

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY  
WATER RESOURCES DIVISION  
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STAFF REPORT

BIOLOGICAL SURVEYS OF SELECTED NORTHWEST LOWER PENINSULA STREAMS  
ANTRIM, CHARLEVOIX, EMMET, GRAND TRAVERSE, KALKASKA, AND  
LEELANAU COUNTIES, MICHIGAN  
JULY-SEPTEMBER 2013

## Introduction

Biological and physical habitat conditions of northwest Lower Peninsula (NWLP) streams in Antrim, Charlevoix, Emmet, Grand Traverse, Kalkaska, and Leelanau Counties were assessed by Surface Water Assessment Section (SWAS) staff in 2013. The primary objectives of the assessments were:

1. Identify nonpoint sources (NPS) of water quality impairment.
2. Evaluate the effectiveness of NPS projects.
3. Assess the current status and condition of individual water bodies and determine if Michigan Water Quality Standards (WQS) are being met.
4. Gather water quality data needed for future Total Maximum Daily Load (TMDL) development.
5. Satisfy monitoring requests submitted by internal and external customers.

The macroinvertebrate community and physical habitat were qualitatively assessed at 26 stations (Table 1; Figure 1) using the SWAS Procedure 51 (Michigan Department of Environmental Quality [MDEQ], 1990; Creal et al., 1996) for wadeable streams.

The macroinvertebrate communities were assessed and scored with metrics that rate the communities on a scale from excellent to poor. Possible scores can range from 9 to -9. Stations with a score greater than or equal to +5 are considered excellent. Stations with a score less than or equal to -5 are classified as poor. Stations with a score of -4 through +4 are classified as acceptable (minimally to moderately impaired). Habitat evaluations are based on 10 metrics, with a possible maximum total score of 200. Stations are classified as excellent with a habitat score >154, good with a score between 105 and 154, marginal with a score between 56 and 104, and poor with a score <56.

Two site-selection methods were used to assess NWLP streams in 2013: stratified random and targeted. A probabilistic monitoring approach, using stratified random site selection to address statewide and regional questions about water quality, was used to select 12 sites within the NWLP watersheds. The sites were chosen randomly from a combined pool of streams that included this sampling area and the remainder of Leelanau County and the Platte and Betsie Rivers watersheds. The total pull from this broader area was 17 sites. In addition to probabilistic monitoring, sites within the NWLP were selected for targeted monitoring to fulfill specific monitoring requests, assess known or potential areas of concern, collect information and assess attainment of designated uses from areas where historic information was lacking, or to track water quality trends across the state (there are two sites in the NWLP that are sampled to evaluate statewide trends).

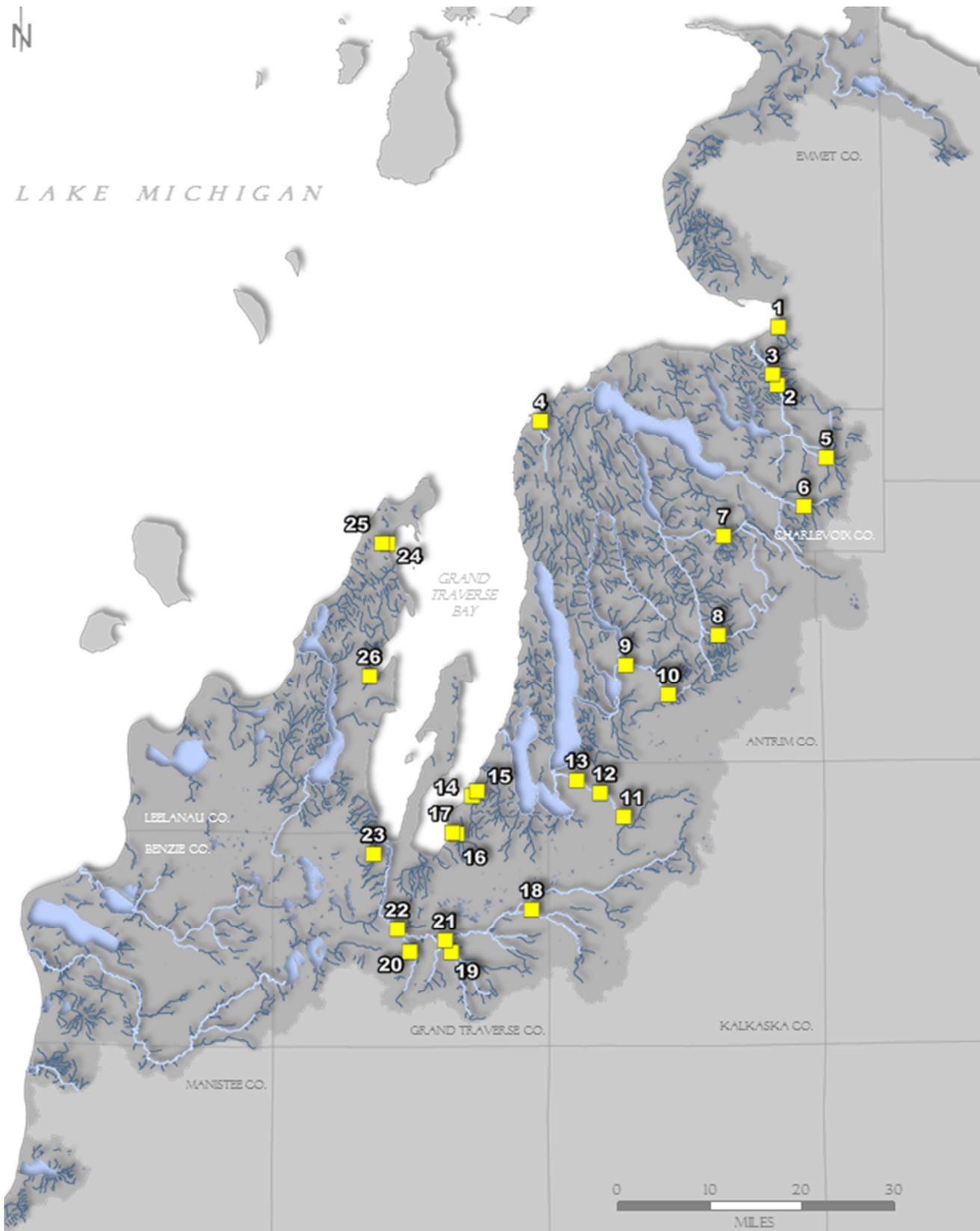


Figure 1. 2013 monitoring locations in the NWLP, Michigan.

## **Watershed Information**

Many streams within the NWLP drain relatively small coastal watersheds. Two of the larger watersheds in the region are the Boardman River and the Elk River Chain of Lakes. The Boardman River drains approximately 300 square miles of land in Kalkaska and Grand Traverse Counties and consists of approximately 130 miles of river and stream tributaries (MDNR, 1975). Twelve lakes also drain into the river system (MDNR, 1975). The Elk River Chain of Lakes watershed covers over 500 square miles in Antrim, Charlevoix, Grand Traverse, and Kalkaska Counties and is the largest subwatershed of Grand Traverse Bay. The Elk River Chain of Lakes includes Elk and Torch Lakes, two of the clearest and largest lakes in Michigan.

Most of the NWLP is located in the Northern Central Hardwood Forests ecoregion (Omernik and Gallant, 1988). The northeastern half of Emmet County and the eastern half of Kalkaska County are located in the Northern Lakes and Forest ecoregion (Omernik and Gallant, 1988). The region is a mixture of state and private forest and agricultural and urban land uses. Agriculture in the area is a mixture of fruit orchards, grain and row crops, and livestock production. Most agricultural practices are small and interspersed with residential and natural land. Tourism is a major industry in the region and land with access to, or views, of the region's water bodies is highly valued.

The 26 biological surveys performed in the region were located on the following streams (Table 1; Figure 1): Tannery Creek and Bear River in Emmet County; Inwood Creek, South Branch Spring Brook, North Branch Boyne River, and Deer Creek in Charlevoix County; Jordan River, unnamed tributary to Cedar River, and Cedar River in Antrim County; Rapid River in Kalkaska County; Yuba Creek, Acme Creek, South Branch Boardman River, East Creek, unnamed tributary to Jaxson Creek, Boardman River, and Kids Creek in Grand Traverse County; and Northport Creek and Leo Creek in Leelanau County.

There are a few water bodies in the NWLP that currently do not meet Michigan WQS. Kids Creek, from its confluence with the Boardman River upstream to US-31/M-37, is on the Clean Water Act Section 303(d) nonattainment list as not meeting the other indigenous aquatic life and wildlife designated use due to a poor macroinvertebrate community (Goodwin et al., 2014). A TMDL for Kids Creek is currently in development. Mitchell Creek in Antrim County does not attain designated uses because of elevated *E. coli* concentrations and will be part of the statewide *E. coli* TMDL. Elevated water column concentrations of PCBs in the Boardman River indicate the other indigenous aquatic life and wildlife designated use is not being met. A statewide PCB TMDL, including the Boardman River, has been submitted to the United States Environmental Protection Agency (USEPA) for approval.

## **2013 Macroinvertebrate and Habitat Biosurvey Sampling Results**

### Tannery Creek

Targeted and trend sites are noted in the ensuing discussion; otherwise, sites are randomly selected status sites (sites are labeled in Table 1). Tannery Creek was targeted for sampling downstream of US-31 (Station 1). The riffle/run habitat scored good (124; Table 3). The substrate was dominated by gravel and sand. The section of stream sampled was surrounded by many parking lots and roads and had an open canopy. The stream exhibited evidence of flashiness and the stream banks were moderately unstable. The upstream part of the stream section was altered by a sluiceway. The macroinvertebrate community scored acceptable

(-1; Table 2), was dominated by Amphipoda and Chironomidae taxa, and had only three pollution-intolerant Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa.

The habitat and macroinvertebrate community scores in 2013 were an improvement from scores recorded in 2008, which were marginal (104) for habitat and poor (-5) for macroinvertebrates (Holden, 2008). The improvement in these scores was likely due to the inclusion of a larger reach that contained less of the sluiceway. Lillard et al. (2013) summarized the results of intensive monitoring of the entire Tannery Creek watershed, which included Station 1, and found that site to be the most impacted site in the watershed. While Station 1 did not score poor, it is impacted by historic modifications to the channel and ongoing storm water impacts.

### Bear River

The Bear River in Emmet County was sampled upstream of Evergreen Trail (Station 2) and upstream of Click Road (Station 3). The glide/pool habitat of Station 2 scored good (144; Table 3). The substrate was dominated by sand and silt (visual estimation 98%) and heavy sediment deposits were present. The immediate riparian area was dominated by shrubs and lacked large trees for canopy cover and the recorded water temperature was 82° F. However, the overall surrounding area was mostly forest. The macroinvertebrate community scored acceptable (-2; Table 2) with a mix of pollution-tolerant and intolerant taxa. Tolerant taxa included six different Mollusca taxa and Isopoda. Pollution-intolerant taxa included four Ephemeroptera and six Trichoptera taxa.

Bear River was also sampled at the next road crossing downstream from Evergreen Trail at Click Road (Station 3), as a trend site. The glide/pool habitat scored good (143; Table 3). Similar to the upstream site, sediment was dominated by sand and silt (99% visual estimate). However, the banks appeared to be stable and there was no obvious evidence of flashiness. Along the left bank of the sampled section was one residential lawn, which reduced canopy cover and the recorded water temperature was 80° F. The majority of the surrounding riparian area was forested. The macroinvertebrate community scored acceptable (-2; Table 2). Similar to the upstream site at Evergreen Trail, the macroinvertebrate community consisted of a mix of pollution-tolerant and intolerant taxa. Six different taxa from the Isopod/leech/snail category were collected and five taxa each were collected from Ephemeroptera and Trichoptera orders.

The 2013 macroinvertebrate score at Station 2 was an improvement from the 2008 survey, which scored poor (-5). The 2013 habitat score was also slightly improved from the 2008 score (123). Station 3 was acceptable for macroinvertebrates in 2008 (2) as well, but the score decreased in 2013 (-2). The habitat score increased from 115 in 2008 to 143 in 2013.

Bear River is designated as a coldwater stream, and the Michigan Department of Natural Resources (MDNR) still actively stocks it with brown trout and rainbow trout (MDNR Fish Stocking Database, 2014). However, recorded temperatures were high. Walker (1994) sampled rainbow and brook trout in 1993, mostly near the mouth of the river. Walker (1994) also recorded elevated summer temperatures (68-70° F) and classified Bear River as a marginal trout stream.

### Inwood Creek

Inwood Creek was sampled at Clipperview Road (Station 4). The riffle/run habitat scored good (132; Table 3). The substrate was dominated by sand, with some gravel. There was a

moderate amount of large woody debris in the channel and extensive rootwads along the banks. Evidence of flashiness was present and banks were moderately stable to unstable. Evidence of new sand deposits was also present. Despite the presence of mowed lawns along sections of both banks, there was a heavy canopy cover (90%) and the surrounding area was mostly forested. The macroinvertebrate community scored acceptable (-2; Table 2) and was dominated by Simuliidae (60%), which are intermediately tolerant of pollution (Hilsenhoff, 1988).

### South Branch Spring Brook

South Branch Spring Brook was sampled at Chandler Hill Road (Station 5). The glide/pool habitat scored good (147; Table 3). Substrate was sand-dominated (95% visual estimate); however, woody debris was extensive in the channel. There was no evidence of flashiness, and the banks were well-protected and intact. The immediate and surrounding riparian area was intact forest and canopy cover was high (90% visual estimate). The macroinvertebrate community scored on the high end of acceptable (4; Table 2). The stream had a diverse number of taxa (33), including EPT taxa, but was dominated by a large number of Amphipoda (48%).

### North Branch Boyne River

North Branch Boyne River was sampled upstream of Springbrook Road (Station 6). The site was randomly selected, but was coincidentally sampled about one year after improvements were made to the Springbrook Road-stream crossing. Prior to 2012, two undersized, 36-inch culverts were in place. The undersized culverts retained water and sediment upstream of the road berm and the culverts were perched on the downstream side of the road berm. In 2012, a 28-foot span bridge replaced the culverts, allowing a more natural flow under the bridge (Conservation Resource Alliance, 2012; Figure 2).

The riffle/run habitat scored good (126; Table 3). The section of stream that was sampled had a steep gradient and fast flow. The substrate was predominantly gravel and cobble. The left bank had residential lawn, but the immediate right bank contained intact forest. The greater surrounding area was a mixture of forest and agriculture.



Figure 2. Before and after photos of Springbrook Road crossing. Photos taken by Kim Balke, Conservation Resource Alliance, and used with permission. Images accessed at [\(The link provided was broken and has been removed\)](#)

No immediate evidence of flashiness was apparent; however, the banks were very unstable and eroding (Figure 3). The soft nature of the banks was most likely the result of sediment accumulation behind the undersized culverts and associated road berm. Most likely after the culverts were replaced by the span bridge, the unimpeded, natural flow of the stream incised into the soft sediment. Because this site was visited only one year after the improved road crossing was put in place, and new soil was subsequently exposed when the channel narrowed, riparian vegetation still had not become established along the banks. The macroinvertebrate community scored excellent (6; Table 2). Twenty-five different taxa were present including three Ephemeroptera taxa, seven Trichoptera taxa, and four Plecoptera taxa.



Figure 3. Significantly eroding banks were observed in 2013 upstream of Springbrook Road on the north branch of the Boyne River.

### Deer Creek

Deer Creek was sampled upstream of Marvin Road (Station 7). The glide/pool habitat scored good (141; Table 3), which was similar to what Walker (2008) scored the site in 2003 (147). The substrate was entirely composed of sand and silt; however, moderate amounts of rootwads, large woody debris, and macrophytes were available for epifaunal colonization. There was also a high amount of coarse and fine organic matter. High amounts of sediment deposition were noted. Both Walker (2008) and the field biologists in the most recent survey noted that the culvert at the Marvin Road crossing was undersized and artificially retaining water and sediment behind the road berm. No evidence of flashiness was observed and the banks appeared to be stable. The section of stream that was sampled flowed through a wetland area, so there was a lack of large trees immediately alongside the stream. The stream generally flows parallel to Marvin Road for about 160 feet and only 50 to 80 feet away from the road, resulting in reduced riparian vegetation along the left bank and reduced canopy cover. The larger surrounding area is a mix of forest and agriculture.

The macroinvertebrate community scored acceptable (0; Table 2). Deer Creek had a high diversity with 35 different taxa, including EPT. However, it was dominated by Chironomidae larvae, and 17% of the community was composed of Gastropods, which are tolerant to in-stream stressors.

### Jordan River

Targeted monitoring was performed at the Jordan River at Pinney Bridge, off of Pinney Bridge Road (Station 8). The Jordan River was targeted for monitoring because a biosurvey had not been performed in the watershed since 2003 and there is considerable public interest in the water quality of the river. The riffle/run habitat scored excellent (168; Table 3). The substrate was sand-dominated; however, there was extensive large woody debris and undercut banks that provided habitat. Several in-stream islands also contributed to the habitat complexity. The immediate and greater surrounding area is intact forest. Walker (2003) also scored the habitat as excellent.

The macroinvertebrate community scored on the high end of acceptable (4; Table 2). Walker (2003) sampled a macroinvertebrate community that scored excellent in 2003. The site had a high diversity of taxa (32) including EPT. However, a high percentage of Oligochaeta (28.57%) was found, which brought the score down. While Oligochaeta are often viewed as being tolerant of pollution, Voshell (2002) points out that over 170 different species of Oligochaeta are found in North America, and that some of them are pollution sensitive. Coarse and fine particulate organic matter were estimated to cover 25% of the stream bottom, and it is possible that a dense accumulation of oligochaetes were sampled in an organic matter accumulation.

#### Unnamed tributary to the Cedar River

The small, unnamed intermittent tributary to the Cedar River that was sampled flows through a wetland/forest complex (Station 9). This site was a targeted sample because it has a long history of metal contamination that was first documented by Kenaga (1980). Anchor Danly (formerly Lamina Bronze Products) is located just upland of the stream. From 1971-1986 the company discharged treated copper-cyanide plating wastes to a seepage lagoon adjacent to the stream (Wilson, 1991). The Anchor Danly facility is a Resource Conservation and Recovery Act site overseen by the USEPA and the MDEQ, Waste and Hazardous Materials Division. The facility developed a post-closure plan in 1994 and completed clean-closure requirements in 1997. Monitoring was conducted by consultants for the USEPA in 2007 to compare to 1997 monitoring. The 2007 monitoring found two mayfly taxa in the unnamed tributary, but the Procedure 51 score was poor (Great Lakes Environmental Center [GLEC], 2008.)

In the 2013 survey, the glide/pool habitat scored excellent (159; Table 3). The stream flows adjacent to the main stem of the Cedar River, below the Blair Lake Spillway/South Derenzy Road (Station 9; Figure 4). The substrate was a sand/silt mixture that contained a high amount of organic matter. Aquatic

macrophytes and overhanging vegetation were abundant in the stream channel. There was no evidence of flashiness and the stream banks were intact. The immediate riparian area was composed of dense cattail stands; however, the greater area is surrounded by roads and parking lots as well as a small airport. The macroinvertebrate community scored poor (-6; Table 2). Only 12 different taxa were sampled and Isopoda dominated the community (74%). No EPT taxa were collected. This stream is very small and Procedure 51 is generally not an appropriate biological assessment tool for intermittent streams. The results are presented here because of historic use of the procedure at this location by the MDEQ and

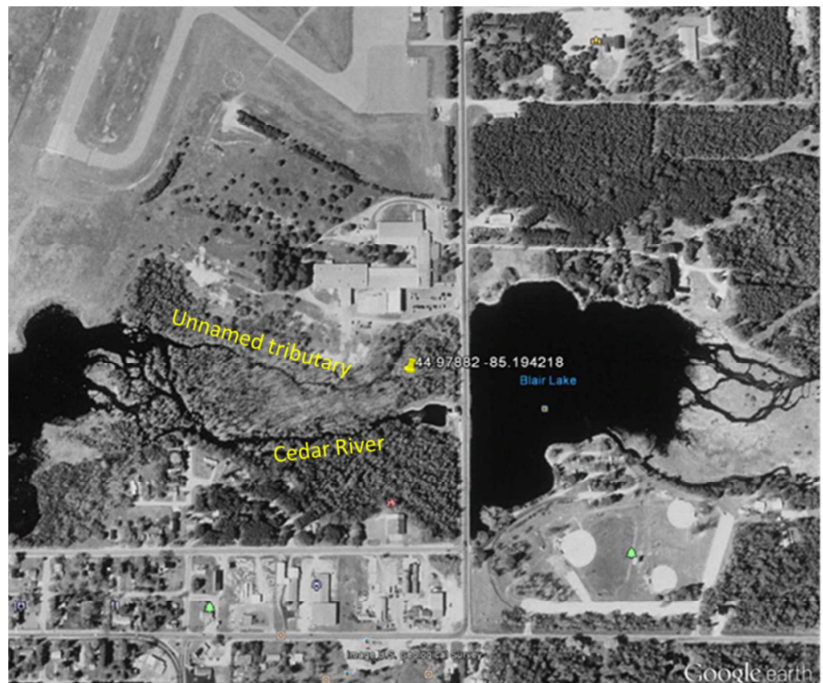


Figure 4. Aerial map of an unnamed tributary to Cedar River.

external parties. The presence of EPT taxa in 1998 and 2007 indicates that when there is enough water, the stream is used by sensitive taxa and we expect the stream to be meeting WQS.

### Cedar River

Cedar River was sampled upstream of Schuss Mountain Road (Station 10). The riffle/run habitat scored good (148; Table 3). The substrate was dominated by sand (70% visual estimate) and some gravel and cobble was present. Large woody debris was abundant and other habitat types (undercut banks, overhanging vegetation, macrophytes, and rootwads) were moderately present. As noted in other reports (Morse, 1992; Walker, 1999), the Cedar River flows over a large carbonate deposit further upstream, and as a result, marl sedimentation usually coats the substrate in this section of the Cedar River. This marl coating may limit macroinvertebrate colonization of available substrate. The Cedar River runs roughly parallel to Cedar River Drive (right bank) for about 350 feet, with the road about 100 feet away in some stretches, which diminished the riparian score. Starting about 500 feet above the Schuss Mountain Road crossing is a large clearing for power lines. The larger area around the site is mostly intact forest.

The macroinvertebrate community scored excellent (5; Table 2) with 33 different taxa and a diversity of EPT taxa. The habitat and macroinvertebrate scores were similar to past biosurveys at that site. Morse reported that both habitat and macroinvertebrates were good in 1991. In 1998, Walker (1999) reported that the macroinvertebrates were acceptable and the habitat was excellent.

About 4 miles to the southwest of Station 10, is the town of Mancelona. From Mancelona, a large groundwater plume of Trichloroethylene (TCE) has been slowly moving northwest towards the Cedar River (Street and Baughman, 2014). TCE is a known carcinogen to humans; however, little information is available regarding its effects on surface water quality. TCE is highly volatile, and typically volatilizes from surface water within hours of contacting it (Wu and Schaum, 2000). However, it is acutely toxic to invertebrates that are exposed to it (Kenaga, 1982). Because we have three prior surveys of the Cedar River dating back to 1991, and the TCE plume is flowing towards the river, we propose performing another biosurvey at this site in 2018.

### Rapid River

The Rapid River was sampled at three different locations: Wood Road (Station 11), Kellogg Road (Station 12), and Rapid City Road (Station 13). All stations scored excellent in both the riffle/run habitat and macroinvertebrate categories. Walker (2001) sampled four different stations for macroinvertebrates in 1998 and three out of the four scored excellent. Four stations were also sampled for fish, and only trout and mottled sculpin were collected.

The Station 11 riffle/run habitat scored excellent (180; Table 3). The station had a mixture of sand, gravel, and cobble substrate. Large woody debris and macrophytes were moderately available for epifaunal colonization instream, but other habitat types were sparse. The water temperature was cold and measured 56° F (air temperature was 82° F) at the time of sampling. The stream banks showed no evidence of stream flashiness and were stable. The immediate riparian area was reduced along one bank by a residential lawn. The greater surrounding area is a mixture of forest, residential, and agriculture. The macroinvertebrate community scored excellent (8; Table 2) with EPT taxa making up the majority of the community.



The Station 12 riffle/run habitat scored excellent (174; Table 3). The substrate was mostly sand, but also had a good mixture of gravel and cobble. Undercut banks, large woody debris, macrophytes, and rootwads were all present in moderate amounts. The water temperature was cold and measured 56° F (air temperature was 85° F) at the time of sampling. The banks showed no evidence of flashiness and were intact, although along the right bank, riparian vegetation was diminished by a residential lawn. The greater surrounding area is a mixture of forest, residential, and agricultural uses. The macroinvertebrate community scored excellent (5; Table 2). Thirty-five different taxa were collected and EPT taxa made up the majority of individuals collected.

The Station 13 riffle/run habitat scored excellent (167; Table 3). The substrate was an even mixture of sand, gravel, and cobble. Undercut banks and rootwads were moderately available for epifaunal colonization; however, other habitat types, such as large woody debris, were sparse. The water temperature was cold and measured 57° F at the time of sampling. No signs of flashiness were evident and the stream banks were well intact. A dense row of trees is present immediately alongside the banks; however, a park lawn diminishes some of the broader riparian zone. The greater surrounding area is a mix of forest and residential use. The macroinvertebrate community scored excellent (6; Table 2). Twenty-eight different taxa were collected and EPT taxa made up the majority of individuals sampled.

### Yuba Creek

Targeted sampling in Yuba Creek took place at Yuba Road (Station 14) and downstream of US-31 (Station 15). Station 14 was targeted because of previous poor macroinvertebrate scores and concerns about large sediment loads. Yuba Creek is a designated coldwater stream; however, Kosek (1994) was only able to collect 17 fish at Station 14. Only one of those fish was a trout and Kosek (1994) stated that Yuba Creek does not seem to be naturally producing trout. Macroinvertebrates scored fair at Station 14 by Kosek (1994) using the previous Procedure 51 scoring method. Holden (2008) sampled Station 14 in 2003 and rated the habitat as good and the macroinvertebrates as poor. That sampling occurred a few hours after a heavy rain event, which may have influenced the macroinvertebrate community and affected the score.



Figure 5. Yuba Creek at Yuba Road. Wetland plants are evident in channel.

The glide/pool habitat of Station 14 scored good (133; Table 3). The substrate was composed of sand and silt, and the water temperature at the time of sampling was 76° F. The stream channel contained an abundance of emergent macrophytes and flowed through a wetland (Figure 5). Undercut banks and rootwads were moderately abundant, but large woody debris and overhanging vegetation were sparse. Although the immediate channel was sinuous and did not exhibit evidence of stream flashiness, heavy sedimentation of fine organic material was evident. Other than a lack of large trees, the

immediate riparian area appeared to be intact and stable. An aerial view of the watershed above Station 14 revealed heavy agriculture near Yuba Creek and the headwaters appeared to begin in a large golf course. Haack et al. (2003) found that Yuba Creek is a significant contributor of *E. coli* to the Yuba Beach water in Grand Traverse Bay following rain events. The macroinvertebrate community scored poor (-6; Table 2). Unlike the previous time Station 14 was sampled, no significant rain event had occurred that day, or the week prior. Sixteen total taxa were collected, with very few EPT. The community was dominated by Amphipoda (52%) and Physidae snails (12%).

The glide/pool habitat of Station 15 scored good (144; Table 3). The substrate was mostly sand (65% visual estimation) with some gravel and cobble present. Large woody debris was moderately available as habitat and all other habitat types were either sparse or absent. Some evidence of channel alteration was present; small raw bank patches and sediment deposit piles were present. The immediate riparian vegetation was intact providing extensive canopy cover; however, the stream temperature was 76° F. The right bank had an extensive forest riparian area, although the stream runs roughly parallel to US-31 in the stretch that was sampled, diminishing the riparian area on the left bank. The greater surrounding area is a mix of forest, residential, and agricultural uses. The macroinvertebrate community scored acceptable (0; Table 2). This was similar to the score calculated for the macroinvertebrate community at that station in 2008 (acceptable; 1). The community was dominated by Amphipoda (50%), but also had a large percentage of Ephemeroptera taxa, mainly Heptageniidae. This site is approximately half a mile downstream of Station 14, which received a poor macroinvertebrate community score. The difference in score is likely due to the improved flow and substrate at Station 15 and the lack of the wetland-like conditions found at Station 14.

### Acme Creek

Two targeted sites in Acme Creek were sampled at M-72 (Station 16) and Creeks Crossing (Station 17). Acme Creek was targeted because it flows through a developing area, which has caused historic sedimentation concerns and low volunteer monitoring macroinvertebrate scores. The station 16 riffle/run habitat scored good (137; Table 3). The substrate was mostly sand with some silt that appeared to shift frequently and large sand deposits were present. Undercut banks and large woody debris were moderately available, but all other habitat types were sparse. The stream did not exhibit signs of flashiness and the banks appeared to be stable. The immediate riparian vegetation was mostly intact providing an estimated 70% canopy cover. Stream temperature at the time of sampling was 56° F (air temperature was 78° F). Not far beyond the immediate riparian vegetation is residential/commercial land use. The greater surrounding area is a mix of residential/commercial areas, agriculture, and forest. Upstream of Station 16, Acme Creek flows near a large agricultural field with minimal buffer vegetation between the stream and the field. The macroinvertebrate community scored acceptable (-1; Table 2). Macroinvertebrate taxa were dominated by Chironomidae and Amphipoda. Baetidae comprised 14% of the organisms collected, but were the only mayfly taxa.

The Station 17 glide/pool habitat scored good (120; Table 3). The substrate consisted of about 90% sand with some silt. The sand appeared to shift often and heavy sand deposits were evident. Undercut banks and large woody debris were moderately available, but all other habitat types were sparse. The large woody debris that was available did not seem to be well colonized by macroinvertebrates. Some evidence of flashiness and bank instability was present. The riparian vegetation was largely diminished by nearby residential land use. Upstream of Station 17 is a large golf course. Despite the diminished riparian area, water temperature was 56° F (air temperature was 78° F). The macroinvertebrate community scored

on the low end of acceptable (-4; Table 2). Only 12 different taxa were collected. Macroinvertebrate taxa were dominated by Chironomidae and Amphipoda and few Ephemeroptera and Trichoptera taxa were found.

Taft (1995) reported that the fish community of Acme Creek was dominated by trout and sculpin at three different locations. The macroinvertebrate communities at all three sites scored good. Holden (2008) reported that in 2003, the macroinvertebrate community scored acceptable at a site slightly upstream of Station 17.

In 2013, site visits were also made to three sites upstream of Station 16. The east branch of Acme Creek, off of Bunkerhill Road (44.754923, -85.454295), is a small channel, with cold water. The substrate is dominated by sand with approximately 25% gravel and a good amount of wood. A short search for macroinvertebrates found organisms from several sensitive taxa; Perlidae, Glossosomatidae, Brachycentridae, Leptoceridae, and Hydropsychidae. There was 100% canopy cover. The east branch of Acme Creek downstream of Lautner Road (44.763673, -85.475613) is downstream of a small (2 feet), undersized culvert. The channel has less canopy cover (60%) and more plant growth on the rocks. The substrate was a mixture of sand, gravel, and cobble. Macroinvertebrates found in a short search also included sensitive taxa; Hydropsychidae, Isopoda, Amphipoda, Glossosomatidae, Brachycentridae, Neophylax, and Limnephilidae. Rootwads and both coarse and fine organic matter were noted in the stream. The west branch of Acme Creek was observed downstream of Bunkerhill Road (44.758981, -85.483492). The substrate was 80% sand, with some cobble and silt. The canopy covered approximately 80% of the channel and there was minimal plants or algae growth observed. There were macroinvertebrates found during a short search, but included Perlidae and Isopoda.

### South Branch Boardman River

The South Branch Boardman River, a trend site, was sampled near a power line two-track off of South Branch Road (Station 18). The riffle/run habitat scored good (152; Table 2). The substrate was mostly sand with small amounts of gravel and cobble that was mostly embedded. Evidence of deposition was present. Large woody debris was extensive and all other habitat types were moderately available. There was no evidence of flashiness and the banks appeared to be stable. The riparian vegetation was mostly intact. The greater surrounding area is mostly forested. The macroinvertebrate community scored excellent (5; Table 2). Thirty-two different taxa were collected and the community was dominated by EPT.

### East Creek

East Creek was sampled at Mayfield Road (Station 19). The glide/pool habitat scored excellent (184; Table 3). The substrate consisted mostly of sand (estimated 60%) with a mix of silt and gravel. Some sand deposition was present. The stream had large amounts of available habitat for epifaunal colonization. No evidence of flashiness was present. The banks appeared stable except in two localized areas that are used for a horse trail crossing. The immediate riparian vegetation was intact and the greater surrounding area is mostly forest. The macroinvertebrate community scored excellent (5; Table 2). Thirty-two different taxa were collected and the community was dominated by EPT. This site was sampled in 2008 and the macroinvertebrate community scored a high acceptable (4; Holden, 2009).

### Unnamed tributary to Jaxon Creek

The unnamed tributary to Jaxon Creek was sampled at West Blair Town Hall Road (Station 20). The glide/pool habitat scored good (144; Table 3). The substrate consisted entirely of sand and silt, with deposition present. Large woody debris was extensive; however, a lot of it was out of the water because of low flows at the time of sampling. A large amount of the available channel was exposed. The banks did not exhibit signs of flashiness; however, the bank did appear to be unstable in spots near the road. The culvert at the road crossing appeared to be undersized and may have caused back-scouring that eroded the banks. The riparian vegetation was intact and the greater surrounding area was mostly forested. The macroinvertebrate community scored acceptable (0; Table 2). The community was dominated by Amphipoda (58%). Twenty different taxa were collected including some EPT.

### Boardman River

The Boardman River was sampled at Brown Bridge Dam Road (Station 21) and Boardman Plains Road (Station 22). These sites were targeted because almost one year earlier an uncontrolled water release occurred from Brown Bridge Dam, upstream of those sites, during a dam removal effort (2012 and 2013 photos are in Figure 6). Biosurveys were performed at both stations four days after the uncontrolled water release from the dam. At both stations, large amounts of new sand and gravel had been deposited. The river had a higher discharge than would normally be expected and the water was still turbid at that time. The 2012 monitoring data are presented in Tables 4 and 5 and all of the data are summarized in Table 6. The conclusions immediately following the 2012 monitoring included that (1) much of the original stream benthic substrate appeared to be buried throughout the river downstream of Brown Bridge Dam and (2) the macroinvertebrate community downstream of Brown Bridge Dam has been modified by the presence of lake insect species.

The riffle/run habitat at Station 21 scored excellent (160; Table 3) during the most recent survey. This was a slight improvement from the score it received immediately after the water release (142). The substrate only consisted of about 50% sand and an estimated 40% gravel. Large woody debris was moderately available and all other habitats were sparsely available. Islands with gravel on them added to the channel complexity, which were only recently added by the earlier uncontrolled release of water according to a riparian resident. The banks did not exhibit any signs of flashiness and appeared stable. The immediate riparian area was mostly intact forest, but some residential lawns diminished the riparian area. The greater surrounding area is mostly forested with some residential land use. The macroinvertebrate community scored on the high end of acceptable (4; Table 2). Thirty-one different taxa were collected and the community was dominated by EPT. This was an improvement from the macroinvertebrate community that was sampled immediately after the water release. At that time the community scored -2 (acceptable) and was composed mainly of Amphipoda, Isopoda, and Corixidae taxa. Those taxa are generally more associated with lentic environments, and had probably originated from the upstream impoundment at the time of sampling.

The riffle/run habitat at Station 22 scored good (134; Table 3). This was the same score given to that station immediately after the water release. The substrate was mostly sand and silt with some cobble and gravel present, but it was very embedded. Large sections of soft sediment were noted. Aquatic macrophytes were moderately available, and all other habitat types were sparsely available. Sampling took place above the Boardman Plains Road crossing, which appears to be undersized, and may explain the retention of soft sediments upstream of it. The banks did not exhibit any signs of flashiness; however, the left bank did show signs of erosion.

The riparian vegetation is largely broken up by residential lawns. The greater surrounding area is mostly forested. The macroinvertebrate community scored acceptable (0; Table 2). Thirty different taxa were collected; however, Corixidae was the dominant macroinvertebrate (23%). Corixidae are air-breathers that are very tolerant of stressors (Voshell, 2002). Despite the dominance by Corixidae, EPT taxa were also present. The most recent macroinvertebrate score was a decline from the score it received immediately after the water release (3; acceptable). In both surveys, Corixidae was the dominant taxa; however, the amount of EPT taxa collected declined in the most recent survey.



Figure 6. Boardman River on October 10, 2012 and September 25, 2013. Images taken downstream of Brown Bridge Dam Road looking downstream (A) and upstream (B).

Compared to the week following the dam release, the macroinvertebrate community at Station 21 has changed from one that is dominated by lake taxa to high quality stream macroinvertebrates (Table 6). Although there was still some sand and gravel at this location that will continue to move through the system into the near future, the macroinvertebrate community does not appear to be impacted by the dam release at the location. The large swales of sand observed at this site in 2012 were mostly gone in 2013. Large gravel islands or bars that formed in 2012 remained in 2013. At Station 22, which is approximately 7 miles downstream of Station 21, there was more evidence of large amounts of soft sand piles still moving through the stream. The macroinvertebrate community received a lower score in 2013 than in either 2008 (before the dam release) or 2012, and while it is not impacted to the point of not meeting Michigan WQS, the river appears to still be recovering from the large influx of soft sediment.

## Kids Creek

Kids Creek was sampled at Silver Lake Road (Station 23). This station is in a highly urbanized area and is currently on the 2014 Section 303(d) nonattainment list because it does not meet the Other Indigenous Aquatic Life and Wildlife designated use (AUID 040601050507-01) (Goodwin et al., 2014). This station was sampled in 2008 by Holden (2009) and the macroinvertebrate community received the lowest acceptable score (-4). This station was targeted to determine if the macroinvertebrate community is meeting WQS. The glide/pool habitat scored a low good (109; Table 3). The substrate was mostly sand and silt with minimal gravel. Large sand deposits were noted and large woody debris in the channel was very embedded. An extensive amount of aquatic macrophytes, including the non-native, invasive curly-leaf pond weed (*Potamogeton crispus*) was in the channel. Overhanging vegetation was moderately available and all other habitat types were sparse. Recent evidence of channel alteration was observed. While the surrounding area is mostly urban and the headwater origins are in a dense residential area, there was no development in the immediate riparian area. The stream banks appeared stable, but the riparian vegetation was mostly grasses and lacked large trees. The macroinvertebrate score was acceptable (-2; Table 2), a slight improvement from the last biosurvey. Only 20 different taxa were collected and similar to the previous biosurvey, Oligochaeta and Chironomidae were the dominant taxa. More EPT taxa were collected at Station 23 in 2013 than in 2008 (Holden, 2009); 6 EPT families vs 2 EPT families, respectively.

## Northport Creek

Northport Creek was sampled at Bay Street (Station 24) and 3rd Street (Station 25). Northport Creek was targeted because there was insufficient information for an Other Indigenous Aquatic Life and Wildlife designated use determination. In addition, Station 25 was last sampled in 2003 (Holden, 2008) prior to the introduction of a new Wastewater Treatment Plant groundwater discharge in Northport. The riffle/run habitat at Station 24 scored marginal (99; Table 3). The substrate was mostly sand and silt, with minimal gravel present. Moderate sand deposition was present. At the time of sampling, extensive mats of senesced algae were covering an estimated 30% of the stream bottom. Aquatic macrophytes and rootwads were extensive and overhanging vegetation was moderate. Undercut banks and large woody debris were sparse. Channel dredging was permitted to occur three months after the sampling event, which will likely degrade habitat further. The stream banks appeared to be stable; however, the stream has been largely channelized and the immediate surrounding land use is dense residential and commercial lots. The riparian area consists of mowed lawns, roads, and parking lots. The macroinvertebrate community received the lowest score in the acceptable range (-4; Table 2). Chironomidae dominated the taxa (63%). One individual Baetidae was sampled to represent Ephemeroptera taxa. Otherwise, no Trichoptera or Plecoptera taxa were present.

The glide/pool habitat at Station 25 scored good (122; Table 3). The substrate was mostly sand and silt, with large depositional areas noted. All stable habitat types were only sparsely available. A possible undersized culvert was noted at the road crossing. Riparian vegetation and bank protection was diminished by residential land use on both sides of the creek. The greater surrounding area upstream of the station is mostly forested; however, the Northport Wastewater Treatment Plant discharges to groundwater in the upper portion of the watershed. Nuisance plants were not present at this site in either July or September. The macroinvertebrate community scored acceptable (-2; Table 2). Twenty different taxa were collected and Amphipoda was the dominant macroinvertebrate found (40%).

All of the Northport Creek road crossings between Stations 24 and 25 were visually assessed in July 2013. Downstream of Station 25, Northport Creek flows through the Village of Northport and is in an urban environment. The millpond was noted to be full of plants and senescing algae. At Park Street the channel was full of plant roots and some moss-like plants on boulders, but plants were not considered to be at nuisance levels. Total phosphorus water samples were collected from Northport Creek on July 18 and September 9, 2013. The outlet of the millpond was sampled on both dates and had relatively low phosphorus concentrations (0.008 and 0.007 milligrams per liter, respectively). In September, a sample was collected at Station 25, upstream of the millpond, and the phosphorus concentration was 0.013 milligrams per liter, which is less than the average total phosphorus concentration found in northern Michigan streams (Roush, 2013.)

### Leo Creek

Leo Creek was sampled downstream of Reinke Road (Station 26). The riffle/run habitat scored marginal (103; Table 3). The substrate consisted mostly of sand (estimated 75%) with a mix of silt and gravel. Sand deposition was present and approximately 90% of the substrate was embedded. This is a small groundwater-fed stream with extensive bank erosion on the left bank, likely due to snowmelt. The immediate riparian vegetation was pine woodlot and then a mowed yard further away from the stream bank. The macroinvertebrate community scored poor (-5, Table 2). The community was dominated by Amphipoda (76% of the community), but did include 5 caddisfly taxa and one stonefly taxa. This stream was also sampled in 2003 and 2008 near the location of the 2013 survey. Both of the previous surveys resulted in macroinvertebrate communities that scored at the bottom of the acceptable range (-4) and described the substrate as sandy with minimal woody debris.

## **Summary of Results of Monitoring Objectives**

### **1. Identify NPS of water quality impairment.**

The road crossings at Deer Creek at Marvin Road (Station 7) and the unnamed tributary to Jaxon Creek (Station 20) were both noted as having undersized culverts. The associated road berm at Station 7 appeared to be artificially retaining water and sediment behind it. At Station 20, there appeared to be localized bank scouring near the culvert and road berm where back-scouring during high water events may have occurred. A large groundwater plume of TCE is currently flowing toward the Cedar River. Some media reports have already stated that the plume has reached the Cedar River. The most recent biosurvey scored the macroinvertebrate community as excellent and two previous surveys dating back to 1991 have scored the communities as good. We propose a targeted sampling event in 2018 in order to monitor any potential impacts of the TCE plume.

### **2. Evaluate the effectiveness of the NPS Program.**

About one year prior to the most recent sampling event, an improvement was made to the North Branch Boyne River-Springport Road crossing (Station 6). An undersized, perched culvert was replaced with a span bridge in 2012. The macroinvertebrate community scored excellent upstream of the improved road crossing. However, the banks of the stream were mostly sand, and highly erodible. This sand that is now making up the stream banks is most likely sediment that had been retained by the undersized culvert and associated road berm. We propose targeting this site in 2018 to see if habitat and the stream bank stability have improved.

**3. Assess the current status and condition of individual water bodies and determine if Michigan WQS are being met.**

Twenty-six Procedure 51 surveys were conducted as part of the regional assessment of the NWLP (Table 1). The macroinvertebrate scores of the 11 randomly selected sites ranged from 8 to -2, with 7 stations in the excellent range and 4 stations in the acceptable range. The 13 targeted stations were selected for a variety of reasons, but often because of uncertainty over previous surveys, concern over impacts in the watershed, or requests after low scores were obtained by volunteer groups. The macroinvertebrate scores of the 13 targeted stations ranged from 4 to -6, with 10 stations in the acceptable range and 3 stations in the poor range. The two trend surveys in the NWLP received scores of 5 and -2.

**4. Gather water quality data needed for TMDL development or delisting.**

The lower segment of Kids Creek is included on the Section 303(d) nonattainment list because of historic poor macroinvertebrate community scores. Station 23, Kids Creek at Silver Lake Road, is included in the impaired reach; however, the macroinvertebrate community score has not been in the poor range during any historic monitoring. Previous sampling resulted in Procedure 51 scores of -4, which is only one point above the poor threshold (Holden, 2009). The 2013 survey received a -2 Procedure 51 score. This new information will be taken into consideration while completing the 2016 Integrated Report and in developing the Kids Creek TMDL.

**5. Satisfy monitoring requests submitted by external and internal customers.**

Many different monitoring requests were submitted by NWLP-area stakeholders. The Watershed requested monitoring in Acme Creek because of excessive sedimentation and poor macroinvertebrate communities sampled by volunteers. At M-72 (Station 16), the macroinvertebrate community scored acceptable (-1). Macroinvertebrate taxa were dominated by Chironomidae and Amphipoda. Baetidae taxa comprised 14% of the taxa collected and there were a low number of air-breathing taxa. At Creek's Crossing Road (Station 17) the macroinvertebrate community scored a low acceptable (-4). Only 12 different taxa were collected. Macroinvertebrate taxa were dominated by Chironomidae and Amphipoda, with a few Ephemeroptera and Trichoptera taxa found. Sedimentation and possibly flashy flows did appear to be problems at that station. Although large woody debris was available as habitat, it was not well colonized. Evidence of flashiness and bank instability was evident. The station sampled is in an urban area, and the stream flows through part of a large golf course just above the station.

The Watershed Center requested targeted monitoring of Yuba Creek because of poor macroinvertebrate communities sampled by volunteers and also concerns about increasing development in the watershed. At US-31 (Station 15) the macroinvertebrate community scored acceptable (0). The community was dominated by Amphipoda (50%), but also had a large percentage of Ephemeroptera taxa, mainly Heptageniidae. However, further upstream at Yuba Road (Station 14), the macroinvertebrate community scored poor (-6). Sixteen total taxa were collected, with very few EPT. The community was dominated by Amphipoda (52%) and Physidae snails made up 12% of the community. As discussed earlier, the upper part of the watershed is largely agricultural and the headwaters of Yuba Creek appear to originate from a golf course. Kosek (1994) noted that even though Yuba Creek is a designated trout stream, it does not seem to be naturally producing trout. At both stations, recorded temperatures were 76° F, which would be too warm to sustain trout populations.



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Table 1. NWLP 2013 monitoring locations. Shaded rows = status sites; *Italics rows = trend sites.*

Site	Type	Waterbody Name	Location	County	Latitude	Longitude	Habitat		Macroinvertebrates	
							Rating	Score	Rating	Score
1	Targeted	Tannery Creek	Downstream US31	Emmet	45.3920	-84.9173	Good	124	Acceptable	-1
2	Status	Bear River	Evergreen Trail	Emmet	45.3208	-84.9208	Good	144	Acceptable	-2
3	<i>Trend</i>	<i>Bear River</i>	<i>Click Rd</i>	<i>Emmet</i>	<i>45.3340</i>	<i>-84.9290</i>	<i>Good</i>	<i>143</i>	<i>Acceptable</i>	<i>-2</i>
4	Status	Inwood Creek	Clipperview Road	Charlevoix	45.2795	-85.3416	Good	132	Acceptable	-2
5	Status	South Branch Spring Brook	Chandler Hill Road	Charlevoix	45.2304	-84.8359	Good	147	Acceptable	4
6	Status	North Branch Boyne River	Springbrook Road	Charlevoix	45.1714	-84.8765	Good	126	Excellent	6
7	Status	Deer Creek	Marvon Road	Charlevoix	45.1367	-85.0197	Good	141	Acceptable	0
8	Targeted	Jordan River	Pinney Bridge	Charlevoix	45.0142	-85.0310	Excellent	168	Acceptable	4
9	Targeted	Unnamed Trib to Cedar River	Lamina Bronze	Charlevoix	44.9788	-85.1942	Excellent	159	Poor	-6
10	Status	Cedar River	Schuss Mountain Road	Antrim	44.9420	-85.1200	Good	148	Excellent	5
11	Status	Rapid River	Wood Road	Antrim	44.7924	-85.2005	Excellent	180	Excellent	8
12	Status	Rapid River	Kellogg Road	Kalkaska	44.8222	-85.2413	Excellent	174	Excellent	5
13	Status	Rapid River	D/S Rapid City Road	Kalkaska	44.8380	-85.2824	Excellent	167	Excellent	6
14	Targeted	Yuba Creek	Yuba Rd	Kalkaska	44.8199	-85.4667	Good	133	Poor	-6
15	Targeted	Yuba Creek	d/s US31	Grand Traverse	44.8256	-85.4581	Good	144	Acceptable	0
16	Targeted	Acme Creek	M72	Grand Traverse	44.7729	-85.4940	Good	137	Acceptable	-1
17	Targeted	Acme Creek	Creeks Xing	Grand Traverse	44.7743	-85.5017	Good	120	Acceptable	-4
18	<i>Trend</i>	<i>S B Boardman River</i>	<i>Powerline off South Branch Rd</i>	<i>Grand Traverse</i>	<i>44.6789</i>	<i>-85.3638</i>	<i>Good</i>	<i>152</i>	<i>Excellent</i>	<i>5</i>
19	Status	East Creek	Mayfield Road	Grand Traverse	44.6276	-85.5049	Excellent	184	Excellent	5
20	Targeted	Unnamed Tributary to Jaxon Creek	Blair Townhall Road	Grand Traverse	44.6282	-85.5776	Good	144	Acceptable	0
21	Targeted	Boardman River	d/s Brown Bridge Dam Road	Grand Traverse	44.6419	-85.5154	Excellent	160	Acceptable	4
22	Targeted	Boardman River	Boardman Plains Rd	Grand Traverse	44.6557	-85.5995	Good	134	Acceptable	0
23	Targeted	Kid's Creek	Silver Lake Road	Grand Traverse	44.7489	-85.6407	Good	109	Acceptable	-2
24	Targeted	Northport Creek	Bay Street	Leelanau	45.1305	-85.6128	Marginal	99	Acceptable	-4
25	Targeted	Northport Creek	3rd Street	Leelanau	45.1309	-85.6232	Good	122	Acceptable	-2
26	Targeted	Leo Creek	d/s Reinke Road	Leelanau	44.9672	-85.6462	Marginal	103	Poor	-5

Table 2A. Qualitative macroinvertebrate sampling results for Traverse Bay watershed streams, 2013.

TAXA	Tannery Creek Downstream US 31 7/15/2013 STATION 1	Bear River Evergreen Road 7/15/2013 STATION 2	Bear River Click Road 7/15/2013 STATION 3	Inwood Creek Clipperview Road 7/16/2013 STATION 4
<b>ANNELIDA (segmented worms)</b>				
Hirudinea (leeches)			1	
Oligochaeta (worms)	11	2		6
<b>ARTHROPODA</b>				
<b>Crustacea</b>				
Amphipoda (scuds)	135	29	77	1
Decapoda (crayfish)	1	1	2	
Isopoda (sowbugs)	1	37	2	
<b>Arachnoidea</b>				
Hydracarina	5	2	2	3
<b>Insecta</b>				
<b>Ephemeroptera (mayflies)</b>				
Baetiscidae		2	1	
Baetidae	22	8	9	7
Caenidae		2	5	
Ephemerellidae			1	
Heptageniidae		6	7	
Leptophlebiidae				9
<b>Odonata</b>				
<b>Anisoptera (dragonflies)</b>				
Aeshnidae	1	2	3	1
Cordulegastridae	1		1	1
Gomphidae		1	4	
Libellulidae		3		
<b>Zygoptera (damselflies)</b>				
Calopterygidae	1	6	1	3
Coenagrionidae		1		
<b>Plecoptera (stoneflies)</b>				
Nemouridae				2
<b>Hemiptera (true bugs)</b>				
Belostomatidae		1	1	
Corixidae		8	14	
Gerridae	2			7
Pleidae		1		
<b>Megaloptera</b>				
Corydalidae (dobson flies)				1
Sialidae (alder flies)				1
<b>Trichoptera (caddisflies)</b>				
Brachycentridae		1	30	1
Glossosomatidae				2
Helicopsychidae		1	1	
Hydropsychidae	2	22	51	7
Hydroptilidae	3	5		1
Lepidostomatidae				1
Leptoceridae		20	21	
Polycentropodidae		1	5	
<b>Lepidoptera (moths)</b>				
Pyralidae		1		
<b>Coleoptera (beetles)</b>				
Dytiscidae (total)				5
Hydrophilidae (total)				1
Dryopidae				2
Elmidae	1	17	10	4
<b>Diptera (flies)</b>				
Ceratopogonidae		1		
Chironomidae	124	14	19	33
Dixidae		1		
Simuliidae	60	2		180
Tabanidae				1
Tipulidae	3			1
<b>MOLLUSCA</b>				
<b>Gastropoda (snails)</b>				
Ancylidae (limpets)		2		
Bithyniidae		31	8	
Physidae	6	6	3	16
Planorbidae		1		1
Viviparidae			2	
<b>Pelecypoda (bivalves)</b>				
Sphaeriidae (clams)	1	31	2	2
Unionidae (mussels)		1		
<b>TOTAL INDIVIDUALS</b>	<b>380</b>	<b>270</b>	<b>283</b>	<b>300</b>

Table 2B. Macroinvertebrate metric evaluation of Traverse Bay watershed streams, 2013.

METRIC	Tannery Creek Downstream US 31 7/15/2013 STATION 1		Bear River Evergreen Road 7/15/2013 STATION 2		Bear River Click Road 7/15/2013 STATION 3		Inwood Creek Clipperview Road 7/16/2013 STATION 4	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	18	1	35	1	27	1	28
NUMBER OF MAYFLY TAXA	1	0	4	0	5	1	2	1
NUMBER OF CADDISFLY TAXA	2	0	6	1	5	0	5	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	1	0
PERCENT MAYFLY COMP.	5.79	-1	6.67	-1	8.13	-1	5.33	-1
PERCENT CADDISFLY COMP.	1.32	-1	18.52	-1	38.16	0	4.00	-1
PERCENT DOMINANT TAXON	35.53	0	13.70	1	27.21	0	60.00	-1
PERCENT ISOPOD, SNAIL, LEECH	1.84	0	28.52	-1	5.65	-1	5.67	-1
PERCENT SURF. AIR BREATHERS	0.53	1	3.70	-1	5.30	-1	4.33	-1
TOTAL SCORE		-1		-2		-2		-2
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for Traverse Bay watershed streams, 2013.

TAXA	South Branch Spring Brook Chandler Hill Road 7/16/2013 STATION 5	North Branch Boyne River Springbrook Road 7/16/2013 STATION 6	Deer Creek Marvon Road 7/16/2013 STATION 7	Jordan River Pinney Bridge 7/17/2013 STATION 8
<b>ANNELIDA (segmented worms)</b>				
Hirudinea (leeches)			1	
Oligochaeta (worms)	3	20	10	78
<b>ARTHROPODA</b>				
<b>Crustacea</b>				
Amphipoda (scuds)	169	6	55	7
Decapoda (crayfish)	3		2	
Isopoda (sowbugs)		1		3
<b>Arachnoidea</b>				
Hydracarina	1	1	2	2
<b>Insecta</b>				
<b>Ephemeroptera (mayflies)</b>				
Baetiscidae			1	5
Baetidae	9	37	7	24
Caenidae			6	
Ephemerellidae	6	12		39
Ephemeridae	3		1	1
Heptageniidae	2	4	4	7
Leptophlebiidae	1		1	1
Tricorythidae	41		9	
<b>Odonata</b>				
<b>Anisoptera (dragonflies)</b>				
Aeshnidae			3	
Cordulegastridae	1	1		2
Gomphidae	3			
<b>Zygoptera (damselflies)</b>				
Calopterygidae	8		4	
<b>Plecoptera (stoneflies)</b>				
Leuctridae		6		
Nemouridae		43		1
Perlidae	1			
Perlodidae		8		1
Pteronarcyidae	1	5	1	4
<b>Hemiptera (true bugs)</b>				
Corixidae			2	
Gerridae	1			
Notonectidae				1
<b>Megaloptera</b>				
Corydalidae (dobson flies)	1			
Sialidae (alder flies)			1	1
<b>Trichoptera (caddisflies)</b>				
Brachycentridae	3	10	1	8
Glossosomatidae		7		1
Helicopsychidae	1			
Hydropsychidae	15	5	5	8
Hydroptilidae		8		1
Lepidostomatidae		10		3
Leptoceridae	4		7	
Limnephilidae	7		2	3
Molannidae				1
Philopotamidae	1	14		
Polycentropodidae	1			1
Rhyacophilidae		5	1	
<b>Coleoptera (beetles)</b>				
Dytiscidae (total)	1	1	3	
Hydrophilidae (total)	1		1	
Elmidae	1	1	6	2
Gyrinidae (larvae)			1	
<b>Diptera (flies)</b>				
Athericidae				6
Ceratopogonidae			1	3
Chironomidae	34	36	73	38
Dixidae			1	
Simuliidae	9	6	7	12
Tabanidae	3	2	5	
Tipulidae	1			1
<b>MOLLUSCA</b>				
<b>Gastropoda (snails)</b>				
Hydrobiidae			40	
Physidae	1		3	
Planorbidae		1		1
Pleuroceridae			3	
<b>Pelecypoda (bivalves)</b>				
Sphaeriidae (clams)	12		1	7
<b>TOTAL INDIVIDUALS</b>	<b>349</b>	<b>250</b>	<b>271</b>	<b>273</b>

Table 2B. Macroinvertebrate metric evaluation of Traverse Bay watershed streams, 2013.

METRIC	South Branch Spring Brook Chandler Hill Road 7/16/2013 STATION 5		North Branch Boyne River Springbrook Road 7/16/2013 STATION 6		Deer Creek Marvon Road 7/16/2013 STATION 7		Jordan River Pinney Bridge 7/17/2013 STATION 8	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	33	1	25	1	35	1	32	1
NUMBER OF MAYFLY TAXA	6	1	3	0	7	1	6	1
NUMBER OF CADDISFLY TAXA	7	1	7	1	5	0	8	1
NUMBER OF STONEFLY TAXA	2	1	4	1	1	0	3	1
PERCENT MAYFLY COMP.	17.77	0	21.20	0	10.70	0	28.21	0
PERCENT CADDISFLY COMP.	9.17	-1	23.60	0	5.90	-1	9.52	-1
PERCENT DOMINANT TAXON	48.42	-1	17.20	1	26.94	0	28.57	0
PERCENT ISOPOD, SNAIL, LEECH	0.29	1	0.80	1	17.34	-1	1.47	0
PERCENT SURF. AIR BREATHERS	0.86	1	0.40	1	2.21	0	0.37	1
TOTAL SCORE		4		6		0		4
MACROINV. COMMUNITY RATING		ACCEPT.		EXCELLENT		ACCEPT.		ACCEPT.



Table 2A. Qualitative macroinvertebrate sampling results for Traverse Bay watershed streams, 2013.

TAXA	Unnamed Tributary to Cedar River Lamina Bronze 7/17/2013 STATION 9	Cedar River Schuss Mountain Road 7/17/2013 STATION 10	Rapid River Wood Road 9/10/2013 STATION 11	Rapid River Kellogg Road 9/10/2013 STATION 12
<b>PLATYHELMINTHES (flatworms)</b>				
Turbellaria		1	1	
<b>ANNELIDA (segmented worms)</b>				
Oligochaeta (worms)	28	29	19	10
<b>ARTHROPODA</b>				
<b>Crustacea</b>				
Amphipoda (scuds)		56		11
Isopoda (sowbugs)	193			
<b>Arachnoidea</b>				
Hydracarina		10	9	8
<b>Insecta</b>				
<b>Ephemeroptera (mayflies)</b>				
Baetiscidae			1	
Baetidae		32	21	55
Caenidae		9		3
Ephemerellidae		1	9	12
Ephemeridae		1	1	
Heptageniidae			2	1
Leptophlebiidae		8		1
Tricorythidae			1	4
<b>Odonata</b>				
<b>Zygoptera (damselflies)</b>				
Calopterygidae				1
<b>Plecoptera (stoneflies)</b>				
Leuctridae		1		
Nemouridae		2		
Perlidae			6	1
Perlodidae			3	5
Pteronarcyidae		1	3	7
Taeniopterygidae				1
<b>Hemiptera (true bugs)</b>				
Belostomatidae		1		1
Corixidae		1		
Gerridae	1	1		
Notonectidae	1			
<b>Megaloptera</b>				
Sialidae (alder flies)				1
<b>Trichoptera (caddisflies)</b>				
Brachycentridae		6	47	13
Glossosomatidae		3	17	3
Hydropsychidae		3	15	41
Hydroptilidae		14		13
Lepidostomatidae		6		
Leptoceridae		1	18	4
Limnephilidae		10	61	14
Molannidae		1		1
Philopotamidae				1
Polycentropodidae			1	1
Rhyacophilidae		1		
Uenoidae				3
<b>Coleoptera (beetles)</b>				
Dytiscidae (total)	1	1		
Hydrophilidae (total)	3	1		
Elmidae		15	15	4
<b>Diptera (flies)</b>				
Athericidae			3	3
Ceratopogonidae	3	6	1	9
Chironomidae	16	62	41	27
Simuliidae		6	7	10
Tabanidae	1	1		
Tipulidae	2		1	3
<b>MOLLUSCA</b>				
<b>Gastropoda (snails)</b>				
Physidae	4	1	1	12
<b>Pelecypoda (bivalves)</b>				
Pisidiidae				1
Sphaeriidae (clams)	8	7	14	2
<b>TOTAL INDIVIDUALS</b>	<b>261</b>	<b>299</b>	<b>318</b>	<b>287</b>

Table 2B. Macroinvertebrate metric evaluation of Traverse Bay watershed streams, 2013.

METRIC	Unnamed Tributary to Cedar River Lamina Bronze 7/17/2013 STATION 9		Cedar River Schuss Mountain Road 7/17/2013 STATION 10		Rapid River Wood Road 9/10/2013 STATION 11		Rapid River Kellogg Road 9/10/2013 STATION 12	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	12	1	33	1	26	1	35	1
NUMBER OF MAYFLY TAXA	0	-1	5	1	6	1	6	1
NUMBER OF CADDISFLY TAXA	0	-1	9	1	6	1	10	1
NUMBER OF STONEFLY TAXA	0	-1	3	1	3	1	4	1
PERCENT MAYFLY COMP.	0.00	-1	17.06	0	11.01	0	26.48	0
PERCENT CADDISFLY COMP.	0.00	-1	15.05	-1	50.00	1	32.75	0
PERCENT DOMINANT TAXON	73.95	-1	20.74	1	19.18	1	19.16	1
PERCENT ISOPOD, SNAIL, LEECH	75.48	-1	0.33	1	0.31	1	4.18	-1
PERCENT SURF. AIR BREATHERS	2.30	0	1.67	0	0.00	1	0.35	1
TOTAL SCORE		-6		5		8		5
MACROINV. COMMUNITY RATING		POOR		EXCELLENT		EXCELLENT		EXCELLENT



Table 2A. Qualitative macroinvertebrate sampling results for Traverse Bay watershed streams, 2013.

TAXA	Rapid River Rapid River Road 9/10/2013 STATION 13	Yuba Creek Yuba Road 9/10/2013 STATION 14	Yuba Creek US 131 9/10/2013 STATION 15	Acme Creek M72 9/9/2013 STATION 16
<b>ANNELIDA (segmented worms)</b>				
Oligochaeta (worms)	4		7	2
<b>ARTHROPODA</b>				
<b>Crustacea</b>				
Amphipoda (scuds)	5	152	150	93
Decapoda (crayfish)		14	2	
Isopoda (sowbugs)	3			1
<b>Arachnoidea</b>				
Hydracarina		3		2
<b>Insecta</b>				
<b>Ephemeroptera (mayflies)</b>				
Baetidae	49	4	7	43
Ephemerellidae	21			
Ephemeridae			1	
Heptageniidae	6		87	
Leptophlebiidae	1			
Tricorythidae	1			
<b>Odonata</b>				
<b>Anisoptera (dragonflies)</b>				
Aeshnidae	2	9	1	
Cordulegastriidae	1			
<b>Zygoptera (damselflies)</b>				
Calopterygidae	1	6	7	
<b>Plecoptera (stoneflies)</b>				
Nemouridae				1
Perlidae		1		
Pteronarcyidae	1			
Taeniopterygidae	1			
<b>Hemiptera (true bugs)</b>				
Corixidae		11		1
Geridae	1		1	
Pleidae				1
<b>Megaloptera</b>				
<b>Corydalidae (dobson flies)</b>				
Sialidae (alder flies)		5	1	
<b>Trichoptera (caddis flies)</b>				
Brachycentridae	9			1
Glossosomatidae	37		3	
Hydropsychidae	72	4	13	1
Leptoceridae	1			
Limnephilidae	4	5		1
Molannidae	3			
Phryganeidae		3		3
Polycentropodidae	1			
Rhyacophilidae				6
Uenoidae			1	
<b>Coleoptera (beetles)</b>				
<b>Gyrinidae (adults)</b>				
Gyrinidae (adults)		8		
<b>Halplidae (adults)</b>				
Halplidae (adults)		1		
Elmidae	2		3	
<b>Diptera (flies)</b>				
<b>Athericidae</b>				
Athericidae	14			
<b>Ceratopogonidae</b>				
Ceratopogonidae	1			10
<b>Chironomidae</b>				
Chironomidae	14	31	5	120
<b>Simuliidae</b>				
Simuliidae	33			14
<b>Tabanidae</b>				
Tabanidae				1
<b>Tipulidae</b>				
Tipulidae			1	1
<b>MOLLUSCA</b>				
<b>Gastropoda (snails)</b>				
Physidae	1	34		
<b>Pelecypoda (bivalves)</b>				
Sphaeriidae (clams)	2			
<b>TOTAL INDIVIDUALS</b>	<b>291</b>	<b>291</b>	<b>300</b>	<b>302</b>

Table 2B. Macroinvertebrate metric evaluation of Traverse Bay watershed streams, 2013.

METRIC	Rapid River Rapid River Road 9/10/2013 STATION 13		Yuba Creek Yuba Road 9/10/2013 STATION 14		Yuba Creek US 131 9/10/2013 STATION 15		Acme Creek M72 9/9/2013 STATION 16	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	28	1	16	0	17	0	18
NUMBER OF MAYFLY TAXA	5	1	1	-1	3	0	1	-1
NUMBER OF CADDISFLY TAXA	7	1	3	0	3	0	5	0
NUMBER OF STONEFLY TAXA	2	1	1	0	0	-1	1	0
PERCENT MAYFLY COMP.	26.80	0	1.37	-1	31.67	1	14.24	0
PERCENT CADDISFLY COMP.	43.64	1	4.12	-1	5.67	-1	3.97	-1
PERCENT DOMINANT TAXON	24.74	0	52.23	-1	50.00	-1	39.74	-1
PERCENT ISOPOD, SNAIL, LEECH	1.37	0	11.68	-1	0.00	1	0.33	1
PERCENT SURF. AIR BREATHERS	0.34	1	6.87	-1	0.33	1	0.66	1
TOTAL SCORE		6		-6		0		-1
MACROINV. COMMUNITY RATING		EXCELLENT		POOR		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for Traverse Bay watershed streams, 2013.

TAXA	Acme Creek Creeks Xing 9/9/2013 STATION 17	South Branch Boardman River Powerline off South Branch 7/17/2013 STATION 18	East Creek Mayfield Road 7/18/2013 STATION 19	Unnamed Tributary to Blair Townhall Road 7/18/2013 STATION 20
<b>ANNELIDA (segmented worms)</b>				
Oligochaeta (worms)	44	17	15	4
<b>ARTHROPODA</b>				
<b>Crustacea</b>				
Amphipoda (scuds)	105	6	5	142
Isopoda (sowbugs)	1			
<b>Arachnoidea</b>				
Hydracarina	1	3	1	1
<b>Insecta</b>				
<b>Ephemeroptera (mayflies)</b>				
Baetiscidae		1		
Baetidae	16	34	7	11
Caenidae			1	
Ephemerellidae		47	12	
Ephemeridae		2	1	
Heptageniidae		4	1	
Leptophlebiidae		1		2
Tricorythidae		3	3	
<b>Odonata</b>				
<b>Anisoptera (dragonflies)</b>				
Aeshnidae		1	1	2
Cordulegastridae			1	
<b>Zygoptera (damselflies)</b>				
Calopterygidae			1	
<b>Plecoptera (stoneflies)</b>				
Leuctridae		1		4
Nemouridae		9	5	2
Perlidae			1	
Perlodidae		2		
Pteronarcyidae			2	
<b>Hemiptera (true bugs)</b>				
Gerridae		2	1	4
Veliidae	1			
<b>Megaloptera</b>				
<b>Corydalidae (dobson flies)</b>				
Sialidae (alder flies)				1
<b>Trichoptera (caddisflies)</b>				
Brachycentridae	7	6	65	
Glossosomatidae		2	3	
Hydropsychidae		4	7	1
Lepidostomatidae		4	11	22
Leptoceridae		1		
Limnephilidae	1	14	2	2
Molannidae		2		
Philopotamidae			5	
Rhyacophilidae	4		1	
<b>Coleoptera (beetles)</b>				
<b>Dytiscidae (total)</b>				
Gyrinidae (adults)			1	
<b>Hydrophilidae (total)</b>				
Elmidae		2	4	
<b>Diptera (flies)</b>				
Athericidae		16	1	
Chironomidae	149	56	64	21
Ptychopteridae				1
Simuliidae	25	9	4	
Tabanidae		2	3	3
Tipulidae	4			
<b>MOLLUSCA</b>				
<b>Gastropoda (snails)</b>				
Physidae		4		4
Pomatiopsidae		1		
<b>Pelecypoda (bivalves)</b>				
Sphaeriidae (clams)		4	3	3
<b>TOTAL INDIVIDUALS</b>	<b>358</b>	<b>262</b>	<b>235</b>	<b>243</b>

Table 2B. Macroinvertebrate metric evaluation of Traverse Bay watershed streams, 2013.

METRIC	Acme Creek Creeks Xing 9/9/2013 STATION 17		South Branch Boardman River Powerline off South Branch Road 7/17/2013 STATION 18		East Creek Mayfield Road 7/18/2013 STATION 19		Unnamed Tributary to Jaxon Creek Blair Townhall Road 7/18/2013 STATION 20	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	12	-1	32	1	32	1	20	1
NUMBER OF MAYFLY TAXA	1	-1	7	1	6	1	2	1
NUMBER OF CADDISFLY TAXA	3	0	7	1	7	1	3	1
NUMBER OF STONEFLY TAXA	0	-1	3	1	3	1	2	1
PERCENT MAYFLY COMP.	4.47	-1	35.11	1	10.64	0	5.35	-1
PERCENT CADDISFLY COMP.	3.35	-1	12.60	-1	40.00	0	10.29	-1
PERCENT DOMINANT TAXON	41.62	-1	21.37	1	27.66	0	58.44	-1
PERCENT ISOPOD, SNAIL, LEECH	0.28	1	1.91	0	0.00	1	1.65	0
PERCENT SURF. AIR BREATHERS	0.28	1	1.53	0	1.70	0	7.41	-1
TOTAL SCORE		-4		5		5		0
MACROINV. COMMUNITY RATING		ACCEPT.		EXCELLENT		EXCELLENT		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for Traverse Bay watershed streams, 2013.

TAXA	Boardman River downstream Brown Bridge Dam Road 9/25/2013 STATION 21	Boardman River Boardman Plains Road 9/25/2013 STATION 22	Kids Creek Silver Lake Road 7/19/2013 STATION 23	Northport Creek Bay Street 7/18/2013 STATION 24
PORIFERA (sponges)		1		
PLATYHELMINTHES (flatworms)				
Turbellaria	1			10
ANNELIDA (segmented worms)				
Hirudinea (leeches)				1
Oligochaeta (worms)	13	26	136	5
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	4	1	25	28
Decapoda (crayfish)	1	1		
Isopoda (sowbugs)	1		39	1
Arachnoidea				
Hydracarina		2	12	6
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae	1	3		
Baetidae	72	30	13	1
Ephemerellidae	77	31		
Heptageniidae	6	3		
Leptophlebiidae	4			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	1		
Zygoptera (damselflies)				
Calopterygidae	3	1		
Plecoptera (stoneflies)				
Nemouridae			1	
Perlidae	16	8		
Pteronarcyidae	2			
Hemiptera (true bugs)				
Corixidae	10	73	1	
Geridae			1	1
Mesoveliidae				1
Nepidae	1			
Megaloptera				
Corydalidae (dobson flies)	3	1		
Trichoptera (caddisflies)				
Brachycentridae	2	6		
Helicopsychidae		1		
Hydropsychidae	44	35	1	
Hydroptilidae			6	
Lepidostomatidae			1	
Leptoceridae	1			
Linnephilidae	1	3	1	
Philopotamidae	1			
Polycentropodidae	1	3		
Coleoptera (beetles)				
Dytiscidae (total)			1	4
Halplidae (adults)		1		1
Elmidae	11	22	2	1
Diptera (flies)				
Athericidae	8	9	4	11
Ceratopogonidae		2		14
Chironomidae	32	17	138	213
Diixidae	1			
Ephydriidae		1		
Simuliidae	15	20	14	28
Tabanidae		2		
Tipulidae		3	1	5
MOLLUSCA				
Gastropoda (snails)				
Bithyniidae	5			
Lymnaeidae		1		
Physidae			5	1
Planorbidae				2
Pelecypoda (bivalves)				
Dreissenidae	1			
Sphaeriidae (clams)	1	9	8	
TOTAL INDIVIDUALS	341	317	410	334



Table 2B. Macroinvertebrate metric evaluation of Traverse Bay watershed streams, 2013.

METRIC	Boardman River downstream Brown Bridge Dam		Boardman River Boardman Plains Road		Kids Creek Silver Lake Road		Northport Creek Bay Street	
	Road		Road		Road		Road	
	9/25/2013		9/25/2013		7/19/2013		7/18/2013	
	STATION 21		STATION 22		STATION 23		STATION 24	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	31	1	30	1	20	1	19	1
NUMBER OF MAYFLY TAXA	5	1	4	0	1	-1	1	0
NUMBER OF CADDISFLY TAXA	6	1	5	0	4	0	0	-1
NUMBER OF STONEFLY TAXA	2	1	1	0	1	0	0	-1
PERCENT MAYFLY COMP.	46.92	1	21.14	0	3.17	-1	0.30	-1
PERCENT CADDISFLY COMP.	14.66	-1	15.14	-1	2.20	-1	0.00	-1
PERCENT DOMINANT TAXON	22.58	1	23.03	0	33.66	0	63.77	-1
PERCENT ISOPOD, SNAIL, LEECH	1.76	0	0.32	1	10.73	-1	1.50	0
PERCENT SURF. AIR BREATHERS	3.23	-1	23.34	-1	0.73	1	2.10	0
TOTAL SCORE		4		0		-2		-4
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for Traverse Bay watershed streams, 2013.

TAXA	Northport Creek Melkild Road (3rd St) 9/9/2013 STATION 25	Leo Creek D/S Reinke Road 7/18/2013 STATION 26
<b>ANNELIDA (segmented worms)</b>		
Oligochaeta (worms)	38	4
<b>ARTHROPODA</b>		
<b>Crustacea</b>		
Amphipoda (scuds)	116	224
Isopoda (sowbugs)	1	12
<b>Arachnoidea</b>		
Hydracarina	1	1
<b>Insecta</b>		
<b>Ephemeroptera (mayflies)</b>		
Baetidae	23	6
<b>Odonata</b>		
<b>Anisoptera (dragonflies)</b>		
Aeshnidae		1
<b>Plecoptera (stoneflies)</b>		
Nemouridae		3
<b>Hemiptera (true bugs)</b>		
Gerridae	2	1
Pleidae	1	
Veliidae	3	
<b>Trichoptera (caddisflies)</b>		
Glossosomatidae		2
Hydropsychidae	4	7
Lepidostomatidae		1
Limnephilidae	15	7
Molannidae		1
<b>Coleoptera (beetles)</b>		
Dytiscidae (total)	2	
Haliplidae (adults)		2
Hydrophilidae (total)		1
Elmidae		3
Haliplidae (larvae)	1	
<b>Diptera (flies)</b>		
Ceratopogonidae	15	
Chironomidae	33	9
Culicidae	1	
Simuliidae	15	5
Tabanidae	15	1
Tipulidae	1	
<b>MOLLUSCA</b>		
<b>Gastropoda (snails)</b>		
Planorbidae	1	
<b>Pelecypoda (bivalves)</b>		
Pisidiidae	2	
Sphaeriidae (clams)		1
<b>TOTAL INDIVIDUALS</b>	<b>290</b>	<b>292</b>

Table 2B. Macroinvertebrate metric evaluation of Traverse Bay watershed streams, 2013.

METRIC	Northport Creek Melkild Road (3rd St) 9/9/2013 STATION 25		Leo Creek D/S Reinke Road 7/18/2013 STATION 26	
	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	20	1	20
NUMBER OF MAYFLY TAXA	1	0	1	-1
NUMBER OF CADDISFLY TAXA	2	1	5	0
NUMBER OF STONEFLY TAXA	0	-1	1	0
PERCENT MAYFLY COMP.	7.93	-1	2.05	-1
PERCENT CADDISFLY COMP.	6.55	-1	6.16	-1
PERCENT DOMINANT TAXON	40.00	-1	76.71	-1
PERCENT ISOPOD, SNAIL, LEECH	0.69	1	4.11	-1
PERCENT SURF. AIR BREATHERS	3.10	-1	1.37	0
TOTAL SCORE		-2		-5
MACROINV. COMMUNITY RATING		ACCEPT.		POOR

Table 3. Habitat evaluation for Traverse Bay watershed streams, 2013.

	Tannery Creek Downstream US 31 RIFPLE/RUN Station 1	Bear River Evergreen Road GLIDE/POOL Station 2	Bear River Upstream Click Road GLIDE/POOL Station 3	Inwood Creek Clipperview Road RIFPLE/RUN Station 4	South Branch Spring Brook Chandler Hill Road GLIDE/POOL Station 5
<b>HABITAT METRIC</b>					
<b>Substrate and Instream Cover</b>					
Epifaunal Substrate/ Avail Cover (20)	16	11	11	15	9
Embeddedness (20)*	14			12	
Velocity/Depth Regime (20)*	13			13	
Pool Substrate Characterization (20)**		10	10		12
Pool Variability (20)**		11	13		15
<b>Channel Morphology</b>					
Sediment Deposition (20)	15	4	6	10	7
Flow Status - Maint. Flow Volume (10)	8	9	9	6	9
Flow Status - Flashiness (10)	4	9	10	4	10
Channel Alteration (20)	5	18	18	20	18
Frequency of Riffles/Bends (20)*	16			18	
Channel Sinuosity (20)**		18	16		11
<b>Riparian and Bank Structure</b>					
Bank Stability (L) (10)	3	9	10	4	9
Bank Stability (R) (10)	5	9	8	6	9
Vegetative Protection (L) (10)	8	8	9	6	9
Vegetative Protection (R) (10)	8	8	8	8	9
Riparian Veg. Zone Width (L) (10)	4	10	10	4	10
Riparian Veg. Zone Width (R) (10)	5	10	5	6	10
<b>TOTAL SCORE (200):</b>	124	144	143	132	147
<b>HABITAT RATING:</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>
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).					
Date:	7/15/2013	7/15/2013	7/15/2013	7/16/2013	7/16/2013
Weather:	Sunny	Sunny	Sunny	Sunny	Sunny
Air Temperature:	83 Deg. F.	85 Deg. F.	85 Deg. F.	75 Deg. F.	94 Deg. F.
Water Temperature:	68 Deg. F.	82 Deg. F.	80 Deg. F.	66 Deg. F.	72 Deg. F.
Ave. Stream Width:	7 Feet	30 Feet	20 Feet	5 Feet	16 Feet
Ave. Stream Depth:	0.3 Feet	2 Feet	2.5 Feet	0.3 Feet	0.8 Feet
Surface Velocity:	1 Ft./Sec.	0.5 Ft./Sec.	1 Ft./Sec.	1 Ft./Sec.	1.1 Ft./Sec.
Estimated Flow:	2.1 CFS	30 CFS	50 CFS	1.5 CFS	14.08 CFS
Stream Modifications:	Bank Stabilization	None	None	None	None
Nuisance Plants (Y/N):	N	N	N	N	N
STORET No.:	240196	240197	240193	150243	150244
Stream Name:	Tannery Creek	Bear River	Bear River	Inwood Creek	South Branch Spring Brook
Road Crossing/Location:	Downstream US 31	Evergreen Road	Upstream Click Road	Clipperview Road	Chandler Hill Road
County:	Emmet	Emmet	Emmet	Charlevoix	Charlevoix
TRS:	35N05W33	34N05W21	34N05W21	33N08W06	33N04W29
Latitude (dd):	45.39202	45.32075	45.334	45.27946	45.23043
Longitude (dd):	-84.9173	-84.92083	-84.929	-85.34161	-84.83593
Ecoregion:	NCHF	NCHF	NCHF	NCHF	NCHF
Stream Type:	Coldwater	Coldwater	Coldwater		
USGS Basin Code:	4060105	4060105	4060105	4060105	4060105

\* Applies only to Riffle/Run stream Surveys

\*\* Applies only to Glide/Pool stream Surveys

Table 3. Habitat evaluation for Traverse Bay watershed streams, 2013.

	North Branch Boyne River Springbrook Road RIFFLE/RUN Station 6	Deer Creek Marvon Road GLIDE/POOL Station 7	Jordan River Pinney Bridge RIFFLE/RUN Station 8	Unnamed Tributary to Cedar River Lamina Bronze GLIDE/POOL Station 9	Cedar River Schuss Mountain Road RIFFLE/RUN Station 10
<b>HABITAT METRIC</b>					
<b>Substrate and Instream Cover</b>					
Epifaunal Substrate/ Avail Cover (20)	13	6	15	11	15
Embeddedness (20)*	16		11		9
Velocity/Depth Regime (20)*	15		14		14
Pool Substrate Characterization (20)**		9		11	
Pool Variability (20)**		13		8	
<b>Channel Morphology</b>					
Sediment Deposition (20)	8	6	10	13	5
Flow Status - Maint. Flow Volume (10)	8	9	10	10	10
Flow Status - Flashiness (10)	0	9	10	10	10
Channel Alteration (20)	19	20	20	18	19
Frequency of Riffles/Bends (20)*	19		18		12
Channel Sinuosity (20)**		15		18	
<b>Riparian and Bank Structure</b>					
Bank Stability (L) (10)	0	10	10	10	10
Bank Stability (R) (10)	2	10	10	10	10
Vegetative Protection (L) (10)	6	9	10	10	10
Vegetative Protection (R) (10)	8	9	10	10	10
Riparian Veg. Zone Width (L) (10)	3	10	10	10	10
Riparian Veg. Zone Width (R) (10)	9	6	10	10	4
<b>TOTAL SCORE (200):</b>	<b>126</b>	<b>141</b>	<b>168</b>	<b>159</b>	<b>148</b>
<b>HABITAT RATING:</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>EXCELLENT (NON- IMPAIRED)</b>	<b>EXCELLENT (NON- IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>
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).					
<b>Date:</b>	7/16/2013	7/16/2013	7/17/2013	7/17/2013	7/17/2013
<b>Weather:</b>	Sunny	Sunny	Sunny	Sunny	Sunny
<b>Air Temperature:</b>	94 Deg. F.	80 Deg. F.	92 Deg. F.	80 Deg. F.	85 Deg. F.
<b>Water Temperature:</b>	62 Deg. F.	67 Deg. F.	62 Deg. F.	61 Deg. F.	58 Deg. F.
<b>Ave. Stream Width:</b>	18 Feet	20 Feet	50 Feet	1.5 Feet	70 Feet
<b>Ave. Stream Depth:</b>	0.8 Feet	1.5 Feet	1.8 Feet	0.3 Feet	1 Feet
<b>Surface Velocity:</b>	2 Ft./Sec.	0.6 Ft./Sec.	2 Ft./Sec.	0.5 Ft./Sec.	1.5 Ft./Sec.
<b>Estimated Flow:</b>	28.8 CFS	18 CFS	180 CFS	0.225 CFS	105 CFS
<b>Stream Modifications:</b>	Bank Stabilization	None	None	None	None
<b>Nuisance Plants (Y/N):</b>	N	N	N	N	N
<b>STORET No.:</b>	150245	150170	50166	50198	50175
<b>Stream Name:</b>	North Branch Boyne River	Deer Creek	Jordan River	Unnamed Tributary to Cedar River	Cedar River
<b>Road Crossing/Location:</b>	Springbrook Road	Marvon Road	Pinney Bridge	Lamina Bronze	Schuss Mountain Road
<b>County:</b>	Charlevoix	Charlevoix	Charlevoix	Charlevoix	Antrim
<b>TRS:</b>	32N05W13	32N06W26	30N06W09	32N07W19	29N07W02
<b>Latitude (dd):</b>	45.17142	45.1367	45.014167	44.97882	44.942
<b>Longitude (dd):</b>	-84.87653	-85.01972	-85.031	-85.194218	-85.12
<b>Ecoregion:</b>	NCHF	NCHF	NCHF	NCHF	NCHF
<b>Stream Type:</b>	Coldwater	Coldwater	Coldwater	Warmwater	Coldwater
<b>USGS Basin Code:</b>	4060105	4060105	4060105	4060105	4060105

\* Applies only to Riffle/Run stream Surveys

\*\* Applies only to Glide/Pool stream Surveys

Table 3. Habitat evaluation for Traverse Bay watershed streams, 2013.

	Rapid River Wood Road RIFFLE/RUN Station 11	Rapid River Kellogg Road RIFFLE/RUN Station 12	Rapid River Rapid River Road RIFFLE/RUN Station 13	Yuba Creek Yuba Road GLIDE/POOL Station 14	Yuba Creek US 31 GLIDE/POOL Station 15
<b>HABITAT METRIC</b>					
<b>Substrate and Instream Cover</b>					
Epifaunal Substrate/ Avail Cover (20)	18	18	16	7	17
Embeddedness (20)*	13	11	13		
Velocity/Depth Regime (20)*	18	18	15		
Pool Substrate Characterization (20)**				11	13
Pool Variability (20)**				3	11
<b>Channel Morphology</b>					
Sediment Deposition (20)	14	12	12	3	11
Flow Status - Maint. Flow Volume (10)	10	10	10	10	9
Flow Status - Flashiness (10)	10	10	10	9	9
Channel Alteration (20)	20	20	20	18	15
Frequency of Riffles/Bends (20)*	19	19	19		
Channel Sinuosity (20)**				16	15
<b>Riparian and Bank Structure</b>					
Bank Stability (L) (10)	10	10	10	10	8
Bank Stability (R) (10)	10	10	10	10	8
Vegetative Protection (L) (10)	10	10	10	8	8
Vegetative Protection (R) (10)	10	9	10	8	8
Riparian Veg. Zone Width (L) (10)	8	10	6	10	4
Riparian Veg. Zone Width (R) (10)	10	7	6	10	8
<b>TOTAL SCORE (200):</b>	<b>180</b>	<b>174</b>	<b>167</b>	<b>133</b>	<b>144</b>
<b>HABITAT RATING:</b>	<b>EXCELLENT (NON- IMPAIRED)</b>	<b>EXCELLENT (NON- IMPAIRED)</b>	<b>EXCELLENT (NON- IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>
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).					
Date:	9/10/2013	9/10/2013	9/10/2013	9/10/2013	9/10/2013
Weather:	Sunny	Sunny	Sunny	Sunny	Partly Cloudy
Air Temperature:	82 Deg. F.	85 Deg. F.	Deg. F.	84 Deg. F.	83 Deg. F.
Water Temperature:	56 Deg. F.	56 Deg. F.	57 Deg. F.	76 Deg. F.	76 Deg. F.
Ave. Stream Width:	30 Feet	20 Feet	25 Feet	12 Feet	13 Feet
Ave. Stream Depth:	1.5 Feet	15 Feet	1.5 Feet	1 Feet	0.5 Feet
Surface Velocity:	1.8 Ft./Sec.	2 Ft./Sec.	2 Ft./Sec.	0.8 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	81 CFS	600 CFS	75 CFS	9.6 CFS	6.5 CFS
Stream Modifications:	None	None	None	None	Bank Stabilization
Nuisance Plants (Y/N):	N	N	N	N	N
STORET No.:	400104	400165	400108	280300	280404
Stream Name:	Rapid River	Rapid River	Rapid River	Yuba Creek	Yuba Creek
Road Crossing/Location:	Wood Road	Kellogg Road	Rapid River Road	Yuba Road	US 31
County:	Antrim	Kalkaska	Kalkaska	Kalkaska	Grand Traverse
TRS:	28N07W30	28N08W14	28N08W09	28N10W13	28N10W13
Latitude (dd):	44.7924122	44.822217	44.83797	44.81989	44.825569
Longitude (dd):	-85.2004758	-85.241328	-85.28242	-85.46667	-85.458126
Ecoregion:	NCHF	NCHF	NCHF	NCHF	NCHF
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060105	4060105	4060105	4060105	4060105

\* Applies only to Riffle/Run stream Surveys

\*\* Applies only to Glide/Pool stream Surveys

Table 3. Habitat evaluation for Traverse Bay watershed streams, 2013.

	Acme Creek M72 RIFFLE/RUN Station 16	Acme Creek Creeks Xing GLIDE/POOL Station 17	South Branch Boardman River Powerline off South Branch Road RIFFLE/RUN Station 18	East Creek Mayfield Road GLIDE/POOL Station 19	Unnamed Tributary to Jaxon Creek Blair Townhall Road GLIDE/POOL Station 20
<b>HABITAT METRIC</b>					
<b>Substrate and Instream Cover</b>					
Epifaunal Substrate/ Avail Cover (20)	10	7	12	16	11
Embeddedness (20)*	13		7		
Velocity/Depth Regime (20)*	13		15		
Pool Substrate Characterization (20)**		11		19	8
Pool Variability (20)**		11		18	8
<b>Channel Morphology</b>					
Sediment Deposition (20)	4	5	9	13	10
Flow Status - Maint. Flow Volume (10)	9	9	10	10	5
Flow Status - Flashiness (10)	9	8	10	10	9
Channel Alteration (20)	18	16	20	20	20
Frequency of Riffles/Bends (20)*	11		12		
Channel Sinuosity (20)**		15		19	18
<b>Riparian and Bank Structure</b>					
Bank Stability (L) (10)	10	8	10	10	9
Bank Stability (R) (10)	10	8	10	10	8
Vegetative Protection (L) (10)	9	8	9	10	9
Vegetative Protection (R) (10)	8	8	9	9	9
Riparian Veg. Zone Width (L) (10)	8	3	10	10	10
Riparian Veg. Zone Width (R) (10)	5	3	9	10	10
<b>TOTAL SCORE (200):</b>	<b>137</b>	<b>120</b>	<b>152</b>	<b>184</b>	<b>144</b>
<b>HABITAT RATING:</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>EXCELLENT (NON- IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>
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).					
<b>Date:</b>	9/9/2013	9/9/2013	7/17/2013	7/18/2013	7/18/2013
<b>Weather:</b>	Partly Cloudy	Sunny	Sunny	Sunny	Sunny
<b>Air Temperature:</b>	78 Deg. F.	78 Deg. F.	92 Deg. F.	84 Deg. F.	78 Deg. F.
<b>Water Temperature:</b>	56 Deg. F.	56 Deg. F.	63 Deg. F.	63 Deg. F.	55 Deg. F.
<b>Ave. Stream Width:</b>	17 Feet	18 Feet	35 Feet	15 Feet	3 Feet
<b>Ave. Stream Depth:</b>	1.1 Feet	0.8 Feet	1 Feet	1.2 Feet	0.2 Feet
<b>Surface Velocity:</b>	1.3 Ft./Sec	1.5 Ft./Sec.	1 Ft./Sec.	1 Ft./Sec.	0.3 Ft./Sec.
<b>Estimated Flow:</b>	24.31 CFS	21.6 CFS	35 CFS	18 CFS	0.18 CFS
<b>Stream Modifications:</b>	None	None	None	None	None
<b>Nuisance Plants (Y/N):</b>	N	N	N	N	N
<b>STORET No.:</b>	280422	280421	280405	280318	280420
<b>Stream Name:</b>	Acme Creek	Acme Creek	South Branch Boardman River	East Creek	Unnamed Tributary to Jaxon Creek
<b>Road Crossing/Location:</b>	M72	Creeks Xing	Powerline off South Branch Road	Mayfield Road	Blair Townhall Road
<b>County</b>	Grand Traverse	Grand Traverse	Grand Traverse	Grand Traverse	Grand Traverse
<b>TRS:</b>	27N10W2	28N10W3	26N09W02	26N10W27	26N11W25
<b>Latitude (dd):</b>	44.772861	44.774263	44.6789	44.62764	44.628159
<b>Longitude (dd):</b>	-85.494046	-85.501728	-85.36378	-85.50488	-85.577583
<b>Ecoregion:</b>	NCHF	NCHF	NCHF	NCHF	NCHF
<b>Stream Type:</b>	Coldwater	Coldwater	Coldwater	Coldwater	
<b>USGS Basin Code:</b>	4060105	4060105	4060105	4060105	4060105

\* Applies only to Riffle/Run stream Surveys

\*\* Applies only to Glide/Pool stream Surveys

Table 3. Habitat evaluation for Traverse Bay watershed streams, 2013.

	Boardman River downstream Brown Bridge Dam Road RIFFLE/RUN Station 21	Boardman River Boardman Plains Road RIFFLE/RUN Station 22	Kids Creek Silver Lake Road GLIDE/POOL Station 23	Northport Creek Bay Street RIFFLE/RUN Station 24	Northport Creek Melkild Road (3rd St) GLIDE/POOL Station 25
<b>HABITAT METRIC</b>					
<b>Substrate and Instream Cover</b>					
Epifaunal Substrate/ Avail Cover (20)	14	8	7	7	4
Embeddedness (20)*	9	7		11	
Velocity/Depth Regime (20)*	15	14		10	
Pool Substrate Characterization (20)**			12		11
Pool Variability (20)**			8		13
<b>Channel Morphology</b>					
Sediment Deposition (20)	10	4	6	7	5
Flow Status - Maint. Flow Volume (10)	10	10	9	9	8
Flow Status - Flashiness (10)	10	10	9	9	9
Channel Alteration (20)	20	20	7	6	18
Frequency of Riffles/Bends (20)*	15	15		8	
Channel Sinuosity (20)**			13		18
<b>Riparian and Bank Structure</b>					
Bank Stability (L) (10)	10	7	9	9	8
Bank Stability (R) (10)	10	10	9	9	8
Vegetative Protection (L) (10)	10	7	4	4	7
Vegetative Protection (R) (10)	10	9	4	4	7
Riparian Veg. Zone Width (L) (10)	7	5	6	3	4
Riparian Veg. Zone Width (R) (10)	10	8	6	3	2
<b>TOTAL SCORE (200):</b>	<b>160</b>	<b>134</b>	<b>109</b>	<b>99</b>	<b>122</b>
<b>HABITAT RATING:</b>	<b>EXCELLENT (NON- IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>	<b>MARGINAL (MODERATELY IMPAIRED)</b>	<b>GOOD (SLIGHTLY IMPAIRED)</b>
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).					
Date:	9/25/2013	9/25/2013	7/19/2013	7/18/2013	9/9/2013
Weather:	Sunny	Sunny	Sunny	Sunny	Cloudy
Air Temperature:	50 Deg. F.	55 Deg. F.	83 Deg. F.	85 Deg. F.	70 Deg. F.
Water Temperature:	48 Deg. F.	49 Deg. F.	67 Deg. F.	65 Deg. F.	55 Deg. F.
Ave. Stream Width:	60 Feet	35 Feet	8 Feet	4 Feet	3 Feet
Ave. Stream Depth:	1.5 Feet	2.2 Feet	1 Feet	0.3 Feet	0.3 Feet
Surface Velocity:	1.5 Ft./Sec.	2 Ft./Sec.	0.8 Ft./Sec.	1 Ft./Sec.	1.1 Ft./Sec.
Estimated Flow:	135 CFS	154 CFS	6.4 CFS	1.2 CFS	0.99 CFS
Stream Modifications:	None	None	Dredged	Canopy Removal	Canopy Removal
Nuisance Plants (Y/N):	N	N	N	N	N
STORET No.:	280419	280409	280408	450140	450155
Stream Name:	Boardman River downstream Brown	Boardman River Boardman	Kids Creek Silver Lake	Northport Creek	Northport Creek Melkild Road
Road Crossing/Location:	Bridge Dam Road	Plains Road	Road	Bay Street	(3rd St)
County	Grand Traverse	Grand Traverse	Grand Traverse	Leelanau	Leelanau
TRS:	26N10W22	26N11W14	27N11W09	32N11W03	32N11W34
Latitude (dd):	44.64185	44.655737	44.748882	45.13054	45.1309
Longitude (dd):	-85.51544	-85.599502	-85.640684	-85.61284	-85.6232
Ecoregion:	NCHF	NCHF	NCHF	NCHF	NCHF
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060105	4060105	4060105	4060104	4060105

\* Applies only to Riffle/Run stream Surveys

\*\* Applies only to Glide/Pool stream Surveys



Table 3. Habitat evaluation for Traverse Bay watershed streams, 2013.

Leo Creek  
downstream Reinke Road  
RIFFLE/RUN  
Station 26

**HABITAT METRIC**

<b>Substrate and Instream Cover</b>	
Epifaunal Substrate/ Avail Cover (20)	8
Embeddedness (20)*	3
Velocity/Depth Regime (20)*	14
Pool Substrate Characterization (20)**	
Pool Variability (20)**	
<b>Channel Morphology</b>	
Sediment Deposition (20)	4
Flow Status - Maint. Flow Volume (10)	6
Flow Status - Flashiness (10)	5
Channel Alteration (20)	13
Frequency of Riffles/Bends (20)*	14
Channel Sinuosity (20)**	
<b>Riparian and Bank Structure</b>	
Bank Stability (L) (10)	5
Bank Stability (R) (10)	7
Vegetative Protection (L) (10)	8
Vegetative Protection (R) (10)	5
Riparian Veg. Zone Width (L) (10)	6
Riparian Veg. Zone Width (R) (10)	5
<hr/>	
TOTAL SCORE (200):	103

HABITAT RATING: MARGINAL  
(MODERATELY  
IMPAIRED)

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).

Date: 1/0/1900  
Weather: Sunny  
Air Temperature: 95 Deg. F.  
Water Temperature: 63 Deg. F.  
Ave. Stream Width: 10 Feet  
Ave. Stream Depth: 0.5 Feet  
Surface Velocity: 1 Ft./Sec.  
Estimated Flow: 5 CFS  
Stream Modifications: None  
Nuisance Plants (Y/N): N  
Report Number:  
  
STORET No.: 450238  
Stream Name: Leo Creek  
Road Crossing/Location: downstream Reinke Road  
County Code: 45  
TRS: 30N11W33  
  
Latitude (dd): 44.967232  
Longitude (dd): -85.646205  
Ecoregion: NCHF  
Stream Type: Coldwater  
  
USGS Basin Code: 4060105

\* Applies only to Riffle/Run stream Surveys  
\*\* Applies only to Glide/Pool stream Surveys

Table 4A. Qualitative macroinvertebrate sampling results for the Boardman River, 2012 and 2013. The 2013 data is also presented in Table 2.

TAXA	Boardman River d/s Brown Bridge Dam Rd		Boardman River Boardman Plains Road	
	10/10/2012 STATION 21	9/25/2013 STATION 21	10/10/2012 STATION 22	9/25/2013 STATION 22
PORIFERA (sponges)				1
PLATYHELMINTHES (flatworms)				
Turbellaria	1	1		
ANNELIDA (segmented worms)				
Hirudinea (leeches)			1	
Oligochaeta (worms)	2	13	1	26
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	79	4	1	1
Decapoda (crayfish)	1	1	1	1
Isopoda (sowbugs)	60	1	2	
Arachnoidea				
Hydracarina	1		3	2
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae	2	1		3
Baetidae	6	72	39	30
Caenidae	2			
Ephemerellidae	3	77	31	31
Heptageniidae		6	34	3
Isonychiidae			3	
Leptophlebiidae	1	4	1	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	2	3	1
Zygoptera (damselflies)				
Calopterygidae	2	3	6	1
Coenagrionidae	2			
Plecoptera (stoneflies)				
Perlidae	1	16		8
Pteronarcyidae		2		
Hemiptera (true bugs)				
Corixidae	56	10	49	73
Nepidae		1		
Megaloptera				
Corydalidae (dobson flies)	1	3	1	1
Sialidae (alder flies)	2			
Trichoptera (caddisflies)				
Brachycentridae		2	20	6
Helicopsychidae			4	1
Hydropsychidae	7	44	21	35
Lepidostomatidae			1	
Leptoceridae		1	1	
Limnephilidae	3	1	3	3
Philopotamidae	2	1		
Polycentropodidae		1		3
Coleoptera (beetles)				
Dytiscidae (total)			1	
Gyrinidae (adults)	1			
Halpidae (adults)	5			1
Elmidae	1	11	6	22
Diptera (flies)				
Athericidae		8	8	9
Ceratopogonidae	2		1	2
Chironomidae	17	32	13	17
Dixidae		1		
Ephydriidae				1
Simuliidae		15	5	20
Tabanidae				2
Tipulidae	1			3
MOLLUSCA				
Gastropoda (snails)				
Bithyniidae		5		
Hydrobiidae	1			
Lymnaeidae				1
Physidae	1		1	
Planorbidae	1		1	
Pleuroceridae	5			
Pelecypoda (bivalves)				
Dreissenidae	15	1		
Sphaeriidae (clams)	2	1		9
TOTAL INDIVIDUALS	288	341	262	317

Table 4B. Macroinvertebrate metric evaluation of the Boardman River.

METRIC	Boardman River d/s Brown Bridge Dam Rd				Boardman River Boardman Plains Road			
	10/10/2012		9/25/2013		10/10/2012		9/25/2013	
	STATION 21		STATION 21		STATION 22		STATION 22	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	33	1	31	1	29	1	30	1
NUMBER OF MAYFLY TAXA	5	1	5	1	5	1	4	0
NUMBER OF CADDISFLY TAXA	3	0	6	1	6	1	5	0
NUMBER OF STONEFLY TAXA	1	0	2	1	0	-1	1	0
PERCENT MAYFLY COMP.	4.86	-1	46.92	1	41.22	1	21.14	0
PERCENT CADDISFLY COMP.	4.17	-1	14.66	-1	19.08	0	15.14	-1
PERCENT DOMINANT TAXON	27.43	0	22.58	1	18.70	1	23.03	0
PERCENT ISOPOD, SNAIL, LEECH	23.61	-1	1.76	0	1.91	0	0.32	1
PERCENT SURF. AIR BREATHERS	21.53	-1	3.23	-1	19.08	-1	23.34	-1
TOTAL SCORE		-2		4		3		0
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 5. Habitat evaluation for the Boardman River, 2012 and 2013. The 2013 data is also presented in Table 2.

HABITAT METRIC	Boardman River downstream Brown Bridge Dam Road Station 21 RIFFLE/RUN		Boardman River Boardman Plains Road Station 22 RIFFLE/RUN	
	10/10/2012	9/25/2013	10/10/2012	9/25/2013
	<b>Substrate and Instream Cover</b>			
Epifaunal Substrate/ Avail Cover (20)	6	14	9	8
Embeddedness (20)*	6	9	9	7
Velocity/Depth Regime (20)*	14	15	14	14
Pool Substrate Characterization (20)**				
Pool Variability (20)**				
<b>Channel Morphology</b>				
Sediment Deposition (20)	3	10	6	4
Flow Status - Maint. Flow Volume (10)	10	10	10	10
Flow Status - Flashiness (10)	10	10	10	10
Channel Alteration (20)	19	20	18	20
Frequency of Riffles/Bends (20)*	18	15	18	15
Channel Sinuosity (20)**				
<b>Riparian and Bank Structure</b>				
Bank Stability (L) (10)	10	10	10	7
Bank Stability (R) (10)	10	10	10	10
Vegetative Protection (L) (10)	9	10	7	7
Vegetative Protection (R) (10)	9	10	3	9
Riparian Veg. Zone Width (L) (10)	9	7	7	5
Riparian Veg. Zone Width (R) (10)	9	10	3	8
<b>TOTAL SCORE (200):</b>	<b>142</b>	<b>160</b>	<b>134</b>	<b>134</b>

HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON- IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)
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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).

Date:	10/10/2012	9/25/2013	10/10/2012	9/25/2013
Weather:	Cloudy	Sunny	Rainy	Sunny
Air Temperature:	43 Deg. F.	50 Deg. F.	45 Deg. F.	55 Deg. F.
Water Temperature:	59 Deg. F.	48 Deg. F.	55 Deg. F.	49 Deg. F.
Ave. Stream Width:	66 Feet	60 Feet	45 Feet	35 Feet
Ave. Stream Depth:	1 Feet	1.5 Feet	1.5 Feet	2.2 Feet
Surface Velocity:	2.2 Ft./Sec.	1.5 Ft./Sec.	2.5 Ft./Sec.	2 Ft./Sec.
Estimated Flow:	145.2 CFS	135 CFS	168.75 CFS	154 CFS
Stream Modifications:	Bank Stabilization	None	Bank Stabilization	None
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				
STORET No.:	280419	280419	280409	280409
Stream Name:	Boardman River	Boardman River	Boardman River	Boardman River
Road Crossing/Location:	downstream Brown Bridge	downstream Brown Bridge	Boardman Plains Road	Boardman Plains Road
County Code:	28	28	28	28
TRS:	26N10W22	26N10W22	26N11W14	26N11W14
Latitude (dd):	44.64185	44.64185	44.655737	44.655737
Longitude (dd):	-85.51544	-85.51544	-85.599502	-85.599502
Ecoregion:	NCHF	NCHF	NCHF	NCHF
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060105	4060105	4060105	4060105

\* Applies only to Riffle/Run stream Surveys  
 \*\* Applies only to Glide/Pool stream Surveys

Table 6. Summary of the macroinvertebrate communities at Brown Bridge Road (~1/3 mile d/s Brown Bridge Dam) and Boardman Heights Drive (~ 7 miles d/s Brown Bridge Dam).

	Brown Bridge Road Station 21		Boardman Plains Drive Station 22		
	2012	2013	2008	2012	2013
P-51 Score	-2	4	3	3	0
# Taxa	31	31	27	29	30
#EPT Taxa	9	13	13	11	10
%EPT	9%	67%	46%	60%	39%
Top five taxa	<i>Amphipoda</i>	<i>Ephemerellidae</i>	<i>Simuliidae</i>	<i>Corixidae</i>	<i>Corixidae</i>
	<i>Isopoda</i>	<i>Baetidae</i>	<i>Brachycentridae</i>	<i>Baetidae</i>	<i>Hydropsychidae</i>
	<i>Corixidae</i>	<i>Hydropsychidae</i>	<i>Chironomidae</i>	<i>Heptageniidae</i>	<i>Ephemerellidae</i>
	<i>Chironomidae</i>	<i>Chironomidae</i>	<i>Hydropsychidae</i>	<i>Ephemerellidae</i>	<i>Baetidae</i>
	<i>Dreisseniidae</i>	<i>Perlidae</i>	<i>Ephemerellidae</i>	<i>Hydropsychidae</i>	<i>Oligochaeta</i>