RICE CREEK WATERSHED STREAM HEALTH EVALUATION PROGRAM (SHEP)

2011 BENTHIC MACROINVERTEBRATE STREAM MONITORING REPORT

April 15th, 2012

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The Rice Creek Watershed District
Anoka County Parks

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Fortin Consulting

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Cathi Lyman-Onkka – SHEP Team Leader
Ralph Butkowski - SHEP Team Leader

2011 Rice Creek SHEP Volunteers:

The 2011 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*, Linda Gruntner, Diane Hasz, Barb Hoernemann, Wayne LeBlanc, Tere O'Connell, Dana Raines, Don Vegoe, Jasonn Papenfuss, Stephen Lee.

Team Two: Ralph Butkowski*, Bob Bartlett, Jon Bonkoski, Julie Glanton, Mary Ito, James Brozkowski, Ted McCaslin, Frank Sedzielarz, Maija Sedzielarz, Eileen Zierdt.

Team Three: Cathi Lyman-Onkka*, Mary Hangartner, Ryan Hangartner, Jaime Hauter, Katherine Majkrzak , Darrell Majkrzak, Analiese Miller, Marilyn Radmer, Susan Young.

** 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
2011 Field Summary

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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 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 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 (SHEP) 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.

The Stream Health Evaluation Program (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 2011 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 Anoka Conservation District, University of Minnesota Water Resource Center, City of Lino Lakes, City of Centerville, Anoka County Parks, The Wargo Nature Center, and local landowners.

Primary funding for this program was made possible by the Rice Creek Watershed District. Matching resources for the 2011 SHEP season were provided by Friends of the Mississippi River.

The program recruited 30 adult volunteers organized in three teams to monitor a total of seven sites in the fall of 2011. 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 1.5 days of training, covering the in-stream physical assessment and macroinvertebrate collection methods, and laboratory macroinvertebrate identification procedures. For more information on site selection, see section 2.0.

Each volunteer team collected physical assessment data and benthic macroinvertebrate samples at each site. In addition, each team also cross-checked one site sampled by another team. This was done to improve overall sampling quality and monitor standardized sampling methodology.

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.

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 were led by staff from Friends of the Mississippi River in partnership with Rice Creek Watershed District Staff. Recruitment of volunteers was conducted through news releases, list-serves, flyers, city and county publications, presentations, tabling at events and through communication with interested volunteers in existing local programs.

A total of 30 SHEP volunteers were recruited for this program. Volunteers were divided into three teams. Each team was lead by a Team Leader. 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 his/her 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, Clearwater Creek
Team Leader: Gary Averbeck
Team Members: Linda Gruntner, Diane Hasz, Barb Hoernemann, Wayne LeBlanc, Tere O'Connell, Dana Raines, Don Vegoe, Jasonn Papenfuss, Stephen Lee.

Team Two:
Monitoring Location: Rice Creek
Site Names: Rice Creek 'Above', Rice Creek 'Below'
Team Leader: Ralph Butkowski
Team Members: Bob Bartlett, Jon Bonkoski, Julie Glanton, Mary Ito, James Brozkowski, Ted McCaslin, Frank Sedzielarz, Maija Sedzielarz, Eileen Zierdt.

Team Three:
Monitoring Location: Locke Lake inlet & outlet
Site Names: Locke Lake 'Above', Locke Lake 'Below'
Team Leader: Cathi Lyman-Onkka
Team Members: Mary Hangartner, Ryan Hangartner, Jaime Hauter, Katherine Majkrzak , Darrell Majkrzak, Analiese Miller, Marilyn Radmer, Susan Young.

2.3 Training

Advanced volunteer training is essential to the success of SHEP. Volunteers participated in 1.5 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 13th 2011 at the Wargo Nature Center in Lino Lakes, included an introduction to macroinvertebrate monitoring, habitat assessment protocols, stream flow measurement protocols and featured macroinvertebrate collection methods under the guidance of Minnesota Pollution Control Agency (MPCA) 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.

To allow for maximum student participation, program staff organized the second training sessions on Thursday, September 22nd and Saturday, September 24th at the Wargo Nature Center. SHEP volunteers were asked to participate in at least one of these two sessions, though volunteers were permitted to attend both if desired.

These sessions were led by FMR and Fortin Consulting staff and were designed to focus on laboratory analysis portions of the Stream Health Evaluation Program. These training sessions included benthic macroinvertebrate stream sampling history, sample sorting and sample processing, as well as general lab skills and 'family level' macroinvertebrate identification techniques.

2.4 Site Selection

Stream monitoring sites were selected by RCWD staff. Several sites included in the 2011 SHEP season were upstream or downstream of recent watershed restoration activity. A detailed description of the monitoring is included in section 4.0 of this report.

2.5 Field Sampling

SHEP volunteer teams monitored six stream sites across the Rice Creek Watershed during the fall of 2011. FMR and Fortin Consulting staff members performed site visits to assure monitoring was performed according to MPCA guidelines and protocols.

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.

Project staff from the FMR or Fortin Consulting made in-field team visits whenever possible. These visits are conducted to ensure the teams were following the correct protocols in collecting and preserving macroinvertebrates and conducting habitat assessments.

2.6 Cross-Checks

In an effort to improve our data and ensure that each team is implementing field sampling protocols correctly, SHEP teams cross-check some sites each season to ensure consistency between teams. In 2011, two sites were cross-checked by a second team for accuracy.

2011 Cross-Check Protocol

Team One:
Monitoring Locations: Hardwood Creek 'Above' & 'Below' & Clearwater Creek
Cross-Check Location: No Cross Check

Team Two:
Monitoring Location: Rice Creek Re-meander 'Above' & 'Below'
Cross-Check Monitoring Location: Locke Lake Below

Team Three:
Monitoring Location: Locke Lake 'Above' & 'Below'
Cross-Check Monitoring Location: Rice Creek 'Below'

During cross-checks, 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.

This dual-purpose cross-check allowed SHEP to collect additional data from cross-checked sites, but more importantly helped program staff determine whether or not all teams were following similar protocols in the field. A description of cross-check data, and an interpretation of any variance between sampling scores and cross-checked scores at each site, is included in section 4.0 of this report.

2.7 Lab Identification

SHEP teams sorted and identified macroinvertebrate samples during multiple lab sessions throughout October and November 2011. Lab identification sessions were held in partnership with Anoka County Parks at the Wargo Nature Center in Lino Lakes, 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.

2.8 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: Clearwater Creek sample
Accuracy Score: 100%

Team Two:
Sample: Rice Creek 'Above' sample
Accuracy Score: 93%

Team Three:
Sample: Rice Creek 'Below' Cross-Check sample
Accuracy Score: 98.2%

The overall combined QA/QC accuracy score for the 2011 Rice Creek Watershed Stream Health Evaluation Program was: 97.7%.

3.0 MONITORING TERMS

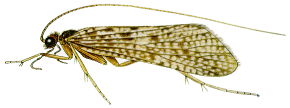
3.1 Monitoring Terms

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

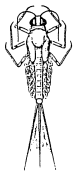
Benthic – of, relating to, or happening on stream, lake or ocean bottoms.

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

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 indexes 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 4.3 score during a cross check at the 'Above' Locke Lake site in 2006. The highest (poorest) historical FBI value reported was an 8.8 above the Rice Creek Re-meander 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 the 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 (16) were discovered at the Hardwood Creek 'above' site, while the fewest number of families (8) were found at the Rice Creek 'below' sampling location.

Number of Organisms Identified- The protocol used requires a minimum of 100 organisms to confidently assess a site. When fewer than 100 organisms are collected, the information is still useful, but we cannot be as confident about characterizing the site's health.

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 indexes 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 2011 FIELD SAMPLING RESULTS

4.1 Hardwood Creek 'Above' & 'Below" Sites

4.1.1 Existing Conditions

Hardwood Creek drains an area of 24 square miles in the cities of Hugo, Forest Lake, and Lino Lakes. Its headwaters drain from Rice Lake through Hardwood Creek before emptying into Lake Peltier at the head of the Chain of Lakes, which is located in the cities of Lino Lakes and Centerville.

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.

Hardwood Creek is listed as impaired for biota (fish) on the lower portion of the creek (downstream of Highway 61), and low dissolved oxygen (DO) for the full length of the creek. The natural background level of DO is used as the water quality endpoint above Highway 61 due to naturally low oxygen levels occurring in that wetland-dominated part of the watershed.

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.

4.1.2 Site Maps

Below are map of each of the 2011 Hardwood sampling locations. The pin on each 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.

The Hardwood Creek 'Above' site was first included in the SHEP sampling protocol in 2007. The 'Below' site is a newer SHEP monitoring location, added to the monitoring protocol for the 2010 season and sampled again in 2011.

Due to the private nature of these parcels and associated challenges with volunteer access, this site is not regularly cross-checked by SHEP volunteer monitors.

2011 Hardwood Creek 'Above' sampling location.

2011 Hardwood Creek 'Below' sampling location.

4.1.3 Sampling Methodology
Team Leader: Gary Averbeck
Team Members: Linda Gruntner, Diane Hasz, Barb Hoernemann, Wayne LeBlanc, Tere O'Connell, Dana Raines, Don Vegoe, Jasonn Papenfuss, Stephen Lee.

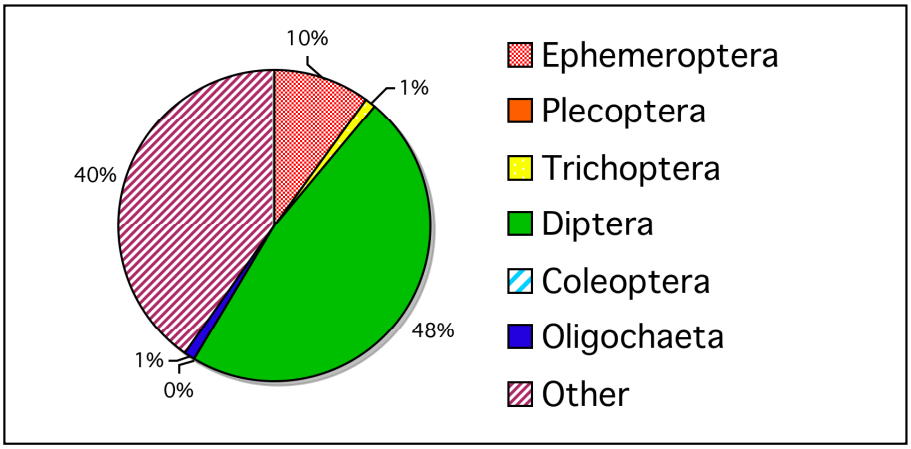
SHEP volunteers used the MPCA's multi-habitat monitoring protocol at this monitoring location. At least 20 dip-net samples (or 'jabs') were taken from across

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%
Cross-Check Results: N/A						



Hardwood Creek 'Above' – 2011 Primary Sampling Data

Our 2011 SHEP field sampling results produced a Family Biotic Index (FBI) score of 5.0 for the Hardwood Creek 'Above' site. This score corresponds to a "Good" rating on the Family Biotic Index stream health chart. This represents a continued improvement in stream health from 2007 (7.2) to 2011 (5.0).

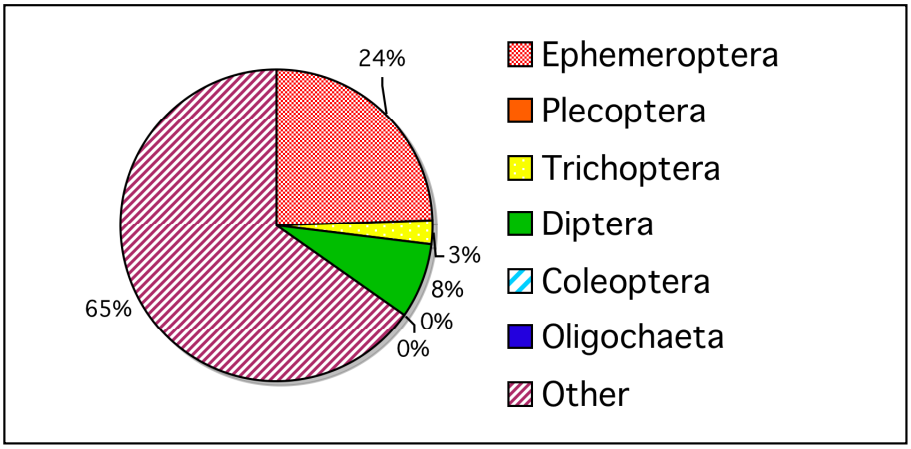
The dominant family at this site was Gammaridae, which has a tolerance value of 4 on a scale of 0-10 (the lower the tolerance value, the lower their tolerance to pollution). They are closely related to Hyalellidae, but have a much lower tolerance to pollution. They are important food sources for fish 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).

In 2011, Gammaridae made up 44% of the sample. Their dominance in 2011, as opposed to the closely-related Hyalellidae in 2010, may account for some of the improvement in HBI.

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%



Hardwood Creek 'Below' – 2011 Primary Sampling Data

Our 2011 SHEP field sampling results produced a Family Biotic Index (FBI) score of 4.4 for the Hardwood Creek 'Below' site. This score corresponds to a "Good" rating on the Family Biotic Index stream health chart.

Overall, the Hardwood Creek 'Below' site represents the best stream health score in the history of the Stream Health Evaluation Program. While data from a pair of monitoring seasons is insufficient to draw conclusions as to the health of the stream, this initial data is certainly promising for the long-term health of the resource.

The dominant family at this site was Gammaridae. Gammaridae 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 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).

Hardwood Creek Overall Data Summary

Interpretation of the Hilsenhoff Biotic Index					
Sampling Site	**2007**	**2008**	**2009**	**2010**	**2011**
Hardwood Creek 'Above'	**7.2**	**6.3**	**6.6**	**6.0**	**5.0**
Hardwood Creek 'Below'	Na	Na	Na	5.1	4.4

The Family Biotic Index (FBI) scores for 2011 show strong stream health scores. While more data is needed, especially at the Hardwood Creek 'Below' Site, the initial findings indicate that an abundance of habitat and modest organic pollution levels contribute to good overall stream health in this portion of the watershed.

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. Both tributaries join Rice Creek in Anoka County as part of the Chain of Lakes.

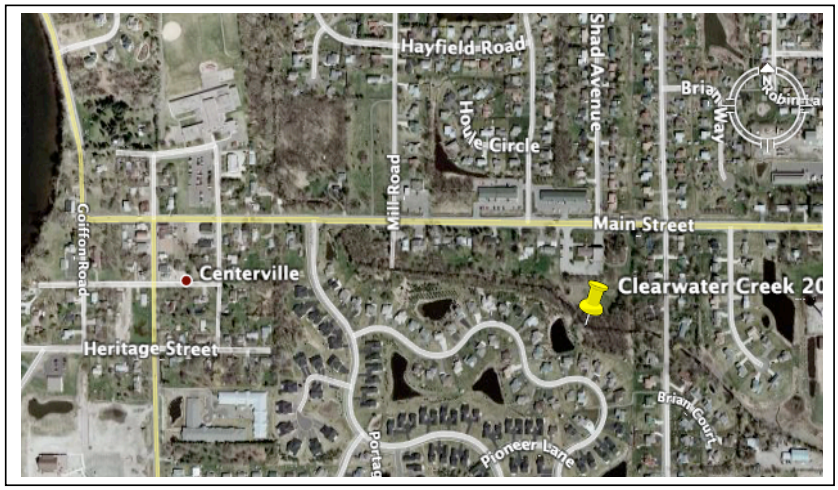
Clearwater Creek is listed as impaired for aquatic life, due to fecal coliform, low dissolved oxygen, and negatively impacted aquatic insect communities.

4.2.2 Site Maps

Below is a map of the Clearwater Creek sampling location. The Clearwater Creek site was sampled for the first time in 2007, and sampling was repeated again at the same location in 2008 - 2011. This site also served as our 2011 volunteer field-training site.

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.

2011 Clearwater Creek sampling location.



4.2.3 Sampling Methodology

Team Leader: Gary Averbeck
Team Members: Linda Gruntner, Diane Hasz, Barb Hoernemann, Wayne LeBlanc, Tere O'Connell, Dana Raines, Don Vegoe, Jasonn Papenfuss, Stephen Lee.

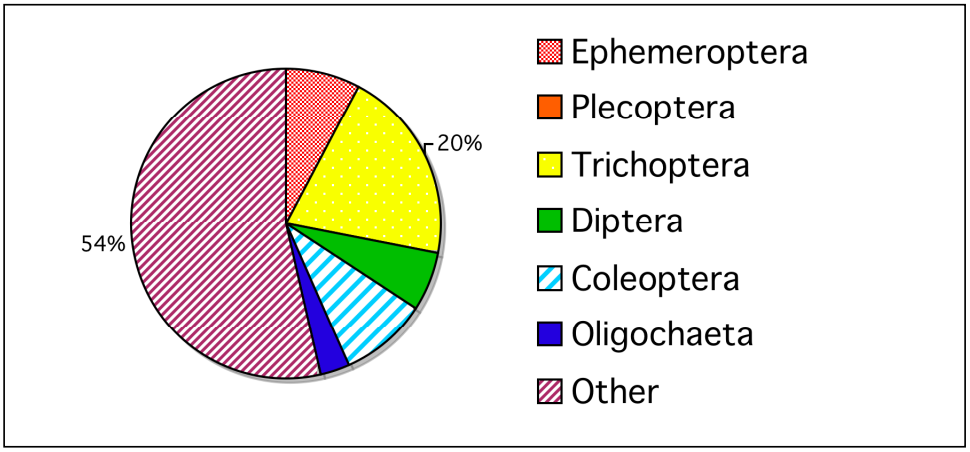
SHEP volunteers used the MPCA's multi-habitat monitoring protocol at each monitoring location. At least 20 dip-net samples (or 'jabs') were taken from across all major habitat types in the reach. Program staff members performed site visits to assure monitoring was performed according to MPCA guidelines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

In 2011, this sample was also submitted to project staff for quality control review.

4.2.4 Field Sampling Results

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%
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%



Clearwater Creek – 2011 Primary Sampling Data

Our 2011 sampling results gave Clearwater Creek a Family Biotic Index score of 4.7. This score corresponds to a stream health rating of "Good". Overall, 363 invertebrates

were identified in this sample. A large sample offers more confidence for a more reliable data set.

The dominant family at this site was once again Gammaridae 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 (note the pollution tolerance difference). 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).

Interpretation of the Hilsenhoff Biotic Index					
Sampling Sites	**2007**	**2008**	**2009**	**2010**	**2011**
Clearwater Creek	5.9	5.5	6.3	4.5	4.7
Cross Check	5.9	6.8	4.7	Na	Na

Overall, Clearwater Creek site results indicate relatively stable stream conditions, with increasing populations of lower pollution tolerance families in the last three seasons. Clearwater Creek continues to post some of the strongest stream health scores in the Rice Creek Watershed.

Further long-term sampling data is required in order to more accurately gauge the overall rate of stream health change at this site.

4.3 Rice Creek Re-Meander

4.3.1 Existing Conditions

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The Rice Creek 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 these 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.

4.3.2 Site Map

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Below is a map of the 2011 Rice Creek Re-Meander 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.

2011 Rice Creek Re-Meander Sampling Locations

4.3.3 Sampling Methodology

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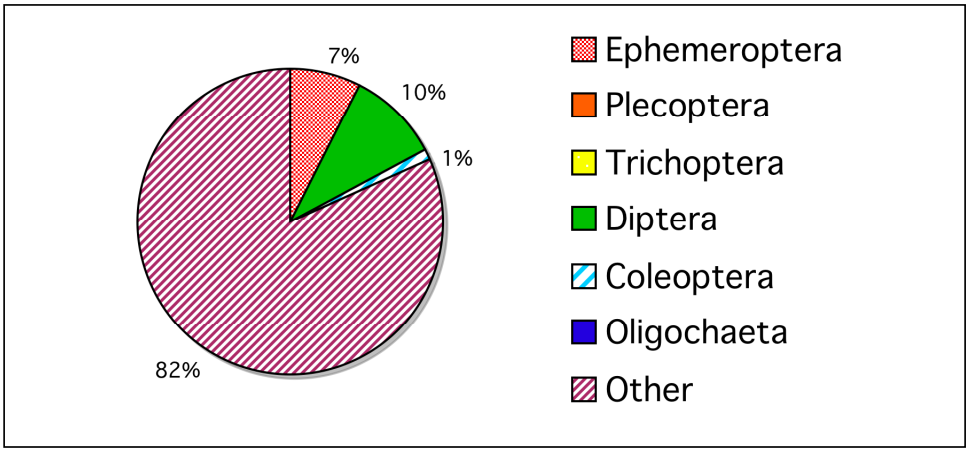
Team Leader: Ralph Butkowski
Team Members: Bob Bartlett, Jon Bonkoski, Julie Glanton, Mary Ito, James Brozkowski, Ted McCaslin, Frank Sedzielarz, Maija Sedzielarz, Eileen Zierdt.

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.

In 2011, samples from both sites were submitted to project staff for quality control review.

4.3.4a Field Sampling Results - '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%
Cross Check Results:						
9/20/09	421	**6.8**	4	14	Chironomidae	40%
9/18/10	510	**7.8**	3	11	Hyalellidae	75%



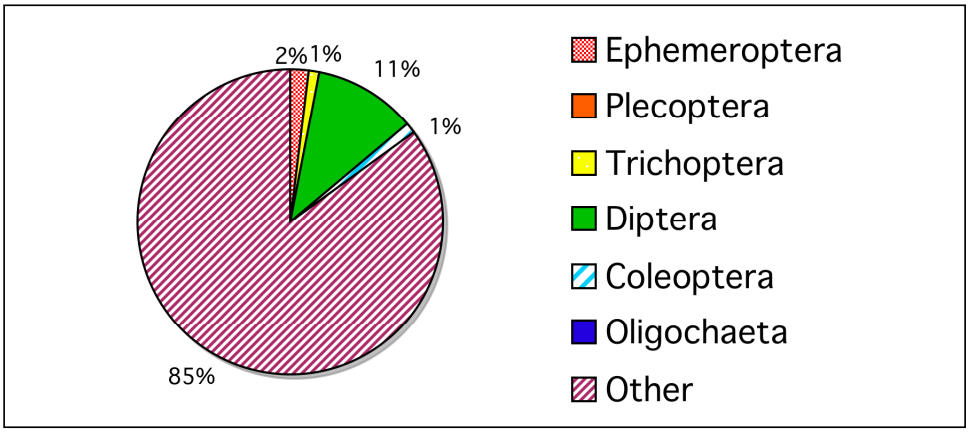
Rice Creek "Above" - 2011 Primary Sampling Data

Our 2011 sampling results (page 23 - above) show that the Rice Creek 'Above' monitoring site received a 7.8 Family Biotic Index score, which indicates a stream health rating of "Very Poor". A total of 612 invertebrates were identified in this sample. A large sample offers more confidence for a more reliable data set.

The dominant family in the aquatic community was Hyalellidae has a tolerance value of 8 on a scale of 0-10. They are closely related to Gammaridae, though more tolerant of pollution. 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).

4.3.4b Field Sampling Results - '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%
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	16	Hyalellidae	58%



Rice Creek "Below" - 2011 Primary Sampling Data

Our 2011 sampling results (above, page 24) show that the 'Below' site received a 7.8 FBI score, which corresponds to a "Very Poor" stream health rating. This rating is identical to 2010. 347 invertebrates were identified in this sample. A large sample offers more confidence for a more reliable data set.

While the overall number of invertebrates (347), total families (15) and EPT families (3) suggest fairly strong habitat diversity – the superabundance of Hyalellidae, a high-tolerance family, drags the score down. Hyalellidae has a tolerance value of 8 on a scale of 0-10 (the lower the tolerance value, the lower their tolerance to pollution). They are closely related to Gammaridae (note the pollution tolerance difference). 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).

Rice Creek Overall Data Summary

Interpretation of the Hilsenhoff Biotic Index						
Sampling Site	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
'Above' restoration	8.8	7.9	7.3	7.0	7.3	7.8
'Below' restoration	8.3	6.7	5.2	6.3	7.8	7.8
Cross Check 'Above'	-	-	-	6.8	7.8	
Cross Check 'Below'	6.1	6.8	5.8	-	-	7.4

These sites had shown some improvement in recent years. However, in 2010 & 2011, stream health scores remain elevated and indicate "Very Poor" stream health conditions overall.

Further long-term sampling data is required in order to more accurately gauge the overall rate of stream health change at these sites.

4.4 **Locke Lake 'Above' & 'Below'**

4.4.1 Existing Conditions

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Locke Lake is located just upstream of the Rice Creek Watershed's outlet to the Mississippi River. All outflows from the Rice Creek Watershed passes through Locke Lake and flows directly 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 is a map of the 2011 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.

2011 Locke Lake Sampling Locations

4.4.3 Sampling Methodology

Team Leader: Cathi Lyman-Onkka
Team Members: Mary Hangartner, Ryan Hangartner, Jaime Hauter, Katherine Majkrzak , Darrell Majkrzak, Analiese Miller, Marilyn Radmer, Susan Young.

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 'Above' Site

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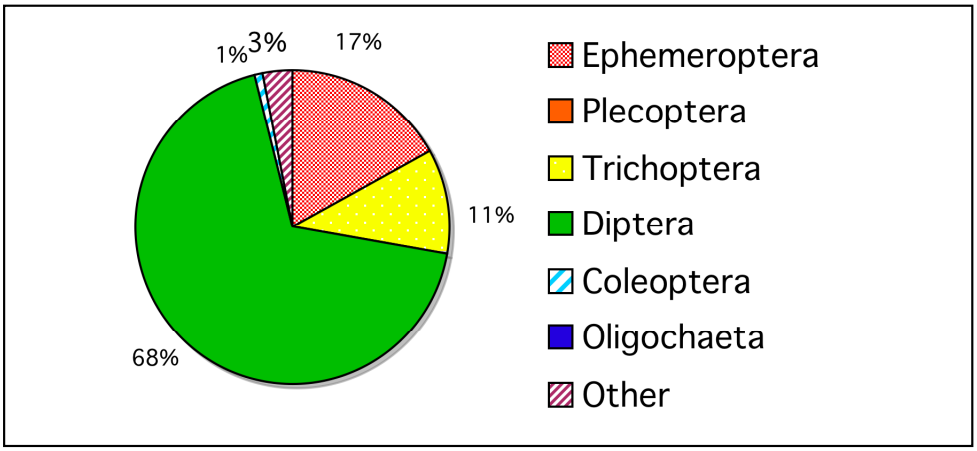
Historical Field Results for Locke Lake Creek 'Above' Site						
Date	# Identified	Family Biotic Index	EPT	# of Families	Dominant Family	Dominant Family % Overall
Field Sampling Results:						
9/28/06	95	**5.0**	2	12	Hydropsychidae	58%
9/9/07	103	**5.1**	3	13	Baetidae	26.2%
10/11//08	163	**5.7**	4	14	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%
Cross Check Results:						
9/20/08	115	**4.9**	4	17	Hydropsychidae	33%
9/19/09	107	**6.7**	4	14	Corixidae	36%



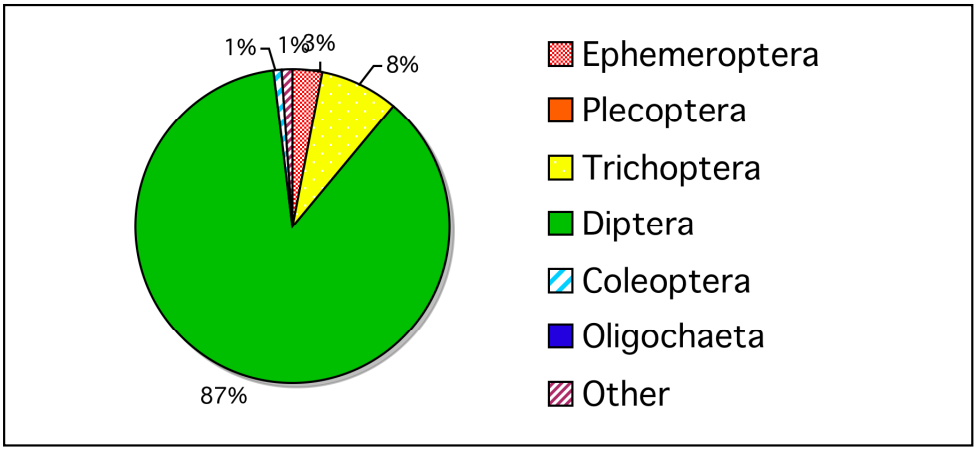
Locke Lake "Above" – 2011 Primary Sampling Data

Our 2011 sampling results show that the 'Above' site received a 5.4 FBI score, which reflects a "Fair" stream health rating. 362 invertebrates were identified in this sample. A large sample offers a higher degree of confidence and a more reliable data set.

The dominant family was Simuliidae, a kind of black fly, which has a tolerance value of 6 on a scale of 0-10. 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.)

4.4.4b 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%
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%



Locke Lake "Below "- 2011 Primary Sampling Data

Our 2011 sampling results show that the 'Below' site received a 5.6 FBI Score that reflects a "Fair" stream health rating. 2536 invertebrates were identified Team 3's sample, by far the largest single sample identification in the history of this program. A large sample offers a higher degree of confidence and a more reliable data set.

The Dominant Family at the "Below" site was Simuliidae, a black fly. Simuliidae has a tolerance value of 6 on a scale of 0-10. 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.)

The cross-check showed a different dominant family – Chironomidae – which has a tolerance value of 6 on a scale of 0-10 (the lower the tolerance value, the lower their tolerance to pollution). 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).

Locke Lake Overall Data Summary

Interpretation of the Hilsenhoff Biotic Index						
Sampling Sites	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Above Locke Lake	5.0	5.1	5.7	6.1	5.9	5.4
Below Locke Lake	5.3	5.7	5.1	5.0	5.0	5.7
Cross Check ('Above')	-	-	4.9	6.7	-	-
Cross Check ('Below')	4.3	5.4	-	-	5.6	5.1

The Family Biotic Index (FBI) for 2011 shows that the Locke Lake 'Above' and Locke Lake 'Below' sites continue to show strong stream health scores. The Family Biotic Index score of 5.4 at the above Locke Lake 'Above' site and the Family Biotic Index score of 5.7 at the above Locke Lake 'Below' site indicates a stream health score "Fair".

Both sites continue to show consistent stream health scores, with an unusually dry 2009 year being an outlier in an otherwise stable data set. The Locke Lake sites continue to post some of the most consistently strong stream health scores in the Rice Creek Watershed.

Further long-term sampling data is required in order to more accurately gauge the overall rate of stream health change at these sites.

APPENDIX A:

2011 Rice Creek Watershed District
Stream Health Evaluation Program (SHEP) Sampling Sites