2007 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 2008

Prepared by Anoka Conservation District

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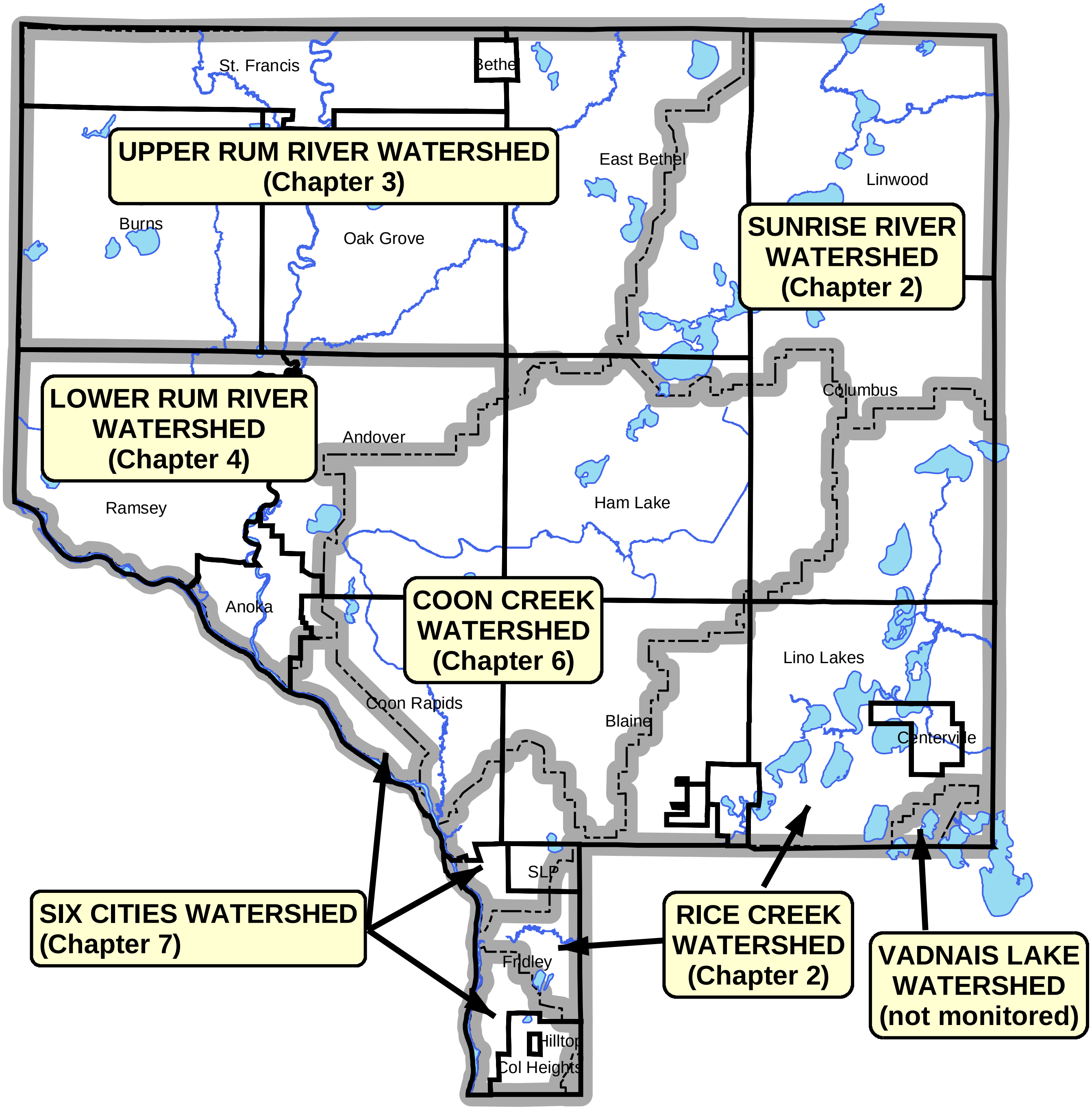
Digital copies of data in this report are available at www.AnokaNaturalResources.com



St. Francis
Bethel
UPPER RUM RIVER WATERSHED
(Chapter 3)
East Bethel
Linwood
Burns
Oak Grove
SUNRISE RIVER
WATERSHED
(Chapter 2)
LOWER RUM RIVER
WATERSHED
(Chapter 4)
Andover
Columbus
Ramsey
Ham Lake
Anoka
COON CREEK
WATERSHED
(Chapter 6)
Lino Lakes
Coon Rapids
Blaine
Centerville
SLP
SIX CITIES WATERSHED
(Chapter 7)
RICE CREEK
WATERSHED
(Chapter 2)
VADNAIS LAKE
WATERSHED
(not monitored)
Fridley
Hilltop
Col Heights

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EXECUTIVE SUMMARY AND ORGANIZATION OF THIS REPORT

The Anoka Conservation District (ACD) coordinates most of the water resource monitoring efforts in Anoka County, as well as other water quality improvement and education projects. Some of this work is done independently, but most of it is done as a cooperative effort with watershed management organizations, watershed districts, cities, or the state. This cooperative approach is appropriate because these organizations have similar interests in good water resource management, because it eliminates duplication, and minimizes costs. In 2007 monitoring, education, and water quality improvement work included:

- 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
    - eurasian watermilfoil signage at public boat accesses
    - lakeshore landscaping education,
    - booklet – "Outdoors in Anoka County: A Homeowner's Guide," and
    - websites
- Water quality improvement projects
    - Cost share grants for erosion correction, lakeshore restorations, and rain gardens

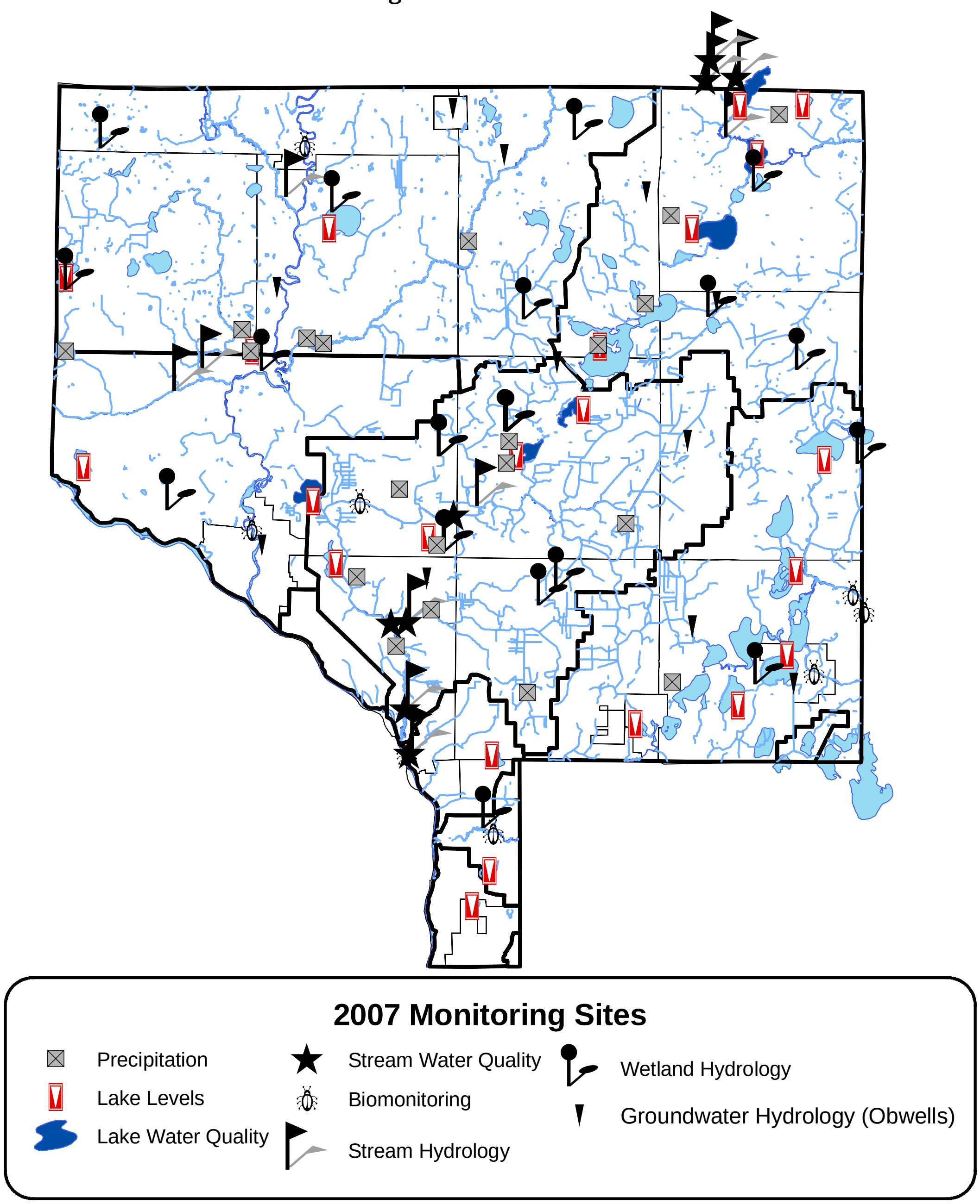
The results of this work are presented on a watershed basis - this document serves as an annual report to each of the watershed districts and watershed management organizations that have helped fund the work. Readers who are interested in a certain lake, stream or river should first determine which watershed 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. Chapter 1 also provides county-wide summaries, methodologies, explanations of terminology, and hints on interpreting data.

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 necessarily a summary of all work that each watershed organization accomplished in 2007; it is a summary of all work each watershed organization did in conjunction with the Anoka Conservation District. Furthermore, some work (for example, water quality monitoring on a particular lake) is not conducted every year and therefore would be found in the Water Almanac for another year. For data from other years or to obtain raw data not presented in this report use the website www.AnokaNaturalResources.com. The Data Access tool on the website can be used to get all data available. If you are still unable to locate the data you need, contact Anoka Conservation District staff for help.

CHAPTER 1:
WATER RESOURCE MONITORING PRIMER

This chapter provides an overview of the various monitoring activities the ACD conducts throughout the county, the methodologies used, and information that will help the layperson interpret information found in later chapters. County-wide precipitation and groundwater hydrology data is also presented here.

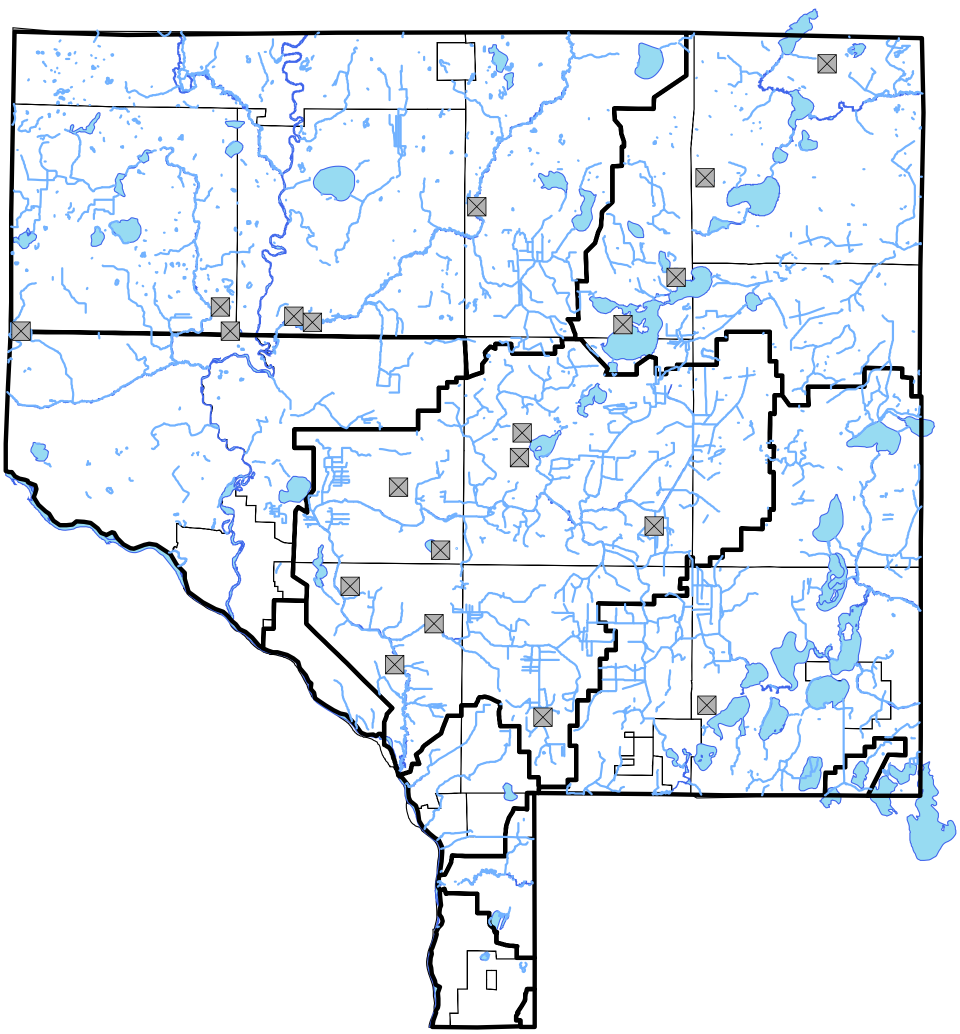
2007 Anoka Conservation District Monitoring Sites



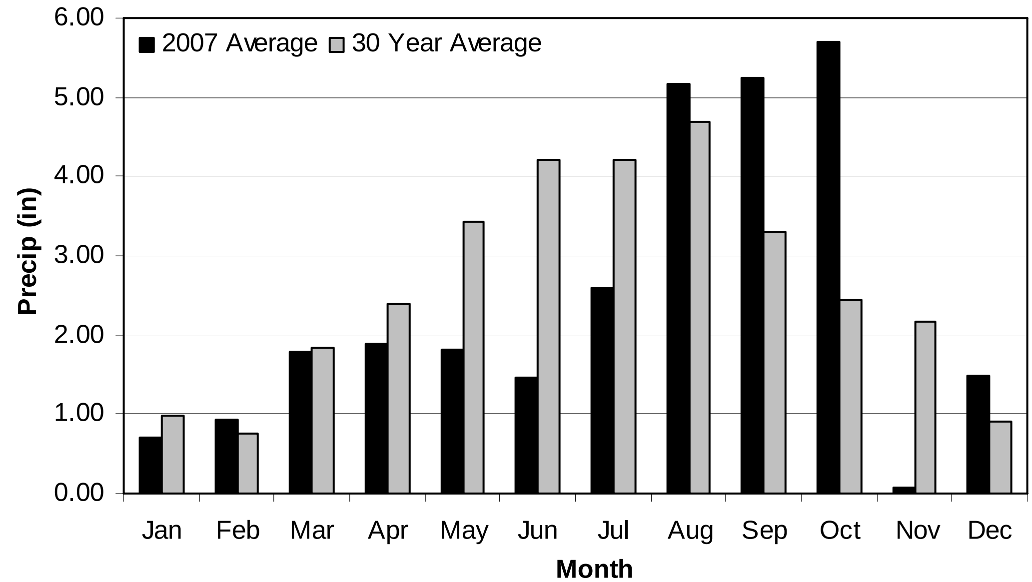
Precipitation

The ACD coordinates a network of 20 rain gauges countywide. Fifteen are monitored by volunteers and five are datalogging stations that are operated 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 three weeks. All data from the volunteer stations is submitted to the Minnesota State Office of Climatology where they are available to the public through http://climate.umn.edu.
A summary of county-wide data is provided on the following page.

2007 Precipitation Monitoring Sites



2007 Anoka County Average Monthly Precipitation (average of all sites)



2007 Anoka County Monthly Precipitation at each Monitoring Site

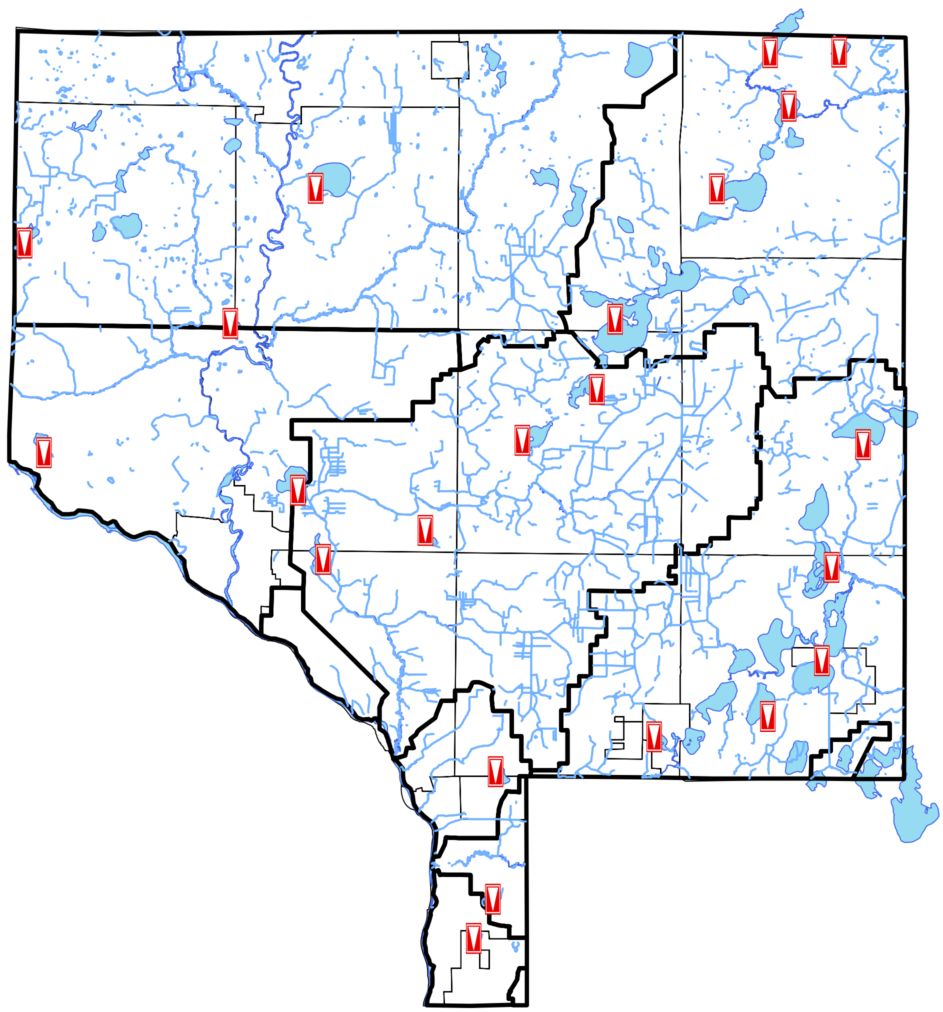
Location or Volunteer	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total	Growing Season (May-Sept)
ACD Office	Ham Lake				1.24	2.12	0.61		5.7	4.65	3.66				
CCWD- Blaine Public Works	Blaine				1.86	1.63	1.69			5.43	4.97				
CCWD- Bunker Hills Park	Andover				1.44	1.84	0.94	1.63	5.83	6.08	4.79				16.32
CCWD- Northern Nat. Gas	Ham Lake					2.27			4.42	6.69	5.23				
CCWD- Ham Lake City Hall	Ham Lake														
CCWD- Coon Rapids City Hall	Coon Rapids				1.63	1.94	1.5	0.91	5.49	5.68	4.86				15.52
N. Myhre	Andover	0.78	0.98	2.24	2.36	1.89	0.86	1.60	6.08	4.94	6.14	0.07	1.74	29.68	15.37
Y. Lyrenmann	Ramsey			1.48	2.22	1.38	2.49	2.95	4.64	4.30	6.19				15.76
M. Gaynor	East Bethel					1.55	1.15	2.86							
B. Guetzko	Burns	1.29	0.92		2.08	1.10	1.52	4.36	5.16	4.29	6.44	0.08	1.61		16.43
J. Rufsvold	Burns					1.24	1.51	3.70	4.54	4.87	6.24				15.86
P. Arzdorf	East Bethel				2.21	1.88	1.12	2.84	5.97	4.35	6.09				16.16
A. Mercil	East Bethel	0.21	0.30	2.38	1.07	2.01	1.21	2.63	4.44	5.19	5.71	0.08	1.23	26.46	15.48
K. Fredrick	Lino Lakes	0.90	1.26	0.16	3.19	3.39				4.43	5.12				
B. Myers	Linwood				0.97	1.94	1.34	1.37	4.29	4.52	4.99				13.46
D. Kramer	Linwood									5.14	5.44	0.09			
P. Freeman	Oak Grove		0.95	1.41	1.88	1.29	1.83	3.10		4.76	6.86		1.11		
S. Scherger	Coon Rapids									6.82	6.30	0.01			
S. Solie	Coon Rapids								5.60	8.13	6.44	0.10			
A. Dalske	Oak Grove	0.40	1.16	3.12	2.43	1.45	2.79	3.13	5.09	4.11	7.03	0.07	1.76	32.54	16.57
2007 Average	County-wide	0.72	0.93	1.80	1.89	1.81	1.47	2.59	5.17	5.24	5.69	0.07	1.49	28.87	16.28
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

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 impact on lake levels. ACD coordinates volunteer who monitor water levels on 24 lakes. An enamel gauge is installed in each lake and surveyed so that readings coincide with sea level elevations. The gauge is read weekly. The ACD reports all lake level data to the MN DNR, who post it on their website (www.dnr.mn.us.state\lakefind\index.html), along with other information about each lake. Results of this monitoring are reported by watershed in the following chapters.

2007 Lake Level Monitoring Sites



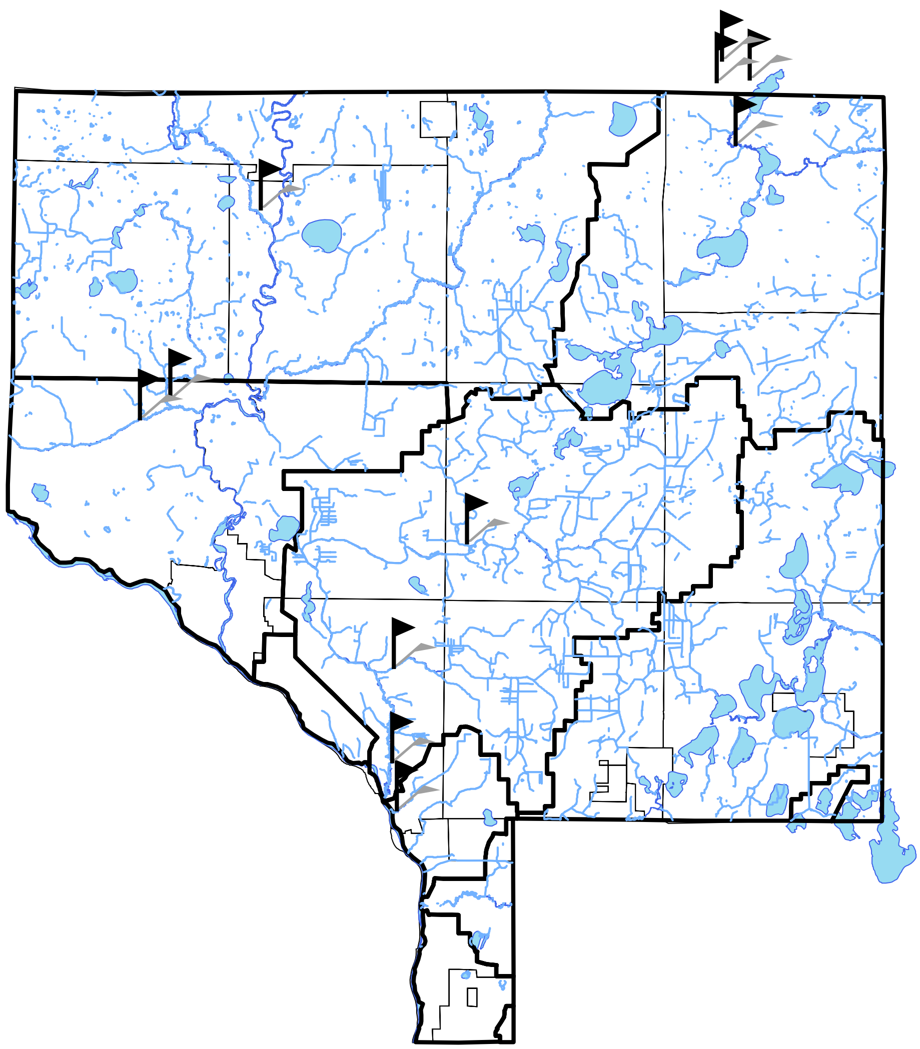
Stream Hydrology

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 needed for calculations of pollutant loading in these water bodies, which is then used in computer models and water pollution regulatory determinations.

The ACD monitored hydrology at 11 stream sites. Each is an electronic gauge that records water levels every four hours or more frequently. These gauges are surveyed and calibrated so that stream water level is measured in feet above sea level. Some sites have rating curves – a known mathematical relationship between water level and flow such that one can be calculated from the other. The information gained from these monitoring wells is used by the ACD, watershed management organizations, watershed districts, townships, cities, and others.

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

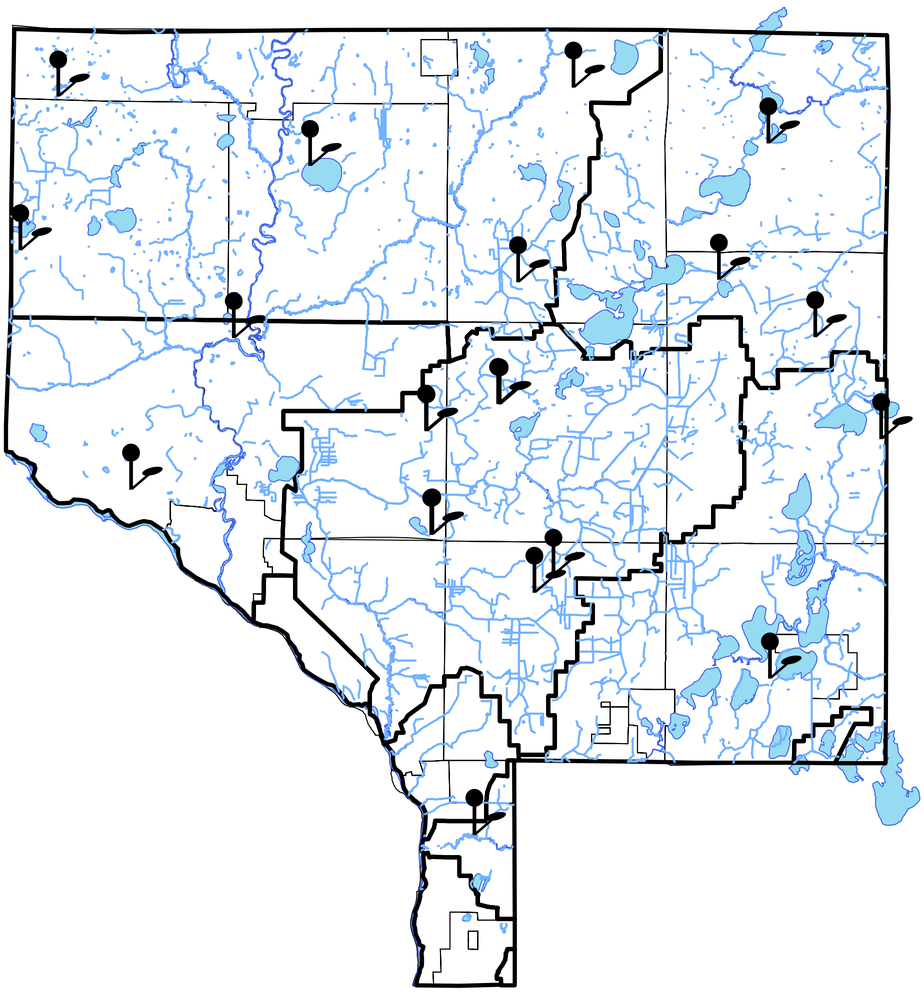
2007 Stream Hydrology Monitoring Sites



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. Electronic monitoring wells are used to measure subsurface water levels at the wetland edge every four hours up to a depth of 40 inches. 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 this monitoring are reported by watershed in the following chapters.

2007 Reference Wetland Monitoring Sites

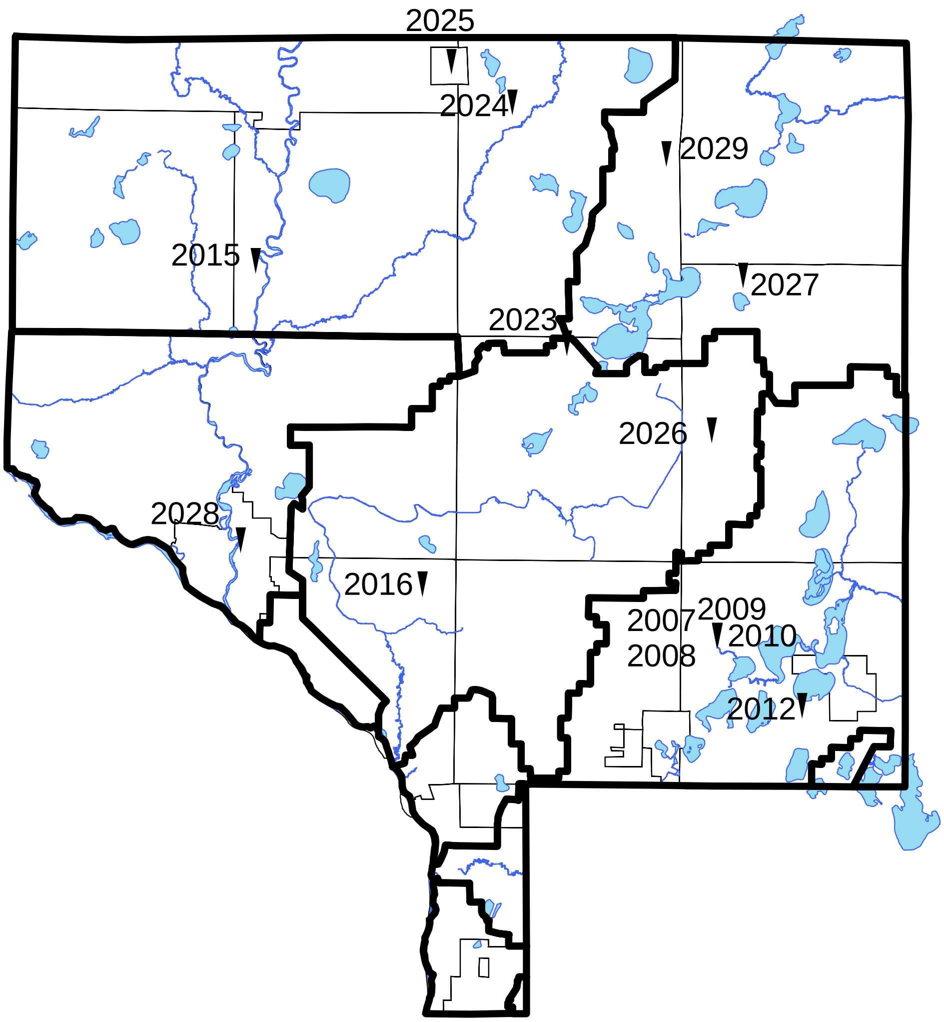


Groundwater Hydrology

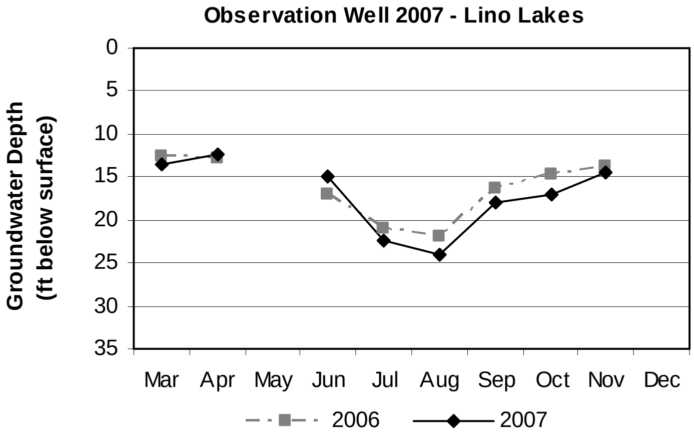
The Minnesota Department of Natural Resources (MN DNR) and ACD are interested in understanding Minnesota's groundwater quantity and flow. The MN DNR maintains a network of groundwater observation wells across the state. The ACD is contracted to take monthly water level readings at 15 wells in Anoka County during March – 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 2006-2007. This data is not presented elsewhere in this report. Raw data can be downloaded from the MN DNR website.

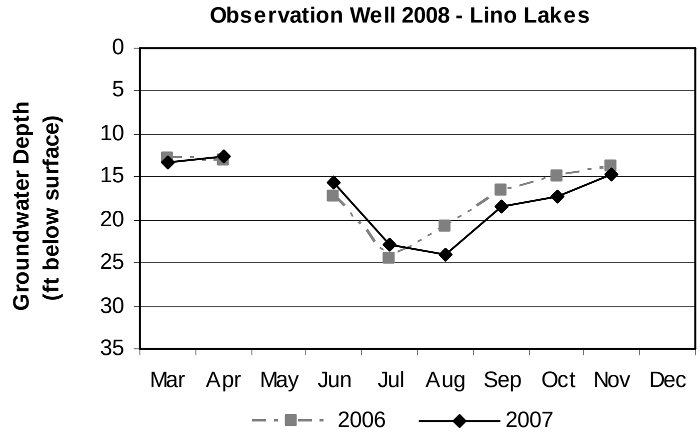
Groundwater Observation Well Sites and Well ID Numbers



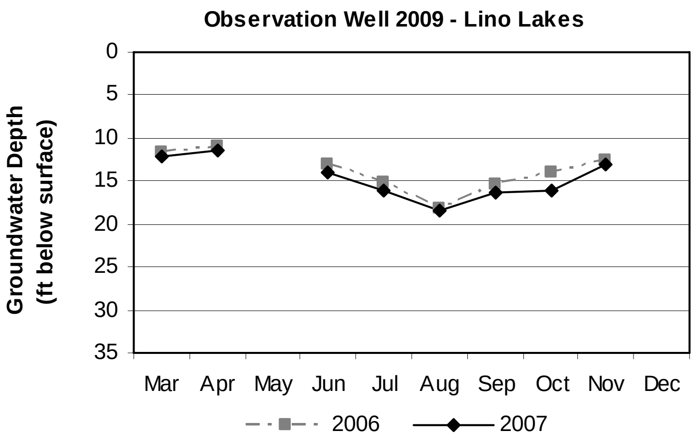
Well 2007 - Lino Lakes – 270 ft Deep



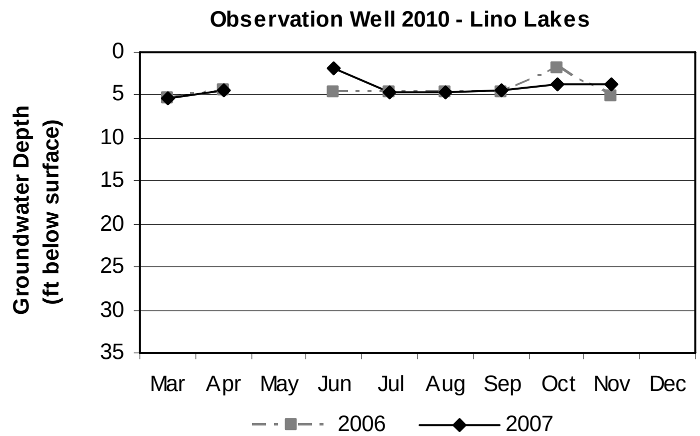
Well 2008 - Lino Lakes – 214 ft Deep



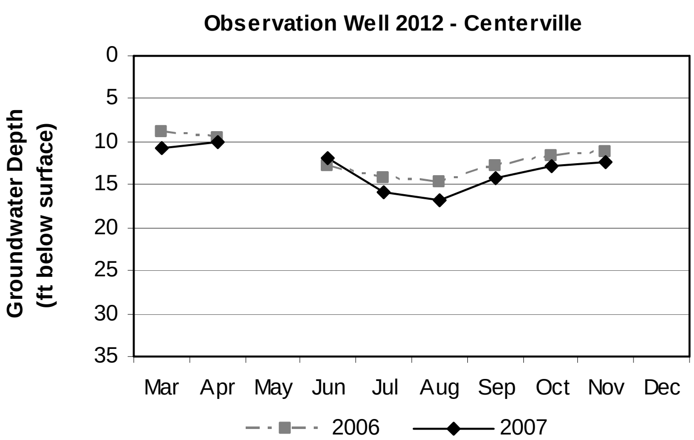
Well 2009 – Lino Lakes – 125 ft Deep



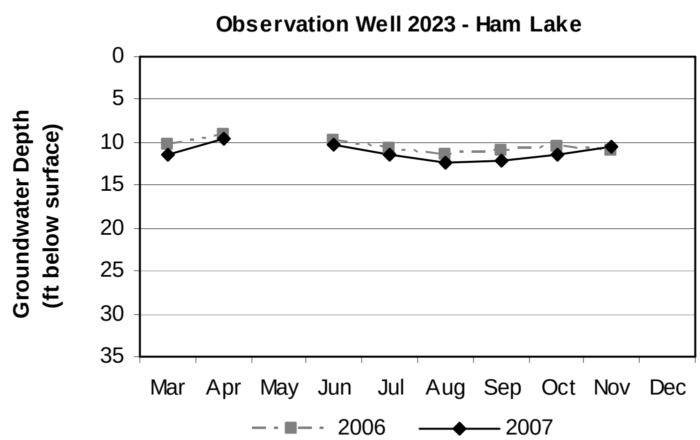
Well 2010 – Lino Lakes – 13 ft Deep



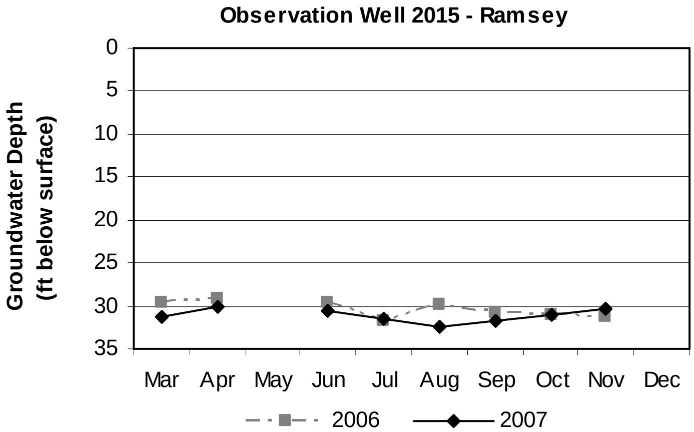
Well 2012 – Centerville – 277 ft Deep



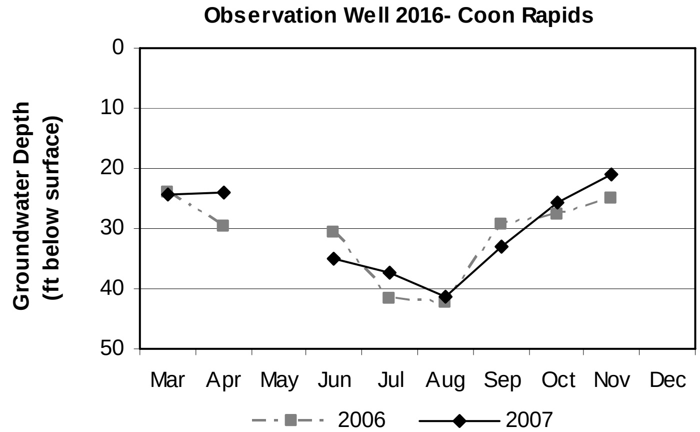
Well 2023 – Ham Lake – 21 ft Deep



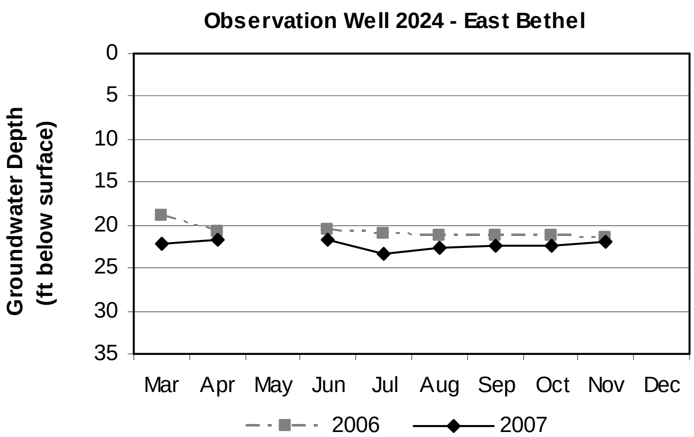
Well 2015 – Ramsey – 280 ft Deep



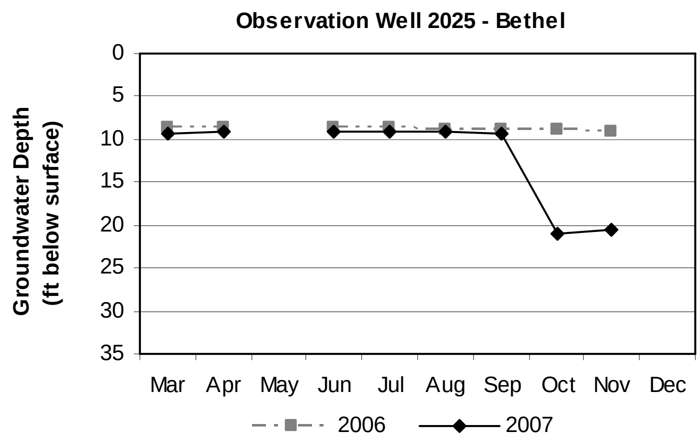
Well 2016 – Coon Rapids – 193 ft Deep



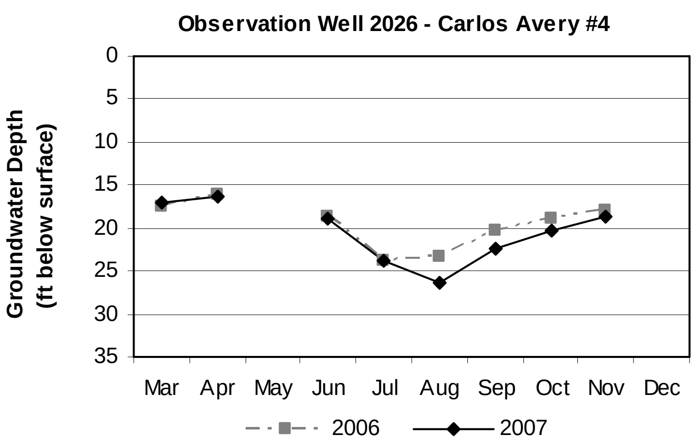
Well 2024 – East Bethel – 141 ft Deep



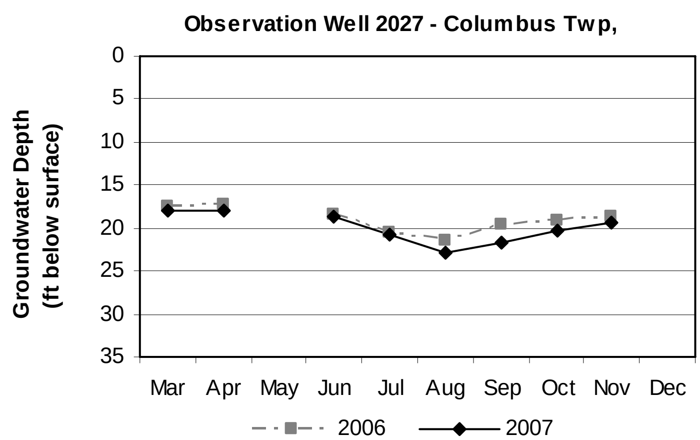
Well 2025 – Bethel – 21 ft Deep



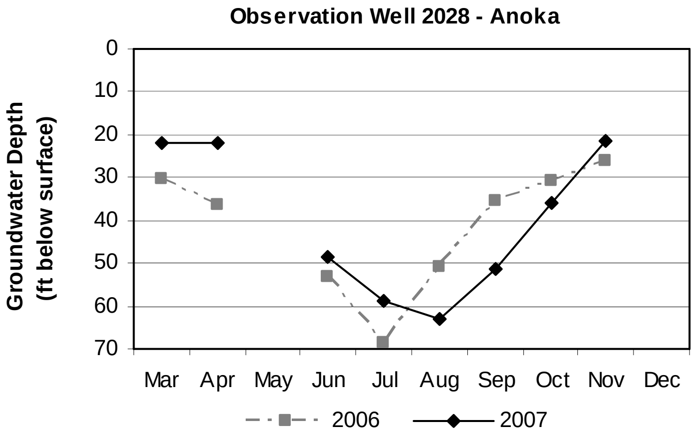
Well 2026 – Carlos Avery #4 – 150 ft Deep



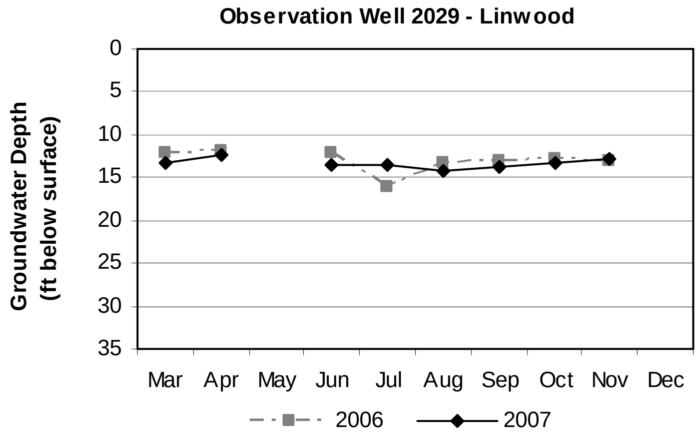
Well 2027 – Columbus Twp. – 333 ft Deep



Well 2028 – Anoka – 510 ft Deep



Well 2029 – Linwood – 221 ft Deep



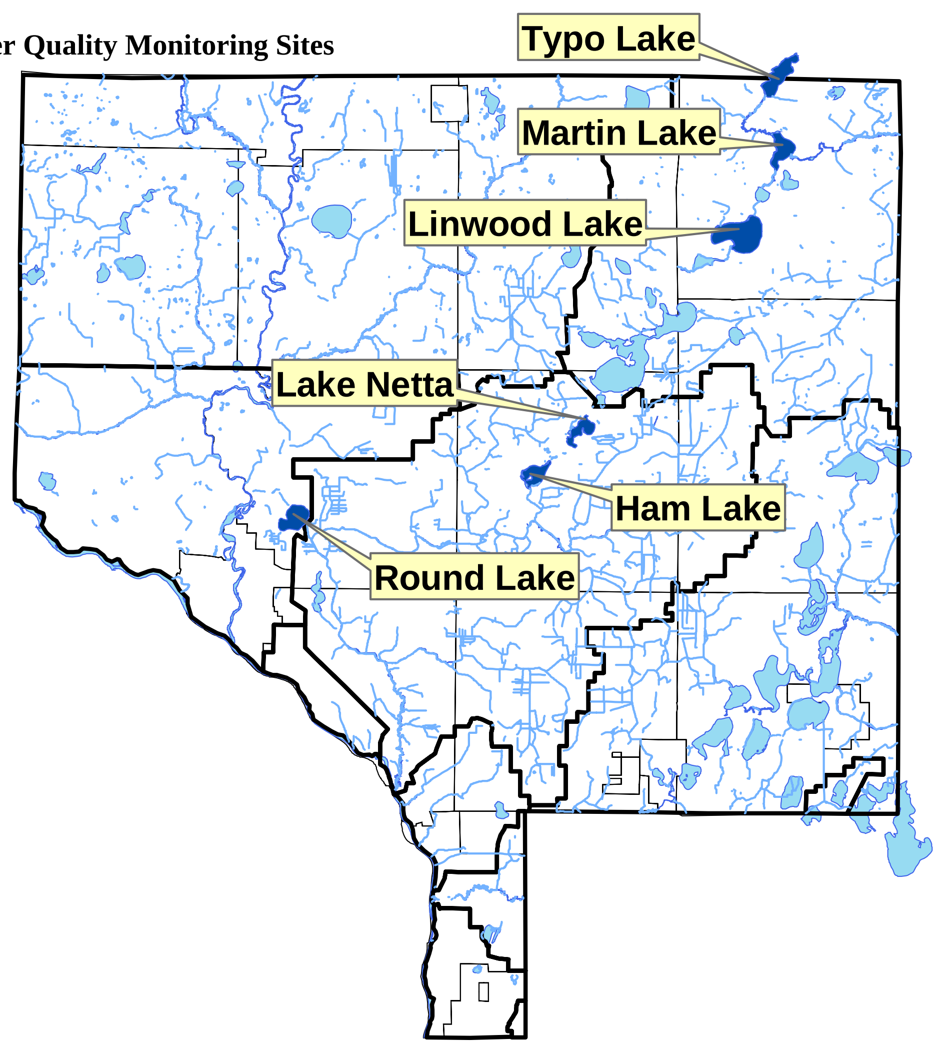
Lake Water Quality

Lake water quality monitoring began in the 1980's in Anoka County, 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 monitoring 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. Others with stable conditions and no suspected new problems are monitored less. We do not duplicate any monitoring efforts of the Minnesota Pollution Control Agency or Metropolitan Council, nor are their results presented in this report.

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

Funding for ACD's lake water quality program has come from many sources over the last five years including Natural Resources Block Grant sponsored by the Board of Water and Soil Resources (BWSR), the Anoka County Ag. Preserves Program, Coon Creek Watershed District, Rice Creek Watershed District, Sunrise River Watershed Management Organization, Lower Rum River Watershed Management Organization, Upper Rum River Watershed Management Organization, and the City of Fridley.

2007 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. pH, conductivity, turbidity, DO, salinity and temperature were 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. The laboratory provides sample bottles. 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 are 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 be 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) - Dissolved oxygen is essential to the metabolism of all aquatic organisms. The lower the DO concentration, the less likely a lake will support a wide range of organisms. 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 lake and by the decomposition processes. During the winter, the ice can restrict the supply of oxygen to the lake (limited aeration and dark conditions under snow-covered ice limiting photosynthesis). At any time of year decomposition may consume the oxygen faster than it is replenished. Low dissolved oxygen is often the reason for fish kills. Extremely low DO concentrations occurring in the bottom sediments can also trigger a chemical reaction that causes phosphorus to be released from the sediment into the water column. Elevated phosphorus levels can lead to excessive algal and plant growth that can be detrimental to water quality.

Salinity- This parameter measures the amount of dissolved salts is in the water. Dissolved salts in a lake are not naturally occurring. 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°F-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 that limits and stimulates 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 from lakeshore properties carrying fertilizer, 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. In shallow lakes, recreational activities such as power boating stir up the sediment and resuspend the nutrients in the water. Carp stir up the bottom sediment when they forage. Dissolved oxygen also has a role in controlling the release of phosphorus from the sediment. When the bottom sediments become oxygen-depleted phosphorus can be released into the water through a chemical change in iron.

Chlorophyll-a (Cl-a) - Chlorophyll-a is the inorganic portion of all green plants that absorbs the light needed for photosynthesis. This parameter is used to evaluate the concentration of algae in the water column. It does not provide a measure of large plants (macrophytes) or filamentous algae.

Lake Water Quality Monitoring Parameters

Parameter	Units	Reporting Limit	Accuracy	Average Summer Range for North Central Hardwood Forest
pH	pH units	0.1	± .05	8.6 - 8.8
Conductivity	mS/cm	.01	± 1%	.3 - .4
Turbidity	NTU	1	± 3%	1-2
D.O.	mg/L	0.01	± 0.1	N/A
Temp.	°C	1	± 0.17 °	N/A
Salinity	%	0.01	± 0.1%	N/A
T.P.	µg/l	10	NA	23 – 50
Cl-a	µg/l	0.5	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 are the inter-quartile range (25th to 75th 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 table below). It is 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

Physical Condition	Rank	Interpretation
	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, similar to grades given in school, which is based upon 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 to only 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 the average 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.

Each trophic state index is calculated monthly by a unique formula. 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, called 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.

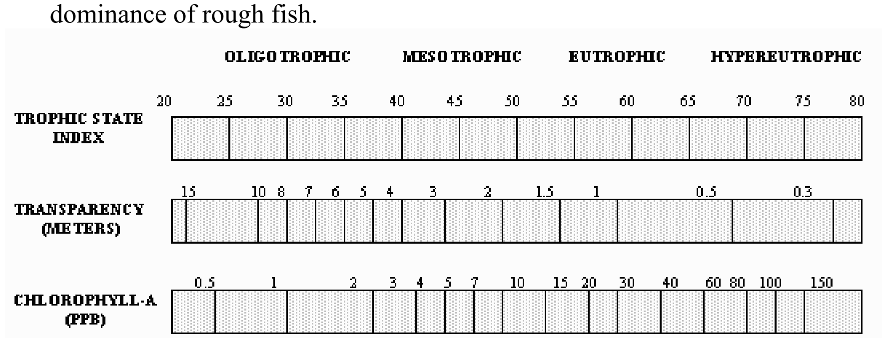
3. Eutrophic- In these lakes, the water is nutrient-rich. Productivity is high for both plants and fish. Abundant plant life, especially algae, results in poorer water clarity and can reduce the dissolved oxygen content when it decays. Algae blooms in the "dog days of summer" are commonplace. Bass and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

4. Hypereutrophic- In these lakes nutrients are extremely abundant. Algae are grossly abundant, starving all other plants of light. The poor conditions can 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 α= 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
Cenaiko																		B	A	A	A	B	A	A	A	A	A	
Coon	C				C					C					C			C	B	A	B	C	B		C		C	
Crooked				C		C				C					B	C	B	B	B		B		B	B		B	B	
E. Twin	A	B		C						B						B		A	B	A	A		A			A		
Fawn									B									A	B	A	A	A	A		A		A	
George	A	A	A		A					A					B			A	B	A	A		A			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
Hart																									D	F	F	
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			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	
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

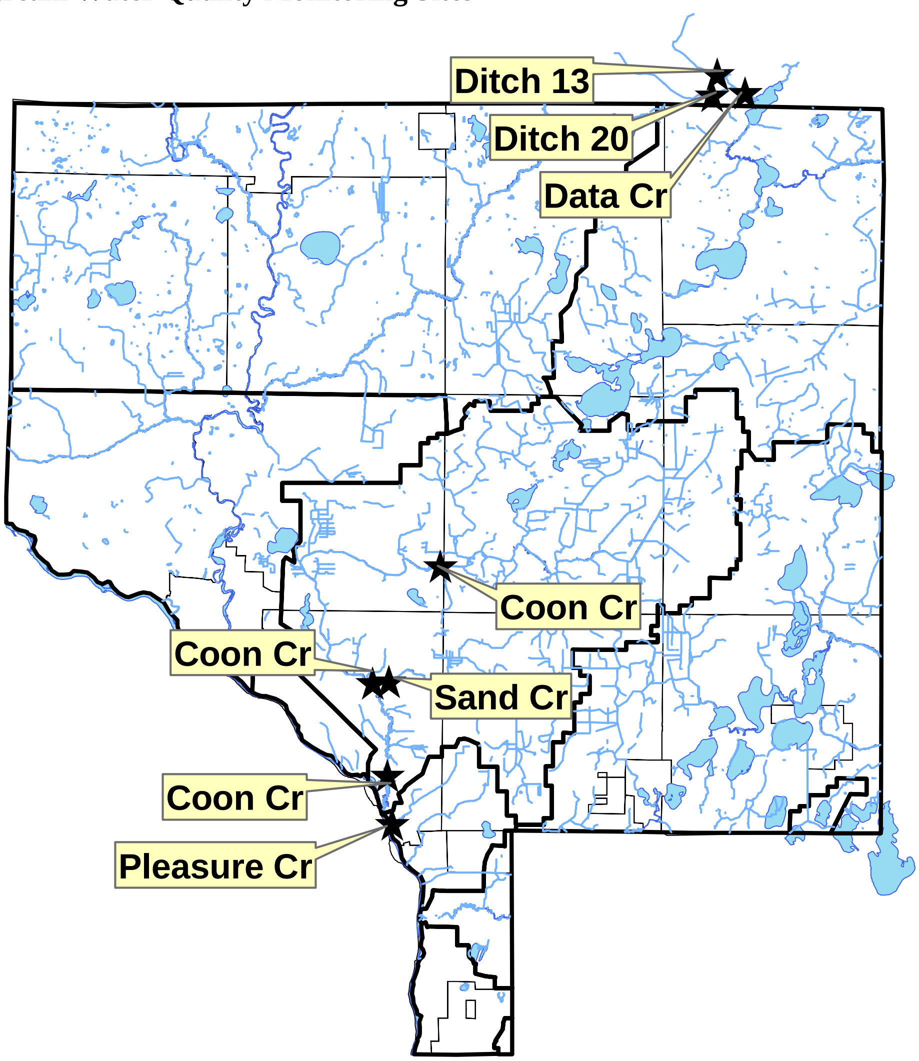
Stream Water Quality – Chemical Monitoring

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 2007 was conducted at three tributaries to Typo Lake (Ditches 13 and 20, Data Creek), three sites on Coon Creek, Sand Creek, and 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.

2007 Chemical Stream Water Quality Monitoring Sites



STREAM WATER QUALITY MONITORING METHODS

Stream water is monitored four times during base flow conditions and four during storm event flows between the months of April and September (some special studies have different sampling regimes). Grab samples are used. Grab samples are a single sample of water being collected to represent water quality for a given moment or stream condition. A composite sample is the other alternative, which consists of collecting several small samples over a period of time and mixing them. Composite samples were not taken.
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.

pH, DO, turbidity, conductivity, temperature, salinity and temperature were measured in the field using the Horiba Water Checker® U-10 multi-probe. Total phosphorus, chlorides, total suspended solids, and any others were analyzed by an independent laboratory (MVTL Labs). The laboratory provided sample bottles, complete with any necessary preservatives. These water samples were kept on ice and delivered to the laboratory within 24 hours. Stream water level is noted when the sample is taken.

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 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 be viable.

Conductivity- This is a measure of the amount of dissolved minerals in the lake. 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 column, 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 column. 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 Thresholds for Stream Water Quality Parameters

Parameter	Method Detection Limit	Reporting Limit	Analysis Method
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	Horiba U-10
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: 1. to published water quality values for the ecoregion and 2. to other streams we have monitored within Anoka County.

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.

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	
Conductivity	µmhos/cm	.389	.298	0.305
Turbidity	FNRU		7.1	
Dissolved Oxygen	mg/L	-	-	6.95
Temperature	°F		71.6	
Salinity	%		0	
Total Phosphorus	µg/L	220	130	135
Total Suspended Solids	mg/L		13.7	14
Chloride	mg/L		8	11

[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.

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.

Stream Water Quality – Biological Monitoring

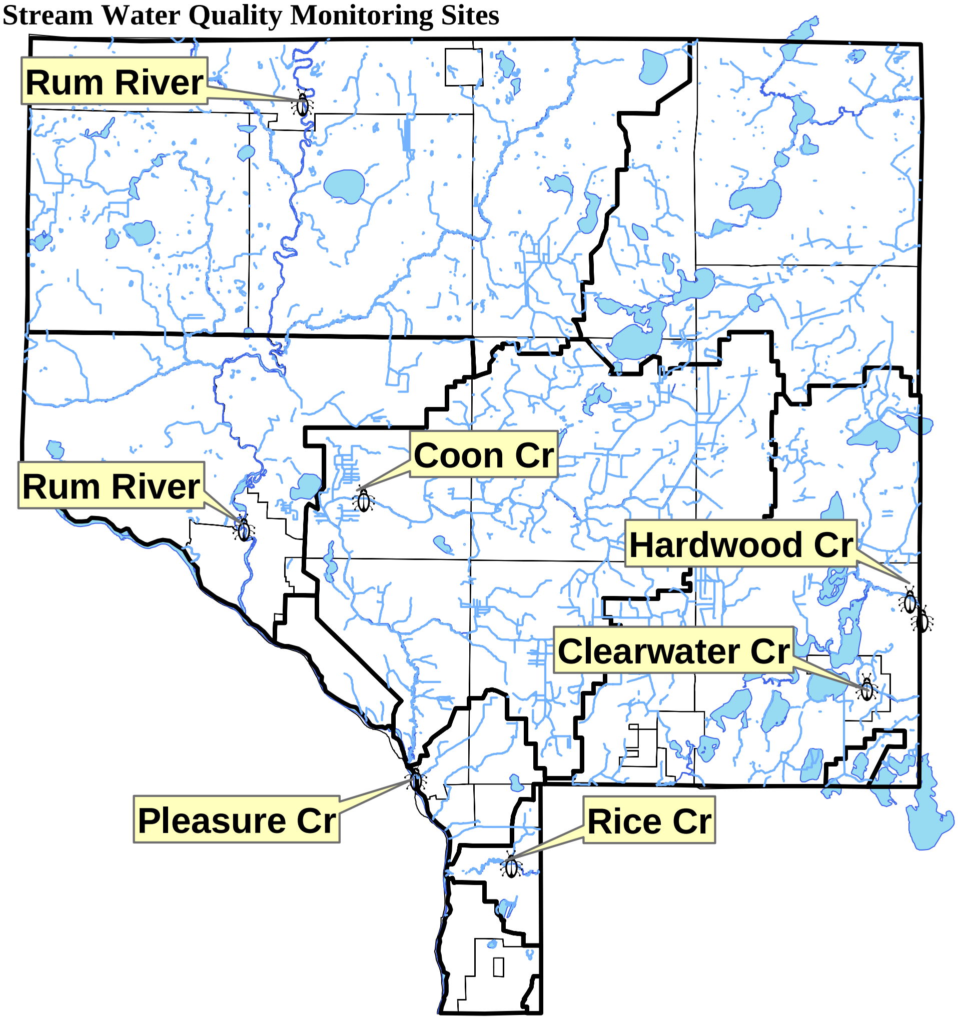
The stream biological monitoring program, often called biomonitoring, is both a stream health assessment and educational program. This biomonitoring program uses benthic (bottom dwelling) macroinvertebrates to determine stream health. Macroinvertebrates are animals without a backbone and large enough 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, they serve as good indicators of stream health.

ACD involves students in the biomonitoring, which adds an educational component to the program. High school science classes are the primary volunteers. In 2007 there were approximately 499 students from seven high schools who monitored seven sites. The students use nets to collect invertebrates from the stream using EPA protocols, identify the invertebrates, and use the resulting tallies calculate indices of stream health. The experience affords students an opportunity to learn scientific methodologies and become involved in local natural resource management.

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 reported by watershed in the following chapters.

2007 Biological Stream Water Quality Monitoring Sites



Biomonitoring Methods

ACD biomonitoring methodologies correspond with those recommended by the VSMP and are based upon US Environmental Protection Agency (EPA) protocols for monitoring low-gradient streams. The EPA protocols can be found at www.epa.gov/owow/monitoring/volunteer/stream/.

This methodology is often referred to as the "multi-habitat method." Volunteers 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. All macroinvertebrates are preserved and returned to the lab for identification to the family level. At least 100 individual macroinvertebrates must be captured for a representative sample. For sites monitored by student groups, Anoka Conservation District staff are present during fieldwork to ensure protocols are followed. All invertebrates captured are preserved in denatured alcohol.

Students take the captured invertebrates back to the classroom for identification. Identifications are done to the family level. The identified invertebrates are preserved in labeled vials. All identifications are checked by Anoka Conservation District staff before any analysis is done. Biomonitoring indices are calculated to rank stream health.

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 indice 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.

Family Biotic Index Key

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
7.26 - 10.00	Very Poor	Severe organic 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 2007 eight sites were monitored for benthic macroinvertebrates. High school classes, with ACD staff supervision, sampled all eight of these sites.

2007 Biomonitoring Sites and Groups who Monitored the Site

Monitoring Group	Stream
Andover HS	Coon Creek
Anoka HS	Rum River (near Anoka)
Blaine HS	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

Financial Summary

The Anoka Conservation District tracks all financial transactions utilizing QuickBooks accounting software. The accounts within the software are organized by program. In addition to this, ACD employees log their hours and mileage according to the same programs groups. This allows us to track all of the labor and materials expenses for a program such as our lake water quality monitoring program. The percentage of ACD resources (time and materials) that goes into each program is then calculated (e.g. 10% of total time and materials is expended on lake water quality monitoring). Overhead expenses that cannot be directly associated with any given program (rent, utilities, and office supplies) are then subdivided between programs based on the percentage of total ACD resources consumed by a given 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 following table summarizes the total costs for ACD programs covered in this report and the various funding sources. In order to make the programs cost effective for local governments, ACD staff secure funding from other sources such as state grants to match local expenditures. It is not uncommon to have as many as six funding sources for a single program.

ACD 2007 Program Financial Summary

Annual Report	Wetland Levels	Milfoil Signage	Lake Levels	Groundwater Observation Wells	Stream Levels	Shoreland Survey	Lake Water Quality	Stream Biomonitoring	Martin Lake Investigation	Stream Water Quality	Website	Precip. Monitoring	Homeowner Guide	CCWD Precip Analysis	Total
Revenues															
State	0	0	0	1,320	0	0	0	0	0	0	0	0	2,621	0	3,941
County	0	0	0	2,080	0	1,952	0	0	154	0	0	0	0	0	4,185
County Ag Preserves	2,799	0	0	0	0	0	4,021	5,795	0	0	0	0	13,400	0	26,015
BWSR General Services	0	0	0	0	0	0	0	0	0	0	4,196	0	0	0	4,196
Local Water Planning	0	135	2,581	0	2,463	605	806	0	0	1,012	0	832	0	9	8,444
WMO															
SRWMO/Martin Lake Assoc	1,575	962	500	0	2,100	0	2,730	0	0	3,171	300	0	1,360	0	12,698
URRWMO	0	0	105	0	0	2,325	0	0	0	0	300	0	0	0	2,730
LRRWMO	525	0	545	0	0	0	910	365	0	0	300	0	0	0	2,645
RCWD	1,575	0	1,350	0	0	0	0	2,190	0	0	0	0	0	0	5,115
CCWD	3,275	0	645	0	1,575	0	1,820	730	0	3,580	300	2,625	1,500	1,000	17,050
SCWMO	0	0	200	0	525	0	0	730	0	1,629	300	0	0	0	3,384
TOTAL	9,749	1,097	5,926	3,400	6,663	4,882	10,287	9,810	154	9,392	5,696	3,457	18,881	1,009	90,403
Expenses-															
Capital Outlay/Equip	979	0	145	191	199	0	143	176	11	818	109	25	48	89	2,932
Personnel Salaries/Benefits	3,816	1,119	4,786	2,643	5,432	4,498	6,082	7,813	119	3,539	3,461	3,013	15,222	674	62,218
Office Supplies/Maintenance	345	82	425	227	489	307	586	623	10	402	304	231	1,184	62	5,278
Employee Training	59	11	75	58	78	49	84	112	3	142	59	39	166	20	954
Vehicle/Mileage	75	13	87	55	102	47	119	119	3	143	63	40	200	18	1,084
Rent	167	1	249	138	227	(34)	385	203	5	440	193	59	212	50	2,293
Monthly Bills	49	2	69	38	67	(2)	107	62	1	116	53	19	78	13	672
Fees and Dues	43	1	41	48	50	4	42	50	3	191	32	10	26	21	561
Program Supplies	42	137	50	3	19	13	2,740	382	0	3,600	1,424	21	14,291	60	22,781
TOTAL	5,573	1,366	5,926	3,400	6,663	4,882	10,287	9,541	153	9,392	5,696	3,457	31,427	1,009	98,773
NET	4,176	(269)	0	(0)	(0)	0	0	269	0	0	(0)	(0)	0	0	(8,370)

In the financial table above some programs show a positive balance while others show a zero balance. In order for each program budget to balance, ACD often subsidizes a program using general funds from the County and the State in addition to the fees charged to local governments and grants secured by ACD.
Financial summaries for each watershed are found on the last page of each chapter, respectively.

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CHAPTER 2:
SUNRISE RIVER WATERSHED

Raw data and data summaries can be found at the SRWMO website – use the Data Access tool (www.AnokaNaturalResources.com/SRWMO)

Task	Partners	Page
Lake Levels	SRWMO, ACD, volunteers	2-28
Lake Water Quality	SRWMO, ACD, ACAP	2-30
Stream Hydrology	SRWMO, ACD	2-37
Stream Water Quality	SRWMO, ACD	2-42
Wetland Hydrology	SRWMO, ACD, ACAP	2-51
Water Quality Improvement Projects	SRWMO, ACD, landowner	2-55
SRWMO Website	SRWMO, ACD	2-57
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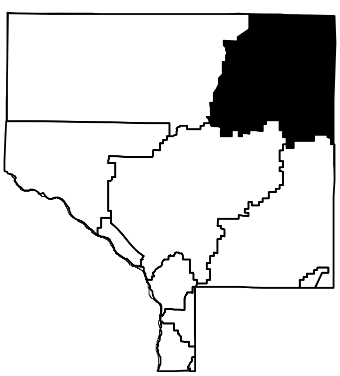
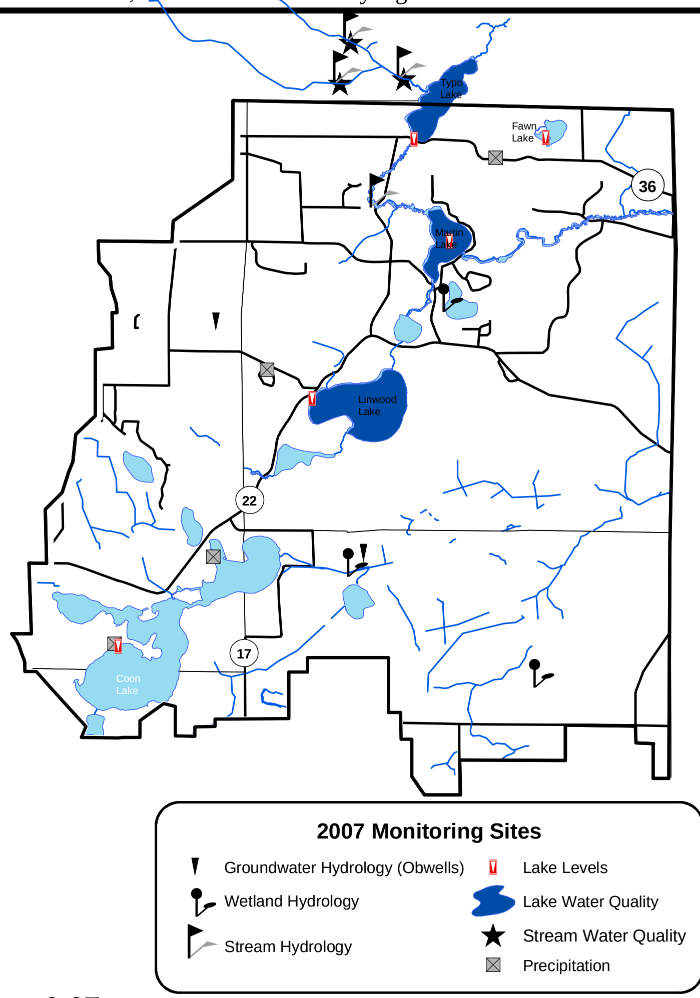
Groundwater Hydrology (obwells)	ACD, MNDNR	see Chapter 1
Precipitation	ACD, volunteers	see Chapter 1

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).

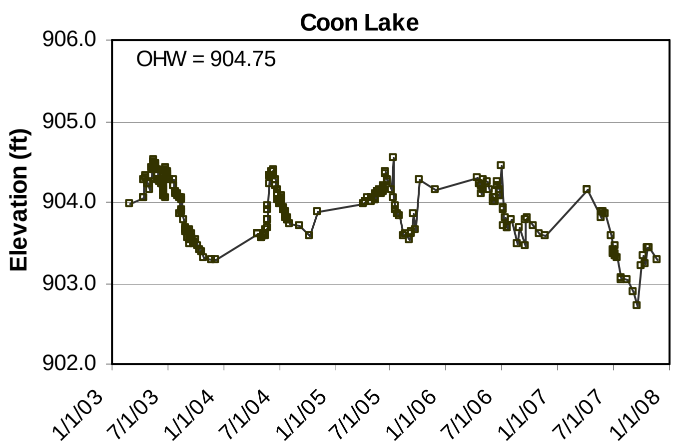
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

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

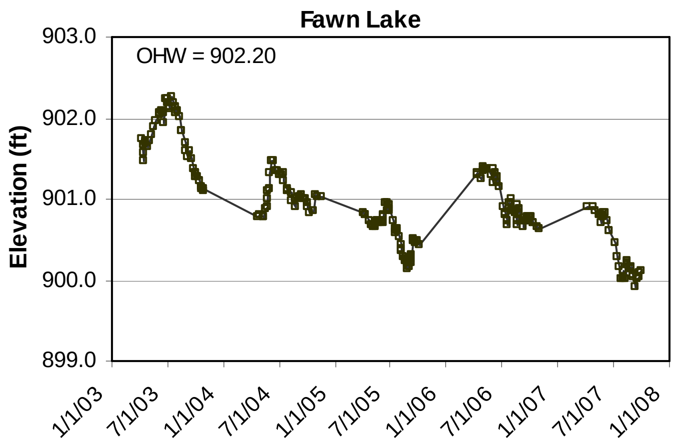
Results: Lake levels were measured by volunteers 18 to 38 times, depending upon the lake. Readings were generally taken at least weekly. Water levels on all five of these lakes followed a similar seasonal pattern. All fell continuously throughout most of the summer during drought conditions. In late summer, Martin Lake was only 0.03 feet higher than the lowest ever recorded, and Typo Lake was 0.16 higher than the lowest ever recorded. The other lakes were between 0.36 and 0.72 feet of their record lows. When the drought ended in mid-August, lake levels began to rebound.

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.

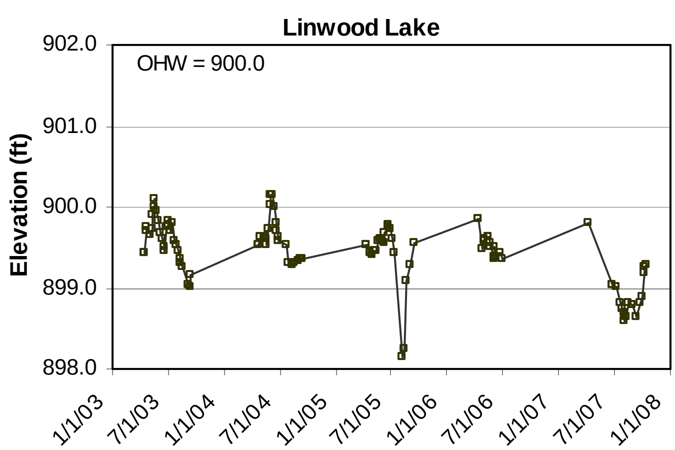
Coon Lake Levels 2003-2007



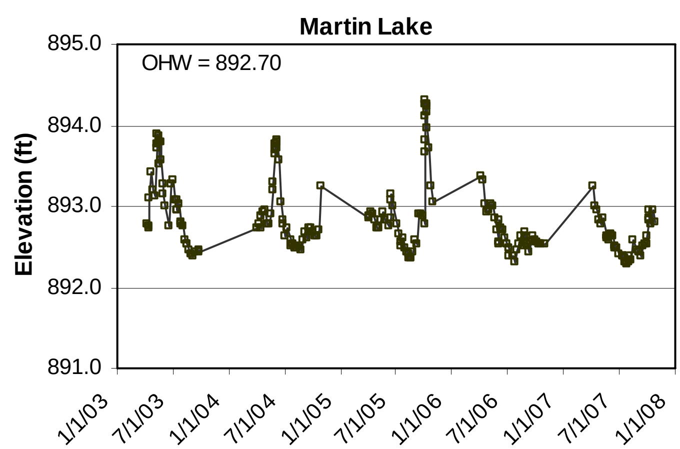
Fawn Lake Levels 2003-2007



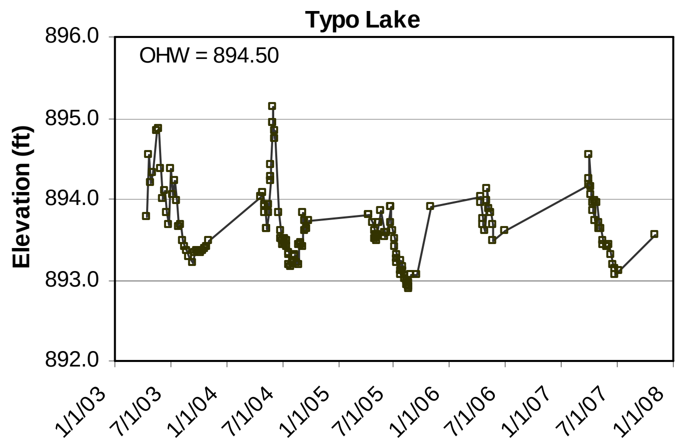
Linwood Lake Levels 2003-2007



Martin Lake Levels 2003-2007



Typo Lake Levels 2003-2007



Sunrise River Watershed Lake Levels Summary

Lake	Year	Average	Min	Max
Coon	2003	904.06	903.28	904.52
	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
Fawn	2003	901.74	901.11	902.27
	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
Linwood	2003	899.60	899.01	900.10
	2004	899.61	899.28	900.16
	2005	899.40	898.15	899.79
	2006	incomplete data		
	2007	898.94	898.60	899.81
Martin	2003	893.06	892.38	893.88
	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
Typo	2003	893.81	893.22	894.86
	2004	893.75	893.15	895.13
	2005	893.40	892.90	893.90
	2006	incomplete data		
	2007	893.67	893.06	894.54

Lake Water Quality

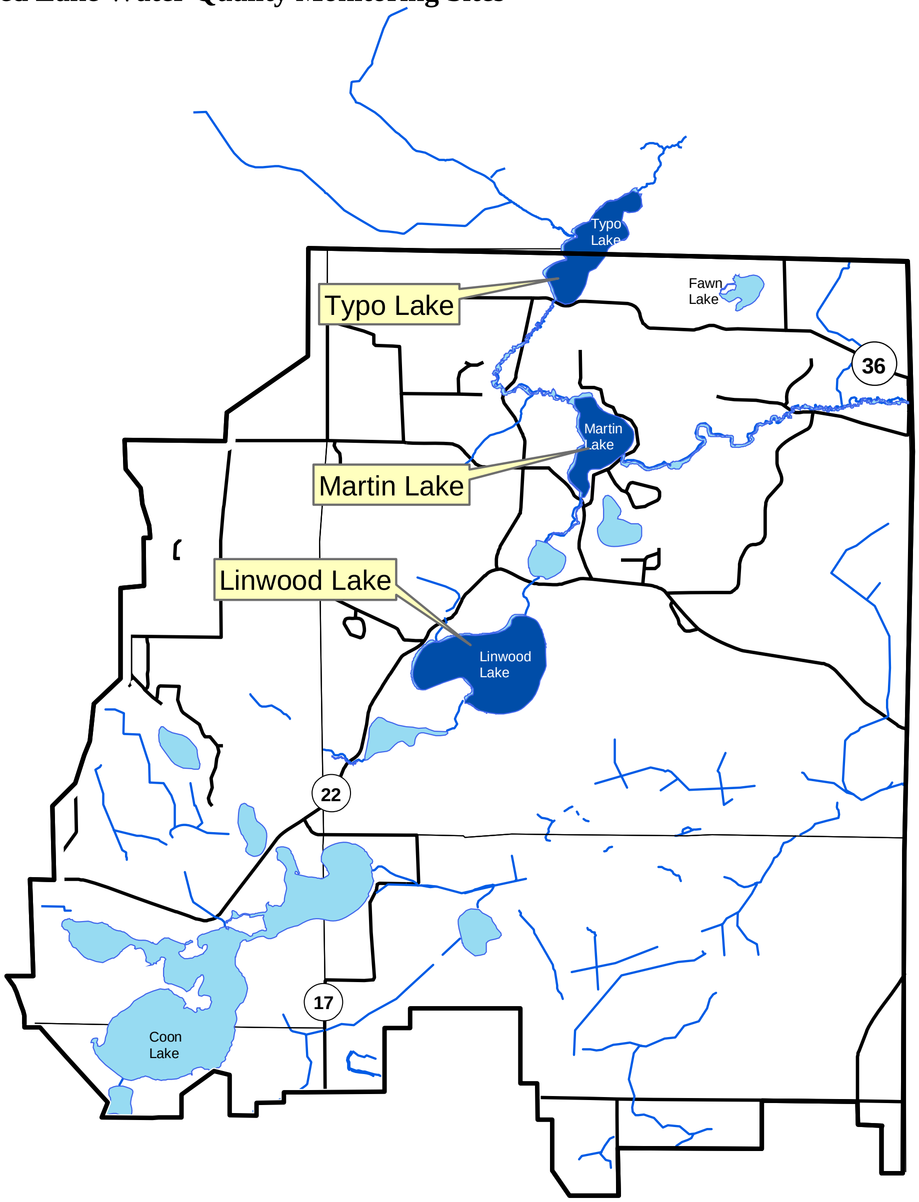
Description: May through September twice-monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

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

Locations: Linwood Lake
Martin Lake
Typo 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



Linwood Lake

Linwood Township, Lake ID # 02-0026

Background

Linwood Lake is located in the northeast portion of Anoka County. Linwood Lake has a surface area of 559 acres and maximum depth of 42 feet (12.8 m). Public access is available on the north side of the lake at Martin-Island-Linwood Regional Park, and includes a boat landing and fishing areas. The lake's shoreline is about 1/3 developed and 2/3 undeveloped. Most of the undeveloped shoreline is on the eastern shore and is part of a regional park. The lake's watershed is primarily vacant with scattered residential.

Linwood Lake is on the Minnesota Pollution Control Agency's 303(d) list of impaired waters for excess nutrients.

2007 Results

In 2007 Linwood Lake had average or slightly below average water quality for this region of the state (NCHF Ecoregion), receiving an overall C grade. The lake is slightly eutrophic. In 2007 water quality in late summer was disappointingly worse than the other most recent years. At that time of year phosphorus levels were high (maximum 77 ug/L) and a substantial algae bloom developed (maximum chlorophyll-a 51 mg/L). ACD staff's subjective observations of the lake's physical characteristics were that there was a "definite" algae presence until July when algae levels became "high." The lake went from "slightly swimming impaired" to a staff subjective assessment of "no swimming, boating ok." Still, when compared to all data over the last 10 years, it seems that the severity of the 2007 late summer algae bloom is not particularly unusual. Seven of the last 10 years have been monitored, and the maximum total phosphorus and chlorophyll-a has been higher than 2007 in two of those years.

Trend Analysis

Thirteen years of water quality data have been collected by the Metropolitan Council (1980, '81, '83, '89, '94, and'97) and the ACD (1998-2001, 2003, 2005, and 2007). Water quality has not significantly changed from 1980 to 2007 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth; $F_{2,10}=0.78$, $p=0.49$).

Discussion

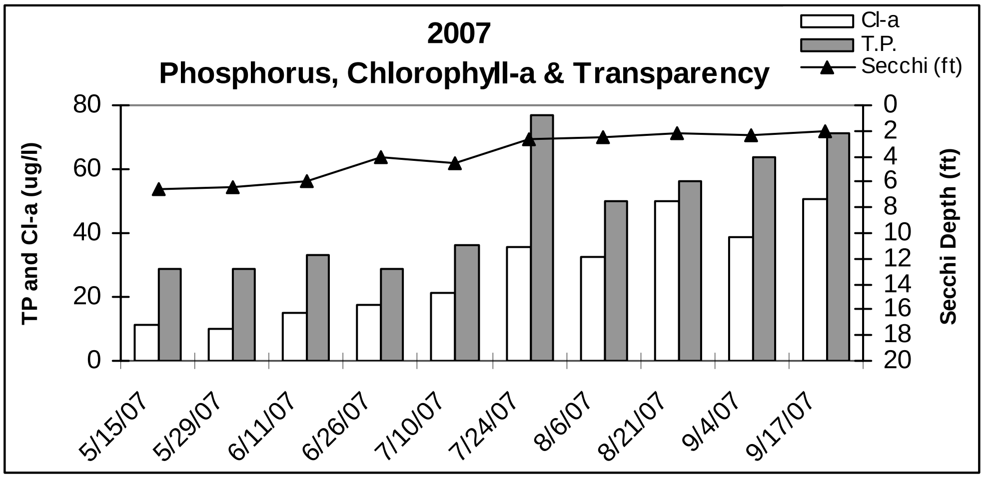
While several of the most recent years of monitoring suggested that Linwood Lake may not belong on the Minnesota Pollution Control Agency's (MPCA) list of impaired waters, 2007 reaffirmed the listing is appropriate. The threshold for listing is summertime average total phosphorus exceeding 40 ug/L, but in 2007 Linwood's was 47.4 ug/L and a substantial algae bloom persisted throughout late summer.

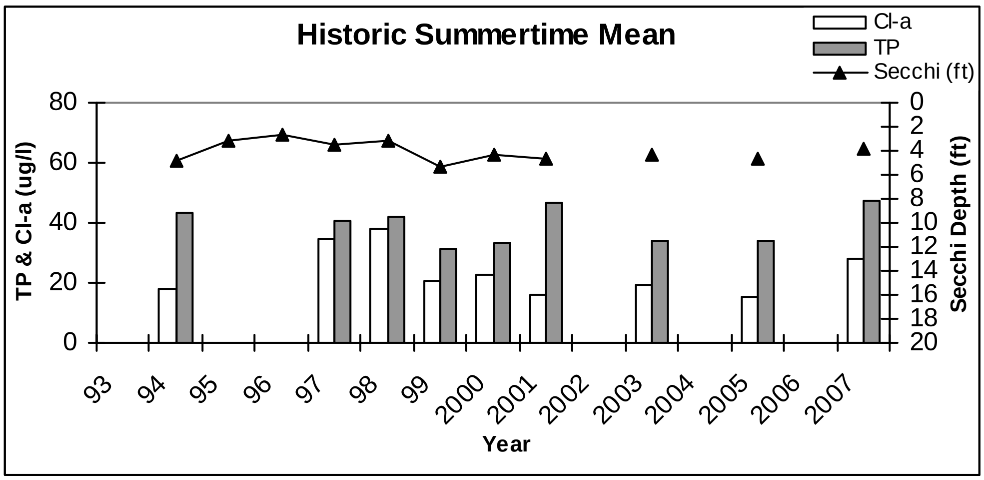
The primary inlet to Linwood Lake comes from Boot Lake, a scientific and natural area, and it is likely that this water is of high quality. It is likely that factors degrading water quality originate from the lake itself, activities within the roughly 1/3 of the shoreline that is developed, or other portions of the watershed. Threats to this lake may include rough fish , failing shoreland septic systems, poor lakeshore lawn care practices, and natural sources such as nutrient-rich lake sediments. High powered boats may be impacting water quality by disturbing sediments because the lake is large enough for these boats to get up to full speed, but is mostly shallow.

2007 Linwood Lake Water Quality Data

Linwood Lake 2007			5/15/2007	5/29/2007	6/11/2007	6/26/2007	7/10/2007	7/24/2007	8/6/2007	8/21/2007	9/4/2007	9/17/2007			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.56	8.48	9.06	8.98	na	na	na	na	9.24	8.57	8.82	8.48	9.24
Conductivity	mS/cm	0.01	0.228	0.231	0.226	0.210	0.212	0.196	0.186	0.175	0.174	0.176	0.201	0.174	0.231
Turbidity	FNRU	1	5	3	0	4	6	13	19	20	15	16	10	0	20
D.O.	mg/l	0.01	9.59	9.65	11.38	10.29	7.85	11.24	6.39	8.45	11.07	9.72	9.56	6.39	11.38
D.O.	%	1	102%	105%	133%	129%	96%	138%	76%	94%	130%	102%	110%	76%	138%
Temp.	°C	0.1	18.3	19.2	22.6	26.9	25.9	26.0	24.3	20.2	23.8	17.0	22.4	17.0	26.9
Temp.	°F	0.1	64.9	66.6	72.7	80.4	78.6	78.8	75.7	68.4	74.8	62.6	72.4	62.6	80.4
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	ug/l	0.5	11.1	10.1	15.2	17.8	21.1	35.5	32.6	50.2	38.9	50.9	28.3	10.1	50.9
T.P.	mg/l	0.010	0.029	0.029	0.033	0.029	0.036	0.077	0.050	0.056	0.064	0.071	0.047	0.029	0.077
T.P.	ug/l	10	29	29	33	29	36	77	50	56	64	71	47	29	77
Secchi	ft	0.1	6.5	6.4	6.0	4.0	4.5	2.7	2.5	2.2	2.3	2.0	3.9	2.0	6.5
Secchi	m	0.1	2.0	2.0	1.8	1.2	1.4	0.8	0.8	0.7	0.7	0.6	1.2	0.6	2.0
Field Observations															
Physical			1.5	3.0	3.0	3.0	3.0	4.0	4.0	4.5	4.0	4.0	3.4	1.5	4.5
Recreational			1.5	3.0	3.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	3.3	1.5	4.0

Linwood Lake Water Quality Results





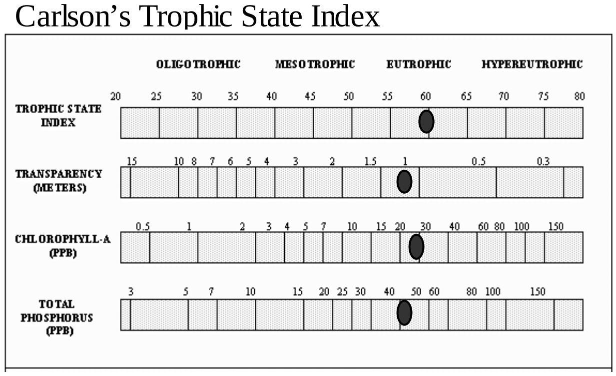
Linwood Lake Summertime Historic Mean

	CAMP	MC	MC	MC	CAMP	CAMP	MC	MC	CAMP	CAMP	MC	ACD	ACD	ACD	ACD	ACD	ACD	ACD
	75	80	81	83	85	88	89	94	95	96	97	98	99	2000	2001	2003	2005	2007
TP		30.0	28.5	40.7			64.8	43.3			40.6	41.8	31.6	33.4	46.6	34.2	34.0	47.4
Cl-a		20.0	32.0	37.9			25.1	18.3			34.4	37.8	20.4	22.4	16.1	19.4	15.3	28.3
Secchi (m)	0.64	1.30	1.70	1.20	0.82	1.17	1.12	1.45	0.96	0.82	1.06	0.85	1.62	1.57	1.39	1.32	1.4	1.2
Secchi (ft)	2.1	4.3	5.6	3.9	2.7	3.8	3.7	4.8	3.2	2.7	3.5	3.1	5.3	4.4	4.6	4.3	4.6	3.9
Carlson's Tropic State Indices																		
TSIP		53	52	58			64	58			58	58	54	54	59	55	55	60
TSIC		60	65	66			62	59			65	66	60	61	57	60	57	63
TSIS	66	56	52	57	63	58	58	55	61	63	59	62	53	55	56	56	55	57
TSI		57	57	60			62	57			61	62	56	57	57	57	56	60

Linwood Lake Water Quality Report Card

Year	75	80	81	83	85	88	89	94	95	96	97	98	99	2000	2001	2003	2005	2007
TP		A	B	C			B	A			C	C	A	A	C	C	C	C
Cl-a		A	A	A			A	A			A	A	A	A	B	B	B	C
Secchi	F	A	A	A			A	A			A	A	A	A	C	C	C	C-
Overall		**B**	**C**	**C**			**C**	**C**			**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**

Carlson's Trophic State Index



Martin Lake

Linwood Township, Lake ID # 02-0034

Background

Martin Lake is located in the northeast portion of Anoka County. Martin Lake has a surface area of 223 acres and maximum depth of 20 ft (6.1 m). Public access is available on the southern end of the lake. The lake is used moderately by recreational boaters and fishers, and would likely be used more if water quality were improved. Martin Lake is almost entirely surrounded by private residences. The 5402 acre watershed is 18% developed, with the remainder being vacant, agricultural, or wetlands. Martin is on the Minnesota Pollution Control Agency's (MPCA) list of impaired waters for excess nutrients.

2007 Results

In 2007 Martin Lake had poor water quality compared to other lakes in the North Central Hardwood Forest Ecoregion (NCHF), receiving a D letter grade. This eutrophic lake has chronically high total phosphorus and chlorophyll-a, and some of the poorest water quality in the county. 2007 had some of the worst water quality of all years monitored. Average total phosphorus (135 ug/L) was the highest of 9 years that it has been monitored and chlorophyll-a was the third worst. Secchi transparency was the second worst of 27 years that it has been monitored. Water quality was poor until late August, when it worsened. The conditions in Martin Lake were reflective of conditions in upstream Typo Lake, which drains into Martin Lake. Typo Lake has extremely severe water quality problems, and was especially bad in 2007, likely because of internal loading driven by low water conditions caused by drought.

ACD staff's subjective perceptions of the lake's physical characteristics and recreational suitability were that "high" algae made the lake unsuitable for swimming during the entire monitored period from May through September. In some other years, such as 2005, water quality was much better in spring and early summer.

Trend Analysis

Nine years of water quality data have been collected by the Minnesota Pollution Control Agency (1983), Metropolitan Council (1998), and ACD (1997, 1999-2001, 2003, 2005, 2007). Citizens monitored Secchi depths 17 other years. Anecdotal notes from DNR fisheries data indicate poor water quality back to at least 1954. A water quality change from 1983 to 2005 is detectable with statistical tests (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth; $F_{2,6}=5.69$, $p=0.04$). However, further examination of the data a mixture of changes, some indicating improvement and other indicating deterioration. In the end, it is concluded that no true trend is present. This lake needs improvement regardless.

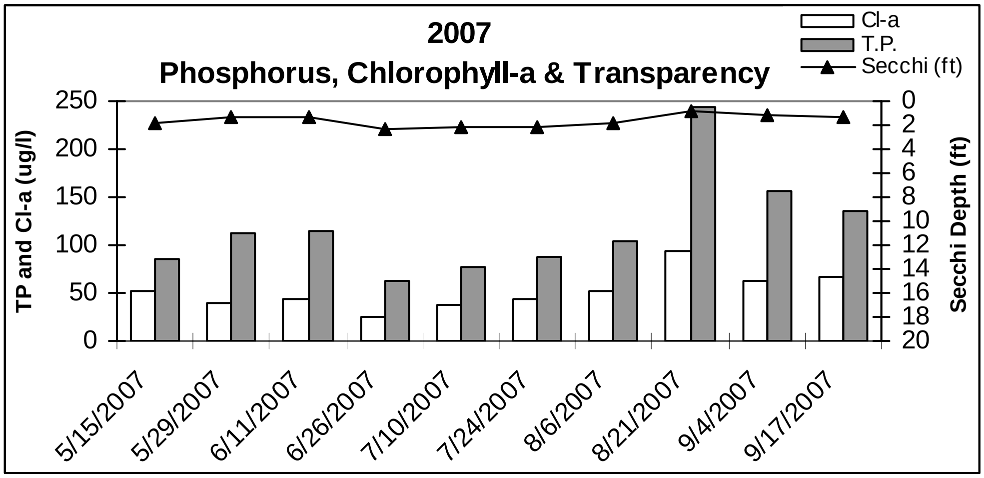
Discussion

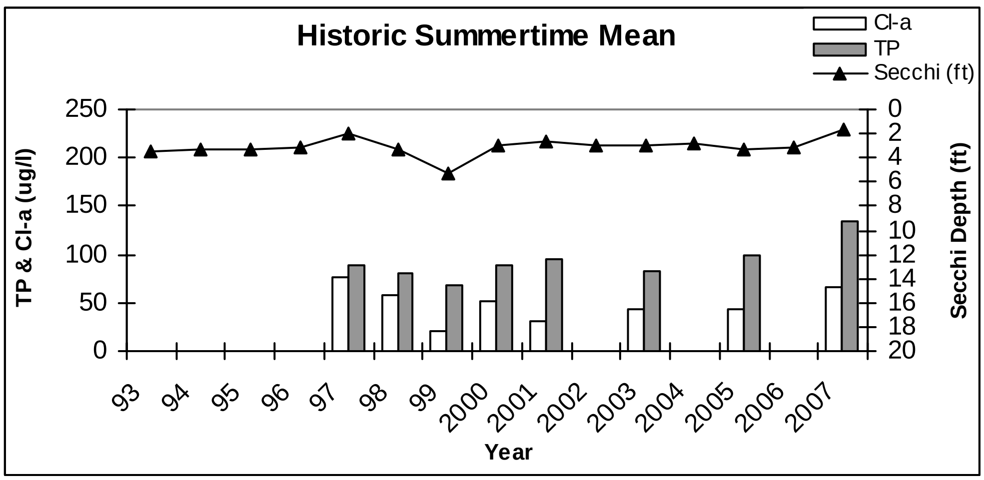
Martin Lake, along with Typo Lake upstream, were the subject of an intensive TMDL study from 2001-03 by the Anoka Conservation District. This study documented the source of nutrients to the lake, the degree to which each is impacting the lake, and put forward lake rehabilitation strategies. The study report was completed in early 2006, however it is still waiting for review and approval by the MPCA. In the meantime, the ACD and Sunrise River WMO are pursuing some lake improvement strategies recommended in the report.

2007 Martin Lake Water Quality Data

Martin Lake 2007			5/15/2007	5/29/2007	6/11/2007	6/26/2007	7/10/2007	7/24/2007	8/6/2007	8/21/2007	9/4/2007	9/17/2007			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.89	9.20	9.23	9.27	na	na	na	na	9.62	9.21	9.24	8.89	9.62
Conductivity	mS/cm	0.01	0.230	0.231	0.227	0.217	0.221	0.195	0.182	0.179	0.172	0.169	0.202	0.169	0.231
Turbidity	FNRU	1	26.00	25.00	na	10.00	14.00	20.00	33.00	55.00	35.00	30.00	28	10	55
D.O.	mg/l	0.01	9.80	10.00	10.83	9.75	8.31	13.07	7.17	6.33	13.36	10.46	9.91	6.33	13.36
D.O.	%	1	104%	107%	122%	120%	102.00	158%	86%	70%	157%	108%	1123%	70%	10200%
Temp.	°C	0.1	18.1	19.4	22.0	25.9	26.0	25.3	24.7	20.5	23.1	17.0	22.2	17.0	26.0
Temp.	°F	0.1	64.6	66.9	71.6	78.6	78.8	77.5	76.5	68.9	73.6	62.6	72.0	62.6	78.8
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	ug/l	0.5	51.9	40.1	43.5	24.8	36.8	44.2	52.0	93.0	63.3	65.8	51.5	24.8	93.0
T.P.	mg/l	0.010	0.085	0.113	0.114	0.062	0.077	0.088	0.104	0.244	0.156	0.135	0.118	0.062	0.244
T.P.	ug/l	10	85	113	114	62	77	88	104	244	156	135	118	62	244
Secchi	ft	0.1	1.9	1.4	1.4	2.4	2.1	2.2	1.9	0.8	1.1	1.4	1.7	0.8	2.4
Secchi	m	0.1	0.6	0.4	0.4	0.7	0.6	0.7	0.6	0.2	0.3	0.4	0.5	0.2	0.7
Field Observations															
Physical			4.00	4.50	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	4.5	4.0	5.0
Recreational			4.00	4.00	4.00	3.50	4.00	3.00	4.00	4.00	4.00	4.00	3.9	3.0	4.0

Martin Lake Water Quality Results





Martin Lake Summertime Historic Means

Agency	CLMP	CLMP	CLMP	MPCA	CLMP	CLMP	CLMP	CLMP	CLMP	CLMP	CLMP	CLMP	CLMP	CLMP
Year	75	76	77	83	84	85	86	87	88	89	90	91	92	93
TP				79.6										
Cl-a				75.4										
Secchi (m)	0.73	0.49	0.85	0.78	0.75	0.90	1.05	0.81	1.11	0.93	1.07	0.89	0.82	1.05
Secchi (ft)	2.4	1.6	2.8	2.6	2.5	3.0	3.4	2.7	3.6	3.1	3.5	2.9	2.7	3.4

Agency	CLMP	CLMP	CLMP	ACD	MC	ACD	ACD	ACD	CLMP	ACD	CLMP	ACD	ACD	ACD
Year	94	95	96	97	98	99	2000	2001	2002	2003	2004	2005	2006	2007
TP				88.0	80.0	61.7	89.4	95.4		81.9		100		135.0
Cl-a				77.0	58.8	18.0	52.5	31.4		43.3		44.3		65.8
Secchi (m)	1.00	1.02	0.98	0.61	0.97	1.80	0.88	0.78	0.93	0.90	0.85	1.00	0.97	0.5
Secchi (ft)	3.3	3.4	3.22	2.0	3.3	5.3	2.9	2.6	3.1	3.0	2.8	3.3	3.2	1.7

Carlson's Tropic State Indices

Year	75	76	77	83	84	85	86	87	88	89	90	91	92	93
TSIP				67										
TSIC				73										
TSIS	65	70	62	64	64	62	59	63	58	61	59	62	63	59
TSI				68										

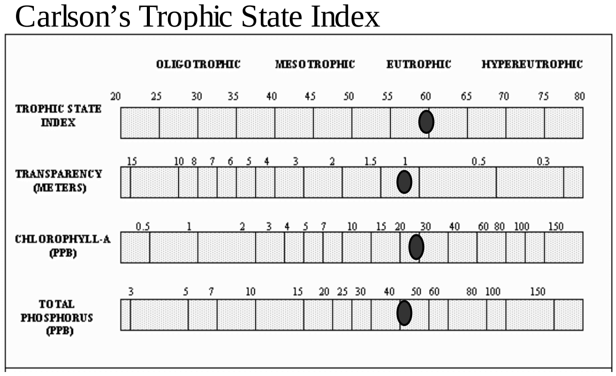
Year	94	95	96	97	98	99	2000	2001	2002	2003	2004	2005	2006	2007
TSIP				69	67	64	68	69		68		71		75
TSIC				73	71	59	67	63		68		68		72
TSIS	60	60	60	67	60	52	63	65	65	62	62	60	60	70
TSI				70	66	58	66	66		66		66		72

Martin Lake Water Quality Report Card

Year	75	76	77	83	84	85	86	87	88	89	90	91	92	93
TP				D										
Cl-a				D										
Secchi	D	F	D	D	D	D	D	D	D	D	D	D	D	D
Overall				**D**										

Year	94	95	96	97	98	99	2000	2001	2002	2003	2004	2005	2006	2007
TP				D	D	C	D	D		D		D		D
Cl-a				D	D	B	C	C		C		C		D
Secchi	D	D	D	F	D	C	D	D	D	D	D	D	D	F
Overall				**D**	**D**	**C**	**D**	**D**		**D**		**D**		**D**

Carlson's Trophic State Index



Typo Lake
Linwood Township, Lake ID # 03-0009

Background

Typo Lake is located in the northeast portion of Anoka County and the southeast portion of Isanti County. It has a surface area of 290 acres and maximum depth of 6 feet (1.82 m), though most of the lake is about 3 feet deep. The lake has a mucky, loose, and unconsolidated bottom in some areas, while other areas have a sandy bottom. Public access is at the south end of the lake along Fawn Lake Drive. The lake is used very little for fishing or recreational boating because of the shallow depth and extremely poor water quality. The lake's shoreline is mostly undeveloped, with only 21 homes within 300 feet of the lakeshore. The lake's watershed of 11,520 acres is 3% residential, 33% agricultural, 28% wetlands, with the remainder being forested or grassland. Typo Lake is on the Minnesota Pollution Control Agency's (MPCA) list of impaired waters for excess nutrients.

2007 Results

In 2007 Typo Lake had extremely poor water quality compared to other lakes in this region (NCHF Ecoregion), receiving an overall F letter grade. This is the same letter grade as the previous ten years monitored, but 2007 was the worst of all. Average total phosphorus, chlorophyll-a, and Secchi transparency were the worst ever recorded and are so extreme that they may be the worst for a lake in Minnesota. A bright white Secchi disk could be seen only 3 to 8 inches below the surface. The reason for the especially poor conditions in 2007 seems to be drought-induced low water levels. The lake's major inlet was monitored in 2007 and found to be similar to previous years or better. During drought it seems that internal loading (wind, rough fish, etc) builds nutrients and algae to very high levels because there is little flushing by storm water. Phosphorus and algae levels dropped by more than half when drought ended and ample rains fell in late August and September.

Trend Analysis

Eleven years of water quality monitoring have been conducted by the Minnesota Pollution Control Agency (1993, '94, and '95) and the Anoka Conservation District (1997-2001, 2003, 2005, 2007). Water quality has not significantly changed from 1993 to 2007 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,8}=3.74$, $p=0.07$). Minnesota DNR fisheries data has anecdotal notes of severe algae blooms back to the earliest records in 1960. Locals familiar with the lake before 1960 indicate that the lake used to have better water quality, had aquatic plants including abundant wild rice, and was heavily used by waterfowl.

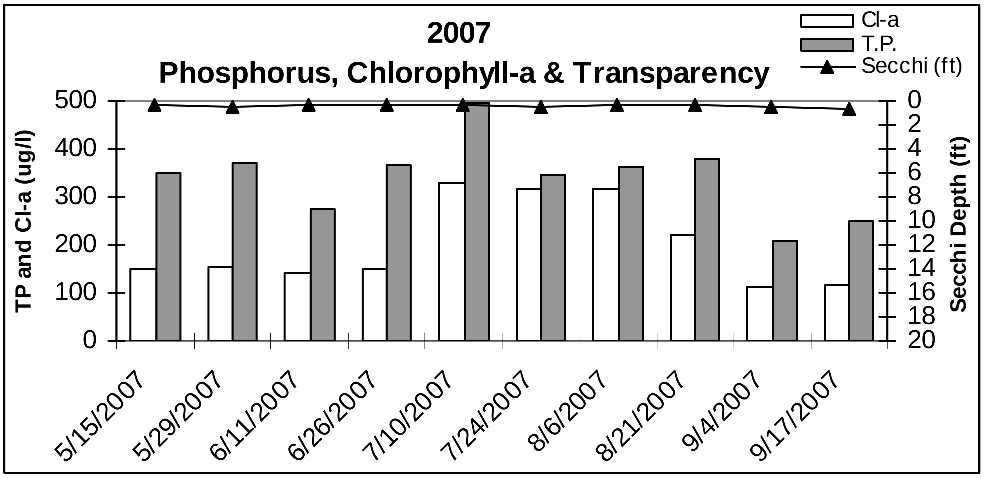
Discussion

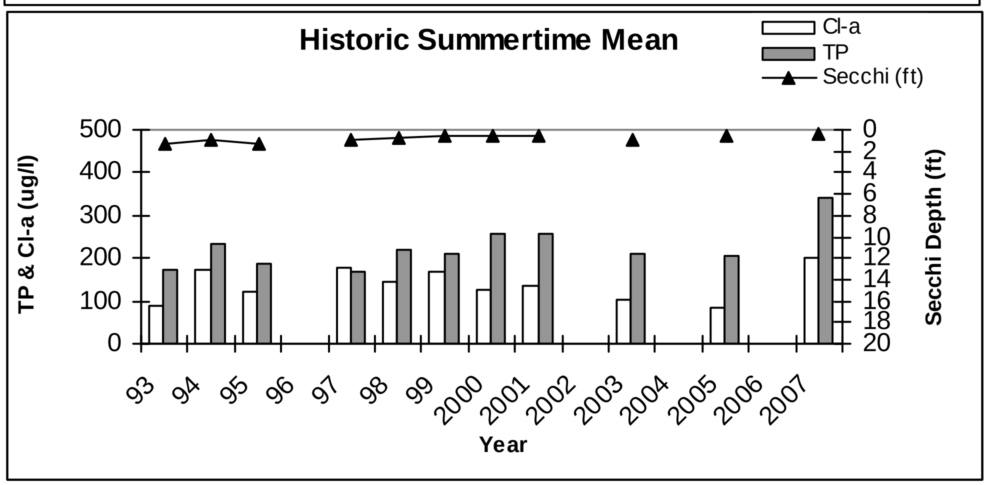
Typo Lake, along with Martin Lake downstream, were the subject of an intensive TMDL study from 2001-03 by the Anoka Conservation District. This study documented the source of nutrients to the lake, the degree to which each is impacting the lake, and put forward lake rehabilitation strategies. Some factors impacting water quality on Typo Lake include rough fish, high phosphorus inputs from a ditched wetland west of the lake, and lake sediments. The study report was completed in early 2006, however it is still waiting for review and approval by the MPCA. In the meantime, the ACD and Sunrise River WMO are pursuing some lake improvement strategies recommended in the report.

2007 Typo Lake Water Quality Data

Martin Lake 2007			5/15/2007	5/29/2007	6/11/2007	6/26/2007	7/10/2007	7/24/2007	8/6/2007	8/21/2007	9/4/2007	9/17/2007			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.52	9.06	8.55	9.57	na	na	na	na	9.39	9.35	9.07	8.52	9.57
Conductivity	mS/cm	0.01	0.236	0.243	0.256	0.212	0.188	0.185	0.177	0.156	0.170	0.187	0.201	0.156	0.256
Turbidity	FNRU	1	210.00	113.00	na	166.00	387	166	259.00	140.00	124.00	76.00	182	76	387
D.O.	mg/l	0.01	8.34	10.35	9.49	9.04	5.46	3.24	8.23	11.64	9.21	6.86	8.19	3.24	11.64
D.O.	%	1	90%	115%	98%	115%	83%	38%	94%	124%	108%	70%	94%	38%	124%
Temp.	°C	0.1	18.8	21.1	22.5	28.1	26.5	24.0	22.3	18.9	23.4	16.5	22.2	16.5	28.1
Temp.	°F	0.1	65.8	70.0	72.5	82.6	79.7	75.2	72.1	66.0	74.1	61.7	72.0	61.7	82.6
Salinity	%	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Cl-a	ug/l	0.5	149	156	142	151	328	316	318	220	112	117	200.9	112.0	328.0
T.P.	mg/l	0.010	0.351	0.371	0.276	0.368	0.496	0.345	0.363	0.379	0.208	0.248	0.341	0.208	0.496
T.P.	ug/l	10	351	371	276	368	496	345	363	379	208	248	341	208	496
Secchi	ft	0.1	0.3	0.5	0.3	0.3	0.3	0.5	0.4	0.4	0.5	0.7	0.4	0.3	0.7
Secchi	m	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.2
Field Observations															
Physical			5.00	5.00	5.00	5.00	5.0	5.0	5.00	5.00	5.00	5.00	5.0	5.0	5.0
Recreational			4.00	4.00	4.00	5.00	4.0	5.0	5.00	5.00	5.00	4.00	4.5	4.0	5.0

Typo Lake Water Quality Results





Lake Typo Summertime Historic Mean

Agency	CLMP	CLMP	MPCA	MPCA	MPCA	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	74	75	93	94	95	97	98	99	2000	2001	2003	2005	2007
TP			172.0	233.0	185.6	168.0	225.7	202.1	254.9	256.0	209.8	204	340.5
Cl-a			88.1	172.8	119.6	177.8	134.7	67.5	125.3	136.0	102.5	84.7	200.9
Secchi (m)	0.23	0.27	0.43	0.29	0.38	0.27	0.21	0.25	0.18	0.19	0.3	0.2	0.1
Secchi (ft)	0.2	0.3	1.4	1.0	1.3	0.9	0.7	0.8	0.6	0.6	0.9	0.6	0.4

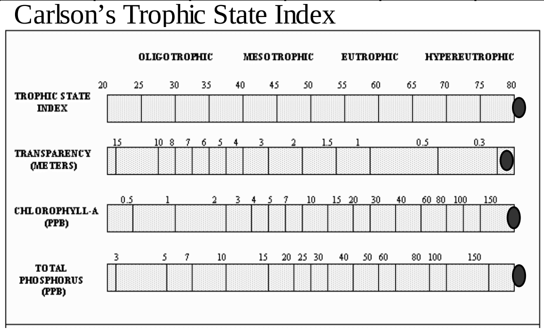
Carlson's Tropic State Indices

TSIP			78	83	79	78	82	81	83	82	81	81	88
TSIC			75	81	78	82	79	72	74	77	76	74	83
TSIS	81	79	72	78	74	79	82	80	86	85	77	83	93
TSI			75	81	77	79	81	78	81	81	78	79	88

Lake Typo Water Quality Report Card

Year	74	75	93	94	95	97	98	99	2000	2001	2003	2005	2007
TP			F	F	F	F	F	F	F	F	F	F	F
Cl-a			F	F	F	F	F	D	F	F	F	F	F
Secchi	F	F	F	F	F	F	F	F	F	F	F	F	F
Overall			**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**

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.

In 2007 these sites were chosen to compliment water quality monitoring. The purpose of this work is to determine the influence of ditched wetlands on Typo Lake water quality.

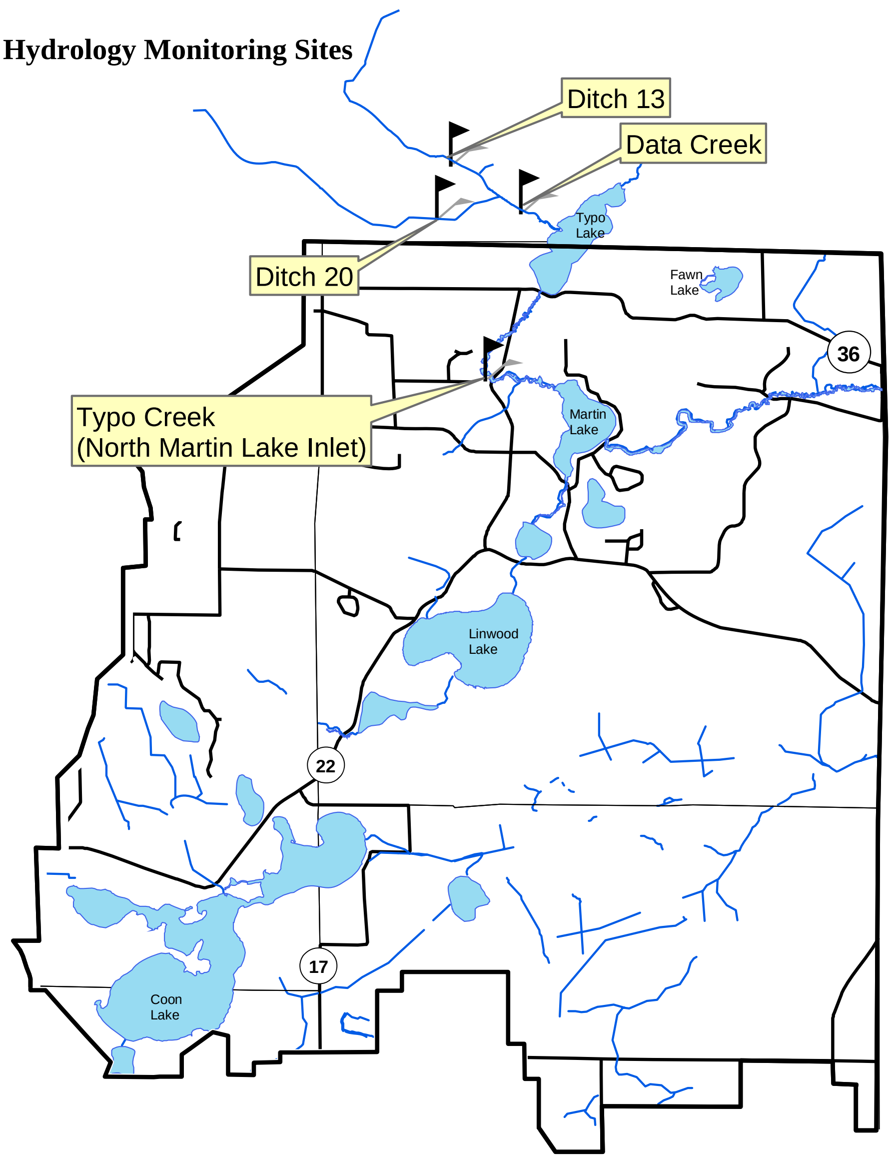
Locations: North Martin Lake Inlet (Typo Creek at Typo Creek Drive)

Data Creek (Typo Lake Inlet; aka West Branch Sunrise River)

Ditch 13

Ditch 20

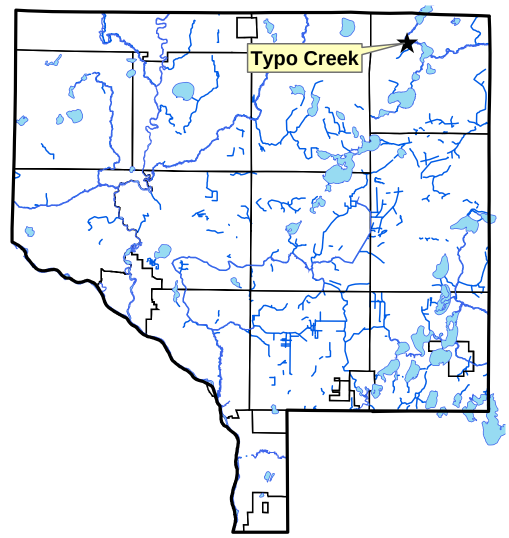
Sunrise Watershed Stream Hydrology Monitoring Sites



TYPO CREEK (NORTH MARTIN LAKE INLET)

At Typo Creek Drive, Isanti County

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:

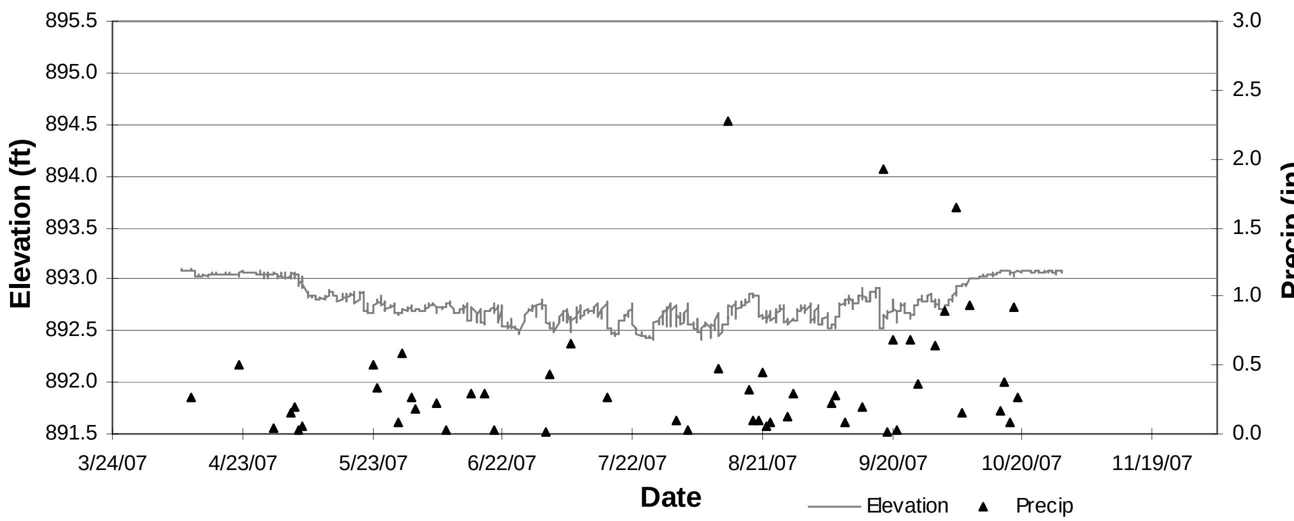
Discharge (cfs) = $3.2637*(\text{stage}-892)^2 - 6.6933*(\text{stage}-892) - 4.0004$
R^2=0.66

Summary of All Monitored Years

Percentiles	2000	2001	2002	2003	2004	2005*	2006	2007	All Years
Min	893.14	892.42	892.71	892.50	892.43	892.64	892.61	892.41	892.41
2.5%	893.18	892.45	892.89	892.55	892.47	892.67	892.72	892.47	892.49
10.0%	893.22	892.49	892.99	892.59	892.51	892.97	892.85	892.56	892.56
25.0%	893.30	892.53	893.10	892.66	892.68	893.04	892.95	892.64	892.71
Median (50%)	893.48	892.56	893.28	892.75	892.88	893.09	893.07	892.74	892.99
75.0%	893.53	892.59	893.44	893.07	893.00	893.14	893.32	892.94	892.99
90.0%	893.53	893.264	893.54	893.34	893.27	893.30	893.50	893.06	893.46
97.5%	893.55	893.628	893.69	893.75	893.84	893.33	893.55	893.07	893.68
Max	893.55	894.91	893.76	893.91	893.92	893.39	893.61	893.11	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.

2007 Hydrograph

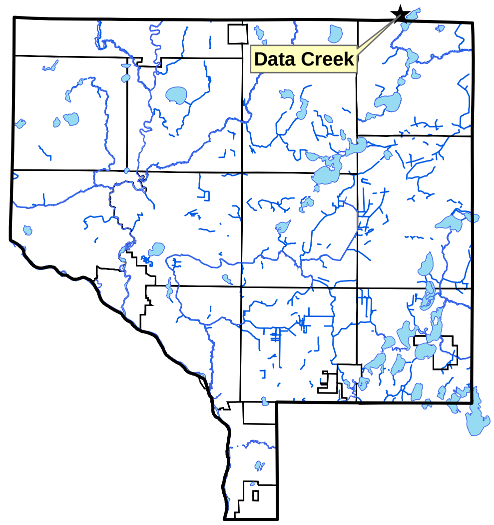


Stream Hydrology Monitoring

DATA CREEK – WEST TYPO LAKE INLET

At Typo Creek Drive, Linwood Township

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:

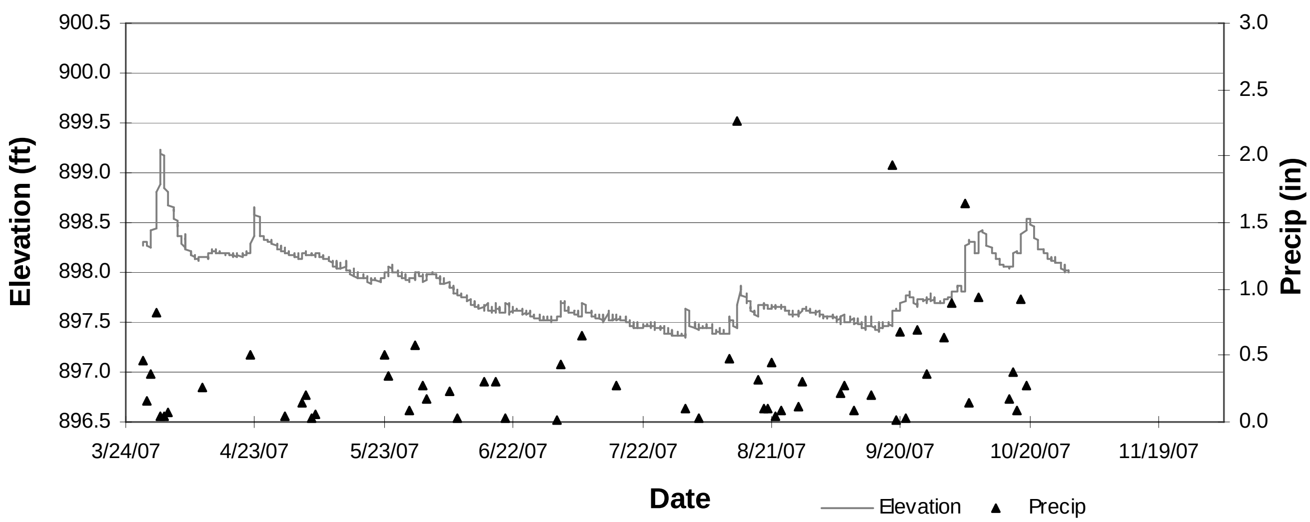
Discharge (cfs) = $2.71459*(\text{stage}-897)^2 - 4870.11*(\text{stage}-897) + 2184303$ $R^2=0.97$

Summary of All Monitored Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	All Years
Min	897.56	897.83	897.48	897.65	897.53	897.50	897.35	897.35
2.5%	897.65	897.99	897.52	897.70	897.55	897.55	897.40	897.47
10.0%	897.67	898.12	897.55	897.74	897.58	897.59	897.47	897.57
25.0%	897.70	898.28	897.64	897.83	897.67	897.65	897.57	897.69
Median (50%)	897.79	898.39	898.04	897.96	897.98	897.76	897.73	897.97
75.0%	898.14	898.55	898.36	898.14	898.09	898.03	898.16	897.97
90.0%	898.36	898.99	898.65	898.57	898.21	898.26	898.29	898.48
97.5%	898.65	899.49	899.05	898.91	898.54	898.49	898.53	898.92
Max	898.76	899.86	899.64	899.57	898.86	898.78	899.23	899.86

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

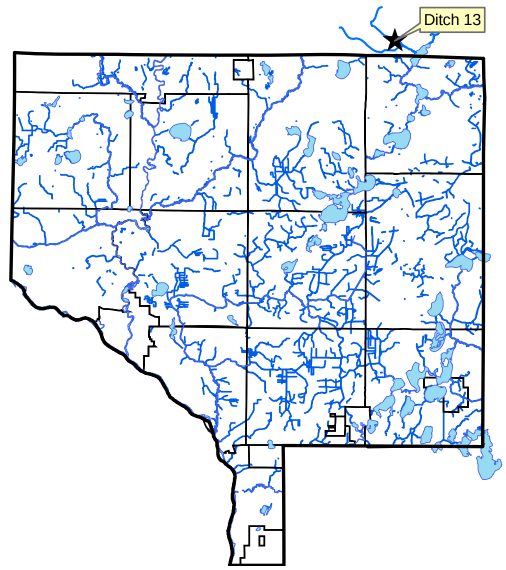
2007 Hydrograph



DITCH 13

At Isanti County Hwy 20 (253rd Ave NE), Oxford Township

Notes



Ditch 13 is one of two ditches that join to form Data Creek, just before the Creek enters Typo Lake. Data Creek accounts for about 70-75% of the water budget of Typo Lake. The majority of Data Creek's 7,673 acre watershed drains to Ditch 13. Agriculture is the dominant land use in Ditch 13's watershed. The ditch is moderate sized, typically 1-3 feet deep and 5-10 feet wide. Typical flow volumes range from one to seven cfs. Ditch 13 is of interest because of its contribution to Typo Lake, and Martin Lake further downstream, both of which are impaired waters.

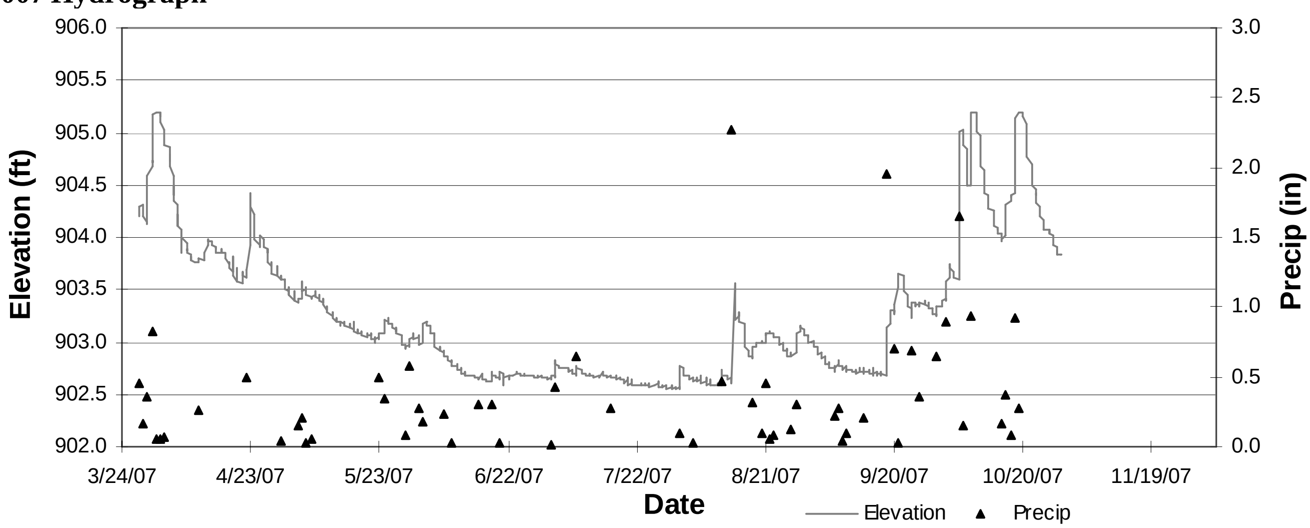
Ditch 13 water levels fluctuated 2.65 feet in 2007. It responded relatively quickly to storms with brief, high flows. For example, the ditch rose 0.46 feet within the first 4 hours of a 1.32-inch rain on October 10, but was steady or receeding within 12 hours. The exception was during the 2007 mid-summer drought when soils absorbed the small rains that fell and there was little change in stream levels after rains.

Summary of All Monitored Years

Percentiles	2007	AllYears
Min	902.55	902.55
2.5%	902.58	902.58
10.0%	902.64	902.64
25.0%	902.70	902.70
Median(50%)	903.08	903.08
75.0%	903.66	903.66
90.0%	904.31	904.31
97.5%	905.09	905.09
Max	905.20	905.20

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

2007 Hydrograph

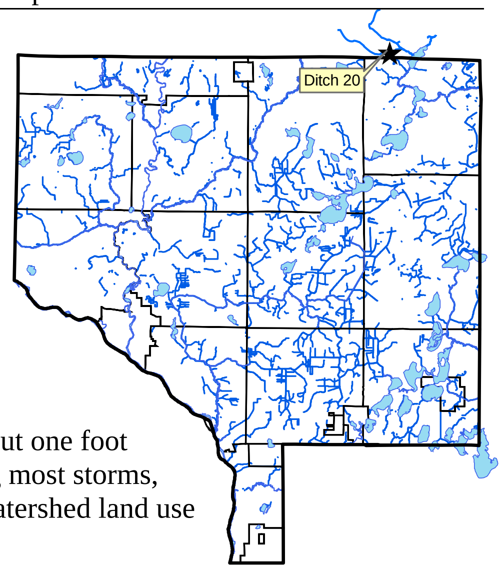


Stream Hydrology Monitoring

DITCH 20

At Mattsson Property, Oxford Township

Notes



Ditch 20 is one of two ditches that join to form Data Creek, just before the Creek enters Typo Lake. Data Creek accounts for about 70-75% of the water budget of Typo Lake. Ditch 20's watershed is small, roughly 2,000 acres, and is almost entirely peatland through which the ditch flows. The ditch is small, typically 1-2 feet deep and less than 5 feet wide. Typical flow volumes range from 0.5 to 1.5 cfs. Ditch 13 is of interest because it has been found to be a major source of phosphorus to Typo Lake, and Martin Lake further downstream, both of which are impaired waters. It appears the ditch's hydrology, combined with the surrounding peat soils are responsible for this phosphorus.

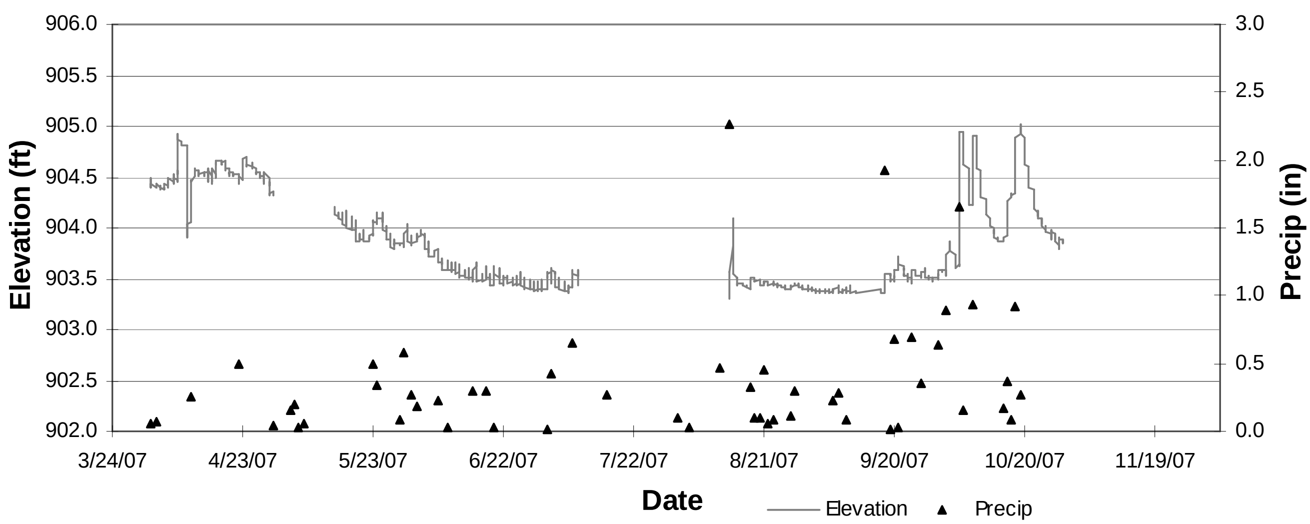
Ditch 13 water levels fluctuated 1.71 feet in 2007. Water levels were about one foot higher in spring and fall than during the mid-summer drought. Following most storms, change in ditch water levels was hardly noticeable, mostly because the watershed land use generates little runoff and soil infiltration is high.

Summary of All Monitored Years

Percentiles	2007	All Years
Min	903.31	903.31
2.5%	903.38	903.38
10.0%	903.40	903.40
25.0%	903.48	903.48
Median (50%)	903.75	903.75
75.0%	904.23	904.23
90.0%	904.56	904.56
97.5%	904.82	904.82
Max	905.02	905.02

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

2007 Hydrograph



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, and total phosphorus.

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

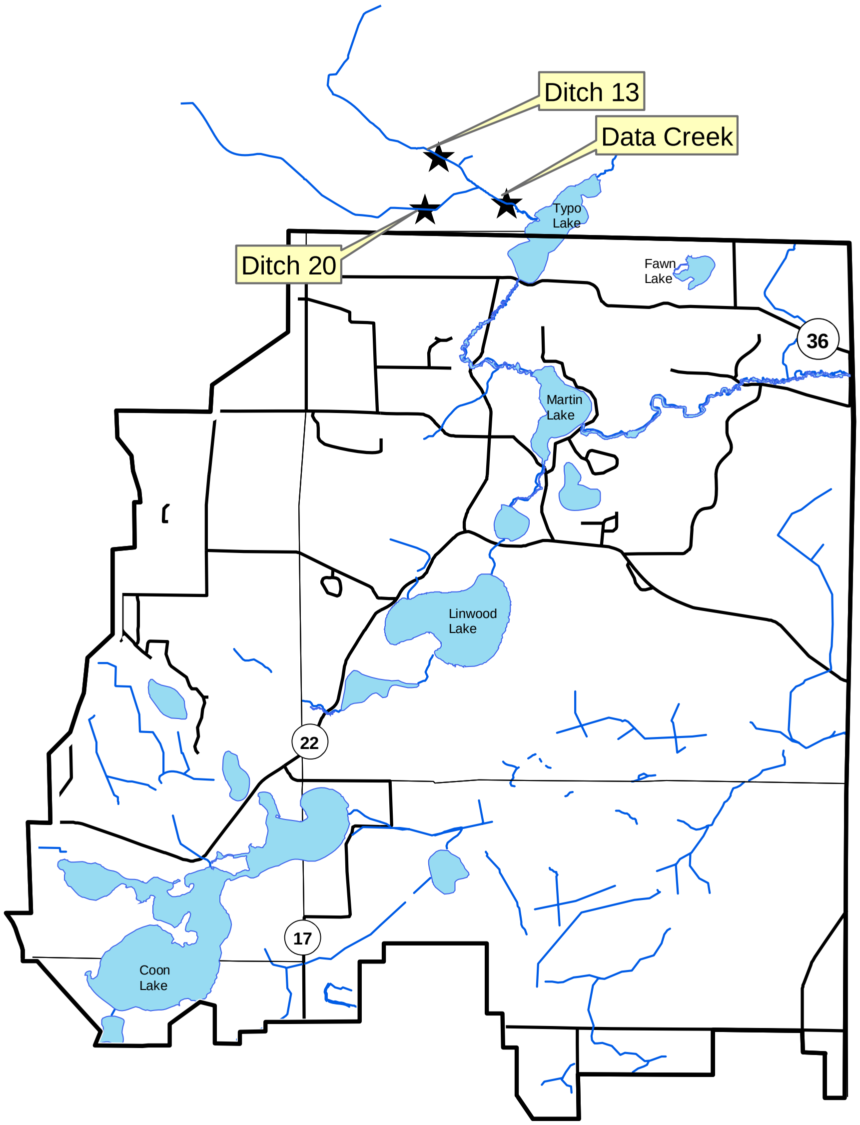
Locations: Data Creek (W. Typo Lake Inlet), Oxford Township

Ditch 13, Oxford Township

Ditch 20, Oxford Township

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

Sunrise Watershed Stream Water Quality Monitoring Sites

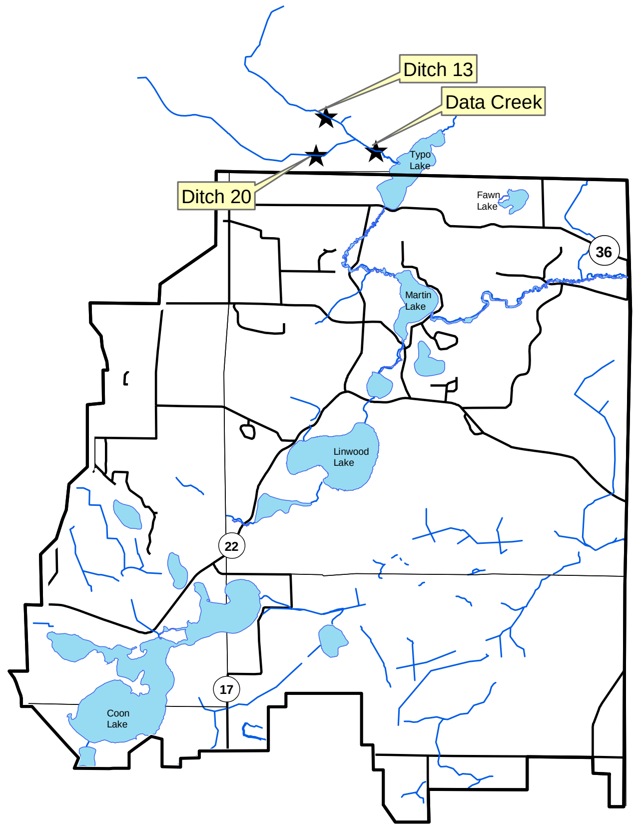


DITCHES WEST OF TYPO LAKE

Data Creek at Typo Creek Drive, Oxford Township

Ditch 13 at Highway 20, Oxford Township

Ditch 20 at Mattsson Property, Oxford Township



Background

Data Creek and its tributaries Ditch 13 and Ditch 20 have been the subject of studies since 2001. Data Creek drains to Typo Lake, which is strongly impaired by excessive amounts of phosphorus and the algae blooms that phosphorus fuels. Martin Lake, just downstream of Typo Lake, is also affected. A Total Maximum Daily Load (TMDL) study in 2001-03 found that Data Creek, and especially the Ditch 20 tributary, were the source of large amounts of phosphorus to Typo Lake. The phosphorus was coming from the peat soils around the ditch. Research from 2001-2005 suggests that the soils release this phosphorus because of alternating drying and rewetting hydrologic conditions that cause chemical and biological changes. More recent data from 2006 suggested that other mechanisms, such as soil drying also can release substantial amounts of phosphorus to the ditch under certain conditions. Textbook knowledge tells us that continuously wet conditions can cause phosphorus releases from these soils. In 2007 targeted diagnostic study was done to better understand the relative importance of these phosphorus release mechanisms and how (or if) the ditches should be managed to improve the downstream lakes.

2007 Methodology

The 2007 monitoring was designed to determine if cycles of drying and rewetting of the peat soils around Ditch 20 were causing high phosphorus, as theorized. Monitoring included water testing during “rewetting events,” which were major rainstorms after extended dry periods. These “rewetting” samples were taken 3-6 days after the storm because phosphorus release from rewetting dried soils peak 3-6 days after the storm, according to literature. Storm samples and baseflow samples were taken for comparison.

The 2007 monitoring included three phosphorus tests – total phosphorus, dissolved phosphorus, and ortho phosphorus. The relative abundance of each gives insight into the source of phosphorus. Definitions of these phosphorus tests are:

> <u>Total phosphorus</u> is all forms phosphorus, including that dissolved and attached to particles suspended in the water.
>
> <u>Dissolved phosphorus</u> measures only the dissolved portion, such that subtracting dissolved phosphorus from total phosphorus gives the phosphorus attached to suspended materials.
>
> <u>Ortho phosphorus</u> is the form most readily usable by algae and other aquatic life, and causes the most immediate water quality problems.

Water Quality Results

Assessment of Each Ditch

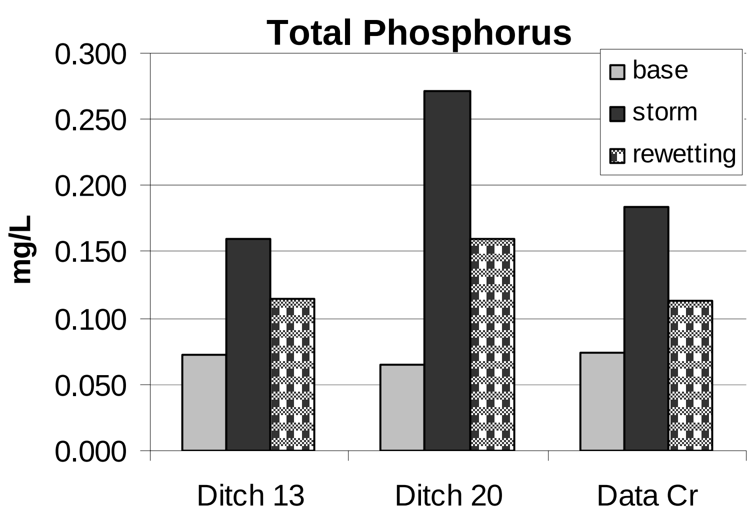
Total Phosphorus

The highest phosphorus levels were in Ditch 20, as in previous years, but this difference was only during storms and during rewetting following dry periods. Baseflow phosphorus, though only sampled once, was similar at all three sites monitored. Phosphorus was highest during storms at all three sites.

Despite having a much smaller watershed and much more benign land uses, Ditch 20 had higher total phosphorus than the other sites. Ditch 20 total phosphorus during storms (average 272 ug/L) was 70% higher than the average at Ditch 13 and 48% higher than Data Creek. Ditch 20 total phosphorus during rewetting periods (159 ug/L) was 38% higher than the average at Ditch 13 and 41% higher than Data Creek. Ditch 20 total phosphorus during the one baseflow sample (65 ug/L) was nearly the same as the other two sites, and actually a bit lower. All of the sites had low phosphorus during baseflow.

Ditch 20, but not Ditch 13, had higher phosphorus than is typical for streams in the area. The median total phosphorus for all monitored streams in Anoka County is 134 ug/L when samples from all types of weather and flows are considered. The average Ditch 13 total phosphorus (130 ug/L) was slightly lower. Ditch 20 averaged much higher (199 ug/L). Data Creek had an average in between its two tributaries, as would be expected (140 ug/L). In other years, Ditch 20 has been even worse. For example, in 2001 the average total phosphorus of eight samples was 588 ug/L, and the lowest was 462 ug/L! Climate differences from year to year seem to be responsible.

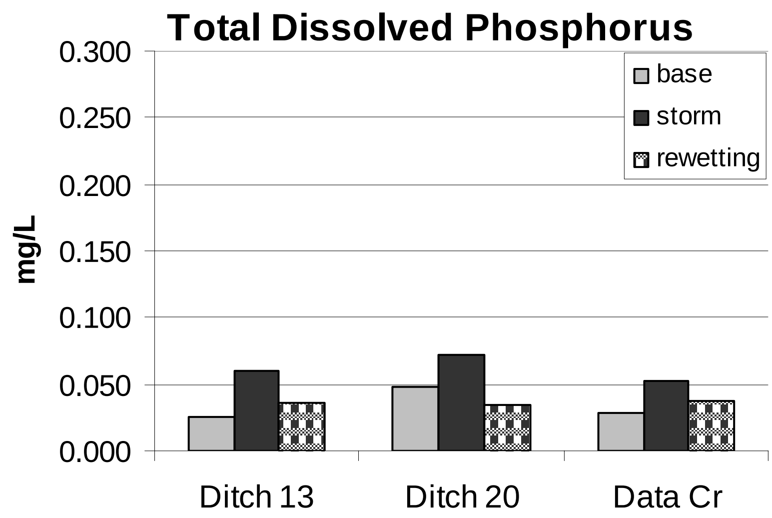
Total dissolved phosphorus at Data Creek and tributaries in 2007. (n=1 for baseflow, 4 for storms, and 4 for rewetting)



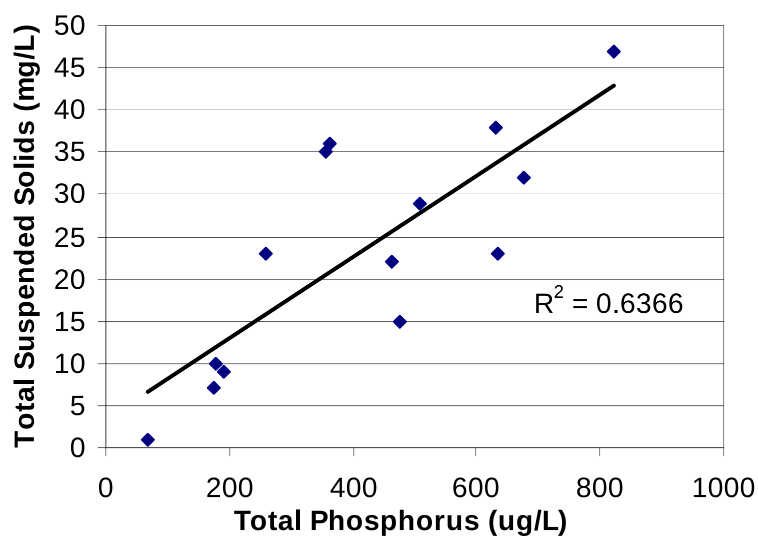
Total Dissolved Phosphorus

Most of the phosphorus at all three monitoring sites is attached to particles. Particulate phosphorus is the total phosphorus minus total dissolved phosphorus. Dissolved phosphorus is, on average, one-quarter to one-third of the total phosphorus (26%at Ditch 20, 35% at Ditch 13, and 31% at Data Creek). In other words, 65-74% of phosphorus is attached to particles. This is corroborated by the total suspended solids data - there is a positive correlation between suspended solids and total phosphorus (see figure below). Dissolved phosphorus was highest during storms at all sites.

Total dissolved phosphorus at Data Creek and tributaries in 2007. (n=1 for baseflow, 4 for storms, and 4 for rewetting)



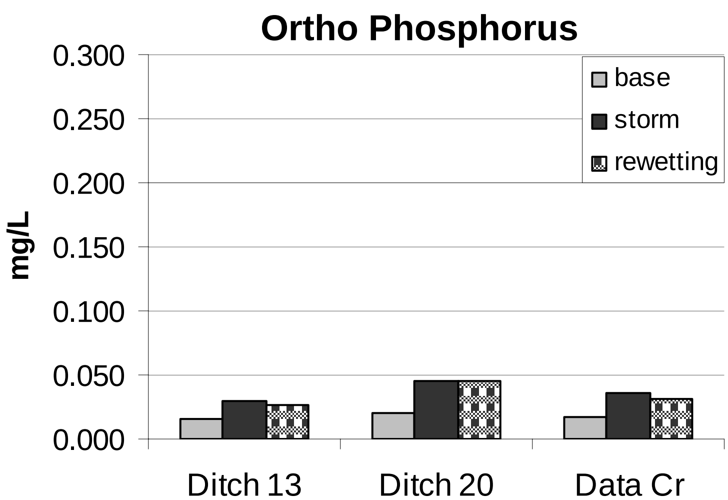
Relationship between total suspended solids and total phosphorus at Data Creek, 2001-2007.



Ortho Phosphorus

Ortho phosphorus, the form that is usable to algae, was highest in Ditch 20. It was similar to, but slightly lower than, total dissolved phosphorus on almost every occasion. At all three monitoring sites, ortho phosphorus levels were more than twice as high during storms and rewetting periods following storms than during baseflow.

Ortho Phosphorus at Data Creek and tributaries in 2007. (n=1 for baseflow, 4 for storms, and 4 for rewetting)



Evaluation of the Drying and Rewetting Theory of Phosphorus Release

Previous studies of these ditch systems theorized that Ditch 20 phosphorus was higher due to alternating drying and rewetting of the peat soils around the ditch. Peat soils contain much higher phosphorus levels than other soils because they are primarily plant material in various states of decomposition. Also, phosphorus is not held as tightly as it is in soils with higher mineral content. When soils dry or freeze soil microbes undergo osmotic shock and often rupture, releasing their phosphorus-rich contents. Most of this phosphorus is released in organic form. Rewetting of these dried soils mobilizes the phosphorus, and it is carried with subsurface water flows to the ditch. Research of this phenomena elsewhere has found that these releases peak 3 to 4 days after the rewetting, so high phosphorus levels would not be expected during storms, when monitoring is traditionally done.

Up until 2007, a number of pieces of evidence supported the theory that alternating drying and rewetting was a primary cause of phosphorus releases to Ditch 20. First, there are virtually no human phosphorus sources such as agriculture in the watershed; it’s almost entirely forest and wetland. This leaves the soil as the likely phosphorus source. Laboratory simulations found the soil is prone to phosphorus release when rewetted. The field data corroborated – total phosphorus in the ditch was correlated with rewetting periods (rainfall in the last 30 days). Lastly, alternating drying and rewetting of the soils was easy to observe underfoot during visits by staff. Yet previous monitoring all took place during baseflow or storms, and did not target the periods of rewetting, specifically 3-6 days after rainy periods following extended dryness.

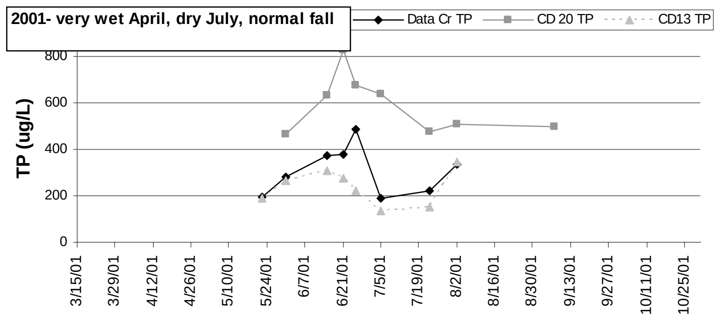
The 2007 data strongly suggests that the peat soils are the phosphorus source to Ditch 20, but show that alternating drying and rewetting is not the only mechanism causing phosphorus release from the soils into the ditch. During previous years the ditch has had high phosphorus during both storms and baseflows. The “rewetting” monitoring in 2007 found only moderate phosphorus 3-6 days after major storms that followed dry periods. Storms had higher phosphorus. Only one baseflow sample was taken in 2007, and it had very low phosphorus, perhaps because it was taken during drought. Late May and mid-August storms serve as well-monitored example of rewetting storms and how phosphorus changed in the days after the storm. Total phosphorus was high (355 ug/L and 363 ug/L) immediately after each storm, but fell in the following days to 260 ug/L for the May storm and to less than half of storm levels (136 and 174 ug/L) for the August storm. A basic tenent of the drying/rewetting theory was violated – the highest phosphorus was not a few days after the storm.

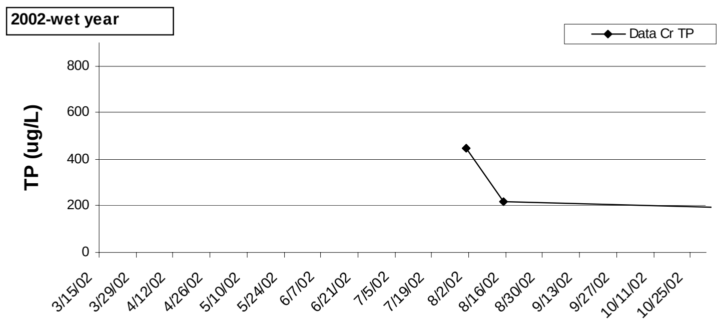
Still, the evidence that peat soils are the phosphorus source remains strong. Human pollutant sources are few in the ditch's watershed, and all are located far from the waterway. Most of the phosphorus is particulate, and it is highly likely that much of the phosphorus is attached to soil particles. Because dense vegetation exists for several hundred feet on either side of the ditch in almost all locations, these soil particles are not likely coming from erosion of the surrounding landscape. Rather, erosion of the streambank by sloughing of the organic soils is the likely source of particles causing high total suspended solids and associated phosphorus. The soil types present have small particle sizes that easily suspend in the water column.

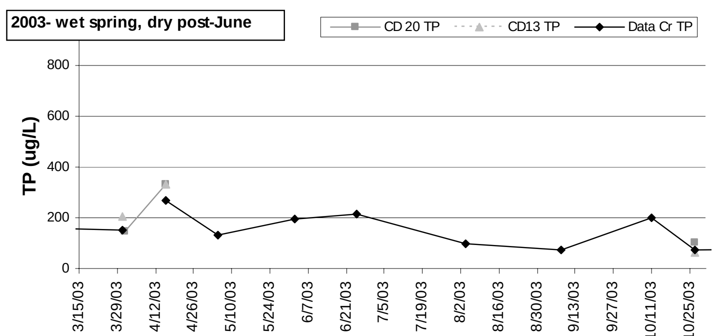
In addition to bank sloughing due to higher flows during storms, and to a lesser extent, rewetting periods, it appears that subsurface water flows through the soil profile are carrying phosphorus to the ditch. The magnitude of this phenomena is high during storms and moderate during "rewetting" periods after storms. Total, dissolved, and ortho phosphorus were all highest during storm flows, but second highest several days after storms when storm runoff had ended but the soil was still saturated and subsurface flows were high. Ditches were dug to drain the surrounding landscape, so subsurface water flow toward the ditch is expected. In many soils, phosphorus is not mobile, it is tightly bound to the soil. Yet organic soils like peat are not able to hold it as tightly and more becomes mobile. Several mechanisms make it mobile. First, drying and wetting can mobilize phosphorus, as described earlier. Second, during dry periods allow aerobic (with oxygen) decomposition of the soils (peat soil is decaying vegetation), which is much faster than decomposition in saturated conditions. Decomposition makes some of the phosphorus mobile and rewetting moves it. Third, under continuously saturated conditions iron, to which the phosphorus is bound, is changed from it's ferric to ferrous state which is not able to hold phosphorus tightly. This is a reason that extended wet periods might cause greater phosphorus. Lastly, some soils with an agricultural history export phosphorus because they are phosphorus-saturated due to past fertilization. Even though peatlands adjacent to Ditch 20 have undergone agricultural usage prior to the 1960's, most of this was hay production that requires little or no fertilization making this scenario less likely. Still, the first three mechanisms seem to be occurring.

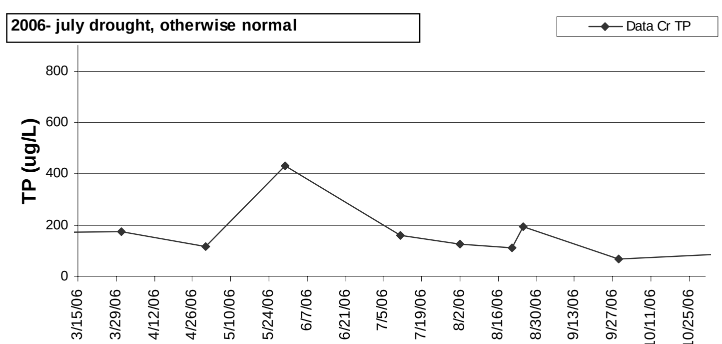
In summary, several mechanisms of phosphorus release from the peat soils are occurring. Suspended soils with its attached phosphorus from sloughing soils on the ditch bank or bottom, as well as other overland or subsurface flows is one. Subsurface flows to the ditch carrying phosphorus mobilized within the peat soils is another. Which mechanism occurs depends on climate conditions. The figures below show the wide variation in phosphorus concentrations found in different years with different weather patterns.

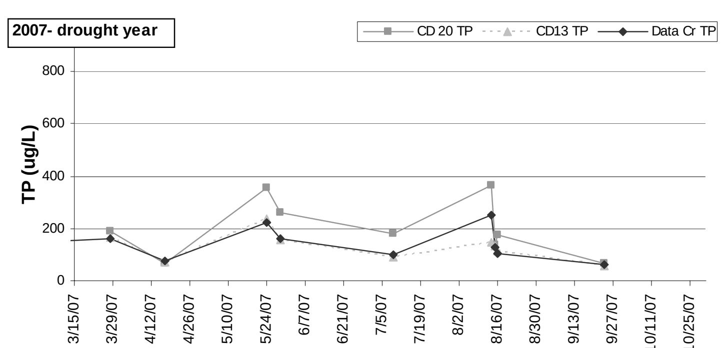
Total Phosphorus during different years and climate conditions for Data Creek, Ditch 20, and Ditch 13.











Implications for Lake Management

Ditch 20 and Data Creek deliver significant levels of phosphorus to Typo Lake, but not as much every year as previously thought. In 2001 Ditch 20 and Data Creek's phosphorus levels were very high, but in the years since it has been only moderately high. After 2001 the highest ditch phosphorus has been associated with storms, and to a lesser extent, wet periods. Phosphorus dropped when drying occurred. Yet under other climate conditions phosphorus export is very different. Storms and wet periods still had the highest phosphorus, but the magnitude was much lower.

The lake itself is a more important source of phosphorus than the ditch systems. 2007 provides a good demonstration of this. In 2007 water entering the lake through Data Creek had an average phosphorus concentration of 140ug/L, which is similar to the expectation for minimally impacted streams in his ecoregion of 130 ug/L and similar to the median of Anoka County streams of 134 ug/L. Despite this relatively good stream water quality, Typo Lake water quality was terrible. Average total phosphorus, chlorophyll-a, and Secchi transparency were the worst ever recorded for any Anoka County lake. A bright white Secchi disk could be seen only 3 to 8 inches below the surface. The reason for the especially poor conditions in 2007, despite good quality water coming into the lake, seems to be drought-induced low water levels. Mixing by wind and rough fish was able to deteriorate lake water quality. Incoming water volumes to the lake were too small to dilute or flush these negative forces. Even in years with average lake water quality, the lake water quality is worse than Data Creek so Data Creek provides some dilution effect.

Data Creek nonetheless has short and long term negative effects on Typo Lake. In the short term, ortho phosphorus that enters the lake can fuel immediate algae growth. Ortho phosphorus is the form of phosphorus immediately usable by algae. Also in the short term, suspended solids in creek water adds to the lake's non-algal turbidity. In the long term, the large percentage of phosphorus that is attached to particles will accumulate in the lake, creating a large reservoir of the nutrient which will be cycled through the lake system. Over time, portions of it will be converted to forms of phosphorus usable by algae.

The implication of this for Typo Lake and Martin Lake management is that processes in Typo Lake that cause internal loading of phosphorus should be the top management priority. Ditch 20 and Data Creek's phosphorus export is of secondary concern. However, in order for any efforts to improve the lakes to be successful, both need to be addressed.

Recommended Ditch Management Strategies

Previously, water control structures along Ditch 20 and Data Creek were considered. The goal of these would be to maintain stable water levels in the peatlands such that phosphorus release by alternating drying and rewetting of the soils would be minimized. New data suggests that this mechanism of phosphorus release is not as dominant as previously thought. Additionally, this management technique had a risk – continuously saturated conditions can lead to a new kind of phosphorus release when ferric iron that binds phosphorus is reduced to the ferrous form which cannot bind phosphorus well. Water control structures of this type are no longer recommended because the phosphorus release mechanism it is designed to treat is not dominant and because of the risk of creating a new mechanism of phosphorus release.

Still, ditches are a problem because they serve as a conveyor of phosphorus out of the peatlands. Historically phosphorus would have been trapped in the wetland. The ditch delivers it directly to Typo Lake. Because of development and land uses, plugging the entire ditch is not a reasonable solution. However, plugging certain lateral ditches might be practical. The lateral ditches near Typo Creek Drive, some of which are on state land, should be examined. Plugging these would reduce the peatland area that is drained.

Ditch 20 cleaning is not recommended. While ditch cleaning (re-excavation to the original profile) might minimize the duration of wet periods in the peatlands when phosphorus can be carried by subsurface flows to the ditches, it has a negative side. Cleaning would likely enlarge the peatland area drained by the ditch. It would also increase flow volumes such that the water would have more erosive force during storms and would be able to keep larger materials suspended in the water. Maintenance of Ditch 20 should be intentionally neglected.

A settling basin for suspended materials carried by Data Creek would be beneficial since most of the phosphorus delivered to Typo Lake is attached to solid particles. The basin would need a large capacity to capture and hold storm and post-storm flows, which have the highest phosphorus and suspended solids. However, the flat topography and wetland soils may make this difficult.

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: Carlos Avery Reference Wetland, Carlos Avery Wildlife Management Area, Columbus Township

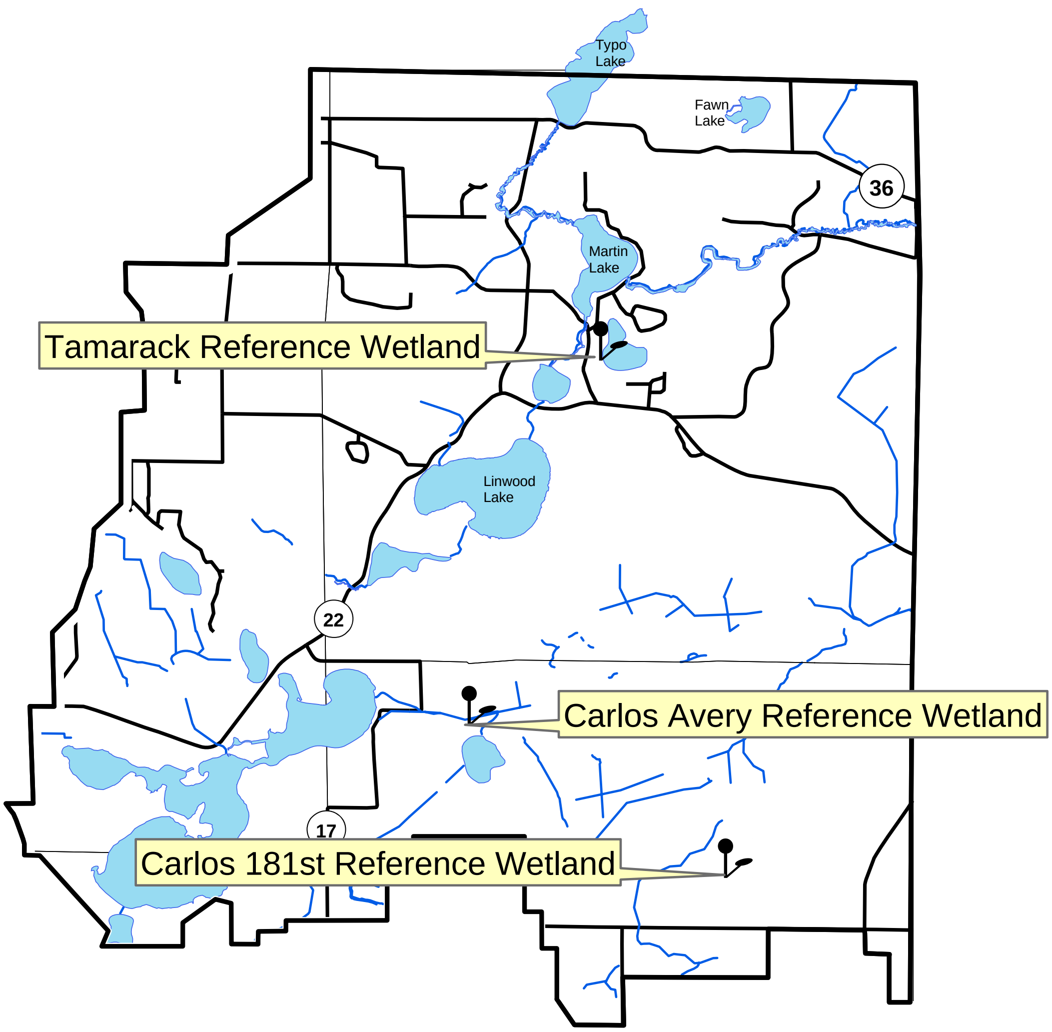
Carlos 181st Reference Wetland, Carlos Avery Wildlife Management Area, Columbus Township

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.

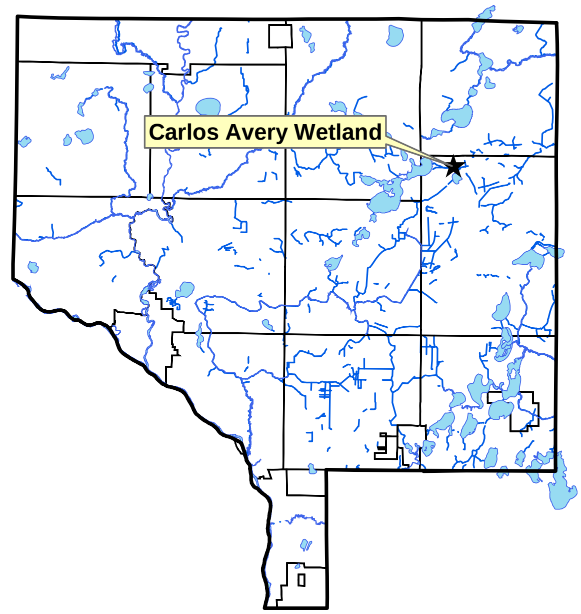
In the graphs, note that well depths were 40 inches, so when a graph stabilizes at a reading of–40, water levels were at or deeper than 40 inches.

Sunrise Watershed Wetland Hydrology Monitoring Sites



CARLOS AVERY REFERENCE WETLAND

Carlos Avery Wildlife Management Area, Columbus Township



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

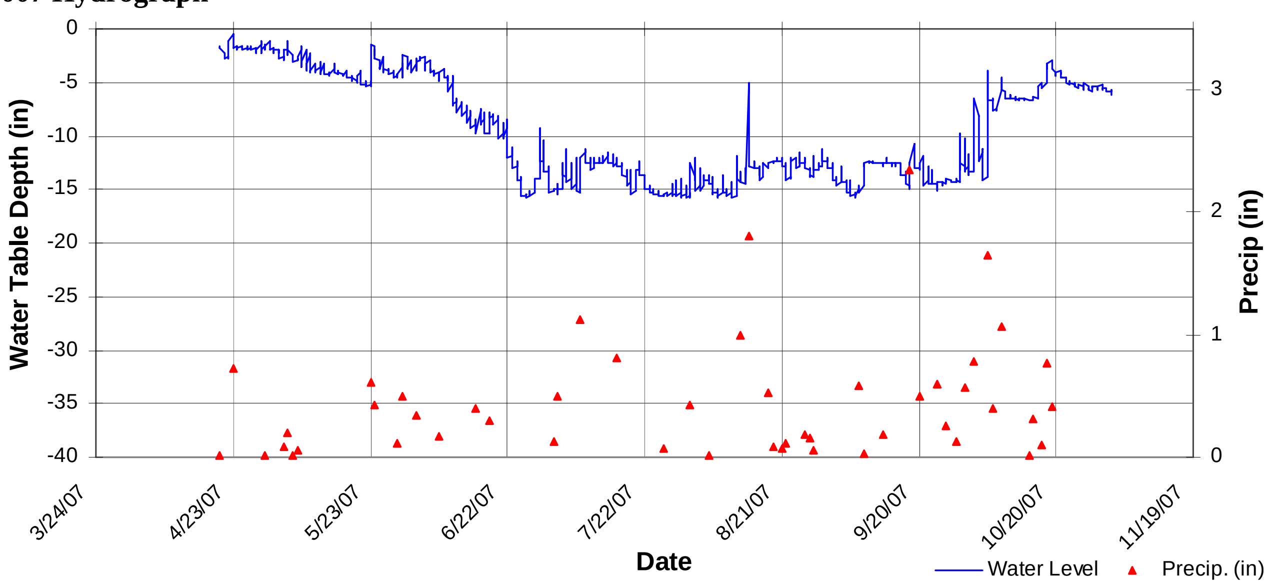
Surrounding Soils: Lino loamy fine sand

Vegetation at Well Location:

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

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

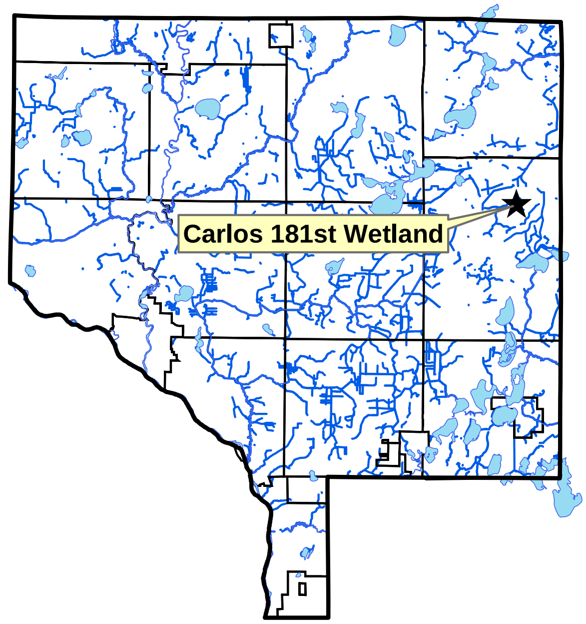
2007 Hydrograph



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.

CARLOS 181ST REFERENCE WETLAND

Carlos Avery Wildlife Management Area, Columbus Township



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	

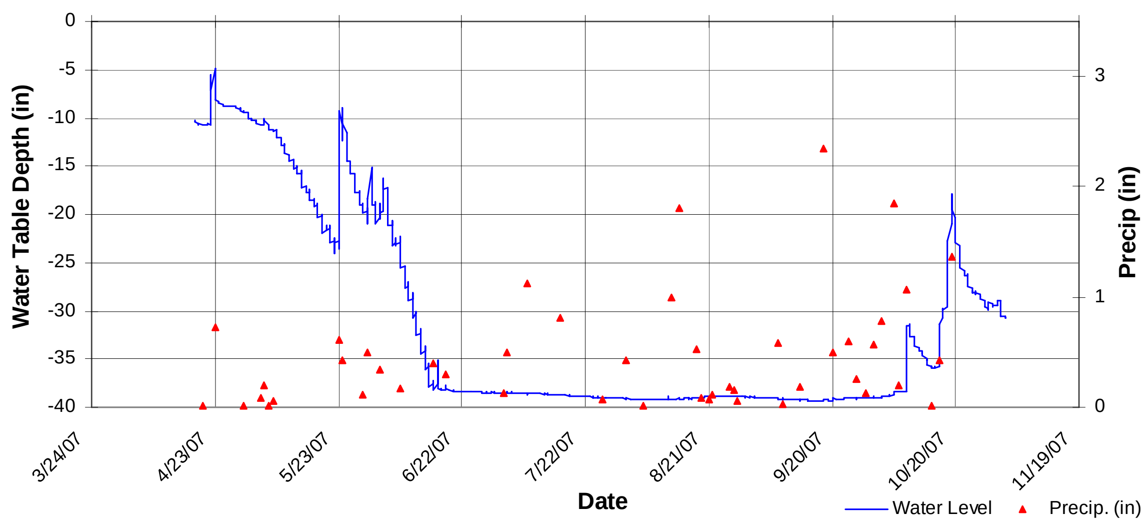
Surrounding Soils: Soderville fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary	100
Rhamnus frangula (S)	Glossy Buckthorn	40
Ulmus american (S)	American Elm	15
Populas trembulodies (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.

2007 Hydrograph

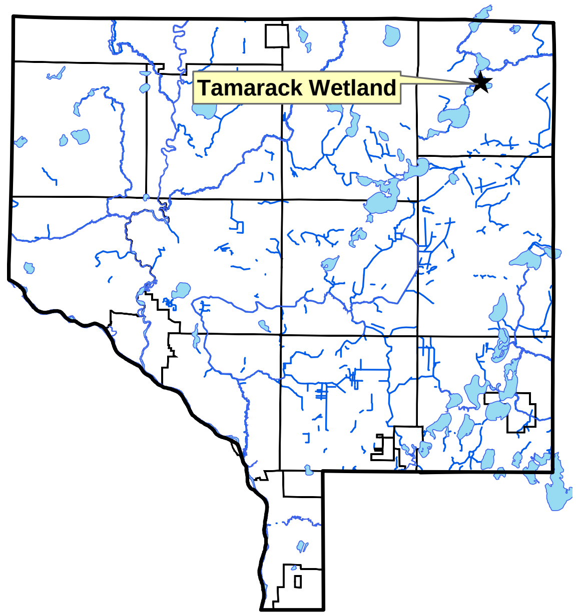


Well depths were 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

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	-

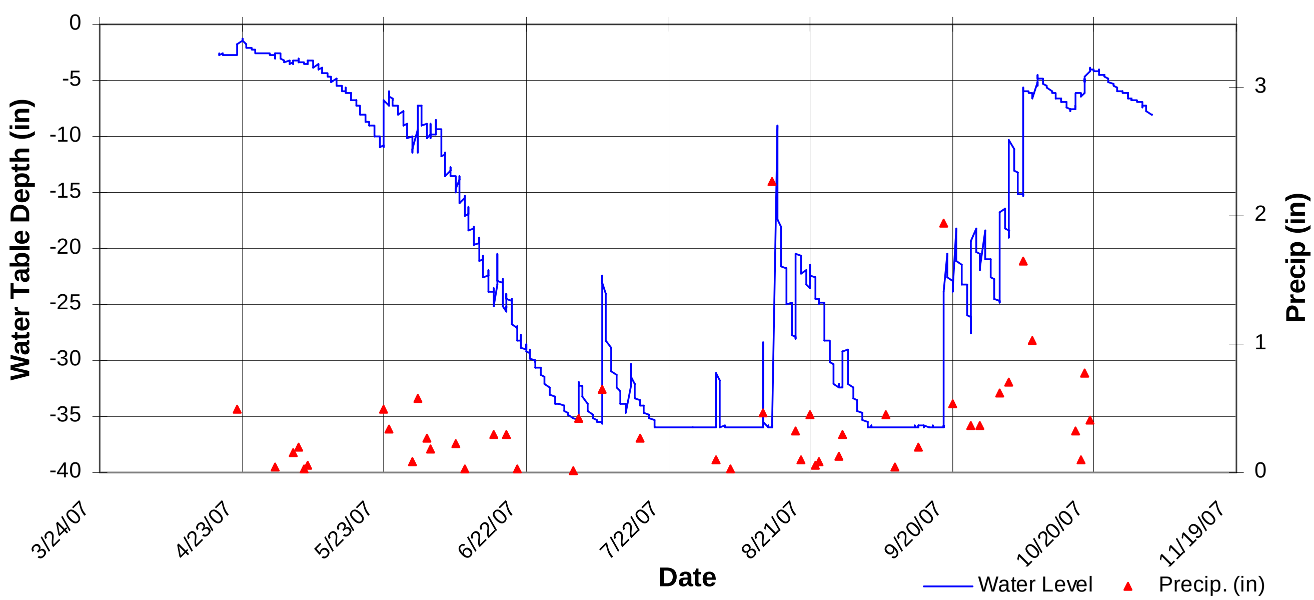
Surrounding Soils: Sartell fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Rhamnus cathartica	Glossy Buckthorn	70
Betula alleghaniensis	Yellow Birch	40
Impatiens capensis	Spotte touch-me not	40
Phalaris arundinacea	Reed Canary	40

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

2007 Hydrograph



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

Water Quality Improvement Projects

Description: In 2005 and 2006 the Sunrise River Watershed Management Organization (SRWMO) partnered with the Anoka Conservation District's Water Quality Cost Share Program. The SRWMO contributed $1,000 in cost share grant dollars each year for projects that improve water quality in lakes, streams, or rivers with the SRWMO area. Eligible projects included those that correct erosion or rehabilitate native shoreline vegetation adjacent to a lake or stream. The funds could be used to cost share 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 Anoka Conservation District (ACD) continuously 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 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: **2007 Activity:**
In 2007 no water quality improvement projects used SRWMO cost share funds. Therefore, the fund balance remains at $1,429.43. These funds will be carried over into subsequent years.

Cost Share Fund Balance:

2005 SRWMO Contribution	+	$1,000
2006 SRWMO Contribution	+	$1,000
2006 Expense - Coon Lake, Rogers Property Project	-	$ 570.57
2007 – no expenses or contributions		$ 0.00
Fund Balance		**$1,429.43**

Update on the 2006 Coon Lake, Rogers Property Project:
In 2006 a shoreline rehabilitation project was installed on Coon Lake at the Rogers residence using SRWMO cost share funds. This project included a 677 square foot buffer of native plants at the shoreline, some plantings of aquatic plants, installation of a deadfall tree in a backwater area for fish and wildlife habitat, and temporary erosion control measures. ACD staff designed the project, the landowner installed it, and SRWMO cost share funded 75% of materials and the design costs.

ACD staff and the chair of the SRWMO inspected this project on August 22, 2007 and found to be successful. The property owner has cared for the project, including the native plants which are flourishing. They went to additional personal expense and effort to make this shoreline restoration resemble more formalized landscaping, without sacrificing the benefits to the lake. This project is a good example of lake-friendly landscaping.

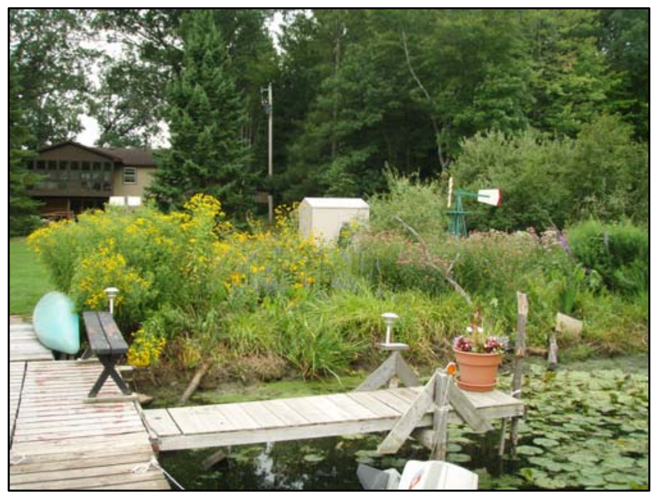
Photos are on the following page.

Rogers Property Shoreline Restoration, Coon Lake

Pre-Project Photo – 2006

Project Installation – 2006

One Year After Planting – Aug. 2007



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.

Locations: 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

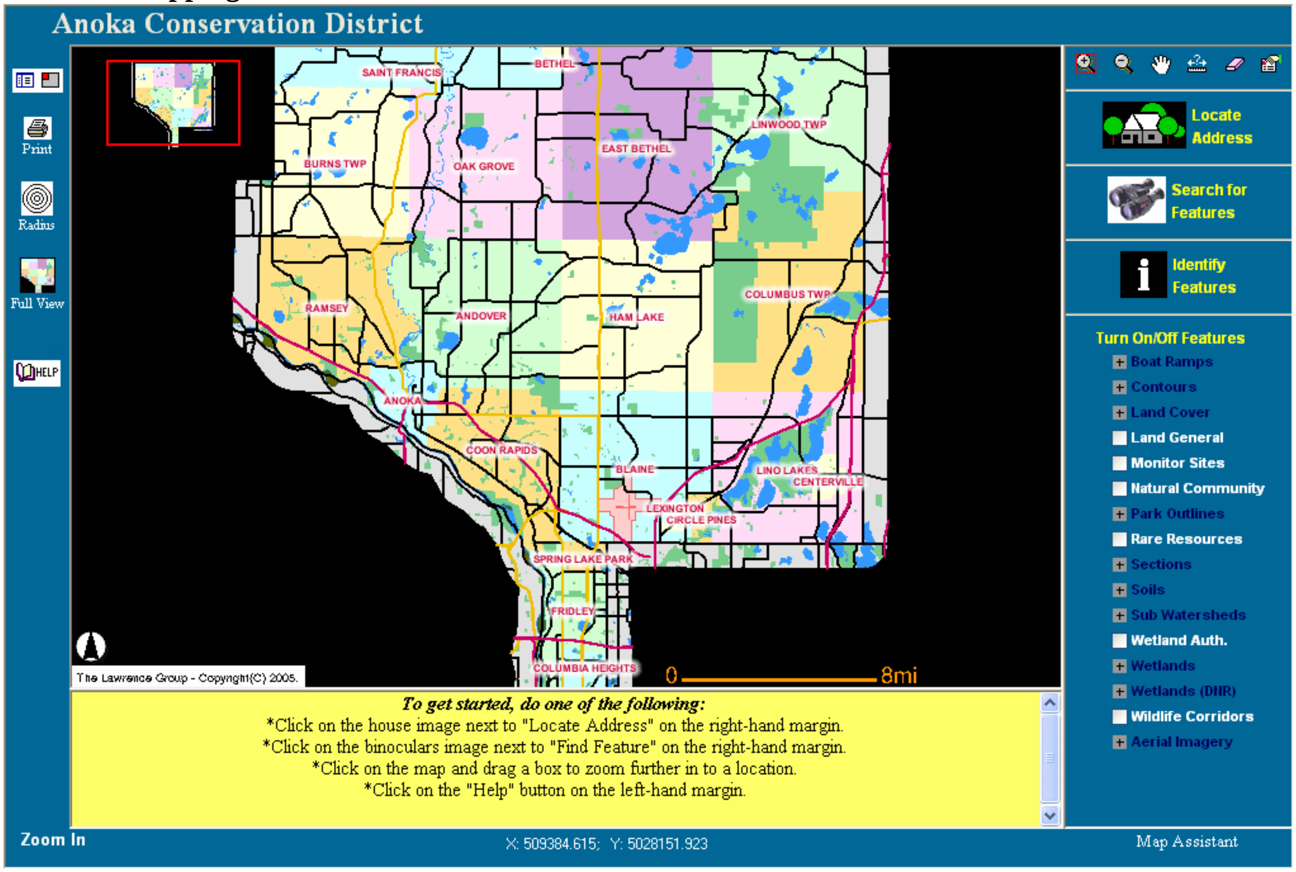
Other tools on the website include:

- 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

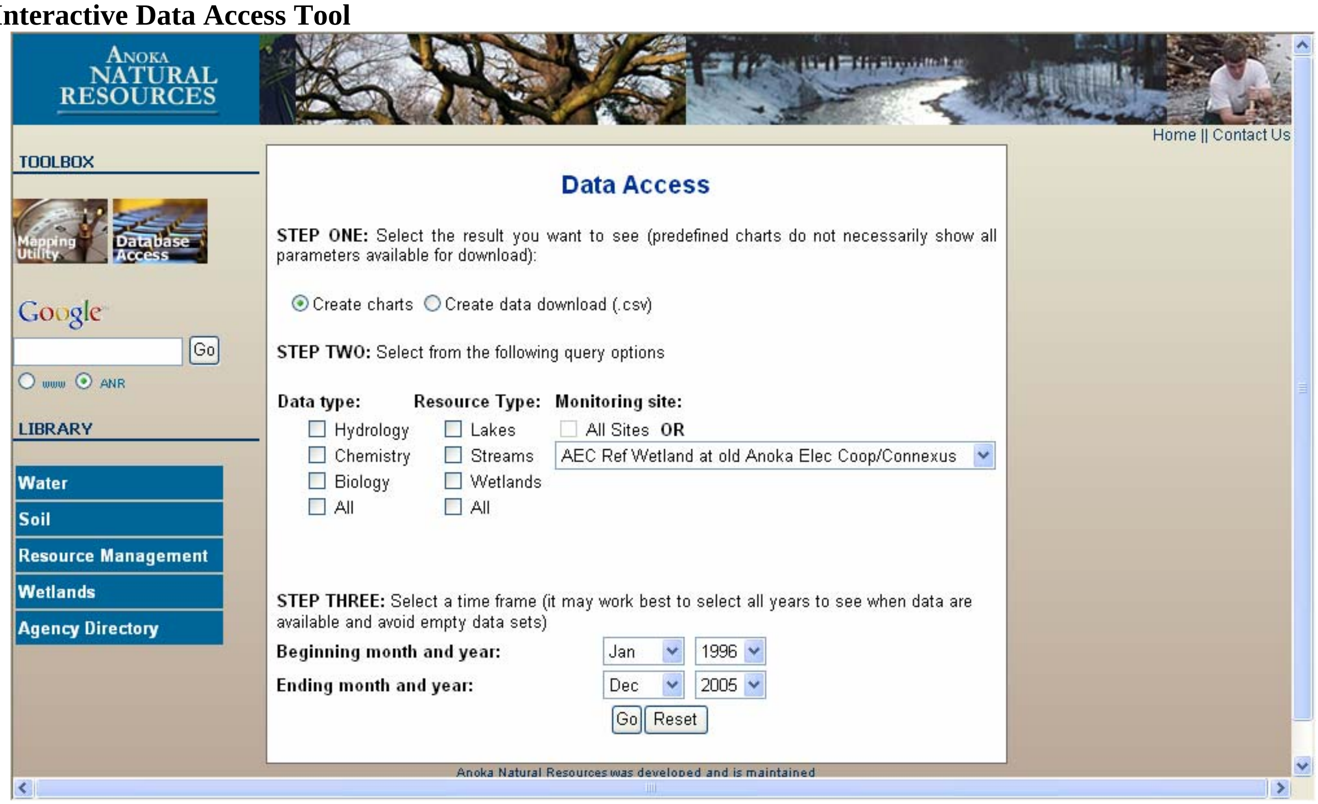
SRMWO Website Homepage

more on next page

Interactive Mapping Tool



Interactive Data Access Tool



Eurasian Watermilfoil Signage

Description: The Sunrise River Watershed Management Organization (SRWMO) contracted the Anoka Conservation District (ACD) to design and install signage at the five major public boat landings in the watershed that will increase awareness of Eurasian Watermilfoil (EWM). EWM is an invasive aquatic plant that cannot be eradicated from a lake once it has been introduced. Coon Lake already had this invasive species, and the SRWMO wants to prevent its introduction into other lakes.

While the Minnesota DNR already places signs about invasive aquatic plants at public boat accesses, the SRWMO and ACD felt that additional signage was warranted. DNR signs are numerous, addressing so many issues (rules, fish regulations, funding, etc) that the EWM message, which is most important to the SRWMO, may not receive adequate attention. The SRWMO signs have a local message and appearance.

Purpose: To encourage the boating public to be diligent about removing aquatic plants from boats and trailers to invasive species are not spread between lakes.

Locations: Coon Lake North County Park Access

Coon Lake Thielen Public Access

Linwood Lake North County Park Access

Martin Lake Public Access

Typo Lake Public Access

Results: Permissions for sign placement were obtained from the Minnesota DNR. Signs were then designed and printed to aluminum. ACD staff installed the signs at each location to the posts already in place to hold DNR signs. The ACD will periodically update the portion of the sign indicating the number of Anoka County Lakes already infested, in hopes of increasing awareness of the magnitude of the problem. Photos below show the design and the installed signs at several locations.

For Coon Lake (infested)

For other lakes (not infested yet)

Photos of some installed Eurasian watermilfoil signs

Linwood Lake Public Access

Typo Lake Public Access


Coon Lake – Co. Park North Access

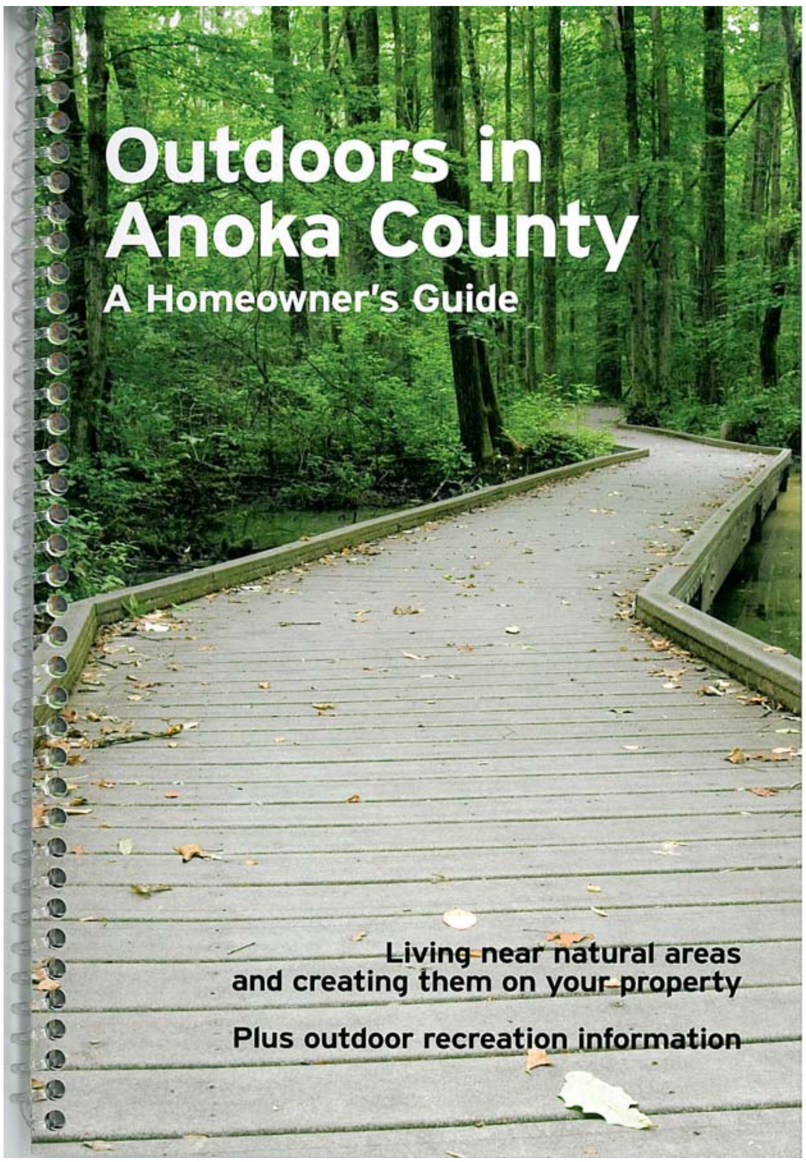
Homeowner Guide

Description: The Anoka Conservation District 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. Therefore, the SRWMO is funding the printing of 450 booklets to be distributed in the SRWMO area. The target audience will be homeowners living next to important natural resources such as unique wetlands, woodlands, and lakes.

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

Locations: Throughout the watershed.

Results: "Outdoors in Anoka County – a homeowner's guide" has been written, laid out by a graphic designer, and printed. 450 copies have been reserved for the SRWMO area. The ACD will follow direction the SRWMO Board's direction on where these should be distributed, such as at city halls and direct mailings to the target audience.



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	Wetland Levels	Milfoil Signage	Lake Levels	Groundwater Observation Wells	Stream Levels	Lake Water Quality	Stream Water Quality	Website	Homeowner Guide	Total
Revenues										
SRWMO	1575	962	500	0	2100	2730	3171	300	1360	12698
State	0	0	0	189	0	0	0	0	356	420
County	0	0	0	297	0	0	0	0	0	1765
County Ag Preserves	646	0	0	0	0	2010	0	0	1820	2770
BWSR General Services	0	0	0	0	0	0	0	649	0	447
Local Water Planning	0	404	144	0	323	403	351	0	0	899
TOTAL	929	1366	644	486	2423	5144	3522	949	3536	17653
Expenses-										
Capital Outlay/Equip	163	0	16	27	72	72	307	18	5	680
Personnel Salaries/Benefits	636	1119	520	378	1975	3041	1327	577	1712	11286
Office Supplies/Maintenance	58	82	46	32	178	293	151	51	133	1024
Employee Training	10	11	8	8	28	42	53	10	19	190
Vehicle/Mileage	12	13	9	8	37	59	54	10	22	226
Rent	28	1	27	20	83	192	165	32	24	571
Monthly Bills	8	2	8	5	24	53	44	9	9	162
Fees and Dues	7	1	4	7	18	21	72	5	3	138
Program Supplies	7	137	5	0	7	1370	1350	237	1608	4721
TOTAL	929	1366	644	486	2423	5144	3522	949	3536	18998
NET	0	0	0	0	0	0	0	0	0	1346

Recommendations

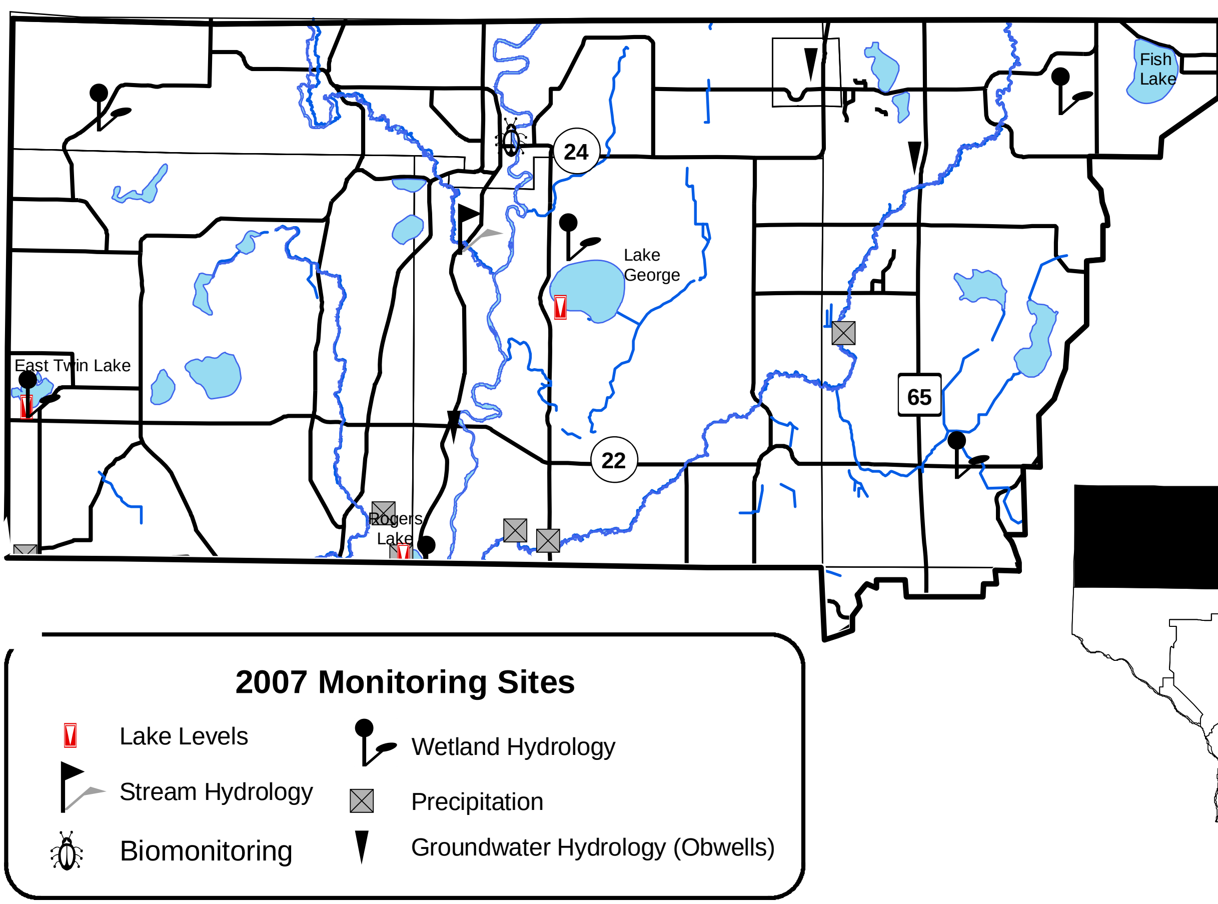
- **Update the SRWMO Watershed Management Plan**, which expires at the end of 2009.
- **Focus on water quality improvement projects** and diagnostic monitoring. Reduce screening-type monitoring.
- **Update the Typo and Martin Lake Total Maximum Daily Load (TMDL) Study Report**. The report was submitted to the Minnesota Pollution Control Agency in early 2006, but they have not yet reviewed it. Since that time, new information has been collected, especially in 2007. Most notable among the new findings is that water level manipulation in Ditch 20 will not be an effective strategy for phosphorus reduction.
- **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 the contents of this report 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. The SRWMO should include lake improvement monies into budgeting.
- **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.
- **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.

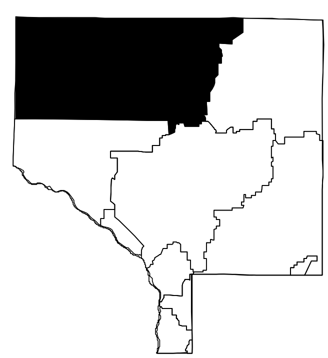
CHAPTER 3:
UPPER RUM RIVER WATERSHED

Raw data and data summaries can be found at the URRWMO website – use the Data Access tool (www.AnokaNaturalResources.com/URRWMO)

Task	Partners	Page
Lake Levels	URRWMO, ACD, MN DNR, volunteers	3-64
Stream Hydrology	ACD	3-65
Stream Water Quality – Biological	ACD, ACAP, St. Francis High School	3-68
Wetland Hydrology	ACD, ACAP	3-71
Lakeshore Mapping and Education	ACD, URRWMO	3-77
Water Quality Improvement Projects	URRWMO, ACD, Landowners	3-80
URRWMO Website	URRWMO, ACD	3-81
Financial Summary		3-83
Recommendations		3-83
Groundwater Hydrology (obwells)	ACD, MNDNR	see Chapter 1
Precipitation	ACD, volunteers	see Chapter 1

ACD = Anoka Conservation District, URRWMO = Upper Rum River Watershed Mgmt Org,
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.

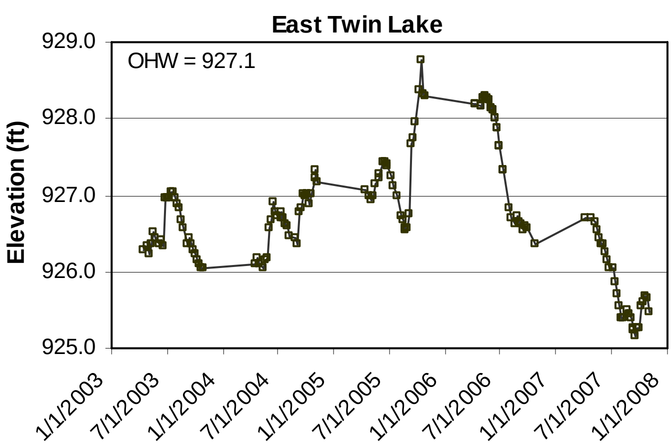
Locations: East Twin Lake, Lake George, Rogers Lake

Results: East Twin Lake water levels returned to lower levels in 2007, after high levels in 2005 and 2006. Residents near the lake indicated that a beaver dam was the reason for the high water in 2005, but the beavers were removed in 2006. By mid-2007 the lake was the lowest it has been since 2002, following a trend similar to other lakes in response to drought this year.

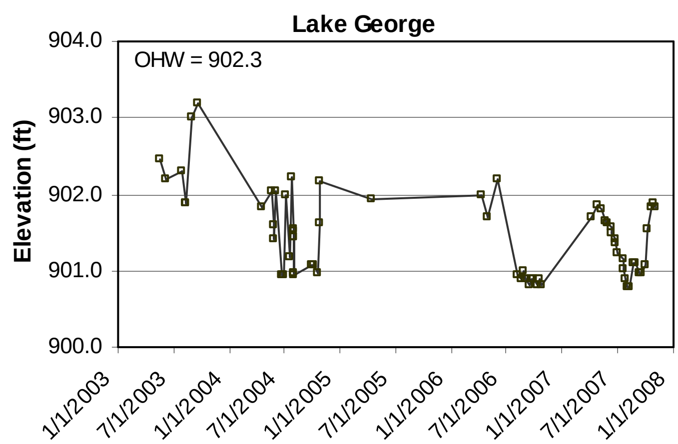
Lake George is experiencing low water levels, and in mid-summer 2007 was the lowest it has been since the severe droughts of the late 1980's. Drought in 2007 contributed to low levels this year. The lake's only inlet, County Ditch #19, may also be responsible for low water - residents have complained it is clogged and needs maintenance. Interestingly, the long term record shows that Lake George water levels fluctuate much more dramatically within each year than they did in the past, perhaps reflecting low summer inflows.

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.

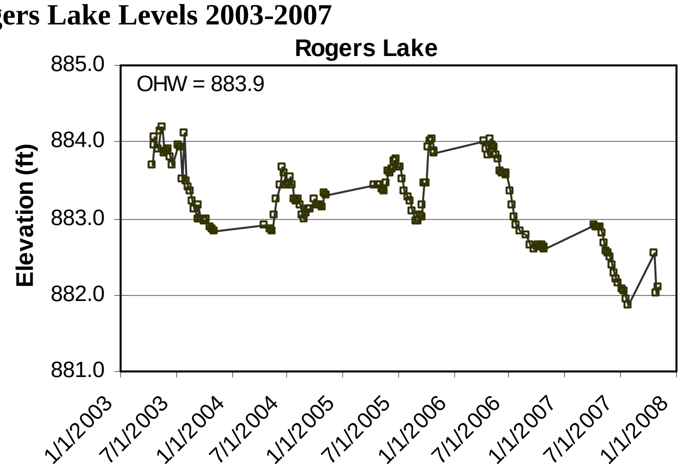
East Twin Lake Levels 2003-2007



Lake George Levels 2003-2007



Rogers Lake Levels 2003-2007



Upper Rum River Watershed Lake Levels Summary

Lake	Year	Average	Min	Max
East Twin	2003	926.50	926.05	927.03
	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
George	2003	902.42	901.88	903.18
	2004	901.48	900.95	902.22
	2005	not available		
	2006	901.13	900.82	902.20
	2007	901.36	900.78	901.88
Rogers	2003	883.53	882.84	884.18
	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

Stream Hydrology

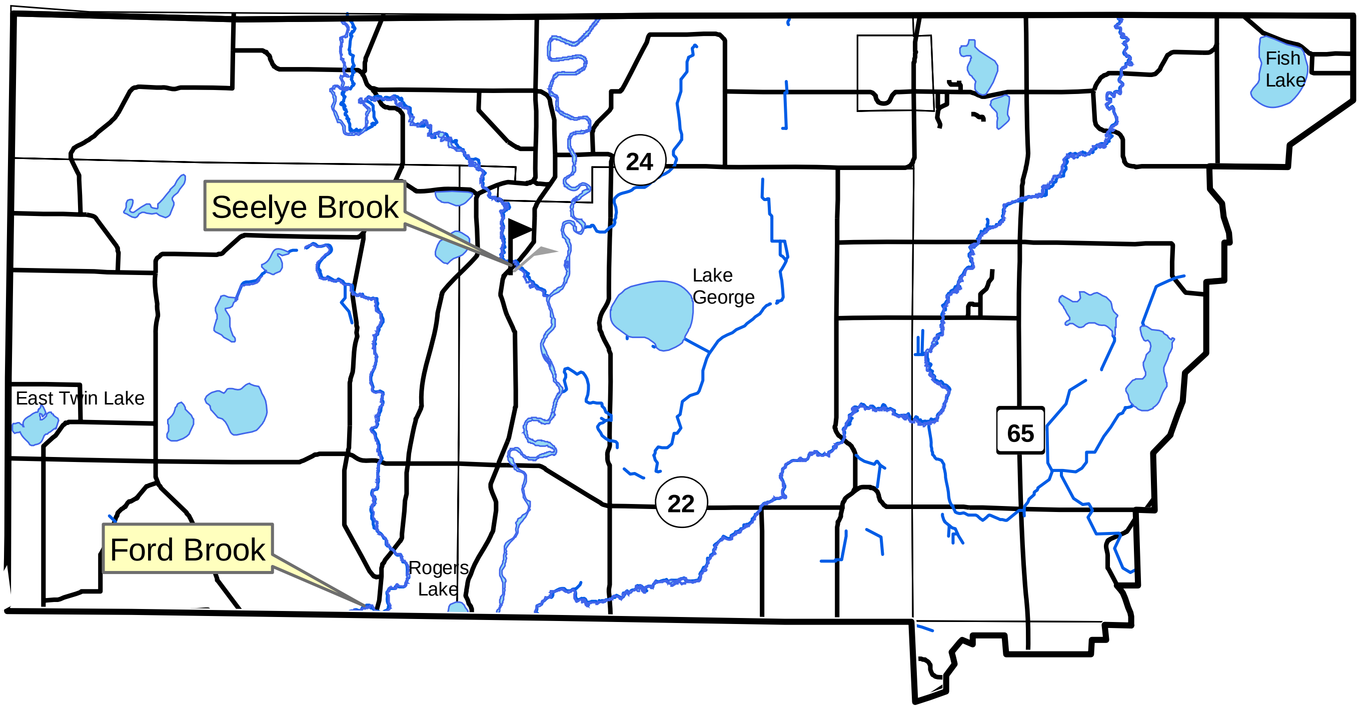
Description: Continuous water level monitoring in streams.

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 and use of computer models for developing management strategies.

Locations: Ford Brook at Highway 63, Ramsey

Seelye Brook at Highway 7, Oak Grove

Upper Rum River Watershed Stream Hydrology Monitoring Sites



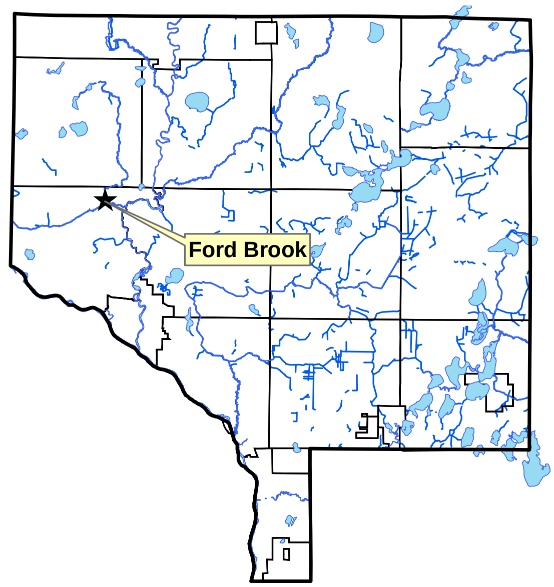
FORD BROOK

at Highway 63 (Green Valley Rd NW), Ramsey

Notes

This is a medium-large creek that originates from Ekstrom Lake in north-central Burns Township, flows through Burns Township, and outlets to the Rum River in northeast Ramsey. It does not inlet or outlet to any lakes. Overall, the watershed is rural residential with 5 acre lots. The creek is about 25 feet wide and 2.5 feet deep at the monitoring site during baseflow.

Due to equipment malfunctions, Ford Brook was only monitored in mid-summer 2007. This was a drought period, and as a result the stream fluctuated very little, even when it did rain because the dry soils absorbed the moisture.

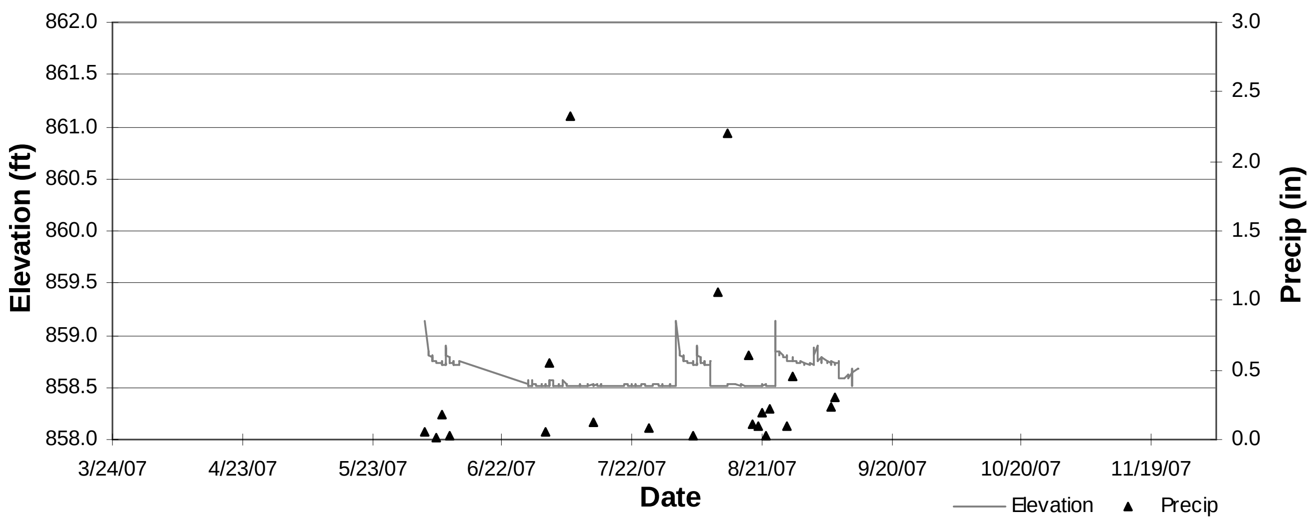


Summary of All Monitored Years

Percentiles	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	All Years
Min	859.22	859.21	859.15	859.06	859.13	858.86	858.89	858.71	858.74	858.74	858.63	858.51	858.51
2.5%	859.28	859.40	859.18	859.09	859.15	858.86	858.95	858.74	858.77	858.76	858.66	858.51	858.71
10.0%	859.40	859.58	859.18	859.12	859.15	858.86	859.15	858.77	858.91	858.82	858.80	858.51	858.89
25.0%	859.51	859.69	859.26	859.20	859.15	858.86	859.46	858.94	859.11	859.08	858.86	858.51	859.20
Median (50%)	859.67	859.85	859.30	859.32	859.18	858.89	859.74	859.20	859.40	859.51	858.97	858.53	859.48
75.0%	859.84	860.39	859.32	859.38	859.18	859.21	860.00	859.59	89.65	859.76	859.28	858.73	859.48
90.0%	860.04	861.09	859.38	859.53	859.24	859.97	860.39	860.07	860.05	860.12	859.73	858.79	860.19
97.5%	860.60	861.45	859.55	859.87	859.35	860.56	860.79	860.45	860.53	860.78	860.11	858.85	861.09
Max	861.44	861.65	859.61	860.10	859.50	861.05	861.13	861.24	860.90	861.43	860.59	859.13	861.65

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

2007 Hydrograph



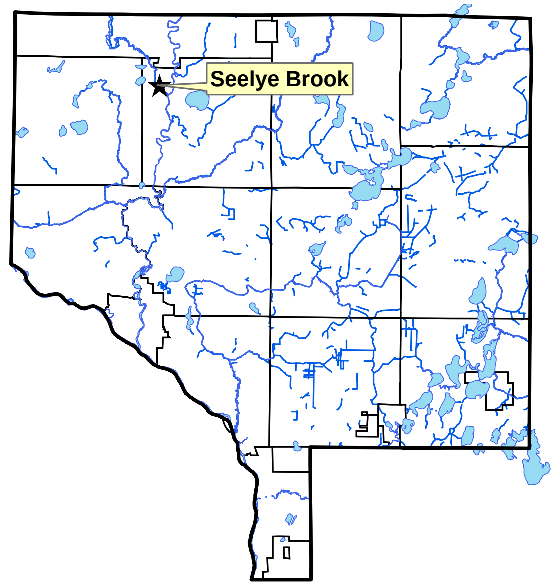
SEELYE BROOK

at Highway 7, Oak Grove

Notes

This is a large creek that originates in southwest Isanti County, flows through St. Francis, and outlets to the Rum River in northwest Oak Grove. It does not inlet or outlet to any lakes. Overall, the watershed is rural residential, wetland, and agricultural. The creek is about 25 feet wide and 2.5 feet deep at the monitoring site during baseflow. This stream receives special protections as a tributary to the Rum River under state scenic and recreational rivers laws.

Seelye Brook responds more extremely to rainfall than the other large streams in the area, such as Ford Brook and Cedar Creek, despite being of similar size and having similar watershed land uses. From 1996 to 2007 Seelye Brook water levels ranged 6.7 feet, compared to 3.14 and 5.09 feet for Ford Brook and Cedar Creek, respectively. A rudimentary analysis on five isolated rain events greater than one inch in 2004 found that Seelye Brook rose an average of 8.3 inches per inch of rainfall received. 2007 was atypical because of summertime drought.

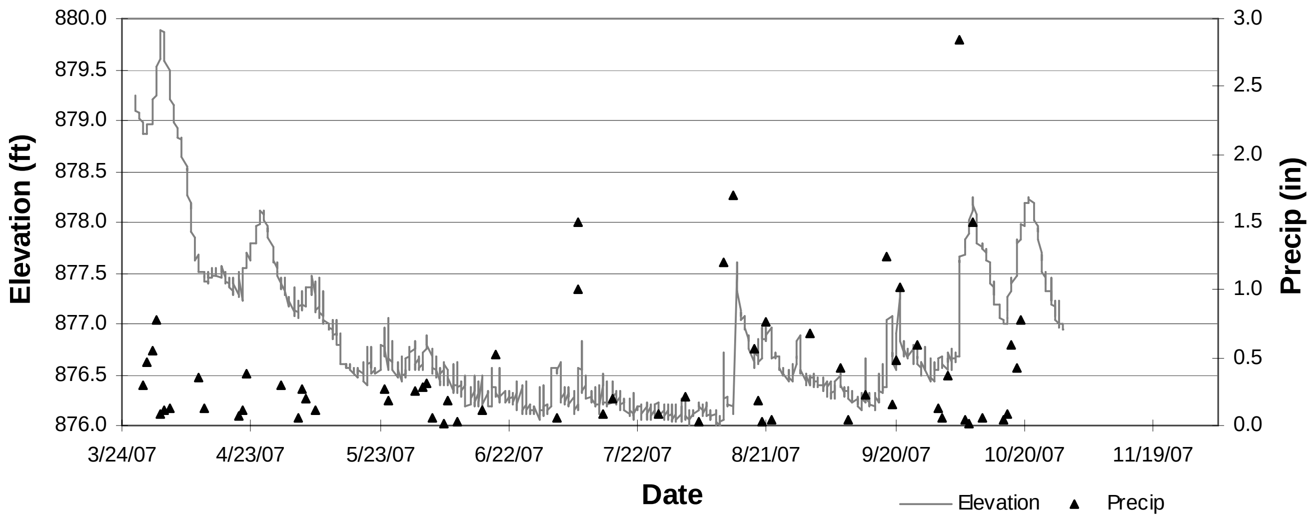


Summary of All Monitored Years

Percentiles	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	All Years
Min	876.38	875.93	876.05	875.95	na	876.02	876.24	876.13	876.12	876.09	876.06	875.98	875.93
2.5%	876.50	876.66	876.19	876.12		876.13	876.41	876.17	876.23	876.21	876.15	876.09	876.17
10.0%	876.55	876.74	876.28	876.15		876.25	876.73	876.31	876.34	876.32	876.23	876.18	876.29
25.0%	876.64	877.03	876.39	876.17		876.39	877.35	876.66	876.63	876.69	876.43	876.29	876.5
Median (50%)	876.87	877.58	876.53	876.32		876.59	877.86	877.16	877.03	877.42	876.72	876.61	876.84
75.0%	877.66	879.09	876.78	876.68		877.44	878.71	877.75	877.82	878.19	877.31	877.31	876.84
90.0%	877.89	880.72	877.21	877.45		879.40	879.82	879.03	878.95	878.84	878.29	877.94	878.83
97.5%	878.00	882.13	879.17	880.03		881.95	880.73	879.79	879.60	880.55	879.13	879.07	880.5218
Max	878.21	882.60	879.85	880.57		882.63	881.03	880.28	880.03	881.16	879.75	879.89	882.63

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

2007 Hydrograph



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.

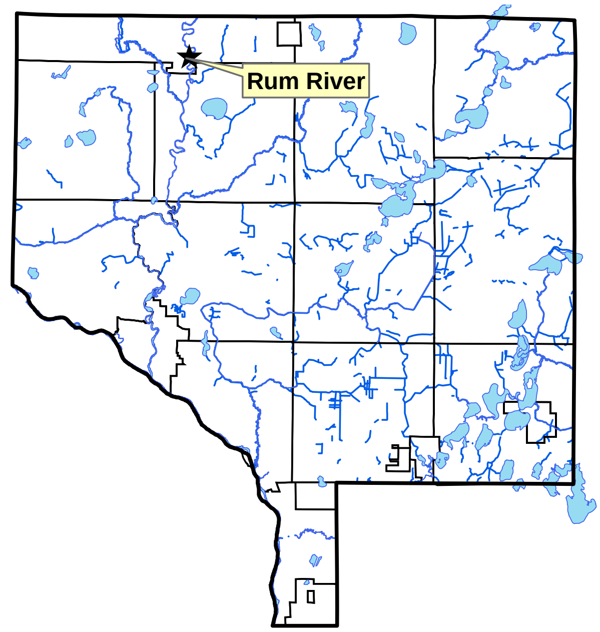
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

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 2007

Monitored Since

2000

Student Involvement

105 students in 2007, approx 700 since 2000

Background

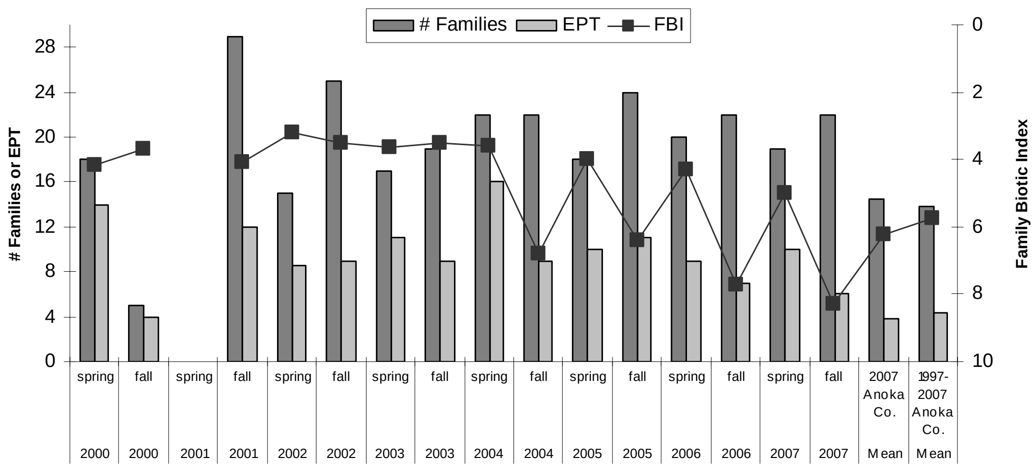
The Rum River originates from Lake Mille Lacs, and flows south through western Anoka County where it joins the Mississippi River in the City of Anoka. Other than the Mississippi, this is the largest river in the county. In Anoka County the river has both rocky ripples as well as pools and runs with sandy 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 2007, facilitated by the Anoka Conservation District. Biological data for 2007, and historically, indicate the Rum River in northern Anoka County has the best conditions of all streams and rivers monitored throughout Anoka County. Biological indices were above the county averages. One exception is that the Family Biotic Index (FBI) in fall 2007 was much lower than previously observed and much lower than the average for Anoka County; the same was true in fall 2006. This poor FBI was primarily driven by a high abundance of a few pollution-tolerant families. Specifically, the family hydropsychidae (netspinner caddisflies) was 43% of all captures in fall 2007 and 35% in fall 2006, while family corixidae (water boatmen) was 59% of all captures in fall 2007 and 66% in fall 2006. While high diversity partially makes up for this dominance by pollution-tolerant families, student groups have observed lower captures of sensitive families, such as stoneflies, in recent years, and this is concerning.

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	2004	2004	2005	2005	2006	2006	2007	2007	Mean	Mean
Season	spring	fall	spring	fall	spring	spring	fall	spring	spring	fall	fall	spring	fall	spring	fall	spring	fall	spring	fall	2007 Anoka Co.	1997-2007 Anoka Co.
FBI	4.16	3.70	not sampled	6.30	3.80	2.90	4.80	4.10	3.20	3.70	3.60	3.60	6.80	4.00	6.40	4.30	7.70	5.00	8.30	6.2	5.7
# Families	18	5		29	10	20	25	18	16	12	26	22	22	18	24	20	22	19	22	14.4	13.9
EPT	14	4		12	7	10	9	11	10	6	11	16	9	10	11	9	7	10	6	3.8	4.4
Date	5/24	?		23-Oct	3-Jun	29-May	8-Oct	30-May	29-May	10-Oct	1-Oct	19-May	29-Sep	25-May	29-Sep	25-May	2-Oct	16-May	11-Oct		
sampling by	ACD	Xroads		SFHS	Xroads	SFHS	SFHS	Xroads	SFHS	Xroads	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS		
sampling method	MH	MH		MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
# individuals	125	233		152.5	164	112	133	132	104	278	102	151	468	138	272	152	187	262	502		
# replicates	1	1		2	1	2	2	1	2	1	2	3	2	1	2	2	2	2	2		
Dominant Family	heptageniidae	hydropyschidae		corixidae	hydropyschidae	perlodidae	hydropsychidae	hydropyschidae	hydropsychidae	baetidae	oligoneuridae	hydropsychidae	corixidae	perlodidae	gyrinidae	hydropsychidae	corixidae	ydropsychida	corixidae		
% Dominant Family	22	81.5		21	64	36.6	19.9	41.6	48.3	61.2	30.9	40.5	38.2	29.7	22.4	35.3	66.3	42.7	58.8		
% Ephemeroptera	46.4	1.7		18	6.1	11.2	20.3	11.4	11	78.1	51	31.7	15.4	50	25	20.8	9.9	17.2	2		
% Trichoptera	20.8	87.6		9.2	70.1	29	20.3	42.4	54.1	13.3	13.7	48.9	1.5	11.6	5.9	35.3	4.8	44.3	1		
% Plecoptera	7.2	9.4		3.9	15.2	45.1	13.2	12.9	31.1	0.4	9.8	13.9	2.6	31.2	8.1	22.4	1.6	8	0.2		

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 areas within 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 should be continued to inform residents of the direct impact their actions have on the river's health.
- Continue water quality monitoring programs. In addition to continuous monitoring of the Rum River by Metropolitan Council's Watershed Outlet Monitoring Program (WOMP), additional upstream monitoring should be conducted every 2-3 years at the sites utilized in 2004. Monitoring should be coordinated to occur on the same days as the Met Council testing so direct comparisons are possible. Additionally, periodic monitoring of the primary tributary streams should also occur every 2-3 year. The Upper and Lower Rum River Watershed Management Organizations are best suited to coordinate this watershed-level monitoring.


St. Francis High School classes biomonitoring the Rum River in 2007.

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

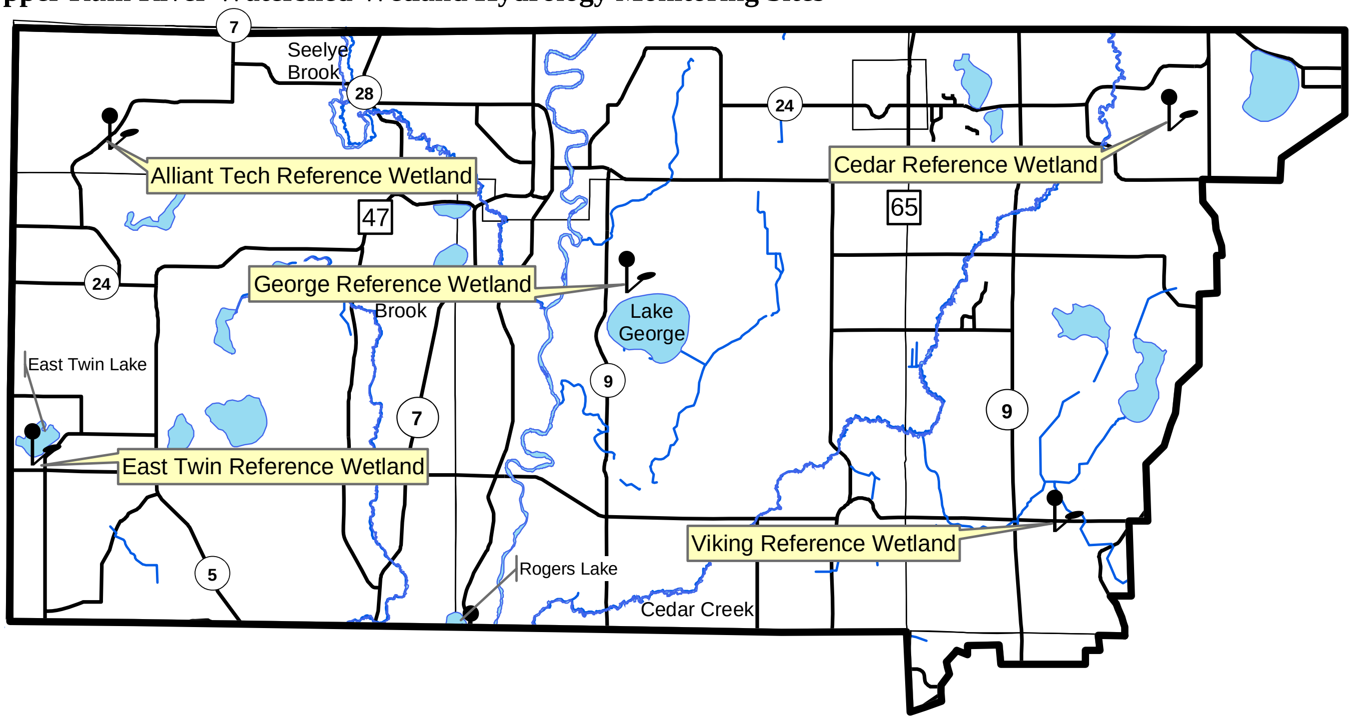
East Twin Reference Wetland, East Twin Township Park, Burns

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.

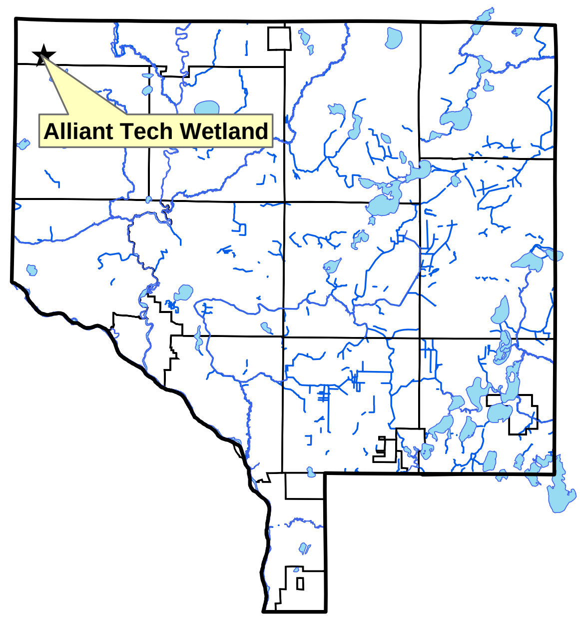
Upper Rum River Watershed Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

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	-

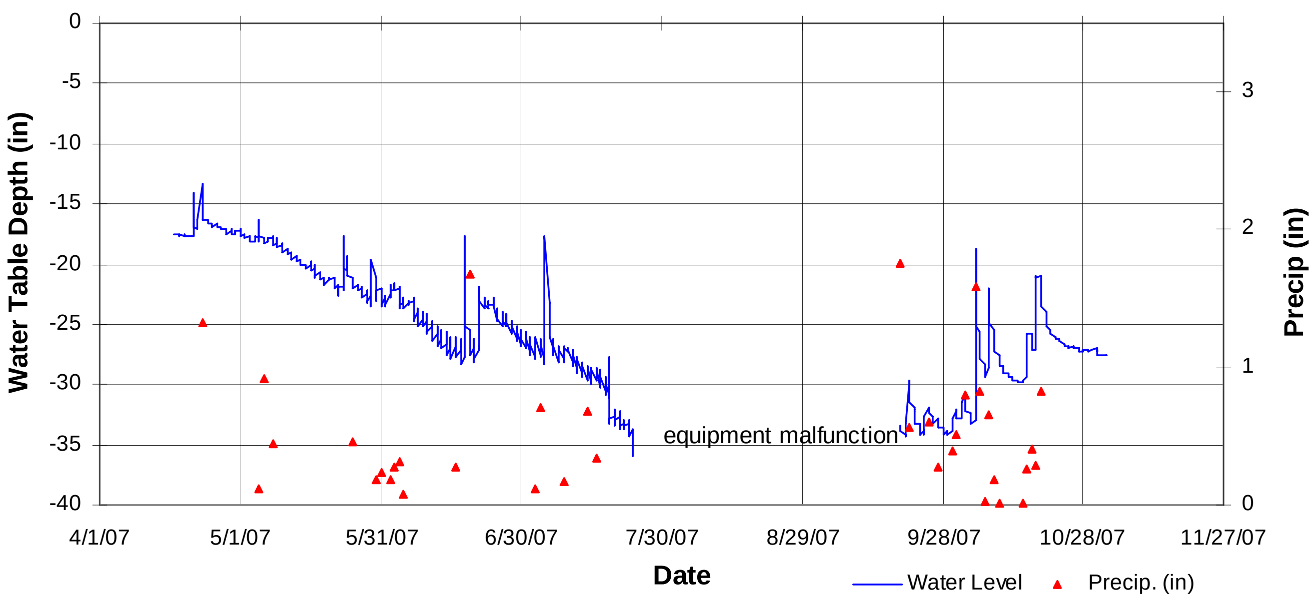
Surrounding Soils: Emmert

Vegetation at Well Location:

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

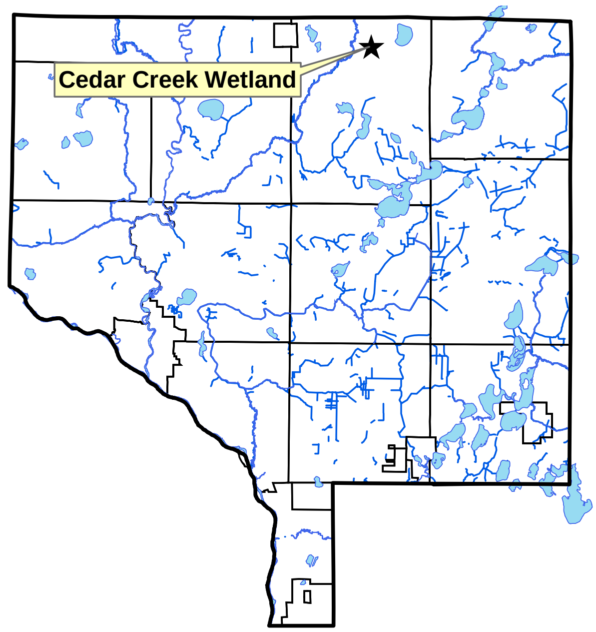
2007 Hydrograph



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.

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

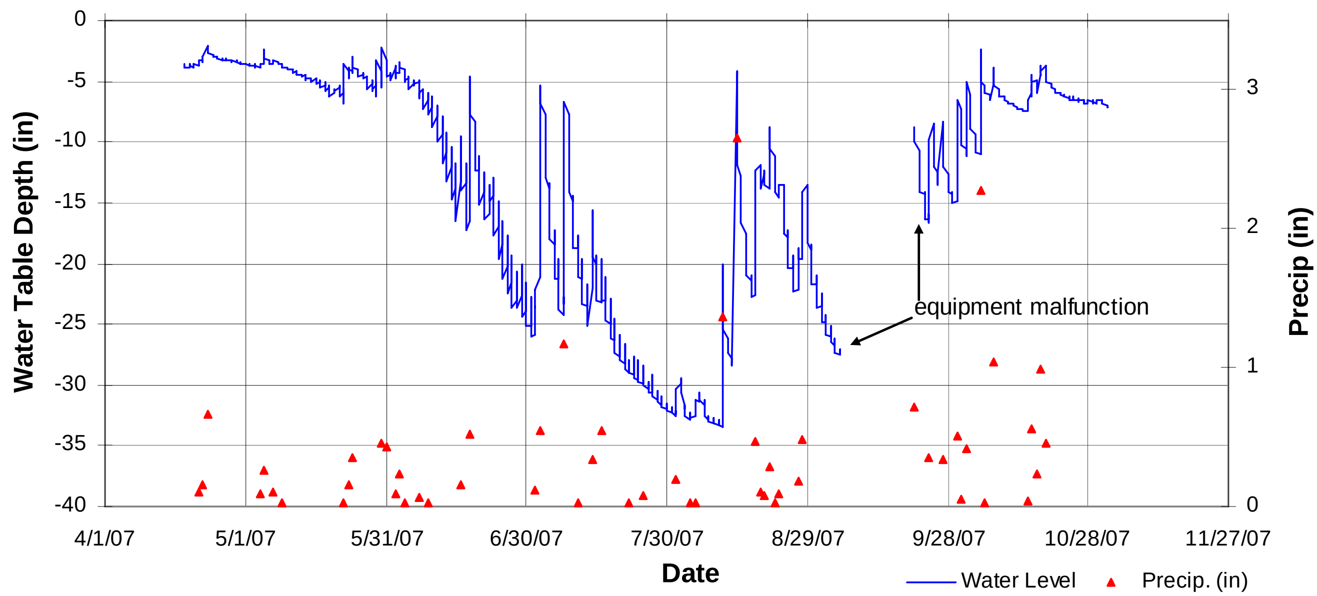
Soils at Well Location: not yet available

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.

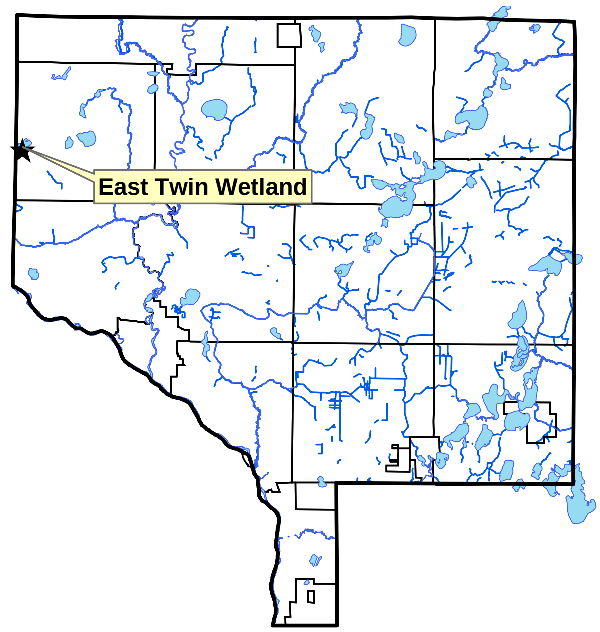
2007 Hydrograph



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.

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	-

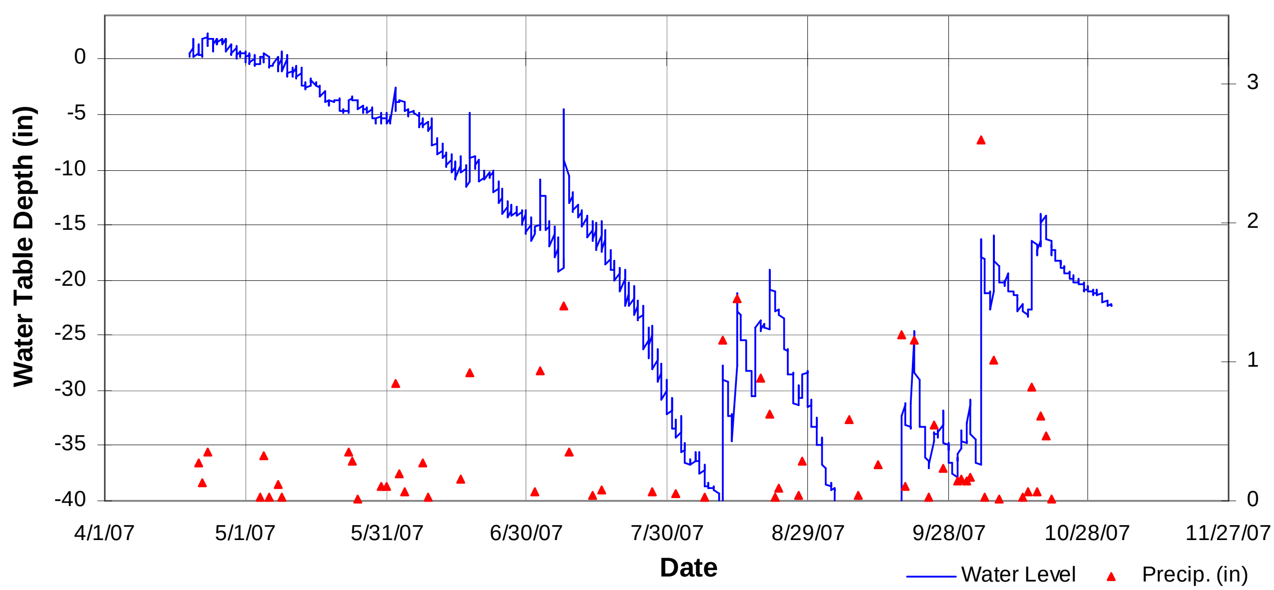
Surrounding Soils: Lake beach, Growton and Heyder fine sandy loams

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary	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.

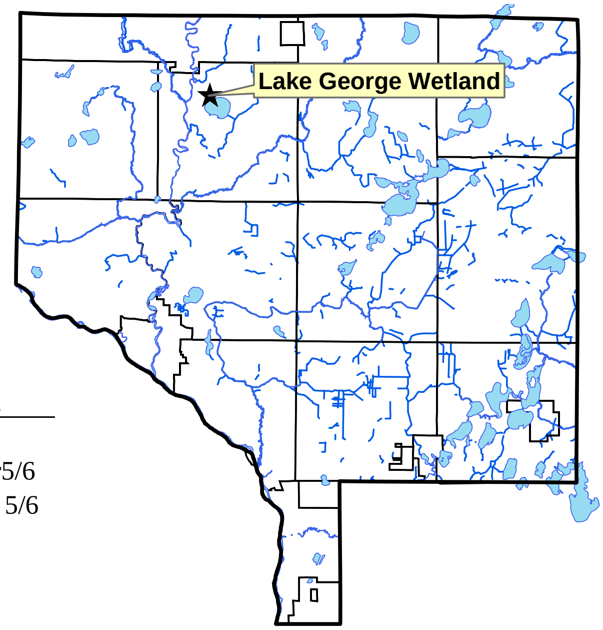
2007 Hydrograph



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

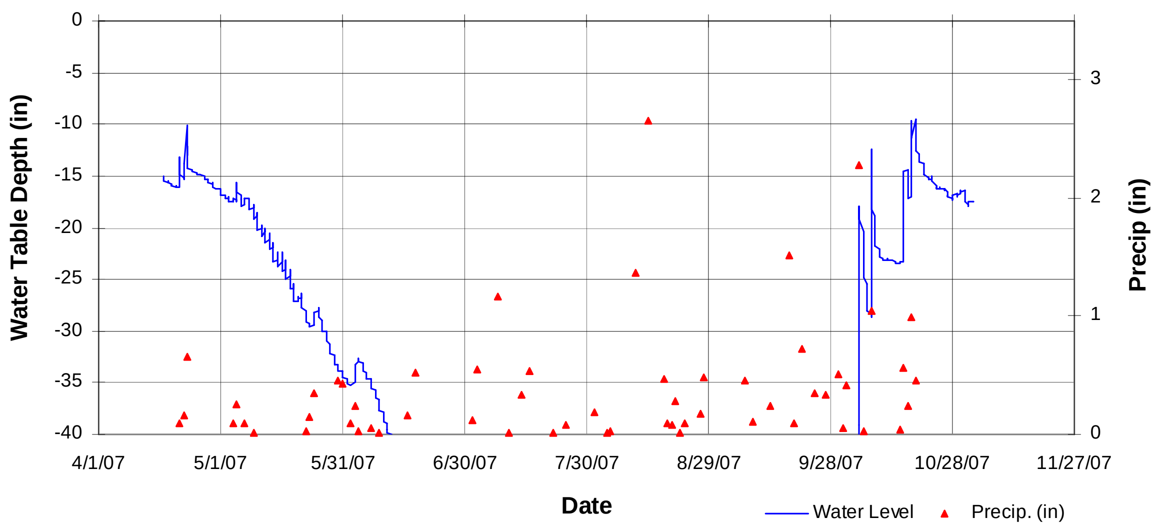
Surrounding Soils: Lino loamy fine sand and Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Cornus stolinifera	Red-osier Dogwood	90
Populus tremuloides	Quaking Aspen	40
Quercus rubra	Red Oak	30
Onoclea senibilis	Sensitive Fern	20
Phalaris arundinacea	Reed Canary	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.

2007 Hydrograph



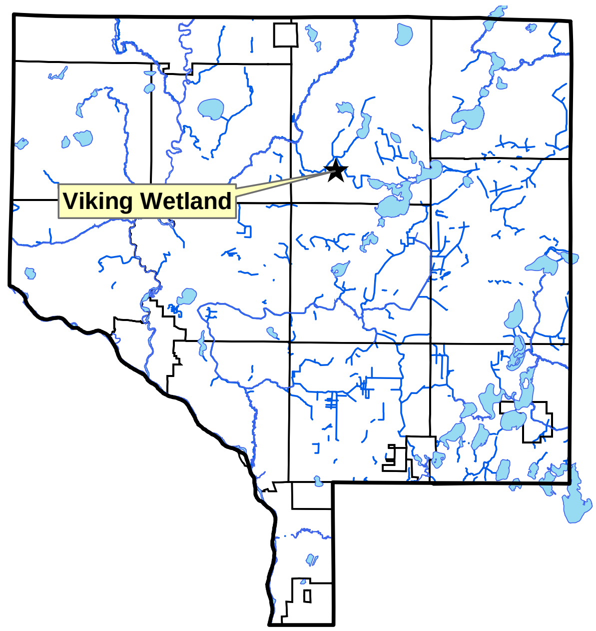
Well depths were 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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

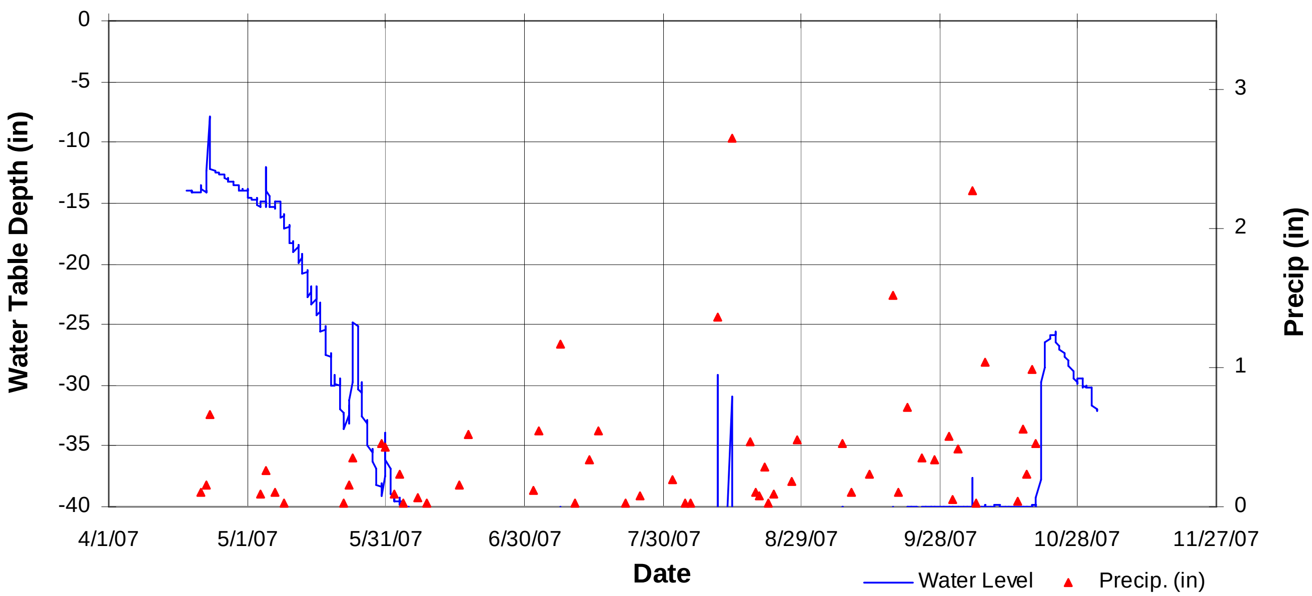
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary	100
Acer rubrum (T)	Red Maple	75
Acer negudo (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).

2007 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.

Lakeshore Mapping and Education

Description: Shoreland areas of two lakes were mapped. The result was a Geographic Information System (GIS) containing the type of shoreline (mowed, unmowed, rock, etc), the severity of erosion, and other features that could impact lake quality. This information was used to determine which properties have lakeshore erosion problems or practices that are likely to lead to problems, and send them a mailing including information about lake-friendly landscaping and services offered by the Anoka Conservation District, such as help correcting problems and cost share grants. The maps are also being used as part of an educational brochure to all homeowners on each lake.

Purpose: To identify areas of poor shoreland management and areas in need of erosion control, and work with those landowners to correct the problems.

Locations: East Twin Lake

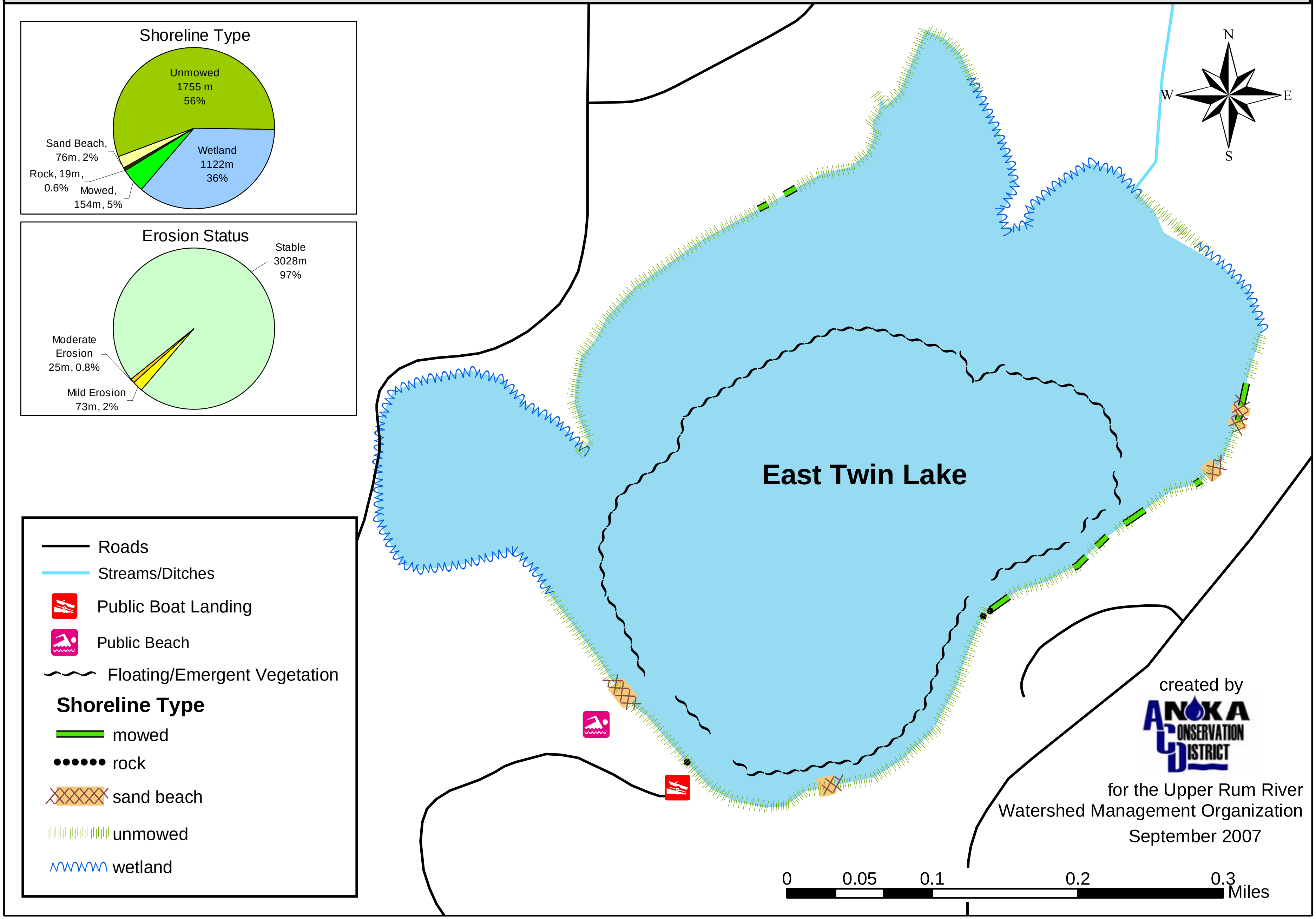
Lake George

Results: The final lakeshore maps on the following pages. Raw GIS data layers are available from the Anoka Conservation District.

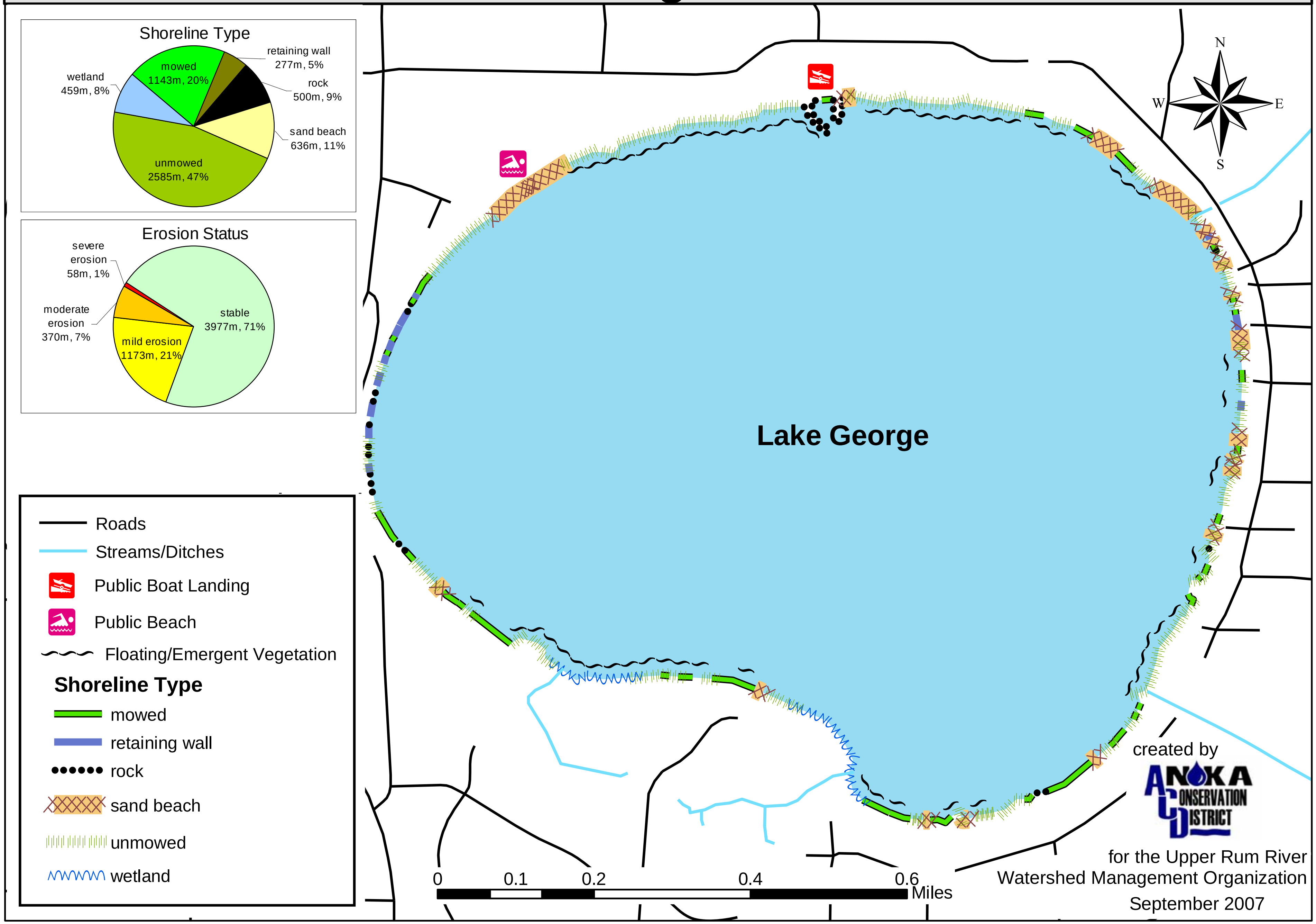
Through this project, 20 properties with moderate or severe erosion were identified and targeted for assistance (19 on Lake George, 1 on East Twin Lake). All of these property owners received a customized letter, copy of the lakeshore map, and brochure about lake-friendly landscaping. In the letter, Anoka Conservation District staff offered free technical advice, including visiting the property and designing corrective action, if requested. Cost share grants were also promoted to help willing landowners fix lakeshore erosion problems. If little response is received from the initial mailing to these problems, a follow-up mailing in spring 2008 is planned.

The Anoka Conservation District is working with the Lake George Conservation Club to further use the lakeshore maps as an educational tool. 150 lakeshore maps will be printed for distribution at meetings and/or newsletters. The maps will be integrated into a brochure about lakeshore landscaping.

East Twin Lake Shoreline



Lake George Shoreline



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 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.

The Anoka Conservation District (ACD) continuously 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 to landowners throughout a project, 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 on private property (such as the lakeshore mapping described earlier in this report).

Cost Share Fund Balance:

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

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.

Locations: www.AnokaNaturalResources.com/URRWMO

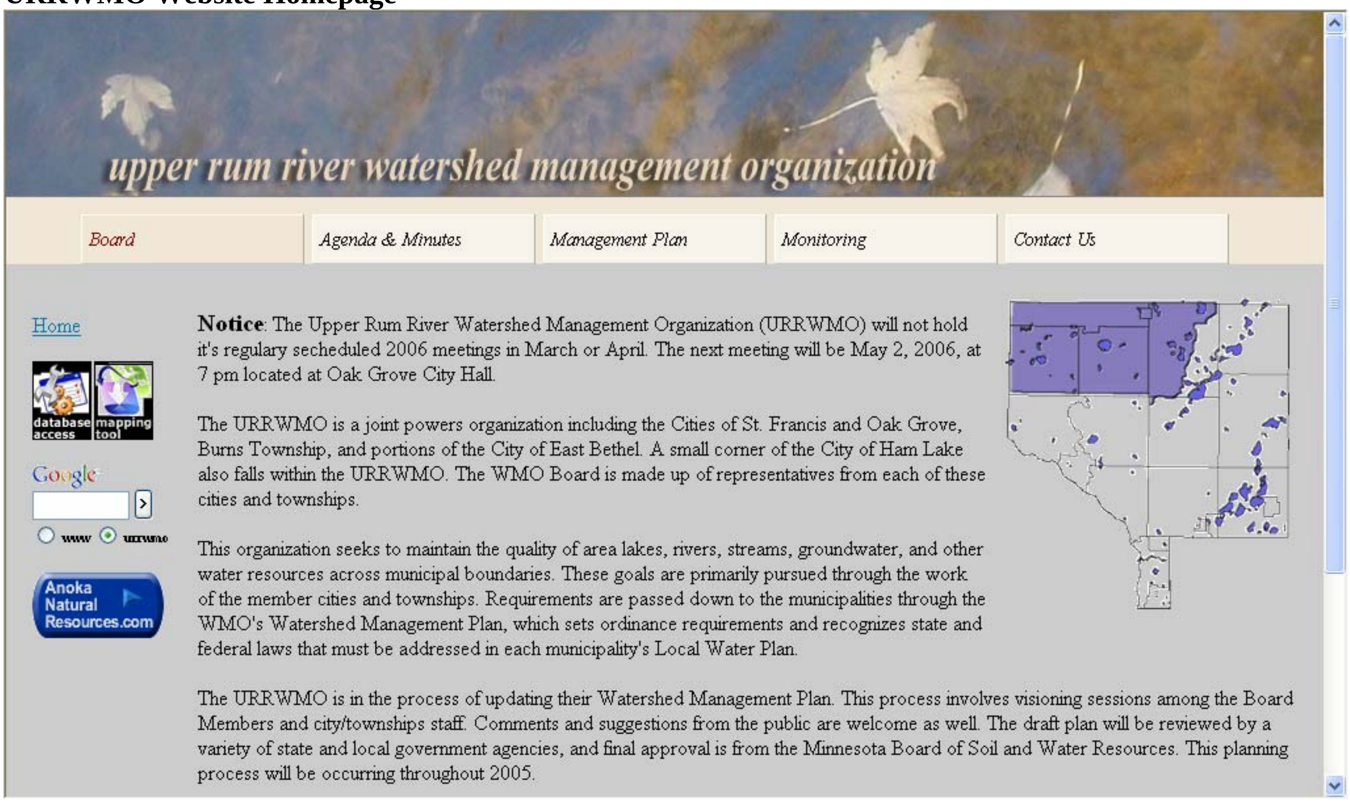
Results: The URRWMO website contains information about both the URRWMO and about natural resources in the area.
Information about the URRWMO includes:

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

URRWMO Website Homepage



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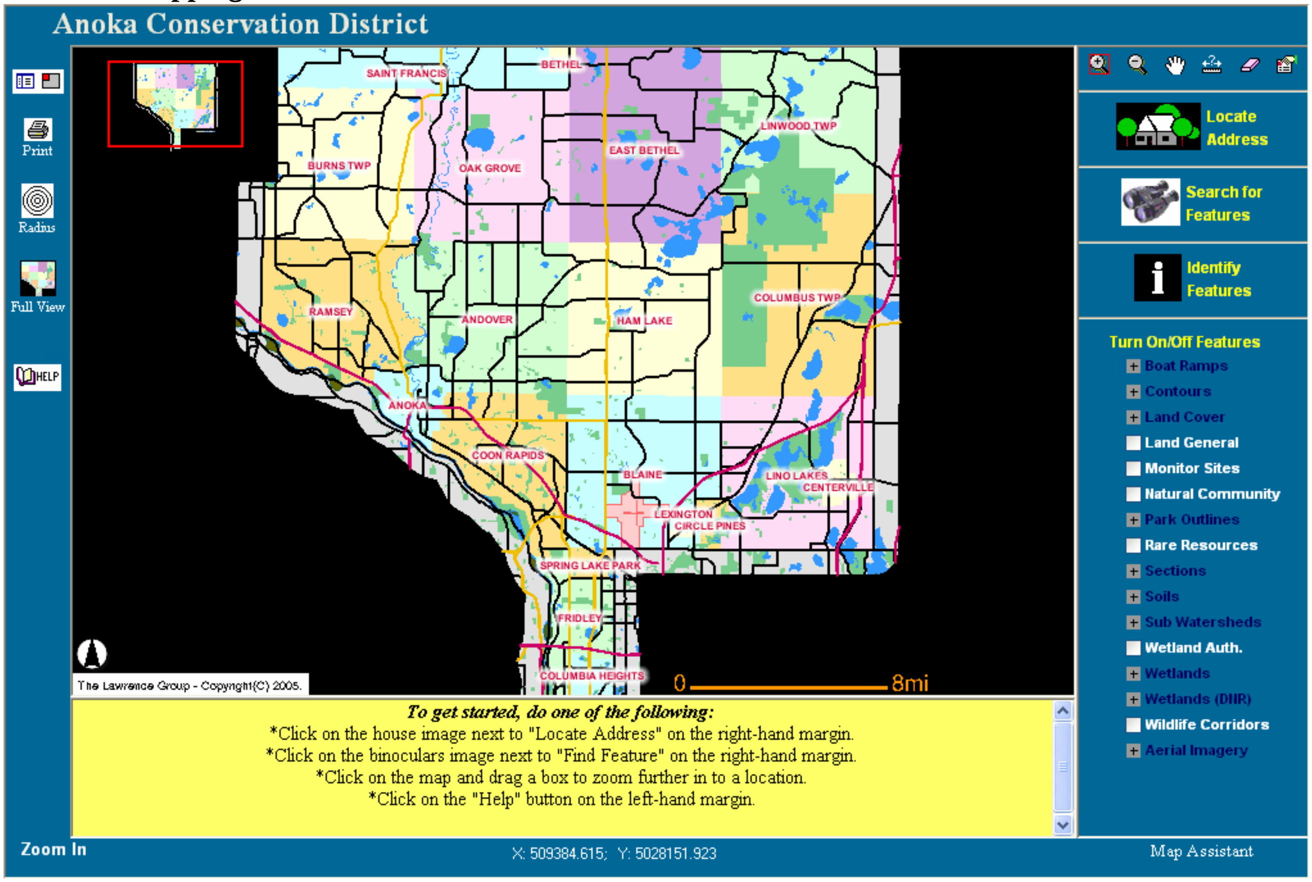
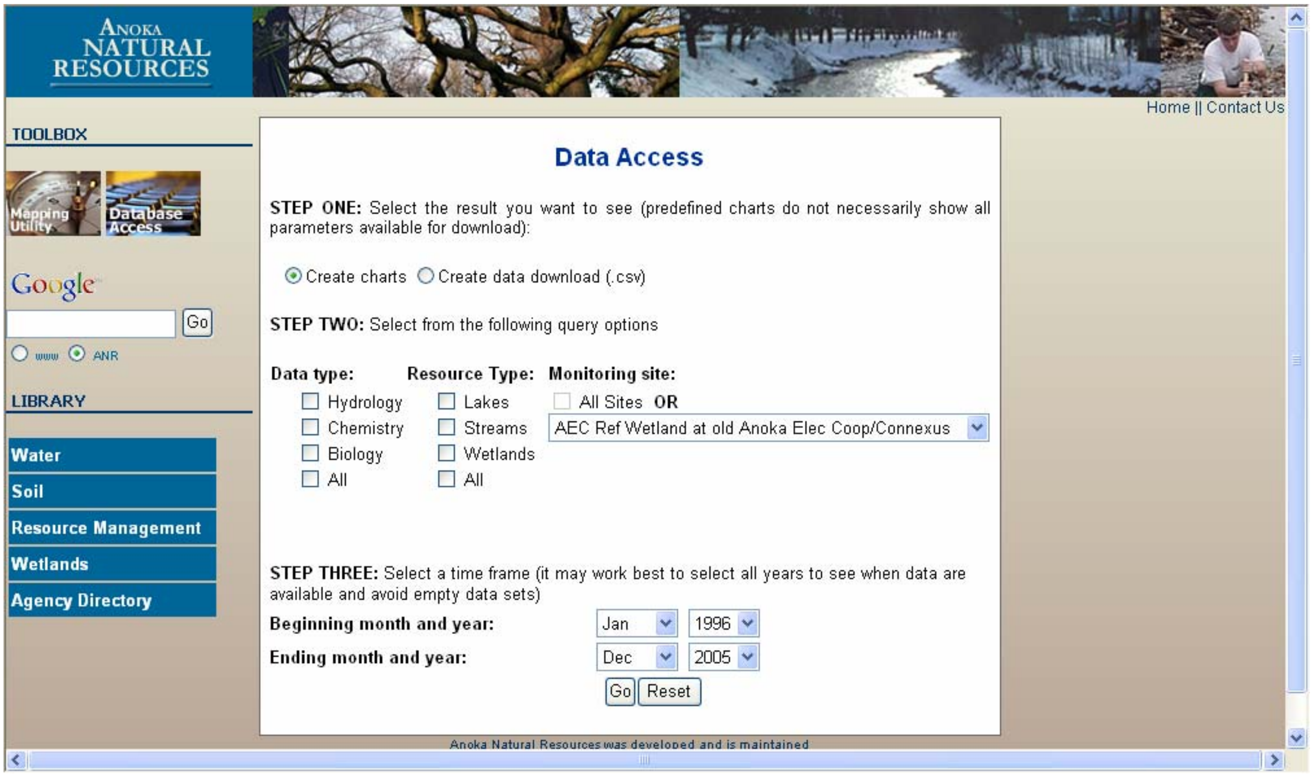
Interactive Mapping Tool



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.

Upper Rum River Watershed Financial Summary

Upper Rum River Watershed	Wetland Levels	Lake Levels	Groundwater Observation Wells	Stream Levels	Shoreland Survey	Stream Biomonitoring	Website	Total
Revenues								
URRWMO	0	105	0	0	2325	0	300	2730
State	0	0	283	0	0	0	0	283
County	0	0	446	0	1952	0	0	2397
County Ag Preserves	1548	0	0	0	0	1363	0	2911
BWSR General Services	0	0	0	0	0	0	649	649
Local Water Planning	0	282	0	1211	605	0	0	2098
TOTAL	1548	387	729	1211	4882	1363	949	11069
Expenses-								
Capital Outlay/Equip	272	9	41	36	0	25	18	402
Personnel Salaries/Benefits	1060	312	566	988	4498	1116	577	9117
Office Supplies/Maintenance	96	28	49	89	307	89	51	708
Employee Training	16	5	12	14	49	16	10	122
Vehicle/Mileage	21	6	12	19	47	17	10	131
Rent	46	16	30	41	34	29	32	161
Monthly Bills	14	5	8	12	2	9	9	54
Fees and Dues	12	3	10	9	4	7	5	50
Program Supplies	12	3	1	3	13	55	237	324
TOTAL	1548	387	729	1211	4882	1363	949	11069
NET	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** that are consistent with the newly-updated URRWMO Watershed Management Plan.
- **Encourage Anoka County to investigate the need for cleaning Ditch 19, the only inlet to Lake George**. Anoka County is the legal ditch authority. Residents have complained the ditch is clogged and contributing to low water levels in recent years.
- **Promote water quality improvement projects** for lakes, streams, and rivers. Utilize existing cost share grant programs and technical assistance 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. Actions might include fish surveys, septic surveys, and landowner best-practices education. This lake is on the state list of impaired waters.
- **Monitor water quality of Lake George and East Twin Lake every three years** to track any trends or changes. Next monitoring should be in 2008.

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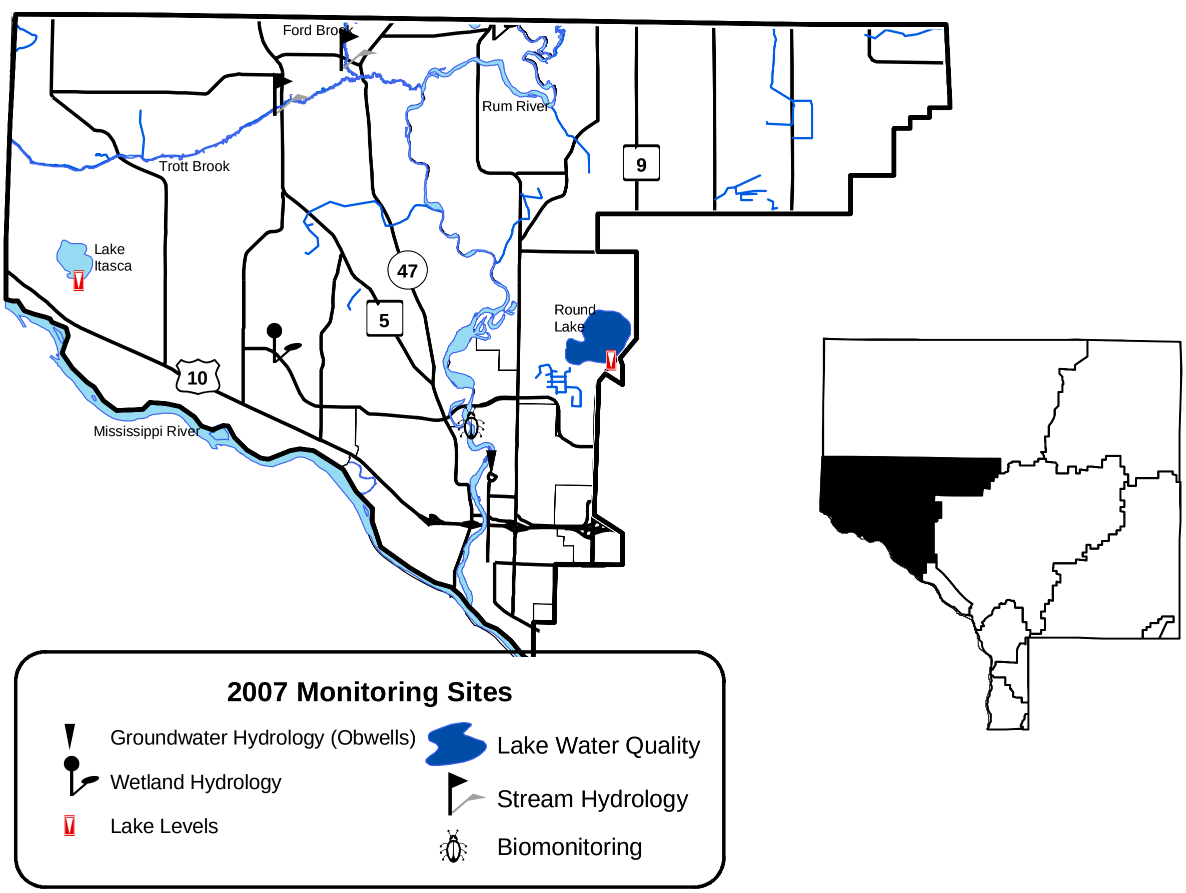
CHAPTER 4:
LOWER RUM RIVER WATERSHED

Raw data and data summaries can be found at the LRRWMO website – use the Data Access tool (www.AnokaNaturalResources.com/LRRWMO)

Task	Partners	Page
Lake Levels	LRRWMO, ACD, volunteers, MNDNR	4-86
Lake Water Quality	LRRWMO, ACD, ACAP	4-87
Stream Hydrology	ACD	4-90
Stream Water Quality – Biological	LRRWMO, ACD, ACAP, Anoka High School	4-93
Wetland Hydrology	LRRWMO, ACD, ACAP	4-96
Water Quality Improvement Projects	LRRWMO, ACD, landowners	4-99
LRRWMO Website	LRRWMO, ACD	4-100
Financial Summary		4-102
Recommendations		4-102
Groundwater Hydrology (obwells)	ACD, MNDNR	Chapter 1
Precipitation	ACD, volunteers	Chapter 1

ACD = Anoka Conservation District, LRRWMO = Lower Rum River Watershed Mgmt Org, MNDNR = Minnesota Dept. of Natural Resources, 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).

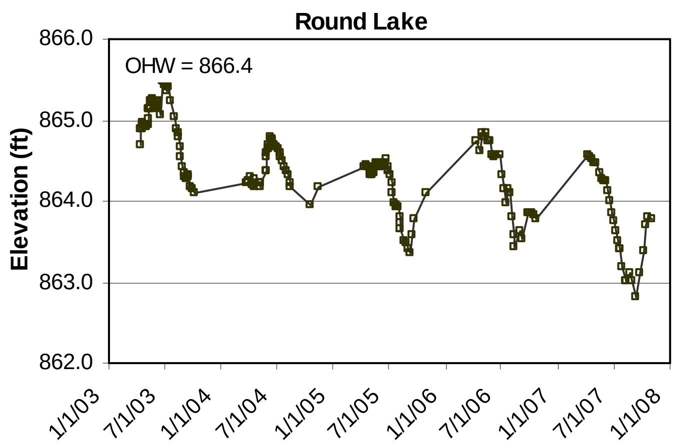
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

Locations: Lake Itasca, Round Lake, Rogers Lake

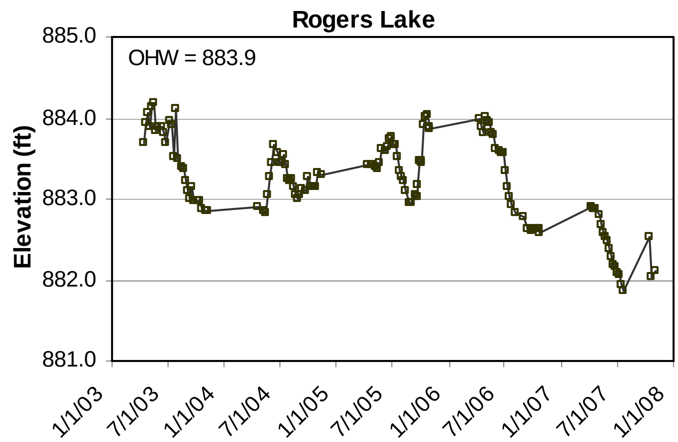
Results: Water levels were measured 20 to 28 times. Water levels on all three lakes dropped the entire open water season until late August when drought conditions ended and ample rains occurred. The total drop in water levels during the drought period of summer 2007 was 1.05 feet at Rogers Lake, 1.74 feet at Round Lake, and >2.02 feet at Lake Itasca. Lake Itasca could not be monitored after August 10th because of low water levels; open water was present only in the middle of the basin which was not accessible.

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.

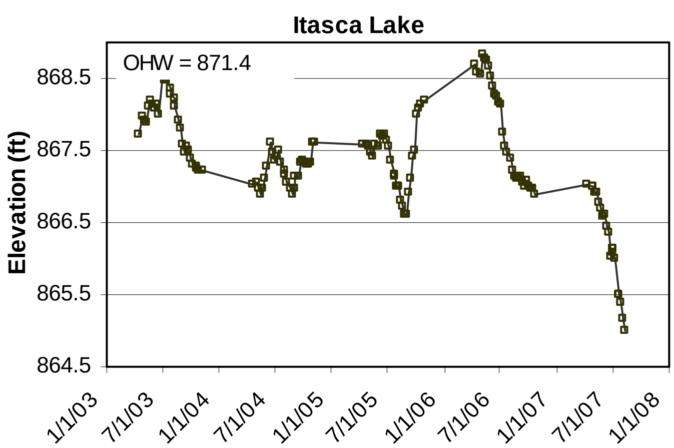
Round Lake Levels 2003-2007



Rogers Lake Levels 2003-2007



Lake Itasca Levels 2003-2007



Lower Rum River Watershed Lake Levels Summary

Lake	Year	Average	Min	Max
Itasca	2003	867.87	867.21	868.56
	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
Rogers	2003	883.53	882.84	884.18
	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
Round	2003	864.96	864.11	865.49
	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

Lake Water Quality

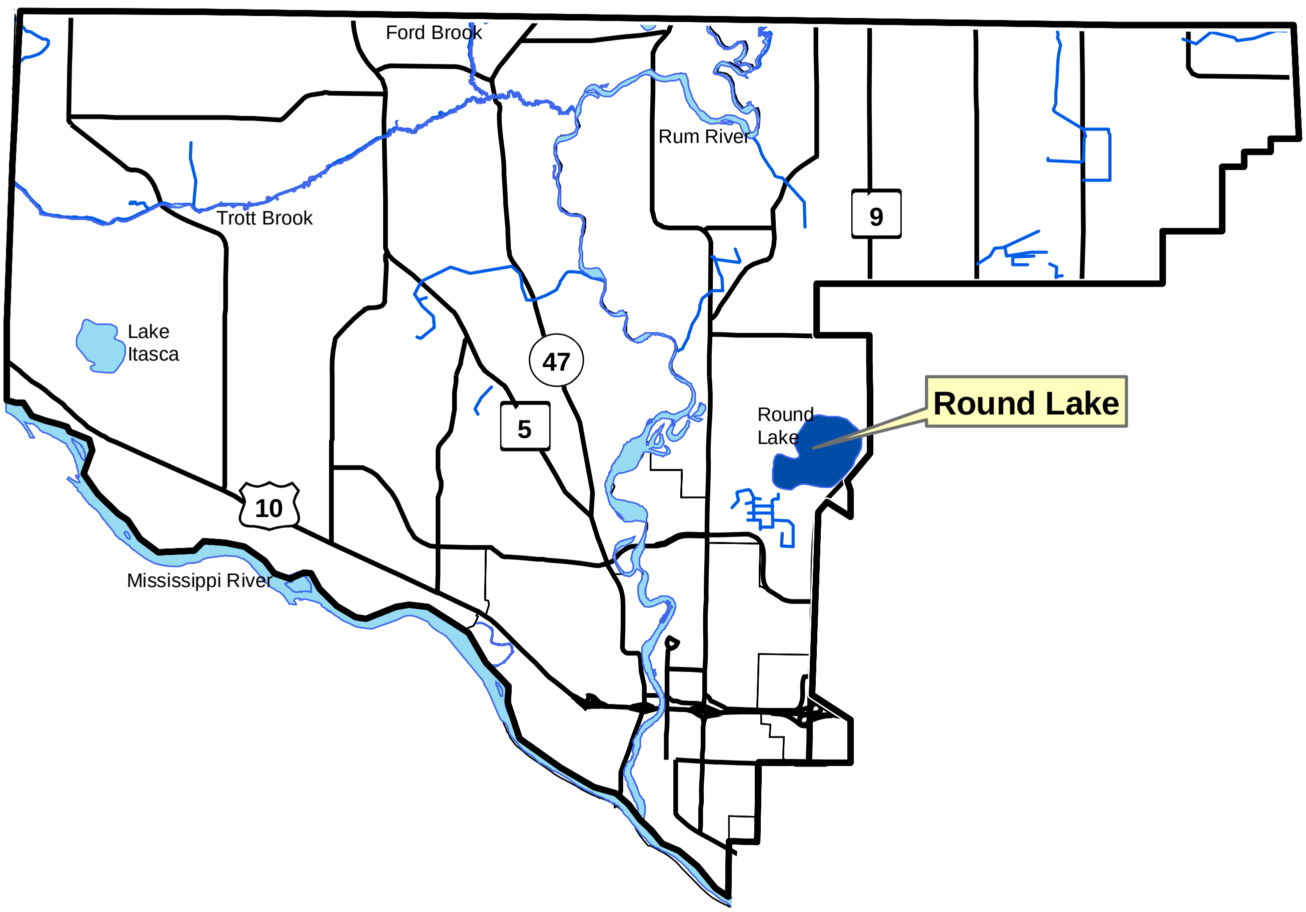
Description: May through September twice-monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, Secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

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

Locations: Round 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



Round Lake

City of Andover, Lake ID # 03-0089

Background

Round Lake is located in west-central Anoka County. It has a surface area of 220 acres and a maximum depth of 19 feet, though the majority of the lake is less than 4 feet in depth. The lake is surrounded by a cattail fringe, and has submerged aquatic vegetation growing throughout, including carpets of the macrophyte-like algae Chara (aka muskgrass, stonewort, and sand grass). This lake has a small watershed, with a watershed to surface area ratio of less than 10:1. The primary public access is from Round Lake Boulevard on the southeast side of the lake. Most of the lake is too shallow for motorized boat traffic. Waterfowl and other wildlife usage of this lake is high.

2007 Results

In 2007 Round Lake had average water quality compared to other lakes in this region (NCHF Ecoregion), receiving an overall C letter grade. The lake was slightly eutrophic. Total phosphorus was the highest of the six years this lake has been monitored. Chlorophyll-a and Secchi depth were the second worst observed (1998 was worse). Water clarity stayed greater than 6.5 feet until August, when algae levels increased several-fold. Water color was green throughout most of summer. Aquatic plants grew to the surface over much of the lake because water levels were low, lake is shallow, and water clarity is relatively good. Dissolved oxygen was within the range needed by fish and other aquatic life, except that a low reading of 3.65 mg/L was recorded on August 6.

Trend Analysis

Six years of water quality monitoring have been conducted by the Anoka Conservation District (1998-2000, 2003, 2005, 2007). This is not enough data for a powerful statistical test of trend analysis. If the test is attempted, it shows no significant trend (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,3}=3.46$, $p>0.05$). However, it is concerning that the two most recent years had the highest total phosphorus of the six years this lake has been monitored.

Discussion

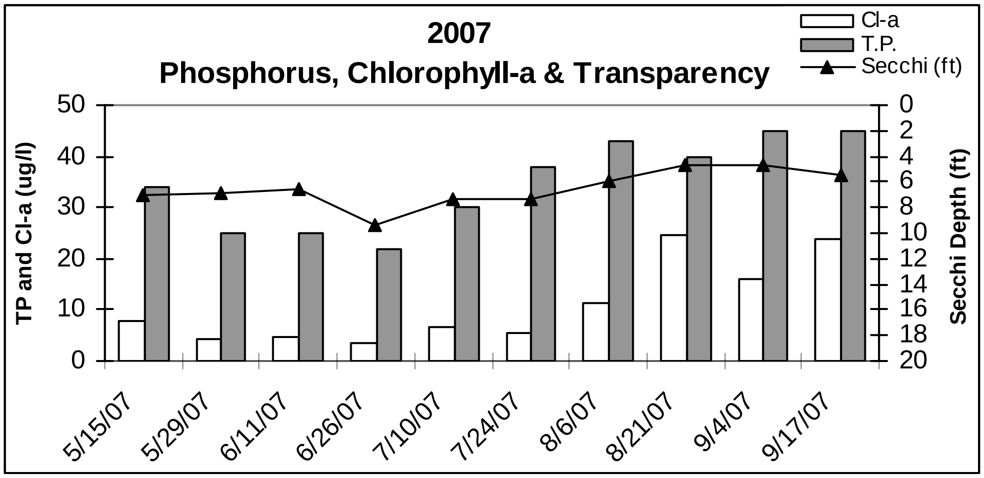
During the last 10 years Round Lake has generally been considered one of the four clearest lakes in Anoka County, but in 2005 it was slighly poorer and 2007 had only average water quality. These years, especially 2007, were also years with low water levels, which would make wind mixing of nutrient-rich bottom sediments more likely to occur. However, 2000 was also a low water year and water quality was very good, suggesting low water levels alone are not to blame. Aside from climate-driven water levels, the only other notable change within this lake's small watershed since 2003 is the reconstruction and widening of adjacent Round Lake Boulevard. However, this road reconstruction included ponds to intercept and treat road runoff before it reaches the lake, and road surfaces are not typically a source of large amounts of phosphorus. Excessive numbers of waterfowl are a third possible cause of recently poorer water quality. Lastly, the observed water quality might be within the range of natural variation experienced on this lake; only a short record is available. This lake should be closely watched in the coming years for unnatural causes of water quality degradation.

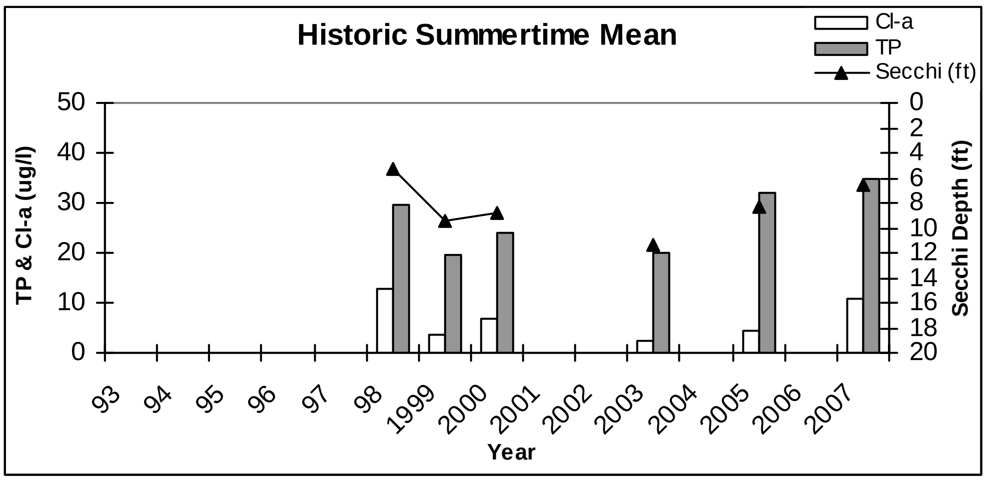
Aquatic plants are an important part of shallow lakes, and Round Lake's aquatic vegetation should be protected.

2007 Round Lake Water Quality Data

	Units	R.L.*	5/15/07 Results	5/29/07 Results	6/11/07 Results	6/26/07 Results	7/10/07 Results	7/24/07 Results	8/6/07 Results	8/21/07 Results	9/4/07 Results	9/17/07 Results	Average	Min	Max
pH		0.1	8.44	8.83	x	7.22	x	x	x	x	8.98	8.66	8.43	7.22	8.98
Conductivity	mS/cm	0.01	0.318	0.305	0.263	0.239	0.257	0.263	0.280	0.266	0.278	0.299	0.277	0.239	0.318
Turbidity	FNRU	1	4.00	2.00	x	0x	3	1	1.00	6.00	6.00	6.00	4	1	6
D.O.	mg/l	0.01	8.70	9.10	9.45	8.45	4.99	6.55	3.65	6.70	8.52	10.83	7.69	3.65	10.83
D.O.	%	1	93%	102%	110%	105%	61%	79%	43%	72%	100%	108%	87%	43%	110%
Temp.	°C	0.1	18.6	20.5	23.0	26.7	25.9	25.0	23.8	19.3	23.4	15.7	22.2	15.7	26.7
Temp.	°F	0.1	65.5	68.9	73.4	80.1	78.6	77.0	74.8	66.7	74.1	60.3	71.9	60.3	80.1
Salinity	%	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Cl-a	ug/l	0.5	7.8	4.3	4.5	3.5	6.8	5.5	11.5	25	16.1	23.7	10.9	3.5	24.8
T.P.	mg/l	0.010	0.034	0.025	0.025	0.022	0.030	0.038	0.043	0.040	0.045	0.045	0.035	0.022	0.045
T.P.	ug/l	10	34	25	25	22	30	38	43	40	45	45	35	22	45
Secchi	ft	0.1	7.0	6.9	6.5	9.4	7.3	7.3	5.9	4.7	4.7	5.4	6.5	4.7	9.4
Secchi	m	0.1	2.1	2.1	2.0	2.9	2.2	2.2	1.8	1.4	1.4	1.6	2.0	1.4	2.9
Field Observations															
Physical			1.50	2.50	3.00	2.00	2.0	3.0	3.00	3.50	3.50	3.50	2.8	1.5	3.5
Recreational			1.50	2.00	2.50	2.00	2.0	2.0	3.00	3.00	3.50	3.00	2.5	1.5	3.5

Round Lake Water Quality Results

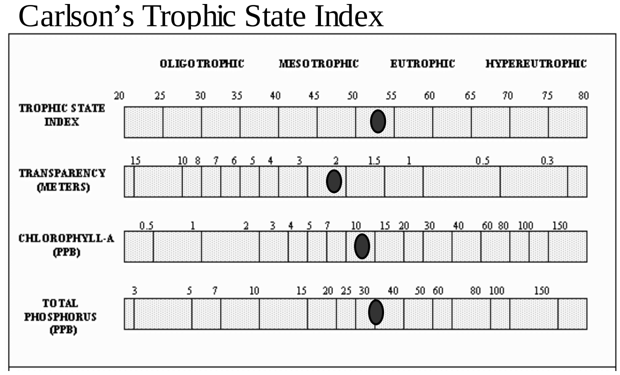




Round Lake Summertime Historic Mean

Agency	ACD	ACD	ACD	ACD	ACD	ACD
Year	98	1999	2000	2003	2005	2007
TP	29.8	19.6	24.1	20.0	32.0	34.7
Cl-a	12.8	3.7	6.9	2.4	4.6	10.9
Secchi (m)	1.4	2.9	2.7	3.4	2.5	2.0
Secchi (ft)	5.2	9.5	8.8	11.3	8.3	6.5
Carlson's Tropic State Indices						
TSIP	53	47	50	47	54	55
TSIC	56	44	48	39	46	54
TSIS	55	45	46	42	47	50
TSI	55	45	48	43	49	53
Round Lake Water Quality Report Card						
Year	98	99	2000	2003	2005	2007
TP	B	A	B	A	B	C
Cl-a	B	A	A	A	A	B+
Secchi	C	B	B	A	B	C
Overall	**B**	**A**	**B**	**A**	**B**	**C**

Carlson's Trophic State Index



Stream Hydrology

Description: Continuous water level monitoring in streams.

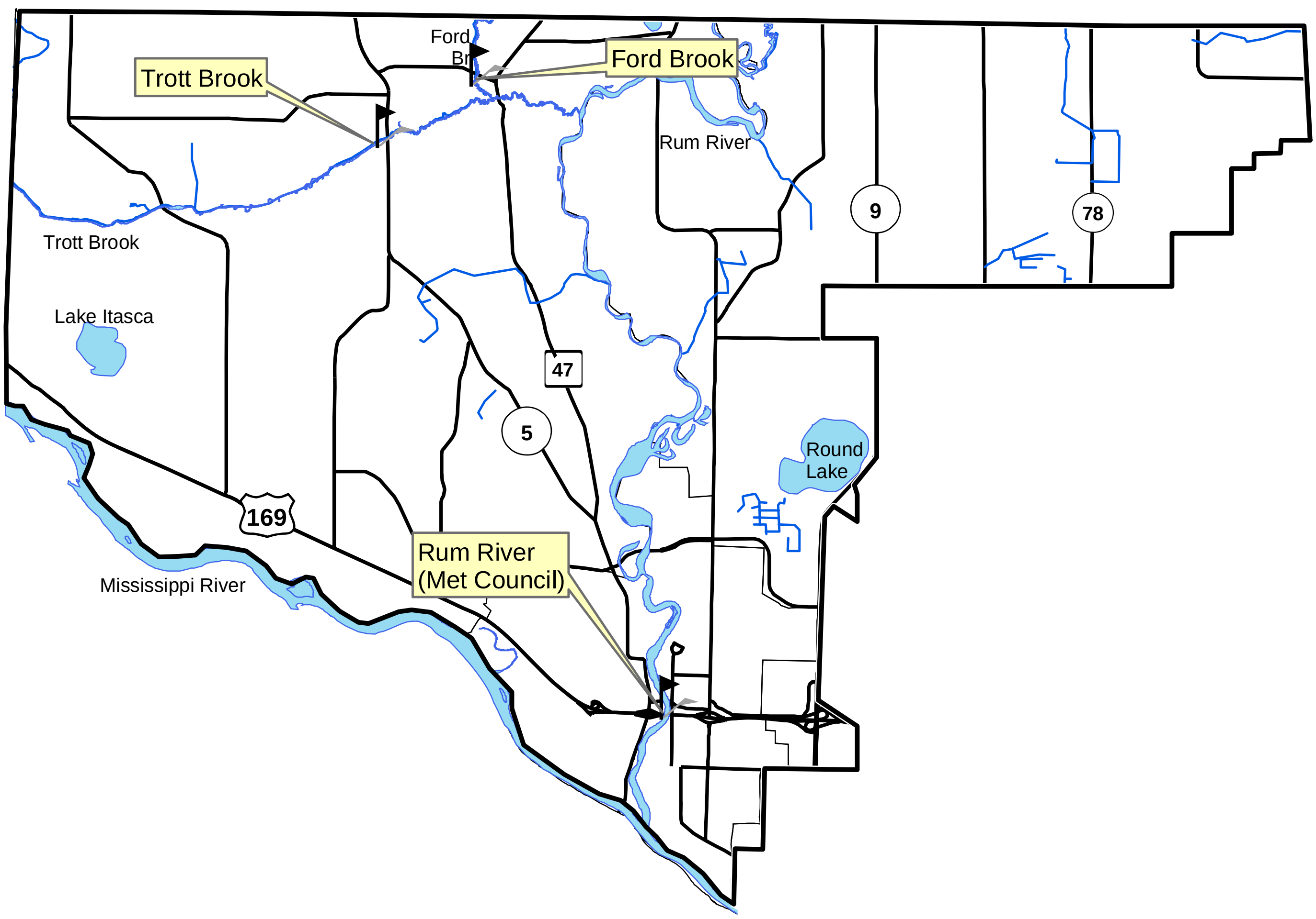
Purpose: To provide understanding of stream hydrology, including the impact of climate, land use or discharge changes. These data also facilitate pollutant load calculation, and are therefore often paired with water quality monitoring. Other uses include use in computer models for developing management strategies and water appropriations permit decisions.

Locations: Ford Brook at Highway 63, Ramsey

Trott Brook at Highway 5, Ramsey

Rum River at Anoka Dam, Anoka (Met Council WOMP program, contact Met Council for results)

Lower Rum River Watershed Stream Hydrology Monitoring Sites

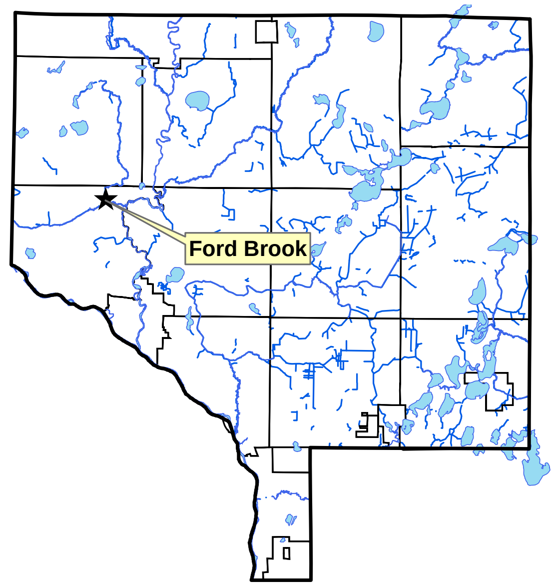


Stream Hydrology Monitoring

FORD BROOK

at Highway 63 (Green Valley Rd NW), Ramsey
STORET SiteID = S003-200

Notes



This is a medium-large creek that originates from Ekstrom Lake in north-central Burns Township, flows through Burns Township, and outlets to the Rum River in northeast Ramsey. Overall, the watershed is rural residential with 5 acre lots. The creek is about 25 feet wide and 2.5 feet deep at the monitoring site during baseflow.

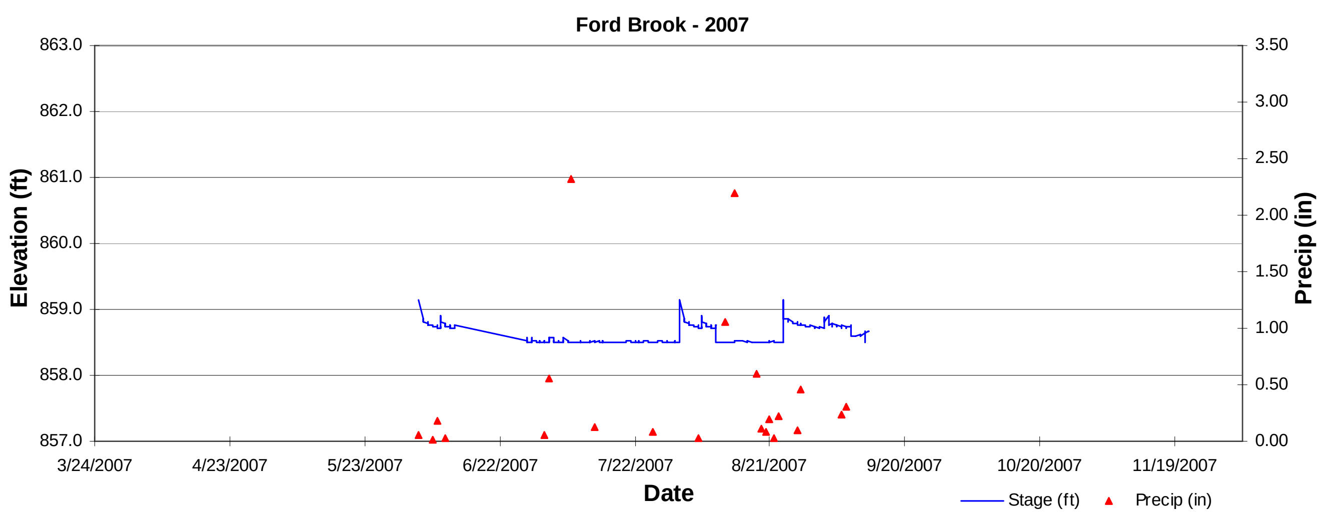
Ford Brook had low flows in 2007, similar to 2006. However, in 2007 there were equipment malfunctions during the wettest parts of the year, so summaries of data are not representative of the entire year. The water level monitoring device completely failed in spring and fall. Summer, when the equipment worked, was a drought. The drought broke in late August, but the equipment again failed in mid-September. However, during the rainy period of late August and early September stream levels increased only less than 0.5 feet, probably because the rainstorms were small (<0.5 inch) and the soils were very dry.

Summary of All Monitored Years

Percentiles	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	All Years
Min	859.22	859.21	859.15	859.06	859.13	858.86	858.89	858.71	858.74	858.74	858.63	858.51	858.51
2.5%	859.28	859.40	859.18	859.09	859.15	858.86	858.95	858.74	858.77	858.76	858.66	858.51	858.69
10.0%	859.40	859.58	859.18	859.12	859.15	858.86	859.15	858.77	858.91	858.82	858.80	858.51	858.89
25.0%	859.51	859.69	859.26	859.20	859.15	858.86	859.46	858.94	859.11	859.08	858.86	858.51	859.21
Median (50%)	859.67	859.85	859.30	859.32	859.18	858.89	859.74	859.20	859.40	859.51	858.97	858.53	859.48
75.0%	859.84	860.39	859.32	859.38	859.18	859.21	860.00	859.59	89.65	859.76	859.28	858.73	859.81
90.0%	860.04	861.09	859.38	859.53	859.24	859.97	860.39	860.07	860.05	860.12	859.73	858.79	860.21
97.5%	860.60	861.45	859.55	859.87	859.35	860.56	860.79	860.45	860.53	860.78	860.11	858.85	861.11
Max	861.44	861.65	859.61	860.10	859.50	861.05	861.13	861.24	860.90	861.43	860.59	859.13	861.65

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

2007 Hydrograph

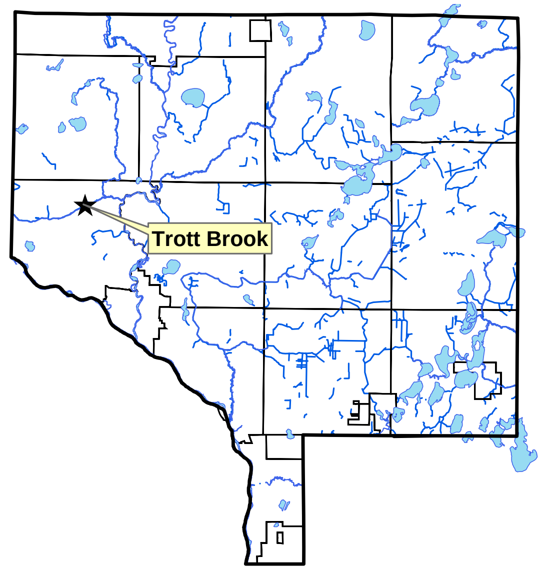


Stream Hydrology Monitoring

TROTT BROOK

at Highway 5 (Nowthen Blvd NW), Ramsey
STORET SiteID = S003-176

Notes



Trott Brook is a medium-sized creek that flows south through Sherburne County, paralleling the Anoka-Sherburne County boundary before turning east through the City of Ramsey where outlets to the Rum River. Overall, the watershed is rural or suburban residential, and areas within the watershed are undergoing rapid development. The creek is about 25 feet wide and 2.5 feet deep at the monitoring site during baseflow.

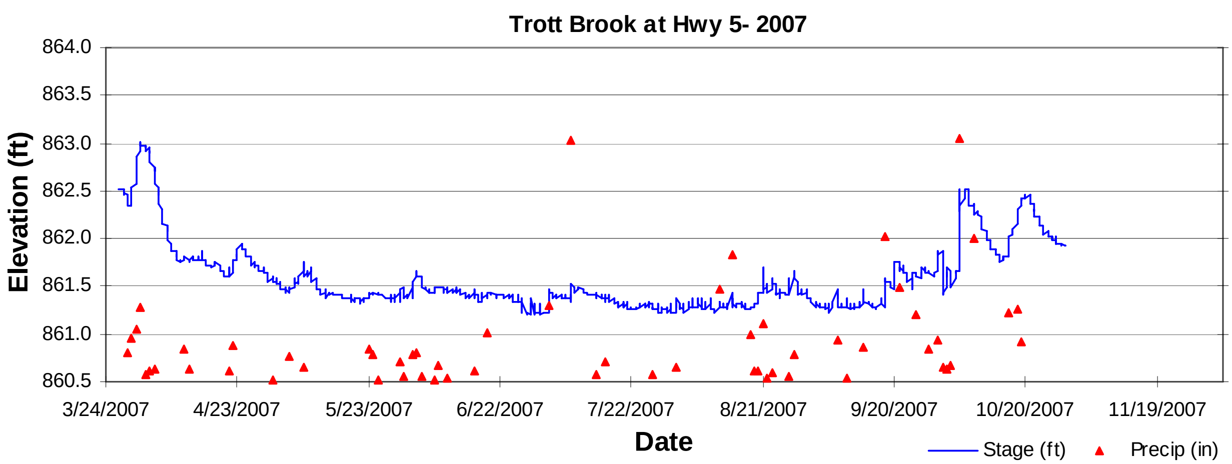
In 2007, like 2006, a mid-summer drought developed and therefore stream levels were low most of summer. Trott Brook had its highest water in spring in response to snowmelt and in fall in response to rainfalls. The largest response was a 0.85 ft increase in stream levels in response to a 2.55-inch storm on October 5. The stream's response to other late summer rains was tiny because the parched soils absorbed most of those drought-breaking rains.

Summary of All Monitored Years

Percentiles	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	All Years
Min	861.75	861.46	861.15	861.30	861.30	861.21	861.68	861.39	861.44	861.30	861.23	861.20	861.15
2.5%	861.83	861.54	861.17	861.43	861.32	861.27	861.76	861.59	861.50	861.45	861.35	861.22	861.22
10.0%	861.89	861.69	861.20	861.51	861.35	861.36	862.14	861.74	861.76	861.57	861.38	861.28	861.32
25.0%	862.07	861.98	861.28	861.63	861.49	861.46	862.38	861.91	862.05	861.77	861.42	861.34	861.5
Median (50%)	862.30	862.24	861.33	861.77	861.51	861.75	862.96	862.26	862.26	862.06	861.50	861.43	861.95
75.0%	862.50	862.62	861.42	861.88	861.60	862.27	863.17	862.81	862.55	862.39	861.70	861.71	862.4
90.0%	862.79	863.11	861.55	862.19	861.63	862.36	863.34	863.17	862.99	863.18	862.28	862.15	862.94
97.5%	863.31	863.34	861.74	863.05	861.71	862.53	863.69	863.79	863.40	863.90	862.86	862.53	863.34
Max	863.66	863.78	861.90	863.56	861.77	862.86	863.89	864.45	863.63	864.08	863.25	863.01	864.45

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

2007 Hydrograph



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.

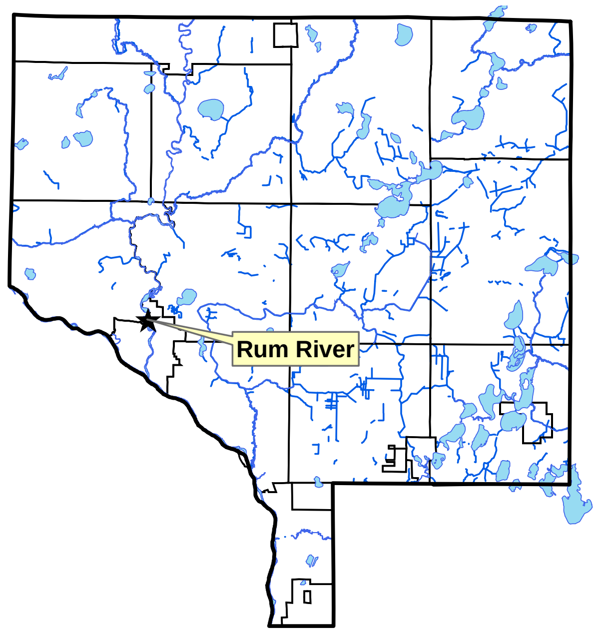
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

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 2007

Monitored Since

2001

Student Involvement

28 students in 2007, approx 230 since 2001

Background

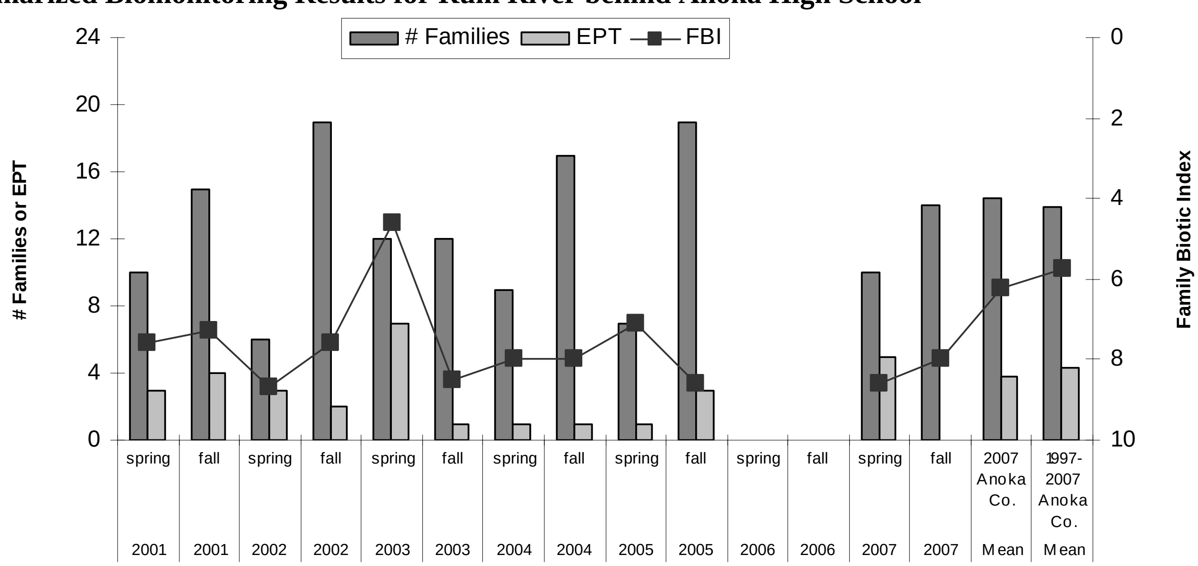
The Rum River originates from Lake Mille Lacs, and flows south through western Anoka County where it joins the Mississippi River in the City of Anoka. Other than the Mississippi, this is the largest river in the county. In Anoka County the river has both rocky ripples (northern part of county) as well 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 planned to monitor this site in both spring and fall, but only monitored in fall because their aquatic ecology class was not offered in spring. Anoka Conservation District staff monitored in spring.

The results for this site in 2007 were similar to previous years. The various indices, taken together, indicate a below average macroinvertebrate community. In 2007, and historically, the family biotic index is well below the county mean, and few of the pollution-sensitive EPT families are found. In fact, no EPT families were found in fall 2007. 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	Mean	Mean
Season	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	2007 Anoka Co.	1997-2007 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	6.2	5.7
# Families	10	15	6	19	12	12	9	17	7	19	10	14	14.4	13.9
EPT	3	4	3	2	7	1	1	1	1	3	5	0	3.8	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		
sampling by	AHS	AHS	ACD	AHS	ACD	AHS	ACD	Anoka HS	AHS	AHS	ACD	AHS		
sampling method	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		
# replicates	1	1	1	2	1	1	1	1	1	1	1	1		
Dominant Family	corixidae	hemiptera	corixidae	taltridae	baetidae	corixidae	corixidae	corixidae	siphlonuridae	corixidae	corixidae	coenagrionidae		
% 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		
% Ephemeroptera	7	16.9	4.5	1.4	73	0.5	24.5	0.2	82.3	1.7	5.3	0		
% Trichoptera	0	0	0	0	2.4	0	0	0	0	0	0	0		
% Plecoptera	4	0	0.6	0	7.1	0	0	0	0	0	0.5	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
pH	7.66	8.63	8.27	9.12	8.45	8.04	8.50	7.42
Conductivity (mS/cm)	0.305	0.343	0.140	0.203	0.193	0.171	0.283	0.243
Turbidity (NTU)	3	1	3	2	5	5	17	13
Dissolved Oxygen (mg/L)	8.50	8.24	6.2	9.30	11.81	11.23 (95%)	11.41	9.72 (87%)
Salinity (%)	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00
Temperature (C)	17.7	15.9	20.2	11.6	13.1	9.0	15.3	10.6

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. Upstream the human population density is lower, so there are fewer areas of disturbance and fewer storm water inputs. 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. Overall, there is less desirable habitat for invertebrates in the downstream reaches.

Water quality also 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. 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.

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.

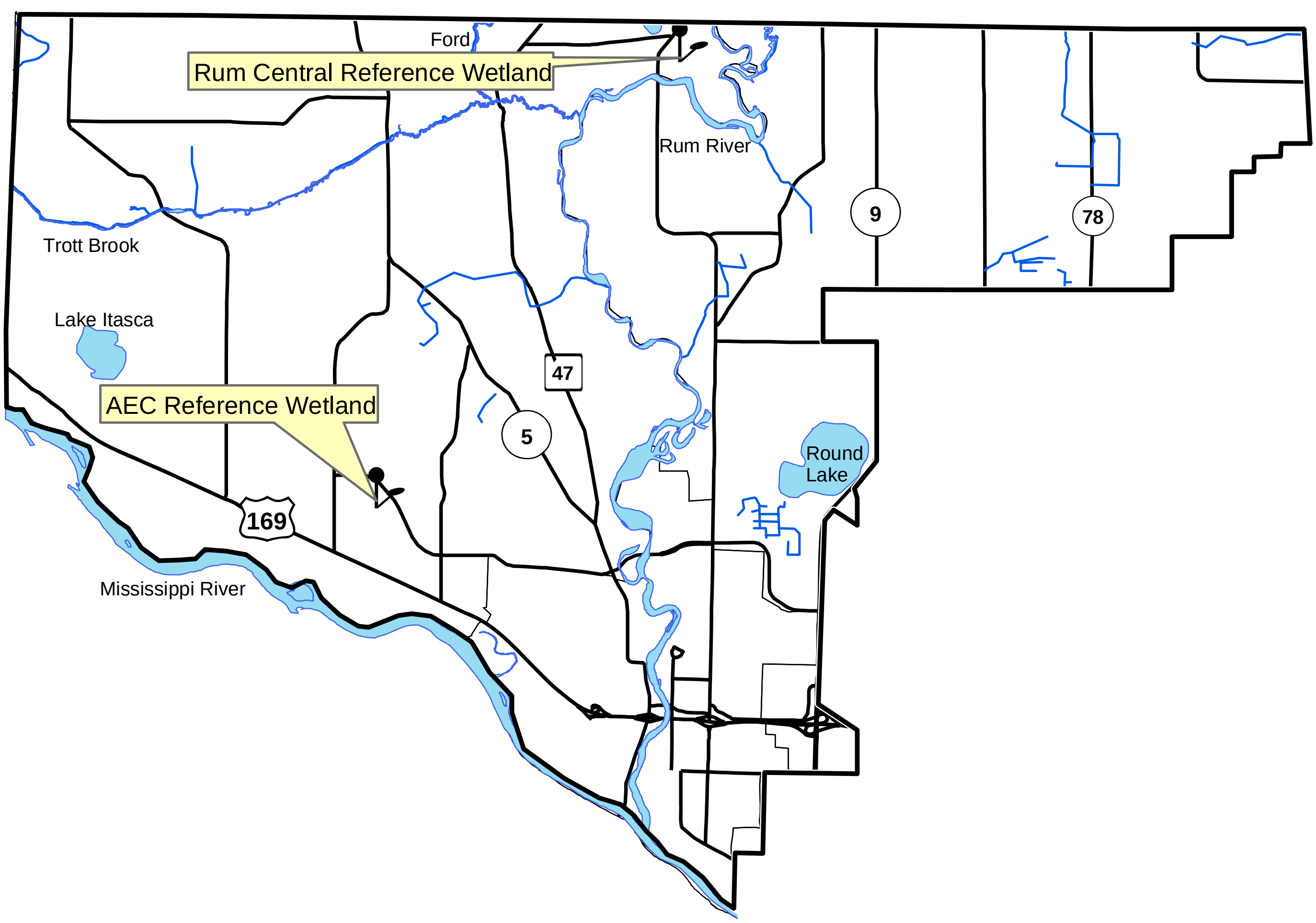
Purpose: To provide understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

Locations: 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

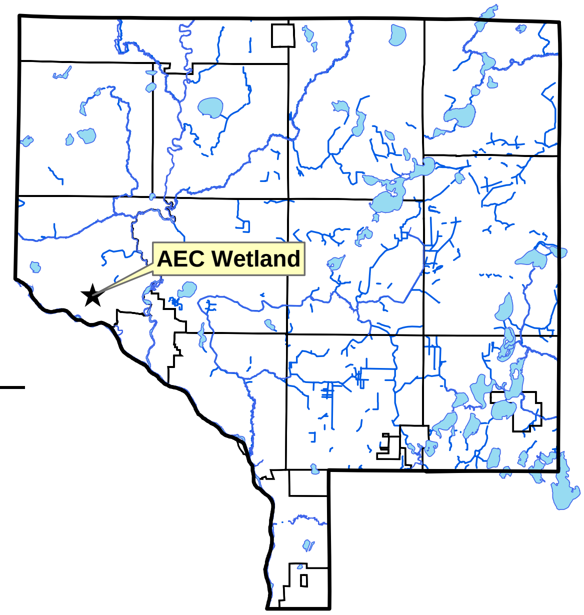
Monitored Since: 1999

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	-

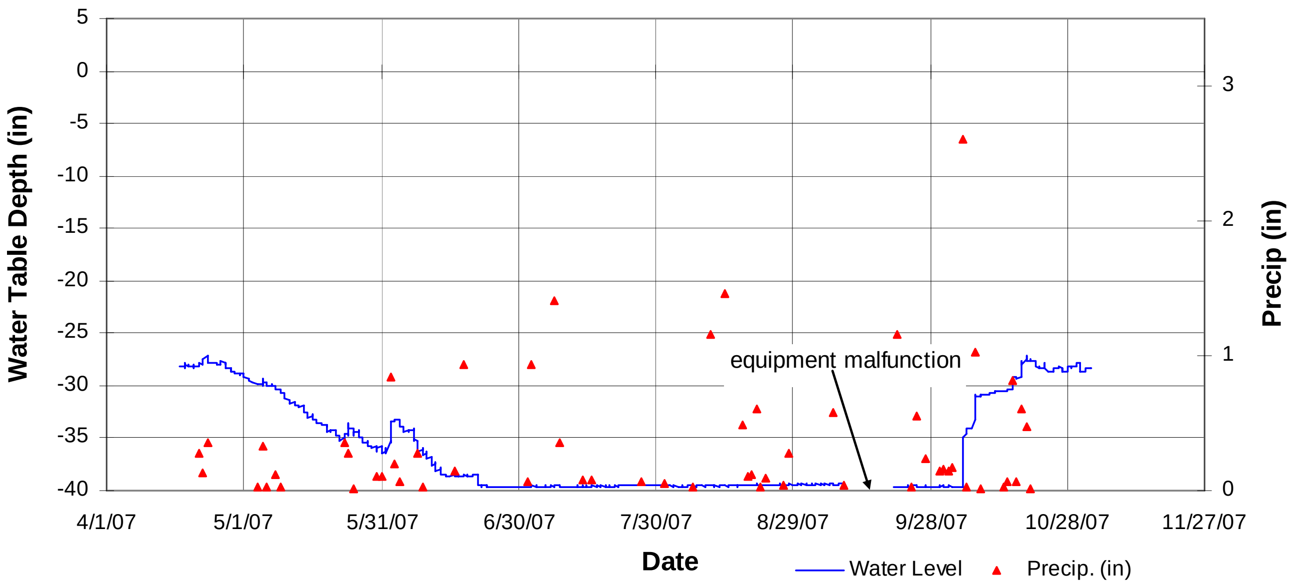
Surrounding Soils: Hubbard coarse sand

Vegetation at Well Location:

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

Other Notes: Well is located at the wetland boundary.

2007 Hydrograph

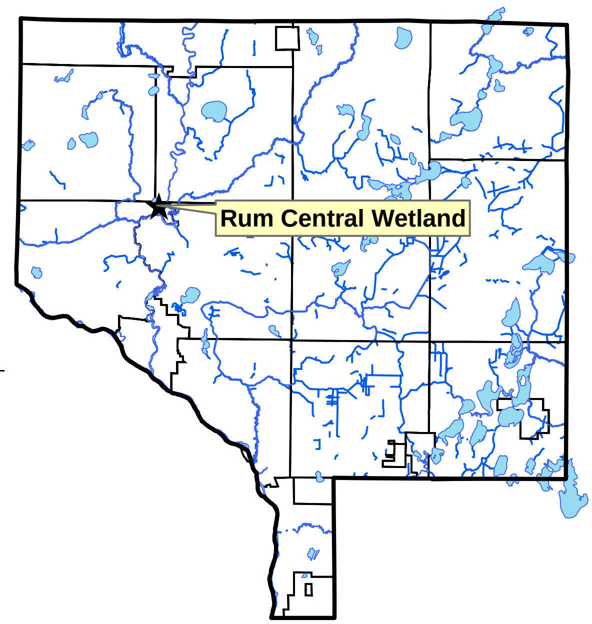


Well depths were 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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	-

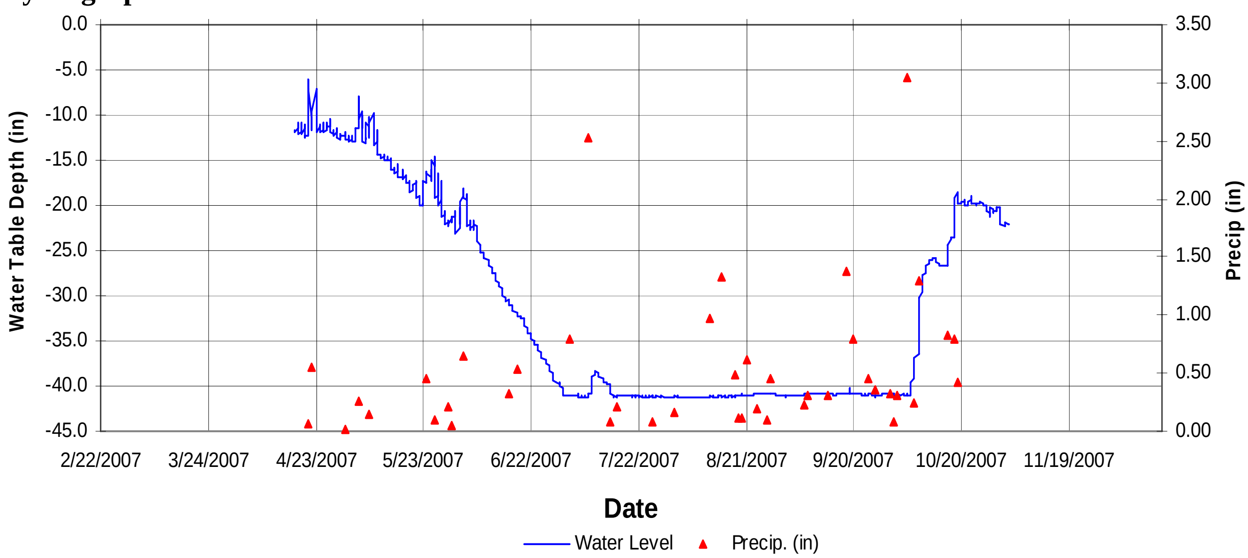
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary	40
Corylus americanum	American Hazelnut	40
Onoclea senibilis	Sensitive Fern	30
Rubus stigosus	Raseberry	30
Quercus rubra	Red Oak	20

Other Notes: Well is located at the wetland boundary.

2007 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.

Cost Share for 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: In 2007 no water quality improvement projects utilized the LRRWMO cost share funds. The funds will remain available in 2008 and subsequent years, until consumed. No new cost share funding is being requested from the LRRWMO until the current funds (authorized in 2006) have been utilized. Currently available funds total $1,000.

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.

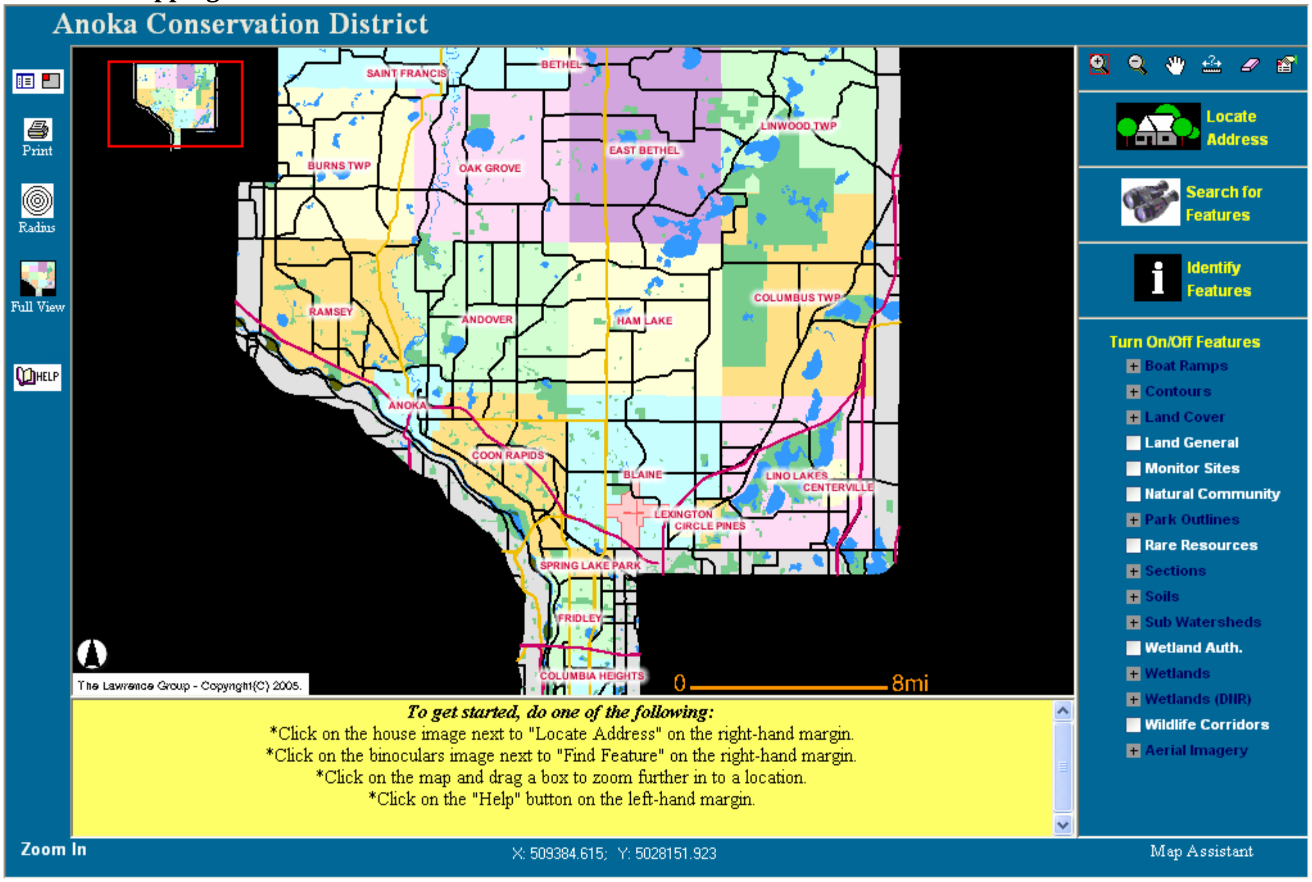
Other tools on the website include:

- 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

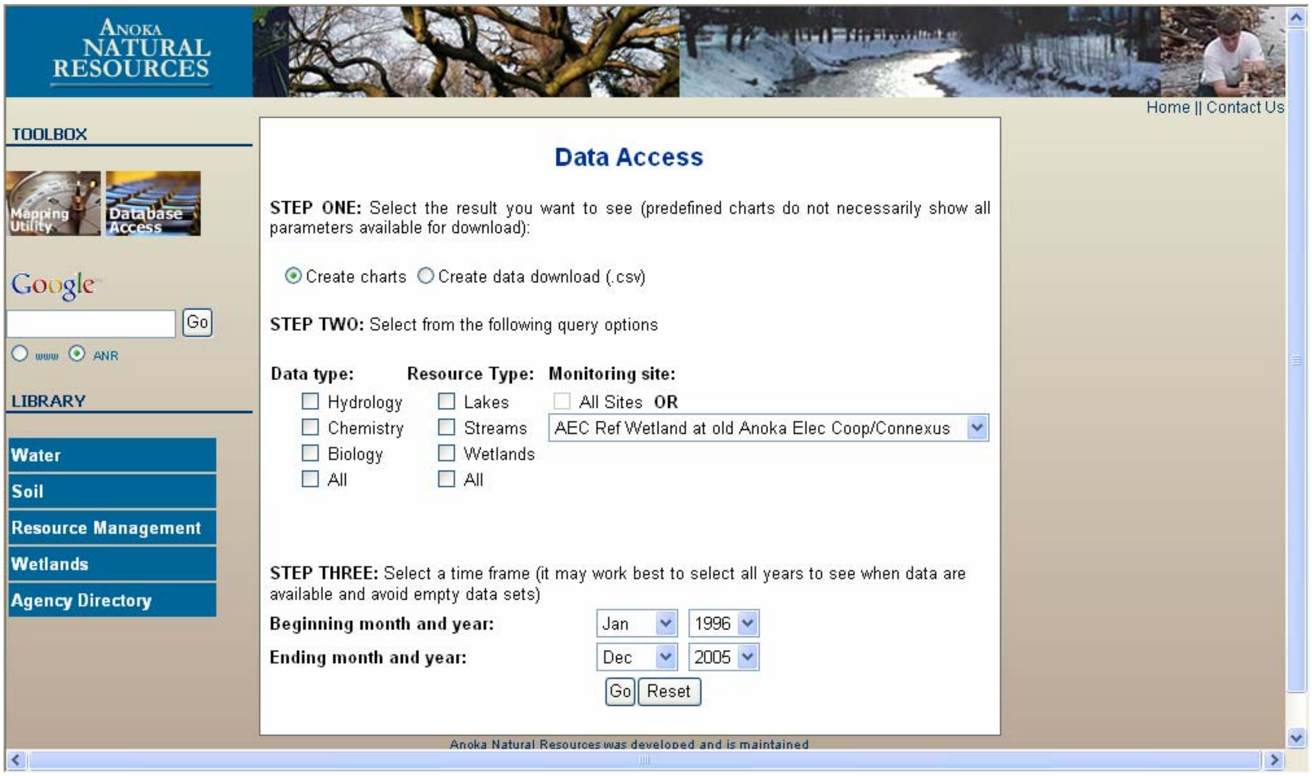
LRRWMO Website Homepage

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	Wetland Levels	Lake Levels	Groundwater Observation Wells	Stream Levels	Lake Water Quality	Stream Biomonitoring	Website	Total
Revenues								
LRRWMO	525	545	0	0	910	365	300	2645
State	0	0	94	0	0	0	0	94
County	0	0	149	0	0	0	0	149
County Ag Preserves	94	0	0	0	670	998	0	1762
BWSR General Services	0	0	0	0	0	0	649	649
Local Water Planning	0	99	0	606	134	0	0	839
TOTAL	619	644	243	606	1715	1363	949	6139
Expenses-								
Capital Outlay/Equip	109	16	14	18	24	25	18	223
Personnel Salaries/Benefits	424	520	189	494	1014	1116	577	4334
Office Supplies/Maintenance	38	46	16	44	98	89	51	383
Employee Training	7	8	4	7	14	16	10	66
Vehicle/Mileage	8	9	4	9	20	17	10	78
Rent	19	27	10	21	64	29	32	201
Monthly Bills	5	8	3	6	18	9	9	57
Fees and Dues	5	4	3	5	7	7	5	37
Program Supplies	5	5	0	2	457	55	237	761
TOTAL	619	644	243	606	1715	1363	949	6139
NET	0	0	0	0	0	0	0	0

Recommendations

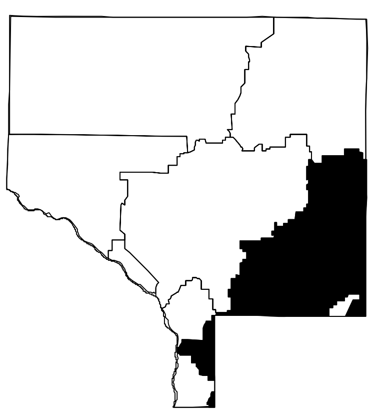
- **Continue monitoring Round Lake** water quality at least every other year to determine if poorer water quality recently is within this lake's natural variation or is a sign of developing problems.
- **Diagnose and improve Rogers Lake water quality problems** through a joint effort of the LRRWMO and URRWMO. Actions might include homeowner interviews, fish surveys, septic surveys, diagnostic water testing.
- **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 impairment in this watershed.

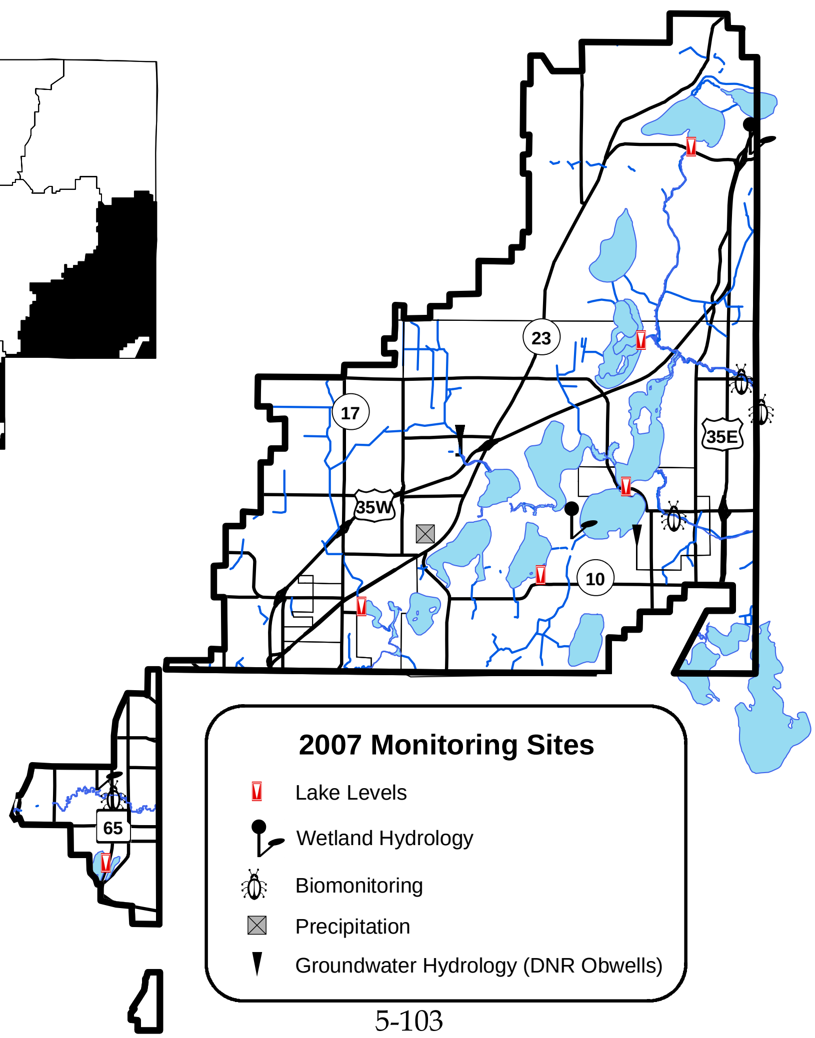
CHAPTER 5:
RICE CREEK WATERSHED

Raw data and summaries can be found at the Anoka Natural Resources website – use the Data Access tool (www.AnokaNaturalResources.com)

Task	Partners	Page
Lake Levels	RCWD, ACD	5-104
Wetland Hydrology	RCWD, ACD	5-106
Stream Water Quality – Biological	ACD, RCWD, ACAP, Centennial HS, Forest Lake Area Learning Center, Totino Grace HS	5-110
Financial Summary		5-117
Recommendations	ACD	5-117
Precipitation	ACD, volunteers	see chapter 1
Ground Water Hydrology (obwells)	ACD, MNDNR	see chapter 1
Additional monitoring 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, Howard, Moore, Peltier, Reshanau, and Rondeau Lakes

Results: Lake levels were measured by volunteers 19 (roughly weekly) to 107 times (nearly daily), depending upon the lake. All six of these lakes showed the same general trend, declining during summer drought, rebounding when rains returned in August, and further rising during the rainy fall. However, there were large differences in the magnitude of changes despite their close proximity to each other, and in some cases, hydrologic connectedness. Howard, Moore, and Rondeau ranged more than 1.5 to 1.69 feet. Reshanau ranged 2.38 feet, even though no readings are available after August 9. Yet Golden ranged only 0.84 feet and Peltier 0.78 feet.

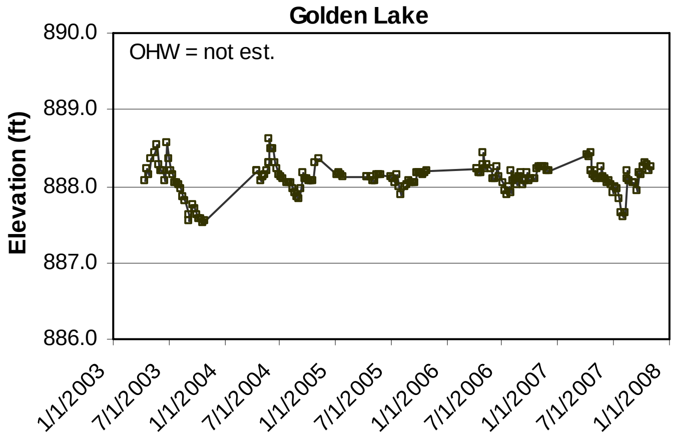
Ordinary High Water Levels (OHW), the elevation below which a DNR permit is needed to perform work, are listed for each lake on the graph.

Rice Creek Watershed Lake Levels Summary

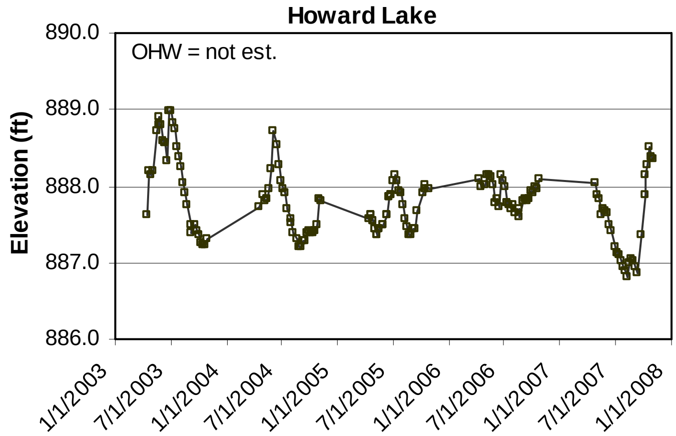
Lake	Year	Average	Min	Max
Golden	2003	887.99	887.52	888.57
	2004	888.15	887.83	888.61
	2005	888.10	887.87	888.20
	2006	888.14	887.88	888.44
	2007	888.09	887.60	888.44
Howard	2003	888.12	887.22	888.97
	2004	887.70	887.19	888.71
	2005	887.67	887.35	888.15
	2006	887.90	887.60	888.15
	2007	887.49	886.81	888.50
Moore	2003	876.80	876.16	877.53
	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

Lake	Year	Average	Min	Max
Peltier	2003	incomplete data		
	2004	incomplete data		
	2005	incomplete data		
	2006	884.60	884.51	884.91
	2007	884.57	884.21	884.99
Reshanau	2003	881.19	880.26	882.05
	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
Rondeau	2003	886.12	885.47	886.91
	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

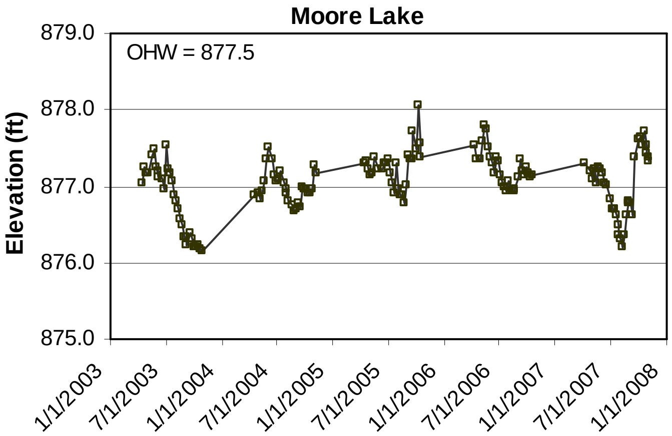
Golden Lake Levels 2003-07



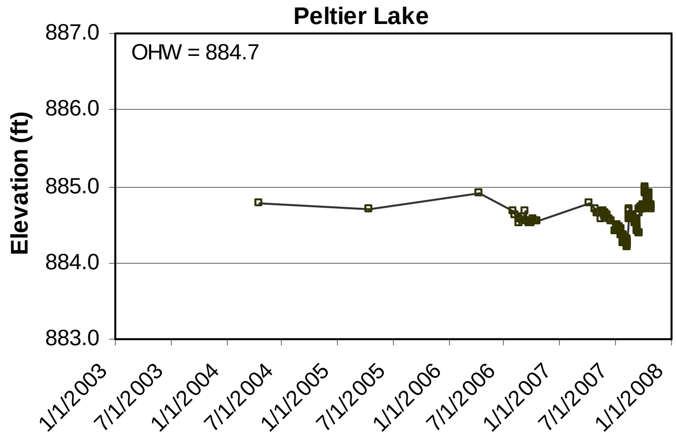
Howard Lake Levels 2003-07



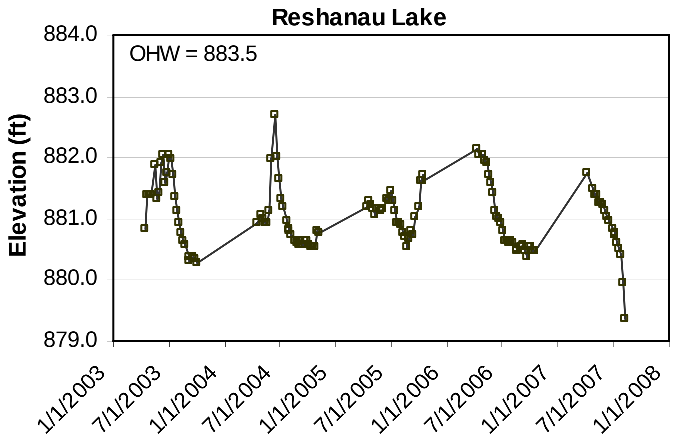
Moore Lake Levels 2003-07



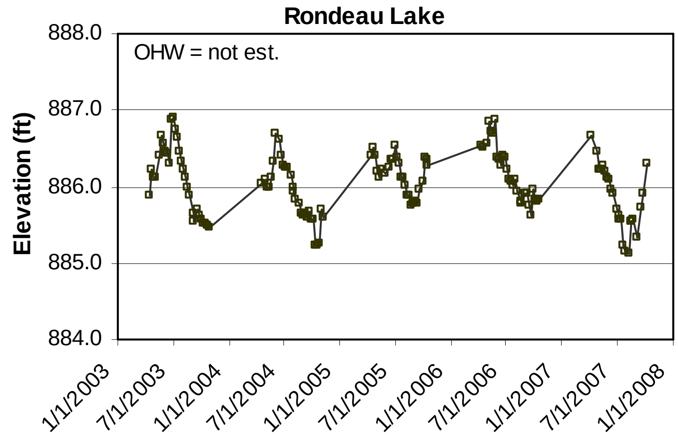
Peltier Lake Levels 2003-07



Reshanau Lake Levels 2003-07



Rondeau Lake Levels 2003-07



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.

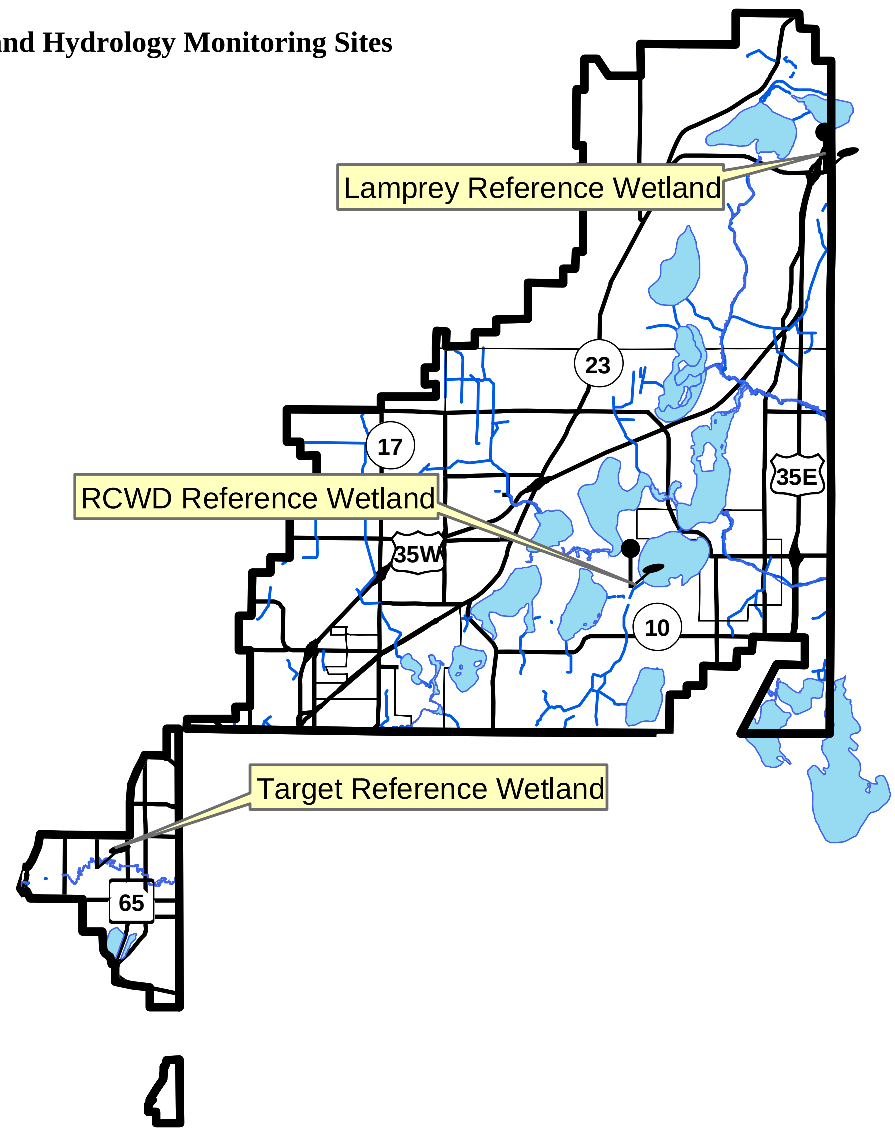
Locations: Lamprey Reference Wetland, Lamprey Pass Wildlife Management Area, Columbus

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



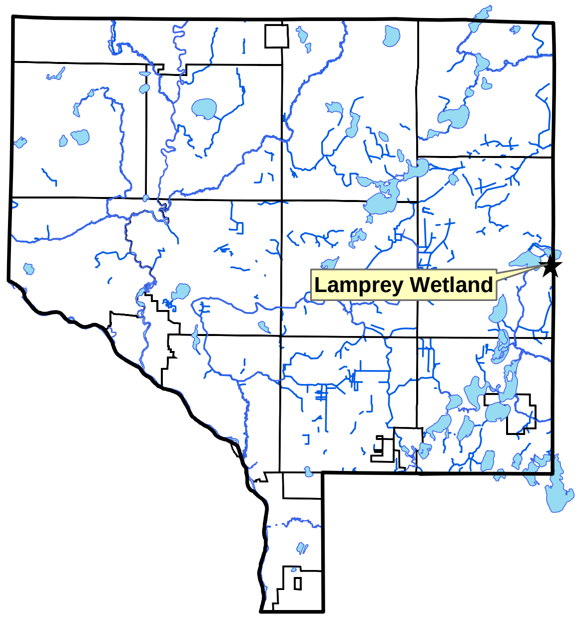
Wetland Hydrology Monitoring

LAMPREY REFERENCE WETLAND

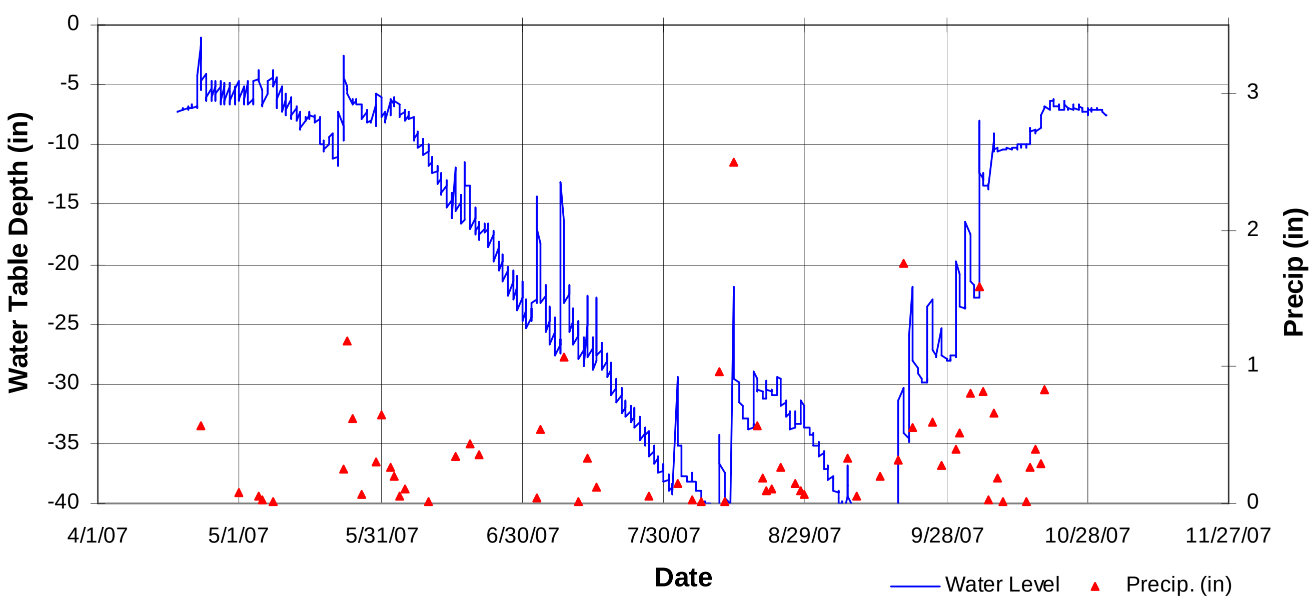
Lamprey Pass Wildlife Mgmt Area, Columbus

<u>Site Information</u>

Monitored Since:	1999
Wetland Type:	4
Wetland Size:	~0.5 acres
Isolated Basin?	Yes
Connected to a Ditch?	No
Soils at Well Location:	info to be collected in 2008
Surrounding Soils:	Braham loamy fine sand
Vegetation at Well Location:	info to be collected in 2008
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.



2007 Hydrograph

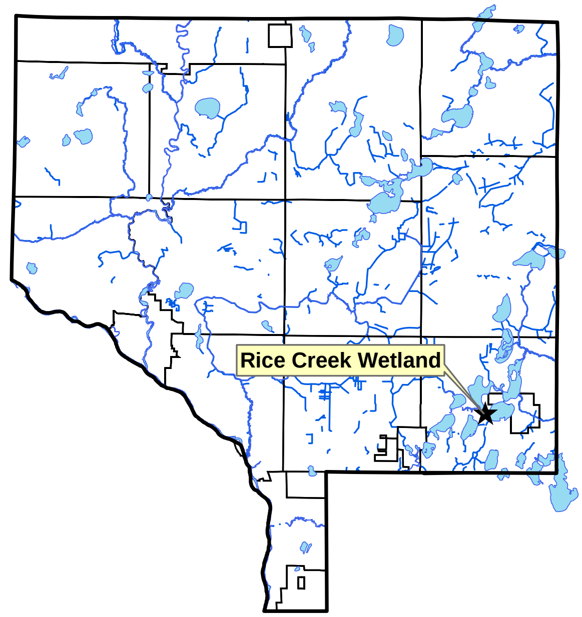


Well depths were 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

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

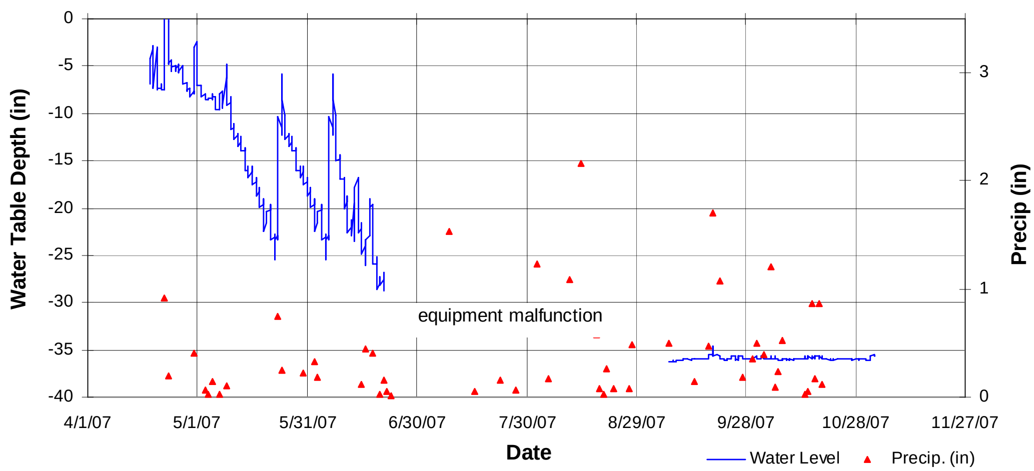
Surrounding Soils: Nessel fine sandy loam and Blomford loamy fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Rubus stigosus	Raspberry	30
Onoclea senibilis	Sensitive Fern	20
Fraxinus pennsylvanica	Green Ash	40
Amphicarpaea 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.

2007 Hydrograph

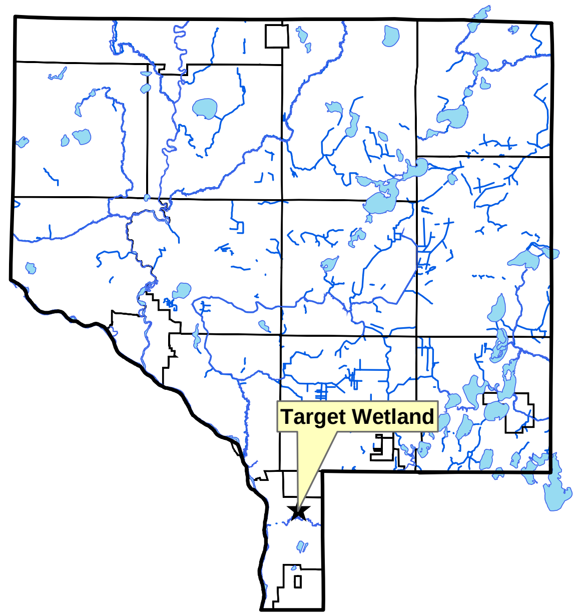


Well depth was 34.5 inches, so a reading of–34.5 indicates water levels were at an unknown depth greater than or equal to 34.5 inches.

Wetland Hydrology Monitoring

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

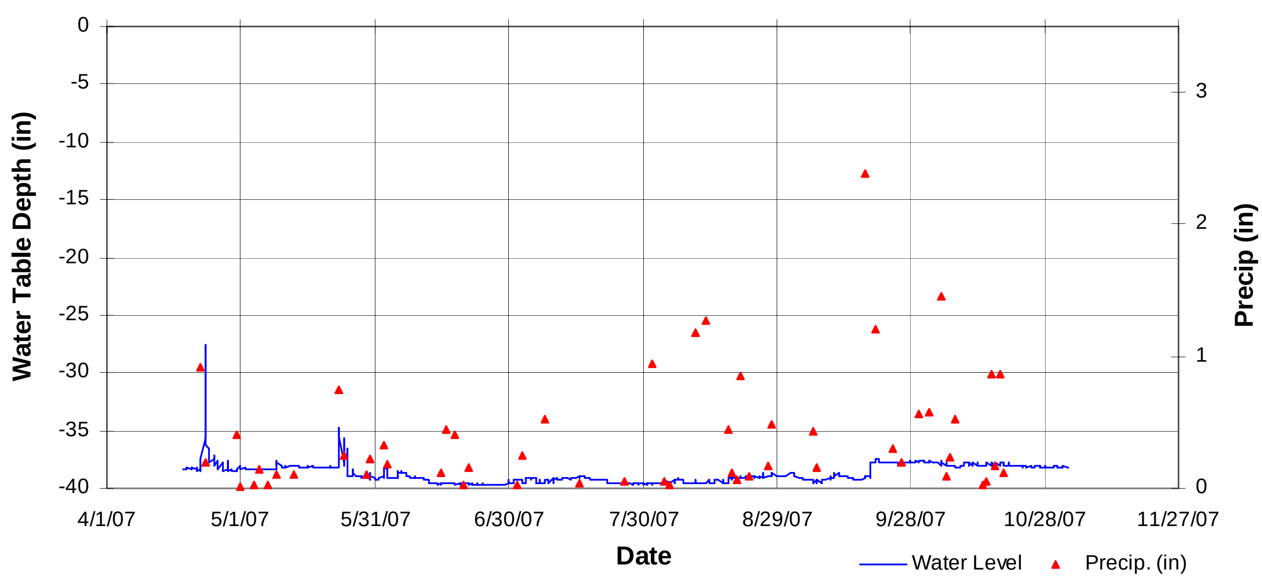
Surrounding Soils: Unknown, mostly pavement

Vegetation at Well Location:

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

Other Notes: Well is at the wetland boundary.

2007 Hydrograph



Well depth was 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.

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

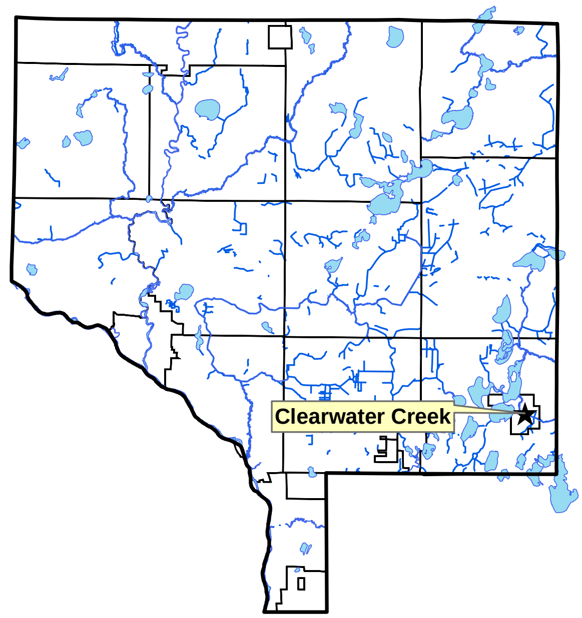
Last Monitored

By Centennial High School in 2007

Monitored Since

1999

Background



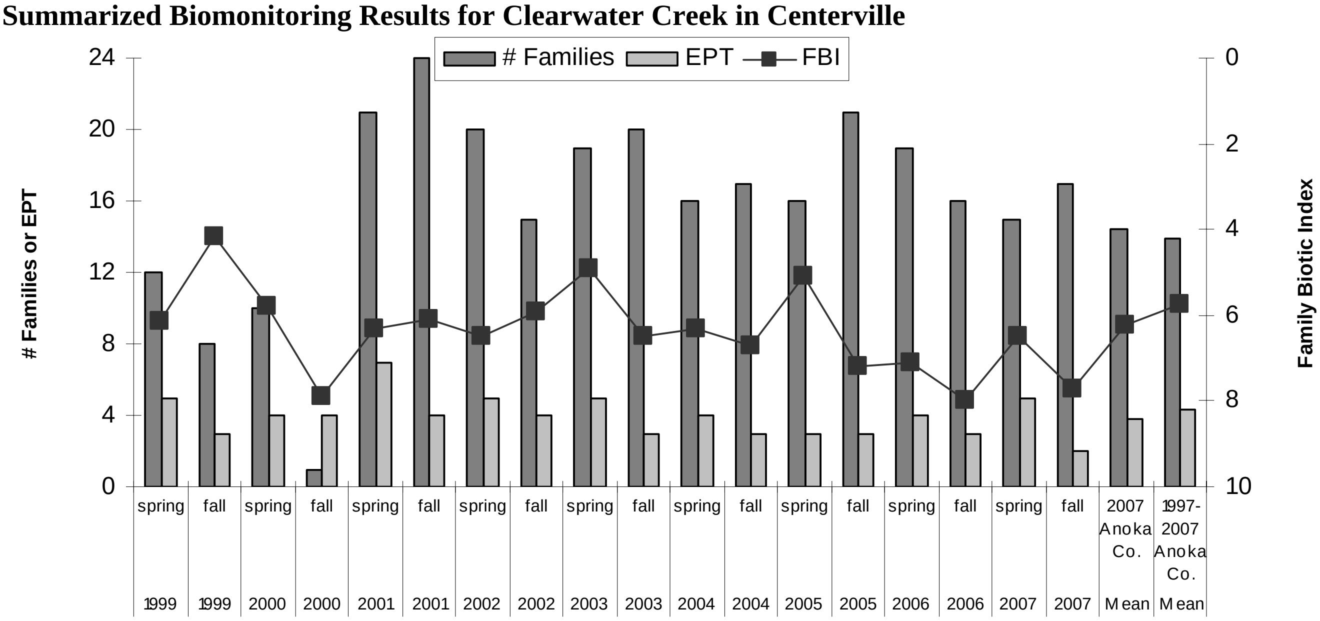
Clearwater Creek originates from Bald Eagle Lake in northwest Ramsey County and flows northwest into Peltier Lake. Land use is an approximately equal mix of residential and vacant/agricultural with some small commercial sites. The land use immediately surrounding the sampling site is entirely residential 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 2007, with oversight by the Anoka Conservation District. Overall, this stream has slightly below average conditions based upon the biological data. The number of families found in 2007 (15 and 17), 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.

Limited supplemental stream water chemistry readings were taken during biomonitoring (table on next page). Most notably, conductivity was mildly elevated, indicating mildly elevated dissolved pollutants. Previously, notable water quality results included high turbidity in October 2004 and elevated conductivity in October 2003.

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	2005	2005	2006	2006	2007	2007	Mean	Mean
Season	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	Fall	spring	fall	2007 Anoka Co.	1997-2007 Anoka Co.
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	5.10	7.20	7.10	8.00	6.50	7.70	6.2	5.7
# Families	12	8	10	11	21	24	20	15	19	20	16	17	16	21	19	16	15	17	14.4	13.9
EPT	5	3	4	4	7	4	5	4	5	3	4	3	3	3	4	3	5	2	3.8	4.4
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	5-May	27-Sep	18-May	3-Oct		9-Oct		
sampling by	?	?	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS		
sampling method	MH	MH	MH	MH	MH	MH	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	376	250	211	238	213	200		
# replicates	1	1	1	1	4	5	4	1	4	1	1	1	1	1	1	1	1	1		
Dominant Family	hyalellidae	hydropsychidae	chironomidae	corixidae	caenidae	hyalellidae	hyalellidae	hyalellidae	hydropsychidae	hyalellidae	baetidae	hyalellidae	baetidae	corixidae	coenagrionidae	corixidae	chironomidae	corixidae		
% Dominant Family	24.6	71.1	52	67.3	18.4	47.8	26.2	27	38	33.2	32.3	48.4	63.3	40.4	22.3	64.7	20.2	53		
% Ephemeroptera	5.2	17.6	24.2	23.6	23.3	19	19.5	11.3	18.7	26.2	57.1	27.5	74.7	18.8	24.6	6.3	34.7	17.5		
% Trichoptera	3.7	71.1	0	18.1	0.8	21.8	7.5	20	38.6	0.5	0.3	2.6	0.0	0.8	0.0	0.4	0.0	0.0		
% Plecoptera	5.2	0	0	0	0.3	0	1.2	0	0.0	0.0	0.3	0.0	0.0	0.0	0.5	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

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

Discussion

This stream's biological community may be impacted by intermittently degraded water chemistry. In our supplemental water chemistry measurements we have found occasions when one or more water quality parameters are substandard. The cause of intermittent water chemistry impacts is not necessarily runoff. 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, and 2007 was during low water levels. The buffer of grasses and trees on either side of the stream at the sampling site probably provides habitat for a large variety of invertebrates which are able to tolerate occasionally poor water quality, but some vegetation adjacent to the sampling site is being removed as part of city renovations and reconstruction.

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.

Centennial High School students presented their 2007 Clearwater Creek biomonitoring results at the River Summit, held at the Science Museum of Minnesota.

Large-scale city reconstruction projects were underway adjacent to the sampling site during fall 2007 monitoring.

HARDWOOD CREEK

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

Last Monitored

By Forest Lake Area Learning Center in 2007

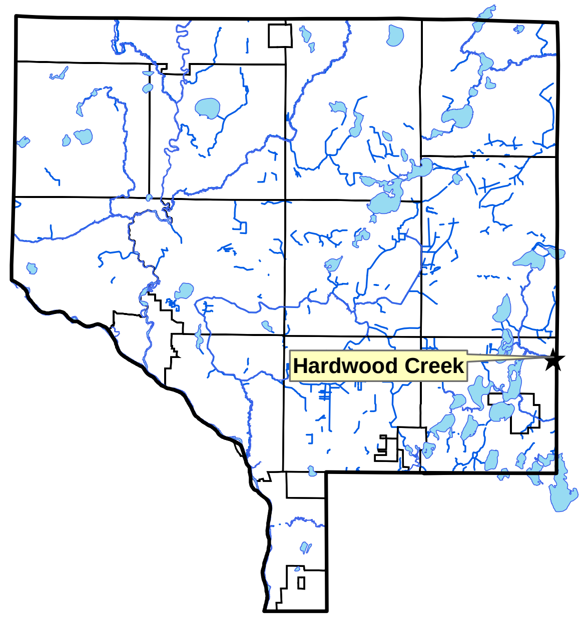
Monitored Since

1999 at Hwy 140

Fall 2007 at 165th Ave NW

Background

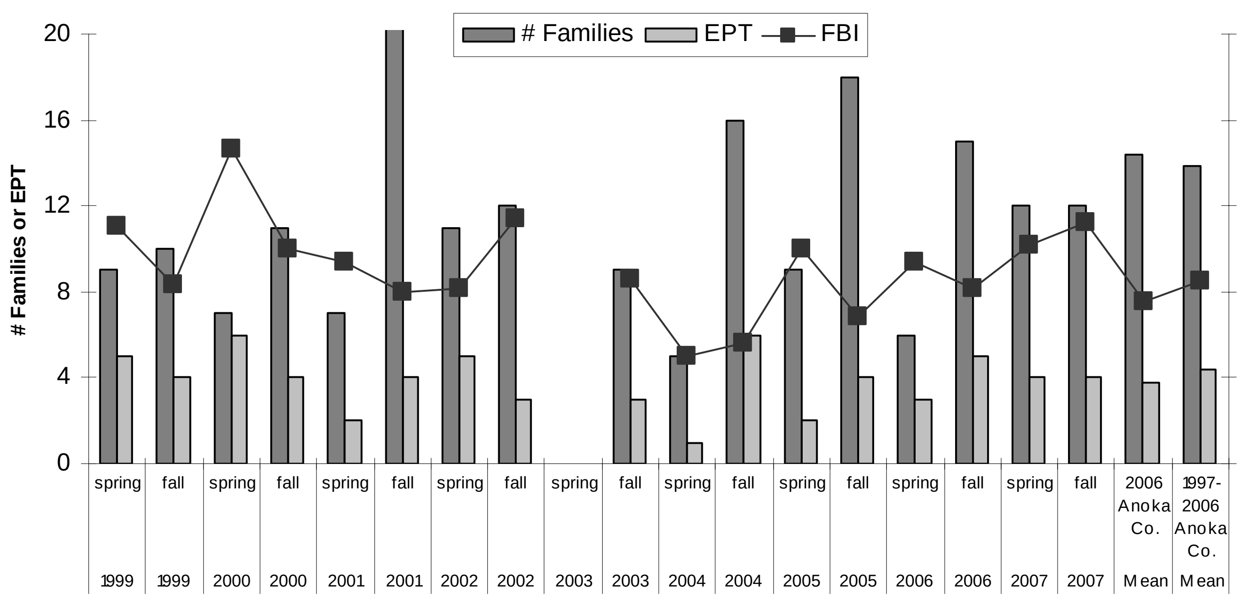
Hardwood Creek originates in Washington County and flows west to Rice Creek and the Rice Creek Chain of Lakes. This is a small creek with a width at baseflow of approximately 10-15 feet and depth of approximately 6-12 inches. The surrounding land use is primarily agricultural, with some residential areas. The stream bottom is sand, gravel, and some cobble. Until fall 2007 the creek was monitored at Highway 140, but permissions to access that property could no longer be obtained so monitoring switched to the 165th Avenue stream crossing, about 1 mile upstream.



Results

Forest Lake Area Learning Center classes monitored Hardwood Creek at Highway 140 in spring and 165th Avenue in fall 2007, facilitated by the Anoka Conservation District. Biological data from this stream has had a lot of year to year and seasonal variation, sometime indicating ok stream health and other times indicating very poor health. 2006 is a good example of this variation. In spring only six families were found, and 87% of those were from only two pollution-tolerant families. Invertebrates were difficult to catch because of low abundance. The stream smelled like manure. In contrast, in fall 2006 the number of families more than doubled to 15. Stream habitat improvements and erosion repairs completed by the Rice Creek Watershed District in 2006 may have played a role in these improvements, though fall results have been better than spring for the last several years. Interestingly, in 2007 the spring and fall results were nearly identical despite being from different sites.

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	2006	2006	2007	2007	Mean	Mean
Season	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	2007 Anoka Co.	1997-2007 Anoka Co.
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	5.30	5.90	4.90	4.40	6.2	5.7
# Families	9	10	7	11	7	24	11	12		9	5	16	9	18	6	15	12	12	14.4	13.9
EPT	5	4	6	4	2	4	5	3		3	1	6	2	4	3	5	4	4	3.8	4.4
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	10-May	10-Oct	8-May	5-Oct		
sampling by	ACD	ACD	FLALC	FLALC	FLALC	FLALC	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	MH	MH	MH	MH		
# individuals	60	137	82	144	92	187.5	165	365	samples lost	171	82	306	94	219	136	243	290	80		
# replicates	1	1	1	1	1	2	1	1		1	1	2	1	2	1	1	1	1		
Dominant Family	heptagenidae	chironomidae	perlidae	baetidae	simulidae	gastropoda	simulidae	hydropyschidae		hydropsychidae	hyalellidae	hyalellidae	gammariidae	hyalellidae	hydropsychi	heptageniida	baetidae	heptageniidae		
% Dominant Family	57	62	68.3	32	63	13.7	73.9	79.7		43.3	78	34.4	48.9	43.4	60.3	53.1	27.9	48.8		
% Ephemeroptera	80	26.3	29.3	49.3	30.4	12	10.3	9.3		7.6	0	17.8	36.2	10	5.9	44.9	39.7	60		
% 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	60.3	5.3	1.4	2.5		
% Plecoptera	6.7	0	68.3	0	0	0	0	0		0	0	0	0	0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

	Hwy 140 site									165th Ave site
Parameter	**27-May-03**	**29-Sept-03**	**12-May-04**	**6-Oct-04**	**31-May-05**	**25-Oct-05**	**10-May-06**	**10-Oct-06**	**8-May-07**	**12-Oct-07**
pH	7.39	9.08	8.66	9.00	10.33	8.10	7.27	8.05	7.97	7.26
Conductivity (mS/cm)	0.328	0.395	0.225	0.237	0.251	0.284	0.409	0.500	0.400	0.326
Turbidity (NTU)	9	3	10	na	27	21	13	4	3	5
Dissolved Oxygen (mg/L)	7.90	10.58	na	10.15	86.2%	12.25 (101%)	5.45	11.99	11.95	9.10
Salinity (%)	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.02	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

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. Intermittent water quality degradation, such as low dissolved oxygen, may be partially responsible. The water's strong manure smell in spring 2006 is also concerning. Habitat degradation is also probably partially responsible. The habitat at both monitoring sites is better than found elsewhere along Hardwood Creek. For example, some adjacent stretches of the creek are used heavily by livestock and have little habitat.

Forest Lake Area Learning Center students at Hardwood Creek, Hwy 140 site.

Forest Lake Area Learning Center at Hardwood Creek, 165th Avenue site.

RICE CREEK

at Hwy 65, Locke Park, Fridley

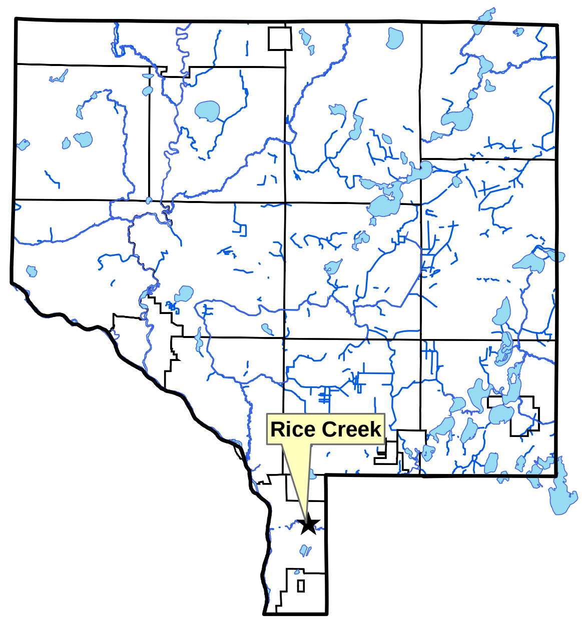
Last Monitored

By Totino Grace High School in 2007

Monitored Since

1999

Background

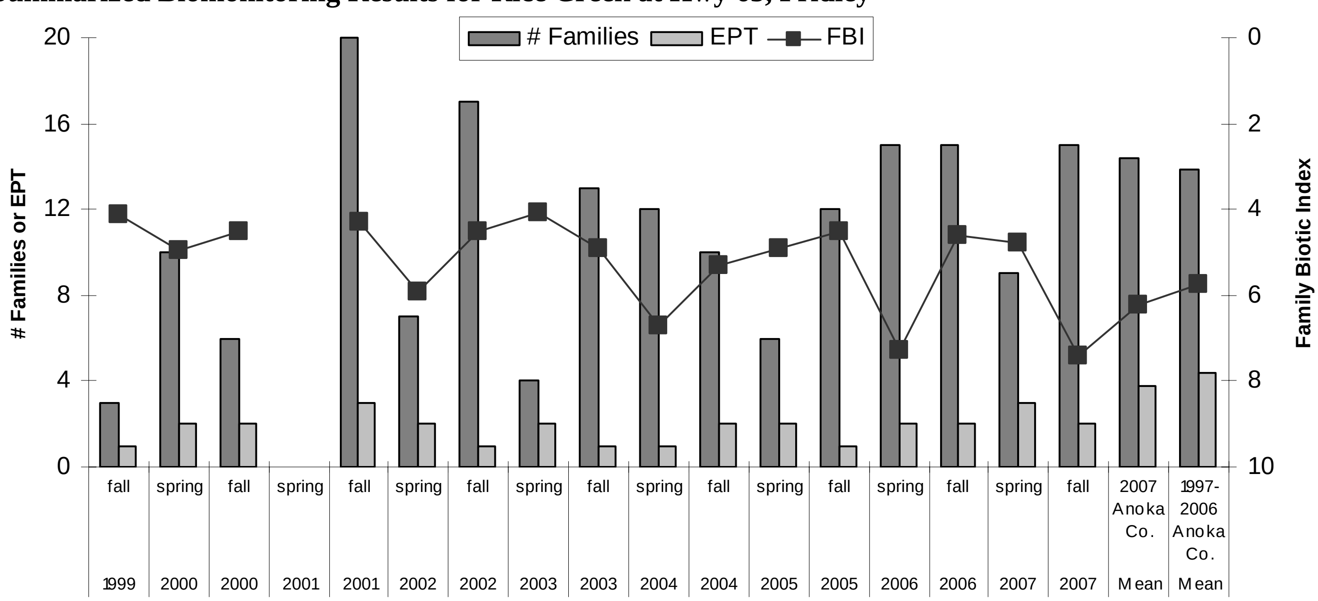


Rice Creek originates from Howard Lake in east-central Anoka County and flows south and west through the Rice Creek Chain of Lakes and eventually to the Mississippi River. Sampling is conducted in Locke Park, which encompasses a large portion of the stream's riparian zone in Fridley. This site is wooded. 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 2006, 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 highly 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. Only two or three EPT families were found in 2006. In 11 of the 16 times this creek has been sampled the caddisfly hydropsychidae, which thrives in low-quality streams, was most abundant, often >50% of catches. Other times the dominant family has been, at best, modestly pollution intolerant. 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	2005	2005	2006	2006	2007	2007	Mean	Mean
Season	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	2007 Anoka Co.	1997-2006 Anoka Co.
FBI	4.11	4.95	4.50	not sampled	4.30	5.90	4.50	4.10	4.90	6.70	5.30	4.90	4.50	7.30	4.60	4.80	7.40	6.2	5.7
# Families	3	10	6		20	7	17	4	13	12	10	6	12	15	15	9	15	14.4	13.9
EPT	1	2	2		3	2	1	2	1	1	2	2	1	2	2	3	2	3.8	4.4
Date	11/15	4/26	10/3		10/9	6/10	10/16	6/18	10/9	6/9	10/13	11-May	19-Oct	17-May	27-Sep	10-May	2-Oct		
sampling by	?	BHS	CHHS		CHHS	ACD	CHHS	ACD	CHHS	ACD	TGHS	TGHS	TGHS	ACD	TGHS	ACD	TGHS		
sampling method	MH	MH	MH		MH	MH	MH	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	149	378	106	166	116	132		
# replicates	1	1	1		4	1	3	1	2	1	1	1	1	1	3	1	2		
Dominant Family	hydropyschidae	hydropyschidae	hydropyschidae		hydropsychidae	simulidae	hydropsychidae	hydropsychidae	hydropsychidae	veliidae	hydropsychidae	hydropsychidae	hydropsychidae	corixidae	hydropsychidae	baetidae	corixidae		
% Dominant Family	92.7	66.4	78		88	51.7	83	96.2	58.2	19.1	65.0	44.3	87.6	24.5	81.7	49.1	61.2		
% Ephemeroptera	0	0.4	10.9		1.3	0.8	0	1.9	0.0	0.0	1.0	22.1	0.0	3.1	0.2	49.1	0.4		
% Trichoptera	92.7	66.4	77.6		88.2	27.5	83	96.2	58.2	8.8	65.0	44.3	87.6	0	81.7	13.8	27.6		
% Plecoptera	0	0	0		0	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

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

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.

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	Wetland Levels	Lake Levels	Groundwater Observation Wells	Stream Biomonitoring	Total
Revenues					
RCWD	1575	1350	0	2190	5115
State	0	0	471	0	471
County	0	0	743	0	743
County Ag Preserves	646	0	0	1899	1253
BWSR General Services	0	0	0	0	0
Local Water Planning	0	1356	0	0	1356
TOTAL	929	2706	1214	4089	8938
Expenses-					
Capital Outlay/Equip	163	66	68	75	373
Personnel Salaries/Benefits	636	2185	944	3348	7113
Office Supplies/Maintenance	58	194	81	267	600
Employee Training	10	34	21	48	113
Vehicle/Mileage	12	40	20	51	123
Rent	28	113	49	87	278
Monthly Bills	8	32	13	27	80
Fees and Dues	7	19	17	21	64
Program Supplies	7	23	1	164	194
TOTAL	929	2706	1214	4089	8938
NET	0	0	0	0	0

Recommendations

- **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.

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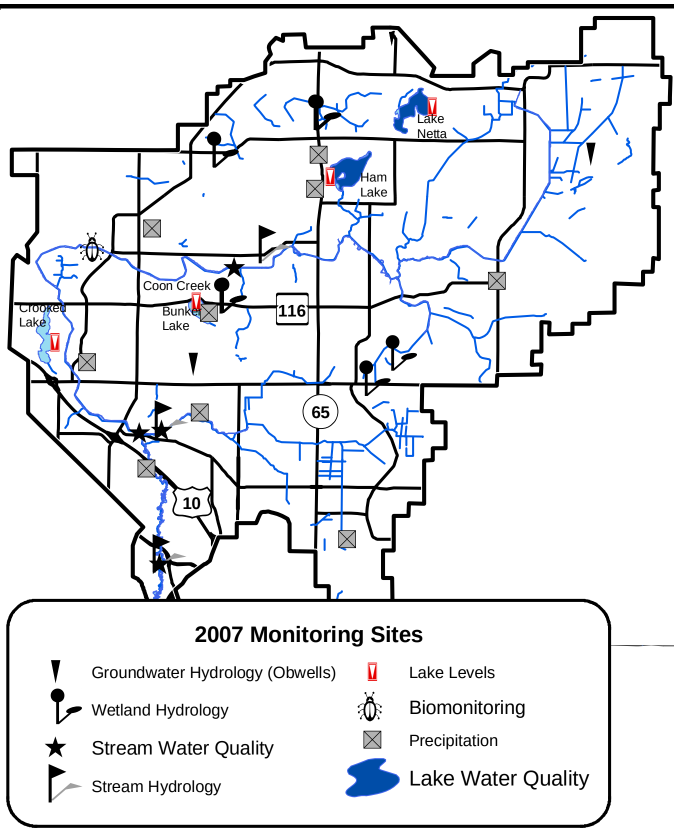
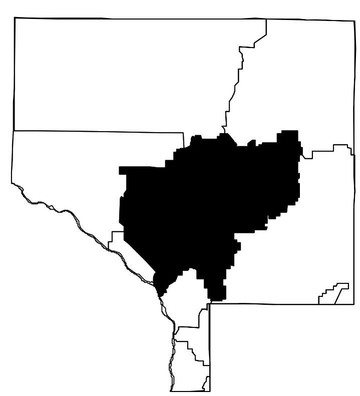
CHAPTER 6:
COON CREEK WATERSHED

Raw data and data summaries can be found at the CCWD website – use the Data Access tool (www.AnokaNaturalResources.com/CCWD)

Task	Partners	Page
Precipitation	CCWD, ACD, volunteers	6-120
Precipitation Analyses	CCWD, ACD	6-122
Lake Levels	CCWD, ACD, volunteers	6-123
Lake Water Quality	CCWD, ACD, ACAP	6-125
Stream Hydrology	CCWD, ACD	6-130
Stream Water Quality - Chemical	CCWD, ACD	6-135
Stream Water Quality - Biological	ACD, ACAP, Andover HS	6-142
Wetland Hydrology	CCWD, ACD, ACAP	6-145
Reference Wetland Analyses	CCWD, ACD	6-154
Reference Wetland Veg. Transects	CCWD, ACD	6-158
CCWD Website	CCWD, ACD	6-162
Homeowner's Guide	CCWD, ACD, MNDNR	6-164
Financial Summary		6-165
Recommendations		6-165
Groundwater Hydrology (obwells)	ACD, MNDNR	see chapter 1

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





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.

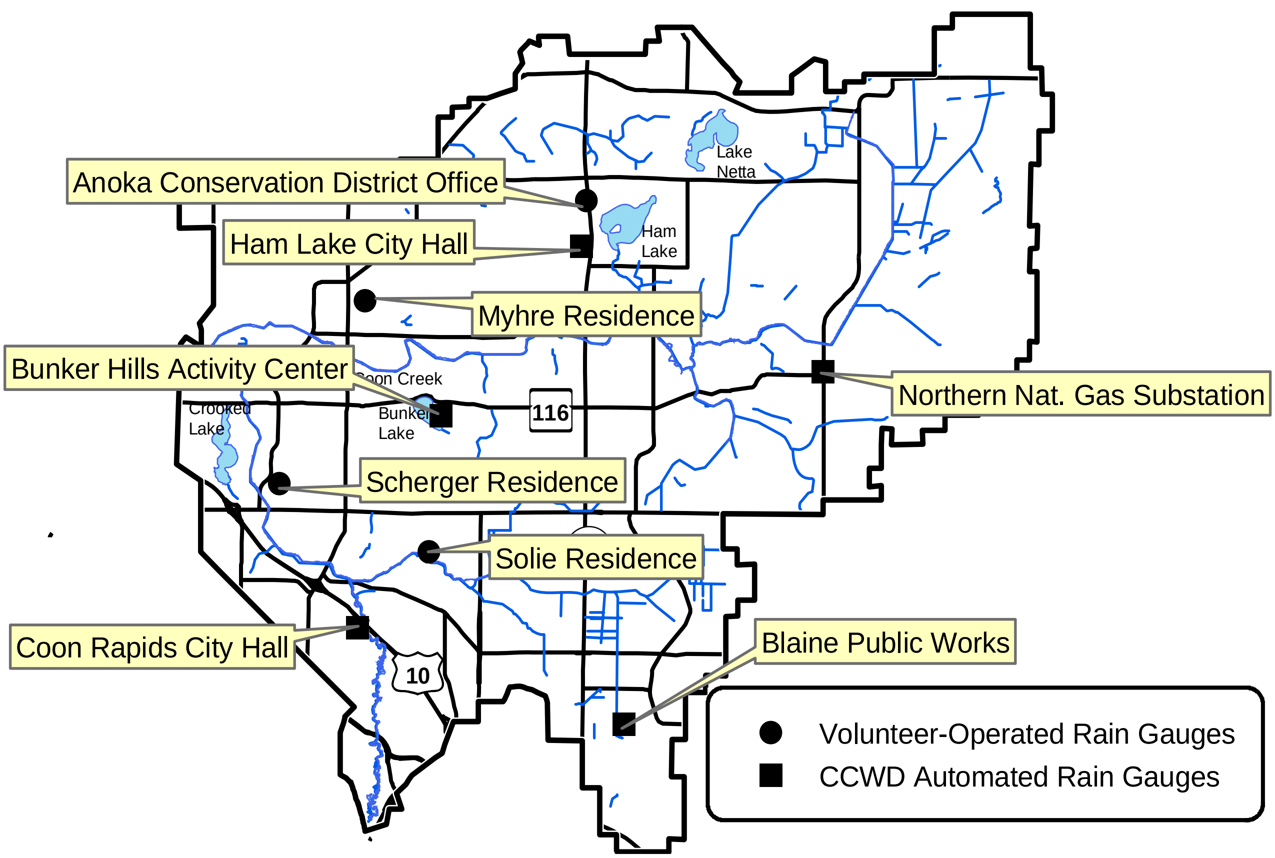
Purpose: To aid in all types of hydrologic analyses, predictions, and regulatory decisions within the watershed.

Locations:
Anoka Conservation District office, Ham Lake
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
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 2007 Precipitation Monitoring Sites



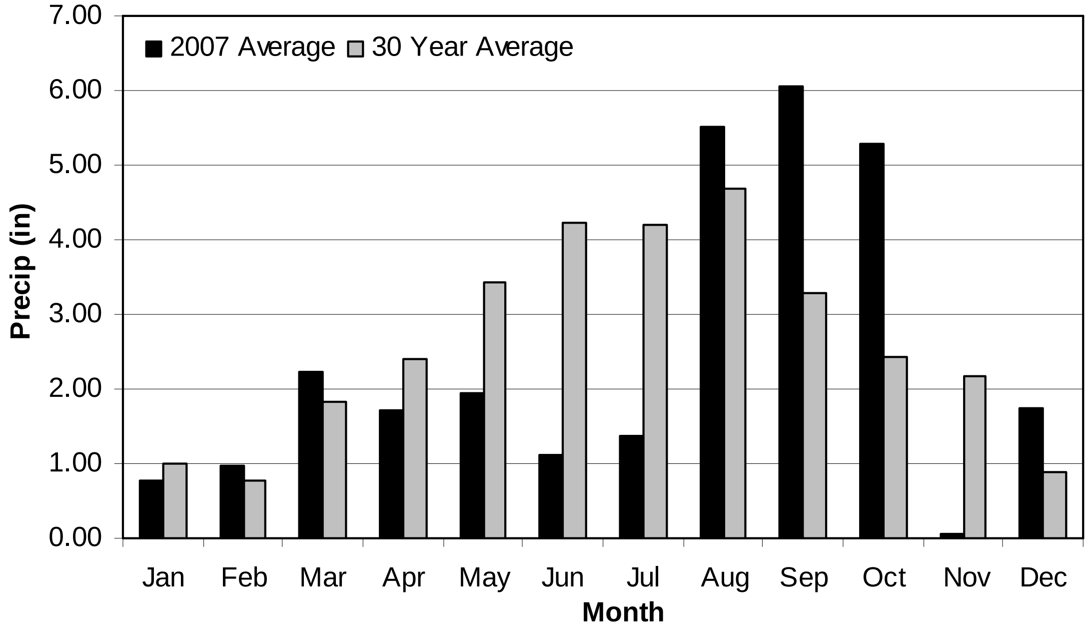
Coon Creek Watershed 2007 Precipitation Summary Table and Graph

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				1.24	2.12	0.61		5.7	4.65	3.66				
CCWD- Blaine Public Works	Blaine				1.86	1.63	1.69			5.43	4.97				
CCWD- Bunker Hills Park	Andover				1.44	1.84	0.94	1.63	5.83	6.08	4.79				16.32
CCWD- Northern Nat. Gas	Ham Lake					2.27			4.42	6.69	5.23				
CCWD- Coon Rapids City Hall	Coon Rapids				1.63	1.94	1.5	0.91	5.49	5.68	4.86				15.52
N. Myhre	Andover	0.78	0.98	2.24	2.36	1.89	0.86	1.60	6.08	4.94	6.14	0.07	1.74	29.68	15.37
S. Scherger	Coon Rapids									6.82	6.30	0.01			
S. Solie	Coon Rapids								5.60	8.13	6.44	0.10			
2007 Average	All CCWD	0.78	0.98	2.24	1.71	1.95	1.12	1.38	5.52	6.05	5.30	0.06	1.74	28.83	16.02
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

monthly totals are shown only if a complete, uninterrupted month-long record is available

Results from the Ham Lake City Hall rain gauge are not included because it was collecting incorrect rainfall totals. Problems were detected early in summer, and several repairs were made. However, at the end of the year it was determined that the data was still unreliable.



Precipitation Analyses

Description: Two different precipitation analyses were done. The results of each are delivered to the Coon Creek Watershed District in digital form.

2007 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).

Long Term Precipitation Trends Analysis: Monthly rainfall deviations from normal were graphed for 1986 to present. 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: 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: Results were delivered to the Coon Creek Watershed District in digital format and are not presented here.

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).

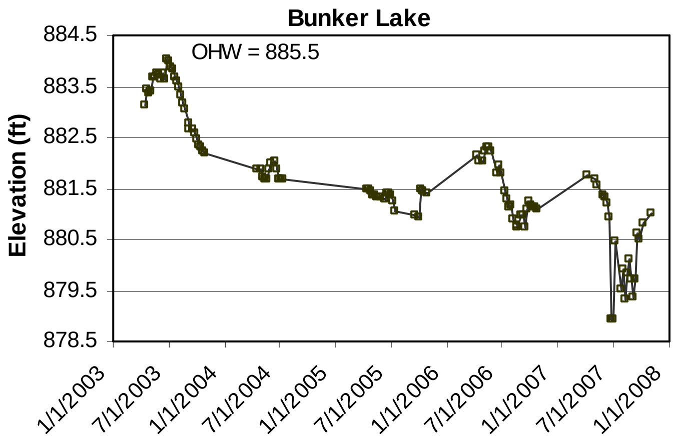
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

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

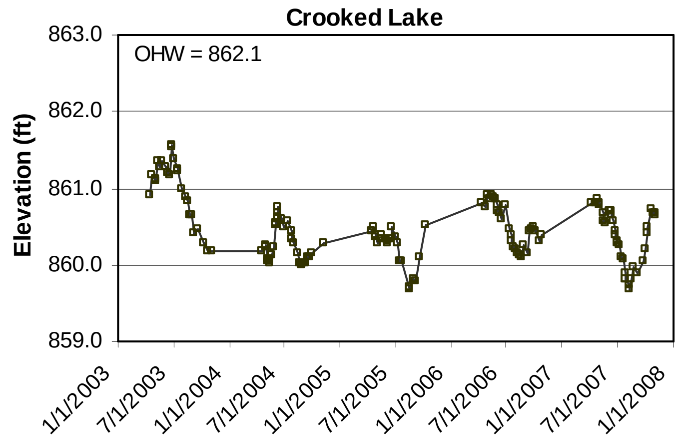
Results: Lake levels were measured 22 to 36 times, depending upon the lake, except for Ham Lake. Ham Lake levels were monitored at the same frequency, but all readings except 10 were apparently lost when mailed to the Anoka Conservation District. Water levels of these four lakes fell throughout summer 2007 in response to drought, but rebounded starting in mid-August when ample rainfall broke the drought. Ample rain continued through fall. Bunker Lake was especially low in mid-summer, with only a small area of open water. At that time, 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.

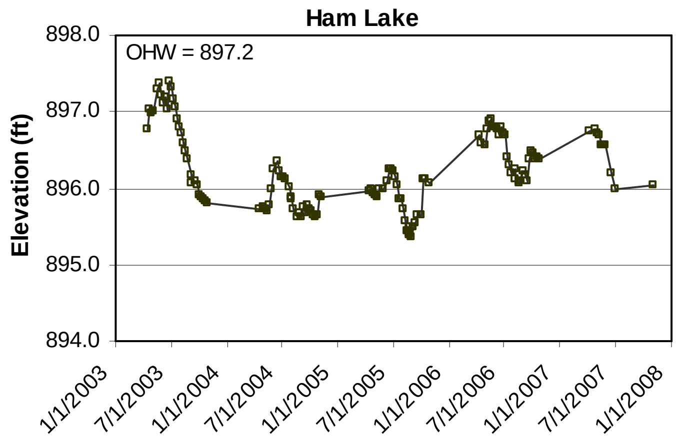
Bunker Lake Levels 2003-07



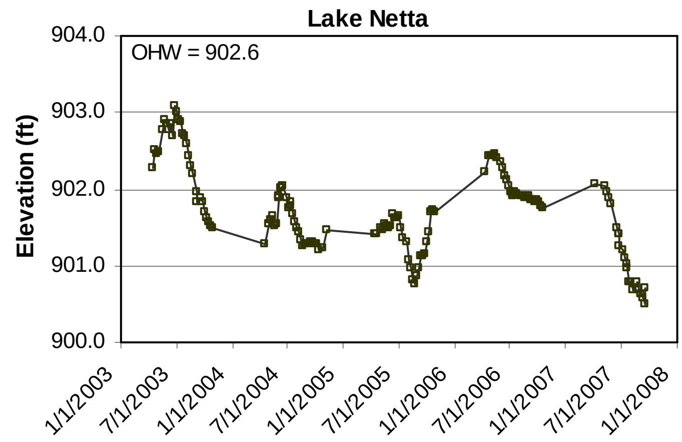
Crooked Lake Levels 2003-07



Ham Lake Levels 2003-07



Netta Lake Levels 2003-07



Coon Creek Watershed Lake Levels Summary 2003-07

Lake	Year	Average	Min	Max
Bunker	2003	883.24	882.19	884.02
	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
Crooked	2003	860.98	860.17	861.57
	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
Ham	2003	896.67	895.80	897.40
	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
Netta	2003	902.37	901.49	903.08
	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

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.

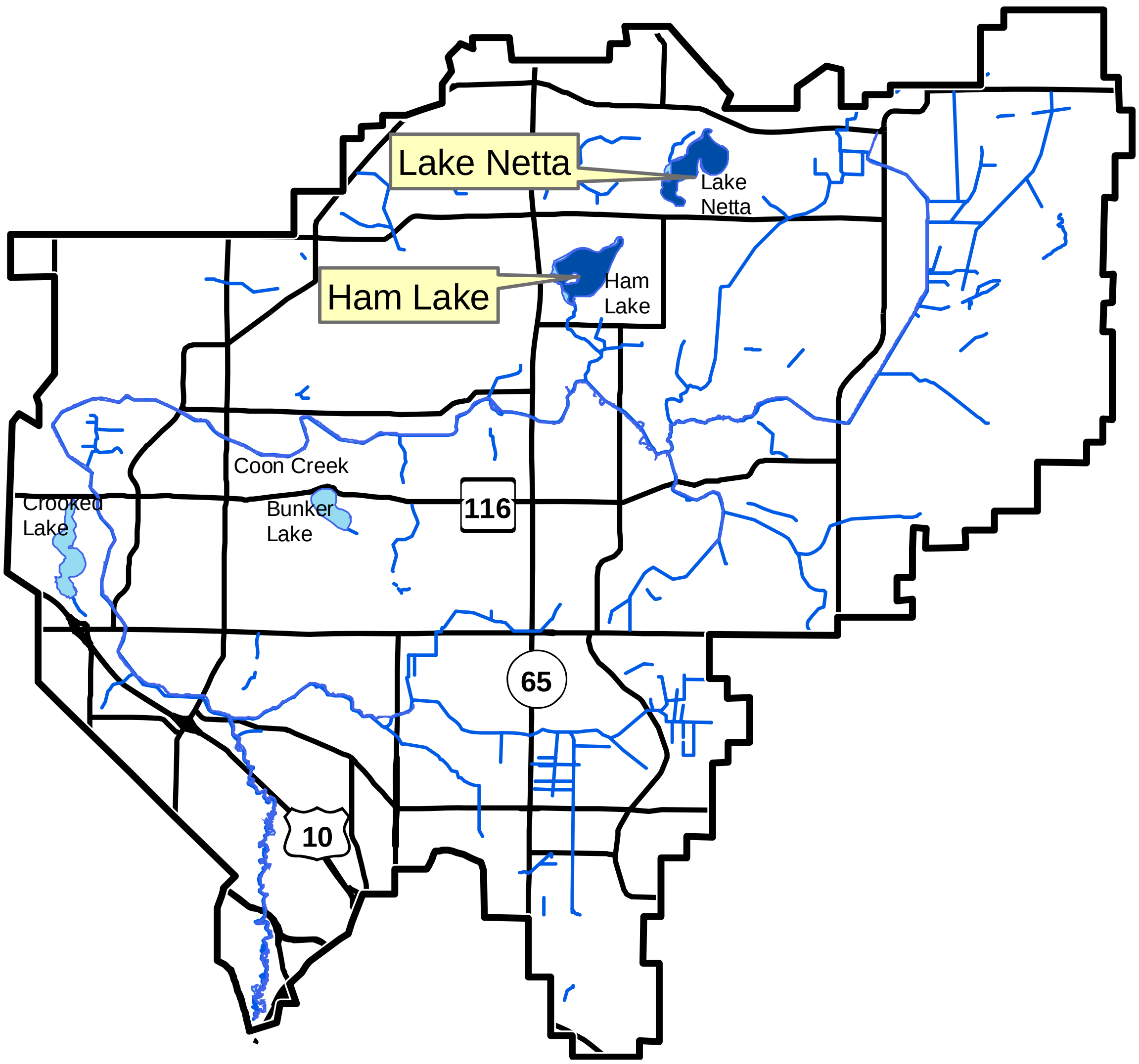
Purpose: To detect water quality trends and diagnose the cause of changes.

Locations: Ham Lake

Lake Netta

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 2007 Lake Water Quality Monitoring Sites



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.

2007 Results

In 2007 Ham Lake had above-average water quality for this region of the state (NCHF Ecoregion), receiving an overall B grade. The lake is slightly eutrophic. Chlorophyll-a and Secchi depths in 2007 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 2007 included that the lake was nearly crystal clear in early spring, and progressed to having "some" algae during 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, especially on the south end of the lake, but died back in mid-June.

Trend Analysis

Twelve 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 and 2007). 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, $F_{2,9}=0.33$, $p=0.73$).

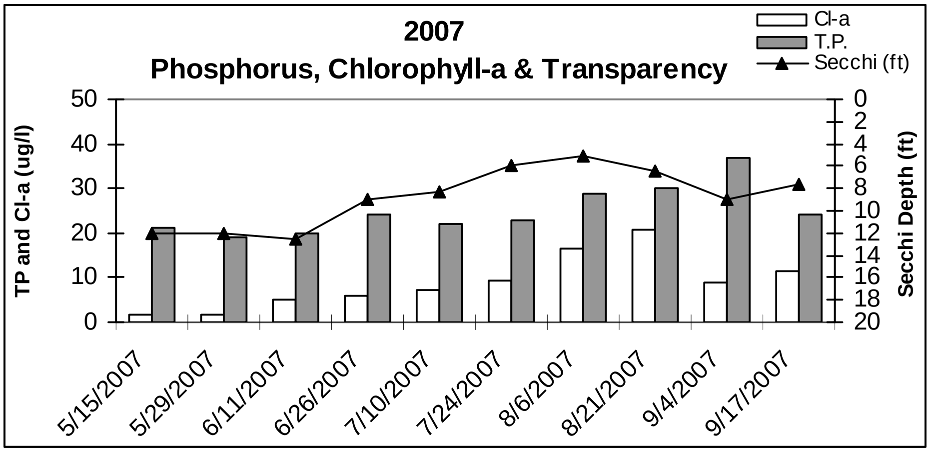
Discussion

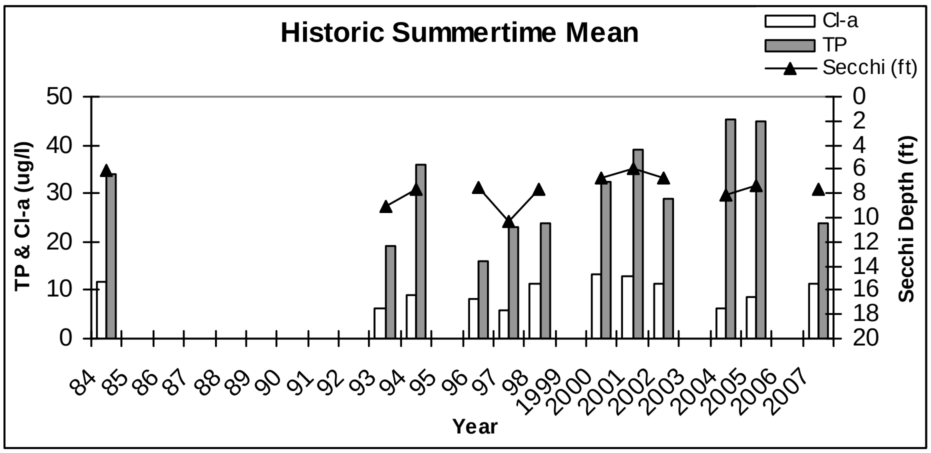
Current threats to lake water quality include runoff from residential areas, aquatic plant removal by lakeshore homeowners, curly leaf pondweed, and perhaps sediment disturbance by high-powered boats and jet-skis.

2007 Ham Lake Water Quality Data

Ham Lake 2007			5/15/2007	5/29/2007	6/11/2007	6/26/2007	7/10/2007	7/24/2007	8/6/2007	8/21/2007	9/4/2007	9/17/2007			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.80	9.39	na	6.86	na	na	na	na	8.65	8.42	8.42	6.86	9.39
Conductivity	mS/cm	0.010	0.225	0.218	0.225	0.221	0.224	0.222	0.223	0.212	0.216	0.218	0.220	0.212	0.225
Turbidity	FNRU	1	1.00	2.00	na	na	3.00	2.00	5.00	4.00	3.00	3.00	3	1	5
D.O.	mg/l	0.01	10.33	9.96	8.31	9.35	7.79	8.37	6.05	6.49	8.91	10.06	8.59	6.05	10.33
D.O.	%	1	112%	104%	95%	114%	96%	102%	73%	72%	105%	104%	98%	72%	114%
Temp.	°C	0.1	19.4	19.2	21.9	25.7	25.9	25.2	24.5	20.4	23.5	17.1	22.28	17.10	25.90
Temp.	°F	0.1	66.9	66.6	71.4	78.3	78.6	77.4	76.1	68.7	74.3	62.8	72	63	79
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	ug/l	0.5	1.5	1.7	5.2	6.1	7.2	9.5	16.7	20.8	8.8	11.4	8.9	1.5	20.8
T.P.	mg/l	0.010	0.021	0.019	0.020	0.024	0.022	0.023	0.029	0.030	0.037	0.024	0.025	0.019	0.037
T.P.	ug/l	10	21	19	20	24	22	23	29	30	37	24	25	19	37
Secchi	ft	0.1	12.0	12.0	12.5	8.9	8.3	6.0	5.1	6.5	9.0	7.7	8.8	5.1	12.5
Secchi	m	0.1	3.7	3.7	3.8	2.7	2.5	1.8	1.6	2.0	2.7	2.3	2.7	1.6	3.8
Field Observations															
Physical			1.5	2.0	2.0	2.0	2.0	2.0	3.0	2.0	2.0	1.5	2.0	1.5	3.0
Recreational			2.0	2.0	2.0	2.0	2.0	2.0	3.0	2.0	2.0	1.5	2.1	1.5	3.0

Ham Lake Water Quality Results





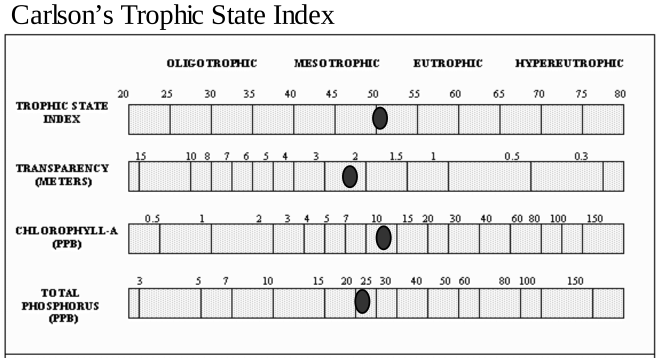
Ham Lake Summertime Historic Mean

Agency	MC	MC	MC	MC	MC	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	84	93	94	96	97	98	2000	2001	2002	2004	2005	2007
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
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
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
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
Carlson's Tropic State Indices												
TSIP	55	47	56	44	49	50	54	57	53	59	59	50
TSIC	55	49	52	51	48	54	56	56	55	49	52	55
TSIS	51	45	48	48	43	48	50	51	50	47	49	48
TSI	54	47	52	48	47	51	53	55	52	52	53	51

Ham Lake Water Quality Report Card

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

Carlson’s Trophic State Index



Lake Netta

CITY OF HAM LAKE, LAKE ID # 02-0053

Background

Lake Netta is located in the central portion of Anoka County, southwest of Coon Lake. It has a surface area of 168 acres and a maximum depth of 19 feet (5.8 m). There is a small, rugged public access on the west side of the lake in a neighborhood park. This access can accommodate canoes only. The lake receives little recreational use due to the difficulty of public access. The lakeshore is only lightly developed, with a few small lakeside neighborhoods and scattered housing elsewhere. The watershed is a mixture of residential, commercial and vacant land, but is under development pressure. No exotic plant species have been documented in Lake Netta.

2007 Results

In 2007 Lake Netta had very good water quality for this region of the state (NCHF Ecoregion), receiving an overall B+ letter grade. The lake is slightly eutrophic. Total phosphorus, chlorophyll-a, and secchi depths were all similar to past years and were a testament to the clear water and healthy vegetation in the lake. One exception is a high total phosphorus reading on July 24 of 74 ug/L. This could have been due to a contaminated sample, however an August 14th sample in 2006 was similarly high (60 ug/L), suggesting the cause might be a mid-summer natural phenomena. ACD staff's subjective observations of the lake's physical characteristics and recreational suitability were that there was little or "some" algae present and conditions were good or excellent for swimming and boating.

Trend Analysis

Eight years of water quality data have been collected by the Anoka Conservation District (1997-99, 2001, 2003-04, 2006, 2007), along with Secchi measurements by citizens five other years. Lake water quality has fluctuated between "A" and "B" grades. There is no significant long-term trend (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,5}=1.08$, $p=0.41$). However, this analysis excludes secchi depths taken in the early 1990's by volunteers. Some longer-term trend may be occurring; annual average secchi depth before 1998 was 1.5 to 2.5 m, but have been 2.5 to 3m since 1998 indicating better water clarity in recent years.

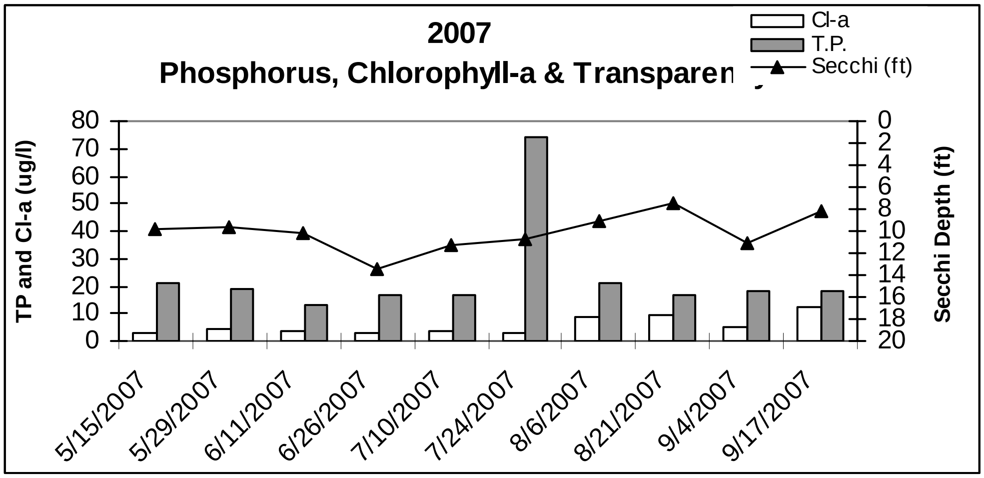
Discussion

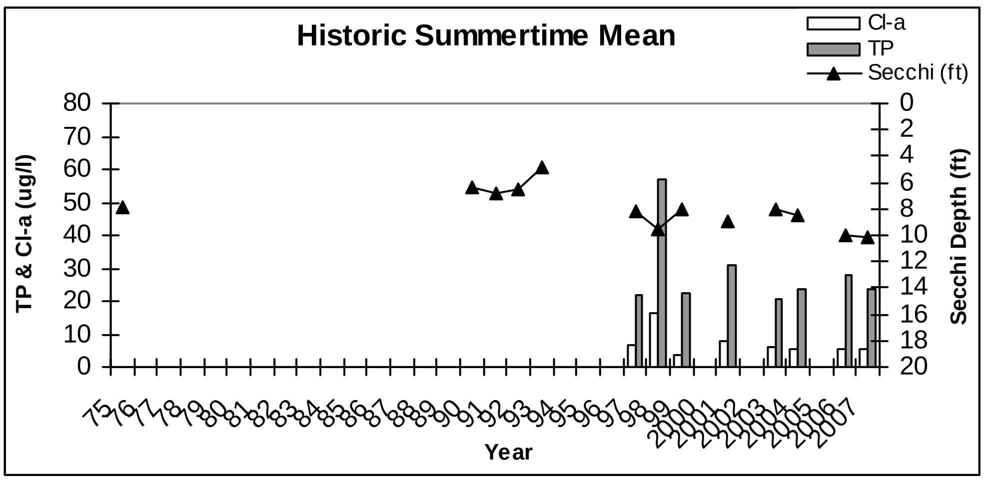
This lake has excellent water quality. It is a macrophyte (large plant) dominated lake, as opposed to algae dominated. These plants are essential to maintaining good water quality. The plants consume nutrients in the water, making them unavailable to algae. They also minimize sediment disturbance by wind or boats and provide refuges for zooplankton, which eat algae. Other reasons for good water quality in this lake include that it has a small watershed and receives little direct runoff. No streams of any consequence enter this lake. Maintaining good water quality in this lake will be, in large part, dependent upon protecting the in-lake aquatic vegetation, as well maintenance of vegetated buffers near the water's edge by property owners.

2007 Lake Netta Water Quality Data

Lake Netta 2007			5/15/2007	5/29/2007	6/11/2007	6/26/2007	7/10/2007	7/24/2007	8/6/2007	8/21/2007	9/4/2007	9/17/2007			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.28	8.57	8.89	8.80	na	na	na	na	8.55	8.11	9	8.11	8.89
Conductivity	mS/cm	0.010	0.184	0.184	0.185	0.161	0.155	0.154	0.160	0.155	0.158	0.156	0.165	0.154	0.185
Turbidity	FNRU	1	2	1	na	na	1	0	1	2	2	2	1	0	2
D.O.	mg/l	0.01	8.97	9.76	10.11	9.28	7.39	8.59	5.81	5.50	9.26	10.07	8	5.50	10.07
D.O.	%	1	97%	109%	117%	115%	91%	105%	70%	60%	110%	104%	98%	60%	117%
Temp.	°C	0.1	19.1	20.2	22.5	26.4	26.1	25.6	24.4	20.1	24.0	17.1	22.6	17.1	26.4
Temp.	°F	0.1	66.4	68.4	72.5	79.5	79.0	78.1	75.9	68.2	75.2	62.8	72.6	62.8	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	ug/l	0.5	2.7	4.4	3.5	3.1	3.3	3.0	8.8	9.1	5.4	12.4	5.6	2.7	12.4
T.P.	mg/l	0.01	0.021	0.019	0.013	0.017	0.017	0.074	0.021	0.017	0.018	0.018	0.024	0.013	0.074
T.P.	ug/l	10	21	19	13	17	17	74	21	17	18	18	24	13	74
Secchi	ft	0.1	9.9	9.7	10.2	13.5	11.3	10.8	9.0	7.4	11.0	8.2	10.1	7.4	13.5
Secchi	m	0.1	3.0	3.0	3.1	4.1	3.4	3.3	2.7	2.3	3.4	2.5	3.1	2.3	4.1
Field Observations															
Physical			1.5	1.5	1.5	2.0	2.0	2.0	1.5	1.5	1.5	1.5	1.7	1.5	2.0
Recreational			1.5	1.5	1.5	2.0	2.0	2.0	1.5	1.5	1.5	1.5	1.7	1.5	2.0

Lake Netta Water Quality Results





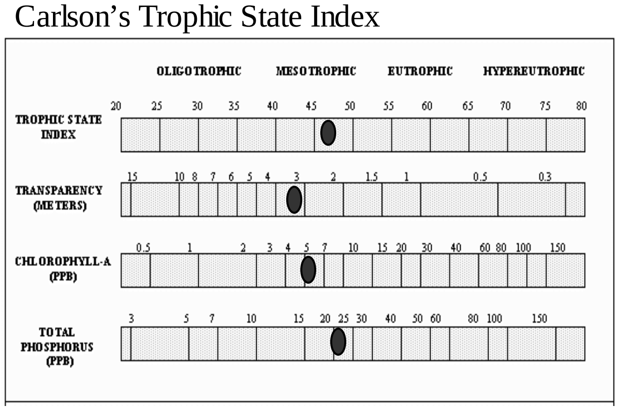
Lake Netta Historical Summertime Mean Values

Agency	CLMP	CLMP	CLMP	CLMP	CLMP	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1975	1990	1991	1992	1993	1997	1998	1999	2001	2003	2004	2006	2007
TP						21.8	56.9	22.2	30.7	20.8	23.8	28.0	23.5
Cl-a						6.7	16.6	3.8	7.7	6.2	5.7	5.5	5.6
Secchi (m)	2.4	1.93	2.08	1.98	1.47	2.53	2.90	2.47	2.70	2.47	2.58	3.00	3.10
Secchi (ft)	7.9	6.3	6.8	6.5	4.8	8.3	9.5	8.1	8.9	8.1	8.5	10.0	10.1
TSIP						49	62	49	54	48	50	52	50
TSIC						49	58	44	51	48	48	47	48
TSIS	47	51	49	50	54	47	45	47	46	47	46	44	44
TSI						48	55	47	50	48	48	48	47

Lake Netta Water Quality Report Card

Year	75	90	91	92	93	97	98	99	2001	2003	2004	2006	2007
TP						A	A	A	B	A	B+	B	B
Cl-a						A	A	A	A	A	A	A	A
Secchi	B	C	C	C	C	A	A	A	B	B	B	B+	B
Overall						**B**	**B**	**A**	**B**	**A**	**A**	**B+**	**B+**

Carlson's Trophic State Index



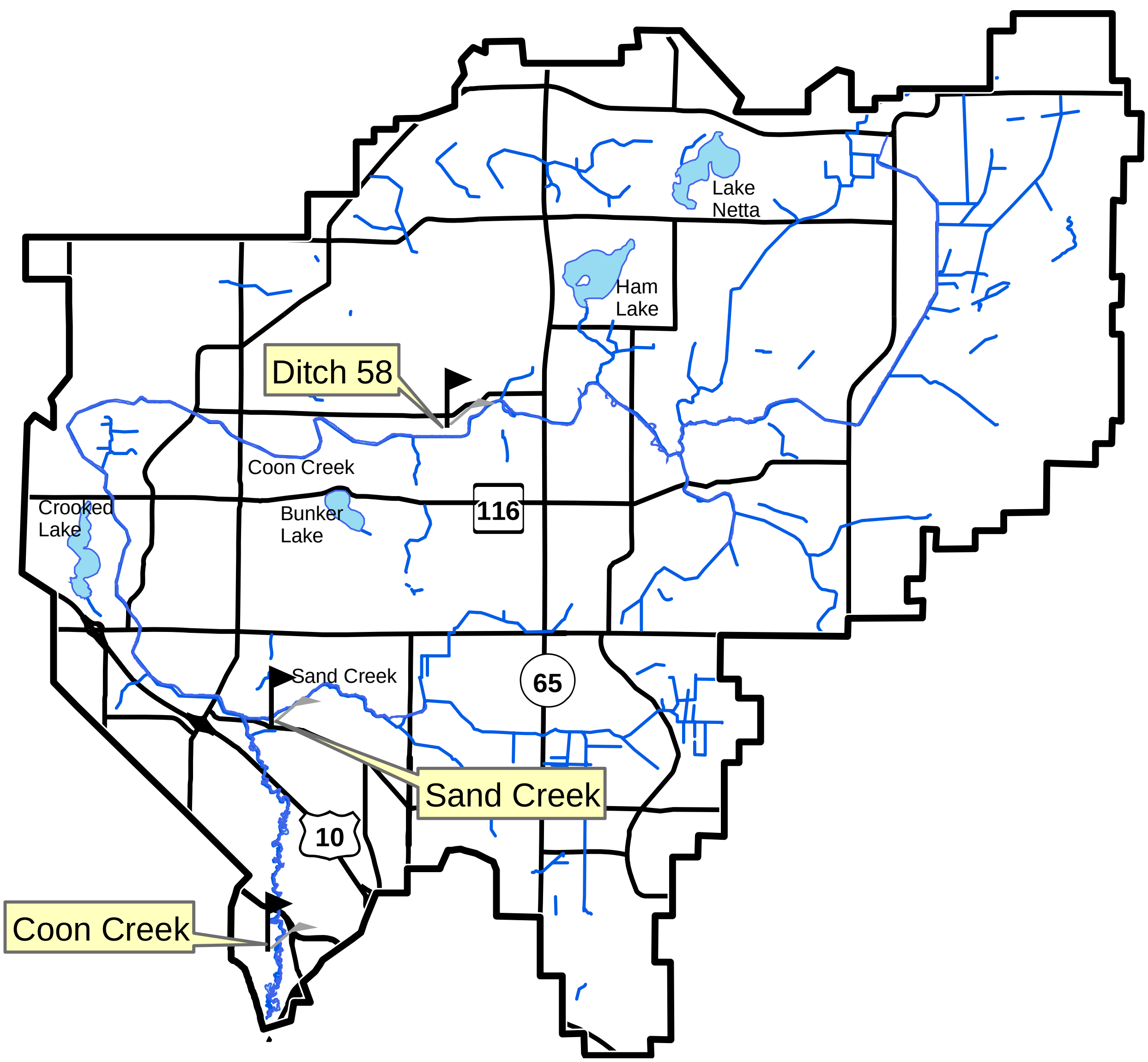
Stream Hydrology

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
Sand Creek at Xeon Street, Coon Rapids

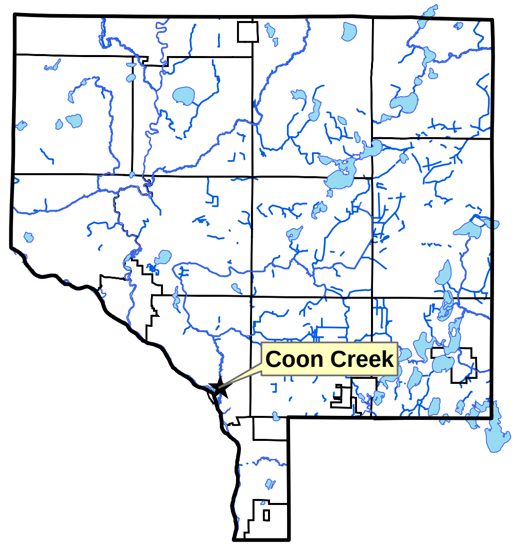
Coon Creek Watershed 2007 Stream Hydrology Monitoring Sites



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 2007 and 2006 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. As a final example, 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.

Coon Creek's water level increases substantially per inch of rainfall. Examining six relatively isolated storms >0.9 inches in 2006, the creek rose an average of 1.95 feet per inch of rainfall. The creek increase per inch of rain ranged from 1.38 to 2.52 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 2007 creek flows ranged from 10.27 cfs to over 38.19 cfs. Given that the maximum water levels in 2007 were 2.47 feet greater than the capacity of the rating curve it is likely that the highest flows in 2007 had flows of >50 cfs.

(over)

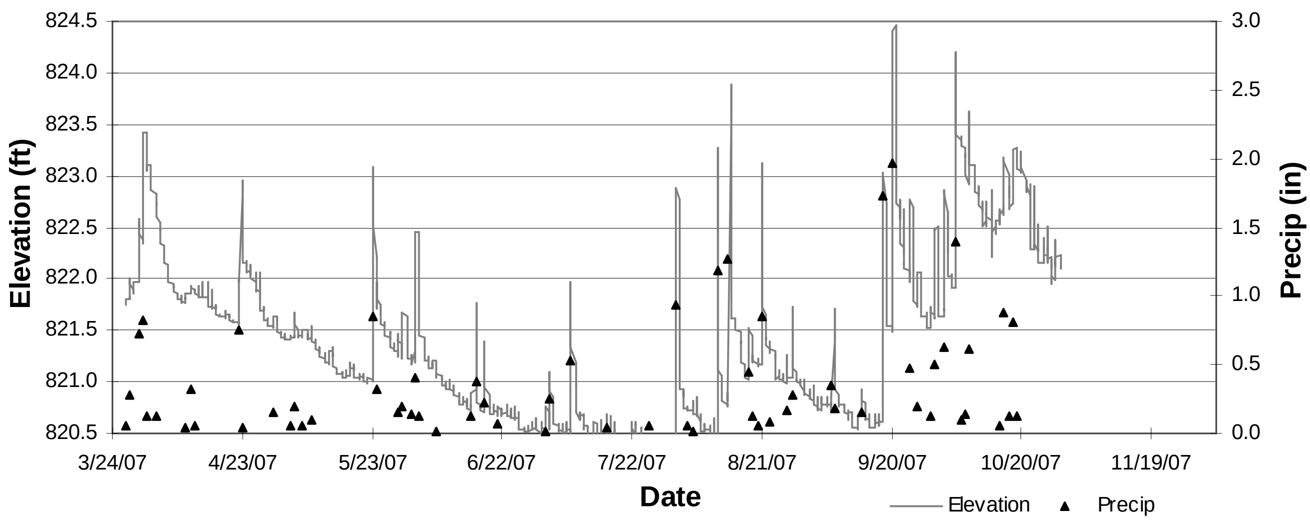
Coon Creek Hydrology (continued)

Summary of All Monitored Years

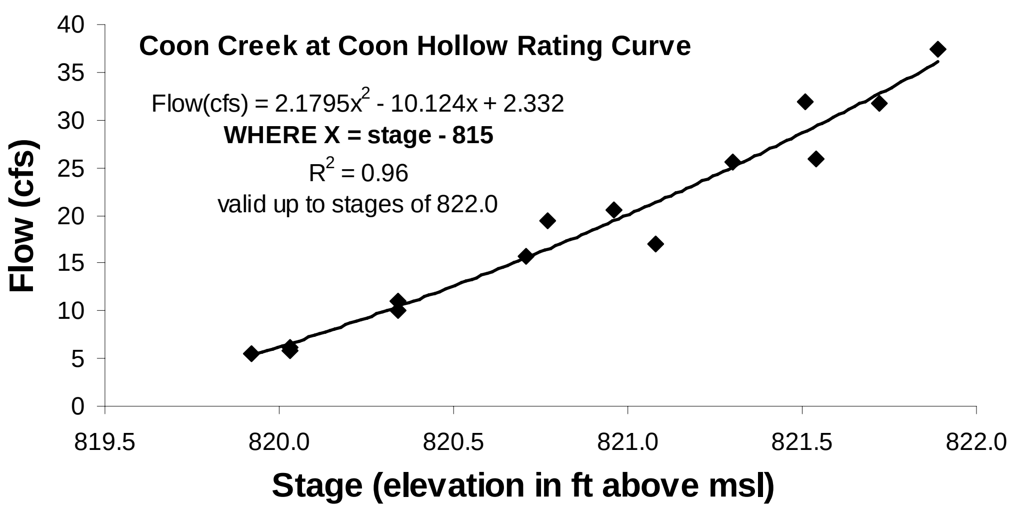
Percentiles	2005	2006	2007	All Years
Min	820.04	820.26	820.33	820.04
2.5%	820.06	820.42	820.40	820.15
10.0%	820.19	820.53	820.53	820.45
25.0%	820.57	820.78	820.73	820.69
Median (50%)	820.91	821.35	821.25	821.13
75.0%	821.26	821.78	821.88	821.13
90.0%	821.77	822.27	822.63	822.28
97.5%	822.92	822.76	823.21	823.05
Max	823.26	824.18	824.47	824.73

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

2007 Hydrograph



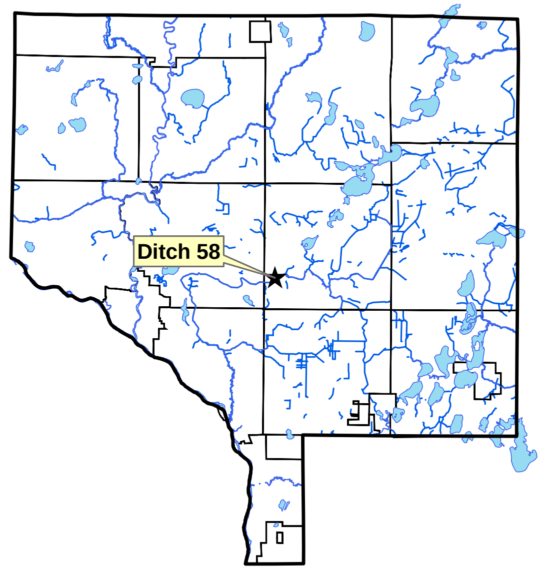
Rating Curve (2005)



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.

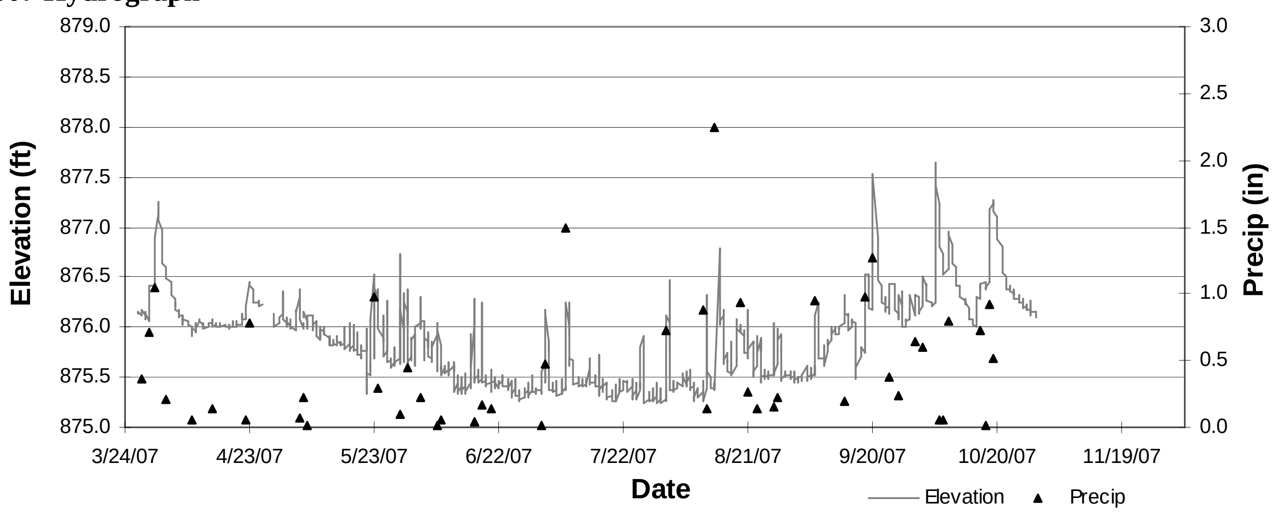
Ditch 58 water levels fluctuated 2.40 feet throughout 2007, nearly the same as in 2006. The lowest water occurred during the moderate drought conditions of mid-summer when water levels were about 0.5 feet lower than other times of the year. Perhaps the ditch's most dramatic event of 2007 was a 1.4 foot rise in four hours in response to a 2.25-inch storm on August 13th. In 2006, a 1.94 foot rise occurred in response to back-to-back 1.81- and 0.44-inch storms. Given that the ditch is about 10-12 inches deep during baseflow, these are relatively large increases in flow.

Summary of All Monitored Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	All Years
Min	875.29	875.81	875.28	875.23	875.05	875.31	875.24	875.05
2.5%	875.35	876.18	875.57	875.63	875.54	875.91	875.29	875.34
10.0%	875.48	876.33	875.64	875.51	875.37	875.66	875.37	875.50
25.0%	875.58	876.41	875.74	875.63	875.54	875.91	875.49	875.67
Median (50%)	875.65	876.51	876.10	875.83	875.78	876.20	875.89	876.01
75.0%	875.77	876.73	876.59	876.05	876.04	876.35	876.16	876.01
90.0%	876.23	877.42	877.01	876.45	876.22	876.47	876.40	876.69
97.5%	876.30	878.13	878.16	877.04	876.98	876.89	876.90	877.52
Max	876.48	878.13	878.19	878.03	878.12	877.75	877.64	878.19

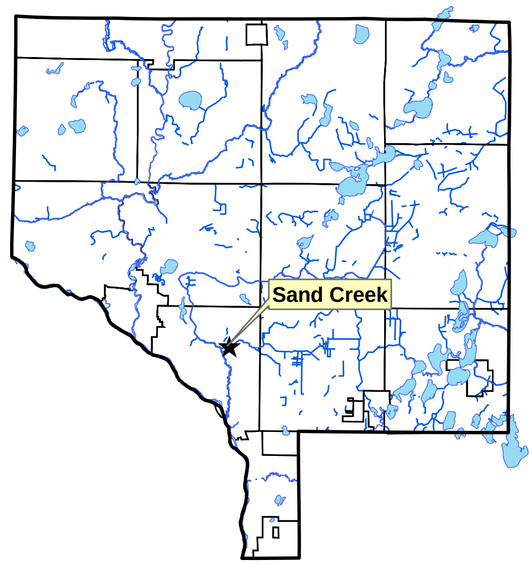
"All Years" is not an average of each year's summary statistic. Rather, it is calculated from the continuous, multi-year record.

2007 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 20 feet wide and 2.5-3 feet deep at the monitoring site during baseflow.

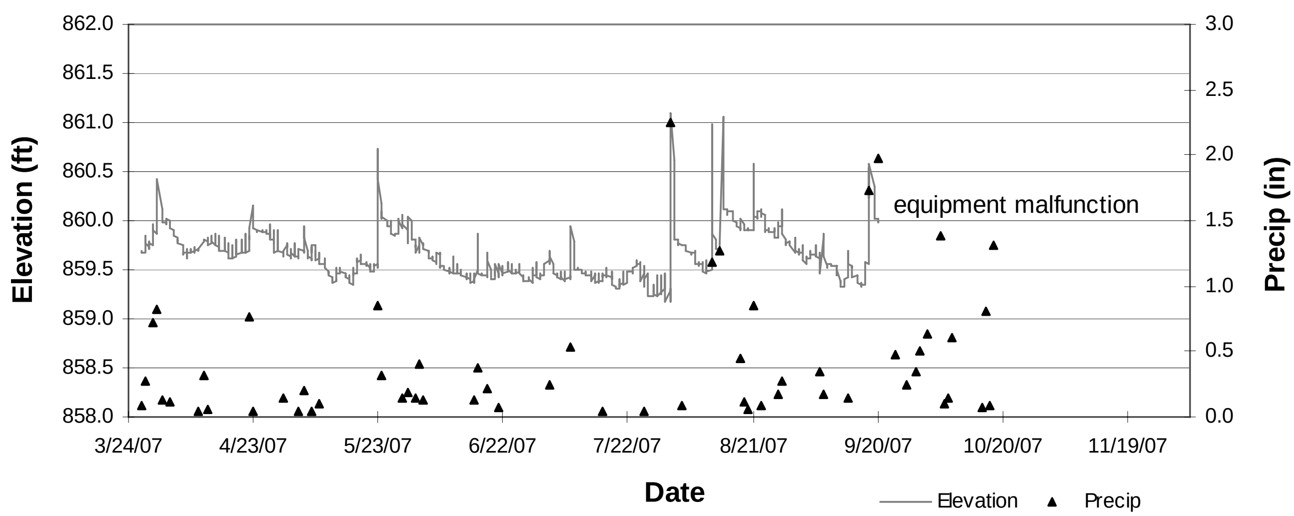
Sand Creek water levels fluctuated 1.93 feet in 2007, which is similar to 2005 and 2006. The lowest water occurred during a mid-summer drought, but even then were only ¼ to ½ feet lower than spring baseflow. The highest water levels occurred during the rainer-than-normal fall. The most notable event in 2007 was a 1.93 feet rise 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.

Summary of All Monitored Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	All Years
Min	859.06	859.22	859.21	859.31	859.35	859.32	859.17	859.06
2.5%	859.09	859.44	859.26	859.33	859.41	859.43	859.30	859.22
10.0%	859.15	859.48	859.32	859.40	859.45	859.54	859.41	859.34
25.0%	859.23	859.61	859.41	859.46	859.55	859.70	859.47	859.47
Median (50%)	859.33	859.75	859.55	859.60	859.72	859.86	859.64	859.64
75.0%	859.49	859.93	859.75	859.80	859.97	860.01	859.81	859.64
90.0%	859.54	860.09	860	860.03	860.21	860.12	859.98	860.08
97.5%	859.65	860.32	860.28	860.32	860.51	860.27	860.11	860.32
Max	860	861.22	861.13	861.27	861.50	861.38	861.10	861.50

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

2007 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, total phosphorus, and for some selected sites, volatile suspended solids.

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

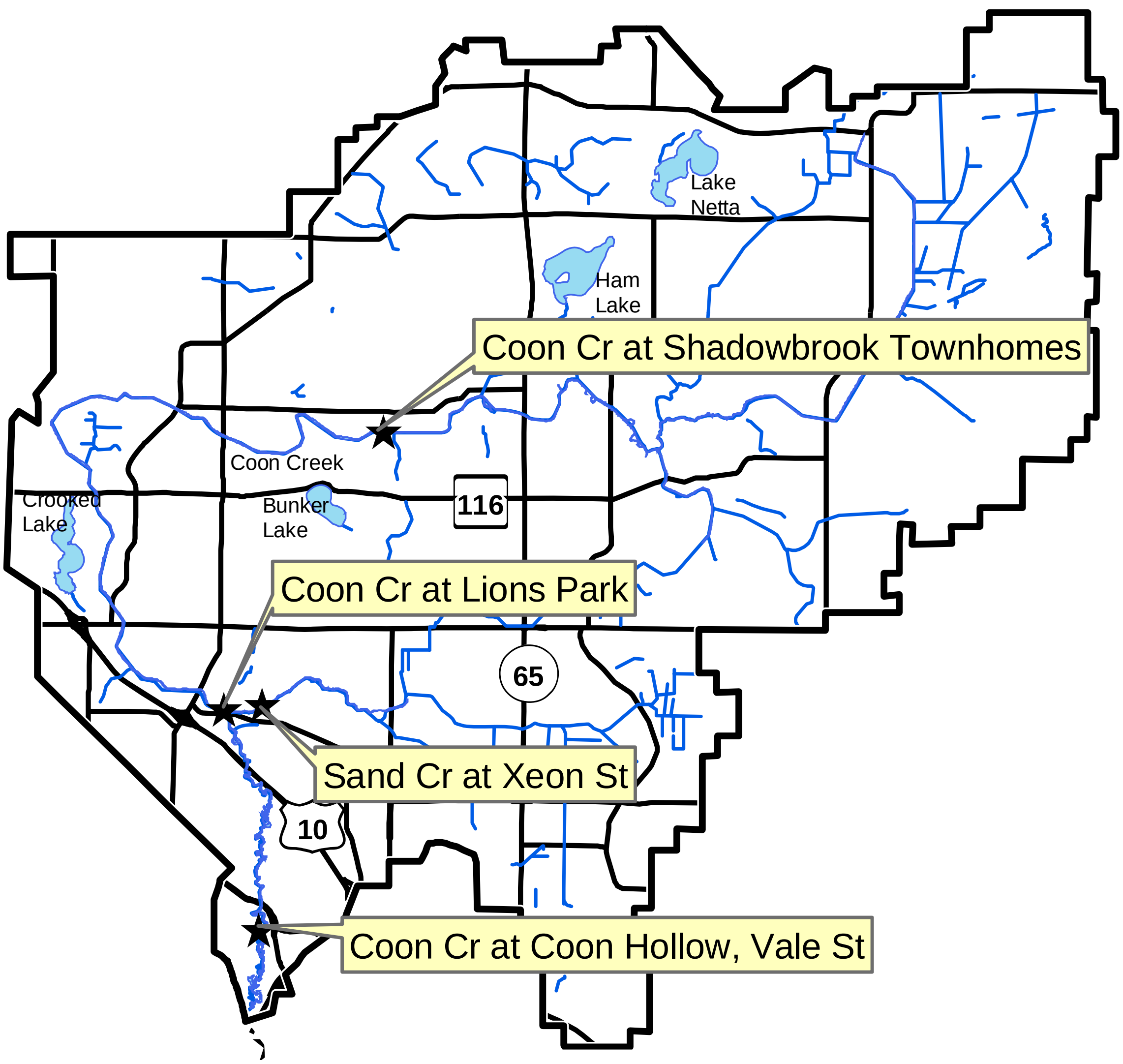
Locations: Coon Creek at Shadowbrook Townhomes, Andover

Coon Creek at Lions Park, Coon Rapids

Coon Creek at Coon Hollow, Vale St., Coon Rapids
Sand Creek at Xeon Street, Coon Rapids

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

Coon Creek Watershed Stream Water Quality Monitoring Sites

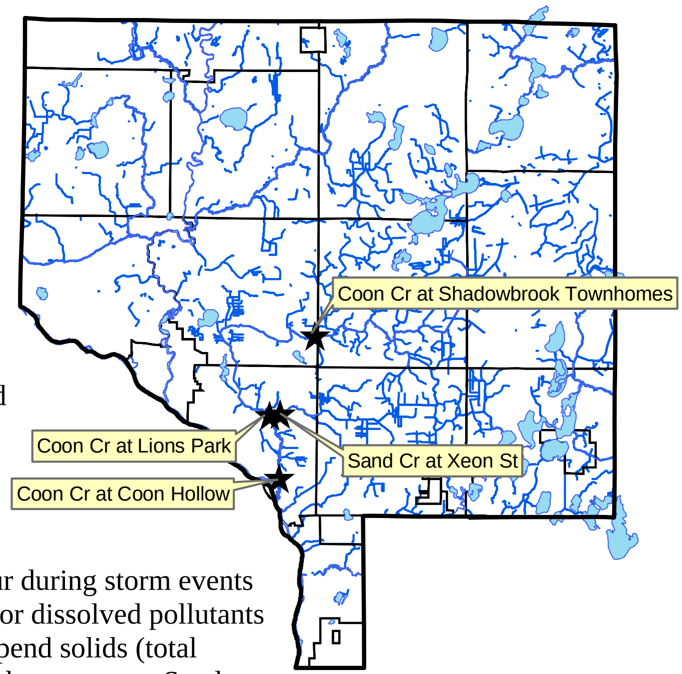


COON CREEK AND SAND CREEK

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 = S003-99
Sand Creek at Xeon Street, Coon Rapids	STORET SiteID = S004-619

Years Monitored

Coon Creek at Coon Hollow - 2005, 2006 and 2007
Other sites – 2007 only



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. In 2007, it was monitored simultaneously at upstream, midstream, and downstream locations, plus the tributary Sand Creek was monitored.

Results and Discussion

Eight water quality samples were taken in 2007, including four during storm events and four during baseflow. Water quality was below average for dissolved pollutants (as measured by conductivity, chlorides, and salinity) and suspend solids (total suspended solids and turbidity), and got progressively poorer downstream. Sand Creek, the largest tributary to Coon Creek, had higher dissolved pollutants than Coon Creek, and significantly contributes to higher levels of these pollutants downstream, but was similar to Coon Creek for suspended materials. Dissolved pollutants were highest during baseflow, but suspended solids were highest during storms. This indicates that an important source of dissolved pollutants is the shallow groundwater that feeds the creek during baseflow, while storm runoff is an important source of suspended solids.

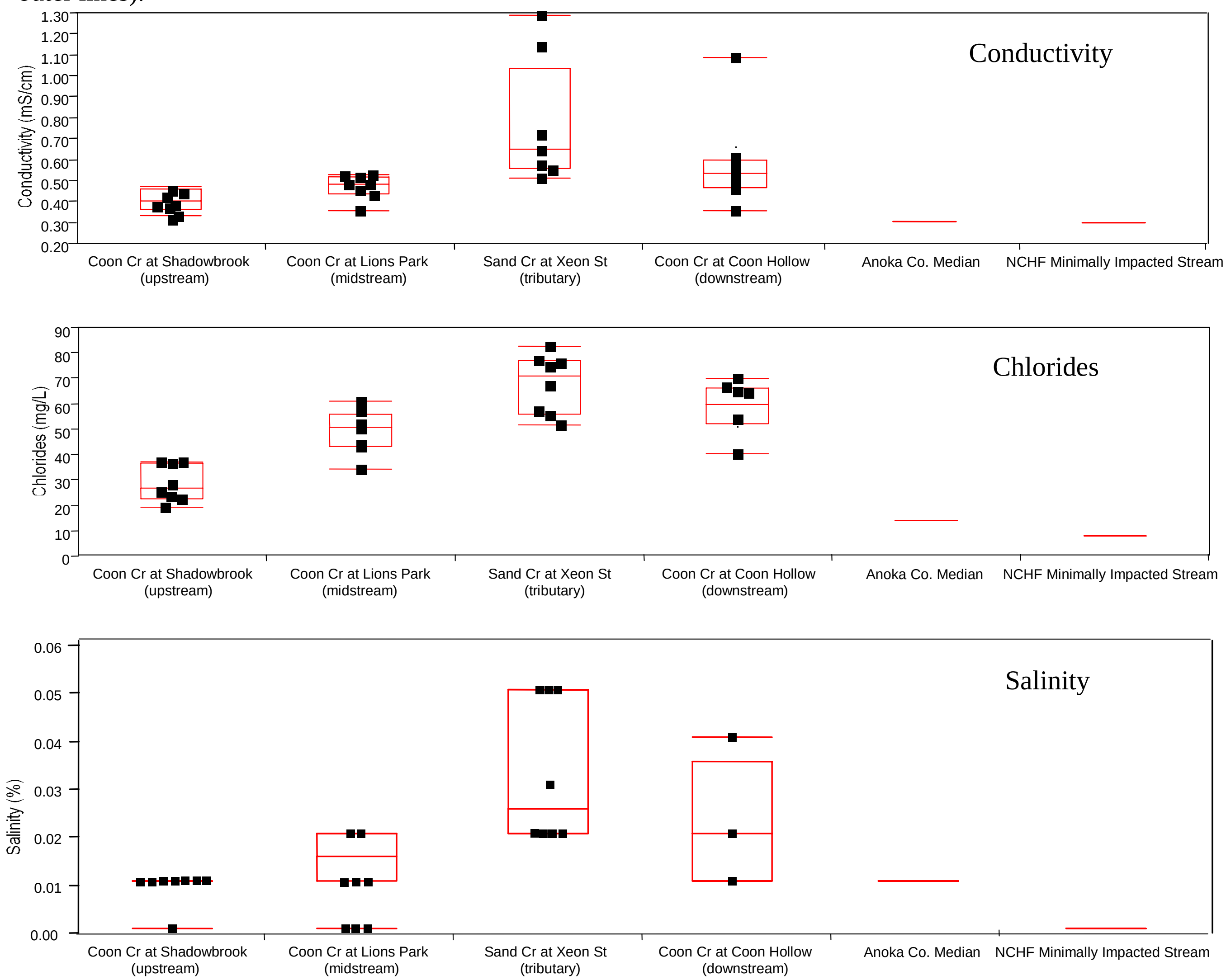
Different approaches will be needed to address this creek's two generalized pollution problems. Dissolved pollutants migrating from the shallow groundwater into the creek must be controlled at the source. Once on the ground, sandy soils in the watershed facilitate quick movement of dissolved materials 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, were progressively higher downstream (see figures on next page). Farthest upstream, at Shadowbrook Townhomes, salinity was the same as the median for other Anoka County streams, while conductivity and chlorides were slightly higher than their countywide medians. All three parameters increased slightly a the midstream site (at Lions Park), but increased much more dramatically at the farthest downstream site (Coon Hollow). For example, the average conductivity from upstream to downstream was 0.409, 0.474, 0.582 mS/cm. Chlorides, often from road deicing salts, nearly doubled from upstream to the downstream. The Sand Creek tributary significantly contributed to high levels of all three parameters at the downstream Coon Creek site; Sand Creek consistently had the highest levels of all the parameters.

At all sites, conductivity was nearly always higher during baseflow, chlorides was usually higher at baseflow, and salinity was generally higher during baseflow but showed much less variability. Because the highest levels of dissolved pollutants occur during baseflow, the largest source is probably the shallow groundwater that feeds the creek during baseflow.

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

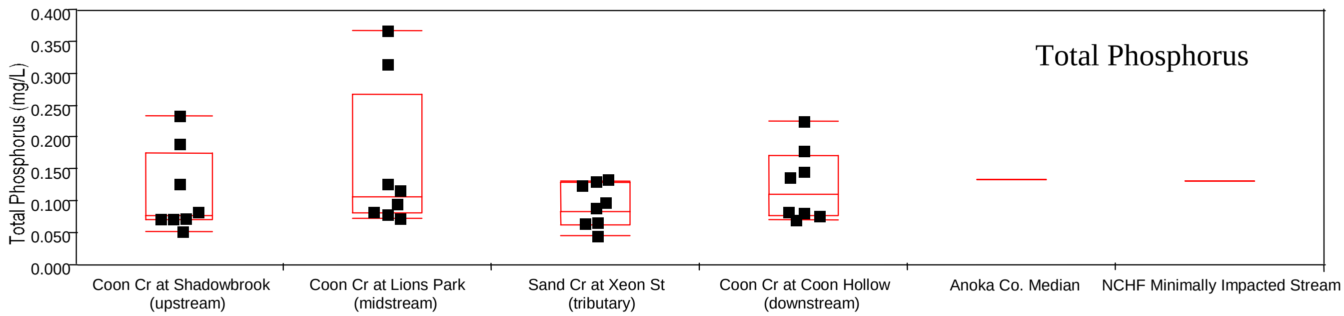


Total Phosphorus

Total phosphorus (TP) in Coon Creek and Sand Creek is relatively good and did not progressively increase downstream (see figure below). The average TP at each Coon Creek site (0.112, 0.157, and 0.125 mg/L upstream to downstream) and in Sand Creek (0.90 mg/L) were similar to the median of all Anoka County streams (0.134 mg/L). Sand Creek had a positive influence on Coon Creek water quality in the case of TP, unlike for most of the other pollutants monitored.

Total phosphorus was almost always highest during storms at all three sites. At the downstream Coon Creek site the average stormflow TP in 2007 was 0.172 mg/L, but during baseflow was 0.078 mg/L. This is similar to 2006, when the storm and baseflow averages were 0.151 and 0.095 mg/L, respectively. Interestingly, the storm average in 2005 (0.375 mg/L) was more than two times higher than either of the two most recent years. Baseflow TP was similar in 2006 (0.096 mg/L).

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

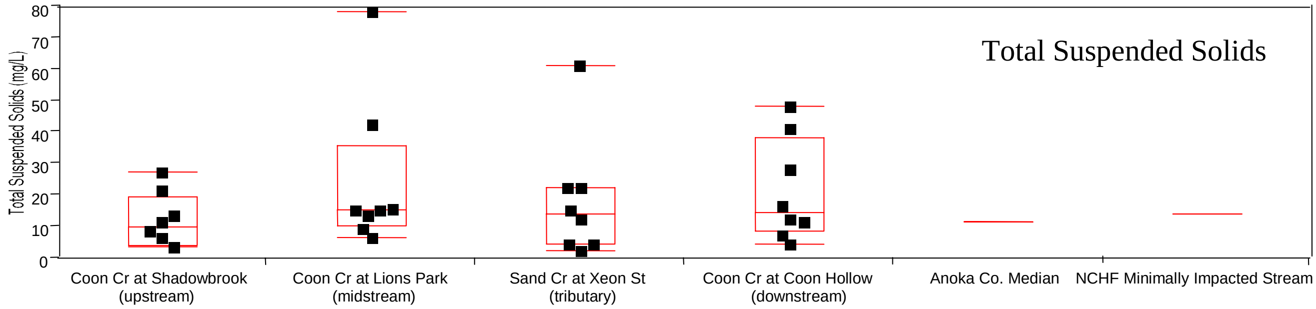


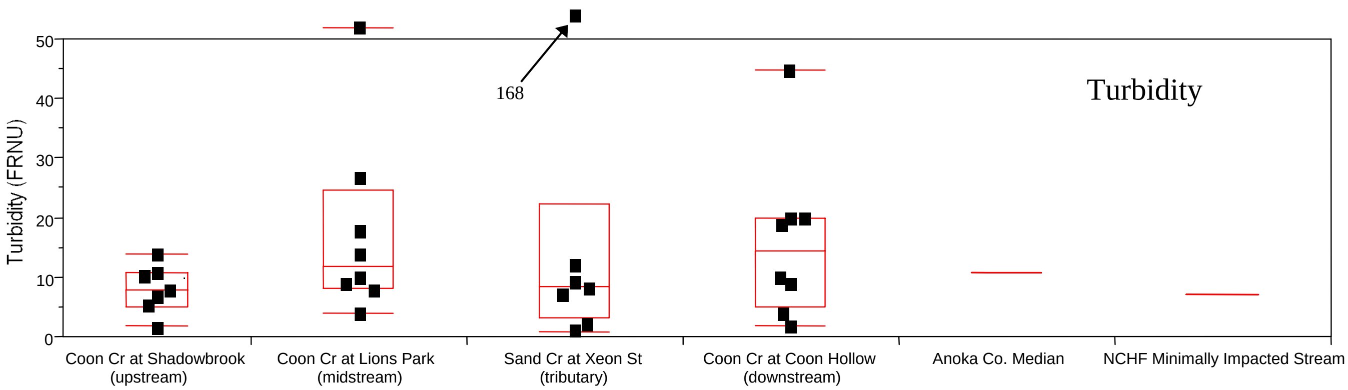
Total Suspended Solids and Turbidity

On average, total suspended solids (TSS) and turbidity were similar at all sites and similar to other Anoka County streams, but both were at least two times higher during storms than baseflow . The difference between baseflow and storms became progressively larger downstream. At the upstream site, average storm TSS was 2.3 times baseflow, and the difference was even greater when this site was monitored in 2005 and 2006. At the midstream site it was 2.7 times greater during storms. At the downstream site it was 3.3 times greater during storms, on average. In the tributary Sand Creek, baseflow TSS was actually higher than storms, but this baseflow average is driven by a single reading of 61 mg/L on November 28. If that reading is removed, then storm TSS is two times baseflow TSS, similar to Coon Creek.

The November 28th, 2007 samples were particularly interesting with respect to TSS and turbidity. This date was just before ice up. It was a baseflow period when few, if any surface flows into the stream would have occurred recently because of freezing temperatures. Yet, the water at all of the Coon and Sand Creek sites was strongly greenish brown. This had not been observed during baseflow in summer. Turbidity, which is measured by light refraction and therefore most sensitive to large particles, was more than two times higher than any other reading during the year at the furthest downstream site. Sand Creek turbidity was 6.5 times higher than any other reading during the year. TSS, which is measured by filtering and weighing suspended material and can better detect small particles, was not particularly high, except at Sand Creek.

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

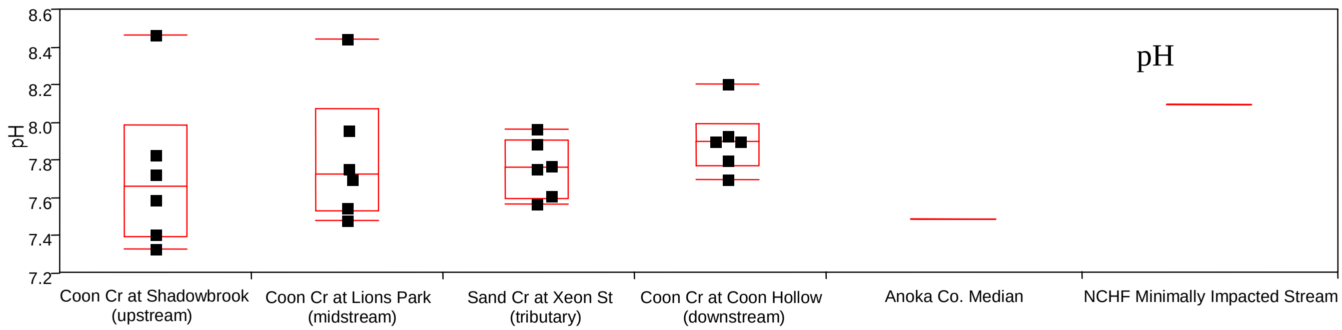




pH

pH was within the expected range at all sites, but did increase slightly downstream. From upstream to downstream, the average pH was 7.73, 7.82, and 7.91. Sand Creeks average was 7.76.

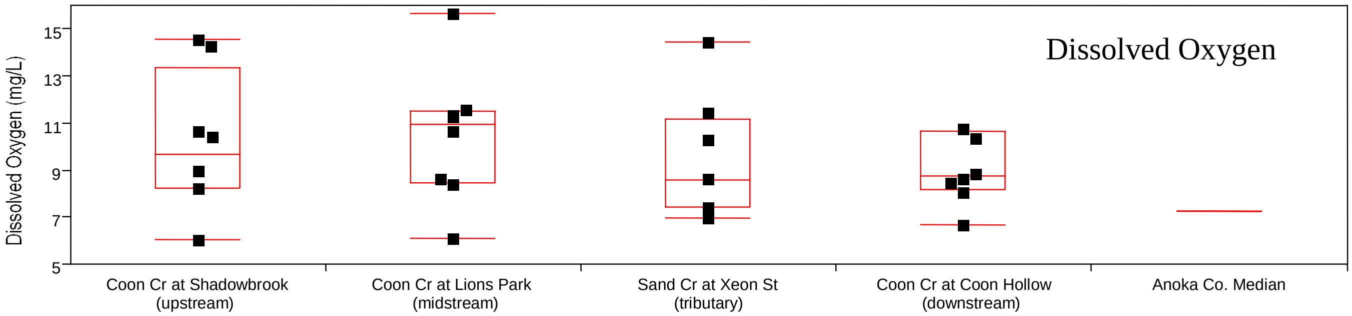
pH at Coon Creek and Sand Creek 2007. Dots are individual readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



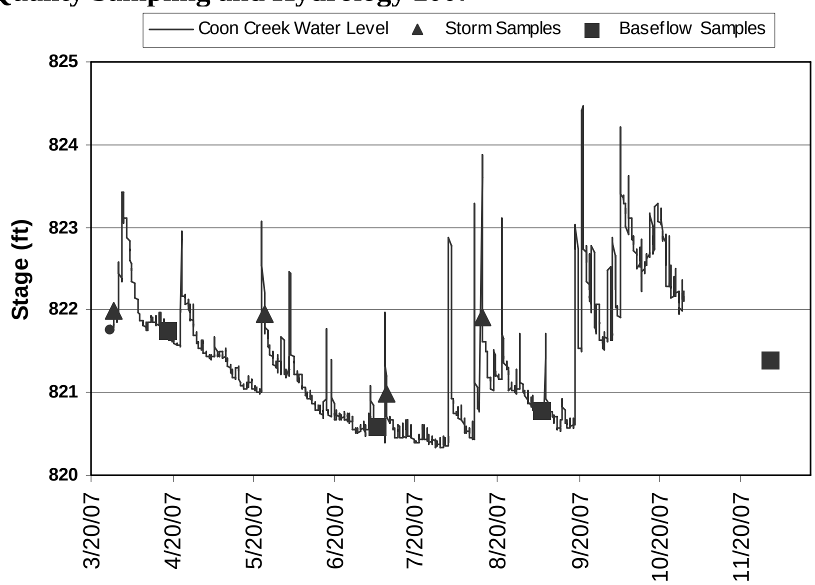
Dissolved Oxygen

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

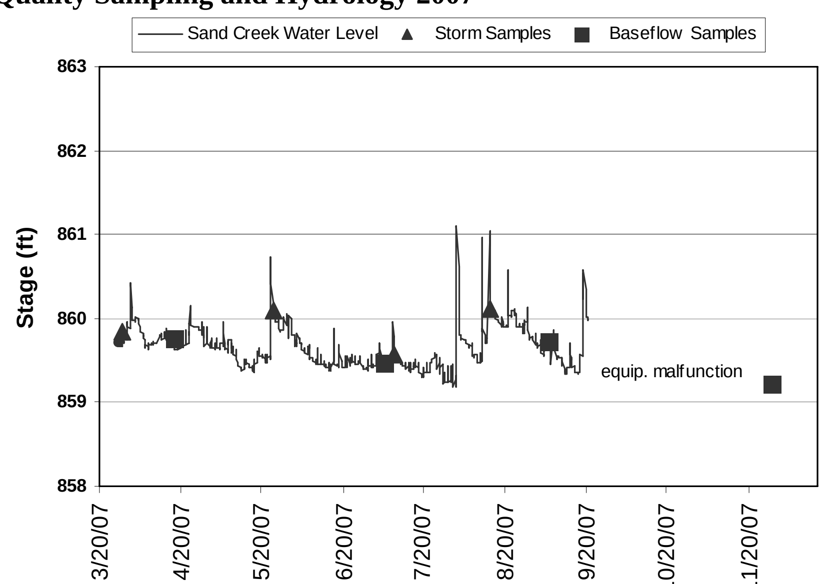
Dissolved Oxygen at Coon Creek and Sand Creek 2007. Dots are individual readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Coon Creek Water Quality Sampling and Hydrology 2007



Sand Creek Water Quality Sampling and Hydrology 2007



Coon Creek and Sand Creek Water Quality Data 2007

Coon Creek at Shadowbrook Townhomes - 2007

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
3/28/2007	14:45	storm	7.41	0.352	10	10.68	86.2	6.2	0.01	0.126	19.1	13.0	na	
4/17/2007	10:20	base	7.59	0.406	7	10.48	91.6	10.0	0.01	0.070	23.6	11.0	872.60	
5/24/2007	12:30	storm	7.33	0.398	11	8.3	81.0	14.8	0.01	0.190	25.3	27.0	872.29	
7/5/2007	10:10	base	7.83	0.476	2	9	103.7	20.7	0.01	0.070	37.0	3.0	871.80	
7/9/2007	9:40	storm	na	0.394	5	8.31	90.0	19.7	0.01	0.072	28.0	3.0	871.99	
8/14/2007	12:30	storm	na	0.336	14	6.11	65.0	18.7	0.00	0.234	22.2	21.0	872.34	
9/5/2007	13:10	base	8.47	0.444	8	14.33	167.0	22.6	0.01	0.083	36.3	6.0	871.72	
11/28/2007	12:15	base	7.73	0.465	na	14.62	104.0	2.3	0.01	0.051	36.8	8.0	872.34	
Min			7.33	0.336	2	6.11	65.0	2.3	0.00	0.051	19.1	3.0	871.72	
Mean			7.73	0.409	8	10.27	98.6	14.4	0.01	0.112	28.5	11.5	872.154	
Max			8.47	0.476	14	14.62	167.0	22.6	0.01	0.234	37.0	27.0	872.60	

Coon Creek at Lions Park - 2007

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
3/28/2007	15:30	storm	7.55	0.454	10	11.39	95.9	8.0	0.01	0.117	43.1	15.0	na	
4/17/2007	10:45	base	7.70	0.487	8	10.69	96.8	11.2	0.01	0.079	44.0	13.0	849.44	
5/24/2007	12:55	storm	7.48	0.519	18	8.47	85.0	15.8	0.02	0.315	57.3	42.0	849.27	
7/5/2007	11:10	base	7.96	0.534	4	11.34	132.7	23.8	0.02	0.073	60.9	9.0	na	
7/9/2007	10:20	storm	na	0.431	14	8.66	101.0	22.8	0.01	0.096	52.3	6.0	848.76	
8/14/2007	13:50	storm	na	0.358	52	6.12	70.0	22.1	0.00	0.368	34.1	78.0	849.17	
9/5/2007	14:10	base	8.45	0.485	9	11.62	146.0	26.8	0.02	0.126	51.2	15.0	848.66	
11/28/2007	12:55	base	7.76	0.523	27	15.74	108.0	0.7	0.02	0.082	50.2	15.0	849.25	
Min			7.48	0.358	4	6.12	70.0	0.7	0.00	0.073	34.1	6.0	848.7	
Mean			7.82	0.474	18	10.50	104.4	16.4	0.01	0.157	49.1	24.1	849.1	
Max			8.45	0.534	52	15.74	146.0	26.8	0.02	0.368	60.9	78.0	849.4	

Coon Creek at Coon Hollow - 2007

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
3/28/2007	16:30	storm	7.80	0.490	20	10.42	88	8.0	0.01	0.145	51.6	28	821.84	35.05
4/17/2007	11:30	base	7.93	0.552	9	10.82	98	11.0	0.02	0.081	54.8	16	821.5	28.61
5/24/2007	13:25	storm	7.70	0.523	20	8.9	90	16.0	0.02	0.225	65.0	48	821.71	32.53
7/5/2007	12:15	base	7.90	0.614	2	8.66	98	21.7	0.02	0.070	70.0	7	821.32	25.40
7/9/2007	11:50	storm	na	0.461	10	8.1	94	22.6	0.01	0.137	64.2	11	820.53	13.00
8/14/2007	14:55	storm	na	0.360	19	6.72	77	22.5	0.01	0.179	40.1	41	821.5	28.61
9/5/2007	15:10	base	8.21	1.090	4	8.54	98	23.3	0.04	0.083	66.5	4	820.42	11.49
11/28/2007	13:50	base	7.90	0.565	45	16.64	114	0.2	0.04	0.076	54.0	12	821.40	26.80
Min			7.70	0.360	2	77	6.72	0.2	0.01	0.070	40.1	4	820.42	11.49
Mean			7.91	0.582	16	95	9.85	15.7	0.02	0.125	58.3	21	821.28	25.19
Max			8.21	1.090	45	114	16.64	23.3	0.04	0.225	70.0	48	821.84	35.05

Sand Creek at Xeon Street - 2007

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
3/28/2007	16:00	storm	7.61	0.513	26	10.36	86.8	7.6	0.02	0.132	55.2	22	859.50	
4/17/2007	11:05	base	7.89	0.722	9	11.54	103.0	10.5	0.03	0.061	74.7	15	859.27	
5/24/2007	13:05	storm	7.57	0.576	12	8.69	89.0	16.6	0.02	0.129	67.0	22	859.55	
7/5/2007	11:35	base	7.77	1.29	1	8.54	94.4	20.3	0.05	0.046	82.5	2	859.10	
7/9/2007	11:00	storm	na	1.14	2	7.44	85.0	22.0	0.05	0.075	77.2	4	859.20	
8/14/2007	14:20	storm	na	0.556	8	7.04	82.1	23.2	0.02	0.089	57.2	12	859.45	
9/5/2007	14:30	base	7.97	0.664	7	7.48	87.0	23.1	0.02	0.061	76.2	4	859.21	
11/28/2007	13:20	base	7.76	0.645	168	14.53	107.0	2.7	0.05	0.126	51.7	61	859.22	
Min			7.57	0.513	1	7.04	82.10	2.7	0.02	0.046	51.7	2.0	859.10	
Mean			7.76	0.763	29	9.45	91.79	15.8	0.03	0.090	67.7	17.8	859.31	
Max			7.97	1.290	168	14.53	107.00	23.2	0.05	0.132	82.5	61.0	859.55	

Anoka County Median		7.49	0.308	11	7.3			0.01	0.134	14	11
NCHF Ecoregion Mean			0.390						0.220		
NCHF Minimally Impacted Stream		8.1	0.300	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

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.

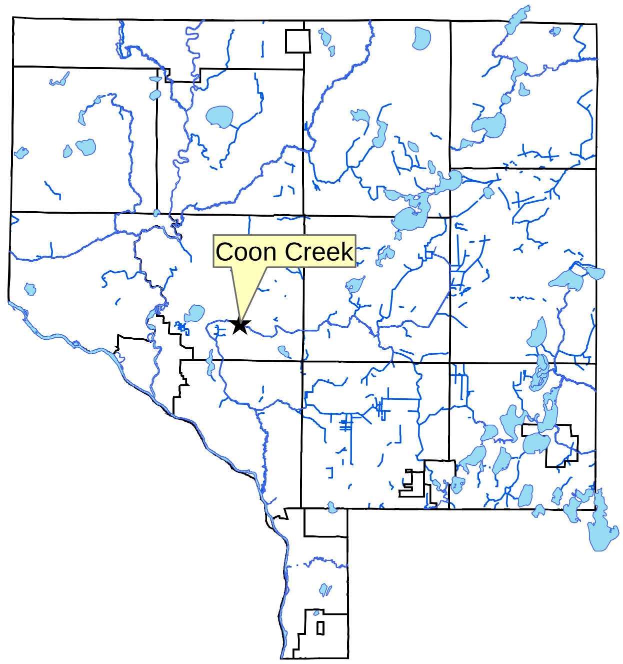
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

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.

COON CREEK

at Andover High School, Centerville



Last Monitored

By Andover High School in 2007

Monitored Since

Fall 2003

Student Involvement

202 students in 2007, approx 377 since 2003

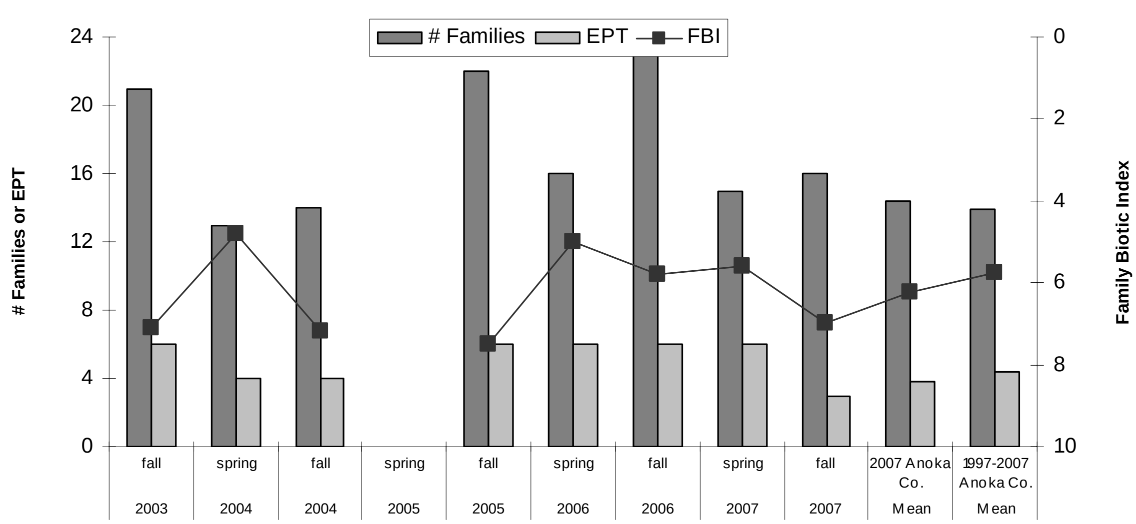
Background

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

Two Andover High School classes monitored this stream in spring 2007. In fall 2007 six classes monitored, but invertebrates were kept and analyzed for only the first two. 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 over the years, likely due to different climate and stream flow conditions prior to and during sampling. Still, 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	Mean	Mean
Season	fall	spring	fall	spring	fall	spring	fall	spring	fall	2007 Anoka Co.	1997-2007 Anoka Co.
FBI	7.10	4.80	7.20		7.50	5.00	5.80	5.60	7.00	6.2	5.6
# Families	21	13	14		22	16	23	15	16	14.4	13.2
EPT	6	4	4		6	6	6	6	3	3.8	4.4
Date	21-Oct	10-May	19-Oct	2-May	17-Oct	24-May	6-Oct	1-May	3-Oct		
sampling by	AHS	AHS	AHS	AHS	AHS	AHS	AHS	AHS	AHS		
sampling method	MH	MH	MH	MH	MH	MH	MH	MH	MH		
# individuals	267	89	130	inadequate	301	141	415	317	176		
# replicates	2	1	1	sample	1	1	2	2	1		
Dominant Family	corixidae	baetidae	corixidae		corixidae	calopterygidae	calopterygidae	calopterygidae	corixidae		
% Dominant Family	46.4	48.3	50		53.5	29.1	49.6	31.9	36.4		
% Ephemeroptera	6.0	51.7	4.6		9.0	29.8	3.4	13.9	1.7		
% Trichoptera	16.5	11.2	22.3		5.0	14.9	6.7	6.0	4.5		
% Plecoptera	0.0	0.0	0.0		0	0.7	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

Parameter	21-Oct-03	10-May-04	19-Oct-04	2-May-05	16-Oct-05	24-May-06	6-Oct-06	1-May-07	3-Oct-07
pH	8.66	9.25	9.45	8.72	7.75	7.77	7.62	8.50	7.62
Conductivity (mS/cm)	0.662	0.496	0.379	0.357	0.310	0.508	0.559	0.454	0.417
Turbidity (NTU)	10	12	22	11	15	15	16	11	14
Dissolved Oxygen (mg/L)	7.71	na	9.83	na	10.07 (93%)	6.70 (70.3%)	9.46 (82%)	11.19 (106%)	8.93 (88%)
Salinity (%)	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.01	0.01
Temperature (C)	10.8	14.5	7.9	5.9	10.9	16.8	9.6	13.3	15.1

Discussion

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 2007.

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: 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)

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

(middle and edge of Ilex Wetland are monitored)

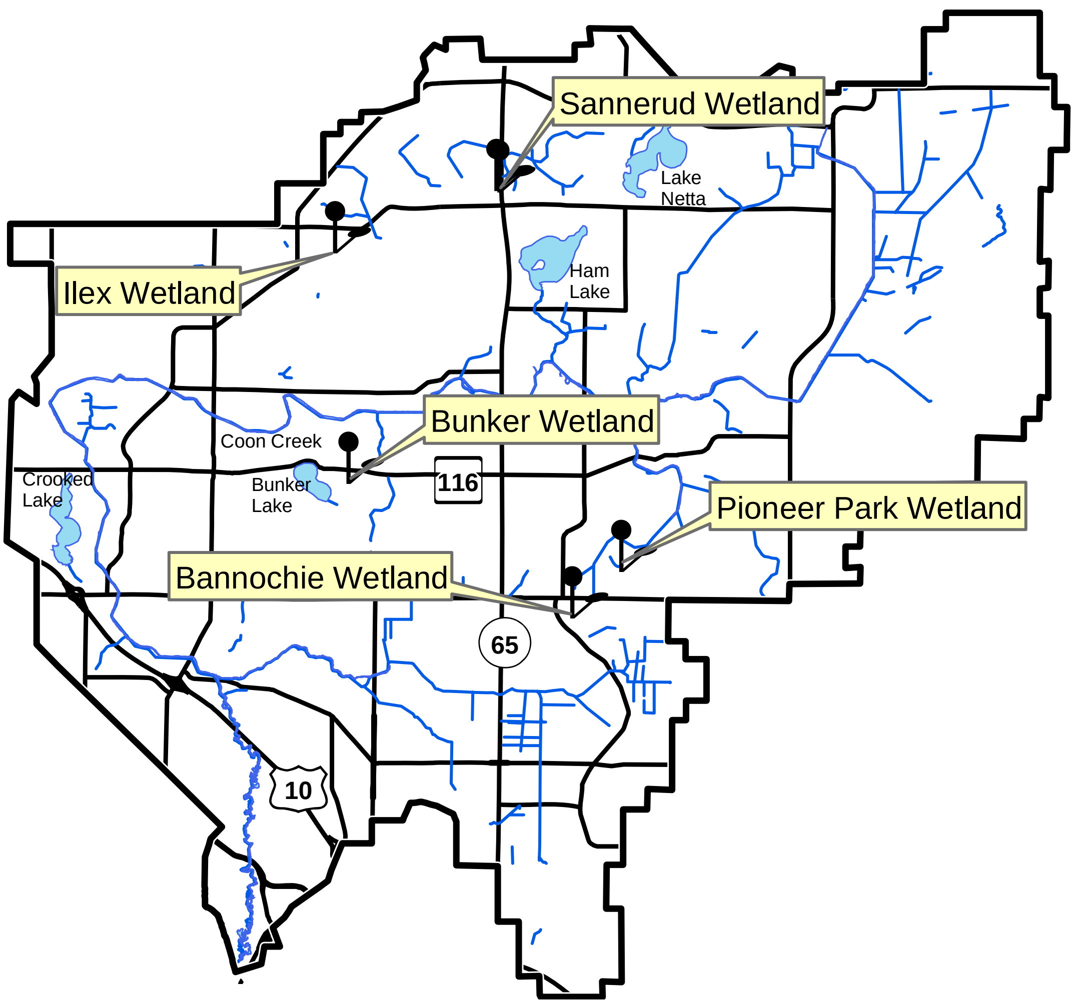
Pioneer Park Wetland, Pioneer Park off Main St., Blaine

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.

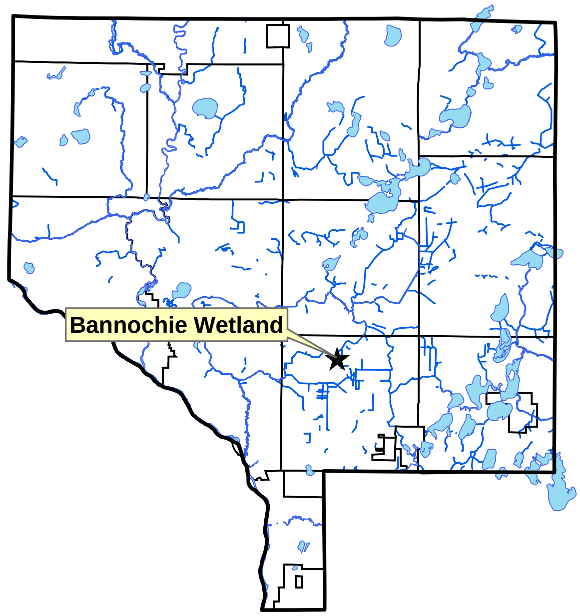
Coon Creek Watershed 2007 Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

BANNOCHIE REFERENCE WETLAND

SE quadrat 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	-

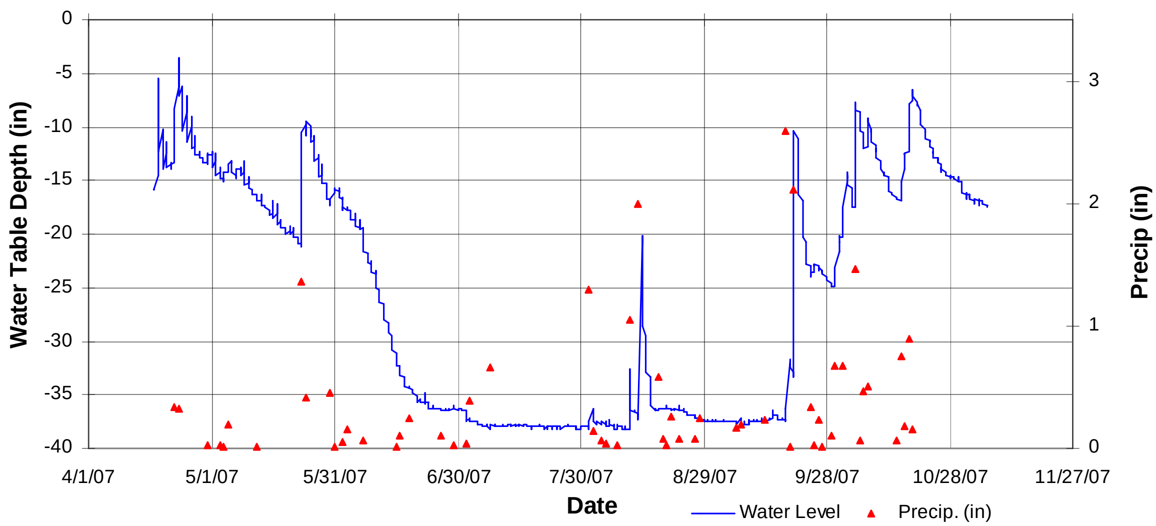
Surrounding Soils: Rifle and some Zimmerman fine sand

Vegetation at Well Location:

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

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

2007 Hydrograph

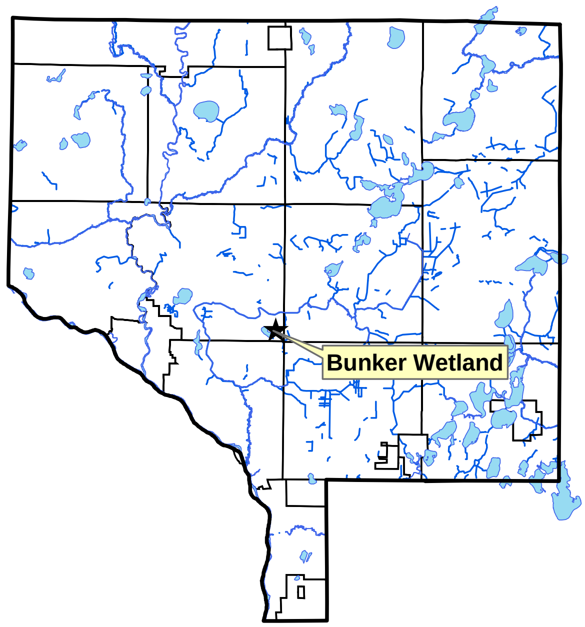


Well depth was 37 inches, so a reading of–37 or less indicates water levels were at an unknown depth greater than or equal to 37 inches.

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	-

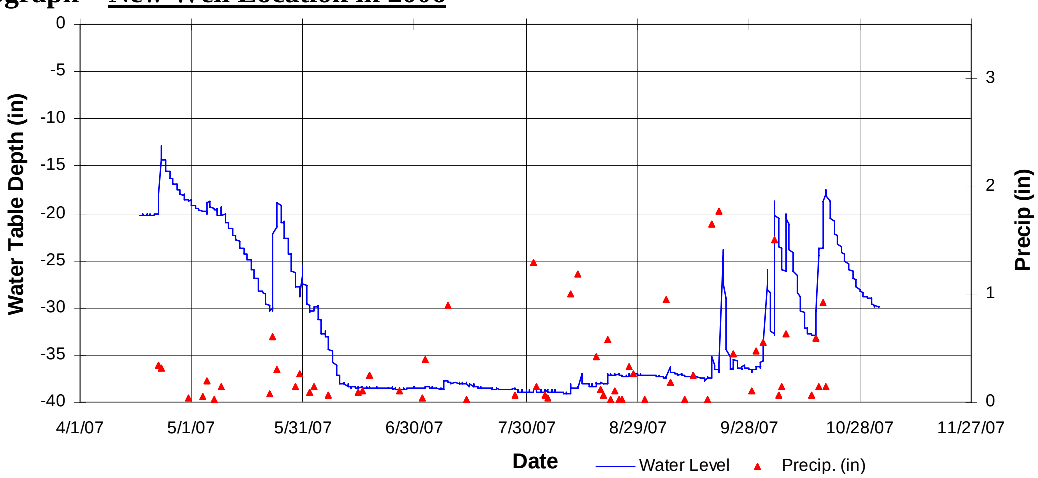
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

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

Other Notes: 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.

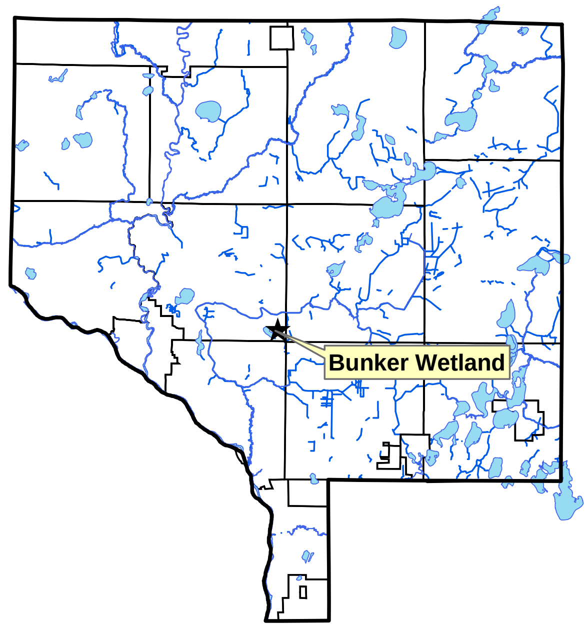
2007 Hydrograph – New Well Location in 2006



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.

BUNKER REFERENCE WETLAND - MIDDLE

Bunker Hills Regional Park, Andover



Site Information

Monitored Since: Wetland edge monitored since 1996, but this well in wetland's middle 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	-

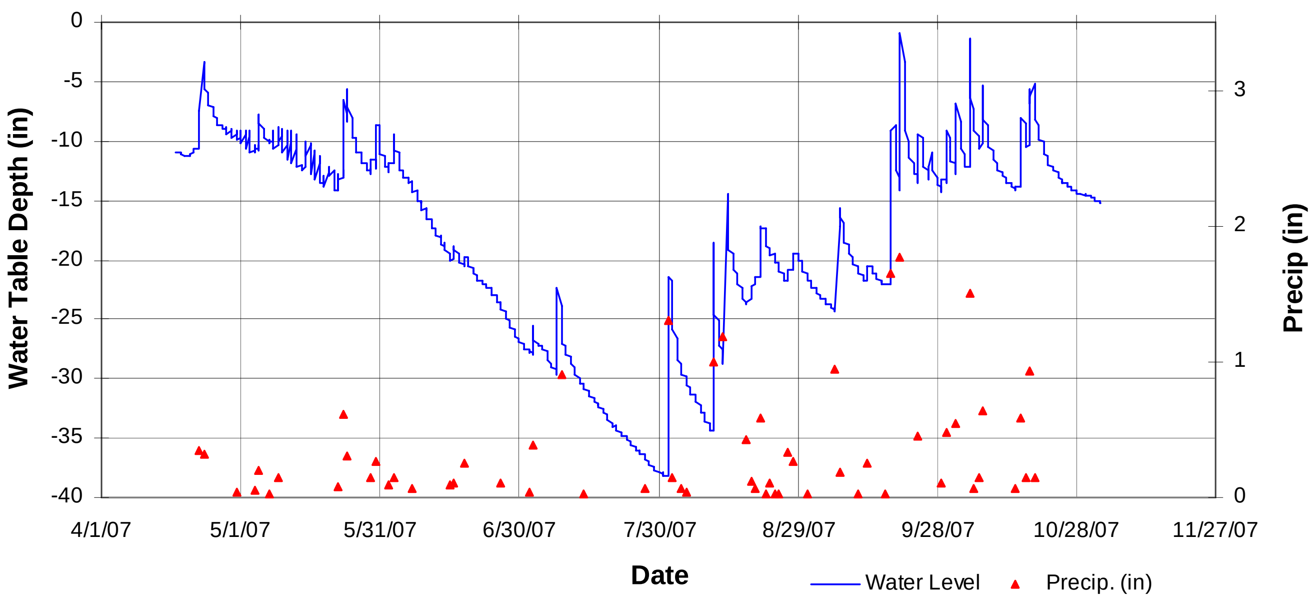
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Poa palustris	Fowl Bluegrass	90
Polygonum sagitatum	Arrow-leaf Tearleaf	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.

2007 Hydrograph



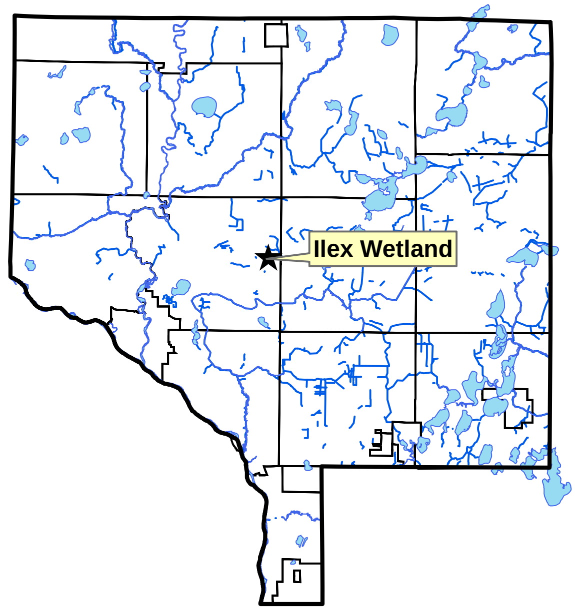
Well depth was 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

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	-

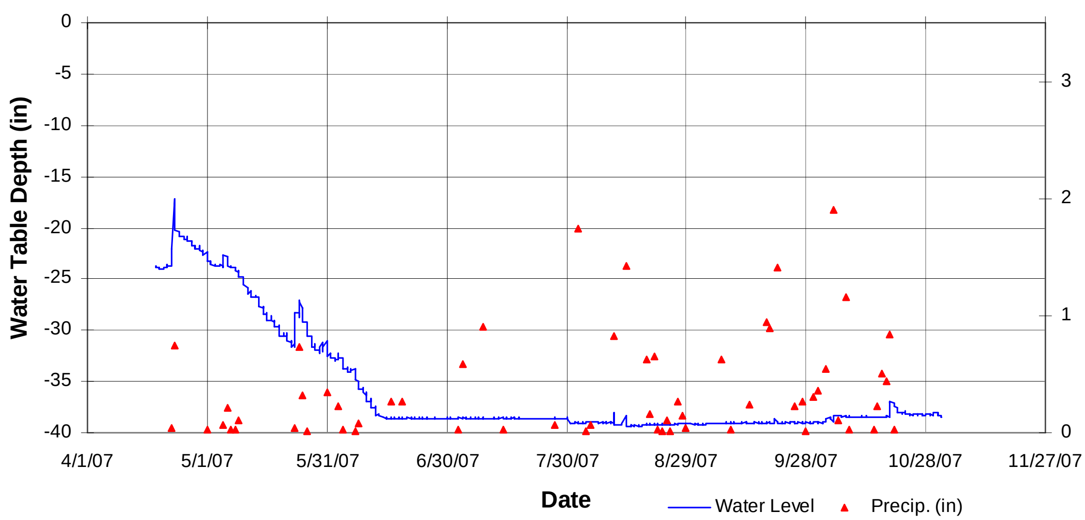
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

Vegetation at Well Location:

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

Other Notes: 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.

2007 Hydrograph



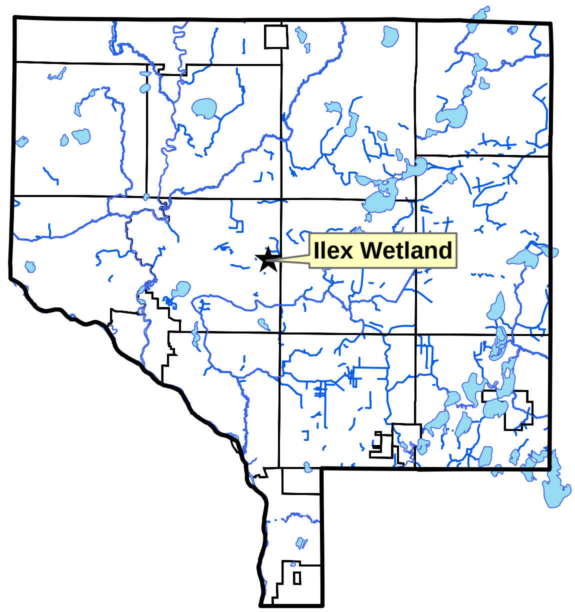
Well depth was 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

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	-

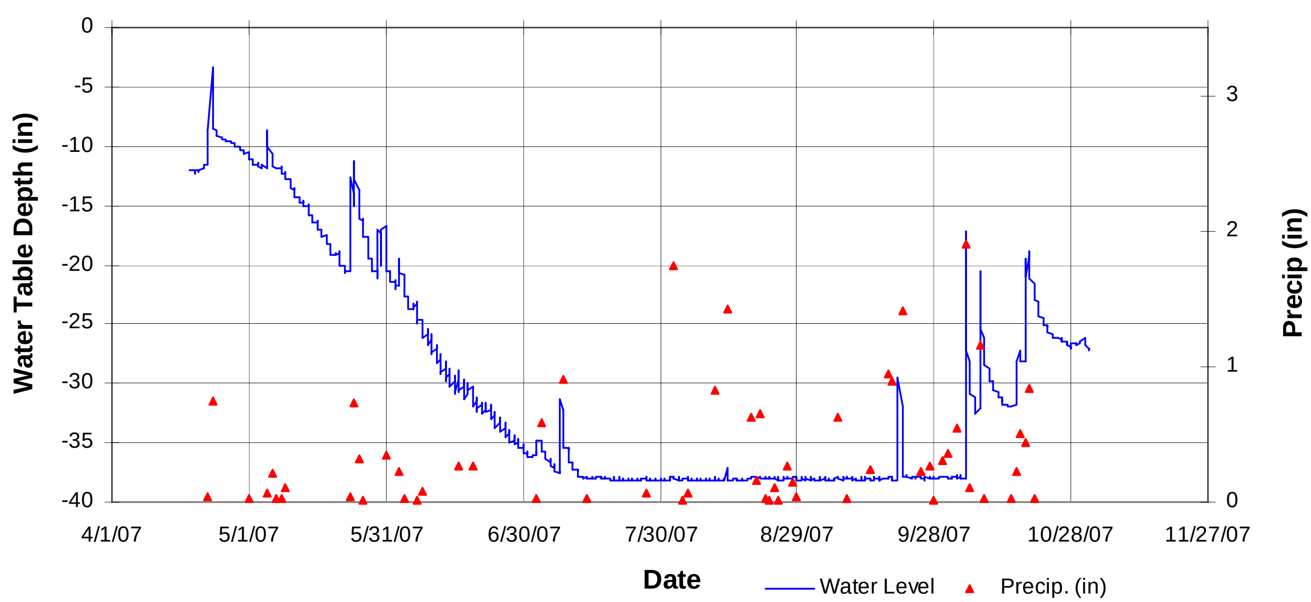
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

Vegetation at Well Location:

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

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

2007 Hydrograph

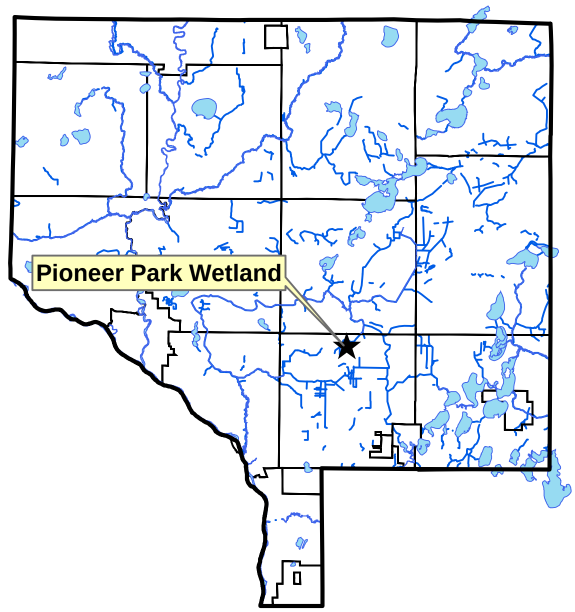


Well depth was 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

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	-

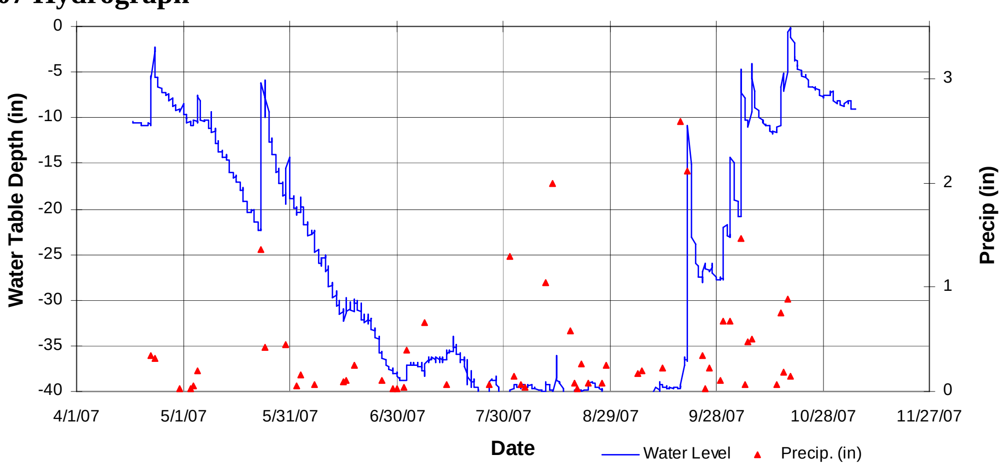
Surrounding Soils: Rifle and loamy wet sand.

Vegetation at Well Location:

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

Other Notes:

2007 Hydrograph

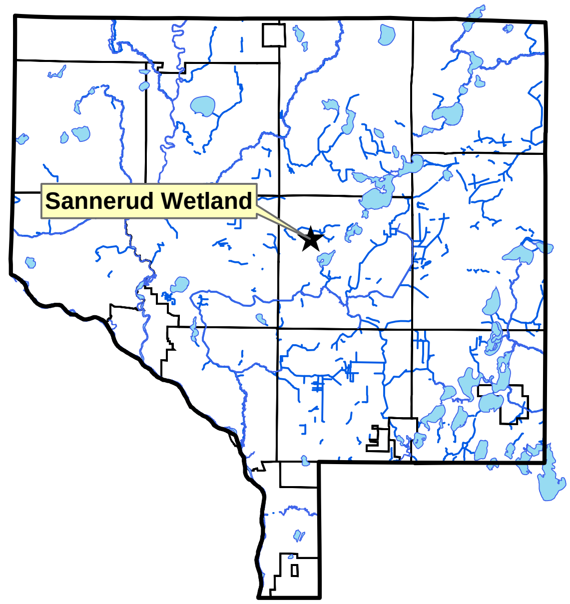


Well depth was 40 inches, so a reading of–40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

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	-

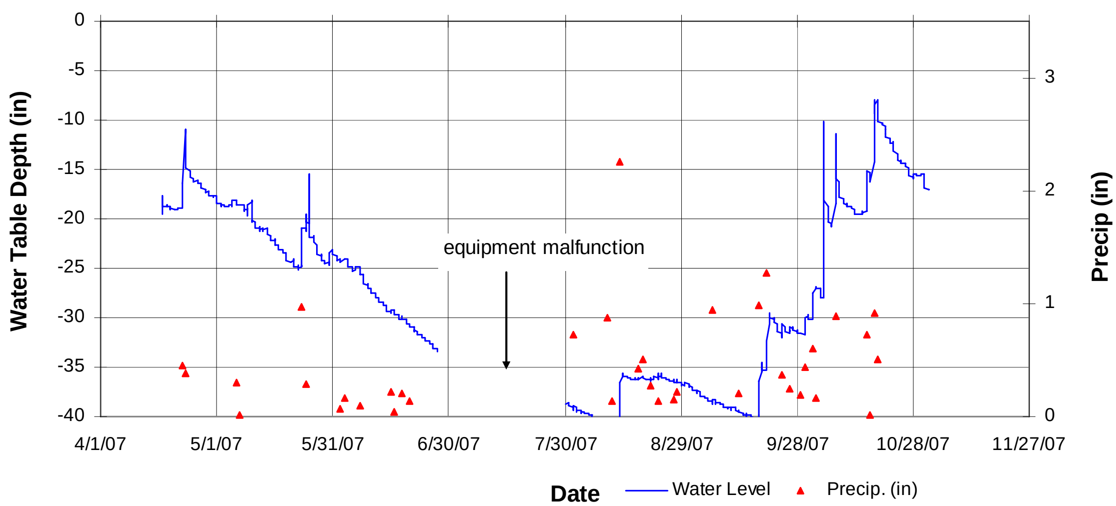
Surrounding Soils: Zimmerman and Lino.

Vegetation at Well Location:

Scientific	Common	% Coverage
Rubus spp.	Undiff Rasberry	70
Phalaris arundinacea	Reed Canary	40
Acer rubrum (T)	Red Maple	30
Populas trembulodies (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.

2007 Hydrograph



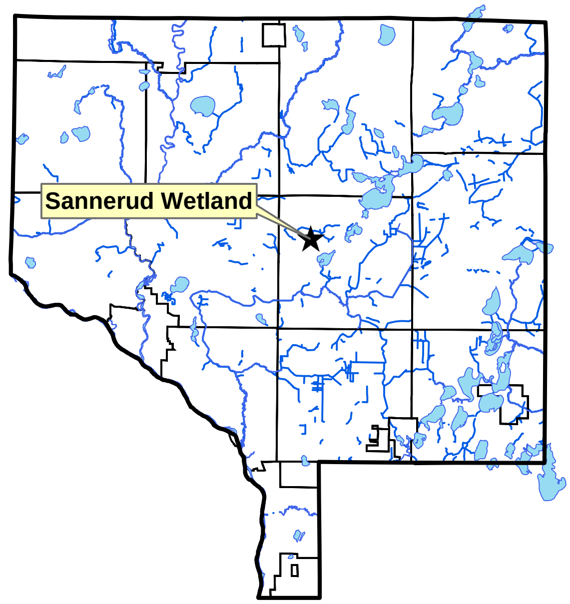
Well depth was 43.5 inches, so a reading of–43.5 indicates water levels were at an unknown depth greater than or equal to 43.5 inches.

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.

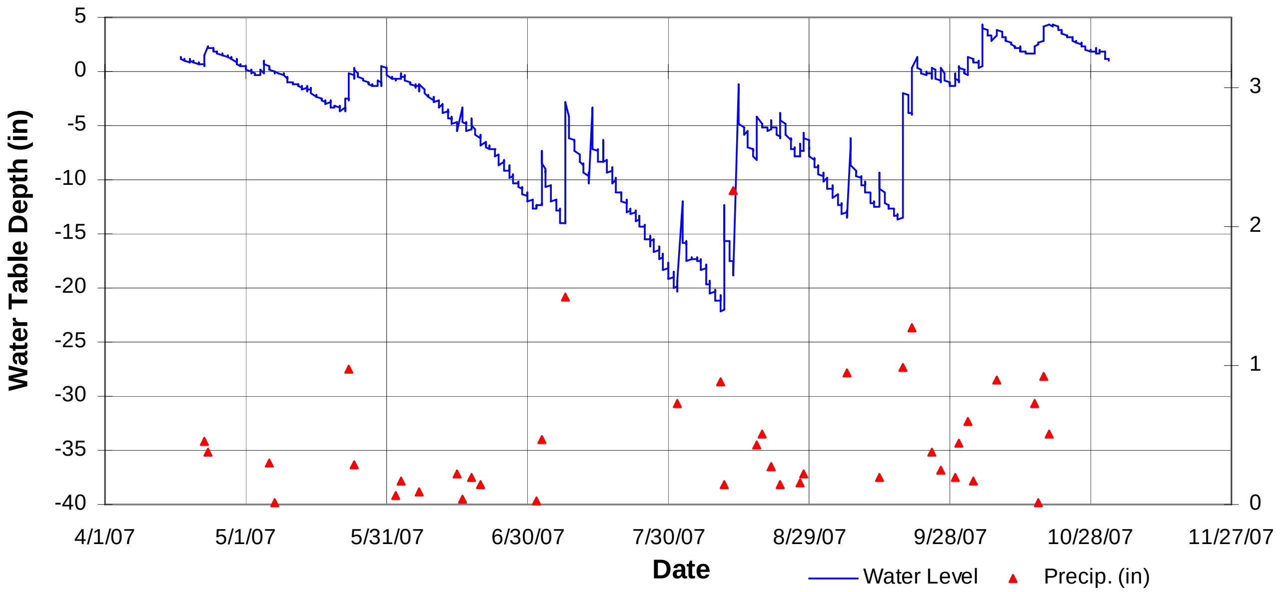
Soils at Well Location: Detailed profile not available. However, soils were frozen into late June, suggesting peats.

Surrounding Soils: Zimmerman and Lino.

Vegetation at Well Location: Not available.

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.

2007 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

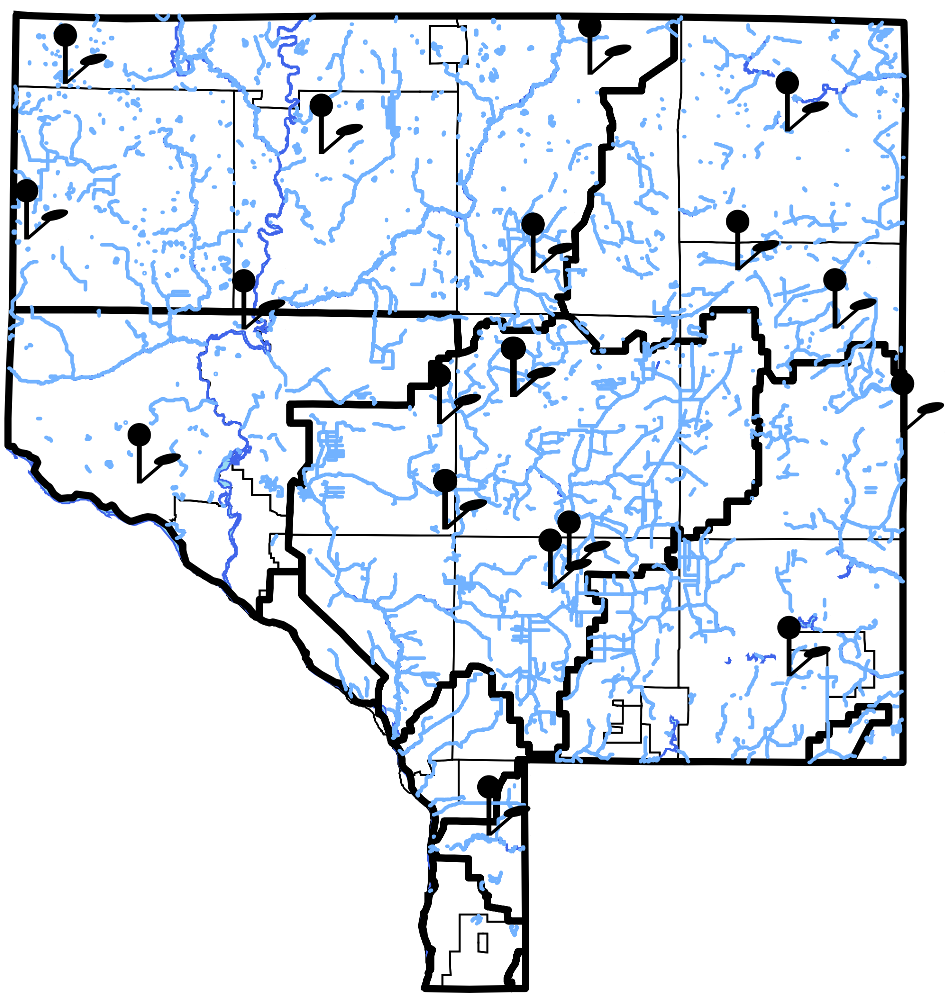
Description: This section includes analyses of wetland hydrology data that has been collected at 18 reference wetland sites. Shallow groundwater levels at the edge of these wetlands are recorded every four hours. Many have been monitored since 1996. This analysis summarizes this enormous multi-year, 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.

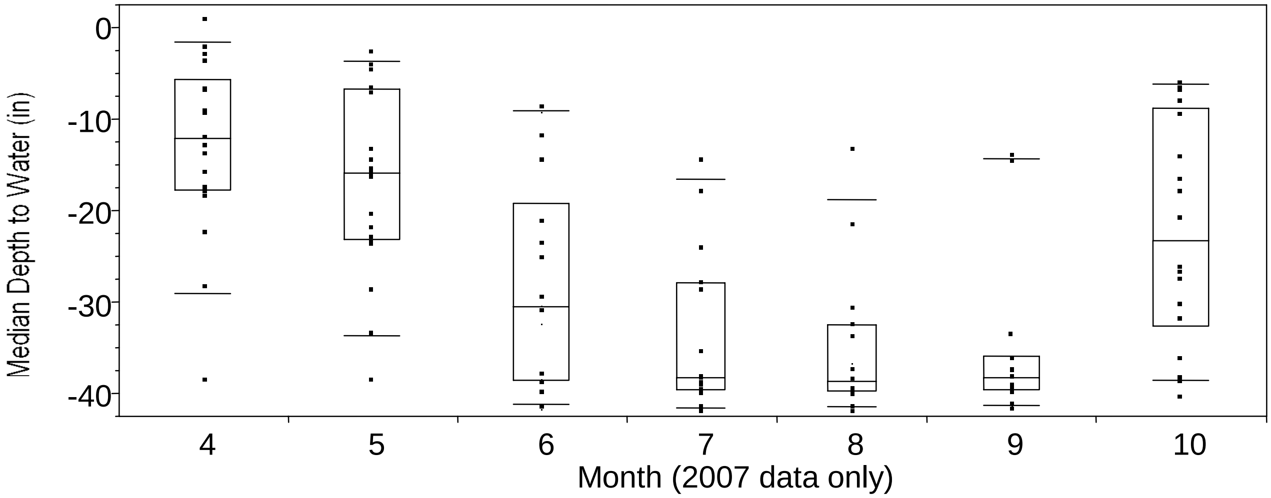
Locations: All 18 reference wetland hydrology monitoring sites in Anoka County.

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



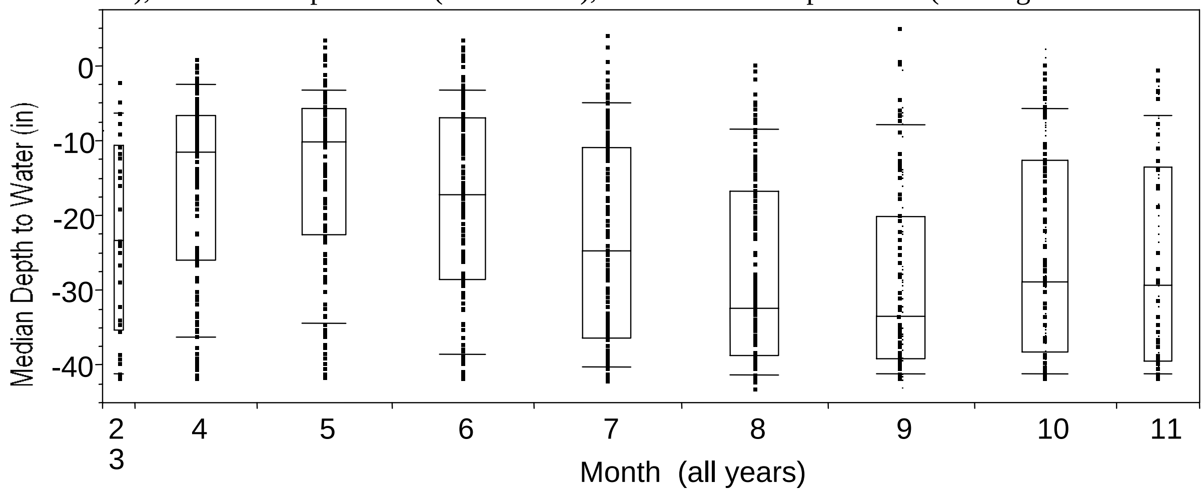
2007 Reference Wetland Water Levels Summary. Each dot represents the median depth to the water table at the edge of one reference wetland for a given month in 2006. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines).



Quantiles

month	minimum	10.0%	25.0%	median	75.0%	90.0%	maximum
4	-38.2	-29.02	-17.65	-12.1	-5.625	-1.5	1.2
5	-38.2	-33.61	-23.15	-15.8	-6.675	-3.56	-2.3
6	-41.6	-41.15	-38.5	-30.45	-19.125	-9.02	-8.3
7	-41.6	-41.53	-39.525	-38.25	-27.775	-16.48	-14.1
8	-41.6	-41.39	-39.725	-38.6	-32.45	-18.81	-13
9	-41.4	-41.31	-39.5	-38.25	-35.875	-14.23	-13.6
10	-40	-38.47	-32.6	-23.2	-8.75	-6.15	-5.7

1996-2007 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 2007. 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	-34.3	-22.5	-10	-5.6	-3.1	3.8
6	-41.6	-38.42	-28.5	-17.1	-6.9	-3.18	3.8
7	-41.8	-40.1	-36.25	-24.6	-10.9	-4.88	4.3
8	-43	-41.3	-38.65	-32.3	-16.65	-8.34	0.3
9	-43	-41.1	-39.15	-33.4	-20.1	-7.78	5.3
10	-41.6	-41.03	-38.225	-28.8	-12.475	-5.64	2.4
11	-41.8	-41.1	-39.4	-29.2	-13.5	-6.6	-0.2

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.
New water table levels are recorded every 4 hours at all 18 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 one high quality wetland that is under a number of pressures. The goal is to understand changes that may happen to this and other similar wetlands. 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 will be monitored every couple of years by assessing percent cover of various species along transects that were established in 2007. The wetland selected is the Sannerud reference wetland located 0.25 miles northwest of the intersection of Highway 65 and Constance Boulevard in the City of Ham Lake.

Purpose: To understand the influence of pressures upon this, and other similar wetlands, especially with respect to hydrology and vegetation. Pressures on this wetland include increased traffic on the adjacent highway and potential future road expansions, building and increased impervious surface, 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

Results:

Wetland Description

This wetland is a classified as a Circular 39 Type 2 Inland fresh sedge meadow. 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 10-20 inches below the surface.

The dominate plant species within this wetland are sedges and grasses, specifcally *Carex lasiocarpa* (Wooly-fruit sedge) and *Calamagrostis canaddensis* (Canada bluejoint). 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 arundinace* (Reed Canary Grass), and *Populas trembelodies* (Quaking Aspen).

Looking at the wetland center

Looking at the wetland edge

Listed below are the results of 4 transects which collect basal area data of the existing vegetation. Each transect had 4 sample plots. These plots used 1 meter quadrants for the herbaceous layer, and a thirty-foot radius for the shrub and tree layer. The transects where chosen to best represent the typical vegetation on-site. Also attached is a map depicting the sample locations and the vegetation community distribution.

Sample Site 1-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Rubus flagellaris	Dew Berry	70	Native
Calamagrostis canadensis	Canada Blue Joint	30	Native
Phalaris arundinacea	Reed Canary Grass	20	Invasive
Populas trembelodies	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 tementosa	Steeple Bush	5	Native
Salix petiolaris	Meadow Willow	5	Native

Sample 1-2

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	100	Native
Calamagrostis canadensis	Canada Blue Joint	30	Native
Salaix nigra	Black Willow	5	Native
Spirea tementosa	Steeple Bush	5	Native

Sample 1-3

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	100	Native
Calamagrostis canadensis	Canada Blue Joint	40	Native
Spirea tementosa	Steeple Bush	5	Native

Sample 1-4

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	100	Native
Calamagrostis canadensis	Canada Blue Joint	20	Native
Typha angustifolia	Narrow-leaf Cattail	30	Native

Sample 2-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	40	Native
Calamagrostis canadensis	Canada Blue Joint	30	Native
Phalaris arundinacea	Reed Canary Grass	60	Invasive
Typha angustifolia	Narrow-leaf Cattail	10	Native

Sample 2-2

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	40	Native
Calamagrostis canadensis	Canada Blue Joint	100	Native
Salaix nigra	Black Willow	10	Native

Sample 2-3

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	30	Native
Calamagrostis canadensis	Canada Blue Joint	100	Native

Sample 2-4

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	30	Native
Calamagrostis canadensis	Canada Blue Joint	100	Native

Sample 3-1

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

Sample 3-2

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

Sample 3-3

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	30	Native
Calamagrostis canadensis	Canada Blue Joint	100	Native

Sample 3-4

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	20	Native
Calamagrostis canadensis	Canada Blue Joint	100	Native

Sample 4-1

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 tementosa	Steeple Bush	5	Native
Salix exigia	Sandbar Willow	20	Native

Sample 4-2

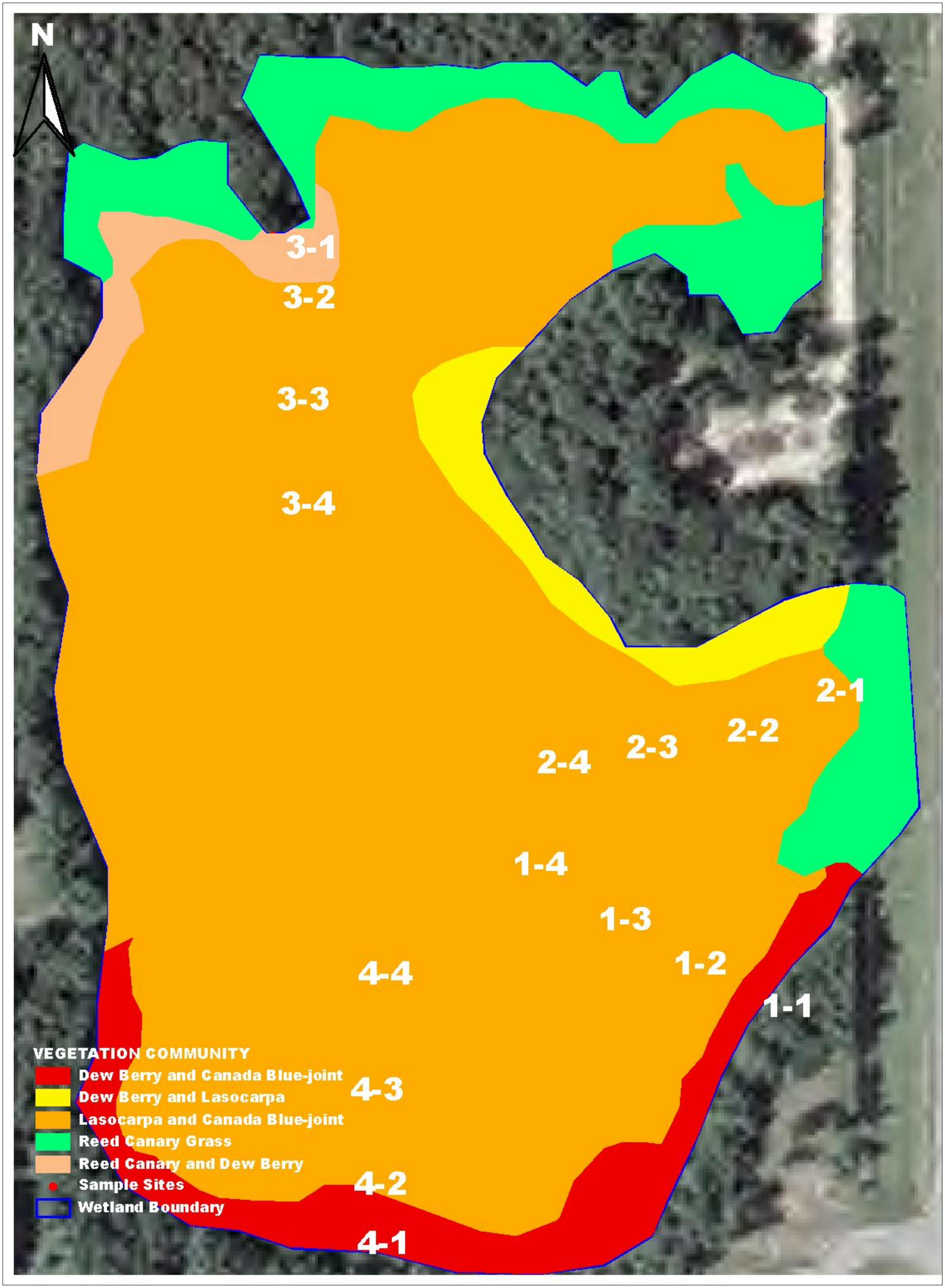
Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	20	Native
Calamagrostis canadensis	Canada Blue Joint	100	Native
Salix exigia	Sandbar Willow	20	Native

Sample 4-3

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	20	Native
Calamagrostis canadensis	Canada Blue Joint	100	Native
Polygonum amphibium	Water Smartweed	5	Native

Sample 4-4

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	100	Native
Calamagrostis canadensis	Canada Blue Joint	20	Native


N
3-1
3-2
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4-4
4-3
4-2
4-1
VEGETATION COMMUNITY
Dew Berry and Canada Blue-joint
Dew Berry and Lasocarpa
Lasocarpa and Canada Blue-joint
Reed Canary Grass
Reed Canary and Dew Berry
Sample Sites
Wetland Boundary

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 in the area.

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.

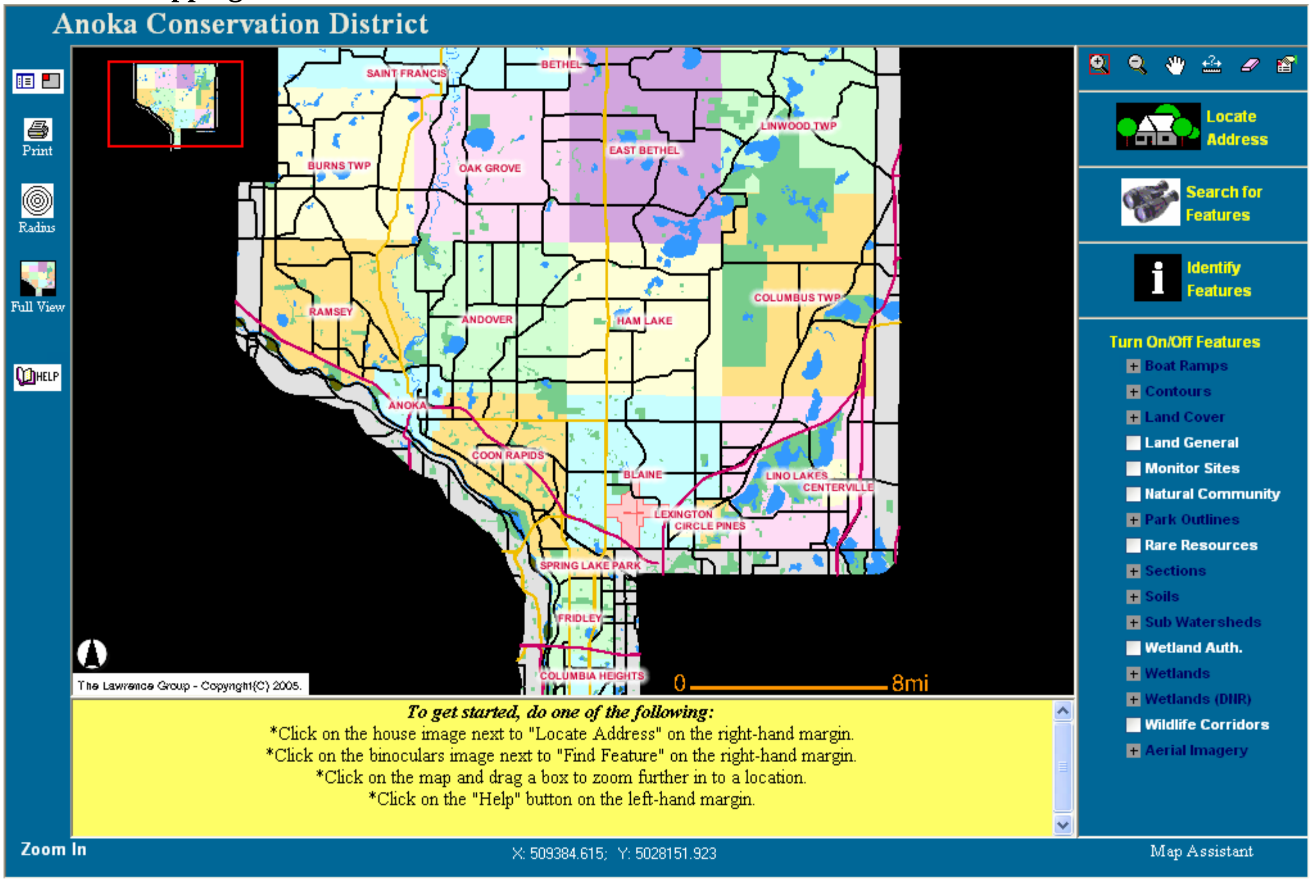
Other tools on the website include:

- 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
- narrative discussions of what the monitoring data mean

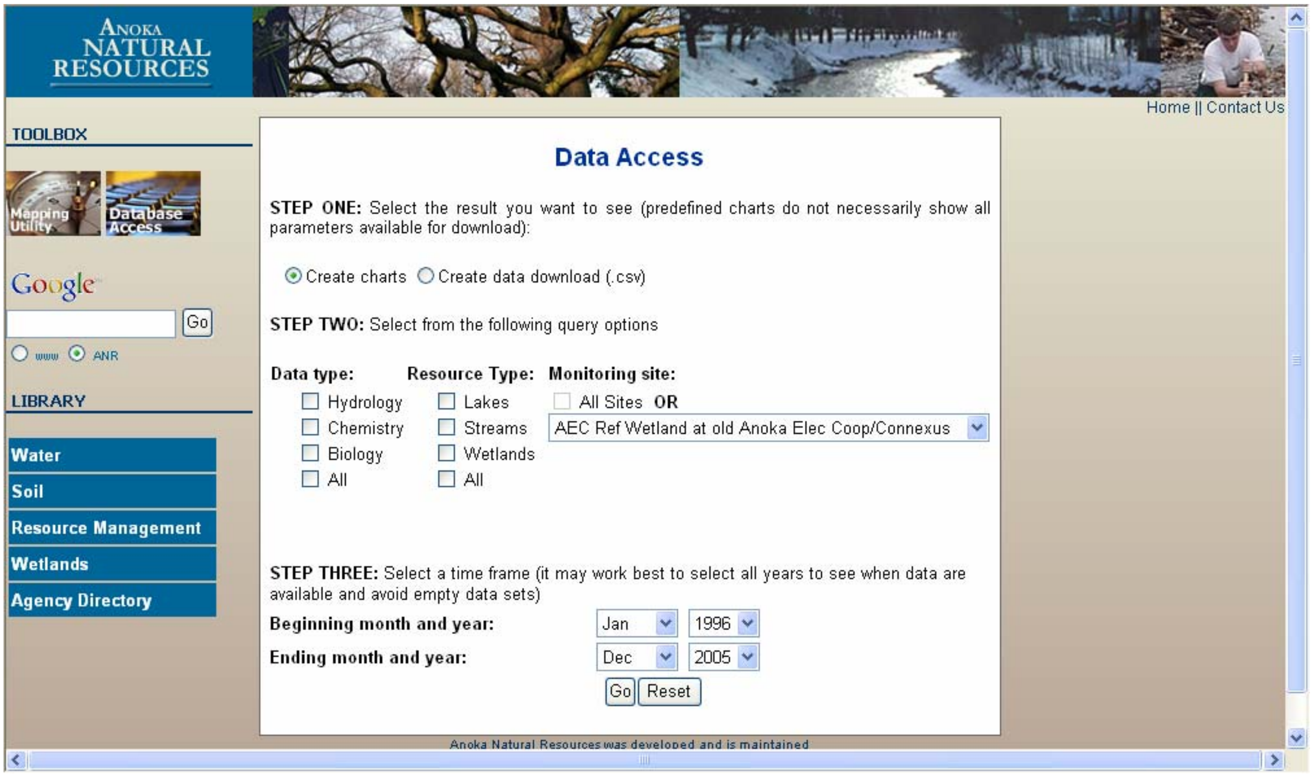
CCWD Website Homepage

more on next page

Interactive Mapping Tool



Interactive Data Access Tool



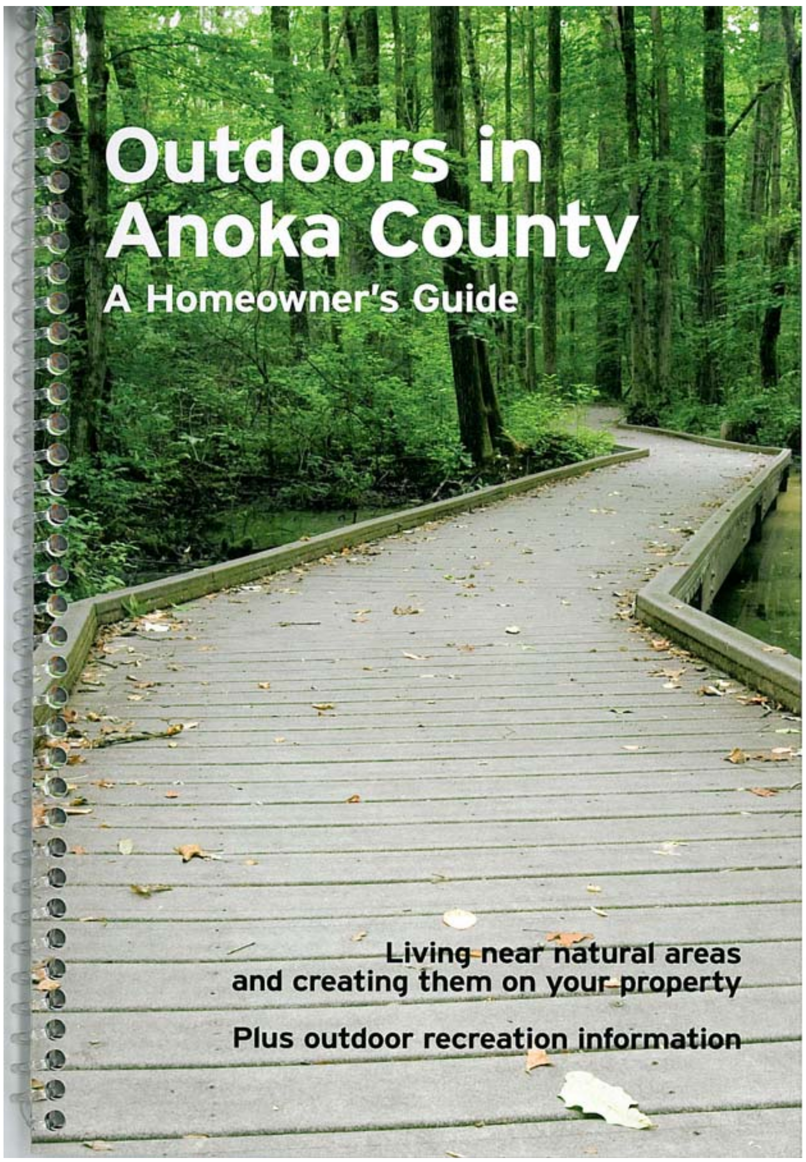
Homeowner Guide

Description: The Anoka Conservation District wrote, designed, and printed an educational booklet for homeowners. The booklet included information on topics of interest to the CCWD, including landscaping for water quality, wetlands, well water, septic systems, and hazardous household wastes. Therefore, the CCWD is funding the printing of 500 booklets to be distributed in the CCWD area. The target audience will be homeowners living next to important natural resources such as unique wetlands, woodlands, and lakes.

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

Locations: Throughout the watershed.

Results: "Outdoors in Anoka County – a homeowner's guide" has been written, laid out by a graphic designer, and printed. 500 copies have been reserved for the CCWD area. The ACD will follow the CCWD's direction on where these should be distributed, such as at city halls and direct mailings to the target audience.



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	Wetland Levels	Lake Levels	Groundwater Observation Wells	Stream Levels	Lake Water Quality	Stream Biomonitoring	Stream Water Quality	Website	Precip. Monitoring	Homeowner Guide
Revenues										
CCWD	3275	645	0	1575	1820	730	3580	300	2625	1500
State	0	0	283	0	0	0	0	0	0	397
County	0	0	446	0	0	0	0	0	0	0
County Ag Preserves	1727	0	0	0	1340	633	0	0	0	2031
BWSR General Services	0	0	0	0	0	0	0	1599	0	0
Local Water Planning	0	643	0	242	269	0	1116	0	832	0
TOTAL	1548	1288	729	1817	3429	1363	4696	1899	3457	3928
Expenses-										
Capital Outlay/Equip	272	31	41	54	48	25	409	36	25	6
Personnel Salaries/Benefits	1060	1040	566	1481	2027	1116	1770	1154	3013	1903
Office Supplies/Maintenance	96	92	49	133	195	89	201	101	231	148
Employee Training	16	16	12	21	28	16	71	20	39	21
Vehicle/Mileage	21	19	12	28	40	17	71	21	40	25
Rent	46	54	30	62	128	29	220	64	59	27
Monthly Bills	14	15	8	18	36	9	58	18	19	10
Fees and Dues	12	9	10	14	14	7	96	11	10	3
Program Supplies	12	11	1	5	913	55	1800	475	21	1786
TOTAL	1548	1288	729	1817	3429	1363	4696	1899	3457	3928
NET	0	0	0	0	0	0	0	0	0	0

Recommendations

- **Replace the automated rain gauge at Ham Lake City Hall**, which is broken.
- **Actively pursue and/or encourage water quality improvement projects**. CCWD and ACD's cost share grant programs should be used as incentives to private landowners. Opportunities to retrofit public stormwater utilities should also be identified and implemented.
- **Install projects that will reduce loading of solids and nutrients into Coon Creek** during storms.
- **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.
- **Coordinate the ACD and CCWD's stream monitoring program with cities' efforts** to detect illicit stormwater discharges.
- **Repeat 2007's vegetation inventory in Sannerud reference wetland in 2010.**

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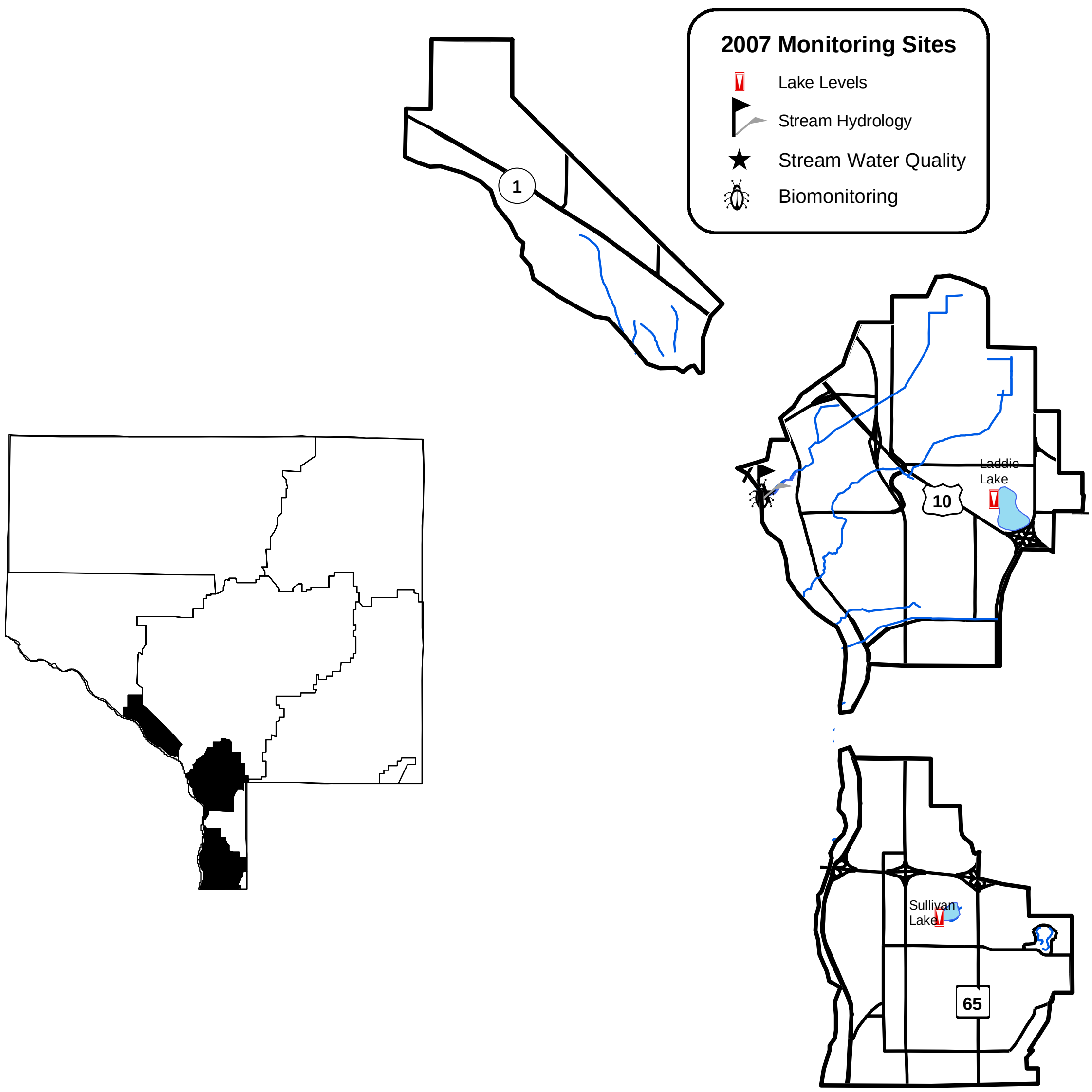
CHAPTER 7:
SIX CITIES WATERSHED

Raw data and data summaries can be found at the SCWMO website – use the Data Access tool (www.AnokaNaturalResources.com/SCWMO)

Task	Partners	Page
Lake Levels	SCWMO, ACD, MNDNR, volunteers	7-168
Stream Hydrology	SCWMO, ACD	7-169
Stream Water Quality – Chemical	SCWMO, ACD	7-171
Stream Water Quality – Biological	SCWMO, ACD, Blaine High School, ACAP	7-178
SCWMO Website	SCWMO, ACD	7-181
Financial Summary		7-183
Recommendations		7-183
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.

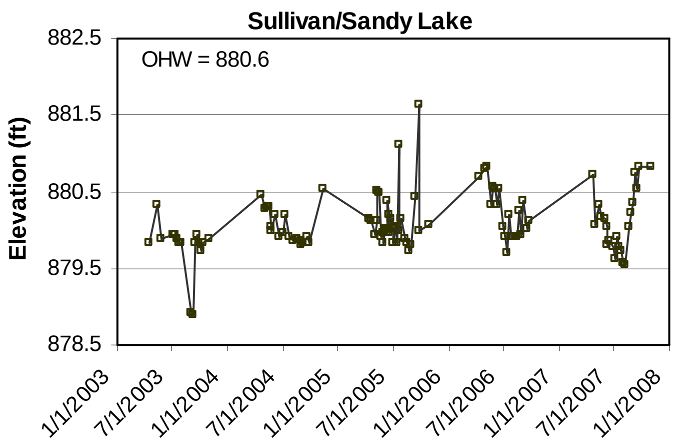
Locations: Laddie Lake

Sullivan/Sandy Lake

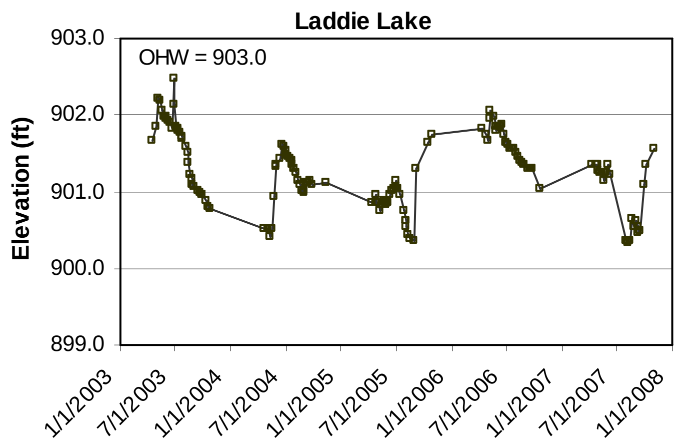
Results: Lake levels were measured 22 times on both Laddie and Sullivan Lakes. Readings were taken approximately weekly. Both lakes decreased throughout late spring and summer. By the first week of August, Laddie Lake was 1.02 feet lower than the highest water of spring, and Sullivan was down 1.17 feet. The summer drought ended in early August with abundant rainfall throughout fall. Lake levels rebounded to their springtime levels. Both lakes receive storm water inputs from their urbanized watersheds, especially Sullivan Lake which is in a highly urbanized area.

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 2003-07



Laddie Lake Levels 2003-07



Six Cities Watershed Lake Levels Summary

Lake	Year	Average	Min	Max
Sullivan	2003	879.78	878.88	880.33
	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

Lake	Year	Average	Min	Max
Laddie	2003	901.61	900.79	902.49
	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

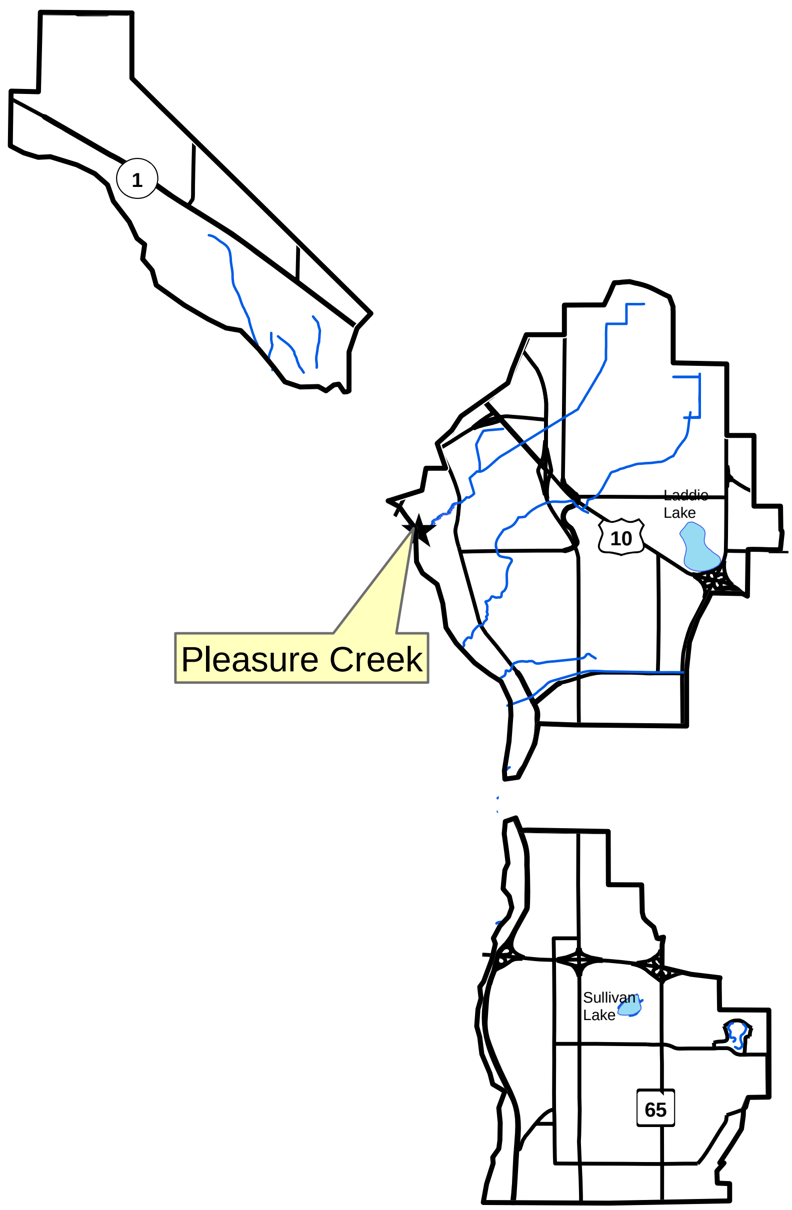
Stream Hydrology

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 pollutant load calculation, and are therefore often paired with water quality monitoring. Other uses include use in computer models for developing management strategies and water appropriations permit decisions.

Locations: Pleasure Creek at 86th Ave NW, Coon Rapids (just upstream of confluence with Mississippi R)

Six Cities Watershed Stream Hydrology Monitoring Sites



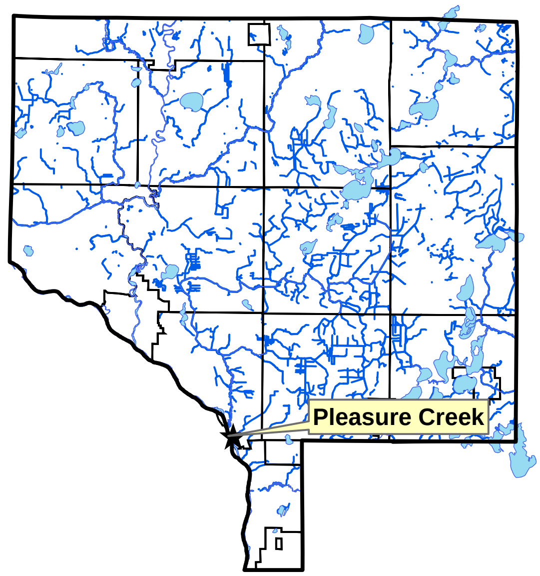
PLEASURE CREEK

at 86th Ave NW, South end of Coon Rapids Dam Park, Coon Rapids

STORET SiteID – S003-995

Notes

Pleasure Creek flows through the southwestern portion of Blaine and southern Coon Rapids. The watershed is highly urbanized. The creek serves to convey storm water, and portions of the creek are confined to underground pipes. This monitoring location is about 300m upstream of the outlet to the Mississippi River, and is within a regional park. The stream is about 8-10 feet wide and 0.5 to 1 foot deep at the monitoring site during baseflow.



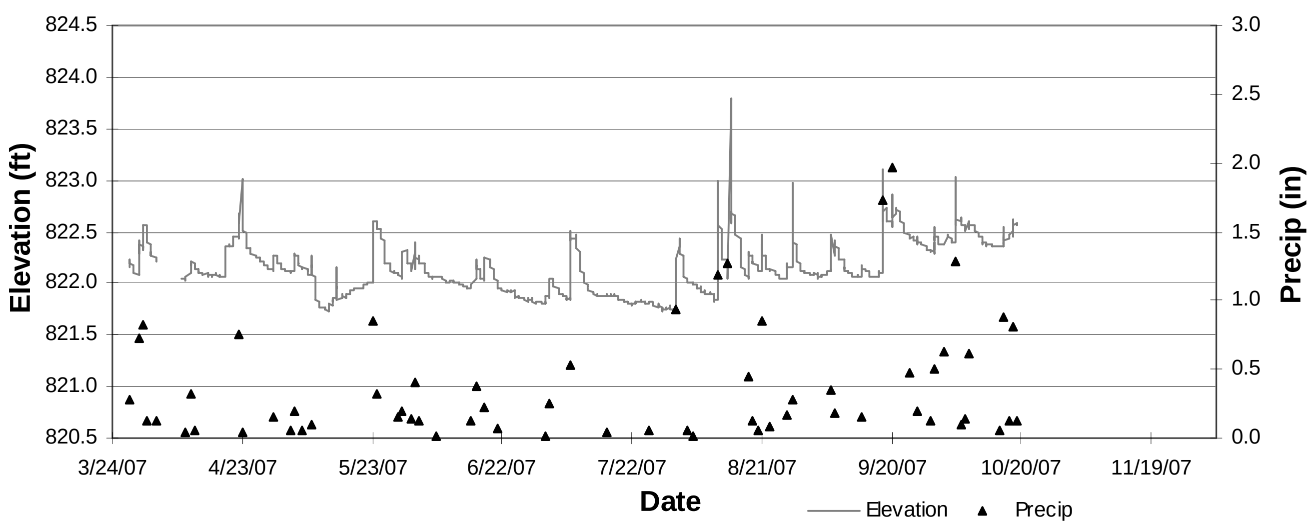
Landowners adjacent to Pleasure Creek at this location have complained that brief, but intense high flows during storms are eroding the stream bank. Areas of erosion are visible. The 2007 data show it was common for creek water levels to rise 0.5 feet within the first 2-4 hours of a 0.5inch or greater rainfall. The difference between the stream's highest and lowest water levels throughout 2007 was 2.04 feet.

Summary of All Monitored Years

Percentiles	2007	All Years
Min	821.73	821.73
2.5%	821.77	821.77
10.0%	821.84	821.84
25.0%	821.95	821.95
Median (50%)	822.10	822.10
75.0%	822.32	822.10
90.0%	822.49	822.49
97.5%	822.63	822.63
Max	823.79	823.79

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

2007 Hydrograph



Stream Water Quality – Chemical Monitoring

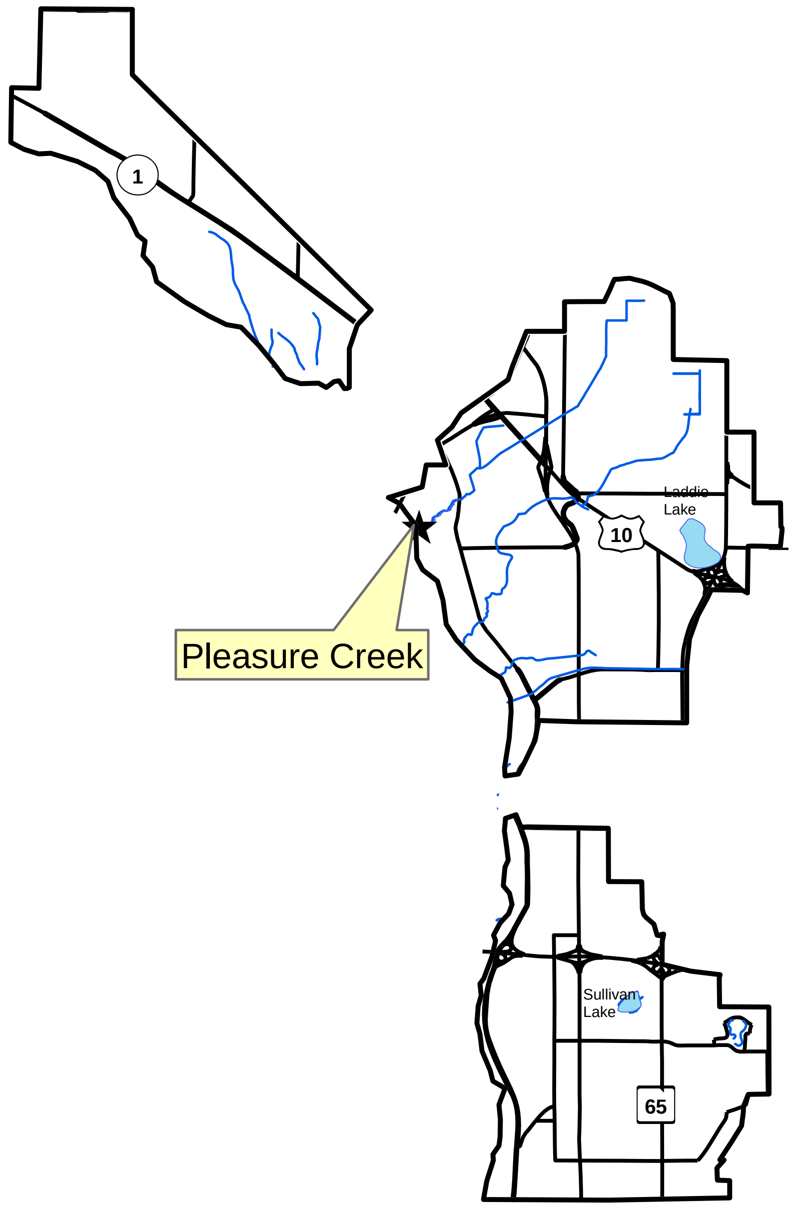
Description: Streams were monitored eight times between April and October; four times during baseflow and four times during storm flow. Storm flow events were defined as an approximately one-inch rainfall in 24 hours. Each stream was tested for pH, conductivity, turbidity, dissolved oxygen, temperature,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

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

Locations: Pleasure Creek at 86th Ave NW, S end of Coon Rapids Dam Park, Coon Rapids

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

Six Cities Watershed Stream Chemical Water Quality Monitoring Sites



PLEASURE CREEK

at 86th Ave NW, South end of Coon Rapids Dam Park, Coon Rapids

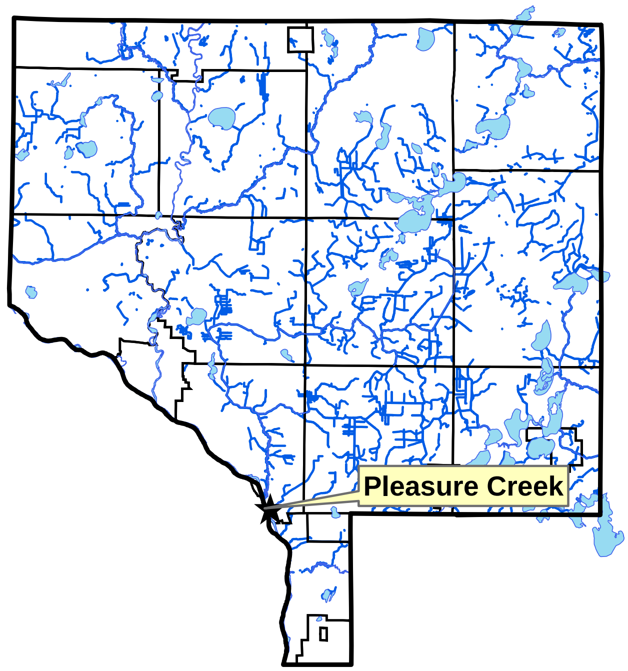
STORET SiteID – S003-995

Years Monitored

2006 and 2007

Background

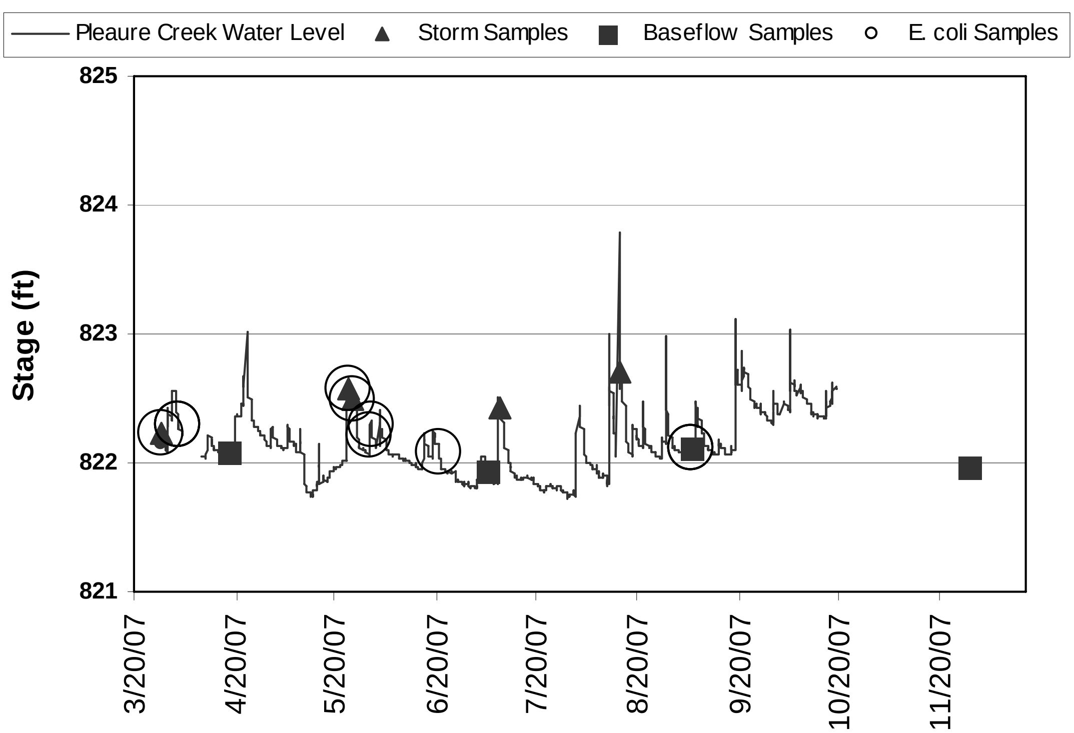
Pleasure Creek flows through the southwestern portion of Blaine and southern Coon Rapids. The watershed is highly urbanized. This monitoring location is about 300m upstream of the outlet to the Mississippi River, and is within a regional park. The stream is about 8-10 feet wide and 0.5 to 1 foot deep at the monitoring site during baseflow.



Results and Discussion

Pleasure Creek was visited 13 times for water quality monitoring in both 2006 and 2007 (see figures on the following pages). E coli bacteria plus a suite of nine chemical parameters were monitored. These reveal substantial water quality problems during both storms and baseflow conditions. Water quality problems include excessive dissolved pollutants at all times, excessive E. coli bacteria frequently and especially following storms, and excessive suspended solids following storms. Results for each of these are discussed below.

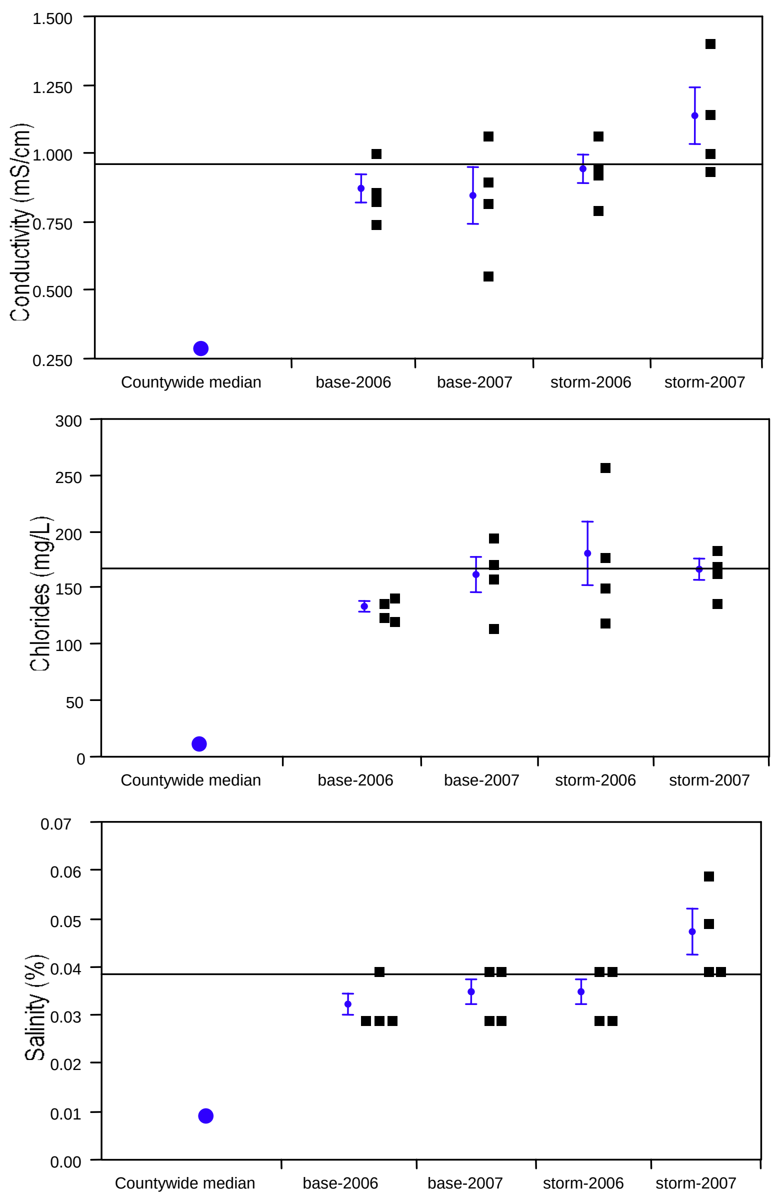
Pleasure Creek Water Levels and Monitoring



Dissolved Pollutants – conductivity, chlorides, and salinity

Three of the parameters tested (conductivity, chlorides, and salinity) measure dissolved pollutants. Conductivity and salinity measure many different dissolved pollutants simultaneously. Pleasure Creek conductivity was, on average, three times higher than the median of other area Anoka County streams and the second highest among all 35 Anoka County streams that have been tested (Springbrook is higher). Chlorides, often associated with road salts but also in industrial and wastewater discharges, approached the Minnesota Pollution Control Agency's chronic standard for aquatic life of 230 mg/L, above which fish and insects living in the stream can be killed (Pleasure Creek's average was 166 and maximum 262). Salinity was similarly high. All three of these parameters were consistently high and varied little between storms and baseflow conditions. In other words, storm water runoff is not the only source of these pollutants; the baseflow water supply is also polluted.

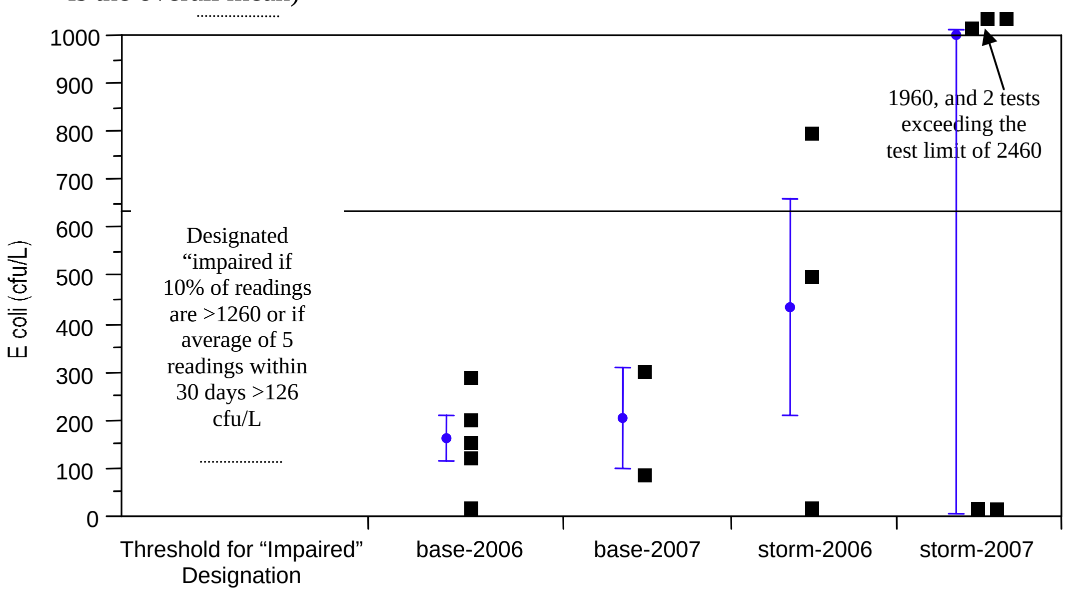
Dissolved Pollutant Results During Base and Storm Conditions (Square dots are individual measurements, circles with vertical lines are mean +/- one standard deviation, the horizontal line is the overall mean)



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). They designate a stream as "impaired" if 10% of measurements 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 the standard either way. Three of 14 (21%) of samples had >1260 cfu/L (1960 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 the geometric mean is 934 cfu/L. On all accounts Pleasure Creek exceeds the E. coli standard and poses a level of risk to those contacting the water that the State of Minnesota deems unacceptable. E. coli levels are high during baseflow and very high during storms, so the source is not simply storm water runoff.

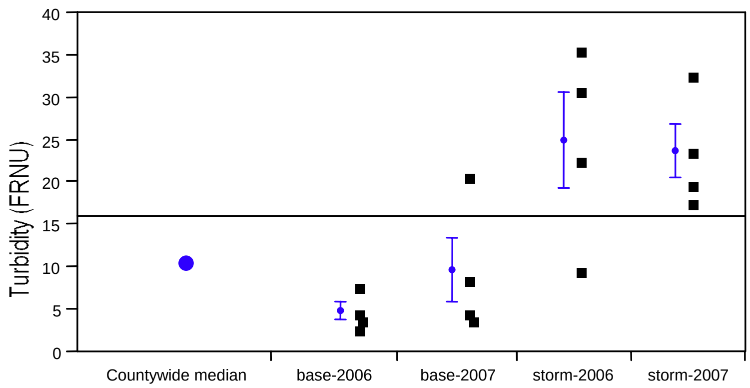
E. coli Bacteria Results During Base and Storm Conditions (Square dots are individual measurements, circles with vertical lines are mean +/- one standard deviation, the horizontal line is the overall mean)

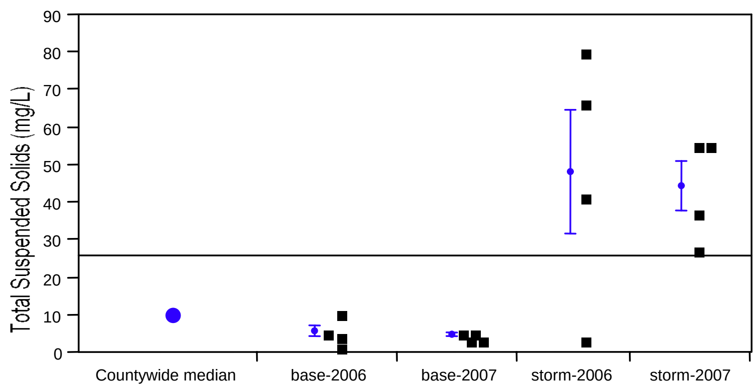


Turbidity and Suspended Solids

Pleasure Creek experienced high turbidity and total suspended solids, but only after storms. That problem appears to be largely separate from the dissolved pollutants discussed above. After storms turbidity and total suspended solids were significantly higher, and transparency was poorer, but conductivity, salinity, and chlorides were not different or only slightly higher. At baseflow Pleasure Creek is acceptably 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 was 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. This is 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 in to the stream.

Turbidity and Suspended Solids Results During Base and Storm Conditions (Square dots are individual measurements, circles with vertical lines are mean +/- one standard deviation, th horizontal line is the overall mean)

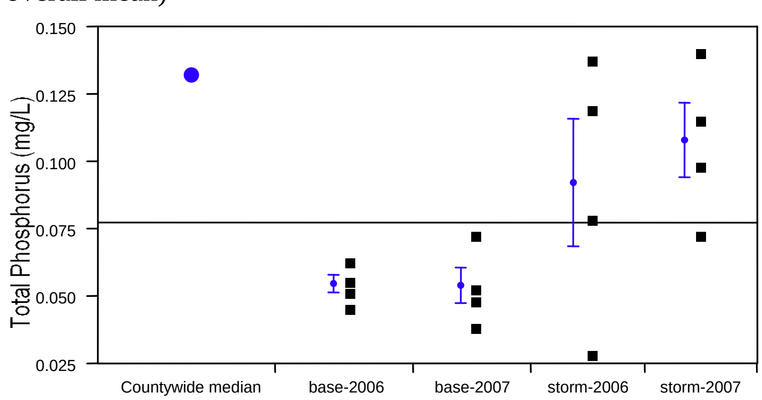




Phosphorus

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. 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 seems to suggest that inorganic chemical inputs, not organic nutrient-rich inputs like those found in wastewater, are the primary pollution source to Pleasure Creek. Likewise, it seems to suggest that the source of E. coli is not active inputs of wastewater (sewage).

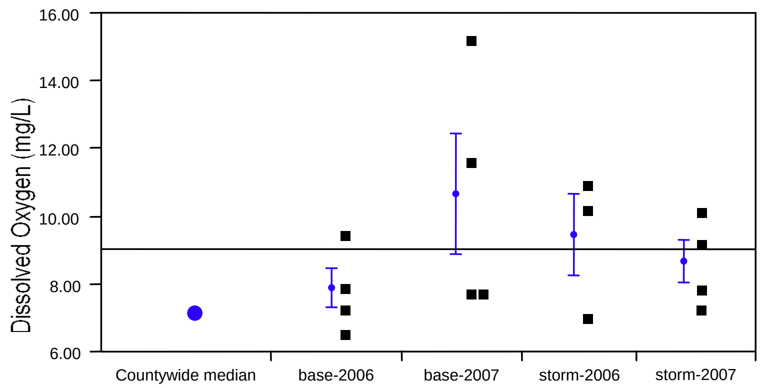
Phosphorus Results During Base and Storm Conditions (Square dots are individual measurements, circles with vertical lines are mean +/- one standard deviation, the horizontal line is the overall mean)

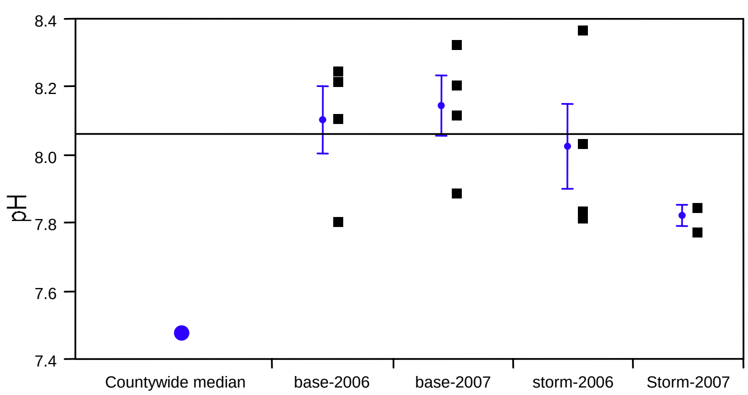


Other Parameters

Dissolved oxygen and pH were at acceptable levels. Dissolved oxygen was within the range needed for aquatic life, staying above 6 mg/L (below 5 mg/L is concerning). pH was higher than the median of other streams in Anoka County, but was still within the range of pH values that is common.

Dissolved Oxygen and pH Results During Base and Storm Conditions (Square dots are individual measurements, circles with vertical lines are mean +/- one standard deviation, th horizontal line is the overall mean)





Pleasure Creek Water Quality Results 2007

Pleasure Creek at 86th

Date	Time	Type	pH	Conductivity	Turbidity	DO	DO	Temp	Salinity	TP	Total Dissolved P	Ortho-P	Cl	TSS	E. coli	Stage	Flow	Notes
				mS/cm	FNRU	mg/L	%	C	%	mg/L	mg/L	mg/L	mg/L	mg/L	cfu/L	ft	cfs	
3/28/2007	17:00	storm	7.79	0.950	18	10.26	89.6	9.4	0.04	0.074			187	28	3	822.03		rained all day, water clear but shallow,
4/2/2007	13:15	storm													8	822.08		steady slow rain over last 2 days totaling ~1".
4/2/2007	13:16	storm													6	822.08		Duplicate sample
4/17/2007	11:50	base	8.34	1.080	9	11.75	110.0	12.4	0.04	0.050			198	4		821.88		clear, slightly brown, recalibrated DO meter, no E coli samples
5/24/2007	13:45	storm	7.86	1.020	24	9.33	99.0	18.3	0.04	0.100			174	56	>2419.6	822.37		strongly brown, E coli sample taken
5/25/2007	9:15	storm													>2419.6	822.30		E coli sample taken, water strongly brown and running high in response to storms on 5-23 and 5-24
5/30/2007	20:10	storm													1986.3			taken within 2 hours of 0.5" rainstorm
5/31/2007	8:50	storm													261.3	822.05		1/2" rain last night
6/20/2007	11:00	base													235.9	821.85		water clear/slightly brown
7/5/2007	12:45	base	7.90	0.834	5	7.88	95.7	25.2	0.03	0.074			175	6		821.68		appearance mostly clear, slightly brown, low water level and slow flow
7/9/2007	11:25	storm		1.420	20	7.95	98.0	26.4	0.06	0.117			167	56		822.21		appearance strongly brown
8/14/2007	15:20	storm		1.160	33	7.35	89.8	25.5	0.05	0.142			140	38		822.44		very strongly brown, fast current, lots of suspended sediment
9/5/2007	15:35	base	8.13	0.569	4	7.86	96.0	25.8	0.04	0.054			118	4	579.4	821.84		clear, 2 Ecoli samples
9/5/2007	15:36	base													435.2	821.84		Duplicate sample
11/28/2007	14:40	base	8.22	0.911	21	15.35	112	2.4	0.03	0.04			162	6		821.96		murky brown
Min			7.79	0.569	4	7.35		2.4	0.03	0.040			118.0	4	3	821.68		
Mean			8.00	0.993	17	9.72		18.2	0.04	0.081			165.1	25	440	822.04		
Max			8.34	1.420	33	15.35		26.4	0.06	0.142			198.0	56	1986	822.44		

Anoka County Median		7.49	0.308	11	7.3			0.01	0.134			14	11	
NCHF Ecoregion Mean			0.390						0.220					
NCHF Minimally Impacted Stream		8.1	0.300	7.1				0.00	0.130			8.0	13.7	
"Impaired" Threshold		<6.5 or >8.5		>25	<5							>=230		1260 or 126 ave.

Diagnosis and 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 tiny, the water quality is very poor. 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, of course, 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 monitoring conducted in 2006 and 2007 provides some diagnosis of the nature of the problems. Dissolved pollutants, possibly from stormwater, wastewater, or industrial sources are high during both baseflow and storms. High dissolved pollutants are typical in urban storm water runoff, but the fact that it stays high even during drought conditions points to other sources as well. High baseflow dissolved pollutants could be from continuous discharges to the creek, such as industrial wastes or illicit discharges through the stormwater conveyance system. Contamination of the shallow groundwater that feeds the stream at baseflow is another possible source. Lastly, storm water ponds upstream may retain pollutants from storms and release them to the creek continuously.

E. coli bacteria are also high during baseflow and storms, but are more variable and are highest following storms. It is common for E. coli to be highest after storms as a result of storm runoff. Because E. coli is found in the feces of warm blooded animals, one possible source to Pleasure Creek could be failing or illicit wastewater systems. For example, if a wastewater pipe improperly intersects with a storm water pipe the wastewater could reach the stream, especially during large storms. Pet waste is another possible source. A last possible source is stormwater ponds. Although stormwater ponds generally remove pollutants, including fecal contaminants, there have been some instances elsewhere in the country where storm water ponds accumulate fecal contaminants, releasing them to the creek slowly during baseflow and at high rates following storms. Bird feces, which can be a source of E. coli especially for lakes, is unlikely to be a problem for Pleasure Creek unless some of the creek's storm water ponds host large numbers of geese.

Turbidity and total suspended solids problems are typical of urban watersheds. Storm water runoff, often across impervious surfaces and at high flow rates, carries solid materials into the stream and keeps them suspended in the water column. Water clarity was much better during base flows. The problem of suspended solids during storms is best addressed with traditional methods, such as storm water ponds, wherever they can be done. No additional diagnostic or investigative work of this problem is recommended. It is recommended that efforts be focused on dissolved pollutant and E. coli investigations.

While the nature and magnitude of dissolved pollutant and E. coli problems is understood, investigative work is needed to determine the sources. A network of testing sites throughout the stream's watershed is needed to determine where the pollutants are coming from. Testing sites should be selected after review of detailed storm water maps so the contribution of each tributary to the creek can be determined. In many cases the tributaries are underground storm water conveyances. Testing above and below storm water ponds is also desirable to determine if the ponds are a source of E. coli.

The Six Cities WMO and member cities should expect that improving Pleasure Creek's water quality will carry a substantial price. The cost of investigative study to determine the source of problems starts around ten thousand dollars. The cost of fixing problems will depend upon the work needed. The most expensive fixes would be those involving stormwater or wastewater conveyances, if needed.

This stream is already on the MPCA's list of impaired waters for "impaired biota," and other impairments are likely to be added soon. Any work done by the SCWMO or others should be done in a way that can be compliment future TMDL studies. Grant dollars for TMDL studies are available from the State.

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 (<u>E</u>phemeroptera, or mayflies; <u>P</u>lecoptera, or stoneflies; and <u>T</u>richoptera, 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 <u>E</u>phemeroptera (mayflies), <u>P</u>lecoptera (stoneflies), and <u>T</u>richoptera (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.

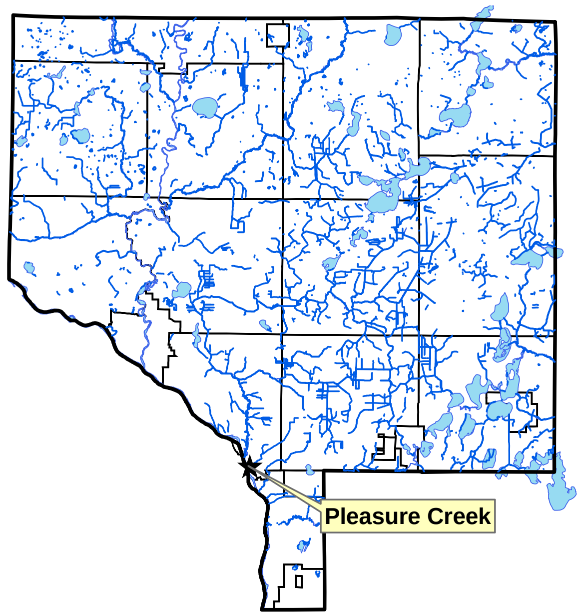
FBI	Stream Quality Evaluation
0.00-3.75	Excellent
3.76-4.25	Very Good
4.26-5.00	Good
5.01-5.75	Fair
5.76-6.50	Fairly Poor
6.51-7.25	Poor
7.26-10.00	Very Poor

<u>% Dominant Family</u> High numbers indicates an uneven community; likely a poorer condition.

Biomonitoring

PLEASURE CREEK

at 86th Ave NW, South end of Coon Rapids Dam Park, Coon Rapids



Last Monitored

By Blaine High School in 2007

Monitored Since

Spring 2000

Student Involvement

55 students in 2007, approx 400 since 2000

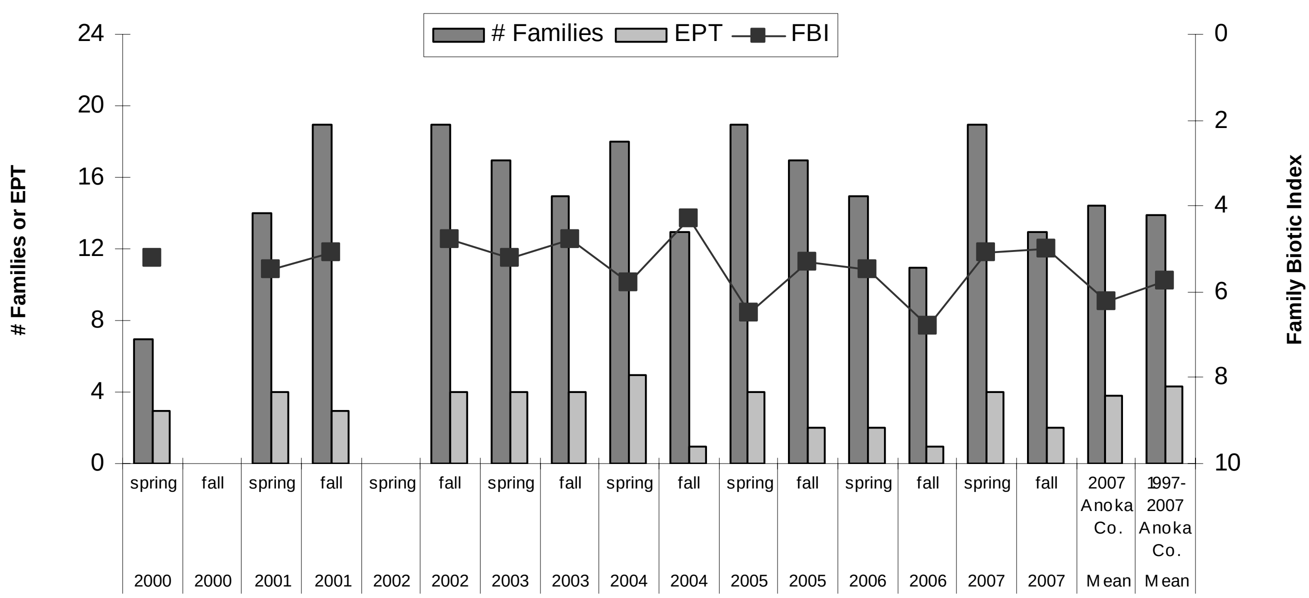
Background

Pleasure Creek is on the 2006 State List of Impaired Waters for an impaired invertebrate biota. It originates in Blaine and flows through southern Coon Rapids ending in the Mississippi River. The sampling site is the area between 86th Avenue and the outlet to the Mississippi. This site is wooded, unlike the urbanized remainder of the watershed. The stream channel is ~10 feet wide and 0.5-1 feet deep at baseflow, and is predominantly sand and silt. A disadvantage of this site is that the Mississippi River has a considerable influence, especially during flood events when it backs up into the creek.

Results

Blaine High School classes monitored this stream in both spring and fall 2007, supervised and quality-checked by the Anoka Conservation District. Overall, the biologic data indicate slightly below average condition. Across all years monitored, EPT has been consistently below average, FBI about average, and total number of families usually slightly above average. Invertebrate abundance has been low each time this stream has been sampled. Typically a crew of 25 students works for over two hours to capture 100-200 invertebrates. This is very poor. In 2007 the results were similar to previous years. FBI was slightly above average, while EPT and the number of families were above average in spring and below average in fall. The families found were generalists that survive in a wide range of conditions. Water chemistry readings taken at this site indicate serious water quality problems.

Summarized Biomonitoring Results for Pleasure Creek in Coon Rapids



Biomonitoring Data for Pleasure Creek in Coon Rapids

Year	2000	2000	2001	2001	2002	2002	2003	2003	2004	2004	2005	2005	2006	2006	2007	2007	Mean	Mean
Season	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	spring	fall	2007 Anoka Co.	1997-2007 Anoka Co.
FBI	5.20	not sampled	5.50	5.10	invalid	4.80	5.20	4.80	5.80	4.30	6.50	5.3	5.5	6.8	5.1	5	6.2	5.7
# Families	7		14	19	sample	19	17	15	18	13	19	16	15	11	19	13	14.4	13.9
EPT	3		4	3		4	4	4	5	1	4	2	2	1	4	2	3.8	4.4
Date	6/16		5/21	10/12	5/3	4-Oct	2-May	25-Sep	7-May	8-Oct	13-May	7-Oct	16-May	29-Sep	11-May	12-Oct		
sampling by	ACD		BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS	BHS		
sampling method	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		
# replicates	1		1	1		2	1	1	1	1	1	2	1	1	1	1		
Dominant Family	elimidae		simulidae	calopterigidae		hydropyschidae	calopterygidae	calopterygidae	calopterygidae	tipulidae	calopterygidae	simulidae	calopterygidae	hyalellidae	simuliidae	gammaridae		
% 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		
% Ephemeroptera	3		15.2	7.5		9.7	6.4	1.4	0.7	0	10.2	0	0	0	1	0		
% 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		
% Plecoptera	0		0	0		0	0	0	0.7	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
pH	8.67	8.76	9.29	8.96	9.44	7.85	8.04	8.23	7.99	7.82
Conductivity (mS/cm)	1.06	1.05	1.31	0.517	0.739	0.332	.0910	0.845	1.09	0.483
Turbidity (NTU)	1	5	2	5	15	22		5	2	13
Dissolved Oxygen (mg/L)	na	9.25	na	9.07	10.20 (93%)	9.69 (94.5%)	9.03 (91.6)	9.57 (90%)	8.83 (91%)	10.78 (101%)
Salinity (%)	0.04	0.04	0.05	0.02	0.03	0.01	0.04	0.03	0.04	0.01
Temperature (C)	13.6	13.1	12.4	15.2	11.7	13.8	15.4	13.0	17.1	12.4
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 (one other higher was Springbrook, just south of Pleasure Creek). 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 confined in concrete channels or buried storm water pipes.

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.

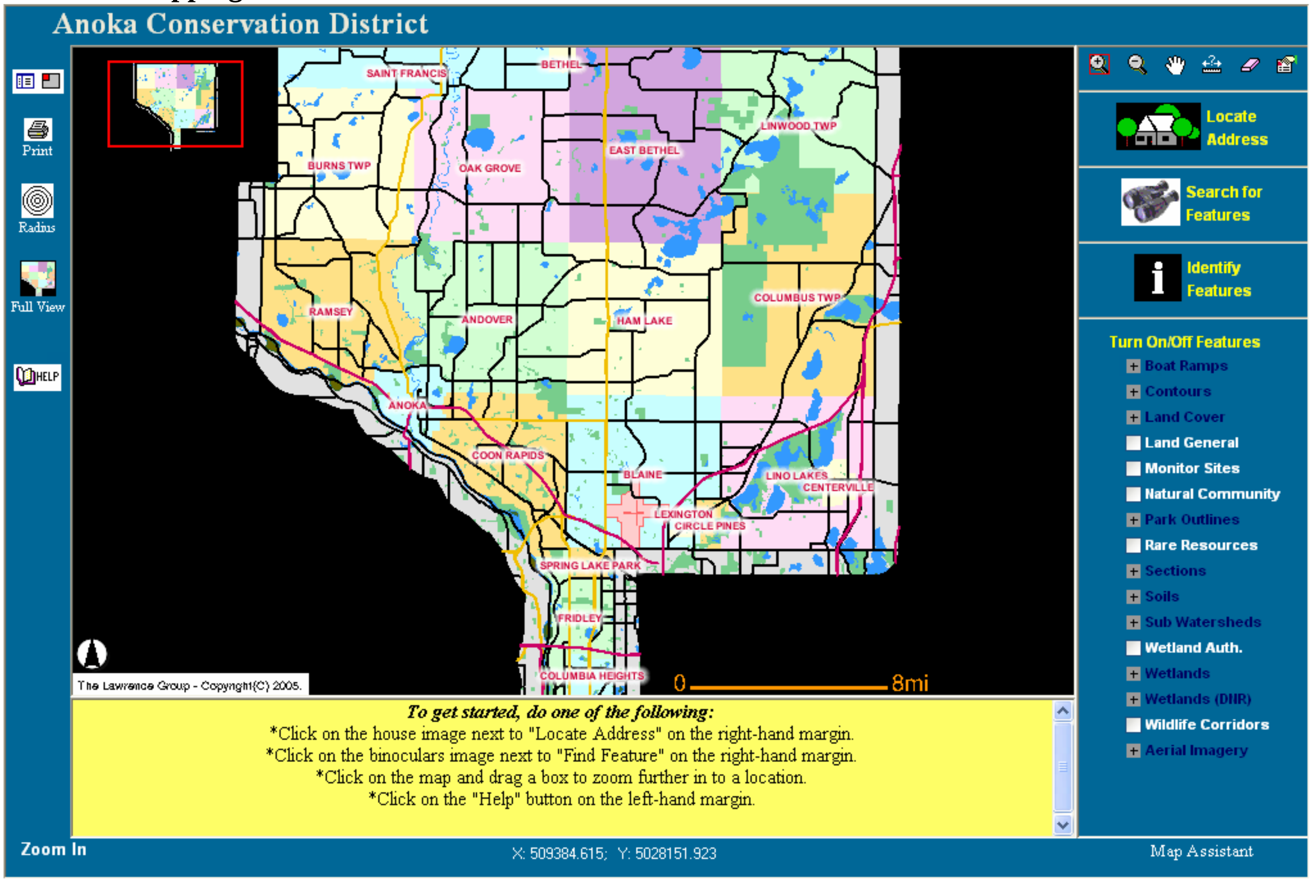
Other tools on the website include:

- 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

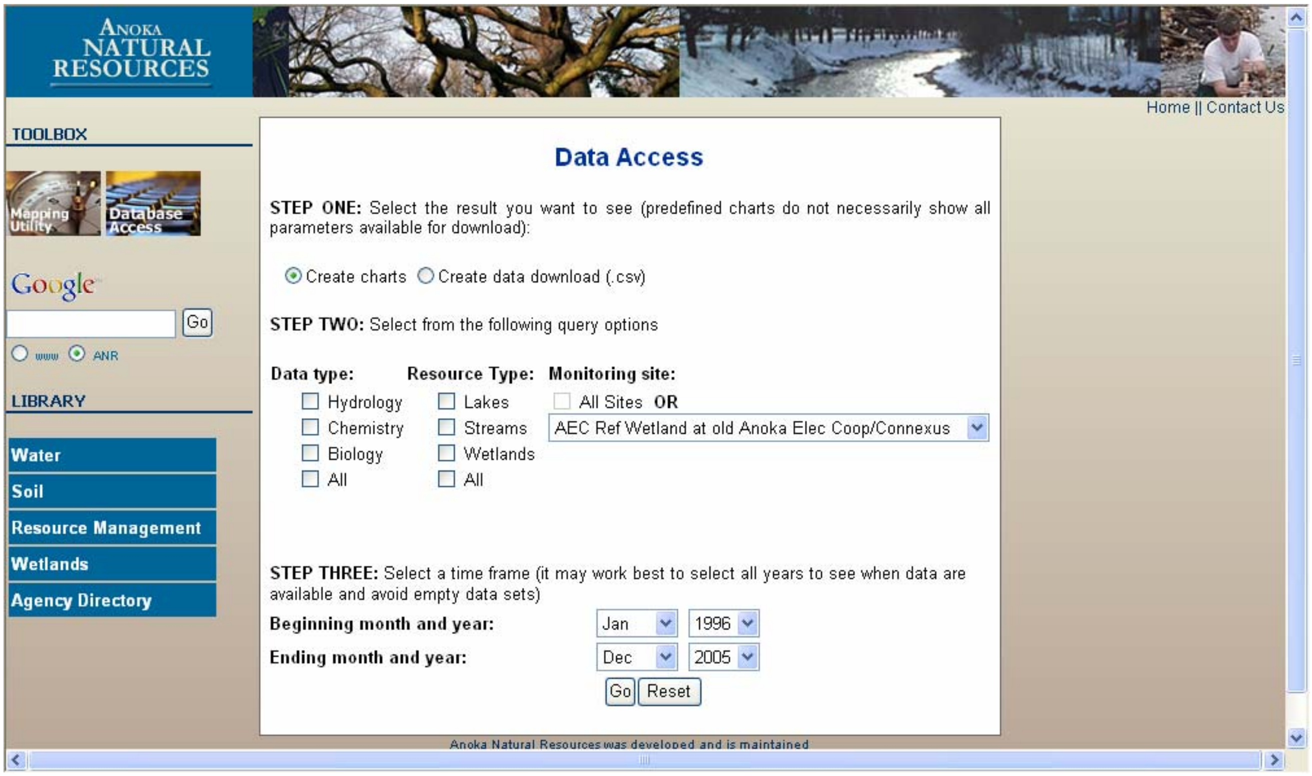
SCWMO Website Homepage - www.AnokaNaturalResources.com/SCWMO

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	Lake Levels	Stream Levels	Stream Biomonitoring	Stream Water Quality	Website	Total
Revenues						
SCWMO	200	525	730	1629	300	3384
State	0	0	0	0	0	0
County	0	0	0	0	0	0
County Ag Preserves	0	0	633	0	0	633
BWSR General Services	0	0	0	0	649	649
Local Water Planning	58	81	0	455	0	317
TOTAL	258	606	1363	1174	949	4350
Expenses-						
Capital Outlay/Equip	6	18	25	102	18	170
Personnel Salaries/Benefits	208	494	1116	442	577	2837
Office Supplies/Maintenance	18	44	89	50	51	253
Employee Training	3	7	16	18	10	54
Vehicle/Mileage	4	9	17	18	10	58
Rent	11	21	29	55	32	148
Monthly Bills	3	6	9	15	9	41
Fees and Dues	2	5	7	24	5	43
Equipment Maintenance	0	0	0	0	0	0
Program Supplies	2	2	55	450	237	746
TOTAL	258	606	1363	1174	949	4350
NET	0	0	0	0	0	0

Recommendations

- **The SCWMO should engage in short and long-term planning** to 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).
- **Do reconnaissance of the storm water conveyance systems draining to troubled waterways** to identify pollution sources and opportunities for water treatment.
- **Conduct extensive monitoring throughout Pleasure Creek** to determine sources of pollutants to this highly degraded stream.
- **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 of management changes.