2008 Anoka Water Almanac

Water Quality and Quantity Conditions of Anoka County, MN

A Report of Activities by
Watershed Organizations and the
Anoka Conservation District

March 2009

Prepared by Anoka Conservation District

2008 ANOKA WATER ALMANAC

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ANOKA CONSERVATION DISTRICT

Digital copies of data in this report are available at www.AnokaNaturalResources.com

EXECUTIVE SUMMARY AND ORGANIZATION OF THIS REPORT

This report summarizes water resources management and monitoring work done as a cooperative effort between the Anoka Conservation District (ACD) and a watershed district or watershed management organization. It includes information about lakes, streams, wetlands, precipitation, and groundwater. The results of this work are presented on a watershed basis—this document serves as an annual report to each of the watershed organizations that have helped fund the work. Readers who are interested in a certain lake, stream or river should first determine which watershed it is located in, and then refer to the chapter corresponding to that watershed. The maps and county-wide summaries in Chapter 1 will help the reader determine if the information they are seeking is available and, if so, in which chapter to find it. In addition to county-wide summaries, chapter 1 also provides methodologies used, explanations of terminology, and hints on interpreting data.

The water resource management and monitoring work reported here include:

- Monitoring
    - precipitation,
    - lake levels,
    - lake water quality,
    - stream hydrology,
    - stream water quality,
    - stream benthic macroinvertebrates,
    - shallow groundwater levels in wetlands, and
    - deep groundwater in observation wells
- Education
    - lakeshore landscaping education, and
    - websites
- Water quality improvement projects
    - cost share grants for erosion correction, lakeshore restorations, and rain gardens, and
    - promotion of available grants for water quality improvement projects
- Studies and analyses
    - precipitation storm analyses,
    - precipitation long term antecedent moisture analyses,
    - reference wetland vegetation inventories, and
    - reference wetland analyses

While this report is perhaps the most comprehensive source of monitoring data on lakes, stream, rivers, groundwater and wetlands in Anoka County, it is not the only source. Nor is this report a summary of all work completed throughout Anoka County in 2008. Rather, it is a summary of work carried out by the Anoka Conservation District in conjunction with watershed organizations within the county. Furthermore, only work conducted during 2008 is presented in this almanac. For results of work completed in years past (for example, water quality monitoring on a particular lake) readers should refer to previous Water Almanacs. All data collected in 2008 and in years past is also available via the Data Access Tool at www.AnokaNaturalResources.com. If you are unable to locate the data you need, contact Anoka Conservation District staff for help.

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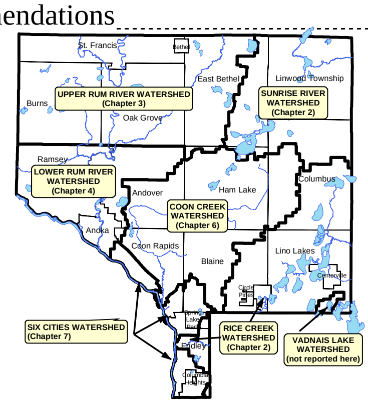
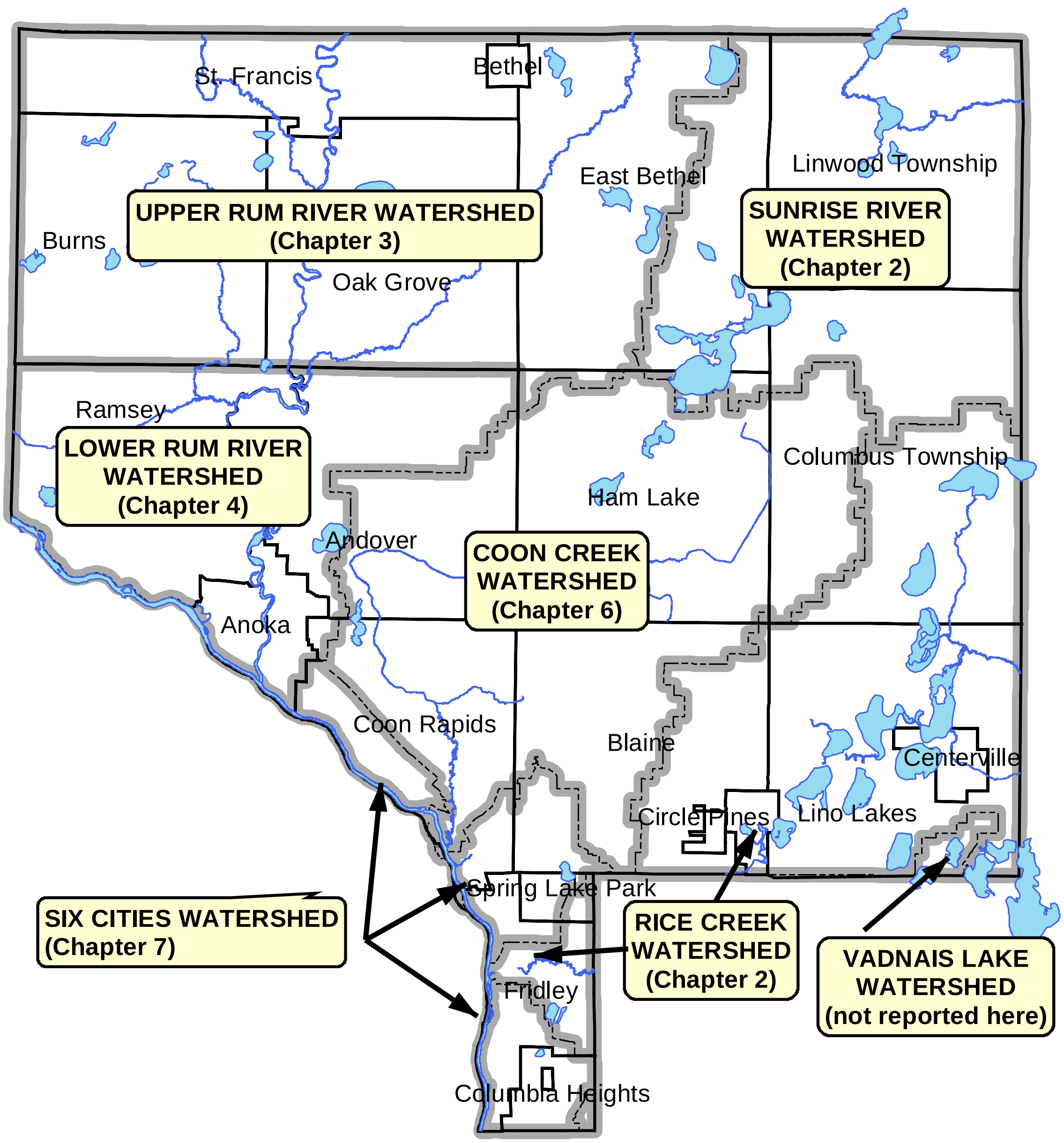


Chapter 1 - Primer



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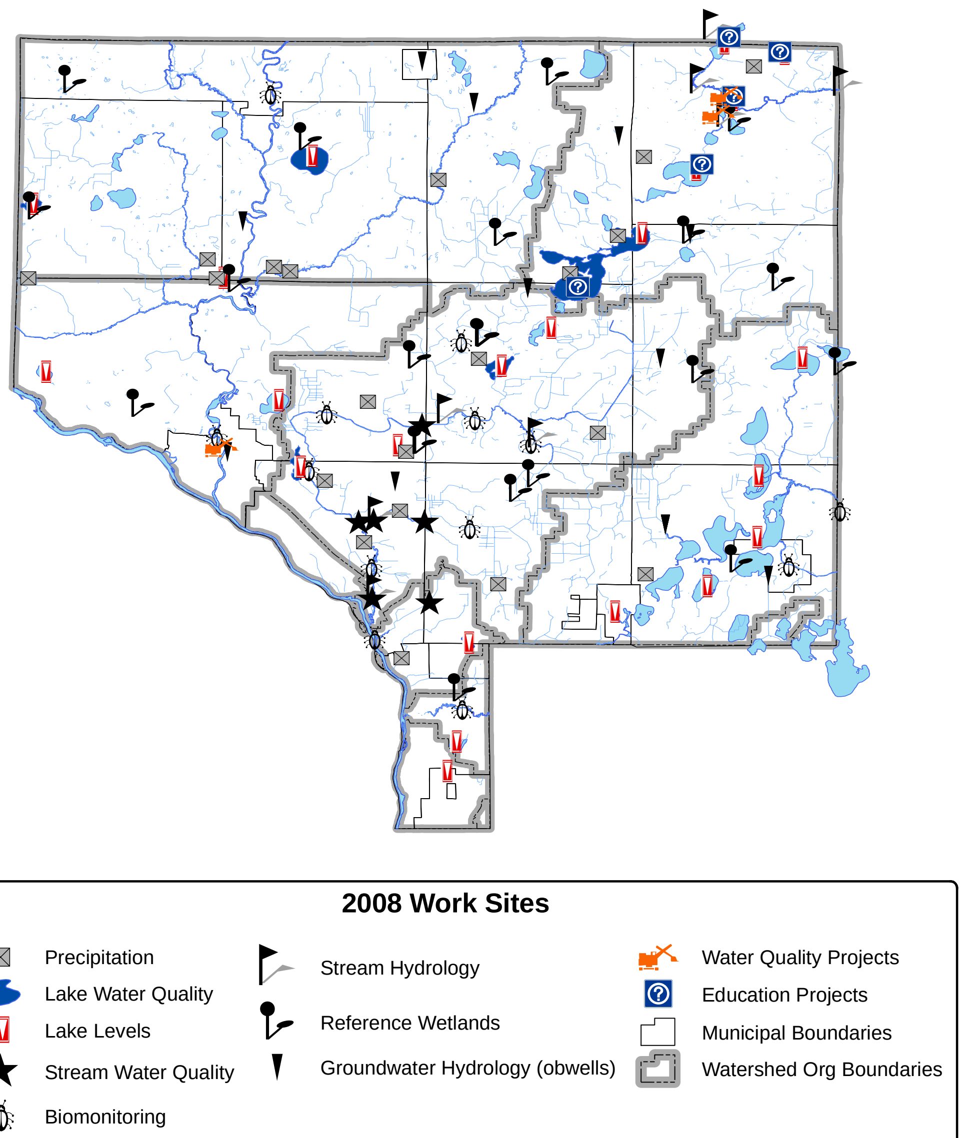
CHAPTER 1:
WATER RESOURCE MONITORING PRIMER

This report is an annual report to watershed organizations that helped fund water monitoring and management in cooperative efforts with the Anoka Conservation District. It also includes all other water-related work carried out by the ACD without partners. This chapter provides an overview of the monitoring activities reported in later chapters, the methodologies used, and information that will help the layperson interpret information found in later chapters. This report includes a variety of work aimed at managing water resources, including lakes, streams, rivers, wetlands, groundwater, and precipitation (see map below).

County-wide precipitation and groundwater hydrology data is also presented in Chapter 1.

2008 Work Sites

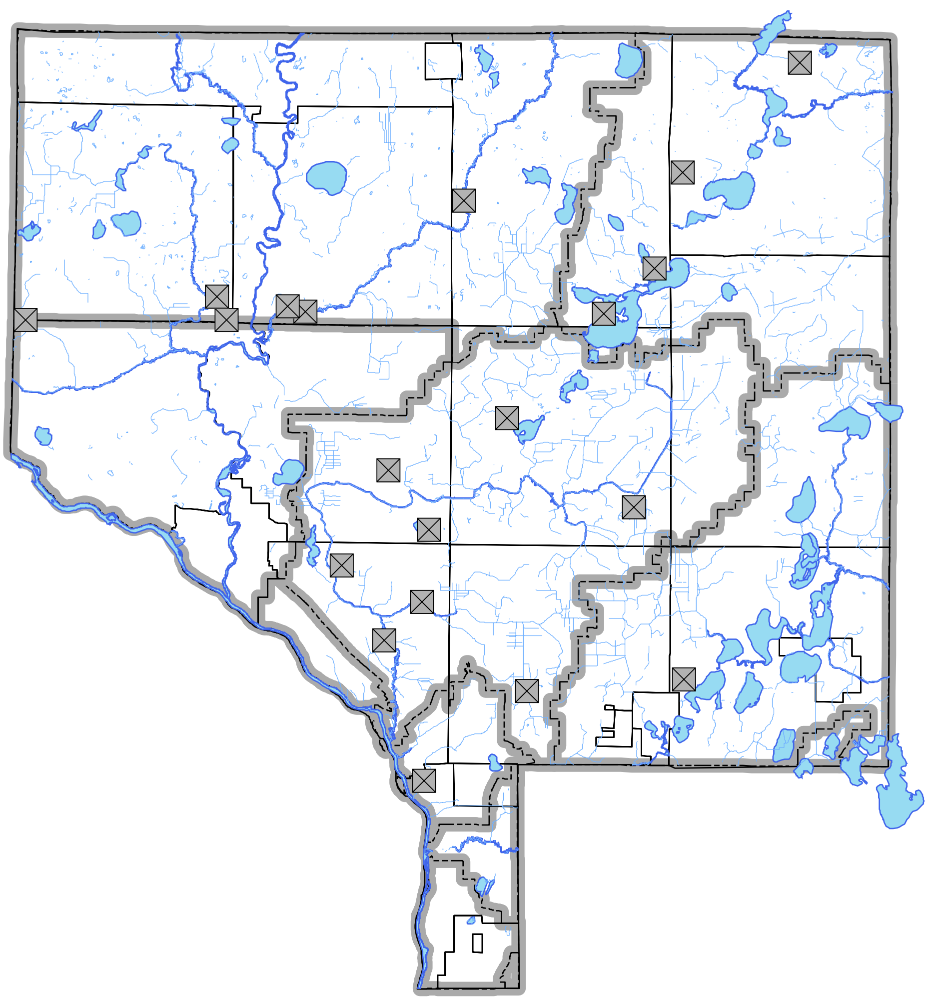


Precipitation

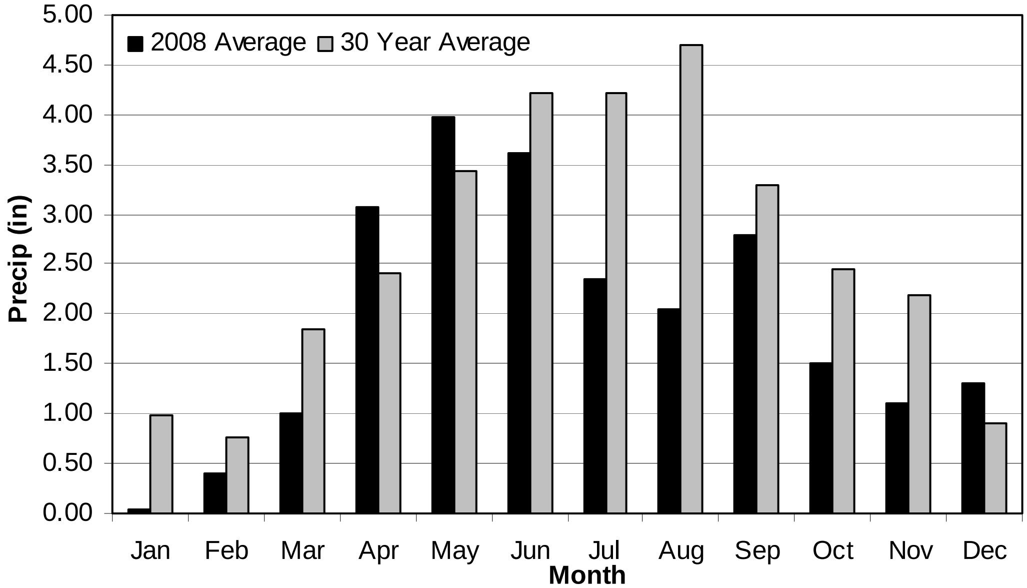
Precipitation data is useful for understanding the hydrology of water bodies, predicting flooding and groundwater limitations, and is needed to guide the use of special regulations that protect property and the environment in times of high or low water. Rainfall can vary substantially, even within one city. The ACD coordinates a network of 20 rain gauges countywide. Fifteen are monitored by volunteers and five are monitored using datalogging stations operated by the ACD for the Coon Creek Watershed District. The volunteer-operated stations are cylinder-style rain gauges located at the volunteer's home. Total rainfall is read daily. The datalogging rain gauges electronically record the time and date of each 0.01 inch of rain that falls. These gauges are downloaded approximately every four weeks. All data collected by volunteers is submitted to the Minnesota State Office of Climatology where it is available to the public through http://climate.umn.edu.

A summary of county-wide data is provided on the following page. Analyses of antecedent moisture for selected locations are provided in the Coon Creek Watershed chapter.

2008 Precipitation Monitoring Sites



2008 Anoka County Average Monthly Precipitation (average of all sites)



2008 Anoka County Monthly Precipitation at each Monitoring Site

		Month													
Location or Volunteer	**Location**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual Total**	**Growing Season (May-Sept)**
ACD Office	Ham Lake				1.40	3.38	4.28	2.42	1.15	2.37	1.77			16.77	13.60
CCWD- Blaine Public Works	Blaine				3.33	3.47	2.32			1.53				10.65	7.32
CCWD- Bunker Hills Park	Andover				2.59	3.27	2.98	2.19	1.38	1.72	1.46			15.59	11.54
CCWD- Northern Nat. Gas	Ham Lake				3.25	4.30	2.97	3.54	1.59	2.06	1.36			19.07	14.46
CCWD- Ham Lake	Ham Lake				1.40	3.38	4.31	2.60	0.57	2.44	1.86			16.56	13.30
CCWD- Coon Rapids City Hall	Coon Rapids				2.50	3.55	3.64	2.42	1.90	2.21	1.46			17.68	13.72
N. Myhre	Andover	0.08	0.47	1.06	3.42	3.63	3.75	2.30	1.44	2.11	1.51	0.86	1.52	22.15	13.23
B. Guetzko	Burns	0.00	0.25	0.97	4.02	5.12	4.61	1.13	3.83	4.30	1.41			25.64	18.99
J. Rufsvold	Burns				3.43	5.38	5.05	2.03	3.97	4.54	1.43			25.83	20.97
S. Scherger	Coon Rapids				3.29	3.60	3.59		1.65	2.34	1.53			16.00	11.18
S. Solie	Coon Rapids					3.08	4.35	3.15	2.25	2.14	1.27			16.24	14.97
M. Gaynor	East Bethel				1.70	4.60	2.71	2.60	1.36					12.97	11.27
P. Arzdorf	East Bethel				3.64	4.01	3.99	2.83	1.84	4.15	1.68			22.14	16.82
A. Mercil	East Bethel	0.04	0.41	0.61	1.81	4.42	2.85	2.60	1.40	2.00	1.56	1.22	1.09	20.01	13.27
D. Hansen	Fridley			0.89	4.17	3.26	3.36	1.70	3.79	2.23	1.81	0.89		22.10	14.34
B. Myers	Linwood				2.08	3.54	2.47	2.50	1.58	2.21	1.32			15.70	12.30
D. Kramer	Linwood			0.97	4.51	3.64	3.23	2.66	3.12	2.79	1.53	1.45		23.90	15.44
P. Freeman	Oak Grove		0.29	1.01	4.42	4.78	3.86	1.92	2.10	3.73	1.17			23.28	16.39
A. Dalske	Oak Grove	0.03	0.63	1.52	3.72	4.72	4.40	1.93	2.41	4.50	1.41			25.27	17.96
Y. Lyrenmann	Ramsey				3.77	4.20	3.64	1.64	1.54	3.54	1.61	1.11		21.05	14.56
2008 Average	County-wide	0.04	0.41	1.00	3.08	3.97	3.62	2.34	2.05	2.78	1.51	1.11	1.31	23.20	14.76
30 Year Average	Cedar	0.99	0.76	1.84	2.40	3.43	4.22	4.21	4.70	3.29	2.44	2.18	0.90	31.36	19.85

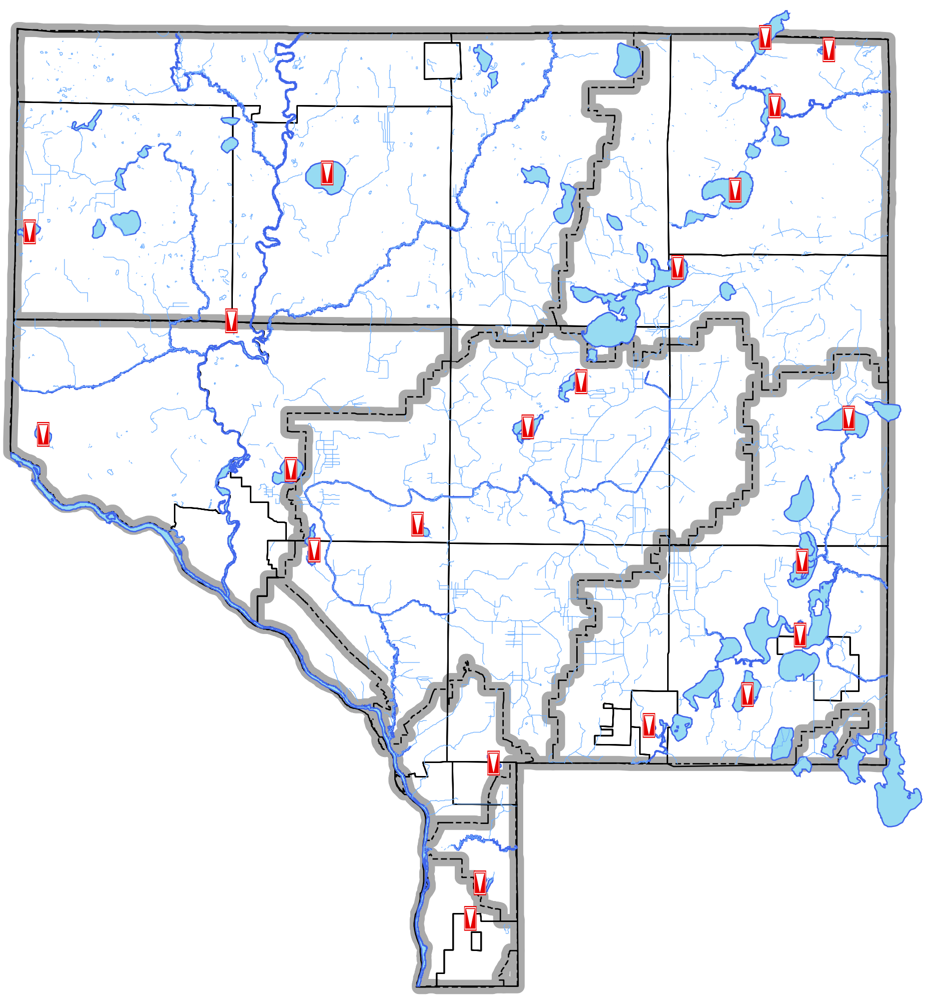
Lake Levels

Long-term lake level records are useful for regulatory decision-making, building/development decisions, lake hydrology manipulation decisions, and investigation of possible non-natural impacts on lake levels. ACD coordinates volunteers who monitor water levels on 22 lakes.

An enamel gauge is installed in each lake and surveyed so that readings coincide with sea level elevations. Each gauge is read weekly. The ACD reports all lake level data to the MN DNR, where it is posted on their website (www.dnr.mn.us.state\lakefind\index.html), along with other information about each lake.

Results of 2008 lake level monitoring are separated by watershed in the following chapters.

2008 Lake Level Monitoring Sites



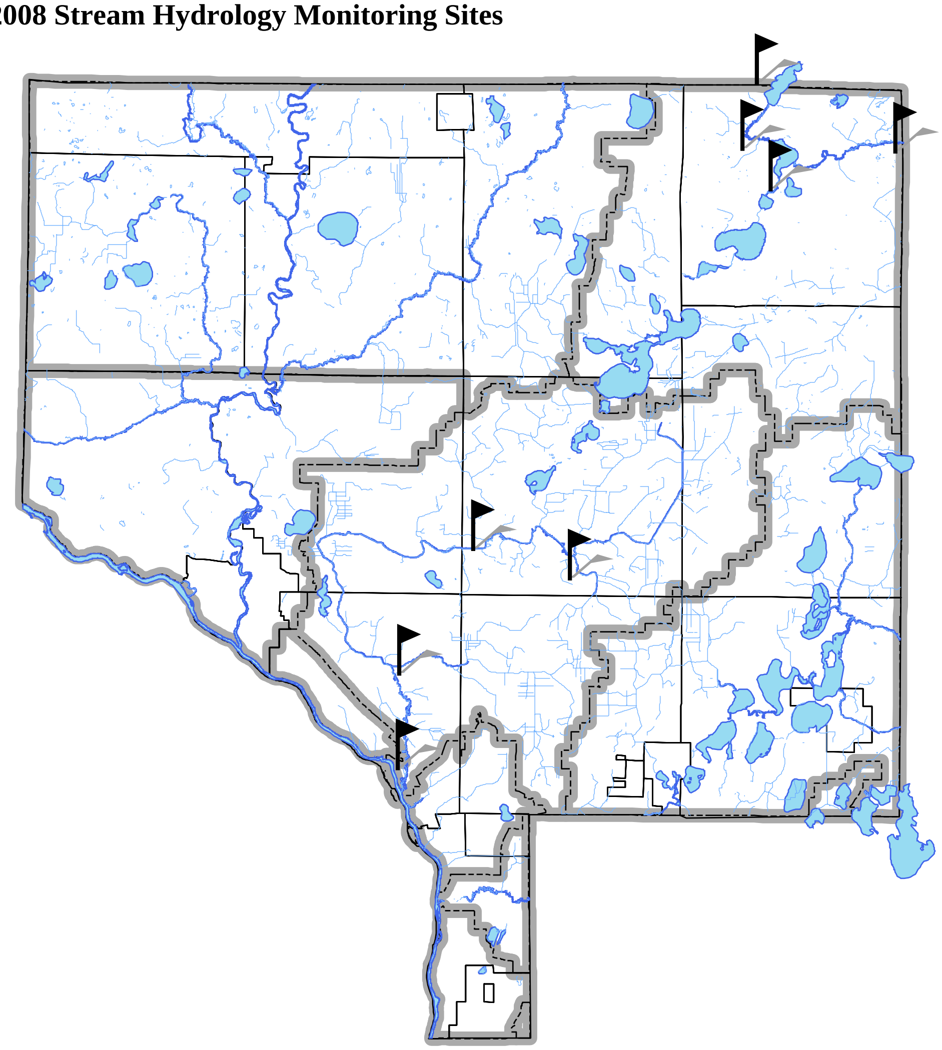
Stream Hydrology

Hydrology is the study of water quantity and movements. Records of the quantity of water flowing in a stream helps engineers and natural resource managers better understand the effects of rain events, land development and storm water management. This information is also often paired with water quality monitoring and used to calculate pollutant loadings, which is then used in computer models and water pollution regulatory determinations.

The ACD monitored hydrology at 8 stream sites in 2008. At each site is an electronic gauge that records water levels every two hours. These gauges are surveyed and calibrated so that stream water level is measured in feet above sea level. Rating curves—a known mathematical relationship between water level and flow such that one can be calculated from the other—have been developed for some sites. The information gained from the stream hydrology monitoring sites is used by the ACD, watershed management organizations, watershed districts, townships, cities, and others.

Results of 2008 stream hydrology monitoring are separated by watershed in the following chapters.

2008 Stream Hydrology Monitoring Sites

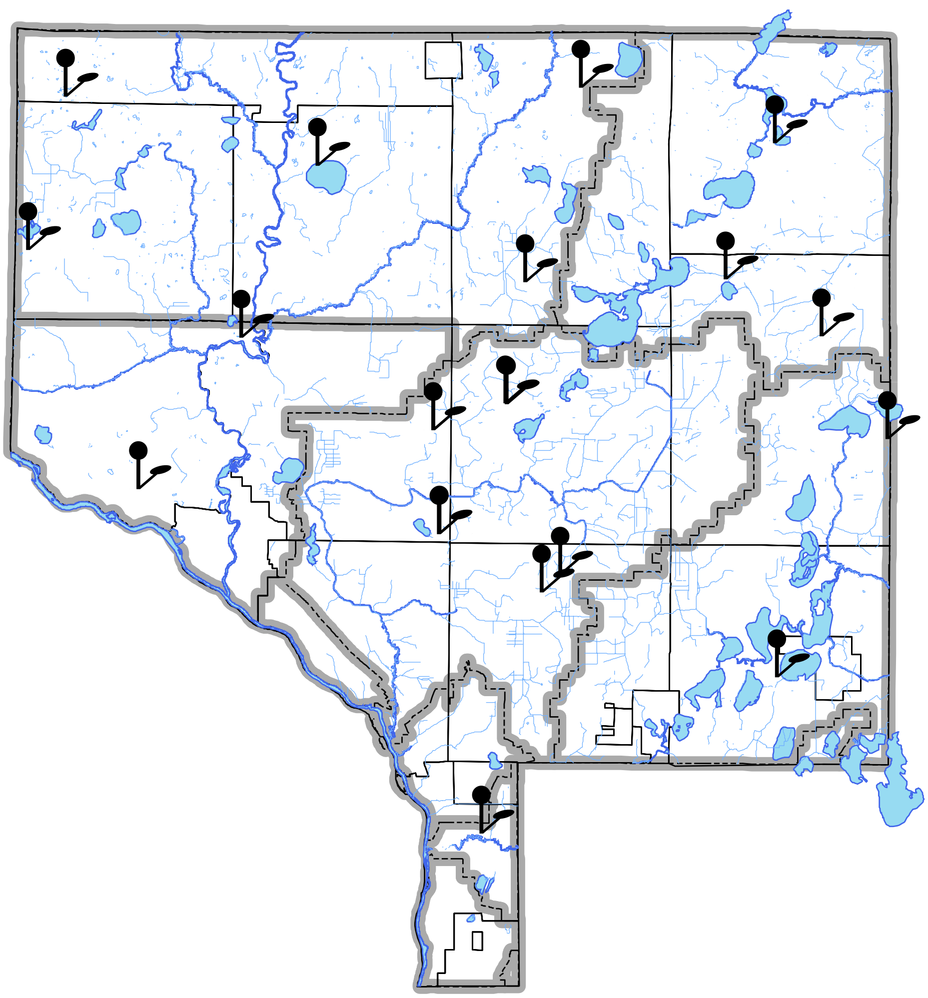


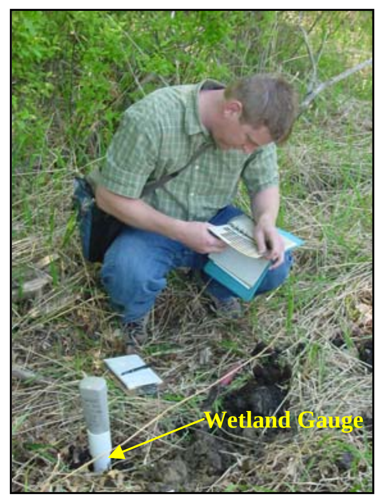
Wetland Hydrology

Wetland regulations are often focused upon determining whether an area is, or is not, a wetland. This is difficult at times because most wetlands are not continually wet. In order to facilitate fair, accurate wetland determinations the ACD monitors 18 wetlands throughout the county that serve as a reference of conditions county-wide. These are called reference wetlands. Electronic monitoring wells are used to measure subsurface water levels at the wetland edge every four hours down to a depth of 40 inches below grade. This hydrologic information, along with examination of the vegetation and soils, aids in accurate wetland determinations and delineations. These reference wetlands represent several wetland types and some have been monitored for 10+ years.

Results of 2008 wetland hydrology monitoring are separated by watershed in the following chapters. The Coon Creek Watershed chapter includes a multi-year and 2008 analysis of all the wetlands.

2008 Reference Wetland Monitoring Sites



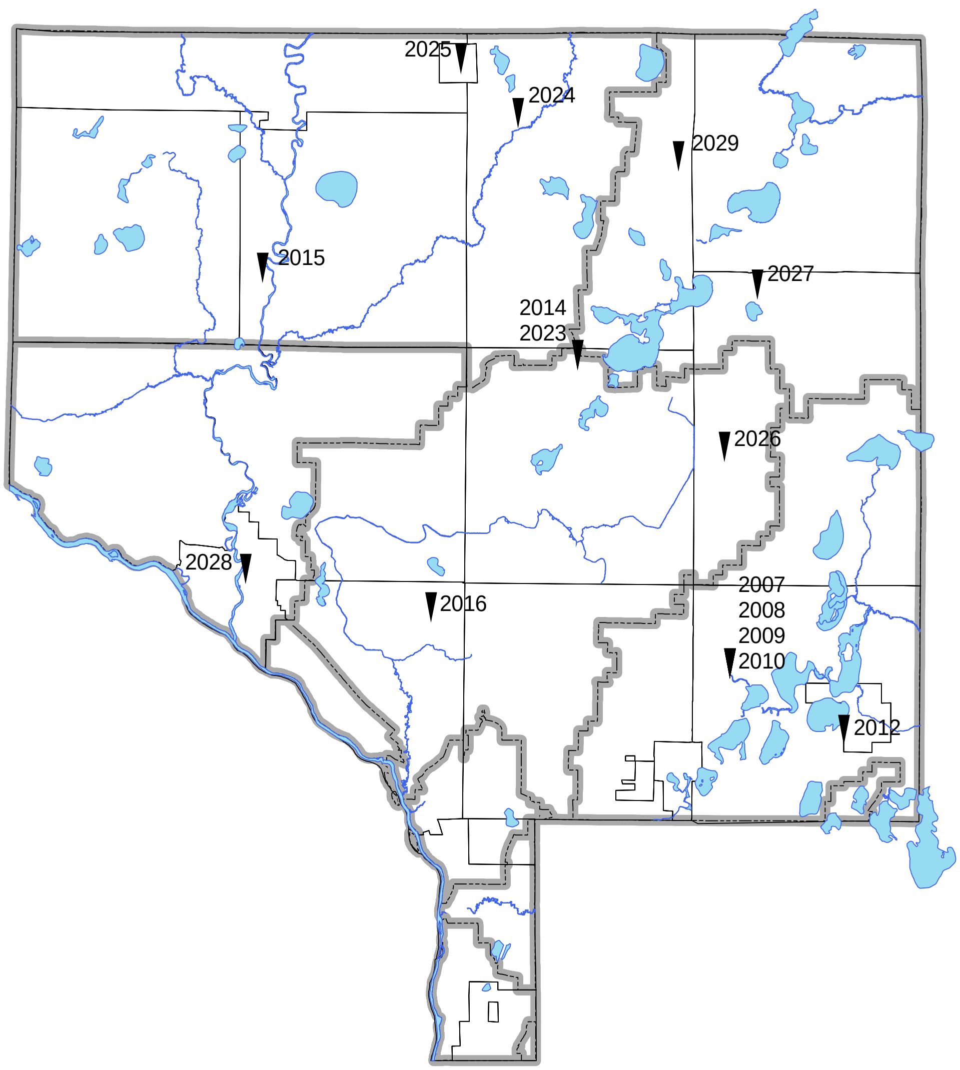


Groundwater Hydrology

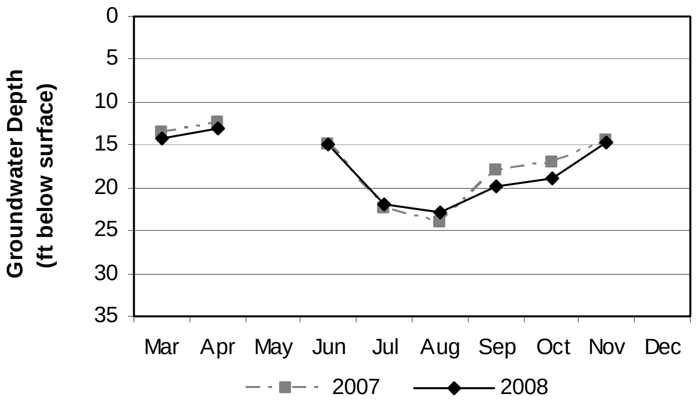
The Minnesota Department of Natural Resources (MN DNR) and ACD are interested in understanding Minnesota's groundwater quantity and flow. The MN DNR maintains a network of groundwater observation wells across the state. The ACD is contracted to take monthly water level readings at 15 wells in Anoka County from March to December. The MN DNR incorporates these data into a statewide database that aids in groundwater mapping. The data are reported by the MN DNR on their web site www.dnr.state.mn.us/waters/programs/gw_section/obwell. These deep groundwater wells are not as sensitive to precipitation as other hydrologic systems such as wetlands and streams, but rather, respond to longer term trends.

The charts on the following pages show groundwater levels for 2007-2008. These results are not presented elsewhere in this report. Raw data can be downloaded from the MN DNR website.

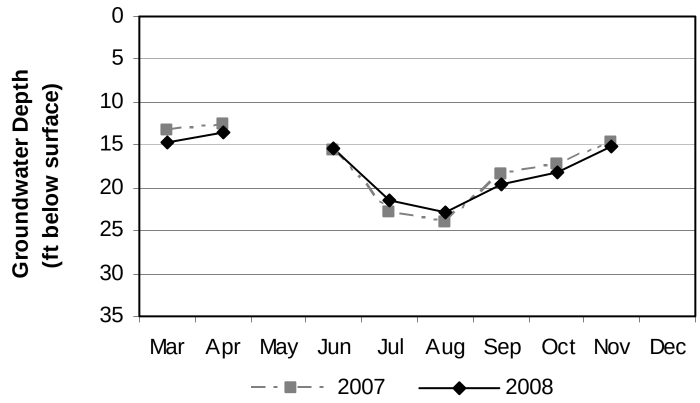
Groundwater Observation Well Sites and Well ID Numbers



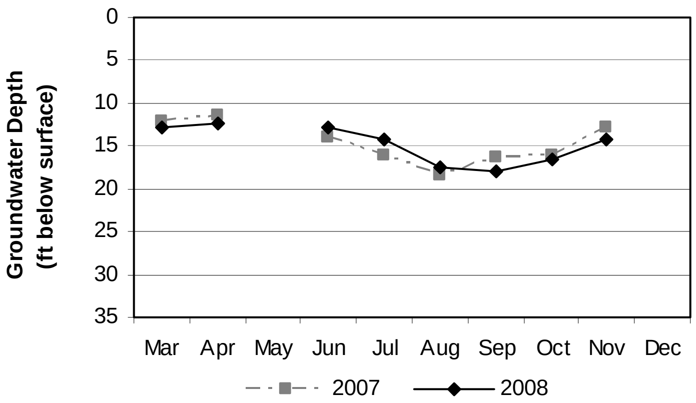
Observation Well #2007 (270 ft deep)—Lino Lakes



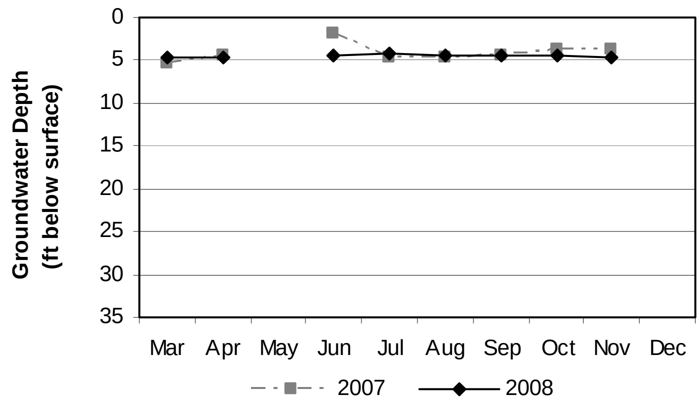
Observation Well #2008 (214 ft deep)—Lino Lakes



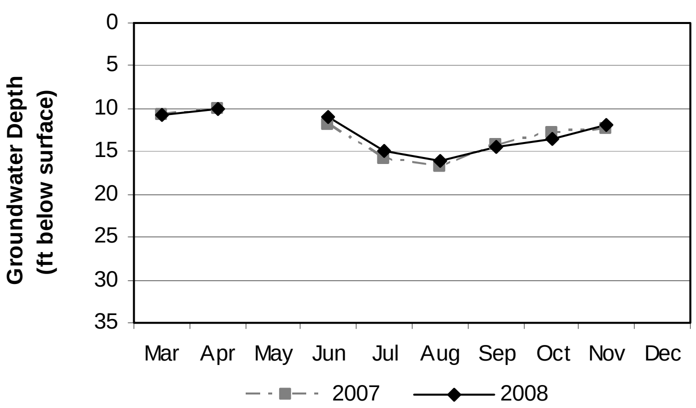
Observation Well #2009 (125 ft deep)—Lino lakes



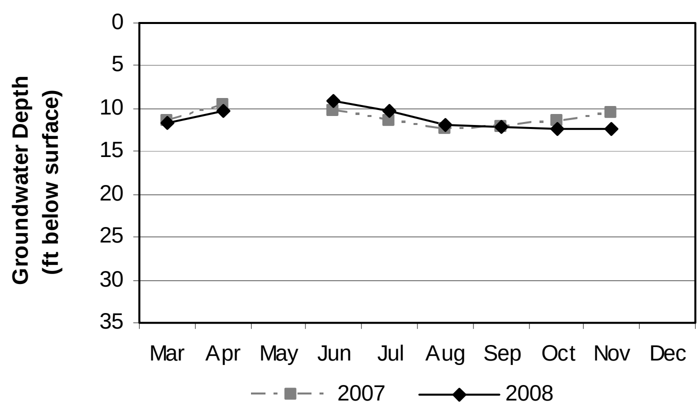
Observation Well #2010 (13 ft deep)—Lino Lakes



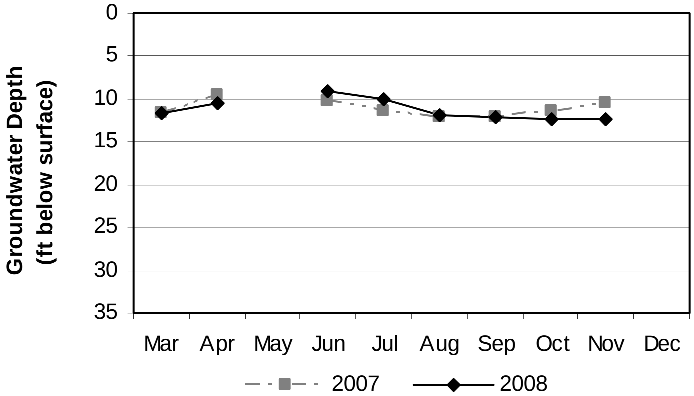
Observation Well #2012 (277 ft deep)—Centerville



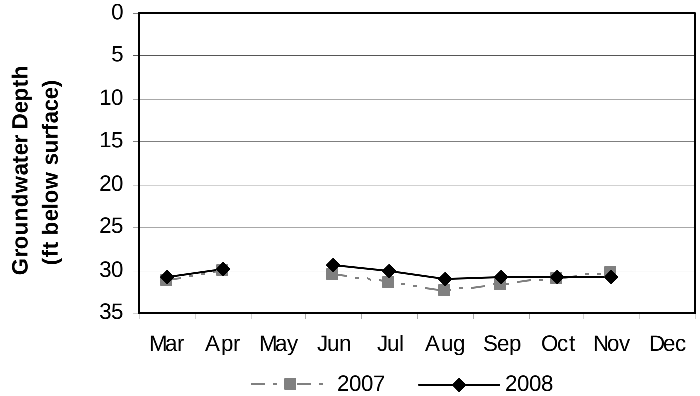
Observation Well #2023 (21 ft deep)—Ham Lake



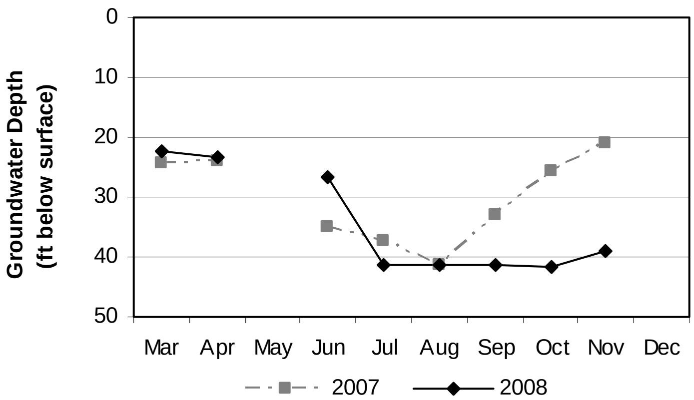
Observation Well #2014 (21 ft deep)—Ham Lake



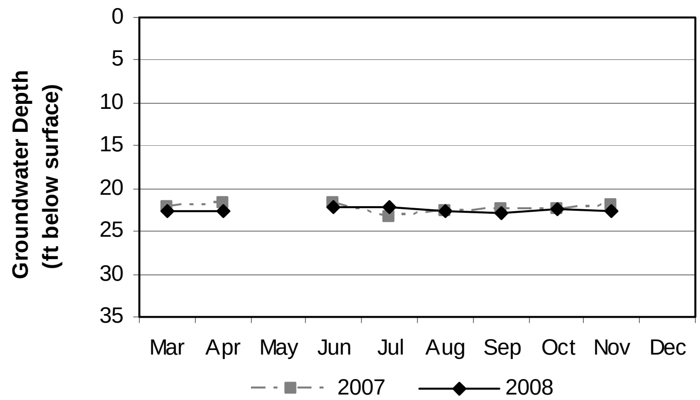
Observation Well #2015 (280 ft deep)—Ramsey



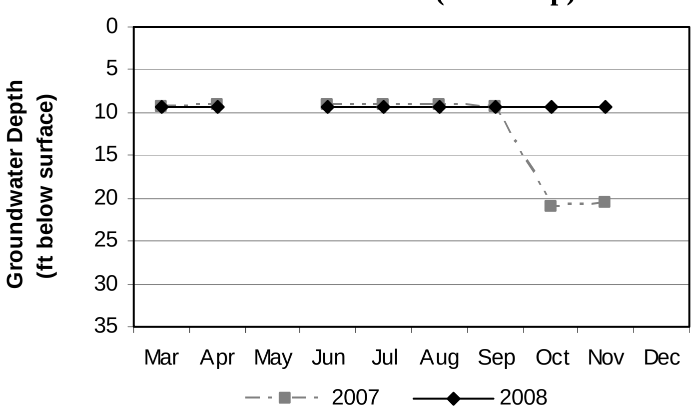
Observation Well #2016 (193 ft deep)—Coon Rapids



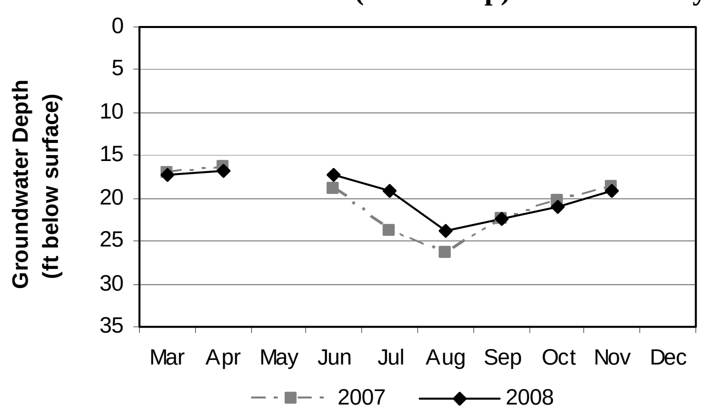
Observation Well #2024 (141 ft deep)—East Bethel



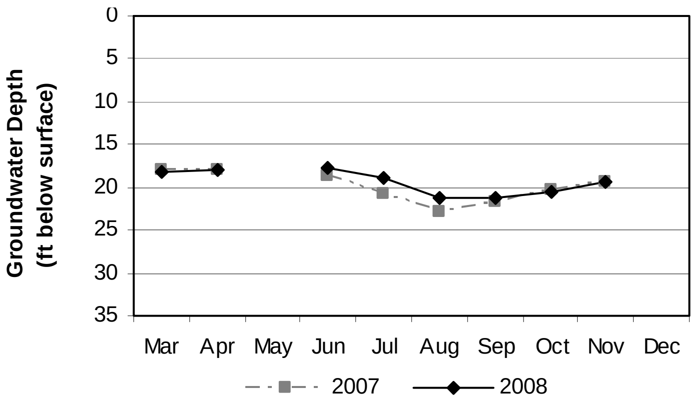
Observation Well #2025 (21 ft deep)—Bethel



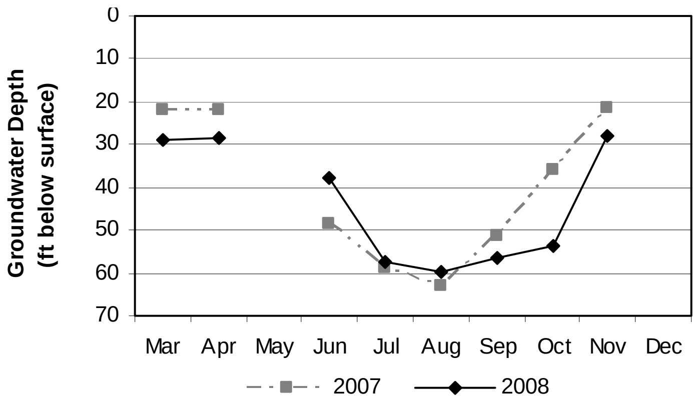
Observation Well #2026 (150 ft deep)—Carlos Avery



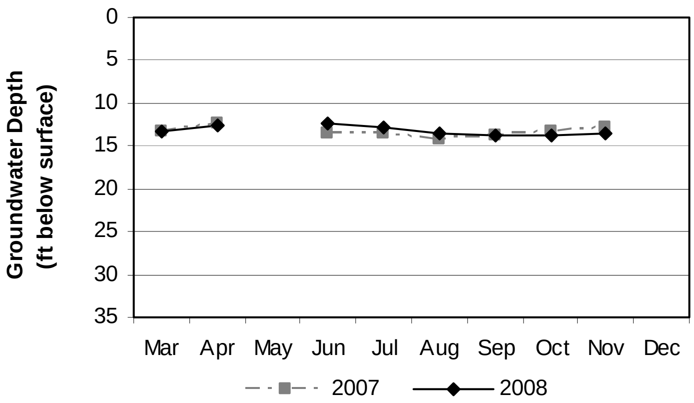
Observation Well #2027 (333 ft deep)—Columbus Twp.



Observation Well #2028 (510 ft deep)—Anoka



Observation Well #2029 (221 ft deep)—Linwood Twp.

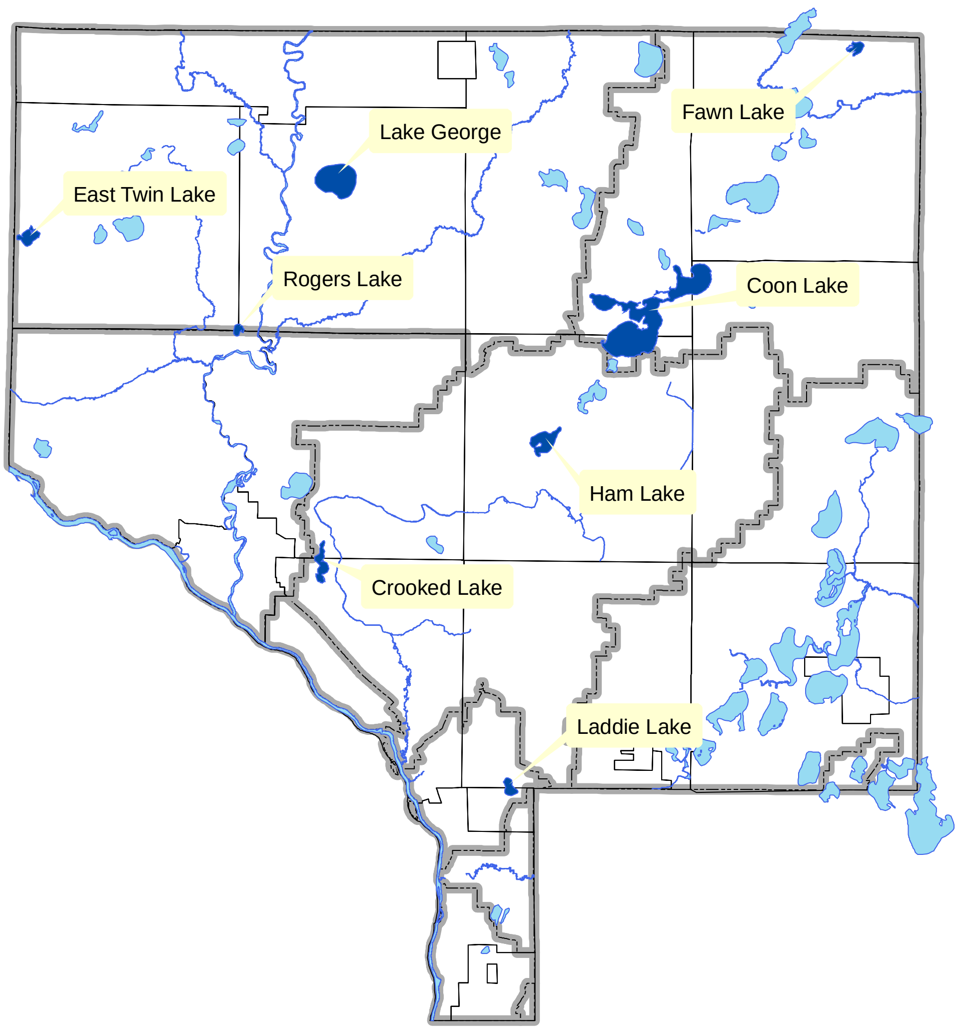


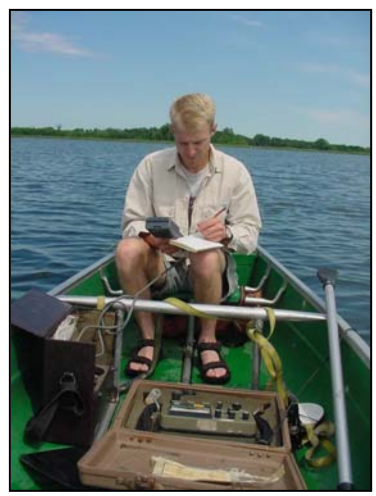
Lake Water Quality

Lake water quality monitoring in Anoka County began in the 1980's and was conducted primarily by the Metropolitan Council, Minnesota Pollution Control Agency (MPCA), and volunteer programs. The Anoka Conservation District (ACD) began a lake monitoring program in 1997 aimed at lakes that were not previously monitored. The purpose of these programs is to detect and diagnose water quality problems that may affect the suitability of lakes for recreation and that may adversely affect people or wildlife. The monitoring regime is designed to ensure all major recreational lakes are monitored every 2-3 years. Some lakes are monitored more frequently if problems are suspected or projects are occurring that could affect lake water quality. Lakes with stable conditions, no suspected new problems, and robust datasets are monitored less often. Monitoring efforts of the Minnesota Pollution Control Agency or Metropolitan Council are not duplicated, and are not presented in this report.

In addition to this report, there are several sources of lake water quality data. For lakes monitored by the ACD prior to 2008, see the website www.AnokaNaturalResources.com or the summary table on page 17. Otherwise, try the MPCA website.

2008 Lake Water Quality Monitoring Sites





LAKE WATER QUALITY MONITORING METHODS

The following parameters are tested at each lake:

- Dissolved Oxygen (DO);
- Turbidity;
- Conductivity;
- Temperature;
- Salinity;
- Total Phosphorus (TP);
- Transparency (Secchi Disk);
- Chlorophyll-a (Cl-a);
- pH.

Lakes are sampled every two weeks from May to September. Monitoring is conducted by boat at the deepest area of the lake. These sites are located using a portable depth finder or GPS. Conductivity, pH, turbidity, DO, salinity and temperature are measured using the Horiba Water Checker® U-10 multi-probe at a depth of one meter. Water samples are collected with a Kemmerer sampler from a depth of one meter, to be analyzed by an independent laboratory (MVTL Labs) for chlorophyll-a and total phosphorus. Sample bottles are provided by the laboratory. Total phosphorus sample bottles contain preservative sulfuric acid (H_2SO_4), while bottles for Chlorophyll-a analyses are wrapped in aluminum foil to exclude light. Water samples are kept on ice and delivered to the laboratory within 24 hours.

Transparency is measured using a Secchi disk. The disk is lowered over the shaded side of the boat until it disappears and is then pulled up to the point where it reappears again. The midpoint between these two depths is the Secchi disk measurement.

To evaluate the lake, results are compared to other lakes in the region and past readings at the lake. Comparisons to other lakes are based on the Metropolitan Council's lake quality grading system and the Carlson's Trophic State Index for the North Central Hardwood Forest ecoregion. Historical data for each lake can be obtained from the U.S. EPA's national water quality database, STORET, via the Minnesota Pollution Control Agency.

Lake Water Quality Questions and Answers

This section is intended to answer basic questions about the Anoka Conservation District's methodology for monitoring lake water quality and interpreting the data.

Q- Which parameters did you test and what do they mean?

A- The table on the following page outlines technical information about the parameters measured, which include:

pH- This test measures if the lake water is basic or acidic. A pH reading of greater than 7 signifies that the lake is basic and a reading of less than 7 means the lake is acidic. Many fish and other aquatic organisms need a pH in the range of 6.5 to 9.0 in order to remain viable. Eutrophic lakes are often pH basic (pH = >7). The pH of a lake will fluctuate daily and seasonally due to algal photosynthesis, runoff, and other factors.

Conductivity- This is a measure of the amount of dissolved minerals in the lake. Although every lake has a certain amount of dissolved matter, high conductivity readings may indicate additional inputs from sources such as storm water, agricultural runoff, or from failing septic systems.

Turbidity- This is a measure of the amount of solid material suspended in the water column, due to "muddiness" or algae.

Dissolved Oxygen (DO) - Sources of dissolved oxygen include the atmosphere, aeration from stream inflow, and submerged plants in the lake creating oxygen through photosynthesis. During the winter, ice can restrict the supply of oxygen to the lake (limited aeration and dark conditions under snow-covered ice limiting photosynthesis). Dissolved oxygen is consumed by organisms in the lake and by the decomposition processes. Dissolved oxygen is essential to the metabolism of all aquatic organisms and low dissolved oxygen is often the reason for fish kills. Extremely low DO concentrations at the lake bottom can also trigger a chemical reaction that causes phosphorus to be released from the sediment into the water column.

Salinity- This parameter measures the amount of dissolved salts in the water. Dissolved salts in a lake are not naturally occurring in Anoka County. High salinity measurements may be the result of inputs from other sources such as failing septic systems, spring runoff from roads, and farm field runoff.

Temperature- Fish species are sensitive to water temperature. Lake trout and salmon prefer temperatures between 46-56°F, while bass and pan fish will withstand temperatures of 76°F or greater. Temperature also affects the amount of dissolved oxygen that the water can hold in solution. At warmer temperatures, oxygen is readily released to the atmosphere and dissolved oxygen concentrations fall.

Secchi Transparency- A Secchi disk is a device used to measure transparency or clarity of the lake. Transparency is directly related to the amount of algae and suspended solids in the water column. A Secchi disk is a white and black disk attached to the end of a rope that is marked 0.1-foot intervals. The disk is lowered over the shaded side of the boat until it disappears and then pulled up to the point where it reappears again. The midpoint between these two points is the Secchi disk measurement. Shallow measurements typically indicate abundant algae and/or suspended solids.

Total Phosphorus (TP) - Phosphorus is an essential nutrient. Algal growth is normally limited by low phosphorous supplies. However, phosphorous inputs can rapidly stimulate growth of algae. A single pound of phosphorus can result in 500 pounds of algal growth. Large amounts of algae reduce water clarity, deplete dissolved oxygen levels when the algae decays, and degrade aesthetics for recreation. Minnesota Pollution Control Agency standards designate a lake in our ecoregion as "impaired" if average summertime phosphorus is >40 µg/L (or 60 ug/L for shallow lakes). Sources of phosphorus include runoff from agricultural land, runoff carrying fertilizer from lakeshore properties, failing septic systems, pet wastes, and storm water runoff. The lake itself can also be a source of phosphorus. High levels of total phosphorus contained in the bottom sediments of lakes can be released when the sediment is disturbed through recreation or animal activity, or when dissolved oxygen levels are low.

Chlorophyll-a (Cl-a) - Chlorophyll-a is the inorganic portion of all green plants that absorbs the light needed for photosynthesis. Chlorophyll-a measurements are used to indicate the concentration of algae in the water column. It does not provide an indication of large plant (macrophytes) or filamentous algae abundance.

Lake Water Quality Monitoring Parameters

Parameter	Units	Reporting Limit	Accuracy	Average Summer Range for North Central Hardwood Forest
pH	pH units	0.01	± .05	8.6 - 8.8
Conductivity	**mS/cm**	0.01	± 1%	0.3 - 0.4
Turbidity	FNRU	1	± 3%	1-2
D.O.	mg/L	0.01	± 0.1	N/A
Temperature	°C	0.1	± 0.17 °	N/A
Salinity	%	0.01	± 0.1%	N/A
T.P.	mg/l	1	NA	23 – 50
Cl-a	mg/l	0.005	NA	5 – 27
Secchi Depth	ft m	NA	NA	4.9 - 10.5 1.49 – 3.2

Q- Lakes are often compared to the "ecoregion." What does this mean?

A- We compare our lakes to other lakes in the same ecoregion. The U.S. Environmental Protection Agency mapped regions of the U.S based on soils, landform, potential natural vegetation, and land use. These regions are referred to as ecoregions. Minnesota has seven ecoregions. Anoka County is in the North Central Hardwood Forest ecoregion. Reference lakes, deemed to be representative and minimally impacted by man (e.g., no point source wastewater discharges, no large urban areas in the watershed, etc.), were sampled in each ecoregion to establish a standard range for water quality that should be expected in each ecoregion.
The average summer range of water quality values in the table above (pg. 13) are the inter-quartile range (25^{th} to 75^{th} percentile) of the reference lakes for the North Central Hardwood Forest ecoregion. This provides a range of values that represent the central tendency of the reference lakes' water quality.

Q- What do the lake physical condition and recreational suitability numbers mean?

A- The Minnesota Pollution Control Agency has established a subjective ranking system that ACD staff use during each lake visit (see adjacent table). Ranks are based purely upon the observer's perceptions. These physical and recreational rankings are designed to give a narrative description of algae levels (physical condition) and recreational suitability of each lake. While the physical condition is straight-forward, the recreational suitability may be complicated by the impacts of both water quality and dense aquatic vegetation (the influence of these two factors is not separated in the ranking).

Lake Physical and Recreational Conditions Ranking System

	Rank	Interpretation
Physical Condition	1	crystal clear
	2	some algae
	3	definite algae
	4	high algae
	5	severe bloom
Recreational Suitability	1	beautiful
	2	minimal problems, excellent swimming and boating
	3	Slightly swimming impaired
	4	no swimming / boating ok
	5	no swimming or boating

Q- What is the lake quality letter grading system?

A- The Metropolitan Council developed the lake water quality report card in 1989 (see table below). Each lake receives a letter grade, that is based on average summertime (May-Sept) chlorophyll-a, total phosphorus and Secchi depth. In the same way that a teacher would grade students on a "curve," the lake grading system compares each lake only to other lakes in the region. Thus, a lake that gets an "A" in the Twin Cities Metro might only get a "C" in northern Minnesota. The goal of this grading system is to provide a single, easily understandable description of lake water quality.

Lake Grading System Criteria

Grade	**Percentile**	**TP (µg/L)**	**Cl-a (µg/L)**	**Secchi Disk (m)**
A	**< 10**	**<23**	**<10**	**>3.0**
B	**10 - 30**	**23 – 32**	**10 - 20**	**2.2 - 3.0**
C	**30 – 70**	**32 – 68**	**20 – 48**	**1.2 – 2.2**
D	**70 – 90**	**68 – 152**	**48 – 77**	**0.7 – 1.2**
F	**> 90**	**> 152**	**> 77**	**< 0.7**

Q- What is the Carlson Trophic State Index?

A- Carlson's Trophic State Index (see figure below) is a number used to describe a lake's stage of eutrophication (nutrient level, amount of algae). The index ranges from oligotrophic (clear, nutrient poor lakes) to hypereutrophic (green, nutrient overloaded lakes). The index values generally range between 0 and 100 with increasing values indicating more eutrophic conditions. Unlike the lake letter grading system, the Carlson's Trophic State Index does not compare lakes only within the same ecoregion; it is a scale used worldwide.

There are four trophic state index values: one for phosphorus, chlorophyll-a, and transparency, plus an overall trophic state index value which is a composite of the others. The indices are abbreviated as follows:

TSI- Overall Trophic State Index.
TSIP- Trophic State Index for Phosphorus.
TSIS- Trophic State Index for Secchi transparency.
TSIC- Trophic State Index for the inorganic part of algae, Chlorophyll-a.

Trophic state indices are calculated monthly. At the conclusion of the monitoring season, the summertime (May to September) average for each trophic state index is calculated.

Q- What does the "trophic state" of a lake mean?

A- Lakes fall into four categories, or trophic states, based on lake productivity and clarity.

1. Oligotrophic- In these lakes, nutrients (total phosphorus and nitrogen) are low. Oligotrophic lakes are the deepest and clearest of all lakes, but the least productive (i.e. least amount of plants and fish due to lack of nutrients).

2. Mesotrophic- In these lakes, plant nutrients are available in limited quantities allowing for some, but not excessive plant growth. These lakes are still considered relatively clear. Northern Minnesota walleye and lake trout lakes are usually mesotrophic.

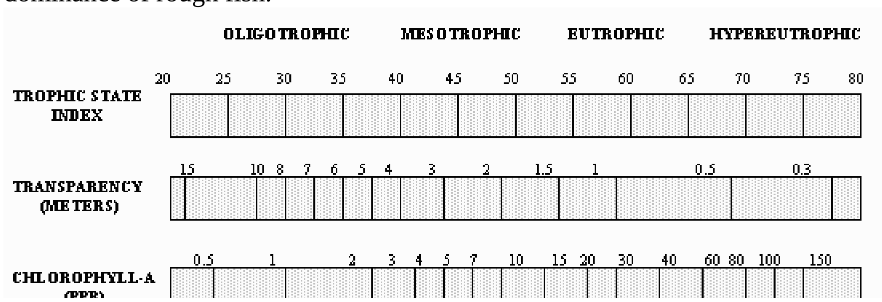
3. Eutrophic- In these lakes, the water is nutrient-rich. Productivity is high for both plants and fish. Abundant plant life, especially algae, results in poorer water clarity and can reduce the dissolved oxygen content when it decays. Algae blooms in the "dog days of summer" are commonplace. Bass and panfish are usually large components of the fish community, but rough fish can become problematic.

4. Hypereutrophic- In these lakes, nutrients are extremely abundant. Algae are grossly abundant, starving all other plants of light. The poor conditions often favor rough fish over game fish. These lakes have the poorest recreational potential.

Carlson's Trophic State Index Scale

CARLSON'S TROPHIC STATE INDEX

TSI < 30	Classic Oligotrophy: Clear water, oxygen throughout the year in the hypolimnion, salmonid fisheries in deep lakes.
TSI 30-40	Deeper lakes still exhibit classical oligotrophy, but some shallower lakes will become anoxic in the hypolimnion during the summer.
TSI 40-50	Water moderately clear, but increasing probability of anoxia in hypolimnion during the summer.
TSI 50-60	Lower boundary of classical eutrophy: Decreased transparency, anoxic hypolimnion during the summer, submerged plant growth problems evident, warm-water fisheries only.
TSI 60-70	Dominance of blue-green algae, algal scum probable, extensive submerged plant problems.
TSI 70-80	Heavy algal blooms possible throughout the summer, dense submerged plant beds, but extent limited by light penetration. Often classified as hypereutrophic.
TSI >80	Algal scum, summer fish kills, few submerged plants due to restricted light penetration, dominance of rough fish.



Q- At what concentrations do total phosphorus and chlorophyll-a become a problem in lake water?

A- Lakes in the North Central Hardwood Forests have a certain criteria set for both total phosphorus and chlorophyll-a. For total phosphorus, the concentration for primary contact, recreation and aesthetics set at < 40 μg/L (60 ug/L in shallow lakes). For chlorophyll-a, the average concentrations range from 5 to 22 μg/L, with maximums ranging from 7 to 37 μg/L. Once these set limits have been reached or exceeded, noticeable and excessive plant and algae growth will be observed.

Q- How do lakes change throughout the year and how does this affect water quality?

A- Water temperature is very important to the function of lakes. Lakes undergo seasonal changes that can influence water quality conditions. Because many Anoka County lakes are shallow (< 20 ft), some of the seasonal changes that are typical for deep lakes do not occur. The following discussion does not apply to these shallow lakes.

In the summer after the lake has warmed, deep lakes typically will be divided into three layers (stratified) based on the water's temperature and density; the well-mixed upper layer (epilimnion); the middle transition layer (metalimnion); and the cool, deep bottom layer (hypolimnion). The hypolimnion is usually depleted of oxygen because of decomposition of organic matter, the lack of photosynthesis, and because there is no contact with the surface where gas exchange with air can occur. Nutrients attached to sediment or decomposing organic material also fall into the hypolimnion where they are temporarily or permanently lost from the system. This is one reason deep lakes are usually not as nutrient rich and do not experience algae problems like shallow lakes.

In the autumn, the water near the surface eventually cools to the same temperature as the water at the bottom of the lake. When the water is of uniform temperature from top to bottom, it is easily mixed by the wind. This mixes nutrients that were formerly trapped at the bottom and may cause an autumn algal bloom. If the algal bloom is too severe, it could be detrimental to the lake during the winter when it is covered with ice. These algae will decay consuming dissolved oxygen, already impaired due to ice over, which may lead to a winter kill. This situation is typically observed in shallow eutrophic and/or hypereutrophic lakes.

In winter an inverse thermal stratification sets up. Ice is less dense than water and therefore floats. The coldest water is nearest the surface. Water has a maximum density at 4^{o} C, and that water is found at the bottom. The reversal of the temperature layers in spring and fall is called "turning over."

In spring, the lake "turns over" with the warmer water rising to the top and the colder sinking to the bottom. When this occurs, nutrients needed for plant growth (total phosphorus and nitrogen) are distributed throughout the lake from the bottom. As solar radiation slowly warms the deeper lakes during the spring and summer, the lake starts to stratify into the three layers again, this time with the warmest water on top.

Q- How do we determine if there is trend of improving or worsening lake water quality?

A- Because of inherent natural variation, lake water quality is not the same each year. Sorting out this natural variation from true trends is best accomplished with statistical tests that see the data objectively. When at least 5 years of monitoring data are present, ACD staff test for lake trends using a Multivariate Analysis of Variance (MANOVA). MANOVA tests the vector response of correlated response variables (Secchi depth, total phosphorus, and chlorophyll-a) while maintaining the probability of making a type I error (rejecting a true null hypothesis) at $\alpha = 0.05$. In other words we are simultaneously testing the three most important measurements of lake water quality. Testing each response variable separately would increase the chance of making a type I error.

Historic Water Quality Grades for Anoka County Lakes (includes monitoring by ACD and Met Council's CAMP program, post-1980 only)

Year→	1980	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07	08
Centerville	D	C		C					D												C	C		C	C	A			
Cenaiko																		B	A	A	A	B	A	A	A	A	A		
Coon	C				C					C					C			C	B	A	B	C	B		C		C		C
Crooked				C		C				C					B	C	B	B	B		B		B	B		B	B		B
E. Twin	A	B		C						B						B		A	B	A	A		A			A			A
Fawn									B									A	B	A	A	A	A		A		A		A
George	A	A	A		A					A					B			A	B	A	A		A			B			B
George Watch		F	D	D		D		D	D	F	D	F					F	D	F	D	D	F	D	D	F	D	F		
Golden	D					D	C	D	F	F	F	F		D			C	D	C	C	C	D	D	D	D	C	C		
Ham					C									A	B		A	A	B		C	C	B		B	B		B	A
Highland																				D	C	D	F	F	F	F	F		
Howard										F	F	F							F	D	D								
Island				C																				B	B	C	C		
Itasca																			A	B	B								
Laddie	D													B	B	B			C	B	B	B	B	B	B	B			B
Linwood	B	C		C						C					C			C	C	C	C	C		C		C		C	
Martin				D														D	D	C	D	D		D		D		D	
E. Moore	C	C	C	C	C	B	C	C							C				C	B	B	C	C	C		C			
W. Moore	C	C	F	C	B	C	F	C												B	B	C	C	C		C			
Mud														B						B	C								
Netta																		B	C	A		B		A	A		B	B	
Peltier				D										D	F	D	D	D	D	D	D	F	F	D	D	D	F		
Pickerel	C															B		A	A	B	C								
Reshanau																											D		
Rogers																			C		C			B			D		B
Round																			B	A	B			A		B		C	
Sandy														D	D	D		D	D	D	D	D	F	D	D	D			
Typo														F	F	F		F	F	F	F	F		F		F		F	

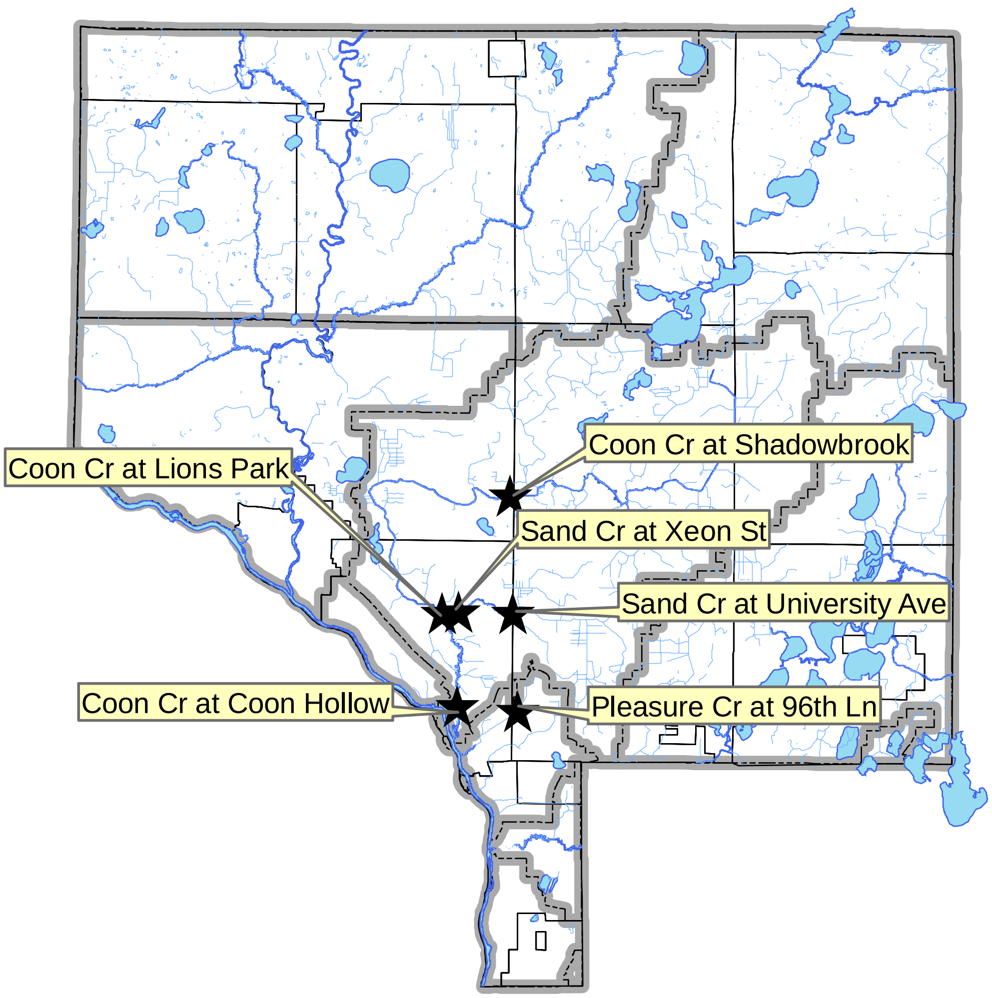
Stream Water Quality – Chemical Monitoring

Stream water quality monitoring is conducted to detect and diagnose water quality problems impacting the ecological integrity of waterways or impacting human health. Because many streams flow into lakes, stream water quality is often studied as part of lake improvement studies.

Chemical stream water quality monitoring in 2008 was conducted at three sites on Coon Creek, two sites on Sand Creek, and one on Pleasure Creek. Additionally, the ACD continued a cooperative effort with the Metropolitan Council for monitoring of the Rum River at the Anoka Dam as part of the Metropolitan Council's Watershed Outlet Monitoring Program (WOMP). Those data are housed with the Metropolitan Council, and methodologies are available upon request from either organization.

The methodologies for chemical stream water quality monitoring and information on data interpretation can be found on the following pages. Monitoring results are presented in the following chapters.

2008 Chemical Stream Water Quality Monitoring Sites



STREAM WATER QUALITY MONITORING METHODS

Stream water is monitored four times during base flow conditions and four immediately following storm events between the months of April and September (some special studies have different sampling regimes). Grab samples are a single sample of water collected to represent water quality for a given moment or stream condition. A composite sample, conversely, consists of collecting several small samples over a period of time and mixing them. Grab samples are used for all stream water quality monitoring performed by the ACD. Each stream grab sample was tested for the following parameters:

- pH;
- Dissolved Oxygen (DO);
- Turbidity;
- Conductivity;
- Temperature;
- Salinity;
- Total Phosphorus (TP);
- Chlorides;
- Total Suspended Solids;
- others for some special investigations.

DO was measured in the field using a YSI® DO 200 dissolved oxygen and temperature probe. Likewise, pH, turbidity, conductivity, temperature, and salinity were measured in the field using a Horiba Water Checker® U-10 multi-probe. Total phosphorus, chlorides, total suspended solids, and any other chemical parameters were analyzed by an independent laboratory (MVTL Labs). Sample bottles were provided by the laboratory, complete with necessary preservatives. Water samples were kept on ice and delivered to the laboratory within 24 hours. Stream water level was noted when the sample was collected.

Stream Water Quality Monitoring Questions and Answers

This section is intended to answer basic questions about the Anoka Conservation District's methodology for monitoring stream water quality and interpreting the data.

Q- What do the parameters that you test mean?

A- pH- This test measures if the water is basic or acidic. A pH reading of greater than 7 signifies that the stream is basic and a reading of less than 7 means the stream is acidic. Many fish and other aquatic organisms need a pH in the range of 6.5 to 9.0.

Conductivity- This is a measure of the amount of dissolved minerals in the stream. Although every stream has a certain amount of dissolved matter, high conductivity readings may indicate additional inputs from sources such as storm water, agricultural runoff, or from failing septic systems.

Turbidity- This is a measure of the amount of solid material suspended in the water, due to "muddiness" or algae.

Dissolved Oxygen (DO) - Dissolved oxygen is essential to all aquatic organisms. The lower the DO concentration, the less likely a stream will support a wide range of organisms, including fish.
Sources of dissolved oxygen include the atmosphere, aeration from stream inflow, and submerged plants in the lake creating oxygen through photosynthesis. Dissolved oxygen is consumed by the organisms in the stream and by decomposition within the stream. Large inputs of organic matter (manure, for example) are harmful, in part, because decomposition of these materials can reduce dissolved oxygen to harmfully low levels.

Salinity- Salinity is a measure of dissolved salts in the water. High salinity measurements may be the result of inputs from failing septic systems, spring runoff of road salts, farm field runoff, or others.

Temperature- Fish species and other aquatic life are sensitive to water temperature. Some can only survive in particular temperature ranges. Temperature also affects the amount of dissolved oxygen that the water can hold in solution. At warmer temperatures, oxygen is readily released to the atmosphere and dissolved oxygen concentrations fall.

Total Phosphorus (TP) - Phosphorus is an essential nutrient that stimulates algae growth. A single pound of phosphorus can result in 500 pounds of algal growth. Large amounts of algae reduce water clarity, deplete dissolved oxygen levels from algae decay which impacts fish populations, and degrade aesthetics for recreation. Ideally, total phosphorus should be below 40 µg/L in lakes and 130 ug/L in streams. Sources of phosphorus include runoff from agricultural land, runoff from lakeshore properties carrying fertilizer and untreated human waste from failing septic systems, pet wastes, and storm water runoff.

Total Suspended Solids (TSS) - This is similar to turbidity, in that it measures the amount of solid material in the water. Turbidity is measured by sending a beam of light through a water sample and measuring how much of it is deflected. In this way it is particularly sensitive to large suspended particles, but not to small particles. Total suspended solids is measured by filtering a water sampling and weighing the filtered material.

Chlorides– This is a measure of dissolved chloride materials. The most common source is road salt (sodium chloride), but other sources include various chemical pollutants and sewage effluent.

Analytical Limits for Stream Water Quality Parameters

Parameter	Method Detection Limit	Reporting Limit	Analysis or Instrument Used
pH	0.01	0.01	Horiba U-10
Conductivity	0.001	0.001	Horiba U-10
Turbidity	1.0	1.0	Horiba U-10
Dissolved Oxygen	0.01	0.01	YSI DO 200
Temperature	0.1	0.1	Horiba U-10
Salinity	0.01	0.01	Horiba U-10
Total Phosphorus	0.3	1.0	EPA 365.4
Total Suspended Solids	5.0	5.0	EPA 160.2
Chloride	0.005	0.01	EPA 325.1

Q- How do you rate the quality of a stream's water?

A- We make two comparisons: first, with published water quality values for the ecoregion and second, with other streams monitored by the ACD. Ecoregions are areas with similar soils, landform, potential natural vegetation, and land use. All of Anoka County is within the North Central Hardwood Forest (NCHF) Ecoregion. Mean values for our ecoregion, and for minimally impacted streams in our ecoregion are in the table below.

Q- What Quality Assurance/Quality Control procedures are in place?

A- QA/QC was accomplished in the following ways:

Minnesota Valley Testing Laboratories (MVTL) conducted the laboratory analysis. MVTL has a comprehensive QA/QC program, which is available by contacting them directly. ACD followed field protocols supplied by MVTL including keeping samples on ice, avoiding sample contamination, delivering samples to the lab within 24 hours of sampling, and providing duplicates and blanks. Sample bottles were provided by MVTL and included the necessary preservatives.

The hand held Horiba U-10 multi-probe used to conduct in-stream monitoring was calibrated at least daily.

Typical Stream Water Quality Values for the North Central Hardwood Forest (NCHF) Ecoregion and for Anoka County

Parameter	Units	NCHF Ecoregion Mean[1]	NCHF Ecoregion Minimally Impacted Stream[1]	Median of Anoka County Streams
pH	pH units		8.1	7.53
Conductivity	µmhos/cm	.389	.298	0.318
Turbidity	FNRU		7.1	9
Dissolved Oxygen	mg/L	-	-	7.14
Temperature	°F		71.6	
Salinity	%		0	0.01
Total Phosphorus	µg/L	220	130	126
Total Suspended Solids	mg/L		13.7	14
Chloride	mg/L		8	12

[1]MPCA 1993 Selected Water Quality Characteristics of Minimally Impacted Streams for Minnesota's Seven Ecoregions: Addendum to Descriptive Characteristics of the Seven Ecoregions of Minnesota. McCollor & Heiskary.

Stream Water Quality – Biological Monitoring

The stream biological monitoring program, often called biomonitoring, is both a stream health assessment and educational program. This biomonitoring program uses benthic (bottom dwelling) macroinvertebrates to determine stream health. Macroinvertebrates are animals without a backbone and large enough to see without a microscope, such as aquatic insects, snails, leeches, clams, and crayfish. Certain macroinvertebrates, such as stoneflies, require high quality streams, while others, such as midges, thrive in poor quality streams. Because of their extended exposure to stream conditions and sensitivity to habitat and water quality, benthic macroinvertebrates serve as good indicators of stream health.

ACD adds an educational component to the program by involving students in the biomonitoring at many of the sites. High school science classes are the primary volunteers. In 2008 there were approximately 404 students from seven high schools who monitored seven sites. Since 2000 approximately 3,205 students have participated. The experience affords students an opportunity to learn scientific methodologies and become involved in local natural resource management.

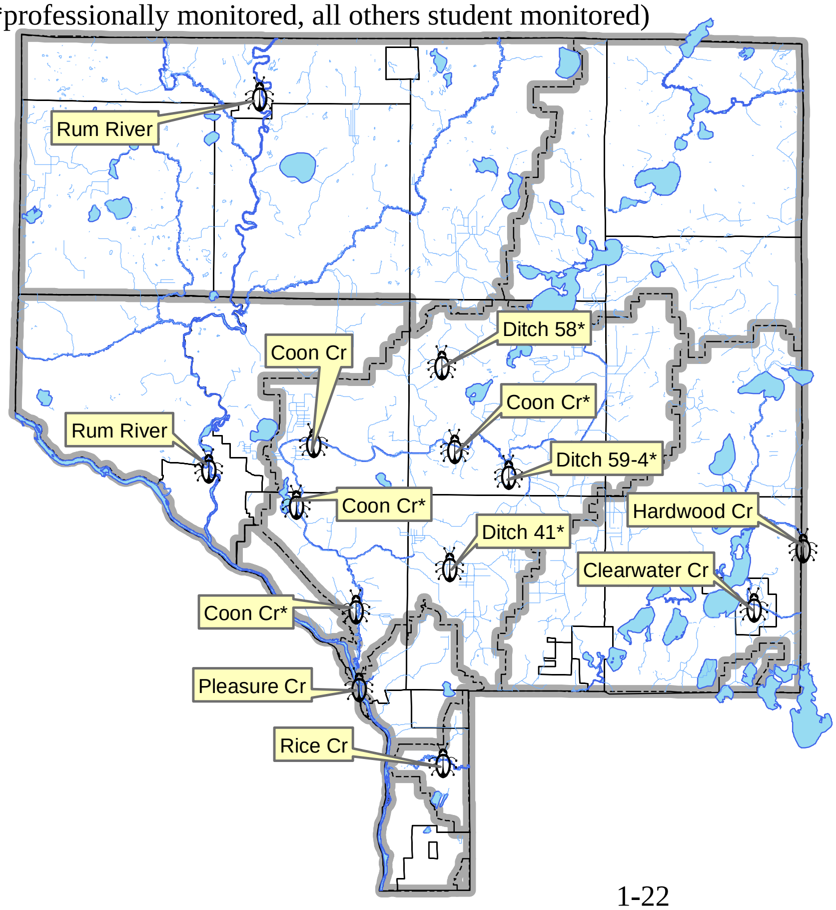
In 2008 six sites were monitored by professionals without student involvement. These sites were all within the Coon Creek drainage. The purpose was to examine sites listed by the MCPA as "impaired" for biota based on a single sample and to compare the biotic community in ditched and unditched stream reaches.

The Anoka County biomonitoring program is part of a metro-wide program coordinated by the Volunteer Stream Monitoring Partnership (VSMP; see website www.vsmp.org) based at the University of Minnesota, St. Paul campus. This program ensures consistent methodologies are employed throughout the region and provides a central location for data storage and analysis.

Results of this monitoring are separated by watershed in the following chapters.

2008 Biological Stream Water Quality Monitoring Sites

(*professionally monitored, all others student monitored)



Biomonitoring Methods

ACD biomonitoring utilizes the US Environmental Protection Agency (EPA) multi-habitat protocol for low-gradient streams (www.epa.gov/owow/monitoring/volunteer/stream/). Using this methodology, individuals doing the sampling determine how much of the stream is occupied by four types of micro-habitat: vegetated bank margins, snags and logs, aquatic vegetation beds and decaying organic matter, and silt/sand/gravel substrate. Sampling is by "jabs" or sweeps with a D-frame net. Each habitat type is sampled in proportion to the prevalence of the habitat type. At least 100 individual macroinvertebrates must be captured for a representative sample. All macroinvertebrates are preserved and returned to the lab (or classroom) for identification to the family level. The identified invertebrates are preserved in labeled vials. From the identifications, biomonitoring indices are calculated to rank stream health. Fieldwork is overseen by Anoka Conservation District (ACD) staff and identifications are checked by ACD staff before any analysis is done.

Biomonitoring Indices

Indices are mathematical calculations that summarize tallies of identified macroinvertebrates and known values of their pollution tolerance into a single number that serves as a gauge of stream health. The indices listed below are used in the biomonitoring program, but are not the only indices available. No single index is a complete measure of stream health. Multiple indices should be considered in concert.

Taxa Richness and Composition Measures

Number of Families: This is a count of the number of taxa (families) found in the sample. A high diversity or variety is good.

EPT: This is a measure of the number of families in each of three generally pollution-sensitive orders: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). A high number of these families is good.

Tolerance and Intolerance Metrics

Family Biotic Index (FBI): The Family Biotic Index summarizes the various pollution tolerance values of all families in the sample. FBI ranges from 0 to 10, with LOWER values reflecting HIGHER water quality. Each macroinvertebrate family has a unique pollution tolerance value associated with it. The table below provides a guide to interpreting the FBI.

Key to interpreting the Family Biotic Index (FBI)

Family Biotic Index (FBI)	Water Quality Evaluation	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

Population Attributes Metrics

% EPT: This measure compares the number of organisms in the EPT orders (Ephemeroptera - mayflies: Plecoptera - stoneflies: Trichoptera - caddisflies) to the total number of organisms in the sample. A high percent of EPT is good.

% Chironomidae: This measure compares the number of midges to the total number of organisms in the sample. A low percentage of midge larvae is good.

% Dominant Family: This measures the percentage of individuals in the sample that are in the sample's most abundant family. A high percentage is usually bad because it indicates low evenness (one or a few families dominate, and all others are rare).

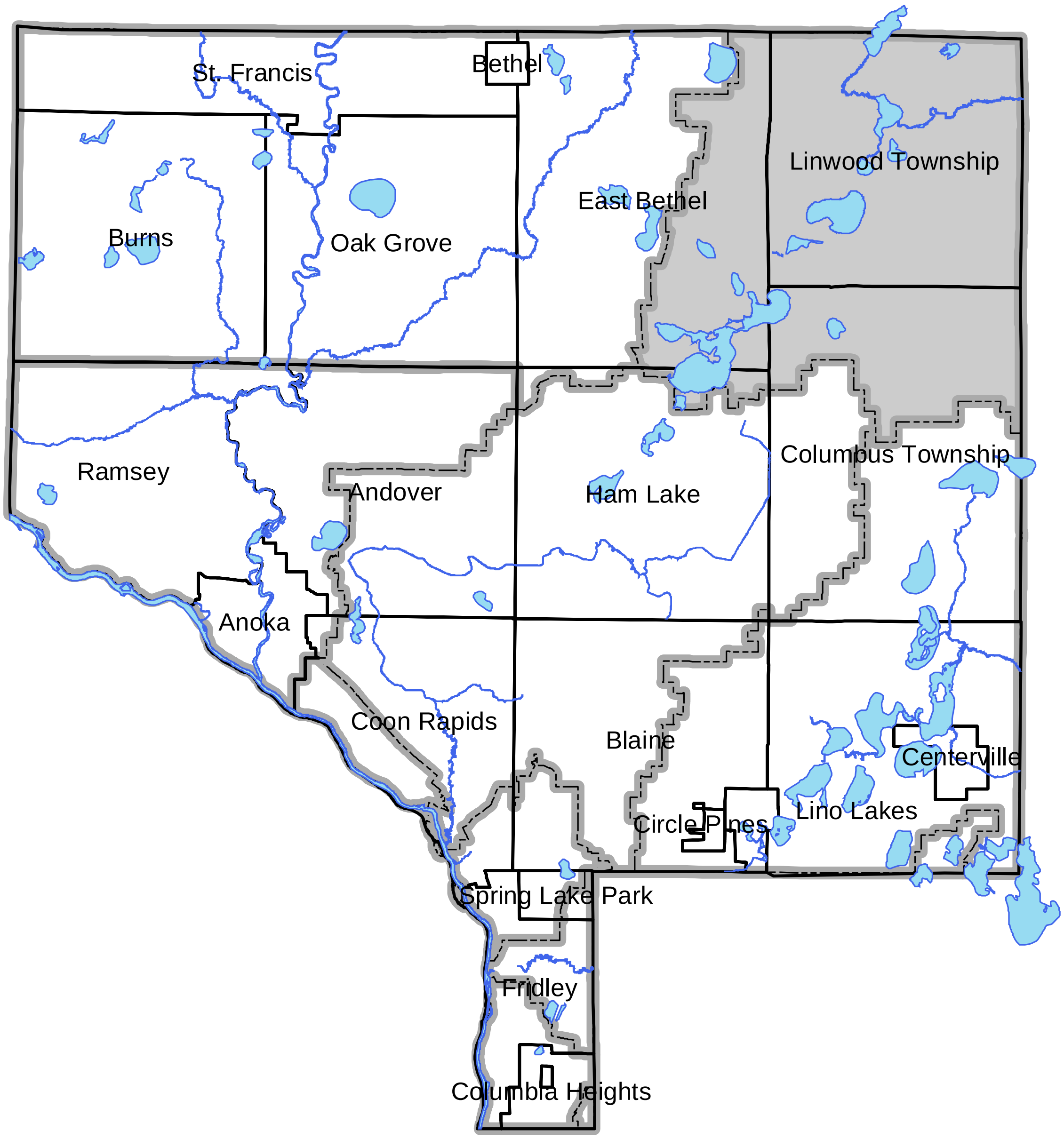
Sites

In 2008, 13 sites were monitored for benthic macroinvertebrates. High school classes, with ACD staff supervision, sampled six of these sites.

2008 Biomonitoring Sites and Groups who Monitored the Site

Monitoring Group	Stream
Andover HS	Coon Creek
Anoka HS	Rum River (near Anoka)
ACD	Pleasure Creek
Centennial HS	Clearwater Creek
Forest Lake Area Learning Center	Hardwood Creek
St. Francis HS	Rum River (St. Francis)
Totino Grace HS	Rice Creek
ACD	Coon Creek at 131st Ave
ACD	Coon Creek at Egret Blvd
ACD	Coon Creek at Hwy 65
ACD	Ditch 41 at Ulysses St
ACD	Ditch 58 at 165th Ave
ACD	Ditch 59- at Bunker Lake Blvd

Sunrise River Watershed



Contact Info: Sunrise River Watershed Management Organization
www.AnokaNaturalResources.com/SRWMO
763-434-9569

Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 2:
SUNRISE RIVER WATERSHED

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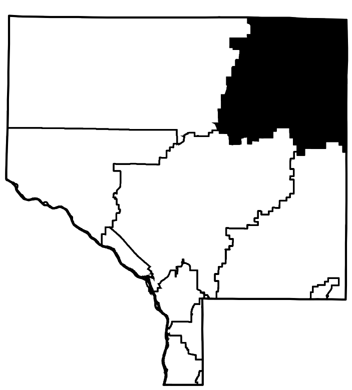
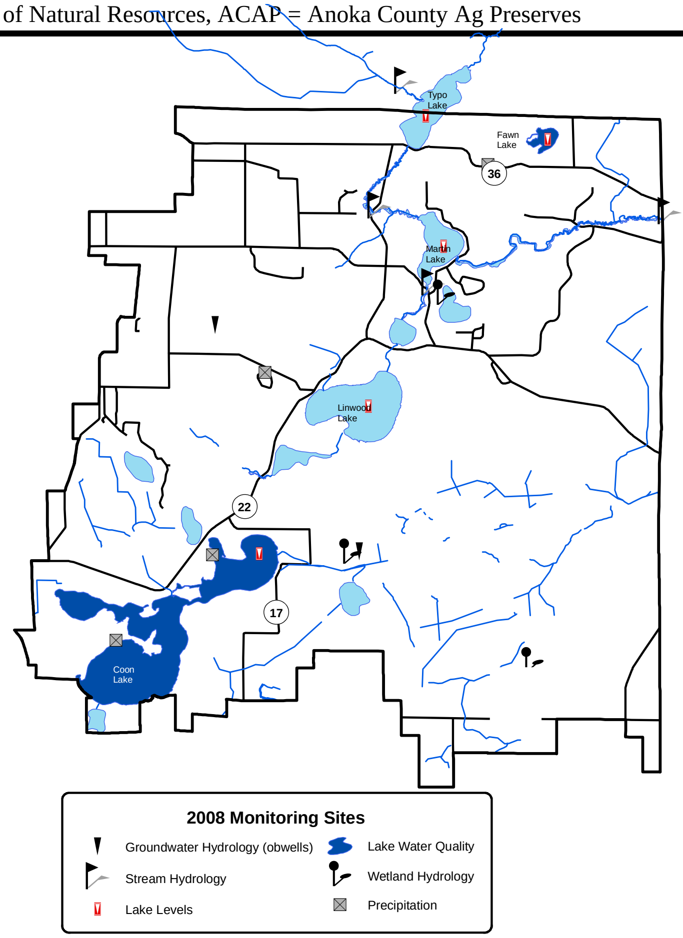
Groundwater Hydrology (obwells)	ACD, MNDNR	see Chapter 1
Precipitation	ACD, volunteers	see Chapter 1

ACD = Anoka Conservation District, SRWMO = Sunrise River Watershed Management Organization, MNDNR = Minnesota Dept. of Natural Resources, ACAP = Anoka County Ag Preserves





Lake Levels

Description: Weekly water level monitoring in lakes. All are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state \lakefind\index.html).

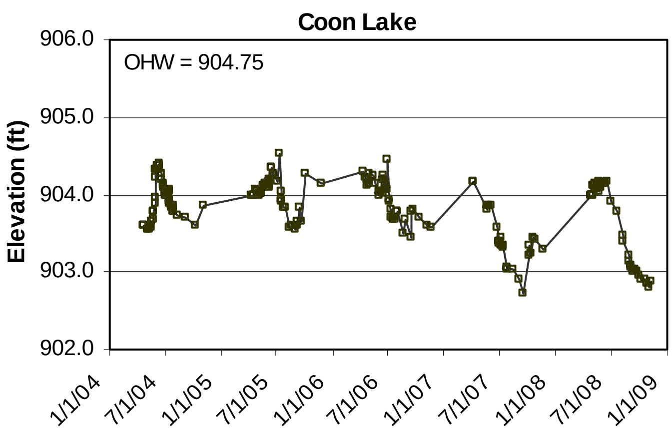
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

Locations: Coon, Fawn, Linwood, Martin, and Typo Lakes

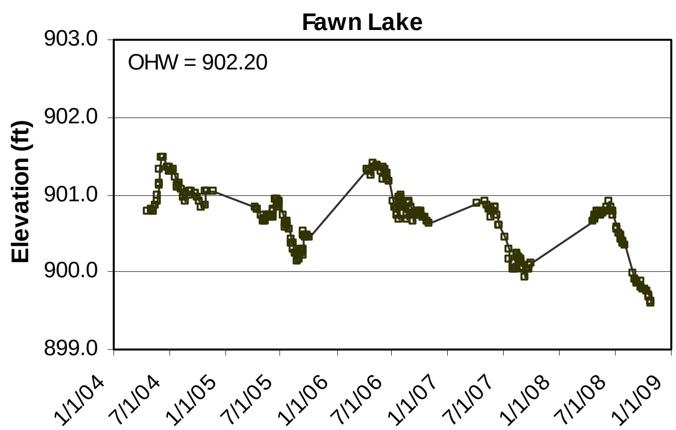
Results: Lake levels were measured by volunteers 10 to 39 times, depending upon the lake. With the exception of Linwood Lake, readings were taken at least 24 times and generally taken at least weekly. Water levels of these lakes, except for Typo, followed a similar seasonal pattern, falling continuously throughout most of the summer, as is seen in most years. Low rainfalls in 2008, combined with drought in 2007, led to low lake levels. Rainfall in Anoka County was below normal each month of June-November, and more than 1-inch below normal in all of those months except June and September. Coon, Fawn, and Martin Lakes all dipped to their lowest values since the late-1980's drought and at least as low as the 2000 drought. Linwood Lake was low too, but less data is available. Typo Lake levels did not get as low as the other lakes, instead rising beginning in August.

All lake level data can be downloaded from the Minnesota DNR website using the "LakeFinder" tool. Only the last five years are shown in the graphs on the following page. Ordinary High Water Levels (OHW), the elevation below which a DNR permit is needed to perform work, are listed for each lake on the graph.

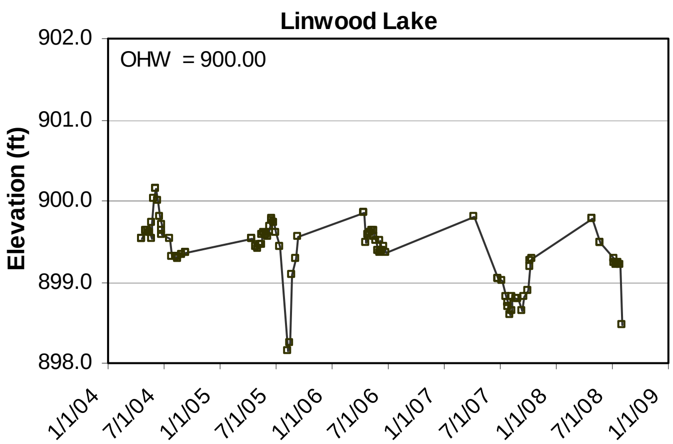
Coon Lake Levels 2004-2008



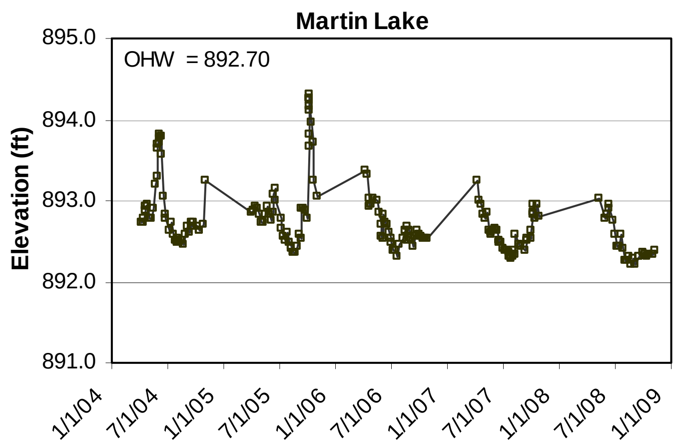
Fawn Lake Levels 2004-2008



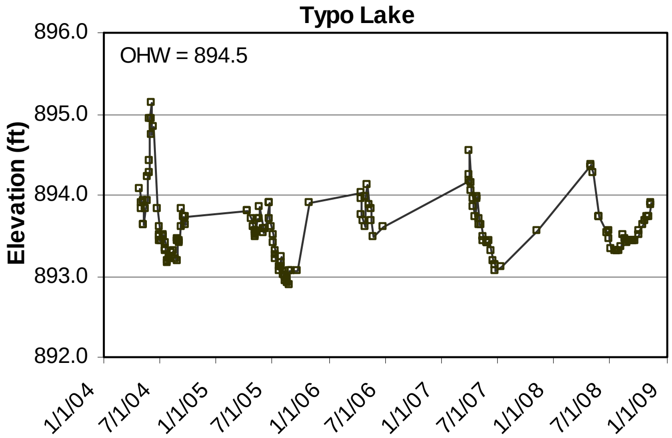
Linwood Lake Levels 2004-2008



Martin Lake Levels 2004-2008



Typo Lake Levels 2004-2008



Sunrise River Watershed Lake Levels Summary

Lake	Year	Average	Min	Max
Coon	2004	903.91	903.55	904.39
	2005	904.03	903.54	904.54
	2006	903.96	903.45	904.45
	2007	903.42	902.72	904.16
	2008	903.61	902.80	904.17
Fawn	2004	901.06	900.77	901.47
	2005	900.57	900.14	900.94
	2006	900.94	900.62	901.40
	2007	900.37	899.92	900.90
	2008	900.34	899.59	900.91
Linwood	2004	899.61	899.28	900.16
	2005	899.40	898.15	899.79
	2006	incomplete data		
	2007	898.94	898.60	899.81
	2008	incomplete data		
Martin	2004	892.90	892.45	893.81
	2005	893.03	892.35	894.31
	2006	892.67	892.32	893.36
	2007	892.61	892.28	893.25
	2008	892.48	892.21	893.02
Typo	2004	893.75	893.15	895.13
	2005	893.40	892.90	893.90
	2006	incomplete data		
	2007	893.67	893.06	894.54
	2008	893.62	893.32	894.38

Lake Water Quality

Description: May through September twice-monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

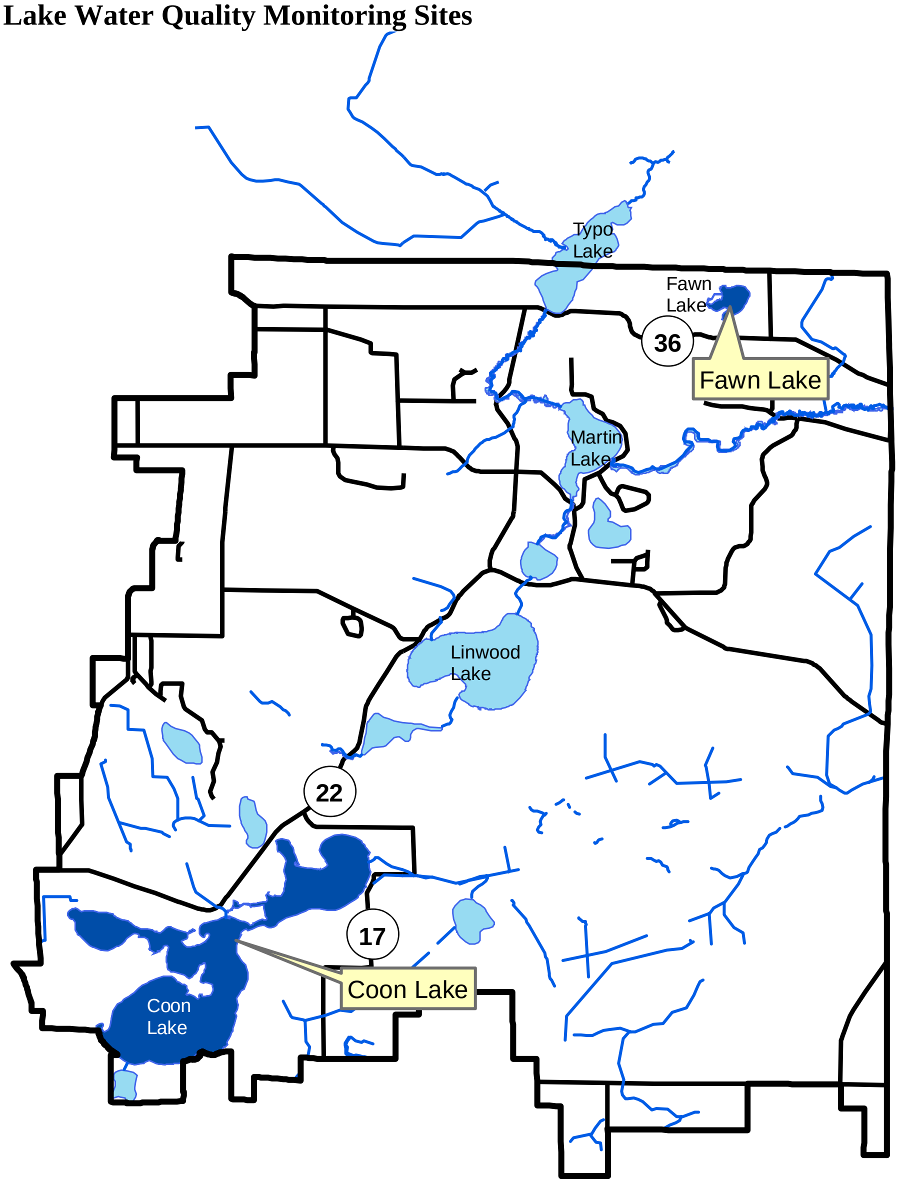
Purpose: To detect water quality trends and diagnose the cause of changes.

Locations: Coon Lake

Fawn Lake

Results: Detailed data for each lake are provided on the following pages, including summaries of historical conditions and trend analysis. Previous years' data are available from the ACD. Refer to Chapter 1 for additional information on interpreting the data and on lake dynamics.

Sunrise Watershed Lake Water Quality Monitoring Sites



Coon Lake

City of East Bethel, City of Ham Lake & City of Columbus, Lake ID # 02-0042

Background

Coon Lake is located in east central Anoka County and is the county's largest lake. Coon Lake has a surface area of 1498 acres and a maximum depth of 27 feet (9 m). Public access is available at three locations with boat ramps including one park with a swimming beach. The lake is used extensively by recreational boaters and fishers. Most of the lake is surrounded by private residences. The watershed of 6,616 acres is rural residential.

Two recent issues for Coon Lake are the exotic, invasive plant Eurasian Watermilfoil (EWM) and the idea of adding municipal sewer and water services around the lake. In 2008 a Coon Lake Improvement District was formed, with EWM management as a core of its function. Eradication is not possible. Cities around the lake are working toward municipal sewer and water services around the lake. One reason for adding this service is that there are suspected to be many septic system problems around the lake, especially in the Coon Lake Beach and Interlachen neighborhoods.

2008 Results

In 2008 Coon Lake had average water quality for this region of the state (NCHF Ecoregion), receiving an overall C grade. This was similar to other years, but on the poorer end of this distribution. The lake is slightly eutrophic. In May water was brown or green, but improved to a clearer condition with less algae in June. Algae progressively increased from July to early September, causing a green water color. ACD staff's subjective observations were that "definite" or "high" algae levels occurred at this time, causing some swimming impairment. Conditions were worst in August.

Trend Analysis

Thirteen years of water quality data have been collected by the Metropolitan Council (1980, '84, '94, '97), the Minnesota Pollution Control Agency (1989), and the Anoka Conservation District (1998-2002, '04, '06, '08). No water quality trend exists when all of the data are analyzed (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,10}=1.58$, $p=0.25$). However, it is worth noting that water quality improvements did occur between 1989 and 1994 when no monitoring occurred. Earlier trend analyses detected this improvement. Since 1994, water quality has remained similar among years.

Discussion

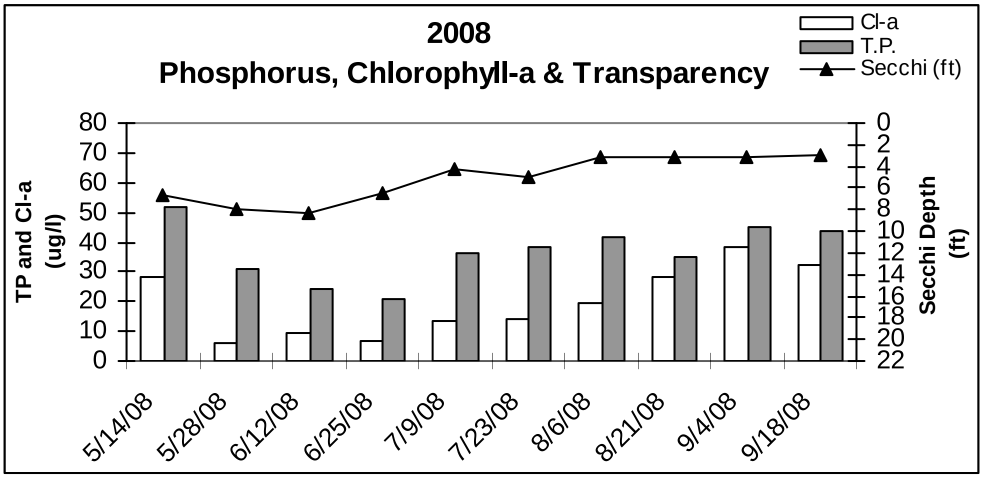
The primary threats to Coon Lake include EWM, poor lakeshore management by property owners, and failing lakeshore septic systems. ACD staff noticed a high abundance of EWM fragments in the water on several occasions, probably partly from boat propellers fragmenting plants and partly due to homeowners physically clearing near-shore vegetation. Each fragment can grow into a new plant and begin new infestation centers. EWM has spread rapidly in this lake, both in terms of acreage and locations, since it was discovered in 2003. Residents can best prevent the spread of EWM by not disturbing or removing the native plants. Residents should also increase the use of shoreline practices that improve water quality and lake health, such as native vegetation buffers and rain gardens. On a community level, correcting problem septic systems, perhaps by adding municipal sewer services, would likely be beneficial to the lake. While this lake is not listed as "impaired" by the MN Pollution Control Agency, it is close to their criteria of 40 ug/L phosphorus (2006 was 42 and 2008 was 37 ug/L).

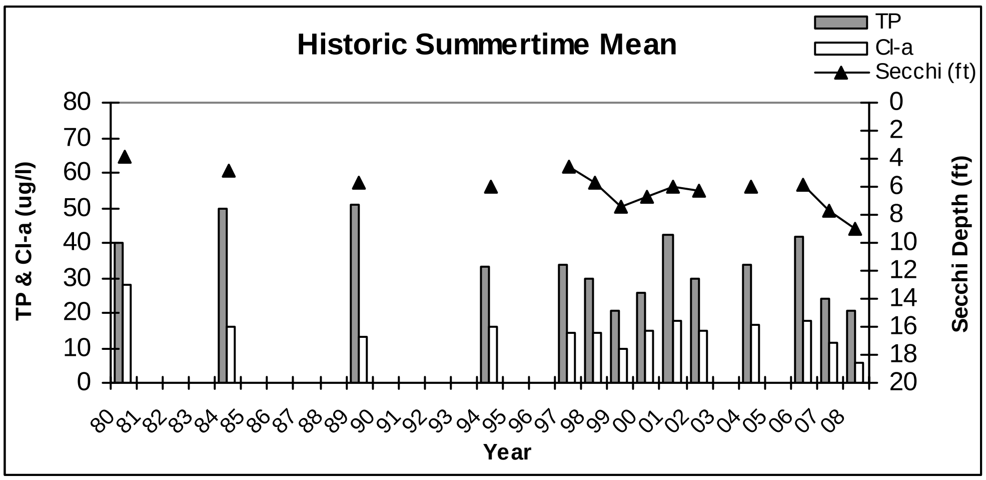
2008 Coon Lake Water Quality Data

Coon Lake 2008	Units	R.L.*	5/14/2008 Results	5/28/2008 Results	6/12/2008 Results	6/25/2008 Results	7/9/2008 Results	7/23/2008 Results	8/6/2008 Results	8/21/2008 Results	9/4/2008 Results	9/18/2008 Results	Average	Min	Max
pH		0.1	8.73	8.55	7.99	8.78	8.30	8.87	8.79	8.88	8.20	8.68	8.58	7.99	8.88
Conductivity	mS/cm	0.010	0.196	0.192	0.178	0.174	0.189	0.188	0.186	0.195	0.193	0.192	0.188	0.174	0.196
Turbidity	FNRU	1	8	6	4	3	7	8	8	10	10	14	8	3	14
D.O.	mg/L	0.01	11.26	8.86	9.02	9.62	8.07	9.38	9.33	8.79	7.46	10.13	9.19	7.46	11.26
D.O.	%	1	104%	93%	97%	116%	99%	114%	115%	107%	85%	109%	104%	85%	116%
Temp.	°C	0.1	13.8	17.6	18.9	25.2	25.6	25.9	26.3	25.6	21.7	18.9	22.0	13.8	26.3
Temp.	°F	0.1	56.8	63.7	66.0	77.4	78.1	78.6	79.3	78.1	71.1	66.0	71.5	56.8	79.3
Salinity	%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl-a	mg/L	0.5	28.0	5.9	9.2	6.5	13.6	13.9	19.3	28.2	38.4	32.3	19.5	5.9	38.4
T.P.	mg/L	0.01	0.052	0.031	0.024	0.021	0.036	0.038	0.042	0.035	0.045	0.044	0.037	0.021	0.052
T.P.	ug/L	10	52	31	24	21	36	38	42	35	45	44	37	21	52
Secchi	ft	0.1	6.6	8.0	8.4	6.4	4.2	4.9	3.2	3.2	3.2	2.9	5.1	2.9	8.4
Secchi	m	0.1	2.0	2.4	2.6	2.0	1.3	1.5	1.0	1.0	1.0	0.9	1.6	0.9	2.6
Field Observations															
Physical			2.5	3.0	2.0	2.0	3.0	3.0	4.0	4.0	3.0	3.0	3	2.00	4.00
Recreational			2.5	3.0	2.0	2.0	3.0	3.0	4.0	3.0	3.0	3.0	3	2.00	4.00

*reporting limit

Coon Lake Water Quality Results





Coon Lake Historic Summertime Mean Values

Agency	MC	MC	MPCA	MC	MC	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	80	84	89	94	97	98	99	2000	2001	2002	2004	2006	2008
TP	40.0	50.0	51.0	33.0	34.0	29.8	20.6	25.8	42.3	29.6	33.7	41.7	36.8
Cl-a	28.3	16.2	13.1	15.7	14.5	14.4	9.4	14.6	17.6	14.8	16.6	17.6	19.5
Secchi (m)	1.18	1.50	1.76	1.85	1.39	1.76	2.26	2.04	1.82	1.90	1.81	1.80	1.55
Secchi (ft)	3.9	4.9	5.8	6.1	4.6	5.8	7.4	6.7	6.0	6.2	5.9	5.8	5.1

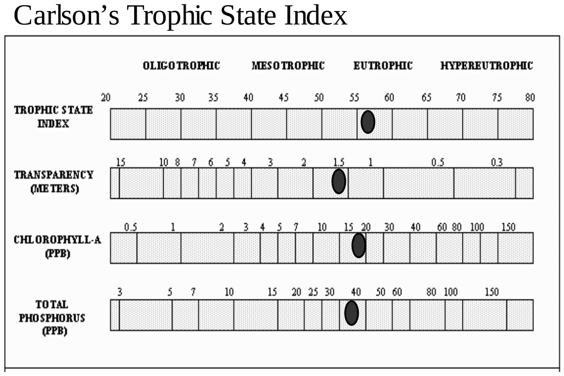
Carlsons trophic state indices

TSIP	57	61	61	55	55	53	48	51	58	53	55	58	56
TSIC	63	58	56	58	57	57	53	57	59	57	58	59	60
TSIS	58	54	53	51	55	52	48	50	51	51	51	52	54
TSI	59	58	57	54	56	54	50	53	56	54	55	56	57

Coon Lake Water Quality Report Card

Year	80	84	89	94	97	98	99	2000	2001	2002	2004	2006	2008
TP	C	C	C	C	C	B	A	B	C	B	C	C	C
Cl-a	C	B	B	B	B	B	A	B	B	B	B	B	B
Secchi	D	C	C	C	C	C	B	C	C	C	C	C	C
Overall	C	C	C	C	C	B	A	B	C	B	C	C	C

Carlson's Trophic State Index



Fawn Lake

Linwood Township Lake ID # 02-0035

Background

Fawn Lake is located in extreme northeast Anoka County. Fawn Lake has a surface area of 57 acres and a maximum depth of 30 feet (10 m). There is no public access to this lake and no boat landing. A neighborhood association has established a small park and swimming beach for the homeowners. Most of the lake is surrounded by private residences, with the densest housing on the southern and western shores. The watershed for this lake is quite small, consisting mostly of the area within less than ¼ mile of the basin.

Fawn is one of the clearest lakes in the county. Groundwater probably feeds this lake to a large extent. Vegetation in the lake is healthy, but not so prolific to be a nuisance, and contributes to high water quality. In 2008 an invasive plant species, curly-leaf pondweed, was noticed in a few locations, although it may have been present for some time.

2008 Results

In 2008 Fawn Lake had excellent water quality for this region of the state (NCHF Ecoregion), receiving an overall A grade. This mesotrophic lake has some of the clearest water in the county. Clarity was best in May at an impressive 19 feet, but decreased 6-8 feet by June, coinciding with a brief increase in algae growth that was too mild to be noticed by most lake users. This algae growth could have been associated with the seasonal die-off and decomposition of curly-leaf pondweed. Clarity was maintained at 10-14 feet for the remainder of summer. ACD staff's subjective observations of the lake's physical characteristics and recreational suitability were that conditions were excellent for swimming and boating throughout the summer.

Trend Analysis

Ten years of water quality data have been collected by the Minnesota Pollution Control Agency (1988) and the Anoka Conservation District (1997-2008). Water quality has significantly improved from 1988 to 2008 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,7}$=5.8, p=0.03). The trend is driven by poorer quality, specifically high chlorophyll-a and low transparency, in 1988. If 1988 data is excluded from the analysis, no changes in water quality have occurred.

Discussion

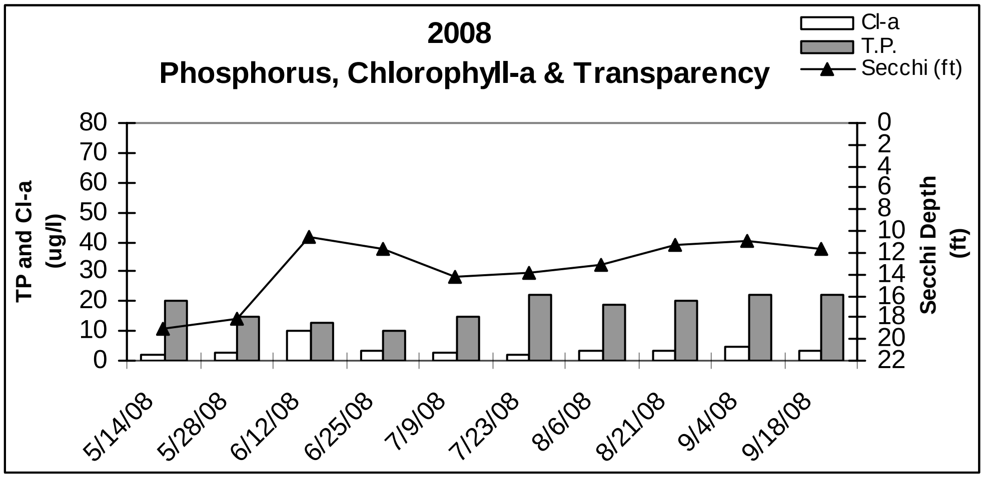
This lake's water quality future lies with the actions of the lakeshore homeowners. Because the lake has such a small watershed each lakeshore lot comprises a significant portion of the watershed. Poor practices on a few lots could result in noticeable changes to the lake. Some ways to protect the lake include lakeshore buffers of native vegetation, washing cars on the grass not driveways, keeping yard waste out of the lake, using phosphorus-free fertilizers. Soil testing on nearby lakes and throughout the metro has found that soil phosphorus fertility is high, and lawns do not benefit from additional phosphorus. Additionally, lakeshore homeowners should refrain from disturbing or removing lake vegetation whenever possible. One reason is that this lake's exceptionally good water quality is in part due to its healthy plant community. Another reason is that curly-leaf pondweed, an invasive only recently noticed in the lake, readily colonizes disturbed areas and can affect both water quality and recreation.

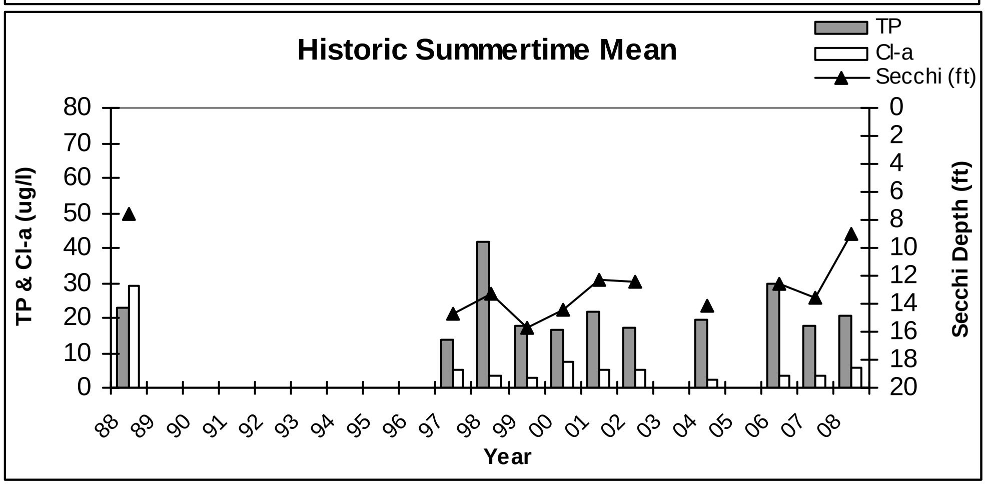
2008 Fawn Lake Water Quality Data

Fawn Lake 2008	Units	R.L.*	5/14/2008 Results	5/28/2008 Results	6/12/2008 Results	6/25/2008 Results	7/9/2008 Results	7/23/2008 Results	8/6/2008 Results	8/21/2008 Results	9/4/2008 Results	9/18/2008 Results	Average	Min	Max
pH		0.10	8.13	8.46	8.34	8.64	8.53	8.73	8.84	8.87	8.04	7.97	8.46	7.97	8.87
Conductivity	mS/cm	0.010	0.210	0.205	0.188	0.180	0.180	0.178	0.169	0.178	0.181	0.188	0.186	0.169	0.210
Turbidity	FNRU	1	1	3	2	2	1	2	2	1	1	1	2	1	3
D.O.	mg/L	0.01	10.33	10.07	9.29	8.58	7.91	9.08	8.98	8.57	7.62	8.25	8.87	7.62	10.33
D.O.	%	1	101%	106%	101%	104%	97%	111%	111%	106%	87%	90%	101%	87%	111%
Temp.	°C	0.1	14.5	17.8	19.5	25.8	25.7	25.9	26.4	26.1	22.0	19.3	22.3	14.5	26.4
Temp.	°F	0.1	58.1	64.0	67.1	78.4	78.3	78.6	79.5	79.0	71.6	66.7	72.1	58.1	79.5
Salinity	%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl-a	mg/L	0.5	1.8	2.4	10.1	3.4	2.4	2.2	3.6	3.5	4.4	3.3	3.7	1.8	10.1
T.P.	mg/L	0.010	0.020	0.015	0.013	0.010	0.015	0.022	0.019	0.020	0.022	0.022	0.018	0.010	0.022
T.P.	ug/L	10	20	15	13	10	15	22	19	20	22	22	18	10	22
Secchi	ft	0.1	> 19	18.1	10.5	11.7	14.2	13.9	13.2	11.3	10.9	11.7	13.5	10.5	19.0
Secchi	m	0.1	> 5.8	5.5	3.2	3.6	4.3	4.2	4.0	3.4	3.3	3.6	4.1	3.2	5.8
Field Observations															
Physical			1.0	1.5	2.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0	1.3	1.0	2.0
Recreational			1.0	1.5	2.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0	1.3	1.0	2.0

*reporting limit

Fawn Lake Water Quality Results





Fawn Lake Historic Summertime Mean Values

Agency	MPCA	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	88	97	98	99	2000	2001	2002	2004	2006	2008
TP	23.0	13.6	41.6	18.0	16.3	21.7	17.4	19.4	30.0	18.0
Cl-a	29.4	5.0	3.4	3.1	7.5	5.2	5.1	2.4	3.5	3.7
Secchi (m)	2.30	4.48	4.05	4.80	4.42	3.76	3.80	4.30	3.80	4.10
Secchi (ft)	7.5	14.7	13.3	15.7	14.5	12.3	12.5	14.1	12.6	13.5

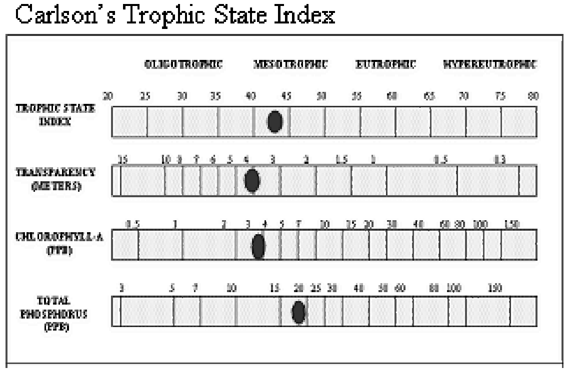
Carlson's Trophic State Indices

TSIP	49	42	58	46	44	49	45	47	53	46
TSIC	64	46	43	42	50	47	47	39	43	44
TSIS	48	38	40	37	39	41	41	39	41	40
TSI	54	42	47	42	44	45	44	42	46	43

Fawn Lake Water Quality Report Card

Year	88	97	98	99	2000	2001	2002	2004	2006	2008
TP	B	A	C	A	A	A	A	A	B	A
Cl-a	C	A	A	A	A	A	A	A	A	A
Secchi	A	A	A	A	A	A	A	A	A	A
Overall	**B**	**A**	**B**	**A**	**A**	**A**	**A**	**A**	**A**	**A**

Carlson's Trophic State Index



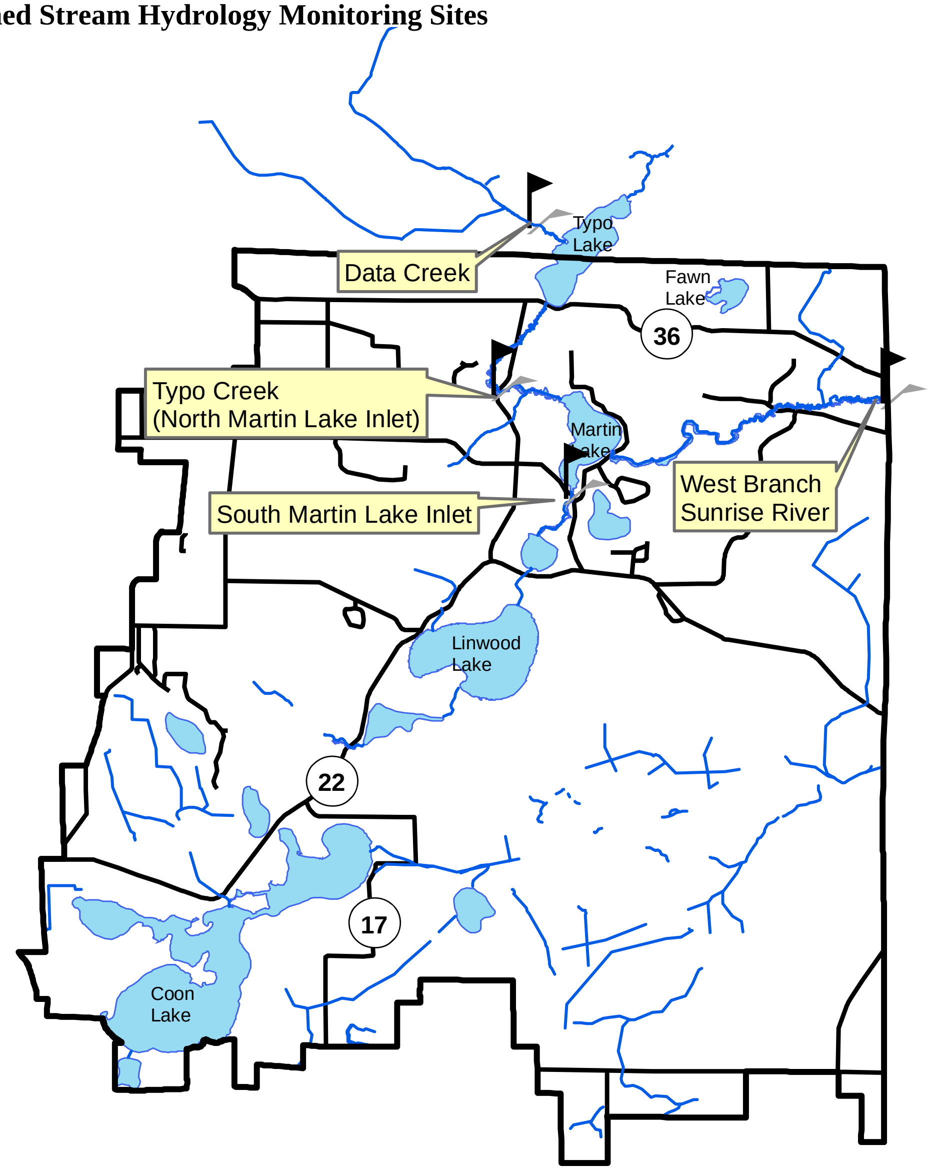
Stream Hydrology

Description: Continuous water level monitoring in streams.

Purpose: To provide understanding of stream hydrology, including the impact of climate, land use or discharge changes. These data are also needed for calculation of pollutant loads and use of computer models for developing management strategies. In the Sunrise River Watershed, the monitoring sites are the inlets and outlet of Martin and Typo Lakes, which have been studied intensely and will likely be the subject of water quality improvement projects. Maintaining hydrology data on these systems will help determine the best management strategies and evaluate the success of projects, primarily through computer modeling.

Locations: Typo Creek at Typo Creek Drive (North Martin Lake inlet)
Data Creek at Typo Creek Drive
South Martin Lake Inlet
West Branch Sunrise River at Hwy 77 (Martin Lake outlet)

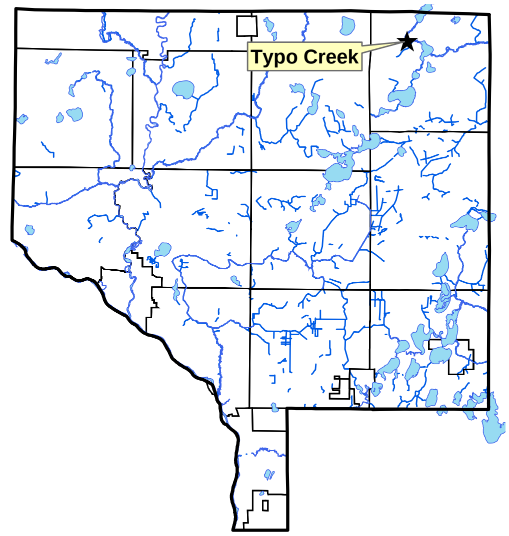
Sunrise Watershed Stream Hydrology Monitoring Sites



TYPO CREEK (NORTH MARTIN LAKE INLET)

At Typo Creek Drive, Linwood Township

Notes



This moderately-sized stream flows from Typo Lake to Martin Lake. It accounts for about 45-50% of the water budget of Martin Lake. The watershed between Typo and Martin Lakes is mostly undeveloped, but development is underway. Monitoring of stream hydrology at this site has been critical to calculating nutrient loading from Typo Lake to Martin Lake during a Total Maximum Daily Load (TMDL, aka impaired waters) study of these lakes that began in 2001. Hydrology data are being used for evaluating lake management proposals with computer modeling.

A rating curve to calculate flows (cfs) from stage data was constructed in 2002, and is:

Discharge (cfs) = $3.2637*(\text{stage}-892)^2 - 6.6933*(\text{stage}-892) - 4.0004$
$R^2=0.66$

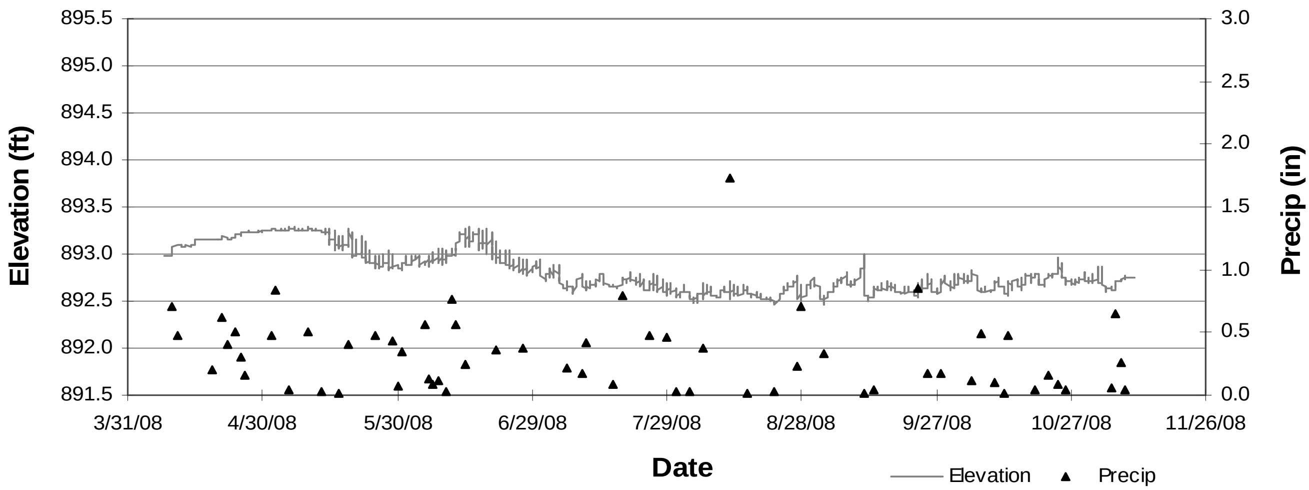
Summary of All Monitored Years

Percentiles	2000	2001	2002	2003	2004	2005*	2006	2007	2008	All Years
Min	893.14	892.42	892.71	892.50	892.43	892.64	892.61	892.41	892.46	892.41
2.5%	893.18	892.45	892.89	892.55	892.47	892.67	892.72	892.47	892.52	892.49
10.0%	893.22	892.49	892.99	892.59	892.51	892.97	892.85	892.56	892.58	892.57
25.0%	893.30	892.53	893.10	892.66	892.68	893.04	892.95	892.64	892.65	892.68
Median (50%)	893.48	892.56	893.28	892.75	892.88	893.09	893.07	892.74	892.74	892.93
75.0%	893.53	892.59	893.44	893.07	893.00	893.14	893.32	892.94	892.99	892.93
90.0%	893.53	893.264	893.54	893.34	893.27	893.30	893.50	893.06	893.22	893.41
97.5%	893.55	893.628	893.69	893.75	893.84	893.33	893.55	893.07	893.26	893.59
Max	893.55	894.91	893.76	893.91	893.92	893.39	893.61	893.11	893.28	894.91

"All Years" is not an average of each year's summary statistic. Rather, it is calculated from the continuous, multi-year record.

*** 2005 data is only March 25 to July 7.**

2008 Hydrograph

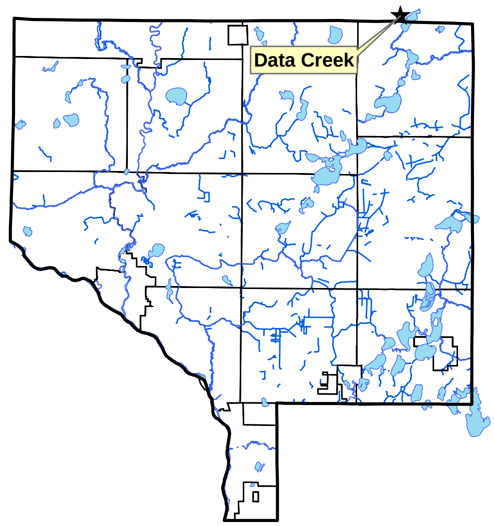


Stream Hydrology Monitoring

DATA CREEK – WEST TYPO LAKE INLET

At Typo Creek Drive, Isanti County

Notes



This stream is also referred to as the West Branch of the Sunrise River. It accounts for about 70-75% of the water budget of Typo Lake. The watershed of this stream and its tributaries is mostly agricultural, wetland, and upland forest (in order of prevalence). The stream is moderate sized, typically 1-3 feet deep and 5-10 feet wide. Monitoring of stream hydrology at this site has been critical to calculating nutrient loading to Typo Lake during a Total Maximum Daily Load (TMDL, aka impaired waters) study of Typo and Martin Lakes that began in 2001. Hydrology data will be used for evaluating lake management proposals with computer modeling.

A rating curve to calculate flows (cfs) from stage data was constructed in 2002, and is:

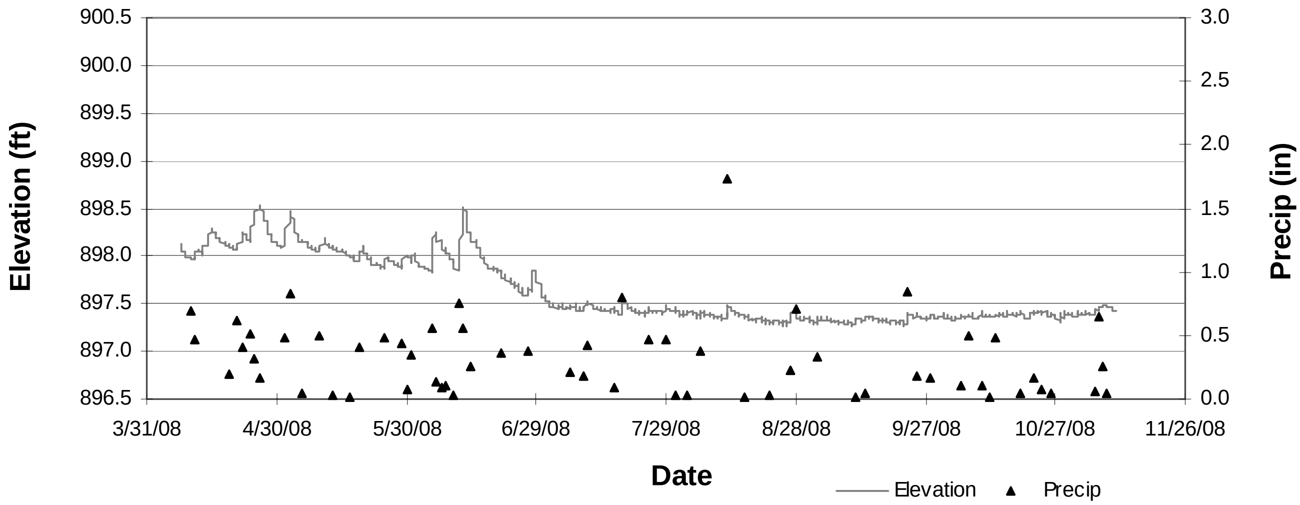
Discharge (cfs) = $2.71459*(\text{stage}-897)^2 - 4870.11*(\text{stage}-897) + 2184303$ $R^2=0.97$

Summary of All Monitored Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	2008	All Years
Min	897.56	897.83	897.48	897.65	897.53	897.50	897.35	897.26	897.26
2.5%	897.65	897.99	897.52	897.70	897.55	897.55	897.40	897.29	897.33
10.0%	897.67	898.12	897.55	897.74	897.58	897.59	897.47	897.32	897.41
25.0%	897.70	898.28	897.64	897.83	897.67	897.65	897.57	897.37	897.61
Median (50%)	897.79	898.39	898.04	897.96	897.98	897.76	897.73	897.42	897.91
75.0%	898.14	898.55	898.36	898.14	898.09	898.03	898.16	897.97	897.91
90.0%	898.36	898.99	898.65	898.57	898.21	898.26	898.29	898.14	898.43
97.5%	898.65	899.49	899.05	898.91	898.54	898.49	898.53	898.36	898.85
Max	898.76	899.86	899.64	899.57	898.86	898.78	899.23	898.52	899.86

"All Years" is not an average of each year's summary statistic. Rather, it is calculated from the continuous, multi-year record.

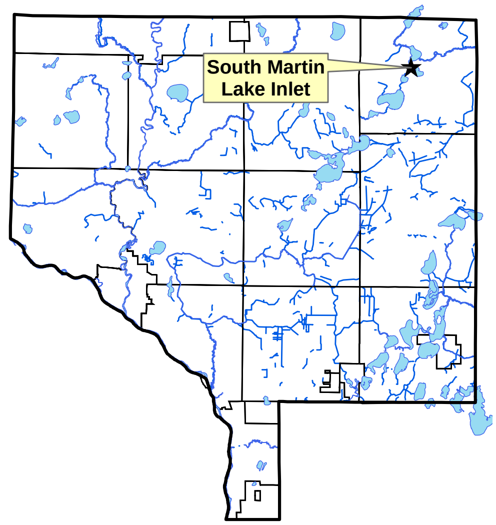
2008 Hydrograph



SOUTH MARTIN LAKE INLET

In township park off Martin Lake Road, Linwood Township

Notes



This small stream flows from Island Lake to Martin Lake. It accounts for about 40% of the water budget of Martin Lake. The watershed between Island and Martin Lakes is undeveloped. Its water quality is exceptionally good. Monitoring of stream hydrology at this site has been critical to calculating nutrient loading to Martin Lake during a Total Maximum Daily Load (TMDL, aka impaired waters) study of Typo and Martin Lakes that began in 2001. Hydrology data will be used for evaluating lake management proposals with computer modeling.

A rating curve to calculate flows (cfs) from stage data was constructed in 2002, and is:

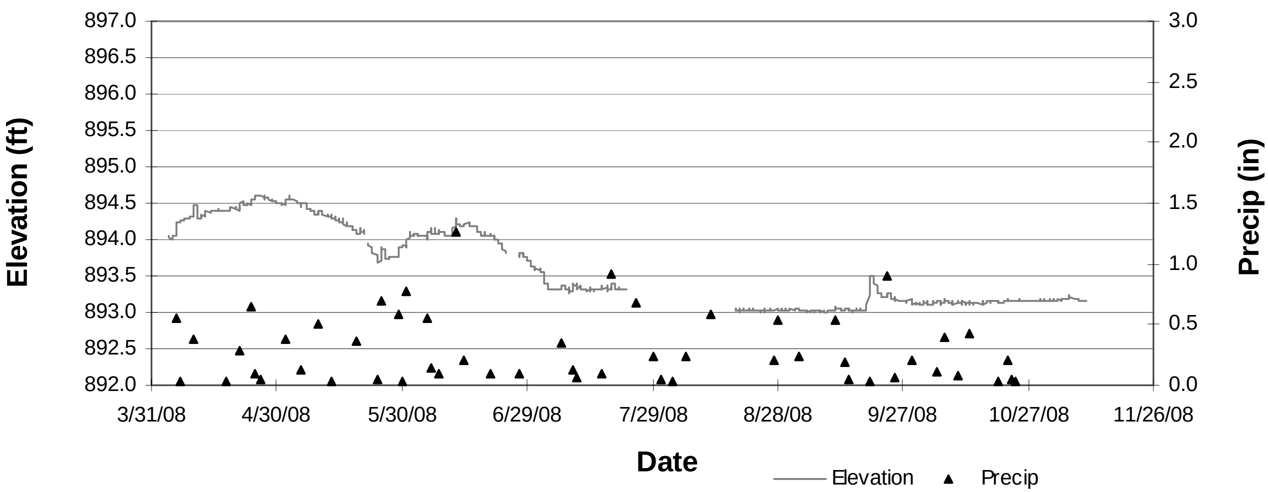
Discharge (cfs) = 7.13144*(stage) – 6369.7
R^2=0.88

Summary of All Monitored Years

Percentiles	2000*	2001	2002	2003	2004	2005	2006	2008	All Years
Min	895.11	893.08	893.36	893.09	893.11	893.28	893.34	893.00	893.00
2.5%	895.11	893.09	893.45	893.15	893.15	893.32	893.39	893.02	893.04
10.0%	895.12	893.12	893.53	893.17	893.18	893.48	893.41	893.04	893.16
25.0%	895.12	893.20	893.79	893.22	893.28	893.70	893.51	893.15	893.32
Median (50%)	895.14	893.30	893.93	893.65	893.45	893.83	893.63	893.32	893.69
75.0%	895.26	893.68	894.19	894.10	893.62	893.98	893.88	894.17	893.69
90.0%	895.27	896.64	894.35	894.30	893.98	894.28	894.10	894.42	894.41
97.5%	895.31	897.26	894.46	894.73	894.52	895.13	894.36	894.55	895.27
Max	895.32	897.35	894.54	895.22	894.63	895.19	894.40	894.60	897.35

"All Years" is not an average of each year's summary statistic. Rather, it is calculated from the continuous, multi-year record.
* in 2000 only the end of Oct. and beginning of Nov. were monitored

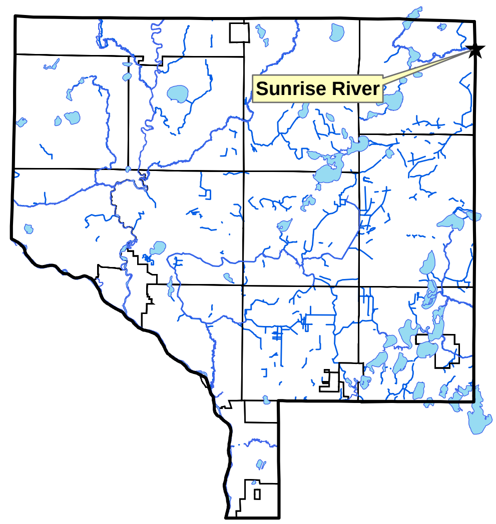
2008 Hydrograph



SUNRISE RIVER

At Hwy 77, Linwood Township

Notes



This monitoring site is the bottom of this watershed in Anoka County, at the Chisago County border. About three miles upstream of the monitoring site is the outlet of Martin Lake. The watershed of this river is developing. Monitoring of this site will, among other things, track changes in flooding as the areas surrounding the river become increasingly developed and homes are sited close to the floodplain. This site is important because it is the bottom of this river's watershed in Anoka County, representing all upstream effects. In 2008 this site was monitored to collect data for a computer model of the entire Sunrise River watershed being done by the US Army Corps of Engineers, Chisago County, and other partners.

A rating curve to calculate flows (cfs) from stage data was constructed in 2002, and is:

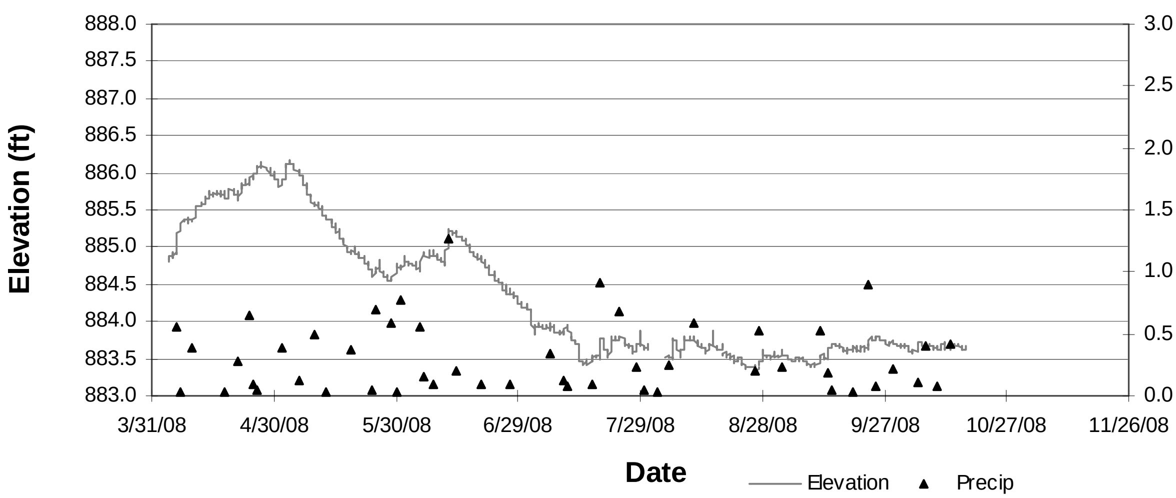
Discharge (cfs) = $2.9171*(\text{stage}-883.5)^3 - 7.9298*(\text{stage}-883.5)^2 + 10.131*(\text{stage}-883.5) + 10.18$ $R^2=0.94$

Summary of All Monitored Years

Percentiles	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2008	All Years
Min	883.78	884.25	885.25	884.06	883.41	883.65	884.36	883.28	883.84	884.33	883.76	883.31	883.28
2.5%	884.00	884.31	885.35	884.12	883.50	883.76	884.50	883.64	883.93	884.44	883.87	883.40	883.55
10.0%	884.14	884.48	885.42	884.22	883.52	883.81	884.63	883.73	884.02	884.58	884.04	883.51	883.89
25.0%	884.48	884.79	885.71	884.58	883.55	883.91	885.13	883.83	884.31	884.69	884.50	883.64	884.47
Median (50%)	884.77	885.51	886.06	884.80	883.68	884.25	885.59	884.62	884.59	884.93	885.06	883.89	885.12
75.0%	885.39	886.03	886.46	884.99	884.21	885.60	886.18	885.66	885.10	885.29	885.27	884.99	885.12
90.0%	885.88	886.58	887.10	885.21	884.42	886.69	886.48	886.12	886.03	885.61	885.59	885.74	886.45
97.5%	886.90	886.82	887.61	885.65	885.75	887.05	886.84	886.74	886.82	885.92	886.06	886.04	887.06
Max	887.13	887.14	887.81	885.77	886.02	887.05	886.89	886.91	886.89	886.67	886.14	886.17	887.81

"All Years" is not an average of each year's summary statistic. Rather, it is calculated from the continuous, multi-year record.

2008 Hydrograph



Wetland Hydrology

Description: Continuous groundwater level monitoring at a wetland boundary, to a depth of 40 inches. County-wide, the ACD maintains a network of 19 wetland hydrology monitoring stations.

Purpose: To provide understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

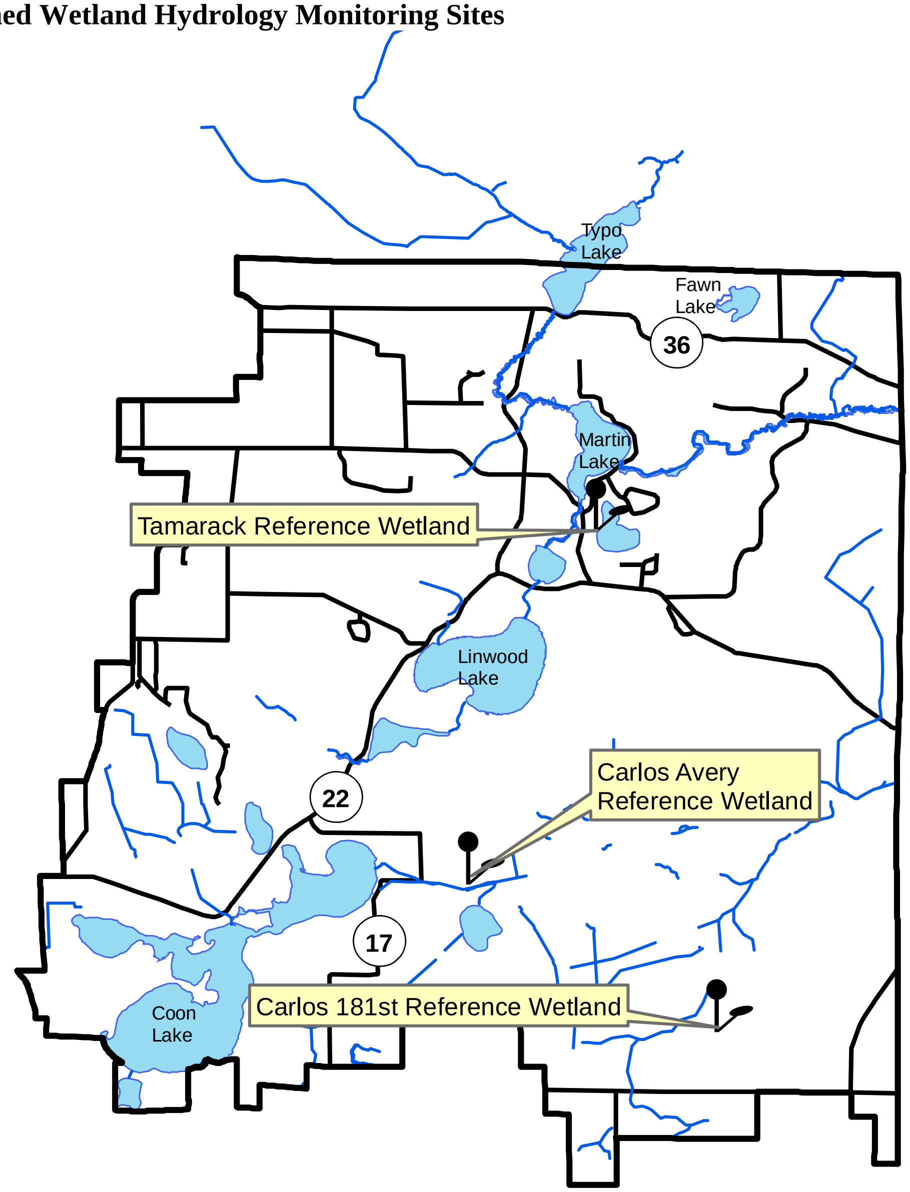
Locations: Carlos Avery Reference Wetland, Carlos Avery Wildlife Management Area, City of Columbus

Carlos 181st Reference Wetland, Carlos Avery Wildlife Management Area, City of Columbus

Tamarack Reference Wetland, Linwood Township

Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

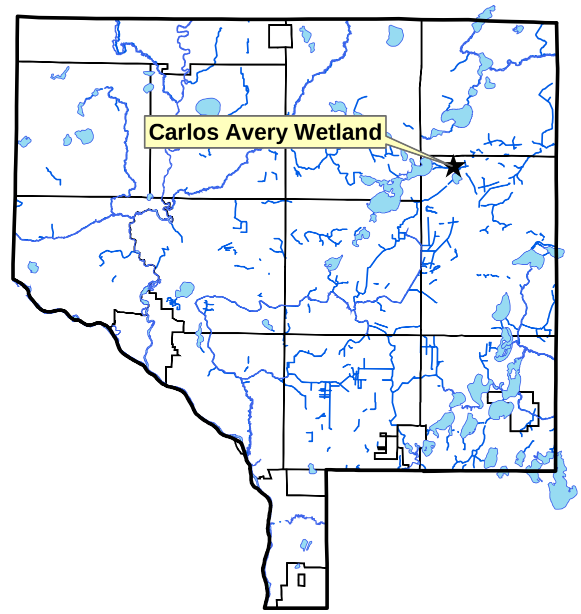
Sunrise Watershed Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

CARLOS AVERY REFERENCE WETLAND

Carlos Avery Wildlife Management Area, City of Columbus



Site Information

Monitored Since: 1997

Wetland Type: 3

Wetland Size: >300 acres

Isolated Basin? No

Connected to a Ditch? Yes

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-4	N2/0	Organic	-
Bg	4-25	10yr 5/2	Sandy Loam	25%10yr 5/6 with organic streaking

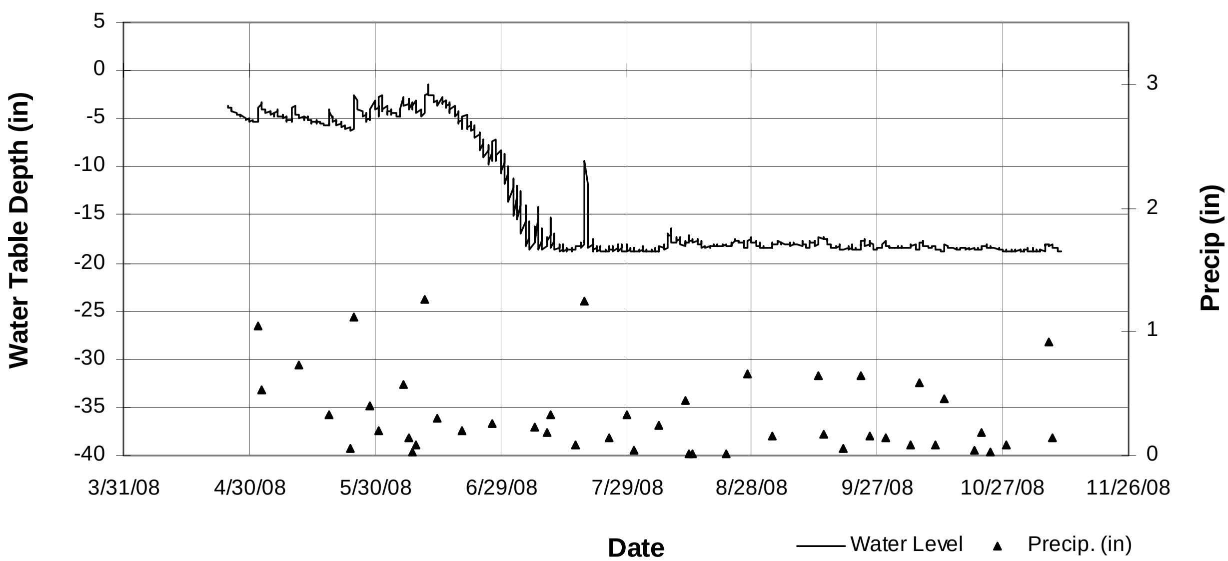
Surrounding Soils: Lino loamy fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	80
Carex Spp	Sedge undiff.	40
Quercus macrocarpa	Bur Oak	40
Sagitaria latifolia	Broad-leaf Arrowhead	20
Cornus stolonifera	Red-osier Dogwood	20

Other Notes: This is a broad, expansive wetland within a state-owned wildlife management area. Cattails dominate within the wetland.

2008 Hydrograph

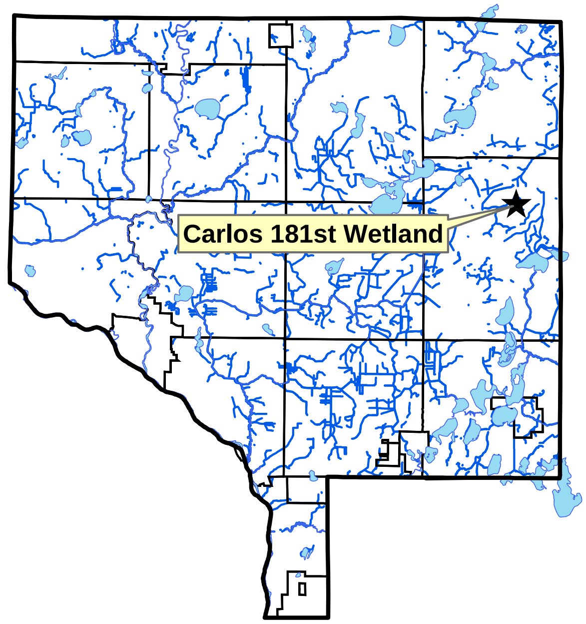


Well depths were 37.5 inches, so a reading of–37.5 indicates water levels were at an unknown depth greater than or equal to 37.5 inches.

Wetland Hydrology Monitoring

CARLOS 181ST REFERENCE WETLAND

Carlos Avery Wildlife Management Area, City of Columbus



Site Information

Monitored Since:	2006
Wetland Type:	2-3
Wetland Size:	3.9 acres (approx)
Isolated Basin?	Yes
Connected to a Ditch?	Roadside swale only

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-3	N2/0	Sapric	-
A	3-10	N2/0	Mucky Fine Sandy Loam	-
Bg1	10-14	10yr 3/1	Fine Sandy Loam	-
Bg2	14-27	5Y 4/3	Fine Sandy Loam	-
Bg3	27-40	5y 4/2	Fine Sandy Loam	-

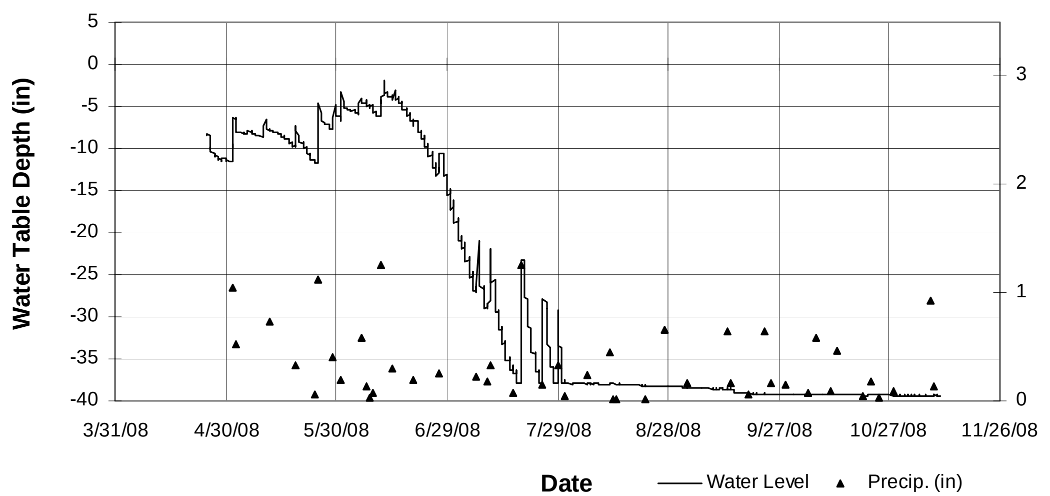
Surrounding Soils: Soderville fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Rhamnus frangula (S)	Glossy Buckthorn	40
Ulmus american (S)	American Elm	15
Populus tremulodies (T)	Quaking Aspen	10
Acer saccharum (T)	Silver Maple	10

Other Notes: The site is owned and managed by MN DNR. Access is from 181st Avenue.

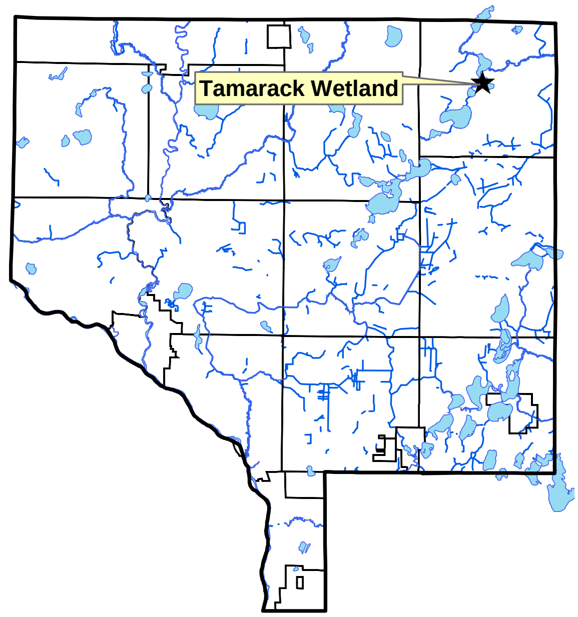
2008 Hydrograph



Well depths were 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

TAMARACK REFERENCE WETLAND

Martin-Island-Linwood Regional Park, Linwood Township



Site Information

Monitored Since: 1999

Wetland Type: 6

Wetland Size: 1.9 acres (approx)

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-6	N2/0	Mucky Sandy Loam	-
A2	6-21	10yr 2/1	Sandy Loam	-
AB	21-29	10yr3/2	Sandy Loam	-
Bg	29-40	2.5y5/3	Medium Sand	-

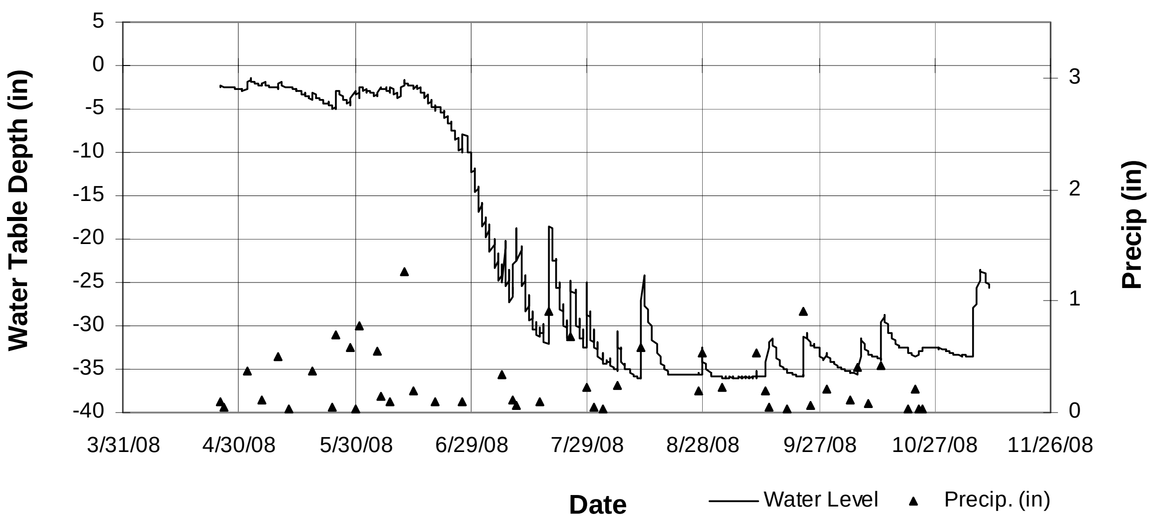
Surrounding Soils: Sartell fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Rhamnus frangula	Common Buckthorn	70
Betula alleghaniensis	Yellow Birch	40
Impatiens capensis	Spotted Touch-Me Not	40
Phalaris arundinacea	Reed Canary Grass	40

Other Notes: The site is owned and managed by Anoka County Parks.

2008 Hydrograph



Well depth was 36 inches, so a reading of–36 indicates water levels were at an unknown depth greater than or equal to 36 inches.

Promotion of Water Quality Improvement Projects

Description: Water quality improvement projects were promoted on the five largest developed lakes – Coon, Linwood, Martin, Typo, and Fawn. A customized mailing including a customized letter and a full-color "Landscaping on Lakeshores" brochure was sent to each property owner on these lakes who had been identified as having moderate or severe shoreline erosion, and those that were likely to develop problems because of shoreline management practices. These properties were identified during a lakeshore mapping exercise in 2003 and 2004.

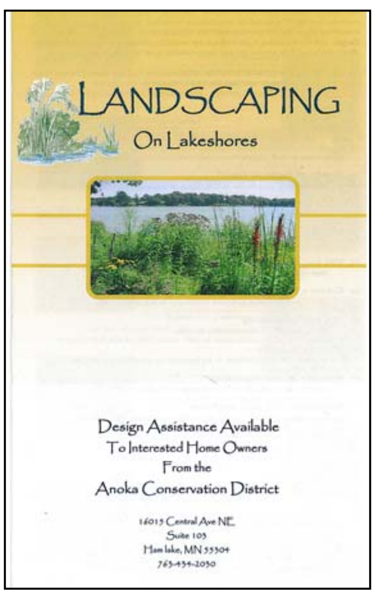
Purpose: To educate lakeshore homeowners who have shoreline erosion or are likely to develop problems about lake-friendly shoreline management practices and programs that assist homeowners with correcting problems.

Locations: Coon, Linwood, Martin, Typo, and Fawn Lakes.

Results: A customized mailing was sent to 102 residences that were identified as having moderate or severe shoreline erosion in 2003 and 2004 when the shoreline condition of these lakes was mapped. The mailing included a letter noting their property had been identified as one with problems or likely to develop problems, and inviting them to utilize ACD's free technical assistance services and the SRWMO cost share. The mailing also included a full-color brochure about "Landscaping on Lakeshores." That brochure included a list of landscaping principles, descriptions of projects often done to repair lakeshore erosion, a sampling of native plants and wildflowers that are recommended for lakeshore, and information about assistance from the ACD and SRWMO.

The ACD responded to seven inquiries (7% response rate) resulting from the mailing. In each case the landowner requested an on-site consultation by ACD staff, which was done. Three installed projects in 2008, one has a project planned for 2009, one may install a project at some time in the future, and two decided to do nothing. The largest of these projects utilized SRWMO cost share grant funds.

Brochure



Mailing Results

Lake	# Mailings Sent	Requests for on-site consultations	Projects installed or planned
Coon	44	2	2
Fawn	6	0	0
Linwood	28	1	0
Martin	20	4	2
Typo	4	0	0
Total	102	7	4

Cost Share for Water Quality Improvement Projects

Description: Since 2005 the Sunrise River Watershed Management Organization (SRWMO) and Anoka Conservation District have partnered to offer Water Quality Improvement Cost Share Grants. These grants, administered by the ACD, offer up to 50% cost sharing of the materials needed for a project. The landowner is responsible for the other 50% of materials, all labor, and any aesthetic components of the project.

In 2008 the SRWMO promoted these water quality improvement projects and the cost share grants through a customized mailing to lakeshore residents. The Anoka Conservation District (ACD) also promotes these types of projects and the availability of cost share. Promotion occurs by approaching landowners with known problems, presentations to lake associations and other community groups, community newsletters, and website postings. The ACD assists interested landowners throughout a project, including design, materials acquisition, installation, and maintenance.

Purpose: To improve water quality in area lakes, streams, and rivers by promoting the correction of shoreline erosion problems and rehabilitation to native shoreline.

Locations: Throughout the watershed.

Results:

SRWMO Cost Share Fund Summary

2005 SRWMO Contribution	+	$1,000.00
2006 SRWMO Contribution	+	$1,000.00
2006 Expense - Coon Lake, Rogers Property Project	-	$ 570.57
2007 – no expenses or contributions		$ 0.00
2008 SRWMO Contribution	+	$2,000.00
2008 Expense - Martin Lake, Moos Property Project	-	$1,091.26
Fund Balance		**$2,338.17**

2008 Moos Shoreline Restoration Project

In 2008 a shoreline rehabilitation project was installed on Martin Lake at the Moos residence using SRWMO cost share funds. This project included an approximately 3600 square foot buffer of native plants at the shoreline, some plantings of aquatic plants, installation of biologs to correct erosion and protect the new plantings, and temporary erosion control measures. The buffer width varied between 12 feet in the middle of the yard near the dock and 70 feet on the sides of the yard. One special feature installed was a small settling basin to remove some pollutants from a storm sewer outfall. The landowners and a friend designed the project (with ACD assistance), installed it, and SRWMO provided 50% cost share of materials (plants, biologs, erosion control blanket, mulch, stakes).

ACD staff inspected the project in June (immediately after installation) and in September. The project was well-installed and the September visit found the plants had established successfully. Some areas required more weeding, and this was communicated to the landowner. In the areas nearest the water, beggar tick and other plants that had come up voluntarily were crowding the planted stock. Farther upslope weeding had been successful and the planted stock was doing well. The aquatic plants which were planted into the biolog and near shore were growing and expanding.

Photos are on the following page.

Moos Property Shoreline Restoration, Martin Lake

Pre-Project – April 2008

Pre-Project– April 2008

Immediately after planting – June 2008

Immediately after planting – June 2008

Immediately after planting – June 2008

Three months after planting – Sept 2008

Martin Lake Rough Fish Harvests

Description: The Sunrise River Watershed Management Organization (SRWMO) contracted with a commercial fisherman to remove rough fish (black bullheads and carp) from Martin Lake.

Purpose: To improve water quality by removing rough fish that cause increases in turbidity and nutrients.

Locations: Martin Lake, Linwood Township

Results: A commercial fisherman set hoop nets in Martin Lake in early October, when the fish tend to school and cruise shallow areas. The nets were left in place for over a week and retrieved. Bullhead captures were lower than expected, and the fish were in poor condition suggesting their population is in decline. Incidental harvests of carp were much higher than expected, and suggest that the carp population is large. Follow-up work may be done at a later date.

Bullhead Harvest from Martin Lake, October 2008

Landcover Update

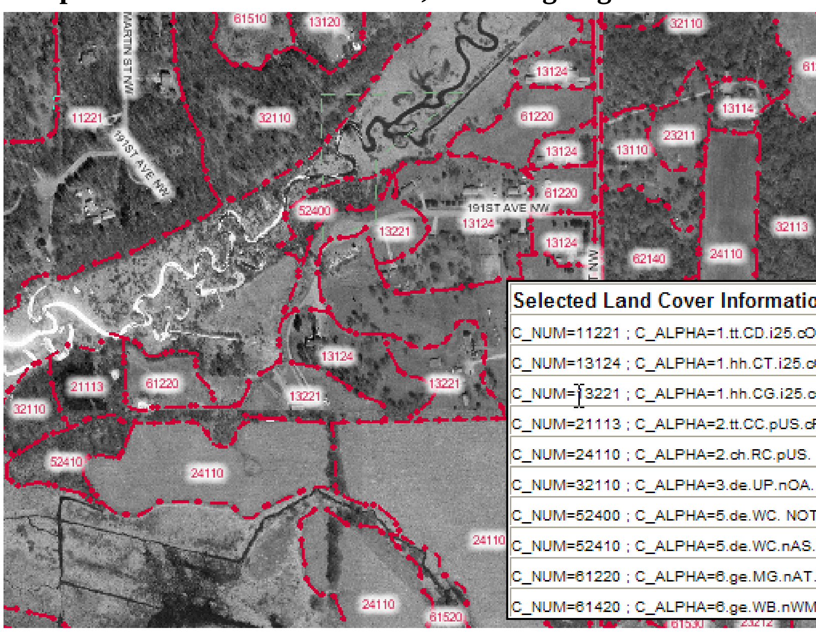
Description: The Minnesota Land Cover Classification System (MLCCS) is a Geographic Information System (GIS) map of land uses and land covers. It includes delineation and coding of any land use >2.5 acres (but often smaller), and follows Minnesota Department of Natural Resources methodologies. The maps are publicly-available tools for municipal and natural resource planners, and offer a high degree of detail.

Purpose: To update the MLCCS maps for a 21,000 acre area in north central Anoka County that was previously done before current land mapping standards were implemented. This will result in a county-wide coverage consistent with current standards and methods. This provides municipal and natural resources planners with a detailed map of land uses including detailed accounts of natural communities found at any location.

Locations: North-central Anoka County.

Results: In 2008 MLCCS was updated for 21,000 acres in north-central Anoka County that were done in 1999 using less detailed methods. This work was accomplished using new aerial photos. Field verification is scheduled for 2009. The result is an updated county-wide coverage with a high degree of detail. A sample map is provided below.

Sample of MLCCS Work Results, Including Legend



Selected Land Cover Information
C_NUM=11221 ; C_ALPHA=1.tt.CD.i25.cOA. NOTES=Oak (forest or woodland) with 11- 25% impervious cover
C_NUM=13124 ; C_ALPHA=1.hh.CT.i25.cGS. NOTES=Short grasses and mixed trees with 11-25% impervious cover
C_NUM=13221 ; C_ALPHA=1.hh.CG.i25.cGS. NOTES=Short grasses with 11-25% impervious cover
C_NUM=21113 ; C_ALPHA=2.tt.CC.pUS.cPR. NOTES=Red pine trees on upland soils
C_NUM=24110 ; C_ALPHA=2.ch.RC.pUS. NOTES=Upland soils - cropland
C_NUM=32110 ; C_ALPHA=3.de.UP.nOA. NOTES=Oak forest
C_NUM=52400 ; C_ALPHA=5.de.WC. NOTES=Seasonally flooded deciduous shrubland
C_NUM=52410 ; C_ALPHA=5.de.WC.nAS. NOTES=Alder swamp
C_NUM=61220 ; C_ALPHA=6.ge.MG.nAT. NOTES=Medium-tall grass altered/non-native dominated grassland
C_NUM=61420 ; C_ALPHA=6.ge.WB.nWM. NOTES=Wet meadow

Homeowner Guide

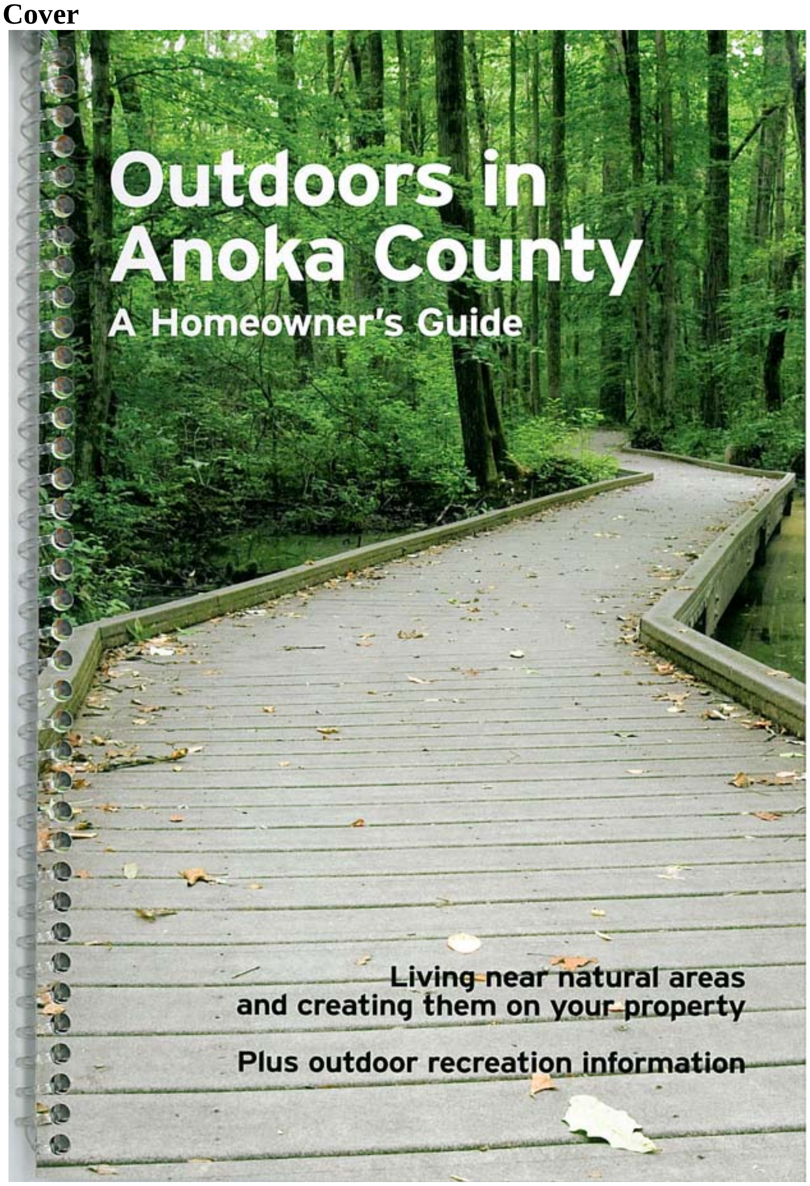
Description: The Anoka Conservation District (ACD) wrote, designed, and printed an educational booklet for homeowners. The booklet included information on topics of interest to the SRWMO, including landscaping for water quality, wetlands, well water, septic systems, and hazardous household wastes.

Purpose: To educate homeowners about topics that will impact local natural resources.

Locations: Throughout the watershed

Results: "Outdoors in Anoka County – a homeowner's guide" was written, laid out by a graphic designer, and printed in 2007. The SRWMO funded the printing of 450 booklets in 2007 to be distributed within the SRWMO area following the SRWMO Board's direction to distribute to several public places including city halls, and homes adjacent to important water resources. The ACD accomplished that distribution and continued with an additional distribution of 228 booklets to homes near other important natural areas of the ACD's choosing.

Homeowner's Guide Cover



SRWMO Website

Description: The Sunrise River Watershed Management Organization (SRWMO) contracted the Anoka Conservation District (ACD) to design and maintain a website about the SRWMO and the Sunrise River watershed. The website has been in operation since 2003.

Purpose: To increase awareness of the SRWMO and its programs. The website also provides tools and information that helps users better understand water resources issues in the area. The website serves as the SRWMO's alternative to a state-mandated newsletter.

Location: www.AnokaNaturalResources.com/SRWMO

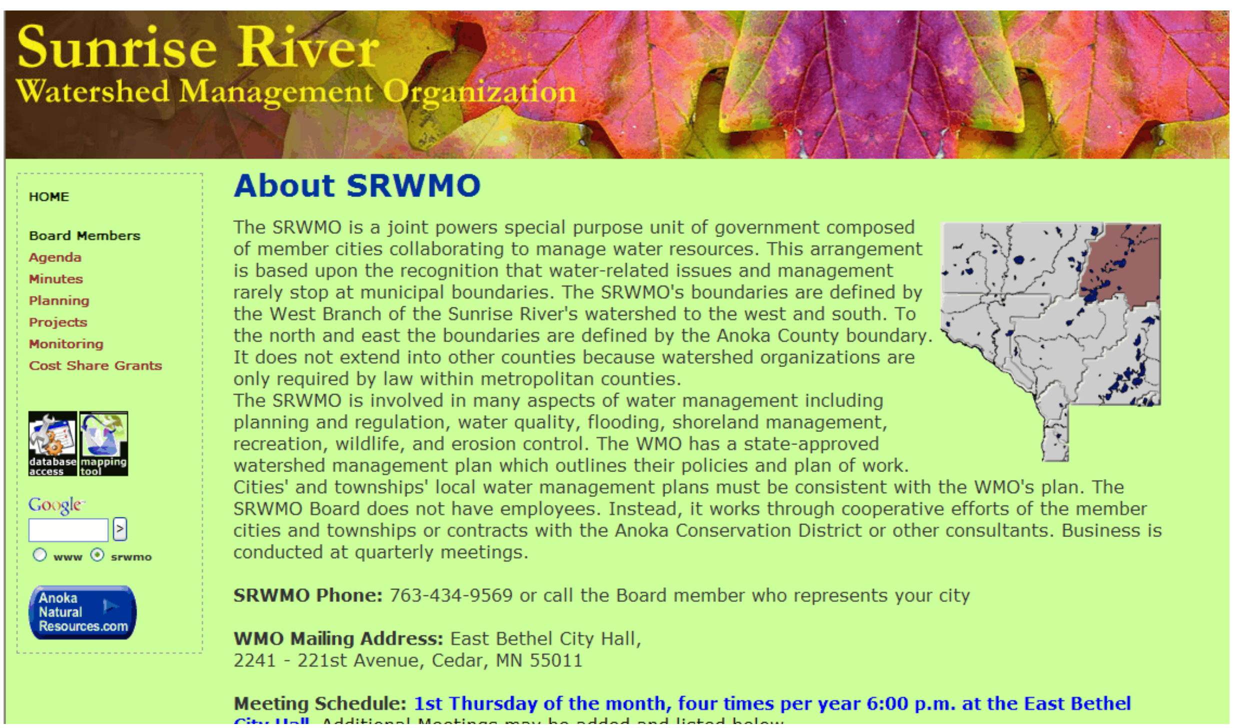
Results: The SRWMO website contains information about both the SRWMO and about natural resources in the area.
Information about the SRWMO includes:

- a directory of board members,
- meeting minutes and agendas,
- descriptions of work that the organization is directing,
- highlighted projects.
- information about the process of updating the watershed plan (added in 2008)

Other tools on the website include:

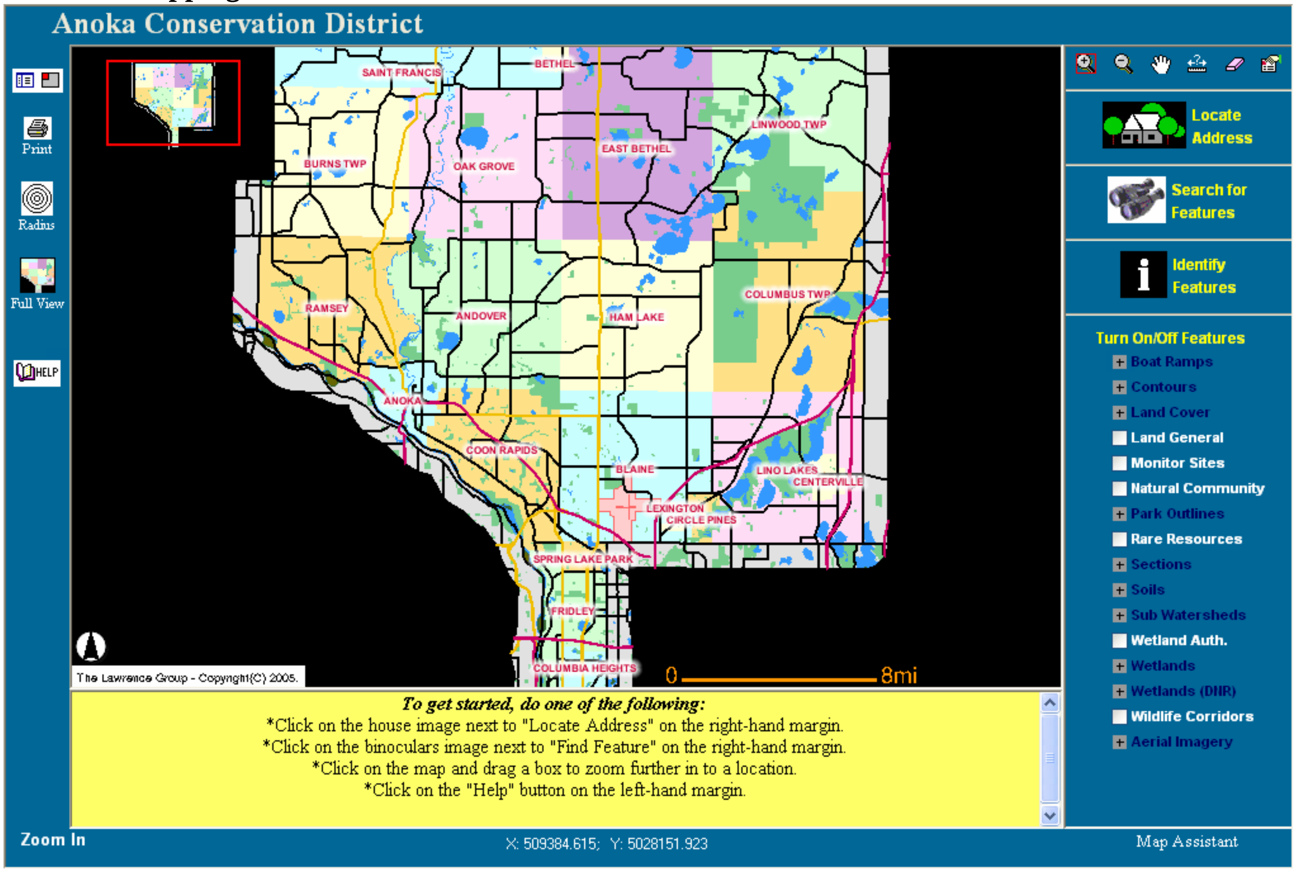
- an interactive mapping tool that shows natural features and aerial photos
- an interactive data download tool that allows users to access all water monitoring data that has been collected
- narrative discussions of what the monitoring data mean

SRMWO Website Homepage

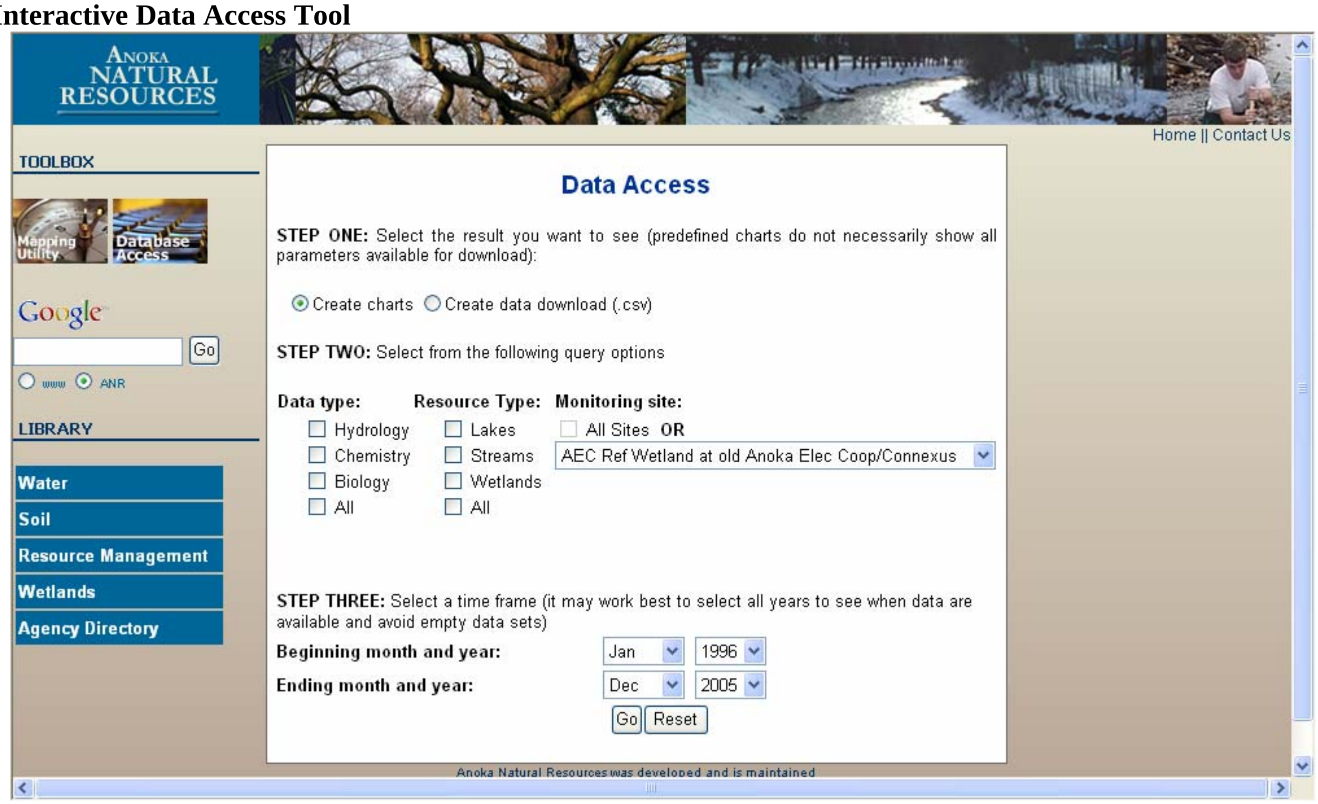


more on next page

Interactive Mapping Tool



Interactive Data Access Tool



SRWMO 2007 Annual Report to BWSR

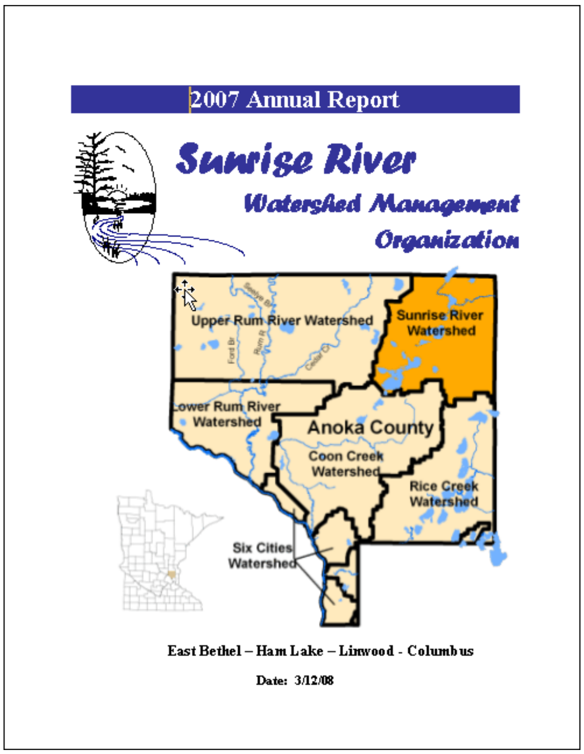
Description: The Sunrise River Watershed Management Organization (SRWMO) is required by law to submit an annual report to the Minnesota Board of Water and Soil Resources (BWSR), the state agency with oversight authorities. This report consists of an up-to-date listing of SRWMO Board members, activities related to implementing the SRWMO Watershed Management Plan, the status of municipal water plans, financial summaries, and other work results. The report is due annually 120 days after the end of the SRWMO's fiscal year (April 30th).

Purpose: To document required progress toward implementing the SRWMO Watershed Management Plan and to provide transparency of government operations.

Locations: Watershed-wide

Results: Anoka Conservation District (ACD) assisted the SRWMO with preparation of a 2007 Sunrise River WMO Annual Report. ACD provided copies of this report and a cover letter to the SRWMO Chair, Marie Holm, on March 13, 2008. This allowed one month for review and to request changes, though no such requests were made. The Chair submitted the report to BWSR.

Cover



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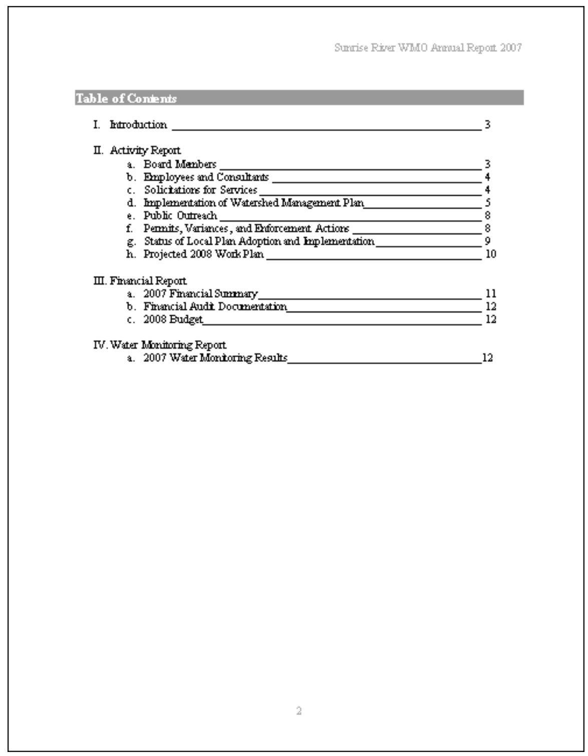
Sunrise River WMO Annual Report 2007

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2

SRWMO 3rd Generation Watershed Plan

Description: The Sunrise River Watershed Management Organization (SRWMO) is required by law to update its Watershed Management Plan generally every 10 years. This plan is analogous to a city's comprehensive plan. It sets the organization's goals, policies, and actions. It also estimates the financial impact of the activities. Updating the plan is typically a 12-18 month project when required review periods are included. The current plan expires December 31, 2009.

Purpose: To provide direction to the SRWMO for the next 10 years.

Locations: Watershed-wide

Results: In 2008 the SRWMO solicited bids to assist with the planning process and writing of the plan from seven organizations who have provided similar services to other Anoka County watershed organizations. The Anoka Conservation District was selected from four proposals received.

Beginning in October 2008 the Anoka Conservation District began the planning process with the SRWMO Board. Work accomplished in 2008 included:

- Evaluating the 2nd Generation Watershed Management Plan, this has been in effect for the last 9 years.
- Holding a public input meeting.
- Three work sessions with the SRWMO Board to set goals, policies, and action plans.
- Formation of a technical advisory committee (TAC) to assist the SRWMO Board. Participants include staff from member cities, state review agencies, and the Anoka Conservation District.
- Creation of a space on the SRWMO website where information about the planning process is being posted.

The planning process continues in 2009.

Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program, such as our lake water quality monitoring program. We do not, however, know specifically which expenses are attributed to monitoring which lakes. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer. The process also takes into account equipment that is purchased for monitoring in a specific area.

Sunrise River Watershed Financial Summary

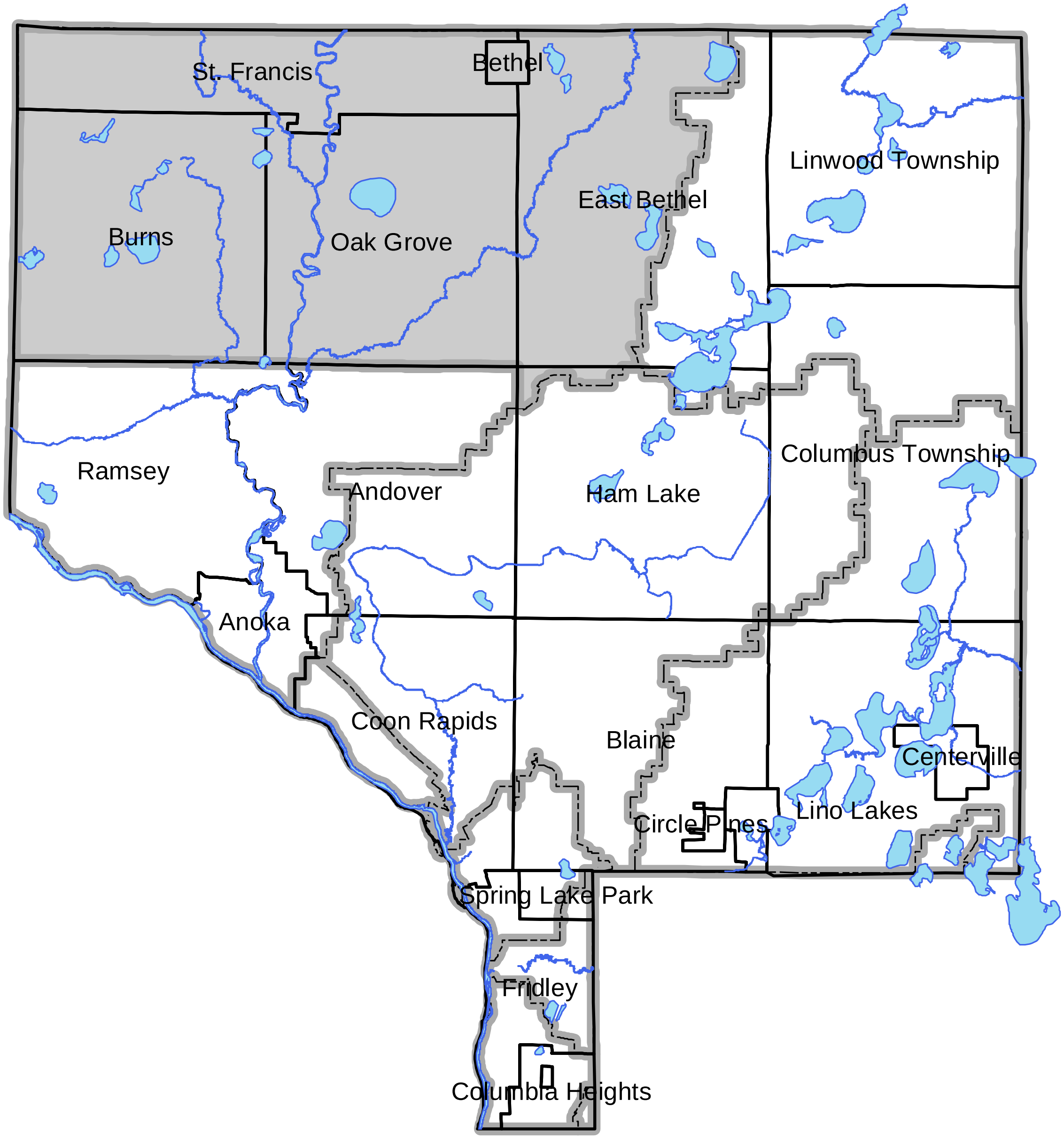
Sunrise River Watershed	Web site	Precipitation Monitoring	Wetland Hydrology	Lake Levels	Groundwater Observation Wells	Stream Hydrology	Lake Water Quality	Martin and Typo Lake TMDL	MLCCS Update	WMO Annual Report Preparation	Outdoor Guide	Sunrise River WMO Plan	Moos Lakeshore Restoration	Martin Lake Rough Fish Harvest	Total
Revenues															
SRWMO	180	0	1575	550	0	2100	1840	0	0	400	0	0	1091	500	8236
State	0	0	0	0	240	0	0	2350	0	70	0	0	0	0	2660
Anoka Conservation District	1218	309	0	1099	359	1292	0	1412	5863	0	811	9460	0	0	21824
County Ag Preserves	0	0	56	0	0	0	1393	0	1250	70	0	0	1091	0	3860
Other Service Fees	170	227	0	137	0	0	0	0	0	0	6	521	2379	0	3440
Local Water Planning	0	0	87	0	0	1030	495	0	0	70	0	0	0	0	1682
TOTAL	1568	536	1718	1786	599	4422	3728	3762	7113	610	817	9981	4561	500	41701
Expenses-															
Capital Outlay/Equip	19	7	283	29	8	49	28	28	152	0	1	211	0	0	813
Personnel Salaries/Benefits	1018	441	1132	1512	497	3524	2394	3014	6212	426	579	8705	0	0	29453
Overhead	76	42	114	119	46	309	205	329	435	100	121	614	0	0	2511
Employee Training	20	7	20	25	7	60	38	37	66	18	23	92	0	0	414
Vehicle/Mileage	25	17	50	45	21	142	111	184	172	17	22	247	0	0	1053
Rent	41	19	62	52	22	176	131	171	75	48	60	112	0	0	969
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0		0	0
Program Supplies	369	3	56	5	0	162	821	0	0	0	10	1	4561	500	6488
Equipment Maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1568	536	1718	1786	599	4422	3728	3762	7113	610	817	9981	4561	500	41701
NET	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Recommendations

- **Update the SRWMO Watershed Management Plan**, which expires at the end of 2009. Future work should follow that plan.
- **Promote and install more water quality improvement projects**. Problems on several waterbodies are well-documented and cost share grants are available as incentives.
- **Continue the cost share grant program** to encourage projects that improve water quality. The program should be a joint effort between the SRWMO and ACD.
- **Complete the Typo and Martin Lake Total Maximum Daily Load (TMDL) Study Report and Implementation Plan**. The report was submitted to the Minnesota Pollution Control Agency in early 2006, but has only recently been reviewed because of updates to shallow lakes standards. Since that time, new information has been collected which needs to be incorporated into the TMDL. Then, an Implementation Plan needs to be drafted. The ACD has secured funding from MPCA to do both.
- **Do projects to improve water quality in Typo and Martin Lakes**. The Total Maximum Daily Load (TMDL) study of these lakes (currently in review at the Minnesota Pollution Control Agency) and TMDL Implementation Plan (soon to be drafted) will contain specific recommendations. Local funding from the Sunrise River Watershed Management Organization and other local sources will be key to leveraging state funding for the improvements.
- **Work cooperatively with other agencies that are doing a study of the entire Sunrise River watershed.** Key partners include the US Army Corps of Engineers and Chisago County.
- **Map Fawn Lake curly-leaf pondweed infestations** in several years to determine if management actions are warranted.

- **Work cooperatively with the newly-formed Coon Lake Improvement District**. This organization's focus is Eurasian watermilfoil management, but is also interested in other water quality topics.
- **Support an aquatic vegetation survey and management plan for Linwood Lake**. The lake association is actively seeking this work. Vegetation management is a key aspect of the health of this lake.
- **Coordinate Coon Lake monitoring with the Coon Lake Improvement Association**, who has volunteers monitoring, to avoid duplication.

Upper Rum River Watershed



Contact Info: Upper Rum River Watershed Management Organization
www.AnokaNaturalResources.com/URRWMO
763-753-1920

Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 3:
UPPER RUM RIVER WATERSHED

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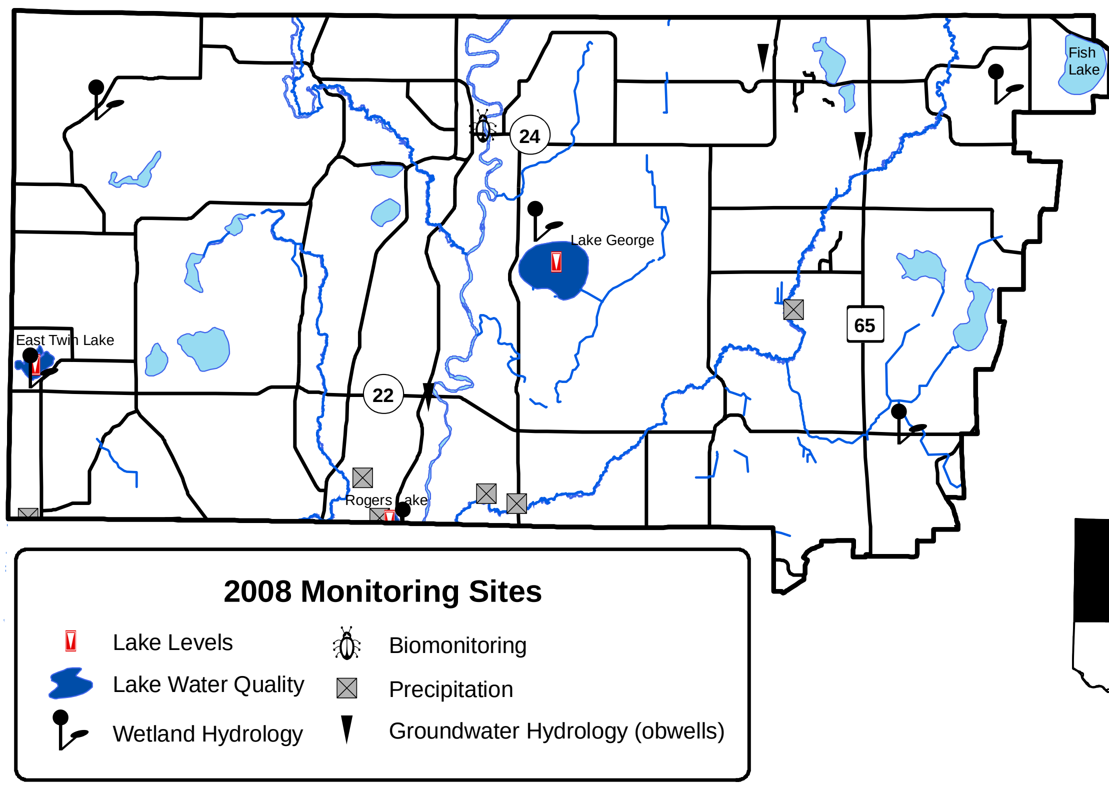
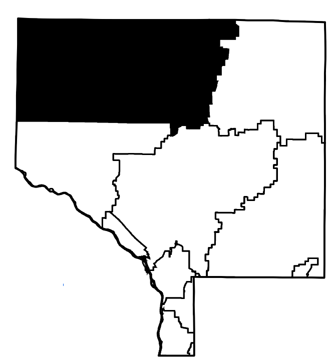
Precipitation	ACD, volunteers	See Chapter 1

ACAP = Anoka County Ag Preserves, ACD = Anoka Conservation District, MC = Metropolitan Council
MNDNR = Minnesota Dept. of Natural Resources, URRWMO = Upper Rum River Watershed Mgmt Org





Lake Levels

Description: Weekly water level monitoring in lakes. These data, as well as all additional historic data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

Locations: East Twin Lake, Lake George, Rogers Lake

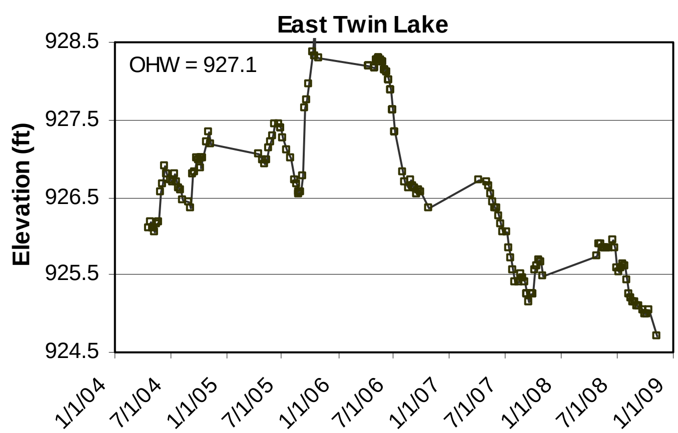
Results: Water levels on Lake George, Rogers, and East Twin Lakes were measured 14, 23, and 26 times, respectively, by volunteers. All three lakes declined throughout summer, as is typical.

East Twin Lake had lower water in 2007 and 2008 compared to the preceding six years (2001-06), when water was rising and high. Residents near the lake indicated that a beaver dam was the reason for the higher water, and that the beavers were removed in 2006. By the end of 2008 water was four feet lower than in highest recorded level in October 2005.

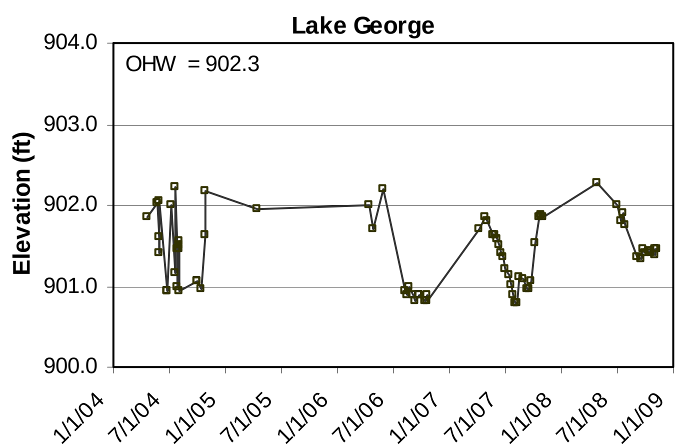
Lake George experienced low water levels in 2006 and 2007, but was somewhat higher in 2008. In 2007, when the mid-summer drought occurred, Lake George had the lowest water since the severe droughts of the late 1980's. In 2008 water levels were maintained about 1 foot higher than in 2006 or 2007. Management of the lake's only inlet, County Ditch #19, is of interest - residents have complained it is clogged and needs maintenance.

Ordinary High Water Levels (OHW), the elevation below which a DNR permit is needed to perform work, are listed for each lake on the graph below.

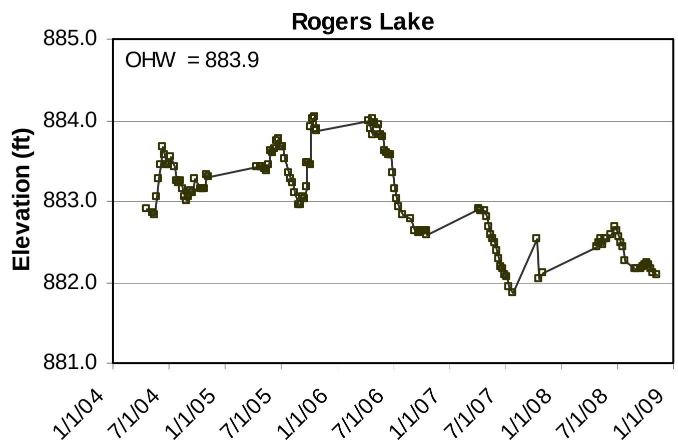
East Twin Lake Levels 2004-2008



Lake George Levels 2004-2008



Rogers Lake Levels 2004-2008



Upper Rum River Watershed Lake Levels Summary

Lake	Year	Average	Min	Max
East Twin	2004	926.67	926.05	927.33
	2005	926.67	926.05	927.33
	2006	927.61	926.37	928.29
	2007	925.79	925.15	926.71
	2008	925.45	924.70	925.94
George	2004	901.48	900.95	902.22
	2005	not available		
	2006	901.13	900.82	902.20
	2007	901.36	900.78	901.88
	2008	901.60	901.33	902.27
Rogers	2004	883.22	882.82	883.66
	2005	883.48	882.95	884.04
	2006	883.28	882.59	884.02
	2007	882.19	881.79	882.91
	2008	882.36	882.09	882.69

Lake Water Quality

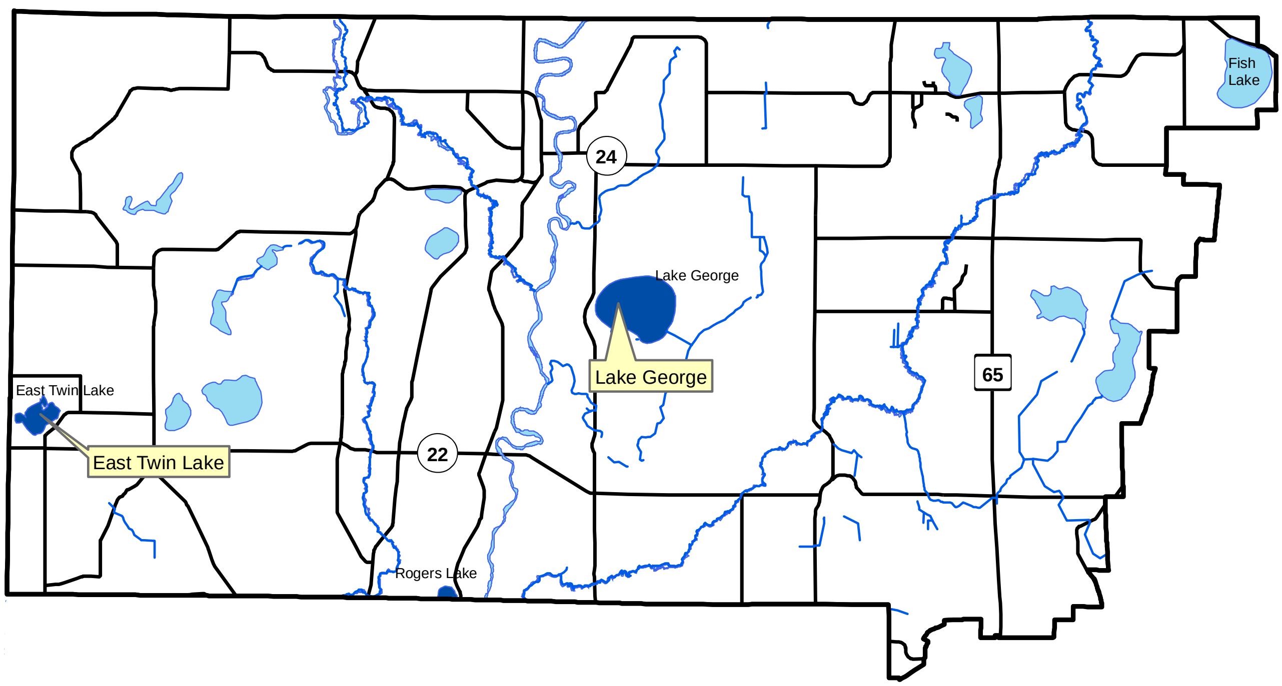
Description: May through September twice-monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, Secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

Purpose: To detect water quality trends and diagnose the cause of changes.

Locations: East Twin Lake,
Lake George

Results: Detailed data for each lake are provided on the following pages, including summaries of historical conditions and trend analysis. Previous years' data are available at www.AnokaNaturalResources.com. Refer to Chapter 1 for additional information on interpreting the data and on lake dynamics.

Upper Rum River Watershed Lake Water Quality Monitoring Sites



East Twin Lake

BURNS TOWNSHIP, LAKE ID # 02-0133

Background

East Twin Lake is located on Anoka County's western boarder in the City of Nowthen. The lake has a surface area of 116 acres with a maximum depth of 77 feet (20.1 m), making it Anoka County's deepest lake. Public access is from East Twin Lake City Park, where there is both a swimming beach and boat launch. The lakeshore is only moderately developed, with residences being mostly of low density and encompassing about half of the lake. The watershed is >75% undeveloped, with low-density residential areas. This lake is one of the clearest in the county. One exotic invasive plant is known to this lake, curly-leaf pondweed.

2008 Results

In 2008 East Twin Lake had excellent water quality for this region of the state (NCHF Ecoregion), receiving an overall A grade; the same as in 10 of the previous 11 years monitored. The lake is mesotrophic. Of particular notability is the 22 ft Secchi transparency on May 28, 2008 and 20 ft in spring 2002; these are the deepest at any Anoka County lake since at least 1996. Even later in summer, transparency was >10 ft. Throughout summer total phosphorus held relatively steady at <22 ug/L and chlorophyll-a was consistently at <6 mg/L. These are low and considered excellent. Subjective observation by ACD staff ranked physical and recreational conditions optimal.

Trend Analysis

Twelve years of water quality data have been collected by the Metropolitan Council (1980, '81,'83, '95, and '98), the Minnesota Pollution Control Agency (1989), and the Anoka Conservation District (1997, '99, 2000, 2002, 2005, and 2008). Water quality significantly improved from 1980 to 2008 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,9}$= 7.31, p=0.01). One-way ANOVAs revealed that reduction in chlorophyll-a is the most important factor in this trend, but total phosphorus reductions also occurred. Secchi transparency changes have been minimal. The improvements have been small and slow, and not likely noticed by most lake users. The most obvious differences are from the 1980's data and the post-1980's data.

Discussion

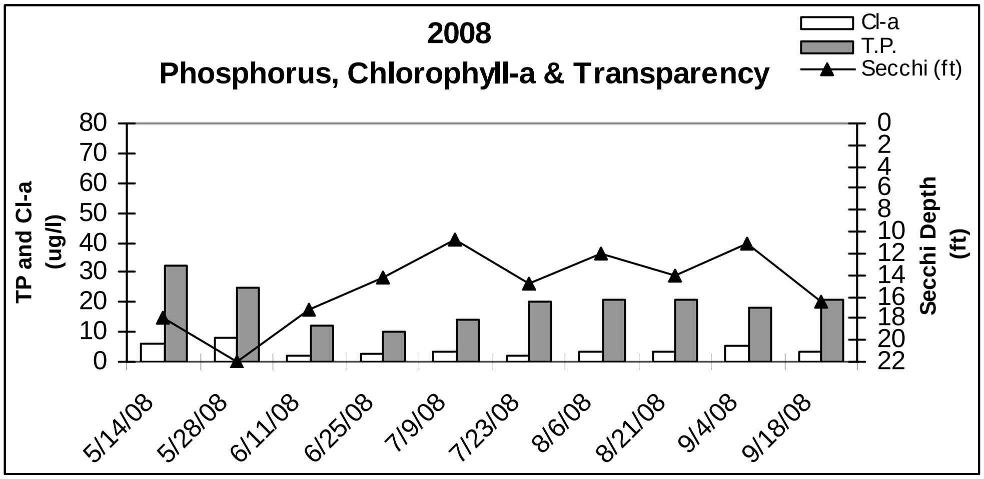
The ecology of this lake is different from that of many other Anoka County Lakes because it is deep. Sediment and dead algae can sink to the bottom and are essentially lost from the system because resuspension by wind, rough fish, and other forces is minimal. In shallower lakes, these nutrients circulate within the lake much more readily and the lake sediments can be a source of nutrients and turbidity that affect water quality. Additionally, East Twin Lake's direct watershed is small, so there is a small area from which polluted runoff might enter the lake. Aquatic vegetation is also healthy, but not so prolific as to be a nuisance, further contributing to high water quality. One exotic invasive plant is present in the lake, curly leaf pondweed, though its growth is moderate and restricted in extent due to lake depth.

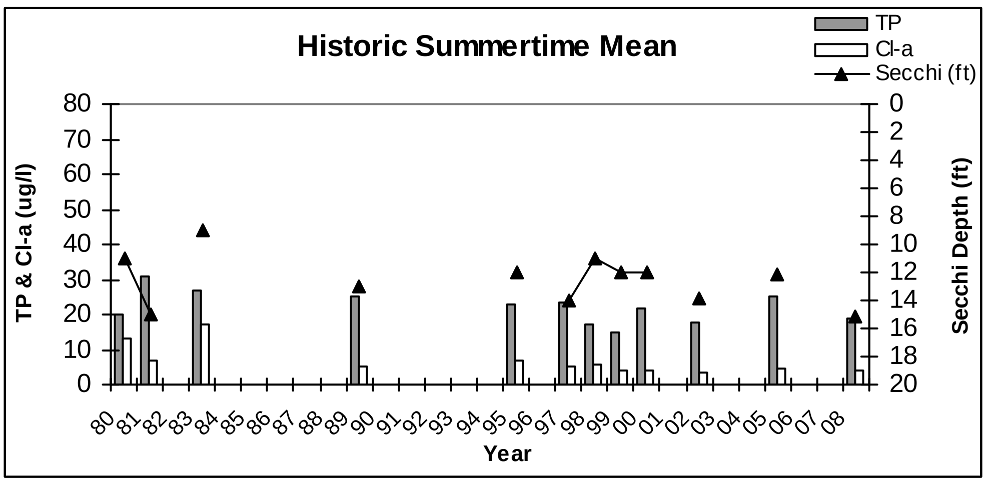
2008 East Twin Lake Water Quality Data

East Twin Lake 2008			5/14/2008	5/28/2008	6/11/2008	6/25/2008	7/9/2008	7/23/2008	8/6/2008	8/21/2008	9/4/2008	9/18/2008			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.29	8.24	7.85	8.55	8.06	7.88	7.74	7.81	7.40	7.66	7.95	7.40	8.55
Conductivity	mS/cm	0.01	0.201	0.198	0.187	0.179	0.189	0.191	0.189	0.201	0.198	0.198	0.193	0.179	0.201
Turbidity	FNRU	1	2.00	1.00	1.00	2.00	1	2	1.00	2.00	1.00	1.00	1	1	2
D.O.	mg/l	0.01	11.23	9.10	8.36	9.31	7.38	7.88	8.05	7.82	6.93	8.85	8.45	6.93	11.23
D.O.	%	1	108%	94%	91%	112%	90%	96%	99%	95%	79%	95%	96%	79%	112%
Temp.	°C	0.1	13.5	17.0	19.2	24.9	25.0	25.4	25.7	25.3	21.2	18.6	21.6	13.5	25.7
Temp.	°F	0.1	56.3	62.6	66.6	76.8	77.0	77.7	78.3	77.5	70.2	65.5	70.8	56.3	78.3
Salinity	%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl-a	mg/m^3	0.5	6.0	7.9	2	3.0	3.4	2.1	3.5	3.6	5.1	3.3	4.0	1.7	7.9
T.P.	mg/l	0.010	0.032	0.025	0.012	0.010	0.014	<0.02	0.021	0.021	0.018	0.021	0.019	0.010	0.032
T.P.	ug/l	10	32	25	12	10	14	<20	21	21	18	21	19	10	32
Secchi	ft	0.1	18.0	22.0	17.2	14.2	10.7	14.8	12.1	14.0	11.1	16.4	15.1	10.7	22.0
Secchi	m	0.1	5.49	6.71	5.24	4.33	3.26	4.51	3.69	4.27	3.38	5.00	4.6	3.3	6.7
Field Observations															
Physical			1	1	1	1	1	1	1	1	1	1	1	1	1
Recreational			1	1	1	1	1	1	1	1	1	1	1	1	1

*reporting limit

East Twin Lake Water Quality Results





East Twin Lake Summertime Annual Mean

Agency	MC	MC	MC	MPCA	MC	ACD	MC	ACD	ACD	ACD	ACD	ACD
Year	1980	1981	1983	1989	1995	1997	1998	1999	2000	2002	2005	2008
TP	20.0	31.0	27.0	25.0	23.0	23.5	17.0	14.8	21.6	17.7	25.0	19.0
Cl-a	13.0	7.0	17.0	5.0	7.1	5.1	5.6	4.1	4.2	3.2	4.3	4.0
Secchi (m)	3.3	4.7	2.7	4.1	3.5	4.2	3.4	3.6	3.7	4.3	3.7	4.6
Secchi (ft)	11.0	15.0	9.0	13.0	12.0	14.0	11.0	12.0	12.0	13.9	12.2	15.1

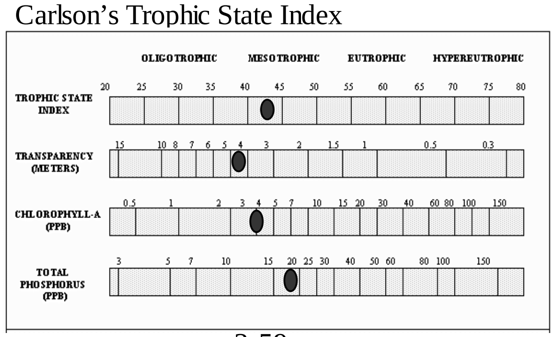
Carlson's Tropic State Indices

TSIP	47	54	52	51	49	50	45	43	48	45	51	47
TSIC	56	50	58	46	50	47	48	44	45	40	45	44
TSIS	43	38	46	40	42	39	42	42	41	40	41	38
TSI	49	47	52	46	47	45	45	43	45	42	46	43

East Twin Lake Water Quality Report Card

Year	80	81	83	89	95	97	98	99	2000	2002	2005	2008
TP	A	B	B	B	B	B	B	A	A	A	B	A
Cl-a	B	A	B	A	A	A	A	A	A	A	A	A
Secchi	A	A	B	A	A	A	A	A	A	A	A	A
Overall	**A**	**A**	**B**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**

Carlson's Trophic State Index



Lake George

CITY OF OAK GROVE, LAKE ID # 02-0091

Background

Lake George is located in north-central Anoka County. The lake has a surface area of 535 acres with a maximum depth of 32 feet (9.75 m). Public access is from Lake George County Park on the lake's north side, where there is both a swimming beach and boat launch. About 70% of the lake is circumscribed by homes; the remainder is county parkland. The watershed is mostly undeveloped or vacant, with some residential areas, particularly on the lakeshore and in the southern half of the watershed. Two invasive exotic aquatic plants are established in this lake, Curly-leaf pondweed and Eurasian Water Milfoil.

2008 Results

In 2008 Lake George had excellent water quality for this region of the state (NCHF Ecoregion), receiving an overall A grade. In monitoring since 1980 the lake has gotten ten A letter grades and three B's. The lake is mesotrophic. Transparencies of 13 to 17 feet were found in spring. Conditions only slightly deteriorated throughout summer, when algal growth and sediment disturbance by boat traffic are likely causes of transparency decreases. Still, transparency was >7 ft throughout summer. Subjective observations by ACD staff were typically that "some algae" was present and there were minimal water quality issues that would affect swimming or boating.

Trend Analysis

Thirteen years of water quality data have been collected by the Metropolitan Council (between 1980 and '94, and 1998) and the Anoka Conservation District (1997, 1999, 2000, 2002, 2005, and 2008). Water quality has not significantly changed from 1980 to 2008 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,10}$= 0.16, $p>0.05$).

Discussion

Lake George remains one of the clearest of Anoka County Lakes. Lake George and nearby East Twin Lake are especially valuable resources because of their condition, size, suitability for many types of recreation, and ample public access. Both will be under continued or increasing stresses from recreational usage and/or development. Continued efforts are needed to maintain the lakes' quality including monitoring, education, and lakeshore and nutrient best management practices. One example is residential lakeshore restorations which have occurred on several properties. Because of the number of shoreland homes, failing septic systems may be a threat to the lake and a cooperative effort with the Lake George Conservation Club to conduct a shoreland septic survey is advised.

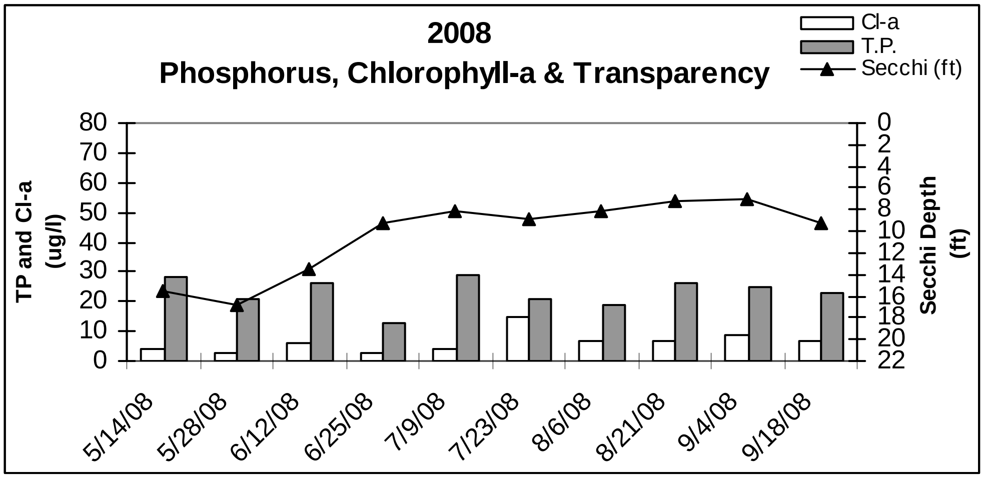
Two exotic invasive plants are present in Lake George. Curly leaf pondweed causes only a brief impairment in the spring but dies back by mid-June. Eurasian Water Milfoil is present, and in recent years has begun to affect recreation by matting to the surface in some localized areas. Control of Eurasian Water Milfoil has occurred in multiple years, orchestrated by the Lake George Conservation Club. In 2008 and 2009 there is a citizen-initiated effort underway to establish a Lake Improvement District which would tax lakeshore homeowners and have invasive species control as one of its primary purposes. Other aspects of the aquatic vegetation seem to be diverse and healthy, but not so prolific as to be a nuisance. In fact, a healthy native plant community may be serving to limit invasive species and certainly contributes to the lake's good water quality. Lakeshore homeowners should encourage native aquatic plants.

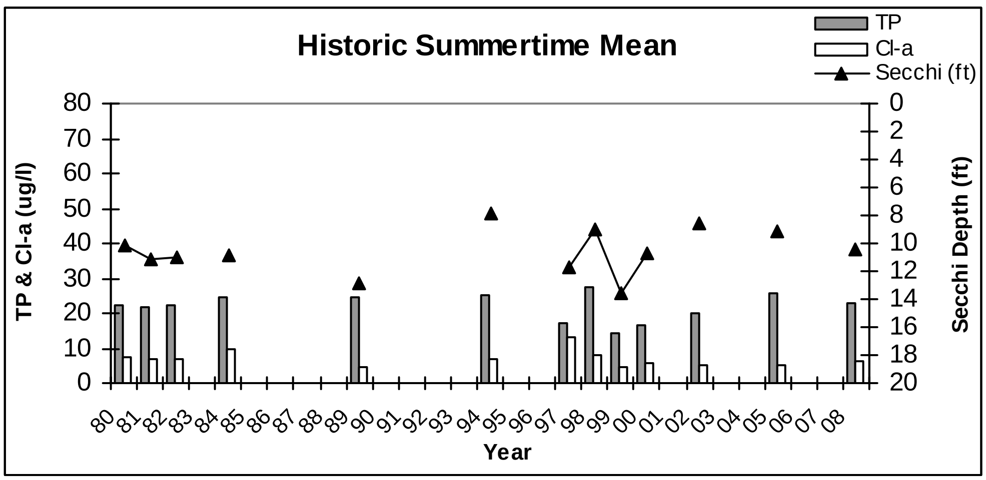
2008 Lake George Water Quality Data

Lake George 2008			5/14/2008	5/28/2008	6/12/2008	6/25/2008	7/9/2008	7/23/2008	8/6/2008	8/21/2008	9/4/2008	9/18/2008			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.15	8.32	7.93	8.73	8.72	8.73	8.52	8.52	7.86	8.27	8.38	7.86	8.73
Conductivity	mS/cm	0.01	0.195	0.191	0.178	0.174	0.179	0.176	0.173	0.181	0.180	0.180	0.181	0.173	0.195
Turbidity	FNRU	1	2.00	2.00	1.00	2.00	3.00	4.00	3.00	2.00	2.00	2.00	2	1	4
D.O.	mg/L	0.01	10.66	9.21	8.78	9.35	8.48	9.09	8.02	8.17	7.65	9.24	8.87	7.65	10.66
D.O.	%	1	100%	95%	94%	113%	102%	110%	98%	100%	87%	100%	100%	87%	113%
Temp.	°C	0.1	13.3	17.0	18.7	25.0	25.0	25.4	25.7	25.3	21.3	18.7	21.5	13.3	25.7
Temp.	°F	0.1	55.9	62.6	65.7	77.0	77.0	77.7	78.3	77.5	70.3	65.7	70.8	55.9	78.3
Salinity	%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl-a	mg/L	0.5	4.3	2.4	5.8	2.7	4.3	15	7.0	7.0	9.0	7.0	6.4	2.4	14.8
T.P.	mg/L	0.010	0.028	0.021	0.026	0.013	0.029	0.021	0.019	0.026	0.025	0.023	0.023	0.013	0.029
T.P.	ug/L	10	28	21	26	13	29	21	19	26	25	23	23	13	29
Secchi	ft	0.1	15.6	16.8	13.5	9.3	8.2	8.8	8.2	7.2	7.1	9.3	10.4	7.1	16.8
Secchi	m	0.03	4.75	5.12	4.11	2.83	2.50	2.68	2.50	2.19	2.16	2.83	3.2	2.2	5.1
Field Observations															
Physical			1.0	1.5	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	3.0
Recreational			1.0	1.5	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	3.0

*reporting limit

Lake George Water Quality Results





Lake George Summertime Annual Means

Agency	MC	MC	MC	MC	MC	MC	ACD	MC	ACD	ACD	ACD	ACD	ACD
Year	1980	1981	1982	1984	1989	1994	1997	1998	1999	2000	2002	2005	2008
TP	22.5	22.0	22.3	24.4	24.3	25.4	17.4	27.5	14.2	16.3	19.9	26.0	23.0
Cl-a	7.3	7.1	7.0	9.5	4.5	6.9	13.2	7.8	4.8	5.8	5.2	5.4	6.4
Secchi (m)	3.1	3.4	3.4	3.3	3.9	2.4	3.6	2.7	4.1	2.8	2.6	2.8	3.2
Secchi (ft)	10.2	11.2	11.0	10.8	12.9	7.8	11.7	9.0	13.5	10.7	8.6	9.1	10.4

Carlson's Tropic State Indices

TSIP	49	49	49	50	50	51	45	52	42	44	47	51	49
TSIC	50	50	50	53	45	50	56	51	46	48	47	46	49
TSIS	44	42	43	43	40	48	42	45	40	45	46	46	43
TSI	48	47	47	49	45	49	48	49	43	46	47	47	47

Lake George Water Quality Report Card

Year	80	81	82	84	89	94	97	98	99	2000	2002	2005	2008
TP	A	A	A	B	B	B	A	B	A	A	A	B	B+
Cl-a	A	A	A	A	A	A	B	A	A	A	A	A	A
Secchi	A	A	A	A	A	B	A	B	A	B	B	B	A
Overall	**A**	**A**	**A**	**A**	**A**	**B**	**A**	**B**	**A**	**A**	**A**	**B**	**A**

Stream Water Quality – Biological Monitoring

Description: This program combines environmental education and stream monitoring. Under the supervision of ACD staff, high school science classes collect aquatic macroinvertebrates from a stream, identify their catch to the family level, and use the resulting numbers to gauge water and habitat quality. These methods are based upon the knowledge that different families of macroinvertebrates have different water and habitat quality requirements. The families collectively known as EPT (Ephemeroptera, or mayflies; Plecoptera, or stoneflies; and Trichoptera, or caddisflies) are pollution intolerant. Other families can thrive in low quality water. Therefore, a census of stream macroinvertebrates yields information about stream health.

Purpose: To assess stream quality, both independently as well as by supplementing chemical data.
To provide an environmental education service to the community.

Locations: Rum River at Hwy 24, Rum River North County Park, St. Francis

Results: Results for each site are detailed on the following pages.

Tips for Data Interpretation

Consider all biological indices of water quality together rather than looking at each alone, as each gives only a partial picture of stream condition. Compare the numbers to county-wide averages. This gives some sense of what might be expected for streams in a similar landscape, but does not necessarily reflect what might be expected of a minimally impacted stream. Some key numbers to look for include:

Families — Number of invertebrate families. Higher values indicate better quality.

EPT — Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.

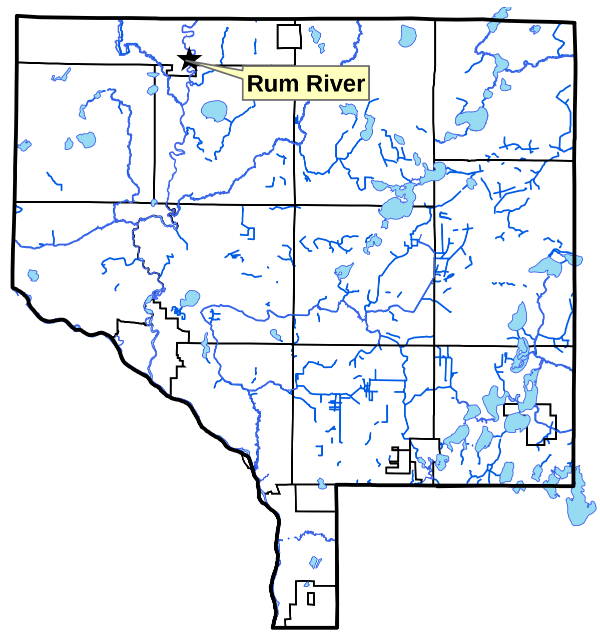
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

FBI	Stream Quality Evaluation
0.00-3.75	Excellent
3.76-4.25	Very Good
4.26-5.00	Good
5.01-5.75	Fair
5.76-6.50	Fairly Poor
6.51-7.25	Poor
7.26-10.00	Very Poor

% Dominant Family — High numbers indicates an uneven community, and likely poorer stream health.

RUM RIVER

at Hwy 24, Rum River North County Park, St. Francis



Last Monitored

By St. Francis High School in 2008

Monitored Since

2000

Student Involvement

168 students in 2008, approx 868 since 2000

Background

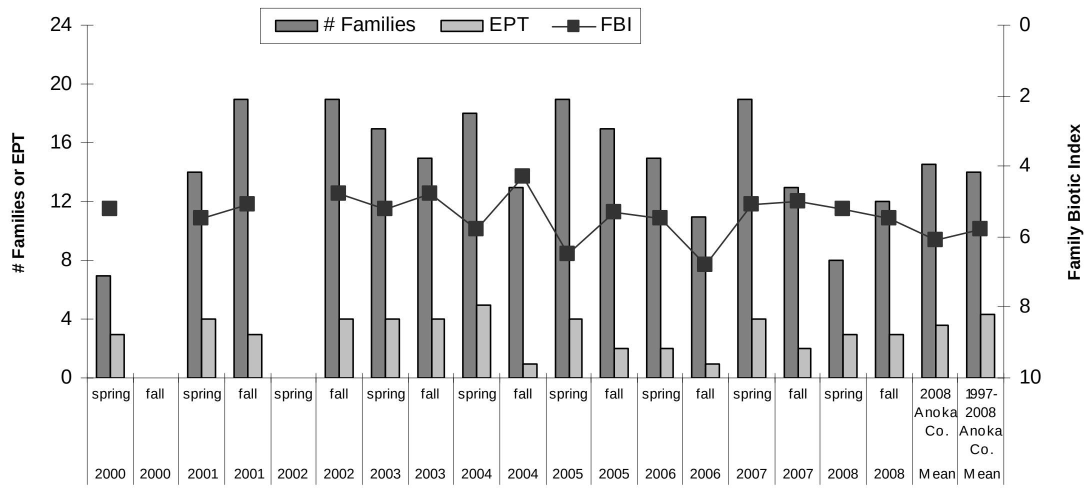
The Rum River originates from Lake Mille Lacs, and flows south through western Anoka County where it joins the Mississippi River in the City of Anoka. Other than the Mississippi, this is the largest river in the county. In Anoka County the river has both rocky ripples as well as pools and runs with sandy bottoms. The river's condition is generally regarded as excellent. Portions of the Rum in Anoka County have a state "scenic and recreational" designation.

The sampling site is in Rum River North County Park. This site is typical of the Rum in northern Anoka County, having a rocky bottom with numerous pool and ripple areas.

Results

St. Francis High School classes monitored the Rum River in both spring and fall 2008, with Anoka Conservation District oversight. Biological data for 2008, and historically, indicate the Rum River in northern Anoka County has the best conditions of all streams and rivers monitored throughout Anoka County. In 2008 the number of families and number of EPT families were substantially above the county averages. Thirty-five families were found in fall 2008; the next highest number of families ever found at 25 other Anoka County monitored streams is 24. One reason that so many families were found is that a large number of students (~112) helped with the sampling, finding 17 families that were in low abundance (< 5 individuals). The Family Biotic Index (FBI) in 2008 and other years was slightly lower than the average for Anoka County streams, due to high abundance of a few pollution-tolerant families; in 2008 corixidae accounted for 60% of all captures.

Summarized Biomonitoring Results for Rum River at Hwy 24, St. Francis (samplings by St. Francis High School and Crossroads Schools in 2002-2003 are averaged)



Biomonitoring Data for Rum River at Rum River North County Park, St. Francis

Year	2000	2000	2001	2001	2002	2002	2002	2003	2003	2003	2003
Season	spring	fall	spring	fall	spring	spring	fall	spring	spring	fall	fall
FBI	4.16	3.70	not sampled	6.30	3.80	2.90	4.80	4.10	3.20	3.70	3.60
# Families	18	5		29	10	20	25	18	16	12	26
EPT	14	4		12	7	10	9	11	10	6	11
Date	5/24	?		23-Oct	3-Jun	29-May	8-Oct	30-May	29-May	10-Oct	1-Oct
sampling by	ACD	Xroads		SFHS	Xroads	SFHS	SFHS	Xroads	SFHS	Xroads	SFHS
sampling method	MH	MH		MH	MH	MH	MH	MH	MH	MH	MH
# individuals	125	233		152.5	164	112	133	132	104	278	102
# replicates	1	1		2	1	2	2	1	2	1	2
Dominant Family	heptageniidae	hydropyschidae		corixidae	hydropyschidae	perlodidae	hydropsychidae	hydropyschidae	hydropsychidae	baetidae	oligoneuridae
% Dominant Family	22	81.5		21	64	36.6	19.9	41.6	48.3	61.2	30.9
% Ephemeroptera	46.4	1.7		18	6.1	11.2	20.3	11.4	11	78.1	51
% Trichoptera	20.8	87.6		9.2	70.1	29	20.3	42.4	54.1	13.3	13.7
% Plecoptera	7.2	9.4		3.9	15.2	45.1	13.2	12.9	31.1	0.4	9.8

Year	2004	2004	2005	2005	2006	2006	2007	2007	2008	2008	Mean	Mean
Season	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	2008 Anoka Co.	1997-2008 Anoka Co.
FBI	3.60	6.80	4.00	6.40	4.30	7.70	5.00	8.30	6.40	6.50	6.1	5.8
# Families	22	22	18	24	20	22	19	22	21	35	14.4	14.0
EPT	16	9	10	11	9	7	10	6	11	14	3.5	4.3
Date	19-May	29-Sep	25-May	29-Sep	25-May	2-Oct	16-May	11-Oct	27-May	30-Sep		
sampling by	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS		
sampling method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
# individuals	151	468	138	272	152	187	262	502	348	156		
# replicates	3	2	1	2	2	2	2	2	2	4		
Dominant Family	hydropsychidae	corixidae	perlodidae	gyrinidae	hydropsychidae	corixidae	hydropsychidae	corixidae	Corixidae	Corixidae		
% Dominant Family	40.5	38.2	29.7	22.4	35.3	66.3	42.7	58.8	57.5	61.4		
% Ephemeroptera	31.7	15.4	50	25	20.8	9.9	17.2	2	11.9	17.9		
% Trichoptera	48.9	1.5	11.6	5.9	35.3	4.8	44.3	1	5.9	6.9		
% Plecoptera	13.9	2.6	31.2	8.1	22.4	1.6	8	0.2	17.1	2.1		

Supplemental Stream Chemistry Readings

Parameter	5-29-03	5-19-03	9-29-04	9-29-05	5-25-06	10-2-06	5-16-07	10-11-07	5-27-08	9-30-08
pH	7.86	8.26	9.05	8.05	7.70	7.94	8.53	7.76	7.73	7.70
Conductivity (mS/cm)	0.274	0.163	0.168	0.194	0.265	0.351	0.278	0.242	0.284	0.341
Turbidity (NTU)	4	5	8	10	14	6	11	17	7	4
Dissolved Oxygen (mg/L)	na	na	9.13	8.86 (87%)	8.00 (86%)	10.87 (106%)	10.34 (106.4%)	9.66 (89%)	10.18 (101%)	7.83 (76%)
Salinity (%)	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01
Temperature (C)	17.8	16.0	14.4	14.0	18.3	14.7	16.8	12.3	15.3	13.4

Discussion

Both chemical and biological monitoring indicate the good quality of this river. Habitat is ideal for a variety of stream life, and includes a variety of substrates, plenty of woody snags, riffles, and pools. Habitat deteriorates somewhat downstream near Anoka where the river is slower and the bottom is heavily sediment laden. Water chemistry monitoring done at various locations on the Rum River throughout Anoka County found that water quality also declines in the downstream reaches, though was still good. One cause of downstream deterioration is probably higher-density development and more intense land use. Overall, the condition of the river is regarded as very good throughout Anoka County.

Water resource management should be focused upon protecting the Rum's quality. Some steps to protect the Rum River could include:

- Enforce the building and clear cutting setbacks from the river required by state scenic river laws to avoid bank erosion problems.
- Use the best available technologies to reduce pollutants delivered to the river and its tributaries through the storm sewer system. This should include all of the watershed, not just those adjacent to the river.
- Survey the river by boat for bank erosion problems and initiate projects to correct them.
- Education programs to encourage actions by residents that will benefit the river's health.
- Continue water quality monitoring programs.

Stream Water Quality – WOMP Program

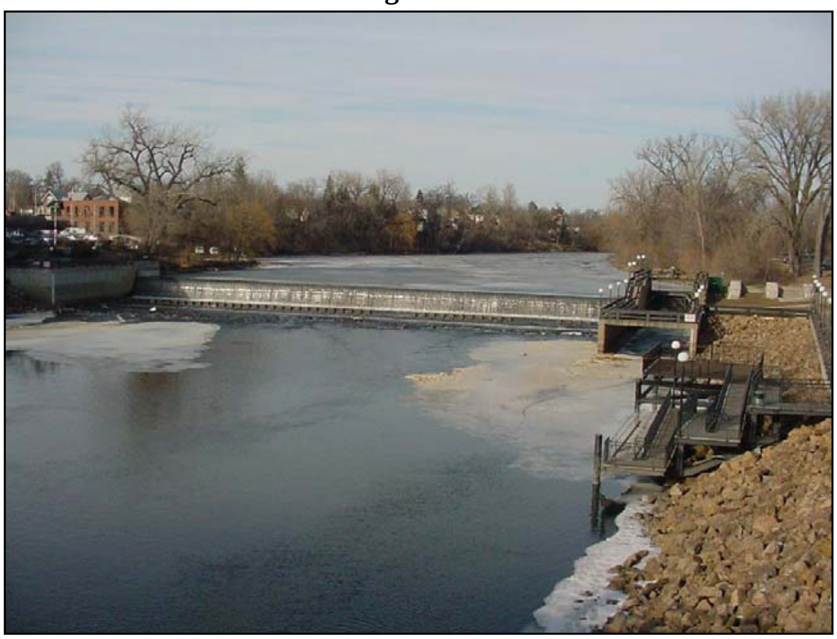
Description: The Watershed Outlet Monitoring Program (WOMP) is a Metropolitan Council stream and river monitoring program. In Anoka County, the program has an established monitoring station for the Rum River in Anoka, near its outlet to the Mississippi River. Water levels, flows, and 20+ water quality parameters are measured. Loading rates for important pollutants are estimated continuously and the Metropolitan Council provides in-depth analysis and reporting (not provided here). The Anoka Conservation District provides staffing for operations of the monitoring station.

Purpose: To understand water quality and hydrology throughout the twin cities metropolitan area.

Locations: Rum River at the Anoka Dam, City of Anoka

Results: Presented elsewhere by the Metropolitan Council. See http://www.metrocouncil.org/Environment/RiversLakes/

Rum River WOMP Monitoring Station



Wetland Hydrology

Description: Continuous groundwater level monitoring at a wetland boundary, to a depth of 40 inches. County-wide, the ACD maintains a network of 18 wetland hydrology monitoring stations.

Purpose: To provide understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

Locations: Alliant Tech Reference Wetland, Alliant TechSystems property, St. Francis

Cedar Creek, Cedar Creek Natural History Area, East Bethel

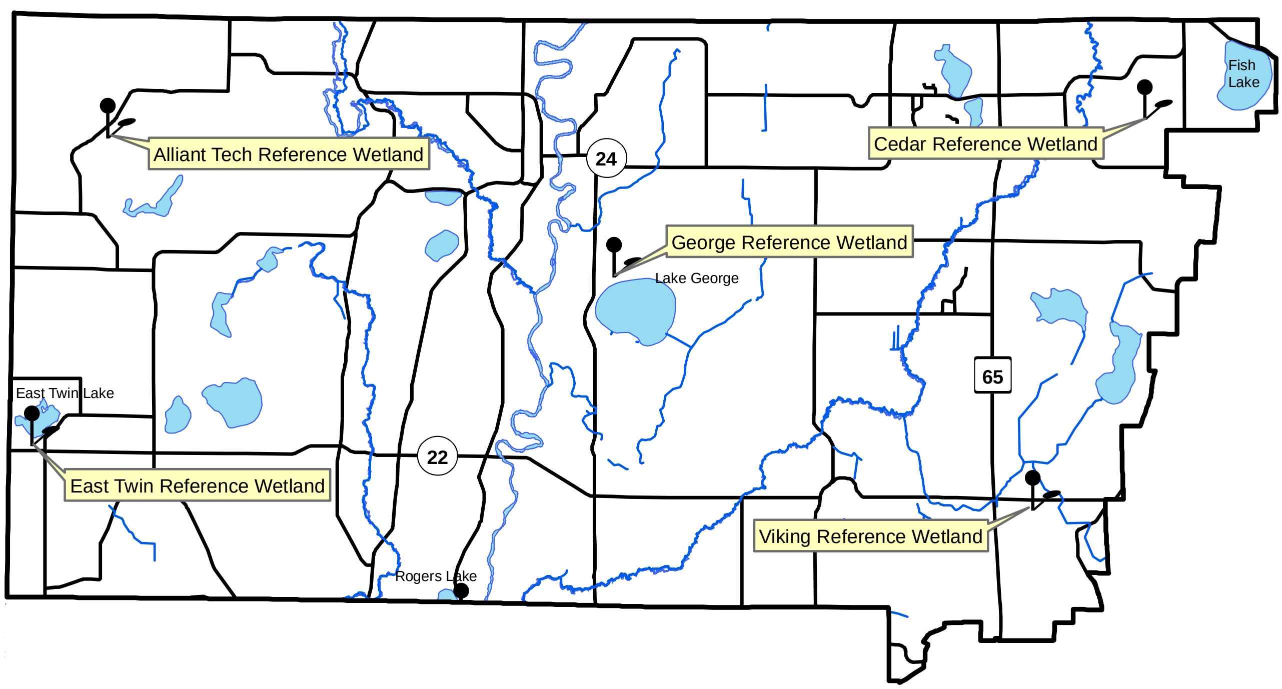
East Twin Reference Wetland, East Twin Township Park, Burns

Lake George Reference Wetland, Lake George County Park, Oak Grove

Viking Meadows Reference Wetland, Viking Meadows Golf Course, East Bethel

Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

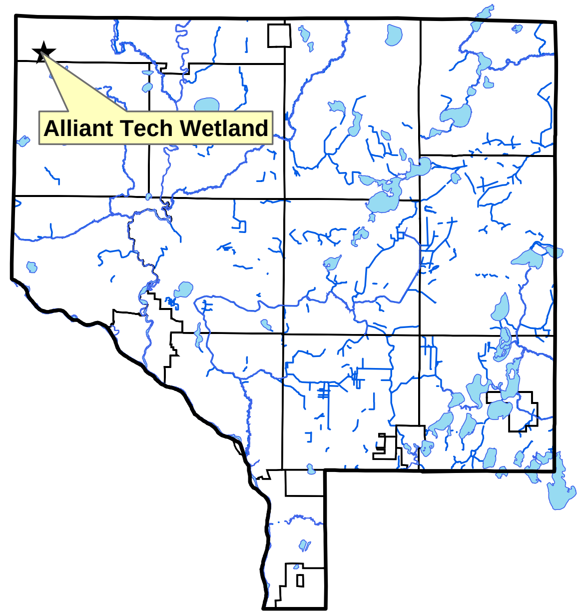
Upper Rum River Watershed Wetland Hydrology Monitoring Sites



ALLIANT TECH REFERENCE WETLAND

Alliant Techsystems Property, St. Francis

Site Information



Monitored Since: 2001

Wetland Type: 5

Wetland Size: ~12 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-8	N2/0	Mucky loam	-
Bg	8-35	5y5/1	Sandy loam	-

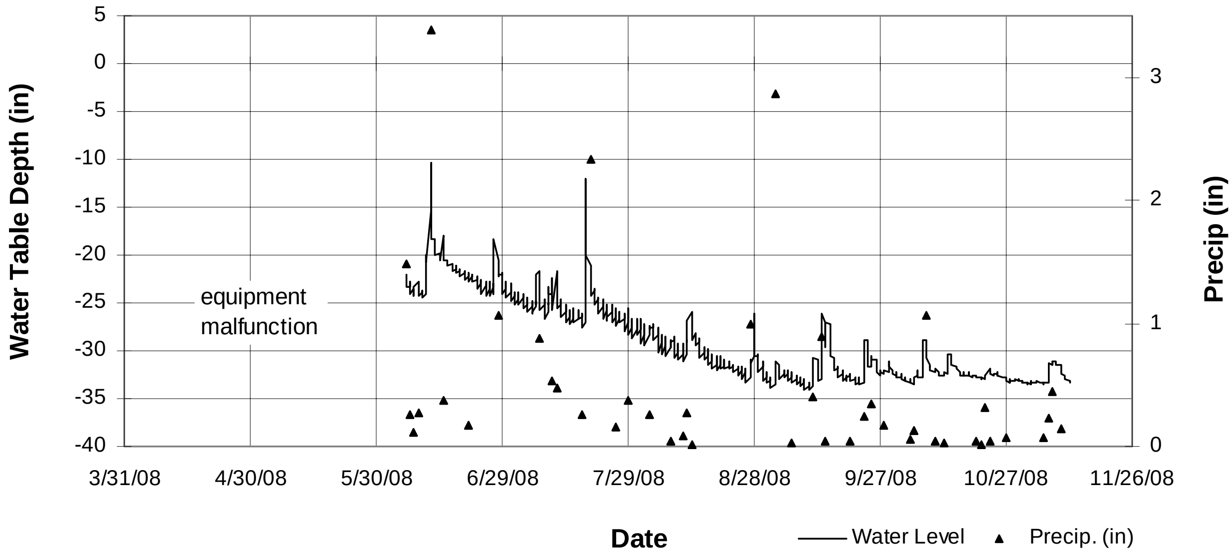
Surrounding Soils: Emmert

Vegetation at Well Location:

Scientific	Common	% Coverage
Carex Spp	Sedge undiff.	90
Lycopus americanus	American Bungleweed	20
Phalaris arundinacea	Reed Canary Grass	5

Other Notes: This wetland lies next to the highway, in a low area surrounded by hilly terrain. It holds water throughout the year, and has a beaver den.

2008 Hydrograph

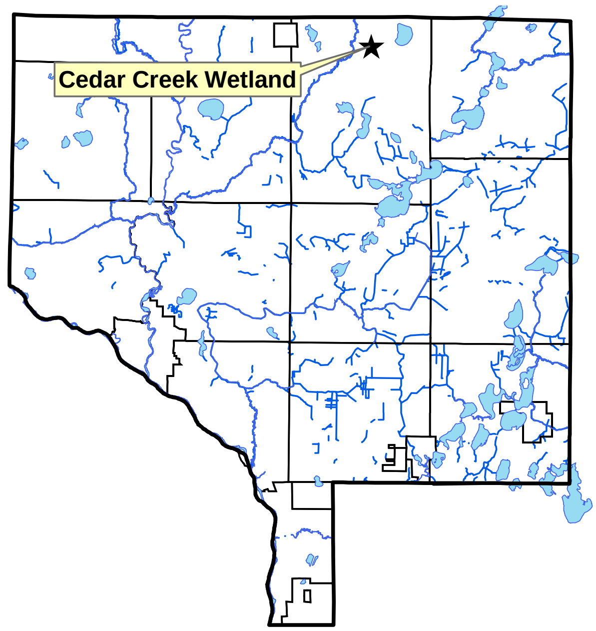


Well depths were 39 inches, so a reading of–39 indicates water levels were at an unknown depth greater than or equal to 39 inches.

Wetland Hydrology Monitoring

CEDAR CREEK REFERENCE WETLAND

Univ. of Minnesota Cedar Creek Natural History Area, East Bethel



Site Information

Monitored Since: 1996

Wetland Type: 6

Wetland Size: unknown, likely >150 acres

Isolated Basin? No

Connected to a Ditch? No

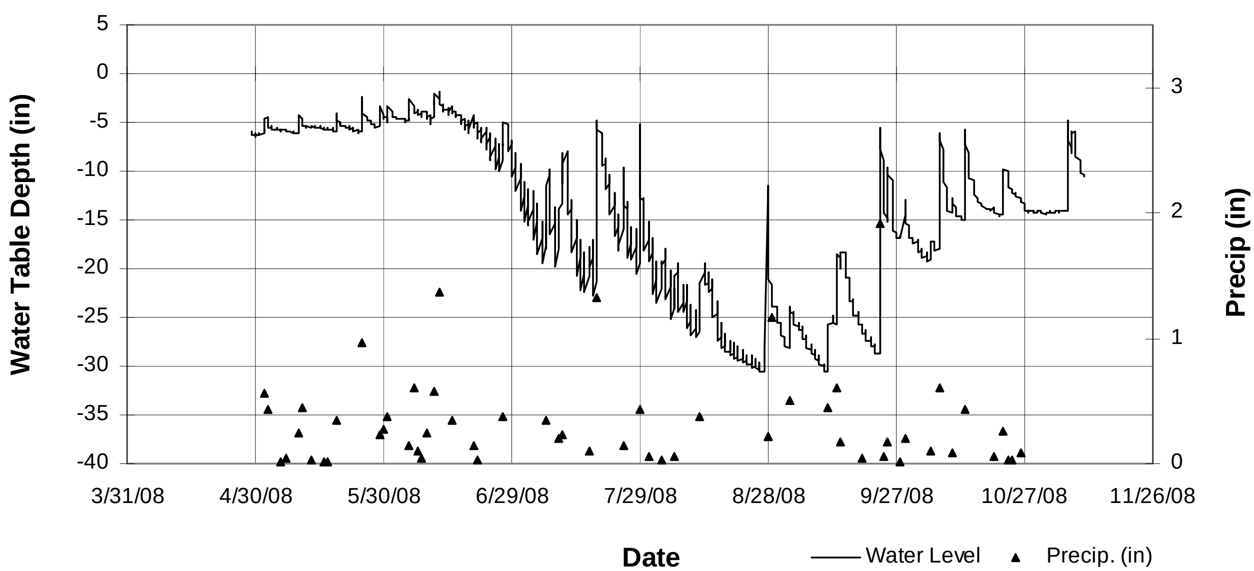
Soils at Well Location: not yet available

Surrounding Soils: Zimmerman

Vegetation at Well Location: not yet available

Other Notes: The Cedar Creek Natural History Area, where this wetland is located, is a University of Minnesota research area. Much of this area, including the area surrounding the monitoring site, is in a natural state. This wetland probably has some hydrologic connection to the floodplain of Cedar Creek, which is 0.7 miles from the monitoring site.

2008 Hydrograph



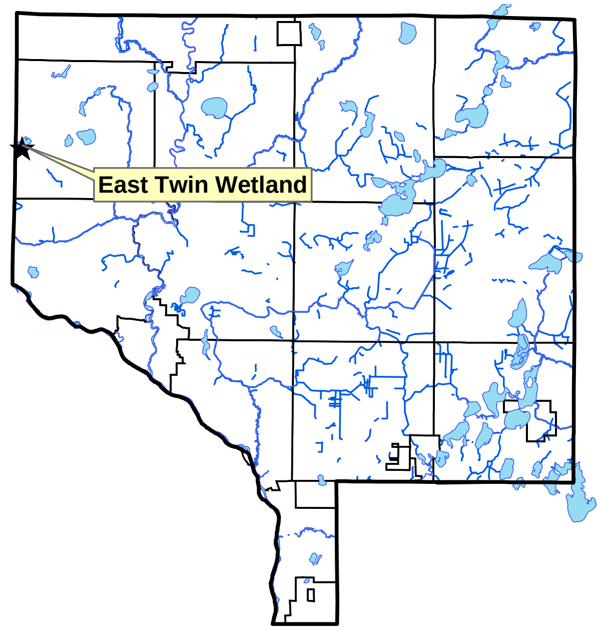
Well depths were 39 inches, so a reading of–39 indicates water levels were at an unknown depth greater than or equal to 39 inches.

Wetland Hydrology Monitoring

EAST TWIN REFERENCE WETLAND

East Twin Lake Township Park, Burns Township

Site Information



Monitored Since: 2001

Wetland Type: 5

Wetland Size: ~5.9 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-8	10yr 2/1	Mucky Loam	-
Oa	Aug-40	N2/0	Organic	-

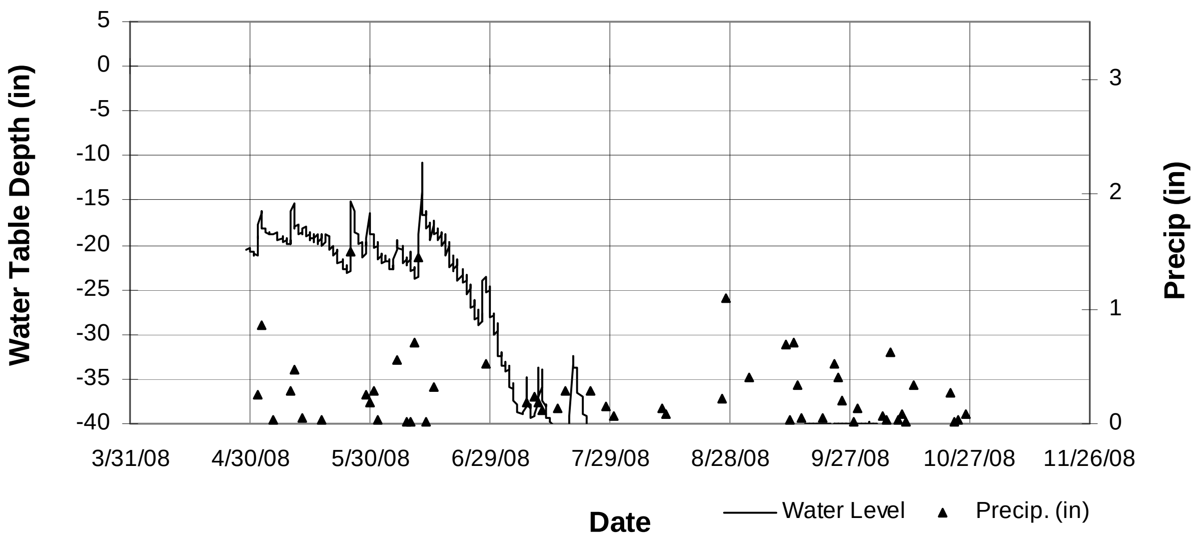
Surrounding Soils: Lake Beach, Growton and Heyder fine sandy loams

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Cornus amomum	Silky Dogwood	30
Fraxinus pennsylvanica	Green Ash	30

Other Notes: This wetland is located within East Twin Lake County Park, and is only 180 feet from the lake itself. Water levels in the wetland are influenced by lake levels.

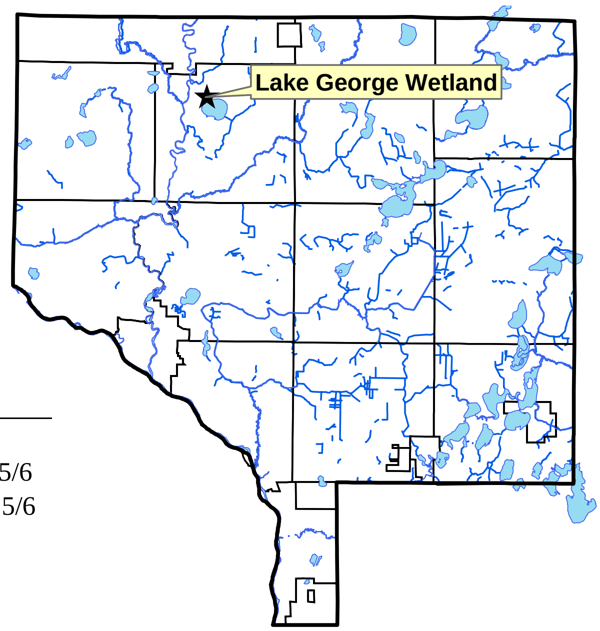
2008 Hydrograph



Well depths were 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

LAKE GEORGE REFERENCE WETLAND

Lake George County Park, Oak Grove



Site Information

Monitored Since: 1997

Wetland Type: 3/4

Wetland Size: ~9 acres

Isolated Basin? Yes, but only separated from wetland complexes by roadway.

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-8	10yr2/1	Sandy Loam	-
Bg	8-24	2.5y5/2	Sandy Loam	20% 10yr5/6
2Bg	24-35	10gy 6/1	Silty Clay Loam	10% 10yr 5/6

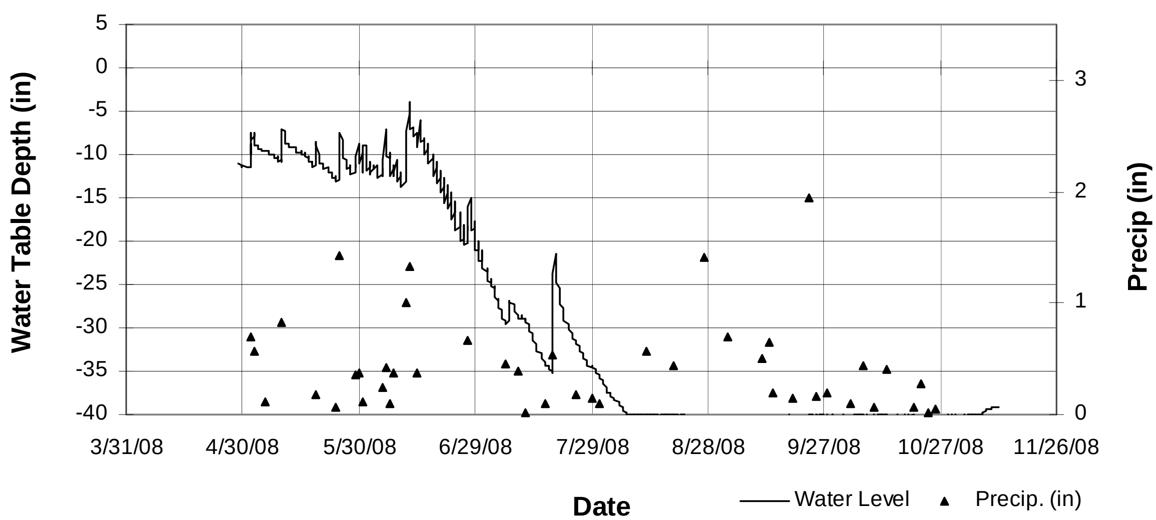
Surrounding Soils: Lino loamy fine sand and Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Cornus stolonifera	Red-osier Dogwood	90
Populus tremuloides	Quaking Aspen	40
Quercus rubra	Red Oak	30
Onoclea sensibilis	Sensitive Fern	20
Phalaris arundinacea	Reed Canary Grass	10

Other Notes: This wetland is located within Lake George County Park, and is only about 600 feet from the lake itself. Much of the vegetation within the wetland is cattails.

2008 Hydrograph

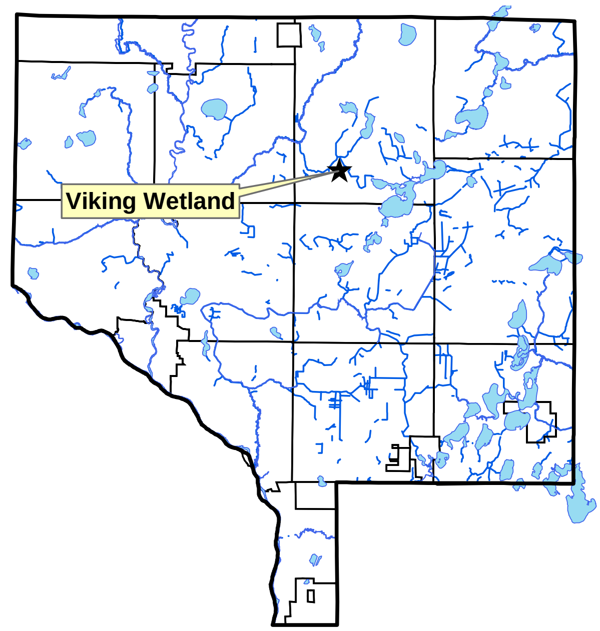


Well depths were 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

VIKING MEADOWS REFERENCE WETLAND

Viking Meadows Golf Course, East Bethel



Site Information

Monitored Since: 1999

Wetland Type: 2

Wetland Size: ~0.7 acres

Isolated Basin? No

Connected to a Ditch? Yes, highway ditch is tangent to wetland

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-12	10yr2/1	Sandy Loam	-
Ab	12-16	N2/0	Sandy Loam	-
Bg1	16-25	10yr4/1	Sandy Loam	-
Bg2	25-40	10yr4/2	Sandy Loam	5% 10yr5/6

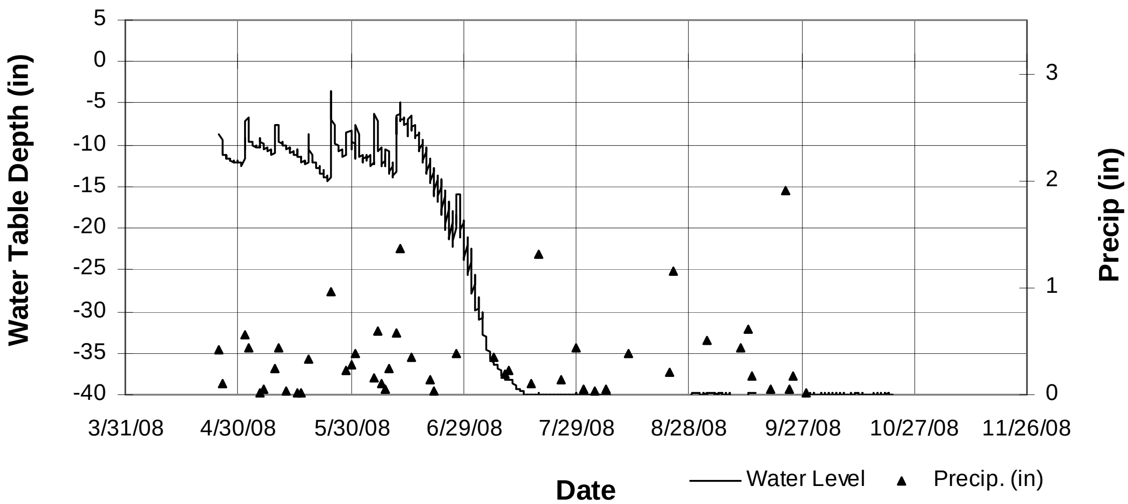
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Acer rubrum (T)	Red Maple	75
Acer negundo (T)	Boxelder	20

Other Notes: This wetland is located at the entrance to Viking Meadows Golf Course, and is adjacent to Viking Boulevard (Hwy 22).

2008 Hydrograph



Well depths were 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Water Quality Improvement Projects

Description: In 2006 the Upper River Watershed Management Organization (URRWMO) partnered with the Anoka Conservation District's Water Quality Cost Share Program. The URRWMO contributed $990 to be used as cost share grants for projects that improve water quality in lakes, streams, or rivers with the URRWMO area. Eligible projects included those that correct erosion, filter runoff to waterbodies, or restore native shoreline vegetation adjacent to a lake or stream. The funds may be used for up to 75% of the costs of materials and designing the project. Labor, aesthetic components of the project, and other costs, along with 25% of materials are the grant applicant's responsibility. The ACD's cost share grant policies apply and ACD administers the grant program.

The Anoka Conservation District (ACD) and Upper Rum River WMO have both undertaken efforts to promote these types of projects and the availability of cost share. Most recently, in 2007 the URRWMO did a customized mailing to 20 homeowners on East Twin and George Lakes who had been identified as having erosion problems or likely to develop problems. The ACD periodically does presentations to lake associations and other community groups, community newsletters, and website postings. In order to promote these types of projects the ACD also assists landowners throughout projects, including design, materials acquisition, installation, and maintenance.

Purpose: To improve water quality in area lakes, streams and rivers.

Locations: Throughout the watershed.

Results: No projects have utilized the cost share funds, so they will remain available in subsequent years. The availability of these funds is an important component of recent and upcoming efforts to promote water quality improvement practices.

Cost Share Fund Balance:

2006 URRWMO Contribution	+	$ 990
2006 Expenditures		$ 0
2007 URRWMO Contribution	+	$ 1,000
2007 Expenditures		$ 0
2008 Expenditures		$ 0
Fund Balance		**$ 1,990**

Homeowner Guide

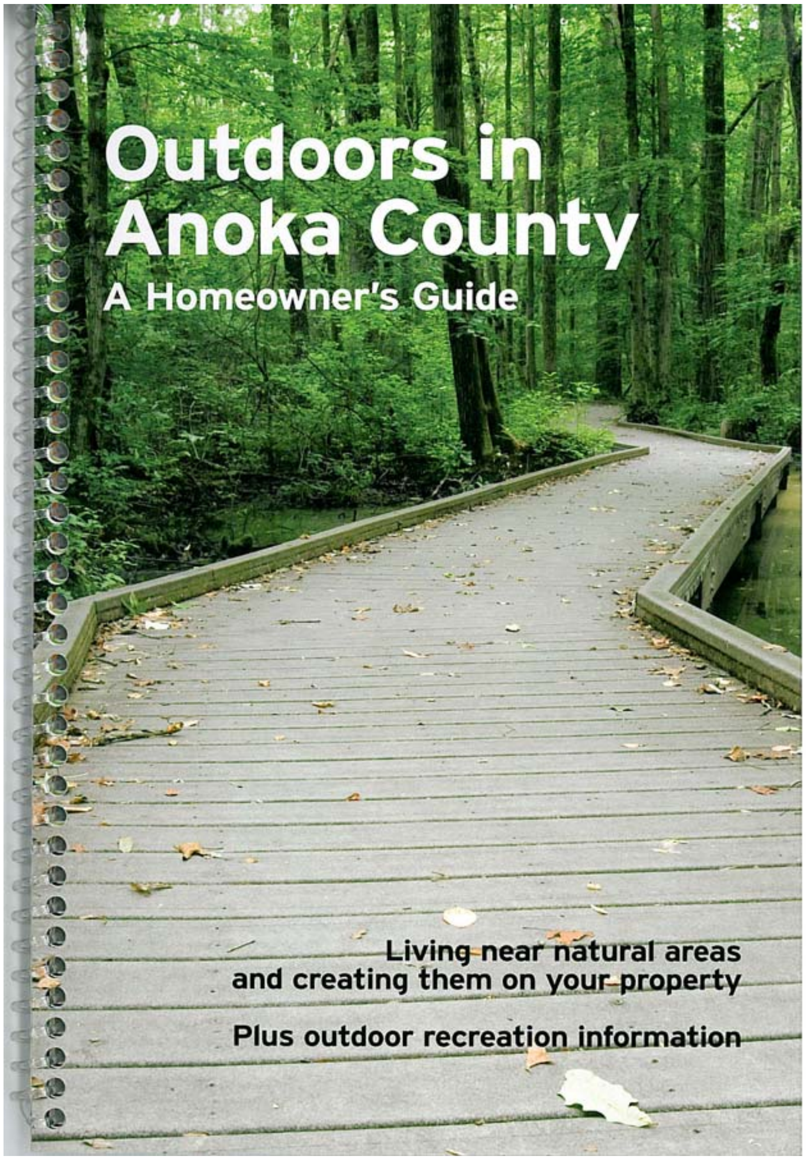
Description: The Anoka Conservation District (ACD) wrote, designed, and printed an educational booklet for homeowners. The booklet included information on topics of interest to the URRWMO, including landscaping for water quality, wetlands, well water, septic systems, and hazardous household wastes.

Purpose: To educate homeowners about topics that will impact local natural resources.

Locations: Throughout the watershed.

Results: "Outdoors in Anoka County – a homeowner's guide" was written, laid out by a graphic designer, and printed in 2007. The ACD distributed 1,212 booklets to homes near other important natural areas in the URRWMO area.

Homeowner's Guide Cover



URRWMO Website

Description: The Upper Rum River Watershed Management Organization (URRWMO) contracted the Anoka Conservation District (ACD) to design and maintain a website about the URRWMO and the Upper Rum River watershed. The website has been in operation since 2003.

Purpose: To increase awareness of the URRWMO and its programs. The website also provides tools and information that helps users better understand water resources issues in the area. The website serves as the URRWMO's alternative to a state-mandated newsletter.

Location: www.AnokaNaturalResources.com/URRWMO

Results: The URRWMO website contains information about both the URRWMO and about natural resources in the area.

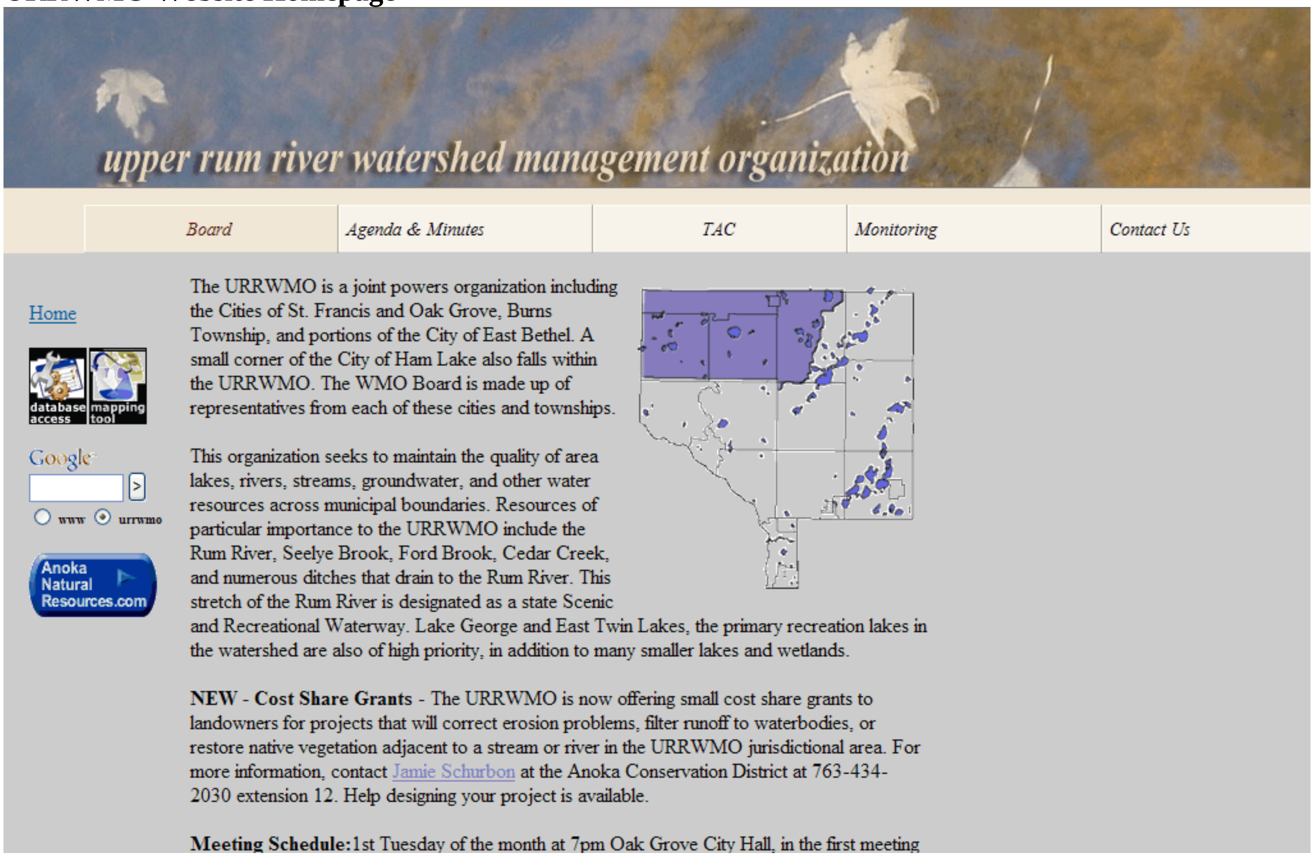
Information about the URRWMO includes:

- a directory of board members,
- meeting minutes and agendas,
- descriptions of work that the organization is directing,
- highlighted projects.

Other tools on the website include:

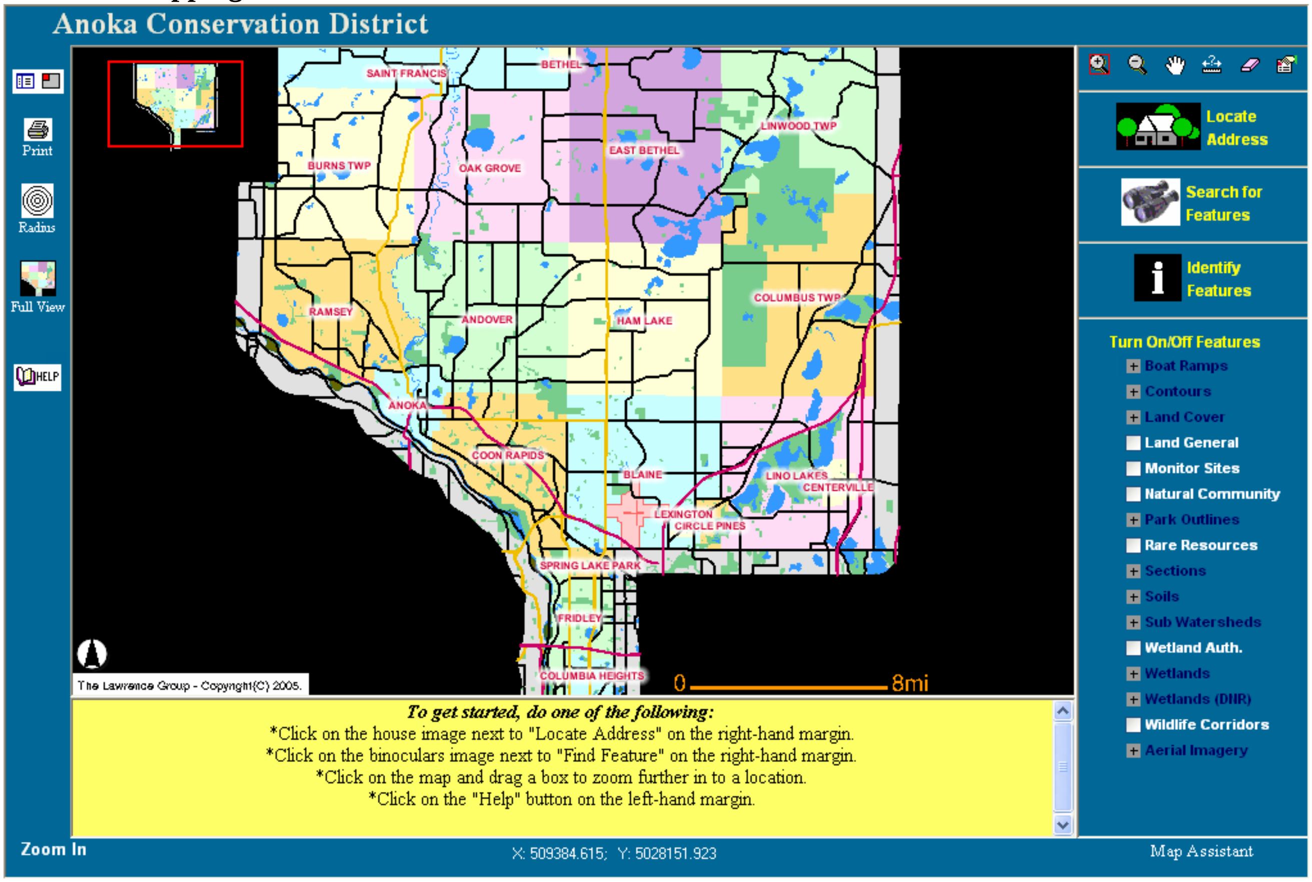
- an interactive mapping tool that shows natural features and aerial photos
- an interactive data download tool that allows users to access all water monitoring data that has been collected
- narrative discussions of what the monitoring data mean

URRWMO Website Homepage

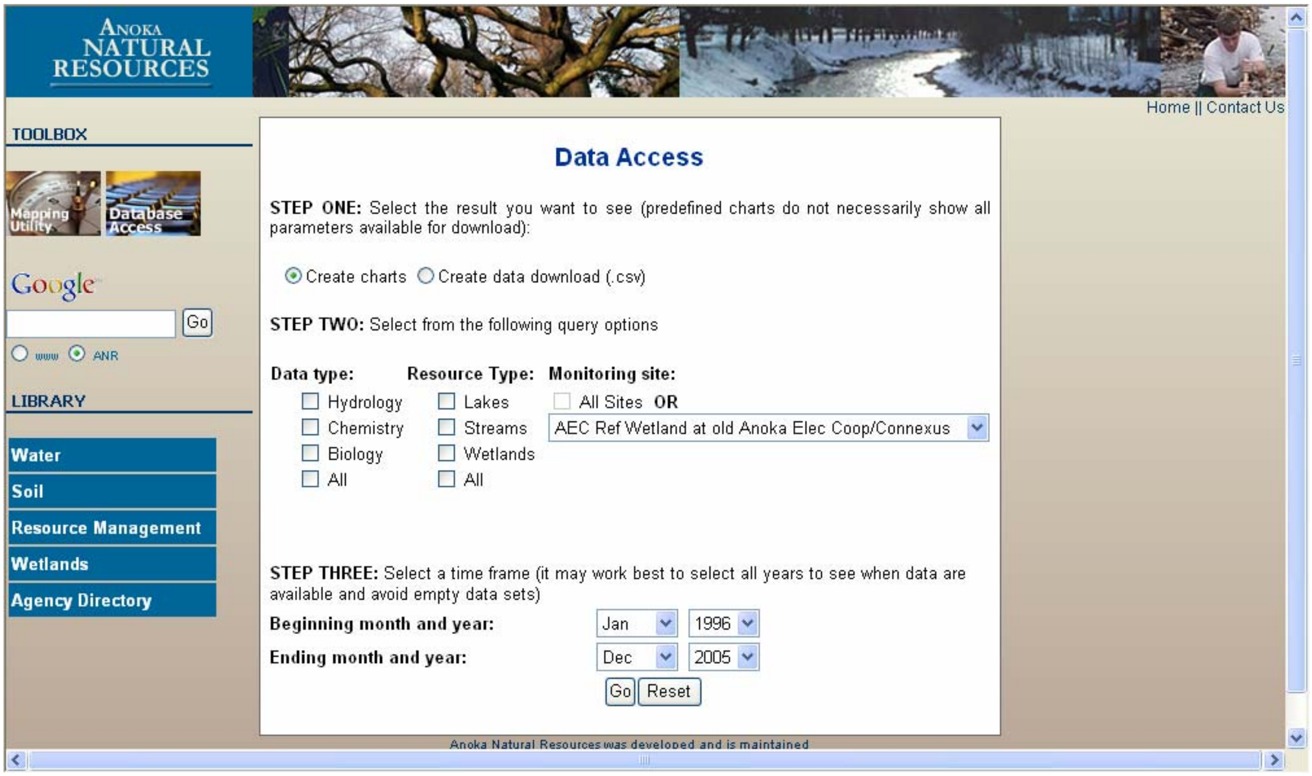


more on next page

Interactive Mapping Tool



Interactive Data Access Tool



Landcover Update

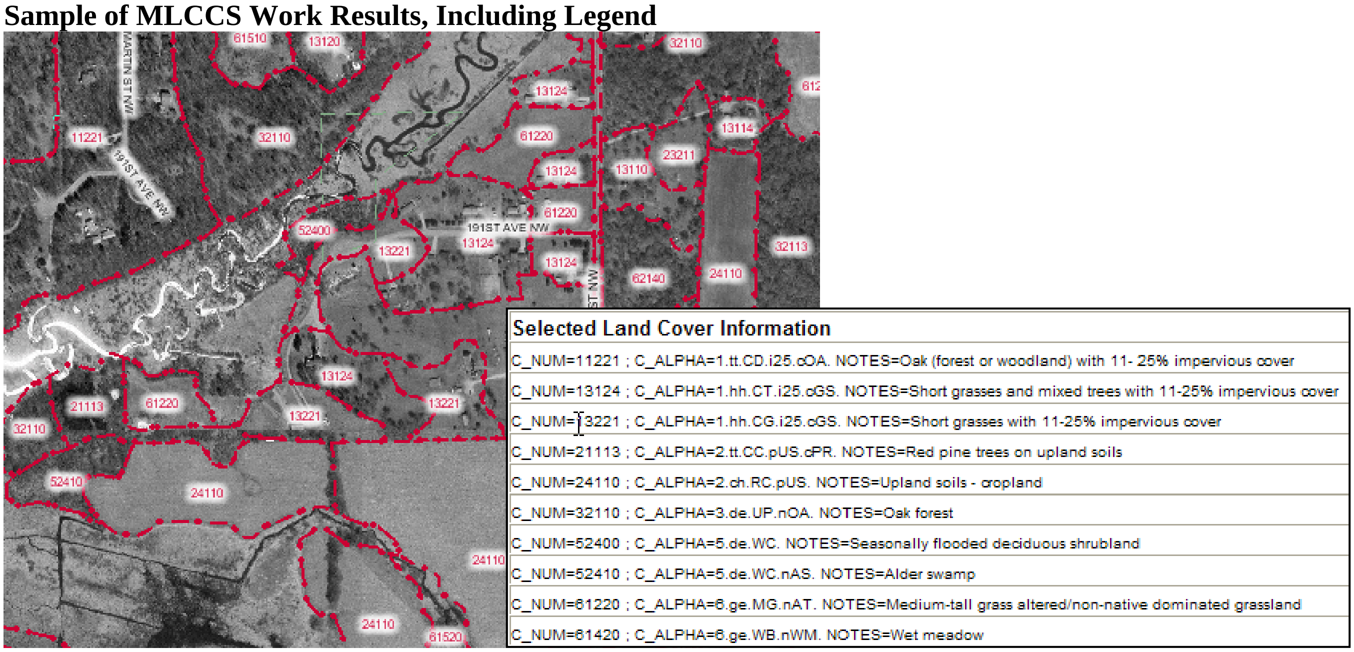
Description: The Minnesota Land Cover Classification System (MLCCS) is a Geographic Information System (GIS) map of land uses and land covers. It includes delineation and coding of any land use >2.5 acres (but often smaller), and follows Minnesota Department of Natural Resources methodologies. The maps are publicly-available tools for municipal and natural resource planners, and offer a high degree of detail.

Purpose: To update the MLCCS maps for a 21,000 acre area in north central Anoka County was done before current land mapping standards were implemented. This will result in a county-wide coverage consistent with current standards and methods. This provides municipal and natural resources planners with a detailed map of land uses including detailed accounts of natural communities found at any location.

Locations: North-central Anoka County.

Results: In 2008 MLCCS was updated for 21,000 acres in north-central Anoka County that were done in 1999 using less detailed methods. This work was accomplished using new aerial photos. Field verification is scheduled for 2009. The result is an updated county-wide coverage with a high degree of detail. A sample map is provided below.

Sample of MLCCS Work Results, Including Legend



URRWMO 2007 Annual Report to BWSR

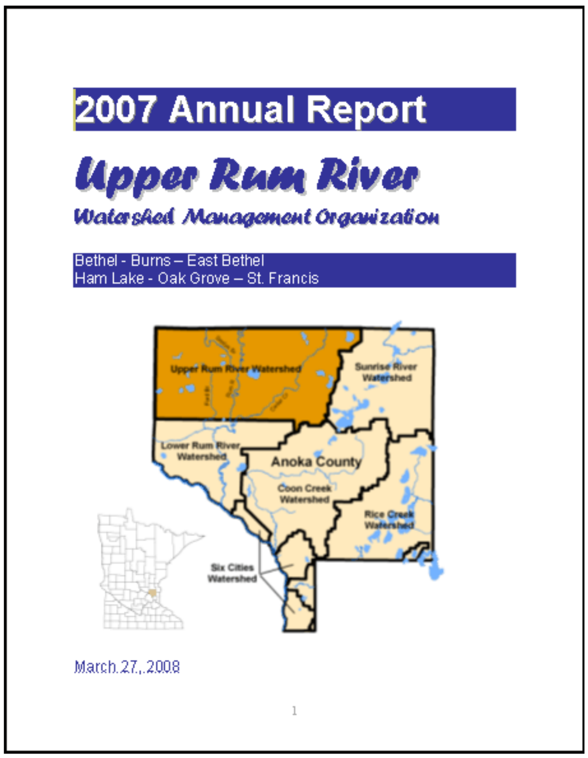
Description: The Upper Rum River Watershed Management Organization (URRWMO) is required by law to submit an annual report to the Minnesota Board of Water and Soil Resources (BWSR), the state agency with oversight authorities. This report consists of an up-to-date listing of URRWMO Board members, activities related to implementing the URRWMO Watershed Management Plan, the status of municipal water plans, financial summaries, and other work results. The report is due annually 120 days after the end of the URRWMO's fiscal year (April 30th).

Purpose: To document required progress toward implementing the URRWMO Watershed Management Plan and to provide transparency of government operations.

Locations: Watershed-wide

Results: The Anoka Conservation District assisted the URRWMO with preparation of a 2007 Upper Rum River WMO Annual Report. ACD provided copies of this report and a cover letter to the URRWMO Chair, Randy Bettinger, on March 26, 2008. This allowed one month for review and to request changes, though no such requests were made. The Chair submitted the report to BWSR.

Cover


2007 Annual Report

Upper Rum River

Watershed Management Organization

Bethel - Burns – East Bethel
Ham Lake - Oak Grove – St. Francis

March 27, 2008

1

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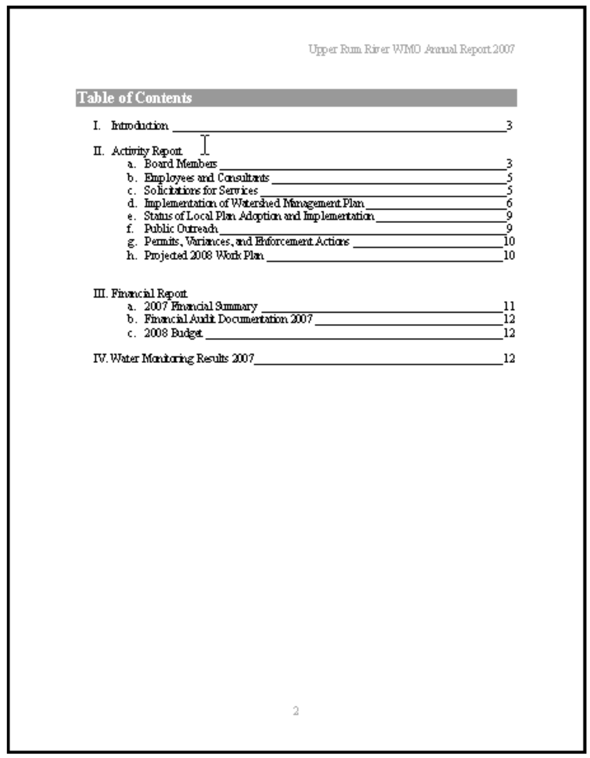
Upper Rum River WMO Annual Report 2007

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Review of Municipal Local Water Plans

Description: The URRWMO Watershed Management Plan specifies:
"The URRWMO shall review local water management plans and evaluate their consistency with the Watershed Plan. All local water management plans shall be consistent with the URRWMO Watershed Management Plan. Member communities shall have two years from the date of the Board of Water and Soil Resource's approval of this Plan to adopt their local water management plans."

The URRWMO wishes to have these reviews of local water management plans conducted by staff with technical expertise in water resources, and has selected the Anoka Conservation District (ACD) to provide this service. The ACD agreed to:

- review local water management plans, as they are completed, and provide a summary of their consistency with the URRWMO Plan to the URRWMO Board, and
- orally presenting review findings at a URRWMO meeting.

The URRWMO makes final decisions about which comments are submitted to the city.
This work is being completed in both 2008 and 2009, but all fees were paid in 2008.

Purpose: To provide consistency across the watershed that will ensure the URRWMO's goals for water resources are met.

Locations: Watershed-wide

Results: Draft local water management plans were received from the cities of Bethel and Nowthen. The ACD reviewed each for consistency with the URRWMO Watershed Management Plan, and presented findings to the URRWMO Board.

URRWMO Watershed Management Plan Amendments

Description: The URRWMO's Watershed Management Plan, approved in 2007, did not include several components, and completion of these components was specified in the work plan for 2008. The components that the URRWMO Board wished to complete included water quality standards, a water quality monitoring plan, stormwater infiltration standards, and wetland standards.

Purpose: To provide consistency across the watershed that will ensure the URRWMO's goals for water resources are met.

Locations: Watershed-wide

Results: The URRWMO contracted the Anoka Conservation District (ACD) to assemble a technical advisory committee (TAC) including representatives from member municipalities, state review agencies, and the Builder's Association of the Twin Cities. This TAC created recommended standards for each of the four selected topics. These recommendations were reviewed by the URRWMO Board. The ACD facilitated the formal 60 and 45-day review periods for these proposed watershed plan amendments. Several minor edits followed. The final draft amendments were approved by the MN Board of Water and Soil Resources on January 8, 2009 and adopted by the URRWMO Board on February 3, 2009.

The entire URRWMO Watershed Management Plan and amendments are available at www.AnokaNaturalResources.com/URRWMO.

Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program, such as our lake water quality monitoring program. We do not, however, know specifically which expenses are attributed to monitoring which lakes. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer. The process also takes into account equipment that is purchased for monitoring in a specific area.

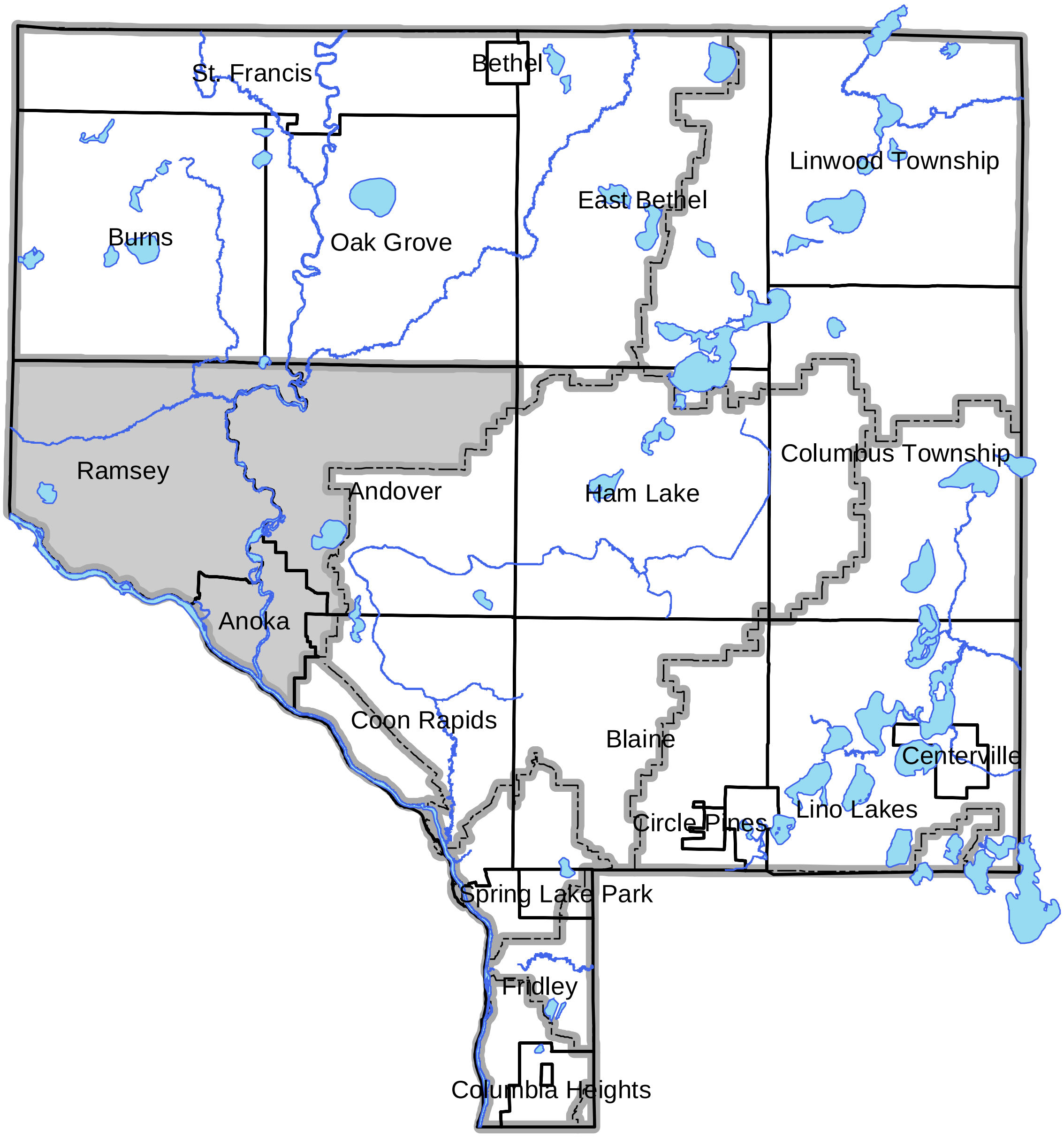
Upper Rum River Watershed Financial Summary

Upper Rum River Watershed	Web site	Precipitation Monitoring	Wetland Hydrology	Lake Levels	Groundwater Observation Wells	Lake Water Quality	Rum River WOMP	Student Biomonitoring	MLCCS Update	Upper Rum River Plan	Upper Rum River City Plan Reviews	WMO Annual Report Preparation	Outdoor Guide	Total
Revenues														
URRWMO	320	0	0	220	0	1840	0	0	0	10771	2400	400	0	15951
State	0	0	0	0	360	0	0	0	0	0	(20)	70	0	410
Anoka Conservation District	2471	386	0	439	539	0	560	287	5863	10362	0	0	1450	22358
County Ag Preserves	0	0	1116	0	0	1393	0	1189	1250	0	(20)	70	0	4998
Other Service Fees	344	283	0	55	0	0	800	0	0	0	(20)	0	11	1474
Local Water Planning	0	0	1747	0	0	495	0	0	0	0	(20)	70	0	2293
TOTAL	3136	670	2863	714	899	3728	1360	1476	7113	21132	2322	610	1461	47484
Expenses-														
Capital Outlay/Equip	37	9	471	12	11	28	12	24	152	95	34	0	2	888
Personnel Salaries/Benefits	2036	551	1887	605	745	2394	1082	1147	6212	17942	1959	426	1036	38022
Overhead	152	53	190	48	68	205	89	87	435	1827	161	100	217	3632
Employee Training	40	9	33	10	11	38	17	18	66	263	19	18	41	585
Vehicle/Mileage	50	21	84	18	31	111	51	30	172	351	88	17	40	1063
Rent	82	23	104	21	32	131	62	33	75	635	60	48	107	1415
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	738	3	94	2	0	821	46	137	0	18	0	0	18	1880
Equipment Maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3136	670	2863	714	899	3728	1360	1476	7113	21132	2322	610	1461	47484
NET	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Recommendations

- **The Upper Rum River WMO should assist member cities with drafting and adopting local water plans and ordinances** that are consistent with the recently-updated URRWMO Watershed Management Plan and amendments to the Plan.
- **Investigate the condition of Ditch 19, the only inlet to Lake George**. Residents have complained that condition of the ditch and water control structures are contributing to low lake water levels in recent years. Anoka County is the legal ditch authority.
- **Promote water quality improvement projects** for lakes, streams, and rivers. Cost share grants are available through the URRWMO and ACD to encourage landowners to do projects that will have public benefits to water quality. Technical assistance for landowners is available through the Anoka Conservation District.
- **Diagnose and correct low dissolved oxygen problems in Crooked Brook**. This stream is on the state list of impaired waters.
- **Diagnose and improve Rogers Lake water quality problems** through a joint effort of the LRRWMO and URRWMO. First, monitoring in 2009 is recommended to better understand this unstable lake (see lake water quality discussion in Lower Rum River Watershed chapter of this report). In following years diagnostic work or active management of the lake may be needed.
- **Monitor water quality of Lake George and East Twin Lake every three years** to track any trends or changes. Next monitoring should be in 2011.
- **Monitor the Rum River at the top and bottom of the URRWMO area** to detect any water quality issues.

Lower Rum River Watershed



Contact Info: Lower Rum River Watershed Management Organization
www.AnokaNaturalResources.com/LRRWMO
763-421-8999

Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 4:
LOWER RUM RIVER WATERSHED

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Lake Levels	LRRWMO, ACD, volunteers, MNDNR	4-82
Lake Water Quality	LRRWMO, ACD, ACAP	4-83
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Wetland Hydrology	LRRWMO, ACD, ACAP	4-90
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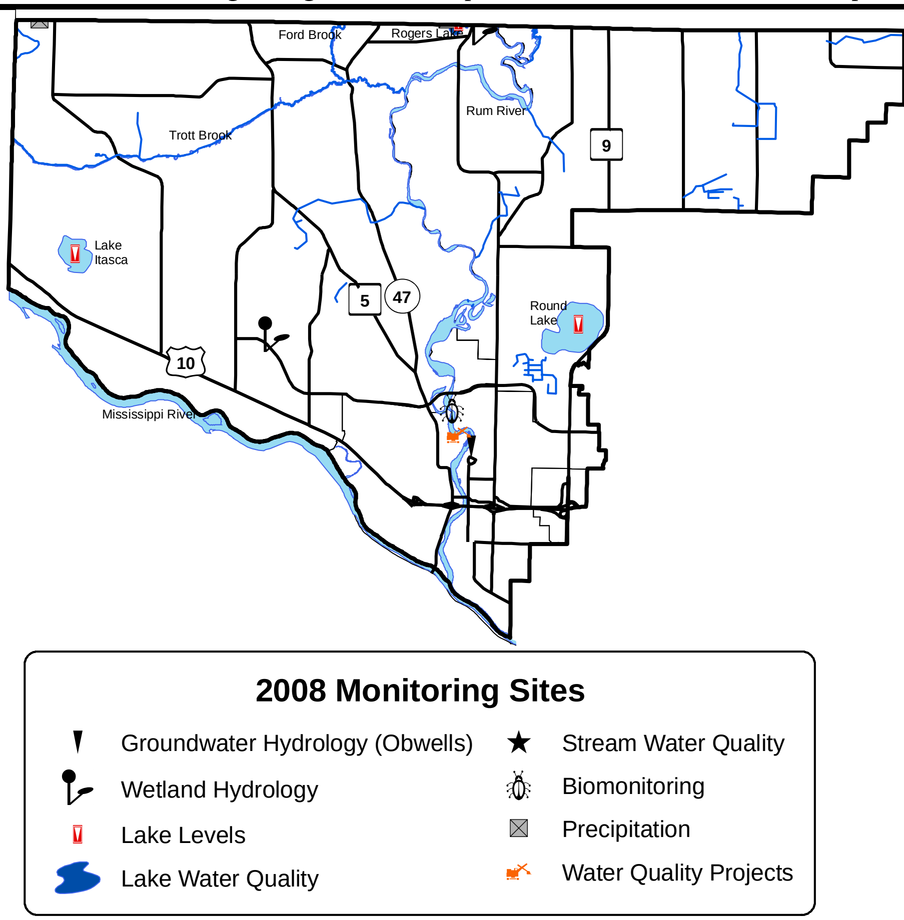
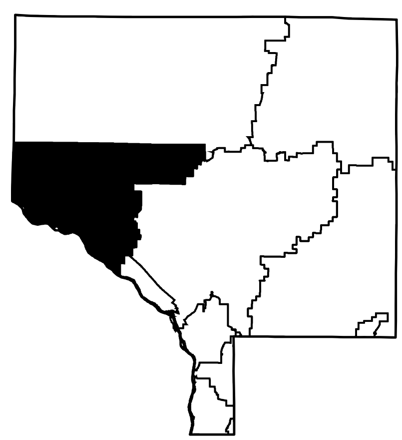
Groundwater Hydrology (obwells)	ACD, MNDNR	see Chapter 1
Precipitation	ACD, volunteers	see Chapter 1

ACAP = Anoka County Ag Preserves, ACD = Anoka Conservation District, LRRWMO = Lower Rum River Watershed Mgmt Org, MC = Metropolitan Council, MNDNR = MN Dept. of Natural Resources





Lake Level Monitoring

Description: Weekly water level monitoring in lakes. These data, as well as all additional historic data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

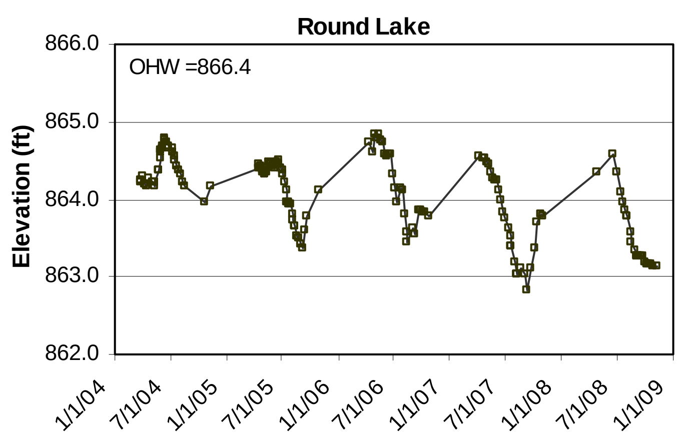
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

Locations: Lake Itasca, Round Lake, Rogers Lake

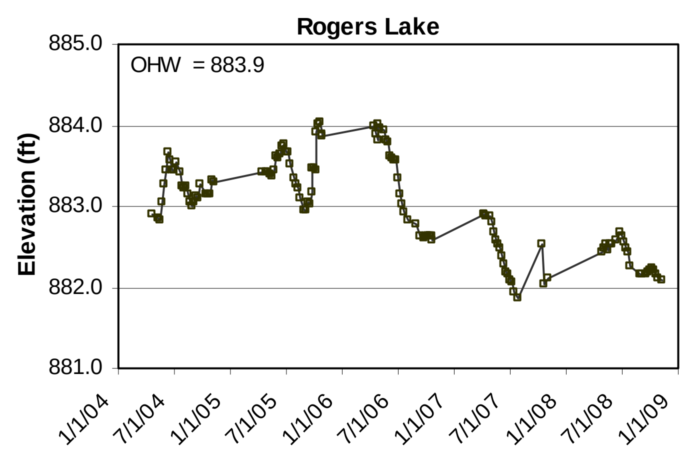
Results: Water levels were measured 22 to 53 times. At Lake Itasca volunteers stopped monitoring because emergent vegetation made it impossible for them to read the lake gauge from shore; an electronic gauge substitution was provided by the Anoka Conservation District. Water levels on all three lakes dropped the entire open water season. The total drop in water levels during the drought of summer 2007 was 1.05 feet at Rogers Lake, 1.74 feet at Round Lake, and >2.02 feet at Lake Itasca. By comparison, 2008 water level drops were 0.6, 1.45, and 1.55 feet, respectively.

Ordinary High Water Levels (OHW), the elevation below which a DNR permit is needed to perform work, are listed for each lake on the graph.

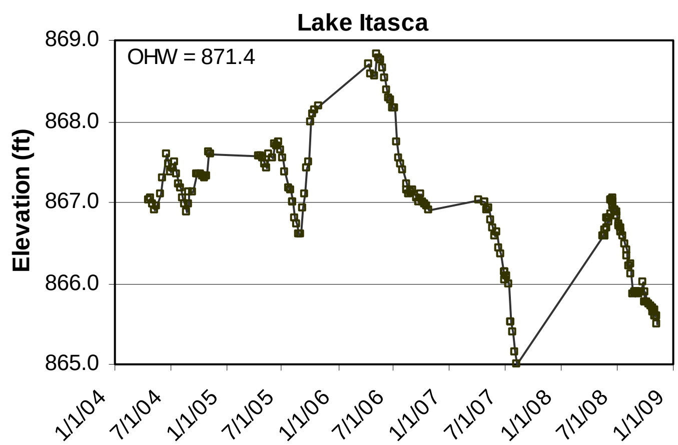
Round Lake Levels 2004-2008



Rogers Lake Levels 2004-2008



Lake Itasca Levels 2004-2008



Lower Rum River Watershed Lake Levels Summary

Lake	Year	Average	Min	Max
Itasca	2004	867.23	866.88	867.61
	2005	867.39	866.61	868.19
	2006	867.81	866.90	869.77
	2007	866.25	865.01	867.03
	2008	866.36	865.50	867.05
Rogers	2004	883.22	882.82	883.66
	2005	883.48	882.95	884.04
	2006	883.28	882.59	884.02
	2007	882.19	881.79	882.91
	2008	882.36	882.09	882.69
Round	2004	864.42	863.95	864.78
	2005	864.14	863.37	864.51
	2006	864.21	863.44	864.85
	2007	864.21	863.44	864.85
	2008	863.56	863.13	864.58

Lake Water Quality

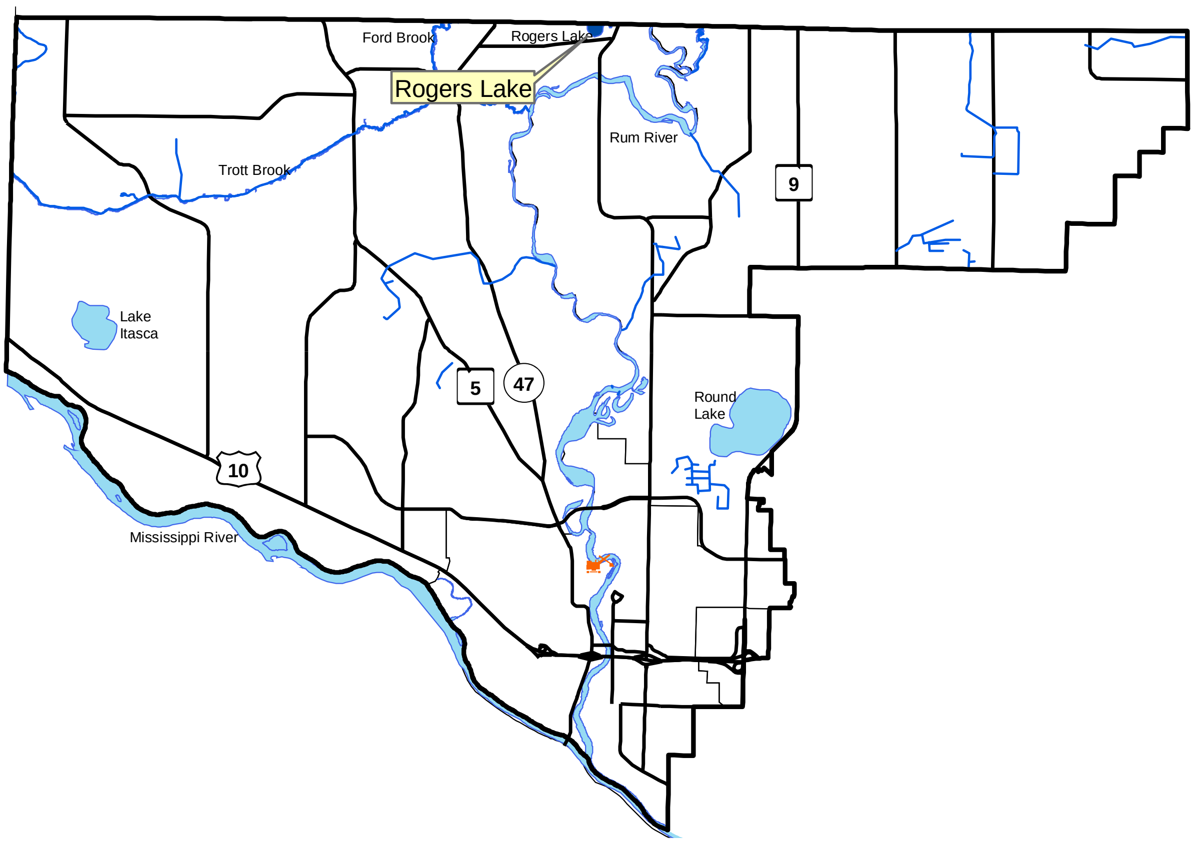
Description: May through September twice-monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, Secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

Purpose: To detect water quality trends and diagnose the cause of changes.

Locations: Rogers Lake

Results: Detailed data for each lake are provided on the following pages, including summaries of historical conditions and trend analysis. Previous years' data are available from the ACD. Refer to Chapter 1 for additional information on interpreting the data and on lake dynamics.

Lower Rum River Watershed Lake Water Quality Monitoring Sites



Rogers Lake

Cities of Oak Grove, Ramsey, and Nowthen, LAKE ID # 03-0104

Background

Rogers Lake is in west-central Anoka County, and lies partially within the jurisdictional areas of both the Lower and Upper Rum River Watershed Management Organizations. It has a surface area of 40 acres and a maximum depth of 6 feet. The shoreline is about 1/3 developed, primarily on the western shore. There are no streams of any consequence entering or leaving this lake; it is an isolated basin with a small watershed. There is no public access. Rogers Lake is designated as “impaired” for excess nutrients by the MPCA.

2008 Results

In 2008 Rogers Lake received an overall B letter grade for water quality, but this does not appropriately categorize the ecological health of the lake, which was much poorer. The lake’s condition has changed significantly within recent 1-2 year periods (see graph on next page). In 2006 total phosphorus was high (averaged 110 ug/L, state impaired standard is 40 ug/L), the water was brown and turbid (average 12 FNRU), and algae levels were relatively high (average chlorophyll-a 38.5 mg/L). Plants were limited by the turbid water, and ACD staff estimated 20-40% of the lake had plants growing to the surface. In 2008 phosphorus was lower (average 32 ug/L), the water was clear (average 3 FNRU), and algae levels were low (average chlorophyll-a 12.3 mg/L), but plant growth had exploded. Plants grew densely and to the surface across 95% of the lake. Increased plant growth was consuming the phosphorus, out-competing algae, and minimizing sediment disturbance. Species included curly-leaf pondweed, large-leaf pondweed, floating-leaf pondweed, water shield, and lilies. In late June and July dissolved oxygen began to drop because of plant decomposition (presumably culy-leaf pondweed at this time). In August and September other pondweeds began to die, and dissolved oxygen dropped lower than fish can tolerate and stayed that low for about eight weeks. No dead fish were seen, but residents said similar conditions occurred in 2007, likely killing most fish at that time. In summary, water is clear, but excessive plant growth has eliminated the fishery and recreation.

Trend Analysis

Five years of water quality monitoring have been conducted by the Anoka Conservation District and Secchi depths were taken by citizens one other year. This is not enough data to perform a trend analysis.

Discussion

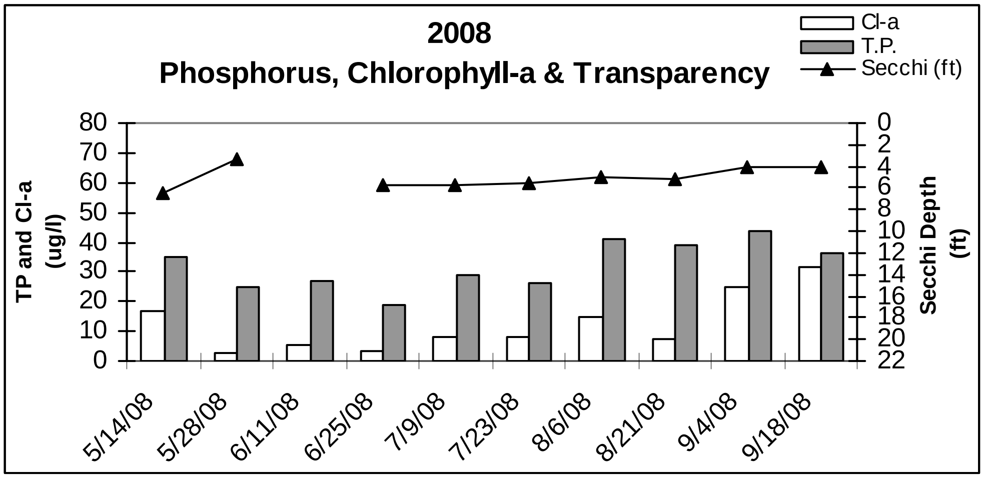
Rogers is a troubled and unstable lake. The high nutrient levels that fueled brown algae in 2006 and large plants in 2008 are surprising given that the lakeshore is only partially developed and there are no streams flowing into the lake (i.e. small watershed). Pollutant sources are likely from within or adjacent to the lake. The organic lake sediments are one possible nutrient source, though the lake is too small and vegetated for much wind mixing. It’s also possible that rough fish have, at times, contributed to poor water quality, but no rough fish activity was seen by ACD staff and recently low dissolved oxygen has likely killed most fish. The water’s sewage odor on May 23, 2006 may be a clue that septic system failure(s) on lakeshore homes are occuring and impacting the lake, but this is uncertain. Unlawful herbicide treatments to the lake by residents have been documented, and probably contribute to the lake’s unstable nature. It is desirable for this lake to have a healthy aquatic plant community for wildlife and water quality, yet to control the harmfully excessive growth seen in 2008.

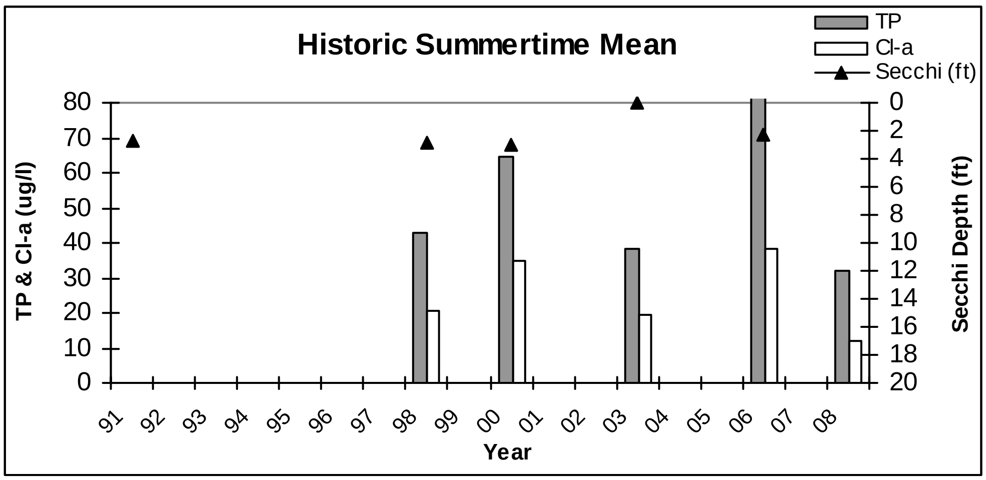
2008 Rogers Lake Water Quality Data

Fawn Lake 2008			5/14/2008	5/28/2008	6/11/2008	6/25/2008	7/9/2008	7/23/2008	8/6/2008	8/21/2008	9/4/2008	9/18/2008			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.10	7.27	7.62	7.34	7.16	6.47	6.67	5.50	6.44	5.62	6.16	6.63	5.50	7.62
Conductivity	mS/cm	0.010	0.078	0.077	0.071	0.064	0.065	0.065	0.064	0.069	0.070	0.067	0.069	0.064	0.078
Turbidity	FNRU	1	3	2	1	1	5	2	2	2	3	5	3	1	5
D.O.	mg/L	0.01	8.39	8.98	7.35	6.22	4.46	4.40	1.67	2.60	2.36	3.07	4.95	1.67	8.98
D.O.	%	1	82%	95%	80%	73%	52%	50%	19%	30%	25%	30%	54%	19%	95%
Temp.	°C	0.1	15.2	17.8	19.4	24.6	23.7	22.7	22.5	22.4	17.8	16.5	20.3	15.2	24.6
Temp.	°F	0.1	59.4	64.0	66.9	76.3	74.7	72.9	72.5	72.3	64.0	61.7	68.5	59.4	76.3
Salinity	%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl-a	mg/L	0.5	16.5	2.5	5.3	3.5	8.3	7.9	14.9	7.4	24.6	31.6	12.3	2.5	31.6
T.P.	mg/L	0.010	0.035	0.025	0.027	0.019	0.029	0.026	0.041	0.039	0.044	0.036	0.032	0.019	0.044
T.P.	ug/L	10	35	25	27	19	29	26	41	39	44	36	32	19	44
Secchi	ft	0.1	> 6.5	> 3.4		> 5.7	> 5.8	> 5.5	> 5.0	> 5.1	> 4.1	> 4.1	5.0	3.4	6.5
Secchi	m	0.1	> 2.0	> 1.0		> 1.7	> 1.8	> 1.7	> 1.5	> 1.6	> 1.2	> 1.2	1.4	0.0	2.0
Field Observations															
Physical			1.5	1.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.5	2.0
Recreational			1.5	1.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.3	1.5	5.0

*reporting limit

Rogers Lake Water Quality Results





Rogers Lake Historical Means

Agency	CAMP	ACD	ACD	ACD	ACD	ACD
Year	91	98	2000	2003	2006	2008
TP		42.70	64.70	38.4	110.0	32
Cl-a		20.30	35.10	19.4	38.5	12.3
Secchi (m)	0.81	0.85	0.91	n/a	0.7	1.4
Secchi (ft)	2.7	2.8	3.00	n/a	2.3	5.0
Carlson's Trophic State Index						
TSIP		58	62	57	72	54
TSIC		60	62	60	67	55
TSIS	63	62	63	n/a	65	55
TSI		59*	62*	58*	68	55*

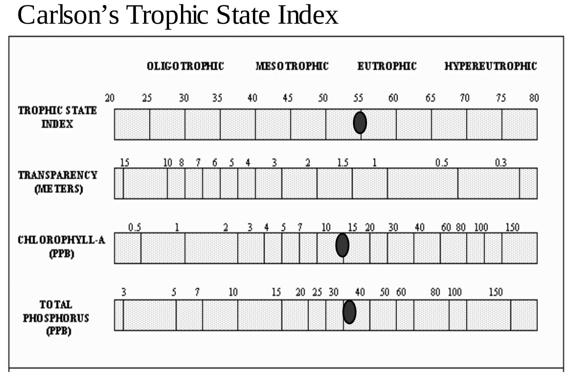
*TSIS was not included in mean TSI

Rogers Lake Water Quality Report Card

Year	91	98	2000	2003	2006	2008
TP		C	C	C	D	B-
Cl-a		C	C	B	C	B
Secchi	D	n/a**	n/a**	n/a**	D-	n/a**
Overall		**C**	**C**	**B**	**D**	**B**

**Secchi transparency not graded as secchi depth exceeded lake depth

Carlson's Trophic State Index



Rogers Lake, June 10, 2008

July 7, 2008

September 4, 2008

September 18, 2008. Decomposing large-leaf pondweed.

Stream Water Quality – Biological Monitoring

Description: This program combines environmental education and stream monitoring. Under the supervision of ACD staff, high school science classes collect aquatic macroinvertebrates from a stream, identify their catch to the family level, and use the resulting numbers to gauge water and habitat quality. These methods are based upon the knowledge that different families of macroinvertebrates have different water and habitat quality requirements. The families collectively known as EPT (Ephemeroptera, or mayflies; Plecoptera, or stoneflies; and Trichoptera, or caddisflies) are pollution intolerant. Other families can thrive in low quality water. Therefore, a census of stream macroinvertebrates yields information about stream health.

Purpose: To assess stream quality, both independently as well as by supplementing chemical data.
To provide an environmental education service to the community.

Locations: Rum River behind Anoka High School, south side of Industry Ave, Anoka

Results: Results for each site are detailed on the following pages.

Tips for Data Interpretation

Consider all biological indices of water quality together rather than looking at each alone, because each gives only a partial picture of stream condition. Compare the numbers to county-wide averages. This gives some sense of what might be expected for streams in a similar landscape, but does not necessarily reflect what might be expected of a minimally impacted stream. Some key numbers to look for include:

Families — Number of invertebrate families. Higher values indicate better quality.

EPT — Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.

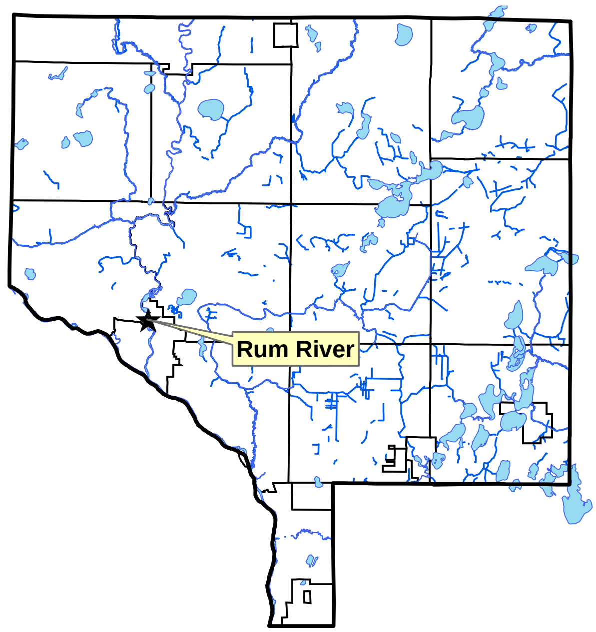
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

FBI	Stream Quality Evaluation
0.00-3.75	Excellent
3.76-4.25	Very Good
4.26-5.00	Good
5.01-5.75	Fair
5.76-6.50	Fairly Poor
6.51-7.25	Poor
7.26-10.00	Very Poor

% Dominant Family — High numbers indicates an uneven community, and likely poorer stream health.

RUM RIVER

behind Anoka High School, Anoka
STORET SiteID = S003-189



Last Monitored

By Anoka High School in 2008

Monitored Since

2001

Student Involvement

30 students in 2008, approx 260 since 2001

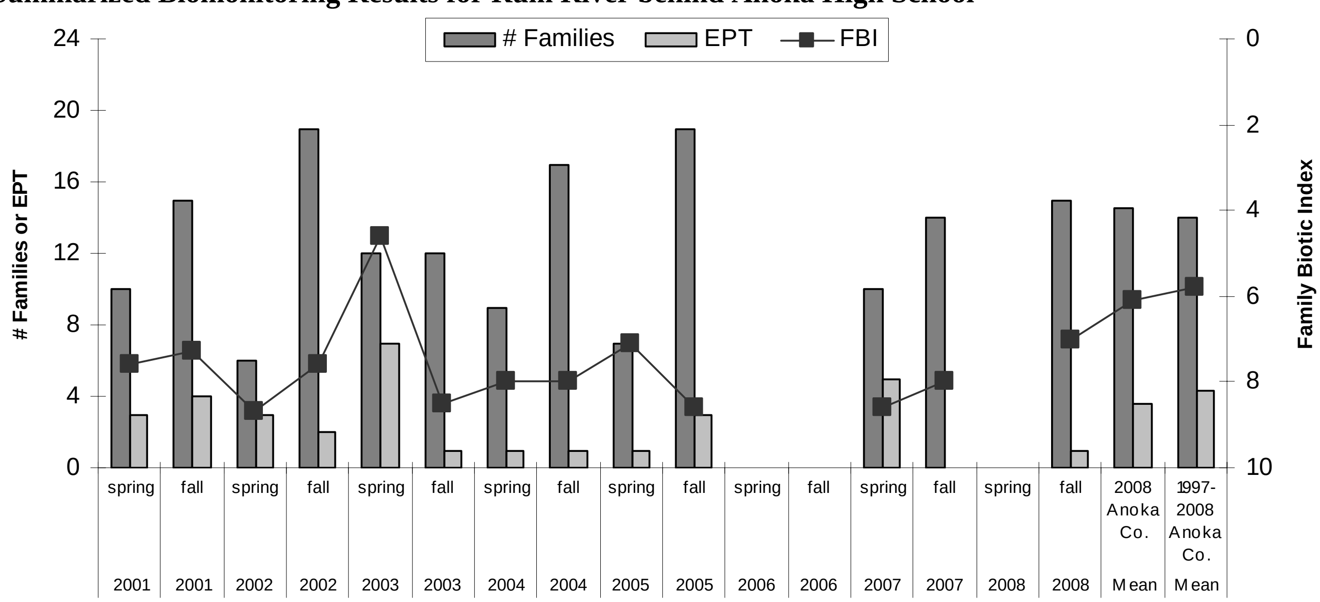
Background

The Rum River originates from Lake Mille Lacs, and flows south through western Anoka County where it joins the Mississippi River in the City of Anoka. Other than the Mississippi, this is the largest river in the county. In Anoka County the river has both rocky riffles (northern part of county) as well as pools and runs with sandy bottoms. The river's condition is generally regarded as excellent. Most of the Rum River in Anoka County has a state "scenic and recreational" designation. The sampling site is near the Bunker Lake Boulevard bridge behind Anoka High School. Sampling is not conducted in the main channel. Rather, it occurs in a backwater area. Water is not flowing in this location and the bottom is mucky. This site is not particularly representative of this reach of the river.

Results

Anoka High School monitored this site in fall 2008; spring monitoring does not occur because aquatic ecology class is not offered in spring. The results for this site in 2008 were similar to previous years. The various indices, taken together and across years, indicate a below average macroinvertebrate community. In 2008, and historically, the family biotic index was below the county mean, and few of the pollution-sensitive EPT families are found. The number of families found has fluctuated widely, sometimes above and sometimes below the county mean. However, most of the families are pollution-tolerant generalists.

Summarized Biomonitoring Results for Rum River behind Anoka High School



Biomonitoring Data for Rum River at Anoka High School

Year	2001	2001	2002	2002	2003	2003	2004	2004	2005	2005	2007	2007	2008	2008	Mean	Mean
Season	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	2008 Anoka Co.	1997-2008 Anoka Co.
FBI	7.60	7.30	5.90	7.60	4.60	8.50	8.00	8.00	7.10	8.60	8.6	8		7	6.1	5.8
# Families	10	15	6	19	12	12	9	17	7	19	10	14		15	14.6	14.0
EPT	3	4	3	2	7	1	1	1	1	3	5	0		1	3.6	4.4
Date	5/24	10/17	5/28	10/9	6/2	10/10	6/9	10/4	17-May	24-Oct	5/7	10/22		10/13		
sampling by	AHS	AHS	ACD	AHS	ACD	AHS	ACD	Anoka HS	AHS	AHS	AHS	AHS		AHS		
sampling method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		MH		
# individuals	100	178	179	144	126	569	192	572	124	360	208	244		626		
# replicates	1	1	1	2	1	1	1	1	1	1	1	1		1		
Dominant Family	corixidae	hemiptera	corixidae	taltridae	baetidae	corixidae	corixidae	corixidae	siphlonuridae	corixidae	corixidae	coenagrionidae		baetidae		
% Dominant Family	66	30.9	91.1	20.1	51.6	43.9	33.9	57.3	82.3	69.7	91.8	37.3		26.5		
% Ephemeroptera	7	16.9	4.5	1.4	73	0.5	24.5	0.2	82.3	1.7	5.3	0		26.5		
% Trichoptera	0	0	0	0	2.4	0	0	0	0	0	0	0		0		
% Plecoptera	4	0	0.6	0	7.1	0	0	0	0	0	0.5	0		0		

Supplemental Stream Chemistry Readings

Parameter	6-2-03	10-10-03	6-9-04	10-4-04	5-17-05	10-24-05	5-7-07	10-22-07	10-10-08
pH	7.66	8.63	8.27	9.12	8.45	8.04	8.50	7.42	7.75
Conductivity (mS/cm)	0.305	0.343	0.140	0.203	0.193	0.171	0.283	0.243	0.348
Turbidity (NTU)	3	1	3	2	5	5	17	13	3
Dissolved Oxygen (mg/L)	8.50	8.24	6.2	9.30	11.81	11.23 (95%)	11.41	9.72 (87%)	8.99 (85%)
Salinity (%)	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01
Temperature (C)	17.7	15.9	20.2	11.6	13.1	9.0	15.3	10.6	12.3

Discussion

Biomonitoring results for this site are much different from the monitoring farther upstream in St. Francis. In St. Francis the Rum River harbors the most diverse and pollution-sensitive macroinvertebrate community of all sites monitored in Anoka County. At the Anoka location the biotic indices indicate a poorer than average river health. The reason for this dramatic difference is probably habitat differences, and to a lesser extent, water quality.

The habitat and overall nature of the river is different in St. Francis and Anoka. In the upstream areas around St. Francis the river has a steeper gradient, moves faster, and has a variety of pools, riffles, and runs. Downstream, near Anoka, the river is much slower moving, lacking pools, riffles and runs. The bottom is heavily silt laden. The area is more developed, so there are more direct and indirect human impacts to the river.

Water quality declines downstream, though it is still quite good at all locations. Chemical monitoring in 2004 revealed that total suspended solids, total phosphorus, and chlorides were all higher near Anoka than upstream. This is probably due more urbanized development and the accompanying storm water inputs, as well as land uses that are more likely to generate pollutants. Given that water quality is still quite good even in these downstream areas, it is unlikely that water quality is the primary factor limiting macroinvertebrates at Anoka.

One additional factor to consider when comparing the up and downstream monitoring results is the type of sampling location. Sampling near Anoka was conducted mostly in a backwater area that has a mucky bottom and does not receive good flow. This area is unlikely to be occupied by families which are pollution intolerant because those families generally favor rocky habitats and require high dissolved oxygen not found in stagnant areas.

Stream Water Quality – WOMP Program

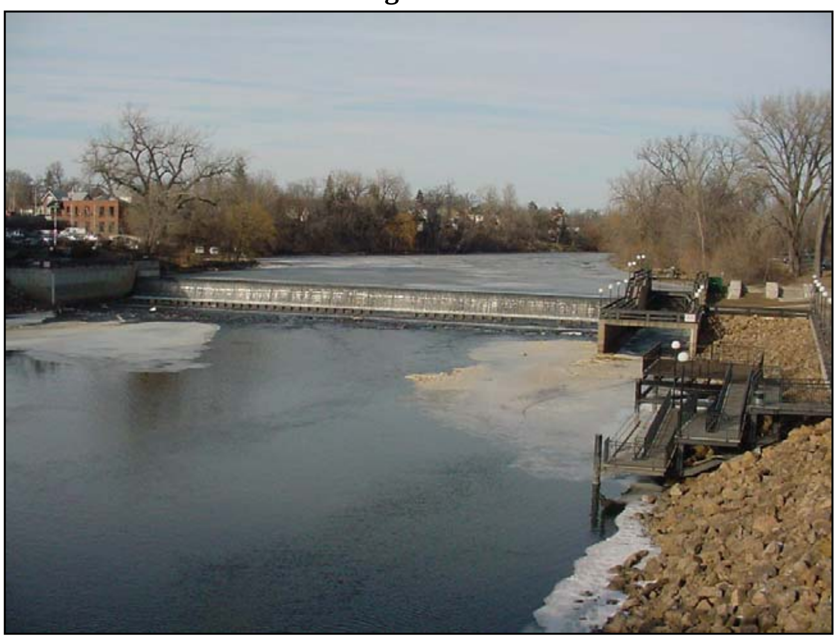
Description: The Watershed Outlet Monitoring Program (WOMP) is a Metropolitan Council stream and river monitoring program. In Anoka County, the program has an established monitoring station for the Rum River in Anoka, near its outlet to the Mississippi River. Water levels, flows, and 20+ water quality parameters are measured. Loading rates for important pollutants are estimated continuously and the Metropolitan Council provides in-depth analysis and reporting (not provided here). The Anoka Conservation District provides staffing for operations of the monitoring station.

Purpose: To understand water quality and hydrology throughout the twin cities metropolitan area.

Locations: Rum River at the Anoka Dam, City of Anoka

Results: Presented elsewhere by the Metropolitan Council. See http://www.metrocouncil.org/Environment/RiversLakes/

Rum River WOMP Monitoring Station



Wetland Hydrology

Description: Continuous groundwater level monitoring at a wetland boundary to a depth of 40 inches. County-wide, the ACD maintains a network of 21 wetland hydrology monitoring stations.

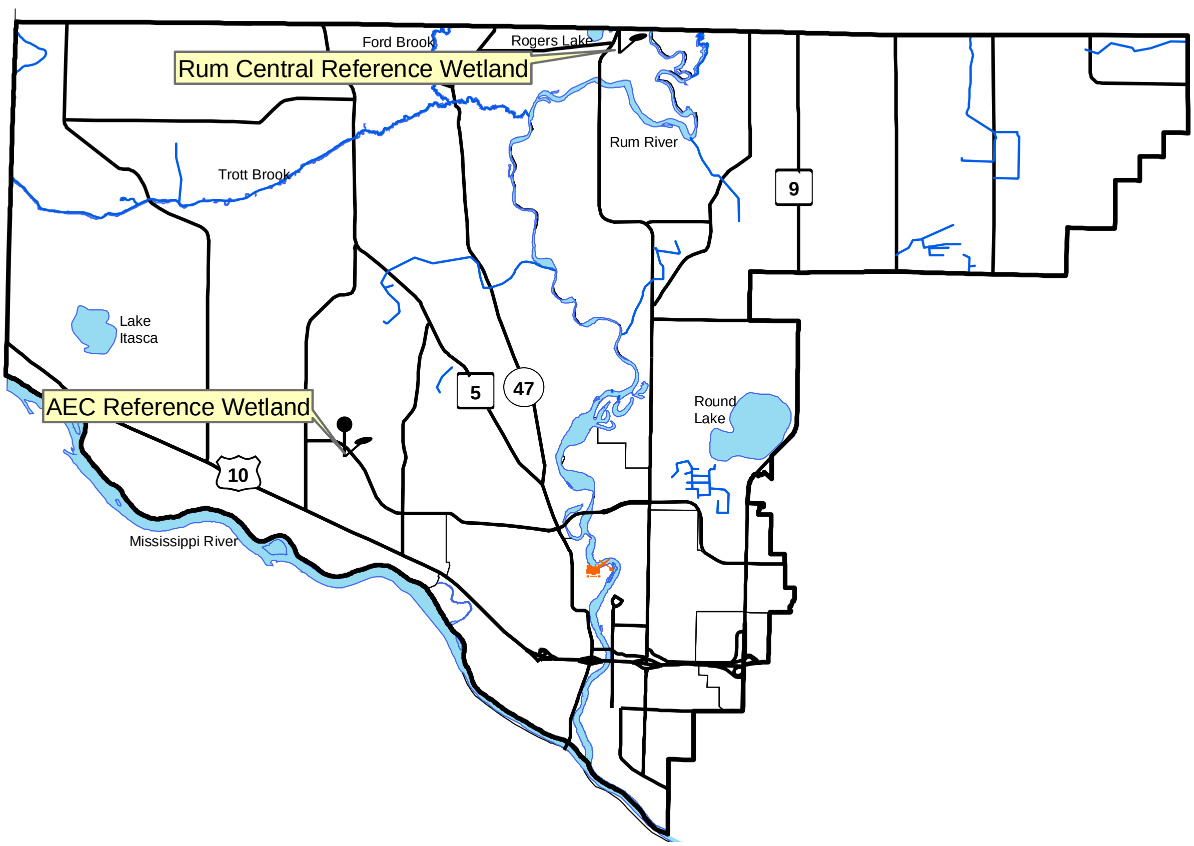
Purpose: To provide understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

Locations: AEC Reference Wetland, Connexus Energy Property on Industry Ave, Ramsey

Rum River Central Reference Wetland, Rum River Central Park, Ramsey

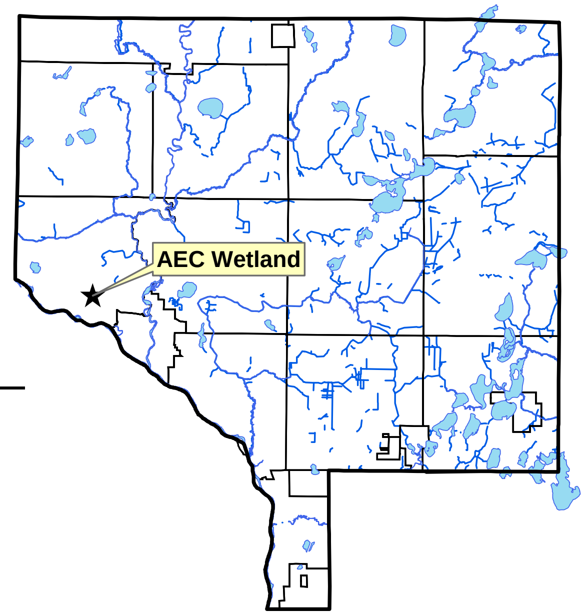
Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

Lower Rum River Watershed Wetland Hydrology Monitoring Sites



AEC REFERENCE WETLAND

Cottonwood Park, adjacent to Connexus Energy Offices (formerly Anoka Electric Coop), Ramsey



Site Information

Monitored Since: 1999

Wetland Type: 3

Wetland Size: ~18 acres

Isolated Basin? No, probably receives storm water

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-15	10yr2/1	Sandy Loam	-
Bw	15-40	10yr3/2	Gravelly Sandy loam	-

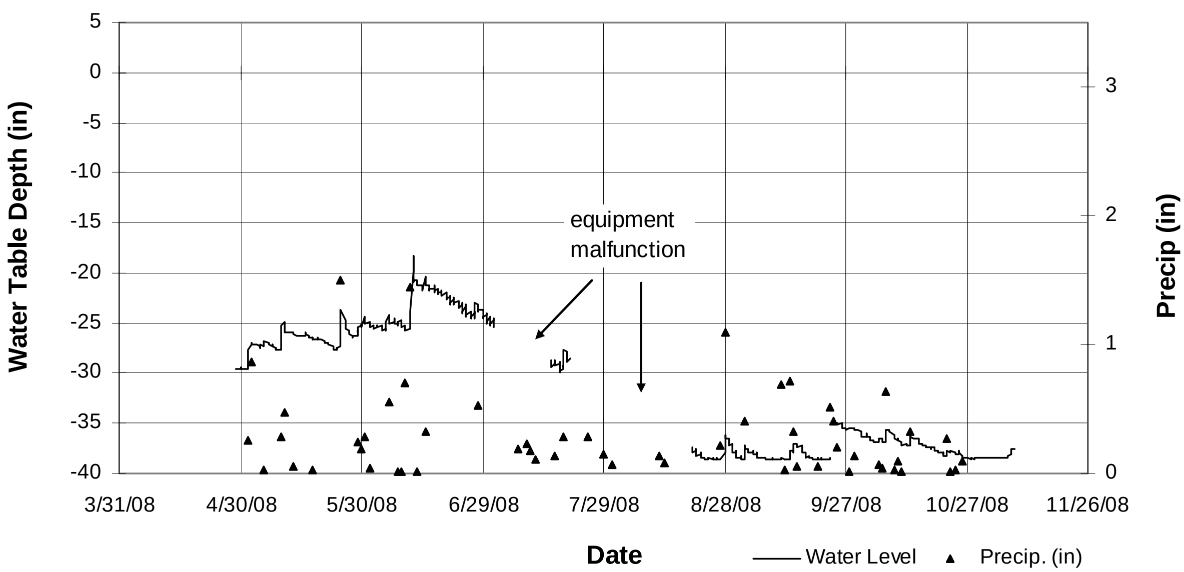
Surrounding Soils: Hubbard coarse sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Populus tremuloides	Quaking Aspen	30
Salix bebbiana	Bebb Willow	30
Carex Spp	Sedge undiff.	30
Solidago canadensis	Canada Goldenrod	20

Other Notes: Well is located at the wetland boundary.

2008 Hydrograph



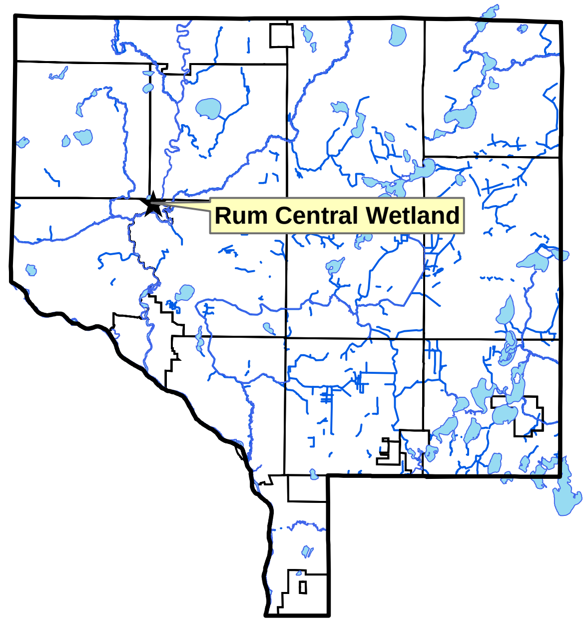
Well depths were 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

RUM RIVER CENTRAL REFERENCE WETLAND

Rum River Central Regional Park, Ramsey

Site Information



Monitored Since: 1997

Wetland Type: 6

Wetland Size: ~0.8 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-12	10yr2/1	Sandy Loam	-
Bg1	12-26	10ry5/6	Sandy Loam	-
Bg2	26-40	10yr5/2	Loamy Sand	-

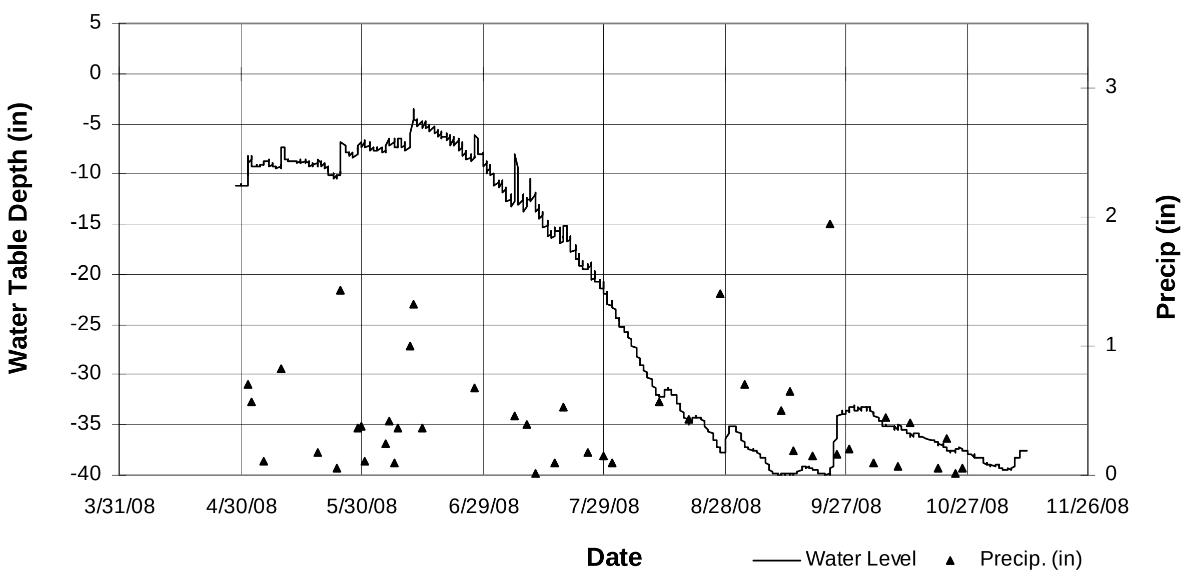
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	40
Corylus americanum	American Hazelnut	40
Onoclea sensibilis	Sensitive Fern	30
Rubus strigosus	Raspberry	30
Quercus rubra	Red Oak	20

Other Notes: Well is located at the wetland boundary.

2008 Hydrograph



Well depths were 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Water Quality Improvement Projects

Description: The LRRWMO provided cost share for projects on either public or private property that will improve water quality, such as repairing streambank erosion, restoring native shoreline vegetation, or rain gardens. This funding was administered by the Anoka Conservation District, which works with landowners on conservation projects. Projects affecting the Rum River were given the highest priority because it is viewed as an especially valuable resource.

Purpose: To improve water quality in lakes streams and rivers by correcting erosion problems and providing buffers or other structures that filter runoff before it reaches the water bodies.

Results: Projects described individually below.

2008 Rusin and Herrala Riverbank Stabilizations

In 2008 two water quality improvement projects utilized LRRWMO cost share funds. The projects were on adjacent properties, resulting in 158 continuous feet of Rum Riverbank erosion correction. One of the property owners also will do additional work in 2009 to repair minor erosion higher on the bluff. Both property owners received 50% cost share grants for materials and received a no-cost work crew through Minnesota Conservation Corps with State of Minnesota funds.

At both the Herrala and Rusin properties cedar tree revetments were used to correct streambank erosion and prevent future erosion. This technique involves anchoring cut cedar trees tightly along the bank. The dense branches simultaneously protect the bank from high flows and allow sediment to settle behind the trees during lower flows. Cedar trees are chosen because they are resistant to decay and have dense branches. Trees for these projects were harvested at no cost from a county park and a private property. Installation of this project was coordinated with the lowering of the Anoka dam for maintenance, making installation easier.

Rum Riverbank Stabilization – Herrala and Rusin Properties – Cedar tree revetments were installed during river drawn down for Anoka Dam maintenance. Duckbill anchors and galvanized cable secure the cut trees to the bank.

LRRWMO Cost Share Fund Summary

2006 LRRWMO Contribution	+	$1,000.00
2008 Expense – Herrala Rum Riverbank stabilization	-	$ 150.91
2008 Expense – Rusin Rum Riverbank stabilization	-	$ 225.46
Deffered Expense – anticipated 2009 Rusin bluff stabilization	-	$ 342.87
Fund Balance		**$ 280.76**

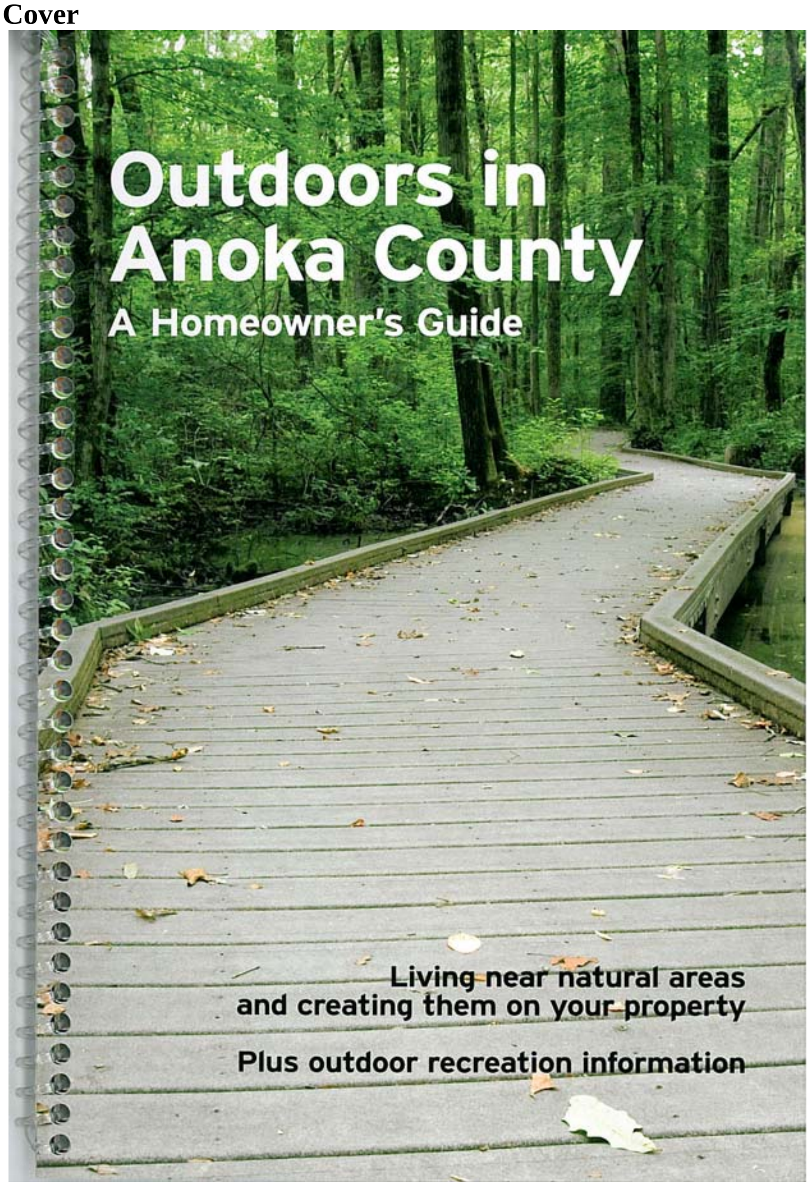
Rum Central Regional Park Cedar Tree Revetment

This project did not use LRRWMO cost share, but did occur in the Lower Rum River Watershed. The project was a continuation of an earlier, and much larger, stabilization of riverbank within the county park. This follow-up work included the installation of cedar tree revetments to further provide stabilization from bank failures, erosion, and to provide near-shore fish and wildlife habitat. This project was led by the Anoka Conservation District and Anoka County Parks.

Homeowner Guide

Description:	The Anoka Conservation District (ACD) wrote, designed, and printed an educational booklet for homeowners. The booklet included information on topics of interest to the LRRWMO, including landscaping for water quality, wetlands, well water, septic systems, and hazardous household wastes.
Purpose:	To educate homeowners about topics that will impact local natural resources.
Locations:	Throughout the watershed.
Results:	"Outdoors in Anoka County – a homeowner's guide" was written, laid out by a graphic designer, and printed in 2007. The ACD distributed 556 booklets to homes near other important natural areas in the Lower Rum River watershed.

Homeowner's Guide Cover



LRRWMO Website

Description: The Lower Rum River Watershed Management Organization (LRRWMO) contracted the Anoka Conservation District (ACD) to design and maintain a website about the LRRWMO and the Lower Rum River watershed. The website has been in operation since 2003. The LRRWMO pays the ACD annual fees for maintenance and update of the website.

Purpose: To increase awareness of the LRRWMO and its programs. The website also provides tools and information that helps users better understand water resources issues in the area. The website serves as the LRRWMO's alternative to a state-mandated newsletter.

Location: www.AnokaNaturalResources.com/LRRWMO

Results: The LRRWMO website contains information about both the LRRWMO and about natural resources in the area.

Information about the LRRWMO includes:

- a directory of board members,
- meeting minutes and agendas,
- descriptions of work that the organization is directing,
- highlighted projects,
- permit applications.

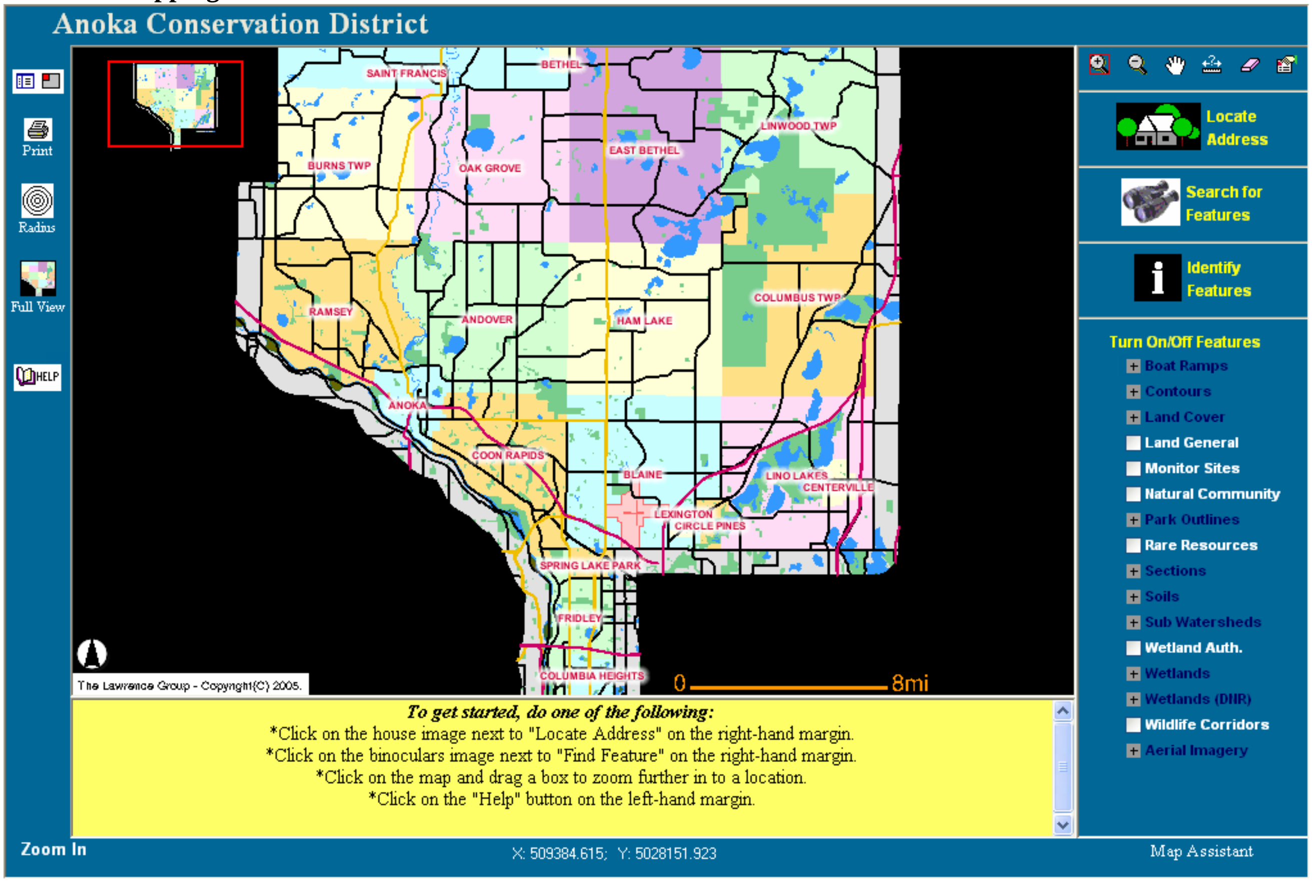
Other tools on the website include:

- an interactive mapping tool that shows natural features and aerial photos
- an interactive data download tool that allows users to access all water monitoring data that has been collected
- narrative discussions of what the monitoring data mean

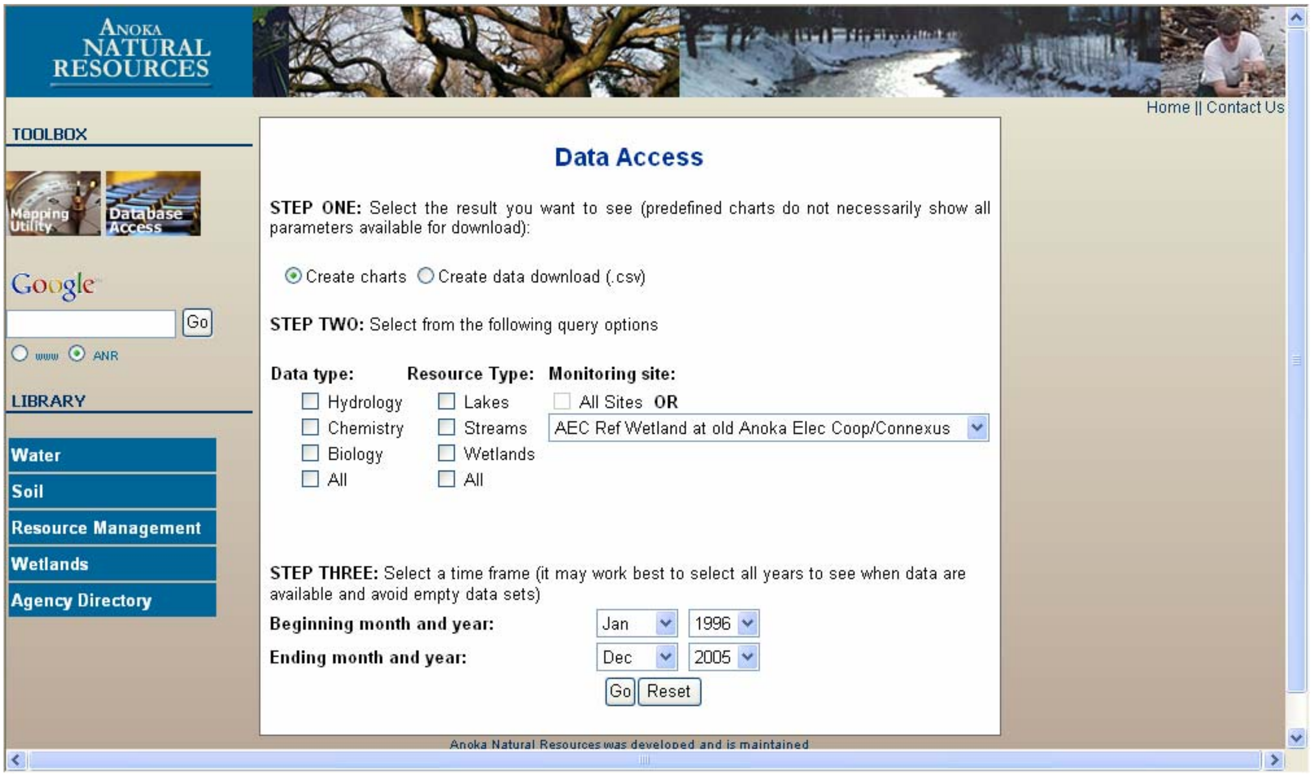
LRRWMO Website Homepage

more on next page

Interactive Mapping Tool



Interactive Data Access Tool



Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program, such as our lake water quality monitoring program. We do not, however, know specifically which expenses are attributed to monitoring which lakes. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer. The process also takes into account equipment that is purchased for monitoring in a specific area.

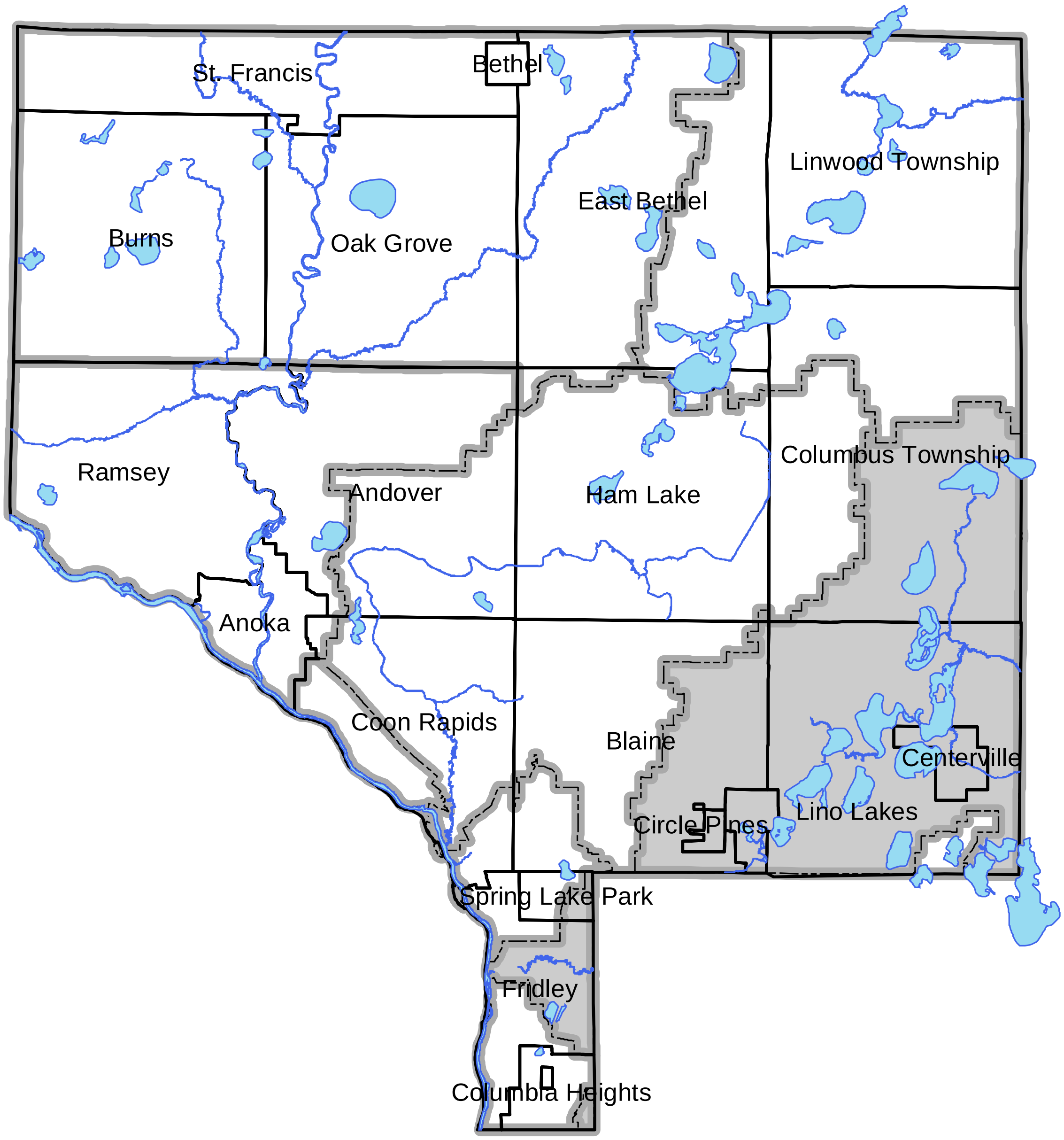
Lower Rum River Watershed Financial Summary

Lower Rum River Watershed	Web site	Precipitation Monitoring	Wetland Hydrology	Lake Levels	Groundwater Observation Wells	Lake Water Quality	Rum River WOMP	Student Biomonitoring	Outdoor Guide	Rusin Cedar Tree Revetment	Herrala Cedar Tree Revetment	Rum River Central Regional Park Cedar Tree Revetment	Total
Revenues													
LRRWMO	340	0	525	480	0	920	0	375	0	225	151	0	3016
State	0	0	0	0	120	0	0	0	0	0	0	0	120
Anoka Conservation District	2454	77	0	526	180	0	560	214	665	0	0	0	4676
County Ag Preserves	0	0	242	0	0	697	0	887	0	0	0	0	1825
Other Service Fees	342	57	0	66	0	0	800	0	5	225	151	5439	7085
Local Water Planning	0	0	379	0	0	247	0	0	0	0	0	0	626
TOTAL	3136	134	1145	1071	300	1864	1360	1476	670	451	302	5439	17348
Expenses-													
Capital Outlay/Equip	37	2	188	17	4	14	12	24	1	0	0	0	299
Personnel Salaries/Benefits	2036	110	755	907	248	1197	1082	1147	475	0	0	4876	12832
Overhead	152	11	76	72	23	103	89	87	99	0	0	0	711
Employee Training	40	2	13	15	4	19	17	18	19	0	0	0	147
Vehicle/Mileage	50	4	34	27	10	55	51	30	18	0	0	0	280
Rent	82	5	42	31	11	65	62	33	49	0	0	0	381
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	738	1	38	3	0	411	46	137	8	451	302	563	2698
Equipment Maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3136	134	1145	1071	300	1864	1360	1476	670	451	302	5439	17348
NET	0	0	0	0	0	0	0	0	0	0	0	0	0

Recommendations

- **Continue monitoring Round Lake** water quality at least every other year to determine if poorer water quality recently is within this lake's natural variation or is a sign of developing problems.
- **Diagnose and improve Rogers Lake water quality problems** through a joint effort of the LRRWMO and URRWMO. First, monitoring in 2009 is recommended to better understand this unstable lake. In following years diagnostic work or active management of the lake may be needed.
- **Diagnose the cause of periodically low dissolved oxygen in Trott Brook.**
- **Continue lake level monitoring, especially on Round Lake** where residents have expressed concerns with levels. Other nearby lakes should be monitored for comparison and in case problems develop.
- **Maintain a cost share program for water quality improvement projects** on private properties. This program should be actively promoted by identifying problems and contacting landowners.
- **Encourage public works departments to implement measures to minimize road deicing salt applications**. Monitoring and special investigations in the LRRWMO have shown that road salts are one of the largest and most widespread sources of stream degradation in this watershed.
- **Incorporate the above recommendations into the LRRWMO Watershed Plan**. The Plan provides an organized and prioritized way to address these issues. Several state grants are only open to projects listed in watershed plans.

Rice Creek Watershed



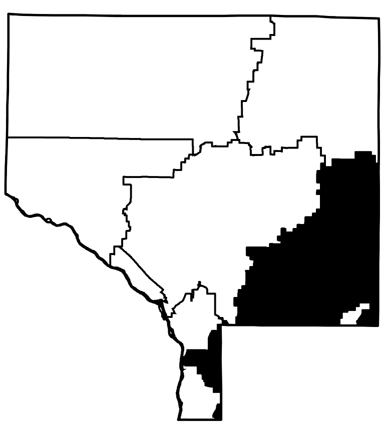
Contact Info: Rice Creek Watershed District
www.ricecreekwd.com
763-398-3070

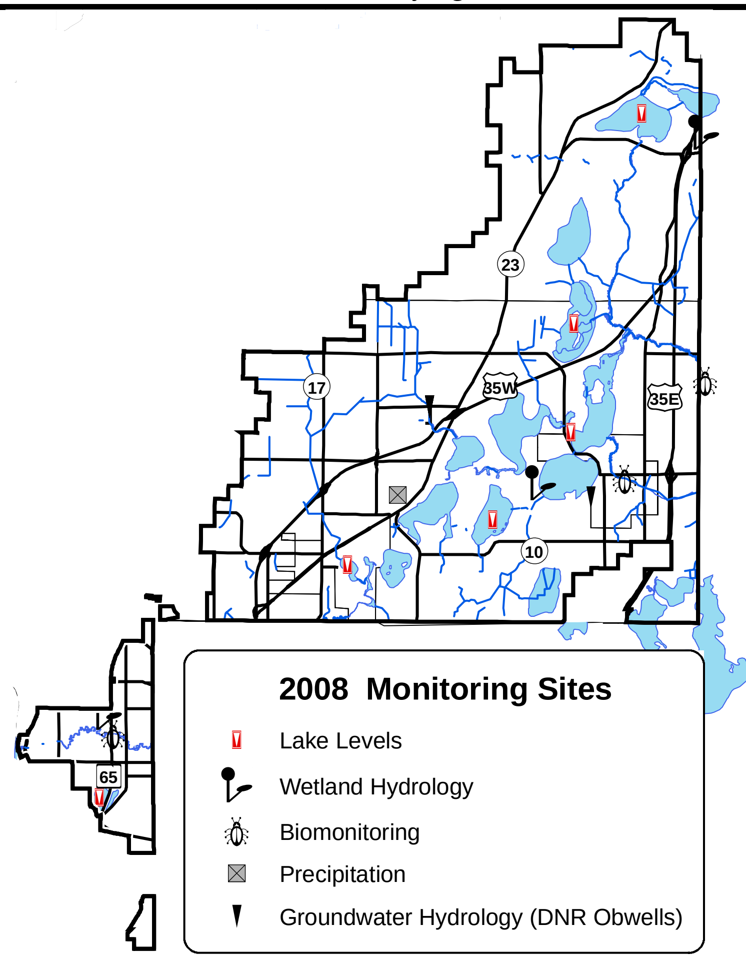
Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 5: RICE CREEK WATERSHED

Task	Partners	Page
Lake Levels	RCWD, ACD	5-100
Wetland Hydrology	RCWD, ACD	5-102
Stream Water Quality – Biological	RCWD, ACD, ACAP, Centennial HS, Forest Lake Area Learning Center, Totino Grace HS	5-106
Water Quality Improvement Projects	RCWD, ACD, landowners, others	5-113
Homeowner Guide	ACD, MNDNR, ACAP	5-114
Financial Summary		5-115
Recommendations		5-115
Precipitation	ACD, volunteers	see Chapter 1
Ground Water Hydrology (obwells)	ACD, MNDNR	see Chapter 1
Additional work not reported here	RCWD	contact RCWD

ACD = Anoka Conservation District, RCWD = Rice Creek Watershed District,
MNDNR = Minnesota Dept. of Natural Resources, ACAP = Anoka County Ag Preserves





Lake Levels

Description: Weekly water level monitoring in lakes. These data, as well as all additional historic data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

Locations: Golden Lake

Howard Lake,

Moore Lake,

Peltier Lake,

Reshanau Lake, and

Rondeau Lake

Results: Lake levels were measured by volunteers 18 to 39 times, depending upon the lake, with the exception of Rondeau Lake where the volunteer only took five measurements and Reshanau Lake where the volunteer submitted 12 measurements but then misplaced those taken later (both volunteers decided to retire from volunteer monitoring). All of these lakes showed the same general trend, beginning high in spring, declining throughout summer, and rising slightly in late fall. There were large differences in the magnitude of changes despite their close proximity to each other, and in some cases, hydrologic connectedness. Howard Lake ranged 2.06 feet from its highest to lowest point and Reshanau ranged 1.20 feet from spring to mid-July when it was monitored. Moore Lake ranged 0.84 feet. On the other hand, Peltier and Golden Lakes were relatively steady, changing only 0..38 and 0.36 feet all year.

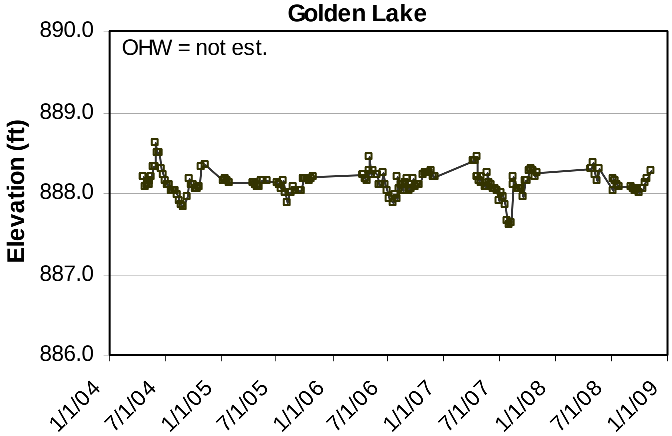
Ordinary High Water Levels (OHW), the elevation below which a DNR permit is needed to perform work, are listed for each lake on the graph.

Rice Creek Watershed Lake Levels Summary

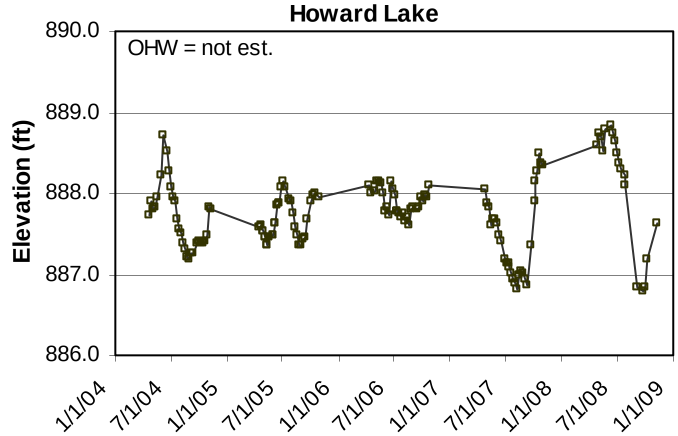
Lake	Year	Average	Min	Max
Golden	2004	888.15	887.83	888.61
	2005	888.10	887.87	888.20
	2006	888.14	887.88	888.44
	2007	888.09	887.60	888.44
	2008	888.15	888.01	888.37
Howard	2004	887.70	887.19	888.71
	2005	887.67	887.35	888.15
	2006	887.90	887.60	888.15
	2007	887.49	886.81	888.50
	2008	888.13	886.79	888.85
Moore	2004	876.99	876.68	877.50
	2005	877.23	876.77	878.07
	2006	877.25	876.93	877.81
	2007	876.99	876.21	877.71
	2008	877.13	876.82	877.66

Lake	Year	Average	Min	Max
Peltier	2004	incomplete data		
	2005	incomplete data		
	2006	884.60	884.51	884.91
	2007	884.57	884.21	884.99
	2008	884.61	884.48	884.86
Reshanau	2004	880.97	880.52	882.69
	2005	881.11	880.55	881.71
	2006	880.99	880.38	882.13
	2007	880.88	879.36	881.74
	2008	incomplete data		
Rondeau	2004	885.90	885.23	886.69
	2005	886.16	885.75	886.53
	2006	886.18	885.61	886.88
	2007	885.83	885.13	886.67
	2008	incomplete data		

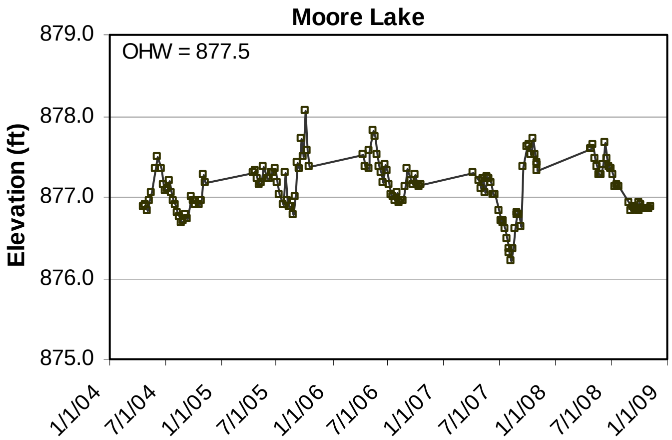
Golden Lake Levels 2004-2008



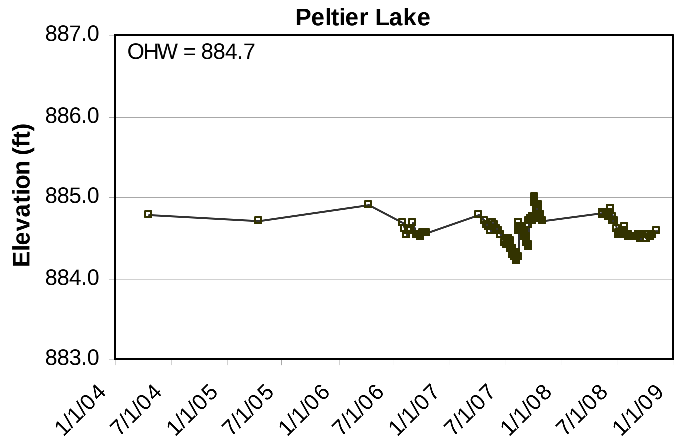
Howard Lake Levels 2004-2008



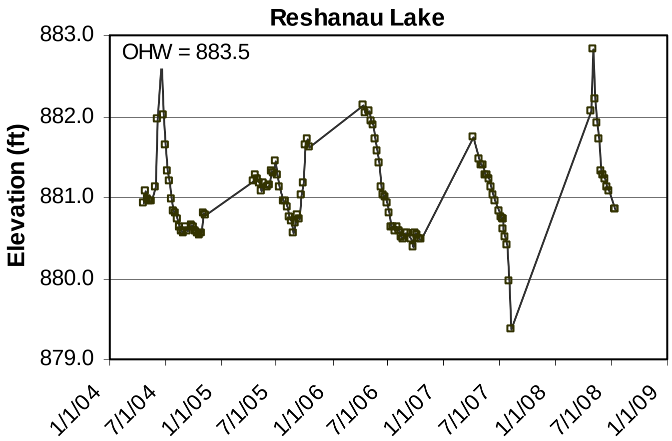
Moore Lake Levels 2004-2008



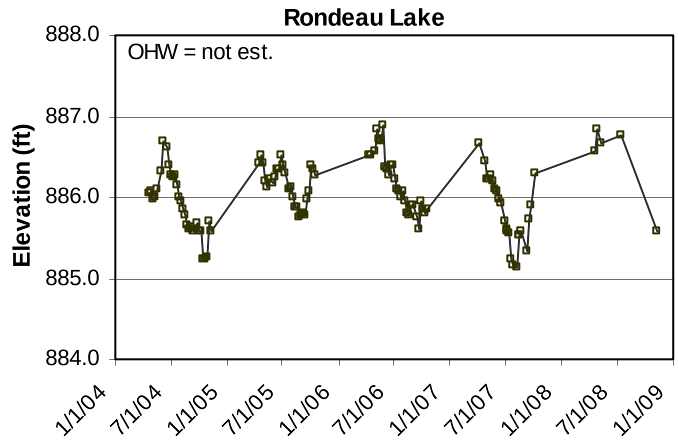
Peltier Lake Levels 2004-2008



Reshanau Lake Levels 2004-2008



Rondeau Lake Levels 2004-2008



Wetland Hydrology

Description: Continuous groundwater level monitoring at a wetland boundary, to a depth of 40 inches. County-wide, the ACD maintains a network of 19 wetland hydrology monitoring stations.

Purpose: To provide understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

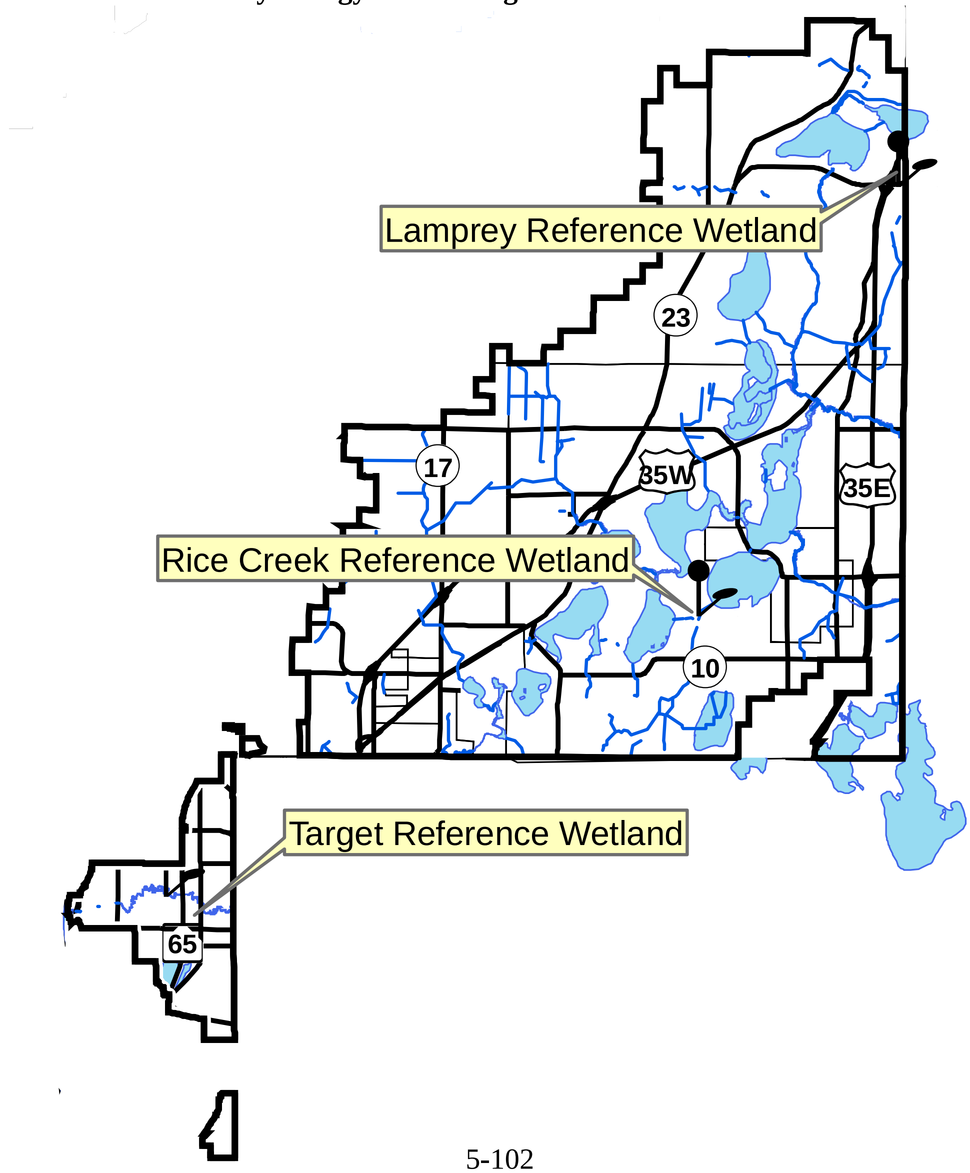
Locations: Lamprey Reference Wetland, Lamprey Pass Wildlife Management Area, Columbus

Rice Creek Reference Wetland, Rice Creek Chain of Lakes Regional Park Reserve, Lino Lakes

Target Reference Wetland, Target Co. Distribution Center, Fridley

Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

Rice Creek Watershed Wetland Hydrology Monitoring Sites

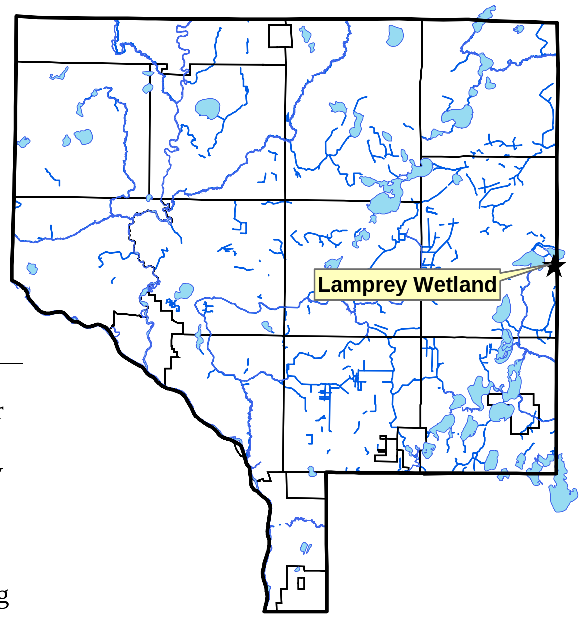


Wetland Hydrology Monitoring

LAMPREY REFERENCE WETLAND

Lamprey Pass Wildlife Mgmt Area, Columbus

Site Information



Monitored Since:	1999
Wetland Type:	4
Wetland Size:	~0.5 acres
Isolated Basin?	Yes
Connected to a Ditch?	No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-9	10yr 2/1	Fine Sandy Loam	-
AB	9-19	10yr 2/1	Fine Sandy Loam	2% 10yr 5/6
Bw	19-35	10ry 3/1	Loam	2% 10ty 5/4
2C1	35-42	5y 5/2	Clay Laom	5y 3/1 Organic Streaking
2C2	42-48	2.5y 5/1	Sandy Loam	2.5y 5/6

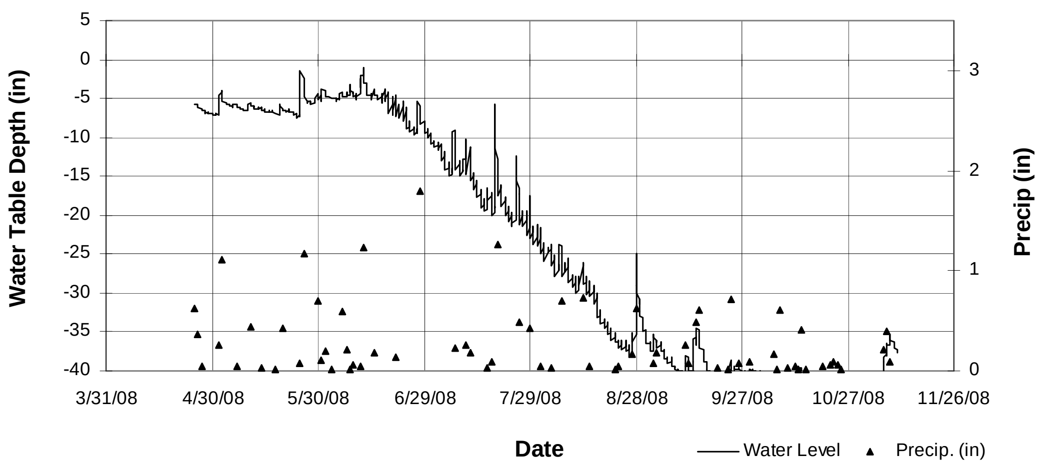
Surrounding Soils: Braham loamy fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Carex pennsylvanica	Pennsylvania Sedge	50
Cornus stolonifera (S)	Red-osier Dogwood	20
Fraxinus pennslyvanicum (T)	Green Ash	40
Xanthoxylum americanum	Pricly Ash	20
Bare Ground		20

Other Notes: Wetland is about 200 feet west of Interstate Highway 35, but within a state wildlife management area. Well is located at the wetland boundary.

2008 Hydrograph

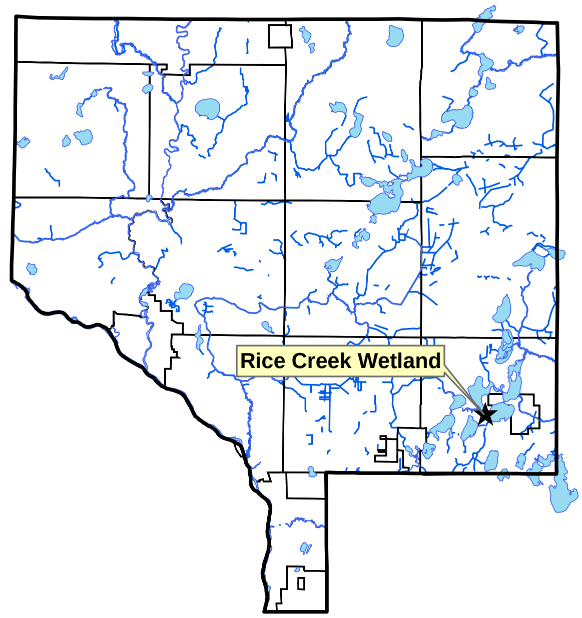


Well depths were 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

RICE CREEK REFERENCE WETLAND

Rice Creek Chain of Lakes Regional Park, Lino Lakes

Site Information



Monitored Since: 1996

Wetland Type: 7

Wetland Size: ~0.5 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-12	10yr 3/1	Sandy Loam	-
Ab	12-16	10yr 2/1	Sandy Loam	-
Bg1	16-21	10yr4/1	Sandy Loam	-
Bg2	21-35	10yr5/2	Sandy Loam	5% 10yr 5/6
2Cg	35-42	2.5y 5/2	Silt Loam	5% 10yr 5/6

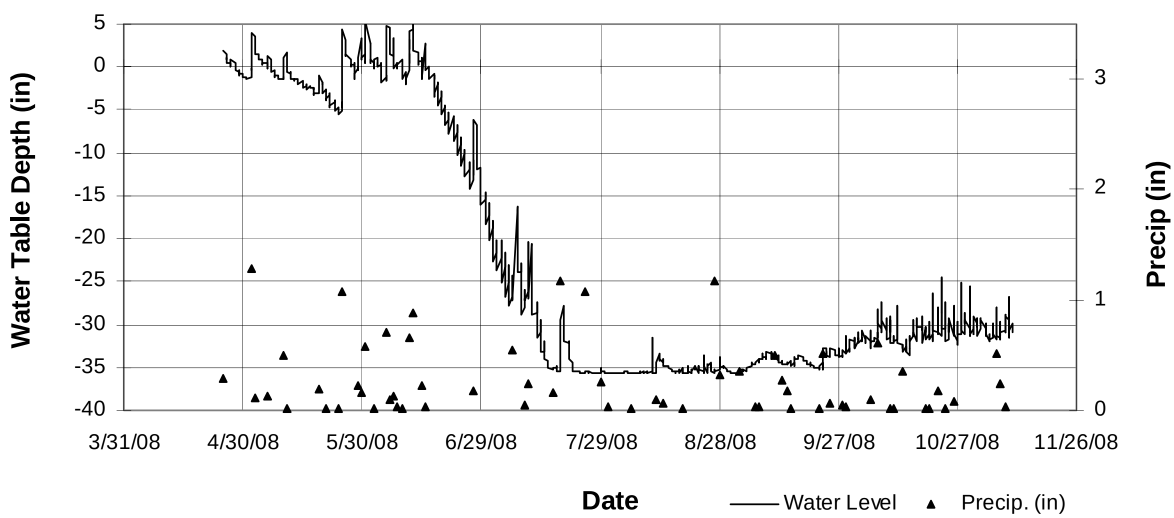
Surrounding Soils: Nessel fine sandy loam and Blomford loamy fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Rubus strigosus	Raspberry	30
Onoclea sensibilis	Sensitive Fern	20
Fraxinus pennsylvanica	Green Ash	40
Amphicarpa bracteata	Hog Peanut	20

Other Notes: This is an intermittent, forested wetland within the regional park between Centerville and George Watch Lakes. It is about 900 feet from George Watch Lake and 800 feet from Centerville Lake. Well is at wetland boundary.

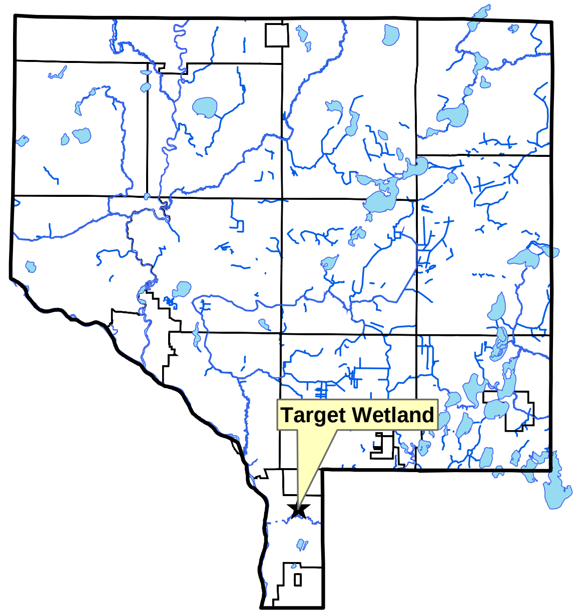
2008 Hydrograph



Well depths were 35 inches, so a reading of–35 indicates water levels were at an unknown depth greater than or equal to 40 inches.

TARGET REFERENCE WETLAND

Target Co. Distribution Center, Fridley



Site Information

Monitored Since: 2001

Wetland Type: 3

Wetland Size: ~3.2 acres

Isolated Basin? No, receives storm water

Connected to a Ditch? No, but receives storm water from commercial area and parking lots

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-8	10yr2/1	Sandy Loam	-
Bg1	8-27	2.5y5/3	Sandy Loam	5% 10yr5/1
Bg2	27-42	2.5y5/1	Sandy Loam	5% 10yr5/1-5/6

Surrounding Soils: Unknown, mostly pavement

Vegetation at Well Location:

Scientific	Common	% Coverage
Spirea spp.	Spirea	70
Typha angustifolia	Narrow-leaf Cattail	50
Populus deltoides (S)	Cottonwood	10
Salix petiolaris	Meadow Willow	10

Other Notes: Well is at the wetland boundary.

2008 Hydrograph

No data collected in 2008 due to repeated equipment malfunctions.

Stream Water Quality – Biological Monitoring

Description: This program combines environmental education and stream monitoring. Under the supervision of ACD staff, high school science classes collect aquatic macroinvertebrates from a stream, identify their catch to the family level, and use the resulting numbers to gauge water and habitat quality. These methods are based upon the knowledge that different families of macroinvertebrates have different water and habitat quality requirements. The families collectively known as EPT (Ephemeroptera, or mayflies; Plecoptera, or stoneflies; and Trichoptera, or caddisflies) are pollution intolerant. Other families can thrive in low quality water. Therefore, a census of stream macroinvertebrates yields information about stream health.

Purpose: To assess stream quality, both independently as well as by supplementing chemical data.
To provide an environmental education service to the community.

Locations: Clearwater Creek at Centerville City Hall, Centerville

Hardwood Creek at Hwy 140, Lino Lakes

Rice Creek at Hwy 65, Fridley

Results: Results for each site are detailed on the following pages.

Tips for Data Interpretation

Consider all biological indices of water quality together rather than looking at each alone, as each gives only a partial picture of stream condition. Compare the numbers to county-wide averages. This gives some sense of what might be expected for streams in a similar landscape, but does not necessarily reflect what might be expected of a minimally impacted stream. Some key numbers to look for include:

Families — Number of invertebrate families. Higher values indicate better quality.

EPT — Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.

Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

FBI	Stream Quality Evaluation
0.00-3.75	Excellent
3.76-4.25	Very Good
4.26-5.00	Good
5.01-5.75	Fair
5.76-6.50	Fairly Poor
6.51-7.25	Poor
7.26-10.00	Very Poor

% Dominant Family — High numbers indicates an uneven community, and likely poorer stream health.

CLEARWATER CREEK

at Centerville City Hall, Centerville

Last Monitored

By Centennial High School in 2008

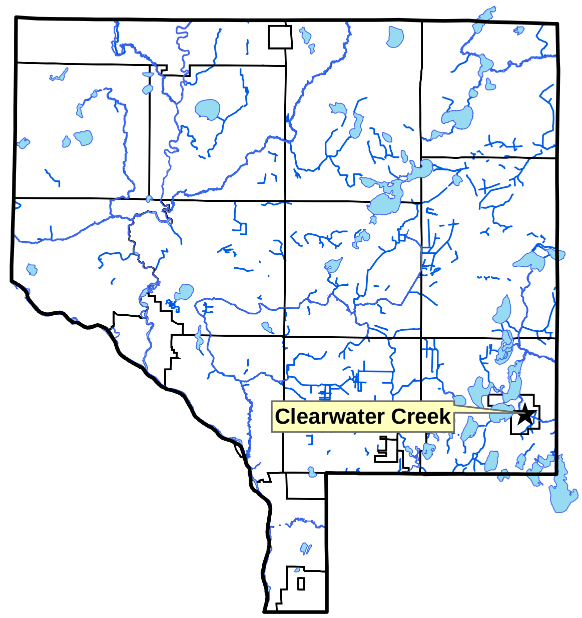
Monitored Since

1999

Student Involvement

48 students in 2008, approx 431 since 2001

Background

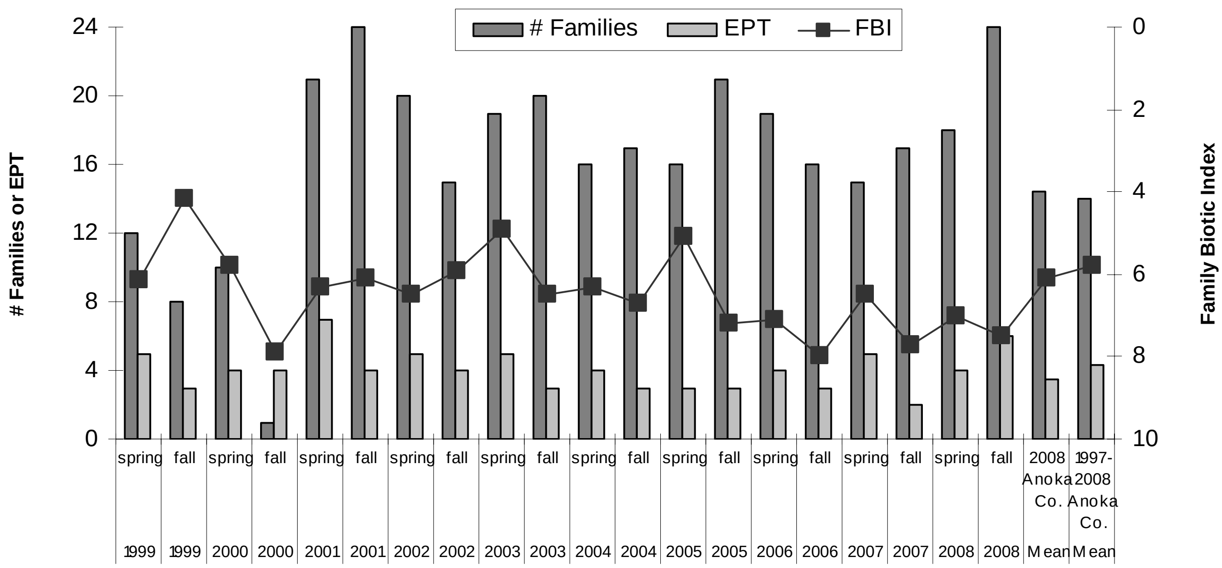


Clearwater Creek originates from Bald Eagle Lake in northwest Ramsey County and flows northwest into Peltier Lake. Land use is an approximately equal mix of residential and vacant/agricultural with some small commercial sites. The land use immediately surrounding the sampling site is entirely residential and developed, however in late summer 2007 a major city reconstruction project began near the stream monitoring site in Centerville, and large areas are being graded or disturbed. The stream banks are steep with erosion in spots. The streambed is composed of sand and silt with a few areas of gravel. The stream is 6-12 inches deep at baseflow and approximately 10-15 feet wide.

Results

Centennial High School classes monitored Clearwater Creek in both spring and fall 2008, with oversight by the Anoka Conservation District. Overall, this stream has average or slightly below average conditions based upon the biological data. The number of families found in 2008 (18 and 24), and in previous years, is more than typically found in Anoka County streams. The number of EPT families is typical of streams in this area. Still, the Family Biotic Index is poor. This is because there are few sensitive families. The families in high abundance are generalists that can survive in poor conditions. For example, in the last few years the most abundant families, representing 22-64% of captures, were corixidae (water boatmen), simulidae (blackfly larvae), and chironomidae (midges, which vary in pollution sensitivity).

Summarized Biomonitoring Results for Clearwater Creek in Centerville



Biomonitoring Data for Clearwater Creek in Centerville – All Years

Year	1999	1999	2000	2000	2001	2001	2002	2002	2003	2003	2004	2004
Season	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall
FBI	6.16	4.16	5.80	7.90	6.30	6.10	6.50	5.90	4.90	6.50	6.30	6.70
# Families	12	8	10	11	21	24	20	15	19	20	16	17
EPT	5	3	4	4	7	4	5	4	5	3	4	3
Date	10-Jun	28-Oct	1-May	12-Oct	18-May	2-Oct	21-May	8-Oct	1-May	7-Oct	20-May	7-Oct
sampling by	?	?	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS
sampling method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH
mean # individuals/rep	134	142	128	72	92.3	81.5	60.3	115	171	187	366	153
# replicates	1	1	1	1	4	5	4	1	4	1	1	1
Dominant Family	hyalellidae	hydropsychidae	chironomidae	corixidae	caenidae	hyalellidae	hyalellidae	hyalellidae	hydropsychidae	hyalellidae	baetidae	hyalellidae
% Dominant Family	24.6	71.1	52	67.3	18.4	47.8	26.2	27	38	33.2	32.3	48.4
% Ephemeroptera	5.2	17.6	24.2	23.6	23.3	19	19.5	11.3	18.7	26.2	57.1	27.5
% Trichoptera	3.7	71.1	0	18.1	0.8	21.8	7.5	20	38.6	0.5	0.3	2.6
% Plecoptera	5.2	0	0	0	0.3	0	1.2	0	0.0	0.0	0.3	0.0

Year	2005	2005	2006	2006	2007	2007	2008	2008	Mean	Mean
Season	spring	fall	spring	Fall	spring	fall	spring	fall	2008 Anoka Co.	1997-2008 Anoka Co.
FBI	5.10	7.20	7.10	8.00	6.50	7.70	7.00	7.50	6.2	5.8
# Families	16	21	19	16	15	17	18	24	14.4	14.0
EPT	3	3	4	3	5	2	4	6	3.8	4.3
Date	5-May	27-Sep	18-May	3-Oct		9-Oct	8-May	1-Oct		
sampling by	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS		
sampling method	MH	MH	MH	MH	MH	MH	MH	MH		
mean # individuals/rep	376	250	211	238	213	200	180	450		
# replicates	1	1	1	1	1	1	1	1		
Dominant Family	baetidae	corixidae	coenagrionidae	corixidae	chironomidae (other)	corixidae	Simuliidae	Corixidae		
% Dominant Family	63.3	40.4	22.3	64.7	20.2	53	27.8	42.3		
% Ephemeroptera	74.7	18.8	24.6	6.3	34.7	17.5	10.6	4.7		
% Trichoptera	0.0	0.8	0.0	0.4	0.0	0.0	2.2	0.7		
% Plecoptera	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

Parameter	10/7/03	5/20/04	10/7/04	5/20/05	9/26/05	5/18/06	10/3/06	5/5/07	10/9/07	5/5/08	10/1/08
pH	8.75	8.22	9.13	na	7.71	8.13	7.32	8.31	7.34	8.00	7.65
Conductivity (mS/cm)	0.624	0.274	0.314	0.352	0.293	0.451	0.578	0.639	0.400	0.452	0.607
Turbidity (NTU)	3	3	57	8	10	na	3	3	13	10	13
Dissolved Oxygen (mg/L)	9.84	na	9.72	8.43	9.25	11.52	6.18	12.57	6.52	11.84	8.74
Salinity (%)	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02
Temperature (C)	12.7	18.3	13.1	13.4	15.1	15.4	14.3	15.8	15.3	14.3	9.5

Discussion

This creek's biological community is probably limited by a combination of habitat, hydrology, and water chemistry factors. The portion of the creek that is monitored has been ditched, and is straight with steep banks, no pools or riffles, and homogeneous bottom composition. There is a strip of forested land approximately 20-50 feet wide on each side of the stream, but other areas upstream and downstream have less adjacent natural habitat. Flows are generally slow and water levels are low during much of the year, such that the stream sides are seldom submerged to provide habitat. When higher water does occur, it is usually during large storms. In our supplemental water chemistry measurements we have found occasions when one or more water quality parameters are substandard, but not necessarily during storms when runoff to the creek would be greatest. For example, the highly turbid condition noted in October 2004 was during a baseflow period when the water was barely moving. Likewise, high conductivity in fall 2003, 2006, 2007, and 2008 was during low water levels. Overall, this creek seems to provide enough habitat and good enough water quality for a variety of pollution-tolerant invertebrates, but more sensitive varieties are unable to survive.

The number of families found in this stream increased dramatically beginning in spring 2001. This is not necessarily due to an improvement in stream health. This coincided with increased sampling efforts (more students sampling) and improved execution of protocols.

HARDWOOD CREEK

at Hwy 140, Lino Lakes and 165th Ave NW, Hugo

Last Monitored

By Forest Lake Area Learning Center in 2008

Monitored Since

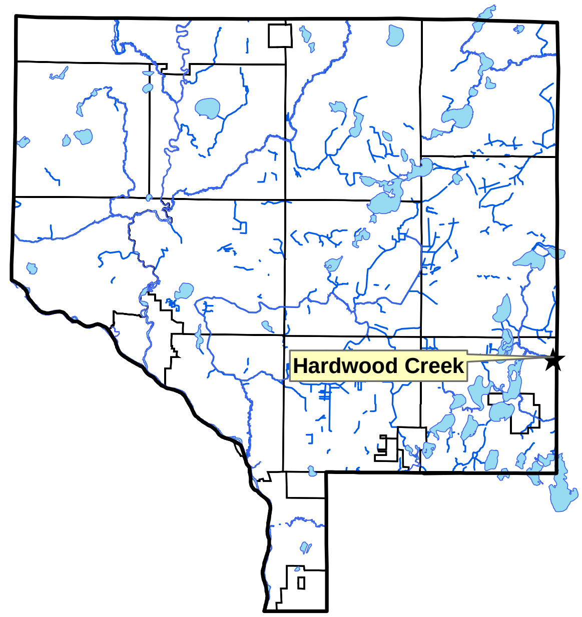
1999 to Fall 2007 at Hwy 140
Fall 2007 at 165th Ave NW
2008 SW of intersection of 170th St and Fenway Ave

Student Involvement

27 students in 2008, approx 160 since 2001

Background

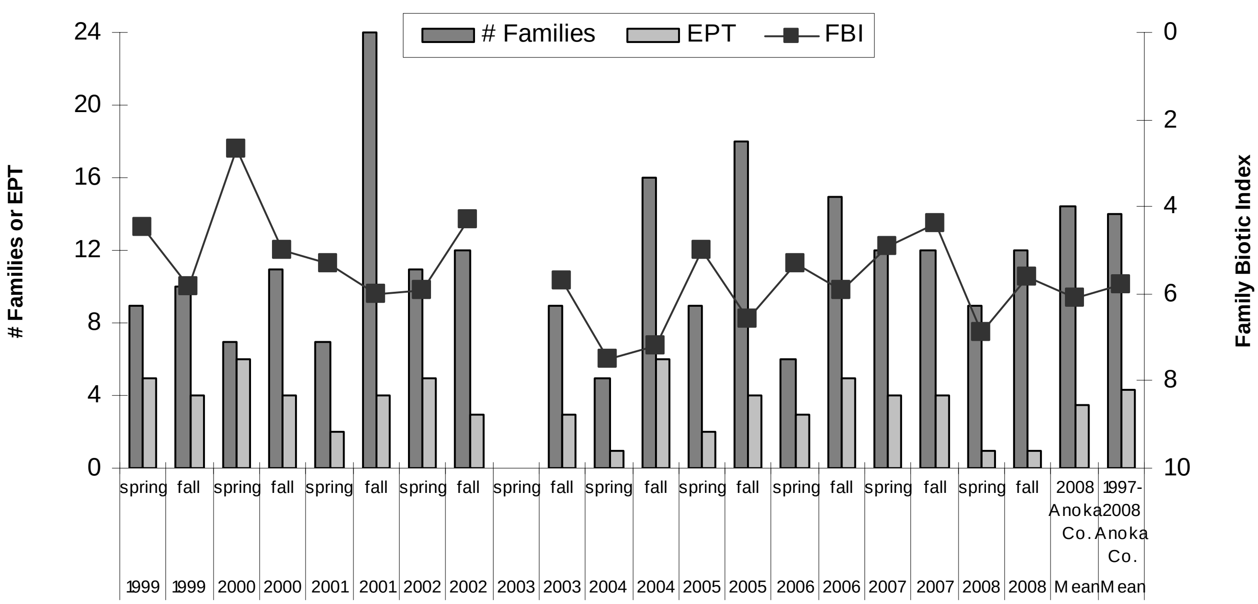
Hardwood Creek originates in Washington County and flows west to Rice Creek and the Rice Creek Chain of Lakes. This is a small creek with a width at baseflow of approximately 10-15 feet and depth of approximately 6-12 inches. The surrounding land use is primarily agricultural, with some residential areas. The stream bottom is sand, gravel, and some cobble in some locations such as at Highway 140 where the creek was monitored until fall 2007 when landowner permissions could no longer be obtained. Upstream locations monitored in 2008 have fewer in-stream habitat components.



Results

Forest Lake Area Learning Center classes monitored Hardwood Creek southwest of the intersection of 170th Street and Fenway Avenue in spring and fall 2008, facilitated by the Anoka Conservation District. This site had fewer rocks, riffles, pools, and other habitat types than previous monitoring locations. Compared to sites monitored in previous years, the number of families found and family biotic index (FBI) were similar, but fewer sensitive EPT families were found. While the FBI seemed similar to other nearby streams, other biological measures of stream health were lower. Overall, biological data indicate poorer than average stream health.

Summarized Biomonitoring Results for Hardwood Creek at Hwy 140, Lino Lakes



Biomonitoring Data for Hardwood Creek at Hwy 140, Lino Lakes – All Years

Year	1999	1999	2000	2000	2001	2001	2002	2002	2003	2003	2004	2004	2005	2005
Season	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall
FBI	4.48	5.85	2.69	5.00	5.30	6.00	5.90	4.30		5.80	7.50	7.20	5.00	6.60
# Families	9	10	7	11	7	24	11	12		9	5	16	9	18
EPT	5	4	6	4	2	4	5	3		3	1	6	2	4
Date	10-Jun	28-Oct	17-May	?	1-May	11-Oct	22-May	30-Sep	27-May	29-Sep	12-May	6-Oct	31-May	25-Oct
sampling by	ACD	ACD	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC
sampling method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH
# individuals	60	137	82	144	92	187.5	165	365	samples lost	171	82	306	94	219
# replicates	1	1	1	1	1	2	1	1		1	1	2	1	2
Dominant Family	heptagenidae	chironomidae	perlidae	baetidae	simulidae	gastropoda	simulidae	hydropyschidae		hydropsychidae	hyalellidae	hyalellidae	gammariidae	hyalellidae
% Dominant Family	57	62	68.3	32	63	13.7	73.9	79.7		43.3	78	34.4	48.9	43.4
% Ephemeroptera	80	26.3	29.3	49.3	30.4	12	10.3	9.3		7.6	0	17.8	36.2	10
% Trichoptera	1.7	0.7	1.2	22.2	0	2.9	4.2	79.7		43.3	2.4	4.1	0	19.2
% Plecoptera	6.7	0	68.3	0	0	0	0	0		0	0	0	0	0

Year	2006	2006	2007	2007	2008	2008	Mean	Mean
Season	spring	fall	spring	fall	spring	fall	2008 Anoka Co.	1997-2008 Anoka Co.
FBI	5.30	5.90	4.90	4.40	6.90	5.60	6.2	5.8
# Families	6	15	12	12	9	12	14.4	14.0
EPT	3	5	4	4	1	1	3.8	4.3
Date	10-May	10-Oct	8-May	5-Oct	15-May	8-Oct		
sampling by	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC		
sampling method	MH	MH	MH	MH	MH	MH		
# individuals	136	243	290	80	440	159		
# replicates	1	1	1	1	1	1		
Dominant Family	hydropsychidae	heptageniidae	baetidae	heptageniidae	Simuliidae	Dystidae		
% Dominant Family	60.3	53.1	27.9	48.8	49.1	57.2		
% Ephemeroptera	5.9	44.9	39.7	60	0	0.6		
% Trichoptera	60.3	5.3	1.4	2.5	0.2	0		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

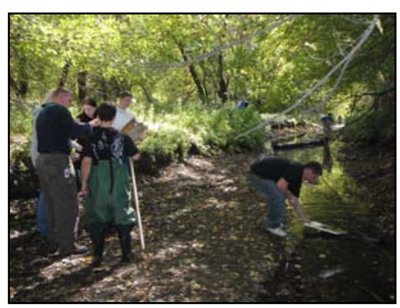
	Hwy 140 site									165th Ave site	Fenway Ave site	
Parameter	**5/27/03**	**9/29/03**	**5/12/04**	**10/6/04**	**5/31/05**	**10/25/05**	**5/10/06**	**10/10/06**	**5/8/07**	**10/12/07**	**5/15/08**	**10/8/08**
pH	7.39	9.08	8.66	9.00	10.33	8.10	7.27	8.05	7.97	7.26	7.13	7.46
Conductivity (mS/cm)	0.328	0.395	0.225	0.237	0.251	0.284	0.409	0.500	0.400	0.326	0.361	0.431
Turbidity (NTU)	9	3	10	na	27	21	13	4	3	5	13	11
Dissolved Oxygen (mg/L)	7.90	10.58	na	10.15	86.2%	12.25 (101%)	5.45	11.99	11.95	9.10	10.88 (101%)	7.14 (65%)
Salinity (%)	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.01	0.01	0.01
Temperature (C)	15.5	8.0	18.8	9.0	19.5	6.7	15.4	8.5	14.5	10.4	12.4	12.4

Discussion

Hardwood Creek is on the Minnesota Pollution Control Agency's 303(d) list of impaired waters for impaired biota and dissolved oxygen. The Rice Creek Watershed District is coordinating a TMDL investigative study. Our biological monitoring does indicate a below-average biological community, but lends only modest insight into what might be causing this impairment. Habitat seems to be an important factor. Biological indices of stream health seemed to decline when monitoring was moved from the north side of Highway 140, where habitat was moderate to good, to Fenway Avenue where little in-stream habitat exists. Other important factors affecting the biotic community probably include water quality and flow regimes (creek dried to just a few puddles at the site monitored in fall 2008, perhaps because of blockages elsewhere).

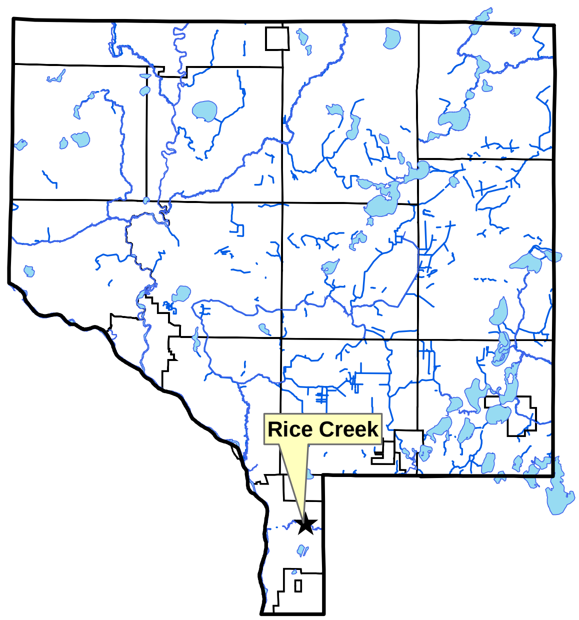
Spring 2008

Fall 2008



RICE CREEK

at Hwy 65, Locke Park, Fridley



Last Monitored

By Totino Grace High School in fall 2008

Monitored Since

1999

Student Involvement

25 students in 2008, approx 603 since 2001

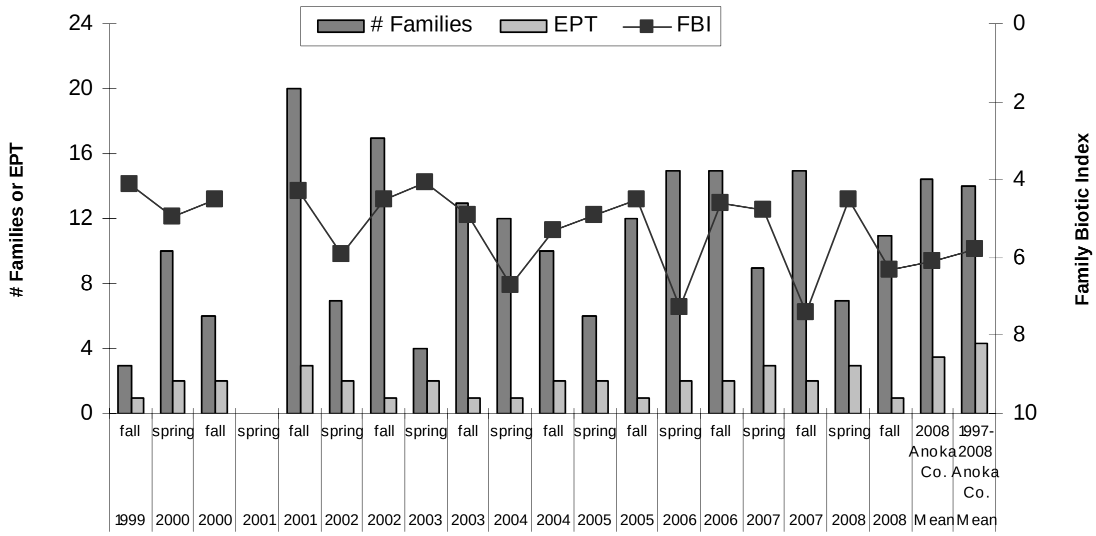
Background

Rice Creek originates from Howard Lake in east-central Anoka County and flows south and west through the Rice Creek Chain of Lakes and eventually to the Mississippi River. Sampling is conducted in Locke Park, which encompasses a large portion of the stream's riparian zone in Fridley. This site is wooded. Outside of this buffer, though, the watershed is highly urbanized and the stream receives runoff from a variety of urban sources. The stream has a rocky bottom with pools and riffles, some due to stream bank stabilization projects.

Results

Two Totino Grace High School classes monitored this stream in fall 2008, facilitated by the Anoka Conservation District (ACD). ACD staff monitored it in spring, when the school was unable. At first glance, it may appear that Rice Creek has only a slightly below average condition. A closer examination reveals a more strongly impaired macroinvertebrate community. While the number of families found is often similar to the average for Anoka County streams, virtually all of these are generalist species that can tolerate polluted conditions. In spring 2008 an especially low number of families, seven, were found because sampling was done by two ACD staff instead of large student groups who are more likely to find low-abundance families. Still, in fall the students found only one EPT family. EPT are generally pollution-sensitive, but the family found, the caddisfly hydropsychidae, is an exception to that rule. Hydropsychidae has been the most abundant family in 12 of 18 creek samplings, often >50% of catches. Overall, the invertebrate community of Rice Creek at near Highway 65 is poor.

Summarized Biomonitoring Results for Rice Creek at Hwy 65, Fridley



Biomonitoring Data for Rice Creek at Hwy 65, Fridley – All Years

Year	1999	2000	2000	2001	2001	2002	2002	2003	2003	2004	2004
Season	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall
FBI	4.11	4.95	4.50	not sampled	4.30	5.90	4.50	4.10	4.90	6.70	5.30
# Families	3	10	6		20	7	17	4	13	12	10
EPT	1	2	2		3	2	1	2	1	1	2
Date	11/15	4/26	10/3		10/9	6/10	10/16	6/18	10/9	6/9	10/13
sampling by	?	BHS	CHHS		CHHS	ACD	CHHS	ACD	CHHS	ACD	TGHS
sampling method	MH	MH	MH		MH	MH	MH	MH	MH	MH	MH
mean # individuals/rep	110	226	174		112.5	120	129.3	104	91	68	103
# replicates	1	1	1		4	1	3	1	2	1	1
Dominant Family	hydropyschidae	hydropyschidae	hydropyschidae		hydropsychidae	simulidae	hydropsychidae	hydropsychidae	hydropsychidae	veliidae	hydropsychidae
% Dominant Family	92.7	66.4	78		88	51.7	83	96.2	58.2	19.1	65.0
% Ephemeroptera	0	0.4	10.9		1.3	0.8	0	1.9	0.0	0.0	1.0
% Trichoptera	92.7	66.4	77.6		88.2	27.5	83	96.2	58.2	8.8	65.0
% Plecoptera	0	0	0		0	0	0	0	0.0	0.0	0.0

Year	2005	2005	2006	2006	2007	2007	2008	2008	Mean	Mean
Season	spring	fall	spring	fall	spring	fall	spring	fall	2007 Anoka Co.	1997-2006 Anoka Co.
FBI	4.90	4.50	7.30	4.60	4.80	7.40	4.50	6.30	6.2	5.7
# Families	6	12	15	15	9	15	7	11	14.4	13.9
EPT	2	1	2	2	3	2	3	1	3.8	4.4
Date	11-May	19-Oct	17-May	27-Sep	10-May	2-Oct	23-May	10-Oct		
sampling by	TGHS	TGHS	ACD	TGHS	ACD	TGHS	ACD	TGHS		
sampling method	MH	MH	MH	MH	MH	MH	MH	MH		
mean # individuals/rep	149	378	106	166	116	132	180	104		
# replicates	1	1	1	3	1	2	1	1		
Dominant Family	hydropsychidae	hydropsychidae	corixidae	hydropsychidae	baetidae	corixidae	Baetidae	Hydropsychidae		
% Dominant Family	44.3	87.6	24.5	81.7	49.1	61.2	70.0	40.0		
% Ephemeroptera	22.1	0.0	3.1	0.2	49.1	0.4	74.4	0.0		
% Trichoptera	44.3	87.6	0	81.7	13.8	27.6	7.2	42.3		
% Plecoptera	0	0	0	0.0	0.0	0.0	0	0		

Supplemental Stream Chemistry Readings

Parameter	6/18/03	10/14/03	6/9/04	10/13/04	5/11/05	10/19/05	5/18/06	9/27/06	5/10/07	10/2/07	5/23/08	10/10/08
pH	7.86	8.22	8.14	9.12	8.84	8.02	8.23	7.80	8.25	7.85	8.12	7.73
Conductivity (mS/cm)	0.405	0.639	0.249	0.365	0.324	0.264	0.457	0.515	0.401	0.402	0.461	0.639
Turbidity (NTU)	7	6	6	6	5	7	na	13	65	25	15	13
Dissolved Oxygen (mg/L)	7.0	6.87	6.53	9.15	10.43	9.02	9.95	9.65	Na	9.06	9.56 (102%)	9.01 (85%)
Salinity (%)	0.01	0.02	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02
Temperature (C)	25.6	11.0	22.0	13.1	16.8	13.7	16.8	14.8	20.6	16.8	19.0	12.9

Discussion

The poor macroinvertebrate community in this creek is likely due to poor water quality, not poor habitat. Habitat at the sampling site and nearby is good, in part because of past stream habitat improvement projects. The stream has riffles, pools, and runs with a variety of snags and rocks. The area immediately surrounding the stream is wooded, with walking trails. However, outside of this natural corridor around the stream, the watershed is urbanized and storm water inputs probably degrade water quality.

Totino Grace High School students at Rice Creek.

Water Quality Improvement Projects

Description: Projects on either public or private property that will improve water quality, such as repairing streambank erosion, restoring native shoreline vegetation, or rain gardens. These projects are partnerships between the landowner, the Anoka Conservation District, and sometimes with grant funding from the watershed organization or the Anoka Conservation District.

Purpose: To improve water quality in lakes streams and rivers by correcting erosion problems and providing buffers or other structures that filter runoff before it reaches the water bodies.

Results: Projects are described individually below. Many other projects have also been completed by the Rice Creek Watershed District that are not reported here.

Metcalf Lakeshore Restoration, Moore Lake

The Metcalf property lies on the shore of Moore Lake. The purpose of this project was to provide some near-shore habitat and some filtering of runoff to the lake. Prior to the restoration, the shoreline consisted of debris. The plant community was dominated by turf grass, a variety of invasive plant species, and limited native plant species. The debris was removed, a small strip of native plants was established at the water's edge, and a biolog was placed near shore for additional protection. This project was funded primarily by the landowner, but with some funding from Anoka County Ag Preserves grants, watershed district grants, and with technical assistance from the Anoka Conservation District.

Homeowner Guide

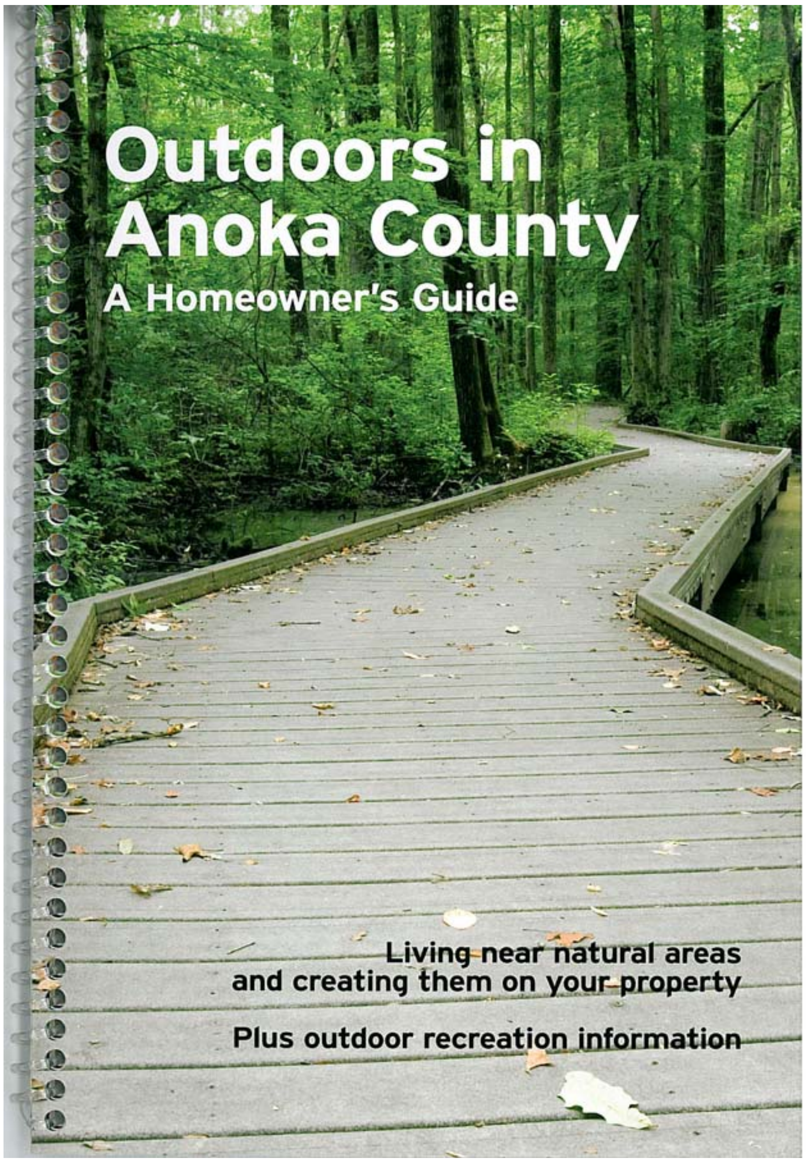
Description: The Anoka Conservation District (ACD) wrote, designed, and printed an educational booklet for homeowners. The booklet included information on topics of interest to the RCWD, including landscaping for water quality, wetlands, well water, septic systems, and hazardous household wastes.

Purpose: To educate homeowners about topics that will impact local natural resources.

Locations: Throughout the watershed.

Results: "Outdoors in Anoka County – a homeowner's guide" was written, laid out by a graphic designer, and printed in 2007. Distribution of the booklet was primarily to homes adjacent to notable natural resources in the northern third of Anoka County, however 19 booklets were distributed to selected homes in the RCWD area.

Homeowner's Guide Cover



Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program, such as our lake water quality monitoring program. We do not, however, know specifically which expenses are attributed to monitoring which lakes. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer. The process also takes into account equipment that is purchased for monitoring in a specific area.

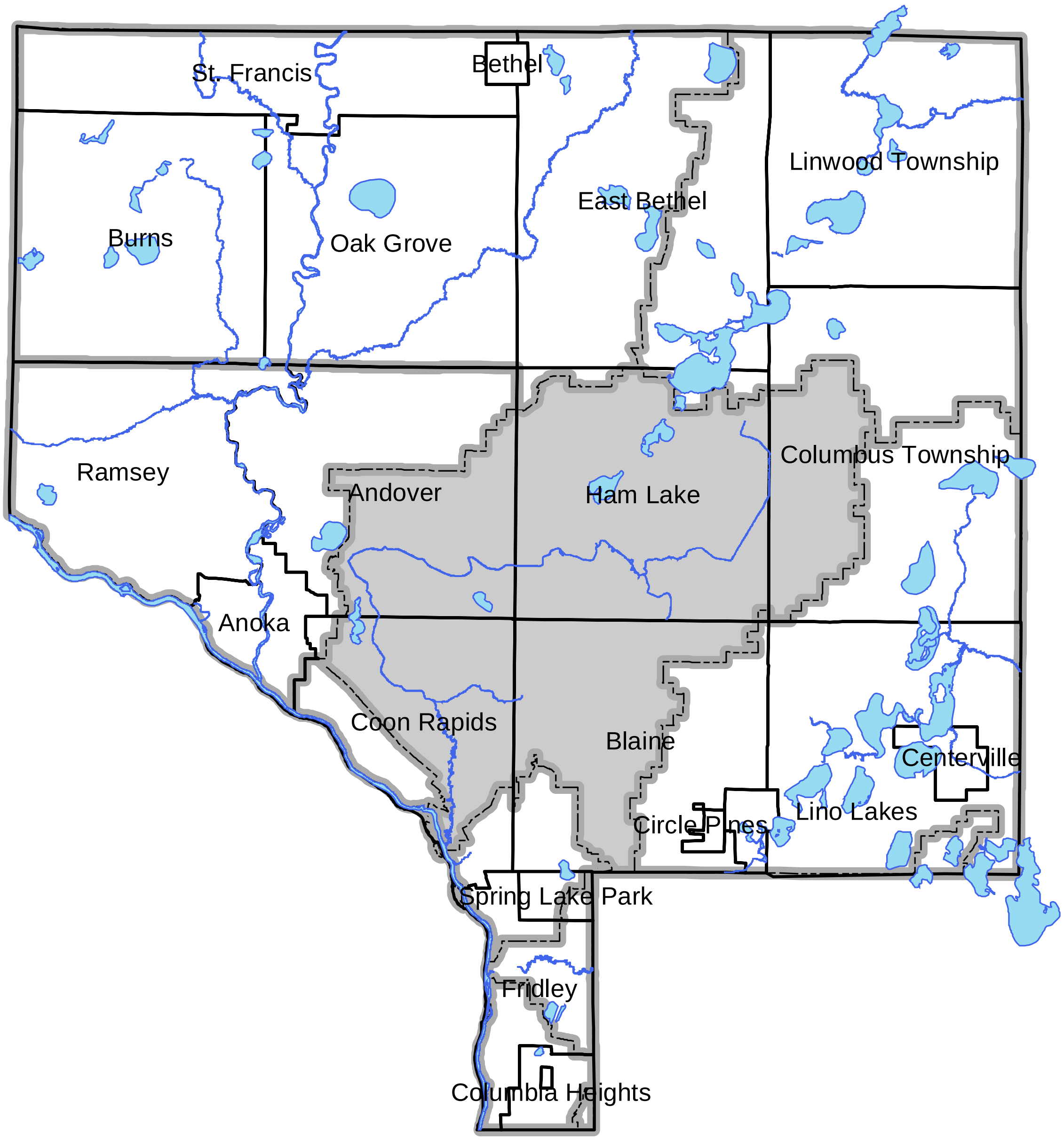
Rice Creek Watershed Financial Summary

Rice Creek Watershed	Precipitation Monitoring	Wetland Hydrology	Lake Levels	Groundwater Observation Wells	Student Biomonitoring	Metcalf Lakeshore Restoration	Outdoor Guide	Total
Revenues								
RCWD	0	1575	0	0	2250	0	0	3825
State	0	0	0	240	0	0	0	240
Anoka Conservation District	77	0	1905	359	424	0	23	2789
County Ag Preserves	0	56	0	0	1755	236	0	2046
Other Service Fees	57	0	238	0	0	772	0	1066
Local Water Planning	0	87	0	0	0	0	0	87
TOTAL	134	1718	2143	599	4429	1007	23	10053
Expenses-								
Capital Outlay/Equip	2	283	35	8	71	0	0	398
Personnel Salaries/Benefits	110	1132	1814	497	3440	0	16	7009
Overhead	11	114	143	46	260	0	3	576
Employee Training	2	20	30	7	55	0	1	115
Vehicle/Mileage	4	50	53	21	91	0	1	220
Rent	5	62	62	22	100	0	2	253
Program Participants	0	0	0	0	0	0	0	0
Program Supplies	1	56	6	0	412	1007	0	1482
Equipment Maintenance	0	0	0	0	0	0	0	0
TOTAL	134	1718	2143	599	4429	1007	23	10053
NET	0	0	0	0	0	0	0	0

Recommendations

- **Find a new Hardwood Creek biomonitoring location** or drop this creek from the program. The current site is a poor outdoor classroom for student groups.
- **Secure new volunteers to monitor lake levels on Reshanau and Rondeau Lakes.** The previous volunteers "retired."
- **Abandon the Target Reference Wetland monitoring site.** It serves as a stormwater pond, and is not representative of most wetlands.
- **Improve the ecological health of Clearwater, Hardwood, and Rice Creeks.** Hardwood and Clearwater Creeks are designated as "impaired" for aquatic life (based on fish IBI's) by the MPCA. Rice Creek does not have this designation and its fish community monitoring does not indicate problems, but its macroinvertebrate community is troubled, perhaps due to water quality degradation by storm water inputs.
- **Expand the network of reference wetlands** to include altered and ditched sites. These aid in accurate wetland regulatory determinations.
- **Address water quality and invasive species problems in Moore Lake**. Storm water inputs and over-abundant waterfowl are likely sources of water quality problems. Storm water conveyance system retrofits and a ban on feeding waterfowl are two generalized options for addressing these. Herbicide treatments could be pursued for invasive aquatic plant control, though multiple years of whole-lake treatment would likely be needed.

Coon Creek Watershed



Contact Info: Coon Creek Watershed District
www.cooncreekwd.org
763-755-0975

Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 6:
COON CREEK WATERSHED

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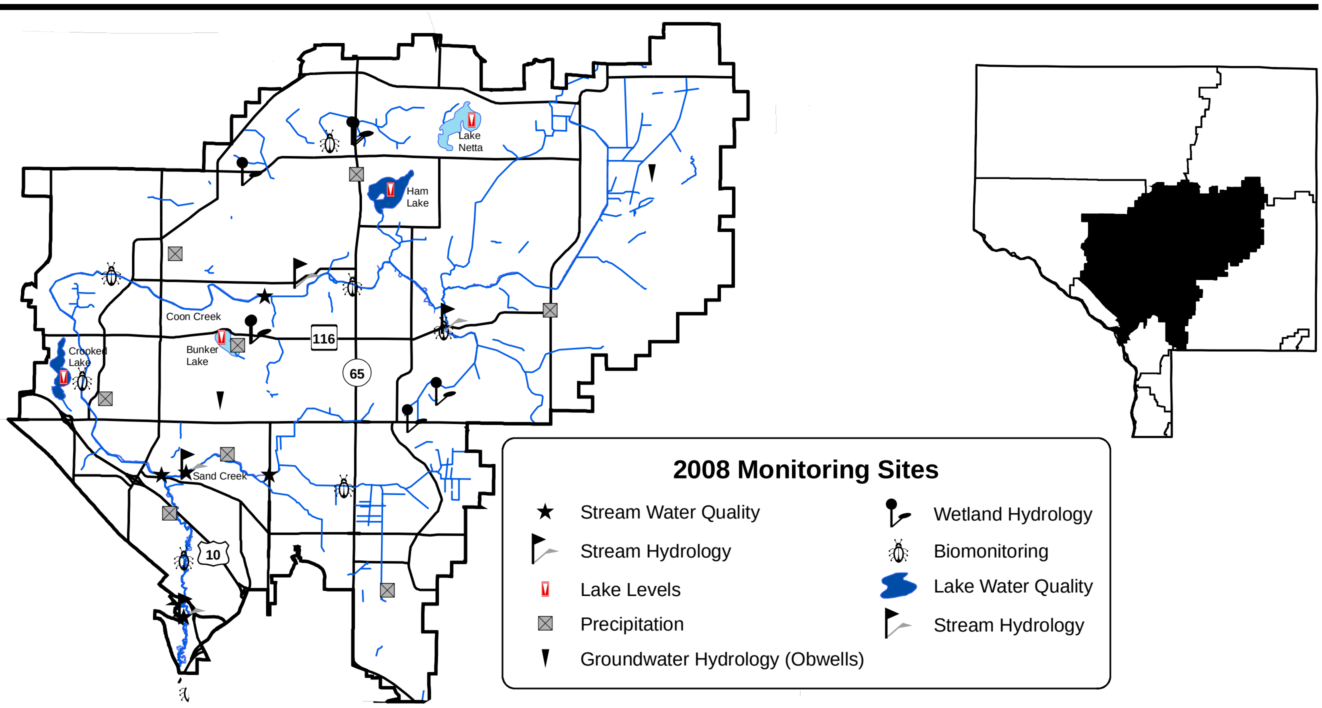
ACAP = Anoka County Ag Preserves, ACD = Anoka Conservation District, CCWD = Coon Creek Watershed District, CLA - Crooked Lake Association, MNDNR = Minnesota Dept. of Natural Resources



Precipitation

Description: Continuous monitoring of precipitation with both data-logging rain gauges and non-logging rain gauges that are read daily by volunteers. Rain gauges are placed around the watershed in recognition that rainfall totals and storm phenology vary over distance, and these differences are critical to understanding local hydrology, including predicting flooding.

Purpose: To aid in all types of hydrologic analyses, predictions, and regulatory decisions within the watershed.

Locations: Anoka Conservation District office, Ham Lake (cylinder gauge read daily)

Anoka Conservation District office, Ham Lake (datalogging gauge)

Blaine Public Works, off 101st Ave, Blaine

Bunker Hills Regional Park Activity Center, Andover

Coon Rapids City Hall, Coon Rapids

Myhre residence, Andover

Northern Natural Gas Substation at Lexington Blvd and Bunker Lake Blvd, Ham Lake

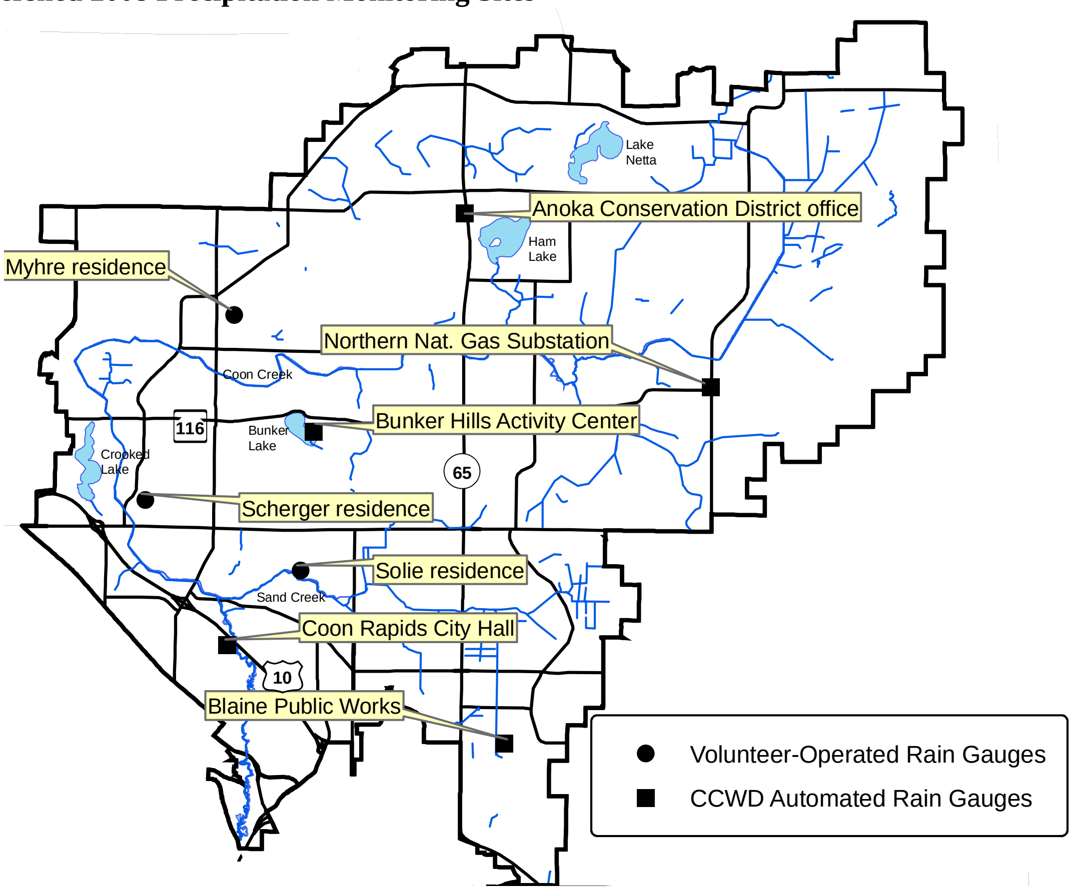
Scherger residence, Coon Rapids

Solie residence, Coon Rapids

Note: Additional county-wide precipitation summaries can be found in Chapter 1.

Results: Precipitation data were reported to the Coon Creek Watershed in digital format. A summary table and graph are presented on the following page.

Coon Creek Watershed 2008 Precipitation Monitoring Sites

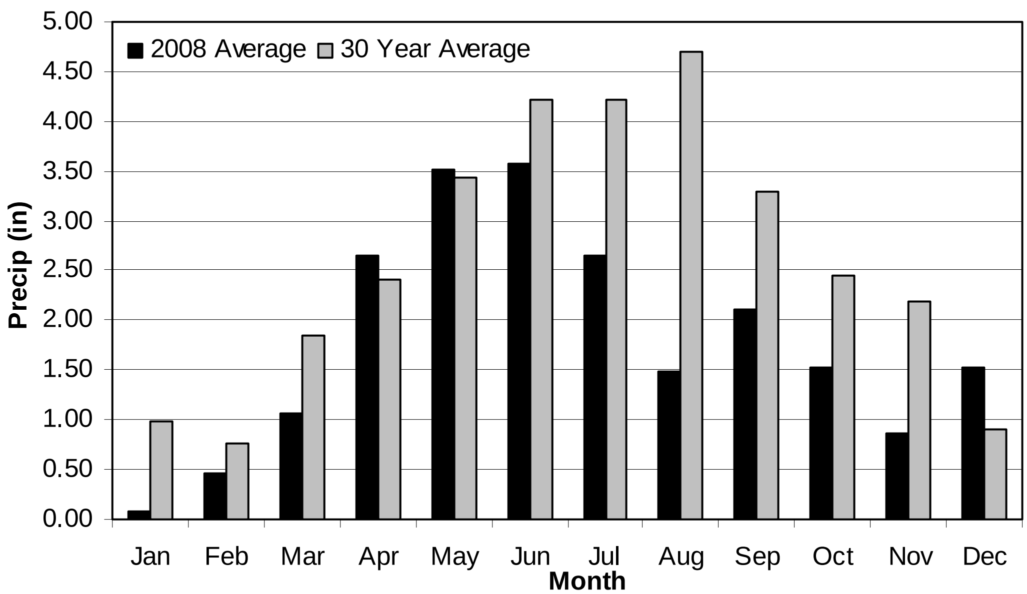


Coon Creek Watershed 2008 Precipitation Summary Table and Graph

Site	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total	Growing Season (May-Sept)
							Month								
ACD Office	Ham Lake				1.40	3.38	4.28	2.42	1.15	2.37	1.77			16.77	13.60
CCWD- Blaine Public Works	Blaine				3.33	3.47	2.32			1.53				10.65	7.32
CCWD- Bunker Hills Park	Andover				2.59	3.27	2.98	2.19	1.38	1.72	1.46			15.59	11.54
CCWD- Northern Nat. Gas	Ham Lake				3.25	4.30	2.97	3.54	1.59	2.06	1.36			19.07	14.46
CCWD- ACD office	Ham Lake				1.40	3.38	4.31	2.60	0.57	2.44	1.86			16.56	13.30
CCWD- Coon Rapids City Hall	Coon Rapids				2.50	3.55	3.64	2.42	1.90	2.21	1.46			17.68	13.72
N. Myhre	Andover	0.08	0.47	1.06	3.42	3.63	3.75	2.30	1.44	2.11	1.51	0.86	1.52	22.15	13.23
S. Scherger	Coon Rapids				3.29	3.60	3.59		1.65	2.34	1.53			16.00	11.18
S. Solie	Coon Rapids					3.08	4.35	3.15	2.25	2.14	1.27			16.24	14.97
2008 Average	County-wide	0.08	0.47	1.06	2.65	3.52	3.58	2.66	1.49	2.10	1.53	0.86	1.52	21.51	13.35
30 Year Average	Cedar	0.99	0.76	1.84	2.40	3.43	4.22	4.21	4.70	3.29	2.44	2.18	0.90	31.36	19.85

precipitation as snow is given in melted equivalents

CCWD gauges are datalogging. All others are cylinders read daily.



Precipitation Analyses

Description: Two different precipitation analyses were done – 1) 2008 storms analyses and 2) long term precipitation trend analysis. The second analysis is reported below.

1.) **2008 Storms Analyses:** Precipitation events at each of the five Coon Creek Watershed District data-logging rain gauges were analyzed. Total precipitation, storm duration, intensity, and recurrence interval were determined for all precipitation events of >0.03 inches. Storms with a recurrence that was two months or longer were analyzed further. For those storms intensity was tracked throughout the storm and graphed (similar to storm typing, but a type was not assigned). The rate of effective precipitation was determined from the rainfall intensity and surrounding soil type. Effective precipitation was defined as precipitation occurring at an intensity that is lower than the soil infiltration rate (i.e. rain that soaks in and doesn't run off).

   The results this analysis were delivered to the Coon Creek Watershed District in digital form and are not reported here due to complexity and lengthiness.

2.) **Long Term Precipitation Trends Analysis:** Monthly rainfall deviations from normal were graphed for 1986 to present utilizing data from the National Weather Service (NWS) station closest to the middle of the Coon Creek Watershed District. Normal precipitation totals for each month are from the NWW Cedar station. Deviation from normal during the preceding 6- and 12-month time periods were calculated and graphed.

Purpose: To aid in hydrologic modeling of the watershed. Also useful for all types of hydrologic analyses, predictions, and regulatory decisions within the watershed.

Locations: Anoka Conservation District office, Ham Lake

Blaine Public Works, off 101st Ave, Blaine

Bunker Hills Regional Park Activity Center, Andover

Coon Rapids City Hall, Coon Rapids

Ham Lake City Hall, near 157th Ave and Hwy 65, Ham Lake

Northern Natural Gas Substation at Lexington Blvd and Bunker Lake Blvd, Ham Lake

Results:

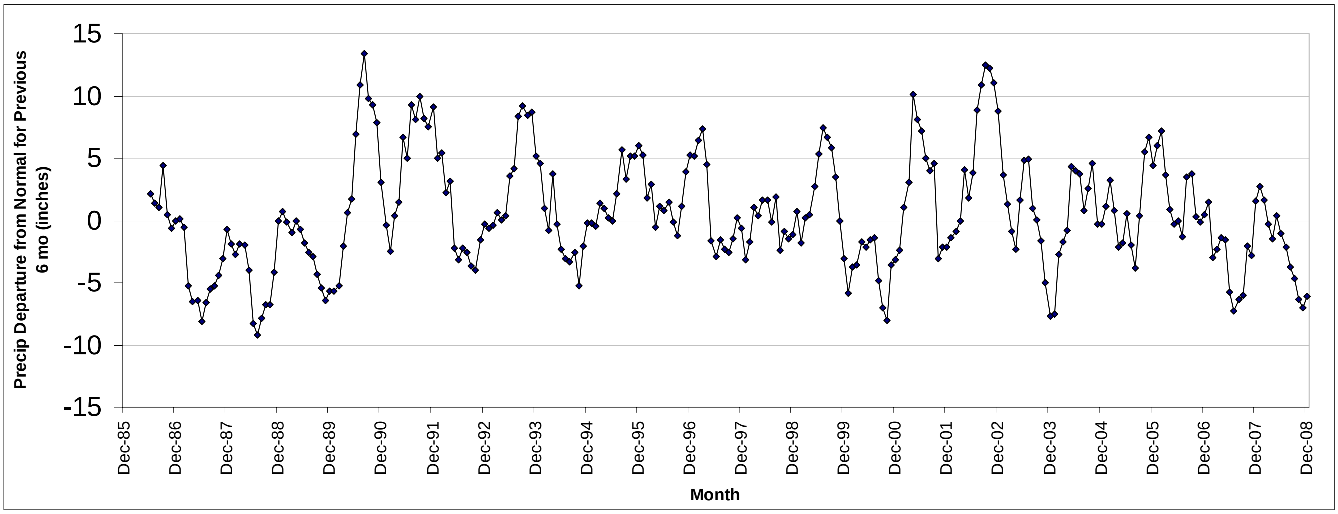
1.) **2008 Storms Analyses:** The results of this analysis were delivered to the Coon Creek Watershed District in digital form and are not reported here due to complexity and lengthiness.

2.) **Long Term Precipitation Trends Analysis:** Results are presented on the following page.

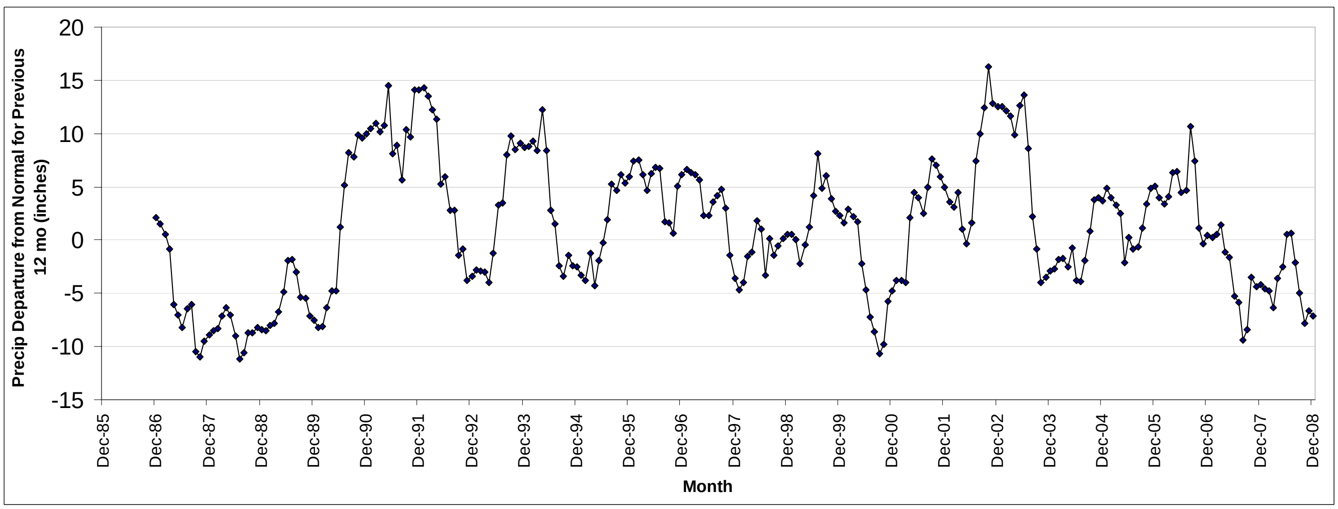
Long Term Precipitation Trends

Notes: Period is 1986 to present. Monthly precipitation totals are from the NWS station nearest the center of the Coon Creek Watershed District with available data (MN State Climatology website). Normal precipitation totals for each month are from the NWS Cedar station.

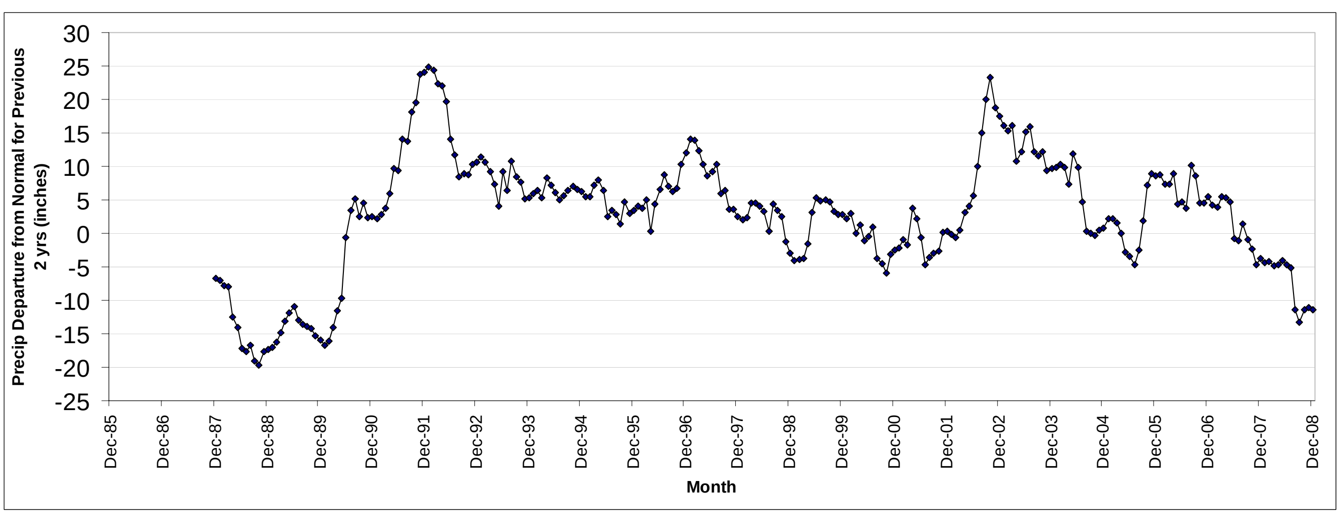
Precipitation departure from normal during the previous 6 months



Precipitation departure from normal during the previous 12 months



Precipitation departure from normal during the previous 2 years



Lake Levels

Description: Weekly water level monitoring in lakes. These data, as well as all additional historic data are available on the Minnesota DNR website using the “LakeFinder” feature (www.dnr.mn.us.state \lakefind\index.html).

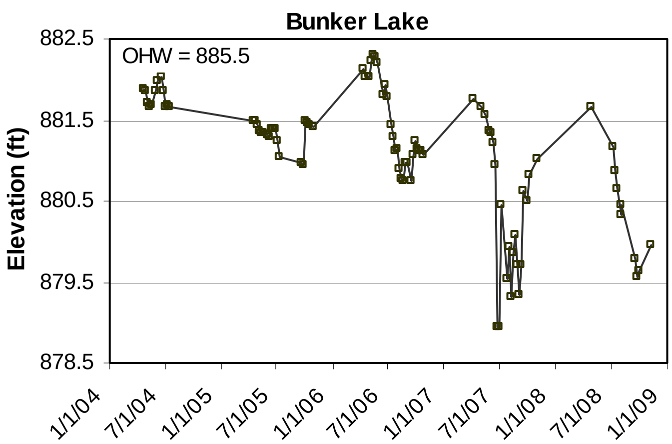
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

Locations: Bunker Lake, Ham Lake, Lake Netta, Crooked Lake

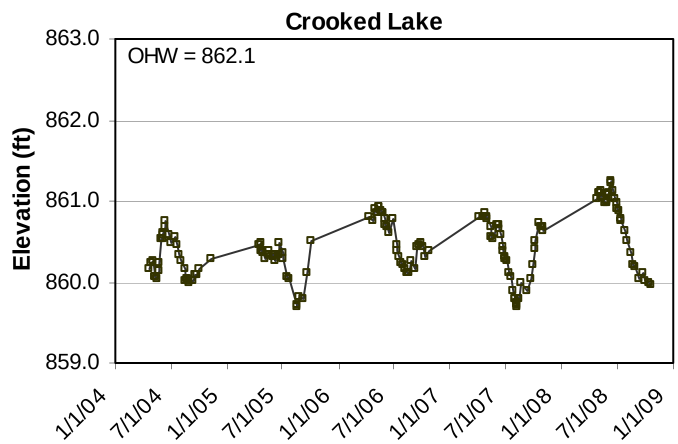
Results: Lake levels were measured 22 to 30 times, depending upon the lake, except for Bunker Lake. At Bunker Lake 10 total measurements were taken, mostly by ACD staff and not by the volunteer who had been secured to do the work. Water levels of these four lakes fell throughout summer 2008. Bunker Lake has proven especially difficult to measure in recent years, including 2008, because only a small, unreachable area of open water is present by mid-summer. To overcome this, water levels in the lake muck were measured inside a perforated PVC well.

Ordinary High Water Levels (OHW), the elevation below which a DNR permit is needed to perform work, are listed for each lake on the graph.

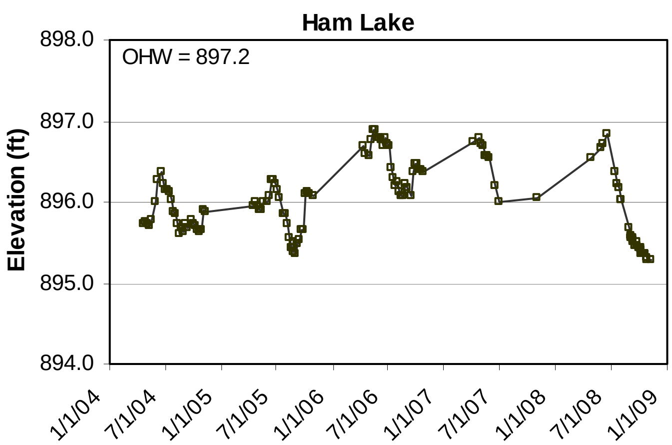
Bunker Lake Levels 2004-2008



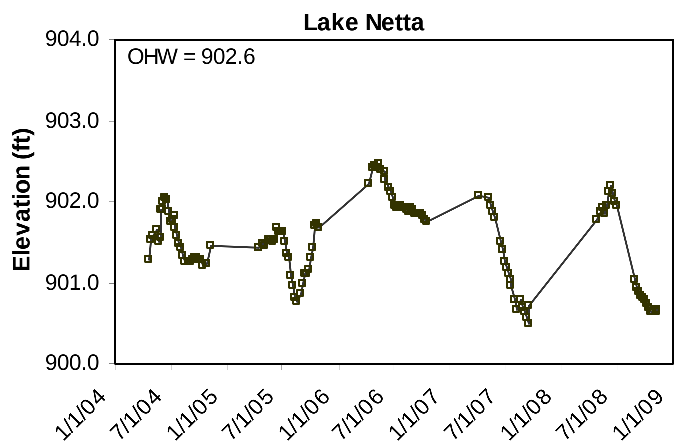
Crooked Lake Levels 2004-2008



Ham Lake Levels 2004-2008



Netta Lake Levels 2004-2008



Coon Creek Watershed Lake Levels Summary 2004-2008

Lake	Year	Average	Min	Max
Bunker	2004	881.80	881.66	882.04
	2005	881.33	880.94	881.50
	2006	881.45	880.75	882.31
	2007	880.39	878.95	881.77
	2008	880.41	879.57	881.66
Crooked	2004	860.27	859.99	860.75
	2005	860.23	859.68	860.51
	2006	860.54	860.10	860.92
	2007	860.35	859.68	860.86
	2008	860.75	859.96	861.24
Ham	2004	895.85	895.61	896.36
	2005	895.85	895.37	896.26
	2006	896.48	896.07	896.89
	2007	896.49	895.99	896.78
	2008	895.74	895.29	896.83
Netta	2004	901.55	901.21	902.05
	2005	901.36	900.76	901.72
	2006	902.05	901.76	902.46
	2007	901.17	900.49	902.07
	2008	901.32	900.63	902.19

Lake Water Quality

Description: May through September twice-monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, Secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

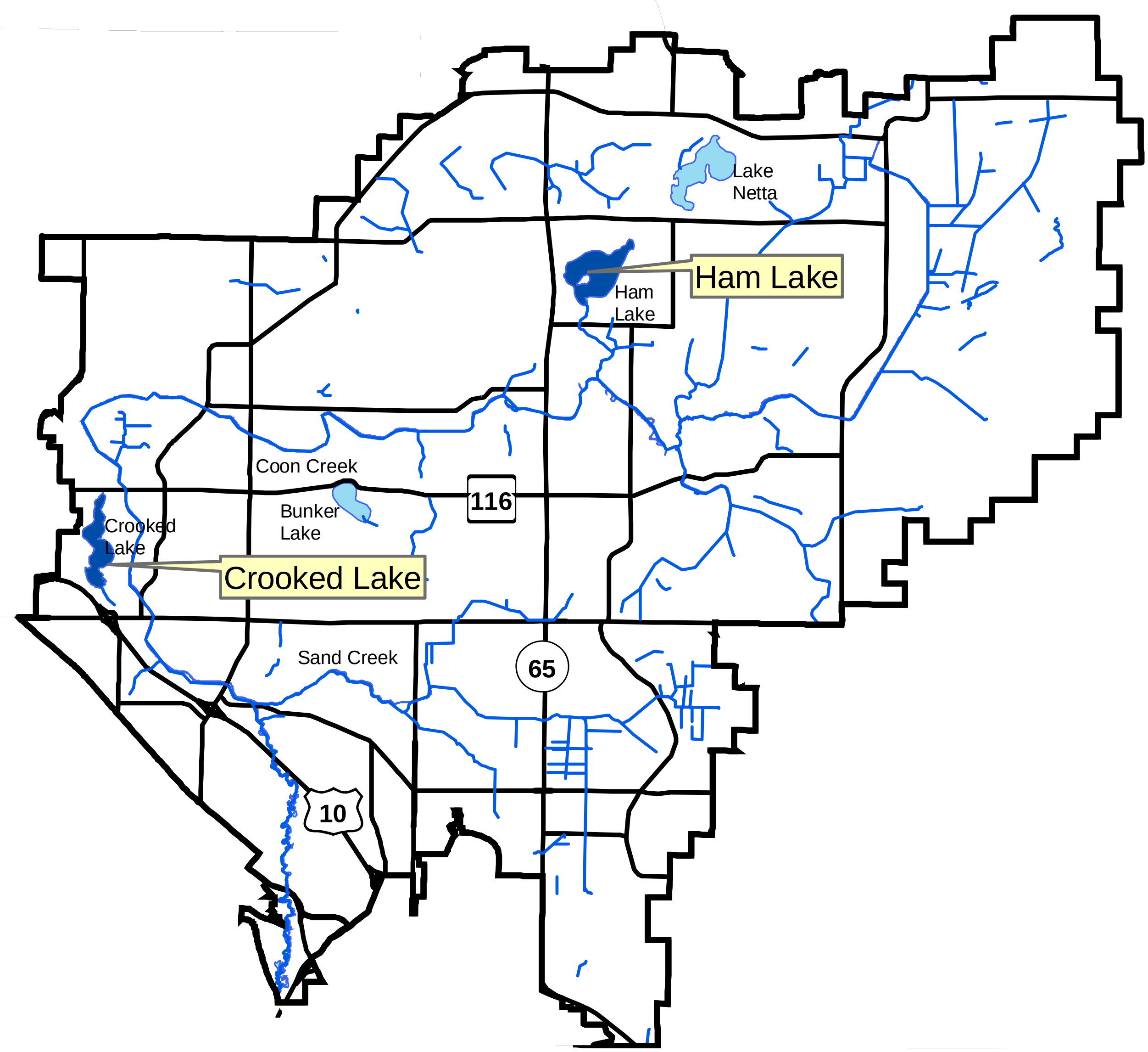
Purpose: To detect water quality trends and diagnose the cause of changes.

Locations: Crooked Lake

Ham Lake

Results: Detailed data for each lake are provided on the following pages, including summaries of historical conditions and trend analysis. Previous years' data are available from the ACD. Refer to Chapter 1 for additional information on interpreting the data and on lake dynamics.

Coon Creek Watershed 2008 Lake Water Quality Monitoring Sites



Crooked Lake

CITIES OF ANDOVER AND COON RAPIDS, LAKE ID # 02-0084

Background

Crooked Lake is located in west-central Anoka County, lying half in Andover and half in Coon Rapids. It has a surface area of 117.5 acres with a maximum depth of 26 feet (7.9 m). Public access is from two locations, at a boat launch off Bunker Lake Boulevard and at a City of Coon Rapids Park on the east side of the lake where a fishing pier is located. The lake is used extensively by recreational boaters and fishers. Most of the lake is surrounded by tightly-packed single family homes. The watershed is urban/developed.

In 1990 Eurasian Water Milfoil was discovered in the lake, followed by a whole-lake treatment with fluridone in 1992 that eradicated nearly all aquatic vegetation. Eurasian Water Milfoil was discovered again in 1996. In 2002 the DNR implemented a low dose of fluridone, which has eliminated or nearly eliminated the milfoil, while having a lesser impact on other vegetation. In 2005 ACD staff noticed an abundance of curly leaf pondweed in spring.

2008 Results

In 2008 Crooked Lake had slightly above-average water quality for this region of the state (NCHF Ecoregion), receiving an overall B grade. It had earned a B letter grade the previous seven years. Overall, the lake is slightly eutrophic. In 2008 Crooked Lake water quality was the best of all monitored years since 1975, when monitoring began. Average total phosphorus in 2008 was the lowest of all monitored years, and chlorophyll-a and clarity were only 0.5 ug/L and 0.1 ft poorer than the best ever observed. Still, the water was not perfect. ACD staff noted “definite algae” present from July to early September, and “some algae” other times of year. A mild swimming impairment coincided with the periods of higher algae.

Trend Analysis

Fourteen years of water quality data have been collected by the Metropolitan Council (between 1983 and 1998) and the Anoka Conservation District (between 2000 and 2008) with eight additional years of Secchi measurements by citizens. Water quality has significantly improved from 1983 to 2008 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,11}$=18.62, p=0.0003). Most improvements occurred between 1989 and 1994. If only data after 1993 are examined, Secchi transparency has an improving trend, but total phosphorus and chlorophyll-a are statistically unchanged (one-way ANOVAs).

Discussion

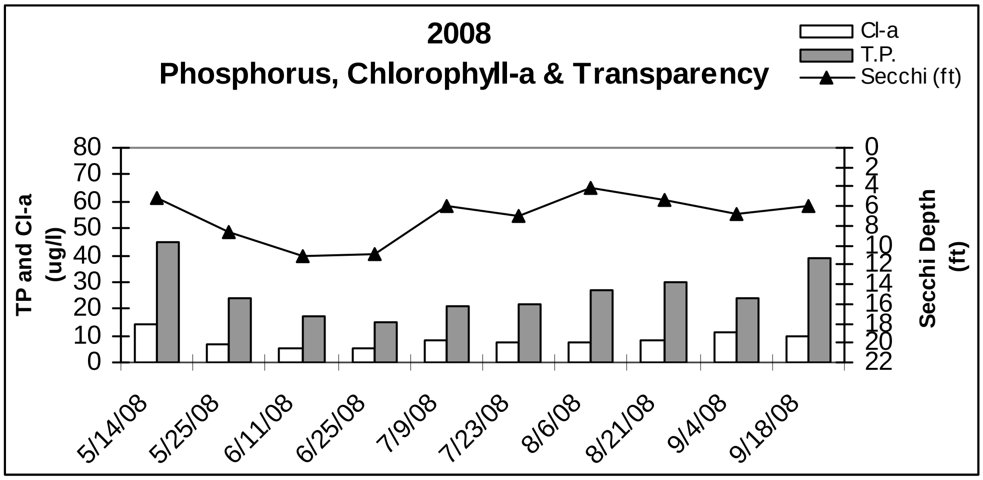
The Crooked Lake Association and Coon Creek Watershed District are preparing a Crooked Lake Managemnt Plan, which is likely to be completed in 2009. This plan addresses issues including nuisance growth of invasive exotic aquatic plants, poor shoreline mangagement, urban runoff, and waterfowl. Aquatic plants, including an abundance of non-native curly leaf pondweed are matted to the surface in some near-shore areas, especially at the north end during spring. Manicured shorelines and boat wakes on this long, narrow lake are likely contributing to shoreline erosion and runoff to the lake. Boat traffic may suspend lake bottom sediments. Measures that could be considered to protect and improve the lake include correcting shoreline erosion, installing shoreline buffers of native plants, and storm water system retrofits.

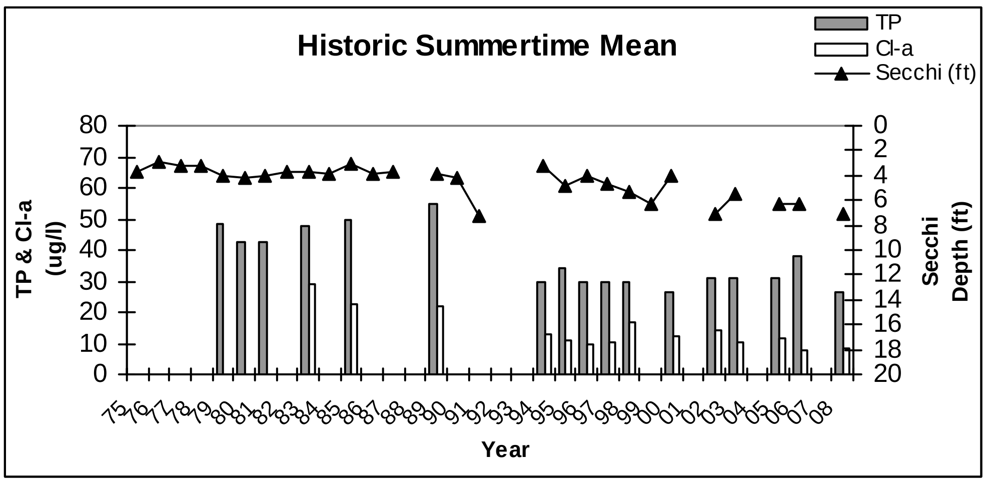
2008 Crooked Lake Water Quality Data

Crooked Lake 2008			5/14/2008	5/25/2008	6/11/2008	6/25/2008	7/9/2008	7/23/2008	8/6/2008	8/21/2008	9/4/2008	9/18/2008			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.65	8.73	8.30	8.55	8.46	8.42	8.21	8.29	8.08	8.25	8.39	8.08	8.73
Conductivity	mS/cm	0.01	0.453	0.444	0.422	0.414	0.437	0.448	0.450	0.478	0.472	0.471	0.449	0.414	0.478
Turbidity	FNRU	1	9	8	3	4	4	6	5	4	3	5	5	3	9
D.O.	mg/L	0.01	10.93	10.27	8.94	9.64	6.67	8.47	7.06	8.42	7.90	9.07	8.49	6.67	10.27
D.O.	%	1	105%	107%	98%	115%	93%	104%	87%	104%	90%	98%	100%	87%	115%
Temp.	°C	0.10	13.6	17.4	20.0	24.4	25.0	25.8	25.8	25.0	21.7	18.9	21.8	13.6	25.8
Temp.	°F	0.10	56.5	63.3	68.0	75.9	77.0	78.4	78.4	77.0	71.1	66.0	71.2	56.5	78.4
Salinity	%	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cl-a	mg/L	0.5	13.9	7.1	5.5	5.5	8.5	7.6	7.4	8.2	11.4	9.9	8.5	5.5	13.9
T.P.	mg/L	0.010	0.045	0.024	0.017	0.015	0.021	0.022	0.027	0.030	0.024	0.039	0.026	0.015	0.045
T.P.	ug/L	10	45	24	17	15	21	22	27	30	24	39	26	15	45
Secchi	ft	0.1	5.1	8.7	11.0	10.8	6.0	6.9	4.2	5.3	6.8	5.9	7.1	4.2	11.0
Secchi	m	0.1	1.6	2.7	3.4	3.3	1.8	2.1	1.3	1.6	2.1	1.8	2.2	1.3	3.4
Field Observations															
Physical			2.0	3.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	2.7	2.0	3.0
Recreational			2.0	3.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	2.6	2.0	3.0

*reporting limit

Crooked Lake Water Quality Results





Crooked Lake Historical Summertime Mean Values

Agency	CAMP	CAMP	CAMP	CAMP	CAMP	CAMP	CAMP	CAMP	MC	CAMP	MC	CAMP	CAMP	MC	CAMP	CAMP
Year	75	76	77	78	79	80	81	82	83	84	85	86	87	89	90	91
TP					48.5	42.8	42.3		48.0		50.0			55.0		
Cl-a									29.2		22.7			21.7		
Secchi (m)	1.1	0.9	1.0	1.0	1.2	1.3	1.2	1.1	1.1	1.2	1.0	1.2	1.1	1.0	1.3	2.2
Secchi (ft)	3.7	2.9	3.2	3.3	4.0	4.3	4.0	3.7	3.7	3.9	3.1	3.9	3.7	3.8	4.3	7.2

Carlson's Tropic State Indices

TSIP					60	58	58		60		61			62		
TSIC									64		61			61		
TSIS	58	62	60	60	57	56	57	58	58	57	61	57	58	60	56	49
TSI									61		61			61		

Crooked Lake Water Quality Report Card

Year	75	76	77	78	79	80	81	82	83	84	85	86	87	89	90	91
TP									C		C			C		
Cl-a									C		C			C		
Secchi	C	D	D	D	C	C	C	D	D		D	C	D	D	C	C
Overall									**C**		**C**			**C**		

Crooked Lake Historical Summertime Mean Values

Agency	MC	MC	MC	MC	MC	CAMP	ACD	ACD	ACD	ACD	ACD	ACD
Year	94	95	96	97	98	99	2000	2002	2003	2005	2006	2008
TP	30.0	34.0	30.0	30.0	30.0		26.7	31.1	30.9	31.0	38.0	26.4
Cl-a	13.0	10.7	9.8	10.6	16.7		12.5	14.0	10.2	11.6	8.0	8.5
Secchi (m)	1.4	1.5	1.3	1.4	1.6	1.9	1.2	2.2	1.7	1.9	1.9	2.2
Secchi (ft)	3.2	4.8	4.1	4.6	5.4	6.2	4.0	7.1	5.5	6.3	6.3	7.1

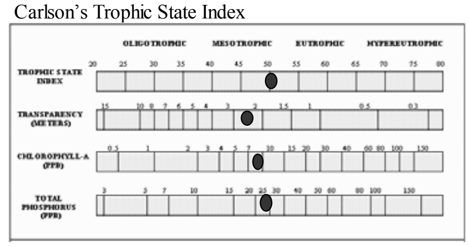
Carlson's Tropic State Indices

TSIP	53	55	53	53	53		52	54	54	54	57	51
TSIC	56	54	53	54	58		56	57	53	55	51	52
TSIS	56	55	57	55	53	51	57	49	52	51	51	49
TSI	55	55	54	54	55		55	53	53	53	53	51

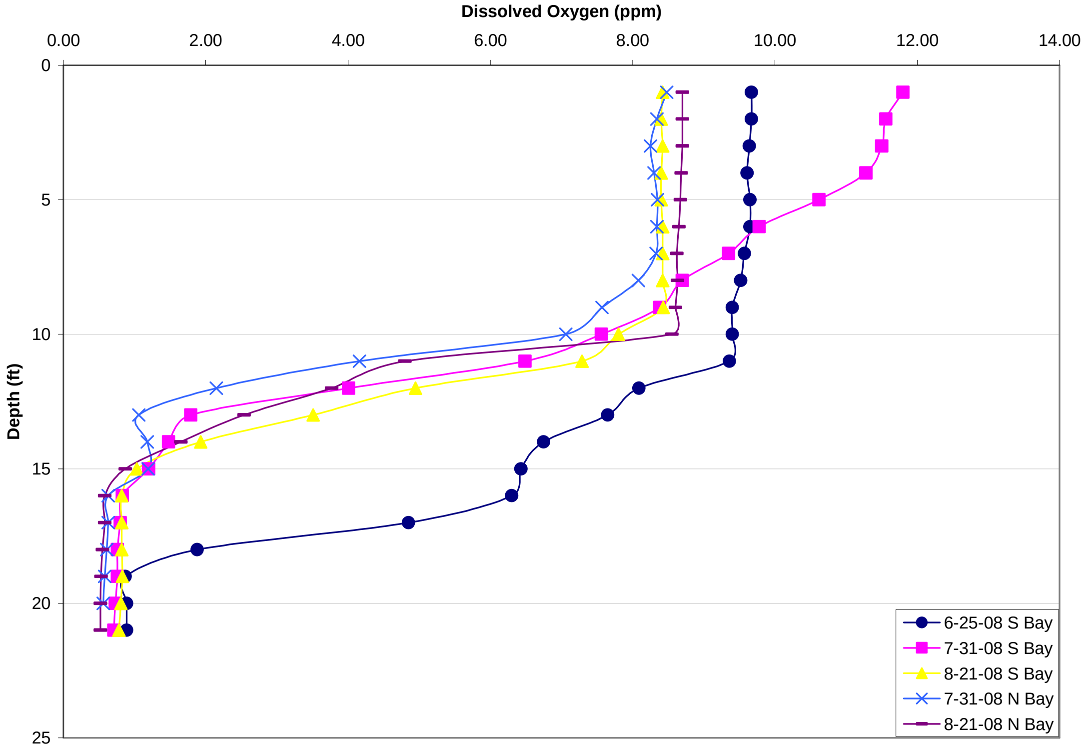
Crooked Lake Water Quality Report Card

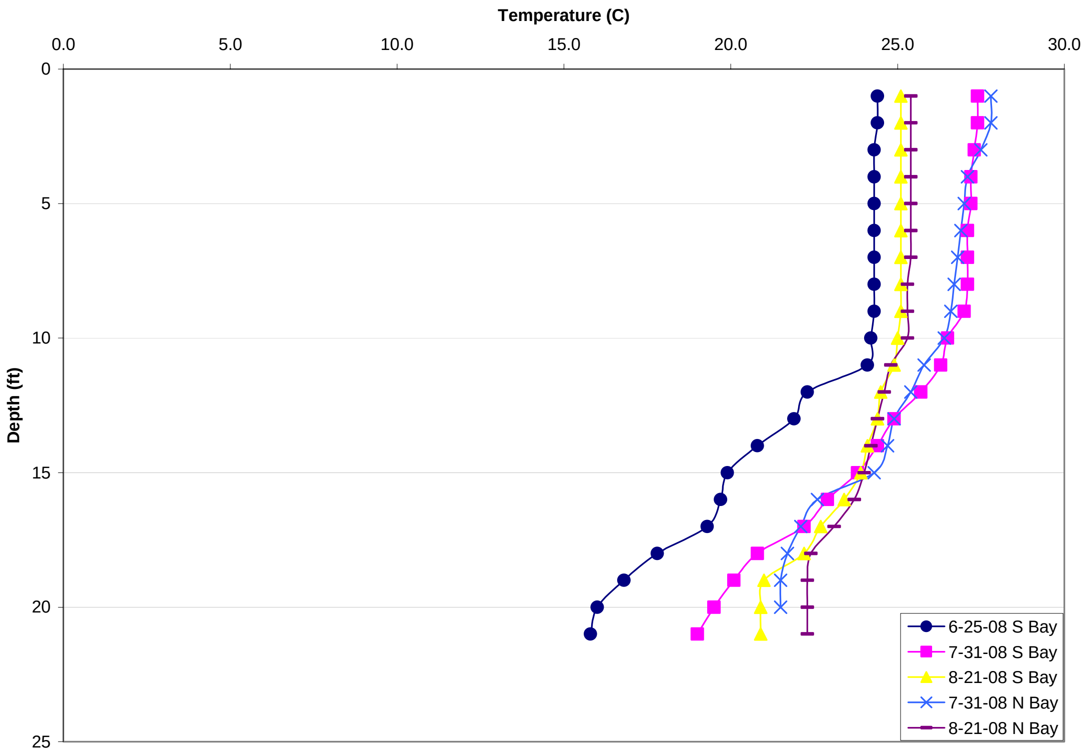
Year	94	95	96	97	98	99	2000	2002	2003	2005	2006	2008
TP	B	C	B	B	B		B	B	B	B	C	B
Cl-a	B	B	A	B	B		B	B	B	B	A	A
Secchi	C	C	C	C	C	C	C	C	C	C	C	B-
Overall	**B**	**C**	**B**	**B**	**B**		**B**	**B**	**B**	**B**	**B-**	**B**

Carlson's Trophic State Index



Crooked Lake Dissolved Oxygen and Temperature Profiles – 2008





Ham Lake

CITY OF HAM LAKE, LAKE ID # 02-0053

Background

Ham Lake has a surface area of 193 acres with a maximum depth of 22 feet (6.7 m). Public access is from Ham Lake County Park on the south side of the lake, which includes a boat landing. The lake is used extensively by recreational boaters and fishers. Ham Lake has a winter aeration system to prevent winter fish kills. The lake is surrounded by single-family homes of moderate density and vacant/forested land. The watershed is a mixture of residential, commercial and vacant land.

2008 Results

In 2008 Ham Lake had above-average water quality for this region of the state (NCHF Ecoregion), receiving an overall A grade. The lake is slightly eutrophic, and typically gets an A or B grade, with the exception of an occasional C. Phosphorus, chlorophyll-a, and Secchi transparency in 2008 were similar other monitored years, with the exceptions of 2004 and 2005. In those two years average total phosphorus levels were the highest ever recorded, but both of these averages were driven by a single high reading which may have been a contaminated sample. ACD staff's subjective observations of the lake in 2008 included that the lake was nearly crystal clear in early spring, and progressed to having "some" algae throughout most of the summer. Conditions were worst in early August with "definite" algae and a slight swimming impairment, but this was short-lived. As in past years, curly-leaf pondweed was moderately abundant in the spring, but was dense growths were largely restricted the south end of the lake near the public boat landing. Curly-leaf pondweed died back in mid-June.

Trend Analysis

Thirteen years of water quality data have been collected by the Minnesota Pollution Control Agency (between 1984 and 1997) and the Anoka Conservation District (between 1998, 2007, and 2008). Lake water quality has fluctuated from "A" to "C" water quality grades, but there is no significant long-term trend (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,10}$=0.20, p=0.82).

Discussion

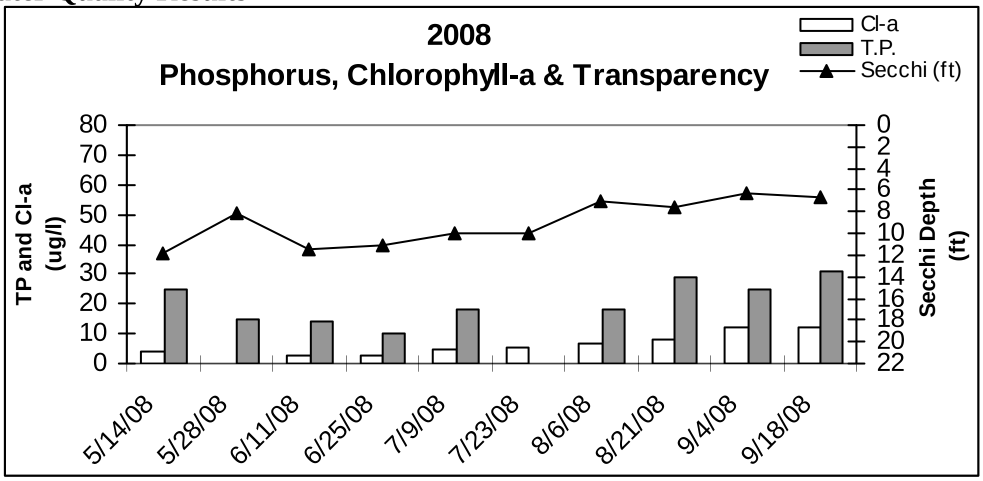
Water quality in Ham Lake is very good for a metro-area lake. Current threats to lake water quality include runoff from residential areas, aquatic plant removal by lakeshore homeowners, curly leaf pondweed, and perhaps sediment disturbance by high-powered boats and jet-skis.

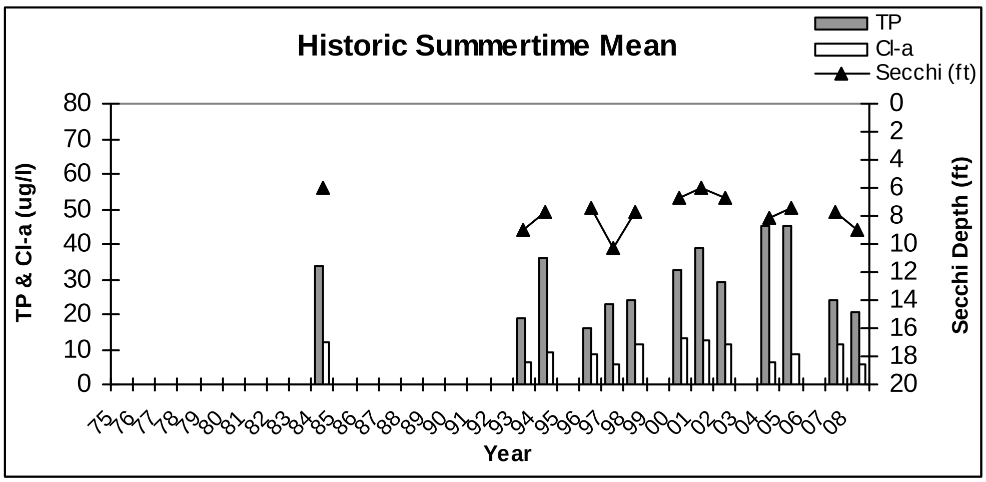
2008 Ham Lake Water Quality Data

2008 Ham Lake	Units	R.L.*	5/14/2008 Results	5/28/2008 Results	6/11/2008 Results	6/25/2008 Results	7/9/2008 Results	7/23/2008 Results	8/6/2008 Results	8/21/2008 Results	9/4/2008 Results	9/18/2008 Results	Average	Min	Max
pH		0.10	8.12	8.22	8.08	8.79	8.52	8.46	8.21	8.03	7.76	8.21	8.24	7.76	8.79
Conductivity	mS/cm	0.010	0.292	0.282	0.255	0.236	0.248	0.251	0.250	0.271	0.277	0.282	0.264	0.236	0.292
Turbidity	FNRU	1	3	4	2	2	2	3	3	2	3	3	3	2	4
D.O.	mg/l	0.01	10.62	9.32	8.90	10.06	8.32	5.93	7.04	n/a	8.64	10.19	8.77	5.93	10.62
D.O.	%	1	102%	96%	97%	120%	100%	73%	86%	n/a	98%	108%	98%	73%	120%
Temp.	°C	0.1	13.8	16.8	19.6	24.3	24.4	25.8	25.4	24.8	21.4	17.9	21.4	13.8	25.8
Temp.	°F	0.1	56.8	62.2	67.3	75.7	75.9	78.4	77.7	76.6	70.5	64.2	70.6	56.8	78.4
Salinity	%	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01
Cl-a	mg/m^3	0.5	4.3	< 1.0	2.5	2.8	4.5	5.5	6.5	8.2	11.9	12.4	6.0	1.0	12.4
T.P.	mg/l	0.010	0.025	0.015	0.014	0.010	0.018	< .02	0.018	0.029	0.025	0.031	0.021	0.010	0.031
T.P.	ug/l	10	25	15	14	10	18	<20	18	29	25	31	21	10	31
Secchi	ft	0.1	11.8	8.2	11.5	11.1	9.9	9.9	7.1	7.6	6.3	6.6	9.0	6.3	11.8
Secchi	m	0.1	3.6	2.5	3.5	3.4	3.0	3.0	2.2	2.3	1.9	2.0	2.7	1.9	3.6
Field Observations															
Physical			1.5	2.0	2.0	2.0	2.0	2.0	3.0	2.0	2.0	2.0	2.1	1.5	3.0
Recreational			1.5	2.0	2.0	2.0	2.0	2.0	3.0	2.0	2.0	2.0	2.1	1.5	3.0

*reporting limit

Ham Lake Water Quality Results





Ham Lake Summertime Historic Mean

Agency	MC	MC	MC	MC	MC	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	84	93	94	96	97	98	2000	2001	2002	2004	2005	2007	2008
TP	34.0	19.0	36.0	16.0	23.0	24.0	32.6	39.1	29.1	45.2	45.0	24.0	20.5
Cl-a	11.8	6.2	9.1	8.3	5.9	11.3	13.1	12.7	11.5	6.3	8.4	11.4	6.0
Secchi (m)	1.84	2.76	2.35	2.27	3.14	2.35	2.04	1.81	2.1	2.5	2.2	2.3	2.7
Secchi (ft)	6.0	9.1	7.7	7.4	10.3	7.7	6.7	5.9	6.7	8.2	7.4	7.7	9.0

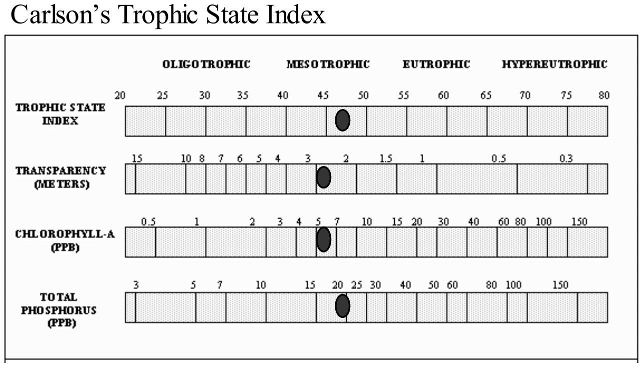
Carlson's Tropic State Indices

TSIP	55	47	56	44	49	50	54	57	53	59	59	50	48
TSIC	55	49	52	51	48	54	56	56	55	49	52	55	48
TSIS	51	45	48	48	43	48	50	51	50	47	49	48	45
TSI	54	47	52	48	47	51	53	55	52	52	53	51	47

Ham Lake Water Quality Report Card

Year	84	93	94	96	97	98	2000	2001	2002	2004	2005	2007	2008
TP	C	A	C	A	A	B	C	C	B	C	C	B	A
Cl-a	B	A	A	A	A	B	B	B	B	A	A	B	A
Secchi	C	B	B	B	A	B	C	C	C	B	B	B	B
Overall	**C**	**A**	**B**	**A**	**A**	**B**	**C**	**C**	**B**	**B**	**B**	**B**	**A**

Carlson's Trophic State Index



Stream Hydrology

Description: Continuous water level monitoring in streams.

Purpose: To provide understanding of stream hydrology, including the impact of climate, land use or discharge changes. These data also facilitate calculation of pollutant loads, use of computer models for developing management strategies, and water appropriations permit decisions.

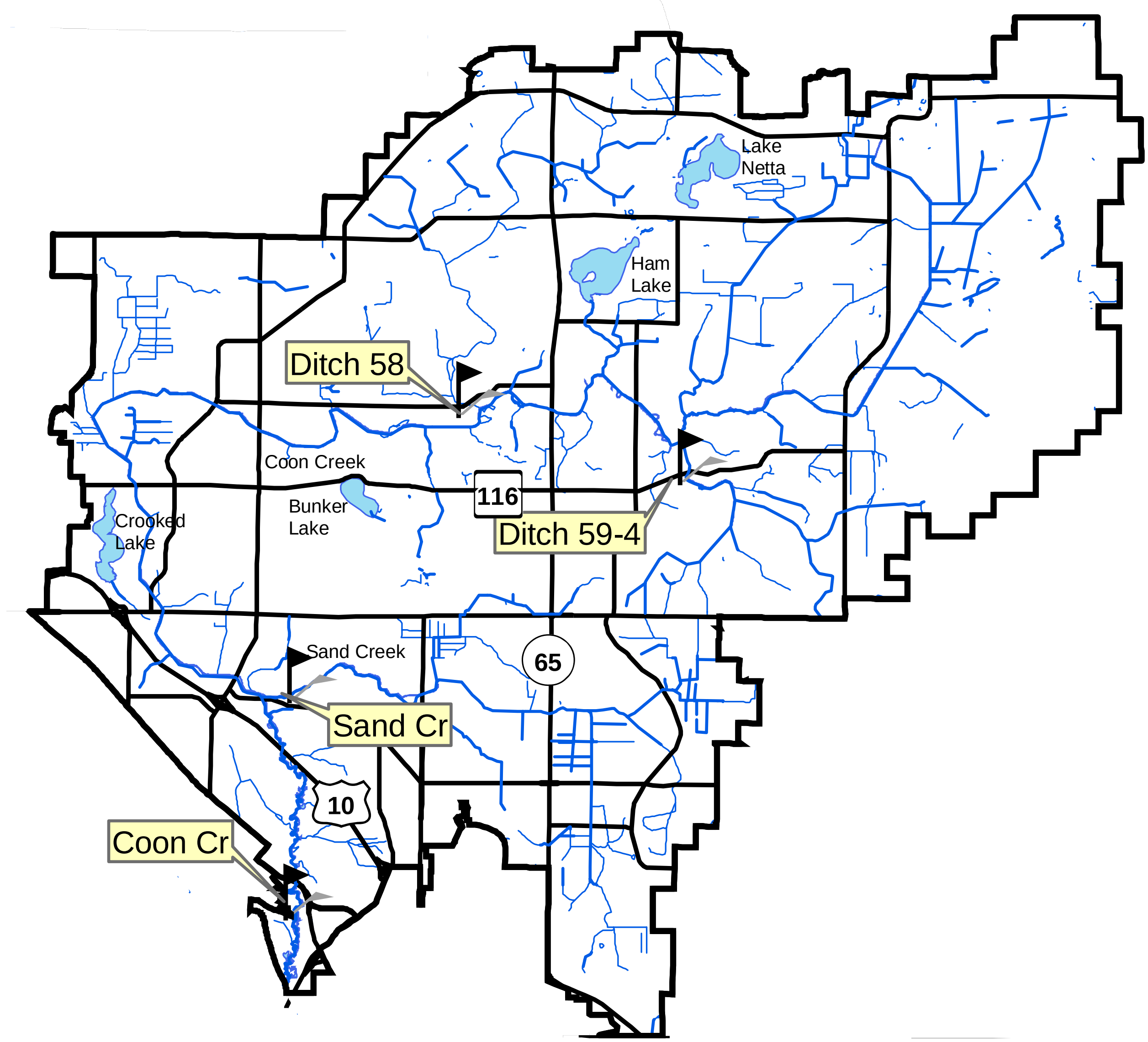
Locations: Coon Creek at Coon Hollow, Coon Rapids

Ditch 58 at Andover Blvd (Highway 16), Ham Lake

Ditch 59-4 at Bunker Lake Boulevard NE, Ham Lake

Sand Creek at Xeon Street, Coon Rapids

Coon Creek Watershed 2008 Stream Hydrology Monitoring Sites

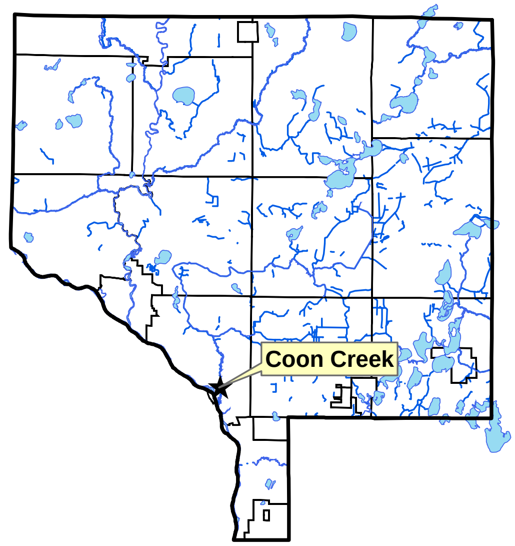


Stream Hydrology Monitoring

COON CREEK

at Coon Creek Hollow, Vale Street, Coon Rapids

Notes



Coon Creek is a major drainage through central Anoka County. This monitoring location is the closest to the outlet to the Mississippi River that is accessible and does not have backwater effects from the Mississippi during high water. Land use in the upstream watershed ranges from rural residential upstream to highly urbanized downstream. The creek is about 30 feet wide and 1.5 to-2 feet deep at the monitoring site during baseflow. Both creek water levels and flow are available for this site.

Coon Creek has flashy responses to storms (see hydrograph on next page). Water levels rise quickly in response to precipitation, but return to baseflow conditions more slowly. The quick, intense response to rainfall is runoff from the urbanized downstream watershed near the monitoring station. The slower return to baseflow is probably due, in large part, to water being released more slowly from the less-developed upstream portions of the watershed. Several storms in 2006-2008 serve to illustrate this phenomena. Following a 0.94-inch rainfall on August 1st, 2007 the creek rose 0.73 feet in the first two hours, and another 1.76 feet during the second two hours. Thereafter, it began receding but did not reach pre-storm levels for nine days (two rainfalls in between were 0.02 and 0.05 inches). A similarly sized storm (0.94-inches) fell on July 19, 2006, causing the creek to rise 1.01 feet during the first two hours and another 1.05 feet in the next two hours, returning to pre-storm levels six days later. In the few hours following larger storms, water levels can rise nearly 4 feet in a few hours. During 2006's largest storm, a 2.23-inch storm on June 16, water levels rose 3.4 feet in the first 16 hours, including one two-hour period when it rose 2.23 feet. It took about 15 days for water level to return to pre-storm levels, despite only three rain events of less than 0.15 inches during that time. During 2008's largest storm, 1.54-inches on August 27, creek levels rose 2.42 inches during a two hour period, rising a total of 3.46 feet in response to the storm.

Coon Creek's water level increases substantially per inch of rainfall. Examining 14 relatively isolated storms ranging in size from 0.72 to 2.23 inches in 2006-08, the creek rose an average of 2.07 feet per inch of rainfall. The creek increase per inch of rain ranged from 1.38 to 2.64 feet. This discussion, as well as the one in the preceding paragraph, is obviously simplified because it neglects to consider the phenology of each of the storms. It only serves to emphasize that this creek responds quickly and dramatically to storms but water levels fall much more slowly.

A rating curve was developed in 2005 so that creek flow estimates can be calculated from the continuous water level record (see next page). A rating curve is the mathematical relationship between water level and flow. This mathematical relationship is determined by taking manual measurements of creek flow during many different water levels. Under extremely high water levels flow measurements could not be safely taken, so the rating curve is only considered accurate for water levels less than 822.0 ft msl (i.e. flows >38.19). In 2008 creek flows ranged from 11.64 cfs to over 38.19 cfs. The maximum water level observed since monitoring began in 2005 was 2.73 feet greater than the capacity of the rating curve; if the rating curve is projected forward this water level would correspond to a flow of >80 cfs.

(over)

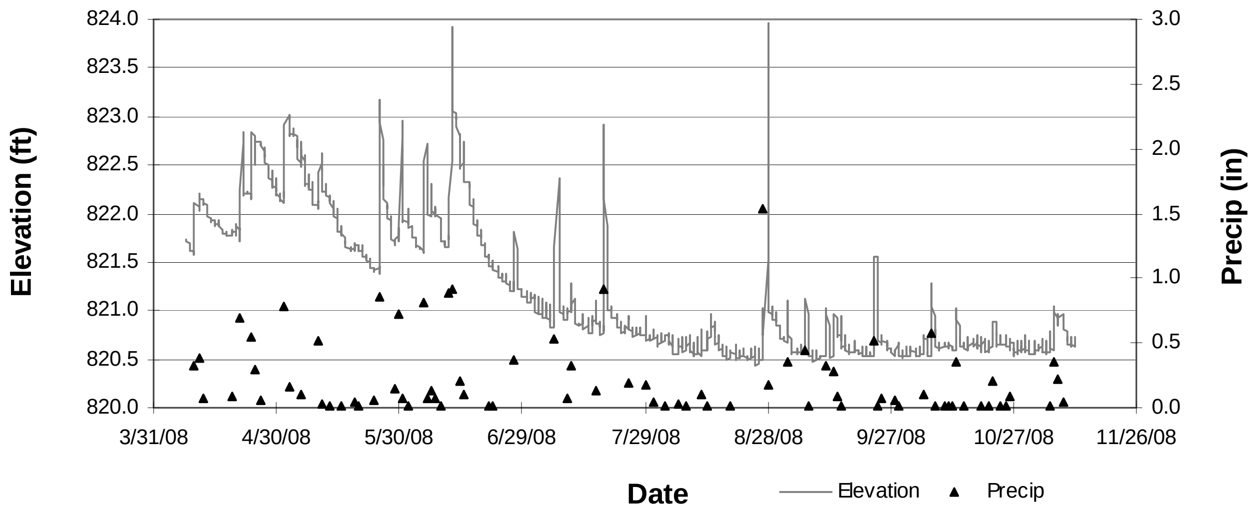
Coon Creek Hydrology (continued)

Summary of All Monitored Years

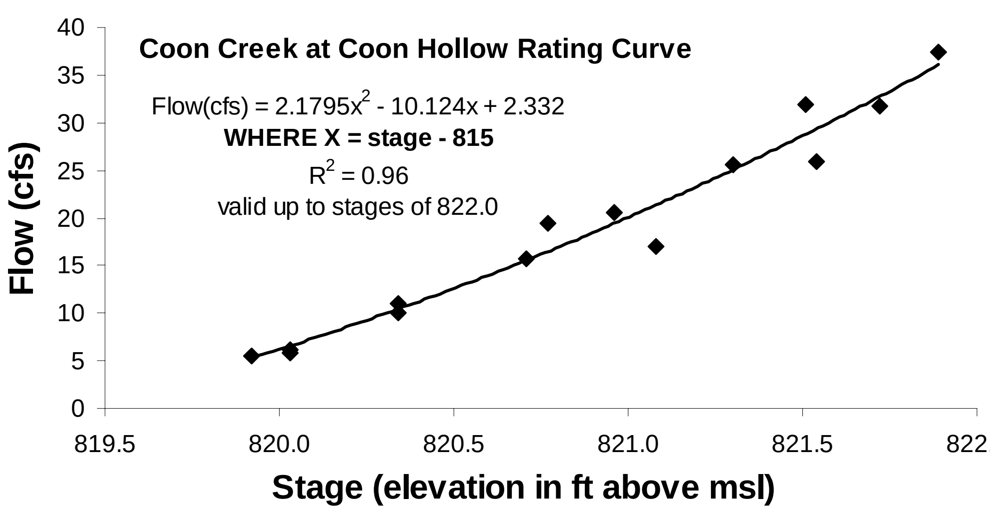
Percentiles	2005	2006	2007	2008	All Years
Min	820.04	820.26	820.33	820.43	820.04
2.5%	820.06	820.42	820.40	820.52	820.19
10.0%	820.19	820.53	820.53	820.57	820.51
25.0%	820.57	820.78	820.73	820.63	820.67
Median (50%)	820.91	821.35	821.25	820.88	821.07
75.0%	821.26	821.78	821.88	821.78	821.70
90.0%	821.77	822.27	822.63	822.26	822.27
97.5%	822.92	822.76	823.21	822.79	822.92
Max	823.26	824.18	824.47	823.96	824.47

"All Years" is not an average of each year's summary statistic. Rather, it is calculated from the continuous multi-year record.

2008 Hydrograph



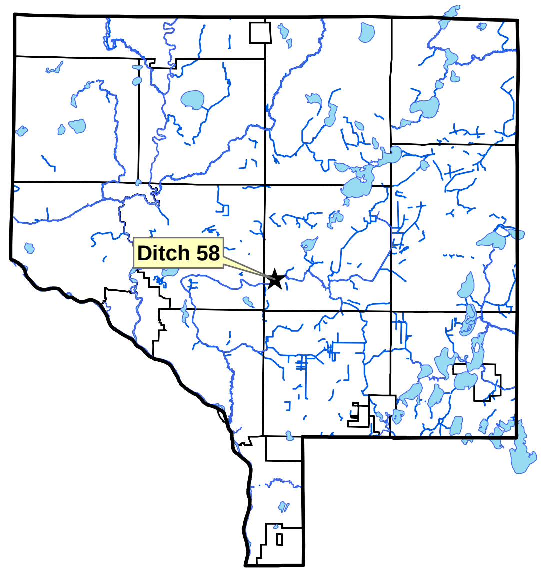
Rating Curve (2005)



DITCH 58

at Andover Boulevard, Ham Lake

Notes



Ditch 58 is a tributary to Coon Creek. Upstream of the monitoring site, Ditch 58 consists of 20 miles of ditch, including many small tributaries. Its light bulb-shaped watershed is roughly delimited by Lake Netta to the northeast, Crosstown Boulevard to the northwest and southwest, and highway 65 to the southeast. Watershed land uses are dominated by suburban residential and sod fields. The ditch is about 10 feet wide and 2 feet deep at the monitoring site during baseflow.

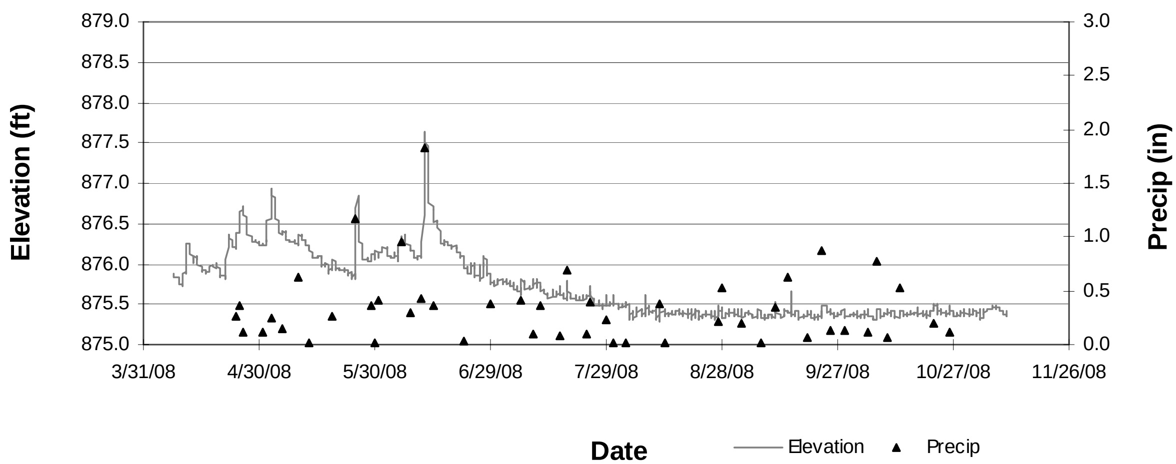
Ditch 58 water levels fluctuated 2.34 feet throughout 2008. Water levels were highest and rose in response to storms from early spring through June. Water levels declined slowly and modestly through July, and stabilized at a baseflow elevation of 875.4 for the remainder of the year. At baseflow in late summer the ditch water levels were unchanged, even following storms as large at 1.5 inches. This is reflective the importance of shallow groundwater in the ditch's hydrology, as opposed to surface runoff.

Summary of All Monitored Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	2008	All Years
Min	875.29	875.81	875.28	875.23	875.05	875.31	875.24	875.29	875.05
2.5%	875.35	876.18	875.57	875.63	875.54	875.91	875.29	875.33	875.33
10.0%	875.48	876.33	875.64	875.51	875.37	875.66	875.37	875.36	875.39
25.0%	875.58	876.41	875.74	875.63	875.54	875.91	875.49	875.39	875.60
Median (50%)	875.65	876.51	876.10	875.83	875.78	876.20	875.89	875.56	875.92
75.0%	875.77	876.73	876.59	876.05	876.04	876.35	876.16	876.06	875.92
90.0%	876.23	877.42	877.01	876.45	876.22	876.47	876.40	876.28	876.61
97.5%	876.30	878.13	878.16	877.04	876.98	876.89	876.90	876.61	877.36
Max	876.48	878.13	878.19	878.03	878.12	877.75	877.64	877.63	878.19

"All Years" is not an average of each year's summary statistic. Rather, it is calculated from the continuous, multi-year record.

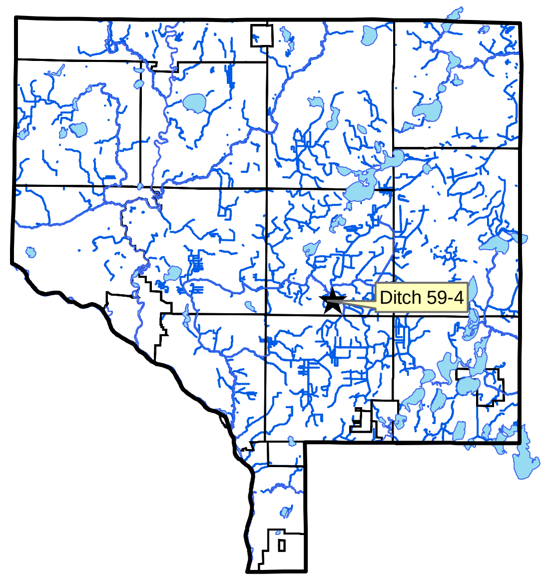
2008 Hydrograph



DITCH 59-4

at Bunker Lake Boulevard NE, Ham Lake

Notes



Ditch 59-4 originates in northeast Blaine and flows northwest to join Coon Creek approximately 0.3 miles downstream of the monitoring site. Upstream of the monitoring site, Ditch 59-4 has three main branches which have a total length exceeding 5 miles. Watershed land uses are dominated by suburban residential and sod fields. The ditch is about 7 feet wide and 1.5 feet deep at the monitoring site during baseflow.

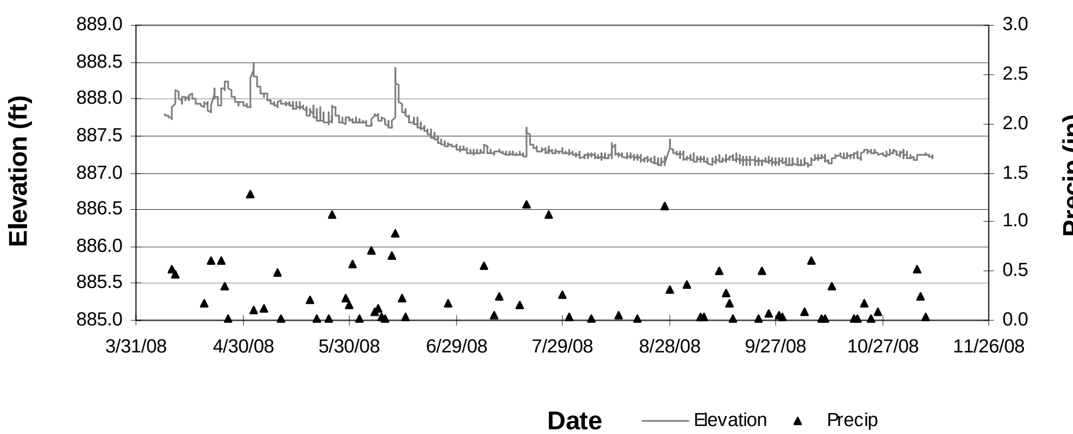
2008 was the first year of monitoring Ditch 59-4 hydrology. The total range of water levels was 1.41 feet. More generally, water levels in spring were about 0.7 feet higher than in late summer. Water levels declined slowly and modestly through May and June, and stabilized at a baseflow elevation of 887.2 for the remainder of the year. At baseflow in late summer the ditch water levels were nearly unchanged in response to rainfall. This is reflective the importance of shallow groundwater in the ditch's hydrology, as opposed to surface runoff.

Summary of All Monitored Years

Percentiles	2008	All Years
Min	887.09	887.09
2.5%	887.12	887.12
10.0%	887.16	887.16
25.0%	887.21	887.21
Median (50%)	887.28	887.28
75.0%	887.74	887.74
90.0%	887.95	887.95
97.5%	888.13	888.13
Max	888.50	888.50

"All Years" is not an average of each year's summary statistic. Rather, it is calculated from the continuous, multi-year record.

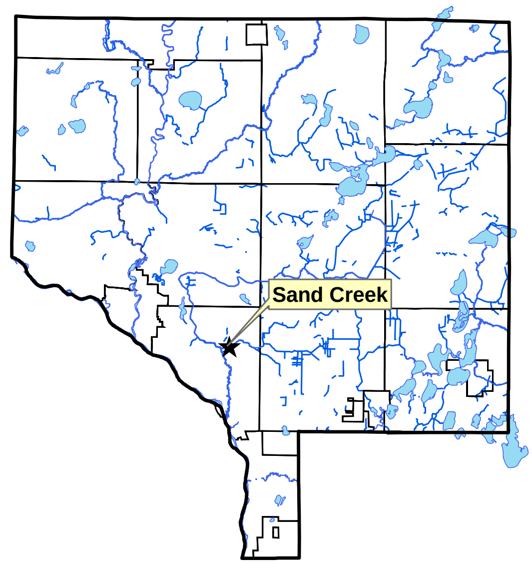
2008 Hydrograph



SAND CREEK

at Xeon Street, Coon Rapids

Notes



Sand Creek is the largest tributary to Coon Creek. It drains suburban residential, commercial and retail areas throughout northeastern Coon Rapids and western Blaine. The stream is about 15 feet wide and 2.5-3 feet deep at the monitoring site during baseflow.

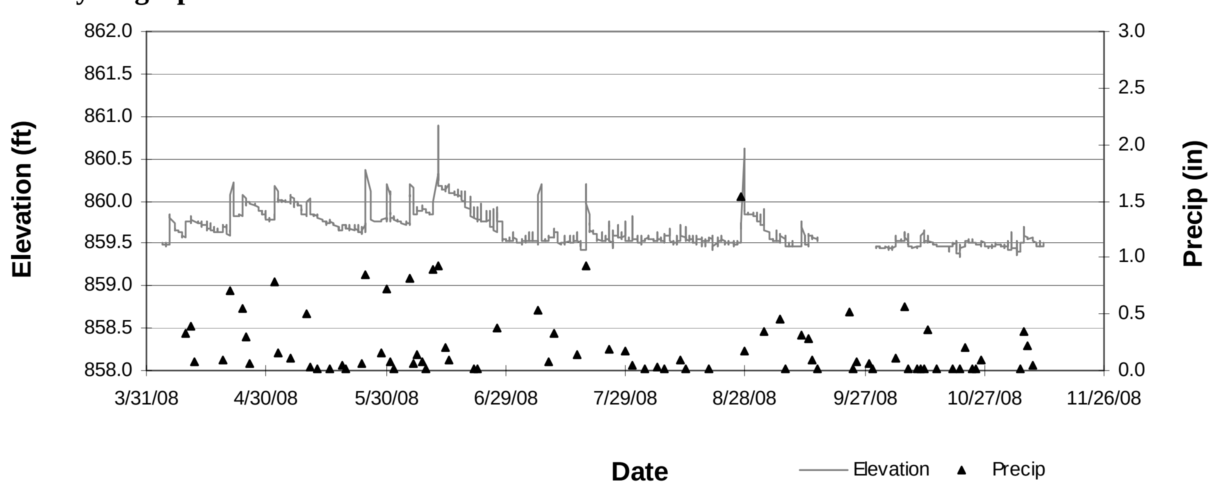
Sand Creek shows little variation in water levels, which is unusual for a stream with a suburban watershed. Sand Creek water levels fluctuated 1.53 feet in 2008. Excluding storms, the total seasonal variability in water levels was only about 1 foot. Still, the creek can have more dramatic hydrologic changes following large storms. For example, in 2007 Sand Creek rose 1.93 feet in 4 hours in response to a 2.25-inch storm on August 1. It is typical for Sand Creek to rise and fall very quickly following rainfall, often on a time scale of only a few hours.

Summary of All Monitored Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	2008	All Years
Min	859.06	859.22	859.21	859.31	859.35	859.32	859.17	859.35	859.06
2.5%	859.09	859.44	859.26	859.33	859.41	859.43	859.30	859.44	859.23
10.0%	859.15	859.48	859.32	859.40	859.45	859.54	859.41	859.48	859.38
25.0%	859.23	859.61	859.41	859.46	859.55	859.70	859.47	859.53	859.49
Median (50%)	859.33	859.75	859.55	859.60	859.72	859.86	859.64	859.58	859.63
75.0%	859.49	859.93	859.75	859.80	859.97	860.01	859.81	859.78	859.63
90.0%	859.54	860.09	860.00	860.03	860.21	860.12	859.98	859.94	860.04
97.5%	859.65	860.32	860.28	860.32	860.51	860.27	860.11	860.13	860.28
Max	860.00	861.22	861.13	861.27	861.50	861.38	861.10	860.88	861.50

"All Years" is not an average of each year's summary statistic. Rather, it is calculated from the continuous, multi-year record.

2008 Hydrograph



Stream Water Quality – Chemical Monitoring

Description: Each stream was monitored eight times between April and October; four times during baseflow and four times during storm flow. Storm flow events were defined as an approximately one-inch rainfall in 24 hours, though totals vary from location to location. Each stream was tested for pH, conductivity, turbidity, dissolved oxygen, temperature, salinity, total suspended solids, chlorides, and total phosphorus.

Purpose: To detect water quality trends and problems, and diagnose the source of problems.

Locations: Coon Creek at Shadowbrook Townhomes, Andover

Coon Creek at Lions Park, Coon Rapids

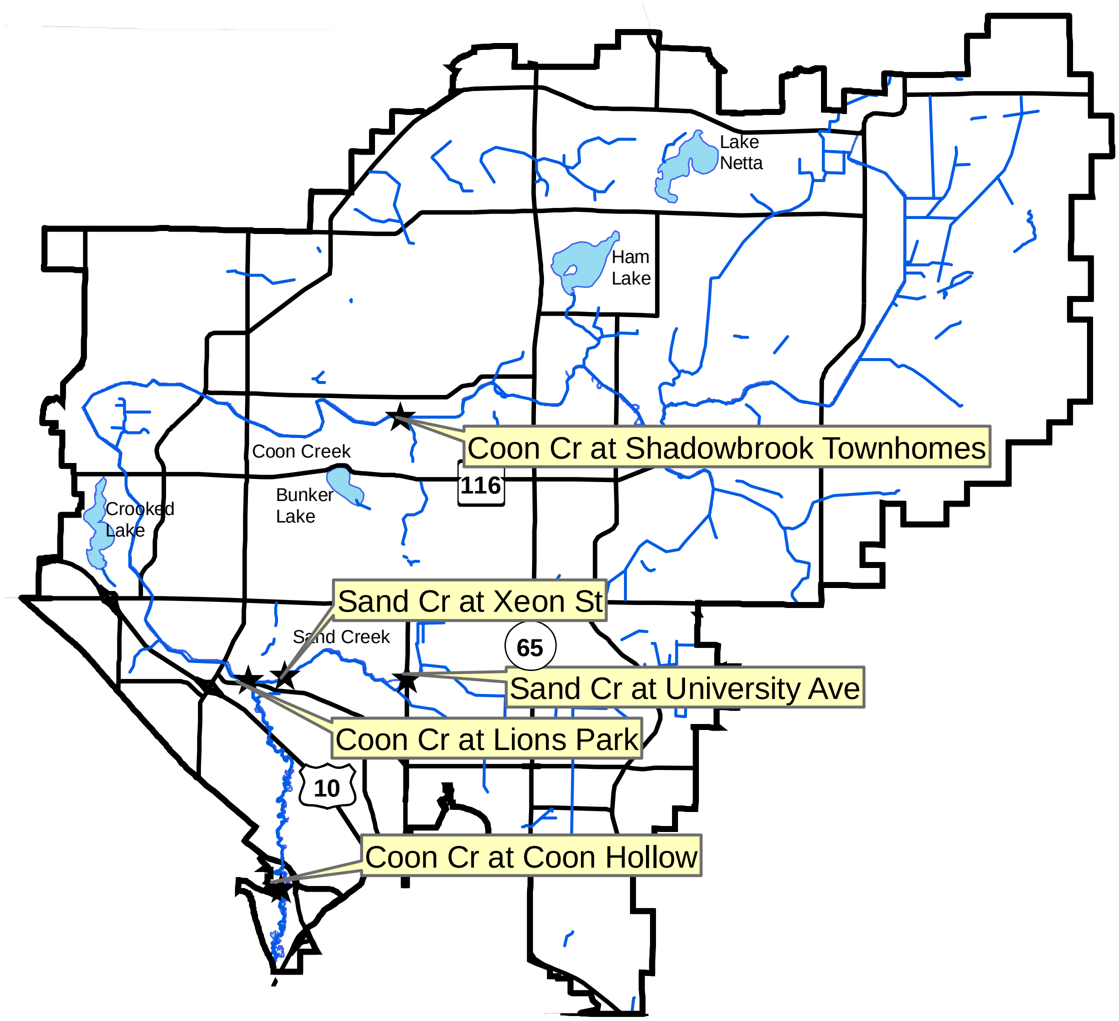
Coon Creek at Coon Hollow, Vale St., Coon Rapids

Sand Creek at University Ave, Coon Rapids

Sand Creek at Xeon Street, Coon Rapids

Results: Results for each stream are presented on the following pages.

Coon Creek Watershed Stream Water Quality Monitoring Sites

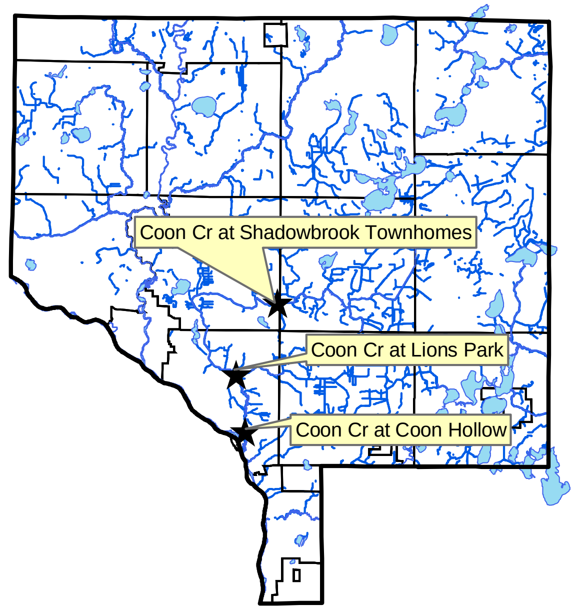


COON CREEK

Coon Creek at Shadowbrook Townhomes, Andover	STORET SiteID = S004-620
Coon Creek at Lions Park, Coon Rapids	STORET SiteID = S004-171
Coon Creek at Coon Hollow, Vale St., Coon Rapids	STORET SiteID = S003-993

Years Monitored

Coon Creek at Coon Hollow - 2005, 2006, 2007, 2008
Coon Creek at Shadowbrook Townhomes – 2007, 2008
Coon Creek at Lions Park – 2007, 2008



Background

Coon Creek is a major drainage through central Anoka County. Development in the watershed ranges from rural residential to urbanized. Farthest downstream, the creek is about 30 feet wide and 1.5 to-2 feet deep during baseflow. Coon Creek has been monitored for several years close to the Mississippi River, at Coon Hollow, and two upstream sites were added in 2007 and 2008. All three sites were monitored synchronously. This report includes data from all years to provide a broad view of Coon Creek's water quality under a variety of conditions, but does specifically denote the 2008 data.

Coon Creek's largest tributary, Sand Creek, has also been monitored. That data is reported separately.

Results and Discussion

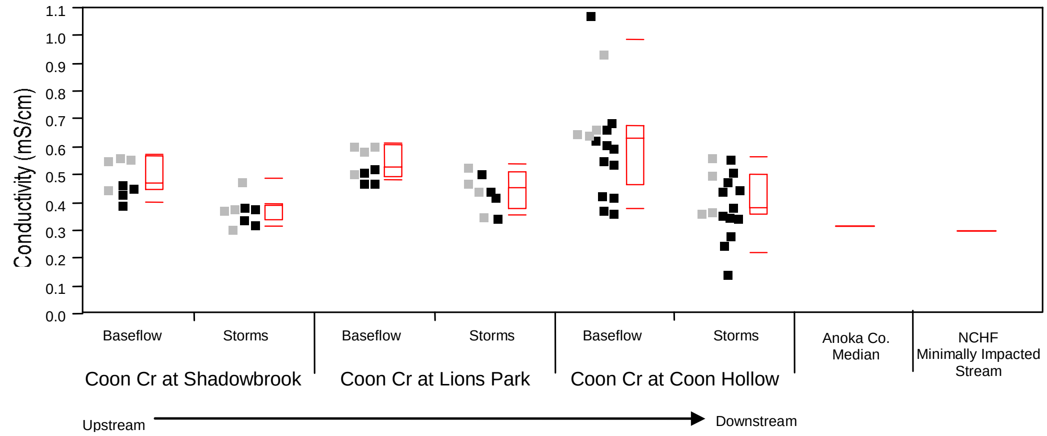
Eight water quality samples were taken in 2008, including four during storm events and four during baseflow. The data presented and discussed below includes both the 2008 data and data collected in 2005-07. These data show several areas of water quality concern, and most of these problems develop or increase during storms and at the downstream monitoring locations. Dissolved pollutants, as measured by conductivity, salinity, and chlorides, were slightly elevated in Coon Creek and showed little variability in different flow conditions and little variability from upstream to downstream. Some of these dissolved pollutants are originating from the shallow groundwater which feeds the creek during baseflow. Phosphorus was at acceptably low levels during baseflow, but was much more variable and generally higher during storms. Suspended solids and turbidity were also reasonably low at baseflow, but increased several-fold during storms and increased from upstream to downstream. Coon Creek's water is often brown and sometimes strongly brown. Other water quality measures, including pH and dissolved oxygen were with the range considered normal and healthy for streams in this area.

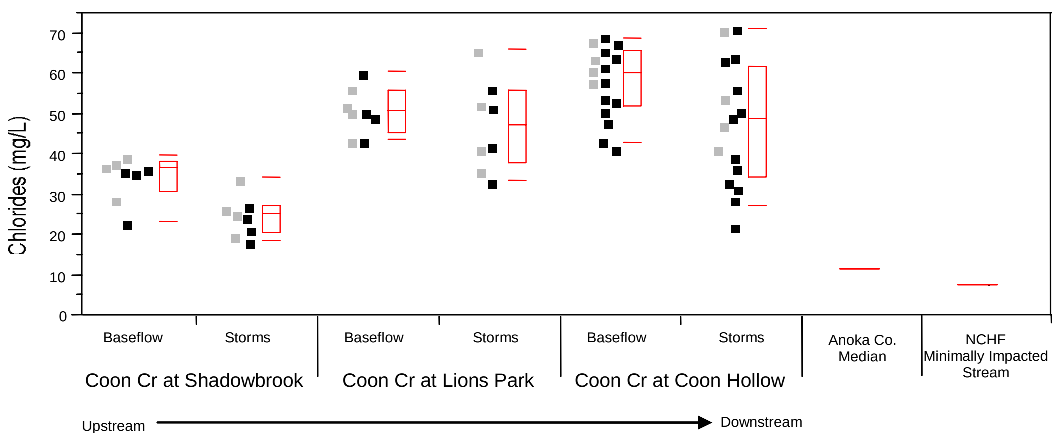
Different approaches will be needed to address this creek's two generalized pollution problems. Dissolved pollutants migrating from the shallow groundwater into the creek must be controlled at the source. Once on the ground, sandy soils in the watershed facilitate quick movement of dissolved materials into the groundwater. The results suggest that while road deicing salts are a large component of the dissolved pollutants, they are not the only one. Suspended materials swept into the creek during storms can be addressed with a combination of prevention and best management practices to capture them before storm water conveyances deliver them to the creek. Storms greater than one-inch produce the worst creek water quality, so practices aimed at reducing suspended solids and phosphorus entering the creek during those storms are especially important. Good water quality in this stream is important for its own sake, but also because it is degrading the Mississippi River. Coon Creek empties in to the Mississippi just upstream of drinking water intakes for the Twin Cities and important recreational areas on the river.

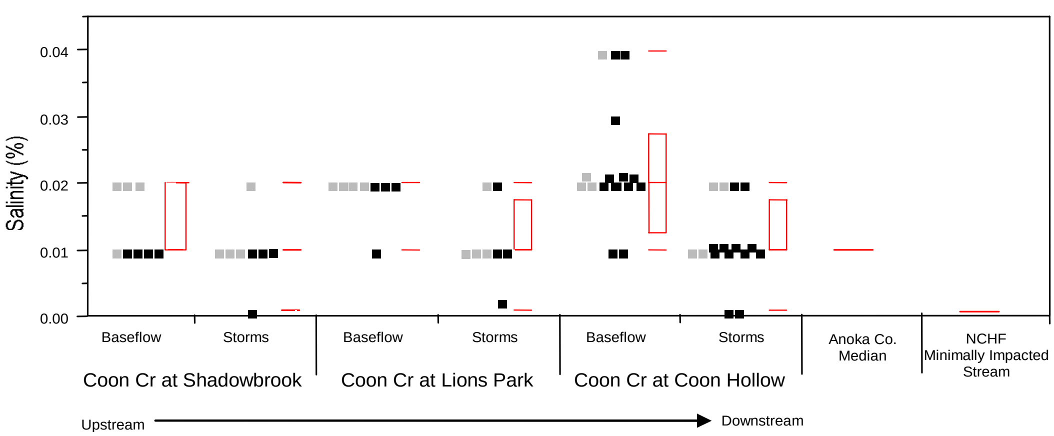
Conductivity, Chlorides, and Salinity

Conductivity, chlorides, and salinity, which are all measures of dissolved pollutants, showed little variability from upstream to downstream (see figures below). All three, but especially chorides (most often associated with road deicing salts) tended to be above the median levels found in other Anoka County streams and above the levels expected of minimally impacted streams in this ecoregion. The highest levels of all three were at the farthest downstream monitoring site (Coon Hollow) during baseflow. This suggests that dissolved pollutants accumulate and become of higher concentration as Coon Creek flows downstream into more urbanized areas. The higher levels during baseflow suggest that these dissolved pollutants, which are highly mobile in the environment, have infiltrated to the shallow groundwater which feeds the creek during baseflow. The high variability of chlorides during storms at Coon Hollow is indicative of various levels of dilution of this shallow groundwater.

Conductivity, chlorides, and salinity at Coon Creek. Dots are individual readings. Grey dots are 2008 readings, black dots are readings in 2005-2007. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



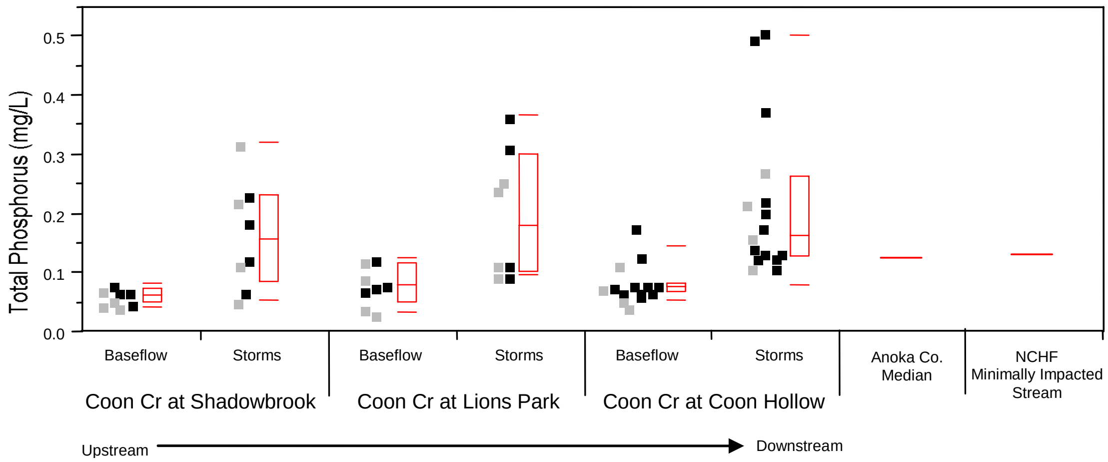




Total Phosphorus

Total phosphorus (TP) in Coon Creek was consistently low during baseflow conditions, but on average it doubled during storms (see figure below). During storms TP was also much more variable at all sites, with occasional readings 3-5 times higher than baseflow. Some of this variability can be attributed to the storm type and when the sampling occurred. The highest observed readings increased from upstream to downstream. Phosphorus reduction efforts should be focused upon capturing and treating storm runoff.

Total phosphorus at Coon Creek. Dots are individual readings. Grey dots are 2008 readings, black dots are readings in 2005-2007. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

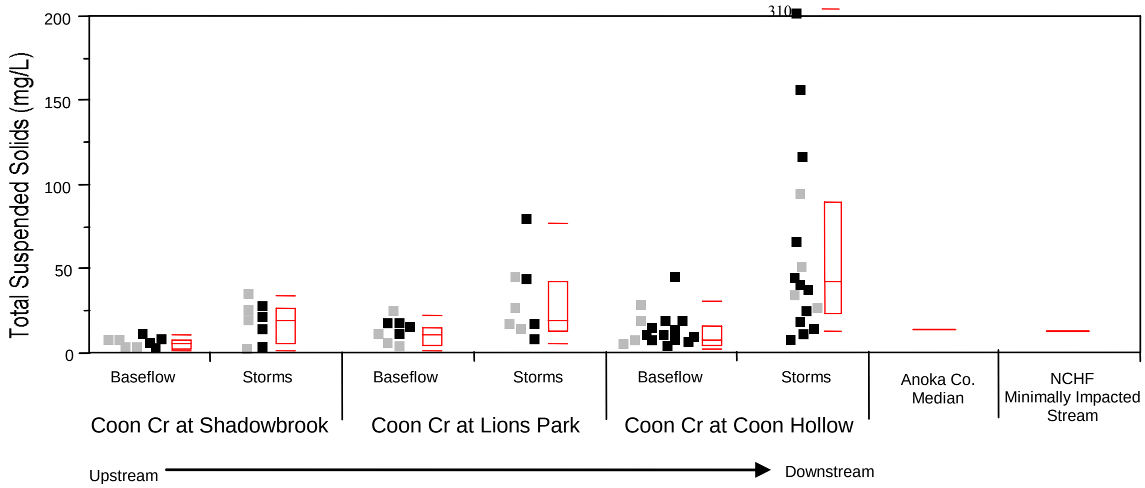


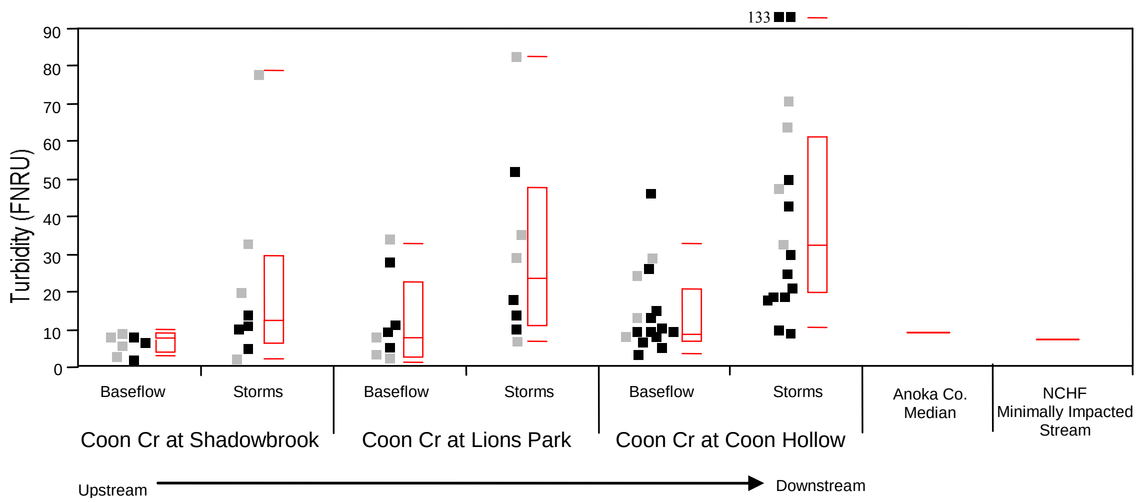
Total Suspended Solids and Turbidity

Suspended solids, as measured by total suspended solids (TSS) and turbidity, were reasonably low during baseflow but increased substantially during storms and increased in an upstream-to-downstream direction (see figure below). The average TSS during baseflow was at or near the median for Anoka County streams (14 mg/L) and the expected values for minimally impacted streams (14 mg/L). The baseflow average TSS and turbidity did creep upward at downstream monitoring sites; from upstream to downstream TSS baseflow averages were 6, 11, and 12 mg/L and turbdity baseflow averages were 6, 11, and 14 FNRU. At all sites the average TSS and turbidity were three or more times higher during storms. The greatest difference was at Coon Hollow (farthest downstream) where storm TSS averaged more than five times higher than baseflow. The levels of these pollutants during storms also increased from upstream to downstream during storms, probably reflecting the greater urbanization downstream. Average TSS during storms from upstream to downstream was 18, 30, and 69 mg/L. Average turbidity during storms from upstream to downstream was 22, 31, and 46 NRFU. Excessively high occurred during some storms at the downstream monitoring site, including TSS of 310 mg/L and turbidity of 133 FNRU. For all of the higher averages mentioned above, averages were pulled up by a few high measurements. Generally, the water of Coon Creek has a brown appearance.

Figures on next page

Total suspended solids and turbidity at Coon Creek. Dots are individual readings. Grey dots are 2008 readings, black dots are readings in 2005-2007. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

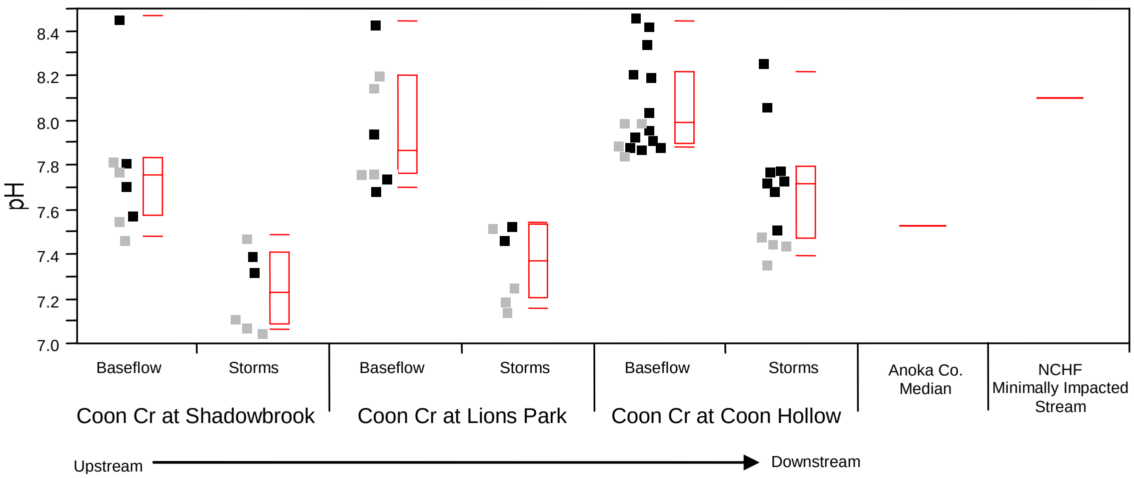




pH

pH was within the expected range at all sites, but did increase downstream. From upstream to downstream, the median pH during storms and baseflow combined was 7.53, 7.87, and 8.00. There was a noticeable difference in pH during baseflow and storms, with storms pH averaging 0.5 lower.

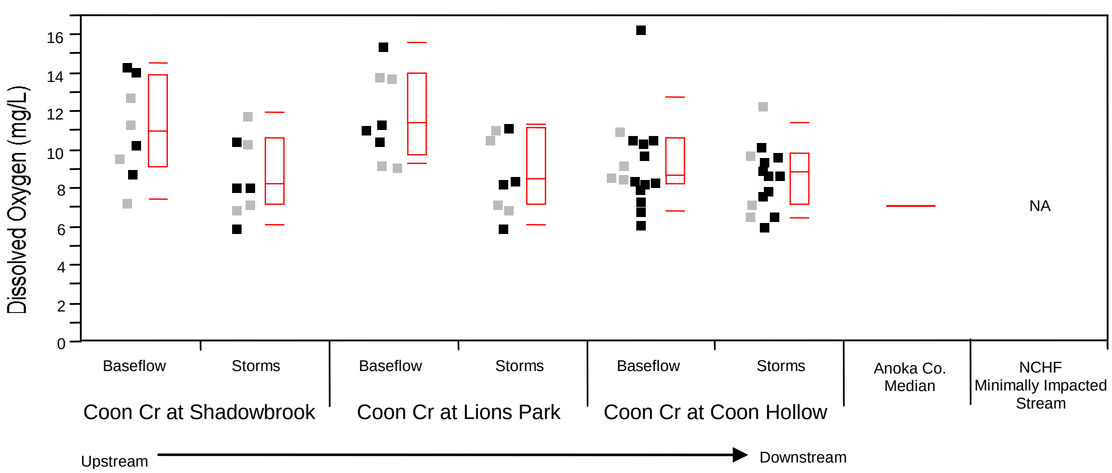
pH at Coon Creek. Dots are individual readings. Grey dots are 2008 readings, black dots are readings in 2005-2007. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



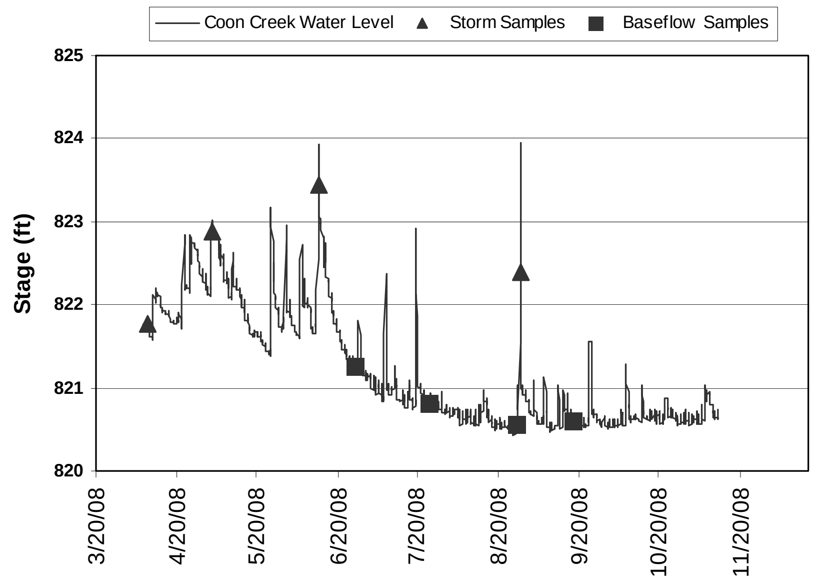
Dissolved Oxygen

Dissolved oxygen was similar at all sites, never dropping below 5 mg/L at which point some aquatic life becomes stressed.

Dissolved Oxygen at Coon Creek. Dots are individual readings. Grey dots are 2008 readings, black dots are readings in 2005-2007. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Coon Creek Water Quality Sampling and Hydrology 2008



Coon Creek Raw Water Quality Data 2008

Coon Creek at Shadowbrook Townhomes - 2008

Date	Time	Type	pH	Conductivity	Turbidity	DO	DO	Temp	Salinity	TP	Cl	TSS	Stage*	Flow
				mS/cm	FNRU	mg/L	%	C	%	mg/L	mg/L	mg/L	ft	cfs
4/7/2008	10:00	Storm	7.07	0.389	33	12.08	89.0	3.4	0.01	0.223	27.2	19.0	873.23	
5/3/2008	9:45	Storm	7.09	0.394	20	10.61	0.9	6.1	0.01	0.121	25.9	25.0	874.12	
6/12/2008	13:10	Storm	7.13	0.315	79	7.09	74.0	17.8	0.01	0.321	20.6	34.0	874.11	
6/26/2008	12:40	Base	7.57	0.464	8	9.80	106.0	19.5	0.01	0.074	29.5	8.0	872.76	
7/24/2008	7:30	Base	7.48	0.57	9	7.50	80.1	18.9	0.02	0.056	37.9	3.0	872.47	
8/26/2008	10:45	Base	7.84	0.566	6	11.60	116.3	15.8	0.02	0.042	40.2	< 2	865.97	
8/28/2008	8:35	Storm	7.49	0.492	2	7.42	76.0	16.6	0.02	0.052	34.6	2.0	865.83	
9/17/2008	12:40	Base	7.79	0.576	3	13.06	129.9	14.9	0.02	0.049	38.7	5.0	865.83	
Min			7.07	0.315	2	7.09	0.9	3.4	0.01	0.042	20.6	2.0	865.83	
Mean			7.43	0.471	20	9.90	84.0	14.1	0.02	0.117	31.8	13.7	870.540	
Max			7.84	0.576	79	13.06	129.9	19.5	0.02	0.321	40.2	34.0	874.12	

Coon Creek at Lions Park - 2008

Date	Time	Type	pH	Conductivity	Turbidity	DO	DO	Temp	Salinity	TP	Cl	TSS	Stage	Flow
				mS/cm	FNRU	mg/L	%	C	%	mg/L	mg/L	mg/L	ft	cfs
4/7/2008	10:45	Storm	7.16	0.486	35	11.36	87.0	4.2	0.01	0.244	53.0	25.0	849.76	
5/3/2008	10:15	Storm	7.21	0.458	29	10.78	88.4	7.1	0.01	0.118	42.1	15.0	850.45	
6/12/2008	13:30	Storm	7.27	0.366	83	7.13	76.0	18.8	0.01	0.258	36.7	43.0	850.66	
6/26/2008	13:00	Base	7.78	0.519	33	9.45	107.0	21.7	0.02	0.123	44.2	23.0	849.25	
7/24/2008	8:10	Base	7.78	0.615	7	9.38	84.6	20.3	0.02	0.093	52.8	9.0	848.92	
8/26/2008	11:20	Base	8.22	0.617	1	14.00	150.7	18.7	0.02	0.033	57.3	< 2	848.65	
8/28/2008	9:30	Storm	7.54	0.543	7	7.40	79.0	18.5	0.02	0.096	66.7	12.0	849.07	
9/17/2008	13:15	Base	8.17	0.602	2	14.13	150.9	18.4	0.02	0.042	51.4	4.0	848.67	
Min			7.16	0.366	1	7.13	76.0	4.2	0.01	0.033	36.7	4.0	848.7	
Mean			7.64	0.526	25	10.45	103.0	16.0	0.02	0.126	50.5	18.7	849.4	
Max			8.22	0.617	83	14.13	150.9	21.7	0.02	0.258	66.7	43.0	850.7	

Coon Creek at Coon Hollow - 2008

Date	Time	Type	pH	Conductivity	Turbidity	DO	DO	Temp	Salinity	TP	Cl	TSS	Stage	Flow
				mS/cm	FNRU	mg/L	%	C	%	mg/L	mg/L	mg/L	feet	cfs
4/7/2008	11:45	Storm	7.37	0.576	49	12.53	96	4.4	0.02	0.176	71.7	37	821.77	33.69
5/3/2008	11:30	Storm	7.47	0.516	34	9.96	83.1	7.6	0.02	0.111	54.7	30	822.88	beyond rating curve
6/12/2008	14:50	Storm	7.47	0.379	72	7.35	79	18.7	0.01	0.219	42.1	54	823.44	beyond rating curve
6/26/2008	14:00	Base	7.91	0.950	28	8.74	98	21.3	0.04	0.116	58.6	26	821.07	21.18
7/24/2008	10:15	Base	7.86	0.659	12	8.75	87.9	21.2	0.02	0.077	64.4	5	820.57	13.56
8/26/2008	13:30	Base	8.01	0.682	23	9.40	99.4	18.1	0.02	0.056	68.9	16	820.19	8.50
8/28/2008	10:35	Storm	7.50	0.375	65	6.72	72	18.9	0.01	0.275	48.2	98	821.42	27.17
9/17/2008	14:30	Base	8.01	0.662	7	11.16	114.80	16.6	0.02	0.044	62.0	3	820.61	14.13
Min			7.37	0.375	7	6.72	72.00	4.4	0.01	0.044	42.1	3	820.19	8.50
Mean			7.70	0.600	36	9.33	91.28	15.9	0.02	0.134	58.8	34	821.49	19.70
Max			8.01	0.950	72	12.53	114.80	21.3	0.04	0.275	71.7	98	823.44	33.69

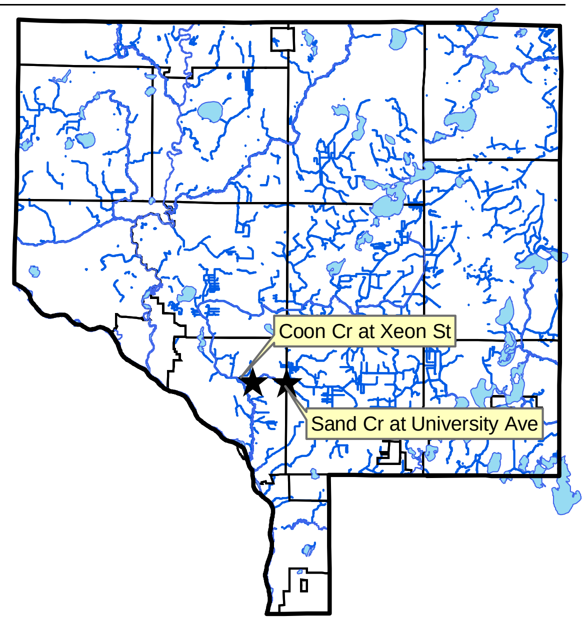
	pH	Conductivity	Turbidity	DO	DO	Temp	Salinity	TP	Cl	TSS
Anoka County Median	7.53	0.318	9		7.14		0.01	0.126	12	14
NCHF Ecoregion Mean		0.389						0.220		
NCHF Minimally Impacted Stream	8.1	0.298	7.1				0.00	0.130	8.0	13.7
"Impaired" Threshold	<6.5 or >8.5		>25		<5				>=230	

SAND CREEK

Sand Creek at Xeon Street, Coon Rapids — STORET SiteID = S004-619
Sand Creek at University Avenue, Coon Rapids — STORET SiteID = S005-264

Years Monitored

Sand Creek at Xeon Street – 2007 and 2008
Sand Creek at University Avenue – 2008 only



Background

Sand Creek is the largest tributary to Coon Creek. It drains suburban residential, commercial and retail areas throughout northeastern Coon Rapids and western Blaine. The stream is about 15 feet wide and 2.5-3 feet deep at the monitoring site during baseflow.

Sand Creek was first monitored in 2007 at Xeon Street, near its confluence with Coon Creek. In 2008 that montoring continued and a site approximately 1.7 miles upstream was monitoring at University Avenue. This site is the boundary between the cities of Blaine and Coon Rapids.

Results and Discussion

Eight water quality samples were taken in 2008, including four during storm events and four during baseflow. The results presented below also include similar monitoring done in 2007 at Xeon Street in order to provide the best picture of variability in this creek. Overall, water quality in Sand Creek is good, especially for a creek with a suburban watershed. Phosphorus, suspended solids, and turbidity, which are often elevated in urban streams were generally lower than the median of other Anoka County streams and lower than the published value for minimally impacted streams in the North Central Hardwood Forest ecoregion. Some minor water quality degradation was noticeable when comparing upstream to downstream, but this was minor. One pollutant type that was elevated in Sand Creek was dissolved pollutants, as measured by conductivity, chlorides, and salinity. Dissolved pollutants were 6-8 times higher than the Anoka County median and minimally impacted streams, and were high during both baseflow and storms.

Generally, Sand Creek water does not degrade Coon Creek, into which if flows. Sand Creek phosphorus, total suspended solids, and turbidity were all lower than Coon Creek. Conductivity was the exception, which was notably higher in Sand Creek. After 2007 monitoring, it appeared that generally Sand Creek had worse water quality than Coon Creek. This new information in 2008 indicates that efforts to improve water quality should be focused upon Coon Creek rather than Sand Creek. Coon Creek has several water quality problems, including dissolved pollutants, and both phosphorus and suspended solids during storms.

Detailed results for each pollutant type are below.

Conductivity, Chlorides, and Salinity

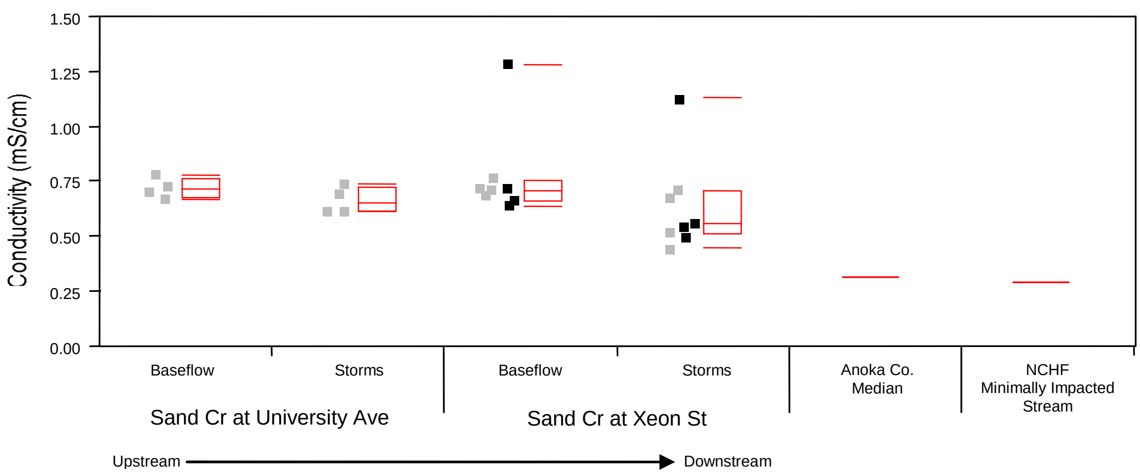
Conductivity, chlorides, and salinity are all measures of, or surrogates for, a broad range of dissolved pollutants. Dissolved pollutants in Sand Creek are moderately high (see figures below). Conductivity is typically at least two times greater than the median for Anoka County streams and minimally impacted streams in the North Central Hardwood Forest ecoregion. Chlorides, which are most often associated with road deicing salts, were even higher, at 6-8 times greater than the median of Anoka County streams and minimally impacted streams. Salinity was similar.

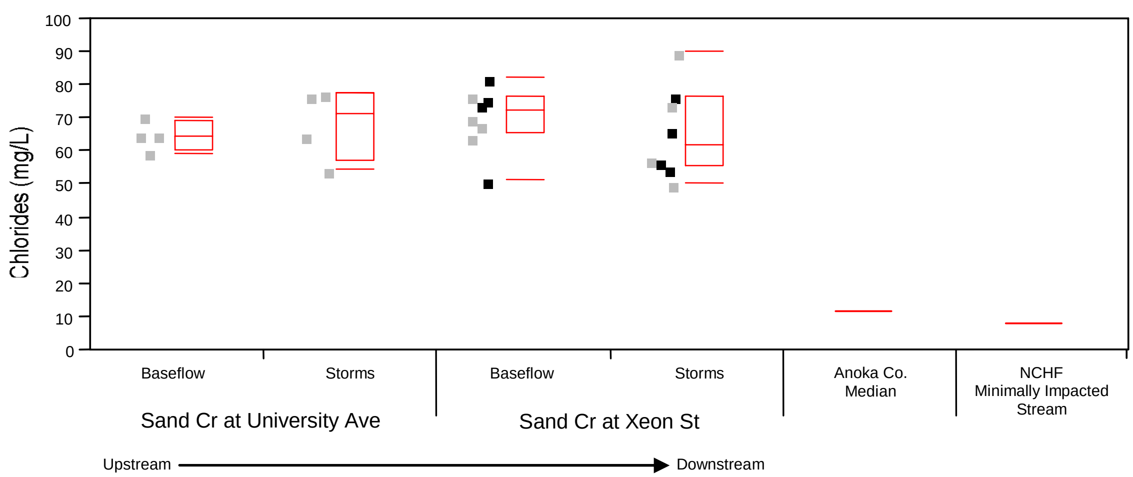
All three of these measures of dissolved pollutants were similar during baseflow and storm flushing. High dissolved pollutants during baseflow is an indication that these substances have infiltrated into the shallow groundwater which feeds the creek during baseflow. Some dilution is likely to happen during storms, but this is offset by new inputs with stormwater.

These levels are not high enough to affect most aquatic life. For example, the Minnesota Pollution Control Agency's chronic standard for chloride impairments is 230 mg/L, or approximately three times higher than the levels found in Sand Creek. It is possible that higher levels do occur at certain times, such as during snowmelt, but were not captured by the monitoring.

Sand Creek degrades Coon Creek with dissolved pollutants. Both creeks were monitored just before Sand Creek joins with Coon Creek. Sand Creek conductivity was 0.213 mS/cm, or 43%, greater than in Coon Creek. Sand Creek chlorides were 19 mg/L higher, on average, than Coon Creek where chlorides averaged 50 mg/L. The two streams have similar salinity, but this measure is not very sensitive.

Conductivity, chlorides, and salinity at Sand Creek. Dots are individual readings. Grey dots are 2008 readings, black dots are 2007 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





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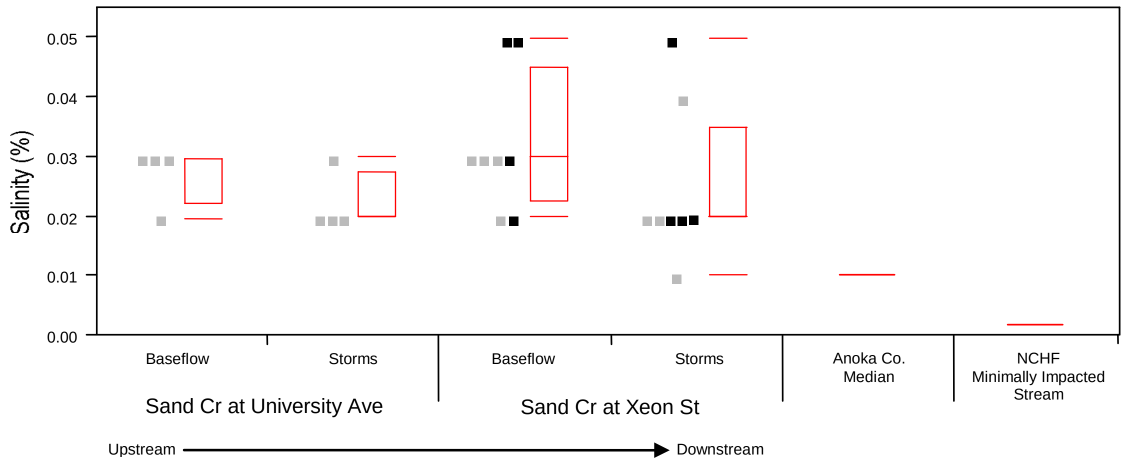
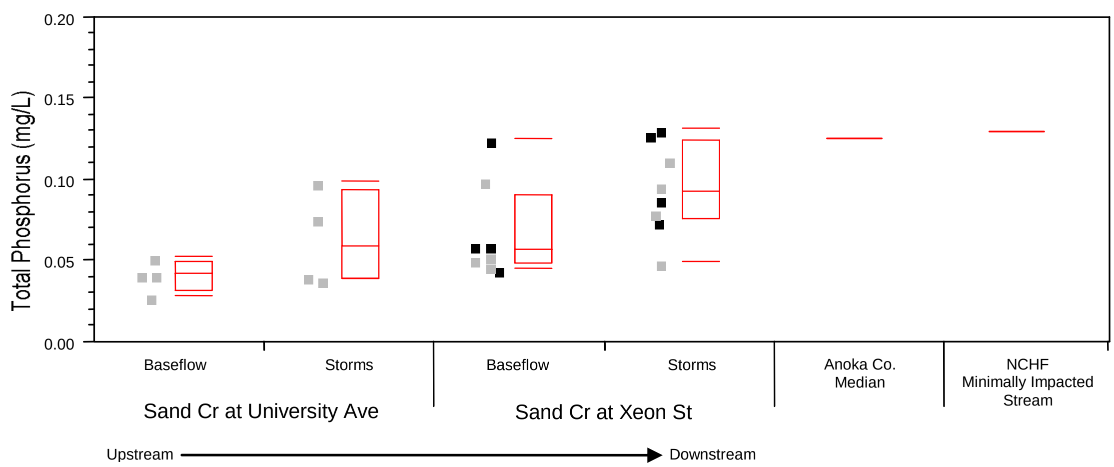


Total Phosphorus

Total phosphorus, a nutrient pollutant, was low in Sand Creek (see figure below). Even during storms phosphorus was below the median for Anoka County streams and below the published value for minimally impacted streams in this ecoregion. Phosphorus increases little or none from the upstream monitoring site to the downstream monitoring site. Phosphorus during storms was only slightly higher than baseflow. The median at University Avenue during storms and baseflow were 0.060 and 0.043 mg/L, respectively. Further downstream at Xeon Street storm and baseflow averages were 0.093 and 0.058 mg/L, respectively.

These low phosphorus levels, even during storms, is surprising in a suburban setting. The fact that the watershed is mostly residential probably helps to keep phosphorus inputs relatively low. Additionally, storm flushing into Sand Creek is minimal; the hydrograph (earlier in this report) is relatively flat, even in response to storms over one-inch.

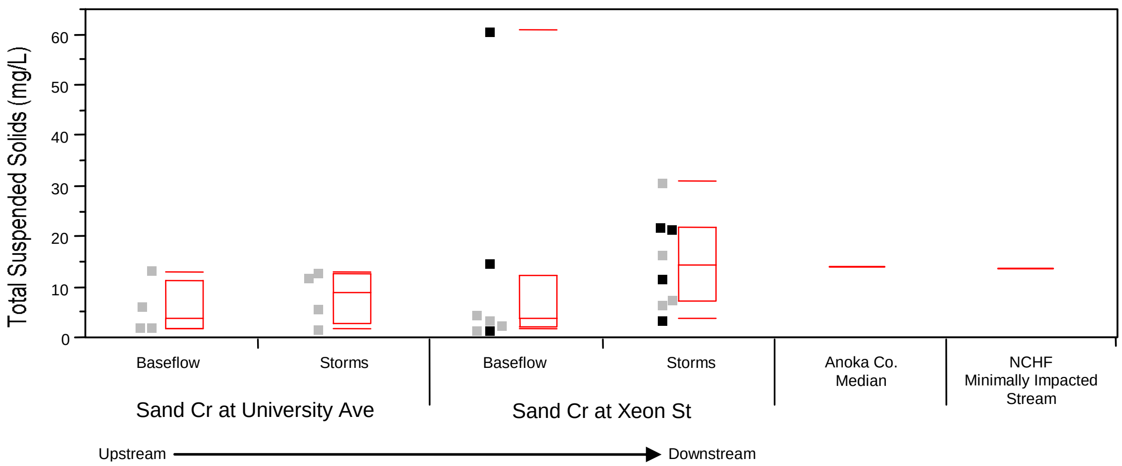
Total phosphorus at Sand Creek. Dots are individual readings. Grey dots are 2008 readings, black dots are 2007 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

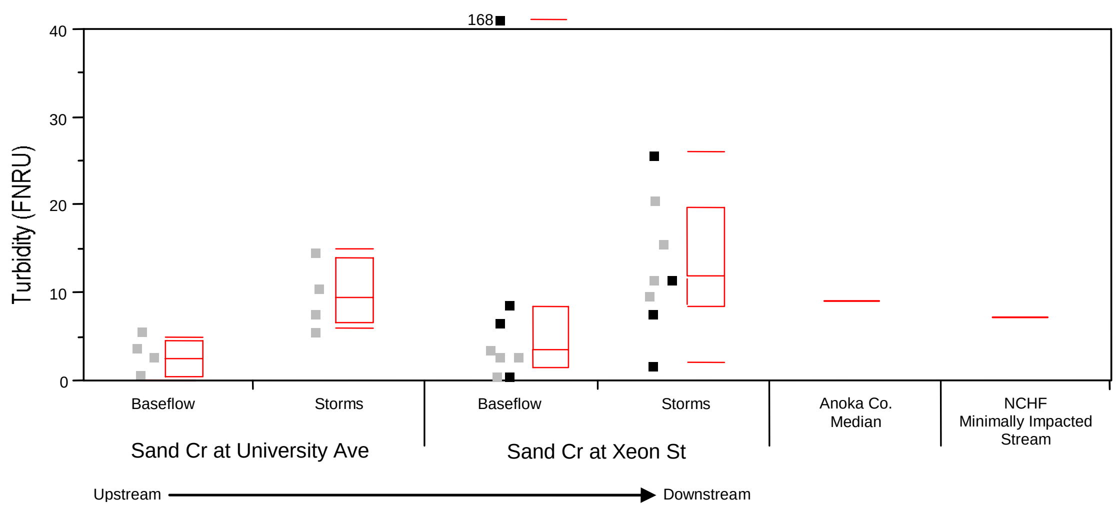


Total Suspended Solids and Turbidity

Total suspended solids (TSS) and turbidity both measure solid particles in the water. TSS measures these particles by weighing all materials filtered out of the water. Turbidity measures the defraction of a beam of light sent though the water sample, and is therefore most sensitive to large particles. Neither TSS nor turbidity is high in Sand Creek, although storms were higher than baseflow and downstream was higher than upstream (see figures below). During baseflow at both monitoring sites the median TSS was 4 mg/L, while median turbidity was 3-4 FNRU. This is less than half of levels typically found in stream in this area and of published values for minimally impacted streams. During storms at the upstream monitoring site (University Ave) TSS doubled and turbidity tripled, but were still reasonably low. Eleveated suspended material was only found during storms at the downstream monitoring site (Xeon St), where median TSS was 14.5 mg/L and median turbidity was 12 FNRU. Overall, this is still good for a suburban creek that receives stormwater inputs.

Total suspended solids and turbidity at Sand Creek. Dots are individual readings. Grey dots are 2008 readings, black dots are 2007 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

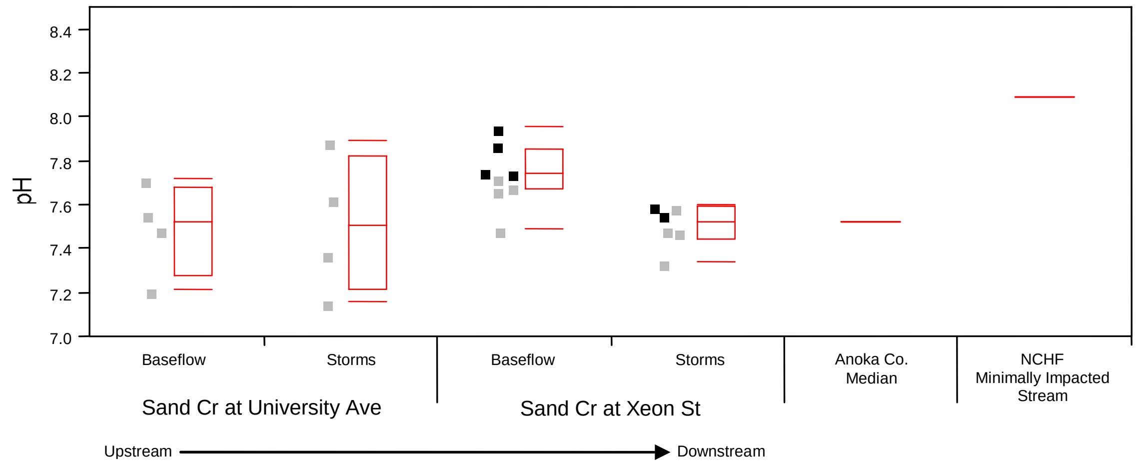




pH

pH was within the expected range at all sites and during all conditions (see figure below), ranging from 7.17 to 797.

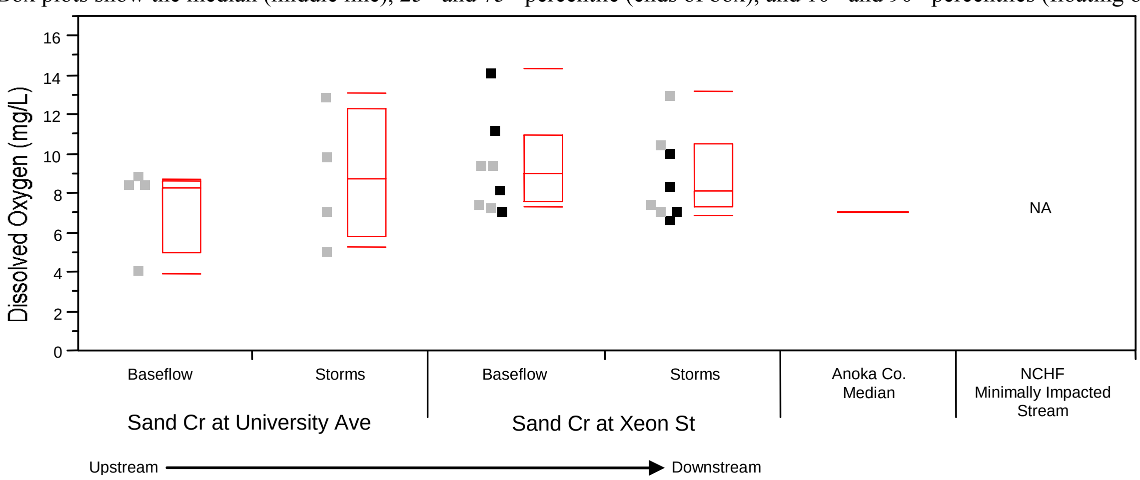
pH at Sand Creek. Dots are individual readings. Grey dots are 2008 readings, black dots are 2007 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



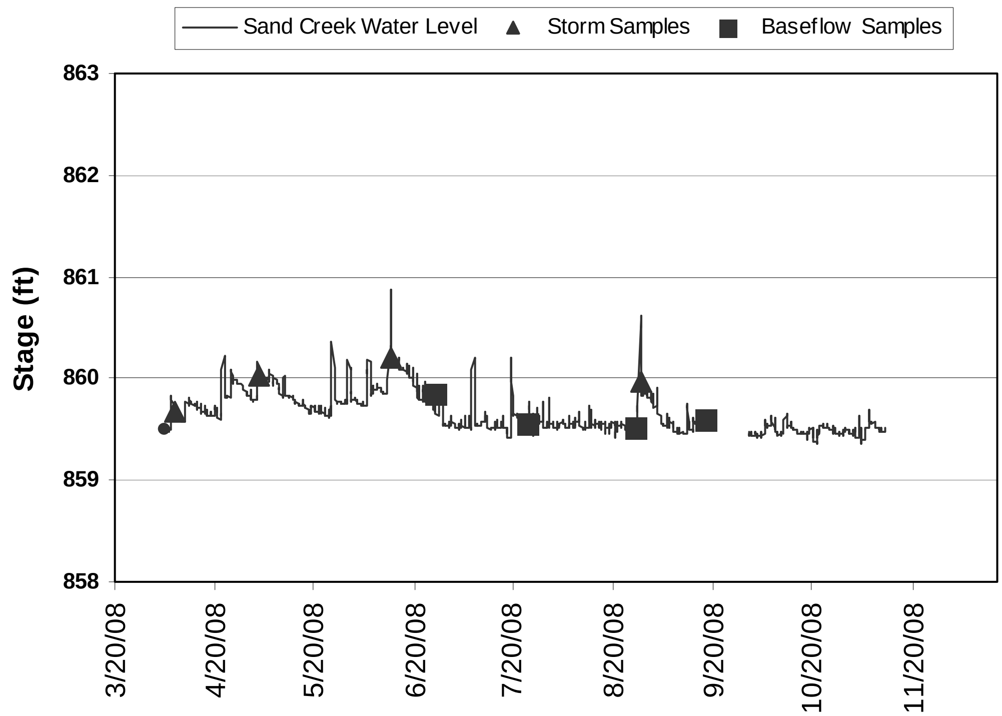
Dissolved Oxygen

Dissolved oxygen was similar at all sites, only once dropping below 5 mg/L at which point some aquatic life becomes stressed. Dissovled oxygen was 4.42 mg/L on July 24, 2008 under baseflow condtions. Given that this is only modestly low and only occurred once during low flow it is not of great concern. Low, slow moving water conditions sometimes result in low oxygen.

Dissolved Oxygen at Sand Creek. Dots are individual readings. Grey dots are 2008 readings, black dots are 2007 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Sand Creek Water Quality Sampling and Hydrology 2008



Sand Creek Water Quality Raw Data 2008

Sand Cr at University Ave - 2008													
Date	Time	Type	pH	Conductivity	Turbidity	DO	DO	Temp	Salinity	TP	Cl	TSS	Stage
				mS/cm	FNRU	mg/L	%	C	%	mg/L	mg/L	mg/L	ft
4/7/2008	11:15	Storm	7.17	0.697	15	13.24	100.0	3.7	0.02	0.077	77.4	13	870.52
5/3/2008	11:00	Storm	7.90	0.746	11	10.22	89.6	9.7	0.03	0.039	77.8	6	870.52
6/12/2008	14:15	Storm	7.64	0.617	6	7.45	84.0	21.2	0.02	0.042	65.2	<2	870.52
6/26/2008	13:40	Base	7.73	0.674	0	9.22	110.0	24.3	0.02	0.029	64.7	13	870.52
7/24/2008	9:15	Base	7.22	0.709	3	4.42	52.1	23.6	0.03	0.043	64.5	<2	870.52
8/26/2008	12:20	Base	7.50	0.783	2	8.79	98.0	20.6	0.03	0.043	70.6	< 2	870.52
8/28/2008	10:00	Storm	7.39	0.624	8	5.39	60.0	20.3	0.02	0.100	54.8	12	870.52
9/17/2008	14:00	Base	7.57	0.729	5	8.83	95.7	19.5	0.03	0.053	59.3	6	870.52
Min			7.17	0.617	0.0	4.42	52.1	3.7	0.02	0.029	54.8	6	870.52
Mean			7.52	0.697	6.3	8.45	86.2	17.9	0.03	0.053	66.8	10	870.52
Max			7.90	0.783	15.0	13.24	110.0	24.3	0.03	0.100	77.8	13	870.52

Sand Creek at Xeon Street - 2008													
Date	Time	Type	pH	Conductivity	Turbidity	DO	DO	Temp	Salinity	TP	Cl	TSS	Stage
				mS/cm	FNRU	mg/L	%	C	%	mg/L	mg/L	mg/L	ft
4/7/2008	11:00	Storm	7.35	0.720	16	13.33	101.0	3.9	0.02	0.081	90.4	7	859.30
5/3/2008	10:30	Storm	7.60	0.690	12	10.82	92.1	8.4	0.04	0.050	74.4	8	859.58
6/12/2008	15:25	Storm	7.50	0.531	21	7.81	87.0	20.4	0.02	0.097	57.6	31	859.74
6/26/2008	13:25	Base	7.68	0.688	1	7.82	90.0	22.3	0.02	0.054	70.5	5	859.20
7/24/2008	8:45	Base	7.50	0.712	4	7.65	87.4	22.0	0.03	0.101	68.1	4	859.05
8/26/2008	11:50	Base	7.70	0.770	3	9.80	101.8	17.4	0.03	0.052	77.0	< 2	858.82
8/28/2008	9:45	Storm	7.49	0.455	10	7.48	81.0	19.2	0.01	0.113	50.6	17	859.33
9/17/2008	13:30	Base	7.74	0.725	3	9.74	101.1	17.0	0.03	0.048	64.9	3	858.97
Min			7.35	0.455	1	7.48	81.00	3.9	0.01	0.048	50.6	3.0	858.82
Mean			7.57	0.661	9	9.31	92.68	16.3	0.03	0.075	69.2	10.7	859.25
Max			7.74	0.770	21	13.33	101.80	22.3	0.04	0.113	90.4	31.0	859.74

Anoka County Median	7.53	0.318	9		7.14		0.01	0.126	12	14
NCHF Ecoregion Mean		0.389						0.220		
NCHF Minimally Impacted Stream	8.1	0.298	7.1				0.00	0.130	8.0	13.7
"Impaired" Threshold	<6.5 or >8.5		>25		<5				>=230	

Stream Water Quality – Biological Monitoring (Students)

Description: This program combines environmental education and stream monitoring. Under the supervision of ACD staff, high school science classes collect aquatic macroinvertebrates from a stream, identify their catch to the family level, and use the resulting numbers to gauge water and habitat quality. These methods are based upon the knowledge that different families of macroinvertebrates have different water and habitat quality requirements. The families collectively known as EPT (Ephemeroptera, or mayflies; Plecoptera, or stoneflies; and Trichoptera, or caddisflies) are pollution intolerant. Other families can thrive in low quality water. Therefore, a census of stream macroinvertebrates yields information about stream health.

Purpose: To assess stream quality, both independently as well as by supplementing chemical data. To provide an environmental education service to the community.

Locations: Coon Creek at Andover High School, Andover

Results: Results for each site are detailed on the following pages.

Tips for Data Interpretation

Consider all biological indices of water quality together rather than looking at each alone, as each gives only a partial picture of stream condition. Compare the numbers to county-wide averages. This gives some sense of what might be expected for streams in a similar landscape, but does not necessarily reflect what might be expected of a minimally impacted stream. Some key numbers to look for include:

Families — Number of invertebrate families. Higher values indicate better quality.

EPT — Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.

Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

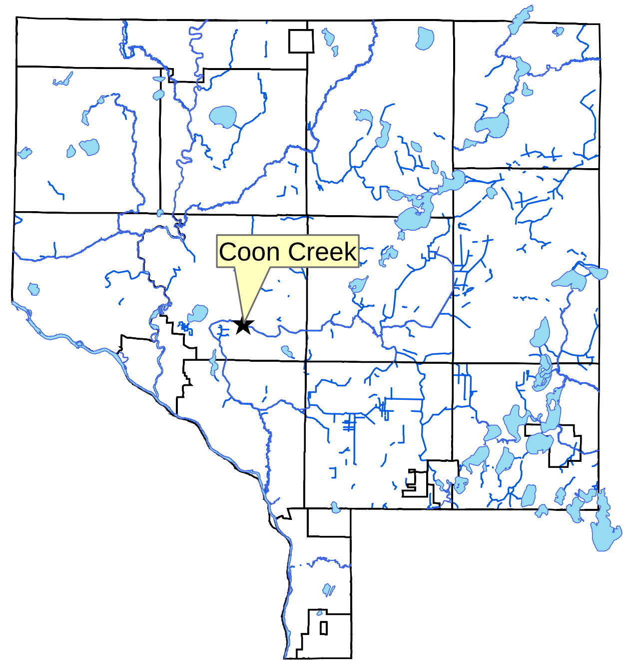
FBI	Stream Quality Evaluation
0.00-3.75	Excellent
3.76-4.25	Very Good
4.26-5.00	Good
5.01-5.75	Fair
5.76-6.50	Fairly Poor
6.51-7.25	Poor
7.26-10.00	Very Poor

% Dominant Family — High numbers indicates an uneven community, and likely poorer stream health.

Biomonitoring

COON CREEK

at Crosstown Blvd near Andover High School, Andover



Last Monitored

By Andover High School in 2008

Monitored Since

Fall 2003

Student Involvement

106 students in 2008, approx 483 since 2003

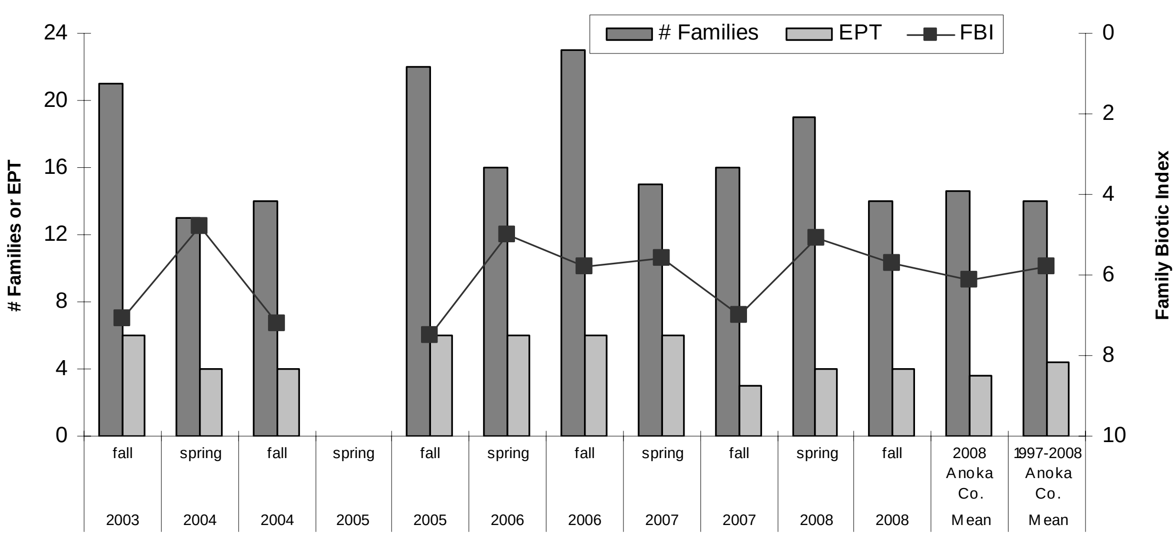
Background

Coon Creek originates in the southern part of the Carlos Avery Wildlife Management Area in western Columbus Township. It flows west, then south, and empties into the Mississippi River at Coon Rapids Dam Regional Park. Coon Creek has a number of ditch tributaries. Land use is an approximately equal mix of residential and vacant/agricultural with some small commercial sites. The land use immediately surrounding the sampling site is residential on the south side of the creek and the high school campus on the north side. A vegetated buffer 20-100 feet wide is present at the sampling site, and is typical elsewhere. The banks are steep with moderate to heavy erosion in spots. The streambed is composed of sand and silt. The stream is 1 to 2.5 feet deep at baseflow and approximately 10-15 feet wide.

Results

Three Andover High School classes monitored this stream in spring 2008, while one class monitored in fall. This year, like previous years, the number of sensitive families and Family Biotic Index (FBI) were typical of streams in Anoka County. The number of families found has been variable, but generally higher than the average Anoka Coutny stream over the years. The variability is likely due to different climate and stream flow conditions prior to and during sampling. Most of the families found are relatively pollution insensitive, including the EPT families which as a group are more pollution sensitive.

Summarized Biomonitoring Results for Coon Creek in Andover



Biomonitoring Data for Coon Creek in Andover

Year	2003	2004	2004	2005	2005	2006	2006	2007	2007	2008	2008	Mean	Mean
Season	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	2008 Anoka Co.	1997-2008 Anoka Co.
FBI	7.10	4.80	7.20		7.50	5.00	5.80	5.60	7.00	5.10	5.70	6.2	5.6
# Families	21	13	14		22	16	23	15	16	19	14	14.4	13.2
EPT	6	4	4		6	6	6	6	3	4	4	3.8	4.4
Date	21-Oct	10-May	19-Oct	2-May	17-Oct	24-May	6-Oct	1-May	3-Oct	30-May	2-Oct		
sampling by	AHS	AHS	AHS	AHS	AHS	AHS	AHS	AHS	AHS	AHS	AHS		
sampling method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
# individuals	267	89	130	inadequate	301	141	415	317	176	90.7	195		
# replicates	2	1	1	sample	1	1	2	2	1	3	1		
Dominant Family	corixidae	baetidae	corixidae		corixidae	calopterygidae	calopterygidae	calopterygidae	corixidae	Baetidae	Calopterygidae		
% Dominant Family	46.4	48.3	50		53.5	29.1	49.6	31.9	36.4	38.2	25.6		
% Ephemeroptera	6.0	51.7	4.6		9.0	29.8	3.4	13.9	1.7	40.4	23.1		
% Trichoptera	16.5	11.2	22.3		5.0	14.9	6.7	6.0	4.5	12.5	2.6		
% Plecoptera	0.0	0.0	0.0		0	0.7	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

Parameter	10/21/03	5/10/04	10/19/04	5/2/05	10/16/05	5/24/06	10/6/06	5/01/07	10/03/07	5/30/08	10/02/08
pH	8.66	9.25	9.45	8.72	7.75	7.77	7.62	8.50	7.62	7.41	7.66
Conductivity (mS/cm)	0.662	0.496	0.379	0.357	0.310	0.508	0.559	0.454	0.417	0.458	0.609
Turbidity (NTU)	10	12	22	11	15	15	16	11	14	12	4
Dissolved Oxygen (mg/L)	7.71	na	9.83	na	10.07 (93%)	6.70 (70%)	9.46 (82%)	11.19 (106%)	8.93 (88%)	8.79 (83%)	9.52 (81%)
Salinity (%)	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.02
Temperature (C)	10.8	14.5	7.9	5.9	10.9	16.8	9.6	13.3	15.1	13.0	8.2

Discussion

The invertebrate community suggests Coon Creek's health is average compared to other nearby streams. The stream's habitat is relatively sparse, mostly due to past excavations aimed at making the creek perform like a ditch. The supplemental stream water chemistry readings taken during biomonitoring indicate a higher than expected level of dissolved pollutants, as measured by conductivity. Conductivity and salinity were similar to, though not as extreme as, some urbanized streams at the same time of year. The source could be road salts, failing septic systems, and/or chemical wastes. Turbidity was also high. These factors, as well as the general lack of habitat in this ditched stream, probably limit the invertebrate community.

Andover High School students at Coon Creek in 2008

Stream Water Quality – Biological Monitoring (Professional)

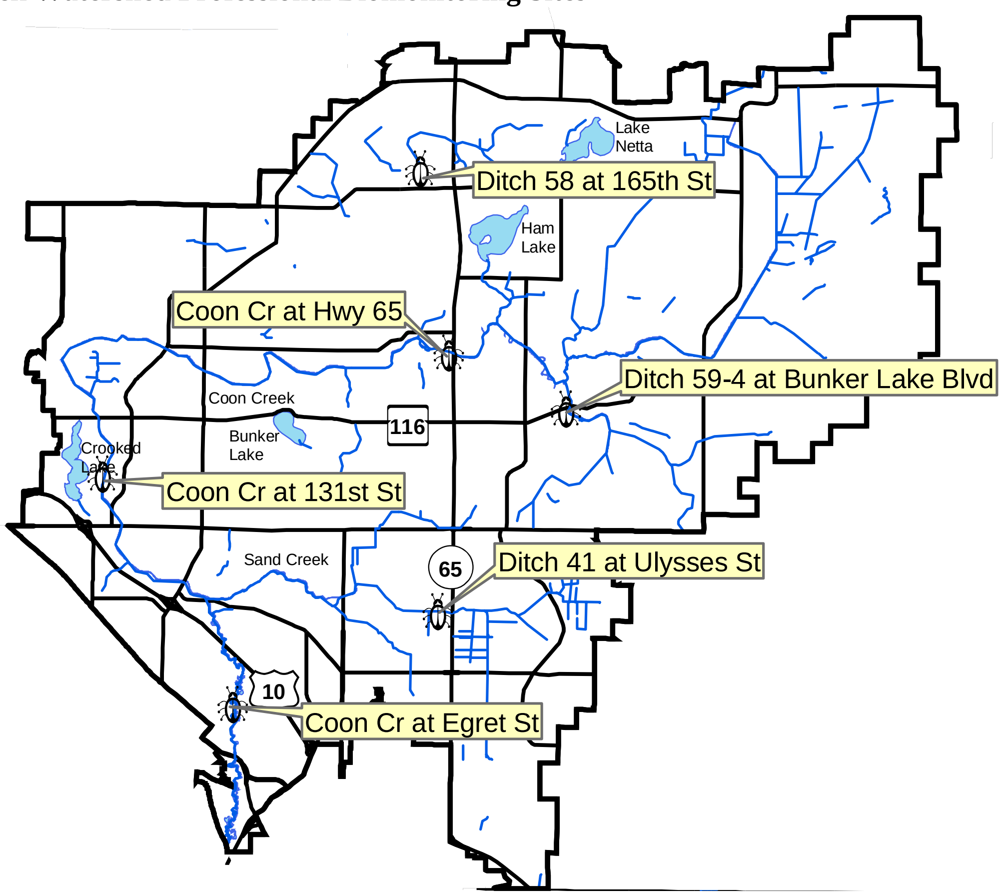
Description: The professional biological monitoring program is more comprehensive than student biomonitoring. All field work, identifications, and analyses are completed by professional aquatic ecologists. Sampling and habitat assessment methods are taken from the U.S. EPA or MPCA. Interpretation of results is based on invertebrate communities sampled and is based upon the knowledge that different families of macroinvertebrates have different water and habitat quality requirements. The families collectively known as EPT (Ephemeroptera, or mayflies; Plecoptera, or stoneflies; and Trichoptera, or caddisflies) are pollution intolerant. Other families can thrive in low quality water. Therefore, a census of stream macroinvertebrates yields information about stream health.

Purpose: To assess stream quality, both independently as well as by supplementing chemical data. To provide an environmental education service to the community.

Locations:
Coon Cr at 131st St
Coon Cr at Hwy 65
Coon Cr at Egret Blvd
Ditch 58 at 165th St
Ditch 41 at Ulysses St (W side of Lowes)
Ditch 59-4 at Bunker Lake Blvd

Results: Results for each site are detailed on the following pages.

Coon Creek Watershed Professional Biomonitoring Sites



COON CREEK SYSTEM

Reaches Unmaintained in the last 10 years
- Coon Cr at Egret Blvd
- Ditch 58 at 165th St

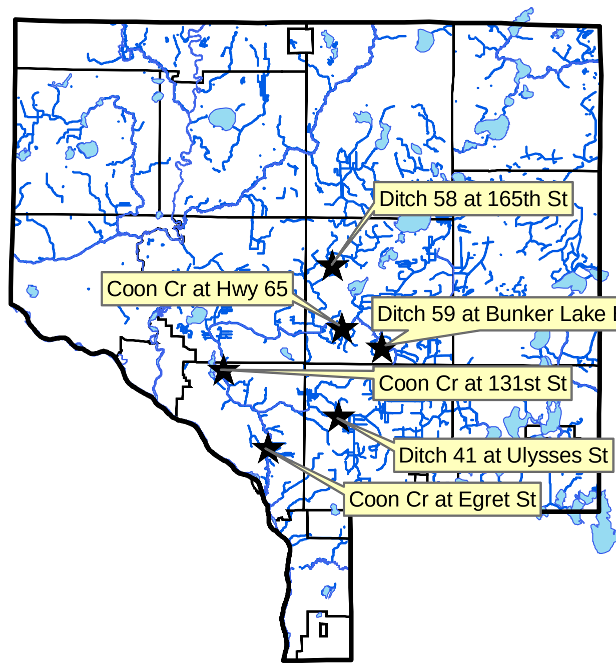
Reaches Maintained within the last 10 years
- Coon Cr at Hwy 65
- Coon Cr at 131st St
- Ditch 41 at Ulysses St (W side of Lowes)
- Ditch 59-4 at Bunker Lake Blvd

Years Monitored

All sites—Fall 2008

Background

Coon Creek is a major drainage through central Anoka County. Development in the watershed ranges from rural residential to urbanized. Farthest downstream, the creek is about 30 feet wide and 1.5 to-2 feet deep during baseflow.



The Minnesota Pollution Control Agency (MPCA) has listed Coon Creek as biologically impaired based on single samples from two sites in August of 2000. Both of these reaches are actively maintained ditches that had been cleaned recently. The purpose of this work is to:

- compare maintained and unmaintained creek reaches,
- compare the Coon Creek system with similar nearby streams,
- examine the effect of total suspended solids on invertebrate communities, and to
- verify the MPCA's findings.

Six sites were examined twice in 2008. The sites studied included the two sites sampled by the MPCA—Coon Creek at Hwy 65 and at 131st Street. Four of the sites were ditches that had been cleaned or maintained within the last 10 years and two had not been maintained during that time. All sites were examined twice—in August when MPCA does their invertebrate monitoring and again at the beginning of October for comparison with numerous high school groups that monitor other sites at this time.

This professional biomonitoring is more rigorous and more comprehensive than student biomonitoring programs. All of the field work, identifications, and analyses are done by professional aquatic ecologists. In this case, both staff have Masters degrees in aquatic ecology and combined have over 10 years of biological monitoring experience. The sampling methods used were the same as those used by the MPCA, the US EPA's multihabitat method. In addition, the MCPA's Stream Habitat Assessment (MSHA) worksheet was completed for each site. Going beyond MPCA's standard operating procedures, water chemistry data was collected, including pH, conductivity, turbidity, temperature, dissolved oxygen, salinity, and total suspended solids.

Several measures of stream biological health were used. After identifying the macroinvertebrates to the family level, we calculated the EPT and FBI indices of stream health. EPT is a count of families belonging to the orders Ephmeroptera, Plecoptera, and Trichoptera. With a few exceptions, macroinvertebrates in these three orders are generally more sensitive to pollution. Therefore, more EPT families present in a stream indicate a healthier system. FBI, the Family Biotic Index, scores each family of macroinvertebrate based on its tolerance of pollution. The lower the score, the more tolerant the family is of pollution. The tolerance scores for all macroinvertebrates collected in a site are compiled to give an overall score for that site. The FBI ranges from 0-10, with 0 being best.

Results and Discussion

Summary

The data used in this study are limited in several ways and therefore the results should be interpreted with caution. Limitations included that only one year of data was collected and that only two "unmaintained" sites were sampled. Yet, the following general conclusions seem apparent:

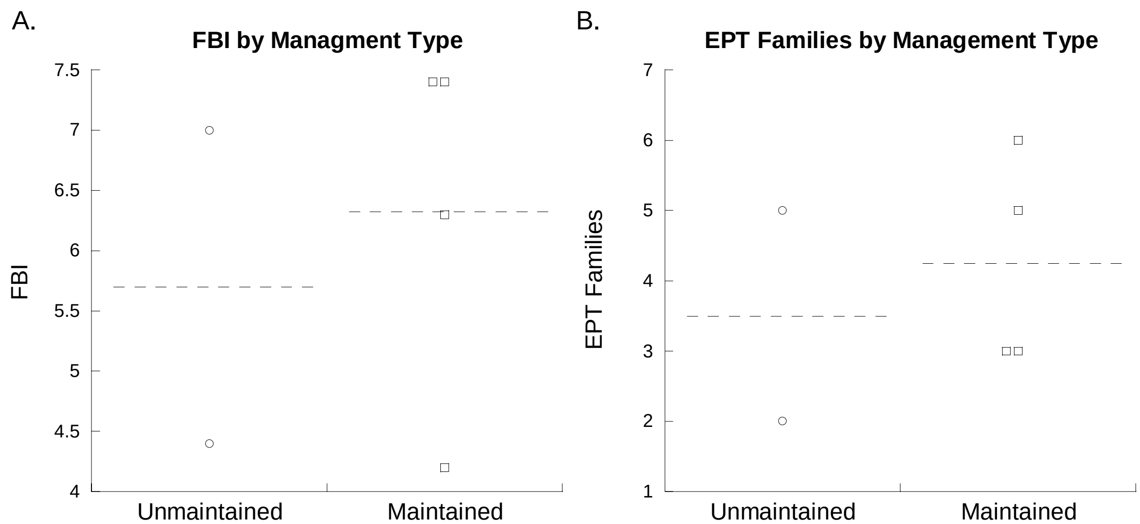
- FBI and EPT indices of stream health are not different among unmaintained reaches of stream and those that have been maintained (cleaned with a backhoe) in the last 10 years.
- There was no difference in MSHA habitat scores between maintained and unmaintained stream reaches.
- There was no difference in total suspended solids between maintained and unmaintained stream reaches.
- Coon Creek sites monitored by the MPCA and used to designate the creek as "biologically impaired" rank in the upper half of 12 sites on six streams that were monitored throughout Anoka County in 2008 (includes student-monitored sites), though few of the sites had significantly different FBI or EPT.
- EPT and FBI stream health indices improve with improving habitat scores, decreased TSS and decreased turbidity.
- MPCA sampling in September, 2000 indicated better stream health than we found in 2008.

Detailed results are below.

Effect of Management Activity on Invertebrate Indices

Four of the six sites examined by ACD are channelized and actively maintained with backhoe or similar equipment for drainage capacity. The remaining two sites have not been maintained for at least 10 years. Biotic indices from maintained and unmaintained sites were compared to examine the effect of management activity. While no statistical test was performed due to limited sample size of unmaintained sites, there is no readily apparent relationship between channel management and the two primary invertebrate indices.

FBI (A.) and EPT (B.) scores for unmaintained and maintained sites examined in this study.

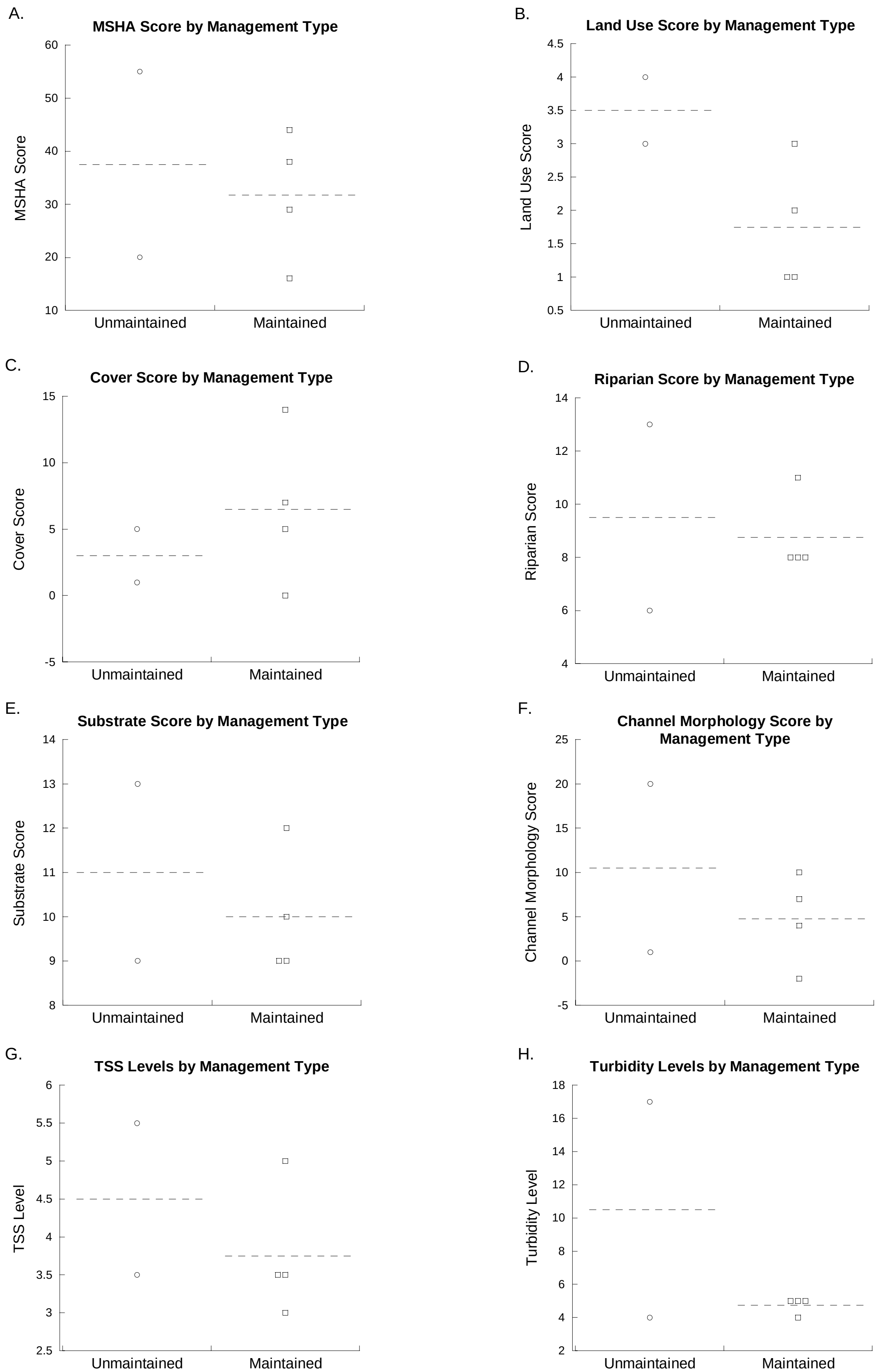


Effect of Management Activity on Habitat and Suspended Solids

A habitat assessment was conducted at each site following the Minnesota Pollution Control Agency's Stream Habitat Assessment Protocol (MSHA). The MSHA rates stream habitat on a scale of 0-100 (100 being best) and is a summation of subjective scores rating surrounding land use, quality of the riparian zone, substrate characteristics, available in stream cover, and channel morphology components of habitat quality. In addition, water quality measurements were taken at each site and water samples were collected to be analyzed for total suspended solids (TSS). MSHA scores, individual habitat component scores, TSS levels, and turbidity levels were compared between maintained and unmaintained sites to examine the effect of management type. Temperature, dissolved oxygen, conductivity, salinity, flow rates, and pH were not compared across maintained and unmaintained sites as they were similar across all locations and/or any significant variation would likely be due to location in the stream system (upstream or downstream) rather than management type. While land use scores appear to be significantly higher in unmaintained sites, there appears to be no significant differences in overall MSHA scores. Additionally, there appears to be no statistical differences in riparian quality, substrate quality, cover quality, channel morphology scores, or TSS levels between maintained and unmaintained sites. While turbidity appears to be higher in unmaintained sites, the data is skewed by one site that lies adjacent to both a sod farm and residential yard, which is mowed to the stream edge. Overall, the data indicates that channel management does not significantly affect habitat quality or macroinvertebrate community health. However, any effect due to management activity would be very difficult to detect given the extremely small sample size of this project to date.

Figures on the next page

Comparisons of habitat and suspended solids measurements in actively managed stream reaches of Coon Creek and reaches not maintained in at least 10 years. (A.) MSHA, (B.) land use, (C.) cover, (D.) riparian, (E.) substrate, (F.) channel morphology, (G.) TSS levels, and (H.) turbidity levels for unmaintained and maintained sites examined in this study.



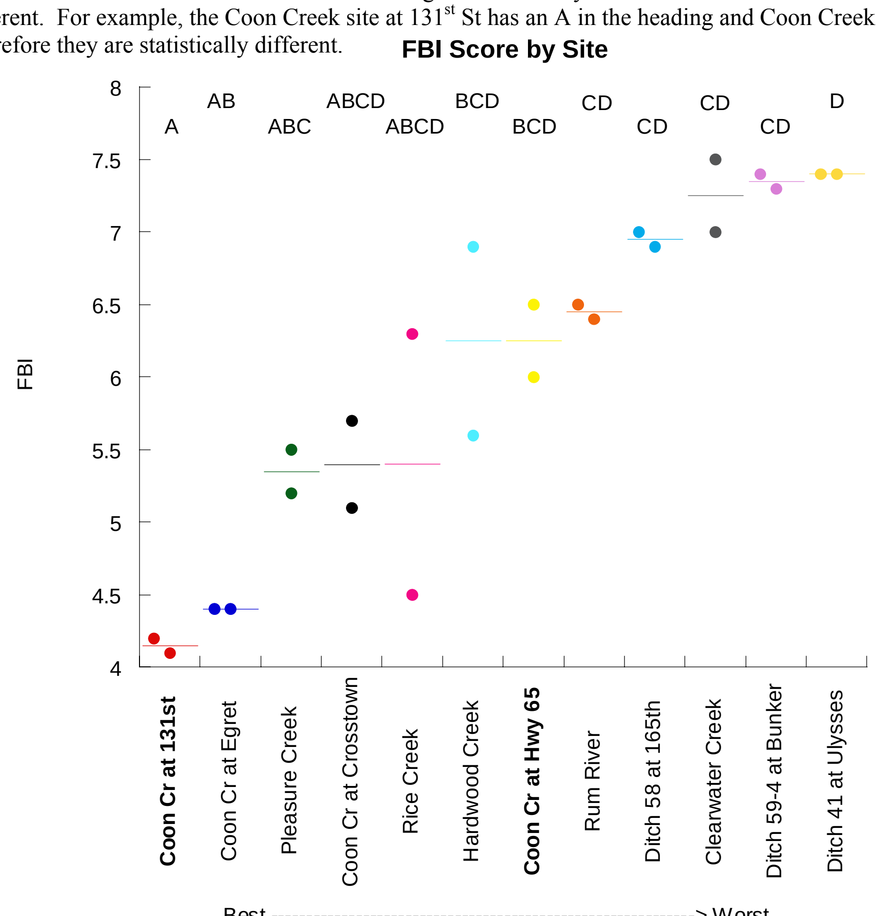
Comparison between Coon Creek and other local streams

Comparing the Coon Creek monitoring sites to a variety of other streams nearby provides some context for its relative ecological health and "impaired" designation. Six other streams in Anoka County underwent biological monitoring twice in 2008 (May and October), and all have at least five prior years of monitoring to provide a measurement of the variability they experience. The streams monitored include Pleasure Creek, Rice Creek, Hardwood Creek, Rum River, Clearwater Creek, and a site on Coon Creek that was not part of the professional biomonitoring. These sites were monitored in cooperation with local high schools as part of their biology curriculum. Students, under the supervision of Anoka Conservation District (ACD) staff and teachers, conducted the field sampling and initial invertebrate identifications. ACD staff checked all identifications. The same indices of stream health as those used for the professional biomonitoring were calculated

FBI and EPT scores of the student biomonitoring sites were compared with those from the six Coon Creek sites examined in this study. Separate one-way ANOVAs were used to test for differences among the 12 sties followed by post-hoc Tukey HSD (α=0.5) pairwise comparisons to identify significant differences among the sites. The figures below ranks the sites from best ecological health to worst based upon FBI and EPT, and indicate which differences are statistically significant. These analyses did find statistically significant differences, but this should be taken cautiously due to the extremely limited sample size.

Using FBI as an indicator of stream quality or health, the Coon Creek site at 131st Street was the best site monitored in 2008. The Ditch 41 site at Ulysses was the worst. Only five of the monitored sites are considered to have at least fair water quality (see table on following page). Only two of the monitored sites are considered to have good or very good water quality, both of which are part of the Coon Creek system. However, of the seven sites considered to have fairly poor, poor, or very poor water quality, four are also part of the Coon Creek system.

FBI scores for all Anoka County biomonitoring sites sampled in 2008: Sites in bold were previously sampled by the MPCA in their determination of impairment status. Dots indicate actual scores for each site and lines indicate site means. Sites with a common letter in the heading are statistically similar. Those without a common letter are statistically different. For example, the Coon Creek site at 131st St has an A in the heading and Coon Creek site at Hwy 65 does not. Therefore they are statistically different.

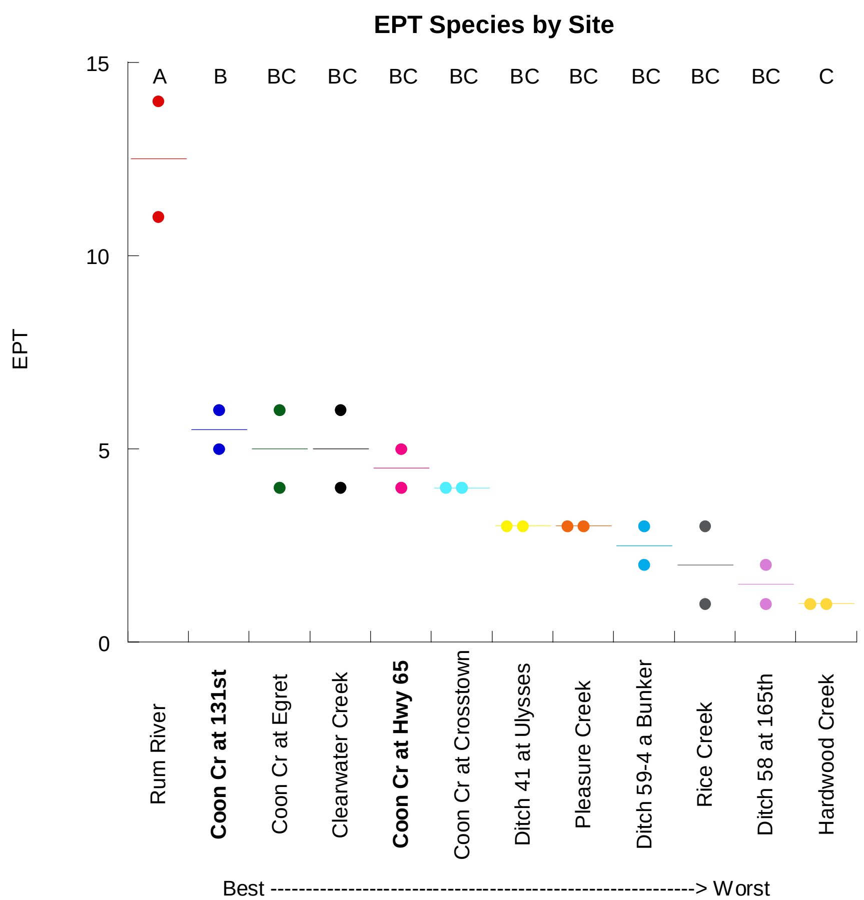


Qualitative water quality ratings corresponding to quantitative FBI scores

FBI Score	Corresponding Water Quality Rating
0-3.75	Excellent
3.76-4.25	Very Good
4.26-5	Good
5.01-5.75	Fair
5.76-6.5	Fairly Poor
6.51-7.25	Poor
7.26-10	Very Poor

Using EPT as an indicator of stream quality or health, the Rum River site was the best site monitored in 2008. The Hardwood Creek was the worst. All of the Coon Creek sites sampled in 2008 had significantly fewer EPT species than the Rum River site, which is not surprising as EPT richness tends to increase with stream size. Generally, main channel Coon Creek sites had higher EPT richness than similar streams in Anoka County, though those differences were not statistically significant. Also of note is that the two sites sampled by MPCA in their study had relatively high EPT richness than similar Anoka County streams. Sites within the ditch drainage system, however, generally had lower EPT richness than main channel sites.

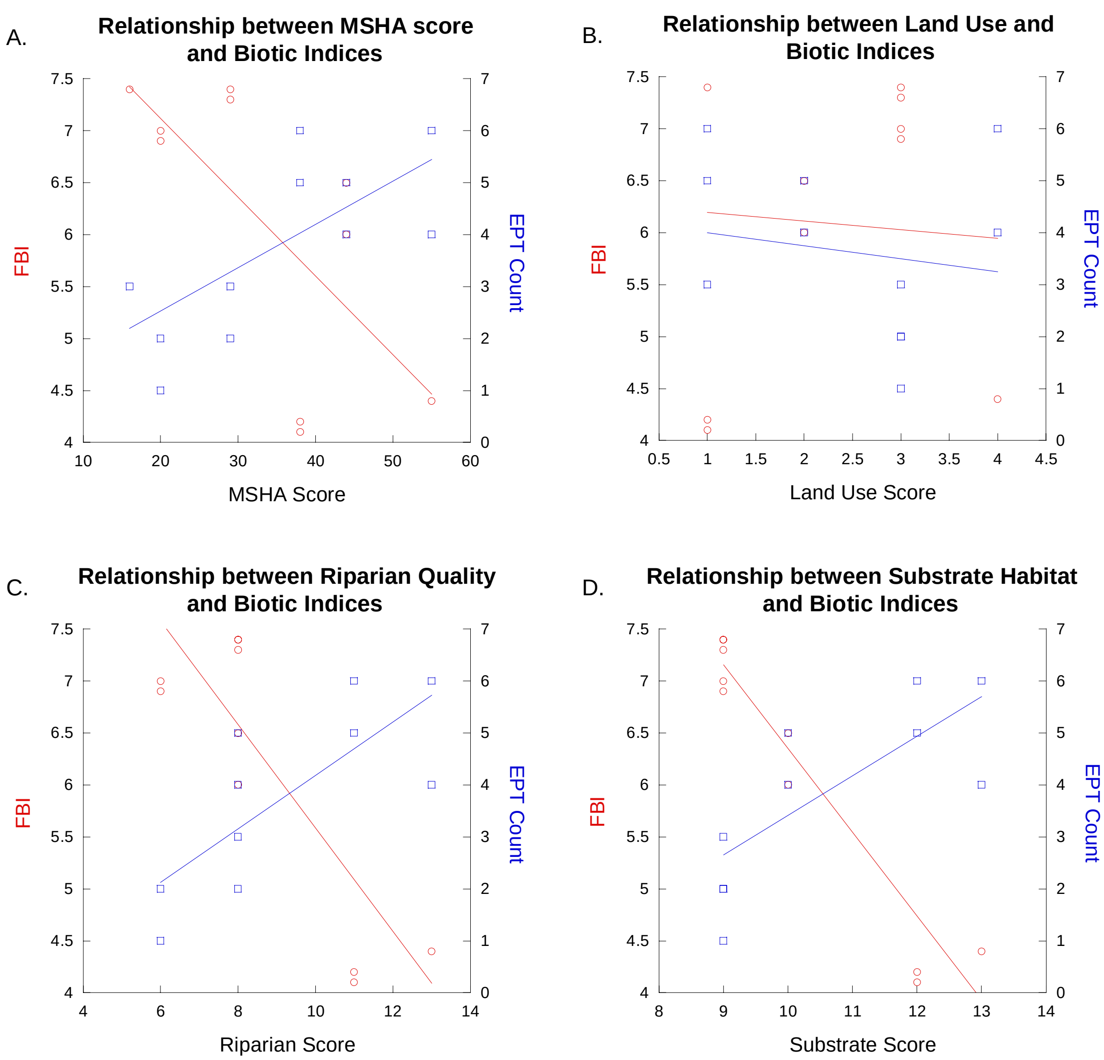
Number of EPT species collected from all Anoka County biomonitoring sites sampled in 2008: Sites in bold were previously sampled by the MPCA in their determination of impairment status. Dots indicate actual scores for each site and lines indicate site means. Sites with a common letter in the heading are statistically similar. Those without a common letter are statistically different. For example, the Coon Creek sites at 131st St and Hwy 65 both have a B in the heading; therefore they are statistically the same.



Relationships between measured physical and chemical parameters and macroinvertebrate indices

Data collected at each site was plotted against the two biotic indices (FBI and EPT) to examine the relationships between physical and chemical parameters and the macroinvertebrate community. In general, relationships turned out as expected, though there is great variability (see figures below). FBI scores decreased (lower indicates a healthier site) with increasing MSHA and individual habitat component scores. FBI scores increased with increasing TSS and turbidity. With one exception, EPT scores also turned out as expected. EPT scores increased with increasing MSHA and all but one individual habitat component scores. EPT scores decreased with increasing land use scores and TSS and turbidity levels. Land use score was the only parameter that appeared to be affected by channel management type. However, it is also the most weakly related parameter with the biotic indices. Overall, better habitat conditions resulted in healthier macroinvertebrate communities, even though habitat conditions do not seem to be significantly affected by management type.

Relationship between biotic indices and habitat and water chemistry parameters: (A.) MSHA score, (B.) land use score, (C.) riparian score, (D.) substrate score, (E.) cover score, (F.) channel morphology score, (G.) TSS levels, and (H.) turbidity levels in sties examined for this study. The left Y axis is FBI (red lines and circle markers). The right Y axis is EPT (blue lines and square markers).



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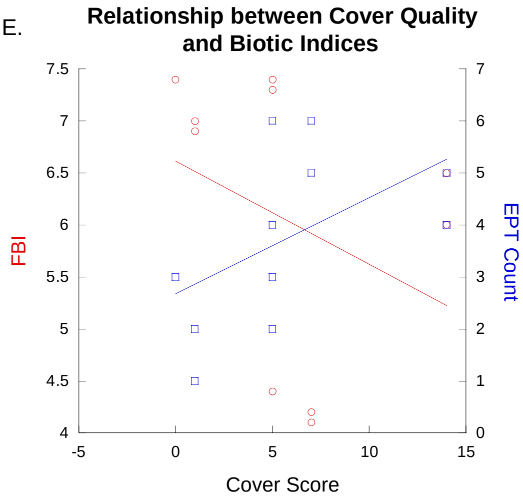
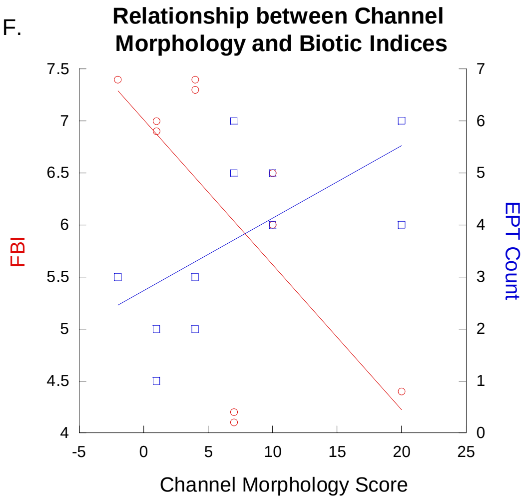
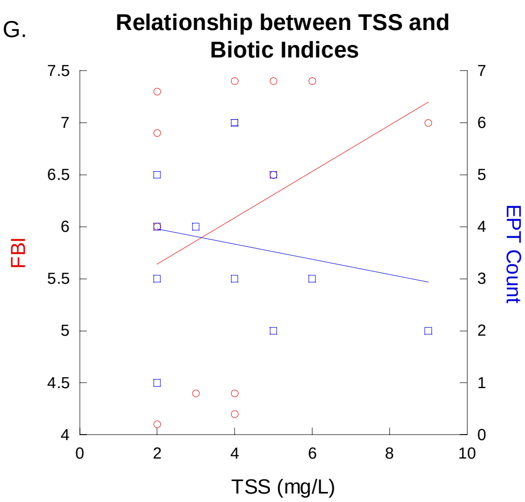


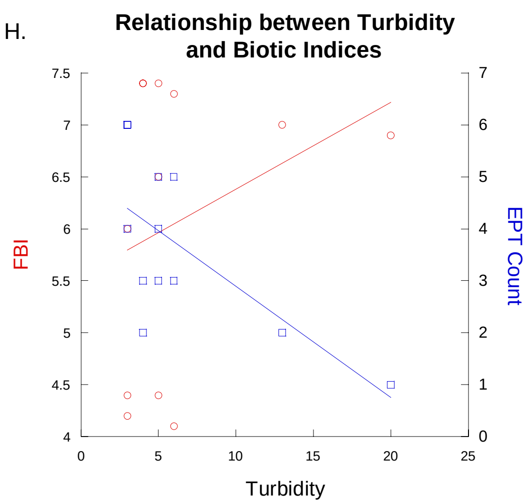
F.



G.



H.



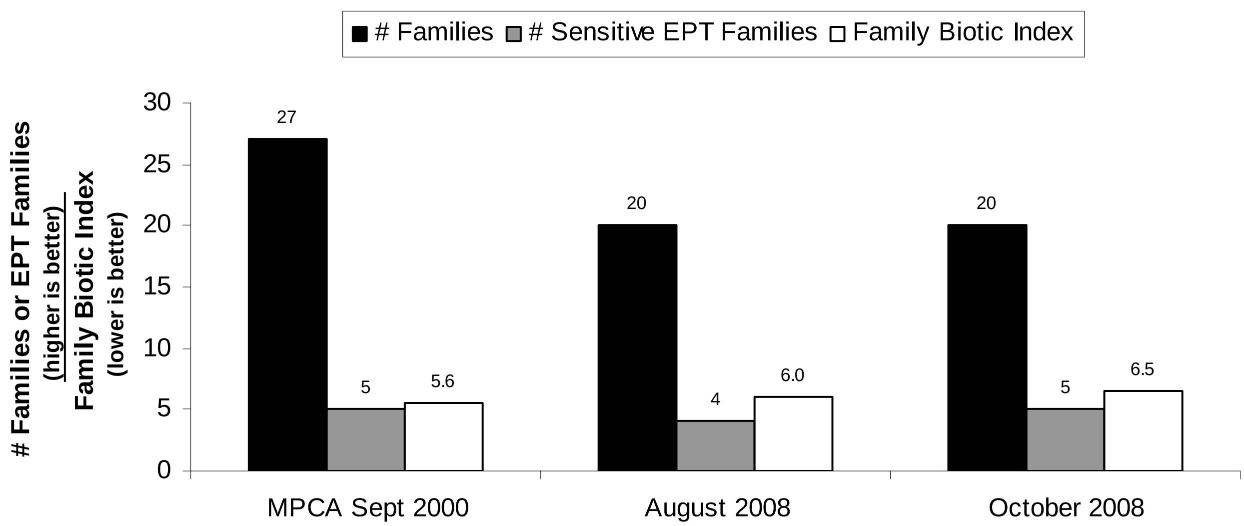
Comparison with results obtained by the Minnesota Pollution Control Agency

One goal of this study was to compare MPCA's invertebrate data from Coon Creek in 2000 to 2008 data at the same sites. This comparison would serve to check the accuracy of the impaired designation that was made based upon just one sample. In making such a comparison, it is important to recognize that MPCA identifies all of their invertebrate samples to the genus level, which is more specific than the family-level identifications done for this study. Genus-level identifications allows sorting the sometimes different pollution tolerances of different genus within each family, and is therefore better. Overall, MPCA found a rich invertebrate community downstream at Egret Boulevard, fewer upstream at Highway 65, and their results indicated better stream health than the 2008 data.

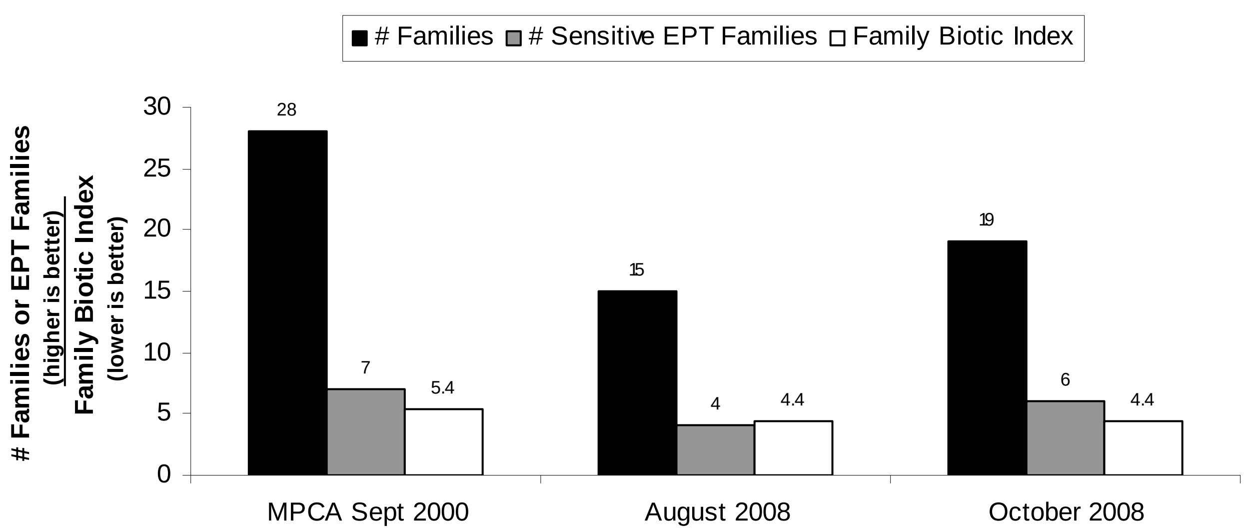
MPCA found a rich invertebrate community at Egret Boulevard (Erlandson Park), but the Hilsenhoff Biotic Index (HBI) indicated poorer stream health than at Highway 65. At Egret Boulevard, 57 different genus were found. MPCA staff indicated that this total is notably higher than most sites in the metro, but 28 of these were listed as [pollution] "tolerant." By comparison, 36 genus were found at Highway 65 (29 in a later replicate), of which 22 were listed as [pollution] "tolerant." Conversely, the HBI, which has a scale of 0 to 10 with lower numbers indicating better stream health, was 6.05 at Egret Boulevard, which corresponds to a water quality assessment of "fair." At Highway 65 the HBI was 5.67, which corresponds to a water quality assessment of "good." Aside from these differences in the invertebrate community, there are significant habitat differences between these two sites – at Highway 65 the stream is ditched whereas at Egret Boulevard the creek is not ditched an flows as riffles, pools, and runs through a nature park preserve.

MPCA's data indicate better stream health than found by our sampling in 2008, though the datasets are similar. We summarized MPCA's data back into families (broader categories) so it would be comparable to this study's data. The figures below show the number of families; number of sensitive families of the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies, collectively referred to as EPT); and Family Biotic Index (FBI) by MCPA in 2000 and the Anoka Conservation District (ACD) in August and October 2008. At both Highway 65 and Egret Boulevard a similar number of families (27 and 28) were found, but MPCA sampling found more families at each location than 2008 sampling. Family biotic index ratings for the Egret Boulevard sampling site were better than for the Highway 65 sampling site in all datasets.

Coon Creek at Highway 65 - comparison of family-level invertebrate indices of stream health



Coon Creek at Egret Boulevard - comparison of family-level invertebrate indices of stream health



Wetland Hydrology

Description: Continuous groundwater level monitoring at a wetland boundary to a depth of 40 inches. County-wide, the ACD maintains a network of 19 wetland hydrology monitoring stations.

Purpose: To provide understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

Locations: Bannochie Wetland, SW of Main St and Radisson Rd, Blaine

Bunker Wetland, Bunker Hills Regional Park, Andover

(middle and edge of Bunker Wetland are monitored)

Camp Three Wetland, Carlos Avery WMA on Camp Three Road, Columbus Township

Ilex Wetland, City Park at Ilex St and 159th Ave, Andover

(middle and edge of Ilex Wetland are monitored)

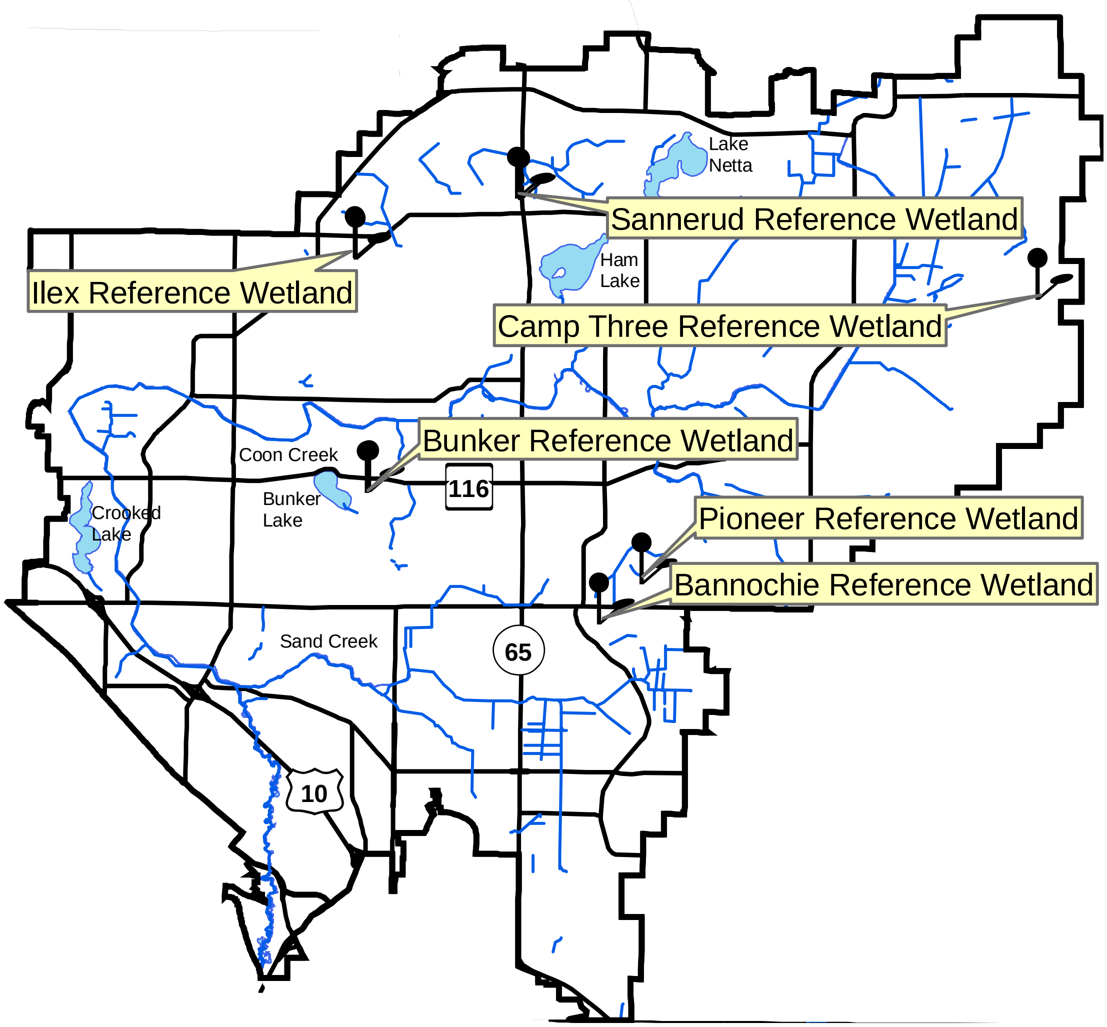
Pioneer Park Wetland, Pioneer Park off Main St., Blaine

Sannerud Wetland, W side of Hwy 65 at 165th Ave, Ham Lake

(middle and edge of Sannerud Wetland are monitored)

Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

Coon Creek Watershed 2008 Wetland Hydrology Monitoring Sites

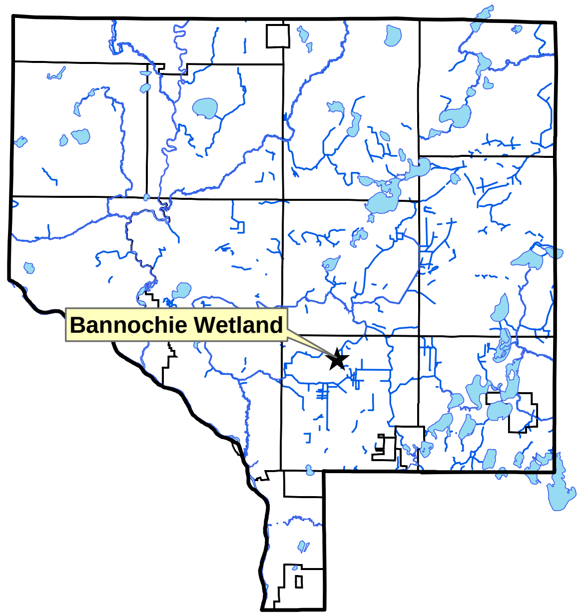


Wetland Hydrology Monitoring

BANNOCHIE REFERENCE WETLAND

SE quadrant of Radisson Rd and Hwy 14, Blaine

Site Information



Monitored Since: 1997

Wetland Type: 2

Wetland Size: ~21.5 acres

Isolated Basin? No

Connected to a Ditch? Yes, on edges, but not the interior of wetland

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oe1	0-6	10yr 2/1	Organic	-
Oe2	6-40	10yr 2/1-7.5yr2.5/1	Organic	-

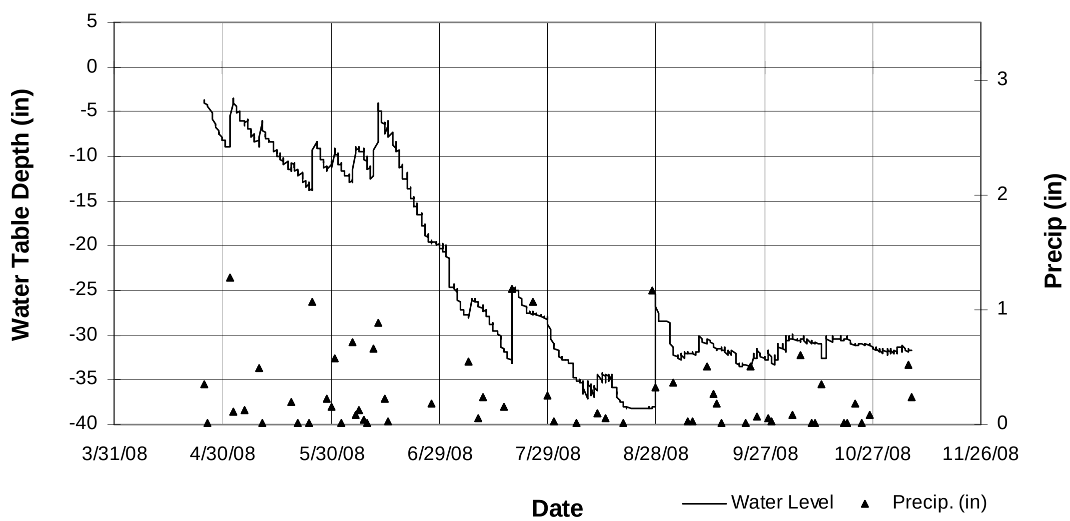
Surrounding Soils: Rifle and some Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phragmites australis	Giant Reed	80
Rubus spp.	Dewberry	100
Onoclea sensibilis	Sensitive Fern	10

Other Notes: This well is not at the wetland boundary, but rather is within the basin. Intense residential construction has occurred nearby in recent years, including construction dewatering.

2008 Hydrograph

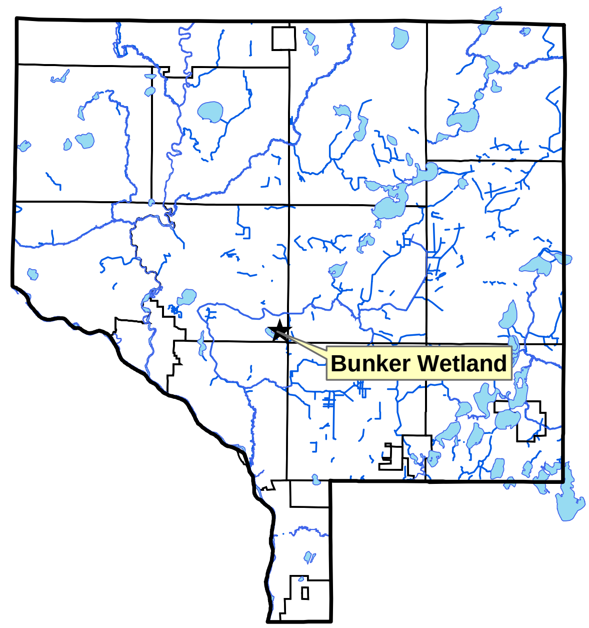


Well depth was 37 inches, so a reading of–37 or less indicates water levels were at an unknown depth greater than or equal to 36.75 inches.

Wetland Hydrology Monitoring

BUNKER REFERENCE WETLAND - EDGE

Bunker Hills Regional Park, Andover



Site Information

Monitored Since: 1996-2005 at wetland edge. In 2006 re-delineated wetland moved well to new wetland edge (down-gradient).

Wetland Type: 2

Wetland Size: ~1.0 acre

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
AC1	0-3	7.5yr3/1	Sandy Loam	50% 7.5yr 4/6
AC2	3-20	10yr2/1-5/1	Sandy Loam	-
2Ab1	20-31	N2/0	Mucky Sandy Loam	-
2Oa	31-39	N2/0	Organic	-
2Oe	39-44	7.5yr 3/3	Organic	-

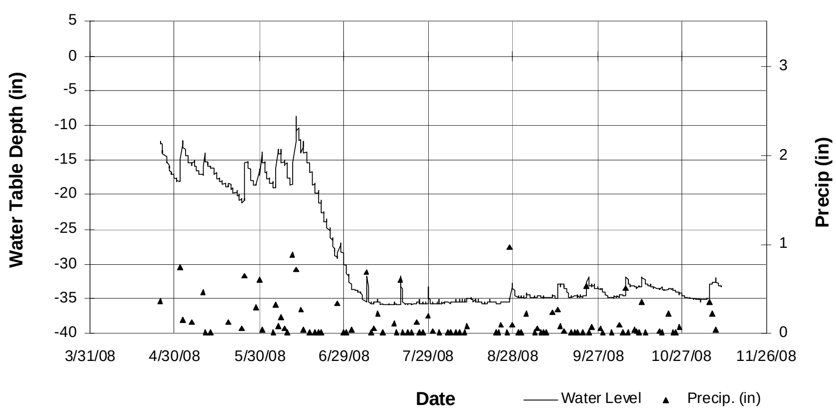
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Populus tremuloides(T)	Quaking Aspen	30

Other Notes: This well is located at the wetland boundary. In 2000-2005 the water table was >40 inches below the surface throughout most or all of the growing season. This prompted us to re-delineate the wetland and move the well down-gradient to the new wetland edge at the end of 2005. As a result, water levels post-2005 are not directly comparable to previous years.

2008 Hydrograph



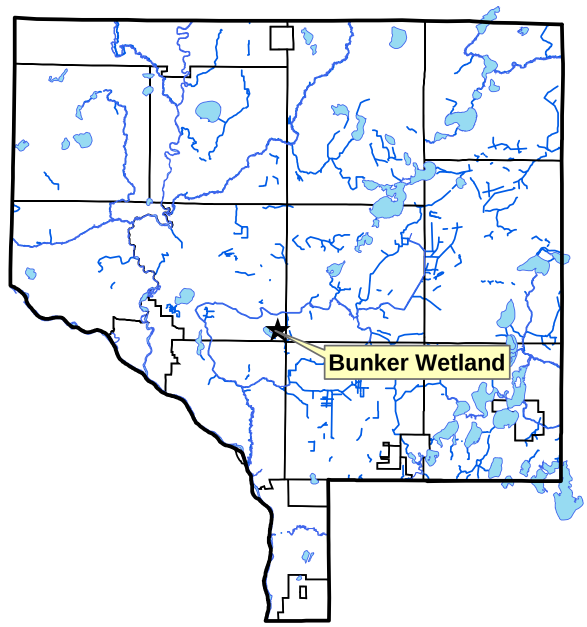
Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

BUNKER REFERENCE WETLAND - MIDDLE

Bunker Hills Regional Park, Andover

Site Information



Monitored Since: Wetland edge monitored since 1996, but this well in middle of wetland began in 2006.

Wetland Type: 2

Wetland Size: ~1.0 acre

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-22	N2/0	Organic	-
Oe1	22-41	10yr2/1	Organic	-
Oe2	41-48	7.5yr3/4	Organic	-

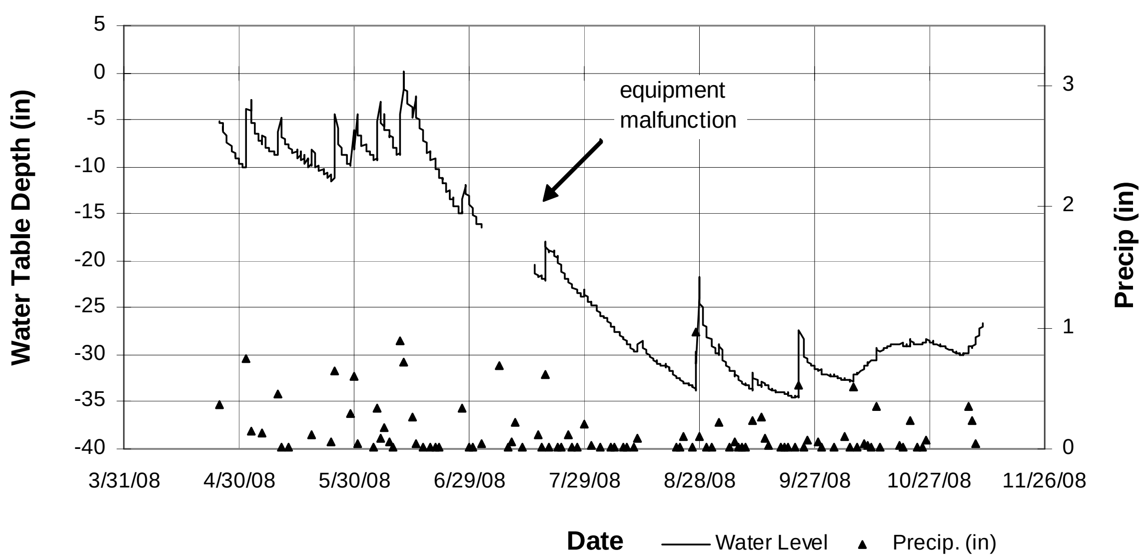
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Poa palustris	Fowl Bluegrass	90
Polygonum sagitatum	Arrow-leaf Tearthumb	20
Aster spp.	Aster undiff.	10

Other Notes: This well at the middle of this wetland was installed at the end of 2005 and first monitored in 2006.

2008 Hydrograph



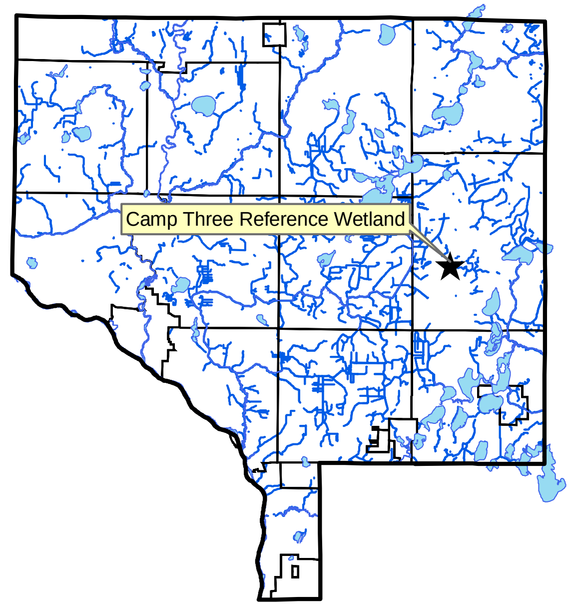
Well depth was 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

CAMP THREE REFERENCE WETLAND

Carlos Avery Wildlife Management Area, Columbus Township

Site Information



Monitored Since: 2008

Wetland Type: 3

Wetland Size: Part of complex > 200 acres

Isolated Basin? No

Connected to a Ditch? Yes

Soils at Well Location: Markey Muck

Horizon	Depth	Color	Texture	Redox
A	0-4	N2/0	Mucky Fine Sandy Loam	-
A2	4-13	10yr 3/1	Fine Sandy Loam	20% 5yr 5/6
Bg1	13-21	10yr 5/1	Fine Sandy Loam	2% 10yr 5/6
Bg2	21-39	10yr 5/1	Fine Sandy Loam	5% yr 5/6
Bg3	39-55	10yr 5/1	Very Fine Sandy Loam	10% 10yr 5/6

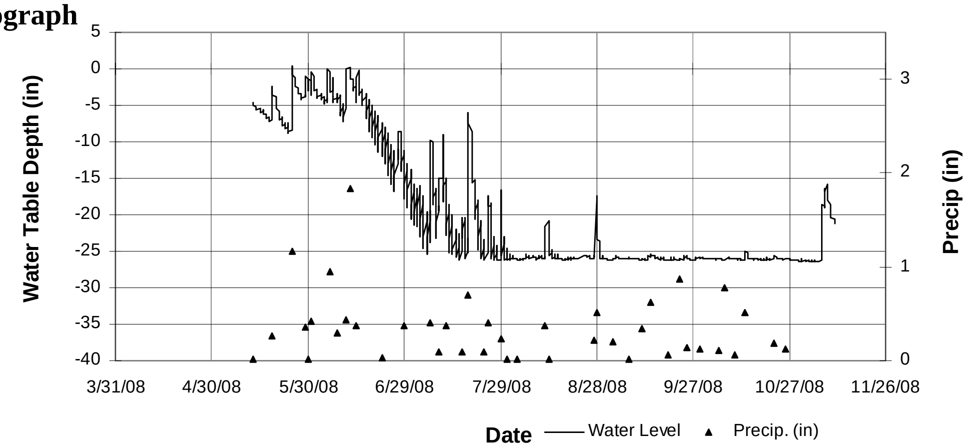
Surrounding Soils: Zimmerman Fine Sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Populus tremuloides (T)	Quaking Aspen	30
Acer negundo (S)	Boxelder	30
Acer rubrum (T)	Red Maple	10

Other Notes: This well is located at the wetland boundary. It maintained a consistent water level of -26 inches throughout summer 2008. This may have been due to water control structures elsewhere in the Carlos Avery Wildlife Management Area.

2008 Hydrograph

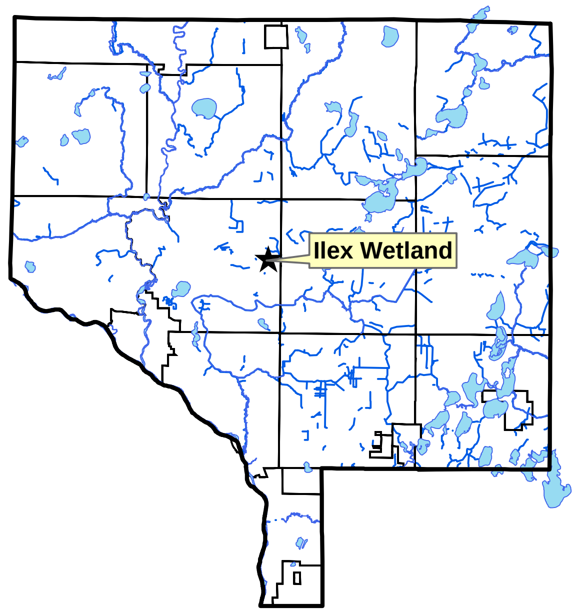


Well depth was 40 inches, so a reading of–40.0 indicates water levels at an unknown depth greater than or equal to 40.0 inches.

ILEX REFERENCE WETLAND - EDGE

City Park at Ilex St and 159th Ave, Andover

Site Information



Monitored Since: 1996

Wetland Type: 2

Wetland Size: ~9.6 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-10	10yr2/1	Fine Sandy Loam	-
Bg	10-14	10yr4/2	Fine Sandy Loam	-
2Ab	14-21	N2/0	Sandy Loam	-
2Bg1	21-30	10yr4/2	Fine Sandy Loam	-
2Bg2	30-45	10yr5/2	Fine Sand	-

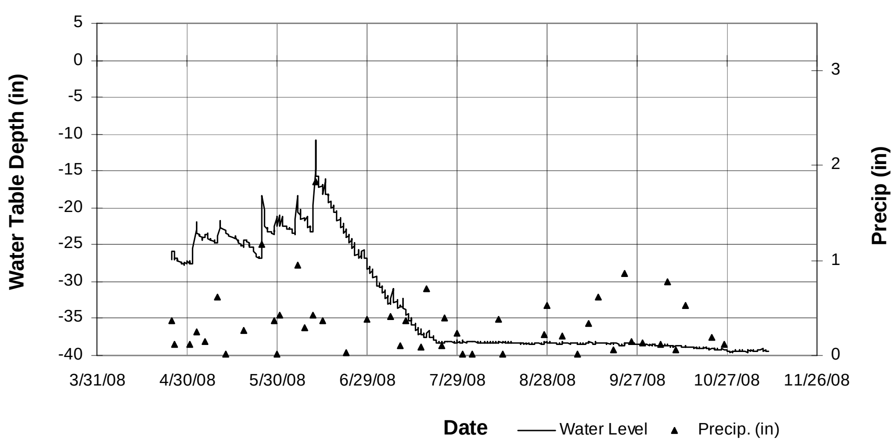
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Solidago gigantia	Giant Goldenrod	20
Populus tremuloides (T)	Quaking Aspen	20
Rubus strigosus	Raspberry	10

Other Notes: This well is located at the wetland boundary. In 2000-2005 the water table was only once within 15 inches of the surface and seldom within 40 inches. This prompted us to re-delineate the wetland and move the well down-gradient to the new wetland edge at the beginning of 2006. As a result, water levels post-2005 are not directly comparable to previous years.

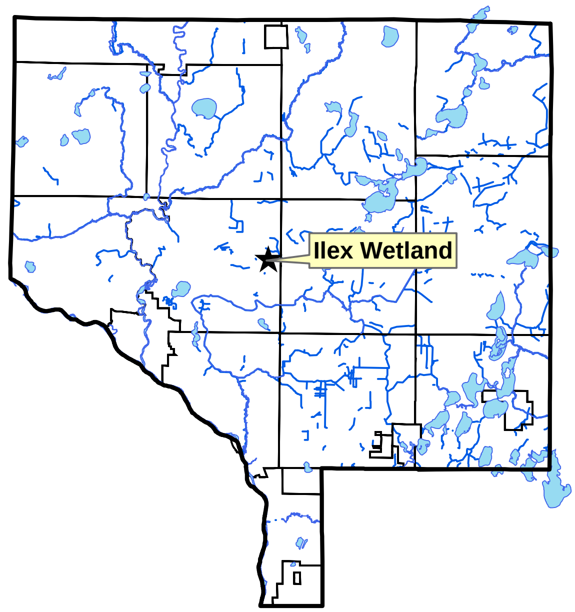
2008 Hydrograph



Well depth was 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

ILEX REFERENCE WETLAND - MIDDLE

City Park at Ilex St and 159th Ave, Andover



Site Information

Monitored Since: 2006

Wetland Type: 2

Wetland Size: ~9.6 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-9	N2/0	Organic	-
Bg1	9-19	10yr4/2	Fine Sandy Loam	-
Bg2	19-45	10yr5/2	Fine Sand	-

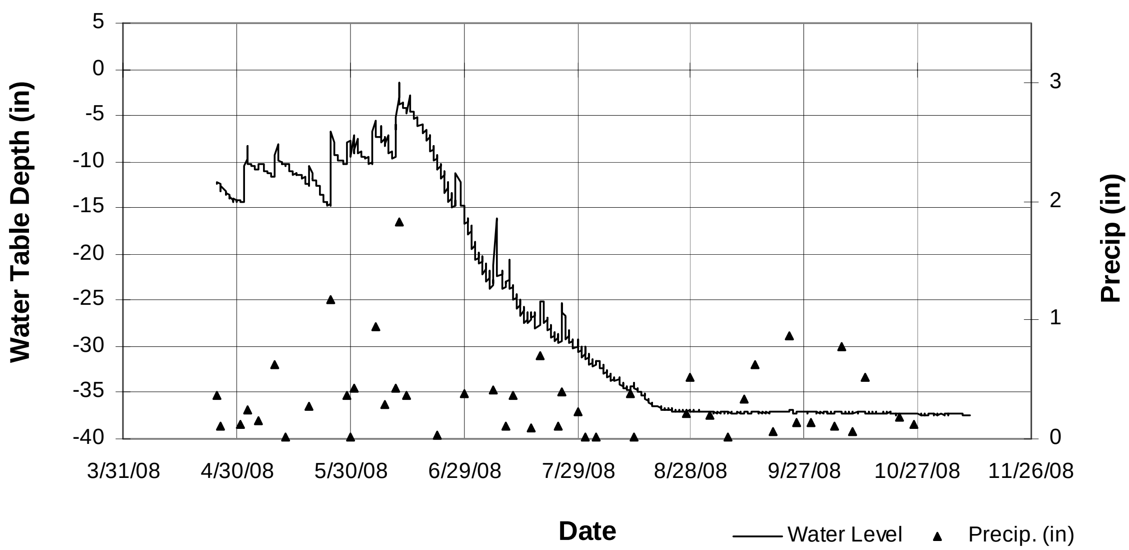
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	80
Typha angustifolia	Narrow-leaf Cattail	40

Other Notes: This well is located near the middle of the wetland basin.

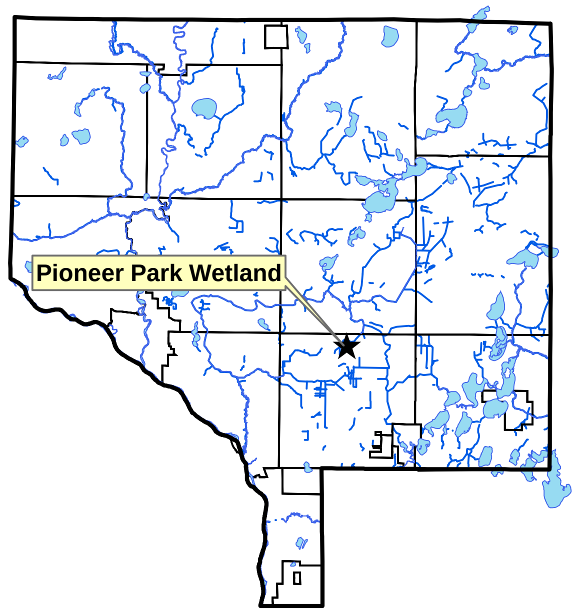
2008 Hydrograph



Well depth was 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

PIONEER PARK REFERENCE WETLAND

Pioneer Park N Side of Main St. E of Radisson Road, Blaine



Site Information

Monitored Since:	2005
Wetland Type:	2
Wetland Size:	Undetermined. Part of a large wetland complex.
Isolated Basin?	No
Connected to a Ditch?	Not directly, but wetland complex is has small drainage ways, culverts, and nearby ditches.

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa1	0-4	10yr 2/1	Sapric	-
Oa2	4-8	N 2/0	Sapric	-
AB	8-12	10yr 3/1	Mucky Sandy Loam	-
Bw	12-27	2.5y 5/3	Loamy Sand	-
Bg	27-40	2.5y 5/2	Loamy Sand	-

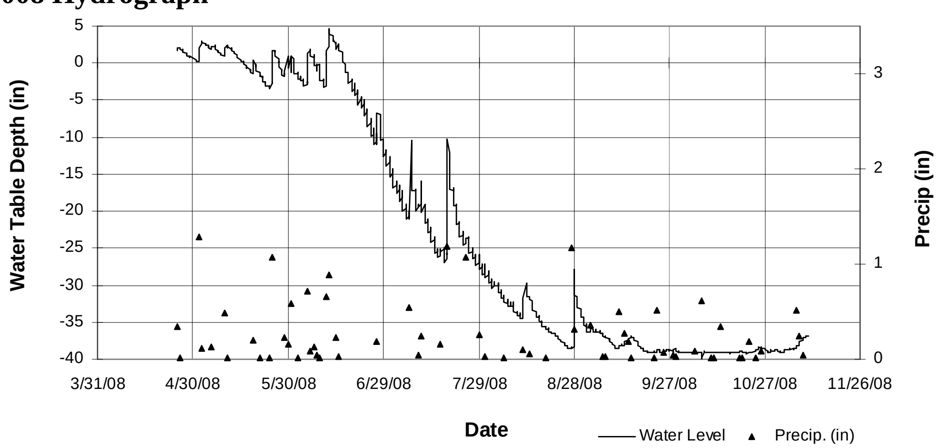
Surrounding Soils: Rifle and loamy wet sand.

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Carex lacustris	Lake Sedge	20
Fraxinus pennsylvanica (T)	Green Ash	30
Rhamnus frangula (S)	Glossy Buckthorn	20
Ulmus americana (T)	American Elm	20
Populus tremuloides (S)	Quaking Aspen	20
Urtica dioica	Stinging Nettle	10

Other Notes: This well is located within the wetland, not at the edge.

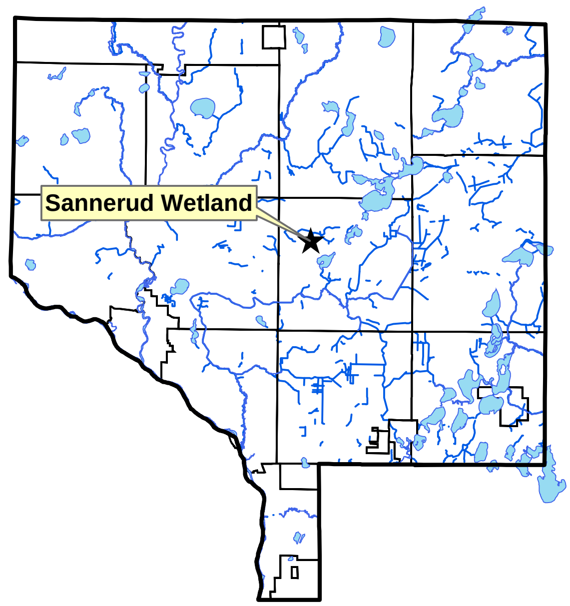
2008 Hydrograph



Well depth was 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

SANNERUD REFERENCE WETLAND - EDGE

W side of Hwy 65 at 165th Ave, Ham Lake



Site Information

Monitored Since: 2005

Wetland Type: 2

Wetland Size: ~18.6 acres

Isolated Basin? Yes

Connected to a Ditch? Is adjacent to Hwy 65 and its drainage systems. Small remnant of a ditch visible in wetland.

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-8	N2/0	Sapric	-
Bg1	8-21	10yr 4/1	Sandy Loam	-
Bg2	21-40	10yr 4/2	Sandy Loam	-

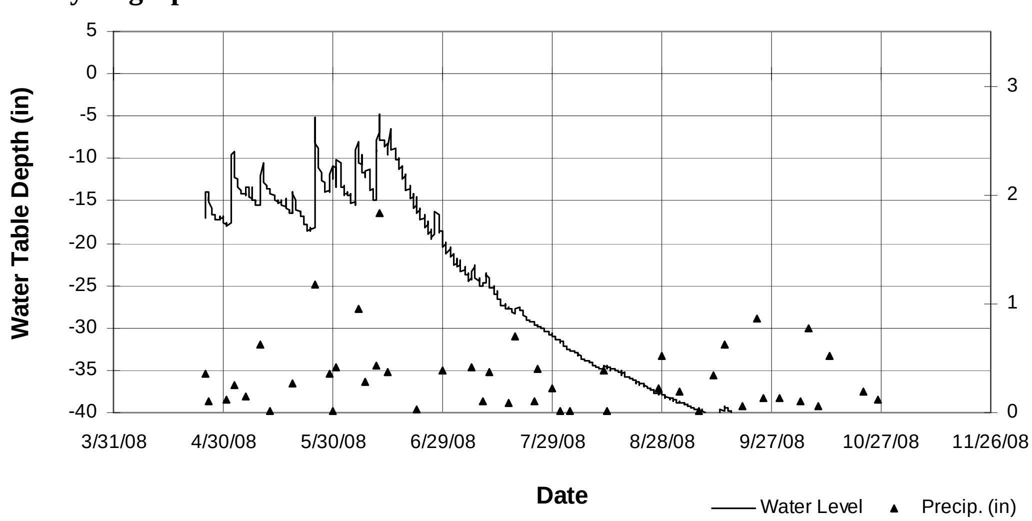
Surrounding Soils: Zimmerman and Lino.

Vegetation at Well Location:

Scientific	Common	% Coverage
Rubus spp.	Undiff Rasberry	70
Phalaris arundinacea	Reed Canary Grass	40
Acer rubrum (T)	Red Maple	30
Populus tremuloides (S)	Quaking Aspen	30
Betula papyrifera (T)	Paper Birch	10
Rhamnus frangula (S)	Glossy Buckthorn	10

Other Notes: This is one of two monitoring wells on this wetland. This one is at the wetland's edge, while the other is near the middle. The wetland edge well is slightly deeper than most reference wetland wells, at 43.5 inches deep.

2008 Hydrograph

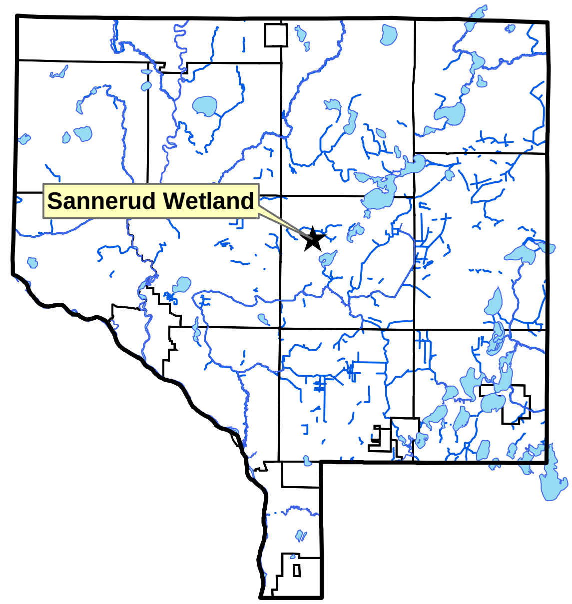


Well depth was 43.5 inches, so a reading of–43.5 indicates water levels were at an unknown depth greater than or equal to 43.5 inches.

Wetland Hydrology Monitoring

SANNERUD REFERENCE WETLAND - MIDDLE

W side of Hwy 65 at 165th Ave, Ham Lake



Site Information

Monitored Since: 2005

Wetland Type: 2

Wetland Size: ~18.6 acres

Isolated Basin? Yes

Connected to a Ditch? Is adjacent to Hwy 65 and its drainage systems. Small remnant of a ditch visible in wetland.

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oe	0-3	7.5yr 3/1	Organic	-
Oe2	18-Mar	10yr 2/1	Organic	-
Oa	18-48	10yr 2/1	Organic	-

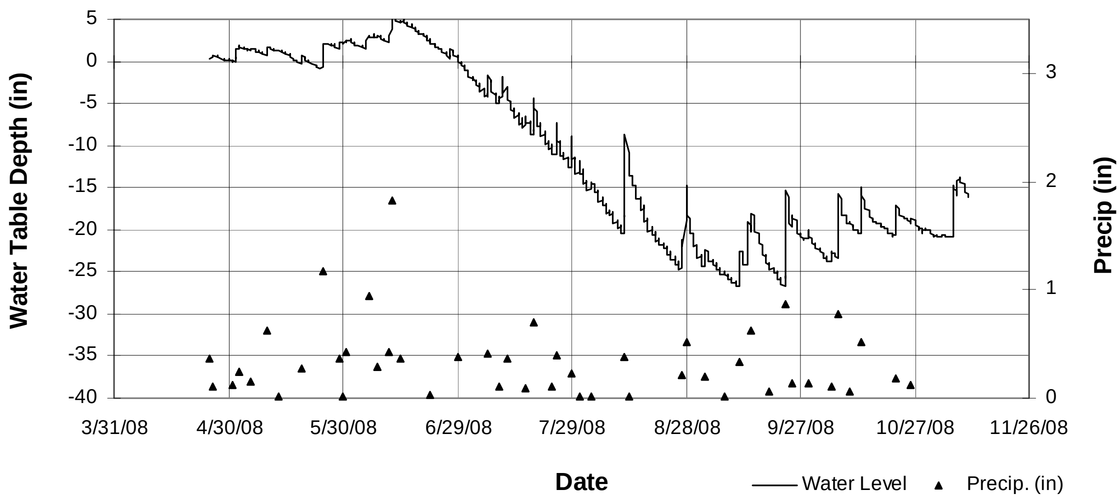
Surrounding Soils: Zimmerman and Lino.

Vegetation at Well Location:

Scientific	Common	% Coverage
Carex lasiocarpa	Wooly-Fruit Sedge	90
Calamagrostis canadensis	Blue-Joint Reedgrass	40
Typha angustifolia	Narrow-Leaf Cattail	5
Scirpus validus	Soft-Stem Bulrush	5

Other Notes: This is one of two monitoring wells on this wetland. This one is near the center of the wetland, while the other is at the wetland's edge.

2008 Hydrograph



Well depths were 38.5 inches, so a reading of–38.5 indicates water levels were at an unknown depth greater than or equal to 38.5 inches.

Reference Wetland Analyses

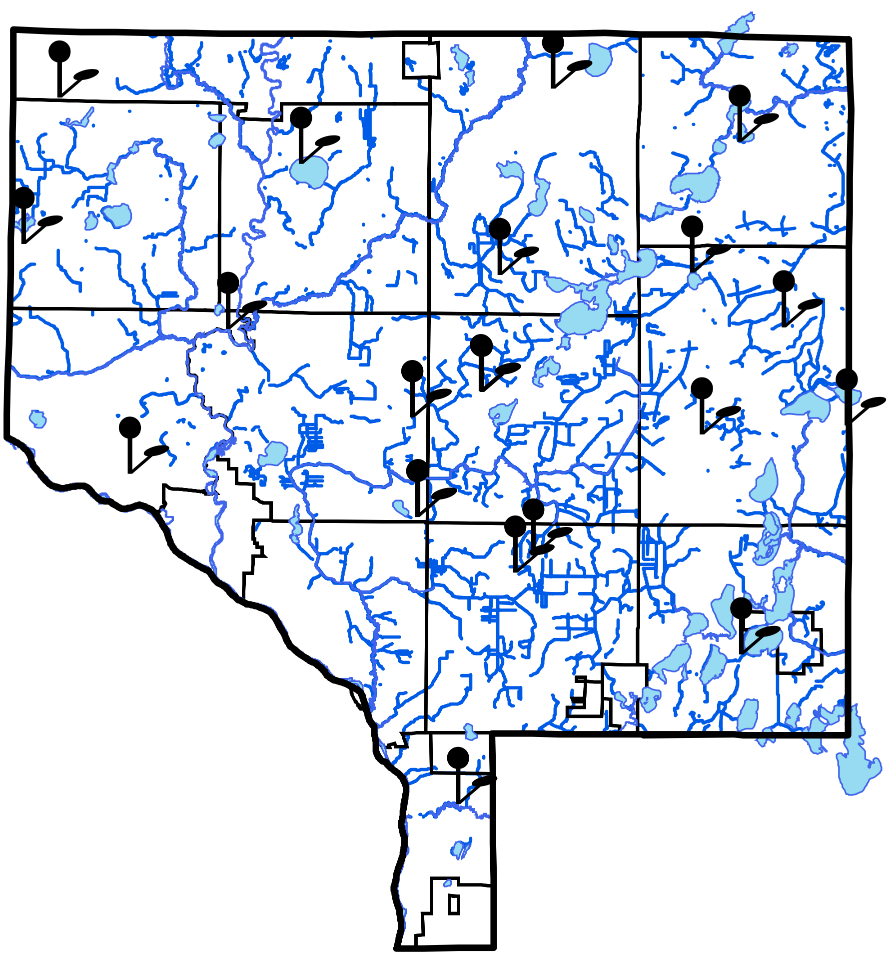
Description: This section includes analyses of wetland hydrology data that has been collected at 19 reference wetland sites. Shallow groundwater levels at the edge of these wetlands are recorded every four hours. Many have been monitored since 1996. These analyses summarize this enormous multi-year, multi-wetland dataset. In the process of doing this analysis, a database summarizing all of the data was created. This database will allow many other, more specific, analyses to be done to answer questions as they arise, particularly through the wetland regulatory process.

Purpose: To provide a summary of known the hydrological conditions in wetlands across Anoka County that can be used assist with wetland regulatory decisions. In particular, these data assist with deciding if an area is or is not a wetland by comparing the hydrology of an area in question to known wetlands in the area. The database created to produce the summaries below can be used to answer other, more specific, questions as they arise.

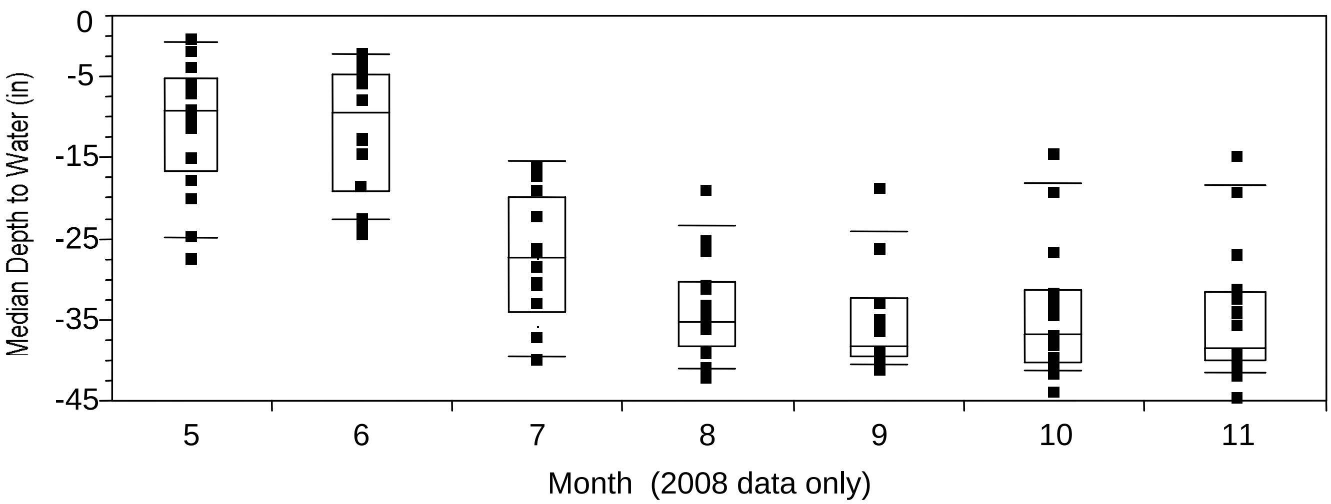
Locations: All 19 reference wetland hydrology monitoring sites in Anoka County.

Results: On the following pages. Data has been summarized for the most recent year alone, as well as across all years with available data.

Reference Wetland Hydrology Monitoring Sites – Anoka County



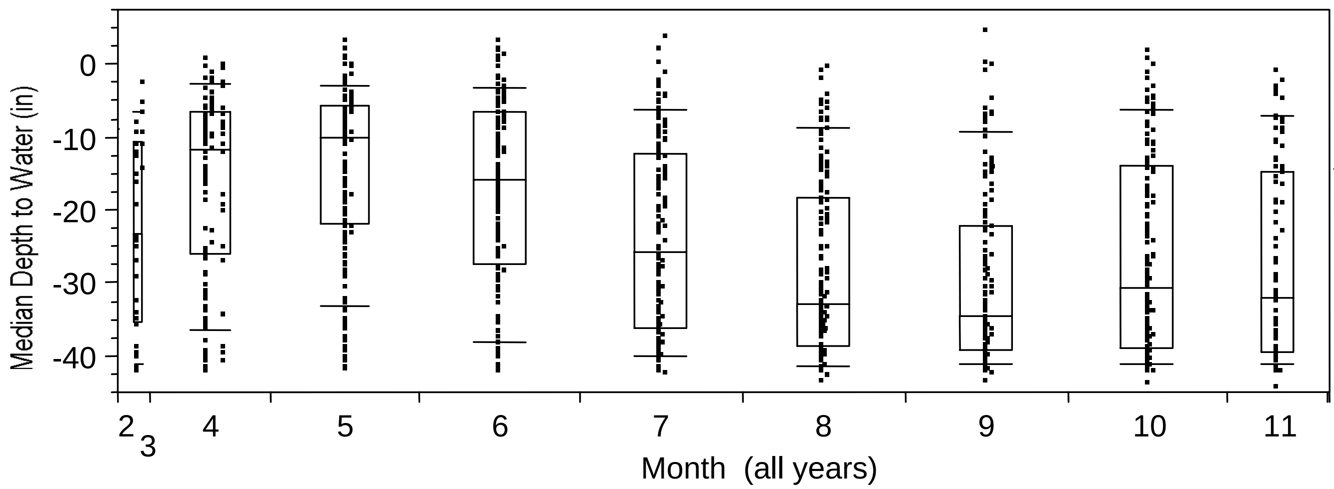
2008 Reference Wetland Water Levels Summary: Each dot represents the median depth to the water table at the edge of one reference wetland for a given month in 2008. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines).



Quantiles

Month	minimum	10.0%	25.0%	median	75.0%	90.0%	maximum
5	-26.6	-24.78	-16.425	-9.1	-5.125	-0.62	0.5
6	-23.8	-22.54	-18.95	-9.35	-4.625	-2.21	-1.4
7	-40	-39.28	-33.85	-27.3	-19.85	-15.36	-15.2
8	-41.3	-40.9	-38.2	-35.1	-30.2	-23.32	-18.2
9	-40.5	-40.42	-39.4	-38.2	-32.25	-24.02	-18.1
10	-43.1	-41.21	-40.05	-36.7	-31.075	-17.95	-13.9
11	-43.8	-41.37	-40	-38.5	-31.4	-18.14	-14

1996-2008 Reference Wetland Water Levels Summary: Each dot represents the mean depth to the water table at the edge of one reference wetland for a month between 1996 and 2008. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines).



Quantiles

Month	minimum	10.0%	25.0%	median	75.0%	90.0%	maximum
2	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
3	-41.6	-41.08	-35.2	-23.2	-10.5	-6.3	-1.9
4	-41.5	-36.2	-25.8	-11.5	-6.5	-2.42	1.2
5	-41.4	-33.14	-21.75	-9.9	-5.55	-2.72	3.8
6	-41.6	-38.04	-27.4	-15.6	-6.3	-3.16	3.8
7	-41.8	-40.01	-35.975	-25.5	-12.1	-6.05	4.3
8	-43	-41.3	-38.425	-32.75	-18.275	-8.59	0.3
9	-43	-41.1	-39.125	-34.45	-22.05	-9.22	5.3
10	-43.1	-41	-38.7	-30.45	-13.85	-6.1	2.4
11	-43.8	-41.1	-39.5	-32	-14.65	-6.88	-0.2
12	-14	-14	-14	-14	-14	-14	-14

Discussion:

The purpose of reference wetland data is to help assure that wetlands are accurately identified by regulatory personnel. State and federal laws place restrictions on filling, excavations, and other activities in wetlands. Commonly, citizens wish to do work in an area that is sometimes, or perhaps only rarely, wet. Whether this area is a wetland under regulatory definitions is often in dispute. Complicating the issue is that conditions in wetlands are constantly changing—an area that is very wet and clearly wetland at one time may be completely dry only a few weeks later (dramatically displayed in the graphs above). As a result, regulatory personnel look at a variety of factors, including soils, vegetation, and current moisture conditions. Reference wetland data provide a benchmark for comparing moisture conditions in a disputed area to known wetlands, thereby helping assure accurate regulatory decisions. The analysis of reference wetland data provided above is a quantitative, non-subjective tool.

The simplest use of the reference wetland data is to compare water levels in the reference wetlands to water levels in a disputed area. The graphics and tables above are based upon percentiles of the water levels experienced at known wetland boundaries. The quantile boxes in the figures delineate the 10^{th} , 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles. Water table depths outside of the box have a low likelihood of occurring, or may only occur under extreme circumstances such as extreme climate conditions or in the presence of anthropogenic hydrologic alterations. If sub-surface water levels in a disputed area are similar to those in reference wetlands, there is a high likelihood that the disputed area is a wetland.

This approach can be refined by examining data from only the year of interest and only certain wetland types. This removes much of the variation that is due to climatic variation among years and due to wetland type. Substantial variation in water levels will no doubt remain among wetlands even after these factors are accounted for, but this exercise should provide a reasonable framework for understanding what hydrologic conditions were present in known wetlands during a given time period.

Water table levels are recorded every 4 hours at all 19 reference wetlands (except during winter), and the raw water level data available through the Data Access tool at www.AnokaNaturalResources.com.

Reference Wetland Vegetation Transects

Description: This project is designed to track hydrology and vegetation changes in high quality wetlands that are under a number of pressures. The goal is to understand changes occurring to these wetlands and others that are similar. The project includes monitoring of hydrology and vegetation in multiple years. Shallow groundwater hydrology is monitored every year at the wetland edge and in the middle of the wetland as part of the Anoka Conservation District's Reference Wetland Program. Vegetation is monitored every couple of years by assessing percent cover of various species along transects that were established in 2007.

Purpose: To understand the influence of pressures upon this, and other similar wetlands, especially with respect to hydrology and vegetation. Pressures include increased traffic on adjacent highways and potential future road expansions, building and increased impervious surface, dewatering associated with nearby construction projects, depression of the water table due to climate or unknown factors, and the presence (and possible expansion) of invasive reed canary grass. Of particular interest is how wetland hydrology will affect invasive species expansion.

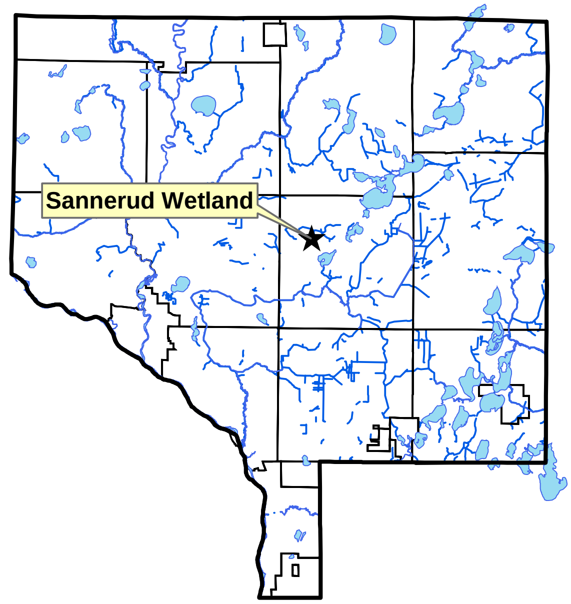
Locations: Sannerud Reference Wetland, City of Ham Lake

Bunker Reference Wetland, City of Andover

Results: On the following pages

SANNERUD REFERENCE WETLAND

W side of Hwy 65 at 165th Ave, Ham Lake



Wetland Description

This wetland is a classified as a Circular 39 Type 2 Inland Fresh Sedge Meadow covering about 19 acres. During the early and late growing season the water table is at or above the ground surface. However, during summer months or periods of drought the water table recedes to depths ranging from 10-25 inches below the surface.

The dominate plants within this wetland are sedges and grasses. Within the basin *Carex lasiocarpa* (Wooly-Fruit Sedge) and *Calamagrostis canadensis* (Canada bluejoint) are dominant. Both of these species are native to Minnesota and are indicative of a high quality wetland habitat. The edge of the wetland is predominately a mixture of *Rubus flagellaris* (Dew Berrry), *Phalaris arundinacea* (Reed Canary Grass), and *Populus tremueloides* (Quaking Aspen).

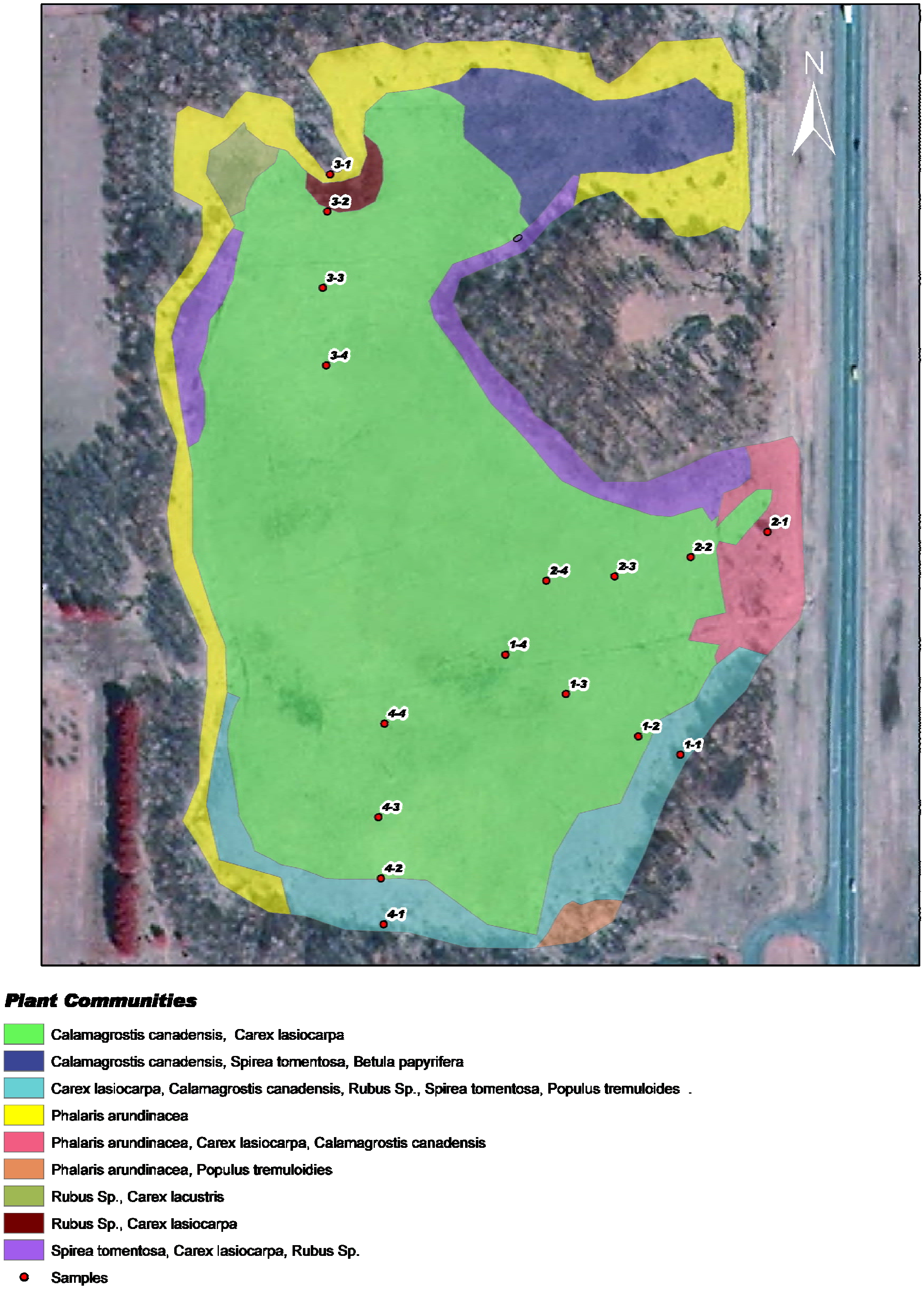
Looking at the wetland center

Looking at the wetland edge

Results

Transects to inventory vegetation in Sannerud wetland have been done in 2007 and 2008. A hand-held GPS was used to establish and locate the study plots (see map below). Four transects spanning from the wetland edge to the middle of the wetland were used, and their locations were chosen to be representative of typical vegetation in and around the wetland. The Anoka Conservation District Wetland Specialist visited these transects in August or September and collected basal area data of the existing vegetation. Plots used 1 meter quadrants for the herbaceous layer and a thirty-foot radius for the shrubs and trees. The tables below show the percent coverage of each vegetative species. The map below shows distribution of the vegetation communities.

Sannerud Reference Wetland vegetation communities and transect plot locations 2008.



Sannerud Reference Wetland vegetation plots 2008

Sample Site 1-1 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Rubus flagellaris	Dew Berry	70	Native
Calamagrostis canadensis	Canada Bluejoint	30	Native
Phalaris arundinacea	Reed Canary Grass	20	Invasive
Populus tremueloides	Quaking Aspen (S)	20	Native
Carex lasiocarpa	Wooly-Fruit Sedge	10	Native
Betula papyrifera	Paper Birch (s)	10	Native
Acer rubrum	Red Maple (T)	10	Native
Spirea tomentosa	Steeple Bush	5	Native
Salix petiolaris	Meadow Willow	5	Native

Sample 1-2 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	100	Native
Calamagrostis canadensis	Canada Bluejoint	30	Native
Salix nigra	Black Willow	5	Native
Spirea tomentosa	Steeple Bush	5	Native

Sample 1-3 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	100	Native
Calamagrostis canadensis	Canada Bluejoint	40	Native
Spirea tomentosa	Steeple Bush	5	Native

Sample 1-4 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	100	Native
Calamagrostis canadensis	Canada Bluejoint	20	Native
Typha angustifolia	Narrow-Leaf Cattail	30	Native

Sample 2-1 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	40	Native
Calamagrostis canadensis	Canada Bluejoint	30	Native
Phalaris arundinacea	Reed Canary Grass	60	Invasive
Typha angustifolia	Narrow-Leaf Cattail	10	Native

Sample 2-2 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	40	Native
Calamagrostis canadensis	Canada Bluejoint	100	Native
Salix nigra	Black Willow	10	Native

Sample 2-3 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	30	Native
Calamagrostis canadensis	Canada Bluejoint	100	Native

Sample 2-4 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	30	Native
Calamagrostis canadensis	Canada Bluejoint	100	Native

Sample 3-1 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Phalaris arundinacea	Reed Canary Grass	100	Invasive
Rubus flagellaris	Dew Berry	40	Native
Populus tremueloides	Quaking Aspen (S)	30	Native
Betula papyrifera	Paper Birch (s)	30	Native
Solidago gigantia	Giant Goldenrod	10	Native

Sample 3-2 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	40	Native
Rubus flagellaris	Dew Berry	40	Native
Spirea tomentosa	Steeple Bush	10	Native
Carex stricta	Uptight Sedge	5	Native

Sample 3-3 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	30	Native
Calamagrostis canadensis	Canada Bluejoint	100	Native

Sample 3-4 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	20	Native
Calamagrostis canadensis	Canada Bluejoint	100	Native

Sample 4-1 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Rubus flagellaris	Dew Berry	30	Native
Acer rubrum	Red Maple	10	Native
Fraxinus pennsylvanicum	Green Ash	10	Invasive
Ilex verticillata	Winterberry (S)	5	Native
Carex lasiocarpa	Wooly-Fruit Sedge	40	Native
Cornus stolonifera	Red-Osier Dogwood (s)	10	Native
Acer rubrum	Red Maple (T)	10	Native
Spirea tomentosa	Steeple Bush	5	Native
Salix exigya	Sandbar Willow	20	Native

Sample 4-2 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	20	Native
Calamagrostis canadensis	Canada Blue Joint	100	Native
Salix exigia	Sandbar Willow	20	Native

Sample 4-3 2008

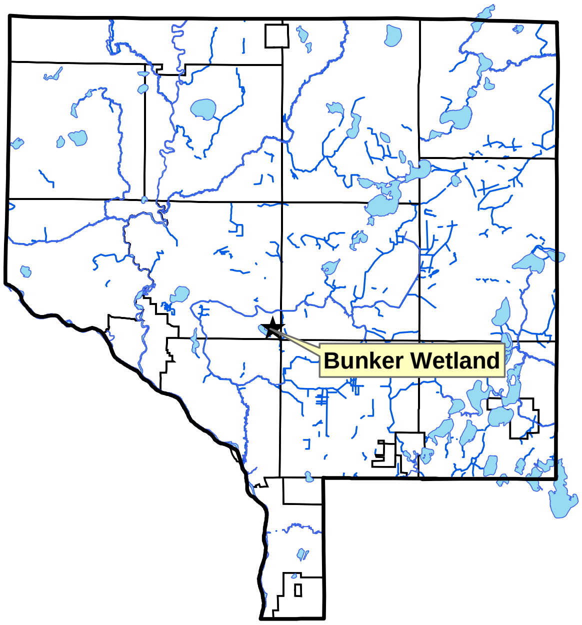
Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	20	Native
Calamagrostis canadensis	Canada Bluejoint	100	Native
Polygonum amphibium	Water Smartweed	5	Native

Sample 4-4 2008

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-Fruit Sedge	100	Native
Calamagrostis canadensis	Canada Bluejoint	20	Native

BUNKER REFERENCE WETLAND - EDGE

Bunker Hills Regional Park, Andover



Wetland Description

This wetland is a classified as a Circular 39 Type 2 Inland Fresh Sedge Meadow covering about 1 acre. During the early and late growing season the water table is at the ground surface. However, during summer months or periods of drought the water table recedes to depths of 35 inches below the surface.

The dominate plants within this wetland are short grasses. Within the basin *Poa paulustris* (Fowl Bluegrass), *Poylgonum sagitatum* (Arrowleaf Tearthumb), and asters are dominant. These species are native to Minnesota and are indicative of a high quality wetland habitat. The edge of the wetland is predominately *Phalaris arundinacea* (Reed Canary Grass) and *Populus tremueloides* (Quaking Aspen).

Photo of Bunker Wetland in April

Results

Transects to inventory vegetation in Bunker wetland were to be first done in 2008. Unfortunately, this work was not completed but will be done in 2009.

A transect method with plots will be used to inventory the vegetation. A hand-held GPS will be used to establish and locate the study plots. Four transects spanning from the wetland edge to the middle of the wetland will be used, and their locations will be chosen to be representative of typical vegetation in and around the wetland. The Anoka Conservation District Wetland Specialist will visit these transects and collect basal area data of the existing vegetation. Plots used will be 1 meter quadrants for the herbaceous layer and a thirty-foot radius for the shrubs and trees.

Water Quality Improvement Projects

Description: Projects on either public or private property that will improve water quality, such as repairing streambank erosion, restoring native shoreline vegetation, or rain gardens. These projects are partnerships between the landowner, the Anoka Conservation District, and sometimes with grant funding from the watershed organization or the Anoka Conservation District.

Purpose: To improve water quality in lakes streams and rivers by correcting erosion problems and providing buffers or other structures that filter runoff before it reaches the water bodies.

Results: **2008 Lindenberg Lakeshore Restoration—**This project on Crooked Lake involved installation of a native plant buffer along 40 feet of steeply sloping lakeshore. The project replaced a mowed hillside. The primary purposes were to provide near-shore habitat, to filter runoff to the lake, and provide a highly-visible example of attractive landscaping with native plants.

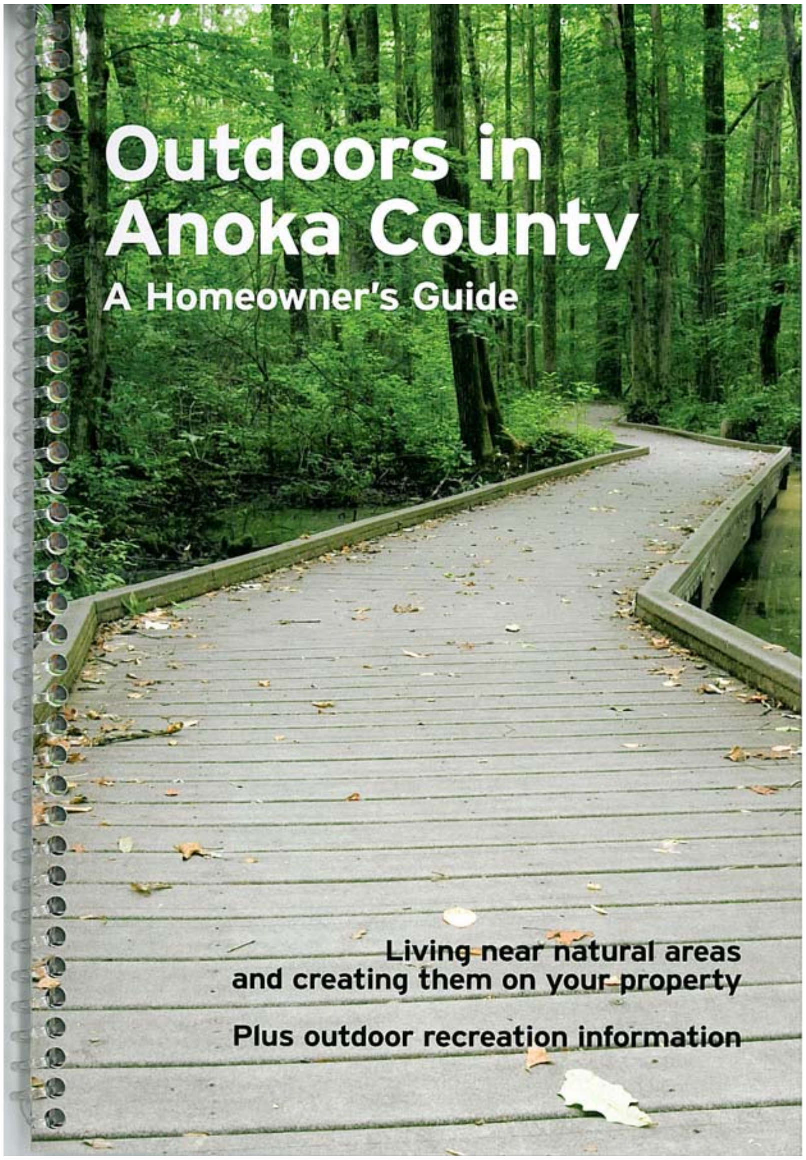
This project was installed in early summer 2008 and a small portion was replanted later the same year. Mulch provided temporary erosion control. A cost share grant was obtained through the Anoka Conservation District to assist with purchase of materials.

Lakeshore Restoration—Lindenberg Property: Native plants replaced mowed lawn on a lakeshore hillside.

Homeowner Guide

Description:	The Anoka Conservation District (ACD) wrote, designed, and printed an educational booklet for homeowners. The booklet included information on topics of interest to the SRWMO, including landscaping for water quality, wetlands, well water, septic systems, and hazardous household wastes.
Purpose:	To educate homeowners about topics that will impact local natural resources.
Locations:	Throughout the watershed.
Results:	"Outdoors in Anoka County—a homeowner's guide" was written, laid out by a graphic designer, and printed in 2007. The Coon Creek Watershed District (CCWD) funded the printing of 500 booklets in 2007 to be distributed within the CCWD area following the CCWD's direction. The ACD accomplished that distribution and continued with an additional distribution of 215 booklets to homes near other important natural areas of the ACD's choosing.

Homeowner's Guide Cover



Crooked Lake Management Plan

Description: A comprehensive plan for health of Crooked Lake which provides a review and analysis of watershed hydrology, lake water quality, nutrient budgets, aquatic communities and ecology, and management and control of the invasive species Eurasian watermilfoil and curly-leaf pondweed.

Purpose: To protect and enhance the long term health of Crooked Lake.

Locations: Crooked Lake, Cities of Andover and Coon Rapids

Results: The Coon Creek Watershed District headed this project in 2008, working closely with the Crooked Lake Association. Work included several input meetings with the public, consultations with lake ecology professionals, compiling historic information about the lake that can guide future action, and writing the plan. The Anoka Conservation District served in an advisory role. The plan has been completed as of March 2009.

CCWD Website

Description: The Coon Creek Watershed District (CCWD) contracted the Anoka Conservation District (ACD) to design and maintain a website about the CCWD and the Coon Creek watershed. The website has been in operation since 2003.

Purpose: To increase awareness of the CCWD and its programs. The website also provides tools and information that helps users better understand water resources issues in the area. The website serves as the CCWD's alternative to a state-mandated newsletter.

Locations: www.AnokaNaturalResources.com/CCWD

Results: The CCWD website contains information about both the CCWD and about natural resources. Information about the CCWD includes:

- a directory of board members,
- meeting minutes and agendas,
- descriptions of work that the organization is directing,
- highlighted projects,
- permit applications.

Other tools on the website include:

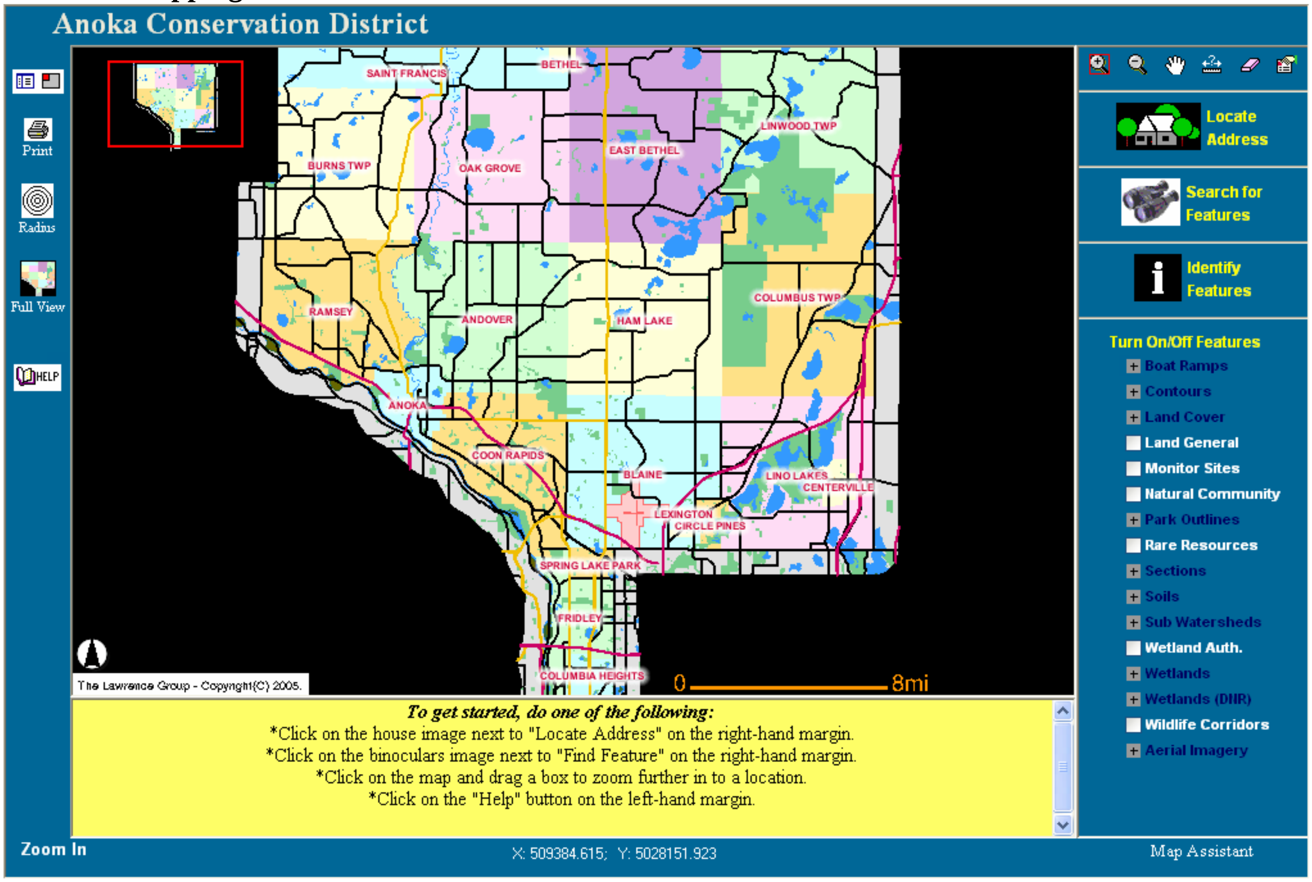
- an interactive mapping tool that shows natural features and aerial photos,
- an interactive data download tool that allows users to access all water monitoring data that has been collected, and
- narrative discussions of what the monitoring data mean

ACD provided website administration and hosting to the CCWD until April 31, 2008. At that time the CCWD implemented their own, independently hosted and maintained website. The old CCWD website was taken off line.

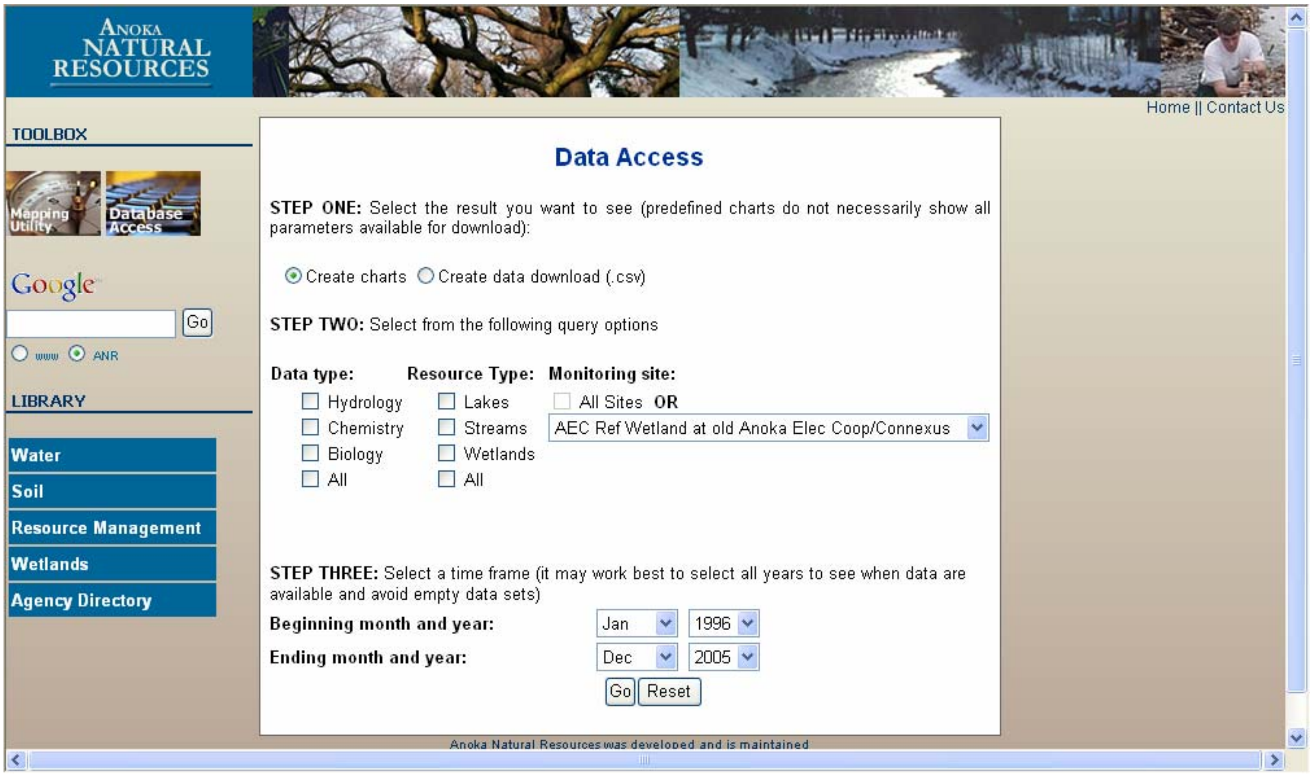
CCWD Website Homepage

more on next page

Interactive Mapping Tool



Interactive Data Access Tool



Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program, such as our lake water quality monitoring program. We do not, however, know specifically which expenses are attributed to monitoring which lakes. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer. The process also takes into account equipment that is purchased for monitoring in a specific area.

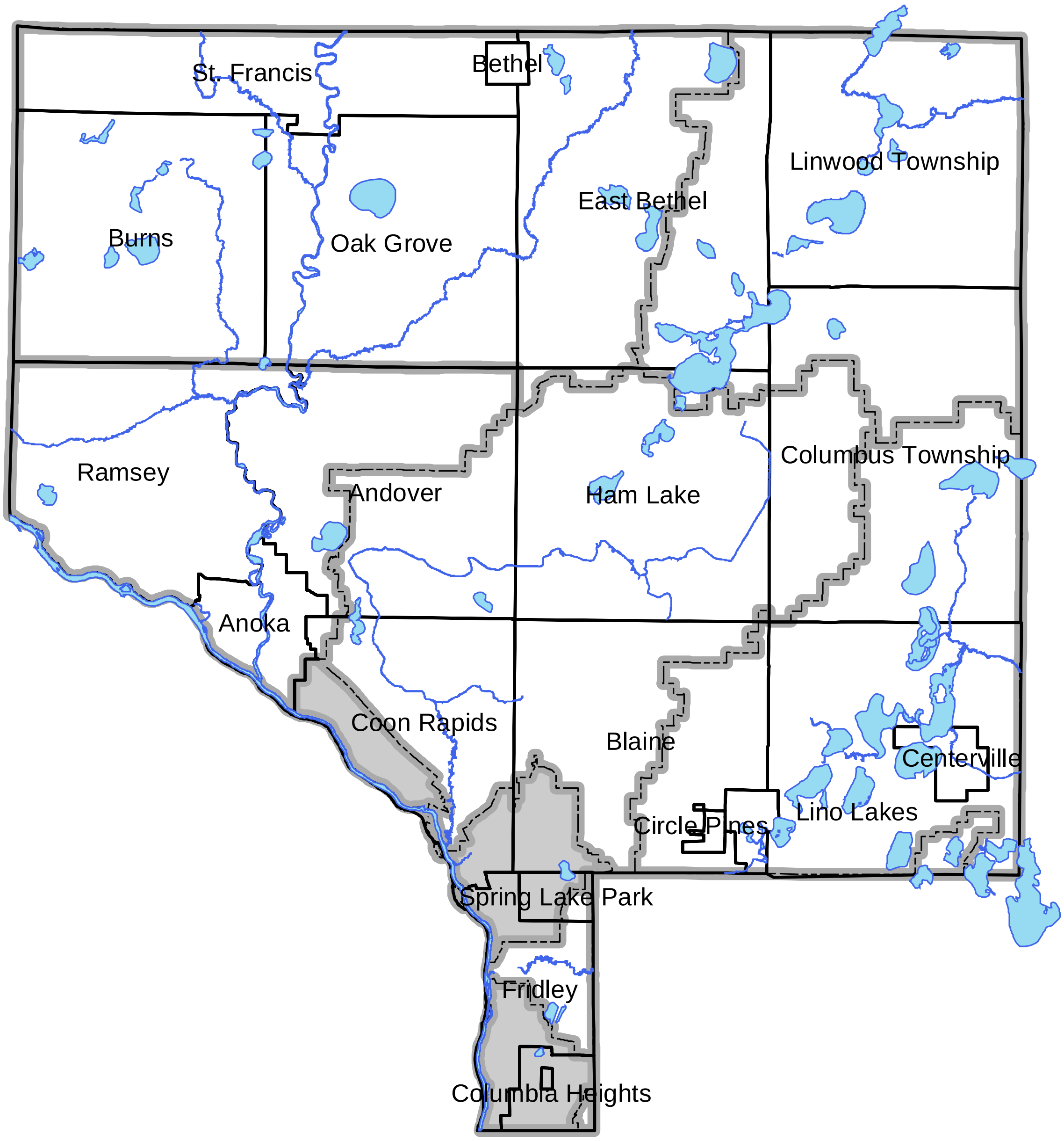
Coon Creek Watershed Financial Summary

Coon Creek Watershed	Web site	Precipitation Monitoring	Coon Creek Precip Monitoring and Analysis	Wetland Hydrology	Lake Levels	Groundwater Observation Wells	Stream Hydrology	Lake Water Quality	Stream Water Quality	Student Biomonitoring	Professional Biomonitoring	Crooked Lake Mgmt Plan	Outdoor Guide	Lindenberg Lakeshore Restoration	Total
Revenues															
CCWD	273	0	2625	4150	440	0	2100	1940	4575	750	7500	525	0	0	24878
State	0	0	0	(0)	0	360	0	0	0	0	0	0	0	0	360
Anoka Conservation District	448	232	1861	0	879	539	1292	0	0	141	1524	446	855	0	8218
County Ag Preserves	0	0	0	(502)	0	0	0	1320	0	585	0	0	0	89	1492
Other Service Fees	63	170	0	0	110	0	0	0	(0)	0	0	0	7	89	438
Local Water Planning	0	0	0	(786)	0	0	1030	469	3892	0	0	0	0	0	4605
TOTAL	784	402	4486	2863	1429	899	4422	3728	8467	1476	9024	971	862	179	39992
Expenses-															
Capital Outlay/Equip	9	5	39	471	23	11	49	28	89	24	143	24	1	0	917
Personnel Salaries/Benefits	509	331	3643	1887	1209	745	3524	2394	5827	1147	7664	861	611	0	30350
Overhead	38	32	351	190	95	68	309	205	618	87	606	56	128	0	2784
Employee Training	10	5	63	33	20	11	60	38	119	18	78	10	24	0	490
Vehicle/Mileage	12	13	173	84	36	31	142	111	194	30	318	17	23	0	1184
Rent	21	14	215	104	41	32	176	131	283	33	215	4	63	0	1332
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	185	2	3	94	4	0	162	821	1337	137	0	0	11	179	2935
Equipment Maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	784	402	4486	2863	1429	899	4422	3728	8467	1476	9024	971	862	179	39992
NET	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Recommendations

- **Actively pursue opportunities to upgrade storm water quality treatment where it will result in the greatest benefits**. Coon Creek water quality deteriorates significantly during storms. In 2009 a reconnaissance of the storm water system in certain neighborhoods is planned. This work will locate project opportunities that will have the greatest benefit for the lowest cost, and will result in designs for those projects. Installation should be pursued. This process may be a good model to follow for the future.
- **Encourage private property owners to install water quality and flood abatement practices on their property.** CCWD and ACD's cost share grant programs should be used as incentives. Efforts to educate the public about this assistance are needed.
- **Share professionally-collected biomonitoring data with the MN Pollution Control Agency** to improve the system of biological impairment determinations. Additional work is planned for 2009 that should further bolster the integrity of this data.
- **Revise the professional biomonitoring sites in 2009** such that there are three "maintained" (currently four) and three "unmaintained" (currently two) stream reaches studied.
- **Increase the usage of reference wetland data** among wetland regulatory personnel as a means for efficient, accurate wetland determinations.
- **Provide educational opportunities for shoreland property owners** on septic system care, low impact lawn care practices, and restoring their shoreline with native plants.
- **Integrate stream hydrology, precipitation, and water quality data into watershed-wide computer models.**

Six Cities Watershed



Contact Info: Six Cities Watershed Management Organization
www.AnokaNaturalResources.com/SCWMO
763-785-6188

Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 7: SIX CITIES WATERSHED

Task	Partners	Page
Lake Levels	SCWMO, ACD, MNDNR, volunteers	7-190
Lake Water Quality	SCWMO, ACD, ACAP	7-191
Stream Water Quality – Chemical	SCWMO, ACD	7-194
Stream Water Quality – Biological	SCWMO, ACD, Blaine High School, ACAP	7-203
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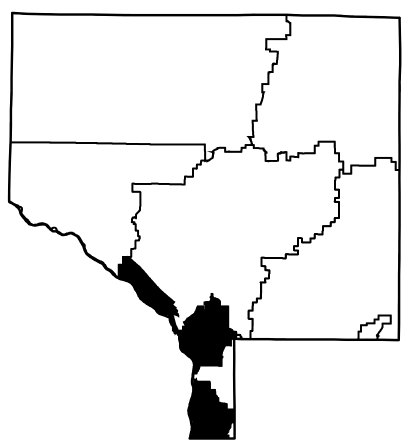
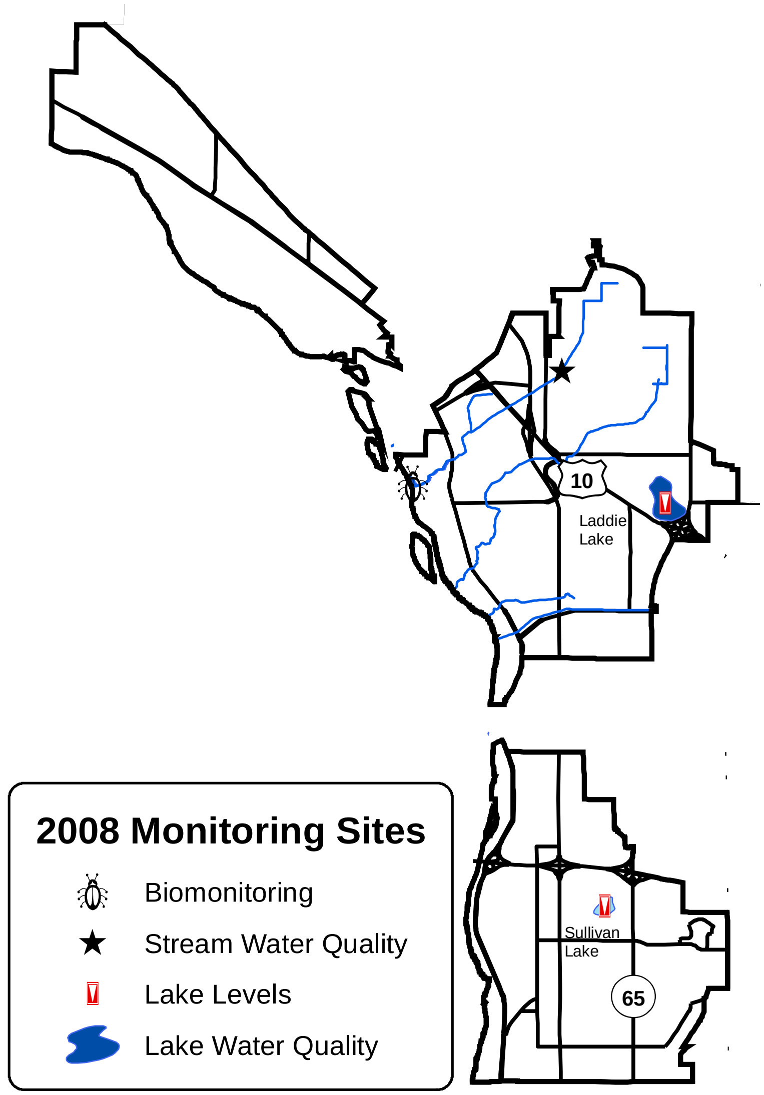
SCWMO Website	SCWMO, ACD	7-208
Financial Summary		7-210
Recommendations		7-210
Precipitation	ACD, volunteers	Chapter 1
Ground Water Hydrology (obwells)	ACD, MNDNR	Chapter 1

ACD = Anoka Conservation District, MNDNR = Minnesota Department of Natural Resources,
SCWMO = Six Cities Watershed Management Organization, ACAP = Anoka County Ag Preserves





Lake Level Monitoring

Description: Weekly water level monitoring in lakes. These data, as well as all additional historic data are available on the Minnesota DNR website using the “LakeFinder” feature (www.dnr.mn.us.state\lakefind\index.html).

Purpose: To provide understanding of lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake hydrology manipulation decisions.

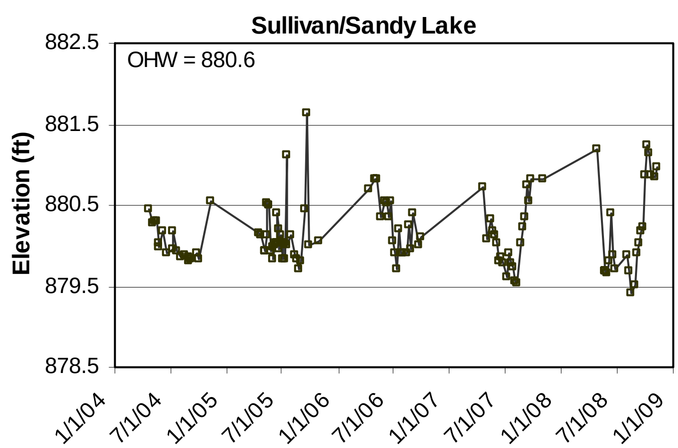
Locations: Laddie Lake

Sullivan/Sandy Lake

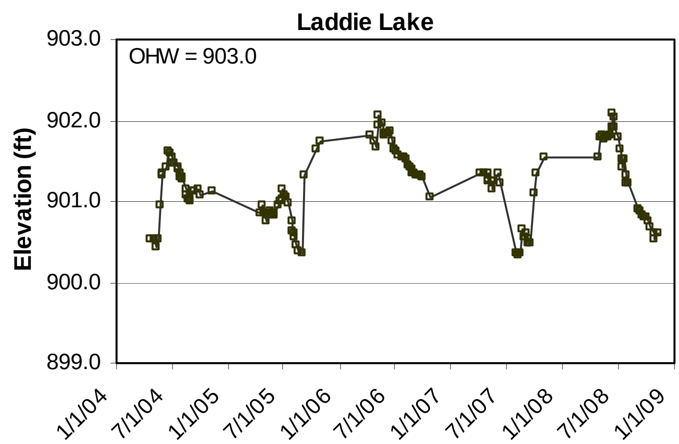
Results: Water levels were recorded 22 times at Sullivan Lake and 31 times at Laddie Lake. Sullivan Lake levels were variable, starting high in spring, declining quickly to low levels throughout summer, and then rising again starting in September. This rapid variation, which is different form other lakes, is because Sullivan serves as a storm water retention basin for urbanized areas. Laddie Lake also receives storm water inputs, but to a lesser degree. Laddie Lake’s water levels declined throughout 2008, as is typical of most lakes.

Raw lake level data for all sites and all years can be downloaded from the Minnesota DNR website using the "LakeFinder" tool. Ordinary High Water Levels (OHW), the elevation below which a DNR permit is needed to perform work, are listed for each lake on the graph below.

Sullivan/Sandy Lake Levels 2004-2008



Laddie Lake Levels 2004-2008



Six Cities Watershed Lake Levels Summary

Lake	Year	Average	Min	Max
Sullivan	2004	880.06	879.82	880.55
	2005	880.14	879.72	881.63
	2006	880.32	879.52	881.92
	2007	880.12	879.54	880.83
	2008	880.22	879.42	881.24

Lake	Year	Average	Min	Max
Laddie	2004	901.16	900.42	901.62
	2005	900.89	900.35	901.74
	2006	901.60	901.04	902.05
	2007	900.96	900.33	901.55
	2008	901.35	900.53	902.09

Lake Water Quality

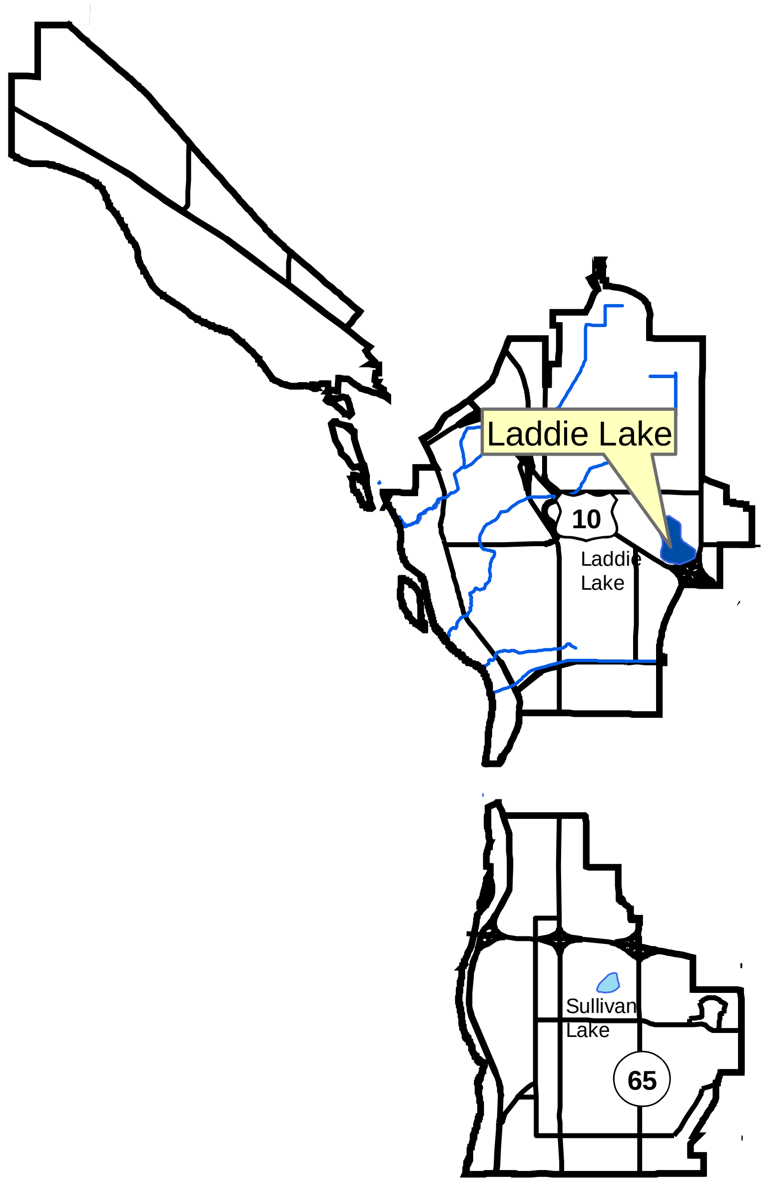
Description: May through September twice-monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

Purpose: To detect water quality trends and diagnose the cause of changes.

Locations: Laddie Lake

Results: Detailed data for each lake are provided on the following pages, including summaries of historical conditions and trend analysis. Previous years' data are available at www.AnokaNaturalResources.com. Refer to Chapter 1 for additional information on interpreting the data and on lake dynamics.

Six Cities Watershed Lake Water Quality Monitoring Sites



Laddie Lake

CITIES OF BLAINE AND SPRING LAKE PARK, LAKE ID # 02-0072

Background

Laddie Lake is located in south-central Anoka County, half in Blaine and half in Spring Lake Park. It has a surface area of 77 acres and maximum depth of 4 feet (1.2 m). Public access is limited to a city park at the north end of the lake. There is no easy access to the water's edge from this park, as the lake's cattail fringe is wide. The lake is used little for recreation because of its shallow depths, abundance of aquatic plants, and lack of public access to the water's edge. It does, however, attract large numbers of waterfowl. Most of the lake is surrounded by single family homes, and a four-lane highway on the south. The watershed is urban.

2008 Results

In 2008 Laddie Lake had slightly above-average water quality for this region (NCHF Ecoregion), receiving an overall B grade; the same as since 1993. The lake is slightly eutrophic, but much of the plant growth is manifested as marcophytes (large plants), not algae. Large numbers of plants are healthy in a shallow lake such as this one. Macrophytes were to the surface on 95% of the lake from June through August. Even when matted on the surface, the plants are not excessively dense, spaced about 1-2 feet apart. ACD staff's subjective observations of algae levels were "some algae" except in July when "definite algae" was noted.

Trend Analysis

Thirteen years of water quality data have been collected by the Metropolitan Council and the Anoka Conservation District. This lake has vastly improved water quality since 1980, but recently a slow degradation is occurring. To search for trends since 1992, a repeated measures MANOVA with response variables TP and Cl-a was used on those years only. Secchi depth was excluded because measurements were not available in all years. Water quality has a negative trend ($F_{1,10}$=7.23, p=0.02). Based on linear regressions, this trend is due to increases in total phosphorus, but not chlorophyll-a. It is likely that additional phosphorus is consumed by macrophytes, and therefore algae are not increasing and water clarity is not suffering. If this trend continues, it can be expected that at some point macrophytes will be overwhelmed by phosphorus and the lake will shift toward algae-domination.

Discussion

Abundant macrophytes in this lake is an indication of a healthy system, not an impairment. As a shallow lake, macrophytes should be expected throughout and contribute to clear water. They are consuming nutrients that would otherwise fuel algae blooms and they provide excellent waterfowl habitat. Curly leaf pondweed, an invasive exotic, has not been documented in Laddie Lake. It is impressive that this lake is in such good condition given its urban watershed and shoreline development.

The trend of nutrient increases in this lake is probably modest enough that it could be successfully counteracted. A review of stormwater management in the lake's watershed should be conducted to seek out ways to treat storm water before it enters the lake. Periodic future monitoring is recommended.

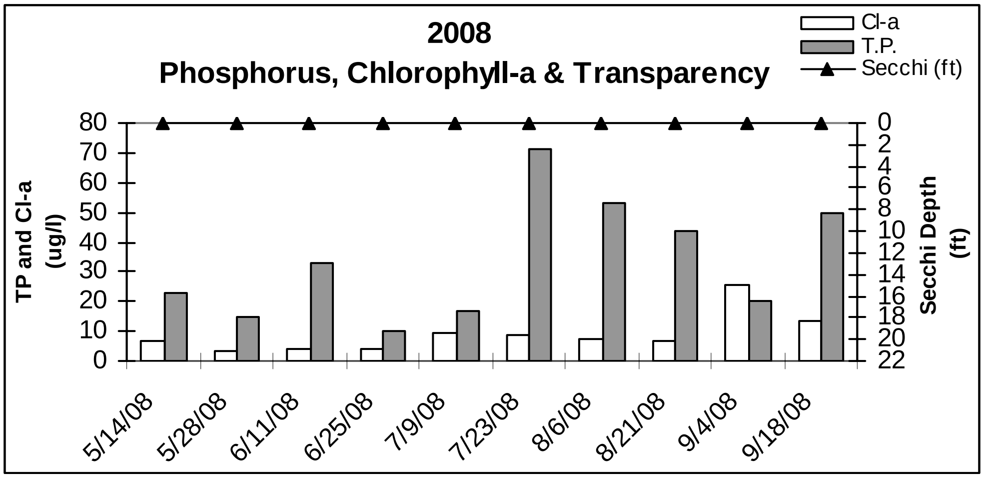
Note: Secchi depth was not considered in 2004, 2005, or 2008 analyses because secchi depth was greater than the lake depth throughout the year, so secchi could not be accurately determined.

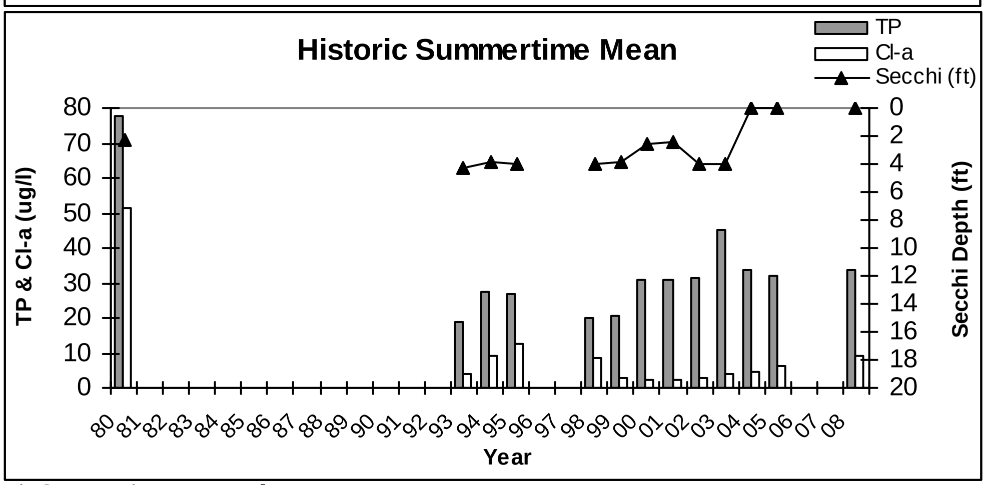
2008 Laddie Lake Water Quality Data

2008 Water Quality Data			5/14/2008	5/28/2008	6/11/2008	6/25/2008	7/9/2008	7/23/2008	8/6/2008	8/21/2008	9/4/2008	9/18/2008			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.10	9.37	10.10	10.27	9.65	9.95	7.50	9.21	9.29	9.48	9.19	9.40	7.50	10.27
Conductivity	mS/cm	0.010	0.445	0.464	0.417	0.408	0.452	0.425	0.490	0.563	0.520	0.510	0.469	0.408	0.563
Turbidity	FNRU	1	2	2	3	1	4	6	2	2	1	2	3	1	6
D.O.	mg/l	0.01	10.53	9.90	9.67	7.84	7.80	5.93	6.67	5.30	8.59	8.53	8.08	5.30	10.53
D.O.	%	1	100%	102%	106%	94%	96%	73%	81%	63%	93%	92%	90%	63%	106%
Temp.	°C	0.1	13.6	16.9	20.4	24.7	24.7	25.8	25.6	24.1	19.2	19.0	21.4	13.6	25.8
Temp.	°F	0.1	56.5	62.4	68.7	76.5	76.5	78.4	78.1	75.4	66.6	66.2	70.5	56.5	78.4
Salinity	%	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.02
Cl-a	mg/m^3	0.5	6.8	3.2	4.0	3.9	9.1	8.9	7.6	6.9	25.8	13.5	9.0	3.2	25.8
T.P.	mg/l	0.010	0.023	0.015	0.033	0.010	0.017	0.071	0.053	0.044	0.020	0.050	0.034	0.010	0.071
T.P.	ug/l	10	23	15	33	10	17	71	53	44	20	50	34	10	71
Secchi	ft	0.1	>4.0	>3.9	>4.0	>4.0	>3.6	>3.5	>3.2	>2.8	>3.1	>3.0	3.5	2.8	4.0
Secchi	m	0.1	>1.2	>1.2	>1.2	>1.2	>1.1	>1.1	>1.0	>0.9	>0.9	>0.9	1.1	0.9	1.2
Field Observations															
Physical			1.5	2.0	2.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.2	1.5	3.0
Recreational			1.5	2.0	2.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.2	1.5	3.0

*reporting limit

Laddie Lake Water Quality Results





Laddie Lake Historic Summertime Mean Values

Agency	MC	MC	MC	MC	ACD	ACD	MC	MC	MC	MC	ACD	ACD	ACD
Year	80	93	94	95	98	99	2000	2001	2002	2003	2004	2005	2008
TP	78.0	19.1	27.5	27.0	20.0	20.4	31.0	30.9	31.7	45.2	33.8	32	34
Cl-a	51.6	4.0	8.9	12.6	8.5	2.9	2.3	2.5	2.6	4.0	4.6	6.2	9.0
Secchi (m)	0.70	1.30	1.18	1.23	1.22	1.18	0.77	0.75	1.20	1.20	na	na	na
Secchi (ft)	2.3	4.3	3.9	4.0	4.0	3.9	2.5	2.5	3.9	3.9	na	na	na

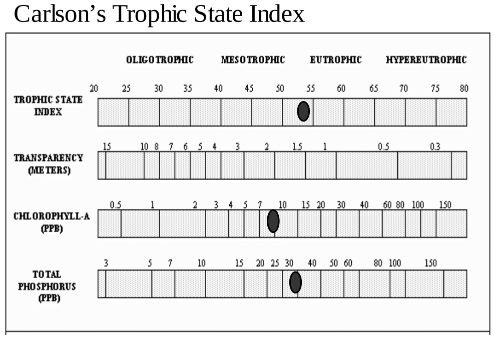
Carlson's Tropic State Indices

TSIP	67	47	52	52	47	48	54	54	54	59	55	54	55
TSIC	69	44	52	56	52	41	39	40	40	44	46	49	52
TSIS	65	56	58	57	57	58	64	64	57	57	na	na	na
TSI	67	49	54	55	52	49	52	52	50	54	50	51	54

Laddie Lake Water Quality Report Card

Year	80	93	94	95	98	99	2000	2001	2002	2003	2004	2005	2008
TP	D	A	B	B	B	B	B	B	B	C	C	B	C
Cl-a	D	A	A	B	A	A	A	A	A	A	A	A	A
Secchi	D	C	C	C	C	C	D	C	C	C	na	na	na
Overall	**D**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**

Carlson's Trophic State Index



Stream Water Quality – Chemical Monitoring

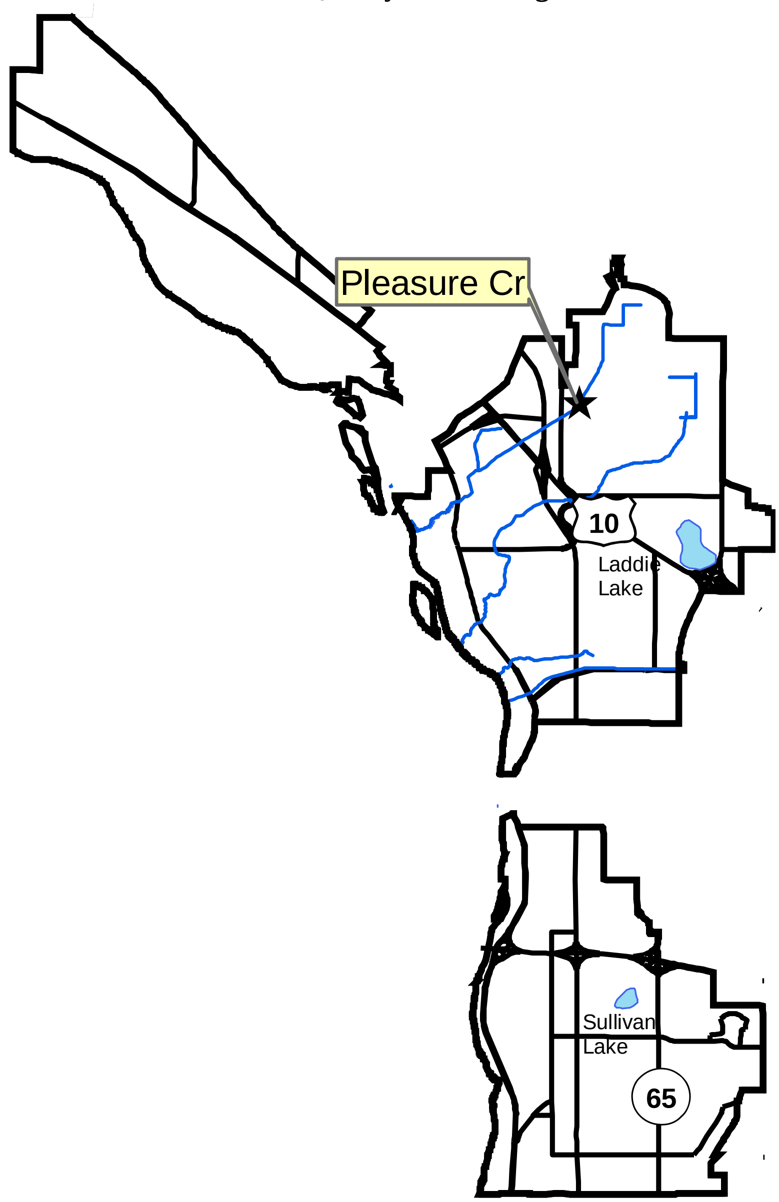
Description: Streams were monitored eight times between April and October; four times during baseflow and four times during storm flow. Storm flow events were defined as an approximately one-inch rainfall in 24 hours. Each stream was tested for pH, conductivity, turbidity, dissolved oxygen, temperature, salinity, total suspended solids, chlorides, total phosphorus, and in some cases other tests.

Purpose: To detect water quality trends and problems, and diagnose the source of problems.

Locations: Pleasure Creek at 96th Lane NE, extreme southwestern Blaine

Results: Results for each stream are presented on the following pages.

Six Cities Watershed Stream Chemical Water Quality Monitoring Sites

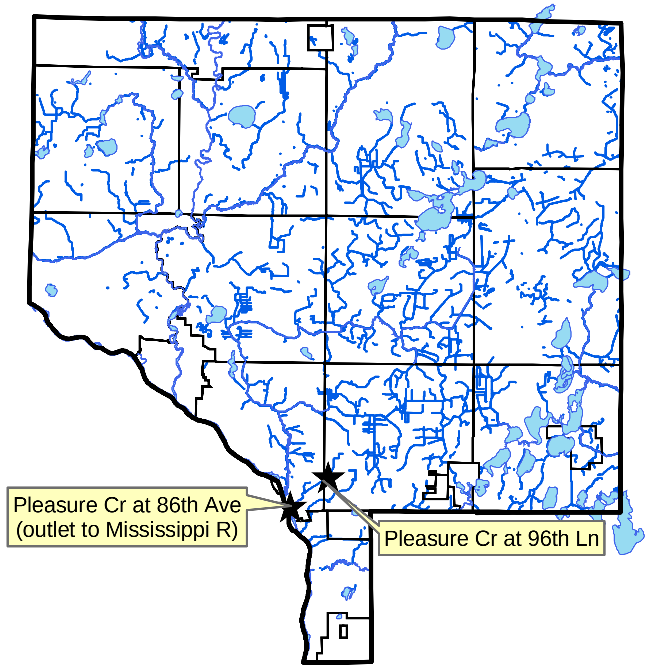


PLEASURE CREEK

at 96th Lane NE, approximately the Blaine-Coon Rapids boundary	STORET SiteID – S005-263
at 86th Ave NW, South end of Coon Rapids Dam Park, Coon Rapids	STORET SiteID – S003-995

Years Monitored

At 86th Ave (outlet to Mississppi) - 2006 and 2007
At 96th Ln NE (Blaine-Coon Rapids city boundary) - 2008



Background

Pleasure Creek flows through the southwestern portion of Blaine and southern Coon Rapids. The watershed is highly urbanized. The creek is about 8-10 feet wide and 0.5 to 1 foot deep at the monitoring sites during baseflow. Past monitoring near the creek's outlet to the Mississppi River has found high levels of dissolved pollutants and E. coli. In 2008 monitoring was moved upstream to begin determining the sources of pollution.

Results and Discussion

Pleasure Creek was monitored in 2006 and 2007 near the creek's outlet to the Mississippi River (86th Ave). That work found high dissolved pollutants (as measured by conductivity, chlorides, and salinity) as well as high E. coli during storms. In 2008 monitoring was done upstream at the Blaine-Coon Rapids city boundary (96th Ln) to determine if the problem sources were up or downstream of that point. This reporting focuses on the 2008 monitoring but includes the earlier monitoring as well to provide an assessment of the entire stream system.

In 2008 Pleasure Creek was visited 9 times for water quality monitoring (see figures on the following pages). Four of these events were immediately after a storm more than 1-inch of precipitation in 24 hours, four were during baseflow conditions, and one was characterized as baseflow but immediately followed an approximately 0.15-inch rainfall. E. coli bacteria plus a suite of nine chemical parameters were monitored. These reveal water quality problems during both storms and baseflow conditions.

Differences and similarities between the upstream and downstream monitoring sites provide substantial insight into the source of the problems. Problems with dissolved pollutants were present at both the upstream and downstream monitoring site, but were of less severity upstream. This suggests that dissolved pollutants are originating from throughout the watershed. Problems with suspended solids and turbidity occur at the downstream location during storms, but no such problems exist at the upstream site, so that problem originates in the Coon Rapids portion of the watershed. E. coli measurements at the upstream and downstream monitoring sites were similar. It is likely that most E. coli problems are originating from the Blaine part of the watershed, which consists of a network of stormwater ponds linked by short ditch segments. In all, addressing these problems will require action across the watershed, but different types of work is needed in different parts of the watershed.

Results for each pollutant type are detailed in the next few pages.

Dissolved Pollutants – conductivity, chlorides, and salinity

Three of the parameters tested (conductivity, chlorides, and salinity) measure dissolved pollutants (graphs on following page). All three were high and increased from upstream (96th Lane) to downstream (outlet to Mississippi R). Conductivity and salinity measure many different dissolved pollutants simultaneously. At the upstream monitoring site Pleasure Creek conductivity averaged 0.643 mS/cm, or two times higher than the median of other Anoka County streams. Downstream conductivity was 0.994 mS/cm or three times higher than the Anoka County median and the third highest among 41 Anoka County streams that have been tested (nearby Springbrook was second highest). Salinity readings were similar to conductivity - high and increasing downstream. Chlorides, often associated with road salts but also found in industrial and wastewater discharges, was 66 mg/L at the upstream site, which is 5.5 times the median for Anoka County streams (12 mg/L). Yet, this was notably lower than at the outlet to the Mississippi River where chlorides averaged 162 mg/L. The only Anoka County stream with higher chloride levels documented is Springbrook. These chloride levels approach the Minnesota Pollution Control Agency's (MPCA) chronic standard for aquatic life of 230 mg/L, and in some cases exceed it (maximum observed was 262 mg/L).

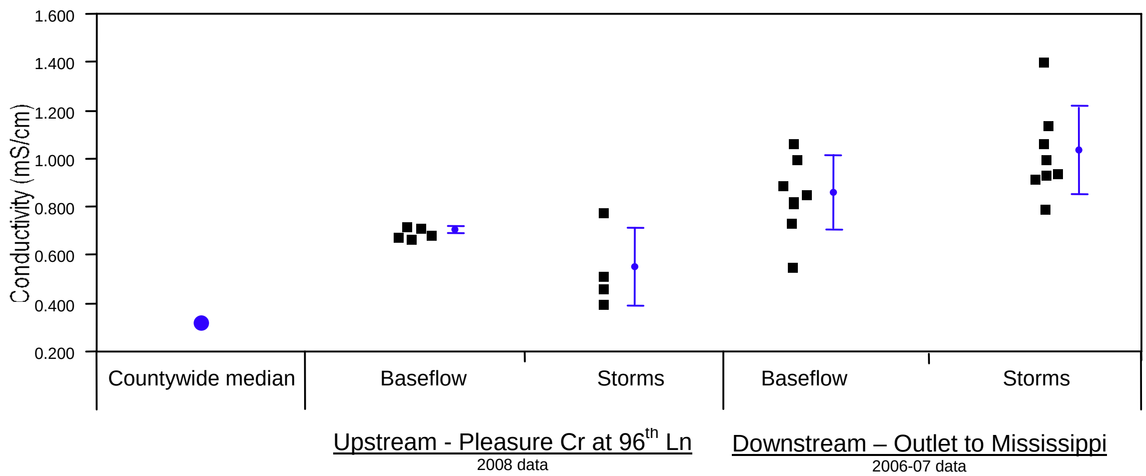
These pollutants are accumulating in the stream throughout its entire length, suggesting pollution sources throughout the watershed. A long list of sources is probably to blame in an urban watershed such as this one. One important source is urban runoff containing a myriad of pollutants. These dissolved pollutants are difficult to remove from surfaces once they are introduced. Traditional stormwater management practices (examples - street sweeping, settling ponds) are oriented toward particulate pollutants, not dissolved pollutants. Therefore preventing their introduction into the environment is important.

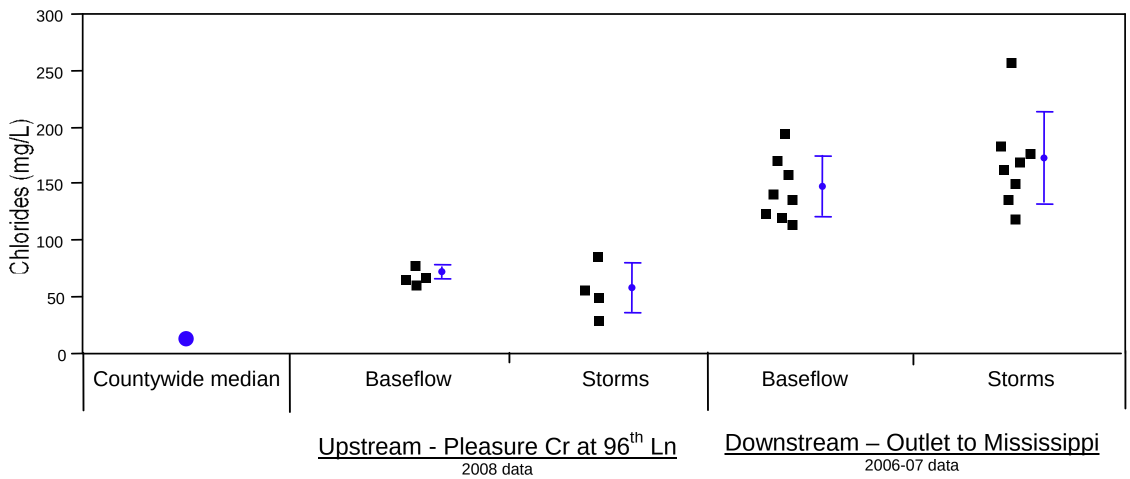
Similarly high dissolved pollutants during baseflow indicates that road runoff is not the only important pollutant source. Dissolved pollutants during baseflow are from one or more of the following:

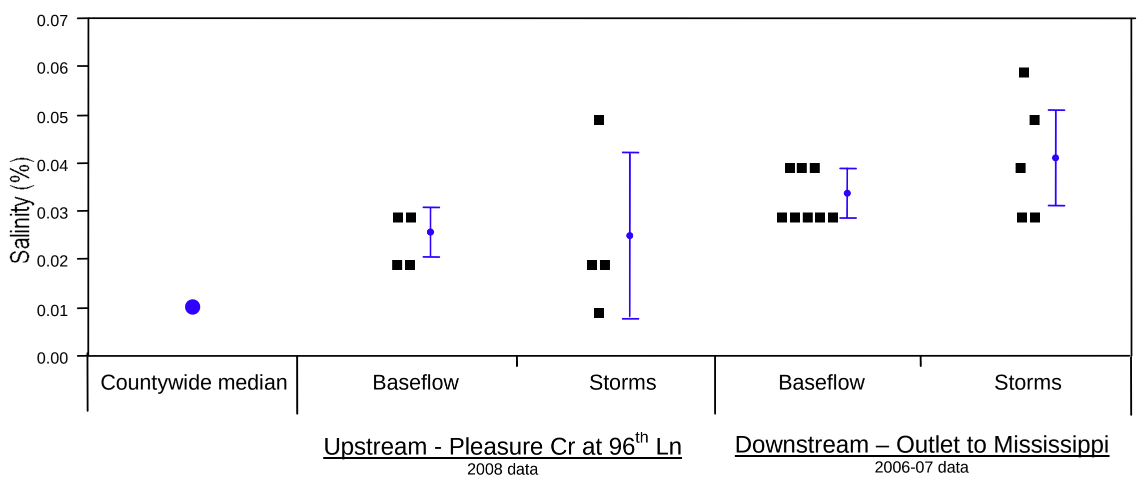
a. Dissolved pollutants that have permeated into the shallow groundwater that feeds the stream during baseflow.
b. Continuous discharges to the creek, such as industrial wastes or illicit discharges through the stormwater conveyance system.
c. Storm water ponds upstream which may retain pollutants from storms and release them to the creek continuously.

In any case, there are multiple sources of dissolved pollutants to Pleasure Creek.

Dissolved Pollutant Results During Base and Storm Conditions (Squares are individual measurements, circles with vertical lines are mean +/- one standard deviation)





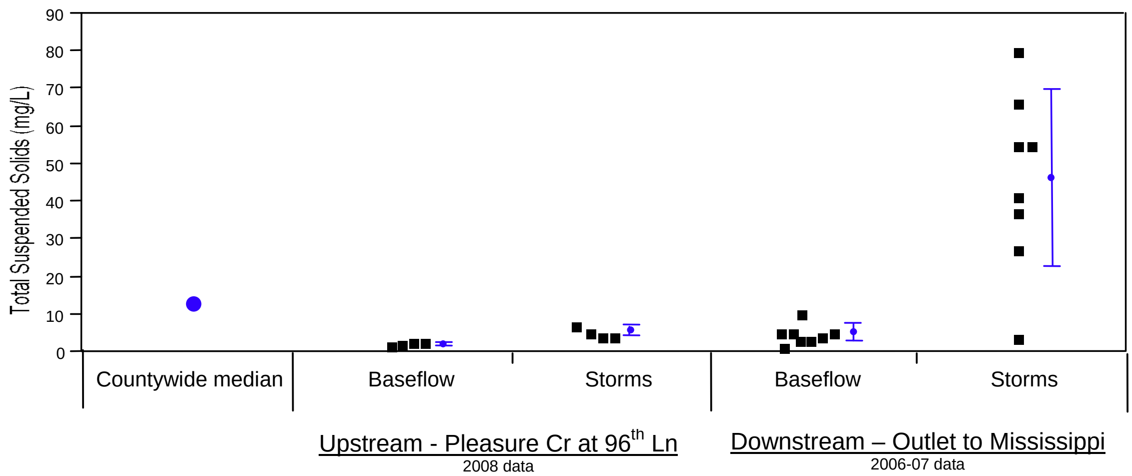


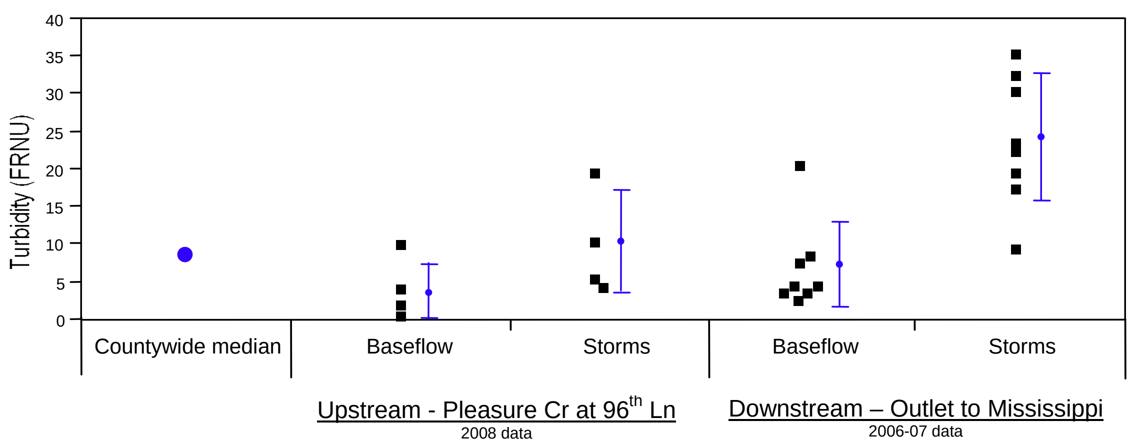
Turbidity and Suspended Solids

Turbidity and total suspended solids were not problematic at the upstream monitoring site (96th Lane), but are elevated at the downstream site (outlet to Mississippi R) during storms. The headwaters of Pleasure Creek are a network of storm water ponds throughout a residential area, mostly townhomes. The 96th Lane monitoring site is just downstream of this area which is well-treated by stormwater ponds. Suspended solids averaged 5 mg/L and were always well below the median for Anoka County streams of 14 mg/L. Even during storms the average suspended solids was 6 mg/L, which is low. Turbidity was also low during both baseflow and storms, and was similar to the median for Anoka County streams.

Downstream portions of the Pleasure Creek watershed include older development, fewer stormwater treatment facilities, and higher suspended solids and turbidity during storms. At baseflow the water was clear, with total suspended solids and turbidity slightly lower than in other Anoka County streams. During storm flows turbidity rose five-fold and total suspended solids rose even higher. The source of this turbidity is likely solid materials swept into the stream through storm water conveyances, but may also include spot erosion of the stream bank. These results are not unusual for a stream in a highly urbanized watershed because flow velocities during storms are fast enough to pick up solid materials and sweep them into the stream.

Total Suspended Solids and Turbidity Results During Base and Storm Conditions (Squares are individual measurements, circles with vertical lines are mean +/- one standard deviation)





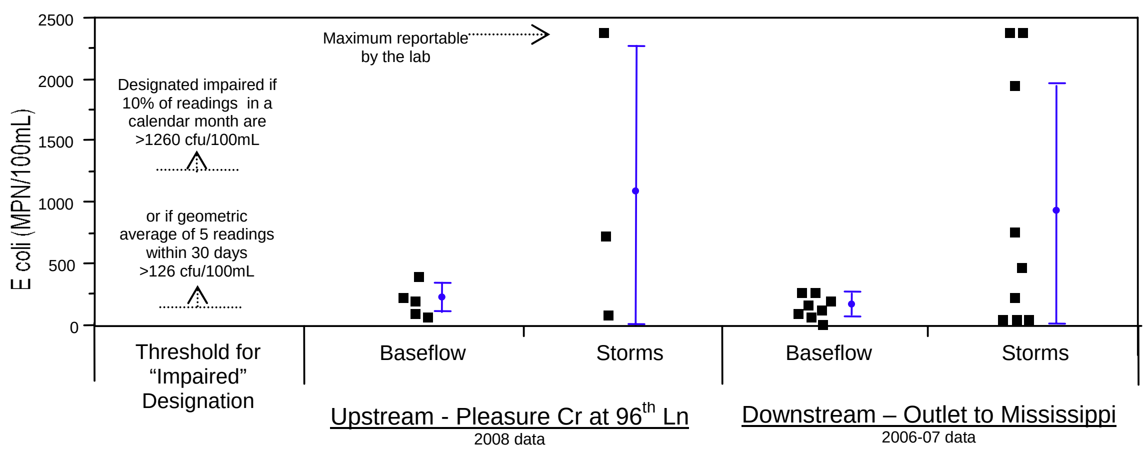
E. coli Bacteria

E. coli, a bacteria found in the feces of warm blooded animals, is unacceptably high in Pleasure Creek. The Minnesota Pollution Control Agency sets E. coli standards for contact recreation (swimming, etc). A stream is designated as "impaired" if 10% of measurements in a calendar month are >1260 colony forming units per liter of water (cfu/L) or if the geometric mean of five samples taken within 30 days is greater than 126 cfu/L. Pleasure Creek exceeds both criteria (see graph below).

Enough data is available for the downstream monitoring site (outlet to Mississippi River) to clearly document exceedances of the "impaired" criteria. At the upstream site not enough data has been gathered, but the E. coli values observed are nearly the same as at the downstream site. At the downstream monitoring site three of four samples in May 2007 exceeded 1260 cfu/L (261, 1986 and two samples exceeding the test limits of 2420 cfu/L). In 2006, five samples taken between 5/24 and 6/21 had a geometric mean of 318 cfu/L. In 2007 five samples were taken between 5/24 and 6/20, but calculating their geometric mean is impossible because two of the samples exceed the test's capacity of 2420 cfu/L. If we conservatively replace those readings with 2420 cfu/L, then geometric mean is 934 cfu/L. On all accounts, Pleasure Creek at the outlet to the Mississippi River exceeds the E. coli standard and poses a level of risk to anyone contacting the water that the State of Minnesota deems unacceptable.

E. coli levels probably exceeded water quality standards during baseflow but grossly exceeded standards during storms, both at both the upstream and downstream monitoring sites. Average baseflow E. coli at the upstream and downstream monitoring sites were similar (235 and 257 MPN/100 mL, respectively) and varied little (standard deviations 135 and 179, respectively). During storms E. coli was much higher and much more variable. Average E coli during storms was 1102 MPN/100mL (n=3) upstream and 935 (n=9) downstream, with standard deviations of 1187 and 1046, repectively. A large part of this variability could be explained by the intensity of the storm, phenology of the storm, and when during the storm the sampling was done. In any case, E. coli is continuously present in Pleasure Creek, but storms flush much more of it into the stream, or suspend and transport E. coli that was already present.

E. coli Bacteria Results During Base and Storm Conditions (Squares are individual measurements, circles with vertical lines are mean +/- one standard deviation)



The source of E. coli is upstream of the 96th Lane monitoring site, and somewhere within the City of Blaine. This is somewhat surprising that E. coli counts were similar at the upstream and downstream monitoring sites given that research throughout the U.S. has consistently found that urban watersheds have high E. coli. One would expect that the urban areas between the two monitoring sites would contribute to an increase in E. coli at the downstream site, as was seen for other pollutants.

The area upstream of the 96th Lane monitoring site in Blaine consists of residential development. The newest part of this residential area was constructed post-1995 and has an impressive network of ponds designed to remove pollutants from stormwater and serve as an amenity for the neighborhoods. Pleasure Creek flows through these ponds. Storm water from more distant neighborhoods is carried to Pleasure Creek and the pond system by way of underground stormwater pipes. While the exact source of the E coli cannot be pinpointed from the work done so far, we can create a list of possibilities, including:

- **The stormwater ponds themselves**. Although stormwater ponds generally remove pollutants by allowing settling there are many documented instances throughout the U.S. where the ponds accumulate fecal bacteria that are then flushed out during larger storms. E. coli can survive, and sometimes grow, outside of the intestinal tract. Survival is longest when the water temperature is lower, sun exposure is less, and bacterivorous predators (nematodes, ciliates, rotifers, etc) are fewer. Some bacteria are attached to particles that settle within stormwater ponds (but are still vulnerable to resuspension during storms), while others are "free" and less likely to settle.

  Based upon total suspended solids data, the ponds are doing a good job of removing particulates from the water, even during storms. However, the ponds do not appear to do a good job regulating the rate of stormwater discharge during storms. In one instance in 2008 staff observed debris on a culvert trash rack that indicated water levels had surged 2.2 feet vertically within a few hours following a 1 inch storm (normal water level is <6 inches). These "flashy," high-volume flows are a powerful means for resuspending and transporting bacteria.

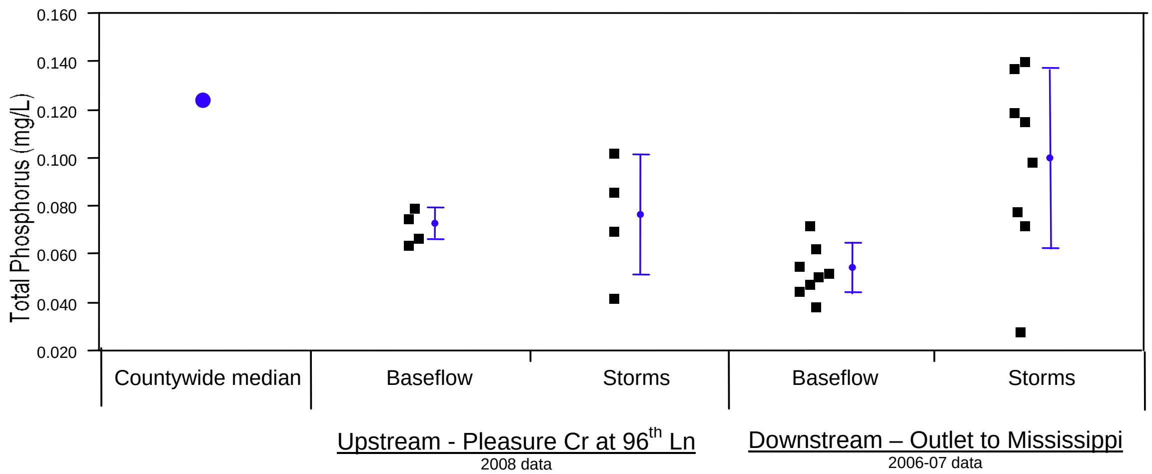
- **Congregations of waterfowl on the stormwater ponds.** Bird droppings in large numbers could significantly contribute to E. coli originating from stormwater ponds. Resident input on the number and frequency of waterfowl is needed. Most of these stormwater ponds directly north of 99th Avenue include a buffer of unmowed vegetation, which typically discourages geese from congregating.
- **Activities anywhere within the stormwater drainage network.** While all land uses can generate high bacterial concentrations, especially during storms, this is particularly true for urbanized areas. Multiple bacteria sources exist, including pet wastes, while impervious surfaces and storm water conveyances serve to transport them quickly to the waterway.
- **Sanitary sewer.** Sanitary sewer could contribute either through leaking pipes or if a wastewater pipe improperly intersects with a storm water pipe. The extent of this occurring is unknown. Dry-weather screening of stormwater outfalls for illicit discharges could be used to detect any such problems.
- **Other unknown sources**.

Phosphorus

Interestingly, phosphorus in Pleasure Creek is low. This nutrient is one of the most common pollutants in our region, and can be associated with urban runoff, agricultural runoff, wastewater, and many other sources. In Pleasure Creek total phosphorus was consistently lower than the median for Anoka County streams at both the upstream and downstream monitoring sites. Even the maximum phosphorus level observed (0.142 mg/L) was close to levels expected in minimally impacted streams in our ecoregion (0.130 mg/L).

The lack of nutrient inputs despite high levels of other dissolved pollutants and E. coli lends some insight into the source of these other pollutants. High dissolved pollutants are likely due to inorganic chemical inputs, not organic nutrient-rich inputs like those found in wastewater. Likewise, it indicates that the source of E. coli is not likely to be active inputs of wastewater.

Phosphorus Results During Base and Storm Conditions (Squares are individual measurements, circles with vertical lines are mean +/- one standard deviation)



Other Parameters

Dissolved oxygen and pH were at acceptable levels commonly found in the area.

Raw Pleasure Creek Water Quality Results 2008

Pleasure Creek at 96th Ln - 2008

Date	Time	Type	pH	Conductivity	Turbidity	DO	DO	Temp	Salinity	TP	Cl	TSS	E. coli	Stage	Flow	Notes
				mS/cm	FNRU	mg/L	%	C	%	mg/L	mg/L	mg/L	MPN/100 mL	ft	cfs	
4/7/2008	12:10	Storm	7.07	0.414	20	11.78	91.0	4.5	0.01	0.088	34.5	6.00	116.20	883.24		slight sewage smell. Shallow, can't tell water is moving in wide part of stream, but is about 6" deep flowing in culvert apron. 4.45 ft from US culvert top to bottom of culvert apron
5/3/2008	12:00	Storm	7.56	0.795	11	10.9	100.6	11.8	0.05	0.072	89.6	5.00		883.42		higher flow than previous sample at this site, clumps of organic crap floating everywhere
6/12/2008	3:25	Storm	7.71	0.534	5	8.59	100.0	22.8	0.02	0.044	54.1	5.00	770.10	883.60		slightly brown
6/26/2008	2:30	Base	7.43	0.733	0	10.88	133.0	24.3	0.03	0.069	83.2	3.00	435.20	883.10		cloudy; lots of slime and filamentous algae in channel US of sample site; Low flow, but moderate flow inside culvert
7/24/2008	9:45	Base	7.07	0.697	4	6.64	71.6	19.5	0.02	0.081	72.0	<2	238.20	883.13		lots of filamentous algae US of sample site; low flow in channel; moderate flow in culvert
8/26/2008	13:30	Base	7.21	0.703	2	11.41	131.2	22.3	0.03	0.077	69.2	< 2	106.30	883.03		sunny, no recent rains, appearance clear, surface 50% algae covered with low flow and faint sewage smell
8/28/2008	10:10	Storm	7.36	0.480	6	6.24	69.0	19.9	0.02	0.104	59.7	8.00	>2419.6	883.72		overcast, ~ 1" rain overnight, appearance moderately brown, highest flow we've observed, but debris piled on culvert grate suggests water had surged ~ 2.2' higher during storm
9/17/2008	3:00	Base	7.28	0.691	2	8.19	93.6	21.7	0.02	0.066	65.6	3.00	137.40	882.98		sunny, no recent rains, appearance clear with low flow and lots of fillamentous algae
9/23/2008	8:40	Base	6.95	0.738	10	4.87	50.0	16.7	0.03				261.30	883.00		0.1 - 0.2" rain in 2.5 hrs before sample, appearance clear, sides of stream bottom are orange (iron reduction), low flow-similar to baseflow
Min			6.95	0.414	0	4.87		4.5	0.01	0.044	34.5	3.00	106.30	882.98		
Mean			7.29	0.643	7	8.83		18.2	0.03	0.075	66.0	5.00	294.96	883.25		
Max			7.71	0.795	20	11.78		24.3	0.05	0.104	89.6	8.00	770.10	883.72		

		pH	Conductivity	Turbidity	DO	DO	Temp	Salinity	TP	Cl	TSS	E. coli
Anoka County Median		7.53	0.318	9	7.14			0.01	0.126	12.0	14.00	
NCHF Ecoregion Mean			0.390						0.220			
NCHF Minimally Impacted Stream		8.1	0.300	7.1				0.00	0.130	8.0	13.70	
"Impaired" Threshold		<6.5 or >8.5		>25	<5					>=230		1260 or 126 ave.

Recommendations

Pleasure Creek has water quality problems that affect aquatic life, recreation, and pose a health threat to humans that contact the water. Because Pleasure Creek is a tributary to the Mississippi River, there are also concerns about the creek's effect on the river. While the volume of water contributed to the Mississippi is relatively small, its effects could be much greater due to the poor water quality. The river is an important ecosystem and serves as a drinking water source for many downstream communities, including the Cities of St. Paul and Minneapolis who have their drinking water intakes just downstream of the confluence of Pleasure Creek and the Mississippi. This drinking water is treated before consumption but it is highly desirable to avoid pollutants rather than try to remove them later. Because of the magnitude and chronic nature of water quality problems in Pleasure Creek, and because of the effects on ecosystems and humans, improving Pleasure Creek water quality should be a high priority for the Six Cities Watershed Management Organization, the Cities of Blaine and Coon Rapids, and other agencies.

The work done to date provides some understanding of the problem, but additional diagnostic work can further refine understanding of the problem causes. Some corrective actions can also begin immediately. Recommendations include:

- **Screen for illicit discharges** at stormwater outfalls during dry weather, and correct any found.
- **Continue E. coli diagnostic monitoring in Blaine portions of the Pleasure Creek watershed.** The next steps should include testing further upstream at strategic locations to allow pollutant contributions of subwatersheds (as defined by the municipal storm sewer system) to be determined. Simultaneous monitoring above and below stormwater ponds is desirable to determine if the ponds themselves are a source of E. coli, however this is complicated by the fact that there are multiple stormwater discharges into some ponds. In some cases it may be necessary to take water samples from within underground storm water conveyances.
- **Install stormwater treatments in older neighborhoods of the Coon Rapids portion of the Pleasure Creek watershed.** Large portions of the Pleasure Creek watershed were developed before modern stormwater treatment requirements and techniques. These same neighborhoods have many urban features that contribute significantly to dissolved pollutants and E. coli. Strategic placement of stormwater "retrofits" in these locations provides the greatest benefit per dollar spent. Because larger techniques, such as storm water ponds, are not feasible in these fully built neighborhoods, "retrofitting" with smaller techniques on a property-by-property basis is necessary. These smaller techniques includes grassy swales, infiltration basins, rain gardens, proprietary devices, and others. Techniques used should be selected with the target pollutant(s) in mind.
- **Modify or add stormwater structures to slow rates and volumes during storms**. This should occur in both Blaine and Coon Rapids portions of the watershed. Benefits will include reducing suspended solids in downstream reaches during storms, reducing in-stream erosion, and reducing resuspension of E. coli that may have settled in stormwater ponds.
- **Structure all investigative work to fit into future TMDL studies.** This stream is already on the MPCA's list of impaired waters for "impaired biota," and other impairments are likely to be added soon (E. coli). Any work done should be done in a way that can compliment future TMDL studies. For instance, water stage or flow should be taken during every water sampling so that loading can be back-calculated later. Grant dollars for TMDL studies are available from the State.
- **Pursue grants for the work mentioned above.** This work could be a candidate for US Environmental Protection Agency 319 grants, Minnesota Pollution Control Agency TMDL grants, and others.

Stream Water Quality – Biological Monitoring

Description: This program combines environmental education and stream monitoring. Under the supervision of ACD staff, high school science classes collect aquatic macroinvertebrates from a stream, identify their catch to the family level, and use the resulting numbers in mathematical equations that summarize water and habitat quality. These methods are based upon the knowledge that different families of insects have different water and habitat quality requirements. The families collectively known as EPT (Ephemeroptera, or mayflies; Plecoptera, or stoneflies; and Trichoptera, or caddisflies) are pollution intolerant. Other families thrive in low quality water. Therefore, a census of stream macroinvertebrates yields information about stream health.

Purpose: To assess stream quality, both independently as well as by supplementing chemical data. To provide an environmental education service to the community.

Locations: Pleasure Creek at 86th Ave NW, S end of Coon Rapids Dam Park, Coon Rapids

Results: Results for each site are detailed on the following pages.

Tips for Data Interpretation

Consider biological indices of water quality in concert rather than alone, as each gives only a partial picture of stream condition. Compare the numbers to county-wide averages. This gives some sense of what might be expected for streams in a similar landscape, but does not necessarily reflect what might be expected of a minimally impacted stream. Some key numbers to look for include:

<u># Families</u> Number of invertebrate families. Higher values indicate better quality.

<u>EPT</u> Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). Higher numbers indicate better stream quality.

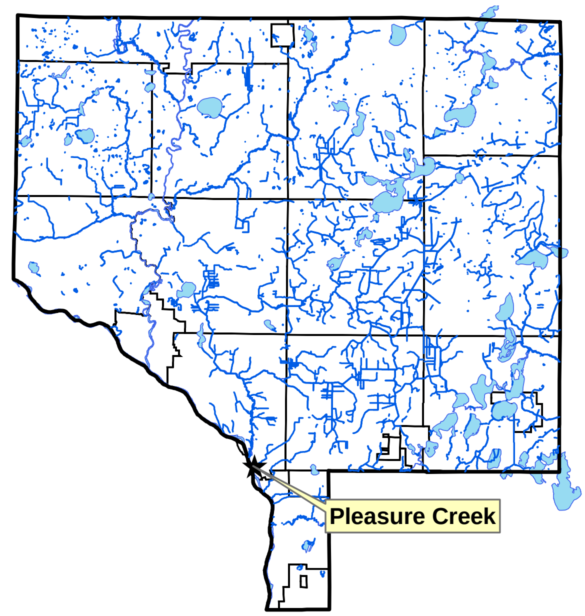
<u>Family Biotic Index (FBI)</u> An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

FBI	Stream Quality Evaluation
0.00-3.75	Excellent
3.76-4.25	Very Good
4.26-5.00	Good
5.01-5.75	Fair
5.76-6.50	Fairly Poor
6.51-7.25	Poor
7.26-10.00	Very Poor

<u>% Dominant Family</u> High numbers indicates an uneven community; likely a poorer condition.

PLEASURE CREEK

at 86th Ave NW, South end of Coon Rapids Dam Park, Coon Rapids



Last Monitored

By ACD in 2008

Monitored Since

Spring 2000

Student Involvement

Approx 400 since 2000

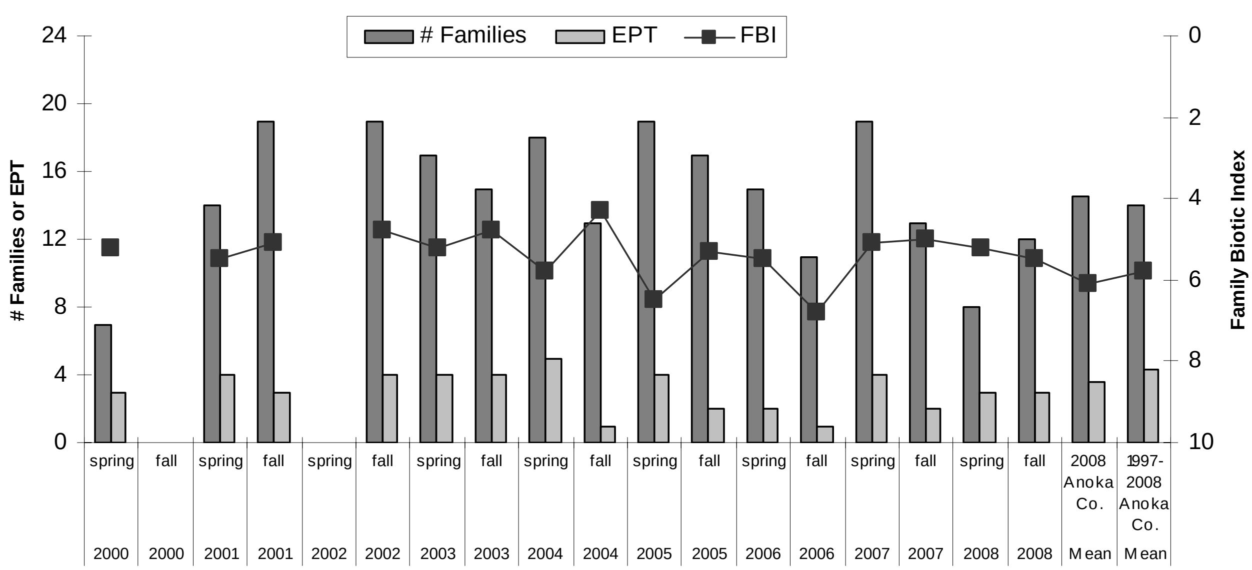
Background

Pleasure Creek is on the MN Pollution Control Agency's List of Impaired Waters for an impaired invertebrate biota. Newer data indicates E. coli and dissolved pollutant problems. Pleasure Creek originates in Blaine and flows through southern Coon Rapids to the Mississippi River. The sampling site is between 86th Avenue and the outlet to the Mississippi. This site is forested, unlike the generally urbanized watershed. The stream is ~10 feet wide and 0.5-1 feet deep at baseflow, and has a sand and silt bottom.

Results

Blaine High School classes monitored this stream in the past, but in 2008 were unable so the work was done by Anoka Conservation District staff. Overall, the biologic data indicate slightly below average conditions. Across all years monitored, EPT has been consistently below average, FBI about average, and total number of families usually slightly above average. The dominant species is always pollution-tolerant; in both 2008 samplings black-fly larva (family simulidae) were most abundant. Overall invertebrate abundance has been consistently low. Typically a crew of 25 students works for over two hours to capture 100-300 invertebrates. This is very poor. In 2008 the results were similar to previous years except that fewer families were found, perhaps because only two ACD staff were sampling instead of 25 students. FBI was slightly above average, while EPT and the number of families were below average. The families found were generalists that survive in a wide range of conditions, and most families had low abundance (<5). Water chemistry readings taken at this site indicate serious water quality problems, particularly for dissolved pollutants (as measured by conductivity and salinity).

Summarized Biomonitoring Results for Pleasure Creek in Coon Rapids



Biomonitoring Data for Pleasure Creek in Coon Rapids

Year	2000	2001	2001	2002	2003	2003	2004	2004	2005	2005	2006	2006	2007	2007	2008	2008	Mean	Mean
Season	spring	spring	fall	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	2008 Anoka Co.	1997-2008 Anoka Co.
FBI	5.20	5.50	5.10	4.80	5.20	4.8	5.8	4.3	6.5	5.3	5.5	6.8	5.1	5	5.2	5.5	6.1	5.8
# Families	7	14	19	19	17	15	18	13	19	17	15.0	11.0	19	13	8	12	14.6	14.0
EPT	3	4	3	4	4	4	5	1	4	2	2.0	1.0	4	2	3	3	3.6	4.4
Date	16-Jun	21-May	12-Oct	4-Oct	2-May	25-Sep	7-May	8-Oct	13-May	7-Oct	16-May	29-Sep	11-May	12-Oct	23-May	9-Oct		
Sampling by	ACD	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	ACD	ACD		
Sampling method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
# individuals	199	112	268	98	235	147	144	106	128	176	129	121	208	401	171	302		
# replicates	1	1	1	2	1	1	1	1	1	2	1	1	1	1	1	1		
Dominant Family	elimidae	simulidae	calopterigidae	hydropyschidae	calopterygidae	calopterygidae	calopterygidae	tipulidae	calopterygidae	simulidae	calopterygidae	hyalellidae	simuliidae	gammaridae	simuliidae	simuliidae		
% Dominant Family	31	41.1	22.8	35.7	50	36.7	31.9	33	21.9	18.8	46.5	43	34.6	32.4	50	75		
% Ephemeroptera	3	15.2	7.5	9.7	6.4	1.4	0.7	0	10.2	0	0	0	1	0	39.2	15.2		
% Trichoptera	8.5	12.5	21.3	36.2	20	21.8	2.1	1.9	1.6	8.5	7.8	10.7	13.5	20.2	1.8	2		
% Plecoptera	0	0	0	0	0	0	0.7	0	0	0	0	0	0	0	0	0		

Supplemental Stream Chemistry Readings

Parameter	23-May-03	25-Sept-03	7-May-04	8-Oct-04	13-May-05	7-Oct-05	19-May-06	29-Sept-06	11-May-07	12-Oct-07	5-May-08	9-Oct-08
pH	8.67	8.76	9.29	8.96	9.44	7.85	8.04	8.23	7.99	7.82	8.02	7.97
Conductivity (mS/cm)	1.06	1.05	1.31	0.517	0.739	0.332	.0910	0.845	1.09	0.483	1.64	1.44
Turbidity (NTU)	1	5	2	5	15	22		5	2	13	12	10
Dissolved Oxygen (mg/L)	na	9.25	na	9.07	10.20 (93%)	9.69 (95%)	9.03 (92%)	9.57 (90%)	8.83 (91%)	10.78 (101%)	9.12 (99%)	9.20 (88%)
Salinity (%)	0.04	0.04	0.05	0.02	0.03	0.01	0.04	0.03	0.04	0.01	0.07	0.06
Temperature (C)	13.6	13.1	12.4	15.2	11.7	13.8	15.4	13.0	17.1	12.4	19.3	12.9
Notes						3-6" rain 48 hrs ago						

Discussion

Despite the indications that stream health is only slightly below average based on biomonitoring data, overall the stream is severely polluted. The conductivity and salinity readings taken in this stream are some of the highest ever recorded by the Anoka Conservation District throughout Anoka County. E. coli bacteria are above state standards. Turbidity and suspended solids are high during storms. These problems are probably the result of several pollutant sources including road salts, untreated wastewater, industrial chemicals, stormwater runoff, and others. The watershed is highly urbanized and the list of likely pollutant sources is long. It is suspected that the relatively good habitat at the sampling site, compared to all other upstream portion of Pleasure Creek, causes the quality of this stream to be overestimated by biomonitoring. Most other reaches of this stream are relatively devoid of habitat, and in many places the stream is in unnatural channels or buried storm water pipes.

Water Quality Improvement Projects

Description: Projects on either public or private property that will improve water quality, such as repairing streambank erosion, restoring native shoreline vegetation, or rain gardens. These projects are partnerships between the landowner, the Anoka Conservation District, and sometimes with grant funding from the watershed organization or the Anoka Conservation District.

Purpose: To improve water quality in lakes streams and rivers by correcting erosion problems and providing buffers or other structures that filter runoff before it reaches the water bodies.

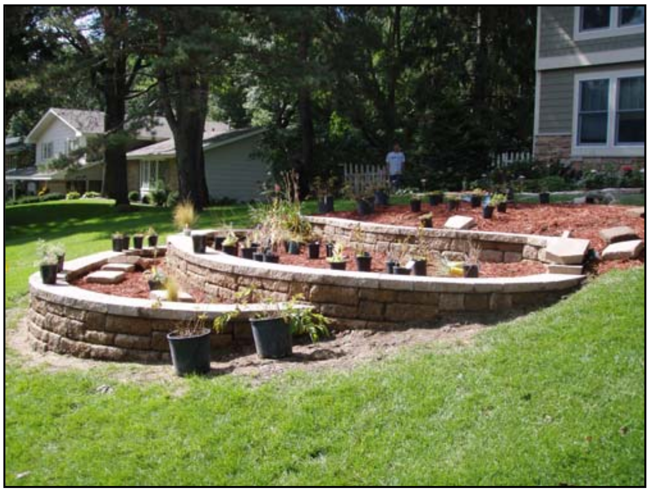
Results: Projects are described individually below.

2008 Chaudhary Residence Rain Garden

Three rain gardens were installed on the Chaudhary property to treat storm water from both the property and offsite. Prior to installation, rain falling on the Chaudhary property was directed, unfiltered, into the road. The storm water eventually made its way to Highland Lake and the Mississippi River via the storm sewer system. This excess runoff from impervious surfaces can cause:

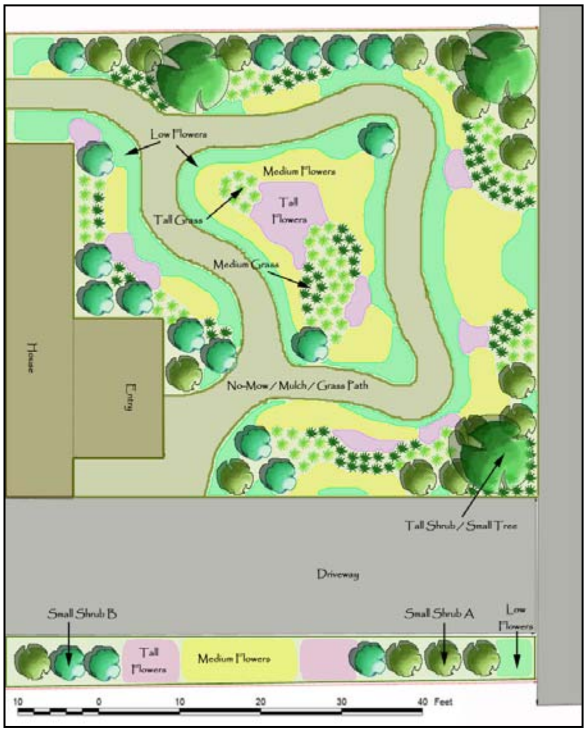
- An influx of sediments, nutrients and pollutants
- Algae blooms and unwanted aquatic vegetation
- An increase in water temperatures.

This project was fully funded by the landowner.



2008 Early Residence Rain Garden

This project is within the Laddie Lake subwatershed in southwestern Blaine, and involved replanting an entire residential front yard to native plants. A rain garden was installed to capture and infiltrate storm runoff from the roof. In the absence of this project, drainage was to Laddie Lake via the storm sewers with no treatment. This project was funded by the landowner, a cost share grant through the Anoka County Ag Preserves Program, and with technical assistance from the Anoka Conservation District.



2008 Hanley Residence Streambank Stabilization, Glen Greek

The Hanley property lies along Glen Creek where it flows into the Mississippi River. The site consists of a steep slope from the top of the property to the creek 30 feet below. Active erosion and bank undercutting has led to severe bank failure that will threaten the Hanley residence in the future. For this project, a cedar tree revetment was chosen to slow erosion and buy time for a larger scale project to take shape. Benefits of cedar revetments include improved fish and wildlife habitat and repair of bank undercutting and erosion.

SCWMO Website

Description: The Six Cities Watershed Management Organization (SCWMO) contracted the Anoka Conservation District (ACD) to design and maintain a website about the SCWMO and the Six Cities watershed. The website has been in operation since 2003. The SCWMO pays the ACD annual fees for maintenance and update of the website.

Purpose: To increase awareness of the SCWMO and its programs. The website also provides tools and information that helps users better understand water resources issues in the area. The website serves as the SCWMO's alternative to a state-mandated newsletter.

Location: www.AnokaNaturalResources.com/SCWMO

Results: The SCWMO website contains information about both the SCWMO and about natural resources in the area.

Information about the SCWMO includes:

- a directory of board members,
- meeting minutes and agendas,
- descriptions of work that the organization is directing,
- highlighted projects.

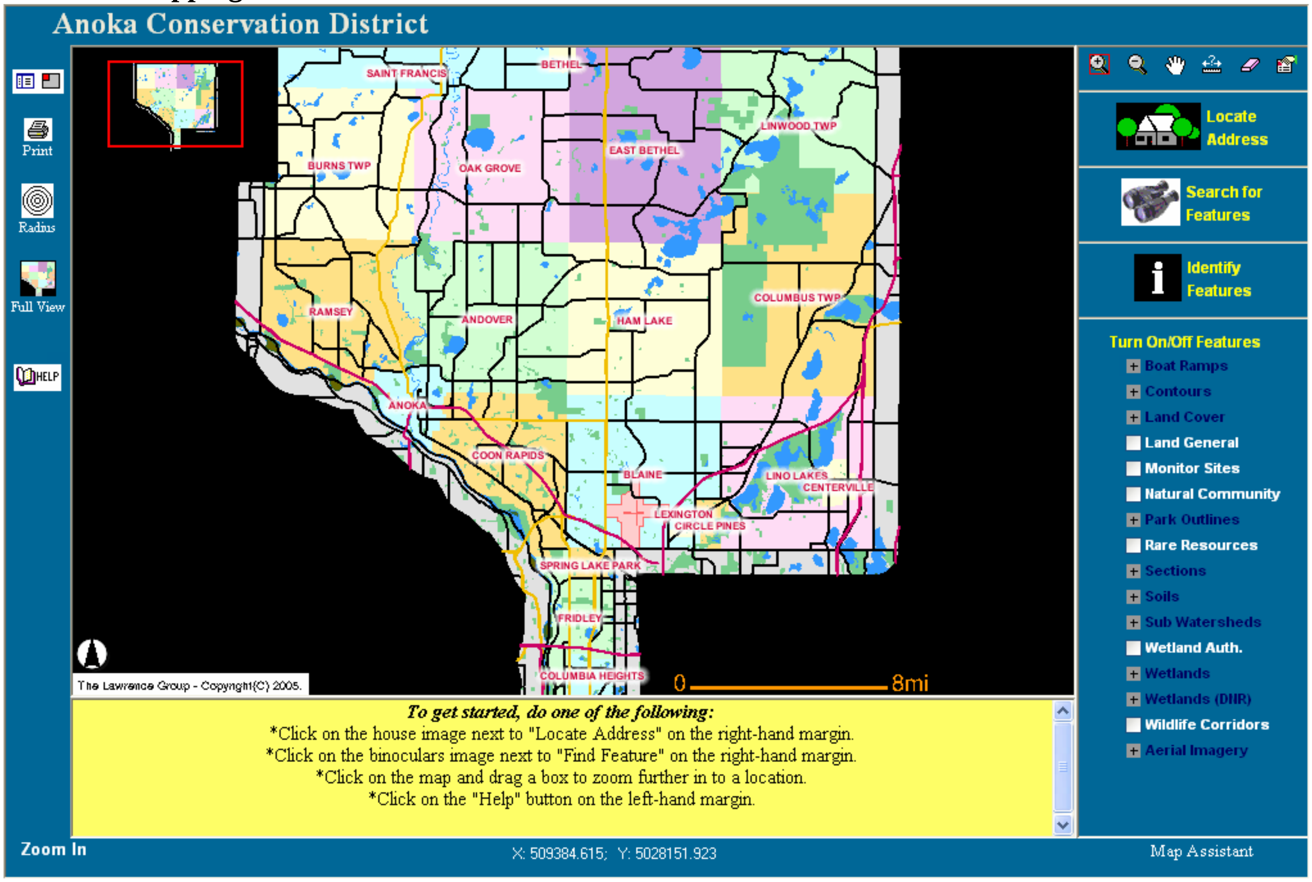
Other tools on the website include:

- an interactive mapping tool that shows natural features and aerial photos
- an interactive data download tool that allows users to access all water monitoring data that has been collected
- narrative discussions of what the monitoring data mean

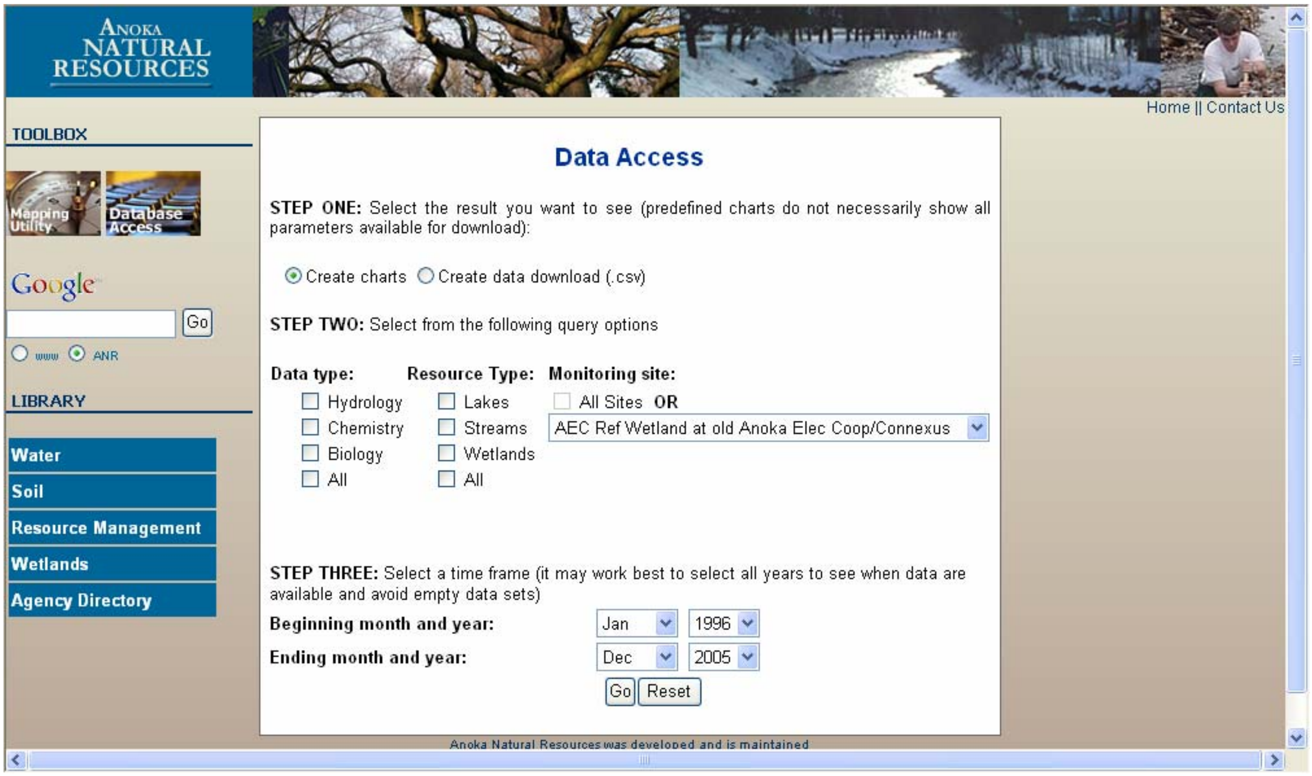
SCWMO Website Homepage - www.AnokaNaturalResources.com/SCWMO

more on next page

Interactive Mapping Tool



Interactive Data Access Tool



Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program, such as our lake water quality monitoring program. We do not, however, know specifically which expenses are attributed to monitoring which lakes. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer. The process also takes into account equipment that is purchased for monitoring in a specific area.

Six Cities Watershed Financial Summary

Six Cities Watershed	Web site	Precipitation Monitoring	Lake Levels	Lake Water Quality	Stream Water Quality	Student Biomonitoring	Outdoor Guide	Hanley Cedar Tree Revetment	Chaudhary Rain Garden	Early Rain Garden	Total
Revenues											
SCWMO	250	0	220	920	1303	750	0	0	0	0	3443
State	0	0	0	0	0	0	0	1248	0	0	1248
Anoka Conservation District	1845	77	439	0	0	141	26	0	0	0	2529
County Ag Preserves	0	0	0	697	0	585	0	248	0	1395	2924
Other Service Fees	257	57	55	0	0	0	0	1000	20000	1395	22764
Local Water Planning	0	0	0	247	1237	0	0	0	0	0	1485
TOTAL	2352	134	714	1864	2540	1476	27	2495	20000	2790	34392
Expenses-											
Capital Outlay/Equip	28	2	12	14	27	24	0	0	0	0	106
Personnel Salaries/Benefits	1527	110	605	1197	1748	1147	19	0	0	0	6352
Overhead	114	11	48	103	186	87	4	0	0	0	551
Employee Training	30	2	10	19	36	18	1	0	0	0	116
Vehicle/Mileage	37	4	18	55	58	30	1	0	0	0	204
Rent	62	5	21	65	85	33	2	0	0	0	273
Program Participants	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	554	1	2	411	401	137	0	2495	20000	2790	26791
Equipment Maintenance	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2352	134	714	1864	2540	1476	27	2495	20000	2790	34392
NET	0	0	0	0	0	0	0	0	0	0	0

Recommendations

- **The SCWMO Watershed Plan, currently under revision, should address multiple water quality problems.** Within the watershed there are two impaired lakes (Sullivan and Highland), two impaired streams (Pleasure and Springbrook) and one lake with declining water quality (Laddie).
- **Continue E. coli diagnostic monitoring in Blaine portions of the Pleasure Creek watershed** to determine sources.
- **Install stormwater treatments in older neighborhoods of the Coon Rapids portion of the Pleasure Creek watershed.**
- **Modify or add stormwater structures to slow rates and volumes during storms**. This should occur in both Blaine and Coon Rapids portions of the Pleasure Creek watershed.
- **Structure all investigative work to fit into future TMDL studies.**
- **Reduce the frequency of lake and stream water quality monitoring**. An adequate baseline of data currently exists, so future monitoring should be focused upon detecting changes, especially changes resulting from land use and management changes.