 (Dicrotendipes)	1		6
8126 (Glyptotendipes)	2		6
8157 (Parachironomus)	1		4
8168 (Paratendipes albimanus)	1		4
8172 (Phaenopsectra)	1		7
8179 (Polypedilum)	1		. .
8228 (Cladotanytarsus)	1		4

<u>Type</u>	Value	<u>Metric</u> <u>Score</u>
Total Taxa:	42	5
Total No. Individuals:	87	1
EPT Taxa:	4	3
% Orthocladiinae + Tanytarsini of Chironomidae:	12.12	5
% Non-insects excluding Astacidae:	13.79	5
Diptera Taxa:	19	5
% Intolerant (0-3):	11.49	1
% Tolerant (8-10):	11.49	5
% Predators FFG 1:	21.84	3
% Shredders + Scrapers FFG 1:	12.64	3
% Collector-Filterers FFG 1:	5.75	5
% Sprawlers:	2.3	1
mIBI Metric	42	

НВІ	5
Shannon-Weaver Index	3.53
Shannon Equitability	0.94
% Dominant 3 Taxon	19.54
% Chironomidae	37.93



TAXON	COUNT	NOTES	HBI Tolerance
8235 (Paratanytarsus)	1		4
8238 (Rheotanytarsus)	2		3
8180 (Polypedilum tritum)	2		
9277 (Polypedilum Scalaenum	1		
Gr.)			
9241 (Polypedilum Illinoense	3		
Gr.)			

Identifier Dat	e Count	%PSE
----------------	---------	------



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.									
Site Name	EPA ID	Macro Samp	le Type	Sample #	Macro Event	# Sample Date	County		
WEM-07-0020	21T-022	MHA	3	AB47674 210816701		8/16/21	Jennings		
	Stream Name			Location		HUC 12	HUCTO14		
S	ixmile Creek			CR 415 No	orth	051202070702	05120207070050		
Northing	Eas	ting	Eco	region	Gradient	Drainage Area	QHEI Score		
4322688.11	6145	37.51	į	55	16.916	8.944	57		

TAXON	COUNT	NOTES	HBI	Туре	Value	<u>Metric</u> <u>Score</u>
			Tolerance	Total Taxa:	57	5
1260 (Nemata)	1		6	Total No. Individuals:	237	3
1526 (Slavina appendiculata)	1		6	EPT Taxa:	3	1
1486 (Chaetogaster limnaei)	2		6		5	I
1504 (Nais pardalis)	1		8	% Orthocladiinae + Tanytarsini of	53.23	1
1501 (Nais bretscheri)	1		6	Chironomidae:	00.20	
1561 (Nais communis/variabilis	1			% Non-insects	17.72	5
complex)				excluding Astacidae:		
1552 (Tubificinae with bifid	1			Diptera Taxa:	22	5
chetae and no hair chetae)				% Intolerant (0-3):	3.38	1
1565 (Aeolosoma)	1		8	9/ Telerent (9.40)	10 E	3
1204 (GASTROPODA)	1	no shell,	7	% Tolerant (8-10):	13.5	3
		damaged, ferrissia?		% Predators FFG 1:	13.5	1
1087 (Ferrissia)	5	161115518 !	6	% Shredders +	17.72	3
1088 (Gyraulus)	2	? imm?	8	Scrapers FFG 1: % Collector-Filterers	00.04	
1090 (Physa)	20		8	FFG 1:	23.21	1
1083 (Acari)	2		4	% Sprawlers:	2.95	1
9031 (Lirceus)	3		8			
8996 (Faxonius)	2	female	4	mIBI Metric	Score:	30
9016 (Faxonius sloanii)	3	form II male				
3020 (Stenonema femoratum)	5		3			
9361 (Caenis Diminuta Gr.)	13					
3245 (Boyeria vinosa)	1		4	<u>Sı</u>	upplemen	tal Metrics
3448 (Somatochlora)	1	ensigera grp?	1			
1022 (CALOPTERYGIDAE)	2	? imm.	5		HBI	5.29
3534 (Calopteryx)	2	no gills, imm.	4			
1026 (COENAGRIONIDAE)	3	imm.	9	Shannon-We	aver Index	3.3
3546 (Enallagma)	1	no gills	9			
3549 (Enallagma divagans)	2			Shannon E	quitability	0.82
3568 (Argia)	7	imm. no gills	5			
9095 (Argia fumipennis)	1			% Domina	nt 3 Taxon	36.71
7225 (Notonecta irrorata)	1					
1038 (GERRIDAE)	4	nymphs		% Chir	ronomidae	52.32
		Aquarius?				
7111 (Rheumatobates)	1	beat up female				
7120 (Trepobates pictus)	2	males				
7123 (Microvelia americana)	1					
3600 (Peltodytes	14					
duodecimpunctatus)						
7307 (Stenelmis)	4	3 females (crenata?) 1 larva	5			
3000 (Hydroptila)	1		3]		



TAXON	COUNT	NOTES	HBI
			Tolerance
7975 (Thienemannimyia)	1	pharate larva	
7984 (Procladius)	2		7
9153 (Tribelos)	1		5
9248 (Ablabesmyia Mallochi Gr.)	4		
9261 (Thienemannimyia Gr.)	8		
9354 (Stempellinella fimbriata)	2		
8051 (Orthocladius)	1	robacki?	4
8086 (Chironomus)	1		8
8099 (Cryptochironomus)	4		5
8104 (Cryptotendipes)	2		4
8112 (Dicrotendipes)	5		6
9296 (Microtendipes Pedellus	1		
Gr.)			
9335 (Paratendipes albimanus	10		
grp)			
8172 (Phaenopsectra)	8		7
8192 (Polypedilum flavum)	7		
8206 (Stenochironomus)	1		4
8228 (Cladotanytarsus)	1		4
8235 (Paratanytarsus)	8		4
8238 (Rheotanytarsus)	1		3
8241 (Tanytarsus)	53	7 pupae	4
9277 (Polypedilum Scalaenum	2		
Gr.)			
9241 (Polypedilum Illinoense	1		
Gr.)			

Identifier Date Count %PSE



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.								
Site Name	EPA ID	Macro Sam	ple Type	Sample #	Macro Even	t #	Sample Date	County
WEM070-0020	21T-009	MHA	٨B	AB47661	21081890	1	8/18/21	Jackson
Stream Name Location			HUC 12	HUCTO14				
Vernon Fo	rk Muscatatuc	k River		US 31		05	1202070705	05120207070070
Northing	Eas	ting	Eco	region	Gradient		Drainage Area	QHEI Score
4307017.25	6022	22.65	ļ	55	1.458		292.076	74

TAXON	COUNT	NOTES	HBI	
			Tolerance	
1085 (Tubificinae)	1	w/ hair chastae,	10	Т
		bifid ventrals with		
		short upper teeth,		
		papillate, foreign		
		matter adhered to		
1430 (Isochaetides curvisetosus)	1	body wall		_
1502 (Nais communis)	1		8	е
1357 (BRANCHIOBDELLIDAE)	19		6	
2211 (Pleurocera)	3		0	
2156 (Corbicula fluminea)	4		6	
· · · · · · · · · · · · · · · · · · ·	4		6	
2181 (Sphaerium)			0	
9050 (Hyalella)	3	fomalaa		
8996 (Faxonius)	2	females	4	_
1251 (ISOTOMIDAE)	1	Isotoma viridis?		%
1254 (Entomobryidae)	1	Entomobrya assuta?		
1017 (HEPTAGENIIDAE)	1	imm.	4	
9156 (Maccaffertium)	3	imm.		
		pulchellum/exigu		
		um?		
3019 (Maccaffertium exiguum)	5	J21-037.3	2	
3018 (Maccaffertium pulchellum)	9	? J21-037.4,	2	
		037.5		
3048 (Stenacron)	4		3	
9366 (Baetis intercalaris	16	J21-037.6, 037.7	3	
complex)				
3109 (Isonychia)	19		2	
3175 (Tricorythodes)	4		3	
3129 (Stylurus)	1	plagiatus? not final instar	4	
7027 (Hetaerina americana)	1			
3568 (Argia)	1	no gills	5	
3572 (Argia tibialis)	2	_		
1041 (CORIXIDAE)	5	nymphs	5	
7201 (Trichocorixa calva)	4	2m 2f	4	
7209 (Belostoma lutarium)	1			
3600 (Peltodytes	2			
duodecimpunctatus)				
3604 (Peltodytes sexmaculatus)	2	1f 1m		
3776 (Uvarus)	1	falli (or lacustris?)		
3851 (Berosus peregrinus)	1		6	

Туре	Value	<u>Metric</u> <u>Score</u>
Total Taxa:	54	5
Total No. Individuals:	227	3
EPT Taxa:	13	5
% Orthocladiinae + Tanytarsini of Chironomidae:	17.86	5
% Non-insects excluding Astacidae:	14.98	5
Diptera Taxa:	10	3
% Intolerant (0-3):	50.66	5
% Tolerant (8-10):	1.76	5
% Predators FFG 1:	7.49	1
% Shredders + Scrapers FFG 1:	10.13	3
% Collector-Filterers FFG 1:	24.23	1
% Sprawlers:	0	1
mIBI Metric	42	

HBI	3.63
Shannon-Weaver Index	3.37
Shannon Equitability	0.84
% Dominant 3 Taxon	32.6
% Chironomidae	12.33



TAXON	COUNT	NOTES	HBI
	000111	NOTED	Tolerance
1096 (SCIRTIDAE)	1		5
7293 (Psephenus herricki)	1		4
7307 (Stenelmis)	2	larvae	5
7310 (Stenelmis decorata)	1	J21-037.1	
7317 (Stenelmis sexlineata)	5		
7300 (Dubiraphia vittata)	1	J21-037.2 ~260 um (slightly bent)	
7295 (Ancyronyx variegatus)	1		4
7321 (Macronychus glabratus)	1		3
3799 (Corydalus cornutus)	2		2
3267 (Chimarra obscura)	3		4
3432 (Cheumatopsyche)	16		3
3423 (Hydropsyche)	6	imm.	4
9154 (Hydropsyche venularis)	36	some less mature with incomplete pigment on the side?	3
1054 (HYDROPTILIDAE)	3		4
8083 (Chironomini)	1	Glyptotendipes?	
9250 (Ablabesmyia Rhamphae Gr.)	2	1 pupa w/ exuvia rhampe grp?	
9261 (Thienemannimyia Gr.)	3		
8086 (Chironomus)	2		8
8112 (Dicrotendipes)	2		6
8179 (Polypedilum)	1	pupa	
8192 (Polypedilum flavum)	8		
8238 (Rheotanytarsus)	3		3
8241 (Tanytarsus)	2		4
9241 (Polypedilum Illinoense Gr.)	4		

Identifier Date Count %PSE	
----------------------------	--



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.							
Site Name	EPA ID	Macro Sam	ple Type	Sample #	Macro Event	# Sample Date	County
WEM-07-0017	21T-019	MHA	B.	AB47671	210816703	8/16/21	Jennings
	Stream Name	Location		HUC 12	HUCTO14		
S	ixmile Creek			CR 500 Sc	buth	051202070702	05120207070060
Northing	Eas	ting	Eco	region	Gradient	Drainage Area	QHEI Score
4307645.38	6073	07.92	Ę	55	2.423	30.679	44

TAXON	COUNT	NOTES	HBI
			Tolerance
1426 (Branchiura sowerbyi)	1		6
1090 (Physa)	2		8
2156 (Corbicula fluminea)	2		6
1083 (Acari)	1		4
8996 (Faxonius)	2	F & damaged M form II	4
1251 (ISOTOMIDAE)	1		
1017 (HEPTAGENIIDAE)	1	imm., no gills	4
3020 (Stenonema femoratum)	1		3
3036 (Leucrocuta)	2		2
3183 (Caenis)	5	imm prob. C. diminuta grp.; dmg.	3
9361 (Caenis Diminuta Gr.)	41		
9215 (Sparbarus)	1	has three ocellar tubercles & operculate gills with posterolateral corners evenly rounded; imm.	
3109 (Isonychia)	3		2
3175 (Tricorythodes)	32		3
1021 (GOMPHIDAE)	1		1
3546 (Enallagma)	4		9
3549 (Enallagma divagans)	2		
1038 (GERRIDAE)	2	N; very imm.	
7111 (Rheumatobates)	1	Ň	
3600 (Peltodytes duodecimpunctatus)	6	А	
3846 (Berosus)	3	L	7
3851 (Berosus peregrinus)	5	A	6
1096 (SCIRTIDAE)	1	L	5
7307 (Stenelmis)	2	adult F	5
7296 (Dubiraphia)	1	adult F	5
3899 (Helophorus)	1	A	5
3267 (Chimarra obscura)	3		4
1057 (HYDROPSYCHIDAE)	2		4
3432 (Cheumatopsyche)	53		3
3419 (Hydropsyche Morosa Gr.)	1		
3487 (Hydropsyche simulans) 8922 (Nectopsyche candida)	6 2		2

Туре	<u>Value</u>	<u>Metric</u> <u>Score</u>
Total Taxa:	53	5
otal No. Individuals:	280	5
EPT Taxa:	14	5
% Orthocladiinae + Tanytarsini of Chironomidae:	26.44	3
% Non-insects excluding Astacidae:	2.14	5
Diptera Taxa:	21	5
% Intolerant (0-3):	41.07	5
% Tolerant (8-10):	3.57	5
% Predators FFG 1:	11.07	1
% Shredders + Scrapers FFG 1:	5.36	1
% Collector-Filterers FFG 1:	29.29	1
% Sprawlers:	4.64	3
mIBI Metric	Score	44

HBI	3.85
Shannon-Weaver Index	3.16
Shannon Equitability	0.8
% Dominant 3 Taxon	45
% Chironomidae	31.07



TAXON	COUNT	NOTES	HBI Tolerance
9370 (Ceratopogon grp.)	2		8
7940 (Natarsia)	4		6
7926 (Tanypodinae)	2		
8083 (Chironomini)	4	2P & 2L	
9248 (Ablabesmyia Mallochi Gr.)	2		
9250 (Ablabesmyia Rhamphae	2		
Gr.)			
9261 (Thienemannimyia Gr.)	8		
9284 (Tribelos jucundum)	2		
8086 (Chironomus)	2		8
8099 (Cryptochironomus)	11		5
8112 (Dicrotendipes)	3		6
8126 (Glyptotendipes)	1		6
9296 (Microtendipes Pedellus	1		
Gr.)			
8179 (Polypedilum)	2		
8192 (Polypedilum flavum)	11		
8228 (Cladotanytarsus)	4		4
8238 (Rheotanytarsus)	10		3
9093 (Stempellinella)	2		3
8241 (Tanytarsus)	7		4
9278 (Polypedilum Halterale Gr.)	1		
9241 (Polypedilum Illinoense	8		
Gr.)			

Identifier	Date	Count	%PSE
------------	------	-------	------



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.							
Site Name	EPA ID	Macro Samp	le Type	Sample #	Macro Event	# Sample Date	County
WEM080-0025	21T-015	MHA	3	AB47667	210816901	8/16/21	Jennings
	Stream Name Location				HUC 12	HUCTO14	
Ν	lutton Creek			CR 300 No	orth	051202070704	05120207080010
Northing	Eas	ting	Eco	Ecoregion Gradient		Drainage Area	QHEI Score
4320605.46	6068	64.92	Į	55	6.52	8.239	53

TAXON	COUNT	NOTES	HBI Tolerance
1515 (Pristina aequiseta)	1		8
1552 (Tubificinae with bifid	1		
chetae and no hair chetae)			
1090 (Physa)	1		8
2181 (Sphaerium)	8		6
8996 (Faxonius)	4	females (imm.)	4
3020 (Stenonema femoratum)	1		3
3048 (Stenacron)	6		3
7011 (Acerpenna pygmaea)	2		2
3065 (Baetis)	1	imm. intercalaris? J21-029.1	3
1018 (LEPTOPHLEBIIDAE)	1	imm.	2
9361 (Caenis Diminuta Gr.)	8		
3109 (Isonychia)	2		2
3248 (Basiaeschna janata)	1		6
9351 (Phanogomphus)	1		
3448 (Somatochlora)	1	ensigera?	1
3534 (Calopteryx)	1	maculata? small	4
3546 (Enallagma)	1	no gills	9
3549 (Enallagma divagans)	6		
9095 (Argia fumipennis)	4		
3572 (Argia tibialis)	2		
1038 (GERRIDAE)	1	Gerrinae? nymph	
7111 (Rheumatobates)	1	nymph	
7112 (Rheumatobates palosi)	1	? male adult	
7117 (Trepobates)	1	nymph	
7118 (Trepobates inermis)	1	adult female	
7122 (Microvelia)	1	(Kirkaldya)	
		female,	
3600 (Peltodytes	4		
duodecimpunctatus)			
3959 (Helichus lithophilus)	1		
3960 (Helichus basalis)	1	female	
7307 (Stenelmis)	1	larva	5
7309 (Stenelmis crenata)	2	J21-029.2	5
7296 (Dubiraphia)	1	female, larger	5
		than other one	
		(~2.5mm) weird	
		qaudrinotata or	
		small bivittata?	
7300 (Dubiraphia vittata)	1	J21-029.3	
		aedaegus	

Туре	<u>Value</u>	<u>Metric</u> <u>Score</u>
Total Taxa:	56	5
Total No. Individuals:	157	3
EPT Taxa:	13	5
% Orthocladiinae + Tanytarsini of Chironomidae:	11.54	5
% Non-insects excluding Astacidae:	7.01	5
Diptera Taxa:	17	5
% Intolerant (0-3):	32.48	5
% Tolerant (8-10):	3.18	5
% Predators FFG 1:	14.65	1
% Shredders + Scrapers FFG 1:	8.28	1
% Collector-Filterers FFG 1:	44.59	1
% Sprawlers:	1.91	1
mIBI Metric	Score	: 42

HBI	3.96
Shannon-Weaver Index	3.3
Shannon Equitability	0.82
% Dominant 3 Taxon	38.85
% Chironomidae	16.56



TAXON	COUNT	NOTES	HBI
			Tolerance
		~280um	
1045 (PHILOPOTAMIDAE)	1	pupa	3
3267 (Chimarra obscura)	20		4
3432 (Cheumatopsyche)	33		3
3423 (Hydropsyche)	1	imm.	4
8980 (Hydropsyche betteni grp)	1		
8952 (Helicopsyche borealis)	2		3
7732 (Anopheles)	2		
7814 (Simulium)	1		5
9105 (Ablabesmyia janta)	1	variety II	5
7984 (Procladius)	1		7
8227 (Tanytarsini)	1		
9261 (Thienemannimyia Gr.)	1		
9284 (Tribelos jucundum)	1		
8066 (Rheocricotopus)	1	robacki?	5
8084 (Axarus)	2		
8086 (Chironomus)	2		8
8099 (Cryptochironomus)	2		5
9296 (Microtendipes Pedellus	1		
Gr.)			
9335 (Paratendipes albimanus	5		
grp)			
8172 (Phaenopsectra)	1		7
8192 (Polypedilum flavum)	5		
8211 (Stictochironomus)	1		4
8238 (Rheotanytarsus)	1		3

Identifier Date Count %F	6PSE
--------------------------	------



Warning: Macro Data	Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.							
Site Name	EPA ID	Macro Samp	ole Type	Sample #	Macro Event	# Sample Date	County	
WEM080-0027	21T-014	MHA	В	AB47666	210816902	8/16/21	Jackson	
	Stream Name			Location	1	HUC 12	HUCTO14	
N	lutton Creek			CR 800 No	orth	051202070704	05120207080020	
Northing	Eas	ting	Ecol	Ecoregion Gradient		Drainage Area	QHEI Score	
4317303.85	6033	60.99	Ę	55	4.798	18.199	52	

TAXON	COUNT	NOTES	HBI	Туре	Value	<u>Metric</u> <u>Score</u>
			Tolerance	Total Taxa:	59	5
1561 (Nais communis/variabilis complex)	2			Total No. Individuals:	167	3
1357 (BRANCHIOBDELLIDAE)	2		6	EPT Taxa:	6	3
1090 (Physa)	1		8	% Orthocladiinae +		
2156 (Corbicula fluminea)	3		6	Tanytarsini of Chironomidae:	50.94	1
2181 (Sphaerium)	6		6	% Non-insects	40.57	
1083 (Acari)	2		4	excluding Astacidae:	12.57	5
9050 (Hyalella)	5			Diptera Taxa:	18	5
8996 (Faxonius)	1	female	4	% Intolerant (0-3):	4.79	1
1110 (EPHEMEROPTERA)	1	imm.				-
3020 (Stenonema femoratum)	1		3	% Tolerant (8-10):	4.19	5
9347 (Procloeon viridoculare)	1	? J21-013.1 no gills, small		% Predators FFG 1:	39.52	5
9361 (Caenis Diminuta Gr.)	11	one very beat up		% Shredders +	2.4	1
3248 (Basiaeschna janata)	1	one very beat up	6	Scrapers FFG 1: % Collector-Filterers		-
3251 (Nasiaeschna	1		0	FFG 1:	11.98	3
pentacantha)				% Sprawlers:	4.19	3
1021 (GOMPHIDAE)	1	imm.	1	-		
3448 (Somatochlora)	2	ensigera? imm.	1	mIBI Metric	Score:	40
1026 (COENAGRIONIDAE)	1	not argia	9		L	
3542 (Ischnura posita)	1	Ŭ				
3546 (Enallagma)	3		9			
3549 (Enallagma divagans)	28			<u>S</u>	upplement	al Metrics
3557 (Enallagma civile)	1	or germinatum, leaning toward imm. civile			НВІ	4.99
3560 (Enallagma basidens)	1			Shannon-We	eaver Index	3.54
3568 (Argia)	3	small / no gills	5			
9095 (Argia fumipennis)	5			Shannon I	Equitability	0.87
3572 (Argia tibialis)	7					
7230 (Neoplea striola)	1			% Domina	int 3 Taxon	28.74
7209 (Belostoma lutarium)	1					
7217 (Ranatra buenoi)	1			% Chi	ronomidae	31.74
1038 (GERRIDAE)	1	nymph, Limnoporus?			l	
7111 (Rheumatobates)	1	nymph				
7107 (Limnoporus canaliculatus)	1	macropterous male?				
7108 (Limnoporus dissortis)	1	macropterous male?				
7122 (Microvelia)	1	nymph				
7123 (Microvelia americana)	1	male				



TAXON	COUNT	NOTES	HBI Tolerance
3600 (Peltodytes	5		
duodecimpunctatus)			
9114 (Copelatus chevrolati)	1		
3809 (Gyrinus)	1	confinis group?	4
1096 (SCIRTIDAE)	2		5
7295 (Ancyronyx variegatus)	1	adult	4
3000 (Hydroptila)	1	imm.	3
8926 (Oecetis)	1	tiny	3
7723 (Dixella)	1		
1077 (CERATOPOGONIDAE)	1	pupa (Psychodidae?)	6
7984 (Procladius)	3		7
9464 (Nanocladius	1		
crassicornus/rectinervis			
complex)			
8083 (Chironomini)	2		
9248 (Ablabesmyia Mallochi Gr.)	1		
9261 (Thienemannimyia Gr.)	1		
8023 (Cricotopus bicinctus)	1		7
8074 (Thienemanniella)	2		4
8086 (Chironomus)	2		8
8099 (Cryptochironomus)	1		5
8112 (Dicrotendipes)	6		6
8211 (Stictochironomus)	3		4
8228 (Cladotanytarsus)	4	1 pupa	4
8235 (Paratanytarsus)	8	2 pupae	4
8238 (Rheotanytarsus)	2		3
8241 (Tanytarsus)	9		4
9241 (Polypedilum Illinoense Gr.)	7		

Identifier	Date	Count	%PSE
SEZ	10/12/2022	0	100



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.							
Site Name	EPA ID	Macro Samp	le Type	Sample #	Macro Event	# Sample Date	County
WEM090-0003	21T-001	MHA	В	AB47653	210824701	8/24/21	Jackson
Stream Name				Location		HUC 12	HUCTO14
Vernon Fork Muscatatuck River			CR 600 South		051202070706	05120207090010	
Northing	Eas	sting	Eco	region	Gradient	Drainage Area	QHEI Score
4294456.83	5969	11.39	ļ	55	1.343	391.167	43

TAXON	COUNT	NOTES	HBI
			Tolerance
1552 (Tubificinae with bifid	1		
chetae and no hair chetae)			
1319 (Helobdella stagnalis)	3		8
1090 (Physa)	2		8
9050 (Hyalella)	34		
1017 (HEPTAGENIIDAE)	1	small, beat up, Stenacron?	4
9156 (Maccaffertium)	1	J21-010.1 terminatum/ exiguum/ pulchellum	
3109 (Isonychia)	7		2
7046 (Epitheca princeps)	1	(Epicordulia)	
3546 (Enallagma)	1	no gills	9
3549 (Enallagma divagans)	2		
3568 (Argia)	1	no gills	5
3572 (Argia tibialis)	8		
1041 (CORIXIDAE)	1	nymph	5
7230 (Neoplea striola)	4		
7217 (Ranatra buenoi)	2		
7220 (Ranatra nigra)	2		4
7113 (Rheumatobates rileyi)	1	male	
7116 (Metrobates hesperius)	6	3 adults 3	
	_	nymphs 1	
		headless nymph	
3809 (Gyrinus)	1		4
7307 (Stenelmis)	1	larva	5
7310 (Stenelmis decorata)	7	J21-010.2 m5 f2	
7317 (Stenelmis sexlineata)	1		
9266 (Stenelmis grossa)	13	J21-010.3/.4/.5 m 9 f 4	
9490 (Stenelmis cheryl)	1		
7321 (Macronychus glabratus)	1	adult	3
1160 (TRICHOPTERA)	1	Hydroptilid or Hydropsychid? imm.	
3432 (Cheumatopsyche)	10		3
9154 (Hydropsyche venularis)	11	? rossi/simulans?	3
1054 (HYDROPTILIDAE)	1		4
8908 (Ceraclea maculata)	1	could be punctata / tarsipunctata?	4
8837 (Neureclipsis	1		

Туре	<u>Value</u>	<u>Metric</u> Score
Total Taxa:	41	5
Total No. Individuals:	142	3
EPT Taxa:	9	3
% Orthocladiinae + Tanytarsini of Chironomidae:	7.14	5
% Non-insects excluding Astacidae:	28.17	3
Diptera Taxa:	10	3
% Intolerant (0-3):	20.42	3
% Tolerant (8-10):	4.93	5
% Predators FFG 1:	20.42	3
% Shredders + Scrapers FFG 1:	8.45	1
% Collector-Filterers FFG 1:	11.97	3
% Sprawlers:	2.11	1
mIBI Metric	38	

НВІ	4
Shannon-Weaver Index	3
Shannon Equitability	0.81
% Dominant 3 Taxon	40.85
% Chironomidae	9.86



TAXON	COUNT	NOTES	HBI Tolerance
crepuscularis)			
9153 (Tribelos)	1	fuscicorne?	5
9250 (Ablabesmyia Rhamphae Gr.)	3	monilis/rhamphae	
9261 (Thienemannimyia Gr.)	2		
8086 (Chironomus)	1		8
8099 (Cryptochironomus)	1		5
8112 (Dicrotendipes)	1		6
8192 (Polypedilum flavum)	1		
8228 (Cladotanytarsus)	1	(Sp. C)	4
9278 (Polypedilum Halterale Gr.)	1		
9241 (Polypedilum Illinoense Gr.)	2		

Identifier	Date	Count	%PSE
SEZ	10/5/2021	5	96.48



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.							
Site Name	EPA ID	Macro Sample	е Туре	Sample #	Macro Event	# Sample Date	County
WEM080-0005	21T-017	MHAB		AB47669	210817904	8/17/21	Jennings
Stream Name			Location			HUC 12	HUCTO14
Tributary to Richart Lake		CR 900 West		051202070703	05120207080040		
Northing	Eas	ting	Ecoreg	ion	Gradient	Drainage Area	QHEI Score
4314106.22	6059	13.95	55		17.212	1.529	56

TAXON	COUNT	NOTES	HBI	<u>Type</u>	Value	<u>Metric</u> Score
			Tolerance	Total Taxa:	31	3
1552 (Tubificinae with bifid	1			Total No. Individuals:	74	1
chetae and no hair chetae)	2		6	EPT Taxa:	3	3
1357 (BRANCHIOBDELLIDAE)	2 9		6 8	% Orthocladiinae +		
1090 (Physa) 1083 (Acari)	1		4	Tanytarsini of	3.33	5
9031 (Lirceus)	2		8	Chironomidae:		
9056 (Crangonyx)	1		6	% Non-insects excluding Astacidae:	21.62	3
8996 (Faxonius)	7	female	4	Diptera Taxa:	11	3
9016 (Faxonius sloanii)	3	male form II		· · -		
3048 (Stenacron)	1		3	% Intolerant (0-3):	2.7	1
1020 (LIBELLULIDAE)	1	imm.	9	% Tolerant (8-10):	20.27	3
7026 (Calopteryx maculata)	1			% Predators FFG 1:	12.16	1
1026 (COENAGRIONIDAE)	1	probably Argia,	9	% Shraddara		
		imm.		Scrapers FFG 1:	17.57	3
3549 (Enallagma divagans)	1	imm.		% Collector-Filterers	6.76	5
3568 (Argia)	1	probably tibialis	5	FFG 1:		
		but maybe		% Sprawlers:	0	1
		apicalis		mIBI Metric	Scoro:	32
1038 (GERRIDAE)	3	2 definitely			Score.	52
		Gerrinae, one				
		probably (very				
7122 (Microvelia)	2	imm.)		S.,	nnlomont	al Metrics
7123 (Microvelia americana)	1	nymphs 2		<u>5u</u>	ippiement	ai wietrics
1096 (SCIRTIDAE)	2	<u>'</u>	5		НВІ	5.88
3267 (Chimarra obscura)	1		4		пы	5.00
3432 (Cheumatopsyche)	1		3	Shannon-Wea	wor Index	2.99
7732 (Anopheles)	1		5	Shannon-wea	aver muex	2.99
9153 (Tribelos)	1	fuscicorne?	5	Shannon Eo	quitability	0.87
8227 (Tanytarsini)	1	pupa, no	0	Shannon Eo	quitability	0.07
		abdomen		% Dominan	+ 2 Toyon	40.54
9248 (Ablabesmyia Mallochi Gr.)	4					40.54
8086 (Chironomus)	2		8	% Chir	onomidae	40.54
8126 (Glyptotendipes)	1		6		ononnuae	40.54
8167 (Paratendipes)	1	pupa	6			
9335 (Paratendipes albimanus	14					
grp)						
8172 (Phaenopsectra)	1	flavipes	7			
8211 (Stictochironomus)	5		4			
8714 (Lytogaster)	1	? maybe				
		Nostima?				



Residuals			
Identifier	Date	Count	%PSE



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.							
Site Name	EPA ID	Macro Samp	ole Type	Sample #	Macro Event	# Sample Date	County
WEM070-0029	21T-007	MHA	В	AB46803	210817703	8/17/21	Jennings
Stream Name				Locatior	ז	HUC 12	HUCTO14
	Tea Creek			CR 650 W	/est	051202070705	05120207070040
Northing	Eas	sting	Ecol	region	Gradient	Drainage Area	QHEI Score
4304896.05	6100	36.43	Ę	55	2.676	10.632	43

TAXON	COUNT	NOTES	HBI	Туре	<u>Value</u>	<u>Metric</u> Score
	000111		Tolerance	Total Taxa:	37	3
1552 (Tubificinae with bifid	2			Total No. Individuals:	86	1
chetae and no hair chetae)				EPT Taxa:	2	1
1357 (BRANCHIOBDELLIDAE)	1		6	% Orthocladiinae +	2	
1206 (PLANORBIDAE)	1	shell very broken	6 8	Tanytarsini of	16.36	5
1090 (Physa) 1083 (Acari)	1		0 4	Chironomidae:		
9031 (Lirceus)	1		8	% Non-insects excluding Astacidae:	8.14	5
8996 (Faxonius)	3	1 Form II M & 2F	4	Diptera Taxa:	19	5
3020 (Stenonema femoratum)	3		3	1 -		
9361 (Caenis Diminuta Gr.)	3		5	% Intolerant (0-3):	11.63	1
3245 (Boyeria vinosa)	1		4	% Tolerant (8-10):	9.3	5
1021 (GOMPHIDAE)	1	early instar (~5.5	1	% Predators FFG 1:	17.44	1
		mm long)	•		17.44	1
3448 (Somatochlora)	5	early instars	1	% Shredders + Scrapers FFG 1:	4.65	1
7026 (Calopteryx maculata)	2			% Collector-Filterers	6.98	5
3546 (Enallagma)	1	no gills	9	FFG 1:	0.90	5
1038 (GERRIDAÉ)	1	Nymph; likely		% Sprawlers:	3.49	3
		Limnoporus			0	
1096 (SCIRTIDAE)	1	larva	5	mIBI Metric \$	Score:	36
7296 (Dubiraphia)	1	Adult F	5		I	I
7295 (Ancyronyx variegatus)	1	A	4			
7963 (Labrundinia)	3		4	_		
7977 (Zavrelimyia)	1		4	<u>Su</u>	pplement	al Metrics
9153 (Tribelos)	1		5			
8083 (Chironomini)	4				HBI	4.56
9248 (Ablabesmyia Mallochi Gr.)	13					
9261 (Thienemannimyia Gr.)	1			Shannon-Wea	ver Index	3.27
9284 (Tribelos jucundum)	7					
8086 (Chironomus)	5		8	Shannon Ec	quitability	0.91
8112 (Dicrotendipes)	2		6	-		
8126 (Glyptotendipes)	1		6	% Dominan	t 3 Taxon	29.07
9335 (Paratendipes albimanus	2					
grp)				% Chirc	onomidae	63.95
8179 (Polypedilum)	1					
8228 (Cladotanytarsus)	1		4	4		
8235 (Paratanytarsus)	3		4	4		
8238 (Rheotanytarsus)	1		3			
8241 (Tanytarsus)	4		4	4		
9240 (Polypedilum Fallax Gr.)	1			4		
9241 (Polypedilum Illinoense	4					
Gr.) 8355 (Tabanus)	1		5	4		
osos (Tabanus)			Э	J		



Residuals			
Identifier	Date	Count	%PSE



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.								
Site Name	EPA ID	Macro Sam	ole Type	Sample #	Macro Event	# Sample Date	County	
WEM-07-0021 21T-006 MHAB		В	AB47658	210816704	4 8/16/21	Jennings		
Stream Name				Location		HUC 12	HUCTO14	
Tea Creek				CR 650 So	outh	051202070705	05120207070040	
Northing Easting		Eco	region	Gradient	Drainage Area	QHEI Score		
4305200.12	6136	96.23	ļ	55	20.301	4.617	57	

TAXON	COUNT	NOTES	HBI
			Tolerance
1357 (BRANCHIOBDELLIDAE)	28		6
1087 (Ferrissia)	1	fragilis?	6
1090 (Physa)	7		8
9056 (Crangonyx)	1		6
9016 (Faxonius sloanii)	5	1 Form I, 4 Form II	
1017 (HEPTAGENIIDAE)	2	imm. beatup.	4
3020 (Stenonema femoratum)	2		3
3365 (Procloeon)	1	imm. beat up J21-042.1	
9361 (Caenis Diminuta Gr.)	2		
1038 (GERRIDAE)	2	Gerrinae nymphs, probably Aquarius remigis	
7099 (Aquarius remigis)	2	1m 1f	
9494 (Agabinus)	1	? larva	
9112 (Laccophilus fasciatus)	1		
7307 (Stenelmis)	1	larva	5
7732 (Anopheles)	5	4 larvae 1 pupa	
7977 (Zavrelimyia)	1		4
9248 (Ablabesmyia Mallochi Gr.)	6		
8086 (Chironomus)	1		8
8099 (Cryptochironomus)	6		5
9296 (Microtendipes Pedellus Gr.)	1		
9335 (Paratendipes albimanus grp)	5		
8211 (Stictochironomus)	5		4
9277 (Polypedilum Scalaenum Gr.)	1		

<u>Type</u>	Value	<u>Metric</u> <u>Score</u>	Value
Total Taxa:	23	3	23
Total No. Individuals:	87	1	87
EPT Taxa:	4	5	4
% Orthocladiinae + Tanytarsini of Chironomidae:	0	5	0
% Non-insects excluding Astacidae:	42.53	1	2.53
Diptera Taxa:	9	3	9
% Intolerant (0-3):	2.3	1	2.3
% Tolerant (8-10):	9.2	5	9.2
% Predators FFG 1:	13.79	1	3.79
% Shredders + Scrapers FFG 1:	10.34	3	0.34
% Collector-Filterers FFG 1:	5.75	5	5.75
% Sprawlers:	6.9	5	6.9
mIBI Metric	: 38		

НВІ	5.76
Shannon-Weaver Index	2.54
Shannon Equitability	0.81
% Dominant 3 Taxon	47.13
% Chironomidae	29.89

Identifier Date Count %PSE



Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.								
Site Name	EPA ID	Macro Samp	le Type	Sample #	Macro Event	# Sample Date	County	
WEM-07-0019	21T-021	MHAI	3	AB47673	210816702	8/16/21	Jennings	
Stream Name				Location		HUC 12	HUCTO14	
Sixmile Creek				CR 175 North		051202070702	05120207070050	
Northing Easting		Eco	region	Gradient	Drainage Area	QHEI Score		
4318694.71	6121	24.45	į	55	9.933	13.834	67	

ΤΑΧΟΝ	COUNT	NOTES	HBI
	000111	110120	Tolerance
1357 (BRANCHIOBDELLIDAE)	24		6
1234 (GLOSSIPHONIIDAE)	1		
8996 (Faxonius)	2	F	4
3048 (Stenacron)	4		3
9365 (Baetis flavistriga complex)	1	S21-035.4	3
9366 (Baetis intercalaris	18	S21-035.2 & .3	3
complex)			
3079 (Paracloeodes minutus)	1		
9361 (Caenis Diminuta Gr.)	5		
3016 (Arigomphus cornutus)	1		
7026 (Calopteryx maculata)	1		
3546 (Enallagma)	2	no gills	9
3568 (Argia)	1	no gills	5
1038 (GERRIDAE)	5	imm., likely a	
		larger genus	
7115 (Metrobates)	5		
7132 (Rhagovelia oriander)	3	adult M	
7307 (Stenelmis)	2	adult F	5
7300 (Dubiraphia vittata)	6	S21-035.1 (PL -	
		255 um); Adults	
		(2M & 4F)	
7321 (Macronychus glabratus)	2	A	3
1057 (HYDROPSYCHIDAE)	1	imm.	4
3432 (Cheumatopsyche)	11		3
8980 (Hydropsyche betteni grp)	1		
7926 (Tanypodinae)	7	5L & 2P	
9248 (Ablabesmyia Mallochi Gr.)	3		
9261 (Thienemannimyia Gr.)	17		
8023 (Cricotopus bicinctus)	1		7
8099 (Cryptochironomus)	3		5
8112 (Dicrotendipes)	1		6
9296 (Microtendipes Pedellus	3		
Gr.)			
8179 (Polypedilum)	1		
8192 (Polypedilum flavum)	18		<u> </u>
8211 (Stictochironomus)	3		4
8241 (Tanytarsus)	1		4
9260 (Cricotopus / Orthocladius)	1		
9241 (Polypedilum Illinoense	8		
Gr.)			
8320 (Chrysops)	1		5

Туре	<u>Value</u>	<u>Metric</u> <u>Score</u>
Total Taxa:	35	3
Total No. Individuals:	165	3
EPT Taxa:	8	5
% Orthocladiinae + Tanytarsini of Chironomidae:	4.48	5
% Non-insects excluding Astacidae:	15.15	5
Diptera Taxa:	14	5
% Intolerant (0-3):	21.82	3
% Tolerant (8-10):	1.21	5
% Predators FFG 1:	15.76	1
% Shredders + Scrapers FFG 1:	4.24	1
% Collector-Filterers FFG 1:	7.88	5
% Sprawlers:	1.82	1
mIBI Metric	Score	: 42

НВІ	4.44
Shannon-Weaver Index	3
Shannon Equitability	0.84
% Dominant 3 Taxon	36.36
% Chironomidae	40.61



Residuals			
Identifier	Date	Count	%PSE



Warning: Macro Data	is not finalized (stat	us is not "Appro	oved"); IBI so	cores may not be fin	al.		
Site Name	EPA ID	Macro Sam	ple Type	Sample #	Macro Event #	sample Date	County
WEM-07-0015	21T-005	MHA	B	AB47657	210824703	8/24/21	Jackson
	Stream Name			Location		HUC 12	HUCTO14
John	McDonald Dite	h		CR 125 So	uth	051202070706	05120207090010
Northing	Eas	sting	Ecol	region	Gradient	Drainage Area	QHEI Score
4302210.85	6001	56.26	Ę	55	2.349	4.799	42

TAXON	COUNT	NOTES	HBI Tolerance
1233 (Erpobdellidae)	1		Torcranec
1089 (Helisoma)	3	immatures	6
1090 (Physa)	4	1 is very small	8
1000 (11)32)	-	and broken, can't	0
		find small one,	
		may have slipped	
		out of vial	
2181 (Sphaerium)	1		6
2162 (Pisidium)	1		6
9031 (Lirceus)	1		8
9036 (Caecidotea)	6		8
9050 (Hyalella)	13		
9056 (Crangonyx)	1		6
9016 (Faxonius sloanii)	1	male form 2	
3248 (Basiaeschna janata)	2		6
3251 (Nasiaeschna	1		
pentacantha)			
1021 (GOMPHIDAE)	2	poor condition	1
9351 (Phanogomphus)	3	middle sized	
		probably exilis,	
		smallest & largest	
		might be	
		graslinellus,	
		single S7 spinule	
		each	
1020 (LIBELLULIDAE)	1	IMM, poor	9
		condition, no	
		lateral spines,	
		sympetrum?	
3326 (Libellula cyanea)	1	probably not F-0	
7045 (Epitheca)	1		
1026 (COENAGRIONIDAE)	1	IMM, 1 mm length	9
3540 (Ischnura)	2	no gills, one with	9
		undeveloped gills	
		probably posita	
3546 (Enallagma)	15	no gills	9
3549 (Enallagma divagans)	41		
3552 (Enallagma signatum)	1		
1041 (CORIXIDAE)	3	IMM	5
7189 (Sigara)	4	IDed to	
		grossolineata,	
		leave at genus	

Туре	Value		<u>Metric</u> <u>Score</u>
Total Taxa:	46		5
Total No. Individuals:	162		3
EPT Taxa:	0		1
% Orthocladiinae + Tanytarsini of Chironomidae:	12.5		5
% Non-insects excluding Astacidae:	19.14		3
Diptera Taxa:	11		3
% Intolerant (0-3):	1.23		1
% Tolerant (8-10):	25.93		1
% Predators FFG 1:	55.56		5
% Shredders + Scrapers FFG 1:	6.17		1
% Collector-Filterers FFG 1:	3.09		5
% Sprawlers:	0		1
mIBI Metric	:	34	

Supplemental Metrics

HBI	6.81
Shannon-Weaver Index	3.12
Shannon Equitability	0.81
% Dominant 3 Taxon	42.59
% Chironomidae	14.81



TAXON	COUNT	NOTES	HBI Tolerance
		per Paul	
7201 (Trichocorixa calva)	7	4 male 3 female	4
7186 (Palmacorixa nana)	1	male	4
7225 (Notonecta irrorata)	2		
7230 (Neoplea striola)	1	head separated, but 1 individual	
3599 (Peltodytes dunavani)	1	female, Key was inconsistent and caused to ID to pedunculatus but Paul IDed to dunavani	
3602 (Peltodytes muticus)	1		
3729 (Neoporus clypealis)	2		
3828 (Dineutus)	1	female, Marissa thinks assimilis, Julien thinks hornii	4
1096 (SCIRTIDAE)	2		5
7300 (Dubiraphia vittata)	3	2 male, 1 female, 1 male penis mounted on slide M21-01.1, penis length: 265 um	
3773 (Sialis)	4		5
9370 (Ceratopogon grp.)	3		8
7929 (Clinotanypus pinguis)	6		8
9248 (Ablabesmyia Mallochi Gr.)	2		
9261 (Thienemannimyia Gr.)	1		
9284 (Tribelos jucundum)	1		
8086 (Chironomus)	3		8
8112 (Dicrotendipes)	1		6
8179 (Polypedilum)	1	pupa	
8241 (Tanytarsus)	3	1 pupa	4
8180 (Polypedilum tritum)	1		
9241 (Polypedilum Illinoense Gr.)	5		

Residuals

Identifier	Date	Count	%PSE
JMB	12/8/2021	18	88.89



Warning: Macro Data i	is not finalized (stat	us is not "Approv	ved"); IBI sc	ores may not be fin	al.		
Site Name	EPA ID	Macro Samp	le Type	Sample #	Macro Event #	# Sample Date	County
WEM-07-0014	21T-018	MHA	3	AB47670	210816904	8/16/21	Jennings
	Stream Name			Location	1	HUC 12	HUCTO14
S	Storm Creek			Base Roa	ad	051202070703	05120207080030
Northing	Eas	ting	Ecor	region	Gradient	Drainage Area	QHEI Score
4315612.51	6050	87.48	5	5	4.073	9.378	53

TAXON	COUNT	NOTES	HBI Tolerance
1090 (Physa)	1		8
2181 (Sphaerium)	5		6
9031 (Lirceus)	1		8
9056 (Crangonyx)	2		6
8996 (Faxonius)	2	females	4
9016 (Faxonius sloanii)	3	Form II males	
7011 (Acerpenna pygmaea)	6		2
9366 (Baetis intercalaris complex)	2	J21-007.2	3
1018 (LÉPTOPHLEBIIDAE)	1	imm. gills are filaments, maybe choroterpes basalis (gill 1 not forked)	2
3245 (Boyeria vinosa)	1		4
3248 (Basiaeschna janata)	6	one post molt	6
3251 (Nasiaeschna pentacantha)	1	big	
3116 (Progomphus obscurus)	1	big	
3448 (Somatochlora)	1	not mature	1
7026 (Calopteryx maculata)	3		
1026 (COENAGRIONIDAE)	1	small	9
3542 (Ischnura posita)	5	? 2 might be verticalis, outer bands obscure	
3546 (Enallagma)	1	no gills	9
3549 (Enallagma divagans)	6		
1038 (GERRIDAE)	1	imm. probably Rheumatobates/ Metrobates	
7122 (Microvelia)	1	(Kirkaldya) female, americana?	
1096 (SCIRTIDAE)	1		5
7300 (Dubiraphia vittata)	6	J21-007.1 ~285um aedaegus 2f 4m	
1057 (HYDROPSYCHIDAE)	1	imm.	4
3432 (Cheumatopsyche)	19		3
8980 (Hydropsyche betteni grp)	1		
1054 (HYDROPTILIDAE)	1	imm. maybe Hydropsychidae?	4
7723 (Dixella)	6		

Туре	Value	<u>Metric</u> <u>Score</u>
Total Taxa:	44	5
Total No. Individuals:	107	1
EPT Taxa:	7	3
% Orthocladiinae + Tanytarsini of Chironomidae:	15	5
% Non-insects excluding Astacidae:	8.41	5
Diptera Taxa:	17	5
% Intolerant (0-3):	28.04	3
% Tolerant (8-10):	3.74	5
% Predators FFG 1:	28.04	3
% Shredders + Scrapers FFG 1:	2.8	1
% Collector-Filterers FFG 1:	24.3	1
% Sprawlers:	1.87	1
mIBI Metric	Score:	38

Supplemental Metrics

HBI	4.19
Shannon-Weaver Index	3.32
Shannon Equitability	0.88
% Dominant 3 Taxon	28.97
% Chironomidae	18.69

2/9/2022 9:03:59 AM OWQ Biological Studies: MHAB Report, Page 1 of 2



TAXON	COUNT	NOTES	HBI Tolerance
7732 (Anopheles)	1		
7943 (Ablabesmyia)	1	pupa	5
9162 (Nilotanypus fimbriatus)	1		3
7984 (Procladius)	1		7
7926 (Tanypodinae)	1	pupa, maybe Larsia/Paramerin a	
9248 (Ablabesmyia Mallochi Gr.)	4		
9261 (Thienemannimyia Gr.)	2		
8006 (Orthocladiinae)	1	probably Corynoneura, no antennae	
8066 (Rheocricotopus)	1	robacki?	5
9296 (Microtendipes Pedellus Gr.)	1	pupa w/ head capsule of larva	
9335 (Paratendipes albimanus grp)	1		
8192 (Polypedilum flavum)	2		
9165 (Saetheria tylus)	1	?	4
8211 (Stictochironomus)	1		4
8228 (Cladotanytarsus)	1		4
9241 (Polypedilum Illinoense Gr.)	1		

Residuals

Identifier	Date	Count	%PSE
SEZ	10/1/2021	1	99.07



Warning: Macro Data i	s not finalized (stat	us is not "Approved"); IB	I scores may not be fi	nal.		
Site Name	EPA ID	Macro Sample Type	e Sample #	Macro Event #	sample Date	County
WEM070-0036	21T-023	MHAB	AB47675	210818702	8/18/21	Jennings
	Stream Name		Location	n	HUC 12	HUCTO14
Vernon Fo	rk Muscatatuc	k River	CR 400 W	/est	051202070701	05120207070020
Northing	Eas	sting E	coregion	Gradient	Drainage Area	QHEI Score
4312526.91	6139	44.76	55	1.437	218.283	62

TAXON	COUNT	NOTES	HBI
	0		Tolerance
2156 (Corbicula fluminea)	2		6
1083 (Acari)	1		4
3048 (Stenacron)	1		3
9366 (Baetis intercalaris	5	Slide S21-089.1	3
complex)			
9361 (Caenis Diminuta Gr.)	10		
3197 (Ephemera)	1	imm.	3
3109 (Isonychia)	5		2
3175 (Tricorythodes)	1		3
3099 (Hagenius brevistylus)	1	Photo taken, then released	1
9351 (Phanogomphus)	1	imm.	
9125 (Phanogomphus exilis)	1		
1020 (LIBELLULIDAE)	1	imm.	9
7027 (Hetaerina americana)	2		
1026 (COENAGRIONIDAE)	2	imm.	9
3546 (Enallagma)	8	imm./no gills	9
3549 (Enallagma divagans)	1	Ŭ	
7117 (Trepobates)	1	imm.	
7107 (Limnoporus canaliculatus)	1	Α	
3600 (Peltodytes	1	А	
duodecimpunctatus)			
3828 (Dineutus)	1		4
3846 (Berosus)	8	L	7
3851 (Berosus peregrinus)	1	А	6
3872 (Tropisternus)	8	L	
3959 (Helichus lithophilus)	1	A	
7317 (Stenelmis sexlineata)	8	A	
7295 (Ancyronyx variegatus)	1	Α	4
3799 (Corydalus cornutus)	3		2
3267 (Chimarra obscura)	29		4
1057 (HYDROPSYCHIDAE)	3	imm. / teneral	4
3432 (Cheumatopsyche)	57		3
3487 (Hydropsyche simulans)	8		2
3000 (Hydroptila)	3		3
7814 (Simulium)	2		5
9370 (Ceratopogon grp.)	4		8
7984 (Procladius)	12		7
9153 (Tribelos)	2		5
7926 (Tanypodinae)	1		<u> </u>
8083 (Chironomini)	3		
9248 (Ablabesmyia Mallochi Gr.)	10		

Туре	Value	<u>Metric</u> Score
Total Taxa:	52	5
Total No. Individuals:	322	5
EPT Taxa:	11	3
% Orthocladiinae + Tanytarsini of Chironomidae:	5.76	5
% Non-insects excluding Astacidae:	0.93	5
Diptera Taxa:	20	5
% Intolerant (0-3):	26.71	3
% Tolerant (8-10):	10.56	5
% Predators FFG 1:	14.29	1
% Shredders + Scrapers FFG 1:	4.04	1
% Collector-Filterers FFG 1:	32.3	1
% Sprawlers:	4.35	3
mIBI Metric	Score:	42

Supplemental Metrics

HBI	4.67
Shannon-Weaver Index	3.17
Shannon Equitability	0.8
% Dominant 3 Taxon	40.06
% Chironomidae	43.17



TAXON	COUNT	NOTES	HBI Tolerance
9250 (Ablabesmyia Rhamphae	1		
Gr.)			
9261 (Thienemannimyia Gr.)	9		
8023 (Cricotopus bicinctus)	2		7
8086 (Chironomus)	19		8
8099 (Cryptochironomus)	2		5
8112 (Dicrotendipes)	3		6
8126 (Glyptotendipes)	2		6
8179 (Polypedilum)	8		
8192 (Polypedilum flavum)	43		
8228 (Cladotanytarsus)	2		4
8238 (Rheotanytarsus)	1		3
8241 (Tanytarsus)	3		4
9241 (Polypedilum Illinoense	16		
Gr.)			

Residuals

Identifier Date Count %PSE				
	Identifier	Date	L'OUDT	%PSE



Warning: Macro Data	is not finalized (stat	us is not "Appro	ved"); IBI se	cores may not be fin	al.		
Site Name	EPA ID	Macro Samp	ole Type	Sample #	Macro Event	# Sample Date	County
WEM-07-0018	21T-020	MHA	В	AB47672	210818701	8/18/21	Jennings
	Stream Name			Location		HUC 12	HUCTO14
S	ixmile Creek			CR 200 So	uth	051202070702	05120207070060
Northing	Eas	ting	Eco	region	Gradient	Drainage Area	QHEI Score
4312478.94	6098	58.73	ļ	55	9.117	24.444	62

ΤΑΧΟΝ	COUNT	NOTES	HBI
			Tolerance
2156 (Corbicula fluminea)	1		6
8996 (Faxonius)	2	2F	4
1251 (ISOTOMIDAE)	1		
3048 (Stenacron)	1		3
1012 (BAETIDAÉ)	6	dmg.	4
9366 (Baetis intercalaris	15	S21-036.2 & .3	3
complex)			
9361 (Caenis Diminuta Gr.)	5		
3248 (Basiaeschna janata)	2		6
3099 (Hagenius brevistylus)	2	Photos taken,	1
	-	then released	
7046 (Epitheca princeps)	1		
3448 (Somatochlora)	3	imm.	1
7026 (Calopteryx maculata)	2		
1026 (COENAGRIONIDAE)	2	imm.	9
3546 (Enallagma)	10	no gills, imm.	9
3549 (Enallagma divagans)	4		
3568 (Argia)	3	no gills	5
9095 (Argia fumipennis)	3		
3572 (Argia tibialis)	1		
7122 (Microvelia)	3	3N	
7123 (Microvelia americana)	2	A (1M & 1F)	
3600 (Peltodytes	37	A	
duodecimpunctatus)			
3851 (Berosus peregrinus)	1	A	6
3959 (Helichus lithophilus)	1	A	
7293 (Psephenus herricki)	1	L	4
7317 (Stenelmis sexlineata)	1	A	
7300 (Dubiraphia vittata)	9	S21-036.1 (PL =	
		250 um); adults	
		(4M & 5F)	
7295 (Ancyronyx variegatus)	13	A	4
7321 (Macronychus glabratus)	6	A	3
3267 (Chimarra obscura)	8		4
1057 (HYDROPSYCHIDAE)	4	imm.	4
3432 (Cheumatopsyche)	24		3
3000 (Hydroptila)	1		3
7814 (Simulium)	3		5
7965 (Larsia)	1		4
7984 (Procladius)	1		7
7926 (Tanypodinae)	4	3L & 1P	
8083 (Chironomini)	1		

<u>Type</u>	<u>Value</u>		Metric Score
Total Taxa:	52		5
Total No. Individuals:	236		3
EPT Taxa:	8		5
% Orthocladiinae + Tanytarsini of Chironomidae:	12.28		5
% Non-insects excluding Astacidae:	0.42		5
Diptera Taxa:	20		5
% Intolerant (0-3):	23.73		3
% Tolerant (8-10):	5.08		5
% Predators FFG 1:	17.8		1
% Shredders + Scrapers FFG 1:	2.97		1
% Collector-Filterers FFG 1:	19.92		3
% Sprawlers:	2.54		1
mIBI Metric	Score	:	42

Supplemental Metrics

HBI	4.14
Shannon-Weaver Index	3.32
Shannon Equitability	0.84
% Dominant 3 Taxon	34.32
% Chironomidae	24.15



TAXON	COUNT	NOTES	HBI Tolerance
9248 (Ablabesmyia Mallochi Gr.)	4		
9250 (Ablabesmyia Rhamphae	1		
Gr.)			
9261 (Thienemannimyia Gr.)	6		
9284 (Tribelos jucundum)	1		
8099 (Cryptochironomus)	2		5
8112 (Dicrotendipes)	1		6
8126 (Glyptotendipes)	1		6
9296 (Microtendipes Pedellus	1		
Gr.)			
8179 (Polypedilum)	3		
8192 (Polypedilum flavum)	3		
8238 (Rheotanytarsus)	4		3
8241 (Tanytarsus)	2		4
8981 (Cricotopus/Orthocladius)	1		
9241 (Polypedilum Illinoense	20		
Gr.)			
8397 (Hemerodromia)	1		

Residuals

Identifier Date Count %PSE

APPENDIX C. FISH AND MACROINVERTEBRATE COMMUNITY QUALITATIVE HABITAT EVALUATION INDEX

	\mathbf{M}	OWQ B	Biologic	al Stu	<u>idies C</u>	<u> NEI (</u>	Qual	itativ	e Ha	bitat E	Evaluation	Index)
Sample #	QHEI Type	bioSampl	le #	Stream N	lame				Locatio	on		
AB47674	Fish	21T022		Sixmile C	reek				CR 415	North		
Surveyor	Sample	Date C	ounty	Ма	acro Sample	е Туре		itat Came			QHEI Scor	'e: 55
CWY	8/16/21		ennings	N//			∞ пар	itat Comp	piete			
1-SUBST	RATE		Y Two substra						Ch	eck ONE (d	or 2 & average)	
BEST TYP	ES	ootiiniato ,o		•••	R TYPES				OF	RIGIN	QUALITY	
		TOTAL PO	OOL RIFFL	E		TOTAL	POOL	RIFFLE			SILT	
◊ ◊ Bldrs/Sl	labs (10)				rdpan (4)					stone (1)	Heavy (-2)	Substrate
◊ ◊ Boulder	rs (9)				tritus (3)		<u>x</u>		 ♦ Tills (♦ Wetla 		 Moderate (-1) ◊ Normal (0) 	
\diamond \diamond Cobble	(8)				ıck (2)				♦ Hardi		 Free (1) 	10
◊ ◊ Gravel ((7)				t (2)		x		♦ Sands ♦ Rip/R	stone (0)	EMBEDDEDNESS	
◊ ◊ Sand (6))	х	х	◇ ◇ Art	tificial (0)					strine (0)	 Extensive (-2) Moderate (-1) 	Maximum 20
* * Bedrock	• •	x	х		(Sc	ore natura	l substrate		♦ Shale	e (-1)	Normal (0)	
NUMBER C	OF BEST T	YPES:	◇ 4 or more			sludge	from poin	t-sources)		fines (-2)	◇ None (1)	
COMMENTS	S		♦ 3 or less (U)								
2-Moderate a amounts (e.g. water, or deep	mounts, but n	ot of highest oulders in de d, functional p	•	mall amoun er, large dia	nts of highest	quality; 3 -l at is stable	Highest qı , well dev	uality in mo	oderate o otwad in d	r greater leep / fast	AMOUI Check ONE (or 2	& average) 5 (11)
·	verhanging v	()		0 Rootv	• • •		_	ic macrop	•	•	* Sparse 5-<25%	()
2 Sh	allows (in sl	ow water) ((1)	0 Bould	lers (1)	1	Logs a	and wood	ly debris	, (1)	 Nearly absent 	.,
1 Ro	ootmats (1) S								-			Cover
											Maxii	mum 9 20
3-CHANN SINUOSITY ◇ High (4) ◇ Moderate ◇ Low (2) ◇ None (1) COMMENTS	(3)	HOLOGY DEVELOPM > Excellent > Good (5) > Fair (3) > Poor (1)	IENT	CHAI ◈ No ◇ Re ◇ Re	each categor NNELIZATIO ne (6) covered (4) covering (3 cent or no r	ON)	S * *	TABILITY High (3) Moderate Low (1)				annel imum 14 20
	EROSION king downstrea			Check	k ONE in eac	ch category	for EAC		•	ank & aver AIN QUAL	•	
0	ROSION	L			L	R		FLU				
L R	ite (2)		Wide >50m Moderate 10 Narrow 5-10 Very narrow None (0))-50m (3) m (2)	 ◇ ◇ ◇ ◇ ◇ 	Forest, S Shrub or Resident Fenced J Open Pa	Old field tial, Park basture (d (2) , New fiel 1)	.,	◇ ◇ Urb ◇ ◇ Min Indicate µ	nservation Tillage pan or Industrial (0 hing, construction predominant land use(m riparian.) (0)
COMMENTS	s	• •			v v	Open Fa	Sture/NO		')	puot rooi	i Rij	parian ximum 7 10
	-	ס מובבי ה	/RUN QU/									
MAXIMUM Check ONE (M DEPTH (ONLY!) (4) m (2) m (1))) (metric=0)	CH/ Check C Pool widtl Pool widtl	ANNEL WIDT DNE (or 2 & av ch > riffle wid ch = riffle wid ch < riffle wid	ΓΗ ^{/erage)} th (2) th (1)	 ◇ Torrenti ◇ Very Fa ◇ Fast (1) ◇ Moderation Indication 	Check ial (-1) st (1)	♦ Inter♦ Edd	apply v (1) rstitial (-1 rmittent (- ies (1)	-		CREATION POTE	ct tact on back) rrent
	-											12 5
RIF ◇ Best Area ◇ Best Area		ck ONE (<i>ONI</i>	areas must l ////) RUN DE Maximum > Maximum <	EPTH 50cm (2)	RIF ◇ Stable ◇ Mod. S		eck ONE SUBSTI ble, boul I. large g	(or 2 & ave RATE (der) (2) (ravel) (1)	erage) RIFFL	-	MBEDDEDNESS Riffi	l e/Run timum0
	, ···	u=U)			Unotat	(g. a toi) (Extensive	e (-1)	8
<u>6-GRADIE</u> (16.916 DRAINAGE (8.944 m	ft/mi) AREA		♦ Mode	low – Lov erate (6-10 – Very hig))`´		DOL: 40 RUN: 60		6 GLIDE			dient ^{mum} 10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES		
>85% - Open	Nuisance algae	◊ Public	◊ Private	◇ WWTP		♦ CSO	
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime	
^{>} 30%-<55%	◊ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◊ Landfill	◊ Industry	
^{>} 10%-<30%	Discoloration	◇ Spray		◇ Construction BMPs	◊ Sediment BMPs		
<10% - Closed	◊ Foam/Scum			◇ Logging	◇ Irrigation	♦ Cooling	
	◊ Oil sheen	Leveed – One side	ded	♦ Bank Erosion ♦ Surface Eros		♦ H2O table	
	◇ Trash/Litter	◇ Leveed – Both Banks					
Canopy Upstream Reading		◇ Moving – Bedload		◇ False bank	♦ Manure	♦ Lagoon	
		Stable - Bedload					
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow	
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow	
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	Quarry Mine	◇ Golf	♦ Home	
7 Middle		Impounded	Desiccated	◇ Park	Oata Paucity	♦ Lawn	
		Flood Control	Orainage	◇ Agriculture	Livestock		
		Snag Removed		Atmosphere			
		Snag Modified		Deposition			
Left							

	TY I	<u>OWQ Bi</u>	ological	<u>Studies Q</u>	HEI (Qual	itativ	<u>e Hab</u>	oitat E	Evaluation I	ndex)
Sample #	QHEI Type	bioSample	# Stre	am Name				Location	า		
AB47671	Fish	21T019	Sixm	nile Creek				CR 500	South		
Surveyor	Sample	e Date Cou	unty	Macro Sample	Туре	A Hob	itat Comp	ploto		QHEI Score) : 49
CWY	8/16/21		nings	N/A		· nau	niai Comp	piete			43
<u>1-SUBST</u>	RATE		Two substrate T' r note every type					Che	ck ONE (or 2 & average)	
BEST TYP	PES			THER TYPES				OR	IGIN	QUALITY	
		TOTAL PO	OL RIFFLE		TOTAL	POOL	RIFFLE			SILT	
◊ ◊ Bldrs/S	Slabs (10)		◇	Hardpan (4)				♦ Limest		Heavy (-2)	Substrate
◊ ◊ Boulde	ers (9)		◇	Oetritus (3)		x		 ♦ Tills (1 ♦ Wetlan) ds (0)	 Moderate (-1) ◇ Normal (0) 	_
\diamond \diamond Cobble	e (8)		◇	Muck (2)		x		♦ Hardpa	an (0)	Free (1)	7
$\diamond \diamond$ Gravel	(7)	·	<u>×</u>	◇ Silt (2)		x		♦ Sands ♦ Rip/Ra		EMBEDDEDNESS ◇ Extensive (-2)	
◊ ♦ Sand (6)	6)	<u> </u>	<u>×</u>	Artificial (0)				♦ Lacust	rine (0)	Moderate (-1)	Maximum 20
◊ ◊ Bedroc				(Sco	ore natura	I substrat	es; ignore	◇ Shale◇ Coal fi		◇ Normal (0) ◇ None (1)	
NUMBER	OF BEST T		4 or more (2)		sludge	from poin	nt-sources)		nes (-z)	· None (1)	
COMMENT	ſS	Ň	[,] 3 or less (0)								
2-INSTRE	EAM COVE	ER Indicate pr	esence 0 to 3: 0-A	bsent; 1 -Very smal	II amounts	s or if mor	e common	of margina	al quality;	AMOUN	т
2-Moderate a	amounts, but r	not of highest q	uality or in small a	mounts of highest of diameter log that	quality; 3-	Highest q	uality in mo	oderate or	greater	Check ONE (or 2 &	-
		d, functional po		ge diameter log tha		, wen dev	eloped 100	Jiwau ili ue	ep / last	♦ Extensive >75%	(11)
	ndercut bank	.,		Pools > 70cm (2)	1	_	vs, Backw	• • •		* Moderate 25-75%	5 (7)
		vegetation (1)		Rootwads (1)	<u> </u>		ic macrop	• • • •		* Sparse 5-<25% (3	•
	hallows (in sl ootmats (1)	low water) (1)	<u> </u>	Boulders (1)	2	_Logs a	and wood	ly debris	(1)	♦ Nearly absent <5	% (1)
COMMENT										Co Maxim	
2 CHANK		HOLOGY	Chook O	NE in each category	100028	avorago)					20
SINUOSITY	(e (3)	DEVELOPME	NT ')	CHANNELIZATIC ◇ None (6) ◇ Recovered (4) ◇ Recovering (3) ◇ Recent or no re	N	S	TABILITY High (3) Moderate Low (1)			Cha r Maxin	
	-										
	EROSION	<u> & RIPARI</u>		Check ONE in each	n category	/ for EAC					
•	EROSION	LR	RIPARIAN WI		र		FLU	OOD PLA		11 T	
L R ◇ ◇ None c ◇ ◇ Modera ◇ ◇ Heavy/	ate (2)	◇ ◇ N ◇ ◇ N ◆ ◇ V	Vide >50m (4) Noderate 10-50n Iarrow 5-10m (2 Yery narrow <5n Ione (0)	n (3)	Shrub o Residen Fenced	pasture (d (2) k, New fiel		◇ ◇ Urb ◇ ◇ Mir Indicate))
COMMENT	ſS									Maxi	10
<u>5-POOL/</u>	<u>GLIDE AN</u>	D RIFFLE/	<u>RUN QUALIT</u>	<u>.</u>				-			
MAXIMU Check ONE > 1m (6) * 0.7-<1m * 0.4-<0.7 * 0.2-<0.4 * <0.2m (0 COMMENT	n (4) 7m (2) Im (1) 0) _(metric=0)	Check ON * Pool width * Pool width	NNEL WIDTH IE (or 2 & average > riffle width (2) = riffle width (1) < riffle width (0))	Check al (-1) st (1) e (1)	◇ Inter ◇ Edd	apply			CREATION POTEN	t ct back) rent um 9
Indicate for	r functional r	iffles: Best a	reas must be la	rge enough to su	pport a r	opulatio	on of riffle	-obligate	species	:	12
RII ◇ Best Area ◇ Best Area ◇ Best Area	Che FFLE DEPTH as >10cm (2) as 5-10cm (1 as <5cm _{(metri}	ck ONE (ONL) I ○ ◇ N) ◇ N		RIFI (2) ◇ Stable (Ch FLE/RUN (e.g. cob table (e.g	eck ONE I SUBSTI ble, boul g. large g	(or 2 & ave RATE Ider) (2) Jravel) (1)	erage) RIFFLE ◇ N ◇ L ◇ N	-	MBEDDEDNESS Riffle (0)	/Run
6-GRADI											
(2.423 f DRAINAGE (30.679	ft/mi) E AREA		 ⊗ Very low - ◇ Moderate ◇ High – Ve 			DOL: 25 RUN: 60		6 GLIDE:		Grad Maxim	



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
× 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
^{>} 30%-<55%	◊ Excess turbidity	 Young – Success Old - Succession 		◇ Contaminated	◊ Landfill	◇ Industry
^{>} 10%-<30%	Discoloration	◇ Spray		◇ Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	◊ Bank Erosion ◊ Surface Erosion ◊ H2C		♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedload		◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	Islands	♦ Scoured	◊ Acid Mine	◊ Wetlands	Stagnant Flow
	♦ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	♦ Golf	◇ Home
95 Midd	e	Impounded	Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

		OWQ Bio	logical Stu	udies QHI	EI (Qual	itative	e Habitat E	Evaluation	Index)
Sample #	QHEI Type	bioSample #	Stream N	lame			Location		
AB47672	Fish	21T020	Sixmile C	reek			CR 200 South		
Surveyor	Sample	Date Coun	ty Ma	acro Sample Typ)e ────────────────────────────────────	itat Comp	loto	QHEI Score	e: 62
CWY	8/18/21	Jennir	-		1100				02
<u>1-SUBST</u>	RATE		vo substrate TYPE E ote every type prese				Check ONE (or 2 & average)	
BEST TYP	PES		OTHE	R TYPES			ORIGIN	QUALITY	
		TOTAL POOL			TAL POOL	RIFFLE		SILT	Substrate
◊ ◊ Bldrs/S	. ,			rdpan (4)	<u>x</u>		Limestone (1) Tills (1)	 ◇ Heavy (-2) ◇ Moderate (-1) 	Substrate
◊ ◊ Boulde				tritus (3)	^		Wetlands (0)	Normal (0)	14
		<u>x</u>	◇ ◇ Mu X ◇ ◇ Sil	.,	<u>x</u>		 Hardpan (0) Sandstone (0) 	Free (1) EMBEDDEDNESS	1-1
◊ ♦ Gravel		x			<u> </u>		◇ Rip/Rap (0) `́	 Extensive (-2) 	Maximum
	-	^	_ <u>* </u> * * Ar	tificial (0)	^		 Lacustrine (0) Shale (-1) 	◇ Moderate (-1)	20
◇ ◇ Bedroc NUMBER (نة (ع) OF BEST T۱	(PFS: ◇ 4	or more (2)	·	atural substrat udge from poir	es, ignore	 Coal fines (-2) 	 None (1) 	
COMMENT			or less (0)	5		1 3001003)			
			ence 0 to 3: 0-Absen					AMOUN	т
2-Moderate a amounts (e.c.	amounts, but no	ot of highest qual	ity or in small amour r fast water, large dia	nts of highest quali ameter log that is s	ty; 3 -Highest q	uality in mo eloped root	derate or greater wad in deep / fast	Check ONE (or 2 &	& average)
water, or dee	ep, well-defined	l, functional pools	S.					◊ Extensive >75%	(11)
	ndercut banks	.,		s > 70cm (2)	0 Oxbov			* Moderate 25-75%	.,
	verhanging ve nallows (in slo		<u>1</u> Root 0 Bould	wads (1)	_ <u> </u>	ic macrop	nytes (1) / debris (1)	 Sparse 5-<25% (Nearly absent < 	
	ootmats (1)				_ <u> </u>				576(1)
COMMENT	S							Co Maxim	
3-CHANN			Check ONE in	each category (Or	r 2 & average)				20
SINUOSITY		DEVELOPMENT		NNELIZATION		TABILITY			
High (4)Moderate		Excellent (7)		one (6)		High (3) Moderate	(2)	Chai	nnel
 Moderate Low (2) 	• •	 Good (5) Fair (3) 		covered (4) covering (3)		Low (1)	(2)	Maxin	
◇ None (1)		Poor (1)	◇ Re	cent or no recov	very (1)				20
COMMENT									
		& RIPARIAN			egory for EAC	`	or 2 per bank & ave	0,	
-	oking downstrear EROSION	L R	RIPARIAN WIDTH	LR		FLO	OD PLAIN QUAL	.ITY	
	vr little (2)	♦ ♦ Wic	le >50m (4)	♦ ♦ Fore	est, Swamp (◊ ◊ Cor	nservation Tillage (,
◇ ◇ None o ◇ ◇ Modera	• • •		derate 10-50m (3) row 5-10m (2)		ub or Old fiel			ban or Industrial (0) hing, construction (
◊ ◊ Heavy/		♦ ♦ Ver	y narrow <5m (1)	◇ ◇ Fen	ced pasture ((1)	Indicate	predominant land use(s	•
		◇ ◇ Nor	ne (0)	♦ ♦ Ope	en Pasture/Ro	owcrop (0)	past 100		arian
COMMENT	S							IVIAX	imum 3 10
5-POOL/	GLIDE AND	D RIFFLE/RU	<u>JN QUALITY</u>						
-		-					RF	CREATION POTEN	TIAL
Check ONE		Pool width >	(or 2 & average) riffle width (2)	CI	heck ALL that a 1)			Primary Contac	
♦ 0.7-<1m	• •	Pool width =	• • •	◊ Very Fast (1)		rstitial (-1)		Secondary Conta	nct
◇ 0.4-<0.7 ◇ 0.2-<0.4		Pool width <	riffle width (0)	 Fast (1) Moderate (1) 		rmittent (-: ies (1)	2) (circ	cle one and comment or	n back)
◇ <0.2m (0	0) _(metric=0)			• • •	reach – pools a	• • •		Pool/Cur	
COMMENT	S							Maxim	num 7 12
Indicate for	r functional ri	ffles; Best area	is must be large e	nough to suppo	rt a populatio	on of riffle-	obligate species	: ◇ <u>No Riffle (</u>	metric=0)
		k ONE (ONLY!)		סובבו בי		•	0,		
	FFLE DEPTH as >10cm (2)	♦ Max	RUN DEPTH timum >50cm (2)	KIFFLE/ Stable (e.g.	RUN SUBST		× None (2)	MBEDDEDNESS	
	as 5-10cm (1) as <5cm _{(metric}		kimum <50cm (1)	 ♦ Mod. Stable ♦ Unstable (e 	e (e.g. large g	ravel) (1)	 ♦ Low (1) ♦ Moderate ♦ Extension 	(0) Maxi	e/ Run mum 4 8
COMMENT	•						✓ ◇ Extensive	; (-1)	
6-GRADI									
(9.117 f	ft/mi)		◊ Very low – Lov		% POOL: 60	%	GLIDE: 0	Grad	
DRAINAGE (24.444			 Moderate (6-1) High – Very hi 	,	% RUN: 30	%	RIFFLE: 10	Maxin	num 10
,	,		J, II						L



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
× 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
[→] 30%-<55%	◇ Excess turbidity	 Young – Success Old - Succession 		◇ Contaminated	◇ Landfill	◇ Industry
× 10%-<30%	Discoloration	◇ Spray		◇ Construction BMPs	◊ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◇ Oil sheen	Leveed – One side	ded	♦ Bank Erosion ♦ Surface Erosion ♦ H2C		♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		◊ Moving – Bedload		◇ False bank	◊ False bank ◊ Manure	
		Stable - Bedload				
Right	Nuisance odor	Armoured	Slumps	◊ Wash H2O	◇ Tile	◇ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◊ Acid Mine	◊ Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
35 Middle	e	Impounded	Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

		WQ Biol	ogical Stu	idies QH	<u>IEI (</u>	Qual	itative	e Hal	<u>oitat E</u>	Evaluation	Index)
Sample #	QHEI Type	bioSample #	Stream N	ame				Locatio	n		
AB47670	Fish	21T018	Storm Cre	ek				Base Ro	bad		
Surveyor	Sample	Date County		cro Sample Ty	уре	« Нарі	itat Comp			QHEI Scor	'e: 61
KAG	8/16/21	Jenning						nele			01
<u>1-SUBSTR</u>	RATE	Check ONLY Two estimate % or no	substrate TYPE B te every type presented	OXES; nt				Che	eck ONE (d	or 2 & average)	
BEST TYPE	ES			R TYPES				OR	IGIN	QUALITY	
		TOTAL POOL	RIFFLE	т	OTAL	POOL	RIFFLE			SILT	.
◊ ◊ Bldrs/Sla	abs (10)	·		rdpan (4)				◇ Limes	tone (1)	 ◇ Heavy (-2) ◇ Moderate (-1) 	Substrate
◊ ◊ Boulders	• •		·	tritus (3)				 Wetla 		 Normal (0) 	14
◊ ◊ Cobble (♦ Hardp	an (0) stone (0)	◇ Free (1)	14
♦ ♦ Gravel (7)	-	<u> </u>				x		Sands A Rip/Raip		EMBEDDEDNESS	Maximum
♦ ♦ Sand (6)		X	× × Art	ificial (0)					trine (0)	◇ Moderate (-1)	20
	• •		(<u>a</u>)				s, ignore	 ◇ Shale ◇ Coal f 	(-1) ines (-2)	 Normal (0) ◇ None (1) 	
NUMBER O			or more (2) or less (0)	:	sludge f	rom poin	t-sources)		()		
COMMENTS											
2-Moderate ar amounts (e.g., water, or deep 2 Uno 1 Ove 1 Sha	mounts, but no , very large bo o, well-defined dercut banks erhanging ve allows (in sic	ot of highest qualit bulders in deep or , functional pools. s (1) egetation (1)	ice 0 to 3: 0 -Absent y or in small amoun fast water, large dia <u>2</u> Pools <u>1</u> Rootv <u>0</u> Bould	ts of highest qua imeter log that is > 70cm (2) vads (1)	ality; 3 -H s stable, 0 0	ighest qu well deve Oxbow Aquati	uality in mo	oderate or twad in d vaters (1 hytes (1	greater eep / fast	AMOUN Check ONE (or 2 Check ONE (or 2) Check O	& average) 6 (11) % (7) (3)
1 Roc COMMENTS	otmats (1)									С	over
										Maxir	mum 15 20
SINUOSITY	(3)	EVELOPMENT Excellent (7) Good (5) Fair (3) Poor (1)	 ◇ No ◇ Re ◇ Re 	NNELIZATION ne (6) covered (4) covering (3) cent or no reco	overy (*	 ♦ ♦ 	FABILITY High (3) Moderate Low (1)	e (2)			innel imum 20
4- BANK E		& RIPARIAN	ZONE Check	ONE in each c	ategory	for EACH	H BANK (C	Dr 2 per b	ank & avei	rage)	
River right look	king downstrear		IPARIAN WIDTH				FLO			ITY	
EF L R ◇ ◇ None or ◇ ◆ Moderat ◇ ◇ Heavy/S	te (2)	◇ ◇ Mode ◇ ◇ Narre	e >50m (4) erate 10-50m (3) ow 5-10m (2) narrow <5m (1) e (0)	◇ ◇ Sh ◇ ◇ Re ◇ ◇ Fe	nrub or esidenti enced p	asture (d (2) , New field	.,	◇ ◇ Urb ◇ ◇ Min Indicate µ) (0)
COMMENTS	;									, inclusion of the second se	10
5-POOL/G		RIFFLE/RU	N QUALITY								
MAXIMUM Check ONE ((* >1m (6) > 0.7-<1m (> 0.4-<0.7m > 0.2-<0.4m > <0.2m (0) COMMENTS	ONLY!) (4) ◇ n (2) ◇ n (1)) (metric=0)		ffle width (1)		Check A (-1) [1) 1)	◇ Inter◇ Eddi	opply (1) stitial (-1) mittent (-2 ies (1)			CREATION POTER	ct fact on back) rrent
Indicate for f	functional ri	ffles; Best areas	must be large er	nough to supp	ort a p	opulatio	n of riffle-	-obligate	e species	· · · No Riffle	
	Chec FLE DEPTH s >10cm (2) s 5-10cm (1) s <5cm _{(metric}	k ONE (<i>ONLY!</i>) ◈ Maxi ◇ Maxi	RUN DEPTH mum >50cm (2) mum <50cm (1)		Che E/RUN g. cobb ble (e.g.	ck ONE SUBSTF le, boul large g	(or 2 & ave RATE der) (2) ravel) (1)	erage) RIFFL ◇ ◇ ◇		MBEDDEDNESS Riffl (0)	le/Run imum 8
6-GRADIE											
(4.073 ft/ DRAINAGE / (9.378 m	/mi) AREA		 ◊ Very low – Low ◊ Moderate (6-10 ◊ High – Very hig)`´		OL: 40 UN: 50		GLIDE: RIFFLE:		Gra Maxi	dient ^{mum} 6 10



Pool depth >3ft

A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
[⊳] >85% - Open	Vuisance algae	◊ Public	◊ Private	◇ WWTP		♦ CSO
◇ 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
◇ 30%-<55%	◇ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
◇ 10%-<30%	Oiscoloration	◊ Spray		◇ Construction BMPs	♦ Sediment BMPs	
[◈] <10% - Closed	◊ Foam/Scum			◇ Logging	◇ Irrigation	Cooling
	◊ Oil sheen	A Leveed – One side	ded	◇ Bank Erosion	♦ H2O table	
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		◇ Moving – Bedload		◇ False bank	♦ Manure	Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	Quarry Mine	◊ Golf	◇ Home
4 Middle	9	Impounded	Desiccated	◇ Park	Oata Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

	$\overline{\mathbf{M}}$	DWQ Bio	logical Stu	udies QH	<u>EI (</u>	Qual	itativ	e Ha	bitat E	Evaluation	Index)
Sample #	QHEI Type	bioSample #	Stream N	lame				Locatio	on		
AB47661	Fish	21T009	Vernon F	ork Muscatatuck	River			US 31			
Surveyor	Sample	Date Count	iy Ma	acro Sample Ty	ре	≜ II-b	itet Comm			QHEI Score	e: 70
SLS	8/18/21	Jackso				∞ нар	itat Comp	Diete			70
<u>1-SUBST</u>	RATE		ro substrate TYPE E ote every type prese					Ch	eck ONE (d	or 2 & average)	
BEST TYP	PES			R TYPES				OF	RIGIN	QUALITY	
		TOTAL POOL	RIFFLE	т	OTAL	POOL	RIFFLE			SILT	
◊ ◊ Bldrs/S	Slabs (10)			rdpan (4) 🛛					stone (1)	Heavy (-2)	Substrate
◊ ◊ Boulde	ers (9)		<u>x</u>	tritus (3)		х		◇ Tills (◇ Wetla	1) nds (0)	◇ Moderate (-1)	_
\diamond \diamond Cobble	e (8)		<u>x</u>	ıck (2)				♦ Hard	oan (0)	 Free (1) 	7
$\diamond \diamond \textbf{Gravel}$	(7)	<u> </u>	_ <u>×</u> _	t (2)	·	х		 Sand: Rip/R 	stone (0)	EMBEDDEDNESS	
◊ ◊ Sand (6)	6)	<u>x</u>		tificial (0)			Х	♦ Lacus	strine (0)	◊ Moderate (-1)	Maximum 20
* Bedroc	• •	x		(Score	natural	substrate	es; ignore	* Shale	e (-1) fines (-2)	 Normal (0) None (1) 	
NUMBER	OF BEST T		or more (2) or less (0)	S	sludge f	rom poin	t-sources)		iiies (-2)	• None (1)	
COMMENT	ſS	~ 3	or less (0)								
			ence 0 to 3: 0- Absen							AMOUN	т
amounts (e.g	g., very large bo	oulders in deep o	ity or in small amour r fast water, large dia							Check ONE (or 2 8	• •
	ep, well-defined ndercut bank	l, functional pools		> 70 om (2)	0	Ovhou	vs, Backw	votoro (1	、	♦ Extensive >75%	
	verhanging v	.,		s > 70cm (2) wads (1)		-	ic macrop	•	,	 Moderate 25-75% Sparse 5-<25% (3) 	.,
	hallows (in slo			ders (1)			and wood	• •	•	 Nearly absent <5 	
	ootmats (1)								()	·····,	
COMMENT	ſS									Co Maxim	over num 15
3-CHANN	NEL MORP	HOLOGY	Check ONE in	each category (C)r 2 & a	verage)					
SINUOSITY		DEVELOPMENT	-	NNELIZATION		-	TABILITY	,			
 High (4) Moderate 		Excellent (7) Good (5)		ne (6) covered (4)			High (3) Moderate	e (2)		Char	
* Low (2)	<	> Fair (3)	◇ Re	covering (3)		\diamond	Low (1)	-)		Maxin	num 16 20
◇ None (1) COMMENT		Poor (1)	◇ Re	cent or no reco	overy (1)					
-	EROSION	& RIPARIAN	I <u>ZONE</u> Chec RIPARIAN WIDTH	k ONE in each ca	ategory	for EAC		•	ank & avei	0 /	
0	EROSION	LR		LR			FLU				
L R ♦ ♦ None c	or little (3)		le >50m (4) derate 10-50m (3)	 ◇ ◇ For ◇ ◇ Shi 						nservation Tillage (an or Industrial (0)	
◊ ◊ Modera	• • •		row 5-10m (2)				a (2) a, New fiel	ld (1)		ning, construction (
◊ ♦ Heavy/	/Severe (1)		y narrow $<5m(1)$	◇ ◇ Fer	•	•		、		predominant land use(s m riparian.	
		◇	ie (0)	~	en Pas	sture/Ro	wcrop (0))	past root	RIP	arian imum 7
COMMENT	rs									THE A	10
5-POOL/	GLIDE ANI	D RIFFLE/RU	IN QUALITY								YB
MAXIMU Check ONE		-	EL WIDTH (or 2 & average)			IT VELC			RE	CREATION POTEN	TIAL
* >1m (6)		Pool width > r		♦ Torrential (-		Slov	v (1)			◊ Primary Contac	t
◇ 0.7-<1m	• •	Pool width = r	• • •	 Very Fast (1 Fast (4) 	1)		rstitial (-1			Secondary Conta	nct
◇ 0.4-<0.7 ◇ 0.2-<0.4		Pool width < r	ime width (0)	 Fast (1) Moderate (1))	✓ Intel	rmittent (- ies (1)	-2)	(circ	le one and comment or	n back)
◇ <0.2m (0	0) (metric=0)			Indicate for			• •			Pool/Cur	
COMMENT	ſS									Maxim	12 12
Indicate for	r functional ri	ffles; Best area	s must be large e	nough to suppo	ort a po	opulatio	on of riffle	-obligat	e species	:	metric=0)
		ck ONE (ONLY!)					(or 2 & ave		E/DUN:		
	FFLE DEPTH as >10cm (2)		RUN DEPTH (imum >50cm (2)	* Stable (e.g		SUBSTI le, boul		\diamond	None (2)	MBEDDEDNESS	
♦ Best Area	as 5-10cm (1)	♦ Max	timum <50cm (1)	♦ Mod. Stabl	le (e.g.	large g	ravel) (1)	*	Low (1)	(n) Riffle	
♦ Best Area	as <5cm _{(metric}	:=0)		◊ Unstable (e.g. sa	nd, fine	gravel) (01	Moderate Extensive	(0)	8
COMMENT	ſS										
6-GRADI				(6.4)							,
(1.458) DRAINAGE			 Very low – Low Moderate (6-10) 	• •	% PO	OL: 40	%	6 GLIDE	: 0	Grac Maxin	
(292.07			◇ High – Very high	,	% RI	UN: 45	%	RIFFLE	: 15	maxin	10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
[⊳] >85% - Open	Vuisance algae	◇ Public	◇ Private	◊ WWTP		◇ CSO
[⊳] 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	◇ Dirt & Grime
30%-<55%	♦ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
○ 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◊ Foam/Scum			◇ Logging	Irrigation	♦ Cooling
	◊ Oil sheen	Leveed – One side	ded	♦ Bank Erosion ♦ Surface Erosion ♦ H2		♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		◇ Moving – Bedload		◊ False bank ◊ Manure		♦ Lagoon
		Stable - Bedload				
40 Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flov
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	♦ Home
45 Middle		Impounded	Desiccated	◇ Park	◊ Data Paucity	♦ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
15 Left						

DET OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index
--

Sample #	QHEI Type	bioSample #	Stream Na	ame			Location		
AB48619	Fish	21T022.5	Sixmile Cr	eek			CR 415 North		
Surveyor	Sample	Date County	Ma	cro Sample Typ	pe ────────────────────────────────────	itat Comp	lete	QHEI Score) : 74
KAG	9/9/21	Jennings			1100				
1-SUBST	<u>RATE</u>	Check ONLY Two estimate % or note	substrate TYPE B e every type preser				Check ONE (or 2 & average)	
BEST TYP	ES			R TYPES			ORIGIN	QUALITY	
		TOTAL POOL	RIFFLE	тс	DTAL POOL	RIFFLE		SILT	
◊ ◊ Bldrs/Sl	labs (10)			dpan (4)			Limestone (1)	Heavy (-2)	Substrate
◊ ◊ Boulder	rs (9)			ritus (3)	x		Tills (1)♦ Wetlands (0)	 ◇ Moderate (-1) ◇ Normal (0) 	
◊ ♦ Cobble	(8)	<u> </u>		ck (2)			 Wetlands (0) Hardpan (0) 	 Normal (0) Free (1) 	16
◊ ◊ Gravel (7)	x	x	(2)	x	X	Sandstone (0)	EMBEDDEDNESS	
)	x		ificial (0)	x		 Rip/Rap (0) Lacustrine (0) 	 ◇ Extensive (-2) ◇ Moderate (-1) 	Maximum
		<u> </u>	x	.,			♦ Shale (-1)	 Normal (0) 	20
	OF BEST TY	/PES: * 4 or	more (2)	•	natural substrate ludge from poin		◇ Coal fines (-2)	None (1)	
			less (0)		0 .				
COMMENTS	5								
2-INSTRE	AM COVE	R Indicate presend	ce 0 to 3: 0-Absent	; 1 -Very small am	nounts or if mor	e common	of marginal quality;	AMOUN	т
amounts (e.g. water, or deep	., very large bo	ot of highest quality oulders in deep or fa , functional pools.	ast water, large dia			eloped root	wad in deep / fast	Check ONE (or 2 &	(11)
	erhanging ve	., _		/ads (1)	0 Aquati		.,	 Sparse 5-<25% (3) 	
	allows (in slo		1 Bould	• •		-	/ debris (1)	 ◇ Nearly absent < 	
	otmats (1)	,			0	-			
COMMENTS	5							Co Maxim	over 15
								WIAXIII	um 15 20
3-CHANN	EL MORPI	HOLOGY	Check ONE in e	each category (O	r 2 & average)				
SINUOSITY		EVELOPMENT		NELIZATION		TABILITY			
 High (4) Moderate 		Excellent (7) Good (5)	◇ Nor ⊗ Rec	ne (6) covered (4)		High (3) Moderate	(2)	Chai	
 Low (2) 	• •	Fair (3)		covering (3)		Low (1)	(2)	Maxin	num 13 20
◊ None (1)		Poor (1)	◇ Rec	ent or no recov					20
COMMENTS	5								
<u>4- BANK </u>	EROSION	& RIPARIAN 2	ZONE Check	ONE in each cat	tegory for EAC	H BANK (C)r 2 per bank & ave	rage)	
-	king downstrear ROSION		PARIAN WIDTH			FLO	OD PLAIN QUAL	.ITY	
LR		L R ◇ ◇ Wide	>50m (4)	L R ◇	est, Swamp (3	3)	L R ◇ ◇ Coi	nservation Tillage (1)
* * None or		◊ ◊ Mode	rate 10-50m (3)	◇ ◇ Shr	ub or Old fiel	d (2)	◇ ◇ Urk	oan or Industrial (0)	
◇ ◇ Moderation ◇ ◇ Heavy/S			w 5-10m (2) narrow <5m (1)		sidential, Park Iced pasture (· · ·	ning, construction (predominant land use(s	•
		◇ ◇ None	• • •		en Pasture/Ro			m riparian.	arian
			. ,			• • • •			imum 7
COMMENTS	S								10
5-POOL/0	SLIDE AND	RIFFLE/RUN	<u>I QUALITY</u>						
MAXIMUN		CHANNEL					PE	CREATION POTEN	τιλι
Check ONE (Check ONE (or Pool width > riff	0,	C	heck ALL that a 1)			 Primary Contact 	
♦ 0.7-<1m		Pool width = riff	• •	◊ Very Fast (1)		rstitial (-1))	Secondary Conta	
◇ 0.4-<0.7n		Pool width < riff	le width (0)	◇ Fast (1)		rmittent (-:	2) (circ	cle one and comment or	back)
◇ 0.2-<0.4n ◇ <0.2m (0)	.,			Moderate (1) Indicate for) reach – pools a	• •		Pool/Cur	ront
COMMENTS					roadin poolo c			Maxim	um 7
Indicato for	functional rit	flos: Rost aroas	must be large on	ough to suppo	rt a nonulatio	n of rifflo	-obligate species		12
indicate for		k ONE (ONLY!)	indst be large en	lough to suppo	Check ONE		• •	◇ <u>No Riffle (</u>	<u>metric=0)</u>
RIF	FLE DEPTH	. ,	UN DEPTH	RIFFLE	RUN SUBSTI	•	0,	MBEDDEDNESS	
	is >10cm (2)		num >50cm (2)		. cobble, boul		◇ None (2)	Riffle	/Run
	ls 5-10cm (1) ls <5cm _{(metric}		1) num <50cm		e (e.g. large g e.g. sand, fine		♦ Low (1) ♦ Moderate	Mavi	mum 6
	-	=0)				- graver) (U	♦ Extensive	· · /	8
COMMENTS									
6-GRADIE		,	Vondend	(2.4)				-	— – –
(16.916) DRAINAGE			Very low – Low Moderate (6-10)		% POOL: 20	%	GLIDE: 0	Grac Maxin	
(8.944 n			High – Very hig	,	% RUN: 70	%	RIFFLE: 10		10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Vuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
[»] 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	◊ Sediment BMPs	
<10% - Closed	* Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	Output Bank Erosion	♦ Surface Erosion	◇ H2O table
	◇ Trash/Litter	♦ Leveed – Both Banks				
Canopy Upstream Reading		◊ Moving – Bedload		◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	◇ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
14 Middle	9	Impounded	Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) QHEI Type bioSample # Stream Name Location Sample # AB47662 Fish 21T010 Vernon Fork Muscatatuck River CR 50 North Sample Date Surveyor County Macro Sample Type QHEI Score: 57 * Habitat Complete KAG 8/30/21 Jackson N/A Check ONLY Two substrate TYPE BOXES; **1-SUBSTRATE** Check ONE (or 2 & average) estimate % or note every type present **BEST TYPES** OTHER TYPES ORIGIN QUALITY TOTAL POOL RIFFLE TOTAL POOL RIFFLE SILT Substrate ◊ ◊ Bldrs/Slabs (10) ◊ ◊ Hardpan (4) Х х Limestone (1) Heavy (-2) * Tills (1) ♦ Moderate (-1) ◊ ◊ Detritus (3) ♦ ♦ Boulders (9) Normal (0) Vetlands (0) 13 ◊ ◊ Cobble (8) ◊ ◊ Muck (2) Hardpan (0) Free (1) Sandstone (0) EMBEDDEDNESS ◊ ◊ Gravel (7) ◊ ◊ Silt (2) х х Rip/Rap (0) Extensive (-2) Maximum х х ◊ ◊ Artificial (0) х * * Sand (6) A Lacustrine (0) ◇ Moderate (-1) 20 (Score natural substrates; ignore \diamond Coal fines (-2) Normal (0) None (1) NUMBER OF BEST TYPES: ◊ 4 or more (2) sludge from point-sources) * 3 or less (0) COMMENTS 2-INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; AMOUNT 2-Moderate amounts, but not of highest guality or in small amounts of highest guality; 3-Highest guality in moderate or greater Check ONE (or 2 & average) amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast Extensive >75% (11) water, or deep, well-defined, functional pools. 1 Undercut banks (1) Pools > 70cm (2) 1 Oxbows, Backwaters (1) 1 * Moderate 25-75% (7) 0 Overhanging vegetation (1) 2 0 Rootwads (1) Aquatic macrophytes (1) Sparse 5-<25% (3) </p> 1 Shallows (in slow water) (1) 1 Boulders (1) 3 Logs and woody debris (1) Nearly absent <5% (1)</p> 2 Rootmats (1) Cover **COMMENTS** Maximum 14 20 3-CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average) STABILITY SINUOSITY DEVELOPMENT **CHANNELIZATION** Excellent (7) None (6) High (3) High (4) Channel Moderate (3) Recovered (4) Moderate (2) * Good (5) Maximum 11 Recovering (3) ◇ Low (2) Fair (3) * Low (1) 20 Poor (1) Recent or no recovery (1) None (1) COMMENTS **4- BANK EROSION & RIPARIAN ZONE** Check ONE in each category for EACH BANK (Or 2 per bank & average) River right looking downstream **RIPARIAN WIDTH** FLOOD PLAIN QUALITY EROSION LR LR LR LR ◊ ◊ Wide >50m (4) ◇ ◇ Forest, Swamp (3) ◊ ◊ Conservation Tillage (1) * * None or little (3) ◊ ◊ Moderate 10-50m (3) ◇ ◇ Shrub or Old field (2) ◊ ◊ Urban or Industrial (0) * * Moderate (2) ◊ ◊ Narrow 5-10m (2) ◊ ◊ Mining, construction (0) * * Very narrow <5m (1) </p> ◇ ◇ Fenced pasture (1) Indicate predominant land use(s) past 100m riparian. * * Open Pasture/Rowcrop (0) Riparian Maximum 4 COMMENTS 10 5-POOL/GLIDE AND RIFFLE/RUN QUALITY MAXIMUM DEPTH **CHANNEL WIDTH CURRENT VELOCITY RECREATION POTENTIAL** Check ONE (ONLY!) Check ONE (or 2 & average) Check ALL that apply * >1m (6) Pool width > riffle width (2) Torrential (-1) * Slow (1) Primary Contact * Pool width = riffle width (1) Very Fast (1) ◊ 0.7-<1m (4)</p> Interstitial (-1) * Secondary Contact ◇ 0.4-<0.7m (2) Pool width < riffle width (0)</p> ◇ Intermittent (-2) Fast (1) (circle one and comment on back) ◇ 0.2-<0.4m (1) Moderate (1) Eddies (1) Indicate for reach - pools and riffles. Pool/Current 9 COMMENTS Maximum 12 Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: * No Riffle (metric=0) Check ONE (ONLY!) Check ONE (or 2 & average) **RIFFLE DEPTH RUN DEPTH RIFFLE/RUN SUBSTRATE RIFFLE/RUN EMBEDDEDNESS** None (2) Sest Areas >10cm (2) Maximum >50cm (2) Stable (e.g. cobble, boulder) (2) Riffle/Run ◇ Low (1) Maximum <50cm (1)</p> Mod. Stable (e.g. large gravel) (1) Sest Areas 5-10cm (1) 0 Maximum Moderate (0) ◊ Best Areas <5cm_(metric=0) Unstable (e.g. sand, fine gravel) (0) 8 Extensive (-1) COMMENTS 6-GRADIENT (1.458 ft/mi) Very low – Low (2-4) % POOL: 40 % GLIDE: 0 Gradient ♦ Moderate (6-10) DRAINAGE AREA Maximum 6

6/8/2022 10:08:17 AM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index), Page 1 of 2

% RUN: 60

% RIFFLE: 0

High – Very high (10-6)

(364.501 mi²)

10



Pool area >100ft^2; Pool depth >3ft

A-CANOPY	B-AESTHETICS	<u>C-M</u>	AINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◇ Public	◇ Private	◊ WWTP		◇ CSO
[∞] 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
> 10%-<30%	Oiscoloration	◊ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◊ Foam/Scum			◇ Logging	Irrigation	Cooling
	◊ Oil sheen	Leveed – One sid	led	Sank Erosion	♦ Surface Erosion	♦ H2O table
	Trash/Litter	♦ Leveed – Both Banks				
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	Lagoon
		Stable - Bedload				
53 Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◇ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
91 Middle		Impounded	Desiccated	◇ Park	◊ Data Paucity	◇ Lawn
		Flood Control	◊ Drainage	◇ Agriculture	◇ Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
77 Left						

		WQ Biol	ogical Stu	dies QI	<u> 1EI (C</u>	Qualita	ative	Habitat E	Evaluation I	<u>ndex)</u>
Sample #	QHEI Type	bioSample #	Stream N	ame			L	ocation		
AB47675	Fish	21T023	Vernon Fo	ork Muscatatuc	k River		C	CR 400 West		
Surveyor	Sample			cro Sample T	уре	Habitat	Comple	ato .	QHEI Score	: 73
CWY	8/18/21	Jenning					Comple	ele		75
1-SUBST	RATE	Check ONLY Two estimate % or not	substrate TYPE B te every type present	OXES; nt				Check ONE (c	or 2 & average)	
BEST TYP	ES			RTYPES				ORIGIN	QUALITY	
		TOTAL POOL	RIFFLE	-	TOTAL F	OOL RI	FFLE		SILT	
◊ ◊ Bldrs/S	labs (10)		<u>x</u>	dpan (4)				Limestone (1)	 ◇ Heavy (-2) 	Substrate
◊ ◊ Boulde	rs (9)		◇ ◇ Det	ritus (3)	×			Tills (1)	♦ Moderate (-1)	
◊ ◊ Cobble	(8)			ck (2)	x	[Wetlands (0) Hardpan (0)	 Normal (0) ◇ Free (1) 	15
◊ ◊ Gravel	(7)		x	(2)	×	:	\diamond	Sandstone (0)	EMBEDDEDNESS	
* * Sand (6	.,	x		ificial (0)				Rip/Rap (0) Lacustrine (0)	◇ Extensive (-2)	Maximum
◊ ◊ Bedroc	-	x	x	• •			<u> </u>	Shale (-1)	◇ Moderate (-1) Normal (0)	20
	OF BEST TY	/PES: * 4 c	or more (2)	(Score		ubstrates; i om point-sc	ignore _🛇	Coal fines (-2)	◇ None (1) ´	
COMMENT			or less (0)		oluugo lii	, point of				
	-									
2-Moderate a amounts (e.g water, or dee 2 Ur 1 Ov 2 Sh	amounts, but no g., very large bo	ot of highest quality pulders in deep of , functional pools. s (1) egetation (1)	2 Rootv	ts of highest qu meter log that is > 70cm (2)	ality; 3 -Hi s stable, v <u>1</u> 0	ghest qualit vell develop Oxbows, Aquatic n	ty in mod bed rootw Backwa nacroph	erate or greater vad in deep / fast ters (1)	AMOUNT Check ONE (or 2 & > Extensive >75% (> Moderate 25-75% > Sparse 5-<25% (3 > Nearly absent <5%	average) 11) (7))
COMMENT									Co Maximu	<i>ver</i> ^{Im} 16 20
3-CHANN SINUOSITY High (4) Moderate Low (2) None (1) COMMENT	 ◇ ◇ ◇ ◇ ◇ 	HOLOGY EVELOPMENT Excellent (7) Good (5) Fair (3) Poor (1)	 ♦ Nor ♦ Rec ♦ Rec 	each category (NELIZATION ne (6) covered (4) covering (3) cent or no rec	I	STAI ◇ Hig ◈ Mo ◈ Lo	BILITY gh (3) oderate (w (1)	2)	Chan Maxim	
					otogonyf		ANKOr	2 par bank 8 aver	2000)	
	king downstrear	& RIPARIAN	IPARIAN WIDTH		Lategory it		-	2 per bank & aver	• ·	
	EROSION or little (3) ate (2)	L R ◇ ◇ Wide ◇ ◇ Mode ◇ ◇ Narro	e >50m (4) erate 10-50m (3) ow 5-10m (2) narrow <5m (1)	◇ ◇ SI ◈ ◇ Re ◇ ◇ Fe	esidentia enced pa	old field (2 II, Park, N	2) ew field	L R	nservation Tillage (1 an or Industrial (0) ing, construction (0 predominant land use(s) m riparian. Ripa) nrian
COMMENT	s								Maxii	num 4 10
5-POOL/0	GLIDE AND	RIFFLE/RUI	N QUALITY							I
MAXIMUI Check ONE (M DEPTH (ONLY!) (4) ◇ m (2) ◇ m (1)	CHANNE	EL WIDTH br 2 & average) ffle width (2) ffle width (1)	 ◇ Torrential ◇ Very Fast ◊ Fast (1) ◊ Moderate 	Check AL (-1) (1) (1)	T VELOCI L that appl ♦ Slow (1 ♦ Interstin ♦ Intermin ♦ Eddies	y) tial (-1) ttent (-2) (1)		CREATION POTENT	ct
◇ <0.2m (0 COMMENT)		lock @ large poo	l behind house	Indicate fo	or reach –	pools and	riffles.		Pool/Curr Maximu	
Indicate for	functional rit	ffles; Best areas	must be large er	ough to supp	port a po	pulation c	of riffle-c	bligate species:	◇ No Riffle (m)	
RII ◇ Best Area ◇ Best Area		k ONE (<i>ONLY!</i>) I ♦ Maxii ♦ Maxii	RUN DEPTH mum >50cm (2) mum <50cm (1)	• • • •	Chec E/RUN S .g. cobbl ble (e.g. l	k ONE (or UBSTRA e, boulder arge grav	2 & avera TE ') (2) 'el) (1)	age) RIFFLE/RUN EM ◇ None (2) ◇ Low (1) ◇ Moderate	ABEDDEDNESS Riffle (0)	(Run
							-	Extensive	(-1)	

COMME	NTS
-------	-----

6-GRADIENT				
(1.437 ft/mi) DRAINAGE AREA	♦ Very low – Low (2-4) ♦ Mederate (6, 10)	% POOL: 40	% GLIDE: 0	Gradient Maximum 6
(218.283 mi ²)	◇ Moderate (6-10) ◇ High – Very high (10-6)	% RUN: 35	% RIFFLE: 25	Maximum 6 10



Pool area >100ft^2; Pool depth >3ft

A-CANOPY	B-AESTHETICS	<u>C-M</u>	AINTENANCE		D-ISSUES	
◇ >85% - Open	Vuisance algae	◊ Public		◊ WWTP		♦ CSO
♦ 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
◇ 30%-<55%	♦ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
◇ 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
◇ <10% - Closed	◊ Foam/Scum			◇ Logging	Irrigation	♦ Cooling
	◊ Oil sheen	Leveed – One side	led	Output Series Bank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	Lagoon
		Stable - Bedload				
44 Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
76 Middle		Impounded	Desiccated	◇ Park	◊ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	◇ Livestock	
		Snag Removed		◇ Atmosphere		
		Snag Modified		Deposition		
74 Left						

OWQ Biological Studies QHEI	(Qualitative Habitat Evaluation Index)

Π

Sample #	QHEI Type	bioSample #	Stream N	ame		I	_ocation		
AB47659	Fish	21T007	Tea Creek	((CR 650 West		
Surveyor	Sample	Date County	Ma	cro Sample Typ	pe	itot Comul	.	QHEI Score	e: 49
CWY	8/17/21	Jenning	s N/A	A	* Hab	oitat Compl	ete		49
1-SUBST	RATE		substrate TYPE B				Check ONE (d	or 2 & average)	
BEST TYPE		estimate % or not	e every type prese				ORIGIN	QUALITY	
BLOTITI		TOTAL POOL	-	-			ONION	QUALITY	
◇ ◇ Bldrs/Sl	ahe (10)	IUTAL POOL		dpan (4)	TAL POOL		Limestana (1)	SILT	Substrate
				,			² Limestone (1) ² Tills (1)	 ◇ Heavy (-2) ◇ Moderate (-1) 	
◊ ◊ Boulder	.,			ritus (3)	^	·	Vetlands (0)	 Normal (0) 	13
◊ ◊ Cobble ((8)		◇	.,		¢	[•] Hardpan (0)	Free (1)	13
◊ ◊ Gravel (7)		x ◊ ◊ Silt	(2)	<u>x</u>	· 0	Sandstone (0) Rip/Rap (0)	EMBEDDEDNESS	
* * Sand (6)		x	x	ificial (0)			Lacustrine (0)	 Moderate (-1) 	Maximum 20
◊ ◊ Bedrock	c (5)			(Score r	natural substrat	¢	Shale (-1)	Normal (0)	20
NUMBER C		/PES: ◇ 4 o	r more (2)		ludge from poir	- ~	Coal fines (-2)	◊ None (1)	
			or less (0)						
COMMENTS	5								
2-INSTRE	AM COVE	R Indicate presen	ce 0 to 3: 0-Absent	• 1-Verv small am	nounts or if mor	e common o	f marginal guality.	AMOUN	
amounts (e.g. water, or deep 2 Une 0 Ove 1 Sha	., very large bo p, well-defined dercut banks erhanging ve allows (in slo	oulders in deep or f , functional pools. s (1)	v or in small amoun ast water, large dia 2 Pools 2 Rootw 0 Bould	meter log that is : > 70cm (2) vads (1)	stable, well dev	veloped rootv	vad in deep / fast nters (1) nytes (1)	Check ONE (or 2 & Check ONE (or 2 & Extensive >75% Moderate 25-75% Sparse 5-<25% (Nearly absent <	(11) % (7) 3)
	otmats (1)							0	
COMMENTS	5							Maxim	over num 11
									20
3-CHANN	EL MORPI	<u>HOLOGY</u>	Check ONE in e	each category (O	r 2 & average)				
SINUOSITY		EVELOPMENT		NELIZATION	-	TABILITY			
◇ High (4)◇ Moderate		Excellent (7) Good (5)		ne (6) covered (4)		High (3) Moderate	(2)	Chai	nnel
* Low (2)		Fair (3)		covering (3)		Low (1)	(2)	Maxin	num 9 20
◊ None (1)		Poor (1)		cent or no recov		()			20
COMMENTS	6								
4- BANK I	EROSION	& RIPARIAN	ZONE Check	ONE in each cat	tegory for EAC	H BANK (Or	2 per bank & aver	rage)	
	king downstrear		IPARIAN WIDTH			FLO	DD PLAIN QUAL	ITY	
	ROSION	LR		LR		-	LR		
L R ◇ ◇ None or	r little (3)		>50m (4)		est, Swamp (nservation Tillage (
* * Moderat	te (2)		erate 10-50m (3) ow 5-10m (2)		ub or Old fiel sidential, Park			oan or Industrial (0) hing, construction (
◊ ◊ Heavy/S			narrow <5m (1)		ced pasture (predominant land use(s	
		◊ ◊ None	(0)	♦ ♦ Ope	en Pasture/Ro	owcrop (0)	past 100i	m riparian. Rip	arian
									imum 4
COMMENTS									10
<u>5-POOL/G</u>	SLIDE AND	RIFFLE/RU	<u>N QUALITY</u>						
MAXIMUN		CHANNE	L WIDTH	cu	IRRENT VELO	OCITY			TIAL
Check ONE (Check ONE (c			heck ALL that a		RE	CREATION POTEN	
∛ >1m (6) ◇ 0.7-<1m (Pool width > rif Pool width = rif	• • •	 ◇ Torrential (-	,	w (1) rstitial (-1)		 Primary Contac Constant 	
◇ 0.4-<0.7n	• •	Pool width < rif	• • •	 very rast (1) ◇ Fast (1) 		rmittent (-2)	Secondary Conta	
◇ 0.2-<0.4n				 Moderate (1) 		lies (1)	(circ	le one and comment or	1 back)
◇ <0.2m (0)				Indicate for	reach – pools a	and riffles.		Pool/Cur	
COMMENTS	5							Maxim	12 Num
Indicate for	functional ri	ffles: Best areas	must be large er	ough to suppo	ort a populatio	on of riffle-	obligate species	* No Riffle (I	
		k ONE (ONLY!)		0		(or 2 & aver	• •		<u></u>
RIF	FLE DEPTH		RUN DEPTH	RIFFLE	RUN SUBST		RIFFLE/RUN EN	MBEDDEDNESS	
Or Best Area	• • •		mum >50cm (2)	Stable (e.g.			◇ None (2)	Riffle	e/Run
	s 5-10cm (1)		num <50cm (1)	◇ Mod. Stable			♦ Low (1)♦ Moderate	Mavi	mum 0
○ Best Area	s <5cm _{(metric}	=0)		◊ Unstable (e)	e.g. sand, fine	e gravel) (0)	 ◇ Moderate ◇ Extensive 		8
COMMENTS	<u> </u>							· ·	
6-GRADIE	ENT								
(2.676 ft			♦ Very low – Low		% POOL: 70	%	GLIDE: 0	Grad	dient
DRÀINAGE			Moderate (6-10)				Maxin	num 4
(10.632	mı²)		High – Very high	jn (10-6)	% RUN: 30	% R	RIFFLE: 0		10



depth>3 ft; isolated pools

A-CANOPY	B-AESTHETICS	<u>C-M</u>	AINTENANCE		D-ISSUES	
♦ >85% - Open	Nuisance algae	◇ Public	◇ Private	◊ WWTP		◇ CSO
◇ 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
◇ 30%-<55%	♦ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
◇ 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
◇ <10% - Closed	◊ Foam/Scum			◇ Logging	Irrigation	Cooling
	◊ Oil sheen	Leveed – One side	led	Sank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	◇ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
100 Middle		Impounded	Desiccated	◇ Park	◊ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	◇ Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

БЗ	\mathbf{M}	OWQ Biol	ogical Studies	QHEI (Qualitative	Habitat Evalua	<u>tion Index)</u>
Comple #		hioComple#	Ctroom Nomo		eastion	

Sample #	QHEI Type	bioSample #	Strea	am Name				Location			
AB48036	Fish	21T018.5	Storn	n Creek				Base Road			
Surveyor	Sample	Date Count	у	Macro Sample	Туре	ŵ Uch	oitat Com	nloto		QHEI Sco	re: 51
KRW	9/9/21	Jennin	0	N/A			onat Com	piete			51
1-SUBSTR	RATE	Check ONLY Tw estimate % or no						Check	ONE (o	r 2 & average)	
BEST TYPE		estimate % of hi						ORIG	IN	QUALITY	
		TOTAL POOL	-		τοται	POOL	RIFFLE				
◇ ◇ Bldrs/Sl	abs (10)	IOTAL FOOL		> Hardpan (4)	IUIAL	FOOL		_ ◇ Limestor	ר) מ ר	SILT ◇ Heavy (-2)	Substrate
♦ ♦ Boulder:	. ,			> Detritus (3)		x		* Tills (1)		 Moderate (-1) 	
				• Muck (2)				♦ Wetlands	• •	Normal (0)	13
◊ ◊ Cobble (x				x	x	 Hardpan Sandstor 		◇ Free (1) EMBEDDEDNESS	
◊ ◊ Gravel ()				○ Silt (2)			^	 ◇ Rip/Rap 		 ◇ Extensive (-2) 	Maximum
* * Sand (6)		<u>x</u>	<u> </u>	Artificial (0)		x		♦ Lacustrii		◇ Moderate (-1)	20
				(Scc	ore natura	I substrat	es; ignore	◇ Shale (-1◇ Coal fine))s (-2)	 Normal (0) ◇ None (1) 	
NUMBER C	OF BEST TY	-	or more (2)		sludge	from poir	nt-sources)	· Obai mie	.3 (-2)		
COMMENTS		* 3	or less (0)								
		_									
				bsent; 1 -Very smal						AMOU	NT
				mounts of highest of ge diameter log tha						Check ONE (or 2	& average)
water, or deep	o, well-defined	, functional pools		-		,				Extensive >75%	a (11)
	dercut banks	.,		ools > 70cm (2)	0	Oxbov	ws, Backv	vaters (1)		Moderate 25-75	% (7)
	erhanging ve	• • • •		ootwads (1)	0	_	•	ohytes (1)		 Sparse 5-<25% 	.,
	allows (in slo	ow water) (1)	<u> </u>	oulders (1)	1	_ Logs a	and wood	ly debris (1)		Nearly absent	:5% (1)
	otmats (1)										Cover 🕅
COMMENTS	5									Maxi	
											20
<u>3-CHANN</u>	EL MORPI	HOLOGY	Check ON	IE in each category	(Or 2 &	average)					
SINUOSITY ◇ High (4)		EVELOPMENT Excellent (7)			N		TABILITY	/			
 ◇ Moderate 		Good (5)		None (6) Recovered (4)			High (3) Moderate	e (2)			annel
* Low (2)	• •	Fair (3)		Recovering (3)			Low (1)	- ()		Max	imum 12 20
◇ None (1)		Poor (1)	<	Recent or no re	ecovery	(1)					
COMMENTS											
<u>4- BANK I</u>	EROSION	<u>& RIPARIAN</u>	ZONE	Check ONE in each	category	/ for EAC	H BANK (Or 2 per bank	k & aver	age)	
-	king downstrear	-	RIPARIAN WI				FLO	OOD PLAIN		ТҮ	
	ROSION	L R ∗ ◇ Wid	e >50m (4)	L F ♦ ◊		Swamp (3)		LR ∘◇Cor	servation Tillage	(1)
* * None or	• • •		derate 10-50m			r Old fiel				an or Industrial (0	• •
◇ ◇ Moderat ◇ ◇ Heavy/S			row 5-10m (2)				k, New fie	• •		ing, construction	. ,
	bevere (1)	◇ ∜ Ver ◇ ◇ Non	y narrow <5m			pasture (sture/Ro	(1) owcrop (0			redominant land use(n riparian.	
								,			parian ximum 6
COMMENTS	5										10
5-POOL/G		RIFFLE/RU		Y							II
MAXIMUN				-	CUPPE	NT VELO					
Check ONE (ONLY!)	Check ONE (or 2 & average			ALL that a	apply		RE	CREATION POTE	
◇ >1m (6)		Pool width > r	• • •		• •		• •			Primary Conta	
◇ 0.7-<1m (◇ 0.4-<0.7n		Pool width = r Pool width < r	• • •	•	t (1)		rstitial (-1 rmittent (-		<	Secondary Cont	tact
◇ 0.2-<0.4n				 Moderate 	∋ (1)		lies (1)		(circl	e one and comment of	on back)
◊ <0.2m (0)	(metric=0)			Indicate	for reach		and riffles.			Pool/Cu	
COMMENTS	3									Maxi	mum 6
Indicate for	functional rif	fles; Best area	s must be lar	ge enough to su	pport a p	oopulatio	on of riffle	e-obligate s	pecies:	◇ No Riffle	(metric=0)
		k ONE (ONLY!)		- '	••••••	•	(or 2 & av	•			<u></u>
	FLE DEPTH		RUN DEPTH			SUBST		-	-	IBEDDEDNESS	
♦ Best Areas ♦ Best Areas	s >10cm (2) s 5-10cm (1)		imum >50cm imum <50cm	• • • •					ne (2) v (1)		le/Run
	s <5cm _{(metric}			(1) ♦ Mod. St ♦ Unstabl				רא ∧ Mo	derate	(0)	kimum () 8
		-1				,	/ (♦ Ext	ensive	(-1)	-
6-GRADIE			◊ Very low -	- Low (2-4)	o/ =		-			-	
(4.073 ft DRAINAGE			✓ very low –		% P (OOL: 30	%	% GLIDE: 0			imum 6
(9.378 m				ry high (10-6)	% F	RUN: 60	%	RIFFLE: 10)		10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◊ WWTP		◇ CSO
◇ 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
◇ 30%-<55%	◇ Excess turbidity	 Young – Success Old - Succession 		◇ Contaminated	◊ Landfill	◇ Industry
10%-<30%	Discoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	Output Bank Erosion	♦ Surface Erosion	♦ H2O table
	Trash/Litter	◇ Leveed – Both Banks				
Canopy Upstream Reading		◊ Moving – Bedload		◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Righ	^t ◇ Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
11 Midd	le	Impounded	Desiccated	◇ Park	◊ Data Paucity	♦ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

Sample #	QHEI Type bioSample # St								Location			
AB47658	Fish	21T006	Теа	a Creek				CR 650	South			
Surveyor	Sample	Date Cou	unty	Macro Sample	Туре		itat Comp			QHEI Sco	re: 62	
CWY	8/16/21		nings	N/A		• Hab		hele			02	
<u>1-SUBSTF</u>	<u>RATE</u>	Check ONLY estimate % o	Two substrate 7 r note every type	TYPE BOXES; e present				Che	ck ONE (o	r 2 & average)		
BEST TYPE	ES			OTHER TYPES				OR	GIN	QUALITY		
◇ ◇ Bldrs/Sla		TOTAL POO		>	TOTAL	POOL	RIFFLE	* I :		SILT	Substrate	
				• • • •				 Limest Tills (1) 	• • •	 ♦ Heavy (-2) ♦ Moderate (-1) 		
◇ ◇ Boulders	.,			> < Detritus (3)			·	◊ Wetlan	ds (0)	Normal (0)	18	
◊ ♦ Cobble (<u>x</u>		> < Muck (2)	·	×		 Hardpa Sandst 		Free (1) EMBEDDEDNESS	10	
♦ ♦ Gravel (7	,			>		<u>x</u>		 Rip/Ra 		 Extensive (-2) 	Maximum	
◊ ◊ Sand (6)		<u> </u>		> <> Artificial (0)					rine (0)	◇ Moderate (-1)	20	
	.,		<u> </u>		ore natural		es; ignore	◇ Shale◇ Coal fi				
NUMBER O	F BESI II		4 or more (2) 3 or less (0)		sludge	from poin	it-sources)					
COMMENTS	;											
2-INSTRE		R Indicate pr	esence 0 to 3. 0	Absent; 1-Very sma	ll amounts	or if mor	e common	of margin	al quality:	AMOU		
2-Moderate ar amounts (e.g. water, or deep 0 Uno 0 Ove 1 Sha	nounts, but no , very large bo	ot of highest quo pulders in deep , functional po (1) (1) (1) (1)	uality or in small o or fast water, la ols. 0 1	amounts of highest arge diameter log tha Pools > 70cm (2) Rootwads (1) Boulders (1)	quality; 3 -h at is stable 1 0	Highest q , well dev _ Oxbov _ Aquati	uality in mo	oderate or twad in de vaters (1) ohytes (1)	greater ep / fast	Check ONE (or 2 ◇ Extensive >75% ◇ Moderate 25-75 ◇ Sparse 5-<25% ◇ Nearly absent	2 & average) % (11) 5% (7) (3)	
COMMENTS	;										Cover imum 8 20	
3-CHANN		HOLOGY	Check C	ONE in each categor	y (Or 2 & a	average)						
SINUOSITY		EVELOPME		CHANNELIZATIO		S	TABILITY					
◇ High (4) ♦ Mederate		Excellent (7	7)	* None (6)		۵ ۵	High (3)	(2)		Ch	annel	
 ♦ Moderate ♦ Low (2) 	• •	Good (5) Fair (3)		 Recovered (4) Recovering (3) 		* \$	Moderate Low (1)	÷(2)			imum 15 20	
◊ None (1)	\diamond	Poor (1)		♦ Recent or no r			()				20	
COMMENTS	;											
<u>4- BANK E</u>	ROSION	<u>& RIPARI</u>	<u>AN ZONE</u>	Check ONE in eac	h category	for EAC	H BANK (C	Or 2 per ba	nk & aver	age)		
River right look	ing downstrear ROSION		RIPARIAN W		-		FLC	DOD PLA		ТҮ		
LR		L R ∗ ◇ V	Vide >50m (4)	L ♦ ◊	R Forest, S	wamp (3)		L R ◇ ◇ Con	servation Tillage	: (1)	
◇ ◇ None or		◇ ◈ N	loderate 10-50	m (3) ◇ ◇	Shrub or	Old fiel	d (2)			an or Industrial (
♦ ♦ Moderat ♦ ♦ Moderat ♦ ♦ Heavy/S			arrow 5-10m (ery narrow <5		Resident Fenced p		(, New fiel (1)	d (1)		ing, construction predominant land use	• •	
			one (0)	• •	•		owcrop (0))	past 100n	n riparian.	iparian aximum 7	
COMMENTS	;									, with	10	
5-POOL/G		RIFFLE/F	RUN QUALI	TY							N	
MAXIMUM Check ONE ((> >1m (6) > 0.7-<1m (> 0.4-<0.7m > 0.2-<0.4m > <0.2m (0) COMMENTS	ONLY!) (4) ◇ n (2) ◇ n (1) (metric=0)	Check ON Pool width Pool width	NNEL WIDTH E (or 2 & averag > riffle width (; = riffle width (< riffle width (2) ◇ Torrentia 1) ◇ Very Fas 0) ◇ Fast (1) ◇ Moderat	al (-1) st (1)	ALL that a * Slow * Inter * Inter * Edd	apply v (1) rstitial (-1) rmittent (- ies (1)		<	CREATION POTE	act htact on back)	
Indicate for	functional rif	ffles; Best ar	eas must be la	arge enough to su	pport a p	opulatio	on of riffle	-obligate	species:	♦ No Riffle	(metric=0)	
		k ONE (<i>ONL</i> Y	,				(or 2 & ave	U /				
 Best Areas Best Areas Best Areas 	s 5-10cm (1) s <5cm _{(metric}	♦ M	RUN DEPT laximum >50cı laximum <50cı	m (2)	table (e.g	ble, boul . large g		◇ N ◇ L ○ N	CRUN EN lone (2) ow (1) loderate xtensive	(0) ^{Ma}	fle/Run ximum 0 8	
<u>6-GRADIE</u> (20.301 f DRAINAGE / (4.617 m	it/mi) AREA		Moderat A Moderat A	v – Low (2-4) e (6-10) ery high (10-6)		OOL: 10 20N: 90		GLIDE: RIFFLE:			adient ^{imum} 10 10	



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	◇ Nuisance algae	◊ Public	◇ Private	◊ WWTP		♦ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	◇ Dirt & Grime
> 30%-<55%	◊ Excess turbidity	◊ Young – Success ◊ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
^{>} 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	♦ Cooling
	◊ Oil sheen	Leveed – One side	ded	Output Bank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	Islands	♦ Scoured	♦ Acid Mine	Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◇ Quarry Mine	◊ Golf	♦ Home
9 Middl	e	Impounded	Desiccated	◇ Park	◊ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

				-				<u>[Qua</u>	Πατιν			Evaluatio		<u>lexj</u>
-	El Type		•		ream Na					Locati				
AB47664 Fish Surveyor	¹ Sample	21T012	County	IVI	utton Cre Mac	ro Sample				CR 40	0 North	QHEI So	oro:	
· · · · ·	8/17/21		Jackson	1	N/A	TO Campic	e Type		itat Com	plete			Lore.	47
1-SUBSTRAT	E	Check ON	ILY Two	substrate						CI	neck ONE (or 2 & average)		
BEST TYPES	-	estimate	% or not	e every typ							RIGIN	QUALIT	Y	
		TOTAL	POOL				ΤΟΤΑΙ	POOL	RIFFLE	•			-	
◊ ◊ Bldrs/Slabs	(10)				◇	dpan (4)		<u>x</u>		_	stone (1)	SILT ◇ Heavy (-2)	Si	ıbstrate
◊ ◊ Boulders (9)					◇ ◇ Detr	itus (3)				♦ Tills	(1)	♦ Moderate (
◇ ◇ Cobble (8)		<u> </u>				k (2)		x	х		ands (0) Ipan (0)	 ♦ Normal (0) ♦ Free (1) 		7
◇ ◇ Gravel (7)					◇ ◇ Silt ((2)		x	x		Istone (0)			
◇		:	х	x	◊ ◊ Artif	icial (0)				ORIP/I <	(0) strine (0)	 ♦ Extensive (♦ Moderate (· · · ·	aximum 20
◊ ◊ Bedrock (5)						(Sc	ore natura	al substrat	es; ignore	♦ Shal	e (-1)	Normal (0)		20
NUMBER OF B	EST T	PES:		r more (2))	,			nt-sources)		fines (-2)	◊ None (1)		
COMMENTS			⊗3 0	r less (0)										
	001/5	D												
2-INSTREAM 2-Moderate amount amounts (e.g., very water, or deep, we 0 Underc 0 Overha 0 Shallow 2 Rootma	nts, but no / large bo ll-defined ut banks nging vo /s (in slo	ot of highes oulders in c I, functiona s (1) egetation	st quality deep or fa al pools. (1)	or in smal ast water, 2 1	l amounts large dian	s of highest neter log th > 70cm (2) ads (1)	quality; 3 - at is stable <u> </u>	Highest q e, well dev Oxbov Aquat	uality in m	oderate otwad in waters (phytes (or greater deep / fast 1) 1)	AMG Check ONE (75% (11) 5-75% (7) 5% (3)	
COMMENTS												N	Cover Iaximum 20	14
<u>3-CHANNEL</u> SINUOSITY ◇ High (4) ◇ Moderate (3) ◇ Low (2) ◇ None (1) <i>COMMENTS</i>	C 0 0	DEVELOP > Exceller > Good (5 > Fair (3) > Poor (1)	MENT nt (7))	Check	CHAN ◇ Non ◇ Reco ◇ Reco	ach categor NELIZATIC e (6) overed (4) overing (3 ent or no r	ON)	S	TABILITY High (3) Moderat Low (1)				Channel Maximum 20	4
4- BANK ERC River right looking d EROS L R * * None or little * * Moderate (2) ◇ ◆ Heavy/Seven	ownstrea ION e (3))	m ♦ ♦ ♦	RI R ♦ Wide ♦ Mode ♦ Narro	PARIAN \ >50m (4) erate 10-5 w 5-10m narrow <	WIDTH 0m (3) (2)	L ♦ ♦ ○ ○ ○ ○	R Forest, S Shrub o Residen Fenced	Swamp (r Old fiel tial, Park pasture (FL 3) d (2) s, New fie	00D PL	◇ ◇ Urk ◇ ◇ Mir Indicate	0,	al (0) ion (0)	n
COMMENTS													Maximu 1	<i>n</i> 10 0
5-POOL/GLID	<u>e and</u>	<u>D RIFFL</u>	<u>E/RUN</u>	I QUAL	ITY									
MAXIMUM DE Check ONE (ONL)	Y!) 《 《		tONE (o dth > rif dth = rif	fle width	(2) (1) (0)	 ◇ Torrenti ◇ Very Fa ◇ Fast (1) ◇ Moderat Indicat 	Check ial (-1) st (1) te (1)	◇ Inte ◇ Edd	apply	(-2)			ontact Contact	.k) . 8
Indicate for func	tional ri	ffles; Bes	st areas	must be	large end	ough to su	upport a	populatio	on of riffle	e-obliga	te species	* <u>No Ri</u>	ffle (met	
RIFFLE Best Areas >1(Best Areas 5-1 Best Areas <50 COMMENTS	DEPTH 0cm (2) 0cm (1)		R Maxin ¢	RUN DEP1 num >50c num <50c	:m (2)	◇ Stable◇ Mod. S	FLE/RUN (e.g. cob stable (e.g	l SUBST ble, bou g. large g		ŘÍFF ◇ (0) ◇	LE/RUN EI None (2) Low (1) Moderate Extensive	(0)	Riffle/Ru Maximun	-
6-GRADIENT														
(2.112 ft/mi) DRAINAGE ARE (29.807 mi ²)	A		~	◊ Very lov◊ Modera◊ High – V	te (6-10)	. ,		DOL: 10 RUN: 0		% GLIDE 6 RIFFLE			Gradien Aaximum 1(4



OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some & COMMENT

Sheen and duckweed on surface of water; several beaver dams; Pool depth >3ft

A-CANOPY	B-AESTHETICS	<u>C-M</u>	AINTENANCE		D-ISSUES	
[⊳] >85% - Open	Vuisance algae	◇ Public	◇ Private	◇ WWTP		◇ CSO
55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	◇ Dirt & Grime
◇ 30%-<55%	◊ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
○ 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	◊ Sediment BMPs	
◇ <10% - Closed	◊ Foam/Scum			◇ Logging	Irrigation	Cooling
	Oil sheen	Leveed – One side	led	♦ Bank Erosion	Surface Erosion	♦ H2O table
	◊ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	Quarry Mine	◊ Golf	◇ Home
70 Middle		Impounded	Desiccated	◇ Park	◊ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	◇ Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

) =	$\overline{\mathbf{M}}$	OWQ B	Biologic	<u>al Stı</u>	udies Q	<u> HEI (</u>	Qual	litativ	<u>e Ha</u>	bitat E	Evaluation	<u>Index)</u>
Sample #	QHEI Type	bioSampl	le #	Stream N	lame				Locatio	on		
AB47665	Fish	21T013	1	Tributary	of Mutton Cr	eek			CR 700	North		
Surveyor	Sample	Date C	ounty	Ма	acro Sample	е Туре	ŵ ∐ab	oitat Comp	nloto		QHEI Scor	'e: 65
KAG	8/16/21		ackson	N/.			∛⊓ар	niai Comp	piete			05
1-SUBST	<u>RATE</u>	Check ONL estimate %	YTwo substra	te TYPE E	BOXES; ent				Ch	eck ONE (d	or 2 & average)	
BEST TYP	ES	oouniato ,o			R TYPES				OF	RIGIN	QUALITY	
		TOTAL PO	OOL RIFFLE	E		TOTAL	POOL	RIFFLE			SILT	
◇ ◇ Bldrs/Sl	labs (10)			_	rdpan (4)		x	X		stone (1)	Heavy (-2)	Substrate
◊ ◊ Boulder	rs (9)			_	tritus (3)				♦ Tills (♦ Wetla		 ◇ Moderate (-1) ◇ Normal (0) 	
◊ ◊ Cobble	(8)	<u>x</u>		_	ıck (2)					• • •	 Normal (0) ◇ Free (1) 	11
◊ ◊ Gravel ((7)	<u> </u>		_	t (2)		x	х		stone (0)	EMBEDDEDNESS	
)	х	х	◇ ◇ Art	tificial (0)		х	х	◇ Rip/R ◇ Lacus	ap (0) strine (0)	 ◇ Extensive (-2) ◇ Moderate (-1) 	Maximum 20
◊ ◊ Bedrock	k (5)				(Sci	ore natura	l substrat	es; ignore	♦ Shale	e (-1)	Normal (0)	20
NUMBER O	OF BEST T	YPES:	◇ 4 or more	(2)	(00)			nt-sources)		fines (-2)	◊ None (1)	
COMMENTS	S		* 3 or less (D)								
2-INSTRE		R Indicate r	presence 0 to 3	. 0 -Ahsen	t [.] 1- Verv sma	all amounts	s or if mor	e common	of margi	nal quality.	AMOUI	
2-Moderate a amounts (e.g water, or dee	amounts, but n	ot of highest oulders in de d, functional p	quality or in sn ep or fast wate pools.	nall amour r, large dia	nts of highest	quality; 3 - at is stable	Highest q , well dev	uality in mo	oderate o otwad in c	r greater leep / fast	Check ONE (or 2	& average) 5 (11)
	verhanging v	.,		2 Root		1		ic macrop	•	•	◇ Sparse 5-<25%	.,
1 Sh	allows (in sl			0 Bould	ders (1)	1	Logs a	and wood	ly debris	. (1)	 Nearly absent 	:5% (1)
	otmats (1)						_					
COMMENTS	S										C Maxii	num 16
3-CHANN	IEL MORP	HOLOGY	Chec	k ONE in	each categor	y (Or 2 & a	average)					
SINUOSITY		DEVELOPM		-		NC	-	TABILITY	,			·
 High (4) Moderate 		 Excellent Good (5) 	(7)		ne (6) covered (4)			High (3) Moderate	e (2)			annel
◇ Low (2)	()	✤ Fair (3)		♦ Re	covering (3))	۲	Low (1)			Maxi	imum 12 20
◇ None (1) COMMENTS		Poor (1)		◇ Re	cent or no r	ecovery	(1)					
	EROSION king downstrea				k ONE in eac	h category	for EAC					
•	ROSION	L	RIPARIAI R		L	R		FLU		AIN QUAL L R	11 Y	
	r little (2)		Wide >50m (Forest, S				◊ ◊ Cor	nservation Tillage	• •
 ◇ ◇ None or ◇ ◇ Modera 			Moderate 10 Narrow 5-10			Shrub or Residen		d (2) <, New fiel	ld (1)		oan or Industrial (0 ning, construction	
◊ ◊ Heavy/\$		* *	Very narrow		\diamond \diamond	Fenced	pasture ((1)	.,	Indicate p	predominant land use(• •
		\diamond \diamond	None (0)		* *	Open Pa	sture/Ro	owcrop (0)	past 100		parian
COMMENTS	s										Ma	ximum 3 10
5-POOL/G	GLIDE ANI	D RIFFLE	RUN QUA	LITY								J
MAXIMUN		-	ANNEL WIDT				NT VELO			DF	CREATION POTE	
Check ONE (DNE (or 2 & ave h > riffle widt		◇ Torrenti		ALL that a Slov الم				◇ Primary Conta	
♦ 0.7-<1m			h = riffle widt		◇ Very Fas			rstitial (-1)		Secondary Cont	
◇ 0.4-<0.7r	• •	Pool widt	h < riffle widt	h (0)	* Fast (1)			rmittent (·	-2)		le one and comment o	
◇ 0.2-<0.4r ◇ <0.2m (0					Moderat Indicate	t e (1) e for reach		l ies (1) and riffles.			Pool/Cu	rrent
COMMENTS	S (metric=0)										Maxii	
Indicate for			areas must b	e large e	nough to su	•••••••••••••••••••••••••••••••••••••••	•		-	e species	☆ No Riffle	(metric=0)
DIE	Cheo FFLE DEPTH	ck ONE (<i>ONI</i>	LY!) RUN DE	ртн	DIC	Ch FLE/RUN		(or 2 & ave RATE	• •		MBEDDEDNESS	
	as >10cm (2)		Maximum >5		* Stable				\diamond	None (2)		
* Best Area	as 5-10cm (1))	Maximum <5	• • •	◇ Mod. S	table (e.g	j. large g	jravel) (1)	·	Low (1) Moderate	May	<i>le/Run</i> kimum6
○ Best Area	as <5cm _{(metric}	c=0)			◊ Unstab	ole (e.g. s	and, fine	e gravel) (01	Extensive	· ·	8
COMMENTS	S											
6-GRADIE					(a)							,
(11.518 DRAINAGE				low – Lov rate (6-10		% PC	OOL: 30	%	6 GLIDE	: 0		idient imum 8
(5.117 n					gh (10-6)	% F	RUN: 60	%	RIFFLE	: 10	maxi	10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	◇ Nuisance algae	◊ Public	◇ Private	◊ WWTP		♦ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
> 10%-<30%	Discoloration	◇ Spray		Construction BMPs	◊ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	♦ Cooling
	◊ Oil sheen	Leveed – One side	ded	Sank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	♦ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	♦ Home
100 Middl	e	Impounded	Desiccated	◇ Park	◊ Data Paucity	♦ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

Sample # AB47660 Surveyor	QHEI Type Fish	bioSample #	Stream Na	-			Location		
			VEITION FOI	rk Muscatatuck F	River		CR 500 South		
	Sample	Date County	Mac	ro Sample Type	e			QHEI Score:	
CWY	8/17/21	Jennings	N/A		→ • Hal	oitat Comp	olete		62
1-SUBST	RATE	Check ONLY Two sub	strate TYPE BC	DXES;			Check ONE (or 2 & average)	
BEST TYP		estimate % or note ev		TYPES			ORIGIN	QUALITY	
	-	TOTAL POOL RIF			TAL POOL		Ontoin	QUALITY	
◇ ◇ Bldrs/S		TOTAL FOOL KI	· ∟∟ ◇ ◇ Haro		X		Limestone (1)	SILT ◇ Heavy (-2)	Substrate
◇ ◇ Boulder	. ,			• • • •	x	x	* Tills (1)	 Moderate (-1) 	
	.,		◇ ◇ Muc		<u>x</u>		◊ Wetlands (0)	 Normal (0) Energy (4) 	13
					<u> </u>		 Hardpan (0) Sandstone (0) 	◇ Free (1) EMBEDDEDNESS	-
	. ,						◇ Rip/Rap (0)		Maximum
♦ ♦ Sand (6)		<u> </u>	◇ ◇ Artii	ncial (0)	X		 Lacustrine (0) Shala (4) 	Moderate (-1)	20
◇ ◇ Bedrocl	• •				atural substra	les, ignore	 Shale (-1) Coal fines (-2) 	 Normal (0) ◇ None (1) 	
NUMBER	OF BEST TY	PES: ◇ 4 or mo	• •	slu	Idge from poi	nt-sources)	····· (_)		
COMMENTS	s	* 3 01 les	SS (0)						
		R Indicate presence 0 It of highest quality or i							
amounts (e.g	., very large bo	ulders in deep or fast v						Check ONE (or 2 & a	
	ep, well-defined, Idercut banks	, functional pools.	2 Boole	70om (2)	1 Oxbo	wo Booku	(1)	* Extensive >75% (1	,
	verhanging ve		<u>3</u> Pools : 2 Rootwa	· · ·		ws, Backw tic macrop	.,	 Moderate 25-75% (Sparse E (25%) (2) 	
	allows (in slo					-	y debris (1)	 Sparse 5-<25% (3) Nearly absent <5% 	
	otmats (1)	w water)(1)					y debris (1)		0(1)
COMMENTS	.,							Cov	rer
	-							Maximui	
			beck ONE in e	ach category (Or	2 & average)			4	20
SINUOSITY		EVELOPMENT			• •	TABILITY			
 ◇ High (4) 		Excellent (7)	◇ Non	-		High (3)			
Moderate	()	Good (5)		overed (4)		Moderate	e (2)	Chann Maximu	-
♦ Low (2) ♦ None (1)		Fair (3) Poor (1)		overing (3)		› Low (1)			20
◇ None (1) COMMENTS		Poor (1)	~ Reci	ent or no recove	ery (1)				
		& RIPARIAN ZO		ONE in each cate	egory for EAC		Or 2 per bank & ave		
	king downstrean		RIAN WIDTH	LR		FLC	OD PLAIN QUAL L R	.11 Y	
LR		♦ ♦ Wide >50			st, Swamp ((3)		nservation Tillage (1)	1
◇ ◇ None or	• • •	◊ ◊ Moderate			b or Old fie			oan or Industrial (0)	
 * Modera * Heavy/s 		◇ ◇ Narrow 5 ◇ ◇ Very narr			dential, Parl ed pasture		.,	ning, construction (0) predominant land use(s)	
,, ,	(-)	◊ ◊ None (0)			n Pasture/R	• •		m riparian. Ripar	rian
	-							Maxim	num 6
COMMENTS	S								10
<u>5-POOL/0</u>	<u>GLIDE AND</u>	RIFFLE/RUN Q	<u>UALITY</u>						
MAXIMUN	M DEPTH	CHANNEL W	IDTH	CUF		OCITY			
Check ONE (Check ONE (or 2 8			eck ALL that		RE		IAL
♦ >1m (6) ♦ 0.7-<1m		Pool width > riffle v Pool width = riffle v	• • •	 Torrential (-1) Very Fast (1) 	•	w (1) erstitial (-1	`	♦ Primary Contact	
◇ 0.7-<1111 ◇ 0.4-<0.7r		Pool width < riffle v	• • •	 Very Fast (1) Fast (1) 		ermittent (-	2)	Secondary Contact	
◇ 0.2-<0.4r			natir (0)	 Moderate (1) 		dies (1)	(cire	cle one and comment on b	back)
◇ <0.2m (0				Indicate for r		• • •		Pool/Curre	ent
COMMENTS		of fishing activity						Maximu	m 9 12
Indicate for	functional rif	fles; Best areas mu	st be large en	ough to suppor	t a populati	on of riffle	-obligate species		
		k ONE (<i>ONLY!</i>)			Check ONE				<u>=1110=0)</u>
	FFLE DEPTH		DEPTH	RIFFLE/F	RUN SUBST	•	RIFFLE/RUN E	MBEDDEDNESS	
RIF			n >50cm (2)	Stable (e.g.)	cobble, bou	lder) (2)	None (2)		
Or Best Area	• • •		• • •					Riffle/F	Run
◇ Best Area◇ Best Area	as 5-10cm (1)	Maximum	• • •	♦ Mod. Stable	(e.g. large	gravel) (1)	◇ Low (1)	Maxim	um ()
◇ Best Area◇ Best Area	• • •	Maximum	• • •		(e.g. large	gravel) (1)	◇ Low (1)	(0) Maximi	-

(1.678 ft/mi) DRAINAGE AREA	⊗ Very low – Low (2-4)◇ Moderate (6-10)	% POOL: 40	% GLIDE: 0	Gradient	0
(234.161 mi ²)	 ◇ Moderate (8-10) ◇ High – Very high (10-6) 	% RUN: 60	% RIFFLE: 0	Maximum 10	0



garbage bag on sandbar at site; pool area>100ft^2; Pool depth>3ft

A-CANOPY	B-AESTHETICS	<u>C-M</u>	AINTENANCE		D-ISSUES	
◇ >85% - Open	Vuisance algae	◊ Public	◇ Private	◊ WWTP		♦ CSO
◇ 55%-<85%	Invasive macrophytes	♦ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
◇ 30%-<55%	◊ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
◇ 10%-<30%	Discoloration	◇ Spray		◇ Construction BMPs	◊ Sediment BMPs	
[◈] <10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	Cooling
	◊ Oil sheen	Leveed – One side	led	♦ Bank Erosion	♦ Surface Erosion	♦ H2O table
	* Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	A Lagoon
		Stable - Bedload				
1 Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
18 Middle	9	Impounded	Desiccated	◇ Park	◊ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	◇ Livestock	
		Snag Removed		◇ Atmosphere		
		Snag Modified		Deposition		
0 Left		-				

Sample #	QHEI Type	bioSar	nple #	S	tream N	ame				Location		
AB47667	Fish	21T015	5	N	lutton Cr	eek				CR 300 North		
Surveyor	Sample	Date	County	4		cro Sample	а Туре	⊗ Hal	oitat Com	alata	QHEI Score	e: 60
KAG	8/16/21		Jenninę	•	N/A			110				
1-SUBST	RATE			o substrate ote every ty						Check ONE	(or 2 & average)	
BEST TYP	ES			····		R TYPES				ORIGIN	QUALITY	
		TOTAL	POOL	RIFFLE			TOTAL	POOL	RIFFLE		SILT	
◊ ◊ Bldrs/S	labs (10)				_	rdpan (4)		<u>x</u>	<u>x</u>	◇ Limestone (1)	Heavy (-2)	Substrate
◊ ◊ Boulde	rs (9)				◇ ◇ Det	tritus (3)				Tills (1)♦ Wetlands (0)	♦ Moderate (-1) ♦ Normal (0)	
◊ ◊ Cobble	(8)		х		o ⇔ Mu	ck (2)				 Wetlands (0) Hardpan (0) 	 Normal (0) ◇ Free (1) 	11
◊ ◊ Gravel	(7)		х	x	_◇ ◇ Silt	. (2)		x	х	Sandstone (0)	EMBEDDEDNESS	
	5)		х			ificial (0)				 Rip/Rap (0) Lacustrine (0) 	 ◇ Extensive (-2) ◇ Moderate (-1) 	Maximum
◊ ◊ Bedroc	, k (5)				-				tes; ignore	♦ Shale (-1)	♦ Normal (0)	20
	OF BEST T	PES:	♦ 4 0	or more (2	2)	(30			nt-sources)	Coal fines (-2)	◇ None (1)	
			* 3 (or less (0)								
COMMENT	S											
1 Ov 1 Sh	ndercut banks verhanging ve nallows (in slo potmats (1)	egetatio			Rootv	> 70cm (2) vads (1) ers (1)	1	Aqua	ws, Backv tic macrop and wood	()	 Moderate 25-75% ◇ Sparse 5-<25% (3 ◇ Nearly absent <5 	5)
COMMENT	S										Co Maximi	ver um 16 20
3-CHANN	IEL MORP	HOLO	GY	Check	ONE in e	each catego	ry (<i>Or</i> 2 &	average)				
SINUOSITY		EVELO				NELIZATI	ON		TABILITY			
 High (4) Moderate 		Excelle Good (• •		♦ No ♦ Re	ne (6) covered (4)			> High (3) > Moderate	a (2)	Chan	
* Low (2)	• •	Fair (3)			♦ Rec	covering (3	5)	<	· Low (1)	- (-)	Maxim	um 15 20
◇ None (1)		Poor (1)		◇ Red	cent or no i	recovery	(1)				20
COMMENT												
	EROSION		ARIAN	ZONE	Check	ONE in eac	ch categor	y for EAC		Or 2 per bank & av	•	
-	king downstrear EROSION		R R	RIPARIAN	WIDTH	L	D		FLC	DOD PLAIN QUA L R	LITY	
LR				e >50m (4)		Forest,	Swamp ((3)		onservation Tillage (1)
◇ ◇ None o ◇ ◇ Modera	• • •			lerate 10-5			Shrub o				rban or Industrial (0)	N
♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦	· · ·			ow 5-10m / narrow <			Fenced	•	k, New fiel (1)	.,	ining, construction (0 e predominant land use(s)	,
			∘ ◇ None		()				owcrop (0		Óm riparian.	arian
	· C										Maxi	mum 4
COMMENT	3											10
	S GLIDE AND) RIFFI	LE/RU	N QUAL	<u>ITY</u>							10

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: No Riffle (metric=0) Check ONE (ONLY!) Check ONE (or 2 & average) **RIFFLE/RUN EMBEDDEDNESS RIFFLE DEPTH RUN DEPTH RIFFLE/RUN SUBSTRATE** ◇ None (2)
 ◇ Low (1) ♦ Best Areas >10cm (2) Maximum >50cm (2) Stable (e.g. cobble, boulder) (2) Riffle/Run Or Best Areas 5-10cm (1) Maximum <50cm (1)</p> Mod. Stable (e.g. large gravel) (1) Maximum Moderate (0) Best Areas <5cm_(metric=0) Unstable (e.g. sand, fine gravel) (0) 8 Extensive (-1)

COMMENTS

6-GRADIENT ◊ Very low – Low (2-4) (6.52 ft/mi) % POOL: 40 % GLIDE: 0 Gradient DRÀINAGE AREA Maximum * Moderate (6-10) 6 10 % RUN: 50 % RIFFLE: 10 (8.239 mi²) ◇ High – Very high (10-6)

0



Sheen on surface of water; pipe running through beginning of reach.

A-CANOPY	B-AESTHETICS	<u>C-M</u>	AINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◇ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	◇ Dirt & Grime
» 30%-<55%	◊ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
> 10%-<30%	Discoloration	◇ Spray		◇ Construction BMPs	◊ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	Cooling
	◊ Oil sheen	Leveed – One side	led	Output Series Bank Erosion	♦ Surface Erosion	♦ H2O table
	Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
31 Middle		Impounded	Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		Flood Control	◊ Drainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

Sample # QHEI Typ	e bioSarr	nple #	Stream N	ame				Locatio	on		
AB47668 Fish	21T016	5	Storm Cre	ek Ditch				CR 400	North		
	le Date	County	Ма	cro Sample	Туре		itat Com	nlete		QHEI Scor	e: 4
KAG 8/17/2		Jackson				Tub					-
<u>1-SUBSTRATE</u>			ubstrate TYPE E every type prese					Ch	eck ONE (d	or 2 & average)	
BEST TYPES			OTHE	R TYPES				O	RIGIN	QUALITY	
	TOTAL	POOL R			TOTAL		RIFFLE			SILT	0.4.4
◇ ◇ Bldrs/Slabs (10)				rdpan (4)	<u> </u>	<u>x</u>	x	. ◇ Lime: ◇ Tills (stone (1)	 ◇ Heavy (-2) ◇ Moderate (-1) 	Substrat
◇ ◇ Boulders (9)				tritus (3)		<u>x</u>		• Wetla		 Normal (0) 	10
◇ ◇ Cobble (8)		<u> </u>		.,		<u>x</u>	<u>x</u>	♦ Hard	• • •	◇ Free (1)	10
◊ ◊ Gravel (7)		<u>x x</u>			<u> </u>	x	X		stone (0) ap (0)	EMBEDDEDNESS	Maximui
♦ ♦ Sand (6)		<u>x</u> <u>x</u>		ificial (0)		x	x		strine (0)	Moderate (-1)	20
◇ ◇ Bedrock (5)			<u>(a)</u>	(Sco			es; ignore	 ◇ Shale ◇ Coal 	e (-1) fines (-2)	 Normal (0) ◇ None (1) 	
NUMBER OF BEST	TTPES:	♦ 4 or n ♦ 3 or le	• • •		sludge	from poin	nt-sources)		()		
COMMENTS		0.01.1									
2-INSTREAM CO	/ER Indicat	e presence	0 to 3: 0-Absen	• 1- Verv smal		or if mor	e common	of mardi	nal quality.	AMOUN	T
2-Moderate amounts, but	not of highe	est quality or	r in small amoun	ts of highest of	quality; 3- I	Highest q	uality in m	oderate o	r greater	Check ONE (or 2 a	
amounts (e.g., very large water, or deep, well-defin			i water, large dia	uneter log tha	t is stable	, well dev	eloped roc	otwad in d	ieep / fast	 Extensive >75% 	• • •
0 Undercut bar	nks (1)	·	1 Pools	> 70cm (2)	1	Oxbov	vs, Backv	vaters (1)	* Moderate 25-75%	% (7)
0 Overhanging	vegetation	n (1)	2 Rootv	vads (1)	1	Aquat	ic macrop	ohytes (I)	 Sparse 5-<25% (3)
0 Shallows (in	slow water) (1)	0 Bould	lers (1)	2	Logs a	and wood	ly debris	; (1)	◇ Nearly absent <	5% (1)
1 Rootmats (1) COMMENTS										C	over
COMMENTS										Maxin	
3-CHANNEL MOR	PHOLOC	<u>SY</u>	Check ONE in	each category	/ (Or 2 & a	average)					
					N	-		,			
 High (4) Moderate (3) 	 Exceller Good (5) 	• •		ne (6) covered (4)			High (3) Moderate	e (2)			nnel
◇ Low (2)	◇ Fair (3)			covering (3)			Low (1)			Maxii	num 4 20
None (1) COMMENTS	* Poor (1))	* Re	cent or no re	ecovery (1)					
4- BANK EROSIO				ONE in each		for EAC		Or 2 por l	ank & aver	200)	
River right looking downstr			ARIAN WIDTH		realegory					•	
EROSION	L	R		LF					LR		
L R		♦ Wide >5 ♦ Modera	50m (4) ite 10-50m (3)	$\otimes \otimes$	Forest, S Shrub or	Wamp (Old fiel	3) d (2)			nservation Tillage (an or Industrial (0)	
◊		 Narrow 		\diamond \diamond	Resident	ial, Park	k, New fie	ld (1)		ing, construction (
◊ ◊ Heavy/Severe (1)		-	rrow <5m (1)		Fenced p		(1) owcrop (0	•		oredominant land use(s n riparian.	;)
	·	◇ None (0	"	~ ~	Ореп Ра	Slure/RC	owcrop (u)	puor roor	Rip	arian simum 8
COMMENTS											10
5-POOL/GLIDE AI		E/RUN	QUALITY								N
MAXIMUM DEPTH	С	HANNEL	WIDTH		CURRE	NT VELO	OCITY				
Check ONE (ONLY!)		k ONE (or 2 dth > riffle				ALL that a Slov ♦			RE	CREATION POTEN	
∻ >1m (6) ◇ 0.7-<1m (4)		dth = riffle		 Torrentia Very Fas 	• •		rstitial (-1)		 Frimary Contact Secondary Contact 	
◇ 0.4-<0.7m (2)	Pool wi	dth < riffle	width (0)	◇ Fast (1)		Interview	rmittent (le one and comment o	
 ◇ 0.2-<0.4m (1) ◇ <0.2m (0) (metric=0) 				Moderate Indicate	• •	♦ Edd – pools a	ies (1) and riffles.		(10	Pool/Cur	
COMMENTS				maroato						Maxin	
Indicate for functional	riffles; Be	st areas m	ust be large e	nough to su	pport a p	opulatio	on of riffle	-obligat	e species	♦ No Riffle (L
	eck ONE (C	,					(or 2 & av	• •			
RIFFLE DEPT		_	N DEPTH Im >50cm (2)	RIFF ♦ Stable (ELE/RUN				.E/RUN EN None (2)	MBEDDEDNESS	
 Best Areas 5-10cm (,		im <50cm (2)	 Stable (Mod. St 		•		\diamond	Low (Ì)	Max	e/Run imum 0
♦ Best Areas <5cm(me)	tric=0)		.,	Our Constable				0) ^	Moderate Extensive	(0)	8
COMMENTS								,		` ''	<u> </u>
6-GRADIENT											
(2.682 ft/mi)			Very low – Lov		% PC	OL: 20	9	6 GLIDE	: 80		dient
DRAINAGE AREA (17.513 mi ²)			Moderate (6-10 High – Very hig	,	% R	UN: 0	%	RIFFLE	: 0	Maxir	num 4 10



Pool depth >3ft

A-CANOPY	B-AESTHETICS	<u>C-M</u>	AINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◇ WWTP		♦ CSO
55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
^{>} 10%-<30%	Discoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◊ Cooling
	Oil sheen	Leveed – One side	led	♦ Bank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	Natural Flow
	Sludge deposits	Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◇ Quarry Mine	◊ Golf	◇ Home
80 Middl	е	Impounded	Desiccated	◇ Park	◇ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

	M	OWQ	Biolo	ogica	l St	udies C	<u> HEI (</u>	Qua	litativ	<u>e Ha</u>	bitat E	Evaluation	Index)
Sample #	QHEI Type	e bioSan	nple #	St	tream	Name				Locati	on		
AB47669	Fish	21T017	7	T	ributary	/ to Richart La	ake			CR 900	0 West		
Surveyor	Sample		County		N	lacro Sample	е Туре	* Hat	oitat Com	nloto		QHEI Sco	re: 49
SLS	8/17/21		Jenning			/A		° пак		hiere			
<u>1-SUBST</u>	RATE		NLYTwo % or note							Cł	neck ONE (c	or 2 & average)	
BEST TYP	ES					ER TYPES				0	RIGIN	QUALITY	
		TOTAL	POOL	RIFFLE			TOTAL	POOL	RIFFLE			SILT	
◊ ◊ Bldrs/S	ilabs (10)					ardpan (4)		X			stone (1)	Heavy (-2)	Substrate
◊ ◊ Boulde	rs (9)				-	etritus (3)		х		♦ Tills ♦ Wetla	(1) ands (0)	 Moderate (-1) ◊ Normal (0) 	10
\diamond \diamond Cobble	(8)				-	uck (2)				_	pan (Ò)	◇ Free (1)	13
* * Gravel	(7)		x	x	◊ ◊ S	ilt (2)		Х		◇ Sand ○ Rip/F	Istone (0) San (0)	EMBEDDEDNESS ♦ Extensive (-2)	Massimum
◊ ◊ Sand (6	5)		x		◊ ◊ A	rtificial (0)				_	strine (0)	 Moderate (-1) 	Maximum 20
◊ ◊ Bedroc					-	(Sc			tes; ignore		e (-1) fines (-2)	◇ Normal (0)◇ None (1)	
NUMBER	OF BEST T	YPES:		r more (2 r less (0)			sludge	from poir	nt-sources)		iiies (-z)	• None (1)	
COMMENT	S		∞ 3 0	r iess (U)									
						nt; 1 -Very sma						AMOU	NT
amounts (e.g	g., very large b	oulders in	deep or fa			iameter log th						Check ONE (or 2	0,
	ep, well-define dercut banl		al pools.	0	Pool	ls > 70cm (2)		Ovhou	ws, Backv	Nators (1)	 Extensive >75% Moderate 25.75 	. ,
	verhanging v	• •	- (1) -	<u> </u>	_	twads (1)	$\frac{0}{0}$		tic macro	•	,	 Moderate 25-75 Sparse 5-<25% 	()
	allows (in s	-				lders (1)			and wood			 Nearly absent 	.,
1 Rc	ootmats (1)		,,,, <u> </u>		_					,		•	Cover
COMMENT	5											Maxi	
3-CHANN	NEL MORF	PHOLOC	<u>GY</u>	Check	ONE ir	n each categoi	ry (<i>Or</i> 2 & a	average)					
SINUOSITY		DEVELOF				ANNELIZATI one (6)	ON	-	TABILITY High (3)				
 Moderate 		 Cood (• •			ecovered (4)	1		Moderat				annel imum 10
♦ Low (2)		◇ Fair (3)				ecovering (3 ecent or no r			[,] Low (1)			IVIAX.	imum 10 20
◇ None (1) COMMENT		* Poor (1)		~ K		ecovery	(1)					
4- BANK	EROSION			ZONE	Che	ck ONE in eac	h category	for EAC	HBANK	Or 2 per	bank & aver	ade)	
-	king downstrea			PARIAN			, eategory						
L R E	ROSION			. E0m (4)		L			2)			oonvotion Tillogo	(4)
♦ ♦ None o	or little (3)		· ◇ Wide · ◇ Mode				Forest, S Shrub or					nservation Tillage an or Industrial (0	
♦ ♦ Modera ♦ ♦ Modera ♦ ♦ Heavy/3			◇ Narro					•	k, New fie	eld (1)	◇ ◇ Min	ing, construction	(0)
° ∼ ⊓eavy/	Severe (1)		·		5m (1)		Fenced Open Pa		(1) owcrop (0))		predominant land use(m riparian.	
				(-)						,			parian ximum 7
COMMENT													10
<u>5-POOL/0</u>	<u>GLIDE AN</u>	<u>D RIFFI</u>	<u>E/RUN</u>		<u>.ITY</u>								
MAXIMUI Check ONE			KONE (0)				CURRE	NT VELO			RE	CREATION POTE	NTIAL
◇ >1m (6)		* Pool w	idth > riff	fle width	(2)	♦ Torrent		Slov				◊ Primary Conta	ct
◇ 0.7-<1m	• •	◇ Pool wi			• •	◇ Very Fa	• •		erstitial (-1	,		Secondary Cont	tact
◇ 0.4-<0.7	• •	◇ Pool wi	iath < rin	ne width	(0)	◇ Fast (1)◇ Modera			ermittent (lies (1)	-2)	(circ	le one and comment of	on back)
◇ <0.2m (0 COMMENT)	0) _(metric=0) S					Indicat	e for reach	i – pools i	and riffles.		L	Pool/Cu Maxi	mum 1
Indicate for	functional	riffles: Be	st areas	must be	large	enough to su	upport a r	opulatio	on of riffle	e-obliga	te species	◇ No Riffle	12 (metric=0)
		eck ONE (C					•••••••••••••••••••••••••••••••••••••••	•	(or 2 & av	-			(metric=0)
	FFLE DEPTH	·	Ŕ				FLE/RUN	SUBST	RATE	RIFF		BEDDEDNESS	
	as >10cm (2) as 5-10cm (1			num >500 num <500	• • •		(e.g. cob table (e.c	•	lder) (2) gravel) (1)		None (2) Low (1)		le/Run
	as <5cm _{(metr}		maxin		(1)				e gravel) (1)	, (0) [~]	Moderate	(0)	kimum 0 8
COMMENT	S									~	Extensive	(-1)	
6-GRADI													.
(17.212 DRAINAGE				Very lo Modera			% PC	OOL: 90	9	% GLIDE	: 0		adient imum 10
(1.529 r					•	igh (10-6)	% F	RUN: 5	%		: 5	Waxi	10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Vuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
> 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	◊ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			Logging	◇ Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	Sank Erosion	♦ Surface Erosion	♦ H2O table
	Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◇ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	◇ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	♦ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
9 Middl	е	Impounded	Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

Sample #	QHEI Type	bioSar	nple #	St	tream Nam	e				Locatio	n			
AB47673	Fish	21T02 ⁻	1	Si	ixmile Creel	(CR 175	North			
Surveyor	Sample	Date	County	y	Macro	Sample T	уре	* Hab	itat Com	aloto		QHEI S	Score:	72
CWY	8/16/21		Jennin	0	N/A			* Hab		Jiele				12
1-SUBSTR	RATE	Check O estimate	NLYTw	o substrate ote every type ote every type ote every type ote substrate ote substrate ote ote substrate ote substrate ote ote substrate ote substrate ote ote ote substrate ote substrate ote substrate ote ote ote ote ote ote ote o	TYPE BOX	ES;				Ch	eck ONE (d	or 2 & average))	
BEST TYPE	S	ootimate	, , , , , , , , , , , , , , , , , , ,		OTHER T	YPES				OF	RIGIN	QUALI	ITY	
		TOTAL	POOL	RIFFLE		٦	TOTAL P	POOL	RIFFLE			011 T		
◊ ◊ Bldrs/Sla	abs (10)			x	◇ ◇ Hardp	an (4) _				♦ Limes	stone (1)	SILT ♦ Heavy (-2	2)	Substrate
◊ ◊ Boulders	s (9)				◊ ◊ Detritu	ıs (3)	x	[♦ Tills (♦ Moderate		
◊ ◊ Cobble (8)	8)			x		(2)				 ♦ Wetla ♦ Hardı 	• • •	 ♦ Normal (0 ♦ Free (1) 	0)	16
◊ ♦ Gravel (7)	,		x		◊ ◊ Silt (2)		x				stone (0)	EMBEDDEDN	ESS	
 ♦ ◊ Sand (6) 	,		x		◇ ◇ Artific		x			◇ Rip/R		Extensive		Maximum
	(5)				· · Altine					 Lacus Shale 	strine (0)	 Moderate Normal (0) 		20
◇ ◇ Bedrock NUMBER O	• •	VPES.	÷ 4 4	or more (2	<u>.</u>				es; ignore nt-sources)	Coal f	ines (-2)	 None (1) 	,	
NOMBER	DEGIN			or less (0)	•		sludge in	Jii poli	11-3001063)					
COMMENTS				()										
	lercut banks erhanging v	• •	m (4)		Pools > 7	· · /	0	Oxbov	vs, Backv	vaters (1)	Moderate 2		• •
<u>1</u> Sha 1 Roo COMMENTS <u>3-CHANNE</u> SINUOSITY	ullows (in slo otmats (1) <u>EL MORP</u>	Water HOLO	r) (1) <u>GY</u> PMENT	1 1 Check	Boulders ONE in eac	(1)	1	Logs a erage) S	ic macrop and wood TABILITY High (3)	y debris	•	 Sparse 5 Nearly abs 	sent <5% Cov Maximu	% (1) rer
<u>1</u> Sha <u>1</u> Roo <i>COMMENTS</i> <u>3-CHANNE</u>	Illows (in slo otmats (1) EL MORP	ow water	r) (1) <u>GY</u> PMENT ent (7)	<u> </u>	Boulders ONE in eac	(1) n category (ELIZATION 6)	1	Logs a erage) S ⇔	and wood	y debris	•	◇ Nearly abs	Sent <5% Cov Maximu Chanr	6 (1) m 20 12
1 Sha 1 Roo COMMENTS 3-CHANNE SINUOSITY ◇ High (4) ◇ Moderate (※ Low (2)	EL MORP	HOLO DEVELO > Excelle > Good (> Fair (3)	r) (1) GY PMENT ent (7) 5)	<u> </u>	Boulders ONE in eac CHANNE [⊗] None ([⊗] Recov [⊗] Recov	(1) category (ELIZATION 6) ered (4) ering (3)	0r2&ave	Logs a erage) S & * *	TABILITY High (3)	y debris	•	◇ Nearly abs	Sent <5% Cov Maximu Chanr Maximu	6 (1) m 20 12
1 Sha 1 Roo COMMENTS 3-CHANNE SINUOSITY ◊ High (4) ◊ Moderate (◊ Low (2) ◊ None (1)	EL MORP	HOLO DEVELO > Excelle > Good (r) (1) GY PMENT ent (7) 5)	<u> </u>	Boulders ONE in eac CHANNE [⊗] None ([⊗] Recov [⊗] Recov	(1) category (ELIZATION 6) ered (4)	0r2&ave	Logs a erage) S & * *	TABILITY High (3) Moderate	y debris	•	◇ Nearly abs	Sent <5% Cov Maximu Chanr Maximu	6 (1) er m 20 12 nel 15
1 Sha 1 Roo COMMENTS 3-CHANNE SINUOSITY ◇ High (4) ◇ Moderate ((EL MORP	HOLO(DEVELO) > Excelle > Good (> Fair (3) > Poor (1	GY PMENT ent (7) 5)	Check	ONE in eac CHANNE None (Recov Recov Recov	(1) ELIZATION 6) ered (4) ering (3) t or no rec	Or 2 & ave	Logs a erage) S ↔ ↔	TABILITY High (3) Moderate Low (1)	y debris	(1)	◇ Nearly abs	Sent <5% Cov Maximu Chanr Maximu	6 (1) er m 20 12 nel 15
1 Sha 1 Roo COMMENTS 3-CHANNE SINUOSITY ◇ High (4) ◇ Moderate ((◇ Low (2) ◇ None (1) COMMENTS 4- BANK E	EROSION	HOLO(DEVELO) > Excelle > Good (> Fair (3) > Poor (1 & RIP/	GY PMENT ent (7) 5)	Check	Boulders ONE in eac CHANNE ♦ None (◊ Recov ◊ Recov ◊ Recon	(1) category (ELIZATION 6) ered (4) ering (3)	Or 2 & ave	Logs a erage) S ↔ ↔	TABILITY High (3) Moderato Low (1)	y debris 	(1)	◇ Nearly abs age)	Sent <5% Cov Maximu Chanr Maximu	6 (1) er m 20 12 nel 15
1 Sha 1 Roo COMMENTS 3-CHANNE SINUOSITY ◇ High (4) ◇ Moderate ((◇ Low (2) ◇ None (1) COMMENTS 4- BANK E River right looki	EL MORP	HOLO(DEVELO) > Excelle > Good (> Fair (3) > Poor (1 & RIP/ m	(1) <u>GY</u> PMENT ent (7) 5) ARIAN ARIAN R ARIAN N Mod Nor	Check Check ZONE RIPARIAN e >50m (4) lerate 10-5 ow 5-10m / narrow <	ONE in eac ONE in eac CHANNE * None (* Recov * Recov * Recov Check Of WIDTH () (2)	(1)	Or 2 & ave	erage) S S or EAC	TABILITY High (3) Moderate Low (1) <i>H BANK ((</i> FL(3) d (2) c, New fie	y debris	, (1) eank & aver AIN QUAL L R ◇ Cor ◇ Urb ◇ Min Indicate p	◇ Nearly abs age)	sent <5% Cov Maximu Chanr Maximu Ilage (1) rial (0) ction (0)	6 (1) rer 20 12 nel 10 15 15 rian
1 Sha 1 Roo COMMENTS 3-CHANNE SINUOSITY ◇ High (4) ◇ Moderate (: ◇ Low (2) ◇ None (1) COMMENTS 4- BANK E River right lookin ER ◇ None or ◇ Moderate (: ◇ None or ◇ Heavy/Se	EL MORP	HOLO(DEVELO) > Excelle > Good (> Fair (3) > Poor (1 <u>& RIP/</u> m	(1) <u>GY</u> PMENT ent (7) 5) ARIAN ARIAN ARIAN ARIAN Non × Non	Check Check ZONE RIPARIAN e >50m (4) lerate 10-5 ow 5-10m / narrow < e (0)	ONE in eac CHANNE	(1)	Or 2 & ave	erage) S S or EAC	TABILITY High (3) Moderate Low (1) <i>H BANK ((</i> FL(3) d (2) c, New fie (1)	y debris	, (1) eank & aver AIN QUAL L R ◇ Cor ◇ Urb ◇ Min Indicate p	 Nearly abs rage) ITY Inservation Tition or Industry ing, construction construction 	sent <5% Cov Maximu Chanr Maximu Maximu Ilage (1) rial (0) ction (0) duse(s) Ripa	6 (1) rer 20 12 12 12 12 12 15 15 15 15 15 15 15 15 15 15

12 Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: No Riffle (metric=0) Check ONE (ONLY!) Check ONE (or 2 & average) **RIFFLE/RUN EMBEDDEDNESS RIFFLE DEPTH RUN DEPTH RIFFLE/RUN SUBSTRATE** None (2) Best Areas >10cm (2) * Maximum >50cm (2) Stable (e.g. cobble, boulder) (2) Riffle/Run * Low (1) Sest Areas 5-10cm (1) Aaximum <50cm (1)</p> * Mod. Stable (e.g. large gravel) (1) Maximum 6 Moderate (0) ◊ Best Areas <5cm_(metric=0) Unstable (e.g. sand, fine gravel) (0) 8 Extensive (-1)

Maximum

8

COMMENTS

COMMENTS

6-GRADIENT ◊ Very low – Low (2-4) % POOL: 30 (9.933 ft/mi) % GLIDE: 0 Gradient DRÀINAGE ARÉA * Moderate (6-10) Maximum 10 10 % RUN: 60 % RIFFLE: 10 (13.834 mi²) ◇ High – Very high (10-6)



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
^{>} 10%-<30%	Discoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	Output Bank Erosion	♦ Surface Erosion	◇ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Right	◇ Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	◇ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	♦ Acid Mine	Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◇ Quarry Mine	◊ Golf	♦ Home
1 Middl	e	Impounded	Desiccated	◇ Park	◊ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

	T A	<u>OWQ B</u>	iological Studies	<u>s QHEI (Qu</u>	alitative Habi	tat Evaluation	Index)
Sample #	OHEL TV	ne hioSample	# Stream Name		Location		

Sample # Q	HEI Type	bioSan	nple #	Str	eam I	Name				Location			
AB47676 Fi	ish	21T025	;	Ve	rnon F	ork Muscatat	uck River	r		CR 60 So	outh		
Surveyor	Sample	Date	County		М	acro Sample	туре					QHEI Scor	'e: 00
CWY	8/17/21		Jennings	3	N	/A		* Hab	itat Comp	lete			e. 80
1-SUBSTRA				substrate						Chec	k ONE (c	or 2 & average)	
BEST TYPES		estimate	% of note	e every type						ORI	GIN	QUALITY	
520111120		τοται	POOL	RIFFLE			τοται	BOOL	RIFFLE	U.I.I		QUALITY	
◊ ◊ Bldrs/Slab:		IUIAL			>	ardpan (4)	TOTAL	FUUL		◇ Limost	ono (1)	SILT ◇ Heavy (-2)	Substrate
	. ,					etritus (3)		x		 Limesto Tills (1) 		 Moderate (-1) 	
◊ ◊ Boulders (Vetland	ds (0)	Normal (0)	16
◊ ◊ Cobble (8)			<u> </u>			uck (2)				♦ Hardpa		◇ Free (1)	10
◊ * Gravel (7)			x		>	.,		<u>x</u>		 Sandste Rip/Rap 		EMBEDDEDNESS	Maximum
♦ ♦ Sand (6)			x	<u>x</u>	>	tificial (0)				A Lacustr		♦ Moderate (-1)	20
◊ ◊ Bedrock (5	5)		х	х		(Sc	ore natura	l substrat		◇ Shale (Normal (0) Alarra (4)	
NUMBER OF	BEST TY	PES:		[.] more (2)			sludge	from poin	nt-sources)	Coal fin	ies (-2)	◊ None (1)	
			◊ 3 οι	· less (0)									
COMMENTS													
1 Overh	ounts, but no ery large bo well-defined, rcut banks nanging ve ows (in slo	t of highe ulders in function (1) getatior	est quality deep or fa al pools. • (1)	or in small ast water, la 2 1	amou arge di Pool: Root	nts of highest	quality; 3 - at is stable 2 1	Highest q , well dev Oxbov Aquati	uality in mo	oderate or g twad in dee vaters (1) hytes (1)	greater ep / fast	AMOUI Check ONE (or 2 Extensive >75% Moderate 25-75 Sparse 5-<25% Nearly absent <	& average) 5 (11) % (7) (3)
COMMENTS												C Maxii	over
												Maxii	mum 17 20
3-CHANNEL		HOLOC	SY	Check C	ONE in	each categor	y (Or 2 & a	average)					
SINUOSITY		EVELOF				NNELIZATIO	N		TABILITY				
 ◇ High (4) ◇ Moderate (3) 		Excelle Good (• •			one (6) ecovered (4)			High (3) Moderate	(2)		Cha	annel
* Low (2)		Fair (3)	"			ecovering (3)			Low (1)	~ (~)		Maxi	imum 15 20
◇ None (1)		Poor (1)			ecent or no r			()				20
COMMENTS													
4- BANK ER	ROSION	& RIPA	RIAN	ZONE	Cheo	k ONE in eac	h category	for EAC	H BANK (C	Dr 2 per bai	nk & aver	age)	
River right looking	-	n	RI	PARIAN V	VIDTH				FLO	OD PLAII	N QUAL	ITY	
ERO L R	SION		. R • Wida	>50m (4)		L	R Forest, S	Swamp (2)			servation Tillage	(1)
♦ ♦ None or lit	ttle (3)			rate 10-50	m (3)		Shrub or					an or Industrial (0	
* * Moderate (\$	♦ Narro	w 5-10m (2)	$\diamond \ \diamond$	Residen	tial, Park	, New fiel	d (1)	◊ ◊ Min	ing, construction	(0)
◊ ◊ Heavy/Sev	/ere (1)		 ◊ Very I ◊ None 	narrow <5	m (1)		Fenced		(1) owcrop (0)			oredominant land use(n riparian.	s)
		Ň	* None	(0)		~ ~	Ореп Ра	ISTUI E/RC	Swerop (0)			Ri	parian ximum 7
COMMENTS												ivia.	10
5-POOL/GL		DIEEI			ту								
					<u></u>					Г			
MAXIMUM D Check ONE (ON		-	KONE (0)	2 & avera	ae)			NT VELC ALL that a			RE	CREATION POTE	NTIAL
◇ >1m (6)				le width (Torrenti		Slov				Primary Conta	ct
* 0.7-<1m (4)				le width (◇ Very Fas	st (1)		rstitial (-1)			Secondary Cont	act
◇ 0.4-<0.7m (2 ◇ 0.2-<0.4m (Pool wi	dth < riff	le width (0)	 ♦ Fast (1) ♦ Moderat 	o (1)		rmittent (-: ies (1)	2)	(circ	e one and comment o	on back)
 0.2-<0.4m (< <0.2m (0) (m) 							• •		and riffles.			Pool/Cu	rrent
COMMENTS		y FWA tı	ail to rive	r.								Maxii	mum 9
Indicate for fur	nctional rif	flos: Bo	st aroas	must ha l	arno c	nough to su	nnort a r	onulatio	on of riffle	-obligate	snocios		12
indicate for ful		ONE (C			ai ge e	inough to su	••••••	•	(or 2 & ave	•	species	◊ No Riffle	<u>(metric=0)</u>
RIFFL	E DEPTH		,	UN DEPT	н	RIF	FLE/RUN		•	•	RUN EN	BEDDEDNESS	
♦ Best Areas >	• • •			num >50c	• • •	Stable					one (2)	Riff	le/Run
♦ Best Areas 5	• • •		◊ Maxin	num <50c	m (1)				(1) (1) (1) (1) (1) (1)		ow (1) oderate	140	kimum 6
♦ Best Areas	(metric:	=0)					ie (e.y. S	ana, iiie	, graver) (t		ktensive		8
COMMENTS	_												
6-GRADIEN						(0 , 1)							
(4.424 ft/m DRAINAGE AR	,			Very low Moderat			% PC	DOL: 30	%	GLIDE: ()		<i>dient</i> mum 10
(197.56 mi ²				High – V	•		% F	RUN: 40	%	RIFFLE: 3	30	Maxi	10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	AINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		♦ CSO
» 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
> 10%-<30%	Discoloration	◇ Spray		◇ Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	Cooling
	◊ Oil sheen	Leveed – One side	led	Output Series Bank Erosion	Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	◇ Lagoon
		Stable - Bedload				
51 Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	A Natural Flow Second State Second State
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
88 Middle		Impounded	Desiccated	◇ Park	Oata Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
66 Left						

	M	OWQ Biolog	gical Stu	dies QI	HEI (Qual	itativ	e Hat	oitat E	Evaluation	Index)
Sample #	QHEI Type	bioSample #	Stream Na	ame				Locatio	n		
AB47666	Fish	21T014	Mutton Cre	ek				CR 800	North		
Surveyor	Sample	Date County	Ma	cro Sample 1	Туре	⊗ Uob	itat Comp			QHEI Sco	re: 61
KAG	8/16/21	Jackson	N/A			° пар		nere			01
<u>1-SUBST</u>	RATE	Check ONLY Two su estimate % or note e						Che	ck ONE (or 2 & average)	
BEST TYP	ES			R TYPES				OR	IGIN	QUALITY	
		TOTAL POOL R	IFFLE		TOTAL	POOL	RIFFLE			SILT	
◊ ◊ Bldrs/S	labs (10)			dpan (4)		<u>x</u>	<u>x</u>	♦ Limes	tone (1)	Heavy (-2)	Substrate
◊ ◊ Boulde	.,	<u>x</u>		ritus (3)		X		♦ Tills (1♦ Wetlar		 Moderate (-1) Normal (0) 	
◊ ◊ Cobble	(8)	<u> </u>	◇ ◇ Mu	.,				♦ Hardp	an (Ò)	◊ Free (1)	13
◊ ◊ Gravel (.,	<u> </u>		(2)		x		◇ Sands◇ Rip/Ra		EMBEDDEDNESS	Maximum
♦ ♦ Sand (6	i)	<u>x</u>	◇ ◇ Arti	ificial (0)				♦ Lacus	trine (0)	◇ Moderate (-1)	20
◊ ◊ Bedroc	• •			(Scor			es; ignore	◇ Shale◇ Coal f			
NUMBER	OF BEST T	YPES: ♦4 or n ◇3 or k	nore (2)		sludge	rom poin	t-sources)	oourn	100 (2)	None (1)	
COMMENT	s	· 501	ess (0)								
2-Moderate a amounts (e.g water, or dee <u>1</u> Un <u>0</u> Ov <u>1</u> Sh <u>1</u> Ro	amounts, but n j., very large be op, well-defined adercut bank verhanging v hallows (in sle potmats (1)	egetation (1)	r in small amount t water, large dia 2 Pools	is of highest qu meter log that > 70cm (2) vads (1)	uality; 3 -H is stable, <u>1</u>	lighest qu well dev Oxbow Aquati	uality in mo	oderate or twad in de vaters (1) ohytes (1	greater eep / fast	AMOU Check ONE (or 2 Extensive >75% Moderate 25-75% Sparse 5-<25% Nearly absent	2 & average) % (11) 5% (7) 6 (3) <5% (1)
COMMENT	S										Cover ^{imum} 16
			Check ONE in e		(0r28c)	worago)					20
SINUOSITY		DEVELOPMENT				• •	TABILITY				
High (4)	<	Excellent (7)	Nor	ne (6)	-	\$	High (3)			Ch	annel
 Moderate Low (2) 		[»] Good (5) [⊳] Fair (3)		overed (4)			Moderate Low (1)	∋ (2)			kimum 14
◇ None (1)		Poor (1)		ent or no rec	covery (2011 (1)				20
COMMENT	S										
4- BANK	EROSION	& RIPARIAN Z	DNE Check	ONE in each	category	for <i>EACI</i>	H BANK (C	Or 2 per b	ank & avei	rage)	
	king downstrea		ARIAN WIDTH				FLC	DOD PLA	IN QUAL	ITY	
LR		L R ◇ ◇ Wide >!	50m (4)	L R ◇	orest, S	wamp (3	3)		L R ◇ ◇ Coi	nservation Tillage	e (1)
◇ ◇ None o ◇ ◇ Modera			te 10-50m (3)		Shrub or					oan or Industrial (,
		◇ ◇ Narrow	5-10m (2) rrow <5m (1)		enced p		, New fiel 1)	d (1)		ning, construction predominant land use	• •
	.,	◊ ◊ None (0			•	•	wcrop (0))	,	m riparian.	iparian
COMMENT	s										aximum 3 10
5-POOL/0	GLIDE ANI	D RIFFLE/RUN	QUALITY								1
MAXIMUI Check ONE (* >1m (6) * 0.7-<1m * 0.4-<0.7i * 0.2-<0.4i * <0.2m (0 COMMENTS	M DEPTH (ONLY!) (4) (4) m (2) (1) (metric=0)	CHANNEL \ Check ONE (or 2 ◇ Pool width > riffle ◇ Pool width = riffle ◇ Pool width < riffle	WIDTH & average) width (2) width (1)	 ◇ Torrential ◇ Very Fast ◇ Fast (1) ◊ Moderate 	l (-1) : (1) (1)	ALL that a * Slow < Inter < Inter < Eddi	apply v (1) stitial (-1) mittent (-			CREATION POTE	act htact on back)
Indicate for	functional ri	iffles; Best areas m	ust be large en	ough to sup	port a p	opulatio	n of riffle	-obligate	species	∶	(metric=0)
	Cheo	ck ONE (<i>ONLY!</i>)	_		Che	eck ONE	(or 2 & ave	erage)	-		
	FFLE DEPTH as >10cm (2)	-	N DEPTH m >50cm (2)	RIFFI ♦ Stable (e	LE/RUN				E/RUN EN None (2)	MBEDDEDNESS	
Or Best Area	as 5-10cm (1))	m <50cm (2)	 Stable (e Mod. Sta 	-			\$ L	.ow (1)	Ma	f le/Run ximum ()
	as <5cm _{(metric}		.,	◊ Unstable				∩) ◇ľ	<i>l</i> oderate Extensive	(0)	8
COMMENT	s									× 7	<u> </u>
6-GRADII	ENT										

 (4.798 ft/mi)
 ◇ Very low – Low (2-4)
 % POOL: 30
 % GLIDE: 0
 Gradient

 DRAINAGE AREA
 ※ Moderate (6-10)
 ※ Moderate (6-10)
 Maximum
 6

 (18.199 mi²)
 ◇ High – Very high (10-6)
 % RUN: 70
 % RIFFLE: 0
 10



Deep pool at start of sampling reach; Pool area >100ft^2; Pool depth >3ft.

A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
◇ >85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		♦ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
» 30%-<55%	◊ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
^{>} 10%-<30%	Discoloration	◇ Spray		Construction BMPs	◊ Sediment BMPs	
<10% - Closed	♦ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	♦ Bank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	Quarry Mine	◊ Golf	◇ Home
51 Middl	е	Impounded	Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

NE 🤇	<u>0</u>	WQ	Biolo	ogica	I St	tudies Q	HEI (Qual	itativ	e Ha	bitat E	valuatior	<u>n Index)</u>
Sample # QHEI	Туре	bioSan	nple #	St	ream	Name				Locati	on		
AB48037 Fish		21T014	1.5	М	utton	Creek				CR 80	0 North		
	mple I	Date	County		Ν	Vacro Sample	Туре	⊗ Hah	itat Com	nloto		QHEI Sco	ore: 52
CWY 8/3	30/21		Jackson			N/A		° пар		Jiele			52
<u>1-SUBSTRATE</u>	(Check O l estimate	NLYTwo % or note	substrate every type	TYPE	EBOXES; sent				Cł	neck ONE (a	r 2 & average)	
BEST TYPES						ER TYPES				0	RIGIN	QUALITY	
		TOTAL	POOL	RIFFLE			TOTAL	POOL	RIFFLE			SILT	
◊ ◊ Bldrs/Slabs (10)) _				$\diamond \diamond H$	lardpan (4)		X	x		stone (1)	Heavy (-2)	Substrate
◊ ◊ Boulders (9)	-				$\diamond \diamond D$	Detritus (3)		x		♦ Tills ♦ Wetl	(1) ands (0)	 ♦ Moderate (-1) ♦ Normal (0) 	·
◊ ◊ Cobble (8)	-				◇ ◇ N	/luck (2)		X		♦ Hard	lpan (Ò)	◇ Free (1)	12
◊ ◊ Gravel (7)	-				◊ ◊ \$	Silt (2)		x		◇ Sanc ◇ Rip/F	Istone (0) Rap (0)	EMBEDDEDNESS ♦ Extensive (-2	
♦ ♦ Sand (6)	-		x	x	\$ \$ A	Artificial (0)		Х		◇ Lacu	strine (0)	♦ Moderate (-1)	, maximum
◊ ◊ Bedrock (5)						(Scc			es; ignore	 ◇ Shal ◇ Coal 	e (-1) fines (-2)	 Normal (0) ◇ None (1) 	
NUMBER OF BES	эт тү	PES:		r more (2)		sludge	from poin	nt-sources)	• Coai	iiies (-2)	· None (1)	
COMMENTS			∞ 3 0	r less (0)									
2-INSTREAM C 2-Moderate amounts, amounts (e.g., very la water, or deep, well-d 1 Undercut 1 Overhang	but not irge bou efined, banks ing ve	t of highe ulders in function (1) getatior	est quality deep or fa al pools. 	or in sma ast water, 2 0	ll amoi large d Poo Roo	unts of highest of diameter log tha ols > 70cm (2) otwads (1)	quality; 3- I t is stable	Highest q , well dev _ Oxbov _ Aquati	uality in mo reloped roc vs, Backv ic macrop	oderate o otwad in vaters (ohytes (or greater deep / fast 1) 1)	AMOU Check ONE (or Extensive >75 Moderate 25-7 Sparse 5-<25%	2 & <i>average</i>) % (11) 5% (7) % (3)
<u> </u>		w water	·) (1) _	0	Bou	ılders (1)	1	_Logs a	and wood	ly debri	s (1)	Nearly absent	<5% (1)
	(1)											Max	Cover kimum 11 20
SINUOSITY	◇◇◇	EVELOF Excelle Good (Fair (3) Poor (1)	nt (7) 5)		◇ N ◈ R ◇ R	ANNELIZATIO Ione (6) Recovered (4) Recovering (3) Recent or no re		\$	TABILITY High (3) Moderate Low (1)				h annel ximum 20
4- BANK EROS	ION 8	& RIPA		ZONE	Che	eck ONE in each	category	for EAC	H BANK (Or 2 per	bank & aver	age)	
River right looking dow				PARIAN	WIDT				FLC	DOD PL	AIN QUALI	ТҮ	
EROSIO L R ◇ ◇ None or little (: ◇ ◇ Moderate (2) ◇ ◇ Heavy/Severe	3)	 <!--</td--><td> ♦ Mode ♦ Marro </td><td>>50m (4) rate 10-5 w 5-10m narrow < (0)</td><td>0m (3 (2)</td><td>3)</td><td>Forest, S Shrub or Resident Fenced p</td><td>Old fiel tial, Park basture (</td><td>d (2) k, New fiel</td><td>.,</td><td>◇ ◇ Urb ◇ ◇ Min</td><td>' F</td><td>(0) n (0) e(s) Riparian</td>	 ♦ Mode ♦ Marro 	>50m (4) rate 10-5 w 5-10m narrow < (0)	0m (3 (2)	3)	Forest, S Shrub or Resident Fenced p	Old fiel tial, Park basture (d (2) k, New fiel	.,	◇ ◇ Urb ◇ ◇ Min	' F	(0) n (0) e(s) Riparian
COMMENTS												101	aximum 3 10
5-POOL/GLIDE	AND	RIFFL	_E/RUN		<u>ITY</u>								
MAXIMUM DEPT Check ONE (<i>ONLY</i> !)	<!--</td--><td>Check Pool wi Pool wi</td><td>k ONE (or idth > riff idth = riff</td><td>L WIDTH 2 & avera ile width ile width ile width</td><td>(2) (1)</td><td> ◇ Torrentia ◇ Very Fas ◇ Fast (1) ◇ Moderate Indicate </td><td>al (-1) st (1) e (1)</td><td>ALL that a * Slow * Inter * Inter * Edd</td><td>apply</td><td>•</td><td><</td><td></td><td>act ntact</td>	Check Pool wi Pool wi	k ONE (or idth > riff idth = riff	L WIDTH 2 & avera ile width ile width ile width	(2) (1)	 ◇ Torrentia ◇ Very Fas ◇ Fast (1) ◇ Moderate Indicate 	al (-1) st (1) e (1)	ALL that a * Slow * Inter * Inter * Edd	apply	•	<		act ntact
Indicate for functio	nal rif	fles; Be	st areas	must be	large	enough to su	pport a p	opulatio	on of riffle	e-obliga	te species:		e (metric=0)
RIFFLE DE	Check EPTH m (2) :m (1)	ONE (C	ONLY!) R ◇ Maxin	UN DEP num >500 num <500	- FH :m (2)	RIFF)	Ch FLE/RUN e.g. cobl able (e.g	eck ONE SUBST ble, boul large g	(or 2 & avi RATE Ider) (2) Jravel) (1)	erage) RIFF 0)		IBEDDEDNESS Rin (0)	ffle/Run aximum 8
6-GRADIENT													
(4.798 ft/mi) DRAINAGE AREA (18.199 mi ²)			<	> Very lo > Modera > High – `	te (6-			OOL: 20 RUN: 80		6 GLIDE RIFFLE			r adient ximum 6 10

6/8/2022 10:08:17 AM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index), Page 1 of 2



Pool depth >3ft

A-CANOPY	B-AESTHETICS	<u>C-M</u>	AINTENANCE		D-ISSUES	
[⊳] >85% - Open	Nuisance algae	◊ Public	◇ Private	◇ WWTP		♦ CSO
55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
◇ 30%-<55%	♦ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
> 10%-<30%	Oiscoloration	◊ Spray		◇ Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◊ Foam/Scum			◇ Logging	◇ Irrigation	Cooling
	◊ Oil sheen	Leveed – One side	led	♦ Bank Erosion	Surface Erosion	♦ H2O table
	♦ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	Quarry Mine	◊ Golf	◇ Home
69 Middle		Impounded	Desiccated	◇ Park	◇ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

Sample # QHE	І Туре	bioSan	nple #	St	tream Na	me				Loca	tion			
AB47653 Fish		21T001		V	ernon For	k Muscata	tuck Rive	ŕ		CR 6	00 South			
-	ample	Date	County			ro Sample	е Туре		oitat Com	plete		QHEI Sco	re:	55
	/24/21	Check O	Jacksor	n substrate						P .010				
<u>1-SUBSTRATE</u>				e every typ						0	Check ONE (c	or 2 & average)		
BEST TYPES					OTHER	TYPES				(ORIGIN	QUALITY		
		TOTAL	POOL	RIFFLE			TOTAL	POOL	RIFFLE			SILT	0	
◊ ◊ Bldrs/Slabs (1	0)				$\diamond \diamond$ Harc	• • • •		<u>x</u>		_ ◇ Lin ♦ Till	nestone (1)	 ◇ Heavy (-2) ◈ Moderate (-1) 		bstrate
◊ ◊ Boulders (9)					◇ ◇ Detr	• •		<u>x</u>	x		tlands (0)	 Normal (0) 		11
◊ ◊ Cobble (8)				~	◇ ◇ Muc	• •		<u>x</u>	·		rdpan (0)	◇ Free (1)		
◇ ◇ Gravel (7)				x	◊ ◊ Silt			<u>x</u>	X		ndstone (0) /Rap (0)	EMBEDDEDNESS ♦ Extensive (-2)	Ma	aximum
* * Sand (6)			x	x	◇ ◇ Artif	icial (0)		x	· . <u> </u>		ustrine (0)	Moderate (-1)		20
◇ ◇ Bedrock (5)	· • • • •					(Sc			tes; ignore	♦ Co:	ale (-1) al fines (-2)	◇ Normal (0)◇ None (1)		
NUMBER OF BE	5111	PES:		r more (2 r less (0)			sludge	from poir	nt-sources)				
COMMENTS				1 1035 (0)										
2-INSTREAM	COVE	R Indicat	to nroson	ce 0 to 3.	0 -Absent	1-\/erv sma	all amount	or if mor		ofma	rainal quality:	A.M.O.I		
2-Moderate amounts	s, but no	ot of highe	est quality	/ or in sma	II amounts	of highest	quality; 3-	Highest q	juality in m	oderate	e or greater	AMOU Check ONE (or 2		rane)
amounts (e.g., very l water, or deep, well-				ast water,	large dian	neter log tha	at is stable	, well dev	eloped ro	otwad i	n deep / fast	 Extensive >759 		uge)
2 Undercut		,		2	Pools >	• 70cm (2)	1	Oxbov	ws, Back	waters	(1)	Moderate 25-7	5% (7)	
0 Overhan	ging ve	egetatior	n (1)	1	Rootwa	ads (1)	0	Aquat	ic macro	phytes	s (1)	* Sparse 5-<25%	o (3)	
0 Shallows		ow water)(1)	0	Boulde	rs (1)	1	_ Logs a	and wood	dy deb	ris (1)	Nearly absent	<5% (1)
2 Rootmat	s (1)												Cover	ı
COMMENTS													imum 20	12
3-CHANNEL M	IORP	HOLOC	<u>SY</u>	Check	ONE in ea	ach categor	y (Or 2 &	average)						<u></u>
SINUOSITY		EVELOF				NELIZATI	NC	-	TABILIT					
◇ High (4)◇ Moderate (3)		Excelle Good (5 Cood (5	• •		◇ Non ◇ Rece	e (6) overed (4)			High (3) Moderat			-	annel	
* Low (2)		• Fair (3)				overing (3			Low (1)			Max	kimum 20	9
None (1) COMMENTS	\$	Poor (1)		◇ Rece	ent or no r	ecovery	(1)						
4- BANK ERO						ONE in eac	h category	for EAC		-	er bank & aver	•		
River right looking dov EROSIC			. R	PARIAN	WIDTH	L	R		FL		LAIN QUAL	IIY		
	(2)	\diamond	◊ Wide	>50m (4)		\diamond \diamond	Forest, \$				◊ ◊ Cor	servation Tillage		
 None or little Moderate (2) 	(3)			erate 10-5 ow 5-10m			Shrub o Residen		ld (2) k, New fie	eld (1)		an or Industrial (ing, constructior		
◊ ◊ Heavy/Severe	e (1)	\diamond	◊ Very	narrow <	• •	\diamond \diamond	Fenced	pasture ((1)		Indicate p	predominant land use	• •	h
		\$	♦ None	(0)		* *	Open Pa	sture/Ro	owcrop (0))	past 100r		ipariaı	
COMMENTS												Ma	aximun 1	
5-POOL/GLIDE		D RIFFL	E/RUN		ITY									
MAXIMUM DEP	тн	c	HANNE	L WIDTH			CURRE	NT VELO	OCITY					
Check ONE (ONLY!				r 2 & avera				ALL that a Slov ∜ Slov			RE	CREATION POTE		•
∜ >1m (6) ◇ 0.7-<1m (4)				fle width fle width		◇ Torrenti ◇ Very Fa	• •		rstitial (-1	1)		 Frimary Cond Secondary Cord 		
◇ 0.4-<0.7m (2)				fle width	(0)	Fast (1)	.,	Intel	rmittent (le one and comment		c)
◊ 0.2-<0.4m (1)						Moderat *	• •		lies (1) and riffles.		(0.10	Pool/C		,, 1
	;=U)							2000					imum 12	9
Indicate for functi	onal ri	ffles; Be	st areas	must be	large en	ough to su	ipport a j	oopulatio	on of riffl	e-oblig	ate species	◊ No Riffle		ic=0)
		k ONE (C	,						(or 2 & av	• •				
RIFFLE D ♦ Best Areas >100				RUN DEP [.] num >500		RIF ♦ Stable	FLE/RUN (e.a. cob			RIF	FLE/RUN EN ◇ None (2)	ABEDDEDNESS		1
Sest Areas 5-10	cm (1)			num <50	• •			•	gravel) (1))	◇ Low (Ì)	1/1=	f le/Rui ximum	-
◊ Best Areas <5cr	n _{(metric}	:=0)				♦ Unstab	ole (e.g. s	and, fine	e gravel)	(0)	 Moderate Extensive 	(0)		3
COMMENTS												<u> </u>		
6-GRADIENT		_						-						_
(1.343 ft/mi)				◊ Very lo		(2-4)	% P(OOL: 45	C	% GLI	DE: 0		adient	-
DRAINAGE AREA (391.167 mi ²)				♦ Modera ♦ High – ¹	ite (6-10) Very higi	n (10-6)	% I	RUN: 35	%		E: 20	Max	amum 10	6



Floating algal mats; Pool area >100ft^2; Pool depth > 3ft.

A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
[⊳] >85% - Open	Nuisance algae	◊ Public	◊ Private	◊ WWTP		♦ CSO
◇ 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
◇ 30%-<55%	◊ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
[≫] 10%-<30%	Discoloration	◊ Spray		◇ Construction BMPs	♦ Sediment BMPs	
[⊳] <10% - Closed	◊ Foam/Scum			◇ Logging	Irrigation	Cooling
	◊ Oil sheen	Leveed – One side	ded	♦ Bank Erosion	♦ Surface Erosion	♦ H2O table
	Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	Lagoon
		Stable - Bedload				
12 Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◇ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
60 Middle	1	Impounded	Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
12 Left						

				•				aud	many			Evaluatio	
Sample # AB47654	QHEI Type Fish	bioSam 21T002	•		eam Name assy Creek	-				Locat			
Surveyor	Sample		County	Gra	,	Sample	Type				0	QHEI Sco	oro-
KRW	8/24/21		Jackson		N/A	oumpie	, i ype	♦ Hab	oitat Com	plete			JIE.
1-SUBST	TRATE				TYPE BOXE	ES;	I			C	heck ONE (or 2 & average)	
BEST TYP		estimate	% or note	e every type	e present DTHER T	YPES						QUALITY	
		TOTAL	POOL				TOTAL	POOL	RIFFLE	-			
◇ ◇ Bldrs/S	Slabs (10)				◇ ◇ Hardpa	an (4)			. <u> </u>		estone (1)	SILT ◇ Heavy (-2)	Substr
◇ ◇ Boulde	ers (9)				◇ ◇ Detritu	ıs (3)				♦ Tills ♦ Wet	(1) lands (0)	 Moderate (-1 Normal (0) 	<i>`</i>
◊ ◊ Cobble	e (8)				◇ ◇ Muck ((2)		Х	·	_ ◇ Har	dpan (0)	 Free (1) 	12
◊ ♦ Gravel	l (7)		х	<u>x</u>	◇ ◇ Silt (2)	1		x	x		dstone (0) Rap (0)	EMBEDDEDNESS	
♦ ♦ Sand ((6)		х	<u>x</u>	◇ ◇ Artifici	ial (0)				_	ustrine (0)	♦ Moderate (-1	, maxim
◇ ◇ Bedroo						(Sco			es; ignore	$\sim coa$	le (-1) I fines (-2)	 Normal (0) ◇ None (1) 	
NUMBER	OF BEST T	YPES:		r more (2) r less (0)			sludge	from poir	nt-sources)) 000			
COMMENT	TS			1033 (0)									
2-INSTR	EAM COVE	ER Indicat	e presen	ce 0 to 3. 0	-Absent: 1-\	Verv sma	II amounts	s or if mor	e commor	n of mar	ninal quality.	AMO	
2-Moderate amounts (e.s water, or der 0 U 1 O 1 Si	amounts, but r .g., very large b eep, well-define Indercut bank Overhanging v Shallows (in sl	not of highe boulders in d, functiona (s (1) regetation	st quality deep or fa al pools. (1)	or in small ast water, la 1 0	amounts of	f highest o ter log tha 7 0cm (2) s (1)	quality; 3 - at is stable 0 1	Highest q , well dev Oxbov Aquat	uality in m	oderate otwad in waters phytes	or greater deep / fast (1) (1)	Check ONE (or Check ONE (or Extensive >75 Moderate 25-7 Sparse 5-<25 Nearly absent	² 2 & average 5% (11) 75% (7) % (3)
	ootmats (1)												0 au rain
COMMENT	TS											Ma	Cover ximum 1 20
3-CHANI	NEL MORF	PHOLOG	<u>Y</u>	Check (ONE in each	n category	y (Or 2 &	average)					
SINUOSITY High (4) Moderate Low (2) None (1) COMMENT	e (3)	DEVELOP	nt (7))		CHANNE ◇ None (◇ Recove ◇ Recove ◇ Recone	(6) ered (4) ering (3))		TABILITY High (3) Moderat Low (1)				hannel aximum { 20
	-		DIAN										
	CEROSION			<u>ZONE</u> PARIAN V		IE in each	h category	for EAC		-	^r bank & aver L AIN QUAL	•	
L R * * None c * * Moder	EROSION or little (3)	L ◇ ◇ ◇	R ◇ Wide ◇ Mode ◇ Narro	>50m (4) rate 10-50 w 5-10m (narrow <5)m (3) (2)	$\begin{array}{c} \diamond \ \diamond \\ \diamond \ \diamond \\ \diamond \ \diamond \end{array}$	Forest, S Shrub of Residen Fenced	r Old fiel tial, Park pasture (3) d (2) <, New fie	eld (1)	L R ◇ ◇ Cor ◇ ◇ Urb ◇ ◇ Min Indicate µ	nservation Tillag nan or Industrial ning, constructio predominant land us m riparian.	(0) on (0) se(s) Riparian
COMMENT	TS											7	laximum 10
5-POOL/	/GLIDE AN		E/RUN		TY								
Check ONE) n (4) 7m (2) 4m (1) (0) _(metric=0)	-	t ONE (م) dth > rifl dth = rifl	fle width (2)	Torrentia Very Fas Fast (1) Moderat	Check al (-1) st (1) ce (1)	◇ Inte ◇ Edd	apply	(-2)			tact entact ht on back) Current ximum
Indicate fo	or functional r	iffles: Bes	st areas	must be l	arge enou	gh to su	ipport a r	opulatio	on of riffle	e-oblia	ate species	⊗ No Piff	12 e (metric=0
RI ◇ Best Are ◇ Best Are ◇ Best Are	Che IFFLE DEPTH eas >10cm (2) eas 5-10cm (1 eas <5cm _{(metri}	ck ONE (O I)	NLY!) R ◇ Maxin	UN DEPT num >50c num <50c	"H m (2) ◇ m (1) ◇	RIFI Stable (Mod. St	۲۰۰۰ Ch FLE/RUN (e.g. cob table (e.ç	eck ONE SUBST ble, bou J. large g	(or 2 & av RATE	verage) RIFF)	•	MBEDDEDNESS Ri (0)	iffle/Run laximum 8
<u>6-GRADI</u> (1.972 DRAINAGE (12.633	ft/mi) E AREA		<	> Moderat	v – Low (2- :e (6-10) /ery high ('	•		DOL: 30 RUN: 0		% GLID 6 RIFFL			a radient aximum 10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Vuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
[°] 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
[»] 30%-<55%	♦ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
[•] 10%-<30%	Discoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	Sank Erosion	◊ Surface Erosion	◇ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
62 Middle	e	Impounded	Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

		<u>owq</u>	Biolo	ogical	Studie	<u>s QHE</u>	I (Q	ual	itativ	e H	abitat E	valuatio	on Inde	<u>ex)</u>
Sample #	QHEI Type	bioSar	nple #	Stre	eam Name					Loca	ition			
AB47657	Fish	21T00		Joh	n McDonald	Ditch					25 South			
Surveyor	Sample	e Date	County		Macro Sa	ample Type		* Uah	itat Came			QHEI So	core:	29
KRW	8/24/21		Jackson		N/A			∞ нар	itat Comp	piete				29
<u>1-SUBST</u>	RATE			substrate 7 e every type	YPE BOXES;					(Check ONE (o	or 2 & average)		
BEST TYP	PES	ootiinate	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		THER TYP	ES				(ORIGIN	QUALIT	Y	
		TOTAL	POOL	RIFFLE		тот	AL P	OOL	RIFFLE			SILT		
◊ ◊ Bldrs/S	ilabs (10)			♦	♦ Hardpan	(4)					nestone (1)	* Heavy (-2)		strate
◊ ◊ Boulde	rs (9)			<u> </u>	♦ Detritus ((3)				♦ Tills ♦ We	s (1) tlands (0)	 ◇ Moderate (◇ Normal (0) 		
$\diamond \diamond \textbf{Cobble}$	(8)			<u> </u>	* * Muck (2)		<u>x</u>		x		rdpan (0)	 Free (1) 		0
◊ ◊ Gravel	(7)			~	◇ Silt (2)		<u>x</u>				ndstone (0) b/Rap (0)	EMBEDDEDNES		
◊ ◊ Sand (6	5)			◇	♦ Artificial	(0)				♦ Lac	custrine (0)	 ♦ Moderate (a inda	amum 20
◊ ◊ Bedroc						(Score nat	ural su	ubstrate	es; ignore	◇ Sha	ale (-1) al fines (-2)	 ◇ Normal (0) ◇ None (1) 		
NUMBER	OF BEST T	YPES:		r more (2)		sluc	lge fro	m poin	t-sources)	~ 60	ai fines (-2)	V None (1)		
COMMENT	S		⊗ 3 0	r less (0)										
2-Moderate a amounts (e.g water, or dee 0 Ur 1 Ov	EAM COVI amounts, but r g., very large b ep, well-define ndercut bank verhanging v nallows (in s potmats (1)	not of high ooulders in d, function (s (1) /egetation	est quality deep or fa nal pools. n (1)	or in small ast water, la 0 1	amounts of hig	ghest quality log that is sta m (2) 1)	; 3 -Hig ible, w 0	hest qu ell devo Dxbow Aquati	uality in mo	oderate otwad in vaters ohytes	e or greater n deep / fast s (1) s (1)	AMC Check ONE (Check ONE (Extensive > Moderate 25 Sparse 5-<2 Nearly abse	75% (11) 5-75% (7) 5% (3)	
COMMENT	.,											Μ	Cover Iaximum 20	8
SINUOSITY	e (3)	DEVELO ◇ Excelle ◇ Good (◇ Fair (3) ◈ Poor (1	ent (7) 5)		CHANNELIZ None (6) Recovered Recovering Recent of	ed (4) ng (3)	ry (1)		TABILITY High (3) Moderate Low (1)				Channel ⁄Iaximum 20	4
4- BANK	EROSION	& RIP		ZONE	Check ONE i	in each cated	ory fo	r EACI	H BANK (Or 2 pe	er bank & aver	age)		
River right loo	king downstrea			PARIAN W	IDTH		, ,		FLC		LAIN QUALI	TY		
E R ♦ ♥ None o ◊ ◊ Modera ◊ ◊ Heavy/	ate (2)	ہ د د د	> ◇ Mode > ◇ Narro	>50m (4) rate 10-50 w 5-10m (2 narrow <5i (0)	2)	L R * * Fores > > Shrut * > Resid > > Fence > * Open	o or O ential ed pas	ld field , Park sture (d (2) , New fiel 1)	. ,	◇ ◇ Urb ◇ ◇ Min	aservation Tilla an or Industria ing, constructioned oredominant land of n riparian.	al (0) ion (0) use(s) Riparian	
COMMENT	-												Maximum 10	9
	<u>GLIDE AN</u>				<u> </u>									
MAXIMUI Check ONE > 1m (6) > 0.7-<1m > 0.4-<0.7i > 0.2-<0.4i > <0.2m (0 COMMENT	(4) m (2) m (1) 0) _(metric=0)	Chec ◇ Pool w ◇ Pool w	idth > rifi idth = rifi	L WIDTH r 2 & averag fle width (2 fle width (1 fle width (0	2)	Che rrential (-1) ry Fast (1)	ck ALI	◇ Inter ◇ Eddi	apply v (1) rstitial (-1 rmittent (- ies (1)		<		ontact Contact	4
Indicate for	functional r	iffles; Be	st areas	must be la	irge enough	to support	a pop	oulatio	on of riffle	e-oblig	jate species:	* No Rif	ifle (metric	;=0)
RII ◇ Best Area ◇ Best Area	Che FFLE DEPTH as >10cm (2) as 5-10cm (1 as <5cm _{(metr}	eck ONE (0 	ONLY!) R ◇ Maxin	UN DEPTH num >50cn num <50cn	H n (2) ◇ St n (1) ◇ M	RIFFLE/R table (e.g. c od. Stable (nstable (e.g	Check UN SU obble e.g. la	CONE UBSTF , boul arge g	(or 2 & ave RATE der) (2) ravel) (1)	erage) RIF		IBEDDEDNES		0
6-GRADI														
(2.349 f DRAINAGE (4.799 r	ft/mi) AREA		<	> Moderate	– Low (2-4) ∋ (6-10) ery high (10-		900 % RU			6 GLIE RIFFI	DE: 100 LE: 0		Gradient ⁄laximum 10	4



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Vuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◇ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
[≫] 10%-<30%	Discoloration	◇ Spray		◇ Construction BMPs	Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	Oil sheen	Leveed – One side	ded	◇ Bank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◇ Golf	◇ Home
13 Middle	9	Impounded	Desiccated	◇ Park	◊ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

Sample # QHEI Typ	e bioSample #	Stream Na	ame			Location		
AB47666 Macro	210816902	Mutton Cre	eek			CR 800 North		
Surveyor Samp	le Date County	Mac	cro Sample Typ	e 🔬 🔬 Uph	itat Comp	loto	QHEI Scor	'e: 52
JMB 8/16/2		MH		· nau	ntat Comp	iele		52
<u>1-SUBSTRATE</u>	Check ONLY Two s estimate % or note					Check ONE	(or 2 & average)	
BEST TYPES			TYPES			ORIGIN	QUALITY	
	TOTAL POOL	RIFFLE	то	TAL POOL	RIFFLE		SILT	
◊ ◊ Bldrs/Slabs (10)			dpan (4)	X		Limestone (1)) \land Heavy (-2)	Substrate
◇ ◇ Boulders (9)		<u> </u>	ritus (3)	Х		◇ Tills (1)	 Moderate (-1) Normal (0) 	
◇ ◇ Cobble (8)			ck (2)			 Wetlands (0) Hardpan (0) 	◇ Normal (0) ◇ Free (1)	9
◇ ◇ Gravel (7)	<u> </u>	≺	(2)	Х		Sandstone (0)) EMBEDDEDNESS	
◊ * Sand (6)	х х	≺	ficial (0)			 Rip/Rap (0) Lacustrine (0) 	 Extensive (-2) Moderate (-1) 	Maximum
◊ ◊ Bedrock (5)			··· <u> </u>	atural substrat		◊ Shale (-1) `	Normal (0)	20
NUMBER OF BEST	TYPES:	more (2)		idge from poir		Coal fines (-2)) ◇ None (1)	
	* 3 or	less (0)						
COMMENTS								
2-INSTREAM COV 2-Moderate amounts, but								Т
1 Undercut ban	. ,		> 70cm (2)	1 Oxbov	vs, Backw	aters (1)	♦ Moderate 25-75	% (7)
2 Shallows (in s	• • –	0 Rootw 0 Boulde	.,	1 Aquat	•	hytes (1) y debris (1)	 Sparse 5-<25% ◇ Nearly absent 	.,
	• • –		.,	- <u> </u>	•	•	◇ Nearly absent	5% (1) Cover
2 Shallows (in s 2 Rootmats (1)	slow water) (1)	0 Boulde	.,	<u>1</u> Logs :	•	•	◇ Nearly absent < C	Sover 12
2 Shallows (in s 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY	slow water) (1)	0 Boulde	ers (1)	2 & average)	and woody	•	◇ Nearly absent < C	Sover 12
2 Shallows (in s 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY	slow water) (1)	0_ Boulde Check ONE in e CHAN ◇ Non	ers (1)	Logs : Logs : 2 & average) S ◇	and woody	y debris (1)	◇ Nearly absent < C Maxin	s5% (1) cover 12 20 12
2 Shallows (in s 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY [⊗] High (4) [◊] Moderate (3) [◊] Low (2)	Slow water) (1) PHOLOGY DEVELOPMENT ◇ Excellent (7) ◇ Good (5) ◇ Fair (3)	0_ Boulde Check ONE in e CHAN ◇ Non ◈ Rec ◇ Rec	ers (1)	Logs : Logs : 2 & average) S ⇔ ⊗ ⊗	TABILITY High (3)	y debris (1)	◇ Nearly absent < C Maxin	Cover mum 12 20
2 Shallows (in s 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY [§] High (4) [◊] Moderate (3) [◊] Low (2) [◊] None (1)	Slow water) (1) PHOLOGY DEVELOPMENT ◇ Excellent (7) ◈ Good (5)	0_ Boulde Check ONE in e CHAN ◇ Non ◈ Rec ◇ Rec	ers (1)	Logs : Logs : 2 & average) S ⇔ ⊗ ⊗	TABILITY High (3) Moderate	y debris (1)	◇ Nearly absent < C Maxin	annel
2 Shallows (in s) 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY * High (4) ◇ Moderate (3) ◇ Low (2) ◇ None (1) COMMENTS	slow water) (1) PHOLOGY DEVELOPMENT ◇ Excellent (7) ◇ Good (5) ◇ Fair (3) ◇ Poor (1)	0_ Boulde Check ONE in e CHAN ◇ Non ◇ Rec ◇ Rec ◇ Rec	ers (1) each category (<i>Or</i> INELIZATION he (6) covered (4) covering (3) covering (3)	2 & average) 2 & average) S ◇ ery (1)	TABILITY High (3) Moderate Low (1)	y debris (1)	◇ Nearly absent < C Maxin Cha Maxin	annel
2 Shallows (in s 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY High (4) Moderate (3) Low (2) None (1) COMMENTS 4- BANK EROSIOI	slow water) (1) PHOLOGY DEVELOPMENT ◇ Excellent (7) ◇ Good (5) ◇ Fair (3) ◇ Poor (1) N & RIPARIAN Z	0 Boulde Check ONE in e CHAN ◇ Non ◇ Rec ◇ Rec ◇ Rec ONE Check	ers (1)	2 & average) 2 & average) S ◇ ery (1)	TABILITY High (3) Moderate Low (1)	y debris (1) (2) Dr 2 per bank & av	◇ Nearly absent < C Maxin Cha Maxin Verage)	annel
2 Shallows (in s) 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY * High (4) ^ Moderate (3) > Low (2) > None (1) COMMENTS	slow water) (1) PHOLOGY DEVELOPMENT ◇ Excellent (7) ◇ Good (5) ◇ Fair (3) ◇ Poor (1) N & RIPARIAN Z	0_ Boulde Check ONE in e CHAN ◇ Non ◇ Rec ◇ Rec ◇ Rec	ers (1) each category (<i>Or</i> INELIZATION he (6) covered (4) covering (3) covering (3)	2 & average) 2 & average) S ◇ ery (1)	TABILITY High (3) Moderate Low (1)	y debris (1)	◇ Nearly absent < C Maxin Cha Maxin Verage)	annel
2 Shallows (in s 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY * High (4) ^ Moderate (3) > Low (2) > None (1) COMMENTS 4- BANK EROSION River right looking downstre EROSION L R	slow water) (1) PHOLOGY DEVELOPMENT ◇ Excellent (7) ◇ Good (5) ◇ Fair (3) ◇ Poor (1) N & RIPARIAN Z eam L R ◇ ◇ Wide >	0 Boulde Check ONE in e CHAN ◇ Non ◇ Rec ◇ Rec ◇ Rec ONE Check ARIAN WIDTH -50m (4)	ers (1) each category (<i>Or</i> INELIZATION he (6) covering (3) covering (3) eent or no recov ONE in each cate L R \diamond \diamond Fore	2 & <i>average</i>) 2 & <i>average</i>) S ◇ ery (1) egory for <i>EAC</i>	TABILITY High (3) Moderate Low (1) <i>H BANK</i> (C FLC 3)	y debris (1) (2) (2) (2) (2) (2) (2) (2) (2	◇ Nearly absent < Comparing Maxin Cha Maxin Verage) NLITY onservation Tillage	(1) 5% (1) 50ver 20 12 12 12 14 (1)
2 Shallows (in state 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY * High (4) > Moderate (3) > Low (2) > None (1) COMMENTS 4- BANK EROSION River right looking downstre EROSION L R ◇ < None or little (3)	slow water) (1) PHOLOGY DEVELOPMENT ◇ Excellent (7) ◇ Good (5) ◇ Fair (3) ◇ Poor (1) N & RIPARIAN Z sam RIP L R ◇ ◇ Wide > ◇ ◇ Modera	0 Boulde Check ONE in e CHAN ◇ Non ◇ Rec ◇ Rec ○ Rec ONE Check ARIAN WIDTH -50m (4) ate 10-50m (3)	ers (1) each category (<i>Or</i> INELIZATION he (6) covering (3) covering (3) covering (3) cover no recov ONE in each cate L R $\diamond *$ Fore $\diamond \diamond$ Shru	2 & <i>average</i>) 2 & <i>average</i>) S ⇔ ery (1) egory for <i>EAC</i> est, Swamp (ib or Old fiel	TABILITY High (3) Moderate Low (1) <i>H BANK</i> (C FLC 3) d (2)	y debris (1) (2) (2) (2) (2) (2) (2) (2) (2	◇ Nearly absent < C Maxin Cha Maxin Verage) NLITY onservation Tillage rban or Industrial (0	(1) (1) (1) (1) (1)
2 Shallows (in s 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY * High (4) ^ Moderate (3) > Low (2) > None (1) COMMENTS 4- BANK EROSION River right looking downstre EROSION L R	slow water) (1) PHOLOGY DEVELOPMENT ◇ Excellent (7) ◇ Good (5) ◇ Fair (3) ◇ Poor (1) N & RIPARIAN Z sam L R ◇ Wide > ◇ Modera ◇ Narrow	0 Boulde Check ONE in e CHAN ◇ Non ◇ Rec ◇ Rec ○ Rec ONE Check ARIAN WIDTH -50m (4) ate 10-50m (3)	ers (1) each category (<i>Or</i> INELIZATION he (6) covering (3) covering (3) eent or no recover ONE in each cate L R $\diamond *$ Fore $\diamond \diamond$ Shru $\diamond \diamond$ Resi $\diamond \diamond$ Fenc	2 & <i>average</i>) 2 & <i>average</i>) 2 & <i>average</i>) S ⇔ ery (1) egory for <i>EAC</i> est, Swamp (b or Old fiel dential, Park ced pasture (TABILITY High (3) Moderate Low (1) <i>H BANK (C</i> FLC 3) d (2) c, New fiel (1)	y debris (1) (2) (2) (2) (2) (2) (2) (2) (2	◇ Nearly absent Conservation Tillage rban or Industrial (0 lining, construction e predominant land use((1) (1) (1) (0)
2 Shallows (in state 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY * High (4) > Moderate (3) > Low (2) > None (1) COMMENTS 4- BANK EROSION River right looking downstre EROSION L A < None or little (3)	slow water) (1) PHOLOGY DEVELOPMENT ◇ Excellent (7) ◇ Good (5) ◇ Fair (3) ◇ Poor (1) N & RIPARIAN Z sam L R ◇ Wide > ◇ Modera ◇ Narrow	0 Boulde Check ONE in e CHAN ◇ Non ◇ Rec ◇ Rec ◇ Rec ONE Check ARIAN WIDTH -50m (4) ate 10-50m (3) ◊ 5-10m (2) arrow <5m (1)	ers (1) each category (<i>Or</i> INELIZATION he (6) covering (3) covering (3) eent or no recover ONE in each cate L R $\diamond *$ Fore $\diamond \diamond$ Shru $\diamond \diamond$ Resi $\diamond \diamond$ Fenc	2 & <i>average</i>) 2 & <i>average</i>) 2 & <i>average</i>) 9 ery (1) egory for <i>EAC</i> est, Swamp (bo or Old fiel dential, Park	TABILITY High (3) Moderate Low (1) <i>H BANK (C</i> FLC 3) d (2) c, New fiel (1)	y debris (1) (2) (2) (2) (2) (2) (2) (2) (2	◇ Nearly absent Characteristic Characteristic Characteristic Characteristic Characteristic Characteristic Characteristic Verage) NLITY onservation Tillage rban or Industrial (0) lining, construction e predominant land use(00m riparian. Rij	(1) (1) (1) (1) (0) (1) (0) (1) (1) (1) (1) (1) (1) (2) (1) (1) (2) (1) (2) (1) (2) (1) (2) (1) (2) (1) (1) (1) (1) (1) (1) (1) (1
2 Shallows (in state 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY * High (4) > Moderate (3) > Low (2) > None (1) COMMENTS 4- BANK EROSION River right looking downstre EROSION L A < None or little (3)	slow water) (1) PHOLOGY DEVELOPMENT ◇ Excellent (7) ◇ Good (5) ◇ Fair (3) ◇ Poor (1) N & RIPARIAN Z sam RIP L R ◇ ◇ Wide > ◇ ◇ Modera ◇ ◇ Narrow ◇ ♥ Very na	0 Boulde Check ONE in e CHAN ◇ Non ◇ Rec ◇ Rec ◇ Rec ONE Check ARIAN WIDTH -50m (4) ate 10-50m (3) ◊ 5-10m (2) arrow <5m (1)	ers (1) each category (<i>Or</i> INELIZATION he (6) covering (3) covering (3) eent or no recover ONE in each cate L R $\diamond *$ Fore $\diamond \diamond$ Shru $\diamond \diamond$ Resi $\diamond \diamond$ Fenc	2 & <i>average</i>) 2 & <i>average</i>) 2 & <i>average</i>) S ⇔ ery (1) egory for <i>EAC</i> est, Swamp (b or Old fiel dential, Park ced pasture (TABILITY High (3) Moderate Low (1) <i>H BANK (C</i> FLC 3) d (2) c, New fiel (1)	y debris (1) (2) (2) (2) (2) (2) (2) (2) (2	◇ Nearly absent Characteristic Characteristic Characteristic Characteristic Characteristic Characteristic Characteristic Verage) NLITY onservation Tillage rban or Industrial (0) lining, construction e predominant land use(00m riparian. Rij	(1) (1) (1) (0) (5% (1) (1) (1) (0) (1)
2 Shallows (in standard structure) 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY * High (4) ◊ Moderate (3) ◊ Low (2) ◊ None (1) COMMENTS 4- BANK EROSIOI River right looking downstructure EROSION L R ◊ ◊ None or little (3) ◊ ◊ Moderate (2) * ◊ Heavy/Severe (1)	PHOLOGY DEVELOPMENT ◇ Excellent (7) ◇ Good (5) ◇ Fair (3) ◇ Poor (1) N & RIPARIAN Z am RIP L R ◇ ◊ Wide > ◇ ◊ Modera ◇ ◊ Narrow ◇ ◊ None (0	0 Boulde Check ONE in e CHAN ◇ Non ◎ Rec ◇ Rec ◇ Rec ONE Check ARIAN WIDTH -50m (4) ate 10-50m (3) / 5-10m (2) arrow <5m (1) 0)	ers (1) each category (<i>Or</i> INELIZATION he (6) covering (3) covering (3) eent or no recover ONE in each cate L R $\diamond *$ Fore $\diamond \diamond$ Shru $\diamond \diamond$ Resi $\diamond \diamond$ Fenc	2 & <i>average</i>) 2 & <i>average</i>) 2 & <i>average</i>) S ⇔ ery (1) egory for <i>EAC</i> est, Swamp (b or Old fiel dential, Park ced pasture (TABILITY High (3) Moderate Low (1) <i>H BANK (C</i> FLC 3) d (2) c, New fiel (1)	y debris (1) (2) (2) (2) (2) (2) (2) (2) (2	◇ Nearly absent Characteristic Characteristic Characteristic Characteristic Characteristic Characteristic Characteristic Verage) NLITY onservation Tillage rban or Industrial (0) lining, construction e predominant land use(00m riparian. Rij	(1) (1) (1) (1) (1) (1) (2) (1) (1) (2) (1) (2) (3) (3) (4) (5) (6) (5) (7) (7) (7) (7) (7) (7) (7) (7
2 Shallows (in state 2 Rootmats (1) COMMENTS 3-CHANNEL MOR SINUOSITY * High (4) ^ Moderate (3) > Low (2) > None (1) COMMENTS 4- BANK EROSION River right looking downstre EROSION L A <> None or little (3) > <> Moderate (2) * * Heavy/Severe (1)	PHOLOGY DEVELOPMENT ◇ Excellent (7) ◇ Good (5) ◇ Fair (3) ◇ Poor (1) N & RIPARIAN Z am RIP L R ◇ ◊ Wide > ◇ ◊ Modera ◇ ◊ Narrow ◇ ◊ None (0	0 Boulde Check ONE in e CHAN ◇ Non ◎ Rec ◇ Rec ◇ Rec ○ Rec ONE Check ARIAN WIDTH -50m (4) ate 10-50m (3) y 5-10m (2) arrow <5m (1) 0) QUALITY WIDTH 2 & average) e width (2) e width (1)	ers (1) each category (<i>Or</i> INELIZATION the (6) covered (4) covering (3) cent or no recov ONE in each cate CNE i	2 & average) 2 & average) 2 & average) 2 & average) 3 4 2 & average) 3 4 5 6 6 6 7 8 8 8 8 8 8 8 8 9 1 1 1 1 1 1 1 1 1 1 1 1 1	TABILITY High (3) Moderate Low (1) <i>H BANK</i> (C FLC 3) d (2) c, New fiel (1) owcrop (0) OCITY apply w (1) rstitial (-1) rmittent (- ies (1)	y debris (1) (2) (2) (2) (2) (2) (2) (1) (1) (1) (1) (2) (1) (1) (1) (1) (1) (1) (1) (1	◇ Nearly absent Characteristic Characteristic Characteristic Characteristic Characteristic Characteristic Characteristic Verage) NLITY onservation Tillage rban or Industrial (0) lining, construction e predominant land use(00m riparian. Rij	(1) (1) (1) (1) (1) (1) (1) (1)

Check ONE (ONLY!) RUN DEPTH Check ONE (or 2 & average) RIFFLE DEPTH **RIFFLE/RUN SUBSTRATE Riffle/Run** Maximum 8 ♦ Best Areas >10cm (2) $^{\diamond}$ Stable (e.g. cobble, boulder) (2) ♦ Maximum >50cm (2) Best Areas 5-10cm (1) Aaximum <50cm (1)</p> ◊ Mod. Stable (e.g. large gravel) (1) 0 ◇ Moderate (0)
 ◇ Extensive (-1) Sest Areas <5cm_(metric=0) Onstable (e.g. sand, fine gravel) (0) COMMENTS 6-GRADIENT

(4.798 ft/mi) DRAINAGE AREA	 ◊ Very low – Low (2-4) ◊ Moderate (6-10) 	% POOL: 60	% GLIDE: #\$	Gradient Maximum 6
(18.199 mi ²)	 ◇ High – Very high (10-6) 	% RUN: 40	% RIFFLE: #\$	10 Naximum 6



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Vuisance algae	◊ Public	◇ Private	◇ WWTP		◇ CSO
× 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
^{>} 30%-<55%	◊ Excess turbidity	 Young – Success Old - Succession 		◇ Contaminated	◊ Landfill	◇ Industry
^{>} 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	Cooling
	◊ Oil sheen	Leveed – One side	ded	♦ Bank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading	9	Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Righ	^{nt} ◇ Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	Quarry Mine	◊ Golf	◇ Home
51 Midd	dle	Impounded	Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

		DWQ	Bio	ogica	al Studies (QHEI	(Qua	litativ	e Habitat E	Evaluation	<u>Index)</u>
Sample #	QHEI Type	bioSar	nple #	5	Stream Name				Location		
AB47670	Macro	210816	6904	Ş	Storm Creek				Base Road		
Surveyor	Sample	Date	County	/	Macro Samp	le Туре				QHEI Score	e:
JMB	8/16/21		Jennin	gs	MHAB		* Hat	oitat Com	plete		53
1-SUBST	RATE				e TYPE BOXES; ype present	·			Check ONE (d	or 2 & average)	
BEST TYP	PES			-	OTHER TYPES				ORIGIN	QUALITY	
◇ ◇ Bldrs/S	Slabs (10)	TOTAL	POOL	RIFFLE	_	TOTAL	POOL	RIFFLE X	_	SILT ◇ Heavy (-2)	Substrate
◇ ◇ Boulde	ers (9)				◊ ◊ Detritus (3)		Х	Х	* Tills (1)	Moderate (-1)	
◊ ◊ Cobble	e (8)			Х	_				○ Wetlands (0) ○ Hardpan (0)	 ◇ Normal (0) ◇ Free (1) 	12
◊ ◊ Gravel	(7)			Х	_		Х	Х	◇ Sandstone (0)	EMBEDDEDNESS	
♦ ♦ Sand (6)		Х	Х	◊ ◊ Artificial (0)				 ◇ Rip/Rap (0) ◇ Lacustrine (0) 	 ◇ Extensive (-2) ◇ Moderate (-1) 	Maximum 20
◇ ◇ Bedroo NUMBER	k (5) OF BEST T`	PES:	♦ 4	or more (core natura		tes; ignore	\vee Logi tines (-7)	 Normal (0) ◇ None (1) 	

sludge from point-sources)

Maximum

10

6

COMMENTS

DRAINAGE AREA

(9.378 mi²)

NUMBER OF BEST TYPES:

4 or more (2)

* 3 or less (0)

2-INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; AMOUNT 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater Check ONE (or 2 & average) amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast Extensive >75% (11) water, or deep, well-defined, functional pools. 1 Undercut banks (1) Pools > 70cm (2) 1 Oxbows, Backwaters (1) 1 Moderate 25-75% (7) 0 Rootwads (1) 0 Aquatic macrophytes (1) 1 Overhanging vegetation (1) * Sparse 5-<25% (3) 2 Shallows (in slow water) (1) 0 Boulders (1) Logs and woody debris (1) Nearly absent <5% (1)</p> 2 Rootmats (1) Cover **COMMENTS** Maximum 11 20 Check ONE in each category (Or 2 & average) 3-CHANNEL MORPHOLOGY SINUOSITY DEVELOPMENT **CHANNELIZATION** STABILITY None (6) ◇ High (4) ♦ Excellent (7) High (3) Channel Moderate (3) Moderate (2) Good (5) Recovered (4) Maximum 9 * Low (2) * Fair (3) Recovering (3)
 * Low (1) 20 Poor (1) None (1) Recent or no recovery (1) COMMENTS **4- BANK EROSION & RIPARIAN ZONE** Check ONE in each category for EACH BANK (Or 2 per bank & average) River right looking downstream **RIPARIAN WIDTH** FLOOD PLAIN QUALITY EROSION LR LR LR LR ♦ ♦ Wide >50m (4) * <> Forest, Swamp (3) ◊ ◊ Conservation Tillage (1) ◊ ◊ Moderate 10-50m (3) ◇ ◇ Shrub or Old field (2) ◊ ◊ Urban or Industrial (0) ◊ ◊ Narrow 5-10m (2) ◊ ◊ Residential, Park, New field (1) ◊ ◊ Mining, construction (0) * * Heavy/Severe (1) ◊ ♦ Very narrow <5m (1)</p> ◇ ◇ Fenced pasture (1) Indicate predominant land use(s) past 100m riparian. * * Open Pasture/Rowcrop (0) Riparian Maximum 4 COMMENTS 10 5-POOL/GLIDE AND RIFFLE/RUN QUALITY MAXIMUM DEPTH **CHANNEL WIDTH CURRENT VELOCITY RECREATION POTENTIAL** Check ONE (ONLY!) Check ONE (or 2 & average) Check ALL that apply ◊ >1m (6) * Pool width > riffle width (2) Torrential (-1) * Slow (1) Primary Contact * 0.7-<1m (4) Pool width = riffle width (1) Very Fast (1) Interstitial (-1) Secondary Contact Pool width < riffle width (0)</p> ◇ Fast (1) Intermittent (-2) 0.4-<0.7m (2)
</p> (circle one and comment on back) ◇ 0.2-<0.4m (1) Moderate (1) Eddies (1) Indicate for reach - pools and riffles. Pool/Current 7 COMMENTS Maximum 12 Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: No Riffle (metric=0) Check ONE (ONLY!) Check ONE (or 2 & average) **RIFFLE DEPTH RUN DEPTH RIFFLE/RUN SUBSTRATE RIFFLE/RUN EMBEDDEDNESS** None (2) Sest Areas >10cm (2) * Maximum >50cm (2) Stable (e.g. cobble, boulder) (2) Riffle/Run * Low (1) * Best Areas 5-10cm (1) Maximum <50cm (1)</p> Mod. Stable (e.g. large gravel) (1) Maximum 4 Moderate (0) ◊ Best Areas <5cm_(metric=0) Unstable (e.g. sand, fine gravel) (0) 8 Extensive (-1) **COMMENTS 6-GRADIENT** (4.073 ft/mi) ◊ Very low – Low (2-4) % POOL: 40 % GLIDE: 20 Gradient

% RUN: 20

% RIFFLE: 20

2/8/2022 10:57:40 AM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index), Page 1 of 2

♦ Moderate (6-10)

◇ High – Very high (10-6)



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
[⊳] >85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		♦ CSO
[⊳] 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
[⊳] 10%-<30%	Discoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	♦ Cooling
	Oil sheen	Leveed – One side	ded	Sank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	♦ Home
4 Middl	е	Impounded	Desiccated	◇ Park	◇ Data Paucity	♦ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

NE 🤇	OWQ Biological Studies QHEI	(Qualitative Habitat Evaluation Index)

Π

Sample #	QHEI Type	bioSample #	Stream N	lame				Location			
AB47667	Macro	210816901	Mutton C	reek				CR 300 North	ı		
Surveyor	Sample	Date Count	y Ma	acro Sample	Туре	⊗ Habi	itat Comp		QHE	I Score:	53
JMB	8/16/21	Jennin	0	HAB				hele			
1-SUBST	<u>RATE</u>		o substrate TYPE E ote every type prese					Check Ol	NE (or 2 & avera	ge)	
BEST TYPE	ES			R TYPES				ORIGIN	I QUA	ALITY	
		TOTAL POOL	RIFFLE		TOTAL	POOL	RIFFLE		SILT		
◊ ◊ Bldrs/Sl	abs (10)		_ <u>X</u>	rdpan (4)		Х		Limestone	(1) · Heavy	(-2)	ostrate
◊ ◊ Boulder	s (9)			etritus (3)		Х	Х	* Tills (1)			
◊ ◊ Cobble ((8)		X	uck (2)				 ♦ Wetlands (♦ Hardpan (0) 		• •	16
◇		x	X ♦ ♦ Sil			Х		♦ Sandstone		,	
* Sand (6)	-	x		tificial (0)				Aip/Rap (0) Aip/Rap (0) Aip/Rap (1) Aip/Ra			ximum
♦ ♦ Bedrock				.,		<u> </u>		LacustrineShale (-1)	(0) ◇ Modera		20
	OF BEST TY	/PES: * 4	or more (2)	(Sco	re natural sludae f		es; ignore t-sources)	Coal fines			
			or less (0)				,				
COMMENTS	5										
2-INSTRE	AM COVE	R Indicate prese	nce 0 to 3: 0-Absen	t: 1 -Verv small	amounts	or if more	common	of marginal gua	alitv:	AMOUNT	
amounts (e.g. water, or deep 0 Une 1 Ove 2 Sha	, very large bo	oulders in deep or , functional pools 5 (1) egetation (1)		ameter log that s > 70cm (2) wads (1)	t is stable,	well deve Oxbow Aquati	eloped root vs, Backw c macrop	twad in deep / t	ter Check O (ast Check O Check O Che	ve >75% (11) te 25-75% (7) 5-<25% (3) absent <5% (1)	
COMMENTS										Cover	
COMMENT	,									Maximum	10
			Check ONE in	anah aatagan	(0+2.8 a					20	
SINUOSITY	EL MORPI	EVELOPMENT	Check ONE in	NNELIZATIO		•	TABILITY				
 ◇ High (4) 		Excellent (7)	-	one (6)			High (3)			<i></i>	
♦ Moderate	• •	Good (5)		covered (4)			Moderate	e (2)		Channel Maximum	11
		Fair (3) Poor (1)		covering (3) cent or no re	coverv (Low (1)			20	
COMMENTS						,				Ľ	<u> </u>
4- BANK	FROSION	& RIPARIAN	ZONE Chec	k ONE in each	category	for EACH	BANK	Dr 2 per bank &	average)		
	king downstrear		RIPARIAN WIDTH		category			DOD PLAIN Q	÷ .		
	ROSION	LR	50 (1)	LR		(L			
L R ◇	r little (3)	◇ ◇ Wid ◇ ◇ Mor	e >50m (4) lerate 10-50m (3)		Forest, S Shrub or				Conservation Urban or Indu	• • • •	
* Moderat	te (2)		row 5-10m (2)				, New fiel		Mining, const		
◊ ◊ Heavy/S	Severe (1)		y narrow <5m (1)		Fenced p	•	,		cate predominant t 100m riparian.	land use(s)	
		◇ ◇ Non	e (0)	* * (Open Pas	sture/Ro	wcrop (0)	pus	room npanan.	Riparian Maximum	
COMMENTS	5									10	
5-POOL /0			N QUALITY								
MAXIMUN											
Check ONE (or 2 & average)		CURREN Check A	LL that a	pply		RECREATION	N POTENTIAL	
◇ >1m (6)		Pool width > r	()	◇ Torrentia	• •	* Slow				y Contact	
◇ 0.7-<1m(◇ 0.4-<0.7n		Pool width = r Pool width < r	• • •	 ◊ Very Fast ◊ Fast (1) 	t (1)		stitial (-1) mittent (-		Seconda	ary Contact	
◇ 0.2-<0.4n				 Moderate 	e (1)	Eddi	•	-,	(circle one and c	comment on back))
◇ <0.2m (0) COMMENTS) (metric=0)			Indicate	for reach	– pools a	nd riffles.			Pool/Current Maximum 12	5
Indicate for	functional rif	ffles; Best area	s must be large e	nough to sup	oport a p	opulatio	n of riffle	-obligate spe	cies: ◇ N	o Riffle (metri	c=0)
		k ONE (ONLY!)	_	- •		-	(or 2 & ave			<u></u>	
	FLE DEPTH	~ ••	RUN DEPTH		LE/RUN			RIFFLE/RU ◇ None		NESS	
 ◇ Best Area ◇ Best Area 	s >10cm (2) s 5-10cm (1)		imum >50cm (2) imum <50cm (1)	 ♦ Stable (♦ Mod. State 	-			◇ None		Riffle/Run	-
	s <5cm _{(metric}			◊ Unstable)) ◇ Mode	rate (0)	Maximum 8	0
COMMENTS	-							○ Exten	isive (-1)		
6-GRADIE											
(6.52 ft/r			◊ Very low – Lov	N (2-4)	% PO	OL: 10	%	GLIDE: #\$		Gradient	
DRÀINAGE	AŔEA		♦ Moderate (6-1)	D)`´						Maximum	6
(8.239 m	1I²)		High – Very hi	gh (10-6)	% R	UN: 80	%	RIFFLE: 10		10	



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Vuisance algae	◊ Public	◇ Private	◊ WWTP		♦ CSO
× 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
^{>} 30%-<55%	◊ Excess turbidity	 Young – Success Old - Succession 		◇ Contaminated	◊ Landfill	◇ Industry
^{>} 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	◇ Bank Erosion	Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Bare	anks			
Canopy Upstream Reading	1	Moving – Bedloa	d	◇ False bank	♦ Manure	◇ Lagoon
		Stable - Bedload				
Righ	^t	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	♦ Acid Mine	◊ Wetlands	Stagnant Flow
	♦ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◇ Quarry Mine	◊ Golf	♦ Home
31 Mide	lle	Impounded	Desiccated	◇ Park	◇ Data Paucity	♦ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

	M	OWQ B	Biological St	<u>tudies Q</u>	HEI (Qual	itativ	e Ha	bitat E	Evaluation	Index)
Sample #	QHEI Type	bioSampl	e # Stream	Name				Locatio	on		
AB47664	Macro	21081790		Creek Ditch				CR 400			
Surveyor	Sample	e Date Co	ounty	Macro Sample	Туре	<u> </u>				QHEI Sco	re: 🛺
JMB	8/17/21	Ja	ackson	MHAB		* нар	itat Comp	plete			48
1-SUBST	<u>RATE</u>		Y Two substrate TYPE or note every type pre					Ch	eck ONE (d	or 2 & average)	
BEST TYP	ES	coliniate 70						OF	RIGIN	QUALITY	
		TOTAL PO	OOL RIFFLE		TOTAL	POOL	RIFFLE			SILT	
◇ ◇ Bldrs/Sl	labs (10)			Hardpan (4)		Х			stone (1)	 ◇ Heavy (-2) 	Substrate
◊ ◊ Boulder	rs (9)		◇◇	Detritus (3)		Х		 ♦ Tills (♦ Wetla 		 ♦ Moderate (-1) ♦ Normal (0) 	
\diamond \diamond Cobble	(8)			Muck (2)		Х		♦ Wella	• • •	 Vornal (0) Free (1) 	5
◊ ◊ Gravel ((7)			Silt (2)		Х			stone (0)		
◊ ◊ Sand (6))		$\diamond \diamond$	Artificial (0)					strine (0)	 ◇ Extensive (-2) ◇ Moderate (-1) 	Maximum 20
◊ ◊ Bedrock	k (5)			(Sco	ore natura	l substrate	es; ignore		e (-1)	Normal (0) Normal (1)	20
NUMBER (OF BEST T	YPES:	◊ 4 or more (2)		sludge	from poin	t-sources)		fines (-2)	◊ None (1)	
COMMENTS	s		* 3 or less (0)								
2-Moderate a amounts (e.g water, or dee 0 Un 2 Ov 0 Sh	amounts, but r I., very large b p, well-define Idercut bank verhanging v	not of highest poulders in dee d, functional p	I) <u>3</u> Poo	ounts of highest of	quality; 3 -l t is stable <u>1</u> 2	Highest qı , well dev Oxbov Aquati	uality in mo	oderate o otwad in d vaters (1 ohytes (1	r greater leep / fast) I)	AMOU Check ONE (or 2 Extensive >75% Moderate 25-75 Sparse 5-<25% Nearly absent	2 & <i>average</i>) % (11) 5% (7) (3)
COMMENTS	. ,										Cover
										Maxi	mum 15 20
SINUOSITY	(3)	DEVELOPMI ◇ Excellent (◇ Good (5) ◇ Fair (3) ◈ Poor (1)	(7) ◇ I ◇ I ◇ I	IANNELIZATIO None (6) Recovered (4) Recovering (3) Recent or no re			TABILITY High (3) Moderate Low (1)				annel ^{imum} 6 20
4- BANK	EROSION	& RIPAR	IAN ZONE Ch	eck ONE in each	category	for EAC	H BANK (Or 2 per k	oank & aver	age)	
-	king downstrea	am	RIPARIAN WIDT				FLC		AIN QUAL	ΙΤΥ	
E L R ♦ ♦ None of ♦ ♦ Modera ♦ ♦ Heavy/\$	ite (2)	$\begin{array}{c} \diamond \\ \diamond \\ \diamond \\ \diamond \\ \diamond \\ \end{array}$	R Wide >50m (4) Moderate 10-50m (3 Narrow 5-10m (2) Very narrow <5m (1 None (0)	3)	Forest, S Shrub or Resident Fenced p	Old field tial, Park pasture (d (2) , New fiel	()	◊ ◊ Urb ◊ ◊ Min Indicate p) (0)
COMMENTS	S									Wie -	10
<u>5-POOL/0</u>	<u>GLIDE AN</u>	D RIFFLE	<u>/RUN QUALITY</u>								
MAXIMUM Check ONE ((ONLY!) (4) m (2) m (1))) (metric=0)	Check O • Pool width • Pool width	ANNEL WIDTH DNE (or 2 & average) h > riffle width (2) h = riffle width (1) h < riffle width (0)	 ◇ Torrentia ◇ Very Fas ◇ Fast (1) ◇ Moderate Indicate 	Check , al (-1) t (1) e (1)	◇ Inter ◇ Edd	apply v (1) rstitial (-1 rmittent (-			CREATION POTE	act tact on back) irrent mum 8
Indicate for	functional r	iffles; Best a	areas must be large	enough to sup	pport a p	opulatio	on of riffle	e-obligat	e species	No Riffle	12 (metric=0)
	FLE DEPTH as >10cm (2) as 5-10cm (1 as <5cm _{(metri}		RUN DEPTH Maximum >50cm (2 Maximum <50cm (1) 🛛 👌 Stable (LE/RUN e.g. cobl able (e.g	SUBSTI ble, boul 1. large g	der) (2) ravel) (1)	RIFFL	E/RUN EM None (2) Low (1) Moderate Extensive	IBEDDEDNESS Riff (0)	ile/Run ximum 8
<u>6-GRADIE</u> (2.112 fr DRAINAGE (29.807	<u>ENT</u> t/mi) AREA		 ♦ Very low – L ♦ Moderate (6- ♦ High – Very 	·10) ໌		DOL: #\$ RUN: #\$		6 GLIDE RIFFLE			adient imum 4 10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
» 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	 Young – Success Old - Succession 		◇ Contaminated	◊ Landfill	◇ Industry
^{>} 10%-<30%	Discoloration	◇ Spray		◇ Construction BMPs	Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	Output Bank Erosion	Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	♦ CSOs/SSOs/Outfalls	Relocated	◇ Cutoffs	◊ Quarry Mine	◇ Golf	◇ Home
70 Middl	e	Impounded	Desiccated	◇ Park	◊ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

			-			•			Evaluation	
Sample #	QHEI Type	-		tream Name				Location		
AB47668 Surveyor	Macro Sample	21081790	ounty	torm Creek Ditch Macro Sam	nle Type			CR 400 North	QHEI Scor	0.
JMB	8/17/21		ackson	MHAB	pie i ype	♦ Hab	itat Com	plete		e. 44
1-SUBSTR		Check ONL	YTwo substrate	TYPE BOXES;				Check ONF	(or 2 & average)	
BEST TYPE		estimate %	or note every ty	pe present OTHER TYPE	5			ORIGIN	QUALITY	
	_0		OOL RIFFLE	OTHER THE	-	POOL	RIFFLE	ORIGIN	QUALITI	
◇ ◇ Bldrs/Sla	abs (10)	IUTAL P		◇ ◇ Hardpan (4)	-	X	KIFFLE	♦ Limestone (1)	SILT)	Substrat
◊ ◊ Boulders	s (9)			◇ ◇ Detritus (3)		х		◇ Tills (1)	♦ Moderate (-1)	
◇ ◇ Cobble ((8)			_ ◇		х		♦ Wetlands (0)♦ Hardpan (0)	 ◇ Normal (0) ◇ Free (1) 	2
◊ ◊ Gravel (7				_		Х		◇ Sandstone (0)) EMBEDDEDNESS	
◊ ◊ Sand (6)	-	Х		◇ ◇ Artificial (0)	1			 Rip/Rap (0) Lacustrine (0) 	 ◇ Extensive (-2) ◇ Moderate (-1) 	Maximun
◊ ◊ Bedrock					Score natura	al substrat	es: ianore	♦ Shale (-1)	Normal (0)	20
NUMBER O		YPES:	◇ 4 or more (2			e from poin		♦ Coal fines (-2) ◇ None (1)	
			* 3 or less (0)	1						
COMMENTS	5									
2-Moderate ar amounts (e.g., water, or deep 0 Unc 2 Ove 1 Sha	mounts, but n , very large b	ot of highest oulders in de d, functional p s (1) egetation (*	quality or in smaller uep or fast water, pools. 1) 2	0-Absent; 1-Very s all amounts of highe large diameter log Pools > 70cm Rootwads (1) Boulders (1)	est quality; 3 that is stable (2) 2 1	-Highest q e, well dev 2Oxbov Aquati	uality in m eloped roc vs, Backv ic macrop	oderate or greater		& average) (11) % (7) (3)
COMMENTS	3								C Maxin	num 20
3-CHANNE			_	ONE in each cate		• •		,		
SINUOSITY ◇ High (4)		DEVELOPM > Excellent		CHANNELIZA ◇ None (6)	TION	-	TABILITY High (3)			
Moderate (> Good (5)		◇ Recovered			Moderat	e (2)	Cha Maxii	mum 4
◇ Low (2) ◊ None (1)		 Pair (3) Poor (1) 		 Recovering Recent or n 			Low (1)			20
COMMENTS	No Red	covery			-					
4- BANK E	EROSION	& RIPAR	IAN ZONE	Check ONE in e	each categor	y for EAC	H BANK (Or 2 per bank & av	verage)	
River right look	-		RIPARIAN		_		FLO	DOD PLAIN QUA	LITY	
	ROSION	L * *	R Wide >50m (4		_ R ∵	Swamp (3)	L R ◇ ◇ C	onservation Tillage	(1)
 ♦ ♦ None or ♦ ♦ Moderat 			Moderate 10-	50m (3) 🛛 🗘	• • Shrub o	or Old fiel	d (2)	◊ ◊ U	rban or Industrial (0))
 			Narrow 5-10m Very narrow <	· · /	 ♦ Resider ♦ Fenced 	•	•	• •	lining, construction (e predominant land use(s	· /
		\diamond \diamond	None (0)	\$	♦ Open Pa	asture/Ro	owcrop (0) past 10	00m riparian. Rip	barian
COMMENTS	;								Max	kimum 10 10
5-POOL/G	LIDE AN		RUN QUAL	<u>.ITY</u>						I
MAXIMUM	I DEPTH	CH	ANNEL WIDTH	l	CURRE		OCITY			
Check ONE ((* >1m (6)			DNE (or 2 & aver h > riffle width		Check ntial (-1)	ALL that a Slov *			RECREATION POTEN	
◇ 0.7-<1m (h = riffle width		Fast (1)		rstitial (-1)	 Secondary Conta 	
◇ 0.4-<0.7m		Pool widt	h < riffle width	()			rmittent (-2) (c	ircle one and comment o	n back)
◇ 0.2-<0.4m ◇ <0.2m (0)					e rate (1) cate for reac		ies (1) and riffles.		Pool/Cu	rrent
COMMENTS						-			Maxin	
Indicate for f		•		large enough to	••	• •		•	es: <u> </u>	<u> </u>
DIE	Che FLE DEPTH	ck ONE (ON	LY!) RUN DEP	ти г	CI RIFFLE/RU			• •		
Or Best Areas	s >10cm (2)	\diamond	Maximum >50		le (e.g. cot			None (2))	e/Run
 ◇ Best Areas ◇ Best Areas 			Maximum <50		. Stable (e. table (e.g. s			0)	te (0) Max	imum 0
0011151170	;							✓ A Extensi	ve (-1)	
COMMENTS										
6-GRADIE	<u>NT</u>									
	/mi)			ow – Low (2-4) ate (6-10)	% P	00L: #\$	9	6 GLIDE: 100	Gra Maxii	dient



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		♦ CSO
» 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	 Young – Success Old - Succession 		◇ Contaminated	◊ Landfill	◇ Industry
> 10%-<30%	Discoloration	◇ Spray		◇ Construction BMPs	Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	◊ Bank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Barbara	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	◇ Lagoon
		Stable - Bedload				
Right	◇ Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	Islands	♦ Scoured	♦ Acid Mine	◊ Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	♦ Home
80 Midd	e	Impounded	Desiccated	◇ Park	◇ Data Paucity	♦ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

DETIN OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSamp	le #	Stream	Name				Locatio	n		
AB46803	Macro	21081770)3	Tea Cre	ek				CR 650	West		
Surveyor	Sample	Date C	ounty		Macro Sample	Туре		itat Camp			QHEI Sco	re: 43
PDM	8/17/21	Je	ennings	I	MHAB			itat Comp	Diete			43
1-SUBST	RATE	Check ONL	YTwo substra	te TYPE	BOXES;				Che	eck ONE (a	or 2 & average)	
BEST TYP		estimate %	or note every		ER TYPES				OF		QUALITY	
BLOTIN	20		OOL RIFFL	-		TOTAL	POOL				QUALITY	
◇ ◇ Bldrs/Sl	lahs (10)	IUTAL P	OOL RIFFL		lardpan (4)	TOTAL	X		^ imag	tono (1)	SILT	Substrate
	· /				• • • •		<u>x</u>		 ✓ Limes ♦ Tills ([*] 	stone (1)	 ◇ Heavy (-2) ◇ Moderate (-1) 	
◊ ◊ Boulder	.,		·		Detritus (3)				◊ Wetla		◇ Normal (0)	9
◊ ◊ Cobble	(8)				Muck (2)				♦ Hardp	• • •	Free (1)	9
◊ ◊ Gravel ((7)	<u> </u>	<u>x</u>		Silt (2)		X		 Sands Rip/Ratio 	stone (0)	EMBEDDEDNESS	
* Sand (6))	х	х	$\diamond \diamond \mu$	Artificial (0)					ap (0) strine (0)	 Moderate (-1) 	Maximum 20
◊ ◊ Bedrock	k (5)				(Sco	ore natural	substrate		♦ Shale	(-1)	◇ Normal (0)	20
	OF BEST TY	PES:	♦ 4 or more	(2)	(000			t-sources)	Coal f	ines (-2)	◊ None (1)	
			* 3 or less			-						
COMMENTS	S											
2-INSTRE	AM COVE	R Indicate	presence 0 to	3. 0 -Abs	ent; 1 -Very smal	II amounts	or if more	e common	of margin	nal quality.	AMOU	
amounts (e.g. water, or dee 0 Un 0 Ov 1 Sha	., very large bo p, well-defined dercut banks rerhanging ve allows (in slo	oulders in de , functional p s (1) egetation (1	eep or fast wate pools. 1)	er, large <u>2</u> Poo <u>1</u> Roo	unts of highest of diameter log tha ols > 70cm (2) otwads (1) ulders (1)	it is stable,	well deve Oxbow Aquati		twad in d /aters (1 phytes (1	eep / fast))	Check ONE (or 2 Check ONE (or 2 Extensive >75% Moderate 25-75 Sparse 5-<25% Nearly absent <	6 (11) 5% (7) (3)
	otmats (1)											
COMMENTS	5										Maxi	Cover mum 9
												20
3-CHANN	EL MORPI	HOLOGY	Che	ck ONE	in each category	y (Or 2 & a	iverage)					
SINUOSITY		EVELOPM			ANNELIZATIC	N	-	TABILITY				
 High (4) Moderate 		Excellent Good (5)	(7)		None (6) Recovered (4)			High (3) Moderate	a (2)		Cha	annel
 Low (2) 	• •	Fair (3)			Recovering (3)			Low (1)	- (-)		Max	imum 10 20
◊ None (1)		Poor (1)			Recent or no re			()				20
COMMENTS	S											
4- BANK	EROSION	& RIPAR		Ch	eck ONE in each	n category	for EAC	H BANK (C	Or 2 per b	ank & aver	age)	
	king downstrear		RIPARIA		н	0,		FLC			ITY	
	ROSION	L			LF					LR		
L R ◇ ◇ None or	r little (3)		Wide >50m			Forest, S					servation Tillage	• •
 None of Modera 	ite (2)		Moderate 10 Narrow 5-10			Shrub or Resident		d (2) , New fiel	d (1)		an or Industrial (0 ing, construction	
♦ ♦ Heavy/S			Very narrow			Fenced p			u (1)		predominant land use	
		\diamond \diamond	None (0)		* *	Open Pa	sture/Ro	wcrop (0))	past 100n	n riparian. Ri	iparian
COMMENT	•											iximum 3
COMMENTS	5											10
5-POOL/0	<u>GLIDE AND</u>) RIFFLE	<u>/RUN QU/</u>	<u>ALITY</u>					_			
MAXIMUN	I DEPTH					CURRE				20		
Check ONE (DNE (or 2 & av		♦ Terrenti		ALL that a			KE	CREATION POTE	
◈ >1m (6) ◇ 0.7-<1m			h > riffle wid h = riffle wid		 ◇ Torrentia ◇ Very Fas 	• •	♦ Slow ♦ Inter	v (1) rstitial (-1))		 Primary Conta Secondary Conta 	
◇ 0.4-<0.7r			h < riffle wid	• •	 ◇ Fast (1) 			mittent (-			-	
◇ 0.2-<0.4r				(-)	♦ Moderate	e (1)	♦ Eddi	•	,	(circl	e one and comment of	on back)
◇ <0.2m (0) _(metric=0)				Indicate	e for reach	– pools a	and riffles.	-		Pool/Cu	-
COMMENTS	S										Maxi	mum 8
Indicate for	functional rif	fles; Best	areas must l	be large	enough to su	pport a p	opulatio	n of riffle	-obligat	e species:	No Riffle	(metric=0)
		k ONE (ON		0-	•	••••••	•	(or 2 & ave	-			<u>1.110110-01</u>
RIF	FLE DEPTH	1 -	RUN DE	PTH	RIFF	FLE/RUN		•	RIFFL		BEDDEDNESS	·
	is >10cm (2)		Maximum >	•	· ·					None (2)	Riff	ile/Run
	is 5-10cm (1)		Maximum <	50cm (1	•					Low (1) Moderate	Mar	ximum 0
✓ best Area	is <5cm _{(metric}	=0)				ie (e.g. sa	ina, tine	gravel) ((Extensive	• •	8
COMMENTS	S											
6-GRADIE	<u>ENT</u>											_
(2.676 ft			•		ow (2-4)	% PO	OL: 50	%	GLIDE:	:#\$		adient
DRAINAGE (10.632				erate (6- – Verv	·10) high (10-6)	% P	UN: 50	0/_	RIFFLE:	#\$	Max	imum 4 10
(10.052	,		· nigh	- v CI Y		70 N	511.00	70		··· ·		



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE	<u>D-ISSUES</u>					
> >85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO			
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	◇ Dirt & Grime			
◇ 30%-<55% ◇ Excess turbidity		◇ Young – Success ◇ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry			
[⊳] 10%-<30%	Discoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs				
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling			
	◊ Oil sheen	Leveed – One side	ded	Output Bank Erosion	♦ Surface Erosion	♦ H2O table			
	◇ Trash/Litter	Leveed – Both B	anks						
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon			
		◊ Stable - Bedload							
Righ	^t	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow			
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow			
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	♦ Home			
0 Midd	le	Impounded	Desiccated	◇ Park	◊ Data Paucity	◊ Lawn			
		Flood Control	Orainage	◇ Agriculture	Livestock				
		Snag Removed		Atmosphere					
		Snag Modified		Deposition					
Left									

	$\overline{\mathbf{M}}$	OWQ E	Biologica	al Stu	idies C	<u> HEI (</u>	Qua	litativ	e Ha	bitat E	Evaluation	<u>Index)</u>
Sample # QHEI Type bioSample #			le #	Stream Name					Locatio			
AB47653	Macro	21082470)1	Vernon Fo	ork Muscata	tuck River	•		CR 600	South		
Surveyor	Sample		ounty		cro Sample	е Туре		oitat Com	plete		QHEI Score	e: 43
PDM	8/24/21		ackson		IAB							
<u>1-SUBST</u>	RATE	estimate %	Y Two substrat	ype presei	DXES; nt				Ch	eck ONE (d	or 2 & average)	
BEST TYP	PES			OTHER	R TYPES				OF	RIGIN	QUALITY	
		TOTAL PO	OOL RIFFLE	:		TOTAL	POOL	RIFFLE			SILT	
◊ ◊ Bldrs/S	5labs (10)				rdpan (4)					stone (1)	◇ Heavy (-2) ♦ Mederate (1)	Substrate
◊ ◊ Boulde	• •			_	tritus (3)		x	x	♦ Tills (♦ Wetla		 Moderate (-1) ◊ Normal (0) 	
◊ ◊ Cobble	(8)			_				·	♦ Hardp	• • •	◇ Free (1)	8
◊ ◊ Gravel	.,		<u> </u>	_◇ ◇ Silt	: (2)		x	x	◇ Sands ◇ Rip/R	stone (0) ap (0)	EMBEDDEDNESS	Maximum
	5)	X	x	_	ificial (0)				♦ Lacus	strine (0)	Moderate (-1)	20
◊ ◊ Bedroc				_	(Sc	core natura				e (-1) fines (-2)	◇ Normal (0)◇ None (1)	
NUMBER	OF BEST T	YPES:	 ◇ 4 or more (◇ 3 or less (0) 	• •		sludge	from poir	nt-sources)	· Obai i	ines (-2)		
COMMENT	s		* 5 01 less (t	")								
2-INSTRE	EAM COVE	R Indicate	presence 0 to 3	: 0-Absent	; 1 -Very sma	all amounts	s or if mor	e common	of margir	nal quality;	AMOUN	Т
2-Moderate a	amounts, but n	ot of highest	quality or in sm ep or fast water	all amoun	ts of highest	quality; 3-	Highest q	uality in me	oderate o	r greater	Check ONE (or 2 a	
	ep, well-defined			i, large dia	meter log tri		, well dev	eloped foc	Jiwau in u	eep / last	♦ Extensive >75%	
	ndercut bank	.,		2 Pools	> 70cm (2)	00	Oxbo	ws, Backv	waters (1)	Moderate 25-75%	% (7)
	verhanging v	-		1 Rootv	.,	0		ic macrop		•		
	nallows (in sl potmats (1)	ow water) (1)	Bould	ers (1)	2	_Logs a	and wood	ly debris	(1)	♦ Nearly absent <	5% (1)
											Co Maxin	over num 9
												20
	NEL MORP		_		each catego	•	• •					
SINUOSITY		DEVELOPM		-	NNELIZATIO ne (6)	ON	-	TABILITY High (3)	r			
Moderate	ə (3) <	> Good (5)	(•)	◇ Ree	covered (4)		*	Moderat	e (2)		Cha Maxir	nnel num 10
 Low (2) None (1) 		୬ Fair (3) ○ Poor (1)			covering (3 cent or no r	,		Low (1)			Maxii	20
COMMENT		• 1 001 (1)		* Net	,ent of no i	lecovery	(')					
4- BANK	FROSION	& RIPAR		Check	ONE in eac	ch category	for EAC	H BANK (Or 2 per h	ank & ave	rage)	
	oking downstrea		RIPARIAN							AIN QUAL		
L R E	EROSION	L		Δ	L		wown (2)		L R	nonvotion Tillogo ((4)
◊ ◊ None o			Wide >50m (Moderate 10-			Forest, S Shrub or	• •	,			nservation Tillage (an or Industrial (0)	
◊ ◊ Modera			Narrow 5-10r			Residen			ld (1)	◇ ◇ Mir	ing, construction ((0)
	Severe (1)		Very narrow None (0)	<5m (1)			pasture (1) asture/Rowcrop (0)			Indicate predominant land use(s) past 100m riparian. Riparian		
									,			arian timum 3
COMMENT	S											10
<u>5-POOL/0</u>	GLIDE ANI	D RIFFLE	<u>/RUN QUA</u>	<u>LITY</u>								
-							NT VELO			RF	CREATION POTEN	ΙΤΙΔΙ
Check ONE			DNE (or 2 & ave h > riffle widt l		♦ Torrent		≀ALL that ♦ Slo				 Primary Contac 	
◇ 0.7-<1m	(4)	Pool widt	h = riffle widt	h (1)	Very Fa	• •	Intel	rstitial (-1			Secondary Conta	
 ◇ 0.4-<0.7 ◇ 0.2-<0.4 	• •	Pool widt	h < riffle widtl	h (0)	 ◇ Fast (1) ◇ Modera 			rmittent (lies (1)	-2)	(circ	le one and comment or	n back)
 0.2-<0.4 < <0.2m (0 						te for reach		• • •	l		Pool/Cur	rent
COMMENT											Maxin	
Indicate for			areas must b	e large er	nough to su	upport a p	opulatio	on of riffle	e-obligat	e species		metric=0)
		ck ONE (<i>ONI</i>		оти	סיר			(or 2 & av				
	FFLE DEPTH as >10cm (2)		RUN DEI Maximum >5			FLE/RUN (e.g. cob				.E/RUN Eľ None (2)	MBEDDEDNESS	
♦ Best Area	as 5-10cm (1)) *	Maximum <5	• • •	◇ Mod. S	Stable (e.g	j. large g	gravel) (1)	A	Low (1) Moderate	May	e/Run imum 3
◇ Best Area	as <5cm _{(metric}	c=0)			Unstat Output Out	ble (e.g. s	and, fine	e gravel) (Moderate Extensive	(0)	8
COMMENT	S											
6-GRADI			_									
(0 ft/mi DRAINAGE				ow – Low rate (6-10		% PC	OOL: 70	%	% GLIDE:	: #\$	Gra o Maxir	dient
(0 mi ²)				- Very hig		% F	RUN: 20	%	RIFFLE	: 10	With Million	10

2/8/2022 10:57:40 AM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index), Page 1 of 2



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE	<u>D-ISSUES</u>					
> >85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP	♦ NPDES	♦ CSO			
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime			
> 30%-<55%	♦ Excess turbidity	 ◇ Young – Succession ◇ Old - Succession 		◇ Contaminated	◊ Landfill	◇ Industry			
[≫] 10%-<30%	Oiscoloration	◇ Spray		◇ Construction BMPs	♦ Sediment BMPs				
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	Cooling			
	Oil sheen	Leveed – One side	ded	Sank Erosion	♦ H2O table				
	◇ Trash/Litter	Leveed – Both Bath	anks						
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	◇ Lagoon			
		◊ Stable - Bedload							
12 Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	Aatural Flow Second State Second State			
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flov			
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◇ Golf	◇ Home			
47 Middl	e	Impounded	Desiccated	◇ Park	Oata Paucity	◇ Lawn			
		Flood Control	Orainage	◇ Agriculture	Livestock				
		Snag Removed		◇ Atmosphere					
		Snag Modified		Deposition					
12 Left									

		OWQ B	iological St	<u>udies Q</u>	HEI (Qual	litativ	<u>e Ha</u>	bitat E	Evaluation	Inde	<u>ex)</u>
Sample #	QHEI Type	bioSample	# Stream	Name				Locatio	on			
AB47654	Macro	210824702	Grassy G	Creek				CR 600				
Surveyor	Sample			lacro Sample	Туре	♦ Hab	itat Com	olete		QHEI Scor	e:	46
PDM	8/24/21		kson N Two substrate <i>TYPE</i>	IHAB								
<u>1-SUBS1</u>	<u>TRATE</u>		or note every type pres					Ch	eck ONE (d	or 2 & average)		
BEST TYP	PES		OTHE	ER TYPES				OF	RIGIN	QUALITY		
		TOTAL PO	OL RIFFLE		TOTAL	POOL	RIFFLE			SILT	Suba	trata
◊ ◊ Bldrs/S	· · /	<u> </u>		ardpan (4)		x	x	. ◇ Limes ◇ Tills (stone (1)	 ◇ Heavy (-2) ◈ Moderate (-1) 	Subs	trate
◊ ◊ Boulde	()			etritus (3)		<u>^</u>		· ♦ Wetla	nds (0)	◊ Normal (0)	7	,
◇ ◇ Cobble		<u> </u>		luck (2)		<u> </u>	x	. ◇ Hardj ◇ Sand	oan (0) stone (0)	◇ Free (1) EMBEDDEDNESS	,	
◊ ◊ Gravel	.,					<u>x</u>	<u>*</u>	◇ Rip/R		 ◇ Extensive (-2) 	Maxii	mum
		X	× × × A	rtificial (0)				 ♦ Lacus ♦ Shale 	strine (0)	 Moderate (-1) ◊ Normal (0) 	2	0
	CK (5) OF BEST T			(Sco			es, ignore	◇ Shale ◇ Coal f	ines (-2)	 None (1) 		
NOWIDER			◇ 4 or more (2) ୬ 3 or less (0)		sludge	nom pom	nt-sources)					
COMMENT	rs											
2-INSTR	EAM COVE	R Indicate p	resence 0 to 3: 0-Abse	nt; 1-Very smal	l amounts	or if mor	e common	of margi	nal quality;	AMOUN	νT	
2-Moderate amounts (e. water, or de	amounts, but n .g., very large b ep, well-defined	ot of highest q oulders in dee d, functional po	uality or in small amou p or fast water, large d pols.	ints of highest c liameter log that	quality; 3- l t is stable	Highest q , well dev	uality in mo eloped roo	oderate o otwad in c	r greater eep / fast	Check ONE (or 2 ♦ Extensive >75%	& averag 5 (11)	ge)
	ndercut bank verhanging v	()		ls > 70cm (2) twads (1)		_	vs, Backw ic macrop	•		 Moderate 25-75 Sparse 5, -25% 	• •	
	hallows (in sl			.,			and wood	•		 Sparse 5-<25% Nearly absent 	• •	
	ootmats (1)		, <u> </u>		·			ly dobrie	(.)	Nearly about s		
COMMENT	rs									C Maxir	Cover mum 20	12
3-CHANI	NEL MORP	HOLOGY	Check ONE ir	n each category	(Or 2 & a	average)						
SINUOSITY				ANNELIZATIO	N	-	TABILITY	,				
 Moderate 		Excellent (Good (5)		one (6) ecovered (4)			High (3) Moderate	e (2)			annel	7
◇ Low (2)		◇ Fair (3) ◇ Paar (1)		ecovering (3)			Low (1)			IVIAXI	imum 20	'
None (1) COMMENT		Poor (1)	~ K	ecent or no re	covery	(1)						
4- RANK		& RIPARI		ck ONE in each		for FAC	HBANK	Or 2 ner h	ank & ave	race)		
-	oking downstrea		RIPARIAN WIDTH		reategory							
	EROSION		2	LF			2)		LR		(4)	
L R ♦ ♦ None d	or little (3)		Nide >50m (4) Noderate 10-50m (3)		Forest, S Shrub or					nservation Tillage ban or Industrial (0		
	ate (2) /Severe (1)	$\diamond \diamond$	Narrow 5-10m (2)	$\diamond \diamond$	Resident	tial, Park	, New fiel	ld (1)	◇ ◇ Mir	ing, construction	(0)	
• • neavy	Jevere (I)		/ery narrow <5m (1) None (0)		Fenced µ Open Pa		(1) owcrop (0))		predominant land use(m riparian.	1	
								,			parian ximum	8
COMMENT	TS										10	
<u>5-POOL/</u>	GLIDE AN	D RIFFLE/	<u>RUN QUALITY</u>									
-	JM DEPTH	-							RE	CREATION POTE	ΝΤΙΔΙ	
Check ONE * >1m (6)			NE (or 2 & average) > riffle width (2)	♦ Torrentia		ALL that a Slov (Primary Conta 		
◇ 0.7-<1m	n (4)	Pool width	= riffle width (1)	Very Fas	• •	Intel	rstitial (-1			Secondary Cont	tact	
 ◇ 0.4-<0.7 ◇ 0.2-<0.4 	• •	Pool width	< riffle width (0)	◇ Fast (1)◇ Moderate	⊳ (1)		rmittent (· ies (1)	-2)	(circ	le one and comment o	on back)	
	(0) _(metric=0)				• •		and riffles.			Pool/Cu		
COMMENT										Maxir	тит 12	8
Indicate fo	or functional r	iffles; Best a	reas must be large	enough to sup	pport a p	opulatio	on of riffle	e-obligat	e species	:		=0)
		ck ONE (ONL	,				(or 2 & ave	• •				
	IFFLE DEPTH as >10cm (2)		RUN DEPTH /aximum >50cm (2)	RIFF ♦ Stable (ELE/RUN				.E/RUN El None (2)	MBEDDEDNESS	, _ F	
◇ Best Are	eas 5-10cm (1))	Maximum <50cm (1)	♦ Mod. St	able (e.g	. large g	ravel) (1)	♦	Low (Ì)	May	le/Run kimum	0
♦ Best Are	eas <5cm _{(metri}	c=0)		Vnstabl	le (e.g. s	and, fine	e gravel) (01	Moderate Extensive	(0)	8	Ĭ
COMMENT	TS								_		Ľ	
6-GRAD												
(1.972 DRAINAGE			◇ Very low – Lo ◇ Moderate (6-1		% PC	OOL: 50	%	6 GLIDE	50	Gra Maxi	dient mum	4
(12.633			◇ High – Very h	,	% F	RUN: #\$	%	RIFFLE	: #\$		10	ŕ



A-CANOPY	B-AESTHETICS	<u>C-M</u>	AINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
» 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
^{>} 30%-<55%	◊ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
^{>} 10%-<30%	Discoloration	◇ Spray		Construction BMPs	Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	led	◊ Bank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	♦ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◇ Quarry Mine	◇ Golf	◇ Home
62 Middl	e	Impounded	Desiccated	◇ Park	◇ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

		owq	Biol	ogical	Studi	es Q	HEI (Qua	litativ	<u>e Ha</u>	abitat E	valuation	<u>Index)</u>
Sample #	QHEI Type	e bioSar	nple #	Str	eam Name					Locat	ion		
AB47657	Macro	210824			n McDonal	d Ditch					25 South		
Surveyor	Sample	e Date	County		Macro	Sample	Туре	ô 11-1				QHEI Sco	ore: 42
PDM	8/24/21		Jackson	1	MHAB			* Har	oitat Com	piete			42
<u>1-SUBST</u>	RATE			substrate 7	TYPE BOXE	S;				С	heck ONE (o	r 2 & average)	
BEST TYP	ES	ootiinate	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		OTHER TY	PES				C	RIGIN	QUALITY	
		TOTAL	POOL	RIFFLE			TOTAL	POOL	RIFFLE			SILT	
◊ ◊ Bldrs/S	labs (10)			<	> < Hardpa	n (4)					estone (1)	 Heavy (-2) 	Substrate
◊ ◊ Boulder	rs (9)			<	> < Detritus	s (3)		х	<u>x</u>	♦ Tills ♦ Wet	(1) lands (0)	 Moderate (-1) Normal (0) 	
$\diamond \diamond \textbf{Cobble}$	(8)			<	>	2)		x	<u>x</u>	_	dpan (Ò)	 Free (1) 	6
◊ ◊ Gravel ((7)			<	>			х	<u>x</u>		dstone (0) Rap (0)	EMBEDDEDNESS ♦ Extensive (-2)	
*	5)		x	x <	> < Artificia	ıl (0)				♦ Laci	ustrine (0)	* Moderate (-1)	maximani
◊ ◊ Bedroc						(Sco	re natura	l substrat	tes; ignore	♦ Sha ♦ Coal	le (-1) I fines (-2)	◇ Normal (0) ◇ None (1)	
NUMBER	OF BEST T	YPES:		r more (2) r less (0)			sludge	from poir	nt-sources)) * 00a	i iiies (-z)		
COMMENT	S		* 3 0	1 1855 (0)									
2-Moderate a amounts (e.g water, or dee 0 Un 1 Ov 0 Sh	EAM COVI amounts, but i g., very large b p, well-define ndercut banl verhanging v nallows (in s potmats (1)	not of high boulders in td, function ts (1) vegetation	est quality deep or f al pools. n (1)	v or in small ast water, la	amounts of arge diamete Pools > 70 Rootwads	highest q r log that Icm (2) (1)	uality; 3 -l t is stable	Highest o , well dev Oxbov Aquat	quality in m	oderate otwad in waters (phytes	or greater deep / fast (1) (1)	AMOL Check ONE (or: Extensive >75° Moderate 25-7 Sparse 5-<25% Nearly absent	2 & average) % (11) 5% (7) ‰ (3)
	. ,												Cover
												Max	timum 6 20
SINUOSITY High (4) Moderate Low (2) None (1) COMMENTS	: (3)	DEVELOI	ent (7) 5)		CHANNEL	i) red (4) ring (3)		0 0 *	TABILITY High (3) Moderat Low (1)				ximum 20
4- BANK	EROSION	& RIP	ARIAN	ZONE	Check ON	E in each	category	for EAC	H BANK (Or 2 per	bank & aver	age)	
-	king downstre			PARIAN W	VIDTH				FL	OOD PI		ТҮ	
L R	ate (2)	0 0 0 0	>	>50m (4) erate 10-50 ow 5-10m (narrow <5 (0)	2)	◇	Forest, S Shrub or Resident Fenced p	Old fiel tial, Parl pasture	ld (2) k, New fie	.,	◇ ◇ Urb ◇ ◇ Min	, K	0) n (0)
COMMENT	s											101	10
<u>5-POOL/0</u>	GLIDE AN	D RIFFI	LE/RUN	N QUALI	<u>TY</u>								
MAXIMUI Check ONE (◇ >1m (6) ◇ 0.7-<1m ◇ 0.4-<0.7r ◇ 0.2-<0.4r ◇ <0.2m (0 COMMENTS	(4) m (2) m (1))) _(metric=0)	Chec Pool w Pool w	k ONE (o idth > rif idth = rif	L WIDTH r 2 & averag fle width (; fle width (; fle width (;	2) ◇ T 1) ◇ V 0) ◇ F	orrentia ery Fas ast (1) Ioderate	ıl (-1) t (1) ≥ (1)	ALL that * Slow o Inte o Inte C Edo	apply	(-2)	<	CREATION POTE	act ntact on back)
Indicate for	functional	riffles; Be	st areas	must be la	arge enoug	h to sup	oport a p	opulatio	on of riffle	e-obliga	ate species:	* No Riffle	e (metric=0)
◇ Best Area◇ Best Area	FFLE DEPTH as >10cm (2) as 5-10cm (1 as <5cm _{(metr})	F ♦ Maxir	RUN DEPT num >50cı num <50cı	m (2)	Stable (Mod. Sta	LE/RUN e.g. cobl able (e.g	SUBST ble, bou j. large ç	: (or 2 & av RATE Ilder) (2) gravel) (1) e gravel) (RIFF) (0)	ELE/RUN EM None (2) Low (1) Moderate Extensive	IBEDDEDNESS Rif (0)	f le/Run aximum 8
6-GRADI													
(2.349 f DRAINAGE (4.799 r	it/mi) AREA			Moderat	/ – Low (2-4 e (6-10) ′ery high (1			DOL: 20 RUN: 80		% GLID 5 RIFFL			r adient ximum 4 10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Vuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◇ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
[≫] 10%-<30%	Oiscoloration	◇ Spray		◇ Construction BMPs	Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	Oil sheen	Leveed – One side	ded	◊ Bank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◇ Golf	◇ Home
13 Middle	9	Impounded	Desiccated	◇ Park	◊ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

D J	$\overline{\Omega}$	<u>)WQ</u>	Biolo	ogical	I Stu	dies C	<u> 2HEI (</u>	Qua	litative	e Ha	<u>ıbitat E</u>	Evaluatio	<u>n Index)</u>
Sample # QH	- El Type	bioSan	nple #	St	ream Na	me				Locat	ion		
r	acro	210818		Six	xmile Cre	ek				CR 20	0 South		
Surveyor	Sample	Date	County		Mac	ro Sample	е Туре	⊛ Uak	itat Camp			QHEI Sc	ore: 62
PDM	8/18/21		Jennings		MHA			* Had	pitat Comp	Diete			02
1-SUBSTRA				substrate e every typ						С	heck ONE (d	or 2 & average)	
BEST TYPES		ootiinato	,			TYPES				0	RIGIN	QUALITY	,
		TOTAL	POOL	RIFFLE			TOTAL	POOL	RIFFLE			SILT	
◊ ◊ Bldrs/Slabs	s (10)				◇ ◇ Harc	dpan (4)					estone (1)	Heavy (-2)	Substrate
◊ ◊ Boulders (9)))				◇ ◇ Detr	itus (3)		х		♦ Tills	(1) ands (0)	 Moderate (-1 Normal (0) 	1)
◊ ◊ Cobble (8)					◇ ◇ Muc	k (2)					dpan (0)	 Normal (0) Free (1) 	14
♦ ♦ Gravel (7)			x	x	◇ ◇ Silt ((2)		х			dstone (0)		2)
◇			х	х	◇ ◇ Artif	icial (0)		х		•	Rap (0) Jstrine (0)	 Extensive (-2 Moderate (-1 	, maximum
◊ ◊ Bedrock (5))					(Sc	core natura	l substrat		◇ Sha		 Normal (0) Normal (1) 	, 20
NUMBER OF	BEST TY	PES:		r more (2))		sludge	from poir	nt-sources)	Coal Coa	fines (-2)	◊ None (1)	
COMMENTS			* 3 OI	r less (0)									
2-INSTREAM 2-Moderate amou amounts (e.g., ve water, or deep, w 0 Under 1 Overha 0 Shallo	unts, but no ry large bo ell-defined, cut banks anging ve ws (in slo	ot of highe oulders in , functiona s (1) egetatior	est quality deep or fa al pools. (1)	or in smal ast water, I 0 1	l amounts arge dian	s of highest neter log th > 70cm (2) ads (1)	t quality; 3 - at is stable	Highest q , well dev Oxbov Aquat	juality in mo	oderate twad in vaters (ohytes	or greater deep / fast (1) (1)	AMO Check ONE (or Check ONE (or Extensive >7 Moderate 25- Sparse 5-<25 Nearly absen	r 2 & average) 5% (11) 75% (7) % (3)
2 Rootm COMMENTS	nats (1)											140	Cover
												IVIA	20 ximum
SINUOSITY High (4) Moderate (3) Low (2) None (1) COMMENTS	 <!--</td--><td>EVELOF Excelle Good (5 Fair (3) Poor (1)</td><td>nt (7) 5)</td><td></td><td> ◇ Non ◆ Reco ◇ Reco </td><td>NELIZATI e (6) overed (4) overing (3 ent or no l</td><td>) 3)</td><td>\$ \$</td><td>TABILITY High (3) Moderate Low (1)</td><td></td><td></td><td></td><td>Shannel aximum 20</td>	EVELOF Excelle Good (5 Fair (3) Poor (1)	nt (7) 5)		 ◇ Non ◆ Reco ◇ Reco 	NELIZATI e (6) overed (4) overing (3 ent or no l) 3)	\$ \$	TABILITY High (3) Moderate Low (1)				Shannel aximum 20
4- BANK ER	OSION	& RIPA		ZONE	Check	ONE in ead	ch category	for EAC	H BANK (C	Dr 2 per	bank & aver	rage)	
River right looking	downstream				NIDTH				FLC	DOD PL	AIN QUAL	ITY	
EROS L R ◇ ◇ None or litt ◇ ◇ Moderate (2 ◇ ◇ Heavy/Seve	2) ິ	 <!--</td--><td>◇ Mode◆ Narro</td><td>>50m (4) rate 10-50 w 5-10m narrow <5 (0)</td><td>(2)</td><td></td><td>Forest, S Shrub or Residen Fenced</td><td>Old fiel tial, Parl pasture (</td><td>ld (2) k, New fiel</td><td>.,</td><td>◇ ◇ Urb ◇ ◇ Min Indicate p</td><td></td><td>(0) on (0) se(s) Riparian</td>	◇ Mode◆ Narro	>50m (4) rate 10-50 w 5-10m narrow <5 (0)	(2)		Forest, S Shrub or Residen Fenced	Old fiel tial, Parl pasture (ld (2) k, New fiel	.,	◇ ◇ Urb ◇ ◇ Min Indicate p		(0) on (0) se(s) Riparian
COMMENTS												X	Aaximum 4 10
5-POOL/GLI) RIFFL	E/RUN		ΙΤΥ								J[
MAXIMUM DE Check ONE (ONI ◇ >1m (6) ◇ 0.7-<1m (4) ◇ 0.4-<0.7m (2 ◇ 0.2-<0.4m (*) ◇ <0.2m (0) (me COMMENTS	EPTH └ Y!) ◇ ◊) () ()	C Checl Pool wi Pool wi	HANNEI k ONE (or dth > riff	L WIDTH r 2 & avera fle width (fle width (nge) (2) (1) (0)	 ◇ Torrent ◇ Very Fa ◊ Fast (1) ◊ Modera Indicat 	Check ial (-1) ist (1)	◇ Inte ◇ Edd	apply w (1) erstitial (-1) ermittent (- lies (1)				ntact ontact
Indicate for fun	ctional rif	fles Be	st aroas	must ha l	arge en	ough to si	unnorf a r	onulatio	on of riffle	-obliga	to sporios	A N. D.(()	12
RIFFLE ◇ Best Areas > ◇ Best Areas 5- ◇ Best Areas <	Chec E DEPTH 10cm (2) -10cm (1)	k ONE (C	ONLY!) R ◇ Maxin	CUN DEPT num >50c num <50c	「H :m (2)	RIF ◇ Stable ◈ Mod. S	Ch FFLE/RUN (e.g. cob Stable (e.g	eck ONE SUBST ble, bou j. large g	(or 2 & ave RATE	erage) RIFF	-	IBEDDEDNESS R (0)	iffle/Run laximum 8
COMMENTS	r												
6-GRADIEN (9.117 ft/mi DRAINAGE ARI (24.444 mi ²) EA		<	> Very lov> Moderation> High – \	te (6-10)	. ,		DOL: 30 RUN: 60		6 GLIDI RIFFLI			Gradient aximum 10 10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
» 30%-<55%	◊ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
> 10%-<30%	Discoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	♦ Cooling
	◊ Oil sheen	Leveed – One side	ded	Sank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Right	◇ Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	♦ Home
35 Midd	e	Impounded	Desiccated	◇ Park	◇ Data Paucity	♦ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSar	nple #		Stream I	Name				Location			
AB47661	Macro	210818	3901		Vernon F	Fork Muscata	atuck Rive	r		US 31			
Surveyor	Sample	Date	County			acro Samp	le Type	∗ Hab	itat Comp	lete	QHEI S	Score:	74
JMB	8/18/21	Chask O	Jackson NLY Two			HAB							
<u>1-SUBSTI</u>	<u>RATE</u>		% or not							Check Of	NE (or 2 & average)	
BEST TYPE	ES				OTHE	R TYPES				ORIGIN	QUAL	TY	
		TOTAL		RIFFLE			TOTAL	POOL	RIFFLE		SILT		
◊ ◊ Bldrs/Sl	abs (10)		<u>X</u>	<u>X</u>		ardpan (4)	. <u></u>	<u>X</u>		◇ Limestone◇ Tills (1)	(1) ◇ Heavy (-2	-)	bstrate
◊ ◊ Boulder	's (9)		X	<u>X</u>		etritus (3)		<u>X</u>		 Metlands (f) 	 ♦ Moderate 0) ♦ Normal (n\	
◊ ◊ Cobble (.,			<u>X</u>		uck (2)		·		◇ Hardpan (Ò) ◇ Free (1)		11
◊ ◊ Gravel (7)	. <u> </u>		Х	_	lt (2)		<u>X</u>		 Sandstone Rip/Rap (0) 			vinauna
* Sand (6))		X		_	rtificial (0)		<u>.</u>		♦ Lacustrine	(0)	(-1)	ximum 20
◊ ♦ Bedrock	.,		Х	Х		(S	core natura	al substrate		 Shale (-1) Coal fines (◇ Normal (((-2) ◇ None (1)))	
NUMBER C	OF BEST TY	PES:		r more	• •		sludge	from poin	t-sources)		(-2) V None (1)		
COMMENTS	5		~ 3 0	r less (l	J)								
	-	D · · ·						.,					
2-Moderate and amounts (e.g. water, or deep 0 Uno 0 Ovo 3 Sha	mounts, but no	ot of highe oulders in , function s (1) egetation	est quality deep or fa al pools. n (1)	or in sn ast wate	nall amou r, large di 3 Pool 2 Root	nts of highes	t quality; 3 - nat is stable) 0 2	Highest que, well devo Oxbow Aquati	uality in mo eloped root vs, Backw c macrop		er Chock ONE	25-75% (7) <25% (3)	
COMMENTS	.,											Cover Maximum 20	12
3-CHANN	EL MORP	HOLO	<u>GY</u>	Cheo	k ONE in	each catego	ory (<i>Or</i> 2 &	average)					
SINUOSITY High (4) Moderate Low (2) None (1) COMMENTS	(3)	EVELOI Excelle Good (Fair (3) Poor (1	PMENT ent (7) 5)		♦ No ♦ Ro ♦ Ro	NNELIZAT one (6) ecovered (4 ecovering (3 ecent or no) 3)	* \$ \$	TABILITY High (3) Moderate Low (1)	(2)		Channel Maximum 20	18
4- BANK I	EROSION	& RIP		ZONE	Cheo	ck ONE in ea	ch categor	v for EACI	H BANK (C)r 2 per bank &	average)		
River right look	king downstrear						0				÷ .		
L R E	ROSION		L R ∕ ◇ Wide	50m (4)		R ▹ Forest, \$	Swamn (3	8)	L	R Conservation Ti	llage (1)	
 ♦ ◊ None or ◊ ♦ Moderat ◊ ♦ Heavy/S 	te (2)	0 0 0	 ◇ Mode ◇ Narro ◇ Very ◇ None 	rate 10 w 5-10 narrow	-50m (3) n (2)	> < > < > <	 Shrub o Residen Fenced 	r Old field itial, Park pasture (d (2) , New field	 ♦ ♦ d (1) ♦ ♦ India 	Urban or Indust Mining, constru- cate predominant lan 100m riparian.	rial (0) ction (0) d use(s) <i>Riparian</i>	
COMMENTS	6											Maximum 10	
5-POOL /0) RIFFI			LITY								
MAXIMUN Check ONE (* >1m (6) * 0.7-<1m (* 0.4-<0.7m * 0.2-<0.4m * <0.2m (0) COMMENTS	/ DEPTH ONLY!) (4) ◇ n (2) ◇ n (1)) (metric=0)	Chec Pool w	CHANNE k ONE (0. idth > rifi idth = rifi	L WIDT r 2 & ave fle widt fle widt	H erage) h (2) h (1)	 ◇ Torren: ◇ Very Fa ◇ Fast (1 ◇ Modera Indica 	Check tial (-1) ast (1))	◇ Inter Eddi	apply rstitial (-1) rmittent (-2 ies (1)		RECREATION F	Contact Contact	
Indicate for	functional ri	ffles; Be	st areas	must b	e large e	enough to s	upport a	populatio	on of riffle	-obligate spe	cies: ◇ No F	Riffle (metri	c=0)
RIF ◈ Best Area ◇ Best Area	Chec FLE DEPTH s >10cm (2) s 5-10cm (1) s <5cm _{(metric}	k ONE (C	ONLY!)	UN DE num >5	PTH 0cm (2)	Ri ♦ Stable ♦ Mod. \$	Cł FFLE/RUN e (e.g. cob Stable (e.g	neck ONE I SUBSTF ble, boul g. large g	(or 2 & ave RATE der) (2)	erage) RIFFLE/RU ⊗ None ◇ Low ()) ◇ Mode	N EMBEDDEDNE (2) 1)	•	8
6-GRADIE													
(1.458 ft DRAINAGE (292.076	t/mi) AREA		~	> Mode	ow – Lo rate (6-1 – Very h			OOL: 40 RUN: 40		GLIDE: #\$ RIFFLE: 20		Gradient Maximum 10	6



<u>A-CANOPY</u>	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Vuisance algae	◊ Public	◊ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	◊ Dirt & Grime
» 30%-<55%	◇ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
> 10%-<30%	Oiscoloration	◊ Spray		◇ Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	♦ Cooling
	Oil sheen	Leveed – One side	ded	Sank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
40 Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flov
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	♦ Home
45 Middle	9	Impounded	Desiccated	◇ Park	◊ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	◇ Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
15 Left						

		OWQ	Biol	ogica	al Studies C	<u>HEI</u>	(Qua	litativ	e Habitat I	Evaluation	Index)
Sample #	QHEI Type	bioSa	nple #	:	Stream Name				Location		
AB47675	Macro	21081	3702	N N	/ernon Fork Muscata	tuck Rive	er		CR 400 West		
Surveyor	Sample	Date	County	/	Macro Sample	е Туре	۵ Llak			QHEI Score	e: 62
PDM	8/18/21		Jenning	gs	MHAB			bitat Com	piete		02
1-SUBST	RATE				e <i>TYPE BOXES</i> ; ype present				Check ONE (or 2 & average)	
BEST TYP	PES	ooumaa	70 01 110		OTHER TYPES				ORIGIN	QUALITY	
◇ ◇ Bldrs/S	ilabs (10)	TOTAL	POOL	RIFFLE X		ΤΟΤΑΙ	POOL		. ◇ Limestone (1)	SILT ◇ Heavy (-2)	Substrate
◊ ◊ Boulde	rs (9)				◇ ◇ Detritus (3)		x	x	 Tills (1) Wetlands (0) 	◇ Moderate (-1) Normal (0)	
◊ ◊ Cobble	(8)			<u> </u>	_			<u> </u>	 Vietiands (0) ♦ Hardpan (0) 	 Normal (0) Free (1) 	14
◊ ♦ Gravel	(7)		х	x	_		x	x	 Sandstone (0) 	EMBEDDEDNESS	
◊ ◊ Sand (6)	5)		х	х	◊ ◊ Artificial (0)				 ◇ Rip/Rap (0) ◇ Lacustrine (0) 	 ◇ Extensive (-2) ◈ Moderate (-1) 	Maximum 20
	· · /			x				tes; ignore	 Shale (-1) ◊ Coal fines (-2) 	 Normal (0) ◇ None (1) 	20
NUMBER	OF BEST T	PES:		or more (or less (0		sludge	e from poir	nt-sources)			
COMMENT	S										
2-Moderate a amounts (e.g	amounts, but n	ot of high oulders in	est qualit deep or	y or in sm fast wate	: 0 -Absent; 1 -Very sma all amounts of highest , large diameter log that	quality; 3	-Highest o	juality in m	oderate or greater	AMOUN Check ONE (or 2 & Extensive >75%	& average)
0_ Ur	ndercut bank	s (1)		2	2 Pools > 70cm (2)		Oxbo	ws, Backv	vaters (1)	* Moderate 25-75%	6 (7)
	verhanging v	•	• •		Rootwads (1)			•	ohytes (1)	* Sparse 5-<25% (,
	nallows (in sl potmats (1)	ow wate	r) (1)		Boulders (1)		Logs	and wood	ly debris (1)	♦ Nearly absent <	5% (1)

Cover Maximum

Maximum

10

6

20

12

```
COMMENTS
```

DRAINAGE AREA

(218.283 mi²)

3-CHANNEL MORPHOLOGY Check ONE in each category (*Or* 2 & *average*)

SINUOSITY DEVELOPMENT **CHANNELIZATION** STABILITY Excellent (7) High (4) * None (6) High (3) Channel Moderate (3) Recovered (4) Moderate (2) * Good (5) Maximum 16 Low (2) ◇ Fair (3) Recovering (3) ◇ Low (1) 20 None (1) Recent or no recovery (1) Poor (1) COMMENTS **4- BANK EROSION & RIPARIAN ZONE** Check ONE in each category for EACH BANK (Or 2 per bank & average) River right looking downstream **RIPARIAN WIDTH** FLOOD PLAIN QUALITY EROSION LR LR LR LR ◊ ◊ Wide >50m (4) ◇ ◇ Forest, Swamp (3) ◊ ◊ Conservation Tillage (1) ◊ ◊ None or little (3) ◊ ◊ Moderate 10-50m (3) ◊ ◊ Shrub or Old field (2) ◊ ◊ Urban or Industrial (0) *
 * Moderate (2) * * Narrow 5-10m (2) ♦ ♦ Residential, Park, New field (1) ◊ ◊ Mining, construction (0) * * Heavy/Severe (1) ◊ ◊ Very narrow <5m (1)</p> ♦ ♦ Fenced pasture (1) Indicate predominant land use(s) past 100m riparian. ◊ ◊ None (0) * * Open Pasture/Rowcrop (0) Riparian Maximum 4 COMMENTS 10 5-POOL/GLIDE AND RIFFLE/RUN QUALITY MAXIMUM DEPTH **CHANNEL WIDTH CURRENT VELOCITY RECREATION POTENTIAL** Check ONE (ONLY!) Check ONE (or 2 & average) Check ALL that apply ◇ >1m (6) Pool width > riffle width (2) Torrential (-1) * Slow (1) Primary Contact ◊ 0.7-<1m (4) Pool width = riffle width (1) Very Fast (1) Interstitial (-1) ◊ Secondary Contact * 0.4-<0.7m (2) * Pool width < riffle width (0)</p> * Fast (1) Intermittent (-2) (circle one and comment on back) Eddies (1) ◊ 0.2-<0.4m (1) Moderate (1) ◊ <0.2m (0) (metric=0)</p> Indicate for reach - pools and riffles. Pool/Current 5 COMMENTS Maximum 12 Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: No Riffle (metric=0) Check ONE (ONLY!) Check ONE (or 2 & average) **RIFFLE DEPTH RUN DEPTH RIFFLE/RUN SUBSTRATE RIFFLE/RUN EMBEDDEDNESS**

 ♦ Best Areas >10cm (2) ♦ Best Areas 5-10cm (1) ♦ Best Areas <5cm_(metric=0) 	Maximum >50cm (2) Aximum <50cm (1)	♦ Mod. \$	e (e.g. cobble, boulder) (/ Stable (e.g. large gravel) ble (e.g. sand, fine grave	(1)	 ◇ None (2) ◇ Low (1) ◊ Moderate (0) ◇ Extensive (-1) 	Riffle/Run Maximum 8	5
COMMENTS						l	
6-GRADIENT							
(1.437 ft/mi)	◊ Very low – Low	(2-4)	% POOL: 10	% GL	IDE: #\$	Gradient	

% RUN: 70

% RIFFLE: 20

2/8/2022 10:57:40 AM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index), Page 1 of 2

♦ Moderate (6-10)

◇ High – Very high (10-6)



<u>A-CANOPY</u>	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
[⊳] >85% - Open	Vuisance algae	◊ Public	◊ Private	◊ WWTP		♦ CSO
55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	◇ Dirt & Grime
◇ 30%-<55%	♦ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
◇ 10%-<30%	Oiscoloration	◊ Spray		◇ Construction BMPs	◊ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	Oil sheen	Leveed – One side	ded	Sank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	◇ Lagoon
		Stable - Bedload				
44 Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flov
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◇ Quarry Mine	◊ Golf	◇ Home
76 Middle	9	Impounded	Desiccated	◇ Park	◇ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
74 Left						

	M	OWQ	Biolo	ogica	I St	udies C	<u> HEI (</u>	Qual	litativ	e Ha	bitat E	Evaluation	Index)
Sample #	QHEI Type	bioSam	ple #	St	tream I	Name				Locati	on		
AB46789	Macro	2108247	704	V	ernon F	ork Muscata	tuck River			CR 50	North		
Surveyor	Sample		County		М	acro Sample	е Туре		oitat Comp	nlete		QHEI Sco	re: 42
PDM	8/24/21		Jackson			HAB		Tab		piete			
<u>1-SUBST</u>	RATE	Check ON estimate 9								Cł	neck ONE (d	or 2 & average)	
BEST TYP	PES				OTHE	R TYPES				0	RIGIN	QUALITY	
		TOTAL I	POOL	RIFFLE			TOTAL	POOL	RIFFLE			SILT	.
◊ ◊ Bldrs/S	· · /					ardpan (4)			·	. ◇ Lime	stone (1)	◇ Heavy (-2)◈ Moderate (-1)	Substrate
◊ ◊ Boulde	()					etritus (3)		x	<u>x</u>	 ♦ Wetla 	(') ands (0)	 Normal (0) 	7
◊ ◊ Cobble						uck (2)					pan (0)	◇ Free (1)	1
◊ ◊ Gravel	. ,							x	x		lstone (0) Rap (0)	EMBEDDEDNESS ♦ Extensive (-2)	Maximum
	-		x	X	• • AI	rtificial (0)		x	<u>x</u>		strine (0)	Moderate (-1)	20
		VDES.	<u> </u>			(Sc	ore natura			 ◇ Shale ◇ Coal 	e (-1) fines (-2)	◇ Normal (0)◇ None (1)	
NUNDER	OF BEST T	TPES:		^r more (2 ^r less (0)	•		sludge	from poir	nt-sources)		()		
COMMENT	S												
	EAM COVE											AMOU	NT
	amounts, but n g., very large b											Check ONE (or 2	& average)
water, or dee	ep, well-defined	d, functiona			•	-						Extensive >75%	. ,
	ndercut bank	• •			_	s > 70cm (2)	$-\frac{0}{0}$		ws, Backv	•	,	♦ Moderate 25-75	()
	verhanging v hallows (in sl	-		<u> </u>		wads (1) ders (1)	0		ic macrop and wood	•	•	 Sparse 5-<25% Nearly absent 	.,
	ootmats (1)	ow water)	(') _	0	_ Doui	uers (1)	<u> </u>	_ LUgs (5(1)		CJ /0 (1)
COMMENT	.,											(Maxi	Cover mum 7 20
3-CHANN	NEL MORP	HOLOG	Y	Check	ONE in	each catego	rv (<i>Or</i> 2 & a	average)					20
SINUOSITY		DEVELOPI				NNELIZATI	• •		TABILITY	,			
 High (4) Moderate 		Excellen Good (5)	• •			one (6) ecovered (4)			High (3) Moderate	o (2)		Cha	annel
* Low (2)		* Good (3) * Fair (3))			ecovering (3			Low (1)	6 (2)		Max	imum 10 20
♦ None (1) COMMENT		Poor (1)			◇ Re	ecent or no r	recovery	(1)					20
	-			20115				·					
	EROSION oking downstrea			<u>LONE</u> PARIAN		ck ONE in eac I	ch category	for EAC			bank & aver AIN QUAL		
Ĕ	EROSION	L	R			L					LR		
L R ◇ ◇ None o	or little (3)			>50m (4) rate 10-5			Forest, S Shrub or	• •				nservation Tillage an or Industrial (0	
◊ ◊ Modera	ate (2)	<u>ب</u>	Narro Narro	w 5-10m	(2)	\diamond \diamond	Residen	tial, Park	k, Néw fiel	ld (1)		ing, construction	
* * Heavy/	/Severe (1)		◊ Very ı ◊ None	narrow <	5m (1)		Fenced Open Pa					predominant land use m riparian.	(s)
		Ŷ	* NONE	(0)		• •	Openra	Sture/N	Swerop (u	')	patriot	' Ri	i parian iximum 3
COMMENT	S												10
5-POOL/	GLIDE ANI	D RIFFL	E/RUN	I QUAL	<u>ITY</u>								
-		-									RF	CREATION POTE	ΝΤΙΔΙ
<pre>Check ONE</pre>		Check Pool wid		2 & avera le width		◇ Torrenti		ALL that a Slov ∜ Slov				 Primary Conta 	
◇ 0.7-<1m	n (4)	* Pool wid	dth = riff	le width	(1)	Very Fa	st (1)	Intel	rstitial (-1			Secondary Con	
◇ 0.4-<0.7 ◇ 0.2-<0.4	• •	Pool wid	dth < riff	le width	(0)	◇ Fast (1)			rmittent (· lies (1)	-2)	(circ	le one and comment of	on back)
 < <0.2 <0.4 < <0.2 m (0 							te for reach		• •			Pool/Cu	irrent
COMMENT												Maxi	mum 9 12
Indicate for	r functional r	iffles; Bes	t areas	must be	large e	enough to su	upport a p	opulatio	on of riffle	e-obliga	te species	* No Riffle	(metric=0)
	Chee FFLE DEPTH	ck ONE (<i>OI</i>			тц	D 15			(or 2 & ave	• •			
	as >10cm (2)			10M DEP			FLE/RUN (e.g. cob				None (2)	MBEDDEDNESS	
♦ Best Area	as 5-10cm (1)) <		num <50	• • •	◇ Mod. S	Stable (e.g	j. large g	jravel) (1)	· ^	Low (1) Moderate	Mar	i le/Run ximum ()
◇ Best Area	as <5cm _{(metric}	c=0)				♦ Unstat	ole (e.g. s	and, fine	e gravel) (Extensive		8
COMMENT													
6-GRADI				Vent		w (2.4)							
(1.458 f DRAINAGE				> Very lo > Modera			% PC	OOL: 30	%	% GLIDE	:: #\$		adient imum 6
(364.50						igh (10-6)	% F	RUN: 70	%	RIFFLE	: #\$		10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
◇ >85% - Open	Vuisance algae	◊ Public	◇ Private	◇ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
◇ 30%-<55%	◊ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
[⊳] 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	♦ Cooling
	◊ Oil sheen	Leveed – One side	ded	Sank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Read	ing	Moving – Bedloa	d	◇ False bank	♦ Manure	♦ Lagoon
		Stable - Bedload				
R	ight	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◇ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
N	liddle	Impounded	Desiccated	◇ Park	◇ Data Paucity	♦ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
L	eft					

		<u>)WQ</u>	Biol	ogic	<u>al Stu</u>	udies C	<u> RHEI (</u>	Qua	litativ	e Ha	abitat E	valuati	on Ir	<u>ndex)</u>
Sample #	QHEI Type	bioSan	nple #		Stream N	lame				Locati	ion			
AB47674	Macro	210816	701		Sixmile C	reek				CR 41	5 North			
Surveyor	Sample	Date	County		Ма	acro Sample	е Туре	* Hat				QHEI S	Score:	57
PDM	8/16/21		Jenning			HAB		* Had	oitat Comp	Diete				57
1-SUBSTI	RATE				te TYPE E type prese					C	heck ONE (a	or 2 & average))	
BEST TYP		estimate	76 01 1101	eevery						0	RIGIN	QUALI	TY	
		TOTAL	POOL	RIFFL			τοτλι	BOOI	RIFFLE	•				
◇ ◇ Bldrs/Sl		IOTAL	FUUL			rdpan (4)	TOTAL	FOOL		◇ l ime	estone (1)	SILT ♦ Heavy (-2	2	Substrate
◇ ◇ Boulder	. ,					tritus (3)		x	·	* Tills		 Moderate 		
	()		x	x	_	.,			·		ands (0)	* Normal (D)	14
◇ ◇ Cobble (.,		<u>x</u>	x		• •		x			dpan (0) dstone (0)	 Free (1) EMBEDDEDN 	FSS	
◊ ◊ Gravel (_			<u>~</u>		◇ Rip/I	Rap (0)	♦ Extensive		Maximum
◊ ♦ Sand (6)			x	х	_	tificial (0)				♦ Lacu	ustrine (0)	Overate		20
* Bedrock			x	Х		(Sc	ore natura	l substrat	es; ignore	 ◇ Shal ◇ Coal 	le (-1) fines (-2)	 ♦ Normal (0 ♦ None (1)))	
NUMBER C	OF BEST TY	PES:		r more			sludge	from poir	nt-sources)	ooui	111100 (2)			
COMMENTS	5		~ 30	or less (0)									
2-Moderate a amounts (e.g. water, or deep 0 Un 1 Shi 1 Ro <i>COMMENTS</i> 3-CHANN SINUOSITY ◇ High (4) ◇ Moderate ⊗ Low (2) ◇ None (1) <i>COMMENTS</i> 4- BANK I River right look	EL MORPH D (3) * * * * * * * * * * * * *	to of higher ulders in , function: s (1) egetation w water HOLOC EVELOF Excelle Good (5 Fair (3) Poor (1)	est quality deep or f al pools. (1) (1) (1) (1) (2) (1) (2) (1) (2) (2) (2) (2) (2) (2) (2) (2) (2) (2	v or in sr ast wate	nall amour er, large dia 2 Roots 0 Bould ck ONE in CHA	nts of highest	quality; 3- at is stable	Highest q , well dev Aquat Logs a average) S ⊗ ⊗ ⊘ (1)	uality in mo veloped roo ws, Backw ic macrop and wood TABILITY High (3) Moderate Low (1)	oderate otwad in vaters (ohytes (y debri y debri	or greater deep / fast (1) (1) is (1)	Check ONE ◇ Extensive ◇ Moderate 2 ◇ Sparse 5 ◇ Nearly abs age)	>75% (1 25-75% (225% (3) sent <5% <i>Cov</i> <i>Maximu</i> <i>Chanr</i> <i>Maximu</i>	average) 1) (7) % (1) % (1) mer 8 20
	ROSION		- R			L			2)		L R		U.a.v.a. (4)	
L R * * None or	r little (3)		◊ Wide◊ Mode		4) -50m (3)		Forest, S Shrub or	• •				iservation Ti an or Industi	• • • •)
		*	◊ Narro	w 5-10	m (2) `́	* *	Residen	tial, Parl	<, New fiel	ld (1)	◊ ◊ Min	ing, construe	ction (0))
◊ ◊ Heavy/S	severe (1)		◇ Very◇ None		<5m (1)		Fenced		(1) owcrop (0)	۰		redominant lan n riparian.	. ,	
COMMENTS	6		None	(0)			openra	Sturent	Swelop (0	,	,		Ripa Maxin	
5-POOL/C	LIDE AND	RIFFL	E/RU											
MAXIMUN Check ONE (◇ >1m (6) ◇ 0.7-<1m ◇ 0.4-<0.7m ◇ 0.2-<0.4m ◇ <0.2m (0) COMMENTS	ONLY!) (4)	-	dth = rif	or 2 & av f le wid f le wid	e <i>rage</i>) :h (2) :h (1)	 ◇ Torrent ◇ Very Fa ◇ Fast (1) ◊ Modera Indicat 	Check . ial (-1) st (1)	◇ Inte ◇ Edd	apply w (1) rstitial (-1 rmittent (- lies (1)	,	<		Contact Contac ment on t ol/Curre Maximut	ent m 4
Indicate for	functional		of erc ==	muct	o lorg	nouch to		onul-4		a h!!	to one las			12
indicate for	functional rif			must k	e large e	nough to si		-		-	ite species:	♦ <u>No F</u>	Riffle (m	etric=0)
RIF	FLE DEPTH	k ONE (C	,	RUN DE	PTH	RIF	Ch FLE/RUN		(or 2 & ave RATE	• •	LE/RUN EN	IBEDDEDNE	SS	
◇ Best Area◇ Best Area		=0)	♦ Maxir	num >{	i0cm (2) i0cm (1)	♦ Stable♦ Mod. S	(e.g. cob stable (e.g	ble, bou j. large ç		≎ ⊗ 0)	 None (2) Low (1) Moderate Extensive 	(0)	Riffle/I Maxim	-

			• •
۲	Best	Areas	<5cm(metric=0)

COMMENTS **6-GRADIENT** (16.916 ft/mi) DRAINAGE AREA ◊ Very low – Low (2-4) Gradient Maximum % POOL: 20 % GLIDE: 0 ♦ Moderate (6-10) 10 10 % RUN: 70 % RIFFLE: 10 (8.944 mi²) ♦ High – Very high (10-6)



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
^{>} 10%-<30%	Discoloration	◇ Spray		◇ Construction BMPs	Sediment BMPs	
[≫] <10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	◊ Bank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
7 Middl	e	Impounded	Desiccated	◇ Park	◇ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

		OWQ	Biolo	ogical Stu	idies Q	<u>HEI (</u>	Qual	itativ	e Ha	bitat E	Evaluation	<u>Index)</u>
Sample #	QHEI Type	bioSam	ple #	Stream N	ame				Locati	on		
AB46802	Macro	2108179	903	Mutton Cr	eek Ditch				CR 40	0 North		
Surveyor	Sample		County	Ма	cro Sample	Туре	⊗ Hah	itat Com	nloto		QHEI Scor	'e: 49
JMB	8/17/21		Jackson		IAB				piere			75
1-SUBSTR	<u>RATE</u>			substrate TYPE B every type preser					Cł	neck ONE (d	or 2 & average)	
BEST TYPE	ES				R TYPES				0	RIGIN	QUALITY	
		TOTAL I	POOL	RIFFLE		TOTAL	POOL	RIFFLE			SILT	
◊ ◊ Bldrs/Sl	labs (10)				rdpan (4)		<u>X</u>			stone (1)	Heavy (-2)	Substrate
◊ ◊ Boulder	rs (9)				tritus (3)		Х		◇ Tills ·	(1) ands (0)	 ♦ Moderate (-1) ♦ Normal (0) 	_
◊ ◊ Cobble ((8)			◇	ck (2)		X		• Hard	pan (Ò)	◇ Free (1)	5
◊ ◊ Gravel ((7)		<u> </u>	◇ ◇ Silt	: (2)		X		◇ Sanc ◇ Rip/F	Istone (0) San (0)	EMBEDDEDNESS	
◊ ◊ Sand (6))	<u> </u>		◇ ◇ Art	ificial (0)				◇ Lacu	strine (0)	◊ Moderate (-1)	Maximum 20
◊ ◊ Bedrock			<u> </u>		(Sco	re natura	substrate	es; ignore		e (-1) fines (-2)	 Normal (0) ◇ None (1) 	
NUMBER C	OF BEST T	YPES:		more (2)		sludge	from poin	t-sources)	Coai	nnes (-2)	• None (1)	
COMMENTS	S		* 3 Or	less (0)								
2-INSTRF		ER Indicate	e presenc	e 0 to 3: 0-Absent	: 1-Verv small		or if more	e common	of marg	inal quality.	AMOU	<u></u>
2-Moderate a	amounts, but r	not of highes	st quality	or in small amoun	ts of highest o	uality; 3 -l	Highest q	uality in me	oderate o	or greater	Check ONE (or 2	
amounts (e.g. water, or deep				st water, large dia	meter log that	t is stable	, well dev	eloped roc	otwad in	deep / fast	 Extensive >75% 	•
	dercut bank			3 Pools	> 70cm (2)	3	Oxbov	vs, Backv	waters (1)	Moderate 25-75	% (7)
	erhanging v	-			vads (1)	2		ic macrop		•	◊ Sparse 5-<25%	(3)
	allows (in s	low water)	(1)	0 Bould	ers (1)	2	Logs a	and wood	ly debri	s (1)	Nearly absent <	:5% (1)
	otmats (1)										c	over
COMMENT	5										Maxii	
3-CHANN	IEL MORF	PHOLOG	iY_	Check ONE in e	each category	(Or 2 & a	average)					
SINUOSITY		DEVELOPI Excellen			NNELIZATIO	N	-	TABILITY High (3)	(
 Moderate 		 Cood (5) 	• •		covered (4)			Moderate	e (2)			innel
◇ Low (2) ◊ None (1)		◇ Fair (3) ◇ Paar (4)			covering (3)			Low (1)			IVIAXI	imum 6 20
None (1) COMMENTS		* Poor (1)		~ Rec	cent or no re	covery (1)					
4- BANK I	FROSION		ΒΙΔΝ 7		ONE in each		for FAC	HBANK	Or 2 ner	hank & aver	rage)	
River right look				PARIAN WIDTH		reategory				AIN QUAL	•	
	ROSION		R		LF					LR		<i>(</i> 1)
L R ♦ ♦ None or	r little (3)			>50m (4) rate 10-50m (3)		Forest, S Shrub or	• •				nservation Tillage an or Industrial (0	
◇ ◇ Moderat	• •		Narrov	v 5-10m (2)	\diamond \diamond	Resident	ial, Park	, New fie	ld (1)	◇ ◇ Min	ing, construction	(0)
◊ ◊ Heavy/S	Severe (1)		♦ Very n ♦ None (arrow <5m (1)		Fenced p Onen Pa	•	1) wcrop (0	N		predominant land use(m riparian.	,
			None	(0)		openna	51010/110	, noi op (o	''		Ri	parian _{ximum} 10
COMMENTS	S											10
5-POOL/G	GLIDE AN	D RIFFL	<u>E/RUN</u>	QUALITY								
MAXIMUN		-	HANNEL				NT VELC			RF	CREATION POTE	ΙΔΙΤΙΛ
Check ONE (* >1m (6)				2 & average) le width (2)	◇ Torrentia		ALL that a Slov الم				◇ Primary Conta	
◇ 0.7-<1m	(4)	* Pool wid	dth = riffl	le width (1)	Very Fas		Inter	rstitial (-1	,		Secondary Cont	tact
◇ 0.4-<0.7n ◇ 0.2-<0.4n		Pool wid	dth < riffl	le width (0)	 ◇ Fast (1) ◇ Moderate 	s (1)	◇ Inter ◇ Edd	rmittent (·	-2)	(circ	le one and comment o	on back)
 ◊ <0.2-<0.41 ◊ <0.2m (0) 						• •		and riffles.			Pool/Cu	rrent
COMMENTS											Maxii	mum 8 12
Indicate for				nust be large er	nough to su	oport a p	opulatio	on of riffle	e-obliga	te species	♦ <u>No Riffle</u>	(metric=0)
סור	Che FFLE DEPTH	eck ONE (<i>Ol</i>		UN DEPTH	DIFF	Ch LE/RUN		(or 2 & av	0,			
◇ Best Area	as >10cm (2)) <		um >50cm (2)	× Stable (\diamond	None (2)		le/Run
♦ Best Area	-	-	Maxim	um <50cm (1)	♦ Mod. St	able (e.g	. large g	ravel) (1)	· ^	Low (1) Moderate	May	kimum 0
♦ Best Area	•	ic=0)			◊ Unstabl	e (e.g. s	and, fine	gravel) (Extensive		8
COMMENTS												
6-GRADIE			~	Von low low	(2.4)	a. –	· ·		, .		-	
(2.112 ft DRAINAGE				Very low – Low Moderate (6-10		% PC)OL: #\$	%	% GLIDE	:: 100		dient mum 4
(29.807	mi²)		\$	High – Very hig	gh (10-6)	% F	RUN: #\$	%	RIFFLE	: #\$		10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◇ Public	◇ Private	◊ WWTP		◇ CSO
» 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	 Young – Success Old - Succession 		◇ Contaminated	◊ Landfill	◇ Industry
^{>} 10%-<30%	Discoloration	◇ Spray		Construction BMPs	Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	Output Bank Erosion	Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Bath	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	♦ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◇ Golf	◇ Home
70 Middl	e	Impounded	Desiccated	◇ Park	◊ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

OWQ Biological Studies QHEI	(Qualitative Habitat Evaluation Index)

0		1.1.0					•	-		1			-
Sample # AB47669	QHEI Type Macro	bioSan 210817	•		Stream N	to Richart La	ako				on) West		
Surveyor	Sample		County			acro Sample				CK 900	5 WESI	QHEI Sco	
JMB	8/17/21	Dale	Jenning			HAB	e iype	♦ Hab	itat Com	plete			^{re:} 56
		Check O								0			
<u>1-SUBSTR</u>	AIE	estimate	% or note	e every t	ype prese	nt						or 2 & average)	
BEST TYPE	ES				OTHE	R TYPES				0	RIGIN	QUALITY	
		TOTAL	POOL	RIFFLE			TOTAL	POOL	RIFFLE			SILT	.
◊ ◊ Bldrs/Sl	abs (10)					rdpan (4)		<u>×</u>	X		stone (1)	◇ Heavy (-2)	Substrate
◊ ◊ Boulder	s (9)				_	tritus (3)		X		♦ Tills (♦ Wetl:	(1) ands (0)	 ♦ Moderate (-1) ♦ Normal (0) 	
\diamond \diamond Cobble ((8)			Х	_	ıck (2)				_ ◇ Hard	pan (0)	 ◇ Free (1) 	12
◇	7)			Х	_◇ ◇ Sil	t (2)		Х			stone (0)	EMBEDDEDNESS	
♦ ♦ Sand (6)			Х	Х	◇ ◇ Ar	tificial (0)				ORID A STATE OR STA	(0) strine (0)	 Extensive (-2) Moderate (-1) 	, maximum
◊ ◊ Bedrock					_	(50	ore natura			♦ Shale	e (-1) 🎽	 Normal (0) 	20
NUMBER C		PES:	♦ 4 0	more (2)	(50			t-sources)	♦ Coal	fines (-2)	◇ None (1)	
			* 3 oi	r less (Ö)		0						
COMMENTS	5												
2-INSTRE	AM COVE	R Indicat	e presend	ce 0 to 3	0 -Absen	t; 1-Very sma	all amounts	s or if mor	e common	of marg	inal quality;	AMOL	INT
2-Moderate a	mounts, but no	ot of highe	st quality	or in sm	all amour	nts of highest	quality; 3-	Highest q	uality in m	oderate o	or greater	Check ONE (or	
amounts (e.g. water, or deep	, very large bo , well-defined			ast water	, large dia	ameter log tha	at is stable	, well dev	eloped roc	otwad in o		Extensive >75	0,
	dercut banks			(Pools	s > 70cm (2)	1	Oxbov	vs, Backv	waters (*		Moderate 25-7	()
0 Ov	erhanging ve	egetation	n (1) –	2	Root	wads (1)	0	 Aquati	ic macro	phytes (Sparse 5-<25%	.,
3 Sha	allows (in slo	ow water) (1)	(Bould	ders (1)	3	Logs a	and wood	ly debris	s (1)	Nearly absent	<5% (1)
1 Ro	otmats (1)		_					_					
COMMENTS	5												Cover aimum 8
												ivia,	20
3-CHANN	EL MORPI	HOLOG	θY	Chec	k ONE in	each categor	ry (<i>Or</i> 2 & a	average)					
SINUOSITY	D	EVELOF	MENT		СНА	NNELIZATIO	ON	-	TABILITY	(
◇ High (4)♦ Moderate		Excelle Good (5	• •			ne (6) covered (4)			High (3) Moderate	o (2)		Cł	nannel
 Moderate Low (2) 	• •	Fair (3)	"			covering (3			Low (1)	e (2)		Ma	ximum 16 20
◊ None (1)	\$	Poor (1))			cent or no r			. ,				20
COMMENTS	5												
4- BANK	EROSION	& RIPA	RIAN	ZONE	Chec	k ONE in eac	ch category	for EAC	H BANK (Or 2 per	bank & aver	age)	
	king downstrear			PARIAN	I WIDTH				FLO	OOD PL	AIN QUALI	ITY	
LR	ROSION		. R ◇ Wide	50m (1)	L	R Forest, S	Swamn (2)			servation Tillage	o (1)
◊ ◊ None or			 Mode 	•	,		Shrub or	• •				an or Industrial (
* Moderat			♦ Narro			* *	Residen	tial, Park	, New fie	ld (1)	◊ ◊ Min	ing, construction	n (0)
◊ ♦ Heavy/S	Severe (1)		♦ Very I♦ None		<5m (1)		Fenced Open Pa	•		n.	Indicate p past 100n	predominant land use n riparian	e(s)
		· ·	* NONE	(0)		•••	Open r a	Sturento	werop (o	')	,	, F	R iparian aximum 5
COMMENTS	5												10
5-POOL/G			E/RUN										
							CURRE						
MAXIMUN Check ONE (-	ONE (0					NT VELC ALL that a			RE	CREATION POTE	ENTIAL
◇ >1m (6)		Pool wi			• •	♦ Torrenti		* Slov	• •			Primary Cont	
◇ 0.7-<1m (◇ 0.4-<0.7n	· /	Pool wi Pool wi			• •	 ◊ Very Fa ◊ Fast (1) 			rstitial (-1 rmittent (<	Secondary Col	ntact
◇ 0.4-<0.711 ◇ 0.2-<0.4n		FUUIWI	uui < mi		1(0)	 Moderat 		 ♦ Edd 	•	-2)	(circl	e one and comment	on back)
◇ <0.2m (0)							e for reach		• •			Pool/C	
COMMENTS	5											Max	timum 5 12
Indicate for	functional ri	ffles; Be	st areas	must b	e large e	nough to su	upport a p	opulatio	on of riffle	e-obliga	te species:	♦ No Riffle	e (metric=0)
		k ONE (C			•	-	•• •	•	(or 2 & av	•	-		<u>,</u>
	FLE DEPTH			UN DEI			FLE/RUN					BEDDEDNESS	
 ♦ Best Areas ♦ Best Areas 	s >10cm (2) s 5-10cm (1)		 ◇ Maxin ◇ Maxin 		• • •		(e.g. cob stable (e.g				None (2) Low (1)		fle/Run
	s <5cm _{(metric}		maAll				ble (e.g. s			(0) [*]	Moderate	(0)	aximum () 8
COMMENTS	-	-,						-	- /	. ↓	Extensive	(-1)	
6-GRADIE (17.212 1			<	> Verv I	ow – Lov	v (2-4)	0/ D/	OOL: 30	0	% GLIDE	:- #¢	<u> </u>	radient
DRAINAGE			<	> Mode	ate (6-10	D)`´	70 PU	JUL. 30	9		# ⊅		ximum 10
(1.529 m		<	> High -	- Very hi	gh (10-6)	% F	RUN: 50	%	RIFFLE	: 20		10	



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◇ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
^{>} 10%-<30%	Discoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◇ Oil sheen	Leveed – One side	ded	Output Bank Erosion	♦ Surface Erosion	◇ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Right	A Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	◇ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
9 Midd	le	Impounded	Desiccated	◇ Park	◊ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

	JV	OWQ Biol	ogical Stu	idies QI	HEI (Qual	itativ	e Ha	bitat E	Evaluati	ion In	<u>idex)</u>
Sample #	QHEI Type	bioSample #	Stream N	ame				Locati	on			
AB47673	Macro	210816702	Sixmile C	eek				CR 17	5 North			
Surveyor	Sample	e Date County	Ma	cro Sample 1	Туре	⊗ II-b	itet Comm	lata		QHEI	Score:	67
PDM	8/16/21	Jenning	js M⊦	IAB		* Hab	itat Comp	blete				67
1-SUBST	RATE		substrate TYPE B te every type presented					Cł	neck ONE (d	or 2 & average)	
BEST TYP								0	RIGIN	QUAL	ΙΤΥ	
		TOTAL POOL	RIFFLE		TOTAL	POOL	RIFFLE					
◇ ◇ Bldrs/S	Slabs (10)			rdpan (4)				◇ Lime	stone (1)	SILT ♦ Heavy (-2	2) <u>-</u>	Substrate
◊ ◊ Boulde	ers (9)		◇ ◇ Det	ritus (3)		x		♦ Tills	(1)	* Moderate		
◊ ◊ Cobble	(8)		x						ands (0) pan (0)	 ◇ Normal (◇ Free (1) 	0)	11
♦ ♦ Gravel		x	x			x			Istone (0)	EMBEDDEDN	ESS	
 	.,	x		ificial (0)		x		◇ Rip/F		♦ Extensive	. ,	Maximum
◇ ◇ Bedroc	-			.,				 ✓ Lacu ♦ Shale 	strine (0) e (-1)	 Moderate Normal (20
	OF BEST T	YPES: ×4 c	or more (2)	(Scor					fines (-2)		-,	
			or less (0)		oluugo		(0001000)					
COMMENT	s											
2-Moderate a amounts (e.c water, or dee 0 Ur 1 Ov 2 Sh	amounts, but r g., very large b ep, well-define ndercut bank verhanging v	not of highest quality oulders in deep or d, functional pools. as (1) regetation (1)	1 Rootv	ts of highest q	uality; 3 -F is stable,	lighest qu well dev Oxbow Aquati	uality in mo	oderate o twad in o vaters (* ohytes (or greater deep / fast 1) 1)	Al Check ONE Check ONE Extensive Moderate Sparse 5 Nearly ab	>75% (1 25-75% (<25% (3)	1) 7)
	.,										Cov	er 📃
COMMENT	5										Maximur	ⁿ 12
		HOLOGY	Check ONE in	aach category	(0r28.a)	werage)					2	20
SINUOSITY		DEVELOPMENT					TABILITY					
High (4)		Excellent (7)	* No	ne (6)		\diamond	High (3)				Chann	a/
 Moderate Low (2) 	• •	∗ Good (5) ◇ Fair (3)		covered (4) covering (3)			Moderate Low (1)	e (2)			Maximu	m 15
 None (1) 		 Pair (3) Poor (1) 		cent or no re	covery (LOW (1)				2	20
COMMENT	S					-						
4- BANK	EROSION	& RIPARIAN	ZONE Check	ONE in each	category	for EAC	H BANK (Dr 2 per	bank & avei	rage)		
-	oking downstrea	am R	IPARIAN WIDTH				FLC	DOD PL	AIN QUAL	ITY		
LR	EROSION	L R ⇔ ⇔ Wide	e >50m (4)	L R	Forest, S	wamn (3	3)			nservation Ti	illago (1)	
* * None o			erate 10-50m (3)	◊ ◊ \$	Shrub or	Old field	d (2)			an or Indust	• • • •	
◇ ◇ Modera◇ ◇ Heavy/	· · ·		ow 5-10m (2)	◇ ◆ F	Resident	ial, Park	, New fiel	d (1)		ning, constru		
• • neavy/	Severe (1)	◇ ◇ Very ◇ ◇ None	narrow <5m (1) (0)		Fenced p		(1) (0) (0))		predominant lar m riparian.	. ,	
COMMENT	s										Ripar Maxim	
5-POOL/	GLIDE AN	D RIFFLE/RUI	N QUALITY									/ I
MAXIMUI Check ONE > 1m (6) • 0.7-<1m • 0.4-<0.7 • 0.2-<0.4 • <0.2m (0 COMMENT	(4) 'm (2) .m (1) 0) _(metric=0)	-	ffle width (1)	 ◇ Torrential ◇ Very Fast ◇ Fast (1) ◊ Moderate 	l (-1) t (1) t (1)	ALL that a * Slow < Inter < Inter < Eddi	apply v (1) rstitial (-1) rmittent (-	•		CREATION I	Contact Contact ment on ba ol/Curren Maximur	t ack) nt
Indicate for	r functional r	iffles; Best areas	must be large er	nough to sup	port a p	opulatio	on of riffle	-obliga	te species	:	Riffle (me	etric=0)
_		ck ONE (ONLY!)					(or 2 & ave	0,			•	
	FFLE DEPTH as >10cm (2)		RUN DEPTH mum >50cm (2)	RIFF ♦ Stable (e	LE/RUN				LE/RUN EN None (2)	MBEDDEDNE		
Or Best Area	as 5-10cm (1) * Maxi	mum <50cm (1)	* Mod. Sta	-			\diamond	Low (1)	(0)	Riffle/R Maximu	
♦ Best Area	as <5cm _{(metri}	c=0)	. ,	♦ Unstable					Moderate Extensive		maxim	8
COMMENT	s											<u>[]</u>
6-GRADI	ENT											

0-GRADIENT					
(9.933 ft/mi) DRAINAGE AREA	 ◊ Very low – Low (2-4) ◊ Moderate (6-10) 	% POOL: 20	% GLIDE: 0	Gradient Maximum	10
(13.834 mi ²)	◇ High – Very high (10-6)	% RUN: 70	% RIFFLE: 10	10	10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES		
>85% - Open	Nuisance algae	◊ Public	◊ Private	◊ WWTP		♦ CSO	
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	◇ Dirt & Grime	
> 30%-<55%	◊ Excess turbidity	♦ Young – Success ♦ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry	
^{>} 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs		
[≫] <10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	♦ Cooling	
	◊ Oil sheen	Leveed – One side	ded	Sank Erosion	♦ Surface Erosion	♦ H2O table	
◊ Trash/Litter		Leveed – Both B	anks				
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon	
		Stable - Bedload					
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow	
	Sludge deposits	Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow	
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	♦ Home	
1 Middl	e	Impounded	Oesiccated	◇ Park	◊ Data Paucity	◊ Lawn	
		Flood Control	Orainage	◇ Agriculture	Livestock		
		Snag Removed		Atmosphere			
		Snag Modified		Deposition			
Left							

	M	OWQ Biolo	ogical Stu	idies Q	HEI (Qual	itativo	e Ha	bitat E	Evaluatio	<u>n Index)</u>
Sample #	QHEI Type	bioSample #	Stream N	ame				Locati	on		
AB47671	Macro	210816703	Sixmile Cr	eek				CR 50) South		
Surveyor	Sample	Date County	Ма	cro Sample ⁻	Туре		itat Comp	lata		QHEI Sco	ore: 44
PDM	8/16/21	Jennings		IAB		° ⊓au	nai Comp	nele			47
1-SUBSTR	<u>RATE</u>	Check ONLY Two s estimate % or note						Cł	neck ONE (d	or 2 & average)	
BEST TYPE	ES			R TYPES				0	RIGIN	QUALITY	
		TOTAL POOL	RIFFLE		TOTAL	POOL	RIFFLE			SILT	
◇ ◇ Bldrs/Sl	abs (10)	·	◇ ◇ Hai	rdpan (4)					stone (1)	Heavy (-2)	Substrate
◊ ◊ Boulder	s (9)			tritus (3)		x		♦ Tills♦ Wetl	(1) ands (0)	 ♦ Moderate (-1 ♦ Normal (0) 	·
◊ ◊ Cobble ((8)		◇ ◇ Mu	ck (2)				♦ Hard	pan (Ò)	 Free (1) 	12
	7)	<u> </u>	x	: (2)		x			Istone (0)		
◇		x	×	ificial (0)				◇ Rip/F ◇ Lacu	strine (0)	 Extensive (-2 Moderate (-1 	, maximum
◇ ◇ Bedrock	c (5)			(Sco	re natura	l substrat	os: ignoro	Shal	e (-1)	◊ Normal (0)	/ 20
NUMBER C	OF BEST T	(PES:	more (2)	(000			nt-sources)	♦ Coal	fines (-2)	◇ None (1)	
		* 3 or	less (0)								
COMMENTS		-									
		R Indicate presence of of highest quality								AMO	UNT
		oulders in deep or fa								Check ONE (or	0,
water, or deep	p, well-defined	, functional pools.	-	_						♦ Extensive >75	. ,
	dercut banks	.,		> 70cm (2)	<u> </u>	_	vs, Backw	•		 Moderate 25-7 Annual E 1000 	.,
		egetation (1)		vads (1) ers (1)	<u> </u>		ic macrop and wood [,]	-	•	 Sparse 5-<25^o Nearly absent 	.,
	otmats (1)			ers (1) _		_ LUgs a		y uebri	5(1)		(1)
COMMENTS	• •									140	Cover
										Ma	ximum 7 20
3-CHANN	EL MORP	HOLOGY	Check ONE in e	each category	(Or 2 & a	average)					
SINUOSITY		EVELOPMENT		NELIZATIO	N		TABILITY				
 High (4) Moderate 		 Excellent (7) Good (5) 		ne (6) covered (4)			High (3) Moderate	2)			hannel
* Low (2)	*	Fair (3)	♦ Red	covering (3)		۲	Low (1)	- (-)		Ma	aximum 10 20
◇ None (1)		Poor (1)	♦ Rec	cent or no re	covery ((1)					
COMMENTS											
		<u>& RIPARIAN Z</u>		ONE in each	category	for EAC	`	,		0,	
-	king downstrear	n RIF LR	PARIAN WIDTH	LR	,		FLC	DOD PL	AIN QUAL	ITY	
LR		♦ ♦ Wide :	>50m (4)			Swamp (3)			nservation Tillag	je (1)
◇ ◇ None or ◇ ◇ Moderat			ate 10-50m (3)			Old fiel	• •	1.41		an or Industrial	· ·
 	• •		v 5-10m (2) arrow <5m (1)			basture (k, New fiel (1)	a (1)		ing, construction predominant land us	• •
-		◊ ◊ None (•		owcrop (0))		n riparian.	Riparian
COMMENTS											Naximum 3
											10
		D RIFFLE/RUN									
MAXIMUN Check ONE (CHANNEL Check ONE (or				NT VELC ALL that a			RE	CREATION POT	ENTIAL
◇ >1m (6)		Pool width > riff		◇ Torrentia		Slov	v (1)			◊ Primary Con	tact
◇ 0.7-<1m	• •	Pool width = riff	• • •	♦ Very Fast	t (1)		rstitial (-1)			Secondary Co	ontact
♦ 0.4-<0.7n ♦ 0.2-<0.4n		Pool width < riff	e wiath (U)	 Fast (1) Moderate 	e (1)		rmittent (- ies (1)	Z)	(circ	le one and commer	nt on back)
◇ <0.2m (0)) (metric=0)				• •		and riffles.		L		Current
COMMENTS	5									Ma	ximum 5 12
Indicate for	functional ri	ffles; Best areas r	nust be large er	nough to sup	port a p	opulatio	on of riffle	-obliga	te species:	♦ <u>No Riff</u>	e (metric=0)
		k ONE (ONLY!)					(or 2 & ave	0,			
RIF * Best Area	FLE DEPTH		UN DEPTH um >50cm (2)	RIFF ♦ Stable (e		SUBST			LE/RUN EN None (2)	MBEDDEDNESS	
	s 5-10cm (2)		um <50cm (2)	 ◇ Stable (e ◇ Mod. Sta 				\diamond	Low (1)	۸.	iffle/Run laximum 3
	s <5cm _{(metric}			* Unstable				D) 👌	Moderate Extensive	(0)	8
COMMENTS	5							Ŷ	LAGUSIVE	Υ Ψ	<u> </u>
6-GRADIE	INT										

(2.423 ft/mi) DRAINAGE AREA	◊ Very low – Low (2-4)◊ Moderate (6-10)	% POOL: 20	% GLIDE: 30	Gradient Maximum	4
(30.679 mi ²)	 High – Very high (10-6) 	% RUN: 40	% RIFFLE: 10	10	4



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
[≫] >85% - Open	Vuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◇ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
^{>} 10%-<30%	Discoloration	◇ Spray		Construction BMPs	◊ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	Output Bank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	♦ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	♦ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	♦ Home
93 Middle	e	Impounded	Desiccated	◇ Park	◇ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSamp	ole #	Str	eam Na	ame				Locati	on			
AB47658	Macro	2108167	04	Теа	a Creek	(CR 65	0 South			
Surveyor	Sample	Date C	County			cro Sample	Туре		itat Comp	olete		QHEI Sco	ore:	57
PDM	8/16/21		lennings		MH			nub						
1-SUBST	RATE	Check ON estimate %								CI	neck ONE (o	or 2 & average)		
BEST TYP	ES					R TYPES				0	RIGIN	QUALITY		
		TOTAL P	POOL R	IFFLE			TOTAL	POOL	RIFFLE			SILT		
◊ ◊ Bldrs/Sl	abs (10)			<	>	dpan (4)					stone (1)	 ◇ Heavy (-2) 	Subst	rate
◊ ◊ Boulder	's (9)		x	<	> ◇ Det	ritus (3)		x	x	* Tills	(1) anda (0)	♦ Moderate (-1))	
◊ ♦ Cobble	(8)	x	<u>x x</u>	<	> < Mu	ck (2)					ands (0) Ipan (0)	 Normal (0) ◇ Free (1) 	17	, ,
◊ ◊ Gravel (7)	x	x x		>			x		Sance	lstone (0)	EMBEDDEDNESS		
◊ ◊ Sand (6)		x	<u>x</u> x			ificial (0)					Rap (0) Istrine (0)	♦ Extensive (-2)	Maxin	
* Bedrock		<u> </u>	<u>x</u>			.,		<u> </u>		 ✓ Lacu ♦ Shal 	e (-1)	 Moderate (-1) Normal (0) 	20	1
	OF BEST TY	PES:	♦ 4 or ı ♦ 3 or l	nore (2) ess (0)		(Sc	ore natural sludge t		es; ignore t-sources)	♦ Coal	fines (-2)	♦ None (1)		
COMMENTS	6													
2-INSTRE	AM COVE		nresence	0 to 3. 0	Absont	• 1 -\/erv sma	ll amounts	or if more	a common	of marg	inal quality:	4.40		
2-Moderate a amounts (e.g. water, or dee 0 Un 0 Ov 2 Sha	mounts, but no ., very large bo p, well-defined dercut banks erhanging ve allows (in slo	ot of highes oulders in de l, functional s (1) egetation (t quality o eep or fas pools. (1)	r in small t water, la 0 1	amount arge dia Pools Rootw	ts of highest	quality; 3 -H at is stable, 0 0	Highest qu well devo Oxbow Aquati	uality in mo	oderate otwad in vaters (ohytes (or greater deep / fast 1) (1)	AMOL Check ONE (or: Extensive >75' Moderate 25-7 Sparse 5-<25% Nearly absent	2 & average % (11) 5% (7) 5 (3)	e)
	otmats (1)												Cover	_
COMMENTS	2												timum	5
													20	
	EL MORP			Check C		each categor								
SINUOSITY ◇ High (4)		DEVELOPN Excellent				NNELIZATIO ne (6))N		TABILITY High (3)					
♦ Moderate	(3)	Good (5)	• •		◇ Rec	covered (4)		\diamond	Moderate	e (2)		-	n annel ximum 1	14
 Low (2) None (1) COMMENTS 	\$	 Fair (3) Poor (1) 				covering (3) cent or no r			Low (1)				20	- T
4- BANK	EROSION	& RIPA		ONE	Check	ONE in eac	h category	for EACI	H BANK (Or 2 per	bank & aver	age)		
	king downstrear			ARIAN W			0,				AIN QUALI	•		
E L R	ROSION		R ◇ Wide >	E0m (4)		L	R Forest, S						- <i>(</i> 1)	
♦ ♦ None or	r little (3)		Modera		m (3)		Shrub or	• •				servation Tillage an or Industrial (• •	
◇ ◇ Modera		\diamond	Narrow	5-10m (2)	\diamond \diamond	Resident	ial, Park	, New fiel	ld (1)	◊ ◊ Min	ing, construction	n (0)	
◊ ◊ Heavy/S	Severe (1)		> Very na > None (0)		m (1)		Fenced p Open Pas	•		`	Indicate p past 100n	predominant land use n riparian	e(s)	_
COMMENTS	6	· · ·		<i>י</i>)		Ŷ Ŷ	Open Fa	sture/NO		,	<i>puot 1001</i>	· · · · · · · · · · · · · · · · · · ·	Riparian aximum 10	8
5-POOL/0			F/RUN		тү								I	
MAXIMUN Check ONE (A DEPTH ONLY!) ○ (4) 《 n (2) ○ n (1)) (metric=0)	СН	IANNEL ONE (or 2 hth > riffle	WIDTH & average width (2 width (2	ge) 2) 1)	 ◇ Torrenti ◇ Very Fast ◇ Fast (1) ◇ Moderate Indicate 	al (-1) st (1)	ALL that a * Slow ^ Inter > Inter > Eddi	apply v (1) stitial (-1) mittent (- ies (1)		<	CREATION POTE	act ntact on back)	3
Indicate for	functional ri	ffles; Best	t areas m	ust be la	arge er	nough to su	pport a p	opulatio	n of riffle	-obliga	te species:	◇ No Riffle	e (metric=0	0)
◇ Best Area◇ Best Area	FLE DEPTH s >10cm (2) s 5-10cm (1) s <5cm _{(metric}	۲	,		n (2)	♦ Stable♦ Mod. S	Che FLE/RUN (e.g. cobb table (e.g le (e.g. sa	SUBSTF ble, boul . large g	der) (2) ravel) (1)	RIFF ☆ ⊗ 0) [◊]	LE/RUN EM None (2) Low (1) Moderate Extensive	IBEDDEDNESS Rif (0)	f le/Run aximum 8	0
6-GRADIE														
(20.301 DRAINAGE (4.617 n	ft/mi) AREA		\diamond	Very low Moderat High – V	e (6-10			OL: 20 UN: 60		6 GLIDE RIFFLE			radient kimum 1 10	10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Nuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◇ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
^{>} 10%-<30%	Discoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	Output Bank Erosion	♦ Surface Erosion	◇ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Right	A Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	◇ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
9 Midd	le	Impounded	Desiccated	◇ Park	◊ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

) =		DWQ	Biol	ogic	al S	tudies C		(Qua	litativ	e Habitat E	Evaluation	Index)
Sample #	QHEI Type	bioSar	nple #		Stream	n Name				Location		
AB47676	Macro	210817	7701		Vernor	n Fork Muscata	atuck Rive	r		CR 60 South		
Surveyor	Sample	Date	County	/		Macro Sample	е Туре				QHEI Score	e: 07
PDM	8/17/21		Jenning	gs		MHAB		* Hat	oitat Com	plete		e. 87
1-SUBST	RATE			o substra te every		E BOXES; esent				Check ONE (or 2 & average)	
BEST TYP	ES			-	OTH	HER TYPES				ORIGIN	QUALITY	
 ◇ ◇ Boulder ◇ ◇ Cobble ◇ ◇ Gravel (◇ ◇ Sand (6) 	(8) (7))	TOTAL	x x	RIFFLI X X X X		Hardpan (4) Detritus (3) Muck (2) Silt (2) Artificial (0)		POOL x x x	RIFFLE	 ◇ Limestone (1) ◊ Tills (1) ◇ Wetlands (0) ◇ Hardpan (0) ◇ Sandstone (0) ◇ Rip/Rap (0) ◇ Lacustrine (0) ◇ Shalo (-1) 	SILT Heavy (-2) Moderate (-1) Normal (0) Free (1) EMBEDDEDNESS Extensive (-2) Moderate (-1) Normal (0) 	Substrate
	k (5) OF BEST T`	YPES:	× • 4 (or more	(2)	(So			tes; ignore nt-sources)	\diamond Coal tines (-2)	 Normal (0) ◇ None (1) 	

3 or less (0)

COMMENTS

(197.56 mi²)

2-INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; AMOUNT 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater Check ONE (or 2 & average) amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast * Extensive >75% (11) water, or deep, well-defined, functional pools. 1 Undercut banks (1) 3 Pools > 70cm (2) 1 Oxbows, Backwaters (1) * Moderate 25-75% (7) 0 Overhanging vegetation (1) 1 1 Rootwads (1) Aquatic macrophytes (1) Sparse 5-<25% (3)</p> 3 Shallows (in slow water) (1) 3 Boulders (1) Logs and woody debris (1) Nearly absent <5% (1)</p> 1 Rootmats (1) Cover **COMMENTS** Maximum 19 20 3-CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average) SINUOSITY DEVELOPMENT **CHANNELIZATION** STABILITY * None (6) ◇ High (4) ♦ Excellent (7) Image: High (3) Channel Moderate (3) Moderate (2) * Good (5) Recovered (4) Maximum 16 * Low (2) Fair (3) Recovering (3) ◇ Low (1) 20 Poor (1) None (1) Recent or no recovery (1) COMMENTS **4- BANK EROSION & RIPARIAN ZONE** Check ONE in each category for EACH BANK (Or 2 per bank & average) River right looking downstream **RIPARIAN WIDTH** FLOOD PLAIN QUALITY EROSION LR LR LR LR ♦ ♦ Wide >50m (4) * * Forest, Swamp (3) ◊ ◊ Conservation Tillage (1) *
 * None or little (3) ◊ ♦ Moderate 10-50m (3) ◇ ◇ Shrub or Old field (2) ◊ ◊ Urban or Industrial (0) ◊ ◊ Narrow 5-10m (2) ◊ ◊ Mining, construction (0) * Residential, Park, New field (1) ◊ ◊ Heavy/Severe (1) Indicate predominant land use(s) ◊ ◊ Very narrow <5m (1)</p> ◇ ◇ Fenced pasture (1) past 100m riparian. ◊ ◊ None (0) ◊ ◊ Open Pasture/Rowcrop (0) Riparian Maximum 9 COMMENTS 10 5-POOL/GLIDE AND RIFFLE/RUN QUALITY MAXIMUM DEPTH **CHANNEL WIDTH CURRENT VELOCITY RECREATION POTENTIAL** Check ONE (ONLY!) Check ONE (or 2 & average) Check ALL that apply * >1m (6) * Pool width > riffle width (2) Torrential (-1) * Slow (1) Primary Contact ◊ 0.7-<1m (4)</p> Pool width = riffle width (1) Very Fast (1) Interstitial (-1) Secondary Contact Pool width < riffle width (0)</p> * Fast (1) 0.4-<0.7m (2)
</p> Intermittent (-2) (circle one and comment on back) ◇ 0.2-<0.4m (1) Moderate (1) Eddies (1) Indicate for reach - pools and riffles. Pool/Current COMMENTS Maximum 11 12 Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: No Riffle (metric=0) Check ONE (ONLY!) Check ONE (or 2 & average) **RIFFLE DEPTH RUN DEPTH RIFFLE/RUN SUBSTRATE RIFFLE/RUN EMBEDDEDNESS** * None (2) Best Areas >10cm (2) * Maximum >50cm (2) Stable (e.g. cobble, boulder) (2) Riffle/Run * Low (1) Output Best Areas 5-10cm (1) Maximum <50cm (1)</p> * Mod. Stable (e.g. large gravel) (1) Maximum 7 Moderate (0) ◊ Best Areas <5cm_(metric=0) Our Oracle Unstable (e.g. sand, fine gravel) (0) 8 Extensive (-1) **COMMENTS** 6-GRADIENT (4.424 ft/mi) ◊ Very low – Low (2-4) % POOL: 30 % GLIDE: #\$ Gradient DRAINAGE AREA ♦ Moderate (6-10)

% RUN: 60

% RIFFLE: 10

Maximum

10

10

2/8/2022 10:57:40 AM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index), Page 1 of 2

High – Very high (10-6)



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
◇ >85% - Open	Nuisance algae	◇ Public	◇ Private	◊ WWTP		◇ CSO
♦ 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
◇ 30%-<55%	◊ Excess turbidity	◇ Young – Success ◇ Old - Succession		◇ Contaminated	◊ Landfill	◇ Industry
◇ 10%-<30%	Discoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	Cooling
	◊ Oil sheen	Leveed – One side	ded	Sank Erosion	♦ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both Barbara	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	◇ Lagoon
		Stable - Bedload				
51 Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	♦ Acid Mine	◊ Wetlands	Stagnant Flov
	◊ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
88 Middle		Impounded	Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	◇ Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
66 Left						

ME I	<u>owq</u>	Biolo	ogical S	tudies Q	HEI (Qual	itative	e Hab	itat E	valuation	Index)
Sample # QHEI Ty	pe bioSar	nple #	Stream	Name				Location			
AB47665 Macro	210816		Tributa	ry of Mutton Cre	eek			CR 700 N	lorth		
Surveyor Sam	ple Date	County		Macro Sample	Туре	ŵ Uab	itat Comp			QHEI Score	e: 48
JMB 8/16		Jackson		MHAB			ntat Comp	liete			40
<u>1-SUBSTRATE</u>			substrate TYPE e every type pre					Chec	k ONE (d	or 2 & average)	
BEST TYPES				IER TYPES				ORI	GIN	QUALITY	
	TOTAL	POOL	RIFFLE		TOTAL	POOL	RIFFLE			SILT	
◊ ◊ Bldrs/Slabs (10)				Hardpan (4)		<u>X</u>		Climeston		◇ Heavy (-2)	Substrate
◊ ◊ Boulders (9)				Detritus (3)				◊ Tills (1)◊ Wetland		 Moderate (-1) ◇ Normal (0) 	10
◊ ◊ Cobble (8)				Muck (2)	. <u></u>	V		 Hardpa Canadat 	• •	◇ Free (1)	10
◊ ◊ Gravel (7)				Silt (2)		<u>X</u>		Sandst Rip/Rap		EMBEDDEDNESS	Maximum
♦ ♦ Sand (6)		X	X ◊ ◊ /	Artificial (0)		<u>х</u>				Moderate (-1)	20
◇ ◇ Bedrock (5) NUMBER OF BEST	TVDES.	<u> </u>	(<u>0</u>)	(Sco			es; ignore	 ◇ Shale (◇ Coal fin 		◇ Normal (0) ◇ None (1)	
COMMENTS	TIFES.		r more (2) r less (0)		sludge	from poir	nt-sources)		. ,		
						.,					<u> </u>
2-INSTREAM CO 2-Moderate amounts, bu amounts (e.g., very larg water, or deep, well-def 1 Undercut ba	ut not of high e boulders in ined, function	est quality deep or fa	or in small amo ast water, large	ounts of highest of	quality; 3- I it is stable	Highest q , well dev	uality in mo	derate or g twad in dee	preater ep / fast	AMOUN Check ONE (or 2 & Check O	& <i>average</i>) (11)
3 Overhangin	g vegetatio	n (1)	0 Ro	otwads (1)	1	Aquat	ic macrop	hytes (1)		✤ Sparse 5-<25% (3)
1 Shallows (ir		r) (1) _	<u>0</u> Bo	ulders (1)	1	Logs a	and woody	y debris (1)	Nearly absent <	5% (1)
1 Rootmats (1 COMMENTS)									Co Maxim	over num 9 20
3-CHANNEL MO	RPHOLO	GY	Check ONE	in each category	(Or 2 & a	average)					20
SINUOSITY	DEVELO	ent (7) 5)	◇ ◇ ◆	IANNELIZATIC None (6) Recovered (4) Recovering (3) Recent or no re		\$	TABILITY High (3) Moderate Low (1)			Cha i Maxir	
4- BANK EROSIC	DN & RIP	ARIAN	ZONE Ch	eck ONE in each	n category	for EAC	H BANK (C	Dr 2 per bai	nk & aver	age)	<u> </u>
River right looking downs			PARIAN WIDT				FLC			ITY	
EROSION L R * * None or little (3) > Moderate (2) > Heavy/Severe (1)	0 0 0 * (> ◇ Mode > ◇ Narro	>50m (4) rate 10-50m (3 w 5-10m (2) narrow <5m (1 (0)	3)	Forest, S Shrub or Resident Fenced p	Old fiel tial, Park basture (d (2) k, New fiel	d (1)	◊ ◊ Urb◊ ◊ MinIndicate p		0)) þarian
COMMENTS										Max	imum 4 10
5-POOL/GLIDE A		LE/RUN	I QUALITY					_			
MAXIMUM DEPTH Check ONE (<i>ONLY</i> !) [◊] >1m (6) [◊] 0.7-<1m (4) [§] 0.4-<0.7m (2) [◊] 0.2-<0.4m (1) [◊] <0.2m (0) (metric=0) COMMENTS	Chec ◇ Pool w ◇ Pool w	idth > riff idth = riff	L WIDTH r 2 & average) fle width (2) fle width (1) fle width (0)	 ◇ Torrentia ◇ Very Fas ◇ Fast (1) ◇ Moderate Indicate 	Check / al (-1) st (1) e (1)	◇ Inter ◇ Edd	apply			CREATION POTEN	et act h back) rrent hum 3
Indicate for functiona	al riffles [.] Re	st areas	must be large	enough to su	pport a n	opulatio	on of riffle	-obligate	species		12
C RIFFLE DEP * Best Areas >10cm * Best Areas 5-10cm * Best Areas <5cm _{(m}	Check ONE (0 TH (2) (1)	ONLY!) R ◇ Maxin	:UN DEPTH num >50cm (2 num <50cm (1	RIFF)	Ch FLE/RUN (e.g. cobl table (e.g	eck ONE SUBST ble, boul l. large g	(or 2 & ave RATE Ider) (2)	erage) RIFFLE ◇ No ◇ Lo ◇ M	-	IBEDDEDNESS Riffle (0)	<i>metric=0)</i> / <i>Run</i> /mum 8
<u>6-GRADIENT</u> (11.518 ft/mi) DRAINAGE AREA (5.117 mi ²)		<	 Very low – L Moderate (6- High – Very 	-10) ົ		DOL: 10 RUN: 10		GLIDE: 7		Grac Maxin	dient num 8 10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
>85% - Open	Vuisance algae	◇ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	Oirt & Grime
> 30%-<55%	◊ Excess turbidity	 Young – Success Old - Succession 		◇ Contaminated	◇ Landfill	◇ Industry
^{>} 10%-<30%	Oiscoloration	◇ Spray		Construction BMPs	◊ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	Output Bank Erosion	♦ Surface Erosion	◇ H2O table
	◇ Trash/Litter	Leveed – Both Based	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◇ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	Wetlands	Stagnant Flow
	♦ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	◊ Golf	◇ Home
100 Middle	е	Impounded	Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		Atmosphere		
		Snag Modified		Deposition		
Left						

NE 🚺	OWQ Biological	Studies QHEI	Qualitative Habitat	t Evaluation Index)

Sample #	QHEI Type	bioSample #	t Stre	am Name				Location			
AB47659	Macro	210817702	Tea	Creek				CR 650 V	Vest		
Surveyor	Sample	Date Cou	nty	Macro Sample	Туре	^				QHEI Scor	e: 46
PDM	8/17/21	Jenn	ings	MHAB		* Hab	itat Comp	piete			40
1-SUBST	RATE	Check ONLYT	wo substrate T	PE BOXES;	-			Chec	k ONE (c	or 2 & average)	
BEST TYP		estimate % or	note every type	THER TYPES				ORI	GIN	QUALITY	
		TOTAL POO	-		τοτλι	POOL	RIFFLE	•	•	Q0/12111	
◇ ◇ Bldrs/S	labs (10)	IUTAL FUU		◇ Hardpan (4)	TOTAL	FOOL	X	. ◇ Limeste	one (1)	SILT ◇ Heavy (-2)	Substrate
◇ ◇ Boulder	• •	· · · · · · · · · · · · · · · · · · ·		 Detritus (3) 		x	x	* Tills (1)		* Moderate (-1)	
								♦ Wetlan	ds (0)	◊ Normal (0)	12
◊ ◊ Cobble	.,	<u></u>		◊ Muck (2)			~	♦ Hardpa ♦ Sandst		◇ Free (1)	12
◊ ♦ Gravel (<u> </u>		◇ Silt (2)		X		◇ Sanust ◇ Rip/Raj		EMBEDDEDNESS ♦ Extensive (-2)	Maximum
♦ ♦ Sand (6))	X	<u>×</u> ◇	Artificial (0)				♦ Lacust	rine (0)	* Moderate (-1)	20
◊ ◊ Bedrocl				(Sce	ore natura	l substrat	es; ignore	 ◇ Shale (◇ Coal fir 	-1)	◇ Normal (0) ◇ None (1)	
NUMBER (OF BEST TY	-	4 or more (2)		sludge	from poin	nt-sources)		165 (-2)	None (1)	
0011115115	•	* :	3 or less (0)								
COMMENTS	5										
amounts (e.g water, or dee 0 Un 0 Ov 1 Sh	., very large bo	oulders in deep , functional poo s (1) egetation (1)	or fast water, lar ls. <u>2</u> F <u>1</u> F	mounts of highest ge diameter log tha Pools > 70cm (2) Rootwads (1) Boulders (1)		e, well dev Oxbov Aquati	veloped roo vs, Backw ic macrop		ep / fast	AMOUN Check ONE (or 2 Extensive >75% Moderate 25-75% Sparse 5-<25% Nearly absent <	& average) (11) % (7) (3)
COMMENTS	S									C Maxir	over num 9 20
3-CHANN	IEL MORPI	HOLOGY	Check Of	NE in each categor	y (Or 2 &	average)					
SINUOSITY	D	EVELOPMEN	т	CHANNELIZATIC	N	S	TABILITY	,			
◇ High (4)		Excellent (7)		◇ None (6) ◇ Deceivered (4)			High (3)	o (2)		Cha	nnel
 Moderate Low (2) 	• •	Good (5) Fair (3)		 Recovered (4) Recovering (3) 			Moderate Low (1)	e (2)		Maxi	<i>mum</i> 10
 ◇ None (1) 		Poor (1)		Recent or no r			(!)				20
COMMENTS	S										
4- BANK	EROSION	& RIPARIA	N ZONE	Check ONE in eac	h category	for EAC	H BANK (Or 2 per ba	nk & aver	age)	
	king downstrear		RIPARIAN WI			, 	•			e ,	
	ROSION	LR	50 (1)	L			•		LR		(A)
L R ◇ ◇ None o	r little (3)		ide >50m (4) oderate 10-50n		Forest, S Shrub or	• •	,			servation Tillage an or Industrial (0	
	• • •		rrow 5-10m (2)				(, New fiel	ld (1)		ing, construction	
	Severe (1)	◇ ◆ Ve	ry narrow <5m	n (1) ◇ ◇	Fenced	pasture ((1)		Indicate p	predominant land use(
COMMENTS	S	◊ ◊ Νc	one (0)	* *	Open Pa	isture/Ro	owcrop (0)	past 100r	Rij	b arian kimum 3 10
			UN QUALIT	v							I
				1	00000			Γ]
MAXIMUN Check ONE (NEL WIDTH	9)		ALL that a			RE	CREATION POTEN	ITIAL
⊗ >1m (6)	¢,	Pool width >	riffle width (2)	♦ Torrenti	• •	♦ Slov	• •			Primary Contact	ct .
◇ 0.7-<1m	• •		riffle width (1)		st (1)		rstitial (-1		<	Secondary Cont	act
◇ 0.4-<0.7r ◇ 0.2-<0.4r	• •	[°] Pool width <	riffle width (0)	 ♦ Fast (1) ♦ Moderat 	e (1)		rmittent (· ies (1)	-2)	(circl	e one and comment o	n back)
< <0.2m (0					• •		and riffles.			Pool/Cu	rrent
COMMENTS										Maxin	num 8
Indicate for	functional rit	ffles: Best are	as must be la	ge enough to su	nnort a r	onulatio	on of riffle	-obligate	snecies		
indicato ioi		k ONE (ONLY!		ge energin te eu	••••••	-	(or 2 & ave	-	000000	♦ <u>No Riffle</u>	<u>metric=0)</u>
RIF	FLE DEPTH	<u>-</u> (3/12/1)	RUN DEPTH	RIF	FLE/RUN		•	RIFFLE		BEDDEDNESS	
	as >10cm (2)		ximum >50cm	• •					one (2) ow (1)	Riffl	e/Run
	as 5-10cm (1) as <5cm _{(metric}		ximum <50cm	(1)				^ B4	oderate	(0) Max	imum 0 8
		=0)		Shatab			g. a toi) (→ E:	xtensive	(-1)	0
6-GRADIE			∧ Vans lass					(a l := -		-	"
(2.676 fr DRAINAGE			 Very low - Moderate 		% PC	DOL: 50	%	6 GLIDE: #	#\$	Gra Maxii	dient mum 4
(10.632				ry high (10-6)	% F	RUN: 50	%	RIFFLE: #	¥\$		10



A-CANOPY	B-AESTHETICS	<u>C-M</u>	IAINTENANCE		D-ISSUES	
> >85% - Open	◇ Nuisance algae	◊ Public	◇ Private	◊ WWTP		◇ CSO
> 55%-<85%	Invasive macrophytes	◇ Active	♦ Historic	◇ Hardened	◊ Urban	◇ Dirt & Grime
> 30%-<55%	◇ Excess turbidity	 ◇ Young – Success ◇ Old - Succession 		◇ Contaminated	◊ Landfill	◇ Industry
[⊳] 10%-<30%	Discoloration	◇ Spray		Construction BMPs	♦ Sediment BMPs	
<10% - Closed	◇ Foam/Scum			◇ Logging	Irrigation	◇ Cooling
	◊ Oil sheen	Leveed – One side	ded	Output Bank Erosion	◊ Surface Erosion	♦ H2O table
	◇ Trash/Litter	Leveed – Both B	anks			
Canopy Upstream Reading		Moving – Bedloa	d	◇ False bank	◊ Manure	♦ Lagoon
		Stable - Bedload				
Righ	^t ◇ Nuisance odor	Armoured	◊ Slumps	◊ Wash H2O	◊ Tile	♦ Natural Flow
	Sludge deposits	◊ Islands	♦ Scoured	◇ Acid Mine	◊ Wetlands	Stagnant Flow
	◇ CSOs/SSOs/Outfalls	Relocated	◊ Cutoffs	◊ Quarry Mine	♦ Golf	♦ Home
0 Mido	le	Impounded	Desiccated	◇ Park	◇ Data Paucity	◊ Lawn
		Flood Control	Orainage	◇ Agriculture	Livestock	
		Snag Removed		◇ Atmosphere		
		Snag Modified		Deposition		
Left						

APPENDIX D. REASSESSMENT NOTES FOR THE VERNON FORK MUSCATATUCK RIVER WATERSHED TMDL

Watershed							
1	Assessment Date: 02/16/2022						
2	Staff Participating in assessment meetin Buchbinder, Kayla Werbianskyj, Lindsay Mitchell Owens, Marissa Cubbage, Stac (USDA NRCS North Vernon), Kelly Ken	/ Hylton Adams, Allie Gates, Michae ey Sobat, Andy Ertel (Jennings Co	ella Hecox, Kathleen	Hagan, Dylan Brown,			
3	Assessments based on the best profess indicated in cases where assessments b assessment criteria in IDEM's Consolida	based on data collected on the reac	h in question do not e				
	Other acronyms used in these notes i	include:					
	AUID = Assessment Unit ID	WS = Watershed	US = Upstream				
	RECR = Recreational Use Support	HW = Headwaters	DS = Downstream				
	ALUS = Aquatic Life Use Support	NS = Not supporting the use (impaired)	DO = Dissolved oxygen				
4	IBI = Fish Community Index of Biotic Integrity	FS = Fully supporting the use	TP = Total phosphorus				
Т	mIBI = Macroinvertebrate Community Index of Biotic Integrity	LSITE = Site identifier used in IDEM's AIMS database					
	QHEI = Qualitative Habitat Evaluation Index	WTP = Wastewater treatment plant					
		CFO = confined feeding operation (may or may not be required to have an IDEM permit)					
Method Note Watershed	es: 2022 TMDL/Watershed Chara		or Vernon Fork N	luscatatuck River			
	ta used in Assessments		Year Assessed	Method Code			
-	k of the Muscatatuck River (Fixed station ph	nysical/chemical monitoring					
conventional po		· · · · · ·	2022	210			
2021 Vernon For conventional po	k of the Muscatatuck River (Non-fixed static Ilutants only))	on physical/chemical monitoring	2022	220			
2021 Vernon For	k of the Muscatatuck River (Water column s	surveys of E. coli)	2022	420			
2021 Vernon For	k of the Muscatatuck River (non-fixed static	on physical, chemical)	2022	240			
2021 Vernon For	k of the Muscatatuck River (biosurveys of m	nultiple taxonmonic groups)	2022	720			
METHODCODE	METHODNAME		IDEM Definition				
210	Fixed station physical/chemical monitoring (conventional pollutants only)	Used for aquatic life use assessments bas results for toxicants (e.g. dissolved metal fixed station monitoring sites. If the data	s, free cyanide, and amm	onia) collected by IDEM at its			
220	Non-fixed station physical/chemical monitoring (conventional pollutants only)	Used for aquatic life use assessments bas results for toxicants (e.g. dissolved metal fixed station monitoring sites. If the data	s, free cyanide, and amm	onia) collected by IDEM at its			
240	Non-fixed station physical/chemical (conventional + toxicants)	Used for aquatic life use assessments IDEM at its probablistic or targeted m		mistry data collected by			
310	Ecological/habitat surveys	Applied to aquatic life use assessmen community surveys conducted by IDE					
420	Water column surveys (e.g. fecal coliform)	Used for recreational use assessments based on E. coli data collected by IDEM at its probablistic or targeted monitoring sites.					

General Notes: 2022 TMDL/Watershed Characterization Assessments for Vernon Fork Muscatatuck River

720	Biosurveys of multiple taxonomic groups (e.g. fish/invertebrates/algae)	Used for aquatic life use assessments based on the results of macroinvertebrate and fish community surveys conducted by IDEM. (For use only with assessments based on results that include both types of data.)
910	Physical/Chemical ALUS (Discrepancy among different data types)	Used for aquatic life use assessments in which the physical/chemical data indicates impairment and biological data for one/more assemblages indicates full support.
915	Biological Community ALUS (Discrepancy among different assemblages)	Used for aquatic life use assessments in which the biological data for one/more assemblage indicates impairment while another/others indicate full support.
920	Biological ALUS (Discrepancy among different data types)	Used for aquatic life use assessments in which the biological data for one/more assemblages indicates impairment and chemistry data indicates full support.
925	Habitat ALUS (Discrepancy among different data types)	Used for aquatic life use assessments in which the biological data for one/more assemblages indicates impairment and their corresponding Qualititative Habitat Evaluation Index (QHEI) scores are greater than or equal to 51 indicating good habitat conditions.

Source Name	Application to Assessments
SOURCE UNKNOWN	Associated with all impaired biotic communities to indicate that additional unidentified stressors may be contributing to impairment; Also applied to metals impairments except where a specific sources are suspected or known.
NON-POINT SOURCE	Non-Point Source. Source is unknown, but there are no permitted point sources upstream.
AGRICULTURE	Agriculture. Agriculture can represent a wide array of potential Agriculture related sources. Agriculture is used when either land-use analysis or impairment point to some type of Agriculture being the source, but a specific type of Agriculture could not be identified.
LIVESTOCK (GRAZING OR FEEDING OPERATIONS)	Livestock (Grazing or Feeding Operations). Insufficient information exists to specifically identify a particular type of animal feeding operation. Includes grazing and unpermitted animal feeding operations. Also includes CAFOs until a permitted facility is identified.
CONFINED ANIMAL FEEDING OPERATIONS (NPS)	Pollution resulting from inappropriate land application of manure from permitted confined feeding operations.
NATURAL SOURCES	Natural Sources. Natural Sources can represent one or a combination of factors that are natural occurring, and no other potential sources can be identified; applies to impairments suspected to be driven entirely by factors natural occurring; does not apply in combination with other source codes.
WILDLIFE OTHER THAN WATERFOWL	Pollution impacts (often pathogen indicators-related) from wildlife other than waterfowl (e.g., deer, rodents, etc.).
UNSPECIFIED URBAN STORMWATER	Unspecified Urban Stormwater: Generalized Impacts from stormwater in urban areas. IDEM applies this code only to aquatic life use impairments, not recreational use impairments driven by stormwater in urban areas with no CSOs upstream.
MUNICIPAL POINT SOURCE DISCHARGES	Impacts resulting from end-of-pipe discharges from publicly owned treatment works (POTWs).
UPSTREAM SOURCE	Upstream Source. For impairments where the source is attributable in part or whole to sources upstream of the boundaries of the Assessment Unit.
COMBINED SEWER OVERFLOW	Impacts from combined sewer overflows (CSOs); applies only to recreational use or aquatic life use impairments downstream of CSOs.
UNRESTRICTED CATTLE ACCESS	Impacts resulting from unrestricted cattle access; includes pathogen-related impairments and impacts to aquatic communities such as destruction of aquatic habitat, streambank instability and erosion.
PACKAGE PLANT OR OTHER PERMITTED SMALL FLOWS DISCHARGES	Impacts from NPDES-permitted semi-public facilities including treatment systems for small communities or rural schools that often operate only intermittently.
SEWAGE DISCHARGES IN UNSEWERED AREAS	Sewage Discharges in Unsewered Areas: Impacts from failing septic systems, straightpipes and domestic waste water system tie-ins to agricultural tiles.

AUID	EPA Site ID	IDEM Station ID	Stream	IBI	Integrity Class	QHEI (IBI)	mIBI	Integrity Class	QHEI (mIBI)	Use Comment	ALU Suppor	ALU_Impairments	ALU Sources	ATTAINS FLAG	ATTAINS METHOD CODE
										Vernon Fork Muscatatuck River @ County Road 400 W. WEM070-0036:					
INW0771_02	217-023	WEM070-0036	Vernon Fork Muscatatuck River	52	Good	73	42	Fair	62	IBIS2_QHEI73.mBI42_QHEI62. Chem: J/J1 high TP, DO 0k. GMI51.74 ctu/ID0mt: One small cattle operation to N; rest of area is woods - wildlife influenced? House on septics on left bank. Vernon Fork Muscatatuk R; New G County Road GS _WEM070-0001:	FS				220+310+720
INW0771_03	217-025	WEM070-0001 (also a fixed station site)	Vernon Fork Muscatatuck River	54	Excellent	80	40	Fair	87	181 SG, QHH 80, mH 40, QHH 87. Chem; J/18 Jayin; TD Ook: GM 141.34 cHu/100mt: US subdivision with septics, but reserves a should be up to code. Indian Thails subdivision is older so could be a problem. Probaby wildlife indimence. No a mining operations. Site is a Faed Station and a Reference site. future Regional Monitoring Interview site.	PS				210 + 220+310+720
INW0772_01A	217-022	WEM-07-0020	Sixmil e Creek	32	Poor	74	30	Poor	57	Simile Creek @ State Road 7. WBM 07-0020: Bill 32, 30, 0HB 55, 74. mill 30, QHB 57. Half of reach was reservoir backwater pold hart transistomet to bearcick with hallow (1°-2°) water. Roating algul mats during first visit. Ghm 2/11 Ling x/11 Ling 2/10. may be due to reservoir backing up water. GM 1730.5 fu/100mt: Subdivision to the W has septic issues. No livestock in area.	NS	BIOLOGICAL INTEGRITY + DISSOLVED OXYGEN	SOURCE UNKNOWN (biology) + DAM OR MPOUNDMENT		220+310+720+925
INW0772_04	217-021	WEM-07-0019	Sixmile Creek	38	Fair	72	42	Fair	67	n sister Sizmile Creek & County Road 175 N. WEM-07-0019: IBI 38, QHB 72. mBl 42, QHB 67. Chem: 2/7 high P. D0 0 k GM 186.89 cfu/100mL: Subdivision on septic; wildlife from wooded areas possible sources	FS				220+310+720
INW0772_05	217-020	WEM-07-0018	Sixmile Creek	52	Good	62	42	Fair	62	Jossiure sources Simile Creek & County Road 200 S. WEM-07-0018: IBI 52, QHEI 62. mBI 42, QHEI 62. Chem: 2/7 high P. D0 0 k GM 484.04 cfu/100mit. Small patch of forest to E. Few scatted cattle operation, possibly septic.	PS				220+310+720
INW0772_06	217-019	WEM-07-0017	Sixmile Creek	46	Good	49	44	Fair	44	Semile Creek @ Coump Road S00 S WBA03-0017: 184 A Quiel 8 and 144 A Quiel 44. Chem: Chem ok GM 83702 d Quiel 2000m: 200 s and/bill cranes migrate to this location in early spring and late fail but Coll collected at different times. Site 1 a few miles Sform RNU facility. Bits 21 Just 05 d RNU was passing for coll. Little mip buffer around nearby ag fields. Possible sources are wildlife, septice, agfields.	PS				220+310+720
INW0773_01	217-018	WEM-07-0014	Storm Creek	42	Fair	61	38	Fair	53	Storm Creek @ Base Road, WEM-07-0014: IBI 42, 38, QHB 61, 51. mBI 38, QHB 53. Chem: 1/7 high (Pt, 1/1 I low 00, 1/11 marg DO: no co-occurance GM 493.11 cfu/100m:1: two permitted animal operations: upstream; some homs: may be on spoil; some agit (elds with min inteffer.	FS				220+310+720
INW0773_02	217-016	WEM080-0013	Storm Creek Ditch	32	Poor	46	34	Poor	44	Storm Creek Ditch @ County Road 400 N. WEM808-0013: Bit 32, QH41 44 mbl 33, QH41 44. mt refige, stapant, Rojam US of bridge, excessive duckwend, sheen on water. Wetland infleunced. Difficult to sample. Original impairment may have been due to logjam - check on date it was sampled. Access as 4 C for DO and IBC. Chem: J11 high TP, 8/JS low D0, 1/15 marg D0; no co-occurance GM 59.9.4 ct/J00mk.	NS	BIOLOGICAL INTEGRITY + DISSOLVED OXYGEN	SOURCE UNKNOWN (biology) + NATURAL SOURCES (dissolved oxygen)	4C	220+310+720
INW0773_T1002	217-017	WEM080-0005	Tributary to Richart Lake	20	Very Poor	49	32	Poor	56	Thubury to Richart Lake (County Read 900 W. WKM600055 B10, Qiel 40, Min B2, Qiel 1955 Sites van Lainda point during most withs, Uite habitar, gravet sandy substrain, moving bedouds - sand/site B10, Qiel 40, Min B1, Qiel 90, Qiel 10, Min B1, Qiel 10, Qiel 10, Qiel 10, Qiel Min B1, B10, P10, Qiel 90, Qiel 10, Min B1, Qiel 10, Qiel 10, Qiel 10, Qiel Min B1, B10, P10, Qiel 10, Qiel 40, Min B1, Qiel 10, Q	NS	BIOLOGICAL INTEGRITY + DISSOLVED OXYGEN	SOURCE UNIXNOWN (biology) + NATURAL SOURCES (dissolved oxygen)		220+310+720
INW0774_01	217-015	WEM080-0025	Mutton Creek	36	Fair	60	42	Fair	53	Jule - Windmin. Matter Creek (# County Road 300 N. WEM080 0025: 181 36, 0941 60. mB1 42, 0941 33. Chem No T Phits, 211 marg DO. GM 555.48 cfu/J00mt: US forested areas and Country Squire Lakes - relatednta J area with Jakes and pondris, a few cattle upstream, some potential septic; a few permitted CFOs (Storm Creek and Rose Acres - chicken marune).	PS				220+310+720
	217-012	WEM080-0014	Mutton Creek	38	Fair	47	36	Fair	49	Auton Creek Ditch @ County Road 400 N. WEM080-0014: IBI 38, QHE 47. mBI 30, 36, QHE 48, 49. Chem: NOT Phile, 6/11 low DO. Sites were stagnant with little flow. Possible 4C due to low flow for DO. GM 166.4 cfu/DOmL:Located in refuge = wildlife infleunced.	NS	DISSOLVED OXYGEN	NATURAL SOURCES (dissolved oxygen)	4C	220+310+720+910
INW0774_02	217-014	WEM080-0027	Mutton Creek	40	Fair	61	40	Fair	52	Mutton Creek @ County Road 800 N. WEM080-0027: 181 38, 40, 04H 61, 52. mBH 40, 04H 52. Chem: 1 high T9, 211 marg D0, no cooccurance GM 131.04 cfu/200m: Large dairy operation NW of site, could be spreading manure. Possible septics due to US home not within any major manicipality.	NS				220+310+720
INW0774_T1003	217-013	WEM-07-0016	Tributary of Mutton Creek	40	Fair	65	40	Fair	48	Tributary of Mutton Creek & County Road 700 N. WEM-07-0016: IBI 40, QHEI 65. mBI 40, QHEI 48: Lots of longear sumfish from good pools. Chem: 27h Jahp Fi JJ11 Jahp 49: DO Sat no co-occurance GM 460.2 cful/100mL: No permitted facilities, ag fields with minimal riparian buffer on US tribs. Potential houses on specific.	PS				220+310+720
INW0774_T1005	217-011	WEM080-0015	Sandy Branch	N/A	N/A	N/A	N/A	N/A	N/A	Sindy Branch @ US Hwy 31. WEM08-0015: IBI N/A, DHI N/A. milli N/A, DHI N/A. Beave: Dam impounded stream, not representative. Water backed up into neighboring fields. Chem. 17. htp: TP, DO ak. Chem. 17. htp:	PS				220
INW0775_01	217-008	WEM070-0039	Vernon Fork Muscatatuck River	48	Good	62	40	Fair	56	Vernon Fork Muscatatuck River @ County Road 500 S. WEM070-0039: 181 48, 0946 62. milli 38, 40, 0981 56, 55. 173 tead exceedance, 1710 bigh T. J. 174 arag DO: no co-occurance 1/3 TP exceedance in May. 60 2335. ScH2000m. Minimal riparian buffer to W, but little manure applied to those fields due to frequency of flooding. Wildlife and septics litely but could be non-point source related.	PS				240+220+310+720
INW0775_05	217-009	WEM070-0020	Vernon Fork Muscatatuck River	52	Good	70	42	Fair	74	Vemon Fork Muscatabuck River @ US Hwy 31. WEM070-0020: 181 52, QHE 70. ml81 42, QHE 74. Chem: J111 high TP, 4/34 murg DO, no co-occurance GM 83.77 cfu/100mL Fully Supporting	PS				220+310+720
INW0775_T1003	217-006	WEM-07-0021	Tea Creek	32	Poor	62	38	Fair	57	Tea Creek @ County Boad 650 S. WEM-07-0021: 181 32, 0416 52. mBl 38, 0HB 57: Stream was isolated pools; 93% of fish were ploneer individuals. Chem 1/P high TP. 1/11 marg DO, 3/11 high % DO sat no co-occurrance GM 56057 clu120mk: Manuer runoff from nestry fields; residential homes on sept: Created so could be wildfiel filtureerd as well.	NS	BIOLOGICAL INTEGRITY	SOURCE		220+310+720+915+920+9 25
	217-007	WEM070-0029	Tea Creek	38	Fair	49	42	Fair	46	Tea Creek @ County Road 650 W. WEM070-0029: 181 83, QHEI 49, MBI 42, 36, QHEI 46, 43. Chem: 1/7 high TP, 1/11 low DO, 2/11 marg DO: no co-occurrance. GM 581.59 cfui/100mL. US homes, fairly wooded, manure runoff; could be affected by whatever is affecting site 6.	NS				220+310+720
INW0776_03	217-010	WEM090-0015	Vernon Fork Muscatatuck River	46	Good	57	44	Fair	42	Vernon Fork Muscatatuck River (# County Read E 50 N. WEM090-0015: 181 46, QHE 57. m81 44, QHE 42. Chem: TP: 60, 4/15 marg DO. GM 96.69 cf.vj.00mL Fully Supporting	PS				220+310+720
INW0776_05	217-003	WEM090-0008	Vernon Fork Muscatatuck River	N/A	N/A	N/A	N/A	N/A	N/A	www.naf.ncb. Max.estabuck like of Doumly flood 400.5 MIMM90 0008. III MAX ORE MA. emit MAX ORE MA. Chem 47 High TP, 4710 1ew 00.2,210 marg 00.3, 2 co accurrances GM 113.88 et u/100 marg 12,210 marg 00.3, 2 co accurrances Sale 11 an organia tarte am channel, none onboxe, Rider Dich is main channel. Sale sin organia tarte marg 100 marg 100 marg 100 mbr 100 mbr 200 mbr 100 mbr 100 mbr 100 mbr 100 mbr 100 mbr 100 mbr 200 mbr 100 mbr 100 mbr 100 mbr 100 mbr 100 mbr 100 mbr 200 mbr 100 m	NS	DISSOLVED OXYGEN + NUTRIENTS	NATURAL SOURCES (dissolved oxygen) + NATURAL SOURCES (nutrients)	4C	220
INW0776_T1009	217-005	WEM-07-0015	John McDonald Ditch	28	Poor	29	34	Poor	42	John McDonald Ditch @ County Road 125 S. WEM 07-0015: Bit 26, 0081 29. mill 34, 0181 42. Habitat poor; sand, bit and deritus. 32% Dit annomalies, 127.128 Friste Petch Adu tumors, could be boto Stress. Chem: TP: 64, 5/11 low 00, 2/11 marg DO. Flooded well and, soft substrate, silly Assess as 4 cs. flow driven. GM 22:03 cfu/J00mt: Permitted SacIIIY (Kyl and Lee Brochens) DS; wooded Lis fuelling). Or segistics manue spreading.	NS	BIOLOGICAL INTEGRITY + DISSOLVED OXYGEN	SOURCE UNKNOWN (biology)+ NATURAL SOURCES (dissolved oxygen)	4C	220+310+720
INW0776_T1019	217-002	WEM-07-0010	Grassy Creek	38	Fair	51	32	Paor	46	Gasay Conel, B. Courty, Netd 2005. WEM-0700302. IIII 38, CONE 31	NS	BIOLOGICAL INTEGRITY	SOURCE UNIKNOWN + (MUNICIPAL POINT SOURCE DISCHARGES		220+310+720+915
INW0776_T1022	217-001	WEM090-0003	Rider Ditch	50	Good	55	38	Fair	43	Rider Dirch & Courny Read 600 S. WEM080-0003: IBI 50, QHB 35, mBB 38, QHB 43. Chem 2/11 MpH 79, 3/15 marg 000, no co-occurrence. GM 1074.42 chu/100mL. Fully Supporting. Main pour point for the watershed.	PS				220+310+720

AUID	EPA Site ID	IDEM Station ID	Stream	Use Comment	RECR Support	RECR Impairment	RECR Sources	ATTAINS METHOD CODE
INW0771_02	21T-023	WEM070-0036	Vernon Fork Muscatatuck River	Vernon Fork Muscatatuck River @ County Road 400 W. WEM070-0036: IBI 52, QHEI 73. mIBI 42, QHEI 62. Chem: 1/11 high TP, DO ok. GM 151.74 cfu/JOnni: Cone small cattle operation to N; rest of area is woods = wildlife influenced? House on septics on left bank.	NS	ESCHERICHIA COLI (E. COLI)	SEWAGE DISCHARGES IN UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL + LIVESTOCK (GRAZING OR FEEDING OPERATIONS)	420
INW0771_03	217-025	WEM070-0001 (also a fixed station site)	Vernon Fork Muscatatuck River	Vernon Fort Muscatatuck River @ County Road 60 S. WEM070-0001: IBS 4, QHEI 80: MBI 40, QHEI 87. GME 141, 24 fuly100mL: US subdivision with septics, but recent so should be up to code. Indian Trails subdivision is older so could be a problem. Probably wildlife influenced. No animal operations. Site is a Fued Station and a Reference site: future Resional Monitorine Network site.	NS	ESCHERICHIA COLI (E. COLI)	SEWAGE DISCHARGES IN UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL	420
INW0772_01A	217-022	WEM-07-0020	Sixmile Creek	Sixmile Creek @ State Road 7. WEM-07-0020: IBI 32, 30, QHEI 55, 74. mIBI 30, QHEI 57: Half of reach was reservoir backwater pool that transistioned to bedrock with shallow (1 ^{*,2}) ² water. Floating algal mats during first visit. Chem: 2/11 low, 3/11 amg DC: may be due to reservoir backing up water. GM 1730.5 cfu/100mL: Subdivision to the W has septic issues. No livestock in area.	NS	ESCHERICHIA COLI (E. COLI)	SEWAGE DISCHARGES IN UNSEWERED AREAS	420
INW0772_04	217-021	WEM-07-0019	Sixmile Creek	Sixmile Creek @ County Road 175 N. WEM-07-0019: Bi 38, QHEI 72. mBi 42, QHEI 67. Chem: 3/7 high TP, DO ok GM 186.89 clu/100mL: Subdivision on septic; wildlife from wooded areas possible sources	NS	escherichia coli (e. coli)	SEWAGE DISCHARGES IN UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL	420
INW0772_05	217-020	WEM-07-0018	Sixmile Creek	Sixmile Creek @ County Road 200 S. WEM-07-0018: Bi 52, QHEI 62. mBi 42, QHEI 62. Chem: 2/7 high TP, DO ok GM 484.04 clu/100mL: Small patch of forest to E. Few scatted cattle operations, possibly septics.	NS	escherichia coli (e. coli)	SEWAGE DISCHARGES IN UNSEWERED AREAS + LIVESTOCK (GRAZING OR FEEDING OPERATIONS)	420
INW0772_06	217-019	WEM-07-0017	Sixmile Creek	Skmile Creek @ County Road 500 S. WEM-07-0017: 181 & G, OHE 14 Will AL, QHEI 44. Chem: Chem ok GM 35 70 2 clu/120mL: 20K sandhill cranes migrate to this location in early spring and late fail but E Coil Collected a different times. Site is a few miles DS from JNRU facility, Site 21 just DS of JNRU was passing for E.coil. Little rip buffer around nearby ag fields. Possible sources are wildlife, sentics as fields.	NS	ESCHERICHIA COLI (E. COLI)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL	420
INW0773_01	217-018	WEM-07-0014	Storm Creek	Storm Creek @ Base Road. WEM-07-0014: 181 42, 38, QHEI 61, 51. mlB 38, QHEI 53. Chem: 1/7 high TP, 1/1 low DO, 1/11 marg DO: no co-occurance GM 493.11 cL/100mL: Two permitted animal operations upstream; some homes may be on septic; some ag fields with min buffer.	NS	ESCHERICHIA COLI (E. COLI)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERED AREAS	420
INW0773_02	217-016	WEM080-0013	Storm Creek Ditch	Storm Creek Ditch @ County Road 400 N. WEM080-0013: IBI 32, 0HE 45. mBI 34, 0HE 44. In refuge, stagnant, logiam US of bridge, excessive duckweed, sheen on water. Vetland infleunced Diffuelt to sample. Original impairment may have been due to logiam - check on date it was sampled. Assess as 4C for DO and IBC. Chem: 1/11 high TP, 8/15 low DO, 1/15 marg DO; no co-occurance GM 59.94 (hu/100mL.	FS			420
INW0773_T1002	217-017	WEM080-0005	Tributary to Richart Lake	Tributary to Richart Lake @ County Road 900 W. WEM080-0005: IBI 20, 0HE 49. mBi 32, 0HE 56: Site was isolated pools during most visits. Little habitat, gravel- sandy substrate, moving bedload - sand/sit from US filling in the pools? Chem: 1/6 high TP, 7/2 lo low 00, 7/10 marg 00: no co-occurance. TSS 120 in June, below 30 every other time. Scrapyards US as well; WC doesn't sample for metals so they could be present. GM 602.45 cfu/100m: Countryise subdivision on septic to the E. Hog operation to the N and other animal operations. Relatively wooded near the site = wildlife.	NS	escherichia coli (e. coli)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERD AREAS + WILDLIFE OTHER THAN WATERFOWL	420
INW0774_01	217-015	WEM080-0025	Mutton Creek	Mutton Creek @ County Road 300 N. WEM080-0025: IBI 36, 04EI 60. mBI 42, 04EI 53. Chem: NoT PNik. 2/11 marg 00. GM 505.48 cfu/120mi: US forested areas and Country Squire Lakes - residential area with lakes and ponds; a few cattle upstream; some potential septics; a few permitted CFOs (Storm Creek and Rose Acre chicken manure).	NS	ESCHERICHIA COLI (E. COLI)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERED AREAS	420
INW0774_02	217-012	WEM080-0014	Mutton Creek	Mutton Creek Ditch @ County Road 400 N. WEM080-0014: IBI 38, QHEI 47. mIBI 30, 36, QHEI 48, 49. Chem: No IP hits, 6/11 low DO. Sites were stagnant with little flow. Possible 4C due to low flow for DO. GM 166.4 cfu/100mL: Located in refuge = wildlife infleunced.	NS	ESCHERICHIA COLI (E. COLI)	WILDLIFE OTHER THAN WATERFOWL + WATERFOWL	420
11110774_02	217-014	WEM080-0027	Mutton Creek	Mutton Creek @ County Road 800 N. WEM080-0027: IBI 38, 40, 0HEI 61, 52. mlBI 40, 0HEI 52. Chem 1: high TP, 3/11 marg DO, no co-occurance GM 131.04 dr.100m. Large dairy operation NW of site, could be spreading manure. Possible septics due to US home not within any major municipality.	NS	ESCHERICHIA COLI (E. COLI)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERED AREAS	420
INW0774_T1003	217-013	WEM-07-0016	Tributary of Mutton Creek	Tributary of Mutton Creek @ County Road 700 N. WEM-07-0016: 18I 40, QHEI 65, mIBI 40, QHEI 48: Lots of longear sunfish from good pools. Chem: 2/7 high TP, 1/11 high % DO 5at: no co-occurance GM 4602. c4U/00mL: No permitted facilities, ag fields with minimal riparian buffer on US tribs. Potential houses on septic.	NS	escherichia coli (e. coli)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERED AREAS	420
INW0774_T1005	217-011	WEM080-0015	Sandy Branch	Sandy Branch @ US Hwy 31. WEM080-0015: IBI N/A, QHEI N/A, CHEI N/A: Beaver Dam impounded stream, not representative. Water backed up into neighboring fields. Chem: 1/7 high TP, DO ok. GM 435.7 cfu/100mL: Seymour M54 US; urban/ ag with no riparian buffer US. Refuge to the E, lots of waterfowl - widifie infleuence? Very few cattle in area.	NS	ESCHERICHIA COLI (E. COLI)	MUNICIPAL POINT SOURCE DISCHARGES + WATERFOWL	420
INW0775_01	217-008	WEM070-0039	Vernon Fork Muscatatuck River	Vernon Fork Muscatatuck River @ County Road 500 S. WEM070-0039: IBI 48, QHEI 62. mIBI 38, 40, QHEI 56, 55. 1/3 Lead exceedance, 1/10 high TP, 1/14 marg DO: no co-occurance 1/3 TP exceedance in May. GM 235 5 cfu/100m. Minimal rightaria buffer to W, but little manure applied to those fields due to frequency of flooding. Wildlife and septics likely but could be non-point source related.	NS	ESCHERICHIA COLI (E. COLI)	SEWAGE DISCHARGES IN UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL	420
INW0775_05	217-009	WEM070-0020	Vernon Fork Muscatatuck River	Vernon Fork Muscatatuck River @ US Hwy 31. WEM070-0020: IBI 52, QHEI 70. mBI 42, QHEI 74. Chem: 1/11 high TP, 4/14 marg D0, no co-occurance FS M8.3.77 ch(1/) ColomL. FS				420
INW0775_T1003	217-006	WEM-07-0021	Tea Creek	Tea Creek @ County Road 650 S. WEM-07-0021: IBI 32, 0HE 62. mBI 38, 0HEI 57: Stream was isolated pools; 93% of fish were pioneer individuals. Chem: 1/7 high TP, 1/11 marg DO, 3/11 high % DO sat: no co-occurrance GM 560.57 chr/100mL: Manure runoff from nearby fields; residential homes on septic; forested so could be wildlife influenced as well.	NS	ESCHERICHIA COLI (E. COLI)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL	420
	217-007	WEM070-0029	Tea Creek	Tea Greek @ County Road 650 W. WEM070-0029: IBI 38, 0HEI 49, mEII 42, a56, OHEI 46, 43. Chem: 1/7 high TP, 1/11 low DO, 2/11 marg DO: no co-occurrance. GM 581.55 dci/0DmL. US homes, fairly wooded, manure runoff; could be affected by whatever is affecting site 6.	NS	ESCHERICHIA COLI (E. COLI)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL	420

INW0776_03	217-010	WEM090-0015	Vernon Fork Muscatatuck River	Vernon Fork Muscatatuck River @ County Road E 50 N. WEM090-0015: 181 46, QHEI 57. mBi 44, QHEI 42. Chem: TP ok, 4/15 marg DO. GM 96.69 driu/J00mL Fully Supporting	FS			420
INW0776_05	217-003	WEM090-0008	Vernon Fork Muscatatuck River	Vernon Fork Muscatatuck Niver @ County Road 400 S. WEM090-0008: IBI N/A, CHEI N/A. N/A, CHEI N/A. Chem: 4/7 high TP, 6/10 low DO, 2/10 marg DO, 3 co-occurrances GM 183.88 clu/100mL. Site is in original stream channel, now oxbow; Rider Ditch is main channel. Stagnant water, not functioning as a stream . Usues probably not driven by a pollutant, hydrology issues. CFO US; nearby cattle pairture but no stream access. Wooded, or UV light not burning up E. Coli. Assess as <u>Ar - Browchinen for existion DC impairment will not assess can write a collected</u> .	NS	escherichia coli (e. coli)	LIVESTOCK (GRAZING OR FEEDING OPERATIONS) + WILDLIFE OTHER THAN WATERFOWL	420
INW0776_T1009	217-005	WEM-07-0015	John McDonald Ditch	John McDonald Dirch @ County Road 125 S. WEN-07-0015: IBI 28, OHE 32 will 24, OHE 42 - Wahata poor; sand, sil and detritus. 32% DELT annomalies, 17/18 Pirate Perch had tumors, could be low DO stress. Chem: TP ok, 5/11 low DO, 2/11 marg DO. Flooded wetland, soft substrate, silty. Assess as 4C = flow driven. GM 220.36 chu/100mL: Permitted facility (Kyle and Lee Broshears) DS; wooded LS (wildlife?). Or sentrs or manues reperding	NS	ESCHERICHIA COLI (E. COLI)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL	420
INW0776_T1019	217-002	WEM-07-0010	Grassy Creek	Grassy Creek @ County Road 600 S. WEM 07-0010: IBl 36, 0HE 51. mBl 32, 0HE 46. Very little habitat, wetland influenced. Chem: 7/7 high Tel/7 really high IPD, 5/11 marg 00, no co-occurrance. GM 244.37 cfu/1200m:: Crothersville (fast) WWTP outfalls discharge to US segment = rural homes less likely to have leaking septic systems. Brenda Bobb Hog farms (CFO, East) permit might say where manure is spread = runoff driven due to US ag fields.	NS	escherichia coli (e. coli)	CONFINED ANIMAL FEEDING OPERATIONS (NPS)	420
INW0776_T1022	217-001	WEM090-0003	Rider Ditch	Rider Ditch @ County Road 600 S. WEM090-0003: IBI 50, 0HE 55. miBI 38, 0HEI 43. Chem: 2/11 high TP, 3/15 marg DO, no co-occurrence. GM 107.48 cfu/1200mL Fully Supporting. Main pour point for the watershed.	FS			420

APPENDIX E. SAMPLING AND ANALYSIS WORK PLAN FOR THE VERNON FORK MUSCATAUCK RIVER WATERSHED



2021 Watershed Characterization Work Plan for Vernon Fork Muscatatuck River Watershed (Hydrologic Unit Code 0512020707)

PREPARED BY

Lindsay Hylton Adams and Allie Gates

Indiana Department of Environmental Management Office of Water Quality Watershed Assessment and Planning Branch Watershed Planning and Restoration Section 100 North Senate Avenue MC65-40-2 Shadeland Indianapolis, Indiana 46204-2251

January 14, 2021

B-050-OWQ-WAP-XXX-21-W-R1

This page is intended to be blank

Approval Signatures

____ Date <u>1/12/2021</u>

____ Date <u>1/12/2021</u>

Tim Beckman, Project Manager **Targeted Monitoring Section**

Caleb Rennaker, TMDL Lead Watershed Planning and Restoration Section

Timothy Bowren, Project/Quality Assurance Officer Technical and Logistical Services Section

Saba

Stacey Sobat, Section Chief **Probabilistic Monitoring Section**

Cyndi Wagner, Section Chief **Targeted Monitoring Section**

Kristen Arnold, Section Chief Technical and Logistical Services Section

Irthur

Jody Arthur, Integrated Report Coordinator Watershed Assessment and Planning Branch

nehau

Date <u>1/8/2021</u>

Marylou Renshaw, Branch Chief Watershed Assessment and Planning Branch

IDEM Quality Assurance Staff reviewed and approves this work plan.

Date 15 Jan 2021

Quality Assurance Staff IDEM Office of Program Support Date 1/8/2021

_ Date <u>1/12/2021</u>

Date 1/12/2021

Date 1/13/2021

Date <u>1/12/2021</u>

This page is intended to be blank

Addendum

IDEM

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

We Protect Hoosiers and Our Environment.

100 N. Senate Avenue • Indianapolis, IN 46204

(800) 451-6027 • (317) 232-8603 • www.idem.IN.gov

Eric J. Holcomb

Bruno L. Pigott

Governor

Memorandum

TO: Interested Parties

FROM: Lindsay Hylton Adams TMDL Project Manager Watershed Planning & Restoration Section Watershed Assessment and Planning Branch Office of Water Quality

DATE: September 30, 2021

SUBJECT: Amendment to <u>2021 Watershed Characterization Work Plan for Vernon Fork Muscatatuck River Watershed</u> (Hydrologic Unit Code 0512020707) B-050-OWQ-WAP-XXX-21-W-R1

This memorandum serves as an amendment to the <u>2021 Watershed Characterization Work Plan for Vernon Fork Muscatatuck</u> <u>River Watershed (Hydrologic Unit Code 0512020707) B-050-OWQ-WAP-XXX-21-W-R1</u>. Additional water chemistry and nutrient sampling will be performed at three sites (T26, T27, and T28) added to the watershed characterization project in September 2021 (Table 1). These sites have been added to better understand the source of recurring high total phosphorus discovered at site T02 during previous sampling events. The three new sites will be sampled in September and October 2021, during separate sampling events, following the normal collection of samples at the existing 23 sampling sites. The two additional sampling events will include a set of quality control samples, which include the duplicate, field blank, and MS/MSD. The addition of these three sites will increase the total number of sampling sites in the project from 23 to 26.

The data collected at these three sites in September and October 2021 will serve to provide additional information for regulatory purposes and will not be incorporated into the development of the TMDL report for the Vernon Fork Muscatatuck River watershed.

 Table 1. Amended site list for the 2021 Vernon Fork Muscatatuck River Watershed Characterization Study, with added sites to be sampled in September and October highlighted

21T-002 WEM-07-0010 Grassy Creek CR 600 S Jackson 38.79404813 -85.86931487 INW0776_T 21T-003 WEM090-0008 Vernon Fork Muscatatuck River CR 400 S Jackson 38.82206239 -85.8841949 INW0776_T 21T-005 WEM-07-0015 John McDonald Ditch CR 125 S Jackson 38.86030512 -85.84559017 INW0776_T 21T-006 WEM-07-0021 Tea Creek CR 650 S Jennings 38.88604596 -85.73130525 INW0775_T 21T-007 WEM070-0029 Tea Creek CR 650 S Jennings 38.91091206 -85.73130525 INW0775_T 21T-008 WEM070-0020 Vernon Fork Muscatatuck River CR 500 S Jennings 38.91091206 -85.73130525 INW0776_T 21T-010 WEM090-0015 Vernon Fork Muscatatuck River CR 500 N Jackson 38.90610115 -85.85168772 INW0776_T 21T-010 WEM080-0015 Sandy Branch US HWY 31 Jackson 38.940733 -85.81663235 INW0774_T 21T-014 WEM080-0027								
21T-002 WEM-07-0010 Grassy Creek CR 600 S Jackson 38.79404813 -85.86931487 INW0776_T 21T-003 WEM090-0008 Vernon Fork Muscatatuck River CR 400 S Jackson 38.82206239 -85.8841949 INW0776_T 21T-005 WEM-07-0015 John McDonald Ditch CR 125 S Jackson 38.86303512 -85.84559017 INW0776_T 21T-006 WEM-07-0021 Tea Creek CR 650 S Jennings 38.88831496 -85.68897148 INW0775_T 21T-007 WEM070-0029 Tea Creek CR 650 W Jennings 38.891091206 -85.73130525 INW0775_T 21T-008 WEM070-0020 Vernon Fork Muscatatuck River CR 500 S Jennings 38.91091206 -85.73012452 INW0776_T 21T-010 WEM080-0015 Vernon Fork Muscatatuck River CR 50 N Jackson 38.940131 -85.85168772 INW0774_T 21T-010 WEM080-0015 Sandy Branch US HWY 31 Jackson 38.940733 -85.81663239 INW0774_T 21T-011 WEM080-0014 <t< th=""><th>Site #</th><th>AIMS Site #</th><th>Stream Name</th><th>Location</th><th>County</th><th>Latitude</th><th>Longitude</th><th>AUID</th></t<>	Site #	AIMS Site #	Stream Name	Location	County	Latitude	Longitude	AUID
21T-003 WEM090-0008 Vernon Fork Muscatatuck River CR 400 S Jackson 38.82206239 -85.8841949 INW0776_T 21T-005 WEM-07-0015 John McDonald Ditch CR 125 S Jackson 38.8206239 -85.8841949 INW0776_T 21T-005 WEM-07-0015 John McDonald Ditch CR 125 S Jackson 38.86030512 -85.88459017 INW0776_T 21T-006 WEM-07-0021 Tea Creek CR 650 S Jennings 38.8804596 -85.73130525 INW0775_T 21T-007 WEM070-0029 Tea Creek CR 650 S Jennings 38.91091206 -85.73012452 INW0775_T 21T-009 WEM070-0020 Vernon Fork Muscatatuck River US HWY 31 Jackson 38.90610115 -85.82106187 INW0774_T 21T-010 WEM080-0015 Sandy Branch US HWY 31 Jackson 38.940733 -85.8168772 INW0774_T 21T-012 WEM080-0014 Mutton Creek Ditch CR 400 N Jackson 38.940733 -85.8168239 INW0774_T 21T-012 WEM080-0027 Mutton	21T-001	WEM090-0003	Rider Ditch	CR 600 S	Jackson	38.79353578	-85.88407544	INW0776_T1022
21T-005 WEM-07-0015 John McDonald Ditch CR 125 S Jackson 38.86303512 -85.84559017 INW0776_T 21T-006 WEM-07-0021 Tea Creek CR 650 S Jennings 38.8831496 -85.68897148 INW0775_T 21T-007 WEM070-0029 Tea Creek CR 650 W Jennings 38.88604596 -85.73130525 INW0775_T 21T-008 WEM070-0039 Vernon Fork Muscatatuck River CR 500 S Jennings 38.91091206 -85.73012452 INW0775_T 21T-009 WEM070-0020 Vernon Fork Muscatatuck River US HWY 31 Jackson 38.90610115 -85.82106187 INW0776_T 21T-010 WEM090-0015 Vernon Fork Muscatatuck River CR 50 N Jackson 38.940713 -85.85168772 INW0774_T 21T-010 WEM080-0015 Sandy Branch US HWY 31 Jackson 38.943120545 -85.83400946 INW0774_T 21T-012 WEM080-0014 Mutton Creek CR 700 N Jackson 38.940733 -85.81562399 INW0774_T 21T-013 WEM-07-0016 <	21T-002	WEM-07-0010	Grassy Creek	CR 600 S	Jackson	38.79404813	-85.86931487	INW0776_T1019
21T-006 WEM-07-0021 Tea Creek CR 650 S Jennings 38.88831496 -85.68897148 INW0775_T 21T-007 WEM070-0029 Tea Creek CR 650 S Jennings 38.88604596 -85.73130525 INW0775_T 21T-008 WEM070-0039 Vernon Fork Muscatatuck River CR 500 S Jennings 38.91091206 -85.73130525 INW0775_T 21T-009 WEM070-0020 Vernon Fork Muscatatuck River US HWY 31 Jackson 38.90610115 -85.82106187 INW0776_T 21T-010 WEM090-0015 Vernon Fork Muscatatuck River CR 50 N Jackson 38.940733 -85.85168772 INW0774_T 21T-011 WEM080-0015 Sandy Branch US HWY 31 Jackson 38.940733 -85.81662399 INW0774_T 21T-012 WEM080-0014 Mutton Creek CR 700 N Jackson 38.940733 -85.81662399 INW0774_T 21T-013 WEM-07-0016 Tributary of Mutton Creek CR 700 N Jackson 38.9405313 -85.80638235 INW0774_T 21T-015 WEM080-0025	21T-003	WEM090-0008	Vernon Fork Muscatatuck River	CR 400 S	Jackson	38.82206239	-85.8841949	INW0776_05
21T-007 WEM070-0029 Tea Creek CR 650 W Jennings 38.88604596 -85.73130525 INW0775_T 21T-008 WEM070-0039 Vernon Fork Muscatatuck River CR 500 S Jennings 38.91091206 -85.7312452 INW0775_T 21T-009 WEM070-0020 Vernon Fork Muscatatuck River US HWY 31 Jackson 38.90610115 -85.82106187 INW0776_T 21T-010 WEM090-0015 Vernon Fork Muscatatuck River CR 50 N Jackson 38.98857071 -85.85168772 INW0776_T 21T-010 WEM080-0015 Sandy Branch US HWY 31 Jackson 38.93120545 -85.83400946 INW0774_T 21T-012 WEM080-0014 Mutton Creek Ditch CR 400 N Jackson 38.940733 -85.81562399 INW0774_T 21T-013 WEM-07-0016 Tributary of Mutton Creek CR 700 N Jackson 38.9834506 -85.82854896 INW0774_T 21T-014 WEM080-0027 Mutton Creek CR 300 N Jennings 39.02796877 -85.76541025 INW0774_T 21T-016 WEM080-0005	21T-005	WEM-07-0015	John McDonald Ditch	CR 125 S	Jackson	38.86303512	-85.84559017	INW0776_T1009
21T-008WEM070-0039Vernon Fork Muscatatuck RiverCR 500 SJennings38.91091206-85.73012452INW0775_21T-009WEM070-0020Vernon Fork Muscatatuck RiverUS HWY 31Jackson38.90610115-85.82106187INW0775_21T-010WEM090-0015Vernon Fork Muscatatuck RiverCR 50 NJackson38.88857071-85.85168772INW0776_21T-011WEM080-0015Sandy BranchUS HWY 31Jackson38.93120545-85.83400946INW0774_T21T-012WEM080-0014Mutton Creek DitchCR 400 NJackson38.940733-85.81562399INW0774_T21T-013WEM-07-0016Tributary of Mutton CreekCR 700 NJackson38.98394506-85.82854896INW0774_T21T-014WEM080-0027Mutton CreekCR 800 NJackson38.99864464-85.80638235INW0774_T21T-015WEM080-0025Mutton CreekCR 300 NJennings39.02796877-85.76541025INW0774_T21T-017WEM080-0013Storm Creek DitchCR 400 NJackson38.98320116-85.78679099INW0773_T21T-017WEM080-0013Storm CreekBase RoadJennings38.931205487-85.77740246INW0773_T21T-019WEM-07-0014Storm CreekCR 500 SJennings38.94320116-85.78670909INW0773_T21T-020WEM-07-0018Sixmile CreekCR 200 SJennings38.95438451-85.73213824INW0772_T21T-021WEM-07-0019Sixmile Creek <td< td=""><td>21T-006</td><td>WEM-07-0021</td><td>Tea Creek</td><td>CR 650 S</td><td>Jennings</td><td>38.88831496</td><td>-85.68897148</td><td>INW0775_T1003</td></td<>	21T-006	WEM-07-0021	Tea Creek	CR 650 S	Jennings	38.88831496	-85.68897148	INW0775_T1003
21T-009 WEM070-0020 Vernon Fork Muscatatuck River US HWY 31 Jackson 38.90610115 -85.82106187 INW0775_ 21T-010 WEM090-0015 Vernon Fork Muscatatuck River CR 50 N Jackson 38.88857071 -85.85168772 INW0776_ 21T-010 WEM080-0015 Sandy Branch US HWY 31 Jackson 38.93120545 -85.83400946 INW0774_T1 21T-012 WEM080-0014 Mutton Creek Ditch CR 400 N Jackson 38.940733 -85.81562399 INW0774_T1 21T-013 WEM-07-0016 Tributary of Mutton Creek CR 700 N Jackson 38.99864464 -85.82854896 INW0774_T1 21T-015 WEM080-0027 Mutton Creek CR 300 N Jackson 38.99864464 -85.80638235 INW0774_T1 21T-016 WEM080-0013 Storm Creek CR 300 N Jackson 38.9405313 -85.876541025 INW0773_ 21T-017 WEM080-0005 Tributary of Richart Lake CR 900 W Jennings 38.96953087 -85.77740246 INW0773_ 21T-017 WEM-07-0014 </td <td>21T-007</td> <td>WEM070-0029</td> <td>Tea Creek</td> <td>CR 650 W</td> <td>Jennings</td> <td>38.88604596</td> <td>-85.73130525</td> <td>INW0775_T1003</td>	21T-007	WEM070-0029	Tea Creek	CR 650 W	Jennings	38.88604596	-85.73130525	INW0775_T1003
21T-010 WEM090-0015 Vernon Fork Muscatatuck River CR 50 N Jackson 38.88857071 -85.85168772 INW0776_ 21T-011 WEM080-0015 Sandy Branch US HWY 31 Jackson 38.93120545 -85.83400946 INW0774_T1 21T-012 WEM080-0014 Mutton Creek Ditch CR 400 N Jackson 38.940733 -85.81562399 INW0774_T1 21T-013 WEM-07-0016 Tributary of Mutton Creek CR 700 N Jackson 38.98394506 -85.82854896 INW0774_T1 21T-014 WEM080-0027 Mutton Creek CR 800 N Jackson 38.99864464 -85.80638235 INW0774_T1 21T-015 WEM080-0025 Mutton Creek CR 300 N Jennings 39.02796877 -85.76541025 INW0774_1 21T-016 WEM080-0013 Storm Creek Ditch CR 400 N Jackson 38.98320116 -85.77740246 INW0773_1 21T-017 WEM080-0005 Tributary of Richart Lake CR 900 W Jennings 38.96953087 -85.76232742 INW0773_1 21T-017 WEM-07-0014	21T-008	WEM070-0039	Vernon Fork Muscatatuck River	CR 500 S	Jennings	38.91091206	-85.73012452	INW0775_01
21T-011WEM080-0015Sandy BranchUS HWY 31Jackson38.93120545-85.83400946INW0774_T121T-012WEM080-0014Mutton Creek DitchCR 400 NJackson38.940733-85.81562399INW0774_T121T-013WEM-07-0016Tributary of Mutton CreekCR 700 NJackson38.98394506-85.82854896INW0774_T121T-014WEM080-0027Mutton CreekCR 800 NJackson38.99864464-85.80638235INW0774_T121T-015WEM080-0025Mutton CreekCR 300 NJennings39.02796877-85.76541025INW0774_121T-016WEM080-0013Storm Creek DitchCR 400 NJackson38.94055313-85.80592841INW0773_121T-017WEM080-0005Tributary of Richart LakeCR 900 WJennings38.96953087-85.77740246INW0773_121T-018WEM-07-0014Storm CreekBase RoadJennings38.931115337-85.76232742INW0772_021T-020WEM-07-0018Sixmile CreekCR 200 SJennings38.95438451-85.73213824INW0772_021T-021WEM-07-0019Sixmile CreekCR 175 NJennings39.0100959-85.70497622INW0772_021T-022WEM-07-0020Sixmile CreekSR 7Jennings39.04575934-85.67644156INW0772_0	21T-009	WEM070-0020	Vernon Fork Muscatatuck River	US HWY 31	Jackson	38.90610115	-85.82106187	INW0775_05
21T-012 WEM080-0014 Mutton Creek Ditch CR 400 N Jackson 38.940733 -85.81562399 INW0774_ 21T-013 WEM-07-0016 Tributary of Mutton Creek CR 700 N Jackson 38.98394506 -85.82854896 INW0774_T1 21T-014 WEM080-0027 Mutton Creek CR 800 N Jackson 38.99864464 -85.80638235 INW0774_T1 21T-015 WEM080-0025 Mutton Creek CR 300 N Jennings 39.02796877 -85.76541025 INW0774_T1 21T-016 WEM080-0013 Storm Creek Ditch CR 400 N Jackson 38.94055313 -85.80592841 INW0773_T1 21T-017 WEM080-0005 Tributary of Richart Lake CR 900 W Jennings 38.96953087 -85.77740246 INW0773_T1 21T-018 WEM-07-0014 Storm Creek Base Road Jennings 38.95438451 -85.76232742 INW0774_T1 21T-019 WEM-07-0017 Sixmile Creek CR 500 S Jennings 38.95438451 -85.73213824 INW0772_T1 21T-020 WEM-07-0019 Six	21T-010	WEM090-0015	Vernon Fork Muscatatuck River	CR 50 N	Jackson	38.88857071	-85.85168772	INW0776_03
21T-013WEM-07-0016Tributary of Mutton CreekCR 700 NJackson38.98394506-85.82854896INW0774_T121T-014WEM080-0027Mutton CreekCR 800 NJackson38.99864464-85.80638235INW0774_T121T-015WEM080-0025Mutton CreekCR 300 NJennings39.02796877-85.76541025INW0774_T121T-016WEM080-0013Storm Creek DitchCR 400 NJackson38.94055313-85.80592841INW0773_T121T-017WEM080-0005Tributary of Richart LakeCR 900 WJennings38.96953087-85.77740246INW0773_T121T-018WEM-07-0014Storm CreekBase RoadJennings38.98320116-85.78670909INW0773_T121T-019WEM-07-0017Sixmile CreekCR 500 SJennings38.95438451-85.73213824INW0772_021T-020WEM-07-0019Sixmile CreekCR 175 NJennings39.0100959-85.70497622INW0772_021T-022WEM-07-0020Sixmile CreekSR 7Jennings39.04575934-85.67644156INW0772_0	21T-011	WEM080-0015	Sandy Branch	US HWY 31	Jackson	38.93120545	-85.83400946	INW0774_T1005
21T-014WEM080-0027Mutton CreekCR 800 NJackson38.99864464-85.80638235INW077421T-015WEM080-0025Mutton CreekCR 300 NJennings39.02796877-85.76541025INW077421T-016WEM080-0013Storm Creek DitchCR 400 NJackson38.94055313-85.80592841INW077321T-017WEM080-0005Tributary of Richart LakeCR 900 WJennings38.96953087-85.77740246INW0773T21T-018WEM-07-0014Storm CreekBase RoadJennings38.98320116-85.78670909INW0773T21T-019WEM-07-0017Sixmile CreekCR 500 SJennings38.91115337-85.76232742INW077221T-020WEM-07-0018Sixmile CreekCR 200 SJennings38.95438451-85.73213824INW077221T-021WEM-07-0019Sixmile CreekCR 175 NJennings39.0100959-85.70497622INW077221T-022WEM-07-0020Sixmile CreekSR 7Jennings39.04575934-85.67644156INW0772_0	21T-012	WEM080-0014	Mutton Creek Ditch	CR 400 N	Jackson		-85.81562399	INW0774_02
21T-015 WEM080-0025 Mutton Creek CR 300 N Jennings 39.02796877 -85.76541025 INW0774 21T-016 WEM080-0013 Storm Creek Ditch CR 400 N Jackson 38.94055313 -85.80592841 INW0773 21T-017 WEM080-0005 Tributary of Richart Lake CR 900 W Jennings 38.96953087 -85.77740246 INW0773_T1 21T-018 WEM-07-0014 Storm Creek Base Road Jennings 38.98320116 -85.78670909 INW0773_T1 21T-019 WEM-07-0017 Sixmile Creek CR 500 S Jennings 38.91115337 -85.76232742 INW0772_0 21T-020 WEM-07-0018 Sixmile Creek CR 200 S Jennings 38.95438451 -85.73213824 INW0772_0 21T-021 WEM-07-0019 Sixmile Creek CR 175 N Jennings 39.0100959 -85.70497622 INW0772_0 21T-022 WEM-07-0020 Sixmile Creek SR 7 Jennings 39.04575934 -85.67644156 INW0772_0	21T-013	WEM-07-0016	Tributary of Mutton Creek	CR 700 N	Jackson	38.98394506	-85.82854896	INW0774_T1003
21T-016WEM080-0013Storm Creek DitchCR 400 NJackson38.94055313-85.80592841INW0773_21T-017WEM080-0005Tributary of Richart LakeCR 900 WJennings38.96953087-85.77740246INW0773_T121T-018WEM-07-0014Storm CreekBase RoadJennings38.98320116-85.78670909INW0773_21T-019WEM-07-0017Sixmile CreekCR 500 SJennings38.91115337-85.76232742INW0772_21T-020WEM-07-0018Sixmile CreekCR 200 SJennings38.95438451-85.73213824INW0772_21T-021WEM-07-0019Sixmile CreekCR 175 NJennings39.0100959-85.70497622INW0772_21T-022WEM-07-0020Sixmile CreekSR 7Jennings39.04575934-85.67644156INW0772_0	21T-014	WEM080-0027	Mutton Creek	CR 800 N	Jackson	38.99864464	-85.80638235	INW0774_02
21T-017 WEM080-0005 Tributary of Richart Lake CR 900 W Jennings 38.96953087 -85.77740246 INW0773_T 21T-018 WEM-07-0014 Storm Creek Base Road Jennings 38.98320116 -85.78670909 INW0773_T 21T-019 WEM-07-0017 Sixmile Creek CR 500 S Jennings 38.91115337 -85.76232742 INW0772_T 21T-020 WEM-07-0018 Sixmile Creek CR 200 S Jennings 38.95438451 -85.73213824 INW0772_T 21T-021 WEM-07-0019 Sixmile Creek CR 175 N Jennings 39.0100959 -85.70497622 INW0772_T 21T-022 WEM-07-0020 Sixmile Creek SR 7 Jennings 39.04575934 -85.67644156 INW0772_T	21T-015	WEM080-0025	Mutton Creek	CR 300 N	Jennings	39.02796877	-85.76541025	INW0774_01
21T-018 WEM-07-0014 Storm Creek Base Road Jennings 38.98320116 -85.78670909 INW0773 21T-019 WEM-07-0017 Sixmile Creek CR 500 S Jennings 38.91115337 -85.76232742 INW0772 21T-020 WEM-07-0018 Sixmile Creek CR 200 S Jennings 38.95438451 -85.73213824 INW0772 21T-021 WEM-07-0019 Sixmile Creek CR 175 N Jennings 39.0100959 -85.70497622 INW0772 21T-022 WEM-07-0020 Sixmile Creek SR 7 Jennings 39.04575934 -85.67644156 INW0772_0	21T-016	WEM080-0013	Storm Creek Ditch	CR 400 N	Jackson	38.94055313	-85.80592841	INW0773_02
21T-019 WEM-07-0017 Sixmile Creek CR 500 S Jennings 38.91115337 -85.76232742 INW0772_ 21T-020 WEM-07-0018 Sixmile Creek CR 200 S Jennings 38.95438451 -85.73213824 INW0772_ 21T-021 WEM-07-0019 Sixmile Creek CR 175 N Jennings 39.0100959 -85.70497622 INW0772_ 21T-022 WEM-07-0020 Sixmile Creek SR 7 Jennings 39.04575934 -85.67644156 INW0772_0	21T-017	WEM080-0005	Tributary of Richart Lake	CR 900 W	Jennings	38.96953087	-85.77740246	INW0773_T1002
21T-020 WEM-07-0018 Sixmile Creek CR 200 S Jennings 38.95438451 -85.73213824 INW0772 21T-021 WEM-07-0019 Sixmile Creek CR 175 N Jennings 39.0100959 -85.70497622 INW0772 21T-022 WEM-07-0020 Sixmile Creek SR 7 Jennings 39.04575934 -85.67644156 INW0772_0	21T-018	WEM-07-0014	Storm Creek	Base Road	Jennings	38.98320116	-85.78670909	INW0773_01
21T-021 WEM-07-0019 Sixmile Creek CR 175 N Jennings 39.0100959 -85.70497622 INW0772_0 21T-022 WEM-07-0020 Sixmile Creek SR 7 Jennings 39.04575934 -85.67644156 INW0772_0	21T-019	WEM-07-0017	Sixmile Creek	CR 500 S	Jennings	38.91115337	-85.76232742	INW0772_06
21T-022 WEM-07-0020 Sixmile Creek SR 7 Jennings 39.04575934 -85.67644156 INW0772_0	21T-020	WEM-07-0018	Sixmile Creek	CR 200 S	Jennings	38.95438451	-85.73213824	INW0772_05
	21T-021	WEM-07-0019	Sixmile Creek	CR 175 N	Jennings	39.0100959	-85.70497622	INW0772_04
21T-023 WEM070-0036 Vernon Fork Muscatatuck River CR 400 W Jennings 38.95429488 -85.68498536 INW0771_	21T-022	WEM-07-0020	Sixmile Creek	SR 7	Jennings	39.04575934	-85.67644156	INW0772_01A
	21T-023	WEM070-0036	Vernon Fork Muscatatuck River	CR 400 W	Jennings	38.95429488	-85.68498536	INW0771_02
21T-025 WEM070-0001 Vernon Fork Muscatatuck River CR 60 S Jennings 38.97635892 -85.62004239 INW0771_0	21T-025	WEM070-0001	Vernon Fork Muscatatuck River	CR 60 S	Jennings	38.97635892	-85.62004239	INW0771_03
21T-026 WEM-07-0022 Nehrt Ditch E CR 600 S Jackson 38.793730 -85.856081 INW0776_T1	21T-026	WEM-07-0022	Nehrt Ditch	E CR 600 S	Jackson	38.793730	-85.856081	INW0776_T1018
	21T-027	WEM-07-0023	Blau Ditch	CR 1000 E	Jackson	38.8012585	-85.8513440	INW0776_T1016
21T-028 WEM-07-0024 Grassy Creek US HWY 31 Jackson 38.817926 -85.837428 INW0776_T1	21T-028	WEM-07-0024	Grassy Creek	US HWY 31	Jackson	38.81792 <mark>6</mark>	-85.837428	INW0776_T1015

21T-### gray shading of the Site # denotes that these are the selected pour points for this project (7 sites)

Work Plan Organization

This work plan is an extension of the existing Watershed Assessment and Planning Branch (WAPB), March 2017 Quality Assurance Project Plan (QAPP) for Indiana Surface Water Programs (Surface Water QAPP) (IDEM 2017a) and serves as a link to the existing QAPP as well as an independent QAPP of the project. Per the United States Environmental Protection Agency (U.S. EPA) 2006 Guidance on Systematic Planning Using the Data Quality Objectives (DQO) Process (U.S. EPA 2006) and the U.S. EPA 2002 Guidance for Quality Assurance Project Plans (U.S. EPA 2002), this work plan establishes criteria and specifications, pertaining to a specific water quality monitoring project, usually described in the following four groups or sections of a QAPP per Guidance for Quality Assurance Project Plans (U.S. EPA 2002).

Group A. Project Management

- Project Objective
- Project Organization and Schedule
- Background and Project Description
- Data Quality Objectives
- Training and Staffing Requirements

Group B. Data Generation and Acquisition

- Sampling Procedures
- Analytical Methods
- Sample and Data Acquisition Requirements
- Quality Control Measures Specific to the Project

Group C. Assessment and Oversight

- External and Internal Checks
- Audits
- Data Quality Assessments
- Quality Assurance and Quality Control Review Reports

Group D. Data Validation and Usability

• Data Handling and Associated Quality Assurance and Quality Control activities

This page is intended to be blank

Table of Contents

Approval Signatures	i
Work Plan Organization	.5
Table of Contents	.7
List of Attachments	.8
List of Figures	.8
List of Tables	.8
List of Acronyms	.9
DEFINITIONS1	0
A. PROJECT MANAGEMENT1	1
A.1. Project Objective1	11
A.2. Project Organization and Schedule1	12
A.3. Background and Project Description1	12
A.4. Data Quality Objectives (DQOs)1	13
A.5. Training and Staffing Requirements1	9
B. DATA GENERATION AND ACQUISITION2	22
B.1. Sampling Sites and Sampling Design2	22
B.2. Sampling Methods and Sample Handling2	25
B.3. Analytical Methods2	<u>29</u>
B.4. Quality Control and Custody Requirements	30
C. ASSESSMENT AND OVERSIGHT	33
C.1. Field and laboratory performance and system audits	33
D. DATA VALIDATION AND USABILITY	34
REFERENCES	36
DISTRIBUTION LIST4	10
ATTACHMENTS4	1

List of Attachments

Attachment 1: Modified Geometric Design Steps for Watershed Characterization Stu	idies
	41
Attachment 2: IDEM OWQ Site Reconnaissance Form	45
Attachment 3: IDEM OWQ Stream Sampling Field Data Sheet	46
Attachment 4: IDEM OWQ Fish Collection Data Sheet	47
Attachment 5: IDEM OWQ Macroinvertebrate Header Form	48
Attachment 6: IDEM OWQ Biological Qualitative Habitat Evaluation Index (front)	49
Attachment 7: IDEM OWQ Chain of Custody Form	51
Attachment 8: IDEM OWQ Water Sample Analysis Request Form	52
Attachment 9: Test America Chain of Custody Form	53
Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation	54

List of Figures

Figure 1. Vernon Fork - Muscatatuck River Watershed Land Use	15
Figure 2. Vernon Fork - Muscatatuck River Watershed Characterization Sampling A	rea23

List of Tables

Table 1. Water Quality Criteria [327 IAC Article 2]	18
Table 2. Project Roles, Experience, and Training	19
Table 3. Sampling Locations for Watershed Characterization of Vernon Fork - Muse	catatuck
River	24
Table 4. Water Chemistry Sample Handling	25
Table 5. <i>E. coli</i> , Nutrient, and General Chemistry Parameters Test Methods ⁴	29
Table 6. Field Parameters Test Methods	30
Table 7. Personnel Safety and Reference Manuals	35

List of Acronyms

AIMS ASTM AUID CFU DO DQA DQO <i>E. coli</i>	Assessment Information Management System American Society for Testing and Materials Assessment Unit IDs Colony Forming Units Dissolved Oxygen Data Quality Assessment Data Quality Objectives <i>Escherichia coli</i>
GPS HUC	Global Positioning System
IAC	Hydrologic Unit Code Indiana Administrative Code
IBI	Index of Biotic Integrity
IDEM	Indiana Department of Environmental Management
µS/cm	Micro Siemens per Centimeter
mg/L	Milligram per liter
MHAB	Multihabitat
mL	Milliliter
NTU	Nephelometric Turbidity Unit(s)
OHEPA	Ohio Environmental Protection Agency
OWQ	Office of Water Quality
PPE	Personal Protective Equipment
QA/QC	Quality Assurance and Quality Control
QAPP	Quality Assurance Project Plan
QHEI	Qualitative Habitat Evaluation Index
S.U.	Standard Units
SM	Standard Methods
SOP	Standard Operating Procedures
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
U.S. EPA	United States Environmental Protection Agency
WAPB	Watershed Assessment and Planning Branch

DEFINITIONS

Assessment Unit	Reaches of waterbodies, with similar features, assigned unique identifiers to which all assessment information for that specific reach is associated and which allow for mapping with geographic information systems
Elutriate	To purify, separate, or remove lighter or finer particles by washing, decanting, and settling.
Fifteen-(15-)minute pick	A component of the multihabitat macroinvertebrate sampling method, used to maximize taxonomic diversity while in the field, in which the one-minute kick sample and fifty-meter sweep sample collected at a site are first combined and elutriated. Macroinvertebrates are then manually removed from the resulting sample for 15 minutes.
Fifty-(50-)meter sweep sample	A component of the multihabitat macroinvertebrate sampling method in which approximately 50 meters of all available habitat in a stream or river is sampled with a standard 500 micrometer mesh width D-frame dip net by taking 20-25 individual "jab" or "sweep" samples, which are then composited.
Geometric site	Sampling site chosen according to its drainage area within a watershed.
Macroinvertebrate	Aquatic animals which lack a backbone, are visible without a microscope, and spend some period of their lives in or around water.
One-(1-)minute kick sample	A component of the multihabitat macroinvertebrate sampling method in which approximately 1 m ² of riffle or run substrate habitat in a stream or river is sampled with a standard 500 μ m mesh width D-frame dip net for approximately 1 minute.
Pour point	The outlet of a subwatershed or the common point where all the water flows out of any given subwatershed.
Reach Targeted site	A segment of a stream used for sampling. A sampling site intentionally selected based on specific monitoring objectives or decisions to be made.

A. PROJECT MANAGEMENT

A.1. Project Objective

IDEM selected the Vernon Fork Muscatatuck River ("Vernon Fork") watershed (10-digit Hydrologic Unit Code or HUC 0512011118) (Figure 2, Table 3) for a watershed characterization project. The main objective of the watershed characterization monitoring project is to use an intensive targeted watershed design which characterizes the current condition of an individual watershed. This type of monitoring provides valuable data for the purposes of assessment, TMDL development, watershed planning, and allows for future comparisons to evaluate changes in the water quality within the watershed studied. Selecting a spatial monitoring design, with sufficient sampling density to accurately characterize water quality conditions, is a critical step in the process of developing an adequate local scale watershed study.

The water quality data generated from this monitoring effort is anticipated to provide information needed to characterize the watershed for the TMDL program, for local water quality managers, to identify sources of impairment, to designate critical areas, and to enable users in making valid and informed watershed decisions. By design, this project also adds new stream reaches which allow for assessment of aquatic life use support, recreational use support, and future comparisons to evaluate changes in water quality.

The draft 303(d) list for 2020 submitted to the U.S. EPA (IDEM 2020a) identifies 280.72 miles of impaired streams in the Vernon Fork watershed with some reaches affected by multiple impairments. The total number of miles per each impairment in the Vernon Fork watershed is reported in the following ways:

- Category 5(a): Impaired Biotic Community (IBC), 169.80 miles
- Category 5(a): Dissolved Oxygen Impaired (DO), 162.81 miles
- Category 5(a): Escherichia coli (E. coli), 93.78 miles
- Category 5(b): Mercury (Hg), 48.83 miles

Assessment data have been collected in this watershed from multiple IDEM programs and projects.

A.2. Project Organization and Schedule

The main project objective is to provide a comprehensive assessment of the Vernon Fork watershed streams' capability to support aquatic life and recreational uses. Sampling will begin in November 2020 and end in October 2021. Barring any hazardous weather conditions or unexpected physical barriers to access a site, sampling activities will be conducted for physical, chemical and bacteriological parameters, and biological communities.

Sampling activity timeframes include:

- 1. Site reconnaissance activities will be completed in July 2020. Reconnaissance activities will be conducted in the office and through physical site visits.
- 2. Water chemistry will be sampled monthly at all watershed sites during the recreational season, defined as April through October in [327 IAC 2-1-6]. During the months of November through March, only sites at the pour point of each 12-digit HUC will be sampled monthly (six sites for this project). The first sampling event will be conducted in November 2020 and the study will conclude in October 2021.
- 3. Biological sampling activities will begin in the summer of 2021 and end no later than October 18, 2021. Fish and macroinvertebrate community sampling will be conducted at all watershed sites via the observation, counting, and collection techniques described in the "Sampling Methods and Sample Handling" section of this work plan. Habitat quality will also be assessed at all watershed sites. Fish and macroinvertebrate community collection specific dates cannot be given, since sampling may be postponed due to a high-water event resulting in scouring of the stream substrate or instream cover creating nonrepresentative samples. Bacteriological sampling for *E. coli* at all sites in the watershed will take place monthly from April through October of 2021. In addition, *E. coli* samples will be collected five times from each site at equally spaced intervals over a 30-day period during the recreational season of April to October 2021 to determine a geometric mean.

A.3. Background and Project Description

The Watershed Characterization Monitoring program was instituted to assist in characterizing existing conditions in watersheds throughout the state. The Vernon Fork watershed data set will be utilized by the TMDL program and shared with local watershed groups and any other interested parties. The monitoring will provide data for TMDL development and watershed planning and will aid in future evaluations of changes within the basin. For this study, the following data will be used for assessment purposes: water chemistry, bacteriological contamination in the form of *E. coli*, fish community, macroinvertebrate assemblages, and habitat evaluations.

A.4. Data Quality Objectives (DQOs)

The DQO process (U.S. EPA 2006) is a planning tool for data collection activities. The process provides a basis for balancing decision uncertainty with available resources. The DQO process is recommended by U.S. EPA when selecting between two alternatives or deriving an estimate of contamination. The DQO process is a seven-step systematic planning process used to clarify study objectives; define the types of data needed to achieve the objectives; and establish decision criteria for evaluating data quality. Results of the DQO seven step process for the watershed characterization monitoring of the Vernon Fork watershed are documented in the following seven sections.

1. State the Problem

Indiana is required to assess all waters of the state to determine their designated use attainment status. Surface waters of the state are designated for full-body contact recreation; will be capable of supporting a well-balanced, warm water aquatic community; and put-and-take trout fishing [327 IAC 2-1-3] in some northern portions of the state. Data from the intensive sampling of the Vernon Fork watershed is needed to fully characterize the current water quality of the watershed. This project will gather water chemistry, bacteriological, biological (fish and macroinvertebrates), and habitat data for the purpose of assessing the designated use attainment status of the Vernon Fork watershed.

2. Identify the Goals of the Study

The main objective of this study is to fully assess whether the surface waters in this watershed are supporting or nonsupporting for aquatic life use and recreational use. In addition, the data from the watershed characterization monitoring will be used for TMDL development and may also be used for watershed planning and future comparisons to evaluate changes in water quality within the watershed studied.

3. Identify Information Inputs

Grab samples will be collected at the surface water sampling locations for *E. coli* and the parameters listed in Table 5. Field measurements listed in Table 6 will be conducted at each site during each sampling event. Visual field observations will include weather conditions, stream conditions, and percent stream canopy at each sampling location. All samples collected for bacteriological samples will be analyzed for *E. coli* using SM9223B (IDEM 2019a) Idexx Colilert Enzyme Substrate Standard Method. Surface water chemistry samples will be collected monthly and processed and analyzed by TestAmerica Laboratories using the analytical methods listed in Table 5. A fish and macroinvertebrate community sample will be collected once at each site with a corresponding habitat evaluation.

4. Define the Boundaries of the Study

The Vernon Fork watershed covers 212.41 square miles and is located in Jackson and Jennings counties. The watershed is approximately 40% Forest, 24% Agriculture, 24% Hay/Pasture, 9% Developed Land (combined types), 2% Wetlands, and 1% other uses. (Figure 1)

Sampling locations for the 2021 Vernon Fork watershed characterization study are listed in Table 3 and can be viewed spatially in Figure 2.

Site reconnaissance activities will be completed in July 2020. Sampling activities will begin in November 2020 and will conclude in October 2021. Water chemistry will be sampled monthly during the recreational season, defined as April through October in [327 IAC 2-1-6]. Biological sampling activities will be conducted in the summer of 2021 and end no later than October 18, 2021. Bacteriological sampling activities will be conducted from April through October of 2021.

Sampling activities will not be conducted when stream flow is potentially too dangerous for staff to enter the stream, hazardous weather conditions (e.g. thunderstorms or heavy rain in the vicinity) exist, or unexpected physical barriers to accessing the site exist. The field crew chief will make the final determination as to whether or not a stream is safe to enter.

Even when weather conditions and stream flow are safe, sample collections for biological communities may be postponed at a particular site for one to four weeks. The cause of the postponement would be a high-water event resulting in scouring of the stream substrate or instream cover creating nonrepresentative samples.

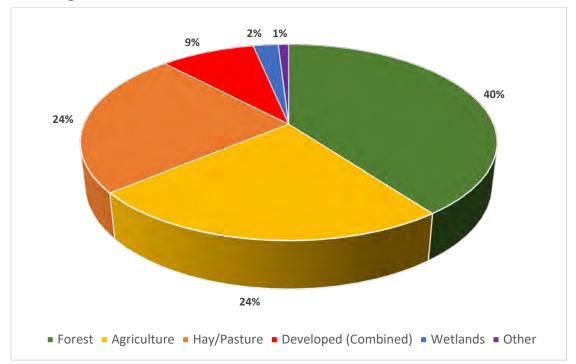


Figure 1. Vernon Fork Muscatatuck River Watershed Land Use

⁴ Data collected/calculated from USDA National Agricultural Statistics Service 2019 Cropland Data Layer

5. Develop the Analytical Approach

Samples will be collected for physical, chemical, and bacteriological parameters, as well as biological communities. Samples will be analyzed for *E.coli* in the IDEM *E. coli* mobile laboratory or IDEM Shadeland laboratory with the IdexxTM Colilert Test. The Colilert Test is a multiple-tube enzyme substrate standard method SM-9223B (Clesceri et al. 2012). Samples will be analyzed for nutrient and general chemistry parameters at TestAmerica Laboratories. The nutrient and general chemistry parameters and respective test methods are listed in Table 5 of this work plan. Field parameters of DO, pH, water temperature, specific conductance, and DO percent saturation will be measured with a datasonde. Turbidity will be measured with a HachTM turbidity kit.

6. Specify Performance or Acceptance Criteria

Sampling design error is minimized by utilizing a comprehensive checklist of informational sources, evaluation of historical information, and a thorough watershed presurvey. Described in Section B.1.5.3 of the Surface Water QAPP (IDEM 2017a), this sampling design has been formulated to address data deficiencies and render the optimum amount of data needed to fill gaps in the decision process.

Good quality data are essential for minimizing decision error. By minimizing both sampling design error and measurement error for physical and biological parameters, more confidence can be placed in the conclusions drawn on the stressors and sources affecting the water quality in the study area.

Site specific aquatic life use and recreational use assessments include program specific controls to identify the introduction of errors. These controls include blanks and duplicates for water chemistry and bacteriological samples; biological site revisits or duplicates; and laboratory controls through verification of species identifications as described in field procedure manuals (IDEM 1992a, 1992b, 2002, 2015, 2017a, 2018a, 2019a, 2019b, 2019c, 2019d, 2020c).

The QA/QC process detects deficiencies in the data collection as set forth in the Surface Water QAPP (IDEM 2017a). The QAPP requires all contract laboratories to adhere to rigorous standards during sample analyses and to provide good quality usable data. Laboratory accreditation is verified before the lab contract is awarded and before the project begins (Attachment 10). Laboratory performance studies are reviewed annually in October. Chemists within the WAPB review the laboratory analytical results for quality assurance. Lab QA/QC for each data set is compared against acceptance limits as specified in laboratory methods, the laboratory's QA Manual, the Surface Water QAPP Section B5.3 (Laboratory Quality Control Checks), and the Surface Water QAPP Section D3 (Reconciliation with DQO). The data is validated based on the QA/QC review. Any data which is "Rejected" due to analytical problems or errors will not be used for water quality assessment decisions. Any data flagged as "Estimated" may be used on a case-by-case basis and is noted in the QA/QC report. Criteria for acceptance or rejection of results as well as application of data quality flags is presented in the following Surface Water QAPP tables:

- Table D3-1: Data Qualifiers and Flags
- Table A7-1: Precision and Accuracy Goals for Data Acceptability by Matrix (Precision and accuracy goals with acceptance limits for applicable analytical methods)
- Table B2.1.1.8-2: Field Parameters

Further investigation will be conducted in response to consistent "rejected" data to determine the source of error. Field techniques, used during sample collection and preparation along with laboratory procedures, will be subject to evaluation by both the WAPB QA manager and project manager to troubleshoot error introduced throughout the entire data collection process. Corrective actions will be implemented once the source of error is determined.

Sites will be evaluated as supporting or nonsupporting following the decision-making processes described in Indiana's 2020 Consolidated Assessment Listing Methodology (CALM), which is based upon the water quality criteria shown in Table 1.

Recreational use attainment decisions will be based on bacteriological criteria developed to protect primary contact recreational activities [<u>327 IAC 2-1-6</u>]. Aquatic life use support decisions will include independent evaluations of biological and chemical data. The fish assemblage data will be evaluated at each site using the appropriate IBI

(Simon and Dufour, 2005). Macroinvertebrate MHAB samples will also be evaluated using a statewide IBI developed for lowest practical taxonomic level identifications.

Indiana narrative biological criteria [327 IAC 2-1-3] states that "(2) All waters, except [limited use waters] will be capable of supporting: (A) a well-balanced, warm water aquatic community." The water quality standard definition of a "well-balanced aquatic community" is "[327 IAC 2-1-9] (59)] An aquatic community that: (A) is diverse in species composition; (B) contains several different trophic levels; and (C) is not composed mainly of pollution tolerant species." An interpretation or translation of narrative biological criteria into numeric criteria would be as follows: A stream segment is nonsupporting for aquatic life use when the monitored fish or macroinvertebrate community receives an Index of Biotic Integrity (IBI) score of less than 36 (on a scale of 0-60 for fish and 12-60 for macroinvertebrate communities), which is considered "Poor" or "Very Poor" (IDEM 2020b).

In addition, data for several nutrient parameters will be evaluated with the benchmarks listed below (IDEM 2020b). Assuming a minimum of three sampling events, if two or more of the conditions below are met on the same date, the waterbody will be classified as nonsupporting due to nutrients.

- Total Phosphorus (TP):
 - One or more measurements greater than 0.3 mg/L
- Nitrogen (measured as Nitrate + Nitrite):
 - $\circ~$ One or more measurements greater than 10.0 mg/L
- Dissolved Oxygen (DO):
 - o Any measurement less than 4.0 mg/L
 - Any measurements consistently at or close to the standard, range 4.0-5.0 mg/L
- DO Percent Saturation
 - o Any measurement greater than 120%
- pH:
 - Any measurement greater than 9.0 SU
 - Measurements consistently at or close to the standard, range 8.7-9.0 SU

Assessment of each site sampled will be reported to U.S. EPA in the 2022 update of <u>Indiana's Integrated Water Monitoring and Assessment Report</u> (Integrated Report). Site-specific data will be used to classify associated assessment units into one of five major categories in the State's Consolidated 303(d) list. Category definitions are available in Indiana's CALM (IDEM 2020b, pp. 1-48 and 1-49).

Parameters	Water Quality Criteria	Criterion
<i>E. coli</i> (April-October	<u><</u> 125 MPN/100 mL	5-Sample Geometric Mean
Recreational season)	<u><</u> 235 MPN/100 mL	Single Sample Maximum
Total Ammonia (NH ₃ -N)	Calculated based on pH and Temperature	Calculated CAC
Nitrate+Nitrite-Nitrogen	<u>≤</u> 10 mg/L	Human Health point of drinking water intake
Sulfate	Calculated based on hardness and chloride	In all waters outside the mixing zone
Dissolved Oxygon	At least 5.0 mg/L (Warm Waters)	Daily Average
Dissolved Oxygen	Not less than 4.0 mg/L at any time	Single Reading
рН	6.0 – 9.0 S.U. except for daily fluctuations that exceed 9.0 due to photosynthetic activity	Single Reading
Temperature	Varies Monthly	1% Annual; Maximum Limits
Chloride	Calculated based on hardness and sulfate values	Calculated CAC
Dissolved Solids	750 mg/L	Public water supply

Table 1. Water Quality Criteria [327 IAC Article 2]

MPN = Most Probable Number, CAC = Chronic Aquatic Criterion, S.U. = Standard Units

7. Optimize the Plan for Obtaining Data

A Modified Geometric Design (OHEPA 1999, 2012) site selection process in Attachment 1 will be used in this study to get the necessary spatial representation of the entire study area. Sites within this watershed have been selected based on a geometric progression of drainage areas and then located to the nearest bridge. Sample sites at road crossings allow for more efficient sampling of the watershed.

A.5. Training and Staffing Requirements

Role	Required Training or Experience	Responsibilities	Training References
Project Manager	- AIMS II database experience - Demonstrated experience in project management and QA/QC procedures	 Establish Project in the AIMS II database Oversee development of project work plan Oversee entry and QC of field data Querying data from AIMS II to determine results not meeting Water Quality Criteria 	- IDEM 2017a, 2017b - U.S. EPA 2006
Field Crew Chief Biological Community Sampling	 At least one year of experience in sampling methodology and taxonomy of aquatic communities in the region Annually review the Principles and Techniques of Electrofishing Annually review relevant safety procedures Annually review relevant SOP documents for field operations 	 Completion of field data sheets Taxonomic accuracy Sampling efficiency and representation Voucher specimen tracking Overall operation of the field crew when remote from central office Adherence to safety and field SOP procedures by crew members Ensure that multiprobe analyzers are calibrated weekly prior to field sampling activities Ensure that field sampling equipment is functioning properly and loaded into field vehicles prior to field sampling activities 	- YSI 2017 - IDEM 1992a, 1992b, 2002, 2008, 2010a, 2010b, 2015, 2017a, 2018a, 2019b, 2019c, 2019d - Newhouse 1998a, 1998b - YSI 2018
Field Crew Members Biological Community Sampling	 Complete hands-on training for sampling methodology prior to participation in field sampling activities Review the Principles and Techniques of Electrofishing Review relevant safety procedures Review relevant SOP documents for field operations 	 Follow all safety and SOP procedures while engaged in field sampling activities Follow direction of field crew chief while engaged in field sampling activities 	- YSI 2017 - IDEM 1992a, 1992b, 2002, 2008, 2010a, 2010b, 2015, 2017a, 2018a, 2019b, 2019c, 2019d - Newhouse 1998a, 1998b - YSI 2018

Dala	Dequired Training or	Deeneneikilitiee	Troining Deferences
Role	Required Training or Experience	Responsibilities	Training References
Field Crew Chief – Water Chemistry or Bacteriological Sampling	 At least one year of experience in sampling methodology Annually review relevant safety procedures Annually review relevant SOP documents for field operations 	 Completion of field data sheets Sampling efficiency and representation Overall operation of the field crew when remote from central office Adherence to safety and field SOP procedures by crew members Ensure multiprobe analyzers are calibrated weekly prior to field sampling activities Ensure field sampling equipment is functioning properly and loaded into field vehicles prior to field sampling activities 	- YSI 2017 - IDEM 1997, 2002, 2008, 2010a, 2010b, 2015, 2017a, 2019a - YSI 2018
Field Crew Members – Water Chemistry or Bacteriological Sampling	 Complete hands-on training for sampling methodology prior to participation in field sampling activities Review relevant safety procedures Review relevant SOP documents for field operations 	 Follow all safety and SOP procedures while engaged in field sampling activities Follow direction of field crew chief while engaged in field sampling activities 	- YSI 2017 - IDEM 1997, 2002, 2008, 2010a, 2010b, 2015, 2017a, 2019a - YSI 2018
Laboratory Supervisor – Biological Community Sample Processing	 At least one year of experience in taxonomy of aquatic communities in the region Annually review relevant safety procedures Annually review relevant SOP documents for laboratory operations 	 Adherence to safety and SOP procedures by laboratory staff Assist with identification of fish or macroinvertebrate specimens Verify taxonomic accuracy of samples Voucher specimen tracking QC calculations on data sheets, check for completeness Ensure data are entered into AIMS II correctly 	- IDEM 1992a, 1992b, 2008, 2010a, 2010b, 2017b - Newhouse 1998a, 1998b
Laboratory Staff – Biological Community Sample Processing	- Complete hands-on training for laboratory sample processing	- Adhere to safety and SOP procedures	- IDEM 1992a, 1992b, 2008, 2010a, 2010b, 2017b

Role	Required Training or	Responsibilities	Training References
KOIE	Experience	Responsibilities	Training References
	methodology prior to laboratory sample processing activities - Annually review relevant safety procedures and relevant SOP documents for laboratory operations	 Follow Laboratory Supervisor direction while processing samples Identify fish or macroinvertebrate specimens Perform necessary calculations on data, enter field sheets 	- Newhouse 1998a, 1998b
Laboratory Supervisor – Water Chemistry or Bacteriological Sample Processing	 Annually review relevant safety procedures Annually review relevant SOP documents for field operations 	 Adherence to safety and SOP procedures by laboratory staff Completion of laboratory data sheets Check data for completeness Perform all necessary calculations on the data Ensure data are entered into the AIMS II database 	- IDEM 1997, 2002, 2008, 2010a, 2010b, 2015a, 2017a, 2017b, 2019a - Newhouse 1998a
Quality Assurance Officer	- Familiarity with QA/QC practices and methodologies - Familiarity with the Surface Water QAPP and data qualification methodologies	 Ensure adherence to QA/QC requirements of Surface Water QAPP Evaluate data collected by sampling crews for adherence to project work plan Review data collected by field sampling crews for completeness and accuracy Perform a data quality analysis of data generated by the project Assign data quality levels based on the data quality analysis Import data into the AIMS II database Ensure field sampling methodology audits are completed according to WAPB procedures 	- IDEM 2017a, 2017b - U.S. EPA 2006

B. DATA GENERATION AND ACQUISITION

B.1. Sampling Sites and Sampling Design

Sample sites will be chosen using a modified geometric site selection process as well as targeted site selection in order to obtain the necessary spatial representation of the entire watershed. Sites within this watershed will be selected based on a geometric progression of drainage areas starting with the area at the mouth of the main stem stream and then working upstream through the tributaries to the headwaters. Monitoring sites will then be established at the nearest bridge.

A more complete description of the Modified Geometric Design Steps for Watershed Characterization Studies selection process is included as Attachment 1. Sample sites will also be chosen at the bridge nearest to the pour point of each 12-digit HUC in the watershed or chosen to characterize sources for TMDL development.

Site reconnaissance activities will be conducted in-house and through physical site visits. In-house activities include preparation and review of site maps and aerial photographs. Physical site visits include verification of accessibility, safety considerations, equipment needed to properly sample the site, and property owner consultations, if required. All information will be recorded on the IDEM OWQ Site Reconnaissance Form (Attachment 2) and entered into the AIMS II database. Precise coordinates for each site will be determined during the physical site visits or at the beginning of the sampling phase of this project, using a Trimble Juno [™] SB Global Positioning System or a Trimble Juno 3D GPS (IDEM 2015), both of which have an accuracy of two to five meters. These coordinates will be entered into the AIMS II database. Digital photos will also be taken upstream and downstream of the site during reconnaissance. Digital photos will be stored on the shared drive upon return to the office in a specific folder for the Vernon Fork watershed characterization. Photos will be labeled with the site number and indication of whether the photo faces upstream or downstream.

Table 3 provides a list of the selected sampling sites with the stream name, AUID, AIMS Site Number, County Name, and the latitude and longitude of each site. Figure 2 gives a spatial overview of the site locations for this project.

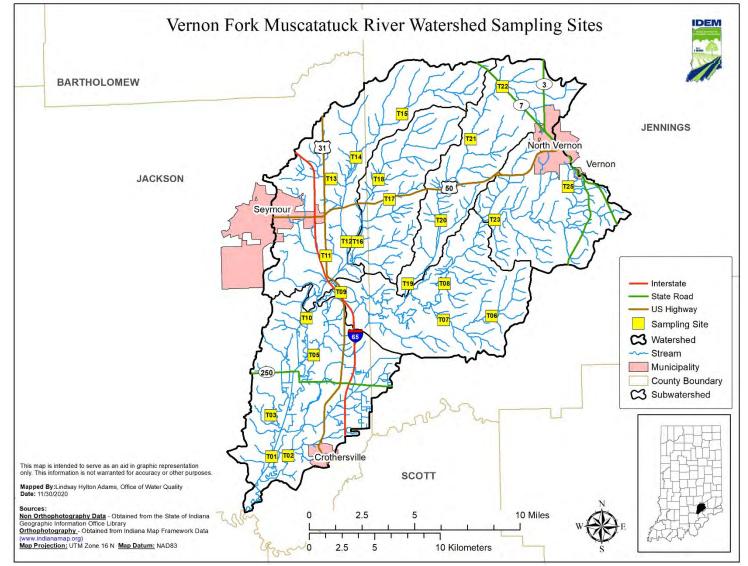


Figure 2. Vernon Fork Muscatatuck River Watershed Characterization Sampling Area

¹ Map site numbers refer to last two digits of site number from Table 3; e.g., 21T-010 is site T10 on map

Table 3. Sampling Locations for Watershed Characterization of Vernon Fork Muscatatuck River (HUC 0512020707)

Site #	AIMS Site #	Stream Name	Location	County	Latitude	Longitude	AUID
21T-001	WEM090-0003	Rider Ditch	CR 600 S	Jackson	38.79353578	-85.88407544	INW0776_T1022
21T-002	WEM-07-0010	Grassy Creek	CR 600 S	Jackson	38.79404813	-85.86931487	INW0776_T1019
21T-003	WEM090-0008	Vernon Fork Muscatatuck River	CR 400 S	Jackson	38.82206239	-85.8841949	INW0776_05
21T-005	WEM-07-0015	John McDonald Ditch	CR 125 S	Jackson	38.86303512	-85.84559017	INW0776_T1009
21T-006	WEM-07-0021	Tea Creek	CR 650 S	Jennings	38.88831496	-85.68897148	INW0775_T1003
21T-007	WEM070-0029	Tea Creek	CR 650 W	Jennings	38.88604596	-85.73130525	INW0775_T1003
21T-008	WEM070-0039	Vernon Fork Muscatatuck River	CR 500 S	Jennings	38.91091206	-85.73012452	INW0775_01
21T-009	WEM070-0020	Vernon Fork Muscatatuck River	US HWY 31	Jackson	38.90610115	-85.82106187	INW0775_05
21T-010	WEM090-0015	Vernon Fork Muscatatuck River	CR 50 N	Jackson	38.88857071	-85.85168772	INW0776_03
21T-011	WEM080-0015	Sandy Branch	US HWY 31	Jackson	38.93120545	-85.83400946	INW0774_T1005
21T-012	WEM080-0014	Mutton Creek Ditch	CR 400 N	Jackson	38.940733	-85.81562399	INW0774_02
21T-013	WEM-07-0016	Tributary of Mutton Creek	CR 700 N	Jackson	38.98394506	-85.82854896	INW0774_T1003
21T-014	WEM080-0027	Mutton Creek	CR 800 N	Jackson	38.99864464	-85.80638235	INW0774_02
21T-015	WEM080-0025	Mutton Creek	CR 300 N	Jennings	39.02796877	-85.76541025	INW0774_01
21T-016	WEM080-0013	Storm Creek Ditch	CR 400 N	Jackson	38.94055313	-85.80592841	INW0773_02
21T-017	WEM080-0005	Tributary of Richart Lake	CR 900 W	Jennings	38.96953087	-85.77740246	INW0773_T1002
21T-018	WEM-07-0014	Storm Creek	Base Road	Jennings	38.98320116	-85.78670909	INW0773_01
21T-019	WEM-07-0017	Sixmile Creek	CR 500 S	Jennings	38.91115337	-85.76232742	INW0772_06
21T-020	WEM-07-0018	Sixmile Creek	CR 200 S	Jennings	38.95438451	-85.73213824	INW0772_05
21T-021	WEM-07-0019	Sixmile Creek	CR 175 N	Jennings	39.0100959	-85.70497622	INW0772_04
21T-022	WEM-07-0020	Sixmile Creek	SR 7	Jennings	39.04575934	-85.67644156	INW0772_01A
21T-023	WEM070-0036	Vernon Fork Muscatatuck River	CR 400 W	Jennings	38.95429488	-85.68498536	INW0771_02
21T-025	WEM070-0001	Vernon Fork Muscatatuck River	CR 60 S	Jennings	38.97635892	-85.62004239	INW0771_03

²21T-### gray shading of the Site # denotes that these are the selected pour points for this project (7 sites).

B.2. Sampling Methods and Sample Handling

1. Water Chemistry Sampling

One team of two staff will collect water chemistry grab samples, record water chemistry field measurements, and record physical site descriptions on the IDEM OWQ Stream Sampling Field Data Sheet (Attachment 3). All water chemistry sampling will adhere to the Water Chemistry Field Sampling Procedures (IDEM 2020c). Samples will be preserved as specified below in Table 4, and all applicable holding times will be followed.

Parameter	Preservative	Holding Times
Alkalinity (as CaCO ₃)	lce	14 days
Solids, Total Residue (TS)	lce	7 days
Solids, Nonfilterable Residue (TSS)	lce	7 days
Solids, Filterable Residue (TDS)	lce	7 days
Sulfate (Dissolved)	lce	28 days
Chloride	lce	28 days
Hardness (as CaCO ₃)	HNO ₃	6 months
Nitrogen, as Ammonia	H ₂ SO ₄	28 days
Nitrogen, Kjeldahl (TKN)	H ₂ SO ₄	28 days
Nitrogen, Nitrate-nitrite	H ₂ SO ₄	28 days
Phosphorous (Applicable to all)	H ₂ SO ₄	28 days
Total Organic Carbon (TOC)	H ₂ SO ₄	28 days
Chemical Oxygen Demand	H ₂ SO ₄	28 days
Calcium	HNO ₃	6 months
Magnesium	HNO ₃	6 months

Table 4. Water Chemistry Sample Handling

2. Bacteriological Sampling

Bacteriological sampling will be conducted by one team consisting of one or two staff. Samples will be processed in an IDEM fixed or mobile *E. coli* laboratory equipped with all materials and equipment necessary to perform the Colilert® Test Method (Standard Method 9223B), per Project Organization and Schedule (above) (IDEM 2019a). The expected time frame for bacteriological sampling will be April through October of 2021. Staff will collect the samples in a 120 mL presterilized wide-mouth container from the center of flow, if the stream is wadeable, or from the shoreline using a pole sampler, if the stream is not wadeable. This is subject to field staff determination based on available PPE, turbidity, and other factors. However, streams waist deep or shallower are generally considered wadeable. All samples will be consistently labeled, cooled, and held at a temperature less than 10°C during transport. Samples will be preserved with 0.0008% Na₂S₂O₃ for CL₂. While still in the field and at the end of each sampling run, water samples will be processed and analyzed for *E. coli* within the six-hour holding time for collection and transportation, and the two-hour holding time for sample processing (IDEM 2019a).

The IDEM mobile *E. coli* laboratory facilitates *E. coli* testing by eliminating the necessity to transport samples to distant contract laboratories within a six-hour holding time. The IDEM mobile *E. coli* laboratory (van) provides a work space containing sample storage; supplies for Colilert® Quanti-tray testing; and all equipment needed for collecting, preparing, incubating, and analyzing results in the same manner as the IDEM fixed *E. coli* laboratory. All supplies will be obtained from IDEXX Laboratories, Inc., Westbrook, Maine.

3. Fish Community Measurements

The fish community sampling will be completed by teams of three to five staff. Sampling will be performed using various standardized electrofishing methodologies dependent upon the stream size and site accessibility. Fish assemblage assessments will be performed in a sampling reach of 15 times the average wetted width, with a minimum reach of 50 meters and a maximum reach of 500 meters (IDEM 2018a). An attempt will be made to sample all habitat types available within the sample reach to ensure adequate representation of the fish community present at the time of the sampling event. The list of possible electrofishers utilized include: the Smith-Root LR-24, Smith-Root LR-20B, or Midwest Lake Electrofishing System (MLES) Infinity XStream backpack electrofisher; the Smith-Root model 1.5KVA electrofishing system; the Smith-Root model 2.5 Generator Powered Pulsator electrofisher, with RCB-6B junction box and rat-tail cathode cable; or MLES Infinity Control Box with MLES junction box and rattail cathode cable, assembled in a canoe (if parts of the stream are not wadeable, the system may require the use of a dropper boom array outfitted in a canoe or possibly a 12 foot Loweline[™] boat); or for nonwadeable sites, the Smith-Root Type VI-A or MLES Infinity Control Box electrofisher assembled in a 16-foot boat (IDEM 2018a).

Sample collections during high flow or turbid conditions will be avoided due to 1) low collection rates which result in nonrepresentative samples and 2) safety considerations for the sampling team. Sample collection during late autumn will be avoided due to the cooling of water temperature, which may affect the responsiveness of some species to the electrical field. This lack of responsiveness can result in samples which are not representative of the streams' fish assemblage (IDEM 2018a).

Fish will be collected using dip nets with fiberglass handles and netting of 1/8 inch mesh bag. Fish collected in the sampling reach will be sorted by species into baskets or

buckets. Young-of-the-year fish less than 20 millimeters (mm) total length will not be retained in the community sample (IDEM 2018a).

For each field taxonomist (generally the crew leader), a complete set of fish vouchers will be retained for each new or different species encountered during the summer sampling season. Vouchers may consist of either preserved specimens or digital images. Prior to processing fish specimens and completion of the IDEM OWQ Fish Collection Data Sheet (Attachment 4), one to two individuals per new species encountered may be preserved in 3.7% formaldehyde solution to serve as representative fish vouchers. If the fish specimens can be positively identified and the individuals for preservation are small enough to fit in a 2000 mL jar. If, however, the specimens are too large to preserve, a photo of key characteristics (e.g., fin shape, size, body coloration) will be taken for later examination (IDEM 2018a). Also, prior to sampling, 10% of the sites will be randomly selected for revisiting, and a few representative individuals of all species found at the site will be preserved or photographed to serve as vouchers. Taxonomic characteristics for possible species encountered in the basin of interest will be reviewed prior to field work.

Fish specimens should also be preserved if positive identification cannot be made in the field (e.g., those co-occurring like the Striped and Common Shiners or are difficult to identify when immature); individuals which appear to be hybrids or have unusual anomalies; or dead specimens which are taxonomically valuable for undescribed taxa (e.g., Red Shiner or Jade Darter); life history studies; or research projects (IDEM 2018a).

Data will be recorded for nonpreserved fish on the IDEM OWQ Fish Collection Data Sheet (Attachment 4) consisting of the following: number of individuals; minimum and maximum total length in millimeters (mm); mass weight in grams (g); and number of individuals with deformities, eroded fins, lesions, tumors, and other anomalies (DELTs). Once the data are recorded, specimens will be released within the sampling reach from which they were collected, when possible. Data will be recorded for preserved fish specimens following taxonomic identification in the laboratory (IDEM 2018a).

4. Macroinvertebrate Community Measurements

The macroinvertebrate community sampling may be conducted immediately following the fish community sampling event or on a different date by crews of two to three staff. Samples will be collected using a modification of the U.S. EPA Rapid Bioassessment Protocol MHAB approach using a D-frame dip net with 500 µm mesh (Plafkin et al. 1989; Klemm et al. 1990; Barbour et al. U.S. EPA 1999; IDEM 2019b). The IDEM MHAB approach (IDEM 2019b) is composed of a 1-minute "kick" sample within a riffle or run (collected by disturbing one square meter of stream bottom substrate in a riffle or run habitat and collecting the dislodged macroinvertebrates within the dip net) and a 50-meter "sweep" sample of all available habitats (collected by disturbing habitat such as

emergent vegetation, root wads, coarse particulate organic matter, depositional zones, logs, and sticks; and collecting the dislodged macroinvertebrates within the dip net). The 50-meter length of riparian corridor sampled at each site will be defined using a rangefinder or tape measure. If the stream is too deep to wade, a boat will be used to sample the 50 meter zone along the shoreline with the best available habitat. In addition, a 1-minute kick sample will not be collected if the stream is too deep to wade and no available shoreline to collect the sample exists. The 1-minute "kick" and 50-meter "sweep" samples are combined in a bucket of water.

The combined sample will be elutriated through a U.S. Standard Number 35 (500 μ m) sieve a minimum of five times so all rocks, gravel, sand, and large pieces of organic debris are removed from the sample. The remaining sample is then transferred from the sieve to a white plastic tray. The collector, while still on-site, will conduct a 15-minute pick of macroinvertebrates at a single organism rate endeavoring to pick for maximum organism diversity, and relative abundance through turning and examining the entire sample in the tray. The resulting picked sample will be preserved in 80% isopropyl alcohol; returned to the laboratory for identification at the lowest practical taxonomic level (usually genus or species level, if possible); and evaluated using the MHAB macroinvertebrate IBI. Before leaving the site, an IDEM OWQ Macroinvertebrate Header Form (IDEM 2019c, Attachment 5) will be completed for the sample.

5. Habitat Assessments

Habitat assessments will be completed immediately following macroinvertebrate and fish community sample collections at each site using a slightly modified version of the Ohio Environmental Protection Agency (OHEPA) QHEI, 2006 edition (Rankin 1995; OHEPA 2006). A separate IDEM OWQ Biological QHEI (Attachment 6) must be completed for each sample type, since the sampling reach length may differ (i.e., 50 meters for macroinvertebrates and between 50 and 500 meters for fish). IDEM 2019d describes the method used in completing the QHEI.

6. Field Parameter Measurements

Dissolved oxygen (DO), pH, water temperature, specific conductance, and DO percent saturation will be measured with a datasonde, during each sampling event regardless of the sample type collected. Measurement procedures and operation of the datasonde shall be performed according to the manufacturers' manuals (YSI 2017; YSI 2018) and Sections 2.0 and 4.0 of the Water Chemistry Field Sampling Procedures TSOP (IDEM 2020c). Turbidity will be measured with a Hach[™] turbidity kit and the meter number written in the comments under the field parameter measurements. If a Hach[™] turbidity kit is not available, the datasonde measurement for turbidity will be recorded and noted in the comments. During each sampling run, field observations from each site and ambient weather conditions at the time of sampling will be noted and documented on IDEM Stream Sampling Field Data Sheets (Attachment 3).

B.3. Analytical Methods

1. Laboratory Procedure for *E. coli* Measurements:

All waters sampled will be processed and analyzed for *E. coli* in the IDEM *E. coli* mobile laboratory or IDEM Shadeland laboratory, which is equipped with required materials and equipment necessary for the IdexxTM Colilert Test. The Colilert Test is a multiple-tube enzyme substrate standard method SM-9223B Enzyme Substrate Coliform Test Method (Clesceri et al., 2012). The *E. coli* test method and quantification limit are identified in Table 5.

2. Nutrient and General Chemistry Parameters Measurements:

Analyses of nutrient and general chemistry parameters will be performed at TestAmerica Laboratories, in accordance with preapproved test methods and within the allotted time frames. The nutrient and general chemistry parameters, and respective test methods and quantification limits are identified below in Table 5.

Parameter	Method	Limits of Quantification	Units	
E. coli	SM-9223B Enzyme Substrate Test	1.0	*MPN/100 mL	
Alkalinity (as CaCO ₃)	EPA 310.2	10.0	mg/L	
Solids, Total Residue (TS)	SM 2540B	10.0	mg/L	
Solids, Nonfilterable Residue (TSS)	SM 2540D	1.0	mg/L	
Solids, Filterable Residue (TDS)	SM 2540C	10.0	mg/L	
Sulfate (Dissolved)	EPA 300.0	0.05	mg/L	
Chloride	EPA 300.0	0.06	mg/L	
Hardness (as CaCO ₃)	SM 2340B	1.41	mg/L	
Nitrogen, as Ammonia	SM 4500NH3-D	0.10	mg/L	
Nitrogen, Kjeldahl (TKN)	SM4500N(Org)-B	0.30	mg/L	
Nitrogen, Nitrate-nitrite	SM4500NO3-F	0.10	mg/L	
Phosphorous (Applicable to all)	EPA 365.1	0.05	mg/L	
Total Organic Carbon (TOC)	SM 5310C	1.0	mg/L	
Chemical Oxygen Demand	EPA 410.4	10.0	mg/L	
Calcium	EPA 200.7	40	mg/L	
Magnesium	EPA 200.7	100	mg/L	

Table 5. *E.coli*, Nutrient, and General Chemistry Parameters Test Methods⁴

* Clesceri et al., 2012. 1 MPN = 1 CFU/100 mL ⁴ Methods accredited by EPA (State of Illinois, 2018)

3. Field Parameters Measurements:

The field measurements of DO, temperature, pH, conductivity, and turbidity will be taken each time a sample is collected. The field parameters, respective test methods, and sensitivity limits are identified in Table 6. The datasonde should be located in the center of flow during sampling. The field staff member collecting the sample should wait for all readings to stabilize before recording the readings on the IDEM Stream Sampling Field Data Sheet (Attachment 3).

Table 6. Field Parar	neters Test Methods
----------------------	---------------------

Parameter	Method	Sensitivity Limit	Units
DO (Datasonde optical)	ASTM D888-09(C)	0.01	mg/L
DO (Membrane Probe)	SM4500-OG ⁵	0.03	mg/L
DO % Saturation (Datasonde optical)	ASTM D888-09(C)	0.01	%
Turbidity (Datasonde)	SM2130B	0.02	NTU
Turbidity (Hach Turbidimeter)	EPA 180.1 ⁵	0.01	NTU
Specific Conductance (Datasonde)	SM 2510B	1.0	µS/cm
Temperature (Datasonde)	SM 2550B(2)	0.1	°C
Temperature (field meter)	SM 2550B(2) ⁵	0.1	°C
pH (Datasonde)	EPA 150.2	0.01	SU
pH (field meter)	SM 4500-HB ⁵	0.01	SU

⁵ Method used for Field Calibration Verification

B.4. Quality Control and Custody Requirements

Quality assurance protocols will follow part B5 of the Surface Water QAPP (IDEM 2017a).

1. Field Instrument Testing and Calibrations

The datasonde will be calibrated prior to each week's sampling (IDEM 2002). Calibration results and drift values will be recorded, maintained, stored, and archived in log books located in the calibration laboratories at the Shadeland facility. The drift value is the difference between two successive calibrations. Field parameter calibrations will conform to the procedures as described in the instrument users' manuals (YSI 2017; YSI 2018). The DO component of the calibration procedure will be conducted using the air calibration method (IDEM 2002, page 74). The unit will be field checked for accuracy once during the week by comparison with a YSI EcoSense DO200A DO Probe (IDEM 2020c, page 24), Hach[™] turbidity, and an Oaktown Series 5 pH meter. Weekly calibration verification results will be recorded on the field calibrations portion of the IDEM OWQ Stream Sampling Field Data Sheets (Attachment 3) and entered into the AIMS II database. At field sites where the DO concentration is 4.0 mg/L or less, the YSI EcoSense DO meter will be used.

2. Field Measurement Data

In-situ water chemistry field data will be collected in the field using calibrated or standardized equipment and recorded on the IDEM OWQ Stream Sampling Field Data Sheet (Attachment 3). The same staff member will collect and record the data. Calculations may be done in the field or later at the office. Analytical results, which have limited QC checks, will be included in this category. Detection limits and ranges have been set for each analysis (Table 6). Quality control checks (such as duplicate measurements, measurements of a secondary standard, or measurements using a different test method or instrument) performed on field or laboratory data, are usable for estimating precision, accuracy, and completeness for the project, as described in the Surface Water QAPP (IDEM 2017a Section C1.1 on page 176 and Section A7.2 page 56).

3. Bacteriological Measurement Data

Analytical results, from an IDEM fixed or mobile *E. coli* laboratory, include QC check sample results from which precision, accuracy, and completeness can be determined for each batch of samples. Raw data will be archived by analytical batch for easy retrieval and review. Chain of custody procedures will be followed, including: time of collection, time of setup, time of reading the results, and time and method of disposal (IDEM 2002). The field staff member who collected the samples signs the chain of custody form upon delivery of samples to the laboratory. Any method deviations will be thoroughly documented in the raw data. All QA/QC samples will be tested according to the following guidelines:

Field Duplicate:	Field Duplicates will be collected at a frequency of one per batch or at least one for every 20 samples collected ($\geq 5\%$).
Field Blank:	Field Blanks will be collected at a frequency of one per batch or at least one for every 20 samples collected (≥ 5%).
Laboratory Blank:	Laboratory Blanks (sterile laboratory water blanks) will be tested at a frequency of one per day.
Positive Control:	Each lot of media will be tested for performance using <i>E. coli</i> bacterial cultures.
Negative Controls:	Each lot of media will be tested for performance using non- <i>E. coli</i> and noncoliform bacterial cultures.

4. Water Chemistry Measurement Data

Sample bottles and preservatives will be certified for purity by the manufacturer. Damaged sample bottles and preservatives are not used, and preservatives are not used past their stated expiration date. The purity of sample bottles and preservatives is checked via field blanks. Sample collection containers for each parameter, preservative, and holding time (Table 4) will adhere to U.S. EPA requirements. Field duplicates and matrix spike/matrix spike duplicates shall be collected at the rate of one per sample analysis set or one per every 20 samples, whichever is greater. Additionally, field blank samples will be taken at a rate of one set per sample analysis set or one per every 20 samples, whichever is greater. A chain of custody (COC) form created by the AIMS II database IDEM OWQ COC (Attachment 7) and an IDEM Water Sample Analysis Request form (Attachment 8) accompany each sample set through the analytical process. The field staff member who collected the samples signs the COC form upon delivery of samples to the laboratory. Additionally, a Test America COC form (Attachment 9) will accompany samples sent to the lab. Shipping labels will be created using Test America account numbers.

5. Fish Community Measurement Data

Fish community sampling revisits will be performed at a rate of 10 percent of the total fish community sites sampled, in this case, three in the watershed (IDEM 2018a). Revisit sampling will be performed with at least two weeks of recovery between the initial and revisit sampling events. The fish community revisit sampling and habitat assessment will be performed with either a partial or complete change in field team members (IDEM 2018a). The resulting IBI and QHEI total score between the initial visit and the revisit will be used to evaluate precision, as described in the QAPP for Biological Community and Habitat Measurements (IDEM 2019e). The IDEM OWQ COC form (Attachment 7) is used to track samples from the field to the laboratory. A field staff member from the crew signs the COC form after sampling is complete, and the samples and COC form are relinquished to a lab custodian to verify the sampling information is accurate. All raw data are: 1) checked for completeness; 2) utilized to calculate derived data (e.g., total weight of all specimens of a taxon), which is entered into the AIMS II database; and 3) checked again for data entry errors.

6. Macroinvertebrate Community Measurement Data

Duplicate macroinvertebrate field samples will be collected at a rate of 10 percent of the total macroinvertebrate community sites sampled, in this case, three in the watershed. The macroinvertebrate community duplicate sample and corresponding habitat assessment will be performed by the same team member who performed the original sample, immediately after the initial sample is collected. The 50 meter section of stream and riffle area utilized for the duplicate sample are different from those used for the original sample but should feature as similar habitat types and availability as possible. This will result in a precision evaluation based on a 10% duplicate of samples collected, as described in the QAPP for Biological Community and Habitat Measurements (IDEM 2019e).

The IDEM OWQ COC form (Attachment 7) is used to track samples from the field to the laboratory. A field staff member from the crew completes the OWQ COC form after sampling is complete. After completion of weekly field sampling activities, the OWQ COC form is used by the laboratory custodian to check in samples prior to long-term

storage. Laboratory identifications and QA/QC of taxonomic work is maintained by the laboratory supervisor of the Probabilistic Monitoring Section of IDEM.

C. ASSESSMENT AND OVERSIGHT

C.1. Field and laboratory performance and system audits

Performance and system audits will be conducted to ensure good quality data. The field and laboratory performance checks include: precision measurements by relative percent difference of field and laboratory duplicate (IDEM 2017a, pp. 56, 61-63); accuracy measurements by percent of recovery of matrix spike and matrix spike duplicate samples analyzed in the laboratory (IDEM 2017a, pp. 58, 61-63); and completeness measurements by the percent of planned samples actually collected, analyzed, reported, and usable for the project (IDEM 2017a, page 58). Fish taxonomic identifications made by IDEM staff in the laboratory may be verified by regionally recognized non-IDEM freshwater fish taxonomists. Ten percent of macroinvertebrate samples (the initial samples taken at sites where duplicate samples were collected) will be sent off to Rithron Associates, Inc. (Missoula, MT) for verification by an outside taxonomist (IDEM 2019c).

Laboratory audits are performed at the beginning of a laboratory contract and at least once a year during the contract. The audit includes any or all of the operational quality control elements of the laboratory's quality assurance system. All applicable elements of this QAPP and the laboratory contract requirements are addressed including, but not limited to, sampling handling, sample analysis, record keeping, preventative maintenance, proficiency testing, personnel requirements, training, and workload. (IDEM 2017a, pp. 177—178).

Field audits will be conducted every other year by staff of the IDEM WAPB to ensure sampling activities adhere to approved SOPs. Audits will be systematically conducted by WAPB staff to include all WAPB personnel engaging in field sampling activities. WAPB field staff involved with sample collection and preparation will be evaluated by staff trained in the associated sampling SOPs and in the processes related to conducting an audit. Staff will produce an evaluation report documenting each audit for review by those field staff audited as well as WAPB management. Corrective actions will be communicated to, and implemented by, field staff as a result of the audit process.

Quality assurance reports are submitted by the QA officer upon completion of the data validation of a dataset, to the program manager or WAPB branch chief. The QA manager, relevant section chief, project manager, any technical staff working on corrective actions, and quality assurance staff receive copies of the progress reports when new developments arise. The section chief, project officer, or QA officer is responsible for working with relevant staff members to develop corrective actions and notifying the QA manager of corrective action progress. Depending on the associated corrective actions, either the section chief or the QA officer approves the final corrective action (IDEM 2017a, page 179).

C.2. Data Quality Assessment Levels

The samples and various types of data collected by this program will be intended to meet the quality assurance criteria and rated DQA Level 3, as described in the Surface Water QAPP (IDEM 2017a, page 182).

D. DATA VALIDATION AND USABILITY

Quality assurance reports to management, and data validation and usability are also important components of Indiana's Surface Water QAPP which ensures good quality data for this project. Quality assurance reports are submitted by the QA officer upon completion of the data validation of a dataset to the program manager or WAPB branch chief. This is done to ensure problems arising during the sampling and analysis phases of the project are investigated and corrected (IDEM 2017a, page 179). As described in Section D of the Surface Water QAPP (IDEM 2017a), data are reduced (converted from raw analytical data into final results in proper reporting units); validated (qualified based on the performance of field and laboratory QC measures incorporated into the sampling and analysis procedures); and reported (described so as to completely document the calibration, analysis, QC measures, and calculations). These steps allow users to assess the data ensuring the project DQOs have been met.

D.1. Quality Assurance, Data Qualifiers, and Flags

The various data qualifiers and flags will be used for quality assurance and validation of the data and are found on pages 184-185 of the Surface Water QAPP (IDEM 2017a).

D.2. Data Usability

The environmental data collected and its usability will be qualified per each lab or field result obtained and classified into one or more of the four categories: Acceptable Data, Enforcement Capable Results, Estimated Data, and Rejected Data as described on page 184 of the Surface Water QAPP (IDEM 2017a).

D.3. Information, Data, and Reports

Data collected in 2020-2021 will be recorded in the AIMS II database and presented in two compilation summaries. The first summary will be a general compilation of the watershed field and water chemistry data prepared for use in the 2022 Indiana Integrated Report. The second summary will be in database report format containing biological results and habitat evaluations, which will be produced for inclusion in the Integrated Report as well as individual site folders. All site folders are maintained at the WAPB facility. All data and reports will be made available to public and private entities, which may find the data useful for municipal, industrial, agricultural, and recreational decision making processes (TMDL, NPDES permit modeling, watershed restoration projects, water quality criteria refinement, etc.,). This work plan will be uploaded into the virtual file cabinet, all field sheets will be stored in the AIMS II database, and results will be uploaded to U.S. EPA's Water Quality

Portal via the Water Quality Exchange (formerly Storet), allowing the data to be shared with U.S. EPA and others. The Water Quality Exchange is a framework which allows states, tribes, and other data partners to submit and share water quality monitoring data via the web to the Water Quality Portal.

D.4. Laboratory and Estimated Cost

Laboratory analysis and data reporting for this project will comply with the Surface Water QAPP (IDEM 2017a); Request for Proposals 16-074 (see IDEM 2016); the IDEM QMP (IDEM 2018b); and TestAmerica contract SCM # 19855. Analytical tests on general chemistry and nutrient parameters outlined in Table 5 will be performed by TestAmerica Laboratories in University Park, Illinois with a total estimated cost of \$34,100. IDEXX Laboratories, Inc., Westbrook, Maine supplies the bacteriological sampling supplies, with a total estimated cost of \$1,400. Bacteriological samples will be tested and analyzed by IDEM staff. All fish and macroinvertebrate samples will be verified by Rhithron Associates, Inc. in Missoula, Montana with a total estimated cost of \$660. The anticipated total budget for laboratory costs for the project is \$37,260.

D.5. Reference Manuals and Personnel Safety

Role	Required Training or Experience	Training References	Training Notes
All Staff that	- Basic First Aid and	- A minimum of 4 hours	-Staff lacking 4 hours of in-service
Participate in Field	Cardio-Pulmonary	of in-service training	training or appropriate certification
Activities	Resuscitation (CPR)	provided by WAPB (IDEM 2010c)	will be accompanied in the field at all times by WAP,200B staff meeting Health and Safety Training requirements
	- Personal Protective Equipment (PPE) Policy	- IDEM 2008	
			- When working on boundary waters as defined by Indiana Code (IC) 14-8-2-27 or between sunset and sunrise on any waters of the state, all personnel in the
	- Personal Flotation	- February 29, 2000	watercraft must wear a high
	Devices	WAPB internal memorandum regarding use of approved Personal Flotation Devices	intensity whistle and Safety of Life at Sea (SOLAS) certified strobe light.

Table 7. Personnel Safety and Reference Manuals

REFERENCES

- *Document may be inspected at the Watershed Assessment and Planning Branch office, located at 2525 North Shadeland Avenue Suite 100, Indianapolis, Indiana.
- U.S. EPA 2002. <u>Guidance for Quality Assurance Project Plans</u> EPA QA/G-5, EPA/240R-02/009 U.S. EPA, Office of Environmental Information, Washington D.C.
- U.S. EPA 2006. <u>Guidance on Systematic Planning Using the Data Quality Objectives Process</u>. EPA QA/G-4. EPA/240/B-06/001. U.S. EPA, Office of Environmental Information, Washington D.C.
- U.S. EPA 1999. Barbour, M.T., J. Gerritsen, B.D. Snyder and J.B. Stribling. 1999. <u>Rapid</u> <u>Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic</u> <u>Macroinvertebrates and Fish, Second Edition</u>. EPA/841/B-99/002. U.S. EPA, Office of Water, Washington, D.C.
- Indiana Administrative Code, <u>Title 327 Water Pollution Control Division, Article 2. Water</u> <u>Quality Standards</u>
- IDEM 1992a, revision 1. Section 3, Quality Assurance Project Plan, Development of Biological Criteria (Fish) for the Ecoregions of Indiana. Biological Studies Section, Surveillance and Standards Branch, Office of Water Management, IDEM, Indianapolis, Indiana.*
- IDEM 1992b, revision 1. Section 2, Biological Studies Section Hazards Communications Manual (List of Contents). Biological Studies Section, Surveillance and Standards Branch, OWQ, IDEM, Indianapolis, Indiana.*
- IDEM 1997. Water Quality Surveys Section Laboratory and Field Hazard Communication Plan Supplement. IDEM 032/02/018/1998, Revised October 1998. Assessment Branch, IDEM, Indianapolis, Indiana.*
- IDEM 2002. <u>Water Quality Surveys Section Field Procedure Manual</u>, Assessment Branch, IDEM, Indianapolis, Indiana. IDEM.
- IDEM 2008. IDEM <u>Personal Protective Equipment Policy</u>, revised May 1 2008. A-059-OEA-08-P-R0. IDEM, Indianapolis, Indiana.
- IDEM 2010a. IDEM Health and Safety Training Policy, revised October 1 2010. A-030-OEA-10-P-R2. IDEM, Indianapolis, Indiana.
- IDEM 2010b. IDEM <u>Injury and Illness Resulting from Occupational Exposure Policy</u>, revised February 21, 2016. A-034-AW-16-P-R3. IDEM, Indianapolis, Indiana.
- IDEM 2010c. <u>Change in status of Water Assessment Branch staff in accordance with the</u> <u>Agency training policy</u>. State Form 4336. IDEM, Indianapolis, Indiana.

REFERENCES (cont.)

- IDEM 2015. <u>Global Positioning System (GPS) Data Creation Technical Standard Operating</u> <u>Procedure</u>. B-001-OWQ-WAP-XXX-15-T-R0. OWQ, Watershed Assessment and Planning Branch. Indianapolis, Indiana.
- IDEM 2016. "State of Indiana Request for Proposals 16-74, Solicitation for: Laboratory Analytical Services", Indiana Department of Administration, Indianapolis, IN, February 26, 2016.*
- IDEM 2017a. <u>Quality Assurance Project Plan (QAPP) for Indiana Surface Waters</u>, (Rev. 4, Mar. 2017). B-001-OWQ-WAP-XX-17-Q-R4. OWQ, Watershed Assessment and Planning Branch. Indianapolis, Indiana.
- IDEM 2017b. AIMS II Database User Guide. Watershed Assessment and Planning Branch. Office of Water Quality, Indiana Department of Environmental Management. Indianapolis, Indiana.*
- IDEM 2018a. <u>Fish Community Field Collection Procedures</u>. B-009-OWQ-WAP-XXX-18-T-R0. OWQ, Watershed Assessment and Planning Branch. Indianapolis, Indiana.
- IDEM 2018b. <u>IDEM Quality Management Plan 2018</u>. IDEM, Indiana Government Center North, 100 N. Senate Ave., Indianapolis, Indiana, 46204.
- IDEM 2019a. <u>*E. coli* Field Sampling and Analysis</u>. B-013-OWQ-WAP-XXX-19-T-R0. OWQ, Watershed Assessment and Planning Branch. Indianapolis, Indiana.
- IDEM 2019b. <u>Multihabitat (MHAB) Macroinvertebrate Collection Procedure.</u> B-011-OWQ-WAP-XXX-19-T-R0. OWQ, Watershed Assessment and Planning Branch. Indianapolis, Indiana.
- IDEM 2019c. Procedures for Completing the Macroinvertebrate Header Field Data Sheet. B-010-OWQ-WAP-XXX-19-T-R0. Office of Water Quality, Watershed Assessment and Planning Branch. Indianapolis, Indiana.
- IDEM 2019d. <u>Procedures for Completing the Qualitative Habitat Evaluation Index.</u> B-003-OWQ-WAP-XX-19-T-R1. OWQ, Watershed Assessment and Planning Branch. Indianapolis, Indiana.
- IDEM 2019e. Quality Assurance Project Plan (QAPP) for Biological Community and Habitat Measurements (Draft). Office of Water Quality, Watershed Assessment and Planning Branch. Indianapolis, Indiana.
- IDEM 2020a. <u>Appendix L: Listing Tables Including Indiana's Finalized 303(d) List of Impaired</u> <u>Waters (Category 5) for 2020 Listing Tables</u>. OWQ, Watershed Assessment and Planning Branch. Indianapolis, Indiana.
- IDEM 2020b. <u>Appendix G: IDEM's 2020 Consolidated Assessment and Listing Methodology.</u> OWQ, Watershed Assessment and Planning Branch. Indianapolis, Indiana.

REFERENCES (cont.)

- IDEM 2020c. <u>Water Chemistry Field Sampling Procedures</u>. B-015-OWQ-WAP-XXX-20-T-R0. Office of Water Quality, Watershed Assessment and Planning Branch. Indianapolis, Indiana.
- OHEPA. 1999. <u>Ohio EPA Five-Year Surface Water Monitoring Strategy: 2000 2004</u>. Ohio EPA Technical Bulletin MAS/1999-7-2. Division of Surface Water, Lazarus Government Center, 211 S. Front Street, Columbus, Ohio 43215. Page 70.
- OHEPA. 2006. <u>Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat</u> <u>Evaluation Index (QHEI)</u>. OHIO EPA Technical Bulletin EAS/2006-06-1. Revised by the Midwest Biodiversity Institute for State of Ohio Environmental Protection Agency, Division of Surface Water, Ecological Assessment Section, Groveport, Ohio.
- OHEPA. 2012. 2011 Biological and Water Quality Study of Mill Creek and Tributaries, Hamilton County, Ohio. Technical Report MBI/2012-6-10. MSD Project Number 10180900. Prepared for: Metropolitan Sewer District of Greater Cincinnati, 1081 Woodrow Street, Cincinnati, OH 45204. Submitted by: Midwest Biodiversity Institute, P.O. Box 21561, Columbus, Ohio 43221-0561. Pages 40-1.
- State of Illinois Environmental Protection Agency. July 2018. Environmental Laboratory Accreditation.
- Clesceri, L.S., Greenburg, A.E., Eaton, A.D., 2012. SM-Standards Methods for the Examination of Water and Wastewater 22nd Edition. American Public Health Association.
- Klemm, D.J., P.A. Lewis, F. Fulk and J.M. Lazorchak. 1990. <u>Macroinvertebrate Field and</u> <u>Laboratory Methods for Evaluating the Biological Integrity of Surface Waters</u>. EPA/600/4-90/030. Environmental Monitoring Systems Laboratory, Monitoring Systems and Quality Assurance, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio.
- Newhouse, S.A. 1998a. Field and laboratory operating procedures for use, handling and storage of chemicals in the laboratory. IDEM/32/03/007/1998. Biological Studies Section, Assessment Branch, Office of Water Management, IDEM, Indianapolis, Indiana.*
- Newhouse, S.A. 1998b. Field and laboratory operating procedures for use, handling and storage of solutions containing formaldehyde. IDEM/32/03/006/1998. Biological Studies Section, Assessment Branch, Office of Water Management, IDEM, Indianapolis, Indiana.*
- Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and R.M. Hughes. 1989. <u>Rapid</u> <u>Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and</u> <u>Fish</u>. EPA/444/4-89/001. Assessment and Watershed Protection Division, U.S. Environmental Protection Agency, Washington, D.C.

REFERENCES (cont.)

- Rankin, E.T. 1995. Habitat Indices in Water Resource Quality Assessments. pp. 181-208, Chapter 13, Biological Assessment and Criteria: Tools for the Risk-based Planning and Decision Making, edited by Wayne S. Davis and Thomas P. Simon, Lewis Publishers, Boca Raton, Florida.*
- Simon, T.P. and R.L. Dufour. 2005. <u>Guide to Appropriate Metric Selection for Calculating the</u> <u>Index of Biotic Integrity (IBI) for Indiana Large and Great Rivers, Inland Lakes, and Great</u> <u>Lakes nearshore</u>. U.S. Department of the Interior, Fish and Wildlife Service, Bloomington Field Office, Bloomington, Indiana

YSI Incorporated. 2012, Operations Manual EcoSense DO200A, Yellow Springs, Ohio.

YSI Incorporated. 2017, revision g. EXO User Manual, Yellow Springs, Ohio.

YSI Incorporated. 2018, revision f. ProDIGITAL User Manual, Yellow Springs, Ohio.

DISTRIBUTION LIST

Electronic Distribution Only

Organization

<u>Name</u>	<u>Organization</u>
Kristen Arnold	IDEM/OWQ/WAPB/Technical and Logistical Services Section Chief
Jody Arthur	IDEM/OWQ/WAPB/Technical E7
James Bailey	IDEM/OPS/Recycling Education and Quality Assurance/Quality
	Assurance
Tim Beckman	IDEM/OWQ/WAPB/Targeted Monitoring Section
Timothy Bowren	IDEM/OWQ/WAPB/Technical and Logistical Services Section
Josh Brosmer	IDEM/OWQ/WAPB/Watershed Planning and Restoration Section
Angie Brown	IDEM/OWQ/WAPB/Watershed Planning and Restoration Section
	Chief
Kevin Gaston	IDEM/OWQ/WAPB/Probabilistic Monitoring Section
Lindsay Hylton Adams	IDEM/OWQ/WAPB/Watershed Planning and Restoration Section
Paul McMurray	IDEM/OWQ/WAPB/Probabilistic Monitoring Section
Caleb Rennaker	IDEM/OWQ/WAPB/Watershed Planning and Restoration Section
Marylou Renshaw	IDEM/OWQ/WAPB/Branch Chief
Stacey Sobat	IDEM/OWQ/WAPB/Probabilistic Monitoring Section Chief
Cyndi Wagner	IDEM/OWQ/WAPB/Targeted Monitoring Section Chief

ATTACHMENTS

Attachment 1: Modified Geometric Design Steps for Watershed Characterization Studies Introduction

The Modified Geometric Site Selection process is employed within watersheds which correspond to the 12-14-digit HUC scale in order to fulfill multiple water quality management objectives, not just the conventional focus on status assessment. The design is employed at a spatial scale which is representative of the scale at which watershed management is generally being conducted.

Sites within the watershed are allocated based on a geometric progression of drainage areas starting with the area at the mouth of the main stem river or stream (pour point) and working "upwards" through the various tributaries to the primary headwaters. This approach allocates sampling sites in a semirandom fashion and according to the stratification of available stream and river sizes based on drainage area. The Geometric Site Selection process is then modified by adding a targeted selection of additional sampling sites used to focus on localized management issues such as point source discharges, habitat modifications, and other potential impacts within a watershed. These sites are then "snapped to bridges" to facilitate safe and easy access to the stream. This design also fosters data analysis which takes into consideration overlying natural and human caused influences within the streams of a watershed. The design has been particularly useful for watersheds targeted for TMDL development.

Selection Process

In ArcGIS, download from NHD Plus site (<u>http://www.horizon-systems.com/nhdplus/HSC-wthMS.php</u>) the following files for Region 5 (and then again for Region 7) and zip them into the appropriate file structure.

File Description	File Name (.zip***)	Format
Region 05, Version 01_01, Catchment Grid	NHDPlus05V01_01_Catgrid	ESRI Grid
Region 05, Version 01_01, Catchment Shapefile	NHDPlus05V01_01_Catshape	Shapefile
Region 05, Version 01_02, Catchment Flowline Attributes	NHDPlus05V01_02_Cat_Flowline_Attr	DBF
Region 05, Version 01_02, Elevation Unit a	NHDPlus05V01_02_Elev_Unit_a	ESRI Grid
Region 05, Version 01_02, Elevation Unit b	NHDPlus05V01_02_Elev_Unit_b	ESRI Grid
Region 05, Version 01_02, Elevation Unit c	NHDPlus05V01_02_Elev_Unit_c	ESRI Grid
Region 05, Version 01_01, Flow Accumulation and Flow Direction Unit a	NHDPlus05V01_01_FAC_FDR_Unit_a	ESRI Grid
Region 05, Version 01_01, Flow Accumulation and Flow Direction Unit b	NHDPlus05V01_01_FAC_FDR_Unit_b	ESRI Grid
Region 05, Version 01_01, Flow Accumulation and Flow Direction Unit c	NHDPlus05V01_01_FAC_FDR_Unit_c	ESRI Grid
Region 05, Version 01_02, National Hydrography Dataset	NHDPlus05V01_03_NHD	Shapefile and DBF
Region 05, Version 01_01, Stream Gage Events	NHDPlus05V01_01_StreamGageEvent	Shapefile
Region 05, Version 01_01, QAQC Sinks Spreadsheet	NHDPlus05V01_01_QAQC_Sinks	Excel Spreadsheet

Create a new point shapefile (or geodatabase featureclass) named Geometric Design within ArcCatalog with the same projection as the unzipped layers above.

Within an ArcMap project, add the following:

- nhdflowline layer
- Geometric Design layer
- catchment shapefile
- the FlowlineAttributesFlow table

Add the following fields to the nhdflowline layer:

- LENGTHMi (type: double, precision: 9, scale 4)
- DrainMi (type: double, precision: 9, scale 4)
- MinElev (type: double, precision: 9, scale 4)
- MaxElev (type: double, precision: 9, scale 4)
- Gradient (type: double, precision: 9, scale 4)

Add the following field to the GeometricDesign layer (use the add field-batch tool):

- Geometric (type: double, precision: 5, scale 2)
- Lat (type: double, precision: 8, scale 5)
- Long (type: double, precision: 8, scale 5)
- COMID (type: long, precision: 9)

Join the nhdflowline layer with the FlowlineAttributesFlow table based on the COMID field.

Use the field calculator within the nhdflowline attribute table, with the appropriate metric to imperial conversion to populate the following fields:

- LENGTHMi (from LENGTHKM kilometers to miles)
- DrainMia (from CumDrainage square kilometers to square miles (sq mi))
- MinElev (from MinElevSmo meters to feet)
- MaxElev (from MaxElevSmo meters to feet)

• Gradient ((MaxElev-MinElev)/LENGTHMI).

Unjoin the FlowlineAttributesFlow table.

Label the "nhdflowline" layer based new "LengthMi" field – note: this field shows the cumulative drainage at the *end* of the line segment, which is rarely more than 2-3 miles in between nodes.

Calculate the geometric break points (i.e., for a 500 sq mi watershed: 500, 250, 125, 62.5, 31, 15, 7, 4, 2).

It is recommended to change the symbology (Symbology: Show Quantities: Classification (Manual)) of the actual flowline to reflect the drainage. This will help identify when and where sites need to be allocated.

Start a new editing session, with the GeometricDesign layer as your target layer.

Add a new point within this layer to the pour point for the watershed (500 sq mi in this case).

Travel upstream through the main stem and "find" the next place on the stream where the river drainage brackets 250 sq mi. Use the catchment shapefile layer to identify more precisely the drainage value, if needed.

Populate the "Geometric" field within the GeometricDesign layer accordingly to the identified drainage level, then change the symbology (Symbology: Categories: Unique Values: Geometric field) of this layer to reflect the drainage levels.

Proceed through the watershed (either around the outer portions or start with largest values and work in), adding points accordingly to each geometric level. Change the symbology to find areas or levels that were missed. Note – the drainage level must be exact. Use the catchment shapefile to subtract drainage areas from larger drainage areas until the exact drainage level is reached. It is ok to "skip" a geometric level if it is not exactly reached. Sometimes there are large tributaries whose contribution to the main stem skips a drainage level.

Populate the COMID (manually), and Lat/Long (right click on field and select calculate geometry - lat = xcoordinates and long = y-coordinates) accordingly for reference within the GeometricDesign Layer.

Once sites are selected in this fashion, they will need to be snapped to a bridge or access point.

Additional sites should be placed at pour points of subwatersheds (12-digit HUCs) to meet TMDL document requirements.

Once the initial sites are selected, the following features are taken into account to move or add sites:

- Permitted facilities
- Urban areas
- Historical sampling sites
- Assessment Unit IDs (AUID)
- External stakeholder information
- Resources maximum of 35 sites per project

After refining site selections, there may be additional sites added to ensure spatial representation of the project area.

Sites may be removed or changed after site reconnaissance if there are problems accessing the site or if sites are dry.

Notes regarding the NHD dataset:

All units are initially set to metric and need to be converted to imperial.

Within the nhdflowline layer, the GNIS_Name/ID refers to the whole river name and ID, while the COMID is a unique identifier for the particular segment.

There is not a value GNIS_Name/ID for every river, especially where primary streams and ditches are concerned.

Segments within the nhdflowline layer are based on linear miles between "nodes," which are broken up (typically) by tributary. Typically these lengths are less than 2-3 miles.

The cumulative drainage values in the NHD dataset have been compared against other and deemed "reasonable" (read – not statistically compared). Also note that the drainage is calculated through the model to be at the pour point of that segment.

The elevation values, however, are **not** reliable and require supervision. These values are calculated from the associated digital elevation model (DEM) and sometimes have null values for either the maximum or minimum elevation values. In addition, the length of the stream is not long enough (i.e. >1 mile) to calculate gradient. In either case, this associated value is helpful to identify contour changes against a USGS contour map. However, to note the calculated gradient from the NHD information has been observed to be within several tenths of mile compared to a manual calculation of gradient.

Important tables from NHD

- FlowlineAttributesFlow (found in: Region 05, Version 01_02, Catchment Flowline Attributes)
- Key fields: CumDrainag, Max ElevRaw, MinElevSmo,

Important Layers from NHD

- Region 05, Version 01_01, Catchment Shapefile
- Region 05, Version 01_02, National Hydrography Dataset

Attachment 2: IDEM OWQ Site Reconnaissance Form

Distributed? Advance? Request Batting: Results: Comments: and Planning Reconnaissance Decision Chricle Equipment Selected Stre Rating By Category (1=easy, 10-difficult) Reconnaissance Decision Equipment Selected Chricle Equipment Needed Access Route Pre-Recon Flecon in process: Approved Sale Backpack No, Landowner Genied aboves: No, Landowner Genied aboves: Backpack Backpack No, Stream channel missing No, Warzh/Wetland Sainoe Sainoe No, Marzh/Wetland No, Streampace on to abostible Weighted r No, Streampace on to actuations No, Streampace on to actuation Waders Sampting Effort No, Streampace of by DockMater Waders No, Other Streampace of by DockMater Waders	Location Des	scription:							
Recon Date Crew Members Hist Name Last Name Avg. Width (m) Avg. Depth (m) Max. Depth (m) Nearest Town Street A ddress (m) Max. Partitive Run Road/Public City State Water Present? Access Possible? City State Image: Street Wadeable? Present? Access Possible? City State Image: Street Wadeable? Collect Sediment? Gauge Present? Telephone E-Mail Address Image: Street Wadeable? Collect Sediment? Gauge Present? Telephone E-Mail Address Image: Street Rating By Category Reconnaissance Decision Pamphler Please Call in Results Results Image: Street Rating By Category Reconnaissance Decision Equipment Selected Citrole Equipment Selected Image: Street Rating By Category Reconnaissance Decision Equipment Selected Backpack Boat No, Maxel Vertand No, Physical cathere No, Maxel Vertand No Street Present Ratinet musting No, Other No, Other No, Other No, Other Waders Sampling Effort No, Other No, Other		Reconnaissa	ance Data Collect	ed	Land	owner/Contact	Information		
(m) Arg. Depth (m) max. Depth (m) meares: Point ddress Water Riffle/Run Road/Public City State Present? Site Wadeable? Present? Access Possible? City State Site Impacted by Collect Sediment? Gauge Present? Telephone E-Mail Address Uvestock? Image: Results. Comments. and Planning Pamphlet Please Call in Results. Distributed? Advance? Requess Requess Image: Results. Comments. and Planning Reconnaissance Decision Equipment Selected Circle Equipment Selected Stree Rating By Category Reconnaissance Decision Equipment Selected Backpack Moccess Route Pre-Recon Preceon In process Approved Sale Backpack Safety Factor No. Stream channel missing No. Stream channel missing Backpack Backpack No. Stream channel missing No. Stream pageted not addressabile No. Stream pageted by CockMater Waders Gitl Net No. Other No. Other No. Other Cother Gitl Net Comments Discride by CockMater No. Other G		the second s			the second se	and the second se			
(m) Arg. Septin (m) max. Deptin (m) meares: Form ddress Water Image: Stree Wadeable? Riffer/Run Road/Public City State Present? Stree Wadeable? Present? Access Possible? City State Stree Impacted by Collect Sediment? Gauge Present? Telephone E-Mail Address Livestock? Image: Results. Comments: and Planning Results. Comments: and Planning Requess Stree Rating By Category Reconnaissance Decision Equipment Selected Circle Equipment Selected Access Route Reconnaissance Decision Equipment Selected Backpack Boat Stree Rating By Category Reconn process Approved Sale Backpack Boat Mo. Landowrer Cented access No. Dry No. Stream charmet missing Backpack No. Other No. Stream page or not actacessatile No. Other Waders Comments Other Cother Seline Wagers	2								
Present? Site Wadeable? Present? Access Possible? City State Site Impacted by Livestock Collect Sediment? Gauge Present? Telephone E-Mail Address Image: Impacted by Livestock Collect Sediment? Gauge Present? Telephone E-Mail Address Image: Impacted by Livestock Collect Sediment? Gauge Present? Telephone E-Mail Address Image: Impacted by Livestock Image:			Max. Depth (m)	Neares: Town	A				
Image: Impacted by Collect Sediment? Gauge Present? Telephone E-Mail Address Image: Impacted by Collect Sediment? Gauge Present? Telephone E-Mail Address Image: Present? Pamphlet Prese Call in Results Distributed? Advance? Request Image: Results. Comments. and Planning Image: Results. Comments. and Planning Image: Results. Comments. and Planning Image: Results. Comments. and Planning Image: Results. Comments. and Planning Cricle Equipment Selected Cricle Equipment Selected Image: Results. Comments. and Planning Pre-Recon Pre-Recon Backpack Present in process. Approved Sale Image: Results. Comments. Backpack Backpack No. Landowner Oenied atoess No. Dry Backpack Boail Tosebarge Sampling Effort No. Stream channel missing No. Stream channel missing Image: Resultade Dy backwate Weighted Head No. Stream channel of backwate No. Other Image: Resultade Dy backwate Image: Resultade Dy backwate Image: Resultade Dy backwate Image: Resultade Dy backwate No. Other No. Other Image: Resultade Dy backwate Image: Resultade Dy backwate Image: Resultade Dy backwate Somments Image: Resultad		Site Wadeable?			City		State Zip		
Stre Impacted by Livestock? Collect Sediment? Gauge Present? Telephone E-Mail Address Pamphlet Pamphlet Please Call in Distributed? Results Pamphlet Please Call in Advance? Results D D D Pamphlet Please Call in Results Results Distributed? Advance? Request D D Batting By Category 1=easy, 10=difficult) Reconnaissance Decision Equipment Selected Circle Equipment Needed Access Route Pre-Recon Pre-Recon Backpack Boat No, Landowner Cented states No, Stream channel missing No, Virpourbed states Backpack Boat No, Stream channel missing No, Gringe gene or not achesisatule No, Gringe gene or not achesisatule No, Other Weigheed H Weigheed H Weigheed H Weigheed H Weigheed H Somments Stream channel missing No, Other No, Other Weigheed H Weigheed H				Street Carbones					
Image: Developer of the second sec	Site Impacte	d by College Se			Telephone		E-Mail Address		
Pamphler Distributed? Please Call in Advance? Results Request Request Batting. Results. Comments. and Planning IIII IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII		62			relephone				
Sine Raung By Caregory Reconnaissance Decision Circle Equination Access Roure Pré-Recon Reconnaissance Decision Backpack Safery Factor Pré-Recon Backpack Backpack Safery Factor No. Landowner Denied aboese No. Stream channel missing Dimension Backpack Safery Factor No. Stream channel missing No. Mareh/Westand Backpack Boar No. Mareh/Westand No. Mareh/Westand No. Stream channel traitic unitocation Seine Weighted H No. Stream pacted by Dackwater No. Other Seine Weighted H Waders Comments Stream channel traitic unitocation No. Stream channel traitic unitocation No. Mareh/Westand Waders Sampling Effort No. Other No. Other Seine Weighted H Comments Stream pacted by Dackwater No. Other Seine Seine	ы				Distributed?	Advance?	Requested?		
Image: stream of the contransative devision Equipment Selected Circle Equipment Selected Access Route Pre-Recon Backpack Pre-Recon Pre-Recon Backpack Safety Factor No, Landowner Genled atoese No, Dry No, Stream channel missing No, Stream channel missing Totebarge No, Wingounded stream No, March/Wetland No, Stream channel missing No, March/Wetland No, Stream channel missing Weighted H No, Stream channel missing No, March/Wetland Weighted H No, Stream channel missing No, Stream channel missing Weighted H No, March/Wetland No, Stream channel missing Weighted H No, Stream channel missing No, Stream channel missing Weighted H No, March/Wetland No, Stream channel missing Weighted H No, Stream channel missing No, Stream channel missing Weighted H No, Other No, Other Weighted H				Rating. Results. Com	nems, and Planning				
Safety Factor Backpack Safety Factor No, Landowner Gented addesse No, Landowner Gented addesse No, Landowner Gented addesse No, Stream channel missing No, Stream channel missing No, March/Wetland Seane Sampting Effort No, Site impacted by backwater No, Other No, Other			Reconnaissai	nce Decision	Equipment S	elected	Circle Equipment Needed		
Approved Sile Boar Safety Factor No, Landowner benied adoese Totebarge No, Stream channel missing No, Stream channel missing Scanoe No, Physical bartiers No, Wripounded stream Scanoe No, Wripounded stream No, Wripounded stream Scanoe Sampling Effort No, Bridge gone or not accessible Weighted H No, Ste impacted by backwater No, Other Waders	Acces	ss Route	Pré-Recori			1	Concerner.		
Safety Factor No, Landowner denied addesse Toxebarge No, Stream channel missing Longline No, Physical barriers Scanoe No, MarshVWetand Seine No, Bridge gone or not addessible Weighted H No, Ste impacted by backwater Waders No, Other Gill Net							and the second sec		
Safety Factor Mb; Stream channel missing Longline N0; Physical barriers N0; Physical barriers Scanoe Scanoe N0; Minpolitided Ebeam N0; Minpolitided Ebeam Seine Seine Seine Sampting Effort N0; Site impacted by backwater Weighted F Weighted F N0; Other N0; Other Seine Waders									
No. Stream channel missing Longline Nin, Physical barriers Scance No. Wrippunded etheam No. Wrippunded etheam No. Marek/Wetland Seine No. Bridge gone or not actessible Weighted H No. Ste impacted by backWater Waders No. Other Gill Net	Safet	y Factor							
Sampling Effor: No, Impounded sheam Serie Serie Serie Serie Weighood it No, Bridge gone or not addessible No, Bridge gone or not addessible Weighood it Waders Waders Gill Net No, Other No, Other Serie Waders Gill Net Serie							1.5 10 10 10 10		
Sampling Effort No. Bridge gone or not adbessible Weighted if Nit, Unsafe due to traffic unicitation Waders Waders No. Site impacted by backwater No. Other Gill Net									
No. Site impacted by backwater Gull Net Gull Net Comments	Camal	ing Effect							
No. Site impacted by Dackwater Gull Net.	Sampl	ing chon					Weighted Handline		
comments									
							Gill Net		
	anne					-			
	omments								
	1.000	1.	1.	The second second					
ketch of Stream & Access Route – Indicate Flow, Direction, Obstacles, & Land Use (Use Back of Page, if Necessary)	ketch of Str	eam & Access Route	- Indicate Flow,	Direction, Obstacles, & La	and Use (Use Back of Pa	ge, if Necessa	(y)		

Sample 1		Site 2	1		Sample A	fedium		S	ampie Type	1	Dupli	cate San	t elon
			-	_			-						
Stream Nan	110 C		1				River Mil	8:		Cou	my:		
ne Descript	Contraction of the local division of the loc	le Collecto	-	Romale	Collected	1		Water	-	1	Sec.	1	1
Survey rew Chief	1 2		4	Date	Time	Hydro	lab Dep	th/Gage H (ft)	t (ct/sec		Flow	7 Algae	7 Aqua
		i ling		-	1 100-		-			_			
Yes No; Stream No; Owner	Dry DNo;		1 02 8 08	UOTS 3 4 12 24 AS-Flow	Pool D	3 Run	Stagnant Flood Other	Clear Murky Brown	Vater Appears Green Black Gray (Se	Contraction of the last of the		0-20%	Closed 9 eo-sos so-100
Special Notes:	-		_		-		-						
ield Dat	a:												
Date (m/d/yy)	24-hr Tim (hh:mm)		pH .	Water Temp (°C)	Spec Cond (polymeiom)	Turbidity (NTU)	% Sat	Chlorine (mg/l)	(mg/l)		ophyll g/l)		D WS 4
omments	-			-				_		_	-		1 1
comments	-					-							
ommente	-				-			_					
omments								1			_		
comments				-				_		_	_		
omments	-		-			-					-		11
		Measur	ament		Meter Measurer Meter Measure		-	1	Weather Coo	ie Defin	itions		_
		Fla		E Estima	ted (See Comm ed (See Comme	ents)	Sky Con	the second second second	WD Wind Dire	ction		WS Strengt	AT Air Ter
ield Cali	bration	s:		-	-		1 Clear 2 Scattered		00 North (0 de 09 East (90 de	grees)	0 Calin 1 Ugh	t.	1<32 233-45
Date (m/d/yy)	Time (hh:mm)	Calibrator Initials	Туре		# Value	Units	3 Partly 4 Cloudy 5 Mist	10 Sleet	18 South (180 27 West (270)	degrees) 3 Mode		lerate	346-60
		1			· ·	0.01	6 Fog 7 Shower		100		5 Stro		576-88
		-	-	1000	-	1.10						1. I	
			1	Q #	-	15. 34	1.1			-		E., 1	1
	0	Calibration Type	pH DO Turbidity										
reservat	tives/Bo			_			Group	s: Preser	vatives		Bot	tie Type	8
Group: Pres	servative	Preservat	ive Lot #	Bottle Ty	pe Bottle L	NX	Nutrients	Chemistry: H2804	ke	2000P	1000mL	Plastic, N	arrow Mos arrow Mos
-	_	1	-			CN		NaOH		500P 250P	250mL F	Plastic, Na	rrow Mout
				Sec	1	OS/ Tox Eco	ics Toxics: i			1000G 500G 250G	500mL 0	Glass, Wo Glass, Wo Glass, Wo	
						VO	A Volatie (Organics: Hi	CI & Thiosulfate		125mL 0	Slass, Wid Slass, Wid Iass Vial	
						Phe	n Phenois: Sedimen	H2SO4		120PB 1000PF	120ml P	lastic (Bad Plastic, C	cteria Only coming Filt
						Giy Hg Cr5	Mercury	ate: Thiosul (1631): HCI mVI(1636):	NaOH			Plastic, Co lastic Tefion	ming Filte

Data Entered By: _____ QC1: _____ QC2: _____

Stream Sampling Field Data Sheet

Attachment 4: IDEM OWQ Fish Collection Data Sheet

IDEM	
OWQ-WATERSHED ASSESSMENT	AND PLANNING BRANCH

Event ID	Voucher jars	Unknown jars	Equipment	Page of
Voltage	Time fished (sec)	Distance fished (m)	Max. depth (m)	Avg. depth (m)
Avg. width (m)	Bridge in reach	Is reach representative	If no, why	and the second second
Elapsed time at si		nments	n.n.o, wriy	

Museum data: Initials_____ID date_____ Jar count_____ Fish Total

Coding for Anomalies: D-deformities E-eroded fins L-lesions T-tumor M-multiple DELT anomalies: O-other (A-anchor worm C-leeches W-swirled scales Y-popeye S-emaciated F-fungus P-parasites) H-heavy L-light (these codes may be combined with above codes)

TOTAL # OF FISH	(mass g)	WEIGHT (s)	(length mm)		6	ANON	ALIES	5	
			Min length	D	Ē	L	τ	М	C
V P			Max length						
			Min length	D	E	L	τ	м	(
VP			Max length						
			Min length	Ď	E	L	τ	м	
VP			Max length						
			Min length	D	Ē	÷.	Ţ	м	
VP			Max length						
• <u> </u>			Min length	D	E	Ĺ	Ť.	м	
VP			Max length			-			
V F			Min length	D	E	Ļ	Т	м	,
- F - F - F			Max length			111			
V P			1.1.1.1.1		1	11	T	TT	1

Attachment 5: IDEM OWQ Macroinvertebrate Header Form

L-Site	Stream Name	Location	County Surveyor
Sample Date Samp		Macro Sample Type: Black Light Kick CPOM MHAB Hester-Dendy Qualitative	Duplicate
Riparian Zone Watershed Erosion Heavy Moderate		Macro Sub Sample (Field o Macro Reach Sampled (m)	V 1984 a 2
	ream Depth Stream Depth Run (m): Pool (m):	Distances Distanc Riffle-Riffle (m): Bend-Bend	
Stream Type: Cold Warm	Turbidity (Est):		
Channelization Predominant Surro Other	Dam Present Unding Land Use: Forest Field/Past	ure 🗆 Agricultural 🗆 Residential	🗆 Commercial 🗆 Industrial

□ Are the undersides of stones, which are not deeply embedded, black?

Sediment Oils: Absent Moderate Profuse Slight

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Relic Shells Other

Substrate Components

(Note: Select from 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, or 100% for each inorganic/ organic substrate component)

	Inorgan	nic Substrate C	components (%	Diameter))		Org	anic Subst	ate Components (%	Гуре)
Bedrock	Boulder (>10 in)	Cobble (2.5-10 in)	Gravel (0.1-2.5 in)	Sand (gritty)	Silt	Clay (slick)	Detritus (sticks, wood)	Detritus (CPOM)	Muck/Mud (black, fine FPOM)	Marl(gray w/ shell fragments)
				-		1.00				1

Water Quality

Water Odors:
Normal Sewage Petroleum Chemical None Other
Water Surface Oils: Slick Sheen Glob Flocks None

IDEM 03/8/18

Attachment 6: IDEM OWQ Biological Qualitative Habitat Evaluation Index (front)

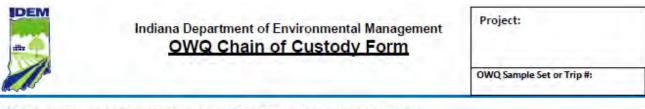
DEM	Sample #	OWQ Bio	logical QHE bioSample #	the second s	ve Habitat am Name	Evaluation	Index) Location	
1	Surveyor	Sample Date	County	Macro Sa	mple Type	🗆 Habitat	QHEI Scor	
				1		Complete	QHEI SCO	e,
] <i>SU</i>		heck ONLY Two pro		te TYPE BOXES		Chade ONE (Or	1 @ peorage)	
EDOMIN	BEST TYPE	PRESENT	OTHER T	PRESENT		Check ONE (Or IGIN STONE [1]	QUALITY	
10 B	LDR/SLABS [1	P/G R/R L 0] □ □		[4] □□		[1]	I MODERAT	Ē[-1]
	OULDER [9]	the second se	DETRITUS Image: Detribution Image: Detribution			ANDS [0] DPAN [0]		0 Substr
	RAVEL [7]				SANE	STONE [0]		FL 31
1.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2	AND [6] EDROCK [5]		ural substrates; ignore			RAP[0] STRINE[0]	EXTENSIV	
UMB	ER OF BEST	TYPES: 4 or	more [2]		SHAL			
omn	nents	∐ 3 or	less [0]		COAL	FINES [-2]	§□ NONE[1]	20
		OVER Indicate pre						NUNT
		Moderate amounts, oderate or greater a					Check ONE (O	DUNT r 2 & average)
amete		ble, well developed					DECTENSIVE >	75% [11]
ols.)	DERCUTBAN	G[1]	POOLS >70	cm [2] 0X	BOWS, BACKWA	TERS [1]	□ MODERATE 2 □ SPARSE 5 - <	
		/EGETATION [1]	BOULDERS		UATIC MACROPH SS OR WOODY D		NEARLY ABSE	and a strategy of a second
	OTMATS [1]	COM MAN COLU	BOULDES	[1]O	35 OR WOOD TL	CORCO [1]	Ma	Cover
omn	nents							20
MO	OSITY 3H[4] DERATE[3] N[2] NE[1]	DEVELO EXCELI GOOD FAIR [: POOR]	ENT [7] [5]]_	CHANNELI NONE [6] RECOVERIN RECOVERIN RECENT OR	D [4]	LOW	h[3] Xerate[2] (Channel aximum 20
	nents			4 . A.L	a the set of	5		2
	NK EROSIC r right looking dowr		RIAN ZONE C ARIAN WIDT	heck ONE in each	D PLAIN QU	ALTTV	er bank & average)	
R	EROSION	ŬŬ WIDE			T, SWAMP[3]		CONSERVATIO	NTILLAGE [1]
	NONE/LITTLE [40DERATE [2]		RATE 10-50m [3 OW 5-10m [2]		OROLD FIELD		URBANOR INE	
	EAVY/SEVERE		NARROW[1]		DPASTURE[1]	Indica	te predominant land u	
		D NONE	[0]	D OPENF	ASTURE, ROWC	ROP[0] past 1		tiparian aximum
	nents			-				10
	<i>OL/GLIDE</i> IMUM DEP	AND RIFFLE/	<i>RUN QUALIT</i> NEL WIDTH		CURRENT VI	FLOCITY	Recreat	ion Potential
Check	k ONE (ONLY!)	Check ON	E (Or 2 & average)	Check ALL th	at apply	(Check one and	d comment on ba
	• 1m [6] 1.7 - < 1m [4]		DTH>RIFFLEW DTH=RIFFLEW		ORRENITIAL [-1] ERY FAST [1]	□ SLOW[1] □ INTERSTI		mary Contact
	.4-<0.7m[2]	POOL WI	DTH <riflew< td=""><td>отној 🗆 Б</td><td>AST [1]</td><td>Intermit</td><td>TENÎ [-2]</td><td>Pool/</td></riflew<>	отној 🗆 Б	AST [1]	Intermit	TENÎ [-2]	Pool/
	1.2-<0.4m [1] <0.2m [0] [me				IODERATE [1] dicate for reach -	Dools and riffles		Current aximum
omn	nents	-				pools and rane	, , , , , , , , , , , , , , , , , , ,	12
	ate for function fle-obligate spe	nal riffles; Best area ecies:	s must be large e	nough to support	and the second se	Or 3.8 morana)		[metric = 0]
RIFF	LE DEPTH	RUN D	EPTH	RIFFLE/RU	N SUBSTRAT	Or 2 & average) FE RI	FFLE/RUN EMB	
	TAREAS > 100		MUM > 50cm [2]			r)[2]	NONE[2] LOW[1]	a:m (5
)cm[1] □ MAXI m[metric=0]	MOM < 30000 [1]		(e.g., Fine Gravel,		MODERATE [0]	Riffle/ Run
omn	nents	- Contraction of the					EXTENSIVE [-1] M	aximum 8
	ADIENT	ft/mi)		-LOW[2-4]	%POOL:	%GL	IDE:	Gradient
DR	AINAGE A	and a second	HIGH-VER		%RUN:			aximum 10
		10-104 _ 104 ·				 		2
ered_		QC1		QC2	_			IDEM 02/28/

Attachment 6 (continued): IDEM OWQ Biological Qualitative Habitat Evaluation Index (back)

A-CANOP	Y	B-AESTHETIC	S	<u>c</u>	-RECRE	ATION	D-MAINTENANCE	E-ISSUES
□ >85%-	Open	🗌 Nuisance algae	e 🗌 Oilsi	heen A	Area	Depth	Public Private	UWWIP CSO NPDES
□ 55%-<	85%	🗌 Invasive macro	ophytes 🗆 Trasl	h/Litter Pool: 🗆	>100ft ²	□>3ft	Active Historic	□ Industry □ Urban
□ 30%-<	55%	🗆 Excess turbidit	y 🗆 Nuis	ance odor			Succession: 🗌 Young 🗌 Old	Hardened Dirt&Grime
□ 10%-<	30%	Discoloration	Slud	ge deposits			Spray Islands Scoured	Contaminated Landfill
<10%-	Closed	🗆 Foam/Soum		s/SSOs/Outfalls			Snag: Removed Modified	BMPs: Construction Sedime
							Leveed: 🗆 One sided 🗆 Both banks	Logging I Inigation Cooling
ooking upstrea	m (> 10m, 3 rea	dings; \leq 10m, 1 reading	in middle); Round	to the nearest whole perc	œnt		Relocated Outoffs	Erosion: Bank Surface
	Right	Middle	Left	Total Average			Bedload: Moving Stable	🗆 False bank 🗆 Manure 🗆 Lagox
%open	%	0/0	%	%			Armoured Slumps	□ Wash H₂O □ Tile □ H₂O Table
				_			Impounded Desiccated	Mine: Acid Quarry
		× 2	1. 1				Flood control Drainage	Flow: 🗌 Natural 🗌 Stagnant
	\sim	\bigvee	\sim					🗆 Wetland 🗆 Park 🗆 Golf
	\wedge	\wedge	\wedge					Lawn 🗆 Home
	1	1 1	1 1					Atmospheric deposition
								Agriculture Livestock

IDEM 02/28/2018

Attachment 7: IDEM OWQ Chain of Custody Form



I Certify that the sample(s) listed below was/were collected by me, or in my presence. Date:

Lab	1.4.5	ter, 🗆 Algae, 🗆 Fish, 🗆 Macro, 🗆 Çyanobacteria/Microcystin, 🗆 Şedim DEM 을 흔 드 프 트 한 트 흔 등 트 한 트 흔 등			Date and Ti	ate and Time Collected							
Assigned Number / Event ID	Control Number	Sample Type	ID	1000 ml	1000 ml G.N.M.	40 ml Vial	120 ml P (Bact)	2000 ml Nakgene	250 ml Natgene	125 ml Glass	Date	Time	per bottle present
										1			
				_						1			
								-					
								-					
-			-										
								_					
P = Plastic M = MS/MSD	G = Glass B = Blank		V. = Na = Dupli	rrow Mo	outh	Bact =	Bacteri	iologica	d Only	5	should sample	s be iced?	Y N

Carriers

I certify that I have received the above sample(s).

Signature	Date	Time	Seals	Intact	Comments
Relinquished By:			v.	N	
Received By:			1. 2. 1	20 L	
Relinquished By:		1	×	N	
Received By:		-			
Relinquished By:			v	N	
Received By:					
IDEM Storage Room #		-		and the second sec	

Lab Custodian

I certify that I have received the above sample(s), which has/have been recorded in the official record book. The same sample(s) will be in the custody of competent laboratory personnel at all times, or locked in a secured area.

Signature:

Date:

Lab:

Address:

Revision Date: 4/27/2016

Time:

Attachment 8: IDEM OWQ Water Sample Analysis Request Form



Indiana Department of Environmental Management

Office of Water Quality Watershed Planning and Assessment Branch www.idem.IN.gov

Water Sample Analysis Request

Project Name: 2021 Vernon Fork Muscatatuck Composite 🗌 Grab 🖂

OWQ Sample Set	20BLWxxx	IDEM Sample Nos.		
Crew Chief	Tim Beckman	Lab Sample Nos.	AB	
Collection Date	-	Lab Delivery Date		

Parameter	Test Method	Total	Dissolved
Alkalinity	SM2320B	⊠ **	
Total Solids	SM2540B	⊠ **	
Suspended Solids	SM2540D	⊠ **	
Dissolved Solids	SM2540C		⊠**
Sulfate	300.0		⊠ **
Chloride	300.0		⊠ **
Hardness (Calculated)	SM-2340B	⊠ **	
Fluoride	300.0	**	
Priority Pollutant M	letals Water P	arameter	rs
Parameter	Test Method		Dissolved
Antimony	200.8	10 De C	
Arsenic	200.8		
Beryllium	200.8		
Cadmium	200.8	1000	
Chromium	200.7	1000	
Copper	200.8	- 0'	
Lead	200.8		
Mercury, Low Level	1631, Rev E.		
Nickel	200.8		
Selenium	200.8		
Silver	200.8		
Thallium	200.8		
Zinc	200.7		
Cations and Secon	ndary Metals P	aramete	rs
Parameter	Test Method	Total	Dissolved
Aluminum	200.7, 200.8		
Barium	200.8		
Boron	200,8		
Calcium	200.7, 200.8	⊠ ***	
Cobalt	200.8		
Iron	200,7		
Magnesium	200.7, 200.8	⊠ ***	
Manganese	200.8		
Sodium	200,7		
Silica, Total Reactive	200.7		
Strontium	200.8		

Send	reports	(Fed.	Ex. or	UPS	to:	Del

) to: Deliver reports to:

Tim Bowren - IDEM Bldg, 20, STE 100 2525 North Shadeland Ave Indianapolis, IN 46219 Tim Bowren – IDEM Bldg, 20, STE 100 2525 North Shadeland Ave. Indianapolis, IN 46219

Parameter		Test	Method	Total
Priority Pollutants: Oranochlorine Pesticic PCBs	les and	608		
Priority Pollutants: VC Purgeable Organics	Cs -	624		
Priority Pollutants: Base/Neutral Extractal	oles	625		
Priority Pollutants: Ac Extractables	id	625		
Phenolics, 4AAP		420.2	2	
Oil and Grease, Total		1664	Á	
	1	1		meters
Parameter	1	1		
Parameter	Test M	ethod	Total	
Ammonia Nitrogen	Test M SM4500	ethod NH3-G		
	Test M	ethod)NH3-G)B	Total	
Ammonia Nitrogen CBODs Total Kjeldahl	Test M SM4500 SM5210	ethod)NH3-G)B)N(Org)	Total	
Ammonia Nitrogen CBOD5 Total Kjeldahl Nitrogen (TKN)	Test M SM4500 SM5210 SM4500	ethod DNH3-G DB DN(Org) DNO3-F	Total	
Ammonia Nitrogen CBODs Total Kjeldahl Nitrogen (TKN) Nitrate # Nitrite	Test M SM4500 SM5210 SM4500 SM4500	ethod DNH3-G DB DN(Org) DNO3-F DP-E	Total	
Ammonia Nitrogen CBODs Total Kjeldahl Nitrogen (TKN) Nitrate + Nitrite Total Phosphorus	Test M SM4500 SM5210 SM4500 SM4500 SM4500	ethod DNH3-G DB DN(Org) DNO3-F DP-E DC	Total	
Ammonia Nitrogen CBODs Total Kjeldahl Nitrogen (TKN) Nitrate + Nitrite Total Phosphorus TOC	Test Mi SM4500 SM5210 SM4500 SM4500 SM4500 SM531	ethod DNH3-G DB DN(Org) DNO3-F DP-E DC DC	Total	
Ammonia Nitrogen CBOD5 Total Kjeldahl Nitrogen (TKN) Nitrate + Nitrite Total Phosphorus TOC COD	Test Mi SM4500 SM5210 SM4500 SM4500 SM4500 SM531 SM5220	ethod DNH3-G DB DN(Org) DNO3-F DP-E DC DC DC DC DC	Total	
Ammonia Nitrogen CBOD5 Total Kjeldahl Nitrogen (TKN) Nitrate + Nitrite Total Phosphorus TOC COD Cyanide (Total)	Test Mi SM4500 SM5210 SM4500 SM4500 SM4500 SM4500 SM531 SM5220 SM4500	ethod INH3-G DB DN(Org) DNO3-F DP-E DC DC DC DC DC DC DC DC DC DC DC DC DC	Total	

RFP 16-074	SCM # 19855
Contract Number:	PO #0020000771

30 day reporting time required.

Notes:

** = DO NOT RUN PARAMETER IF SAMPLE IDENTIFIED AS A BLANK ON THE CHAIN OF CUSTODY

* = RUN ONLY IF TOTAL CYANIDE IS DETECTED

*** = Report Calcium, Magnesium as Total Hardness components

Testing Laboratory

Phone: 708,534,5200

Test America Attn: Robin Kintz 2417 Bond Street University Park, IL 60484

TestAmerica Chicago 2417 Bond Street				Cł	nain	of	Сι	isto	ody	R	eco	ord									
University Park, IL 60484-3101 phone 708.534.5200 fax 708.534.5211	Reau	latory Pro	ogram: [Dw [s [RCF	A L	Othe	٥r.										TestAmerica Labo	
Client Contact	Project M		.			-	Con						Date:							COC No:	
		anayer.					Con						Carri								COCs
Your Company Name here Address	Tel/Fax:	Analysia T	urnaround	Time		Lab	Lon	act				1	Carri	er:		-	-	-	_	Sampler:	0003
		IDAR DAYS		RKING DA	vs															For Lab Use Only:	
City/State/Zip (xxx) xxx-xxxx Phone		T if different fi		KKING DA	15		-													Walk-in Client:	1
(XXX) XXX-XXXX FIIOIle (XXX) XXX-XXXX FAX			2 weeks			_	-													Lab Sampling:	
Project Name:			2 weeks 1 week			22	-													Lub Gumping.	
Site:						Ç G	5													Job / SDG No.:	
PO#			2 days 1 day			aldr M	~													JOD / SDG NO.:	
10 #		1	Sample	1		San	2 M														
Sample Identification	Sample Date	Sample Time	Cample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered														Sample Specifi	ic Notes:
						Ħ	-	\vdash	+	\vdash	-	—	\vdash	+	Ħ	+	┿	-			
						++	-		_			_		-		_	-				
	-						-							-		-	_			<u> </u>	
																	+	\vdash			
														-			+				
						\square	-					+		-		-	+				
						\square	_					-		-		-	+				
	-						_					-		-			+	\vdash			
						\square	_		_		_	_		_		-	+			<u> </u>	
																_	_				
Preservation Used: 1= Ice, 2= HCI; 3= H2SO4; 4=HNO3; 5	=NaOH; 6=	Other		-																	
Possible Hazard Identification: Are any samples from a listed EPA Hazardous Waste? Please Comments Section if the lab is to dispose of the sample.	List any EP/	A Waste Co	odes for the	e sample	in the	s	Samp	le Dis	posa	I (A f	fee m	ay be	asse	ssed	if sar	nples	s are	reta	inec	d longer than 1 month	1)
Non-Hazard Flammable Skin Irritant	Poiso	n B	Unkr	iown				Return	to Clier	nt			isposal	ov Lab		Г	Arci	hive fo	or	Months	
Special Instructions/QC Requirements & Comments:																					
Custody Seals Intact: Yes No	Custody S	Seal No ·						C	ooler	Tem	p. (°C	C): Ob	s'd:		С	orr'd:				Therm ID No .:	
Relinquished by:	Company			Date/T	ime:	F	Receiv	ed by				,. 00		Co	npan				_	Date/Time:	
								,								-					
Relinquished by:	Company	:		Date/T	ime:	F	Receiv	ed by						Co	npan	y:				Date/Time:	
Relinquished by:	Company			Date/T	ime:	F	Receiv	ed in	Labo	ratory	/ by:			Co	npan	y:				Date/Time:	
																F	orm	No. (CA-	C-WI-002, Rev. 4.11, d	lated 1/24/2017

Attachment 9: Test America Chain of Custody Form



State of Illinois Environmental Protection Agency Awards the Certificate of Approval to:

Eurofins TestAmerica Chicago 2417 Bond Street University Park, IL 60484

The Illinois Environmental Laboratory Accreditation Program encourages all clients and data users to verify the most current scope of accreditation for Eurofins TestAmerica Chicago.

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: CWA (Non Potable Water)	
Method EPA 120.1	
Conductivity	IL.
Method EPA 160.4	
Residue-volatile	L.
Method EPA 1664A Rev: 1	
Oil & Grease	IL.
Method EPA 1664B	
Oll & Grease	IL
	16
Method EPA 180.1 Rev: 2	
Turbidity	L
Method EPA 200.7 Rev: 4.4	
Aluminum	IL.
Antimony	1L
Arsenic	11_
Barium	IL
Beryllium	(L.
Boron	IL.
Cadmium	IL.
Calcium Chromium	IL IL
Cobalt	L.
Copper	IL.
Iron	L.
Lead	IL.
Magnesium	Ĩ.
Manganese	ĩ.
Molybdenum	IL.
Nickel	IL.
Potassium	IL.
Selenium	IL.
Silica as SiO2	IL.
Silver	i L
Sodium	IL.
Thallium	IL,
Tin	IL.
Titanium	IL.
Vanadium	1L
Zinc	IL.

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: CWA (Non Potable Water)	
Method EPA 200.8 Rev: 5.4	
Aluminum	IL.
Antimony	IL.
Arsenic	IL.
Barium	IL
Beryllium	IL.
Boron	IL IL
Cadmium	IL.
Calcium	IL.
Chromium	IL.
Cobalt	TL:
Copper	IL.
Iron	IL.
Lead	
Magnesium	L.
Manganese	IL.
Molybdenum	IL.
Nickel	
Potassium	(L.
Selenium	IL.
Silver	IL'
Sodium	IL.
Thallium	IL
Tin	IL.
Titanium	IL.
Vanadium	IL.
Zinc	IL.
Method EPA 218.6 Rev: 3.3	
Chromium VI	11_
Method EPA 245.1 Rev: 3	
Mercury	IL.
	IL.
Method EPA 300.0 Rev: 2.1	
Bromide	IL .
Chloride	IL-
Fluoride	IL.
Nitrate	IL I
Nitrate plus Nitrite as N	. AL.
Nitrite	11
Orthophosphate as P	L_
Sulfate	IL-
Method EPA 335.4 Rev: 1	
Cyanide	IL.
Method EPA 350.1 Rev: 2	
Ammonia	IL.
Method EPA 351.1	
Total Kjeldahl Nitrogen (TKN)	I
	11
Method EPA 353.2 Rev: 2	
Nitrate	<u>II.</u>
Nitrate plus Nitrite as N	L.
Method EPA 420.4 Rev: 1	

Page 3 of 34

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: CWA (Non Potable Water)	
Total phenolics	L
Method EPA 608	
4,4'-DDD	11_
4,4'-DDE	L.
4,4'-DDT	íL.
Aldrin	IL.
alpha-BHC (alpha-Hexachlorocyclohexane)	IL.
Aroclor-1016 (PCB-1016)	Ē.
Aroclor-1221 (PCB-1221)	íL.
Aroclor-1232 (PCB-1232)	íL.
Aroclor-1242 (PCB-1242)	IL.
Aroclor-1242 (PCB-1242) Aroclor-1248 (PCB-1248)	IL
Aroclor-1254 (PCB-1254)	IL.
Aroclor-1260 (PCB-1264) Aroclor-1260 (PCB-1260)	IL IL
beta-BHC (beta-Hexachlorocyclohexane))
Chlordane (tech.)(N.O.S.)	
delta-BHC	IL .
Dieldrin	- (L_
Endosulfan I	IL.
Endosulfan II	IL.
Endosulfan sulfate	IL.
Endrin	IL.
Endrin aldehyde	IL.
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	0_
Heptachlor	L.
Heptachlor epoxide	IL
Methoxychlor	IL.
Toxaphene (Chlorinated camphene)	0
Method EPA 624	
1,1,1-Trichloroethane	IL.
1,1,2,2-Tetrachloroethane	11
1,1,2-Trichloroethane	(L
1,1-Dichloroethane	IL.
1,1-Dichloroethylene	16
1,2-Dichlorobenzene (o-Dichlorobenzene)	- IL
1,2-Dichloroethane (Ethylene dichloride)	11
1,2-Dichloropropane	L.
1,3-Dichlorobenzene	IL.
1,4-Dichlorobenzene	IL.
2-Chloroethyl vinyl ether	IL
Acrolein (Propenal)	- 1L
Acrylonitrile	IL.
Benzene	IL.
Bromodichloromethane	
Bromoform	IL.
Carbon tetrachloride	11
Chlorobenzene	L.
Chlorodibromomethane	Ĩ.
Chloroethane (Ethyl chloride)	ii.
	IL
Chloroform	

Page 4 of 34

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: CWA (Non Potable Water)	
Ethylbenzene	íL.
Methyl bromide (Bromomethane)	IL_
Methyl chloride (Chloromethane)	IL.
Methyl tert-butyl ether (MTBE)	IL.
Methylene chloride (Dichloromethane)	IL.
Tetrachloroethylene (Perchloroethylene)	IL.
Toluene	IL.
trans-1,2-Dichloroethylene	- iC
trans-1,3-Dichloropropylene	- ĨĹ
Trichloroethene (Trichloroethylene)	iL.
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	ĩ.
Vinyl chloride	ĩĽ
Xylene (total)	IL.
Method EPA 625	12
1,2,4-Trichlorobenzene	L
1,2-Dichlorobenzene (o-Dichlorobenzene)	
	L L
1,3-Dichlorobenzene	
1,4-Dichlorobenzene	IL
2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether	
2,4,5-Trichlorophenol	IL.
2,4,6-Trichlorophenol	1L-
2,4-Dichlorophenol	IL.
2,4-Dimethylphenol	IL.
2,4-Dinitrophenol	IL.
2,4-Dinitrotoluene (2,4-DNT)	IL.
2,6-Dinitrotoluene (2,6-DNT)	- IL -
2-Chloronaphthalene	IL.
2-Chlorophenol	IL I
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	IL.
2-Nitrophenol	IL.
3,3'-Dichlorobenzidine	IL.
4-Bromophenyl phenyl ether	IL.
4-Chloro-3-methylphenol	IL "
4-Chlorophenyl phenylether	IL.
4-Nitrophenol	IL
Acenaphthene	IL.
Acenaphthylene	IL.
Anthracene	IL -
Benzidine	IL.
Benzo(a)anthracene	IL.
Benzo(a)pyrene	IL .
Benzo(b)fluoranthene	IL.
Benzo(g,h,i)perylene	L.
Benzo(k)fluoranthene	IL.
bis(2-Chloroethoxy)methane	iL.
bis(2-Chloroethyl) ether	IL.
bis(2-Ethylhexyl) phthalate (DEHP)	
Butyl benzyl phthalate	L
	IL.
Chrysene	
Dibenz(a,h) anthracene	1
Diethyl phthalate	L.
Dimethyl phthalate Page 5 of 34	IL.

Page 5 of 34

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: CWA (Non Potable Water)	
Di-n-butyl phthalate	(L
Di-n-octyl phthalate	1.
Fluoranthene	IL.
Fluorene	iL.
Hexachlorobenzene	IL.
Hexachlorobutadiene	IL.
Hexachlorocyclopentadiene	n_
Hexachloroethane	- IL
Indeno(1,2,3-cd) pyrene	iL.
Isophorone	L.
Naphthalene	íL.
Nitrobenzene	IL.
n-Nitrosodimethylamine	IL.
n-Nitrosodi-n-propylamine	IL.
n-Nitrosodiphenylamine	0_
Pentachlorophenol	íL.
Phenanthrene	th_
Phenol	IL.
Pyrene	- UL-
Method SM 2320 B-1997 Alkalinity as CaCO3	IL.
Method SM 2340 B-1997	
Hardness	íL.
Method SM 2510 B-1997 Conductivity	iL.
Method SM 2540 B-1997 Residue-total	IL.
Method SM 2540 C-1997 Residue-filterable (TDS)	IL.
Method SM 2540 D-1997	44
Residue-nonfilterable (TSS)	L
Method SM 2540 E-1997	
Residue-volatile	IL.
Method SM 2540 F-1997	
Residue-settleable	-IL
Method SM 3500-Cr B-2009	
Chromium VI	í.
Nethod SM 4500-CI F-2000 Total residual chlorine	IL.
Method SM 4500-CI G-2000	
Total residual chlorine	IL.
Method SM 4500-CI E-1997 Rev: 21st ED	
Chloride	.0
Method SM 4500-CN E-1999	
Cyanide	LL.
Method SM 4500-CN G-1999 Available Cyanide	IL.
Method SM 4500-F C-1997 Rev: 21st ED	
the second s	

Page 6 of 34

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: CWA (Non Potable Water)	
Fluoride	L.
Method SM 4500-H+ B-2000	
pH	11_
Method SM 4500-NH3 G Rev: 21st ED	
Ammonia	IL.
Total Kjeldahl Nitrogen (TKN)	IL.
Method SM 4500-NO2 B-2000	
Nitrite	IL.
Method SM 4500-NO3 F-2000	
Nitrate Nitrate plus Nitrite as N	IL.
Method SM 4500-O G-2001	je.
Oxygen, dissolved	0.
Method SM 4500-P E-1999	12
Orthophosphate as P	IL.
Phosphorus	L.
Method SM 4500-S2 F-2000	
Sulfide	IL.
Method SM 4500-SO4 E-1997	
Sulfate	-IL
Method SM 5210 B-2001	
Biochemical oxygeri demand	0_
Carbonaceous BOD, CBOD	IL.
Method SM 5220 C-1997 Rev: 21st ED	
Chemical oxygen demand	íL.
Method SM 5310 C-2000	
Total organic carbon	IL.

Page 7 of 34

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: CWA (Solid & Hazardous Material)	
Method EPA 120.1	
Conductivity	- IL
Method EPA 160.4	
Residue-volatile	1
Method EPA 1664A Rev: 1	
Oil & Grease	n_
) <u>–</u>
Oil & Grease	- IL
	11.
Method EPA 200.7 Rev: 4.4	
Aluminum	- IL
Antimony	IL.
Arsenic	1L
Barium	L
Beryllium	<u>n</u>
Boron	-IL
Cadmium	L.
Calcium	<u>(</u> L
Chromium	
Cobalt	۱L ۲
Copper	IL.
Iron	. L.
Lead	L
Magnesium	L
Manganese	<u>n</u>
Molybdenum	iL.
Nickel	LL
Potassium	L
Selenium	L.
Silica as SiO2	n_
Silver	lL.
Sodium	
Thallium Tin	
	L.
Titanium Vanadium	IL.
Zinc	IL.
	i.
Method EPA 350.1 Rev: 2	
Ammonia	
Method EPA 353.2 Rev: 2	
Nitrate	(L.
Nitrate plus Nitrite as N	IL.
Aethod EPA 420.4 Rev; 1	
Total phenolics	íL.
Method SM 2320 B-1997	
Alkalinity as CaCO3	- 1L
	12
Method SM 2510 B-1997	
Conductivity	IL.
Method SM 4500-CI E-1997 Rev: 21st ED	
Chloride	L.

Page 8 of 34

esting /Matrix: CWA (Solid & Hazardous Material) SM 4500-CN ⁻ E-1999 nide	IL IL
	L
nide	L
	L
SM 4500-F C-1997 Rev: 21st ED	IL.
ide	
SM 4500-NH3 G Rev: 21st ED	
nonia	IL.
l Kjeldahl Nitrogen (TKN)	L
SM 4500-NO2 B-2000	
e	IL
SM 4500-NO3 F-2000	- 0
te	<u>n_</u>
te plus Nitrite as N	11-
SM 4500-P E-1999	
ophosphate as P	11- 10
phorus	₽.
SM 4500-S2 F-2000 de	
And a set of the set o	12
SM 5210 B-2001 hemical oxygen demand	IL
onaceous BOD, CBOD	IL.
SM 5220 C-1997 Rev: 21st ED	
nical oxygen demand	11_
5M 5310 C-2000	
l organic carbon	L

Page 9 of 34

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: RCRA (Non Potable Water)	
Method EPA 1311 Rev: 0	
Toxicity Characteristic Leaching Procedure (TCLP)	IL.
Method EPA 1312 Rev: 0	
Synthetic Precipitation Leaching Procedure (SPLP)	11_
	ji
Method EPA 6010B Rev: 2	
Aluminum	IL.
Antimony	IL
Arsenic	IL.
Barium	IL.
Beryllium	IL.
Boron	۱L.
Cadmium	IL.
Calcium	IL.
Chromium	IL.
Cobalt	L.
Copper	n_
Iron	IL.
Lead	IL.
Lithium	IL.
Magnesium	1L.
Manganese	1L. 1L.
Molybdenum	
Nickel	IL IL
Potassium	
Selenium	IL IL
Silica as SiO2	
Silver	IL-
Sodium	IL.
Strontium	IL .
Thallium Tin	n_
1 M 1	IL.
Titanium Vanadium	iL.
	L.
Zinc	
Nethod EPA 6010C	
Aluminum	IL.
Antimony	IL .
Arsenic	Ľ.
Barium	IL.
Beryllium	IL
Boron	L.
Cadmium	L.
Calcium	IL.
Chromium	IL.
Cobalt	IL.
Copper	LL
Iron	11
Lead	IL.
Lithium	L
Magnesium	IL
Manganese Page 10 of 34	IL.

Page 10 of 34

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: RCRA (Non Potable Water)	
Molybdenum	j)
Nickel	iL.
Potassium	IL.
Selenium	IL.
Silica as SiO2	1
Silver	ſL.
Sodium	IL.
Strontium	iL.
Thallium	lL.
Tin	IL.
Titanium	IL.
Vanadium	JL.
Zinc	IL.
lethod EPA 6020A Rev: 1	
Aluminum	iL.
Antimony	11.
Arsenic	1
Barium	1_
Beryllium	IL.
Boron	L.
Cadmium	L.
Calcium	1.
Chromium	IL.
Cobalt	L
Copper	iL.
Iron	IL.
Lead	IL.
Magnesium	IL.
Manganese	IL.
Molybdenum	lL.
Nickel	IL.
Potassium	IL
Selenium	IL.
Silver	u_
Sodium	1L-
Thallium	ji_
Vanadium	IL.
Zinc	IL.
lethod EPA 7196A Rev: 1 Chromium VI	i i
lethod EPA 7199 Rev: 0	
Chromium VI	IL.
lethod EPA 7470A Rev: 1	
	ñ.,
Mercury	IL.
Nethod EPA 8015B Rev: 2	
Diesel range organics (DRO)	<u>.</u>
Gasoline range organics (GRO)	IL.
lethod EPA 8015C	
Diesel range organics (DRO)	-IL
Gasoline range organics (GRO)	L.

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: RCRA (Non Potable Water)	
Method EPA 8015D	
Diesel range organics (DRO)	IL
Gasoline range organics (GRO)	IL.
Method EPA 8081A Rev: 1	
4,4-DDD	IL.
4,4'-DDE	IL.
4,4-DDT	IL.
Alachlor	IL.
Aldrin	IL.
alpha-BHC (alpha-Hexachlorocyclohexane)	IL.
alpha-Chlordane, cis-Chlordane	,c IL
Atrazine	IL.
beta-BHC (beta-Hexachlorocyclohexane)	L.
Chlordane (tech.)(N.O.S.)	IL
delta-BHC	11_
Dieldrin	IL.
Endosulfan I	IL.
Endosulfan II	L.
Endosulfan sulfate	L.
Endrin	Ĩ.
Endrin aldehyde	IL.
Endrin ketone	IL
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	ĨL.
gamma-Chlordane	i L
Heptachlor	L.
Heptachlor epoxide	IL.
Isodrin	IL.
Kepone	IL.
Methoxychlor	i L
Simazine	IL.
Toxaphene (Chlorinated camphene)	IL.
	10 <u>-</u>
Method EPA 8081B	
4,4'-DDD	IL.
4,4'-DDE	IL.
4,4'-DDT	L.
Alachlor	IL
Aldrin	IL.
alpha-BHC (alpha-Hexachlorocyclohexane)	L.
alpha-Chlordane, cis-Chlordane	IL.
Atrazine	IL.
beta-BHC (beta-Hexachlorocyclohexane)	1
Chlordane (tech.)(N.O.S.)	IL.
delta-BHC	IL
Dieldrin	11_
Endosulfan I	<u>IL</u>
Endosulfan II	1
Endosulfan sulfate	IL.
Endrin	L.
Endrin aldehyde	IL.
Endrin ketone	H
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	IL.

Page 12 of 34

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: RCRA (Non Potable Water)	
gamma-Chlordane	IL.
Heptachlor	IL.
Heptachlor epoxide	IL
Isodrin	IL.
Kepone	IL.
Methoxychlor	IL.
Simazine	IL I
Toxaphene (Chlorinated campnene)	16
Acthod EPA 8082 Rev: 0	
Aroclar-1016 (PCB-1016)	1
Aroclor-1221 (PCB-1221)	n_
Aroclor-1232 (PCB-1232)	IL.
Aroclor-1242 (PCB-1242)	IL
Aroclor-1248 (PCB-1248)	IL.
Aroclor-1254 (PCB-1254)	iL.
Aroclor-1260 (PCB-1260)	IL.
lethod EPA 8082A	
Aroclor-1016 (PCB-1016)	iL.
Aroclor-1221 (PCB-1221)	L.
Aroclor-1232 (PCB-1232)	IL.
Aroclor-1242 (PCB-1242)). L
Araclor-1248 (PCB-1248)	IL.
Aroclor-1254 (PCB-1254)	12
Aroclor-1260 (PCB-1260)	IL.
	(E
Aethod EPA 8151A	
2,4,5-T	IL.
2,4-D	IL
2,4-DB	<u>.</u>
Dalapon	<u>n_</u>
Dicamba Dictioner (Dictioner)	11
Dichloroprop (Dichlorprop)	IL.
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	L.
Pentachlorophenol	n
Picloram	1
Silvex (2,4,5-TP)	IL.
fethod EPA 8260B	
1,1,1,2-Tetrachloroethane	11
1,1,1-Trichloroethane	IL.
1,1,2,2-Tetrachloroethane	IL.
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	IL.
1,1,2-Trichloroethane	. IL.
1,1-Dichloroethane	IL.
1,1-Dichloroethylene	íL.
1,1-Dichloropropene	IL.
1,2,3-Trichlorobenzene	IL
1,2,3-Trichloropropane	IL.
1,2,4-Trichlorobenzene	1 IL-
1,2,4-Trimethylbenzene	L
1,2-Dibromo-3-chloropropane (DBCP)	IL.
1,2-Dibromoethane (EDB, Ethylene dibromide)	IL.
1,2-Dichlorobenzene (o-Dichlorobenzene)	IL.

Page 13 of 34

rtificate No.: 1002012020-7	Primary AE
of Testing /Matrix: RCRA (Non Potable Water)	
1,2-Dichloroethane (Ethylene dichloride)	L.
1,2-Dichloropropane	L
1,3,5-Trichlorobenzene	IL.
1,3,5-Trimethylbenzene	
1,3-Dichlorobenzene	IL .
1,3-Dichloropropane	IL.
1,4-Dichlorobenzene	11
1,4-Dioxane (1,4- Diethyleneoxide)	IL.
1-Chlorohexane	IL.
2,2-Dichloropropane	IL.
2-Butanone (Methyl ethyl ketone, MEK)	L
2-Chloroethyl vinyl ether	IL
2-Chlorotoluene	11_
2-Hexanone	Ĩ.
2-Methylnaphthalene	L
2-Nitropropane	IL.
4-Chlorotoluene	E.
4-Isopropyltoluene (p-Cymene,p-Isopropyltoluene)	E.
4-Methyl-2-pentanone (MIBK)	ĨĹ.
Acetone	IL.
Acetonitrile	Ĩ.
Acrolein (Propenal)	L
Acrylonitrile	1
Allyl chloride (3-Chloropropene)	IL.
Benzene	Ē.
Benzyl chloride	IL.
Bromobenzene	1
Bromochloromethane	L.
Bromodichloromethane	IL.
Bromoform	12 12
Carbon disulfide	Ĩ.
Carbon tetrachloride	L.
Chlorobenzene	IL.
Chlorodibromomethane	IL.
Chloroethane (Ethyl chloride)). L_
Chloroform	IL.
Chloroprene (2-Chloro-1,3-butadiene)	1
cis-1,2-Dichloroethylene	L.
	ii L
cis-1,3-Dichloropropene Dibromomethane (Methylene bromide)	ii.
Dichlorodifluoromethane (Freon-12)	IL.
	IL.
Diethyl ether Di-isopropylether (DIPE) (Isopropyl Ether)	ic.
Ethanol	1L
Ethyl acetate	IL.
Ethyl methacrylate	IL-
Ethylbenzene	IL.
Hexachlorobutadiene	12
Iodomethane (Methyl iodide)	IL.
Isobutyl alcohol (2-Methyl-1-propanol)	L.
Isopropyl alcohol (2-Propanol, Isopropanol) Isopropylbenzene	IL. IL.

Page 14 of 34

Certificate No.: 1002012020-7	Primary AB
ield of Testing /Matrix: RCRA (Non Potable Water)	
m+p-xylene	L.
Methacrylonitrile	IL.
Methyl bromide (Bromomethane)	IL.
Methyl chloride (Chloromethane)	IL.
Methyl methacrylate	IL.
Methyl tert-butyl ether (MTBE)	
Methylene chloride (Dichloromethane)	lL.
m-Xylene	IL.
Naphthalene	IL.
n-Butyl alcohol (1-Butanol, n-Butanol)	L.
n-Butylbenzene	IL.
n-Propylbenzene	IL.
o-Xylene	ſL.
Pentachloroethane	IL.
Propionitrile (Ethyl cyanide)	IL.
p-Xylene	1
sec-Butylbenzene	IL.
Styrene	ſL.
tert-Butyl alcohol	IL.
tert-Butylbenzene	L
Tetrachloroethylene (Perchloroethylene)	L
Tetrahydrofuran (THF)	IL.
Toluene	IL.
trans-1,2-Dichloroethylene	L
trans-1,3-Dichloropropylene	L
trans-1,4-Dichloro-2-butene	IL.
Trichloroethene (Trichloroethylene)	IL.
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	IL.
Vinyl acetate	IL.
Vinyl chloride	IL.
Xylene (total)	IL.
ethod EPA 8270C Rev: 3	
1,2,4,5-Tetrachlorobenzene	IL.
1,2,4-Trichlorobenzene	L.
1,2-Dichlorobenzene (o-Dichlorobenzene)	IL.
1,2-Diphenylhydrazine	R
1,3,5-Trinitrobenzene (1,3,5-TNB)	fL.
1,3-Dichlorobenzene	IL.
1,3-Dinitrobenzene (1,3-DNB)	L.
1,4-Dichlorobenzene	IL.
1,4-Dinitrobenzene	IL.
1,4-Dioxane (1,4- Diethyleneoxide)	IL.
1,4-Naphthoquinone	IL.
1,4-Phenylenediamine	IL.
1-Chloronaphthalene	L.
1-Methylnaphthalene	1L
1-Naphthylamine	n.
2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether	IL.
2,3,4,6-Tetrachlorophenol	IL.
2,4,5-Trichlorophenol	IL.
2,4,6-Trichlorophenol	iL.
	0

ertificate No.: 1002012020-7	Primary AB
d of Testing /Matrix: RCRA (Non Potable Water)	
2,4-Dimethylphenol	14
2,4-Dinitrophenol	IL.
2,4-Dinitrotoluene (2,4-DNT)	IL.
2,6-Dichlorophenol	IL.
2,6-Dinitrotoluene (2,6-DNT)	IL.
2-Acetylaminofluorene	IL.
2-Chloronaphthalene	IL.
2-Chlorophenol	IL.
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	IL
2-Methylaniline (o-Toluidine)	IL.
2-Methylnaphthalene	IL.
2-Methylphenol (o-Cresol)	IL
2-Naphthylamine	íL.
2-Nitroaniline	IL
2-Nitrophenol	IL
2-Picoline (2-Methylpyridine)	IL.
3,3'-Dichlorobenzidine	IL.
3,3'-Dimethylbenzidine	IL.
3-Methylcholanthrene	IL.
3-Methylphenol (m-Cresol)	IL.
3-Nitroaniline	ĨL.
4-Aminobiphenyl	IL.
4-Bromophenyl phenyl ether	ĨL.
4-Chloro-3-methylphenol	IL.
4-Chloroaniline	IL.
4-Chlorophenyl phenylether	IL.
4-Dimethyl aminoazobenzene	L.
4-Methylphenol (p-Cresol)	í.
4-Nitroaniline	IL.
4-Nitrophenol	IL.
4-Nitroquinoline 1-oxide	IL.
5-Nitro-o-toluidine	IL.
7,12-Dimethylbenz(a) anthracene	IL.
a-a-Dimethylphenethylamine	IL
Acenaphthene	1
Acenaphthylene	IL
Acetophenone	Ĩ.
Aniline	L
Anthracene	IL.
Aramite	
Benzidine	IL.
Benzo(a)anthracene	1
Benzo(a)pyrene	1
Benzo(b)fluoranthene	1
Benzo(g,h,i)perylene	IL.
Benzo(k)fluoranthene	IL.
Benzoic acid	IL.
Benzyl alcohol	12
bis(2-Chloroethoxy)methane	L
bis(2-Chloroethyl) ether	L
bis(2-Ethylhexyl) phthalate (DEHP)	
Butyl benzyl phthalate	IL.

Page 16 of 34

tificate No.: 1002012020-7	Primary AB
of Testing /Matrix: RCRA (Non Potable Water)	
Carbazole	1
Carbofuran (Furaden)	IL.
Chlorobenzilate	IL.
Chrysene	IL:
Diallate	IL.
Dibenz(a,h) anthracene	IL.
Dibenz(a,j) acridine	11
Dibenzofuran	IL.
Diethyl phthalate	IL
Dimethoate	IL.
Dimethyl phthalate	IL.
Di-n-butyl phthalate	IL.
	12
Di-n-octyl phthalate	
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	IL.
Diphenylamine	IL.
Ethyl methanesulfonate	IL.
Famphur	IL.
Fluoranthene	ſĽ.
Fluorene	IL.
Hexachlorobenzene	IL.
Hexachlorobutadiene	IL.
Hexachlorocyclopentadiene	IL.
Hexachloroethane	íL.
Hexachlorophene	11
Hexachloropropene	IL.
Indeno(1,2,3-cd) pyrene	IL.
Isodrin	IL.
Isophorone	IL.
Isosafrole	IL.
Kepone	1L.
Methapyrilene	IL.
Methyl methanesulfonate	IL.
Methyl parathion (Parathion, methyl)	IL.
Naphthalene	1L
Nitrobenzene	ĨL.
n-Nitrosodiethylamine	IL.
n-Nitrosodimethylamine	ĨĹ
n-Nitroso-di-n-butylamine	IL.
	IL.
n-Nitrosodi-n-propylamine n-Nitrosodiphenylamine	L.
n-Nitrosomethylethylamine	IL.
n-Nitrosomorpholine	<u>H</u>
n-Nitrosopiperidine	IL.
n-Nitrosopyrrolidine	IL.
o,o,o-Triethyl phosphorothioate	IL
Parathion	IL
Pentachlorobenzene	IL
Pentachloronitrobenzene	
Pentachlorophenol	IL.
Phenacetin	IL.
Phenanthrene	IL.
Phenol	IL.

Page 17 of 34

Certificate No.: 1002012020-7	Primary AB
eld of Testing /Matrix: RCRA (Non Potable Water)	
Phorate	IL.
p-Phenylenediamine	IL_
Pronamide (Kerb)	IL.
Pyrene	- L
Pyridine	IL.
Safrole	íL.
Thionazin (Zinophos)	IL.
lethod EPA 8270D	
1,2,4,5-Tetrachlorobenzene	IL.
1,2,4-Trichlorobenzene	IL.
1,2-Dichlorobenzene (o-Dichlorobenzene)	IL.
1,2-Diphenylhydrazine	IL.
1,3,5-Trinitrobenzene (1,3,5-TNB)	IL 1
1,3-Dichlorobenzene	IL.
1,3-Dinitrobenzene (1,3-DNB)	IL.
1,4-Dichlorobenzene	IL.
1,4-Dinitrobenzene	IL.
1,4-Dioxane (1,4- Diethyleneoxide)	1 IL
1,4-Naphthoquinone	IL.
1,4-Phenylenediamine	IL.
1-Chloronaphthalene	IL.
1-Methylnaphthalene	IL.
1-Naphthylamine	IL.
2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether	IL :
2,3,4,6-Tetrachlorophenol	IL.
2,4,5-Trichlorophenol	IL.
2,4,6-Trichlorophenol	IL.
2,4-Dichlorophenol	L
2,4-Dimethylphenol	ĨĹ.
2,4-Dinitrophenol	L
2,4-Dinitrotoluene (2,4-DNT)	IL.
2,6-Dichlorophenol	IL.
2,6-Dinitrotoluene (2,6-DNT)	IL -
2-Acetylaminofluorene	ĨĹ -
2-Chloronaphthalene	IL.
2-Chlorophenol	IL.
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	1 IL
2-Methylaniline (o-Toluidine)	IL -
2-Methylnaphthalene	iL.
2-Methylphenol (o-Cresol)	IL.
2-Naphthylamine	IL.
2-Nitroaniline	IL.
2-Nitrophenol	IL
2-Picoline (2-Methylpyridine)	i.
3,3'-Dichlorobenzidine	IL.
3,3'-Dimethylbenzidine	L.
3-Methylcholanthrene	L.
3-Methylphenol (m-Cresol)	iL
3-Nitroaniline	i L
4-Aminobiphenyl	ĨL.
4-Bromophenyl phenyl ether	L.

Page 18 of 34

ertificate No.: 1002012020-7	Primary AB
Id of Testing /Matrix: RCRA (Non Potable Water)	
4-Chloroaniline	IL.
4-Chlorophenyl phenylether	IL.
4-Dimethyl aminoazobenzene	IL.
4-Methylphenol (p-Cresol)	IL.
4-Nitroaniline	IL
4-Nitrophenol	IL.
4-Nitroquinoline 1-oxide	ĨL.
5-Nitro-o-toluidine	ĨL.
7,12-Dimethylbenz(a) anthracene	ii.
a-a-Dimethylphenethylamine	íĽ.
Acenaphthene	iL.
Acenaphthylene	L.
Acetophenone	L.
Aniline	IL.
Anthracene	
Aramite	IL.
	IL I
Benzidine	L.
Benzo(a)anthracene	
Benzo(a)pyrene	IL.
Benzo(b)fluoranthene	IL.
Benzo(g,h,i)perylene	n_
Benzo(k)fluoranthene	IL-
Benzoic acid	IL.
Benzyl alcohol	IL.
bis(2-Chloroethoxy)methane	0_
bis(2-Chloroethyl) ether	1L.
bis(2-Ethylhexyl) phthalate (DEHP)	IL.
Butyl benzyl phthalate	1L-
Carbazole	L.
Carbofuran (Furaden)	IL.
Chlorobenzilate	IL.
Chrysene	IL.
Diallate	IL.
Dibenz(a,h) anthracene	IL.
Dibenz(a,j) acridine	IL.
Dibenzofuran	IL.
Diethyl phthalate	11_
Dimethoate	IL.
Dimethyl phthalate	IL.
Di-n-butyl phthalate	IL.
Di-n-octyl phthalate	IL.
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	IL.
Diphenylamine	IL.
Ethyl methanesulfonate	IL.
Famphur	Ĩ.
Fluoranthene	Ĩ.
Fluorene	IL I
Hexachlorobenzene	IL.
Hexachlorobutadiene	
Hexachlorocyclopentadiene	iL.
Hexachloroethane	L.
A STATE OF A	
Hexachlorophene	11-

Page 19 of 34

Certificate No.: 1002012020-7	Primary AE
ield of Testing /Matrix: RCRA (Non Potable Water)	
Hexachloropropene	
Indeno(1,2,3-cd) pyrene	IL.
Isodrin	IL:
Isophorone	IL.
Isosafrole	IL.
Kepone	IL.
Methapyrllene	IL.
Methyl methanesulfonate	IL.
Methyl parathion (Parathion, methyl)	IL.
Naphthalene	IL.
Nitrobenzene	L
n-Nitrosodiethylamine	IL.
n-Nitrosodimethylamine	11_
n-Nitroso-di-n-butylamine	,e
n-Nitrosodi-n-propylamine	11_
n-Nitrosodiphenylamine	11_
n-Nitrosomethylethylamine	IL.
	1
n-Nitrosomorpholine	IL.
n-Nitrosopiperidine	
n-Nitrosopyrrolidine	IL.
o,o,o-Triethyl phosphorothioate	L
Parathion	L.
Pentachlorobenzene	<u>n_</u>
Pentachloronitrobenzene	IL.
Pentachlorophenol	IL.
Phenacetin	IL.
Phenanthrene	<u>IL</u>
Phenol	IL.
Phorate:	IL.
p-Phenylenediamine	IL.
Pronamide (Kerb)	IL.
Pyrene	IL.
Pyridine	IL'
Safrole	IL.
Thionazin (Zinophos)	IL.
ethod EPA 9012B	
Cyanide	L.
	12
Alethod EPA 9014 Rev: 0	
Cyanide	IL.
Method EPA 9034 Rev: 0	
Sulfide	IL.
Method EPA 9038 Rev: 0	
Sulfate	ſL:
	14-
Aethod EPA 9040B Rev: 2	
рH	IL.
Aethod EPA 9040C	
рН	IL.
Nethod EPA 9050A Rev: 1	
Conductivity	IL.
lethod EPA 9056A	14-

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: RCRA (Non Potable Water)	
Bromide	L
Chloride	L
Fluoride	IL.
Nitrate	IL.
Nitrite	IL
Orthophosphate as P	1L
Sulfate	IL.
Method EPA 9060A	
Total organic carbon	۱L.
Method EPA 9066 Rev: 0	
Total phenolics	AL.
Method EPA 9071B	
Oil & Grease	IL .
Method EPA 9095A	
Paint Filter Test	IL.
Method EPA 9095B	
Paint Filter Test	11_
Method EPA 9251 Rev: 0	
Chloride	1
	12

Page 21 of 34

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: RCRA (Solid & Hazardous Material)	
Method EPA 1311 Rev: 0	
Toxicity Characteristic Leaching Procedure (TCLP)	IL.
Method EPA 1312 Rev: 0	
Synthetic Precipitation Leaching Procedure (SPLP)	
그 같은 것 같은	12
Method EPA 6010B Rev: 2	
Aluminum	IL.
Antimony	1
Arsenic	IL.
Barium	IL
Beryllium	IL.
Boron	IL.
Cadmium	IL-
Calcium	IL.
Chromium	L.
Cobalt	IL.
Copper	IL.
Iron	IL.
Lead	IL.
Lithium	IL.
Magnesium	IL.
Manganese	IL.
Molybdenum	L.
Nickel	IL.
Potassium	L.,
Selenium	IL.
Silica as SiO2	L
Silver	IL.
Sodium	IL.
Strontium	IL.
Thallium	L.
Tin	IL.
Titanium	L
Vanadium	<u>IL</u>
Zinc	R
Method EPA 6010C	
Aluminum	IL.
Antimony	12
Arsenic	IL.
Barium	IL.
Beryllium	IL.
Boron	11
Cadmium	IL.
Calcium	IL.
Chromium	IL
Cobalt	IL
Copper	IL.
Iron	IL.
Lead	IL.
Lithium	IL.
Magnesium	IL
Manganese	IL.
Page 22 of 34	

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: RCRA (Solid & Hazardous Material)	
Molybdenum	íL.
Nickel	L.
Potassium	IL.
Selenium	IL.
Silica as SIO2	L.
Silver	íL.
Sodium	n_
Strontium	- IL
Thallium	IL.
Tin	L.
Titanium	IL.
Vanadium	IL.
Zinc	- IL
Method EPA 7196A Rev: 1	
Chromium VI	(L
	12
Method EPA 7471B	
Mercury	1L
Method EPA 8015B Rev: 2	
Diesel range organics (DRO)	IL.
Gasoline range organics (GRO)	L
Method EPA 8015C	
Diesel range organics (DRO)	IL.
Gasoline range organics (GRO)	IL.
Method EPA 8015D	
Diesel range organics (DRO)	IL.
Gasoline range organics (GRO)	iL.
	ii.
Method EPA 8081A Rev: 1	
4,4-DDD	IL.
4,4-DDE	IL.
4,4'-DDT	IL.
Alachlor	L.
Aldrin	L.
alpha-BHC (alpha-Hexachlorocyclohexane)	IL.
alpha-Chlordane, cis-Chlordane	IL.
Atrazine	1L
beta-BHC (beta-Hexachlorocyclohexane)	(L
Chlordane (tech.)(N.O.S.)	IL.
delta-BHC	IL.
Dieldrin	IL
Endosulfan I	IL.
Endosulfan II	IL
Endosulfan sulfate	IL
Endrin	IL.
Endrin aldehyde	- IL
Endrin ketone	IL.
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	IL.
gamma-Chlordane	L
Heptachlor	IL.
Heptachlor epoxide	IL.
Isodrin	(L

Certificate No.: 1002012020-7	Primary AB
eld of Testing /Matrix: RCRA (Solid & Hazardous Material)	
Kepone	0
Methoxychlor	ſĿ.
Simazine	IL.
Toxaphene (Chlorinated camphene)	IL.
ethod EPA 8081B	
4,4'-DDD	11
4,4-DDE	IL-
4,4'-DDT	IL.
Alachlor	IL.
Aldrin	IL.
alpha-BHC (alpha-Hexachlorocyclohexane)	1.
alpha-Chlordane, cis-Chlordane	IL.
Atrazine	IL.
beta-BHC (beta-Hexachlorocyclohexane)	IL.
Chlordane (tech.)(N.O.S.)	L.
delta-BHC	IL.
Dieldrin	IL.
Endosulfan I	L
Endosulfan II	- IL .
Endosulfan sulfate	IL.
Endrin	ſĽ.
Endrin aldehyde	IL.
Endrin ketone	IL.
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane) gamma-Chlordane	1L.
Heptachlor	IL.
Heptachlor epoxide	IL.
Isodrin	IL.
Kepone	IL.
Methoxychlor	IL.
Simazine	IL.
Toxaphene (Chlorinated camphene)	fL_
thod EPA 8082 Rev: 0	
Aroclor=1016 (PCB-1016)	1
Aroclor-1221 (PCB-1221)	IL.
Aroclor-1232 (PCB-1232)	1
Aroclor-1242 (PCB-1242)	IL.
Aroclor-1248 (PCB-1248)	IL.
Aroclor-1254 (PCB-1254)	11
Aroclor-1260 (PCB-1260)	IL.
thod EPA 8082A	
Aroclor-1016 (PCB-1016)	IL.
Aroclor-1221 (PCB-1221)	n_
Aroclor-1232 (PCB-1232)	ſL.
Aroclor-1242 (PCB-1242)	IL.
Aroclor-1248 (PCB-1248)	IL.
Aroclor-1254 (PCB-1254)	IL
Aroclor-1260 (PCB-1260)	IL.
thod EPA 8151A	
2,4,5-T	IL-
2,4-D	IL.
Page 24 of 34	

ertificate No.: 1002012020-7	Primary AB
Id of Testing /Matrix: RCRA (Solid & Hazardous Material)	
2,4-DB	L.
Dalapon	IL.
Dicamba	IL
Dichloroprop (Dichlorprop)	IL.
Pentachlorophenol	IL.
Picloram	IL.
Silvex (2,4,5-TP)	IL .
ethod EPA 8260B	
1,1,1,2-Tetrachloroethane	IL
1,1,1-Trichloroethane	1L.
1,1,2,2-Tetrachloroethane	IL.
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	IL.
1,1,2-Trichloroethane	IL.
1,1-Dichloroethane	IL .
1,1-Dichloroethylene	iL.
1,1-Dichloropropene	IL.
1,2,3-Trichlorobenzene	IL.
1,2,3-Trichloropropane	IL.
1,2,4-Trichlorobenzene	IL.
1,2,4-Trimethylbenzene	IL.
1,2-Dibromo-3-chloropropane (DBCP)	IL
1,2-Dibromoethane (EDB, Ethylene dibromide)	IL.
1,2-Dichlorobenzene (o-Dichlorobenzene)	iL.
1,2-Dichloroethane (Ethylene dichloride)	IL.
1,2-Dichloropropane	ĨĹ.
1,3,5-Trichlorobenzene	IL.
1,3,5-Trimethylbenzene	11_
1,3-Dichlorobenzene	ΪL.
1,3-Dichloropropane	IL
1,4-Dichlorobenzene	IL.
1,4-Dioxane (1,4- Diethyleneoxide)	IL.
1-Chlorohexane	íL.
2,2-Dichloropropane	IL.
2-Butanone (Methyl ethyl ketone, MEK)	IL.
2-Chloroethyl vinyl ether	IL.
2-Chlorotoluene	n_
2-Hexanone	IL.
2-Methylnaphthalene	IL
2-Nitropropane	IL.
4-Chlorotoluene	IL.
4-Isopropyltoluene (p-Cymene,p-Isopropyltoluene)	Ĩ.
4-Methyl-2-pentanone (MIBK)	IL.
Acetone	11_
Acetonitrile	ĨĹ.
Acrolein (Propenal)	11
Acrylonitrile	L.
Allyl chloride (3-Chloropropene)	íL.
Benzene	L
Benzyl chloride	1L
Bromobenzene	u_ IL
biotificactice ()c	10-
Bromochloromethane	IL

Page 25 of 34

tificate No.: 1002012020-7	Primary AE
of Testing /Matrix: RCRA (Solid & Hazardous Material)	
Bromoform	1 D_
Carbon disulfide	11_
Carbon tetrachloride	IL
Chlorobenzene	IL.
Chlorodibromomethane	16
Chloroethane (Ethyl chloride)	IL.
Chloroform	n.
Chloroprene (2-Chloro-1,3-butadiene)	IL.
cis-1,2-Dichloroethylene	IL.
cis-1,3-Dichloropropene	IL.
Dibromomethane (Methylene bromide)	IL.
Dichlorodifluoromethane (Freon-12)	IL
Diethyl ether	IL.
Di-isopropylether (DIPE) (Isopropyl Ether)	IL.
Ethanol	IL.
Ethyl acetate	IL.
Ethyl methacrylate	IL.
Ethylbenzene	IL.
Hexachlorobutadiene	IL.
lodomethane (Methyl iodide)	L.
Isobutyl alcohol (2-Methyl-1-propanol)	L
Isopropyl alcohol (2-Propanol, Isopropanol)	L
	IL.
lsopropylbenzene m+p-xylene	IL.
	L.
Methacrylonitrile	
Methyl bromide (Bromomethane)	IL.
Methyl chloride (Chloromethane)	L.
Methyl methacrylate	IL.
Methyl tert-butyl ether (MTBE)	IL.
Methylene chloride (Dichloromethane)	IL.
m-Xylene	IL.
Naphthalene	IL.
n-Butyl alcohol (1-Butanol, n-Butanol)	IL.
n-Butylbenzene	IL
n-Propylbenzene	IL.
o-Xylene	IL.
Pentachloroethane	IL.
Propionitrile (Ethyl cyanide)	IL.
p-Xylene	IL.
sec-Butylbenzene	IL.
Styrene	IL
tert-Butyl alcohol	- H
tert-Butylbenzene	11
Tetrachloroethylene (Perchloroethylene)	íL.
Tetrahydrofuran (THF)	IL.
Toluene	IL.
trans-1,2-Dichloroethylene	1L
trans-1,3-Dichloropropylene	1
trans-1,4-Dichloro-2-butene	ſL.
Trichloroethene (Trichloroethylene)	IL.
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	IL.
Vinyl acetate	IL.

Page 26 of 34

L L L L L L L L
L L L L L L
և և և և և
և Ա Ա Ա
և Ա Ա Ա
և Ա Ա
1L 1L 1L
IL IL IL
IL. IL
IL.
IL.
IL
IL.
IL.
IL
IL.
IL
IL
IL
IL.
IL
IL
íL.
IL.
IL.
IL.
IL.
n.
IL.
IL.
IL-
IL.
IL.
IL
Ĩ.
iL.
IL.
íL.
IL.
IL.
IL.
IL.

Page 27 of 34

rtificate No.: 1002012020-7	Primary AB
of Testing /Matrix: RCRA (Solid & Hazardous Material)	
4-Nitrophenol	- D_
4-Nitroquinoline 1-oxide	11_
5-Nitro-o-toluidine	IL
7,12-Dimethylbenz(a) anthracene	IL-
a-a-Dimethylphenethylamine	IL.
Acenaphthene	IL.
Acenaphthylene	IL I
Acetophenone	IL.
Aniline	IL.
Anthracene	IL .
Aramite	IL.
Benzidine	IL
Benzo(a)anthracene	11_
Benzo(a)pyrene	IL.
Benzo(b)fluoranthene	Ĩ.
Benzo(g,h,i)perylene	IL.
Benzo(k)fluoranthene	L
Benzoic acid	ĨĹ.
Benzyl alcohol	IL.
bis(2-Chloroethoxy)methane	IL.
bis(2-Chloroethyl) ether	iL.
bis(2-Ethylhexyl) phthalate (DEHP)	IL.
Butyl benzyl phthalate	11_
Carbazole	IL.
Carbofuran (Furaden)	ĨĹ.
Chlorobenzilate	IL.
Chrysene	L.
Diallate	iL.
Dibenz(a,h) anthracene	ĨL.
Dibenz(a,j) acridine	IL.
Dibenzofuran	ii.
Diethyl phthalate	IL.
Dimethoate	IL
Dimethyl phthalate	IL
Di-n-butyl phthalate	12
Di-n-octyl phthalate	IL
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	iL
Diphenylamine	IL.
Ethyl methanesulfonate	IL.
Famphur	IL.
Fluoranthene	IL.
Fluorene	IL.
Hexachlorobenzene	i.
Hexachlorobutadiene	IL.
Hexachlorocyclopentadiene	,c L
Hexachloroethane	IL.
Hexachlorophene	IL.
Hexachloropropene	
Indeno(1,2,3-cd) pyrene	IL.
Isodrin	IL.
	IL.
Isosafrole	IL.
Page 28 of 34	IL.

Certificate No.: 1002012020-7	Primary AB
ield of Testing /Matrix: RCRA (Solid & Hazardous Material)	
Kepone	íL.
Methapyrilene	n
Methyl methanesulfonate	IL.
Methyl parathion (Parathion, methyl)	- IL
Naphthalene	IL.
Nitrobenzene	0
n-Nitrosodiethylamine	n_
n-Nitrosodimethylamine	16
n-Nitroso-di-n-butylamine	10
n-Nitrosodi-n-propylamine	(L
n-Nitrosodiphenylamine	íL.
n-Nitrosomethylethylamine	n_
n-Nitrosomorpholine	IL.
n-Nitrosopiperidine	ĨL.
n-Nitrosopyrrolidine	0
o,o,o-Triethyl phosphorothioate	Ĩ.
Parathion	Ĩ.
Pentachlorobenzene	IL.
Pentachloronitrobenzene	IL.
Pentachlorophenol	Ĩ.
Phenacetin	L
Phenanthrene	L.
Phenol	IL
Phorate	
	IL.
p-Phenylenediamine	
Pronamide (Kerb)	IL.
Pyrene	ſ∟
Pyridine	IL
Safrole	IL.
Thionazin (Zinophos)	L
ethod EPA 8270D	
1,2,4,5-Tetrachlorobenzene	IL.
1,2,4-Trichlorobenzene	IL
1,2-Dichlorobenzene (o-Dichlorobenzene)	(L
1,2-Diphenylhydrazine	<u>n</u>
1,3,5-Trinitrobenzene (1,3,5-TNB)	IL.
1,3-Dichlorobenzene	11.
1,3-Dinitrobenzene (1,3-DNB)	- IL-
1,4-Dichlorobenzene	0_
1,4-Dinitrobenzene	n
1,4-Dloxane (1,4- Dlethyleneoxide)	0_
1,4-Naphthoquinone	
1,4-Phenylenediamine	1L
1-Chloronaphthalene	IL.
1-Methylnaphthalene	n_
1-Naphthylamine	IL.
2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether	IL.
2,3,4,6-Tetrachlorophenol	L
2,4,5-Trichlorophenol	í.
2,4,6-Trichlorophenol	íL.
2,4-Dichlorophenol	íL.
2,4-Dimethylphenol	L.
Page 29 of 34	12

rtificate No.: 1002012020-7	Primary AE
of Testing /Matrix: RCRA (Solid & Hazardous Material)	
2,4-Dinitrophenol	12
2,4-Dinitrotoluene (2,4-DNT)	IL.
2,6-Dichlorophenol	IL.
2,6-Dinitrotoluene (2,6-DNT)	IL
2-Acetylaminofluorene	ĨL.
2-Chloronaphthalene	ĨL.
2-Chlorophenol	IL.
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	IL.
2-Methylaniline (o-Toluidine)	IL.
2-Methylnaphthalene	IL.
2-Methylphenol (a-Cresol)	IL.
	IL.
2-Naphthylamine 2-Nitroaniline	
	IL. IL
2-Nitrophenol	
2-Picoline (2-Methylpyridine)	IL.
3,3'-Dichlorobenzidine	IL.
3,3'-Dimethylbenzidine	IL.
3-Methylcholanthrene	L
3-Methylphenol (m-Cresol)	IL.
3-Nitroaniline	IL.
4-Aminobiphenyl	IL.
4-Bromophenyl phenyl ether	IL.
4-Chloro-3-methylphenol	0_
4-Chloroaniline	IL.
4-Chlorophenyl phenylether	IL.
4-Dimethyl aminoazobenzene	IL.
4-Methylphenol (p-Cresol)	IL.
4-Nitroaniline	IL.
4-Nitrophenol	IL
4-Nitroquinoline 1-oxide	IL.
5-Nitro-o-toluidine	IĹ.
7,12-Dimethylbenz(a) anthracene	IL.
a-a-Dimethylphenethylamine	IL.
Acenaphthene	IL.
Acenaphthylene	IL.
Acetophenone	IL.
Aniline	L
Anthracene	IL.
Aramite	L.
Benzidine	IL.
Benzo(a)anthracene	IL.
Benzo(a)pyrene	11
Benzo(b)fluoranthene	IL .
Benzo(g, h,i)perylene	IL.
Benzo(k)fluoranthene	IL.
Benzoic acid	IL
Benzyl alcohol	ĨL.
bis(2-Chloroethoxy)methane	i L
bis(2-Chloroethyl) ether	ĨĹ
bis(2-Ethylhexyl) phthalate (DEHP)	L.
Butyl benzyl phthalate	L.
Carbazole	1L.
Valuatore	

ChloroberzilateLChryseneLChryseneLDiberz(a, h) anthraceneLDiberz(a, h) anthraceneLDiberz(a, h) anthraceneLDiberz(a, h) anthraceneLDiberz(a, h) anthraceneLDiberz(a, h) anthraceneLDimethodateLDimethodateLDimethodateLDimethodateLDin-ockyl phthalateLDin-ockyl phthalateLDin-ockyl phthalateLDinethodateLDipherylamineLEtryl methanesulfonateLFluoranteneLFluoranteneLFluoranteneLFluoranteneLHexachlorobuldeneLHexachlorobuldeneLHexachlorobuldeneLHexachlorobuldeneLIsodrinLIsodrinLIsodrinLIsodrinLNarober eneLHexachlorobuldylamineLNarober eneLNarober eneLNarober eneLNarober eneLNarober eneLIsodrinLIsodrinLIsodrinLNarober eneLNarober eneLNarober eneLNarober eneLNarober eneLNarober eneLNarober eneLNarober eneLNarobe	Primary AB
ChiorobenziateILChryseneILChryseneILDiberz(a, h) anthraceneILDibenz(a, h) anthraceneILDibenz(a, h) anthraceneILDiberz(a, h) anthraceneILDiberz(a, h) anthraceneILDimethouseneILDimethouseneILDimethouseneILDimethouseneILDimethouseneILDimethouseneILDin-ocky i phrilateILDin-ocky i phrilateILDinethouseneILDinethouseneILDinethouseneILDinethouseneILDinethouseneILDinethouseneILExportanteneILFluoranteneILFluoranteneILFluoranteneILHexachiorocyclopentadieneILHexachiorocyclopentadieneILHexachiorocyclopentadieneILIsodrinILIsodrinILIsodrinILIsodrinILIsodrinILNarobenzeneILNarobenzeneILNarobenzeneILNarobenzeneILNarobenzeneILNarobenzeneILNarobenzeneILNarobenzeneILNarobenzeneILNarobenzeneILNarobenzeneILNarobenzeneILNarobenzeneILNarobenzeneILPe	
ChryseneLDialitateLDialitateLDialitateLDiberz(a, I) acridineLDiberz(a, I) acridineLDiberz(a, I) acridineLDirethyl prihalateLDimethyl prihalateLDin-ockyl prihalateLDin-ockyl prihalateLDinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)LDinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)LHymathianeLHymathianeLHymathianeLHymathianeLHexachloropheneLHexachloropheneLLexachloropheneLLexachloropheneLLexachloropheneLLexachloropheneLNotroberzeneLNotroberzeneLNitrosociterhylamineLNitrosociterhylamineLNitrosociterhyl	IL.
DialisteILDialisteILDiberz(a) artifanceILDiberz(a) artifanceILDiberz(a) artifanceILDiberz(a) phtalateILDinettodeILDinettodeILDinettodeILDinettodeILDinettodeILDin-octyl phthalateILDin-octyl phthalateILDin-octyl phthalateILDin-octyl phthalateILDin-octyl phthalateILDinosto (2-sec-but)-4.6-dinitrophenol, DNBP)ILDinosto (2-sec-but)-4.6-dinitrophenol, DNBP)ILDinosto (2-sec-but)-4.6-dinitrophenol, DNBP)ILDinosto (2-sec-but)-4.6-dinitrophenol, DNBP)ILDinosto (2-sec-but)-4.6-dinitrophenol, DNBP)ILDipherylamineILExportanteneILFluoranteneILFluoranteneILFluoranteneILFluoranteneILFluoranteneILFluoranteneILIndexachioropheneILHexachioropheneILIsodrinILIsodrinILIsodrinILIsodrinILIsodrinILIsodrinILIsodrinILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrosopyroline <td>íL.</td>	íL.
DialitateLDibera(a, h) anthraceneLDibera(a, h) anthraceneLDibera(a, h) anthraceneLDibera(a, h) anthraceneLDibera(a, h) anthraceneLDibera(a, h) anthraceneLDibera(a, h) anthraceneLDimethodeLDimethodeLDimethodeLDin-body InthalateLDin-ocdy InthalateLDin-ocdy InthalateLDin-ocdy InthalateLDin-ocdy InthalateLDin-ocdy InthalateLDin-ocdy InthalateLDin-ocdy InthalateLDin-ocdy InthalateLDin-ocdy InthalateLDinoredo (2-sec-bud)-4.6-dintrophenol, DNBP)LDinoredo (2-sec-bud)-4.6-dintrophenol, DNBP)LEthy methanesulfonateLEthy methanesulfonateLHexachlorochenzeneLHexachlorochenzeneLHexachlorochenzeneLHexachlorochenzeneLHexachlorochenzeneLHexachlorochenzeneLLesachlorochenzeneLLesachlorochenzeneLMethapyrilereLMethapyrilereLMethapyrilereLNitrosocilerty antineLNitrosocilerty antineLNitrosocilerty antineLNitrosocilerty antineLNitrosocilerty antineLNitrosocilerty antineLNitrosocilerty antineL </td <td>IL.</td>	IL.
Diberz(a,h) anthraceneLDiberz(a,h) acridineLDiberz(a,h) acridineLDiberz(a,h) acridineLDiberz(a,h) acridineLDimethyl phthalateLDin-nockyl phthalateLHexachiorocylopentadieneLHexachiorocylopentadieneLHexachiorocylopentadieneLI Indeno(1,2,3-od) pyreneLI IsosofroleLI IsosofroleLI IsosofroleLNitrosocin-notylamineLNitrosocin-notylamineLNitrosocin-notylamineLNitrosocin-notylamineLNitrosocin-notyle phthaleneLNitrosocin-notyle phthaleneLNitrosocin-notyle phthaleneLNitrosocin-notyle phthaleneLNitrosocin-notyle phthaleneL	IL.
Diberz(a,j) acridine L Diberzofuran L Diberzofuran L Dimethyl phthalate L Dimethyl phthalate L Din-butyl phthalate L Din-butyl phthalate L Din-butyl phthalate L Din-butyl phthalate L Dinoseb (2-sec-butyl-46-dinitrophenol, DNBP) L Ethyl methanesulfonate L Hexachlorobutadiene L Hexachlorobutadiene L Hexachlorobutadiene L Hexachlorophene L Hexachlorophene L Hexachlorophene L Isophralene L	
DibersofuranILDiretholateILDiretholateILDiretholateILDirn-dxly phthalateILDin-dxly phthalateILDin-dxly phthalateILDiphenylamineILDiphenylamineILFly methanesulfonateILFloraneILFloraneILFloraneILFloraneILHexachlorobenzeneILHexachlorobenzeneILHexachloropheneILHexachloropheneILIndenofitILIsodarineILIsodarineILIsodarineILIndenofitILIsodarineILIndenofitILIsodarineILIndenofitILIsodarineILIsodarineILIsodarineILIsodarineILIsodarineILIsodarineILIsodarineILIsodarineILNaphthaleneILNitrosodi-n-bulylamineIL- NitrosodientylamineIL- NitrosodientylamineIL- NitrosopiperidineIL- NitrosopiperidineIL- NitrosopiperidineIL- NitrosopiperidineIL- NitrosopiperidineIL- NitrosopiperidineIL- NitrosopiperidineIL- NitrosopiperidineIL- NitrosopiperidineIL-	
Diethyl phthalateILDimethyl phthalateILDinnethyl phthalateILDinnebul yl phthalateILDinnebul / Secolutyl Af-Ginitrophenol, DNBP)ILDinnebul / Secolutyl Af-Ginitrophenol, DNBP)ILDiphenylamineILEthyl methanesulfonateILFluorantheneILFluorantheneILFluorantheneILHexachlorobenzeneILHexachloropheneILHexachloropheneILHexachloropheneILHexachloropheneILIsopartinILIsopartinILIsopartinILIsopartinILIsopartinILIsopartinILIsopartinILIsopartinILIsopartinILIsopartinILIsopartinILIsopartinILIsopartinILIsopartinILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrosopieridineILNitrosopieridineILNitrosopieridineILNitrosopieridineILNitrosopieridineILNitrosopieridineILNitrosopieridineILPentachlorophoneILPentachlorophoneILPentachloropheneILPentachloropheneILPentachlorophene <t< td=""><td></td></t<>	
DimetholateILDimethyl phthalateILDin-bodyl phthalateILDin-bodyl phthalateILDin-bodyl phthalateILDin-bodyl phthalateILDinbernylamineILEthyl methanesulfonateILFamphurILFluorantheneILFluorantheneILFluorantheneILFluorantheneILHexachlorobutadieneILHexachloropheneILHexachloropheneILHexachloropheneILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILIsodarinILNitrobenzeneIL-NitrosodientylamineIL-NitrosodientylethylamineIL-NitrosopiperidineILIsolarineIL-NitrosopiporineIL-NitrosopiporineIL-NitrosopiperidineIL-NitrosopiperidineIL-NitrosopiperidineIL-NitrosopiperidineIL-NitrosopiperidineIL-Nitrosopiperidie <td></td>	
Dimethyl phthalateLDin-butyl phthalateLDin-butyl phthalateLDinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)LDiphenylamineLEthyl methanesulfonateLFamphurLFluorantheneLFluorantheneLFluorantheneLHexachlorobenzeneLHexachlorobenzeneLHexachloropenadieneLHexachloropenadieneLHexachloropenadieneLHexachloropeneLIdenci (1, 2, 3cd) pyreneLIsodrinLIsodrinLIsosafroleLMethyl prathion (Parathion, methyl)LNitrobenzeneLn-NitrosodiethylamineLn-NitrosodinethylamineLn-NitrosodinethylamineLn-NitrosodinethylamineLn-NitrosodinethylamineLn-NitrosodinethylamineLn-NitrosodinethylamineLn-NitrosodinethylamineLn-NitrosodinethylamineLn-NitrosodinethylamineLn-NitrosodinethylamineLn-NitrosodinethylamineLn-NitrosopiperidineLn-NitrosopiperidineLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzene<	
Din-buily iphthalateILDin-buily iphthalateILDinoseb (2-se-buily-4-6-dinitrophenol, DNBP)ILDiphenylamineILEthyl methanesulfonateILFamphurILFluorantheneILFluorantheneILFluorantheneILHexachlorobutadieneILHexachlorobutadieneILHexachloropheneILHexachloropheneILHexachloropheneILIsodafroleILIsodafroleILIsodafroleILIsodafroleILIsodafroleILIsodafroleILIsodafroleILIsodafroleILIsodafroleILIsodafroleILIsodafroleILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrosodiphenylamineILNitrosopiprolineILNitrosopiprolineILPentachloroberzeneILPentachloroberzeneILPentachloroberzeneILPentachloroberzeneILPentachloroberzeneILPentachloroberzeneILPentachloroberzeneILPentachloroberzeneIL </td <td></td>	
Din-octyl phthalateLDinoseb (2-sec-but/-4.6-dinitrophenol, DNBP)LDipherylamineLEthyl methanesulfonateLEthyl methanesulfonateLEthyl methanesulfonateLFluorantheneLFluorantheneLFluorantheneLHexachlorobenzeneLHexachlorocyclopentadieneLHexachlorocyclopentadieneLHexachloropheneLHexachloropheneLHexachloropheneLIndeno(1,2,3-cd) pyreneLIsophoroneLIsophoroneLIsophoroneLMethapynieneLMethapynieneLNitrobenzeneLNitrobenzeneLNitrobenzeneLNitrobenzeneLNitrobenzeneLNitrobenzeneLNitrosodimethylamineLNitrosodinethylamineLNitrosodinethylamineLNitrosodinethylamineLNitrosodinethylamineLNitrosodinethylamineLNitrosodinethylamineLNitrosodinethylamineLNitrosopipenidineLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneL	
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)LDipherylamineLDipherylamineLFamphurLFamphurLFluorantheneLFluorantheneLHexachlorobetzeneLHexachlorobetzeneLHexachlorobetzeneLHexachlorobetzeneLHexachloropolabetalieneLHexachloropolabetalieneLHexachloroporgeneLIndeno(1,2,3-cd) pyreneLIsodaforeLIsodaforeLIsodaforeLNethalpyrileneLMethapyrileneLNitrosodi-n-butylamineL-Nitrosodi-n-butylamineL-Nitrosodi-n-butylamineL-Nitrosodi-n-butylamineL-NitrosodineLNitroberzeneL-NitrosodineL-NitrosodineL-NitrosodineL-NitrosodineL-NitrosodineL-NitrosodineL-NitrosodineL-NitrosophorineL-NitrosophorineL-NitrosophorineL-NitrosophorineL-NitrosophorineL-NitrosophorineL-NitrosophorineL-NitrosophorineL-NitrosophorineL-NitrosophorineL-NitrosophorineL-NitrosophorineL-NitrosophorineL-NitrosophorineL<	
DiphenylamineILEthyl methanesulfonateILEhyl methanesulfonateILFamphurILFluorantheneILFluorantheneILHexachlorobenzeneILHexachlorobutadieneILHexachlorobutadieneILHexachloropheneILHexachloropheneILIndeno(1,2,3-cd) pyreneILIsophoroneILIsophoroneILIsophoroneILMethyl methanesulfonateILMethyl methanesulfonateILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrobenzeneILNitrosodientylamineILNitrosodientylamineILNitrosomothylettylamineILNitrosomothylettylamineILNitrosomothylettylamineILNitrosomothylettylamineILNitrosomothylettylamineILNitrosomothylettylamineILNitrosomothylettylamineILNitrosomothylettylamineILParathionILParathionILParathionILPertachlorobenzeneILPertachlorobenzeneILPertachlorobenzeneILPhenacetinILPhenacetinILPhenacetinILPhenacetinILPhenacetinILPhenacetin <t< td=""><td></td></t<>	
Ethyl methanesulfonateLFamphurLFluorantheneLFluorantheneLHexachlorobenzeneLHexachlorobenzeneLHexachloropolopentadieneLHexachloropolopentadieneLHexachloropopeneLHexachloropopeneLIsodrinLIsodrinLIsodrinLIsodrinLIsodrinLIsodrinLIsodrinLIsodrinLIsodrinLIsodrinLIsodrinLIndenci (1, 2, 3-cd) pyreneLIsodrinLIsodrinLIsodrinLIndenci (1, 2, 3-cd) pyreneLIsodrinLIsodrinLIsodrinLIndenci (1, 2, 3-cd) pyreneLIsodrinLIsodrinLIsodrinLIsodrinLIsodrinLNethyl parthion (Parathion, methyl)LNaphthaleneLIn-NitrosodientylamineLIn-NitrosodientylamineLIn-NitrosodientylamineLIn-NitrosodientylamineLIn-NitrosophorpridineLIn-NitrosophorpridineLIn-NitrosophorpridineLIn-NitrosophorpridineLIn-NitrosophorpridineLIn-NitrosophorpridineLPertachlorobenzeneLPertac	
Famphur L Fluoranthene L Fluoranthene L Fluoranthene L Hexachlorobenzene L Hexachlorobutadiene L Hexachlorocyclopentadiene L Hexachlorocyclopentadiene L Hexachlorocyclopentadiene L Hexachlorocyclopenta L Hexachlorocyclopene L Hexachlorocyclopene L Isdorin L Kepone L Methapyrilene L Methyl parathion (Perathion, methyl) L Naphthalene L n-Nitrosodienhylamine L n-Nitrosodienhylamine L n-Nitrosodiphenylamine L	
FluorantheneILFluoraneILHexachlorobenzeneILHexachlorobutadieneILHexachlorobutadieneILHexachloropothadieneILHexachloropothaneILHexachloropotheneILIndeno(1,2,3-cd) pyreneILIsodrinILIsodrinILIsodrinILIsodrinILIsodrinILKeponeILMethapyrileneILMethapyrileneILMethyl parathion (Parathion, methyl)ILNitrobenzeneILNitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodinethylamineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILperatakloropholineILPeratakloropholineILPertachloropholineILPentachloropholineILPentachloropholineILPentachloropholineILPentachloropholineILPentachlorophoneILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILP	
FluoreneILHexachlorobenzeneILHexachlorobenzeneILHexachloropentadieneILHexachloropheneILHexachloropheneILHexachloropheneILHexachloropheneILIsodrinILIsodrinILIsodrinILIsosafroleILKeponeILMethapyrileneILMethyl parathion (Parathion, methyl)ILNitrobenzeneILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILn-NitrosopholineILPertachlorobenzeneILPertachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneIL	
HexachlorobenzeneILHexachlorobutadieneILHexachlorocyclopentadieneILHexachlorocyclopentadieneILHexachloropheneILHexachloropheneILHexachloropheneILIsodrinILIsodrinILIsodrinILIsophoroneILIsosafroleILKeponeILMethyl parathion (Parathion, methyl)ILNaphthaleneILNitrosodientylamineILn-NitrosodimethylamineILn-NitrosodimethylamineILn-NitrosomorpholineILn-NitrosomorpholineILn-NitrosopropholineILn-NitrosopropholineILn-NitrosopropholineILn-NitrosopropholineILn-NitrosopropholineILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolIL <t< td=""><td></td></t<>	
HexachlorobutadieneLHexachlorocyclopentadieneLHexachlorocyclopentadieneLHexachloropetheneLHexachloropetheneLIndeno(1,2,3-cd) pyreneLIsodtrinLIsodtrinLIsodtrinLIsodtrinLIsosafroleLKeponeLMethyl pyrileneLMethyl pyrileneLMethyl parathion (Parathion, methyl)LNitroberzeneLn-NitrosodiethylamineLn-NitrosodiethylamineLn-NitrosodiethylamineLn-NitrosomethylethylamineLn-NitrosomethylethylamineLn-NitrosomethylethylamineLn-NitrosomethylethylamineLn-NitrosomethylethylamineLn-NitrosomethylethylamineLn-NitrosomethylethylamineLn-NitrosomethylethylamineLn-NitrosomethylethylamineLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorophenolLPentachlorophenolLPentachlorophenolLPentachlorophenolLPentachlorophenolLPentachlorophenolLPentachlorophenolLPentachlorophenolLPentachlorophenol <t< td=""><td></td></t<>	
HexachlorocyclopentadieneILHexachlorochtaneILHexachloropheneILHexachloropheneILHexachloropheneILIndeno(1,2,3-cd) pyreneILIsodrinILIsophroneILIsophroneILIsosafroleILKeponeILMethapyrileneILMethapyrileneILMethapyrileneILNitrobenzeneILNitrobenzeneILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosophenylamineILn-NitrosophenylamineILn-NitrosophenylamineILn-NitrosophenylamineILn-NitrosophenylamineILn-NitrosophenylamineILn-NitrosophylolineILn-NitrosophylolineILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorophenolILPhenacetinILPhenacetinILPhenacetinILPhenacetinILPhenacetinILPhenacetinILPhenacetinILPhenacetinILPhenacetin	
HexachloropheneLHexachloropheneLHexachloropheneLIndeno(1,2,3-cd) pyreneLIsodrinLIsodrinLIsophoroneLIsophoroneLIsosafroleLKeponeLMethapyrileneLMethyl methanesulfonateLMethyl parathion (Parathion, methyl)LNitrobenzeneLn-NitrosodiethylamineLn-Nitrosodi-n-propylamineLn-Nitrosodi-n-propylamineLn-NitrosopiperidineLn-NitrosopiperidineLn-NitrosopiperidineLn-NitrosopiperidineLn-NitrosopiperidineLn-NitrosopiperidineLn-NitrosopiperidineLn-NitrosopiperidineLpentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPentachlorobenzeneLPhenacetinLPhenacetinLPhenacetinLPhenacetinLPhenacetinLPhenacetinLPhenacetinLPhenacetinLPhenacetinLPhenacetinLPhenacetinLPhenacetinLPhenacetinL<	
HexachioropheneILHexachioropropeneILIndenc(1,2,3-cd) pyreneILIsodrinILIsodrinILIsophoroneILIsosafroleILKeponeILMethapyrileneILMethyl methanesulfonateILMethyl parathion (Parathion, methyl)ILNaphthaleneILNitrobenzeneILn-NitrosodiethylamineILn-Nitrosodin-pyropylamineILn-Nitrosodin-pyropylamineILn-NitrosodiphenylamineILn-NitrosopyrroldineILn-NitrosophenolineILn-NitrosophenolineILn-NitrosophenolineILn-NitrosophenolineILn-NitrosophenolineILparathionILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorophenolILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenae	
HexachloropropeneILIndeno(1,2,3-cd) pyreneILIsochroneILIsochroneILIsochroneILIsosafroleILKeponeILMethapyrileneILMethyl methanesulfonateILMethyl parathion (Parathion, methyl)ILNaphhaleneILNitrobenzeneILn-NitrosodiethylamineILn-NitrosodiethylamineILn-Nitrosodin-n-propylamineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILParathionILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorophenoiILPhenacetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinIL	
Indeno(1,2,3-cd) pyreneILIsodrinILIsophroneILIsosafroleILIsosafroleILKeponeILMethapyrileneILMethapyrileneILMethyl parathion (Parathion, methyl)ILNaphthaleneILNitrobenzeneILn-NitrosodirethylamineILn-NitrosodirethylamineILn-NitrosodirethylamineILn-NitrosodirethylamineILn-NitrosodirethylamineILn-NitrosodirethylamineILn-NitrosodirethylamineILn-NitrosodirethylamineILn-NitrosodirethylamineILn-NitrosodirethylamineILn-NitrosodirethylamineILn-NitrosopyropolineILn-NitrosopyropolineILn-NitrosopyropolineILn-NitrosopyropolineILparathionILParathionILParathionILPentachlorobenzeneILPentachlorobenzeneILPentachlorophenolILPentachlorophenolILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetin	
IsodrinILIsophoroneILIsosafroleILKeponeILMethanesulfonateILMethyl methanesulfonateILMethyl parathion (Parathion, methyl)ILNaphthaleneILNitrobenzeneILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodiphenylamineILn-NitrosodiphenylamineILn-NitrosomorpholineILn-NitrosomorpholineILn-NitrosomorpholineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILPentachlorophenzeneILPentachlorophenzeneILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPhenanthreneILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolILPentachlorophenolIL </td <td></td>	
IsophoroneILIsosafroleILKeponeILMethapyrileneILMethyl methanesulfonateILMethyl parathion (Parathion, methyl)ILNaphthaleneILNitrobenzeneILn-NitrosodirethylarnineILn-NitrosodirethylarnineILn-NitrosodirethylarnineILn-NitrosodirethylarnineILn-NitrosodirethylarnineILn-NitrosodirethylarnineILn-NitrosodirethylarnineILn-NitrosodirethylarnineILn-NitrosodirethylarnineILn-NitrosomethylethylarnineILn-NitrosomethylethylarnineILn-NitrosomethylethylarnineILn-NitrosomethylethylarnineILn-NitrosopiperidineILn-NitrosopiperidineILParathionILPentachlorobenzeneILPentachlorobenzeneILPentachlorophenolILPentachlorophenolILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinILPhenaetinIL <td></td>	
IsosafroleILKeponeILMethapyrileneILMethyl methanesulfonateILMethyl parathion (Parathion, methyl)ILNaphthaleneILNitrobenzeneILn-NitrosodiethylamineILn-NitrosodiethylamineILn-NitrosodinethylamineILn-NitrosodinethylamineILn-NitrosodinethylamineILn-NitrosodinethylamineILn-NitrosodinethylamineILn-NitrosodiphenylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-Nitrosomethylethylethylethylethylethylethylethyl	
KeponeILMethapyrileneILMethyl methanesulfonateILMethyl parathion (Parathion, methyl)ILNaphthaleneILNitrobenzeneILn-NitrosodiethylamineILn-NitrosodiethylamineILn-Nitrosodi-n-propylamineILn-Nitrosodi-n-propylamineILn-NitrosodiphenylamineILn-NitrosodiphenylamineILn-NitrosodiphenylamineILn-NitrosodiphenylamineILn-NitrosophylethylamineILn-NitrosophylethylamineILn-NitrosophylethylamineILn-NitrosophylethylamineILn-NitrosophylethylamineILn-NitrosophylethylamineILn-NitrosophyreldineILn-NitrosophyreldineILPentachlorobenzeneILPentachlorobenzeneILPentachlorobenzeneILPentachlorophenolILPentachlorophenolILPhenacetinILPhenacetinILPhenanthreneILPhenanthreneIL	L_
MethapyrileneILMethyl methanesulfonateILMethyl parathion (Parathion, methyl)ILNaphthaleneILNitrobenzeneILn-NitrosodiethylamineILn-NitrosodimethylamineILn-NitrosodinethylamineILn-NitrosodinethylamineILn-NitrosodinethylamineILn-NitrosodinethylamineILn-NitrosodinethylamineILn-NitrosodinethylamineILn-NitrosodinethylamineILn-NitrosodinethylamineILn-NitrosodiphenylamineILn-NitrosomethylethylamineIL<	- ا
Methyl methanesulfonateILMethyl parathion (Parathion, methyl)ILNaphthaleneILNitrobenzeneILn-NitrosodiethylamineILn-NitrosodiethylamineILn-Nitrosodi-n-butylamineILn-Nitrosodi-n-butylamineILn-Nitrosodi-n-propylamineILn-NitrosodiphenylamineILn-NitrosodiphenylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILpentachlorobenzeneILPentachlorobenzeneILPentachlorophenolILPhenacetinILPhenacetinILPhenanthreneIL	IL
Methyl parathion (Parathion, methyl)ILNaphthaleneILNaphthaleneILNitrobenzeneILn-NitrosodiethylamineILn-NitrosodiethylamineILn-Nitrosodi-n-butylamineILn-Nitrosodi-n-propylamineILn-NitrosodiphenylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILpentachlorobenzeneILPentachlorobenzeneILPentachlorophenolILPentachlorophenolILPhenacetinILPhenanthreneIL	IL.
NaphthaleneILNitrobenzeneILn-NitrosodiethylamineILn-NitrosodimethylamineILn-Nitrosodin-n-butylamineILn-Nitrosodi-n-propylamineILn-NitrosodiphenylamineILn-NitrosodiphenylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopyrrolidineILo, o, o-Triethyl phosphorothioateILPentachlorobenzeneILPentachlorophenolILPentachlorophenolILPhenacetinILPhenanthreneILNathonILPhenanthrene<	IL.
NitrobenzeneILn-NitrosodiethylamineILn-NitrosodimethylamineILn-Nitrosodi-n-propylamineILn-NitrosodiphenylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopiperidineILPentachlorobenzeneILPentachlorobenzeneILPentachlorophenolILPhenactinILPhenactinILPhenanthreneILPhenanthreneIL	iL.
n-NitrosodiethylamineILn-NitrosodimethylamineILn-Nitrosodi-n-butylamineILn-Nitrosodi-n-propylamineILn-NitrosodiphenylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopyrrolidineILn-NitrosopyrrolidineILo, o, o-Triethyl phosphorothioateILPentachlorobenzeneILPentachlorophenolILPentachlorophenolILPhenacetinILPhenanthreneIL	IL .
n-NitrosodimethylamineILn-Nitrosodi-n-propylamineILn-Nitrosodi-n-propylamineILn-NitrosodiphenylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopyrrolidineILo, o, o-Triethyl phosphorothioateILParathionILPentachlorobenzeneILPentachloronitrobenzeneILPhenacetinILPhenacetinILPhenanthreneILPhenanthreneIL	IL
n-NitrosodimethylamineILn-Nitrosodi-n-propylamineILn-Nitrosodi-n-propylamineILn-NitrosodiphenylamineILn-NitrosomethylethylamineILn-NitrosomethylethylamineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopyrrolidineILo, o, o-Triethyl phosphorothioateILParathionILPentachlorobenzeneILPentachloronitrobenzeneILPhenacetinILPhenacetinILPhenanthreneILPhenanthreneIL	IL.
n-Nitrosodi-n-propylamineILn-NitrosodiphenylamineILn-NitrosomethylethylamineILn-NitrosomorpholineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopyrrolidineILo, o, o-Triethyl phosphorothioateILParathionILPentachlorobenzeneILPentachlorophenolILPentachlorophenolILPhenacetinILPhenanthreneIL	IL.
n-Nitrosodi-n-propylamineILn-NitrosodiphenylamineILn-NitrosomethylethylamineILn-NitrosomorpholineILn-NitrosopiperidineILn-NitrosopiperidineILn-NitrosopyrrolidineILo, o, o-Triethyl phosphorothioateILParathionILPentachlorobenzeneILPentachlorophenolILPentachlorophenolILPhenacetinILPhenanthreneIL	IL.
n-NitrosodiphenylamineILn-NitrosomethylethylamineILn-NitrosomorpholineILn-NitrosopiperidineILn-NitrosopyrrolidineILo, o, o-Triethyl phosphorothioateILParathionILPentachlorobenzeneILPentachlorophenolILPentachlorophenolILPhenacetinILPhenanthreneIL	L
n-NitrosomethylethylamineILn-NitrosomorpholineILn-NitrosopiperidineILn-NitrosopyrrolidineILo, o, o-Triethyl phosphorothioateILParathionILPentachlorobenzeneILPentachlorobitrobenzeneILPentachlorophenolILPhenacetinILPhenacetinILPhenanthreneIL	
n-Nitrosomorpholine IL n-Nitrosopiperidine IL n-Nitrosopyrrolidine IL o, o, o-Triethyl phosphorothioate IL Parathion IL Pentachlorobenzene IL Pentachlorobenzene IL Pentachlorophenol IL Phenacetin IL Phenanthrene IL	
n-Nitrosopiperidine IL n-Nitrosopyrrolidine IL o, o, o-Triethyl phosphorothioate IL Parathion IL Pentachlorobenzene IL Pentachlorobenzene IL Pentachlorophenol IL Phenacetin IL Phenanthrene IL	IL.
n-Nitrosopyrrolidine IL o, o, o-Triethyl phosphorothioate IL Parathion IL Pentachlorobenzene IL Pentachlorophenol IL Phenacetin IL Phenanthrene IL	
o, o, o-Triethyl phosphorothioateILParathionILPentachlorobenzeneILPentachloronitrobenzeneILPentachlorophenolILPhenacetinILPhenanthreneIL	
Parathion IL Pentachlorobenzene IL Pentachloronitrobenzene IL Pentachlorophenol IL Phenacetin IL Phenanthrene IL	
Pentachlorobenzene IL Pentachloronitrobenzene IL Pentachlorophenol IL Phenacetin IL Phenanthrene IL	
Pentachloronitrobenzene IL Pentachlorophenol IL Phenacetin IL Phenanthrene IL	
Pentachlorophenol IL Phenacetin IL Phenanthrene IL	
Phenacetin IL Phenanthrene IL	100
Phenanthrene	
Phenol	
Phenol IL Phorate IL	

Page 31 of 34

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: RCRA (Solid & Hazardous Material)	
p-Phenylenediamine	1
Pronamide (Kerb)	IL.
Pyrene	IL.
Pyridine	1
Safrole	IL.
Thionazin (Zinophos)	
Method EPA 9012B	
Cyanide	ſL.
Method EPA 9014 Rev: 0	
Cyanide	1L
Method EPA 9034 Rev; 0	
Sulfide	11
Method EPA 9045C Rev: 3	
pH	íL.
Method EPA 9045D	
pH	1.
Method EPA 9050A Rev: 1	
Conductivity	1
Method EPA 9056A	
Bromide	11.
Chloride	1
Fluoride	n.
Nitrate	IL.
Nitrite	IL.
Orthophosphate as P	ſL
Sulfate	n
Method EPA 9060A	
Total organic carbon	IL.
Method EPA 9066 Rev: 0	
Total phenolics	ſL.
Method EPA 9071B	
Oil & Grease	L.
Method EPA 9095A	
Paint Filter Test	IL.
Method EPA 9095B	
Paint Filter Test	11.
Method EPA 9251 Rev: 0	
Chloride	IL.
	1

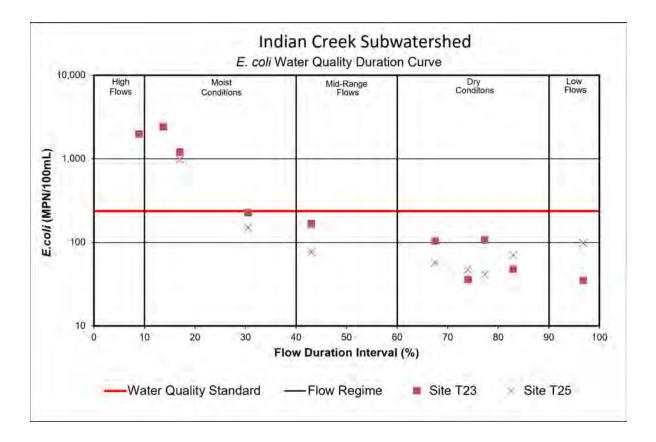
Page 32 of 34

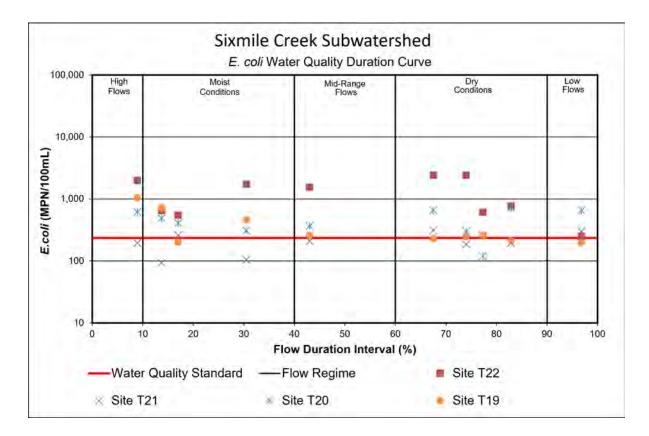
Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: SDWA (Potable Water)	
Method EPA 180.1	
Turbidity	IL.
Method EPA 200.7 Rev: 4.4	
Aluminum	IL .
Arsenic	L.
Barium	IL.
Beryllium	IL.
	IL.
Cadmium Calcium	ic IL
	ic IL
Chromium	
Copper	IL.
Iron	IL.
Magnesium	IL.
Manganese	IL.
Nickel	IL.
Silica as SIO2	IL.
Silver	IL.
Sodium	IL
Zinc	IL.
Method EPA 200.8 Rev: 5.4	
Aluminum	IL.
Antimony	L
Arsenic	IL.
Barium	IL.
Beryllium	L.
Cadmium	L.
Chromium	IL.
Copper	IL.
Lead	IL.
Manganese	IL.
Molybdenum	IL.
Nickel	IL.
Selenium	11
Silver	11
Thallium	IL.
Zinc	IL.
Method EPA 245.1 Rev: 3	
Mercury	IL.
	IC.
Method EPA 300.0 Rev: 2.1	
Chloride	IL.
Fluoride	IL
Nitrate	IL.
Nitrite	IL.
Orthophosphate as P	IL.
Sulfate	IL.
Method EPA 335.4 Rev: 1	
Cyanide	IL.
Method EPA 353.2 Rev: 2	
Nitrate	IL.
1 all dec	
Nitrate plus Nitrite as N	IL.

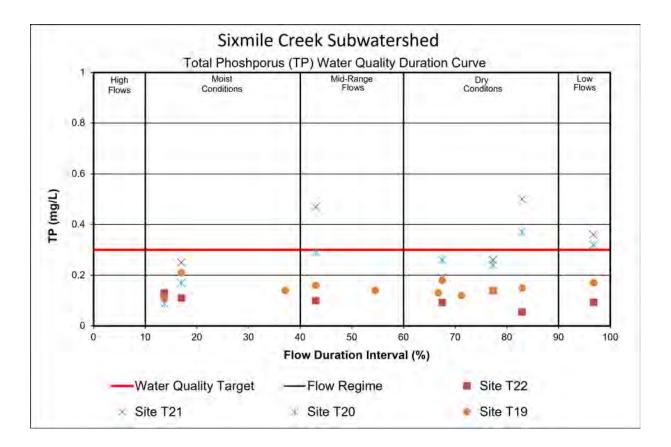
Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: SDWA (Potable Water)	
Method SM 2320 B-1997 Rev: 20th ED Alkalinity as CaCO3	IL.
Method SM 2340 B-1997 Rev: 20th ED Hardness	IL.
Method SM 2510 B-1997 Rev: 20th ED Conductivity	112
Method SM 2540 C-1997 Rev: 20th ED Total dissolved solids	IL.
Method SM 4500-CI F-1993 Rev: 20th ED Chlorine	IL.
Method SM 4500-CN E-1997 Rev: 20th ED Cyanide	C.
Method SM 4500-F C-1997 Rev: 20th ED Fluoride	L
Method SM 4500-H+ B-1996 Rev: 20th ED pH	- TL
Method SM 4500-NO2 B-1993 Rev: 20th ED Nitrite	n_
Method SM 4500-NO3 F-1997 Rev: 20th ED Nitrate	L
Method SM 4500-P E-1997 Rev: 20th ED Orthophosphate as P	IL.
Method SM 4500-SO4 E-1997 Rev: 20th ED Sulfate	IL.
Method SM 5310 B Rev: 21st ED Dissolved organic carbon (DOC) Total organic carbon	L. L
Method SM 5310 C Rev: 20th ED Dissolved organic carbon (DOC)	L.
Total organic carbon End of Scope of Accreditation	n_

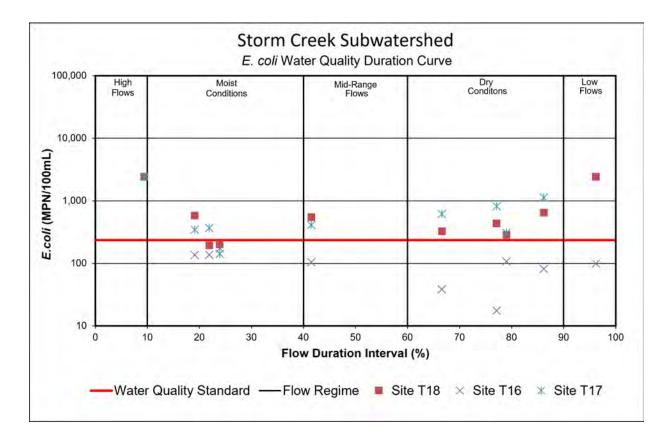
Page 34 of 34

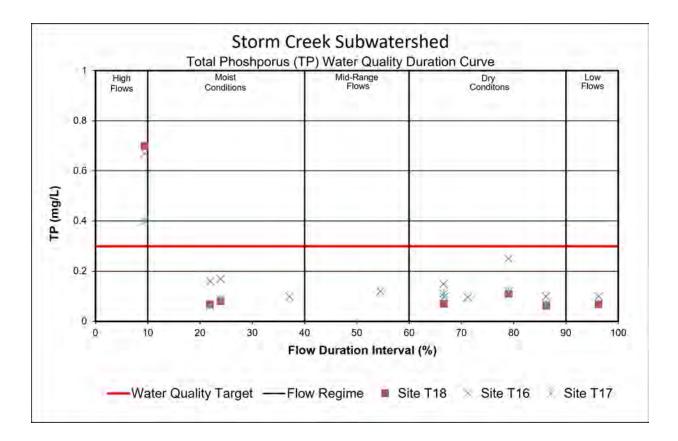
APPENDIX F. WATER QUALITY DURATION GRAPHS FOR THE VERNON FORK MUSCATATUCK RIVER WATERSHED

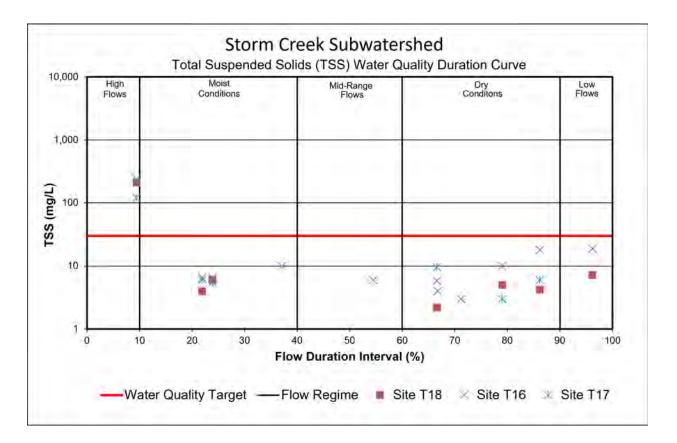


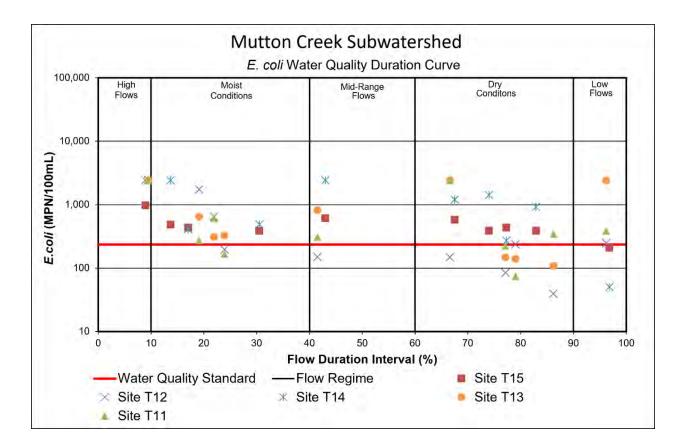


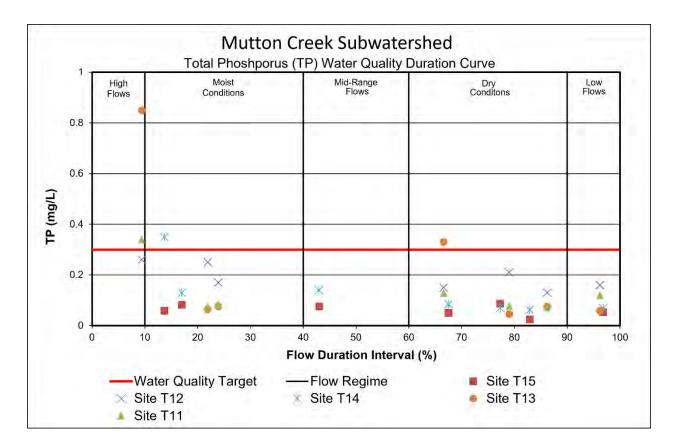


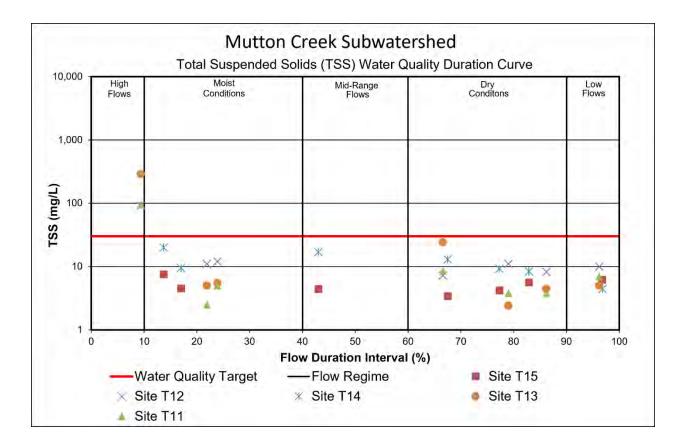


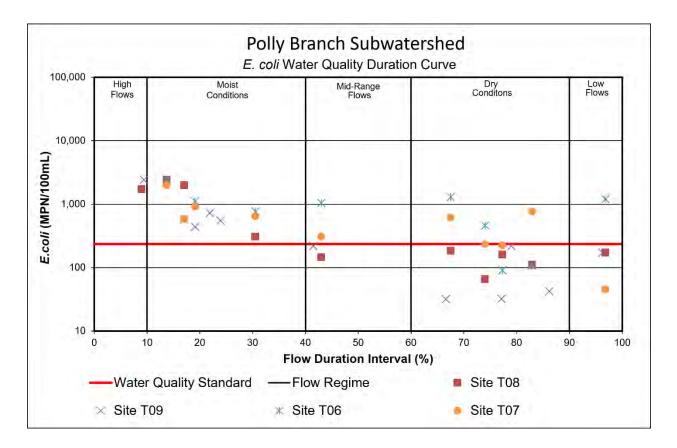


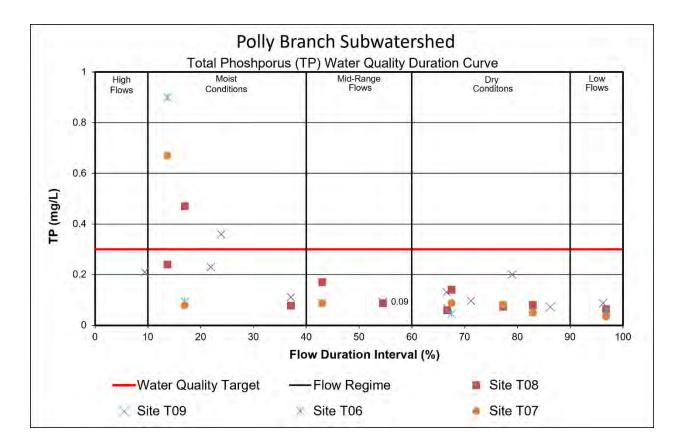


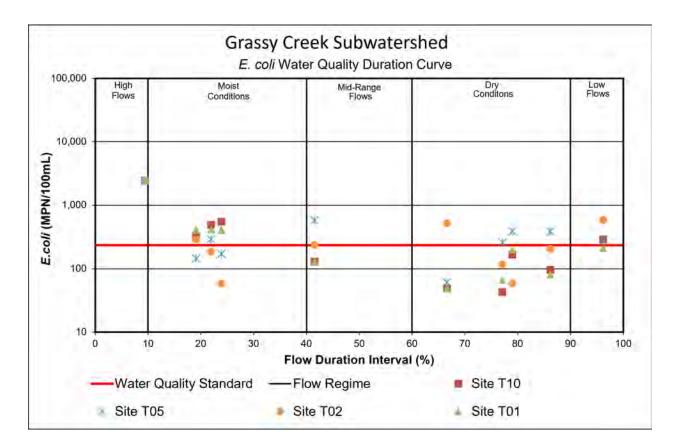


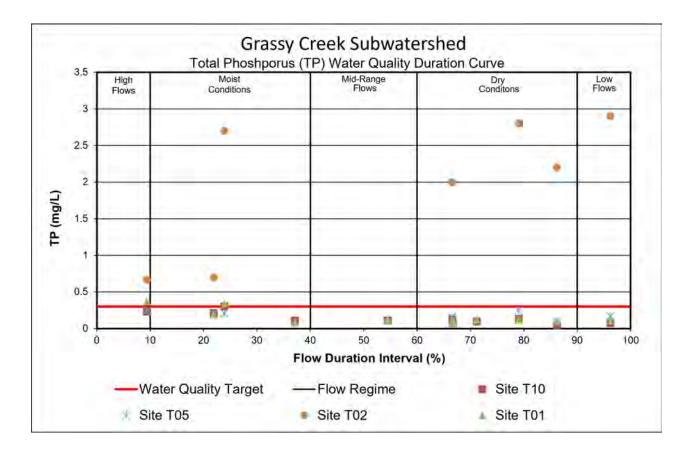












APPENDIX G. NPDES EXECUTIVE SUMMARY

Vernon Fork Muscatatuck River Watershed: NPDES Executive Summary

This appendix summarizes the potential point sources of *E. coli*, TSS, and total phosphorus in the Vernon Fork Muscatatuck River watershed, as regulated through the National Pollutant Discharge Elimination System (NPDES) Program. As authorized by the CWA, the NPDES permit program controls water pollution by regulating facilities that discharge pollutants into waters of the United States. Point sources with NPDES permits within this watershed include wastewater treatment plants (WWTPs), a quarry, industrial facilities, construction activity, and an MS4 community.

Overview of Facilities

There are two municipal wastewater treatment plants (WWTPs) located within the Vernon Fork Muscatatuck River watershed. Effluent from these facilities are potential point sources of *E. coli*, TP, and TSS. The Town of Crothersville WWTP (IN0022683) currently operates a Class II, 0.47 MGD oxidation ditch treatment facility consisting of a bar screen, a grit settling chamber, an influent flow meter, one oxidation ditch, three final clarifiers, ultraviolet light disinfection, post-aeration and an effluent flow meter. The collection system is comprised of combined sanitary and storm sewers with one Combined Sewer Overflow (CSO) location (002) and one Wet Weather Treatment Facility (WWTF) outfall (003). The facility has one outfall (001) that discharges to Nehrt Ditch. Jennings Northwest Regional Utilities WWTP (IN0056049) currently operates a Class II, 0.352 MGD treatment facility consisting of screening, grit removal, a Multi-Stage Activated Biological Process (MSABP), a polishing pond, post aeration and ultraviolet light disinfection. There is an existing flow equalization basin which the permittee contends is not functional and cannot be used. The collection system is comprised of 100% separate sanitary sewers by design with no overflow or bypass points. The facility has one outfall (Outfall 002) that discharges to Six Mile Creek.

There are two facilities that discharge industrial wastewater located within the Vernon Fork Muscatatuck River watershed. Effluent from these facilities are potential sources of TSS. Wastewater discharges from Hanson Aggregates Hayden Quarry (ING490100) are regulated by the Sand, Gravel, Dimension Stone and Crushed Stone General Permit. This general permit addresses discharges of process wastewater and mine dewatering from facilities involved in sand, gravel, dimension stone, or crushed stone operations. This quarry contains one outfall, which discharges into an unnamed ditch to Six Mile Creek. The facility has an average design flow of approximately 3.17 MGD (Outfall 001 with an average daily value of .141 and max. daily value of 3.168), with a TSS limit of 30 mg/l (daily max.). However, this facility does not discharge within a subwatershed where TSS was identified as a pollutant of concern. Therefore, a WLA was not assigned to this facility for purposes of this TMDL report.

Wastewater discharges from HWRT Terminal-Seymour, LLC (ING340019) are regulated by the Petroleum Product Terminals General Permit. "Petroleum products terminals" refers to an area where petroleum products are supplied by pipeline or barge and where petroleum products are stored in above-ground tanks or are transferred to trucks for transport to other locations, or both. This general permit authorizes new and existing discharges described as follows from

petroleum products terminals to surface waters of the State of Indiana: a) discharges of hydrostatic test waters from storage tanks and onsite pipelines which have been used for the storage and /or transfer or conveyance of crude oil or liquid petroleum hydrocarbons; b) discharges of stormwater runoff specifically from the diked containment areas of these storage tanks; and c) discharges of tank bottom water from these storage tanks. However, this permit does not authorize the discharge of any accumulated solids or sludges from the tank bottoms. The permittee is required to properly remove and dispose of such solids in accordance with 327 IAC 5 -5 -2. This facility contains two outfalls which discharge non-process wastewater into Mutton Creek. The facility has an average discharge of approximately 0.072 MGD.

The facility's permit effluent limit for TSS is set at the NPDES limit of 45 mg/L daily maximum. Average design flow was determined from information reported by the facility during the permitting process. Discharges from this facility are not believed to be significant contributions of TSS in the watershed. Compliance with the current NPDES permit limit is consistent with the assumptions used to determine WLAs in the TMDL for protection of applicable water quality standards.

Activities that discharge stormwater are typically regulated through NPDES stormwater general permits. The stormwater general permit requirements were originally contained in IAC and set by Indiana's Environmental Rules Board through its formal rulemaking process. General permits apply universally to all entities required to operate in accordance with the rule. However, IDEM is currently in the process of changing its approach to general permits from permit-by-rule to administrative general permits. The construction stormwater and municipal separate storm sewer system (MS4) administrative general permits have been finalized and are currently active. The industrial stormwater administrative general permit is also currently being developed.

Wasteload Allocations (WLAs)

Allowable pollutant loads and associated allocations were calculated for each of the 12-digit HUC subwatersheds and associated assessment units in the Vernon Fork Muscatatuck River watershed. WLAs are typically calculated based on the design flow or estimated flow of the facility and the TMDL target or applicable permit limit.

Municipal WWTP permit effluent limits for *E. coli* and TP were used to determine WLAs for each treatment plant. As discussed in Section **Error! Reference source not found.**, the TMDL target value for *E. coli* is the 235 counts/100 mL single sample maximum component of the water quality standard. The TMDL target value for total phosphorus is 0.3 mg/L or interpreted from current permit limits. These target values can be used to establish potential permit limits. Flows used to calculate pollutant loads from each treatment plant are estimated based on current flow data from data monitoring reports (DMR), or design flows from the facility permits when actual flow data is not available. Pollutant concentrations used to calculate wasteloads from each treatment plant are based on known technological limitations of the facilities.

The facilities' permit effluent limits for *E. coli* were used to determine *E. coli* wasteload allocations for each treatment plant. The effluent limit for *E. coli* is set at the 235 counts/100 mL single sample maximum component of the water quality standard. Neither facility currently has a permit limit set for total phosphorus. As discussed in Section 1.2.2, treatment plants in compliance with a 1.0 mg/L total phosphorus permit limit typically meet the in-stream target for phosphorus (0.30 mg/L). Total phosphorus loadings from the Jennings Northwest Regional Utility were based upon using the design flow from the facility's permit and a 1.0 mg/L TP concentration. IDEM believes it is reasonable to expect that the issuance of and compliance with a 1.0 mg/L permit limit will result in the necessary reductions for meeting water quality targets in the Sixmile Creek subwatershed. Therefore, the recommended effluent limit for total phosphorus is set at 1.0 mg/L for Jennings Northwest Regional Utility WWTP.

TP loadings for the Town of Crothersville WWTP similarly were based upon using the average design flow for the facility and a 1.0 mg/L TP concentration at all flow regimes other than low flows. However, during low flows, additional total phosphorus reductions are necessary in the Grassy Creek subwatershed in order to remain within the TMDL. Therefore, for the Town of Crothersville WWTP, the TP concentration used for the total phosphorus WLA at the low flow regime is 0.8 mg/L. TP loadings at low flows from the Town of Crothersville WWTP were also based upon using the average reported flow for the facility, as reported in 2021 DMRs. The recommended effluent limit for total phosphorus is set at 1.0 mg/L for the Town of Crothersville WWTP. To better justify this limit, IDEM analyzed the reported effluent TP concentrations from eight Indiana WWTP facilities of similar capacity to Crothersville, with a 1.0 mg/L TP limit, and found an average monthly effluent TP concentration of 0.55 mg/L, over the past five years. It is therefore reasonable to expect that the facility's compliance with a 1.0 mg/L permit limit will in fact result in the necessary reductions for meeting the TP WLA, and water quality targets in the Grassy Creek subwatershed, even at low flows.

TSS was not found to be a pollutant of concern in either the Sixmile Creek or Grassy Creek subwatersheds, therefore, a TSS WLA was not developed for these facilities.

The WLAs for industrial stormwater facilities were determined based on the facility's parcel size within the subwatershed. Stormwater run-off associated with construction activity is currently regulated under the administrative construction general permit (CGP). The WLA for sites regulated under the construction stormwater general permit was determined based on the average annual land disturbance associated with total overall acreage for all sites in the subwatershed. The average annual land disturbance was calculated for each subwatershed using data from permitted constructions sites for the past five years.

Stormwater run-off from certain types of urbanized areas are currently regulated under the administrative municipal storm sewer system (MS4) general permit. The WLAs for MS4 communities were determined based on the overall area the MS4 has jurisdiction over in each subwatershed.

Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Flow Regime	Estimated Design Flow (MGD)	<i>E. coli</i> WLA (MPN/day)	NPDES Permit <i>E. coli</i> Limit	TSS WLA (lbs/day)	NPDES Permit TSS Limit	TP WLA (lbs/day)	NPDES Permit TP Limit
Grassy Creek	rassy Creek Crothersville WWTP IN	IN0022683 IN	INW0776_T1018	Nehrt Ditch	High - Dry	0.47	4.18E+09	235 MPN/100 mL Daily Max.	NA	NA	3.92	1.0 mg/L
					Low	0.31 *	4.18E+09	235 MPN/100 mL Daily Max.	NA	NA	2.07 *	1.0 mg/L *
Mutton Creek	HWRT Terminal Seymour LLC	ING340019	NA	Mutton Creek	All	0.07	NA	NA	27.03	45 mg/L Daily Max.	NA	NA
Sixmile Creek	Jennings Northwest Regional Utility WWTP	IN0056049	INW0772_04	Six Mile Creek	All	0.35	3.13E+09	235 MPN/100 mL Daily Max.	NA	NA	2.94	1.0 mg/L

Table 1: Individual WLAs for NPDES Municipal and Industrial Facilities in the Vernon Fork Muscatatuck River Watershed

Understanding Table 1: The WLA for each NPDES permitted facility will be achieved through compliance with the facility's NPDES permit.

* This TMDL WLA at low flows is based upon using a 0.8 mg/L TP concentration, supported by an IDEM analysis of reported TP discharges from similar WWTP facilities with phosphorus treatment (see p.142 for further detail). It also uses the 2021 average reported flow of 0.31 MGD for the Town of Crothersville WWTP, which is representative of discharge during low flow conditions. The 0.8 mg/L TP value is not intended to be incorporated into the NPDES permit. Based on the aforementioned facilities analysis, IDEM believes that a 1.0 mg/L TP limit for this facility will result in TP discharges of 0.8 mg/L or less, accommodating the WLA at low flows.

Table 2: Individual WLAs for NPDES General Permit MS4 Communities in the Vernon Fork Muscatatuck River Watershed

Subwatershed	MS4 Community	Permit ID	Area in Drainage (Acres)	Percentage of Subwatershed	High Flow Regime <i>E. coli</i> WLA (MPN/day)			Moist Flow Regime TSS WLA (mg/L)		
Mutton Creek	City of Seymour	INR040082	1879.16	6.28%	9.16E+10	1.79E+10	2576.15	502.51	25.78	5.04