RICE CREEK WATERSHED STREAM HEALTH EVALUATION PROGRAM (SHEP)

2016-2017 BENTHIC MACROINVERTEBRATE STREAM MONITORING REPORT

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The Rice Creek Watershed District
Mounds View Public Schools
Edgewood Middle School

Organizations:

Fortin Consulting

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The Rice Creek Watershed Stream Health Evaluation Program wishes to thank the following partners, without whom this program would not be possible:

Katie Farber & Connie Fortin – Fortin Consulting
Gary Averbek – SHEP Team Leader
Wayne LeBlanc – SHEP Team Leader
James Brozowski – SHEP Team Leader
Courtney Jones – SHEP Team Leader
Katherine & Darrell Majkrzak – SHEP Team Leaders

2016 Rice Creek SHEP Volunteers:

The 2016 Rice Creek Watershed Stream Health Evaluation Program extends our most sincere appreciation to all of the SHEP volunteers who donated their time in the stream and in the lab last summer and fall. Each of these volunteers contributed between 30 and 80 hours of volunteer service in monitoring the health of our water resources. Thank You!

Team One: Gary Averbeck*, Wayne LeBlanc*, Landon Acre-Kendall, Amy Anderson, Barbara Bor, Linda Gruntner, Tere O'Connell, Dana Raines, Melissa Seidel, Robin Turner.

Team Two: James Brozowski*, Courtney Jones*, Bob Bartlett, Ralph Butkowski, Gary Ellis, Julie Glanton, Jo Ann Morse, Rod Venterea, Ricco Venterea.

Team Three: Katherine Majkrzak*, Darrell Majkrzak*, Lindsay Coleman, Rich Femling, Cathi Lyman-Onkka, Rob Schroeder, John Steinworth, Susan Young, Maggie Voth.

** SHEP Team Leader.*

For more information on the Rice Creek Watershed Stream Health Evaluation Program or for a copy of this report, please contact Friends of the Mississippi River or visit www.fmr.org

Rice Creek Watershed Stream Health Evaluation Program
2016 Field Monitoring Report

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1.0 BACKGROUND

In an effort to obtain a more comprehensive understanding of the health of our water resources, the Minnesota Pollution Control Agency (MPCA) and other agencies have, over the last 15 years, developed new protocols and indices for the biological assessment of streams. Because aquatic organisms express a range of tolerances to environmental conditions, biological assessment can be a powerful quantitative tool in understanding the health of water resources. Biological monitoring provides a more complete picture of the ecological health of our waters.

By surveying aquatic organisms that grow, develop and reproduce, we can observe any changes occurring to our waters over time. The National River Watch Network states that five years of data should be collected in order to perform a biological characterization of a sample site.

In the early 1990's, Riverwatch, a National volunteer river monitoring program, was brought to Minnesota to engage schools in river monitoring. The program was started by the Mississippi Headwaters Board and taken over by Hennepin County, and eventually spread across the Twin Cities metropolitan area.

In 1997, a citizen wetland monitoring program was formed by local partners and the Minnesota Pollution Control Agency (MPCA) to evaluate wetland health. Sampling methods and evaluation metrics were developed by MPCA scientists to measure the health of the local wetlands. This Wetland Health Evaluation Program (WHEP) is now an award-winning and nationally recognized program that uses citizen volunteers to monitor the biological health of local wetlands. Multiple layers of quality control, volunteer training, and the use of rigorous protocols assure scientifically valid monitoring results. Volunteers enjoy the program, and often become more engaged in wetland and watershed issues and stewardship within their communities.

1.1 A New Model

The Stream Health Evaluation Program is a new model for volunteer stream monitoring modeled after WHEP and Riverwatch. The Stream Health Evaluation Program (SHEP) uses trained adult volunteers to evaluate the biological health of streams using advanced bioassessment protocols and indices specifically developed for this region. The program thoroughly monitors volunteer data collection and lab identification techniques to ensure compatibility with established protocols. Complete data cross-checks and programmatic evaluation ensure accurate and timely data that is quality certified.

SHEP provides local communities and watershed organizations with a premier volunteer benthic macroinvertebrate monitoring program that produces reliable data and actively engages citizens in the work of the watershed.

SHEP, a new model for water quality assessment:

- Monitors the health of valuable water resources

- Uses research-based multiple index metrics
- Professionally trains adult volunteers
- Utilizes multiple levels of quality control to ensure quality results
- Provides relevant, reliable data to local decision makers
- Engages citizens in water resource management and assessment
- Promotes water resource health to community members
- Promotes partnership between local governments, state agencies and community residents.

1.2 Rice Creek SHEP

SHEP was first implemented in a pilot phase into the Rice Creek Watershed District in the summer and fall of 2006. In 2016 SHEP was led by Friends of the Mississippi River (FMR) in partnership with the Rice Creek Watershed District (RCWD), Minnesota Pollution Control Agency (MPCA), and Fortin Consulting. Local program partners included the Mounds View Public Schools, Edgewood Middle School, University of Minnesota Water Resource Center, Anoka County Parks, and local landowners.

Primary funding for this program was made possible by the Rice Creek Watershed District. Matching resources for the 2016 SHEP season were provided by Friends of the Mississippi River.

The program recruited 27 adult volunteers and one teen volunteer organized in three teams to monitor a total of nine sites in the watershed. These sites were located in Hardwood Creek, Clearwater Creek, Rice Creek and the inlet/outlet of Locke Lake. Some sites were chosen in part to gauge the effects of recent restoration and stewardship activity. For more information on site selection, see section 4.0.

The SHEP monitoring protocol was divided into two sections: a physical habitat assessment and a biological assessment of benthic macroinvertebrates. Volunteers participated in 2 training sessions, covering the in-stream physical assessment and macroinvertebrate collection methods, and laboratory macroinvertebrate identification procedures. For more information on methods and training, see section 2.0.

Each volunteer team collected physical assessment data and benthic macroinvertebrate samples at three sites. After macroinvertebrate collection was completed, volunteers participated in laboratory analysis sessions to identify samples. The samples were later cross-checked by macroinvertebrate identification professionals at Fortin Consulting, and results were reported to program partners, local governments and made available to the general public.

SHEP has not only become a reliable source of high-quality data, the program has an established history of recruiting and retaining dedicated volunteers.

1.3 The Rice Creek Watershed

Watershed Districts are special purpose units of local government whose boundaries follow those of a natural watershed. The Rice Creek Watershed District was established in 1972 to conserve and restore the water resources of the District for the beneficial use of current and future generations. It is a governmental organization managed by a Board of Managers appointed by the county commissions of Anoka, Ramsey and Washington Counties.

The Rice Creek watershed drains portions of Anoka, Hennepin, Ramsey, and Washington Counties. The watershed occupies portions of Arden Hills, Birchwood, Blaine, Centerville, Circle Pines, Columbia Heights, Columbus, Dellwood, Falcon Heights, Forest Lake, Fridley, Grant, Hugo, Lauderdale, Lexington, Lino Lakes, Mahtomedi, May Township, Mounds View, New Brighton, New Scandia Township, Roseville, St. Anthony, Shoreview, Spring Lake Park, White Bear Lake, White Bear Township and Willernie.

Rice Creek's principal tributaries are Hardwood Creek, which drains an area of 44 square miles in the cities of Hugo, Forest Lake, and Lino Lakes; and Clearwater Creek, which drains a 62 square mile area of White Bear Lake, White Bear Township, Hugo, Lino Lakes, and Centerville. Both tributaries join Rice Creek in Anoka County as part of the Rice Creek Chain of Lakes.

The Rice Creek has its source at Clear Lake in the City of Forest Lake and flows generally southwestwardly through Anoka and Ramsey Counties, through the cities of Columbus, Lino Lakes, Circle Pines, Shoreview, Arden Hills, Mounds View, New Brighton and Fridley. It joins the Mississippi River at Manomin County Park in Fridley. The creek drops about 84 feet along its course, with most of the drop occurring in the 8 miles upstream of its mouth.

About 10 percent of the watershed's surface area is occupied by lakes, the largest of which are White Bear Lake and Bald Eagle Lake. About 13 percent of the watershed consists of wetland areas.

2.0 METHODS

2.1 Volunteer Recruitment

Volunteer recruitment efforts in 2016 were led by staff from Friends of the Mississippi River in partnership with Rice Creek Watershed District. Recruitment of volunteers was conducted through previous years volunteers friends and family as well as through news releases, city and county publications, presentations, and through communication with interested volunteers in existing local programs.

A total of 28 SHEP volunteers were recruited for this program. Volunteers were divided into three teams. Each team was lead by Team Leaders. Team Leaders are an integral part of SHEP and were selected by project staff. Team Leaders received a small stipend and were responsible for managing monitoring activities and communication within their team.

2.2 Team Assignments

SHEP volunteers were assigned to one of three teams. Team leaders, team members and monitoring location assignments are listed below.

Team One:
Monitoring Locations: Hardwood Creek & Clearwater Creek
Site Names: Hardwood Creek 'Above', Hardwook Creek 'Below', Clearwater Creek
Team Leaders: Gary Averbeck and Wayne LeBlanc
Team Members: Landon Acre-Kendall, Amy Anderson, Barbara Bor, Linda Gruntner, Tere O'Connell, Dana Raines, Melissa Seidel, Robin Turner.

Team Two:
Monitoring Location: Rice Creek Area
Site Names: Rice Creek 'Above', Rice Creek 'Below', Rice Creek 'Irondale'.
Team Leaders: James Brozowski & Courtney Jones
Team Members: Bob Bartlett, Ralph Butkowski, Gary Ellis, Julie Glanton, Jo Ann Morse, Rod Venterea, Ricco Venterea.

Team Three:
Monitoring Location: Locke Lake Area
Site Names: Locke Lake 'Above', Locke Lake 'Below', Rice Creek 'Park'.
Team Leaders: Katherine & Darrell Majkrzak
Team Members: Lindsay Coleman, Rich Femling, Cathi Lyman-Onkka, Rob Schroeder, John Steinworth, Susan Young, Maggie Voth.

2.3 Training

Advanced volunteer training is essential to the success of SHEP. Volunteers participated in 2 days of training in the MPCA's macroinvertebrate sampling protocols. This training

covered in-stream habitat assessment and macroinvertebrate collection methods, along with laboratory procedures for identification of macro-invertebrates.

The first training session, held on Saturday, August 6th 2016 at Edgewood Middle School in Mounds View, included an introduction to macroinvertebrate monitoring, habitat assessment protocols, stream flow measurement protocols and featured macroinvertebrate collection methods under the guidance of Friends of the Mississippi River (FMR) and Fortin Consulting staff. FMR staff also introduced the Rice Creek watershed sampling sites, reviewed each SHEP team's sampling logistics, and distributed necessary sampling equipment. This training was mandatory for all volunteers in their first three years in SHEP, and optional for volunteers who had participated four or more years.

The second training, held on Saturday, October 1st 2016 at Edgewood Middle School, was led by FMR and Fortin Consulting staff and was designed to focus on laboratory analysis portions of the Stream Health Evaluation Program. This training session included benthic, sample sorting and sample processing, general lab skills as well as provided a venue for teams to start the identification process and ask questions.

2.4 Site Selection

Stream monitoring sites were selected by RCWD staff. Several sites included in the 2016 SHEP season were upstream or downstream of recent watershed restoration activity. A detailed description of monitoring sites is included in section 4.0 of this report. 2016 SHEP sites included:

- Hardwood Creek 'Above'
- Hardwood Creek 'Below'
- Clearwater Creek
- Rice Creek 'Above'
- Rice Creek 'Below'
- Rice Creek 'Irondale'
- Locke Lake 'Park'
- Locke Lake 'Above'
- Locke Lake 'Below'

2.5 Field Sampling

SHEP volunteer teams monitored nine stream sites across the Rice Creek Watershed during the fall of 2016.

SHEP volunteers used the MPCA's multi-habitat monitoring protocol at each monitoring location throughout the watershed. The multi-habitat approach samples major habitats in proportional representation within each sampling reach. Benthic macroinvertebrates are collected systematically from all available in-stream habitats by jabbing with a D-frame dip net. At least 20 samples or 'jabs' were taken from across all major habitat types in the reach. Habitat types included snags and woody debris, vegetated banks, cobble, and sand/fine sediment bottom areas.

2.6 Lab Identification

SHEP teams sorted and identified macroinvertebrate samples during multiple lab sessions throughout October 2016. Lab identification sessions were held in partnership with Mounds View School District at Edgewood Middle School in Mounds View, Minnesota.

Lab sessions identified the taxonomic classification of benthic macroinvertebrate samples from each sampling site. Using taxonomic keys, SHEP volunteers identified the Kingdom, Phylum, Class, Order and Family of macroinvertebrate organisms. Once identified, samples were sorted and labeled prior to being submitted to project staff for quality assurance / quality control.

2.7 Quality Assurance/Quality Control (QA/QC)

A Quality Assurance/Quality Control (QA/QC) check was performed on macroinvertebrate samples identified by SHEP volunteers. Fortin Consulting staff performed a QA/QC check on 33% of the macroinvertebrates identified by all three teams.

The samples selected for QA/QC were as follows:

Team One:
Sample: Hardwood Creek Above
Accuracy Score: **100%**

Team Two:
Sample: Rice Creek Irondale
Accuracy Score: **86.4%**

Team Three:
Sample: Locke Lake Park
Accuracy Score: **99.5%**

The overall combined QA/QC accuracy score for the 2016 Rice Creek Watershed Stream Health Evaluation Program was: 95.3%.

3.0 MONITORING TERMS

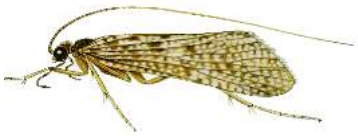
3.1 Monitoring Terms

The descriptions below will help readers understand the results presented on the following pages.

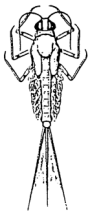
Benthic – Of, relating to, or happening on stream, lake or ocean bottoms.

Complete Metamorphosis – Occurs in the Diptera, Megaloptera, Coleoptera, Trichoptera and Lepidoptera. The life cycle includes the following stages: egg, larva, pupa and adult.

Trichoptera (caddisfly) Larva



Trichoptera (caddisfly) Adult



Ephemeroptera (mayfly) Larva

Ephemeroptera (mayfly) Adult

Dominant Family – The family that comprises the largest single portion of the invertebrate sample.

Dominant Family % Overall – The dominant family's percentage of the total invertebrate sample. This metric indicates how dominant a single family is at a site. A high percent dominance is suboptimal. It indicates a less diverse community of macroinvertebrates.

EPT – The number of mayfly (**E**phemeroptera), stonefly (**P**lecoptera), and caddisfly (**T**richoptera) families in the sample. These families represent the pollution intolerant insects. A higher EPT score reflects better water quality than a lower one.

Family – Family is the level of identification used in this protocol. In the taxonomic rank, family appears as follows: Phylum, Class, Order, Suborder, Family, Subfamily, Genus, and Species. An example of an order is Ephemeroptera or Mayflies. An example of a family is Heptageniidae or Flat Head Mayfly.

Family Biotic Index (FBI) – Each macroinvertebrate family is assigned a pollution tolerance number between '0' and '10' depending on its sensitivity to pollution. A score of zero indicates very sensitive to organic pollution. A '10' indicates very tolerant of organic pollution. The FBI for a site is the weighted average of the biotic indices for all of the invertebrates in the sample. The FBI summarizes the various pollution tolerance values of all families in a sample. Pollution intolerant families such as stoneflies (FBI of 0 – 2) can only survive in excellent water quality. Pollution tolerant organisms such as leeches and aquatic earthworms can live in clean water or poor quality water. They have high FBI values (8 – 10). According to Hilsenhoff, who developed this metric, "Use of the FBI is advantageous for evaluating the general status of organic pollution in streams within a watershed for the purpose of deciding which streams or watersheds should be studied further."

Historically, the lowest (best) FBI value reported by our monitoring was a 4.2 score at Hardwood Creek 'Below' in 2014. The highest (poorest) historical FBI value reported was an 8.8 score at the Rice Creek 'Above' site in 2006.

Index of Biotic Integrity (IBI) – "A synthesis of diverse biological information that numerically depicts associations between human influence and biological attributes. It is composed of several biological attributes or 'metrics' that are sensitive to changes in biological integrity caused by human activities."
Source: Volunteer Surface Water Monitoring Guide, MPCA, 2003

Incomplete Metamorphosis – Occurs in the Ephemeroptera, Plecoptera, Odonata and Hemiptera. The life cycle includes the following stages: egg, early instar larva, late instar larva and adult. This program monitors the larval stages of development.

Macroinvertebrate – An invertebrate that can be seen with the naked eye.

Metric – A measure of stream health calculated using data from macroinvertebrate monitoring. The family biotic index (FBI), EPT and number of families (family richness) are examples of metrics. Metrics are used to help analyze and interpret biological data. Metrics are often compared to charts that place the values into stream health categories.

Number of Families – The number of different benthic macroinvertebrate families found at the site, also known as family richness. In general, more diversity is better. Therefore a larger number of families may reflect a healthier community than a smaller number. The largest number of families (24) was discovered at the Hardwood Creek 'Above' site in 2007, while the fewest number of families (5) were found at both the Rice Creek 'Above' and Rice Creek 'Below' sampling locations in 2007 and Clearwater Creek in 2016.

Number of Organisms Identified – The protocol used requires identification of a minimum of 100 organisms to confidently assess a site. When fewer than 100 organisms are identified in a sub-sample, the information is still useful, but we cannot be as confident about characterizing the site's health. Teams in this circumstance will select another sub-sample of a site sample and identify all organisms in the second sub-sample

in addition to the original sub sample. Scores are tallied based on the combination of both sub-sample results, often resulting in larger numbers of individual macroinvertebrates identified.

Water Quality – Refers to anything that might affect the invertebrates living in the river for part of their life cycle (such as nutrients, oxygen, sediment, organic pollution, toxins, stream flow, and quality of habitat).

Source: Fortin Consulting, 215 Hamel Road, Hamel, MN 55340

3.2 Hilsenhoff Family Level Biotic Index

The family level biotic index (FBI) for a site is the weighted average of the biotic indices for all of the invertebrates in the sample. The FBI summarizes the various pollution tolerance values of all families in a sample. The FBI score for a particular monitoring site corresponds to a likely degree of organic pollution present at that location. As such, the FBI score is a useful tool for evaluating the general status of organic pollution in streams within a watershed.

Evaluation of water quality using Hilsenhoff's Family Level Biotic Index

Family Biotic Index	Stream Health	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.0	Very poor	Severe organic pollution likely

Source: Hilsenhoff, 1988

4.0 2016 FIELD SAMPLING RESULTS

4.1 Hardwood Creek Sites

4.1.1 Existing Conditions

The 24 square miles of land area draining to Hardwood Creek includes portions of May Township and the cities of Hugo, Forest Lake, and Lino Lakes in Anoka and Washington Counties. The upper two-thirds of Hardwood Creek originates south of Rice Lake, flows north to Corrie's Swamp, then turns and continues west emptying into Peltier Lake.

In 2002, Hardwood Creek was included on Minnesota's List of Impaired Waters because the amount, condition and diversity of aquatic life such as fish were too low. Furthermore, there wasn't enough oxygen in the water to support fish and aquatic insects.

A Total Maximum Daily Load (TMDL) study began in 2004 and addresses the impairments on Hardwood Creek. The TMDL is a collaborative effort between the MPCA and Rice Creek Watershed District. The TMDL was approved by the Minnesota Pollution Control Agency (MPCA) in 2009. Additional information is available in the Rice Creek Watershed District's 2009 Stream Monitoring Report.

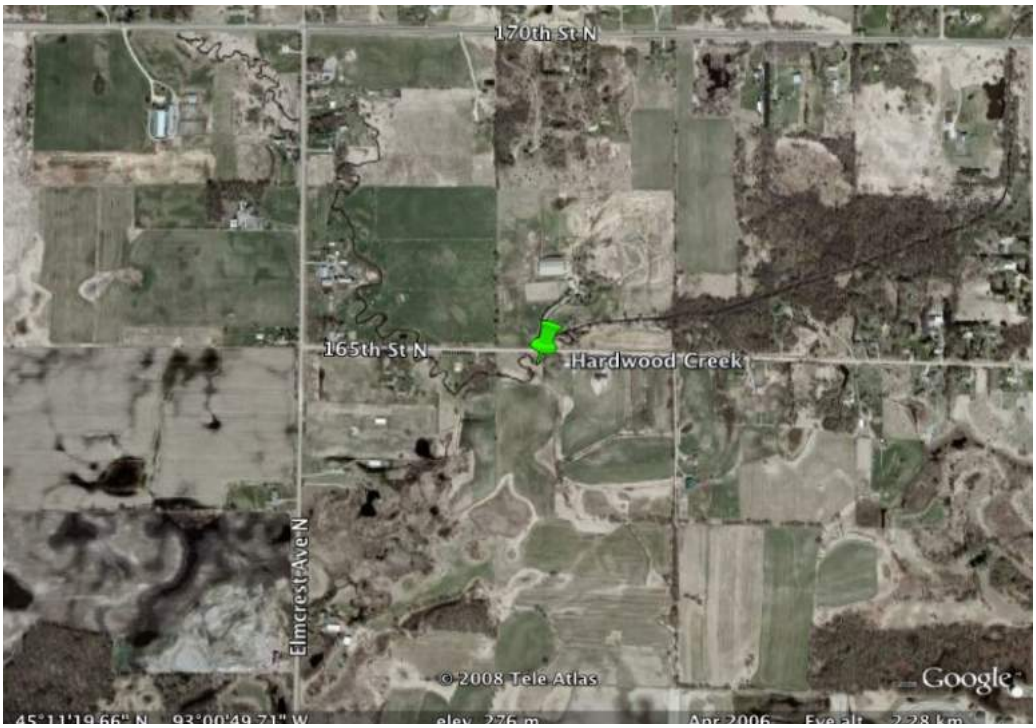
In the summer of 2006, as part of a grant from the Legislative Commission on Minnesota Resources (LCMR), three locations along Hardwood Creek that were identified as having severe bank erosion were stabilized and in-stream habitat improvement techniques were utilized.

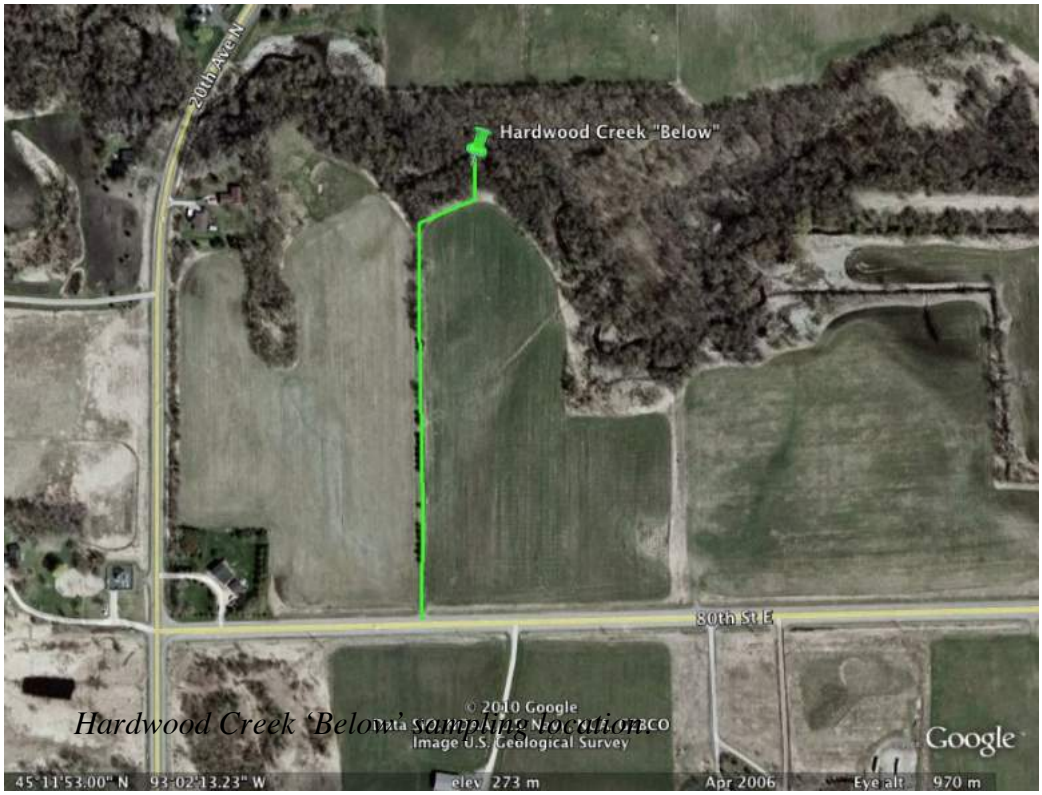
4.1.2 Site Maps

Below are maps of each of the 2016 Hardwood sampling locations. The pins on each site map correspond to the midpoint of the sampled stream reach. Each stream reach sampled is referred to as the 'sampling site' for the purposes of this report.

The Hardwood Creek 'Above' site was first included in the SHEP sampling protocol in 2007. The 'Below' site was added to the SHEP monitoring protocol for the 2010 season.

Hardwood Creek 'Above' sampling location.





Hardwood Creek 'Below' sampling location.

4.1.3 Sampling Methodology

Team Leader: Gary Averbeck and Wayne LeBlanc
Team Members: Landon Acre-Kendall, Amy Anderson, Barbara Bor, Linda Gruntner, Tere O'Connell, Dana Raines, Melissa Seidel, Robin Turner.

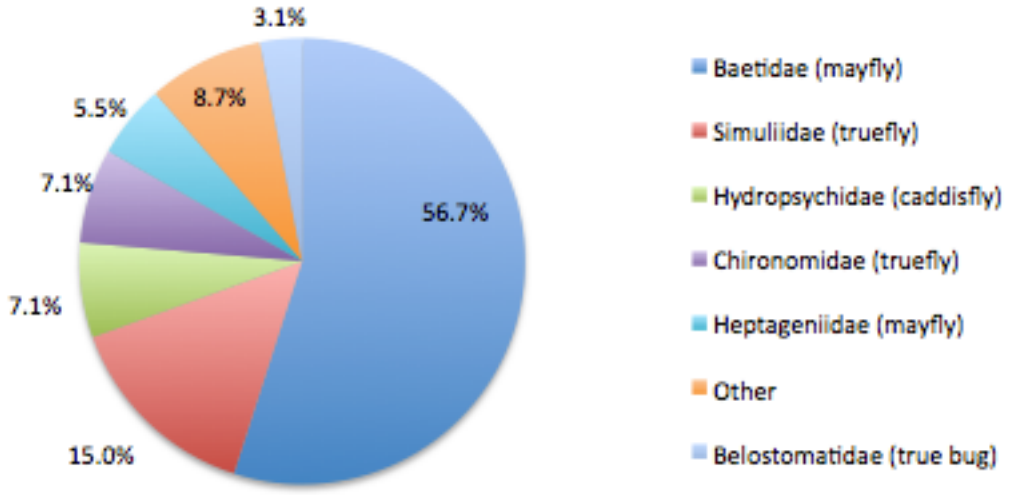
SHEP volunteers used the MPCA's multi-habitat monitoring protocol at this monitoring location. At least 20 dip-net samples (or 'jabs') were taken from across all major habitat types in the reach. Program staff members performed site visits to assure monitoring was performed according to MPCA guidelines and protocols.

In the lab, analysis was done to identify macroinvertebrates from each sampling site. Using taxonomic keys, SHEP volunteers identified the Kingdom, Phylum, Class, Order and Family of macroinvertebrate organisms. Once identified, samples were sorted, labeled and scored.

4.1.4a Field Sampling Results for Hardwood Creek "Above" Site

Historical Field Results for Hardwood Creek 'Above' Site						
Date	# Identified	Family Biotic Index	EPT	Number of Families	Dominant Family	Dominant Family % Overall
Field Sampling Results:						
09/08/07	162	**7.2**	4	24	Hyalellidae	41%
09/20/08	143	**6.3**	5	19	Decapoda	24%
9/12/09	193	**6.6**	4	18	Chironomidae	38%
9/11/10	121	**6.0**	3	18	Hyalellidae	30%
8/20/11	115	**5.0**	3	13	Gammaridae	43%
10/2/12	177	**5.0**	5	18	Heptageniidae	39.5%
8/25/13	157	**6.2**	3	12	Hyaliellidae	35%
9/13/14	178	**5.2**	4	13	Simuliidae	35%
9/05/15	184	**5.2**	4	12	Baetidae	40%
9/10/16	128	**4.8**	5	13	Baetidae	56%

Primary Sampling Data for Hardwood Creek 'Above'



Hardwood Creek 'Above' Data Summary

Family Biotic Index (FBI): The 2016 SHEP field sampling results produced a score of 4.8 for the Hardwood Creek 'Above' site. This score corresponds to a "Good" rating on the Family Biotic Index stream health chart. The FBI trend indicates an improving stream health. The data from year to year is variable; however, the data since 2014 has been similar. They have similar dominant families, EPT families, total number of families, and FBI scores. The same EPT families have been represented in the samples for many years (one more in 2016). Variability in family representation may be caused by environmental factors including water levels, habitat availability, or other sources of disturbance in the area.

Number of individuals: A large sample offers more confidence for a more reliable data set. SHEP protocol requires a minimum of 100 individual invertebrates to be picked and identified per sample. 128 invertebrates were identified in this sample, this is a good sample size.

Dominant Family: The dominant family, Baetidae, has a tolerance value of 4 on a scale of 0-10. (The lower the tolerance value, the lower their tolerance to pollution). Small minnow mayflies are small, and may be very abundant in ideal conditions. They are good swimmers, and are found in streams with moderate currents or slack water. Some species are common in polluted streams. (*Guide to Aquatic Invertebrates of the Upper Midwest, R.W. Bouchard, Jr.*)

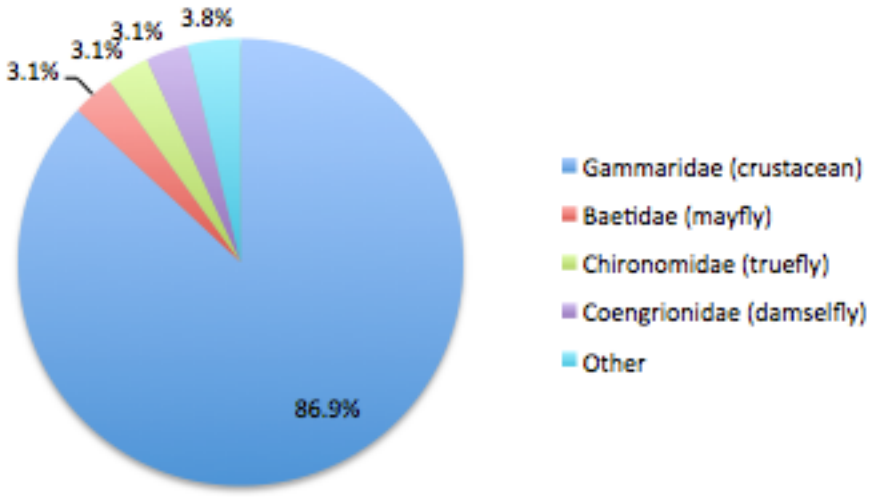
Number of Families: In 2016, 13 families were identified in the sample. This compares to 12 families in 2015 and 13 families in 2014. In general, a more diverse sample suggests a healthier stream environment.

EPT: Ephemeroptera-Plecoptera-Tricoptera (Mayfly-Stonefly-Caddisfly) are three Orders of invertebrates with low tolerance to pollution. The more of these families in a sample, the better. In healthy streams, more than 10-12 EPT families is considered good; in an urban area like the Rice Creek Watershed, 3-5 EPT families is considered good. In 2016, 5 EPT families (Baetidae (Mayflies), Caenidae (Mayflies), Heptageniidae (Mayflies), Hydropsychidae (Caddisfly), and Phyrganeidae (Caddisfly)) were identified in the sample and made up 70.4% of the sample.

4.1.4b Field Sampling Results for Hardwood Creek "Below" Site

Historical Field Results for Hardwood Creek 'Below' Site						
Date	# Identified	Family Biotic Index	EPT	Number of Families	Dominant Family	Dominant Family % Overall
Field Sampling Results:						
9/20/10	136	**5.1**	3	16	Gammaridae	38%
8/20/11	154	**4.4**	3	11	Gammaridae	60.4%
10/2/12	210	**4.6**	4	20	Gammaridae	51.4%
8/25/13	134	**4.9**	4	15	Gammaridae	24%
9/13/14	196	**4.2**	3	10	Gammaridae	63%
9/05/15	159	**4.4**	4	13	Gammaridae	65%
9/10/16	131	**4.3**	2	9	Gammaridae	86%

Primary Sampling Data for Hardwood Creek 'Below'



Hardwood Creek 'Below' Data Summary

Family Biotic Index (FBI): Our 2016 SHEP field sampling results produced a score of 4.3 for the Hardwood Creek 'Below' site. The family biotic index (FBI) trend for Hardwood Creek Below appears stable. The FBI score, family make-up, EPT families present all look similar. Scuds have dominated this site as long as it has been monitored by SHEP. In 2016, the disproportion of family diversity is evident. 2016 also shows the lowest number of families and EPT families represented in the sample.

Number of individuals: A large sample offers more confidence for a more reliable data set. SHEP protocol requires a minimum of 100 individual invertebrates to be picked and identified per sample. 131 invertebrates were identified in this sample. This sample size is a good size.

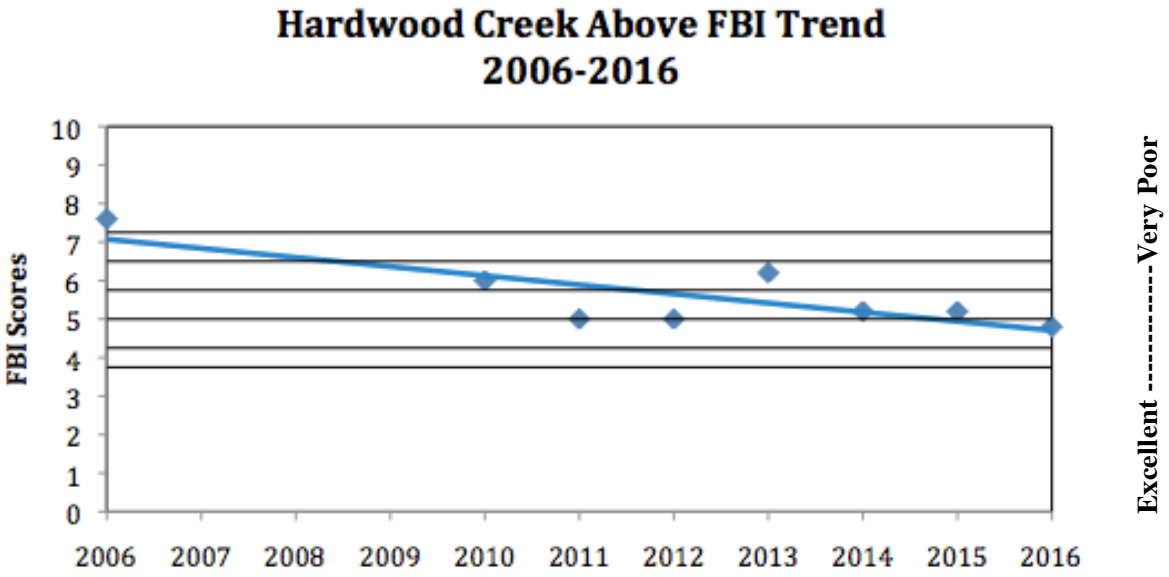
Dominant Family: The dominant family was Gammaridae (Crustacean) has a tolerance value of 4 on a scale of 0-10 (the lower the tolerance value, the lower their tolerance to pollution). They are closely related to Hyalellidae. The distinction between the two families is the flagellum found on the antennae of Gammaridae. They are important food sources for fish and invertebrate predators. They can be extremely abundant in water bodies without fish and are important in the breakdown of organic matter. (Guide to Aquatic Invertebrates of the Upper Midwest, R.W. Bouchard, Jr).

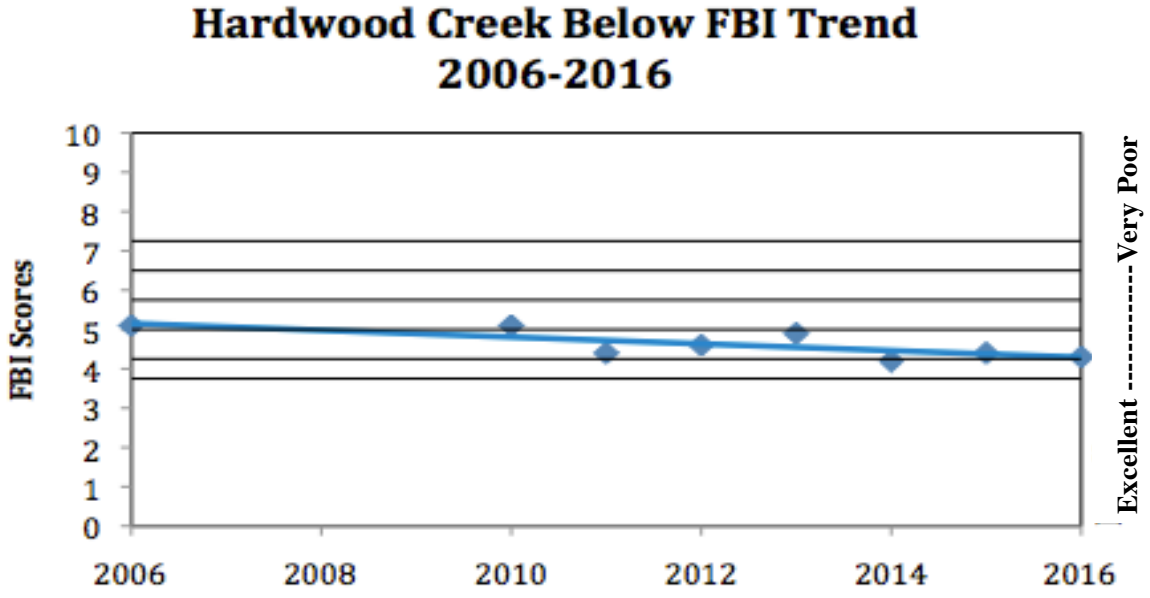
Number of Families: 9 families were identified in the sample. This compares to 13 families in 2015 and 10 families in 2014. In general, a more diverse sample suggests a healthier stream environment.

EPT: Ephemeroptera-Plecoptera-Tricoptera (Mayfly-Stonefly-Caddisfly) are three Orders of invertebrates with low tolerance to pollution. The more of these families in a sample, the better. In healthy streams, more than 10-12 EPT families is considered good; in an urban area like the Rice Creek Watershed, 3-5 EPT families is considered good. In 2016 a total of 2 EPT families (Baetidae (Mayflies), Heptageniidae (Mayflies)) were identified in the sample and made up 3.9% of the sample.

4.1.5 Hardwood Creek Overall Data Summary

Interpretation of the Hilsenhoff Biotic Index										
Sampling Sites	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Hardwood Creek 'Above'	7.2	6.3	6.6	6	5	5	6.2	5.2	5.2	4.8
Hardwood Creek 'Below'	NA	NA	NA	5.1	4.4	4.6	4.9	4.2	4.4	4.3





A stream health trend was created using scores calculated for family biotic index (FBI). Contrary to common sense, a descending trendline indicates improvement in the stream health since organisms with sensitivity to water pollution score lower on the family biotic index.

4.2 Clearwater Creek

4.2.1 Existing Conditions

Clearwater Creek is 8.33 miles long and drains an area of 62 square miles of White Bear Lake, White Bear Township, Hugo, Lino Lakes, and Centerville. Clearwater Creek empties into Peltier Lake in the Rice Creek Chain of Lakes.

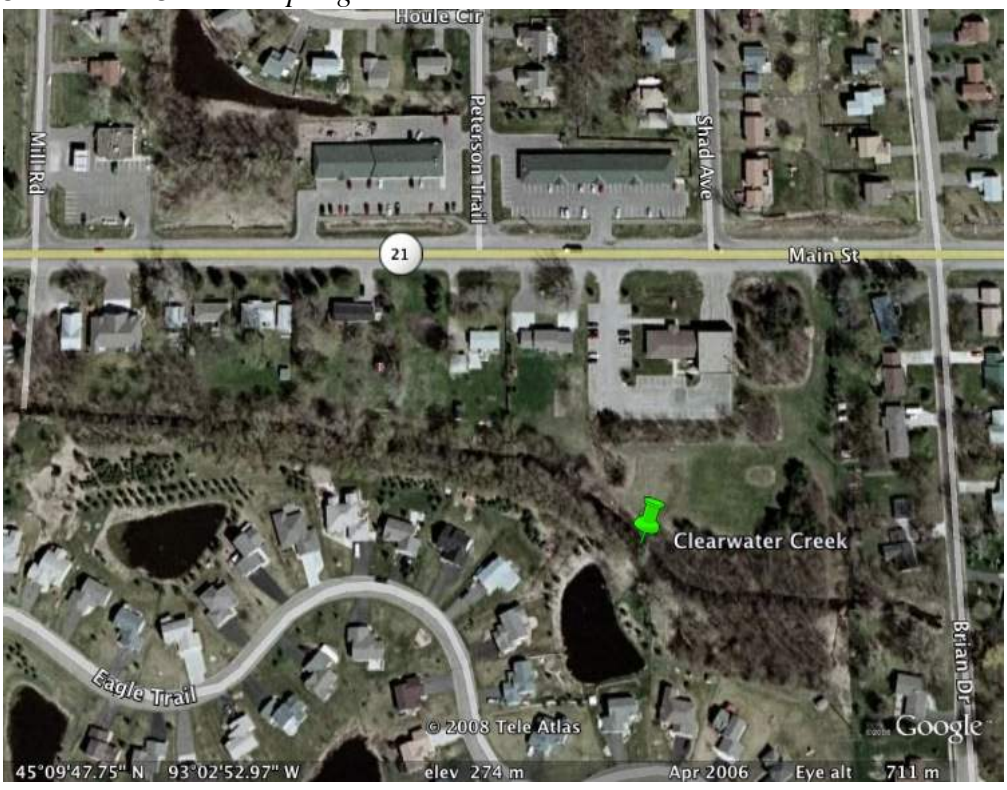
Clearwater Creek is listed as impaired for biota, though recent stream samples indicate low levels of most water quality pollutants. Additional information is available in the Rice Creek Watershed District's 2009 Stream Monitoring Report.

4.2.2 Site Maps

Below is a map of the Clearwater Creek sampling location. The Clearwater Creek site has been sampled since the 2007 SHEP season.

The pin on the site map corresponds to the midpoint of the sampled stream reach. Each stream reach sampled is referred to as the 'sampling site' for the purposes of this report.

Clearwater Creek sampling location.



4.2.3 Sampling Methodology

Team Leader: Gary Averbeck and Wayne LeBlanc

Team Members: Landon Acre-Kendall, Amy Anderson, Barbara Bor, Linda Gruntner, Tere O'Connell, Dana Raines, Melissa Seidel, Robin Turner.

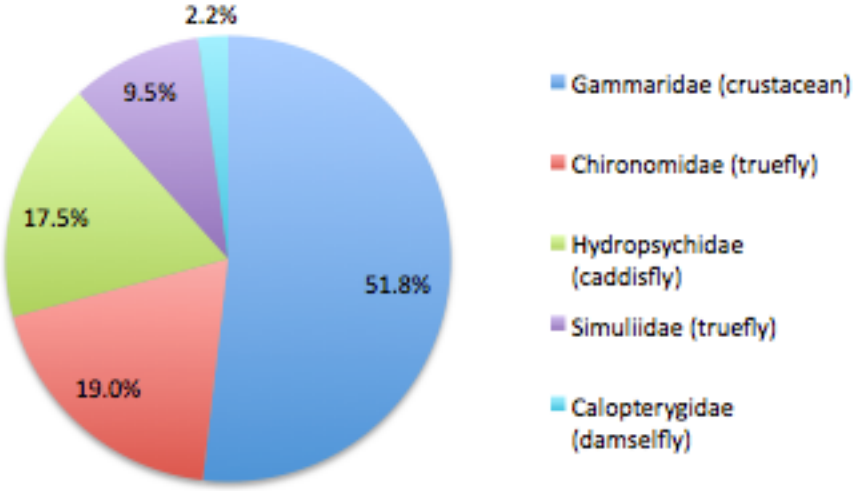
SHEP volunteers used the MPCA's multi-habitat monitoring protocol at each monitoring location. At least 20 dip-net samples (or 'jabs') were taken from across all major habitat types in the reach. Program staff members performed site visits to assure monitoring was performed according to MPCA guidelines and protocols.

Lab analysis identified the taxonomic classification of benthic macroinvertebrate samples from each sampling site. Using taxonomic keys, SHEP volunteers identified the Kingdom, Phylum, Class, Order and Family of macroinvertebrate organisms. Once identified, samples were sorted, labeled and scored.

4.2.4 Field Sampling Results for Clearwater Creek Site

Historical Field Results for Clearwater Creek Site						
Date	# Identified	Family Biotic Index	EPT	# of Families	Dominant Family	Dominant Family % Overall
Field Sampling Results:						
9/8/07	84	**5.9**	4	19	Heptageniidae	19%
9/8/08	100	**5.5**	3	17	Chironomidae	41%
9/12/09	152	**6.3**	5	18	Hydropsychidae	17%
9/11/10	135	**4.5**	2	10	Gammaridae	76%
9/11/11	363	**4.7**	4	19	Gammaridae	43%
10/2/12	146	**4.6**	2	16	Gammaridae	55.5%
8/25/13	134	**4.9**	3	12	Gammaridae	58%
9/13/14	140	**5.6**	2	11	Simuliidae	32%
9/05/15	181	**4.4**	3	10	Gammaridae	67%
9/10/16	138	**4.6**	1	5	Gammaridae	51%
Cross Check Results:						
10/17/07	155	**5.9**	4	20	Hyalellidae	19.4%
9/7/08	109	**6.8**	5	15	Corixidae	22%
9/26/09	113	**4.7**	3	14	Hydropsychidae	43%

Primary Sampling Data for Clearwater Creek



Clearwater Creek Data Summary

Family Biotic Index (FBI): Field sampling results produced a score of 4.6 for the Clearwater Creek site. This score corresponds to a "Good" rating on the Family Biotic Index stream health chart. There are several constants at this stream. FBI trend remains stable despite a few years of variability. Gammaridae has consistently dominated the samples. Hydropsychidae remains a present EPT family; however, it is the only EPT family represented in 2016. The number of families represented declined again. Variability in family representation may be caused by environmental factors including water levels, habitat availability, or other sources of disturbance in the area.

Number of individuals: A large sample offers more confidence for a more reliable data set. SHEP protocol requires a minimum of 100 individual invertebrates to be picked and identified per sample. 138 invertebrates were identified in this sample. This sample size in a good size.

Dominant Family: The dominant family was Gammaridae have a tolerance value of 4 (moderate) on a scale of 0-10 (the lower the tolerance value, the lower their tolerance to pollution). Gammaridae are crustaceans and related to Hyalellidaes. The differentiation between the two families is a tiny flagellum found on the antennae of the Gammaridae. They can be extremely abundant in water bodies without fish and are important in the breakdown of organic matter. They generally live in shallow regions of most waterbodies, and are found in snags and vegetation. They are an important food source for fish and other invertebrate predators. (*Guide to Aquatic Invertebrates of the Upper Midwest, R.W. Bouchard, Jr.*)

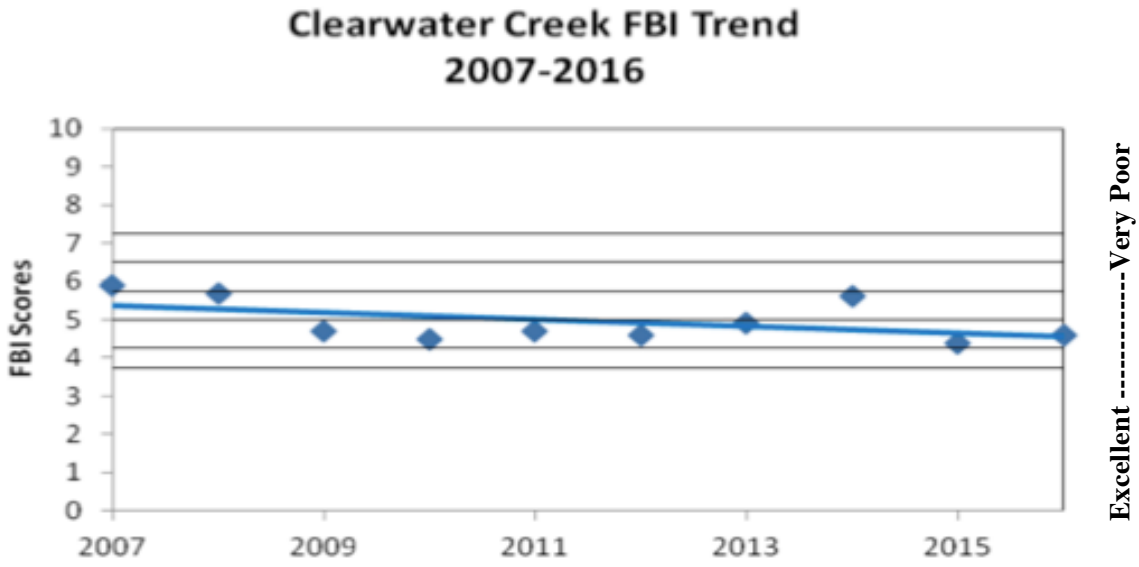
Number of Families: 5 families were identified in the sample. This compares to 10 families in 2015 and 11 families in 2014. In general, a more diverse sample suggests a healthier stream environment.

EPT: Ephemeroptera-Plecoptera-Tricoptera (Mayfly-Stonefly-Caddisfly) are three Orders of invertebrates with low tolerance to pollution. The more of these families in a sample, the better. In healthy streams, more than 10-12 EPT families is considered good; in an urban area like the Rice Creek Watershed, 3-5 EPT families is considered good. In 2016, 1 EPT family (Hydropsychidae (Caddisfly)) was identified in the sample and made up 17% of the total sample.

4.2.5 Clearwater Creek Overall Data Summary

Interpretation of the Hilsenhoff Biotic Index										
Sampling Sites	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Clearwater Creek	5.9	5.5	6.3	4.5	4.7	4.6	4.9	5.6	4.4	4.6
Cross Check	5.9	6.8	4.7	Na	Na	Na	Na	Na	Na	Na

A stream health trend was created using scores calculated for family biotic index (FBI). A descending trend line indicates improvement in the stream health since organisms with sensitivity to water pollution score lower on the family biotic index.



There are several constants at this stream. FBI trend remains stable despite a few years of variability. Gammaridae has consistently dominated the samples. Hydropsychidae remains a present EPT family; however, it is the only EPT family represented in 2016. The number of families represented declined again. Variability in family representation may be caused by environmental factors including water levels, habitat availability, or other sources of disturbance in the area.

4.3 Rice Creek Sites

4.3.1 Existing Conditions

The main stem of Rice Creek run from the Rice Creek Chain of Lakes south and west through Long Lake and Locke Lake before discharging into the Mississippi River in Fridley, MN. Watershed District and Emmons & Olivier Resources Inc. completed a re-meander and restoration of a significant reach of Rice Creek. The project was entirely within Rice Creek North Regional Park and includes a stretch of Rice Creek located between County Road J, Lexington Avenue and County Road I.

The goal of the project was to restore the historical winding flow path and surrounding wetland hydrology for this reach of stream, which was originally straightened in the early 1900's. Many benefits of this project, such as habitat enhancement, water quality improvement and enriched recreation opportunities, have already begun to be realized. While two of the SHEP sampling sites are titled 'Above' and 'Below' for descriptive purposes, both sites are within the boundaries of the restoration. The monitoring sites were selected at the beginning and end of the restoration in part to gauge the long-term stream health changes that result from this restoration activity. A third site, Rice Creek 'Irondale', was introduced to the program in 2012 further downstream of the restoration area, before the Rice Creek discharges into Long Lake.

4.3.2 Site Map

Below are maps of the three Rice Creek sampling locations. The pins correspond to the midpoint of the sampled stream reach. Each stream reach sampled is referred to as the 'sampling site' for the purposes of this report.

Rice Creek 'Above' and 'Below' Sampling Locations

Rice Creek 'Irondale' Sampling Location

4.3.3 Sampling Methodology

Team Leader: James Brozowski & Courtney Jones

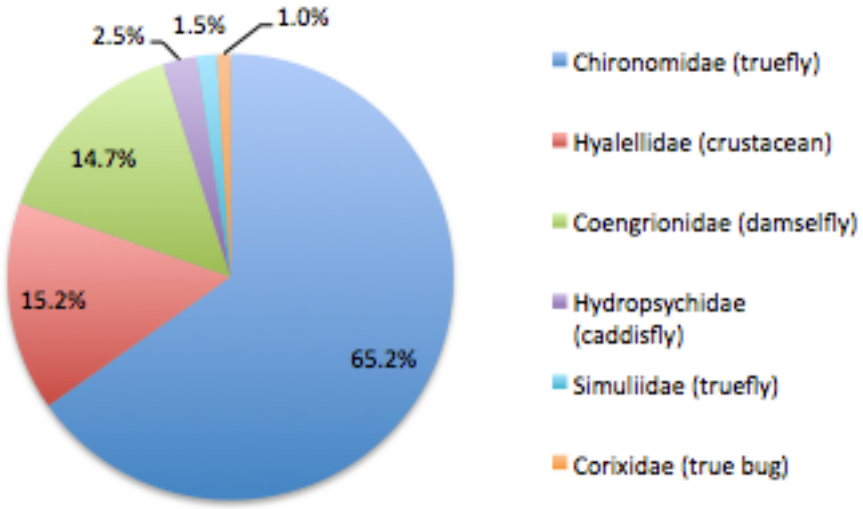
Team Members: Bob Bartlett, Ralph Butkowski, Gary Ellis, Julie Glanton, Jo Ann Morse, Rod Venterea, Ricco Venterea.

SHEP volunteers used the MPCA's multi-habitat monitoring protocol at each monitoring location. At least 20 jabs were taken from across all major habitat types in the reach. Program staff members performed site visits to assure monitoring was performed according to MPCA guidelines and protocols. Lab analysis identified the taxonomic classification of benthic macroinvertebrate samples from each sampling site. Once identified, samples were sorted, labeled and scored.

4.3.4a Field Sampling Results for Rice Creek 'Above' Site

Historical Field Results for Rice Creek 'Above' Site						
Date	# Identified	Family Biotic Index	EPT	# of Families	Dominant Family	Dominant Family % Overall
Field Sampling Results:						
9/1/06	180	**8.8**	2	11	Coenagrionidae	87%
11/13/07	137	**7.9**	0	5	Coenagrionidae	54.5%
9/6/2008	169	**7.3**	2	14	Hyalellidae	38%
9/5/2009	103	**7.0**	3	11	Chironomidae	51%
9/26/10	227	**7.3**	6	11	Hyalellidae	66%
9/18/11	612	**7.8**	3	15	Hyalellidae	70%
9/22/12	174	**8.3**	4	10	Coengrionidae	52.9%
9/21/13	480	**6.1**	1	13	Chironomidae	81.5%
9/7/14	139	**5.9**	1	11	Chironomidae	61%
9/12/15	235	**6.9**	2	8	Chironomidae	62%
9/17/16	204	**6.7**	1	6	Chironomidae	65%
Cross Check Results:						
9/20/09	421	**6.8**	4	14	Chironomidae	40%
9/18/10	510	**7.8**	3	11	Hyalellidae	75%

Primary Sampling Data for Rice Creek 'Above'



Rice Creek 'Above' Data Summary

Family Biotic Index (FBI): SHEP field sampling results produced a score of 6.7 for the Rice Creek 'Above' site. This score corresponds to a "Poor" rating on the Family Biotic Index stream health chart. Despite variable scores, the FBI health trend appears to be improving. The data is similar to 2015: similar FBI score, number of families, and dominant family and make-up. Chironomidae has maintained a high dominance of the samples these last four years. Hydropsychidae was represented in 2016 after several years missing. The presence of high tolerant organisms degrades the FBI score. This site has never made high marks, but there have been years of higher EPT presence.

Number of individuals: A large sample offers more confidence for a more reliable data set. SHEP protocol requires a minimum of 100 individual invertebrates to be picked and identified per sample. 204 invertebrates were identified in this sample. This is a good sample size.

Dominant Family: The dominant family was Chironomidae (Midges). Chironomidae dominated 65% of the sample, and has a tolerance value of 6 on a scale of 0-10. They are a very abundant and diverse group of aquatic insects, and it is common for them to dominate samples (Guide to Aquatic Invertebrates of the Upper Midwest, R.W. Bouchard, Jr). They are predators and prey on mosquito larva, and use their tails for breathing. (Aquatic Entomology, McCafferty, W.P).

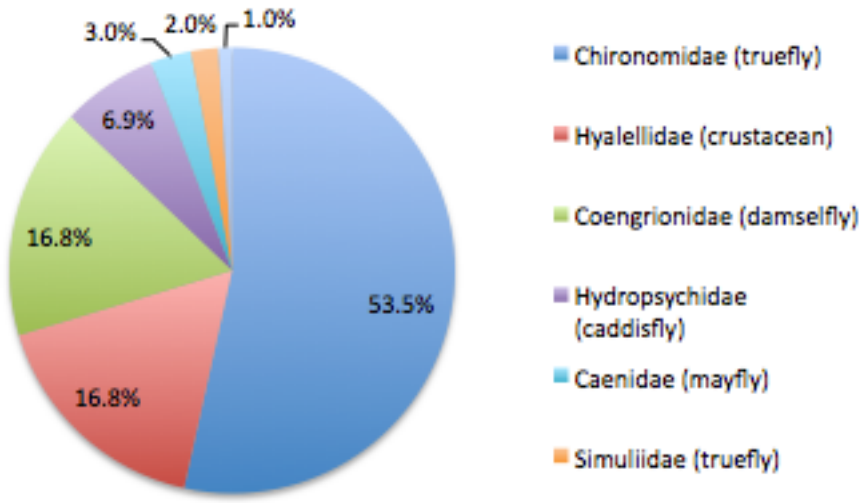
Number of Families: 6 families were identified in the sample. This compares to 11 families in 2014 and 13 families in 2013. In general, a more diverse sample suggests a healthier stream environment.

EPT: Ephemeroptera-Plecoptera-Tricoptera (Mayfly-Stonefly-Caddisfly) are three Orders of invertebrates with low tolerance to pollution. The more of these families in a sample, the better. In healthy streams, more than 10-12 EPT families is considered good; in an urban area like the Rice Creek Watershed, 3-5 EPT families is considered good. In 2016, 1 EPT family was identified in the sample (Hydropsychidae (Caddisfly)) and made up 2.5% of the sample.

4.3.4b Field Sampling Results for Rice Creek 'Below' Site

Historical Field Results for Rice Creek 'Below' Site						
Date	# Identified	Family Biotic Index	EPT	# of Families	Dominant Family	Dominant Family % Overall
Field Sampling Results:						
9/1/06	117	**8.3**	2	12	Coenagrionidae	65%
11/13/07	137	**6.7**	0	5	Coenagrionidae	54.5%
9/6/08	178	**5.2**	2	7	Corixidae	34%
9/6/09	110	**6.3**	2	8	Simuliidae	65%
9/26/10	680	**7.8**	4	15	Hyalellidae	80%
9/18/11	347	**7.8**	3	15	Hyalellidae	75%
9/22/12	129	**7.4**	0	17	Hyalellidae	39.5%
9/14/13	300	**6.4**	0	16	Chironomidae	72%
8/31/14	170	**6.2**	2	9	Chironomidae	67%
9/12/15	125	**6.8**	3	9	Chironomidae	54%
9/10/16	102	**6.7**	2	7	Chironomidae	53%
Cross Check Results:						
10/1/06	142	**6.1**	4	14	Simuliidae	48%
10/6/07	86	**6.8**	2	14	Chironomidae	62.7%
10/12/08	248	**5.8**	4	13	Chironomidae	29%
9/18/11	1409	**7.4**	3	17	Hyalellidae	58%

Primary Sampling Data for Rice Creek 'Below'



Rice Creek 'Below' Data Summary

Family Biotic Index (FBI): SHEP field sampling results produced a score of 6.7 for the Rice Creek 'Below' site. This score corresponds to a "Poor" rating on the Family Biotic

Index stream health chart. The FBI scores are variable; however, the trendline shows slight improvement. Chironomidae and Hyalellidae consistently dominate the samples. These families have mid to poor pollution tolerance values. The FBI score is affected by fluctuations in family representation may be caused by environmental factors including water levels, habitat availability, or other sources of disturbance in the area. The diversity continues to decline.

Number of individuals: A large sample offers more confidence for a more reliable data set. SHEP protocol requires a minimum of 100 individual invertebrates to be picked and identified per sample. 102 invertebrates were identified in this sample. This is a good sized sample.

Dominant Family: The dominant family was Chironomidae (Midges). Chironomidae dominated 53% of the sample, and has a tolerance value of 6 on a scale of 0-10. They are a very abundant and diverse group of aquatic insects, and it is common for them to dominate samples (Guide to Aquatic Invertebrates of the Upper Midwest, R.W. Bouchard, Jr). They are predators and prey on mosquito larva, and use their tails for breathing. (Aquatic Entomology, McCafferty, W.P).

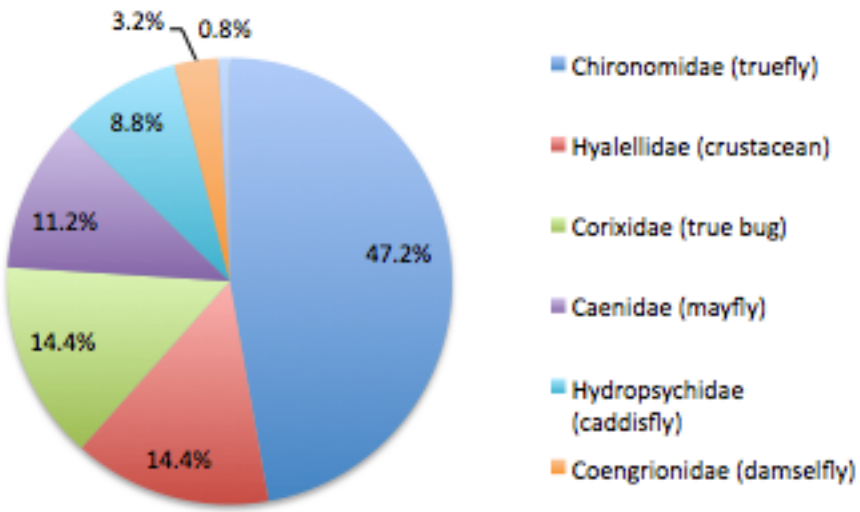
Number of Families: 7 families were identified in the sample. This compares to 9 families in 2015 and 9 families in 2014. In general, a more diverse sample suggests a healthier stream environment.

EPT: Ephemeroptera-Plecoptera-Tricoptera (Mayfly-Stonefly-Caddisfly) are three Orders of invertebrates with low tolerance to pollution. The more of these families in a sample, the better. In healthy streams, more than 10-12 EPT families is considered good; in an urban area like the Rice Creek Watershed, 3-5 EPT families is considered good. In 2016, 2 EPT families (Caenidae (Mayflies) and Hydropsychidae (Caddisflies)) were identified in the sample.

4.3.4c Field Sampling Results for Rice Creek 'Irondale' Site

Historical Field Results for Rice Creek 'Irondale' Site						
Date	# Identified	Family Biotic Index	EPT	# of Families	Dominant Family	Dominant Family % Overall
Field Sampling Results:						
9/2/12	165	**6.8**	2	13	Chironomidae	60.6%
9/14/13	195	**6.8**	1	13	Chironomidae	46%
8/31/14	254	**6.0**	3	13	Chironomidae	60%
8/29/15	104	**6.7**	2	8	Hyalellidae	39%
9/10/16	125	**6.7**	2	7	Chironomidae	47%

Primary Sampling Data for Rice Creek 'Irondale'



Rice Creek 'Irondale' Data Summary

Family Biotic Index (FBI): SHEP field sampling results produced a score of 6.7 for the Rice Creek 'Irondale' site. This score corresponds to a "Poor" rating on the Family Biotic Index stream health chart. The FBI scores appear to be constant and stable. The dominant family, FBI score, and EPT families are similar throughout the years, with expected variability. The diversity has declined in the last two years.

Number of individuals: A large sample offers more confidence for a more reliable data set. SHEP protocol requires a minimum of 100 individual invertebrates to be picked and identified per sample. 125 invertebrates were identified in this sample. This is an acceptable sample size.

Dominant Family: The dominant family was Chironomidae (midges). Chironomidae dominated 47% of the sample, and has a tolerance value of 6 on a scale of 0-10. They are a very abundant and diverse group of aquatic insects, and it is common for them to dominate samples (Guide to Aquatic Invertebrates of the Upper Midwest, R.W. Bouchard, Jr). They are predators and prey on mosquito larva, and use their tails for breathing. (Aquatic Entomology, McCafferty, W.P).

Number of Families: 7 families were identified in the sample. This is a decrease from the 8 families identified in 2015 and 13 in 2014. In general, a more diverse sample suggests a healthier stream environment.

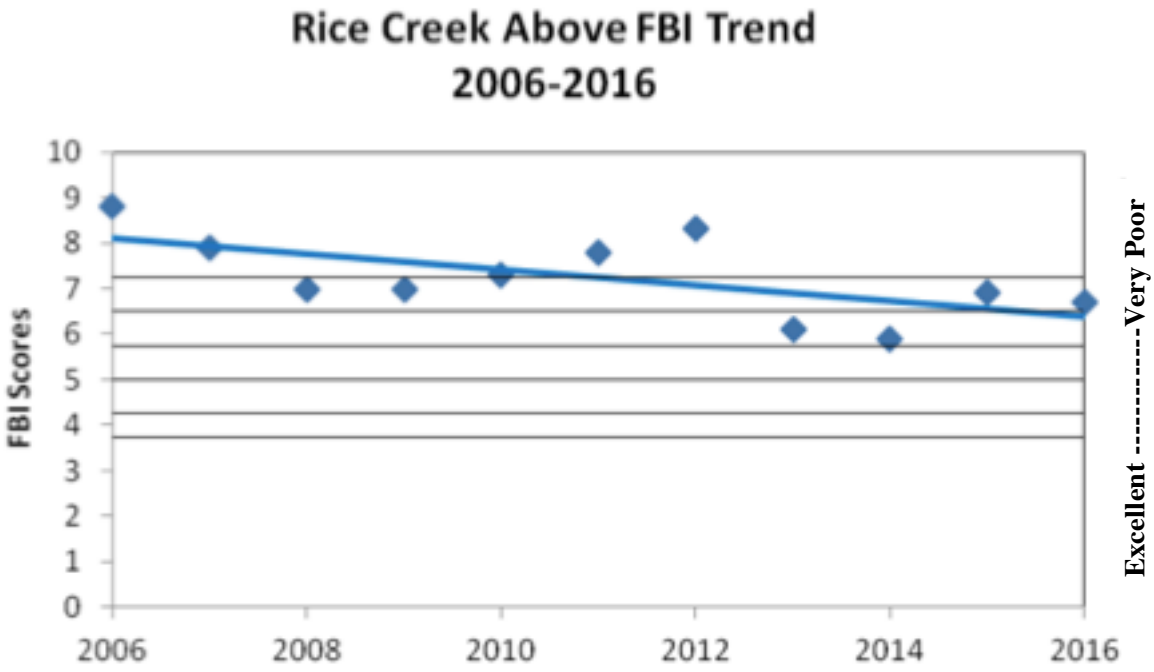
EPT: Ephemeroptera-Plecoptera-Tricoptera (Mayfly-Stonefly-Caddisfly) are three Orders of invertebrates with low tolerance to pollution. The more of these families in a sample, the better. In healthy streams, more than 10-12 EPT families is considered good; in an

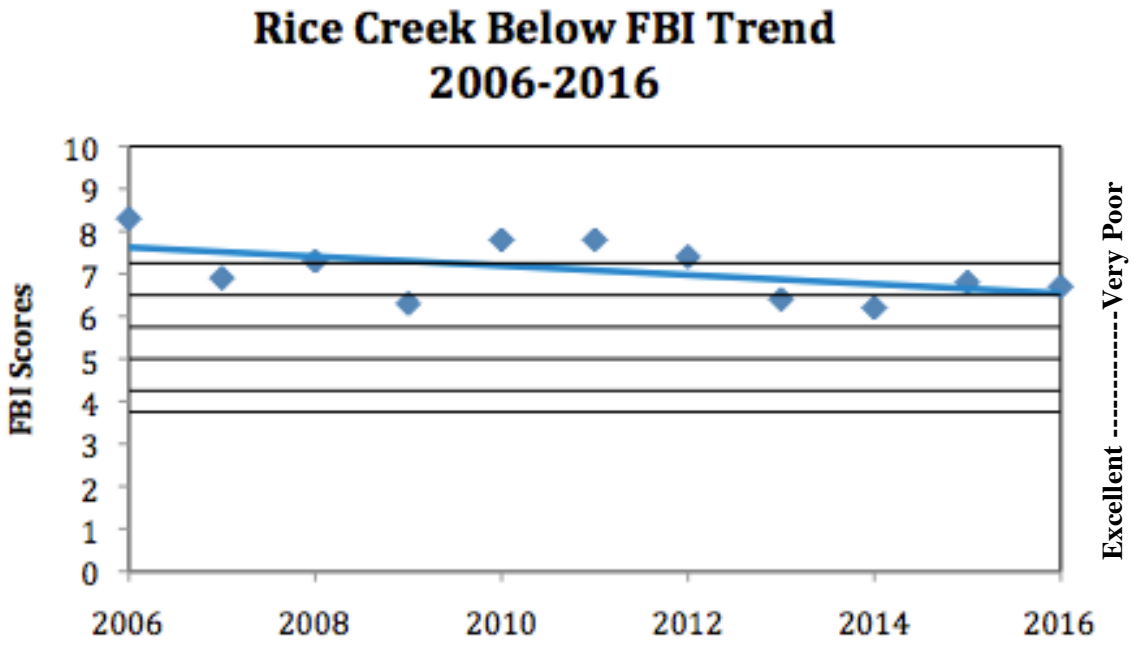
urban area like the Rice Creek Watershed, 3-5 EPT families is considered good. In 2016, 2 EPT families (Caenidae (Mayflies) and Hydropsychidae (Caddisflies)) were identified in the sample.

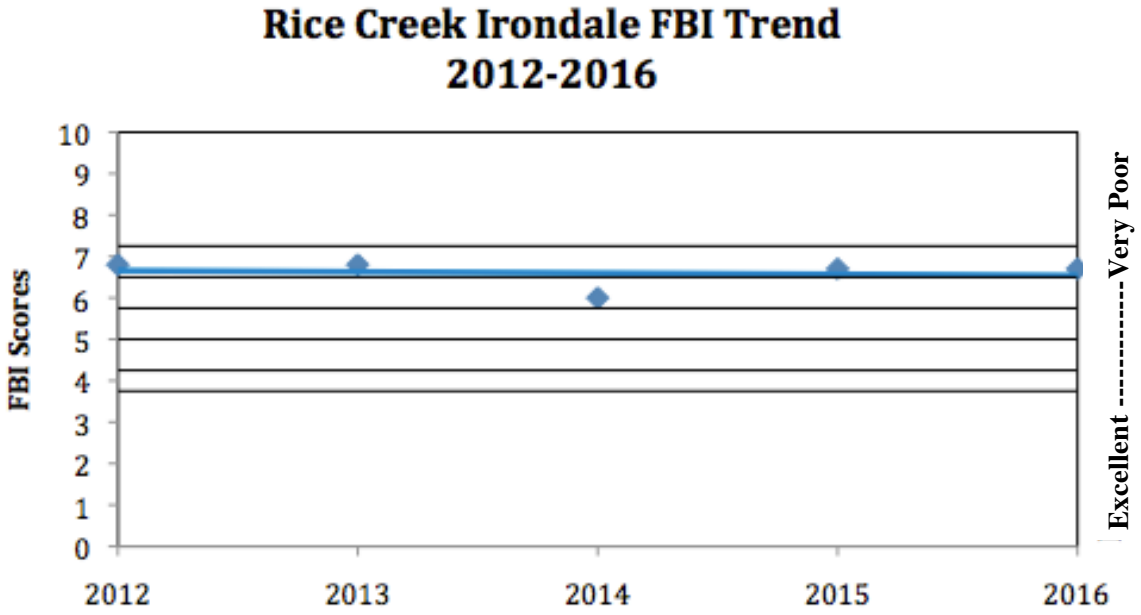
Interpretation of the Hilsenhoff Biotic Index											
Sites	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Rice Creek 'Above'	8.8	7.9	7.3	7	7.3	7.8	8.3	6.1	5.9	6.9	6.7
Rice Creek 'Below'	8.3	6.7	5.2	6.3	7.8	7.8	7.4	6.4	6.2	6.8	6.7
Rice Creek 'Irondale'	Na	Na	Na	Na	Na	Na	6.8	6.8	6	6.7	6.7
Cross Check 'Above'	-	-	-	6.8	7.8	-	Na	Na	Na	Na	Na
Cross Check 'Below'	6.1	6.8	5.8	-	-	7.4	Na	Na	Na	Na	Na

4.3.5 Rice Creek Overall Data Summary

Stream health scores continue to indicate "Fairly Poor" stream health conditions overall, although FBI scores at all three sites have improved in recent years, 2016 saw many of them improve slightly. The individual families present in the samples, and their percentage make-up, have also varied widely in each year. Further long-term sampling data is required in order to more accurately determine what are normal conditions at these sites, especially at the new Rice Creek 'Irondale' site.







A stream health trend was created using scores calculated for family biotic index (FBI). A descending trend line indicates improvement in the stream health since organisms with sensitivity to water pollution score lower on the family biotic index.

4.4 **Locke Lake Area Sites**

4.4.1 Existing Conditions

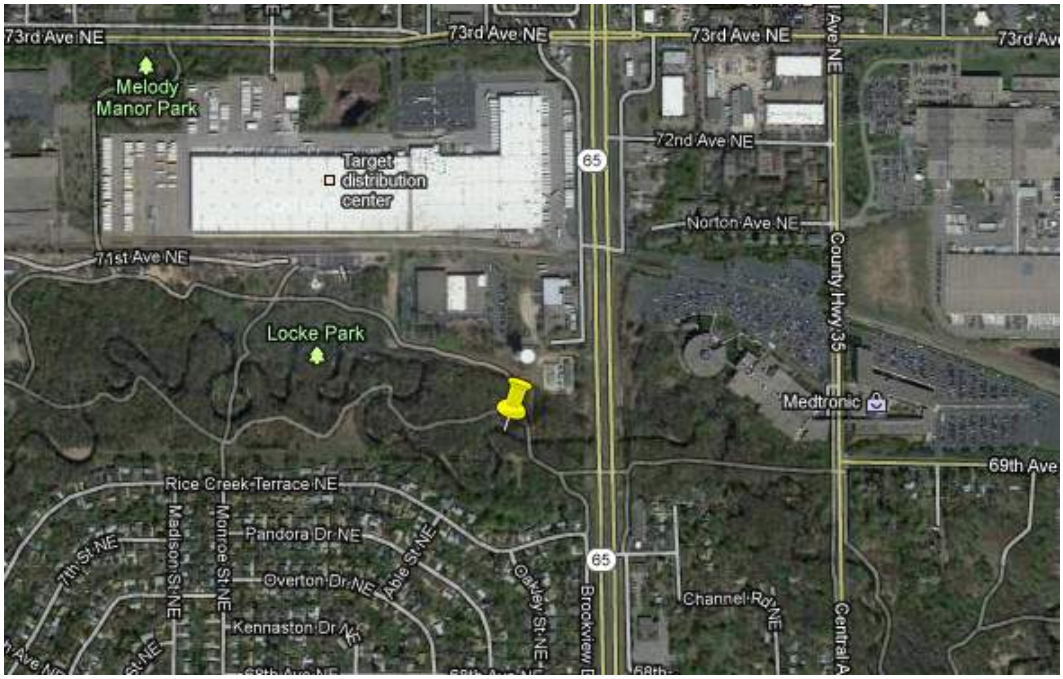
Locke Lake is located just upstream of the Rice Creek Watershed's outlet to the Mississippi River. All outflows from the Rice Creek Watershed pass through the lower reach of the Rice Creek (downstream of Long Lake) and Locke Lake before discharging into the Mississippi River. Recent activity by the Rice Creek Watershed District has focused on installing shoreland restoration and shoreland stabilization measures on properties adjacent to Locke Lake.

4.4.2 Site Map

Below are maps of the Locke Lake sampling locations. The pins correspond to the midpoint of the sampled stream reach. Each stream reach sampled is referred to as the 'sampling site' for the purposes of this report.

Locke Lake 'Above' and 'Below' Sampling Locations

Locke Lake 'Park' Sampling Location



4.4.3 Sampling Methodology

Team Leaders: Katherine & Darrell Majkrzak

Team Members: Lindsay Coleman, Rich Femling, Cathi Lyman-Onkka, Rob Schroeder, Susan Young, Maggie Voth.

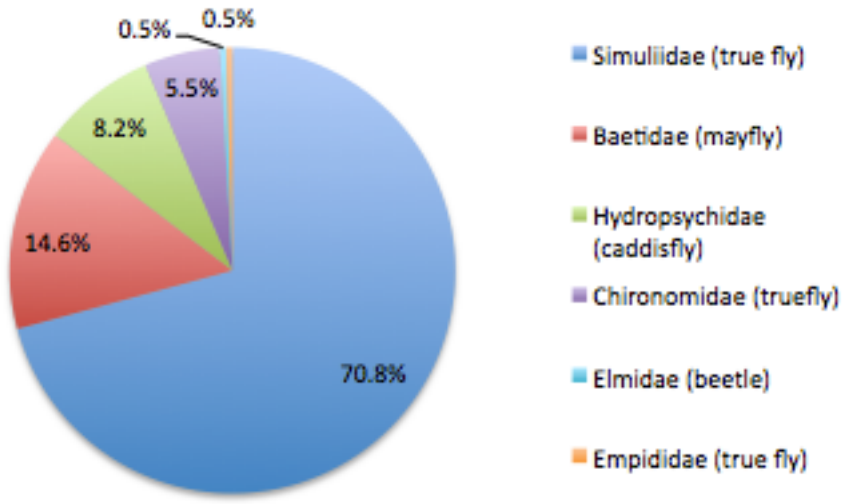
SHEP volunteers used the MPCA's multi-habitat monitoring protocol at each monitoring location. At least 20 jabs were taken from across all major habitat types in the reach. Habitat types include snags and Program staff members performed site visits to assure monitoring was performed according to MPCA guidelines and protocols.

Lab analysis identified the taxonomic classification of benthic macroinvertebrate samples from each sampling site. Using taxonomic keys, SHEP volunteers identified the Kingdom, Phylum, Class, Order and Family of macroinvertebrate organisms. Once identified, samples were sorted, labeled and scored.

4.4.4a Field Sampling Results for Locke Lake 'Park' Site

Historical Field Results for Locke Lake 'Park' Site						
Date	# Identified	Family Biotic Index	EPT	# of Families	Dominant Family	Dominant Family % Overall
Field Sampling Results:						
9/9/12	463	**4.7**	3	14	Chironomidae	31.7%
9/8/13	132	**5.5**	1	11	Nematoda	56%
9/14/14	406	**4.9**	2	11	Hydropsychidae	48%
9/13/15	194	**4.6**	2	10	Hydropsychidae	63%
9/17/16	219	**5.5**	2	6	Simuliidae	71%

Primary Sampling Data for Locke Lake 'Park'



Locke Lake 'Park' Data Summary

Family Biotic Index (FBI): SHEP field sampling results produced a score of 5.5 for the Rice Creek 'Park' site. This score corresponds to a "Fair" rating on the Family Biotic Index stream health chart. The FBI score declined in 2016. The high dominance of black flies, the low diversity of families, and the disproportion of the represented families are not ideal. More years of data are necessary to determine a more reliable health trend.

Number of individuals: A large sample offers more confidence for a more reliable data set. SHEP protocol requires a minimum of 100 individual invertebrates to be picked and identified per sample. 219 invertebrates were identified in this sample. This is a good sample size.

Dominant Family: The dominant family was Simuliidae (Black Fly), which dominated 71% of the sample. Simuliidae has a tolerance value of 6 on a scale of 0-10. (The lower the tolerance value, the lower their tolerance to pollution). Black flies filter fine organic matter from the water. They are common in streams of the Upper Midwest and in some situations can reach huge numbers (Guide to Aquatic Invertebrates of the Upper Midwest, R.W. Bouchard, Jr.)

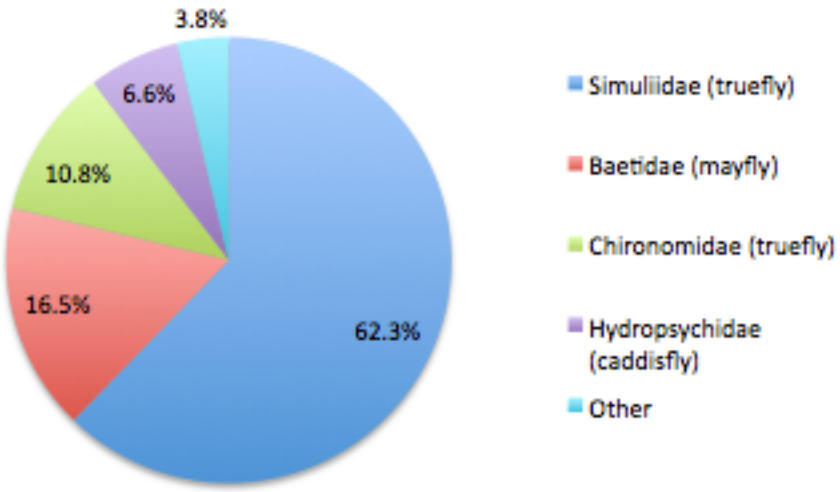
Number of Families: 6 families were identified in the sample. This compares with 10 families identified in 2015 and 11 in 2014. In general, a more diverse sample suggests a healthier stream environment.

EPT: Ephemeroptera-Plecoptera-Tricoptera (Mayfly-Stonefly-Caddisfly) are three Orders of invertebrates with low tolerance to pollution. The more of these families in a sample, the better. In healthy streams, more than 10-12 EPT families is considered good; in an urban area like the Rice Creek Watershed, 3-5 EPT families is considered good. In 2016, 2 EPT families (Baetidae (Mayflies) and Hydropsychidae (Caddisflies)) were identified and made up 23% of the sample.

4.4.4b Field Sampling Results for Locke Lake 'Above' Site

Historical Field Results for Locke Lake Creek 'Above' Site						
Date	# Identified	Family Biotic Index	EPT	# of Families	Dominant Family	Dominant Family % Overall
Field Sampling Results:						
9/28/06	95	**5.0**	2	12	Hydropsychidae	58%
9/9/07	103	**5.1**	3	13	Baetidae	26.2%
10/11//08	163	**5.7**	4	14	Chironomidae	30%
9/13/09	115	**6.1**	3	18	Chironomidae	37%
9/12/10	123	**5.9**	4	13	Chironomidae	43%
9/11/11	362	**5.4**	3	12	Simuliidae	62%
9/9/12	314	**5.2**	6	18	Chironomidae	29.3%
9/08/13	107	**4.9**	2	9	Hydropsychidae	42%
9/14/14	228	**4.4**	2	9	Hydropsychidae	67%
9/13/15	310	**4.5**	2	9	Hydropsychidae	69%
9/17/16	212	**5.5**	3	9	Simuliidae	62%
Cross Check Results:						
9/20/08	115	**4.9**	4	17	Hydropsychidae	33%
9/19/09	107	**6.7**	4	14	Corixidae	36%

Primary Sampling Data for Locke Lake 'Above'



Locke Lake 'Above' Data Summary

Family Biotic Index (FBI): SHEP field sampling results produced a score of 5.5 for the Locke Lake 'Above' site. This score corresponds to a "Fair" rating on the Family Biotic Index stream health chart. The FBI scores have been improving recently; however, the 2016 score has declined. The combination of the black flies regaining dominance of the sample, and the EPT make-up declining has impacted the FBI score.

Number of individuals: A large sample offers more confidence for a more reliable data set. SHEP protocol requires a minimum of 100 individual invertebrates to be picked and identified per sample. 212 invertebrates were identified in this sample. This sample size is good.

Dominant Family: The dominant family was Simuliidae (Black Fly), which dominated 62% of the sample. Simuliidae has a tolerance value of 6 on a scale of 0-10. The lower the tolerance value, the lower their tolerance to pollution). Black flies filter fine organic matter from the water. They are common in streams of the Upper Midwest and in some situations can reach huge numbers (Guide to Aquatic Invertebrates of the Upper Midwest, R.W. Bouchard, Jr.)

Number of Families: 9 families were identified in the sample. This compares to 9 families in 2015, 2014 and 2013. In general, a more diverse sample suggests a healthier stream environment.

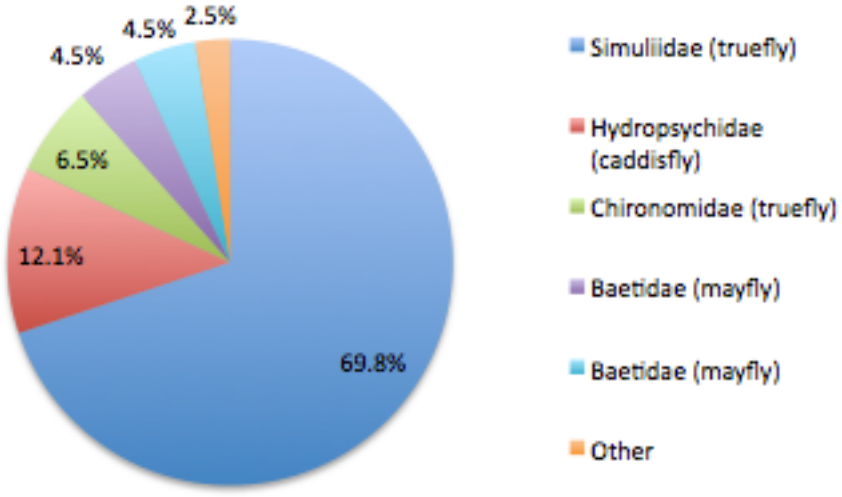
EPT: Ephemeroptera-Plecoptera-Tricoptera (Mayfly-Stonefly-Caddisfly) are three Orders of invertebrates with low tolerance to pollution. The more of these families in a sample, the better. In healthy streams, more than 10-12 EPT families is considered good; in an urban area like the Rice Creek Watershed, 3-5 EPT families is considered good. In 2016

3 EPT families (Baetidae (mayfly), Hydropsychidae (caddisfly), Philpotomidae (caddisfly)) were identified and made up 24% of the sample.

4.4.4c Field Sampling Results for Locke Lake 'Below' Site

Historical Field Results for Locke Lake 'Below' Site						
Date	# Identified	Family Biotic Index	EPT	# of Families	Dominant Family	Dominant Family % Overall
Field Sampling Results:						
9/28/06	111	**5.3**	3	8	Chironomidae	43%
9/16/07	257	**5.7**	2	9	Chironomidae	36.6%
10/11/08	315	**5.1**	5	13	Hydropsychidae	41%
9/13/09	498	**5.0**	2	12	Hydropsychidae	48%
9/12/10	197	**5.0**	5	11	Chironomidae	42%
9/11/11	2536	**5.7**	3	13	Simuliidae	80%
9/9/12	629	**5.6**	3	15	Chironomidae	61.4%
9/8/13	225	**5.6**	2	14	Chironomidae	57%
9/14/14	198	**4.8**	2	9	Hydropsychidae	49%
9/13/15	152	**5.7**	1	10	Chironomidae	72%
9/17/16	190	**5.7**	2	7	Simuliidae	73%
Cross Check Results:						
10/8/06	137	**4.3**	3	10	Hydropsychidae	85%
9/22/07	87	**5.4**	2	9	Gammaridae	23%
10/2/10	100	**5.6**	3	12	Simuliidae	33%
9/3/11	205	**5.1**	4	12	Chironomidae	35%

Primary Sampling Data for Locke Lake 'Below'



Locke Lake 'Below' Data Summary

Family Biotic Index (FBI): SHEP field sampling results produced a score of 5.7 for the Locke Lake 'Below' site. This score corresponds to a "Fair" rating on the Family Biotic Index stream health chart. The 2016 data is similar to 2015. Though the dominant family has shifted from midges to black flies, the tolerance values and percent dominance is the same, imparting no change in the FBI. The dominating family, Chironomidae, has been prevalent for many years. Though the FBI scores are healthy, the low diversity and disproportion of families is not ideal.

Number of individuals: A large sample offers more confidence for a more reliable data set. SHEP protocol requires a minimum of 100 individual invertebrates to be picked and identified per sample. 190 invertebrates were identified in this sample. This sample size is good.

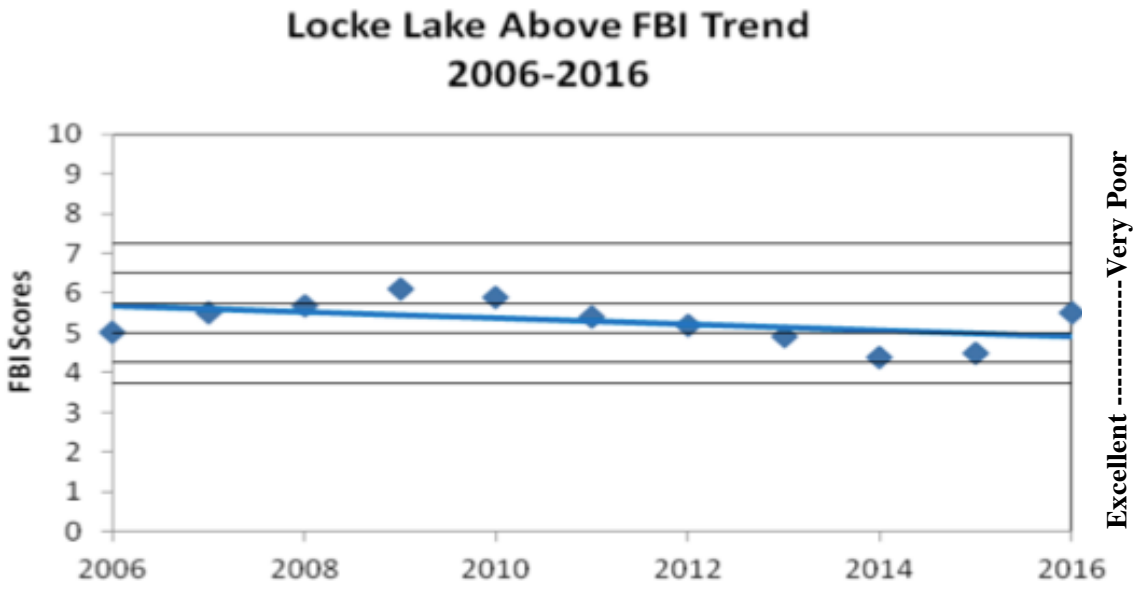
Dominant Family: The dominant family was Simuliidae (black fly), which dominated 73% of the sample. Simuliidae has a tolerance value of 6 on a scale of 0-10. The lower the tolerance value, the lower their tolerance to pollution). Black flies filter fine organic matter from the water. They are common in streams of the Upper Midwest and in some situations can reach huge numbers (Guide to Aquatic Invertebrates of the Upper Midwest, R.W. Bouchard, Jr.)

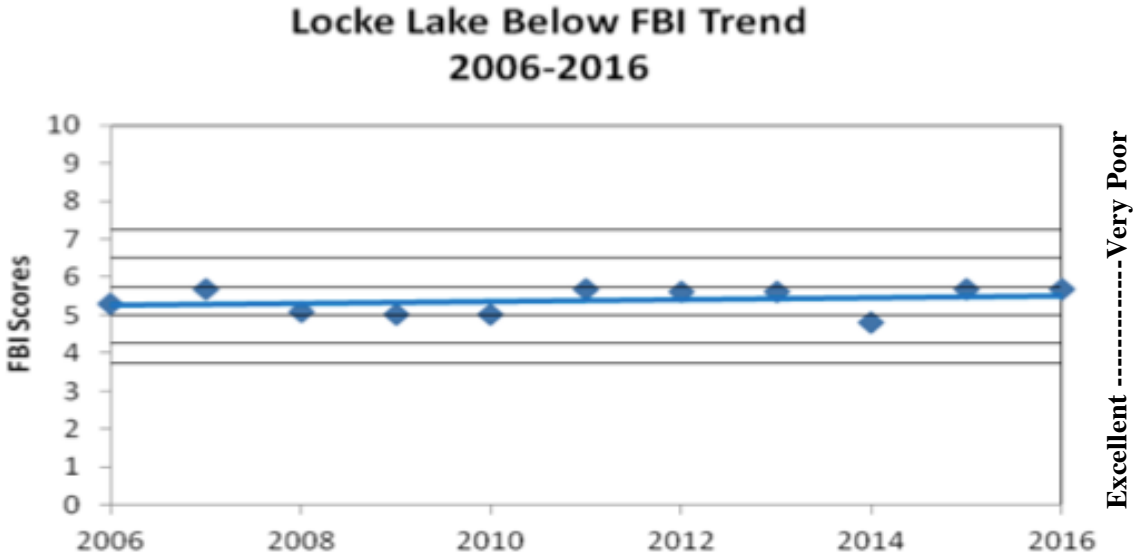
Number of Families: 7 families were identified in the sample. This compares to 10 families in 2015 and 9 families in 2014. In general, a more diverse sample suggests a healthier stream environment.

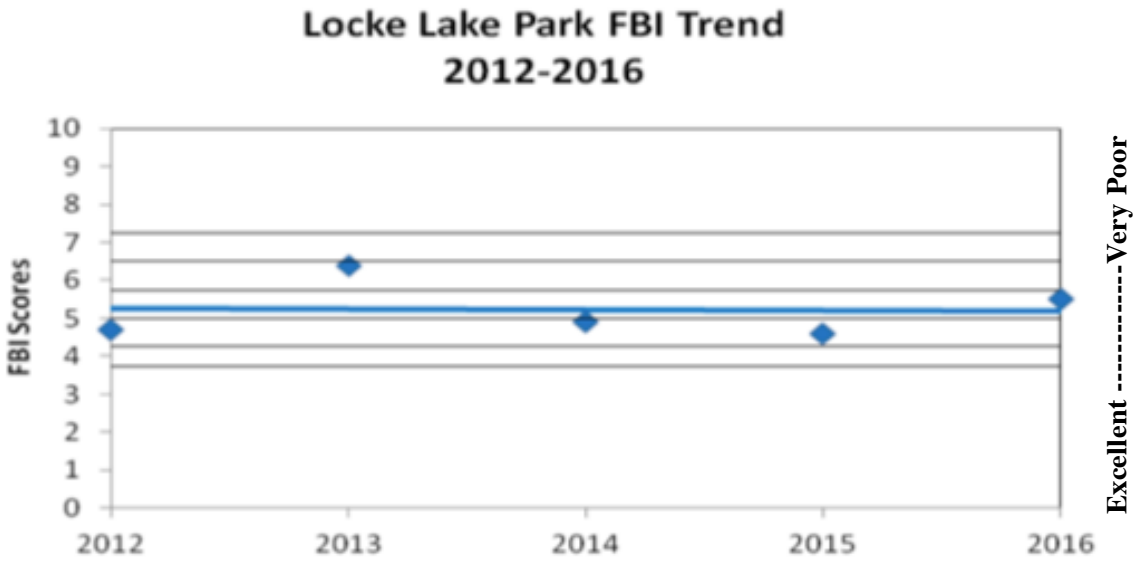
EPT: Ephemeroptera-Plecoptera-Tricoptera (Mayfly-Stonefly-Caddisfly) are three Orders of invertebrates with low tolerance to pollution. The more of these families in a sample, the better. In healthy streams, more than 10-12 EPT families is considered good; in an urban area like the Rice Creek Watershed, 3-5 EPT families is considered good. In 2016, 2 EPT families (Baetidae (mayfly) Hydropsychidae (Caddisflies)) were identified and made up 17.3% of the sample.

4.4.5 Locke Lake Area Overall Data Summary

Interpretation of the Hilsenhoff Biotic Index											
Sites	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Locke Lake 'Above'	5	5.1	5.7	6.1	5.9	5.4	5.2	4.9	4.4	4.5	5.5
Locke Lake 'Below'	5.3	5.7	5.1	5	5	5.7	5.6	5.6	4.8	5.7	5.7
Locke Lake 'Park'	Na	Na	Na	Na	Na	Na	4.7	6.4	4.9	4.6	5.5
Cross Check 'Above'	-	-	4.9	6.7	-	-	Na	Na	Na	Na	Na
Cross Check 'Below'	4.3	5.4	-	-	5.6	5.1	Na	Na	Na	Na	Na


Locke Lake Above FBI Trend
2006-2016
FBI Scores
10
9
8
7
6
5
4
3
2
1
0
2006
2008
2010
2012
2014
2016
Excellent ---------- Very Poor


Locke Lake Below FBI Trend
2006-2016
FBI Scores
10
9
8
7
6
5
4
3
2
1
0
2006
2008
2010
2012
2014
2016
Excellent ---------- Very Poor



A stream health trend was created using scores calculated for family biotic index (FBI). Contrary to common sense, a descending trendline indicates improvement in the stream health since organisms with sensitivity to water pollution score lower on the family biotic index.

APPENDIX A: Rice Creek Watershed District
Stream Health Evaluation Program (SHEP) Sampling Sites