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

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Table of Contents

List of Figures

List of Tables

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:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

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 90^{th} 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.

Table 1: Critical Conditions for TMDL Parameters

Parameter	Subwatershed (HUC)	Critical Condition				
		High	**Moist**	**Mid-Range**	**Dry**	**Low**
E. coli (counts/mL)	Indian Creek (051202070701)	94%	95%	21%	0%	0%
	Sixmile Creek (051202070702)	93%	83%	90%	92%	77%
	Storm Creek (051202070703)	95%	69%	76%	84%	94%
	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%

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.

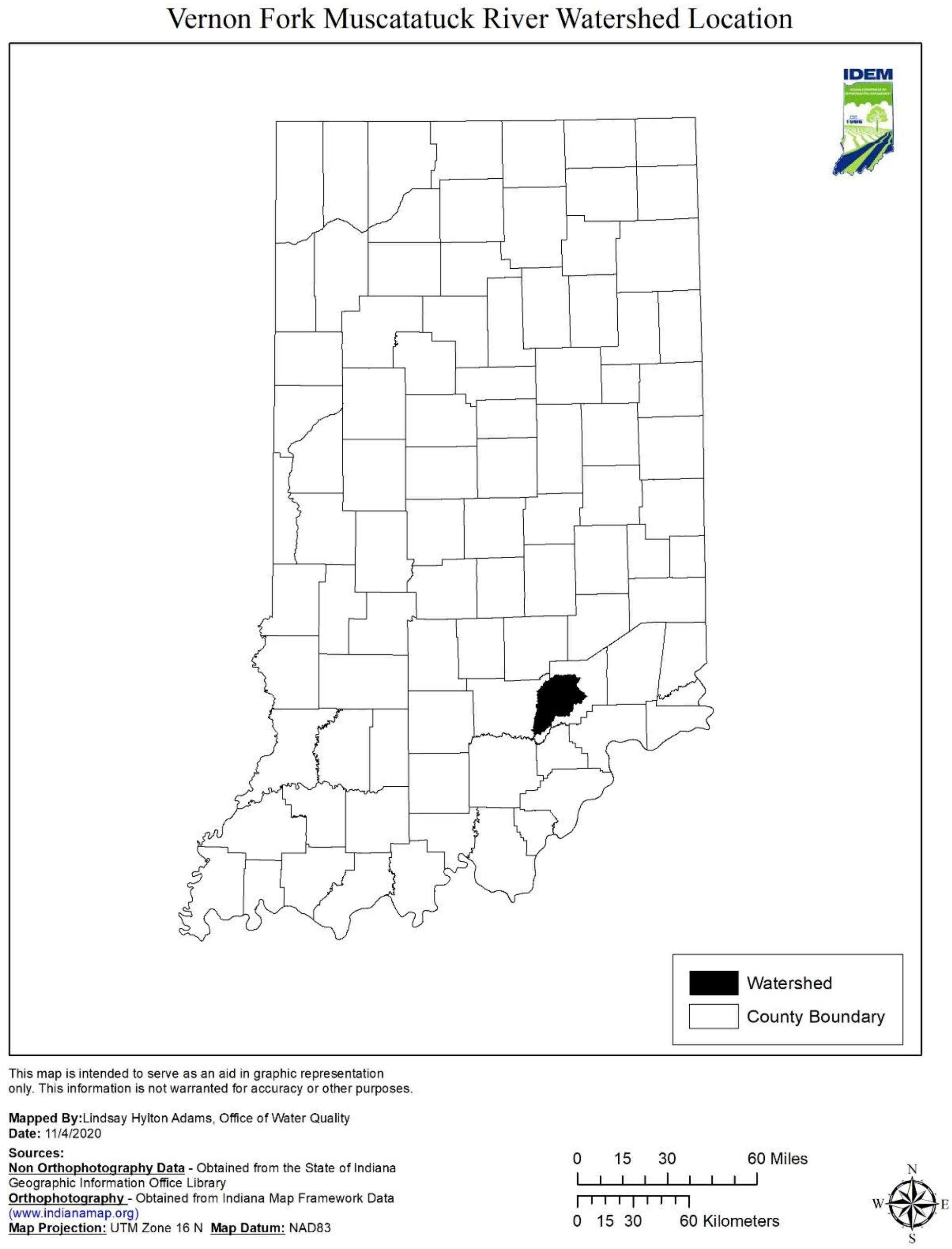


Figure 1: Location of the Vernon Fork Muscatatuck River Watershed

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.

1.1.1 *E. coli*

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.

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

Biotic Index Score and Associated Assessment Decision	Integrity Class	Corresponding Integrity Class Score	Attributes
Fish community Index of Biotic Integrity (IBI) Scores (Range of possible scores is 0-60)			
Fully Supporting IBI ≥ 36 Indicates Full Support	Excellent	53-60	Comparable to "least impacted" conditions, exceptional assemblage of species
	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 IBI < 36 Indicates Impairment	Poor	23-35	Many expected species absent or rare, tolerant species dominant
	Very Poor	12-22	At least one species present, tolerant species dominant
	No Organisms	0	No fish captured during sampling.
Benthic aquatic macroinvertebrate community Index of Biotic Integrity (mIBI) Scores Multihabitat (MHAB) Methods (Range of possible scores is 12-60)			
Fully Supporting mIBI ≥ 36 Indicates Full Support	Excellent	53-60	Comparable to "least impacted" conditions, exceptional assemblage of species
	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 mIBI < 36 Indicates Impairment	Poor	23-35	Many expected species absent or rare, tolerant species dominant
	Very Poor	13-22	At least one species present, tolerant species dominant
	No Organisms	12	No macroinvertebrates captured during sampling.

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.

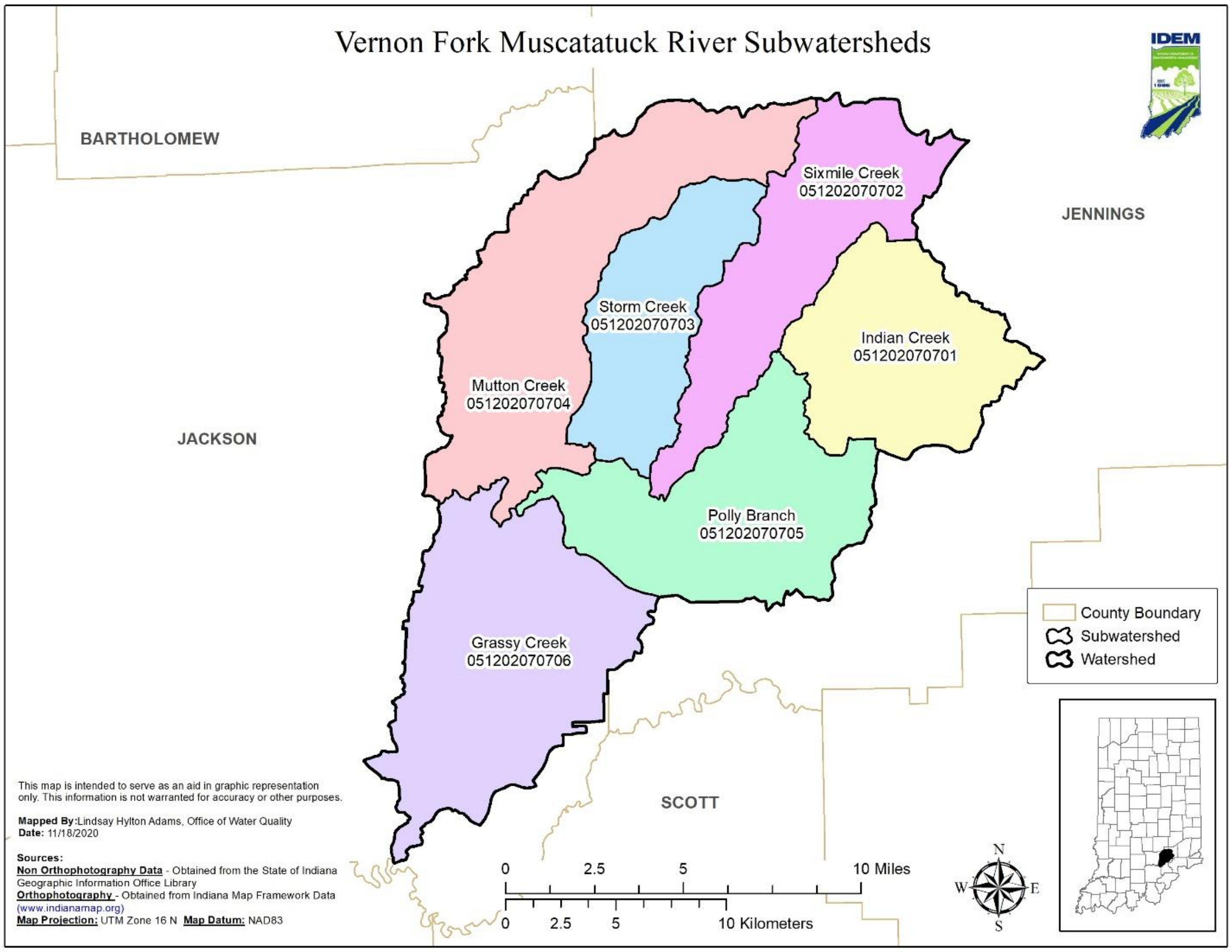


Figure 2: Subwatersheds (12-Digit HUCs) in the Vernon Fork Muscatatuck River Watershed

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)
Indian Creek 051202070701	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		
	INW0771_T1001B	0.43		
	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		
Sixmile Creek 051202070702	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		
	INW0772_T1003	3.16		
	INW0772_T1004	3.92		
	INW0772_T1005	4.84		
	INW0772_T1005A	0.41		
	INW07P1016_00	1.88		
	INW07P1071_00	0.28		
	INW07P1073_00	0.42		
Storm Creek 051202070703	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		
	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		

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		
Mutton Creek 050202070704	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		
	INW0774_T1002	4.93		E. coli
	INW0774_T1003	11.31		E. coli
	INW0774_T1004	3.37		
	INW0774_T1005	12.77	IBC	E. coli, IBC
	INW0774_T1006	5.51		
Polly Branch 051202070705	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		
	INW0775_05	12.26		
	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		
Grassy Creek 051202070706	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		
	INW0776_T1006	0.88		
	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		
	INW0776_T1013	11.69		
	INW0776_T1014	7.31		
	INW0776_T1015	9.54		
	INW0776_T1016	15.44		

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.

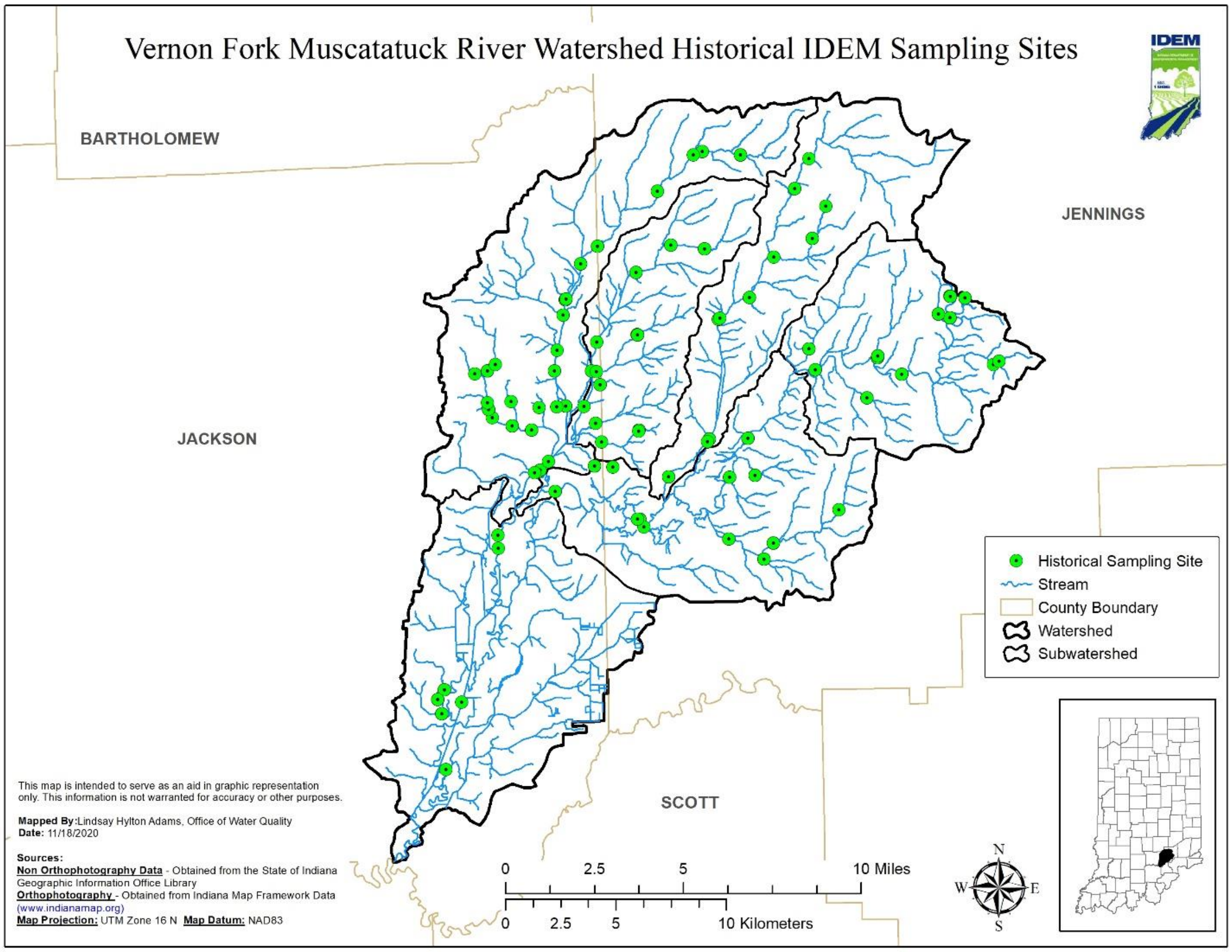


Figure 3: Location of Historical IDEM Sampling Sites in the Vernon Fork Muscatatuck River Watershed

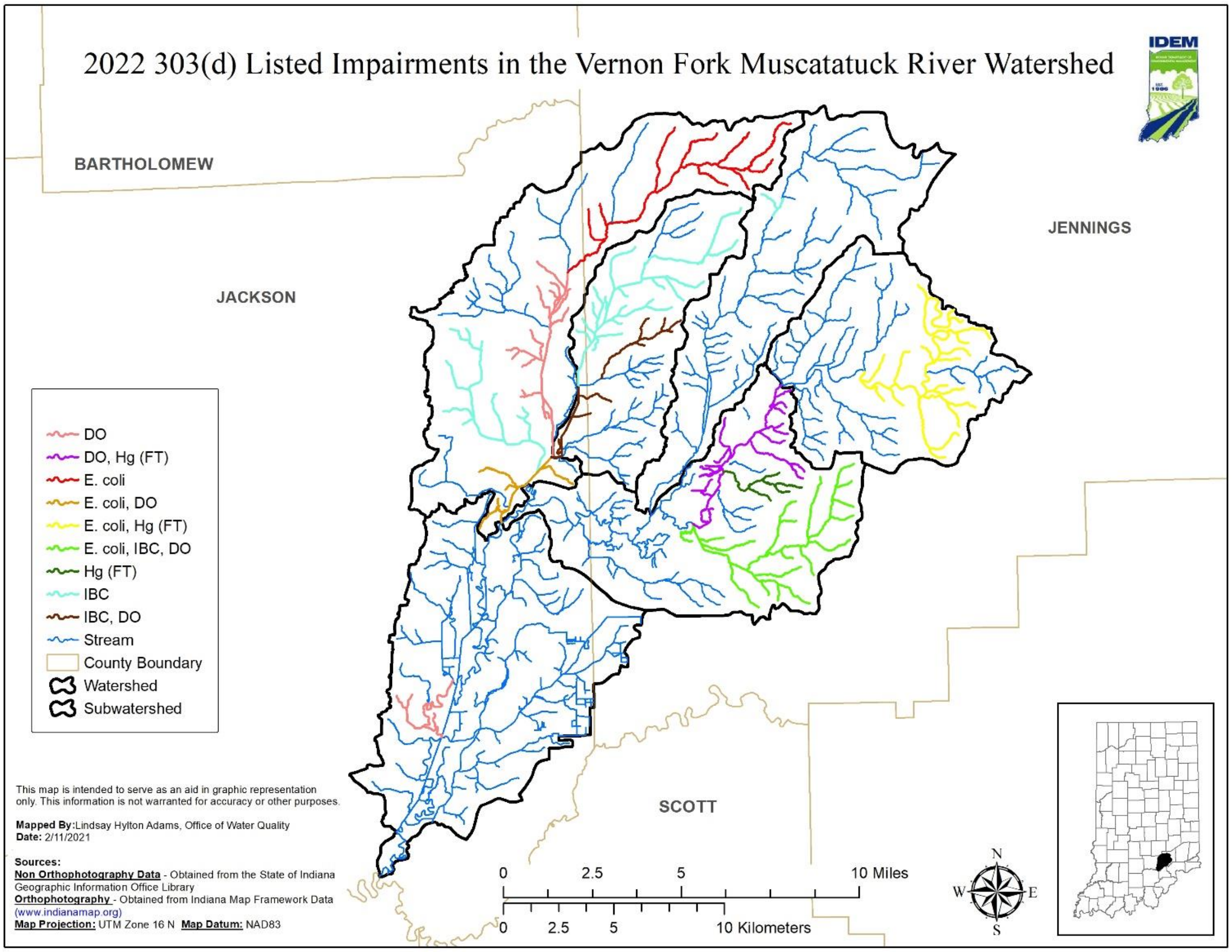


Figure 4: Streams Listed on the 2022 Section 303(d) List of Impaired Waters in the Vernon Fork Muscatatuck River Watershed

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:

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

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

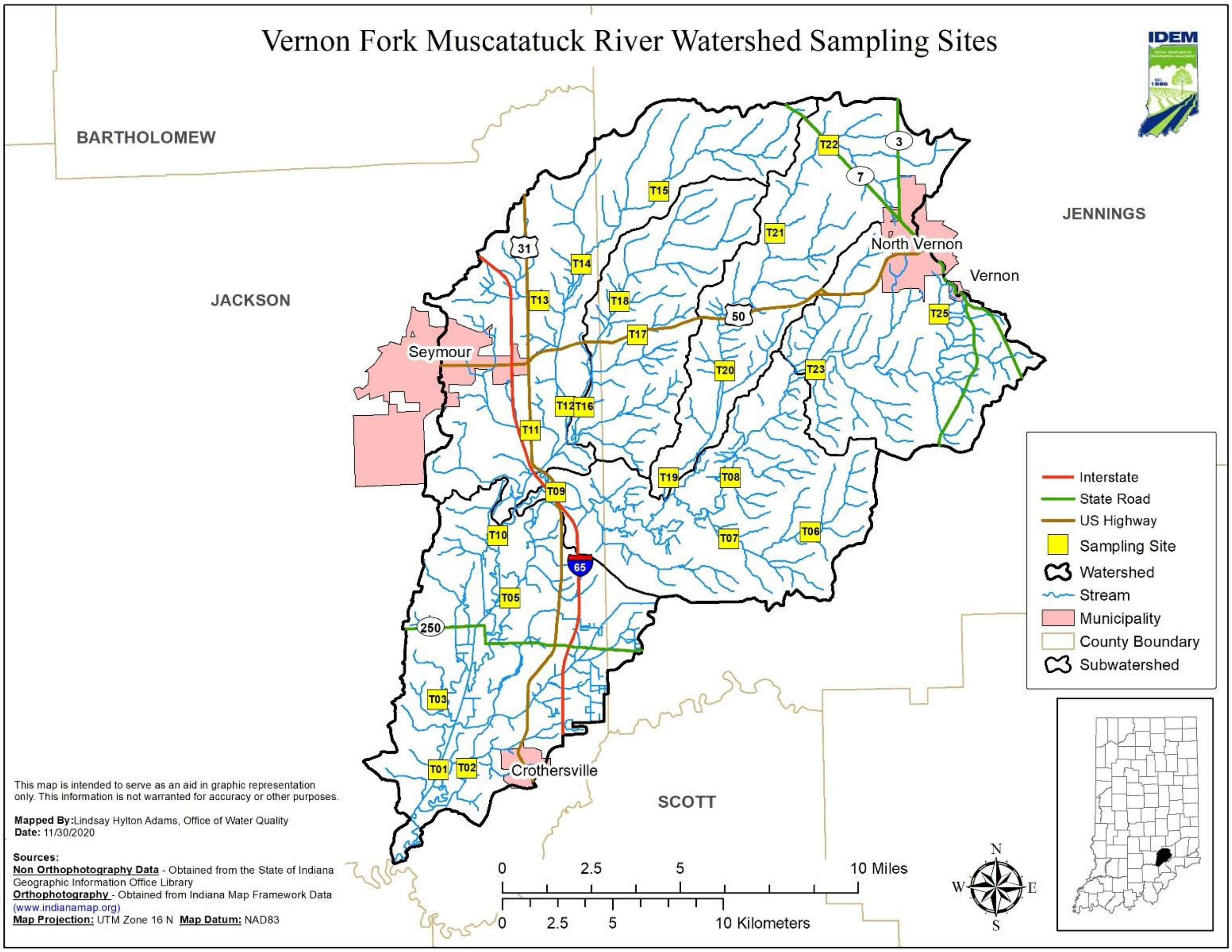


Figure 5: 2020-2021 Sampling Locations for the Vernon Fork Muscatatuck River TMDL Study

Table 5: Vernon Fork Muscatatuck River Watershed Sampling Site Information

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
T03	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
T08	21T-008	WEM070-0039	Vernon Fork Muscatatuck River	County Road 500 S	INW0775_01
T09	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.

1.4.2 *E. coli* Data

Table 6: Summary of Pathogen Data in Vernon Fork Muscatatuck River Watershed by Subwatershed

Subwatershed	Site #	IDEM Station ID	AUID	Period of Record	Total Number of Samples	Percent of Samples Exceeding *E. coli* WQS (#/100 mL)		Geomean (#/100 mL)	*E. coli* Percent Reduction Based on Geomean (125/100mL)	Single Sample Maximum (SSM) (#/100 mL)	*E. coli* Percent Reduction Based on SSM (#/100 mL)
						125	235				
Indian Creek	T23	WEM070-0036	INW0771_02	4/12/21-10/12/21	10	50	30	151.74	17.62	2419.60	90.29
	T25	WEM070-0001	INW0771_03	4/12/21-10/12/21	10	40	30	141.34	11.56	2419.60	90.29
Sixmile Creek	T19	WEM-07-0017	INW0772_06	4/12/21-10/12/21	10	100	60	357.02	64.99	1046.20	77.54
	T20	WEM-07-0018	INW0772_05	4/12/21-10/12/21	10	90	90	484.04	74.18	727.00	67.68
	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
Storm Creek	T16	WEM080-0013	INW0773_02	4/13/21-10/13/21	10	40	10	59.94	NA	2419.60	90.29
	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
Mutton Creek	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
	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
Polly Branch	T06	WEM-07-0021	INW0775_T1003	4/12/21-10/12/21	10	80	80	560.57	77.70	2419.60	90.29
	T07	WEM070-0029	INW0775_T1003	4/12/21-10/12/21	10	90	80	581.59	78.51	1986.30	88.17
	T08	WEM070-0039	INW0775_01	4/12/21-10/12/21	10	80	40	235.5	46.92	2419.60	90.29
	T09	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. coli* in Polly Branch.
- Reductions of 90 percent or greater are needed to meet the TMDL target values for *E. coli* in Grassy Creek.

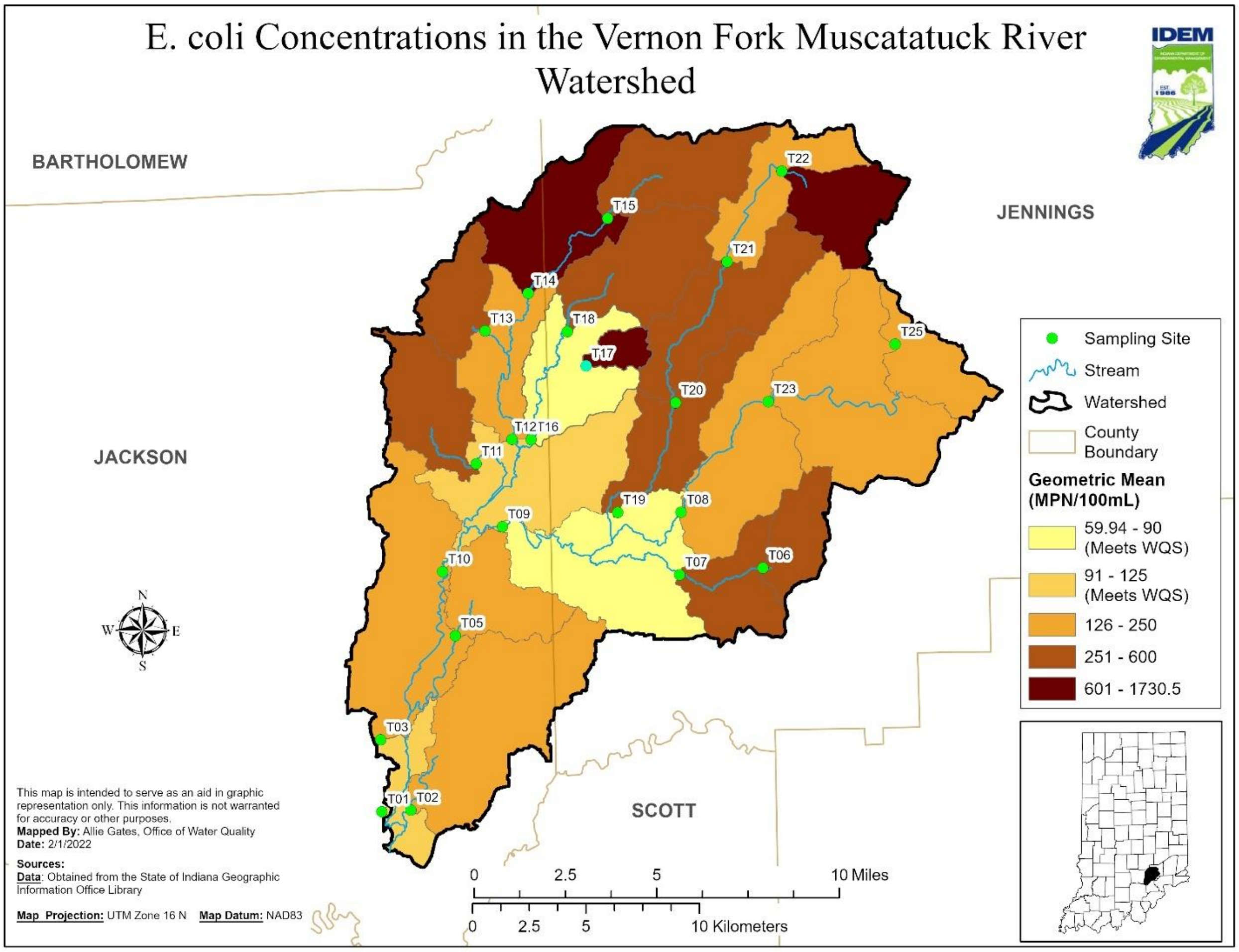


Figure 6: *E. coli* concentrations based on 5-week geometric mean (MPN/100mL) and sampling site drainage areas for 2020 and 2021. Values over 125 MPN/100mL are not meeting the current water quality standard for *E. coli*.

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
Sixmile Creek	T19	WEM-07-0017	INW0772_06	0.21	NA	28	NA	6.82	NA
	T20	WEM-07-0018	INW0772_05	0.37	18.9	14	NA	6.86	NA
	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
Storm Creek	T16	WEM080-0013	INW0773_02	0.67	55.2	240	87.5	0.18	2122.2
	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
Mutton Creek	T11	WEM080-0015	INW0774_T1005	0.34	11.8	95	68.4	5.64	NA
	T12	WEM080-0014	INW0774_02	0.26	NA	92	67.4	0.46	769.6
	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
Polly Branch	T06	WEM-07-0021	INW0775_T1003	0.9	66.7	15	NA	4.59	NA
	T07	WEM070-0029	INW0775_T1003	0.67	55.2	19	NA	2.6	53.8
	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
Grassy Creek	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
	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.

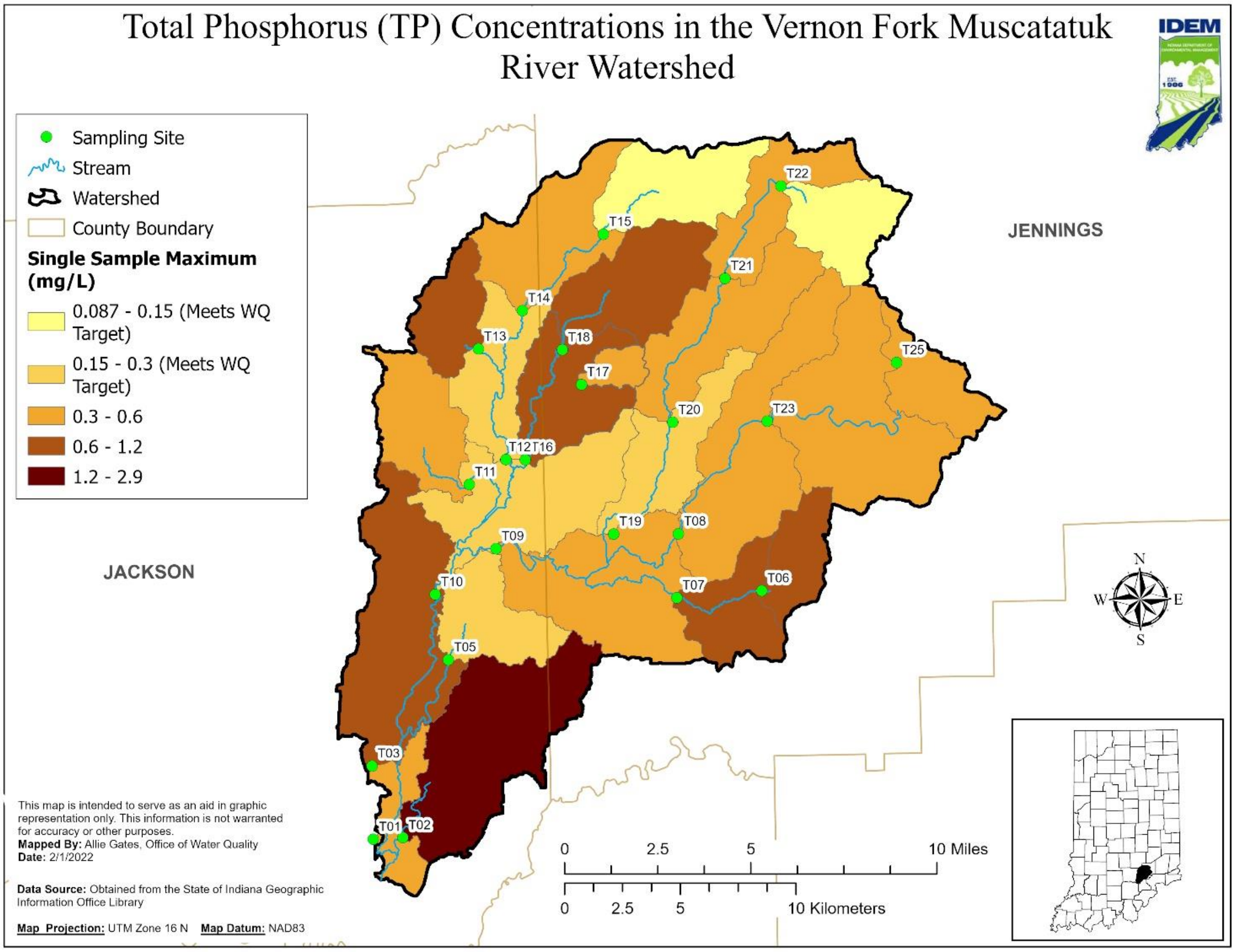


Figure 7: Total phosphorus concentrations based on single sample maximum concentration (mg/L) and sampling site drainage areas for 2020 and 2021. Values over 0.30 mg/L are not meeting the water quality target value for total phosphorus.

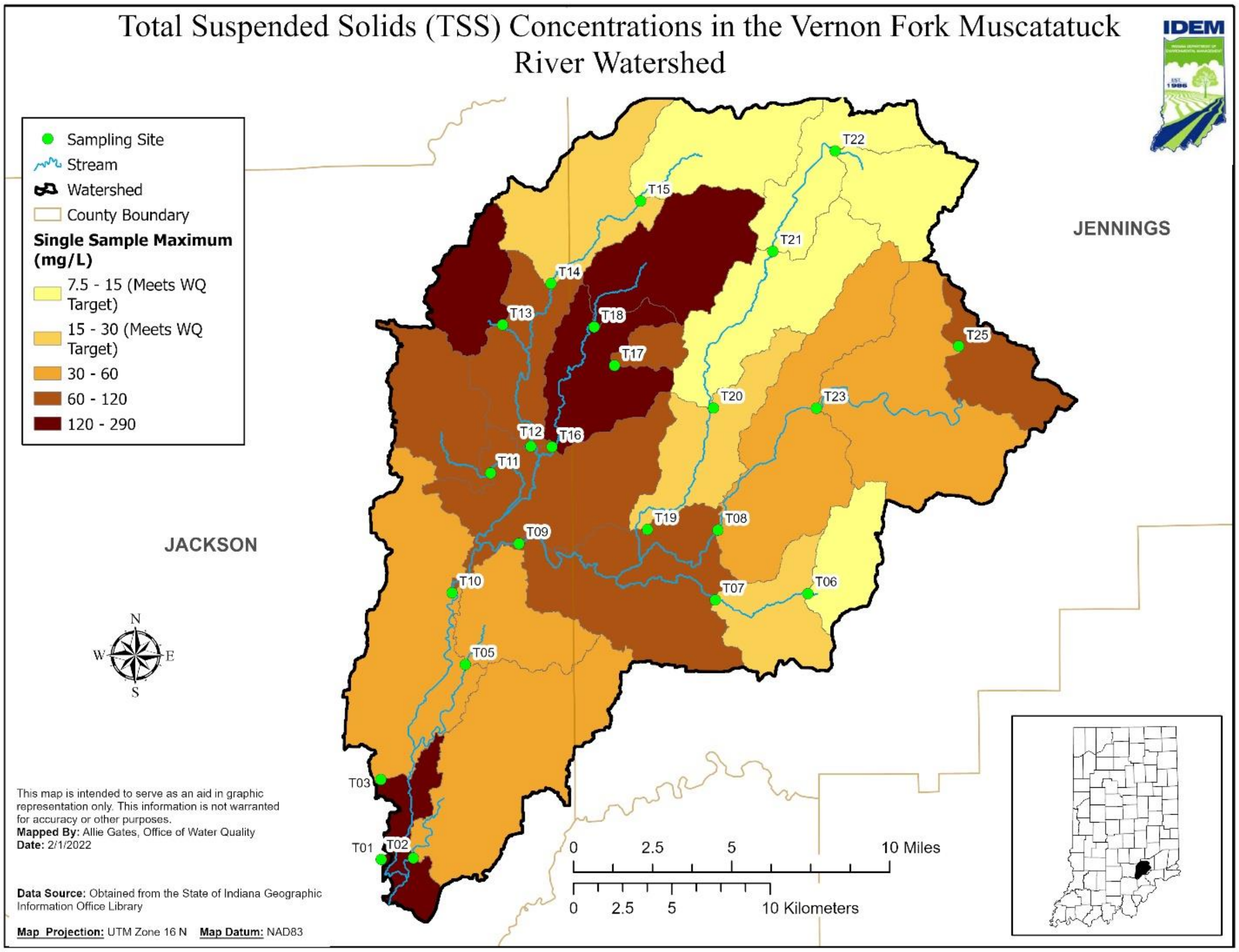


Figure 8: Total Suspended Solids concentrations based on single sample maximum concentration (mg/L) and sampling site drainage areas for 2020 and 2021. Values over 30 mg/L are not meeting the water quality target value for TSS.

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.

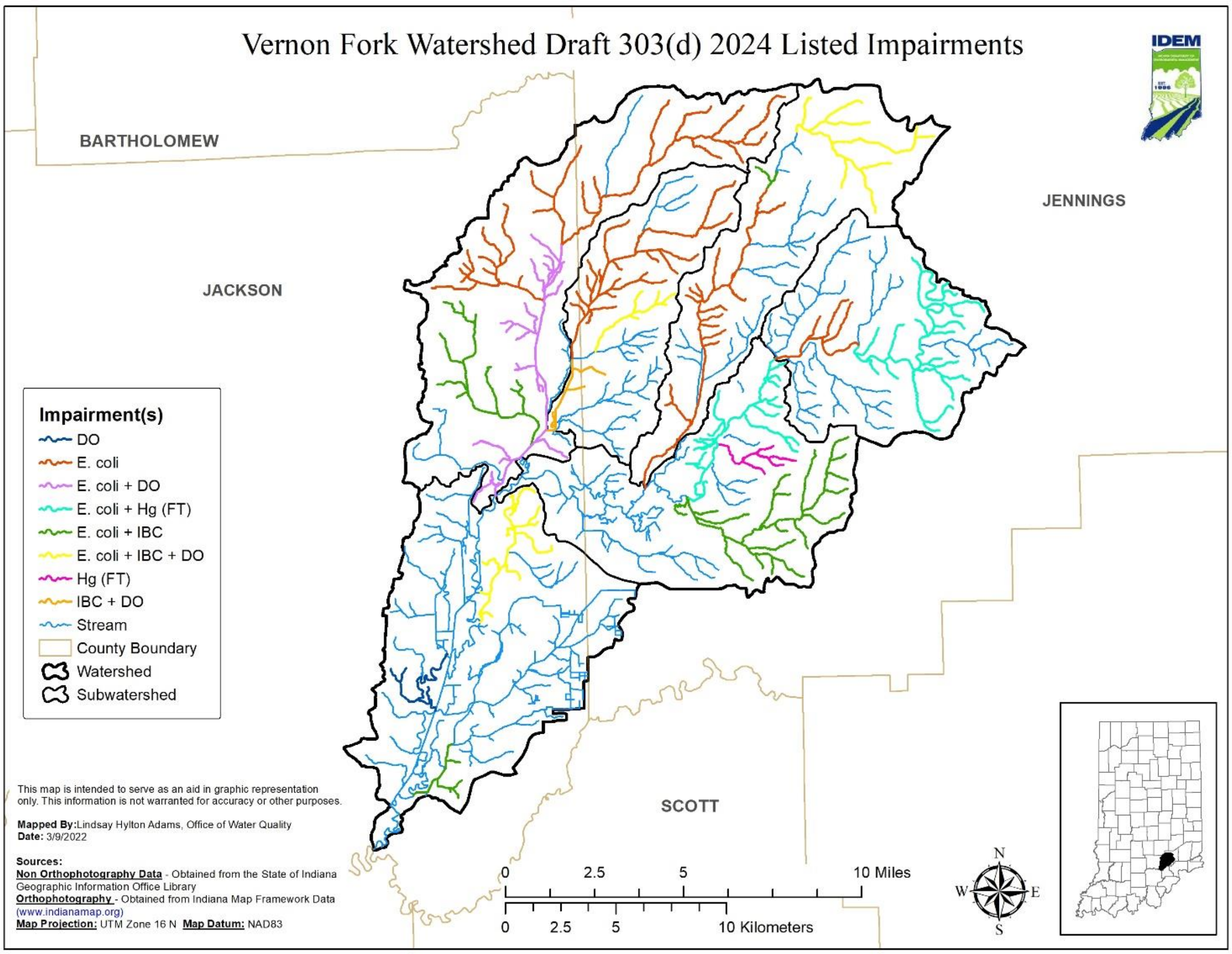
Table 8: Biotic Integrity Scores in the Vernon Fork Muscatatuck River Watershed Identified During August/September 2021 Sampling

Subwatershed	**Stream Name**	**Site #**	**IDEM Station ID**	**Score**	**Integrity Class**	**QHEI**	**Score**	**Integrity Class**	**QHEI**
				mIBI	**mIBI**	**mIBI**	**IBI**	**IBI**	**IBI**
Indian Creek	Vernon Fork Muscatatuck River	T23	WEM070-0036	42	Fair	62	52	Good	73
	Vernon Fork Muscatatuck River	T25	WEM070-0001	40	Fair	87	54	Excellent	80
Sixmile Creek	Sixmile Creek	T19	WEM-07-0017	44	Fair	44	46	Good	49
	Sixmile Creek	T20	WEM-07-0018	42	Fair	62	52	Good	62
	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	Storm Creek Ditch	T16	WEM080-0013	34	Poor	44	32	Poor	46
	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
Mutton Creek	Sandy Branch	T11	WEM080-0015	ND	ND	ND	ND	ND	ND
	Mutton Creek Ditch	T12	WEM080-0014	36	Fair	49	38	Fair	47
	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
Polly Branch	Tea Creek	T06	WEM-07-0021	32	Poor	62	38	Fair	57
	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
Grassy Creek	Rider Ditch	T01	WEM090-0003	38	Fair	43	50	Good	55
	Grassy Creek	T02	WEM-07-0010	32	Poor	46	38	Fair	51
	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

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 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 12-digit 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.

Table 9: Vernon Fork Muscatatuck River Subwatershed Drainage Areas

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%

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 (DNR: Nature Preserves: Endangered Plant and Animals (in.gov)).

Table 10: Land Use of the Vernon Fork Muscatatuck River Watershed

Land Use	**Watershed**		
	Area		**Percent**
	Acres	**Square Miles**	
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%**

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.*

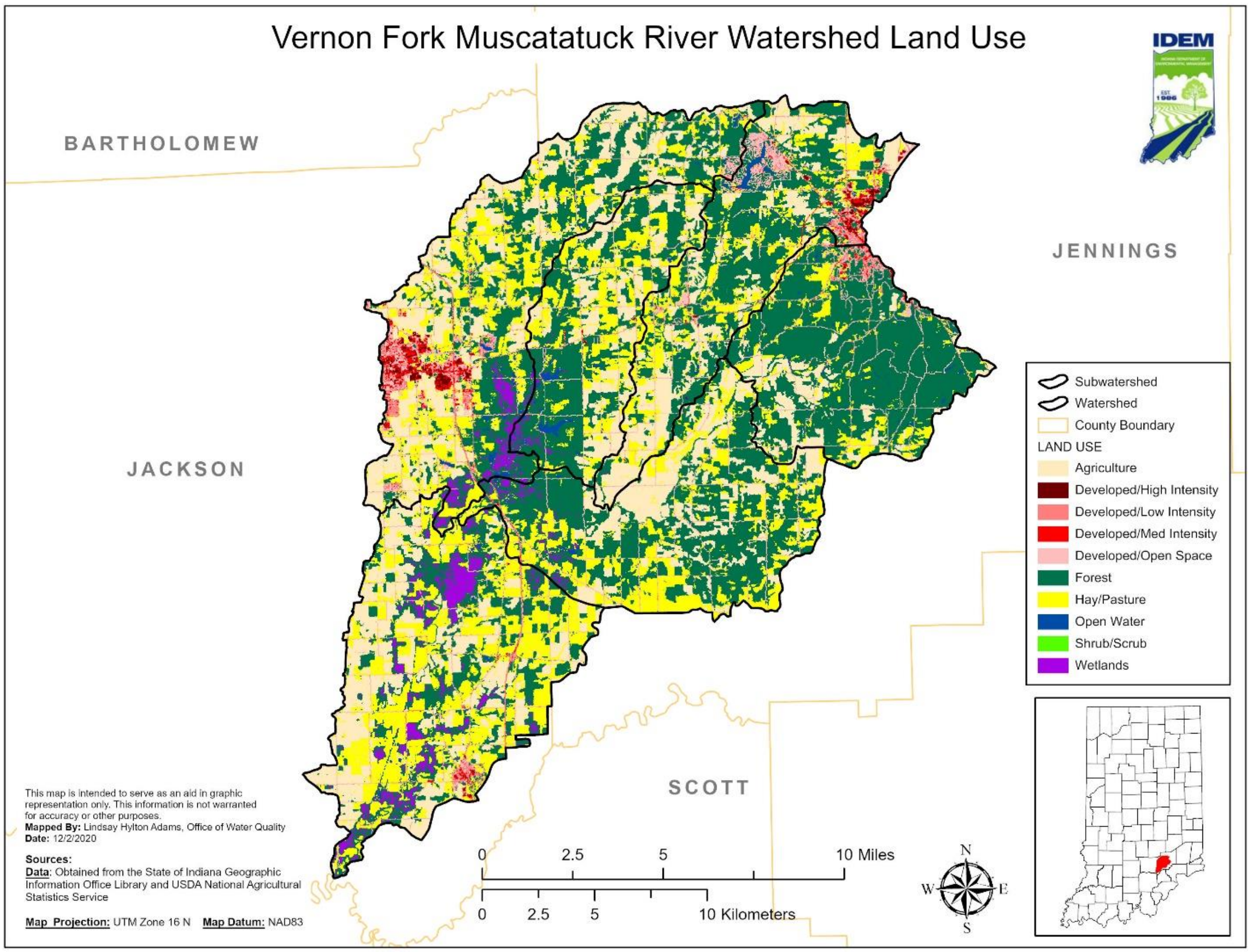


Figure 10: Land use in the Vernon Fork Muscatatuck River Watershed

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

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

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).

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

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

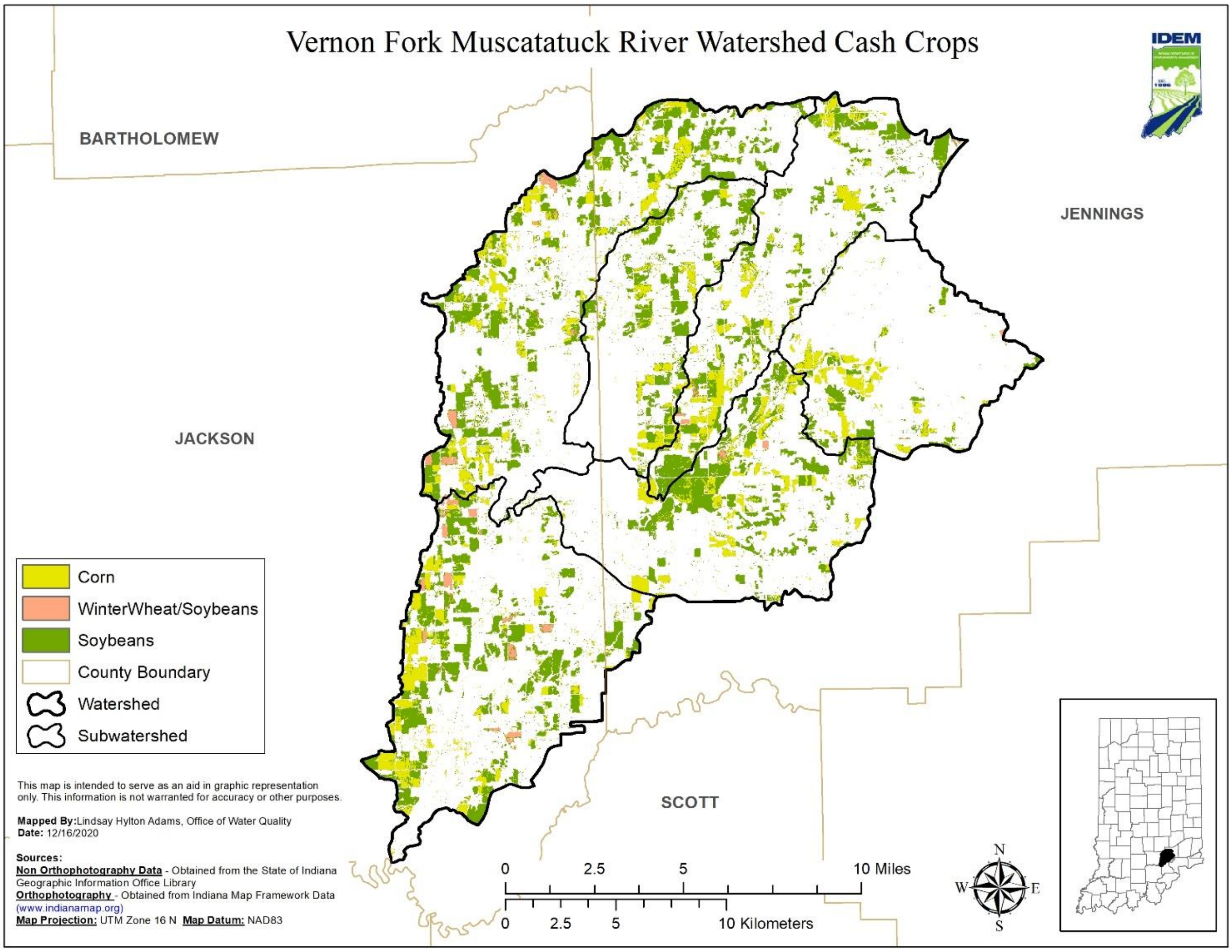


Figure 11: Cash Crop Acreage in the Vernon Fork Muscatatuck River Watershed

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.

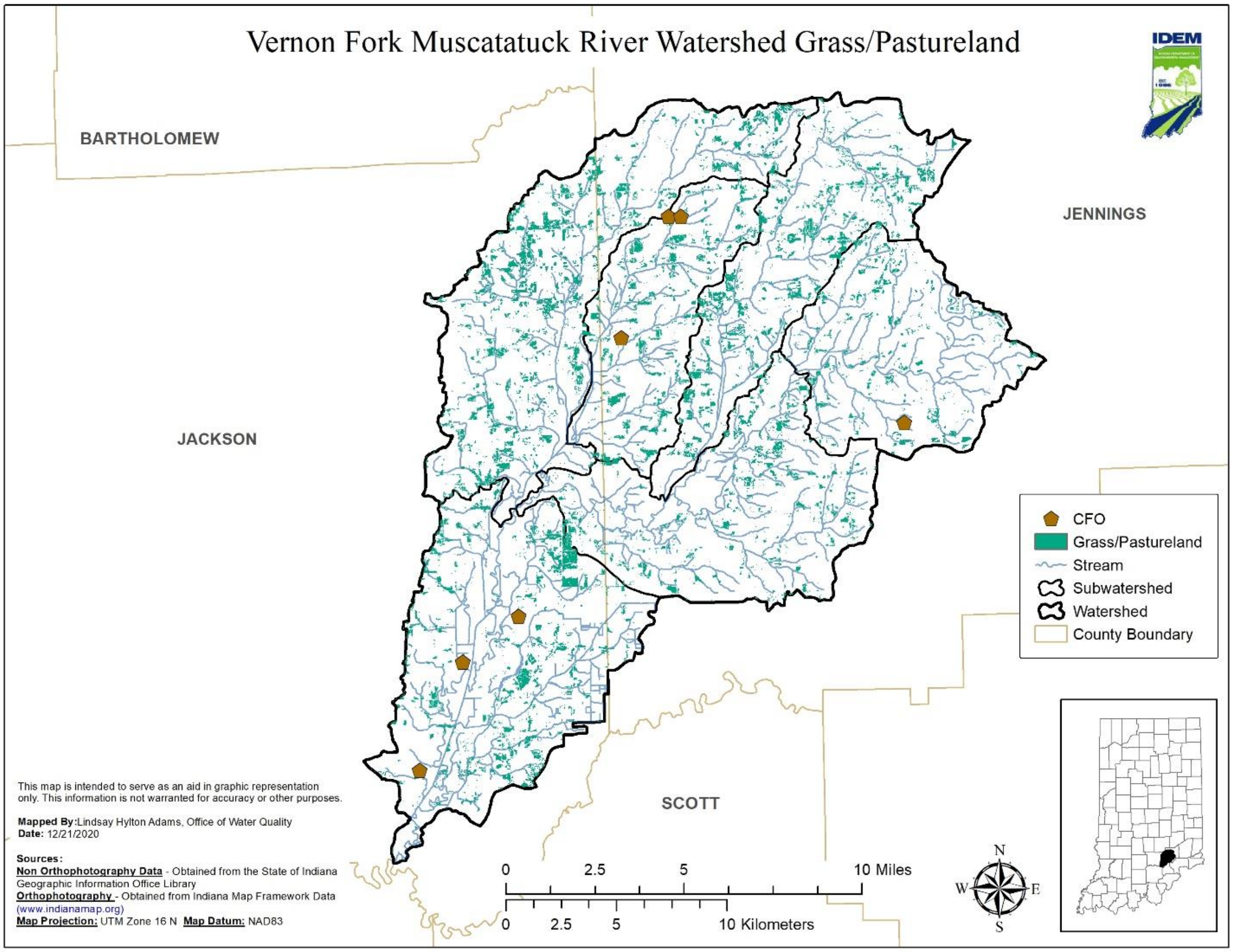


Figure 12: Grassland and Pastureland in the Vernon Fork Muscatatuck River Watershed with CFO locations

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.

Table 13: CFOs in the Vernon Fork Muscatatuck River Watershed

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
Storm Creek	6708	Rose Acre Farms Incorporated Spencer Breeder Farm	Jennings	Layers: 55,000
	1207	Rose Acre Farms Incorporated Woodacres Farm	Jennings	Layers: 275,000
	3571	Rose Acres Farms Incorporated Storm Creek Breeder Farm	Jennings	Layers: 48,000

Subwatershed	CFO Permit ID	Operation Name	County	Animal Type and Permitted number
Grassy Creek	6294	Jonathon Pollert	Jackson	Finishers: 4,400
	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).

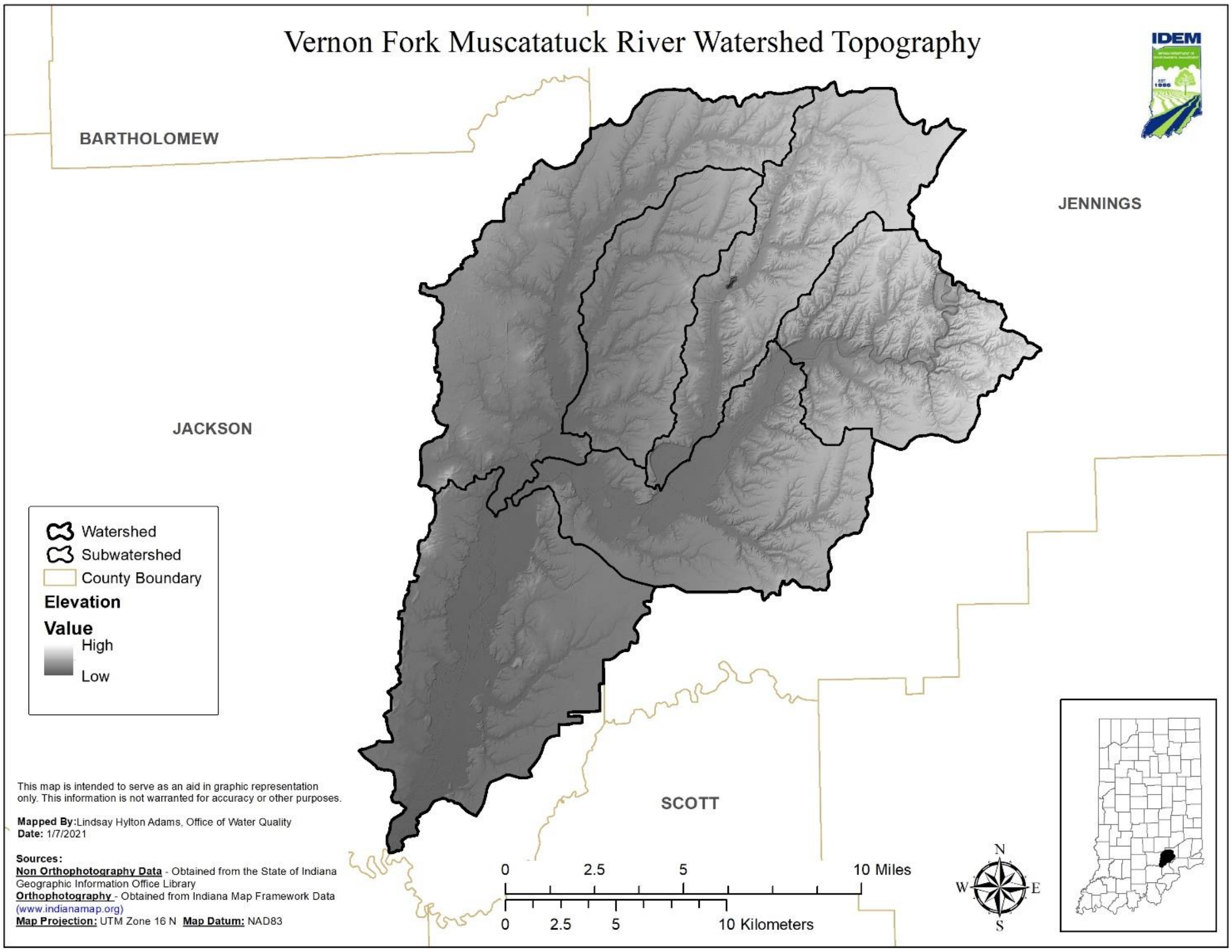


Figure 13: Topography of the Vernon Fork Muscatatuck River Watershed. Digital Elevation Data (DEM) was taken from the State of Indiana's Geographic Information Office (GIO).

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/.

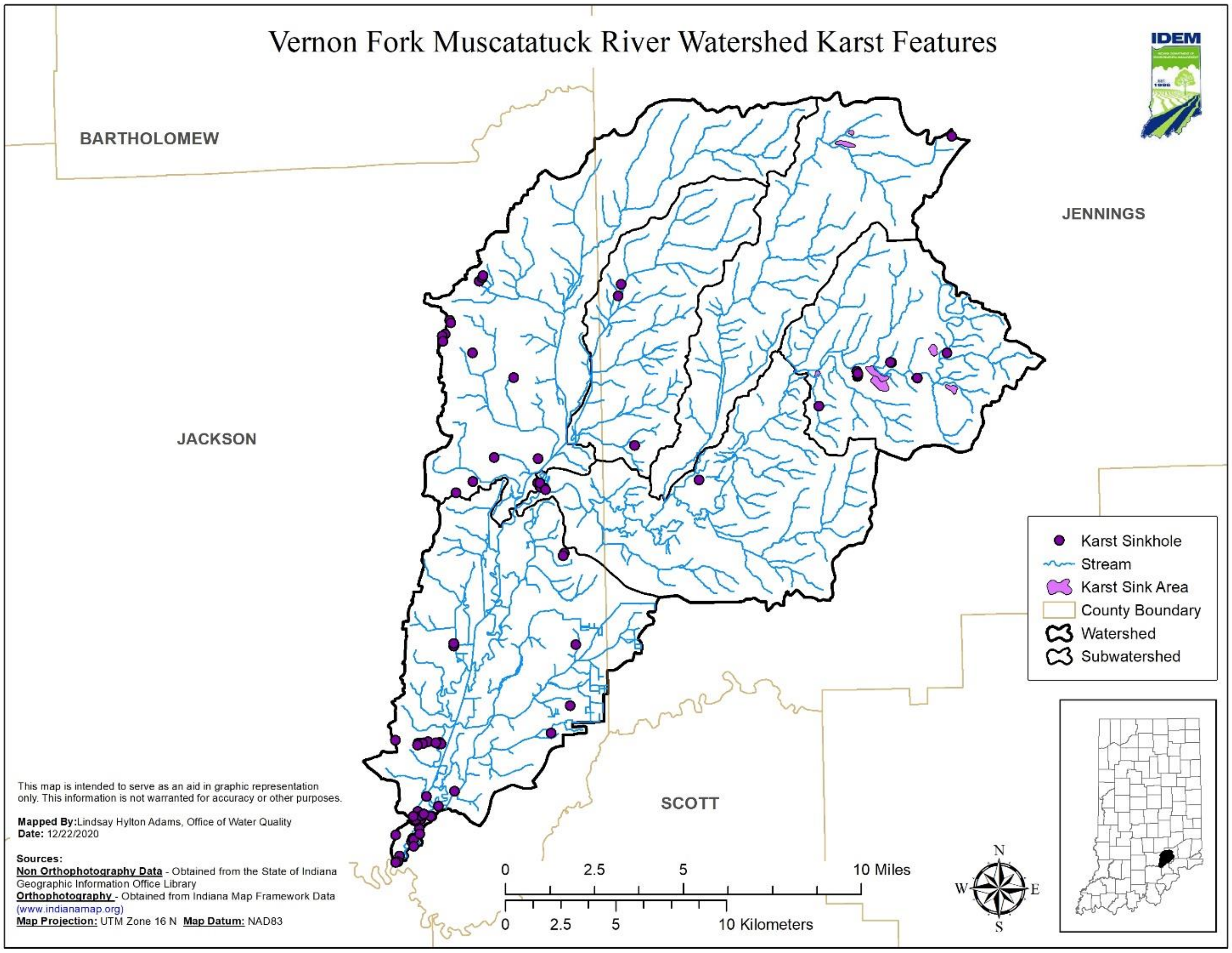


Figure 14: Karst Features in the Vernon Fork Muscatatuck River Watershed

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.

Table 14: Hydrologic Soil Groups

Hydrologic Soils Group	Description
A	Soils with high infiltrations rates. Usually deep, well drained sands or gravels. Little run-off.
B	Soils with moderate infiltration rates. Usually moderately deep, moderately well drained soils.
C	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.

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.

Table 15: Hydrologic Soil Groups in the Vernon Fork Muscatatuck River Subwatersheds

Subwatershed	Hydrologic Soil Group			
	A	B	C	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%

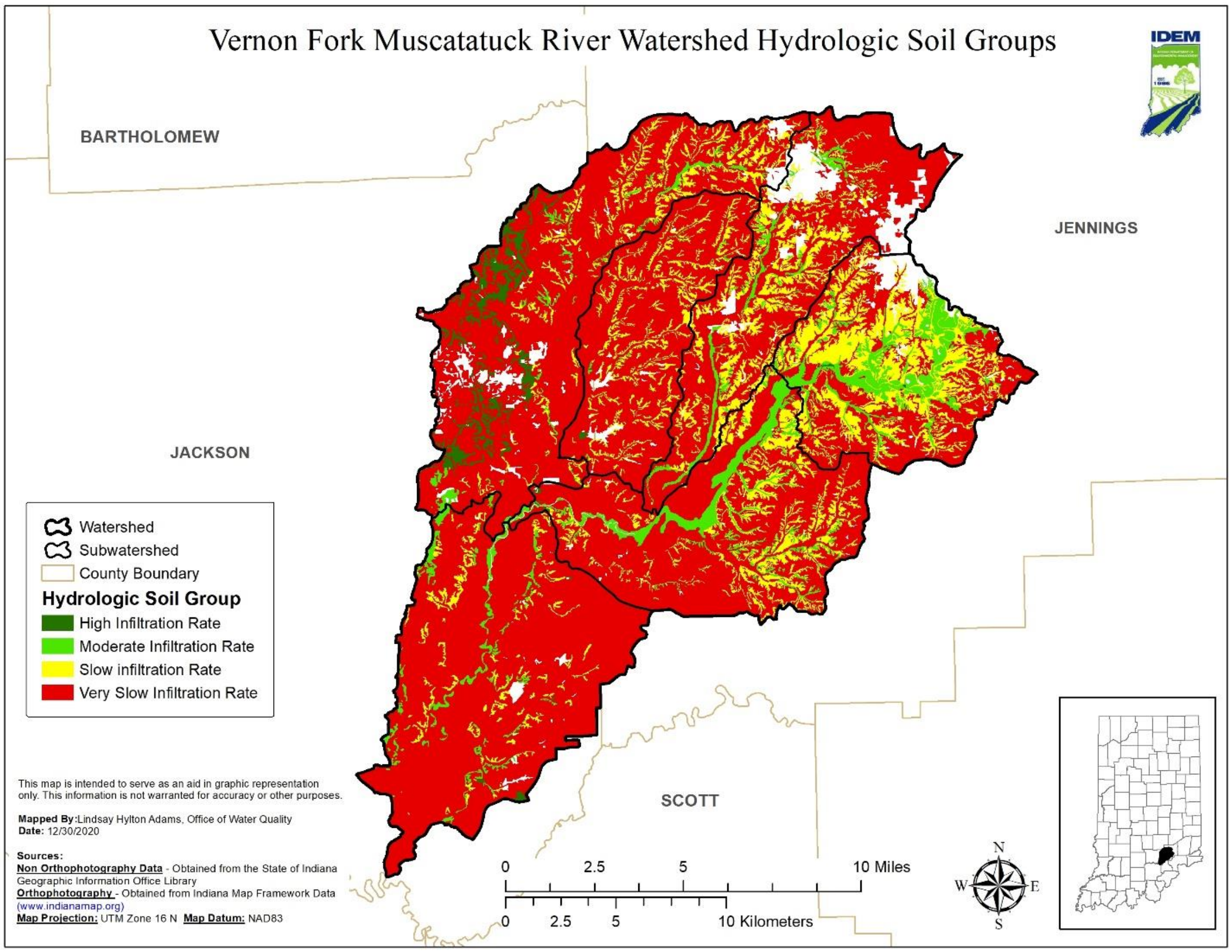


Figure 15: Hydrological Soil Groups in the Vernon Fork Muscatatuck River Watershed

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.

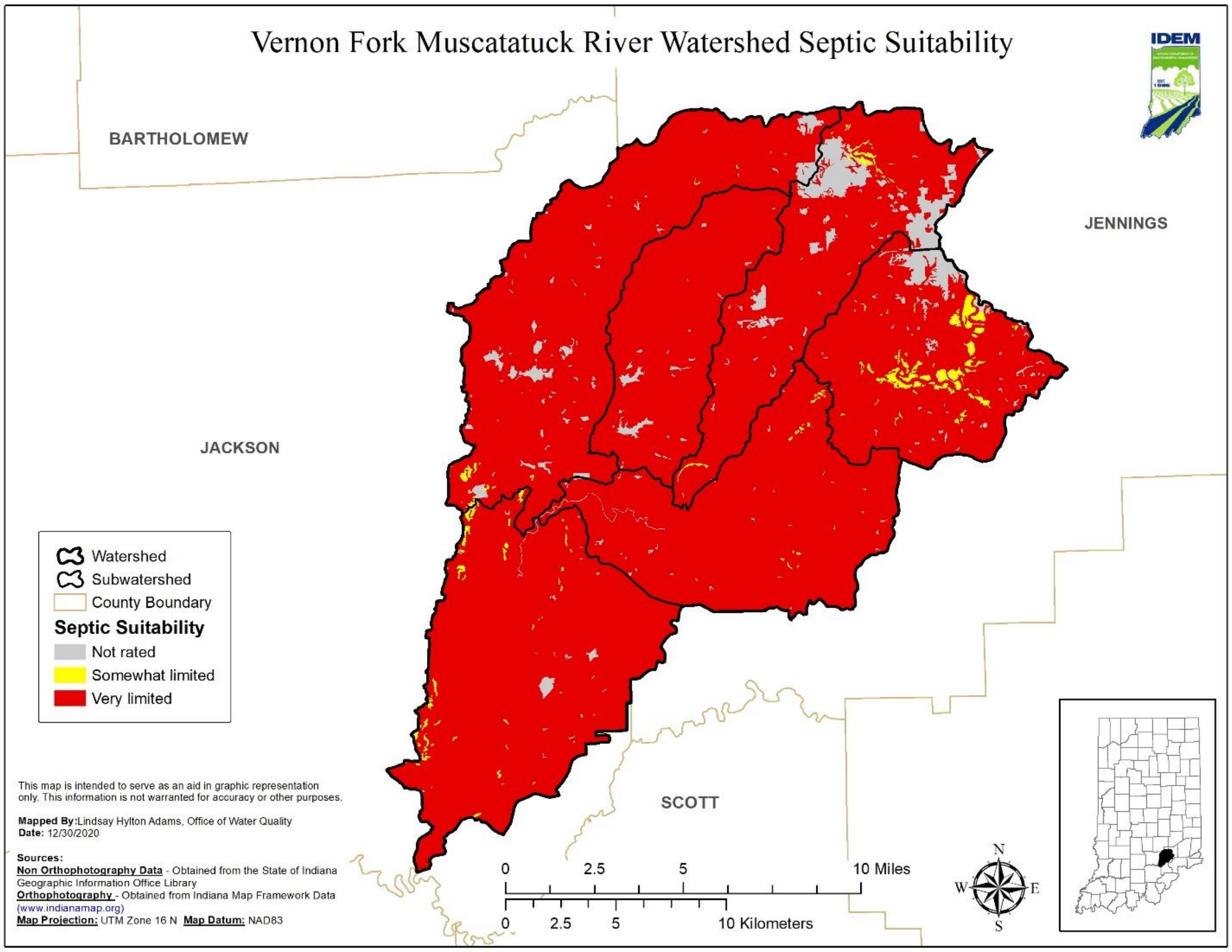


Figure 16: Suitability of Soils for Septic Systems in the Vernon Fork Muscatatuck River Watershed

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 6 or less likely have small areas of hydric soils, and 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
Indian Creek	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
	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**
Sixmile Creek	AddA	Avonburg silt loam, 0 to 2 percent slopes	10	1,531
	AddB2	Avonburg silt loam, 2 to 4 percent slopes, eroded	10	292
	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**
Storm Creek	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
	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**
Mutton Creek	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
	DfnB2	Dubois silt loam, 2 to 6 percent slopes, eroded	3	434
	HleAW	Holton silt loam, 0 to 2 percent slopes, occasionally flooded, very brief duration	5	105
	LvlA	Lyles fine sandy loam, 0 to 1 percent slopes	95	1,640
	PhaA	Peoga silt loam, 0 to 1 percent slopes	93	768
	SldAH	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**
Polly Branch	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
	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
	HleAW	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**
Grassy Creek	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
	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.

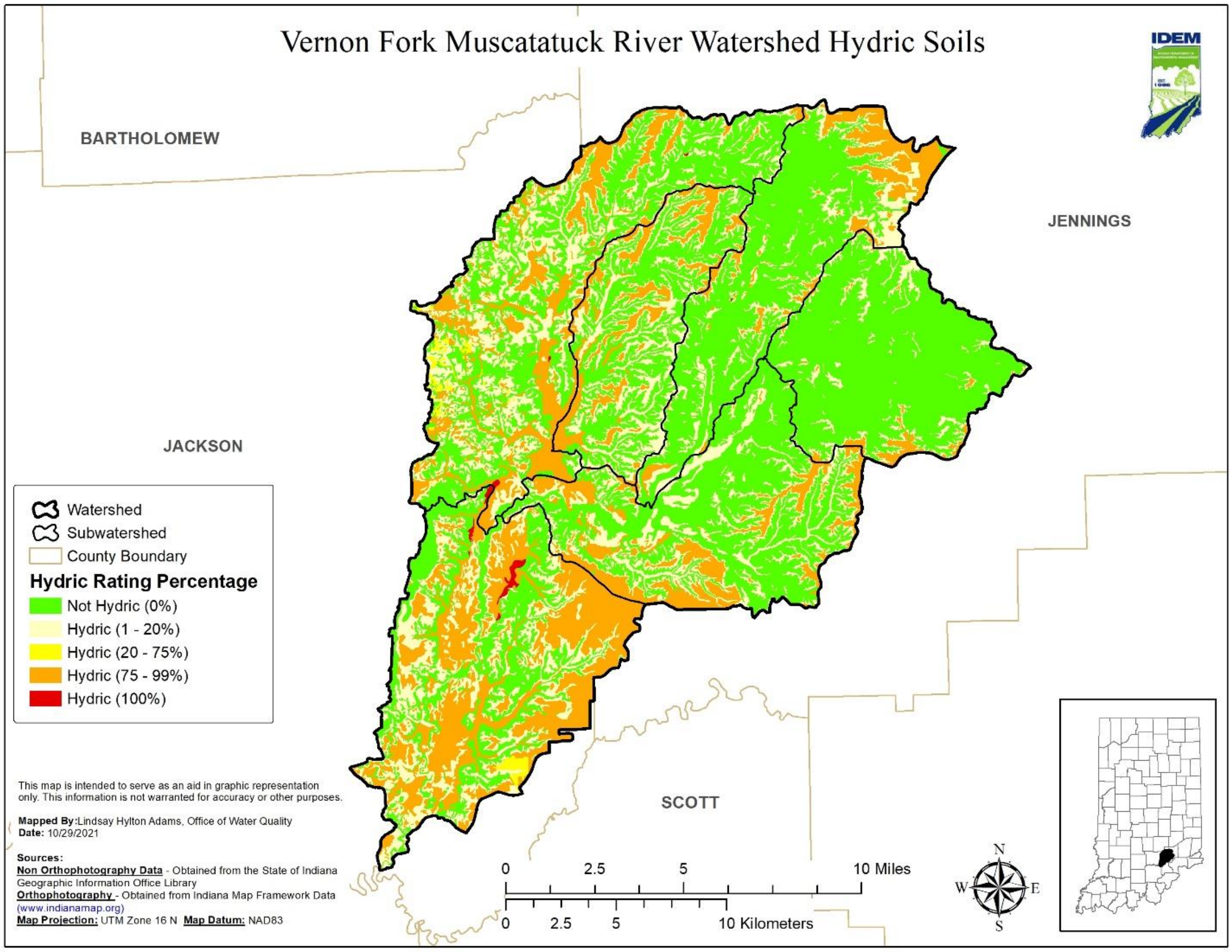


Figure 17: Hydric Soils in the Vernon Fork Muscatatuck River Watershed
(https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/)

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: http://www.in.gov/idem/wetlands/.

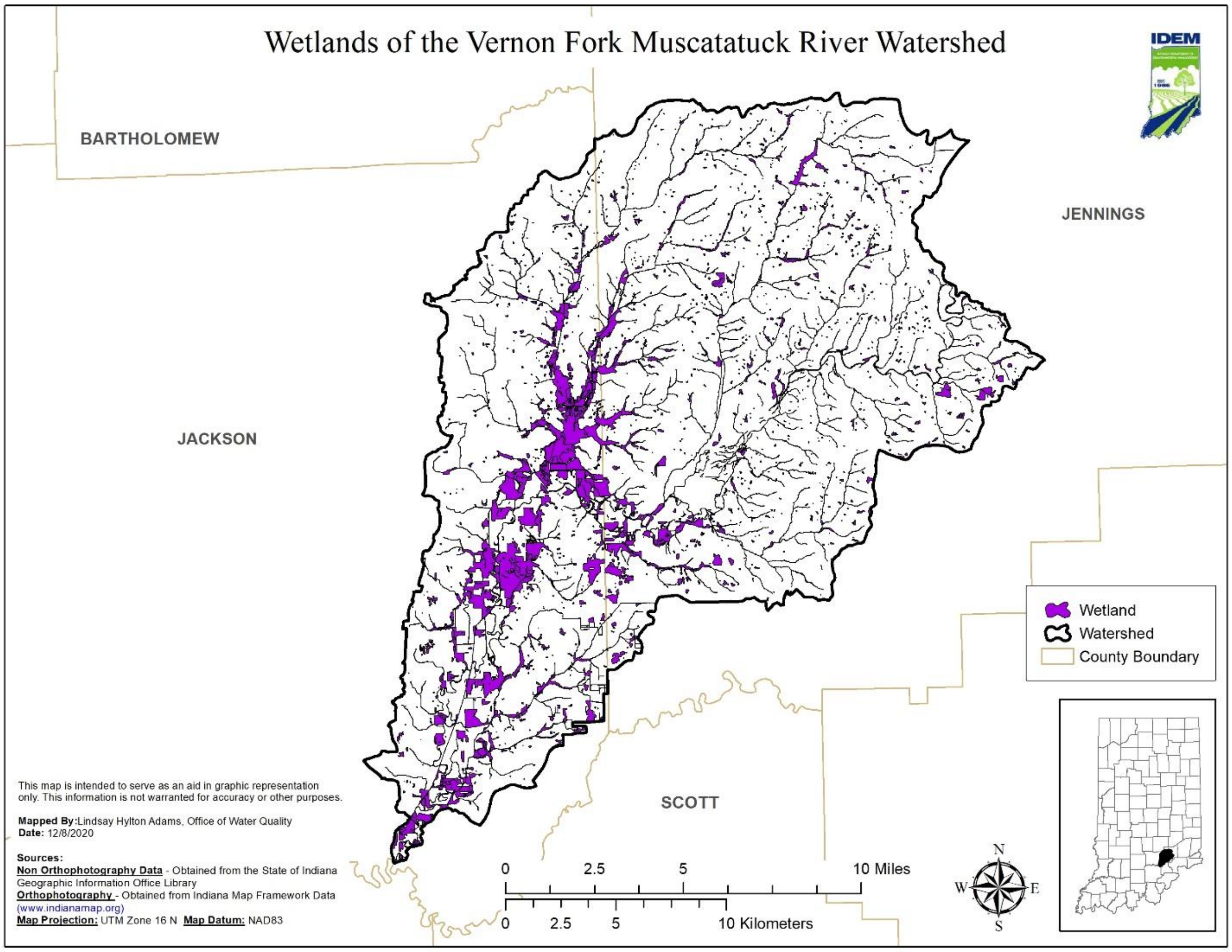


Figure 18: Location of Wetlands in the Vernon Fork Muscatatuck River Watershed

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 quality 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 https://mrcc.purdue.edu/. 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.

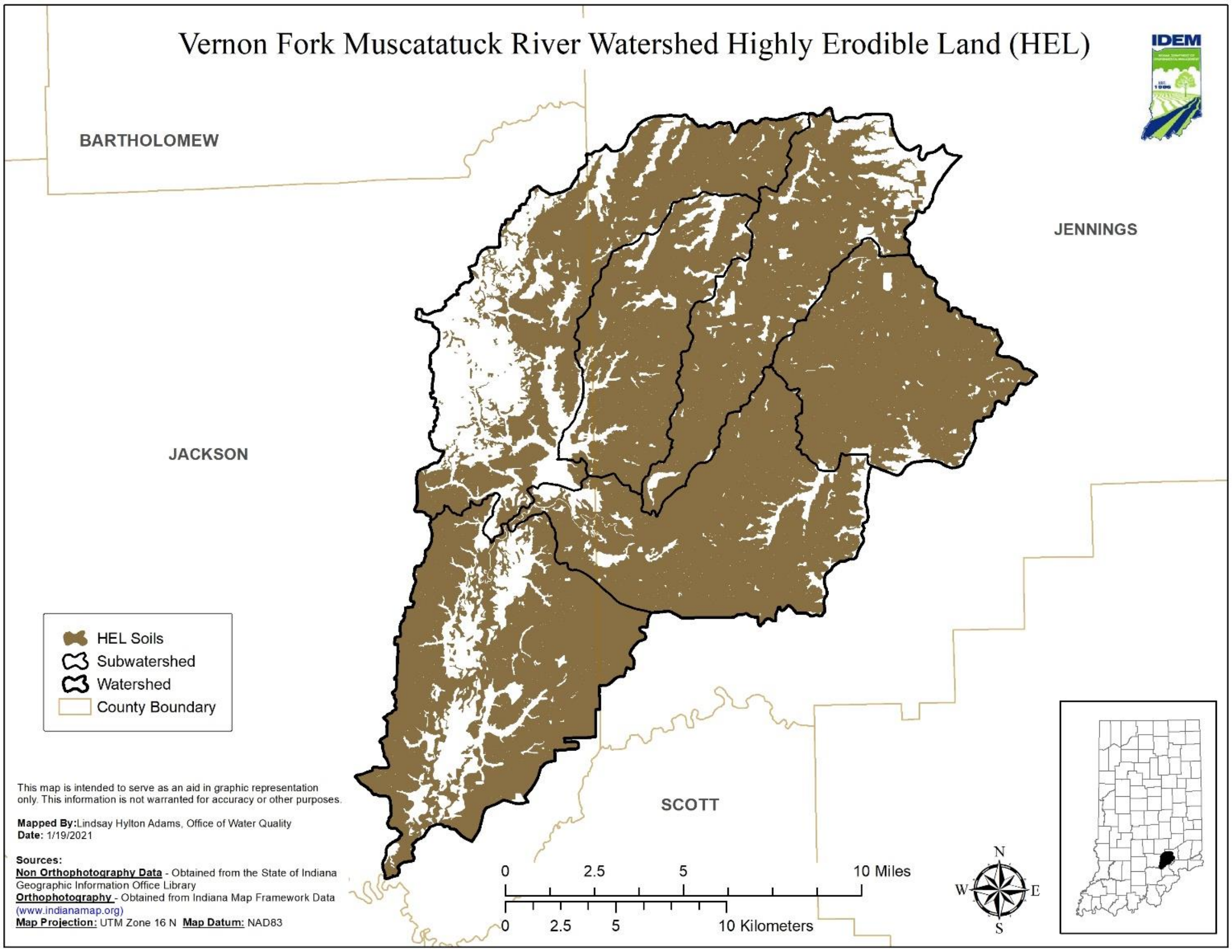


Figure 19: Location of Highly Erodible Lands (HEL) in the Vernon Fork Muscatatuck River Watershed

Table 17: HEL/Potential HEL Acreage 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	1,871
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
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

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	10,239
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	2,636
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	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	8,003
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

Map Symbol	HEL/Potential HEL Soil Types	Acres
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
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
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	10,239
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

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	791
WpuAH	Wirt silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	59
ZnsB	Zenas silt loam, karst, undulating	165
	Total	**107,676**

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).

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

County	Tillage Practice 2019			
	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%

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 (https://www.apps.bse.vt.edu/tmdl/). 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.

Table 19: Bacteria Source Load by Species

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

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.

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

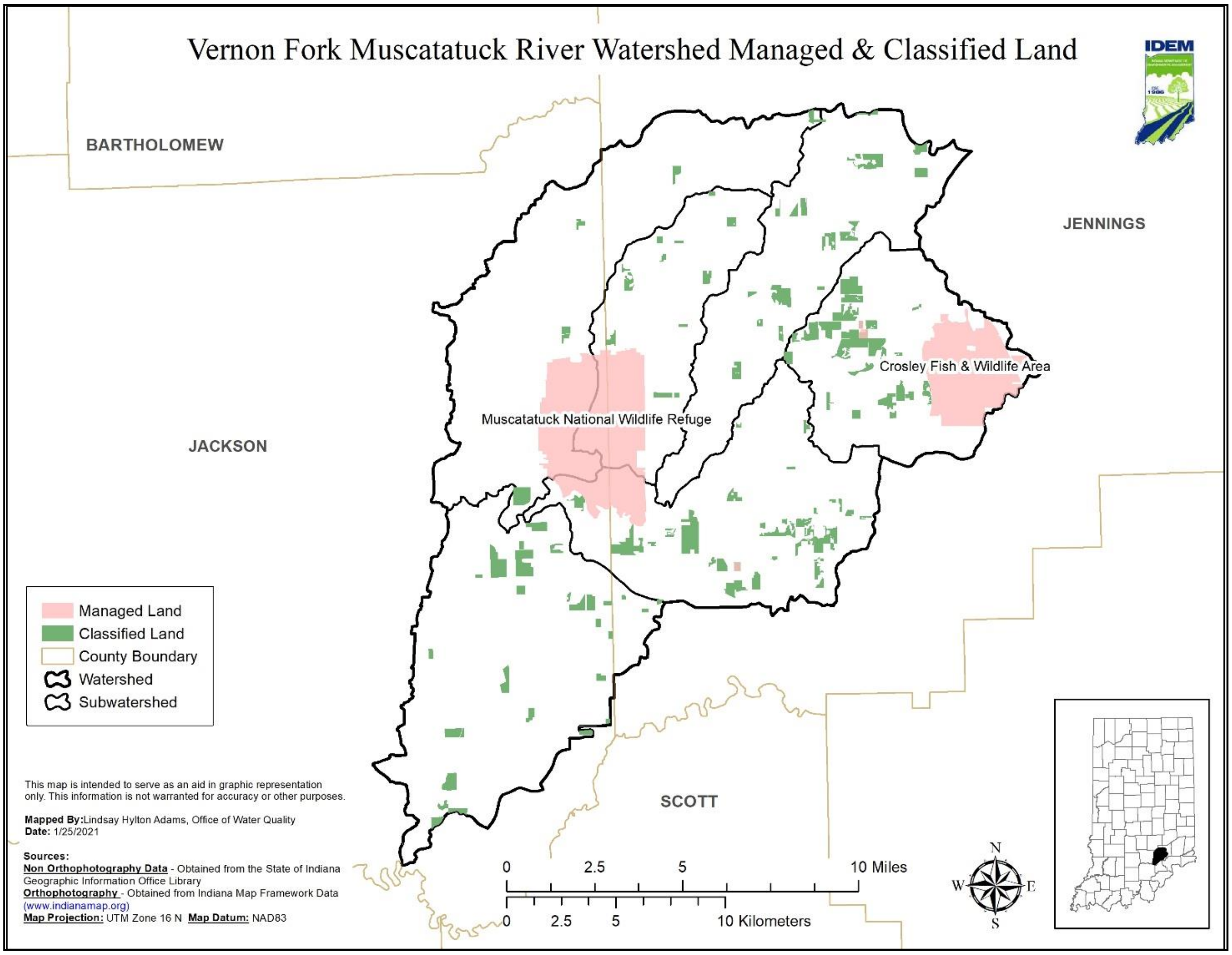


Figure 20: Managed and Classified Lands within the Vernon Fork Muscatatuck River Watershed

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 (https://mrcc.purdue.edu/).

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 annually by between 25 and 38 percent by the end of the century, with the largest percent 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).

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

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

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.

Table 23: Estimated Population in 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%

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).

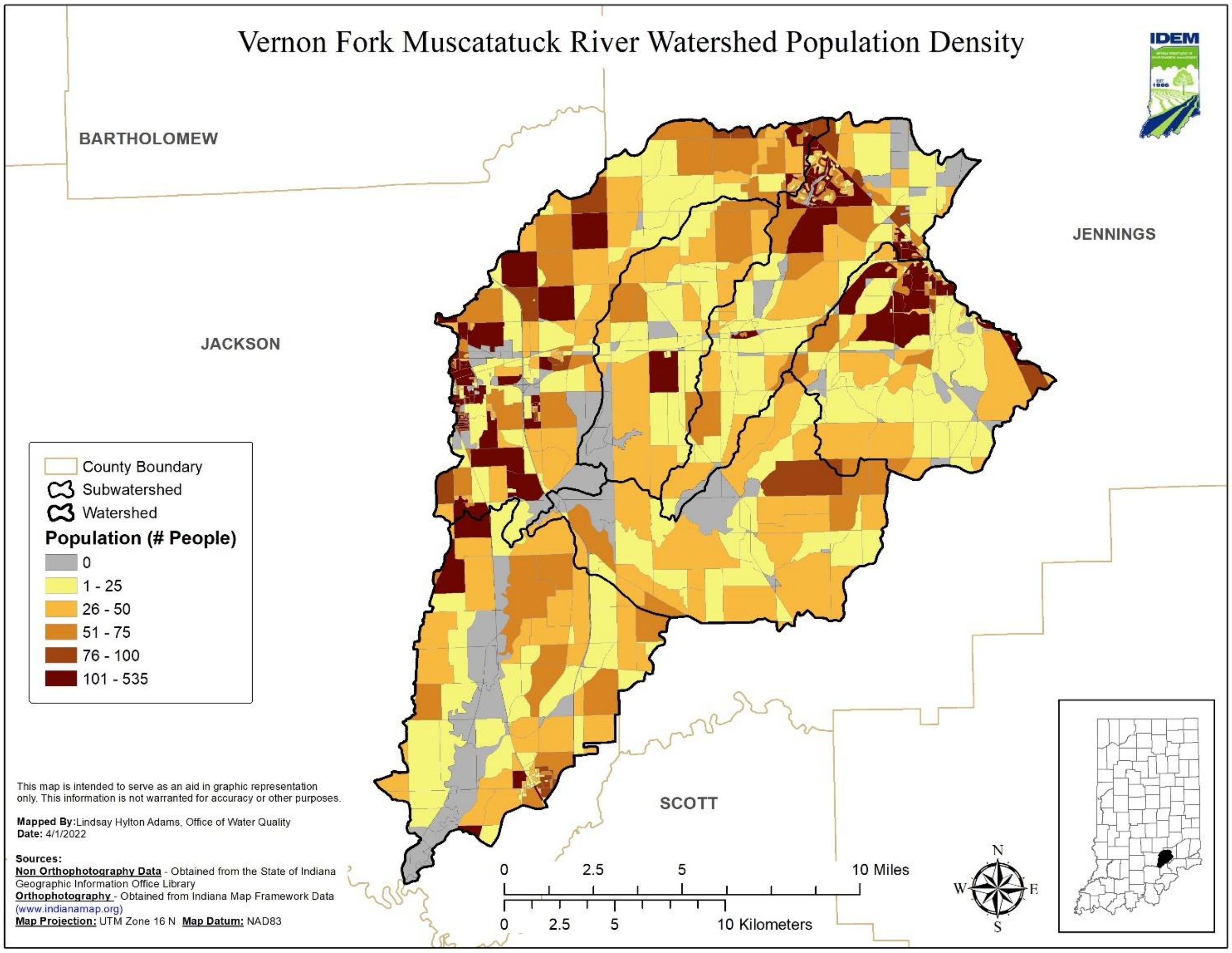


Figure 21: Population Density in the Vernon Fork Muscatatuck River Watershed

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 watershed (U.S. Census Bureau, 2020).

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

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

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.

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

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

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.

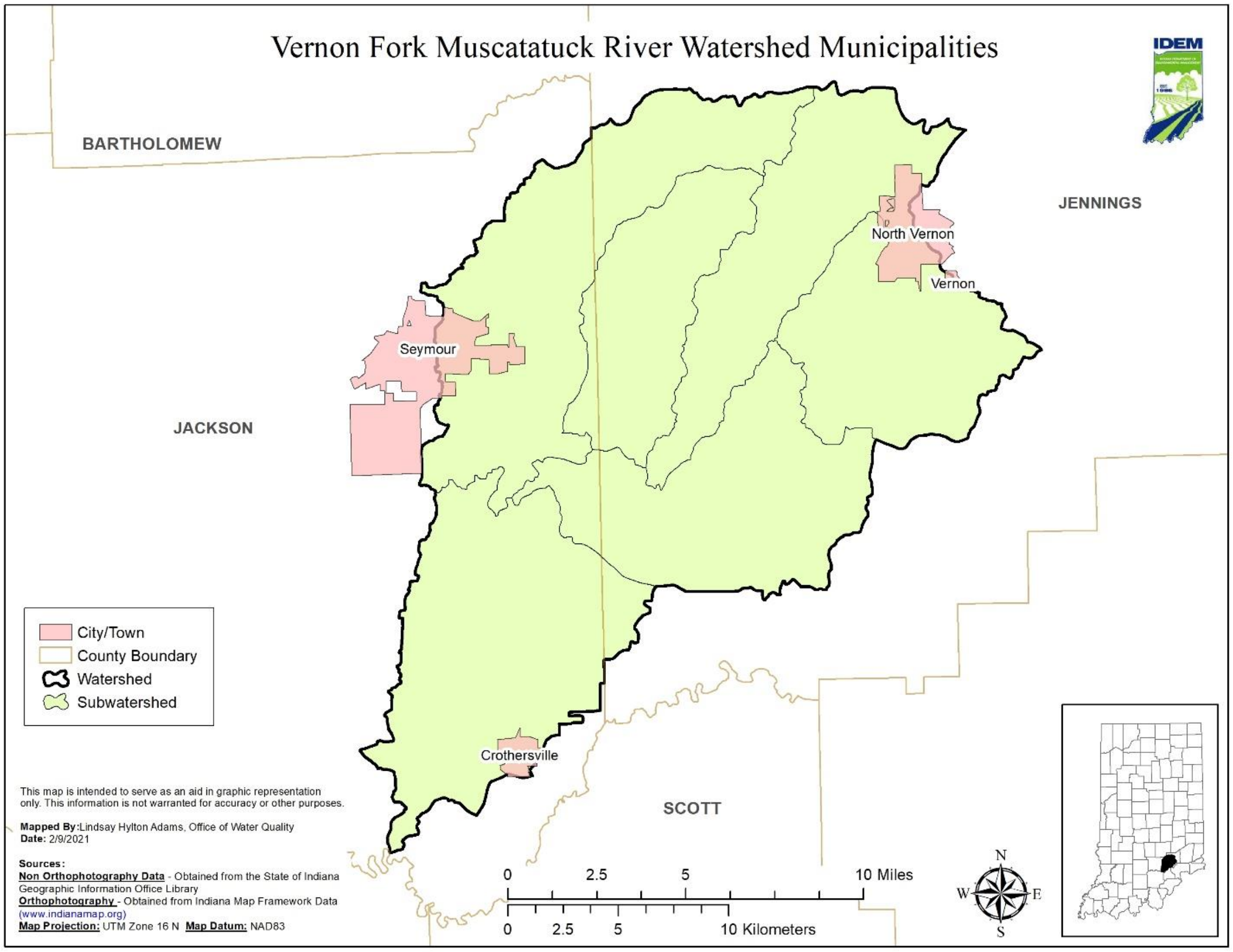


Figure 22: Municipalities in the Vernon Fork Muscatatuck River Watershed

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 Treatment 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
					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.*

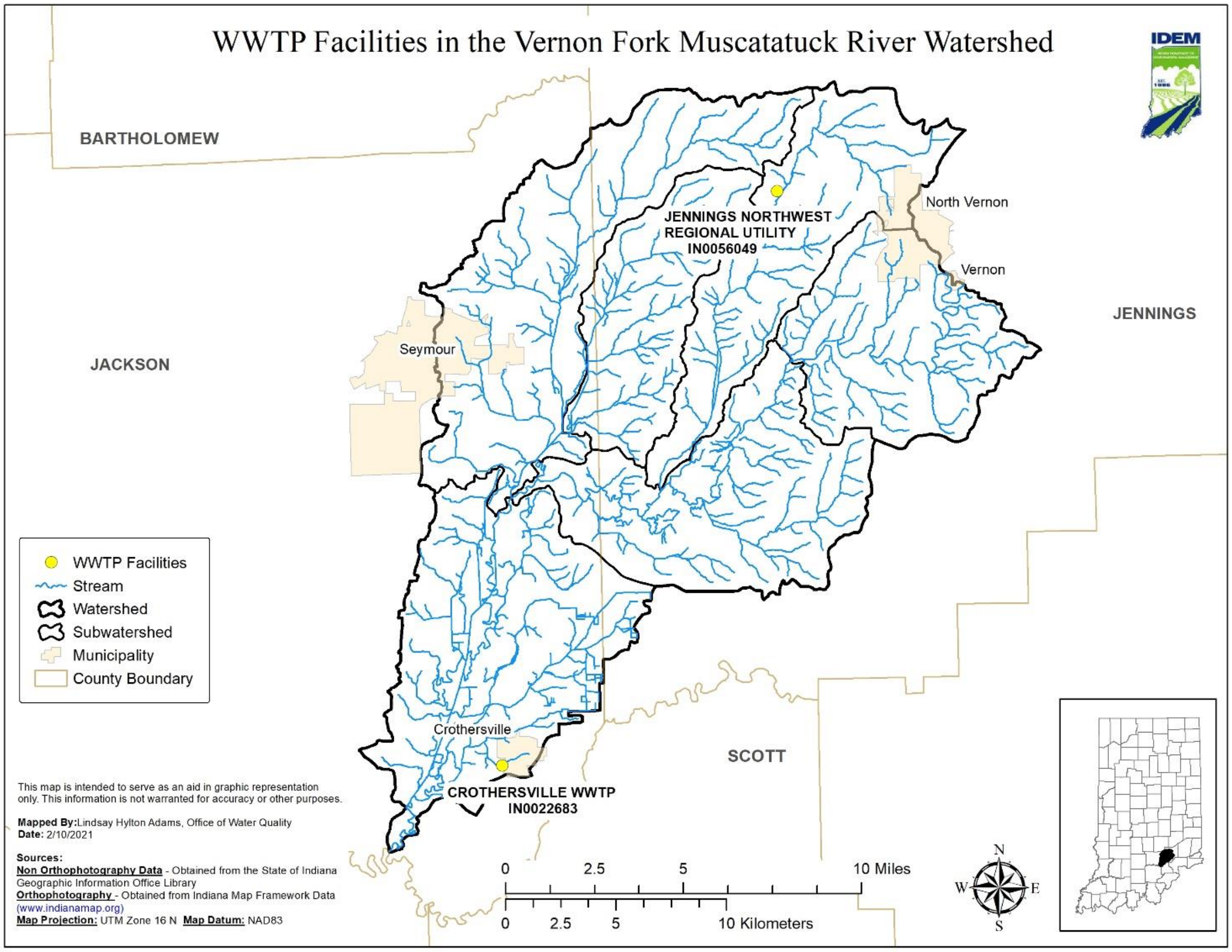


Figure 23: Municipal Wastewater Treatment Facilities Discharging within the Vernon Fork Muscatatuck River Watershed

Permit Compliance

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

Subwatershed	Facility Name	NPDES Permit Number	Stream	Inspections for the Last Five Years	Water Quality Violations for the Last Five Years					
					Outfall	Month	Year	Parameter	Type	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. Aug. Nov. Nov. Nov. Aug. Aug.	2018 2018 2018 2018 2018 2017 2017 2017 2018 2018	NH3-N (mg/L) NH3-N (mg/L) NH3-N (lbs/d) NH3-N (lbs/d) pH TSS (mg/L) TSS (lb/d) TSS (lb/d) TSS (mg/L) 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.	2017	NH3-N (mg/L)	. MO AVG	68%
						Jan.	2017	NH3-N (mg/L)	MX WK AV	107%
						Jan.	2017	NH3-N (lb/d)	MO AVG	17%
						Jan.	2017	NH3-N (lb/d)	MX WK AV	23%
						Feb.	2017	NH3-N (mg/L)	MO AVG	236%
						Feb.	2017	NH3-N (mg/L)	MX WK AV	255%
						Feb.	2017	NH3-N (lb/d)	MO AVG	104%
						Feb.	2017	NH3-N (lb/d)	MX WK AV	21%
						March	2017	NH3-N (mg/L)	MO AVG	46%
						March	2017	NH3-N (mg/L)	MX WK AV	59%
						March	2017	NH3-N (lb/d)	MO AVG	45%
						March	2017	NH3-N (lb/d)	MX WK AV	158%
						April	2017	NH3-N (lb/d)	MX WK AV	73%
						May	2017	NH3-N (mg/L)	MO AVG	41%
						May	2017	NH3-N (mg/L)	MX WK AV	80%
						May	2017	NH3-N (lb/d)	MO AVG	14%
						May	2017	NH3-N (lb/d)	MX WK AV	38%
						June	2017	NH3-N (mg/L)	MX WK AV	38%
						June	2017	NH3-N (lb/d)	MX WK AV	69%
						July	2017	NH3-N (mg/L)	MX WK AV	58%
						July	2017	NH3-N (lb/d)	MX WK AV	75%
						Nov.	2017	NH3-N (mg/L)	MO AVG	9%
						Nov.	2017	NH3-N (mg/L)	MX WK AV	76%
						Nov.	2017	NH3-N (lb/d)	MX WK AV	19%
						Jan.	2018	NH3-N (mg/L)	MO AVG	594%
						Jan.	2018	NH3-N (mg/L)	MX WK AV	509%
						Jan.	2018	NH3-N (lb/d)	MO AVG	263%
						Jan.	2018	NH3-N (lb/d)	MX WK AV	313%
						Feb.	2018	NH3-N (mg/L)	MO AVG	450%
						Feb.	2018	NH3-N (mg/L)	MX WK AV	764%
						Feb.	2018	NH3-N (lb/d)	MO AVG	271%
						Feb.	2018	NH3-N (lb/d)	MX WK AV	195%
						March	2018	NH3-N (mg/L)	MO AVG	26%
						March	2018	NH3-N (mg/L)	MX WK AV	31%
						March	2018	NH3-N (lb/d)	MO AVG	56%
						March	2018	NH3-N (lb/d)	MX WK AV	67%
						June	2018	NH3-N (mg/L)	MO AVG	31%
						June	2018	NH3-N (mg/L)	MX WK AV	81%
						June	2018	NH3-N (lb/d)	MO AVG	67%
						June	2018	NH3-N (lb/d)	MX WK AV	260%
						Nov.	2018	NH3-N (mg/L)	MO AVG	16%
						Jan.	2019	NH3-N (mg/L)	MO AVG	25%
						Jan.	2019	NH3-N (mg/L)	MX WK AV	23%

						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	2019	NH3-N (mg/L)	MO AVG	36%
						March	2019	NH3-N (mg/L)	MX WK AV	30%
						March	2019	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/L)	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/L)	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/L)	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%

Subwatershed	Facility Name	NPDES Permit Number	Stream	Inspections for the Last Five Years	Water Quality Violations for the Last Five Years					
					Outfall	Month	Year	Parameter	Type	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/L)	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	pH	DAILY MX	1%
						May	2017	TSS	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 28: Quarry Facilities Discharging within the Vernon Fork Muscatatuck River Watershed

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

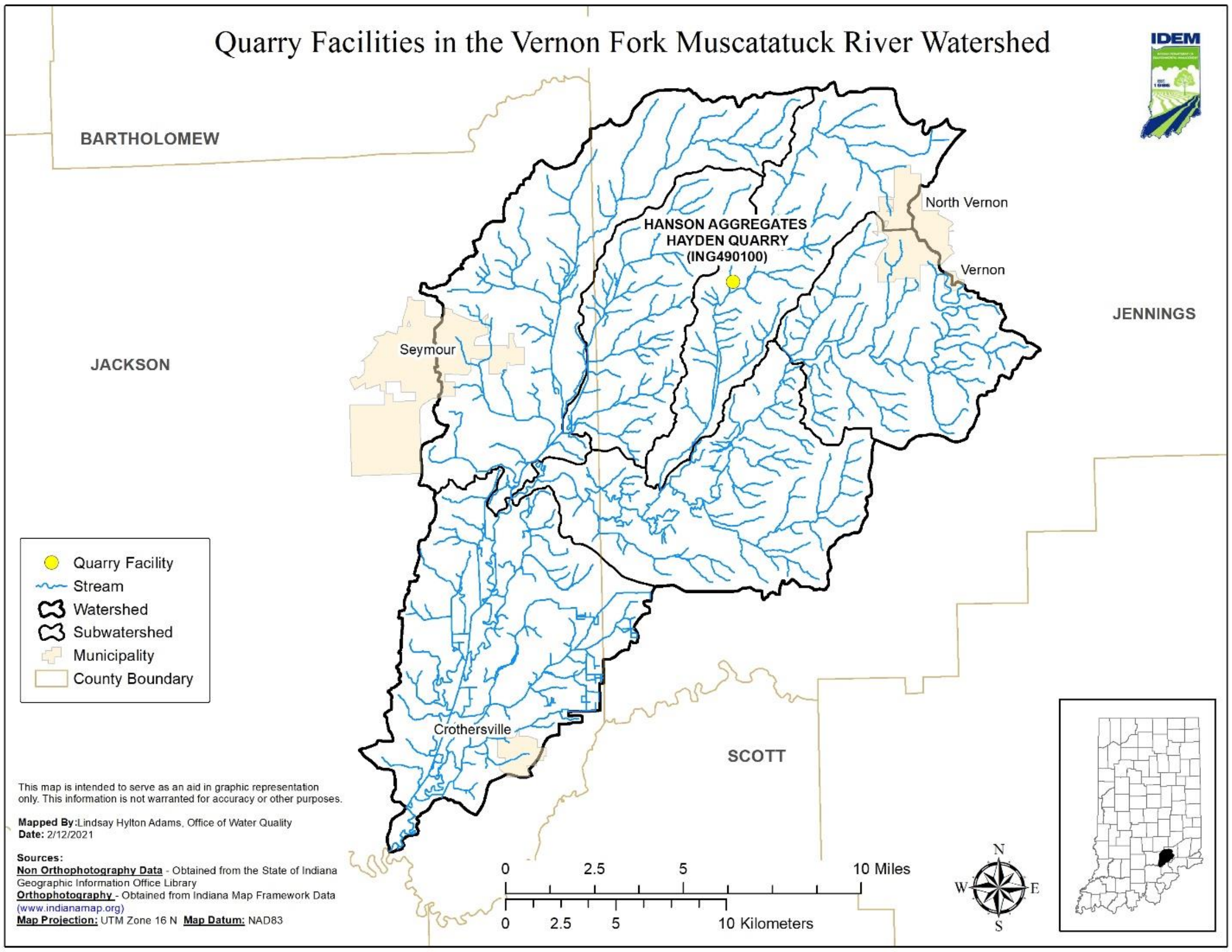


Figure 24: Quarry Facilities Discharging within the Vernon Fork Muscatatuck River Watershed

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) 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.

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.

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

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

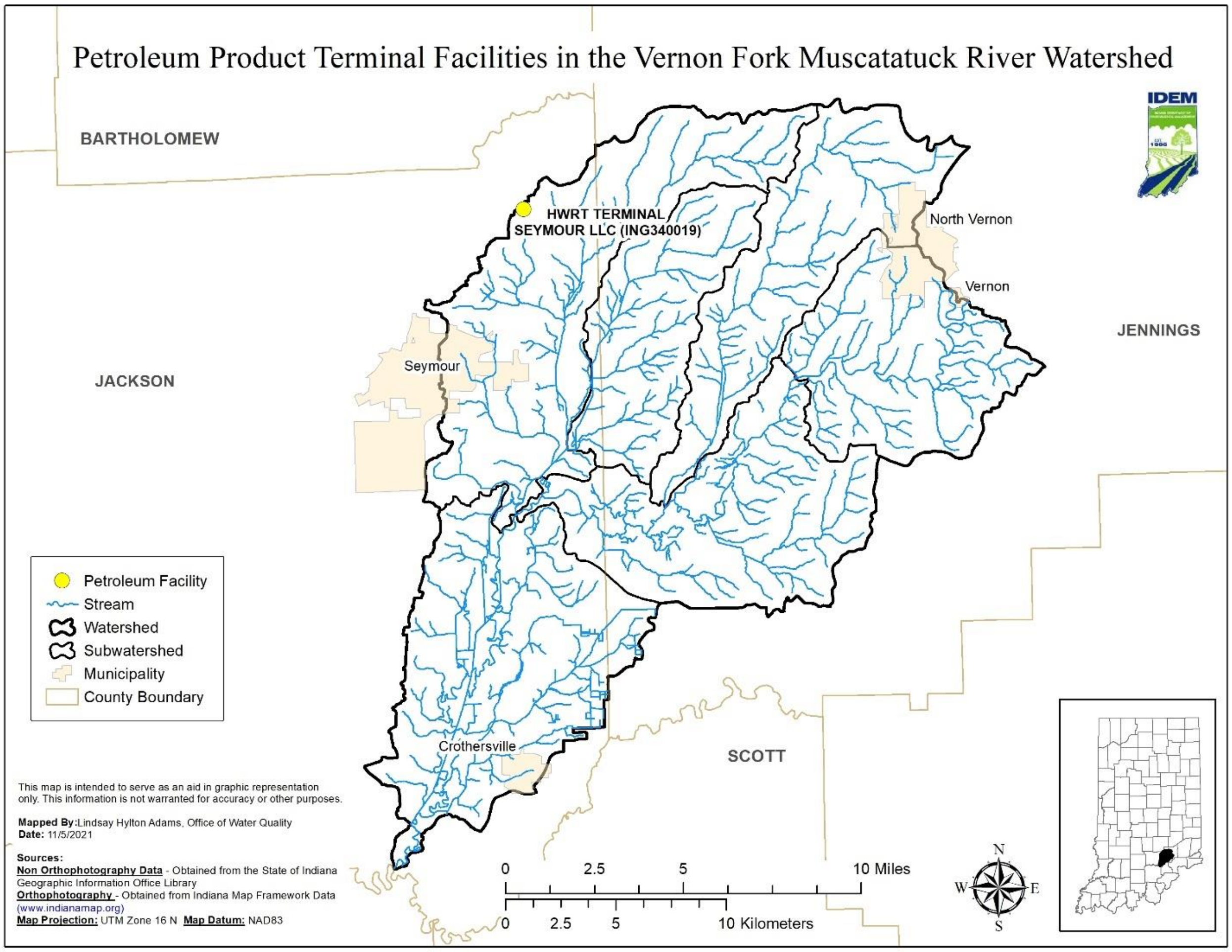


Figure 25: Petroleum Product Terminal Facilities Discharging within the Vernon Fork Muscatatuck River Watershed

Permit Compliance

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

Subwatershed	Facility Name	NPDES Permit Number	Stream	Inspections for the Last Five Years	Water Quality Violations for the Last Five Years					
					Outfall	Month	Year	Parameter	Type	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	pH	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.

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

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

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.

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

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	METALDYNE SINTERFORGED PRODUCTS LLC	INRM01513	Sixmile Creek	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 INCORPORATED	INRM02561	Sandy Branch	4.07
Mutton Creek	THE ANDERSONS INCORPORATED	INRM02560	Sandy Branch	14.27
Mutton Creek	SEYMOUR TUBING INCORPORATED	INRM00375	Sandy Branch	20.35

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

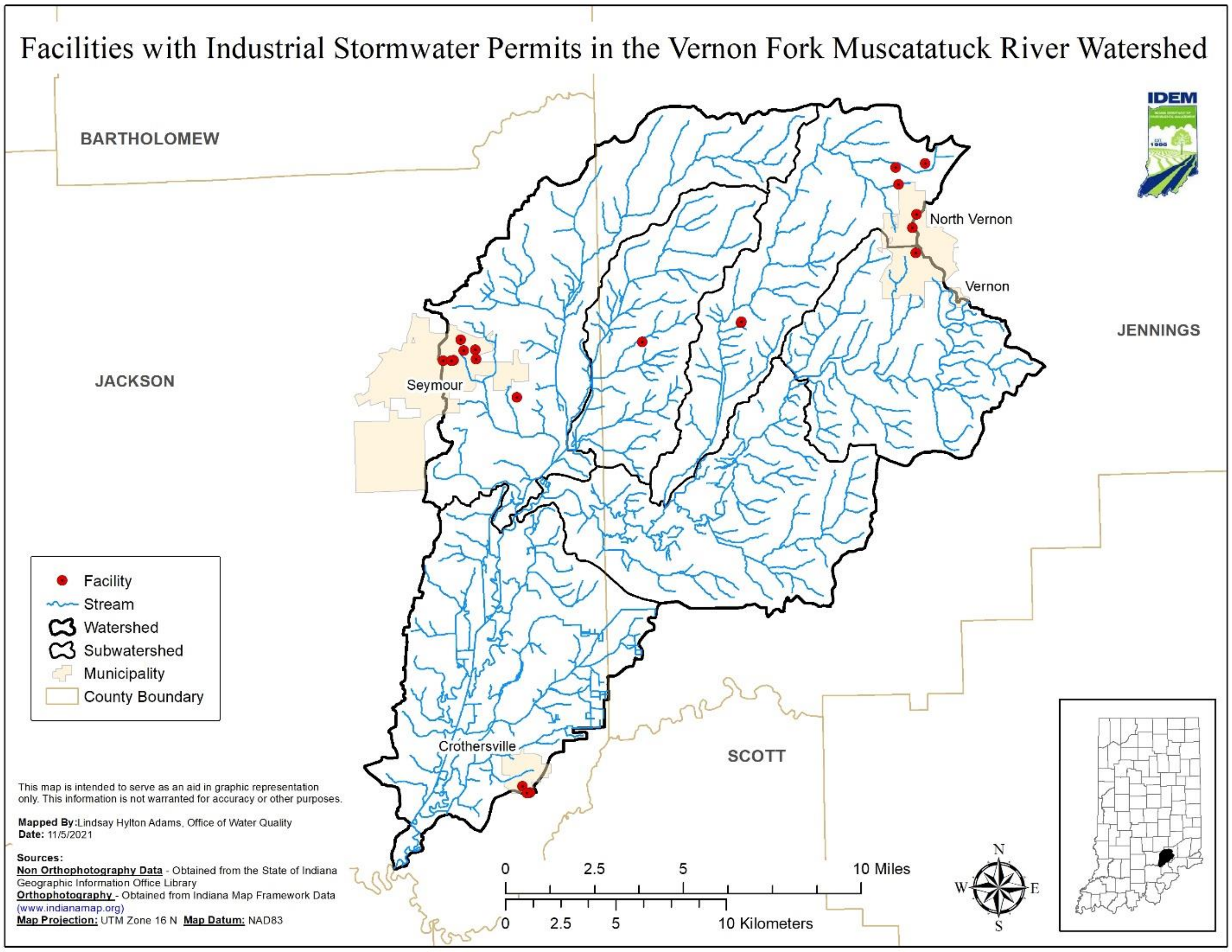


Figure 26: Industrial Stormwater Facilities Discharging within the Vernon Fork Muscatatuck River Watershed

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%

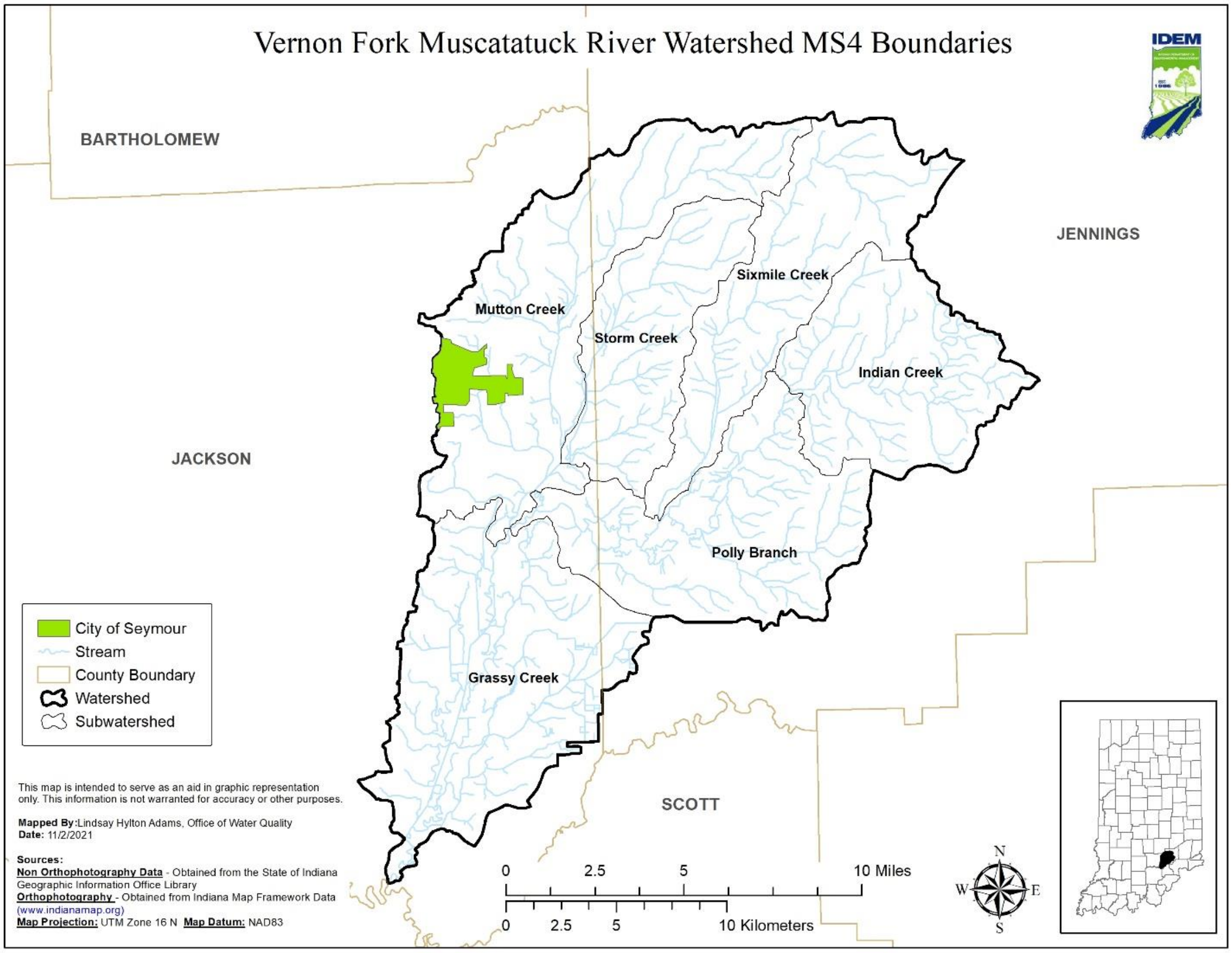


Figure 27: MS4 Boundaries in the Vernon Fork Muscatatuck River Watershed

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.

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

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

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.

Table 35: USGS Site Assignment for Development of Load Duration Curve

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:

$$Q_{ungaged} = \frac{A_{ungaged}}{A_{gaged}} \times Q_{gaged}$$

Where,

$Q_{ungaged}$: Flow at the ungaged location
Q_{gaged}: Flow at surrogate USGS gage station
$A_{ungaged}$: Drainage area of the ungaged location
A_{gaged}: 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.

Table 36: Load Duration Curve Key Flow Percentile Estimates

Subwatershed	Drainage Area (sq. miles)	Flow Duration Exceedance Interval Flows (cfs)				
		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

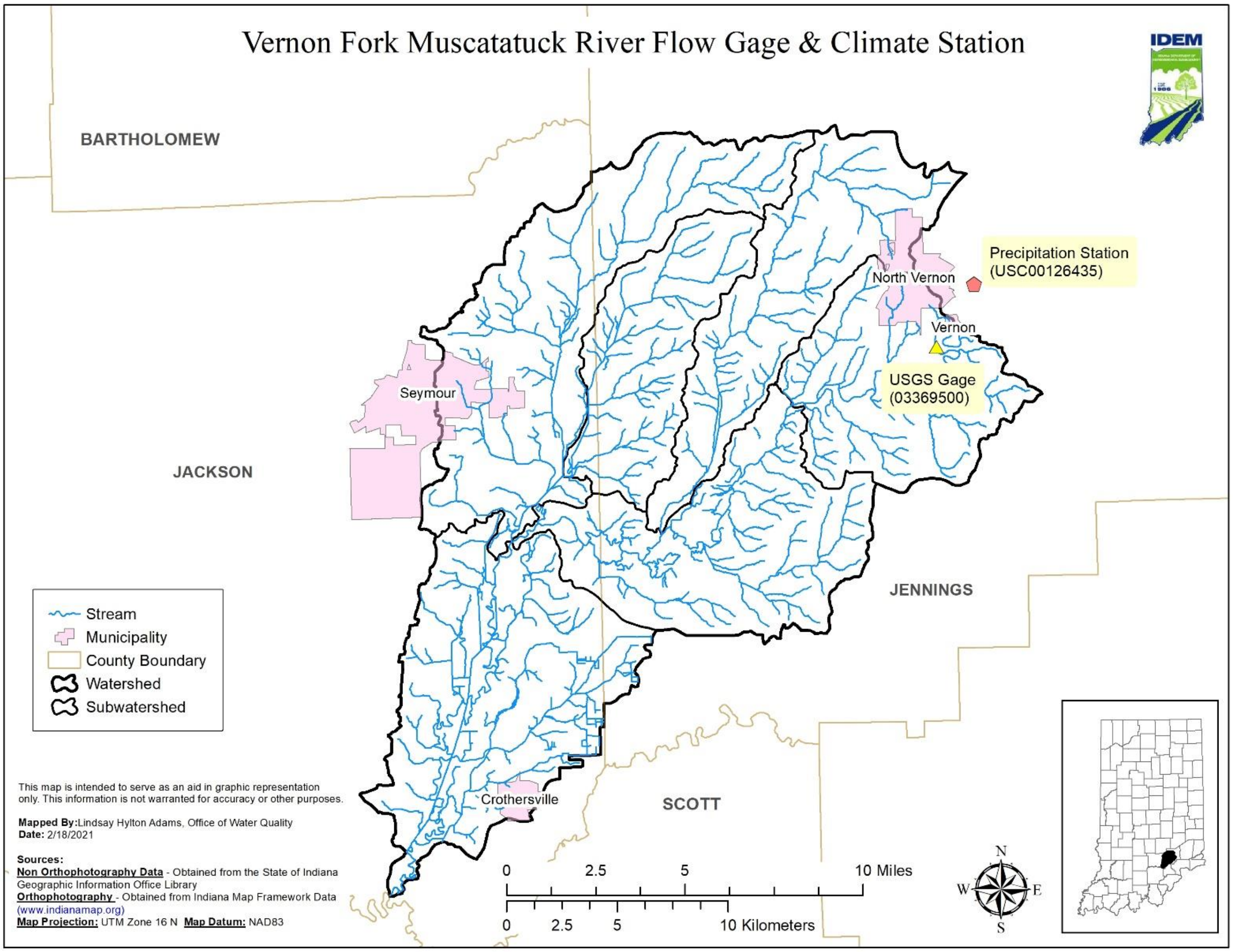


Figure 28: Location of Surrogate Flow Gage in Vernon, IN

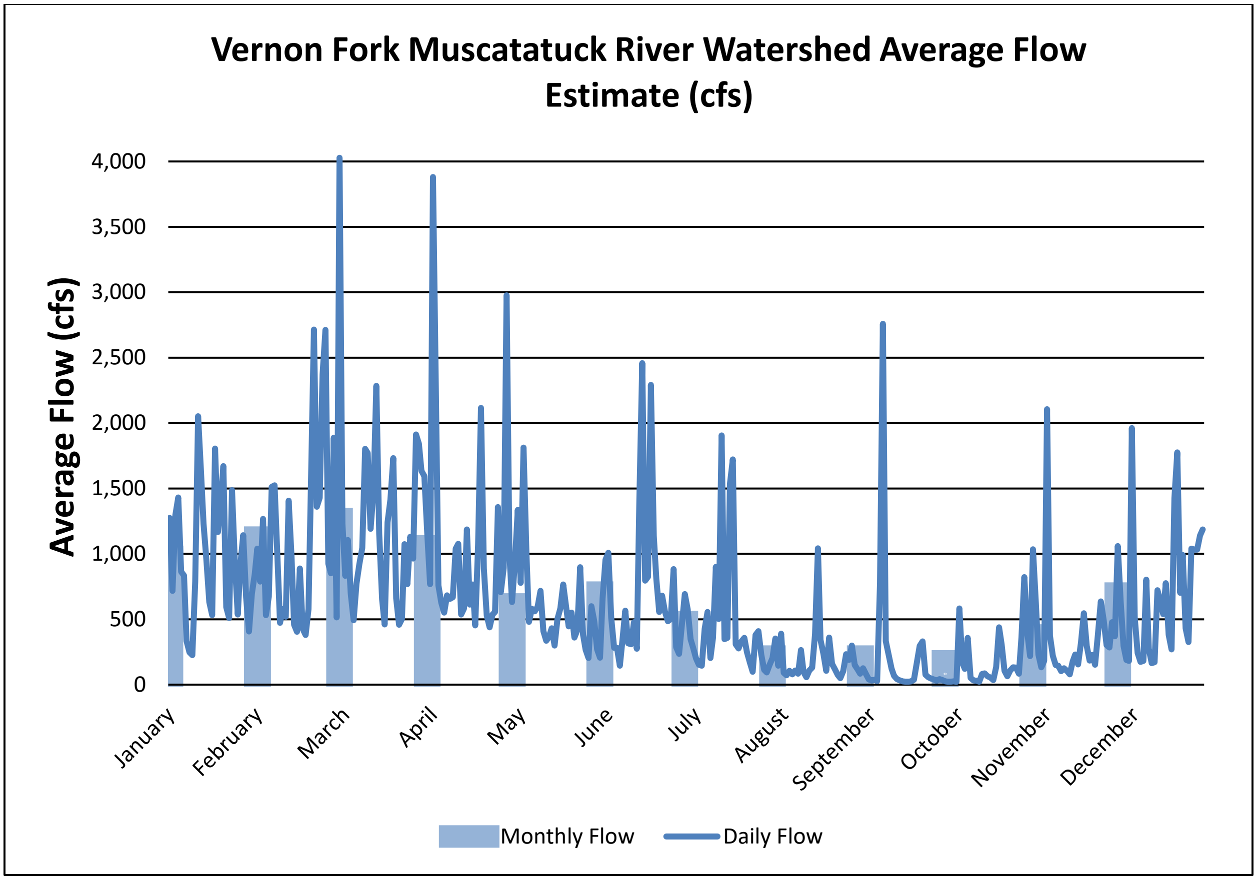


Figure 29: Average Daily Flow Estimate for the Vernon Fork Muscatatuck River Watershed for data from 2012-2021

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

4.1.1 *E. coli*

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 resuspension 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 R^2 value for the fish community analysis was approximately 0.91, and the R^2 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.

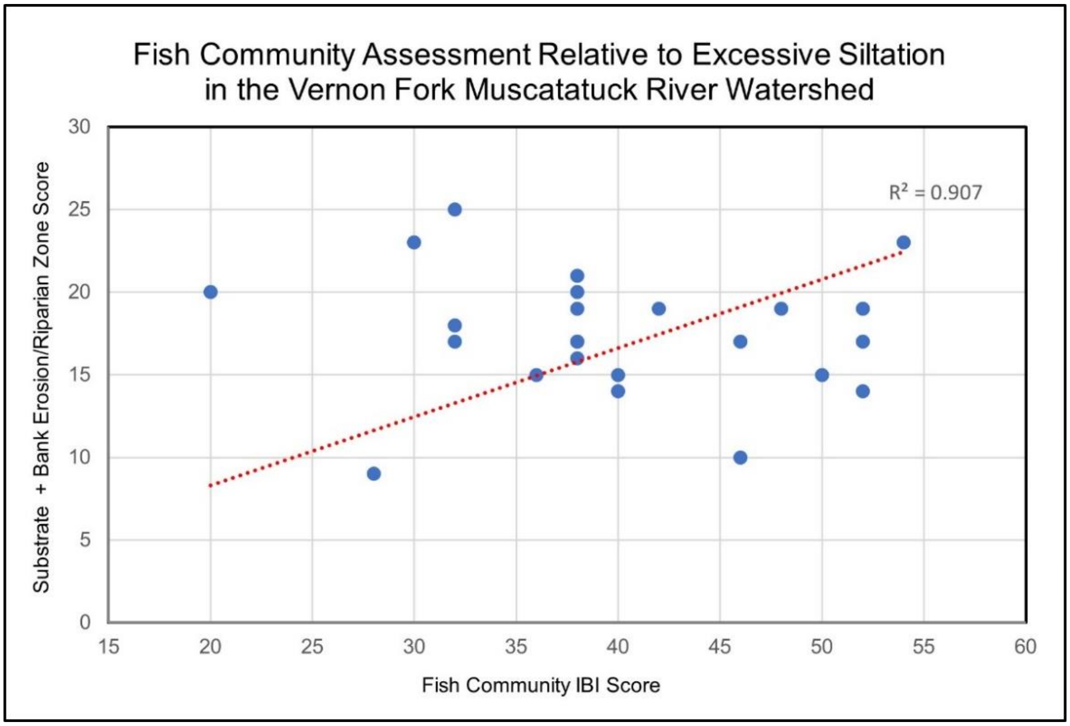


Figure 30: Substrate + Bank Erosion/Riparian Zone Score in Relation to Fish Community IBI Scores in the Vernon Fork Muscatatuck River Watershed

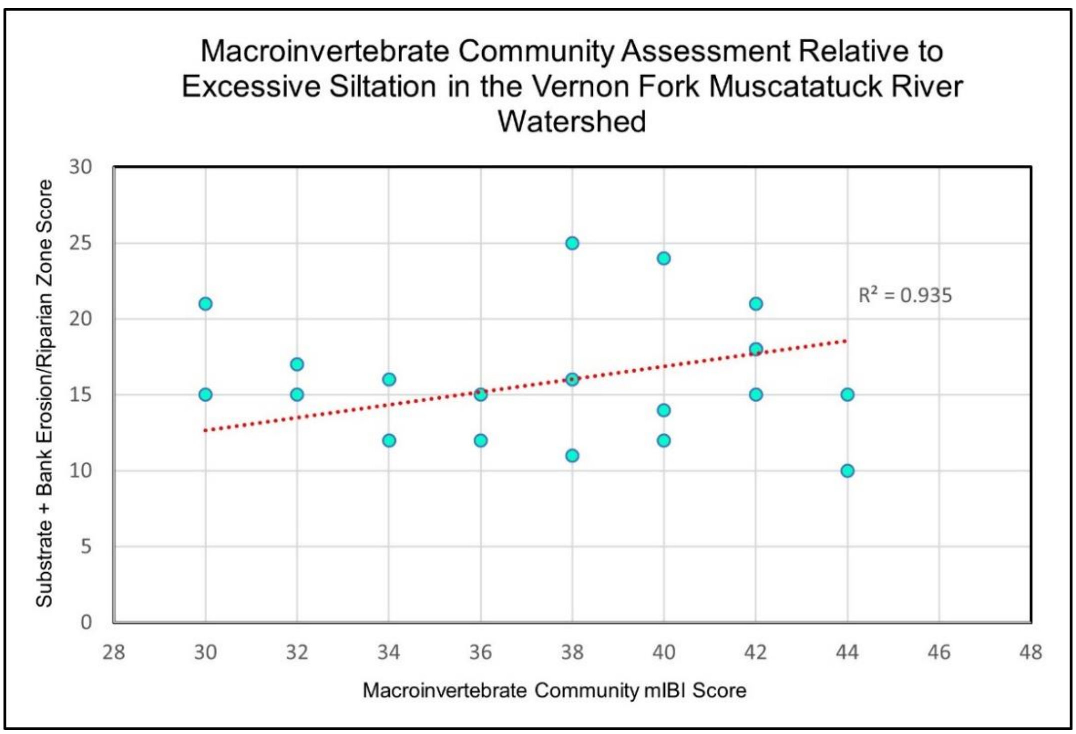


Figure 31: Substrate + Bank Erosion/Riparian Zone Score in Relation to Macroinvertebrate Community mIBI Scores in the Vernon Fork Muscatatuck River Watershed

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 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 quality 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.

Table 37: Summary of Indian Creek Subwatershed Characteristics

Indian Creek (051202070701)					
Drainage Area	225.50 square miles				
Surface Area	29.24 square miles				
Site # [IDEM Station ID]	T23 [WEM070-0036], T25 [WEM070-0001]				
Listed Segments [TMDL(s)]	INW0771_02 [*E. coli*]; INW0771_03 [*E. coli*]; INW0771_04 [*E. coli*]; INW0771_T1006 [*E. coli*]				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*]				
Land Use	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, LLC North Vernon (Farm ID: 4907)				
TMDL *E. coli* Allocations (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
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**

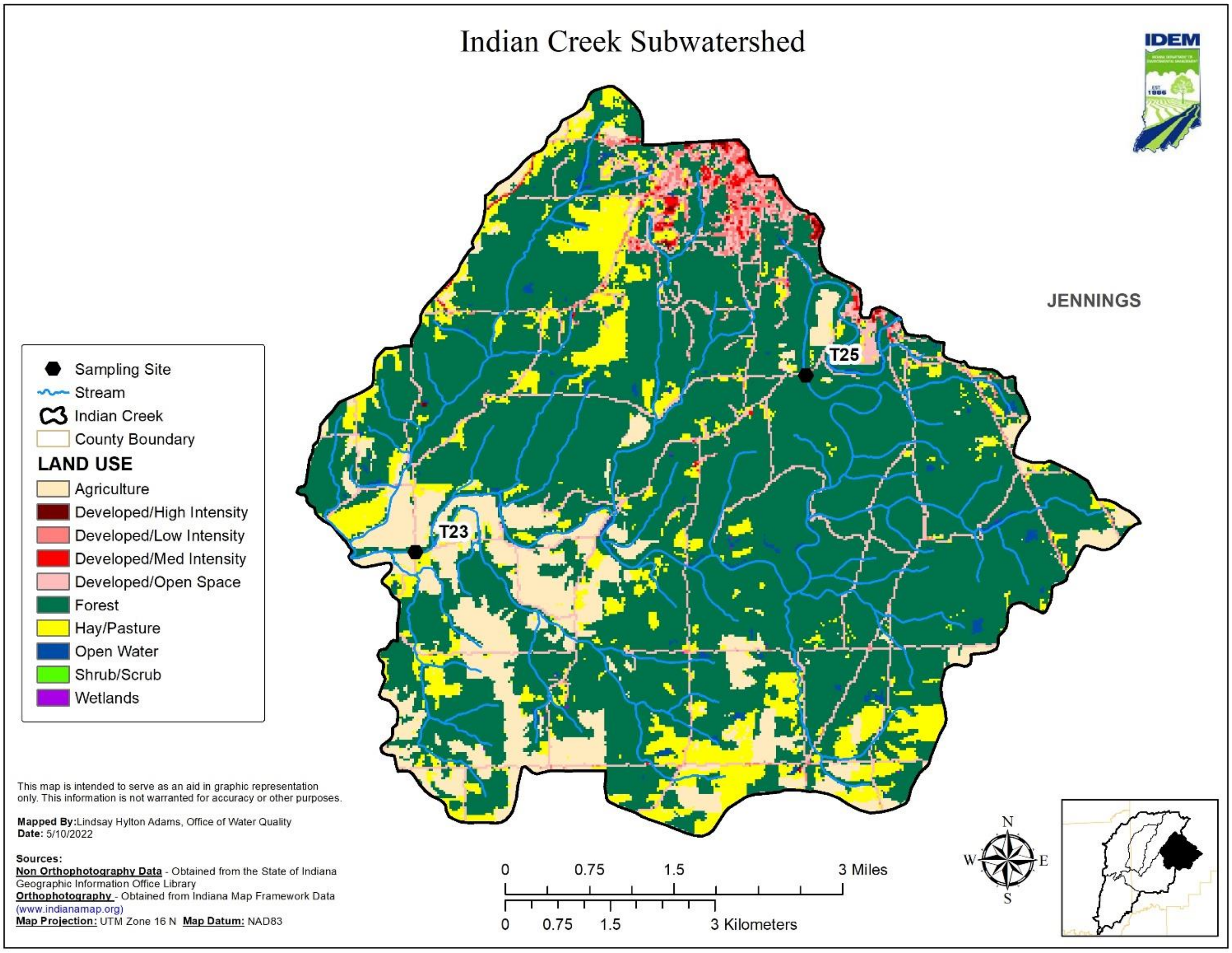


Figure 32: Sampling Stations in Indian Creek Subwatershed

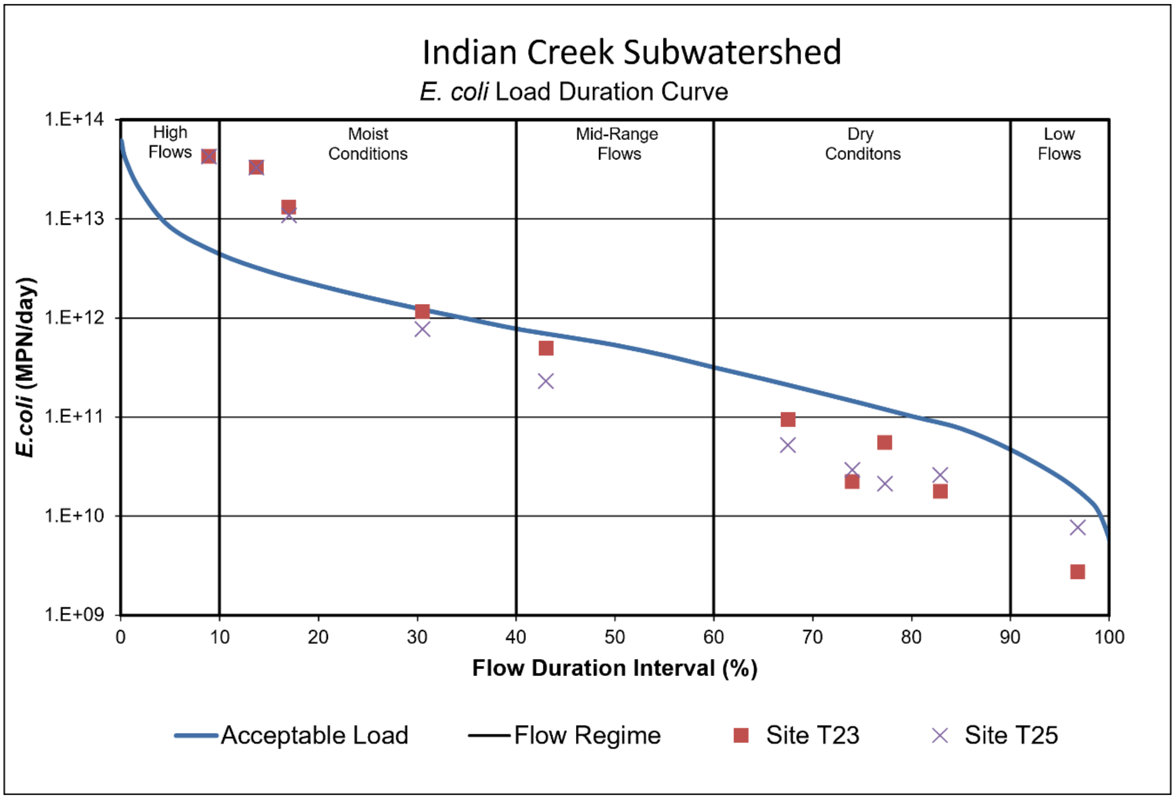


Figure 33: *E. coli* Load Duration Curve for Indian Creek Subwatershed.

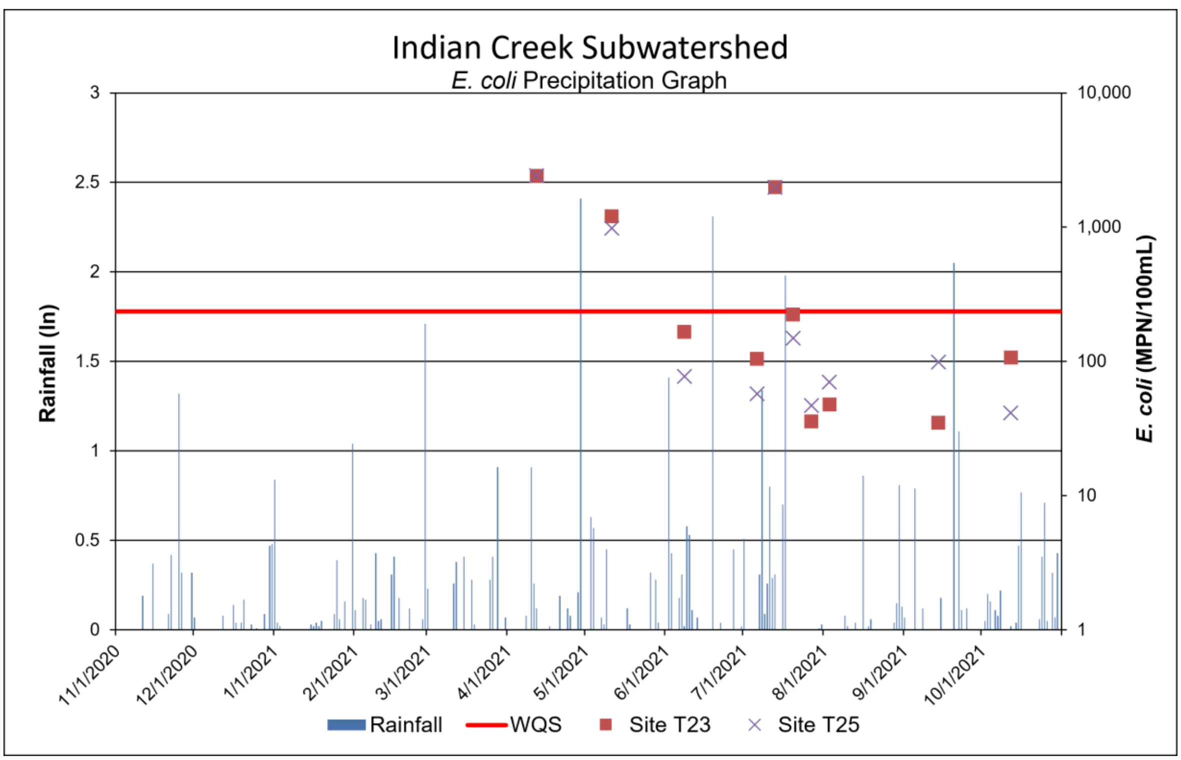


Figure 34: Graph of Precipitation and *E. coli* Data for Indian Creek Subwatershed

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- Hayden 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. 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.

Table 38: Summary of Sixmile Creek Subwatershed Characteristics

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 [*E. coli* & TP]; INW0772_03 [*E. coli* & TP]; INW0772_04 [*E. coli*]; INW0772_05 [*E. coli*]; INW0772_06 [*E. coli*]
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

TMDL *E. coli* Allocations (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 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	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)					
Jennings Northwest Regional Utility (IN0056049)	2.94	2.94	2.94	2.94	2.94

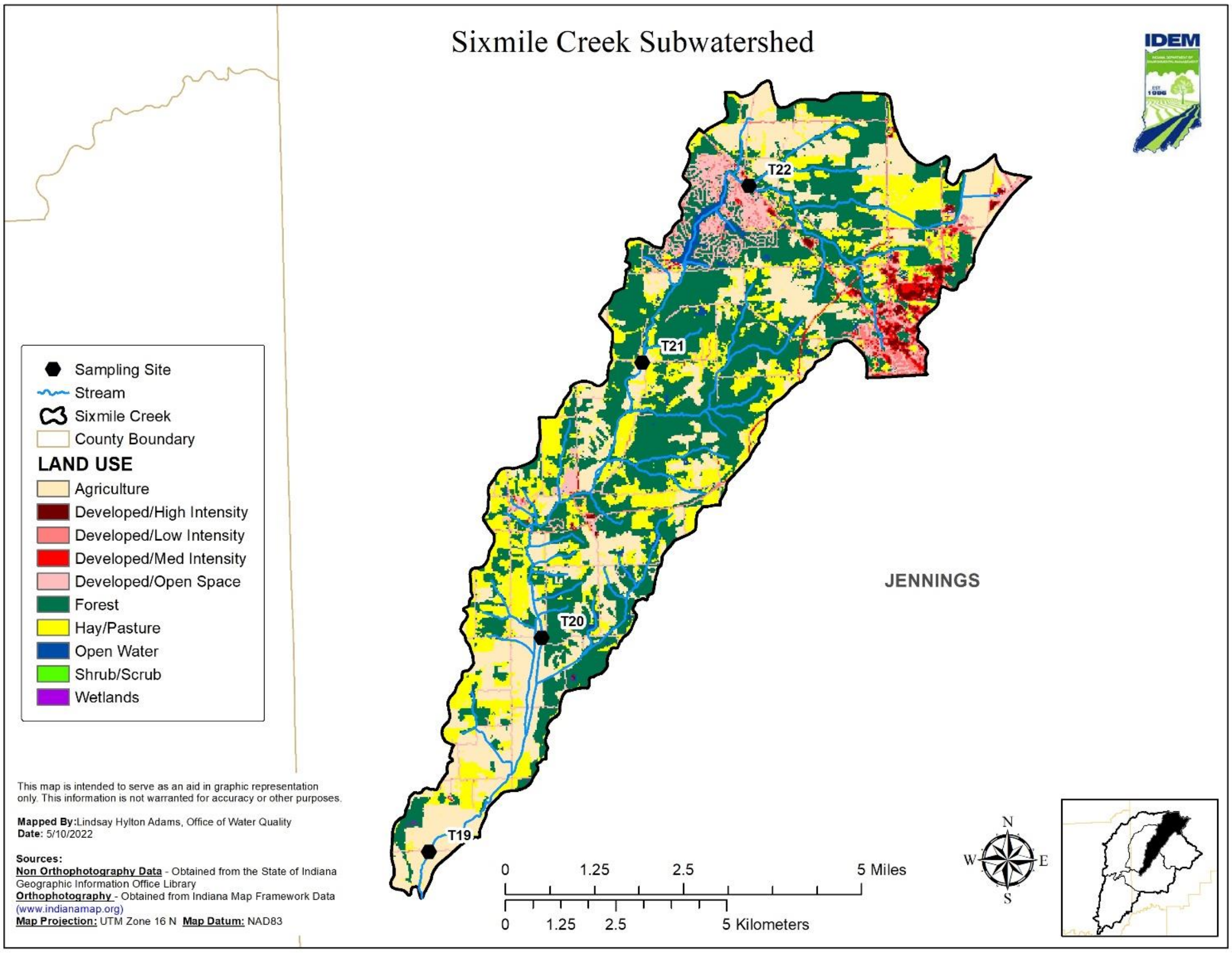


Figure 35: Sampling Stations in Sixmile Creek Subwatershed

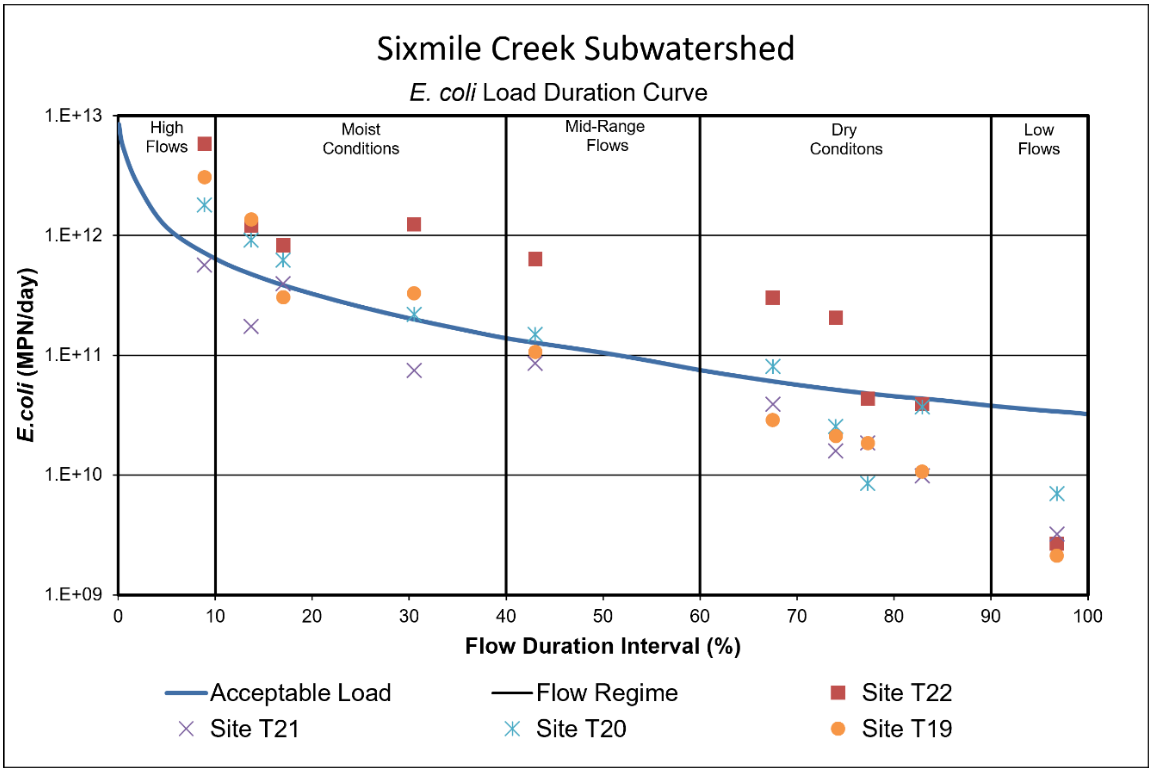


Figure 36: *E. coli* Load Duration Curve for Sixmile Creek Subwatershed

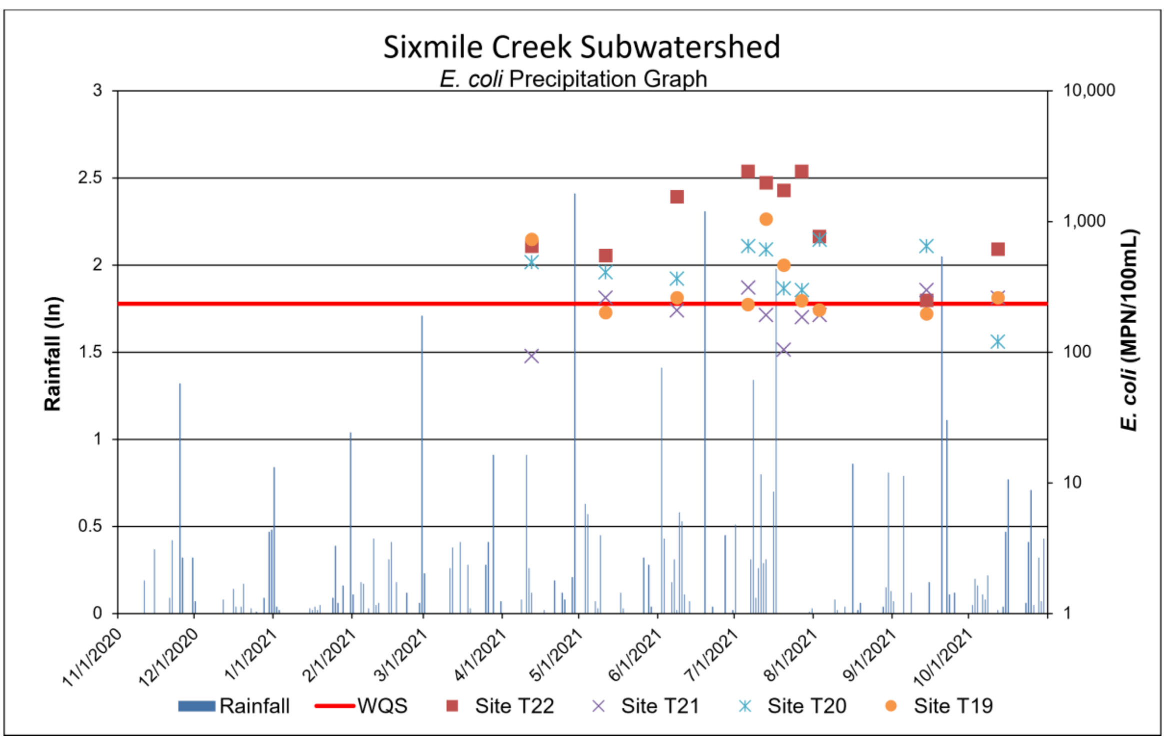


Figure 37: Graph of Precipitation and *E. coli* Data for Sixmile Creek Subwatershed

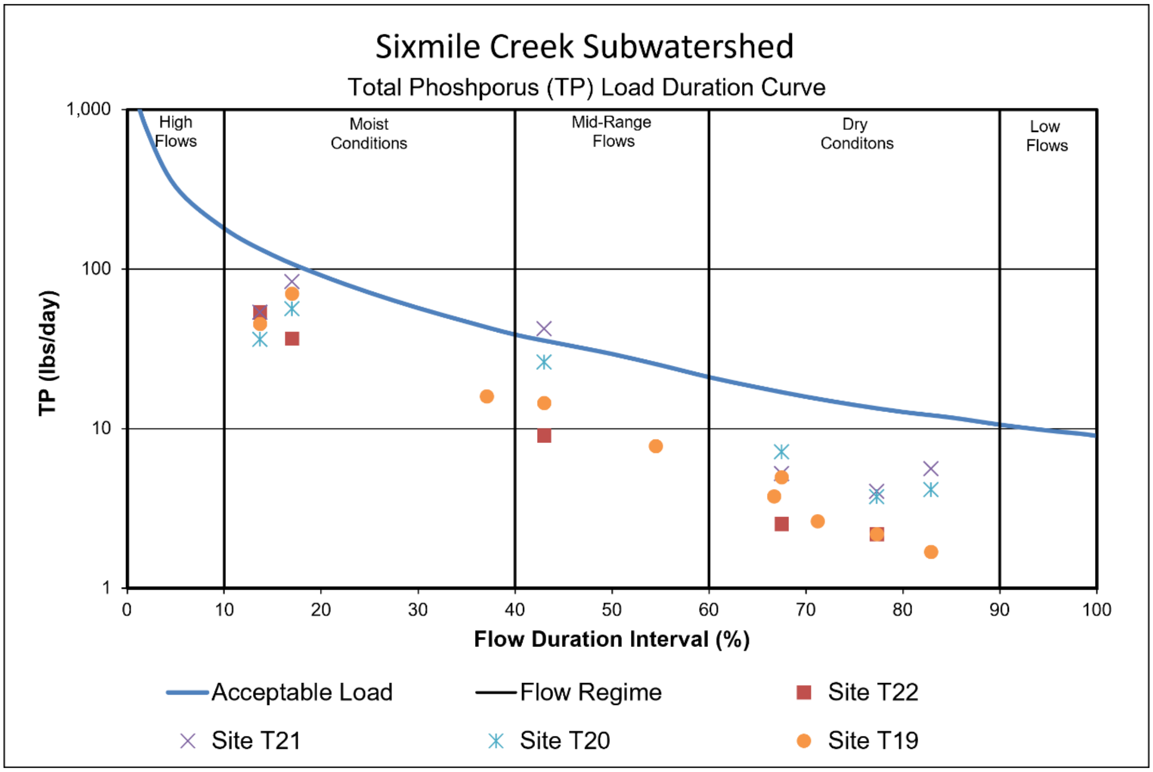


Figure 38: Total Phosphorus Load Duration Curve for Sixmile Creek Subwatershed

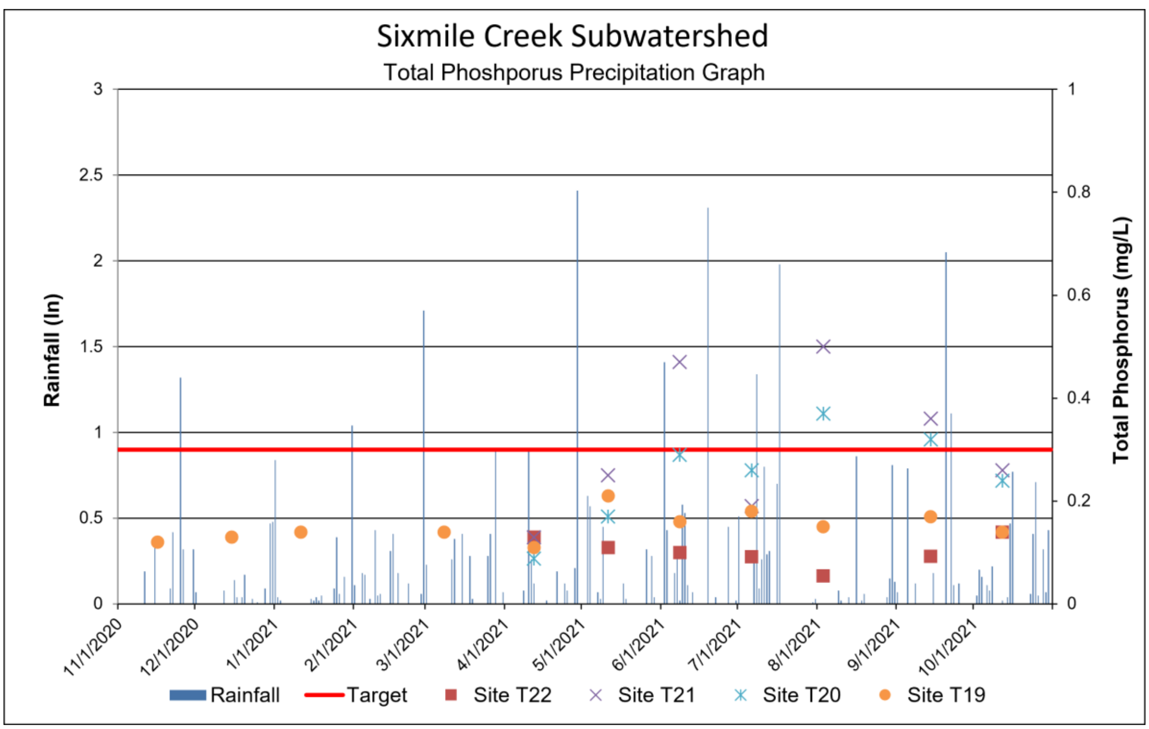


Figure 39: Graph of Precipitation and Total Phosphorus Data for Sixmile Creek Subwatershed

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 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.

Table 39: Summary of Storm Creek Subwatershed Characteristics

Storm Creek (051202070703)					
Drainage Area	23.28 square miles				
Surface Area	23.28 square miles				
Site # [IDEM Station ID]	T16 [WEM080-0013], T17 [WEM080-0005], T18 [WEM-07-0014]				
Listed Segments [TMDL(s)]	INW0773_01 [*E. coli*]; INW0773_02 [N/A]; INW0773_T1002 [*E. coli,* TP & TSS]				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TP & TSS], Dissolved Oxygen [TP & TSS]				
Land Use	Agricultural Land: 23% Forested Land: 44% Developed Land: 5% Open Water: 2% Pasture/Hay: 25% Grassland/Shrubs: <1% Wetland: 1%				
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)				
TMDL *E. coli* Allocations (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**

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	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**

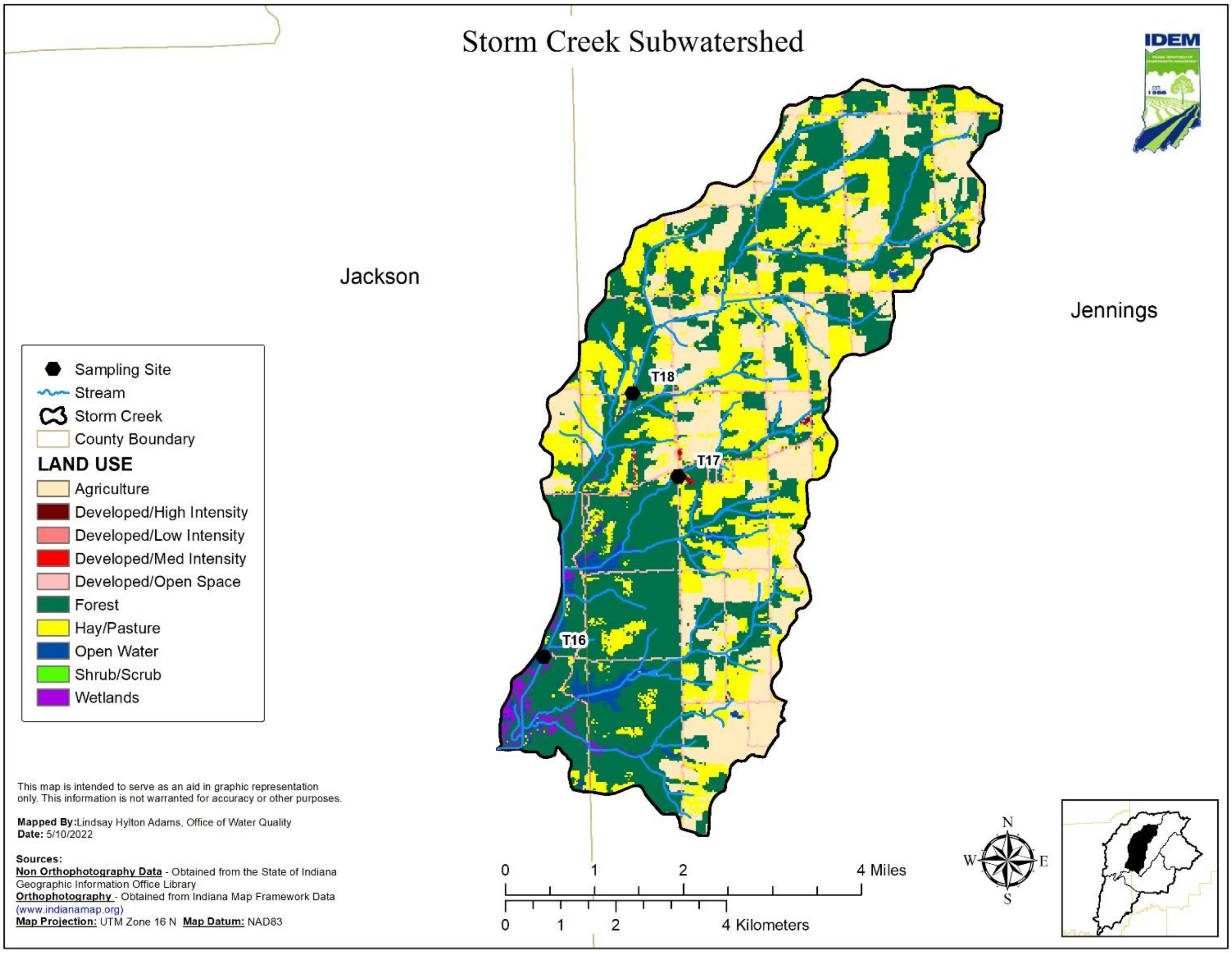


Figure 40: Sampling Stations in Storm Creek Subwatershed

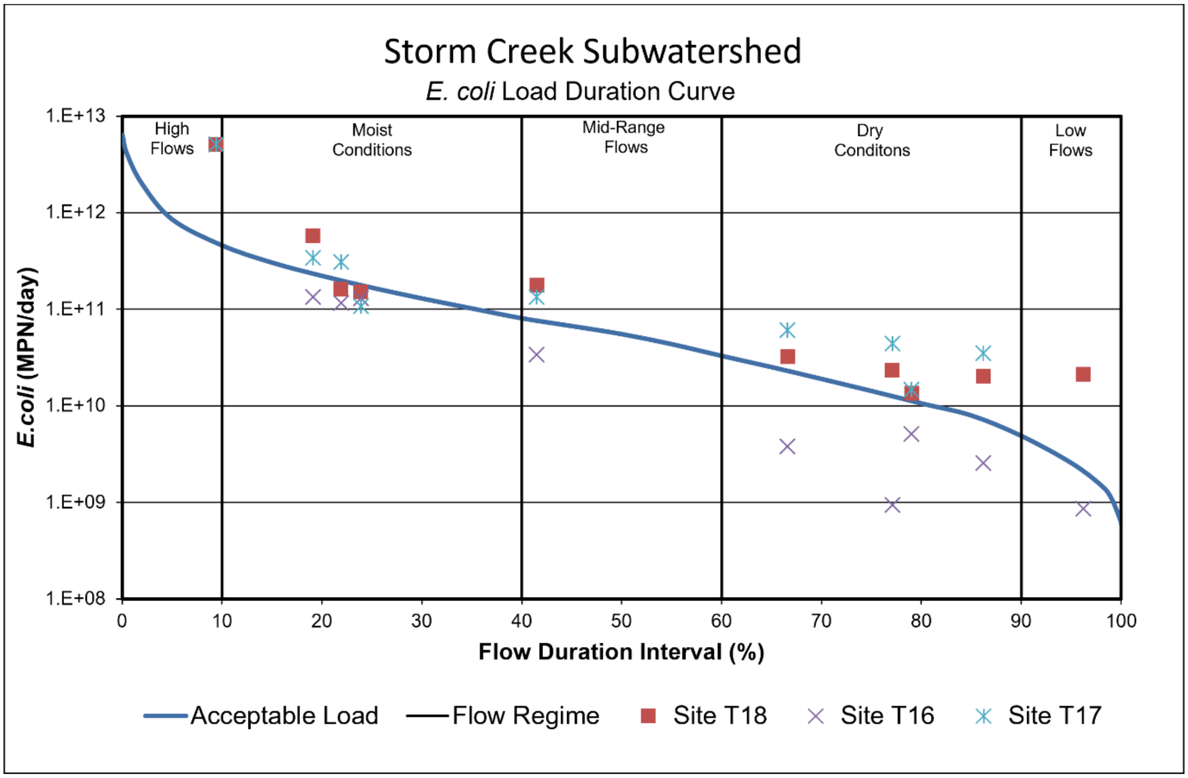


Figure 41: *E. coli* Load Duration Curve for Storm Creek Subwatershed

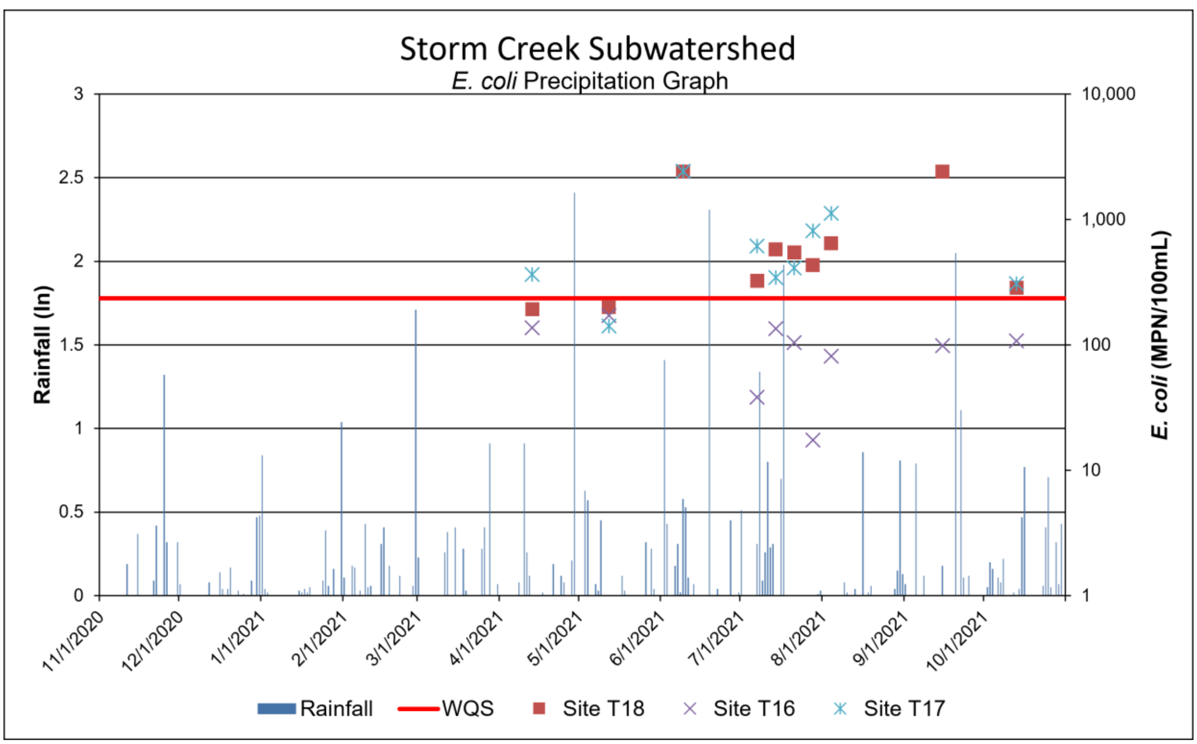


Figure 42: Graph of Precipitation and *E. coli* Data at Storm Creek Subwatershed

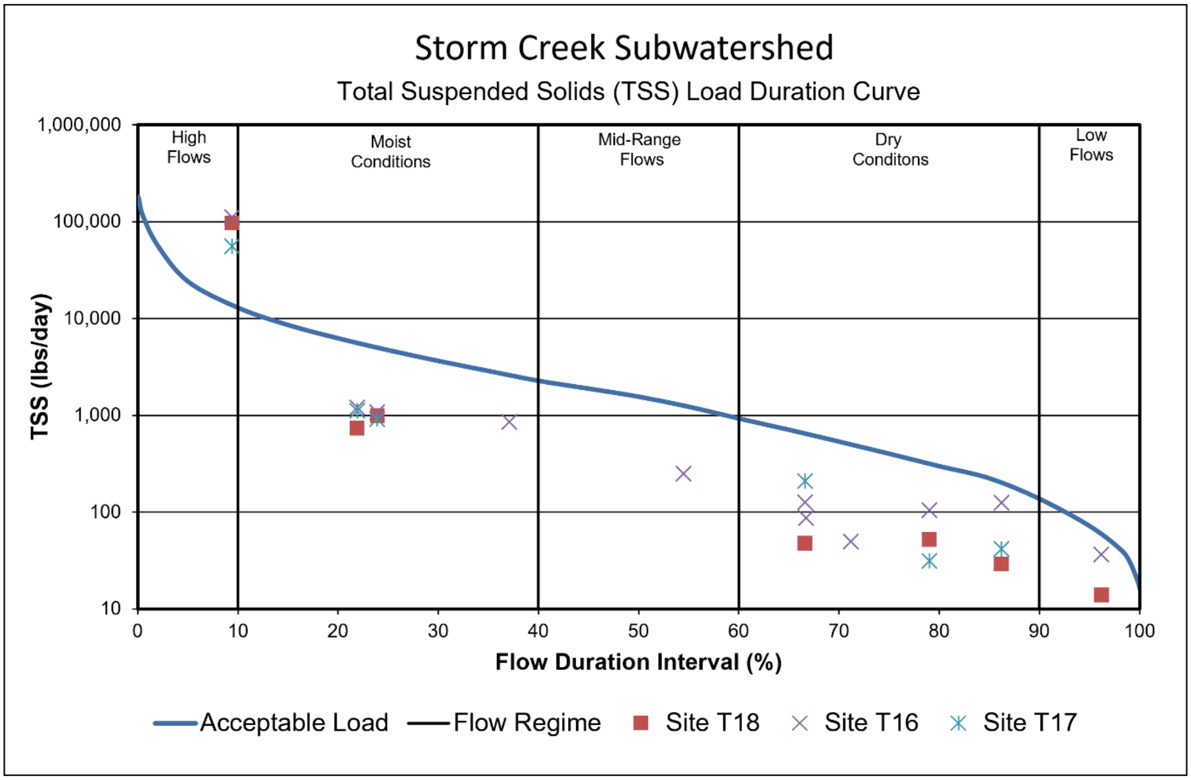


Figure 43: Total Suspended Solids Load Duration Curve for Storm Creek Subwatershed

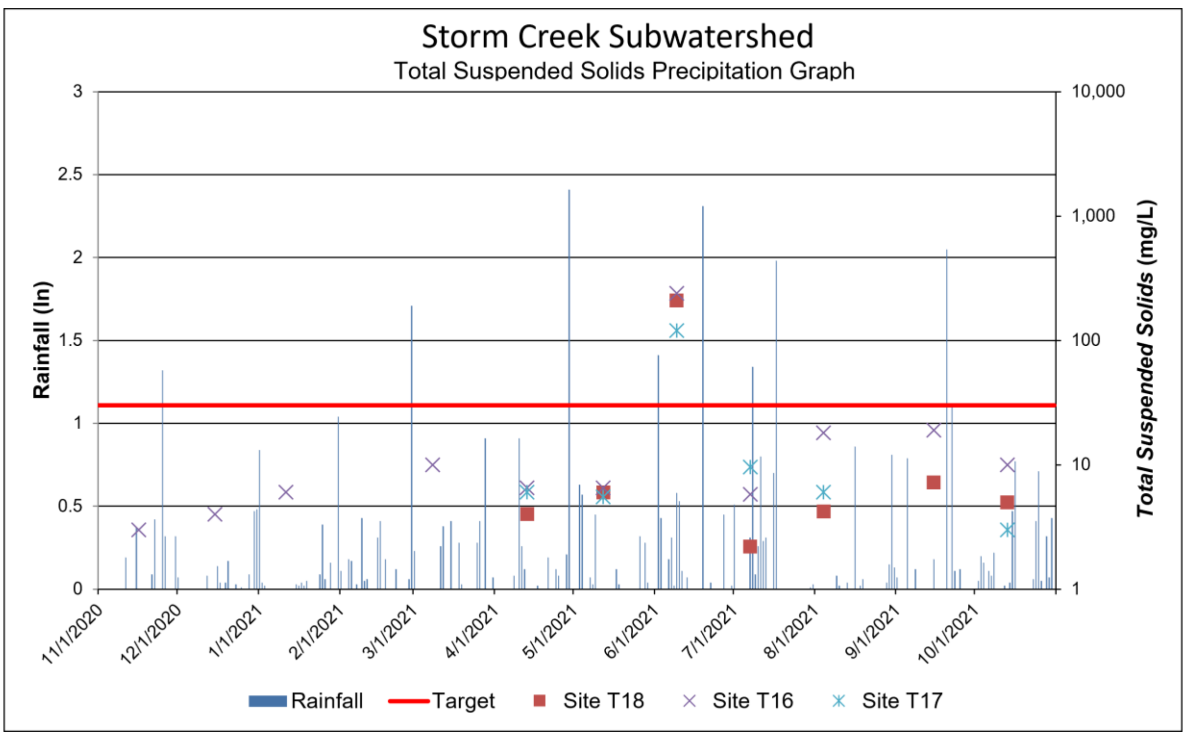


Figure 44: Graph of Precipitation and Total Suspended Solids Data for Storm Creek Subwatershed

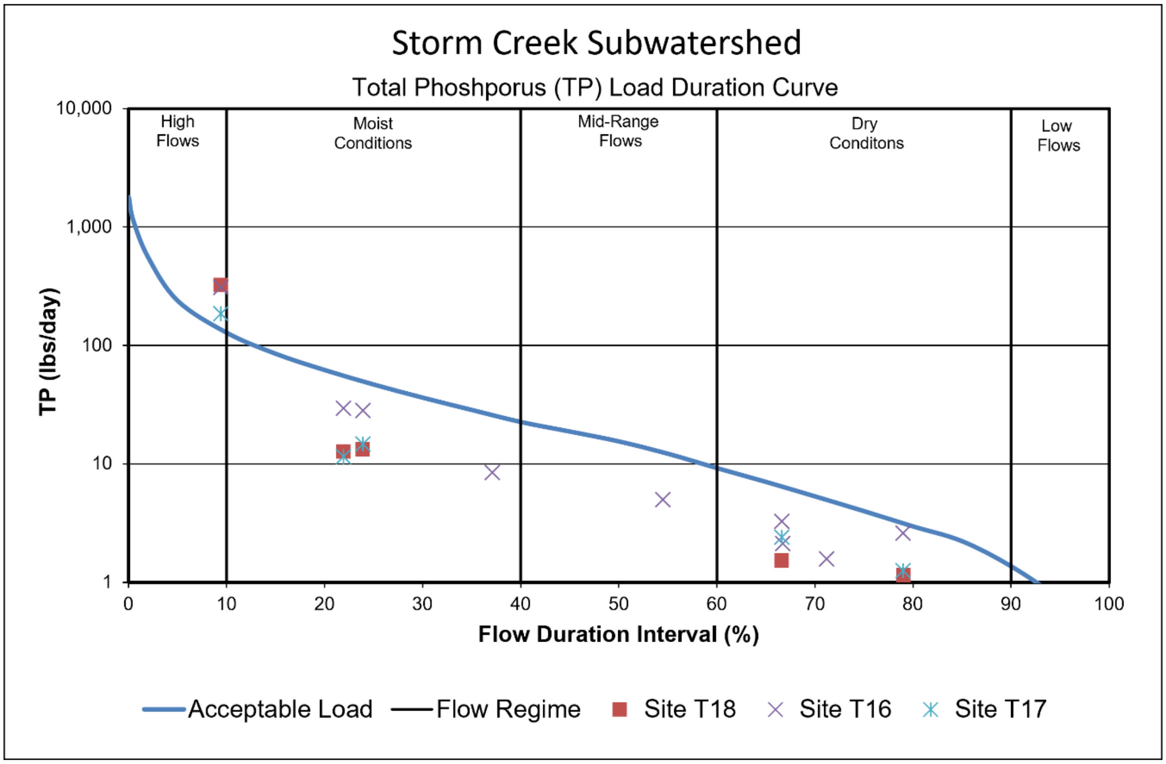


Figure 45: Total Phosphorus Load Duration Curve for Storm Creek Subwatershed

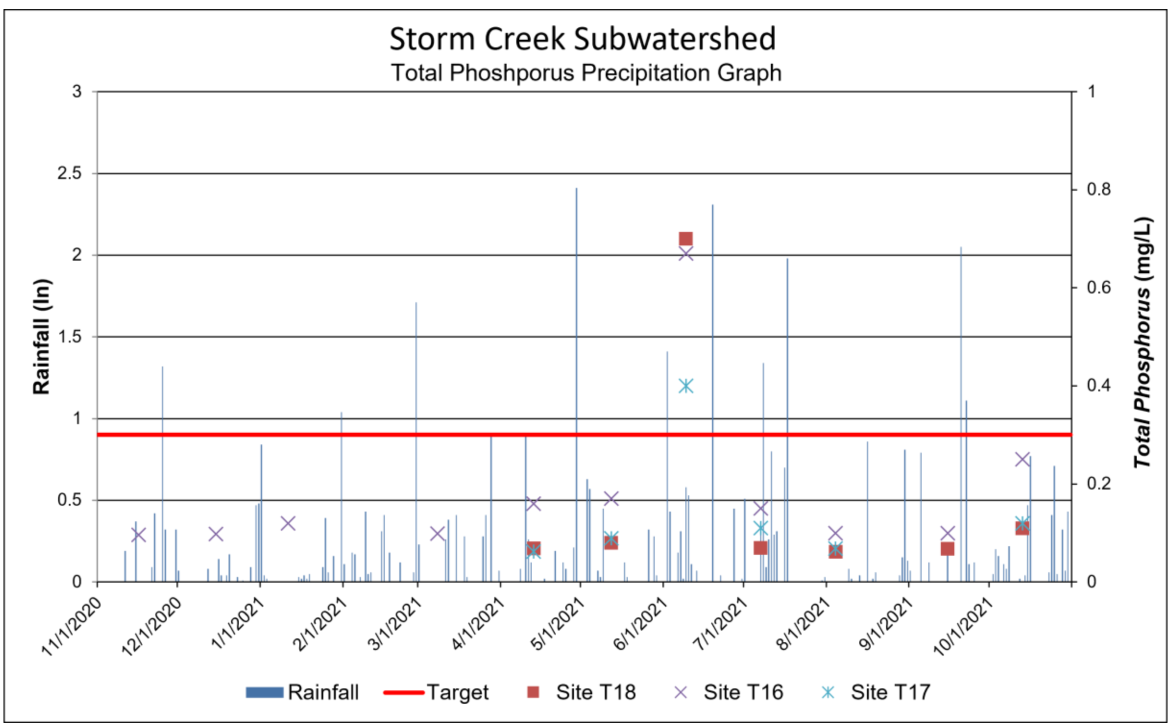


Figure 46 :Graph of Precipitation and Total Phosphorus Data for Storm Creek Subwatershed

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 52 (good). The fish community IBI score for site T15 was 36 (fair) and the QHEI was 60 (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,

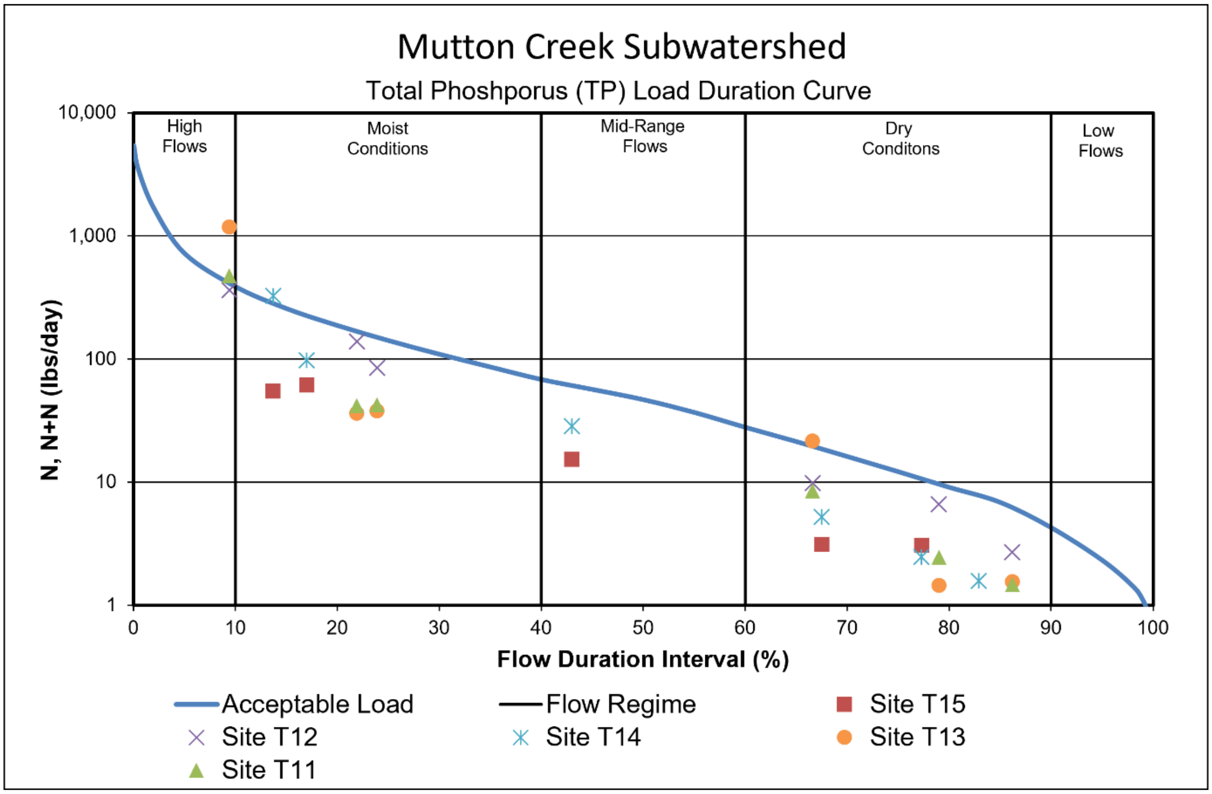


Figure *52*), precipitation graphs (Figure 49, Figure 51,

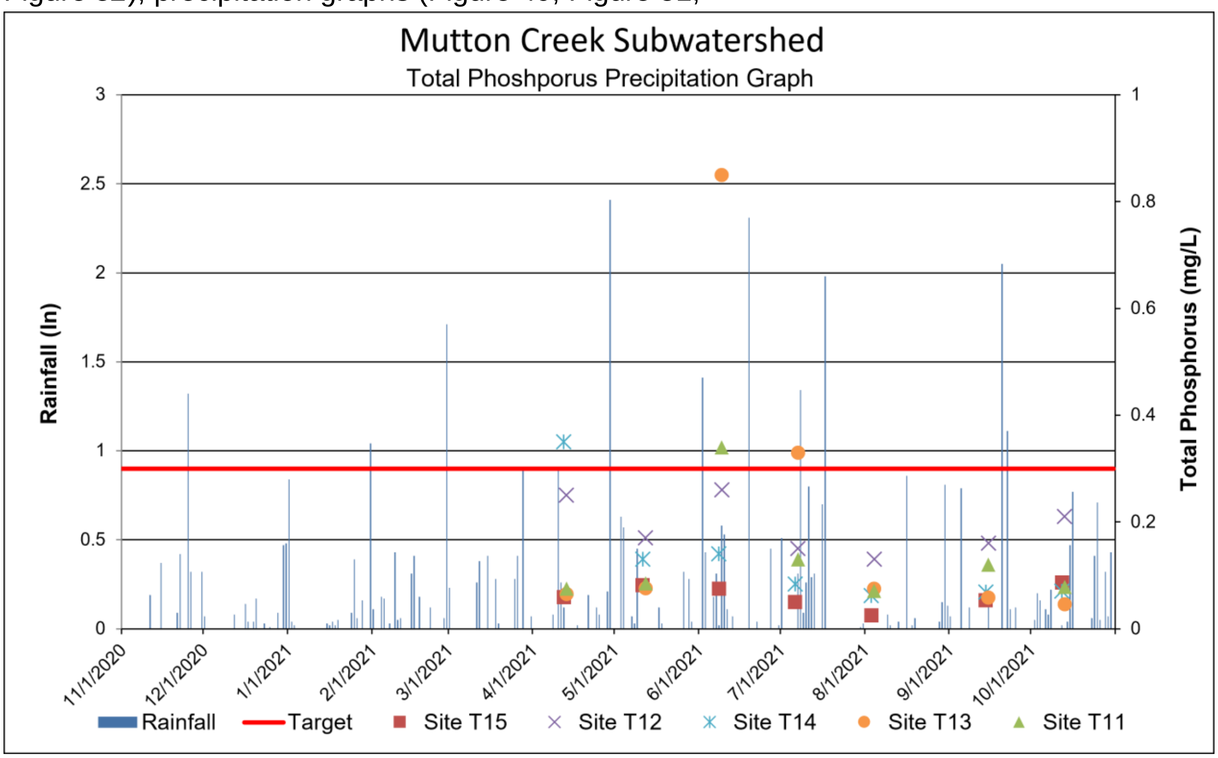


Figure *53*), and water quality duration graphs (Appendix F) were created to further analyze potential sources in the subwatershed. Evaluating these graphs, with consideration of the watershed characteristics, allows for identification of potential point and nonpoint sources that are contributing to 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 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

Mutton 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 [*E. coli*]; INW0774_02 [*E. coli*]; INW0774_03 [*E. coli,* TP & TSS]; INW0774_T1002 [*E. coli*]; INW0774_T1003 [*E. coli*]; INW0774_T1005 [*E. coli*, TP & TSS]				
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], 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/day)					
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**
TMDL = LA+WLA+MOS	**2.57E+12**	**5.03E+11**	**1.67E+11**	**4.34E+10**	**8.30E+09**
WLA (Individual)					
City of Seymour MS4 (INR040082)	9.16E+10	1.79E+10	0.00	0.00	0.00

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

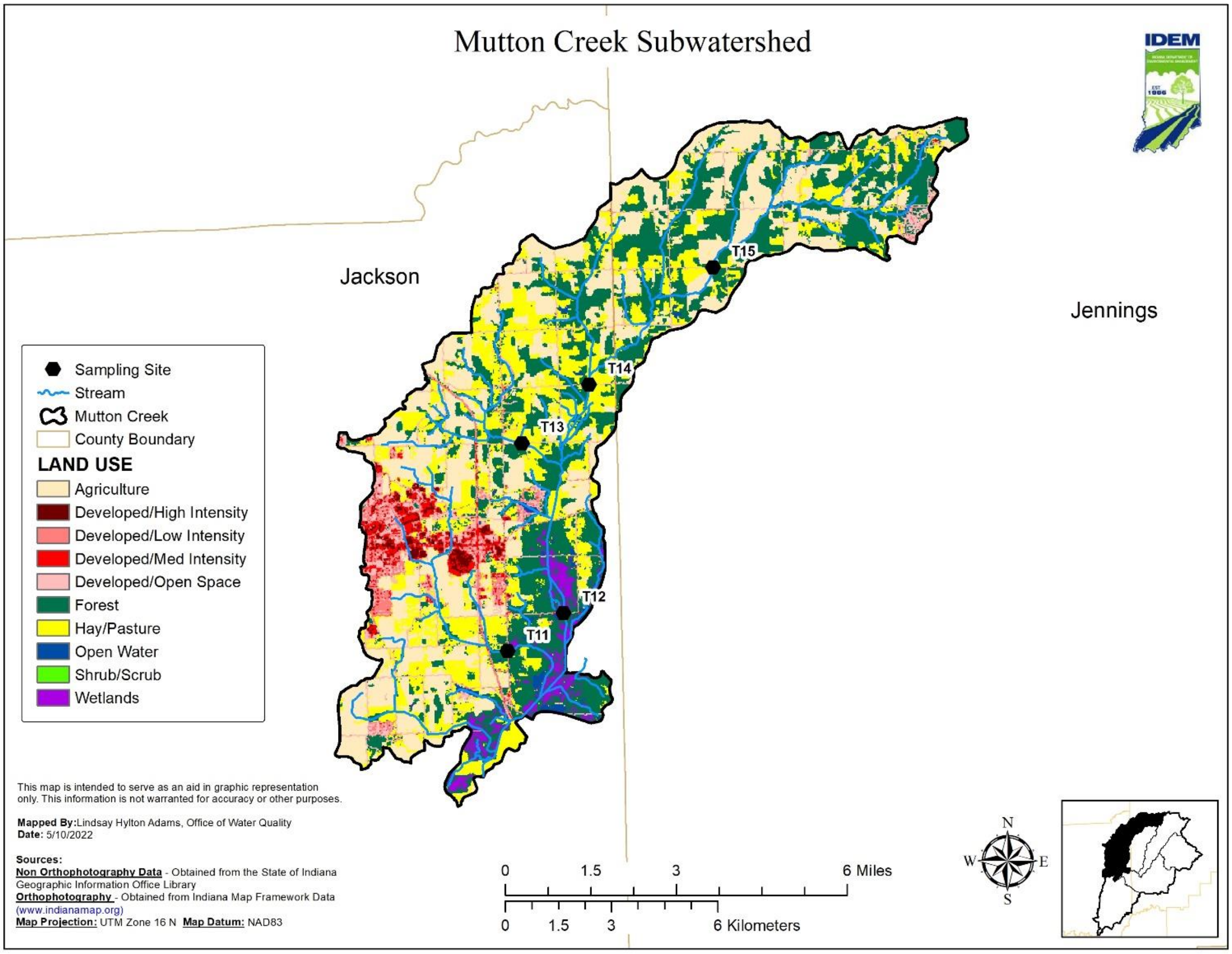


Figure 47: Sampling Stations in Mutton Creek Subwatershed

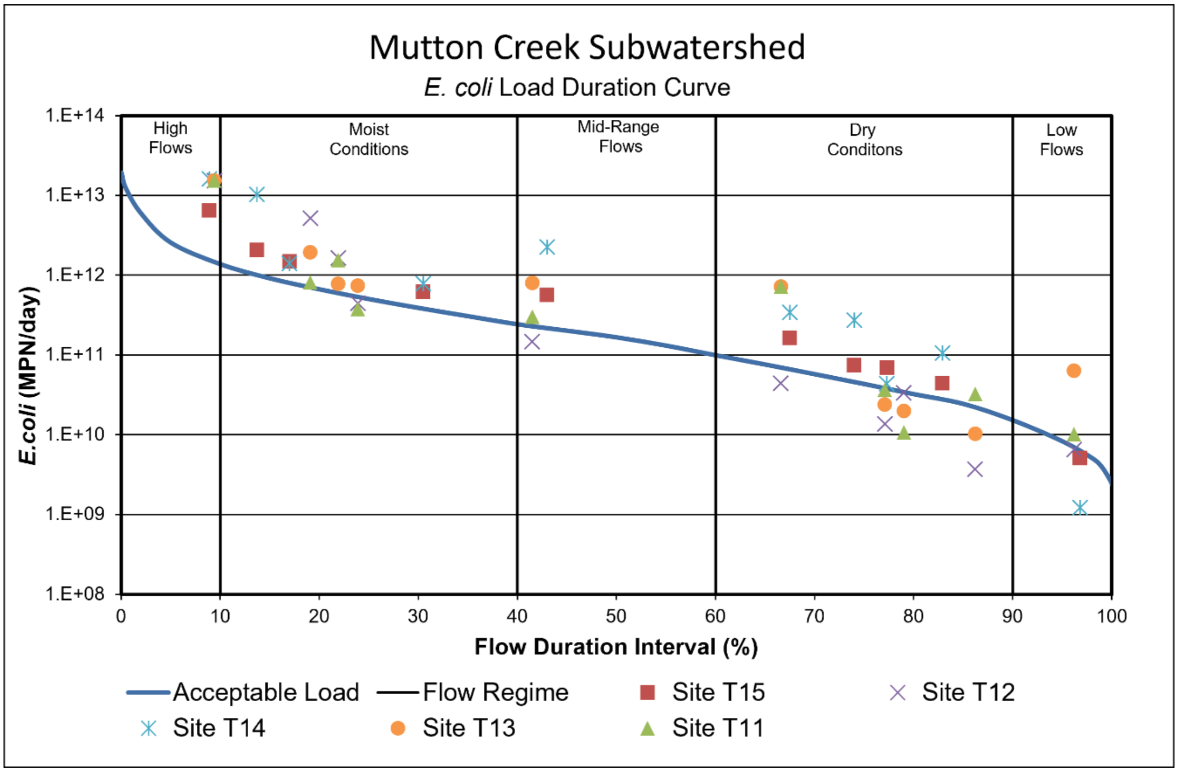


Figure 48: *E. coli* Load Duration Curve for Mutton Creek Subwatershed

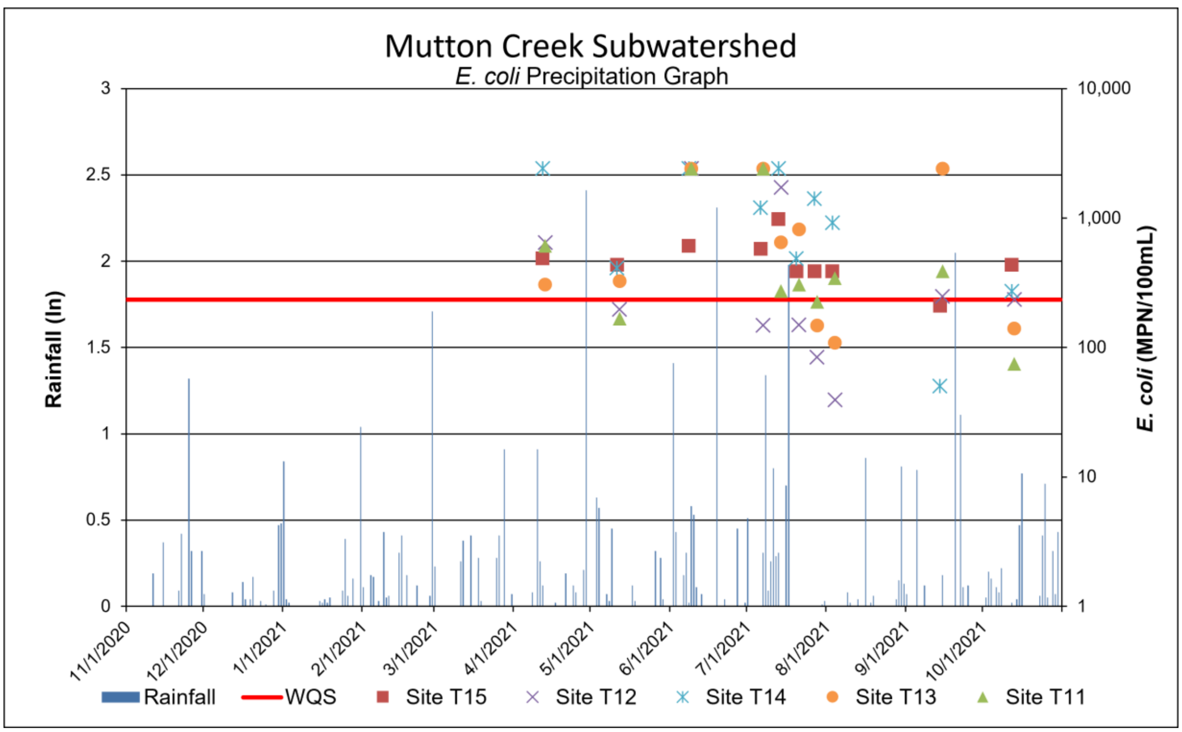


Figure 49: Graph of Precipitation and *E. coli* Data for Mutton Creek Subwatershed

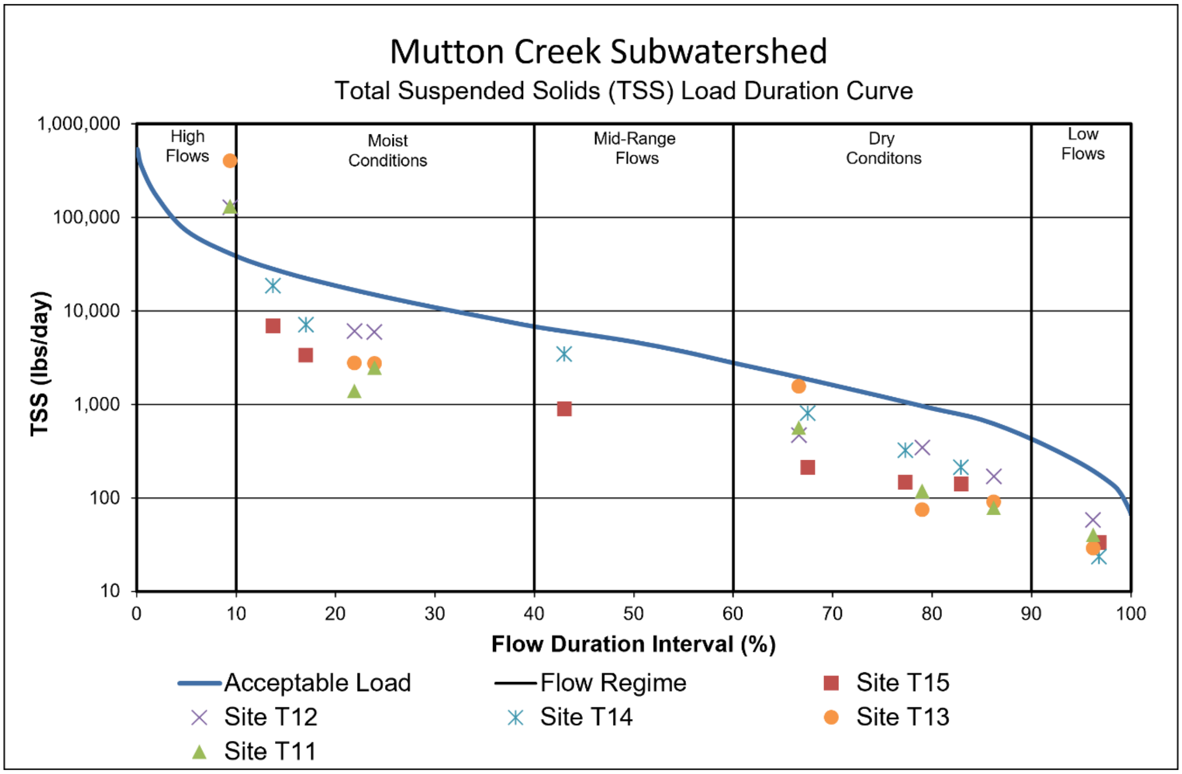


Figure 50: Total Suspended Solids Load Duration Curve for Mutton Creek Subwatershed

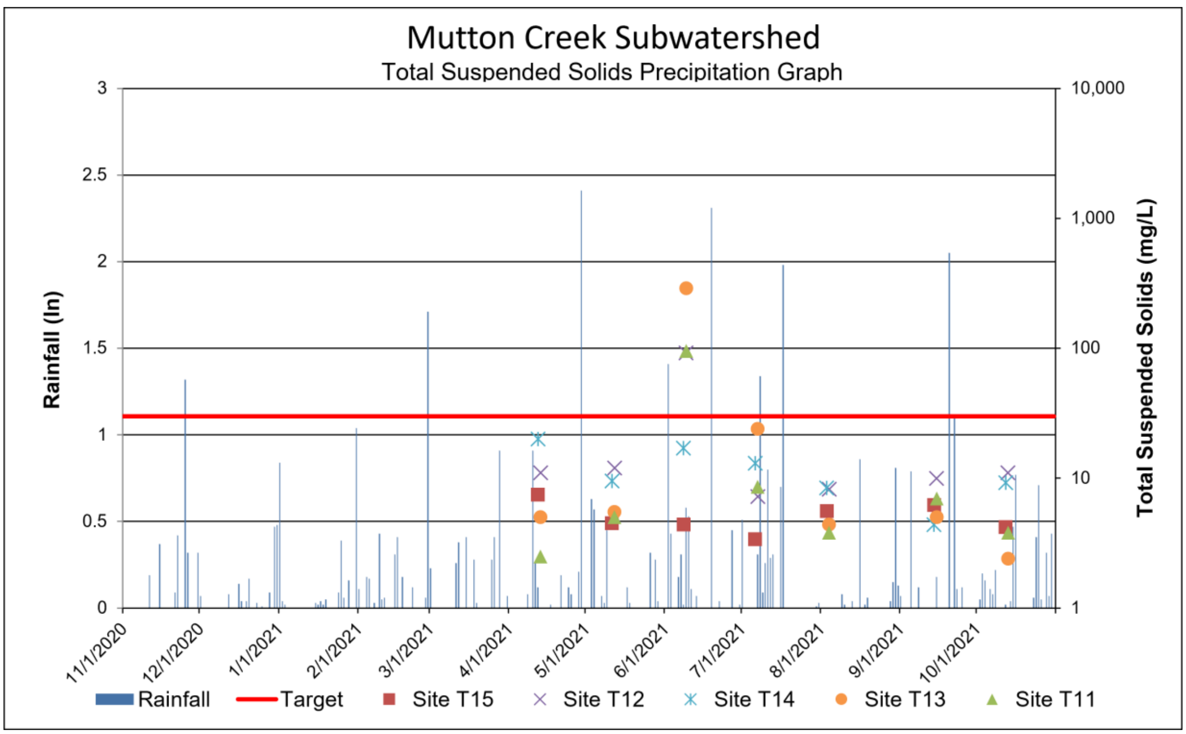


Figure 51: Graph of Precipitation and Total Suspended Solids Data for Mutton Creek Subwatershed

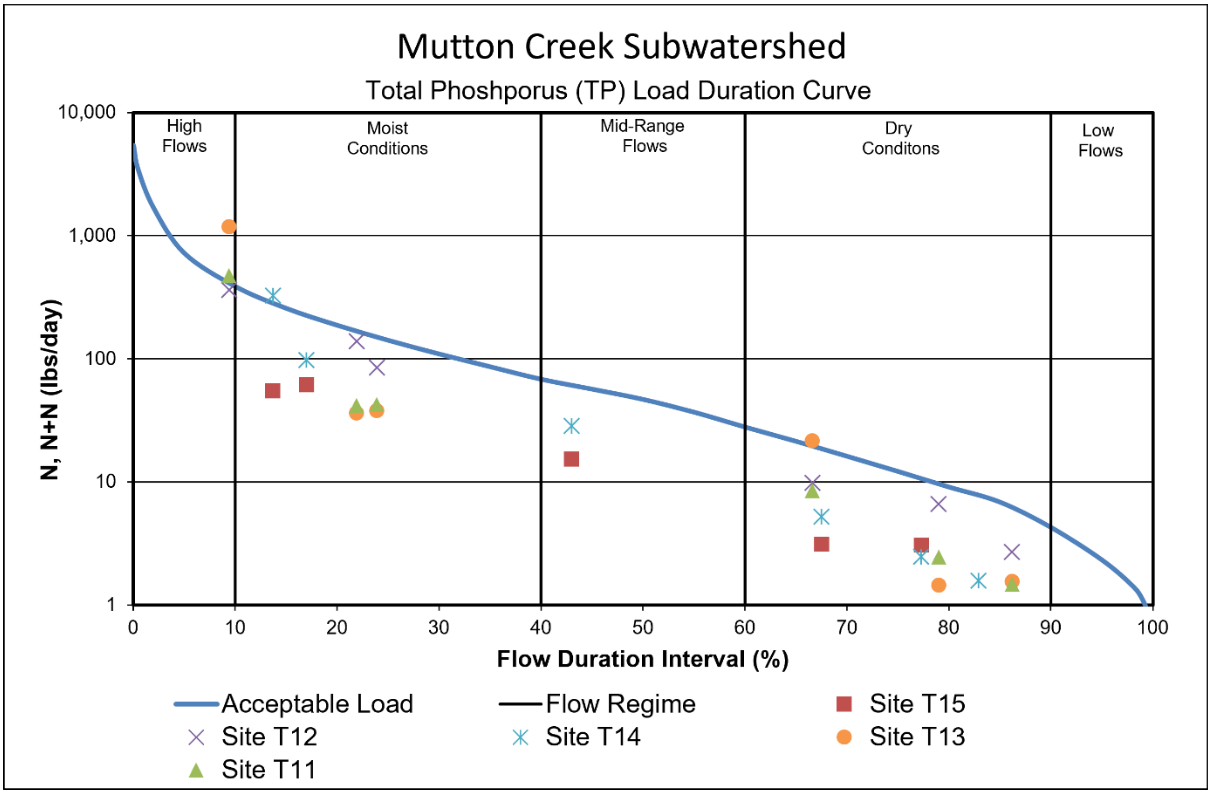


Figure 52: Total Phosphorus Load Duration Curve for Mutton Creek Subwatershed

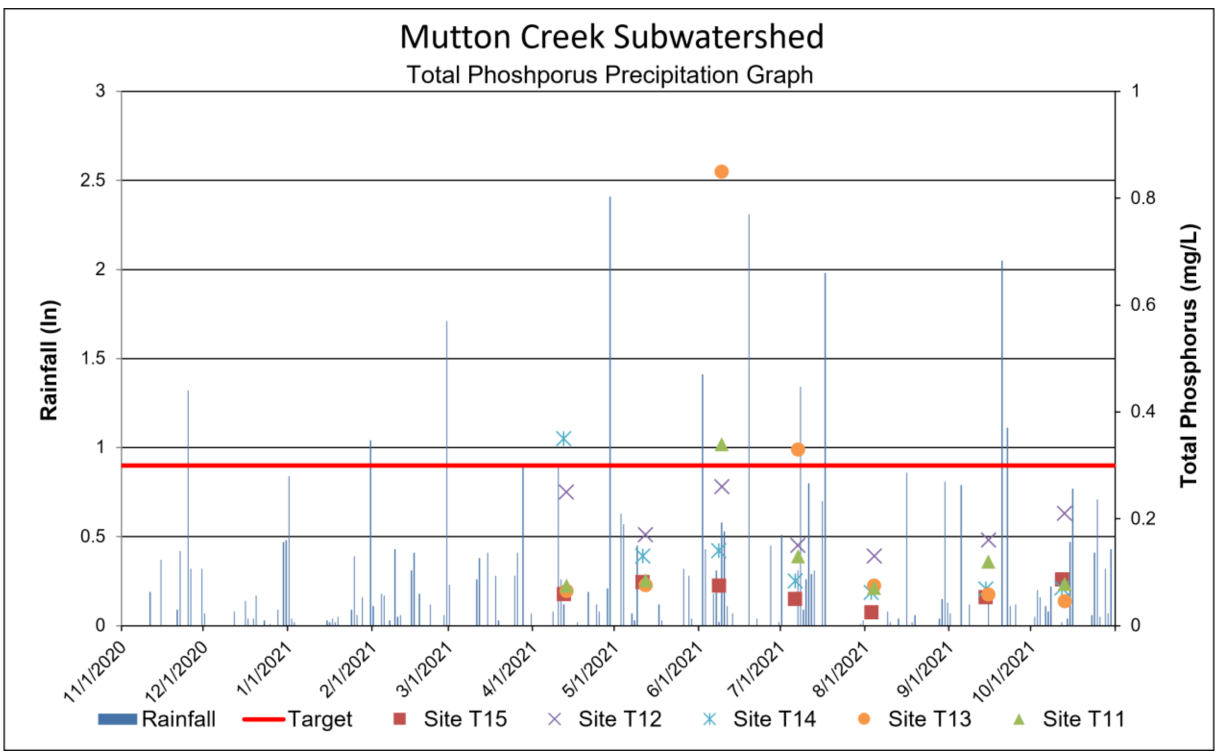


Figure 53: Graph of Precipitation and Total Suspended Solids Data for Mutton Creek Subwatershed

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 (

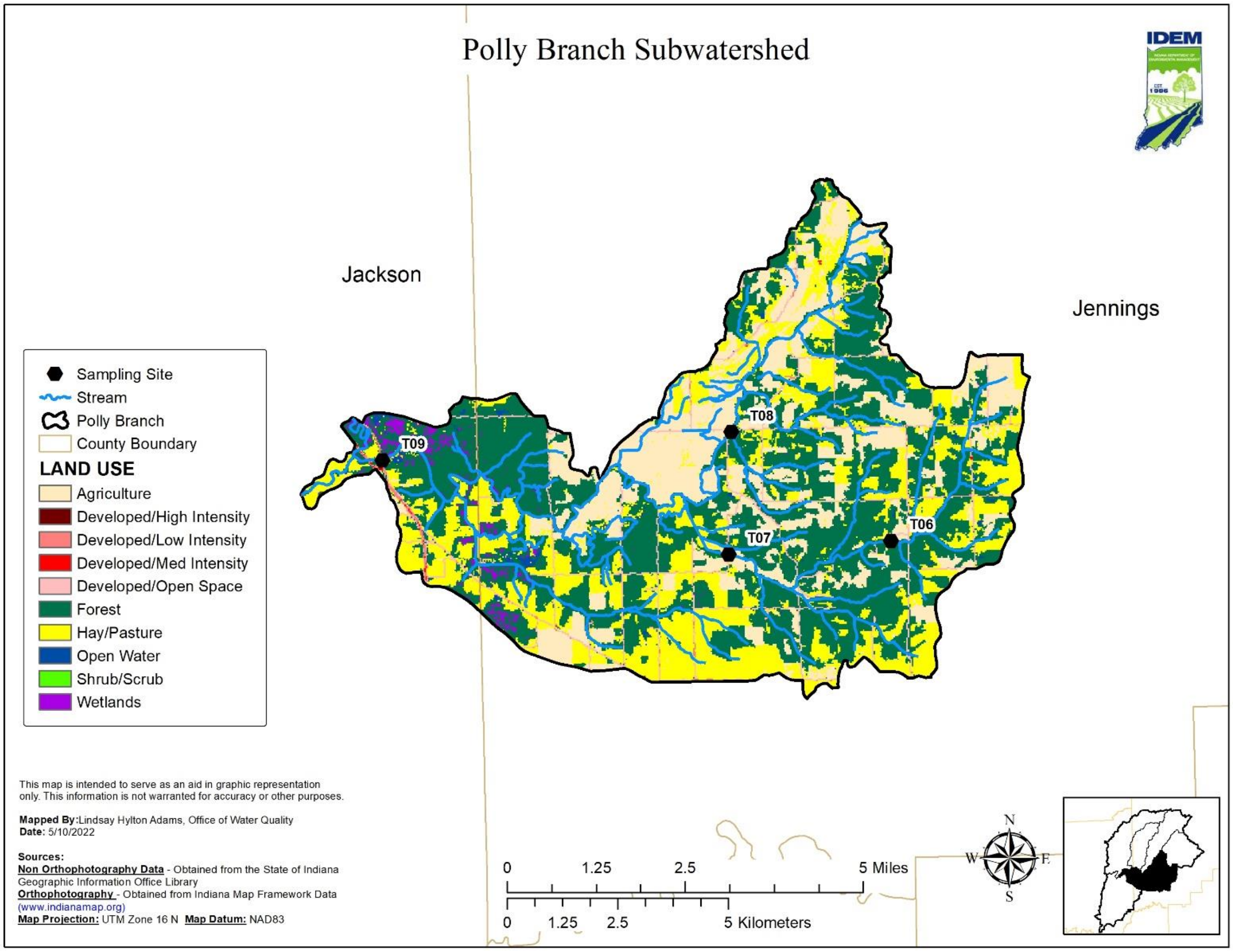


Figure *54*). In 2020 and 2021 this watershed was sampled 43 times between the four sites, resulting in three of the four sites failing the water quality standards for *E. coli*. The *E. coli* geomean for site T06 was 560.57 MPN with 8/10 samples in exceedance of the single sample max. Site T07 had a 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 56 (good). The fish 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.

Table 41: Summary of Polly Branch Subwatershed Characteristics

Polly Branch (051202070705)					
Drainage Area	292.66 square miles				
Surface Area	36.14 square miles				
Site # [IDEM Station ID]	T06 [WEM-07-0021], T07 [WEM070-0029], T08 [WEM070-0039], T09 [WEM070-0020]				
Listed Segments [TMDL(s)]	INW0775_01 [*E. coli*]; INW0775_T1003 [*E. coli* & 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 *E. coli* Allocations (MPN/day)					
Allocation Category Duration Interval (%)	**High Flows 5%**	**Moist Conditions 25%**	**Mid-Range Flows 50%**	**Dry Conditions 75%**	**Low Flows 95%**
LA	1.13E+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**
TMDL Total Phosphorus (lbs/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**

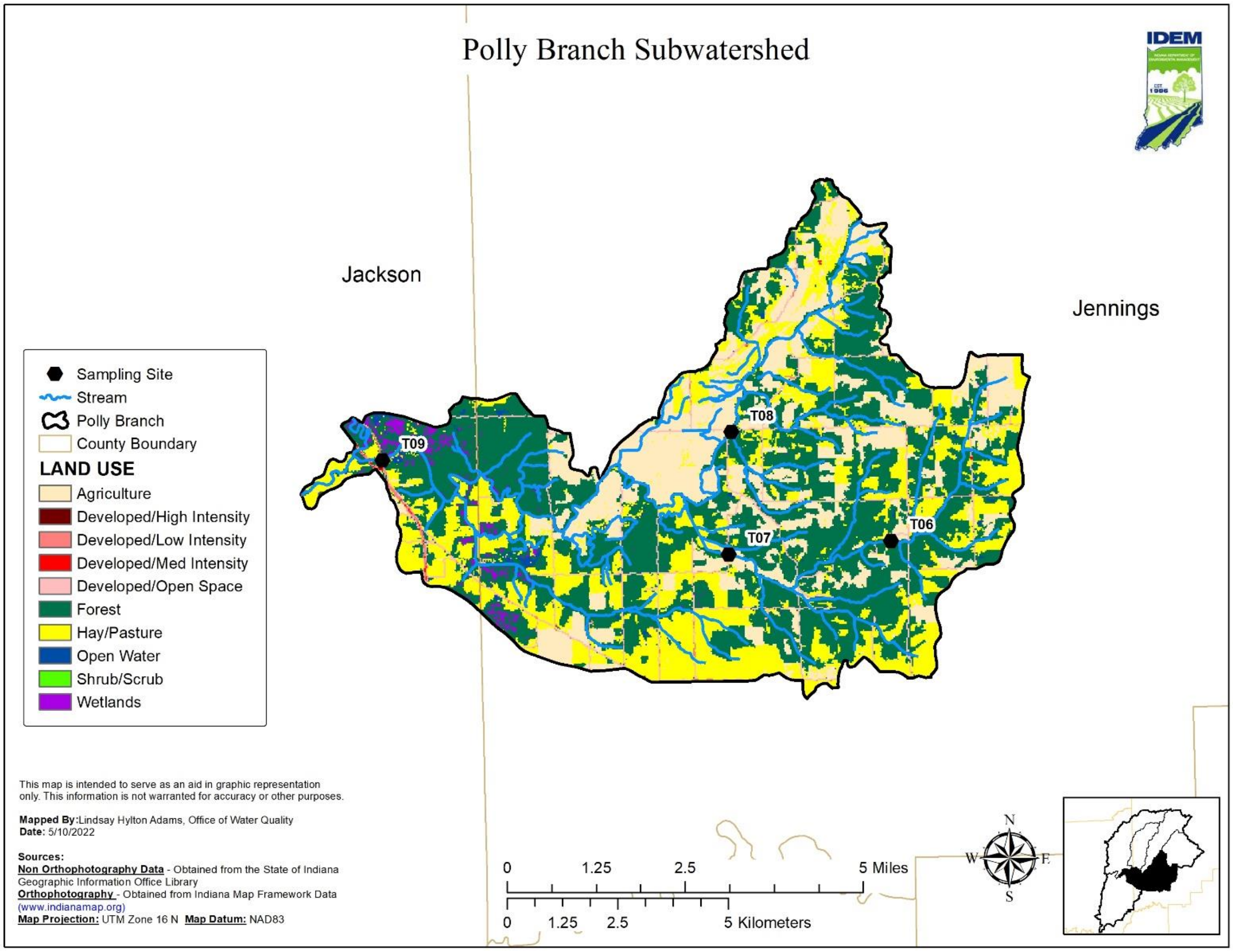


Figure 54: Sampling Stations in Polly Branch Subwatershed

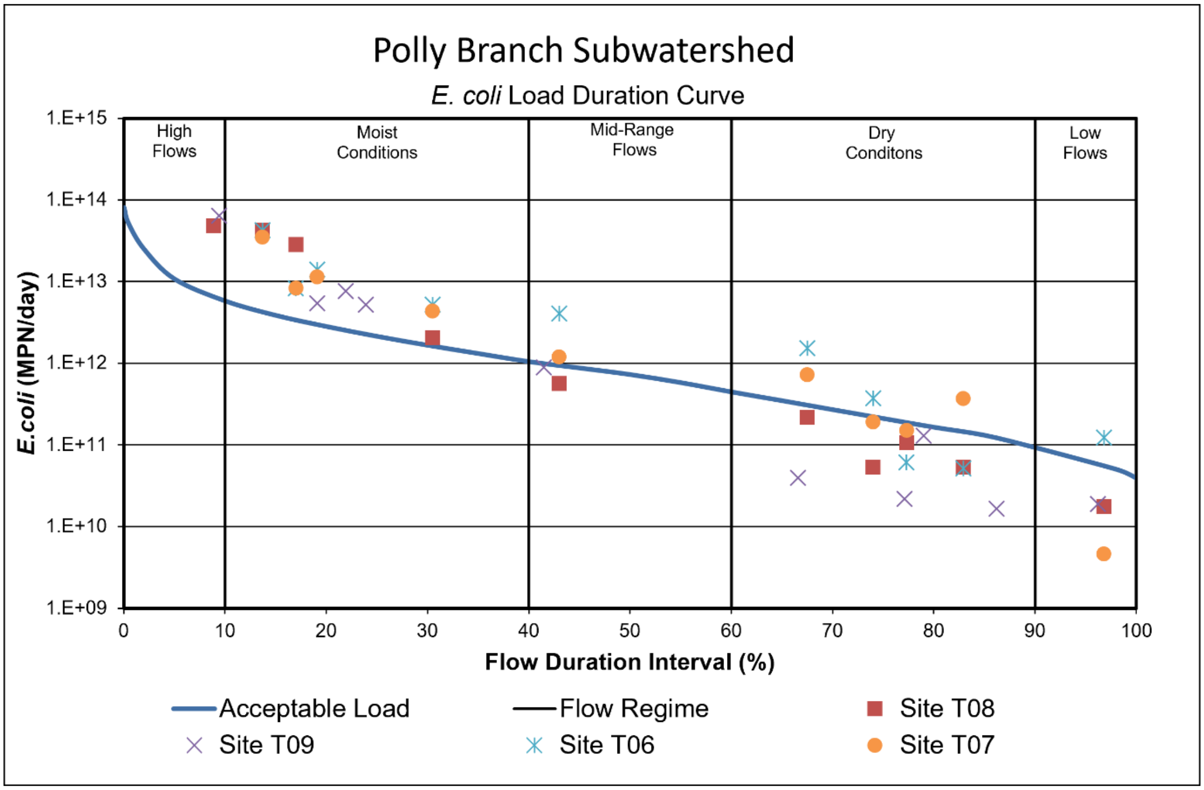


Figure 55: *E. coli* Load Duration Curve for Polly Branch Subwatershed

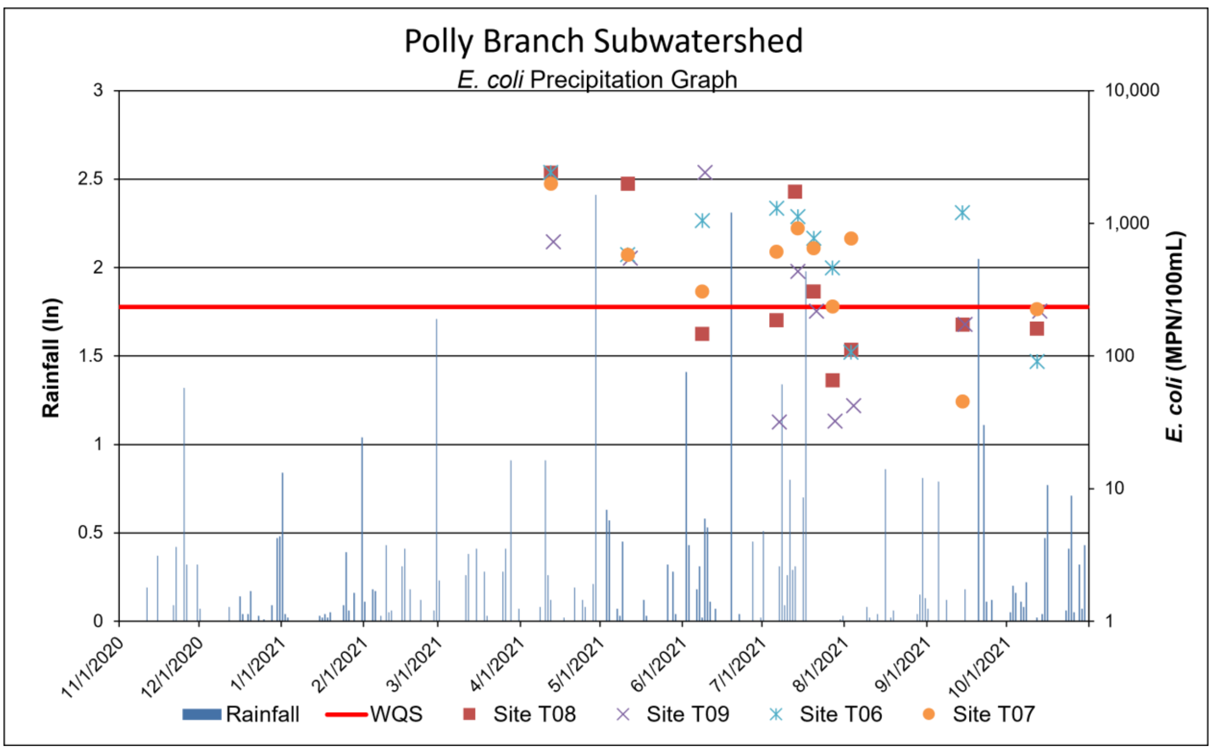


Figure 56: Graph of Precipitation and *E. coli* Data for Polly Branch Subwatershed

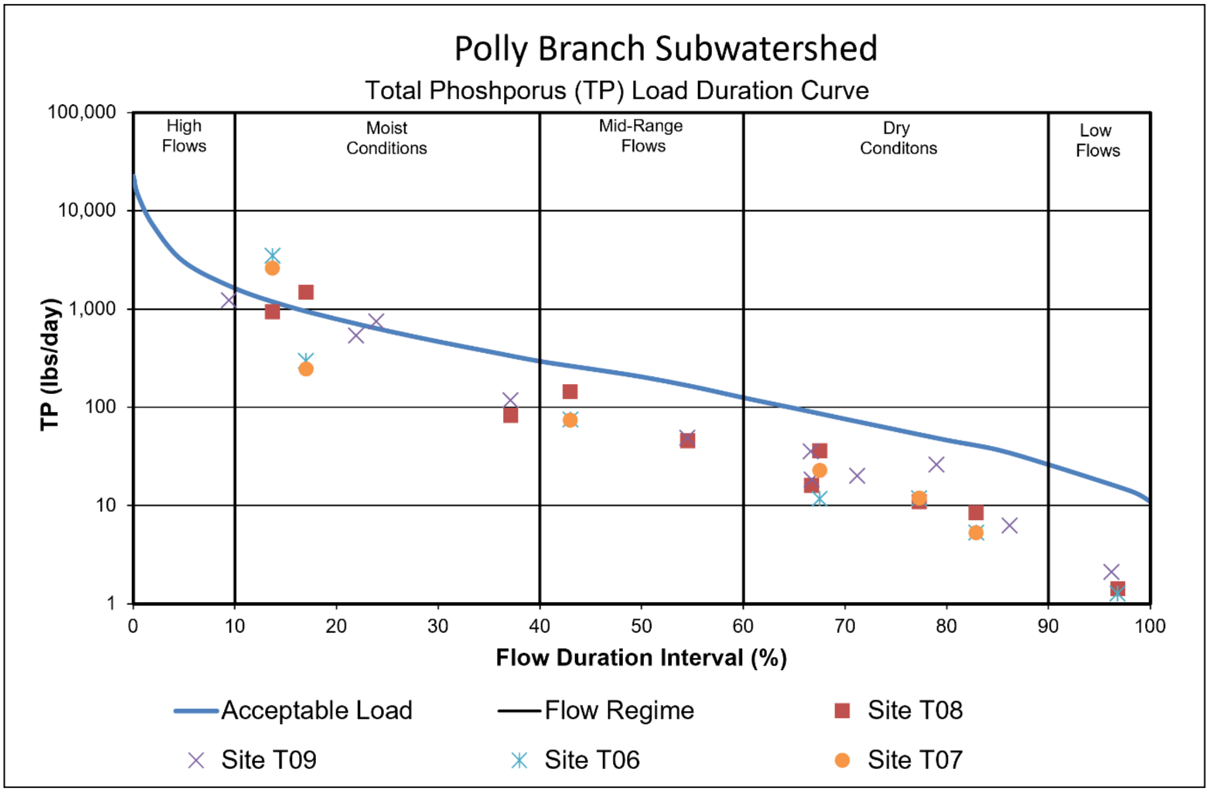


Figure 57: Total Phosphorus Load Duration Curve for Polly Branch Subwatershed

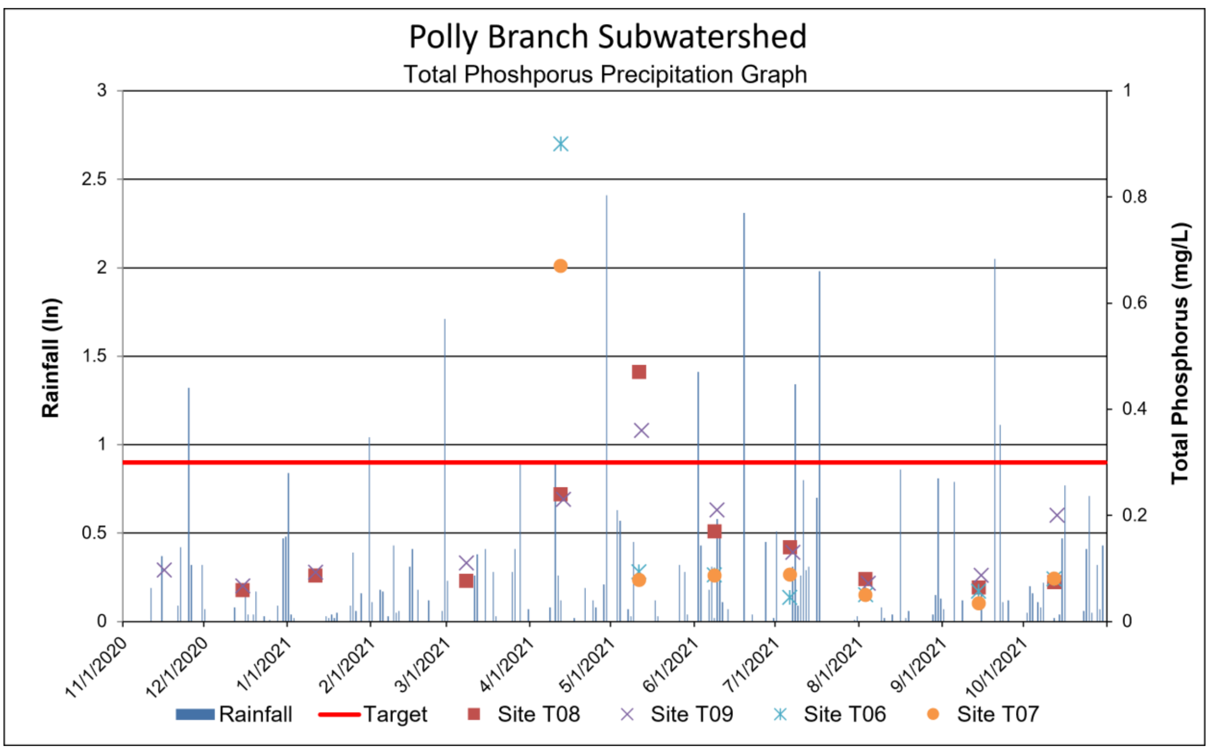


Figure 58: Graph of Precipitation and Total Phosphorus Data for Polly Branch Subwatershed

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 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.

Table 42: Summary of Grassy Creek Subwatershed Characteristics

Grassy Creek (051202070706)	
Drainage Area	412.26 square miles
Surface Area	45.68 square miles
Site # [IDEM Station ID]	T01 [WEM090-0003], T02 [WEM-07-0010], T05 [WEM-07-0015], T10 [WEM090-0015]
Listed Segments [TMDL(s)]	INW0776_05 [N/A]; INW0776_T1009 [*E. coli*]; INW0776_T1019 [*E. coli* & TP]
Listed Impairments [TMDL(s)]	*E. coli* [*E. coli*], Impaired Biotic Communities [TP], Dissolved Oxygen [TP]
Land Use	Agricultural Land: 28% Forested Land: 24% Developed Land: 6% Open Water: 0% Pasture/Hay: 35% Grassland/Shrubs: <1% Wetland: 7%
NPDES Facilities	Town 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 *E. coli* 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 WWTP (IN0022683)	4.18E+09	4.18E+09	4.18E+09	4.18E+09	4.18E+09
Outfall 002 (CSO)	0*	0*	0*	0*	0*

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	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.*

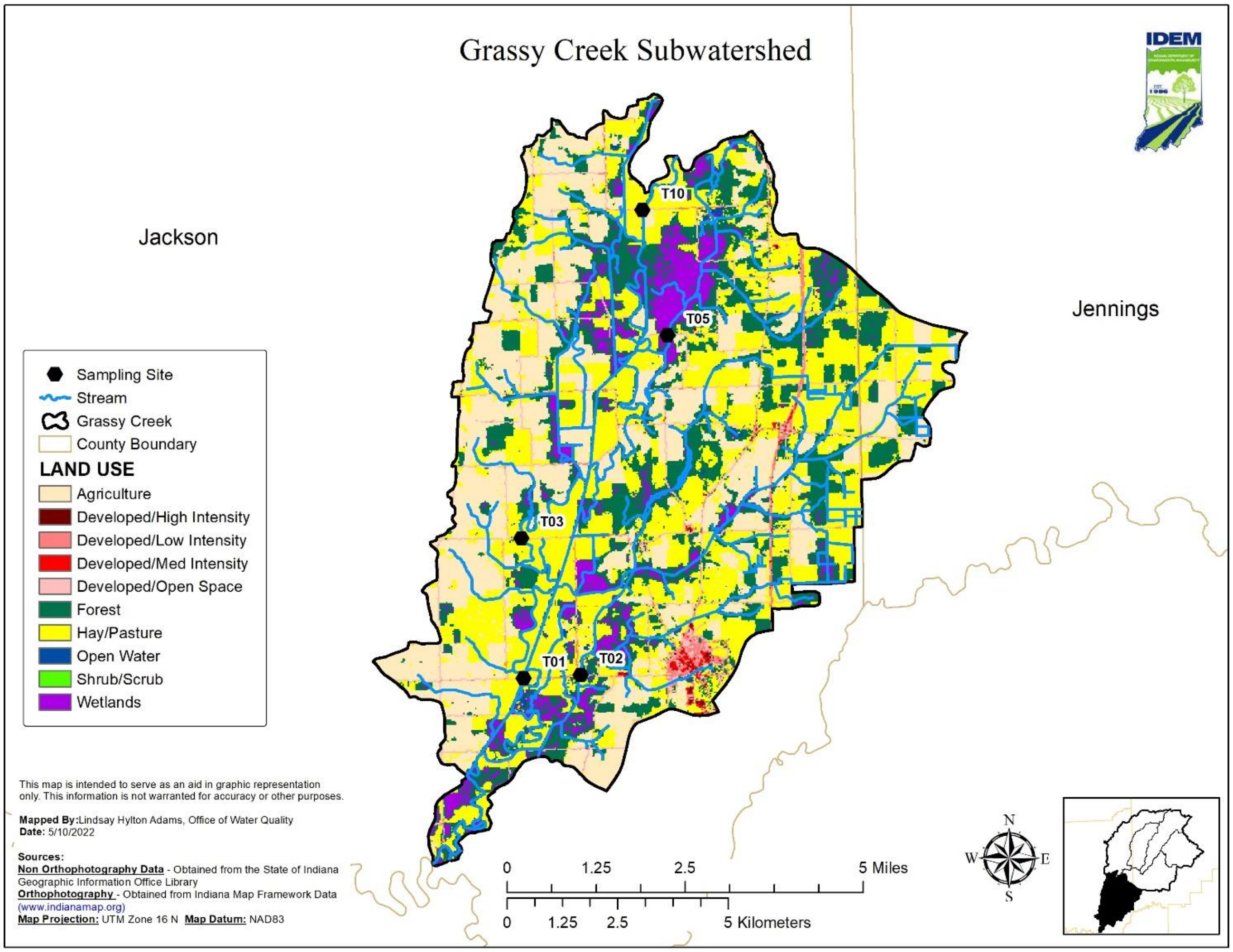


Figure 59: Sampling Stations in Grassy Creek Subwatershed

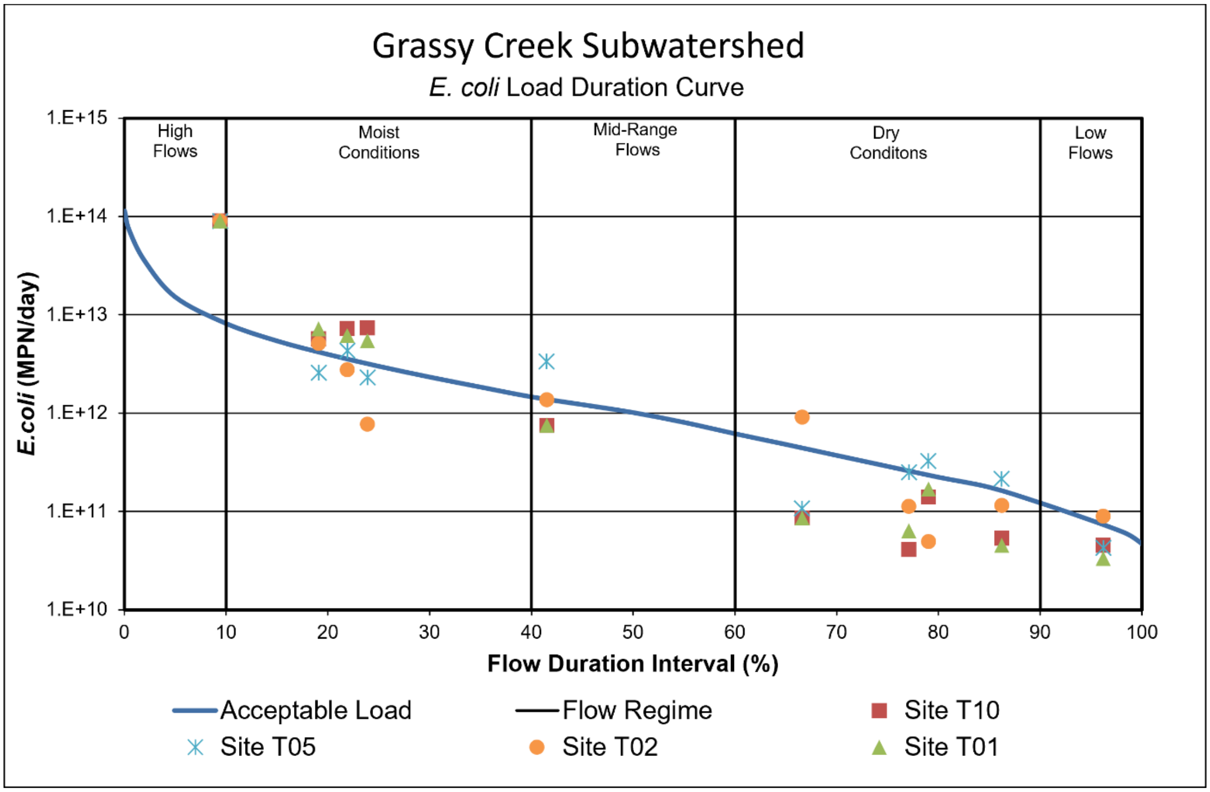


Figure 60: *E. coli* Load Duration Curve for Grassy Creek Subwatershed

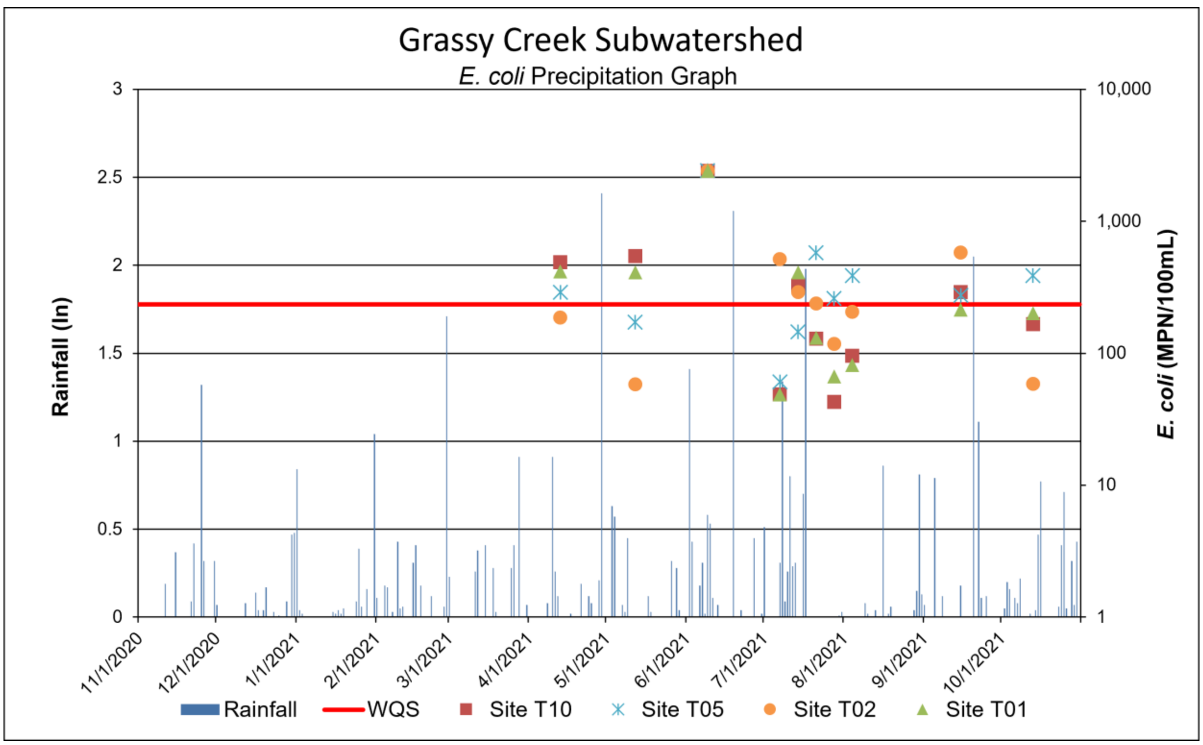


Figure 61: Graph of Precipitation and *E. coli* Data for Grassy Creek Subwatershed

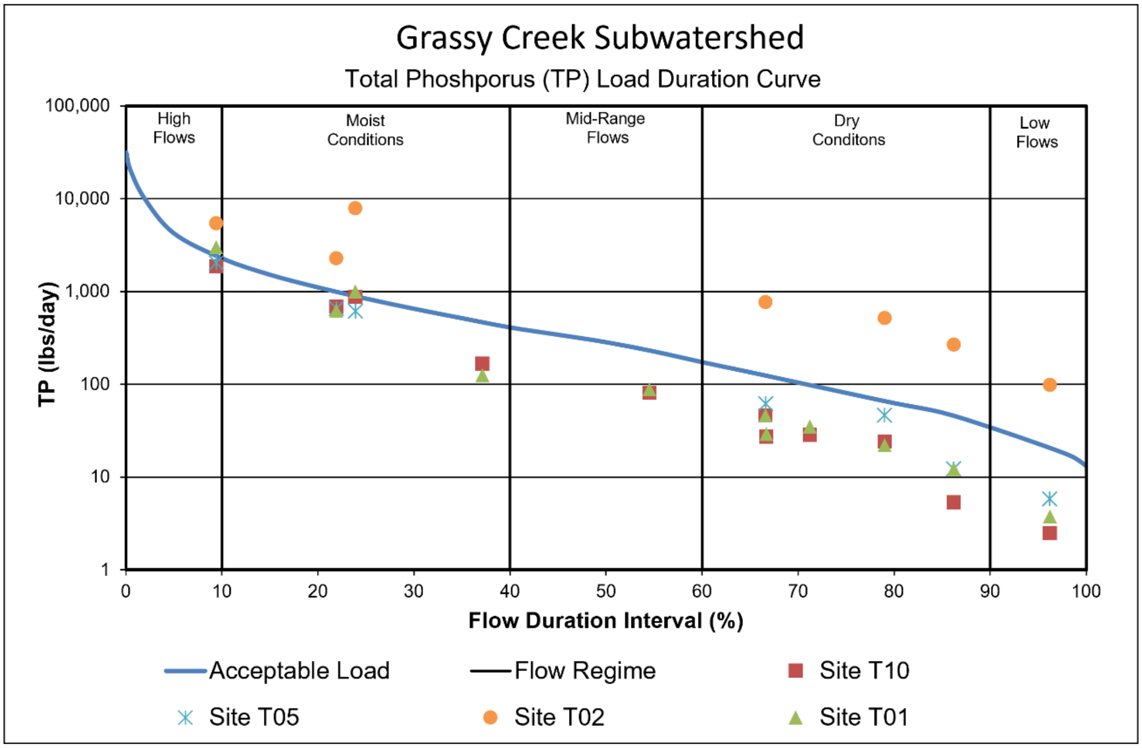


Figure 62: Total Phosphorus Load Duration Curve for Grassy Creek Subwatershed

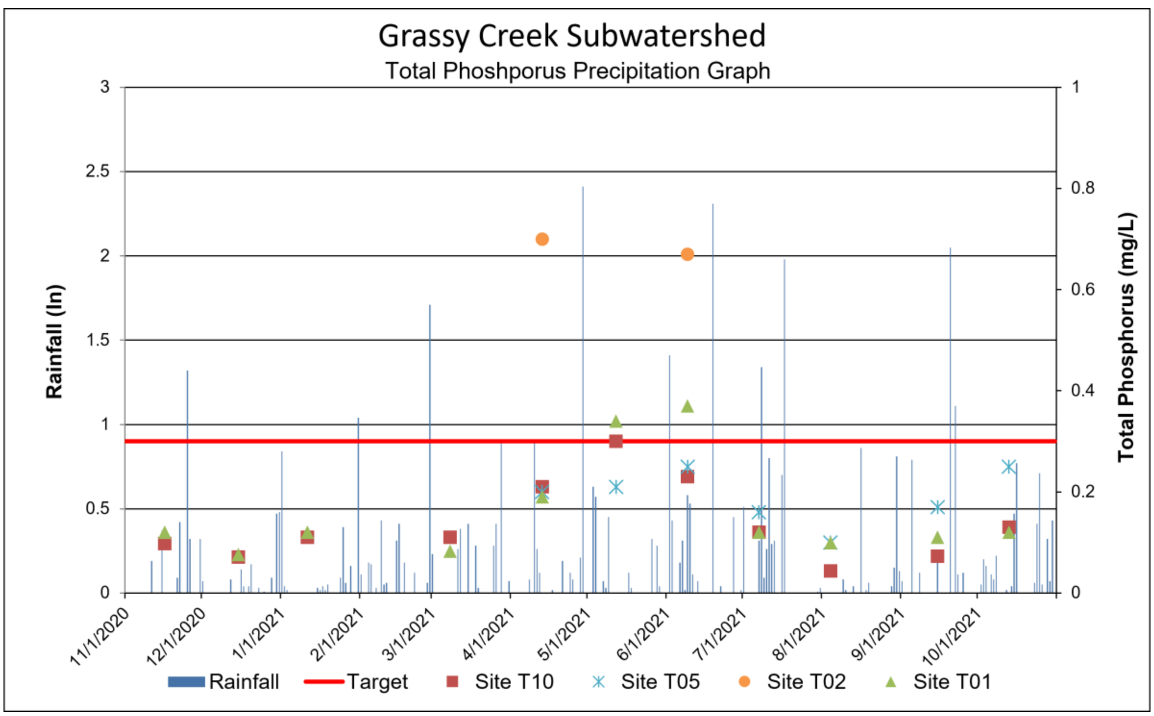


Figure 63: Graph of Precipitation and Total Phosphorus Data for Grassy Creek Subwatershed

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:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

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 by subwatershed.

Table 43: Individual WLAs for NPDES Municipal and Industrial Facilities in the Vernon Fork Muscatatuck River Watershed

Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Flow Regime	Estimated Design Flow (MGD)	*E. coli* WLA (MPN/day)	NPDES Permit *E. coli* Limit	TSS WLA (lbs/day)	NPDES Permit TSS Limit	TP WLA (lbs/day)	NPDES Permit TP Limit
Grassy Creek	Crothersville WWTP	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**
					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**

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.

Table 44: 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 *E. coli* WLA (MPN/day)	Moist Flow Regime *E. coli* WLA (MPN/day)	High Flow Regime TSS WLA (mg/L)	Moist Flow Regime TSS WLA (mg/L)	High Flow Regime TP 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

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.

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

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

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))*

Table 46: Critical Conditions for TMDL Parameters

Parameter	Subwatershed (HUC)	Critical Condition				
		High	**Moist**	**Mid-Range**	**Dry**	**Low**
E. coli (counts/mL)	Indian Creek (051202070701)	94%	95%	21%	0%	0%
	Sixmile Creek (051202070702)	93%	83%	90%	92%	77%
	Storm Creek (051202070703)	95%	69%	76%	84%	94%
	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%

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

Implementation Activities	Pollutant			Point Sources		Nonpoint Sources							
	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	X	X	X	X	X						X		
Outreach and education and training	X	X	X	X	X	X	X	X	X	X	X	X	X
System replacement	X	X				X					X		
Conservation tillage/residue management	X	X	X				X						
Cover crops	X	X	X				X			X			
Filter strips	X	X	X		X		X	X	X	X			
Grassed waterways	X	X	X				X		X	X			
Riparian forested/herbaceous buffers	X	X	X				X	X	X	X		X	X
Manure handling, storage, treatment, and disposal	X	X					X		X				
Alternative watering systems	X	X	X					X	X	X			
Stream fencing (animal exclusion)	X	X	X					X		X			
Prescribed grazing	X	X	X					X		X			
Conservation easements	X	X	X				X			X			
Two-stage ditches		X	X				X	X		X			
Rain barrel		X	X		X								X
Rain garden		X	X		X								X
Bioretention					X								X
Porous pavement		X	X		X								X
Green roof					X								X
Stormwater planning and management	X	X	X	X	X					X	X	X	X
Comprehensive Nutrient Management Plan	X	X					X		X				
Constructed Wetland	X	X	X	X		X	X					X	X
Critical Area Planting		X	X					X		X			
Drainage Water Management		X					X						
Nutrient Management Plan		X					X			X			
Land Reconstruction of Mined Land			X							X			
Sediment Basin		X	X		X		X						X
Pasture and Hay Planting	X	X	X				X	X	X	X		X	
Streambank and Shoreline Protection	X	X	X				X	X	X	X		X	
Conservation Crop Rotation		X	X				X			X			
Field Border	X	X	X				X	X	X			X	

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.

USDA Conservation Reserve Enhancement Program (CREP) (*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.

Table 48: Summary of Programs Relevant to Sources in the Vernon Fork Muscatatuck River 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	X			X			X													
Regulated Stormwater	X			X			X													
Illicitly Connected “Straight Pipe” Systems	X	X		X				X												
Cropland		X	X	X	X	X			X	X	X	X	X	X	X	X	X	X		
Pastures and Livestock Operations		X	X	X	X	X			X	X	X	X	X	X	X	X	X	X		
CFOs	X			X		X														
Streambank Erosion		X	X	X	X	X					X	X	X	X	X		X	X		
Onsite Wastewater Treatment Systems		X		X			X	X												X
In-stream Habitat	X	X	X			X													X	
Wildlife/Domestic Pets		X	X																	
Urban NPS Runoff		X	X																X	X

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 control measures must be used in reducing the potential for pollutants to be exposed to 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

CFOs

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.

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

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

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 https://www.epa.gov/nps/region-5-model-estimating-pollutant-load-reductions.

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.

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Appendices

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

Subwatershed	AUID	Stream	IDEM Station ID	Site #	Location	Date	% Saturation	Alkalinity (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Coliforms (Total)	DO (mg/L)	E. coli	Hardness (mg/L)	Magnesium (mg/L)	Ammonia Nitrogen (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Total Solids (mg/L)	Total Dissolved Solids (mg/L)	Specific Conductance (mg/L)	Sulfate (mg/L)	Temperature (°C)	TKN (mg/L)	TOC (mg/L)	Turbidity (NTU)	2020 303(d) Listing	Draft 2024 303(d) Listing Decision	Potential Sources
Indian Creek	INW0771_02	Vernon Fork Muscatatuck River	WEM070-0036	T23	County Road 400 W	############	90.5	190	57	16		10.56		200	14	0.28	0.85	7.83	0.07	1.7	290	340	396	24	8.6	0.7	3.5	3.44	N/A	E. coli	E. coli: Sewage discharges in unsewered areas + Wildlife other than waterfowl + Livestock (grazing or feeding operations)
						############	94.9	170	58	18		12.47		200	14	0.2	1.6	7.9	0.063	2	250	230	432	23	4.1	0.54	2.5	2.88			
						############	94.4	160	55	14		13		190	12	0.15	1.8	7.92	0.085	2	240	260	411	19	1.9	0.37	3	4.38			
						############	94.3	140	53	11		11.78		180	12	0.15	1.5	7.85	0.079	7	240	170	208	16	5.8	0.47	2.1	11.4			
						############	88	93	33	9.4	2419.6	9.25	2419.6	110	7.6	0.2	0.73	7.92	0.22	49	180	150	244	9.8	13.1	0.99	7.2	67			
						############	90.4	85	32	14	2419.6	9.55	1203.3	110	6.8	0.23	1.4	7.79	0.49	60	320	210	248	8.9	12.8	1.1	8	119			
						############	81.7	130	54	18	2419.6	7.01	166.4	180	12	0.19	4.3	7.76	0.17	22	280	220	375	16	22.8	0.76	5.2	20.2			
						############	86	120	44	12	2419.6	6.85	104.6	150	9.2	0.2	1.6	7.78	0.15	19	240	210	311	13	26.5	0.48	3.5	20			
						############	86.1				2419.6	7.46	1986.3					7.74					268		22.4			72.6			
						############	88.6				2419.6	7.57	224.7					7.71					332		22.8			22.3			
						############	111.2				2419.6	9	35.9					8.01					397		26.1			21			
						############	87.8	170	55	12	2419.6	7.54	48	200	15	0.2	0.6	7.66	0.085	23	330	290	423.9	24	22.9	0.45	2.3	20.5			
						############	82.3					6.85						7.67					468.6		24.5			8.81			
						############	95.9	140	43	11	2419.6	8.06	35	150	9.9	0.2	0.12	7.75	0.08	8.8	340	170	322.6	12	24.1	0.57	3.5	7.82			
						############	79.7	150	48	15	2419.6	7.08	107.1	170	12	0.2	0.4	7.53	0.12	7	240	170	372.9	19	21.1	0.44	4.2	7.35			
	INW0771_03	Vernon Fork Muscatatuck River	WEM070-0001	T25	County Road 60 S	############	103.7	158	49.5	17		14.02		182	14.1	0.1	1.2	8.25	0.047	10	224	221	367	19	2.5	0.4	3.1	24.8	E. coli, Hg (FT)	E. coli, Hg (FT)	E. coli: Sewage discharges in unsewered areas + Wildlife other than waterfowl
						############	106.4	173	57.1	17		14.8		208	15.9	0.1	1.5	8.46	0.041	10	231	229	557	24	0.5	0.3	1.8	8.65			
						############	99.8	129	41.2	9.6		12.16		144	10	0.1	1.4	8.07	0.083	10	205	189	298	16	6.8	0.5	3.5	33.7			
						############	100	157	49.1	16		11.27		181	14.2	0.1	0.8	8.47	0.081	10	217	208	382	26	10	0.5	2.7	3.77			
						############	94.1	98	43.8	15		8.68		150	10	0.2	2.7	8.03	0.346	16	228	190	308	13	19.2	1.3	6.2	34.9			
						############	93.5	99	37.9	15		8.29		132	9.2	0.1	2.9	7.7	0.295	101	300	190	286	13	21.2	1.3	7	252			
						############	93.1	113	39.2	9.1		7.92		137	9.4	0.1	1.3	7.9	0.161	12	201	188	290	9.3	23.4	0.7	5.2	29.5			
						############	88.5	157	45.4	22		7.32		185	17.3	0.1	1.4	8.17	0.166	10	272	244	448	30	24.9	0.6	2.9	7.87			
						############	83.6	119	37.2	11		7.64		130	9.1	0.1	0.5	7.86	0.128	10	177	154	317	15	19.7	0.5	4	8.32			
						############	102.2					9.29						8.17					380		19.9			6.94			
						############	96.2	149	54.2	11		10.9		186	12.4	0.1	1.3	8.04	0.115	10	217	207	355	22	9.8	0.3		10.3			
						############	102.7	172	55.5	17		13.86		206	16.2	0.1	1.2	8.47	0.041	10	235	231	418	26	2.8	0.3	2.6	3.66			
						############	91.1	89	30	10	2419.6	9.6	2419.6	100	6.8	0.23	0.73	7.93	0.32	29	160	150	234	9.4	13	1.2	7.7	59.5			
						############	95.1	90	32	14	2419.6	10.06	980.4	110	6.8	0.21	1.6	7.93	0.4	26	280	210	257	9.2	12.8	0.88	7.5	73			
						############	94.3	130	55	21	2419.6	8.18	77.6	190	12	0.21	4.6	8.03	0.17	8.4	270	240	392	19	22.4	0.76	5	8.66			
						############	88.5	110	40	12	2419.6	7.29	57.3	140	8.6	0.2	1.4	8.07	0.16	6.2	220	200	292	14	25.2	0.28	4.2	8.36			
						############	90.6				2419.6	7.87	1986.3					7.8					257		22.3			61.1			
						############	94.8				2419.6	7.99	149.7					8.29					343		21.9			12			
						############	78.6				2419.6	6.54	47.1					8.04					406		24.6			5.75			
						############	80.5	170	54	14	2419.6	7.14	70.3	200	16	0.2	1	8.03	0.11	4	320	200	418.9	26	21.2	0.47	2.5	4.2			
						############	103.9					8.62						8.35					466.8		24.5			3.2			
						############	89.8	120	40	15	2419.6	7.6	98.7	140	10	0.2	0.57	8.49	0.12	3.8	340	180	327.7	19	23.6	0.57	4.4	4.55			
						############	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	0.47	4.7	3.3			
	INW0771_04																												E. coli, Hg (FT)	E. coli, Hg (FT)	
	INW0771_T1001																														
	INW0771_T1001A																														
	INW0771_T1001B																														
	INW0771_T1002																														
	INW0771_T1003																														
	INW0771_T1004																														
	INW0771_T1005																														
	INW0771_T1006																												E. coli, Hg (FT)	E. coli, Hg (FT)	
	INW07P1041_00																														
Sixmile Creek	INW0772_01A	Sixmile Creek	WEM-07-0020	T22	State Road 7	############	93.8	99	40	54	2419.6	10.17	648.8	140	9.8	0.13	0.73	7.8	0.13	13	280	290	403	32	11.7	0.98	9.3	41.9	N/A	E. coli, IBC, DO	E. coli: Sewage discharges in unsewered areas IBC: Source unknown DO: Dam or impoundment (low flow)
						############	92	140	47	33	2419.6	9.95	547.5	160	11	0.12	1.3	7.58	0.11	6.5	380	340	449	31	11.8	0.87	6.4	18.8			
						############	75.3	130	57	85	2419.6	6.82	1553.1	200	14	0.21	1.4	7.65	0.1		390	360	619	42	19.8	0.53	5.4	5.66			
						############	34.9	170	68	59	2419.6	3.24	2419.6	240	17	0.2	0.89	7.18	0.092	2.2	430	420	590	52	18	0.32	3.4	3.33			
						############	86.3				2419.6	7.59	1986.3					7.55					296		21.6			32			
						############	69.3				2419.6	6.42	1732.9					7.38					461		19			9.55			
						############	28.3				2419.6	2.63	2419.6					7.23					553		19			2.69			
						############	50.7	200	80	29	2419.6	4.8	770.1	280	20	0.2	1.7	7.28	0.055	5	480	460	627	60	17.7	0.48	2.4	5.86			
						############	63.6					5.15						7.54					715		20.1			2.93			
						############	48.5	200	73	49	2419.6	4.38	248.9	250	18	0.11	0.32	7.11	0.093	5	650	380	651	60	19.8	0.75	4.1	1.48			
						############	45.2	190	72	27	2419.6	4.2	613.1	250	17	0.2	0.32	7.19	0.14	2.8	380	320	602	31	18.9	0.48	5.2	2.98			
	INW0772_03																												IBC	E. coli, IBC	E. coli: Sewage discharges in unsewered areas
	INW0772_04	Sixmile Creek	WEM-07-0019	T21	County Road 175 N	############	96.4	93	35	35	2419.6	9.88	93.4	120	7.8	0.12	0.29	8.03	0.13	15	190	200	362	28	14.2	0.92	6.1	16.4	N/A	E. coli	E. coli: Sewage discharges in unsewered areas + wildlife other than waterfowl
						############	93.9	92	34	28	2419.6	9.45	261.3	120	7.7	0.17	0.48	7.93	0.25	15	290	250	331	22	15	0.67	7.7	18.7			
						############	69.8	120	49	42	2419.6	6.27	209.8	170	11	0.21	1.5	7.61	0.47	4.4	280	210	521	30	20.6	0.88	7.5	6.21			
						############	71	89	34	21	2419.6	6.01	313	120	8	0.2	0.42	7.65	0.19	5.8	210	200	289	19	23.8	0.84	6.3	7.56			
						############	83.5				2419.6	7.05	193.5					7.56					246		23.8			21.2			
						############	76.3				2419.6	6.52	104.6					7.56					23.1		23.1			16.8			
						############	75.2				2419.6	6.52	186					7.61					250		22.4			7.59			
						############	74.9	90	29	13	2419.6	6.65	193.5	100	7	0.2	1.4	7.66	0.5	5.8	290	260	271.3	15	21	0.79	6.2	8.29			
						############	84.4					7.15						7.79					276.7		23.6			10.2			
						############	77.6	97	33	16	2419.6	6.66	298.7	120	8	0.2	0.95	7.61	0.36	11	330	160	292.4	17	22.9	1.1	6.8	9.9			
						############	81.4	97	37	18	2419.6	7.34	261.3	130	8.3	0.2	0.65	7.38	0.26	5.2	200	160	313.2	26	20.4	0.59	6.9	6.19			
	INW0772_05	Sixmile Creek	WEM-07-0018	T20	County Road 200 S	############	100.8	90	35	32	2419.6	10.55	488.4	120	8.7	0.12	0.29	8.11	0.088	12	180	190	334	29	13.3	0.89	5.8	17.6	N/A	E. coli	E. coli: Sewage discharges in unsewered areas + livestock (grazing or feeding operations)
						############	105.6	98	39	27	2419.6	10.81	410.6	140	9.5	0.17	0.45	8.07	0.17	13	330	270	356	35	14.2	0.9	6.4	16.6			
						############	83.2	120	48	33	2419.6	7.21	365.4	170	12	0.23	1.1	7.77	0.29	8.4	290	220	420	36	22.5	0.65	6.1	11.4			
						############	91	120	53	28	2419.6	7.51	648.8	190	14	0.2	1.1	7.94	0.26	8	360	320	455	76	25	0.68	5.2	10.4			
						############	95.3				2419.6	8.09	613.1					7.88					268		23.5			31.7			
						############	91.6				2419.6	7.93	307.6					7.71					320		22.5			22			
						############	82				2419.6	6.88	298.7					7.79					419		24.1			11.1			
						############	92.9	110	38	15	2419.6	8.31	727	130	9.1	0.2	1.2	7.98	0.37	9.6	270	240	330.2	31	20.8	0.57	5.4	11.7			
						############	80.1					6.86						7.76					333.9		23			9.26			
						############	102.7	110	43	20	2419.6	8.83	648.8	160	12	0.2	0.67	7.97	0.32	14	500	240	392.1	50	23	0.89	6.4	14.8			
						############	86.7	120	44	19	2419.6	7.76	120.1	150	10	0.2	0.25	7.63	0.24	6.6	240	180	368.8	36	20.7	0.68	6.8	8.14			
	INW0772_06	Sixmile Creek	WEM-07-0017	T19	County Road 500 S	############	86.5	110	43	17		10.35		150	11	0.12	0.66	8.09	0.12	5	320	380	372	48	8.2	0.7	4.7	5.84	N/A	E. coli	E. coli: Confined animal feeding operations (NPS) + sewage discharges in unsewered areas + wildlife other than waterfowl
						############	94.7	110	47	17		13.01		170	12	0.2	1.1	7.99	0.13	5.5	270	130	373	49	2.2	0.53	3.5	8.71			
						############	94.4	110	44	19		13.23		160	11	0.2	1.4	7.99	0.14	6.5	240	230	367	45	1.2	0.35	3.7	13.5			
						############	89.6	83	38	28		11.15		130	9.8	0.17	1.3	8.18	0.14	13		130	350	36	5.9	0.6	3.4	24.6			
						############	96.7	91	36	30	2419.6	10.07	727	130	9.6	0.13	0.52	7.89	0.11	28	240		355	35	13.5	0.85	5.8	26.1			
						############	106.8	94	35	27	2419.6	10.83	201.4	120	8.4	0.14	0.53	7.95	0.21	28	290	240	329	27	14.7	0.91	6.3	25.8			
						############	82.1	120	52	31	2419.6	7.03	260.3	190	14	0.17	1.5	7.7	0.16	12	340	250	430	49	23	0.61	5.3	12.7			
						############	113.4	110	45	24	2419.6	8.8	231	160	11	0.2	0.4	8.05	0.18	12	290	250	377	42	28.4	0.79	5.2	14.9			
						############	90.4				2419.6	7.68	1046.2					7.54					255		23.5			39.6			
						############	95.8				2419.6	8.15	461.1					7.55					291		23.4			34.4			
						############	84.8				2419.6	6.82	248.1					7.67					349		26.4			14.3			
						############	109.9	110	47	20	2419.6	9.36	209.8	170	12	0.2	0.81	8.03	0.15	13	350	310	397.8	60	23.5	0.39	4.5	16			
						############	102.6					8.44						7.9					340		25.2			14.4			
						############	118.4	120	45	21	2419.6	9.58	196.8	170	13	0.2	0.25	8.18	0.17	17	480	270	407	57	26.1	0.74	6.1	15.8			
						############	93.1	120	49	14	2419.6	8.33	260.3	180	13	0.2	0.26	7.62	0.14	7.2	300	230	421.7	37	20.7	0.64	5.9	8.17			
	INW0772_T1001																														
	INW0772_T1003																														
	INW0772_T1004																														
	INW0772_T1005																														
	INW0772_T1005A																														
	INW07P1016_00																														
	INW07P1071_00																														
	INW07P1073_00																														
Storm Creek	INW0773_01	Storm Creek	WEM-07-0014	T18	Base Road	############	84	140	44	15	1553.1	8.8	193.5	160	12	0.13	0.29	7.86	0.069	4	170	180	355	22	13.3	0.58	6.3	11.5	IBC	E. coli	E. coli: Confined animal feeding operations (NPS) + sewage discharges in unsewered areas
						############	86.5	130	41	14	2419.6	9.53	201.4	150	11	0.15	1.3	7.94	0.08	6	270	270	345	19	10.9	0.64	4.7	9.55			
						############	80.7	75	34	19	2419.6	7.27	2419.6	120	9	0.28	2.6	7.34	0.7	210	450	190	272	19	20.5	1.8	14	195			
						############	66.5	180	57	17	2419.6	5.76	325.5	200	15	0.2	0.65	7.51	0.07	2.2	270	290	429	18	22.4	0.27	3.3	3.66			
						############	82.2				2419.6	7.26	579.4					7.6					354		21.5			10.9			
						############	78.4				2419.6	6.95	547.5					7.34					350		21.2			7.44			
						############	67.9				2419.6	5.91	435.2					7.37					394		22.2			4.56			
						############	71	180	53	14	2419.6	6.63	648.8	190	13	0.2	0.81	7.43	0.062	4.2	320	280	414.8	15	18.8	0.41	2.8	5.15			
						############	79					6.77						7.6					311.3		22.6			4.23			
						############	56.4	180	51	14	2419.6	4.97	2419.6	180	14	0.2	0.1	7.5	0.068	7.2	350	280	414.8	13	21.6	0.55	3.7	3.71			
						############	39	160	45	12	2419.6	3.79	285.1	160	12	0.2	0.1	6.98	0.11	5	250	180	356.1	10	16.7	0.5	5.5	2.22			
	INW0773_02	Storm Creek Ditch	WEM080-0013	T16	County Road 400 N	############	40.6	180	50	15		4.66		180	13	0.17	0.33	7.64	0.096	3	340	290	417	16	9.2	0.49	5.5	8.55	IBC, DO	IBC, DO	IBC: Source unknown (stagnant) DO: Natural sources (low flow/stagnant)
						############	72.6	140	47	15		9.23		170	13	0.11	0.68	7.84	0.098	4	270	120	392	23	4.9	0.68	4.8	9.2			
						############	70.6	90	30	9.5		9.8		110	8.3	0.1	0.52	7.84	0.12	6	160	200	252	17	1.8	0.67	7.9	9.93			
						############	83.7	82	30	10		10.24		110	8	0.2	0.56	8.15	0.099	10	170	98	303	13	6.7	0.67	5.4	18.8			
						############	70.7	110	33	13	2419.6	7.12	137.6	120	9.2	0.14	0.21	7.66	0.16	6.5	140	150	306	13	15.1	0.48	8.8	13.3			
						############	68	94	29	12	2419.6	6.99	172.3	110	7.9	0.21	0.63	7.62	0.17	6.5	220	200	276	10	14	0.88	8.4	12.6			
						############	63.7	75	29	12	2419.6	5.71	2419.6	110	8.3	0.51	1.9	7.22	0.67	240	510	170	246	9.8	20.8	1.9	12	196			
						############	15.5	140	42	12	2419.6	1.34	38.4	150	11	0.2	0.27	7.2	0.15	5.8	240	260	329	9.3	23.5	0.64	6.1	6.47			
						############	39.5				2419.6	3.37	135.4					7.15					247		23.4			12.6			
						############	12.1				2419.6	1.03	104.6					6.69					169		23.3			14			
						############	7				2419.6	0.6	17.5					7.08					330		24.1			5.76			
						############	9.6	150	45	11	2419.6	0.84	81.3	160	11	0.7	0.051	7.12	0.1	18	320	190	351.5	7.1	20.8	1.3	5.6	14.5			
						############	2.1					0.18						7.12					388.8		22.7			9.73			
						############	3.6	140	40	11	2419.6	0.28	98.7	140	10	0.18	0.1	6.99	0.1	19	350	280	405.1	7.7	20.8	1.5	15	15.3			
						############	5.1	180	50	15	2419.6	0.49	107.6	180	13	0.18	0.1	7.02	0.25	10	280	200	399.5	11	18.7	0.7	6.8	7.54			
	INW0773_T1001																														
	INW0773_T1002	Tributary to Richart Lake	WEM080-0005	T17	County Road 900 W	############	84.2	130	46	36	2419.6	8.96	365.4	180	15	0.11	0.46	7.74	0.062	6	240	260	457	45	12.5	0.71	7.4	18.5	IBC, DO	E. coli, IBC, DO	E. coli: Confined animal feeding operations (NPS) + sewage discharges in unsewered areas + wildlife other than waterfowl IBC: Source unknown DO: Natural sources (low flow)
						############	86.6	120	40	30	2419.6	9.6	142.1	160	14	0.13	1.6	7.76	0.089	5.5	360	330	423	41	10.7	0.37	4.6	11.2			
						############	81.1	51	23	18	2419.6	7.21	2419.6	84	6.5	0.26	1.9	7.37	0.4	120	370	170	309	13	21.1	1.3	17	132			
						############	53.5	160	60	36	2419.6	4.64	613.1	230	19	0.2	0.41	7.39	0.11	9.6	430	460	533	58	22.2	0.37	4.6	10.5			
						############	81.8				2419.6	7.2	344.8					7.5					392		21.6			14.5			
						############	81.1				2419.6	7.16	410.6					7.37					412		21.5			6.01			
						############	59.4				2419.6	5.19	816.4					7.35					501		22			4.4			
						############	51.2	170	54	32	2419.6	4.86	1119.9	210	18	0.2	0.1	7.4	0.068	6	430	510	523	46	18.1	0.29	3.8	6.01			
						############	4					0.36						7.33					543		22.3			5.93			
						############	22.9	220	64	53	2419.6	2.24	307.6	250	22	0.2	0.1	7.28	0.12	3	420	330	639	38	16.9	0.52	7.1	4.12			
	INW0773_T1003																														
	INW0773_T1004																														
	INW0773_T1005																														
	INW0773_T1006																														
	INW0773_T1007																														
	INW0773_T1008																														
	INW0773_T1009																														
	INW07P1056_00																														
	INW07P1078_00																														
	INW0773_T1010																														
						############	94.2	100	34	11	2419.6	10.23	488.4	120	8.8	0.11	0.47	7.86	0.059	7.5	150	170	284	22	11.6	0.68	12	20			E. coli: Confined animal feeding operations (NPS) + sewage discharges in unsewered areas
						############	101.7	110	37	14	2419.6	11.01	435.2	130	9	0.15	1.2	7.87	0.082	4.5	270	210	308	14	11.7	0.64	5.4	10.2			
						############	74.2	140	58	23	2419.6	6.56	613.1	200	13	0.18	2.6	7.63	0.075	4.4	270	220	414	28	21.3	0.6	4.8	5.27			
						############	61.1	130	47	15	2419.6	5.12	579.4	170	12	0.2	0.95	7.62	0.05	3.4	250	230	351	22	24	0.26	3	5.28			

Mutton Creek	INW0774_01	Mutton Creek	WEM080-0025	T15	County Road 300 N	############	88.9				2419.6	7.78	980.4					7.75					293		22			15.9	E. coli	E. coli	
						############	89.6				2419.6	7.97	387.3					7.68					254		21.1			13.8			
						############	62.7				2419.6	5.36	387.3					7.57					265		23.1			6.75			
						############	71	150	51	12	2419.6	6.52	387.3	180	12	0.2	0.9	7.67	0.025	5.6	300	190	352	20	19.3	0.51	2.7	6.64			
						############	54.3					4.77						7.39					369.9		22.1			6.89			
						############	60.6	150	47	7.9	2419.6	5.32	209.8	170	13	0.2	0.1	7.44	0.053	6.2	310	170	345.4	16	21.7	0.6	3.8	6.55			
						############	49	160	57	13	2419.6	4.46	435.2	200	13	0.2	0.18	7.24	0.087	4.2	250	200	405.5	24	19.9	0.45	5	5.15			
	INW0774_02	Mutton Creek	WEM080-0014	T12	County Road 400 N	############	59.3	100	34	18	2419.6	6	648.8	120	9.8	0.23	0.71	7.42	0.25	11	170	180	294	16	14.6	0.84	8.8	23.3	DO	E. coli, DO	E. coli: Confined animal feeding operations (NPS) + sewage discharges in unsewered areas + wildlife other than waterfowl + waterfowl DO: Natural sources (low flow/stagnant)
						############	70.1	110	34	17	2419.6	7.32	196.8	120	9.6	0.19	1.1	7.65	0.17	12	270	220	318	15	13.3	0.77	6.4	16.9			
						############	72.7	110	41	22	2419.6	6.48	2419.6	150	12	0.35	2.8	7.43	0.26	92	410	200	340	16	21	1.2	7.1	84			
						############	31.6	150	50	23	2419.6	2.64	148.3	180	14	0.16	2	7.29	0.15	7.2	310	320	394	16	24.6	0.61	4.3	7.93			
						############	64.1				2419.6	5.5	1732.9					7.39					303		22.9			26.1			
						############	56.6				2419.6	4.87	150					7.27					304		22.8			13.6			
						############	39.2				2419.6	3.25	84.2					7.24					372		24.8			12.8			
						############	28.3	150	47	18	2419.6	2.51	39.3	170	13	0.2	0.94	7.22	0.13	8.2	360	210	387.9	12	21.1	0.32	4.2	8.66			
						############	16.3					1.4						7.21					405.5		23.4			8.52			
						############	5.4	130	40	15	2419.6	0.46	248.1	140	11	0.2	0.05	6.96	0.16	10	340	270	362.8	8.9	20.8	0.97	9.8	10.5			
						############	16.7	150	49	12	2419.6	1.55	235.9	180	13	0.2	0.45	7.08	0.21	11	280	180	384.1	9.1	19	0.64	6.9	12.6			
		Mutton Creek	WEM080-0027	T14	County Road 800 N	############	84.1	93	32	15	2419.6	9.15	2419.6	120	9.3	0.28	0.65	7.5	0.35	20	180	180	274	18	11.6	0.86	9.2	39.5	DO		
						############	88.7	100	33	15	2419.6	9.48	410.6	120	9.3	0.12	1.3	7.46	0.13	9.5	300	240	295	19	12.3	0.63	6.1	19.9			
						############	73.6	130	50	23	2419.6	6.52	2419.6	180	14	0.27	3.5	7.54	0.14	17	260	210	395	25	21.2	0.76	5.6	14.8			
						############	56.3	150	47	26	2419.6	4.78	1203.3	170	14	0.2	0.55	7.5	0.084	13	250	240	374	17	23.5	0.45	4.6	15.8			
						############	81.2				2419.6	7.05	2419.6					7.43					241		22.4			52.5			
						############	82.2				2419.6	7.16	488.4					7.53					273		22.1			19.6			
						############	57.7				2419.6	4.92	1413.6					7.49					340		23.2			9.62			
						############	65	150	46	12	2419.6	5.89	920.8	170	12	0.2	0.12	7.52	0.062	8.4	260	250	360.7	12	20.2	0.53	3.9	11			
						############	57					4.84						7.4					373.8		23.7			10.4			
						############	65.9	180	47	15	2419.6	5.84	50.4	180	14	0.2	0.062	7.3	0.069	4.4	330	190	391.8	4.1	21.7	0.74	4.8	4.25			
						############	59.7	150	50	15	2419.6	5.42	272.3	180	14	0.2	0.55	7.12	0.07	9.2	240	210	391.6	22	20	0.55	5.6	11.7			
	INW0774_03																												E. coli, DO	E. coli, DO	
	INW0774_T1001																														
	INW0774_T1002																													E. coli	
	INW0774_T1003	Tributary of Mutton Creek	WEM-07-0016	T13	County Road 700 N	############	90	140	48	26	2419.6	9.66	307.6	180	14	0.16	1.7	7.85	0.065	5	210	220	399	18	12.1	0.53	5.4	10.3	N/A	E. coli	E. coli: Confined animal feeding operations (NPS) + sewage discharges in unsewered areas
						############	101.6	140	43	23	2419.6	11.1	325.5	160	13	0.21	2.2	7.94	0.076	5.5	310	290	389	17	11.4	0.56	3.3	8.29			
						############	79.2	62	28	14	2419.6	7.12	2419.6	100	7.5	0.67	2.7	7.22	0.85	290	530	130	222	10	20.6	2.3	19	253			
						############	90.4	110	39	16	2419.6	7.8	2419.6	140	11	0.2	1.7	7.81	0.33	24	260	220	302	12	22.7	0.65	6	34.2			
						############	88.2				2419.6	7.85	648.8					7.59					275		21			10.1			
						############	91.9				2419.6	8.17	816.4					7.6					395		21.1			7.34			
						############	73.8				2419.6	6.46	148.3					7.68					416		21.8			6.04			
						############	73.8	170	55	19	2419.6	6.96	108.6	200	16	0.2	1.8	7.67	0.075	4.4	340	260	424.2	15	18.2	0.42	2.6	3.74			
						############	127.8					10.38						8.04					416.5		25.9			4.9			
						############	65.5	160	48	18	2419.6	5.69	2419.6	180	15	0.2	0.18	7.69	0.058	5	390	260	380	13	22.8	0.65	4.2	3.64			
						############	74	180	58	24	2419.6	7.29	140.1	210	17	0.2	0.91	7.38	0.046	2.4	320	250	452.3	15	16.1	0.52	4.2	4.4			
	INW0774_T1004																														
	INW0774_T1005	Sandy Branch	WEM080-0015	T11	US Hwy 31	############	88.3	180	67	57	2419.6	9.33	613.1	240	18	0.2	0.53	7.86	0.075	2.5	290	310	476	26	12.8	0.55	3.5	6.11	IBC	E. coli, IBC	E. coli: Waterfowl
						############	93.5	190	64	42	2419.6	10	167	230	17	0.27	1.2	7.94	0.085	5	420	370	557	27	12.3	0.6	2.9	6.54			
						############	63.7	60	25	18	2419.6	5.64	2419.6	85	5.6	0.36	0.99	7.13	0.34	95	310	110	206	7.6	21.3	1.1	6.8	81.9			
						############	77.7	130	47	37	2419.6	6.61	2419.6	170	12	0.2	0.58	7.72	0.13	8.6	310	350	390	18	23.4	0.37	4.7	8.96			
						############	81.4				2419.6	7.18	272.3					7.68					498		21.5			5.98			
						############	86.5				2419.6	7.74	307.6					7.78					576		20.8			11.9			
						############	82				2419.6	7.27	224.7					7.76					642		21.2			4.34			
						############	76.7	230	84	55	2419.6	7.16	344.8	300	22	0.2	0.51	7.88	0.071	3.8	560	500	646	34	18.7	0.38	2.3	4.31			
						############	65	230	81	57	2419.6	5.69	387.3	290	21	0.2	0.35	7.68	0.12	7	610	480	647	32	22	0.61	2.8	5.53			
						############	63.9	230	78	55	2419.6	6.16	74.9	280	20	0.2	0.2	7.68	0.078	3.8	440	380	656	29	17.1	0.85	3.3	6.55			
	INW0774_T1006																														
Polly Branch	INW0775_01	Vernon Fork Muscatatuck River	WEM070-0039	T08	County Road 500 S	############	90.4	170	61	17		11.83		210	15	0.2	1.7	7.99	0.059	2.5	260	210	428	23	4	0.47	2.4	5.27	DO, Hg (FT)	E. coli, Hg (FT)	E. coli: Sewage discharges in unsewered areas + wildlife other than waterfowl
						############	94	160	62	14		12.9		210	14	0.2	1.6	7.99	0.087	4	250	270	410	20	2.2	0.48	2.8	12.9			
						############	92.2	150	54	11		11.28		180	12	0.18	1.6	8.03	0.077	9	240	66	369	16	6.7	0.48	2.1	13.6			
						############	87.6	93	33	9.9	2419.6	9.15	2419.6	120	7.8	0.18	0.64	7.9	0.24	49	190	140	247	11	13.3	1.1	7.1	68.4			
						############	89.6	89	30	14	2419.6	9.41	1986.3	100	6.3	0.31	1.4	7.77	0.47	54	310	220	248	9.6	13.2	0.98	7.7	103			
						############	83	130	54	18	2419.6	7.13	146.7	180	11	0.24	4.1	7.72	0.17	30	300	190	375	15	22.8	0.73	5.2	24.8			
						############	76.3	130	49	13	2419.6	6.24	186	160	10	0.2	1.8	7.73	0.14	19	280	240	334	13	25.6	0.45	3.3	19.7			
						############	85				2419.6	7.36	1732.9					7.76					254		22.5			80.7			
						############	86.1				2419.6	7.42	307.6					7.55					337		22.7			35.1			
						############	84.6				2419.6	6.97	65.7					7.69					408		25.1			17.8			
						############	78	180	61	11	2419.6	6.77	111.2	220	16	0.2	0.67	7.64	0.08	23	330	290	439	22	22.4	0.47	2.3	20.3			
						############	55.3					4.67						7.5					476		23.9			11.6			
						############	68.4	140	45	8.8	2419.6	5.74	172.3	150	10	0.2	0.16	7.46	0.064	10	330	190	329.1	10	23.9	0.63	3.3	11			
						############	76.1	150	51	16	2419.6	6.81	160.7	180	12	0.2	0.78	7.35	0.074	6.8	270	200	393.4	24	20.8	0.49	3.9	9.21			
	INW0775_01A																														
	INW0775_01B																														
	INW0775_02																														
	INW0775_04																														
	INW0775_05	Vernon Fork Muscatatuck River	WEM070-0020	T09	US Hwy 31	############	73.3	160	57	14		8.46		190	13	0.2	0.88	7.62	0.097	4.3	320	270	400	23	9.1	0.66	3.8	11.3	N/A		
						############	87.2	170	60	17		11.19		210	14	0.2	1.4	7.81	0.067	3.5	260	170	415	26	4.7	0.57	2.6	7.52			
						############	90.7	150	61	14		12.52		210	14	0.17	1.9	7.74	0.093	5.5	260	230	388	22	2	0.49	3.1	9.29			
						############	87.4	130	51	12		10.68		170	11	0.13	1.4	7.6	0.11	16	250	150	355	18	6.7	0.55	2.4	21.9			
						############	83.6	94	34	12	2419.6	8.52	727	120	7.7	0.19	0.56	7.75	0.23	41	160	150	257	12	14.5	0.9	6.7	54.2			
						############	85.1	96	35	15	2419.6	8.83	547.5	120	7.5	0.15	1.3	7.68	0.36	44	280	240	275	11	13.8	1	6.6	70.4			
						############	74.1	92	38	16	2419.6	6.49	2419.6	130	8.6	0.23	3	7.32	0.21	100	390	170	285	15	21.9	0.87	6.6	111			
						############	54.5	150	52	15	2419.6	4.42	31.8	170	11	0.2	0.92	7.45	0.13	21	300	290	353	14	26	0.49	3.6	18.7			
						############	73.8				2419.6	6.31	435.2					7.43					266		23.1			50.8			
						############	70.8				2419.6	6	218.7					7.26					339		23.7			30.7			
						############	59				2419.6	4.79	32.3					7.3					405		25.9						
						############	52.8	180	60	11	2419.6	4.51	42.2	210	14	0.2	0.45	7.4	0.072	26	380	260	426.7	23	22.9	0.49	3	24			
						############	51	130	43	13	2419.6	4.35	172.5	150	11	0.11	0.17	7.13	0.087	14	370	300	337.4	20	23.3	0.66	4.1	14.4			
						############	61	150	50	16	2419.6	5.58	218.7	170	12	0.2	0.38	7.48	0.2	15	280	190	383.7	25	19.7	0.53	4.5	16.2			
	INW0775_06																														
	INW0775_T1001																												Hg (FT)	Hg (FT)	
	INW0775_T1002																														
	INW0775_T1003	Tea Creek	WEM-07-0021	T06	County Road 650 S	############	102.9	82	29	13	2419.6	10.66	2419.6	100	7.4	0.62	0.7	7.91	0.9	15	160	170	238	9.9	13.8	1.6	11	48.2	E. coli, IBC, DO	E. coli, IBC	E. coli: Confined animal feeding operations (NPS) + sewage discharges in unsewered areas + wildlife other than waterfowl IBC: Source unknown
						############	130.8	140	41	15	2419.6	13.47	579.4	140	10	0.17	0.33	8.53	0.094	2.5	280	250	336	13	13.9	0.53	5.5	9.88			
						############	93.1	150	57	26	2419.6	8.26	1046.2	200	13	0.18	1	7.89	0.088	3	340	220	419	18	21.1	0.53	5.8	4.88			
						############	120.5	170	57	12	2419.6	10	1299.7	190	12	0.2	2	7.97	0.045	2.6	250	230	381	12	24.8	0.33	3.5	3.54			
						############	96.9				2419.6	8.44	1119.9					7.67					276		22.2			11.8			
						############	104.8				2419.6	9.14	770.1					7.85					292		22.1			7.96			
						############	94.1				2419.6	8.12	461.1					7.82					368		22.6			2.58			
						############	95.4	180	58	8.2	2419.6	8.7	107.1	190	12	0.2	0.12	7.97	0.05	2	280	240	390.7	9	19.9	0.64	2.6	2.78			
						############	132.1					11.36						7.99					396.7		22.5			2.22			
						############	52.3	220	70	8.3	2419.6	4.59	1203.3	230	14	0.2	0.044	7.65	0.057	4	390	280	436	11	21.8	0.67	3.8	2.76			
						############	59.7	230	70	10	2419.6	5.5	90.8	230	14	0.2	0.1	7.29	0.08	5	310	210	471.5	8.8	19.4	0.49	6.8	2.39			
		Tea Creek	WEM070-0029	T07	County Road 650 W	############	93.2	86	31	12	2419.6	9.88	1986.3	110	7.2	0.48	0.65	7.73	0.67	19	150	180	238	10	12.7	1.6	18	47.1	E. coli, IBC, DO		
						############	103.4	160	49	13	2419.6	10.76	579.4	170	11	0.12	0.49	7.88	0.078	2	300	280	379	15	13.5	0.49	4.2	10.1			
						############	74.7	180	65	20	2419.6	6.6	307.6	220	14	0.18	1.5	7.7	0.087	4.8	340	230	442	18	21.4	0.45	4.4	7.8			
						############	53.4	190	64	9.4	2419.6	4.48	613.1	210	13	0.2	0.79	7.63	0.088	6.8	280	280	418	13	24.2	0.37	3.5	9.28			
						############	89.1				2419.6	7.8	920.8					7.64					319		21.8			14.8			
						############	85.2				2419.6	7.6	648.8					7.66					376		20.9			9.84			
						############	70.4				2419.6	5.95	235.9					7.66					447		23.7			8.31			
						############	75.3	210	69	7.7	2419.6	6.68	770.1	230	14	0.2	0.25	7.73	0.05	5.2	320	260	454.4	13	21.1	0.33	2.2	9.14			
						############	54					4.64						7.47					467.7		23.6			4.58			
						############	62.6	210	62	8.9	2419.6	5.36	45.5	210	14	0.2	0.1	7.76	0.034	3.6	380	240	429.7	6.6	22.9	0.57	3.3	3.64			
						############	28.5	210	59	9.5	2419.6	2.6	224.7	200	13	0.2	0.1	7.23	0.081	3.4	280	190	420.8	6.6	19.9	2.2	5.6	4.75			
	INW0775_T1004																														
	INW0775_T1009																														
Grassy Creek	INW0776_03	Vernon Fork Muscatatuck River	WEM090-0015	T10	County Road E 50 N	############	75	160	55	16		8.66		190	13	0.13	0.5	7.86	0.098	6	300	260	394	19	9	0.59	4.6	13	N/A		
						############	85.7	160	59	17		11.05		210	14	0.14	1.2	7.89	0.071	3.5	270	170	413	25	4.5	0.57	2.9	7.81			
						############	89.3	140	51	16		12.43		180	12	0.17	1.8	8.06	0.11	8.5	240	270	377	21	1.8	0.43	3.6	15.8			
						############	89.1	130	47	14		10.73		160	11	0.12	1.3	8.05	0.11	13	250	52	354	18	7.2	0.58	2.7	18.5			
						############	82.7	96	34	15	2419.6	8.43	488.4	120	8.2	0.17	0.52	7.73	0.21	30	140	160	267	12	14.5	0.48	7.1	44.5			
						############	82.9	93	32	15	2419.6	8.55	547.5	110	7.2	0.18	1.1	7.85	0.3	37	270	230	271	13	13.9	1	7.2	60.1			
						############	70.8	100	39	17	2419.6	6.16	2419.6	140	9.3	0.32	2.7	7.43	0.23	93	390	170	300	12	22.3	1.2	6.9	91.4			
						############	60.5	150	51	15	2419.6	4.88	48.8	170	11	0.2	0.86	7.63	0.12	21	270	210	361	14	26.5	0.88	4.1	17.4			
						############	67.6				2419.6	5.73	325.5					7.37					259		23.7			36.8			
						############	61.8				2419.6	5.22	129.6					7.27					267		23.8			18.1			
						############	61.6				2419.6	5.03	42.8					7.39					383		25.8			19.5			
						############	51.3	180	57	13	2419.6	4.42	95.9	200	14	0.2	0.42	7.54	0.044	18	280	350	417.8	16	22.5	0.38	3.4	17.7			
						############	55.8					4.35						7.34					430.8		28.2			24.7			
						############	49	130	44	17	2419.6	4.19	290.9	150	11	0.2	0.24	7.19	0.073	16	370	300	347.9	21	23.6	0.69	4.4	16.3			
						############	58.9	160	49	17	2419.6	5.43	166.4	170	12	0.2	0.25	7.66	0.13	15	270	180	384	19	19.4	0.61	5.5	15.5			
	INW0776_04																														
	INW0776_05	Vernon Fork Muscatatuck River	WEM090-0008	T03	County Road 400 S	############	54.7	100	35	15	2419.6	5.65	410.6	120	8.9	0.22	0.6	7.34	0.19	12	150	180	282	12	13.9	1.2	7.7	33.3	DO	DO	Not assessing new data based on BPJ. Site is now an oxbow that no longer functions as a stream.
						############	48.5	100	38	17	2419.6	5.06	201.4	130	8.7	0.3	1.2	7.33	0.22	9.5	300	290	294	13	13.6	1	6.5	28.7			
						############	52.9	35	17	10	2419.6	4.61	2419.6	60	4.3	2.6	7.9	6.86	1.1	42	230	170	198	7.3	22	6.3	17	80.8			
						############	4	160	44	28	2419.6	0.35	387.3	160	12	1.2	0.1	6.75	0.71	10	360	270	430	6.3	23.7	2.3	23	17.4			
						############	57.8				2419.6	4.9	209.8					7.29					244		23.6			21.4			
						############	48.8				2419.6	3.89	167					7					169		26.9			14.5			
						############	0.16				2419.6	2	42.4					6.74					393		24.5			14.7			
						############	5	160	43	27	2419.6	0.41	365.4	160	12	0.52	0.1	6.78	0.46	12	300	380	430.4	6	20.5	1.1	9.9	31.3			
						############	4.5	180	41	36	2419.6	0.42	365.4	160	14	0.2	0.1	6.43	0.22	9	380	190	532	7.2	18.9	0.92	6.5	22.8			
						############	5.6	180	48	34	2419.6	0.53	96	180	14	0.49	0.1	6.81	0.46	10	320	240	474.5	9.3	18.1	0.98	8.1	26.8			
	INW0776_06																														
	INW0776_07																														
	INW0776_08																														
	INW0776_09																														
	INW0776_10																														
	INW0776_T1005																														
	INW0776_T1006																														
	INW0776_T1007																														
	INW0776_T1008																														
	INW0776_T1009	John McDonald Ditch	WEM-07-0015	T05	County Road 125 S	############	56.2	99	31	17	2419.6	5.8	290.9	110	7.8	0.13	0.052	7.32	0.2	9	180	190	267	6.2	13.4	1.1	15	37	N/A	E. coli, IBC, DO	E. coli: confined animal feeding operations (NPS) + sewage discharges in unsewered areas + wildlife other than waterfowl IBC: Source unknown DO: Natural sources (low flow)
						############	62.7	140	38	20	2419.6	6.6	172.3	140	10	0.23	0.21	7.5	0.21	5.5	290	310	356	10	13.1	0.92	8.9	15.8			
						############	59.9	39	18	14	2419.6	5.36	2419.6	61	4.3	0.44	2.3	7.03	0.25	54	230	130	156	7.5	20.8	1.5	11	92.1			
						############	31.9	240	62	19	2419.6	2.76	60.9	220	16	0.2	0.45	7.52	0.16	2.8	360	270	454	14	23.3	0.35	5.5	6.37			
						############	55.4				2419.6	4.87	145.5					7.17					219		21.8			24			
						############	50.8				2419.6	4.46	579.4					7.1					236		21.8			19.7			
						############	31.5				2419.6	2.71	261.3					7.33					453		22.7			7.71			
						############	37.9	220	64	18	2419.6	3.53	387.3	230	16	0.2	0.38	7.53	0.1	5	330	230	495.4	18	19	0.31	3.2	6.87			
						############	75.5					6.17						7.6					520		25.5			4.4			

					############	39.1	230	67	16	2419.6	3.48	275.5	240	18	0.2	0.16	7.46	0.17	4.6	390	340	506	15	21.6	0.59	3.8	6.97			
					############	16	240	67	22	2419.6	1.56	387.3	240	18	0.2	0.1	7.51	0.25	4	360	270	521	12	17.9	0.91	6.6	4.93			
INW0776_T1010																														
INW0776_T1011																														
INW0776_T1012																														
INW0776_T1013																														
INW0776_T1014																														
INW0776_T1015																														
INW0776_T1016																														
INW0776_T1017																														
INW0776_T1018																														
INW0776_T1019	Grassy Creek	WEM-07-0010	T02	County Road 600 S	############	69.3	160	49	39	2419.6	7.06	186	180	13	0.23	0.32	7.61	0.7	12	250	270	495	13	14.6	1.2	11	25.5	N/A	E. coli, IBC	E. coli: Confined animal feeding operations (NPS)
					############	44.1	160	52	49	2419.6	4.6	58.1	180	13	0.29	0.92	7.39	2.7	12	450	440	530	19	13.2	1.1	9.3	23.5			IBC: Source unknown
					############	55	43	17	13	2419.6	4.85	2419.6	60	3.9	0.28	0.74	7.01	0.67	53	180	120	155	5.8	21.6	1.5	12	71.5			
					############	70.2	300	96	54	2419.6	6.27	517.2	350	26	0.2	1.7	7.86	2	5	710	590	832	65	20.9	0.43	2.6	6.46			
					############	58.2				2419.6	5.02	290.9					7.27					289		22.7			19.8			
					############	49.4				2419.6	4.17	238.2					7.16					224		23.9			19.3			
					############	54.4				2419.6	4.81	117.8					7.59					776		21.3			6.61			
					############	68.7	310	99	56	2419.6	6.52	206.4	360	27	0.2	1.9	7.86	2.2	7.4	740	750	886	63	18	0.26	2.1	9.1			
					############	70.4					6.25						7.85					901		21			22.5			
					############	75.3	320	99	82	2419.6	6.84	579.4	360	28	0.2	1.8	7.71	2.9	2.4	810	500	907	59	19.5	0.55	2.6	4.22			
					############	51.7	300	91	97	2419.6	4.89	58.6	330	25	0.2	1	7.69	2.8	2.4	620	510	881	76	18.2	0.54	3.9	4.22			
INW0776_T1020																														
INW0776_T1021																														
INW0776_T1022	Rider Ditch	WEM090-0003	T01	County Road 600 S	############	77.2	160	54	15		8.66		190	13	0.11	0.53	7.94	0.12	4.3	300	250	391	19	9.7	0.44	4.6	11	N/A		
					############	87.5	160	56	17		11.21		190	13	0.13	1.2	7.92	0.076	3.5	270	180	404	23	4.8	0.65	3	8.09			
					############	92.2	140	50	15		12.78		170	12	0.15	1.7	8.07	0.12	11	210	260	365	20	2	0.64	3.8	20			
					############	88.6	120	46	14		10.63		160	10	0.14	1.2	7.94	0.083	19	250	86	340	18	7.7	0.55	3	24.8			
					############	81.8	99	34	11	2419.6	8.27	416	120	8.3	0.2	0.51	7.67	0.19	37	180	170	269	11	14.9	1.1	7.6	50			
					############	82.1	90	34	14	2419.6	8.38	410.6	120	7.7	0.21	1.2	7.67	0.34	44	350	300	263	11	14.4	1	7.2	67.8			
					############	67.7	75	32	10	2419.6	5.88	2419.6	110	7.6	0.38	3.1	7.28	0.37	140	320	180	239	9.5	22.3	1.5	7	153			
					############	67.8	150	51	15	2419.6	5.47	48.8	170	11	0.2	0.76	7.66	0.12	33	300	240	366	14	26.3	0.52	4	25.2			
					############	69.3				2419.6	5.85	410.6					7.41					252		24			44			
					############	59.7				2419.6	4.96	131.4					7.24					230		24.7			21.9			
					############	60				2419.6	4.89	67					7.46					378		25.9			31.6			
					############	59.2	170	57	13	2419.6	5.15	81.3	200	14	0.2	0.38	7.56	0.1	36	340	330	411.6	16	22.4	0.44	3.6	28.8			
					############	58.4					4.76						7.56					435		25.9			21.7			
					############	65.3	130	44	17	2419.6	5.55	214.2	150	11	0.14	0.49	7.43	0.11	24	340	140	348.3	19	23.2	0.56	4.1	21.2			
					############	73.9	150	47	22	2419.6	6.75	201.4	170	11	0.2	0.27	7.62	0.12	17	300	200	381.1	25	19.8	0.54	5.8	16.6			
INW0776_T1023																														
INW0776_T1024																														
INW0776_T1025																														

APPENDIX B. FISH AND MACROINVERTEBRATE COMMUNITY ASSESSMENT REPORTS

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck		**14 digit HUC:** 05120207090010		**LSite:** WEM090-0003	
Site: Vernon Fork Muscatatuck River	**Location:** CR 600 South				**County:** Jackson
Latitude: 38.793535	**Longitude:** -85.884075	**IASNat Region:** 11A		**Topo:** H-61	**Segment:** 83
Ecoregion: Eastern Corn Belt Plains		**Drainage Area (sq.miles):** 391.167			**Gradient (ft/mile):** 1.343

Sample Information

SampleNumber: AB47653 **EventID:** 21T001 **Sample MediumCollected:** Fish Community + Water + Macro

SampleDate: 08/24/2021 **SurveyCrewChief:** KAG **SampleTime:** 09:45:00 AM **HydroLabNumber:** P5

WaterFlowType: Pool **WaterAppearance:** Murky **SkyConditions:** 1 - Clear **AirTemperature:** 5 - 76-85

WindDirection: 27 - West (270 degrees) **WindStrength:** 0 - Calm

DissolvedO2 (mg/l): 4.76 **pH:** 7.56 **WaterTemp(°C):** 25.9 **SpecificConductivity (µS/cm):** 435 **Turbidity (NTU):** 21.7

SpecialNotes:

ElectrofishingEquipment: Canoe **Voltage:** 260 **Avg.StreamWidth(m):** 15 **DistanceFished (m):** 225

SecondsFished: 2955 **WaterDepthAvg (m):** 1 **WaterDepthMax (m):** 2.25 **TimeAtSite:** 03:00

BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**

SpecialComments: Canoe w/MLES and boom

Habitat Information

TotalScore (max100): 55 **SubstrateScore (max20):** 11 **InstreamCover Score (max20):** 12 **ChannelMorphologyScore (max20):** 9

RiparianZoneBankErosion Score(max10): 4 **Pool/GlideQualityScore(max12):** 9 **Riffle/RunQualityScore(max8):** 4

GradientScore (max10): 6 **%Pool:** 45 **%Riffle:** 20 **%Run:** 35 **%Glide:** 0 **CanopyCover PctOpen:** 10%-<30%

SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	26	5
DarterSpeciesCount:	4	5
SunfishSpeciesCount:	6	5
SuckerSpeciesCount:	3	3
SensitiveSpeciesCount:	8	3

	Actual Observation	Metric Score
%TolerantIndividuals:	10.92	5
%OmnivoreIndividuals:	5.04	5
%InsectivoreIndividuals:	78.99	5
%CarnivoreIndividuals:	15.97	5
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 on calibration.

Total IBI Score (min 0, max 60)	50

SampleNumber: AB47653 **EventID:** 21T001 **LSite:** WEM090-0003 **County:** Jackson

StreamName: 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207090020 **LSite:** WEM-07-0010
Site: Grassy Creek **Location:** CR 600 **County:** Jackson
Latitude: 38.794048 **Longitude:** -85.869314 **IASNat Region:** 11A **Topo:** H-62 **Segment:** 76
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 12.633 **Gradient (ft/mile):** 1.972

Sample Information

SampleNumber: AB47654 **EventID:** 21T002 **Sample MediumCollected:** Fish Community + Water + Macro
SampleDate: 08/24/2021 **SurveyCrewChief:** KAG **SampleTime:** 12:49:00 PM **HydroLabNumber:** P5
WaterFlowType: Pool **WaterAppearance:** Green **SkyConditions:** 2 - Scattered **AirTemperature:** 6 - > 86
WindDirection: 27 - West (270 degrees) **WindStrength:** 0 - Calm
DissolvedO2 (mg/l): 6.25 **pH:** 7.85 **WaterTemp(°C):** 21 **SpecificConductivity (µS/cm):** 901 **Turbidity (NTU):** 22.5
SpecialNotes:

ElectrofishingEquipment: Canoe **Voltage:** 190 **Avg.StreamWidth(m):** 7 **DistanceFished (m):** 105
SecondsFished: 1623 **WaterDepthAvg (m):** .7 **WaterDepthMax (m):** 1 **TimeAtSite:** 01:45
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: Canoe w/MLES and boom

Habitat Information

TotalScore (max100): 51 **SubstrateScore (max20):** 12 **InstreamCover Score (max20):** 11 **ChannelMorphologyScore (max20):** 8
RiparianZoneBankErosion Score(max10): 8 **Pool/GlideQualityScore(max12):** 8 **Riffle/RunQualityScore(max8):** 0
GradientScore (max10): 4 **%Pool:** 30 **%Riffle:** 0 **%Run:** 0 **%Glide:** 70 **CanopyCover PctOpen:** 55%-<85%
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	13	5
Darter/Madtom/SculpinSpeciesCount:	0	1
%HeadwaterIndividuals:	0	1
MinnowSpeciesCount:	2	1
SensitiveSpeciesCount:	1	1

	Actual Observation	Metric Score
%TolerantIndividuals:	15.56	5
%OmnivoreIndividuals:	12.22	5
%InsectivoreIndividuals:	52.22	5
%PioneerIndividuals:	1.11	5
Total # of Individuals (CPUE):	90	1
%SimpleLithophilicInd.:	27.78	3
%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 Score (min 0, max 60)	38

SampleNumber: AB47654 **EventID:** 21T002 **LSite:** WEM-07-0010 **County:** Jackson

StreamName: Grassy Creek **LocationDescription:** CR 600

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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207090010 **LSite:** WEM-07-0015
Site: John McDonald Ditch **Location:** CR 125 South **County:** Jackson
Latitude: 38.863035 **Longitude:** -85.845590 **IASNat Region:** 11A **Topo:** H-62 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 4.799 **Gradient (ft/mile):** 2.349

Sample Information

SampleNumber: AB47657 **EventID:** 21T005 **Sample MediumCollected:** Fish Community + Water + Macro
SampleDate: 08/24/2021 **SurveyCrewChief:** KAG **SampleTime:** 02:55:00 PM **HydroLabNumber:** P5
WaterFlowType: Stagnant **WaterAppearance:** Sheen **SkyConditions:** 2 - Scattered **AirTemperature:** 6 - > 86
WindDirection: 27 - West (270 degrees) **WindStrength:** 0 - Calm
DissolvedO2 (mg/l): 6.17 **pH:** 7.6 **WaterTemp(°C):** 25.5 **SpecificConductivity (µS/cm):** 520 **Turbidity (NTU):** 4.4
SpecialNotes:

ElectrofishingEquipment: Backpack **Voltage:** 200 **Avg.StreamWidth(m):** 4 **DistanceFished (m):** 60
SecondsFished: 815 **WaterDepthAvg (m):** .3 **WaterDepthMax (m):** .5 **TimeAtSite:** 01:10
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: MLES backpack

Habitat Information

TotalScore (max100): 29 **SubstrateScore (max20):** 0 **InstreamCover Score (max20):** 8 **ChannelMorphologyScore (max20):** 4
RiparianZoneBankErosion Score(max10): 9 **Pool/GlideQualityScore(max12):** 4 **Riffle/RunQualityScore(max8):** 0
GradientScore (max10): 4 **%Pool:** 0 **%Riffle:** 0 **%Run:** 0 **%Glide:** 100 **CanopyCover PctOpen:** 10%-<30%
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information **Calibration Used:** Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	7	3
Darter/Madtom/SculpinSpeciesCount:	0	1
%HeadwaterIndividuals:	0	1
MinnowSpeciesCount:	2	1
SensitiveSpeciesCount:	0	1

	Actual Observation	Metric Score
%TolerantIndividuals:	45.76	3
%OmnivoreIndividuals:	6.78	5
%InsectivoreIndividuals:	69.49	5
%PioneerIndividuals:	15.25	5
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 on calibration.

Total IBI Score (min 0, max 60)	28

SampleNumber: AB47657 **EventID:** 21T005 **LSite:** WEM-07-0015 **County:** Jackson

StreamName: John McDonald Ditch **LocationDescription:** 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				

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207070040 **LSite:** WEM-07-0021
Site: Tea Creek **Location:** CR 650 South **County:** Jennings
Latitude: 38.888319 **Longitude:** -85.689068 **IASNat Region:** 11B **Topo:** H-40 **Segment:** 76
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 4.617 **Gradient (ft/mile):** 20.301

Sample Information

SampleNumber: AB47658 **EventID:** 21T006 **Sample MediumCollected:** Fish Community + 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):** 396.7 **Turbidity (NTU):** 2.22
SpecialNotes: Becoming isolated pools

ElectrofishingEquipment: Backpack **Voltage:** 250 **Avg.StreamWidth(m):** 5 **DistanceFished (m):** 75
SecondsFished: 593 **WaterDepthAvg (m):** .15 **WaterDepthMax (m):** .35 **TimeAtSite:** 01:00
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: Smithroot backpack

Habitat Information

TotalScore (max100): 62 **SubstrateScore (max20):** 18 **InstreamCover Score (max20):** 8 **ChannelMorphologyScore (max20):** 15
RiparianZoneBankErosion Score(max10): 7 **Pool/GlideQualityScore(max12):** 4 **Riffle/RunQualityScore(max8):** 0
GradientScore (max10): 10 **%Pool:** 10 **%Riffle:** 0 **%Run:** 90 **%Glide:** 0 **CanopyCover PctOpen:** <10%-Closed
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	9	3
Darter/Madtom/SculpinSpeciesCount:	3	5
%HeadwaterIndividuals:	4.87	1
MinnowSpeciesCount:	4	3
SensitiveSpeciesCount:	0	1

	Actual Observation	Metric Score
%TolerantIndividuals:	50.44	1
%OmnivoreIndividuals:	15.04	5
%InsectivoreIndividuals:	20.8	1
%PioneerIndividuals:	93.81	1
Total # of Individuals (CPUE):	226	5
%SimpleLithophilicInd.:	6.64	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.

Total IBI Score (min 0, max 60)	32

SampleNumber: AB47658 **EventID:** 21T006 **LSite:** WEM-07-0021 **County:** Jennings

StreamName: Tea Creek **LocationDescription:** CR 650 South

Common Name	Individual Fish Count	Deformities	Eroded Fins	Lesions	Tumors	Multiple Anomalies
Bluntnose 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207070040 **LSite:** WEM070-0029
Site: Tea Creek **Location:** CR 650 West **County:** Jennings
Latitude: 38.886045 **Longitude:** -85.731305 **IASNat Region:** 11B **Topo:** H-40 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 10.632 **Gradient (ft/mile):** 2.676

Sample Information

SampleNumber: AB47659 **EventID:** 21T007 **Sample MediumCollected:** Fish Community + 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

ElectrofishingEquipment: Backpack **Voltage:** 250 **Avg.StreamWidth(m):** 4 **DistanceFished (m):** 60
SecondsFished: 635 **WaterDepthAvg (m):** .3 **WaterDepthMax (m):** 1.5 **TimeAtSite:** 01:45
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: SR Backpack

Habitat Information

TotalScore (max100): 49 **SubstrateScore (max20):** 13 **InstreamCover Score (max20):** 11 **ChannelMorphologyScore (max20):** 9
RiparianZoneBankErosion Score(max10): 4 **Pool/GlideQualityScore(max12):** 8 **Riffle/RunQualityScore(max8):** 0
GradientScore (max10): 4 **%Pool:** 70 **%Riffle:** 0 **%Run:** 30 **%Glide:** 0 **CanopyCover PctOpen:** >85%-Open
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

Metric	Actual Observation	Metric Score
SpeciesCount:	19	5
Darter/Madtom/SculpinSpeciesCount:	2	3
%HeadwaterIndividuals:	2.84	1
MinnowSpeciesCount:	5	3
SensitiveSpeciesCount:	3	3
%TolerantIndividuals:	29.79	3
%OmnivoreIndividuals:	13.48	5
%InsectivoreIndividuals:	72.34	5
%PioneerIndividuals:	65.25	1
Total # of Individuals (CPUE):	141	3
%SimpleLithophilicInd.:	9.22	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.

Total IBI Score (min 0, max 60)	38

SampleNumber: AB47659 **EventID:** 21T007 **LSite:** WEM070-0029 **County:** Jennings

StreamName: Tea Creek **LocationDescription:** 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207070030 **LSite:** WEM070-0039

Site: Vernon Fork Muscatatuck River **Location:** CR 500 South **County:** Jennings

Latitude: 38.910992 **Longitude:** -85.730084 **IASNat Region:** 11A **Topo:** H-40 **Segment:** 83

Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 234.158 **Gradient (ft/mile):** 1.678

Sample Information

SampleNumber: AB47660 **EventID:** 21T008 **Sample MediumCollected:** Fish Community + Water

SampleDate: 08/17/2021 **SurveyCrewChief:** CWY **SampleTime:** 08:35:00 AM **HydroLabNumber:** P5

WaterFlowType: Run **WaterAppearance:** Clear **SkyConditions:** 1 - Clear **AirTemperature:** 4 - 61-75

WindDirection: 27 - West (270 degrees) **WindStrength:** 0 - Calm

DissolvedO2 (mg/l): 4.67 **pH:** 7.5 **WaterTemp(°C):** 23.9 **SpecificConductivity (µS/cm):** 476 **Turbidity (NTU):** 11.6

SpecialNotes:

ElectrofishingEquipment: Canoe **Voltage:** 230 **Avg.StreamWidth(m):** 20 **DistanceFished (m):** 300

SecondsFished: 2680 **WaterDepthAvg (m):** .6 **WaterDepthMax (m):** 1.7 **TimeAtSite:** 03:00

BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**

SpecialComments: also 21R164; canoe w/MLES

Habitat Information

TotalScore (max100): 62 **SubstrateScore (max20):** 13 **InstreamCover Score (max20):** 17 **ChannelMorphologyScore (max20):** 11

RiparianZoneBankErosion Score(max10): 6 **Pool/GlideQualityScore(max12):** 9 **Riffle/RunQualityScore(max8):** 0

GradientScore (max10): 6 **%Pool:** 40 **%Riffle:** 0 **%Run:** 60 **%Glide:** 0 **CanopyCover PctOpen:** <10%-Closed

SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	**29**	**5**
DarterSpeciesCount:	**7**	**5**
SunfishSpeciesCount:	**4**	**5**
SuckerSpeciesCount:	**5**	**5**
SensitiveSpeciesCount:	**15**	**5**

	Actual Observation	Metric Score
%TolerantIndividuals:	**29.59**	**3**
%OmnivoreIndividuals:	**17.35**	**5**
%InsectivoreIndividuals:	**78.57**	**5**
%CarnivoreIndividuals:	**4.08**	**1**
Total # of Individuals (CPUE):	**294**	**3**
%SimpleLithophilicInd.:	**19.39**	**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.

Total IBI Score (min 0, max 60)	48

SampleNumber: AB47660 **EventID:** 21T008 **LSite:** WEM070-0039 **County:** Jennings

StreamName: 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					
Yellow Bullhead	6					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207070070 **LSite:** WEM070-0020
Site: Vernon Fork Muscatatuck River **Location:** US 31 **County:** Jackson
Latitude: 38.906101 **Longitude:** -85.821061 **IASNat Region:** 11A **Topo:** H-39 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 292.076 **Gradient (ft/mile):** 1.458

Sample Information

SampleNumber: AB47661 **EventID:** 21T009 **Sample MediumCollected:** Fish Community + Water + Macro
SampleDate: 08/18/2021 **SurveyCrewChief:** KAG **SampleTime:** 09:00:00 AM **HydroLabNumber:** P7
WaterFlowType: Run **WaterAppearance:** Clear **SkyConditions:** 2 - Scattered **AirTemperature:** 4 - 61-75
WindDirection: 18 - South (180 degrees) **WindStrength:** 0 - Calm
DissolvedO2 (mg/l): 4 **pH:** 7.33 **WaterTemp(°C):** 24.3 **SpecificConductivity (µS/cm):** 435 **Turbidity (NTU):** 15.1
SpecialNotes: Riffle is riprap DS of bridge, live mussels seen at site, crayfish appears to be F. rusticus based on coloration seen at site; readings taken DS of bridge and riffle in run.

ElectrofishingEquipment: Canoe **Voltage:** 360 **Avg.StreamWidth(m):** 11 **DistanceFished (m):** 165
SecondsFished: 3057 **WaterDepthAvg (m):** 1 **WaterDepthMax (m):** 2 **TimeAtSite:** 04:00
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: Canoe w/MLES; DS of bridge

Habitat Information

TotalScore (max100): 70 **SubstrateScore (max20):** 7 **InstreamCover Score (max20):** 15 **ChannelMorphologyScore (max20):** 16
RiparianZoneBankErosion Score(max10): 7 **Pool/GlideQualityScore(max12):** 12 **Riffle/RunQualityScore(max8):** 7
GradientScore (max10): 6 **%Pool:** 40 **%Riffle:** 15 **%Run:** 45 **%Glide:** 0 **CanopyCover PctOpen:** 30%-<55%
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	38	5
DarterSpeciesCount:	9	5
SunfishSpeciesCount:	4	5
SuckerSpeciesCount:	3	3
SensitiveSpeciesCount:	16	5

	Actual Observation	Metric Score
%TolerantIndividuals:	21.08	5
%OmnivoreIndividuals:	7.97	5
%InsectivoreIndividuals:	85.6	5
%CarnivoreIndividuals:	6.17	3
Total # of Individuals (CPUE):	389	3
%SimpleLithophilicInd.:	38.3	3
%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 Score (min 0, max 60)	**52**

SampleNumber: AB47661 **EventID:** 21T009 **LSite:** WEM070-0020 **County:** Jackson

StreamName: 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					
Spotfin Shiner	56					
Spotted Bass	1					
Steelcolor Shiner	26					
Striped Shiner	1					
Suckermouth Minnow	15					
Warmouth	1					
Western Mosquitofish	2					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207090010 **LSite:** WEM090-0015
Site: Vernon Fork Muscatatuck River **Location:** CR 50 North **County:** Jackson
Latitude: 38.888570 **Longitude:** -85.851687 **IASNat Region:** 11A **Topo:** H-39 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 364.501 **Gradient (ft/mile):** 1.458

Sample Information

SampleNumber: AB47662 **EventID:** 21T010 **Sample MediumCollected:** Fish Community + Water
SampleDate: 08/30/2021 **SurveyCrewChief:** CWY **SampleTime:** 10:49:00 AM **HydroLabNumber:** P5
WaterFlowType: Run **WaterAppearance:** Murky **SkyConditions:** 4 - Cloudy **AirTemperature:** 5 - 76-85
WindDirection: 27 - West (270 degrees) **WindStrength:** 0 - Calm
DissolvedO2 (mg/l): 3.42 **pH:** 7.39 **WaterTemp(°C):** 26.5 **SpecificConductivity (µS/cm):** 437.5 **Turbidity (NTU):** 14.7
SpecialNotes:

ElectrofishingEquipment: Canoe **Voltage:** 272 **Avg.StreamWidth(m):** 14 **DistanceFished (m):** 210
SecondsFished: 2880 **WaterDepthAvg (m):** .75 **WaterDepthMax (m):** 1.5 **TimeAtSite:** 02:30
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: Canoe w/Boom and Infinity Box

Habitat Information

TotalScore (max100): 57 **SubstrateScore (max20):** 13 **InstreamCover Score (max20):** 14 **ChannelMorphologyScore (max20):** 11
RiparianZoneBankErosion Score(max10): 4 **Pool/GlideQualityScore(max12):** 9 **Riffle/RunQualityScore(max8):** 0
GradientScore (max10): 6 **%Pool:** 40 **%Riffle:** 0 **%Run:** 60 **%Glide:** 0 **CanopyCover PctOpen:** 55%-<85%
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	18	3
DarterSpeciesCount:	0	1
SunfishSpeciesCount:	4	5
SuckerSpeciesCount:	4	5
SensitiveSpeciesCount:	5	3

	Actual Observation	Metric Score
%TolerantIndividuals:	14.29	5
%OmnivoreIndividuals:	3.9	5
%InsectivoreIndividuals:	85.71	5
%CarnivoreIndividuals:	10.39	5
Total # of Individuals (CPUE):	77	1
%SimpleLithophilicInd.:	36.36	3
%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 Score (min 0, max 60)	46

SampleNumber: AB47662 **EventID:** 21T010 **LSite:** WEM090-0015 **County:** Jackson

StreamName: 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207080020 **LSite:** WEM080-0014
Site: Mutton Creek Ditch **Location:** CR 400 North **County:** Jackson
Latitude: 38.940733 **Longitude:** -85.815623 **IASNat Region:** 11B **Topo:** H-39 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 29.807 **Gradient (ft/mile):** 2.112

Sample Information

SampleNumber: AB47664 **EventID:** 21T012 **Sample MediumCollected:** Fish Community + Water + Macro
SampleDate: 08/17/2021 **SurveyCrewChief:** KAG **SampleTime:** 11:39:00 AM **HydroLabNumber:** P7
WaterFlowType: Glide **WaterAppearance:** Sheen **SkyConditions:** 4 - Cloudy **AirTemperature:** 5 - 76-85
WindDirection: 9 - East (90 degrees) **WindStrength:** 0 - Calm
DissolvedO2 (mg/l): 1.4 **pH:** 7.21 **WaterTemp(°C):** 23.4 **SpecificConductivity (µS/cm):** 405.5 **Turbidity (NTU):** 8.52
SpecialNotes:

ElectrofishingEquipment: Canoe **Voltage:** 250 **Avg.StreamWidth(m):** 10 **DistanceFished (m):** 150
SecondsFished: 2622 **WaterDepthAvg (m):** 1 **WaterDepthMax (m):** 2 **TimeAtSite:** 03:00
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: several beaver dams; sheen on surface of water; canoe w/MLES

Habitat Information

TotalScore (max100): 47 **SubstrateScore (max20):** 7 **InstreamCover Score (max20):** 14 **ChannelMorphologyScore (max20):** 4
RiparianZoneBankErosion Score(max10): 10 **Pool/GlideQualityScore(max12):** 8 **Riffle/RunQualityScore(max8):** 0
GradientScore (max10): 4 **%Pool:** 10 **%Riffle:** 0 **%Run:** 0 **%Glide:** 90 **CanopyCover PctOpen:** 55%-<85%
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	13	3
DarterSpeciesCount:	0	1
SunfishSpeciesCount:	5	5
SuckerSpeciesCount:	2	3
SensitiveSpeciesCount:	1	1

	Actual Observation	Metric Score
%TolerantIndividuals:	19.44	5
%OmnivoreIndividuals:	16.67	5
%InsectivoreIndividuals:	44.44	3
%CarnivoreIndividuals:	38.89	3
Total # of Individuals (CPUE):	108	1
%SimpleLithophilicInd.:	27.78	3
%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 Score (min 0, max 60)	38

SampleNumber: AB47664 **EventID:** 21T012 **LSite:** WEM080-0014 **County:** Jackson

StreamName: Mutton Creek Ditch **LocationDescription:** 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207080020 **LSite:** WEM-07-0016
Site: Tributary of Mutton Creek **Location:** CR 700 North **County:** Jackson
Latitude: 38.983945 **Longitude:** -85.828548 **IASNat Region:** 11B **Topo:** H-39 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 5.117 **Gradient (ft/mile):** 11.518

Sample Information

SampleNumber: AB47665 **EventID:** 21T013 **Sample MediumCollected:** Fish Community + Water + Macro
SampleDate: 08/16/2021 **SurveyCrewChief:** KAG **SampleTime:** 02:53:00 PM **HydroLabNumber:** P7
WaterFlowType: Run **WaterAppearance:** Clear **SkyConditions:** 3 - Partly **AirTemperature:** 5 - 76-85
WindDirection: 27 - West (270 degrees) **WindStrength:** 1 - Light
DissolvedO2 (mg/l): 10.38 **pH:** 8.04 **WaterTemp(°C):** 25.9 **SpecificConductivity (µS/cm):** 416.5 **Turbidity (NTU):** 4.9
SpecialNotes:

ElectrofishingEquipment: Backpack **Voltage:** 200 **Avg.StreamWidth(m):** 3 **DistanceFished (m):** 50
SecondsFished: 536 **WaterDepthAvg (m):** .25 **WaterDepthMax (m):** .75 **TimeAtSite:** 01:00
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: MLES backpack

Habitat Information

TotalScore (max100): 65 **SubstrateScore (max20):** 11 **InstreamCover Score (max20):** 16 **ChannelMorphologyScore (max20):** 12
RiparianZoneBankErosion Score(max10): 3 **Pool/GlideQualityScore(max12):** 9 **Riffle/RunQualityScore(max8):** 6
GradientScore (max10): 8 **%Pool:** 30 **%Riffle:** 10 **%Run:** 60 **%Glide:** 0 **CanopyCover PctOpen:** >85%-Open
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	14	5
Darter/Madtom/SculpinSpeciesCount:	2	3
%HeadwaterIndividuals:	0	1
MinnowSpeciesCount:	4	3
SensitiveSpeciesCount:	1	1

	Actual Observation	Metric Score
%TolerantIndividuals:	8.09	5
%OmnivoreIndividuals:	4.41	5
%InsectivoreIndividuals:	64.71	5
%PioneerIndividuals:	33.82	3
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 on calibration.

Total IBI Score (min 0, max 60)	40

SampleNumber: AB47665 **EventID:** 21T013 **LSite:** WEM-07-0016 **County:** Jackson

StreamName: Tributary of Mutton Creek **LocationDescription:** 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207080020 **LSite:** WEM080-0027
Site: Mutton Creek **Location:** CR 800 North **County:** Jackson
Latitude: 38.998644 **Longitude:** -85.806382 **IASNat Region:** 11B **Topo:** H-39 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 18.199 **Gradient (ft/mile):** 4.798

Sample Information

SampleNumber: AB47666 **EventID:** 21T014 **Sample MediumCollected:** Fish Community + Water + Macro
SampleDate: 08/16/2021 **SurveyCrewChief:** KAG **SampleTime:** 12:45:00 PM **HydroLabNumber:** P7
WaterFlowType: Pool **WaterAppearance:** Clear **SkyConditions:** 3 - Partly **AirTemperature:** 5 - 76-85
WindDirection: 27 - West (270 degrees) **WindStrength:** 1 - Light
DissolvedO2 (mg/l): 4.84 **pH:** 7.4 **WaterTemp(°C):** 23.7 **SpecificConductivity (µS/cm):** 373.8 **Turbidity (NTU):** 10.4
SpecialNotes: Saw Ancyronyx and Enochrus adults in sample, not picked (not found during 15 minute 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: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: MLES backpack

Habitat Information

TotalScore (max100): 61 **SubstrateScore (max20):** 13 **InstreamCover Score (max20):** 16 **ChannelMorphologyScore (max20):** 14
RiparianZoneBankErosion Score(max10): 3 **Pool/GlideQualityScore(max12):** 9 **Riffle/RunQualityScore(max8):** 0
GradientScore (max10): 6 **%Pool:** 30 **%Riffle:** 0 **%Run:** 70 **%Glide:** 0 **CanopyCover PctOpen:** 30%-<55%
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used:

	Actual Observation	Metric Score
SpeciesCount:	17	5
Darter/Madtom/SculpinSpeciesCount:	1	1
%HeadwaterIndividuals:	0	1
MinnowSpeciesCount:	2	1
SensitiveSpeciesCount:	2	1

	Actual Observation	Metric Score
%TolerantIndividuals:	6.59	5
%OmnivoreIndividuals:	4.4	5
%InsectivoreIndividuals:	91.94	5
%PioneerIndividuals:	3.66	5
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.

Total IBI Score (min 0, max 60)	38

SampleNumber: AB47666 **EventID:** 21T014 **LSite:** WEM080-0027 **County:** Jackson

StreamName: Mutton Creek **LocationDescription:** 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207080010 **LSite:** WEM080-0025
Site: Mutton Creek **Location:** CR 300 North **County:** Jennings
Latitude: 39.027968 **Longitude:** -85.765410 **IASNat Region:** 11B **Topo:** H-16 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 8.239 **Gradient (ft/mile):** 6.52

Sample Information

SampleNumber: AB47667 **EventID:** 21T015 **Sample MediumCollected:** Fish Community + Water + Macro
SampleDate: 08/16/2021 **SurveyCrewChief:** KAG **SampleTime:** 10:19:00 AM **HydroLabNumber:** P7
WaterFlowType: Pool **WaterAppearance:** Clear **SkyConditions:** 4 - Cloudy **AirTemperature:** 4 - 61-75
WindDirection: 18 - South (180 degrees) **WindStrength:** 1 - Light
DissolvedO2 (mg/l): 4.77 **pH:** 7.39 **WaterTemp(°C):** 22.1 **SpecificConductivity (µS/cm):** 369.9 **Turbidity (NTU):** 6.89
SpecialNotes:

ElectrofishingEquipment: Backpack **Voltage:** 200 **Avg.StreamWidth(m):** 6 **DistanceFished (m):** 90
SecondsFished: 1502 **WaterDepthAvg (m):** .2 **WaterDepthMax (m):** .75 **TimeAtSite:** 01:30
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: MLES backpack

Habitat Information

TotalScore (max100): 60 **SubstrateScore (max20):** 11 **InstreamCover Score (max20):** 16 **ChannelMorphologyScore (max20):** 15
RiparianZoneBankErosion Score(max10): 4 **Pool/GlideQualityScore(max12):** 8 **Riffle/RunQualityScore(max8):** 0
GradientScore (max10): 6 **%Pool:** 40 **%Riffle:** 10 **%Run:** 50 **%Glide:** 0 **CanopyCover PctOpen:** 30%-<55%
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	15	5
Darter/Madtom/SculpinSpeciesCount:	2	3
%HeadwaterIndividuals:	0	1
MinnowSpeciesCount:	5	3
SensitiveSpeciesCount:	1	1

	Actual Observation	Metric Score
%TolerantIndividuals:	35.86	3
%OmnivoreIndividuals:	18.55	5
%InsectivoreIndividuals:	28.28	3
%PioneerIndividuals:	74.96	1
Total # of Individuals (CPUE):	647	5
%SimpleLithophilicInd.:	9.27	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.

Total IBI Score (min 0, max 60)	36

SampleNumber: AB47667 **EventID:** 21T015 **LSite:** WEM080-0025 **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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207080040 **LSite:** WEM080-0013

Site: Storm Creek Ditch **Location:** CR 400 North **County:** Jackson

Latitude: 38.940553 **Longitude:** -85.805928 **IASNat Region:** 11B **Topo:** H-39 **Segment:** 83

Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 17.513 **Gradient (ft/mile):** 2.682

Sample Information

SampleNumber: AB47668 **EventID:** 21T016 **Sample MediumCollected:** Fish Community + Water + Macro

SampleDate: 08/17/2021 **SurveyCrewChief:** KAG **SampleTime:** 08:21:00 AM **HydroLabNumber:** P7

WaterFlowType: Glide **WaterAppearance:** Sheen **SkyConditions:** 4 - Cloudy **AirTemperature:** 4 - 61-75

WindDirection: 9 - East (90 degrees) **WindStrength:** 0 - Calm

DissolvedO2 (mg/l): 0.18 **pH:** 7.12 **WaterTemp(°C):** 22.7 **SpecificConductivity (µS/cm):** 388.8 **Turbidity (NTU):** 9.73

SpecialNotes: Canoe site, entirely a deep canal, no kick

ElectrofishingEquipment: Canoe **Voltage:** 240 **Avg.StreamWidth(m):** 9 **DistanceFished (m):** 135

SecondsFished: 2494 **WaterDepthAvg (m):** 1 **WaterDepthMax (m):** 1.5 **TimeAtSite:** 03:00

BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**

SpecialComments: canoe w/boom and MLES; sample collected DS of bridge due to log jam and excessive duckweed; sheen on surface of water

Habitat Information

TotalScore (max100): 46 **SubstrateScore (max20):** 10 **InstreamCover Score (max20):** 12 **ChannelMorphologyScore (max20):** 4

RiparianZoneBankErosion Score(max10): 8 **Pool/GlideQualityScore(max12):** 8 **Riffle/RunQualityScore(max8):** 0

GradientScore (max10): 4 **%Pool:** 20 **%Riffle:** 0 **%Run:** 0 **%Glide:** 80 **CanopyCover PctOpen:** 55%-<85%

SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used:

	Actual Observation	Metric Score
SpeciesCount:	8	3
Darter/Madtom/SculpinSpeciesCount:	0	1
%HeadwaterIndividuals:	0	1
MinnowSpeciesCount:	1	1
SensitiveSpeciesCount:	0	1

	Actual Observation	Metric Score
%TolerantIndividuals:	3.45	5
%OmnivoreIndividuals:	0	5
%InsectivoreIndividuals:	34.48	3
%PioneerIndividuals:	0	5
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.

Total IBI Score (min 0, max 60)	32

SampleNumber: AB47668 **EventID:** 21T016 **LSite:** WEM080-0013 **County:** Jackson

StreamName: Storm Creek Ditch **LocationDescription:** CR 400 North

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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207080040 **LSite:** WEM080-0005
Site: Tributary to Richart Lake **Location:** CR 900 West **County:** Jennings
Latitude: 38.969530 **Longitude:** -85.777402 **IASNat Region:** 11B **Topo:** H-39 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 1.529 **Gradient (ft/mile):** 17.212

Sample Information

SampleNumber: AB47669 **EventID:** 21T017 **Sample MediumCollected:** Fish 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 **pH:** 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: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: isolated pools; MLES backpack

Habitat Information

TotalScore (max100): 49 **SubstrateScore (max20):** 13 **InstreamCover Score (max20):** 8 **ChannelMorphologyScore (max20):** 10
RiparianZoneBankErosion Score(max10): 7 **Pool/GlideQualityScore(max12):** 1 **Riffle/RunQualityScore(max8):** 0
GradientScore (max10): 10 **%Pool:** 90 **%Riffle:** 5 **%Run:** 5 **%Glide:** 0 **CanopyCover PctOpen:** <10%-Closed
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used:

	Actual Observation	Metric Score
SpeciesCount:	5	3
Darter/Madtom/SculpinSpeciesCount:	0	1
%HeadwaterIndividuals:	0	1
MinnowSpeciesCount:	1	1
SensitiveSpeciesCount:	0	1

	Actual Observation	Metric Score
%TolerantIndividuals:	98.75	1
%OmnivoreIndividuals:	12.5	1
%InsectivoreIndividuals:	18.75	1
%PioneerIndividuals:	70	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 on calibration.

Total IBI Score (min 0, max 60)	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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207080030 **LSite:** WEM-07-0014

Site: Storm Creek **Location:** Base Road **County:** Jennings

Latitude: 38.983201 **Longitude:** -85.786709 **IASNat Region:** 11B **Topo:** H-39 **Segment:** 83

Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 9.378 **Gradient (ft/mile):** 4.073

Sample Information

SampleNumber: AB47670 **EventID:** 21T018 **Sample MediumCollected:** Fish Community + Water + Macro

SampleDate: 08/16/2021 **SurveyCrewChief:** KAG **SampleTime:** 04:39:00 PM **HydroLabNumber:** P7

WaterFlowType: Pool **WaterAppearance:** Clear **SkyConditions:** 2 - Scattered **AirTemperature:** 5 - 76-85

WindDirection: 27 - West (270 degrees) **WindStrength:** 0 - Calm

DissolvedO2 (mg/l): 6.77 **pH:** 7.6 **WaterTemp(°C):** 22.6 **SpecificConductivity (µS/cm):** 311.3 **Turbidity (NTU):** 4.23

SpecialNotes:

ElectrofishingEquipment: Backpack **Voltage:** 200 **Avg.StreamWidth(m):** 6 **DistanceFished (m):** 90

SecondsFished: 1004 **WaterDepthAvg (m):** .5 **WaterDepthMax (m):** 1 **TimeAtSite:** 02:00

BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**

SpecialComments: MLES backpack; 54.36% catch Longear Sunfish

Habitat Information

TotalScore (max100): 61 **SubstrateScore (max20):** 14 **InstreamCover Score (max20):** 15 **ChannelMorphologyScore (max20):** 11

RiparianZoneBankErosion Score(max10): 5 **Pool/GlideQualityScore(max12):** 10 **Riffle/RunQualityScore(max8):** 0

GradientScore (max10): 6 **%Pool:** 40 **%Riffle:** 10 **%Run:** 50 **%Glide:** 0 **CanopyCover PctOpen:** <10%- Closed

SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	**18**	**5**
Darter/Madtom/SculpinSpeciesCount:	**3**	**5**
%HeadwaterIndividuals:	**0**	**1**
MinnowSpeciesCount:	**3**	**3**
SensitiveSpeciesCount:	**1**	**1**

	Actual Observation	Metric Score
%TolerantIndividuals:	**18.79**	**5**
%OmnivoreIndividuals:	**3.36**	**5**
%InsectivoreIndividuals:	**85.91**	**5**
%PioneerIndividuals:	**15.44**	**5**
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.

Total IBI Score (min 0, max 60)	42

SampleNumber: AB47670 **EventID:** 21T018 **LSite:** WEM-07-0014 **County:** Jennings

StreamName: Storm Creek **LocationDescription:** 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207070060 **LSite:** WEM-07-0017
Site: Sixmile Creek **Location:** CR 500 South **County:** Jennings
Latitude: 38.911153 **Longitude:** -85.762327 **IASNat Region:** 11A **Topo:** H-39 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 30.679 **Gradient (ft/mile):** 2.423

Sample Information

SampleNumber: AB47671 **EventID:** 21T019 **Sample MediumCollected:** Fish Community + Water + Macro
SampleDate: 08/16/2021 **SurveyCrewChief:** CWY **SampleTime:** 02:05:00 PM **HydroLabNumber:** P5
WaterFlowType: Run **WaterAppearance:** Clear **SkyConditions:** 1 - Clear **AirTemperature:** 5 - 76-85
WindDirection: 27 - West (270 degrees) **WindStrength:** 1 - Light
DissolvedO2 (mg/l): 8.44 **pH:** 7.9 **WaterTemp(°C):** 25.2 **SpecificConductivity (µS/cm):** 340 **Turbidity (NTU):** 14.4
SpecialNotes:

ElectrofishingEquipment: Backpack **Voltage:** 250 **Avg.StreamWidth(m):** 7 **DistanceFished (m):** 105
SecondsFished: 849 **WaterDepthAvg (m):** .3 **WaterDepthMax (m):** .75 **TimeAtSite:** 01:15
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: smithroot backpack

Habitat Information

TotalScore (max100): 49 **SubstrateScore (max20):** 7 **InstreamCover Score (max20):** 13 **ChannelMorphologyScore (max20):** 11
RiparianZoneBankErosion Score(max10): 3 **Pool/GlideQualityScore(max12):** 9 **Riffle/RunQualityScore(max8):** 2
GradientScore (max10): 4 **%Pool:** 25 **%Riffle:** 15 **%Run:** 60 **%Glide:** 0 **CanopyCover PctOpen:** >85%-Open
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used:

	Actual Observation	Metric Score
SpeciesCount:	**24**	**5**
DarterSpeciesCount:	**3**	**5**
SunfishSpeciesCount:	**4**	**5**
SuckerSpeciesCount:	**3**	**3**
SensitiveSpeciesCount:	**6**	**5**

	Actual Observation	Metric Score
%TolerantIndividuals:	**28.31**	**3**
%OmnivoreIndividuals:	**5.29**	**5**
%InsectivoreIndividuals:	**87.83**	**5**
%CarnivoreIndividuals:	**3.7**	**1**
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.

Total IBI Score (min 0, max 60)	46

SampleNumber: AB47671 **EventID:** 21T019 **LSite:** WEM-07-0017 **County:** Jennings

StreamName: Sixmile Creek **LocationDescription:** CR 500 South

Common Name	Individual Fish Count	Deformities	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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck		**14 digit HUC:** 05120207070060		**LSite:** WEM-07-0018	
Site: Sixmile Creek	**Location:** CR 200 South				**County:** Jennings
Latitude: 38.954384	**Longitude:** -85.732138	**IASNat Region:** 11A		**Topo:** H-40	**Segment:** 83
Ecoregion: Eastern Corn Belt Plains		**Drainage Area (sq.miles):** 24.444			**Gradient (ft/mile):** 9.117

Sample Information

SampleNumber: AB47672 **EventID:** 21T020 **Sample MediumCollected:** Fish Community + 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 Hagenius brevistylus, then released.

ElectrofishingEquipment: Backpack **Voltage:** 250 **Avg.StreamWidth(m):** 9 **DistanceFished (m):** 135

SecondsFished: 998 **WaterDepthAvg (m):** .3 **WaterDepthMax (m):** .75 **TimeAtSite:** 01:30

BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**

SpecialComments: Smithroot backpack

Habitat Information

TotalScore (max100): 62 **SubstrateScore (max20):** 14 **InstreamCover Score (max20):** 13 **ChannelMorphologyScore (max20):** 11

RiparianZoneBankErosion Score(max10): 3 **Pool/GlideQualityScore(max12):** 7 **Riffle/RunQualityScore(max8):** 4

GradientScore (max10): 10 **%Pool:** 60 **%Riffle:** 10 **%Run:** 30 **%Glide:** 0 **CanopyCover PctOpen:** 30%-<55%

SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used:

	Actual Observation	Metric Score
SpeciesCount:	23	5
DarterSpeciesCount:	5	5
SunfishSpeciesCount:	4	5
SuckerSpeciesCount:	4	5
SensitiveSpeciesCount:	8	5

	Actual Observation	Metric Score
%TolerantIndividuals:	12.32	5
%OmnivoreIndividuals:	12.32	5
%InsectivoreIndividuals:	83.28	5
%CarnivoreIndividuals:	2.35	1
Total # of Individuals (CPUE):	341	5
%SimpleLithophilicInd.:	11.73	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.

Total IBI Score (min 0, max 60)	**52**

SampleNumber: AB47672 **EventID:** 21T020 **LSite:** WEM-07-0018 **County:** Jennings

StreamName: Sixmile Creek **LocationDescription:** 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207070050 **LSite:** WEM-07-0019

Site: Sixmile Creek **Location:** CR 175 North **County:** Jennings

Latitude: 39.010095 **Longitude:** -85.704976 **IASNat Region:** 11B **Topo:** H-17 **Segment:** 83

Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 13.834 **Gradient (ft/mile):** 9.933

Sample Information

SampleNumber: AB47673 **EventID:** 21T021 **Sample MediumCollected:** Fish Community + Water + Macro

SampleDate: 08/16/2021 **SurveyCrewChief:** CWY **SampleTime:** 12:02:00 PM **HydroLabNumber:** P5

WaterFlowType: Run **WaterAppearance:** Brown **SkyConditions:** 3 - Partly **AirTemperature:** 4 - 61-75

WindDirection: 27 - West (270 degrees) **WindStrength:** 2 - Mod./Light

DissolvedO2 (mg/l): 7.15 **pH:** 7.79 **WaterTemp(°C):** 23.6 **SpecificConductivity (µS/cm):** 276.7 **Turbidity (NTU):** 10.2

SpecialNotes:

ElectrofishingEquipment: Backpack **Voltage:** 250 **Avg.StreamWidth(m):** 5 **DistanceFished (m):** 75

SecondsFished: 700 **WaterDepthAvg (m):** .4 **WaterDepthMax (m):** 1 **TimeAtSite:** 01:00

BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**

SpecialComments: Smithroot Backpack

Habitat Information

TotalScore (max100): 72 **SubstrateScore (max20):** 16 **InstreamCover Score (max20):** 12 **ChannelMorphologyScore (max20):** 15

RiparianZoneBankErosion Score(max10): 5 **Pool/GlideQualityScore(max12):** 8 **Riffle/RunQualityScore(max8):** 6

GradientScore (max10): 10 **%Pool:** 30 **%Riffle:** 10 **%Run:** 60 **%Glide:** 0 **CanopyCover PctOpen:** <10%-Closed

SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used:

	Actual Observation	Metric Score
SpeciesCount:	**16**	**5**
Darter/Madtom/SculpinSpeciesCount:	**4**	**5**
%HeadwaterIndividuals:	**1.44**	**1**
MinnowSpeciesCount:	**5**	**3**
SensitiveSpeciesCount:	**3**	**3**

	Actual Observation	Metric Score
%TolerantIndividuals:	**33.09**	**3**
%OmnivoreIndividuals:	**12.23**	**5**
%InsectivoreIndividuals:	**58.27**	**5**
%PioneerIndividuals:	**42.45**	**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.

Total IBI Score (min 0, max 60)	38

SampleNumber: AB47673 **EventID:** 21T021 **LSite:** WEM-07-0019 **County:** Jennings

StreamName: Sixmile Creek **LocationDescription:** 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207070050 **LSite:** WEM-07-0020
Site: Sixmile Creek **Location:** CR 415 North **County:** Jennings
Latitude: 39.045759 **Longitude:** -85.676441 **IASNat Region:** 11B **Topo:** H-17 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 8.944 **Gradient (ft/mile):** 16.916

Sample Information

SampleNumber: AB47674 **EventID:** 21T022 **Sample MediumCollected:** Fish 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

ElectrofishingEquipment: Backpack **Voltage:** 250 **Avg.StreamWidth(m):** 7 **DistanceFished (m):** 105
SecondsFished: 739 **WaterDepthAvg (m):** .15 **WaterDepthMax (m):** .8 **TimeAtSite:** 01:30
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: half of reach backwater from reservoir, other half becoming isolated pools; Smithroot backpack

Habitat Information

TotalScore (max100): 55 **SubstrateScore (max20):** 10 **InstreamCover Score (max20):** 9 **ChannelMorphologyScore (max20):** 14
RiparianZoneBankErosion Score(max10): 7 **Pool/GlideQualityScore(max12):** 5 **Riffle/RunQualityScore(max8):** 0
GradientScore (max10): 10 **%Pool:** 40 **%Riffle:** 0 **%Run:** 60 **%Glide:** 0 **CanopyCover PctOpen:** <10%-Closed
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	**11**	**3**
Darter/Madtom/SculpinSpeciesCount:	**3**	**5**
%HeadwaterIndividuals:	**0**	**1**
MinnowSpeciesCount:	**3**	**3**
SensitiveSpeciesCount:	**1**	**1**

	Actual Observation	Metric Score
%TolerantIndividuals:	**27.17**	**3**
%OmnivoreIndividuals:	**4.35**	**5**
%InsectivoreIndividuals:	**60.33**	**5**
%PioneerIndividuals:	**89.67**	**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.

Total IBI Score (min 0, max 60)	32

SampleNumber: AB47674 **EventID:** 21T022 **LSite:** WEM-07-0020 **County:** Jennings

StreamName: Sixmile Creek **LocationDescription:** 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					
Tadpole Madtom	1					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

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

Sample Information

SampleNumber: AB47675 **EventID:** 21T023 **Sample MediumCollected:** Fish Community + 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/l): 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

ElectrofishingEquipment: Canoe **Voltage:** 200 **Avg.StreamWidth(m):** 25 **DistanceFished (m):** 375
SecondsFished: 3071 **WaterDepthAvg (m):** .5 **WaterDepthMax (m):** 2 **TimeAtSite:** 04:10
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: Canoe w/Infinity box; portion of reach non-wadeable

Habitat Information

TotalScore (max100): 73 **SubstrateScore (max20):** 15 **InstreamCover Score (max20):** 16 **ChannelMorphologyScore (max20):** 16
RiparianZoneBankErosion Score(max10): 4 **Pool/GlideQualityScore(max12):** 11 **Riffle/RunQualityScore(max8):** 5
GradientScore (max10): 6 **%Pool:** 40 **%Riffle:** 25 **%Run:** 35 **%Glide:** 0 **CanopyCover PctOpen:** 55%-<85%
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	31	5
DarterSpeciesCount:	6	5
SunfishSpeciesCount:	3	3
SuckerSpeciesCount:	5	5
SensitiveSpeciesCount:	16	5

	Actual Observation	Metric Score
%TolerantIndividuals:	7.96	5
%OmnivoreIndividuals:	6.92	5
%InsectivoreIndividuals:	85.64	5
%CarnivoreIndividuals:	3.39	1
Total # of Individuals (CPUE):	766	5
%SimpleLithophilicInd.:	33.81	3
%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 Score (min 0, max 60)	52

SampleNumber: AB47675 **EventID:** 21T023 **LSite:** WEM070-0036 **County:** Jennings

StreamName: 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					
Steelcolor Shiner	8					
Striped Shiner	5					
Suckermouth Minnow	18					
Yellow Bullhead	1					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207070010 **LSite:** WEM070-0001

Site: Vernon Fork Muscatatuck River **Location:** CR 60 South **County:** Jennings

Latitude: 38.976361 **Longitude:** -85.619826 **IASNat Region:** 11A **Topo:** H-41 **Segment:** 83

Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 197.56 **Gradient (ft/mile):** 4.424

Sample Information

SampleNumber: AB47676 **EventID:** 21T025 **Sample MediumCollected:** Fish Community + Water + Macro

SampleDate: 08/17/2021 **SurveyCrewChief:** CWY **SampleTime:** 12:40:00 PM **HydroLabNumber:** P5

WaterFlowType: Riffle **WaterAppearance:** Clear **SkyConditions:** 2 - Scattered **AirTemperature:** 5 - 76-85

WindDirection: 27 - West (270 degrees) **WindStrength:** 2 - Mod./Light

DissolvedO2 (mg/l): 8.62 **pH:** 8.35 **WaterTemp(°C):** 24.5 **SpecificConductivity (µS/cm):** 466.8 **Turbidity (NTU):** 3.2

SpecialNotes:

ElectrofishingEquipment: Canoe **Voltage:** 230 **Avg.StreamWidth(m):** 33 **DistanceFished (m):** 500

SecondsFished: 3388 **WaterDepthAvg (m):** .4 **WaterDepthMax (m):** 1 **TimeAtSite:** 03:30

BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**

SpecialComments: canoe w/MLES

Habitat Information

TotalScore (max100): 80 **SubstrateScore (max20):** 16 **InstreamCover Score (max20):** 17 **ChannelMorphologyScore (max20):** 15

RiparianZoneBankErosion Score(max10): 7 **Pool/GlideQualityScore(max12):** 9 **Riffle/RunQualityScore(max8):** 6

GradientScore (max10): 10 **%Pool:** 30 **%Riffle:** 30 **%Run:** 40 **%Glide:** 0 **CanopyCover PctOpen:** 55%-<85%

SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used:

	Actual Observation	Metric Score
SpeciesCount:	28	5
DarterSpeciesCount:	5	5
SunfishSpeciesCount:	5	5
SuckerSpeciesCount:	4	5
SensitiveSpeciesCount:	14	5

	Actual Observation	Metric Score
%TolerantIndividuals:	4.46	5
%OmnivoreIndividuals:	0.97	5
%InsectivoreIndividuals:	92.44	5
%CarnivoreIndividuals:	6.4	3
Total # of Individuals (CPUE):	516	5
%SimpleLithophilicInd.:	18.99	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.

Total IBI Score (min 0, max 60)	54

SampleNumber: AB47676 **EventID:** 21T025 **LSite:** WEM070-0001 **County:** Jennings

StreamName: 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin:	Muscatatuck	**14 digit HUC:**	05120207080030	**LSite:**	WEM-07-0014		
Site:	Storm Creek	**Location:**	Base Road	**County:**	Jennings		
Latitude:	38.983201	**Longitude:**	-85.786709	**IASNat Region:**	11B	**Topo:**	H-39
Segment:	83						
Ecoregion:	Eastern Corn Belt Plains	**Drainage Area (sq.miles):**	9.378	**Gradient (ft/mile):**	4.073		

Sample Information

SampleNumber: AB48036 **EventID:** 21T018.5 **Sample MediumCollected:** Fish Community + Water

SampleDate: 09/09/2021 **SurveyCrewChief:** KAG **SampleTime:** 09:35:00 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): 5.57 **pH:** 7.59 **WaterTemp(°C):** 18.6 **SpecificConductivity (µS/cm):** 407.6 **Turbidity (NTU):** 4.93

SpecialNotes:

ElectrofishingEquipment: Backpack **Voltage:** 200 **Avg.StreamWidth(m):** 6 **DistanceFished (m):** 90

SecondsFished: 614 **WaterDepthAvg (m):** .25 **WaterDepthMax (m):** .75 **TimeAtSite:** 01:00

BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**

SpecialComments: MLES Backpack

Habitat Information

TotalScore (max100): 51 **SubstrateScore (max20):** 13 **InstreamCover Score (max20):** 8 **ChannelMorphologyScore (max20):** 12

RiparianZoneBankErosion Score(max10): 6 **Pool/GlideQualityScore(max12):** 6 **Riffle/RunQualityScore(max8):** 0

GradientScore (max10): 6 **%Pool:** 30 **%Riffle:** 10 **%Run:** 60 **%Glide:** 0 **CanopyCover PctOpen:** 10%-<30%

SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used:

	Actual Observation	Metric Score
SpeciesCount:	15	5
Darter/Madtom/SculpinSpeciesCount:	2	3
%HeadwaterIndividuals:	0	1
MinnowSpeciesCount:	4	3
SensitiveSpeciesCount:	1	1

	Actual Observation	Metric Score
%TolerantIndividuals:	19.49	5
%OmnivoreIndividuals:	3.39	5
%InsectivoreIndividuals:	92.37	5
%PioneerIndividuals:	22.88	5
Total # of Individuals (CPUE):	118	3
%SimpleLithophilicInd.:	4.24	1
%Ind.withDELT:	2.54	1

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

Total IBI Score (min 0, max 60)	38

SampleNumber: AB48036 **EventID:** 21T018.5 **LSite:** WEM-07-0014 **County:** Jennings

StreamName: Storm Creek **LocationDescription:** 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207080020 **LSite:** WEM080-0027
Site: Mutton Creek **Location:** CR 800 North **County:** Jackson
Latitude: 38.998644 **Longitude:** -85.806382 **IASNat Region:** 11B **Topo:** H-39 **Segment:** 83
Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 18.199 **Gradient (ft/mile):** 4.798

Sample Information

SampleNumber: AB48037 **EventID:** 21T014.5 **Sample MediumCollected:** Fish Community + Water
SampleDate: 08/30/2021 **SurveyCrewChief:** CWY **SampleTime:** 01:05:00 PM **HydroLabNumber:** P5
WaterFlowType: Pool **WaterAppearance:** Murky **SkyConditions:** 7 - Shower **AirTemperature:** 4 - 61-75
WindDirection: 27 - West (270 degrees) **WindStrength:** 1 - Light
DissolvedO2 (mg/l): 5.48 **pH:** 7.61 **WaterTemp(°C):** 25.1 **SpecificConductivity (µS/cm):** 400.2 **Turbidity (NTU):** 28.8
SpecialNotes:

ElectrofishingEquipment: Backpack **Voltage:** 200 **Avg.StreamWidth(m):** 7 **DistanceFished (m):** 105
SecondsFished: 900 **WaterDepthAvg (m):** .5 **WaterDepthMax (m):** 1.5 **TimeAtSite:** 01:40
BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**
SpecialComments: MLES Backpack; 60.42% catch Longear Sunfish

Habitat Information

TotalScore (max100): 52 **SubstrateScore (max20):** 12 **InstreamCover Score (max20):** 11 **ChannelMorphologyScore (max20):** 11
RiparianZoneBankErosion Score(max10): 3 **Pool/GlideQualityScore(max12):** 9 **Riffle/RunQualityScore(max8):** 0
GradientScore (max10): 6 **%Pool:** 20 **%Riffle:** 0 **%Run:** 80 **%Glide:** 0 **CanopyCover PctOpen:** 55%-<85%
SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used: Eastern Corn Belt Plains

	Actual Observation	Metric Score
SpeciesCount:	17	5
Darter/Madtom/SculpinSpeciesCount:	3	3
%HeadwaterIndividuals:	0	1
MinnowSpeciesCount:	3	1
SensitiveSpeciesCount:	2	1

	Actual Observation	Metric Score
%TolerantIndividuals:	3.65	5
%OmnivoreIndividuals:	1.56	5
%InsectivoreIndividuals:	93.75	5
%PioneerIndividuals:	3.65	5
Total # of Individuals (CPUE):	192	3
%SimpleLithophilicInd.:	1.56	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.

Total IBI Score (min 0, max 60)	40

SampleNumber: AB48037 **EventID:** 21T014.5 **LSite:** WEM080-0027 **County:** Jackson

StreamName: Mutton Creek **LocationDescription:** 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					

Indiana Department of Environmental Management
Fish Community Assessments

Site Information

SubBasin: Muscatatuck **14 digit HUC:** 05120207070050 **LSite:** WEM-07-0020

Site: Sixmile Creek **Location:** CR 415 North **County:** Jennings

Latitude: 39.045759 **Longitude:** -85.676441 **IASNat Region:** 11B **Topo:** H-17 **Segment:** 83

Ecoregion: Eastern Corn Belt Plains **Drainage Area (sq.miles):** 8.944 **Gradient (ft/mile):** 16.916

Sample Information

SampleNumber: AB48619 **EventID:** 21T022.5 **Sample MediumCollected:** Fish Community + Water

SampleDate: 09/09/2021 **SurveyCrewChief:** KAG **SampleTime:** 11:00:00 AM **HydroLabNumber:** P5

WaterFlowType: Stagnant **WaterAppearance:** Clear **SkyConditions:** 1 - Clear **AirTemperature:** 4 - 61-75

WindDirection: 27 - West (270 degrees) **WindStrength:** 0 - Calm

DissolvedO2 (mg/l): 5.6 **pH:** 7.39 **WaterTemp(°C):** 17.5 **SpecificConductivity (µS/cm):** 550 **Turbidity (NTU):** 2.14

SpecialNotes:

ElectrofishingEquipment: Backpack **Voltage:** 250 **Avg.StreamWidth(m):** 7 **DistanceFished (m):** 105

SecondsFished: 791 **WaterDepthAvg (m):** .1 **WaterDepthMax (m):** .9 **TimeAtSite:** 01:00

BridgeInReach: ☐ **ReachRepresentative:** ☑ **WhyReachNotRepresentative:**

SpecialComments: MLES Backpack

Habitat Information

TotalScore (max100): 74 **SubstrateScore (max20):** 16 **InstreamCover Score (max20):** 15 **ChannelMorphologyScore (max20):** 13

RiparianZoneBankErosion Score(max10): 7 **Pool/GlideQualityScore(max12):** 7 **Riffle/RunQualityScore(max8):** 6

GradientScore (max10): 10 **%Pool:** 20 **%Riffle:** 10 **%Run:** 70 **%Glide:** 0 **CanopyCover PctOpen:** 10%-<30%

SubjectiveRating: **AestheticRating:** **NOTES:** "NEW RECORD"

Fish Community Index of Biotic Integrity (IBI) Information

Calibration Used:

	Actual Observation	Metric Score
SpeciesCount:	10	3
Darter/Madtom/SculpinSpeciesCount:	2	3
%HeadwaterIndividuals:	0	1
MinnowSpeciesCount:	3	3
SensitiveSpeciesCount:	1	1

	Actual Observation	Metric Score
%TolerantIndividuals:	27.56	3
%OmnivoreIndividuals:	1.57	5
%InsectivoreIndividuals:	64.57	5
%PioneerIndividuals:	76.38	1
Total # of Individuals (CPUE):	127	3
%SimpleLithophilicInd.:	0.79	1
%Ind.withDELT:	2.36	1

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

Total IBI Score (min 0, max 60)	30

SampleNumber: AB48619 **EventID:** 21T022.5 **LSite:** WEM-07-0020 **County:** Jennings

StreamName: Sixmile Creek **LocationDescription:** 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					

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM-07-0010	21T-002	MHAB	AB47654	210824702	8/24/21	Jackson

Stream Name	Location	HUC 12	HUCTO14
Grassy Creek	CR 600	051202070706	05120207090020

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4294529.44	598192.59	55	1.972	12.633	46

TAXON	COUNT	NOTES	HBI Tolerance
1220 (PLATYHELMINTHES)	1		
1555 (Tubificinae with bifid chetae and hair)	3		
1234 (GLOSSIPHONIIDAE)	1		
1210 (BIVALVIA)	2	probably Sphaerium	
1083 (Acari)	5		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 pentacantha)	5		
1027 (CORDULIIDAE)	2	imm.	3
3540 (Ischnura)	2	no gills	9
1041 (CORIXIDAE)	14	nymphs, likely Trichocorixa	5
7201 (Trichocorixa calva)	2	adult F	4
7230 (Neoplea striola)	2		
7207 (Belostoma)	5	nymphs	
1038 (GERRIDAE)	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 Gr.)	1		
8179 (Polypedilum)	1		
8235 (Paratanytarsus)	1		4
8241 (Tanytarsus)	3		4
9278 (Polypedilum Halterale Gr.)	1		
9241 (Polypedilum Illinoense Gr.)	38		

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

Supplemental Metrics

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM-07-0016	21T-013	MHAB	AB47665	210816903	8/16/21	Jackson

Stream Name	Location	HUC 12	HUCTO14
Tributary of Mutton Creek	CR 700 North	051202070704	05120207080020

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4315647.61	601462.41	55	11.518	5.117	48

TAXON	COUNT	NOTES	HBI Tolerance
1220 (PLATYHELMINTHES)	1		
1552 (Tubificinae with bifid chetae and no hair chetae)	1		
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 complex)	6	S21-024.3	3
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. imm.	9
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 duodecimpunctatus)	1	adult female	
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		

Type	Value	Metric Score
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 Score:		**40**

Supplemental Metrics

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

TAXON	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 Gr.)	15		
9375 (Tipuloidea)	1		

Residuals

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM070-0001	21T-025	MHAB	AB47676	210817701	8/17/21	Jennings

Stream Name	Location	HUC 12	HUCTO14
Vernon Fork Muscatatuck River	CR 60 South, Vernon	051202070701	05120207070010

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4315059.3	619553.85	55	4.424	197.56	87

TAXON	COUNT	NOTES	HBI Tolerance
1220 (PLATYHELMINTHES)	1		
1430 (Isochaetides curvisetosus)	1		
2287 (Laevapex fuscus)	1	?	
2211 (Pleurocera)	13		
2337 (Truncatelloidea)	1		7
2156 (Corbicula fluminea)	5		6
2181 (Sphaerium)	8		6
9031 (Lirceus)	1		8
8996 (Faxonius)	1		4
9016 (Faxonius sloanii)	1	form II male	
1017 (HEPTAGENIIDAE)	3		4
9156 (Maccaffertium)	1	exiguum/pulchellum, J21-065.2	
7001 (Nixe inconspicua)	1	J21-065.1	
7011 (Acerpenna pygmaea)	3		2
9366 (Baetis intercalaris complex)	31	J21-065.4-7	3
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 Macromia based on claws	3
7046 (Epitheca princeps)	1		
3568 (Argia)	1	gill undeveloped, tibialis?	5
7118 (Trepobates inermis)	1	male	
7116 (Metrobates hesperius)	1	male	
7122 (Microvelia)	1	nymph	
9290 (Gerridae (Gerrinae))	1	nymph	
9293 (Gerridae (Trepobatinae))	1	nymph, Trepobates?	
3600 (Peltodytes duodecimpunctatus)	2		
7293 (Psephenus herricki)	1		4
7307 (Stenelmis)	10	larvae	5
7317 (Stenelmis sexlineata)	12	adults	
7295 (Ancyronyx variegatus)	3	adults	4
3799 (Corydalus cornutus)	2		2
1045 (PHILOPOTAMIDAE)	1	imm.	3
3267 (Chimarra obscura)	33		4

Type	Value	Metric Score
Total Taxa:	61	5
Total No. Individuals:	325	5
EPT Taxa:	14	5
% Orthocladiinae + Tanytarsini of Chironomidae:	52.43	1
% Non-insects excluding Astacidae:	9.54	5
Diptera Taxa:	22	5
% Intolerant (0-3):	30.77	3
% Tolerant (8-10):	1.54	5
% Predators FFG 1:	5.23	1
% Shredders + Scrapers FFG 1:	4.62	1
% Collector-Filterers FFG 1:	36.92	1
% Sprawlers:	5.54	3
mIBI Metric Score:		**40**

Supplemental Metrics

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

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

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM090-0015	21T-010	MHAB	AB46789	210824704	8/24/21	Jackson

Stream Name	Location	HUC 12	HUCTO14
Vernon Fork Muscatatuck River	CR 50 North	051202070706	05120207090010

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4305037.95	599591.57	55	1.458	364.501	42

TAXON	COUNT	NOTES	HBI Tolerance
1220 (PLATYHELMINTHES)	1		
1426 (Branchiura sowerbyi)	2		6
1435 (Limnodrilus hoffmeisteri)	2		10
1421 (Aulodrilus pigueti)	1		7
1522 (Pristinella jenkinae)	1	? head iffy	8
1552 (Tubificinae with bifid chetae and no hair chetae)	11		
1553 (Tubificinae with pectinate chetae and hair chetae)	1		
1555 (Tubificinae with bifid chetae and hair)	1	(thin upper teeth)	
1234 (GLOSSIPHONIIDAE)	1		
1233 (Erpobdellidae)	1		
2181 (Sphaerium)	11		6
1083 (Acari)	1		4
9050 (Hyalella)	17		
9019 (Cambarus)	1	female	2
9016 (Faxonius sloanii)	1	form II male	
3048 (Stenacron)	3		3
9361 (Caenis Diminuta Gr.)	5	not latipennis, probably diminuta, one with everted ovaries	
3259 (Pachydiplax longipennis)	1		
3282 (Plathemis lydia)	2		8
3397 (Macromia)	3		2
3553 (Enallagma geminatum)	1		
1041 (CORIXIDAE)	162	nymphs	5
7201 (Trichocorixa calva)	102	f 48 m 54	4
7202 (Trichocorixa kanza)	6	f 5 m 1	4
7183 (Palmacorixa)	1	probably nana? female	5
7217 (Ranatra buenoi)	1		
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

Type	Value	Metric Score
Total Taxa:	49	5
Total No. Individuals:	383	5
EPT Taxa:	4	1
% Orthocladiinae + Tanytarsini of Chironomidae:	0	5
% Non-insects excluding Astacidae:	13.32	5
Diptera Taxa:	14	5
% Intolerant (0-3):	2.61	1
% Tolerant (8-10):	3.66	5
% Predators FFG 1:	74.93	5
% Shredders + Scrapers FFG 1:	1.57	1
% Collector-Filterers FFG 1:	5.22	5
% Sprawlers:	0.78	1
mIBI Metric Score:		**44**

Supplemental Metrics

HBI	4.83
Shannon-Weaver Index	2.12
Shannon Equitability	0.54
% Dominant 3 Taxon	73.37
% Chironomidae	7.83

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

TAXON	COUNT	NOTES	HBI Tolerance
		?	
9154 (Hydropsyche venularis)	2	? smaller may be hard to id	3
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 Gr.)	1		

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment
MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM080-0013	21T-016	MHAB	AB47668	210817901	8/17/21	Jackson

Stream Name	Location	HUC 12	HUCTO14
Storm Creek Ditch	CR 400 North	051202070703	05120207080040

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4310857.62	603484.81	55	2.682	17.513	44

TAXON	COUNT	NOTES	HBI Tolerance
1220 (PLATYHELMINTHES)	2		
1552 (Tubificinae with bifid chetae and no hair chetae)	1		
1234 (GLOSSIPHONIIDAE)	2	one with many babies	
1090 (Physa)	3		8
1083 (Acari)	2		4
9036 (Caecidotea)	1		8
9050 (Hyalella)	25		
9056 (Crangonyx)	1		6
3083 (Callibaetis floridanus)	4		
9361 (Caenis Diminuta Gr.)	5		
3259 (Pachydiplax longipennis)	1		
3305 (Erythemis simplicicollis)	1		
3323 (Libellula pulchella)	1		
3331 (Sympetrum)	1		10
3540 (Ischnura)	1	gills undeveloped, probably posita	9
3542 (Ischnura posita)	3		
3546 (Enallagma)	1	small, probably divagans	9
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.	
7217 (Ranatra buenoi)	1		
7220 (Ranatra nigra)	2		4
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		

Type	Value	Metric Score
Total Taxa:	48	5
Total 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
% Collector-Filterers FFG 1:	6.72	5
% Sprawlers:	0	1
mIBI Metric Score:		**34**

Supplemental Metrics

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

TAXON	COUNT	NOTES	HBI Tolerance
3666 (Hygrotus sayi)	1	?	
3789 (Liodessus flavicollis)	2	pattern odd, 2 spots in front of elytra instead of fascia	6
3964 (Suphisellus)	1	larva	
3966 (S. bicolor bicolor)	1	bicolor subsp.??? adult	
1096 (SCIRTIDAE)	2		5
3911 (Hydrochus)	1	female	5
3794 (Chauliodes pectinicornis)	1	? imm.	
7732 (Anopheles)	1		
7780 (Culex)	5	some not 4th 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 carinatus)	1		5
8241 (Tanytarsus)	1		4
8180 (Polypedilum tritum)	4		
9241 (Polypedilum Illinoense Gr.)	6	1 pupa	

Residuals

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM080-0014	21T-012	MHAB	AB47664	210817902	8/17/21	Jackson

Stream Name	Location	HUC 12	HUCTO14
Mutton Creek Ditch	CR 400 North	051202070704	05120207080020

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4310866.62	602644.25	55	2.112	29.807	48

TAXON	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

Type	Value	Metric 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 Score:		**30**

Supplemental Metrics

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

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

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM080-0014	21T-012	MHAB	AB46802	210817903	8/17/21	Jackson

Stream Name	Location	HUC 12	HUCTO14
Mutton Creek Ditch	CR 400 North	051202070704	05120207080020

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4310866.62	602644.25	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 pentacantha)	3		
3080 (Phanogomphus graslinellus)	1	might be a little 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 duodecimpunctatus)	1		
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	

Type	Value	Metric Score
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**

Supplemental Metrics

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

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 modestus/neomodestus?	6
8123 (Endochironomus)	5	subtendens?	6
9296 (Microtendipes Pedellus Gr.)	1		
8172 (Phaenopsectra)	1	flavipes?	7
8241 (Tanytarsus)	2		4
9278 (Polypedilum Halterale Gr.)	1		
9241 (Polypedilum Illinoense Gr.)	4		

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM070-0029	21T-007	MHAB	AB47659	210817702	8/17/21	Jennings

Stream Name	Location	HUC 12	HUCTO14
Tea Creek	CR 650 West	051202070705	05120207070040

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4304896.05	610036.43	55	2.676	10.632	46

TAXON	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 duodecimpunctatus)	3	adult F	
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 Gr.)	1		
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

Type	Value	Metric Score
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 Score:		**42**

Supplemental Metrics

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

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

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM-07-0020	21T-022	MHAB	AB47674	210816701	8/16/21	Jennings

Stream Name	Location	HUC 12	HUCTO14
Sixmile Creek	CR 415 North	051202070702	05120207070050

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4322688.11	614537.51	55	16.916	8.944	57

TAXON	COUNT	NOTES	HBI Tolerance
1260 (Nemata)	1		6
1526 (Slavina appendiculata)	1		6
1486 (Chaetogaster limnaei)	2		6
1504 (Nais pardalis)	1		8
1501 (Nais bretscheri)	1		6
1561 (Nais communis/variabilis complex)	1		
1552 (Tubificinae with bifid chetae and no hair chetae)	1		
1565 (Aeolosoma)	1		8
1204 (GASTROPODA)	1	no shell, damaged, ferrissia?	7
1087 (Ferrissia)	5		6
1088 (Gyraulus)	2	? imm?	8
1090 (Physa)	20		8
1083 (Acari)	2		4
9031 (Lirceus)	3		8
8996 (Faxonius)	2	female	4
9016 (Faxonius sloanii)	3	form II male	
3020 (Stenonema femoratum)	5		3
9361 (Caenis Diminuta Gr.)	13		
3245 (Boyeria vinosa)	1		4
3448 (Somatochlora)	1	ensigera grp?	1
1022 (CALOPTERYGIDAE)	2	? imm.	5
3534 (Calopteryx)	2	no gills, imm.	4
1026 (COENAGRIONIDAE)	3	imm.	9
3546 (Enallagma)	1	no gills	9
3549 (Enallagma divagans)	2		
3568 (Argia)	7	imm. no gills	5
9095 (Argia fumipennis)	1		
7225 (Notonecta irrorata)	1		
1038 (GERRIDAE)	4	nymphs Aquarius?	
7111 (Rheumatobates)	1	beat up female	
7120 (Trepobates pictus)	2	males	
7123 (Microvelia americana)	1		
3600 (Peltodytes duodecimpunctatus)	14		
7307 (Stenelmis)	4	3 females (crenata?) 1 larva	5
3000 (Hydroptila)	1		3

Type	Value	Metric Score
Total Taxa:	57	5
Total No. Individuals:	237	3
EPT Taxa:	3	1
% Orthocladiinae + Tanytarsini of Chironomidae:	53.23	1
% Non-insects excluding Astacidae:	17.72	5
Diptera Taxa:	22	5
% Intolerant (0-3):	3.38	1
% Tolerant (8-10):	13.5	3
% Predators FFG 1:	13.5	1
% Shredders + Scrapers FFG 1:	17.72	3
% Collector-Filterers FFG 1:	23.21	1
% Sprawlers:	2.95	1
mIBI Metric Score:		**30**

Supplemental Metrics

HBI	5.29
Shannon-Weaver Index	3.3
Shannon Equitability	0.82
% Dominant 3 Taxon	36.71
% Chironomidae	52.32

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

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 Gr.)	1		
9335 (Paratendipes albimanus grp)	10		
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 Gr.)	2		
9241 (Polypedilum Illinoense Gr.)	1		

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment
MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM070-0020	21T-009	MHAB	AB47661	210818901	8/18/21	Jackson

Stream Name	Location	HUC 12	HUCTO14
Vernon Fork Muscatatuck River	US 31	051202070705	05120207070070

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4307017.25	602222.65	55	1.458	292.076	74

TAXON	COUNT	NOTES	HBI Tolerance
1085 (Tubificinae)	1	w/ hair chastae, bifid ventrals with short upper teeth, papillate, foreign matter adhered to body wall	10
1430 (Isochaetides curvisetosus)	1		
1502 (Nais communis)	1		8
1357 (BRANCHIOBDELLIDAE)	19		6
2211 (Pleurocera)	3		
2156 (Corbicula fluminea)	4		6
2181 (Sphaerium)	2		6
9050 (Hyalella)	3		
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/exiguum?	
3019 (Maccaffertium exiguum)	5	J21-037.3	2
3018 (Maccaffertium pulchellum)	9	? J21-037.4, 037.5	2
3048 (Stenacron)	4		3
9366 (Baetis intercalaris complex)	16	J21-037.6, 037.7	3
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 duodecimpunctatus)	2		
3604 (Peltodytes sexmaculatus)	2	1f 1m	
3776 (Uvarus)	1	falli (or lacustris?)	
3851 (Berosus peregrinus)	1		6

Type	Value	Metric Score
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 Score:		**42**

Supplemental Metrics

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

TAXON	COUNT	NOTES	HBI 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		

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM-07-0017	21T-019	MHAB	AB47671	210816703	8/16/21	Jennings

Stream Name	Location	HUC 12	HUCTO14
Sixmile Creek	CR 500 South	051202070702	05120207070060

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4307645.38	607307.92	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	N	
3600 (Peltodytes duodecimpunctatus)	6	A	
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)	6		2
8922 (Nectopsyche candida)	2		

Type	Value	Metric Score
Total Taxa:	53	5
Total 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**

Supplemental Metrics

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

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 Gr.)	2		
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 Gr.)	1		
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 Gr.)	8		

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM080-0025	21T-015	MHAB	AB47667	210816901	8/16/21	Jennings

Stream Name	Location	HUC 12	HUCTO14
Mutton Creek	CR 300 North	051202070704	05120207080010

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4320605.46	606864.92	55	6.52	8.239	53

TAXON	COUNT	NOTES	HBI Tolerance
1515 (Pristina aequiseta)	1		8
1552 (Tubificinae with bifid chetae and no hair chetae)	1		
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 duodecimpunctatus)	4		
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 than other one (~2.5mm) weird qaudrinotata or small bivittata?	5
7300 (Dubiraphia vittata)	1	J21-029.3 aedaegus	

Type	Value	Metric Score
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

Supplemental Metrics

HBI	3.96
Shannon-Weaver Index	3.3
Shannon Equitability	0.82
% Dominant 3 Taxon	38.85
% Chironomidae	16.56

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

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 Gr.)	1		
9335 (Paratendipes albimanus grp)	5		
8172 (Phaenopsectra)	1		7
8192 (Polypedilum flavum)	5		
8211 (Stictochironomus)	1		4
8238 (Rheotanytarsus)	1		3

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM080-0027	21T-014	MHAB	AB47666	210816902	8/16/21	Jackson

Stream Name	Location	HUC 12	HUCTO14
Mutton Creek	CR 800 North	051202070704	05120207080020

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4317303.85	603360.99	55	4.798	18.199	52

TAXON	COUNT	NOTES	HBI Tolerance
1561 (Nais communis/variabilis complex)	2		
1357 (BRANCHIOBDELLIDAE)	2		6
1090 (Physa)	1		8
2156 (Corbicula fluminea)	3		6
2181 (Sphaerium)	6		6
1083 (Acari)	2		4
9050 (Hyalella)	5		
8996 (Faxonius)	1	female	4
1110 (EPHEMEROPTERA)	1	imm.	
3020 (Stenonema femoratum)	1		3
9347 (Procloeon viridoculare)	1	? J21-013.1 no gills, small	
9361 (Caenis Diminuta Gr.)	11	one very beat up	
3248 (Basiaeschna janata)	1		6
3251 (Nasiaeschna pentacantha)	1		
1021 (GOMPHIDAE)	1	imm.	1
3448 (Somatochlora)	2	ensigera? imm.	1
1026 (COENAGRIONIDAE)	1	not argia	9
3542 (Ischnura posita)	1		
3546 (Enallagma)	3		9
3549 (Enallagma divagans)	28		
3557 (Enallagma civile)	1	or germinatum, leaning toward imm. civile	
3560 (Enallagma basidens)	1		
3568 (Argia)	3	small / no gills	5
9095 (Argia fumipennis)	5		
3572 (Argia tibialis)	7		
7230 (Neoplea striola)	1		
7209 (Belostoma lutarium)	1		
7217 (Ranatra buenoi)	1		
1038 (GERRIDAE)	1	nymph, Limnoporus?	
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	

Type	Value	Metric Score
Total Taxa:	59	5
Total No. Individuals:	167	3
EPT Taxa:	6	3
% Orthocladiinae + Tanytarsini of Chironomidae:	50.94	1
% Non-insects excluding Astacidae:	12.57	5
Diptera Taxa:	18	5
% Intolerant (0-3):	4.79	1
% Tolerant (8-10):	4.19	5
% Predators FFG 1:	39.52	5
% Shredders + Scrapers FFG 1:	2.4	1
% Collector-Filterers FFG 1:	11.98	3
% Sprawlers:	4.19	3
mIBI Metric Score:		**40**

Supplemental Metrics

HBI	4.99
Shannon-Weaver Index	3.54
Shannon Equitability	0.87
% Dominant 3 Taxon	28.74
% Chironomidae	31.74

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

TAXON	COUNT	NOTES	HBI Tolerance
3600 (Peltodytes duodecimpunctatus)	5		
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 crassicornus/rectinervis complex)	1		
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		

Residuals

Identifier	Date	Count	%PSE
SEZ	10/12/2022	0	100

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM090-0003	21T-001	MHAB	AB47653	210824701	8/24/21	Jackson

Stream Name	Location	HUC 12	HUCTO14
Vernon Fork Muscatatuck River	CR 600 South	051202070706	05120207090010

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4294456.83	596911.39	55	1.343	391.167	43

TAXON	COUNT	NOTES	HBI Tolerance
1552 (Tubificinae with bifid chetae and no hair chetae)	1		
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		

Type	Value	Metric 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 Score:		**38**

Supplemental Metrics

HBI	4
Shannon-Weaver Index	3
Shannon Equitability	0.81
% Dominant 3 Taxon	40.85
% Chironomidae	9.86

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

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		

Residuals

Identifier	Date	Count	%PSE
SEZ	10/5/2021	5	96.48

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	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	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4314106.22	605913.95	55	17.212	1.529	56

TAXON	COUNT	NOTES	HBI Tolerance
1552 (Tubificinae with bifid chetae and no hair chetae)	1		
1357 (BRANCHIOBDELLIDAE)	2		6
1090 (Physa)	9		8
1083 (Acari)	1		4
9031 (Lirceus)	2		8
9056 (Crangonyx)	1		6
8996 (Faxonius)	7	female	4
9016 (Faxonius sloanii)	3	male form II	
3048 (Stenacron)	1		3
1020 (LIBELLULIDAE)	1	imm.	9
7026 (Calopteryx maculata)	1		
1026 (COENAGRIONIDAE)	1	probably Argia, imm.	9
3549 (Enallagma divagans)	1	imm.	
3568 (Argia)	1	probably tibialis but maybe apicalis	5
1038 (GERRIDAE)	3	2 definitely Gerrinae, one probably (very imm.)	
7122 (Microvelia)	2	nymphs	
7123 (Microvelia americana)	1	?	
1096 (SCIRTIDAE)	2		5
3267 (Chimarra obscura)	1		4
3432 (Cheumatopsyche)	1		3
7732 (Anopheles)	1		
9153 (Tribelos)	1	fuscicorne?	5
8227 (Tanytarsini)	1	pupa, no abdomen	
9248 (Ablabesmyia Mallochi Gr.)	4		
8086 (Chironomus)	2		8
8126 (Glyptotendipes)	1		6
8167 (Paratendipes)	1	pupa	6
9335 (Paratendipes albimanus grp)	14		
8172 (Phaenopsectra)	1	flavipes	7
8211 (Stictochironomus)	5		4
8714 (Lytogaster)	1	? maybe Nostima?	

Type	Value	Metric Score
Total Taxa:	31	3
Total No. Individuals:	74	1
EPT Taxa:	3	3
% Orthocladiinae + Tanytarsini of Chironomidae:	3.33	5
% Non-insects excluding Astacidae:	21.62	3
Diptera Taxa:	11	3
% Intolerant (0-3):	2.7	1
% Tolerant (8-10):	20.27	3
% Predators FFG 1:	12.16	1
% Shredders + Scrapers FFG 1:	17.57	3
% Collector-Filterers FFG 1:	6.76	5
% Sprawlers:	0	1
mIBI Metric Score:		**32**

Supplemental Metrics

HBI	5.88
Shannon-Weaver Index	2.99
Shannon Equitability	0.87
% Dominant 3 Taxon	40.54
% Chironomidae	40.54

OWQ/WAPB Macroinvertebrate Community Assessment
MHAB Report

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM070-0029	21T-007	MHAB	AB46803	210817703	8/17/21	Jennings

Stream Name	Location	HUC 12	HUCTO14
Tea Creek	CR 650 West	051202070705	05120207070040

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4304896.05	610036.43	55	2.676	10.632	43

TAXON	COUNT	NOTES	HBI Tolerance
1552 (Tubificinae with bifid chetae and no hair chetae)	2		
1357 (BRANCHIOBDELLIDAE)	1		6
1206 (PLANORBIDAE)	1	shell very broken	6
1090 (Physa)	1		8
1083 (Acari)	1		4
9031 (Lirceus)	1		8
8996 (Faxonius)	3	1 Form II M & 2F	4
3020 (Stenonema femoratum)	3		3
9361 (Caenis Diminuta Gr.)	3		
3245 (Boyeria vinosa)	1		4
1021 (GOMPHIDAE)	1	early instar (~5.5 mm long)	1
3448 (Somatochlora)	5	early instars	1
7026 (Calopteryx maculata)	2		
3546 (Enallagma)	1	no gills	9
1038 (GERRIDAE)	1	Nymph; likely Limnoporus	
1096 (SCIRTIDAE)	1	larva	5
7296 (Dubiraphia)	1	Adult F	5
7295 (Ancyronyx variegatus)	1	A	4
7963 (Labrundinia)	3		4
7977 (Zavrelimyia)	1		4
9153 (Tribelos)	1		5
8083 (Chironomini)	4		
9248 (Ablabesmyia Mallochi Gr.)	13		
9261 (Thienemannimyia Gr.)	1		
9284 (Tribelos jucundum)	7		
8086 (Chironomus)	5		8
8112 (Dicrotendipes)	2		6
8126 (Glyptotendipes)	1		6
9335 (Paratendipes albimanus grp)	2		
8179 (Polypedilum)	1		
8228 (Cladotanytarsus)	1		4
8235 (Paratanytarsus)	3		4
8238 (Rheotanytarsus)	1		3
8241 (Tanytarsus)	4		4
9240 (Polypedilum Fallax Gr.)	1		
9241 (Polypedilum Illinoense Gr.)	4		
8355 (Tabanus)	1		5

Type	Value	Metric Score
Total Taxa:	37	3
Total No. Individuals:	86	1
EPT Taxa:	2	1
% Orthocladiinae + Tanytarsini of Chironomidae:	16.36	5
% Non-insects excluding Astacidae:	8.14	5
Diptera Taxa:	19	5
% Intolerant (0-3):	11.63	1
% Tolerant (8-10):	9.3	5
% Predators FFG 1:	17.44	1
% Shredders + Scrapers FFG 1:	4.65	1
% Collector-Filterers FFG 1:	6.98	5
% Sprawlers:	3.49	3
mIBI Metric Score:		**36**

Supplemental Metrics

HBI	4.56
Shannon-Weaver Index	3.27
Shannon Equitability	0.91
% Dominant 3 Taxon	29.07
% Chironomidae	63.95

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM-07-0021	21T-006	MHAB	AB47658	210816704	8/16/21	Jennings

Stream Name	Location	HUC 12	HUCTO14
Tea Creek	CR 650 South	051202070705	05120207070040

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4305200.12	613696.23	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		

Type	Value	Metric Score
Total Taxa:	23	3
Total No. Individuals:	87	1
EPT Taxa:	4	5
% Orthocladiinae + Tanytarsini of Chironomidae:	0	5
% Non-insects excluding Astacidae:	42.53	1
Diptera Taxa:	9	3
% Intolerant (0-3):	2.3	1
% Tolerant (8-10):	9.2	5
% Predators FFG 1:	13.79	1
% Shredders + Scrapers FFG 1:	10.34	3
% Collector-Filterers FFG 1:	5.75	5
% Sprawlers:	6.9	5
mIBI Metric Score:		**38**

Supplemental Metrics

HBI	5.76
Shannon-Weaver Index	2.54
Shannon Equitability	0.81
% Dominant 3 Taxon	47.13
% Chironomidae	29.89

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM-07-0019	21T-021	MHAB	AB47673	210816702	8/16/21	Jennings

Stream Name	Location	HUC 12	HUCTO14
Sixmile Creek	CR 175 North	051202070702	05120207070050

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4318694.71	612124.45	55	9.933	13.834	67

TAXON	COUNT	NOTES	HBI 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 complex)	18	S21-035.2 & .3	3
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 Gr.)	3		
8179 (Polypedilum)	1		
8192 (Polypedilum flavum)	18		
8211 (Stictochironomus)	3		4
8241 (Tanytarsus)	1		4
9260 (Cricotopus / Orthocladius)	1		
9241 (Polypedilum Illinoense Gr.)	8		
8320 (Chrysops)	1		5

Type	Value	Metric Score
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**

Supplemental Metrics

HBI	4.44
Shannon-Weaver Index	3
Shannon Equitability	0.84
% Dominant 3 Taxon	36.36
% Chironomidae	40.61

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM-07-0015	21T-005	MHAB	AB47657	210824703	8/24/21	Jackson

Stream Name	Location	HUC 12	HUCTO14
John McDonald Ditch	CR 125 South	051202070706	05120207090010

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4302210.85	600156.26	55	2.349	4.799	42

TAXON	COUNT	NOTES	HBI Tolerance
1233 (Erpobdellidae)	1		
1089 (Helisoma)	3	immatures	6
1090 (Physa)	4	1 is very small and broken, can't find small one, may have slipped out of vial	8
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 pentacantha)	1		
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 condition, no lateral spines, sympetrum?	9
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 undeveloped gills probably posita	9
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	

Type	Value	Metric Score
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 Score:		**34**

Supplemental Metrics

HBI	6.81
Shannon-Weaver Index	3.12
Shannon Equitability	0.81
% Dominant 3 Taxon	42.59
% Chironomidae	14.81

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM-07-0014	21T-018	MHAB	AB47670	210816904	8/16/21	Jennings

Stream Name	Location	HUC 12	HUCTO14
Storm Creek	Base Road	051202070703	05120207080030

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4315612.51	605087.48	55	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 (LEPTOPHLEBIIDAE)	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		

Type	Value	Metric Score
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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

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/Paramerina	
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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM070-0036	21T-023	MHAB	AB47675	210818702	8/18/21	Jennings

Stream Name	Location	HUC 12	HUCTO14
Vernon Fork Muscatatuck River	CR 400 West	051202070701	05120207070020

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4312526.91	613944.76	55	1.437	218.283	62

TAXON	COUNT	NOTES	HBI Tolerance
2156 (Corbicula fluminea)	2		6
1083 (Acari)	1		4
3048 (Stenacron)	1		3
9366 (Baetis intercalaris complex)	5	Slide S21-089.1	3
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		
7117 (Trepobates)	1	imm.	
7107 (Limnoporus canaliculatus)	1	A	
3600 (Peltodytes duodecimpunctatus)	1	A	
3828 (Dineutus)	1		4
3846 (Berosus)	8	L	7
3851 (Berosus peregrinus)	1	A	6
3872 (Tropisternus)	8	L	
3959 (Helichus lithophilus)	1	A	
7317 (Stenelmis sexlineata)	8	A	
7295 (Ancyronyx variegatus)	1	A	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		
8083 (Chironomini)	3		
9248 (Ablabesmyia Mallochi Gr.)	10		

Type	Value	Metric 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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

TAXON	COUNT	NOTES	HBI Tolerance
9250 (Ablabesmyia Rhamphae Gr.)	1		
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 Gr.)	16		

Residuals

Identifier	Date	Count	%PSE

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

Warning: Macro Data is not finalized (status is not "Approved"); IBI scores may not be final.

Site Name	EPA ID	Macro Sample Type	Sample #	Macro Event #	Sample Date	County
WEM-07-0018	21T-020	MHAB	AB47672	210818701	8/18/21	Jennings

Stream Name	Location	HUC 12	HUCTO14
Sixmile Creek	CR 200 South	051202070702	05120207070060

Northing	Easting	Ecoregion	Gradient	Drainage Area	QHEI Score
4312478.94	609858.73	55	9.117	24.444	62

TAXON	COUNT	NOTES	HBI Tolerance
2156 (Corbicula fluminea)	1		6
8996 (Faxonius)	2	2F	4
1251 (ISOTOMIDAE)	1		
3048 (Stenacron)	1		3
1012 (BAETIDAE)	6	dmg.	4
9366 (Baetis intercalaris complex)	15	S21-036.2 & .3	3
9361 (Caenis Diminuta Gr.)	5		
3248 (Basiaeschna janata)	2		6
3099 (Hagenius brevistylus)	2	Photos taken, then released	1
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 duodecimpunctatus)	37	A	
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		

Type	Value	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

OWQ/WAPB Macroinvertebrate Community Assessment MHAB Report

TAXON	COUNT	NOTES	HBI Tolerance
9248 (Ablabesmyia Mallochi Gr.)	4		
9250 (Ablabesmyia Rhamphae Gr.)	1		
9261 (Thienemannimyia Gr.)	6		
9284 (Tribelos jucundum)	1		
8099 (Cryptochironomus)	2		5
8112 (Dicrotendipes)	1		6
8126 (Glyptotendipes)	1		6
9296 (Microtendipes Pedellus Gr.)	1		
8179 (Polypedilum)	3		
8192 (Polypedilum flavum)	3		
8238 (Rheotanytarsus)	4		3
8241 (Tanytarsus)	2		4
8981 (Cricotopus/Orthocladius)	1		
9241 (Polypedilum Illinoense Gr.)	20		
8397 (Hemerodromia)	1		

Residuals

Identifier	Date	Count	%PSE

APPENDIX C. FISH AND MACROINVERTEBRATE COMMUNITY QUALITATIVE HABITAT EVALUATION INDEX

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47674	Fish	21T022	Sixmile Creek	CR 415 North

Surveyor	Sample Date	County	Macro Sample Type
CWY	8/16/21	Jennings	N/A

◊ Habitat Complete

QHEI Score: 55

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◊ ◊ Bldrs/Slabs (10)				◊ ◊ Hardpan (4)			
◊ ◊ Boulders (9)				◊ ◊ Detritus (3)		x	
◊ ◊ Cobble (8)				◊ ◊ Muck (2)			
◊ ◊ Gravel (7)				◊ ◊ Silt (2)		x	x
◊ ◊ Sand (6)		x	x	◊ ◊ Artificial (0)			
◈ ◈ Bedrock (5)		x	x				

NUMBER OF BEST TYPES: ◊ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◊ Limestone (1)
- ◈ Tills (1)
- ◊ Wetlands (0)
- ◊ Hardpan (0)
- ◊ Sandstone (0)
- ◊ Rip/Rap (0)
- ◊ Lacustrine (0)
- ◊ Shale (-1)
- ◊ Coal fines (-2)

QUALITY

SILT
- ◊ Heavy (-2)
- ◈ Moderate (-1)
- ◊ Normal (0)
- ◊ Free (1)

EMBEDDEDNESS
- ◊ Extensive (-2)
- ◊ Moderate (-1)
- ◈ Normal (0)
- ◊ None (1)

Substrate 10 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	1	Pools > 70cm (2)	1	Oxbows, Backwaters (1)
0	Overhanging vegetation (1)	0	Rootwads (1)	0	Aquatic macrophytes (1)
2	Shallows (in slow water) (1)	0	Boulders (1)	1	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◊ Extensive >75% (11)
- ◊ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◊ Nearly absent <5% (1)

COMMENTS

Cover 9 — *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◊ High (4)	◊ Excellent (7)	◈ None (6)	◈ High (3)
◊ Moderate (3)	◊ Good (5)	◊ Recovered (4)	◊ Moderate (2)
◈ Low (2)	◈ Fair (3)	◊ Recovering (3)	◊ Low (1)
◊ None (1)	◊ Poor (1)	◊ Recent or no recovery (1)	

COMMENTS

Channel 14 — *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ None or little (3)
- ◊ ◊ Moderate (2)
- ◊ ◊ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◊ ◈ Wide >50m (4)
- ◊ ◈ Moderate 10-50m (3)
- ◊ ◊ Narrow 5-10m (2)
- ◈ ◊ Very narrow <5m (1)
- ◊ ◊ None (0)

FLOOD PLAIN QUALITY (L R)
- ◊ ◈ Forest, Swamp (3)
- ◊ ◊ Shrub or Old field (2)
- ◈ ◈ Residential, Park, New field (1)
- ◊ ◊ Fenced pasture (1)
- ◊ ◊ Open Pasture/Rowcrop (0)
- ◊ ◊ Conservation Tillage (1)
- ◊ ◊ Urban or Industrial (0)
- ◊ ◊ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 7 — *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◊ >1m (6)
- ◈ 0.7-<1m (4)
- ◊ 0.4-<0.7m (2)
- ◊ 0.2-<0.4m (1)
- ◊ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◈ Pool width > riffle width (2)
- ◊ Pool width = riffle width (1)
- ◊ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◊ Torrential (-1)
- ◊ Very Fast (1)
- ◊ Fast (1)
- ◊ Moderate (1)
- ◈ Slow (1)
- ◊ Interstitial (-1)
- ◈ Intermittent (-2)
- ◊ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◊ *Primary Contact*
- ◊ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current 5 — *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
- ◊ Best Areas >10cm (2)
- ◊ Best Areas 5-10cm (1)
- ◊ Best Areas <5cm (metric=0)

RUN DEPTH
- ◊ Maximum >50cm (2)
- ◊ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE
- ◊ Stable (e.g. cobble, boulder) (2)
- ◊ Mod. Stable (e.g. large gravel) (1)
- ◊ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◊ None (2)
- ◊ Low (1)
- ◊ Moderate (0)
- ◊ Extensive (-1)

Riffle/Run 0 — *Maximum 8*

COMMENTS

6-GRADIENT

(16.916 ft/mi)

DRAINAGE AREA

(8.944 mi²)

- ◊ Very low – Low (2-4)
- ◈ Moderate (6-10)
- ◊ High – Very high (10-6)

% POOL: 40 % GLIDE: 0

% RUN: 60 % RIFFLE: 0

Gradient 10 — *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- ◇ >85% - Open
- ◇ 55%-<85%
- ◇ 30%-<55%
- ◇ 10%-<30%
- ◈ <10% - Closed

Canopy Upstream Reading

Right

7 Middle

Left

B-AESTHETICS

- ◈ Nuisance algae
- ◇ Invasive macrophytes
- ◇ Excess turbidity
- ◇ Discoloration
- ◇ Foam/Scum
- ◇ Oil sheen
- ◇ Trash/Litter
- ◇ Nuisance odor
- ◇ Sludge deposits
- ◇ CSOs/SSOs/Outfalls

C-MAINTENANCE

- ◇ Public
- ◇ Private
- ◇ Active
- ◇ Historic
- ◇ Young – Succession
- ◇ Old - Succession
- ◇ Spray
- ◇ Leveed – One sided
- ◇ Leveed – Both Banks
- ◇ Moving – Bedload
- ◇ Stable - Bedload
- ◇ Armoured
- ◇ Slumps
- ◇ Islands
- ◇ Scoured
- ◇ Relocated
- ◇ Cutoffs
- ◇ Impounded
- ◇ Desiccated
- ◇ Flood Control
- ◇ Drainage
- ◇ Snag Removed
- ◇ Snag Modified

D-ISSUES

- ◇ WWTP
- ◇ NPDES
- ◇ CSO
- ◇ Hardened
- ◇ Urban
- ◇ Dirt & Grime
- ◇ Contaminated
- ◇ Landfill
- ◇ Industry
- ◇ Construction BMPs
- ◇ Sediment BMPs
- ◇ Logging
- ◇ Irrigation
- ◇ Cooling
- ◇ Bank Erosion
- ◇ Surface Erosion
- ◇ H2O table
- ◇ False bank
- ◇ Manure
- ◇ Lagoon
- ◇ Wash H2O
- ◇ Tile
- ◇ Natural Flow
- ◇ Acid Mine
- ◇ Wetlands
- ◇ Stagnant Flow
- ◇ Quarry Mine
- ◇ Golf
- ◇ Home
- ◇ Park
- ◇ Data Paucity
- ◇ Lawn
- ◇ Agriculture
- ◇ Livestock
- ◇ Atmosphere Deposition

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47671	Fish	21T019	Sixmile Creek	CR 500 South

Surveyor	Sample Date	County	Macro Sample Type
CWY	8/16/21	Jennings	N/A

◇ Habitat Complete

QHEI Score: 49

1-SUBSTRATE

Check *ONLY* Two substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	
◇ ◇ Cobble (8)				◇ ◇ Muck (2)		x	
◇ ◇ Gravel (7)			x	◈ ◇ Silt (2)		x	x
◇ ◈ Sand (6)		x	x	◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

Check ONE (*or* 2 & *average*)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◈ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate 7 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2	Undercut banks (1)	0	Pools > 70cm (2)	1	Oxbows, Backwaters (1)
2	Overhanging vegetation (1)	1	Rootwads (1)	1	Aquatic macrophytes (1)
1	Shallows (in slow water) (1)	0	Boulders (1)	2	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover *Maximum 20* 13

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◇ Moderate (3)
- ◈ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◈ Good (5)
- ◇ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◇ Recovered (4)
- ◈ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◇ Moderate (2)
- ◈ Low (1)

COMMENTS

Channel *Maximum 20* 11

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◈ ◈ Moderate (2)
- ◈ ◈ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◈ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian *Maximum 10* 3

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◈ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◈ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current *Maximum 12* 9

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

◇ No Riffle (metric=0)

RIFFLE DEPTH

Check **ONE** (*ONLY!*)
- ◇ Best Areas >10cm (2)
- ◈ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◈ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◈ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◈ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run *Maximum 8* 2

6-GRADIENT

(2.423 ft/mi)

DRAINAGE AREA

(30.679 mi²)

- ◈ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 25 % GLIDE: 0

% RUN: 60 % RIFFLE: 15

Gradient *Maximum 10* 4

IDEM

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- >85% - Open
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10% - Closed

Canopy Upstream Reading

Right

95 Middle

Left

B-AESTHETICS

- Nuisance algae
- Invasive macrophytes
- Excess turbidity
- Discoloration
- Foam/Scum
- Oil sheen
- Trash/Litter
- Nuisance odor
- Sludge deposits
- CSOs/SSOs/Outfalls

C-MAINTENANCE

- Public
- Private
- Active
- Historic
- Young – Succession
- Old - Succession
- Spray
- Leveed – One sided
- Leveed – Both Banks
- Moving – Bedload
- Stable - Bedload
- Armoured
- Slumps
- Islands
- Scoured
- Relocated
- Cutoffs
- Impounded
- Desiccated
- Flood Control
- Drainage
- Snag Removed
- Snag Modified

D-ISSUES

- WWTP
- NPDES
- CSO
- Hardened
- Urban
- Dirt & Grime
- Contaminated
- Landfill
- Industry
- Construction BMPs
- Sediment BMPs
- Logging
- Irrigation
- Cooling
- Bank Erosion
- Surface Erosion
- H2O table
- False bank
- Manure
- Lagoon
- Wash H2O
- Tile
- Natural Flow
- Acid Mine
- Wetlands
- Stagnant Flow
- Quarry Mine
- Golf
- Home
- Park
- Data Paucity
- Lawn
- Agriculture
- Livestock
- Atmosphere Deposition

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47672	Fish	21T020	Sixmile Creek	CR 200 South

Surveyor	Sample Date	County	Macro Sample Type
CWY	8/18/21	Jennings	N/A

◈ Habitat Complete

QHEI Score: 62

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	
◇ ◇ Cobble (8)				◇ ◇ Muck (2)			
◇ ◈ Gravel (7)		x	x	◇ ◇ Silt (2)		x	
◈ ◇ Sand (6)		x	x	◇ ◇ Artificial (0)		x	x
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate **14** *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

1	Undercut banks (1)	1	Pools > 70cm (2)	0	Oxbows, Backwaters (1)
0	Overhanging vegetation (1)	1	Rootwads (1)	1	Aquatic macrophytes (1)
1	Shallows (in slow water) (1)	0	Boulders (1)	1	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 **13**

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◇ Moderate (3)
- ◈ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◈ Good (5)
- ◈ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◇ Recovered (4)
- ◈ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◈ Moderate (2)
- ◈ Low (1)

COMMENTS

Channel Maximum 20 **11**

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or* 2 *per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◈ ◈ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◈ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 **3**

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◈ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 **7**

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!*)

RIFFLE DEPTH
- ◇ Best Areas >10cm (2)
- ◈ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◈ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◈ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◈ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run Maximum 8 **4**

6-GRADIENT

(9.117 ft/mi)

DRAINAGE AREA

(24.444 mi²)

- ◇ Very low – Low (2-4)
- ◈ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 60 **% GLIDE:** 0

% RUN: 30 **% RIFFLE:** 10

Gradient Maximum 10 **10**

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◈ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
35 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47670	Fish	21T018	Storm Creek	Base Road

Surveyor	Sample Date	County	Macro Sample Type
KAG	8/16/21	Jennings	N/A

◇ Habitat Complete

QHEI Score: 61

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)			
◇ ◆ Gravel (7)		x	x
◆ ◇ Sand (6)		x	x
◇ ◇ Bedrock (5)			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Hardpan (4)			
◇ ◇ Detritus (3)			
◇ ◇ Muck (2)			
◇ ◇ Silt (2)		x	x
◇ ◇ Artificial (0)			

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◆ 3 or less (0)

Check ONE (*or* 2 & *average*)

ORIGIN
- ◇ Limestone (1)
- ◆ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◇ Moderate (-1)
- ◆ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◆ Normal (0)
- ◇ None (1)

Substrate Maximum 20: **14**

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

- 2 Undercut banks (1)
- 1 Overhanging vegetation (1)
- 1 Shallows (in slow water) (1)
- 1 Rootmats (1)
- 2 Pools > 70cm (2)
- 1 Rootwads (1)
- 0 Boulders (1)
- 0 Oxbows, Backwaters (1)
- 0 Aquatic macrophytes (1)
- 2 Logs and woody debris (1)

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◆ Moderate 25-75% (7)
- ◇ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20: **15**

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◆ Moderate (3)
- ◆ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◆ Good (5)
- ◆ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◇ Recovered (4)
- ◆ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◇ Moderate (2)
- ◆ Low (1)

COMMENTS

Channel Maximum 20: **11**

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◆ ◆ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◆ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◆ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◆ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◆ ◆ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10: **5**

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◆ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◆ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◆ Moderate (1)
- ◆ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12: **10**

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◇ No Riffle (metric=0)

RIFFLE DEPTH

Check **ONE** (*ONLY!*)
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◆ Best Areas <5cm (metric=0)

RUN DEPTH
- ◆ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◆ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◆ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

Riffle/Run Maximum 8: **0**

COMMENTS

6-GRADIENT

(4.073 ft/mi)

DRAINAGE AREA

(9.378 mi²)

- ◇ Very low – Low (2-4)
- ◆ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 40	% GLIDE: 0
% RUN: 50	% RIFFLE: 10

Gradient Maximum 10: **6**

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT Pool depth >3ft

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◈ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
4 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47661	Fish	21T009	Vernon Fork Muscatatuck River	US 31

Surveyor	Sample Date	County	Macro Sample Type
SLS	8/18/21	Jackson	N/A

◇ Habitat Complete

QHEI Score: 70

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)			x	◇ ◇ Detritus (3)		x	
◇ ◇ Cobble (8)			x	◇ ◇ Muck (2)			
◇ ◇ Gravel (7)		x	x	◇ ◇ Silt (2)		x	
◇ ◇ Sand (6)		x		◇ ◈ Artificial (0)			x
◈ ◇ Bedrock (5)		x					

NUMBER OF BEST TYPES: ◈ 4 or more (2) ◇ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

Check ONE (*or 2 & average*)

ORIGIN
- ◇ Limestone (1)
- ◇ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◈ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◈ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 7 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

1	Undercut banks (1)	2	Pools > 70cm (2)	0	Oxbows, Backwaters (1)
0	Overhanging vegetation (1)	1	Rootwads (1)	0	Aquatic macrophytes (1)
1	Shallows (in slow water) (1)	1	Boulders (1)	1	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT

Check ONE (*or 2 & average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◇ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover 15 — *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY
- ◇ High (4)
- ◇ Moderate (3)
- ◈ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◈ Good (5)
- ◇ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◈ None (6)
- ◇ Recovered (4)
- ◇ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◈ High (3)
- ◇ Moderate (2)
- ◇ Low (1)

COMMENTS

Channel 16 — *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◇ None or little (3)
- ◇ ◇ Moderate (2)
- ◇ ◈ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◈ ◈ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◈ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◇ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 7 — *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or 2 & average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◈ Very Fast (1)
- ◈ Fast (1)
- ◈ Moderate (1)
- ◇ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◈ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current 12 — *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◇ No Riffle (metric=0)

RIFFLE DEPTH — Check **ONE** (*ONLY!*)
- ◈ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◈ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

Check ONE (*or 2 & average*)

RIFFLE/RUN SUBSTRATE
- ◈ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◈ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run 7 — *Maximum 8*

6-GRADIENT

(1.458 ft/mi)

DRAINAGE AREA

(292.076 mi^2)

- ◈ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 40 **% GLIDE:** 0

% RUN: 45 **% RIFFLE:** 15

Gradient 6 — *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◈ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ Bank Erosion	◇ Surface Erosion	◇ H2O table
	◇ Trash/Litter	◇ Leveed – Both Banks				
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 Flow
	◇ CSOs/SSOs/Outfalls	◇ Relocated	◇ Cutoffs	◇ Quarry Mine	◇ Golf	◇ Home
45 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
15 Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB48619	Fish	21T022.5	Sixmile Creek	CR 415 North

Surveyor	Sample Date	County	Macro Sample Type
KAG	9/9/21	Jennings	N/A

◇ Habitat Complete

QHEI Score: 74

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	
◇ ◈ Cobble (8)		x		◇ ◇ Muck (2)			
◇ ◇ Gravel (7)		x	x	◇ ◇ Silt (2)		x	x
◇ ◇ Sand (6)		x		◇ ◇ Artificial (0)		x	
◈ ◇ Bedrock (5)		x	x				

NUMBER OF BEST TYPES: ◈ 4 or more (2) ◇ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

Check ONE (*or* 2 & *average*)

ORIGIN
◇ Limestone (1)
◈ Tills (1)
◇ Wetlands (0)
◇ Hardpan (0)
◇ Sandstone (0)
◇ Rip/Rap (0)
◇ Lacustrine (0)
◇ Shale (-1)
◇ Coal fines (-2)

QUALITY
SILT
◇ Heavy (-2)
◇ Moderate (-1)
◈ Normal (0)
◇ Free (1)
EMBEDDEDNESS
◇ Extensive (-2)
◇ Moderate (-1)
◈ Normal (0)
◇ None (1)

Substrate 16 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0 Undercut banks (1)
0 Overhanging vegetation (1)
1 Shallows (in slow water) (1)
1 Rootmats (1)
1 Pools > 70cm (2)
1 Rootwads (1)
1 Boulders (1)
1 Oxbows, Backwaters (1)
0 Aquatic macrophytes (1)
1 Logs and woody debris (1)

AMOUNT
Check ONE (*or* 2 & *average*)
◇ Extensive >75% (11)
◈ Moderate 25-75% (7)
◇ Sparse 5-<25% (3)
◇ Nearly absent <5% (1)

COMMENTS

Cover 15 *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
◇ High (4)
◇ Moderate (3)
◈ Low (2)
◇ None (1)

DEVELOPMENT
◇ Excellent (7)
◈ Good (5)
◈ Fair (3)
◇ Poor (1)

CHANNELIZATION
◇ None (6)
◈ Recovered (4)
◇ Recovering (3)
◇ Recent or no recovery (1)

STABILITY
◈ High (3)
◇ Moderate (2)
◇ Low (1)

COMMENTS

Channel 13 *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION
L R
◈ ◈ None or little (3)
◇ ◇ Moderate (2)
◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH
L R
◇ ◇ Wide >50m (4)
◇ ◇ Moderate 10-50m (3)
◈ ◈ Narrow 5-10m (2)
◇ ◇ Very narrow <5m (1)
◇ ◇ None (0)

FLOOD PLAIN QUALITY
L R
◇ ◈ Forest, Swamp (3)
◇ ◇ Shrub or Old field (2)
◈ ◈ Residential, Park, New field (1)
◇ ◇ Fenced pasture (1)
◇ ◇ Open Pasture/Rowcrop (0)
◇ ◇ Conservation Tillage (1)
◇ ◇ Urban or Industrial (0)
◇ ◇ Mining, construction (0)
Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 7 *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
◇ >1m (6)
◈ 0.7-<1m (4)
◇ 0.4-<0.7m (2)
◇ 0.2-<0.4m (1)
◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
◇ Pool width > riffle width (2)
◈ Pool width = riffle width (1)
◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
◇ Torrential (-1)
◇ Very Fast (1)
◇ Fast (1)
◈ Moderate (1)
◈ Slow (1)
◇ Interstitial (-1)
◇ Intermittent (-2)
◇ Eddies (1)
Indicate for reach – pools and riffles.

RECREATION POTENTIAL
◇ *Primary Contact*
◇ *Secondary Contact*
(circle one and comment on back)

COMMENTS

Pool/Current 7 *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!*)

RIFFLE DEPTH
◇ Best Areas >10cm (2)
◈ Best Areas 5-10cm (1)
◇ Best Areas <5cm (metric=0)

RUN DEPTH
◈ Maximum >50cm (2)
◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
◈ Stable (e.g. cobble, boulder) (2)
◇ Mod. Stable (e.g. large gravel) (1)
◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
◇ None (2)
◈ Low (1)
◇ Moderate (0)
◇ Extensive (-1)

COMMENTS

Riffle/Run 6 *Maximum 8*

6-GRADIENT

(16.916 ft/mi)
DRAINAGE AREA
(8.944 mi^2)

◇ Very low – Low (2-4)
◈ Moderate (6-10)
◇ High – Very high (10-6)

% POOL: 20 **% GLIDE:** 0
% RUN: 70 **% RIFFLE:** 10

Gradient 10 *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

◇ **>85% - Open**
◇ **55%-<85%**
◇ **30%-<55%**
◈ **10%-<30%**
◇ **<10% - Closed**

Canopy Upstream Reading

Right

14 Middle

Left

B-AESTHETICS

◇ **Nuisance algae**
◇ **Invasive macrophytes**
◇ **Excess turbidity**
◇ **Discoloration**
◈ **Foam/Scum**
◇ **Oil sheen**
◇ **Trash/Litter**
◇ **Nuisance odor**
◇ **Sludge deposits**
◇ **CSOs/SSOs/Outfalls**

C-MAINTENANCE

◇ **Public**	◇ **Private**
◇ **Active**	◇ **Historic**
◇ **Young – Succession**	
◇ **Old - Succession**	
◇ **Spray**	
◇ **Leveed – One sided**	
◇ **Leveed – Both Banks**	
◇ **Moving – Bedload**	
◇ **Stable - Bedload**	
◇ **Armoured**	◇ **Slumps**
◇ **Islands**	◇ **Scoured**
◇ **Relocated**	◇ **Cutoffs**
◇ **Impounded**	◇ **Desiccated**
◇ **Flood Control**	◇ **Drainage**
◇ **Snag Removed**	
◇ **Snag Modified**	

D-ISSUES

◇ **WWTP**	◇ **NPDES**	◇ **CSO**
◇ **Hardened**	◇ **Urban**	◇ **Dirt & Grime**
◇ **Contaminated**	◇ **Landfill**	◇ **Industry**
◇ **Construction BMPs**	◇ **Sediment BMPs**	
◇ **Logging**	◇ **Irrigation**	◇ **Cooling**
◇ **Bank Erosion**	◇ **Surface Erosion**	◇ **H2O table**
◇ **False bank**	◇ **Manure**	◇ **Lagoon**
◇ **Wash H2O**	◇ **Tile**	◇ **Natural Flow**
◇ **Acid Mine**	◇ **Wetlands**	◇ **Stagnant Flow**
◇ **Quarry Mine**	◇ **Golf**	◇ **Home**
◇ **Park**	◇ **Data Paucity**	◇ **Lawn**
◇ **Agriculture**	◇ **Livestock**	
◇ **Atmosphere Deposition**		

Stream Drawing

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47662	Fish	21T010	Vernon Fork Muscatatuck River	CR 50 North

Surveyor	Sample Date	County	Macro Sample Type
KAG	8/30/21	Jackson	N/A

◈ Habitat Complete

QHEI Score: 57

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)			
◇ ◇ Gravel (7)			
◈ ◈ Sand (6)		x	x
◇ ◇ Bedrock (5)			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Hardpan (4)		x	x
◇ ◇ Detritus (3)		x	
◇ ◇ Muck (2)			
◇ ◇ Silt (2)		x	x
◇ ◇ Artificial (0)		x	

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES:
- ◇ 4 or more (2)
- ◈ 3 or less (0)

Check ONE (*or* 2 & *average*)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 13 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

1	Undercut banks (1)	1	Pools > 70cm (2)	1	Oxbows, Backwaters (1)
0	Overhanging vegetation (1)	2	Rootwads (1)	0	Aquatic macrophytes (1)
1	Shallows (in slow water) (1)	1	Boulders (1)	3	Logs and woody debris (1)
2	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover 14 — *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◇ Moderate (3)
- ◇ Low (2)
- ◈ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◈ Good (5)
- ◇ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◇ Recovered (4)
- ◈ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◈ Moderate (2)
- ◈ Low (1)

Channel 11 — *Maximum 20*

COMMENTS

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ None or little (3)
- ◈ ◈ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◈ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

Riparian 4 — *Maximum 10*

COMMENTS

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◈ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current 9 — *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

◈ No Riffle (metric=0)

RIFFLE DEPTH — Check **ONE** (*ONLY!*)
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE — Check ONE (*or* 2 & *average*)
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

Riffle/Run 0 — *Maximum 8*

COMMENTS

6-GRADIENT

(1.458 ft/mi)

DRAINAGE AREA

(364.501 mi^2)

- ◈ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 40 **% GLIDE:** 0

% RUN: 60 **% RIFFLE:** 0

Gradient 6 — *Maximum 10*

IDEM

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

Pool area >100ft^2; Pool depth >3ft

A-CANOPY

- >85% - Open
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10% - Closed

Canopy Upstream Reading

53 Right

91 Middle

77 Left

B-AESTHETICS

- Nuisance algae
- Invasive macrophytes
- Excess turbidity
- Discoloration
- Foam/Scum
- Oil sheen
- Trash/Litter
- Nuisance odor
- Sludge deposits
- CSOs/SSOs/Outfalls

C-MAINTENANCE

- Public
- Private
- Active
- Historic
- Young – Succession
- Old - Succession
- Spray
- Leveed – One sided
- Leveed – Both Banks
- Moving – Bedload
- Stable - Bedload
- Armoured
- Slumps
- Islands
- Scoured
- Relocated
- Cutoffs
- Impounded
- Desiccated
- Flood Control
- Drainage
- Snag Removed
- Snag Modified

D-ISSUES

- WWTP
- NPDES
- CSO
- Hardened
- Urban
- Dirt & Grime
- Contaminated
- Landfill
- Industry
- Construction BMPs
- Sediment BMPs
- Logging
- Irrigation
- Cooling
- Bank Erosion
- Surface Erosion
- H2O table
- False bank
- Manure
- Lagoon
- Wash H2O
- Tile
- Natural Flow
- Acid Mine
- Wetlands
- Stagnant Flow
- Quarry Mine
- Golf
- Home
- Park
- Data Paucity
- Lawn
- Agriculture
- Livestock
- Atmosphere Deposition

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47675	Fish	21T023	Vernon Fork Muscatatuck River	CR 400 West

Surveyor	Sample Date	County	Macro Sample Type
CWY	8/18/21	Jennings	N/A

◈ Habitat Complete

QHEI Score: 73

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			x
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)			
◇ ◇ Gravel (7)			x
◈ ◈ Sand (6)		x	x
◇ ◇ Bedrock (5)		x	x

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Hardpan (4)			
◇ ◇ Detritus (3)		x	
◇ ◇ Muck (2)		x	
◇ ◇ Silt (2)		x	
◇ ◇ Artificial (0)			

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ◈ 4 or more (2) ◇ 3 or less (0)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 15 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2	Undercut banks (1)	3	Pools > 70cm (2)
1	Overhanging vegetation (1)	2	Rootwads (1)
2	Shallows (in slow water) (1)	0	Boulders (1)
1	Rootmats (1)		
1	Oxbows, Backwaters (1)		
0	Aquatic macrophytes (1)		
3	Logs and woody debris (1)		

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◇ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 16

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◈ Moderate (3)
- ◇ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◈ Good (5)
- ◇ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◈ None (6)
- ◇ Recovered (4)
- ◇ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◈ Moderate (2)
- ◈ Low (1)

COMMENTS

Channel Maximum 20 16

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or* 2 *per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◈ ◈ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◈ ◈ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◈ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 4

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◈ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◈ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS Boat dock @ large pool behind house

Pool/Current Maximum 12 11

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!*)

RIFFLE DEPTH
- ◇ Best Areas >10cm (2)
- ◈ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◈ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◈ Mod. Stable (e.g. large gravel) (1)
- ◈ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◈ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

Riffle/Run Maximum 8 5

COMMENTS

6-GRADIENT

(1.437 ft/mi)

DRAINAGE AREA (218.283 mi²)

- ◈ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 40 **% GLIDE:** 0

% RUN: 35 **% RIFFLE:** 25

Gradient Maximum 10 6

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT Pool area >100ft^2; Pool depth >3ft

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◈ Private	◇ WWTP	◇ NPDES	◇ CSO
◈ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ Bank Erosion	◇ Surface Erosion	◇ H2O table
	◇ Trash/Litter	◇ Leveed – Both Banks				
Canopy Upstream Reading		◇ Moving – Bedload		◇ 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	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
74 Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47659	Fish	21T007	Tea Creek	CR 650 West

Surveyor	Sample Date	County	Macro Sample Type
CWY	8/17/21	Jennings	N/A

◈ Habitat Complete

QHEI Score: 49

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)			
◇ ◇ Gravel (7)			x
◈ ◈ Sand (6)		x	x
◇ ◇ Bedrock (5)			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Hardpan (4)		x	
◇ ◇ Detritus (3)		x	
◇ ◇ Muck (2)			
◇ ◇ Silt (2)		x	
◇ ◇ Artificial (0)			

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES:
◇ 4 or more (2)
◈ 3 or less (0)

ORIGIN
◇ Limestone (1)
◈ Tills (1)
◇ Wetlands (0)
◇ Hardpan (0)
◇ Sandstone (0)
◇ Rip/Rap (0)
◇ Lacustrine (0)
◇ Shale (-1)
◇ Coal fines (-2)

QUALITY
SILT
◇ Heavy (-2)
◇ Moderate (-1)
◈ Normal (0)
◇ Free (1)
EMBEDDEDNESS
◇ Extensive (-2)
◇ Moderate (-1)
◈ Normal (0)
◇ None (1)

Substrate 13 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2 Undercut banks (1)
0 Overhanging vegetation (1)
1 Shallows (in slow water) (1)
1 Rootmats (1)
2 Pools > 70cm (2)
2 Rootwads (1)
0 Boulders (1)
1 Oxbows, Backwaters (1)
0 Aquatic macrophytes (1)
1 Logs and woody debris (1)

AMOUNT
Check ONE (*or* 2 & *average*)
◇ Extensive >75% (11)
◇ Moderate 25-75% (7)
◈ Sparse 5-<25% (3)
◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 11

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
◇ High (4)
◇ Moderate (3)
◈ Low (2)
◇ None (1)

DEVELOPMENT
◇ Excellent (7)
◇ Good (5)
◈ Fair (3)
◇ Poor (1)

CHANNELIZATION
◇ None (6)
◇ Recovered (4)
◈ Recovering (3)
◇ Recent or no recovery (1)

STABILITY
◇ High (3)
◇ Moderate (2)
◈ Low (1)

COMMENTS

Channel Maximum 20 9

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION
L R
◇ ◇ None or little (3)
◈ ◈ Moderate (2)
◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH
L R
◇ ◇ Wide >50m (4)
◇ ◇ Moderate 10-50m (3)
◈ ◈ Narrow 5-10m (2)
◇ ◇ Very narrow <5m (1)
◇ ◇ None (0)

FLOOD PLAIN QUALITY
L R
◇ ◇ Forest, Swamp (3)
◇ ◇ Shrub or Old field (2)
◇ ◇ Residential, Park, New field (1)
◇ ◇ Fenced pasture (1)
◈ ◈ Open Pasture/Rowcrop (0)
◇ ◇ Conservation Tillage (1)
◇ ◇ Urban or Industrial (0)
◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 4

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
◈ >1m (6)
◇ 0.7-<1m (4)
◇ 0.4-<0.7m (2)
◇ 0.2-<0.4m (1)
◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
◈ Pool width > riffle width (2)
◇ Pool width = riffle width (1)
◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
◇ Torrential (-1)
◇ Very Fast (1)
◇ Fast (1)
◇ Moderate (1)
◈ Slow (1)
◈ Interstitial (-1)
◇ Intermittent (-2)
◇ Eddies (1)
Indicate for reach – pools and riffles.

RECREATION POTENTIAL
◇ *Primary Contact*
◇ *Secondary Contact*
(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 8

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
◇ Best Areas >10cm (2)
◇ Best Areas 5-10cm (1)
◇ Best Areas <5cm (metric=0)

RUN DEPTH
◇ Maximum >50cm (2)
◇ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE
◇ Stable (e.g. cobble, boulder) (2)
◇ Mod. Stable (e.g. large gravel) (1)
◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
◇ None (2)
◇ Low (1)
◇ Moderate (0)
◇ Extensive (-1)

COMMENTS

Riffle/Run Maximum 8 0

6-GRADIENT

(2.676 ft/mi)
DRAINAGE AREA
(10.632 mi²)

◈ Very low – Low (2-4)
◇ Moderate (6-10)
◇ High – Very high (10-6)

% POOL: 70 **% GLIDE:** 0
% RUN: 30 **% RIFFLE:** 0

Gradient Maximum 10 4

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT depth>3 ft; isolated pools

A-CANOPY

- ◈ **>85% - Open**
- ◇ **55%-<85%**
- ◇ **30%-<55%**
- ◇ **10%-<30%**
- ◇ **<10% - Closed**

Canopy Upstream Reading

Right

100 Middle

Left

B-AESTHETICS

- ◇ **Nuisance algae**
- ◇ **Invasive macrophytes**
- ◇ **Excess turbidity**
- ◇ **Discoloration**
- ◇ **Foam/Scum**
- ◇ **Oil sheen**
- ◇ **Trash/Litter**
- ◇ **Nuisance odor**
- ◇ **Sludge deposits**
- ◇ **CSOs/SSOs/Outfalls**

C-MAINTENANCE

◇ **Public**	◇ **Private**
◇ **Active**	◇ **Historic**
◇ **Young – Succession**	
◇ **Old - Succession**	
◇ **Spray**	
◇ **Leveed – One sided**	
◇ **Leveed – Both Banks**	
◇ **Moving – Bedload**	
◇ **Stable - Bedload**	
◇ **Armoured**	◇ **Slumps**
◇ **Islands**	◇ **Scoured**
◇ **Relocated**	◇ **Cutoffs**
◇ **Impounded**	◇ **Desiccated**
◇ **Flood Control**	◇ **Drainage**
◇ **Snag Removed**	
◇ **Snag Modified**	

D-ISSUES

◇ **WWTP**	◇ **NPDES**	◇ **CSO**
◇ **Hardened**	◇ **Urban**	◇ **Dirt & Grime**
◇ **Contaminated**	◇ **Landfill**	◇ **Industry**
◇ **Construction BMPs**	◇ **Sediment BMPs**	
◇ **Logging**	◇ **Irrigation**	◇ **Cooling**
◇ **Bank Erosion**	◇ **Surface Erosion**	◇ **H2O table**
◇ **False bank**	◇ **Manure**	◇ **Lagoon**
◇ **Wash H2O**	◇ **Tile**	◇ **Natural Flow**
◇ **Acid Mine**	◇ **Wetlands**	◇ **Stagnant Flow**
◇ **Quarry Mine**	◇ **Golf**	◇ **Home**
◇ **Park**	◇ **Data Paucity**	◇ **Lawn**
◇ **Agriculture**	◇ **Livestock**	
◇ **Atmosphere Deposition**		

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB48036	Fish	21T018.5	Storm Creek	Base Road

Surveyor	Sample Date	County	Macro Sample Type
KRW	9/9/21	Jennings	N/A

◈ Habitat Complete

QHEI Score: 51

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	
◇ ◇ Cobble (8)				◇ ◇ Muck (2)			
◇ ◇ Gravel (7)		x	x	◇ ◇ Silt (2)		x	x
◈ ◈ Sand (6)		x	x	◇ ◇ Artificial (0)		x	
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

Check ONE (*or* 2 & *average*)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◈ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 13 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

1	Undercut banks (1)	0	Pools > 70cm (2)	0	Oxbows, Backwaters (1)
0	Overhanging vegetation (1)	1	Rootwads (1)	0	Aquatic macrophytes (1)
1	Shallows (in slow water) (1)	1	Boulders (1)	1	Logs and woody debris (1)
0	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover *Maximum 20* 8

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◈ None (6)	◇ High (3)
◇ Moderate (3)	◇ Good (5)	◇ Recovered (4)	◇ Moderate (2)
◈ Low (2)	◈ Fair (3)	◇ Recovering (3)	◈ Low (1)
◇ None (1)	◇ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel *Maximum 20* 12

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ None or little (3)
- ◇ ◇ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◈ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◈ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian *Maximum 10* 6

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◇ 0.7-<1m (4)
- ◈ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current *Maximum 12* 6

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!*)

RIFFLE DEPTH
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◈ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run *Maximum 8* 0

6-GRADIENT

(4.073 ft/mi)

DRAINAGE AREA

(9.378 mi²)

- ◇ Very low – Low (2-4)
- ◈ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 30 **% GLIDE:** 0

% RUN: 60 **% RIFFLE:** 10

Gradient *Maximum 10* 6

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◈ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
11 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47658	Fish	21T006	Tea Creek	CR 650 South

Surveyor	Sample Date	County	Macro Sample Type
CWY	8/16/21	Jennings	N/A

◈ Habitat Complete

QHEI Score: 62

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◈ Cobble (8)			x
◈ ◇ Gravel (7)		x	x
◇ ◇ Sand (6)		x	x
◇ ◇ Bedrock (5)		x	x

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Hardpan (4)			
◇ ◇ Detritus (3)			
◇ ◇ Muck (2)			
◇ ◇ Silt (2)		x	
◇ ◇ Artificial (0)			

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES:
◈ 4 or more (2)
◇ 3 or less (0)

ORIGIN
◈ Limestone (1)
◇ Tills (1)
◇ Wetlands (0)
◇ Hardpan (0)
◇ Sandstone (0)
◇ Rip/Rap (0)
◇ Lacustrine (0)
◇ Shale (-1)
◇ Coal fines (-2)

QUALITY

SILT
◇ Heavy (-2)
◇ Moderate (-1)
◈ Normal (0)
◇ Free (1)

EMBEDDEDNESS
◇ Extensive (-2)
◇ Moderate (-1)
◈ Normal (0)
◇ None (1)

Substrate 18
Maximum 20

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	0	Pools > 70cm (2)
0	Overhanging vegetation (1)	1	Rootwads (1)
1	Shallows (in slow water) (1)	0	Boulders (1)
1	Rootmats (1)		

1	Oxbows, Backwaters (1)
0	Aquatic macrophytes (1)
1	Logs and woody debris (1)

AMOUNT
Check ONE (*or* 2 & *average*)
◇ Extensive >75% (11)
◇ Moderate 25-75% (7)
◈ Sparse 5-<25% (3)
◇ Nearly absent <5% (1)

COMMENTS

Cover 8
Maximum 20

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
◇ High (4)
◈ Moderate (3)
◇ Low (2)
◇ None (1)

DEVELOPMENT
◇ Excellent (7)
◈ Good (5)
◈ Fair (3)
◇ Poor (1)

CHANNELIZATION
◈ None (6)
◇ Recovered (4)
◇ Recovering (3)
◇ Recent or no recovery (1)

STABILITY
◇ High (3)
◈ Moderate (2)
◇ Low (1)

COMMENTS

Channel 15
Maximum 20

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or* 2 *per bank & average*)

River right looking downstream

EROSION
L R
◇ ◇ None or little (3)
◈ ◈ Moderate (2)
◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH
L R
◈ ◇ Wide >50m (4)
◇ ◈ Moderate 10-50m (3)
◇ ◇ Narrow 5-10m (2)
◇ ◇ Very narrow <5m (1)
◇ ◇ None (0)

FLOOD PLAIN QUALITY
L R
◈ ◇ Forest, Swamp (3)
◇ ◇ Shrub or Old field (2)
◇ ◇ Residential, Park, New field (1)
◇ ◇ Fenced pasture (1)
◇ ◈ Open Pasture/Rowcrop (0)

L R
◇ ◇ Conservation Tillage (1)
◇ ◇ Urban or Industrial (0)
◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 7
Maximum 10

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
◇ >1m (6)
◇ 0.7-<1m (4)
◇ 0.4-<0.7m (2)
◈ 0.2-<0.4m (1)
◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
◈ Pool width > riffle width (2)
◇ Pool width = riffle width (1)
◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
◇ Torrential (-1)
◇ Very Fast (1)
◇ Fast (1)
◇ Moderate (1)
◈ Slow (1)
◇ Interstitial (-1)
◇ Intermittent (-2)
◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
◇ *Primary Contact*
◇ *Secondary Contact*
(circle one and comment on back)

COMMENTS

Pool/Current 4
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!*)

RIFFLE DEPTH
◇ Best Areas >10cm (2)
◇ Best Areas 5-10cm (1)
◈ Best Areas <5cm (metric=0)

RUN DEPTH
◇ Maximum >50cm (2)
◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
◇ Stable (e.g. cobble, boulder) (2)
◇ Mod. Stable (e.g. large gravel) (1)
◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
◇ None (2)
◇ Low (1)
◇ Moderate (0)
◇ Extensive (-1)

COMMENTS

Riffle/Run 0
Maximum 8

6-GRADIENT

(20.301 ft/mi)
DRAINAGE AREA
(4.617 mi²)

◇ Very low – Low (2-4)
◇ Moderate (6-10)
◈ High – Very high (10-6)

% POOL: 10 **% GLIDE:** 0
% RUN: 90 **% RIFFLE:** 0

Gradient 10
Maximum 10

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◈ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
9 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47664	Fish	21T012	Mutton Creek Ditch	CR 400 North

Surveyor	Sample Date	County	Macro Sample Type		QHEI Score:
KAG	8/17/21	Jackson	N/A	◈ Habitat Complete	47

1-SUBSTRATE

Check ***ONLY*** **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ **Bldrs/Slabs (10)**				◇ ◈ **Hardpan (4)**		x	x
◇ ◇ **Boulders (9)**				◇ ◇ **Detritus (3)**			
◇ ◇ **Cobble (8)**				◈ ◇ **Muck (2)**		x	x
◇ ◇ **Gravel (7)**				◇ ◇ **Silt (2)**		x	x
◇ ◇ **Sand (6)**		x	x	◇ ◇ **Artificial (0)**			
◇ ◇ **Bedrock (5)**							

NUMBER OF BEST TYPES: ◇ **4 or more (2)** ◈ **3 or less (0)**

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ **Limestone (1)**
- ◈ **Tills (1)**
- ◇ **Wetlands (0)**
- ◇ **Hardpan (0)**
- ◇ **Sandstone (0)**
- ◇ **Rip/Rap (0)**
- ◇ **Lacustrine (0)**
- ◇ **Shale (-1)**
- ◇ **Coal fines (-2)**

QUALITY

SILT
- ◇ **Heavy (-2)**
- ◇ **Moderate (-1)**
- ◈ **Normal (0)**
- ◇ **Free (1)**

EMBEDDEDNESS
- ◇ **Extensive (-2)**
- ◇ **Moderate (-1)**
- ◈ **Normal (0)**
- ◇ **None (1)**

Substrate 7 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	**Undercut banks (1)**	2	**Pools > 70cm (2)**	1	**Oxbows, Backwaters (1)**
0	**Overhanging vegetation (1)**	1	**Rootwads (1)**	1	**Aquatic macrophytes (1)**
0	**Shallows (in slow water) (1)**	0	**Boulders (1)**	2	**Logs and woody debris (1)**
2	**Rootmats (1)**				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ **Extensive >75% (11)**
- ◈ **Moderate 25-75% (7)**
- ◇ **Sparse 5-<25% (3)**
- ◇ **Nearly absent <5% (1)**

COMMENTS

Cover 14 — *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ **High (4)**
- ◇ **Moderate (3)**
- ◇ **Low (2)**
- ◈ **None (1)**

DEVELOPMENT
- ◇ **Excellent (7)**
- ◇ **Good (5)**
- ◇ **Fair (3)**
- ◈ **Poor (1)**

CHANNELIZATION
- ◇ **None (6)**
- ◇ **Recovered (4)**
- ◇ **Recovering (3)**
- ◈ **Recent or no recovery (1)**

STABILITY
- ◇ **High (3)**
- ◇ **Moderate (2)**
- ◈ **Low (1)**

COMMENTS

Channel 4 — *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ **None or little (3)**
- ◈ ◈ **Moderate (2)**
- ◇ ◇ **Heavy/Severe (1)**

RIPARIAN WIDTH (L R)
- ◈ ◈ **Wide >50m (4)**
- ◇ ◇ **Moderate 10-50m (3)**
- ◇ ◇ **Narrow 5-10m (2)**
- ◇ ◇ **Very narrow <5m (1)**
- ◇ ◇ **None (0)**

FLOOD PLAIN QUALITY (L R)
- ◈ ◈ **Forest, Swamp (3)**
- ◇ ◇ **Shrub or Old field (2)**
- ◇ ◇ **Residential, Park, New field (1)**
- ◇ ◇ **Fenced pasture (1)**
- ◇ ◇ **Open Pasture/Rowcrop (0)**
- ◇ ◇ **Conservation Tillage (1)**
- ◇ ◇ **Urban or Industrial (0)**
- ◇ ◇ **Mining, construction (0)**

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 10 — *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
- ◈ **>1m (6)**
- ◇ **0.7-<1m (4)**
- ◇ **0.4-<0.7m (2)**
- ◇ **0.2-<0.4m (1)**
- ◇ **<0.2m (0)** (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
- ◇ **Pool width > riffle width (2)**
- ◈ **Pool width = riffle width (1)**
- ◇ **Pool width < riffle width (0)**

CURRENT VELOCITY
Check ALL that apply
- ◇ **Torrential (-1)**
- ◇ **Very Fast (1)**
- ◇ **Fast (1)**
- ◇ **Moderate (1)**
- ◈ **Slow (1)**
- ◇ **Interstitial (-1)**
- ◇ **Intermittent (-2)**
- ◇ **Eddies (1)**

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ ***Primary Contact***
- ◇ ***Secondary Contact***

(circle one and comment on back)

COMMENTS

Pool/Current 8 — *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
- ◇ **Best Areas >10cm (2)**
- ◇ **Best Areas 5-10cm (1)**
- ◇ **Best Areas <5cm** (metric=0)

RUN DEPTH
- ◇ **Maximum >50cm (2)**
- ◇ **Maximum <50cm (1)**

RIFFLE/RUN SUBSTRATE
- ◇ **Stable (e.g. cobble, boulder) (2)**
- ◇ **Mod. Stable (e.g. large gravel) (1)**
- ◇ **Unstable (e.g. sand, fine gravel) (0)**

RIFFLE/RUN EMBEDDEDNESS
- ◇ **None (2)**
- ◇ **Low (1)**
- ◇ **Moderate (0)**
- ◇ **Extensive (-1)**

COMMENTS

Riffle/Run 0 — *Maximum 8*

6-GRADIENT

(2.112 ft/mi)
DRAINAGE AREA
(29.807 mi²)

- ◈ **Very low – Low (2-4)**
- ◇ **Moderate (6-10)**
- ◇ **High – Very high (10-6)**

% POOL: 10 **% GLIDE: 90**
% RUN: 0 **% RIFFLE: 0**

Gradient 4 — *Maximum 10*

IDEM

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

- ◇ >85% - Open
- ◈ 55%-<85%
- ◇ 30%-<55%
- ◇ 10%-<30%
- ◇ <10% - Closed

Canopy Upstream Reading

Right

70 Middle

Left

B-AESTHETICS

- ◇ Nuisance algae
- ◇ Invasive macrophytes
- ◇ Excess turbidity
- ◇ Discoloration
- ◇ Foam/Scum
- ◇ Oil sheen
- ◇ Trash/Litter
- ◇ Nuisance odor
- ◇ Sludge deposits
- ◇ CSOs/SSOs/Outfalls

C-MAINTENANCE

◇ Public	◇ Private
◇ Active	◇ Historic
◇ Young – Succession	
◇ Old - Succession	
◇ Spray	
◇ Leveed – One sided	
◇ Leveed – Both Banks	
◇ Moving – Bedload	
◇ Stable - Bedload	
◇ Armoured	◇ Slumps
◇ Islands	◇ Scoured
◇ Relocated	◇ Cutoffs
◇ Impounded	◇ Desiccated
◇ Flood Control	◇ Drainage
◇ Snag Removed	
◇ Snag Modified	

D-ISSUES

◇ WWTP	◇ NPDES	◇ CSO
◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ Contaminated	◇ Landfill	◇ Industry
◇ Construction BMPs	◇ Sediment BMPs	
◇ Logging	◇ Irrigation	◇ Cooling
◇ Bank Erosion	◇ Surface Erosion	◇ H2O table
◇ False bank	◇ Manure	◇ Lagoon
◇ Wash H2O	◇ Tile	◇ Natural Flow
◇ Acid Mine	◈ Wetlands	◇ Stagnant Flow
◇ Quarry Mine	◇ Golf	◇ Home
◇ Park	◇ Data Paucity	◇ Lawn
◇ Agriculture	◇ Livestock	
◇ Atmosphere Deposition		

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47665	Fish	21T013	Tributary of Mutton Creek	CR 700 North

Surveyor	Sample Date	County	Macro Sample Type	
KAG	8/16/21	Jackson	N/A	◇ Habitat Complete

QHEI Score: 65

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)		x	
◇ ◇ Gravel (7)		x	
◈ ◇ Sand (6)		x	x
◇ ◇ Bedrock (5)			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◈ Hardpan (4)		x	x
◇ ◇ Detritus (3)			
◇ ◇ Muck (2)			
◇ ◇ Silt (2)		x	x
◇ ◇ Artificial (0)		x	x

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES:
- ◇ 4 or more (2)
- ◈ 3 or less (0)

Check ONE (*or* 2 & *average*)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 11 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2 Undercut banks (1)	1 Pools > 70cm (2)	0 Oxbows, Backwaters (1)
1 Overhanging vegetation (1)	2 Rootwads (1)	1 Aquatic macrophytes (1)
1 Shallows (in slow water) (1)	0 Boulders (1)	1 Logs and woody debris (1)
1 Rootmats (1)		

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◇ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover 16 — *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◈ Moderate (3)
- ◇ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◈ Good (5)
- ◈ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◈ Recovered (4)
- ◈ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◇ Moderate (2)
- ◈ Low (1)

COMMENTS

Channel 12 — *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◈ ◈ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◈ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 3 — *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◈ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◈ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current 9 — *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◇ No Riffle (metric=0)

RIFFLE DEPTH

Check **ONE** (*ONLY!*)
- ◇ Best Areas >10cm (2)
- ◈ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◈ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◈ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◈ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run 6 — *Maximum 8*

6-GRADIENT

(11.518 ft/mi)

DRAINAGE AREA

(5.117 mi²)

- ◇ Very low – Low (2-4)
- ◈ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 30 **% GLIDE:** 0

% RUN: 60 **% RIFFLE:** 10

Gradient 8 — *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- **>85% - Open**
- **55%-<85%**
- **30%-<55%**
- **10%-<30%**
- **<10% - Closed**

Canopy Upstream Reading

Right

100 Middle

Left

B-AESTHETICS

- **Nuisance algae**
- **Invasive macrophytes**
- **Excess turbidity**
- **Discoloration**
- **Foam/Scum**
- **Oil sheen**
- **Trash/Litter**
- **Nuisance odor**
- **Sludge deposits**
- **CSOs/SSOs/Outfalls**

C-MAINTENANCE

- **Public** ◇ **Private**
- **Active** ◇ **Historic**
- **Young – Succession**
- **Old - Succession**
- **Spray**
- **Leveed – One sided**
- **Leveed – Both Banks**
- **Moving – Bedload**
- **Stable - Bedload**
- **Armoured** ◇ **Slumps**
- **Islands** ◇ **Scoured**
- **Relocated** ◇ **Cutoffs**
- **Impounded** ◇ **Desiccated**
- **Flood Control** ◇ **Drainage**
- **Snag Removed**
- **Snag Modified**

D-ISSUES

- **WWTP** ◇ **NPDES** ◇ **CSO**
- **Hardened** ◇ **Urban** ◇ **Dirt & Grime**
- **Contaminated** ◇ **Landfill** ◇ **Industry**
- **Construction BMPs** ◇ **Sediment BMPs**
- **Logging** ◇ **Irrigation** ◇ **Cooling**
- **Bank Erosion** ◇ **Surface Erosion** ◇ **H2O table**
- **False bank** ◇ **Manure** ◇ **Lagoon**
- **Wash H2O** ◇ **Tile** ◇ **Natural Flow**
- **Acid Mine** ◇ **Wetlands** ◇ **Stagnant Flow**
- **Quarry Mine** ◇ **Golf** ◇ **Home**
- **Park** ◇ **Data Paucity** ◇ **Lawn**
- **Agriculture** ◇ **Livestock**
- **Atmosphere Deposition**

Stream Drawing

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47660	Fish	21T008	Vernon Fork Muscatatuck River	CR 500 South

Surveyor	Sample Date	County	Macro Sample Type
CWY	8/17/21	Jennings	N/A

◈ Habitat Complete

QHEI Score: 62

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)			
◇ ◇ Gravel (7)			x
◈ ◈ Sand (6)		x	x
◇ ◇ Bedrock (5)			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Hardpan (4)		x	
◇ ◇ Detritus (3)		x	x
◇ ◇ Muck (2)		x	
◇ ◇ Silt (2)		x	
◇ ◇ Artificial (0)		x	

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES:
- ◇ 4 or more (2)
- ◈ 3 or less (0)

Check ONE (*or* 2 & *average*)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◈ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 13 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2	Undercut banks (1)	3	Pools > 70cm (2)	1	Oxbows, Backwaters (1)
0	Overhanging vegetation (1)	2	Rootwads (1)	0	Aquatic macrophytes (1)
2	Shallows (in slow water) (1)	0	Boulders (1)	3	Logs and woody debris (1)
2	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◈ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◇ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover 17 — *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◇ Moderate (3)
- ◈ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◈ Good (5)
- ◇ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◇ Recovered (4)
- ◈ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◇ Moderate (2)
- ◈ Low (1)

COMMENTS

Channel 11 — *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◈ ◈ Moderate (2)
- ◈ ◈ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◈ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◈ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◇ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 6 — *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◈ *Secondary Contact*

(circle one and comment on back)

COMMENTS traces of fishing activity

Pool/Current 9 — *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!*)

RIFFLE DEPTH
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

Riffle/Run 0 — *Maximum 8*

COMMENTS

6-GRADIENT

(1.678 ft/mi)

DRAINAGE AREA (234.161 mi²)

- ◈ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 40 % GLIDE: 0

% RUN: 60 % RIFFLE: 0

Gradient 6 — *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

garbage bag on sandbar at site; pool area>100ft^2; Pool depth>3ft

A-CANOPY

- ◇ **>85% - Open**
- ◇ **55%-<85%**
- ◇ **30%-<55%**
- ◇ **10%-<30%**
- ◈ **<10% - Closed**

Canopy Upstream Reading

1 Right

18 Middle

0 Left

B-AESTHETICS

- ◇ **Nuisance algae**
- ◇ **Invasive macrophytes**
- ◇ **Excess turbidity**
- ◇ **Discoloration**
- ◇ **Foam/Scum**
- ◇ **Oil sheen**
- ◈ **Trash/Litter**
- ◈ **Nuisance odor**
- ◇ **Sludge deposits**
- ◇ **CSOs/SSOs/Outfalls**

C-MAINTENANCE

- ◇ **Public** ◇ **Private**
- ◇ **Active** ◇ **Historic**
- ◇ **Young – Succession**
- ◇ **Old - Succession**
- ◇ **Spray**
- ◇ **Leveed – One sided**
- ◇ **Leveed – Both Banks**
- ◇ **Moving – Bedload**
- ◇ **Stable - Bedload**
- ◇ **Armoured** ◇ **Slumps**
- ◇ **Islands** ◇ **Scoured**
- ◇ **Relocated** ◇ **Cutoffs**
- ◇ **Impounded** ◇ **Desiccated**
- ◇ **Flood Control** ◇ **Drainage**
- ◇ **Snag Removed**
- ◇ **Snag Modified**

D-ISSUES

- ◇ **WWTP** ◇ **NPDES** ◇ **CSO**
- ◇ **Hardened** ◇ **Urban** ◇ **Dirt & Grime**
- ◇ **Contaminated** ◇ **Landfill** ◇ **Industry**
- ◇ **Construction BMPs** ◇ **Sediment BMPs**
- ◇ **Logging** ◇ **Irrigation** ◇ **Cooling**
- ◇ **Bank Erosion** ◇ **Surface Erosion** ◇ **H2O table**
- ◇ **False bank** ◇ **Manure** ◇ **Lagoon**
- ◇ **Wash H2O** ◇ **Tile** ◇ **Natural Flow**
- ◇ **Acid Mine** ◇ **Wetlands** ◇ **Stagnant Flow**
- ◇ **Quarry Mine** ◇ **Golf** ◇ **Home**
- ◇ **Park** ◇ **Data Paucity** ◇ **Lawn**
- ◇ **Agriculture** ◇ **Livestock**
- ◇ **Atmosphere Deposition**

Stream Drawing

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47667	Fish	21T015	Mutton Creek	CR 300 North

Surveyor	Sample Date	County	Macro Sample Type
KAG	8/16/21	Jennings	N/A

◈ Habitat Complete

QHEI Score: 60

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)		x	
◇ ◇ Gravel (7)		x	x
◈ ◇ Sand (6)		x	x
◇ ◇ Bedrock (5)			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◈ Hardpan (4)		x	x
◇ ◇ Detritus (3)			
◇ ◇ Muck (2)			
◇ ◇ Silt (2)		x	x
◇ ◇ Artificial (0)			

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES:
◇ 4 or more (2)
◈ 3 or less (0)

ORIGIN
◇ Limestone (1)
◈ Tills (1)
◇ Wetlands (0)
◇ Hardpan (0)
◇ Sandstone (0)
◇ Rip/Rap (0)
◇ Lacustrine (0)
◇ Shale (-1)
◇ Coal fines (-2)

QUALITY
SILT
◇ Heavy (-2)
◇ Moderate (-1)
◈ Normal (0)
◇ Free (1)
EMBEDDEDNESS
◇ Extensive (-2)
◇ Moderate (-1)
◈ Normal (0)
◇ None (1)

Substrate 11 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0 Undercut banks (1)	1 Pools > 70cm (2)	0 Oxbows, Backwaters (1)
1 Overhanging vegetation (1)	1 Rootwads (1)	1 Aquatic macrophytes (1)
1 Shallows (in slow water) (1)	1 Boulders (1)	1 Logs and woody debris (1)
1 Rootmats (1)		

AMOUNT
Check ONE (*or* 2 & *average*)
◇ Extensive >75% (11)
◈ Moderate 25-75% (7)
◇ Sparse 5-<25% (3)
◇ Nearly absent <5% (1)

COMMENTS

Cover 16 — *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
◇ High (4)
◇ Moderate (3)
◈ Low (2)
◇ None (1)

DEVELOPMENT
◇ Excellent (7)
◈ Good (5)
◇ Fair (3)
◇ Poor (1)

CHANNELIZATION
◈ None (6)
◇ Recovered (4)
◇ Recovering (3)
◇ Recent or no recovery (1)

STABILITY
◇ High (3)
◈ Moderate (2)
◇ Low (1)

COMMENTS

Channel 15 — *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION
L R
◇ ◇ None or little (3)
◈ ◈ Moderate (2)
◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH
L R
◇ ◇ Wide >50m (4)
◇ ◇ Moderate 10-50m (3)
◈ ◈ Narrow 5-10m (2)
◇ ◇ Very narrow <5m (1)
◇ ◇ None (0)

FLOOD PLAIN QUALITY
L R
◇ ◇ Forest, Swamp (3)
◇ ◇ Shrub or Old field (2)
◇ ◇ Residential, Park, New field (1)
◇ ◇ Fenced pasture (1)
◈ ◈ Open Pasture/Rowcrop (0)

L R
◇ ◇ Conservation Tillage (1)
◇ ◇ Urban or Industrial (0)
◇ ◇ Mining, construction (0)
Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 4 — *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
◇ >1m (6)
◈ 0.7-<1m (4)
◇ 0.4-<0.7m (2)
◇ 0.2-<0.4m (1)
◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
◈ Pool width > riffle width (2)
◇ Pool width = riffle width (1)
◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
◇ Torrential (-1)
◇ Very Fast (1)
◇ Fast (1)
◈ Moderate (1)
◈ Slow (1)
◇ Interstitial (-1)
◇ Intermittent (-2)
◇ Eddies (1)
Indicate for reach – pools and riffles.

RECREATION POTENTIAL
◇ *Primary Contact*
◇ *Secondary Contact*
(circle one and comment on back)

COMMENTS

Pool/Current 8 — *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

◇ No Riffle (metric=0)

RIFFLE DEPTH
Check **ONE** (*ONLY!*)
◇ Best Areas >10cm (2)
◇ Best Areas 5-10cm (1)
◈ Best Areas <5cm (metric=0)

RUN DEPTH
◇ Maximum >50cm (2)
◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
◇ Stable (e.g. cobble, boulder) (2)
◇ Mod. Stable (e.g. large gravel) (1)
◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
◇ None (2)
◇ Low (1)
◇ Moderate (0)
◇ Extensive (-1)

COMMENTS

Riffle/Run 0 — *Maximum 8*

6-GRADIENT

(6.52 ft/mi)
DRAINAGE AREA
(8.239 mi²)

◇ Very low – Low (2-4)
◈ Moderate (6-10)
◇ High – Very high (10-6)

% POOL: 40 % GLIDE: 0
% RUN: 50 % RIFFLE: 10

Gradient 6 — *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

Sheen on surface of water; pipe running through beginning of reach.

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◈ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
31 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47668	Fish	21T016	Storm Creek Ditch	CR 400 North

Surveyor	Sample Date	County	Macro Sample Type
KAG	8/17/21	Jackson	N/A

◈ Habitat Complete

QHEI Score: 46

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ **Bldrs/Slabs (10)**				◇ ◈ **Hardpan (4)**		x	x
◇ ◇ **Boulders (9)**				◇ ◇ **Detritus (3)**		x	
◇ ◇ **Cobble (8)**				◇ ◇ **Muck (2)**		x	x
◇ ◇ **Gravel (7)**		x	x	◇ ◇ **Silt (2)**		x	x
◈ ◇ **Sand (6)**		x	x	◇ ◇ **Artificial (0)**		x	x
◇ ◇ **Bedrock (5)**							

NUMBER OF BEST TYPES: ◇ **4 or more (2)** ◈ **3 or less (0)**

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ **Limestone (1)**
- ◇ **Tills (1)**
- ◈ **Wetlands (0)**
- ◇ **Hardpan (0)**
- ◇ **Sandstone (0)**
- ◇ **Rip/Rap (0)**
- ◇ **Lacustrine (0)**
- ◇ **Shale (-1)**
- ◇ **Coal fines (-2)**

QUALITY

SILT
- ◇ **Heavy (-2)**
- ◇ **Moderate (-1)**
- ◈ **Normal (0)**
- ◇ **Free (1)**

EMBEDDEDNESS
- ◇ **Extensive (-2)**
- ◇ **Moderate (-1)**
- ◈ **Normal (0)**
- ◇ **None (1)**

Substrate 10 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	**Undercut banks (1)**	1	**Pools > 70cm (2)**	1	**Oxbows, Backwaters (1)**
0	**Overhanging vegetation (1)**	2	**Rootwads (1)**	1	**Aquatic macrophytes (1)**
0	**Shallows (in slow water) (1)**	0	**Boulders (1)**	2	**Logs and woody debris (1)**
1	**Rootmats (1)**				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ **Extensive >75% (11)**
- ◈ **Moderate 25-75% (7)**
- ◈ **Sparse 5-<25% (3)**
- ◇ **Nearly absent <5% (1)**

COMMENTS

Cover *Maximum 20* — 12

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ **High (4)**
- ◇ **Moderate (3)**
- ◇ **Low (2)**
- ◈ **None (1)**

DEVELOPMENT
- ◇ **Excellent (7)**
- ◇ **Good (5)**
- ◇ **Fair (3)**
- ◈ **Poor (1)**

CHANNELIZATION
- ◇ **None (6)**
- ◇ **Recovered (4)**
- ◇ **Recovering (3)**
- ◈ **Recent or no recovery (1)**

STABILITY
- ◇ **High (3)**
- ◇ **Moderate (2)**
- ◈ **Low (1)**

Channel *Maximum 20* — 4

COMMENTS

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ **None or little (3)**
- ◇ ◈ **Moderate (2)**
- ◇ ◇ **Heavy/Severe (1)**

RIPARIAN WIDTH (L R)
- ◈ ◇ **Wide >50m (4)**
- ◇ ◇ **Moderate 10-50m (3)**
- ◇ ◇ **Narrow 5-10m (2)**
- ◇ ◈ **Very narrow <5m (1)**
- ◇ ◇ **None (0)**

FLOOD PLAIN QUALITY (L R)
- ◈ ◈ **Forest, Swamp (3)**
- ◇ ◇ **Shrub or Old field (2)**
- ◇ ◇ **Residential, Park, New field (1)**
- ◇ ◇ **Fenced pasture (1)**
- ◇ ◇ **Open Pasture/Rowcrop (0)**

(L R)
- ◇ ◇ **Conservation Tillage (1)**
- ◇ ◇ **Urban or Industrial (0)**
- ◇ ◇ **Mining, construction (0)**

Indicate predominant land use(s) past 100m riparian.

Riparian *Maximum 10* — 8

COMMENTS

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
- ◈ **>1m (6)**
- ◇ **0.7-<1m (4)**
- ◇ **0.4-<0.7m (2)**
- ◇ **0.2-<0.4m (1)**
- ◇ **<0.2m (0)** **(metric=0)**

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
- ◇ **Pool width > riffle width (2)**
- ◈ **Pool width = riffle width (1)**
- ◇ **Pool width < riffle width (0)**

CURRENT VELOCITY
Check ALL that apply
- ◇ **Torrential (-1)**
- ◇ **Very Fast (1)**
- ◇ **Fast (1)**
- ◇ **Moderate (1)**
- ◈ **Slow (1)**
- ◇ **Interstitial (-1)**
- ◇ **Intermittent (-2)**
- ◇ **Eddies (1)**

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ ***Primary Contact***
- ◇ ***Secondary Contact***

(circle one and comment on back)

COMMENTS

Pool/Current *Maximum 12* — 8

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!*)

RIFFLE DEPTH
- ◇ **Best Areas >10cm (2)**
- ◇ **Best Areas 5-10cm (1)**
- ◇ **Best Areas <5cm** **(metric=0)**

RUN DEPTH
- ◇ **Maximum >50cm (2)**
- ◇ **Maximum <50cm (1)**

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◇ **Stable (e.g. cobble, boulder) (2)**
- ◇ **Mod. Stable (e.g. large gravel) (1)**
- ◇ **Unstable (e.g. sand, fine gravel) (0)**

RIFFLE/RUN EMBEDDEDNESS
- ◇ **None (2)**
- ◇ **Low (1)**
- ◇ **Moderate (0)**
- ◇ **Extensive (-1)**

Riffle/Run *Maximum 8* — 0

COMMENTS

6-GRADIENT

(2.682 ft/mi)
DRAINAGE AREA
(17.513 mi²)

- ◈ **Very low – Low (2-4)**
- ◇ **Moderate (6-10)**
- ◇ **High – Very high (10-6)**

% POOL: 20 **% GLIDE: 80**
% RUN: 0 **% RIFFLE: 0**

Gradient *Maximum 10* — 4

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

Pool depth >3ft

A-CANOPY

- ◇ >85% - Open
- ◈ 55%-<85%
- ◇ 30%-<55%
- ◇ 10%-<30%
- ◇ <10% - Closed

Canopy Upstream Reading

Right

80 Middle

Left

B-AESTHETICS

- ◇ Nuisance algae
- ◇ Invasive macrophytes
- ◇ Excess turbidity
- ◇ Discoloration
- ◇ Foam/Scum
- ◇ Oil sheen
- ◇ Trash/Litter
- ◇ Nuisance odor
- ◇ Sludge deposits
- ◇ CSOs/SSOs/Outfalls

C-MAINTENANCE

- ◇ Public ◇ Private
- ◇ Active ◇ Historic
- ◇ Young – Succession
- ◇ Old - Succession
- ◇ Spray
- ◇ Leveed – One sided
- ◇ Leveed – Both Banks
- ◇ Moving – Bedload
- ◇ Stable - Bedload
- ◇ Armoured ◇ Slumps
- ◇ Islands ◇ Scoured
- ◇ Relocated ◇ Cutoffs
- ◇ Impounded ◇ Desiccated
- ◇ Flood Control ◇ Drainage
- ◇ Snag Removed
- ◇ Snag Modified

D-ISSUES

◇ WWTP	◇ NPDES	◇ CSO
◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ Contaminated	◇ Landfill	◇ Industry
◇ Construction BMPs	◇ Sediment BMPs	
◇ Logging	◇ Irrigation	◇ Cooling
◇ Bank Erosion	◇ Surface Erosion	◇ H2O table
◇ False bank	◇ Manure	◇ Lagoon
◇ Wash H2O	◇ Tile	◇ Natural Flow
◇ Acid Mine	◈ Wetlands	◇ Stagnant Flow
◇ Quarry Mine	◇ Golf	◇ Home
◇ Park	◇ Data Paucity	◇ Lawn
◇ Agriculture	◇ Livestock	
◇ Atmosphere Deposition		

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47669	Fish	21T017	Tributary to Richart Lake	CR 900 West

Surveyor	Sample Date	County	Macro Sample Type
SLS	8/17/21	Jennings	N/A

◇ Habitat Complete

QHEI Score: 49

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)		x	
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	
◇ ◇ Cobble (8)				◇ ◇ Muck (2)			
◈ ◈ Gravel (7)		x	x	◇ ◇ Silt (2)		x	
◇ ◇ Sand (6)		x		◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ **4 or more (2)** ◈ **3 or less (0)**

(Score natural substrates; ignore sludge from point-sources)

Check ONE (*or* 2 & *average*)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◈ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate **13** *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2	**Undercut banks (1)**	0	**Pools > 70cm (2)**	0	**Oxbows, Backwaters (1)**
0	**Overhanging vegetation (1)**	1	**Rootwads (1)**	0	**Aquatic macrophytes (1)**
2	**Shallows (in slow water) (1)**	0	**Boulders (1)**	2	**Logs and woody debris (1)**
1	**Rootmats (1)**				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover *Maximum 20* **8**

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◈ None (6)	◇ High (3)
◇ Moderate (3)	◇ Good (5)	◇ Recovered (4)	◇ Moderate (2)
◈ Low (2)	◇ Fair (3)	◇ Recovering (3)	◈ Low (1)
◇ None (1)	◈ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel *Maximum 20* **10**

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◈ ◈ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◈ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◈ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◈ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◇ ◇ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian *Maximum 10* **7**

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◈ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◇ Moderate (1)
- ◇ Slow (1)
- ◇ Interstitial (-1)
- ◈ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ ***Primary Contact***
- ◇ ***Secondary Contact***

(circle one and comment on back)

COMMENTS

Pool/Current *Maximum 12* **1**

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◇ **No Riffle (metric=0)**

RIFFLE DEPTH / **RUN DEPTH** — Check **ONE** (*ONLY!*)
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◈ Best Areas <5cm (metric=0)
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE / **RIFFLE/RUN EMBEDDEDNESS** — Check ONE (*or* 2 & *average*)
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run *Maximum 8* **0**

6-GRADIENT

(17.212 ft/mi)

DRAINAGE AREA

(1.529 mi²)

- ◇ Very low – Low (2-4)
- ◈ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 90 **% GLIDE: 0**

% RUN: 5 **% RIFFLE: 5**

Gradient *Maximum 10* **10**

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- ◇ >85% - Open
- ◇ 55%-<85%
- ◇ 30%-<55%
- ◇ 10%-<30%
- ◈ <10% - Closed

Canopy Upstream Reading

Right

9 Middle

Left

B-AESTHETICS

- ◇ Nuisance algae
- ◇ Invasive macrophytes
- ◇ Excess turbidity
- ◇ Discoloration
- ◇ Foam/Scum
- ◇ Oil sheen
- ◈ Trash/Litter
- ◇ Nuisance odor
- ◇ Sludge deposits
- ◇ CSOs/SSOs/Outfalls

C-MAINTENANCE

- ◇ Public ◇ Private
- ◇ Active ◇ Historic
- ◇ Young – Succession
- ◇ Old - Succession
- ◇ Spray
- ◇ Leveed – One sided
- ◇ Leveed – Both Banks
- ◇ Moving – Bedload
- ◇ Stable - Bedload
- ◇ Armoured ◇ Slumps
- ◇ Islands ◇ Scoured
- ◇ Relocated ◇ Cutoffs
- ◇ Impounded ◇ Desiccated
- ◇ Flood Control ◇ Drainage
- ◇ Snag Removed
- ◇ Snag Modified

D-ISSUES

- ◇ WWTP ◇ NPDES ◇ CSO
- ◇ Hardened ◇ Urban ◇ Dirt & Grime
- ◇ Contaminated ◇ Landfill ◇ Industry
- ◇ Construction BMPs ◇ Sediment BMPs
- ◇ Logging ◇ Irrigation ◇ Cooling
- ◇ Bank Erosion ◇ Surface Erosion ◇ H2O table
- ◇ False bank ◇ Manure ◇ Lagoon
- ◇ Wash H2O ◇ Tile ◇ Natural Flow
- ◇ Acid Mine ◇ Wetlands ◇ Stagnant Flow
- ◇ Quarry Mine ◇ Golf ◇ Home
- ◇ Park ◇ Data Paucity ◇ Lawn
- ◇ Agriculture ◇ Livestock
- ◇ Atmosphere Deposition

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47673	Fish	21T021	Sixmile Creek	CR 175 North

Surveyor	Sample Date	County	Macro Sample Type
CWY	8/16/21	Jennings	N/A

◇ **Habitat Complete**

QHEI Score: 72

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or 2 & average*)

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ **Bldrs/Slabs (10)**			x
◇ ◇ **Boulders (9)**			
◇ ◇ **Cobble (8)**			x
◇ ◈ **Gravel (7)**		x	x
◈ ◇ **Sand (6)**		x	x
◇ ◇ **Bedrock (5)**			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ **Hardpan (4)**			
◇ ◇ **Detritus (3)**		x	
◇ ◇ **Muck (2)**			
◇ ◇ **Silt (2)**		x	
◇ ◇ **Artificial (0)**		x	

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ◈ **4 or more (2)** ◇ **3 or less (0)**

ORIGIN
- ◇ **Limestone (1)**
- ◈ **Tills (1)**
- ◇ **Wetlands (0)**
- ◇ **Hardpan (0)**
- ◇ **Sandstone (0)**
- ◇ **Rip/Rap (0)**
- ◇ **Lacustrine (0)**
- ◇ **Shale (-1)**
- ◇ **Coal fines (-2)**

QUALITY

SILT
- ◇ **Heavy (-2)**
- ◇ **Moderate (-1)**
- ◈ **Normal (0)**
- ◇ **Free (1)**

EMBEDDEDNESS
- ◇ **Extensive (-2)**
- ◇ **Moderate (-1)**
- ◈ **Normal (0)**
- ◇ **None (1)**

Substrate 16 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	**Undercut banks (1)**	2	**Pools > 70cm (2)**	0	**Oxbows, Backwaters (1)**
0	**Overhanging vegetation (1)**	1	**Rootwads (1)**	0	**Aquatic macrophytes (1)**
1	**Shallows (in slow water) (1)**	1	**Boulders (1)**	1	**Logs and woody debris (1)**
1	**Rootmats (1)**				

AMOUNT

Check ONE (*or 2 & average*)
- ◇ **Extensive >75% (11)**
- ◈ **Moderate 25-75% (7)**
- ◈ **Sparse 5-<25% (3)**
- ◇ **Nearly absent <5% (1)**

COMMENTS

Cover *Maximum 20* — 12

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY
- ◇ **High (4)**
- ◇ **Moderate (3)**
- ◈ **Low (2)**
- ◇ **None (1)**

DEVELOPMENT
- ◇ **Excellent (7)**
- ◈ **Good (5)**
- ◇ **Fair (3)**
- ◇ **Poor (1)**

CHANNELIZATION
- ◈ **None (6)**
- ◇ **Recovered (4)**
- ◇ **Recovering (3)**
- ◇ **Recent or no recovery (1)**

STABILITY
- ◇ **High (3)**
- ◈ **Moderate (2)**
- ◇ **Low (1)**

COMMENTS

Channel *Maximum 20* — 15

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ **None or little (3)**
- ◈ ◈ **Moderate (2)**
- ◇ ◇ **Heavy/Severe (1)**

RIPARIAN WIDTH (L R)
- ◇ ◇ **Wide >50m (4)**
- ◇ ◇ **Moderate 10-50m (3)**
- ◈ ◈ **Narrow 5-10m (2)**
- ◇ ◇ **Very narrow <5m (1)**
- ◇ ◇ **None (0)**

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ **Forest, Swamp (3)**
- ◈ ◇ **Shrub or Old field (2)**
- ◇ ◈ **Residential, Park, New field (1)**
- ◇ ◇ **Fenced pasture (1)**
- ◈ ◇ **Open Pasture/Rowcrop (0)**
- ◇ ◇ **Conservation Tillage (1)**
- ◇ ◇ **Urban or Industrial (0)**
- ◇ ◇ **Mining, construction (0)**

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian *Maximum 10* — 5

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ **>1m (6)**
- ◈ **0.7-<1m (4)**
- ◇ **0.4-<0.7m (2)**
- ◇ **0.2-<0.4m (1)**
- ◇ **<0.2m (0)** (metric=0)

CHANNEL WIDTH

Check ONE (*or 2 & average*)
- ◈ **Pool width > riffle width (2)**
- ◇ **Pool width = riffle width (1)**
- ◇ **Pool width < riffle width (0)**

CURRENT VELOCITY

Check ALL that apply
- ◇ **Torrential (-1)**
- ◇ **Very Fast (1)**
- ◇ **Fast (1)**
- ◈ **Moderate (1)**
- ◈ **Slow (1)**
- ◇ **Interstitial (-1)**
- ◇ **Intermittent (-2)**
- ◇ **Eddies (1)**

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ ***Primary Contact***
- ◇ ***Secondary Contact***

(circle one and comment on back)

COMMENTS

Pool/Current *Maximum 12* — 8

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!*)

RIFFLE DEPTH
- ◈ **Best Areas >10cm (2)**
- ◇ **Best Areas 5-10cm (1)**
- ◇ **Best Areas <5cm** (metric=0)

RUN DEPTH
- ◈ **Maximum >50cm (2)**
- ◇ **Maximum <50cm (1)**

Check ONE (*or 2 & average*)

RIFFLE/RUN SUBSTRATE
- ◇ **Stable (e.g. cobble, boulder) (2)**
- ◈ **Mod. Stable (e.g. large gravel) (1)**
- ◇ **Unstable (e.g. sand, fine gravel) (0)**

RIFFLE/RUN EMBEDDEDNESS
- ◇ **None (2)**
- ◈ **Low (1)**
- ◇ **Moderate (0)**
- ◇ **Extensive (-1)**

COMMENTS

Riffle/Run *Maximum 8* — 6

6-GRADIENT

(9.933 ft/mi)

DRAINAGE AREA

(13.834 mi^2)

- ◇ **Very low – Low (2-4)**
- ◈ **Moderate (6-10)**
- ◇ **High – Very high (10-6)**

% POOL: 30 **% GLIDE: 0**

% RUN: 60 **% RIFFLE: 10**

Gradient *Maximum 10* — 10

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- >85% - Open
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10% - Closed

Canopy Upstream Reading

Right

1 Middle

Left

B-AESTHETICS

- Nuisance algae
- Invasive macrophytes
- Excess turbidity
- Discoloration
- Foam/Scum
- Oil sheen
- Trash/Litter
- Nuisance odor
- Sludge deposits
- CSOs/SSOs/Outfalls

C-MAINTENANCE

Public	Private
Active	Historic
Young – Succession	
Old - Succession	
Spray	
Leveed – One sided	
Leveed – Both Banks	
Moving – Bedload	
Stable - Bedload	
Armoured	Slumps
Islands	Scoured
Relocated	Cutoffs
Impounded	Desiccated
Flood Control	Drainage
Snag Removed	
Snag Modified	

D-ISSUES

WWTP	NPDES	CSO
Hardened	Urban	Dirt & Grime
Contaminated	Landfill	Industry
Construction BMPs	Sediment BMPs	
Logging	Irrigation	Cooling
Bank Erosion	Surface Erosion	H2O table
False bank	Manure	Lagoon
Wash H2O	Tile	Natural Flow
Acid Mine	Wetlands	Stagnant Flow
Quarry Mine	Golf	Home
Park	Data Paucity	Lawn
Agriculture	Livestock	
Atmosphere Deposition		

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47676	Fish	21T025	Vernon Fork Muscatatuck River	CR 60 South

Surveyor	Sample Date	County	Macro Sample Type		QHEI Score:
CWY	8/17/21	Jennings	N/A	◈ Habitat Complete	80

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			x	◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	
◇ ◇ Cobble (8)			x	◇ ◇ Muck (2)			
◇ ◈ Gravel (7)		x	x	◇ ◇ Silt (2)		x	
◈ ◇ Sand (6)		x	x	◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)		x	x				

NUMBER OF BEST TYPES: ◈ **4 or more (2)** ◇ **3 or less (0)**

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 16 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

1	Undercut banks (1)	2	Pools > 70cm (2)	2	Oxbows, Backwaters (1)
1	Overhanging vegetation (1)	1	Rootwads (1)	1	Aquatic macrophytes (1)
2	Shallows (in slow water) (1)	0	Boulders (1)	2	Logs and woody debris (1)
2	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◇ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 17

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◈ None (6)	◇ High (3)
◇ Moderate (3)	◈ Good (5)	◇ Recovered (4)	◈ Moderate (2)
◈ Low (2)	◇ Fair (3)	◇ Recovering (3)	◇ Low (1)
◇ None (1)	◇ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel Maximum 20 15

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◈ ◈ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◈ Wide >50m (4)
- ◈ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◈ ◇ Shrub or Old field (2)
- ◇ ◈ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◇ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 7

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◈ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◈ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◈ *Secondary Contact*

(circle one and comment on back)

COMMENTS Crosley FWA trail to river.

Pool/Current Maximum 12 9

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!*)

RIFFLE DEPTH
- ◇ Best Areas >10cm (2)
- ◈ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◈ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◈ Stable (e.g. cobble, boulder) (2)
- ◈ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◈ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

Riffle/Run Maximum 8 6

COMMENTS

6-GRADIENT

(4.424 ft/mi)
DRAINAGE AREA
(197.56 mi^2)

- ◇ Very low – Low (2-4)
- ◈ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL:	30	% GLIDE:	0
% RUN:	40	% RIFFLE:	30

Gradient Maximum 10 10

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◈ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ Bank Erosion	◇ Surface Erosion	◇ H2O table
	◇ Trash/Litter	◇ Leveed – Both Banks				
Canopy Upstream Reading		◇ Moving – Bedload		◇ 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 Flow
	◇ CSOs/SSOs/Outfalls	◇ Relocated	◇ Cutoffs	◇ Quarry Mine	◇ Golf	◇ Home
88 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
66 Left						

Stream Drawing

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47666	Fish	21T014	Mutton Creek	CR 800 North

Surveyor	Sample Date	County	Macro Sample Type
KAG	8/16/21	Jackson	N/A

◈ Habitat Complete

QHEI Score: 61

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or 2 & average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◈ Hardpan (4)		x	x
◇ ◇ Boulders (9)		x		◇ ◇ Detritus (3)		x	
◇ ◇ Cobble (8)		x		◇ ◇ Muck (2)			
◇ ◇ Gravel (7)		x	x	◇ ◇ Silt (2)		x	x
◈ ◇ Sand (6)		x	x	◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◈ 4 or more (2) ◇ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 13 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

1	**Undercut banks (1)**	2	**Pools > 70cm (2)**	1	**Oxbows, Backwaters (1)**
0	**Overhanging vegetation (1)**	1	**Rootwads (1)**	1	**Aquatic macrophytes (1)**
1	**Shallows (in slow water) (1)**	0	**Boulders (1)**	2	**Logs and woody debris (1)**
1	**Rootmats (1)**				

AMOUNT

Check ONE (*or 2 & average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◇ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover *Maximum 20* 16

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◈ None (6)	◇ High (3)
◇ Moderate (3)	◈ Good (5)	◇ Recovered (4)	◇ Moderate (2)
◈ Low (2)	◇ Fair (3)	◇ Recovering (3)	◈ Low (1)
◇ None (1)	◇ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel *Maximum 20* 14

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◈ ◈ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◈ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian *Maximum 10* 3

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or 2 & average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◈ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current *Maximum 12* 9

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!*)

RIFFLE DEPTH
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

Check ONE (*or 2 & average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

Riffle/Run *Maximum 8* 0

COMMENTS

6-GRADIENT

(4.798 ft/mi)

DRAINAGE AREA

(18.199 mi²)

- ◇ Very low – Low (2-4)
- ◈ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 30 **% GLIDE:** 0

% RUN: 70 **% RIFFLE:** 0

Gradient *Maximum 10* 6

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT Deep pool at start of sampling reach; Pool area >100ft^2; Pool depth >3ft.

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◈ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◈ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
51 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB48037	Fish	21T014.5	Mutton Creek	CR 800 North

Surveyor	Sample Date	County	Macro Sample Type
CWY	8/30/21	Jackson	N/A

◈ Habitat Complete

QHEI Score: 52

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)		x	x
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	
◇ ◇ Cobble (8)				◇ ◇ Muck (2)		x	
◇ ◇ Gravel (7)				◇ ◇ Silt (2)		x	
◈ ◈ Sand (6)		x	x	◇ ◇ Artificial (0)		x	
◇ ◇ Bedrock (5)							

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

ORIGIN
◇ Limestone (1)
◈ Tills (1)
◈ Wetlands (0)
◇ Hardpan (0)
◇ Sandstone (0)
◇ Rip/Rap (0)
◇ Lacustrine (0)
◇ Shale (-1)
◇ Coal fines (-2)

QUALITY
SILT
◇ Heavy (-2)
◈ Moderate (-1)
◇ Normal (0)
◇ Free (1)
EMBEDDEDNESS
◇ Extensive (-2)
◇ Moderate (-1)
◈ Normal (0)
◇ None (1)

Substrate 12 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

1	Undercut banks (1)	2	Pools > 70cm (2)	1	Oxbows, Backwaters (1)
1	Overhanging vegetation (1)	0	Rootwads (1)	0	Aquatic macrophytes (1)
1	Shallows (in slow water) (1)	0	Boulders (1)	1	Logs and woody debris (1)
2	Rootmats (1)				

AMOUNT
Check ONE (*or* 2 & *average*)
◇ Extensive >75% (11)
◇ Moderate 25-75% (7)
◈ Sparse 5-<25% (3)
◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 11

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
◇ High (4)
◈ Moderate (3)
◇ Low (2)
◇ None (1)

DEVELOPMENT
◇ Excellent (7)
◇ Good (5)
◈ Fair (3)
◇ Poor (1)

CHANNELIZATION
◇ None (6)
◈ Recovered (4)
◇ Recovering (3)
◇ Recent or no recovery (1)

STABILITY
◇ High (3)
◇ Moderate (2)
◈ Low (1)

COMMENTS

Channel Maximum 20 11

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION
L R
◇ ◇ None or little (3)
◈ ◈ Moderate (2)
◈ ◈ Heavy/Severe (1)

RIPARIAN WIDTH
L R
◇ ◇ Wide >50m (4)
◇ ◇ Moderate 10-50m (3)
◈ ◇ Narrow 5-10m (2)
◈ ◈ Very narrow <5m (1)
◇ ◈ None (0)

FLOOD PLAIN QUALITY
L R
◇ ◇ Forest, Swamp (3)
◇ ◇ Shrub or Old field (2)
◇ ◇ Residential, Park, New field (1)
◇ ◇ Fenced pasture (1)
◈ ◈ Open Pasture/Rowcrop (0)
◇ ◇ Conservation Tillage (1)
◇ ◇ Urban or Industrial (0)
◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 3

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
◈ >1m (6)
◇ 0.7-<1m (4)
◇ 0.4-<0.7m (2)
◇ 0.2-<0.4m (1)
◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
◈ Pool width > riffle width (2)
◇ Pool width = riffle width (1)
◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
◇ Torrential (-1)
◇ Very Fast (1)
◇ Fast (1)
◇ Moderate (1)
◈ Slow (1)
◇ Interstitial (-1)
◇ Intermittent (-2)
◇ Eddies (1)
Indicate for reach – pools and riffles.

RECREATION POTENTIAL
◇ *Primary Contact*
◇ *Secondary Contact*
(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 9

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!*)

RIFFLE DEPTH
◇ Best Areas >10cm (2)
◇ Best Areas 5-10cm (1)
◇ Best Areas <5cm (metric=0)

RUN DEPTH
◇ Maximum >50cm (2)
◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
◇ Stable (e.g. cobble, boulder) (2)
◇ Mod. Stable (e.g. large gravel) (1)
◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
◇ None (2)
◇ Low (1)
◇ Moderate (0)
◇ Extensive (-1)

COMMENTS

Riffle/Run Maximum 8 0

6-GRADIENT

(4.798 ft/mi)
DRAINAGE AREA
(18.199 mi²)

◇ Very low – Low (2-4)
◇ Moderate (6-10)
◇ High – Very high (10-6)

% POOL: 20 **% GLIDE:** 0
% RUN: 80 **% RIFFLE:** 0

Gradient Maximum 10 6

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

Pool depth >3ft

A-CANOPY

◇ >85% - Open
◈ 55%-<85%
◇ 30%-<55%
◇ 10%-<30%
◇ <10% - Closed

Canopy Upstream Reading

Right

69 Middle

Left

B-AESTHETICS

◈ Nuisance algae
◇ Invasive macrophytes
◇ Excess turbidity
◇ Discoloration
◇ Foam/Scum
◇ Oil sheen
◇ Trash/Litter
◇ Nuisance odor
◇ Sludge deposits
◇ CSOs/SSOs/Outfalls

C-MAINTENANCE

◇ Public ◇ Private
◇ Active ◇ Historic
◇ Young – Succession
◇ Old - Succession
◇ Spray
◇ Leveed – One sided
◇ Leveed – Both Banks
◇ Moving – Bedload
◇ Stable - Bedload
◇ Armoured ◇ Slumps
◇ Islands ◇ Scoured
◇ Relocated ◇ Cutoffs
◇ Impounded ◇ Desiccated
◇ Flood Control ◇ Drainage
◇ Snag Removed
◇ Snag Modified

D-ISSUES

◇ WWTP ◇ NPDES ◇ CSO
◇ Hardened ◇ Urban ◇ Dirt & Grime
◇ Contaminated ◇ Landfill ◇ Industry
◇ Construction BMPs ◇ Sediment BMPs
◇ Logging ◇ Irrigation ◇ Cooling
◇ Bank Erosion ◇ Surface Erosion ◇ H2O table
◇ False bank ◇ Manure ◇ Lagoon
◇ Wash H2O ◇ Tile ◇ Natural Flow
◇ Acid Mine ◇ Wetlands ◇ Stagnant Flow
◇ Quarry Mine ◇ Golf ◇ Home
◇ Park ◇ Data Paucity ◇ Lawn
◇ Agriculture ◇ Livestock
◇ Atmosphere Deposition

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47653	Fish	21T001	Vernon Fork Muscatatuck River	CR 600 South

Surveyor	Sample Date	County	Macro Sample Type
CWY	8/24/21	Jackson	N/A

◈ Habitat Complete

QHEI Score: 55

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)		x	
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	x
◇ ◇ Cobble (8)				◇ ◇ Muck (2)		x	
◇ ◇ Gravel (7)			x	◇ ◇ Silt (2)		x	x
◈ ◈ Sand (6)		x	x	◇ ◇ Artificial (0)		x	
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

Check ONE (*or* 2 & *average*)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◈ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate 11 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2	Undercut banks (1)	2	Pools > 70cm (2)	1	Oxbows, Backwaters (1)
0	Overhanging vegetation (1)	1	Rootwads (1)	0	Aquatic macrophytes (1)
0	Shallows (in slow water) (1)	0	Boulders (1)	1	Logs and woody debris (1)
2	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 12

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◇ Moderate (3)
- ◈ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◇ Good (5)
- ◈ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◇ Recovered (4)
- ◈ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◇ Moderate (2)
- ◈ Low (1)

COMMENTS

Channel Maximum 20 9

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◈ ◈ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◈ ◈ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 4

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 9

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!*)

RIFFLE DEPTH
- ◈ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◈ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◈ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◈ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run Maximum 8 4

6-GRADIENT

(1.343 ft/mi)

DRAINAGE AREA

(391.167 mi^2)

- ◇ Very low – Low (2-4)
- ◈ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 45 % GLIDE: 0

% RUN: 35 % RIFFLE: 20

Gradient Maximum 10 6

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

Floating algal mats; Pool area >100ft^2; Pool depth > 3ft.

A-CANOPY

- >85% - Open
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10% - Closed

Canopy Upstream Reading

12 Right

60 Middle

12 Left

B-AESTHETICS

- Nuisance algae
- Invasive macrophytes
- Excess turbidity
- Discoloration
- Foam/Scum
- Oil sheen
- Trash/Litter
- Nuisance odor
- Sludge deposits
- CSOs/SSOs/Outfalls

C-MAINTENANCE

- Public
- Private
- Active
- Historic
- Young – Succession
- Old - Succession
- Spray
- Leveed – One sided
- Leveed – Both Banks
- Moving – Bedload
- Stable - Bedload
- Armoured
- Slumps
- Islands
- Scoured
- Relocated
- Cutoffs
- Impounded
- Desiccated
- Flood Control
- Drainage
- Snag Removed
- Snag Modified

D-ISSUES

- WWTP
- NPDES
- CSO
- Hardened
- Urban
- Dirt & Grime
- Contaminated
- Landfill
- Industry
- Construction BMPs
- Sediment BMPs
- Logging
- Irrigation
- Cooling
- Bank Erosion
- Surface Erosion
- H2O table
- False bank
- Manure
- Lagoon
- Wash H2O
- Tile
- Natural Flow
- Acid Mine
- Wetlands
- Stagnant Flow
- Quarry Mine
- Golf
- Home
- Park
- Data Paucity
- Lawn
- Agriculture
- Livestock
- Atmosphere Deposition

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47654	Fish	21T002	Grassy Creek	CR 600

Surveyor	Sample Date	County	Macro Sample Type
KRW	8/24/21	Jackson	N/A

◈ Habitat Complete

QHEI Score: 51

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or 2 & average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ **Bldrs/Slabs (10)**				◇ ◇ **Hardpan (4)**			
◇ ◇ **Boulders (9)**				◇ ◇ **Detritus (3)**			
◇ ◇ **Cobble (8)**				◇ ◇ **Muck (2)**		x	
◇ ◈ **Gravel (7)**		x	x	◇ ◇ **Silt (2)**		x	x
◈ ◇ **Sand (6)**		x	x	◇ ◇ **Artificial (0)**			
◇ ◇ **Bedrock (5)**							

NUMBER OF BEST TYPES: ◇ **4 or more (2)** ◈ **3 or less (0)**

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ **Limestone (1)**
- ◇ **Tills (1)**
- ◈ **Wetlands (0)**
- ◇ **Hardpan (0)**
- ◇ **Sandstone (0)**
- ◇ **Rip/Rap (0)**
- ◇ **Lacustrine (0)**
- ◇ **Shale (-1)**
- ◇ **Coal fines (-2)**

QUALITY

SILT
- ◇ **Heavy (-2)**
- ◈ **Moderate (-1)**
- ◇ **Normal (0)**
- ◇ **Free (1)**

EMBEDDEDNESS
- ◇ **Extensive (-2)**
- ◇ **Moderate (-1)**
- ◈ **Normal (0)**
- ◇ **None (1)**

Substrate 12 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	**Undercut banks (1)**	1	**Pools > 70cm (2)**	0	**Oxbows, Backwaters (1)**
1	**Overhanging vegetation (1)**	0	**Rootwads (1)**	1	**Aquatic macrophytes (1)**
1	**Shallows (in slow water) (1)**	0	**Boulders (1)**	1	**Logs and woody debris (1)**
0	**Rootmats (1)**				

AMOUNT

Check ONE (*or 2 & average*)
- ◇ **Extensive >75% (11)**
- ◈ **Moderate 25-75% (7)**
- ◈ **Sparse 5-<25% (3)**
- ◇ **Nearly absent <5% (1)**

COMMENTS

Cover 11 *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY
- ◇ **High (4)**
- ◇ **Moderate (3)**
- ◇ **Low (2)**
- ◈ **None (1)**

DEVELOPMENT
- ◇ **Excellent (7)**
- ◇ **Good (5)**
- ◈ **Fair (3)**
- ◇ **Poor (1)**

CHANNELIZATION
- ◇ **None (6)**
- ◇ **Recovered (4)**
- ◈ **Recovering (3)**
- ◇ **Recent or no recovery (1)**

STABILITY
- ◇ **High (3)**
- ◇ **Moderate (2)**
- ◈ **Low (1)**

COMMENTS

Channel 8 *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ **None or little (3)**
- ◈ ◈ **Moderate (2)**
- ◇ ◇ **Heavy/Severe (1)**

RIPARIAN WIDTH (L R)
- ◇ ◇ **Wide >50m (4)**
- ◈ ◈ **Moderate 10-50m (3)**
- ◇ ◇ **Narrow 5-10m (2)**
- ◇ ◇ **Very narrow <5m (1)**
- ◇ ◇ **None (0)**

FLOOD PLAIN QUALITY (L R)
- ◈ ◇ **Forest, Swamp (3)**
- ◇ ◈ **Shrub or Old field (2)**
- ◇ ◇ **Residential, Park, New field (1)**
- ◇ ◇ **Fenced pasture (1)**
- ◇ ◈ **Open Pasture/Rowcrop (0)**
- ◇ ◇ **Conservation Tillage (1)**
- ◇ ◇ **Urban or Industrial (0)**
- ◇ ◇ **Mining, construction (0)**

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 8 *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
- ◈ **>1m (6)**
- ◇ **0.7-<1m (4)**
- ◇ **0.4-<0.7m (2)**
- ◇ **0.2-<0.4m (1)**
- ◇ **<0.2m (0)** (metric=0)

CHANNEL WIDTH
Check ONE (*or 2 & average*)
- ◇ **Pool width > riffle width (2)**
- ◈ **Pool width = riffle width (1)**
- ◇ **Pool width < riffle width (0)**

CURRENT VELOCITY
Check ALL that apply
- ◇ **Torrential (-1)**
- ◇ **Very Fast (1)**
- ◇ **Fast (1)**
- ◇ **Moderate (1)**
- ◈ **Slow (1)**
- ◇ **Interstitial (-1)**
- ◇ **Intermittent (-2)**
- ◇ **Eddies (1)**

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ ***Primary Contact***
- ◇ ***Secondary Contact***

(circle one and comment on back)

COMMENTS

Pool/Current 8 *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◈ **No Riffle (metric=0)**

RIFFLE DEPTH
Check **ONE** (*ONLY!*)
- ◇ **Best Areas >10cm (2)**
- ◇ **Best Areas 5-10cm (1)**
- ◇ **Best Areas <5cm** (metric=0)

RUN DEPTH
- ◇ **Maximum >50cm (2)**
- ◇ **Maximum <50cm (1)**

Check ONE (*or 2 & average*)

RIFFLE/RUN SUBSTRATE
- ◇ **Stable (e.g. cobble, boulder) (2)**
- ◇ **Mod. Stable (e.g. large gravel) (1)**
- ◇ **Unstable (e.g. sand, fine gravel) (0)**

RIFFLE/RUN EMBEDDEDNESS
- ◇ **None (2)**
- ◇ **Low (1)**
- ◇ **Moderate (0)**
- ◇ **Extensive (-1)**

Riffle/Run 0 *Maximum 8*

COMMENTS

6-GRADIENT

(1.972 ft/mi)
DRAINAGE AREA
(12.633 mi²)

- ◈ **Very low – Low (2-4)**
- ◇ **Moderate (6-10)**
- ◇ **High – Very high (10-6)**

% POOL: 30 **% GLIDE:** 70
% RUN: 0 **% RIFFLE:** 0

Gradient 4 *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
>85% - Open	Nuisance algae	Public	Private	WWTP	NPDES	CSO
55%-<85%	Invasive macrophytes	Active	Historic	Hardened	Urban	Dirt & Grime
30%-<55%	Excess turbidity	Young – Succession		Contaminated	Landfill	Industry
		Old - Succession				
10%-<30%	Discoloration	Spray		Construction BMPs	Sediment BMPs	
<10% - Closed	Foam/Scum			Logging	Irrigation	Cooling
	Oil sheen	Leveed – One sided		Bank Erosion	Surface Erosion	H_2O table
	Trash/Litter	Leveed – Both Banks				
Canopy Upstream Reading		Moving – Bedload		False bank	Manure	Lagoon
		Stable - Bedload				
Right	Nuisance odor	Armoured	Slumps	Wash H_2O	Tile	Natural Flow
	Sludge deposits	Islands	Scoured	Acid Mine	Wetlands	Stagnant Flow
	CSOs/SSOs/Outfalls	Relocated	Cutoffs	Quarry Mine	Golf	Home
62 Middle		Impounded	Desiccated	Park	Data Paucity	Lawn
		Flood Control	Drainage	Agriculture	Livestock	
		Snag Removed		Atmosphere Deposition		
		Snag Modified				
Left						

Stream Drawing

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47657	Fish	21T005	John McDonald Ditch	CR 125 South

Surveyor	Sample Date	County	Macro Sample Type
KRW	8/24/21	Jackson	N/A

◈ Habitat Complete

QHEI Score: 29

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)			
◇ ◇ Gravel (7)			
◇ ◇ Sand (6)			
◇ ◇ Bedrock (5)			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Hardpan (4)			
◇ ◇ Detritus (3)			
◈ ◈ Muck (2)		x	x
◇ ◇ Silt (2)		x	x
◇ ◇ Artificial (0)			

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◇ Tills (1)
- ◈ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◈ Heavy (-2)
- ◇ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◈ Extensive (-2)
- ◇ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate 0 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	0	Pools > 70cm (2)	0	Oxbows, Backwaters (1)
1	Overhanging vegetation (1)	1	Rootwads (1)	0	Aquatic macrophytes (1)
1	Shallows (in slow water) (1)	0	Boulders (1)	2	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 — 8

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◇ None (6)	◇ High (3)
◇ Moderate (3)	◇ Good (5)	◇ Recovered (4)	◇ Moderate (2)
◇ Low (2)	◇ Fair (3)	◇ Recovering (3)	◈ Low (1)
◈ None (1)	◈ Poor (1)	◈ Recent or no recovery (1)	

COMMENTS

Channel Maximum 20 — 4

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ None or little (3)
- ◇ ◇ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◈ ◈ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◈ ◈ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◈ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◇ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 — 9

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◇ 0.7-<1m (4)
- ◈ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◇ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 — 4

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!*)

RIFFLE DEPTH
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm(metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

Riffle/Run Maximum 8 — 0

COMMENTS

6-GRADIENT

(2.349 ft/mi)

DRAINAGE AREA (4.799 mi²)

- ◈ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 0 % GLIDE: 100

% RUN: 0 % RIFFLE: 0

Gradient Maximum 10 — 4

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◈ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
13 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47666	Macro	210816902	Mutton Creek	CR 800 North

Surveyor	Sample Date	County	Macro Sample Type
JMB	8/16/21	Jackson	MHAB

◇ Habitat Complete

QHEI Score: 52

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◈ ◇ Hardpan (4)		X	X
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		X	
◇ ◇ Cobble (8)				◇ ◇ Muck (2)			
◇ ◇ Gravel (7)		X	X	◇ ◇ Silt (2)		X	
◇ ◈ Sand (6)		X	X	◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◇ Tills (1)
- ◇ Wetlands (0)
- ◈ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 9 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

1	Undercut banks (1)	3	Pools > 70cm (2)
1	Overhanging vegetation (1)	0	Rootwads (1)
2	Shallows (in slow water) (1)	0	Boulders (1)
2	Rootmats (1)		
1	Oxbows, Backwaters (1)		
1	Aquatic macrophytes (1)		
1	Logs and woody debris (1)		

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover 12 — *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◈ High (4)
- ◇ Moderate (3)
- ◇ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◈ Good (5)
- ◇ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◈ Recovered (4)
- ◇ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◇ Moderate (2)
- ◈ Low (1)

COMMENTS

Channel 14 — *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◇ ◇ Moderate (2)
- ◈ ◈ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◈ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◈ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 3 — *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◇ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current 8 — *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

◈ No Riffle (metric=0)

RIFFLE DEPTH (Check **ONE** (*ONLY!*))
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE (Check ONE (*or* 2 & *average*))
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run 0 — *Maximum 8*

6-GRADIENT

(4.798 ft/mi)

DRAINAGE AREA

(18.199 mi^2)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 60 **% GLIDE:** #$

% RUN: 40 **% RIFFLE:** #$

Gradient 6 — *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◈ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
51 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47670	Macro	210816904	Storm Creek	Base Road

Surveyor	Sample Date	County	Macro Sample Type	
JMB	8/16/21	Jennings	MHAB	◇ Habitat Complete

QHEI Score: 53

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)			X
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		X	X
◇ ◇ Cobble (8)			X	◇ ◇ Muck (2)			
◇ ◇ Gravel (7)			X	◇ ◇ Silt (2)		X	X
◈ ◈ Sand (6)		X	X	◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

Check ONE (*or* 2 & *average*)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◈ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 12 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

- 1 Undercut banks (1)
- 1 Overhanging vegetation (1)
- 2 Shallows (in slow water) (1)
- 2 Rootmats (1)
- 1 Pools > 70cm (2)
- 0 Rootwads (1)
- 0 Boulders (1)
- 1 Oxbows, Backwaters (1)
- 0 Aquatic macrophytes (1)
- 1 Logs and woody debris (1)

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 — 11

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◇ None (6)	◇ High (3)
◇ Moderate (3)	◇ Good (5)	◇ Recovered (4)	◇ Moderate (2)
◈ Low (2)	◈ Fair (3)	◈ Recovering (3)	◈ Low (1)
◇ None (1)	◇ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel Maximum 20 — 9

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◇ ◇ Moderate (2)
- ◈ ◈ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◈ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◈ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 — 4

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◈ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◇ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 — 7

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◇ No Riffle (metric=0)

RIFFLE DEPTH — Check **ONE** (*ONLY!*)
- ◇ Best Areas >10cm (2)
- ◈ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◈ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE — Check ONE (*or* 2 & *average*)
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◈ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◈ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run Maximum 8 — 4

6-GRADIENT

(4.073 ft/mi)

DRAINAGE AREA

(9.378 mi^2)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 40 % GLIDE: 20

% RUN: 20 % RIFFLE: 20

Gradient Maximum 10 — 6

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◈ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
4 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47667	Macro	210816901	Mutton Creek	CR 300 North

Surveyor	Sample Date	County	Macro Sample Type
JMB	8/16/21	Jennings	MHAB

◈ Habitat Complete

QHEI Score: 53

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			X	◇ ◇ Hardpan (4)		X	X
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		X	X
◇ ◇ Cobble (8)			X	◇ ◇ Muck (2)			
◇ ◈ Gravel (7)		X	X	◇ ◇ Silt (2)		X	
◈ ◇ Sand (6)		X	X	◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◈ 4 or more (2) ◇ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 16 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	0	Pools > 70cm (2)	1	Oxbows, Backwaters (1)
1	Overhanging vegetation (1)	1	Rootwads (1)	1	Aquatic macrophytes (1)
2	Shallows (in slow water) (1)	0	Boulders (1)	1	Logs and woody debris (1)
2	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover *Maximum 20* 10

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◇ Moderate (3)
- ◈ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◇ Good (5)
- ◈ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◈ Recovered (4)
- ◇ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◈ Moderate (2)
- ◇ Low (1)

COMMENTS

Channel *Maximum 20* 11

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION

L R
- ◇ ◈ None or little (3)
- ◈ ◇ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH

L R
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◈ ◇ Narrow 5-10m (2)
- ◈ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY

L R
- ◈ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)

L R
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian *Maximum 10* 5

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◇ 0.7-<1m (4)
- ◈ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◇ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ ***Primary Contact***
- ◇ ***Secondary Contact***

(circle one and comment on back)

COMMENTS

Pool/Current *Maximum 12* 5

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◇ No Riffle (metric=0)

RIFFLE DEPTH

Check **ONE** (*ONLY!*)
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◈ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◈ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◈ Stable (e.g. cobble, boulder) (2)
- ◈ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◈ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run *Maximum 8* 0

6-GRADIENT

(6.52 ft/mi)

DRAINAGE AREA

(8.239 mi^2)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 10 **% GLIDE:** #$

% RUN: 80 **% RIFFLE:** 10

Gradient *Maximum 10* 6

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◈ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
31 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47664	Macro	210817902	Mutton Creek Ditch	CR 400 North

Surveyor	Sample Date	County	Macro Sample Type
JMB	8/17/21	Jackson	MHAB

◈ Habitat Complete

QHEI Score: 48

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◈ ◇ Hardpan (4)		X	
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		X	
◇ ◇ Cobble (8)				◇ ◈ Muck (2)		X	
◇ ◇ Gravel (7)				◇ ◇ Silt (2)		X	
◇ ◇ Sand (6)				◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◇ Tills (1)
- ◈ Wetlands (0)
- ◈ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 5 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	3	Pools > 70cm (2)	1	Oxbows, Backwaters (1)
2	Overhanging vegetation (1)	3	Rootwads (1)	2	Aquatic macrophytes (1)
0	Shallows (in slow water) (1)	0	Boulders (1)	2	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◇ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover *Maximum 20* 15

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◇ Moderate (3)
- ◇ Low (2)
- ◈ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◇ Good (5)
- ◇ Fair (3)
- ◈ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◇ Recovered (4)
- ◈ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◇ Moderate (2)
- ◈ Low (1)

COMMENTS

Channel *Maximum 20* 6

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION

L R
- ◈ ◈ None or little (3)
- ◇ ◇ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH

L R
- ◈ ◈ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY

L R
- ◈ ◈ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◇ ◇ Open Pasture/Rowcrop (0)

L R
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian *Maximum 10* 10

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◈ Slow (1)
- ◇ Very Fast (1)
- ◇ Interstitial (-1)
- ◇ Fast (1)
- ◇ Intermittent (-2)
- ◇ Moderate (1)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ ***Primary Contact***
- ◇ ***Secondary Contact***

(circle one and comment on back)

COMMENTS

Pool/Current *Maximum 12* 8

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
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run *Maximum 8* 0

6-GRADIENT

(2.112 ft/mi)

DRAINAGE AREA

(29.807 mi^2)

- ◈ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: #$ **% GLIDE:** 100

% RUN: #$ **% RIFFLE:** #$

Gradient *Maximum 10* 4

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- ◇ >85% - Open
- ◈ 55%-<85%
- ◇ 30%-<55%
- ◇ 10%-<30%
- ◇ <10% - Closed

Canopy Upstream Reading

Right

70 Middle

Left

B-AESTHETICS

- ◇ Nuisance algae
- ◇ Invasive macrophytes
- ◇ Excess turbidity
- ◇ Discoloration
- ◇ Foam/Scum
- ◇ Oil sheen
- ◇ Trash/Litter
- ◇ Nuisance odor
- ◇ Sludge deposits
- ◇ CSOs/SSOs/Outfalls

C-MAINTENANCE

◇ Public	◇ Private
◇ Active	◇ Historic
◇ Young – Succession	
◇ Old - Succession	
◇ Spray	
◇ Leveed – One sided	
◇ Leveed – Both Banks	
◇ Moving – Bedload	
◇ Stable - Bedload	
◇ Armoured	◇ Slumps
◇ Islands	◇ Scoured
◇ Relocated	◇ Cutoffs
◇ Impounded	◇ Desiccated
◇ Flood Control	◇ Drainage
◇ Snag Removed	
◇ Snag Modified	

D-ISSUES

◇ WWTP	◇ NPDES	◇ CSO
◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ Contaminated	◇ Landfill	◇ Industry
◇ Construction BMPs	◇ Sediment BMPs	
◇ Logging	◇ Irrigation	◇ Cooling
◇ Bank Erosion	◇ Surface Erosion	◇ H2O table
◇ False bank	◇ Manure	◇ Lagoon
◇ Wash H2O	◇ Tile	◇ Natural Flow
◇ Acid Mine	◇ Wetlands	◇ Stagnant Flow
◇ Quarry Mine	◇ Golf	◇ Home
◇ Park	◇ Data Paucity	◇ Lawn
◇ Agriculture	◇ Livestock	
◇ Atmosphere Deposition		

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47668	Macro	210817901	Storm Creek Ditch	CR 400 North

Surveyor	Sample Date	County	Macro Sample Type
JMB	8/17/21	Jackson	MHAB

◈ Habitat Complete

QHEI Score: 44

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)		X	
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		X	
◇ ◇ Cobble (8)				◇ ◈ Muck (2)		X	
◇ ◇ Gravel (7)				◈ ◇ Silt (2)		X	
◇ ◇ Sand (6)		X		◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◇ Tills (1)
- ◈ Wetlands (0)
- ◈ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◈ Heavy (-2)
- ◇ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate 2 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	3	Pools > 70cm (2)	2	Oxbows, Backwaters (1)
2	Overhanging vegetation (1)	2	Rootwads (1)	1	Aquatic macrophytes (1)
1	Shallows (in slow water) (1)	0	Boulders (1)	2	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◇ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover 16 — *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◇ Moderate (3)
- ◇ Low (2)
- ◈ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◇ Good (5)
- ◇ Fair (3)
- ◈ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◇ Recovered (4)
- ◇ Recovering (3)
- ◈ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◇ Moderate (2)
- ◈ Low (1)

COMMENTS No Recovery

Channel 4 — *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ None or little (3)
- ◇ ◇ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◈ ◈ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◈ ◈ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◇ ◇ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 10 — *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◈ Slow (1)
- ◇ Very Fast (1)
- ◇ Interstitial (-1)
- ◇ Fast (1)
- ◇ Intermittent (-2)
- ◇ Moderate (1)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current 8 — *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

◈ No Riffle (metric=0)

RIFFLE DEPTH — Check **ONE** (*ONLY!*)
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE — Check ONE (*or* 2 & *average*)
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run 0 — *Maximum 8*

6-GRADIENT

(2.682 ft/mi)

DRAINAGE AREA

(17.513 mi²)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: #$ **% GLIDE:** 100

% RUN: #$ **% RIFFLE:** #$

Gradient 4 — *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◈ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession ◇ Old - Succession		◇ Contaminated	◇ Landfill	◇ Industry
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ Bank Erosion	◇ Surface Erosion	◇ H2O table
	◇ Trash/Litter	◇ Leveed – Both Banks				
Canopy Upstream Reading		◇ Moving – Bedload ◇ Stable - Bedload		◇ False bank	◇ Manure	◇ Lagoon
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 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB46803	Macro	210817703	Tea Creek	CR 650 West

Surveyor	Sample Date	County	Macro Sample Type
PDM	8/17/21	Jennings	MHAB

◇ Habitat Complete

QHEI Score: 43

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)			
◇ ◇ Gravel (7)		x	x
◈ ◇ Sand (6)		x	x
◇ ◇ Bedrock (5)			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◈ Hardpan (4)		x	
◇ ◇ Detritus (3)		x	x
◇ ◇ Muck (2)			
◇ ◇ Silt (2)		x	x
◇ ◇ Artificial (0)			

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES:
◇ 4 or more (2)
◈ 3 or less (0)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate 9 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	2	Pools > 70cm (2)
0	Overhanging vegetation (1)	1	Rootwads (1)
1	Shallows (in slow water) (1)	0	Boulders (1)
2	Rootmats (1)		
0	Oxbows, Backwaters (1)		
0	Aquatic macrophytes (1)		
1	Logs and woody debris (1)		

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 9

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◈ Moderate (3)
- ◈ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◇ Good (5)
- ◈ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◇ Recovered (4)
- ◈ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◇ Moderate (2)
- ◈ Low (1)

COMMENTS

Channel Maximum 20 10

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION

L R
- ◇ ◇ None or little (3)
- ◈ ◈ Moderate (2)
- ◈ ◈ Heavy/Severe (1)

RIPARIAN WIDTH

L R
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◈ ◇ Narrow 5-10m (2)
- ◇ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY

L R
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)

L R
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 3

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◇ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 8

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!*)

RIFFLE DEPTH
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm(metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run Maximum 8 0

6-GRADIENT

(2.676 ft/mi)

DRAINAGE AREA (10.632 mi²)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 50 **% GLIDE:** #$

% RUN: 50 **% RIFFLE:** #$

Gradient Maximum 10 4

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◈ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
0 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47653	Macro	210824701	Vernon Fork Muscatatuck River	CR 600 South

Surveyor	Sample Date	County	Macro Sample Type		
PDM	8/24/21	Jackson	MHAB	◇ Habitat Complete	**QHEI Score: 43**

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or 2 & average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)				◇ ◈ Detritus (3)		x	x
◇ ◇ Cobble (8)				◇ ◇ Muck (2)			
◇ ◇ Gravel (7)			x	◇ ◇ Silt (2)		x	x
◈ ◇ Sand (6)		x	x	◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate **8** *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2	Undercut banks (1)	2	Pools > 70cm (2)	0	Oxbows, Backwaters (1)
0	Overhanging vegetation (1)	1	Rootwads (1)	0	Aquatic macrophytes (1)
0	Shallows (in slow water) (1)	0	Boulders (1)	2	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT

Check ONE (*or 2 & average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover **9** *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◇ None (6)	◇ High (3)
◇ Moderate (3)	◇ Good (5)	◇ Recovered (4)	◈ Moderate (2)
◈ Low (2)	◈ Fair (3)	◈ Recovering (3)	◈ Low (1)
◇ None (1)	◇ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel **10** *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◇ ◇ Moderate (2)
- ◈ ◈ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◈ ◈ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian **3** *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or 2 & average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current **10** *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◇ No Riffle (metric=0)

RIFFLE DEPTH
Check **ONE** (*ONLY!*)
- ◈ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◈ Maximum <50cm (1)

Check ONE (*or 2 & average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◈ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◈ Moderate (0)
- ◇ Extensive (-1)

Riffle/Run **3** *Maximum 8*

COMMENTS

6-GRADIENT

(0 ft/mi)
DRAINAGE AREA
(0 mi²)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 70 % GLIDE: #$
% RUN: 20 % RIFFLE: 10

Gradient **0** *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- >85% - Open
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10% - Closed

Canopy Upstream Reading

12 Right

47 Middle

12 Left

B-AESTHETICS

- Nuisance algae
- Invasive macrophytes
- Excess turbidity
- Discoloration
- Foam/Scum
- Oil sheen
- Trash/Litter
- Nuisance odor
- Sludge deposits
- CSOs/SSOs/Outfalls

C-MAINTENANCE

- Public
- Private
- Active
- Historic
- Young – Succession
- Old - Succession
- Spray
- Leveed – One sided
- Leveed – Both Banks
- Moving – Bedload
- Stable - Bedload
- Armoured
- Slumps
- Islands
- Scoured
- Relocated
- Cutoffs
- Impounded
- Desiccated
- Flood Control
- Drainage
- Snag Removed
- Snag Modified

D-ISSUES

- WWTP
- NPDES
- CSO
- Hardened
- Urban
- Dirt & Grime
- Contaminated
- Landfill
- Industry
- Construction BMPs
- Sediment BMPs
- Logging
- Irrigation
- Cooling
- Bank Erosion
- Surface Erosion
- H2O table
- False bank
- Manure
- Lagoon
- Wash H2O
- Tile
- Natural Flow
- Acid Mine
- Wetlands
- Stagnant Flow
- Quarry Mine
- Golf
- Home
- Park
- Data Paucity
- Lawn
- Agriculture
- Livestock
- Atmosphere Deposition

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47654	Macro	210824702	Grassy Creek	CR 600

Surveyor	Sample Date	County	Macro Sample Type
PDM	8/24/21	Jackson	MHAB

◇ Habitat Complete

QHEI Score: 46

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)			
◇ ◇ Gravel (7)			
◈ ◇ Sand (6)		x	x
◇ ◇ Bedrock (5)			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Hardpan (4)			
◇ ◇ Detritus (3)		x	x
◇ ◇ Muck (2)			
◇ ◈ Silt (2)		x	x
◇ ◇ Artificial (0)			

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES:
◇ 4 or more (2)
◈ 3 or less (0)

ORIGIN
◇ Limestone (1)
◈ Tills (1)
◈ Wetlands (0)
◇ Hardpan (0)
◇ Sandstone (0)
◇ Rip/Rap (0)
◇ Lacustrine (0)
◇ Shale (-1)
◇ Coal fines (-2)

QUALITY

SILT
◇ Heavy (-2)
◈ Moderate (-1)
◇ Normal (0)
◇ Free (1)

EMBEDDEDNESS
◇ Extensive (-2)
◈ Moderate (-1)
◇ Normal (0)
◇ None (1)

Substrate 7 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

Score	Cover type	Score	Cover type	Score	Cover type
0	Undercut banks (1)	3	Pools > 70cm (2)	0	Oxbows, Backwaters (1)
2	Overhanging vegetation (1)	0	Rootwads (1)	2	Aquatic macrophytes (1)
0	Shallows (in slow water) (1)	0	Boulders (1)	1	Logs and woody debris (1)
0	Rootmats (1)				

AMOUNT
Check ONE (*or* 2 & *average*)
◇ Extensive >75% (11)
◈ Moderate 25-75% (7)
◇ Sparse 5-<25% (3)
◇ Nearly absent <5% (1)

COMMENTS

Cover 12 — *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
◇ High (4)
◇ Moderate (3)
◇ Low (2)
◈ None (1)

DEVELOPMENT
◇ Excellent (7)
◇ Good (5)
◇ Fair (3)
◈ Poor (1)

CHANNELIZATION
◇ None (6)
◇ Recovered (4)
◈ Recovering (3)
◇ Recent or no recovery (1)

STABILITY
◇ High (3)
◈ Moderate (2)
◈ Low (1)

COMMENTS

Channel 7 — *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
◈ ◈ None or little (3)
◇ ◇ Moderate (2)
◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
◈ ◇ Wide >50m (4)
◇ ◈ Moderate 10-50m (3)
◇ ◇ Narrow 5-10m (2)
◇ ◇ Very narrow <5m (1)
◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
◈ ◇ Forest, Swamp (3)
◇ ◇ Shrub or Old field (2)
◇ ◇ Residential, Park, New field (1)
◇ ◇ Fenced pasture (1)
◇ ◈ Open Pasture/Rowcrop (0)
◇ ◇ Conservation Tillage (1)
◇ ◇ Urban or Industrial (0)
◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 8 — *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
◈ >1m (6)
◇ 0.7-<1m (4)
◇ 0.4-<0.7m (2)
◇ 0.2-<0.4m (1)
◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
◇ Pool width > riffle width (2)
◈ Pool width = riffle width (1)
◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
◇ Torrential (-1)
◇ Very Fast (1)
◇ Fast (1)
◇ Moderate (1)
◈ Slow (1)
◇ Interstitial (-1)
◇ Intermittent (-2)
◇ Eddies (1)
Indicate for reach – pools and riffles.

RECREATION POTENTIAL
◇ *Primary Contact*
◇ *Secondary Contact*
(circle one and comment on back)

COMMENTS

Pool/Current 8 — *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!*)

RIFFLE DEPTH
◇ Best Areas >10cm (2)
◇ Best Areas 5-10cm (1)
◇ Best Areas <5cm (metric=0)

RUN DEPTH
◇ Maximum >50cm (2)
◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
◇ Stable (e.g. cobble, boulder) (2)
◇ Mod. Stable (e.g. large gravel) (1)
◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
◇ None (2)
◇ Low (1)
◇ Moderate (0)
◇ Extensive (-1)

COMMENTS

Riffle/Run 0 — *Maximum 8*

6-GRADIENT

(1.972 ft/mi)
DRAINAGE AREA
(12.633 mi²)

◇ Very low – Low (2-4)
◇ Moderate (6-10)
◇ High – Very high (10-6)

% POOL: 50 **% GLIDE:** 50
% RUN: #$ **% RIFFLE:** #$

Gradient 4 — *Maximum 10*

IDEM

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- ◇ >85% - Open
- ◈ 55%-<85%
- ◇ 30%-<55%
- ◇ 10%-<30%
- ◇ <10% - Closed

Canopy Upstream Reading

Right

62 Middle

Left

B-AESTHETICS

- ◇ Nuisance algae
- ◇ Invasive macrophytes
- ◇ Excess turbidity
- ◇ Discoloration
- ◇ Foam/Scum
- ◇ Oil sheen
- ◇ Trash/Litter
- ◇ Nuisance odor
- ◇ Sludge deposits
- ◇ CSOs/SSOs/Outfalls

C-MAINTENANCE

- ◇ Public
- ◇ Private
- ◇ Active
- ◇ Historic
- ◇ Young – Succession
- ◇ Old - Succession
- ◇ Spray
- ◇ Leveed – One sided
- ◇ Leveed – Both Banks
- ◇ Moving – Bedload
- ◇ Stable - Bedload
- ◇ Armoured
- ◇ Slumps
- ◇ Islands
- ◇ Scoured
- ◇ Relocated
- ◇ Cutoffs
- ◇ Impounded
- ◇ Desiccated
- ◇ Flood Control
- ◇ Drainage
- ◇ Snag Removed
- ◇ Snag Modified

D-ISSUES

- ◇ WWTP
- ◇ NPDES
- ◇ CSO
- ◇ Hardened
- ◇ Urban
- ◇ Dirt & Grime
- ◇ Contaminated
- ◇ Landfill
- ◇ Industry
- ◇ Construction BMPs
- ◇ Sediment BMPs
- ◇ Logging
- ◇ Irrigation
- ◇ Cooling
- ◇ Bank Erosion
- ◇ Surface Erosion
- ◇ H2O table
- ◇ False bank
- ◇ Manure
- ◇ Lagoon
- ◇ Wash H2O
- ◇ Tile
- ◇ Natural Flow
- ◇ Acid Mine
- ◇ Wetlands
- ◇ Stagnant Flow
- ◇ Quarry Mine
- ◇ Golf
- ◇ Home
- ◇ Park
- ◇ Data Paucity
- ◇ Lawn
- ◇ Agriculture
- ◇ Livestock
- ◇ Atmosphere Deposition

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47657	Macro	210824703	John McDonald Ditch	CR 125 South

Surveyor	Sample Date	County	Macro Sample Type
PDM	8/24/21	Jackson	MHAB

◇ Habitat Complete

QHEI Score: 42

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or 2 & average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	x
◇ ◇ Cobble (8)				◇ ◇ Muck (2)		x	x
◇ ◇ Gravel (7)				◇ ◈ Silt (2)		x	x
◈ ◇ Sand (6)		x	x	◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◈ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◈ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate 6 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	0	Pools > 70cm (2)	0	Oxbows, Backwaters (1)
1	Overhanging vegetation (1)	0	Rootwads (1)	2	Aquatic macrophytes (1)
0	Shallows (in slow water) (1)	0	Boulders (1)	1	Logs and woody debris (1)
0	Rootmats (1)				

AMOUNT

Check ONE (*or 2 & average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover 6 *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◈ None (6)	◇ High (3)
◇ Moderate (3)	◇ Good (5)	◇ Recovered (4)	◇ Moderate (2)
◈ Low (2)	◈ Fair (3)	◇ Recovering (3)	◈ Low (1)
◇ None (1)	◇ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel 12 *Maximum 20*

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ None or little (3)
- ◇ ◇ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◈ ◈ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◈ ◈ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◇ ◇ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian 10 *Maximum 10*

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◇ 0.7-<1m (4)
- ◈ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or 2 & average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◇ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current 4 *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◈ No Riffle (metric=0)

RIFFLE DEPTH (Check **ONE** (*ONLY!*))
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE (Check ONE (*or 2 & average*))
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run 0 *Maximum 8*

6-GRADIENT

(2.349 ft/mi)

DRAINAGE AREA (4.799 mi²)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 20 **% GLIDE:** #$

% RUN: 80 **% RIFFLE:** #$

Gradient 4 *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- >85% - Open
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10% - Closed

Canopy Upstream Reading

Right

13 Middle

Left

B-AESTHETICS

- Nuisance algae
- Invasive macrophytes
- Excess turbidity
- Discoloration
- Foam/Scum
- Oil sheen
- Trash/Litter
- Nuisance odor
- Sludge deposits
- CSOs/SSOs/Outfalls

C-MAINTENANCE

- Public
- Private
- Active
- Historic
- Young – Succession
- Old - Succession
- Spray
- Leveed – One sided
- Leveed – Both Banks
- Moving – Bedload
- Stable - Bedload
- Armoured
- Slumps
- Islands
- Scoured
- Relocated
- Cutoffs
- Impounded
- Desiccated
- Flood Control
- Drainage
- Snag Removed
- Snag Modified

D-ISSUES

- WWTP
- NPDES
- CSO
- Hardened
- Urban
- Dirt & Grime
- Contaminated
- Landfill
- Industry
- Construction BMPs
- Sediment BMPs
- Logging
- Irrigation
- Cooling
- Bank Erosion
- Surface Erosion
- H2O table
- False bank
- Manure
- Lagoon
- Wash H2O
- Tile
- Natural Flow
- Acid Mine
- Wetlands
- Stagnant Flow
- Quarry Mine
- Golf
- Home
- Park
- Data Paucity
- Lawn
- Agriculture
- Livestock
- Atmosphere Deposition

Stream Drawing

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47672	Macro	210818701	Sixmile Creek	CR 200 South

Surveyor	Sample Date	County	Macro Sample Type
PDM	8/18/21	Jennings	MHAB

◇ Habitat Complete

QHEI Score: 62

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)			
◈ ◇ Gravel (7)		x	x
◇ ◈ Sand (6)		x	x
◇ ◇ Bedrock (5)			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Hardpan (4)			
◇ ◇ Detritus (3)		x	x
◇ ◇ Muck (2)			
◇ ◇ Silt (2)		x	x
◇ ◇ Artificial (0)		x	

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES:
◇ 4 or more (2)
◈ 3 or less (0)

Check ONE (*or* 2 & *average*)

ORIGIN
◇ Limestone (1)
◈ Tills (1)
◇ Wetlands (0)
◇ Hardpan (0)
◇ Sandstone (0)
◇ Rip/Rap (0)
◇ Lacustrine (0)
◇ Shale (-1)
◇ Coal fines (-2)

QUALITY
SILT
◇ Heavy (-2)
◇ Moderate (-1)
◈ Normal (0)
◇ Free (1)
EMBEDDEDNESS
◇ Extensive (-2)
◈ Moderate (-1)
◈ Normal (0)
◇ None (1)

Substrate **14** *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0 Undercut banks (1)
1 Overhanging vegetation (1)
0 Shallows (in slow water) (1)
2 Rootmats (1)
0 Pools > 70cm (2)
1 Rootwads (1)
0 Boulders (1)
0 Oxbows, Backwaters (1)
1 Aquatic macrophytes (1)
1 Logs and woody debris (1)

AMOUNT
Check ONE (*or* 2 & *average*)
◇ Extensive >75% (11)
◈ Moderate 25-75% (7)
◈ Sparse 5-<25% (3)
◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 **10**

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
◇ High (4)
◈ Moderate (3)
◈ Low (2)
◇ None (1)

DEVELOPMENT
◇ Excellent (7)
◈ Good (5)
◇ Fair (3)
◇ Poor (1)

CHANNELIZATION
◇ None (6)
◈ Recovered (4)
◇ Recovering (3)
◇ Recent or no recovery (1)

STABILITY
◇ High (3)
◈ Moderate (2)
◇ Low (1)

COMMENTS

Channel Maximum 20 **14**

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION
L R
◇ ◇ None or little (3)
◈ ◈ Moderate (2)
◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH
L R
◇ ◇ Wide >50m (4)
◇ ◇ Moderate 10-50m (3)
◈ ◈ Narrow 5-10m (2)
◇ ◇ Very narrow <5m (1)
◇ ◇ None (0)

FLOOD PLAIN QUALITY
L R
◇ ◇ Forest, Swamp (3)
◇ ◇ Shrub or Old field (2)
◇ ◇ Residential, Park, New field (1)
◇ ◇ Fenced pasture (1)
◈ ◈ Open Pasture/Rowcrop (0)

L R
◇ ◇ Conservation Tillage (1)
◇ ◇ Urban or Industrial (0)
◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 **4**

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
◇ >1m (6)
◇ 0.7-<1m (4)
◈ 0.4-<0.7m (2)
◇ 0.2-<0.4m (1)
◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
◇ Pool width > riffle width (2)
◈ Pool width = riffle width (1)
◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
◇ Torrential (-1)
◇ Very Fast (1)
◈ Fast (1)
◈ Moderate (1)
◈ Slow (1)
◇ Interstitial (-1)
◇ Intermittent (-2)
◇ Eddies (1)
Indicate for reach – pools and riffles.

RECREATION POTENTIAL
◇ *Primary Contact*
◇ *Secondary Contact*
(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 **6**

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!*)

RIFFLE DEPTH
◈ Best Areas >10cm (2)
◇ Best Areas 5-10cm (1)
◇ Best Areas <5cm (metric=0)

RUN DEPTH
◇ Maximum >50cm (2)
◈ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
◇ Stable (e.g. cobble, boulder) (2)
◈ Mod. Stable (e.g. large gravel) (1)
◈ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
◇ None (2)
◇ Low (1)
◈ Moderate (0)
◇ Extensive (-1)

COMMENTS

Riffle/Run Maximum 8 **4**

6-GRADIENT

(9.117 ft/mi)
DRAINAGE AREA
(24.444 mi²)

◇ Very low – Low (2-4)
◇ Moderate (6-10)
◇ High – Very high (10-6)

% POOL: 30
% GLIDE: #$
% RUN: 60
% RIFFLE: 10

Gradient Maximum 10 **10**

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
35 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47661	Macro	210818901	Vernon Fork Muscatatuck River	US 31

Surveyor	Sample Date	County	Macro Sample Type
JMB	8/18/21	Jackson	MHAB

◈ Habitat Complete

QHEI Score: 74

1-SUBSTRATE

Check *ONLY* Two substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)		X	X	◇ ◇ Hardpan (4)		X	
◇ ◇ Boulders (9)		X	X	◇ ◇ Detritus (3)		X	
◇ ◇ Cobble (8)			X	◇ ◇ Muck (2)			
◇ ◇ Gravel (7)			X	◇ ◇ Silt (2)		X	
◈ ◇ Sand (6)		X		◇ ◇ Artificial (0)			
◇ ◈ Bedrock (5)		X	X				

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ◈ 4 or more (2) ◇ 3 or less (0)

ORIGIN
◇ Limestone (1)
◇ Tills (1)
◇ Wetlands (0)
◇ Hardpan (0)
◇ Sandstone (0)
◈ Rip/Rap (0)
◇ Lacustrine (0)
◈ Shale (-1)
◇ Coal fines (-2)

QUALITY
SILT
◇ Heavy (-2)
◈ Moderate (-1)
◇ Normal (0)
◇ Free (1)
EMBEDDEDNESS
◇ Extensive (-2)
◈ Moderate (-1)
◇ Normal (0)
◇ None (1)

Substrate 11 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	3	Pools > 70cm (2)
0	Overhanging vegetation (1)	2	Rootwads (1)
3	Shallows (in slow water) (1)	3	Boulders (1)
0	Rootmats (1)		
0	Oxbows, Backwaters (1)		
2	Aquatic macrophytes (1)		
2	Logs and woody debris (1)		

AMOUNT
Check ONE (*or* 2 & *average*)
◇ Extensive >75% (11)
◈ Moderate 25-75% (7)
◈ Sparse 5-<25% (3)
◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 12

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
◇ High (4)
◇ Moderate (3)
◈ Low (2)
◇ None (1)

DEVELOPMENT
◈ Excellent (7)
◇ Good (5)
◇ Fair (3)
◇ Poor (1)

CHANNELIZATION
◈ None (6)
◇ Recovered (4)
◇ Recovering (3)
◇ Recent or no recovery (1)

STABILITY
◈ High (3)
◇ Moderate (2)
◇ Low (1)

Channel Maximum 20 18

COMMENTS

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION
L R
◈ ◇ None or little (3)
◇ ◈ Moderate (2)
◇ ◈ Heavy/Severe (1)

RIPARIAN WIDTH
L R
◈ ◇ Wide >50m (4)
◇ ◇ Moderate 10-50m (3)
◇ ◈ Narrow 5-10m (2)
◇ ◇ Very narrow <5m (1)
◇ ◇ None (0)

FLOOD PLAIN QUALITY
L R
◈ ◈ Forest, Swamp (3)
◇ ◇ Shrub or Old field (2)
◇ ◇ Residential, Park, New field (1)
◇ ◇ Fenced pasture (1)
◈ ◈ Open Pasture/Rowcrop (0)
◇ ◇ Conservation Tillage (1)
◇ ◇ Urban or Industrial (0)
◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

Riparian Maximum 10 7

COMMENTS

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
◈ >1m (6)
◇ 0.7-<1m (4)
◇ 0.4-<0.7m (2)
◇ 0.2-<0.4m (1)
◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
◈ Pool width > riffle width (2)
◇ Pool width = riffle width (1)
◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
◇ Torrential (-1)
◇ Very Fast (1)
◈ Fast (1)
◈ Moderate (1)
◈ Slow (1)
◇ Interstitial (-1)
◇ Intermittent (-2)
◈ Eddies (1)
Indicate for reach – pools and riffles.

RECREATION POTENTIAL
◇ *Primary Contact*
◇ *Secondary Contact*
(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 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!*)

RIFFLE DEPTH
◈ Best Areas >10cm (2)
◇ Best Areas 5-10cm (1)
◇ Best Areas <5cm (metric=0)

RUN DEPTH
◈ Maximum >50cm (2)
◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
◈ Stable (e.g. cobble, boulder) (2)
◇ Mod. Stable (e.g. large gravel) (1)
◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
◈ None (2)
◇ Low (1)
◇ Moderate (0)
◇ Extensive (-1)

Riffle/Run Maximum 8 8

COMMENTS

6-GRADIENT

(1.458 ft/mi)
DRAINAGE AREA
(292.076 mi²)

◇ Very low – Low (2-4)
◇ Moderate (6-10)
◇ High – Very high (10-6)

% POOL: 40 **% GLIDE:** #$
% RUN: 40 **% RIFFLE:** 20

Gradient Maximum 10 6

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ **>85% - Open**	◇ **Nuisance algae**	◇ **Public**	◇ **Private**	◇ **WWTP**	◇ **NPDES**	◇ **CSO**
◇ **55%-<85%**	◇ **Invasive macrophytes**	◇ **Active**	◇ **Historic**	◇ **Hardened**	◇ **Urban**	◇ **Dirt & Grime**
◇ **30%-<55%**	◇ **Excess turbidity**	◇ **Young – Succession**		◇ **Contaminated**	◇ **Landfill**	◇ **Industry**
		◇ **Old - Succession**				
◇ **10%-<30%**	◇ **Discoloration**	◇ **Spray**		◇ **Construction BMPs**	◇ **Sediment BMPs**	
◇ **<10% - Closed**	◇ **Foam/Scum**			◇ **Logging**	◇ **Irrigation**	◇ **Cooling**
	◇ **Oil sheen**	◇ **Leveed – One sided**		◇ **Bank Erosion**	◇ **Surface Erosion**	◇ **H2O table**
	◇ **Trash/Litter**	◇ **Leveed – Both Banks**				
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 Flow**
	◇ **CSOs/SSOs/Outfalls**	◇ **Relocated**	◇ **Cutoffs**	◇ **Quarry Mine**	◇ **Golf**	◇ **Home**
45 Middle		◇ **Impounded**	◇ **Desiccated**	◇ **Park**	◇ **Data Paucity**	◇ **Lawn**
		◇ **Flood Control**	◇ **Drainage**	◇ **Agriculture**	◇ **Livestock**	
		◇ **Snag Removed**		◇ **Atmosphere Deposition**		
		◇ **Snag Modified**				
15 Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47675	Macro	210818702	Vernon Fork Muscatatuck River	CR 400 West

Surveyor	Sample Date	County	Macro Sample Type
PDM	8/18/21	Jennings	MHAB

◈ Habitat Complete

QHEI Score: 62

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ **Bldrs/Slabs (10)**			x
◇ ◇ **Boulders (9)**			
◇ ◇ **Cobble (8)**			
◇ ◈ **Gravel (7)**		x	x
◇ ◇ **Sand (6)**		x	x
◈ ◇ **Bedrock (5)**			x

NUMBER OF BEST TYPES: ◈ **4 or more (2)** ◇ **3 or less (0)**

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ **Hardpan (4)**			
◇ ◇ **Detritus (3)**		x	x
◇ ◇ **Muck (2)**			
◇ ◇ **Silt (2)**		x	x
◇ ◇ **Artificial (0)**			

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ **Limestone (1)**
- ◈ **Tills (1)**
- ◇ **Wetlands (0)**
- ◇ **Hardpan (0)**
- ◇ **Sandstone (0)**
- ◇ **Rip/Rap (0)**
- ◇ **Lacustrine (0)**
- ◈ **Shale (-1)**
- ◇ **Coal fines (-2)**

QUALITY

SILT
- ◇ **Heavy (-2)**
- ◇ **Moderate (-1)**
- ◈ **Normal (0)**
- ◇ **Free (1)**

EMBEDDEDNESS
- ◇ **Extensive (-2)**
- ◈ **Moderate (-1)**
- ◈ **Normal (0)**
- ◇ **None (1)**

Substrate 14 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	**Undercut banks (1)**	2	**Pools > 70cm (2)**	1	**Oxbows, Backwaters (1)**
0	**Overhanging vegetation (1)**	0	**Rootwads (1)**	1	**Aquatic macrophytes (1)**
2	**Shallows (in slow water) (1)**	1	**Boulders (1)**	1	**Logs and woody debris (1)**
0	**Rootmats (1)**				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ **Extensive >75% (11)**
- ◈ **Moderate 25-75% (7)**
- ◈ **Sparse 5-<25% (3)**
- ◇ **Nearly absent <5% (1)**

COMMENTS

Cover *Maximum 20* 12

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ **High (4)**
- ◈ **Moderate (3)**
- ◇ **Low (2)**
- ◇ **None (1)**

DEVELOPMENT
- ◇ **Excellent (7)**
- ◈ **Good (5)**
- ◇ **Fair (3)**
- ◇ **Poor (1)**

CHANNELIZATION
- ◈ **None (6)**
- ◇ **Recovered (4)**
- ◇ **Recovering (3)**
- ◇ **Recent or no recovery (1)**

STABILITY
- ◇ **High (3)**
- ◈ **Moderate (2)**
- ◇ **Low (1)**

COMMENTS

Channel *Maximum 20* 16

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION

L R
- ◇ ◇ **None or little (3)**
- ◈ ◈ **Moderate (2)**
- ◈ ◈ **Heavy/Severe (1)**

RIPARIAN WIDTH

L R
- ◇ ◇ **Wide >50m (4)**
- ◇ ◇ **Moderate 10-50m (3)**
- ◈ ◈ **Narrow 5-10m (2)**
- ◇ ◇ **Very narrow <5m (1)**
- ◇ ◇ **None (0)**

FLOOD PLAIN QUALITY

L R
- ◇ ◇ **Forest, Swamp (3)**
- ◇ ◇ **Shrub or Old field (2)**
- ◈ ◇ **Residential, Park, New field (1)**
- ◇ ◇ **Fenced pasture (1)**
- ◈ ◈ **Open Pasture/Rowcrop (0)**

L R
- ◇ ◇ **Conservation Tillage (1)**
- ◇ ◇ **Urban or Industrial (0)**
- ◇ ◇ **Mining, construction (0)**

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian *Maximum 10* 4

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ **>1m (6)**
- ◇ **0.7-<1m (4)**
- ◈ **0.4-<0.7m (2)**
- ◇ **0.2-<0.4m (1)**
- ◇ **<0.2m (0)** (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ **Pool width > riffle width (2)**
- ◇ **Pool width = riffle width (1)**
- ◈ **Pool width < riffle width (0)**

CURRENT VELOCITY

Check ALL that apply
- ◇ **Torrential (-1)**
- ◇ **Very Fast (1)**
- ◈ **Fast (1)**
- ◈ **Moderate (1)**
- ◈ **Slow (1)**
- ◇ **Interstitial (-1)**
- ◇ **Intermittent (-2)**
- ◇ **Eddies (1)**

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ ***Primary Contact***
- ◇ ***Secondary Contact***

(circle one and comment on back)

COMMENTS

Pool/Current *Maximum 12* 5

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◇ **No Riffle (metric=0)**

RIFFLE DEPTH

Check **ONE** (*ONLY!*)
- ◈ **Best Areas >10cm (2)**
- ◇ **Best Areas 5-10cm (1)**
- ◇ **Best Areas <5cm** (metric=0)

RUN DEPTH
- ◈ **Maximum >50cm (2)**
- ◇ **Maximum <50cm (1)**

RIFFLE/RUN SUBSTRATE

Check ONE (*or* 2 & *average*)
- ◇ **Stable (e.g. cobble, boulder) (2)**
- ◈ **Mod. Stable (e.g. large gravel) (1)**
- ◈ **Unstable (e.g. sand, fine gravel) (0)**

RIFFLE/RUN EMBEDDEDNESS
- ◇ **None (2)**
- ◇ **Low (1)**
- ◈ **Moderate (0)**
- ◇ **Extensive (-1)**

COMMENTS

Riffle/Run *Maximum 8* 5

6-GRADIENT

(1.437 ft/mi)

DRAINAGE AREA

(218.283 mi²)

- ◇ **Very low – Low (2-4)**
- ◇ **Moderate (6-10)**
- ◇ **High – Very high (10-6)**

% POOL: 10 **% GLIDE:** #$

% RUN: 70 **% RIFFLE:** 20

Gradient *Maximum 10* 6

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- >85% - Open
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10% - Closed

Canopy Upstream Reading

44 Right

76 Middle

74 Left

B-AESTHETICS

- Nuisance algae
- Invasive macrophytes
- Excess turbidity
- Discoloration
- Foam/Scum
- Oil sheen
- Trash/Litter
- Nuisance odor
- Sludge deposits
- CSOs/SSOs/Outfalls

C-MAINTENANCE

- Public
- Private
- Active
- Historic
- Young – Succession
- Old - Succession
- Spray
- Leveed – One sided
- Leveed – Both Banks
- Moving – Bedload
- Stable - Bedload
- Armoured
- Slumps
- Islands
- Scoured
- Relocated
- Cutoffs
- Impounded
- Desiccated
- Flood Control
- Drainage
- Snag Removed
- Snag Modified

D-ISSUES

- WWTP
- NPDES
- CSO
- Hardened
- Urban
- Dirt & Grime
- Contaminated
- Landfill
- Industry
- Construction BMPs
- Sediment BMPs
- Logging
- Irrigation
- Cooling
- Bank Erosion
- Surface Erosion
- H2O table
- False bank
- Manure
- Lagoon
- Wash H2O
- Tile
- Natural Flow
- Acid Mine
- Wetlands
- Stagnant Flow
- Quarry Mine
- Golf
- Home
- Park
- Data Paucity
- Lawn
- Agriculture
- Livestock
- Atmosphere Deposition

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB46789	Macro	210824704	Vernon Fork Muscatatuck River	CR 50 North

Surveyor	Sample Date	County	Macro Sample Type
PDM	8/24/21	Jackson	MHAB

◇ Habitat Complete

QHEI Score: 42

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or 2 & average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	x
◇ ◇ Cobble (8)				◇ ◇ Muck (2)			
◇ ◇ Gravel (7)		x	x	◇ ◈ Silt (2)		x	x
◈ ◇ Sand (6)		x	x	◇ ◇ Artificial (0)		x	x
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate 7 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

- 0 Undercut banks (1)
- 0 Overhanging vegetation (1)
- 2 Shallows (in slow water) (1)
- 0 Rootmats (1)
- 2 Pools > 70cm (2)
- 0 Rootwads (1)
- 0 Boulders (1)
- 0 Oxbows, Backwaters (1)
- 0 Aquatic macrophytes (1)
- 1 Logs and woody debris (1)

AMOUNT

Check ONE (*or 2 & average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover 7 — *Maximum 20*

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY
- ◇ High (4)
- ◇ Moderate (3)
- ◈ Low (2)
- ◈ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◇ Good (5)
- ◈ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◇ None (6)
- ◈ Recovered (4)
- ◇ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◈ Moderate (2)
- ◈ Low (1)

Channel 10 — *Maximum 20*

COMMENTS

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◇ ◇ Moderate (2)
- ◈ ◈ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◈ ◈ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

Riparian 3 — *Maximum 10*

COMMENTS

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or 2 & average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current 9 — *Maximum 12*

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

◈ No Riffle (metric=0)

RIFFLE DEPTH — Check **ONE** (*ONLY!*)
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE — Check ONE (*or 2 & average*)
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

Riffle/Run 0 — *Maximum 8*

COMMENTS

6-GRADIENT

(1.458 ft/mi)

DRAINAGE AREA

(364.501 mi^2)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 30 % GLIDE: #$

% RUN: 70 % RIFFLE: #$

Gradient 6 — *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47674	Macro	210816701	Sixmile Creek	CR 415 North

Surveyor	Sample Date	County	Macro Sample Type
PDM	8/16/21	Jennings	MHAB

◇ **Habitat Complete**

QHEI Score: 57

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ **Bldrs/Slabs (10)**				◇ ◇ **Hardpan (4)**			
◇ ◇ **Boulders (9)**				◇ ◇ **Detritus (3)**		x	
◇ ◇ **Cobble (8)**		x	x	◇ ◇ **Muck (2)**			
◇ ◇ **Gravel (7)**		x	x	◇ ◇ **Silt (2)**		x	x
◇ ◈ **Sand (6)**		x	x	◇ ◇ **Artificial (0)**			
◈ ◇ **Bedrock (5)**		x	x				

NUMBER OF BEST TYPES: ◈ **4 or more (2)** ◇ **3 or less (0)**

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ **Limestone (1)**
- ◈ **Tills (1)**
- ◇ **Wetlands (0)**
- ◇ **Hardpan (0)**
- ◇ **Sandstone (0)**
- ◇ **Rip/Rap (0)**
- ◇ **Lacustrine (0)**
- ◇ **Shale (-1)**
- ◇ **Coal fines (-2)**

QUALITY

SILT
- ◇ **Heavy (-2)**
- ◇ **Moderate (-1)**
- ◈ **Normal (0)**
- ◇ **Free (1)**

EMBEDDEDNESS
- ◇ **Extensive (-2)**
- ◇ **Moderate (-1)**
- ◈ **Normal (0)**
- ◇ **None (1)**

Substrate 14 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	**Undercut banks (1)**	1	**Pools > 70cm (2)**	0	**Oxbows, Backwaters (1)**
0	**Overhanging vegetation (1)**	2	**Rootwads (1)**	0	**Aquatic macrophytes (1)**
1	**Shallows (in slow water) (1)**	0	**Boulders (1)**	0	**Logs and woody debris (1)**
1	**Rootmats (1)**				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ **Extensive >75% (11)**
- ◇ **Moderate 25-75% (7)**
- ◈ **Sparse 5-<25% (3)**
- ◇ **Nearly absent <5% (1)**

COMMENTS

Cover *Maximum 20* — 8

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ **High (4)**	◇ **Excellent (7)**	◈ **None (6)**	◈ **High (3)**
◇ **Moderate (3)**	◇ **Good (5)**	◇ **Recovered (4)**	◇ **Moderate (2)**
◈ **Low (2)**	◈ **Fair (3)**	◇ **Recovering (3)**	◇ **Low (1)**
◇ **None (1)**	◇ **Poor (1)**	◇ **Recent or no recovery (1)**	

COMMENTS

Channel *Maximum 20* — 14

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ **None or little (3)**
- ◇ ◇ **Moderate (2)**
- ◇ ◇ **Heavy/Severe (1)**

RIPARIAN WIDTH (L R)
- ◇ ◇ **Wide >50m (4)**
- ◇ ◈ **Moderate 10-50m (3)**
- ◈ ◇ **Narrow 5-10m (2)**
- ◇ ◇ **Very narrow <5m (1)**
- ◇ ◇ **None (0)**

FLOOD PLAIN QUALITY (L R)
- ◇ ◈ **Forest, Swamp (3)**
- ◇ ◇ **Shrub or Old field (2)**
- ◈ ◈ **Residential, Park, New field (1)**
- ◇ ◇ **Fenced pasture (1)**
- ◇ ◇ **Open Pasture/Rowcrop (0)**
- ◇ ◇ **Conservation Tillage (1)**
- ◇ ◇ **Urban or Industrial (0)**
- ◇ ◇ **Mining, construction (0)**

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian *Maximum 10* — 7

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ **>1m (6)**
- ◇ **0.7-<1m (4)**
- ◈ **0.4-<0.7m (2)**
- ◇ **0.2-<0.4m (1)**
- ◇ **<0.2m (0)** (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ **Pool width > riffle width (2)**
- ◈ **Pool width = riffle width (1)**
- ◇ **Pool width < riffle width (0)**

CURRENT VELOCITY

Check ALL that apply
- ◇ **Torrential (-1)**
- ◇ **Very Fast (1)**
- ◇ **Fast (1)**
- ◈ **Moderate (1)**
- ◈ **Slow (1)**
- ◈ **Interstitial (-1)**
- ◇ **Intermittent (-2)**
- ◇ **Eddies (1)**

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ ***Primary Contact***
- ◇ ***Secondary Contact***

(circle one and comment on back)

COMMENTS

Pool/Current *Maximum 12* — 4

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
- ◇ **Best Areas >10cm (2)**
- ◇ **Best Areas 5-10cm (1)**
- ◈ **Best Areas <5cm** (metric=0)

RUN DEPTH
- ◇ **Maximum >50cm (2)**
- ◈ **Maximum <50cm (1)**

RIFFLE/RUN SUBSTRATE
- ◈ **Stable (e.g. cobble, boulder) (2)**
- ◇ **Mod. Stable (e.g. large gravel) (1)**
- ◇ **Unstable (e.g. sand, fine gravel) (0)**

RIFFLE/RUN EMBEDDEDNESS
- ◇ **None (2)**
- ◈ **Low (1)**
- ◇ **Moderate (0)**
- ◇ **Extensive (-1)**

Riffle/Run *Maximum 8* — 0

COMMENTS

6-GRADIENT

(16.916 ft/mi)

DRAINAGE AREA

(8.944 mi²)

- ◇ **Very low – Low (2-4)**
- ◇ **Moderate (6-10)**
- ◇ **High – Very high (10-6)**

% POOL: 20 **% GLIDE:** 0

% RUN: 70 **% RIFFLE:** 10

Gradient *Maximum 10* — 10

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◈ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
7 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB46802	Macro	210817903	Mutton Creek Ditch	CR 400 North

Surveyor	Sample Date	County	Macro Sample Type	
JMB	8/17/21	Jackson	MHAB	◈ Habitat Complete

QHEI Score: 49

1-SUBSTRATE

Check *ONLY* Two substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◈ ◇ Hardpan (4)		X	
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		X	
◇ ◇ Cobble (8)				◇ ◈ Muck (2)		X	
◇ ◇ Gravel (7)				◇ ◇ Silt (2)		X	
◇ ◇ Sand (6)				◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◇ Tills (1)
- ◈ Wetlands (0)
- ◈ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ None (1)

Substrate **5** *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

1	Undercut banks (1)	3	Pools > 70cm (2)	3	Oxbows, Backwaters (1)
2	Overhanging vegetation (1)	3	Rootwads (1)	2	Aquatic macrophytes (1)
0	Shallows (in slow water) (1)	0	Boulders (1)	2	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◇ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 **16**

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◇ None (6)	◇ High (3)
◇ Moderate (3)	◇ Good (5)	◇ Recovered (4)	◇ Moderate (2)
◇ Low (2)	◇ Fair (3)	◈ Recovering (3)	◈ Low (1)
◈ None (1)	◈ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel Maximum 20 **6**

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ None or little (3)
- ◇ ◇ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◈ ◈ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◈ ◈ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◇ ◇ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 **10**

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
- ◈ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◇ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 **8**

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◈ No Riffle (metric=0)

RIFFLE DEPTH
Check **ONE** (*ONLY!*)
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◇ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE
Check ONE (*or* 2 & *average*)
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run Maximum 8 **0**

6-GRADIENT

(2.112 ft/mi)

DRAINAGE AREA

(29.807 mi²)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: #$ % GLIDE: 100

% RUN: #$ % RIFFLE: #$

Gradient Maximum 10 **4**

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- ◇ >85% - Open
- ◈ 55%-<85%
- ◇ 30%-<55%
- ◇ 10%-<30%
- ◇ <10% - Closed

Canopy Upstream Reading

Right

70 Middle

Left

B-AESTHETICS

- ◇ Nuisance algae
- ◇ Invasive macrophytes
- ◇ Excess turbidity
- ◇ Discoloration
- ◇ Foam/Scum
- ◇ Oil sheen
- ◇ Trash/Litter
- ◇ Nuisance odor
- ◇ Sludge deposits
- ◇ CSOs/SSOs/Outfalls

C-MAINTENANCE

◇ Public	◇ Private
◇ Active	◇ Historic
◇ Young – Succession	
◇ Old - Succession	
◇ Spray	
◇ Leveed – One sided	
◇ Leveed – Both Banks	
◇ Moving – Bedload	
◇ Stable - Bedload	
◇ Armoured	◇ Slumps
◇ Islands	◇ Scoured
◇ Relocated	◇ Cutoffs
◇ Impounded	◇ Desiccated
◇ Flood Control	◇ Drainage
◇ Snag Removed	
◇ Snag Modified	

D-ISSUES

◇ WWTP	◇ NPDES	◇ CSO
◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ Contaminated	◇ Landfill	◇ Industry
◇ Construction BMPs	◇ Sediment BMPs	
◇ Logging	◇ Irrigation	◇ Cooling
◇ Bank Erosion	◇ Surface Erosion	◇ H2O table
◇ False bank	◇ Manure	◇ Lagoon
◇ Wash H2O	◇ Tile	◇ Natural Flow
◇ Acid Mine	◇ Wetlands	◇ Stagnant Flow
◇ Quarry Mine	◇ Golf	◇ Home
◇ Park	◇ Data Paucity	◇ Lawn
◇ Agriculture	◇ Livestock	
◇ Atmosphere Deposition		

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47669	Macro	210817904	Tributary to Richart Lake	CR 900 West

Surveyor	Sample Date	County	Macro Sample Type	
JMB	8/17/21	Jennings	MHAB	◇ Habitat Complete

QHEI Score: 56

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or 2 & average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)		X	X
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		X	
◇ ◇ Cobble (8)			X	◇ ◇ Muck (2)			
◇ ◈ Gravel (7)			X	◇ ◇ Silt (2)		X	
◈ ◇ Sand (6)		X	X	◇ ◇ Artificial (0)			
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate 12 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	**Undercut banks (1)**	0	**Pools > 70cm (2)**	1	**Oxbows, Backwaters (1)**
0	**Overhanging vegetation (1)**	2	**Rootwads (1)**	0	**Aquatic macrophytes (1)**
3	**Shallows (in slow water) (1)**	0	**Boulders (1)**	3	**Logs and woody debris (1)**
1	**Rootmats (1)**				

AMOUNT

Check ONE (*or 2 & average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 8

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◈ None (6)	◇ High (3)
◈ Moderate (3)	◈ Good (5)	◇ Recovered (4)	◈ Moderate (2)
◇ Low (2)	◇ Fair (3)	◇ Recovering (3)	◇ Low (1)
◇ None (1)	◇ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel Maximum 20 16

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◈ ◇ Moderate (2)
- ◇ ◈ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◈ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◇ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◈ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◈ ◈ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◇ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 5

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◇ 0.7-<1m (4)
- ◈ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or 2 & average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◈ Slow (1)
- ◇ Very Fast (1)
- ◇ Interstitial (-1)
- ◇ Fast (1)
- ◇ Intermittent (-2)
- ◇ Moderate (1)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 5

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
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◈ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◈ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◈ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◈ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run Maximum 8 0

6-GRADIENT

(17.212 ft/mi)

DRAINAGE AREA

(1.529 mi²)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 30 **% GLIDE:** #$

% RUN: 50 **% RIFFLE:** 20

Gradient Maximum 10 10

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- ◇ **>85% - Open**
- ◇ **55%-<85%**
- ◇ **30%-<55%**
- ◇ **10%-<30%**
- ◈ **<10% - Closed**

Canopy Upstream Reading

Right

9 Middle

Left

B-AESTHETICS

- ◇ **Nuisance algae**
- ◇ **Invasive macrophytes**
- ◇ **Excess turbidity**
- ◇ **Discoloration**
- ◇ **Foam/Scum**
- ◇ **Oil sheen**
- ◇ **Trash/Litter**
- ◇ **Nuisance odor**
- ◇ **Sludge deposits**
- ◇ **CSOs/SSOs/Outfalls**

C-MAINTENANCE

- ◇ **Public** ◇ **Private**
- ◇ **Active** ◇ **Historic**
- ◇ **Young – Succession**
- ◇ **Old - Succession**
- ◇ **Spray**
- ◇ **Leveed – One sided**
- ◇ **Leveed – Both Banks**
- ◇ **Moving – Bedload**
- ◇ **Stable - Bedload**
- ◇ **Armoured** ◇ **Slumps**
- ◇ **Islands** ◇ **Scoured**
- ◇ **Relocated** ◇ **Cutoffs**
- ◇ **Impounded** ◇ **Desiccated**
- ◇ **Flood Control** ◇ **Drainage**
- ◇ **Snag Removed**
- ◇ **Snag Modified**

D-ISSUES

- ◇ **WWTP** ◇ **NPDES** ◇ **CSO**
- ◇ **Hardened** ◇ **Urban** ◇ **Dirt & Grime**
- ◇ **Contaminated** ◇ **Landfill** ◇ **Industry**
- ◇ **Construction BMPs** ◇ **Sediment BMPs**
- ◇ **Logging** ◇ **Irrigation** ◇ **Cooling**
- ◇ **Bank Erosion** ◇ **Surface Erosion** ◇ **H2O table**
- ◇ **False bank** ◇ **Manure** ◇ **Lagoon**
- ◇ **Wash H2O** ◇ **Tile** ◇ **Natural Flow**
- ◇ **Acid Mine** ◇ **Wetlands** ◇ **Stagnant Flow**
- ◇ **Quarry Mine** ◇ **Golf** ◇ **Home**
- ◇ **Park** ◇ **Data Paucity** ◇ **Lawn**
- ◇ **Agriculture** ◇ **Livestock**
- ◇ **Atmosphere Deposition**

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47673	Macro	210816702	Sixmile Creek	CR 175 North

Surveyor	Sample Date	County	Macro Sample Type		QHEI Score:
PDM	8/16/21	Jennings	MHAB	◇ Habitat Complete	67

1-SUBSTRATE

Check ***ONLY* Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	x
◇ ◇ Cobble (8)			x	◇ ◇ Muck (2)			
◈ ◇ Gravel (7)		x	x	◇ ◇ Silt (2)		x	x
◇ ◈ Sand (6)		x	x	◇ ◇ Artificial (0)		x	
◇ ◇ Bedrock (5)							

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

Check ONE (*or* 2 & *average*)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◈ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate 11 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	2	Pools > 70cm (2)
1	Overhanging vegetation (1)	1	Rootwads (1)
2	Shallows (in slow water) (1)	0	Boulders (1)
1	Rootmats (1)	0	Oxbows, Backwaters (1)
		0	Aquatic macrophytes (1)
		1	Logs and woody debris (1)

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◈ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover *Maximum 20* 12

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY
- ◇ High (4)
- ◇ Moderate (3)
- ◈ Low (2)
- ◇ None (1)

DEVELOPMENT
- ◇ Excellent (7)
- ◈ Good (5)
- ◇ Fair (3)
- ◇ Poor (1)

CHANNELIZATION
- ◈ None (6)
- ◇ Recovered (4)
- ◇ Recovering (3)
- ◇ Recent or no recovery (1)

STABILITY
- ◇ High (3)
- ◈ Moderate (2)
- ◈ Low (1)

COMMENTS

Channel *Maximum 20* 15

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ None or little (3)
- ◇ ◇ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◈ Moderate 10-50m (3)
- ◈ ◇ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◈ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◈ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◇ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian *Maximum 10* 7

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◈ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◈ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current *Maximum 12* 8

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!*)

RIFFLE DEPTH
- ◈ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◈ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◈ Mod. Stable (e.g. large gravel) (1)
- ◈ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◈ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run *Maximum 8* 4

6-GRADIENT

(9.933 ft/mi)

DRAINAGE AREA (13.834 mi²)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 20 % GLIDE: 0

% RUN: 70 % RIFFLE: 10

Gradient *Maximum 10* 10

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◈ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
1 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47671	Macro	210816703	Sixmile Creek	CR 500 South

Surveyor	Sample Date	County	Macro Sample Type
PDM	8/16/21	Jennings	MHAB

◈ Habitat Complete

QHEI Score: 44

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or 2 & average*)

BEST TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)			
◇ ◇ Boulders (9)			
◇ ◇ Cobble (8)			
◈ ◇ Gravel (7)		x	x
◇ ◈ Sand (6)		x	x
◇ ◇ Bedrock (5)			

OTHER TYPES

	TOTAL	POOL	RIFFLE
◇ ◇ Hardpan (4)			
◇ ◇ Detritus (3)		x	x
◇ ◇ Muck (2)			
◇ ◇ Silt (2)		x	x
◇ ◇ Artificial (0)			

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate 12 — *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	0	Pools > 70cm (2)
1	Overhanging vegetation (1)	0	Rootwads (1)
2	Shallows (in slow water) (1)	0	Boulders (1)
1	Rootmats (1)		

0	Oxbows, Backwaters (1)
0	Aquatic macrophytes (1)
1	Logs and woody debris (1)

AMOUNT

Check ONE (*or 2 & average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

Cover 7 — *Maximum 20*

COMMENTS

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◇ None (6)	◇ High (3)
◇ Moderate (3)	◇ Good (5)	◈ Recovered (4)	◇ Moderate (2)
◈ Low (2)	◈ Fair (3)	◇ Recovering (3)	◈ Low (1)
◇ None (1)	◇ Poor (1)	◇ Recent or no recovery (1)	

Channel 10 — *Maximum 20*

COMMENTS

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◇ ◇ None or little (3)
- ◈ ◈ Moderate (2)
- ◈ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◈ ◈ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

Riparian 3 — *Maximum 10*

COMMENTS

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◇ 0.7-<1m (4)
- ◈ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or 2 & average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◈ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

Pool/Current 5 — *Maximum 12*

COMMENTS

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

◇ No Riffle (metric=0)

RIFFLE DEPTH

Check **ONE** (*ONLY!*)
- ◈ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◈ Maximum <50cm (1)

Check ONE (*or 2 & average*)

RIFFLE/RUN SUBSTRATE
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◈ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◇ Low (1)
- ◈ Moderate (0)
- ◈ Extensive (-1)

Riffle/Run 3 — *Maximum 8*

COMMENTS

6-GRADIENT

(2.423 ft/mi)

DRAINAGE AREA

(30.679 mi²)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 20 **% GLIDE:** 30

% RUN: 40 **% RIFFLE:** 10

Gradient 4 — *Maximum 10*

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◈ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
93 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47658	Macro	210816704	Tea Creek	CR 650 South

Surveyor	Sample Date	County	Macro Sample Type		QHEI Score:
PDM	8/16/21	Jennings	MHAB	◈ Habitat Complete	57

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)			x	◇ ◇ Detritus (3)		x	x
◇ ◈ Cobble (8)		x	x	◇ ◇ Muck (2)			
◇ ◇ Gravel (7)		x	x	◇ ◇ Silt (2)		x	x
◇ ◇ Sand (6)		x	x	◇ ◇ Artificial (0)			
◈ ◇ Bedrock (5)		x	x				

NUMBER OF BEST TYPES: ◈ 4 or more (2) ◇ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
- ◇ Limestone (1)
- ◈ Tills (1)
- ◇ Wetlands (0)
- ◇ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◇ Moderate (-1)
- ◈ Normal (0)
- ◈ None (1)

Substrate 17 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	Undercut banks (1)	0	Pools > 70cm (2)	0	Oxbows, Backwaters (1)
0	Overhanging vegetation (1)	1	Rootwads (1)	0	Aquatic macrophytes (1)
2	Shallows (in slow water) (1)	1	Boulders (1)	0	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◇ Sparse 5-<25% (3)
- ◈ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 5

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◈ None (6)	◈ High (3)
◇ Moderate (3)	◇ Good (5)	◇ Recovered (4)	◇ Moderate (2)
◈ Low (2)	◈ Fair (3)	◇ Recovering (3)	◇ Low (1)
◇ None (1)	◇ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel Maximum 20 14

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ None or little (3)
- ◇ ◇ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◈ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◈ Narrow 5-10m (2)
- ◇ ◇ Very narrow <5m (1)
- ◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
- ◈ ◇ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◇ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 8

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◇ 0.7-<1m (4)
- ◇ 0.4-<0.7m (2)
- ◈ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◈ Pool width = riffle width (1)
- ◇ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◇ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 3

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!*)

RIFFLE DEPTH
- ◇ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◈ Best Areas <5cm (metric=0)

RUN DEPTH
- ◇ Maximum >50cm (2)
- ◈ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
- ◈ Stable (e.g. cobble, boulder) (2)
- ◈ Mod. Stable (e.g. large gravel) (1)
- ◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
- ◇ None (2)
- ◈ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

Riffle/Run Maximum 8 0

COMMENTS

6-GRADIENT

(20.301 ft/mi)

DRAINAGE AREA

(4.617 mi^2)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL:	20	% GLIDE:	0
% RUN:	60	% RIFFLE:	20

Gradient Maximum 10 10

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◈ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
9 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47676	Macro	210817701	Vernon Fork Muscatatuck River	CR 60 South

Surveyor	Sample Date	County	Macro Sample Type	
PDM	8/17/21	Jennings	MHAB	◈ Habitat Complete

QHEI Score: 87

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or* 2 & *average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)		x	x	◇ ◇ Hardpan (4)			
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)		x	
◇ ◇ Cobble (8)			x	◇ ◇ Muck (2)			
◇ ◇ Gravel (7)			x	◇ ◇ Silt (2)		x	
◇ ◈ Sand (6)		x	x	◇ ◇ Artificial (0)			
◈ ◇ Bedrock (5)		x					

NUMBER OF BEST TYPES: ◈ 4 or more (2) ◇ 3 or less (0)

(Score natural substrates; ignore sludge from point-sources)

ORIGIN
◇ Limestone (1)
◈ Tills (1)
◇ Wetlands (0)
◇ Hardpan (0)
◇ Sandstone (0)
◇ Rip/Rap (0)
◇ Lacustrine (0)
◇ Shale (-1)
◇ Coal fines (-2)

QUALITY
SILT
◇ Heavy (-2)
◇ Moderate (-1)
◈ Normal (0)
◈ Free (1)
EMBEDDEDNESS
◇ Extensive (-2)
◇ Moderate (-1)
◈ Normal (0)
◇ None (1)

Substrate 15 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

1	Undercut banks (1)	3	Pools > 70cm (2)	1	Oxbows, Backwaters (1)
0	Overhanging vegetation (1)	1	Rootwads (1)	1	Aquatic macrophytes (1)
3	Shallows (in slow water) (1)	3	Boulders (1)	2	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT
Check ONE (*or* 2 & *average*)
◈ Extensive >75% (11)
◈ Moderate 25-75% (7)
◇ Sparse 5-<25% (3)
◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 19

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◈ None (6)	◈ High (3)
◈ Moderate (3)	◈ Good (5)	◇ Recovered (4)	◈ Moderate (2)
◈ Low (2)	◇ Fair (3)	◇ Recovering (3)	◇ Low (1)
◇ None (1)	◇ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel Maximum 20 16

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or* 2 *per bank & average*)

River right looking downstream

EROSION (L R)
◈ ◈ None or little (3)
◇ ◇ Moderate (2)
◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
◈ ◇ Wide >50m (4)
◇ ◈ Moderate 10-50m (3)
◇ ◇ Narrow 5-10m (2)
◇ ◇ Very narrow <5m (1)
◇ ◇ None (0)

FLOOD PLAIN QUALITY (L R)
◈ ◈ Forest, Swamp (3)
◇ ◇ Shrub or Old field (2)
◇ ◈ Residential, Park, New field (1)
◇ ◇ Fenced pasture (1)
◇ ◇ Open Pasture/Rowcrop (0)
◇ ◇ Conservation Tillage (1)
◇ ◇ Urban or Industrial (0)
◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 9

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH
Check **ONE** (*ONLY!*)
◈ >1m (6)
◇ 0.7-<1m (4)
◇ 0.4-<0.7m (2)
◇ 0.2-<0.4m (1)
◇ <0.2m (0) (metric=0)

CHANNEL WIDTH
Check ONE (*or* 2 & *average*)
◈ Pool width > riffle width (2)
◇ Pool width = riffle width (1)
◇ Pool width < riffle width (0)

CURRENT VELOCITY
Check ALL that apply
◇ Torrential (-1)
◇ Very Fast (1)
◈ Fast (1)
◈ Moderate (1)
◈ Slow (1)
◇ Interstitial (-1)
◇ Intermittent (-2)
◇ Eddies (1)
Indicate for reach – pools and riffles.

RECREATION POTENTIAL
◇ *Primary Contact*
◇ *Secondary Contact*
(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 11

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!*)

RIFFLE DEPTH
◈ Best Areas >10cm (2)
◇ Best Areas 5-10cm (1)
◇ Best Areas <5cm (metric=0)

RUN DEPTH
◈ Maximum >50cm (2)
◇ Maximum <50cm (1)

Check ONE (*or* 2 & *average*)

RIFFLE/RUN SUBSTRATE
◈ Stable (e.g. cobble, boulder) (2)
◈ Mod. Stable (e.g. large gravel) (1)
◇ Unstable (e.g. sand, fine gravel) (0)

RIFFLE/RUN EMBEDDEDNESS
◈ None (2)
◈ Low (1)
◇ Moderate (0)
◇ Extensive (-1)

COMMENTS

Riffle/Run Maximum 8 7

6-GRADIENT

(4.424 ft/mi)
DRAINAGE AREA
(197.56 mi²)

◇ Very low – Low (2-4)
◇ Moderate (6-10)
◇ High – Very high (10-6)

% POOL: 30 % GLIDE: #$
% RUN: 60 % RIFFLE: 10

Gradient Maximum 10 10

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◈ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◇ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ Bank Erosion	◇ Surface Erosion	◇ H2O table
	◇ Trash/Litter	◇ Leveed – Both Banks				
Canopy Upstream Reading		◇ Moving – Bedload		◇ 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 Flow
	◇ CSOs/SSOs/Outfalls	◇ Relocated	◇ Cutoffs	◇ Quarry Mine	◇ Golf	◇ Home
88 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
66 Left						

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47665	Macro	210816903	Tributary of Mutton Creek	CR 700 North

Surveyor	Sample Date	County	Macro Sample Type		QHEI Score:
JMB	8/16/21	Jackson	MHAB	◇ Habitat Complete	48

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE
◇ ◇ Bldrs/Slabs (10)				◇ ◇ Hardpan (4)		X	
◇ ◇ Boulders (9)				◇ ◇ Detritus (3)			
◇ ◇ Cobble (8)			X	◇ ◇ Muck (2)			
◇ ◇ Gravel (7)				◇ ◇ Silt (2)		X	X
◈ ◈ Sand (6)		X	X	◇ ◇ Artificial (0)		X	X
◇ ◇ Bedrock (5)							

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ◇ 4 or more (2) ◈ 3 or less (0)

Check ONE (*or* 2 & *average*)

ORIGIN
- ◇ Limestone (1)
- ◇ Tills (1)
- ◇ Wetlands (0)
- ◈ Hardpan (0)
- ◇ Sandstone (0)
- ◇ Rip/Rap (0)
- ◇ Lacustrine (0)
- ◇ Shale (-1)
- ◇ Coal fines (-2)

QUALITY

SILT
- ◇ Heavy (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ Free (1)

EMBEDDEDNESS
- ◇ Extensive (-2)
- ◈ Moderate (-1)
- ◇ Normal (0)
- ◇ None (1)

Substrate 10 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

1	Undercut banks (1)	0	Pools > 70cm (2)	0	Oxbows, Backwaters (1)
3	Overhanging vegetation (1)	0	Rootwads (1)	1	Aquatic macrophytes (1)
1	Shallows (in slow water) (1)	0	Boulders (1)	1	Logs and woody debris (1)
1	Rootmats (1)				

AMOUNT

Check ONE (*or* 2 & *average*)
- ◇ Extensive >75% (11)
- ◇ Moderate 25-75% (7)
- ◈ Sparse 5-<25% (3)
- ◇ Nearly absent <5% (1)

COMMENTS

Cover Maximum 20 9

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or* 2 & *average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ High (4)	◇ Excellent (7)	◇ None (6)	◇ High (3)
◇ Moderate (3)	◇ Good (5)	◇ Recovered (4)	◇ Moderate (2)
◈ Low (2)	◈ Fair (3)	◈ Recovering (3)	◈ Low (1)
◇ None (1)	◇ Poor (1)	◇ Recent or no recovery (1)	

COMMENTS

Channel Maximum 20 9

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)
- ◈ ◈ None or little (3)
- ◇ ◇ Moderate (2)
- ◇ ◇ Heavy/Severe (1)

RIPARIAN WIDTH (L R)
- ◇ ◇ Wide >50m (4)
- ◇ ◇ Moderate 10-50m (3)
- ◇ ◇ Narrow 5-10m (2)
- ◈ ◈ Very narrow <5m (1)
- ◈ ◈ None (0)

FLOOD PLAIN QUALITY (L R)
- ◇ ◈ Forest, Swamp (3)
- ◇ ◇ Shrub or Old field (2)
- ◇ ◇ Residential, Park, New field (1)
- ◇ ◇ Fenced pasture (1)
- ◈ ◈ Open Pasture/Rowcrop (0)
- ◇ ◇ Conservation Tillage (1)
- ◇ ◇ Urban or Industrial (0)
- ◇ ◇ Mining, construction (0)

Indicate predominant land use(s) past 100m riparian.

COMMENTS

Riparian Maximum 10 4

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ◇ >1m (6)
- ◇ 0.7-<1m (4)
- ◈ 0.4-<0.7m (2)
- ◇ 0.2-<0.4m (1)
- ◇ <0.2m (0) (metric=0)

CHANNEL WIDTH

Check ONE (*or* 2 & *average*)
- ◇ Pool width > riffle width (2)
- ◇ Pool width = riffle width (1)
- ◈ Pool width < riffle width (0)

CURRENT VELOCITY

Check ALL that apply
- ◇ Torrential (-1)
- ◇ Very Fast (1)
- ◇ Fast (1)
- ◇ Moderate (1)
- ◈ Slow (1)
- ◇ Interstitial (-1)
- ◇ Intermittent (-2)
- ◇ Eddies (1)

Indicate for reach – pools and riffles.

RECREATION POTENTIAL
- ◇ *Primary Contact*
- ◇ *Secondary Contact*

(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 3

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◇ No Riffle (metric=0)

RIFFLE DEPTH / **RUN DEPTH** — Check **ONE** (*ONLY!*)
- ◈ Best Areas >10cm (2)
- ◇ Best Areas 5-10cm (1)
- ◇ Best Areas <5cm (metric=0)
- ◇ Maximum >50cm (2)
- ◈ Maximum <50cm (1)

RIFFLE/RUN SUBSTRATE / **RIFFLE/RUN EMBEDDEDNESS** — Check ONE (*or* 2 & *average*)
- ◇ Stable (e.g. cobble, boulder) (2)
- ◇ Mod. Stable (e.g. large gravel) (1)
- ◈ Unstable (e.g. sand, fine gravel) (0)
- ◇ None (2)
- ◈ Low (1)
- ◇ Moderate (0)
- ◇ Extensive (-1)

COMMENTS

Riffle/Run Maximum 8 5

6-GRADIENT

(11.518 ft/mi)

DRAINAGE AREA (5.117 mi^2)

- ◇ Very low – Low (2-4)
- ◇ Moderate (6-10)
- ◇ High – Very high (10-6)

% POOL: 10 % GLIDE: 70

% RUN: 10 % RIFFLE: 10

Gradient Maximum 10 8

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY

- >85% - Open
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10% - Closed

Canopy Upstream Reading

Right

100 Middle

Left

B-AESTHETICS

- Nuisance algae
- Invasive macrophytes
- Excess turbidity
- Discoloration
- Foam/Scum
- Oil sheen
- Trash/Litter
- Nuisance odor
- Sludge deposits
- CSOs/SSOs/Outfalls

C-MAINTENANCE

- Public
- Private
- Active
- Historic
- Young – Succession
- Old - Succession
- Spray
- Leveed – One sided
- Leveed – Both Banks
- Moving – Bedload
- Stable - Bedload
- Armoured
- Slumps
- Islands
- Scoured
- Relocated
- Cutoffs
- Impounded
- Desiccated
- Flood Control
- Drainage
- Snag Removed
- Snag Modified

D-ISSUES

- WWTP
- NPDES
- CSO
- Hardened
- Urban
- Dirt & Grime
- Contaminated
- Landfill
- Industry
- Construction BMPs
- Sediment BMPs
- Logging
- Irrigation
- Cooling
- Bank Erosion
- Surface Erosion
- H2O table
- False bank
- Manure
- Lagoon
- Wash H2O
- Tile
- Natural Flow
- Acid Mine
- Wetlands
- Stagnant Flow
- Quarry Mine
- Golf
- Home
- Park
- Data Paucity
- Lawn
- Agriculture
- Livestock
- Atmosphere Deposition

Stream Drawing

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	QHEI Type	bioSample #	Stream Name	Location
AB47659	Macro	210817702	Tea Creek	CR 650 West

Surveyor	Sample Date	County	Macro Sample Type		QHEI Score:
PDM	8/17/21	Jennings	MHAB	◈ Habitat Complete	46

1-SUBSTRATE

Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

Check ONE (*or 2 & average*)

BEST TYPES	TOTAL	POOL	RIFFLE	OTHER TYPES	TOTAL	POOL	RIFFLE	ORIGIN	QUALITY
◇ ◇ **Bldrs/Slabs (10)**				◇ ◇ **Hardpan (4)**			x	◇ **Limestone (1)**	SILT ◇ **Heavy (-2)**
◇ ◇ **Boulders (9)**				◇ ◇ **Detritus (3)**		x	x	◈ **Tills (1)**	◈ **Moderate (-1)**
◇ ◇ **Cobble (8)**				◇ ◇ **Muck (2)**				◇ **Wetlands (0)**	◇ **Normal (0)**
◇ ◈ **Gravel (7)**		x	x	◇ ◇ **Silt (2)**		x	x	◇ **Hardpan (0)**	◇ **Free (1)**
◈ ◇ **Sand (6)**		x	x	◇ ◇ **Artificial (0)**				◇ **Sandstone (0)**	EMBEDDEDNESS ◇ **Extensive (-2)**
◇ ◇ **Bedrock (5)**								◇ **Rip/Rap (0)**	◈ **Moderate (-1)**
								◇ **Lacustrine (0)**	◇ **Normal (0)**
								◇ **Shale (-1)**	◇ **None (1)**
								◇ **Coal fines (-2)**	

NUMBER OF BEST TYPES: ◇ **4 or more (2)** ◈ **3 or less (0)**

(Score natural substrates; ignore sludge from point-sources)

Substrate 12 *Maximum 20*

COMMENTS

2-INSTREAM COVER

Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0	**Undercut banks (1)**	2	**Pools > 70cm (2)**	0	**Oxbows, Backwaters (1)**
0	**Overhanging vegetation (1)**	1	**Rootwads (1)**	0	**Aquatic macrophytes (1)**
1	**Shallows (in slow water) (1)**	0	**Boulders (1)**	1	**Logs and woody debris (1)**
2	**Rootmats (1)**				

AMOUNT

Check ONE (*or 2 & average*)

◇ **Extensive >75% (11)**
◇ **Moderate 25-75% (7)**
◈ **Sparse 5-<25% (3)**
◇ **Nearly absent <5% (1)**

COMMENTS

Cover Maximum 20 9

3-CHANNEL MORPHOLOGY

Check ONE in each category (*Or 2 & average*)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
◇ **High (4)**	◇ **Excellent (7)**	◇ **None (6)**	◇ **High (3)**
◈ **Moderate (3)**	◇ **Good (5)**	◇ **Recovered (4)**	◇ **Moderate (2)**
◈ **Low (2)**	◈ **Fair (3)**	◈ **Recovering (3)**	◈ **Low (1)**
◇ **None (1)**	◇ **Poor (1)**	◇ **Recent or no recovery (1)**	

COMMENTS

Channel Maximum 20 10

4- BANK EROSION & RIPARIAN ZONE

Check **ONE** in each category for ***EACH BANK*** (*Or 2 per bank & average*)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	
◇ ◇ **None or little (3)**	◇ ◇ **Wide >50m (4)**	◇ ◇ **Forest, Swamp (3)**	◇ ◇ **Conservation Tillage (1)**
◈ ◈ **Moderate (2)**	◇ ◇ **Moderate 10-50m (3)**	◇ ◇ **Shrub or Old field (2)**	◇ ◇ **Urban or Industrial (0)**
◈ ◈ **Heavy/Severe (1)**	◈ ◇ **Narrow 5-10m (2)**	◇ ◇ **Residential, Park, New field (1)**	◇ ◇ **Mining, construction (0)**
	◇ ◈ **Very narrow <5m (1)**	◇ ◇ **Fenced pasture (1)**	*Indicate predominant land use(s) past 100m riparian.*
	◇ ◇ **None (0)**	◈ ◈ **Open Pasture/Rowcrop (0)**	

COMMENTS

Riparian Maximum 10 3

5-POOL/GLIDE AND RIFFLE/RUN QUALITY

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY	
Check **ONE** (*ONLY!*)	Check ONE (*or 2 & average*)	Check ALL that apply	
◈ **>1m (6)**	◇ **Pool width > riffle width (2)**	◇ **Torrential (-1)**	◈ **Slow (1)**
◇ **0.7-<1m (4)**	◈ **Pool width = riffle width (1)**	◇ **Very Fast (1)**	◇ **Interstitial (-1)**
◇ **0.4-<0.7m (2)**	◇ **Pool width < riffle width (0)**	◇ **Fast (1)**	◇ **Intermittent (-2)**
◇ **0.2-<0.4m (1)**		◇ **Moderate (1)**	◇ **Eddies (1)**
◇ **<0.2m (0)** (metric=0)		Indicate for reach – pools and riffles.	

RECREATION POTENTIAL

◇ ***Primary Contact***
◇ ***Secondary Contact***

(circle one and comment on back)

COMMENTS

Pool/Current Maximum 12 8

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: ◈ **No Riffle (metric=0)**

RIFFLE DEPTH	RUN DEPTH	RIFFLE/RUN SUBSTRATE	RIFFLE/RUN EMBEDDEDNESS
Check **ONE** (*ONLY!*)		Check ONE (*or 2 & average*)	
◇ **Best Areas >10cm (2)**	◇ **Maximum >50cm (2)**	◇ **Stable (e.g. cobble, boulder) (2)**	◇ **None (2)**
◇ **Best Areas 5-10cm (1)**	◇ **Maximum <50cm (1)**	◇ **Mod. Stable (e.g. large gravel) (1)**	◇ **Low (1)**
◇ **Best Areas <5cm** (metric=0)		◇ **Unstable (e.g. sand, fine gravel) (0)**	◇ **Moderate (0)**
			◇ **Extensive (-1)**

COMMENTS

Riffle/Run Maximum 8 0

6-GRADIENT

(2.676 ft/mi)
DRAINAGE AREA
(10.632 mi²)

◇ **Very low – Low (2-4)**
◇ **Moderate (6-10)**
◇ **High – Very high (10-6)**

% POOL: 50 **% GLIDE:** #$
% RUN: 50 **% RIFFLE:** #$

Gradient Maximum 10 4

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Circle some &
COMMENT

A-CANOPY	B-AESTHETICS	C-MAINTENANCE		D-ISSUES		
◇ >85% - Open	◇ Nuisance algae	◇ Public	◇ Private	◇ WWTP	◇ NPDES	◇ CSO
◇ 55%-<85%	◇ Invasive macrophytes	◇ Active	◇ Historic	◇ Hardened	◇ Urban	◇ Dirt & Grime
◇ 30%-<55%	◇ Excess turbidity	◇ Young – Succession		◇ Contaminated	◇ Landfill	◇ Industry
		◇ Old - Succession				
◇ 10%-<30%	◇ Discoloration	◇ Spray		◇ Construction BMPs	◇ Sediment BMPs	
◈ <10% - Closed	◇ Foam/Scum			◇ Logging	◇ Irrigation	◇ Cooling
	◇ Oil sheen	◇ Leveed – One sided		◇ 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
0 Middle		◇ Impounded	◇ Desiccated	◇ Park	◇ Data Paucity	◇ Lawn
		◇ Flood Control	◇ Drainage	◇ Agriculture	◇ Livestock	
		◇ Snag Removed		◇ Atmosphere Deposition		
		◇ Snag Modified				
Left						

Stream Drawing

APPENDIX D. REASSESSMENT NOTES FOR THE VERNON FORK MUSCATATUCK RIVER WATERSHED TMDL

General Notes: 2022 TMDL/Watershed Characterization Assessments for Vernon Fork Muscatatuck River Watershed

1	Assessment Date: 02/16/2022
2	Staff Participating in assessment meetings: Paul McMurray, Cameron Yeakle, Scott Zello-Dean, Ross Carlson, Julien Buchbinder, Kayla Werbianskyj, Lindsay Hylton Adams, Allie Gates, Michaella Hecox, Kathleen Hagan, Dylan Brown, Mitchell Owens, Marissa Cubbage, Stacey Sobat, Andy Ertel (Jennings Co SWCD), Heather Wirth (319), Jenny Vogel (USDA NRCS North Vernon), Kelly Kent (Jenning Co SWCD)
3	Assessments based on the best professional judgement (BPJ) of IDEM scientists are notated with "(BPJ)". BPJ is indicated in cases where assessments based on data collected on the reach in question do not explicitly follow the assessment criteria in IDEM's Consolidatred Assessment and Listing Methodology (CALM).

4 — **Other acronyms used in these notes 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
IBI = Fish Community Index of Biotic Integrity	FS = Fully supporting the use	TP = Total phosphorus
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 Notes: 2022 TMDL/Watershed Characterization Assessments for Vernon Fork Muscatatuck River Watershed

Monitoring Data used in Assessments	Year Assessed	Method Code
2021 Vernon Fork of the Muscatatuck River (Fixed station physical/chemical monitoring (conventional pollutants only))	2022	210
2021 Vernon Fork of the Muscatatuck River (Non-fixed station physical/chemical monitoring (conventional pollutants only))	2022	220
2021 Vernon Fork of the Muscatatuck River (Water column surveys of E. coli)	2022	420
2021 Vernon Fork of the Muscatatuck River (non-fixed station physical, chemical)	2022	240
2021 Vernon Fork of the Muscatatuck River (biosurveys of multiple taxonmonic groups)	2022	720

METHODCODE	METHODNAME	IDEM Definition
210	Fixed station physical/chemical monitoring (conventional pollutants only)	Used for aquatic life use assessments based on physical/chemistry data that does not include results for toxicants (e.g. dissolved metals, free cyanide, and ammonia) collected by IDEM at its fixed station monitoring sites. If the data set does include toxicants, Code 230 applies.
220	Non-fixed station physical/chemical monitoring (conventional pollutants only)	Used for aquatic life use assessments based on physical/chemistry data that does not include results for toxicants (e.g. dissolved metals, free cyanide, and ammonia) collected by IDEM at its fixed station monitoring sites. If the data set does include toxicants, Code 240 applies.
240	Non-fixed station physical/chemical (conventional + toxicants)	Used for aquatic life use assessments based on physical/chemistry data collected by IDEM at its probablistic or targeted monitoring sites.
310	Ecological/habitat surveys	Applied to aquatic life use assessments based on fish and/or macroinvertabrate community surveys conducted by IDEM that also included habitat evaluations.
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.

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 Notes: 2022 TMDL/Watershed Characterization Assessments for Vernon Fork Muscatatuck River Watershed	
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 Support	ALU_Impairments	ALU Sources	ATTAINS FLAG	ATTAINS METHOD CODE
INW0771_02	21T-023	WEM070-0036	Vernon Fork Muscatatuck River	52	Good	73	42	Fair	62	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/100mL: One small cattle operation to N; rest of area is woods = wildlife influenced? House on septics on left bank.	FS				220+310+720
INW0771_03	21T-025	WEM070-0001 (also a fixed station site)	Vernon Fork Muscatatuck River	54	Excellent	80	40	Fair	87	Vernon Fork Muscatatuck River @ County Road 60 S. WEM070-0001: IBI 54, QHEI 80. mIBI 40, QHEI 87. Chem: 3/18 high TP, DO ok. GM 141.34 cfu/100mL: 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 Fixed Station and a Reference sit**e; future Regional Monitoring Network site.	FS				210 + 220+310+720
INW0772_01A	21T-022	WEM-07-0020	Sixmile Creek	32	Poor	74	30	Poor	57	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") water. Floating algal mats during first visit. Chem: 2/11 low, 3/11 marg DO: 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	BIOLOGICAL INTEGRITY + DISSOLVED OXYGEN	SOURCE UNKNOWN (biology) + DAM OR IMPOUNDMENT		220+310+720+925
INW0772_04	21T-021	WEM-07-0019	Sixmile Creek	38	Fair	72	42	Fair	67	Sixmile Creek @ County Road 175 N. WEM-07-0019: IBI 38, QHEI 72. mIBI 42, QHEI 67. Chem: 3/7 high TP, DO ok GM 186.89 cfu/100mL: Subdivision on septic; wildlife from wooded areas possible sources	FS				220+310+720
INW0772_05	21T-020	WEM-07-0018	Sixmile Creek	52	Good	62	42	Fair	62	Sixmile Creek @ County Road 200 S. WEM-07-0018: IBI 52, QHEI 62. mIBI 42, QHEI 62. Chem: 2/7 high TP, DO ok GM 484.04 cfu/100mL: Small patch of forest to E. Few scatted cattle operations, possibly septics.	FS				220+310+720
INW0772_06	21T-019	WEM-07-0017	Sixmile Creek	46	Good	49	44	Fair	44	Sixmile Creek @ County Road 500 S. WEM-07-0017: IBI 46, QHEI 49. mIBI 44, QHEI 44. Chem: Chem ok GM 357.02 cfu/100mL: 20K sandhill cranes migrate to this location in early spring and late fall but E.coli collected at different times. Site is a few miles DS from JNRU facility, Site 21 just DS of JNRU was passing for E.coli. Little rip buffer around nearby ag fields. Possible sources are wildlife, septics, ag fields.	FS				220+310+720
INW0773_01	21T-018	WEM-07-0014	Storm Creek	42	Fair	61	38	Fair	53	Storm Creek @ Base Road. WEM-07-0014: IBI 42, 38, QHEI 61, 51. mIBI 38, QHEI 53. Chem: 1/7 high TP, 1/11 low DO, 1/11 marg DO: no co-occurance GM 493.11 cfu/100mL: Two permitted animal operations upstream; some homes may be on septic; some ag fields with min buffer.	FS				220+310+720
INW0773_02	21T-016	WEM080-0013	Storm Creek Ditch	32	Poor	46	34	Poor	44	Storm Creek Ditch @ County Road 400 N. WEM080-0013: IBI 32, QHEI 46. mIBI 34, QHEI 44. In refuge, stagnant, logjam US of bridge, excessive duckweed, sheen on water. Wetland infleunced. Difficult to sample. Original impairment may have been due to logjam - 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 cfu/100mL.	NS	BIOLOGICAL INTEGRITY + DISSOLVED OXYGEN	SOURCE UNKNOWN (biology) + NATURAL SOURCES (dissolved oxygen)	4C	220+310+720
INW0773_T1002	21T-017	WEM080-0005	Tributary to Richart Lake	20	Very Poor	49	32	Poor	56	Tributary to Richart Lake @ County Road 900 W. WEM080-0005: IBI 20, QHEI 49. mIBI 32, QHEI 56: Site was isolated pools during most visits. Little habitat, gravel-sandy substrate, moving bedload - sand/silt from US filling in the pools? Chem: 1/6 high TP, 2/10 low DO, 2/10 marg DO: 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/100mL:Countryside subdivision on septic to the E. Hog operation to the N and other animal operations. Relatively wooded near the site = wildlife.	NS	BIOLOGICAL INTEGRITY + DISSOLVED OXYGEN	SOURCE UNKNOWN (biology) + NATURAL SOURCES (dissolved oxygen)		220+310+720
INW0774_01	21T-015	WEM080-0025	Mutton Creek	36	Fair	60	42	Fair	53	Mutton Creek @ County Road 300 N. WEM080-0025: IBI 36, QHEI 60. mIBI 42, QHEI 53. Chem: No TP hits, 2/11 marg DO. GM 505.48 cfu/100mL: 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 Acres - chicken manure).	FS				220+310+720
INW0774_02	21T-012	WEM080-0014	Mutton Creek	38	Fair	47	36	Fair	49	Mutton Creek Ditch @ County Road 400 N. WEM080-0014: IBI 38, QHEI 47. mIBI 30, 36, QHEI 48, 49. Chem: No TP 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	DISSOLVED OXYGEN	NATURAL SOURCES (dissolved oxygen)	4C	220+310+720+910
	21T-014	WEM080-0027	Mutton Creek	40	Fair	61	40	Fair	52	Mutton Creek @ County Road 800 N. WEM080-0027: IBI 38, 40, QHEI 61, 52. mIBI 40, QHEI 52. Chem: 1 high TP, 3/11 marg DO, no co-occurance GM 1131.04 cfu/100m: Large dairy operation NW of site, could be spreading manure. Possible septics due to US home not within any major municipality.	NS				220+310+720
INW0774_T1003	21T-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. mIBI 40, QHEI 48: Lots of longear sunfish from good pools. Chem: 2/7 high TP, 1/11 high % DO Sat: no co-occurance GM 460.2 cfu/100mL: No permitted facilities, ag fields with minimal riparian buffer on US tribs. Potential houses on septic.	FS				220+310+720
INW0774_T1005	21T-011	WEM080-0015	Sandy Branch	N/A	N/A	N/A	N/A	N/A	N/A	Sandy Branch @ US Hwy 31. WEM080-0015: IBI N/A, QHEI N/A. mIBI N/A, QHEI 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 MS4 US; urban/ ag with no riparian buffer US. Refuge to the E, lots of waterfowl - wildlife infleunced? Very few cattle in area.	FS				220
INW0775_01	21T-008	WEM070-0039	Vernon Fork Muscatatuck River	48	Good	62	40	Fair	56	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/100mL. Minimal riparian 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.	FS				240+220+310+720
INW0775_05	21T-009	WEM070-0020	Vernon Fork Muscatatuck River	52	Good	70	42	Fair	74	Vernon Fork Muscatatuck River @ US Hwy 31. WEM070-0020: IBI 52, QHEI 70. mIBI 42, QHEI 74. Chem: 1/11 high TP, 4/14 marg DO, no co-occurance GM 83.77 cfu/100mL. Fully Supporting	FS				220+310+720
INW0775_T1003	21T-006	WEM-07-0021	Tea Creek	32	Poor	62	38	Fair	57	Tea Creek @ County Road 650 S. WEM-07-0021: IBI 32, QHEI 62. mIBI 38, QHEI 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 cfu/100mL: Manure runoff from nearby fields; residential homes on septic; forested so could be wildlife influenced as well.	NS	BIOLOGICAL INTEGRITY	SOURCE UNKNOWN		220+310+720+915+920+925
	21T-007	WEM070-0029	Tea Creek	38	Fair	49	42	Fair	46	Tea Creek @ County Road 650 W. WEM070-0029: IBI 38, QHEI 49. mIBI 42, 36, QHEI 46, 43. Chem: 1/7 high TP, 1/11 low DO, 2/11 marg DO: no co-occurrance. GM 581.59 cfu/100mL. US homes, fairly wooded, manure runoff; could be affected by whatever is affecting site 6.	NS				220+310+720
INW0776_03	21T-010	WEM090-0015	Vernon Fork Muscatatuck River	46	Good	57	44	Fair	42	Vernon Fork Muscatatuck River @ County Road E 50 N. WEM090-0015: IBI 46, QHEI 57. mIBI 44, QHEI 42. Chem: TP ok, 4/15 marg DO. GM 96.69 cfu/100mL. Fully Supporting	FS				220+310+720
INW0776_05	21T-003	WEM090-0008	Vernon Fork Muscatatuck River	N/A	N/A	N/A	N/A	N/A	N/A	Vernon Fork Muscatatuck River @ County Road 400 S. WEM090-0008: IBI N/A, QHEI N/A. mIBI N/A, QHEI N/A. Chem: 4/7 high TP, 6/10 low DO, 2/10 marg DO, 3 co-occurrances GM 183.88 cfu/100mL. Site is in original stream channel, now oxbow; Rider Ditch is main channel. Stagnant water, **not functioning as a stream**. Issues probably not driven by a pollutant, hydrology issues. CFO US; nearby cattle pasture but no stream access. Wooded, so UV light not burning up E. coli. Assess as 4C = flow driven (for existing DO impairment, will not assess new data collected)	NS	DISSOLVED OXYGEN + NUTRIENTS	NATURAL SOURCES (dissolved oxygen) + NATURAL SOURCES (nutrients)	4C	220
INW0776_T1009	21T-005	WEM-07-0015	John McDonald Ditch	28	Poor	29	34	Poor	42	John McDonald Ditch @ County Road 125 S. WEM-07-0015: IBI 28, QHEI 29. mIBI 34, QHEI 42: Habitat poor; sand, silt 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 cfu/100mL: Permitted facility (Kyle and Lee Broshears) DS; wooded US (wildlife?). Or septics or manure spreading.	NS	BIOLOGICAL INTEGRITY + DISSOLVED OXYGEN	SOURCE UNKNOWN (biology) + NATURAL SOURCES (dissolved oxygen)	4C	220+310+720
INW0776_T1019	21T-002	WEM-07-0010	Grassy Creek	38	Fair	51	32	Poor	46	Grassy Creek @ County Road 600 S. WEM-07-0010: IBI 38, QHEI 51. mIBI 32, QHEI 46: Very little habitat, wetland influenced. Chem: 7/7 high TP (5/7 really high TP), 5/11 marg DO, no co-occurrance. GM 244.37 cfu/100mL: Crothersville (East) 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	BIOLOGICAL INTEGRITY	SOURCE UNKNOWN + MUNICIPAL POINT SOURCE DISCHARGES		220+310+720+915
INW0776_T1022	21T-001	WEM090-0003	Rider Ditch	50	Good	55	38	Fair	43	Rider Ditch @ County Road 600 S. WEM090-0003: IBI 50, QHEI 55. mIBI 38, QHEI 43. Chem: 2/11 high TP, 3/15 marg DO, no co-occurrence. GM 107.48 cfu/100mL. Fully Supporting. Main pour point for the watershed.	FS				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/100mL: One 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	21T-025	WEM070-0001 (also a fixed station site)	Vernon Fork Muscatatuck River	Vernon Fork Muscatatuck River @ County Road 60 S. WEM070-0001: IBI 54, QHEI 80. mIBI 40, QHEI 87. Chem: 3/18 high TP, DO ok. GM 141.34 cfu/100mL: 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 Fixed Station and a Reference sit**e: future Regional Monitoring Network site.	NS	ESCHERICHIA COLI (E. COLI)	SEWAGE DISCHARGES IN UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL	420
INW0772_01A	21T-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") water. Floating algal mats during first visit. Chem: 2/11 low, 3/11 marg DO: 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	21T-021	WEM-07-0019	Sixmile Creek	Sixmile Creek @ County Road 175 N. WEM-07-0019: IBI 38, QHEI 72. mIBI 42, QHEI 67. Chem: 3/7 high TP, DO ok GM 186.89 cfu/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	21T-020	WEM-07-0018	Sixmile Creek	Sixmile Creek @ County Road 200 S. WEM-07-0018: IBI 52, QHEI 62. mIBI 42, QHEI 62. Chem: 2/7 high TP, DO ok GM 484.04 cfu/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	21T-019	WEM-07-0017	Sixmile Creek	Sixmile Creek @ County Road 500 S. WEM-07-0017: IBI 46, QHEI 49. mIBI 44, QHEI 44. Chem: Chem ok GM 357.02 cfu/100mL: 20K sandhill cranes migrate to this location in early spring and late fall but E.coli collected at different times. Site is a few miles DS from JNRU facility, Site 21 just DS of JNRU was passing for E.coli. Little rip buffer around nearby ag fields. Possible sources are wildlife, septics, ag fields.	NS	ESCHERICHIA COLI (E. COLI)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL	420
INW0773_01	21T-018	WEM-07-0014	Storm Creek	Storm Creek @ Base Road. WEM-07-0014: IBI 42, 38, QHEI 61, 51. mIBI 38, QHEI 53. Chem: 1/7 high TP, 1/11 low DO, 1/11 marg DO: no co-occurance GM 493.11 cfu/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	21T-016	WEM080-0013	Storm Creek Ditch	Storm Creek Ditch @ County Road 400 N. WEM080-0013: IBI 32, QHEI 46. mIBI 34, QHEI 44. In refuge, stagnant, logjam US of bridge, excessive duckweed, sheen on water. Wetland infleunced. Difficult to sample. Original impairment may have been due to logjam - 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 cfu/100mL.	FS			420
INW0773_T1002	21T-017	WEM080-0005	Tributary to Richart Lake	Tributary to Richart Lake @ County Road 900 W. WEM080-0005: IBI 20, QHEI 49. mIBI 32, QHEI 56: Site was isolated pools during most visits. Little habitat, gravel-sandy substrate, moving bedload - sand/silt from US filling in the pools? Chem: 1/6 high TP, 2/10 low DO, 2/10 marg DO: 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/100mL:Countryside 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 UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL	420
INW0774_01	21T-015	WEM080-0025	Mutton Creek	Mutton Creek @ County Road 300 N. WEM080-0025: IBI 36, QHEI 60. mIBI 42, QHEI 53. Chem: No TP hits, 2/11 marg DO. GM 505.48 cfu/100mL: 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 Acres - chicken manure).	NS	ESCHERICHIA COLI (E. COLI)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERED AREAS	420
INW0774_02	21T-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 TP 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
	21T-014	WEM080-0027	Mutton Creek	Mutton Creek @ County Road 800 N. WEM080-0027: IBI 38, 40, QHEI 61, 52. mIBI 40, QHEI 52. Chem: 1 high TP, 3/11 marg DO, no co-occurance GM 1131.04 cfu/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	21T-013	WEM-07-0016	Tributary of Mutton Creek	Tributary of Mutton Creek @ County Road 700 N. WEM-07-0016: IBI 40, QHEI 65. mIBI 40, QHEI 48: Lots of longear sunfish from good pools. Chem: 2/7 high TP, 1/11 high % DO Sat: no co-occurance GM 460.2 cfu/100mL: 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	21T-011	WEM080-0015	Sandy Branch	Sandy Branch @ US Hwy 31. WEM080-0015: IBI N/A, QHEI N/A. mIBI N/A, QHEI 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 MS4 US; urban/ ag with no riparian buffer US. Refuge to the E, lots of waterfowl - wildlife infleunced? Very few cattle in area.	NS	ESCHERICHIA COLI (E. COLI)	MUNICIPAL POINT SOURCE DISCHARGES + WATERFOWL	420
INW0775_01	21T-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/100mL. Minimal riparian 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	21T-009	WEM070-0020	Vernon Fork Muscatatuck River	Vernon Fork Muscatatuck River @ US Hwy 31. WEM070-0020: IBI 52, QHEI 70. mIBI 42, QHEI 74. Chem: 1/11 high TP, 4/14 marg DO, no co-occurance GM 83.77 cfu/100mL. Fully Supporting	FS			420
INW0775_T1003	21T-006	WEM-07-0021	Tea Creek	Tea Creek @ County Road 650 S. WEM-07-0021: IBI 32, QHEI 62. mIBI 38, QHEI 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 cfu/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
	21T-007	WEM070-0029	Tea Creek	Tea Creek @ County Road 650 W. WEM070-0029: IBI 38, QHEI 49. mIBI 42, 36, QHEI 46, 43. Chem: 1/7 high TP, 1/11 low DO, 2/11 marg DO: no co-occurrance. GM 581.59 cfu/100mL. 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	21T-010	WEM090-0015	Vernon Fork Muscatatuck River	Vernon Fork Muscatatuck River @ County Road E 50 N. WEM090-0015: IBI 46, QHEI 57. mIBI 44, QHEI 42. Chem: TP ok, 4/15 marg DO. GM 96.69 cfu/100mL. Fully Supporting	FS			420
INW0776_05	21T-003	WEM090-0008	Vernon Fork Muscatatuck River	Vernon Fork Muscatatuck River @ County Road 400 S. WEM090-0008: IBI N/A, QHEI N/A. mIBI N/A, QHEI N/A. Chem: 4/7 high TP, 6/10 low DO, 2/10 marg DO, 3 co-occurrances GM 183.88 cfu/100mL. Site is in original stream channel, now oxbow; Rider Ditch is main channel. Stagnant water, **not functioning as a stream**. Issues probably not driven by a pollutant, hydrology issues. CFO US; nearby cattle pasture but no stream access. Wooded, so UV light not burning up E. coli. Assess as 4C = flow driven (for existing DO impairment, will not assess new data collected)	NS	ESCHERICHIA COLI (E. COLI)	LIVESTOCK (GRAZING OR FEEDING OPERATIONS) + WILDLIFE OTHER THAN WATERFOWL	420
INW0776_T1009	21T-005	WEM-07-0015	John McDonald Ditch	John McDonald Ditch @ County Road 125 S. WEM-07-0015: IBI 28, QHEI 29. mIBI 34, QHEI 42: Habitat poor; sand, silt 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 cfu/100mL: Permitted facility (Kyle and Lee Broshears) DS; wooded US (wildlife?). Or septics or manure spreading	NS	ESCHERICHIA COLI (E. COLI)	CONFINED ANIMAL FEEDING OPERATIONS (NPS) + SEWAGE DISCHARGES IN UNSEWERED AREAS + WILDLIFE OTHER THAN WATERFOWL	420
INW0776_T1019	21T-002	WEM-07-0010	Grassy Creek	Grassy Creek @ County Road 600 S. WEM-07-0010: IBI 38, QHEI 51. mIBI 32, QHEI 46: Very little habitat, wetland influenced. Chem: 7/7 high TP (5/7 really high TP), 5/11 marg DO, no co-occurrance. GM 244.37 cfu/100mL: Crothersville (East) 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	21T-001	WEM090-0003	Rider Ditch	Rider Ditch @ County Road 600 S. WEM090-0003: IBI 50, QHEI 55. mIBI 38, QHEI 43. Chem: 2/11 high TP, 3/15 marg DO, no co-occurrence. GM 107.48 cfu/100mL. 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
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January 14, 2021

B-050-OWQ-WAP-XXX-21-W-R1

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Approval Signatures

Date 1/12/2021

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Targeted Monitoring Section

Date 1/12/2021

Caleb Rennaker, TMDL Lead
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Date 1/12/2021

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Date 1/12/2021

Jody Arthur, Integrated Report Coordinator
Watershed Assessment and Planning Branch

Date 1/8/2021

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

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Addendum

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
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Eric J. Holcomb *Governor*
Bruno L. Pigott *Commissioner*

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 2021 Watershed Characterization Work Plan for Vernon Fork Muscatatuck River Watershed (Hydrologic Unit Code 0512020707) B-050-OWQ-WAP-XXX-21-W-R1

This memorandum serves as an amendment to the 2021 Watershed Characterization Work Plan for Vernon Fork Muscatatuck River Watershed (Hydrologic Unit Code 0512020707) B-050-OWQ-WAP-XXX-21-W-R1. 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

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
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_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

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Table of Contents

List of Attachments

List of Figures

List of Tables

List of Acronyms

AIMS	Assessment Information Management System
ASTM	American Society for Testing and Materials
AUID	Assessment Unit IDs
CFU	Colony Forming Units
DO	Dissolved Oxygen
DQA	Data Quality Assessment
DQO	Data Quality Objectives
E. coli	*Escherichia coli*
GPS	Global Positioning System
HUC	Hydrologic Unit Code
IAC	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 µm 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	A segment of a stream used for sampling.
Targeted site	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)

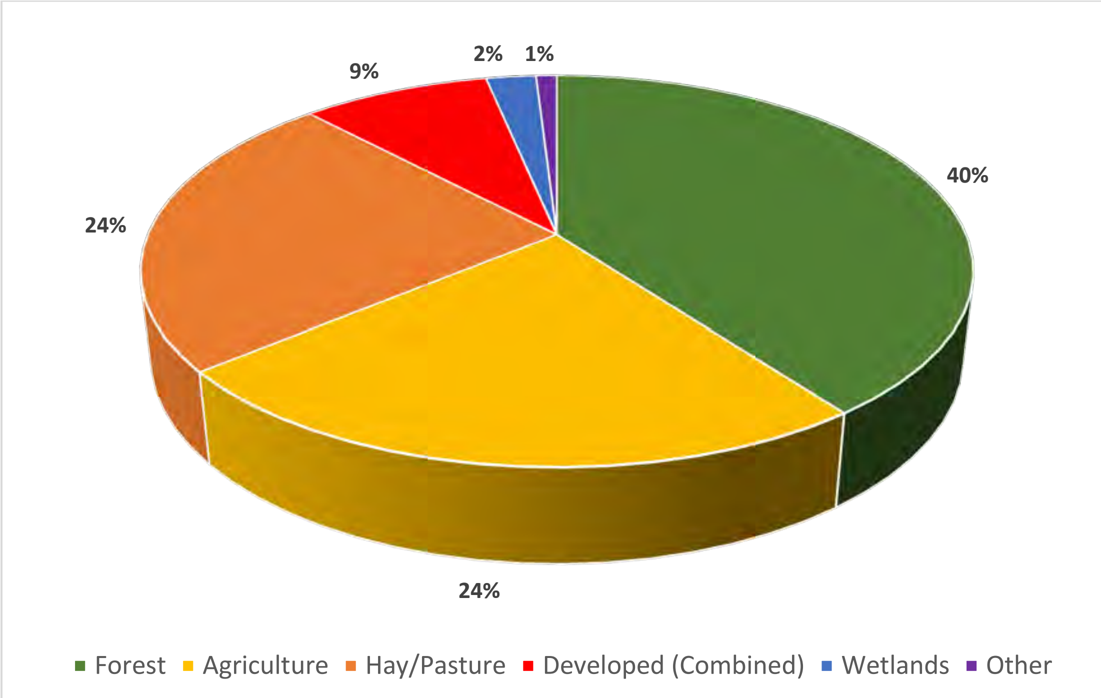
   Sampling locations for the 2021 Vernon Fork watershed characterization study are listed in Table 3 and can be viewed spatially in Figure 2.

   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 Idexx™ 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 Hach™ 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 [327 IAC 2-1-6]. 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):
  - One or more measurements greater than 10.0 mg/L
- Dissolved Oxygen (DO):
  - 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
  - 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 Indiana's Integrated Water Monitoring and Assessment Report (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).

Table 1. Water Quality Criteria [327 IAC Article 2]

Parameters	Water Quality Criteria	Criterion
E. coli (April-October Recreational season)	≤125 MPN/100 mL	5-Sample Geometric Mean
	≤235 MPN/100 mL	Single Sample Maximum
Total Ammonia (NH_3-N)	Calculated based on pH and Temperature	Calculated CAC
Nitrate+Nitrite-Nitrogen	≤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 Oxygen	At least 5.0 mg/L (Warm Waters)	Daily Average
	Not less than 4.0 mg/L at any time	Single Reading
pH	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

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

Table 2. Project Roles, Experience, and Training

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

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 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

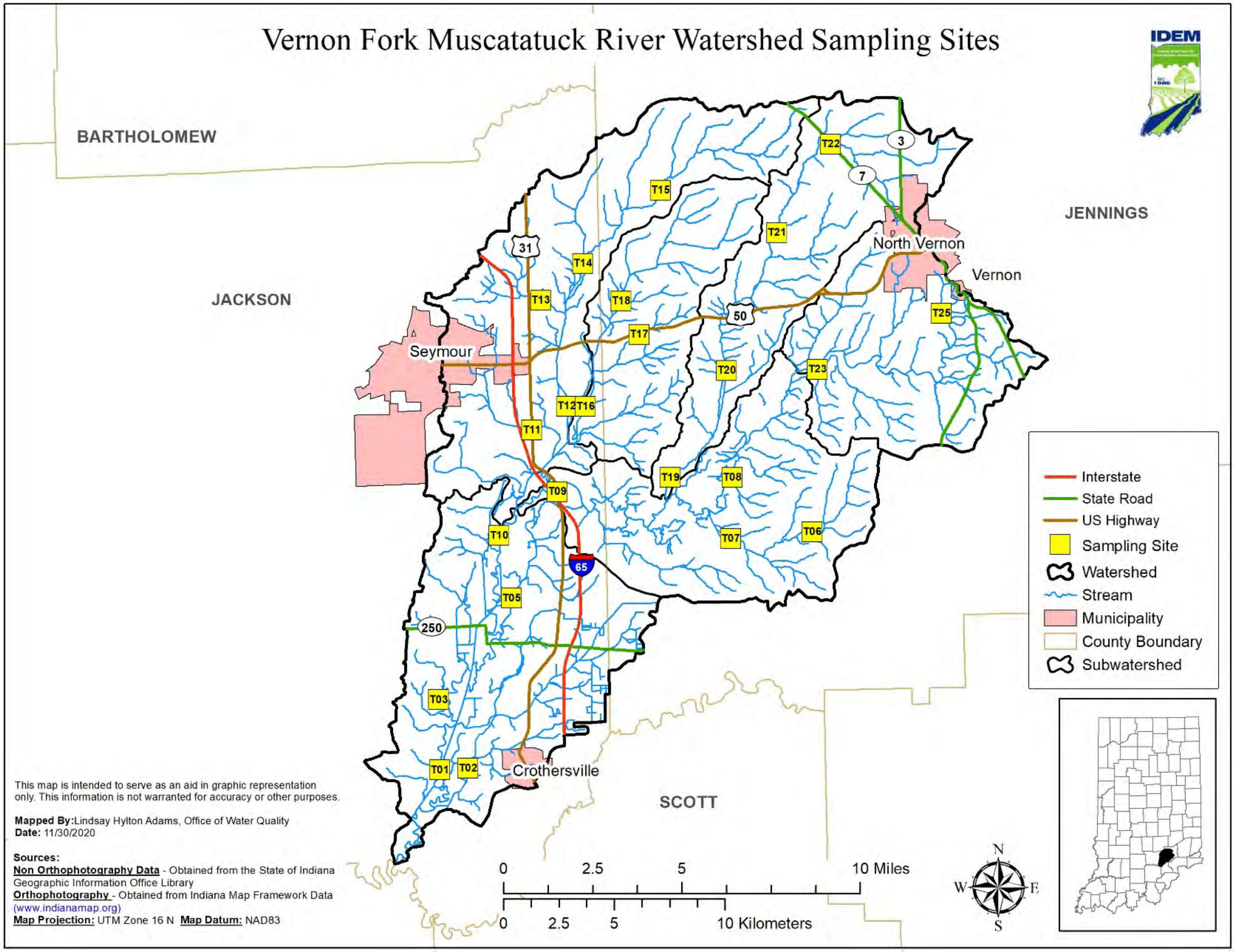
Sample sites will be chosen using a modified geometric site selection process as well as targeted site selection in order to obtain the necessary spatial representation of the entire watershed. Sites within this watershed will be selected based on a geometric progression of drainage areas starting with 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

[2] 21T-### 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.

Table 4. Water Chemistry Sample Handling

Parameter	Preservative	Holding Times
Alkalinity (as $CaCO_3$)	Ice	14 days
Solids, Total Residue (TS)	Ice	7 days
Solids, Nonfilterable Residue (TSS)	Ice	7 days
Solids, Filterable Residue (TDS)	Ice	7 days
Sulfate (Dissolved)	Ice	28 days
Chloride	Ice	28 days
Hardness (as $CaCO_3$)	HNO_3	6 months
Nitrogen, as Ammonia	H_2SO_4	28 days
Nitrogen, Kjeldahl (TKN)	H_2SO_4	28 days
Nitrogen, Nitrate-nitrite	H_2SO_4	28 days
Phosphorous (Applicable to all)	H_2SO_4	28 days
Total Organic Carbon (TOC)	H_2SO_4	28 days
Chemical Oxygen Demand	H_2SO_4	28 days
Calcium	HNO_3	6 months
Magnesium	HNO_3	6 months

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 10ºC during transport. Samples will be preserved with 0.0008% $Na_2S_2O_3$ for CL_2. 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 rat-tail 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 µm) 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 Idexx™ 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.

Table 5. *E.coli*, Nutrient, and General Chemistry Parameters Test Methods[4]

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

***** 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 Parameters 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 (≥ 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 *E. coli* bacterial cultures.
Negative Controls:	Each lot of media will be tested for performance using non-*E. coli* 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 collected and analyzed by IDEM staff. Ten percent of 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

Table 7. Personnel Safety and Reference Manuals

Role	Required Training or Experience	Training References	Training Notes
All Staff that Participate in Field Activities	- Basic First Aid and Cardio-Pulmonary Resuscitation (CPR) - Personal Protective Equipment (PPE) Policy - Personal Flotation Devices	- A minimum of 4 hours of in-service training provided by WAPB (IDEM 2010c) - IDEM 2008 - February 29, 2000 WAPB internal memorandum regarding use of approved Personal Flotation Devices	-Staff lacking 4 hours of in-service training or appropriate certification will be accompanied in the field at all times by WAP,200B staff meeting Health and Safety Training requirements - 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 watercraft must wear a high intensity whistle and Safety of Life at Sea (SOLAS) certified strobe light.

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*Document may be inspected at the Watershed Assessment and Planning Branch office, located at 2525 North Shadeland Avenue Suite 100, Indianapolis, Indiana.

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IDEM 2018b. IDEM Quality Management Plan 2018. IDEM, Indiana Government Center North, 100 N. Senate Ave., Indianapolis, Indiana, 46204.

IDEM 2019a. *E. coli* Field Sampling and Analysis. B-013-OWQ-WAP-XXX-19-T-R0. OWQ, Watershed Assessment and Planning Branch. Indianapolis, Indiana.

IDEM 2019b. Multihabitat (MHAB) Macroinvertebrate Collection Procedure. 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. Procedures for Completing the Qualitative Habitat Evaluation Index. B-003-OWQ-WAP-XX-19-T-R1. OWQ, Watershed Assessment and Planning Branch. Indianapolis, Indiana.

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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 because missing, incomplete, or outdated assessments can be addressed prior to TMDL development.

Selection Process

In ArcGIS, download from NHD Plus site (http://www.horizon-systems.com/nhdplus/HSC-wthMS.php) 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 = x-coordinates 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

Site Reconnaissance Form

EPA Site Identifier	Rank

Recon #:
Trip #:

Site Number: | Stream: | County:

Location Description:

Reconnaissance Data Collected

Recon Date | Crew Members

Avg. Width (m) | Avg. Depth (m) | Max. Depth (m) | Nearest Town

Water Present? ☐ | Site Wadeable? ☐ | Riffle/Run Present? ☐ | Road/Public Access Possible? ☐

Site Impacted by Livestock? ☐ | Collect Sediment? ☐ | Gauge Present? ☐

Landowner/Contact Information

First Name | Last Name

Street Address

City | State | Zip

Telephone | E-Mail Address

Pamphlet Distributed? ☐ | Please Call In Advance? ☐ | Results Requested? ☐

Rating, Results, Comments, and Planning

Site Rating By Category (1=easy, 10=difficult)

- Access Route
- Safety Factor
- Sampling Effort

Reconnaissance Decision

- Pre-Recon
- Recon in process
- Approved Site
- No, Landowner denied access
- No, Dry
- No, Stream channel missing
- No, Physical barriers
- No, Impounded stream
- No, Marsh/Wetland
- No, Bridge gone or not accessible
- No, Unsafe due to traffic or location
- No, Site impacted by backwater
- No, Other

Equipment Selected

Circle Equipment Needed

- Backpack
- Boat
- Totebarge
- Longline
- Scanoe
- Seine
- Weighted Handline
- Waders
- Gill Net

Comments

Sketch of Stream & Access Route – Indicate Flow, Direction, Obstacles, & Land Use (Use Back of Page, If Necessary)

Attachment 3: IDEM OWQ Stream Sampling Field Data Sheet

IDEM Stream Sampling Field Data Sheet

Analysis Set #	EPA Site ID	Rank

Sample #	Site #	Sample Medium	Sample Type	Duplicate Sample #

Stream Name:		River Mile:		County:	

Site Description:

Survey Crew Chief	Sample Collectors 1	2	3	4	Sample Collected Date	Time	Hydrolab #	Water Depth/Gage Ht (ft)	Water Flow (cfSec)	Flow Estimated?	Algae?	Aquatic Life?
										☐	☐	☐

Sample Taken?	Aliquots	Water Flow Type	Water Appearance	Canopy Closed %
☐ Yes ☐ No; Frozen ☐ No; Stream Dry ☐ No; Other ☐ No; Owner refused Access	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 6 ☐ 8 ☐ 12 ☐ 24 ☐ 48 ☐ 72 ☐ AS-Flow	☐ Riffle ☐ Dry ☐ Stagnant ☐ Pool ☐ Run ☐ Flood ☐ Glide ☐ Eddy ☐ Other	☐ Clear ☐ Green ☐ Sheen ☐ Murky ☐ Black ☐ Other ☐ Brown ☐ Gray (Septic/Sewage)	☐ 0-20% ☐ 60-80% ☐ 20-40% ☐ 80-100% ☐ 40-60%

Special Notes:

Field Data:

Date (m/d/yy)	24-hr Time (hh:mm)	D.O. (mg/l)	pH	Water Temp (°C)	Spec Cond (µohms/cm)	Turbidity (NTU)	% Sat.	Chlorine (mg/l)	Chloride (mg/l)	Chlorophyll (mg/l)	Weather Codes SC	WD	WS	AT
Comments														
Comments														
Comments														
Comments														
Comments														
Comments														

Measurement Flags		
	<	< Min. Meter Measurement
	>	> Max. Meter Measurement
	E	Estimated (See Comments)
	R	Rejected (See Comments)

Weather Code Definitions

SC Sky Conditions		WD Wind Direction	WS Wind Strength	AT Air Temp
1 Clear	8 Rain	00 North (0 degrees)	0 Calm	1 < 32
2 Scattered	9 Snow	09 East (90 degrees)	1 Light	2 33-45
3 Partly	10 Sleet	18 South (180 degrees)	2 Mod./Light	3 46-60
4 Cloudy		27 West (270 degrees)	3 Moderate	4 61-75
5 Mist			4 Mod./Strong	5 76-85
6 Fog			5 Strong	6 > 86
7 Shower			6 Gale	

Field Calibrations:

Date (m/d/yy)	Time (hh:mm)	Calibrator Initials	Calibrations Type	Meter #	Value	Units

Calibration Type	
	pH
	DO
	Turbidity

Preservatives/Bottle Lots:

Group: Preservative	Preservative Lot #	Bottle Type	Bottle Lot #

Groups: Preservatives		Bottle Types	
GC	General Chemistry: Ice	2000P	2000mL Plastic, Narrow Mouth
Nx	Nutrients: H2SO4	1000P	1000mL Plastic, Narrow Mouth
Metals	Metals: HNO3	500P	500mL Plastic, Narrow Mouth
CN	Cyanide: NaOH	250P	250mL Plastic, Narrow Mouth
O&G	Oil & Grease: H2SO4	1000G	1000mL Glass, Narrow Mouth
Toxics	Toxics: Ice	500G	500mL Glass, Wide Mouth
Ecoli	Bacteriology: Ice	250G	250mL Glass, Wide Mouth
VOA	Volatile Organics: HCl & Thiosulfate	125G	125mL Glass, Wide Mouth
Pest	Pesticides: Ice	40GV	40mL Glass Vial
Phen	Phenols: H2SO4	120PB	120ml Plastic (Bacteria Only)
Sed	Sediment: Ice	1000PF	1000mL Plastic, Corning Filter
Gly	Glyphosate: Thiosulfate	500PF	500mL Plastic, Corning Filter
Hg	Mercury(1631): HCl	60P	60mL Plastic
Cr6	ChromiumVI(1636): NaOH	250T	250mL Teflon
MeHg	Methyl Mercury(1630): HCl	500T	500mL Teflon
		125T	125mL Teflon

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________
Elapsed time at site (hh:mm)___:___ Comments________

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				WEIGHT (s) (mass g)				(length mm)	ANOMALIES					
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												

KRW: Rev/09.26.18 Calculation:_____ QC1 + Entry_____ QC 1_____ QC 2_____

Attachment 5: IDEM OWQ Macroinvertebrate Header Form

IDEM

Office of Water Quality: Macroinvertebrate Header

L-Site	Stream Name	Location	County	Surveyor

Sample Date	Sample #	Macro#	# Containers

☐ Habitat Complete ☐ Sample Quality Rejected

Macro Sample Type:
☐ Black Light ☐ Kick
☐ CPOM ☐ MHAB
☐ Hester-Dendy ☐ Qualitative

☐ Normal ____________
☐ Duplicate ____________
☐ Replicate ____________

Riparian Zone/Instream Features

Macro Sub Sample (Field or Lab): ______________

Macro Reach Sampled (m): ______________

Watershed Erosion:
☐ Heavy
☐ Moderate
☐ None

Watershed NPS Pollution:
☐ No Evidence
☐ Obvious Sources
☐ Some Potential Sources

Stream Depth Riffle (m):	Stream Depth Run (m):	Stream Depth Pool (m):

Distances Riffle-Riffle (m):	Distances Bend-Bend (m):

Stream Width (m):	High Water Mark (m):

Stream Type:
☐ Cold
☐ Warm

Turbidity (Est):
☐ Clear ☐ Slightly Turbid
☐ Opaque ☐ Turbid

☐ Channelization ☐ Dam Present

Predominant Surrounding Land Use: ☐ Forest ☐ Field/Pasture ☐ Agricultural ☐ Residential ☐ Commercial ☐ Industrial
Other ____________

Sediment

Sediment Odors: ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None Other ____________
Sediment Deposits: ☐ Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Relic Shells Other ____________
Sediment Oils: ☐ Absent ☐ Moderate ☐ Profuse ☐ Slight

☐ Are the undersides of stones, which are not deeply embedded, black?

Substrate Components

(Note: Select from 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, or 100% for each inorganic/ organic substrate component)

Inorganic Substrate Components (% Diameter)						
Bedrock	Boulder (>10 in)	Cobble (2.5-10 in)	Gravel (0.1-2.5 in)	Sand (gritty)	Silt	Clay (slick)

Organic Substrate Components (% Type)			
Detritus (sticks, wood)	Detritus (CPOM)	Muck/Mud (black, fine FPOM)	Marl(gray w/ shell fragments)

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)

IDEM

OWQ Biological QHEI (Qualitative Habitat Evaluation Index)

Sample # | bioSample # | Stream Name | Location

Surveyor | Sample Date | County | Macro Sample Type | ☐ Habitat Complete | **QHEI Score:**

1] *SUBSTRATE* Check ONLY Two predominant substrate TYPE BOXES and check every type present

Check ONE (Or 2 & average)

BEST TYPES (PREDOMINANT)	PRESENT P/G R/R	OTHER TYPES (PREDOMINANT)	PRESENT P/G R/R	ORIGIN	QUALITY
☐☐ BLDR/SLABS [10]	☐☐	☐☐ HARDPAN [4]	☐☐	☐ LIMESTONE [1]	SILT ☐ HEAVY [-2]
☐☐ BOULDER [9]	☐☐	☐☐ DETRITUS [3]	☐☐	☐ TILLS [1]	☐ MODERATE [-1]
☐☐ COBBLE [8]	☐☐	☐☐ MUCK [2]	☐☐	☐ WETLANDS [0]	☐ NORMAL [0]
☐☐ GRAVEL [7]	☐☐	☐☐ SILT [2]	☐☐	☐ HARDPAN [0]	☐ FREE [1]
☐☐ SAND [6]	☐☐	☐☐ ARTIFICIAL [0]	☐☐	☐ SANDSTONE [0]	EMBEDDEDNESS ☐ EXTENSIVE [-2]
☐☐ BEDROCK [5]	☐☐	(Score natural substrates; ignore sludge from point-sources)		☐ RIP/RAP [0]	☐ MODERATE [-1]
				☐ LACUSTRINE [0]	☐ NORMAL [0]
				☐ SHALE [-1]	☐ NONE [1]
				☐ COAL FINES [-2]	

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Substrate Maximum 20

Comments

2] *INSTREAM COVER* Indicate presence 0 to 3: **0**–Absent; **1**–Very small amounts or if more common of marginal quality; **2**–Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**–Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed root wad in deep/fast water, or deep, well-defined, functional pools.)

___ UNDERCUT BANKS [1] ___ POOLS > 70cm [2] ___ OXBOWS, BACKWATERS [1]
___ OVERHANGING VEGETATION [1] ___ ROOTWADS [1] ___ AQUATIC MACROPHYTES [1]
___ SHALLOWS (IN SLOW WATER) [1] ___ BOULDERS [1] ___ LOGS OR WOODY DEBRIS [1]
___ ROOTMATS [1]

AMOUNT Check ONE (Or 2 & average)
☐ EXTENSIVE > 75% [11]
☐ MODERATE 25 - 75% [7]
☐ SPARSE 5 - < 25% [3]
☐ NEARLY ABSENT < 5% [1]

Cover Maximum 20

Comments

3] *CHANNEL MORPHOLOGY* Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Channel Maximum 20

Comments

4] *BANK EROSION AND RIPARIAN ZONE* Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

L R EROSION	L R RIPARIAN WIDTH	L R FLOOD PLAIN QUALITY	L R
☐☐ NONE/LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY/SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW [1]	☐☐ FENCED PASTURE [1]	Indicate predominant land use(s) past 100m riparian.
	☐☐ NONE [0]	☐☐ OPEN PASTURE, ROWCROP [0]	

Riparian Maximum 10

Comments

5] *POOL/GLIDE AND RIFFLE/RUN QUALITY*

MAXIMUM DEPTH Check ONE (ONLY!)	CHANNEL WIDTH Check ONE (Or 2 & average)	CURRENT VELOCITY Check ALL that apply		Recreation Potential (Check one and comment on back)
☐ > 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]	☐ FAST [1]	☐ INTERMITTENT [-2]	
☐ 0.2 - < 0.4m [1]		☐ MODERATE [1]	☐ EDDIES [1]	
☐ < 0.2m [0] [metric = 0]		Indicate for reach – pools and riffles.		

Pool/Current Maximum 12

Comments

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average) ☐ NO RIFFLE [metric = 0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE/RUN SUBSTRATE	RIFFLE/RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5 - 10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5 cm [metric = 0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Riffle/Run Maximum 8

Comments

6] *GRADIENT* (ft/mi) ☐ VERY LOW - LOW [2 – 4] **%POOL:** **%GLIDE:**
DRAINAGE AREA (mi²) ☐ MODERATE [6 - 10] ☐ HIGH - VERY HIGH [10 - 6] **%RUN:** **%RIFFLE:**

Gradient Maximum 10

Entered ______ QC1 ______ QC2 ______ IDEM 02/28/2018

Attachment 6 (continued): IDEM OWQ Biological Qualitative Habitat Evaluation Index (back)

IDEM

OWQ Biological QHEI (Qualitative Habitat Evaluation Index)

COMMENT ______________________________

A-CANOPY
- ☐ >85%-Open
- ☐ 55%-<85%
- ☐ 30%-<55%
- ☐ 10%-<30%
- ☐ <10%-Closed

B-AESTHETICS
- ☐ Nuisance algae ☐ Oil sheen
- ☐ Invasive macrophytes ☐ Trash/Litter
- ☐ Excess turbidity ☐ Nuisance odor
- ☐ Discoloration ☐ Sludge deposits
- ☐ Foam/Scum ☐ CSOs/SSOs/Outfalls

C-RECREATION

Area / Depth

Pool: ☐ > 100 ft^2 ☐ > 3 ft

D-MAINTENANCE
- ☐ Public ☐ Private
- ☐ Active ☐ Historic
- Succession: ☐ Young ☐ Old
- ☐ Spray ☐ Islands ☐ Scoured
- Snag: ☐ Removed ☐ Modified
- Leveed: ☐ One sided ☐ Both banks
- ☐ Relocated ☐ Cutoffs
- Bedload: ☐ Moving ☐ Stable
- ☐ Armoured ☐ Slumps
- ☐ Impounded ☐ Desiccated
- ☐ Flood control ☐ Drainage

E-ISSUES
- ☐ WWTP ☐ CSO ☐ NPDES
- ☐ Industry ☐ Urban
- ☐ Hardened ☐ Dirt & Grime
- ☐ Contaminated ☐ Landfill
- BMPs: ☐ Construction ☐ Sediment
- ☐ Logging ☐ Irrigation ☐ Cooling
- Erosion: ☐ Bank ☐ Surface
- ☐ False bank ☐ Manure ☐ Lagoon
- ☐ Wash H_2O ☐ Tile ☐ H_2O Table
- Mine: ☐ Acid ☐ Quarry
- Flow: ☐ Natural ☐ Stagnant
- ☐ Wetland ☐ Park ☐ Golf
- ☐ Lawn ☐ Home
- ☐ Atmospheric deposition
- ☐ Agriculture ☐ Livestock

Looking upstream (> 10m, 3 readings; ≤ 10m, 1 reading in middle); Round to the nearest whole percent

	Right	Middle	Left	Total Average
% open	___ %	___ %	___ %	___ %

Stream Drawing:

IDEM 02/28/2018

Attachment 7: IDEM OWQ Chain of Custody Form

IDEM

Indiana Department of Environmental Management

OWQ Chain of Custody Form

Project:

OWQ Sample Set or Trip #:

I Certify that the sample(s) listed below was/were collected by me, or in my presence. Date:

Signature: Section:

Sample Media (☐ Water, ☐ Algae, ☐ Fish, ☐ Macro, ☐ Cyanobacteria/Microcystin, ☐ Sediment)

Lab Assigned Number / Event ID	IDEM Control Number	Sample Type	ID	1000 ml P.N.M.	1000 ml G.N.M.	40 ml Vial	120 ml P (Bact)	2000 ml Nalgene	250 ml Nalgene	125 ml Glass	Date and Time Collected		One check per bottle present
											Date	Time	

P = Plastic G = Glass N.M. = Narrow Mouth Bact = Bacteriological Only | Should samples be iced? | Y | N
M = MS/MSD B = Blank D = Duplicate R = Revisit

Carriers

I certify that I have received the above sample(s).

Signature	Date	Time	Seals Intact		Comments
Relinquished By:			Y	N	
Received By:					
Relinquished By:			Y	N	
Received By:					
Relinquished By:			Y	N	
Received By:					
IDEM Storage Room #					

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: Time:

Lab: Address:

Revision Date: 4/27/2016

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	

Anions and Physical Parameters

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 Metals Water Parameters

Parameter	Test Method	Total	Dissolved
Antimony	200.8	☐	☐
Arsenic	200.8	☐	☐
Beryllium	200.8	☐	☐
Cadmium	200.8	☐	☐
Chromium	200.7	☐	☐
Copper	200.8	☐	☐
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 Secondary Metals Parameters

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:
Tim Bowren - IDEM
Bldg. 20, STE 100
2525 North Shadeland Ave.
Indianapolis, IN 46219

Deliver reports to:
Tim Bowren – IDEM
Bldg. 20, STE 100
2525 North Shadeland Ave.
Indianapolis, IN 46219

Organic Water Parameters

Parameter	Test Method	Total
Priority Pollutants: Oranochlorine Pesticides and PCBs	608	☐
Priority Pollutants: VOCs - Purgeable Organics	624	☐
Priority Pollutants: Base/Neutral Extractables	625	☐
Priority Pollutants: Acid Extractables	625	☐
Phenolics, 4AAP	420.2	☐
Oil and Grease, Total	1664A	☐

Nutrient & Organic Water Chemistry Parameters

Parameter	Test Method	Total	Dissolved
Ammonia Nitrogen	SM4500NH3-G	☒	☐
$CBOD_5$	SM5210B	☐	
Total Kjeldahl Nitrogen (TKN)	SM4500N(Org)	☒	☐
Nitrate + Nitrite	SM4500NO3-F	☒	☐
Total Phosphorus	SM4500P-E	☒	☐
TOC	SM 5310C	☒	☐
COD	SM5220C	☒	☐
Cyanide (Total)	SM4500CN-E	☐	☐
Cyanide (Free)	SM4500CN-I	☐ *	☐
Cyanide (Amenable)	SM4500CN-G	☐ *	☐
Sulfide, Total	SM4500S2-F	☐	☐

RFP 16-074 Contract Number:	SCM # 19855 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: Test America
Attn: Robin Kintz
2417 Bond Street
University Park, IL 60484

Phone: 708.534.5200

Attachment 9: Test America Chain of Custody Form

TestAmerica Chicago
2417 Bond Street
University Park, IL 60484-3101
phone 708.534.5200 fax 708.534.5211

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager:**	**Site Contact:**	**Date:**	COC No:
Your Company Name here	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	_______ of _______ COCs
Address	**Analysis Turnaround Time**			Sampler:
City/State/Zip	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(xxx) xxx-xxxx Phone	TAT if different from Below _________			Walk-in Client:
(xxx) xxx-xxxx FAX	☐ 2 weeks			Lab Sampling:
Project Name:	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)																Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for_________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd:________ Corr'd:_________ Therm ID No.:___________		
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.11, dated 1/24/2017

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation

STATE OF ILLINOIS

ENVIRONMENTAL PROTECTION AGENCY
NELAP - RECOGNIZED

ENVIRONMENTAL LABORATORY ACCREDITATION

is hereby granted to

Eurofins TestAmerica Chicago
2417 Bond Street
University Park, IL 60484

NELAP ACCREDITED

Accreditation Number #100201

According to the Illinois Administrative Code, Title 35, Subtitle A, Chapter II, Part 186, ACCREDITATION OF LABORATORIES FOR DRINKING WATER, WASTEWATER AND HAZARDOUS WASTES ANALYSIS, the State of Illinois formally recognizes that this laboratory is technically competent to perform the environmental analyses listed on the scope of accreditation detailed below.

The laboratory agrees to perform all analyses listed on this scope of accreditation according to the Part 186 requirements and acknowledges that continued accreditation is dependent on successful ongoing compliance with the applicable requirements of Part 186. Please contact the Illinois EPA Environmental Laboratory Accreditation Program (IL ELAP) to verify the laboratory's scope of accreditation and accreditation status. Accreditation by the State of Illinois is not an endorsement or a guarantee of validity of the data generated by the laboratory.

Primary Accrediting Authority: Illinois

Celeste M. Crowley

Celeste M. Crowley
Supervisor
Environmental Laboratory Accreditation Program

Certificate No: 1002012020-7
Expiration Date: 4/29/2021
Issued On: 7/30/2020

Page 1 of 34

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

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	IL
Method **EPA 1664A Rev: 1**	
Oil & Grease	IL
Method **EPA 1664B**	
Oil & Grease	IL
Method **EPA 180.1 Rev: 2**	
Turbidity	IL
Method **EPA 200.7 Rev: 4.4**	
Aluminum	IL
Antimony	IL
Arsenic	IL
Barium	IL
Beryllium	IL
Boron	IL
Cadmium	IL
Calcium	IL
Chromium	IL
Cobalt	IL
Copper	IL
Iron	IL
Lead	IL
Magnesium	IL
Manganese	IL
Molybdenum	IL
Nickel	IL
Potassium	IL
Selenium	IL
Silica as SiO2	IL
Silver	IL
Sodium	IL
Thallium	IL
Tin	IL
Titanium	IL
Vanadium	IL
Zinc	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7 | Primary AB

Field of Testing /Matrix: ***CWA (Non Potable Water)***

	Primary AB
Method EPA 200.8 Rev: 5.4	
Aluminum	IL
Antimony	IL
Arsenic	IL
Barium	IL
Beryllium	IL
Boron	IL
Cadmium	IL
Calcium	IL
Chromium	IL
Cobalt	IL
Copper	IL
Iron	IL
Lead	IL
Magnesium	IL
Manganese	IL
Molybdenum	IL
Nickel	IL
Potassium	IL
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	IL
Method EPA 245.1 Rev: 3	
Mercury	IL
Method EPA 300.0 Rev: 2.1	
Bromide	IL
Chloride	IL
Fluoride	IL
Nitrate	IL
Nitrate plus Nitrite as N	IL
Nitrite	IL
Orthophosphate as P	IL
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)	IL
Method EPA 353.2 Rev: 2	
Nitrate	IL
Nitrate plus Nitrite as N	IL
Method EPA 420.4 Rev: 1	

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

	Primary AB
Field of Testing /Matrix: ***CWA (Non Potable Water)***	
Total phenolics	IL
Method EPA 608	
4,4'-DDD	IL
4,4'-DDE	IL
4,4'-DDT	IL
Aldrin	IL
alpha-BHC (alpha-Hexachlorocyclohexane)	IL
Aroclor-1016 (PCB-1016)	IL
Aroclor-1221 (PCB-1221)	IL
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
beta-BHC (beta-Hexachlorocyclohexane)	IL
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
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	IL
Heptachlor	IL
Heptachlor epoxide	IL
Methoxychlor	IL
Toxaphene (Chlorinated camphene)	IL
Method EPA 624	
1,1,1-Trichloroethane	IL
1,1,2,2-Tetrachloroethane	IL
1,1,2-Trichloroethane	IL
1,1-Dichloroethane	IL
1,1-Dichloroethylene	IL
1,2-Dichlorobenzene (o-Dichlorobenzene)	IL
1,2-Dichloroethane (Ethylene dichloride)	IL
1,2-Dichloropropane	IL
1,3-Dichlorobenzene	IL
1,4-Dichlorobenzene	IL
2-Chloroethyl vinyl ether	IL
Acrolein (Propenal)	IL
Acrylonitrile	IL
Benzene	IL
Bromodichloromethane	IL
Bromoform	IL
Carbon tetrachloride	IL
Chlorobenzene	IL
Chlorodibromomethane	IL
Chloroethane (Ethyl chloride)	IL
Chloroform	IL
cis-1,3-Dichloropropene	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7 — Primary AB

Field of Testing /Matrix: ***CWA (Non Potable Water)***

Ethylbenzene	IL
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	IL
trans-1,3-Dichloropropylene	IL
Trichloroethene (Trichloroethylene)	IL
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	IL
Vinyl chloride	IL
Xylene (total)	IL

Method **EPA 625**

1,2,4-Trichlorobenzene	IL
1,2-Dichlorobenzene (o-Dichlorobenzene)	IL
1,3-Dichlorobenzene	IL
1,4-Dichlorobenzene	IL
2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether	IL
2,4,5-Trichlorophenol	IL
2,4,6-Trichlorophenol	IL
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
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	IL
Benzo(k)fluoranthene	IL
bis(2-Chloroethoxy)methane	IL
bis(2-Chloroethyl) ether	IL
bis(2-Ethylhexyl) phthalate (DEHP)	IL
Butyl benzyl phthalate	IL
Chrysene	IL
Dibenz(a,h) anthracene	IL
Diethyl phthalate	IL
Dimethyl phthalate	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: ***CWA (Non Potable Water)***	
Di-n-butyl phthalate	IL
Di-n-octyl phthalate	IL
Fluoranthene	IL
Fluorene	IL
Hexachlorobenzene	IL
Hexachlorobutadiene	IL
Hexachlorocyclopentadiene	IL
Hexachloroethane	IL
Indeno(1,2,3-cd) pyrene	IL
Isophorone	IL
Naphthalene	IL
Nitrobenzene	IL
n-Nitrosodimethylamine	IL
n-Nitrosodi-n-propylamine	IL
n-Nitrosodiphenylamine	IL
Pentachlorophenol	IL
Phenanthrene	IL
Phenol	IL
Pyrene	IL
Method **SM 2320 B-1997**	
Alkalinity as CaCO3	IL
Method **SM 2340 B-1997**	
Hardness	IL
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**	
Residue-nonfilterable (TSS)	IL
Method **SM 2540 E-1997**	
Residue-volatile	IL
Method **SM 2540 F-1997**	
Residue-settleable	IL
Method **SM 3500-Cr B-2009**	
Chromium VI	IL
Method **SM 4500-Cl F-2000**	
Total residual chlorine	IL
Method **SM 4500-Cl G-2000**	
Total residual chlorine	IL
Method **SM 4500-Cl$^-$ E-1997 Rev: 21st ED**	
Chloride	IL
Method **SM 4500-CN$^-$ E-1999**	
Cyanide	IL
Method **SM 4500-CN$^-$ G-1999**	
Available Cyanide	IL
Method **SM 4500-F$^-$ C-1997 Rev: 21st ED**	

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

	Primary AB
Field of Testing /Matrix: ***CWA (Non Potable Water)***	
Fluoride	IL
Method **SM 4500-H+ B-2000**	
pH	IL
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	IL
Nitrate plus Nitrite as N	IL
Method **SM 4500-O G-2001**	
Oxygen, dissolved	IL
Method **SM 4500-P E-1999**	
Orthophosphate as P	IL
Phosphorus	IL
Method **SM 4500-S2¯ F-2000**	
Sulfide	IL
Method **SM 4500-SO4¯ E-1997**	
Sulfate	IL
Method **SM 5210 B-2001**	
Biochemical oxygen demand	IL
Carbonaceous BOD, CBOD	IL
Method **SM 5220 C-1997 Rev: 21st ED**	
Chemical oxygen demand	IL
Method **SM 5310 C-2000**	
Total organic carbon	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7 — Primary AB

Field of Testing /Matrix: ***CWA (Solid & Hazardous Material)***

	Primary AB
Method **EPA 120.1**	
Conductivity	IL
Method **EPA 160.4**	
Residue-volatile	IL
Method **EPA 1664A Rev: 1**	
Oil & Grease	IL
Method **EPA 1664B**	
Oil & Grease	IL
Method **EPA 200.7 Rev: 4.4**	
Aluminum	IL
Antimony	IL
Arsenic	IL
Barium	IL
Beryllium	IL
Boron	IL
Cadmium	IL
Calcium	IL
Chromium	IL
Cobalt	IL
Copper	IL
Iron	IL
Lead	IL
Magnesium	IL
Manganese	IL
Molybdenum	IL
Nickel	IL
Potassium	IL
Selenium	IL
Silica as SiO2	IL
Silver	IL
Sodium	IL
Thallium	IL
Tin	IL
Titanium	IL
Vanadium	IL
Zinc	IL
Method **EPA 350.1 Rev: 2**	
Ammonia	IL
Method **EPA 353.2 Rev: 2**	
Nitrate	IL
Nitrate plus Nitrite as N	IL
Method **EPA 420.4 Rev: 1**	
Total phenolics	IL
Method **SM 2320 B-1997**	
Alkalinity as CaCO3	IL
Method **SM 2510 B-1997**	
Conductivity	IL
Method **SM 4500-Cl^- E-1997 Rev: 21st ED**	
Chloride	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

	Primary AB
Field of Testing /Matrix: ***CWA (Solid & Hazardous Material)***	
Method **SM 4500-CN¯ E-1999**	
Cyanide	IL
Method **SM 4500-F¯ C-1997 Rev: 21st ED**	
Fluoride	IL
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	IL
Nitrate plus Nitrite as N	IL
Method **SM 4500-P E-1999**	
Orthophosphate as P	IL
Phosphorus	IL
Method **SM 4500-S2¯ F-2000**	
Sulfide	IL
Method **SM 5210 B-2001**	
Biochemical oxygen demand	IL
Carbonaceous BOD, CBOD	IL
Method **SM 5220 C-1997 Rev: 21st ED**	
Chemical oxygen demand	IL
Method **SM 5310 C-2000**	
Total organic carbon	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

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)	IL
Method **EPA 6010B Rev: 2**	
Aluminum	IL
Antimony	IL
Arsenic	IL
Barium	IL
Beryllium	IL
Boron	IL
Cadmium	IL
Calcium	IL
Chromium	IL
Cobalt	IL
Copper	IL
Iron	IL
Lead	IL
Lithium	IL
Magnesium	IL
Manganese	IL
Molybdenum	IL
Nickel	IL
Potassium	IL
Selenium	IL
Silica as SiO2	IL
Silver	IL
Sodium	IL
Strontium	IL
Thallium	IL
Tin	IL
Titanium	IL
Vanadium	IL
Zinc	IL
Method **EPA 6010C**	
Aluminum	IL
Antimony	IL
Arsenic	IL
Barium	IL
Beryllium	IL
Boron	IL
Cadmium	IL
Calcium	IL
Chromium	IL
Cobalt	IL
Copper	IL
Iron	IL
Lead	IL
Lithium	IL
Magnesium	IL
Manganese	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: *RCRA (Non Potable Water)*	Primary AB
Molybdenum	IL
Nickel	IL
Potassium	IL
Selenium	IL
Silica as SiO2	IL
Silver	IL
Sodium	IL
Strontium	IL
Thallium	IL
Tin	IL
Titanium	IL
Vanadium	IL
Zinc	IL
Method EPA 6020A Rev: 1	
Aluminum	IL
Antimony	IL
Arsenic	IL
Barium	IL
Beryllium	IL
Boron	IL
Cadmium	IL
Calcium	IL
Chromium	IL
Cobalt	IL
Copper	IL
Iron	IL
Lead	IL
Magnesium	IL
Manganese	IL
Molybdenum	IL
Nickel	IL
Potassium	IL
Selenium	IL
Silver	IL
Sodium	IL
Thallium	IL
Vanadium	IL
Zinc	IL
Method EPA 7196A Rev: 1	
Chromium VI	IL
Method EPA 7199 Rev: 0	
Chromium VI	IL
Method EPA 7470A Rev: 1	
Mercury	IL
Method EPA 8015B Rev: 2	
Diesel range organics (DRO)	IL
Gasoline range organics (GRO)	IL
Method EPA 8015C	
Diesel range organics (DRO)	IL
Gasoline range organics (GRO)	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: ***RCRA (Non Potable Water)***

	Primary AB
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	IL
Atrazine	IL
beta-BHC (beta-Hexachlorocyclohexane)	IL
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	IL
Heptachlor	IL
Heptachlor epoxide	IL
Isodrin	IL
Kepone	IL
Methoxychlor	IL
Simazine	IL
Toxaphene (Chlorinated camphene)	IL
Method EPA 8081B	
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	IL
Atrazine	IL
beta-BHC (beta-Hexachlorocyclohexane)	IL
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

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

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
Toxaphene (Chlorinated campnene)	IL
Method EPA 8082 Rev: 0	
Aroclor-1016 (PCB-1016)	IL
Aroclor-1221 (PCB-1221)	IL
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
Method EPA 8082A	
Aroclor-1016 (PCB-1016)	IL
Aroclor-1221 (PCB-1221)	IL
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
Method EPA 8151A	
2,4,5-T	IL
2,4-D	IL
2,4-DB	IL
Dalapon	IL
Dicamba	IL
Dichloroprop (Dichlorprop)	IL
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	IL
Pentachlorophenol	IL
Picloram	IL
Silvex (2,4,5-TP)	IL
Method EPA 8260B	
1,1,1,2-Tetrachloroethane	IL
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	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

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: ***RCRA (Non Potable Water)***	Primary AB
1,2-Dichloroethane (Ethylene dichloride)	IL
1,2-Dichloropropane	IL
1,3,5-Trichlorobenzene	IL
1,3,5-Trimethylbenzene	IL
1,3-Dichlorobenzene	IL
1,3-Dichloropropane	IL
1,4-Dichlorobenzene	IL
1,4-Dioxane (1,4- Diethyleneoxide)	IL
1-Chlorohexane	IL
2,2-Dichloropropane	IL
2-Butanone (Methyl ethyl ketone, MEK)	IL
2-Chloroethyl vinyl ether	IL
2-Chlorotoluene	IL
2-Hexanone	IL
2-Methylnaphthalene	IL
2-Nitropropane	IL
4-Chlorotoluene	IL
4-Isopropyltoluene (p-Cymene,p-Isopropyltoluene)	IL
4-Methyl-2-pentanone (MIBK)	IL
Acetone	IL
Acetonitrile	IL
Acrolein (Propenal)	IL
Acrylonitrile	IL
Allyl chloride (3-Chloropropene)	IL
Benzene	IL
Benzyl chloride	IL
Bromobenzene	IL
Bromochloromethane	IL
Bromodichloromethane	IL
Bromoform	IL
Carbon disulfide	IL
Carbon tetrachloride	IL
Chlorobenzene	IL
Chlorodibromomethane	IL
Chloroethane (Ethyl chloride)	IL
Chloroform	IL
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
Iodomethane (Methyl iodide)	IL
Isobutyl alcohol (2-Methyl-1-propanol)	IL
Isopropyl alcohol (2-Propanol, Isopropanol)	IL
Isopropylbenzene	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: ***RCRA (Non Potable Water)***	
m+p-xylene	IL
Methacrylonitrile	IL
Methyl bromide (Bromomethane)	IL
Methyl chloride (Chloromethane)	IL
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	IL
tert-Butylbenzene	IL
Tetrachloroethylene (Perchloroethylene)	IL
Tetrahydrofuran (THF)	IL
Toluene	IL
trans-1,2-Dichloroethylene	IL
trans-1,3-Dichloropropylene	IL
trans-1,4-Dichloro-2-butene	IL
Trichloroethene (Trichloroethylene)	IL
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	IL
Vinyl acetate	IL
Vinyl chloride	IL
Xylene (total)	IL
Method EPA 8270C Rev: 3	
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
1,3-Dichlorobenzene	IL
1,3-Dinitrobenzene (1,3-DNB)	IL
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	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	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: ***RCRA (Non Potable Water)***	Primary AB
2,4-Dimethylphenol	IL
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	IL
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	IL
4-Aminobiphenyl	IL
4-Bromophenyl phenyl ether	IL
4-Chloro-3-methylphenol	IL
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	IL
7,12-Dimethylbenz(a) anthracene	IL
a-a-Dimethylphenethylamine	IL
Acenaphthene	IL
Acenaphthylene	IL
Acetophenone	IL
Aniline	IL
Anthracene	IL
Aramite	IL
Benzidine	IL
Benzo(a)anthracene	IL
Benzo(a)pyrene	IL
Benzo(b)fluoranthene	IL
Benzo(g,h,i)perylene	IL
Benzo(k)fluoranthene	IL
Benzoic acid	IL
Benzyl alcohol	IL
bis(2-Chloroethoxy)methane	IL
bis(2-Chloroethyl) ether	IL
bis(2-Ethylhexyl) phthalate (DEHP)	IL
Butyl benzyl phthalate	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: ***RCRA (Non Potable Water)***	Primary AB
Carbazole	IL
Carbofuran (Furaden)	IL
Chlorobenzilate	IL
Chrysene	IL
Diallate	IL
Dibenz(a,h) anthracene	IL
Dibenz(a,j) acridine	IL
Dibenzofuran	IL
Diethyl phthalate	IL
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	IL
Fluoranthene	IL
Fluorene	IL
Hexachlorobenzene	IL
Hexachlorobutadiene	IL
Hexachlorocyclopentadiene	IL
Hexachloroethane	IL
Hexachlorophene	IL
Hexachloropropene	IL
Indeno(1,2,3-cd) pyrene	IL
Isodrin	IL
Isophorone	IL
Isosafrole	IL
Kepone	IL
Methapyrilene	IL
Methyl methanesulfonate	IL
Methyl parathion (Parathion, methyl)	IL
Naphthalene	IL
Nitrobenzene	IL
n-Nitrosodiethylamine	IL
n-Nitrosodimethylamine	IL
n-Nitroso-di-n-butylamine	IL
n-Nitrosodi-n-propylamine	IL
n-Nitrosodiphenylamine	IL
n-Nitrosomethylethylamine	IL
n-Nitrosomorpholine	IL
n-Nitrosopiperidine	IL
n-Nitrosopyrrolidine	IL
o,o,o-Triethyl phosphorothioate	IL
Parathion	IL
Pentachlorobenzene	IL
Pentachloronitrobenzene	IL
Pentachlorophenol	IL
Phenacetin	IL
Phenanthrene	IL
Phenol	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

	Primary AB
Field of Testing /Matrix: ***RCRA (Non Potable Water)***	
Phorate	IL
p-Phenylenediamine	IL
Pronamide (Kerb)	IL
Pyrene	IL
Pyridine	IL
Safrole	IL
Thionazin (Zinophos)	IL
Method 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
1,3-Dichlorobenzene	IL
1,3-Dinitrobenzene (1,3-DNB)	IL
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	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	IL
2,4-Dimethylphenol	IL
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	IL
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	IL
4-Aminobiphenyl	IL
4-Bromophenyl phenyl ether	IL
4-Chloro-3-methylphenol	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: ***RCRA (Non Potable Water)***

	Primary AB
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	IL
7,12-Dimethylbenz(a) anthracene	IL
a-a-Dimethylphenethylamine	IL
Acenaphthene	IL
Acenaphthylene	IL
Acetophenone	IL
Aniline	IL
Anthracene	IL
Aramite	IL
Benzidine	IL
Benzo(a)anthracene	IL
Benzo(a)pyrene	IL
Benzo(b)fluoranthene	IL
Benzo(g,h,i)perylene	IL
Benzo(k)fluoranthene	IL
Benzoic acid	IL
Benzyl alcohol	IL
bis(2-Chloroethoxy)methane	IL
bis(2-Chloroethyl) ether	IL
bis(2-Ethylhexyl) phthalate (DEHP)	IL
Butyl benzyl phthalate	IL
Carbazole	IL
Carbofuran (Furaden)	IL
Chlorobenzilate	IL
Chrysene	IL
Diallate	IL
Dibenz(a,h) anthracene	IL
Dibenz(a,j) acridine	IL
Dibenzofuran	IL
Diethyl phthalate	IL
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	IL
Fluoranthene	IL
Fluorene	IL
Hexachlorobenzene	IL
Hexachlorobutadiene	IL
Hexachlorocyclopentadiene	IL
Hexachloroethane	IL
Hexachlorophene	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: ***RCRA (Non Potable Water)***	Primary AB
Hexachloropropene	IL
Indeno(1,2,3-cd) pyrene	IL
Isodrin	IL
Isophorone	IL
Isosafrole	IL
Kepone	IL
Methapyrilene	IL
Methyl methanesulfonate	IL
Methyl parathion (Parathion, methyl)	IL
Naphthalene	IL
Nitrobenzene	IL
n-Nitrosodiethylamine	IL
n-Nitrosodimethylamine	IL
n-Nitroso-di-n-butylamine	IL
n-Nitrosodi-n-propylamine	IL
n-Nitrosodiphenylamine	IL
n-Nitrosomethylethylamine	IL
n-Nitrosomorpholine	IL
n-Nitrosopiperidine	IL
n-Nitrosopyrrolidine	IL
o,o,o-Triethyl phosphorothioate	IL
Parathion	IL
Pentachlorobenzene	IL
Pentachloronitrobenzene	IL
Pentachlorophenol	IL
Phenacetin	IL
Phenanthrene	IL
Phenol	IL
Phorate	IL
p-Phenylenediamine	IL
Pronamide (Kerb)	IL
Pyrene	IL
Pyridine	IL
Safrole	IL
Thionazin (Zinophos)	IL
Method **EPA 9012B**	
Cyanide	IL
Method **EPA 9014 Rev: 0**	
Cyanide	IL
Method **EPA 9034 Rev: 0**	
Sulfide	IL
Method **EPA 9038 Rev: 0**	
Sulfate	IL
Method **EPA 9040B Rev: 2**	
pH	IL
Method **EPA 9040C**	
pH	IL
Method **EPA 9050A Rev: 1**	
Conductivity	IL
Method **EPA 9056A**	

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7	Primary AB
Field of Testing /Matrix: ***RCRA (Non Potable Water)***	
Bromide	IL
Chloride	IL
Fluoride	IL
Nitrate	IL
Nitrite	IL
Orthophosphate as P	IL
Sulfate	IL
Method **EPA 9060A**	
Total organic carbon	IL
Method **EPA 9066 Rev: 0**	
Total phenolics	IL
Method **EPA 9071B**	
Oil & Grease	IL
Method **EPA 9095A**	
Paint Filter Test	IL
Method **EPA 9095B**	
Paint Filter Test	IL
Method **EPA 9251 Rev: 0**	
Chloride	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: *RCRA (Solid & Hazardous Material)*	Primary AB
Method EPA 1311 Rev: 0	
Toxicity Characteristic Leaching Procedure (TCLP)	IL
Method EPA 1312 Rev: 0	
Synthetic Precipitation Leaching Procedure (SPLP)	IL
Method EPA 6010B Rev: 2	
Aluminum	IL
Antimony	IL
Arsenic	IL
Barium	IL
Beryllium	IL
Boron	IL
Cadmium	IL
Calcium	IL
Chromium	IL
Cobalt	IL
Copper	IL
Iron	IL
Lead	IL
Lithium	IL
Magnesium	IL
Manganese	IL
Molybdenum	IL
Nickel	IL
Potassium	IL
Selenium	IL
Silica as SiO2	IL
Silver	IL
Sodium	IL
Strontium	IL
Thallium	IL
Tin	IL
Titanium	IL
Vanadium	IL
Zinc	IL
Method EPA 6010C	
Aluminum	IL
Antimony	IL
Arsenic	IL
Barium	IL
Beryllium	IL
Boron	IL
Cadmium	IL
Calcium	IL
Chromium	IL
Cobalt	IL
Copper	IL
Iron	IL
Lead	IL
Lithium	IL
Magnesium	IL
Manganese	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: *RCRA (Solid & Hazardous Material)*	Primary AB
Molybdenum	IL
Nickel	IL
Potassium	IL
Selenium	IL
Silica as SiO2	IL
Silver	IL
Sodium	IL
Strontium	IL
Thallium	IL
Tin	IL
Titanium	IL
Vanadium	IL
Zinc	IL
Method **EPA 7196A Rev: 1**	
Chromium VI	IL
Method **EPA 7471B**	
Mercury	IL
Method **EPA 8015B Rev: 2**	
Diesel range organics (DRO)	IL
Gasoline range organics (GRO)	IL
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
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	IL
Atrazine	IL
beta-BHC (beta-Hexachlorocyclohexane)	IL
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	IL
Heptachlor	IL
Heptachlor epoxide	IL
Isodrin	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7 | Primary AB

Field of Testing /Matrix: ***RCRA (Solid & Hazardous Material)***

Kepone	IL
Methoxychlor	IL
Simazine	IL
Toxaphene (Chlorinated camphene)	IL
Method EPA 8081B	
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	IL
Atrazine	IL
beta-BHC (beta-Hexachlorocyclohexane)	IL
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	IL
Heptachlor	IL
Heptachlor epoxide	IL
Isodrin	IL
Kepone	IL
Methoxychlor	IL
Simazine	IL
Toxaphene (Chlorinated camphene)	IL
Method EPA 8082 Rev: 0	
Aroclor-1016 (PCB-1016)	IL
Aroclor-1221 (PCB-1221)	IL
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
Method EPA 8082A	
Aroclor-1016 (PCB-1016)	IL
Aroclor-1221 (PCB-1221)	IL
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
Method EPA 8151A	
2,4,5-T	IL
2,4-D	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7 Primary AB

Field of Testing /Matrix: ***RCRA (Solid & Hazardous Material)***

2,4-DB	IL
Dalapon	IL
Dicamba	IL
Dichloroprop (Dichlorprop)	IL
Pentachlorophenol	IL
Picloram	IL
Silvex (2,4,5-TP)	IL

Method **EPA 8260B**

1,1,1,2-Tetrachloroethane	IL
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	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	IL
1,3,5-Trichlorobenzene	IL
1,3,5-Trimethylbenzene	IL
1,3-Dichlorobenzene	IL
1,3-Dichloropropane	IL
1,4-Dichlorobenzene	IL
1,4-Dioxane (1,4- Diethyleneoxide)	IL
1-Chlorohexane	IL
2,2-Dichloropropane	IL
2-Butanone (Methyl ethyl ketone, MEK)	IL
2-Chloroethyl vinyl ether	IL
2-Chlorotoluene	IL
2-Hexanone	IL
2-Methylnaphthalene	IL
2-Nitropropane	IL
4-Chlorotoluene	IL
4-Isopropyltoluene (p-Cymene,p-Isopropyltoluene)	IL
4-Methyl-2-pentanone (MIBK)	IL
Acetone	IL
Acetonitrile	IL
Acrolein (Propenal)	IL
Acrylonitrile	IL
Allyl chloride (3-Chloropropene)	IL
Benzene	IL
Benzyl chloride	IL
Bromobenzene	IL
Bromochloromethane	IL
Bromodichloromethane	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: ***RCRA (Solid & Hazardous Material)***

	Primary AB
Bromoform	IL
Carbon disulfide	IL
Carbon tetrachloride	IL
Chlorobenzene	IL
Chlorodibromomethane	IL
Chloroethane (Ethyl chloride)	IL
Chloroform	IL
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
Iodomethane (Methyl iodide)	IL
Isobutyl alcohol (2-Methyl-1-propanol)	IL
Isopropyl alcohol (2-Propanol, Isopropanol)	IL
Isopropylbenzene	IL
m+p-xylene	IL
Methacrylonitrile	IL
Methyl bromide (Bromomethane)	IL
Methyl chloride (Chloromethane)	IL
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	IL
tert-Butylbenzene	IL
Tetrachloroethylene (Perchloroethylene)	IL
Tetrahydrofuran (THF)	IL
Toluene	IL
trans-1,2-Dichloroethylene	IL
trans-1,3-Dichloropropylene	IL
trans-1,4-Dichloro-2-butene	IL
Trichloroethene (Trichloroethylene)	IL
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	IL
Vinyl acetate	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

	Primary AB
Field of Testing /Matrix: ***RCRA (Solid & Hazardous Material)***	
Vinyl chloride	IL
Xylene (total)	IL
Method EPA 8270C Rev: 3	
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
1,3-Dichlorobenzene	IL
1,3-Dinitrobenzene (1,3-DNB)	IL
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	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	IL
2,4-Dimethylphenol	IL
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	IL
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	IL
4-Aminobiphenyl	IL
4-Bromophenyl phenyl ether	IL
4-Chloro-3-methylphenol	IL
4-Chloroaniline	IL
4-Chlorophenyl phenylether	IL
4-Dimethyl aminoazobenzene	IL
4-Methylphenol (p-Cresol)	IL
4-Nitroaniline	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: *RCRA (Solid & Hazardous Material)*	Primary AB
4-Nitrophenol	IL
4-Nitroquinoline 1-oxide	IL
5-Nitro-o-toluidine	IL
7,12-Dimethylbenz(a) anthracene	IL
a-a-Dimethylphenethylamine	IL
Acenaphthene	IL
Acenaphthylene	IL
Acetophenone	IL
Aniline	IL
Anthracene	IL
Aramite	IL
Benzidine	IL
Benzo(a)anthracene	IL
Benzo(a)pyrene	IL
Benzo(b)fluoranthene	IL
Benzo(g,h,i)perylene	IL
Benzo(k)fluoranthene	IL
Benzoic acid	IL
Benzyl alcohol	IL
bis(2-Chloroethoxy)methane	IL
bis(2-Chloroethyl) ether	IL
bis(2-Ethylhexyl) phthalate (DEHP)	IL
Butyl benzyl phthalate	IL
Carbazole	IL
Carbofuran (Furaden)	IL
Chlorobenzilate	IL
Chrysene	IL
Diallate	IL
Dibenz(a,h) anthracene	IL
Dibenz(a,j) acridine	IL
Dibenzofuran	IL
Diethyl phthalate	IL
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	IL
Fluoranthene	IL
Fluorene	IL
Hexachlorobenzene	IL
Hexachlorobutadiene	IL
Hexachlorocyclopentadiene	IL
Hexachloroethane	IL
Hexachlorophene	IL
Hexachloropropene	IL
Indeno(1,2,3-cd) pyrene	IL
Isodrin	IL
Isophorone	IL
Isosafrole	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

	Primary AB
Field of Testing /Matrix: ***RCRA (Solid & Hazardous Material)***	
Kepone	IL
Methapyrilene	IL
Methyl methanesulfonate	IL
Methyl parathion (Parathion, methyl)	IL
Naphthalene	IL
Nitrobenzene	IL
n-Nitrosodiethylamine	IL
n-Nitrosodimethylamine	IL
n-Nitroso-di-n-butylamine	IL
n-Nitrosodi-n-propylamine	IL
n-Nitrosodiphenylamine	IL
n-Nitrosomethylethylamine	IL
n-Nitrosomorpholine	IL
n-Nitrosopiperidine	IL
n-Nitrosopyrrolidine	IL
o,o,o-Triethyl phosphorothioate	IL
Parathion	IL
Pentachlorobenzene	IL
Pentachloronitrobenzene	IL
Pentachlorophenol	IL
Phenacetin	IL
Phenanthrene	IL
Phenol	IL
Phorate	IL
p-Phenylenediamine	IL
Pronamide (Kerb)	IL
Pyrene	IL
Pyridine	IL
Safrole	IL
Thionazin (Zinophos)	IL
Method 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
1,3-Dichlorobenzene	IL
1,3-Dinitrobenzene (1,3-DNB)	IL
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	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	IL
2,4-Dimethylphenol	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

	Primary AB
Field of Testing /Matrix: ***RCRA (Solid & Hazardous Material)***	
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	IL
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	IL
4-Aminobiphenyl	IL
4-Bromophenyl phenyl ether	IL
4-Chloro-3-methylphenol	IL
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	IL
7,12-Dimethylbenz(a) anthracene	IL
a-a-Dimethylphenethylamine	IL
Acenaphthene	IL
Acenaphthylene	IL
Acetophenone	IL
Aniline	IL
Anthracene	IL
Aramite	IL
Benzidine	IL
Benzo(a)anthracene	IL
Benzo(a)pyrene	IL
Benzo(b)fluoranthene	IL
Benzo(g,h,i)perylene	IL
Benzo(k)fluoranthene	IL
Benzoic acid	IL
Benzyl alcohol	IL
bis(2-Chloroethoxy)methane	IL
bis(2-Chloroethyl) ether	IL
bis(2-Ethylhexyl) phthalate (DEHP)	IL
Butyl benzyl phthalate	IL
Carbazole	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

Field of Testing /Matrix: ***RCRA (Solid & Hazardous Material)***

	Primary AB
Carbofuran (Furaden)	IL
Chlorobenzilate	IL
Chrysene	IL
Diallate	IL
Dibenz(a,h) anthracene	IL
Dibenz(a,j) acridine	IL
Dibenzofuran	IL
Diethyl phthalate	IL
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	IL
Fluoranthene	IL
Fluorene	IL
Hexachlorobenzene	IL
Hexachlorobutadiene	IL
Hexachlorocyclopentadiene	IL
Hexachloroethane	IL
Hexachlorophene	IL
Hexachloropropene	IL
Indeno(1,2,3-cd) pyrene	IL
Isodrin	IL
Isophorone	IL
Isosafrole	IL
Kepone	IL
Methapyrilene	IL
Methyl methanesulfonate	IL
Methyl parathion (Parathion, methyl)	IL
Naphthalene	IL
Nitrobenzene	IL
n-Nitrosodiethylamine	IL
n-Nitrosodimethylamine	IL
n-Nitroso-di-n-butylamine	IL
n-Nitrosodi-n-propylamine	IL
n-Nitrosodiphenylamine	IL
n-Nitrosomethylethylamine	IL
n-Nitrosomorpholine	IL
n-Nitrosopiperidine	IL
n-Nitrosopyrrolidine	IL
o,o,o-Triethyl phosphorothioate	IL
Parathion	IL
Pentachlorobenzene	IL
Pentachloronitrobenzene	IL
Pentachlorophenol	IL
Phenacetin	IL
Phenanthrene	IL
Phenol	IL
Phorate	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

Certificate No.: 1002012020-7

	Primary AB
Field of Testing /Matrix: ***RCRA (Solid & Hazardous Material)***	
p-Phenylenediamine	IL
Pronamide (Kerb)	IL
Pyrene	IL
Pyridine	IL
Safrole	IL
Thionazin (Zinophos)	IL
Method **EPA 9012B**	
Cyanide	IL
Method **EPA 9014 Rev: 0**	
Cyanide	IL
Method **EPA 9034 Rev: 0**	
Sulfide	IL
Method **EPA 9045C Rev: 3**	
pH	IL
Method **EPA 9045D**	
pH	IL
Method **EPA 9050A Rev: 1**	
Conductivity	IL
Method **EPA 9056A**	
Bromide	IL
Chloride	IL
Fluoride	IL
Nitrate	IL
Nitrite	IL
Orthophosphate as P	IL
Sulfate	IL
Method **EPA 9060A**	
Total organic carbon	IL
Method **EPA 9066 Rev: 0**	
Total phenolics	IL
Method **EPA 9071B**	
Oil & Grease	IL
Method **EPA 9095A**	
Paint Filter Test	IL
Method **EPA 9095B**	
Paint Filter Test	IL
Method **EPA 9251 Rev: 0**	
Chloride	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

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	IL
Barium	IL
Beryllium	IL
Cadmium	IL
Calcium	IL
Chromium	IL
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	IL
Arsenic	IL
Barium	IL
Beryllium	IL
Cadmium	IL
Chromium	IL
Copper	IL
Lead	IL
Manganese	IL
Molybdenum	IL
Nickel	IL
Selenium	IL
Silver	IL
Thallium	IL
Zinc	IL
Method EPA 245.1 Rev: 3	
Mercury	IL
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
Nitrate plus Nitrite as N	IL

Attachment 10: Eurofins TestAmerica Chicago Laboratory Accreditation (cont.)

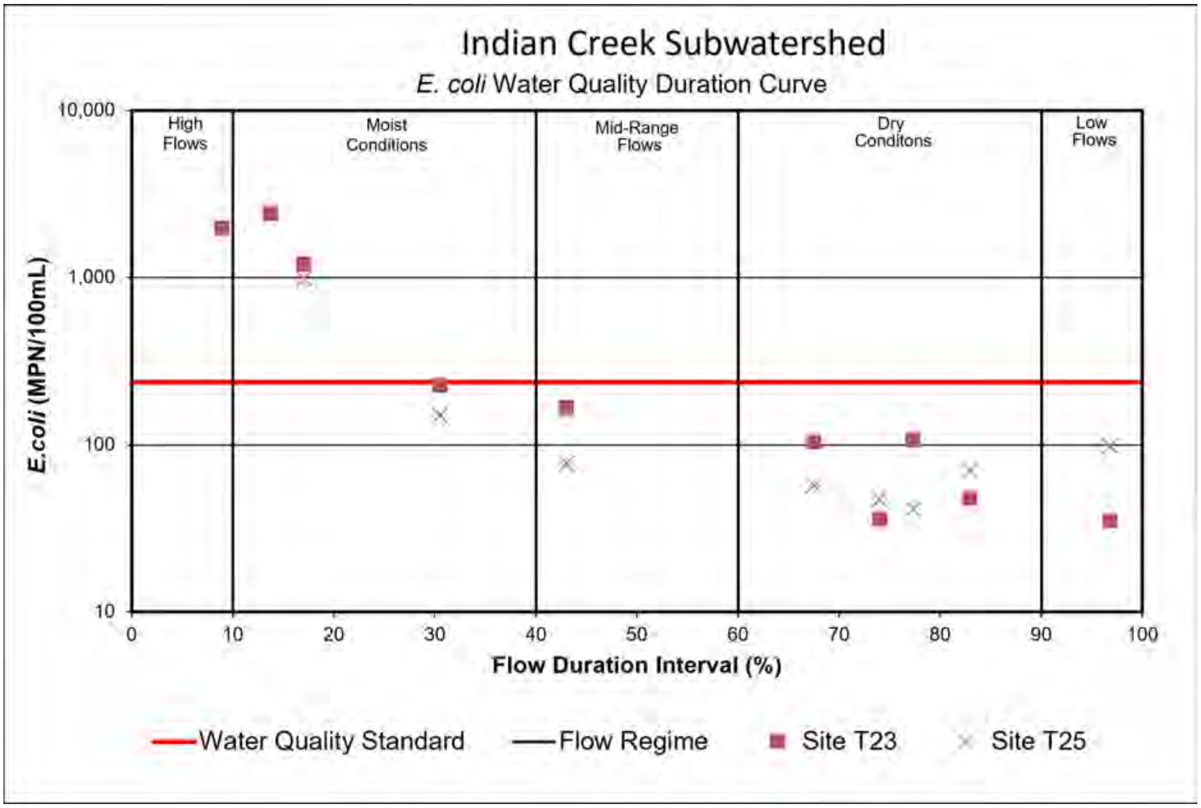
Certificate No.: 1002012020-7

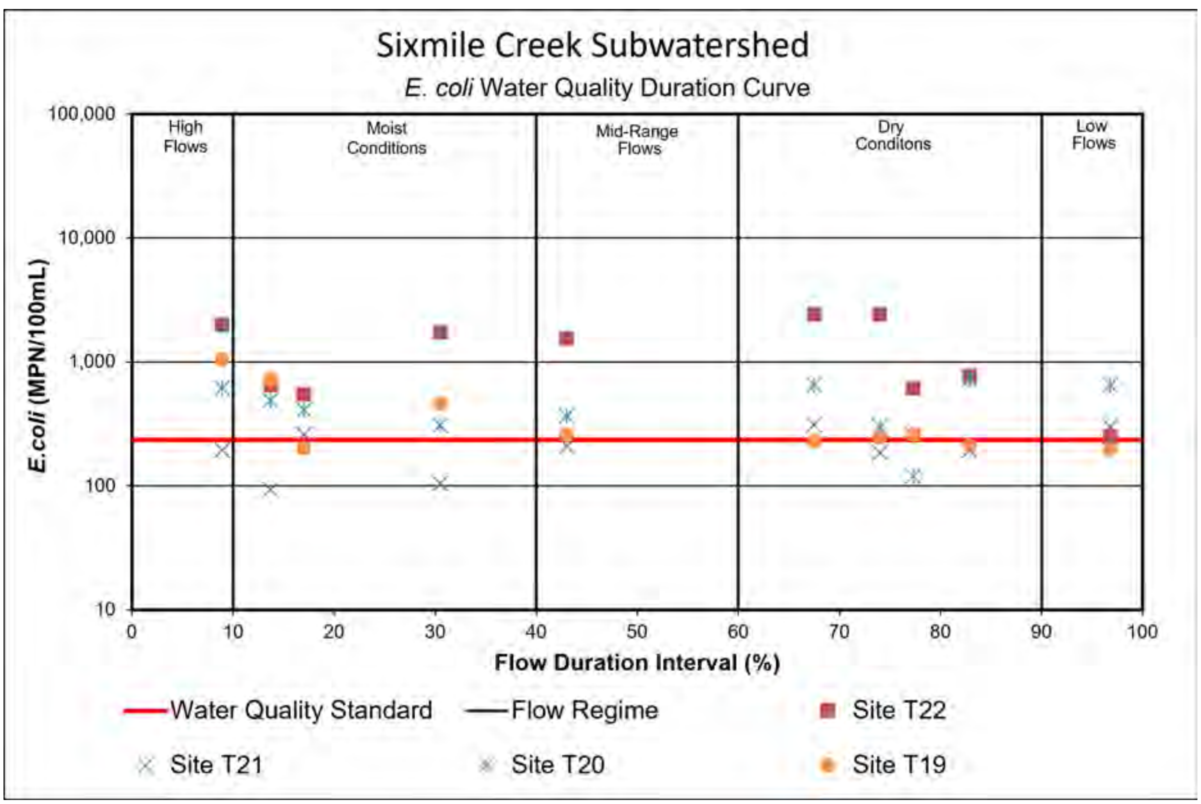
Field of Testing /Matrix: *SDWA (Potable Water)*	Primary AB
Method **SM 2320 B-1997 Rev: 20th ED**	
Alkalinity as CaCO3	IL
Method **SM 2340 B-1997 Rev: 20th ED**	
Hardness	IL
Method **SM 2510 B-1997 Rev: 20th ED**	
Conductivity	IL
Method **SM 2540 C-1997 Rev: 20th ED**	
Total dissolved solids	IL
Method **SM 4500-Cl F-1993 Rev: 20th ED**	
Chlorine	IL
Method **SM 4500-CN¯ E-1997 Rev: 20th ED**	
Cyanide	IL
Method **SM 4500-F¯ C-1997 Rev: 20th ED**	
Fluoride	IL
Method **SM 4500-H+ B-1996 Rev: 20th ED**	
pH	IL
Method **SM 4500-NO2¯ B-1993 Rev: 20th ED**	
Nitrite	IL
Method **SM 4500-NO3¯ F-1997 Rev: 20th ED**	
Nitrate	IL
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)	IL
Total organic carbon	IL
Method **SM 5310 C Rev: 20th ED**	
Dissolved organic carbon (DOC)	IL
Total organic carbon	IL

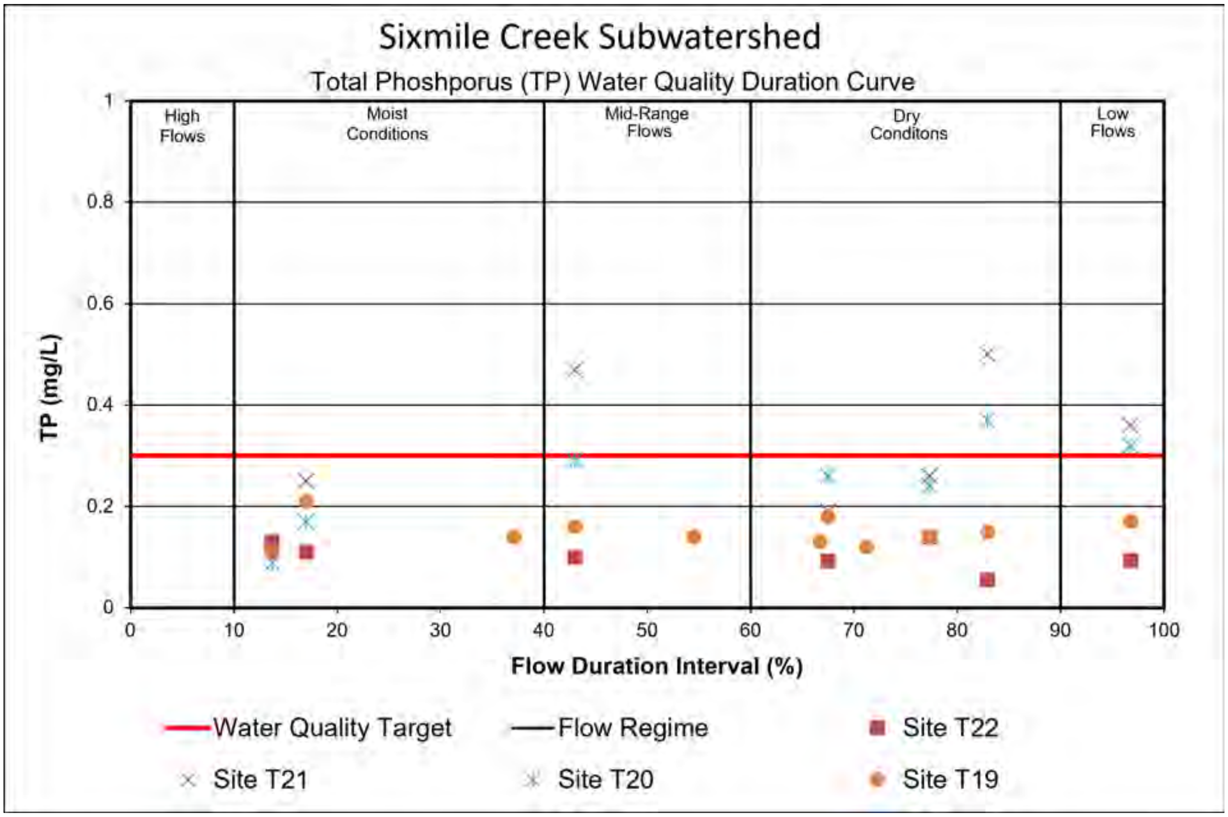
End of Scope of Accreditation

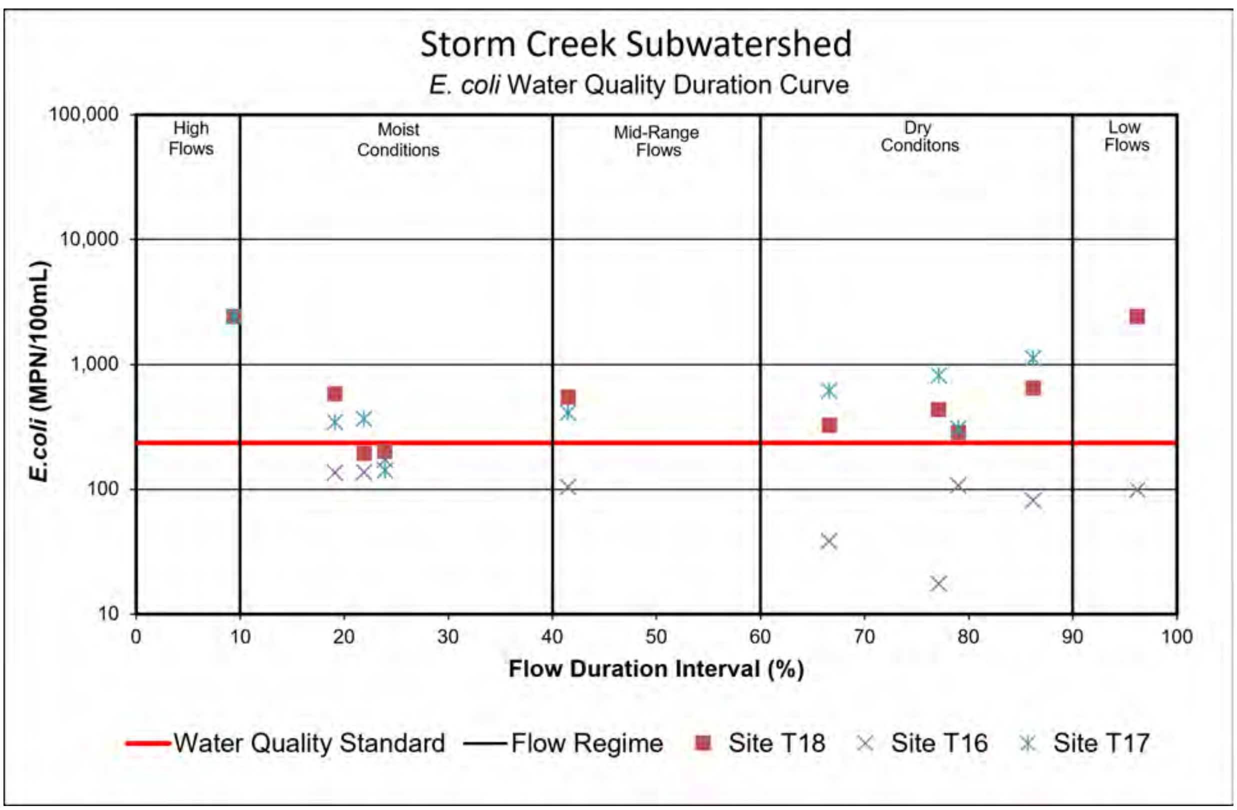
Page 34 of 34

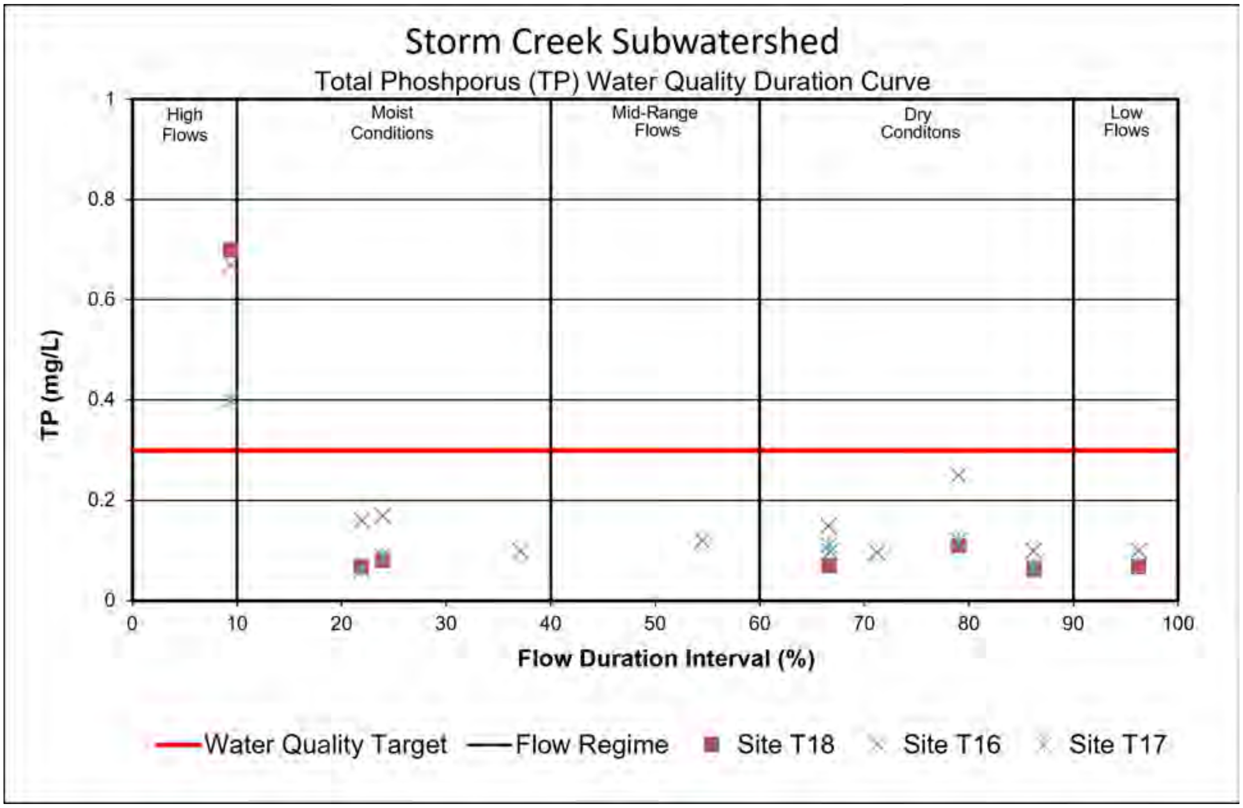
APPENDIX F. WATER QUALITY DURATION GRAPHS FOR THE VERNON FORK MUSCATATUCK RIVER WATERSHED

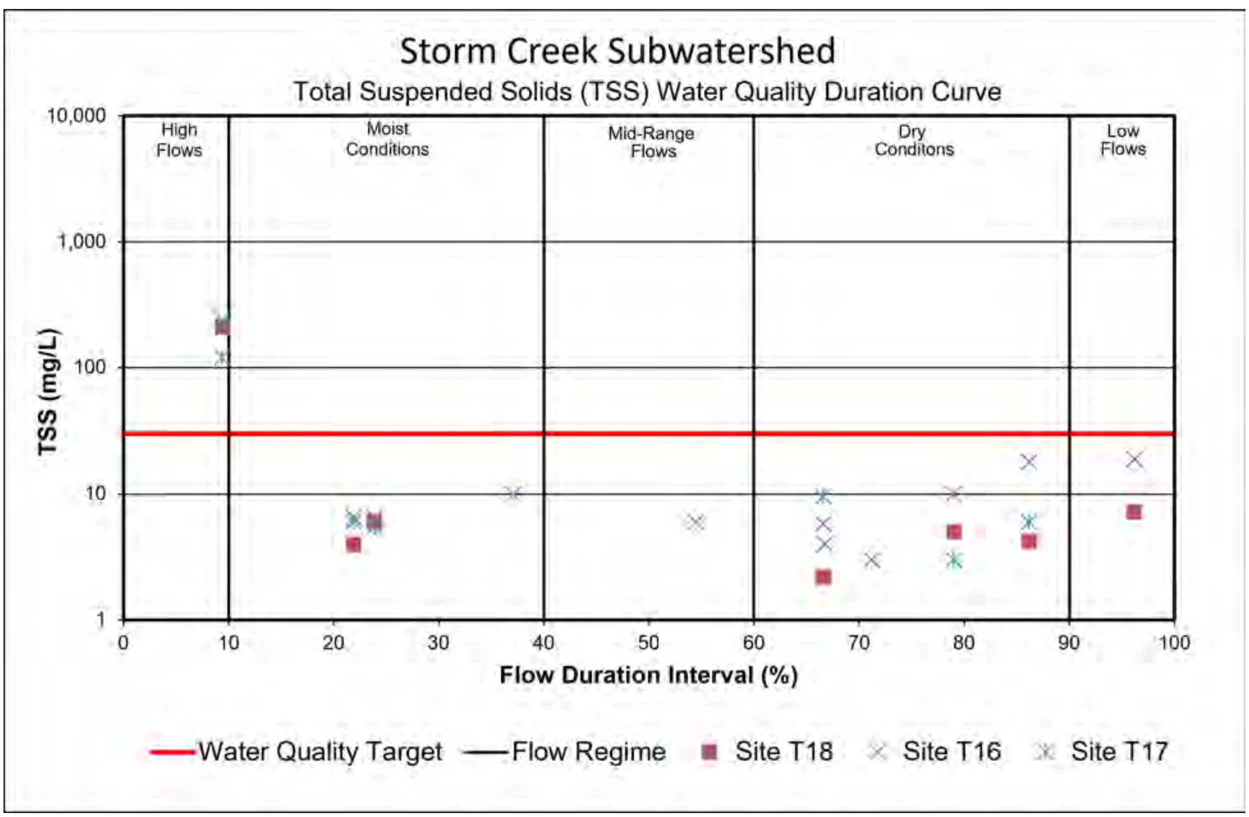

Indian Creek Subwatershed
E. coli Water Quality Duration Curve
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
E.coli (MPN/100mL)
10,000
1,000
100
10
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
Water Quality Standard
Flow Regime
Site T23
Site T25

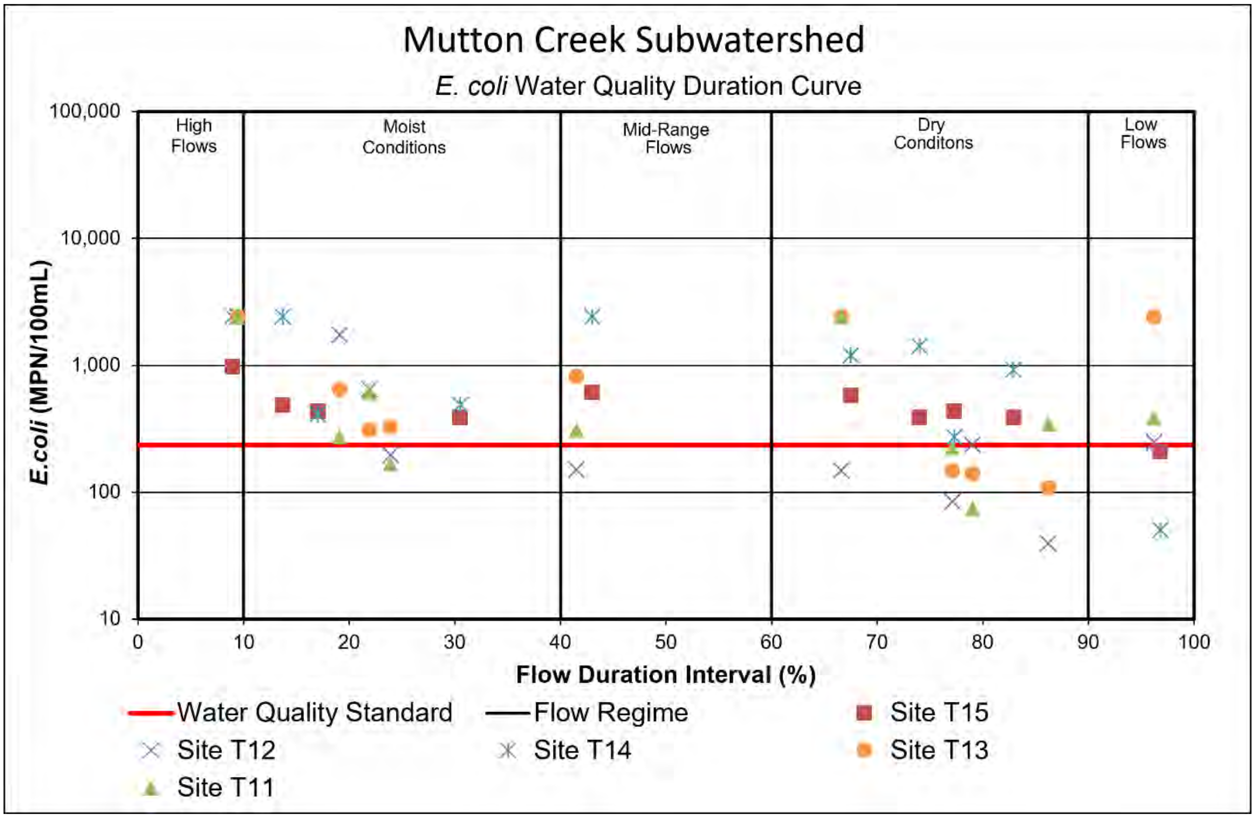

Sixmile Creek Subwatershed
E. coli Water Quality Duration Curve
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
E.coli (MPN/100mL)
100,000
10,000
1,000
100
10
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
Water Quality Standard
Flow Regime
Site T22
Site T21
Site T20
Site T19

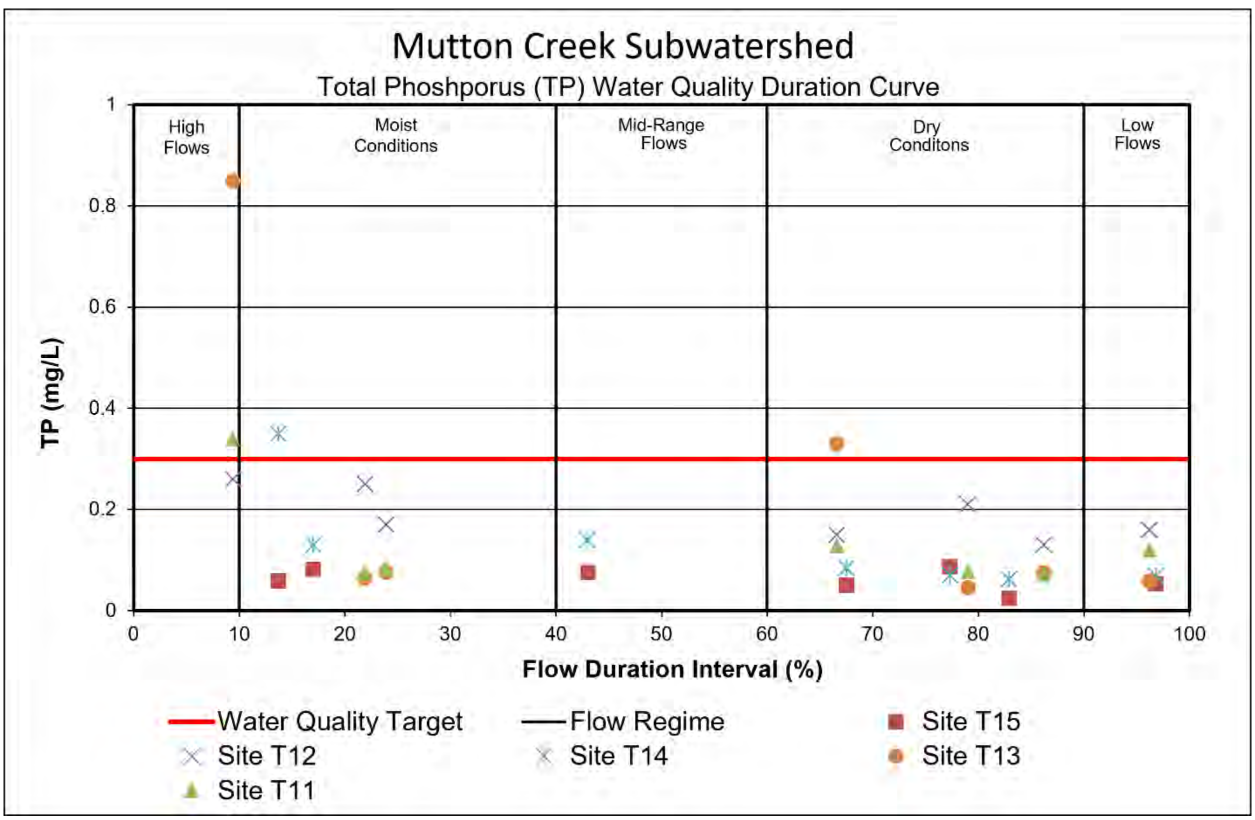

Sixmile Creek Subwatershed
Total Phoshporus (TP) Water Quality Duration Curve
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
TP (mg/L)
Flow Duration Interval (%)
Water Quality Target
Flow Regime
Site T22
Site T21
Site T20
Site T19

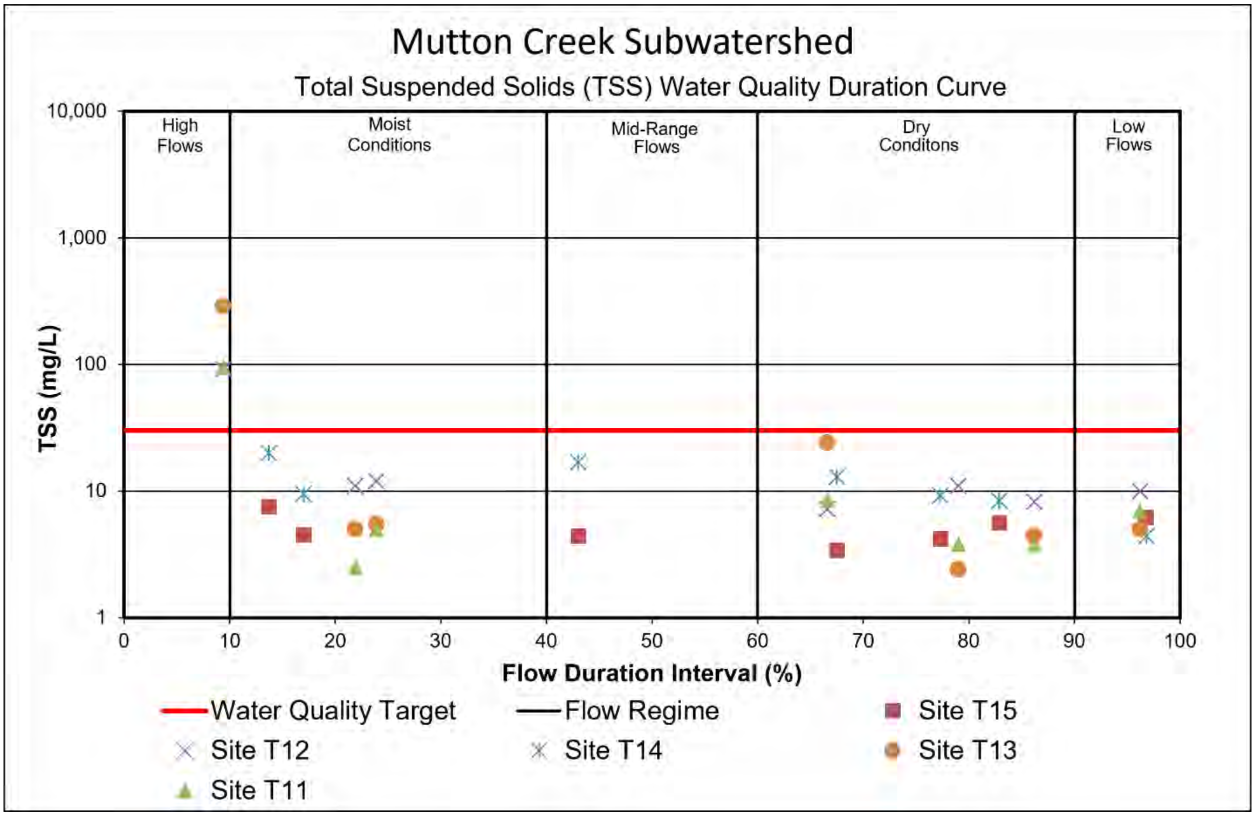

Storm Creek Subwatershed
E. coli Water Quality Duration Curve
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
E.coli (MPN/100mL)
Flow Duration Interval (%)
Water Quality Standard
Flow Regime
Site T18
Site T16
Site T17


Storm Creek Subwatershed
Total Phosphorus (TP) Water Quality Duration Curve
TP (mg/L)
Flow Duration Interval (%)
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50
60
70
80
90
100
Water Quality Target
Flow Regime
Site T18
Site T16
Site T17

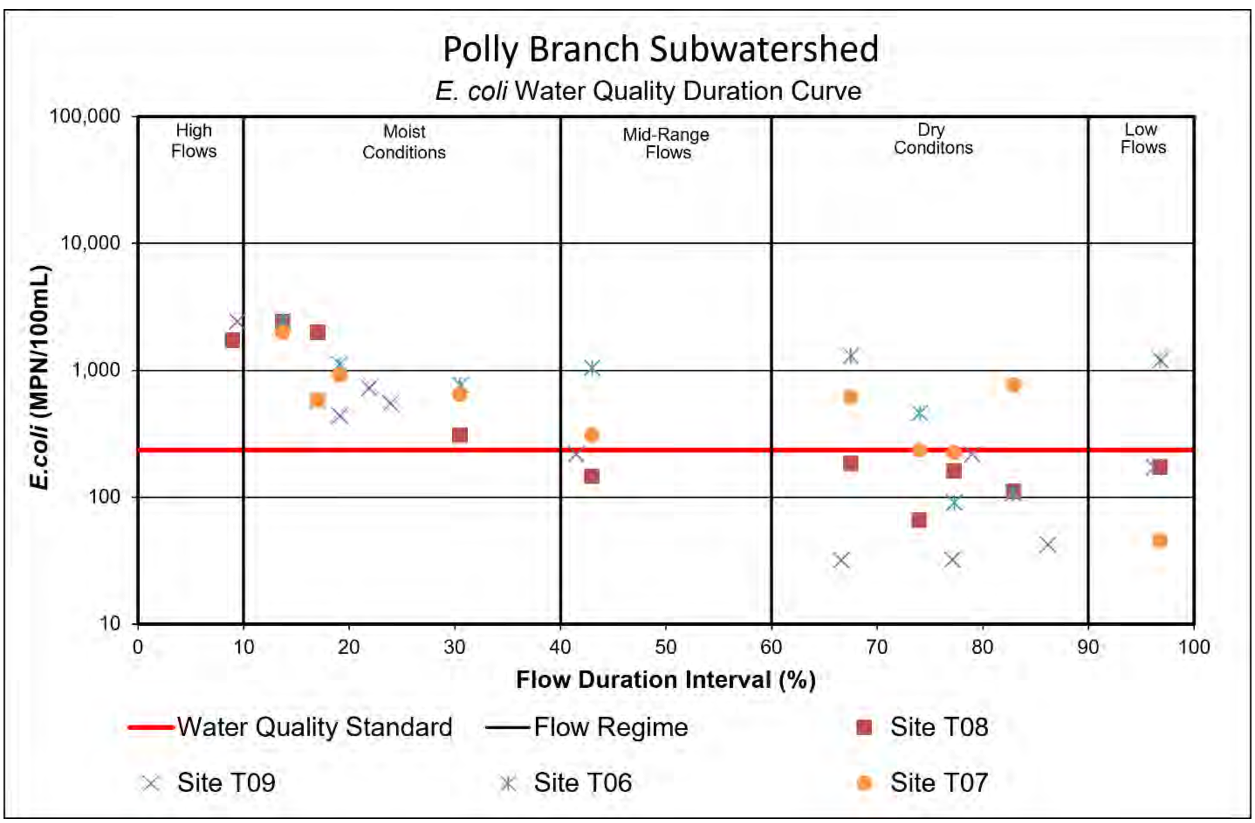

Storm Creek Subwatershed
Total Suspended Solids (TSS) Water Quality Duration Curve
TSS (mg/L)
Flow Duration Interval (%)
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
1
10
100
1,000
10,000
0
10
20
30
40
50
60
70
80
90
100
Water Quality Target
Flow Regime
Site T18
Site T16
Site T17


Mutton Creek Subwatershed
E. coli Water Quality Duration Curve
100,000
10,000
1,000
100
10
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
E.coli (MPN/100mL)
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
Water Quality Standard
Flow Regime
Site T15
Site T12
Site T14
Site T13
Site T11

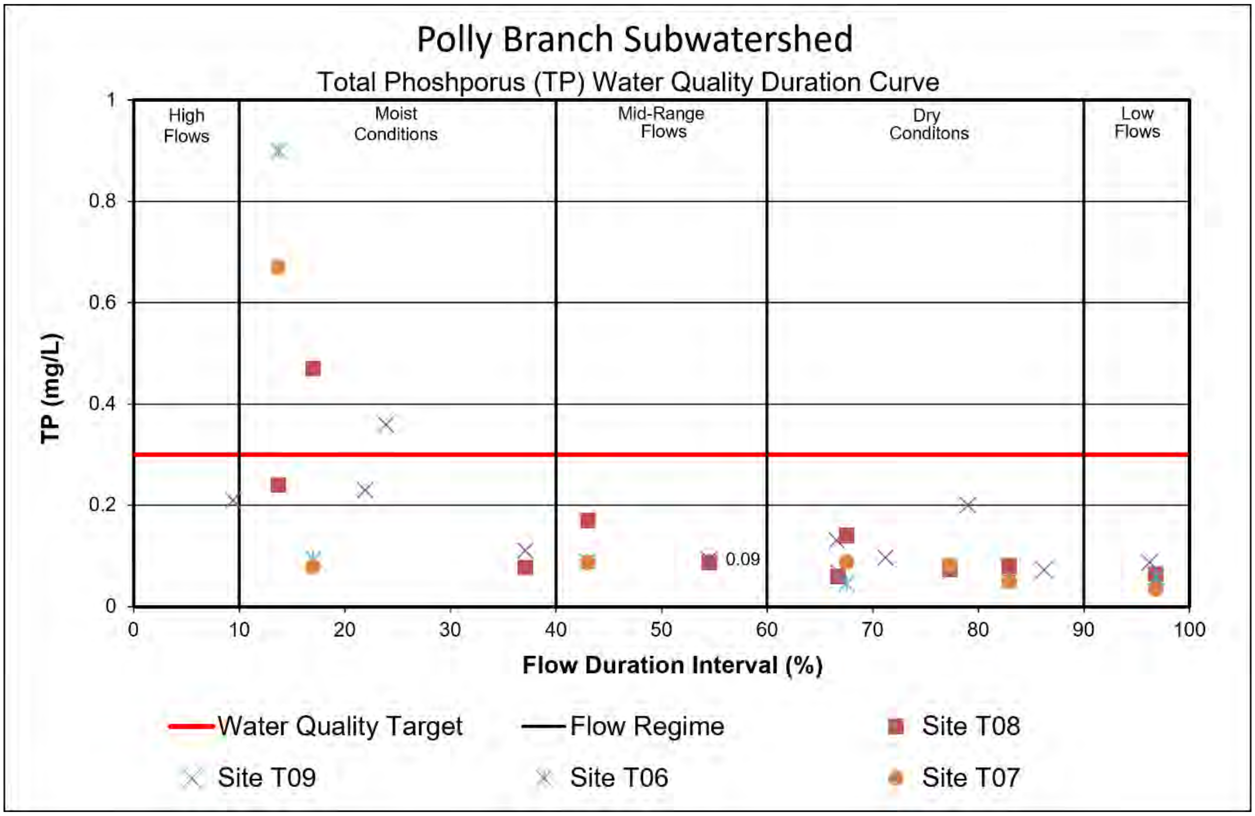

Mutton Creek Subwatershed
Total Phosphorus (TP) Water Quality Duration Curve
1
0.8
0.6
0.4
0.2
0
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
TP (mg/L)
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
Water Quality Target
Flow Regime
Site T15
Site T12
Site T14
Site T13
Site T11

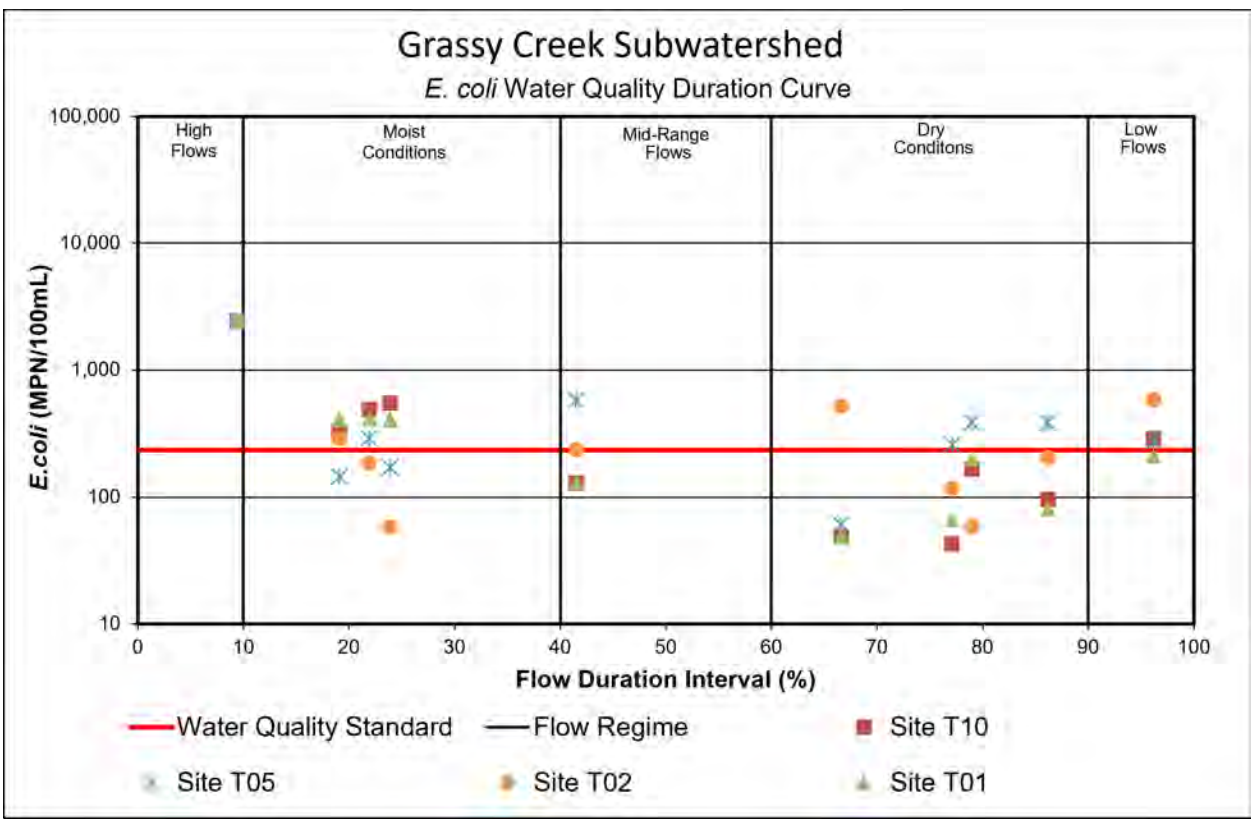


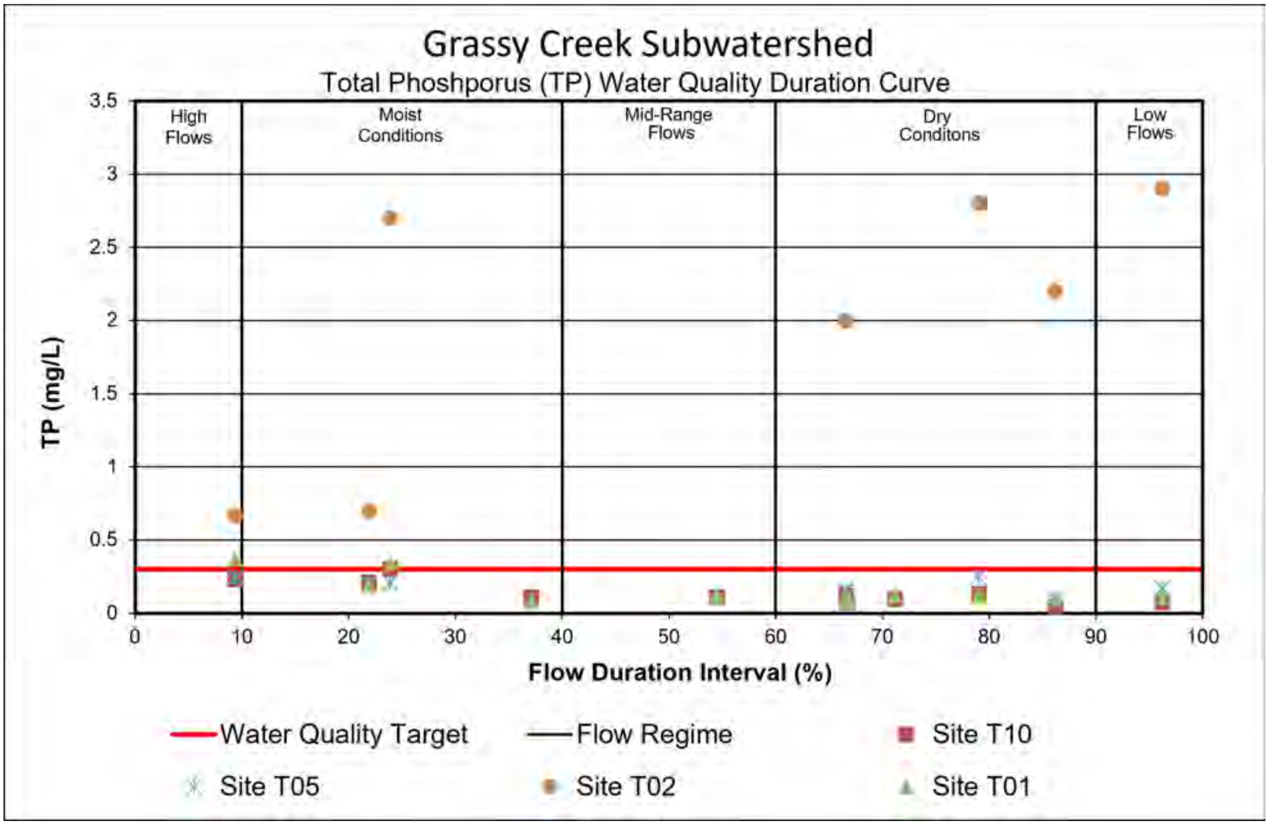
Mutton Creek Subwatershed
Total Suspended Solids (TSS) Water Quality Duration Curve
TSS (mg/L)
10,000
1,000
100
10
1
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
Water Quality Target
Flow Regime
Site T15
Site T12
Site T14
Site T13
Site T11



Polly Branch Subwatershed
E. coli Water Quality Duration Curve
E.coli (MPN/100mL)
100,000
10,000
1,000
100
10
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
Water Quality Standard
Flow Regime
Site T08
Site T09
Site T06
Site T07


Polly Branch Subwatershed
Total Phosphorus (TP) Water Quality Duration Curve
TP (mg/L)
1
0.8
0.6
0.4
0.2
0
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
0.09
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
Water Quality Target
Flow Regime
Site T08
Site T09
Site T06
Site T07


Grassy Creek Subwatershed
E. coli Water Quality Duration Curve
E.coli (MPN/100mL)
100,000
10,000
1,000
100
10
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
Water Quality Standard
Flow Regime
Site T10
Site T05
Site T02
Site T01



Grassy Creek Subwatershed
Total Phoshporus (TP) Water Quality Duration Curve
High Flows
Moist Conditions
Mid-Range Flows
Dry Conditons
Low Flows
TP (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
0
10
20
30
40
50
60
70
80
90
100
Flow Duration Interval (%)
Water Quality Target
Flow Regime
Site T10
Site T05
Site T02
Site T01

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.

<u>Overview of Facilities</u>

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.

<u>Wasteload Allocations (WLAs)</u>

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.

Table 1: Individual WLAs for NPDES Municipal and Industrial Facilities in the Vernon Fork Muscatatuck River Watershed

Subwatershed	Facility Name	Permit Number	AUID	Receiving Stream	Flow Regime	Estimated Design Flow (MGD)	*E. coli* WLA (MPN/day)	NPDES Permit *E. coli* Limit	TSS WLA (lbs/day)	NPDES Permit TSS Limit	TP WLA (lbs/day)	NPDES Permit TP Limit
Grassy Creek	Crothersville WWTP	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
					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

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 *E. coli* WLA (MPN/day)	Moist Flow Regime *E. coli* WLA (MPN/day)	High Flow Regime TSS WLA (mg/L)	Moist Flow Regime TSS WLA (mg/L)	High Flow Regime TP 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