

# **Procedure 51 Aquatic Survey of the Boardman River, Grand Traverse County, Michigan, 2015.**

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**List of Abbreviations, Acronyms, and Symbols**

AEM	Advanced Ecological Management LLC
$\bar{x}$	Average
°C	Degrees Celsius
ft	Feet
e.g.	For example
gpm	Gallons per minute
GLEAS	Great Lakes and Environmental Assessment Section
pH	Measure of acidity or alkalinity of a solution
MDEQ	Michigan Department of Environmental Quality
MNFI	Michigan Natural Features Inventory
$\mu\text{S/cm}$	MicroSiemens per centimeter
mg O <sub>2</sub> /L	Milligrams of oxygen per liter of water
mg/kg	Milligrams per kilogram
ml	Milliliters
N	North
n.a.	Not applicable
n.m.	Not measured
n.s.	Not sampled
P-51	Procedure Number 51
R	Range
<i>n</i>	Sample size
Sec	Section
s	Standard deviation
T	Township
W	West

## **1.0 EXECUTIVE SUMMARY**

The Boardman River is located in Grand Traverse County and Kalkaska County, Michigan as shown on Figure 1-1. This aquatic survey was conducted at the request of the State of Michigan to monitor conditions within the Boardman River in the vicinity of a reach that was impacted by a flood from the failure of the Temporary Dewatering Structure during the Brown Bridge dam removal project in October 2012. The study monitors changes within the river that may occur as part of natural stream recovery processes. Aquatic surveys at each station included fish, macroinvertebrate, and habitat community ratings according to the metrics outlined in the Great Lakes and Environmental Assessment Section (GLEAS) Procedure Number 51 (P-51), a survey protocol for wadable streams and rivers.

Fish were collected from two locations within the Boardman River (Figure 1-2) in accordance with our proposal for this study approved by the State. One location was selected within the portion of the river that was affected by the 2012 de-watering event and the second location was selected approximately 3.8 miles upstream of the affected reach.

The locations that were investigated for this survey are predominantly functioning as cold water trout streams. Because most of the fish communities of the Boardman River were comprised of trout greater than 1% of the fish community composition, as indicated in the P-51 protocol, the P-51 fish community scores were determined from the macroinvertebrate community ratings for the survey stations.

The macroinvertebrate communities within the Boardman River have been scored by AEM as acceptable communities. The station that was surveyed within the affected reach contained a macroinvertebrate community that was predominantly comprised of snail species, compared to the unaffected reach that was predominantly comprised of mayfly nymphs (Ephemeropterans).

The aquatic habitat was rated as excellent in both stations surveyed by AEM. However, the station that was surveyed within the affected reach appeared to contain more sand and fine particles than were observed in the unaffected reach.

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## 2.0 INTRODUCTION

The Brown Bridge Dam was in the process of being removed during October 2012 when the Temporary Dewatering Structure failed resulting in an uncontrolled release of the remaining water that was impounded by the former dam. Numerous environmental studies have been conducted on the Boardman River following the failure of the dewatering structure to evaluate the impact of the flood event on the river. This 2015 aquatic survey represents the first of three annual aquatic surveys that will be conducted by AEM on behalf of the City of Traverse City. The purpose of this aquatic survey is to monitor the aquatic biota and habitat using a rapid bioassessment protocol in the vicinity of the affected reach and compare the data to a similar, but unaffected reach that is located upstream, above the former Brown Bridge impoundment.

## 3.0 STUDY AREA

The principle area investigated for this study is located in Sections 13, 21, and 22 of Paradise Township (T26N, R10W) of Grand Traverse County. Specifically, two 1,000-foot long reaches were investigated as part of this survey. Station 1 is situated in the reach that was affected by the dewatering structure failure and is located approximately 348 feet upstream of Garfield Road and continues upstream for 1,000 feet (Figure 1-2). Station 2 is located approximately 3.8 miles upstream of Station 1 where the upstream extent is marked by the Brown Bridge Road crossing in the vicinity of Sheck's Place State Forrest Campground, and continues downstream for 1,000 feet (Figure 1-2).

The Boardman River drains 287 square miles of land in Grand Traverse and Kalkaska Counties (Kalish and Tonello, 2014). The Boardman River is considered one of Michigan's outstanding trout streams, with populations of brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*), and has a flow regime that is predominantly sustained by groundwater discharging into the river (MDNR, 2002). The Boardman River within the area investigated for this study is a cold water stream that flows through a predominantly forested watershed with minimal development.

## 4.0 METHODS

The 2015 aquatic survey was conducted according to the MDEQ's Surface Water Quality Division *Procedure #51 Survey Protocols for Wadable Rivers* (P-51; MDEQ, 2008). Two stream segments (stations) were sampled in August of 2015 using the P-51

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survey protocol (Figure 1-2). Each station was 1,000 feet in length as was measured in the field using a measuring tape. Station extents were recorded using a handheld Global Positioning System and were also marked with flagging tape.

#### **4.1 Fish Collection**

A tote-barge electroshocker with three anodes was used to sample each station. The duration of electroshocking was recorded for each station, collected fish were placed in a live-well for identification and enumeration, and all fish were released within the station following identification and enumeration.

As part of the enumeration process, the number of each species present was recorded and fish were measured for length to the nearest millimeter and were weighed to the nearest gram. Fish were identified to species using various taxonomic references (Bailey et al., 2003; Coon, 2001; Becker, 1983). The Michigan County Element List (MNFI, 2015) was also reviewed to determine if any threatened, endangered, or special concern aquatic species were collected within the Boardman River stations.

#### **4.2 Macroinvertebrates**

Sampling of aquatic macroinvertebrates, including mussels and crayfish (Decapoda), was conducted according to the P-51 protocol. Upon completion of fish sampling, macroinvertebrates were collected within each station using D-framed kick-nets (Merritt et al., 1996). Stations were sampled for 45 minutes using two kick-nets (total sample time = 1.5 hours) and samples were collected in all habitat types within each station to characterize the macroinvertebrate community. Collected specimens were stored in 250 ml plastic wide-mouth jars containing 70% ethanol, and were identified using various taxonomic references (Merritt et al., 2008; Bright, 2014; McCafferty, 1998; Cummings and Mayer, 1992; Peckarsky et al., 1990; Pennak, 1990).

The macroinvertebrate data were analyzed according to nine metrics identified in the P-51 methodology. The sum of the macroinvertebrate scores can range from -9 to +9; and are graded as excellent, acceptable, or poor according to the summation of the metric scores.

### 4.3 Stream Habitat Evaluation

Riparian and in-stream habitats were qualitatively described for each station during the aquatic survey. A description of stream morphology included run/riffle/pool/shallow pool configurations, substrate, substrate embeddedness, in-stream cover, vegetation, flow stability, and bank stability. Stream habitat was rated as excellent, good, marginal, or poor based on P-51 scores interpreted from 10 habitat metrics. Habitat was rated according to the following P-51 habitat scores (MDEQ, 2008):

Habitat characterization	Total Point Score
1. Excellent	> 154
2. Good	105 – 154
3. Marginal	56 – 104
4. Poor	< 56

Habitat conditions, water quality, and stream dimensions were documented during the aquatic survey. Photographs were taken at each station to illustrate the conditions during the sampling period (Exhibit C). Water temperature, dissolved oxygen, pH, and conductivity were measured as part of the stream habitat evaluation. These water quality parameters were measured using a Yellow Springs Instrument Professional Plus water quality meter.

Wetted stream width was measured at the lower, middle, and upper extent of each sample station. Depth was measured in the center, and at 20% and 80% of each stream width cross section. Stream flow was measured with a Marsh-McBirney Flo-Mate 2000®.

## 5.0 RESULTS

The Boardman River aquatic survey of both stations was conducted on August 20, 2015. Air temperature ranged between 63°F and 67°F, and there was a mix of clouds and intermittent rain, with brief periods of sunshine during the survey.

### 5.1 Fish

A total of 243 fish were collected from both stations with the most fish being captured in Station 1 (Table 5-2). Among both stations, a total of six species of fish were observed during the aquatic survey (Table 5-2).

No Michigan Natural Features Inventory (MNFI) listed threatened or endangered fish species were identified in the stations investigated in the Boardman River in Grand Traverse County, Michigan (MNFI, 2015).

### **5.1.1 Station 1 (Downstream of former Brown Bridge impoundment)**

Mottled sculpin (*Cottus bairdii*) and brown trout were the most frequently collected species of fish in Station 1 (Table 5-2). Mottled sculpin ranged in length from 24 mm (0.9 inches) to 105 mm (4.1 inches), with an average length of 57 mm (2.2 inches; standard deviation,  $s = 23$  mm, 2 inches), and ranged in weight from 0.1 gm (0.003 ounces) to 86 gm (3.0 ounces), with an average weight of 4.3 gm (0.2 ounces;  $s = 9.8$  gm, 0.3 ounces). Brown trout ranged in length from 61 mm (2.4 inches) to 290 mm (11.4 inches), with an average length of 129 mm (5.1 inches;  $s = 65$  mm, 3.0 inches), and ranged in weight from 2.3 gm (0.1 ounces) to 185.1 gm (6.5 ounces), with an average weight of 38.2 gm (1.3 ounces;  $s = 53.2$  gm, 1.9 ounces). Brook trout ranged in length from 75 mm (3.0 inches) to 185 mm (7.3 inches), with an average length of 113 mm (4.4 inches;  $s = 33$  mm, 1.3 inches), and ranged in weight from 3.0 gm (0.1 ounces) to 82.2 gm (2.9 ounces), with an average weight of 19.1 gm (0.7 ounces;  $s = 21.8$  gm, 0.8 ounces).

### **5.1.2 Station 2 (Upstream of former Brown Bridge impoundment)**

Brown trout and mottled sculpin were the most frequently collected species of fish in Station 2 (Table 5-2). Station 2 brown trout ranged in length from 75 mm (2.9 inches) to 446 mm (17.5 inches), with an average length of 185.5 mm (7.3 inches;  $s = 70$  mm, 2.7 inches), and ranged in weight from 3.6 gm (0.1 ounces) to 838.0 gm (29.6 ounces), with an average weight of 89.9 gm (3.2 ounces;  $s = 133$  gm, 4.7 ounces).

Although fewer mottled sculpin were collected in Station 2 than were collected in Station 1, the average size of mottled sculpin was slightly larger in Station 2 compared to Station 1. Mottled sculpin in Station 2 ranged in length from 46 mm (1.8 inches) to 88 mm (3.5 inches), with an average length of 65 mm (2.5 inches;  $s = 10$  mm, 0.4 inches), and ranged in weight from 1.1 gm (0.04 ounces) to 8.2 gm (0.3 ounces), with an average weight of 3.5 gm (0.1 ounces;  $s = 1.6$  gm, 0.1 ounces).

A total of seven brook trout were collected in Station 2 (Table 5-2), and the average length of the brook trout in Station 2 was similar to the average size of the brook trout in



Station 1. However, the average weight of brook trout was slightly higher in Station 2 compared to Station 1. Brook trout in Station 2 ranged in length from 82 mm (3.2 inches) to 221 mm (8.7 inches), with an average length of 114 mm (4.5 inches;  $s = 60$  mm, 2.4 inches), and ranged in weight from 5.3 gm (0.2 ounces) to 109.5 gm (3.8 ounces), with an average weight of 27.0 gm (1.0 ounces;  $s = 46.1$  gm, 1.6 ounces).

## 5.2 Macroinvertebrates

A total of 1,005 macroinvertebrates were collected from both stations (Table 5-3). A total of 702 macroinvertebrates were collected in Station 1, with the majority being small snails (Family Lymnaeidae), followed by Dipterans that were predominantly midges (Chironomidae) and black fly larvae (Simuliidae), and scuds (Amphipoda). A total of 303 macroinvertebrates were collected in Station 2 where a predominance of mayfly nymphs (Ephemeroptera) were observed, followed by Dipterans and caddisflies (Trichoptera).

Table 5-4 summarizes the values and scores for the nine metrics for each station. Both stations were rated as “Acceptable” macroinvertebrate communities in 2015.

## 5.3 Stream Habitat

Station 1 is located in a reach with multiple residences predominantly occupying the west bank of the river. The east bank of the station was vegetated with a combination of woody, shrub and herbaceous vegetation (Photographs C-1 and C-2). The west bank of the reach was also vegetated. However, much of the streambank was maintained lawn up to the margin of the stream.

The streambed within Station 2 was characterized by a variety of particles including silt, sand, gravel, and cobble. Small woody debris complexes were frequently observed along the margins of the river and few pools were present within the station.

Average width of Station 1 was 59.9 feet (sample size -  $n = 3$ ;  $s = 5.1$  feet), and average depth 1.9 feet ( $n = 9$ ;  $s = 0.8$  feet, Table 5-5). Stream flow for Station 1 was estimated at 71,055 gpm in 2015 (Table 5-5).

Station 2 was bordered by a State Forest Campground, with campsites located along the northern margin of the stream, and was predominantly forested along the south margin of the stream. The stream bank was covered with a variety of vegetation, including

wood, shrubs and herbaceous vegetation along both sides of the stream throughout the station (Photographs C-3 and C-4). However, portions of the north stream bank had minimal understory in the vicinity of campsites and where foot paths afforded access to the river.

The streambed within Station 2 was characterized by a variety of particles including silt, sand, gravel, and cobble. However, sand appeared to be less abundant compared to gravel and cobble particles than was observed in Station 1. An island was present approximately mid-reach within Station 2 and several pools were observed at the downstream extent of the station. The pools were deeper than pools within Station 1 and more large woody debris was present within Station 2.

Average width of Station 2 was 40.0 feet (sample size -  $n = 3$ ;  $s = 3.3$  feet), and average depth 1.9 feet ( $n = 9$ ;  $s = 0.5$  feet, Table 5-5). Stream flow for Station 2 was estimated at 67,079 gpm in 2015 (Table 5-5).

### **5.3.1 P-51 Habitat Scores**

Stations 1 and 2 were rated as “Excellent” habitat quality in 2015 (Table 5-6). However, the total habitat score for Station 2 was higher than Station 1.

### **5.4 Water Quality**

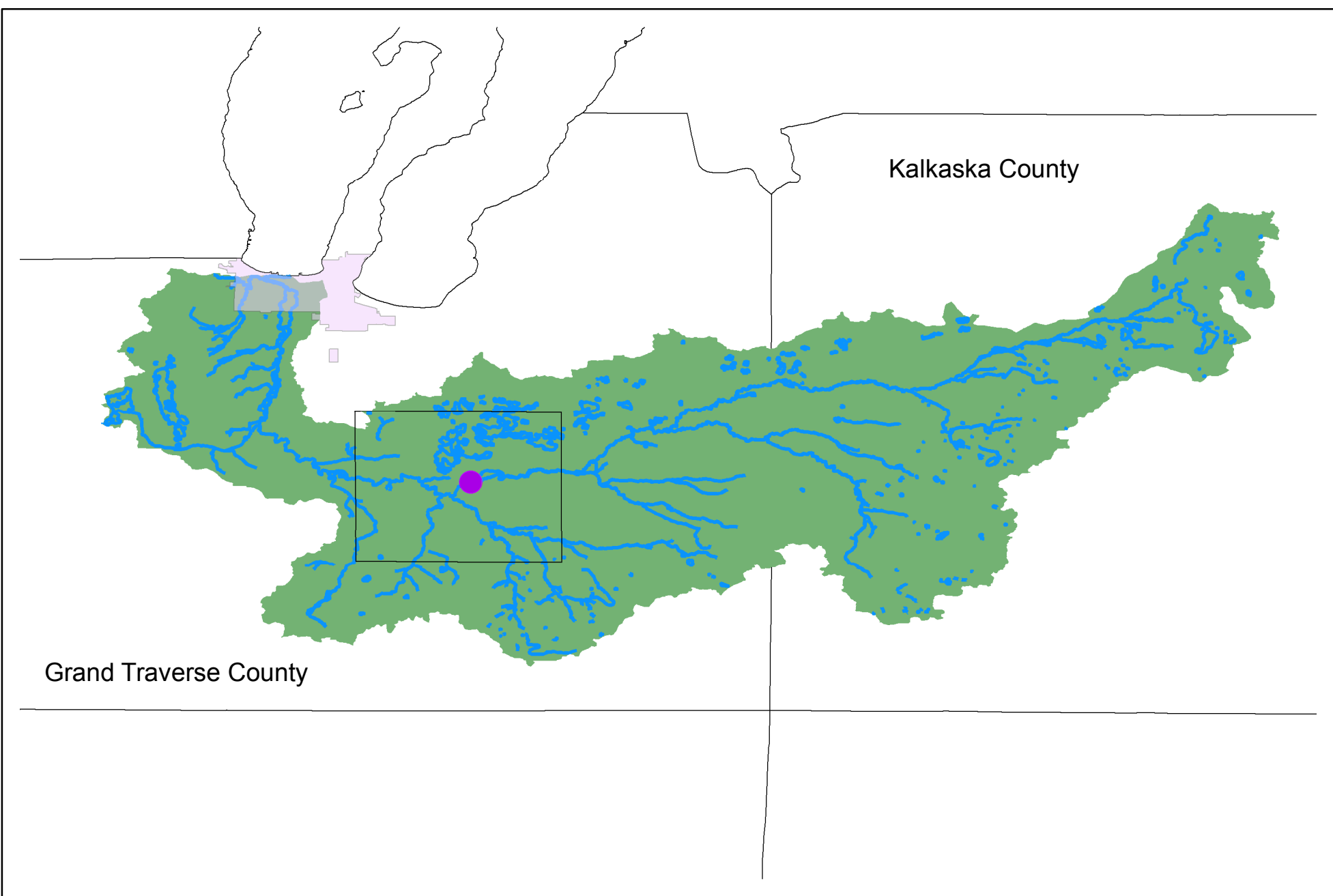
Water quality parameters were similar between Station 1 and Station 2 during the 2015 survey (Table 5-7). Water temperature and dissolved oxygen were slightly higher in Station 2 than were observed in Station 1, and conductivity was slightly lower in Station 2. The average pH was 8.3 for both Station 1 and Station 2 (Table 5-7).

## 6.0 REFERENCES

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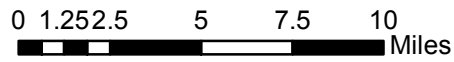
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**EXHIBIT A**  
**REPORT FIGURES**



**Legend**

- Traverse City
- Paradise Township
- Project Vicinity
- Boardman River Watershed



PROJECT	Boardman River P-51
TITLE	Project Vicinity
FIGURE	1-1

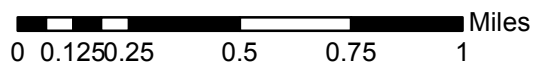


**Legend**

— Survey Stations



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PROJECT	Boardman River P-51
TITLE	Survey Station Locations
FIGURE	1-2

**EXHIBIT B**  
**REPORT TABLES**



**Table 5-1. Sample Station Location Description.**

Station Number	Stream Name	Latitude/Longitude NAD 1983	Township/Range/ Section	Location Description
1	Boardman River	N 46.76130 W 87.90807	Paradise Twp. T26N, R10W, Sec. 21 and 22	Approximately 367 feet upstream of Garfield Road and continuing upstream for 1,000 feet.
2	Boardman River	N 46.75059 W 87.90720	Paradise Twp. T26N, R10W, Sec. 13	Upstream extent located immediately W of Brown Bridge Road and continuing downstream for 1,000 feet.

**Table 5-2. 2015 Fish Collection Data for Stations 1 and 2.**

Scientific Name	Common Name	Station Number	
		1	2
Blacknose dace	<i>Rhinichthys atratulus</i>	3	
Brook trout	<i>Salvelinus fontinalis</i>	22	7
Brown trout	<i>Salmo trutta</i>	51	39
Mottled sculpin	<i>Cottus bairdii</i>	83	35
Northern brook lamprey	<i>Ichthyomyzon fossor</i>	1	
White sucker	<i>Catostomus commersonii</i>	1	1
	<b>Total Number</b>	<b>161</b>	<b>82</b>

**Table 5-3. 2015 Macroinvertebrate Community – Stations 1 and 2.**

Order	Family	Genus	Species	Station Number	
				1	2
Amphipoda	Gammaridae	<i>Gammarus</i>		58	19
Coleoptera	Elmidae	<i>Optioservus</i>		8	7
Coleoptera	Gyrinidae	<i>Gyrinus</i>			2
Diptera	Athericidae	<i>Atherix</i>		7	17
Diptera	Ceratopogonidae	<i>Bezzia/Palpomyia</i>			2
Diptera	Chironomidae			30	16
Diptera	Simuliidae	<i>Simulium</i>		59	18
Diptera	Tabanidae	<i>Chrysops</i>		1	2
Diptera	Tipulidae			1	
Diptera	Tipulidae	<i>Leptotarsus</i>			1
Ephemeroptera	Baetidae	<i>Baetis</i>		20	106
Ephemeroptera	Baetidae	<i>Proclleon</i>		9	7
Ephemeroptera	Baetidae			1	6
Ephemeroptera	Baetiscadae	<i>Baetisca</i>	<i>lacustris</i>		1
Ephemeroptera	Ephemerellidae			10	
Ephemeroptera	Ephemeridae	<i>Ephemera</i>	<i>varia</i>	1	
Ephemeroptera	Ephemeridae	<i>Litobranca</i>	<i>recurvata</i>	1	
Ephemeroptera	Heptageniidae	<i>Heptagenia</i>			1
Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>		2	3
Ephemeroptera	Heptageniidae	<i>Rithrogena</i>		2	
Ephemeroptera	Leptohyphidae	<i>Tricorythodes</i>			24
Hemiptera	Corixidae	<i>Hesperocorixa</i>		24	7
Hemiptera	Gerridae	<i>Trepobates</i>		1	
Hemiptera	Gerridae	<i>Aquarius</i>			2
Isopoda	Asellidae	<i>Asellus</i>		7	5
Limnophila	Physidae	<i>Physa</i>		2	2
Limnophila	Lymnaeidae	<i>Fossaria</i>		388	
Lumbriculida	Lumbriculidae			2	2
Megaloptera	Corydalidae	<i>Chauloides</i>		1	
Odonata	Aeshnidae	<i>Boyeria</i>	<i>vinosa</i>	1	2
Odonata	Calopterygidae	<i>Calopteryx</i>	<i>maculata</i>		4
Odonata	Gomphidae			2	
Plecoptera	Leuctridae	<i>Leuctra</i>			2
Plecoptera	Perlodidae	<i>Isoperla</i>		3	3
Plecoptera	Pteronarcyidae	<i>Pteronarcys</i>		6	10
Rhynchobdellida	Glossiphoniidae				1
Trichoptera	Brachycentridae	<i>Brachycentrus</i>	<i>numerous</i>	1	3
Trichoptera	Brachycentridae	<i>Micrasema</i>	<i>wataga</i>	4	2
Trichoptera	Brachycentridae	<i>Micrasema</i>	<i>rusticum</i>	5	
Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>		16	17
Trichoptera	Limnephilidae	<i>Psychoglypha</i>			5
Trichoptera	Philopotamidae	<i>Dolophilodes</i>		15	
Veneroida	Sphaeriidae	<i>Pisidium</i>		14	
Trombidiformes	Hydracarinae	<i>Sperchon</i>			4
<b>Total</b>				<b>702</b>	<b>303</b>

**Table 5-4. 2015 Macroinvertebrate Scores and Community Ratings for Stations 1 and 2.**

Metric	Station 1		Station 2	
	Value	Score	Value	Score
Total Number of Taxa	26	0	28	1
Number of Mayfly Taxa	4	0	4	0
Number of Caddisfly Taxa	3	0	3	0
Number of Stonefly Taxa	2	1	3	1
Percent Mayfly Comp.	6.55	0	48.84	1
Percent Caddisfly Comp.	5.84	0	8.91	0
Percent Dominant Taxon	55.27	-1	39.27	-1
Percent Isopod, Snail, Leech	56.55	-1	2.64	1
Percent Surf. Air Breathers	3.56	1	3.63	1
<b>Total Score</b>		0		4
<b>Community Rating</b>	<b>Acceptable</b>		<b>Acceptable</b>	

**Table 5-5. 2015 Physical Stream Dimensions within Stations 1 and 2.**

Station	Length (ft)	Wetted width (ft)		Depth (ft)		Discharge (gpm)
		Average*	s	Average	s	
1	1,000	59.9 (3)	5.1	1.9 (9)	0.8	71,055
2	1,000	40.0 (3)	3.3	1.9 (9)	0.5	67,079

\*sample size is indicated within ()

s = standard deviation

gpm = Gallons per minute

**Table 5-6. 2015 Procedure 51 Habitat Evaluation Scores for Stations 1 and 2.**

Habitat Metric	Sample Station	
	1 riffle/run	2 riffle/run
<b>Substrate and In-stream Cover</b>		
Epifaunal Substrate/Avail. Cover	14	20
Embeddedness	18	18
Velocity Depth Regime	15	18
Sediment Deposition	17	19
<b>Channel Morphology</b>		
Maintained Flow Volume	9	10
Flashiness	9	9
Channel Alteration	18	20
Frequency of Riffles/Bends	13	18
<b>Riparian and Bank Structure</b>		
Bank Stability (L)	10	10
Bank Stability (R)	8	8
Vegetative Protection (L)	10	10
Vegetative Protection (R)	6	7
Riparian Veg. Zone Width (L)	10	10
Riparian Veg. Zone Width (R)	5	6
<b>Total Score</b>	<b>162</b>	<b>183</b>
<b>Habitat Rating</b>	<b>Excellent</b>	<b>Excellent</b>

**Table 5-7. 2015 Average Water Quality Parameters within Stations 1 and 2.**

Station Number	Date	Time	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Percent Dissolved Oxygen	pH	Conductivity (µS/cm)
1	8/20/2015	12:58	15.6 (0.3)	8.8 (0.5)	90.5 (2.0)	8.3 (0.1)	251 (1.4)
2	8/20/2015	15:39	15.8 (0.1)	9.5 (0.3)	95.8 (2.7)	8.3 (0.0)	249 (0.4)

°C = Degrees Celsius

mg/L = Milligrams per liter

µS/cm = MicroSiemens per centimeter

standard deviation is indicated within ( )

**EXHIBIT C**  
**STATION PHOTOGRAPHS**



**Photograph C-1. Station 1 - Downstream Extent View North, August, 2015.**



**Photograph C-2. Station 1 - Upstream Extent View South, August, 2015.**



**Photograph C-3. Station 2 – Downstream Extent View East, August, 2015.**



**Photograph C-4. Station 2 – Upstream Extent View West, August, 2015.**