

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY
WATER RESOURCES DIVISION
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STAFF REPORT

Biological Surveys of Selected Stations in the Black River and Belle River
Watersheds in Lapeer, Sanilac, and St. Clair Counties, Michigan
July-September 2017

Introduction

Biological and physical habitat conditions of selected water bodies in the Black River and Belle River watersheds in Lapeer, Sanilac, and St. Clair Counties were assessed by staff of the Michigan Department of Environment, Great Lakes, and Energy (EGLE)¹, Water Resources Division (WRD), Surface Water Assessment Section (SWAS), in July-September 2017. The primary objectives of the assessments were to:

- 1) Assess the current status and condition of individual water bodies and determine if Michigan Water Quality Standards (WQS) are being met.
- 2) Evaluate biological community temporal trends.
- 3) Identify nonpoint sources (NPS) of water quality impairment.

Watershed Information

The Black River and Belle River watersheds are warmwater streams (Michigan Department of Natural Resources [MDNR], 1997) that originate approximately 114 and 97 miles, respectively, upstream from their confluence with the St. Clair River. These watersheds have areas of approximately 710 and 227 square miles, respectively, and they, along with the Pine River (219 square miles), are sometimes collectively referred to as the St. Clair tributaries² watershed group by the SWAS. (*Note: The Pine River is also in this watershed group; however, there were no statewide status or targeted monitoring sites selected in this subwatershed in 2017.*)

These watersheds are located primarily in the Sandusky Lake Plain subsection ecosystem, which consists of clay lake plain and reworked till plain and has mesic to wet-mesic forests, swamp forest, wet and wet-mesic prairie, and emergent marshes (Albert, 1995). This region is a "... flat lake plain that slopes gradually to Lake Huron; a narrow moraine that parallels the shore of Saginaw Bay and Lake Huron occupies the center of the narrow subsection. Agricultural development has been intensive as a result of a lake-modified climate and productive loamy soils;" (e.g., the growing season here is longer and warmer than other parts of Michigan such as the northern

¹ Known as the Michigan Department of Environmental Quality (MDEQ) prior to April 2019.

² The United States Geological Survey's (USGS) 10-digit Hydrologic Unit Code (HUC) numbers for the watersheds in this report are 0409000101 and 0409000102 (Black River) and 0409000104 (Belle River). These watersheds are part of the St. Clair watershed (8-digit HUC 04090001).

Lower Peninsula and the Upper Peninsula [Albert, 1995]). A portion of the lower Belle River is located in the Maumee Lake Plain subsection ecosystem, which is a flat, clay lake plain dissected by broad glacial drainageways of sandy soil. The area contains beech-sugar maple forest, elm-ash forest, deciduous swamp, white oak-black oak savannas, wet prairies, and coastal marshes. It also has favorable conditions (e.g., “lake-moderated climate and productive loamy soils”) that resulted in early and intensive agricultural development (Albert, 1995).

Most (i.e., 8 of 12) biosurvey stations (including a nonwadeable station on the Black River [Station NW-1]) were located within the Southern Michigan Northern Indiana Till Plains (SMNITP) ecoregion, while 4 stations in the northeastern portion of the Black River watershed were located within the Huron Erie Lake Plain (HELP) ecoregion. (Descriptions of ecoregions can be found in Omernik and Gallant [1988, 2010]; see also United States Environmental Protection Agency [USEPA], 2021.)

Land use within the St. Clair tributaries watershed region is dominated by cultivated agriculture, with natural-terrestrial and hay/pasture land use types making up the second- and third-most prevalent land uses (Table 1).

Table 1. Land use summary for the St. Clair tributaries watershed region. Original source of data: 2011 National Land Cover Database (NLCD) (Multi-Resolution Land Characteristics [MRLC], 2014).

Watershed	Cultivated Agriculture	Hay or Pasture	Developed	Natural-Terrestrial	Open Water or Wetlands	Barren Land (Rock/Sand/Clay)
St. Clair tributaries	47%	14%	10%	20%	9%	0.3%

Historical Sampling Efforts and Information

The most recent surveys of tributaries draining to the St. Clair River were conducted in 2012-2013 (Varricchione, 2014), 2007 (Schmitt, 2008), and 2002 (Goodwin, 2007). In 2012-2013, macroinvertebrate community conditions ranged from poor to excellent, with 8 (19.5 percent) out of 41 stations rating as poor (Varricchione, 2014). Fish communities were sampled at two locations on the North Branch of the Belle River, with both scoring acceptable (Varricchione, 2014). A summary of historical survey work in the St. Clair tributaries watershed region can be found in Varricchione (2014).

Methods

Wadeable Sites

Macroinvertebrate community and physical habitat conditions were qualitatively assessed at 11 wadeable stations in 2017 (Table 2, Figure 1) using the SWAS Procedure 51 (MDEQ, 1990), a rapid bioassessment tool. If a wadeable station was at a road crossing, it was sampled upstream unless noted otherwise. Procedure 51 assigns a score to macroinvertebrate communities and habitat conditions using metrics that rate macroinvertebrates as Excellent (+9 to +5), Acceptable (+4 to -4), or Poor (-5 to -9) based on the macroinvertebrate community composition and structure, and habitat as Excellent (>54), Good (154 to 105), Marginal (104 to 56), or Poor (<56) based

on several parameters that describe in-stream and riparian conditions (Creal et al., 1996). Negative macroinvertebrate scores in the acceptable range are considered tending towards a poor rating, while positive scores in the acceptable range are tending towards an excellent rating.

Nonwadeable Site

Macroinvertebrate community and physical habitat conditions were assessed at one nonwadeable station on the Black River (Table 2, Figure 1) using SWAS Procedure 22 (MDEQ, 2013). The range of scores possible for nonwadeable macroinvertebrate community metrics (using Procedure 22) is 0-100, with scores from 25-100 typically representing communities having better than poor conditions (i.e., fair, good, or excellent).

Site Selection

Typically, two site selection methods are used to assess watersheds: (1) stratified random; and (2) targeted. Within the St. Clair River Tributaries Watershed Group, 12 randomly selected sites were chosen to support the SWAS Status (7 sites) and Trend (5 sites) Program. Status sites are randomly chosen each basin cycle to allow extrapolation of results statewide, whereas trend sites were originally randomly chosen and are now fixed to allow evaluation of changes over time (trend sites will be resampled every five years). All sites will be used, in part, to determine attainment status for the Other Indigenous Aquatic Life and Wildlife (OIALW) designated use component of Rule 100 (R 323.1100(e)) of the [Part 4 Rules, WQS](#), promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451 (MDEQ, 2015). All 2017 biosurvey stations in this report were in warmwater streams, rivers, or drains.

Status sites will be part of a future statewide status report. Trend sites will be used to facilitate a measurement of statewide biological community temporal trends (MDEQ, 2015). Statewide trend information will be summarized in a statewide report after 2021; once a sufficient amount of data has been collected and analyzed. Two reports have already been completed for the following years: 2006-2010 (Great Lakes Environmental Center [GLEC], 2015) and 2011-2015 (GLEC et al., 2018).

Targeted sites were solicited statewide from internal and external customers in the fall of 2016. Requests were then ranked following a series of meetings involving WRD managers, watershed biologists, permit biologists, NPS staff, district staff, and water quality/topic specialists based on the severity of the water quality concern, potential ongoing impacts to surface waters, available resources, division priorities, and other factors. These rankings were used to determine the requests to be fulfilled in 2017. No targeted sites were prioritized for monitoring in the St. Clair tributaries watersheds in 2017.

2017 Sampling Results

Table 2. Summary of the aquatic habitat and macroinvertebrate (Macro) community evaluations for selected stations in the Black River and Belle River watersheds, July-September 2017.

Station #	Stream Name	Road Crossing	STORET #	County	Township	Latitude	Longitude	Habitat Evaluation Rating	Habitat Score ³	Macro Evaluation Rating	Macro Score ⁴	Site Type
1	Black River	Shabonna Road	760236	Sanilac	Wheatland	43.53996	-82.78129	Marginal	64	Acceptable	1	Status
2	Elk Creek	Washington Road	760266	Sanilac	Washington	43.39593	-82.70592	Marginal	74	Acceptable	-1	Status
3	Black River	Aitken Road	760009	Sanilac	Lexington	43.32288	-82.63501	Good	113	Acceptable	-2	Trend
4	Potts Drain	Hall Road	760240	Sanilac	Buel	43.28940	-82.74750	Good	110	Acceptable	0	Trend
5	East Branch Speaker and Maple Valley Drain	Harrington Road	760294	Sanilac	Elk	43.27245	-82.84549	Marginal	65	Acceptable	-2	Status
6	Madison Drain	Bohms Road	440261	Lapeer	Goodland	43.13160	-83.05850	Marginal	66	Poor	-6	Status
7	Brant Lake Drain	Lum Road	440262	Lapeer	Arcadia	43.09983	-83.14343	Marginal	89	Acceptable	-4	Status
8	Black River	Off Abbottsford Road	740441	St. Clair	Clyde	43.04095	-82.58954	Excellent	166	Excellent	7	Trend
9	Howe Drain	Off M25, behind Home Depot	740470	St. Clair	Fort Gratiot	43.03044	-82.46049	Poor	55	Poor	-5	Status
NW-1	Black River	Boat launch off Strawberry Lane; upstream of Black River Canal inlet	740267	St. Clair	Port Huron	43.01676	-82.45270	N/A	N/A	Poor	2 **	Status
10	North Branch Belle River	Newark Road, upstream of Pinnacle (Vlasic) Foods outfall	440169	Lapeer	Imlay	43.00834	-83.06056	Marginal	90	Acceptable	-4	Trend
11	Belle River	End of Meskill Road	740216	St. Clair	Columbus	42.86889	-82.73500	n/a	n/a	Excellent	7	Trend

** nonwadeable (NW) site macroinvertebrate community scoring: scores from 25-100 typically represent communities having better than poor conditions (i.e., fair, good, excellent).
 N/A not applicable
 n/a not available

³ Habitat Evaluation Scoring: <56 is Poor, 56-104 is Marginal, 105-154 is Good, >154 is Excellent.

⁴ Macroinvertebrate Community Scoring: 9 to 5 is Excellent, 4 to -4 is acceptable, -5 to -9 is poor.

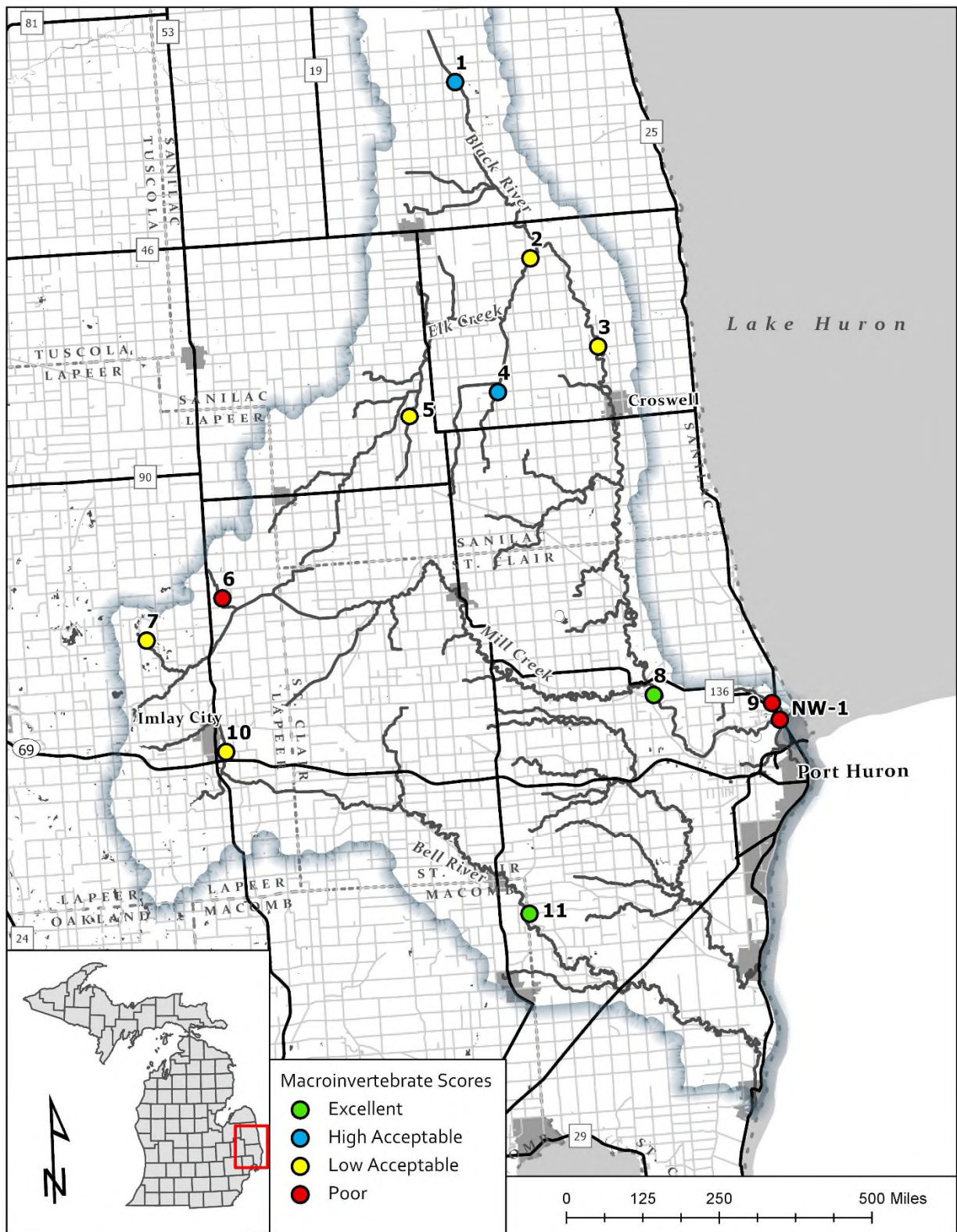


Figure 1. Sampling locations in the Black River and Belle River watersheds. Dots represent 2017 aquatic macroinvertebrate community survey stations ratings.

Summary of Findings by Monitoring Objective

Objective 1: Assess the current status and condition of individual waters of the state and determine whether Michigan WQS are being met.

In 2017, aquatic macroinvertebrate community and habitat assessments were conducted at 12 stations (7 Status, 5 Trend) in the Black River and Belle River watersheds. The OIALW designated use was being met (i.e., acceptable or excellent macroinvertebrate communities) at 4 of the 7 Status stations and at all 5 of the Trend stations. Refer to Figure 1 and Table 2 for a summary of the locations and macroinvertebrate and habitat rating results for the individual biosurvey stations. Tables 3 and 4 provide more detailed information about the habitat conditions and macroinvertebrate communities, respectively, at the survey stations.

Note: The stations below are not always discussed in order of their station identification number; rather they are grouped within geographical regions of the study watersheds.

BLACK RIVER WATERSHED

Upper Black River

Black River at Shabonna Road (Station 1)

The farthest upstream site sampled on the Black River mainstem was at Shabonna Road (Figure 2), in an intensive agricultural area near the northernmost part of the Black River watershed. The river at this location, and much of the river upstream, was channelized and straightened, with steep banks on both sides and a general lack of natural riparian vegetation conditions. The glide/pool habitat conditions scored Marginal (64) overall, with poor scores for pool substrate characterization, pool variability, channel alteration, channel sinuosity, and riparian vegetation zone width. The epifaunal substrate/available cover metric scored at the low end of good and the sediment deposition metric scored marginal, reflecting how while over half of the stream bottom was impacted by sedimentation/siltation, approximately 40 percent of the substrate was of stable habitat size (cobble and gravel).



Figure 2. Black River at Shabonna Road (Station 1).

The macroinvertebrate community rated Acceptable (+1) with 29 total taxa present, eight of which were mayflies (4) or caddisflies (4). Elmid (riffle) beetles (20 percent) and amphipods (scuds and side-swimmers) (18 percent) were the two most dominant taxa at this station. Mayflies and caddisflies made up 22 and 2 percent of the community, respectively. Despite human impacts (e.g., channelization, agricultural runoff) to this site, the moderate amounts of cobble and gravel likely allowed for some flatheaded mayflies (Heptageniidae) and a snail-case-maker caddisfly (Helicopsychidae) to be present in the samples. These taxa are typically clingers (behaviorally) that are adapted either by shape (flattened) or behaviorally (case), respectively, to live in moving water in erosional habitat areas on stable structures like cobble and logs (Merritt et al., 2019; Bouchard, 2004).

Black River at Aitken Road (Station 3)

Another biosurvey site on the Black River was located approximately 20 river miles downstream at Aitken Road (Figure 3). The reach was slow moving, relatively wide (approximately 80 feet) for a wadeable river, and had turbid water. Like Station 1, the river here also courses through an area of intensive agriculture, though some occasional, small patches of riparian forest and light residential development also exist upstream of, or adjacent to, this reach. Based upon aerial imagery, portions of the Black River upstream of this reach appear to have been partly relocated and/or channelized historically to accommodate Old M-51 (and other roads) and also expedite drainage. Some old, remnant river bends can be seen where the river used to likely exist prior to channel relocation.



Figure 3. Black River at Aitken Road (Station 3).

The glide/pool habitat conditions scored low Good (113) overall, with most parameters scoring good or even excellent (i.e., maintained flow volume). A few parameters, however, scored marginal (sediment deposition, flashiness, and channel sinuosity) or poor (pool variability). Approximately 45 percent of the substrate was a sand/silt mixture, with the remainder being a mix of cobble, gravel, and the occasional boulder. Large wood substrate was sparse.

The macroinvertebrate community rated Acceptable (-2), with only 16 total taxa present. Six taxa were mayflies (5) or caddisflies (1), making up 14 and 6 percent of the community, respectively. Hydracarina (water mites) were by far the dominant taxon at 64 percent. While there are over 1,500 species of water mites in North American freshwater environments, and they vary considerably in tolerance to stress and pollution by species, these organisms breathe by absorbing dissolved oxygen (D.O.) all over their body surface, and most kinds can tolerate D.O. oxygen concentrations as low as 1 part per million (Voshell, 2002).

Elk Creek and Tributaries (e.g., Potts Drain, East Branch Speaker and Maple Valley Drain)

Elk Creek at Washington Road (Station 2)

Elk Creek drains into the Black River mainstem between Stations 1 and 3. Station 2 was located on Elk Creek at Washington Road (Figure 4), approximately 1 mile upstream of its confluence with the Black River. Elk Creek at, and upstream of, the sampling station had an occasional curve, but was mostly channelized, straightened,



Figure 4. Elk Creek at Washington Road (Station 2).

dredged, and quite uniform. The substrate was predominantly fine sediment (80 percent sand or clay), and large wood was absent. The land use in the watershed upstream of the station was predominantly intensive agriculture, but also included occasional patches of forest. Trees were not present in the riparian zone of the channel, and the banks were fairly steep and grassy. The habitat scored Marginal (74) overall, with poor scores for pool variability,

channel sinuosity, and riparian vegetation zone width.

The macroinvertebrate community here rated Acceptable (-1). Twenty-six total taxa were present, including 4 mayfly and 3 caddisfly taxa. Mayflies and caddisflies comprised 10 and 6 percent of the community, respectively. Elmids (riffle) beetles were the dominant taxon (38 percent), followed by chironomids (midges) (13 percent).

While only 1 mussel (Unionidae) was observed at Elk Creek using Procedure 51 dip net sampling techniques, multiple species of mussels were informally observed while walking about the survey reach at Station 2 including threeridge, white heelsplitter, fluted-shell, wabash pigtoe, fatmucket (shell only), and giant floater (shell only). The mussel species mentioned here are fairly common in Michigan with the exception of the fluted-shell; it is a state species of special concern (MNFI, n.d.; MDNR, n.d.). Still, these are important observations since North American freshwater mussels have had very high rates of extinction and endangerment in the last 100 years (Haag and Williams, 2014). Mussel populations in Michigan also declined greatly in the early 1900s due to harvest for the pearl button industry (MNFI, 2005). Currently, 43 percent of Michigan's recognized mussel species are listed as threatened or endangered (MDNR, n.d.). Many taxa are sensitive to pollutants, especially pesticides, ammonia, and impoundments (Haag and Williams, 2014; MNFI, 2005), as well as the introduction and spread of invasive zebra mussels (MDNR, n.d.).

Potts Drain at Hall Road (Station 4)

Potts Drain is a tributary to Elk Creek. It was sampled at Hall Road in 2017 (Figure 5). The stream was channelized, straightened, dredged (historically), and generally lacked riparian trees and shrubs, though overhanging grasses did provide some cover and habitat for macroinvertebrates. While habitat scored low Good (110) overall, many parameters scored marginal (epifaunal substrate/available cover, pool variability, sediment deposition, channel alteration, channel sinuosity, riparian vegetation zone width). The substrate was predominantly fine sediment (85 percent sand or silt), and large wood was absent.

Macroinvertebrates scored Acceptable (0) at this site. The overall number of taxa was 21, including 2 mayfly taxa and 3 caddisfly taxa, which made up 11 and 2 percent, respectively, of the community. The dominant taxon was Chironomidae (29 percent).



Figure 5. Potts Drain at Hall Road (Station 4).

East Branch Speaker and Maple Valley Drain at Harrington Road; Station 5)

The East Branch Speaker and Maple Valley Drain (Figure 6) is another tributary to Elk Creek. This agricultural drain was channelized, dredged, and had little sinuosity. The channel substrate was almost entirely fine sediments (99 percent; mostly clay with some silt and sand). Large wood substrate was absent, and the steep banks lacked riparian trees and shrubs. The habitat conditions scored Marginal (65), overall, and for most of the individual parameters. Pool variability, channel sinuosity, and riparian vegetation zone width scored poor.



Figure 6. East Branch Speaker and Maple Valley Drain at Harrington Road (Station 5).

The macroinvertebrate community rated Acceptable (-2). Despite what appeared to be low-marginal quality habitat conditions and a low-acceptable community score, the macroinvertebrate community had a surprisingly relatively high taxa richness (32 taxa overall). The most dominant taxon (caenid mayflies), which are tolerant of slow, silty conditions (Bouchard, 2004), only comprised 21 percent of the community. Mayfly taxa (4) and caddisfly taxa (1)

comprised 22 and 1 percent of the community, respectively. The macroinvertebrate community present was what would be expected in a slow-moving “wetland-like” stream with abundant hemipterans (true bugs), odonates (dragonflies and damselflies), coleopterans (beetles), dipterans (flies), amphipods, molluscs, oligochaete worms, and some turbellarians (flatworms).

Mill Creek Tributaries (Madison Drain and Brant Lake Drain)

Madison Drain at Bohms Road (Station 6)

Madison Drain (Figure 7) was sampled at Bohms Road. It is a mostly straightened, slow-moving tributary to the North Branch of Mill Creek. Much of the watershed

upstream of this location was agricultural, and the sampling reach had agricultural land on both sides. Aside from immediately at the road crossing, this reach lacked riparian trees and had very sparse shrubs. The channelized habitat scored Marginal (66) overall, with the individual parameters pool variability, sediment deposition, channel sinuosity, and riparian vegetation zone width scoring poor. The reach was 100 percent glide (run) habitat, the substrate was all fine sediment (5 percent sand, 95 percent silt), and large wood substrate was absent.

The macroinvertebrate community in Madison Drain's slow-moving water rated Poor (-6). It had a total richness of 21 taxa. Only one mayfly taxon was present (Caenidae; 1 percent of the community), and no caddisfly taxa were observed. The dominant taxon was coenagrionid damselflies (35 percent), a diverse family with many species commonly found in or around the vegetation of standing, lentic, or ditch water that are typically moderately to highly tolerant organisms (Voshell, 2002; Bouchard, 2004). Surface air breathers (i.e., surface dependent macroinvertebrates) (MDEQ, 1990), including Culicidae (mosquito) larvae, hemipterans, coleopterans (Dytiscidae, Hydrophilidae, and adult Haliplidae), made up 29 percent of the community.



Figure 7. Madison Drain at Bohms Road (Station 6).

Brant Lake Drain at Lum Road (Station 7)



Figure 8. Brant Lake Drain at Lum Road (Station 7).

Brant Lake Drain is also known as Castle Creek. This slow-moving drain (Figure 8) was sampled within and below a golf course. Aerial imagery indicated that much of the stream was channelized, straightened, and had its riparian trees and shrubs removed (especially as one moves upstream of the road crossing). Its watershed also contains large, manicured lawns/fields, agricultural fields, and some forest. The sampling location was approximately 1 mile downstream of the outlet of a small chain of lakes (e.g., Stanton Lakes, Rose Lake). Brant Lake Drain empties into Elk Lake Creek, which

eventually becomes the North Branch of Mill Creek.

Habitat at this site rated Marginal (89) overall. The following individual parameters rated poor: pool variability, sediment deposition, and riparian vegetation zone width. The inorganic substrate was mostly fine sediments (10 percent sand, 80 percent silt), and large wood substrate was absent. Most of the sampling reach had heavy amounts of overhanging vegetation (grasses) and moderate amounts of aquatic macrophytes.

The macroinvertebrate community here rated low Acceptable (-4). Two mayfly taxa (Caenidae, Baetidae) and one caddisfly taxon (Phryganeidae) were present, comprising 5 and 1 percent of the community, respectively. (Phryganeid caddisflies are usually found in submerged aquatic vegetation, overhanging grasses, and accumulations of coarse detritus [Bouchard, 2004].) Moderate to highly tolerant taxa (per Bouchard, 2004) were the most dominant taxa here: Isopoda (sowbugs) (38 percent), Amphipoda (scuds, side-swimmers) (19 percent), and coenagrionid damselflies (14 percent).

Lower Black River

Black River off Abbottsford Road (Station 8)

The Black River was sampled off Abbottsford Road (Figure 9) within the Port Huron State Game Area, an area dedicated for wildlife conservation and management by the MDNR Wildlife Division. The station is roughly 28 river miles downstream from Station 3, and it is also approximately 1.6 and 2.1 river miles downstream of the mouth of Mill Creek and a dam on the Black River, respectively. The Black River here is a sinuous, riffle/run system with a relatively wide and intact forest riparian zone. Habitat at this station rated Excellent (166), with all individual parameters

scoring excellent except for velocity/depth regime and bank stability (good) and flashiness (marginal). Some fine sediments were present (20 percent sand or clay), but



Figure 9. Black River off Abbottsford Road (Station 8).

the stream was predominantly gravel (40 percent) and cobble (35 percent), with a small presence of boulders (5 percent).

The macroinvertebrate community rated Excellent (+7) with 31 taxa present, 11 of which were mayflies (7) or caddisflies (4). Mayflies comprised 45 percent of the community and caddisflies made up 16 percent of the community. The dominant taxon (15 percent) was the mayfly family Ephemerellidae.

This station was one of two stations in this report where stonefly (Plecoptera) taxa were observed in 2017; the two families present were Leuctridae and Perlidae. Stoneflies are considered by many to be one of the most sensitive groups of aquatic insects (e.g., MDEQ, 1990; Bouchard, 2004; DeWalt, 2009). Generally, the presence of stoneflies is a reliable indicator of excellent water quality, and many species are restricted to habitats with high levels of D.O. (Bouchard, 2004). While present at this station, the stoneflies were not abundant (i.e., only one individual of each of the stonefly families in the sample), suggesting that stressful conditions may still occasionally occur at this location.

Black River upstream of Black River Canal inlet (Station NW-1)

One location on the Black River (Figures 10 and 11) was nonwadeable and was assessed and scored using the SWAS Procedure 22. The thalweg (deepest thread of the channel) was fairly deep and ranged from 10-13 feet over the course of the sampling reach. Boats and docks were a common sight. Flow velocity appeared generally to be slow. The land uses in the watershed region adjacent to, and upstream of, this reach included agriculture, golf courses, patches of forest, several suburban residential developments, and some commercial development. The sampling reach was somewhat sinuous, although it might have been much more sinuous pre-human settlement since former bends of the river can be seen in aerial imagery and also some sections appear as though they have been somewhat straightened. Sand or other fines were the predominant substrate type observed, with minor amounts of gravel present. Wood, often in the form of shrub or tree roots, and macrophytes were occasionally present along the river margins.



Figure 10. Black River, upstream of boat launch off Strawberry Lane, and upstream of Black River Canal inlet (Station NW-1) (lower end of the sampling reach).



Figure 11. Black River, upstream of boat launch off Strawberry Lane, and upstream of Black River Canal inlet (Station NW-1) (upper end of the sampling reach).

Station NW-1 had a macroinvertebrate community that rated Poor (with a score of 2 out of 100) (Appendix A). Only 7 taxa were observed, with chironomid flies (52 percent) and oligochaete worms (33 percent) dominating the community. Both taxa can be found in just about any habitat but, in general, they can do well in soft sediments. Other taxa that were present in small numbers included Ephemeridae (“common burrowing mayflies,” typically found in soft silt or sand), Coenagrionidae damselflies, Gerridae (“water striders,” surface dependent, air

breathers), Elmidae beetles, and Unionidae (mussels). Most of the areas in the river reach randomly sampled for macroinvertebrates generally were not conducive to supporting a diverse macroinvertebrate community. As opposed to wadeable stream sampling using Procedure 51 where one seeks out and samples all available habitats, sampling according to Procedure 22 is limited to randomly selected (left or right side), safely-wadeable (generally <1 meter deep), nearshore areas, at fixed transects that have been evenly spaced. The sampling areas at Station NW-1 transects mostly had minimal amounts of stable substrates and deep, slow water velocities. The stems of the macrophytes (often emergent plants such as cattails having stiff, thick stems as opposed to submergent vegetation with more flexible stems and submerged leaves) and fine sediments that were common in the abundant slow-flowing areas, were difficult to sample. Any available large wood habitats sampled often were tree branches and roots that were partly in the water but not extending deeply into the water. Rapid habitat assessment data collected at macroinvertebrate sampling locations indicated that while overhanging vegetation/undercut banks, plants, and wood were sometimes present, inorganic substrates were primarily fine sediments (silts, sands) while more stable, coarse sediment (i.e., gravel) was sparse. During the survey, there appeared to be infrequent, small patches of shallow, nearshore river waters with some submergent aquatic vegetation (not within random sample locations) that might provide very limited areas of slightly better habitat. Still, overall, habitat available for benthic invertebrate colonization appeared to be very limited, and sedimentation and siltation impacted sampleable habitats.

Howe Drain

Howe Drain off M25 (Station 9)

Howe Drain off M25 was sampled in a commercial-development, urbanized area of Fort Gratiot, which also had a lot of agricultural and residential land use upstream. Much of the length of this very slow-moving drain has been channelized and straightened; average surface velocity was 0.1 feet per second. Trees were present near the sampling reach and provided some shade to the drain. Banks and riparian areas were quite steep and covered mostly with grasses and forbs (Figure 12). The glide/pool habitat rated Poor (55) overall, with individual parameters mostly scoring poor or marginal. The substrate was mostly clay (85 percent), with some silt (10 percent) and gravel (5 percent). Overhanging vegetation was moderately abundant, otherwise the presence of other structures available for macroinvertebrate colonization (e.g., aquatic macrophytes, undercut banks, large wood pieces, and rootwads) were sparse or absent.



Figure 12. Howe Drain off M25 (Station 9).

The macroinvertebrate community rated Poor (-5), with only 19 taxa identified. The dominant taxon was a “true bug” in the family Corixidae (water boatmen), which are air breathers (i.e., surface dependent) that prefer standing or slow flowing water (Bouchard, 2004). Over half of the taxa collected were water boatmen (51 percent) and, combined with other surface dependent taxa (including mosquitoes [Culicidae]), comprised 59 percent of the community overall (this station had the highest percent surface air breathers in this report). Streams that have high percentages of these organisms may be reflective of stream reaches experiencing conditions such as large diurnal D.O. shifts or other biological or chemical oxygen demanding constraints, elevated temperatures, low flows, and/or erratic flows (MDEQ, 1990). Only one mayfly taxon was observed (Caenidae), and no caddisflies or stoneflies were present. The moderate amounts of overhanging vegetation and slow waters may partly explain why coenagrionid damselflies comprised 24 percent of the community.

BELLE RIVER WATERSHED

North Branch of the Belle River upstream of Newark Road (Station 10)

The North Branch of the Belle River was sampled upstream of Newark Road (Figure 13) in a watershed that is mostly a mix of agricultural and urban (commercial and residential) land uses along with some forest. Much of the waterway has been channelized and straightened, the streambanks lacked trees, and the water was noted as being slightly turbid. The glide/pool habitat rated as Marginal (90) overall, with a few individual parameters scoring poor (i.e., pool variability, sediment deposition, and channel sinuosity). The substrate was mostly silt (90 percent), along with some sand (5 percent) and gravel (5 percent). Other than dense macrophytes, additional habitat



Figure 13. North Branch of the Belle River upstream of Newark Road (Station 10).

structures were sparse (overhanging vegetation) or absent (e.g., large wood pieces, rootwads, undercut banks). In 2017, approximately 95 percent of the sampling area of the channel was covered with the macrophytes (including the aquatic invasive plant curly leaf pondweed *Potamogeton crispus*) and noted as nuisance plant conditions. (Nuisance aquatic plant conditions were *not* noted in 2012, 2007, 1997, or 1992.)

The station's macroinvertebrate community scored low Acceptable (-4). Only 12 taxa were identified, and the community was dominated by the taxon Chironomidae (41 percent), followed by Amphipoda (36 percent). No mayfly or caddisfly families were observed at this location. The primary reason this station did not rate as Poor likely was because the metrics "percent isopod, snail, leech" and "percent surface air breathers" were low (i.e., each <2 percent of the community).

Belle River at the end of Meskill Road (Station 11)

The Belle River at the end of Meskill Road (Figure 14) was sampled southeast of Memphis. While the watershed was dominated by agricultural and some urban residential land use, the riparian zone forest along the mainstem of the river appeared to be relatively wide (>250 feet or more in many places) for the region. This moderately-sinuuous, mostly riffle/run reach does not appear to have been channelized in a long time, but may have



Figure 14. Belle River at the end of Meskill Road (Station 11). *Note: a photo was not available for 2017; this photo is from July 2020.*

been historically, given the old river bends visible in aerial imagery. The riffle/run habitat data is not available for 2017, but rated as Excellent in 2012 and Good in 2007 (Varricchione, 2014; Schmitt, 2008). Based upon previous surveys and records, plus surveys for aquatic plant and algae conditions in 2020, cobble and gravel substrate are believed to have been the dominant substrates in the 2017 biosurvey. Aquatic macrophytes are common in parts of this reach (Figure 14).

The macroinvertebrate community rated Excellent (+7) and 27 taxa were observed. There were 8 mayfly (3) and caddisfly (5) taxa, comprising 27 and 29 percent of the community, respectively. The dominant taxon was hydropsychid caddisflies, which comprised 26 percent of the community. Also, this station was second of 2 stations in this report where stoneflies (Plecoptera) taxa were observed in 2017. The presence of these mayfly, caddisfly, and stonefly taxa likely reflected, in part, the diverse stable substrates and flow velocities as well as the relatively healthy riparian zone conditions alongside the river.

Objective 2: Evaluate biological community temporal trends.

Five of the biosurvey stations described above are considered **trend** sites (refer to Table 2). These sites were originally selected randomly but are now sampled every five years for inclusion in statewide trend analysis. Statewide trend information cannot be summarized until after 2021, when a sufficient amount of data has been collected, and will be summarized in a statewide report. In the meantime, observations of conditions at these sites over time are presented in Table 5.

Objective 3: Identify NPS of water quality impairment.

While there were no occasions during the biosurvey field work for this report where clear signs and/or evidence of direct and obvious NPS pollution were specifically noted for sampling locations, general observations (e.g., intensive land use activities) were made at the stations and their surrounding watershed areas – both in the field and using aerial photographs. These observations were noted in earlier parts of this report. Most of the stations in this report were in watersheds dominated by agricultural land uses. (Two sites (Howe Drain [Station 9] and Black River [Station NW-1]) were surrounded by a mix of urban, residential, and agricultural land uses.) These types of land use commonly result in degraded stream or river ecosystems due to issues such as altered hydrological conditions; increased erosion, sedimentation, channelization, and loss of in-stream habitat integrity; loss of healthy and natural riparian vegetation zone conditions and bank stability; and increased amounts of pollutant runoff (e.g., nutrients, pesticides, metals) (Allan and Castillo, 2007; Carpenter et al., 2011; Capel et al., 2018; Stone et al., 2014). These types of problems are believed to be some of the primary reasons for impairments observed at some stations sampled for this report (Table 2).

Conclusions and Future Monitoring Recommendations

Macroinvertebrate communities were monitored at 12 stations in 2017 for this report. Communities rated as Acceptable or Excellent at most sites; however, 3 stations (2 wadeable, 1 nonwadeable) rated as Poor. Those stations were Station 6 (Madison Drain at Bohms Road), Station 9 (Howe Drain off M25), and Station NW-1 (Black River upstream of Black River Canal inlet).

Additionally, two stations had macroinvertebrate communities with scores of -4 and were rated as (very low) Acceptable (Station 7 [Brant Lake Drain at Lum Road; a status site] and Station 10 [North Branch Belle River upstream of Newark Road; a trend site]). Since those scores were close to the cutoff score for Poor (i.e., -5), they should continue to be watched closely in the future.

The aquatic plant community at one station, the North Branch of the Belle River upstream of Newark Road (Station 10), was observed in 2017 as having a dense population of macrophytes including the aquatic invasive plant curly leaf pondweed (*Potamogeton crispus*), and that situation was noted as being nuisance conditions. (The author of this report could not be there in 2017 due to an injury.) Nuisance aquatic plant conditions were *not* noted during surveys at the station in 2012, 2007, 1997, and 1992. Thus, it is recommended that this station be considered as having insufficient information regarding nuisance plant conditions and that further investigations (including more photographs) be considered, as resources allow, at this trend station in the future to help determine whether it truly has nuisance aquatic plant conditions.

Watershed stakeholders and landowners are encouraged to consider collaborating with local conservation and agricultural organizations to employ best management practices on agricultural, residential, and urban lands alongside, near, and within drains, streams, rivers, and other water bodies to help minimize NPS pollution inputs and habitat

degradation. Sources of information on these practices and associated organizations include, but are not limited to:

- EGLE's NPS Program at <https://www.michigan.gov/egle/about/organization/water-resources/nonpoint-source>.
- Michigan Agriculture Environmental Assurance Program at <https://www.michigan.gov/mdard/environment/maeap>
- Michigan Conservation Districts at <https://www.macd.org/>.
- EGLE's Information & Education Publications page at <https://www.Michigan.gov/egle/about/Organization/Water-Resources/nonpoint-source/information-education-publications>.
- Michigan Department of Natural Resources' (MDNR) page on [Understanding the Importance of Streamside and Lakeshore Habitat: Riparian Areas Have Numerous Values for People and Wildlife](#) (article by John Pepin, 2017).

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Table 3. Habitat evaluation for selected stations in the Black River and Belle River watersheds, July-September 2017. Notes: Maximum score possible for individual metrics shown in parentheses. * Applies only to Riffle/Run stream Surveys. ** Applies only to Glide/Pool stream Surveys.

	STATION 1 Black River, Upstream Shabonna Road 9/6/2017	STATION 2 Elk Creek, Washington Road 8/10/2017	STATION 3 Black River, Upstream Aitken Road 7/11/2017	STATION 4 Potts Drain, Upstream Hall Road 7/10/2017
HABITAT METRICS	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover (20)	11	8	11	10
Embeddedness (20)*				
Velocity/Depth Regime (20)*				
Pool Substrate Characterization (20)**	5	6	15	12
Pool Variability (20)**	2	4	5	8
Channel Morphology				
Sediment Deposition (20)	7	14	8	8
Flow Status - Maint. Flow Volume (10)	8	9	10	10
Flow Status - Flashiness (10)	4	3	4	8
Channel Alteration (20)	5	7	13	10
Frequency of Riffles/Bends (20)*				
Channel Sinuosity (20)**	2	5	10	8
Riparian and Bank Structure				
Bank Stability (L) (10)	3	3	6	9
Bank Stability (R) (10)	3	3	6	9
Vegetative Protection (L) (10)	6	4	7	6
Vegetative Protection (R) (10)	6	4	7	6
Riparian Vegetation Zone Width (L) (10)	1	1	7	3
Riparian Vegetation Zone Width (R) (10)	1	3	4	3

	STATION 1 Black River, Upstream Shabonna Road 9/6/2017	STATION 2 Elk Creek, Washington Road 8/10/2017	STATION 3 Black River, Upstream Aitken Road 7/11/2017	STATION 4 Potts Drain, Upstream Hall Road 7/10/2017
TOTAL SCORE (200):	64	74	113	110
HABITAT RATING:	MARGINAL	MARGINAL	GOOD	GOOD
Date:	9/6/2017	8/10/2017	7/11/2017	7/10/2017
Weather:	partly cloudy	partly cloudy	sunny	rainy
Air Temperature: °F	67	73		65
Water Temperature: °F	68	71	70	69
Ave. Stream Width: Feet	22	36	83	10
Ave. Stream Depth: Feet	0.8	1	2.5	1.5
Surface Velocity: Feet/Second	0.4	0.3	0.4	0.5
Estimated Flow: Cubic Feet/Second	6.2	17.4	68.3	1.1
Stream Modifications:	dredged, canopy removal, snagging	dredged, canopy removal	dredged, canopy removal	dredged, canopy removal
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	760236	760266	760009	760240
County Code:	76	76	76	76
TRS:	13N14E23	11N15E16	10N16E06	10N15E20
Latitude (dd):	43.54	43.39632	43.3219	43.2894
Longitude (dd):	-82.7812	-82.70516	-82.6354	-82.7475
Ecoregion:	HELP	HELP	HELP	HELP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4090001	4090001	4090001	4090001

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

	STATION 5 East Branch Speaker and Maple Valley Drain, Harrington Road 8/10/2017	STATION 6 Madison Drain, Bohms Road 9/6/2017	STATION 7 Brant Lake Drain (Castle Creek), Lum Road 9/6/2017	STATION 8 Black River, Off Abbottsford Road 7/11/2017
HABITAT METRICS	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL	RIFFLE/RUN
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover (20)	6	2	7	16
Embeddedness (20)*				16
Velocity/Depth Regime (20)*				15
Pool Substrate Characterization (20)**	7	6	10	
Pool Variability (20)**	3	2	2	
Channel Morphology				
Sediment Deposition (20)	8	5	5	17
Flow Status - Maint. Flow Volume (10)	9	9	9	10
Flow Status - Flashiness (10)	3	7	8	5
Channel Alteration (20)	7	6	8	20
Frequency of Riffles/Bends (20)*				17
Channel Sinuosity (20)**	2	1	8	
Riparian and Bank Structure				
Bank Stability (L) (10)	5	7	8	6
Bank Stability (R) (10)	5	7	8	6
Vegetative Protection (L) (10)	4	6	6	9
Vegetative Protection (R) (10)	4	6	6	9
Riparian Vegetation Zone Width (L) (10)	1	1	2	10
Riparian Vegetation Zone Width (R) (10)	1	1	2	10
TOTAL SCORE (200):	65	66	89	166
HABITAT RATING:	MARGINAL	MARGINAL	MARGINAL	EXCELLENT

	STATION 5 East Branch Speaker and Maple Valley Drain, Harrington Road 8/10/2017	STATION 6 Madison Drain, Bohms Road 9/6/2017	STATION 7 Brant Lake Drain (Castle Creek), Lum Road 9/6/2017	STATION 8 Black River, Off Abbottsford Road 7/11/2017
Date:	8/10/2017	9/6/2017	9/6/2017	7/11/2017
Weather:	partly cloudy	sunny	sunny	sunny
Air Temperature: °F	75	65	57	85
Water Temperature: °F	74	62	59	73
Ave. Stream Width: Feet	15	13.4	7.3	75
Ave. Stream Depth: Feet	1	1.1	0.7	1.8
Surface Velocity: Feet/Second	0.2	0.4	0.5	2.0
Estimated Flow: Cubic Feet/Second	3.7	5.0	2.6	252.4
Stream Modifications:	dredged, canopy removal, relocated	dredged, canopy removal	dredged, canopy removal	snagging, habitat improvement, dredged
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	760294	440261	440262	740441
County Code:				74
TRS:	10N14E28	08N12E9	08N11E23	07N16E17
Latitude (dd):	43.27245	43.13159	43.09967	43.04015
Longitude (dd):	-82.84549	-83.0585	-83.1434	-82.59195
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:				Warmwater
USGS Basin Code:	4090001	4090001	4090001	4090001

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

	STATION 9 Howe Drain, off M25, behind Home Depot 9/7/2017	STATION 10 North Branch Belle River, Newark upstream of Pinnacle (Vlasic) Foods outfall 7/10/2017	STATION 11 Belle River, End of Meskill Road 7/10/2017
HABITAT METRICS	GLIDE/POOL	GLIDE/POOL	RIFFLE/RUN
Substrate and Instream Cover			
Epifaunal Substrate/ Avail Cover (20)	2	8	
Embeddedness (20)*			
Velocity/Depth Regime (20)*			
Pool Substrate Characterization (20)**	4	13	
Pool Variability (20)**	1	1	
Channel Morphology			
Sediment Deposition (20)	8	1	
Flow Status - Maint. Flow Volume (10)	8	10	
Flow Status - Flashiness (10)	1	7	
Channel Alteration (20)	2	8	
Frequency of Riffles/Bends (20)*			
Channel Sinuosity (20)**	1	2	
Riparian and Bank Structure			
Bank Stability (L) (10)	4	9	
Bank Stability (R) (10)	4	9	
Vegetative Protection (L) (10)	5	7	
Vegetative Protection (R) (10)	5	7	
Riparian Vegetation Zone Width (L) (10)	3	0	
Riparian Vegetation Zone Width (R) (10)	7	8	
TOTAL SCORE (200):	55	90	n/a
HABITAT RATING:	POOR	MARGINAL	n/a

	STATION 9 Howe Drain, off M25, behind Home Depot 9/7/2017	STATION 10 North Branch Belle River, Newark upstream of Pinnacle (Vlasic) Foods outfall 7/10/2017	STATION 11 Belle River, End of Meskill Road 7/10/2017
Date:	9/7/2017	7/10/2017	7/10/2017
Weather:	partly cloudy	cloudy	
Air Temperature: °F	55	68	
Water Temperature: °F	60	64	
Ave. Stream Width: Feet	10	7.8	53
Ave. Stream Depth: Feet	0.7	2	
Surface Velocity: Feet/Second	0.1	0.5	
Estimated Flow: Cubic Feet/Second	0.8	4.8	
Stream Modifications:	dredged	dredged	
Nuisance Plants (Y/N):	N	Y	N
STORET No.:	740470	440169	740216
County Code:		44	74
TRS:	07N17E21	07N12E 21	05N15E07
Latitude (dd):	43.03044	43.008337	42.8687
Longitude (dd):	-82.46049	-83.060559	-82.7354
Ecoregion:	SMNITP	SMNITP	SMNITP
Stream Type:		Warmwater	Warmwater
USGS Basin Code:	4090001	4090001	4090001

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Table 4. Qualitative macroinvertebrate sampling results and metric evaluation for selected stations in the Black River and Belle River watersheds, July-September 2017.

TAXA	STATION 1 Black River Upstream Shabonna Rd 9/6/2017	STATION 2 Elk Creek Washington Rd 8/10/2017	STATION 3 Black River Upstream Aitken Rd 7/11/2017	STATION 4 Potts Drain Upstream Hall Rd 7/10/2017
PLATYHELMINTHES (flatworms)				
Turbellaria	2			
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1			1
Oligochaeta (worms)		3	1	6
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	45	1		32
Decapoda (crayfish)	1	2		9
Arachnoidea				
Hydracarina	11	7	178	57
Insecta				
Ephemeroptera (mayflies)				
Baetidae	7	3		9
Caenidae	30	10	9	26
Ephemerellidae			14	
Heptageniidae	15	3	3	
Potamanthidae			6	
Tricorythidae	5	13	7	
Odonata				
Anisoptera (dragonflies)				

TAXA	STATION 1 Black River Upstream Shabonna Rd 9/6/2017	STATION 2 Elk Creek Washington Rd 8/10/2017	STATION 3 Black River Upstream Aitken Rd 7/11/2017	STATION 4 Potts Drain Upstream Hall Rd 7/10/2017
Aeshnidae	1			
Libellulidae	1			
Zygoptera (damselflies)				
Calopterygidae	1	3		
Coenagrionidae	14	20	3	
Hemiptera (true bugs)				
Belostomatidae	1			
Corixidae	22		4	18
Gerridae		1		
Notonectidae	1			
Pleidae	1	6	1	1
Veliidae				1
Trichoptera (caddisflies)				
Helicopsychidae	1			
Hydropsychidae	3			3
Leptoceridae	1	15	16	1
Limnephilidae	1	1		
Phryganeidae				2
Polycentropodidae		2		
Coleoptera (beetles)				
Gyrinidae (adults)		1		
Haliplidae (adults)		1		3
Hydrophilidae (total)		25		
Elmidae	51	107	12	45

TAXA	STATION 1 Black River Upstream Shabonna Rd 9/6/2017	STATION 2 Elk Creek Washington Rd 8/10/2017	STATION 3 Black River Upstream Aitken Rd 7/11/2017	STATION 4 Potts Drain Upstream Hall Rd 7/10/2017
Gyrinidae (larvae)	1			
Haliplidae (larvae)	3			
Diptera (flies)				
Ceratopogonidae				5
Chironomidae	21	38	21	93
Culicidae	4	3		
Tabanidae		1		
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		3	2	
Hydrobiidae				3
Physidae	3	11	1	2
Planorbidae				7
Pelecypoda (bivalves)				
Pisidiidae	4	1	1	1
Unionidae (mussels)	2	1		
TOTAL INDIVIDUALS	254	282	279	325

	STATION 1 Black River Upstream Shabonna Rd 9/6/2017		STATION 2 Elk Creek Washington Rd 8/10/2017		STATION 3 Black River Upstream Aitken Rd 7/11/2017		STATION 4 Potts Drain Upstream Hall Rd 7/10/2017	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	29	0	26	0	16	-1	21	0
NUMBER OF MAYFLY TAXA	4	1	4	1	5	1	2	1
NUMBER OF CADDISFLY TAXA	4	1	3	0	1	-1	3	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	22.44	0	10.28	-1	13.98	-1	10.77	-1
PERCENT CADDISFLY COMPOSITION	2.36	-1	6.38	0	5.73	0	1.85	-1
PERCENT DOMINANT TAXON	20.08	0	37.94	-1	63.80	-1	28.62	-1
PERCENT ISOPOD, SNAIL, LEECH	1.57	1	4.96	1	1.08	1	4.00	1
PERCENT SURFACE AIR BREATHERS	11.42	0	13.12	0	1.79	1	7.08	1
TOTAL SCORE		1		-1		-2		0
MACROINVERTEBRATE COMMUNITY RATING	Acceptable		Acceptable		Acceptable		Acceptable	

TAXA	STATION 5 E. Br. Speaker & Maple Valley Dr. Harrington Road 8/10/2017	STATION 6 Madison Drain Bohms Road 9/6/2017	STATION 7 Brant Lake Drain Lum Road 9/6/2017	STATION 8 Black River Off Abbottsford Road 7/11/2017
PLATYHELMINTHES (flatworms)				
Turbellaria	5			
ANNELIDA (segmented worms)				
Hirudinea (leeches)	3	2	2	
Oligochaeta (worms)	28	27		10
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	24		71	5
Decapoda (crayfish)	1		1	6
Isopoda (sowbugs)		1	141	
Arachnoidea				
Hydracarina	5		41	8
Insecta				
Ephemeroptera (mayflies)				
Baetidae	2		5	22
Caenidae	106	2	15	16
Ephemerellidae				41
Heptageniidae	1			11
Isonychiidae				7
Potamanthidae				10
Tricorythidae	1			14
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	4	6		3

TAXA	STATION 5 E. Br. Speaker & Maple Valley Dr. Harrington Road 8/10/2017	STATION 6 Madison Drain Bohms Road 9/6/2017	STATION 7 Brant Lake Drain Lum Road 9/6/2017	STATION 8 Black River Off Abbottsford Road 7/11/2017
Corduliidae	3			
Gomphidae				1
Libellulidae			1	
Zygoptera (damselflies)				
Calopterygidae	1	22	2	
Coenagrionidae	20	80	53	1
Plecoptera (stoneflies)				
Leuctridae				1
Perlidae				1
Hemiptera (true bugs)				
Belostomatidae	1	1	2	
Corixidae	20		1	
Gerridae	2			3
Mesoveliidae		1	1	
Nepidae	1			1
Pleidae		12		
Veliidae				4
Megaloptera				
Sialidae (alder flies)	1			
Trichoptera (caddisflies)				
Hydropsychidae				36
Leptoceridae	7			3
Phryganeidae			2	
Polycentropodidae				2

TAXA	STATION 5 E. Br. Speaker & Maple Valley Dr. Harrington Road 8/10/2017	STATION 6 Madison Drain Bohms Road 9/6/2017	STATION 7 Brant Lake Drain Lum Road 9/6/2017	STATION 8 Black River Off Abbottsford Road 7/11/2017
Uenoidae				3
Coleoptera (beetles)				
Dytiscidae (total)	2	1		1
Haliplidae (adults)	19	12	2	
Hydrophilidae (total)	7	1	1	
Elmidae	94		1	21
Diptera (flies)				
Ceratopogonidae	1			
Chironomidae	37	5	28	12
Culicidae		38		
Simuliidae		5		5
Tabanidae	4	1		
Tipulidae				5
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1			3
Physidae	54	3		4
Planorbidae	23	4	1	
Pleuroceridae		1		
Pelecypoda (bivalves)				
Pisidiidae	16	1	1	8
Unionidae (mussels)	1			
TOTAL INDIVIDUALS	495	226	372	268

	E. Br. Speaker and Maple Valley Dr. Harrington Road 8/10/2017 STATION 5		Madison Drain Bohms Road 9/6/2017 STATION 6		Brant Lake Drain Lum Road 9/6/2017 STATION 7		Black River Off Abbotsford Road 7/11/2017 STATION 8	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	32	1	21	0	20	0	31	1
NUMBER OF MAYFLY TAXA	4	1	1	-1	2	0	7	1
NUMBER OF CADDISFLY TAXA	1	-1	0	-1	1	-1	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	2	1
PERCENT MAYFLY COMPOSITION	22.22	0	0.88	-1	5.38	0	45.15	1
PERCENT CADDISFLY COMPOSITION	1.41	-1	0.00	-1	0.54	-1	16.42	0
PERCENT DOMINANT TAXON	21.41	0	35.40	0	37.90	-1	15.30	1
PERCENT ISOPOD, SNAIL, LEECH	16.36	-1	4.87	0	38.71	-1	2.61	1
PERCENT SURFACE AIR BREATHERS	10.51	0	29.20	-1	1.88	1	3.36	1
TOTAL SCORE		-2		-6		-4		7
MACROINVERTEBRATE COMMUNITY RATING	Acceptable		Poor		Acceptable		Excellent	

TAXA	STATION 9 off M25, behind Home Depot 9/7/2017	STATION 10 Newark upstream of Pinnacle (Vlastic) Foods outfall 7/10/2017	STATION 11 End of Meskill Road 7/10/2017
ANNELIDA (segmented worms)			
Hirudinea (leeches)	1		
Oligochaeta (worms)	4	92	9
ARTHROPODA			
Crustacea			
Amphipoda (scuds)		178	60
Decapoda (crayfish)	1	1	1
Arachnoidea			
Hydracarina	1	3	6
Insecta			
Ephemeroptera (mayflies)			
Baetidae			58
Caenidae	1		
Heptageniidae			7
Tricorythidae			44
Odonata			
Zygoptera (damselflies)			
Coenagrionidae	73	4	
Plecoptera (stoneflies)			
Perlidae			1
Hemiptera (true bugs)			
Belostomatidae	1		
Corixidae	155	4	3
Gerridae	1		
Mesoveliidae	5		
Nepidae			1

TAXA	STATION 9 off M25, behind Home Depot 9/7/2017	STATION 10 Newark upstream of Pinnacle (Vlasic) Foods outfall 7/10/2017	STATION 11 End of Meskill Road 7/10/2017
Notonectidae	2		
Veliidae			4
Megaloptera			
Corydalidae (dobson flies)			1
Trichoptera (caddisflies)			
Helicopsychidae			2
Hydropsychidae			105
Hydroptilidae			2
Leptoceridae			6
Uenoidae			3
Coleoptera (beetles)			
Gyrinidae (adults)	1		
Haliplidae (adults)	5	1	1
Psephenidae (adults)			2
Elmidae	1		36
Diptera (flies)			
Ceratopogonidae	3	3	
Chironomidae	34	206	20
Culicidae	8	2	
Simuliidae		1	26
Tipulidae			1
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)			1
Physidae	4	5	1
Viviparidae			1
Pelecypoda (bivalves)			

TAXA	STATION 9 off M25, behind Home Depot 9/7/2017	STATION 10 Newark upstream of Pinnacle (Vlasic) Foods outfall 7/10/2017	STATION 11 End of Meskill Road 7/10/2017
Pisidiidae	1		
Sphaeriidae (clams)			3
TOTAL INDIVIDUALS	302	500	405

	Howe Drain off M25, behind Home Depot 9/7/2017 STATION 9		North Branch Belle River Newark upstream of Pinnacle (Vlasic) Foods outfall 7/10/2017 STATION 10		Belle River End of Meskill Road 7/10/2017 STATION 11	
METRIC	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	19	0	12	0	27	1
NUMBER OF MAYFLY TAXA	1	0	0	-1	3	0
NUMBER OF CADDISFLY TAXA	0	-1	0	-1	5	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	1	1
PERCENT MAYFLY COMPOSITION	0.33	-1	0.00	-1	26.91	1
PERCENT CADDISFLY COMPOSITION	0.00	-1	0.00	-1	29.14	1
PERCENT DOMINANT TAXON	51.32	-1	41.20	-1	25.93	0
PERCENT ISOPOD, SNAIL, LEECH	1.66	1	1.00	1	0.74	1
PERCENT SURFACE AIR BREATHERS	58.94	-1	1.40	1	2.72	1
TOTAL SCORE		-5		-4		7
MACROINVERTEBRATE COMMUNITY RATING	Poor		Acceptable		Excellent	

Table 5. Summary of aquatic habitat and macroinvertebrate community evaluations for trend stations in the Black River and Belle River watersheds between 2007 and 2017. Note that in 2012 two STORETs (740441 and 740216) had been classified as being in the wrong ecoregion and were given macroinvertebrate community scores of 3 and 4 (both acceptable), respectively (see Varricchione [2014]). Instead, the actual scores were 4 (acceptable) and 6 (excellent), respectively, as shown below.

Date	Stream Name, [Station #]	Road Crossing	STORET #	Habitat Evaluation Rating	Score	Macroinvertebrate Evaluation Rating	Score	Site Type
<i>Black River Watershed</i>								
7/11/2017	Black River [3]	Aitken Rd	760009	Good	113	Acceptable	-2	Trend
7/12/2012	Black River	Aitken Rd	760009	Marginal	92	Poor	-7	Trend
7/19/2007	Black River	Aitken Rd	760009	Good	120	Acceptable	-2	Trend
7/10/2017	Potts Drain [4]	Hall Rd	760240	Good	110	Acceptable	0	Trend
7/12/2012	Potts Drain	Hall Rd	760240	Marginal	58	Acceptable	0	Trend
7/19/2007	Potts Drain	Hall Rd	760240	Marginal	85	Acceptable	3	Trend
7/11/2017	Black River [8]	off Abbottsford Rd	740441	Excellent	166	Excellent	7	Trend
7/13/2012	Black River	off Abbottsford Rd	740441	Good	149	Acceptable	4	Trend
9/19/2007	Black River	off Abbottsford Rd	740441	Good	152	Excellent	5	Trend
<i>Belle River Watershed</i>								
7/10/2017	N B Belle River [10]	Newark Rd, upstream of Pinnacle (Vlastic) Foods outfall	440169	Marginal	90	Acceptable	-4	Trend
7/11/2012	N B Belle River	Newark Rd, upstream of Pinnacle (Vlastic) Foods outfall	440169	Marginal	81	Poor	-6	Trend
7/17/2007	N B Belle River	Newark Rd, upstream of Pinnacle (Vlastic) Foods outfall	440169	Marginal	67	Poor	-6	Trend
7/10/2017	Belle River [11]	end of Meskill Rd	740216	n/a	n/a	Excellent	7	Trend
7/13/2012	Belle River	end of Meskill Rd	740216	Excellent	155	Excellent	6	Trend
7/18/2007	Belle River	end of Meskill Rd	740216	Good	141	Excellent	5	Trend

Appendix A. Nonwadeable Procedure 22 -- Results for the Black River watershed, September 2017.

