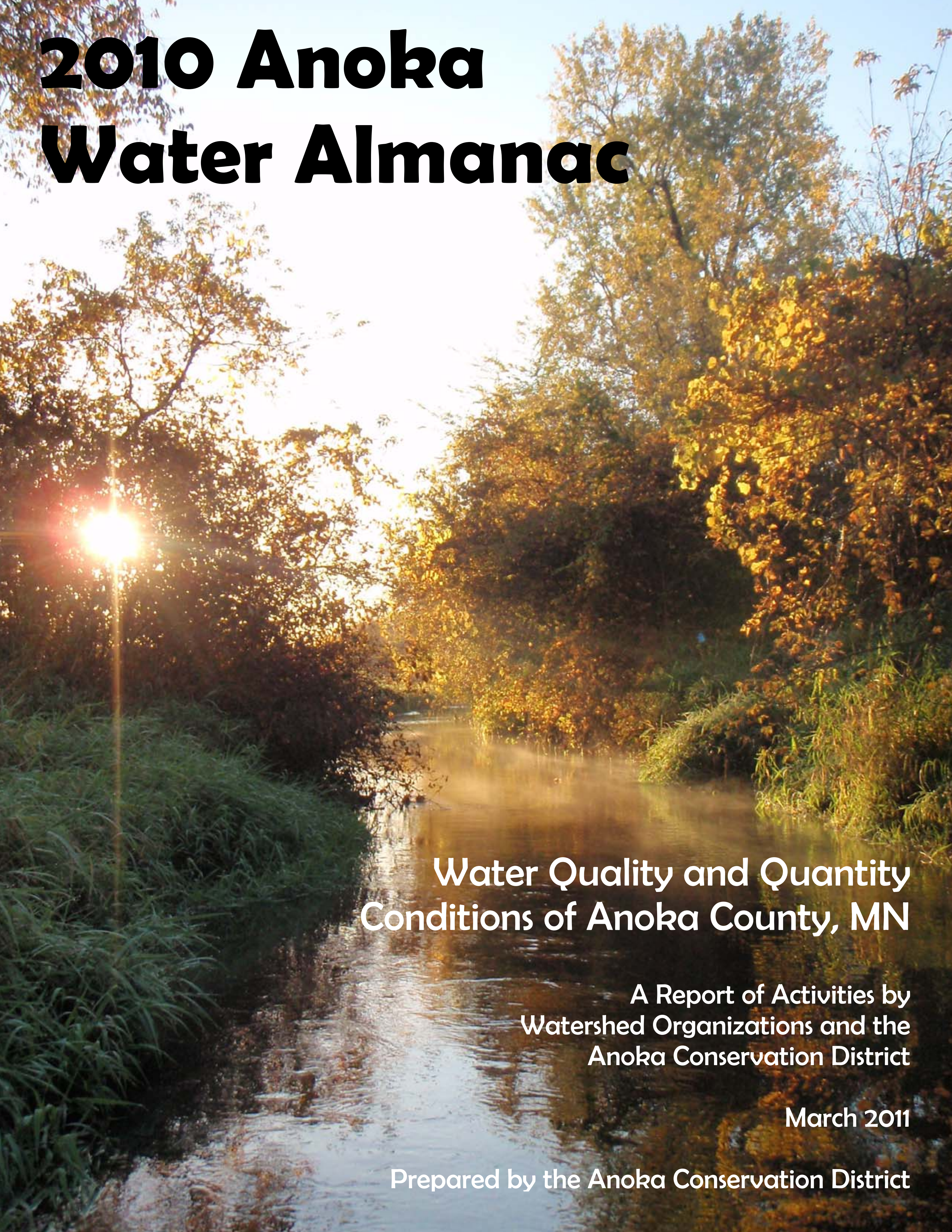
2010 Anoka Water Almanac



Water Quality and Quantity Conditions of Anoka County, MN

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

March 2011

Prepared by the Anoka Conservation District

2010 ANOKA WATER ALMANAC

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Prepared by
Jamie Schurbon
Water Resource Specialist
1318 McKay Drive NE, Suite 300
Ham Lake, MN 55304
(763) 434-2030
Jamie.Schurbon@AnokaSWCD.org

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

EXECUTIVE SUMMARY AND ORGANIZATION OF THIS REPORT

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

The water resource management and monitoring work reported here include:

- Monitoring
  - precipitation,
  - lake levels,
  - lake water quality,
  - stream hydrology,
  - stream water quality,
  - stream benthic macroinvertebrates,
  - shallow groundwater levels in wetlands, and
  - deep groundwater in observation wells.
- Water quality improvement projects
  - projects designed, installed, or planned are briefly discussed in this report and detailed in a separate report of water quality improvement projects,
  - cost share grants for erosion correction, lakeshore restorations, and rain gardens, and
  - promotion of available grants for water quality improvement projects.
- Studies and analyses
  - Stormwater retrofitting assessments,
  - Anoka County geologic atlas,
  - upstream to downstream water quality analyses,
  - water quality trend analyses,
  - precipitation storm analyses and long term antecedent moisture analyses, and
  - reference wetland vegetation inventories and multi-year summary analyses.
- Public education efforts
  - newsletters and mailings,
  - workshops, and
  - websites.

While this report is perhaps the most comprehensive source of monitoring data on lakes, stream, rivers, groundwater and wetlands in Anoka County, it is not the only source. Nor is this report a summary of all work completed throughout Anoka County in 2010. Rather, it is a summary of work carried out by the Anoka Conservation District in conjunction with watershed organizations within the county. Furthermore, only work conducted during 2010 is presented in this almanac. For results of work completed in years past, readers should refer to previous Water Almanacs. All data collected in 2010 and in years past is available in digital format from the Anoka Conservation District. Whenever possible we submit data to state agencies or databases for wider availability; these include the MPCA's EQuIS water quality database, the DNR's lakefinder tool for lake levels, and the State Climatology's online precipitation database.

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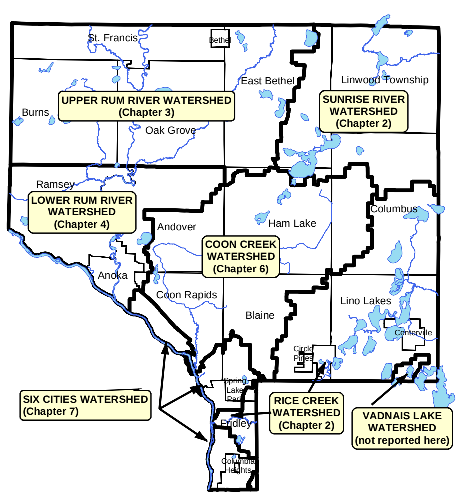
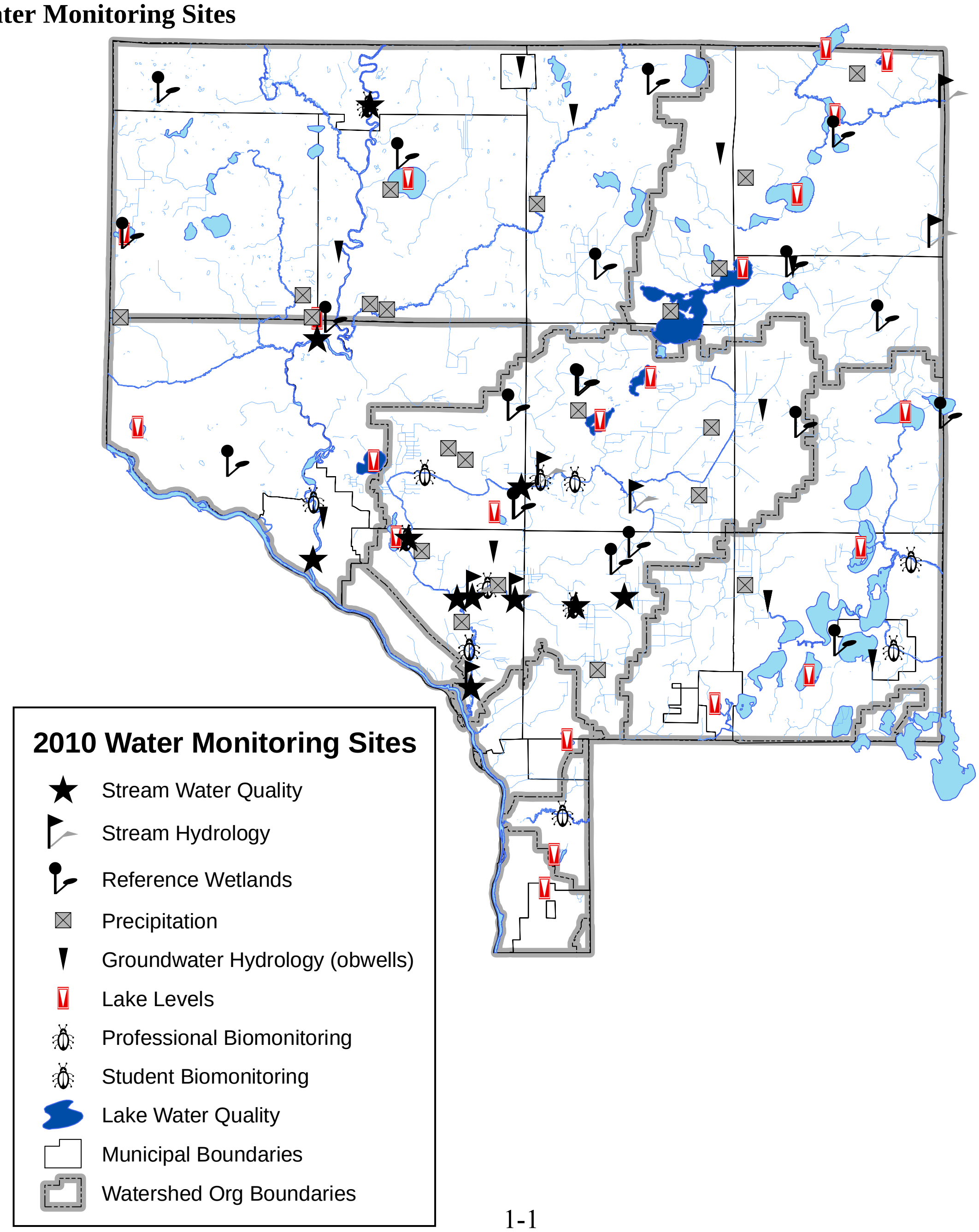


CHAPTER 1:
WATER RESOURCE MONITORING PRIMER

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

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

2010 Water Monitoring Sites

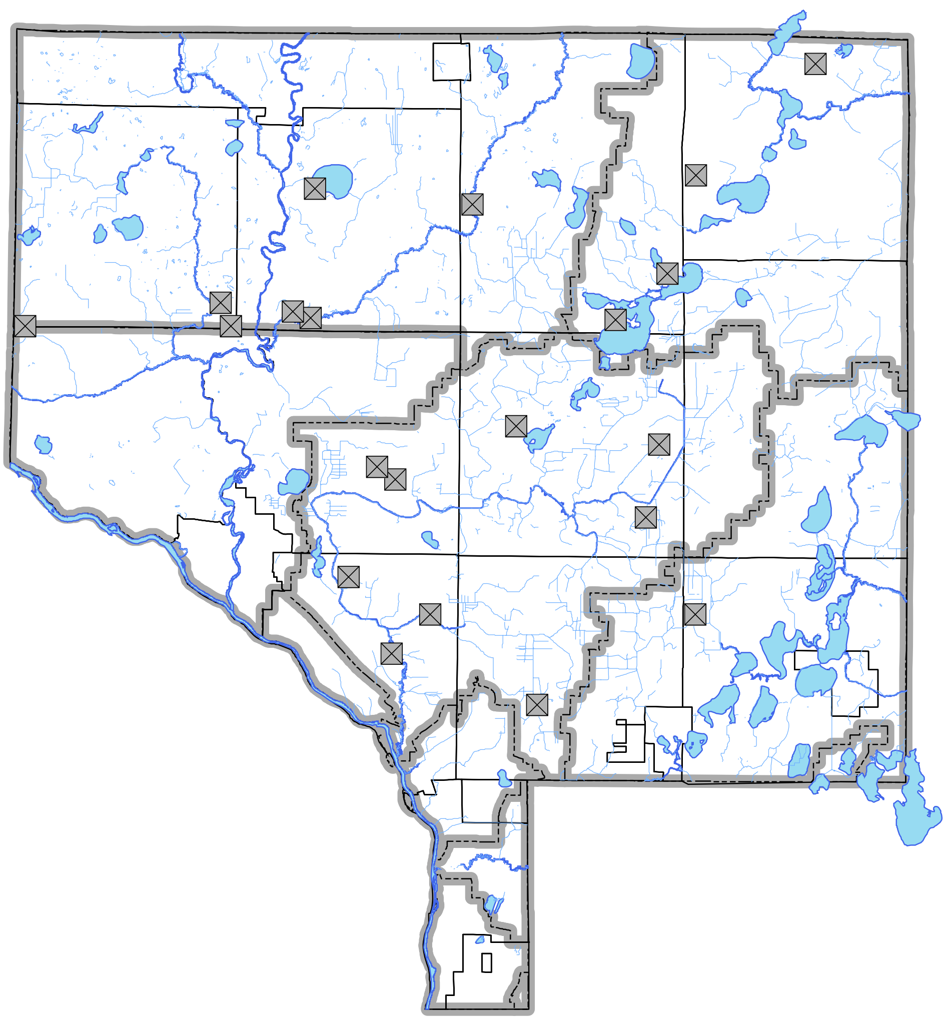


Precipitation

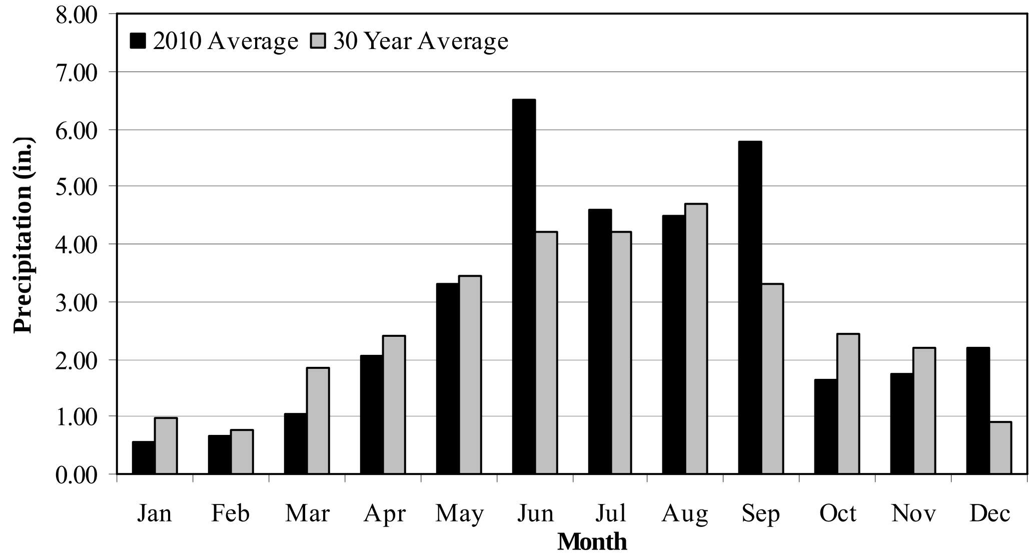
Precipitation data is useful for understanding the hydrology of water bodies, predicting flooding and groundwater limitations, and is needed to guide the use of special regulations that protect property and the environment in times of high or low water. Rainfall can vary substantially, even within one city. The ACD coordinates a network of 21 rain gauges countywide. Fifteen are monitored by volunteers and six are monitored using datalogging stations operated by the ACD for the Coon Creek Watershed District. The volunteer-operated stations are cylinder-style rain gauges located at the volunteer's home. Total rainfall is read daily. The datalogging rain gauges electronically record the time and date of each 0.01 inch of rain that falls. These gauges are downloaded approximately every four weeks. All data collected by volunteers is submitted to the Minnesota State Office of Climatology where it is available to the public through http://climate.umn.edu.

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

2010 Precipitation Monitoring Sites



2010 Anoka County Average Monthly Precipitation (average of all sites)



2010 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)
Tipping bucket, datalogging rain gauges (Time and date of each 0.01" is recorded)															
Andover City Hall	Andover				2.17			3.35	4.15	5.64	1.48			16.79	13.14
Blaine Public Works	Blaine							2.15			1.73			3.88	2.15
Coon Rapids City Hall	Coon Rapids				1.72	2.74	5.36				1.40			11.22	8.10
Anoka Cons. District office	Ham Lake			0.97	2.14	3.60	6.81	3.81	4.93	6.36				28.62	25.51
Hoffman Sod Farm	Ham Lake				1.79	3.11	6.10				1.72			12.72	9.21
Northern Nat. Gas substation	Ham Lake				1.53	2.69	6.14	4.00	3.85	4.95	1.58			24.74	21.63
Cylinder rain gauges (read daily)															
N. Myhre	Andover	0.56	0.59	0.76	2.26	3.16	7.97	4.28	4.39	6.19	1.59	1.64	1.93	35.32	25.99
B. Guetzko	Nowthen			1.02	2.24	3.37		6.88		7.02		2.53		23.06	17.27
J. Rufsvold	Burns					3.20	7.63	4.71	3.86	5.84	1.62			26.86	25.24
S. Scherger	Coon Rapids				1.55	3.66			3.94	4.63	1.79			15.57	12.23
S. Solie	Coon Rapids				2.08	2.61	6.70	4.10	3.15	5.31				23.95	21.87
M. Gaynor	East Bethel				1.63	3.10	5.16	4.29	4.62	5.25	1.45			25.50	22.42
P. Arzdorf	East Bethel			1.20	2.09	3.30	6.85	5.11	6.48	6.13	1.95			33.11	27.87
A. Mercil	East Bethel	0.48	0.81	1.76	2.13	4.09		4.41		5.80	1.62	0.45	1.82	23.37	14.30
C. Ehler	Lino Lakes				1.80	3.42	5.29	6.89	4.37	5.47	1.41			28.65	25.44
B. Myers	Linwood				1.98	2.49	4.61	5.15	5.35	4.31	1.62			25.51	21.91
D. Kramer	Linwood				2.77	3.33	5.83	5.79	6.31	6.27	1.53			31.83	27.53
A. Dalske	Oak Grove	0.63	0.58	1.01	2.44	3.98	6.60	5.12	4.26	5.96	1.77	2.33	2.80	37.48	25.92
P. Freeman	Oak Grove			0.56	2.56	3.29	7.34	4.56	4.51	6.29	1.85			30.96	25.99
D. Conger	Oak Grove					3.53	7.69	3.93	4.67	6.05	1.59				27.46
Y. Lyrenmann	Ramsey				1.81	3.38	7.99	3.84	3.69	6.33	1.91			28.95	25.23
2010 Average	County-wide	0.56	0.66	1.03	2.05	3.29	6.52	4.60	4.48	5.77	1.65	1.74	2.18	34.52	24.66
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.

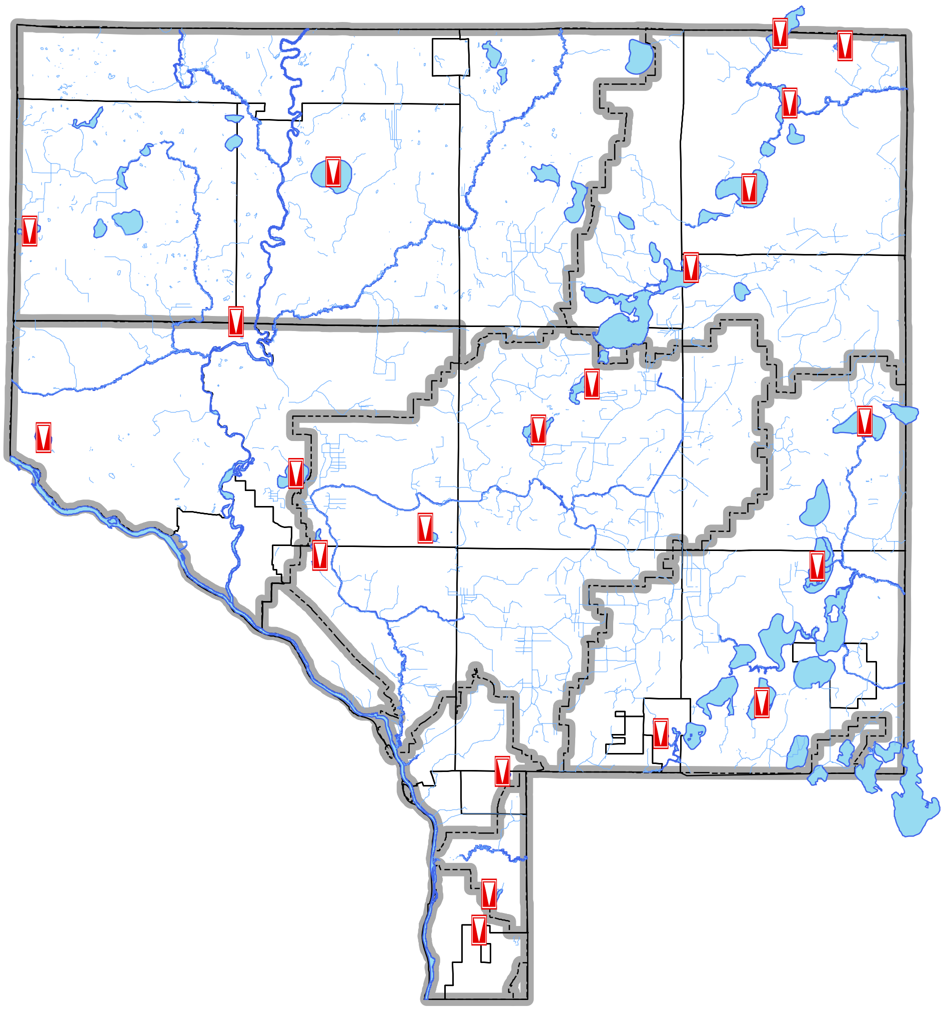
Lake Levels

Long-term lake level records are useful for regulatory decision-making, building/development decisions, lake hydrology manipulation decisions, and investigation of possible non-natural impacts on lake levels. ACD coordinates volunteers who monitor water levels on 21 lakes.

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

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

2010 Lake Level Monitoring Sites



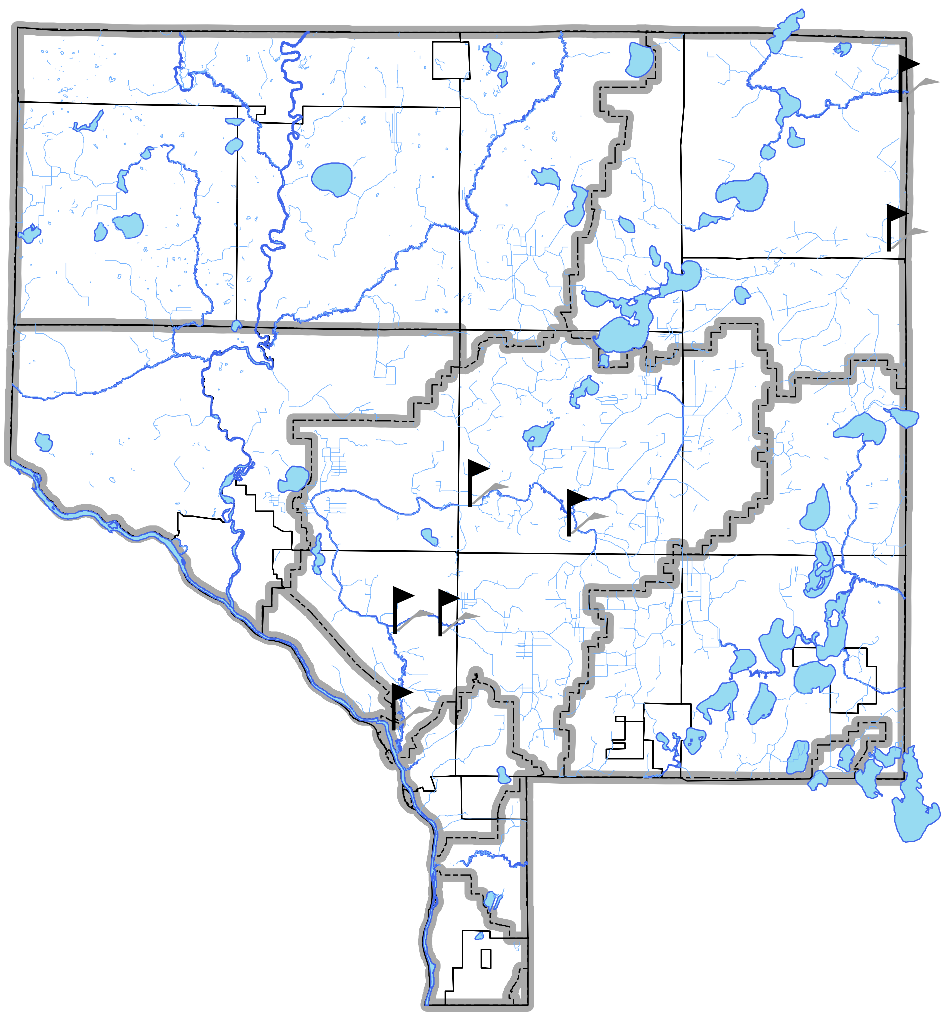
Stream Hydrology

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

The ACD monitored hydrology at 7 stream sites in 2010. At each site is an electronic gauge that records water levels every two hours. These gauges are surveyed and calibrated so that stream water level is measured in feet above sea level. Rating curves—a known mathematical relationship between water level and flow such that one can be calculated from the other—have been developed for some sites. The information gained from the stream hydrology monitoring sites is used by the ACD, watershed management organizations, watershed districts, townships, cities, and others.

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

2010 Stream Hydrology Monitoring Sites



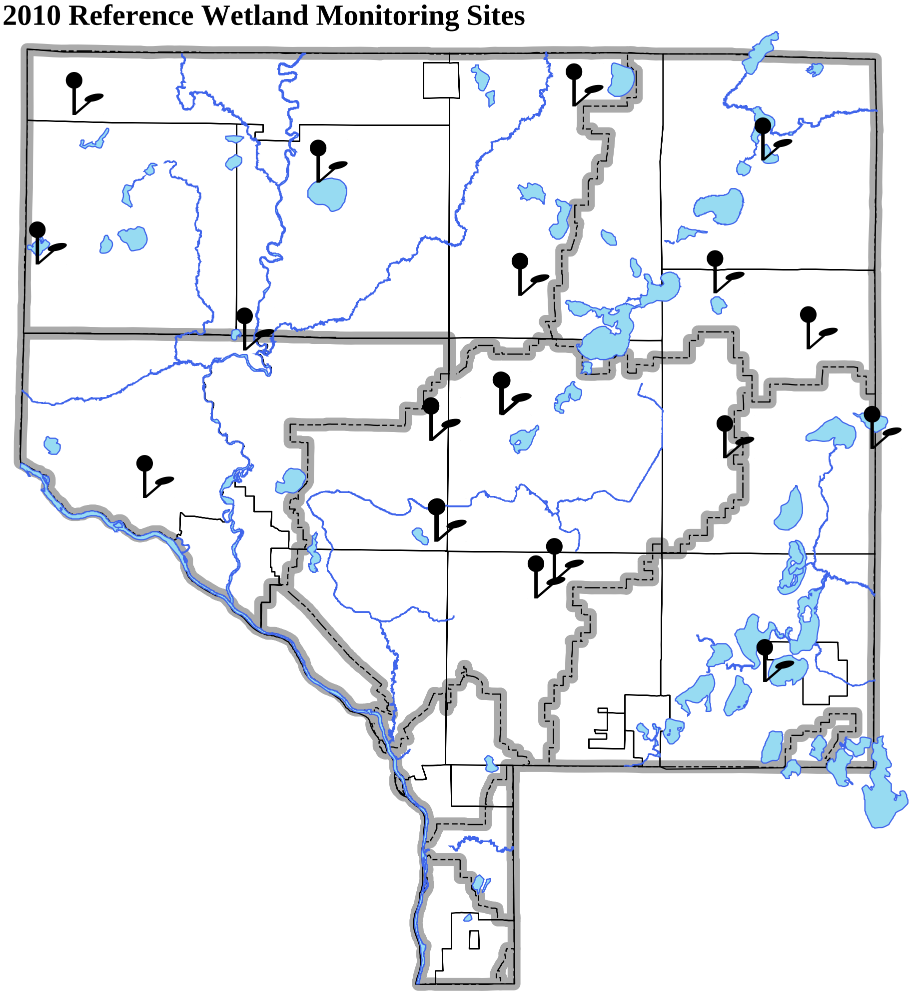
Wetland Hydrology

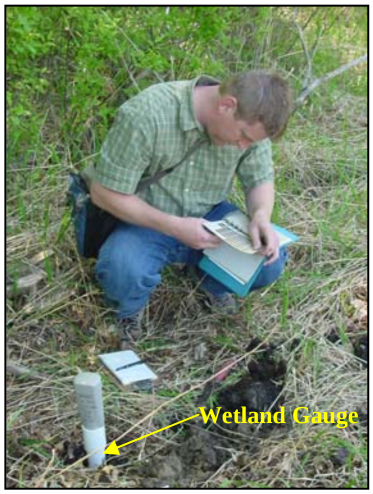
Wetland regulations are often focused upon determining whether an area is, or is not, a wetland. This is difficult at times because most wetlands are not continually wet. In order to facilitate fair, accurate wetland determinations the ACD monitors 18 wetlands throughout the county that serve as a reference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

Reference wetland data provides insights into shallow groundwater hydrology trends. This can be useful for a variety of purposes from flood predictions to indices of drought severity. There are concerns locally that shallow aquifers are being drawn down.

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

2010 Reference Wetland Monitoring Sites



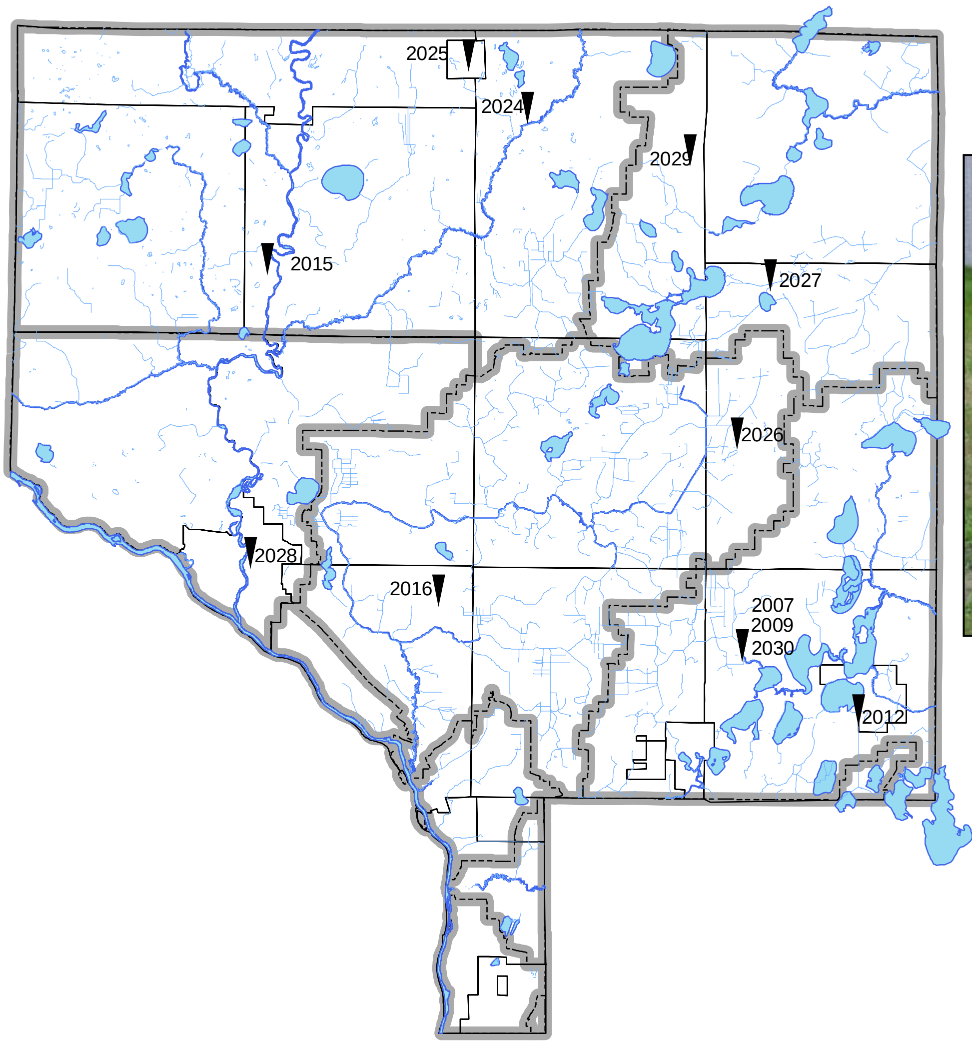


Groundwater Hydrology

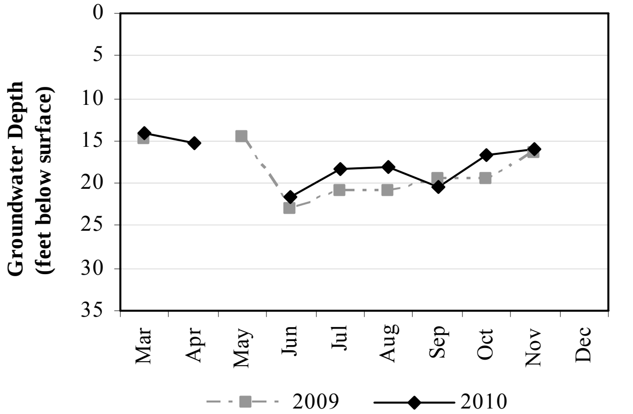
The Minnesota Department of Natural Resources (MN DNR) and ACD are interested in understanding Minnesota's groundwater quantity and flow. The MN DNR maintains a network of groundwater observation wells across the state. The ACD is contracted to take monthly water level readings at 12 wells in Anoka County from March to December. The MN DNR incorporates these data into a statewide database that aids in groundwater mapping. The data are reported by the MN DNR and available to the public 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 2009-2010. These results are not presented elsewhere in this report. Raw data can be downloaded from the MN DNR website.

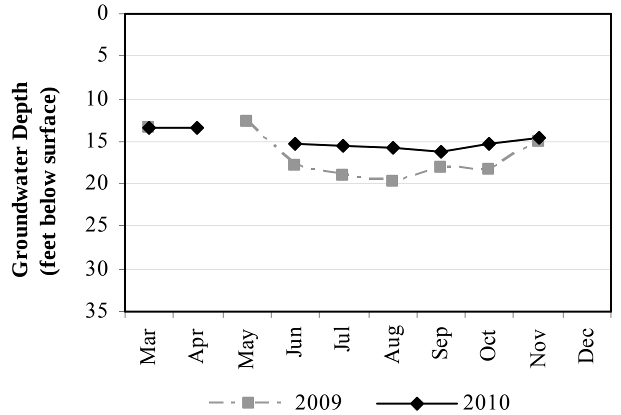
Groundwater Observation Well Sites and Well ID Numbers



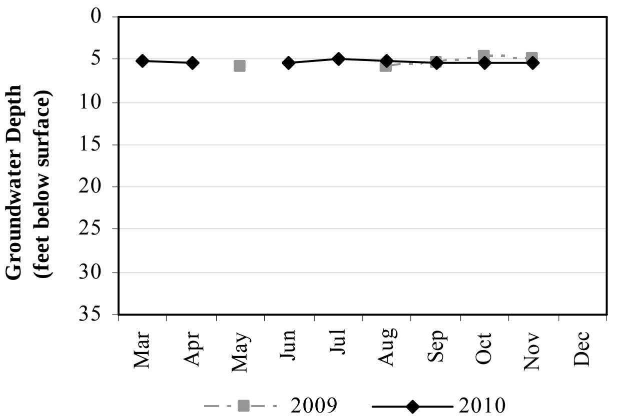
Observation Well #2007 (270 ft deep)—Lino Lakes



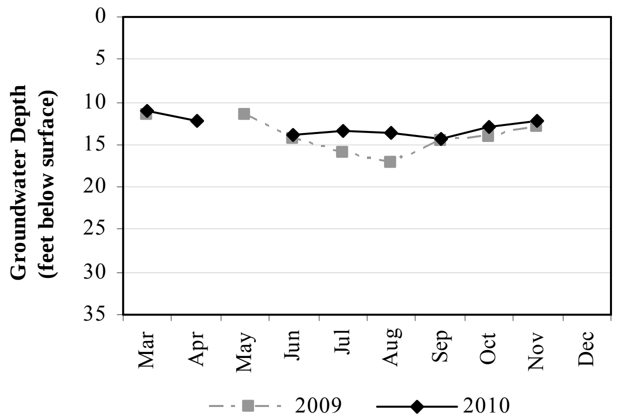
Observation Well #2009 (125 ft deep)—Lino lakes



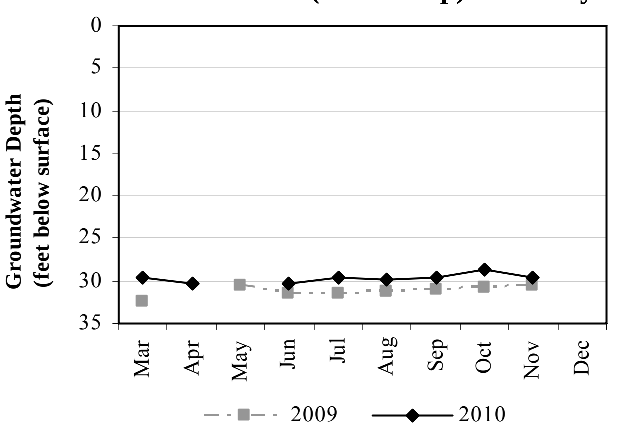
Observation Well #2030 (15 ft deep)—Lino Lakes



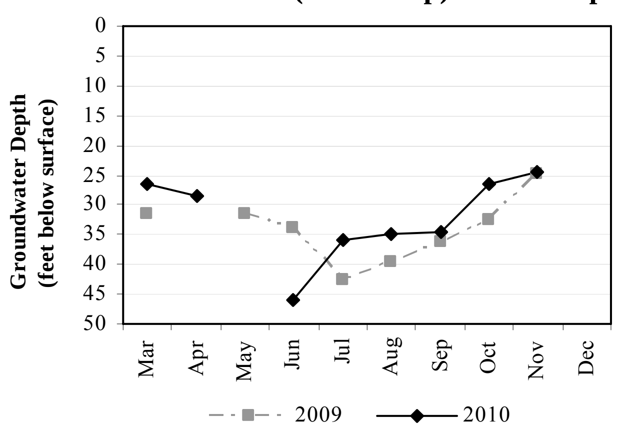
Observation Well #2012 (277 ft deep) – Centerville



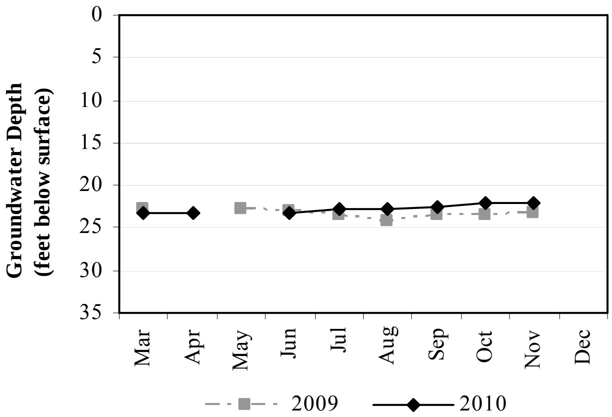
Observation Well #2015 (280 ft deep)—Ramsey



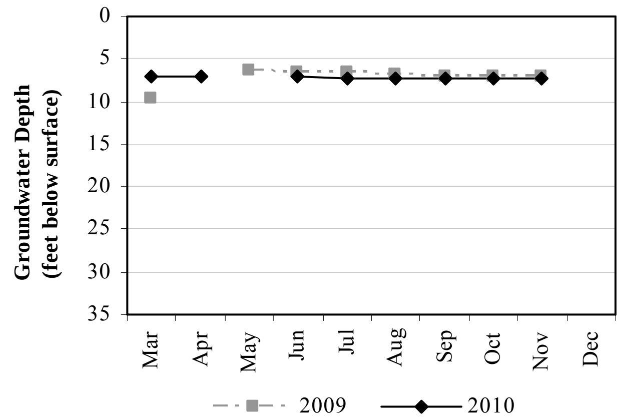
Observation Well #2016 (193 ft deep)—Coon Rapids



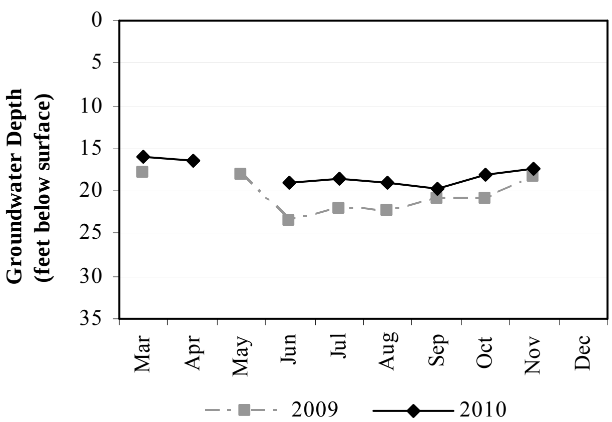
Observation Well #2024 (141 ft deep)—East Bethel



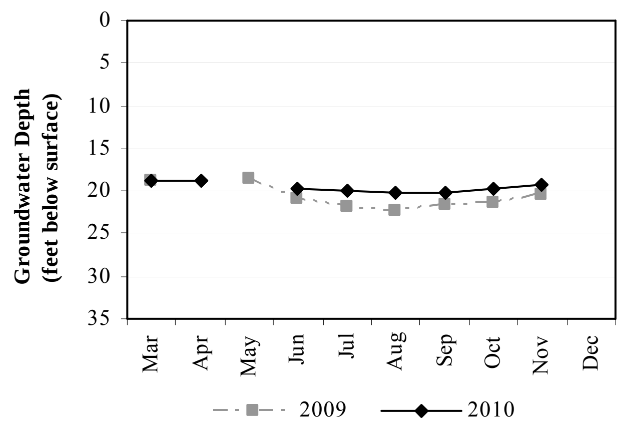
Observation Well #2025 (21 ft deep)—Bethel



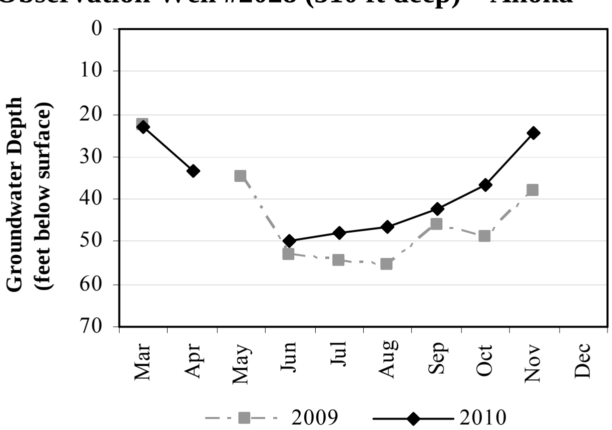
**Observation Well #2026 (150 ft deep)—
Carlos Avery #4**



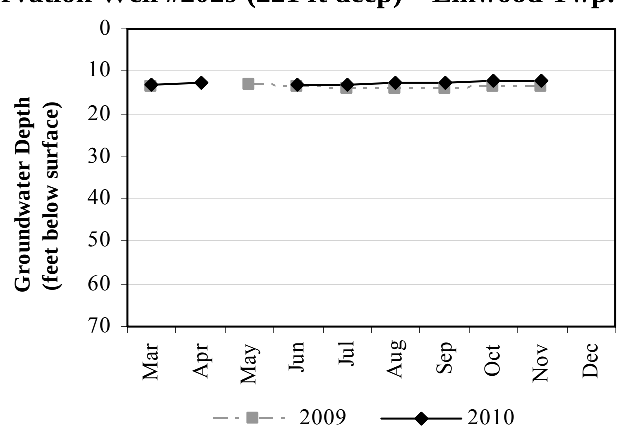
**Observation Well #2027 (333 ft deep)—
Columbus Twp.**



Observation Well #2028 (510 ft deep)—Anoka



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

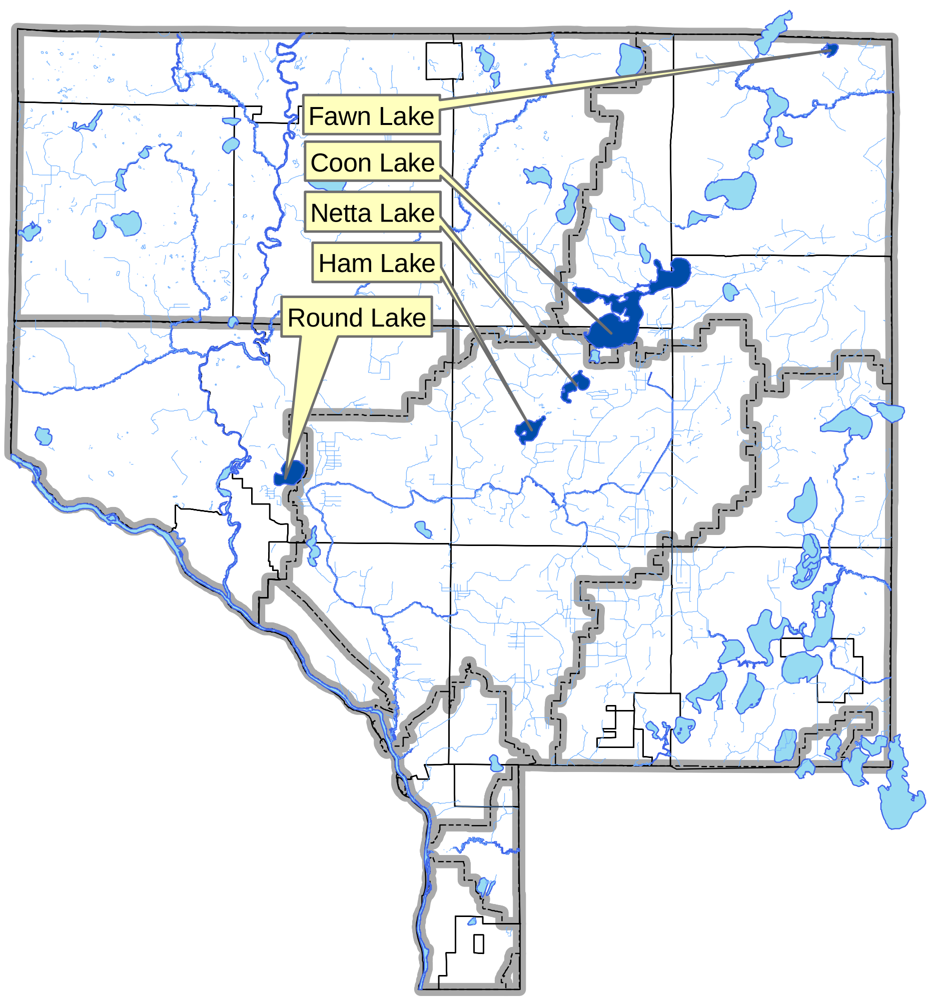


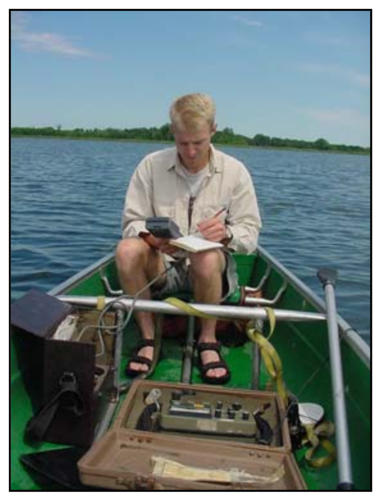
Lake Water Quality

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

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

2010 Lake Water Quality Monitoring Sites





LAKE WATER QUALITY MONITORING METHODS

The following parameters are tested at each lake:

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

Lakes are sampled every two weeks from May to September. Monitoring is conducted by boat at the deepest area of the lake. These sites are located using a portable depth finder or GPS. DO is measured in the field using a YSI® DO 200 dissolved oxygen and temperature probe. Conductivity, pH, turbidity, DO, salinity and temperature are measured using the Horiba Water Checker® U-10 multi-probe at a depth of one meter. Water samples are collected with a Kemmerer sampler from a depth of one meter, to be analyzed by an independent laboratory (MVTL Labs) for chlorophyll-a and total phosphorus. Sample bottles are provided by the laboratory. Total phosphorus sample bottles contain preservative sulfuric acid (H_2SO_4), while bottles for Chlorophyll-a analyses are wrapped in aluminum foil to exclude light. Water samples are kept on ice and delivered to the laboratory within 24 hours of collection.

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

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

Lake Water Quality Questions and Answers

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

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

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

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

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

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

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

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

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

Secchi Transparency- A Secchi disk is a device used to measure transparency or clarity of the lake. Transparency is directly related to the amount of algae and suspended solids in the water column. A Secchi disk is a white and black disk attached to the end of a rope that is marked at 0.1-foot intervals. 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 points is the Secchi disk measurement. Shallow measurements typically indicate abundant algae and/or suspended solids.

Total Phosphorus (TP) - Phosphorus is an essential nutrient. Algal growth is commonly limited by low phosphorous supplies. Therefore, phosphorous inputs to a lake can rapidly stimulate algal 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 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 µg/L for shallow lakes). Sources of phosphorus include runoff from agricultural land, runoff carrying fertilizer from lakeshore properties, failing septic systems, pet wastes, and storm water runoff. The lake itself can also be a source of phosphorus. High levels of total phosphorus contained in the bottom sediments of lakes can be released when the sediment is disturbed through recreation or animal activity, or when dissolved oxygen levels are low.

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

Lake Water Quality Monitoring Parameters

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

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

A- We compare our lakes to other lakes in the same ecoregion. The U.S. Environmental Protection Agency mapped regions of the U.S based on soils, landform, potential natural vegetation, and land use. These regions are referred to as ecoregions. Minnesota has seven ecoregions. Anoka County is in the North Central Hardwood Forest ecoregion. Reference lakes, deemed to be representative and minimally impacted by man (e.g., no point source wastewater discharges, no large urban areas in the watershed, etc.), were sampled in each ecoregion to establish a standard range for water quality that should be expected in each ecoregion.
The average summer range of water quality values in the table above (pg. 12) are the inter-quartile range (25^{th} to 75^{th} percentile) of the reference lakes for the North Central Hardwood Forest ecoregion. This provides a range of values that represent the central tendency of the reference lakes' water quality.

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

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

Lake Physical and Recreational Conditions Ranking System

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

Q- What is the lake quality letter grading system?

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

Lake Grading System Criteria

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

Q- What is the Carlson Trophic State Index?

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

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

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

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

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

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

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

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

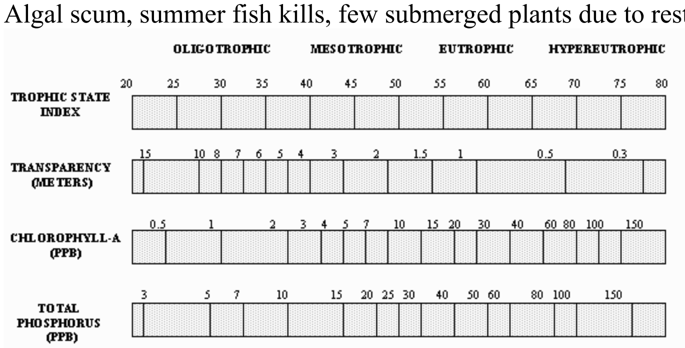
3. Eutrophic- In these lakes, the water is nutrient-rich. Productivity is high for both plants and fish. Abundant plant life, especially algae, results in poorer water clarity and can reduce the dissolved oxygen content when it decays. Algae blooms in the "dog days of summer" are commonplace. Bass and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

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

Carlson's Trophic State Index Scale

CARLSON'S TROPHIC STATE INDEX

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



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 µg/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 decreased due to ice over, which may lead to a winter fish 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 a 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 analyze the data objectively. When at least 5 years of monitoring data are present, ACD staff test for lake trends using a Multivariate Analysis of Variance (MANOVA). MANOVA tests the vector response of correlated response variables (Secchi depth, total phosphorus, and chlorophyll-a) while maintaining the probability of making a type I error (rejecting a true null hypothesis) at $\alpha = 0.05$. In other words we are simultaneously testing the three most important measurements of lake water quality. Testing each response variable separately would increase the chance of making a type I error.

Historic Water Quality Grades for Anoka County Lakes (includes monitoring by ACD and Met Council's CAMP program, post-1980 only. Met Council grades for 2010 were not available at the time of printing of this document)

Year→	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Cenaiko																		B	A	A	A	B	A	A	A	A	A	A	B	B	
Centerville	D	C		C					D												C	C		C	C	A					
Coon	C				C					C					C			C	B	A	B	C	B		C		C		C		
Coon (North Bay)																															B
Coon (South Bay)																															A
Crooked				C		C				C					B	C	B	B	B		B		B	B		B	B		B	B	
E. Twin	A	B		C						B						B		A	B	A	A		A			A			A		
Fawn									B									A	B	A	A	A	A		A		A		A		A
George	A	A	A		A					A					B			A	B	A	A		A			B			B		
George Watch		F	D	D		D		D	D	F	D	F					F	D	F	D	D	F	D	D	F	D	F	F	D	D	
Golden	D					D	C	D	F	F	F	F		D			C	D	C	C	C	D	D	D	D	C	C	C	C	C	
Ham					C									A	B		A	A	B		C	C	B		B	B		B	A		B
Highland																				D	C	D	F	F	F	F	F	F			
Howard										F	F	F							F	D	D										
Island				C																				B	B	C	C	B	B	C	
Itasca																			A	B	B										
Laddie	D													B	B	B			C	B	B	B	B	B	B	B			B		
Linwood	B	C		C						C					C			C	C	C	C	C		C		C		C	C	C	
Lochness																												A	B		
Martin				D														D	D	C	D	D		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		B	A
Peltier				D										D	F	D	D	D	D	D	D	F	F	D	D	D	F	D			
Pickerel	C															B		A	A	B	C										
Reshanau																											D	D	D	D	
Rogers																			C		C			B			D		B	B	
Round																			B	A	B			A		B		C		C	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		F	

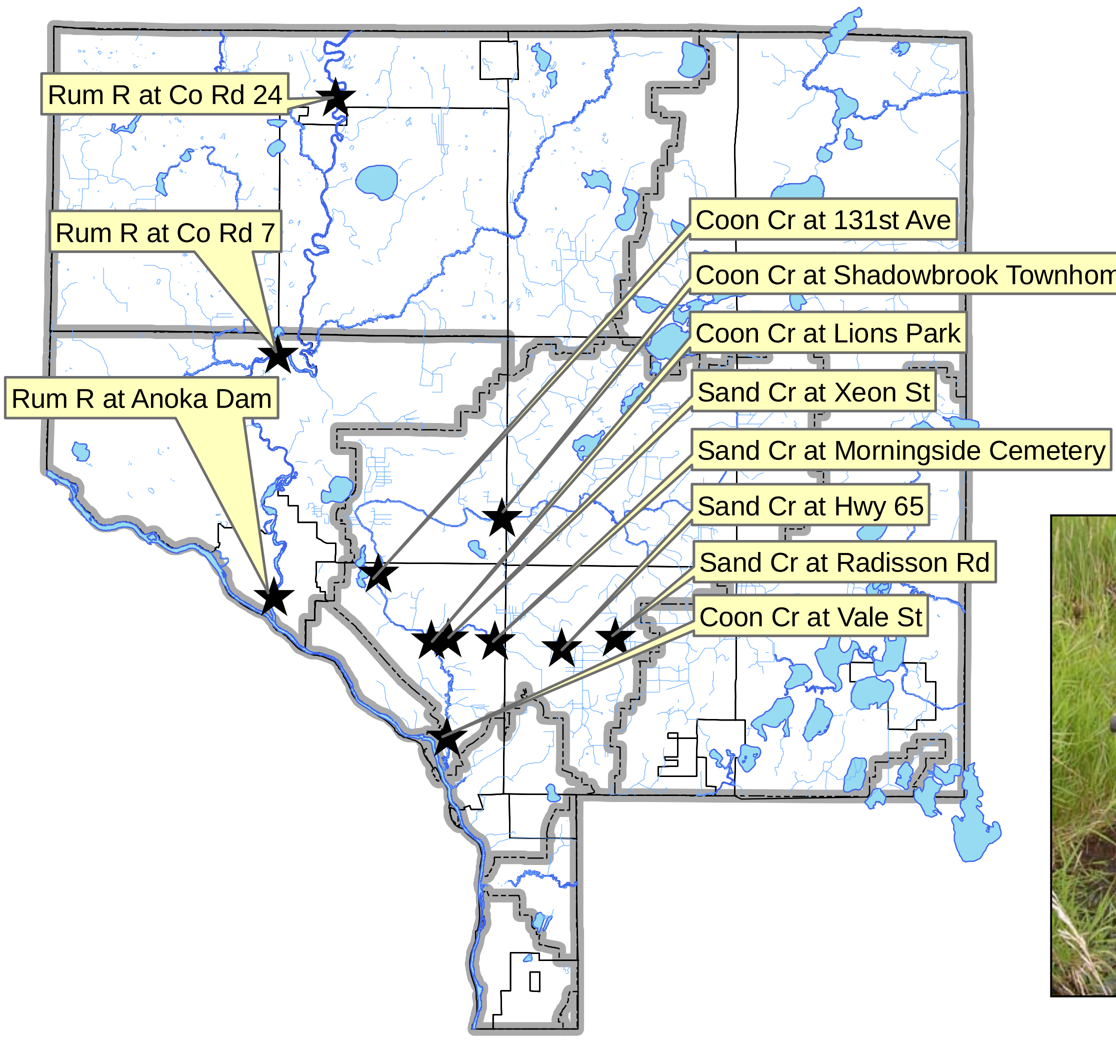
Stream Water Quality – Chemical Monitoring

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 2010 was conducted at three sites on the Rum River and eight on the Coon Creek and Sand Creek drainage. 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.

2010 Chemical Stream Water Quality Monitoring Sites



Stream Water Quality Monitoring Methods

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

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

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

Stream Water Quality Monitoring Questions and Answers

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

Q- What do the parameters that you test mean?

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

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

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

Dissolved Oxygen (DO) - Dissolved oxygen is essential to all aquatic organisms. The lower the DO concentration, the less likely a stream will support a wide range of organisms, including fish.
Sources of dissolved oxygen include the atmosphere, aeration from stream inflow, and submerged plants and algae 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 algal decomposition which impacts fish populations, and degrade aesthetics for recreation. Ideally, total phosphorus should be below 40 μg/L in lakes and 130 μg/L in streams. Sources of phosphorus include runoff from agricultural land, runoff from lakeshore properties carrying fertilizer and untreated human waste from failing septic systems, pet wastes, and storm water runoff.

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

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

Analytical Limits for Stream Water Quality Parameters

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

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

A- We make two comparisons. First, with published water quality values for the ecoregion. 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.

Secondly, we compare each stream to 34 other streams the Anoka Conservation District has monitored throughout the county. The county includes urban, suburban, and rural areas so this comparison incorporates water quality expectations in all these land uses.

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

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

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

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

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

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

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

Stream Water Quality – Biological Monitoring

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

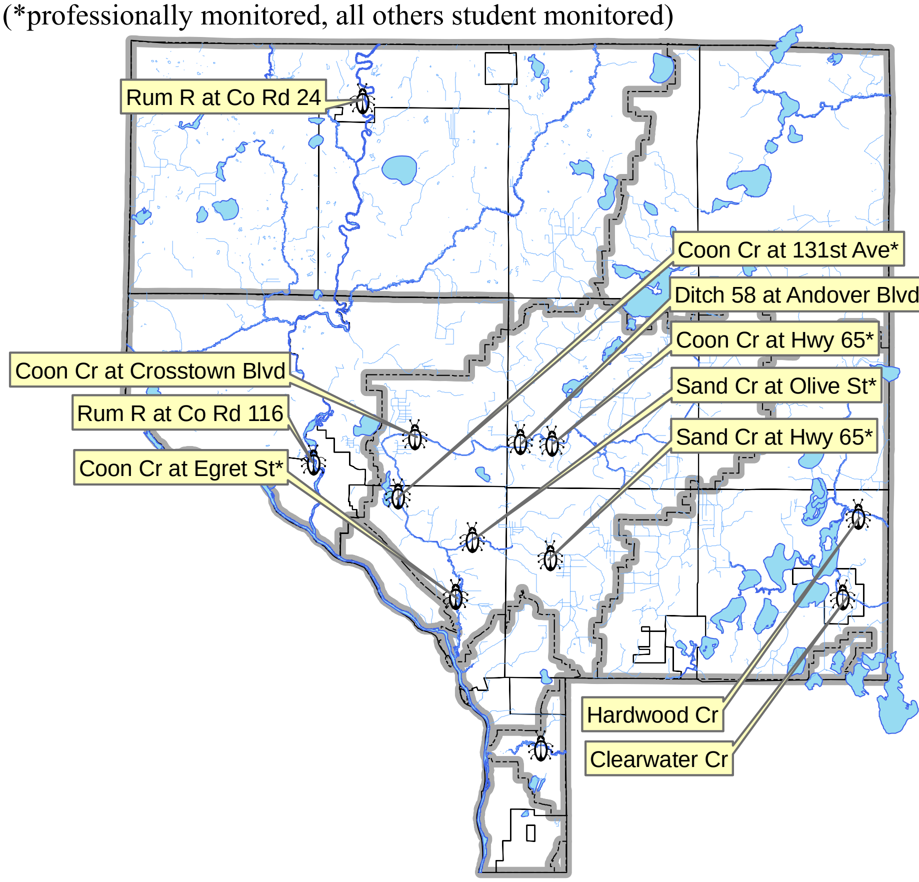
ACD adds an educational component to the program by involving students in the biomonitoring at many of the sites. High school science classes are the primary volunteers. In 2010 there were approximately 577 students from seven high schools who monitored seven sites. Since 2000 approximately 4,323 students have participated. The experience affords students an opportunity to learn scientific methodologies and become involved in local natural resource management.

In 2010 three sites were monitored by professionals without student involvement during both the summer and fall seasons. These sites were all within the Coon Creek drainage. The purpose was to examine sites listed by the MCPA as "impaired" for biota based on a single sample and to compare the biotic community in ditched and unditched stream reaches.

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

2010 Biological Stream Water Quality Monitoring Sites

(*professionally monitored, all others student monitored)



Biomonitoring Methods

ACD biomonitoring utilizes the US Environmental Protection Agency (EPA) multi-habitat protocol for low-gradient streams (www.epa.gov/owow/monitoring/volunteer/stream/). Using this methodology, individuals doing the sampling determine how much of the stream is occupied by four types of micro-habitat: vegetated bank margins, snags and logs, aquatic vegetation beds and decaying organic matter, and silt/sand/gravel substrate. Sampling is by "jabs" or sweeps with a D-frame net. Each habitat type is sampled in proportion to the prevalence of the habitat type. At least 20 jabs are taken. All macroinvertebrates are preserved and returned to the lab (or classroom) for identification to the family level. The identified invertebrates are preserved in labeled vials. From the identifications, biomonitoring indices are calculated to rank stream health. Fieldwork is overseen by Anoka Conservation District (ACD) staff and student identifications are checked by ACD staff before any analysis is done.

Biomonitoring Indices

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

Taxa Richness and Composition Measures

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

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

Tolerance and Intolerance Metrics

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

Key to interpreting the Family Biotic Index (FBI)

Family Biotic Index (FBI)	Water Quality Evaluation	Degree of Organic Pollution
0.00 - 3.75	Excellent	Organic pollution unlikely
3.76 - 4.25	Very Good	Possible slight organic pollution
4.26 - 5.00	Good	Some organic pollution probable
5.01 - 5.75	Fair	Fairly substantial pollution likely
5.76 - 6.50	Fairly Poor	Substantial pollution likely
6.51 - 7.25	Poor	Very substantial pollution likely

Population Attributes Metrics

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

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

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

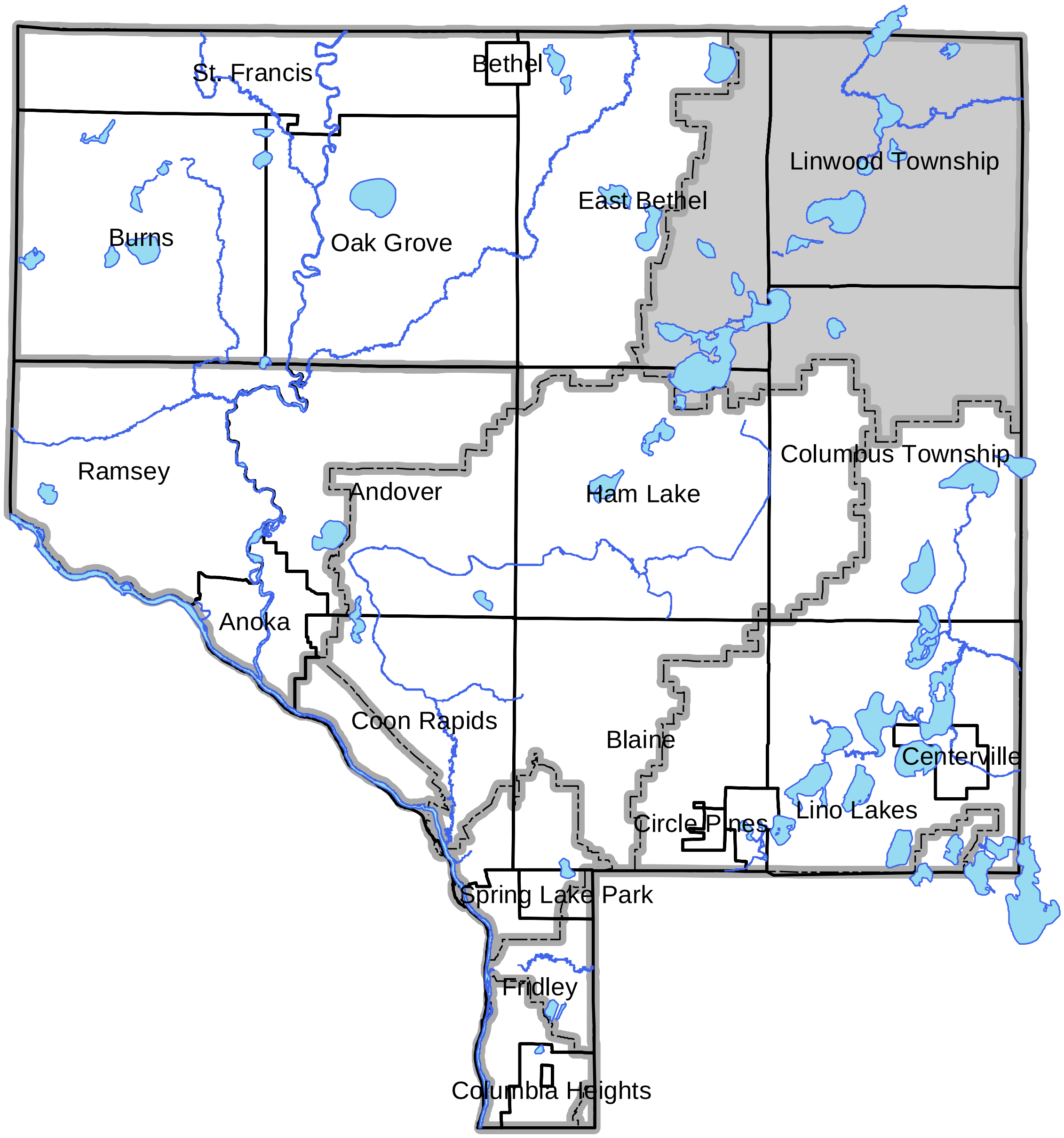
Sites

In 2010, ten sites were monitored for benthic macroinvertebrates. High school classes, with ACD staff supervision, sampled seven of these sites.

2010 Biomonitoring Sites and Corresponding Monitoring Groups

Monitoring Group	Stream
Andover HS	Coon Creek
Anoka HS	Rum River (near Anoka)
Blaine HS	Coon Creek at Egret Blvd.
Centennial HS	Clearwater Creek
Forest Lake Area Learning Center	Hardwood Creek
St. Francis HS	Rum River (St. Francis)
Totino Grace HS	Rice Creek
ACD	Coon Creek at 131st Ave.
ACD	Coon Creek at Egret Blvd.
ACD	Ditch 41 at Highway 65

Sunrise River Watershed



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

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

CHAPTER 2: SUNRISE RIVER WATERSHED

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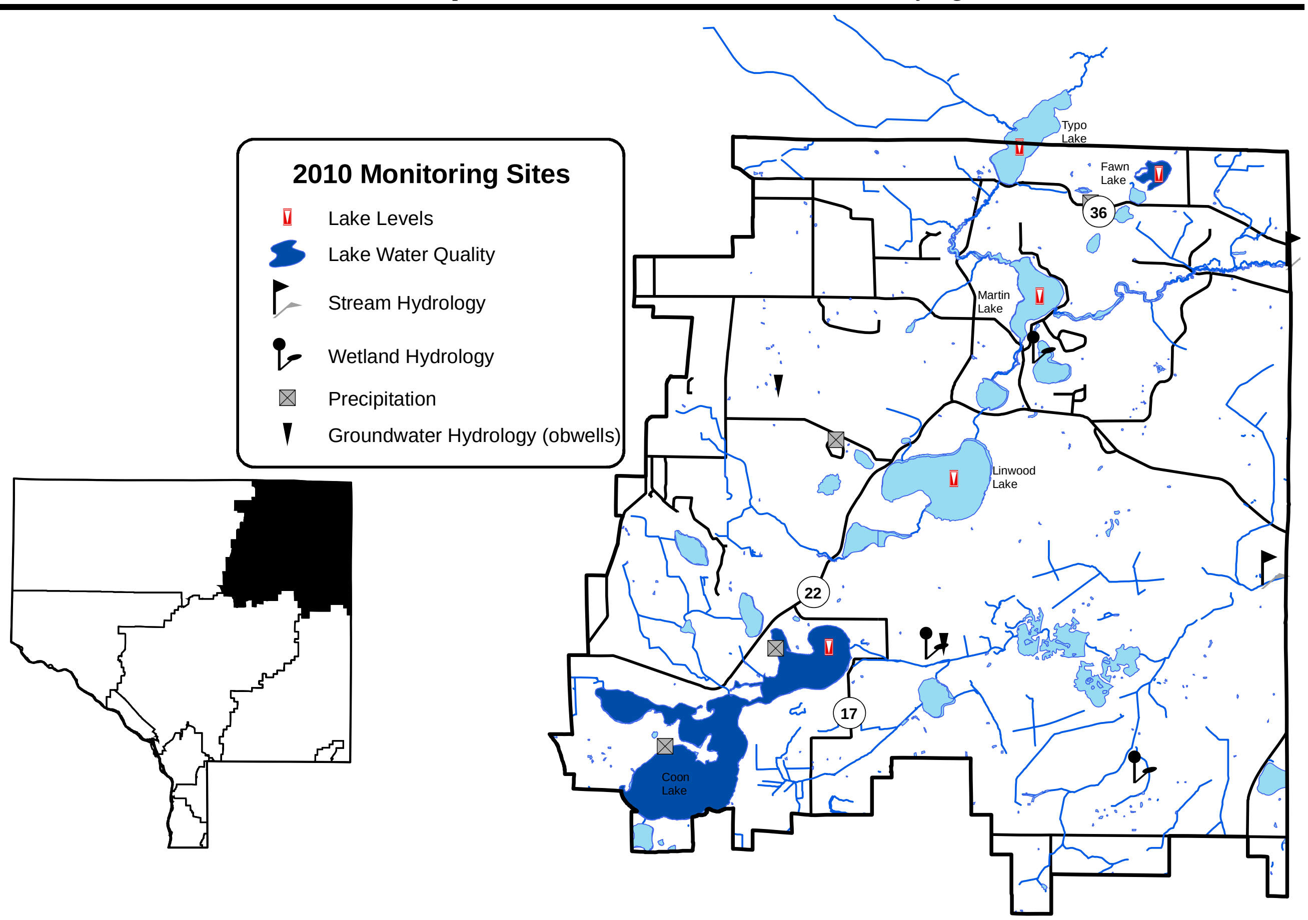
ACD = Anoka Conservation District, SRWMO = Sunrise River Watershed Management Organization, MNDNR = Minnesota Dept. of Natural Resources, ACAP = Anoka County Ag Preserves



Lake Levels

Description: Weekly water level monitoring in lakes. The past five years are shown below, and all historic data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

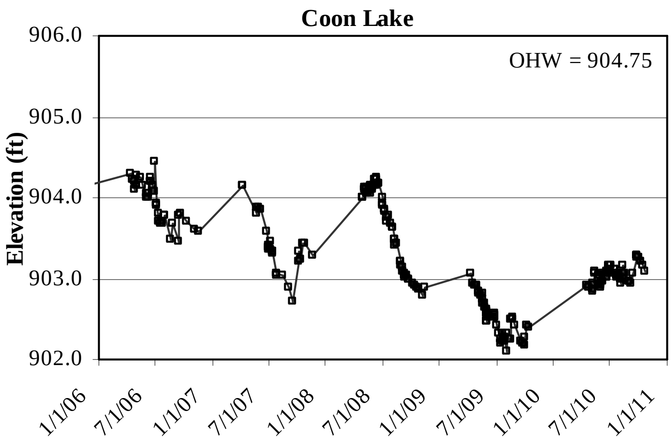
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

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

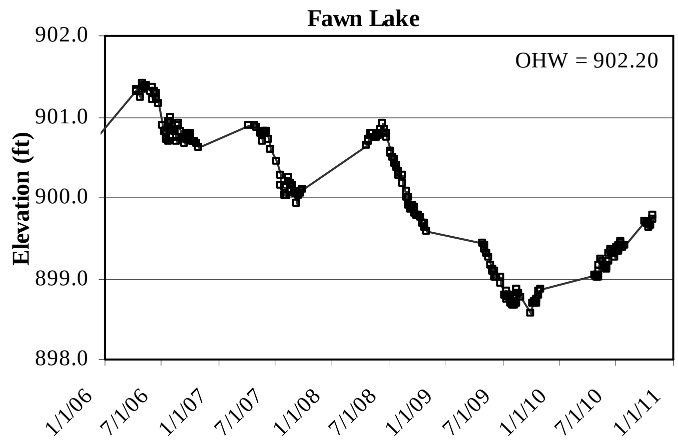
Results: Lake levels were measured by volunteers 22 to 56 times throughout 2010, depending upon the lake. Increased average lake levels were observed in all lakes in 2010 relative to 2009. Above average rainfall totals for June, July, and September in 2010 contributed to the increased water levels. The low water levels observed in 2009 were a result of below average precipitation from 2007 to 2009. In 2010, average levels in Coon and Fawn Lakes increased by approximately 0.5 feet. Average lake levels in Linwood, Typo, and Martin Lakes increased by 0.4 feet, 0.33 feet, and 0.24 feet, respectively.

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

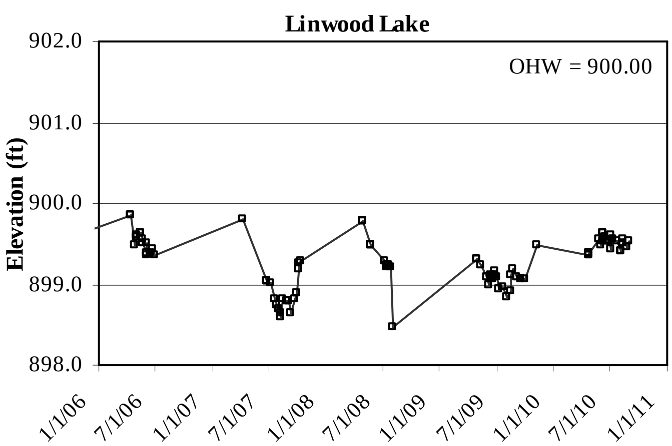
Coon Lake Levels 2006-20010



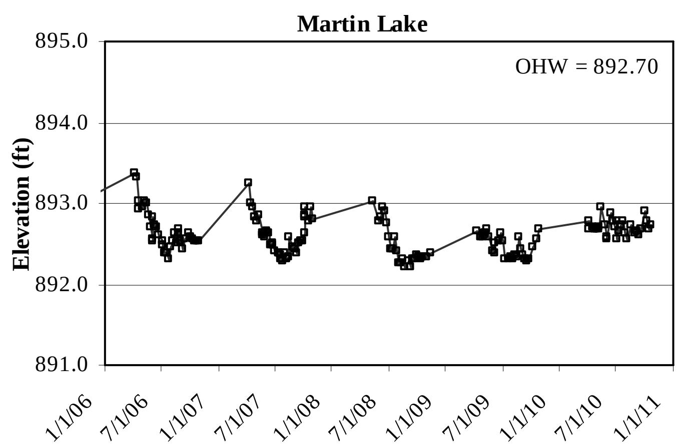
Fawn Lake Levels 2006-2010



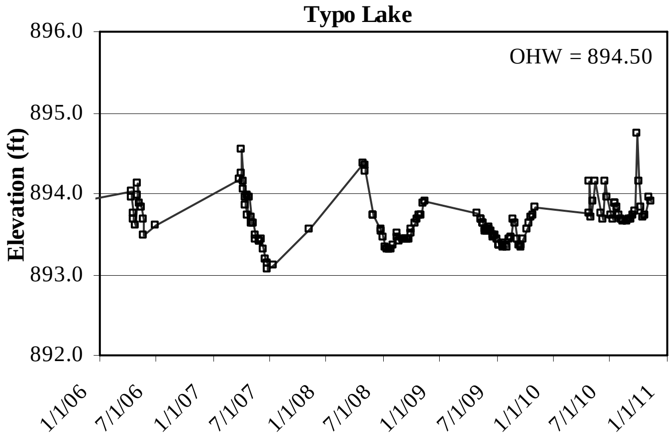
Linwood Lake Levels 2006-2010



Martin Lake Levels 2006-2010



Typo Lake Levels 2006-2010



Sunrise River Watershed Lake Levels Summary 2006-2010

Lake	Year	Average	Min	Max
Coon	2006	903.96	903.45	904.45
	2007	903.42	902.72	904.16
	2008	903.68	902.80	904.25
	2009	902.51	902.11	903.05
	2010	903.05	902.85	903.29
Fawn	2006	900.94	900.62	901.40
	2007	900.37	899.92	900.90
	2008	900.32	899.59	900.91
	2009	898.89	898.56	899.42
	2010	899.34	899.01	899.79
Linwood	2006	incomplete data		
	2007	898.94	898.60	899.81
	2008	incomplete data		
	2009	899.10	898.84	899.49
	2010	899.50	899.37	899.63
Martin	2006	892.67	892.32	893.36
	2007	892.61	892.28	893.25
	2008	892.48	892.21	893.02
	2009	892.47	892.28	892.68
	2010	892.71	892.55	892.96
Typo	2006	incomplete data		
	2007	893.67	893.06	894.54
	2008	893.62	893.32	894.38
	2009	893.52	893.33	893.82
	2010	893.85	893.66	894.73

Lake Water Quality

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

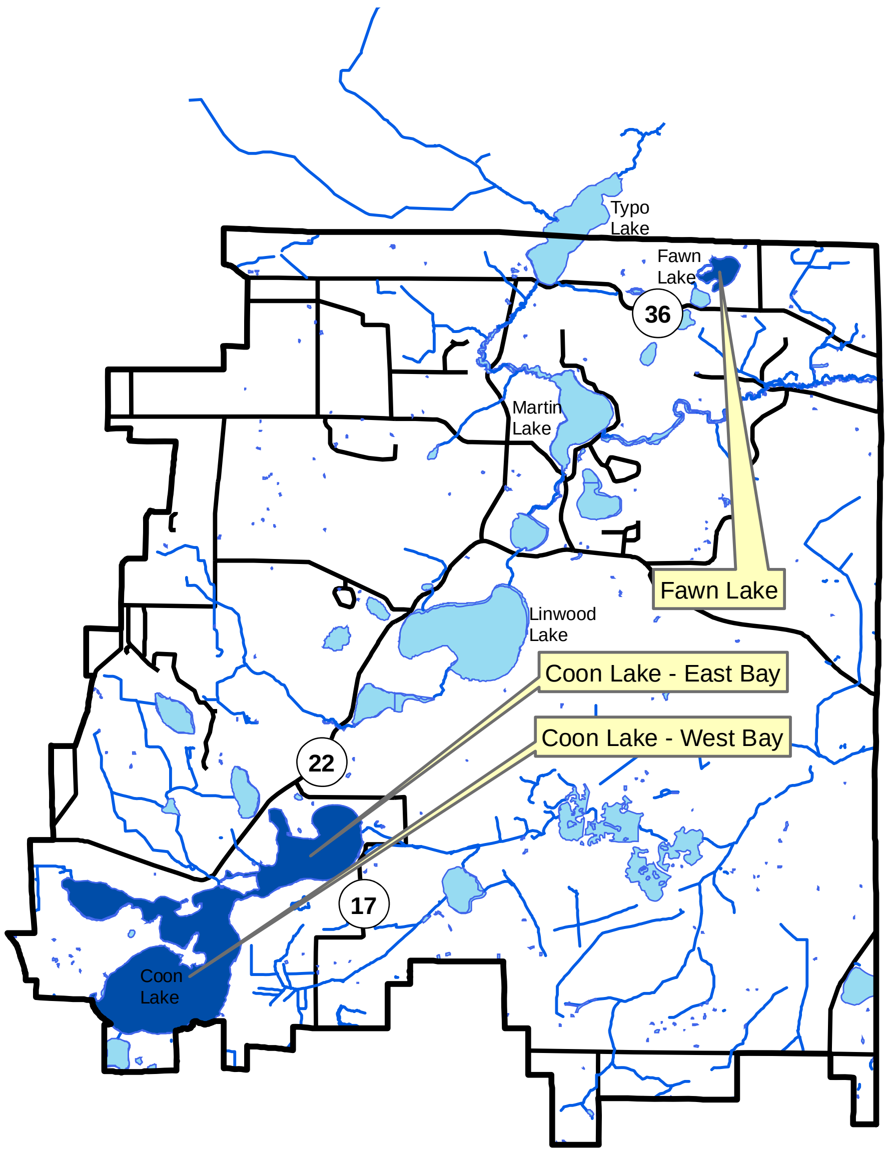
Purpose: To detect water quality trends and diagnose the cause of changes.

Locations: Coon Lake – East and West Bays

Fawn Lake

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

Sunrise Watershed Lake Water Quality Monitoring Sites



Coon Lake –East and West Bays

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

Background

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

This report includes separate information for the East Bay (aka northeast or north bay) and West Bay (aka southwest or south) of Coon Lake. 2010 data is from only Anoka Conservation District monitoring at the MN Pollution Control Agency (MPCA) monitoring site #203 for the East Bay and #206 for the West Bay. Over the years, other sites have been monitored and are included in this report's trend analysis when appropriate. When making comparisons between the two bays, please consider that both bays were monitored simultaneously only in 2010; data from other years do not lend themselves well to direct comparisons because monitoring regimes were likely different.

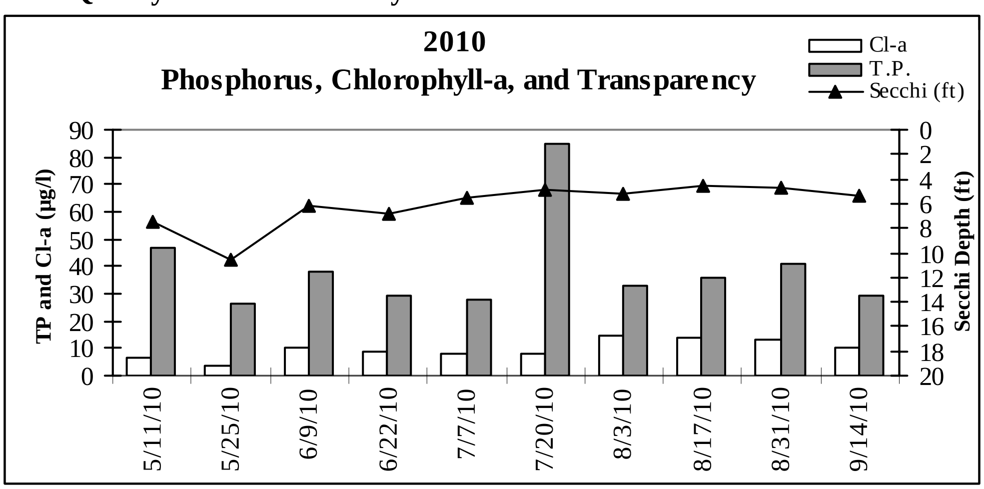
2010 Results

The East and West Bays of Coon Lake have noticeably different water quality. In 2010 the East Bay of Coon Lake had slightly better-than-average water quality for this region of the state (NCHF Ecoregion), receiving a B- grade, while the West Bay had better water quality and earned an A-. On every date, water quality was better in the West Bay than East, with an average difference of 13 µg/L phosphorus and 5.4 µg/L chlorophyll-a (algae). A direct comparison of average Secchi transparency is not possible because transparency exceeded the lake depth on three occasions in the West Bay and a reading could not be obtained. It is noteworthy, however, that the poorest Secchi transparency in the West Bay was greater than the average in the East Bay. Water quality in each bay showed little variation throughout the year, with no notable algae blooms (see graphs below).

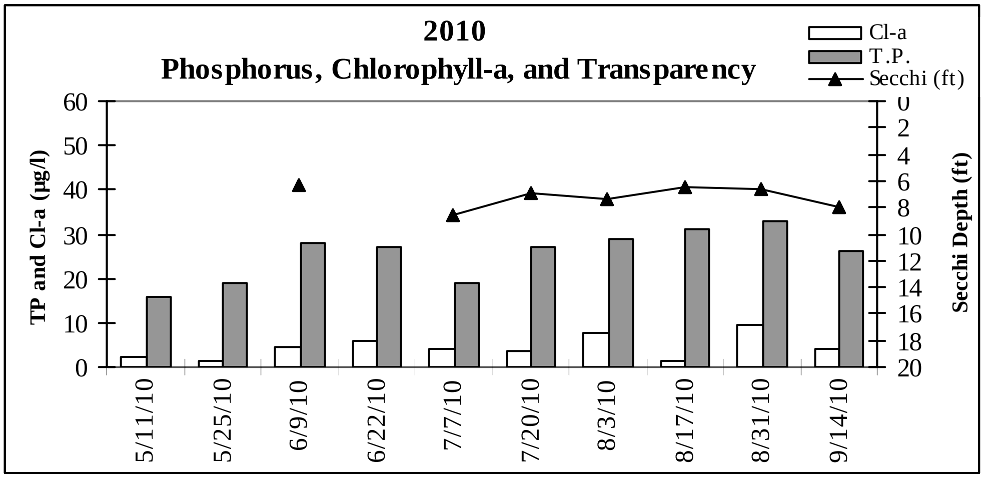
East Bay algal levels were the lowest of all monitored years in 2010, averaging 9.8 µg/L. Interestingly, average phosphorus levels (39.0 µg/L) and Secchi transparency (6.1 ft) were similar to previous years. Therefore, we do not view this as an overall improvement in water quality over other years.

West Bay had good water clarity, low nutrients, and algae levels that were about half of those in the East Bay. West Bay total phosphorus averaged 26.0 µg/L and chlorophyll-a average 4.4 µg/L. As mentioned above, Secchi transparency could not be measured on three occasions because it exceeded lake depth.

2010 Water Quality Results – East Bay of Coon Lake



2010 Water Quality Results –West Bay of Coon Lake



Trend Analysis

To analyze Coon Lake trends we obtained historic monitoring data from the MPCA. Over the years water quality has been monitored at 17 sites on the lake. For the trend analysis, we pooled data from five East Bay sites (#102, 203, 208, 209, and 401) and four West Bay sites (#101, 105, 206, and 207). These sites were chosen because they were all in the bay of interest, close to each other, and distant from the shoreline. The trend analysis is based on average annual water quality data for each year with data. We used data only from years with data from every month from May to September, except we allowed one month of missing data. Only data from May to September were used. Starting in 1998 only data from Anoka Conservation District monitoring were used for greater comparability.

East Bay Trend Analysis

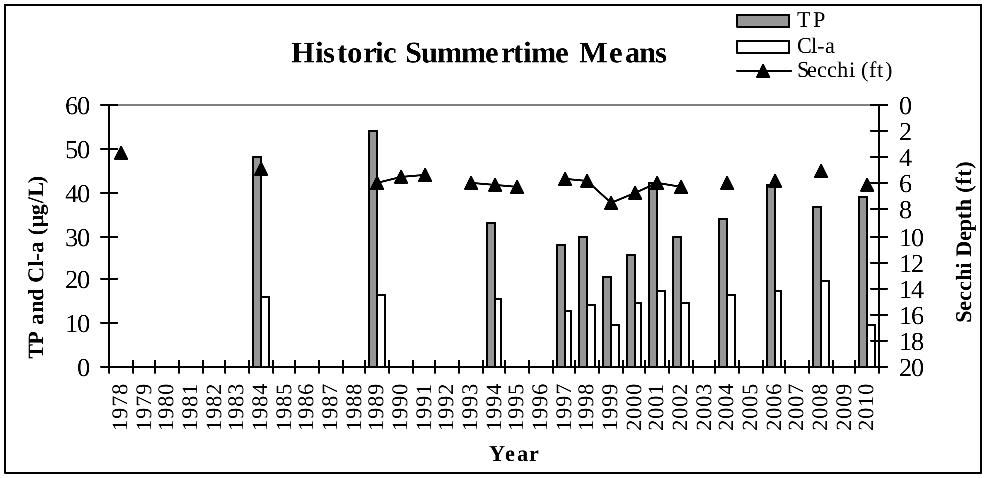
In the East Bay eighteen years of water quality data have been collected since 1978. During the most recent 10 years that were monitored (since 1996), the data collected included total phosphorus, chlorophyll-a, and Secchi transparency. For most of the other eight years (all pre-1997) only Secchi transparency is available. This provides an adequate dataset for a trend analysis, however given that most of the data is from the last 20 years, the analysis is not strong at detecting changes that occurred before 1990.

No water quality trend exists when we examined those years with total phosphorus, chlorophyll-a, and Secchi transparency, and excluded years with only Secchi transparency. The analysis was a repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth. This is our preferred approach because it examines all three parameters simultaneously. This analysis indicated no trend ($F_{2,10}$=0.69, p=0.53).

We also examined Secchi transparencies alone across all 18 years using a one-way ANOVA. Including all years, a significant trend of improving transparency is found ($F_{1,16}$=7.23, p=0.02). However, this trend is driven by unusually poor transparency in 1978 of 1.11 m. We examined the data from that year and found that no transparency readings were collected in May, when water is often clearest. This would have driven the average transparency down. Therefore, we feel it is appropriate to exclude the 1978 data. When this is done, the trend is no longer statistically significant ($F_{1,15}$=1.37, p=0.26).

It is noteworthy that a water quality improvement seems to have occurred between 1989 and 1994 (see graph below). The reason for such a change, if real, is unknown. Because there are only two years of phosphorus and chlorophyll-a data before 1994 it is difficult to determine if water quality was chronically poorer prior to 1994 or if the available monitoring data is not representative of typical conditions.

Historic Water Quality - East Bay of Coon Lake

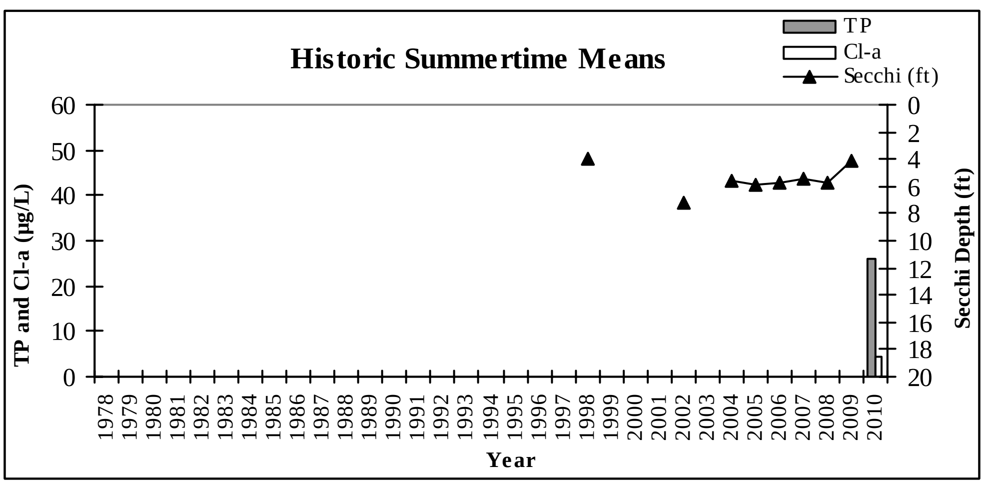


West Bay Trend Analysis

Nine years of data are available for the West Bay including only one year with phosphorus and chlorophyll-a data, so a powerful trend analysis is not possible. We can analyze just Secchi transparency data, but this also has a weakness: 2010 must be excluded because a full suite of Secchi measurements is not available due to clarity exceeding the lake depth occasionally. Despite these limitations, we examined the Secchi data for any trends.

A one-way ANOVA was performed with Secchi transparency from 1998 to 2009 as the response variable. No water quality trend exists ($F_{1,6}$=0.0036, p=0.95). Looking at the data superficially (see graph below), small variations among years is seen but no trend is apparent.

Historic Water Quality - West Bay of Coon Lake



Discussion

While Coon Lake is not listed as "impaired" by the MN Pollution Control Agency, the East Bay is close to the state water quality standard of 40 µg/L phosphorus. In 2006 phosphorus averaged 42 µg/L, was 37 µg/L in 2008, and in 2010 was 39 µg/L. Voluntary efforts to improve water quality are strongly encouraged to prevent the lake from becoming designated as “impaired.” Such a designation would trigger in-depth study under the Federal Clean Water Act.

Given the highly-developed nature of the lakeshore, the practices of lakeshore homeowners are a reasonable place to begin water quality improvement efforts. Residents should increase the use of shoreline practices that improve water quality and lake health, such as native vegetation buffers and rain gardens. Clearing of native vegetation to create a “cleaner” lakefront should be avoided because this vegetation is important to lake health and water quality. Septic system maintenance, and replacement where necessary, should be a priority on an individual home basis and on a community level. In recent years the City of East Bethel has begun the process of installing municipal sewer and water in their Highway 65 district. An eventual extension of that system to Coon Lake has been discussed but there is no assurance this will happen. That might be most beneficial in the Hiawatha Beach and Interlachen neighborhoods, where the greatest frequency of septic system failures is suspected.

A final challenge for Coon Lake is the exotic, invasive plant Eurasian water milfoil (EWM). It was discovered in the lake in 2003 and has spread rapidly. In 2008 a Coon Lake Improvement District was formed, with EWM management as a core of its function. EWM is actively monitored and treated with herbicide in accordance with DNR rules and a lake vegetation management plan, yet it continues to expand.

2010 Coon Lake East Bay Water Quality Data

Coon Lake East Bay 2010		Date	5/11/2010	5/25/2010	6/9/2010	6/22/2010	7/7/2010	7/20/2010	8/3/2010	8/17/2010	8/31/2010	9/14/2010			
		Time	14:15	10:50	11:30	10:45	13:00	11:20	10:55	10:45	11:30	11:10			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.65	8.09	8.45	8.40	8.30	8.31	8.68	7.98	7.81	7.76	8.14	7.65	8.68
Conductivity	mS/cm	0.01	0.229	0.223	0.218	0.220	0.215	0.212	0.213	0.211	0.215	0.218	0.217	0.211	0.229
Turbidity	FNRU	1.0	4	4	9	9	9	18	15	11	10	10	10	4	18
D.O.	mg/L	0.01	10.87	9.71	8.79	9.32	9.60	9.37	10.68	8.72	9.29	N/A	9.59	8.72	10.87
D.O.	%	1.0	96%	108%	93%	103%	112%	106%	122%	92%	100%	N/A	104%	92%	122%
Temp.	°C	0.10	12.0	22.6	21.1	23.8	27.4	25.7	27.2	24.0	25.0	19.0	22.8	12.0	27.4
Temp.	°F	0.10	53.6	72.7	70.0	74.8	81.3	78.3	81.0	75.2	77.0	66.2	73.0	53.6	81.3
Salinity	%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl-a	ug/L	1.0	6.9	3.4	10.4	8.7	8.4	8.2	14.4	13.7	13.2	10.5	9.8	3.4	14.4
T.P.	mg/L	0.005	0.047	0.026	0.038	0.029	0.028	0.085	0.033	0.036	0.041	0.029	0.039	0.026	0.085
T.P.	ug/L	5	47	26	38	29	28	85	33	36	41	29	39	26	85
Secchi	ft	0.1	7.5	10.5	6.2	6.8	5.6	4.9	5.2	4.5	4.7	5.4	6.1	4.5	10.5
Secchi	m	0.1	2.3	3.2	1.9	2.1	1.7	1.5	1.6	1.4	1.4	1.6	1.9	1.4	3.2
Field Observations															
Physical			1.5	2.0	2.0	2.0	2.0	3.0	3.0	3.0	2.0	3.0	2.4	1.5	3.0
Recreational			1.5	2.0	2.0	2.0	2.0	2.5	3.0	3.0	2.0	3.0	2.3	1.5	3.0

*Reporting Limit

2010 Coon Lake West Bay Water Quality Data

Coon Lake West Bay 2010		Date	5/11/2010	5/25/2010	6/9/2010	6/22/2010	7/7/2010	7/20/2010	8/3/2010	8/17/2010	8/31/2010	9/14/2010			
		Time	14:30	11:15	10:40	10:10	12:35	10:50	10:40	10:25	11:00	10:45			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.64	8.38	7.67	8.28	8.14	7.75	7.89	7.68	7.57	7.90	7.89	7.57	8.38
Conductivity	mS/cm	0.01	0.202	0.191	0.169	0.160	0.152	0.155	0.169	0.162	0.169	0.167	0.17	0.15	0.20
Turbidity	FNRU	1.0	1	3	3	3	4	9	7	8	9	6	5.30	1.00	9.00
D.O.	mg/L	0.01	10.52	9.65	8.39	10.72	9.15	7.61	8.81	9.45	8.89	NA	9.24	7.61	10.72
D.O.	%	1.0	90%	108%	89%	118%	107%	85%	100%	97%	96%	NA	0.99	0.85	1.18
Temp.	°C	0.10	10.7	23.6	21.0	23.7	27.3	25.2	26.9	22.1	24.8	18.4	22.4	10.7	27.3
Temp.	°F	0.10	51.3	74.5	69.8	74.7	81.1	77.4	80.4	71.8	76.6	65.1	72.3	51.3	81.1
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	1.0	2.2	1.5	4.6	5.7	3.9	3.8	7.5	1.5	9.3	4.0	4.40	1.50	9.30
T.P.	mg/L	0.005	0.016	0.019	0.028	0.027	0.019	0.027	0.029	0.031	0.033	0.026	0.03	0.02	0.033
T.P.	ug/L	5	16	19	28	27	19	27	29	31	33	26	25.50	16.00	33.0
Secchi	ft	0.1	>9.8	>9.6	6.3	>9.8	8.6	6.9	7.4	6.4	6.6	8.0	NA	6.30	>9.8
Secchi	m	0.1	>3.0	>2.9	1.9	>3.0	2.6	2.1	2.3	2.0	2.0	2.4	NA	1.92	>3.0
Field Observations															
Physical			1	2	2	2	2	3	3	3	2	2	2.2	1	3
Recreational			1	2	2	2	2	2.5	3	3	2	2	2.2	1	3

*Reporting Limit

Fawn Lake

Linwood Township Lake ID # 02-0035

Background

Fawn Lake is located in extreme northeast Anoka County. Fawn Lake has a surface area of 57 acres and a maximum depth of 30 feet (9.1 m). There is no public access to this lake and no boat landing. A neighborhood association has established a small park and swimming beach for the homeowners. Most of the lake is surrounded by private residences, with the densest housing on the southern and western shores. The watershed for this lake is quite small, consisting mostly of the area within less than ¼ mile of the basin.

Fawn is one of the clearest lakes in the county. Groundwater likely feeds this lake to a large extent. Vegetation in the lake is healthy, but not so prolific to be a nuisance, and contributes to high water quality. In 2008 and 2010 an invasive plant species, curly-leaf pondweed, was noticed in a few locations, although it may have been present for some time. It does not appear occur in high densities.

2010 Results

Fawn Lake is classified as mesotrophic and has some of the clearest water in Anoka County. In 2010, Fawn Lake continued its trend of excellent water quality for this region of the state (NCHF Ecoregion) by receiving an overall A grade. Water clarity was high while total phosphorus and chlorophyll *a* were low throughout the 2010 sampling season. Water clarity was 15 feet in spring, and averaged 11.3 feet from May through September. The subjective observations of the lake's physical characteristics and recreational suitability by the ACD staff indicated that lake conditions were excellent for swimming and boating throughout the summer.

Trend Analysis

Eleven years of water quality data have been collected by the Minnesota Pollution Control Agency (1988) and the Anoka Conservation District (between 1997 and 2010). Water quality has fluctuated between an "A" and "B" grade, but there was no significant trend over this time period (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,8} = 3.89$, $p = 0.0662$).

Discussion

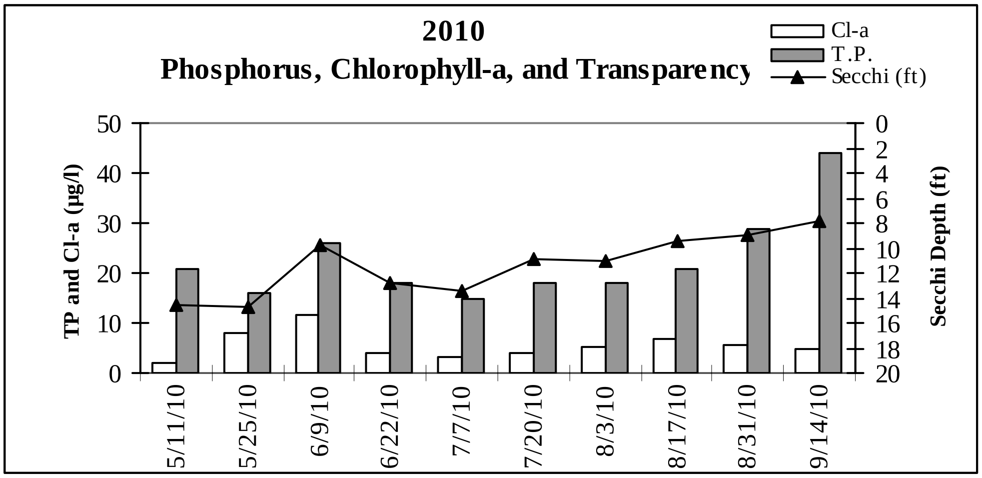
This lake's water quality future lies with the actions of the lakeshore homeowners. Because the lake has such a small watershed each lakeshore lot comprises a significant portion of the watershed. Poor practices on a few lots could result in noticeable changes to the lake. Some ways to protect the lake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

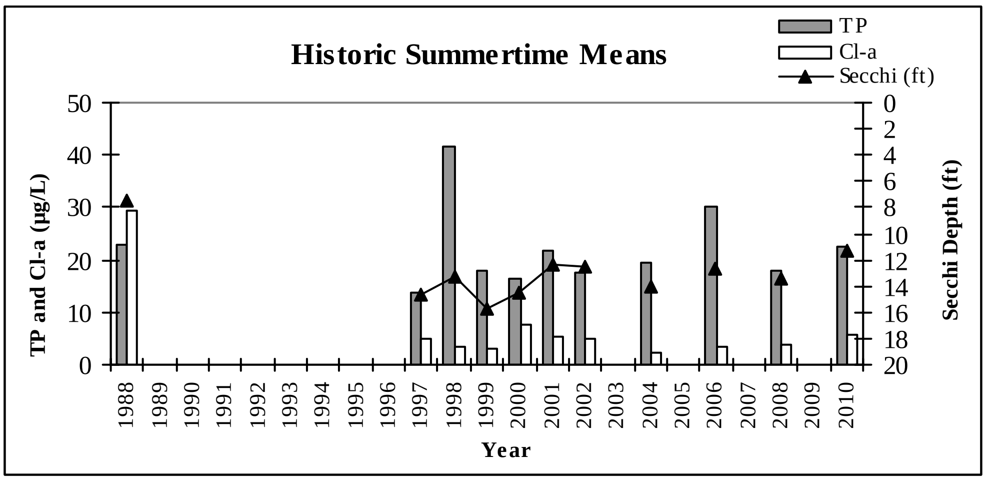
2010 Fawn Lake Water Quality Data

Fawn Lake 2010		Date	5/11/2010	5/25/2010	6/9/2010	6/22/2010	7/7/2010	7/20/2010	8/3/2010	8/17/2010	8/31/2010	9/14/2010			
		Time	15:20	12:00	11:15	11:20	14:00	12:10	12:00	11:35	12:10	12:00			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.77	7.76	8.64	8.41	8.37	8.17	8.71	8.57	7.89	7.86	8.22	7.76	8.71
Conductivity	mS/cm	0.01	0.245	0.241	0.228	0.220	0.209	0.202	0.200	0.198	0.200	0.215	0.216	0.198	0.245
Turbidity	FNRU	1.0	1	2	4	3	2	8	4	3	3	6	4	1	8
D.O.	mg/L	0.01	10.13	9.28	9.55	9.69	9.12	9.32	9.83	10.17	N/A	N/A	9.64	9.12	10.17
D.O.	%	1.0	90	106	101	108	108	106	114	110	N/A	N/A	105	90	114
Temp.	°C	0.10	12.1	24.2	21.1	24.2	28.0	26.1	27.8	24.4	25.4	19.5	23.3	12.1	28.0
Temp.	°F	0.10	53.8	75.6	70.0	75.6	82.4	79.0	82.0	75.9	77.7	67.1	73.9	53.8	82.4
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	µg/L	1.0	2.1	7.9	11.7	3.9	3.2	4.1	5.1	6.9	5.7	5.0	5.6	2.1	11.7
T.P.	mg/L	0.005	0.021	0.016	0.026	0.018	0.015	0.018	0.018	0.021	0.029	0.044	0.023	0.015	0.044
T.P.	µg/L	5	21	16	26	18	15	18	18	21	29	44	23	15	44
Secchi	ft	0.1	14.5	14.7	9.8	12.8	13.4	10.9	11.1	9.5	9.0	7.8	11.3	7.8	14.7
Secchi	m	0.1	4.4	4.5	3.0	3.9	4.1	3.3	3.4	2.9	2.7	2.4	3.5	2.4	4.5
Field Observations															
Physical			1.0	1.0	1.0	1.0	2.0	2.0	1.0	2.0	1.0	2.0	1.4	1.0	2.0
Recreational			1.0	1.0	1.0	1.0	1.0	2.0	1.0	2.0	1.0	2.0	1.3	1.0	2.0

*Reporting Limit

Fawn Lake Water Quality Results





Fawn Lake Historic Summertime Mean Values

Agency	MPCA	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1988	1997	1998	1999	2000	2001	2002	2004	2006	2008	2010
TP (µg/L)	23.0	13.6	41.6	18.0	16.3	21.7	17.4	19.4	30.0	18.0	22.6
Cl-a (µg/L)	29.4	5.0	3.4	3.1	7.5	5.2	5.1	2.4	3.5	3.7	5.6
Secchi (m)	2.3	4.5	4.1	4.8	4.4	3.8	3.8	4.3	3.8	4.1	3.5
Secchi (ft)	7.5	14.7	13.3	15.7	14.5	12.3	12.5	14.1	12.6	13.5	11.3

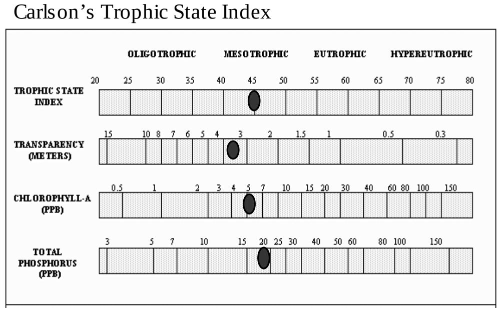
Carlson's Trophic State Indices

Year	1988	1997	1998	1999	2000	2001	2002	2004	2006	2008	2010
TSIP	49	42	58	46	44	49	45	47	53	46	49
TSIC	64	46	43	42	50	47	47	39	43	44	47
TSIS	48	38	40	37	39	41	41	39	41	40	42
TSI	54	42	47	42	44	45	44	42	46	43	46

Fawn Lake Water Quality Report Card

Year	1988	1997	1998	1999	2000	2001	2002	2004	2006	2008	2010
TP (µg/L)	B	A	C	A	A	A	A	A	B	A	A
Cl-a (µg/L)	C	A	A	A	A	A	A	A	A	A	A
Secchi (m)	A	A	A	A	A	A	A	A	A	A	A
Overall	**B**	**A**	**B**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**

Carlson's Trophic State Index



Stream Hydrology

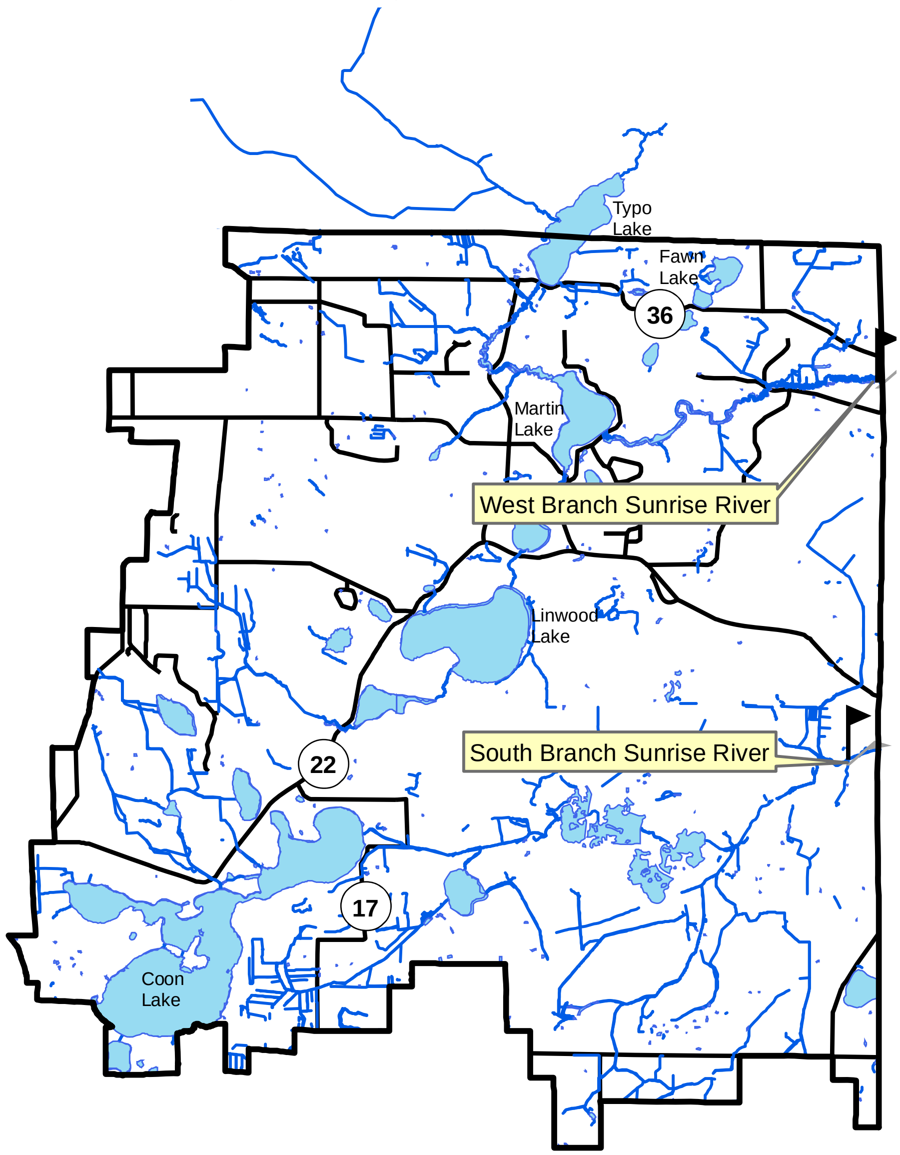
Description: Continuous water level monitoring in streams.

Purpose: To provide understanding of stream hydrology, including the impact of climate, land use or discharge changes. These data are also needed for calculation of pollutant loads and use of computer models for developing management strategies. In the Sunrise River Watershed, the monitoring sites are the outlets of the Sunrise River Watershed Management Organization's jurisdictional area, thereby allowing estimation of flows and pollutant loads leaving the jurisdiction.

Locations: South Branch Sunrise River at Hornsby St NE

West Branch Sunrise River at Co Rd 77

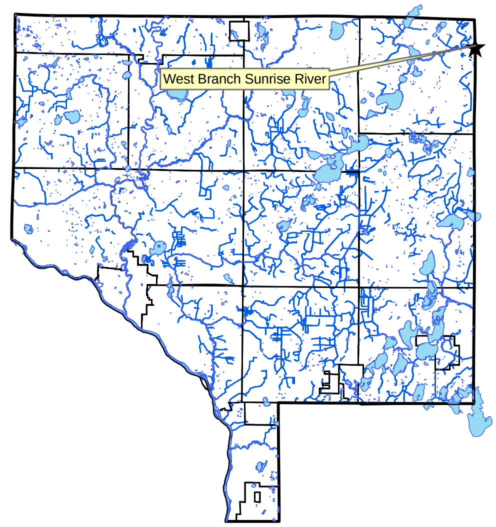
Sunrise Watershed Stream Hydrology Monitoring Sites



WEST BRANCH OF SUNRISE RIVER

At Co Rd 77, Linwood Township

Notes



This monitoring site is the bottom of this watershed in Anoka County, at the Chisago County border. Upstream, this river drains through Linwood, Island, Martin, and Typo Lakes. The Sunrise River Watershed Management Organization monitors this site because it is at the bottom of their jurisdictional area. They have done water quality monitoring at this site and created a rating curve to estimate flow volumes from the water level measurements. In 2008 and 2009 this site was also monitored to collect data for a computer model of the entire Sunrise River watershed being done by the US Army Corps of Engineers, Chisago County, and other partners.

The rating curve to calculate flows (cfs) from stage data is:
Discharge (cfs) = $2.9171(\text{stage}-883.5)^3 - 7.9298(\text{stage}-883.5)^2 + 10.131(\text{stage}-883.5) + 10.18$ $R^2=0.94$

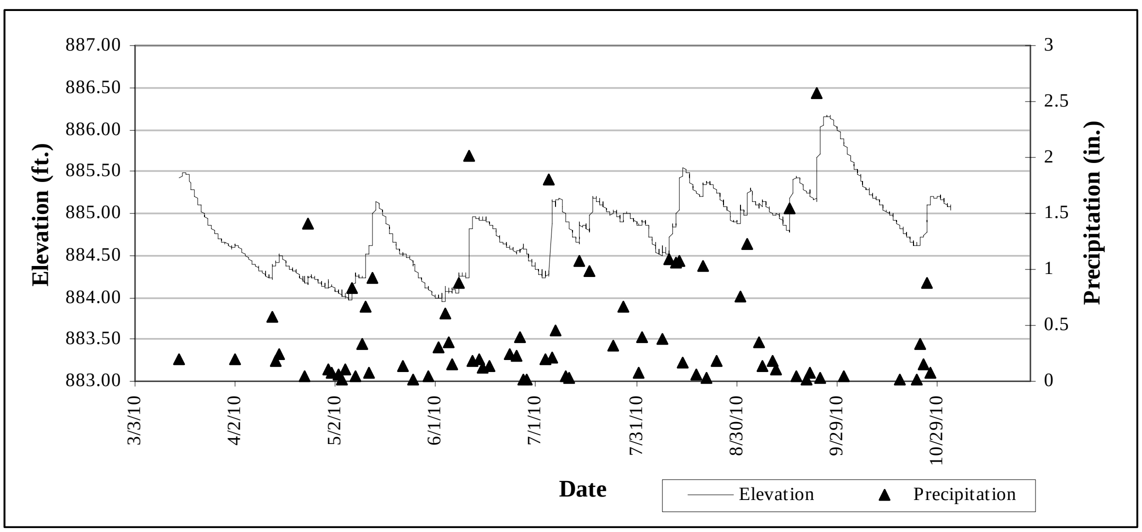
This rating curve was first prepared in 2002. Five additional flow-stage measurements were taken in 2008-09 to keep the equation updated.

Summary of All Monitored Years

Percentiles	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2008	2009	2010	All Years thru 2010
Min	883.78	884.25	885.25	884.06	883.41	883.65	884.36	883.28	883.84	884.33	883.76	883.31	883.02	883.96	883.02
2.5%	884.00	884.31	885.35	884.12	883.50	883.76	884.50	883.64	883.93	884.44	883.87	883.40	883.17	884.03	883.33
10.0%	884.14	884.48	885.42	884.22	883.52	883.81	884.63	883.73	884.02	884.58	884.04	883.51	883.21	884.21	883.70
25.0%	884.48	884.79	885.71	884.58	883.55	883.91	885.13	883.83	884.31	884.69	884.50	883.64	883.30	884.48	884.27
Median (50%)	884.77	885.51	886.06	884.80	883.68	884.25	885.59	884.62	884.59	884.93	885.06	883.89	883.48	884.86	884.95
75.0%	885.39	886.03	886.46	884.99	884.21	885.60	886.18	885.66	885.10	885.29	885.27	884.99	883.83	885.14	884.95
90.0%	885.88	886.58	887.10	885.21	884.42	886.69	886.48	886.12	886.03	885.61	885.59	885.74	884.12	885.37	886.31
97.5%	886.90	886.82	887.61	885.65	885.75	887.05	886.84	886.74	886.82	885.92	886.06	886.04	884.31	885.94	887.00
Max	887.13	887.14	887.81	885.77	886.02	887.05	886.89	886.91	886.89	886.67	886.14	886.17	884.42	886.18	887.81

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

2010 Hydrograph

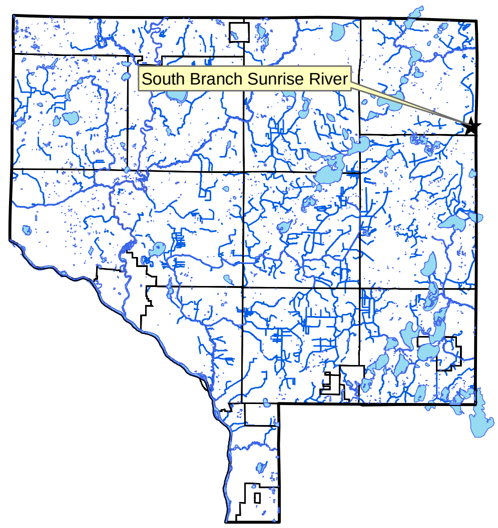


SOUTH BRANCH OF SUNRISE RIVER

At Hornsby St, Linwood Township

Notes

This monitoring site is the bottom of this watershed in Anoka County, at the closest accessible point to the Anoka-Chisago County boundary. Upstream, this river drains from Coon Lake and through the Carlos Avery Wildlife Management Area. The Sunrise River Watershed Management Organization monitors this site because it is at the bottom of their jurisdictional area. This site was first monitored in 2009 to collect data for a computer model of the entire Sunrise River watershed being done by the US Army Corps of Engineers, Chisago County, and other partners. Water quality monitoring has not yet occurred at this site, nor has a rating curve been created to estimate flow volumes from the water level measurements.

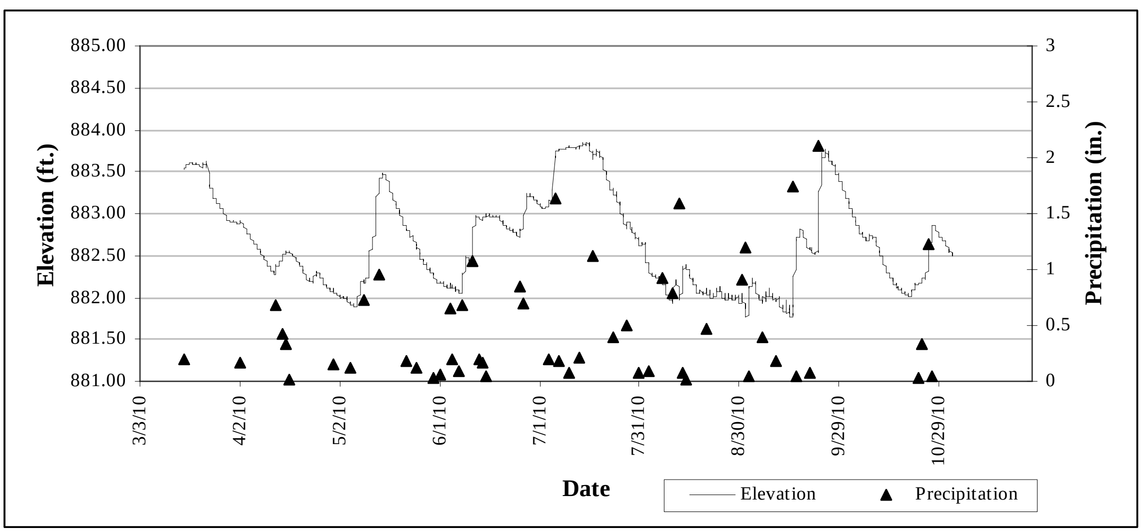


Summary of All Monitored Years

Percentiles	2009	2010	All Years Thru 2010
Min	881.20	881.77	881.20
2.5%	881.34	881.91	881.48
10.0%	881.57	882.02	881.72
25.0%	881.74	882.17	882.02
Median (50%)	882.09	882.59	882.54
75.0%	883.01	883.02	882.54
90.0%	883.34	883.58	883.43
97.5%	883.52	883.79	883.76
Max	883.56	883.85	883.85

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

2010 Hydrograph



Wetland Hydrology

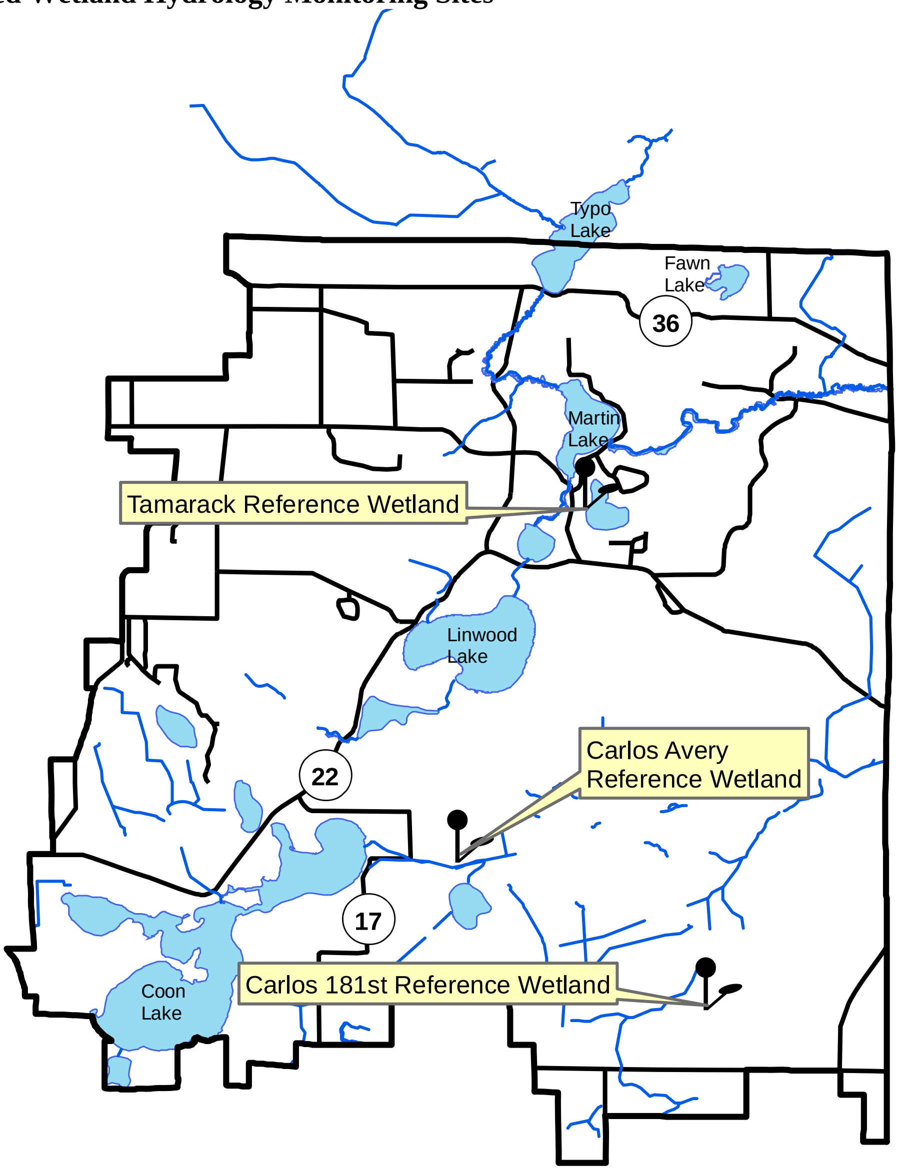
Description: Continuous groundwater level monitoring at a wetland boundary, to a depth of 40 inches. County-wide, the ACD maintains a network of 18 wetland hydrology monitoring stations.

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

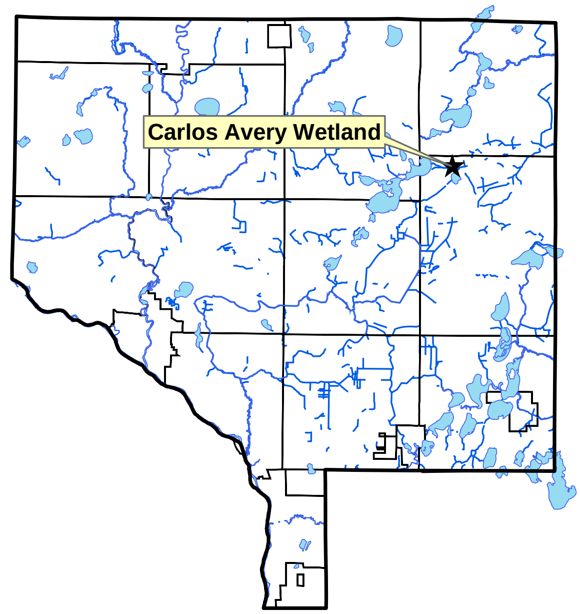
Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

Sunrise Watershed Wetland Hydrology Monitoring Sites



CARLOS AVERY REFERENCE WETLAND

Carlos Avery Wildlife Management Area, City of Columbus



Site Information

Monitored Since: 1997

Wetland Type: 3

Wetland Size: >300 acres

Isolated Basin? No

Connected to a Ditch? Yes

Soils at Well Location:

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

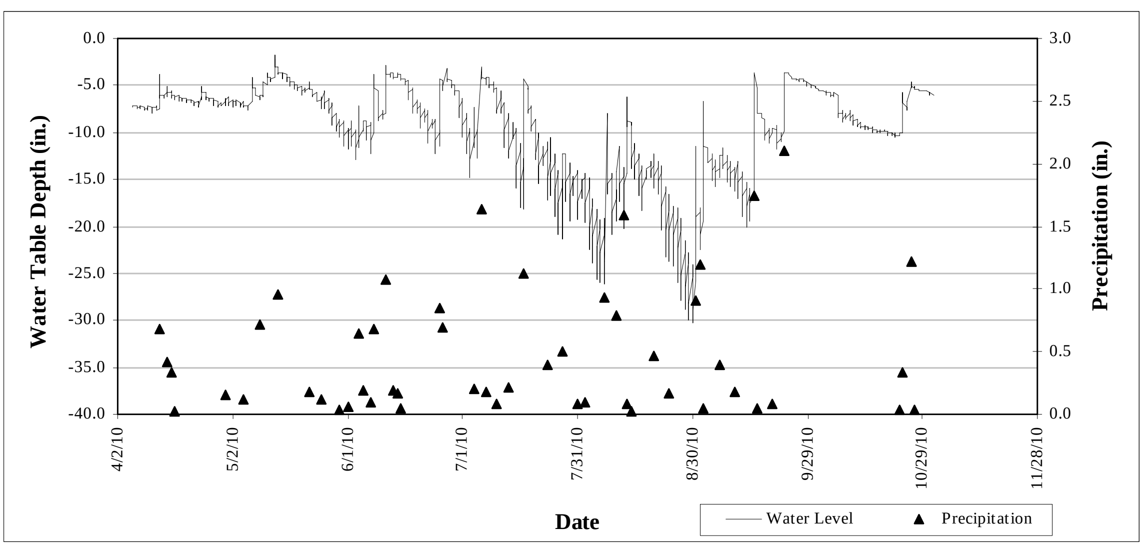
Surrounding Soils: Lino loamy fine sand

Vegetation at Well Location:

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

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

2010 Hydrograph

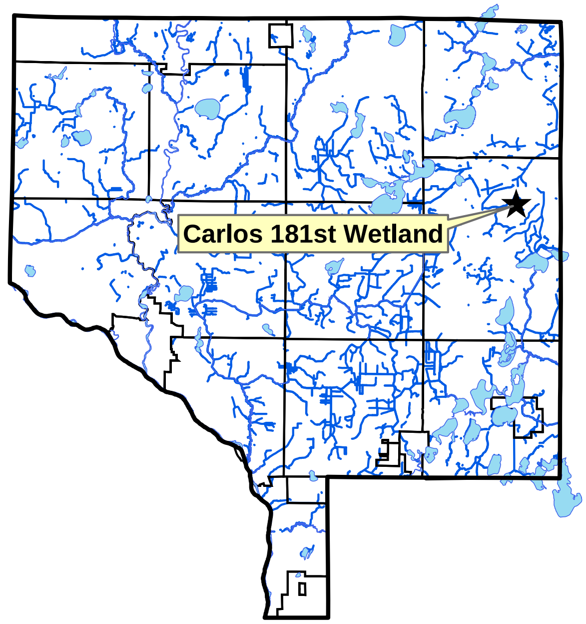


Well depths were 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

CARLOS 181ST REFERENCE WETLAND

Carlos Avery Wildlife Management Area, City of Columbus



Site Information

Monitored Since: 2006

Wetland Type: 2-3

Wetland Size: 3.9 acres (approx)

Isolated Basin? Yes

Connected to a Ditch? Roadside swale only

Soils at Well Location:

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

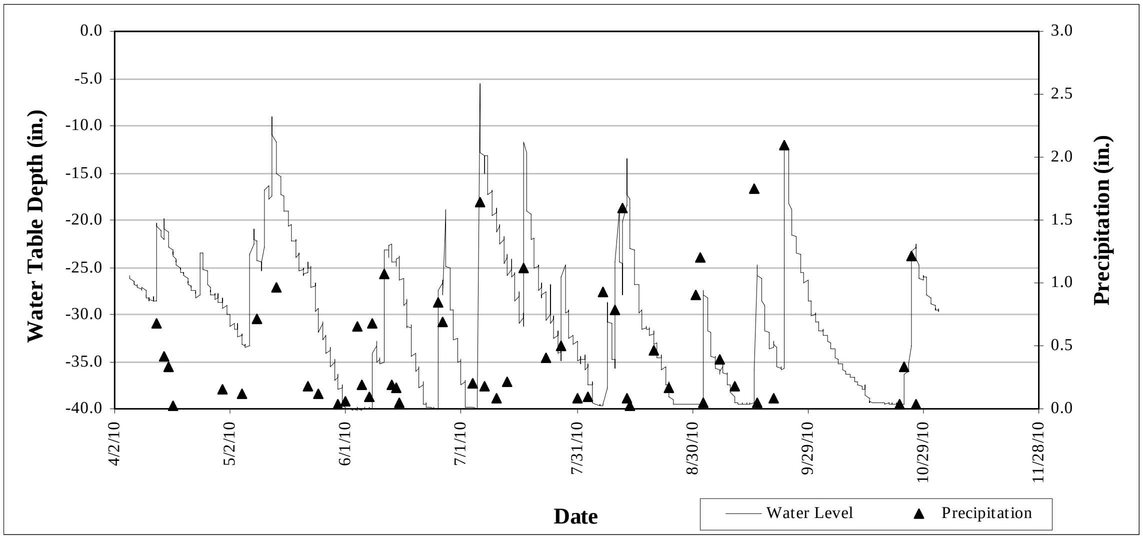
Surrounding Soils: Soderville fine sand

Vegetation at Well Location:

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

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

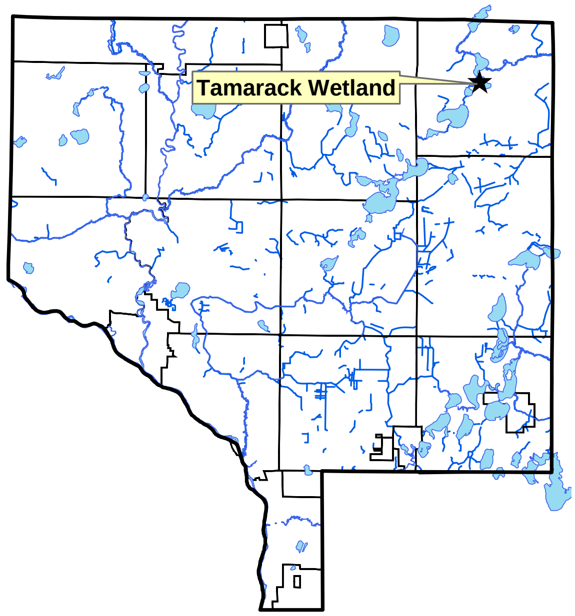
2010 Hydrograph



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

TAMARACK REFERENCE WETLAND

Martin-Island-Linwood Regional Park, Linwood Township



Site Information

Monitored Since: 1999

Wetland Type: 6

Wetland Size: 1.9 acres (approx)

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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

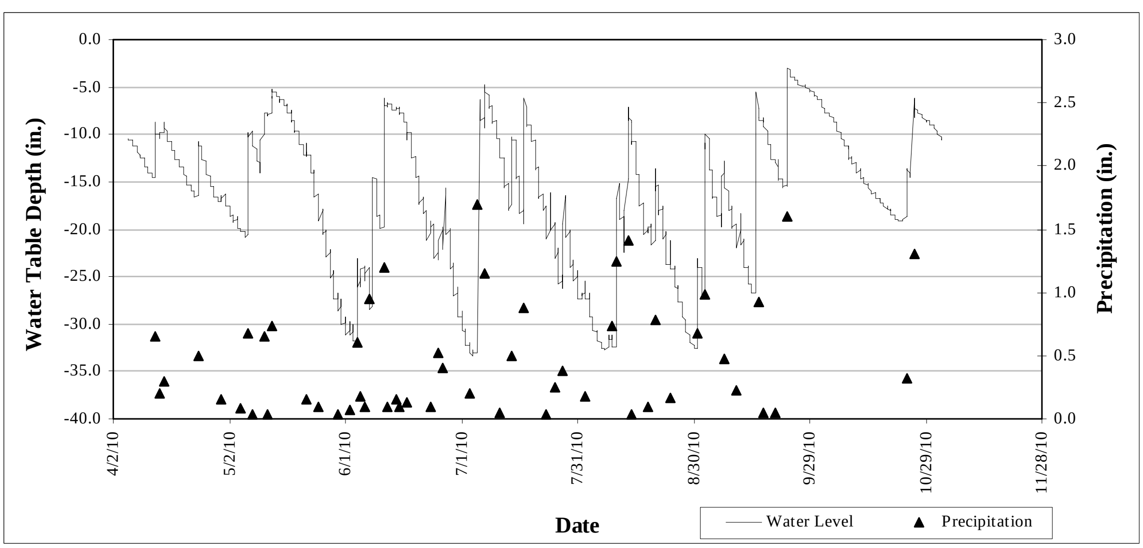
Surrounding Soils: Sartell fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Rhamnus frangula	Common Buckthorn	70
Betula alleghaniensis	Yellow Birch	40
Impatiens capensis	Jewelweed	40
Phalaris arundinacea	Reed Canary Grass	40

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

2010 Hydrograph



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

Water Quality Grant Fund

Description: The Sunrise River Watershed Management Organization (SRWMO) and Anoka Conservation District (ACD) partner to encourage projects that will benefit lake and stream water quality. These projects include lakeshore restorations, rain gardens, erosion correction, and others. Promotion occurs by approaching landowners with known problems, presentations to lake associations and other community groups, community newsletters, and website postings. The ACD assists interested landowners with design, materials acquisition, installation, and maintenance. The SRWMO offers cost share grants. These grants, administered by the ACD, offer 50-70% cost sharing of the materials needed for a project. The landowner is responsible for the remaining materials expenses, all labor, and any aesthetic components of the project.

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

Locations: Throughout the watershed.

Results: Projects reported in the year they are installed. No projects were installed in 2010.

SRWMO Cost Share Fund Summary

2005 SRWMO Contribution	+	$1,000.00
2006 SRWMO Contribution	+	$1,000.00
2006 Expense - Coon Lake, Rogers Property Project	-	$ 570.57
2007 – no expenses or contributions		$ 0.00
2008 SRWMO Contribution	+	$2,000.00
2008 Expense - Martin Lake, Moos Property Project	-	$1,091.26
2009 SRWMO Contribution	+	$2,000.00
2010 SRWMO Contribution	+	$1,840.00
Fund Balance		**$6,178.17**

Water Quality Improvement Projects

Description: Projects on either public or private property that will improve water quality, such as repairing streambank erosion, restoring native shoreline vegetation, or rain gardens. These projects are partnerships between the landowner, the Anoka Conservation District, state agencies, lake associations, or others.

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

Results: Projects are described in a separate report produced by the Anoka Conservation District.

Notable projects that are in the planning phase in the SRWMO include:

- **Rough fish barriers at Typo Lake outlet**. In 2011 funding has been secured to have an engineer design a barrier suitable to the site. Installation in 2012 is being pursued.
- **Rough fish barriers at Martin Lake**'s at two inlets and one outlet. Project timeline is paralleling the Typo Lake rough fish barrier project. An engineer is working on designs in early 2011. Installation in 2012 is being pursued.
- **Tierney stormwater retrofit.** This project will treat stormwater before it enters Coon Lake. Installation in 2011 is likely. The Coon Lake Improvement Association is providing substantial funding.
- **Martin Lake stormwater retrofits.** In early 2011 a stormwater retrofit assessment will take place to identify and prioritize stormwater retrofits for water quality on the lake's west side (see next page for more info). A grant for Minnesota Conservation Corps labor to install water quality projects has already been secured. Project types and locations are not yet determined, but most installations are likely to occur in late 2011 or 2012.

Martin Lake Stormwater Assessment

Description: This project aims to systematically treat stormwater runoff before it reaches Martin Lake, thereby reducing phosphorus and other pollutants in the lake. The west side of Martin Lake was selected for this project because of higher density housing, older development that was not built to present day stormwater treatment standards, and because of the presence of curb and gutter systems. Some areas drain to small stormwater ponds on the lakeshore, while others drain directly to the lake. Some of the existing stormwater treatment features are overwhelmed by large volumes. Sediment and trash buildup around these gutters is problematic, and virtually all of these materials are delivered into the lake during large storms.

This project will include an assessment of stormwater drainages on the west side of Martin Lake and result in stormwater retrofit solution designs. It will identify places where improvements can be made and prioritize these based upon the cost of the project and the amount of pollutant reduction it can accomplish. The end product will be a set of project designs. These projects will be installed in order of priority starting in 2011 using funding from a variety of possible sources, including the Sunrise River Watershed Management Organization, Linwood Township, the Martin Lakers Association, and the Metro Landscape Restoration Program housed at the Anoka Conservation District, State Clean Water Legacy Grants, state cost share, and contributions from property owners.

Purpose: To improve Martin Lake water quality.

Results: This project's timeline has been extended. Originally it was planned that work would occur throughout 2010, with completion and final reporting by March 31, 2011. The SRWMO Board had instructed for this project to begin only after the Martin Lakers Association committed to a contribution of $3,000 to this project. The Martin Lakers Association did not make this commitment until August 18, 2010. Because of this delay, the original project timeline cannot be achieved. The ACD and SRWMO have agreed to a new project completion date of July 31, 2011.

A grant to install projects identified by the stormwater assessment has been secured by the Anoka Conservation District. The grant allows 10 days of labor from a Minnesota Conservation Corps work crew.

Review Local Water Plans

Description: SRWMO member municipalities must update their Local Water Management Plans and ordinances within 2 years of the adoption of the new SRWMO Plan (MN Rules 8410.0130 and 84100160). All must be consistent with the SRWMO Plan. The SRWMO has approval authority over the Local Water Management Plans. Once a city submits their updated Local Water Management Plan to the WMO for review, the WMO has 60 days to provide comments. The Metropolitan Council has a simultaneous 45-day review period, and the WMO's review of the Plan must include a review of Metropolitan Council's comments. ACD assists the SRWMO by providing a technical review of Local Water Management Plans, as they are completed, and Metropolitan Council's comments on each.

ACD's assistance includes:

- Reviewing each of the four member municipalities' draft local water management plan, and any relevant ordinances, for consistency with the SRWMO Plan.
- Writing the comments in the form of a letter to the municipality and presenting it to the SRWMO Board.
- Sending the comments to the municipality when authorized by the SRWMO Board.
- Do all of the above within the 60 day comment period allowed by law.

Purpose: To ensure consistency between municipal local water plans and the SRWMO Watershed Management Plan.

Results: The following is a summary of activity on each city or township's local water plan:

Linwood Township –In the past Linwood Township has adopted the SRWMO Watershed Management Plan by reference. They are still allowed to do this, however notification should be provided to the SRWMO. To date, no such notice has been received.

Ham Lake – The most recent draft of the Ham Lake Local Water Plan was received in early 2009. It was reviewed in comparison to the *draft* SRWMO 3rd Generation Watershed Management Plan. The SRWMO approved the plan and provided a several suggested revisions. Those revisions were aimed at increasing the likelihood the plan would be consistent with the anticipated content of the *final* SRWMO 3rd Generation Plan, thereby avoiding another round of revisions. Since that time the SRWMO 3rd Generation Plan has been finalized. Ham Lake must re-submit their local water plan to the SRWMO.

East Bethel – The SRWMO received a draft local water plan in June 2010. Changes were requested, and SRWMO approval is contingent upon those changes. As of January 2011 no response has been received.

Columbus – Approved at the February 2011 SRWMO meeting.

Deadline for all – June 3, 2012 is the deadline for all SRWMO cities and townships to revise local water plans and ordinances to be consistent with the SRWMO 3rd Generation Watershed Management Plan.

SRWMO Website

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

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

Location: www.AnokaNaturalResources.com/SRWMO

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

Information about the SRWMO includes:

- a directory of board members,
- meeting minutes and agendas,
- the watershed management plan and information about- plan updates,
- descriptions of work that the organization is directing,
- highlighted projects.

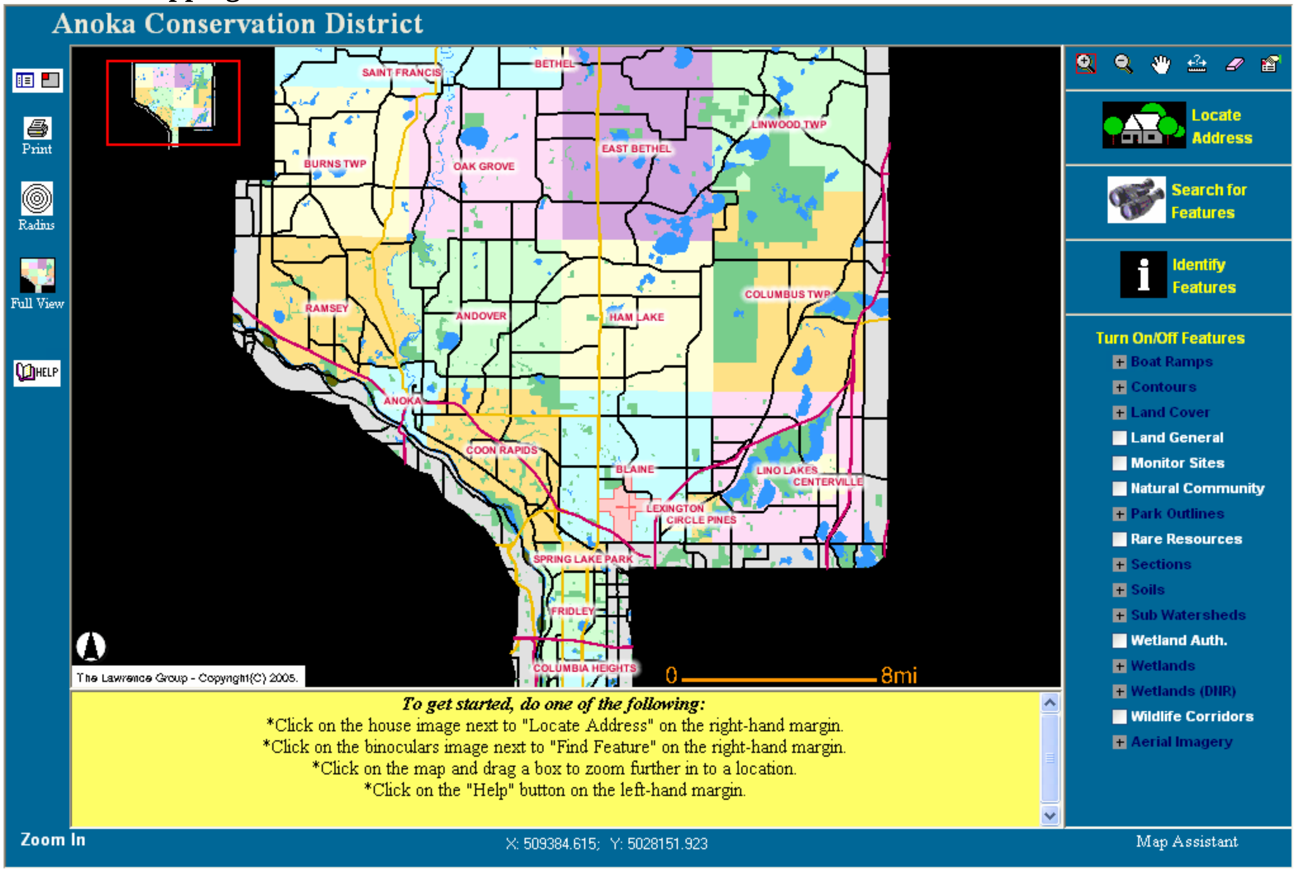
Other tools on the website include:

- 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

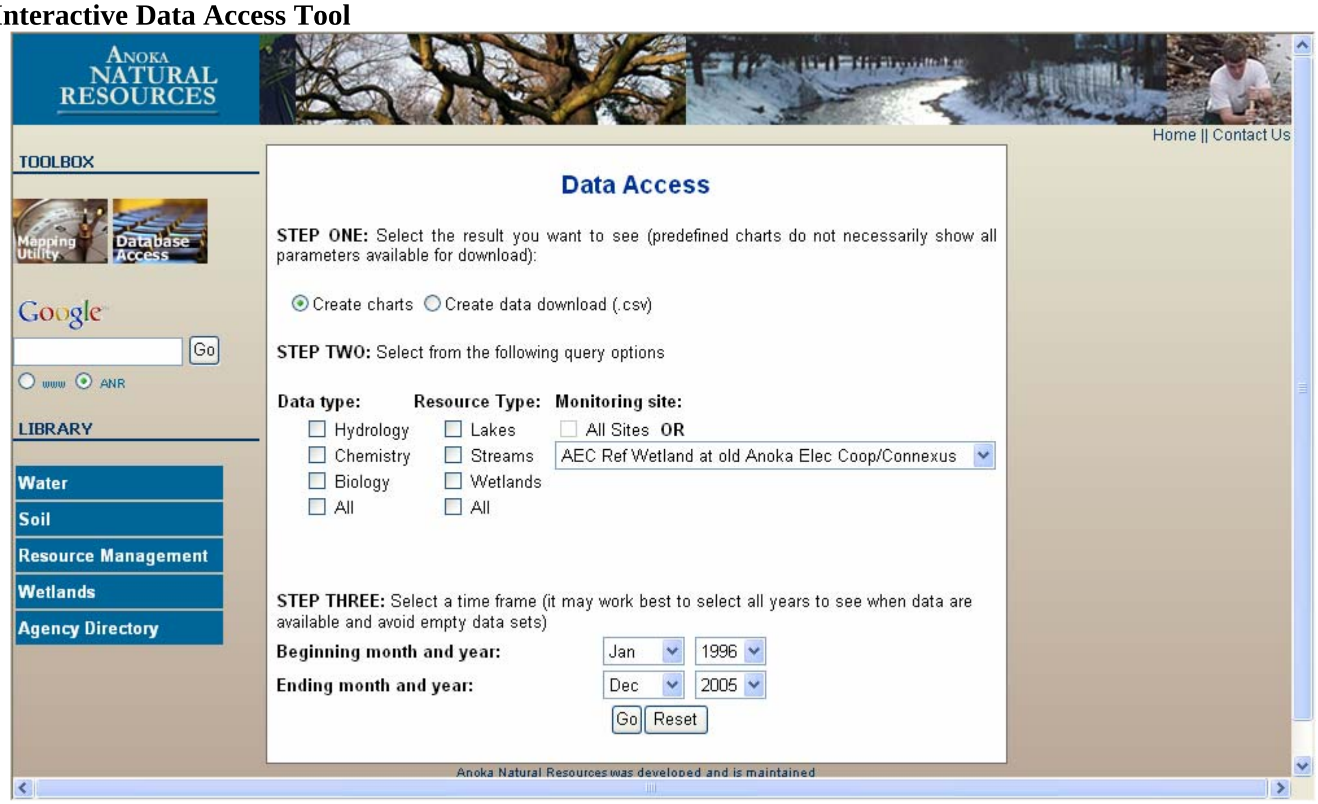
SRMWO Website Homepage

more on next page

Interactive Mapping Tool



Interactive Data Access Tool



SRWMO 2009 Annual Report to BWSR

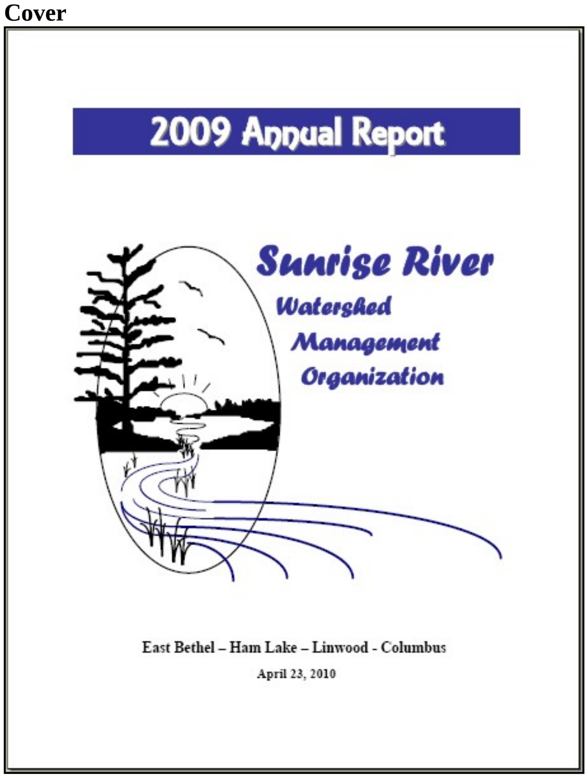
Description: The Sunrise River Watershed Management Organization (SRWMO) is required by law to submit an annual report to the Minnesota Board of Water and Soil Resources (BWSR), the state agency with oversight authorities. This report consists of an up-to-date listing of SRWMO Board members, activities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

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

Locations: Watershed-wide

Results: Anoka Conservation District (ACD) assisted the SRWMO with preparation of a 2009 Sunrise River WMO Annual Report. ACD drafted the report and a cover letter. The draft was provided to the SRWMO Board on April 13, 2010. After a 10-day period of SRWMO Board review, a final draft was delivered to the Chair on April 23, 2010 and immediately forwarded to BWSR. On April 27, 2010 a sufficient number copies of the report were sent to each member community to ensure that each city council person and town board member would receive a copy. A copy was also provided to each SRWMO Board member. The report is available to the public on the SRWMO website.

Cover



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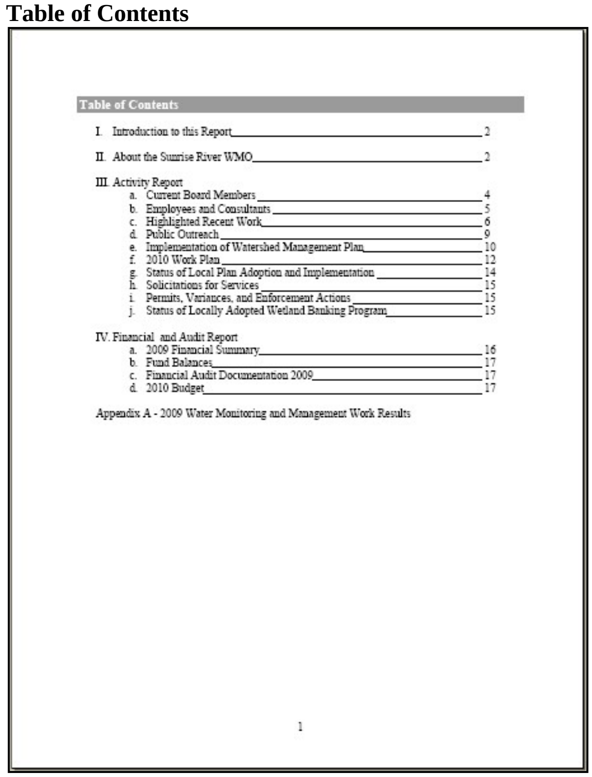

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Member Community Reporting Template

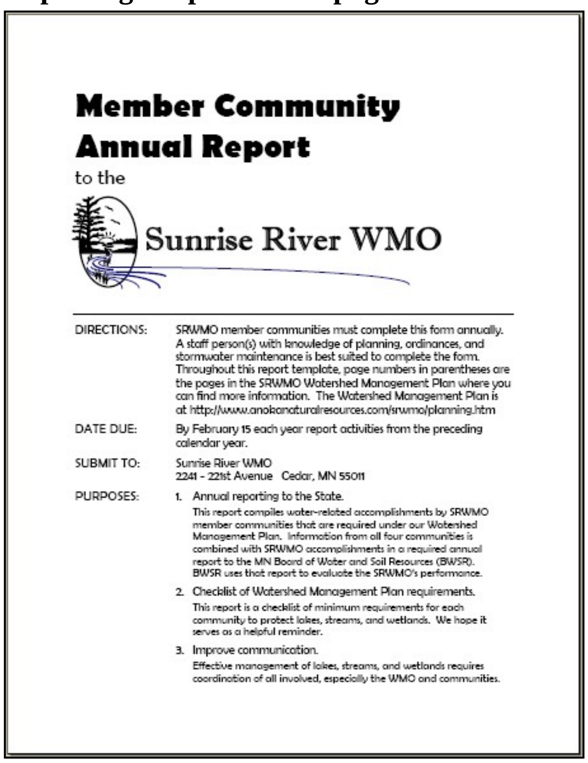
Description: The SRWMO wishes to enhance communication between the WMO and member communities. This is in-part because the SRWMO passes certain tasks in their Watershed Management Plan down to the member municipalities as a way of avoiding duplication, enhancing efficiency, and allowing the municipalities the greatest latitude to accomplish work the way they feel is best. One example is that the cities are best suited to maintain storm water infrastructure, which is important for water quality and flooding, and the WMO provides minimum requirements. Progress on this type of work must be included in the SRWMO's annual reports to the State, so the SRMWO needs to gather and update annually from the municipalities. To facilitate this communication the SRWMO has asked the ACD to create a reporting template that will allow the municipalities to quickly and easily report on work done that is required by the SRWMO Plan.

Purpose: To enhance communication between the WMO and member communities.
To allow the SRWMO to efficiently collect information from member cities that is needed in the SRWMO's annual report to the State.

Locations: Watershed-wide

Results: A member community annual reporting template was produced in October 2010. It was first forwarded to the SRWMO Board for internal review. Thereafter, a final draft was produced. It was emailed to staff at each SRWMO community with a request that it be completed by February 15 of each year.

Reporting template cover page



Member Community Annual Report

to the

Sunrise River WMO

DIRECTIONS: SRWMO member communities must complete this form annually. A staff person(s) with knowledge of planning, ordinances, and stormwater maintenance is best suited to complete the form. Throughout this report template, page numbers in parentheses are the pages in the SRWMO Watershed Management Plan where you can find more information. The Watershed Management Plan is at http://www.anokanaturalresources.com/srwmo/planning.htm

DATE DUE: By February 15 each year report activities from the preceding calendar year.

SUBMIT TO: Sunrise River WMO
2241 - 221st Avenue Cedar, MN 55011

PURPOSES:

1. Annual reporting to the State.
   This report compiles water-related accomplishments by SRWMO member communities that are required under our Watershed Management Plan. Information from all four communities is combined with SRWMO accomplishments in a required annual report to the MN Board of Water and Soil Resources (BWSR). BWSR uses that report to evaluate the SRWMO's performance.
2. Checklist of Watershed Management Plan requirements.
   This report is a checklist of minimum requirements for each community to protect lakes, streams, and wetlands. We hope it serves as a helpful reminder.
3. Improve communication.
   Effective management of lakes, streams, and wetlands requires coordination of all involved, especially the WMO and communities.

Join the St. Croix Basin Team

Description: The SRWMO wishes to join the St. Croix Basin Team. The St. Croix Basin team is a multi-agency group working cooperatively to address water quality issues in the St. Croix River and its tributaries. ACD will provide assistance to the SRWMO in joining the work group.

Purpose: To coordinate SRWMO activities and efforts with activities throughout the larger watershed.

To share knowledge about watershed management with other professionals and officials.

Locations: Watershed-wide

Results: The Anoka Conservation District made contacts with St. Croix Basin Team leaders, requesting the SRWMO Board join this cooperative group. The SRMWO Board now receives correspondence and has participated in workshops and watershed management discussions. Involvement is expected to continue.

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. We do not, however, know specifically which expenses are attributed to monitoring which sites. 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.

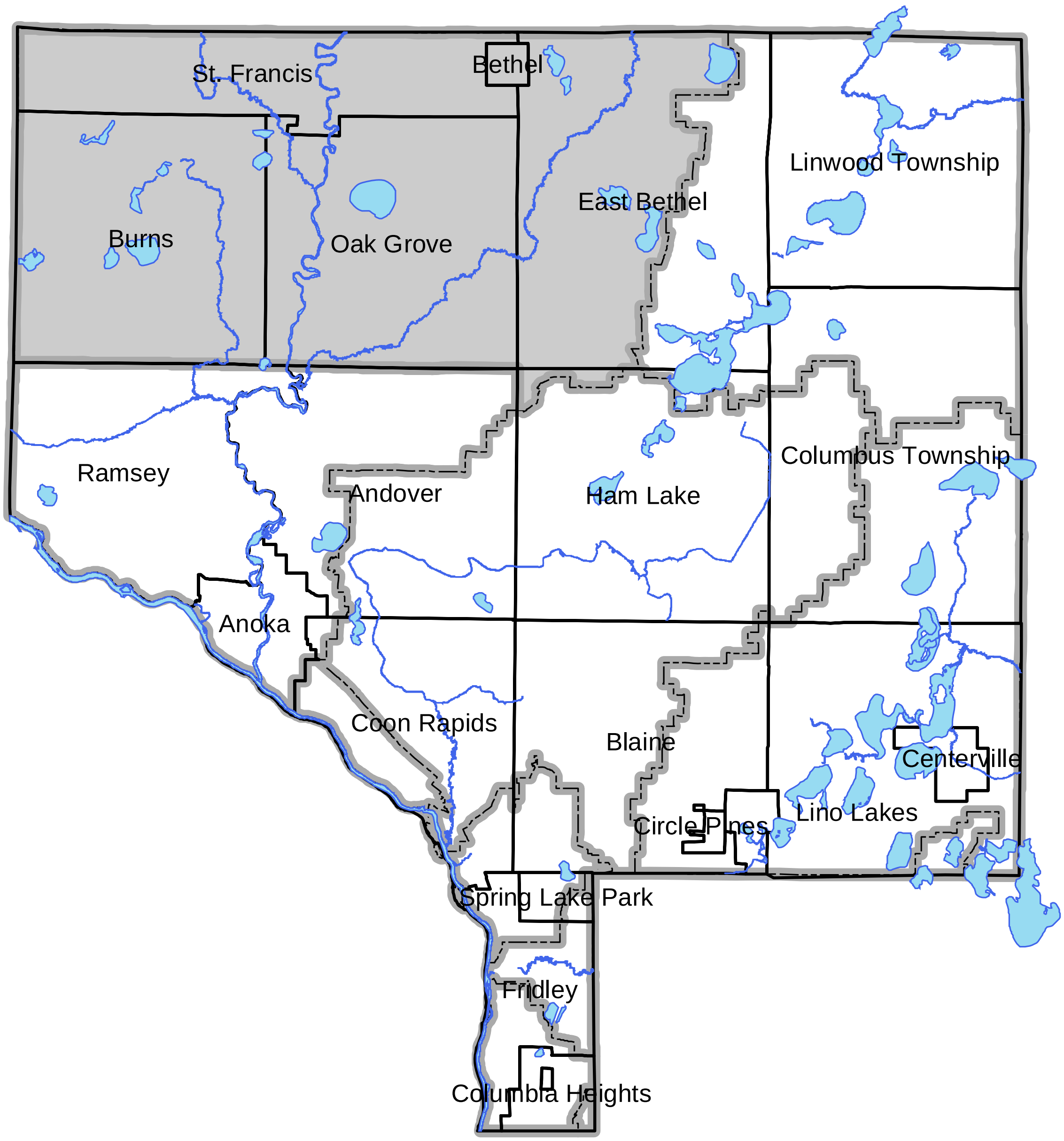
Sunrise River Watershed Financial Summary

Sunrise River Watershed	Website	Volunteer Precip	Ref Wet	Lake Lvl	Obwell	Stream Lvl	Lake WQ	WMO Annual Rpt BWSR	Geologic Atlas	LWP reviews and rpting template	Total
Revenues											
SRWMO	270	0	1605	750	0	1070	2850	675	0	2560	9780
State	0	0	0	0	220	0	0	0	0	0	220
Anoka Conservation District	1350	230	109	579	363	208	106	611	1437	307	6636
County Ag Preserves	0	0	0	0	0	0	1530	0	0	0	1530
Regional/Local	0	0	0	0	0	0	0	0	0	0	(0)
Other Service Fees	97	0	0	0	0	0	0	0	0	0	97
Local Water Planning	97	0	0	0	0	0	0	0	0	0	97
TOTAL	1813	230	1714	1329	583	1278	4486	1286	1437	2867	18359
Expenses-											
Capital Outlay/Equip	122	28	133	70	69	193	1189	12	150	29	2007
Personnel Salaries/Benefits	883	160	1259	1028	406	1381	4786	1078	954	2273	15368
Overhead	648	31	203	149	77	239	1921	80	257	290	3985
Employee Training	7	1	10	9	3	10	29	8	4	10	102
Vehicle/Mileage	13	2	19	15	6	21	77	15	15	35	236
Rent	41	8	70	55	21	73	198	44	55	178	790
Program Participants	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	1	0	20	1	0	38	292	45	1	49	447
Equipment Maintenance	1	0	1	1	0	1	72	2	1	3	84
TOTAL	1716	230	1714	1329	583	1957	8564	1286	1437	2867	23019
NET	97	0	0	0	0	-678	-4078	0	0	0	-4660

Recommendations

- **Follow the guidance of the SRWMO's 10-year watershed management plan,** which as updated in February 2010.
- **Finalize the Typo and Martin Lake Total Maximum Daily Load (TMDL) Study and Implementation Plan**. This project has been delayed at the MN Pollution Control Agency (MPCA). In early 2011 modeling is being completed by the MPCA. The SRWMO will want to review draft versions. The entire TMDL should be finalized in 2011.
- **Actively follow development of St. Croix River and Sunrise River TMDLs**, and become involved as appropriate. The St. Croix TMDL is being finalized in early 2011. The Sunrise River TMDL is beginning in late 2011.
- **Install rough fish barriers round Typo Lake and Martin Lake.** In 2010 multi-agency meetings, which include the SRWMO, determined that these projects were the highest priority for improving water quality in these lakes. Planning and design is underway.
- **Improve stormwater treatment before discharge into lakes**; notably Martin and Coon. A stormwater assessment is underway in early 2010 for Martin Lake. A similar process for identifying projects has support for Coon Lake. Installation of projects should be a high priority.
- **Accelerate efforts to secure grants.** A number of water quality improvement projects are being identified. Outside funding will be necessary for installation of most of these. These projects should be highly competitive for those grants.
- **Continue the SRWMO cost share grant program** to encourage water quality projects.
- **Communicate local water plan and ordinance update deadlines to SRWMO cities and townships.** Both must be consistent with the SRWMO Watershed Management Plan before June 3, 2012.

Upper Rum River Watershed



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

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

CHAPTER 3:
UPPER RUM RIVER WATERSHED

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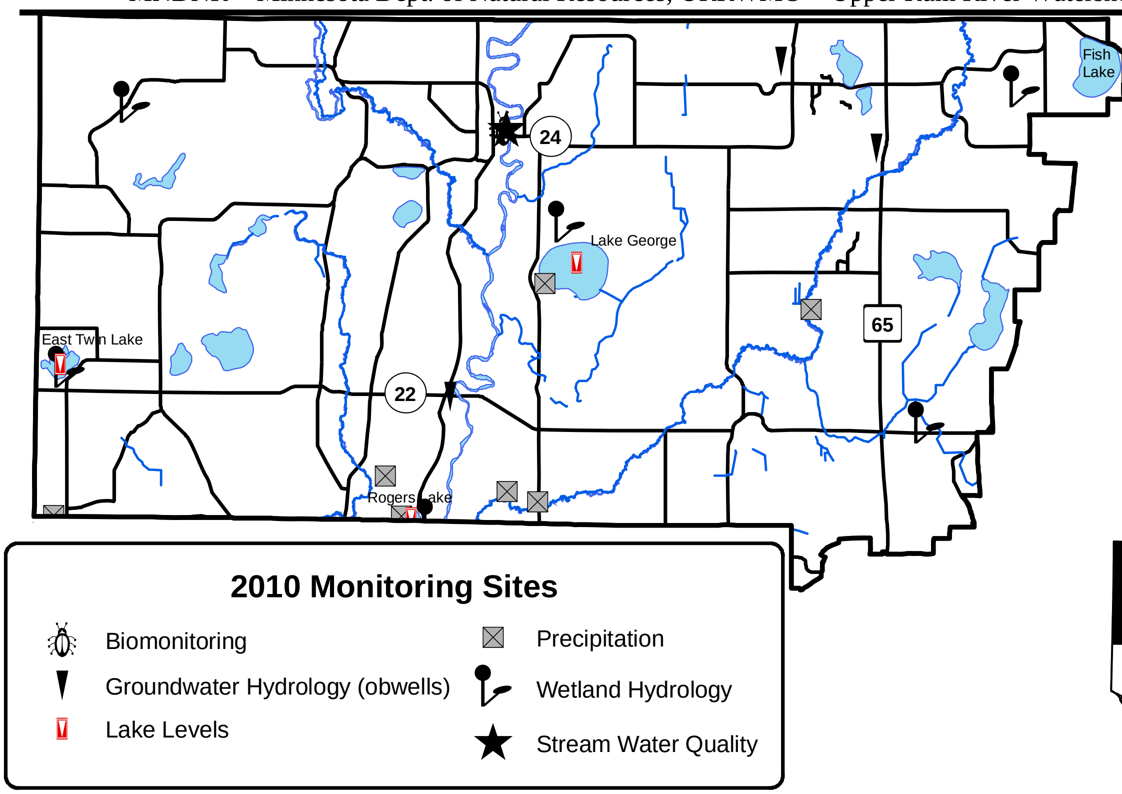
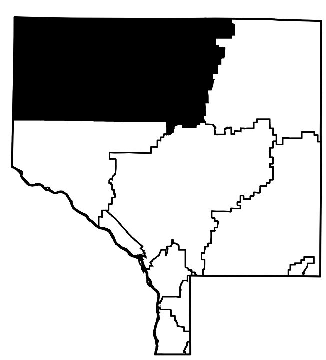
ACAP = Anoka County Ag Preserves, ACD = Anoka Conservation District,
LRRWMO = Lower Rum River Watershed Mgmt Org, MC = Metropolitan Council
MNDNR = Minnesota Dept. of Natural Resources, URRWMO = Upper Rum River Watershed Mgmt Org





Lake Levels

Description: Weekly water level monitoring in lakes. The past five years are shown below, and all historic data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

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

Locations: East Twin Lake, Lake George, Rogers Lake

Results: Water levels on Lake George, Rogers, and East Twin Lakes were measured by volunteers 37, 17, and 23 times, respectively, in 2010. Lake levels increased modestly over the previous years as a result of the above average rainfall observed during the summer of 2010.

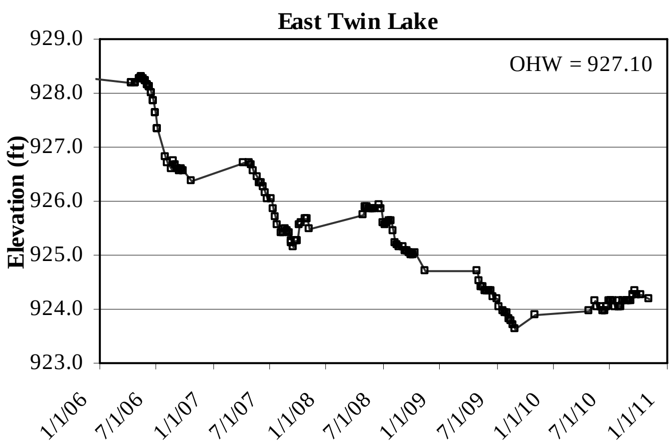
East Twin Lake has declined nearly continuously since late 2006. In 2006 water was abnormally high due to a beaver dam, which was removed. Water declines in the following years were initially due to this dam removal, but more recently reflect drought. The consistent trend of decreasing water levels was not observed in 2010. Rather, water levels remained relatively constant throughout the year.

Relative to 2009, the average lake level in Lake George increased by 0.6 feet during 2010. Lake George water levels have been relatively constant, but low, in recent years because of drought conditions. Management of the lake's only inlet, County Ditch #19, remains to be of interest - residents have complained it is clogged and needs maintenance.

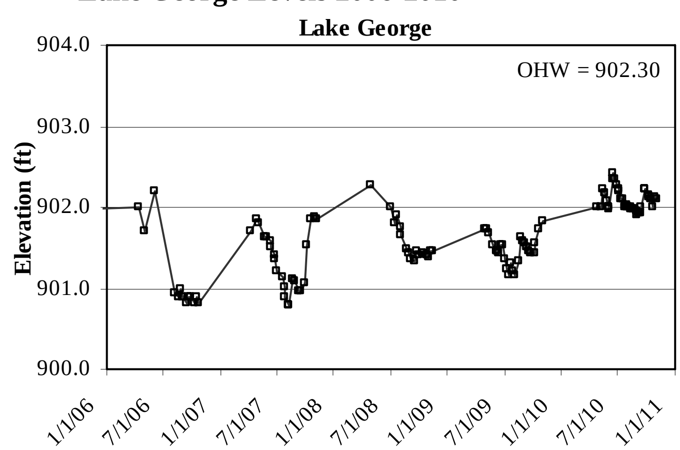
Rogers Lake declined nearly continuously between 2006 and 2009, with a total drop of over two feet. Increases late in the year of 2009 were sustained in 2010 and further increases were observed. The average lake level increased by 0.37 feet between 2009 and 2010.

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

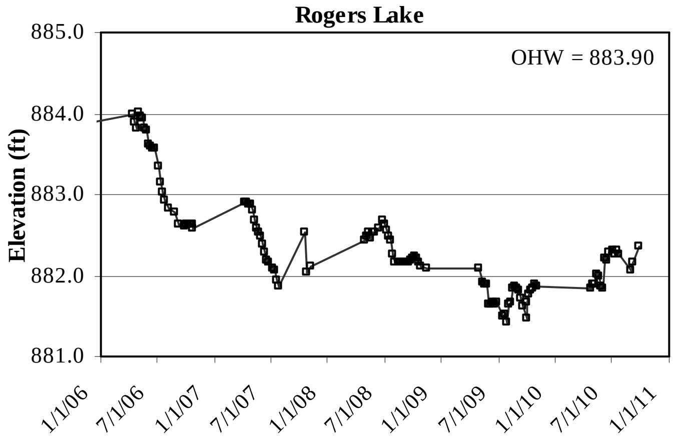
East Twin Lake Levels 2006-2010



Lake George Levels 2006-2010



Rogers Lake Levels 2006-2010



Upper Rum River Watershed Lake Levels Summary 2006-2010

Lake	Year	Average	Min	Max
East Twin	2006	927.61	926.37	928.29
	2007	925.79	925.15	926.71
	2008	925.45	924.70	925.94
	2009	924.13	923.62	924.72
	2010	924.12	923.95	924.35
George	2006	901.13	900.82	902.20
	2007	901.36	900.78	901.88
	2008	901.59	901.33	902.27
	2009	901.48	901.16	901.82
	2010	902.08	901.91	902.41
Rogers	2006	883.28	882.59	884.02
	2007	882.19	881.79	882.91
	2008	882.33	882.09	882.69
	2009	881.73	881.43	882.08
	2010	882.10	881.84	882.36

Stream Water Quality - Chemical Monitoring

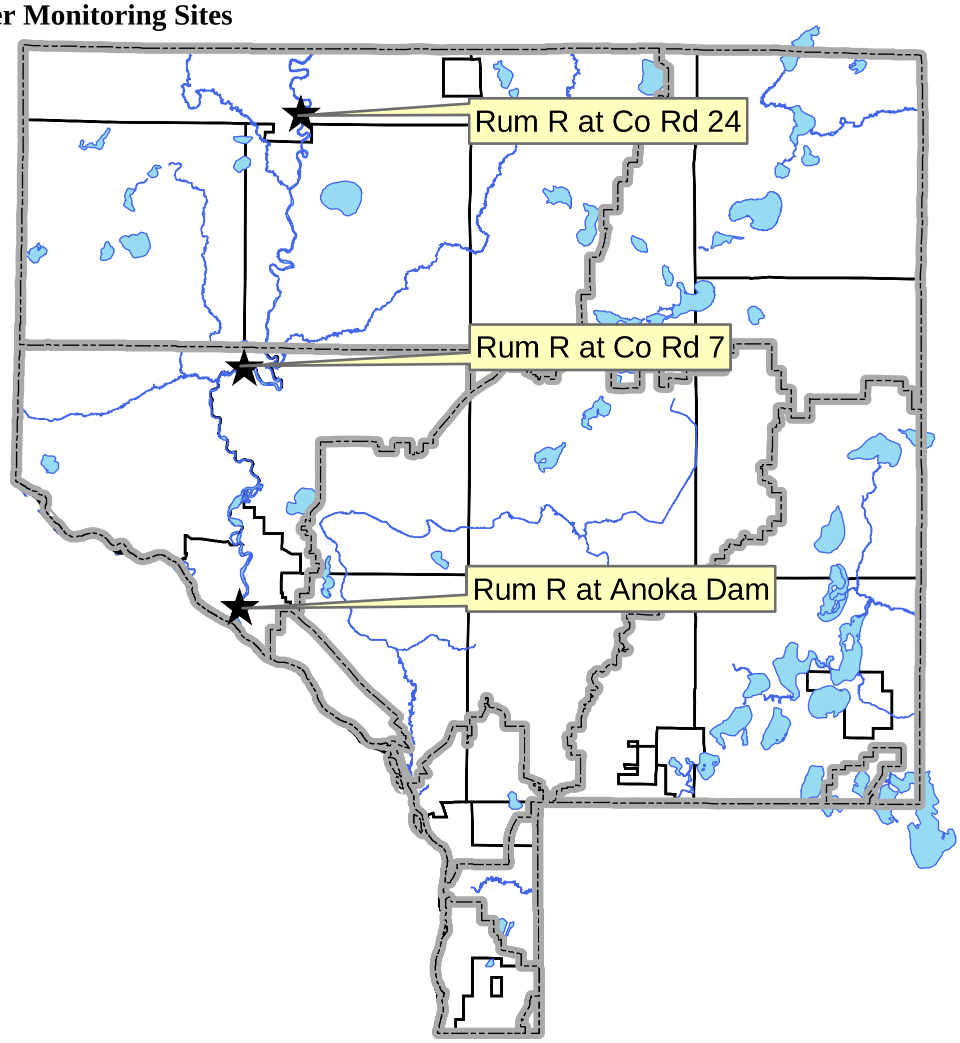
Description: The Rum River has been monitored simultaneously at three strategic locations in 2004, 2009, and 2010. The locations include the approximate top and bottom of the Upper and Lower Rum River Watershed Management Organizations. The two organizations share the middle location. The Metropolitan Council collects additional data at the farthest downstream location. Collectively, the data collected allow for an upstream to downstream water quality comparison within Anoka County, as well as within each watershed organization. While other Rum River monitoring has occurred, it is excluded from this report in order to include only data that were collected simultaneously for the greatest comparative value.

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

Locations: Rum River at Co Rd 24
Rum River at Co Rd 7
Rum River at the Anoka Dam

Results: Results are presented on the following page, with a focus on comparing river conditions from upstream to downstream. More detailed reporting for the Metropolitan Council WOMP monitoring station, including additional parameters and analysis are presented elsewhere by the Metropolitan Council (see http://www.metrocouncil.org/Environment/RiversLakes/).

2010 Rum River Monitoring Sites



RUM RIVER

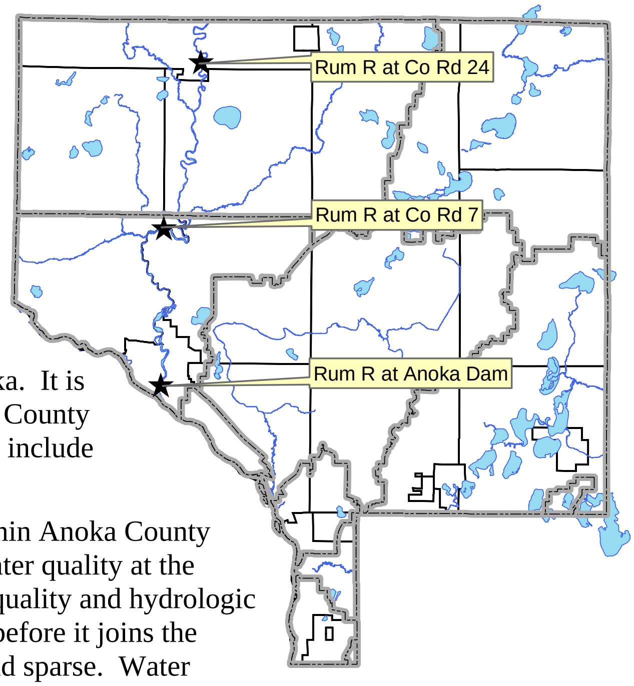
Rum River at Co. Rd. 24 (Bridge St), St. Francis	STORET SiteID =	S000-066
Rum River at Co. Rd. 7 (Roanoke St), Ramsey	STORET SiteID =	S004-026
Rum River at Anoka Dam, Anoka	STORET SiteID =	S003-183

Years Monitored

At Co. Rd. 24 – 2004, 2009, 2010

At Co. Rd. 7 – 2004, 2009, 2010

At Anoka Dam – 1996-2010 by the Met Council WOMP program



Background

The Rum River is regarded as one of Anoka County's highest quality and most valuable water resources. It is designated as a state scenic and recreational river throughout Anoka County, except south of the county fairgrounds in Anoka. It is used for boating, tubing, and fishing. Much of western Anoka County drains to the Rum River. Subwatersheds that drain to the Rum include Seelye, Trott, and Ford Brooks, and Cedar Creek.

The extent to which water quality improves or is degraded within Anoka County has been unclear. The Metropolitan Council has monitored water quality at the Rum's outlet to the Mississippi River since 1996. This water quality and hydrologic data is well suited for evaluating the river's water quality just before it joins the Mississippi River. Monitoring elsewhere has been sporadic and sparse. Water quality changes might be expected from upstream to downstream because land use changes dramatically from rural residential in the upstream areas of Anoka County to suburban in the downstream areas.

Methods

In 2004, 2009, and 2010 monitoring was conducted at three locations simultaneously to determine if Rum River water quality changes in Anoka County, and if so, generally where changes occur. The Upper and Lower Rum River Watershed Management Organizations contributed to this work and monitoring sites were strategically located near the upper and lower boundary of each organization's jurisdictional boundary. The Metropolitan Council maintains a permanent monitoring station at the Anoka Dam, the farthest downstream monitoring site. The Metropolitan Council monitoring was coordinated to occur with the watershed organization monitoring so the data and costs could be shared. The Anoka Conservation District did the field work for both Metropolitan Council and the watershed organizations, ensured monitoring for both programs was conducted simultaneously so the data and costs could be shared, and reports the data together for a more comprehensive analysis of the river from upstream to downstream.

The river was monitored during both storm and baseflow conditions by grab samples. Eight water quality samples were taken each year; half during baseflow and half following storms. Storms were generally defined as one-inch or more of rainfall in 24 hours or a significant snowmelt event combined with rainfall. In some years, particularly the drought year of 2009, smaller storms were sampled because of a lack of larger storms. All storms sampled were significant runoff events. Parameters tested with portable meters included pH, conductivity, turbidity, temperature, salinity, and dissolved oxygen. Parameters tested by water samples sent to a state-certified lab included total phosphorus, total suspended solids, and chlorides. Ten additional parameters were tested by the Metropolitan Council at their laboratory for the Anoka Dam site only and are not reported here. During every sampling the water level (stage) was recorded. The monitoring station at the Anoka Dam includes automated equipment that continuously tracks water levels and calculates flows. Water level and flow data for other sites was obtained from the US Geological Survey, who maintains a hydrological monitoring site at Viking Boulevard.

The purpose of this report is to make an upstream to downstream comparison of Rum River water quality. It includes only parameters and dates that were simultaneously tested at all three sites. It does not include additional parameters tested at the Anoka Dam or additional monitoring events at that site. For that information, see Metropolitan Council reports at http://www.metrocouncil.org/Environment/RiversLakes. All other raw data can be obtained from the Anoka Conservation District and is also available through the Minnesota Pollution Control Agency's EQuIS database, which is available through their website.

Results and Discussion

Overall, Rum River water quality is good throughout Anoka County, however it does decline slightly below the County Road 7 bridge (i.e. in the Cities of Andover, Anoka, and Ramsey) and during storms. The declines in water quality below that point are modest, as are declines in water quality during storms. Dissolved pollutants (as measured by conductivity and chlorides), total phosphorus, turbidity, and total suspended solids were all generally near or below the median of all 34 Anoka County streams that have been monitored, while pH and dissolved oxygen levels were appropriate.

Two areas of concern were noted. First, dissolved pollutants increased at each monitoring site downstream. Dissolved pollutants were highest during baseflow, indicating pollutants have infiltrated into the groundwater which feeds the river and tributaries during baseflow. Road deicing salts are likely the most significant dissolved pollutant. Secondly, total suspended solids increased notably below County Road 7. This was most pronounced during storms.

It is important to recognize the limitations of this report. The data is only from 2004, 2009, and 2010 when all three sites were monitored simultaneously to allow comparisons. It includes drought years (2009), years with slightly above normal precipitation (2010), and years with some excessively wet and some excessively dry months (2004). We did not sample any extreme floods when river water quality is likely worst. If a more detailed analysis of river water quality is desired, data from many years and a variety of conditions is available for the Anoka Dam site through the Metropolitan Council. Their work includes composite samples throughout storms.

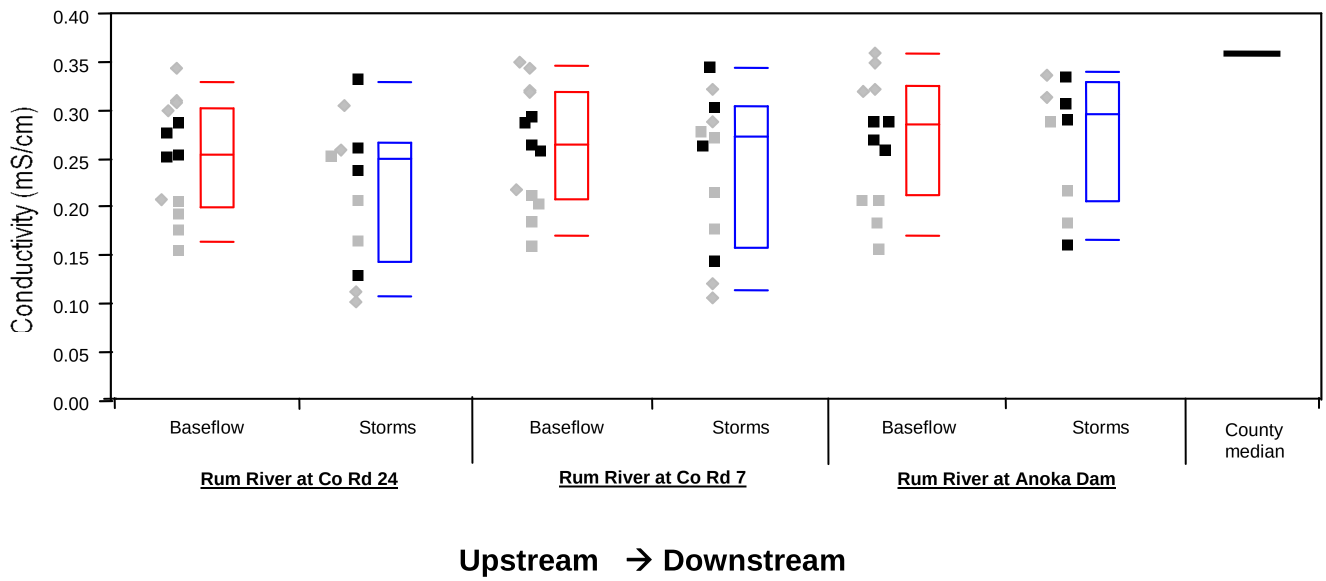
On the following pages data are presented and discussed for each parameter. The last section outlines management recommendations. The Rum River is an exceptional waterbody, and its protection and improvement should be a high priority.

Conductivity and chlorides

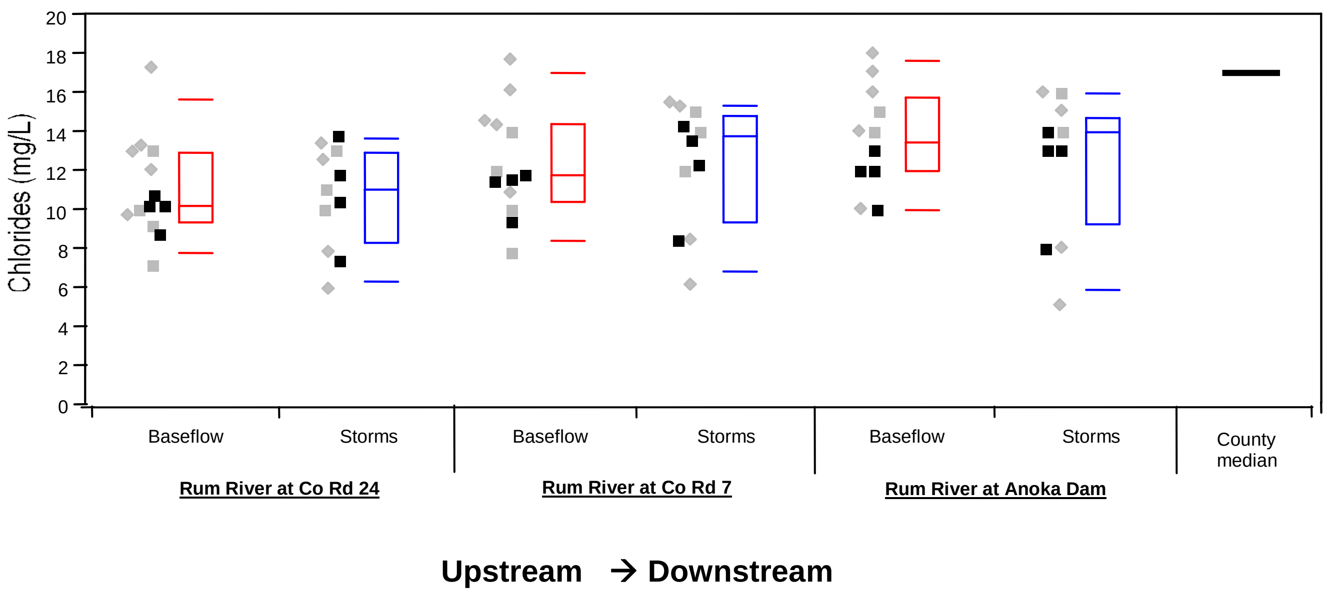
Conductivity and chlorides are measures of dissolved pollutants. Dissolved pollutant sources include urban road runoff, industrial chemicals, and others. Metals, hydrocarbons, road salts, and others are often of concern in a suburban environment. Conductivity is the broadest measure of dissolved pollutants we used. It measures electrical conductivity of the water; pure water with no dissolved constituents has zero conductivity. Chlorides tests for chloride salts, the most common of which are road de-icing chemicals. Chlorides can also be present in other pollutant types, such as wastewater. These pollutants are of greatest concern because of the effect they can have on the stream's biological community. They can also be of concern because the Rum River is upstream from the Twin Cities drinking water intakes on the Mississippi River.

Conductivity is acceptably low in the Rum River, but increases downstream (see figure below) and during baseflow. Median conductivity from upstream to downstream was 0.256 mS/cm, 0.272 mS/cm, and 0.296 mS/cm, respectively. This is lower than the median for 34 Anoka County streams of 0.362 mS/cm. The maximum observed conductivity in the Rum River was 0.365 mS/cm. Conductivity was lowest at all sites during storms, suggesting that stormwater runoff contains fewer dissolved pollutants than the surficial water table that feeds the river during baseflow. High baseflow conductivity has been observed in most other nearby streams too, studied extensively, and the largest cause has been found to be road salts that have infiltrated into the shallow aquifer. Geologic materials also contribute, but to a lesser degree. Baseflow conductivity increases from upstream to downstream, reflecting greater road densities and deicing salt application. Storm conductivity, while lower than baseflow, did also increase from upstream to downstream. This is reflective of greater stormwater runoff and pollutants associated with the more densely developed lower watershed.

Conductivity during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Chloride during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



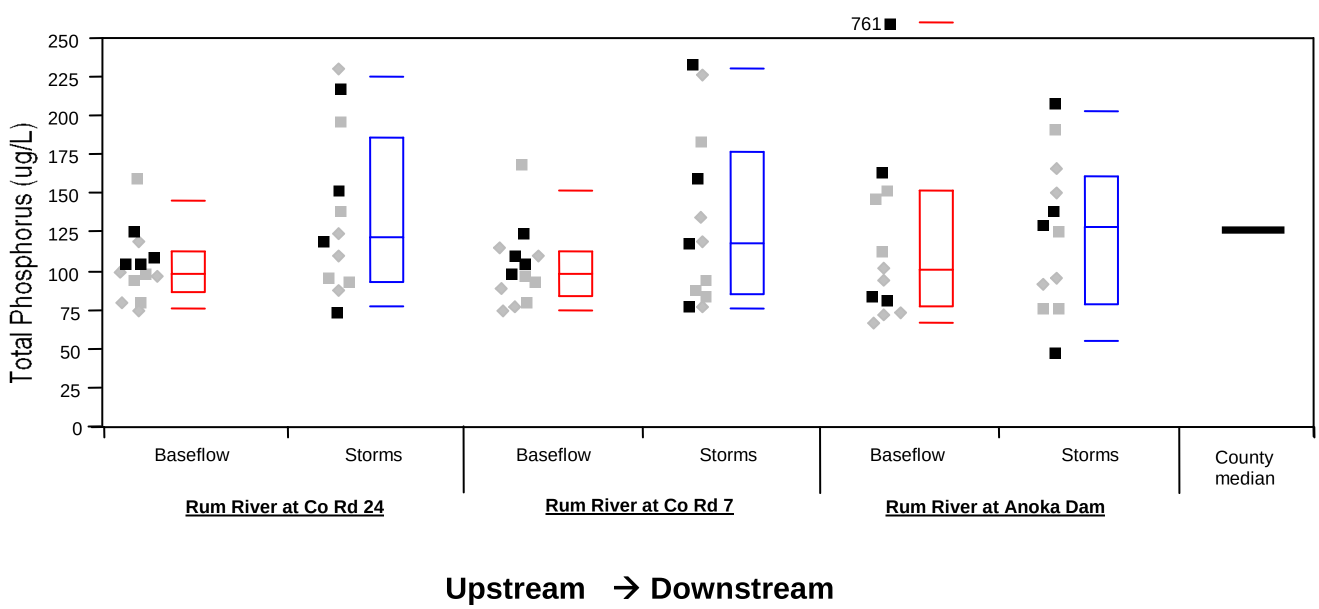
Chloride results parallel those found for conductivity (see figure above), supporting the hypothesis that chloride is an important cause of the conductivity. Chloride levels in the Rum River (median 11, 12, and 14 mg/L from upstream to downstream) are similar to the median for Anoka County streams of 12 mg/L. The highest observed value was 18 mg/L, though higher levels may have occurred during snowmelts which were not monitored. The levels observed are much lower than the Minnesota Pollution Control Agency's (MPCA) chronic standard for aquatic life of 230 mg/L. Like conductivity, chlorides were slightly higher during baseflow than storms at each site and increased from upstream to downstream. Road deicing salt infiltration into the shallow groundwater is likely the primary contributor, as described above.

Total Phosphorus

Total phosphorus in the Rum River is acceptably low and is similar to the median for all other monitored 34 Anoka County streams (see figure below). 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. The median phosphorus concentration at each of the three monitored sites was 106, 105, and 113 ug/L. These upstream-to-downstream differences are negligible and there is no trend of increasing phosphorus downstream. All sites occasionally experience phosphorus concentrations higher than the median for Anoka County streams of 128 ug/L. All of the highest observed total phosphorus readings were during storms, including the maximums at each site of 230, 234, and 761 ug/L (upstream to downstream). In all, phosphorus in the Rum River is at acceptable levels but should continue to be an area of pollution control effort as the area urbanizes.

One 2010 total phosphorus reading was excessively high, but we feel this outlier is likely an error. On September 22 a reading of 761 ug/L was recorded at the Anoka Dam. This was recorded as a baseflow sample because no recent rains had occurred, but was during a period of extended high water. River stage was approximately 0.5 feet higher than during the other baseflow samples. During this event dissolved phosphorus was analyzed in addition to total phosphorus. Dissolved phosphorus was only 13% of total phosphorus. Therefore most of the total phosphorus must be particulate phosphorus. Yet, inconsistently, there were few particulates in the water; total suspended solids was only 6 mg/L. Likewise, nothing in the field notes suggest unusually high turbidity. If this reading of 761 ug/L total phosphorus is excluded, as it probably should be, the next highest observed TP at this site is 209 ug/L.

Total phosphorus during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Turbidity and Total Suspended Solids (TSS)

Turbidity and total suspended solids (TSS) are two different measurements of solid material suspended in the water. Turbidity is measured by refraction of a light beam passed through a water sample. It is most sensitive to large particles. Total suspended solids is measured by filtering solids from a water sample and weighing the filtered material. The amount of suspended material is important because it affects transparency and aquatic life, and because many other pollutants are attached to particles. Many stormwater treatment practices such as street sweeping, sumps, and stormwater settling ponds target sediment and attached pollutants. Suspended solids in the Rum River are moderately high, but only at the Anoka Dam and during storms. The results for turbidity and TSS differ, lending insight into the types of particles that are problematic.

It is important to note the suspended solids can come from sources in and out of the river. Sources on land include soil erosion, road sanding, and others. Riverbank erosion and movement of the river bottom also contributes to suspended solids. A moderate amount of this “bed load” is natural and expected.

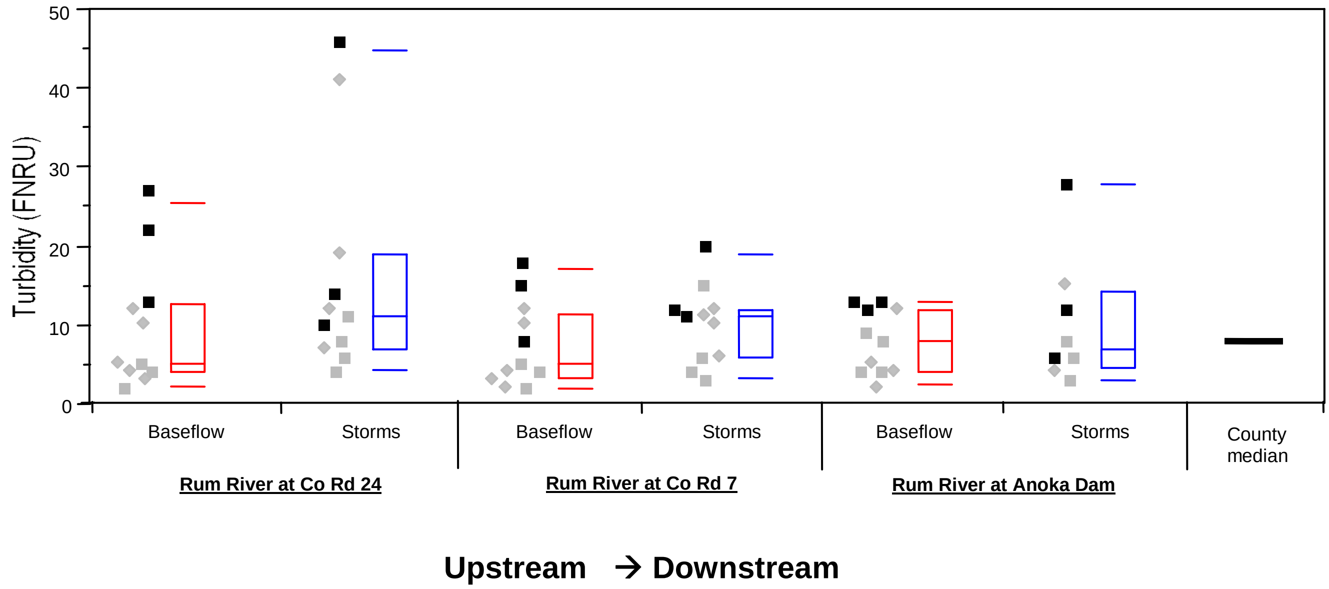
In the Rum River, turbidity was low with only slight increases during storms and no apparent increase at downstream monitoring sites (see figure below). The median turbidity at each site was 10, 8, and 8 FNRU (upstream to downstream), which is similar to the median for Anoka County streams of 8 FNRU. Turbidity was elevated on a few occasions, especially during storms. The maximum observed was 46 FNRU. The Rum River’s turbidity exceeded the Minnesota Pollution Control Agency’s water quality standard of 25 NTU during only four of 65 events (6%).

TSS was similar at the two upstream sites, but higher at the Anoka Dam (see figure below). The countywide TSS median for streams is 12 mg/L. The median at the Rum River sites from upstream to down stream was 8, 9, and 15 mg/L. At all the sites the median during storms was higher than baseflow. At the upstream site the difference between median TSS during storms and baseflow was 2 mg/L, while at County Road 7 it was 4 mg/L and at the Anoka Dam 8 mg/L. TSS during storms was much more variable due to variability in storms sampled. The maximum readings and moderate increases during storms are not unexpectedly high for a large river, and are within the range that should be considered healthy. At the same time, the increase in TSS between County Road 7 and the Anoka Dam is concerning. While it is concerning to have noticeable water quality deterioration in such a short stretch of river, it is not unexpected given the higher levels of land development between these two sites. No sites approached the Minnesota Pollution Control Agency’s surrogate turbidity standard of 100 mg/L TSS.

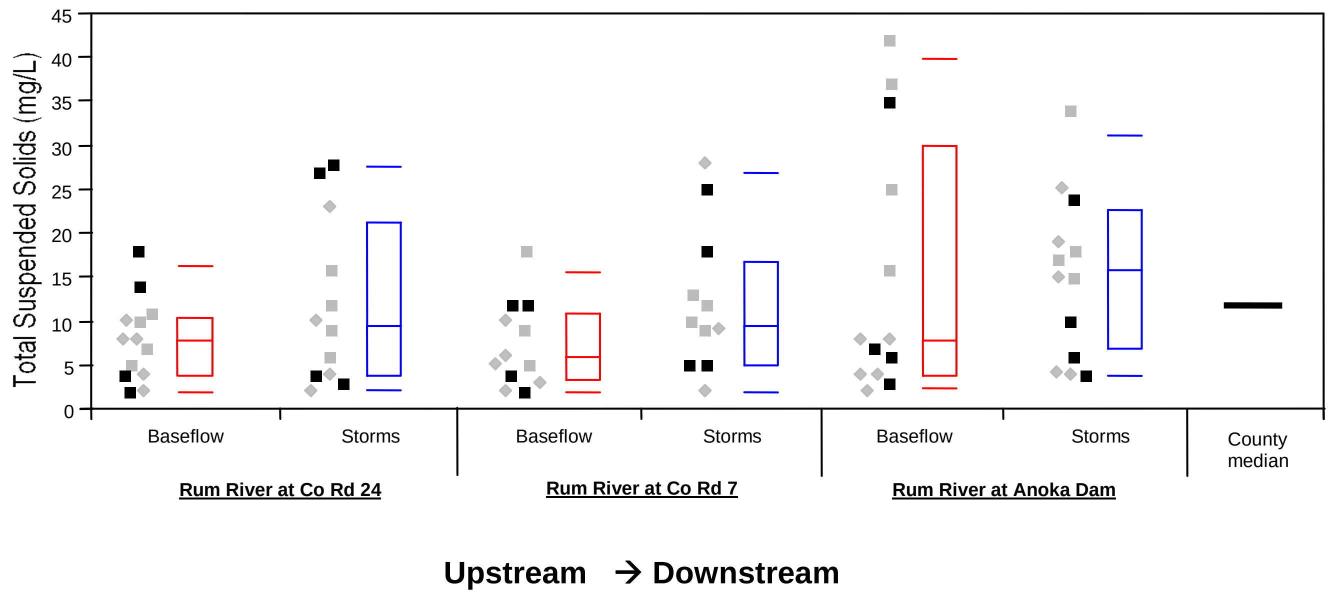
Differences between TSS and turbidity lend insight into the nature of any problems. TSS showed increases at the downstream monitoring site, while turbidity did not. Turbidity is most sensitive to large particles. Therefore, the downstream increases are likely due to smaller particles. Other pollutants, such as phosphorus and metals, are most highly correlated with smaller particles. These other pollutants can “hitch a ride” on smaller particles because of their greater surface area and, in the case of certain soils, ionic charge. Furthermore, small particles stay suspended in the water column and therefore are more likely to be transported by stream flows and are more difficult to remove with stormwater practices like settling ponds.

It should be noted that the data presented here do not include monitoring of any large flood events. The water is known to become muddier during such floods.

Turbidity during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



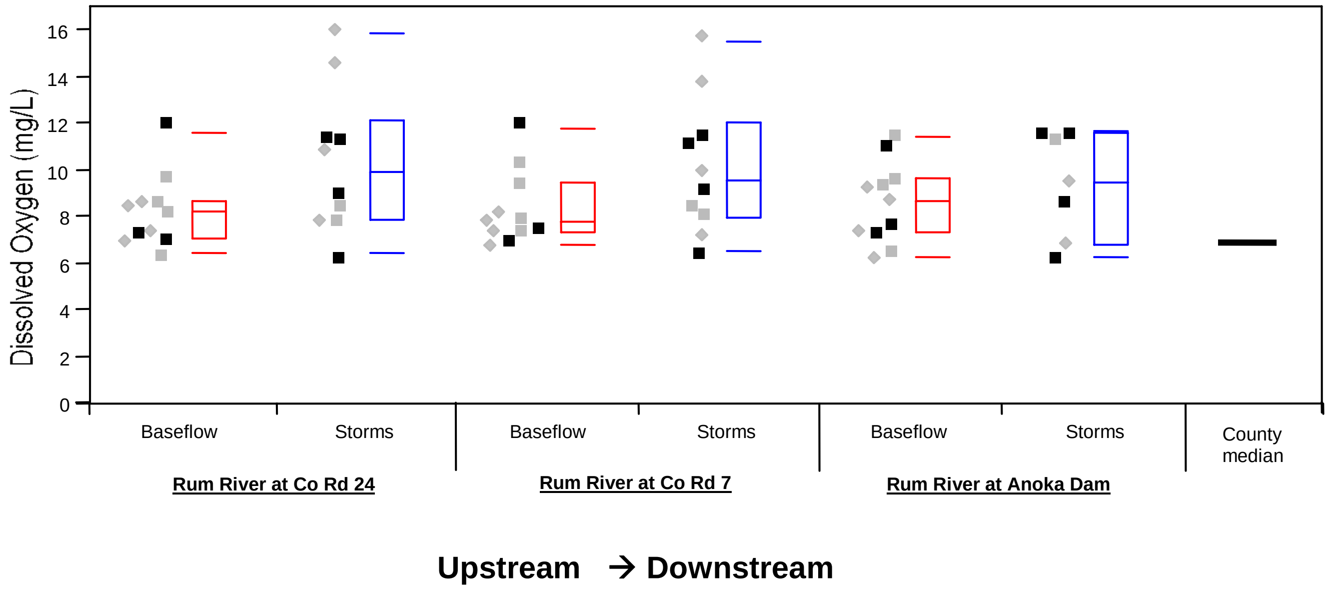
Total suspended solids during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Dissolved Oxygen

Dissolved oxygen is necessary for aquatic life, including fish. Organic pollution consumes oxygen when it decomposes. If oxygen levels fall below 4 mg/L aquatic life begins to suffer. In the Rum River dissolved oxygen was always above 6 mg/L at all monitoring sites.

Dissolved oxygen results during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

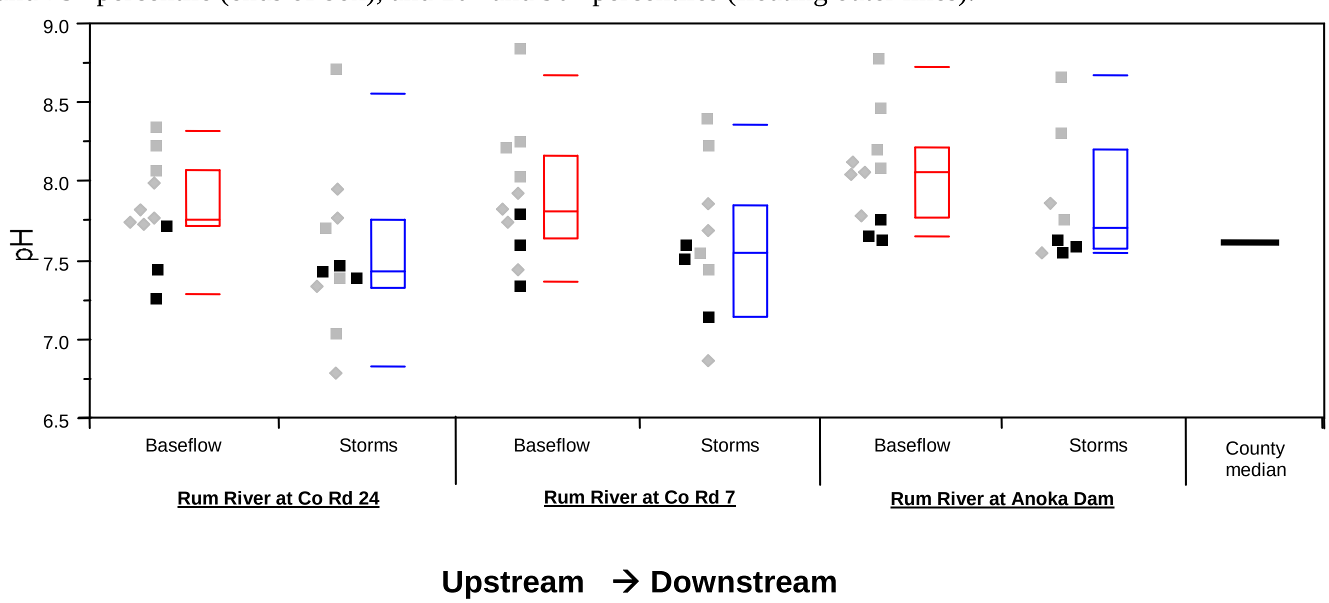


pH

pH refers to the acidity of the water. The Minnesota Pollution Control Agency's water quality standard is for pH to be between 6.5 and 8.5. The Rum River is regularly within this range (see figure below). Each of the three sites exceeded 8.5 on one occasion, but the highest was only 8.85. This rare and modest exceedance of the state water quality standard is not concerning.

It is interesting to note that pH is lower during storms than during baseflow. This is because the pH of rain is typically lower (more acidic). While acid rain is a longstanding problem, it's affect on this aquatic system is small.

pH results during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Recommendations

While the Rum River's water quality is generally good, it does show some deterioration in the downstream areas that are most developed. Protection of the Rum River should be a high priority for local officials. Large population increases are expected for the Rum River's watershed within Anoka County and have the potential to degrade water quality unless carefully sited and managed. Development pressure is likely to be especially high near the river because of its scenic and natural qualities. Measures to maintain the Rum River's good water quality should include:

- Enforce the building and clear-cutting setbacks from the river required by state scenic rivers laws to avoid bank erosion problems and protect the river's scenic nature.
- Use the best available technologies to reduce pollutants delivered to the river and its tributaries through the storm sewer system. Any new development should consider low impact development strategies that minimize stormwater runoff production. Aggressive stormwater treatment should be pursued in all areas of the watershed, not just those adjacent to the river. The area's soils are well suited to stormwater treatment by infiltration.
- Seek improvements to the existing stormwater conveyance system below County Road 7. Total suspended solids in the river increase significantly in this portion of the watershed, reaching their highest concentrations during storms.
- Utilize all practical means to reduce road deicing salt applications. These may include more efficient application methods, application only in priority areas, alternate chemicals, or others. Road salt infiltration into the shallow groundwater has become a regional problem. Deicing salts are apparent year-round in the groundwater that feeds area streams.
- Survey the river by boat for bank erosion problems and initiate projects to correct them.
- Continue education programs to inform residents of the direct impact their actions have on the river's health.
- Continue regular water quality monitoring. 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. 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 do this watershed-level monitoring and should coordinate.

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.

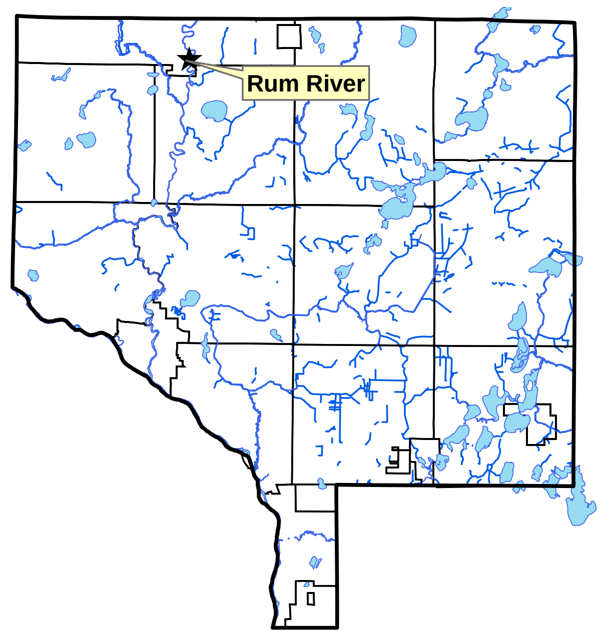
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

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 2010

Monitored Since

2000

Student Involvement

90 students in 2010, approximately 1,070 since 2000

Background

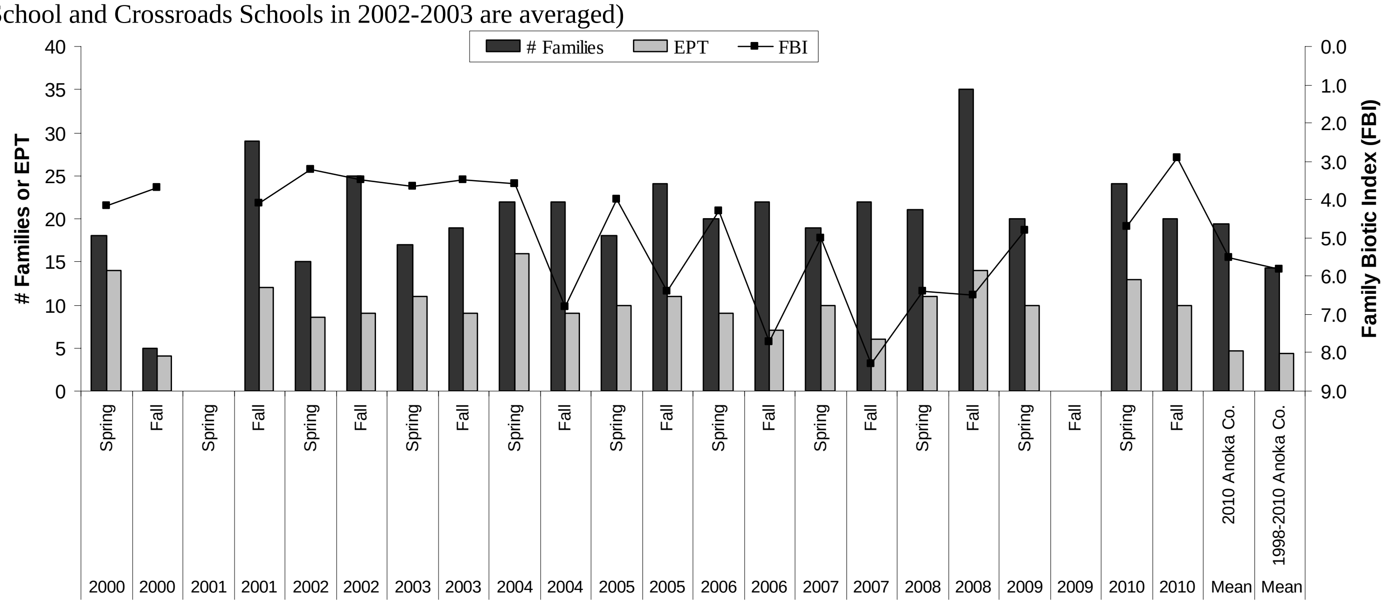
The Rum River originates from Lake Mille Lacs, and flows south through western Anoka County where it joins the Mississippi River in the City of Anoka. Other than the Mississippi, this is the largest river in the county. In Anoka County the river has both rocky ripples as well as pools and runs with sandy bottoms. The river's condition is generally regarded as excellent. Portions of the Rum in Anoka County have a state "scenic and recreational river" 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 spring 2010, with Anoka Conservation District (ACD) oversight. During the fall of 2010, ACD staff monitored the site because students were unable to sample due to a combination of high water conditions and class schedules. Biological data for 2010, and historically, indicate the Rum River in northern Anoka County has the best conditions of all streams and rivers monitored throughout Anoka County. In 2010 the number of families, number of EPT families, and Family Biotic Index (FBI) were substantially above the county averages. Twenty four families were found in spring 2010 and 35 in fall 2008.

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

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2006	2006	2007	2007	2008	2008	2009	2009	2010	2010	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	2010 Anoka Co.	1998-2010 Anoka Co.
FBI	4.30	7.70	5.00	8.30	6.40	6.50	4.80	Unusable	4.7	2.9	5.5	5.8
# Families	20	22	19	22	21	35	20	Sample	24	20	19.4	14.3
EPT	9	7	10	6	11	14	10		13	10	4.7	4.3
Date	25-May	2-Oct	16-May	11-Oct	27-May	30-Sep	29-Apr	13-Oct	27-Apr	29-Oct		
Sampled By	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	ACD		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	152	187	262	502	348	156	267		142	274		
# Replicates	2	2	2	2	2	4	2		3	1		
Dominant Family	Hydropsychidae	Corixidae	Hydropsychidae	Corixidae	Corixidae	Corixidae	Corixidae		Nemouridae	Leptophlebiidae		
% Dominant Family	35.3	66.3	42.7	58.8	57.5	61.4	24.3		28.1	39.4		
% Ephemeroptera	20.8	9.9	17.2	2	11.9	17.9	18.7		23.9	51.1		
% Trichoptera	35.3	4.8	44.3	1.0	5.9	6.9	20.2		10.8	6.2		
% Plecoptera	22.4	1.6	8.0	0.2	17.1	2.1	27.7		32.8	26.6		

Supplemental Stream Chemistry Readings

Data presented from the most recent five years. Contact the ACD to request archived data.

Parameter	5/25/2006	10/2/2006	5/16/2007	10/11/2007	5/27/2008	9/30/2008	4/29/2009	10/13/2009	4/27/2010	10/29/2010
pH	7.7	7.94	8.53	7.76	7.73	7.7	7.62	7.87	na	7.51
Conductivity (mS/cm)	0.265	0.351	0.278	0.242	0.284	0.341	0.266	0.291	0.324	0.249
Turbidity (NTU)	14	6	11	17	7	4	6	na	2	362
Dissolved Oxygen (mg/L)	8	10.87	10.34	9.66	10.18	7.83	10.53	12.22	9.14	na
Salinity (%)	0.01	0.01	0.01	0	0.01	0.01	0.01	0.01	0.01	0
Temperature (°C)	18.3	14.7	16.8	12.3	15.3	13.4	12.2	5.2	12	7.2

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. Water chemistry monitoring done at various locations on the Rum River throughout Anoka County found that water quality is also good. Both habitat and water quality decline, but are still good, in the downstream reaches of the Rum River where development is more intense and the Anoka Dam creates a slow moving pool.

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.
- Use the best available technologies to reduce pollutants delivered to the river and its tributaries through the storm sewer system. This should include all of the watershed, not just those adjacent to the river.
- Education programs to encourage actions by residents that will benefit the river's health.
- Continue water quality monitoring programs.

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 Tech Systems property, St. Francis

Cedar Creek, Cedar Creek Natural History Area, East Bethel

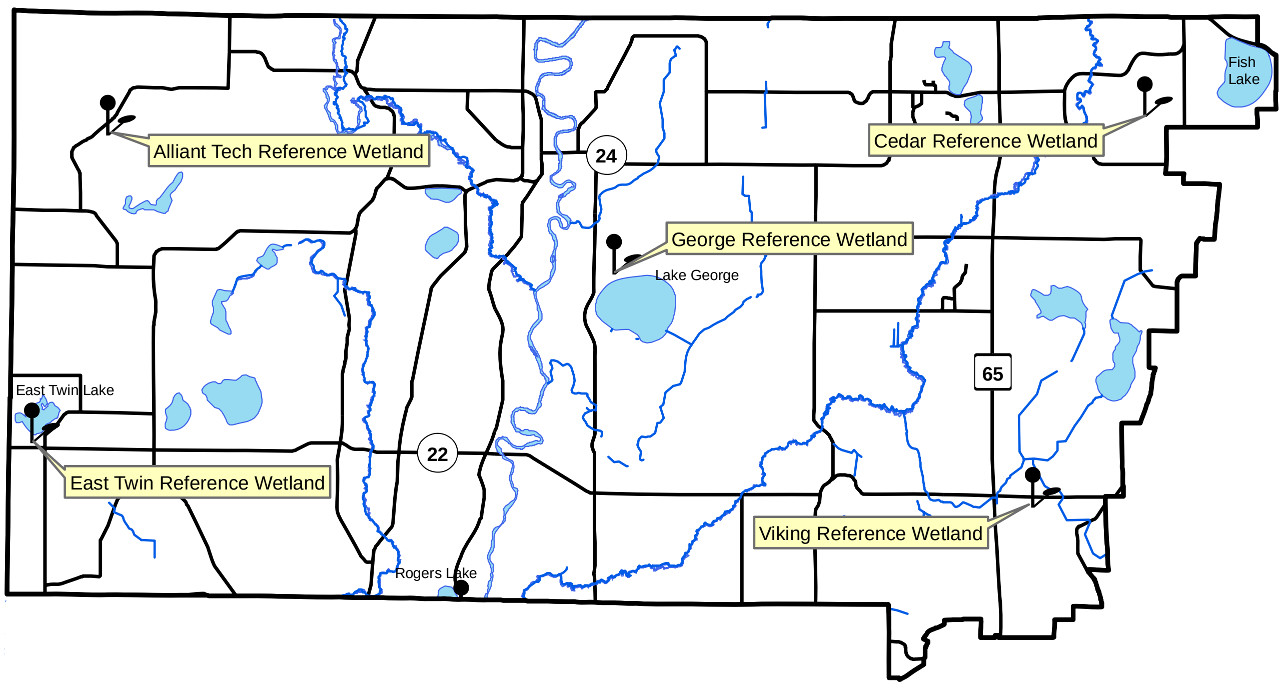
East Twin Reference Wetland, East Twin Township Park, Nowthen

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

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

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

Upper Rum River Watershed Wetland Hydrology Monitoring Sites



ALLIANT TECH REFERENCE WETLAND

Alliant Techsystems Property, St. Francis

Site Information

Monitored Since: 2001

Wetland Type: 5

Wetland Size: ~12 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

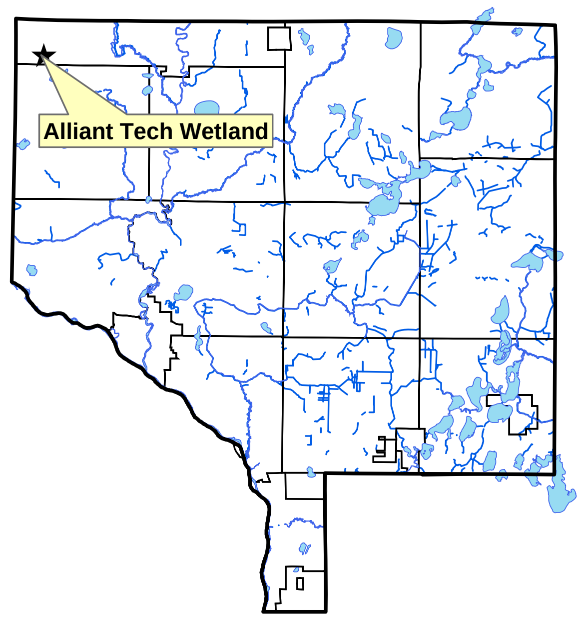
Horizon	Depth	Color	Texture	Redox
A	0-8	N2/0	Mucky loam	-
Bg	8-35	5y5/1	Sandy loam	-

Surrounding Soils: Emmert

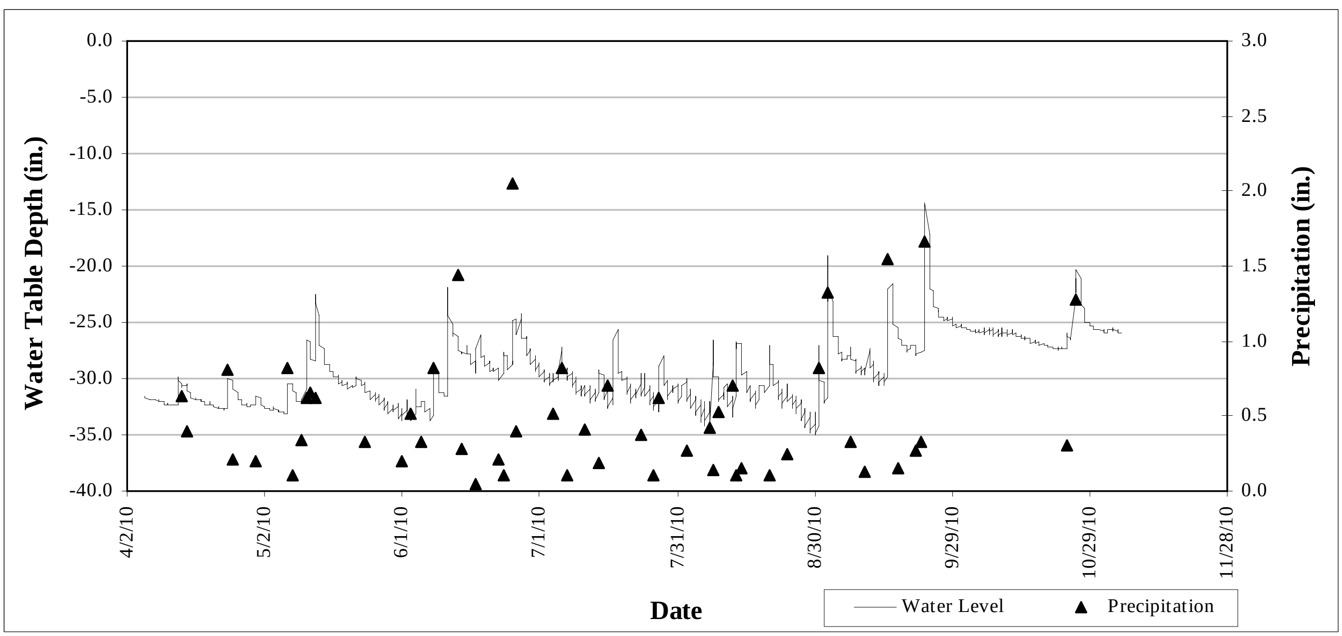
Vegetation at Well Location:

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

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



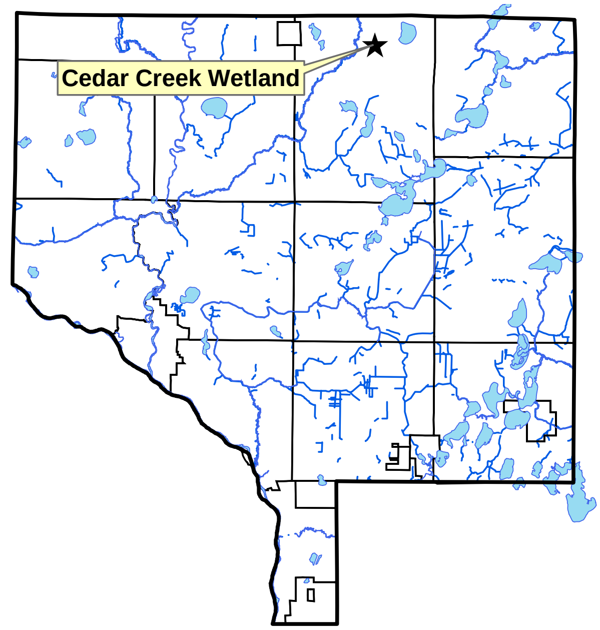
2010 Hydrograph



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.

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

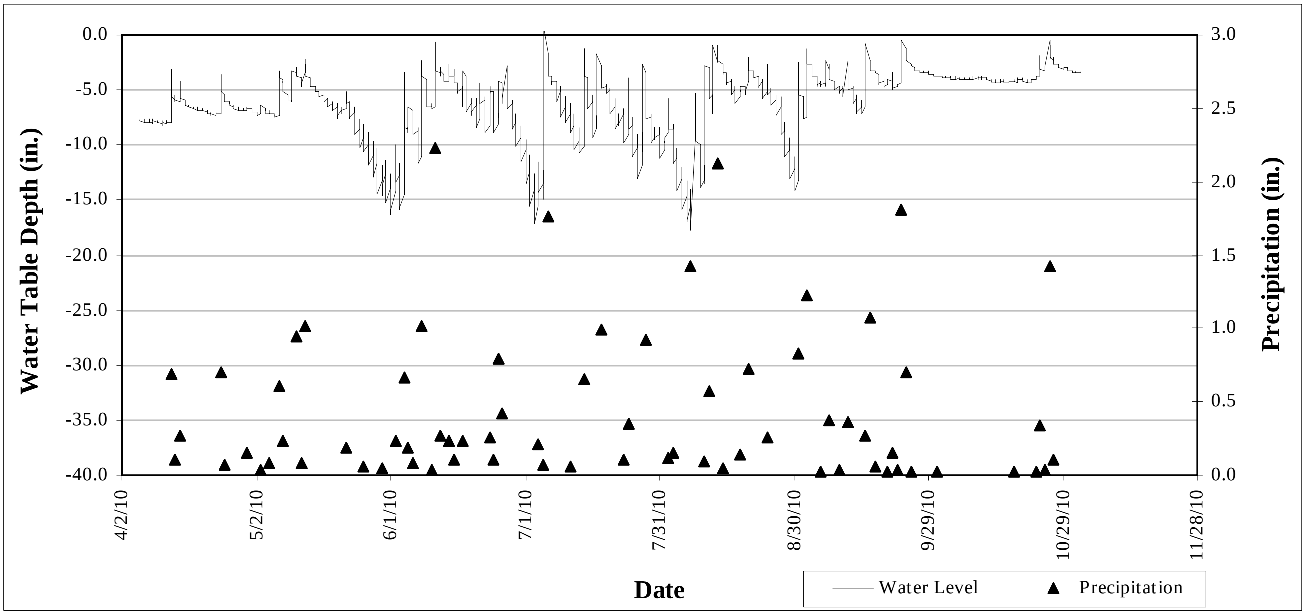
Soils at Well Location: not yet available

Surrounding Soils: Zimmerman

Vegetation at Well Location: not yet available

Other Notes: The Cedar Creek Ecosystem Science Reserve, 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.

2010 Hydrograph



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

Wetland Hydrology Monitoring

EAST TWIN REFERENCE WETLAND

East Twin Lake Township Park, Nowthen

Site Information

Monitored Since: 2001

Wetland Type: 5

Wetland Size: ~5.9 acres

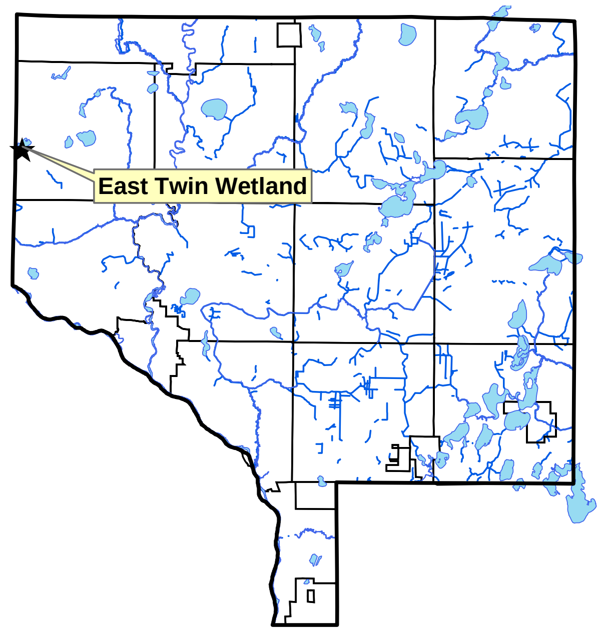
Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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

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

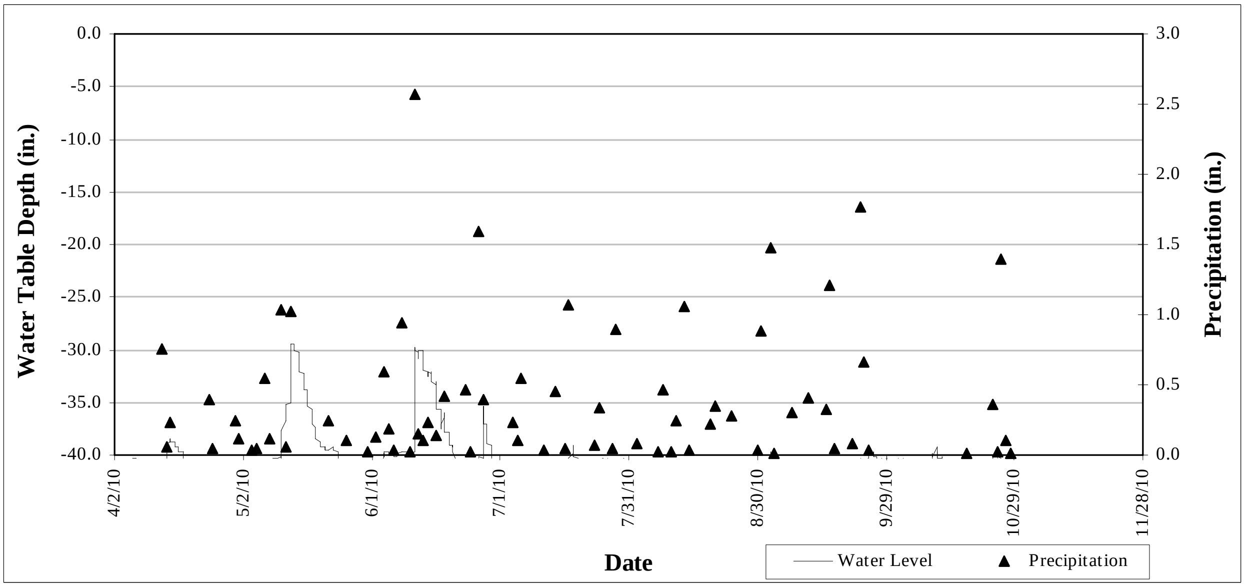


Vegetation at Well Location:

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

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

2010 Hydrograph

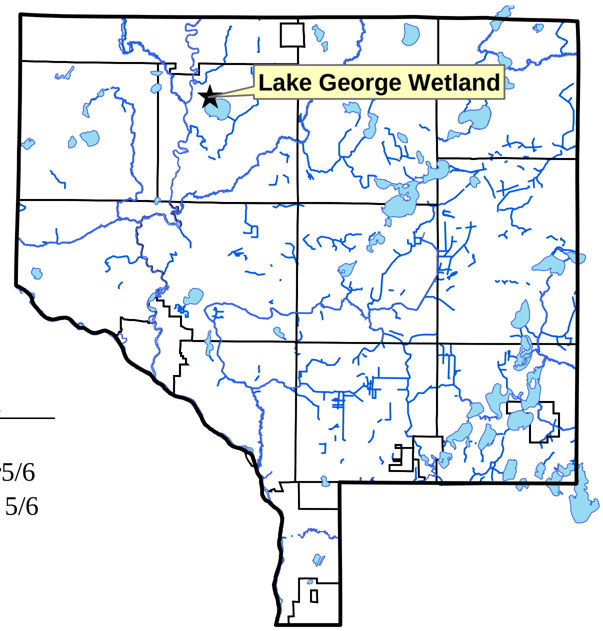


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

LAKE GEORGE REFERENCE WETLAND

Lake George County Park, Oak Grove



Site Information

Monitored Since: 1997

Wetland Type: 3/4

Wetland Size: ~9 acres

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

Connected to a Ditch? No

Soils at Well Location:

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

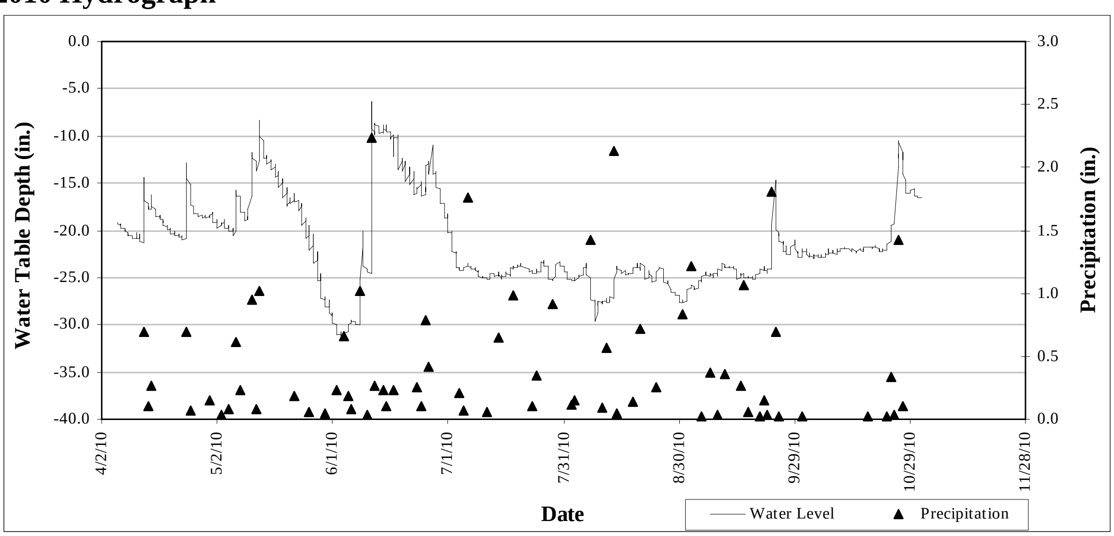
Surrounding Soils: Lino loamy fine sand and Zimmerman fine sand

Vegetation at Well Location:

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

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

2010 Hydrograph

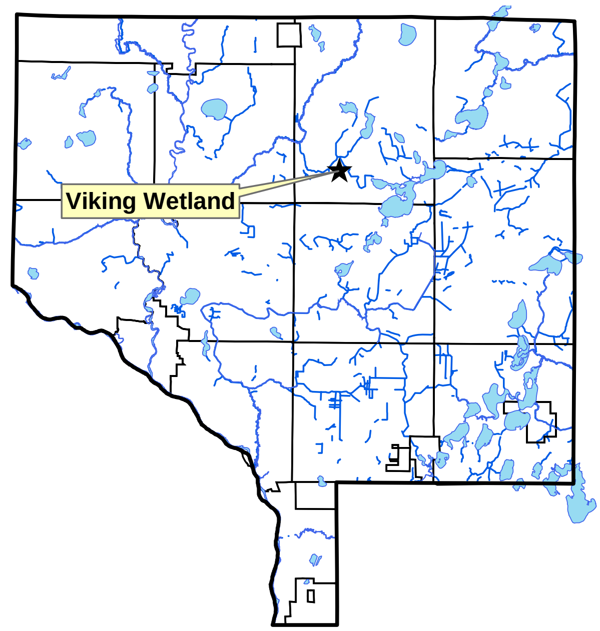


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

VIKING MEADOWS REFERENCE WETLAND

Viking Meadows Golf Course, East Bethel



Site Information

Monitored Since: 1999

Wetland Type: 2

Wetland Size: ~0.7 acres

Isolated Basin? No

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

Soils at Well Location:

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

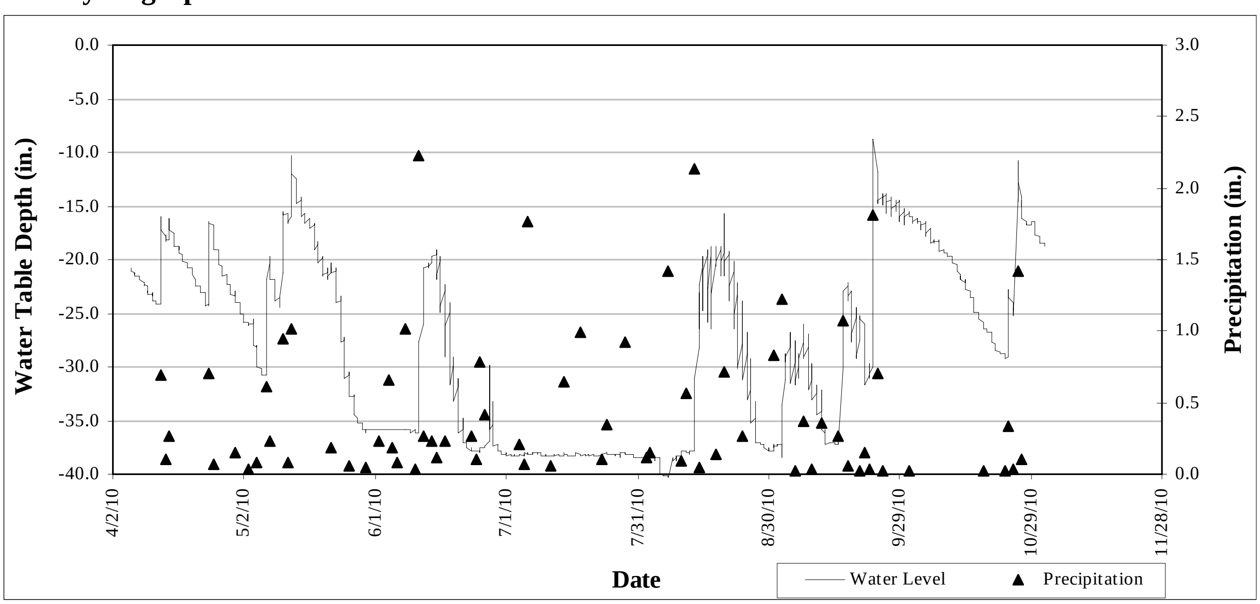
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

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

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

2010 Hydrograph

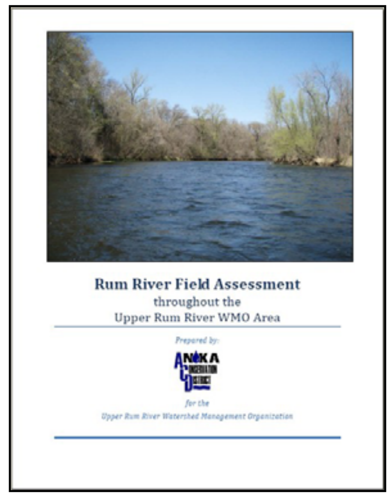


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Rum River Erosion Field Survey

Description: The URRWMO Watershed Management Plan calls for the WMO to do a field review of the Rum River in 2010-11. The purpose is to locate erosion and other problems that are negatively impacting Rum River water quality, fisheries, or scenic nature. The survey was conducted by boat using a GPS to document locations of significant features, which were also photo-documented. Significant features that were inventoried included erosion, major obstructions, possible violations of scenic and recreational river laws or other waters laws, and outfall pipes and other direct discharges to the river. The information is compiled in a GIS and maps were produced.

Correction of erosion and violations of scenic and recreational river laws were pursued. Where erosion was present the landowner was contacted. A customized layout of the erosion problem, and information about possible solutions and funding assistance were mailed to landowners with moderate-to-serious riverbank erosion. Where possible scenic river rule violations were found, we sent our findings to the city administering the scenic river rules.



Purpose: To document and correct riverbank erosion. To correct violations of scenic river rules.

Locations: Entire length of the Rum River in the Upper Rum River WMO.

Results: The Rum River field survey and follow-up work was completed in 2010. The maps, photos, and other information collected are too large to present in this report. They can be found in a stand-alone report produced by the Anoka Conservation District for the Upper Rum River WMO.

<u>Summary of Results</u>

16	River miles were studied.
15	Instances of significant erosion documented.
3	Apparent violations of state scenic and recreational river laws were forwarded to the City of St. Francis. Some may not have been violations because of rule differences in the urban district of St. Francis.
11	Informational packets sent to landowners with moderate-to-severe riverbank erosion.
4	Responses received from landowners who received informational packets. Additional assistance is being provided to them.
120	Geo-tagged photos.
82	Waypoints collected identifying erosion, rule violations, outfall pipes, recreational opportunities, and others.
1	Final report including maps, a 120-photo collection, and summary of findings

Water Quality Grant Fund

Description: In 2006 the Upper River Watershed Management Organization (URRWMO) partnered with the Anoka Conservation District's (ACD) Water Quality Cost Share Program. The URRWMO contributes funds to be used as cost share grants for projects that improve water quality in lakes, streams, or rivers within the URRWMO area. The ACD provides administration of the grants. Grant awards follow ACD policies and generally cover 50% or 70% of materials (see http://www.anokanaturalresources.com/acd/fin_assist/financial_assist.htm). The ACD Board of Supervisors approves any dispersments. Eligible projects included those that correct erosion, filter runoff to waterbodies, or restore native shoreline vegetation adjacent to a lake or stream.

Grant administration is through the Anoka Conservation District for efficiency and simplicity. The ACD administers a variety of other similar grants, thus providing a one-stop-shop for residents. Additionally, the ACD's technical staff provide project consultation and design services at low or no cost, which is highly beneficial for grant applicants. ACD staff also have expertise to process and scrutinize grant requests. Lastly, the ACD Board meets monthly, and can therefore respond to grant requests rapidly, while URRWMO meetings are much less frequent.

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

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

Locations: Throughout the watershed.

Results: Projects are reported in the year they are installed. In 2010 installation began on a Crooked Brooked (Ditch 67) streambank stabilization at the Petro Property.

URRWMO Cost Share Fund Summary

2006 URRWMO Contribution	+	$ 990.00
2006 Expenditures		$ 0.00
2007 URRWMO Contribution	+	$ 1,000.00
2007 Expenditures		$ 0.00
2008 Expenditures		$ 0.00
2009 Expenditures		$ 0.00
2010 URRWMO Contribution	+	$ 500.00
2010 Expenditure- Petro streambank stabilization (encumbered)	-	$1,104.50
Fund Balance		**$ 1,385.50**

Petro Streambank Stabilization Summary

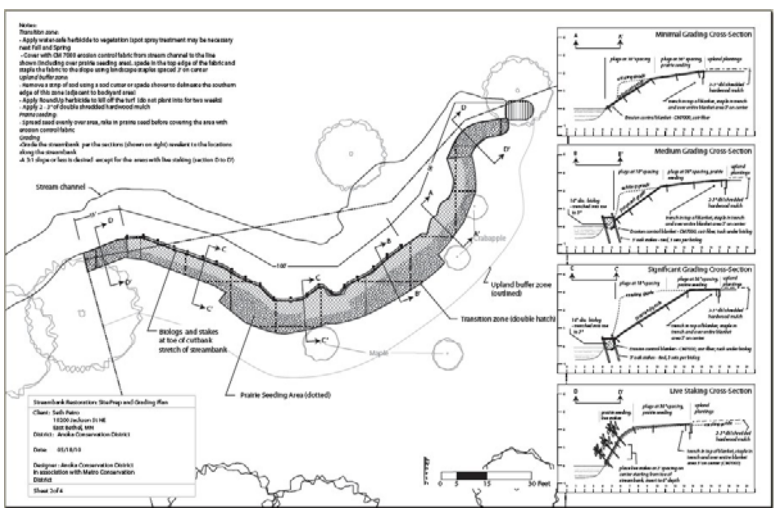
Full project details are available in the Anoka Conservation District's Annual Water Quality Projects Report.

Brief Description:

Crooked Brook flows to Cedar Creek and eventually the Rum River. The project location is 0.8 miles west of Highway 65 and 0.1 mile south of Viking Boulevard. Prior to the project the stream bank was actively eroding. The project will involve invasive species removal, grading, stabilization using fabrics and biologs, and a buffer planting using native plants. The project serves as an example for neighboring property owners, all of whom mow to the edge of the streambank and have varying degrees of streambank erosion. Project installation began in September 2010 and will conclude in spring 2011. Grant payout will occur upon project completion.

Funding sources:

1. State native buffer cost-share grant
   a. grading, stabilization material, herbicide — $1,064.75
2. URRWMO water quality cost share grant
   a. plants, mulch, silt fence — $1,104.50
3. Landowner
   a. Materials — $2,169.25
   b. Labor — $10,000.00
4. Project design was provided by the Anoka Conservation District.

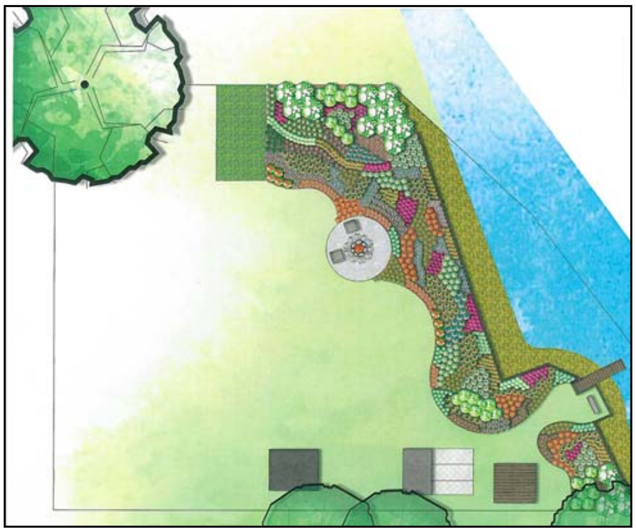


Water Quality Improvement Projects

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

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

Results: Projects are described in a separate report produced by the Anoka Conservation District.



Anoka County Geologic Atlas

Description: A map-based report of groundwater and geology to be used for community planning and groundwater management. The Atlas provides detailed information about groundwater:

- Aquifers, including identifying future water sources,
- Aquifer sustainability,
- Recharge areas,
- Sensitivity to pollution,
- Flow directions,
- Connections to lakes, streams, and wetlands,
- Chemistry,
- Wellhead protection, and others...

Results are provided as GIS files and paper maps, and are especially useful to community planners.

Geologic Atlases are a partnership of the MN Geological Survey, MN DNR, and local governments. 94% of funding was secured by the MN Geological Survey (MGS) and MN Department of Natural Resources (DNR) from the Legislative-Citizen Commission for Minnesota Resources (LCCMR). A required local contribution totaling 6% of project expenses was provided by the seven Anoka County watershed organizations and the Anoka Conservation District. Completion of the project requires 4-5 years.

Purpose: To gain knowledge about groundwater and geology that enables improved management of groundwater, including availability, pollution prevention, and pollution management.

Locations: Throughout Anoka County.

Results: An Anoka County Geologic Atlas began in 2009 with financial support from all seven Anoka County Watershed Management Organizations and the Anoka Conservation District. These funds were used to locate approximately 9,500 groundwater wells, with approximately an additional 500 located in early 2010. Boring logs from these wells and others already in the County Well Index will be used to create the geologic atlas. The MGS has begun the process of using these wells to create the geologic atlas. Thereafter the DNR will perform a groundwater analysis for the atlas. In total, the geologic atlas is expected to be completed around 2014.

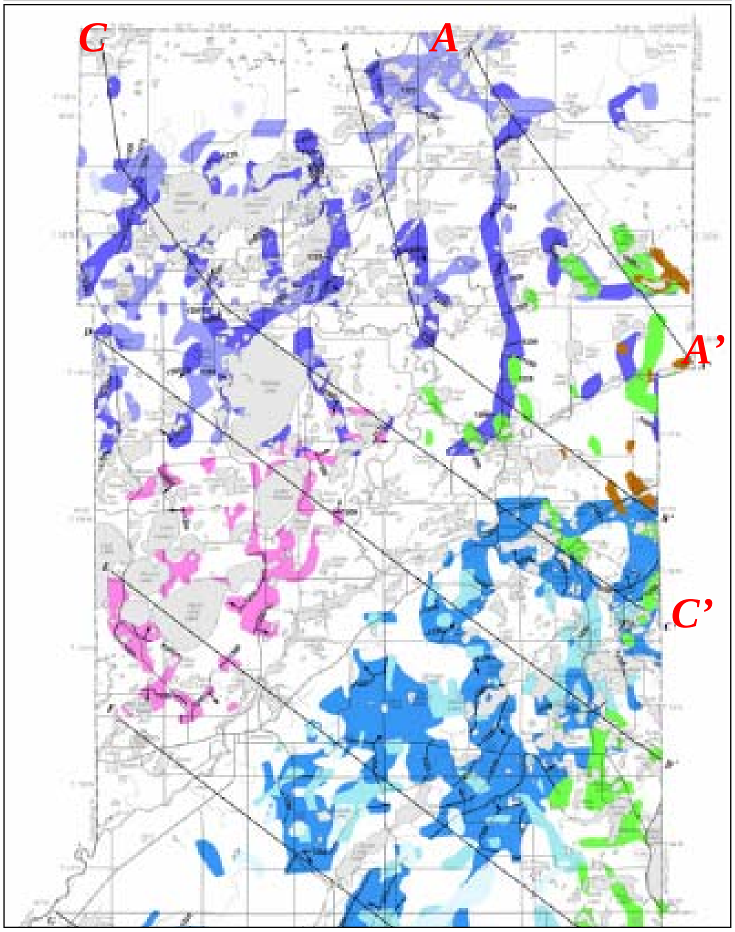
An example of portions of a geologic atlas from Crow Wing County are on the following page.

Example Geologic Atlas Work Products

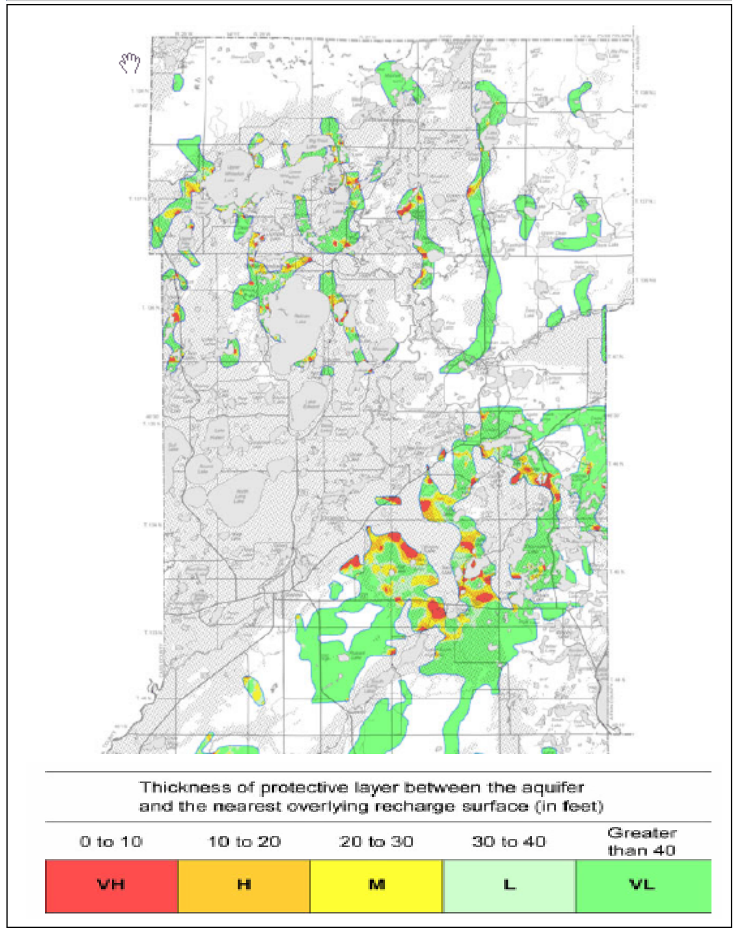
Crow Wing County Geologic Atlas

Excerpted from: Peterson, T. 2008. Hydrogeology, Pollution Sensitivity, and Lake and -Groundwater Interaction. MN Ground Water Association Newsletter 27-3.

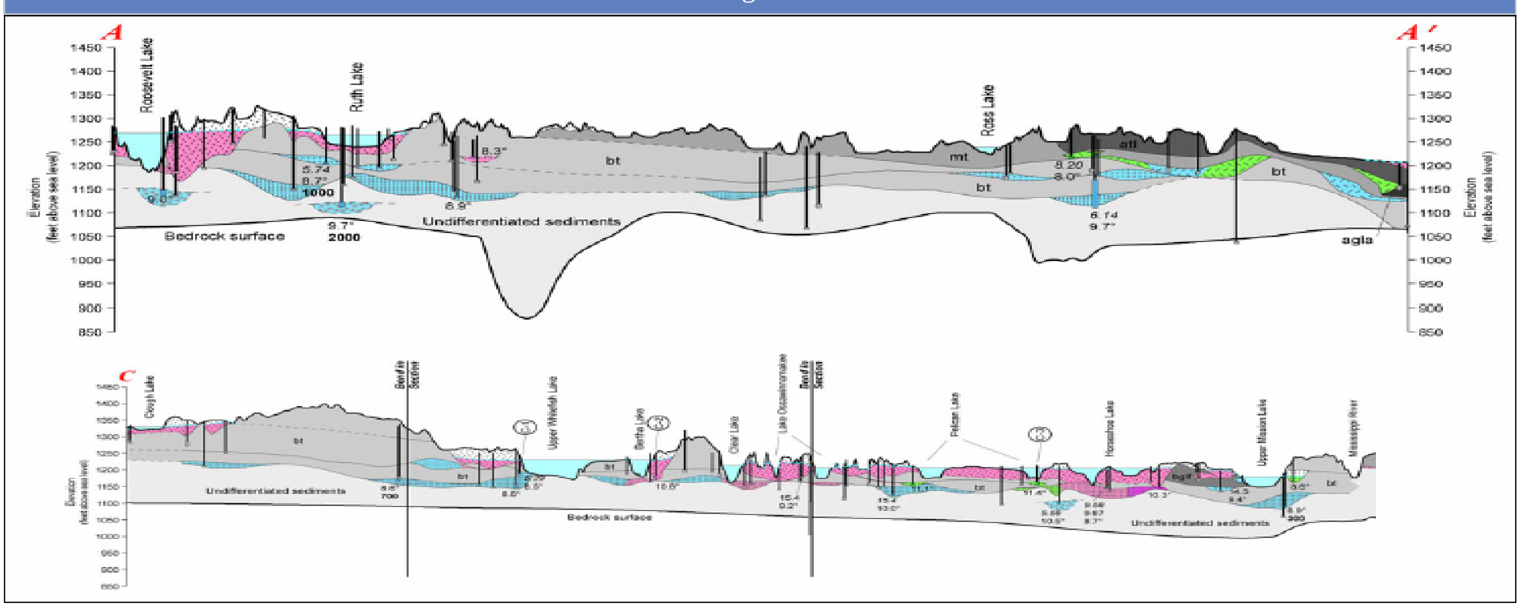
Extent and Distribution of Buried Aquifers Including Direction of Flow



Pollution Sensitivity of Buried Aquifers



Selected hydro-geologic cross sections showing groundwater residence time. Cross sections A-A' and the Northwest 2/3 of C-C' are shown. See above figure for cross section location.



URRWMO Website

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

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

Location: www.AnokaNaturalResources.com/URRWMO

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

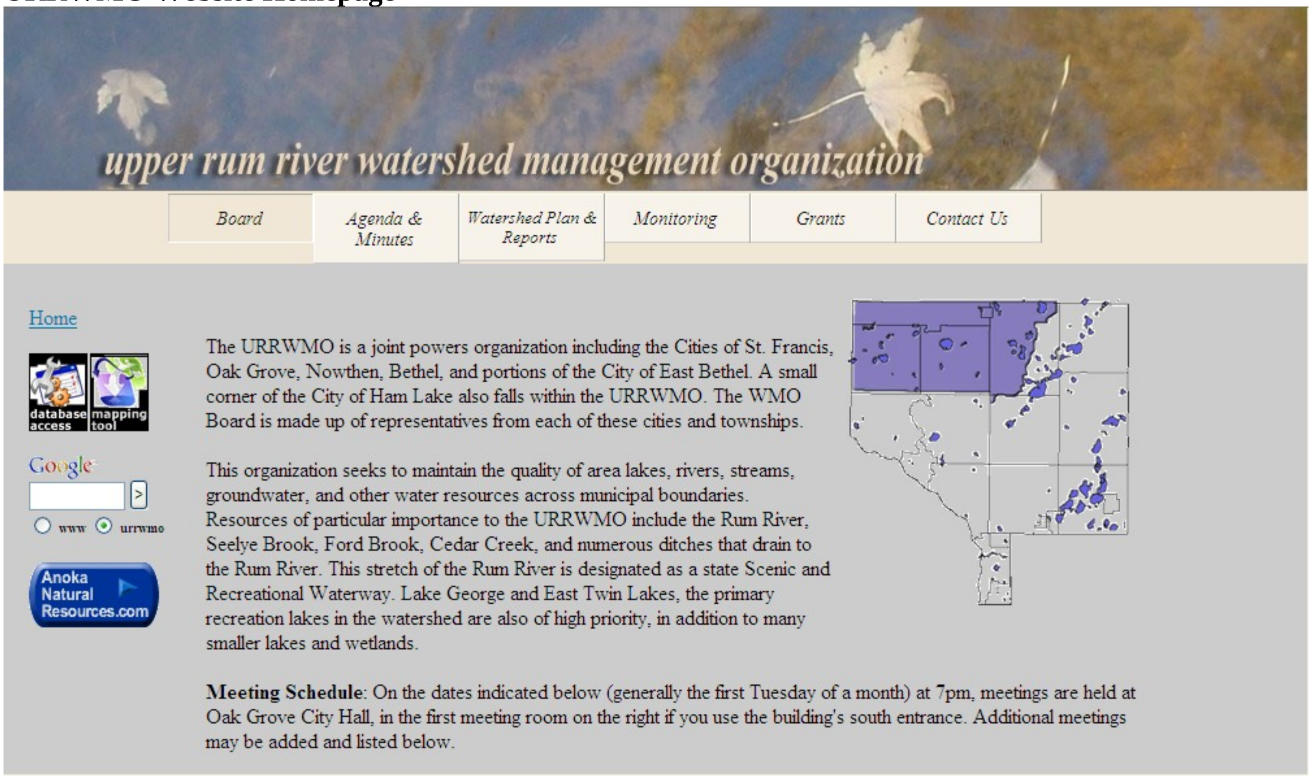
Information about the URRWMO includes:

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

Other tools on the website include:

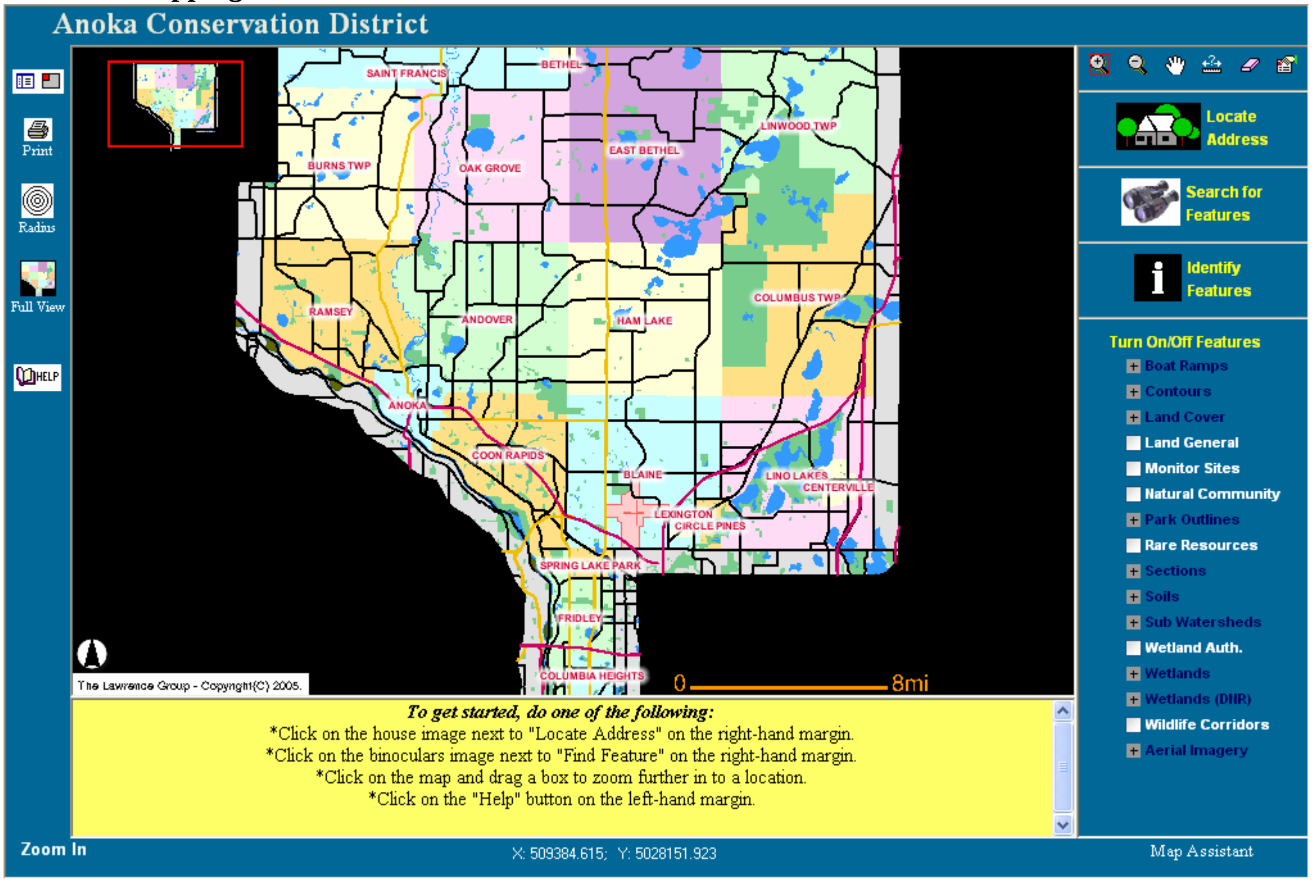
- an interactive mapping tool that shows natural features and aerial photos
- an interactive data download tool that allows users to access all water monitoring data that has been collected
- narrative discussions of what the monitoring data mean

URRWMO Website Homepage

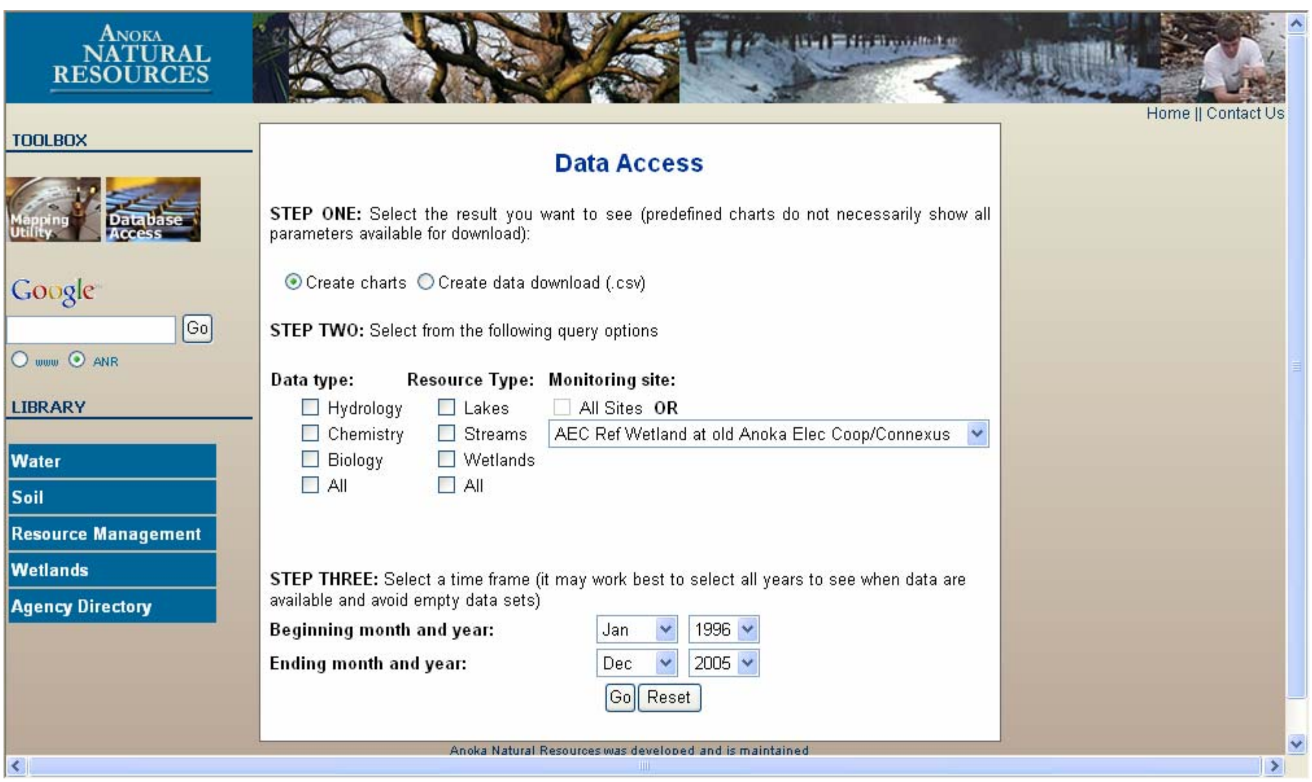


more on next page

Interactive Mapping Tool



Interactive Data Access Tool



URRWMO Annual Newsletter

Description: The URRWMO Watershed Management Plan calls for an annual URRWMO newsletter in addition to the website. The URRWMO will produce a newsletter article including information about the URRWMO, its programs, related educational information, and the URRWMO website address. This article was provided to each member city, and they will be asked to include it in their city newsletters.

Purpose: To increase public awareness of the URRWMO and its programs.

Locations: Watershed-wide.

Results: The Anoka Conservation District assisted the URRWMO by drafting the annual newsletter article. The URRWMO Board reviewed and edited the draft article. The finalized article was sent to each member community on June 15, 2010 with a request that they include it in their city newsletter. Contents of the article included:

- a map of the URRWMO area,
- description of the URRWMO role,
- discussion of work focused upon the Rum River in 2010 including:
  - water quality monitoring throughout the URRWMO and
  - a survey of the entire river in the URRWMO looking for water quality impacts, followed by efforts to correct those impacts,
- past Rum River water quality monitoring results,
- grant information for residential water quality improvement projects,
- URRWMO meeting schedule,
- Information about URRWMO Board vacancies,
- URRWMO website address, and
- phone number for more information.

2010 URRWMO Newsletter Article

UPPER RUM RIVER
WATERSHED MANAGEMENT ORGANIZATION
monitors water quality, offers grants to residents

Lakes, streams, and the Rum River are the focus of the Upper Rum River Watershed Management Organization (URRWMO). This special purpose unit of government is formed jointly by the cities of Bethel, East Bethel, Ham Lake, Nowthen, Oak Grove, and St. Francis. The URRWMO area has several high quality waterbodies, including East Twin Lake, Lake George, and the Rum River. But there are concerns too, including water quality in Crooked Brook and Rogers Lake. The URRWMO works to protect high water quality and improve it where necessary. They especially concentrate on water-related issues that cross municipal boundaries, requiring multi-city coordination.

Rum River Erosion and Water Quality

The Rum River is arguably our most notable waterbody. Locally, the Rum River is designated as a state Scenic and Recreational Waterway, is a great fishery, and is thought to have good water quality. To assess the river's current condition, the URRWMO has begun systematic monitoring of the river's water quality. Additionally, in 2010 the river was surveyed to identify erosion and other issues which affect water quality.

Water quality monitoring of the river is occurring at both the north and south ends of the URRWMO area. This allows detection of any changes that may occur along this stretch of the river. To date, they've observed little change in water quality from St. Francis to the northern boarder of Ramsey. However, there is a low-level increase in chlorides from upstream to downstream, which is likely due to road deicing salts. The chloride increase exists throughout the year, because these salts have infiltrated into the shallow groundwater that feeds the river during dry conditions. During summer storms the chlorides are diluted, further evidence that groundwater is an important source. The highest salt concentrations would likely occur during spring melt, but this has not yet been monitored. Road salts are a widespread water quality concern, especially downstream where road densities are higher due to urbanization.

This spring the URRWMO mapped erosion and other possible impacts to the river, such as violations of State scenic river rules. Riverbank erosion can threaten water quality, fish habitat, and properties through decreased shoreline stability. Overall, this stretch of the river is beautiful, but some problem areas were identified. The URRWMO will be contacting property owners and offering assistance to those interested in improving their property.

Example of erosion along the Rum River identified during a spring 2010 field survey.

Grants

How we manage our own properties can have significant impacts on lakes and rivers, both positive and negative. Understanding the public benefits of high water quality, the URRWMO offers grants to encourage water quality improvement projects on private property. Cost-share grants are available to landowners for projects such as erosion control, stormwater runoff treatment, and/or native vegetation restoration adjacent to lakes and streams. Applications are accepted at any time on a first-come, first-serve basis. The grants are competitive, and the highest ranking projects will be those that will most directly benefit a public waterbody.

Grants typically cover 50-70% of project materials. Remaining costs and labor are the landowner's responsibility. The Anoka Conservation District (ACD) offers free on-site consultations and can assist with project design. The grants are administered through the ACD, and interested landowners should contact Jamie Schurbon at 763-434-2030 extension 12.

Meetings and Contacts

More information about the URRWMO can be found on their website at www.AnokaNaturalResources.com/urrwmo. Citizens are welcome and encouraged to attend URRWMO meetings. Remaining 2010 meetings are July 6, September 7, and November 9 at 7:00 p.m. at the Oak Grove City Hall (south entrance).

Become an Upper Rum River WMO Board Member

There are currently vacant URRWMO board member positions for the cities of Ham Lake, Oak Grove, and St. Francis. If you live in one of those communities and would like to serve, please contact the city. URRWMO board members are appointed by the city.

URRWMO 2009 Annual Report to BWSR

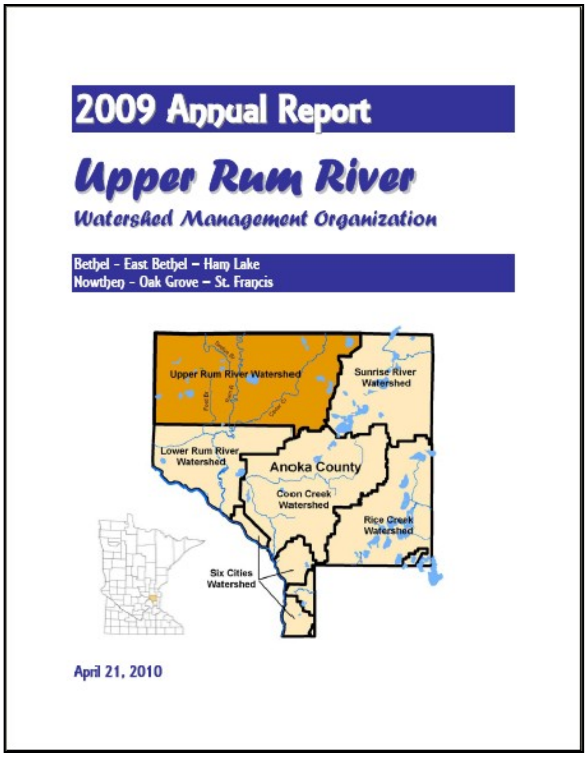
Description: The Upper Rum River Watershed Management Organization (URRWMO) is required by law to submit an annual report to the Minnesota Board of Water and Soil Resources (BWSR), the state agency with oversight authorities. This report consists of an up-to-date listing of URRWMO Board members, activities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

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

Locations: Watershed-wide

Results: The Anoka Conservation District assisted the URRWMO with preparation of a 2009 Upper Rum River WMO Annual Report. ACD provided copies of this report and a cover letter to the entire URRWMO Board on April 8, 2010 for review. On April 21, 2010 the final draft was sent to the URRWMO Chair, Todd Miller. The Chair submitted the report to BWSR.

Cover


2009 Annual Report

Upper Rum River

Watershed Management Organization

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

April 21, 2010

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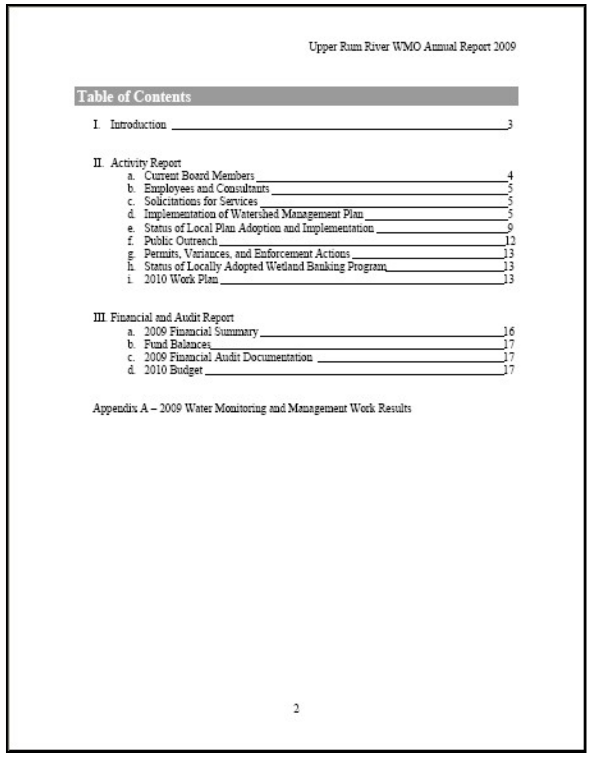
Upper Rum River WMO Annual Report 2009

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2

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. We do not, however, know specifically which expenses are attributed to monitoring which sites. 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.

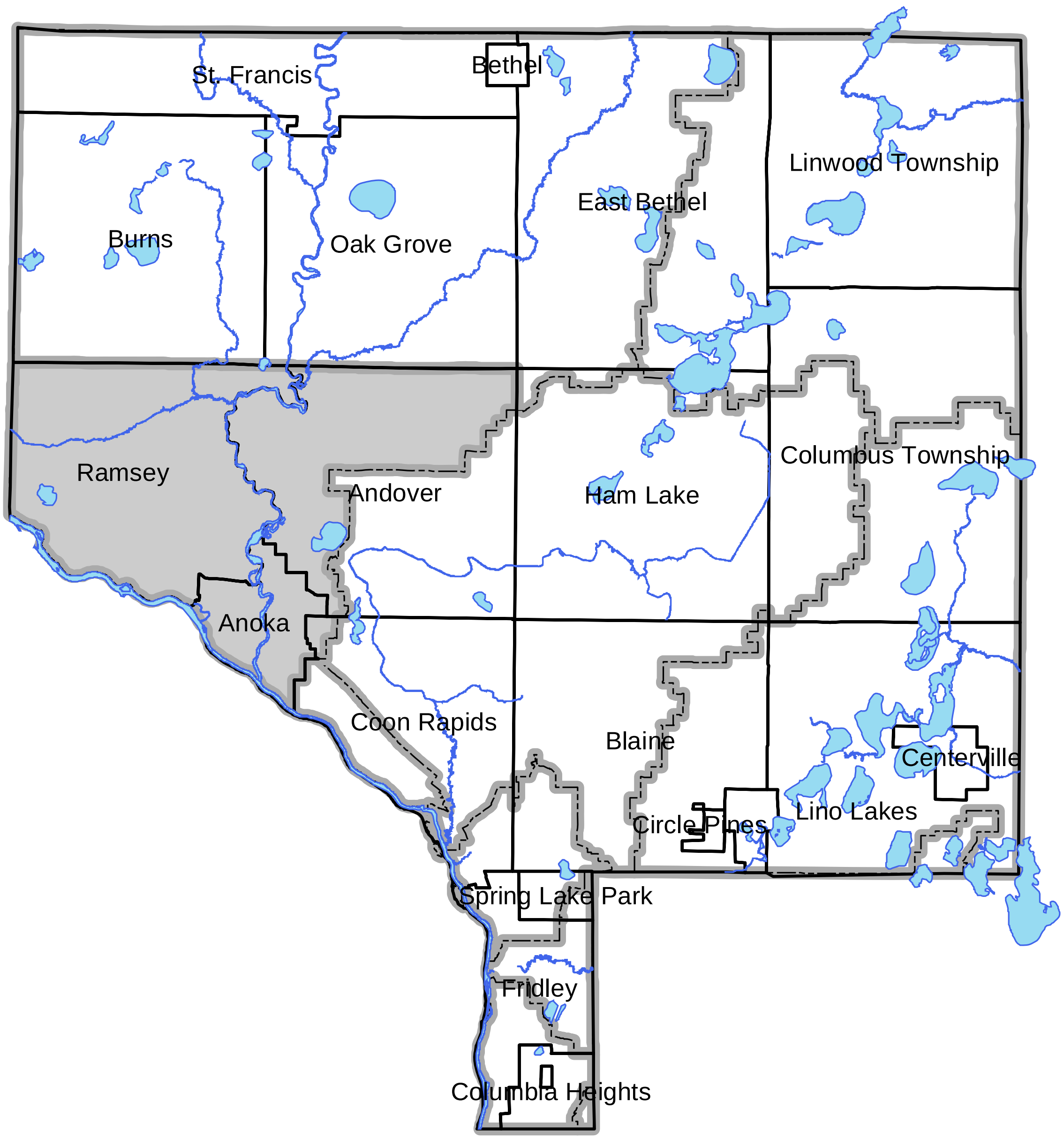
Upper Rum River Watershed Financial Summary

Upper Rum River Watershed	Website	Articles and Gen Edu	Volunteer Precip	Lake Lvl	Obwell	Stream WQ	WO MP	Student Bio	Rum River Field Assmt	WMO Annual Rpt BWSR	Geologic Atlas	Total
Revenues												
URRWMO	270	275	0	300	0	1845	0	0	6940	500	2830	12960
State	0	0	0	0	330	0	0	0	0	0	0	330
Anoka Conservation District	1350	1531	288	232	544	0	1744	817	0	786	0	7292
County Ag Preserves	0	0	0	0	0	0	0	591	0	0	0	591
Regional/Local	0	0	0	0	0	0	500	0	0	0	0	500
Other Service Fees	97	0	0	0	0	0	0	0	0	0	0	97
Local Water Planning	0	0	0	0	0	0	0	0	0	0	0	(0)
TOTAL	1716	1806	288	532	874	1845	2244	1408	6940	1286	2830	21769
Expenses-												
Capital Outlay/Equip	122	249	35	28	103	118	394	50	572	12	272	1955
Personnel Salaries/Benefits	883	1163	200	411	609	852	1433	1091	3005	1078	1733	12459
Overhead	648	194	38	60	116	381	314	140	496	80	468	2934
Employee Training	7	6	2	4	5	4	6	11	23	8	8	84
Vehicle/Mileage	13	18	3	6	9	14	24	16	46	15	27	192
Rent	41	42	10	22	31	59	70	52	101	44	100	572
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	1	131	0	0	1	209	4	47	3	45	1	442
Equipment Maintenance	1	1	0	0	0	19	1	1	3	2	2	31
TOTAL	1716	1806	288	532	874	1656	2244	1408	4249	1286	2611	18670
NET	0	0	0	0	0	189	0	0	2691	0	219	3100

Recommendations

- **Promote groundwater conservation.** Metropolitan Council models predict 3+ft drawdown of surface waters in parts of the URRWMO by 2030, and 5+ft by 2050.
- **Correct water quality issues discovered during the 2010 Rum River survey**.
- **Consider a St. Francis stormwater assessment** that is aimed at identifying and installing cost effective stormwater treatment opportunities before water is discharged into the Rum River. The assessment should be focused on those portions of the city that are generally lacking sufficient stormwater treatment.
- **Encourage public works departments to implement measures to minimize road deicing salt applications**. These salts are the most noticeable form of Rum River deterioration in the URRWMO. MN DOT, University of Minnesota Extension, and others offer training on this topic.
- **Investigate the condition of Ditch 19, the only inlet to Lake George**. Residents have complained that condition of the ditch and water control structures are contributing to low lake water levels in recent years. Anoka County is the legal ditch authority.
- **Facilitate resident efforts to control aquatic plant growth on Rogers Lake** as a means to improving low dissolved oxygen problems. In 2010 a neighborhood meeting was held, and while there was enthusiasm from residents, the needed follow-up by residents did not occur.
- **Continue coordinating Rum River monitoring** in cooperation with the Lower Rum River WMO, Metropolitan Council, and ACD.
- **Promote water quality improvement projects** for lakes, streams, and rivers. Cost share grants are available through the URRWMO and ACD to encourage landowners to do projects that will have public benefits to water quality. Technical assistance for landowners is available through the Anoka Conservation District.
- **Monitor water quality of Lake George and East Twin Lake every three years** to track any trends or changes. Next monitoring should be in 2011.

Lower Rum River Watershed



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

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

CHAPTER 4:
LOWER RUM RIVER WATERSHED

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Water Quality Grant Fund	LRRWMO, ACD, landowners	4-106
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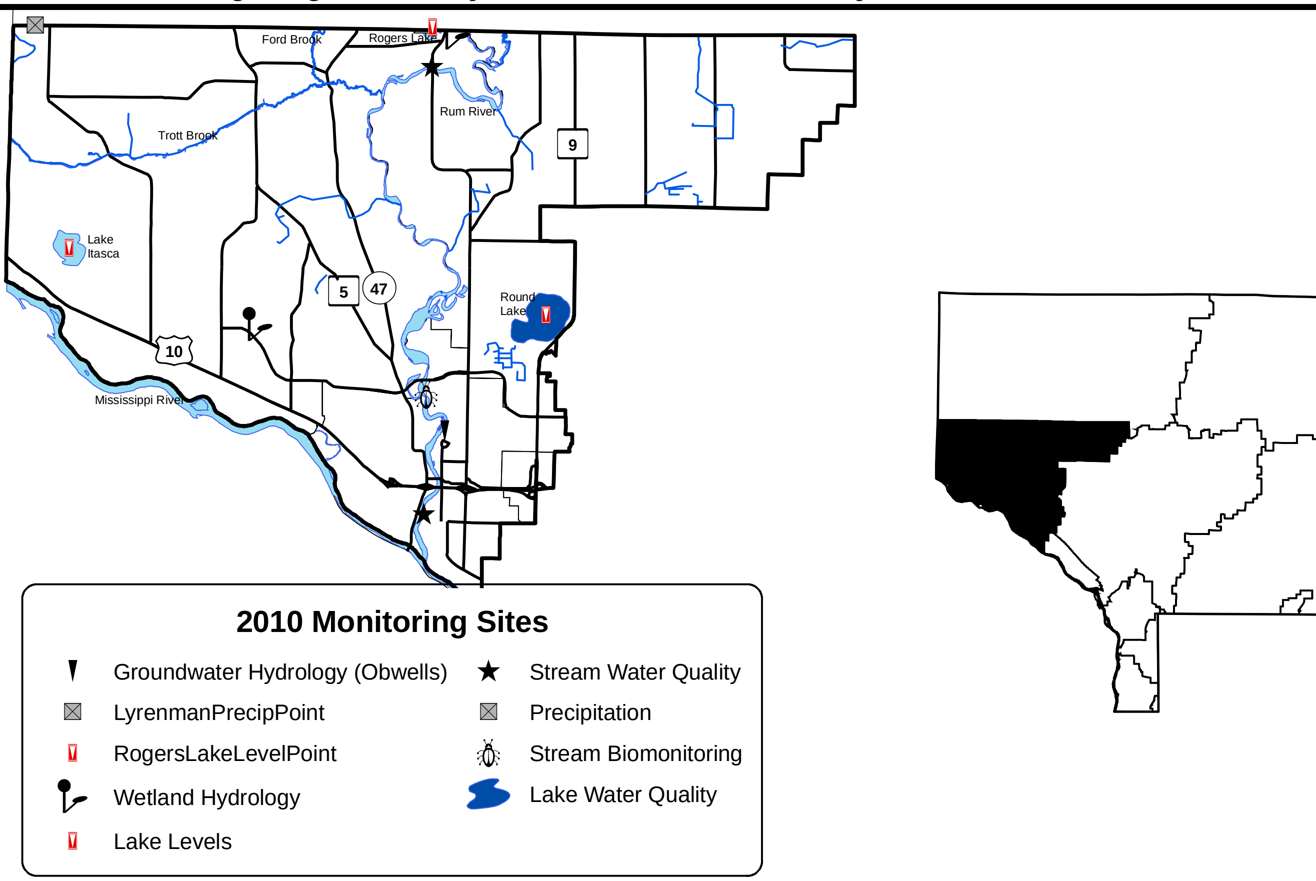
Groundwater Hydrology (obwells)	ACD, MNDNR	Chapter 1
Precipitation	ACD, volunteers	Chapter 1

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



Lake Level Monitoring

Description: Weekly water level monitoring in lakes. The past five years are shown below, and all 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.

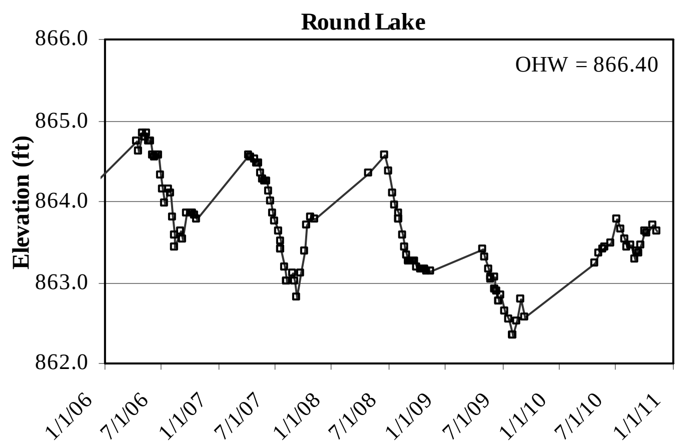
Locations: Lake Itasca, Round Lake, Rogers Lake

Results: Water levels were measured on Rogers, Round, and Itasca lakes 17, 18, and 159 times respectively. The level in Itasca Lake was measured much more frequently because a WL40 data logger was installed to record daily water levels. Reading a manual gauge was not possible because water was low, forcing placement of the gauge far from shore where volunteers could not read it.

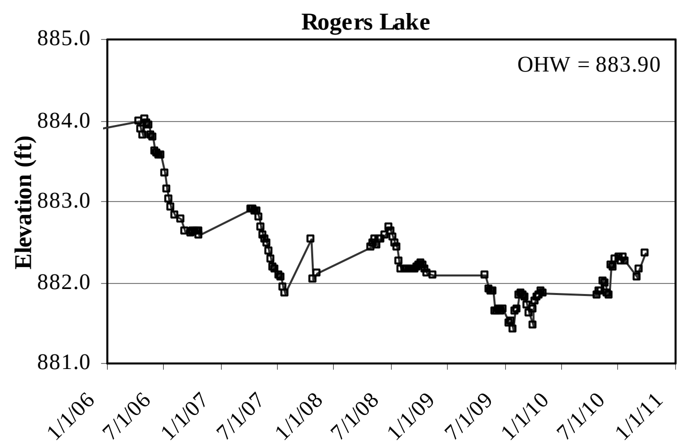
In 2010 these lakes began to rebound from record and near-record low water levels in 2009 because of near normal rainfall. The average water level in Round Lake increased by 0.65 feet between 2009 and 2010. Rogers Lake declined nearly continuously between 2006 and 2009, with a total drop of over two feet. The average Rogers Lake level increased by 0.37 feet between 2009 and 2010. The average Itasca Lake level in was 0.29 feet higher in 2010 than 2009.

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

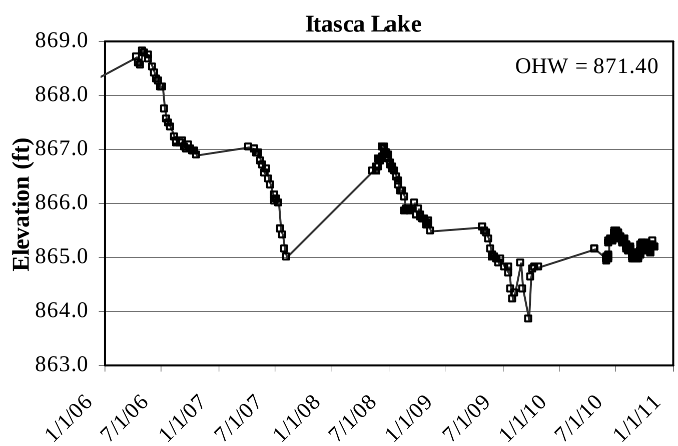
Round Lake Levels 2006-2010



Rogers Lake Levels 2006-2010



Itasca Lake Levels 2006-2010



Lower Rum River Watershed Lake Levels Summary 2006-2010

Lake	Year	Average	Min	Max
Itasca	2006	867.81	866.90	869.77
	2007	866.25	865.01	867.03
	2008	866.36	865.50	867.05
	2009	864.90	863.86	865.57
	2010	865.19	864.92	865.47
Rogers	2006	883.28	882.59	884.02
	2007	882.19	881.79	882.91
	2008	882.33	882.09	882.69
	2009	881.73	881.43	882.08
	2010	882.10	881.84	882.36
Round	2006	864.21	863.44	864.85
	2007	864.21	863.44	864.85
	2008	863.52	863.09	864.54
	2009	862.84	862.35	863.41
	2010	863.49	863.23	863.79

Lake Water Quality

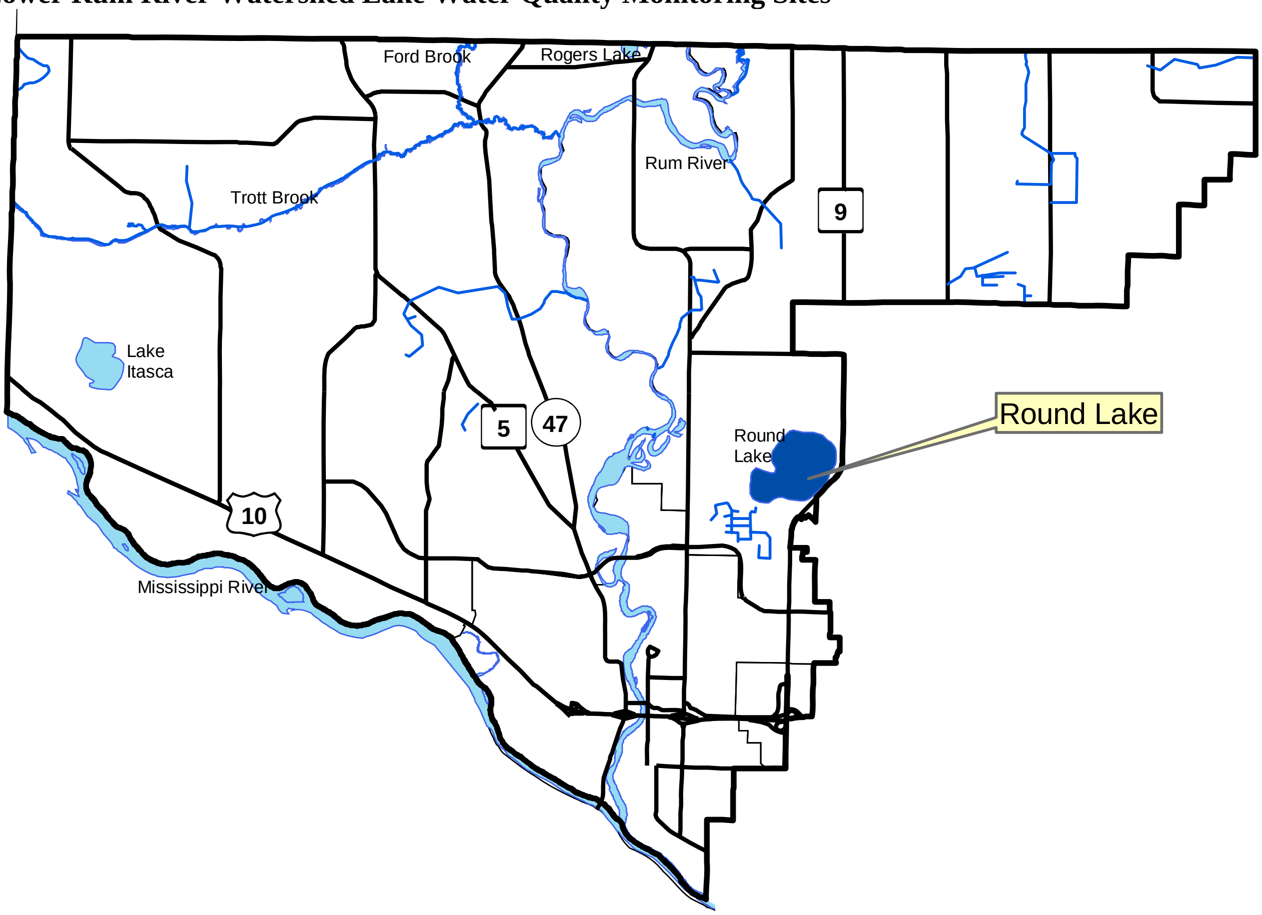
Description: May through September twice-monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, Secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

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 southwest Anoka County. It has a surface area of 220 acres and maximum depth of 19 feet, though the majority of the lake is less than 4 feet deep. The lake is surrounded by cattails and has submerged vegetation interspersed throughout the basin. This lake has a small watershed, with a watershed to surface area ratio of less than 10:1. Public access is from a dirt ramp on the lake's southeast side. Almost no boating and only wintertime fishing occurs. Wildlife, especially waterfowl, usage of the lake is relatively high.

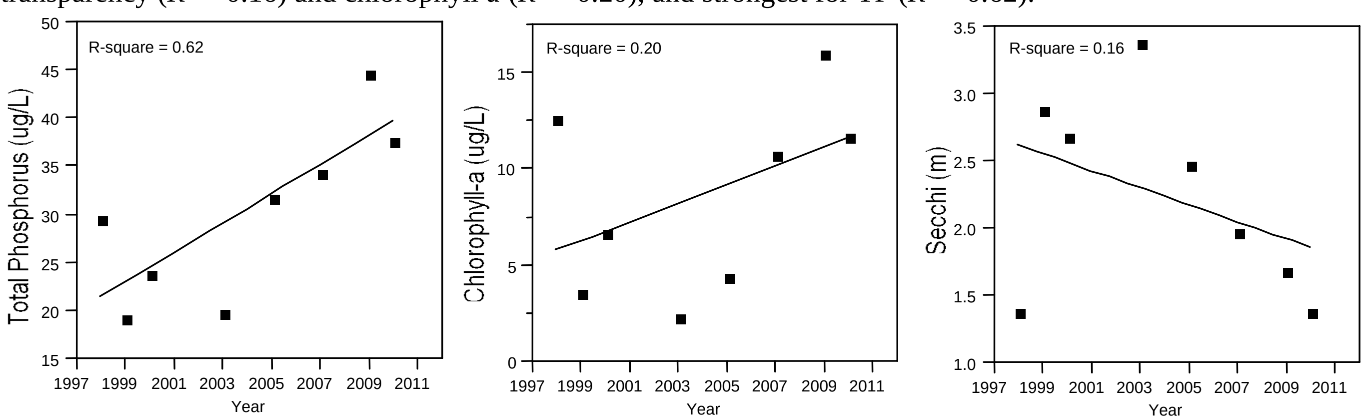
2010 Results

In 2010 Round Lake had average water quality compared with other lakes in this region (NCHF Ecoregion) receiving an overall C letter grade, but water quality was poorer than in most previous years. The lake was slightly eutrophic. Average total phosphorus and chlorophyll *a* were only slightly lower than the highest recorded values from 2009. Secchi transparency was only 4.6 feet, which is the poorest ever observed at this lake.

Lake water quality changed throughout the growing season, but was generally poorer than desired through summer. Total phosphorus concentrations were between 25 and 50 µg/L, which is a relatively large range. This variability in total phosphorus was positively correlated with changes in chlorophyll *a* concentrations. The highest chlorophyll *a* (and total phosphorus) occurred in the spring and mid-late summer. Secchi transparency was consistently poor throughout the summer ranging between 3.4 and 5.7 feet. Subjective ratings of physical condition and recreational suitability by ACD staff indicated minimal problems in the spring, but conditions quickly deteriorated to "definite/high algae" and "swimming impaired" throughout the remainder of 2010.

Trend Analysis

Eight years of water quality monitoring have been conducted by the Anoka Conservation District (1998-2000, 2003, 2005, 2007, and 2009-2010), which is a marginal number of years for a powerful statistical test of trend analysis. Nevertheless, the results of the analysis indicate a significant trend of declining water quality across the years studied (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,5} = 9.6065$, $p = 0.0194$). Examined individually, all three parameters are trending poorer, but the relationship is weak for transparency ($R^2 = 0.16$) and chlorophyll *a* ($R^2 = 0.20$), and strongest for TP ($R^2 = 0.62$).



Discussion

There are few obvious impacts to the lake. Shoreline development and recreational use is light, while the watershed is small with residential land uses. Because long term data are lacking for this lake it is unclear what is "normal" water quality, but poorer recent years are concerning. Possible factors affecting water quality include low water levels and expansion of Round Lake Boulevard, but each is speculative and not supported by data.

The low water levels could be negatively affecting water quality by making the unconsolidated bottom sediments more susceptible to wind mixing. These sediments could be a source of non-algal turbidity or phosphorus. But the low water levels have also resulted in expansion of emergent plants which can benefit water quality. At the same time, the submerged plant community seems to be in decline, presumably because of poorer transparency (and therefore light) and/or greater wind mixing.

Another possible impact on water quality is the expansion of Round Lake Boulevard in summer 2004. This road is 100-300 feet from the lake along the entire eastern shore. It was expanded from two lanes to four. Several new stormwater treatment basins were installed next to the roadway to help protect the lake. Yet some residents were concerned. Water quality has continued to deteriorate during the four monitoring years following the road expansion. It seems unlikely that the road would be responsible for this water quality change given the practices in place to protect the lake and the fact that surrounding areas are residential, but it cannot be eliminated as a possiblity.

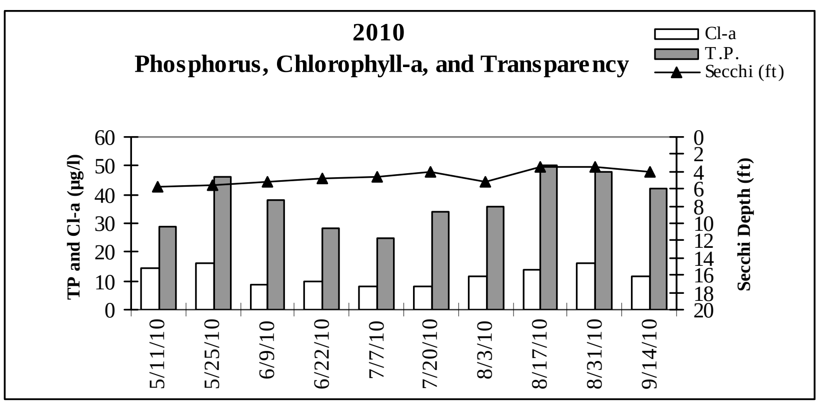
In the end, the reason for poorer water quality in recent years is uncertain. There are no apparent management changes that should be made. This leaves future monitoring and re-evaluation as the only recommendation.

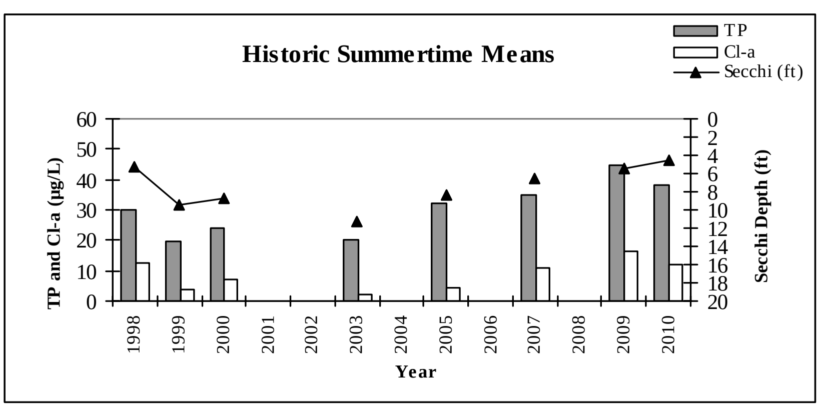
2010 Round Lake Water Quality Data

Round Lake 2010		Date	5/11/2010	5/25/2010	6/9/2010	6/22/2010	7/7/2010	7/20/2010	8/3/2010	8/17/2010	8/31/2010	9/14/2010			
		Time	13:00	9:30	9:30	9:00	11:30	9:30	9:30	9:15	9:45	9:30			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.62	7.92	7.73	8.00	8.37	8.11	7.97	7.75	7.78	8.10	7.94	7.62	8.37
Conductivity	mS/cm	0.01	0.427	0.432	0.430	0.368	0.335	0.343	0.371	0.377	0.404	0.396	0.388	0.335	0.432
Turbidity	FNRU	1.0	6	11	10	9	12	15	11	11	17	17	12	6	17
D.O.	mg/L	0.01	11.14	7.33	6.44	9.67	8.89	8.97	7.72	11.27	8.37	N/A	8.87	6.44	11.27
D.O.	%	1.0	94	84	66	110	104	100	88	115	90	N/A	95	66	115
Temp.	°C	0.10	10.2	24.5	19.7	24.5	26.9	25.2	26.9	21.5	24.8	19.1	22.3	10.2	26.9
Temp.	°F	0.10	50.4	76.1	67.5	76.1	80.4	77.4	80.4	70.7	76.6	66.4	72.2	50.4	80.4
Salinity	%	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cl-a	µg/L	1.0	14.6	16.0	8.9	9.8	7.9	8.1	11.5	14.1	16.0	11.3	11.8	7.9	16.0
T.P.	mg/L	0.005	0.029	0.046	0.038	0.028	0.025	0.034	0.036	0.050	0.048	0.042	0.038	0.025	0.050
T.P.	µg/L	5	29	46	38	28	25	34	36	50	48	42	38	25	50
Secchi	ft	0.1	5.7	5.6	5.1	4.9	4.6	4.1	5.1	3.4	3.5	4.1	4.6	3.4	5.7
Secchi	m	0.1	1.7	1.7	1.6	1.5	1.4	1.2	1.6	1.0	1.1	1.2	1.4	1.0	1.7
Field Observations															
Physical			2	2.0	2.0	3.0	4.0	4.0	4.0	4.0	4.0	3.0	3.2	2.0	4.0
Recreational			2	2.0	2.0	3.0	3.0	3.0	4.0	4.0	4.0	3.0	3.0	2.0	4.0

*Reporting Limit

Round Lake Water Quality Results





Round Lake Summertime Historic Mean

Agency	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1998	1999	2000	2003	2005	2007	2009	2010
TP (µg/L)	29.8	19.6	24.1	20.0	32.0	34.7	45.0	38.0
Cl-a (µg/L)	12.8	3.7	6.9	2.4	4.6	10.9	16.2	11.8
Secchi (m)	1.6	2.9	2.7	3.4	2.5	2.0	1.7	1.4
Secchi (ft)	5.2	9.5	8.8	11.3	8.3	6.5	5.5	4.6

Carlson's Tropic State Indices

Year	1998	1999	2000	2003	2005	2007	2009	2010
TSIP	53	47	50	47	54	55	59	57
TSIC	56	44	48	39	46	54	58	55
TSIS	55	45	46	42	47	50	52	55
TSI	55	45	48	43	49	53	56	56

Round Lake Water Quality Report Card

Year	1998	1999	2000	2003	2005	2007	2009	2010
TP (µg/L)	B	A	B	A	B	C	C	C
Cl-a (µg/L)	B	A	A	A	A	B+	B	B
Secchi (m)	C	B	B	A	B	C	C	C
Overall	**B**	**A**	**B**	**A**	**B**	**C**	**C**	**C**

Stream Water Quality - Chemical Monitoring

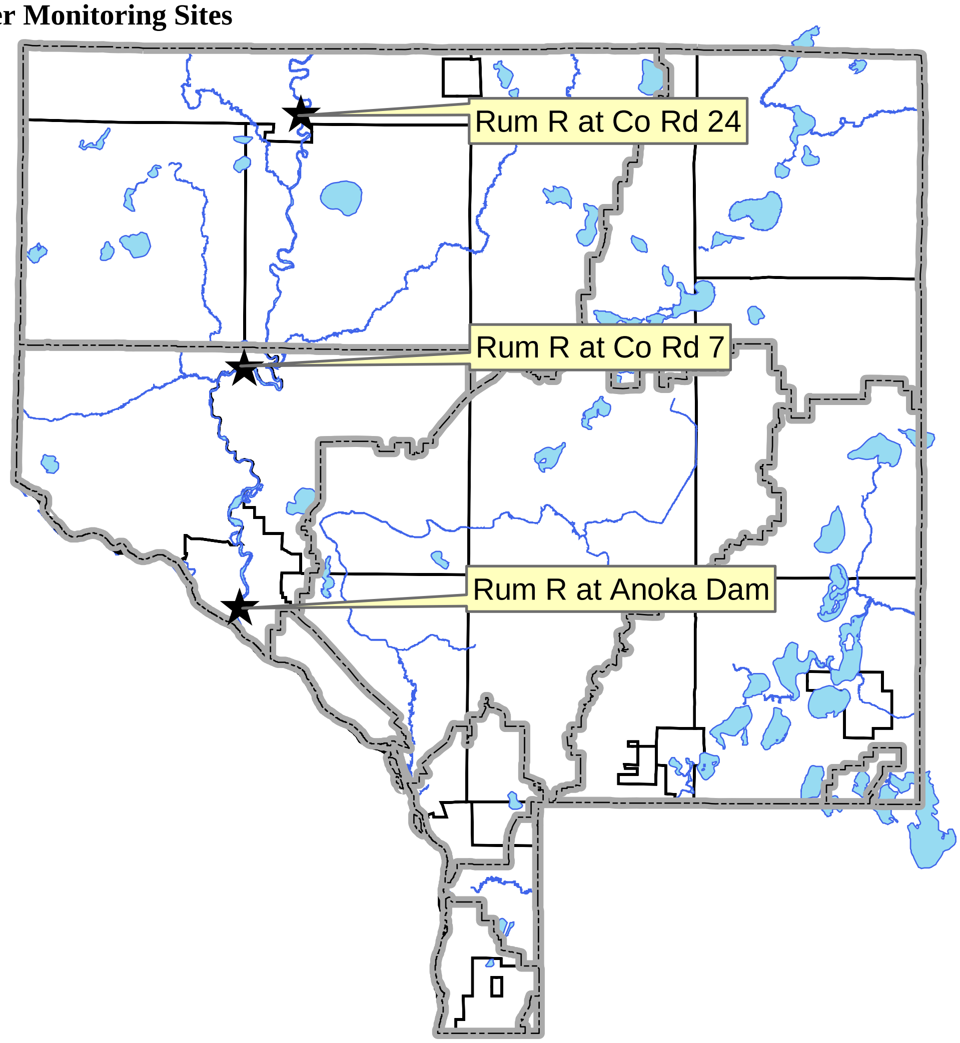
Description: The Rum River has been monitored simultaneously at three strategic locations in 2004, 2009, and 2010. The locations include the approximate top and bottom of the Upper and Lower Rum River Watershed Management Organizations. The two organizations share the middle location. The Metropolitan Council collects additional data at the farthest downstream location. Collectively, the data collected allow for an upstream to downstream water quality comparison within Anoka County, as well as within each watershed organization. While other Rum River monitoring has occurred, it is excluded from this report in order to include only data that were collected simultaneously for the greatest comparative value.

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

Locations: Rum River at Co Rd 24
Rum River at Co Rd 7
Rum River at the Anoka Dam

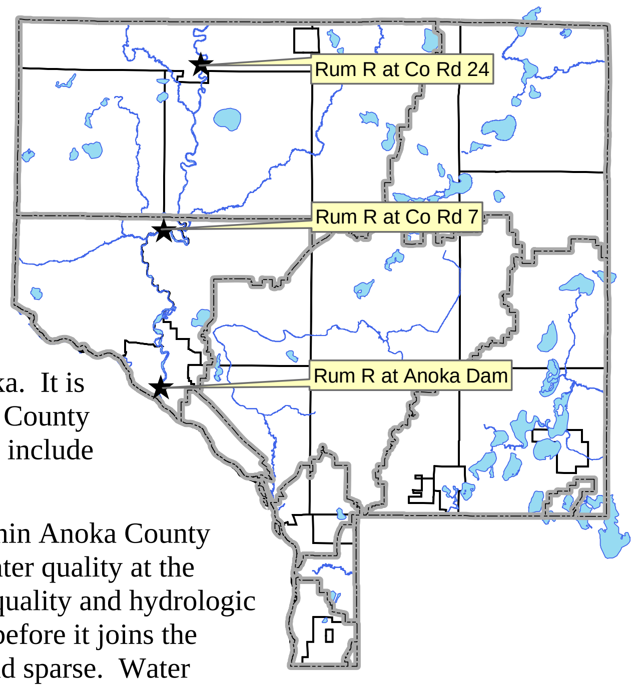
Results: Results are presented on the following page, with a focus on comparing river conditions from upstream to downstream. More detailed reporting for the Metropolitan Council WOMP monitoring station, including additional parameters and analysis are presented elsewhere by the Metropolitan Council (see http://www.metrocouncil.org/Environment/RiversLakes/).

2010 Rum River Monitoring Sites



RUM RIVER

Rum River at Co. Rd. 24 (Bridge St), St. Francis	STORET SiteID = S000-066
Rum River at Co. Rd. 7 (Roanoke St), Ramsey	STORET SiteID = S004-026
Rum River at Anoka Dam, Anoka	STORET SiteID = S003-183



Years Monitored

At Co. Rd. 24 – 2004, 2009, 2010

At Co. Rd. 7 – 2004, 2009, 2010

At Anoka Dam – 1996-2010 by the Met Council WOMP program

Background

The Rum River is regarded as one of Anoka County's highest quality and most valuable water resources. It is designated as a state scenic and recreational river throughout Anoka County, except south of the county fairgrounds in Anoka. It is used for boating, tubing, and fishing. Much of western Anoka County drains to the Rum River. Subwatersheds that drain to the Rum include Seelye, Trott, and Ford Brooks, and Cedar Creek.

The extent to which water quality improves or is degraded within Anoka County has been unclear. The Metropolitan Council has monitored water quality at the Rum's outlet to the Mississippi River since 1996. This water quality and hydrologic data is well suited for evaluating the river's water quality just before it joins the Mississippi River. Monitoring elsewhere has been sporadic and sparse. Water quality changes might be expected from upstream to downstream because land use changes dramatically from rural residential in the upstream areas of Anoka County to suburban in the downstream areas.

Methods

In 2004, 2009, and 2010 monitoring was conducted at three locations simultaneously to determine if Rum River water quality changes in Anoka County, and if so, generally where changes occur. The Upper and Lower Rum River Watershed Management Organizations contributed to this work and monitoring sites were strategically located near the upper and lower boundary of each organization's jurisdictional boundary. The Metropolitan Council maintains a permanent monitoring station at the Anoka Dam, the farthest downstream monitoring site. The Metropolitan Council monitoring was coordinated to occur with the watershed organization monitoring so the data and costs could be shared. The Anoka Conservation District did the field work for both Metropolitan Council and the watershed organizations, ensured monitoring for both programs was conducted simultaneously so the data and costs could be shared, and reports the data together for a more comprehensive analysis of the river from upstream to downstream.

The river was monitored during both storm and baseflow conditions by grab samples. Eight water quality samples were taken each year; half during baseflow and half following storms. Storms were generally defined as one-inch or more of rainfall in 24 hours or a significant snowmelt event combined with rainfall. In some years, particularly the drought year of 2009, smaller storms were sampled because of a lack of larger storms. All storms sampled were significant runoff events. Parameters tested with portable meters included pH, conductivity, turbidity, temperature, salinity, and dissolved oxygen. Parameters tested by water samples sent to a state-certified lab included total phosphorus, total suspended solids, and chlorides. Ten additional parameters were tested by the Metropolitan Council at their laboratory for the Anoka Dam site only and are not reported here. During every sampling the water level (stage) was recorded. The monitoring station at the Anoka Dam includes automated equipment that continuously tracks water levels and calculates flows. Water level and flow data for other sites was obtained from the US Geological Survey, who maintains a hydrological monitoring site at Viking Boulevard.

The purpose of this report is to make an upstream to downstream comparison of Rum River water quality. It includes only parameters and dates that were simultaneously tested at all three sites. It does not include additional parameters tested at the Anoka Dam or additional monitoring events at that site. For that information, see Metropolitan Council reports at http://www.metrocouncil.org/Environment/RiversLakes. All other raw data can be obtained from the Anoka Conservation District and is also available through the Minnesota Pollution Control Agency's EQuIS database, which is available through their website.

Results and Discussion

Overall, Rum River water quality is good throughout Anoka County, however it does decline slightly below the County Road 7 bridge (i.e. in the Cities of Andover, Anoka, and Ramsey) and during storms. The declines in water quality below that point are modest, as are declines in water quality during storms. Dissolved pollutants (as measured by conductivity and chlorides), total phosphorus, turbidity, and total suspended solids were all generally near or below the median of all 34 Anoka County streams that have been monitored, while pH and dissolved oxygen levels were appropriate.

Two areas of concern were noted. First, dissolved pollutants increased at each monitoring site downstream. Dissolved pollutants were highest during baseflow, indicating pollutants have infiltrated into the groundwater which feeds the river and tributaries during baseflow. Road deicing salts are likely the most significant dissolved pollutant. Secondly, total suspended solids increased notably below County Road 7. This was most pronounced during storms.

It is important to recognize the limitations of this report. The data is only from 2004, 2009, and 2010 when all three sites were monitored simultaneously to allow comparisons. It includes drought years (2009), years with slightly above normal precipitation (2010), and years with some excessively wet and some excessively dry months (2004). We did not sample any extreme floods when river water quality is likely worst. If a more detailed analysis of river water quality is desired, data from many years and a variety of conditions is available for the Anoka Dam site through the Metropolitan Council. Their work includes composite samples throughout storms.

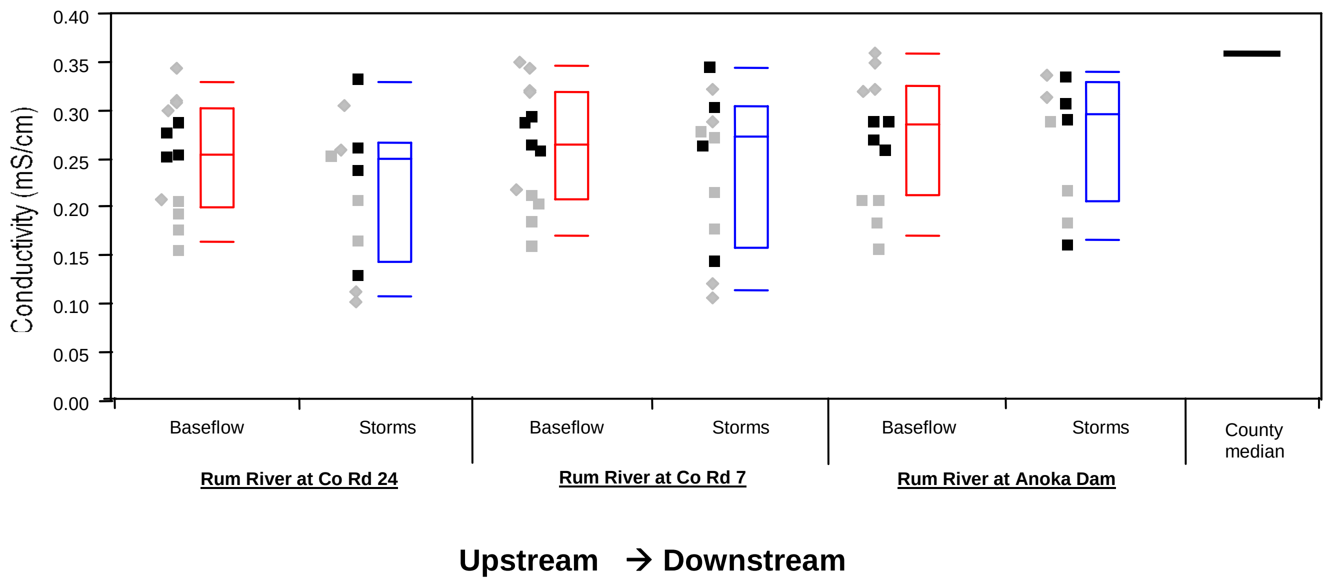
On the following pages data are presented and discussed for each parameter. The last section outlines management recommendations. The Rum River is an exceptional waterbody, and its protection and improvement should be a high priority.

Conductivity and chlorides

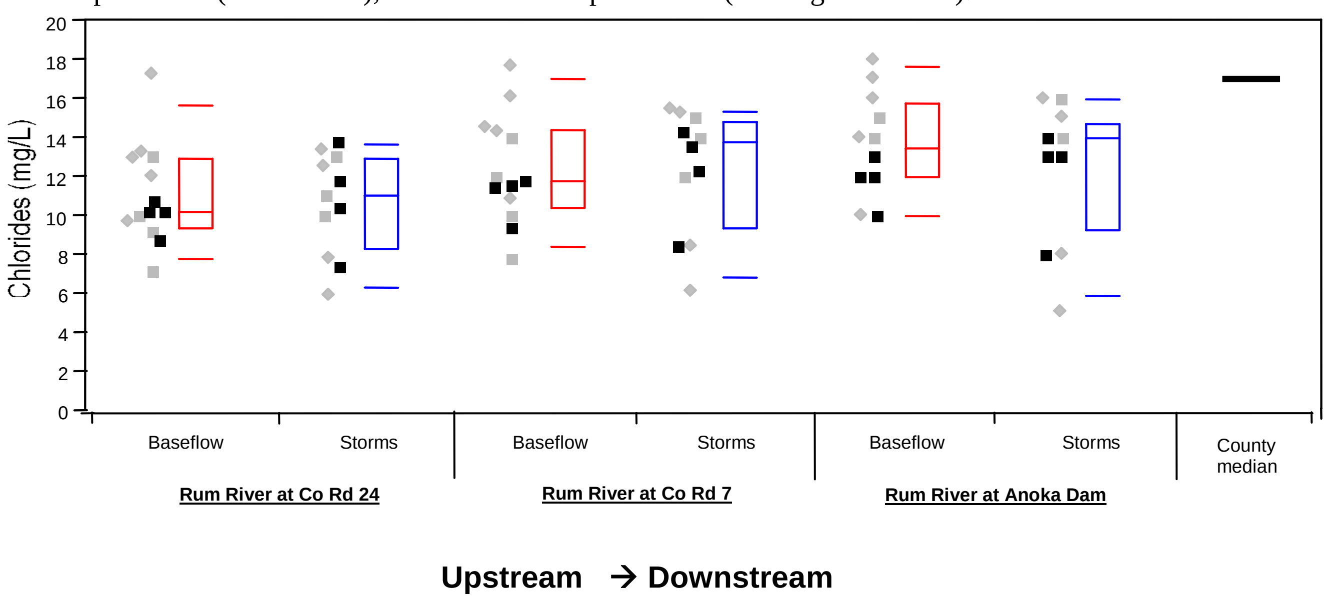
Conductivity and chlorides are measures of dissolved pollutants. Dissolved pollutant sources include urban road runoff, industrial chemicals, and others. Metals, hydrocarbons, road salts, and others are often of concern in a suburban environment. Conductivity is the broadest measure of dissolved pollutants we used. It measures electrical conductivity of the water; pure water with no dissolved constituents has zero conductivity. Chlorides tests for chloride salts, the most common of which are road de-icing chemicals. Chlorides can also be present in other pollutant types, such as wastewater. These pollutants are of greatest concern because of the effect they can have on the stream's biological community. They can also be of concern because the Rum River is upstream from the Twin Cities drinking water intakes on the Mississippi River.

Conductivity is acceptably low in the Rum River, but increases downstream (see figure below) and during baseflow. Median conductivity from upstream to downstream was 0.256 mS/cm, 0.272 mS/cm, and 0.296 mS/cm, respectively. This is lower than the median for 34 Anoka County streams of 0.362 mS/cm. The maximum observed conductivity in the Rum River was 0.365 mS/cm. Conductivity was lowest at all sites during storms, suggesting that stormwater runoff contains fewer dissolved pollutants than the surficial water table that feeds the river during baseflow. High baseflow conductivity has been observed in most other nearby streams too, studied extensively, and the largest cause has been found to be road salts that have infiltrated into the shallow aquifer. Geologic materials also contribute, but to a lesser degree. Baseflow conductivity increases from upstream to downstream, reflecting greater road densities and deicing salt application. Storm conductivity, while lower than baseflow, did also increase from upstream to downstream. This is reflective of greater stormwater runoff and pollutants associated with the more densely developed lower watershed.

Conductivity during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Chloride during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



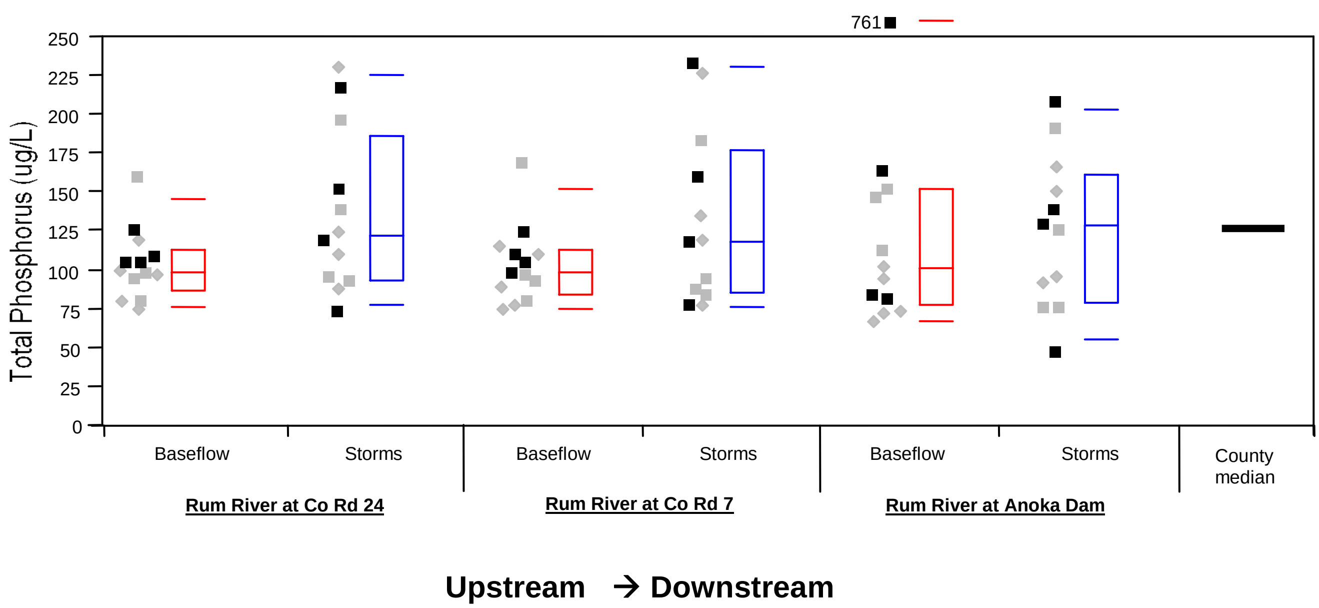
Chloride results parallel those found for conductivity (see figure above), supporting the hypothesis that chloride is an important cause of the conductivity. Chloride levels in the Rum River (median 11, 12, and 14 mg/L from upstream to downstream) are similar to the median for Anoka County streams of 12 mg/L. The highest observed value was 18 mg/L, though higher levels may have occurred during snowmelts which were not monitored. The levels observed are much lower than the Minnesota Pollution Control Agency's (MPCA) chronic standard for aquatic life of 230 mg/L. Like conductivity, chlorides were slightly higher during baseflow than storms at each site and increased from upstream to downstream. Road deicing salt infiltration into the shallow groundwater is likely the primary contributor, as described above.

Total Phosphorus

Total phosphorus in the Rum River is acceptably low and is similar to the median for all other monitored 34 Anoka County streams (see figure below). 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. The median phosphorus concentration at each of the three monitored sites was 106, 105, and 113 ug/L. These upstream-to-downstream differences are negligible and there is no trend of increasing phosphorus downstream. All sites occasionally experience phosphorus concentrations higher than the median for Anoka County streams of 128 ug/L. All of the highest observed total phosphorus readings were during storms, including the maximums at each site of 230, 234, and 761 ug/L (upstream to downstream). In all, phosphorus in the Rum River is at acceptable levels but should continue to be an area of pollution control effort as the area urbanizes.

One 2010 total phosphorus reading was excessively high, but we feel this outlier is likely an error. On September 22 a reading of 761 ug/L was recorded at the Anoka Dam. This was recorded as a baseflow sample because no recent rains had occurred, but was during a period of extended high water. River stage was approximately 0.5 feet higher than during the other baseflow samples. During this event dissolved phosphorus was analyzed in addition to total phosphorus. Dissolved phosphorus was only 13% of total phosphorus. Therefore most of the total phosphorus must be particulate phosphorus. Yet, inconsistently, there were few particulates in the water; total suspended solids was only 6 mg/L. Likewise, nothing in the field notes suggest unusually high turbidity. If this reading of 761 ug/L total phosphorus is excluded, as it probably should be, the next highest observed TP at this site is 209 ug/L.

Total phosphorus during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Turbidity and Total Suspended Solids (TSS)

Turbidity and total suspended solids (TSS) are two different measurements of solid material suspended in the water. Turbidity is measured by refraction of a light beam passed through a water sample. It is most sensitive to large particles. Total suspended solids is measured by filtering solids from a water sample and weighing the filtered material. The amount of suspended material is important because it affects transparency and aquatic life, and because many other pollutants are attached to particles. Many stormwater treatment practices such as street sweeping, sumps, and stormwater settling ponds target sediment and attached pollutants. Suspended solids in the Rum River are moderately high, but only at the Anoka Dam and during storms. The results for turbidity and TSS differ, lending insight into the types of particles that are problematic.

It is important to note the suspended solids can come from sources in and out of the river. Sources on land include soil erosion, road sanding, and others. Riverbank erosion and movement of the river bottom also contributes to suspended solids. A moderate amount of this "bed load" is natural and expected.

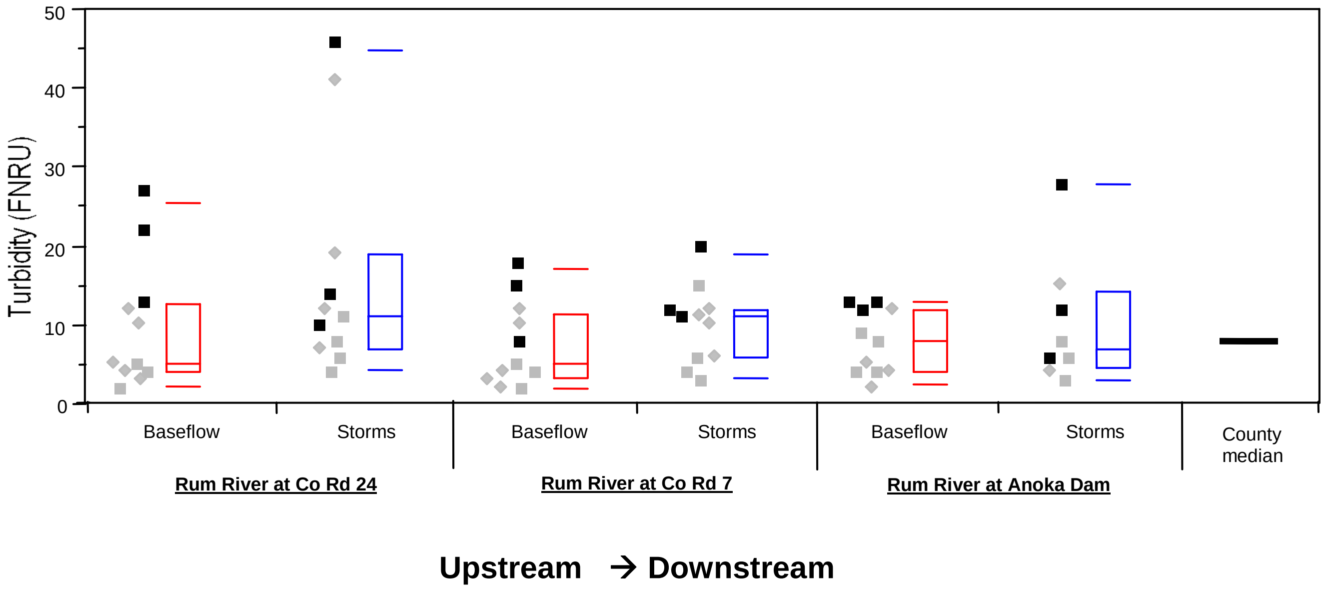
In the Rum River, turbidity was low with only slight increases during storms and no apparent increase at downstream monitoring sites (see figure below). The median turbidity at each site was 10, 8, and 8 FNRU (upstream to downstream), which is similar to the median for Anoka County streams of 8 FNRU. Turbidity was elevated on a few occasions, especially during storms. The maximum observed was 46 FNRU. The Rum River's turbidity exceeded the Minnesota Pollution Control Agency's water quality standard of 25 NTU during only four of 65 events (6%).

TSS was similar at the two upstream sites, but higher at the Anoka Dam (see figure below). The countywide TSS median for streams is 12 mg/L. The median at the Rum River sites from upstream to down stream was 8, 9, and 15 mg/L. At all the sites the median during storms was higher than baseflow. At the upstream site the difference between median TSS during storms and baseflow was 2 mg/L, while at County Road 7 it was 4 mg/L and at the Anoka Dam 8 mg/L. TSS during storms was much more variable due to variability in storms sampled. The maximum readings and moderate increases during storms are not unexpectedly high for a large river, and are within the range that should be considered healthy. At the same time, the increase in TSS between County Road 7 and the Anoka Dam is concerning. While it is concerning to have noticeable water quality deterioration in such a short stretch of river, it is not unexpected given the higher levels of land development between these two sites. No sites approached the Minnesota Pollution Control Agency's surrogate turbidity standard of 100 mg/L TSS.

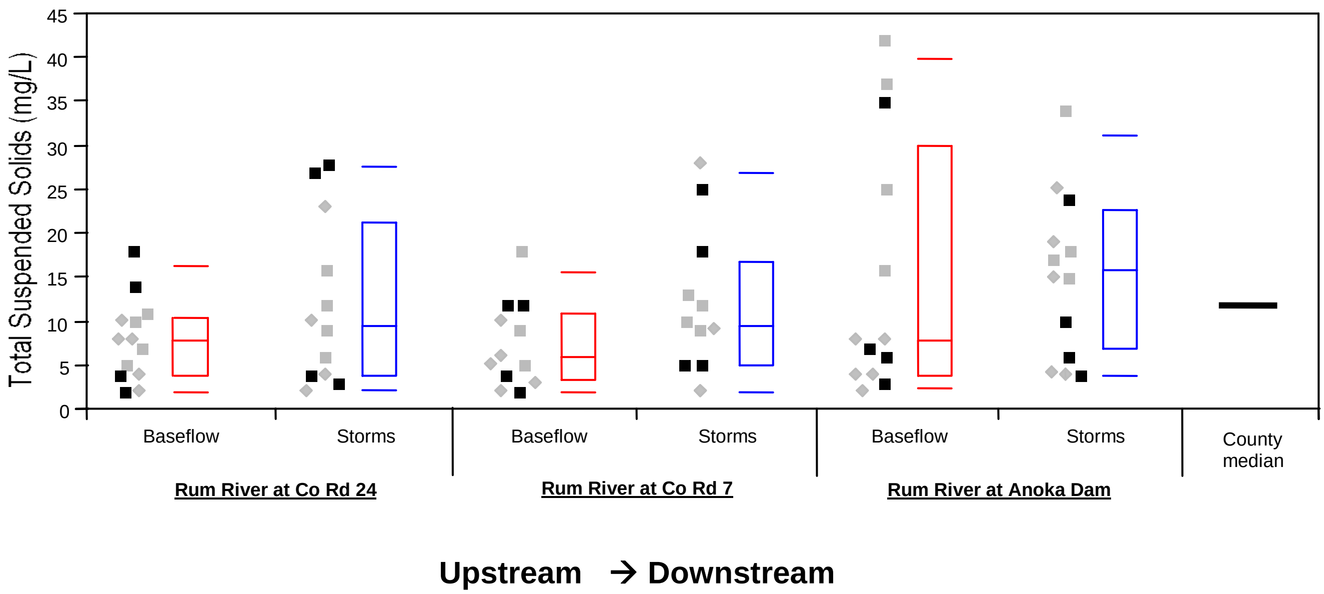
Differences between TSS and turbidity lend insight into the nature of any problems. TSS showed increases at the downstream monitoring site, while turbidity did not. Turbidity is most sensitive to large particles. Therefore, the downstream increases are likely due to smaller particles. Other pollutants, such as phosphorus and metals, are most highly correlated with smaller particles. These other pollutants can "hitch a ride" on smaller particles because of their greater surface area and, in the case of certain soils, ionic charge. Furthermore, small particles stay suspended in the water column and therefore are more likely to be transported by stream flows and are more difficult to remove with stormwater practices like settling ponds.

It should be noted that the data presented here do not include monitoring of any large flood events. The water is known to become muddier during such floods.

Turbidity during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



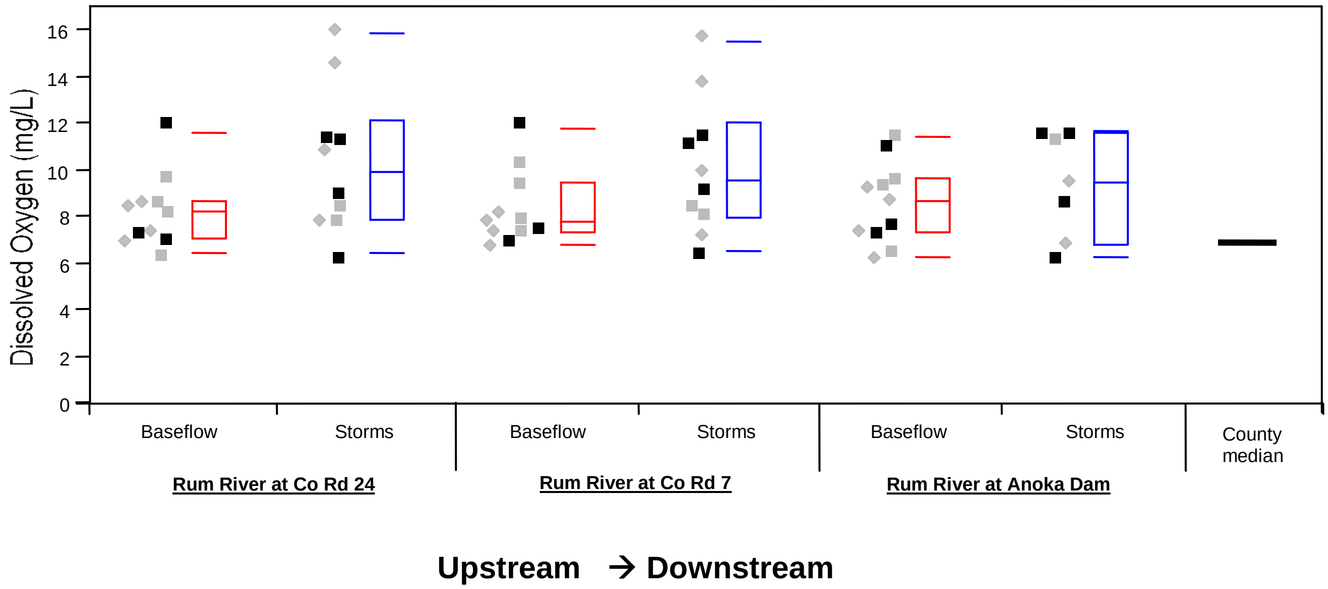
Total suspended solids during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Dissolved Oxygen

Dissolved oxygen is necessary for aquatic life, including fish. Organic pollution consumes oxygen when it decomposes. If oxygen levels fall below 4 mg/L aquatic life begins to suffer. In the Rum River dissolved oxygen was always above 6 mg/L at all monitoring sites.

Dissolved oxygen during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

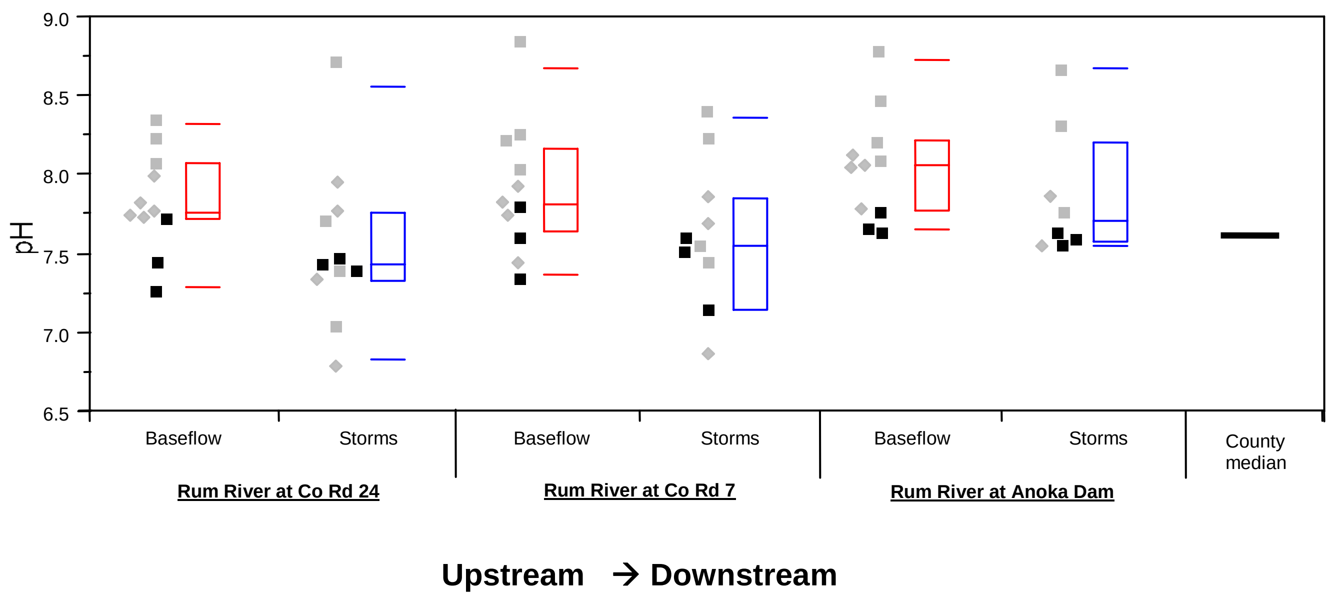


pH

pH refers to the acidity of the water. The Minnesota Pollution Control Agency's water quality standard is for pH to be between 6.5 and 8.5. The Rum River is regularly within this range (see figure below). Each of the three sites exceeded 8.5 on one occasion, but the highest was only 8.85. This rare and modest exceedance of the state water quality standard is not concerning.

It is interesting to note that pH is lower during storms than during baseflow. This is because the pH of rain is typically lower (more acidic). While acid rain is a longstanding problem, it's affect on this aquatic system is small.

pH during baseflow and storm conditions Grey squares are individual readings from 2004; grey diamonds are 2009 readings, and black squares are 2010 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Recommendations

While the Rum River's water quality is generally good, it does show some deterioration in the downstream areas that are most developed. Protection of the Rum River should be a high priority for local officials. Large population increases are expected for the Rum River's watershed within Anoka County and have the potential to degrade water quality unless carefully sited and managed. Development pressure is likely to be especially high near the river because of its scenic and natural qualities. Measures to maintain the Rum River's good water quality should include:

- Enforce the building and clear-cutting setbacks from the river required by state scenic rivers laws to avoid bank erosion problems and protect the river's scenic nature.
- Use the best available technologies to reduce pollutants delivered to the river and its tributaries through the storm sewer system. Any new development should consider low impact development strategies that minimize stormwater runoff production. Aggressive stormwater treatment should be pursued in all areas of the watershed, not just those adjacent to the river. The area's soils are well suited to stormwater treatment by infiltration.
- Seek improvements to the existing stormwater conveyance system below County Road 7. Total suspended solids in the river increase significantly in this portion of the watershed, reaching their highest concentrations during storms.
- Utilize all practical means to reduce road deicing salt applications. These may include more efficient application methods, application only in priority areas, alternate chemicals, or others. Road salt infiltration into the shallow groundwater has become a regional problem. Deicing salts are apparent year-round in the groundwater that feeds area streams.
- Survey the river by boat for bank erosion problems and initiate projects to correct them.
- Continue education programs to inform residents of the direct impact their actions have on the river's health.
- Continue regular water quality monitoring. 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. 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 do this watershed-level monitoring and should coordinate.

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.

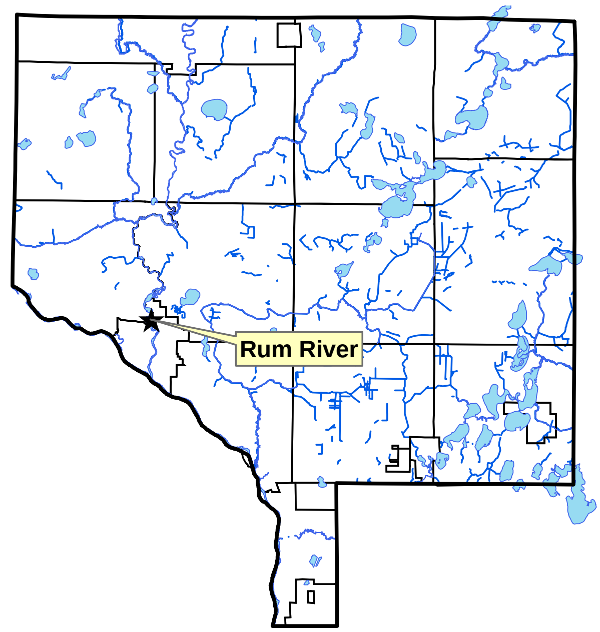
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

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 2010

Monitored Since

2001

Student Involvement

40 students in 2010, approximately 410 since 2001

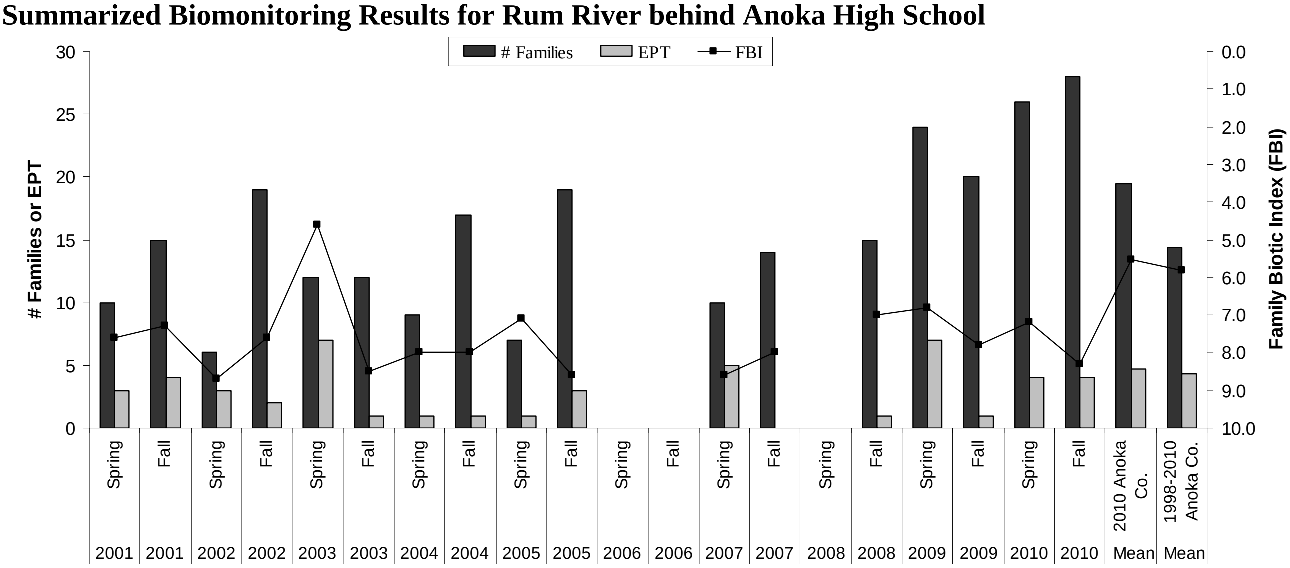
Background

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

Results

Anoka High School monitored this site in both spring and fall 2010. The results for this site in 2010 were slightly better than most previous years, though this may be due to doubling of the number of students sampling compared to previous years. In 2010 more families (26 and 28) were found than ever before at this site, nearly double the county-wide average. Larger rivers generally have more families than smaller streams. In the spring and fall four pollution-sensitive EPT families were found. Because most species were not particularly sensitive to pollution, the Family Biotic Index was lower than the county average and similar to previous years. One likely reason few sensitive families were found is that sampling was in a mucky backwater. More may have been found in the main channel.

Summarized Biomonitoring Results for Rum River behind Anoka High School



Biomonitoring Data for Rum River at Anoka High School

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2006	2006	2007	2007	2008	2008	2009	2009	2010	2010	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	2010 Anoka Co.	1998-2010 Anoka Co.
FBI			8.60	8.00		7.00	6.80	7.80	7.20	8.30	5.5	5.8
# Families			10	14		15	24	20	26	28	19.4	14.3
EPT			5	0		1	7	1	4	4	4.7	4.3
Date			7-May	22-Oct		13-Oct	8-May	28-Sep	18-May	7-Oct		
Sampled By			AHS	AHS		AHS	AHS	AHS	AHS	AHS		
Sampling Method			MH	MH		MH	MH	MH	MH	MH		
Mean # Individuals/Rep.			208	244		626	880	585	443	816		
# Replicates			1	1		1	1	2	1	1		
Dominant Family			Corixidae	Coenagrionidae		Baetidae	Siphlonuridae	Hyalellidae (formerly Talitridae)	Gastropoda	Hyalellidae (formerly Talitridae)		
% Dominant Family			91.8	37.3		26.5	40.7	39.1	31.8	34.1		
% Ephemeroptera			5.3	0		26.5	48.2	0.9	8.1	0.9		
% Trichoptera			0	0		0	0.1	0	0	0.2		
% Plecoptera			0.5	0		0	2.6	0	0.5	0		

Supplemental Stream Chemistry Readings

Data presented from the most recent five years. Contact the ACD to request archived data.

Parameter	5/7/2007	10/22/2007	10/10/2008	5/8/2009	9/28/2009	5/18/2010	10/7/2010
pH	8.5	7.42	7.75	7.91	7.82	7.24	7.22
Conductivity (mS/cm)	0.283	0.243	0.348	0.276	0.421	0.207	0.399
Turbidity (NTU)	17	13	3	6	5	7	7
Dissolved Oxygen (mg/L)	11.41	9.72	8.99	10.82	8.76	6.93	na
Salinity (%)	0.01	0	0.01	0.01	0.01	0	0.01
Temperature (°C)	15.3	10.6	12.3	17.2	15.5	14.8	12.2

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 diversity has been high in recent samplings, but the biotic indices indicate a poorer than average river health. The reason for this dramatic difference is probably habitat differences, and to a lesser extent, water quality.

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

Water quality declines downstream, though it is still quite good at all locations. Chemical monitoring in 2004, 2009, and 2010 revealed that total suspended solids, conductivity, and chlorides were all higher near Anoka than upstream. This is probably due to more urbanized land uses 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 the City of 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 21 wetland hydrology monitoring stations.

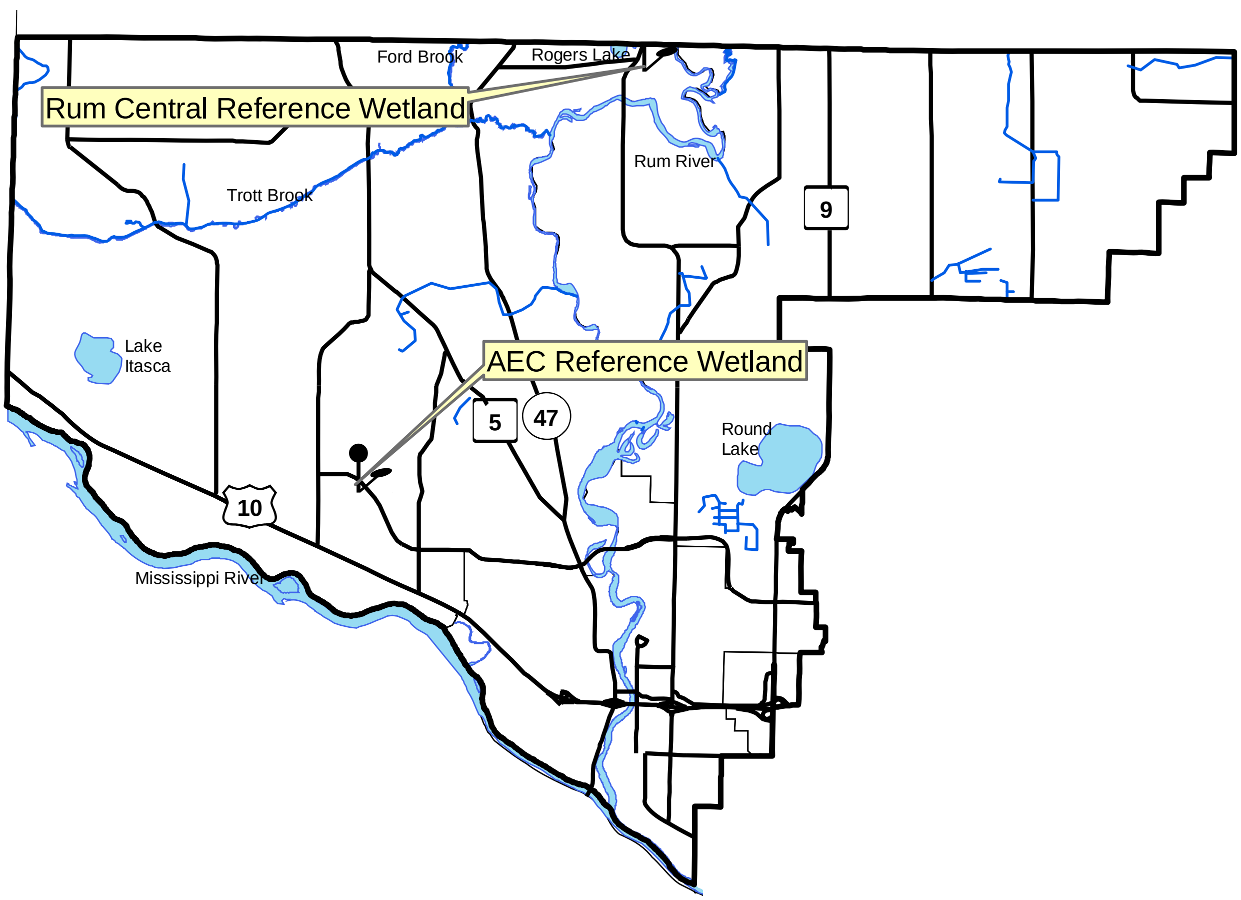
Purpose: To provide understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

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

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

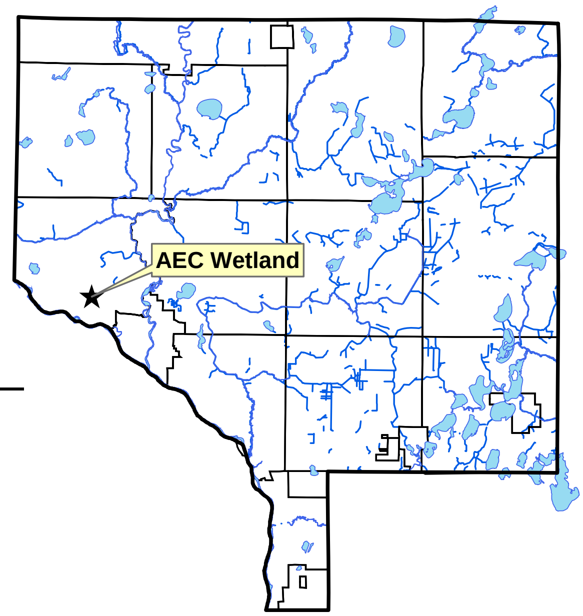
Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

Lower Rum River Watershed Wetland Hydrology Monitoring Sites



AEC Reference Wetland

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



Site Information

Monitored Since: 1999

Wetland Type: 3

Wetland Size: ~18 acres

Isolated Basin? No, probably receives storm water

Connected to a Ditch? No

Soils at Well Location:

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

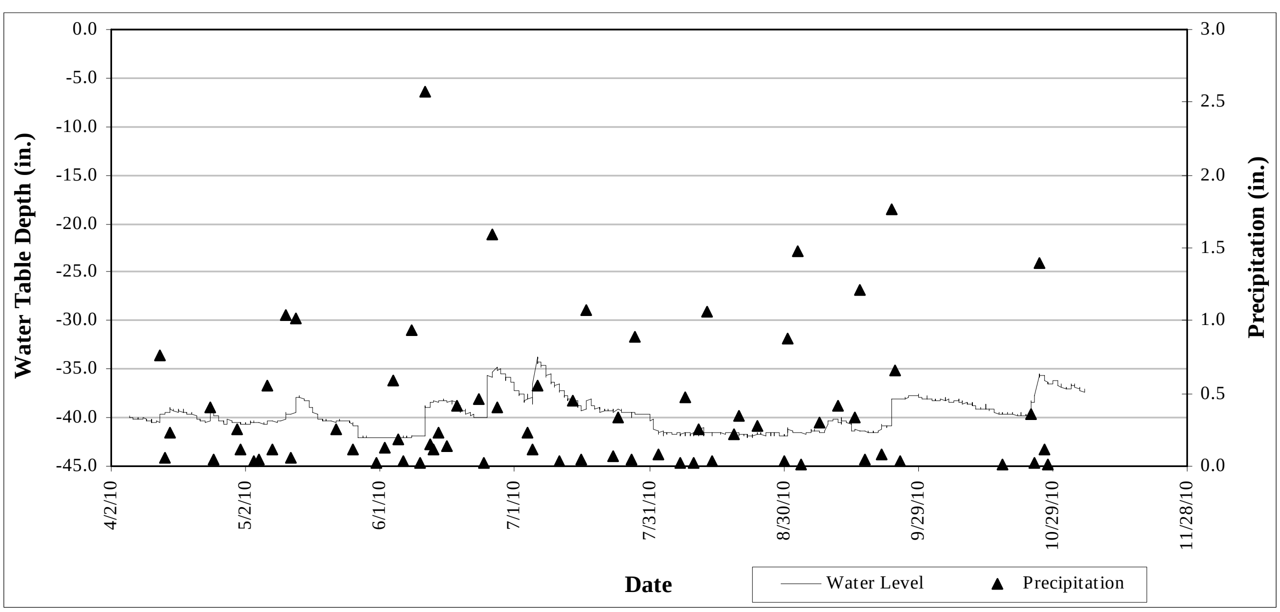
Surrounding Soils: Hubbard coarse sand

Vegetation at Well Location:

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

Other Notes: Well is located at the wetland boundary.

2010 Hydrograph

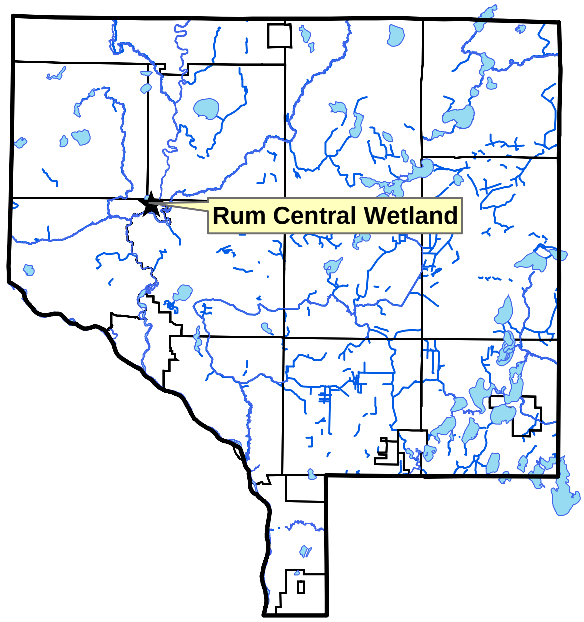


Well depth was 42 inches, so a reading of –42 indicates water levels were at an unknown depth greater than or equal to 42 inches.

Wetland Hydrology Monitoring

RUM RIVER CENTRAL REFERENCE WETLAND

Rum River Central Regional Park, Ramsey



Site Information

Monitored Since: 1997

Wetland Type: 6

Wetland Size: ~0.8 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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

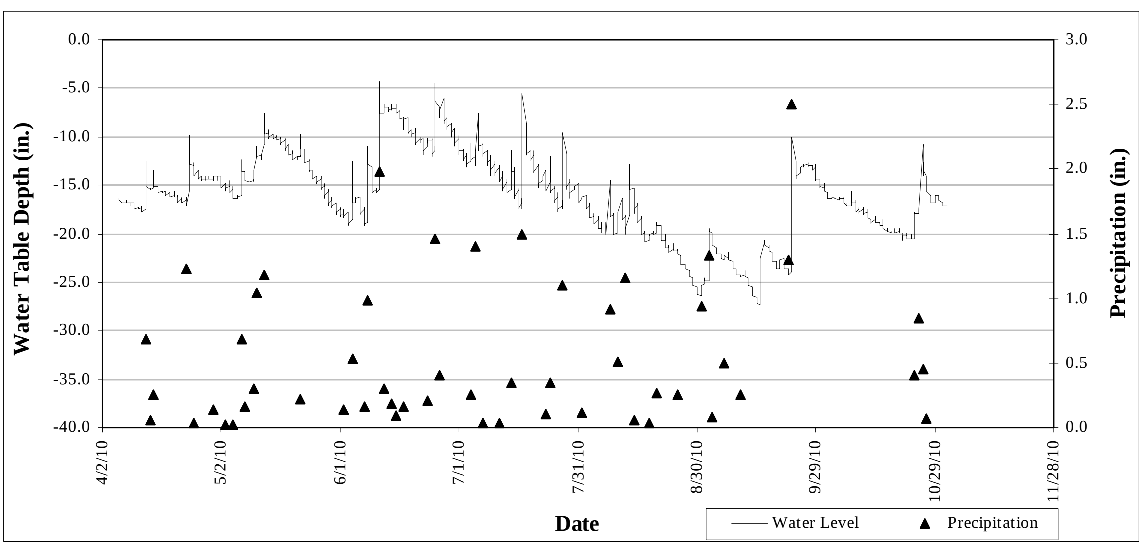
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

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

Other Notes: Well is located at the wetland boundary.

2010 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.

Water Quality Grant Fund

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

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

Results: Projects reported in the year they are installed. No projects were installed in 2010.

LRRWMO Cost Share Fund Summary

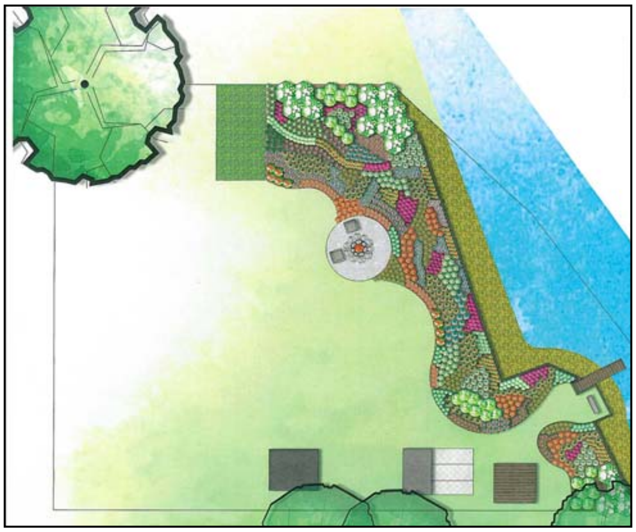
2006 LRRWMO Contribution	+	$1,000.00
2008 Expense – Herrala Rum Riverbank stabilization	-	$ 150.91
2008 Expense – Rusin Rum Riverbank stabilization	-	$ 225.46
2009 LRRWMO Contribution	+	$1,000.00
2009 Expense – Rusin Rum Riverbank bluff stabilization	-	$ 52.05
2010 LRRWMO Contribution	+	$ 0
2010 LRRWMO Expenses	-	$ 0
Fund Balance		**$1,571.58**

Water Quality Improvement Projects

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

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

Results: Projects are described in a separate report produced by the Anoka Conservation District.



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.

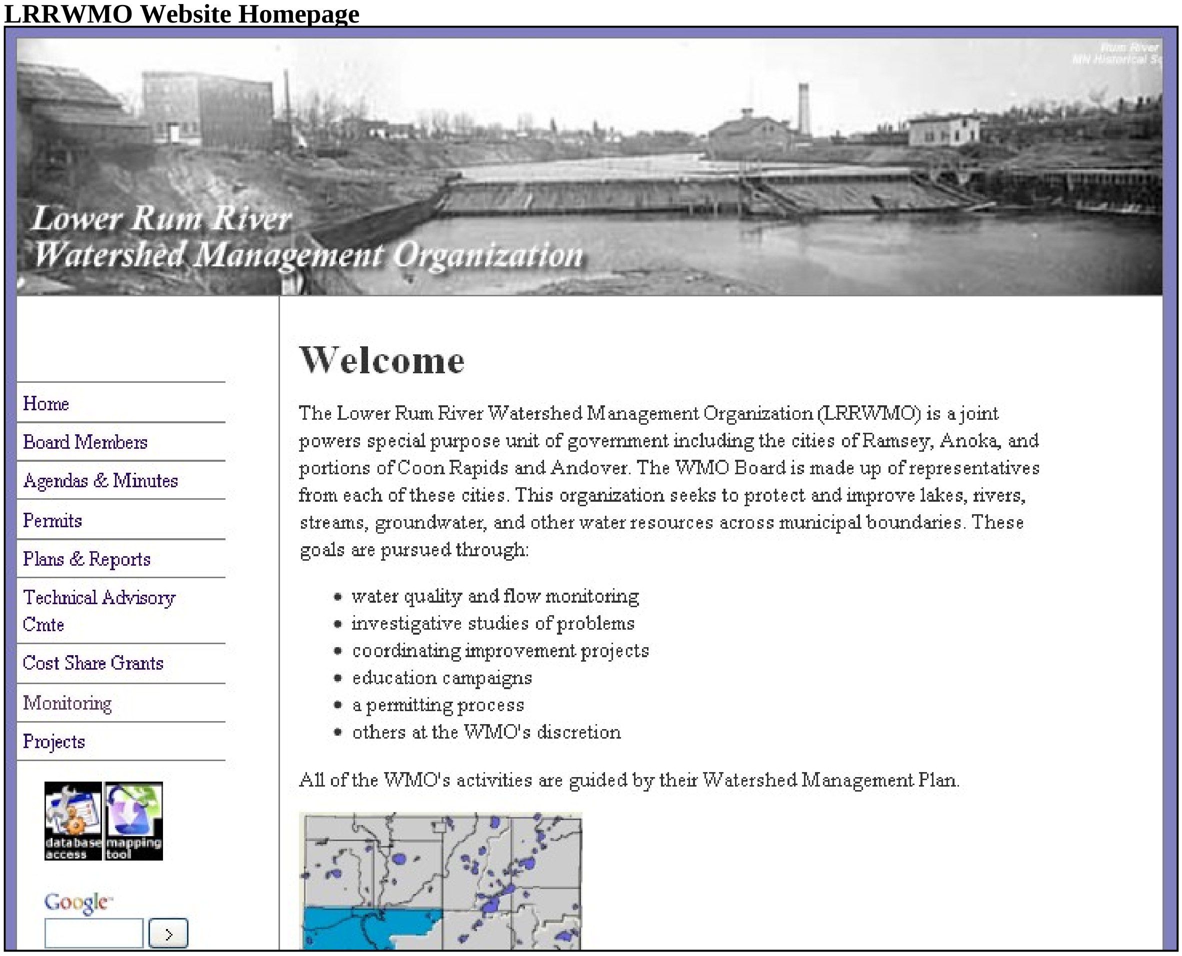
Information about the LRRWMO includes:

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

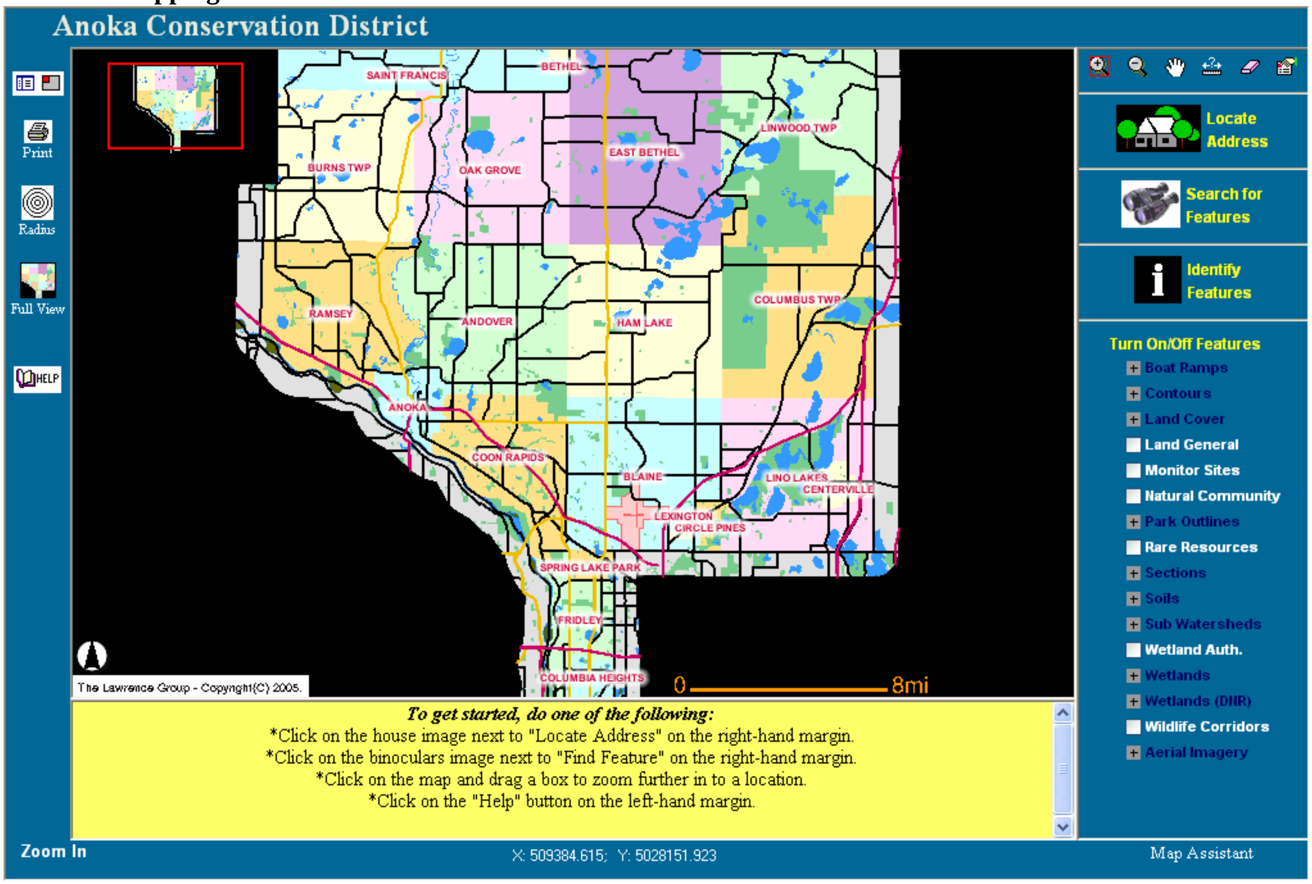
Other tools on the website include:

- 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

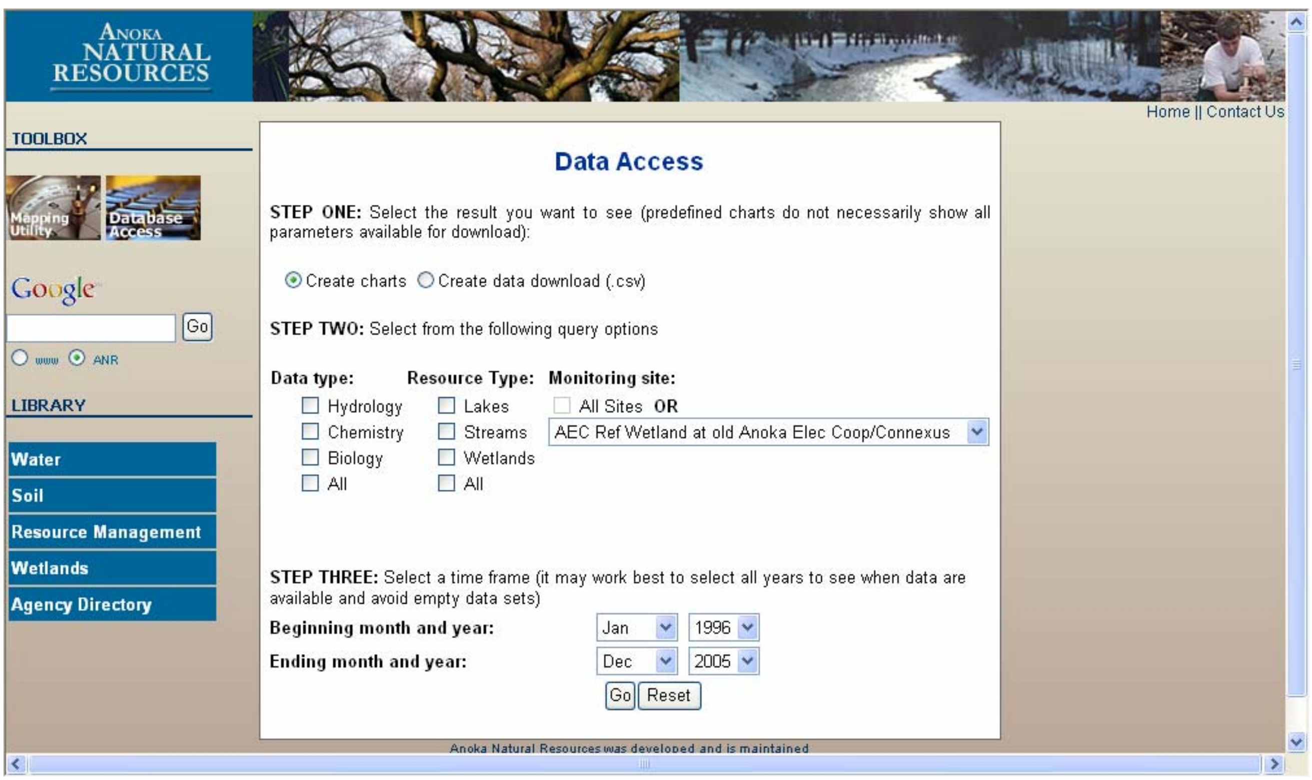
LRRWMO Website Homepage



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. We do not, however, know specifically which expenses are attributed to monitoring which sites. 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.

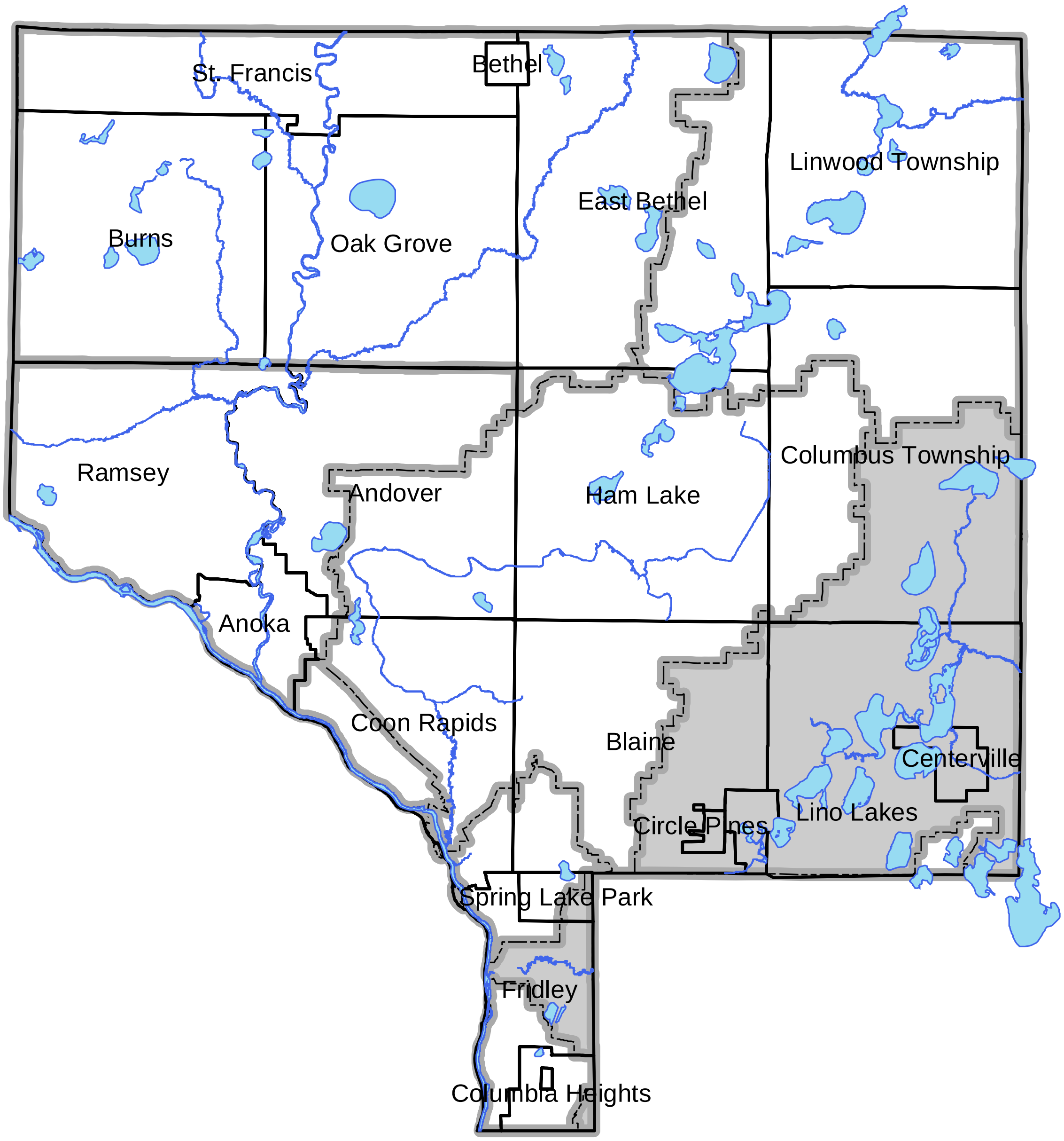
Lower Rum River Watershed Financial Summary

Lower Rum River Watershed	Website	Volunteer Precip	Ref Wet	Lake Lvl	Obwell	Lake WQ	Stream WQ	WO MP	Student Bio	Geologic Atlas	Total
Revenues											
LRRWMO	540	0	535	450	0	1025	1560	0	780	0	4890
State	0	0	0	0	110	0	0	0	0	0	110
Anoka Conservation District	2699	115	36	347	181	34	12	1744	365	1137	6672
County Ag Preserves	0	0	0	0	0	490	0	0	264	0	754
Regional/Local	0	0	0	0	0	0	0	500	0	0	500
Other Service Fees	194	0	0	0	0	0	0	0	0	0	194
Local Water Planning	0	0	0	0	0	1306	84	0	0	0	1389
TOTAL	3433	115	571	797	291	2855	1656	2244	1408	1137	14508
Expenses-											
Capital Outlay/Equip	243	14	44	42	34	396	118	394	50	119	1455
Personnel Salaries/Benefits	1767	80	420	617	203	1595	852	1433	1091	755	8812
Overhead	1296	15	68	89	39	640	381	314	140	204	3186
Employee Training	14	1	3	5	2	10	4	6	11	3	60
Vehicle/Mileage	27	1	6	9	3	26	14	24	16	12	137
Rent	83	4	23	33	10	66	59	70	52	43	443
Program Participants	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	1	0	7	0	0	97	209	4	47	1	366
Equipment Maintenance	1	0	0	1	0	24	19	1	1	1	48
TOTAL	3433	115	571	797	291	2855	1656	2244	1408	1137	14508
NET	0	0	0	0	0	0	0	0	0	0	0

Recommendations

- **Continue monitoring Round Lake** water quality at least every other year to determine if poorer water quality recently is within this lake's natural variation, due to low water levels, or is indicative of new negative influences on the lake.
- **Emphasize protection of Rum River water quality.** The river's water quality declines slightly in the LRRWMO and anticipated future development could cause further deterioration. Continued retrofitting existing stormwater treatment in built-up areas is recommended.
- **Continue coordinating monitoring of the Rum River** with the neighboring Upper Rum River WMO and the Metropolitan Council, who runs a monitoring site at the Anoka Dam.
- **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 problems.
- **Facilitate resident efforts to control aquatic plant growth on Rogers Lake** as a means to improving low dissolved oxygen problems. Treatments should occur in early spring, occur on no more than 15% of the lake, be coordinated, and proceed under DNR permits. In early 2010 a meeting for residents was held, interest expressed, but coordination and work needed by residents did not materialize.
- **Continue the existing cost share grant 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 and elsewhere nearby have shown that road salts are a serious and widespread sources of stream degradation.
- **Promote groundwater conservation.** Water tables in the LRRWMO appear depressed due to regional over-pumping. Metropolitan Council models predict 3+ft drawdown of surface waters in certain areas by 2030, and 5+ft by 2050.
- **Incorporate the above recommendations into the LRRWMO Watershed Plan**. The Plan is being updated in 2010-11.

Rice Creek Watershed



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

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

CHAPTER 5: RICE CREEK WATERSHED

Task	Partners	Page
Lake Levels	RCWD, ACD	5-112
Wetland Hydrology	RCWD, ACD	5-114
Stream Water Quality – Biological	RCWD, ACD, ACAP, Centennial HS, Forest Lake Area Learning Center, Totino Grace HS	5-117
Water Quality Grant Administration	RCWD, ACD	5-124
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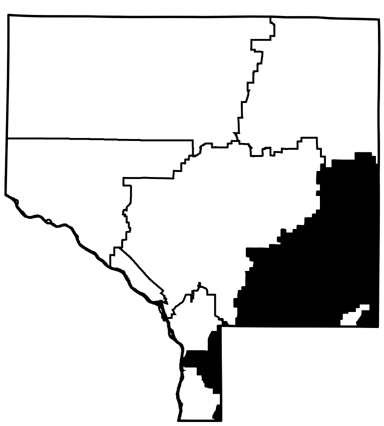
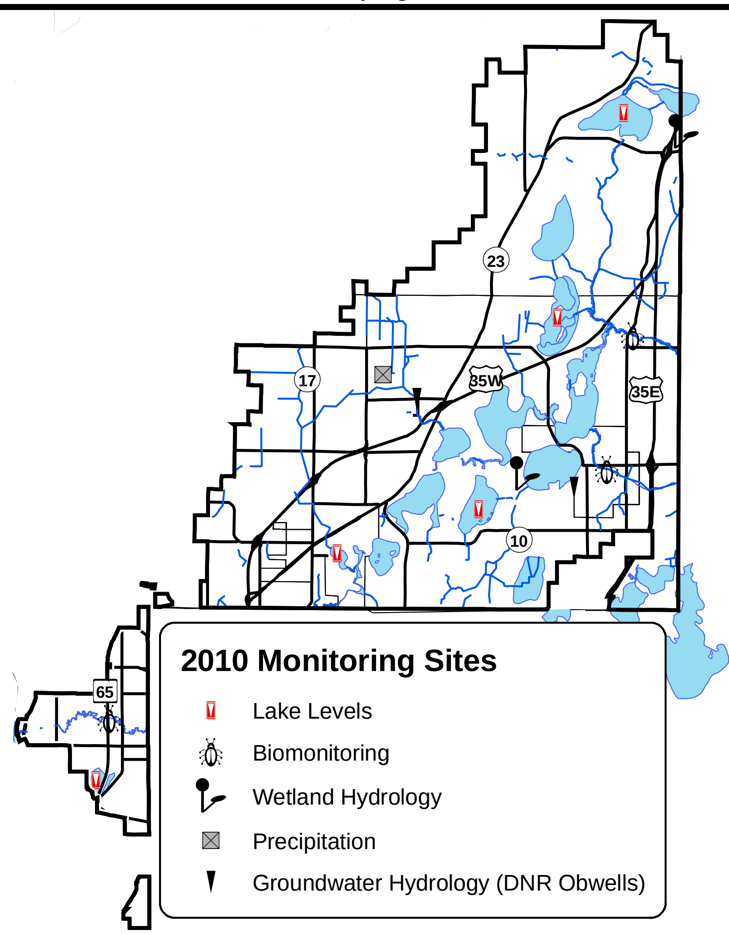
Recommendations		5-127
Precipitation	ACD, volunteers	see Chapter 1
Ground Water Hydrology (obwells)	ACD, MNDNR	see Chapter 1
Additional work not reported here	RCWD	contact RCWD

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





Lake Levels

Description: Weekly water level monitoring in lakes. The past five years are shown below, and all historic data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

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

Locations: Golden Lake, Howard Lake, Moore Lake, Reshanau Lake, and Rondeau Lake

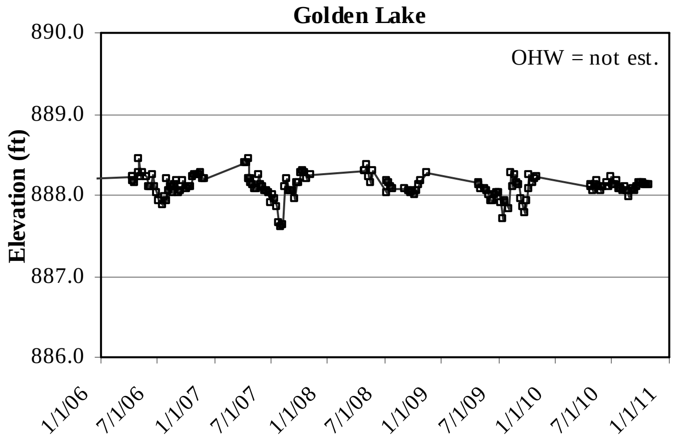
Results: Lake levels were measured by volunteers 20 to 43 times in 2010, depending upon the lake. The average lake level increased in all lakes except Rondeau Lake between 2009 and 2010. Howard, Moore, Reshanau, and Golden Lakes increased by 0.73 feet, 0.55 feet, 0.14 feet, and 0.08 feet, respectively. These increases were likely driven by the above average rainfall in 2010. In contrast, the average level in Rondeau lake decreased by 0.33 feet over the past year.

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

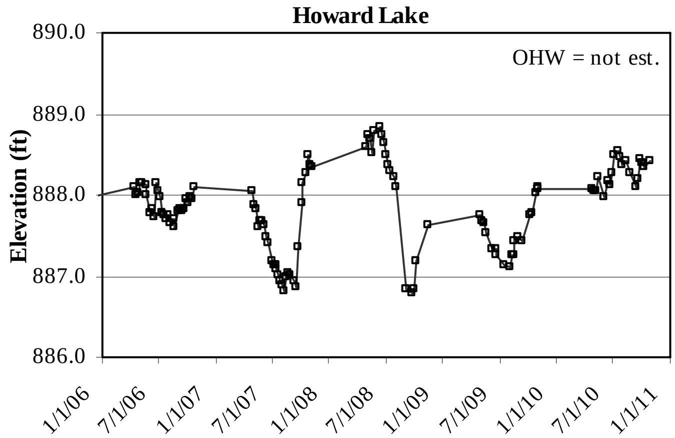
Rice Creek Watershed Lake Levels Summary 2006-2010

Lake	Year	Average	Min	Max
Golden	2006	888.14	887.88	888.44
	2007	888.09	887.60	888.44
	2008	888.15	888.01	888.37
	2009	888.03	887.70	888.26
	2010	888.11	887.98	888.22
Howard	2006	887.90	887.60	888.15
	2007	887.49	886.81	888.50
	2008	888.13	886.79	888.85
	2009	887.54	887.11	888.09
	2010	888.27	887.98	888.54
Moore	2006	877.25	876.93	877.81
	2007	876.99	876.21	877.71
	2008	877.10	876.64	877.66
	2009	876.96	876.47	877.55
	2010	877.51	877.28	878.06
Reshanau	2006	880.99	880.38	882.13
	2007	880.88	879.36	881.74
	2008	incomplete data		
	2009	881.03	880.58	881.58
	2010	881.17	880.80	881.52
Rondeau	2006	886.18	885.61	886.88
	2007	885.83	885.13	886.67
	2008	incomplete data		
	2009	885.93	885.47	886.41
	2010	885.60	885.27	886.33

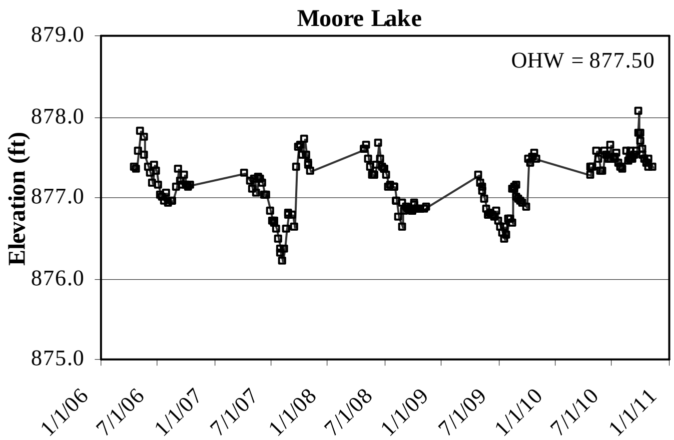
Golden Lake Levels 2006-2010



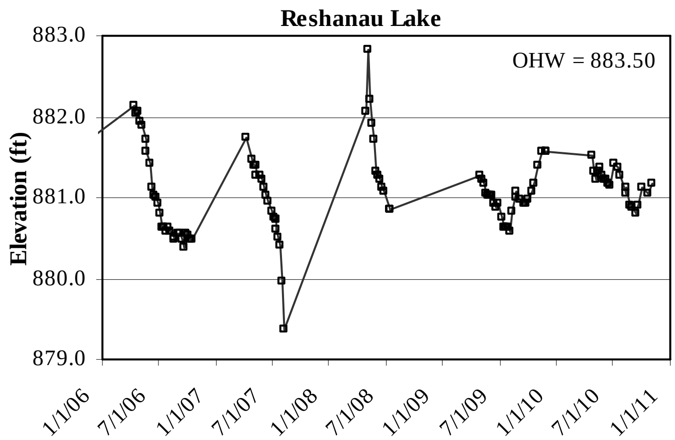
Howard Lake Levels 2006-2010



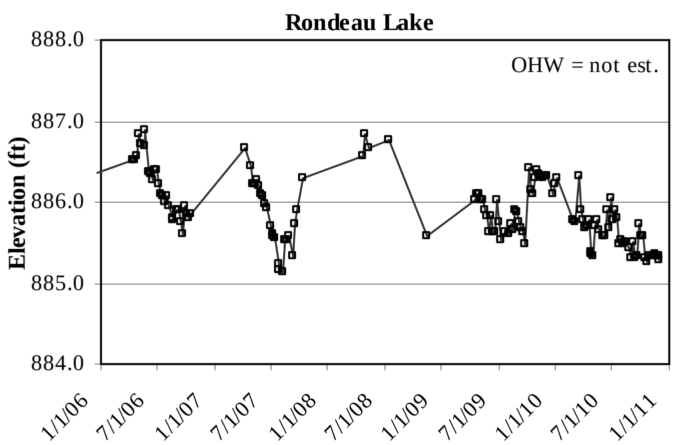
Moore Lake Levels 2006-2010



Reshanau Lake Levels 2006-2010



Rondeau Lake Levels 2006-2010



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.

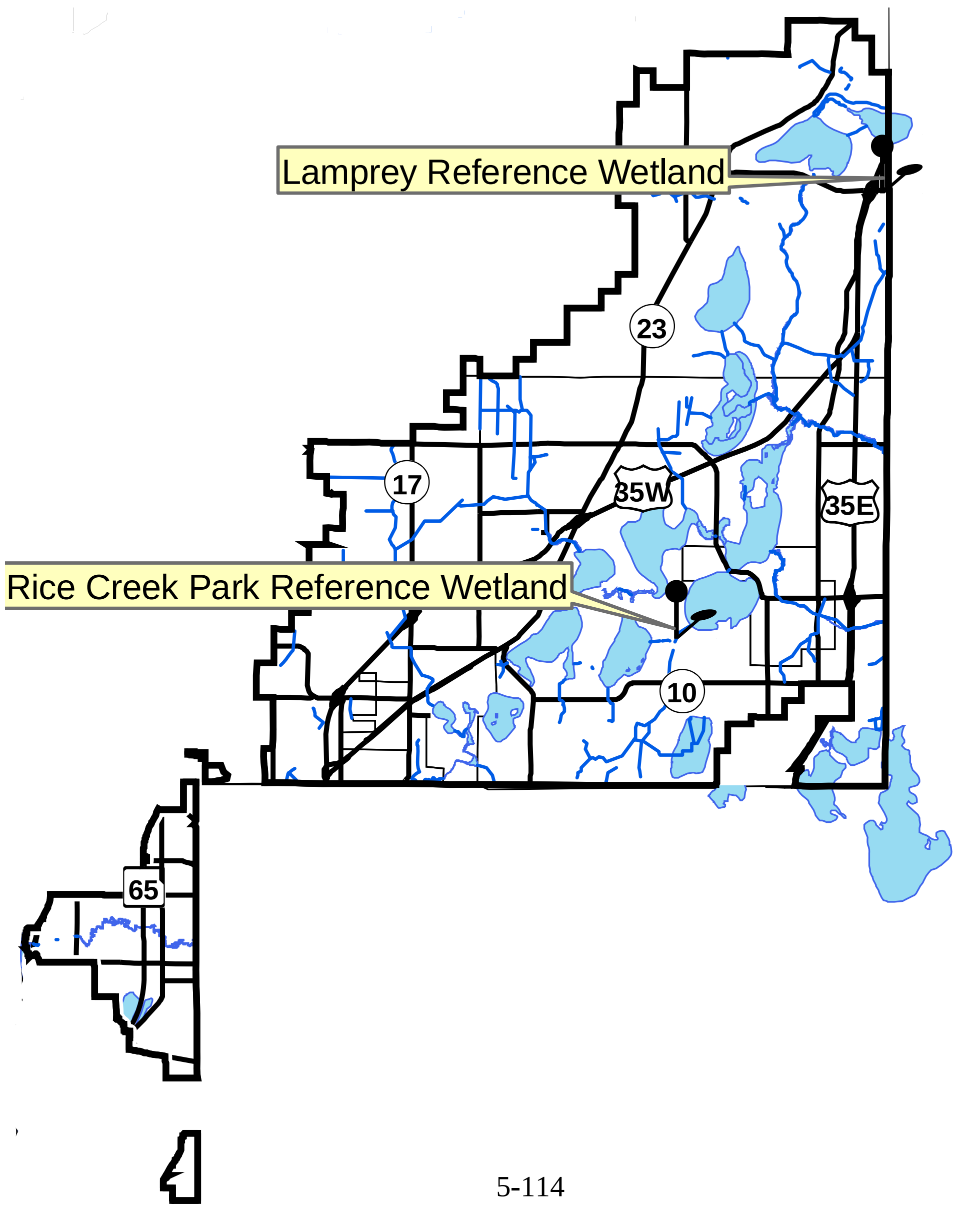
Purpose: To provide an understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

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

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

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

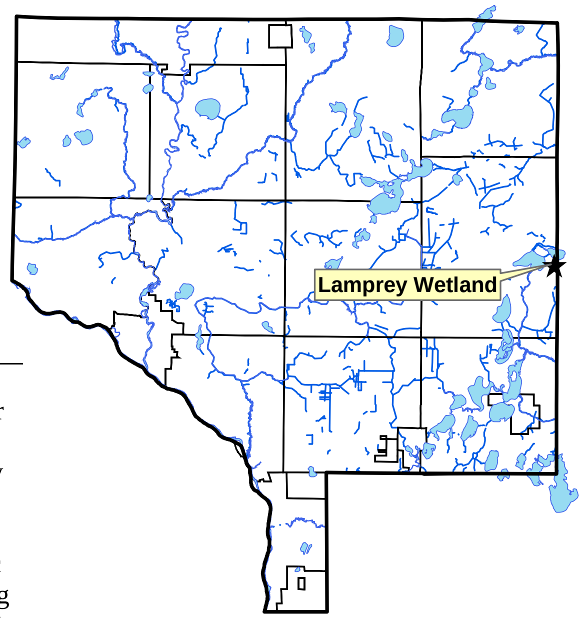
Rice Creek Watershed Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

LAMPREY REFERENCE WETLAND

Lamprey Pass Wildlife Mgmt Area, Columbus



Site Information

Monitored Since: 1999

Wetland Type: 4

Wetland Size: ~0.5 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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

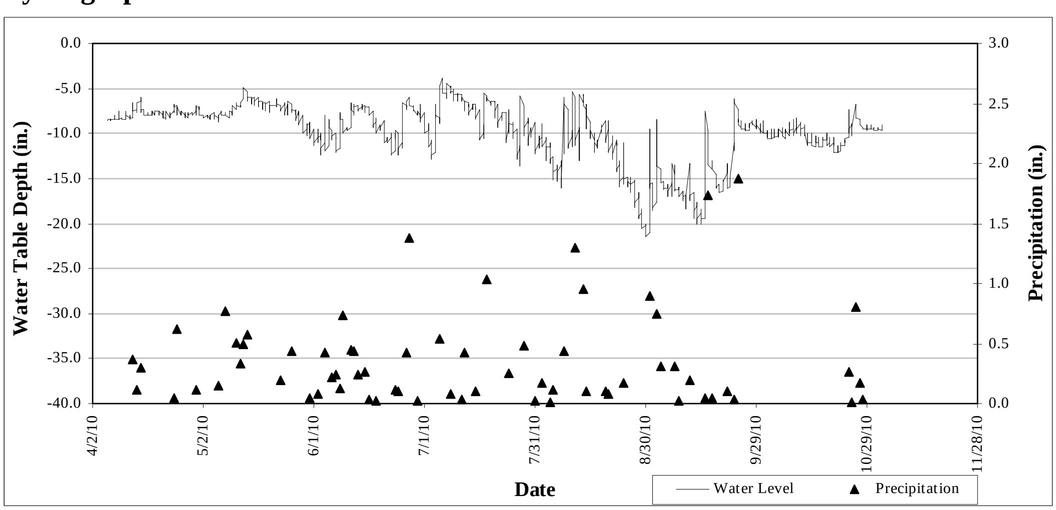
Surrounding Soils: Braham loamy fine sand

Vegetation at Well Location:

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

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

2010 Hydrograph

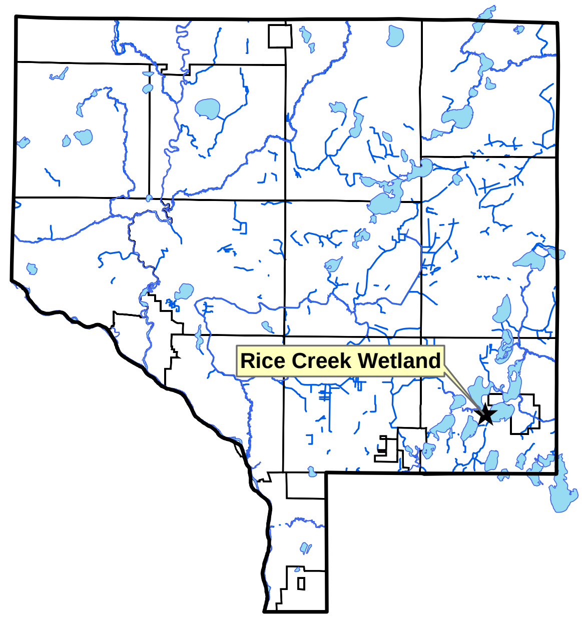


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

RICE CREEK REFERENCE WETLAND

Rice Creek Chain of Lakes Regional Park, Lino Lakes



Site Information

Monitored Since: 1996

Wetland Type: 7

Wetland Size: ~0.5 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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

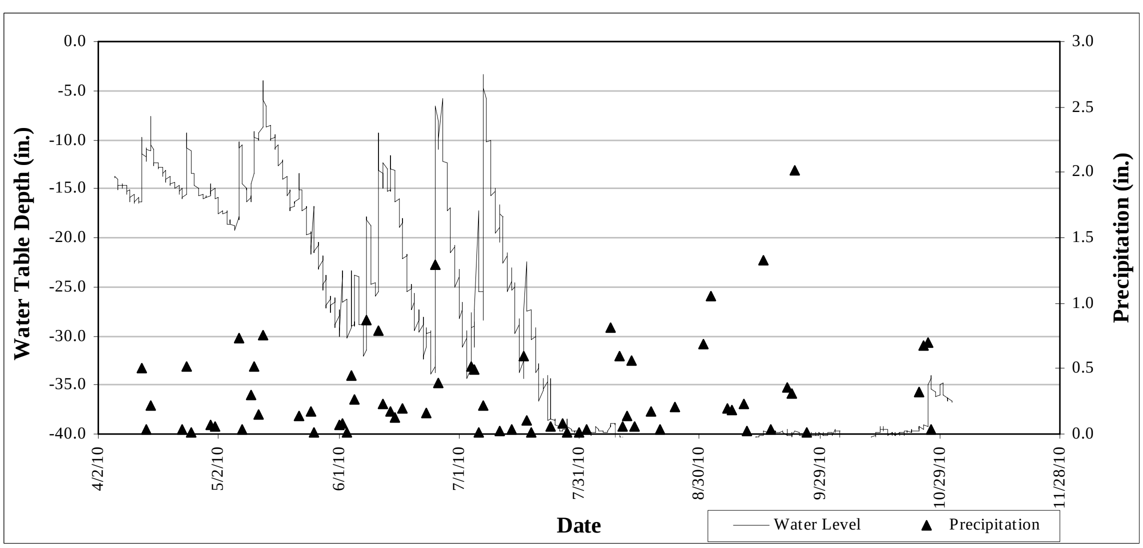
Surrounding Soils: Nessel fine sandy loam and Blomford loamy fine sand

Vegetation at Well Location:

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

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

2010 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.

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 several locations, 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.

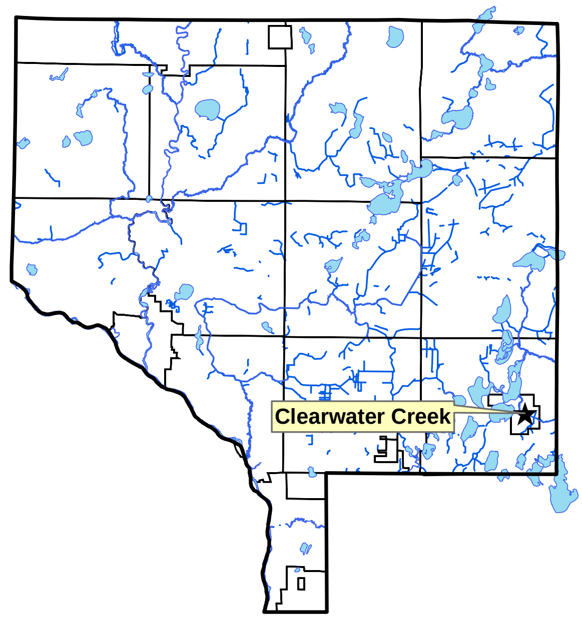
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

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 indicate an uneven community, and likely poorer stream health.

CLEARWATER CREEK

at Centerville City Hall, Centerville



Last Monitored

By Centennial High School in 2010

Monitored Since

1999

Student Involvement

43 students in 2010, approximately 530 since 2001

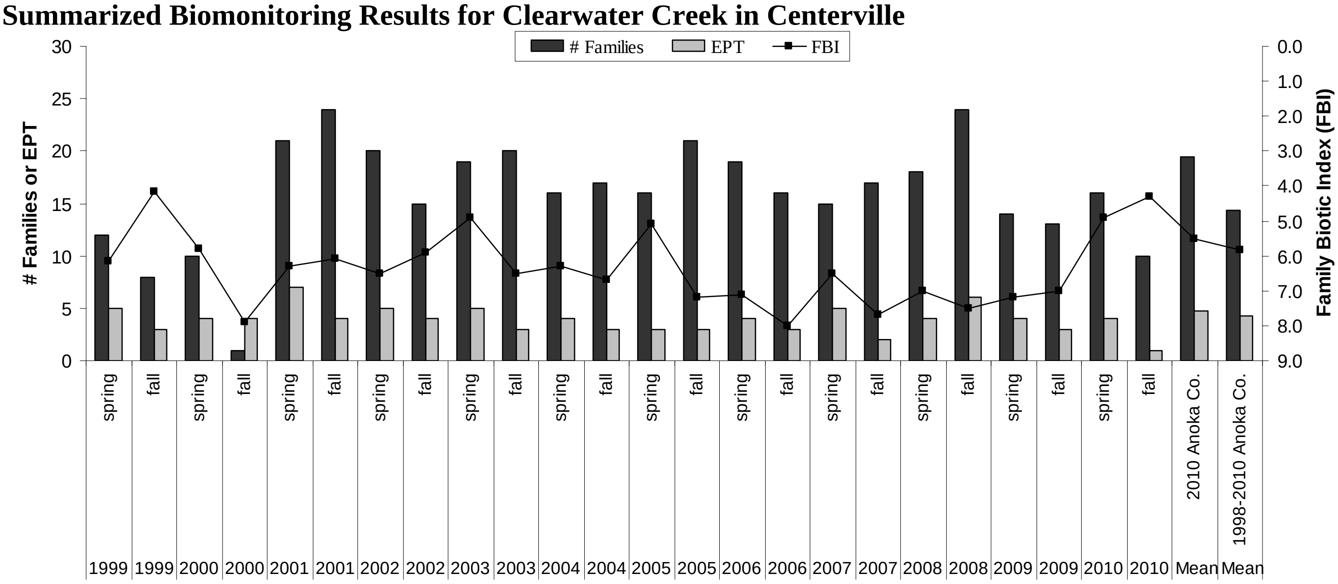
Background

Clearwater Creek originates from Bald Eagle Lake in northwest Ramsey County and flows northwest into Peltier Lake. Land use is an approximately equal mix of residential and vacant/agricultural with some small commercial sites. The land use immediately surrounding the sampling site is entirely residential and developed, however in late summer 2007 a major city reconstruction project began near the stream monitoring site in Centerville, and large areas were 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 2010, with oversight by the Anoka Conservation District. Overall, this stream has average or slightly below average conditions based upon the biological data. Data from 2010 represented an interesting deviation from previous years. A dramatic decrease in the family biotic index (FBI) was noted in both the spring and fall 2010 samplings. The lower FBI value suggests an increase in pollution tolerant species. However, this change was likely driven by the dominance of the invertebrate community by Gammaridae, which has a moderate tolerance value of four. Gammaridae comprised 77.7% and 89.7% of the invertebrate community in the spring and fall of 2010, respectively. Comparison of total number of families and EPT with previous years suggests the overall stream health is similar to previous years.

Summarized Biomonitoring Results for Clearwater Creek in Centerville



Biomonitoring Data for Clearwater Creek in Centerville

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2006	2006	2007	2007	2008	2008	2009	2009	2010	2010	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	2010 Anoka Co.	1998-2010 Anoka Co.
FBI	7.10	8.00	6.50	7.70	7.00	7.50	7.20	7.00	4.9	4.3	5.5	5.8
# Families	19	16	15	17	18	24	14	13	16	10	19.4	14.3
EPT	4	3	5	2	4	6	4	3	4	1	4.7	4.3
Date	18-May	3-Oct	18-May	9-Oct	8-May	1-Oct	20-May	9-Oct	14-May	6-Oct		
Sampled By	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	211	238	213	200	180	450	238	386	664	532		
# Replicates	1	1	1	1	1	1	1	1	1	1		
Dominant Family	Coenagrionidae	Corixidae	Chironomidae (other)	Corixidae	Simuliidae	Corixidae	Hyalellidae	Corixidae	Gammaridae	Gammaridae		
% Dominant Family	22.3	64.7	20.2	53	27.8	42.3	26.1	53.9	77.7	89.7		
% Ephemeroptera	24.6	6.3	34.7	17.5	10.6	4.7	28.2	8.5	1.8	0.6		
% Trichoptera	0.0	0.4	0.0	0.0	2.2	0.7	0.8	2.8	0.6	0.0		
% Plecoptera	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

Data presented from the most recent five years. Contact the ACD to request archived data.

Parameter	5/18/2006	10/3/2006	5/5/2007	10/9/2007	5/5/2008	10/1/2008	5/20/2009	10/9/2009	5/14/2010	10/6/2010
pH	8.13	7.32	8.31	7.34	8	7.65	7.56	7.27	7.23	7.29
Conductivity (mS/cm)	0.451	0.578	0.639	0.4	0.452	0.607	0.699	0.558	0.788	0.701
Turbidity (NTU)	na	3	3	13	10	13	4	8	10	21
Dissolved Oxygen (mg/L)	11.52	6.18	12.57	6.52	11.84	8.74	4.85	9.25	10.31	na
Salinity (%)	0.01	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.03	0.04
Temperature (°C)	15.4	14.3	15.8	15.3	14.3	9.5	16.9	7.6	10.0	12.2

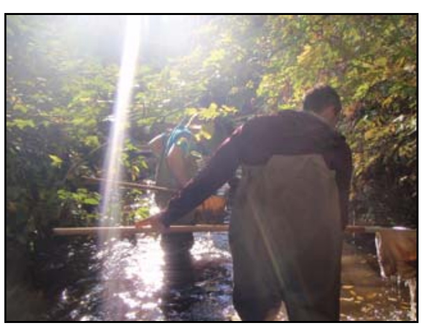
Discussion

This creek's biological community is probably limited by a combination of habitat, hydrology, and water chemistry factors. The portion of the creek that is monitored has been ditched, and is straight with steep banks, no pools or riffles, and homogeneous bottom composition. There is a strip of forested land approximately 20-50 feet wide on each side of the stream, but other areas upstream and downstream have less adjacent natural habitat. Flows are generally slow and water levels are low during much of the year, such that the stream sides are seldom submerged to provide habitat. When higher water does occur, it is usually during large storms. In our supplemental water chemistry measurements we have found occasions when one or more water quality parameters are substandard, but not necessarily during storms when runoff to the creek would be greatest. For example, a highly turbid condition was noted in October 2004 during a baseflow period when the water was barely moving. Likewise, high conductivity values in 2006, 2007, 2008, 2009, and 2010 were during low water levels. Overall, this creek seems to provide enough habitat and good enough water quality for a variety of pollution-tolerant invertebrates, but more sensitive varieties are unable to survive.

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

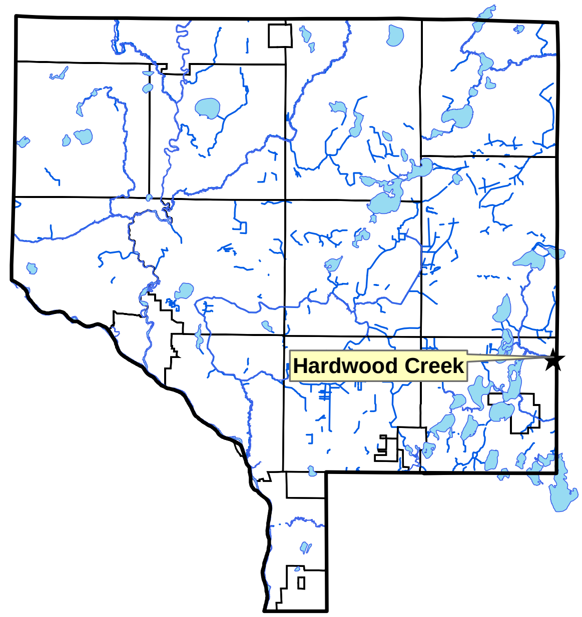
A decrease in total number of families observed in 2009, and continued in 2010. From 2001 to 2008 the number of families found ranged from 15 to 24. In spring and fall 2009, 14 and 13 families were found. In spring and fall 2010 16 and 10 families were found. The number observed during the fall of 2010 (10) was the lowest since the spring of 2000. The reason for the decrease is unknown.

Centennial High School students at Clearwater Creek in 2010.



HARDWOOD CREEK

see list of monitoring locations below



Last Monitored

By Forest Lake Area Learning Center in 2010

Monitored Since

1999 to Fall 2007 at Hwy 140
Fall 2007 at 165th Ave NW
2008 SW of intersection of 170th St and Fenway Ave
2009-10 at Cecelia LaRoux property 600 m W of I-35

Student Involvement

14 students in 2010, approximately 186 since 2001

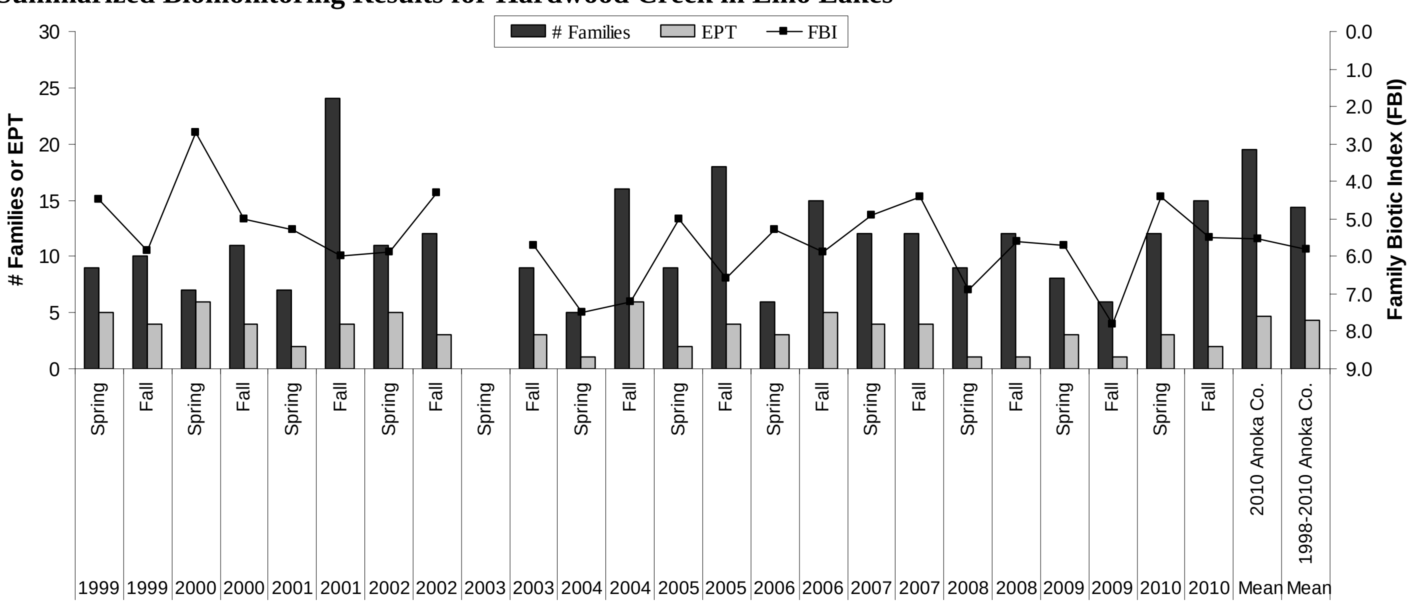
Background

Hardwood Creek originates in Washington County and flows west to Rice Creek and the Rice Creek Chain of Lakes. This is a small creek with a width at baseflow of approximately 10-15 feet and depth of approximately 6-12 inches. The surrounding land use is primarily agricultural, with some residential areas. The stream bottom is sand, gravel, and some cobble in some locations such as at Highway 140 where the creek was monitored until fall 2007. The 2009-10 monitoring site was the subject of a recent stream restoration project. All other monitoring sites have had poor habitat.

Results

Forest Lake Area Learning Center classes monitored Hardwood Creek in the spring and fall 2010, facilitated by the Anoka Conservation District. This site was the subject of a recent stream restoration project that included rock veins, brush bundles, and willow staking. Comparing same-site monitoring in 2009 and 2010, there is an improvement in 2010. This may be due to maturing of the stream rehabilitation project that was done around 2008, or it may simply reflect normal variation. Examining all years and all sites biological data indicate poorer than average stream health.

Summarized Biomonitoring Results for Hardwood Creek in Lino Lakes



Biomonitoring Data for Hardwood Creek in Lino Lakes

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2006	2006	2007	2007	2008	2008	2009	2009	2010	2010	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	2010 Anoka Co.	1998-2010 Anoka Co.
FBI	5.30	5.90	4.90	4.40	6.90	5.60	5.70	7.80	4.40	5.50	5.5	5.8
# Families	6	15	12	12	9	12	8	6	12	15	19.4	14.3
EPT	3	5	4	4	1	1	3	1	3	2	4.7	4.3
Date	10-May	10-Oct	8-May	5-Oct	15-May	8-Oct	19-May	8-Oct	5-May	14-Oct		
Sampled By	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	136	243	290	80	440	159	400	391	290	110		
# Replicates	1	1	1	1	1	1	1	1	1	1		
Dominant Family	Hydropsychidae	Heptageniidae	Baetidae	Heptageniidae	Simuliidae	Dystidae	Simuliidae	Corixidae	Baetidae	Gammaridae		
% Dominant Family	60.3	53.1	27.9	48.8	49.1	57.2	67.3	74.7	68.6	51.8		
% Ephemeroptera	5.9	44.9	39.7	60	0	0.6	19.5	0.3	69	9.1		
% Trichoptera	60.3	5.3	1.4	2.5	0.2	0	0.8	0	1.4	0		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

Data presented from the most recent five years. Contact the ACD to request archived data.

	Hwy 140 Site			165th Ave Site	Fenway Ave Site		C. LaRoux Property			
Parameter	5/10/2006	10/10/2006	5/8/2007	10/12/2007	5/15/2008	10/8/2008	5/19/2009	10/8/2009	5/5/2010	10/14/2010
pH	7.27	8.05	7.97	7.26	7.13	7.46	8.1	7.43	na	7.57
Conductivity (mS/cm)	0.409	0.5	0.4	0.326	0.361	0.431	0.426	0.37	0.457	0.509
Turbidity (NTU)	13	4	3	5	13	11	6	22	7	6
Dissolved Oxygen (mg/L)	5.45	11.99	11.95	9.1	10.88	7.14	12.3	11.5	11.6	na
Salinity (%)	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Temperature (°C)	15.4	8.5	14.5	10.4	12.4	12.4	16.5	9.7	10.4	9.8

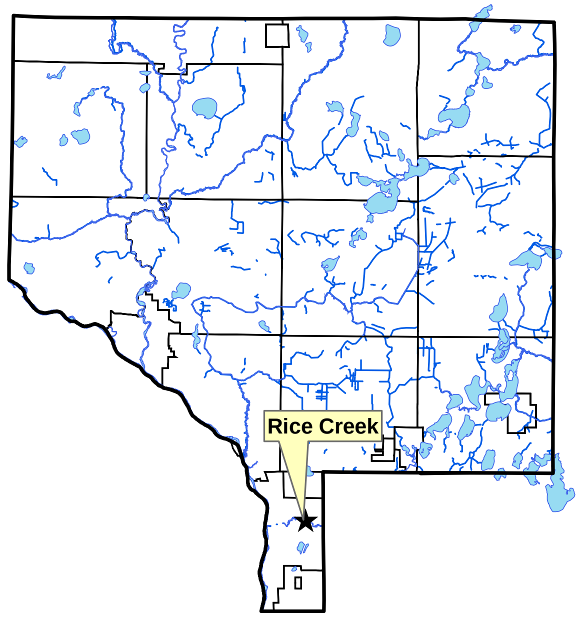
Discussion

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 has conducted a TMDL investigative study. Our biological monitoring does indicate a below-average biological community, but lends only modest insight into what might be causing this impairment. Habitat seems to be an important factor. Biological indices of stream health seemed to decline when monitoring was moved from the north side of Highway 140, where habitat was moderate to good, to Fenway Avenue where little in-stream habitat exists. Likewise, improvements between 2009 and 2010 may be partially attributable to maturing of a habitat restoration project at that site that was finished in 2008, though this is purely speculative.

Forest Lake Area Learning Center students at Hardwood Creek in 2010

RICE CREEK

at Hwy 65, Locke Park, Fridley



Last Monitored

By Totino Grace High School in fall 2010

Monitored Since

1999

Student Involvement

50 students in 2010, approximately 700 since 2001

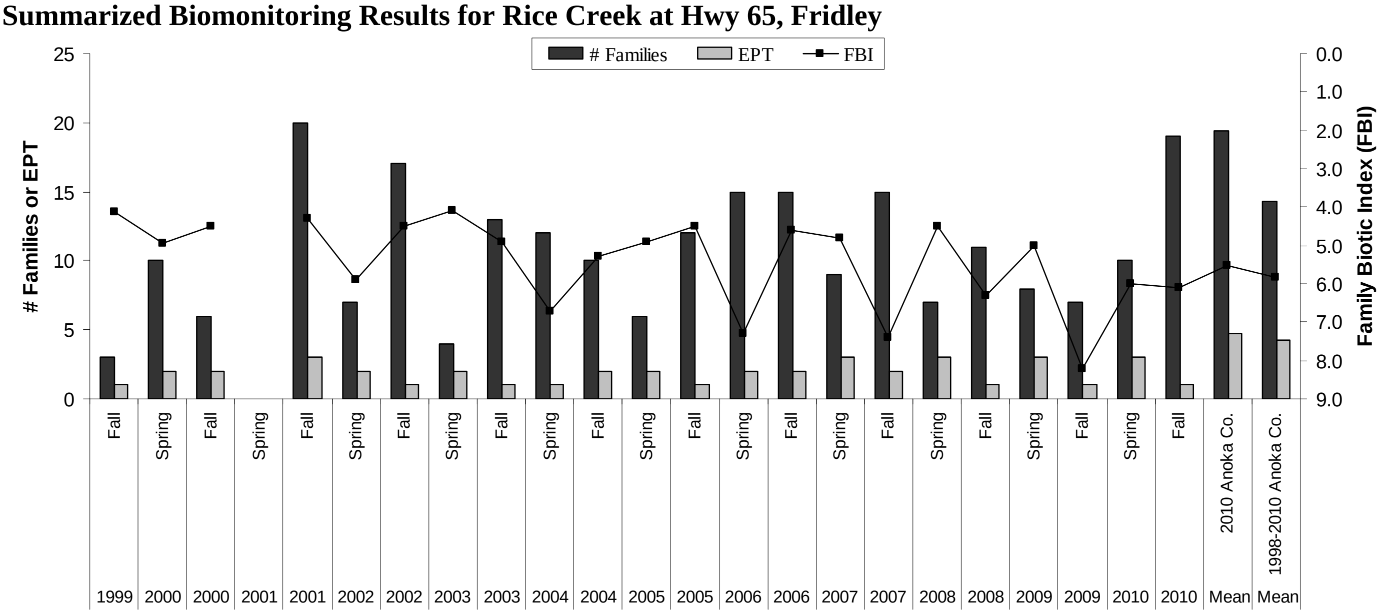
Background

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

Results

Totino Grace High School monitored this stream in fall 2010, facilitated by the Anoka Conservation District (ACD). ACD staff monitored it in spring, when class schedules prevented students from sampling. At this site Rice Creek has an impaired macroinvertebrate community. While the number of families found has been similar to the average for Anoka County streams on several occasions (fall 2010 most recently), virtually all of these are generalist species that can tolerate polluted conditions. In 2008 and 2009 an especially low number of families (7 to 11) were found even though large groups of >50 students participated on several of these occasions. Those large sampling efforts are most likely to find low-abundance families. The number of EPT families have been low in all years. EPT are generally pollution-sensitive, but the EPT family most often found in Rice Creek, the caddisfly hydropsychidae, is an exception to that rule. Hydropsychidae has been the most abundant family in 12 of 19 creek samplings, often >50% of catches.

Summarized Biomonitoring Results for Rice Creek at Hwy 65, Fridley



Biomonitoring Data for Rice Creek at Hwy 65, Fridley

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2006	2006	2007	2007	2008	2008	2009	2009	2010	2010	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	2010 Anoka Co.	1998-2010 Anoka Co.
FBI	7.30	4.60	4.80	7.40	4.5	6.3	5.0	8.2	6	6.1	0.0	0.0
# Families	15	15	9	15	7	11	8	7	10	19	0.0	0.0
EPT	2	2	3	2	3	1	3	1	3	1	0.0	0.0
Date	17-May	27-Sep	10-May	2-Oct	23-May	10-Oct	11-May	8-Oct	14-May	13-Oct		
Sampled By	ACD	TGHS	ACD	TGHS	ACD	TGHS	ACD	TGHS	ACD	TGHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	106	497	116	132	180	104	148	111	154	132		
# Replicates	1	3	1	2	1	1	1	1	1	1		
Dominant Family	Corixidae	Hydropsychidae	Baetidae	Corixidae	Baetidae	Hydropsychidae	Baetidae	Corixidae	Chironomidae (other)	Hydropsychidae		
% Dominant Family	24.5	81.7	49.1	61.2	70.0	40.0	50.0	74.8	29.2	31.1		
% Ephemeroptera	3.1	0.2	49.1	0.4	74.4	0.0	50.7	0.0	23.4	0.0		
% Trichoptera	0.0	81.7	13.8	27.6	7.2	42.3	6.8	9.0	3.2	31.1		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

Data presented from the most recent five years. Contact the ACD to request archived data.

Parameter	5/18/2006	9/27/2006	5/10/2007	10/2/2007	5/23/2008	10/10/2008	5/11/2009	10/8/2009	5/14/2010	10/13/2010
pH	8.23	7.8	8.25	7.85	8.12	7.73	8.23	4.76	7.85	7.92
Conductivity (mS/cm)	0.457	0.515	0.401	0.402	0.461	0.639	0.624	0.638	0.545	0.535
Turbidity (NTU)	na	13	65	25	15	13	16	18	13	15
Dissolved Oxygen (mg/L)	9.95	9.65	Na	9.06	9.56	9.01	12.29	10.74	12.64	na
Salinity (%)	0.01	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Temperature (°C)	16.8	14.8	20.6	16.8	19	12.9	14.5	11.2	12.8	16.5

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 in 2010.

Water Quality Grant Administration

Description: ACD worked with RCWD to develop and coordinate the implementation of a cost-share grant program for private landowners. Tasks included landowner outreach and education, site reviews, project evaluations, BMP design, contractor assistance, construction oversight, long-term project monitoring and other services as needed to ensure a smooth-running program.

Purpose: The RCWD grant program is dedicated to assisting property owners with the implementation of BMPs that improve water quality within the District.

Results: In 2010 ACD provided technical/design assistance valued at $16,205. Efforts resulted in the design and installation of eight practices. Designs for five additional projects were completed and are scheduled to be installed in 2011.

Project Management Details. The entries in this table provide details on ACD's efforts toward the RCWD BMP cost share program summarized in the project management column of the financial summary table at the end of this chapter.

Project	Technical Assistance Hrs	Design Hrs	Total Hrs	Value ($70/hr)
Admin	11.5		11.5	$805
Aveda	7	10	17	$1,190
Rice Lake RG Construction	40.5		40.5	$2,835
Fridley HRA Demo House	3.5		3.5	$245
Fridley Middle School	15	59	74	$5,180
Hawkinson/Hegge	9.5		9.5	$665
Helps	2		2	$140
Johnson	1.5		1.5	$105
Larson	8.5	18	26.5	$1,855
Pehl	3.5		3.5	$245
Ricci	1		1	$70
Sabie	7	14	21	$1,470
Storlien	3		3	$210
Swanson	5.5		5.5	$385
Yackel	3.5	8	11.5	$805
Total	**122.5**	**109**	**231.5**	**$16,205**

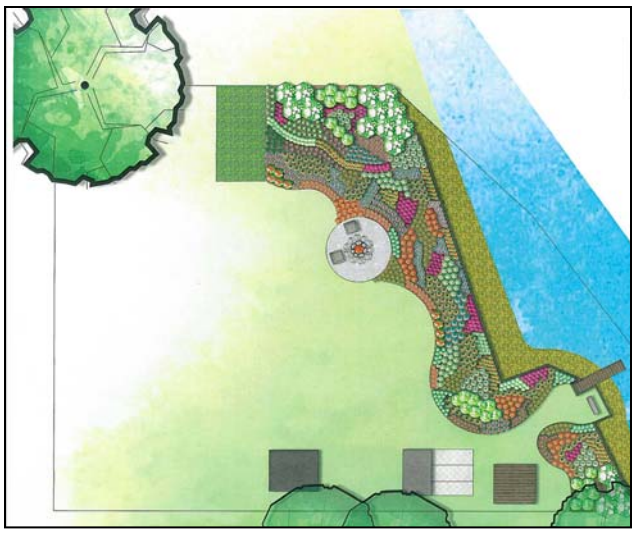
Example project - Lakeshore restoration project on Locke Lake completed in 2010. ACD technical/design assistance and partial construction funding was provided to the landowner through the RCWD BMP cost-share program. More details on projects installed in RCWD are included in a separate report produced by the Anoka Conservation District.

Water Quality Improvement Projects

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

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

Results: Projects are described in a separate report produced by the Anoka Conservation District.



Rice Lake Subwatershed Assessment

Description: The stormwater retrofit assessment takes a systematic approach to identifying and prioritizing water quality improvement projects that provide the greatest amount of stormwater treatment per dollar spent. The Rice Creek Watershed District identified Rice Lake as a high priority water resource and contracted with the Anoka Conservation District to assess the subwatershed in the Cities of Lino Lakes, Blaine and Circle Pines. The goal is to implement projects in a systematic way that maximizes the use of limited financial resources by identifying and prioritizing projects according to cost-effectiveness.

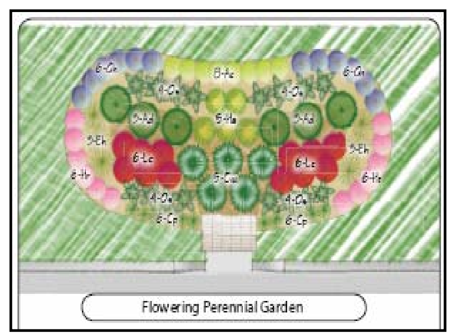
Purpose: To improve stormwater quality and reduce the volume of runoff entering the stormwater system from neighborhoods that most greatly contribute to the degradation of Rice Lake.

Results: The assessment is detailed in a separate report and summarized here. The assessment included delineating 13 stormwater drainage areas, or catchments. A stormwater model of each catchment was created which estimated volume, phosphorus, and sediment export. Using the model, 12 retrofit projects were analyzed for pollutant removal and costs were estimated. Two of the projects are retrofits that implement BMPs on school properties and a third is a stormwater wetland project at Shenandoah Park. The remaining nine projects are groupings of neighborhood rain garden retrofits. Projects were ranked by cost effectiveness. For each project, concept designs were created. The Rice Creek Watershed District and Anoka Conservation District have begun installing the most cost effective projects, including a network of rain gardens in 2010 and projects at Rice Lake Elementary School planned for 2011. Details of installed projects are provided in a separate Anoka Conservation District annual report of water quality improvement projects.

Stormwater Wetland Concept

Campus Retrofit Concept

Rain Garden Concept



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.

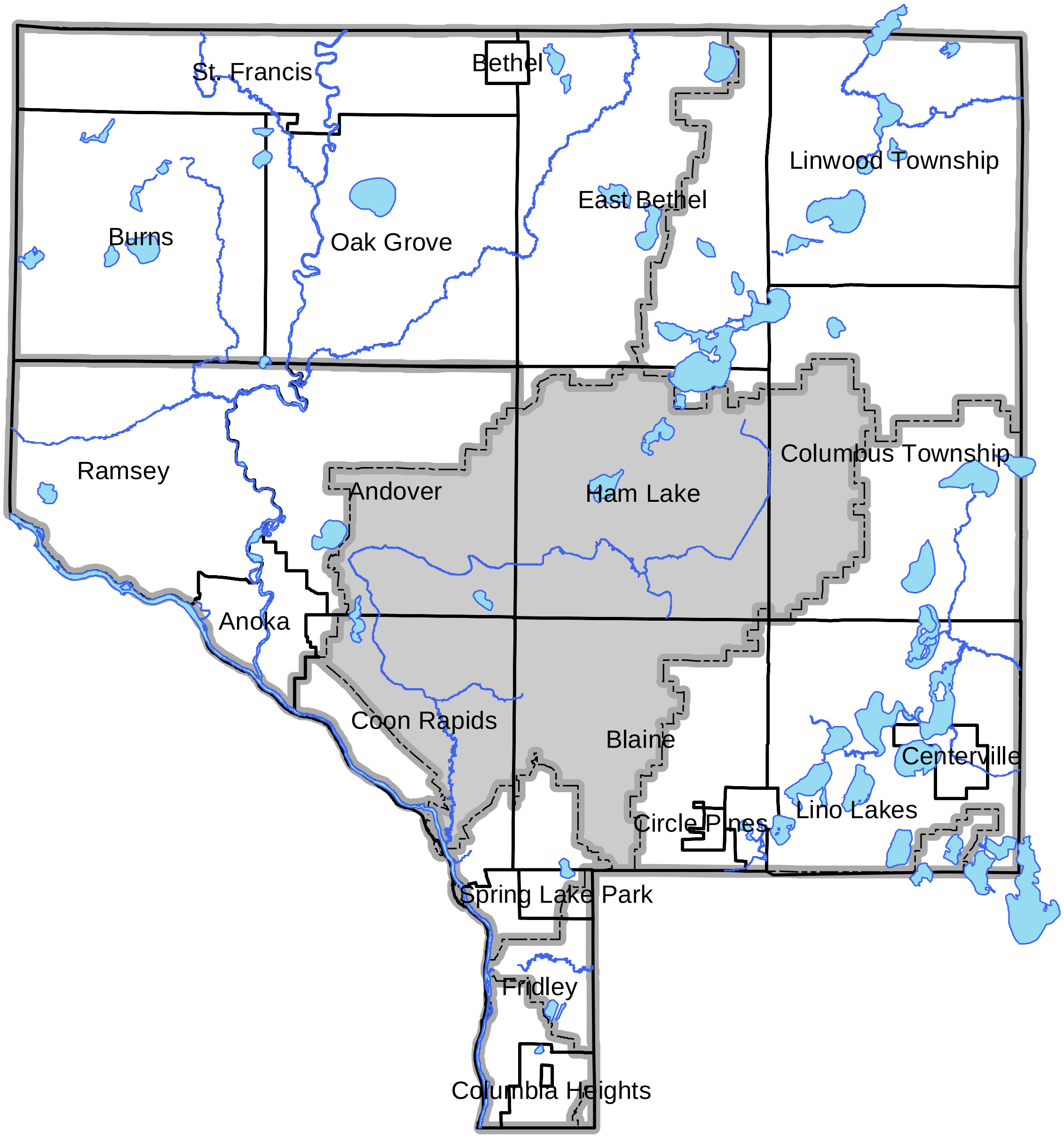
Rice Creek Watershed Financial Summary

Rice Creek Watershed	Volunteer Precip	Ref Wet	Lake Lvl	Obwell	Student Bio	Geologic Atlas	Rice Lake Installation	Rice Lake Promo	RCWD BMPs	Total
Revenues										
RCWD	0	1070	750	0	2340	0	0	10000	14183	28343
State	0	0	0	440	0	0	0	0	0	440
Anoka Conservation District	58	72	579	726	1094	1501	0	0	0	4030
County Ag Preserves	0	0	0	0	791	0	0	0	0	791
Regional/Local	0	0	0	0	0	0	0	0	0	(0)
Other Service Fees	0	0	0	0	0	0	0	0	0	(0)
Local Water Planning	0	0	0	0	0	0	0	0	0	(0)
TOTAL	58	1142	1329	1166	4225	1501	0	10000	14183	33603
Expenses-										
Capital Outlay/Equip	7	88	70	138	151	157	372	2632	882	4498
Personnel Salaries/Benefits	40	839	1028	812	3272	996	5301	9643	4634	26568
Overhead	8	135	149	154	421	269	888	1807	811	4643
Employee Training	0	7	9	6	33	4	73	50	33	216
Vehicle/Mileage	1	13	15	13	47	16	76	155	72	407
Rent	2	46	55	41	155	57	246	294	189	1087
Program Participants	0	0	0	0	0	0	0	0	0	0
Program Supplies	0	14	1	1	141	1	4	13	5	180
Equipment Maintenance	0	1	1	0	3	1	0	10	4	21
TOTAL	58	1142	1329	1166	4225	1501	6960	14606	6631	37618
NET	0	0	0	0	0	0	(6960)	(4606)	7552	-4015

Recommendations

- **Install water quality improvement projects identified through the Rice Lake Subwatershed Assessment and upcoming Golden Lake Subwatershed Assessment.**
- **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.
- **Address water quality problems in Moore Lake**. Storm water inputs and over-abundant waterfowl are likely sources of water quality problems.
- **Expand the network of reference wetlands** to include altered and ditched sites. These aid in accurate wetland regulatory determinations.
- **Reduce road salt use.** Elevated chlorides are pervasive throughout shallow aquifers and the streams that feed them.

Coon Creek Watershed



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

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

CHAPTER 6:
COON CREEK WATERSHED

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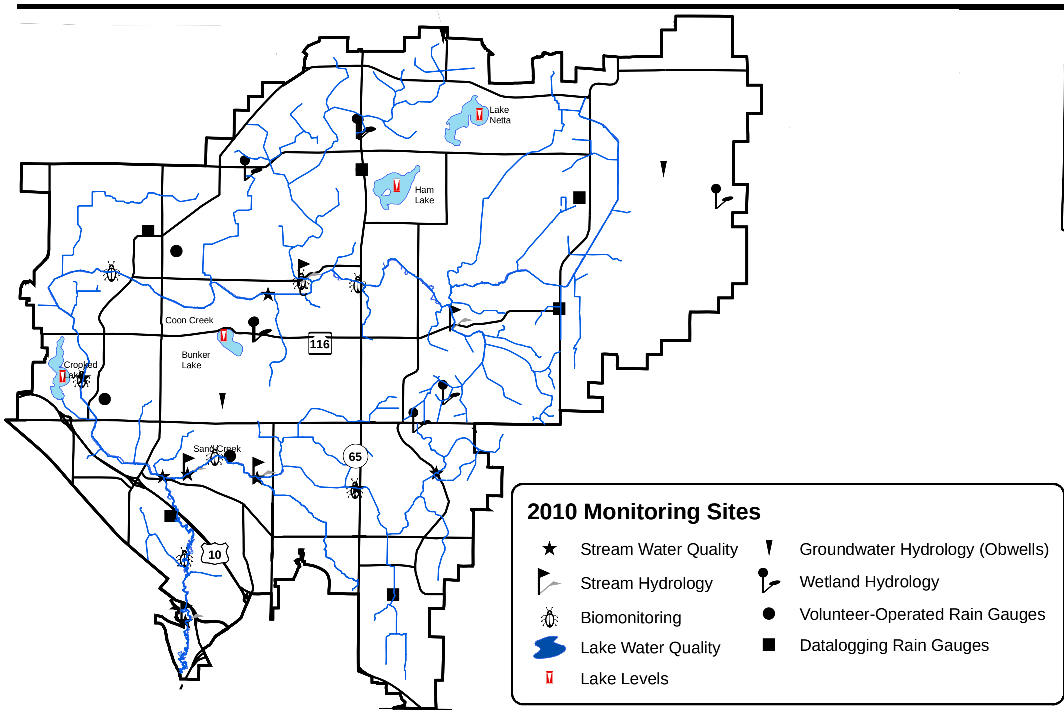
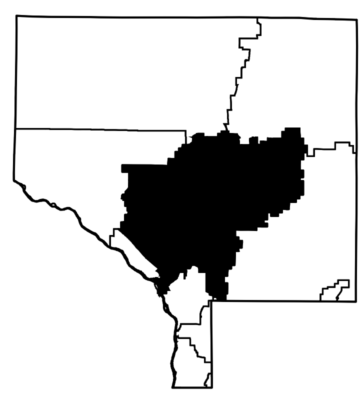
ACAP = Anoka County Ag Preserves, ACD = Anoka Conservation District, CCWD = Coon Creek Watershed District, MNDNR = MN Dept. of Natural Resources





Precipitation

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

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

Locations: Datalogging gauges:

Andover City Hall, Andover

Anoka Conservation District office, Ham Lake

Blaine Public Works, Blaine

Coon Rapids City Hall, Coon Rapids

Hoffman Sod Farm, Ham Lake

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

Cylinder gauges read by volunteers:

Myhre residence, Andover

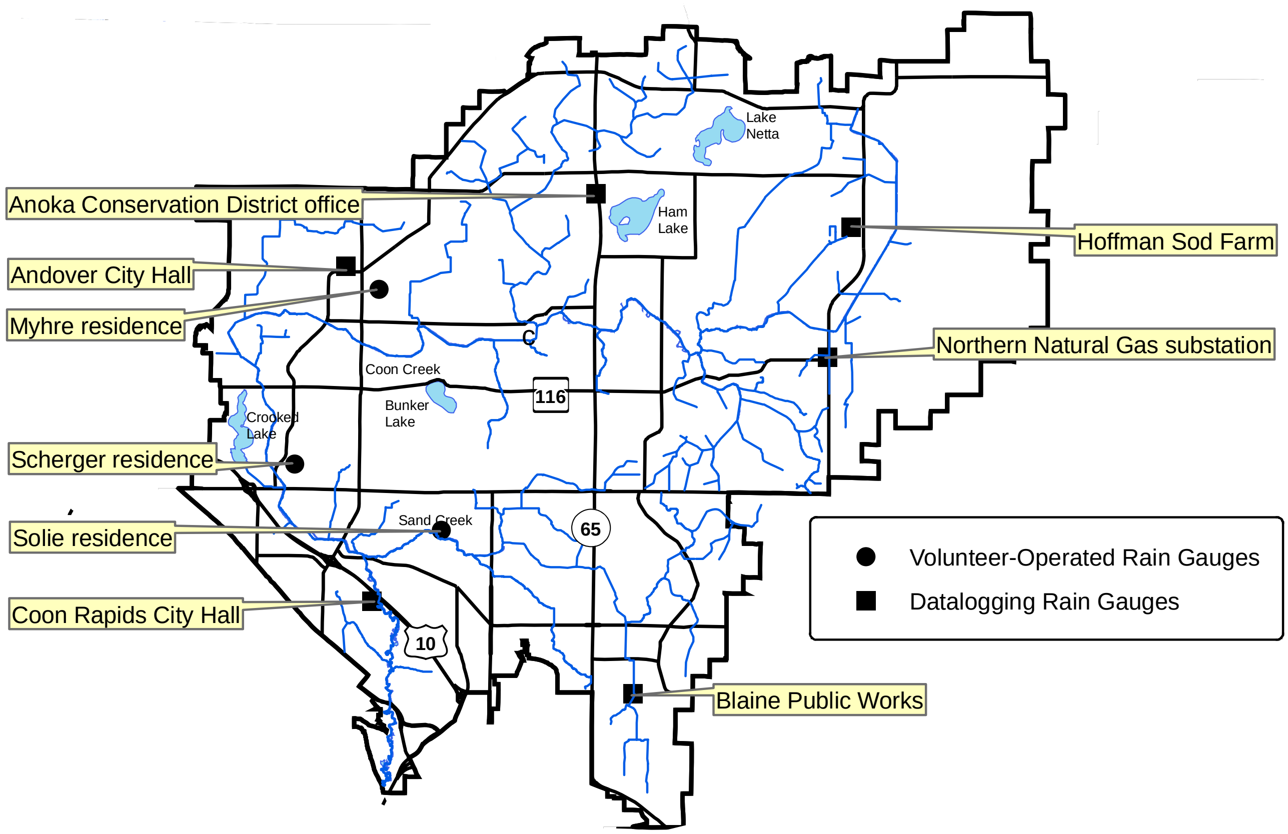
Scherger residence, Coon Rapids

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.

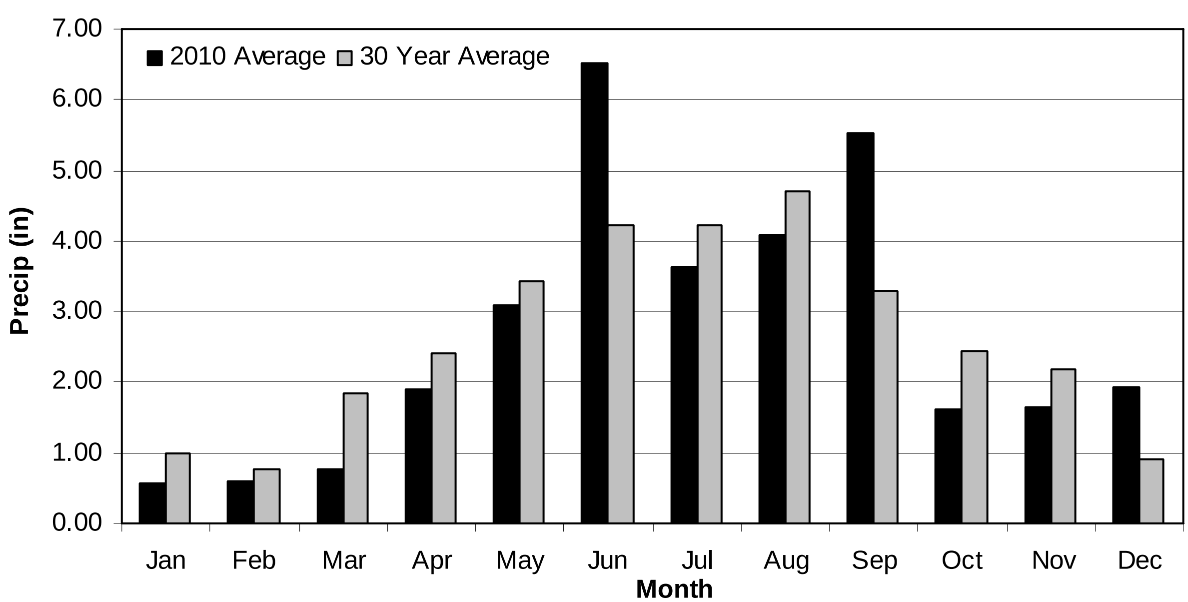
Coon Creek Watershed 2010 Precipitation Monitoring Sites



Coon Creek Watershed 2009 Precipitation Summary Table and Graph

Location or Volunteer	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total	Growing Season (May-Sept)
Tipping bucket, datalogging rain gauges (Time and date of each 0.01" is recorded)															
Andover City Hall	Andover				2.17			3.35	4.15	5.64	1.48			16.79	13.14
Blaine Public Works	Blaine							2.15			1.73			3.88	2.15
Coon Rapids City Hall	Coon Rapids				1.72	2.74	5.36				1.40			11.22	8.10
Anoka Cons. District office	Ham Lake				2.14	3.60	6.81	3.81	4.93	6.36				27.65	25.51
Hoffman Sod Farm	Ham Lake				1.79	3.11	6.10				1.72			12.72	9.21
Northern Nat. Gas substation	Ham Lake				1.53	2.69	6.14	4.00	3.85	4.95	1.58			24.74	21.63
Cylinder rain gauges (read daily)															
N. Myhre	Andover	0.56	0.59	0.76	2.26	3.16	7.97	4.28	4.39	6.19	1.59	1.64	1.93	35.32	25.99
S. Scherger	Coon Rapids				1.55	3.66			3.94	4.63	1.79			15.57	12.23
S. Solie	Coon Rapids				2.08	2.61	6.70	4.10	3.15	5.31				23.95	21.87
2010 Average	County-wide	0.56	0.59	0.76	1.91	3.08	6.51	3.62	4.07	5.51	1.61	1.64	1.93	31.79	22.79
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



Precipitation Analyses

Description: Two different precipitation analyses were done – 1) 2010 storms analyses and 2) long term precipitation trend analysis.

1.) **2010 Storms Analyses:** Precipitation events at each of the six Coon Creek Watershed District data-logging rain gauges were analyzed. Total precipitation, storm duration, intensity, and recurrence interval were determined for all precipitation events of >0.03 inches. Storms with a recurrence that was two months or longer were analyzed further. For those storms intensity was tracked throughout the storm and graphed (similar to storm typing, but a type was not assigned). The rate of effective precipitation was determined from the rainfall intensity and surrounding soil type. Effective precipitation was defined as precipitation occurring at an intensity that is lower than the soil infiltration rate (i.e. rain that soaks in and doesn't run off).

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

2.) **Long Term Precipitation Trends Analysis:** Monthly rainfall deviations from normal were graphed for 1986 to present. Data utilized were from the "Coon Creek-2111785" National Weather Service (NWS) station until 2005 when that station was abandoned. Thereafter, the high density network site closest to the abandoned "Coon Creek" station was used. This location is central to the Coon Creek Watershed District. Normal precipitation totals for each month are from the NWS Cedar station. Deviation from normal during the preceding 6- , 12-, and 24-month time periods were calculated and graphed. This is presented on the following page.

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: Andover City Hall, Andover

Anoka Conservation District office, Ham Lake

Blaine Public Works, off 101st Ave, Blaine

Coon Rapids City Hall, Coon Rapids

Hoffman Sod Farm, Lexington Blvd near 155th Ave, Ham Lake

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

Results:

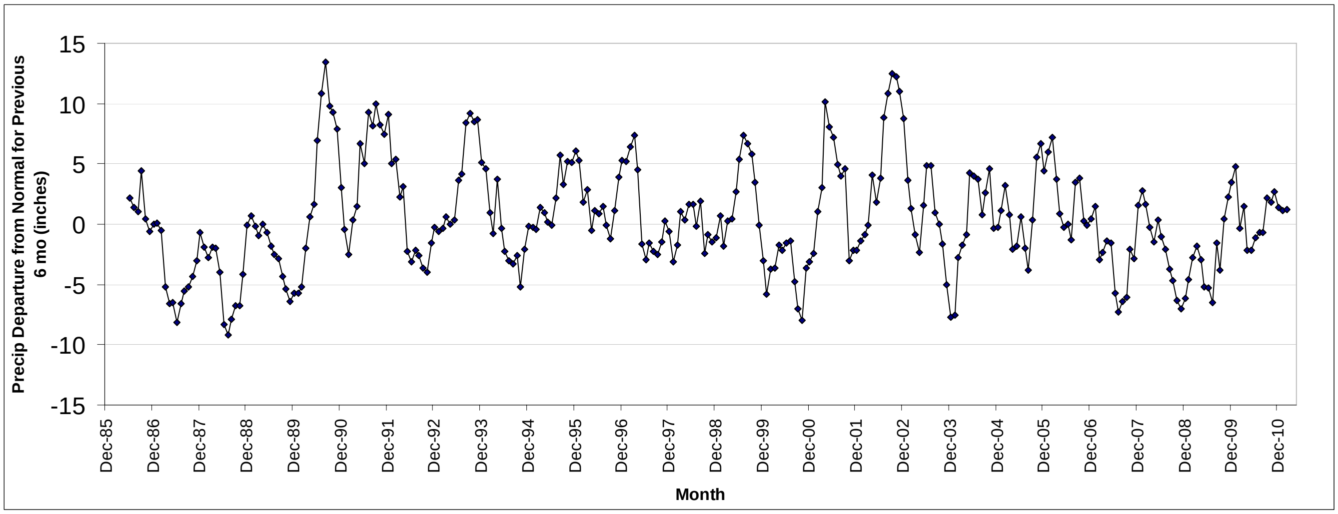
1.) **2010 Storms Analyses:** The results of these analyses were delivered to the Coon Creek Watershed District in digital form and are not reported here due to complexity and lengthiness.

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

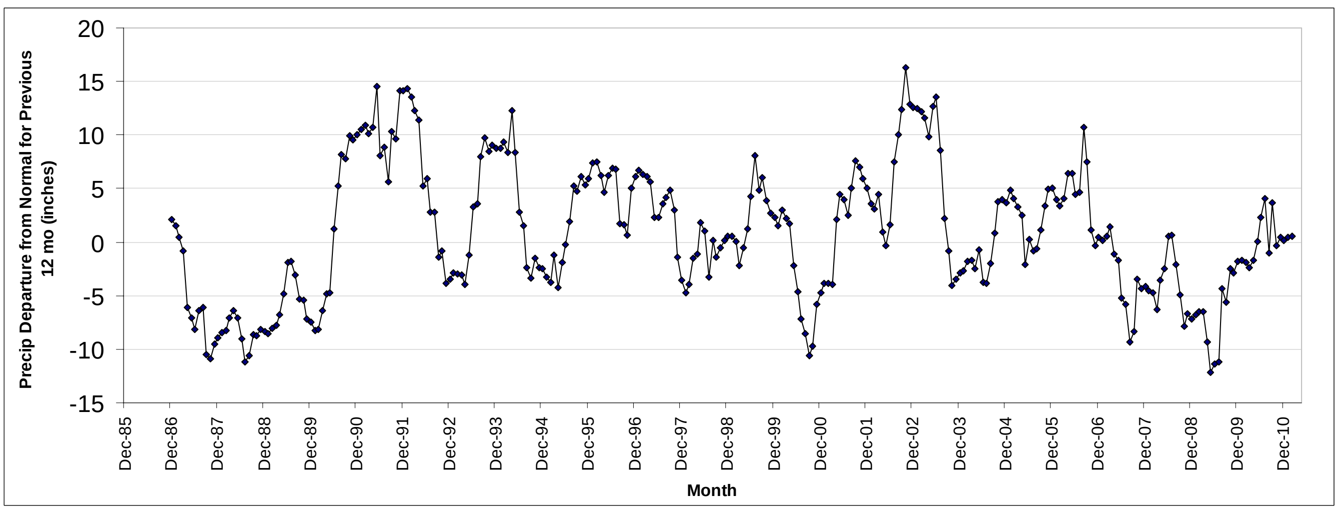
Long Term Precipitation Trends

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

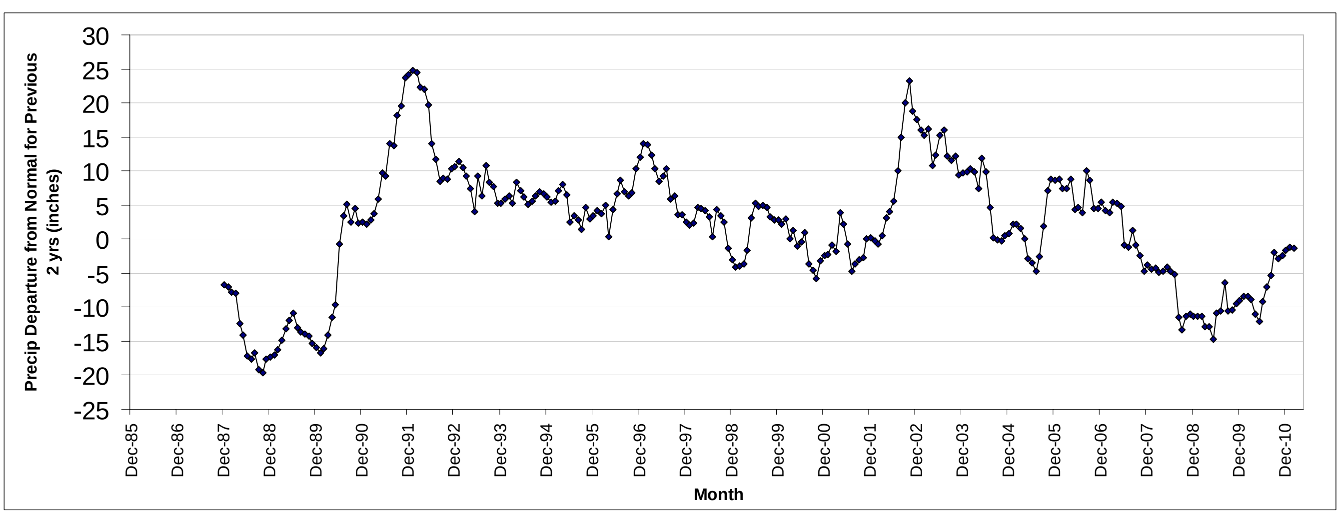
Precipitation departure from normal during the previous 6 months



Precipitation departure from normal during the previous 12 months



Precipitation departure from normal during the previous 2 years



Lake Levels

Description: Weekly water level monitoring in lakes. The past five years are shown below, and all 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.

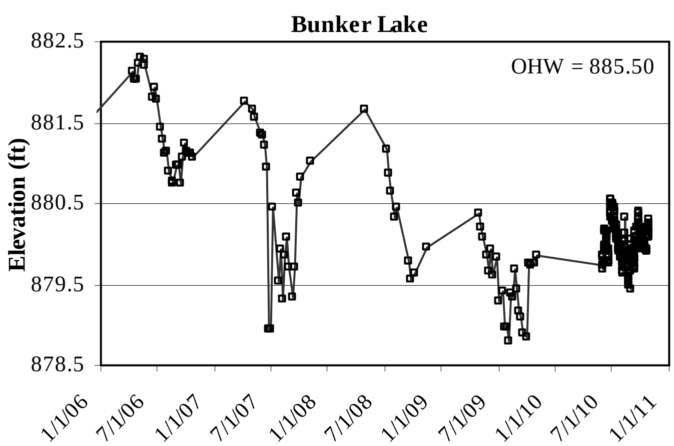
Locations: Bunker Lake, Ham Lake, Lake Netta, Crooked Lake

Results: Lake levels were measured 29 to 153 times, depending upon the lake. The level in Bunker Lake was measured much more frequently because a WL40 data logger was installed in a perforated 40" deep PVC well to record daily water levels.

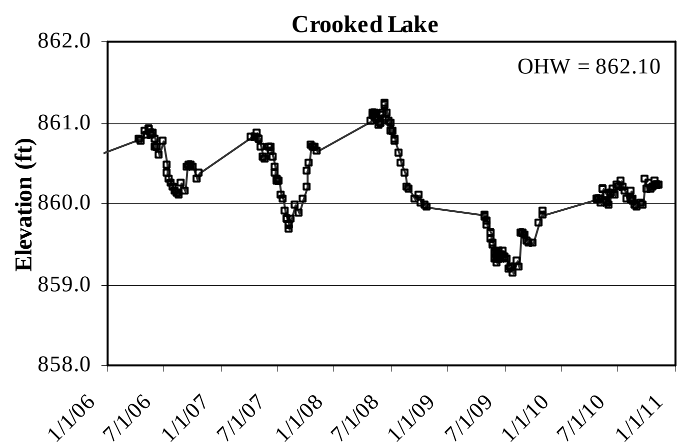
Increased average lake levels were observed in all lakes in 2010 relative to 2009. Above average rainfall totals for June, July, and September in 2010 contributed to maintaining the increased water levels. The low water levels observed in 2009 were a result of drought conditions in 2009 and below average precipitation in 2007 and 2008. In 2010, average levels in Bunker Lake, Crooked Lake, Ham Lake, and Lake Netta increased by 0.49 feet, 0.65 feet, 0.86 feet, and 0.91 feet, respectively when compared with 2009 averages.

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

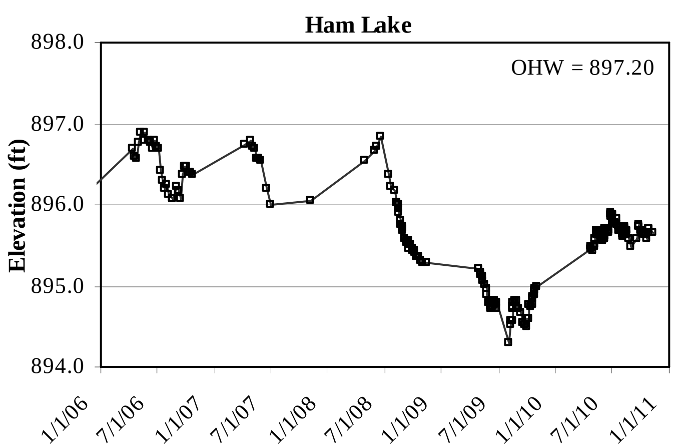
Bunker Lake Levels 2006-2010



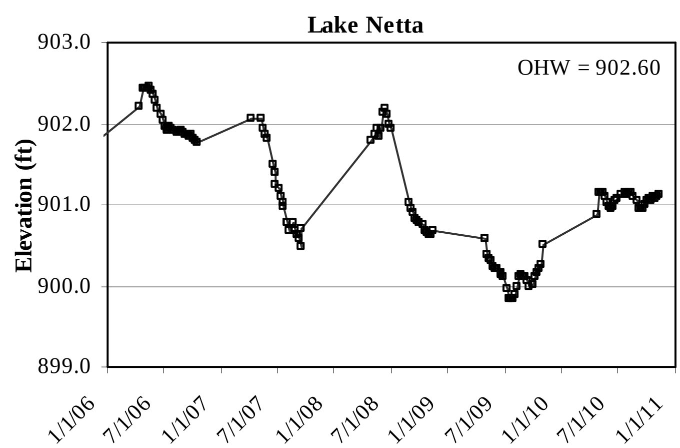
Crooked Lake Levels 2006-2010



Ham Lake Levels 2006-2010



Lake Netta Levels 2006-2010



Coon Creek Watershed Lake Levels Summary 2006-2010

Lake	Year	Average	Min	Max
Bunker	2006	881.45	880.75	882.31
	2007	880.39	878.95	881.77
	2008	880.41	879.57	881.66
	2009	879.52	878.79	880.37
	2010	880.01	879.43	880.54
Crooked	2006	860.54	860.10	860.92
	2007	860.35	859.68	860.86
	2008	860.75	859.96	861.24
	2009	859.47	859.14	859.90
	2010	860.12	859.96	860.30
Ham	2006	896.48	896.07	896.89
	2007	896.49	895.99	896.78
	2008	895.75	895.29	896.83
	2009	894.80	894.30	895.22
	2010	895.66	895.44	895.91
Netta	2006	902.05	901.76	902.46
	2007	901.17	900.49	902.07
	2008	901.32	900.63	902.19
	2009	900.15	899.84	900.58
	2010	901.06	900.88	901.16

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.

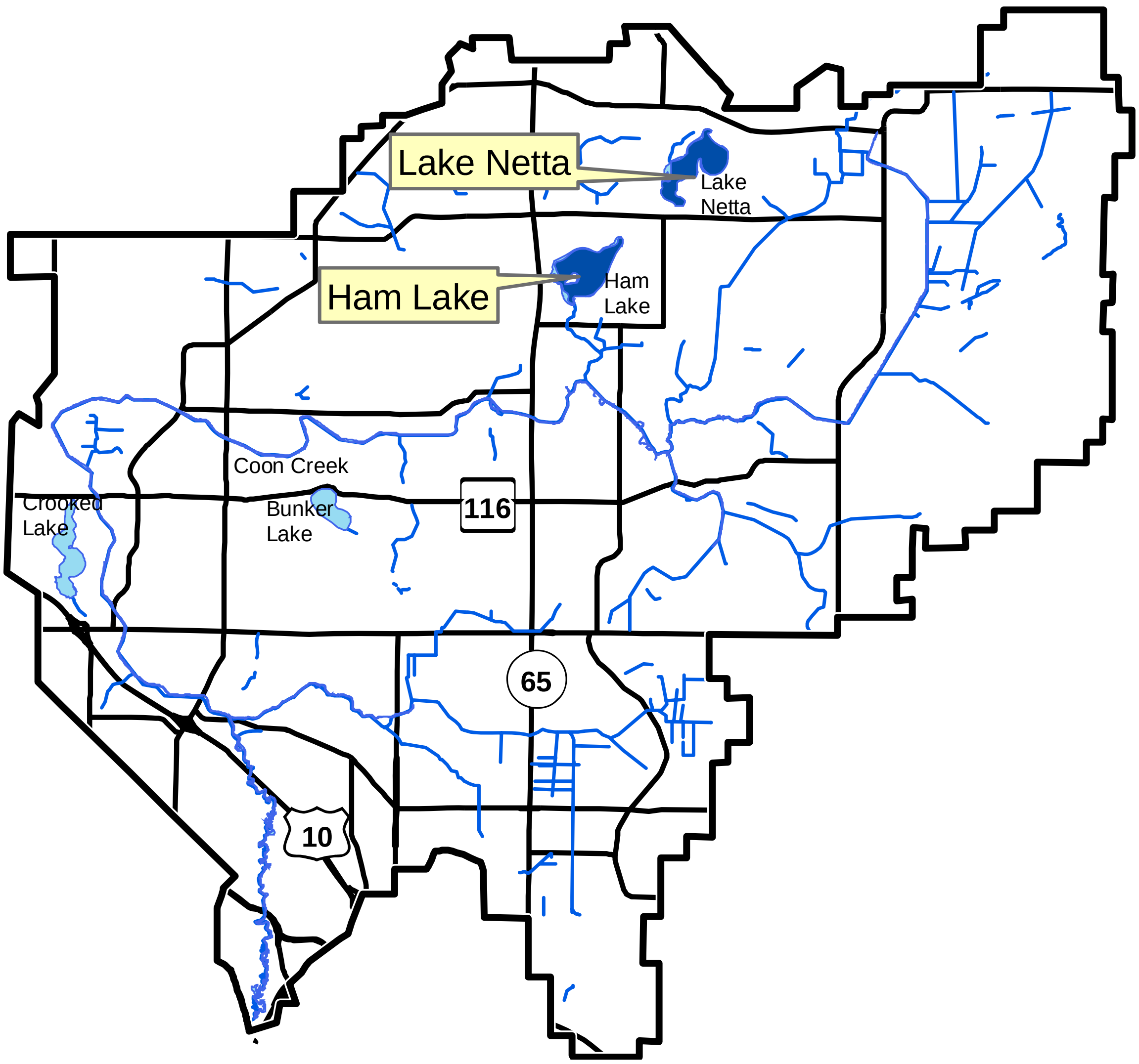
Purpose: To detect water quality trends and diagnose the cause of changes.

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 2010 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.

2010 Results

Ham Lake water quality received a slightly above-average rating for this region of the state (NCHF Ecoregion) in 2010. An overall B grade in 2010 was driven by total phosphorus concentrations and Secchi transparency readings slightly higher than the requirements for an A rating in those categories. In contrast, chlorophyll *a* values were low enough to achieve an A rating. The lake is borderline eutrophic, and typically receives an A or B grade, with the exception of an occasional C. Subjective ratings of physical condition and recreational suitability by ACD staff throughout 2010 indicated predominantly “crystal clear” or the presence of “some algae” throughout much of the year, with the exception of mid-August when a short-lived algal bloom resulted in the documentation of “definite algae.” As in previous years, curly-leaf pondweed was moderately abundant in the spring, but dense growths were largely restricted to the south end of the lake near the public boat landing. Curly-leaf pondweed died back in mid-June.

Trend Analysis

Fourteen 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 2010). 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, $F_{2,11} = 0.40$, $p = 0.6805$).

Discussion

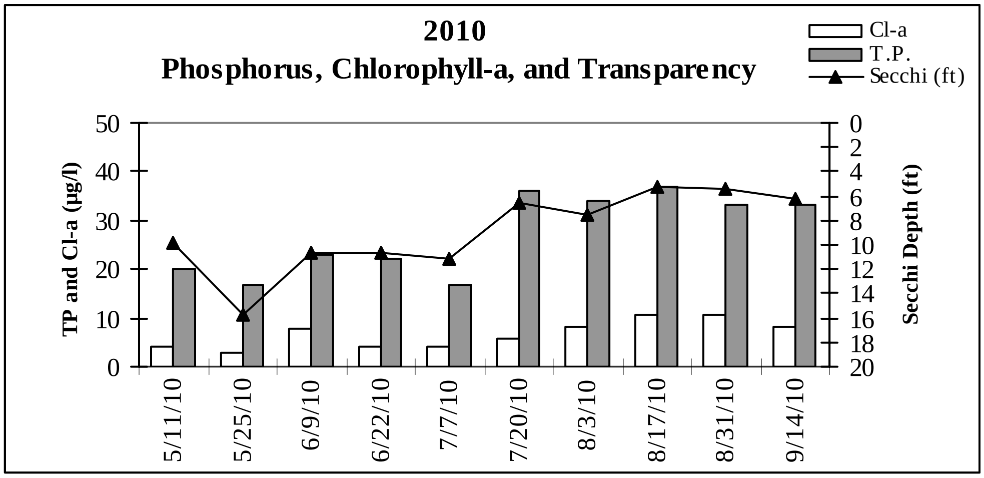
Water quality in Ham Lake is very good for a metro-area lake. Current threats to lake water quality include runoff from residential areas, aquatic plant removal by lakeshore homeowners, curly leaf pondweed, and perhaps sediment disturbance by high-powered boats and jet-skis.

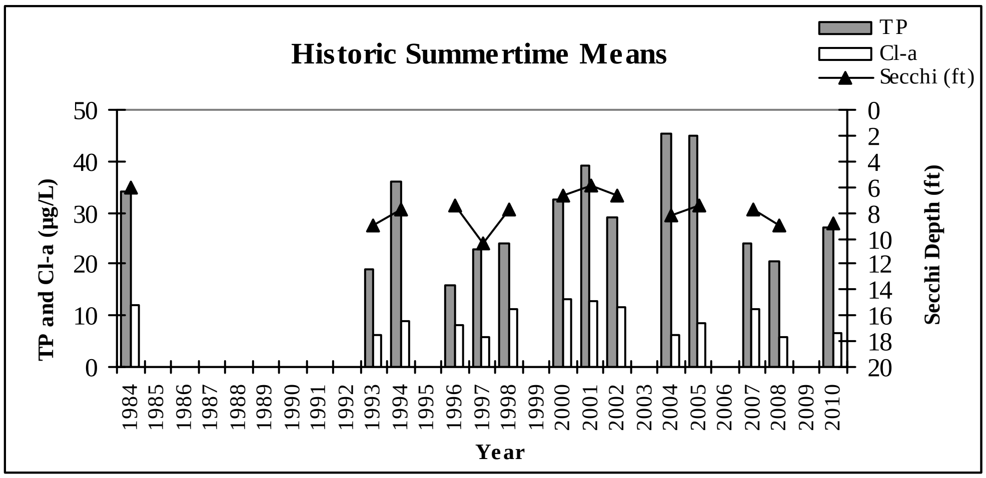
2010 Ham Lake Water Quality Data

Ham Lake 2010		Date	5/11/2010	5/25/2010	6/9/2010	6/22/2010	7/7/2010	7/20/2010	8/3/2010	8/17/2010	8/31/2010	9/14/2010			
		Time	11:15	8:45	8:50	8:20	10:45	8:50	9:00	8:40	9:00	8:50			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.53	8.03	8.61	8.61	8.21	8.25	8.06	8.05	7.73	8.01	8.11	7.53	8.61
Conductivity	mS/cm	0.01	0.316	0.292	0.267	0.271	0.267	0.272	0.281	0.289	0.301	0.305	0.286	0.267	0.316
Turbidity	FNRU	1.0	2	2	2	3	3	8	6	9	8	9	5	2	9
D.O.	mg/L	0.01	11.83	9.58	8.07	9.93	9.26	8.00	9.06	8.73	8.89	N/A	9.26	8.00	11.83
D.O.	%	1.0	104	106	85	110	108	90	103	93	95	N/A	99	85	110
Temp.	°C	0.10	11.9	22.9	20.9	23.5	26.7	25.2	26.5	23.6	24.5	18.9	22.5	11.9	26.7
Temp.	°F	0.10	53.4	73.2	69.6	74.3	80.1	77.4	79.7	74.5	76.1	66.0	72.4	53.4	80.1
Salinity	%	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cl-a	µg/L	1.0	4.3	2.9	7.7	4.2	4.0	5.9	8.1	10.7	10.5	8.3	6.7	2.9	10.7
T.P.	mg/L	0.005	0.020	0.017	0.023	0.022	0.017	0.036	0.034	0.037	0.033	0.033	0.027	0.017	0.037
T.P.	µg/L	5	20	17	23	22	17	36	34	37	33	33	27	17	37
Secchi	ft	0.1	9.9	15.8	10.6	10.6	11.2	6.5	7.5	5.2	5.4	6.3	8.9	5.2	15.8
Secchi	m	0.1	3.0	4.8	3.2	3.2	3.4	2.0	2.3	1.6	1.6	1.9	2.7	1.6	4.8
Field Observations															
Physical			1.5	2.0	1.0	2.0	1.0	2.0	2.0	3.0	2.0	2.0	1.9	1.0	3.0
Recreational			1.5	2.0	1.0	2.0	1.0	2.0	2.0	3.0	2.0	2.0	1.9	1.0	3.0

*Reporting Limit

Ham Lake Water Quality Results





Ham Lake Summertime Historic Mean

Agency	MC	MC	MC	MC	MC	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1984	1993	1994	1996	1997	1998	2000	2001	2002	2004	2005	2007	2008	2010
TP (µg/L)	34.0	19.0	36.0	16.0	23.0	24.0	32.6	39.1	29.1	45.2	45.0	24.0	20.5	27.0
Cl-a (µg/L)	11.8	6.2	9.1	8.3	5.9	11.3	13.1	12.7	11.5	6.3	8.4	11.4	6.0	6.7
Secchi (m)	1.84	2.76	2.35	2.27	3.14	2.35	2.04	1.81	2.1	2.5	2.2	2.3	2.7	2.7
Secchi (ft)	6.0	9.1	7.7	7.4	10.3	7.7	6.7	5.9	6.7	8.2	7.4	7.7	9.0	8.9

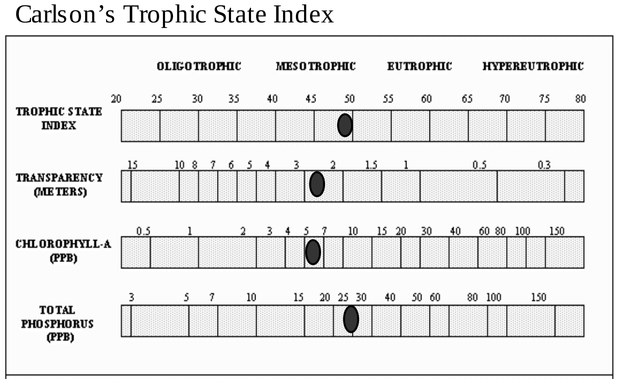
Carlson's Tropic State Indices

Year	1984	1993	1994	1996	1997	1998	2000	2001	2002	2004	2005	2007	2008	2010
TSIP	55	47	56	44	49	50	54	57	53	59	59	50	48	52
TSIC	55	49	52	51	48	54	56	56	55	49	52	55	48	49
TSIS	51	45	48	48	43	48	50	51	50	47	49	48	45	46
TSI	54	47	52	48	47	51	53	55	52	52	53	51	47	49

Ham Lake Water Quality Report Card

Year	1984	1993	1994	1996	1997	1998	2000	2001	2002	2004	2005	2007	2008	2010
TP (µg/L)	C	A	C	A	A	B	C	C	B	C	C	B	A	B
Cl-a (µg/L)	B	A	A	A	A	B	B	B	B	A	A	B	A	A
Secchi (m)	C	B	B	B	A	B	C	C	C	B	B	B	B	B
Overall	**C**	**A**	**B**	**A**	**A**	**B**	**C**	**C**	**B**	**B**	**B**	**B**	**A**	**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.

2010 Results

Lake Netta had above-average water quality for this region of the state (NCHF Ecoretion) in 2010. The overall A- grade was driven by low concentrations of total phosphorus and chlorophyll *a* and high Secchi transparency depths (see table below for specific values). All measured water quality parameters were similar to previous years and indicate the stability of the clear water and healthy vegetation community within this system. The chlorophyll *a* concentration peaked during late August (7.4 µg/L), but returned to low concentrations by mid-September (4.8 µg/L). Subjective rating of physical condition and recreational suitability by ACD staff documented water was either “crystal clear” or only had “some algae” throughout the entire year. In addition, from a recreational standpoint the lake was classified as “beautiful” or only possessing “minimal problems” throughout 2010.

Trend Analysis

Ten years of water quality data have been collected by the Anoka Conservation District (1997-1999, 2001, 2003-2004, 2006-2007, and 2009-2010), along with Secchi depth measurements by citizens five other years. Lake water quality has fluctuated between “A” and “B” grades, but there is no significant long-term trend of changing lake water quality (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,7} = 0.76$, $p = 0.5049$). However, this analysis excludes the Secchi depth measurements by volunteers in the early 1990’s. Consideration of those measurements indicates a trend of increasing water clarity in recent years because average Secchi depth from the early 1990’s (1.5 - 2.4m) was less than current depths (2.3 - 3m).

Discussion

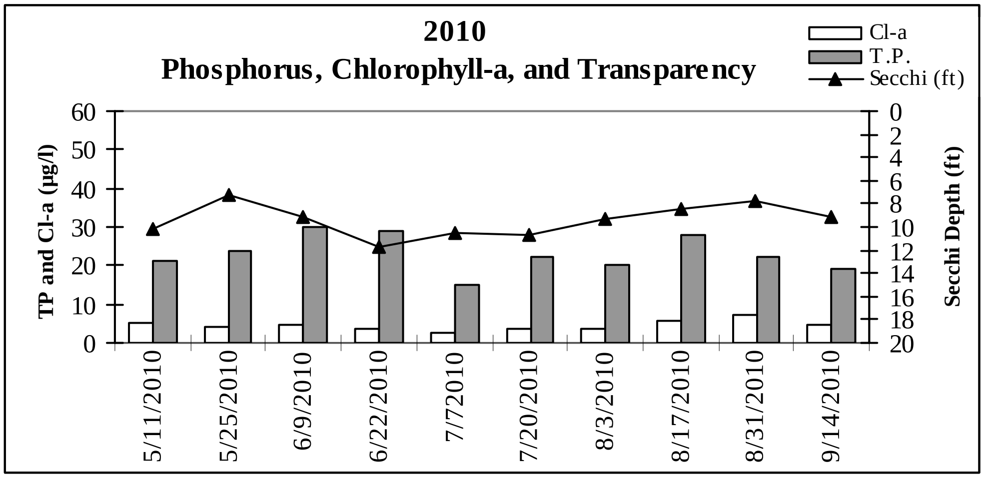
This lake has excellent water quality. It is a submerged macrophyte (large plant) dominated lake, as opposed to algae dominated. These plants are essential to maintaining good water quality. The plants consume nutrients in the water, making them unavailable to algae. They also minimize sediment disturbance by wind or boats and provide refuges for zooplankton, which consume 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 as maintenance of vegetated buffers near the water’s edge by property owners.

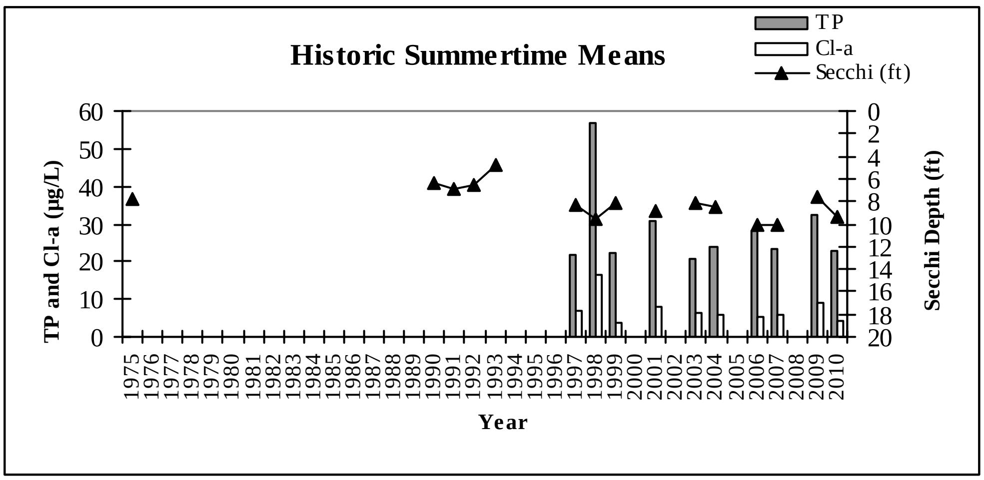
2010 Lake Netta Water Quality Data

Lake Netta 2010		Date	5/11/2010	5/25/2010	6/9/2010	6/22/2010	7/72010	7/20/2010	8/3/2010	8/17/2010	8/31/2010	9/14/2010			
		Time	13:30	10:15	10:10	9:40	12:00	10:10	10:10	9:50	10:30	10:10			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.78	8.11	7.76	8.20	8.09	7.33	7.62	7.23	7.56	7.20	7.69	7.20	8.20
Conductivity	mS/cm	0.01	0.259	0.249	0.237	0.221	0.203	0.202	0.208	0.210	0.210	0.216	0.222	0.202	0.259
Turbidity	FNRU	1.0	2	8	3	3	2	5	3	4	6	5	4	2	8
D.O.	mg/L	0.01	10.31	9.37	7.68	9.61	9.17	7.19	7.55	7.99	9.02	N/A	8.65	7.19	10.31
D.O.	%	1.0	90	107	81	106	107	80	86	85	97	N/A	93	80	107
Temp.	°C	0.10	11.6	24.1	20.9	23.8	27.0	25.2	26.7	23.5	24.7	18.5	22.6	11.6	27.0
Temp.	°F	0.10	52.9	75.4	69.6	74.8	80.6	77.4	80.1	74.3	76.5	65.3	72.7	52.9	80.6
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	µg/L	1.0	5.0	3.9	4.9	3.5	2.8	3.5	3.7	5.7	7.4	4.8	4.5	2.8	7.4
T.P.	mg/L	0.005	0.021	0.024	0.030	0.029	0.015	0.022	0.020	0.028	0.022	0.019	0.023	0.015	0.030
T.P.	µg/L	5	21	24	30	29	15	22	20	28	22	19	23	15	30
Secchi	ft	0.1	10.2	7.3	9.2	11.7	10.5	10.7	9.3	8.4	7.8	9.2	9.4	7.3	11.7
Secchi	m	0.1	3.1	2.2	2.8	3.6	3.2	3.3	2.8	2.6	2.4	2.8	2.9	2.2	3.6
Field Observations															
Physical			1.0	2.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0	1.7	1.0	2.0
Recreational			1.0	2.0	2.0	2.0	1.0	1.0	1.0	2.0	2.0	2.0	1.6	1.0	2.0

*Reporting Limit

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	ACD	ACD
Year	1975	1990	1991	1992	1993	1997	1998	1999	2001	2003	2004	2006	2007	2009	2010
TP (µg/L)						21.8	56.9	22.2	30.7	20.8	23.8	28.0	23.5	32.2	23.0
Cl-a (µg/L)						6.7	16.6	3.8	7.7	6.2	5.7	5.5	5.6	8.9	4.5
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	2.30	2.90
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	7.6	9.4

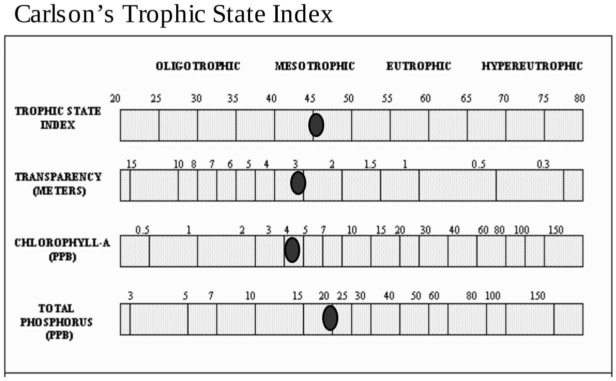
Carlson's Trophic State Index

Year	1975	1990	1991	1992	1993	1997	1998	1999	2001	2003	2004	2006	2007	2009	2010
TSIP						49	62	49	54	48	50	52	50	54	49
TSIC						49	58	44	51	48	48	47	48	52	45
TSIS	47	51	49	50	54	47	45	47	46	47	46	44	44	48	45
TSI						48	55	47	50	48	48	48	47	51	46

Lake Netta Water Quality Report Card

Year	1975	1990	1991	1992	1993	1997	1998	1999	2001	2003	2004	2006	2007	2009	2010
TP (µg/L)						A	A	A	B	A	B+	B	B	C	A-
Cl-a (µg/L)						A	A	A	A	A	A	A	A	A	A
Secchi (m)	B	C	C	C	C	A	A	A	B	B	B	B+	B	B	A-
Overall						**B**	**B**	**A**	**B**	**A**	**A**	**B+**	**B+**	**B**	**A-**

Carlson's Trophic State Index



Stream Hydrology and Rating Curves

Description: Continuous water level monitoring in streams.

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

Locations: Coon Creek at Coon Hollow, Coon Rapids

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

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

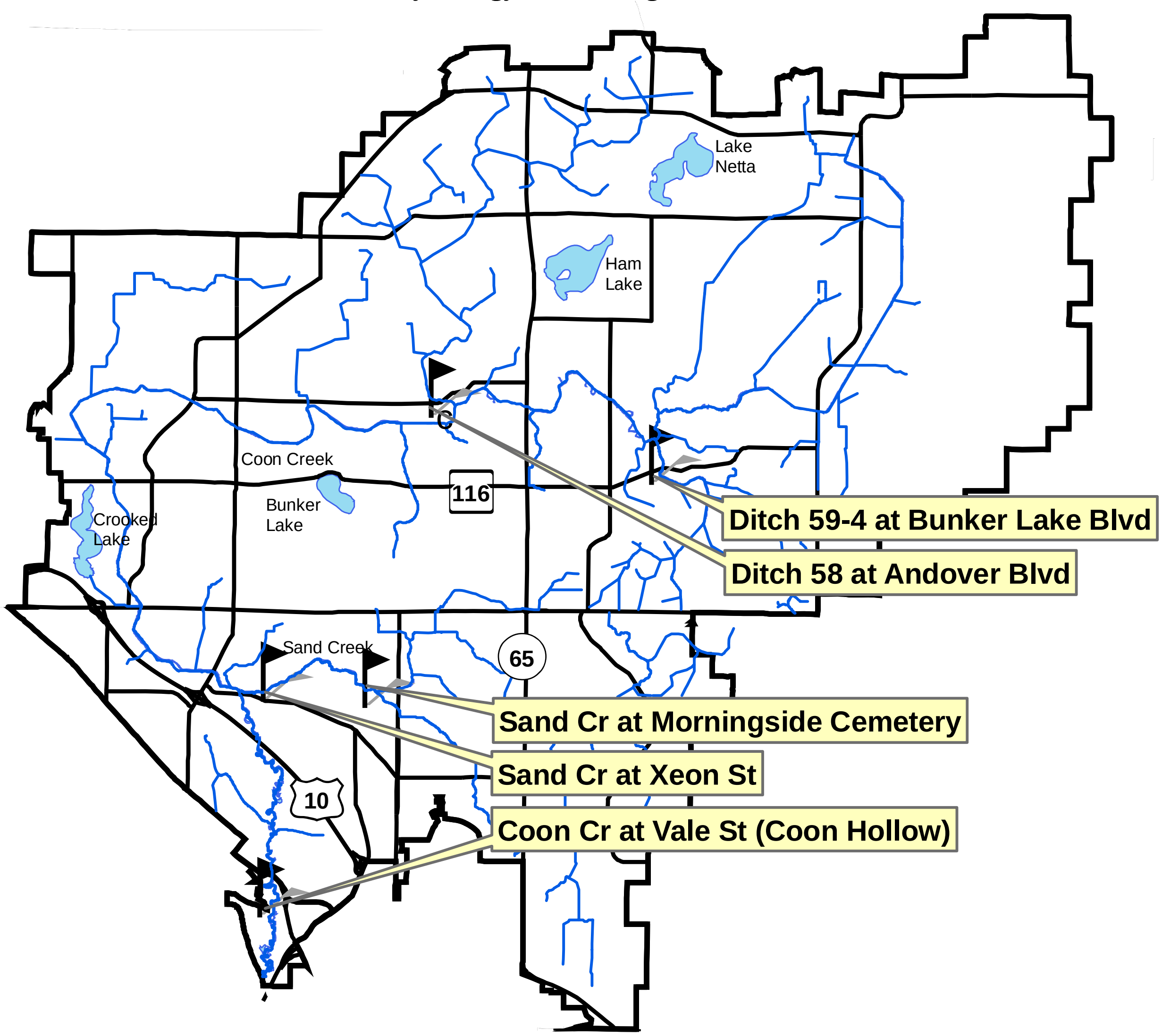
Sand Creek at Xeon Street, Coon Rapids

Sand Creek at Morningside Cemetery, Coon Rapids

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

The rating curve for Coon Creek at Coon Hollow was updated in 2010 and is shown no the following pages.

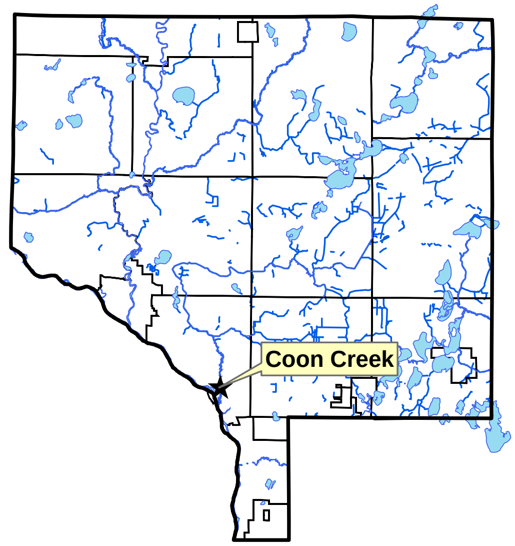
Coon Creek Watershed 2010 Stream Hydrology Monitoring Sites



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 2006-2010 serve to illustrate this phenomenon. In the few hours following larger storms, water levels can rise nearly 4 feet. 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 the creek rose 2.23 feet. It took about 15 days for the water level to return to pre-storm levels, despite only three rain events of less than 0.15 inches during that time. During 2008's largest storm, 1.54-inches on August 27, creek levels rose 2.42 feet during a two hour period, rising a total of 3.46 feet in response to the storm. A 2.11-inch rainfall on August 19th, 2009 caused the creek to rise 3.62 feet within 16 hours. Due to continuous significant rainfall events in the following days, pre-storm levels were not achieved. The largest storm of 2010, 1.62 inches in on June 25th, resulted in an increase in stream elevation of 2.83 feet over approximately 10 hours.

Increases in Coon Creek's water level are also substantial when analyzed using a per inch of rainfall perspective. Examining 24 relatively isolated storms ranging in size from 0.72 to 2.23 inches in 2006-10, the creek rose an average of 1.93 feet per inch of rainfall. The creek increase per inch of rain ranged from 1.33 to 2.64 feet. This discussion, as well as the one in the preceding paragraph, is obviously simplified because it neglects to consider the phenology of each of the storms. It only serves to emphasize that this creek responds quickly and dramatically to storms but water levels fall much more slowly.

The rating curve developed in 2005 was updated with six additional measurements taken during the summer of 2010. The supplemental measurements were taken during a variety of stream flow conditions, ranging from baseflow to high flow following storm events. A rating curve is the mathematical relationship between water level and flow, and allows estimates of creek flow to be calculated from the continuous water level record (see next page). 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 822.21 ft msl (i.e. flows <46.19 cfs). During 2010, creek flows ranged from 12.52 cfs to over 43.03 cfs. The maximum water level observed since monitoring began in 2005 was 2.26 feet greater than the capacity of the rating curve; if the rating curve is projected forward this water level would correspond to a flow of 115.8 cfs. However, this estimate is not accurate because the rating curve has not been calibrated for creek elevations that high. Nevertheless, the extrapolation displays the magnitude of the potential increase in flow following large rainfall events.

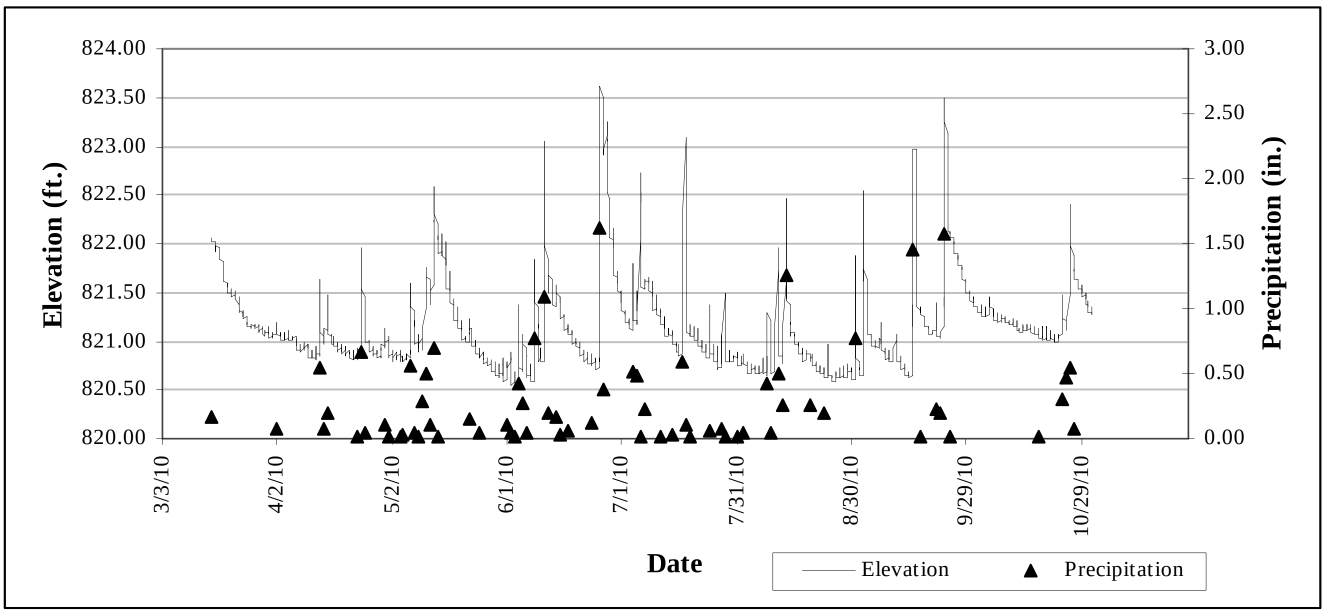
Coon Creek Hydrology (continued)

Summary of All Monitored Years

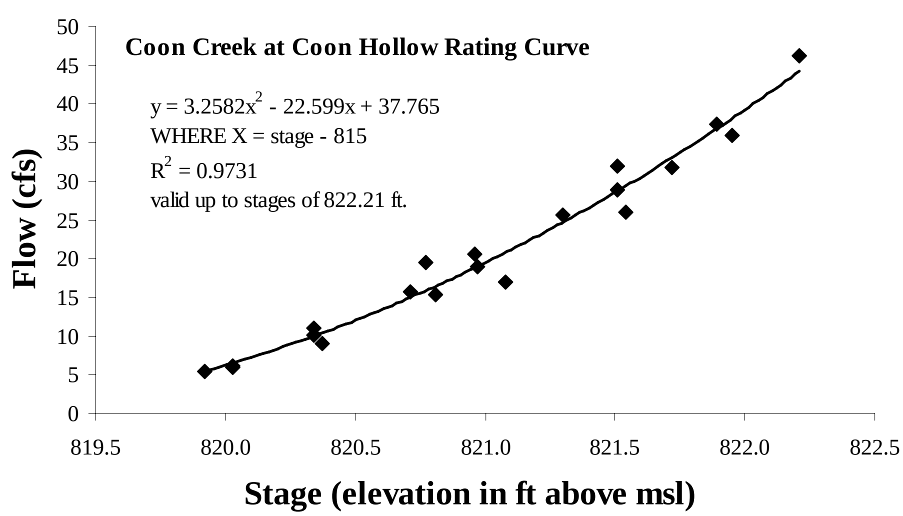
Percentiles	2005	2006	2007	2008	2009	2010	All Years Thru 2010
Min	820.04	820.26	820.33	820.43	820.03	820.54	820.03
2.5%	820.06	820.42	820.40	820.52	820.12	820.64	820.16
10.0%	820.19	820.53	820.53	820.57	820.20	820.73	820.42
25.0%	820.57	820.78	820.73	820.63	820.35	820.85	820.65
Median (50%)	820.91	821.35	821.25	820.88	820.61	821.05	820.98
75.0%	821.26	821.78	821.88	821.78	820.93	821.32	820.98
90.0%	821.77	822.27	822.63	822.26	821.31	821.68	822.10
97.5%	822.92	822.76	823.21	822.79	822.05	822.33	822.83
Max	823.26	824.18	824.47	823.96	824.11	823.62	824.47

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

2010 Hydrograph



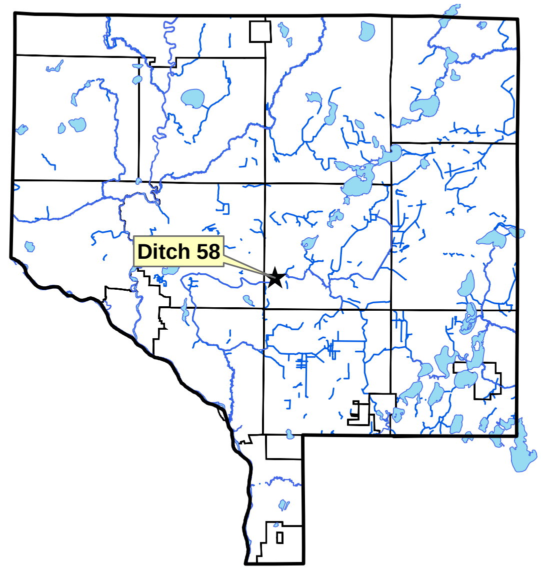
Rating Curve (2010)



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.

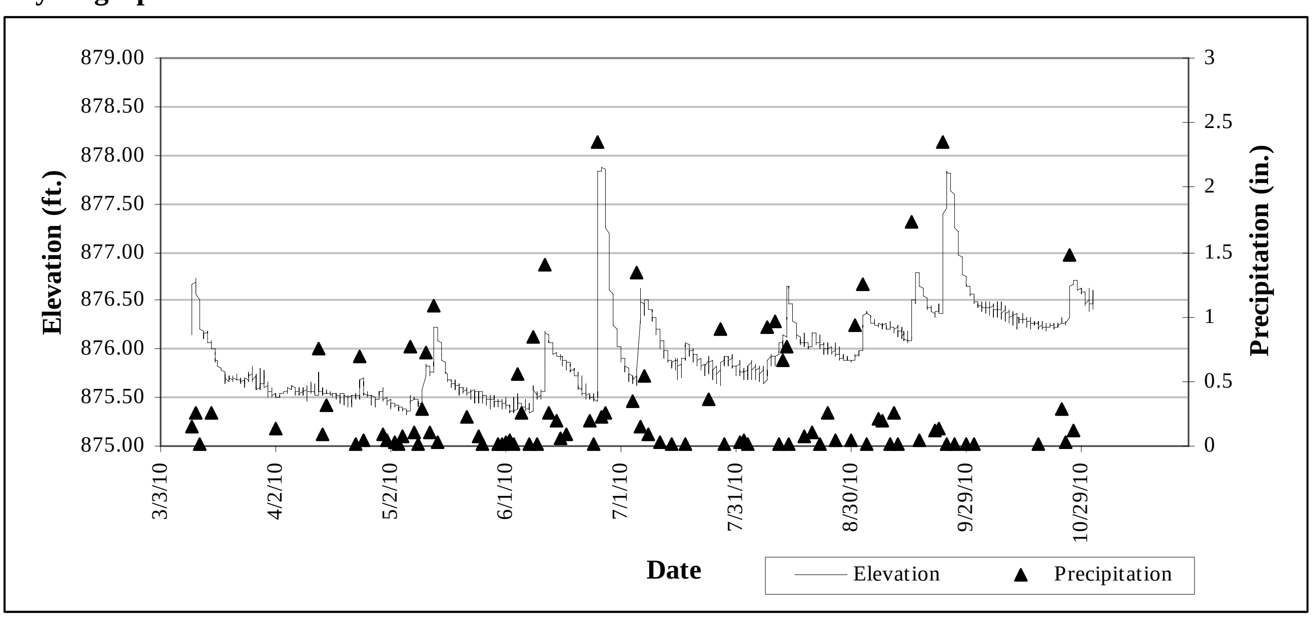
Ditch 58 water levels fluctuated more during 2010 than in previous years because of the increased frequency of larger rainfall events. Water levels spanned a total range of 2.55 feet in response to rainfall events. Of particular note was a 2.35 foot increase in water level over 21 hours following a 2.35 inch rain event on June 25th, 2010.

Summary of All Monitored Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	All Years Thru 2010
Min	875.29	875.81	875.28	875.23	875.05	875.31	875.24	875.29	874.98	875.33	874.98
2.5%	875.35	876.18	875.57	875.63	875.54	875.91	875.29	875.33	875.01	875.39	875.26
10.0%	875.48	876.33	875.64	875.51	875.37	875.66	875.37	875.36	875.16	875.48	875.36
25.0%	875.58	876.41	875.74	875.63	875.54	875.91	875.49	875.39	875.29	875.58	875.49
Median (50%)	875.65	876.51	876.10	875.83	875.78	876.20	875.89	875.56	875.37	875.88	875.82
75.0%	875.77	876.73	876.59	876.05	876.04	876.35	876.16	876.06	875.46	876.25	875.82
90.0%	876.23	877.42	877.01	876.45	876.22	876.47	876.40	876.28	875.54	876.49	876.54
97.5%	876.30	878.13	878.16	877.04	876.98	876.89	876.90	876.61	875.79	877.13	877.25
Max	876.48	878.13	878.19	878.03	878.12	877.75	877.64	877.63	876.65	877.88	878.19

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

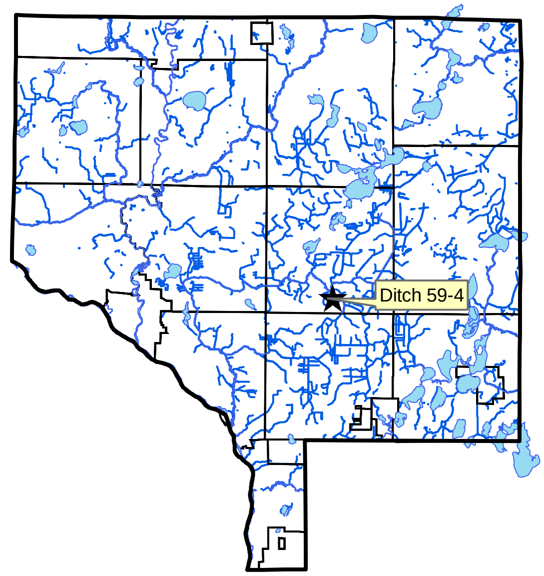
2010 Hydrograph



DITCH 59-4

at Bunker Lake Boulevard NE, Ham Lake

Notes



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

Ditch 59-4 was monitored for the third consecutive year in 2010. The total range in water levels was 1.73 feet. Water levels remained relatively constant throughout the 2010 monitoring season, with the exception of large water level increases associated with spring melt and larger rainfall events. The highest water level observed to date (889.02 ft.) occurred following a 2.4 inch rainfall event on June 25th, 2010.

Summary of All Monitored Years

Percentiles	2008	2009	2010	All Years
Min	887.09	887.09	887.29	885.67
2.5%	887.12	887.13	887.37	887.13
10.0%	887.16	887.16	887.43	887.19
25.0%	887.21	887.24	887.52	887.27
Median (50%)	887.28	887.36	887.62	887.47
75.0%	887.74	887.48	887.68	887.47
90.0%	887.95	887.62	887.77	887.83
97.5%	888.13	887.84	888.03	888.05
Max	888.50	888.28	889.02	889.02

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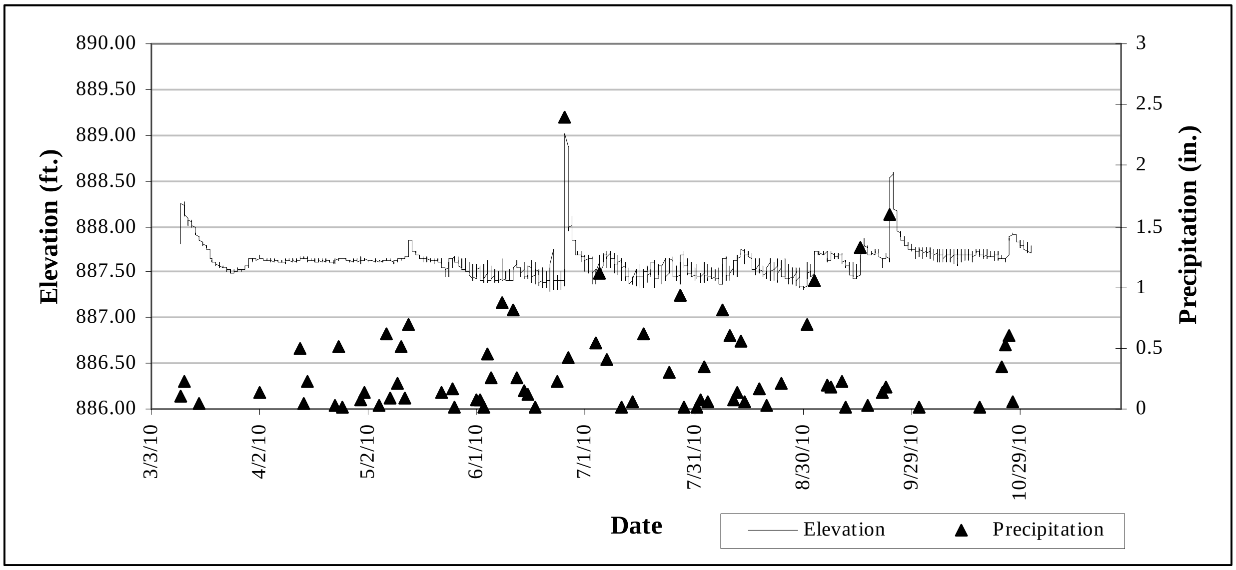
2010 Hydrograph



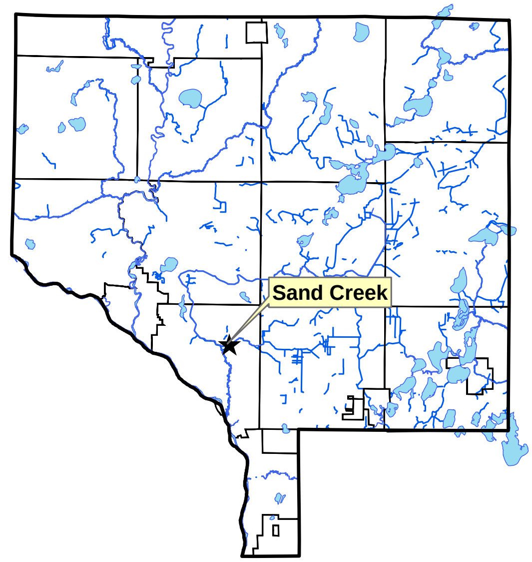
SAND CREEK

at Xeon Street, Coon Rapids

Notes

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

Sand Creek shows little variation in water levels, which is unusual for a stream with a suburban watershed. Sand Creek water levels fluctuated 1.86 feet in 2010. Excluding storms, the total seasonal variability in water levels was only approximately 1 foot. Still, the creek can have more dramatic hydrologic changes following large storms. For example, in 2007 Sand Creek rose 1.93 feet in 4 hours in response to a 2.25-inch storm on August 1. It is typical for Sand Creek to rise and fall very quickly following rainfall, often on a time scale of only a few hours.

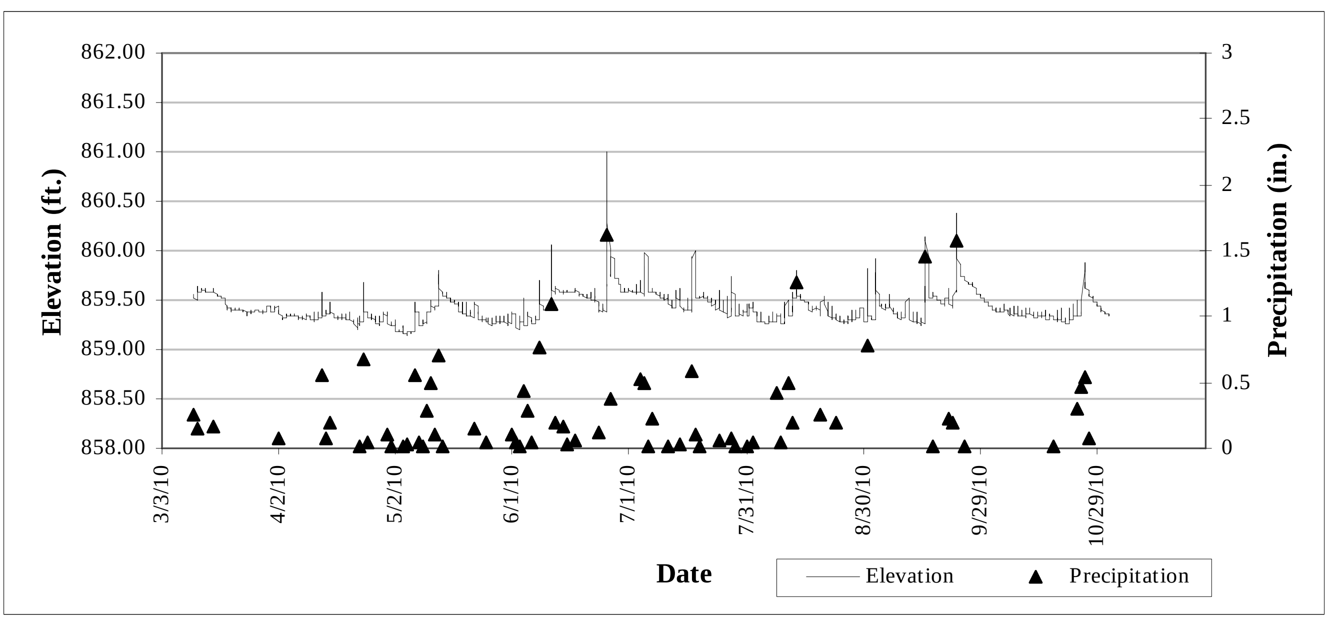


Summary of All Monitored Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	All Years Thru 2010
Min	859.06	859.22	859.21	859.31	859.35	859.32	859.17	859.35	858.91	859.15	858.91
2.5%	859.09	859.44	859.26	859.33	859.41	859.43	859.30	859.44	858.99	859.24	859.04
10.0%	859.15	859.48	859.32	859.40	859.45	859.54	859.41	859.48	859.03	859.28	859.17
25.0%	859.23	859.61	859.41	859.46	859.55	859.70	859.47	859.53	859.05	859.33	859.36
Median (50%)	859.33	859.75	859.55	859.60	859.72	859.86	859.64	859.58	859.10	859.40	859.53
75.0%	859.49	859.93	859.75	859.80	859.97	860.01	859.81	859.78	859.29	859.52	859.53
90.0%	859.54	860.09	860.00	860.03	860.21	860.12	859.98	859.94	859.38	859.60	859.97
97.5%	859.65	860.32	860.28	860.32	860.51	860.27	860.11	860.13	859.54	859.75	860.21
Max	860.00	861.22	861.13	861.27	861.50	861.38	861.10	860.88	860.87	861.01	861.50

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

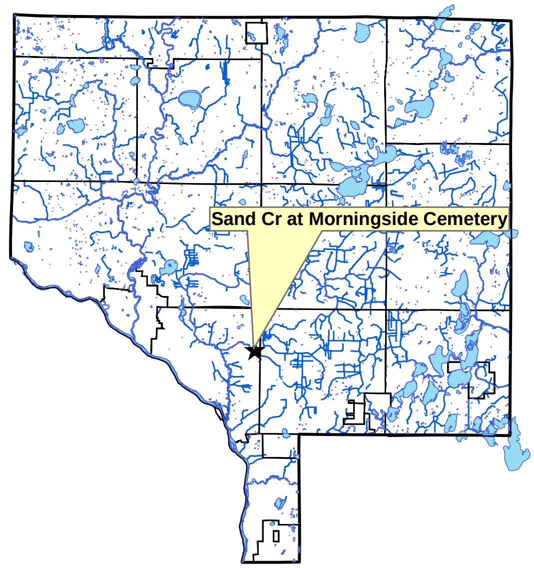
2010 Hydrograph



SAND CREEK

at Morningside Cemetery, 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 approximately 8 feet wide and 3 feet deep at the monitoring site during baseflow.

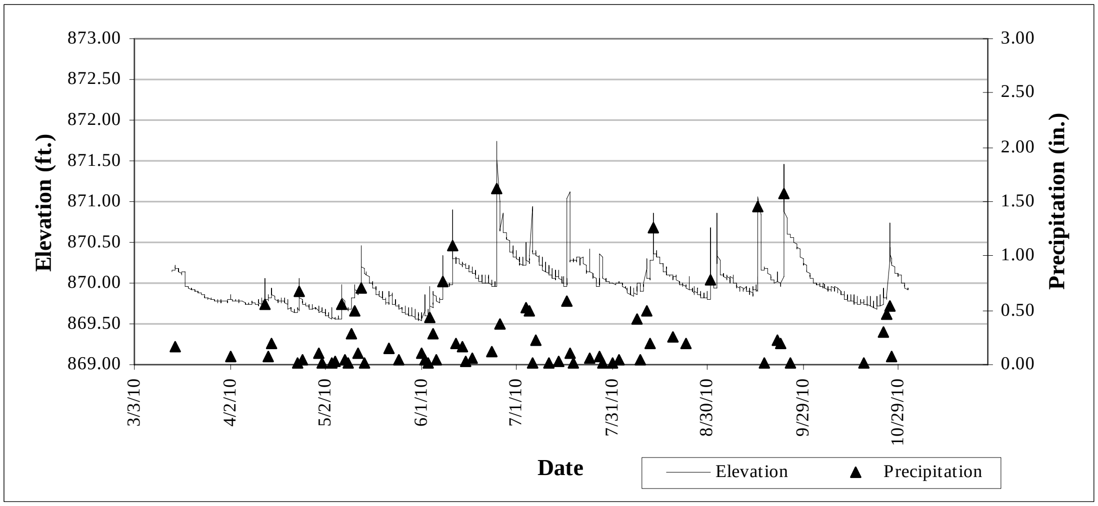
Sand Creek at Morningside Cemetery was monitored for the first time in 2010. The site was added because of its position between the cities of Blaine and Coon Rapids, which provides an estimate of the stormflow contributions from Blaine. In addition, the site is located immediately downstream of the confluence of Ditch 39 with Sand Creek. Water levels in the creek fluctuated 2.22 feet between baseflow and peak flow conditions during 2010. The increased frequency and larger increases in water levels following storms at this site relative to the Xeon St. site could be related to the ditch-like nature of the creek at the Morningside Cemetery location, which is narrower and deeper.

Summary of All Monitored Years

Percentiles	2010	All Years Thru 2010
Min	869.53	869.53
2.5%	869.61	869.61
10.0%	869.70	869.70
25.0%	869.79	869.79
Median (50%)	869.96	869.96
75.0%	869.96	869.96
90.0%	870.29	870.29
97.5%	870.60	870.60
Max	871.75	871.75

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

2010 Hydrograph



Stream Water Quality – Chemical Monitoring

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

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

Locations: Coon Creek at Shadowbrook Townhomes, Andover

Coon Creek at 131st Avenue, Coon Rapids

Coon Creek at Lions Park, Coon Rapids

Coon Creek at Vale Street, Coon Rapids

Sand Creek at Radisson Road, Blaine

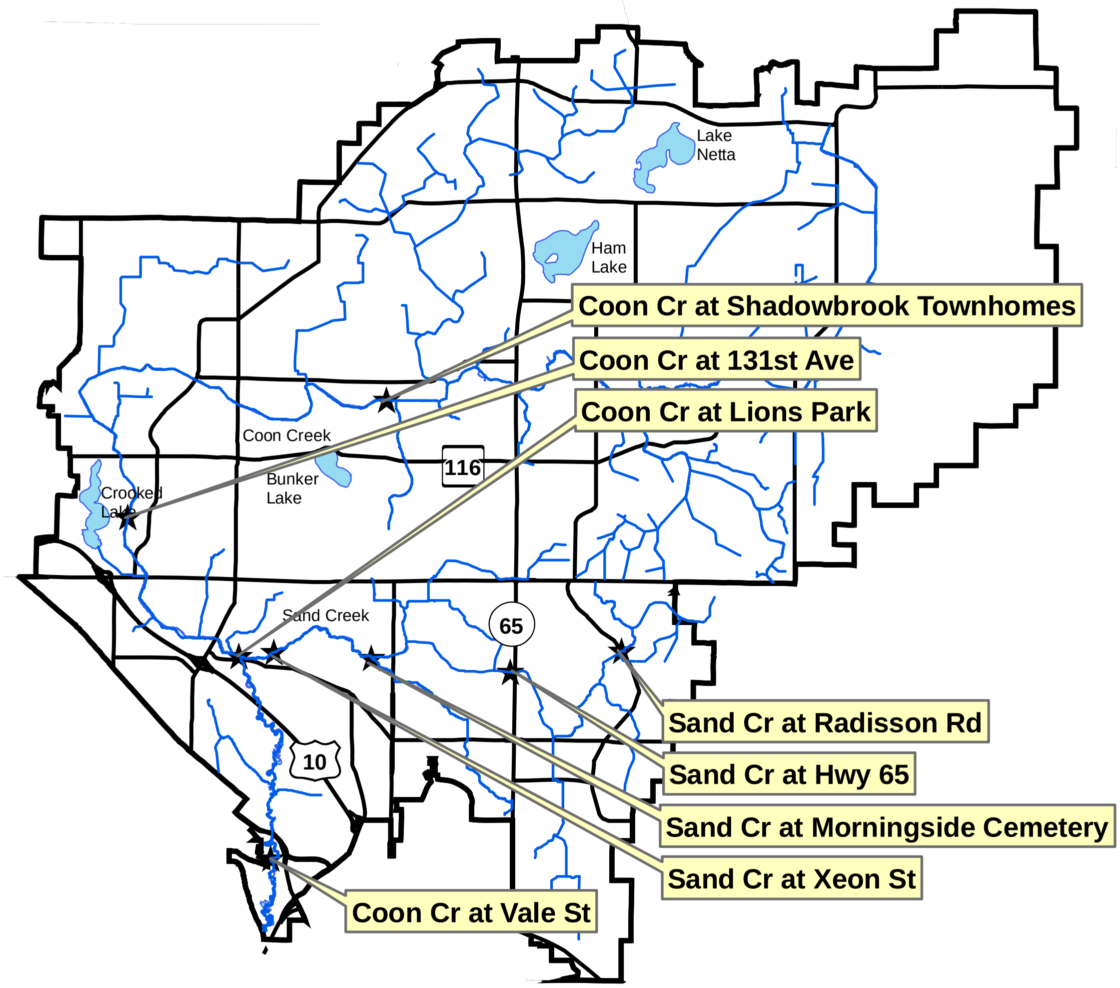
Sand Creek at Highway 65, Blaine

Sand Creek at Morningside Memorial Gardens Cemetery, Coon Rapids

Sand Creek at Xeon Street, Coon Rapids

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

Coon Creek Watershed Stream Water Quality Monitoring Sites



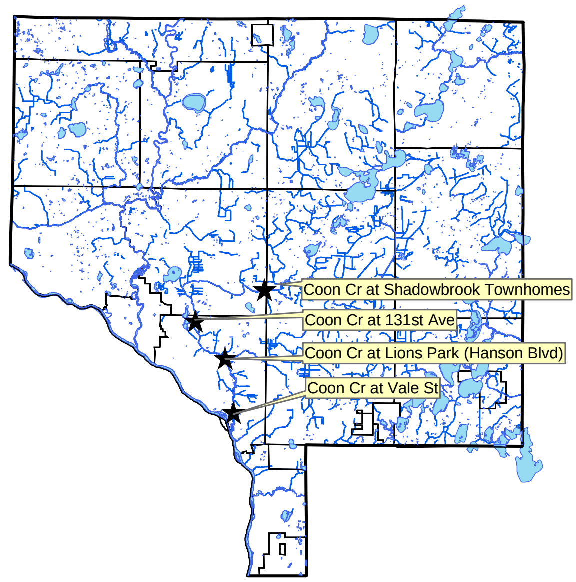
Coon Creek

Coon Creek at Shadowbrook Townhomes, Andover	STORET SiteID = S004-620
Coon Creek at 131st Avenue, Coon Rapids	STORET SiteID = S005-257
Coon Creek at Lions Park, Coon Rapids	STORET SiteID = S004-171
Coon Creek at Vale St., Coon Rapids	STORET SiteID = S003-993

Years Monitored

Coon Cr at Vale Street	2005-2010
Coon Cr at 131st Ave	2010
Coon Cr at Shadowbrook Townhomes	2007-2010
Coon Cr at Lions Park (Hanson Blvd)	2007-2010

Additional, intermittent data available at some other sites



Background

Coon Creek is a major drainage through central Anoka County. Development in the watershed ranges from rural residential to urbanized. Upstream reaches were ditched in the early 1900's for agriculture. There are many ditch tributaries in the upper reaches. Lower reaches of the creek were not ditched. The entire ditch serves as an important stormwater conveyance for the Cities of Ham Lake, Andover, Blaine, and Coon Rapids. The creek outlets into the Mississippi River.

Methods

Coon Creek has been monitored for several years at Vale Street, near its outlet to the Mississippi River as well as at three upstream sites. The monitoring sites were selected to be at the confluence of Coon Creek with tributaries, at municipal boundaries, or other significant locations. All Coon Creek sites, as well as Sand Creek, were monitored at synchronously to allow comparisons.

Streams were monitored during both storm and baseflow conditions by grab samples. Eight water quality samples were taken each year; half during baseflow and half following storms. Storms were generally defined as one-inch or more of rainfall in 24 hours or a significant snowmelt event combined with rainfall. In some years, particularly the drought year of 2009, smaller storms were sampled because of a lack of larger storms. All storms sampled were significant runoff events. Parameters tested with portable meters included pH, conductivity, turbidity, temperature, salinity, and dissolved oxygen. Beginning in 2009 transparency tube measurements were added, as well as photo-documentation of water appearance. Parameters tested by water samples sent to a state-certified lab included total phosphorus, total suspended solids, and chlorides. During every sampling the water level (stage) was recorded using a staff gauge surveyed to sea level elevations. Stage was also continuously recorded using a datalogging electronic gauge at the Vale Street stream crossing (farthest downstream).

Results and Discussion

This report includes data from all years and all sites to provide a broad view of Coon Creek's water quality under a variety of conditions. We focus upon an upstream-to-downstream comparison of water quality, a comparison of baseflow and storm conditions, and an overall assessment. Sand Creek monitoring is reported elsewhere, but some comparisons between Sand Creek and Coon Creek are made here.

Overall, Coon Creek water quality is moderate upstream and during baseflow, but declines downstream and during storms. Dissolved pollutants, as measured by conductivity, salinity, and chlorides, were slightly elevated in Coon Creek and showed little variability in different flow conditions and little variability from upstream to downstream. Some of these dissolved pollutants are originating from the shallow groundwater which feeds the creek during baseflow. Phosphorus was at acceptably low levels during baseflow, but was much more variable and generally higher during storms. Suspended solids and turbidity were also reasonably low at baseflow, but increased several-fold during storms and increased from upstream to downstream. Coon Creek's water is often brown and sometimes strongly brown. Other water quality measures, including pH and dissolved oxygen were with the range considered normal and healthy for streams in this area.

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

Conductivity, Chlorides, and Salinity

Conductivity, chlorides, and salinity are all measures of a broad range of dissolved pollutants. Dissolved pollutant sources include urban road runoff, industrial sources, and others. Metals, hydrocarbons, road salts, and others are often of concern in a suburban environment. Conductivity is the broadest measure of dissolved pollutants we used. It measures electrical conductivity of the water; pure water with no dissolved constituents has zero conductivity. Salinity measures dissolved salts as a percent salinity. Chlorides tests for chloride salts, the most common of which are road de-icing chemicals. Chlorides can also be present in other pollutant types, such as wastewater. These pollutants are of greatest concern because of the effect they can have on the stream's biological community, however it is noteworthy that Coon Creek is upstream from the drinking water intakes on the Mississippi River for the Twin Cities. Overall, dissolved pollutants in Coon Creek are slightly high.

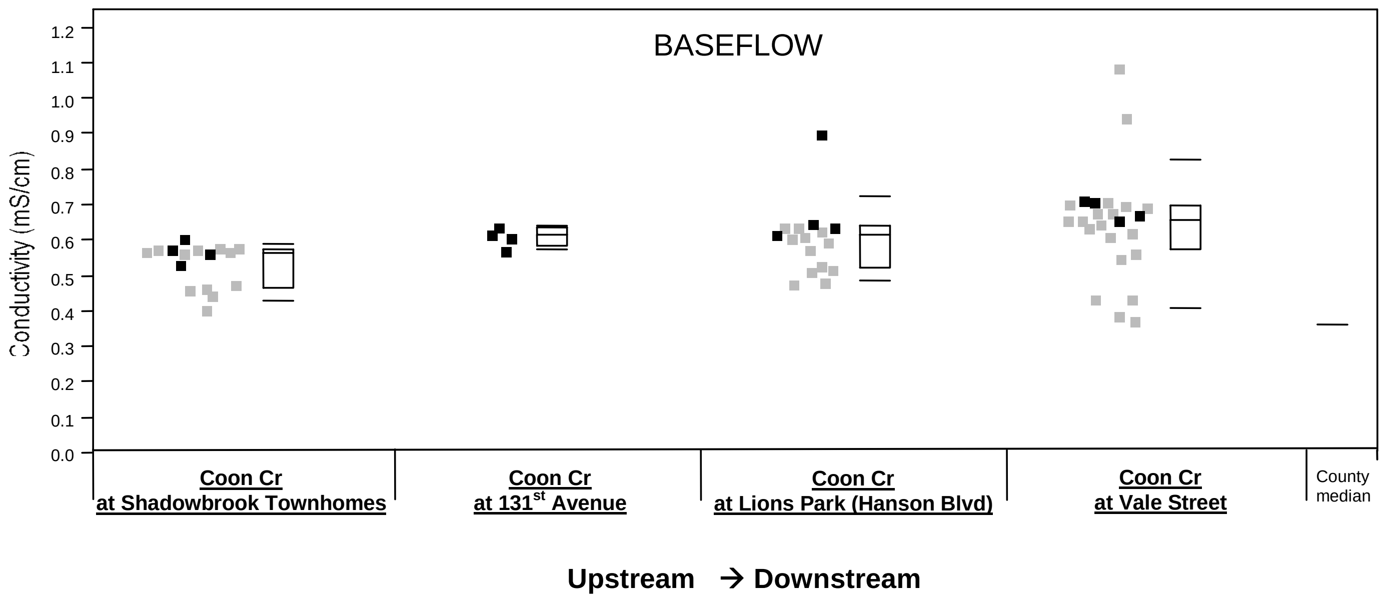
All measures of dissolved pollutants in Coon Creek were notably higher than the median for other Anoka County streams (see figures below). Median conductivity in Coon Creek (all sites, all conditions) was 0.523 mS/cm compared to the countywide median of 0.362 mS/cm. Median salinity in Coon Creek (all sites, all conditions) was 0.02% compared to the countywide median of 0.01%, though salinity is not a very sensitive or useful measure. Median chlorides in Coon Creek (all sites, all conditions) were two and a half times higher than the countywide median (44 vs 17 mg/L).

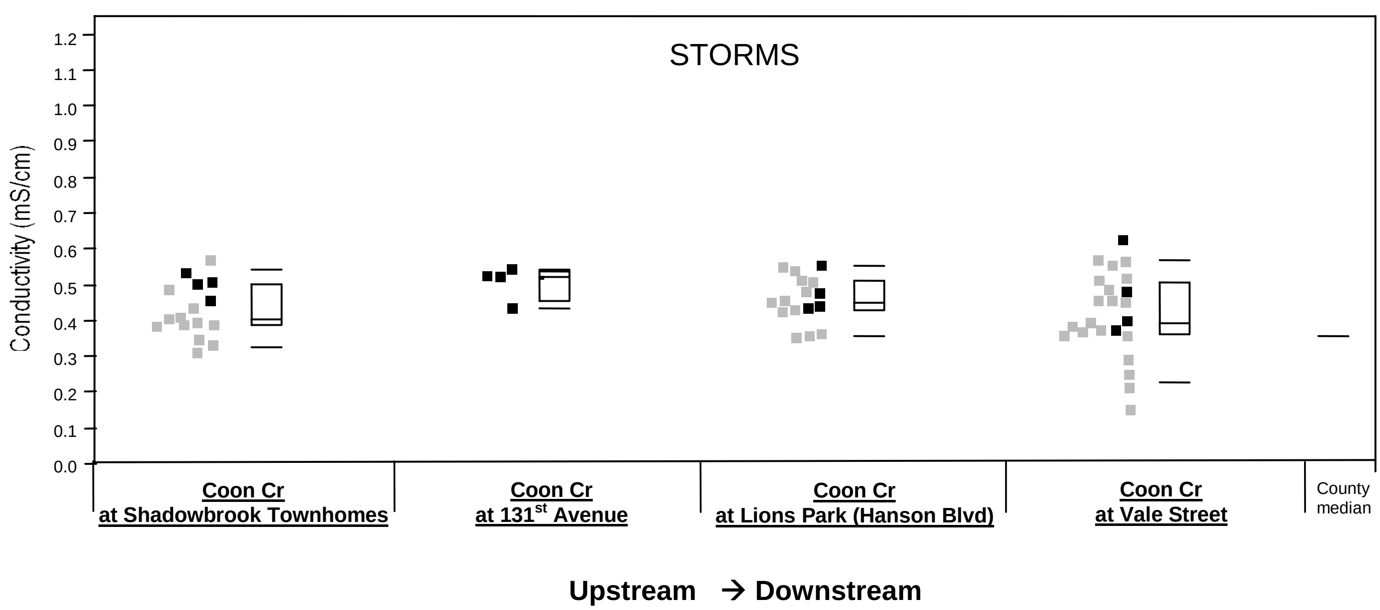
The Minnesota Pollution Control Agency (MPCA) has a water quality standard for only one of the dissolved pollutant parameters, chlorides, but Coon Creek does not exceed this standard. The chronic water quality standard is 230 mg/L. The maximum observed in Coon Creek was 85 mg/L. It is possible that higher levels do occur at other times, such as during snowmelt, but were not captured by the monitoring.

Dissolved pollutants were higher in downstream reaches of Coon Creek, where there is more impervious area (see figures below). The increase is slight for conductivity and salinity during baseflow conditions. Median baseflow conductivity increased modestly from upstream to downstream (0.568, 0.617, 0.615,, and 0.662 mS/cm, respectively). The difference from upstream to downstream for chlorides was much more dramatic, especially between the 131st Avenue and Lions Park monitoring sites. Median baseflow chlorides from upstream to downstream were 37, 42, 51, and 64 mg/L, respectively during baseeflow.

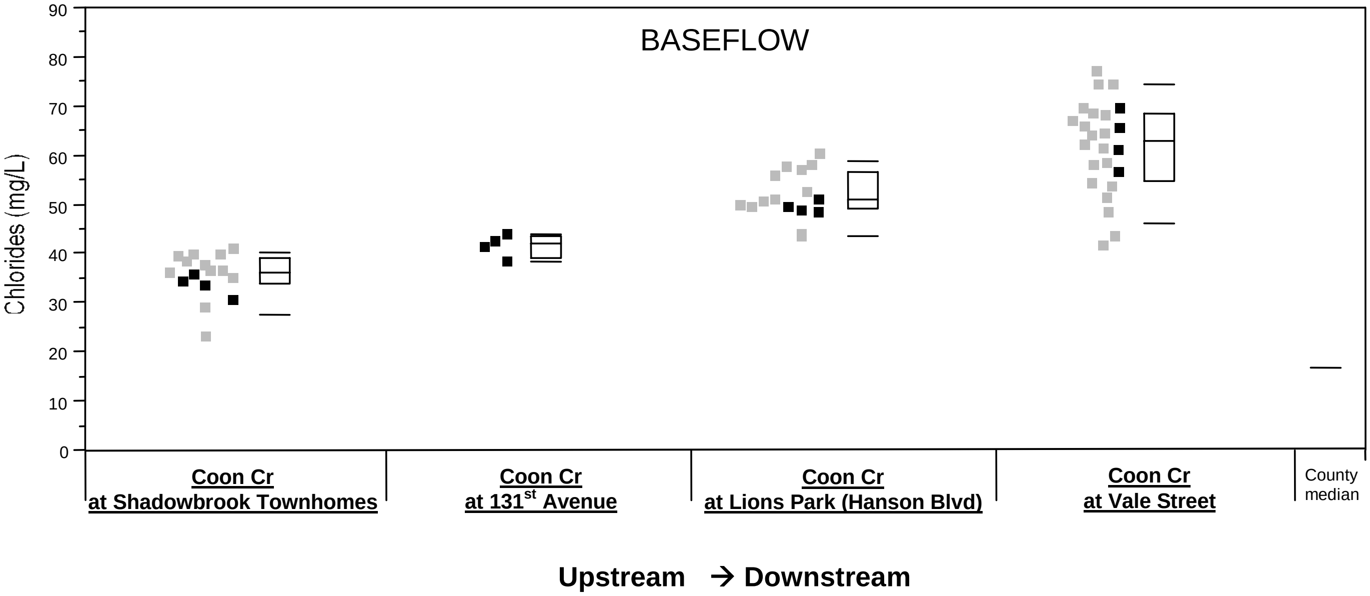
The increases in dissolved pollutants from upstream to downstream were dampened during storms, and overall they were slightly lower during storms. This lends some insight into the pollutant sources. If dissolved pollutants were only elevated during storms, stormwater runoff would be suspected as the primary contributor. If dissolved pollutants were highest during baseflow pollution of the shallow groundwater which feeds the stream during baseflow would be suspected as a primary contributor. In Coon Creek we find similar, but slightly lower dissolved pollutants during storms. For example, median chlorides during baseflow were 64 mg/L during baseflow and 49 mg/L during storms at Vale street. Similarly, median conductivity during baseflow was 0.6 mS/cm, but 0.4 mS/cm during storms at Vale Street. In other words, both stormwater runoff and groundwater are sources of dissolved pollutants, with shallow groundwater being slightly worse. While storms dilute some of the baseflow pollutants, they also carry additional pollutants which somewhat offset the dilution. From a management standpoint, is important to remember that the sources of both stormwater and baseflow dissolved pollutants are generally the same, and preventing their release into the environment and treating them before infiltration should be a high priority. Removing them once they have entered shallow groundwater is exceedingly difficult.

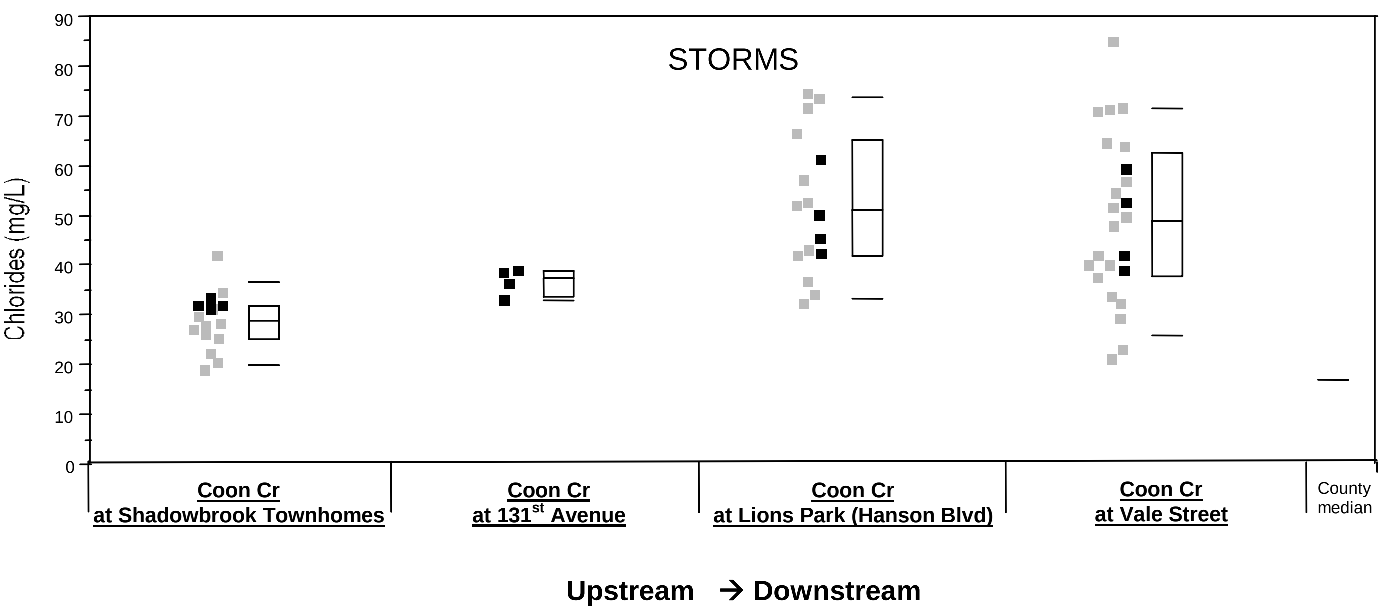
Conductivity Coon Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



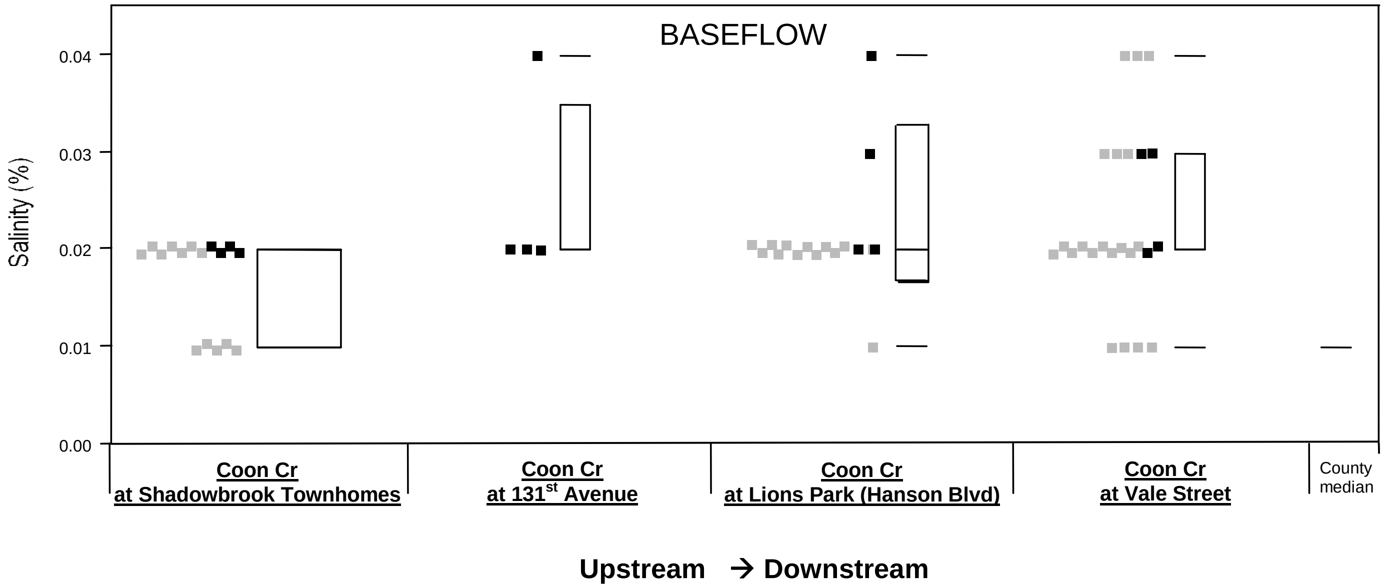


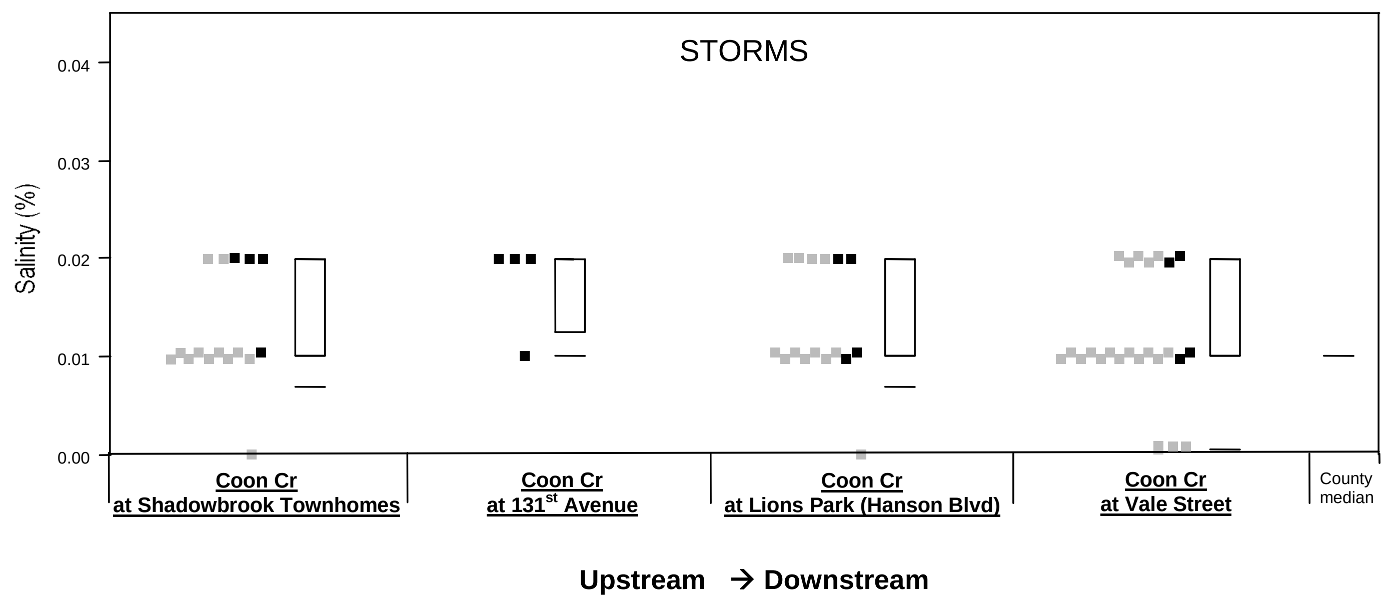
Chloriides Coon Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Salinity Coon Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. 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) is a common nutrient pollutant. It is limiting for most algae growth. Total phosphorus in Coon Creek was consistently low during baseflow conditions, but more than doubled during storms (see figure below). Best management practices for this stream are needed to address stormwater phosphorus along the entire monitored stream length.

Baseflow TP was low. During baseflow the four monitoring sites had median TP of 70, 92, 77, and 78 ug/L, respectively, from upstream to downstream. This is much lower than the countywide median for streams of 128 ug/L. There was little variability among baseflow samples, with only five samples exceeding 128 ug/L. The maximum was 179 ug/L.

During storms TP was higher, and sometimes much higher. Median TP during storms was 1.5 (131^{St} Ave) to 2.4 (Vale St) greater than the median for baseflow. Storms also had much greater variability. The standard deviation for storm readings were 91 ug/L at Shadowbrook, 94 at Lions Park, and 151 at Vale Street. At 131^{st} Avenue the standard deviation was only 55 mg/L, mostly because only one year of monitoring data exists at that site. By contrast, the standard deviations during baseflow were 23, 25, 33, and 33 ug/L, respectively, from upstream to downstream. Variation in the timing, magnitude, and intensity of the storm is likely responsible for the greater variability in TP during storms compared to baseflow.

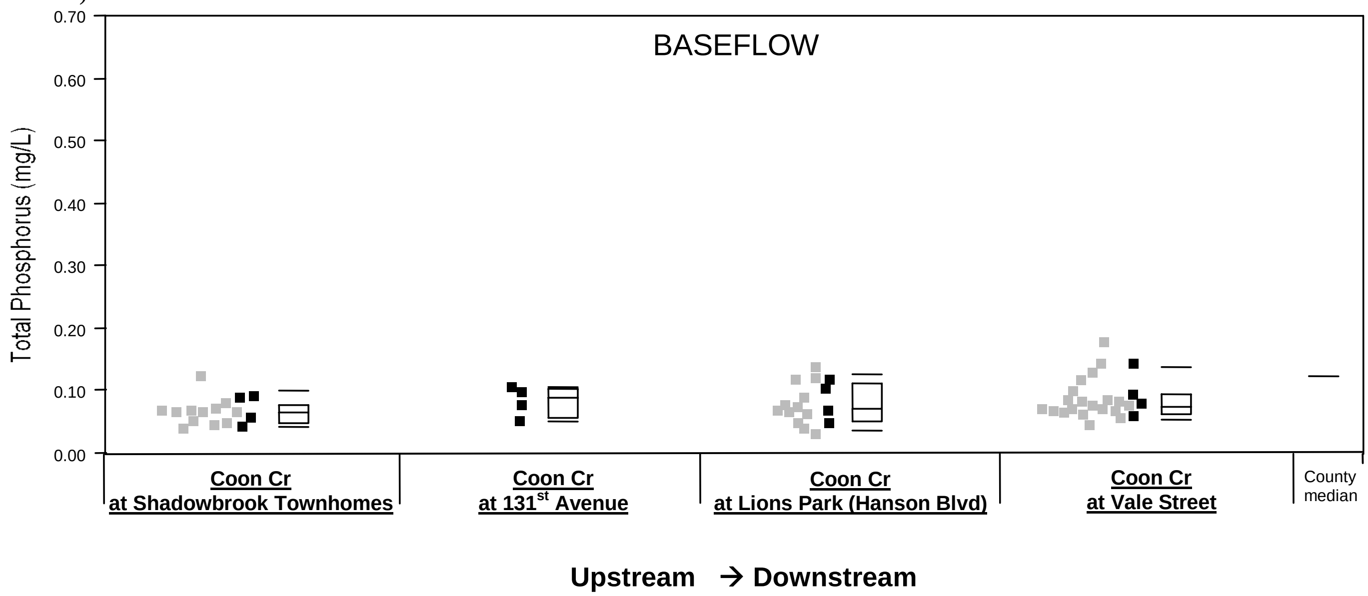
TP increased in an upstream to downstream direction during storms. Median storm TP at the four sites from upstream to downstream were 120, 92, 147, and 187 ug/L, respectively. The second site (131^{st} Avenue) does not show an increase over upstream sites, but this is likely only because only one year of data is available at this site. The Vale Street site had the highest individual readings and much more variability. At Vale Street there were six readings over 300 ug/L, while there were three such instances at Lions Park and only one at Shadowbrook. More sampling events at Vale Street could partially explain this.

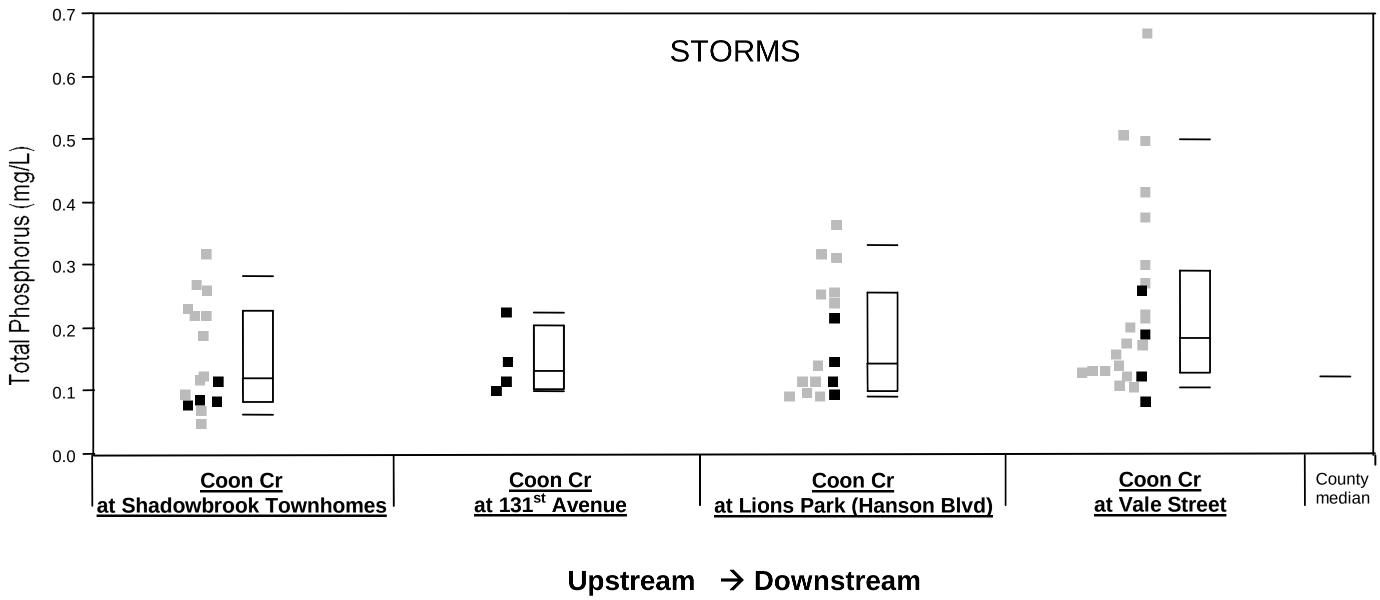
The dominant phosphorus source is likely different in upstream and downstream stream reaches. Upstream is less densely developed and development occurred more recently with more stringent stormwater management standards. Here, mobilization of in-stream sediments and agricultural runoff may be an important phosphorus source, and stormwater runoff to a lesser degree. Downstream areas are more densely developed and were developed before modern-day stormwater standards. Here, flows are often higher and more flashy, so mobilization of in-stream sediments may continue to be important, but stormwater runoff from impervious surfaces is likely quite important.

From a management standpoint, phosphorus reduction during storms needs to occur throughout the watershed. Arguably the highest priority should be addressing phosphorus from urban stormwater runoff in the lower portion of the watershed. This is the area with the highest TP, sometimes very high. Also, this is the area with the highest levels of other pollutants, such as total suspended solids. Improvements to stormwater treatment in this area could address multiple problems.

The Minnesota Pollution Control Agency is currently drafting nutrient water quality standards for rivers and streams. While not final, a phosphorus standard of 100 ug/L (0.1 mg/L – units used on graphs in this report) is proposed for central Minnesota. This is similar, but slightly lower than the median TP in Anoka County streams of 128 ug/L. It appears clear that all monitored segments of Coon Creek would exceed this standard during storms.

Total phosphorus at Coon Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Suspended Solids and Turbidity

Total suspended solids (TSS) and turbidity both measure solid particles in the water. TSS measures these particles by weighing materials filtered out of the water. Turbidity measures by defraction of a beam of light sent though the water sample, and is therefore most sensitive to large particles. In Coon Creek TSS and turbidity were low upstream and during baseflow, but increase dramatically during storms and in downstream reaches (see figures below). The stream appears to exceed state water quality standards for turbidity, though it has not yet been listed as impaired by the MPCA.

During baseflow TSS and turbidity were acceptably low and showed little upstream to downstream increase. Median turbidity during baseflow from upstream to downstream were 8, 11, 7, and 9 FRNU, respectively. This is similar to the countywide median of 8 FRNU and less than the MPCA's water quality standard of 25. Median TSS during baseflow from upstream to downstream was 5, 6, 7, and 8 mg/L, respectively. This is lower than the median for streams county-wide of 12 mg/L.

During storms TSS and turbidity were higher and increased from upstream to downstream. Median TSS during storms was 1.6 to 5.7 times higher than during baseflow (comparison is among site medians). Median storm TSS was 11, 10, 20, and 39 mg/L from upstream to downstream. Median turbidity during storms was 1.7 to 4.4 times higher than during baseflow (comparison is among site medians). Median storm turbidity was 13, 24, 29, and 39 mg/L from upstream to downstream. The greatest increase from baseflow to storms was at the Vale Street monitoring site (farthest downstream).

Turbidity and TSS are highest in downstream reaches. Readings in downstream areas are typically two-times higher than those from upstream areas during storms. Higher flows in downstream areas probably contribute to greater bedload transport of sediment. Greater impervious area in downstream portions of the watershed results more urban stormwater runoff, which is often high in suspended materials. The lower portions of the Coon Creek watershed were mostly developed before rigorous stormwater treatment regulations were enacted.

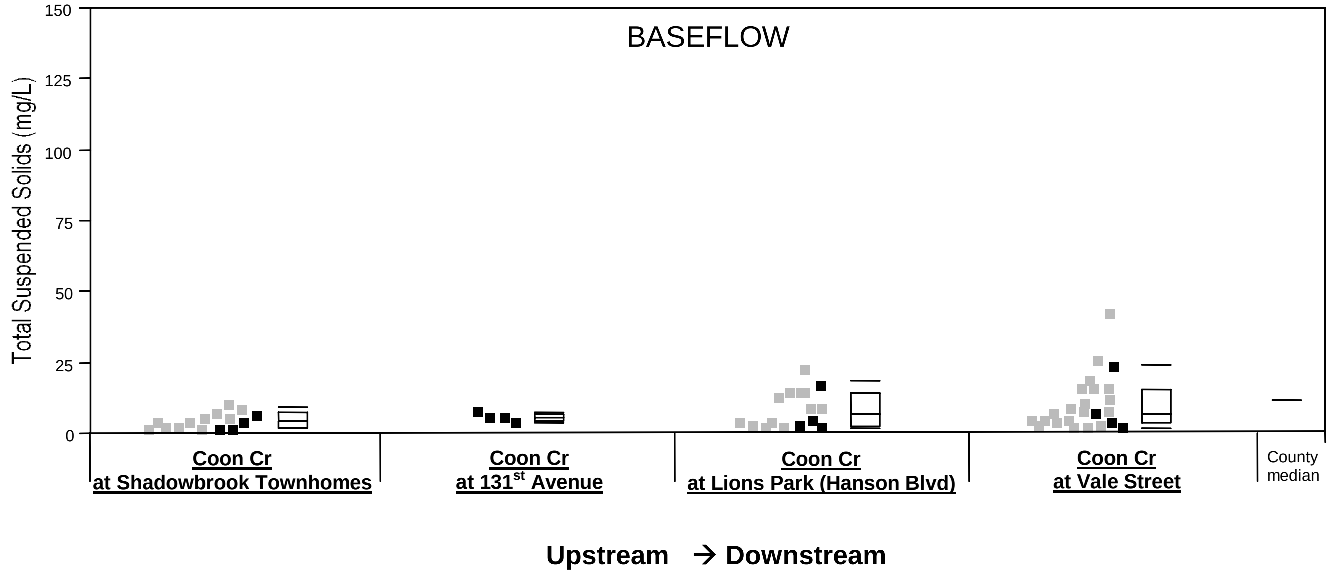
There is likely enough data for the MPCA to consider Coon Creek "impaired" due to violations of turbidity water quality standards. Whenever possible, MPCA prefers to use turbidity for these determinations rather than use TSS and transparency tube as surrogates. A minimum of 20 readings are required. At least three observations and 10% of all observations must exceed the water quality standard of 25 NTU to be considered impaired. At the Shadowbrook monitoring site (farthest upstream), 4 of 29 (14%) readings exceeded the standard. Too few measurements are available at 131st Avenue to determine if state standards are exceeded. At the Lions Park monitoring site, 11 of 32 readings (34%) exceeded the standard. At the Vale Street monitoring site (farthest downstream), 18 of 47 (38%) of readings exceeded the standard. Keep in mind that half of all readings are during storms and half during baseflow. All except four exceedences were during storms. Based on this, the MPCA is likely to list Coon Creek as impaired for high turbidity.

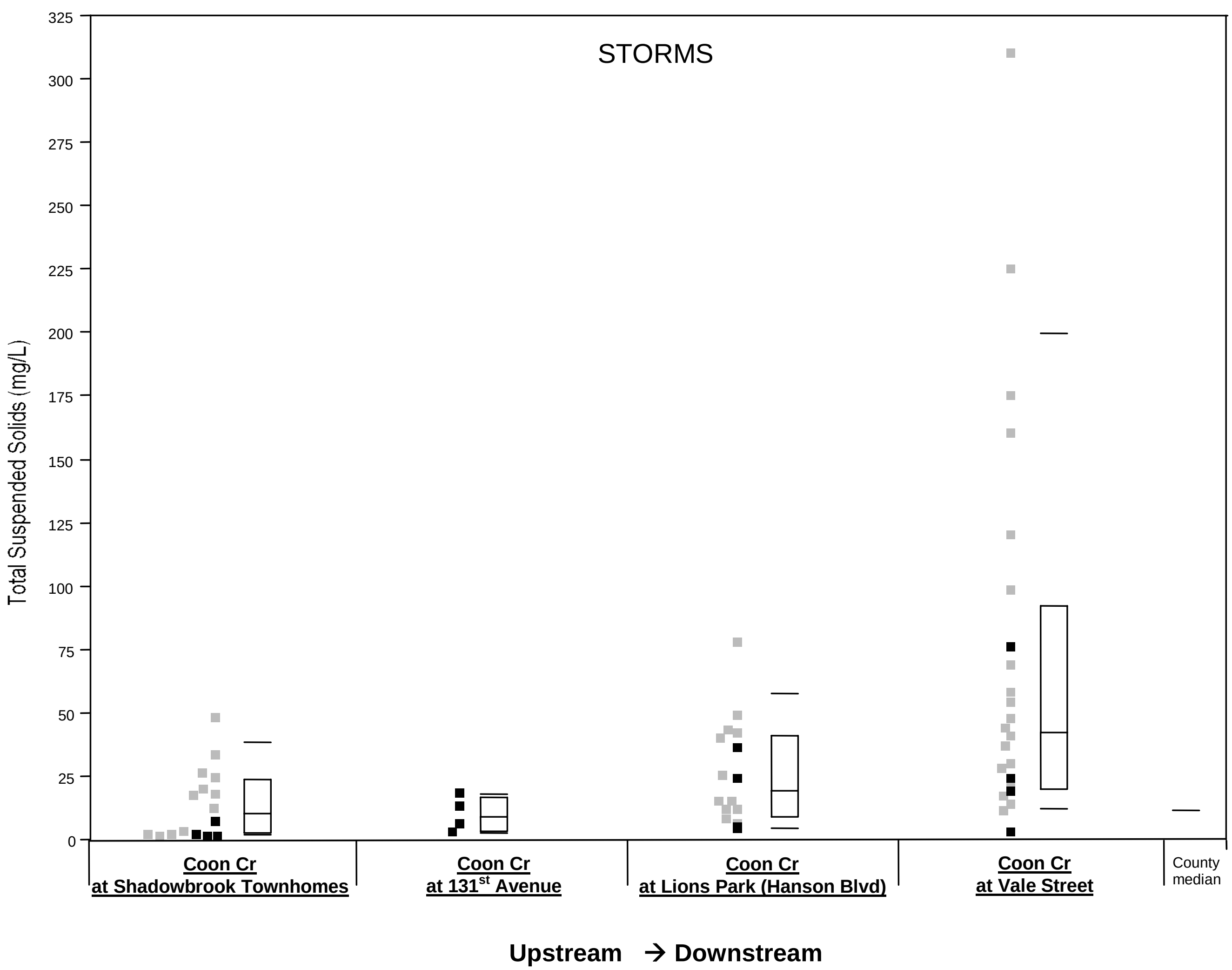
There are some questions regarding the appropriateness of such an impaired listing. First, turbidity measurements were taken using units of FNRU, not NTU. It is uncertain how these units differ, but the difference is likely small. Also, Coon Creek exceeded the surrogate standard of 100 mg/L TSS only five times. Only five of 56 (all sites) transparency tube measurements exceeded that surrogate standard of 20 cm. However, MPCA's preference is to use turbidity.

From a management perspective, water quality improvement projects should focus upon treating stormwater, especially in the lower half of the watershed. Retrofitting the existing stormwater conveyance and treatment system will be necessary in many instances. Where redevelopment occurs, improved stormwater practices should be installed. In some areas, stabilization of the creek itself is needed; several areas of significant streambank erosion exist. This is not surprising given that upper reaches of the creek have been ditched.

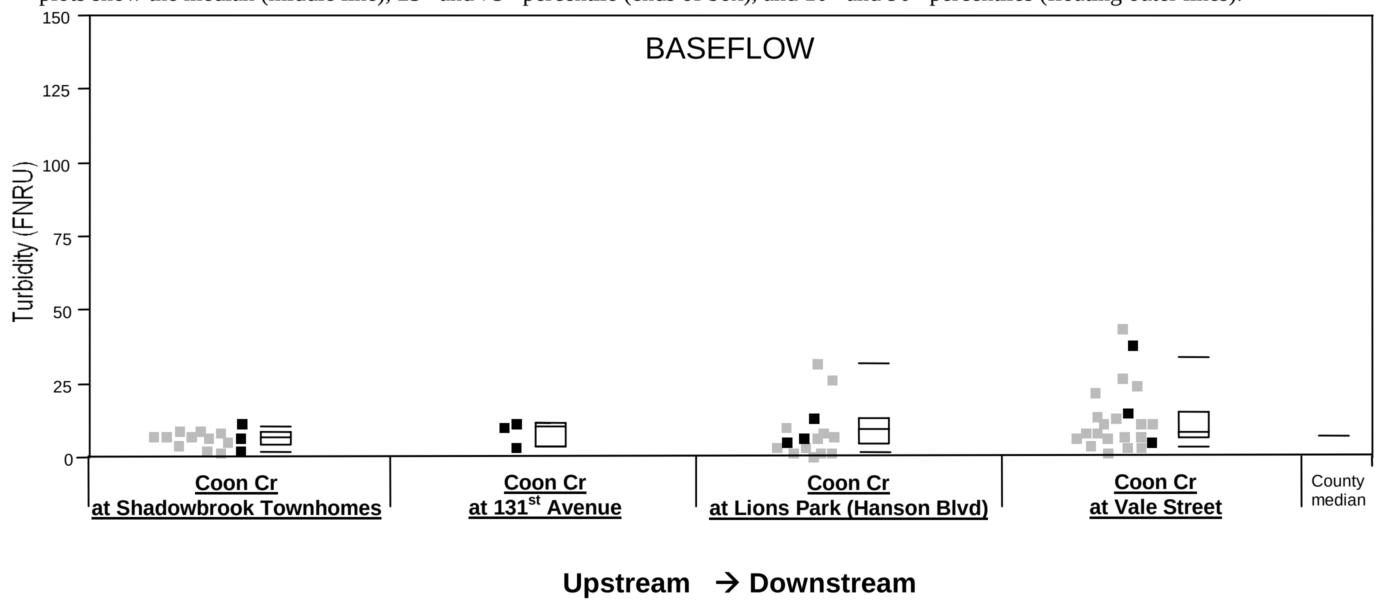
In addition to the data presented above, some transparency tube data and photos are available from the Anoka Conservation District. Transparency tube readings were not included in this report because in many instances water clarity was greater than the tube's length, resulting in a reading of >100cm. Stream appearance was also photo-documented during every sampling, and is available from the Anoka Conservation District.

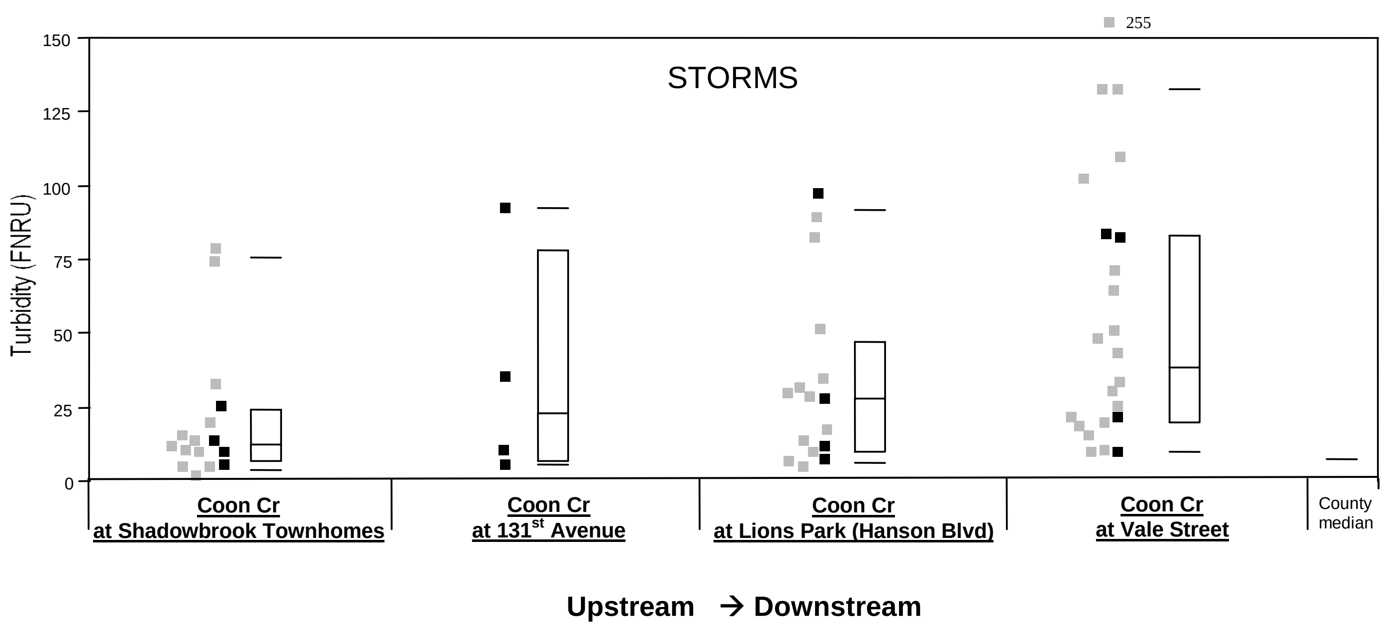
Total suspended solids at Coon Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Turbidity at Coon Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

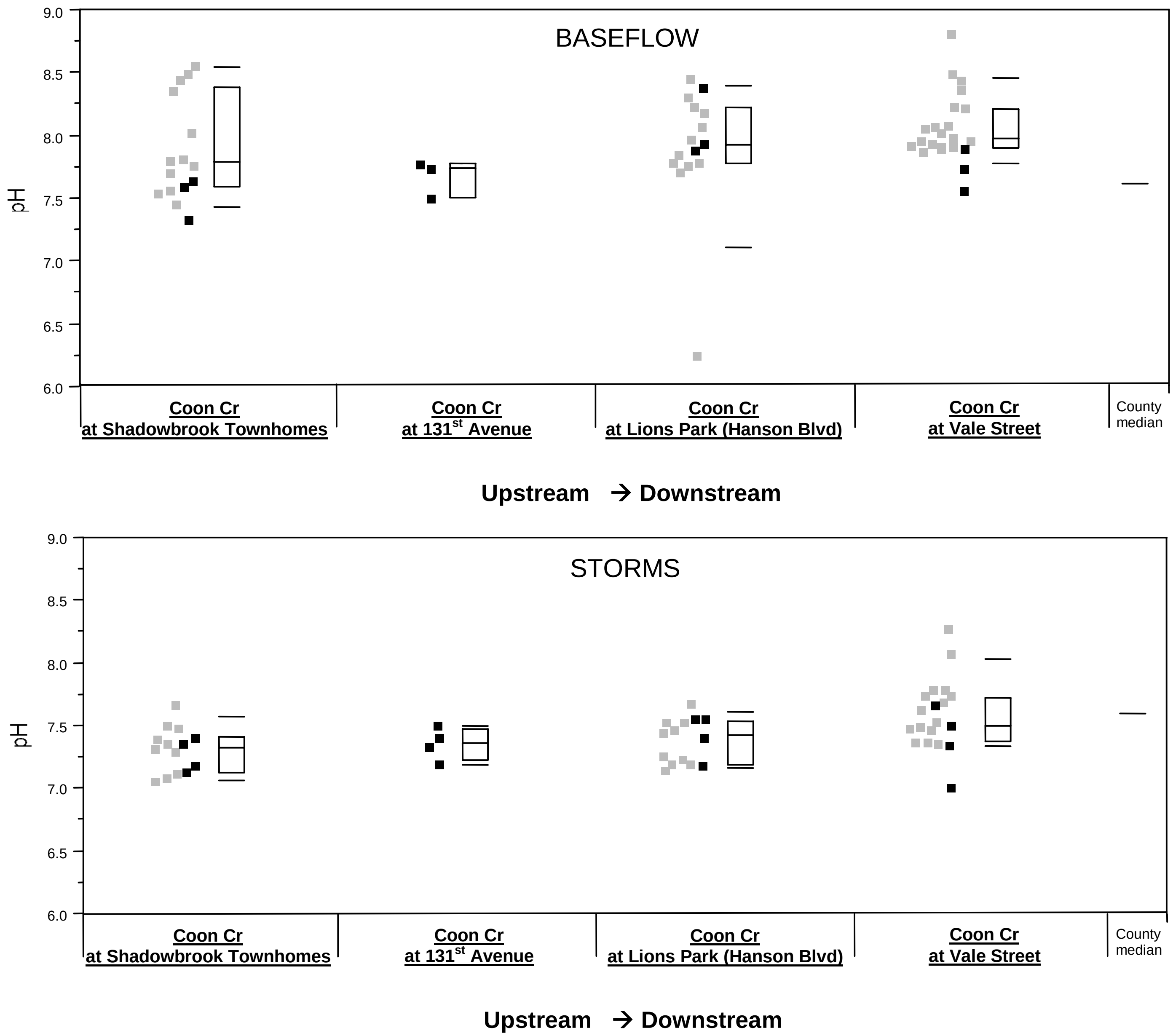




pH

pH was within the expected range at all sites, with rare exceptions. pH is expected to be between 6.5 and 8.5 according to MPCA water quality standards. While occasional readings outside of this range did occur, they were not large departures that generate concerns. pH was notably lower during all storm evens, but this is not surprising because rainfall has a lower pH and the creek serves as a stormwater conveyance for four cities. One unusually low pH reading of 6.24 occurred on July 20, 2009. The reason for this low reading is unknown, but it appears to be isolated.

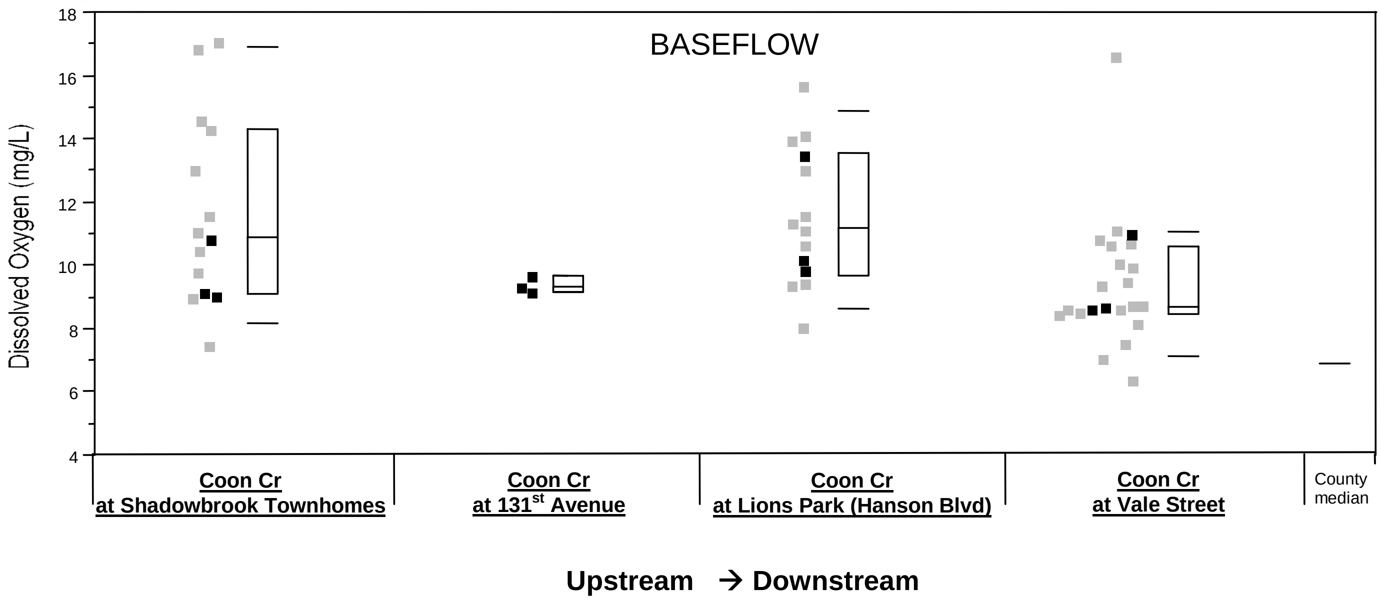
pH at Coon Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

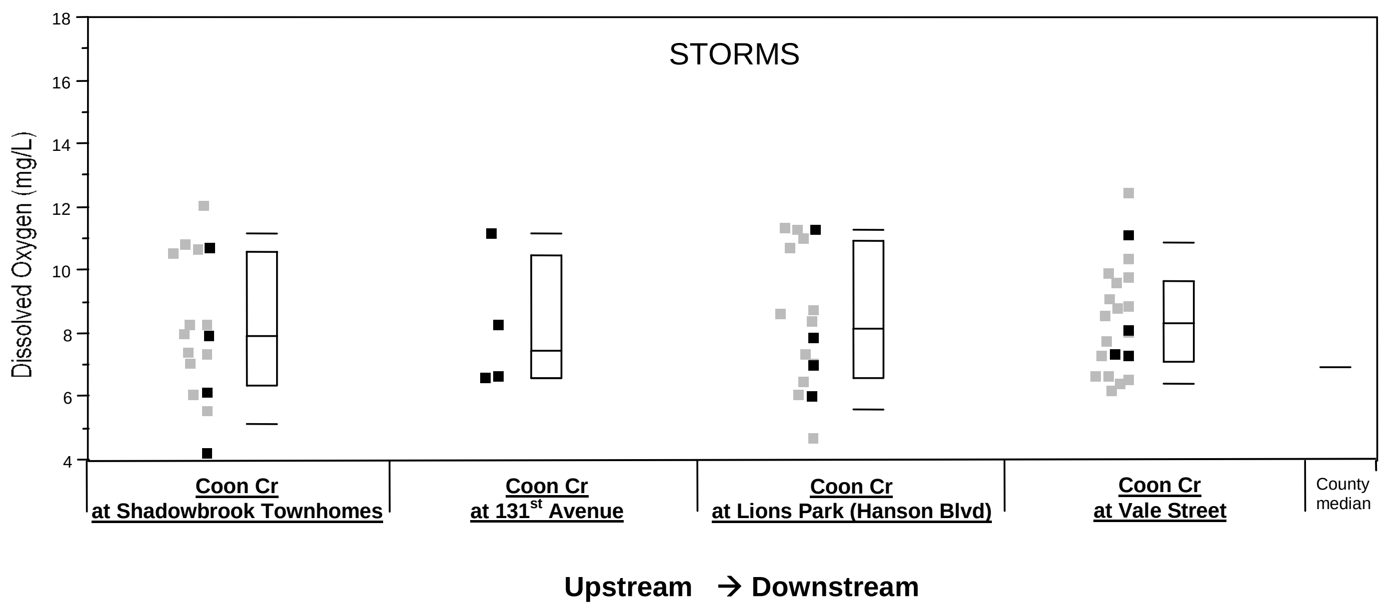


Dissolved Oxygen

Dissolved oxygen was similar at all sites, only twice dropping below 5 mg/L at which point some aquatic life becomes stressed.

Dissolved oxygen at Coon Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





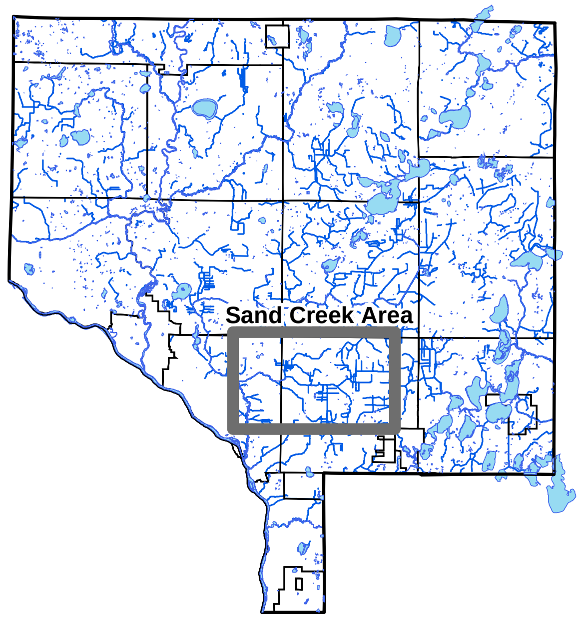
Stream Water Quality Monitoring

SAND CREEK SYSTEM

Sand Cr (Ditch 41) at Radisson Rd, Blaine	STORET SiteID = S006-421
Sand Cr (Ditch 41) at Highway 65, Blaine	STORET SiteID = S005-639
Sand Cr at Happy Acres Park, Blaine	STORET SiteID = S005-641
Ditch 60 at Happy Acres Park, Blaine	STORET SiteID = S005-642
Sand Cr at University Avenue, Coon Rapids	STORET SiteID = S005-264
Ditch 39 at University Avenue, Coon Rapids	STORET SiteID = S005-638
Sand Cr at Morningside Mem. Gardens Cemetery, Coon Rapids	STORET SiteID = S006-420
Sand Cr at Xeon Street, Coon Rapids	STORET SiteID = S004-619

Years Monitored

Sand Cr (Ditch 41) at Radisson Rd	2010
Sand Cr (Ditch 41) at Highway 65	2009, 2010
Sand Cr at Happy Acres Park	2009
Ditch 60 at Happy Acres Park	2009
Sand Cr at University Avenue	2008
Ditch 39 at University Avenue	2009
Sand Cr at Morningside Cemetery	2010
Sand Cr at Xeon Street	2007, 2008, 2009, 2010



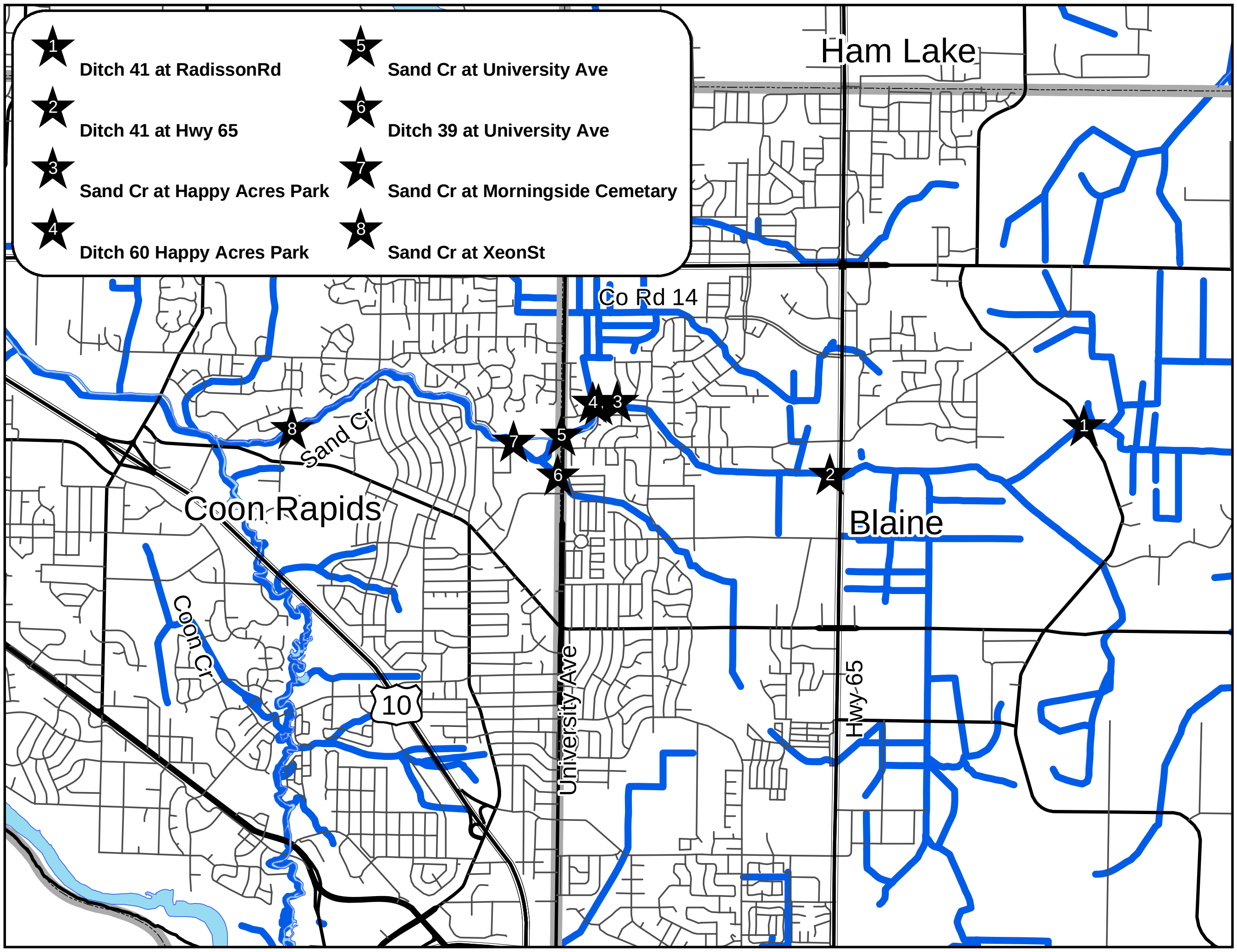
Background

Sand Creek is the largest tributary to Coon Creek. It drains suburban residential, commercial and retail areas throughout northeastern Coon Rapids and western Blaine. In upper portions of the watershed (upstream of Hwy 65), the creek flows through a network of man-made ponds and lakes which serve stormwater treatment and aesthetic purposes. These areas were developed recently, after 1995. Farther downstream there are no in-line ponds and older development. A number of ditch tributaries exist throughout the watershed, and many reaches of Sand Creek itself have been ditched. Sand Creek drains to Coon Creek, which then drains to the Mississippi River. At its confluence with Coon Creek, Sand Creek it is about 15 feet wide and 2.5-3 feet deep during baseflow. Sand Creek has not been listed as “impaired” by the MN Pollution Control Agency for exceeding any water quality parameters.

Methods

Sand Creek and its tributaries were monitored during both storm and baseflow conditions by grab samples. Eight water quality samples were taken each year; half during baseflow and half following storms. Storms were generally defined as one-inch or more of rainfall in 24 hours or a significant snowmelt event combined with rainfall. In some years, particularly the drought year of 2009, smaller storms were sampled because of a lack of larger storms. All storms sampled were significant runoff events. Parameters tested with portable meters included pH, conductivity, turbidity, temperature, salinity, and dissolved oxygen. Beginning in 2009 transparency tube measurements were added, as well as photo-documentation of water appearance. Parameters tested by water samples sent to a state-certified lab included total phosphorus, total suspended solids, and chlorides. During every sampling the water level (stage) was recorded using a staff gauge surveyed to sea level elevations. Stage was also continuously recorded using a datalogging electronic gauge at the Xeon Street stream crossing (farthest downstream).

Sand Creek Monitoring Sites



Results and Discussion

The results presented below include all years of monitoring at all sites. We focus upon an upstream-to-downstream comparison of water quality, as well as an overall assessment. Overall, water quality in Sand Creek is good, especially for a creek with a suburban watershed. Phosphorus, suspended solids, and turbidity are often elevated in urban streams but in Sand Creek were generally lower than the median of other Anoka County streams (Anoka County includes a range of urban to rural). They were similar during baseflow and storms, but did increase from upstream to downstream, and the highest readings generally occur during storms. On the other hand, dissolved pollutants in Sand Creek (as measured by conductivity, chlorides, and salinity) were 4+ times higher than the Anoka County median. During storms dissolved pollutant levels ranged widely, but concentrations were overall highest during baseflow. The concentration of dissolved pollutants did not increase from upstream to downstream. Detailed results are presented below for each pollutant type.

Sand Creek water degrades Coon Creek for some parameters but not others. Sand Creek phosphorus, total suspended solids, and turbidity were all lower than Coon Creek. Dissolved pollutants, as measured by conductivity, chlorides, and salinity were notably higher in Sand Creek than Coon Creek. Coon Creek has several water quality problems, including dissolved pollutants, phosphorus, and suspended solids.

Conductivity, Chlorides, and Salinity

Conductivity, chlorides, and salinity are all measures of a broad range of dissolved pollutants. Dissolved pollutant sources include urban road runoff, industrial sources, and others. Metals, hydrocarbons, road salts, and others are often of concern in a suburban environment. Conductivity is the broadest measure of dissolved pollutants we used. It measures electrical conductivity of the water; pure water with no dissolved constituents has zero conductivity. Salinity measures dissolved salts as a percent salinity. Chlorides measures for chloride salts, the most common of which are road de-icing chemicals. Chlorides can also be present in other pollutant types, such as wastewater. These pollutants are of greatest concern because of the effect they can have on the stream's biological community, however it is noteworthy that Sand Creek is upstream from the drinking water intakes on the Mississippi River for the Twin Cities. Overall, dissolved pollutants in Sand Creek are moderately high.

Sand Creek dissolved pollutant levels are often double the level typically found in Anoka County streams (see figures below). Considering all sites in all years, median conductivity in Sand Creek is more than two times greater than the median for all Anoka County streams (0.740 mS/cm compared to 0.362 mS/cm). Chlorides were even higher. Sand Creek median chlorides were four times greater than the median of all Anoka County streams (70 mg/L vs 17 mg/L). This is still less than the Minnesota Pollution Control Agency's chronic water quality standard for chloride of 230 mg/L. Salinity is not as sensitive of a test, but salinity in Sand Creek averaged 0.03% compared to 0.01% for the county-wide median. It is possible that higher levels of conductivity, chlorides, and salinity do occur at other times, such as during snowmelt, but were not captured by the monitoring.

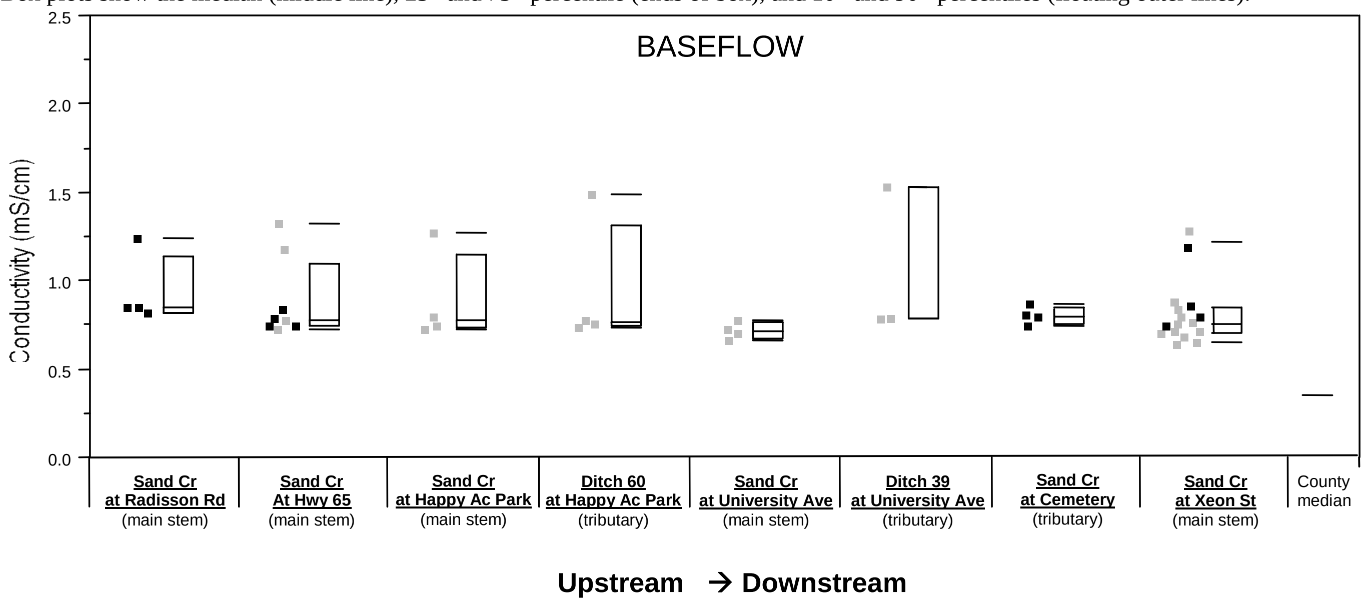
It's not surprising that Sand Creek, which lies in a suburban area, would have greater dissolved pollutants than the county-wide median. The county spans rural to urban areas. Urban stormwater runoff often contains higher dissolved pollutants than those from rural environments. Stormwater treatment practices such as catch basins and settling ponds are relatively ineffective at removing dissolved pollutants. Streams near Sand Creek in similar land use settings have similar dissolved pollutant levels.

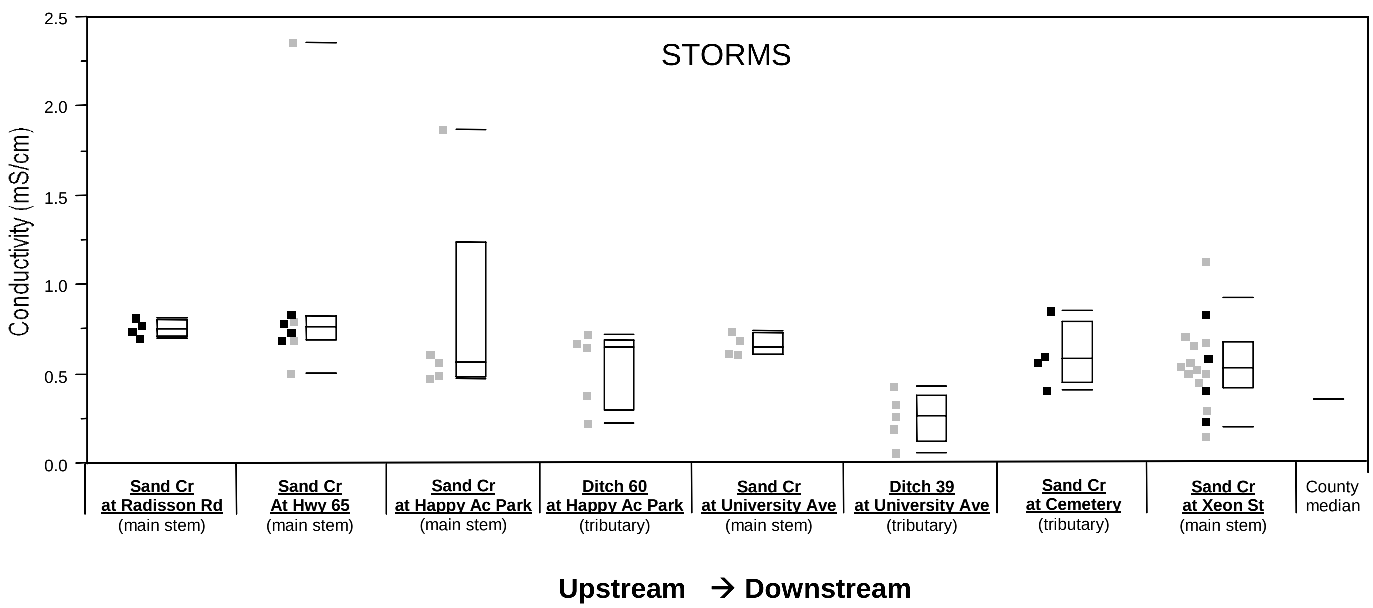
From upstream to downstream there is little change in dissolved pollutants in Sand Creek (see figures below). While upstream sites seem to have a little more variability with an occasional higher reading, all sites were similar. This suggests dissolved pollutant concentrations in all parts of the watershed are similar.

Dissolved pollutants were slightly lower during storms than during baseflow (see figures below). Dissolved pollutants can easily infiltrate into the shallow groundwater that feeds streams during baseflow. If this has occurred, dissolved pollutants will be high during baseflow. If road runoff was the primary dissolved pollutant source, then readings would be highest during storms. In Sand Creek dissolved pollutants are slightly lower during storms because the rainfall runoff dilutes dissolved pollutants in baseflow. Greater areas of impervious surfaces and stormwater inputs in the lower watershed lead to a slight reduction in stream dissolved pollutants from upstream to downstream during storms. This is not to say that rain runoff is free of dissolved pollutants; rather the concentration is only slightly lower than in the shallow groundwater. Dissolved pollutants during storms are still approximately two times higher than the median of other streams. From a management standpoint, is important to remember that the sources of both stormwater and baseflow dissolved pollutants are generally the same, and preventing their release into the environment and treating them before infiltration should be a high priority. Removing them once they have entered shallow groundwater is exceedingly difficult.

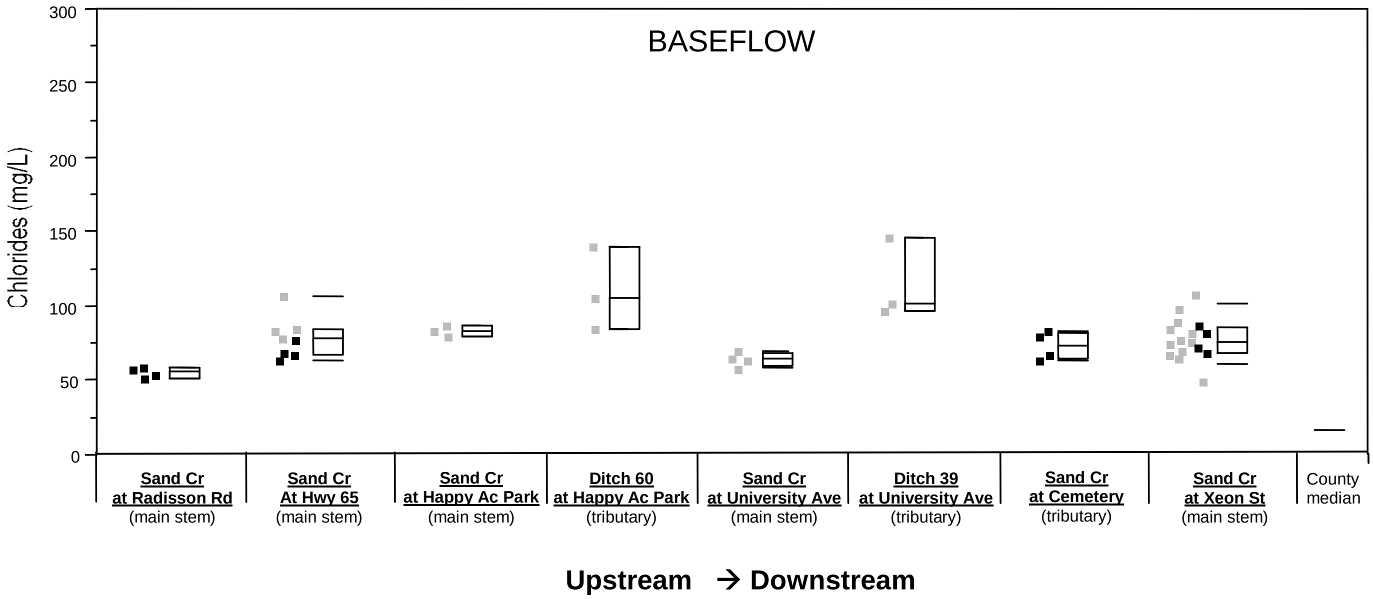
Sand Creek degrades Coon Creek with dissolved pollutants. Both creeks were monitored just before they join. Across all years monitored, Sand Creek's median conductivity was 0.700 mS/cm, while Coon Creek's was 0.520. Sand Creek's median chlorides were 31% (23 mg/L) higher than Coon Creek. The two streams have similar salinity, but this measure is not very sensitive.

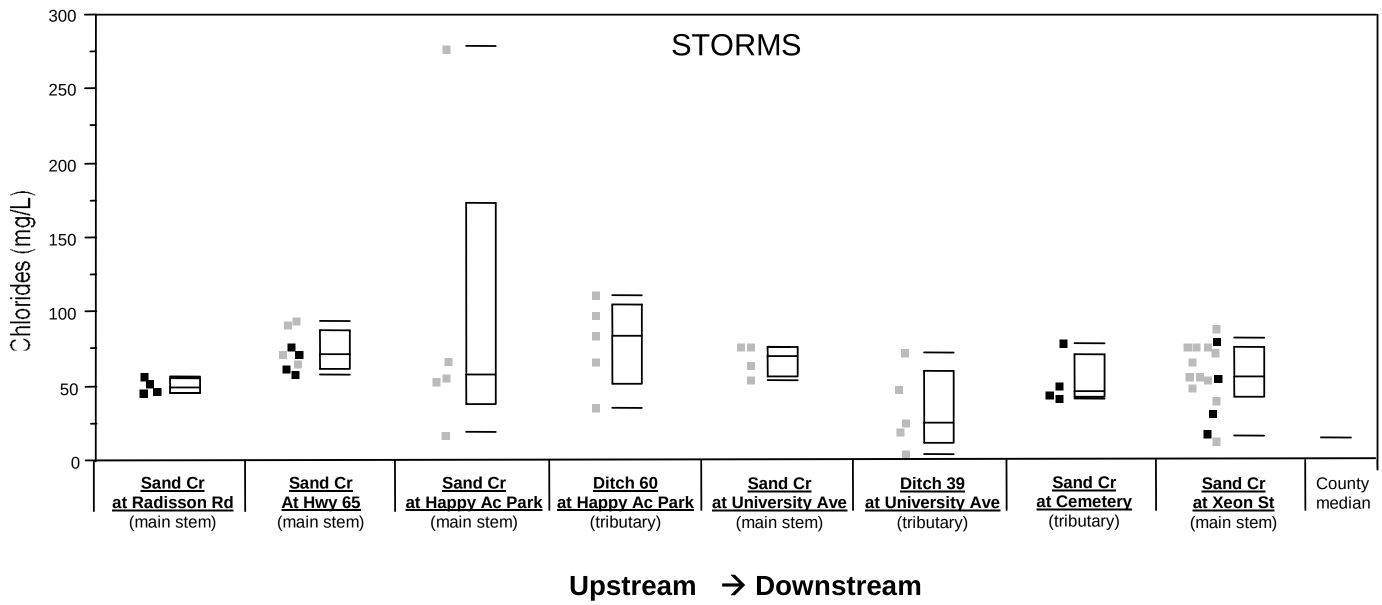
Conductivity at Sand Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



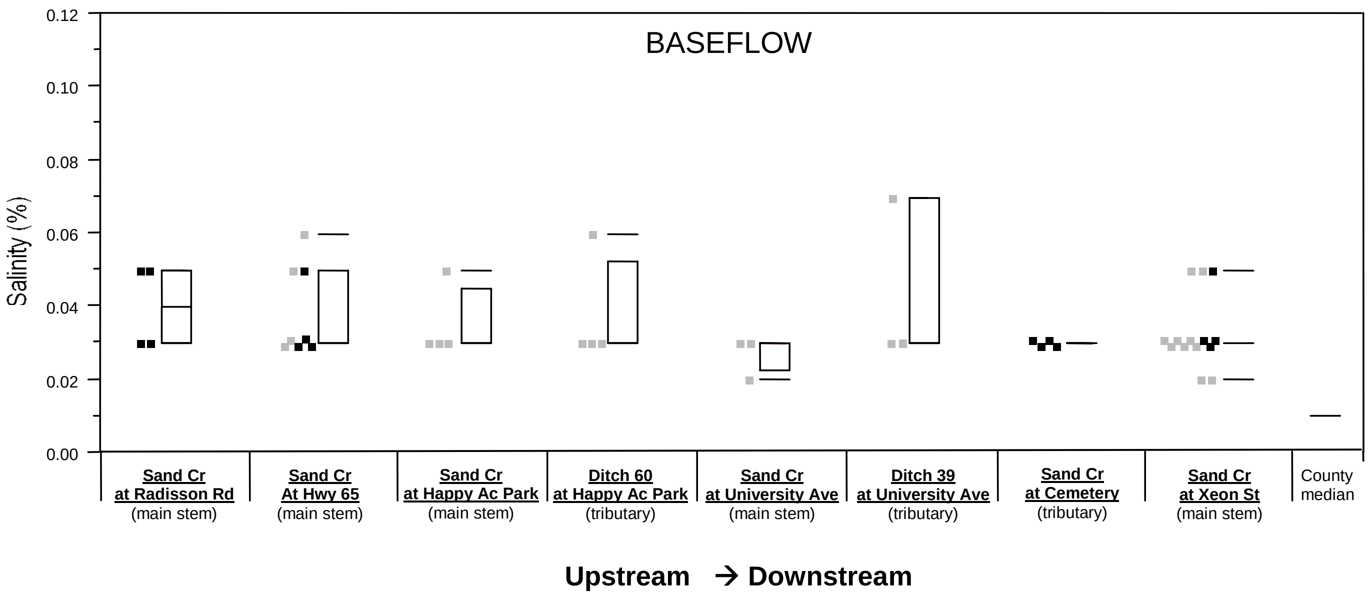


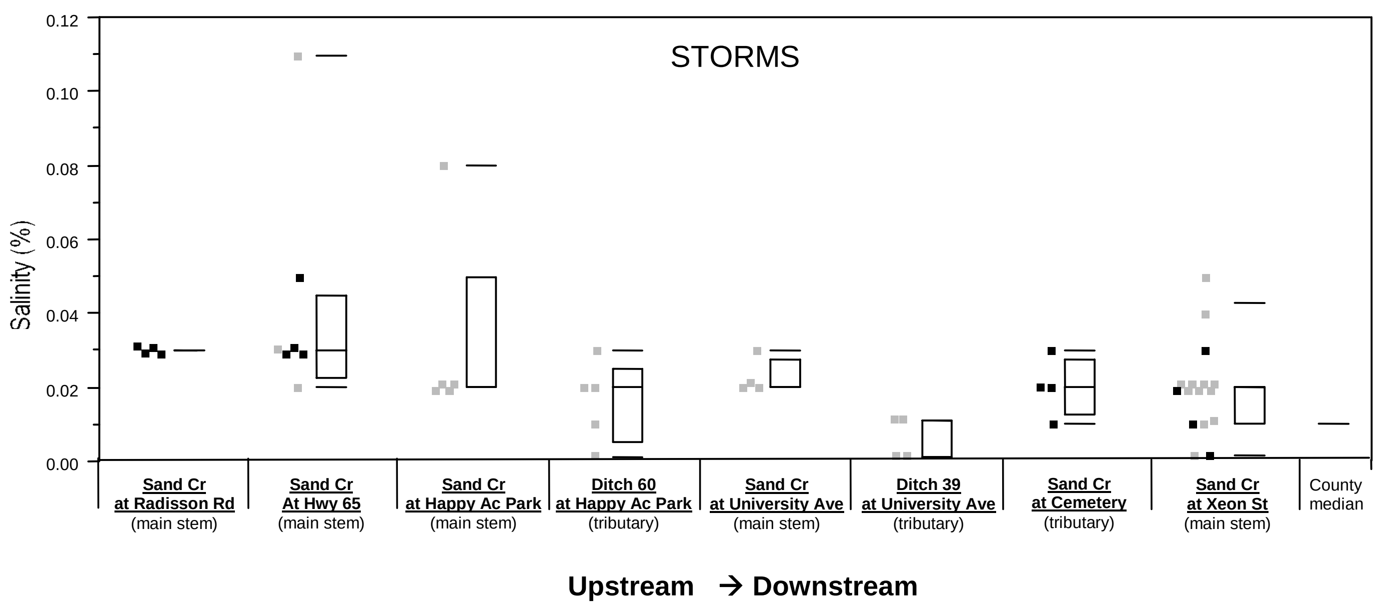
Chlorides at Sand Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Salinity at Sand Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Suspended Solids and Turbidity

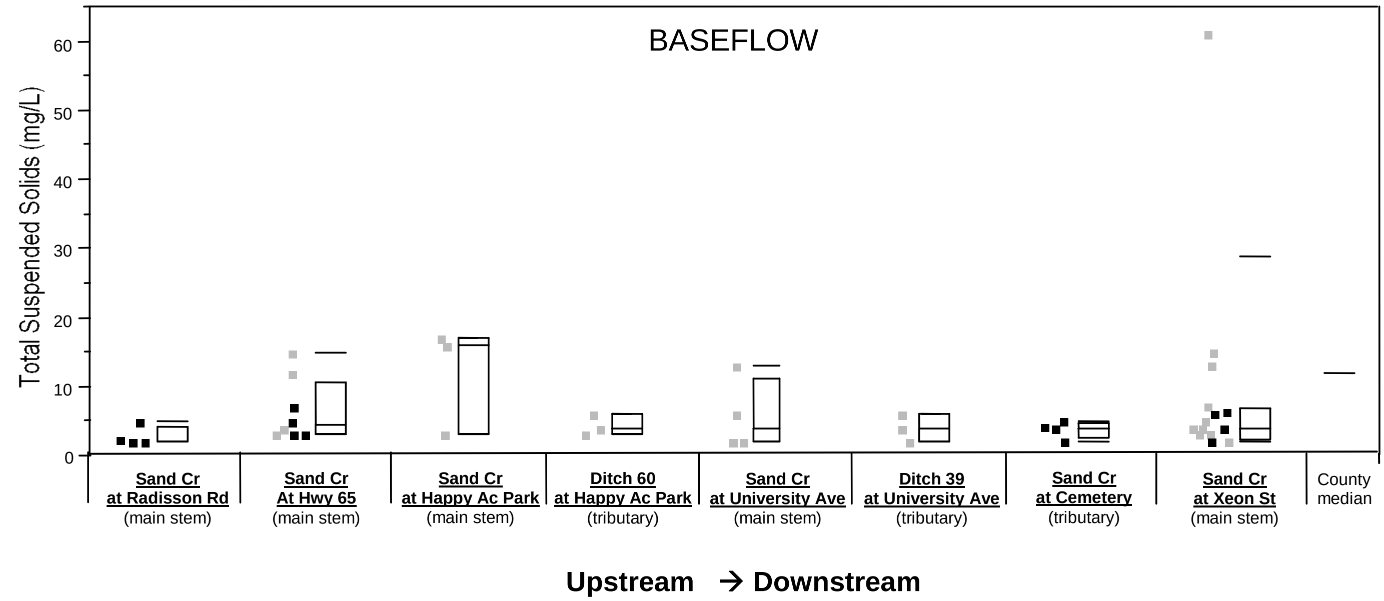
Total suspended solids (TSS) and turbidity both measure solid particles in the water. TSS measures these particles by weighing materials filtered out of the water. Turbidity measures by defraction of a beam of light sent though the water sample, and is therefore most sensitive to large particles. At the outlet of ponds and lakes in the upper watershed turbidity is relatively high due to algal production in the ponds. Farther downstream, both TSS and turbidity are low with the exception of higher readings during storms at the farthest downstream sites (see figures below).

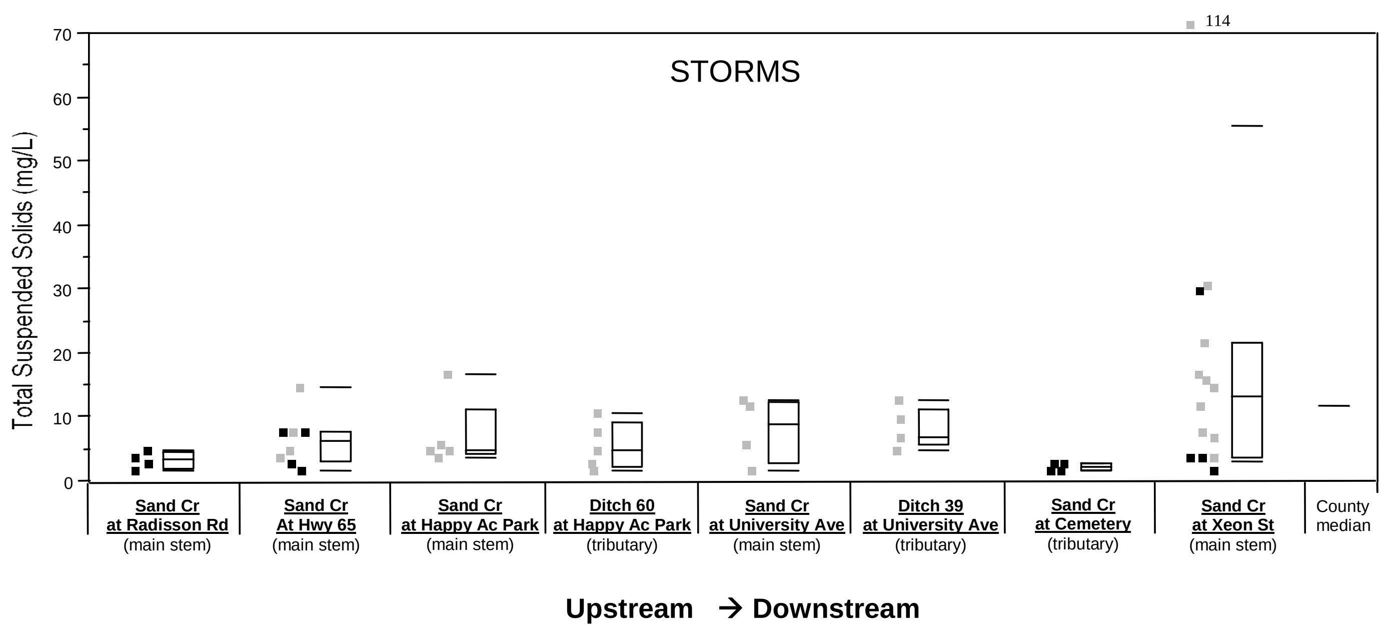
Turbidity was highest at Radisson Road and Highway 65 during baseflow (see figures below). These elevated readings appear to be from algae in water exiting ponds and lakes that the creek flows through. At Radisson Road, the outlet of the largest lakes, turbidity averaged 26 FRNU during baseflow. At Highway 65, turbidity averaged 11 FRNU. The remaining sites downstream had a median turbidity of 5 FRNU, so dominance of algal turbidity decreases as distance form the lakes and ponds increases. During storms, turbidity was not high at the outlet of the lakes and ponds; it appears that stormwater flushing dilutes the algae. Unlike turbidity, TSS was not elevated at the exit of lakes and ponds, presumably because turbidity is more sensitive to large algal particles than TSS.

Both TSS and turbidity is similar at most of the monitoring sites, but occasional higher readings are observed downstream of University Avenue during storms (see figures below). Considering all readings from all sites, median TSS and turbidity are 5 mg/L and 9 FRNU. This is lower than the state turbidity standard of 25 FNRU. At the farthest downstream site, Xeon Street, median TSS and turbidity are 9 mg/L and 6 FRN, respectively. However at this downstream location readings as high as turbidity of 168 FNRU and TSS of 114 mg/L were occasionally encountered during storms. Efforts to manage suspended solids should focus upon stormwater in the lower part of the watershed.

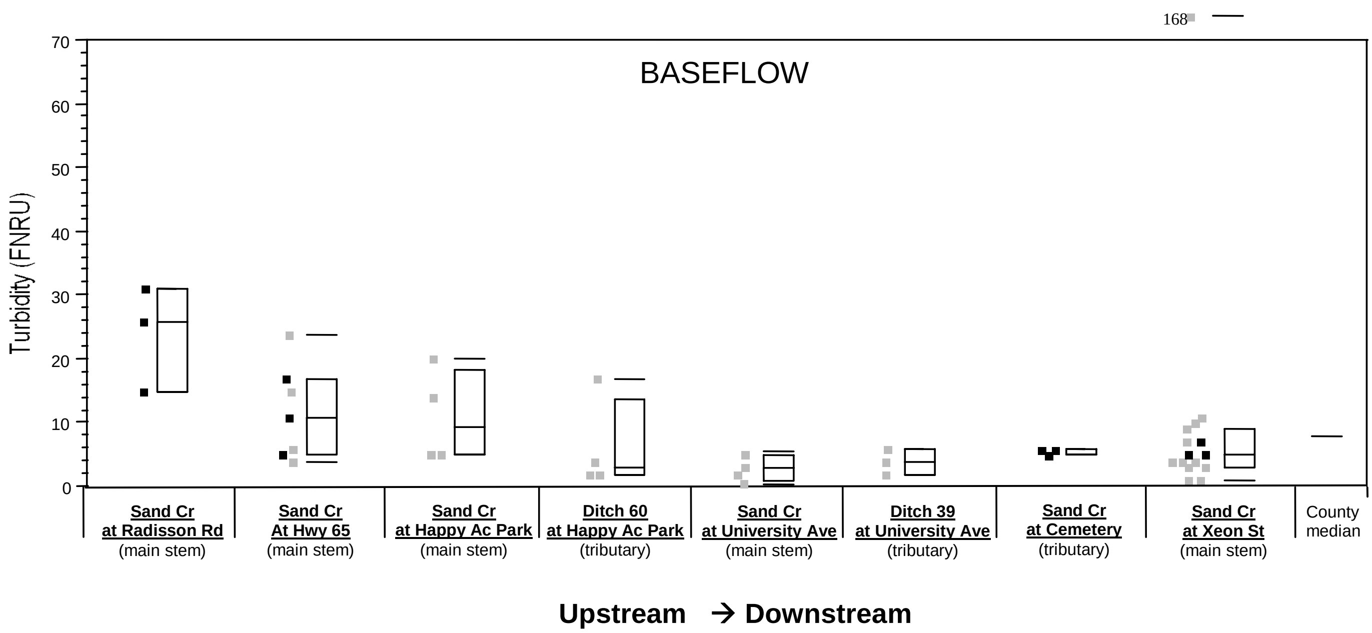
During every water quality sampling since 2009, transparency tube measurements of water clarity were taken and staff photo-documented the appearance of the water at every monitoring site. A transparency tube is a tube filled with water containing a black and white disk at the bottom of the tube. Water is released from the tube until the disk can be seek. The water level in the tube is then recorded. Higher transparency tube readings indicate better water clarity. Transparency tube readings are not included in this analysis because in many instances the bottom of the tube could be seen when the tube was full of water (i.e. reading was >100cm). Photos of water conditions are numerous and are available from the Anoka Conservation District.

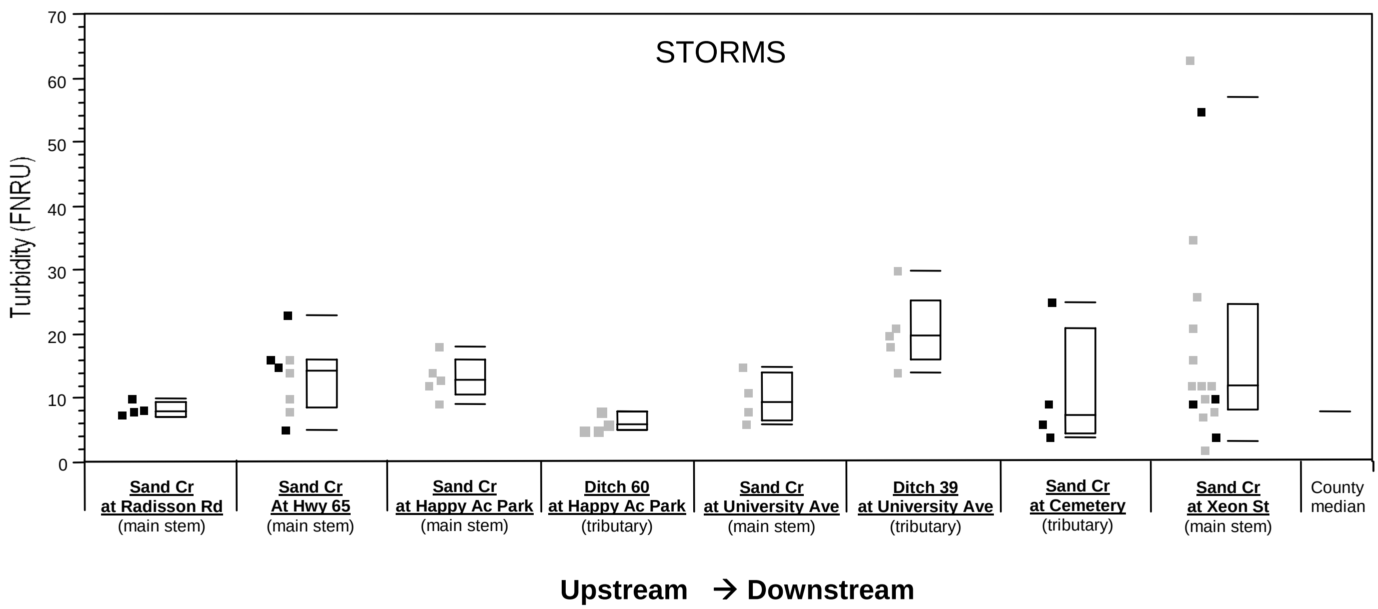
Total suspended solids at Sand Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Turbidity at Sand Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



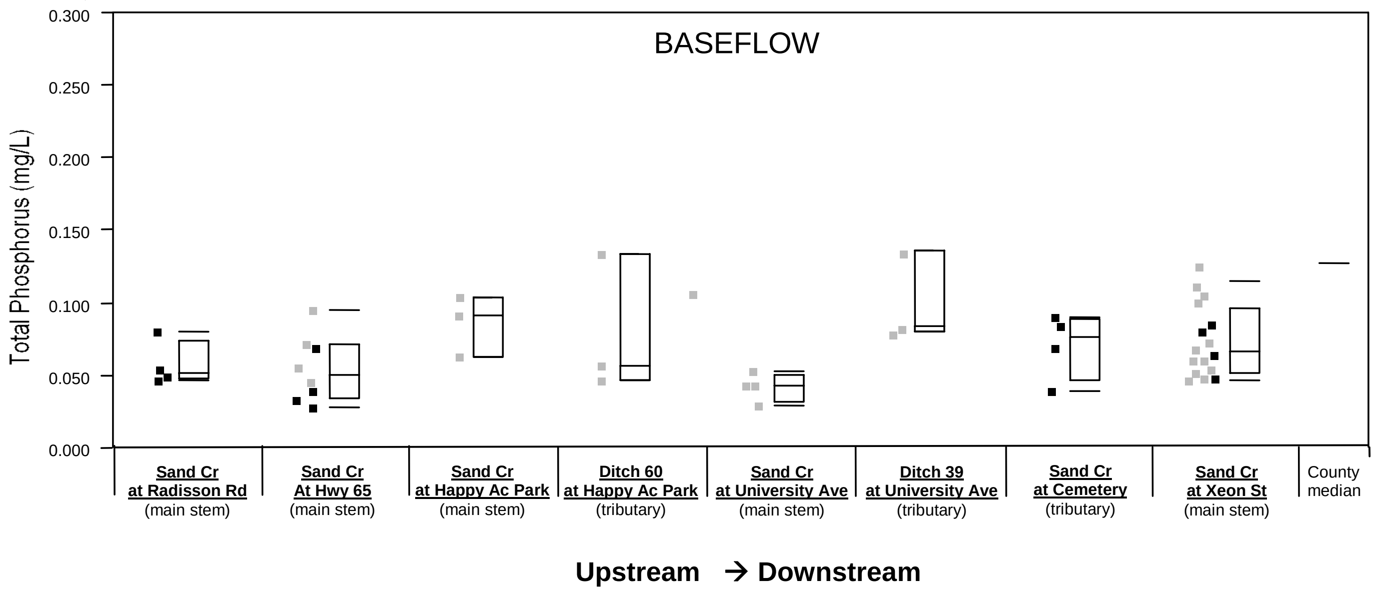


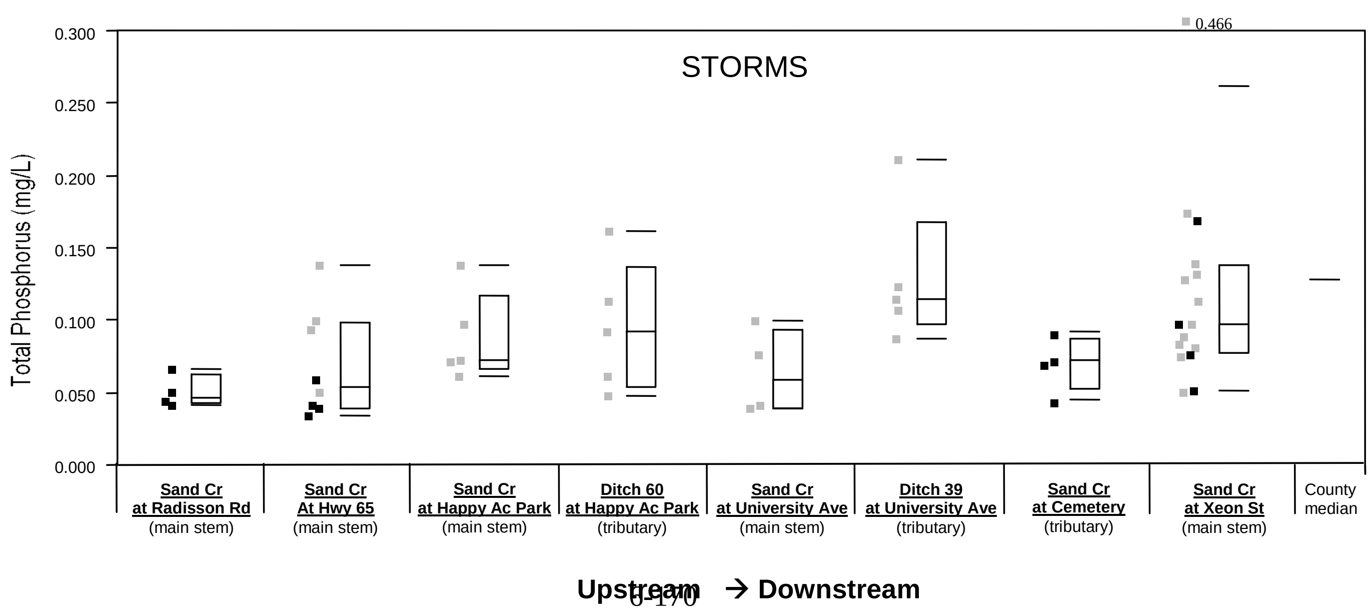
Total Phosphorus

Total phosphorus (TP) is a common nutrient pollutant. It is limiting for most algae growth. TP was low in Sand Creek (see figures below). Median Sand Creek TP for all sites in all years during baseflow (0.063 mg/L) and storms (0.084 mg/L) were below the median for Anoka County streams (0.128 mg/L) and below the published value for minimally impacted streams in this ecoregion (0.130 mg/L). While TP is slightly higher at most sites during storms compared to baseflow, this difference was minor. No apparent TP increase occurs from upstream to downstream, however the highest TP readings observed were during storms at the downstream monitoring sites.

The Minnesota Pollution Control Agency is currently drafting nutrient water quality standards for rivers and streams. While not final, a phosphorus standard of 100 ug/L (0.1 mg/L – units used on graphs in this report) is proposed for central Minnesota. This is similar, but slightly lower than the median TP in Anoka County streams of 128 ug/L. Sand Creek exceeds this standard on occasion, and the MPCA's rules on allowable frequency of exceedence will determine if Sand Creek is designated as failing to meet water quality standards.

Total phosphorus at Sand Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

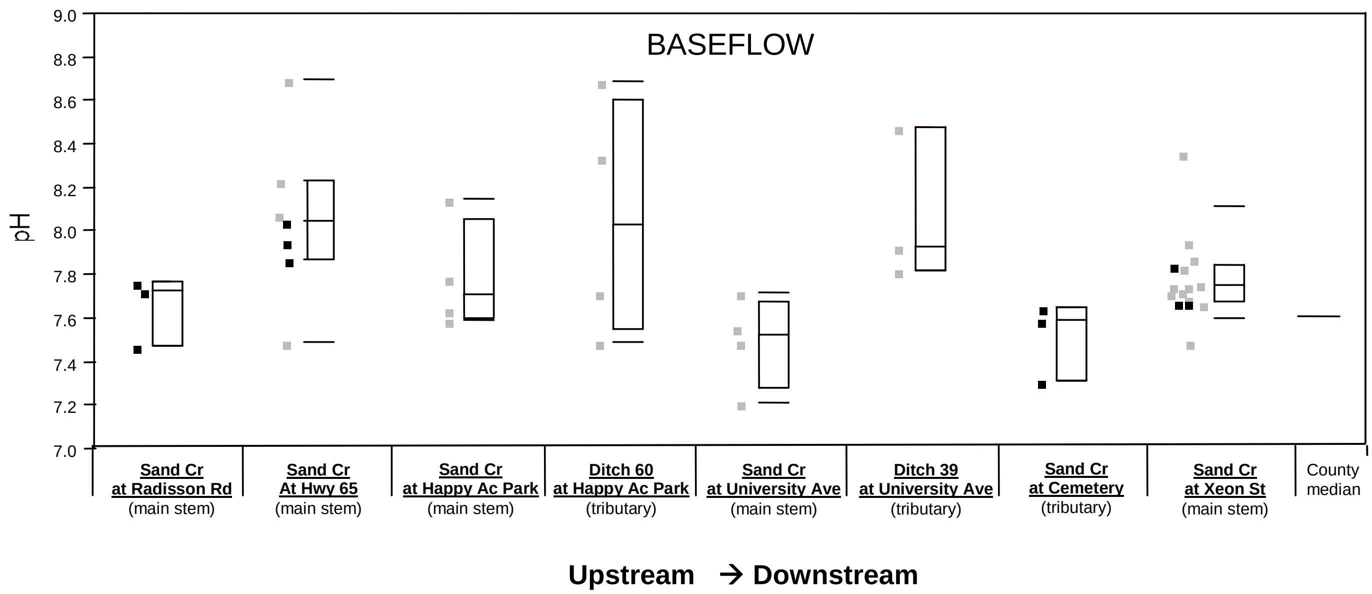


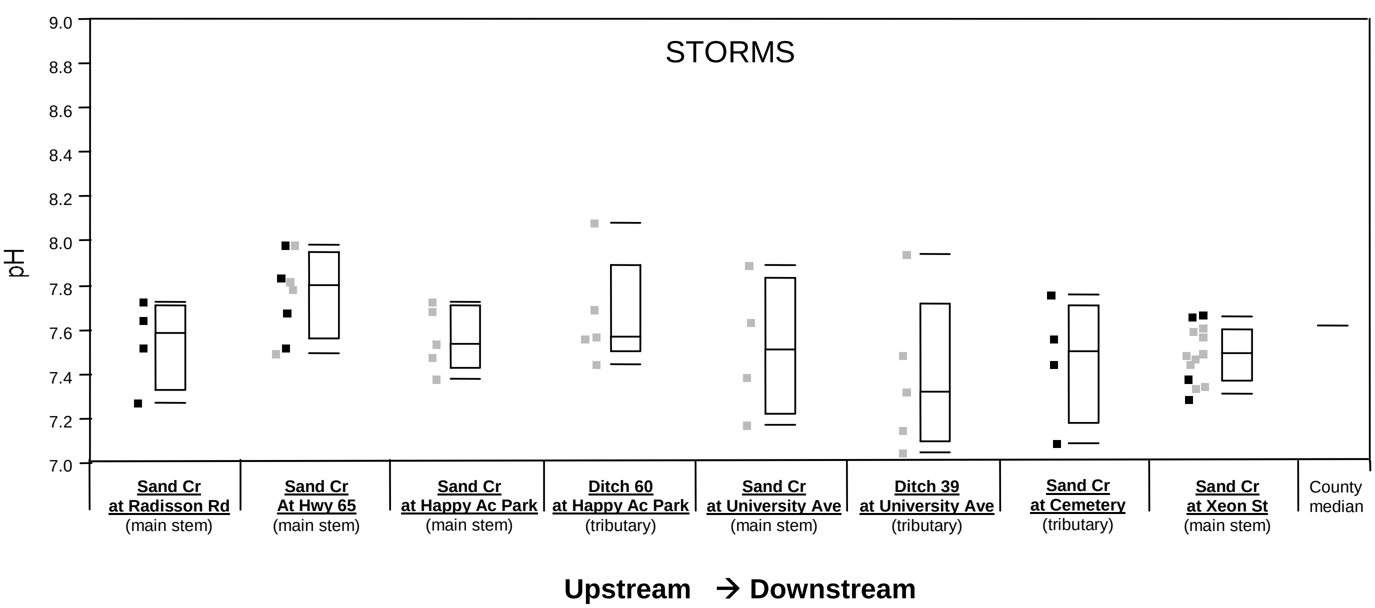


pH

Sand Creek pH was within the expected range at all sites and during all conditions (see figures below), ranging from 7.05 to 8.71. The median was 7.67. The Minnesota Pollution Control Agency water quality standards set an expectation for pH between 6.5 and 8.5. At all sites except Radisson Road the pH was lower during storms because rainwater has a lower pH. This difference was not found at Radisson Road because that site is the outlet of a network of lakes, and water quality is reflective of lake conditions rather than stormwater runoff.

pH at Sand Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



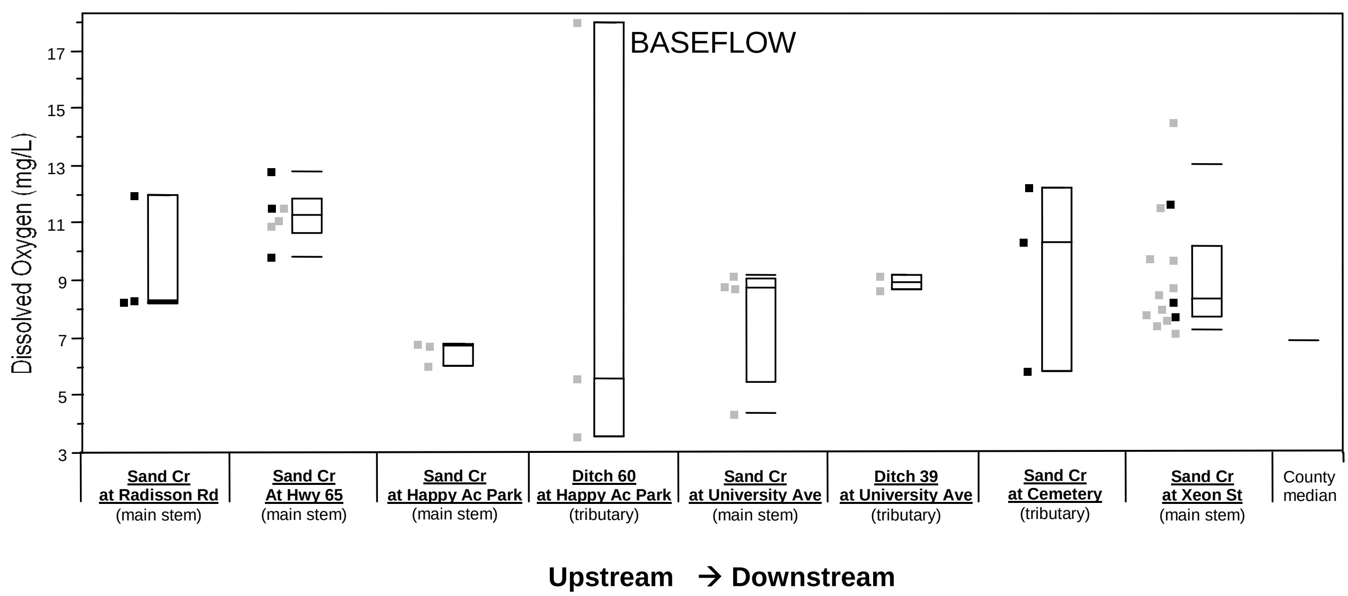


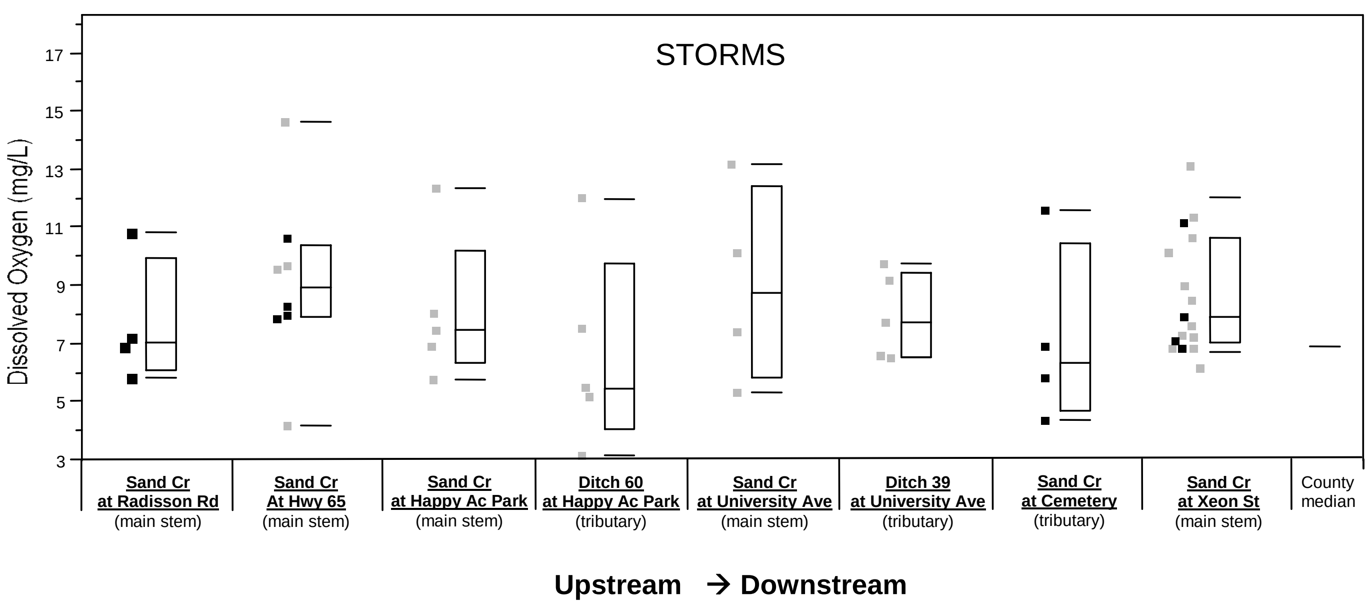
Dissolved Oxygen

Dissovled oxygen (DO) essential for aquatic life. Fish, invertebrates, and other aquatic life suffer if DO is below 5 mg/L. Low DO can be a symptom of organic pollution, the decomposition of which reduces oxygen.

Dissolved oxygen in Sand Creek was within the acceptable level on 94% of the site visits (see figure below). On five occasions it dropped below 5 mg/L. These five readings occurred at three different sites. Three were during storms and two during baseflow. Three occurred in 2009, which was a severe drought year. Stagnant conditions are probably responsible for these low oxygen conditions, and are likely natural.

Dissolved Oxygen at Sand Creek. Dots are individual readings. Black dots are 2010 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Stream Water Quality – Biological Monitoring (Students)

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

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

Locations: Coon Creek at Crosstown Blvd. near Andover High School, Andover

Coon Creek at Erlandson Park (Egret St.)

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

Tips for Data Interpretation

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

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

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

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

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

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

Biomonitoring

COON CREEK

at Crosstown Blvd near Andover High School, Andover

Last Monitored

By Andover High School in 2010

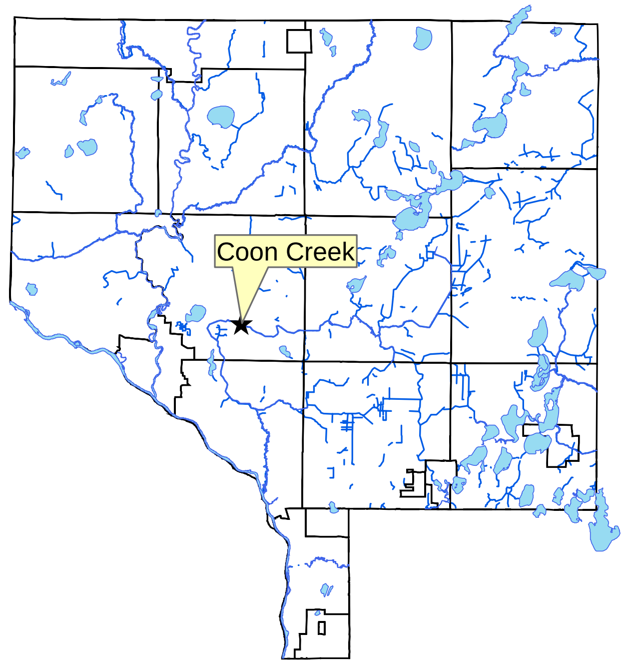
Monitored Since

Fall 2003

Student Involvement

300 students in 2010, approximately 950 since 2003

Background

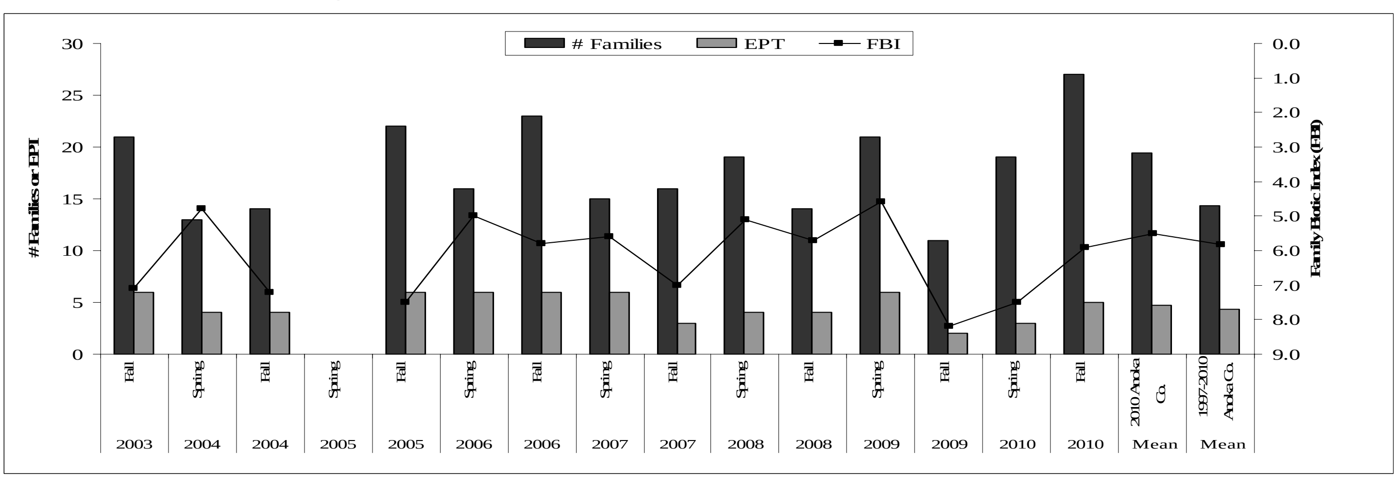


Coon Creek originates in the southern part of the Carlos Avery Wildlife Management Area in western Columbus Township. It flows west, then south, and empties into the Mississippi River at Coon Rapids Dam Regional Park. Coon Creek has a number of ditch tributaries. Land use is an approximately equal mix 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

Five Andover High School classes monitored this stream in spring 2010, while six classes monitored it during the fall. Overall, the multi-year dataset suggests the health of Coon Creek at this particular site is similar to the average of other Anoka County streams. However, relatively large fluctuations in the biotic indices are observed within and across years. Much of this variability is potentially explained by differences in sampling intensity. For example, the decreased stream health observed in the fall of 2009 indicated by the biotic indices occurred when one class sampled the stream. In contrast, the increased total number of families, increased number of EPT families, and decreased FBI value observed in the fall of 2010, all indicative of improved stream conditions, occurred when six classes sampled the stream.

Summarized Biomonitoring Results for Coon Creek in Andover



Biomonitoring data for Coon Creek in Andover

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2006	2006	2007	2007	2008	2008	2009	2009	2010	2010	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	2010 Anoka Co.	1998-2010 Anoka Co.
FBI	5.00	5.80	5.60	7.00	5.10	5.70	4.60	8.20	7.5	5.9	5.5	5.8
# Families	16	23	15	16	19	14	21	11	19	27	19.4	14.3
EPT	6	6	6	3	4	4	6	2	3	5	4.7	4.3
Date	24-May	6-Oct	1-May	3-Oct	30-May	2-Oct	15-May	29-Sep	13-Apr	5-Oct		
Sampled By	AHS	AHS	AHS	AHS	AHS	AHS	AHS	AHS	AHS	AHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	141	415	317	176	90.7	195	679	203	207	446		
# Replicates	1	2	2	1	3	1	1	1	1	1		
Dominant Family	Calopterygidae	Calopterygidae	Calopterygidae	Corixidae	Baetidae	Calopterygidae	Baetidae	Corixidae	Corixidae	Calopterygidae		
% Dominant Family	29.1	49.6	31.9	36.4	38.2	25.6	68.9	51.2	45.4	28.7		
% Ephemeroptera	29.8	3.4	13.9	1.7	40.4	23.1	70.3	1.5	0.5	14.1		
% Trichoptera	14.9	6.7	6.0	4.5	12.5	2.6	3.2	2.0	1.9	2.0		
% Plecoptera	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

Data presented from the most recent five years. Contact the ACD to request archived data.

Parameter	5/24/2006	10/6/2006	5/1/2007	10/3/2007	5/30/2008	10/2/2008	5/15/2009	9/29/2009	4/13/2010	10/5/2010
pH	7.77	7.62	8.5	7.62	7.41	7.66	7.65	7.79	na	7.65
Conductivity (mS/cm)	0.508	0.559	0.454	0.417	0.458	0.609	0.582	0.64	0.553	0.634
Turbidity (NTU)	15	16	11	14	12	4	15	5	25	6
Dissolved Oxygen (mg/L)	6.7	9.46	11.19	8.93	8.79	9.52	8.4	8.6	10.48	na
Salinity (%)	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Temperature (°C)	16.8	9.6	13.3	15.1	13	8.2	13	10	11.1	9.3

Discussion

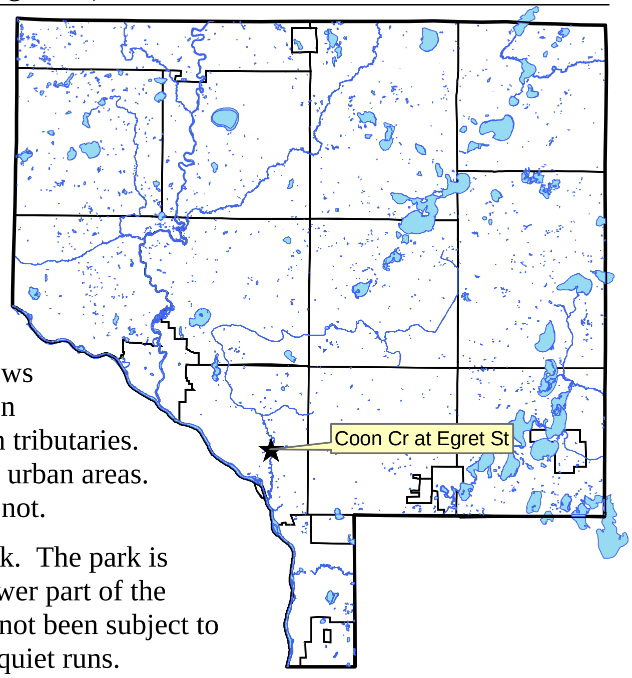
The invertebrate community suggests Coon Creek's health is average compared to other nearby streams. The stream's habitat is relatively sparse, mostly due to past excavations aimed at making the creek perform like a ditch. The supplemental stream water chemistry readings taken during biomonitoring indicate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

Andover High School biomonitoring site at Coon Creek in 2010.

Andover High School Students at Coon Creek in 2009.

COON CREEK

at Erlandson Park (Egret St.)



Last Monitored

By Blaine High School in 2010

Monitored Since

Fall 2009

Student Involvement

30 students in 2010, approximately 62 since 2009

Background

Coon Creek originates in the southern part of the Carlos Avery Wildlife Management Area in western Columbus. 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. The stream flows from rural residential settings to high density urban areas. Upstream reaches have been ditched while lower reaches have not.

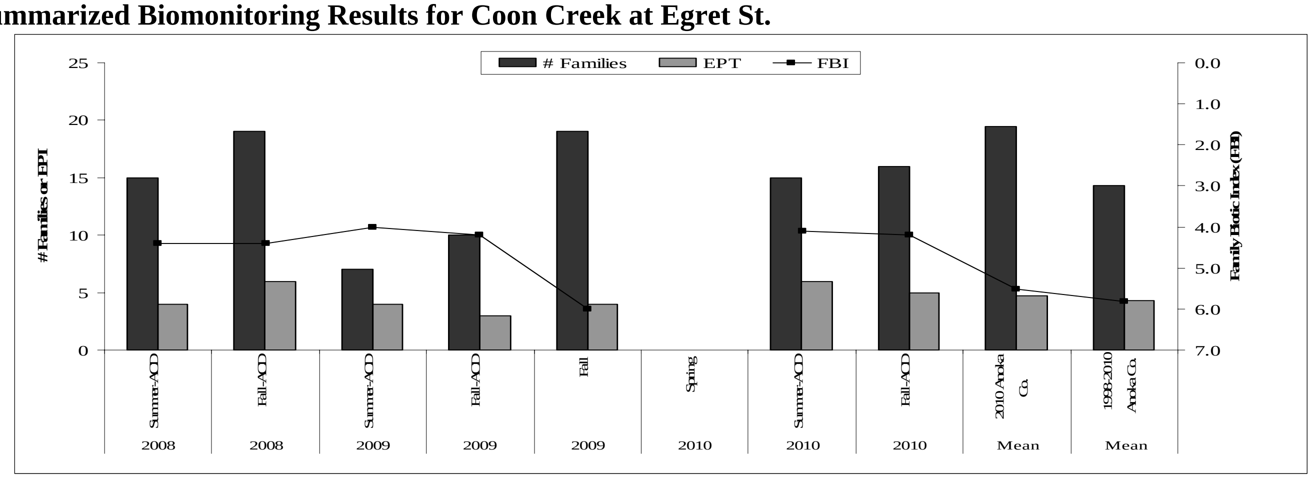
The Egret Street sampling site is within the Erlandson City Park. The park is forested, but surrounding areas are urban. This site is in the lower part of the watershed and therefore carries relatively larger flows and has not been subject to ditching in the past. This site has rock riffles, deep pools, and quiet runs.

Results

This site has a relatively short monitoring history when compared with other sites across Anoka County. Student biomonitoring began in the fall of 2009 with Blaine High School students and continued in the spring of 2010. However, improper preservation of invertebrate samples from spring 2010 prevented analysis of the samples and conflicts with class schedules prevented student sampling during the fall of 2010. Therefore, the single student sampling event from 2009 is supplemented with professional biomonitoring data collected by the Anoka Conservation District since 2008 at the same site in the figure and tables below. Please refer to the Professional Biomonitoring section of this chapter for further analysis of the data collected by the Anoka Conservation District at this site.

The biomonitoring suggests that stream health is similar to the average for Anoka County streams, despite the good quality habitat. Family Biotic Index (FBI) has been consistently higher than the county average, but the number of families and number of pollution sensitive families (EPT) has been similar to county averages. There was little difference between the summer and fall 2010 invertebrate indices.

Summarized Biomonitoring Results for Coon Creek at Egret St.



Biomonitoring Data for Coon Creek at Egret Street

Year	2008	2008	2009	2009	2009	2010	2010	2010	Mean	Mean
Season	Summer-ACD	Fall-ACD	Summer-ACD	Fall-ACD	Fall	Spring	Summer-ACD	Fall-ACD	2010 Anoka Co.	1998-2010 Anoka Co.
FBI	4.40	4.40	4.00	4.20	6.00		4.10	4.20	5.5	5.8
# Families	15	19	7	10	19		15	16	19.4	14.3
EPT	4	6	4	3	4		6	5	4.7	4.3
Date	27-Aug	9-Oct	24-Aug	5-Oct	7-Oct	28-Apr	5-Aug	1-Oct		
Sampled By	ACD	ACD	ACD	ACD	BHS	BHS	ACD	ACD		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	202	177	142	143	296		426	447		
# Replicates	1	1	1	1	1		1	1		
Dominant Family	Baetidae	Heptageniidae	Baetidae	Hydropsychidae	Corixidae		Gammaridae	Gammaridae		
% Dominant Family	41.1	30.5	57.7	39.9	29.1		57.6	32.3		
% Ephemeroptera	59.9	53.1	74.6	46.2	2.7		13.6	40		
% Trichoptera	10.4	15.3	19	39.9	14.2		22.1	19.5		
% Plecoptera	0	0	0	0	0		0	0		

Supplemental Stream Chemistry Readings

Parameter	8/27/2008	10/9/2008	8/24/2009	10/5/2009	10/7/2009	8/5/2010	10/1/2010
pH	7.79	7.78	7.73	7.89	7.55	7.98	7.18
Conductivity (mS/cm)	0.614	0.654	0.613	0.66	0.57	0.633	0.668
Turbidity (NTU)	5	3	11	6	15	11	9
Dissolved Oxygen (mg/L)	8.5	10.26	7.96	10.27	10.82	10.21	na
Salinity (%)	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Temperature (°C)	18.4	10.2	18.7	9.1	9.7	22.1	12.7
Total Suspended Solids (mg/L)	3	4	16	2	na	8	3

Discussion

The invertebrate community suggests Coon Creek's health is average compared to other nearby streams. This is similar to what students at Andover High School have found when sampling Coon Creek near Crosstown Boulevard. This is unexpected because habitat at the Egret Street site is much better, including riffles, pools, snags, and forested areas around the stream. At Crosstown Boulevard the creek has much poorer habitat. One possible explanation is that the biotic community at Egret Street is limited by poorer water quality despite the better habitat. Chemical monitoring has found that Coon Creek's water quality declines from upstream to downstream, which corresponds with an increase in urbanization. Future monitoring and a longer term record of the invertebrate community at the Egret St. site may help provide insight.

Stream Water Quality – Biological Monitoring (Professional)

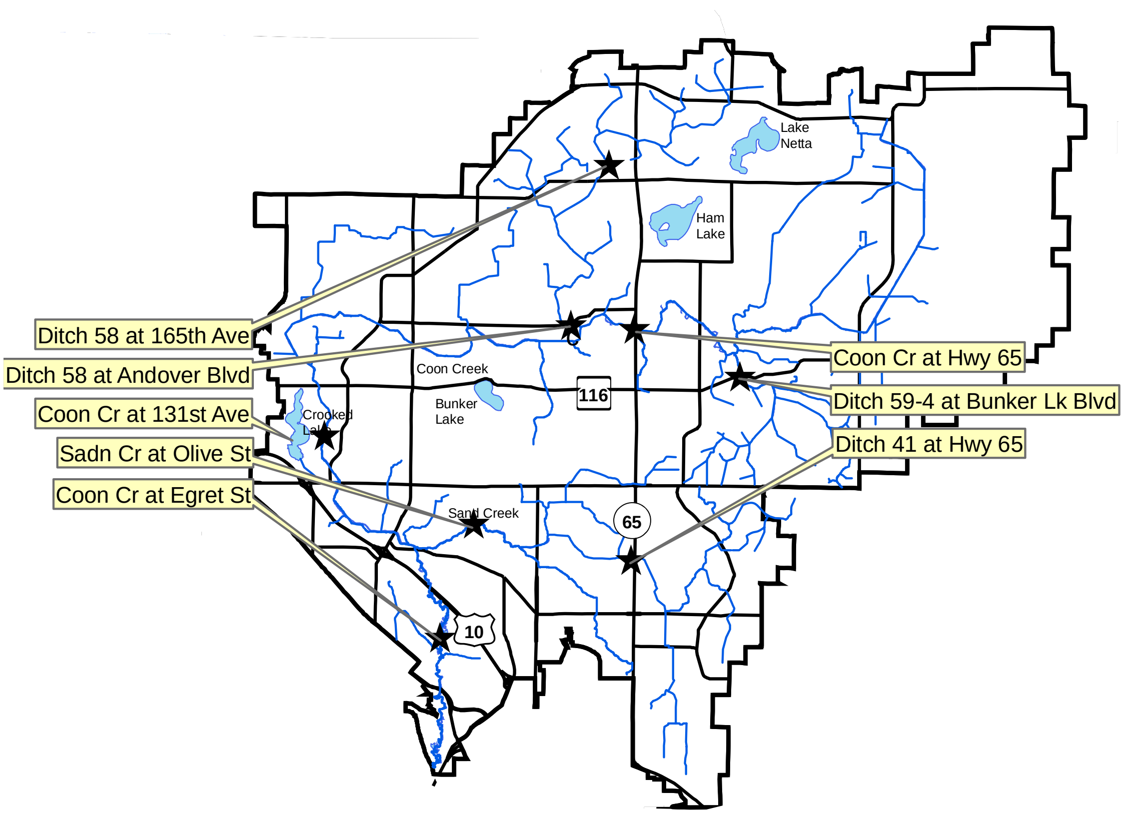
Description: The professional biological monitoring program is more comprehensive than student biomonitoring. All field work, identifications, and analyses are completed by professional aquatic ecologists. Sampling and habitat assessment methods are taken from the U.S. EPA or MPCA. Interpretation of results is based on invertebrate communities sampled and is based upon the knowledge that different families of macroinvertebrates have different water and habitat quality requirements. The families collectively known as EPT (Ephemeroptera, or mayflies; Plecoptera, or stoneflies; and Trichoptera, or caddisflies) are generally pollution intolerant, while other families can thrive in low quality water. Therefore, a comprehensive 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 131st Street
Coon Creek at Highway 65
Coon Creek at Egret Boulevard
Ditch 58 at 165th Street
Ditch 58 at Andover Boulevard
Ditch 59-4 at Bunker Lake Boulevard
Ditch 41 at Ulysses Street (west side of Lowes)
Sand Creek at Olive Street

Results: Results are detailed on the following pages.

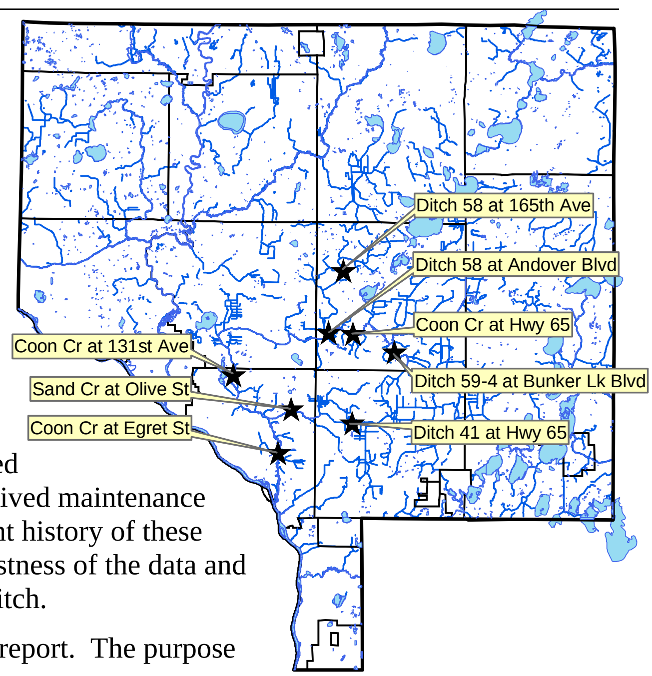
Coon Creek Watershed Professional Biomonitoring Sites



COON CREEK SYSTEM

Maintenance Regime	Site	Monitoring Agency 2000	2008	2009	2010
Unmaintained	Ditch 58 at 165th Ave.		ACD	ACD	
Not ditched or cleaned	Ditch 58 at Andover Blvd.			ACD	MPCA
in last 10 years	Sand Creek at Olive St.			ACD	MPCA
	Coon Creek at Egret St.	MPCA	ACD	ACD	ACD
Maintained	Ditch 59-4 at Bunker Lake Blvd.		ACD		
Ditched or cleaned	Ditch 41 at Highway 65		ACD	ACD	ACD
in last 10 years	Coon Creek at Highway 65	MPCA	ACD	ACD	MPCA
	Coon Creek at 131st Ave.		ACD	ACD	ACD
Anoka Conservation District (ACD), Minnesota Pollution Control Agency (MPCA)					

Background



Coon Creek is a major drainage through central Anoka County. Development in the watershed ranges from rural residential (upstream) to urbanized (downstream). Upstream reaches have been subject to a history of ditching and cleaning, and many ditch tributaries exist. Farther downstream, ditching activity has been minimal, but the effects of the urban environment are more pronounced. The creek has been monitored both chemically and biologically.

The Minnesota Pollution Control Agency (MPCA) has listed Coon Creek as biologically impaired based on single samples from two sites in August of 2000. One of the sites was an actively maintained ditch that had been recently cleaned to sustain desired flow. In contrast, the other site had not received maintenance in the previous 10 years. The drastically different management history of these two reaches caused local water managers to question the robustness of the data and appropriate biological expectations for an actively managed ditch.

The Coon Creek Watershed District initiated the study in this report. The purpose of this work is to:

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

Professional biomonitoring was conducted for this study within the stream and ditch reaches identified in the table above during 2008, 2009, and 2010. All sites within each year were examined twice per year – in August when the MPCA performs invertebrate monitoring and again at the beginning of October for comparison with student stream biomonitoring performed at other sites. Professional biomonitoring is more rigorous and more comprehensive than student biomonitoring programs. All of the field work, identifications, and analyses are performed by professional aquatic ecologists. In this case, both staff possess Master's degrees in aquatic ecology and combined have over 10 years of biological monitoring experience. The sampling methods used were the same as those used by the MPCA, the US EPA's multihabitat method. In addition, the MCPA's Stream Habitat Assessment (MSHA) worksheet was completed for each site. Going beyond MPCA's standard operating procedures, water chemistry data was collected, including pH, conductivity, turbidity, temperature, dissolved oxygen (DO), salinity, and total suspended solids (TSS). TSS was chosen as a parameter of interest because impaired water studies (TMDLs) for biological impairments have often identified TSS as an important stressor.

Several measures of stream biological health were calculated. After identification of macroinvertebrates to the family level, total number of families present, EPT, and FBI indices were determined. The number of different families identified within each sample provides an overall measure of the species richness at a given location. EPT is a count of families belonging to the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). With a few exceptions, macroinvertebrates in these three orders are sensitive to pollution. Therefore, more EPT families present in a stream indicate a healthier system. FBI, the Family Biotic Index, incorporates pollution tolerance scores for each family present. The FBI ranges from 0-10 (see table below), with 0 being best because it represents a macroinvertebrate community with the lowest tolerance for pollution.

Qualitative water quality ratings corresponding to quantitative FBI scores.

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

Results and Discussion

Results are not available at the time of printing of the 2010 Anoka Water Almanac (this document). In 2010 three sites were monitored by the Anoka Conservation District and three by the MN Pollution Control Agency. The MPCA hires a consulting firm to identify their invertebrates, and those identifications are not yet complete. Anticipated completion date is spring 2011. Once that data is available, ACD will compile a separate report and deliver it to the Coon Creek Watershed District.

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)

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

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

(middle and edge of Ilex Wetland are monitored)

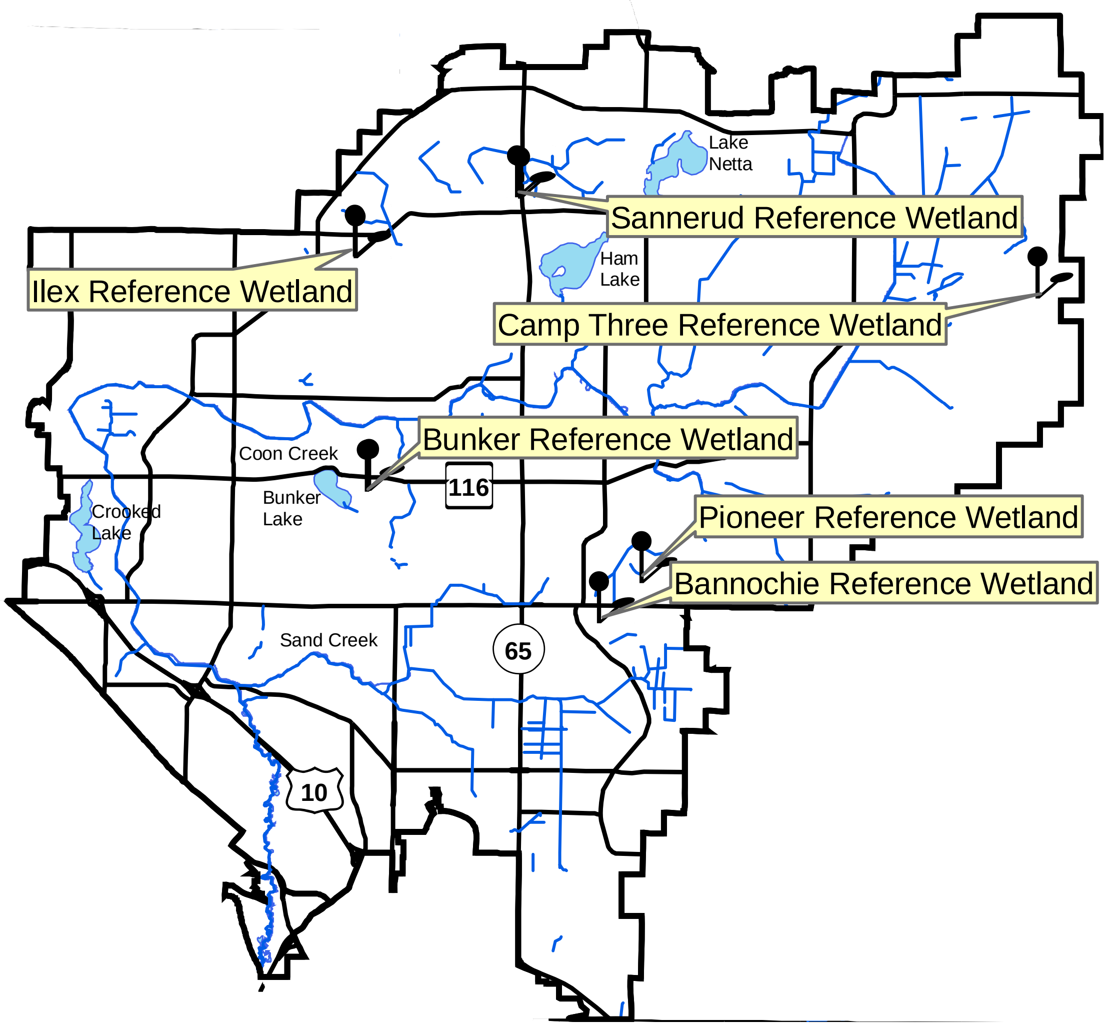
Pioneer Park Wetland, Pioneer Park off Main St., Blaine

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

(middle and edge of Sannerud Wetland are monitored)

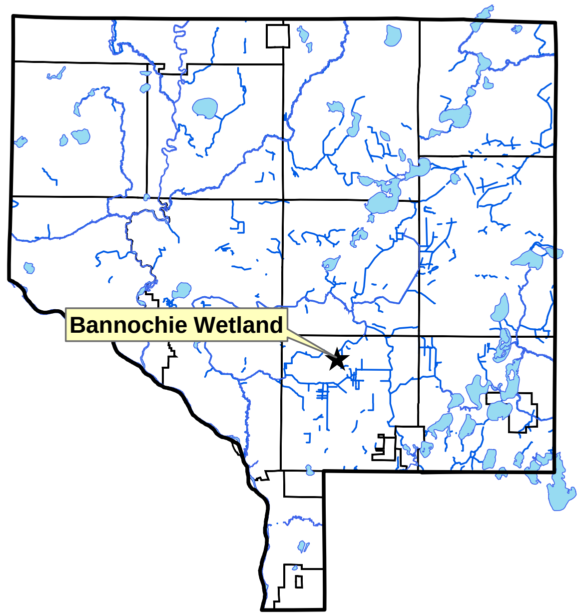
Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

Coon Creek Watershed 2009 Wetland Hydrology Monitoring Sites



BANNOCHIE REFERENCE WETLAND

SE quadrant of Radisson Rd and Hwy 14, Blaine



Site Information

Monitored Since: 1997

Wetland Type: 2

Wetland Size: ~21.5 acres

Isolated Basin? No

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

Soils at Well Location:

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

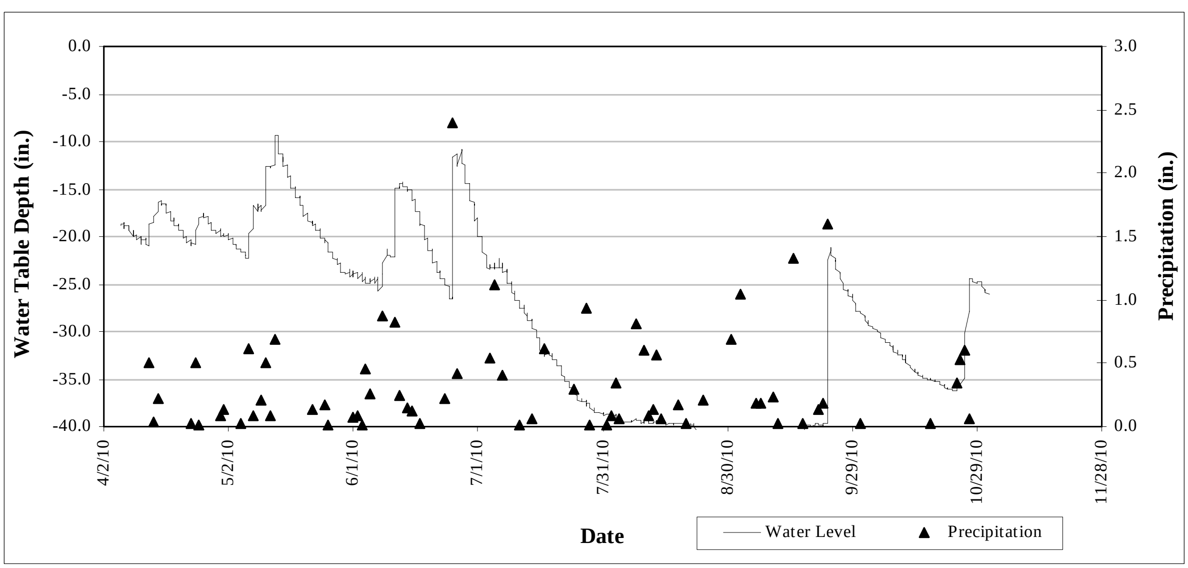
Surrounding Soils: Rifle and some Zimmerman fine sand

Vegetation at Well Location:

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

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

2010 Hydrograph



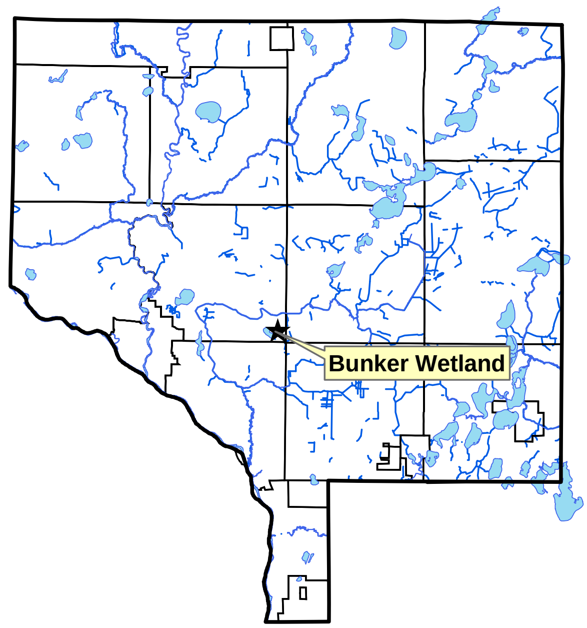
Well depth was 40 inches, so a reading of –40 or less indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

BUNKER REFERENCE WETLAND - EDGE

Bunker Hills Regional Park, Andover

Site Information



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

Wetland Type: 2

Wetland Size: ~1.0 acre

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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

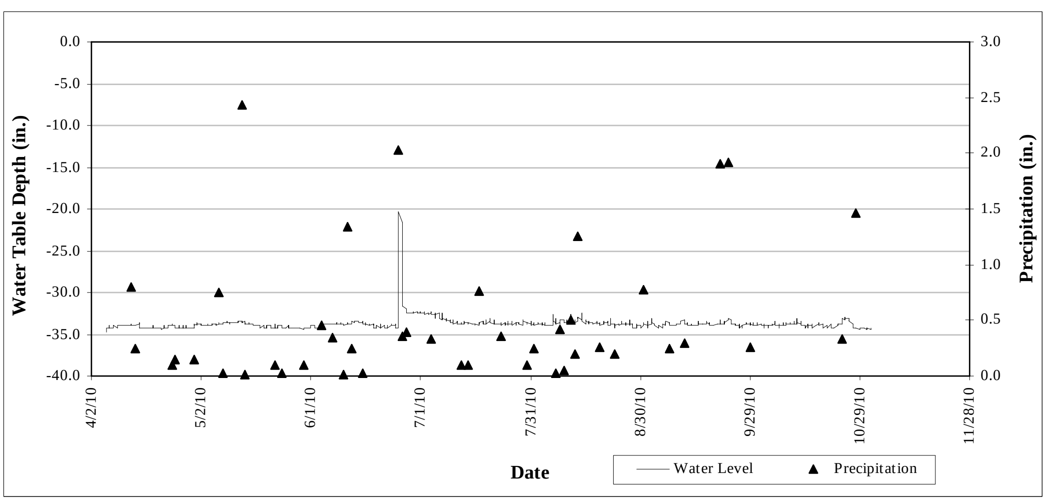
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

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

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

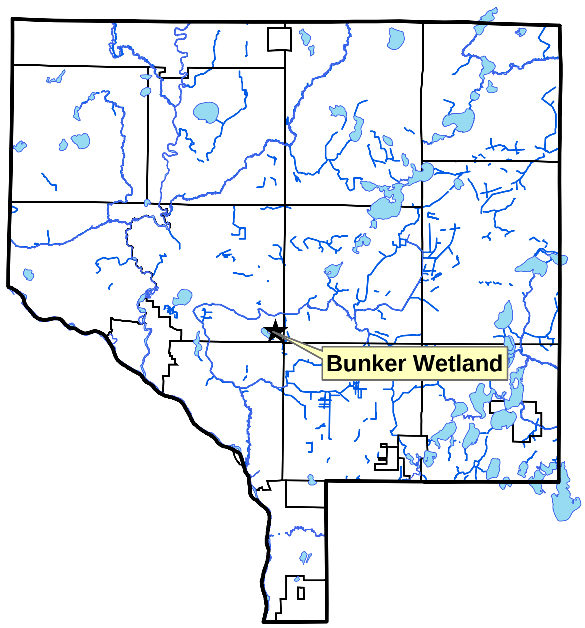
2010 Hydrograph



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

BUNKER REFERENCE WETLAND - MIDDLE

Bunker Hills Regional Park, Andover



Site Information

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

Wetland Type: 2

Wetland Size: ~1.0 acre

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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

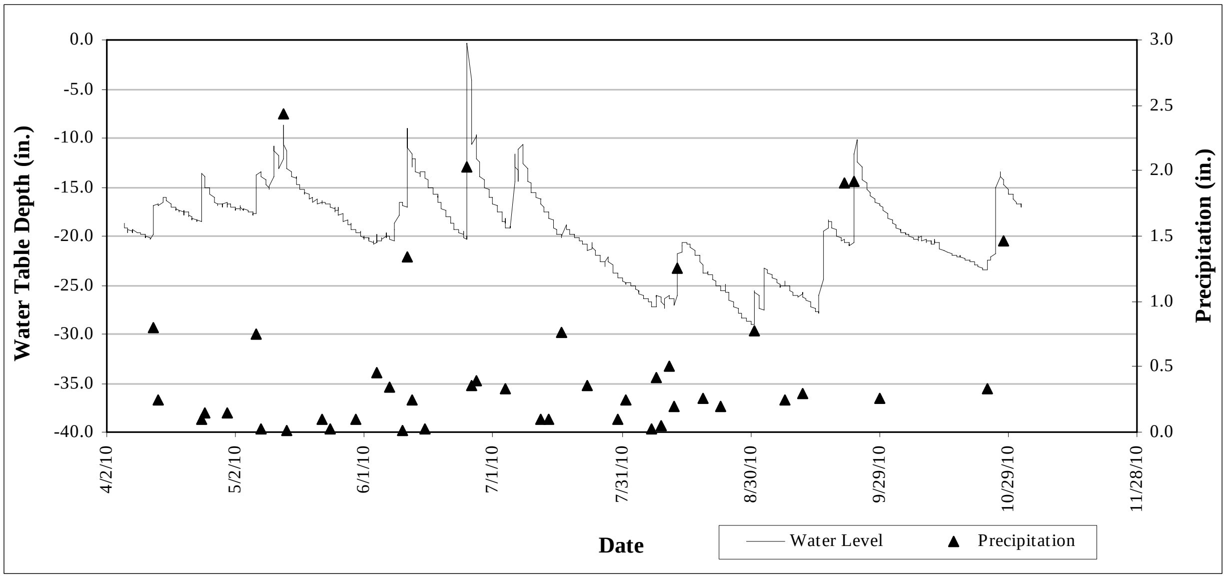
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

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

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

2010 Hydrograph

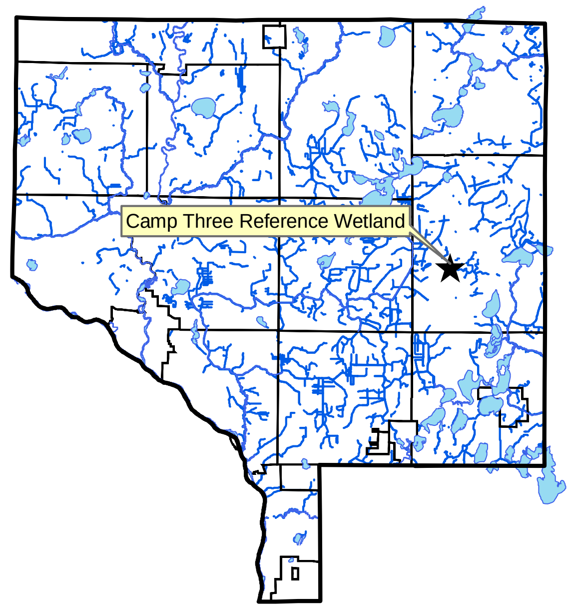


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

CAMP THREE REFERENCE WETLAND

Carlos Avery Wildlife Management Area, Columbus Township



Site Information

Monitored Since: 2008

Wetland Type: 3

Wetland Size: Part of complex > 200 acres

Isolated Basin? No

Connected to a Ditch? Yes

Soils at Well Location: Markey Muck

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

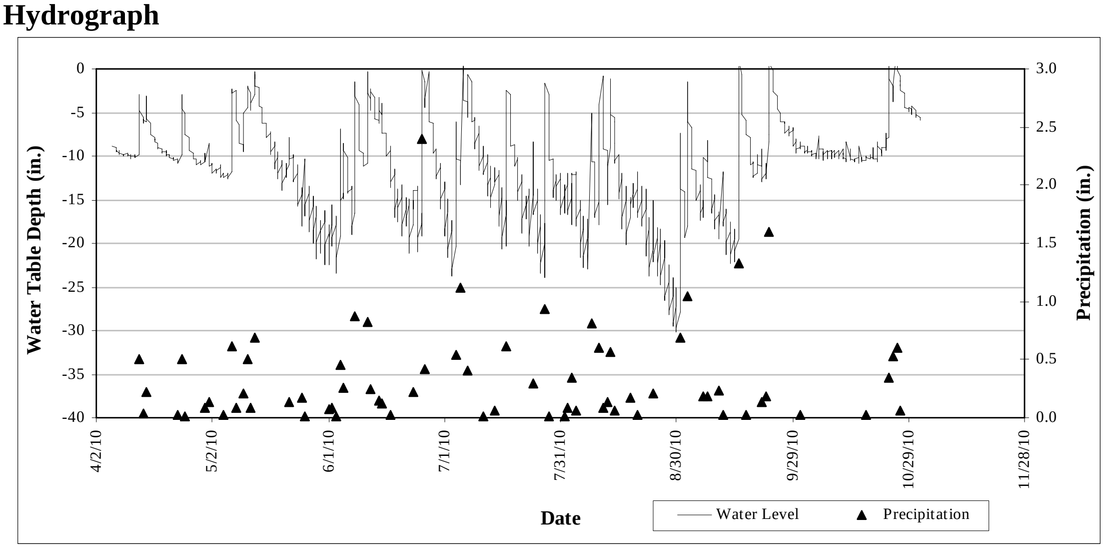
Surrounding Soils: Zimmerman Fine Sand

Vegetation at Well Location:

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

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

2010 Hydrograph

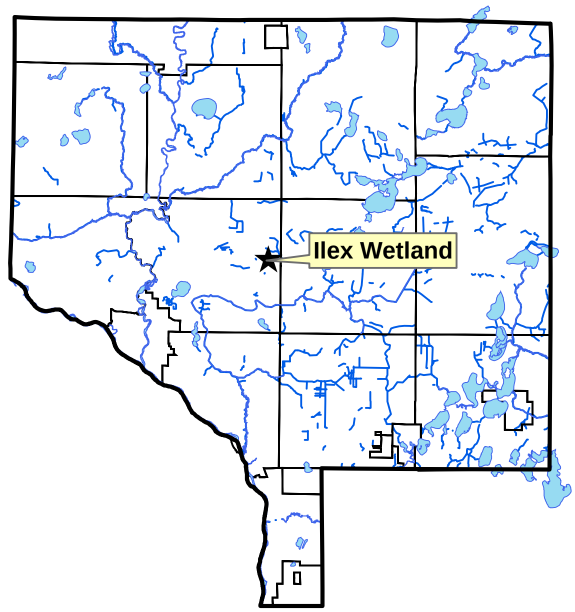


Well depth was 40 inches, so a reading of –40 indicates water levels at an unknown depth greater than or equal to 40 inches.

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	-

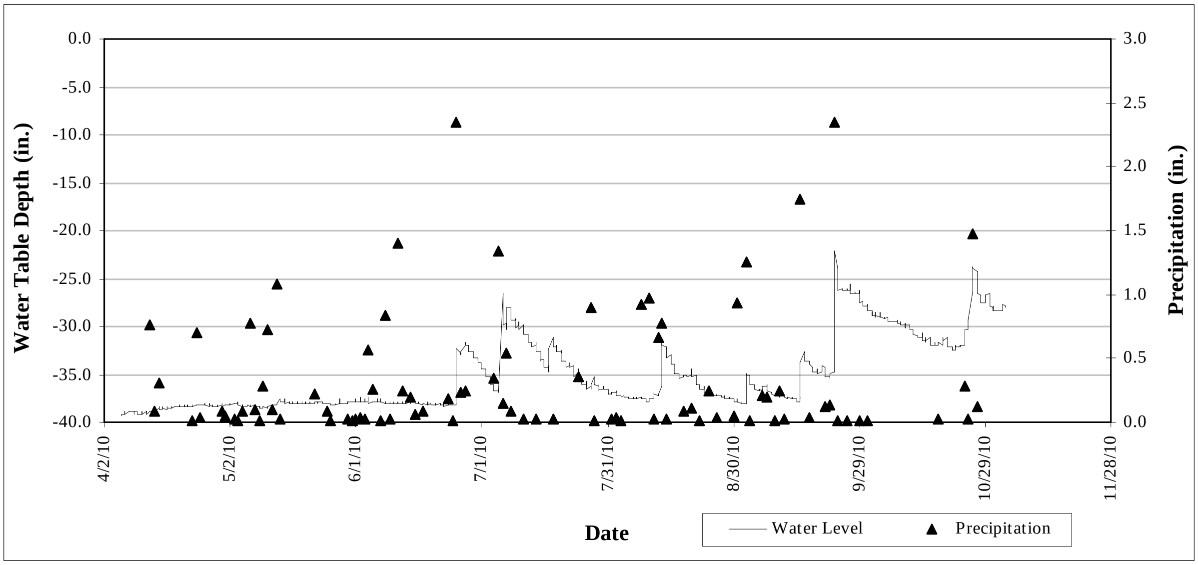
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

Vegetation at Well Location:

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

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

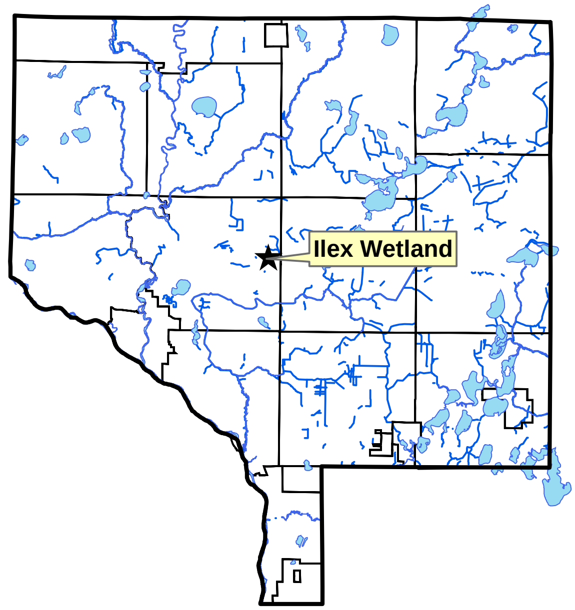
2010 Hydrograph



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

ILEX REFERENCE WETLAND - MIDDLE

City Park at Ilex St and 159th Ave, Andover



Site Information

Monitored Since: 2006

Wetland Type: 2

Wetland Size: ~9.6 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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

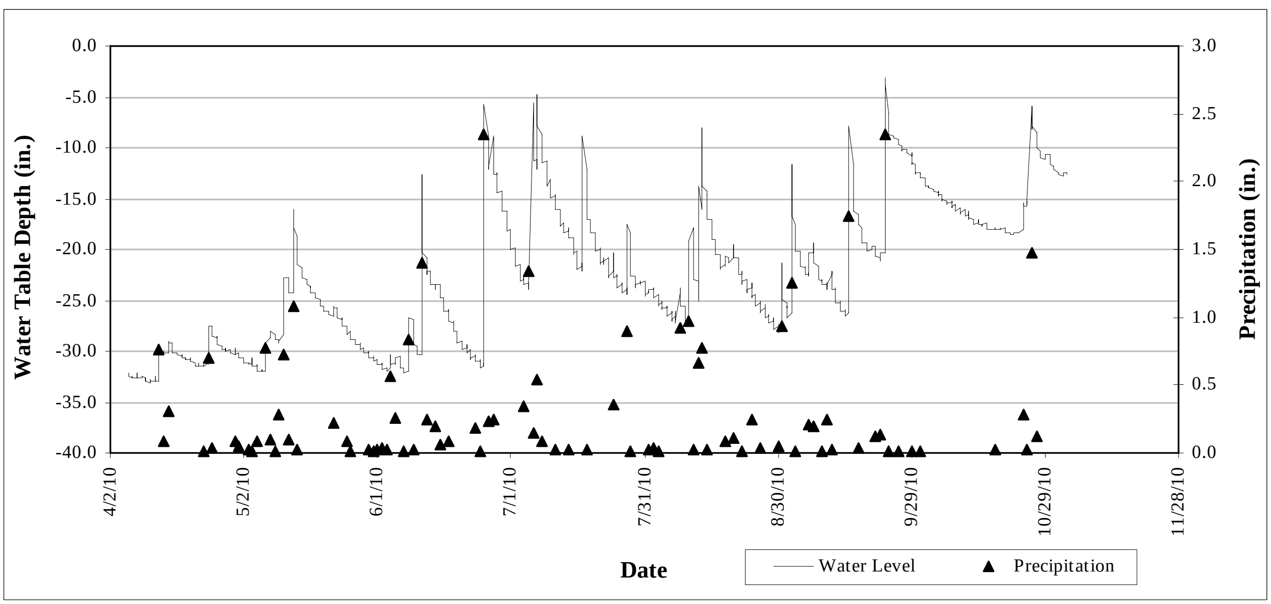
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

Vegetation at Well Location:

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

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

2010 Hydrograph

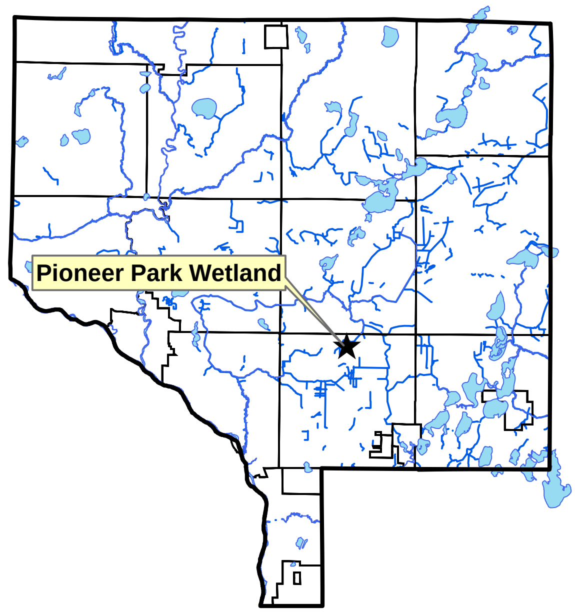


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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.Wetland complex has small drainage ways, culverts, & nearby ditches.

Soils at Well Location:

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

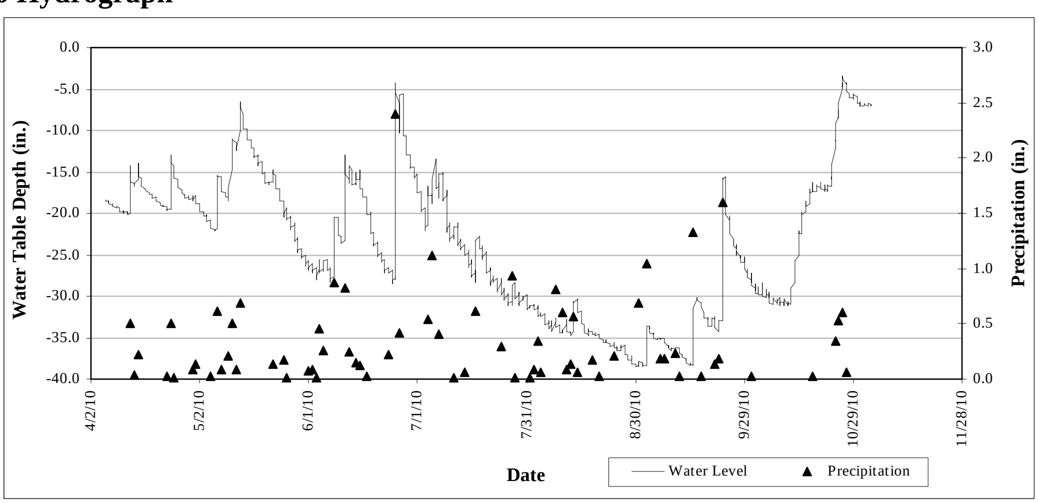
Surrounding Soils: Rifle and loamy wet sand.

Vegetation at Well Location:

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

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

2010 Hydrograph

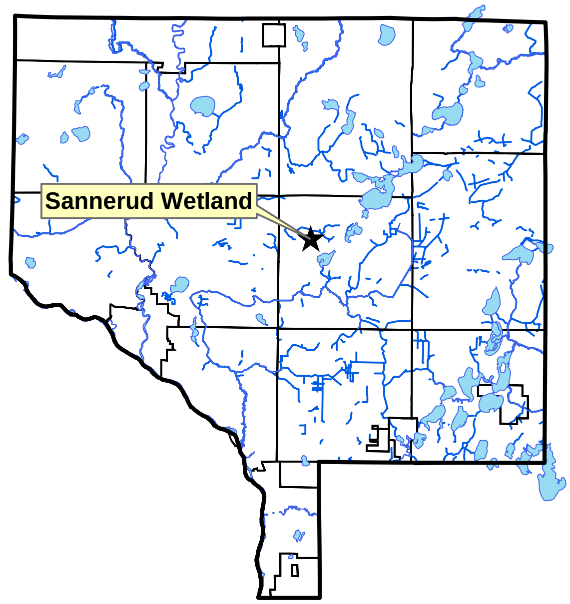


Well depth was 40 inches, so a reading of –40 indicates water levels at an unknown depth greater than or equal to 40 inches.

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	-

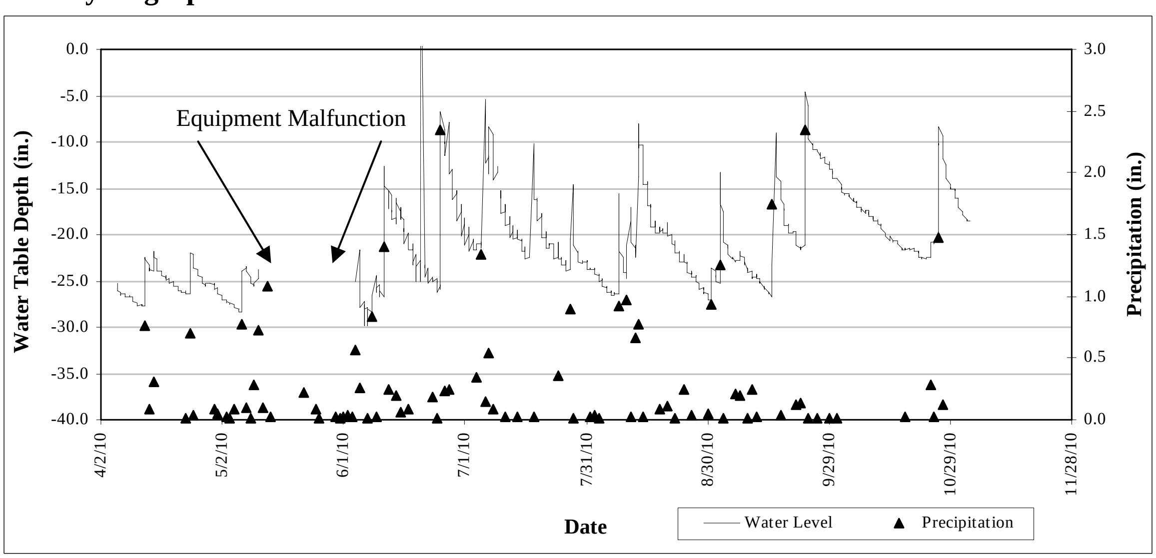
Surrounding Soils: Zimmerman and Lino.

Vegetation at Well Location:

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

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

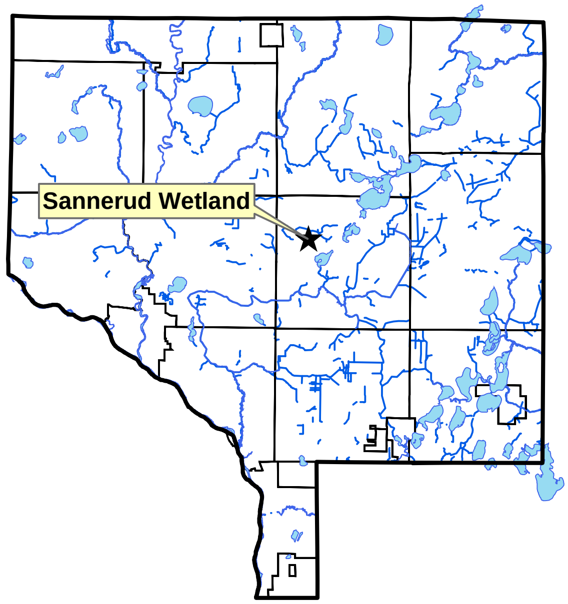
2010 Hydrograph



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.

SANNERUD REFERENCE WETLAND - MIDDLE

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



Site Information

Monitored Since: 2005

Wetland Type: 2

Wetland Size: ~18.6 acres

Isolated Basin? Yes

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

Soils at Well Location:

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

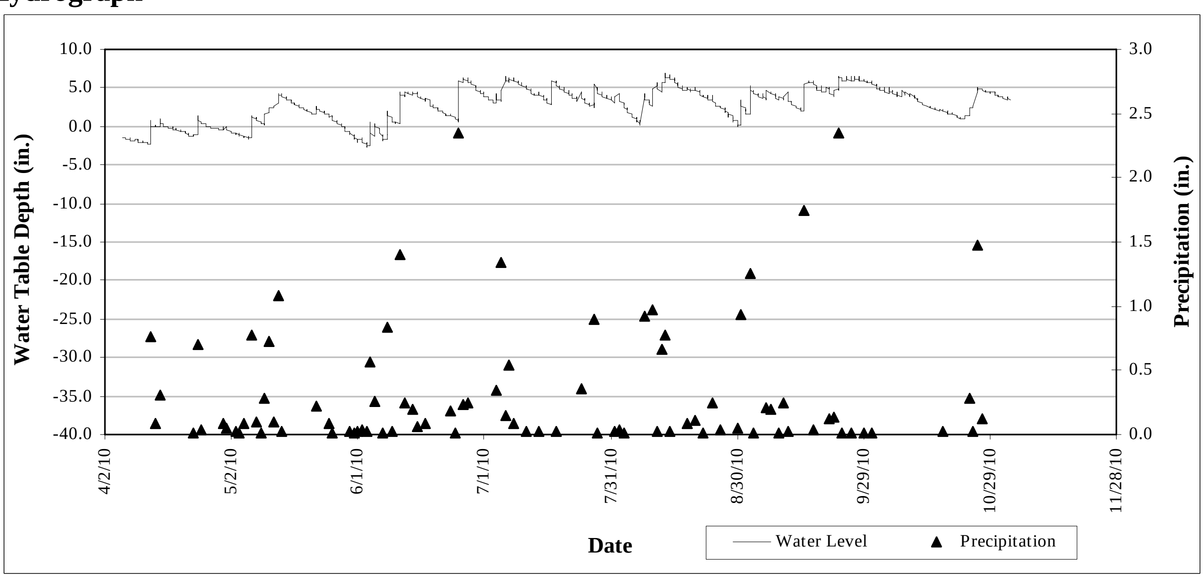
Surrounding Soils: Zimmerman and Lino.

Vegetation at Well Location:

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

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

2010 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.

Reference Wetland Analyses

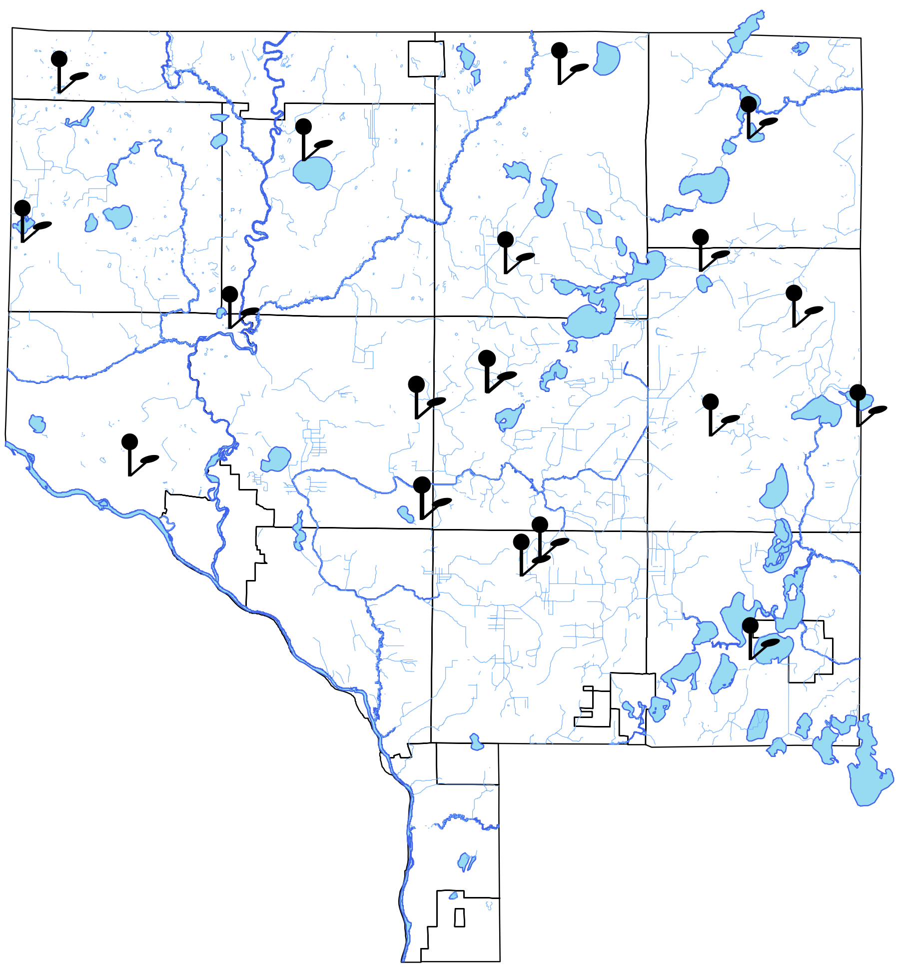
Description: This section includes analyses of wetland hydrology data that has been collected at 18 reference wetland sites. Shallow groundwater levels at the edge of these wetlands are recorded every four hours. Many have been monitored since 1996. These analyses summarize this enormous multi-year, multi-wetland dataset. In the process of doing this analysis, a database summarizing all of the data was created. This database will allow many other, more specific, analyses to be done to answer questions as they arise, particularly through the wetland regulatory process.

Purpose: To provide a summary of the known hydrological conditions in wetlands across Anoka County that can be used to 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.

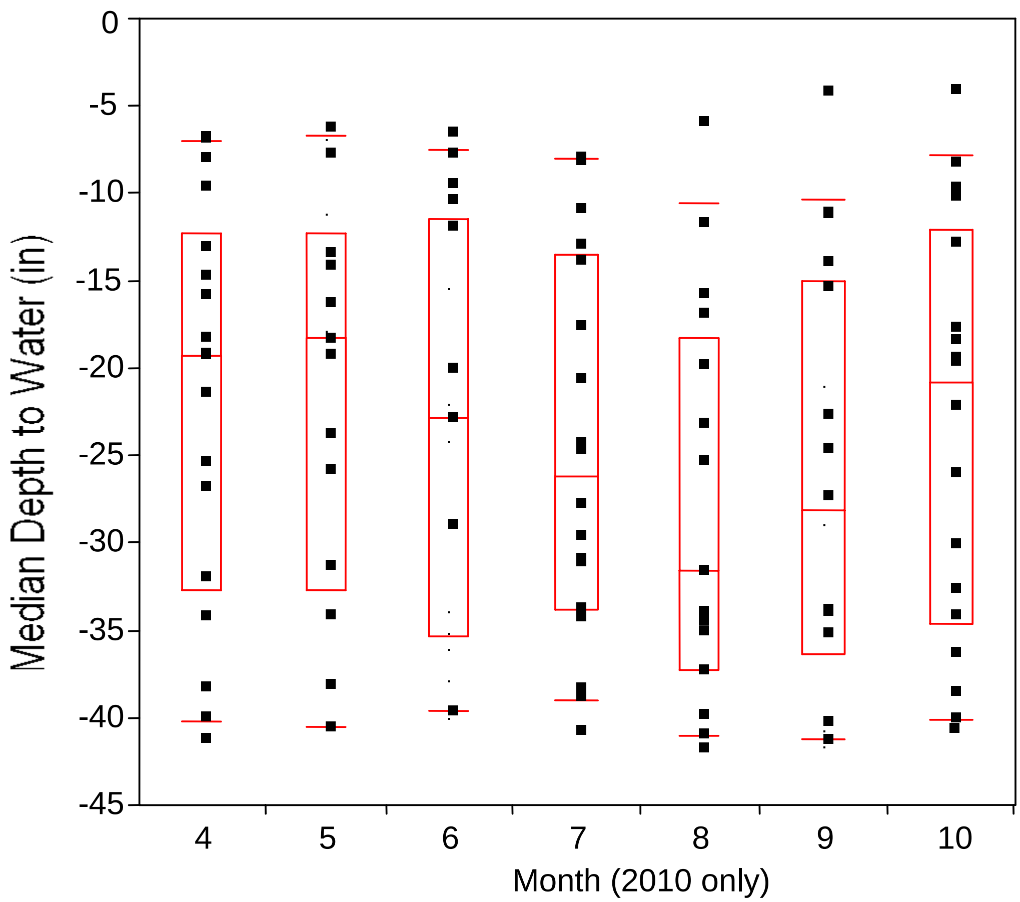
Locations: All 18 reference wetland hydrology monitoring sites in Anoka County.

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



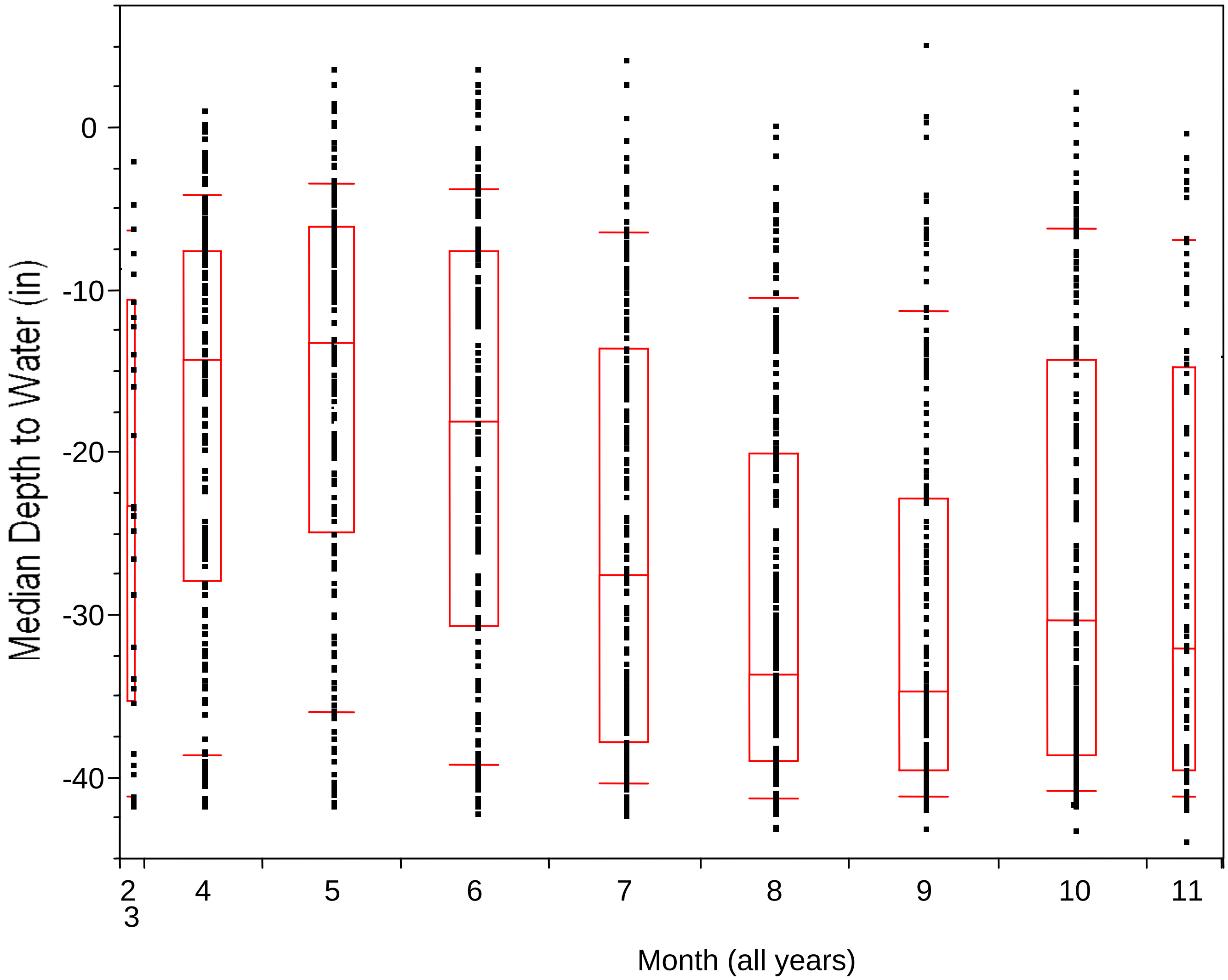
2010 Reference Wetland Water Levels Summary: Each dot represents the median depth to the water table at the edge of one reference wetland for a given month in 2010. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines). Maximum well depths were 40 to 45 inches, so a reading <40 inches likely indicates water was below the well at an unknown depth.



Quantiles

Month	minimum	10.0%	25.0%	median	75.0%	90.0%	maximum
4	-41.2	-40.12	-32.55	-19.15	-12.15	-6.79	-6.7
5	-40.4	-40.4	-32.6	-18.1	-12.1	-6.56	-6
6	-39.9	-39.54	-35.225	-22.75	-11.325	-7.38	-6.3
7	-40.6	-38.89	-33.725	-26.05	-13.375	-7.88	-7.7
8	-41.6	-40.96	-37.2	-31.5	-18.15	-10.34	-5.7
9	-41.5	-41.14	-36.275	-28	-14.825	-10.21	-4
10	-40.6	-39.97	-34.525	-20.7	-11.95	-7.59	-3.9

1996-2010 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 2009. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines). Maximum well depths were 40 to 45 inches, so a reading <40 inches likely indicates water was below the well at an unknown depth.



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	-41.6	-38.6	-27.9	-14.2	-7.55	-4.14	1.2
5	-41.6	-35.89	-24.875	-13.25	-6.05	-3.42	3.8
6	-42	-39.14	-30.6	-18.1	-7.5	-3.7	3.8
7	-42.2	-40.35	-37.725	-27.5	-13.55	-6.4	4.3
8	-43	-41.26	-38.9	-33.6	-20.05	-10.4	0.3
9	-43	-41.1	-39.5	-34.7	-22.8	-11.25	5.3
10	-43.1	-40.78	-38.6	-30.3	-14.275	-6.21	2.4
11	-43.8	-41.1	-39.5	-32	-14.65	-6.88	-0.2
12	-14	-14	-14	-14	-14	-14	-14

Discussion:

The purpose of reference wetland data is to help assure that wetlands are accurately identified by regulatory personnel, as well as to aid understanding of shallow groundwater hydrology. 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. Likewise, it allows us to compare current shallow water levels to the range of observed levels in the past; this is useful for purposes ranging from flood prediction to drought severity indexing. The analysis of reference wetland data is a quantitative, non-subjective tool.

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

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

Water table levels are recorded every 4 hours at all 18 reference wetlands (except during winter), and the raw water level data are available through the Data Access tool at www.AnokaNaturalResources.com, or from the Anoka Conservation District.

Reference Wetland Vegetation Transects

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

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

Locations: Bunker Reference Wetland, City of Andover

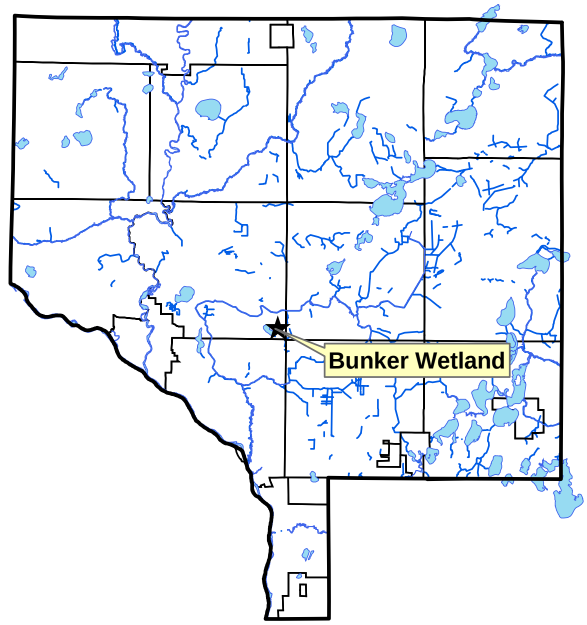
Sannerud Reference Wetland, City of Ham Lake

Results: On the following pages

BUNKER REFERENCE WETLAND

Bunker Hills Regional Park, Andover

Wetland Description



Bunker wetland is one of 18 wetlands in the Anoka Conservation District's reference wetland network. It is located within Bunker Hills Regional Park. It is a Circular 39 Type 2 inland fresh sedge meadow covering about 1 acre. It is located in a concave landscape position with no discernable outlet, but is in close proximity to two similar type wetlands. One of similar size is located to the west, while a second, much larger wetland, is located to the south.

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

The soils in the Bunker Hills are mapped by the Anoka County Soil Survey as the very poorly drained (water table within 0-2 feet) *Isanti Fine Sandy Loam.* While that classification is accurate on the perimeter, the interior is more akin to *Rife Mucky Peat* with the depth of the organic material ranging from a few inches to greater than four feet. In general the organic deposits deepen towards the center of the basin. The surrounding uplands are prairie and oak uplands on the excessively well drained (water table > 6-feet) *Zimmerman Fine Sand*, which is a rapidly conducts through its soil column.

The hydrology appears to be both surface water and groundwater driven. The hydrology data indicates the water table is generally within a few inches of the surface during the early spring and draws down to 30-40 inches during mid-summer. However, during the summer months the water tables rises and falls rapidly in response to rain events, while fall season data indicates the water table recharging.

Photo of Bunker Wetland in April

Introduction

Study of Bunker wetland is two-fold. First, the wetland hydrology (water level) is monitored continuously with automated equipment as part of the ACD's network of reference wetlands. All reference wetlands are hydrologically monitored to provide a reference for the current state of wetlands. Most prominently, this data is used to ensure accurate wetland regulatory determinations. Secondly, the data serves to improve understanding of shallow groundwater hydrology, with uses ranging from flood prediction to drought severity indexing. At the request of the Coon Creek Watershed District, the Anoka Conservation District (ACD) has begun to study the vegetation community of the Bunkers Hills Reference Wetland. The purpose of vegetation surveys is to document vegetation changes associated with hydrological changes, invasive species, and other disturbance.

This wetland has had dramatic hydrological change during the 13 years it has been monitored. From 1996 to 2005 a monitoring well was placed what was considered to be the wetland edge. During this ten year monitoring period it was discovered the water level was decreasing. Our goal, using the jurisdictional wetland hydrology standard, was to keep this and all of our monitoring sites on the wetland edge. With exception of the first two years of monitoring, 1996, 1997, and, a higher than normal precipitation year in 2003, the water level was below the threshold of twelve inches to be considered a jurisdictional wetland. Seven out of ten years failed to meet wetland hydrology standards. Additionally, the water levels had dropped to a level that the monitoring well was no longer considered to be within an acceptable distance of the wetland edge. In 2006 it was decided to move the well down slope in order to capture the full range of hydrology reading throughout the year.

In 2006 the ACD installed a second hydrology monitoring well. This well is located in the middle of the wetland within the most diverse vegetative community. The water level has been at or near the surface in spring and followed predictable summer draw downs and fall recharge patterns. As the area around the wetland is developed, our particular focus will be how wetland hydrology correlates to invasive species expansion into native vegetative communities.

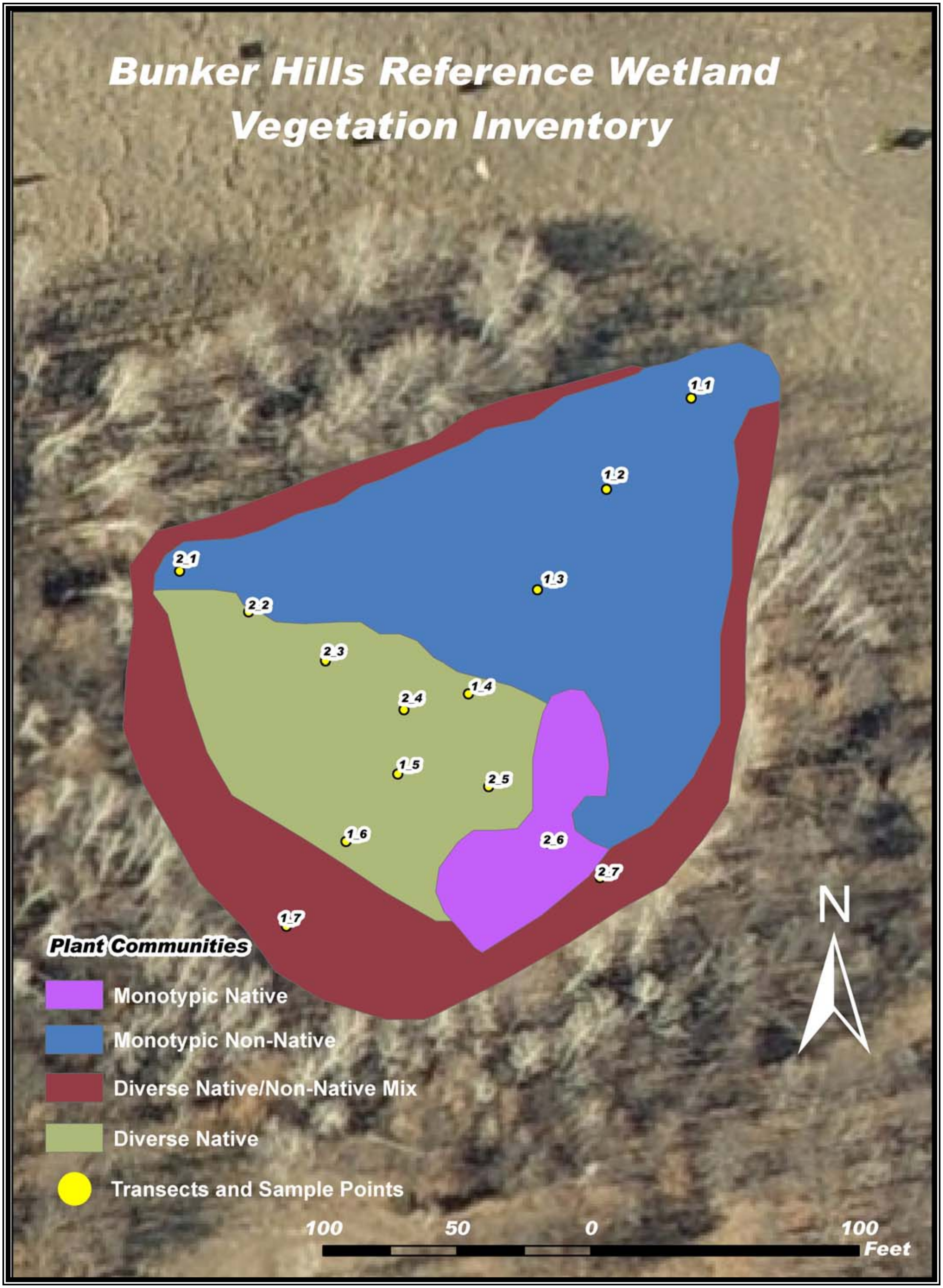
Data Collection Methods

A central goal of this study is to monitor the expansion of invasive species. The primary work product is a plant community map. Maps will be compiled in different years and compared. The wetland boundary location was determined by the Anoka Conservation District Wetland Specialist using state-approved wetland delineation methods. The wetland boundary and vegetation community boundaries were documented with a hand held Lowrance GPS unit and uploaded into Arc Map 9.1. Two perpendicular transects were established for systematically documenting vegetation within the wetland. Along each transect vegetation was documented at seven equally-spaced points. At each point herbaceous vegetation within a one meter quadrat was inventoried, 15-foot radius for the shrub layer, and 30-foot radius for the tree layer. Plants were characterized by percent cover. Sample sites that overlapped into the upland or other plant communities were modified, while keeping the same square footage to stay within the wetland, and respective plant community.

Results

In comparing the 2009 and 2010 vegetation surveys the most significant change to the plant community is the merging of what was a “native monotypic plant community” with the “diverse native plant community” (see map on following page). The former native monotypic plant community had several native species, such as Northern Bugleweed (Lycopus uniflorus) and Tearthumb (Polygonum sagittatum) move in. These species are in abundance in the adjacent plant community, and have populated the former native monotype area sufficiently to garner a merging of these polygons.

Listed below are brief narratives of each plant community and a plant species table. Please note, the sample sites are grouped with their respective plant community rather than in numeric order. For illustration of sample site locations see the attached vegetation inventory figure on the following page.


Bunker Hills Reference Wetland
Vegetation Inventory
1_1
1_2
2_1
1_3
2_2
2_3
1_4
2_4
1_5
2_5
1_6
2_6
2_7
1_7
Plant Communities
Monotypic Native
Monotypic Non-Native
Diverse Native/Non-Native Mix
Diverse Native
Transects and Sample Points
N
100
50
0
100
Feet

Monotypic Non-Native
This plant community has a few sparsely placed native species, but has 100 percent aerial coverage of Reed Canary Grass *(Phalaris arundinacea).* This boundary will continue to be monitored for encroachment into the adjacent native communities. Additional GPS data points were used to obtain an accurate plant community boundary. This wetland boundary is diffuse, leading us to believe it is creeping towards the native plant communities.

Sample Site 1-1

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	120	Invasive	FACW
Solidago gigantia	Giant Goldenrod	5	Native	FACW
Rubus flagellaris	Dewberry	5	Native	FACU

Sample 1-2

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	120	Invasive	FACW

Sample 1-3

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	100	Invasive	FACW
Cirsium arvense	Canadian Thistle	5	Invasive	FACU

Sample 2-1

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	100	Invasive	FACW
Rubus strigosis	Raspberry	10	Native	FACW
Solidago Canadensis	Canada Goldenrod	15	Native	FACU

Diverse Native/Non- Native Mix
This plant community is located on the wetland edges. It is comprised of Red Raspberry *(Rubus strigosis),* Quaking Aspen *(Populas tremulas),* and Reed Canary Grass *(Phalaris arundinacea).* These are typical plant species found on wetland edges. However the high percentage of Reed Canary Grass may at some time overwhelm the natives and encroach into the surrounding native communities. The boundaries on this plant community are fairly clear, this is most likely due to the hydrology of the site since the plant species are known to exist on wetland edges.

Sample 1-7

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Rubus strigosis	Raspberry	70	Native	FACW
Phalaris arundinacea	Reed Canary Grass	50	Invasive	FACW
Populus trembulas	Quacking Aspen	10	Native	FAC

Sample 2-7

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Rubus strigosis	Raspberry	70	Native	FACW
Phalaris arundinacea	Reed Canary Grass	50	Invasive	FACW
Populus trembulas	Quacking Aspen	30	Native	FAC
Urtica Dioca	Stinging Nettle	20	Native	FAC

Diverse Native

The center of this wetland is the most diverse of all the plant communities. Over time the hydrology data suggests this wetland is becoming drier. However, it is likely the center is staying dominated by native plants because the hydrology has been less affected than the wetland perimeter. This plant community has a clear boundary with invasive species on the perimeters, so invasive species encroachment will be closely monitored.

Sample 1-4

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Polygonum sagittatum	Tear thumb	40	Native	OBL
Lycopus uniflorus	Northern Bugleweed	40	Native	OBL
Rubus flagellaris	Dewberry	10	Native	FACU
Thelypteris thelypteroides	Marsh Fern	10	Native	FACW
Solidago gigantia	Giant Goldenrod	15	Native	FACW
Cirsium arvense	Canada Thistle	5	Invasive	FACU

Sample 1-5

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Solidago gigantia	Giant Goldenrod	40	Native	FACW
Thelypteris thelypteroides	Marsh Fern	30	Native	FACW
Rubus flagellaris	Dewberry	30	Native	FACU
Calamagrostis canadensis	Canada blue-joint	10	Native	OBL
Carex lacustris	Lake Sedge	10	Native	OBL

Sample 1-6

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Solidago gigantia	Giant Goldenrod	40	Native	FACW
Carex lacustris	Lake Sedge	10	Native	OBL
Rubus strigosis	Raspberry	20	Native	FACU
Polygonum sagittatum	Tear thumb	30	Native	OBL
Cirsium arvense	Canada Thistle	5	Invasive	FACU

Sample 2-2

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	50	Invasive	FACW
Urtica Dioca	Stinging Nettle	10	Native	FAC
Carex lacustris	Lake Sedge	5	Native	OBL
Cirsium arvense	Canada Thistle	5	Invasive	FACU

Sample 2-3

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Carex lacustris	Lake Sedge	80	Native	OBL
Cirsium arvense	Canada Thistle	25	Invasive	FACU
Polygonum sagittatum	Tear thumb	30	Native	OBL

Sample 2-4

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Carex lacustris	Lake Sedge	40	Native	OBL
Lycopus uniflorus	Northern Bugleweed	30	Native	OBL
Rubus strigosis	Raspberry	10	Native	FACW
Polygonum sagittatum	Tear thumb	20	Native	OBL
Solidago gigantia	Giant Goldenrod	5	Native	FACW

Sample 2-5

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Polygonum hydropiper	Marshpepper smartweed	40	Native	OBL
Lycopus uniflorus	Northern Bugleweed	40	Native	OBL
Solidago gigantia	Giant Goldenrod	20	Native	FACW
Carex lacustris	Lake Sedge	10	Native	OBL
Cirsium arvense	Canada Thistle	10	Invasive	FACU

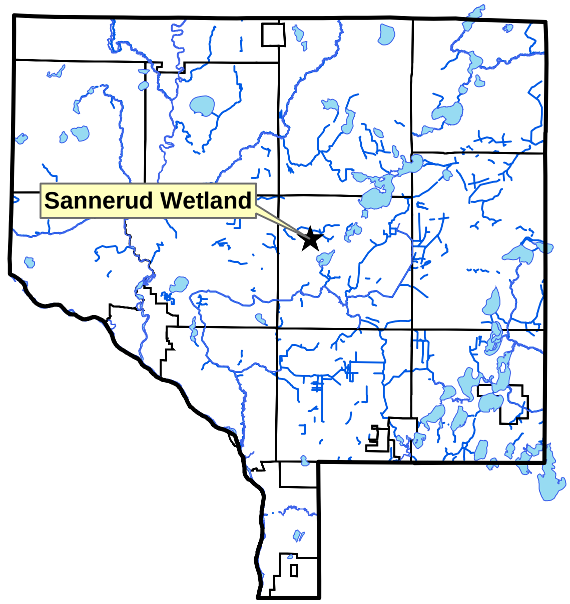
**Sample 2-6 ***This is the sample site that used to be Mono-Typic Native

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Carex lacustris	Lake Sedge	70	Native	OBL
Lycopus uniflorus	Northern Bugleweed	30	Native	OBL
Polygonum sagittatum	Tear thumb	30	Native	OBL
Solidago gigantia	Giant Goldenrod	20	Native	FACW

SANNERUD REFERENCE WETLAND

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

Wetland Description



Sannerud wetland is one of 18 wetlands in the Anoka Conservation District's reference wetland network. It is located within Bunker Hills Regional Park. It is a Circular 39 Type 2 Inland fresh sedge meadow covering about 18.9 acres. It is located in a concave landscape position with no discernable outlet, but is in close proximity to two similar type wetlands. One of similar size is located to the west, while a second, much larger wetland, is located to the south.

The dominate plant species within this wetland are sedges and grasses. Within the basin the most abundant are *Carex lasiocarpa* (Wooly-fruit sedge) and *Calamagrostis canadensis* (Canada bluejoint). Both of these species are native to Minnesota and are indicative of a high quality wetland habitat. Located on the perimeter of the wetland are various mixtures of *Rubus flagellaris* (Dew Berrry), *Phalaris arundinace* (Reed Canary Grass), *Calamagrostis canadensis* (Canada Bluejoint), and *Populas trembelodies* (Quaking Aspen). The vegetation communities are detailed later in this report.

This wetland is a depressional basin with deep (> 51 inches) organic soil deposits, mapped as *Rifle Mucky Peat* with a sandy substrate. The surrounding uplands are oak woodlands on the somewhat poorly drained (water table within 2-4 feet) *Lino Fine Sand*, and the excessively well drained (water Table > 6-feet) *Zimmerman Fine Sand* soils. Both of these sandy soils rapidly conduct water, and discharge to the adjacent wetland.

This hydrology of this wetland is groundwater feed with a fairly stable yearly hydrograph. 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. There is an inlet ditch on the east side of the wetland coming from under Highway 65, and a created outlet ditch on the southwest corner. Both have been over-grown and appear to be non-functional.

Photo of Bunker Wetland in April

Introduction

Study of Bunker wetland is two-fold. First, the wetland hydrology (water level) is monitored continuously with automated equipment as part of the ACD's network of reference wetlands. All reference wetlands are hydrologically monitored to provide a reference for the current state of wetlands. Most prominently, this data is used to ensure accurate wetland regulatory determinations. Secondly, the data serves to improve understanding of shallow groundwater hydrology, with uses ranging from flood prediction to drought severity indexing. At the request of the Coon Creek Watershed District, the Anoka Conservation District (ACD) has begun to study the vegetation community of the Bunkers Hills

Reference Wetland. The purpose of vegetation surveys is to document vegetation changes associated with hydrological changes, invasive species, and other disturbance.

This wetland has had dramatic hydrological change during the 13 years it has been monitored. From 1996 to 2005 a monitoring well was placed what was considered to be the wetland edge. During this ten year monitoring period it was discovered the water level was decreasing. Our goal, using the jurisdictional wetland hydrology standard, was to keep this and all of our monitoring sites on the wetland edge. With exception of the first two years of monitoring, 1996, 1997, and, a higher than normal precipitation year in 2003, the water level was below the threshold of twelve inches to be considered a jurisdictional wetland. Seven out of ten years failed to meet wetland hydrology standards. Additionally, the water levels had dropped to a level that the monitoring well was no longer considered to be within an acceptable distance of the wetland edge. In 2006 it was decided to move the well down slope in order to capture the full range of hydrology reading throughout the year.

In 2006 the ACD installed a second hydrology monitoring well. This well is located in the middle of the wetland within the most diverse vegetative community. The water level has been at or near the surface in spring and followed predictable summer draw downs and fall recharge patterns. As the area around the wetland is developed, our particular focus will be how wetland hydrology correlates to invasive species expansion into native vegetative communities.

Data Collection Methods

A central goal of this study is to monitor the expansion of invasive species. The primary work product is a plant community map. Maps will be compiled in different years and compared. The wetland boundary location was determined by the Anoka Conservation District Wetland Specialist using state-approved wetland delineation methods. The wetland boundary and vegetation community boundaries were documented with a hand held Lowrance GPS unit and uploaded into Arc Map 9.1. Due to complexity of the site, to accurately delineate plant community boundaries three data collection methods were used. First, transects across multiple plant communities were established and quadrats along those transects were studied. Secondly, wherever a plant community was identified that was not crossed by a transect an quadrat was established. Lastly, a meander survey was used to GPS the boundaries of each vegetation community.

The transects and quadrats used standard methodologies for wetland study in Minnesota. Two perpendicular transects were established. Along each transect vegetation was documented at seven equally-spaced points. At each point herbaceous vegetation within a one meter quadrat was inventoried, 15-foot radius for the shrub layer, and 30-foot radius for the tree layer. Plants were characterized by percent cover. Sample sites that overlapped into the upland or other plant communities were modified, while keeping the same square footage to stay within the wetland, and respective plant community.

Results

Three basic plant communities types are listed below. These communities were further broken down into subcategories based on dominant species listed in descending order. On the following pages are brief narratives of each plant community and a plant species table. The boundaries of the communities are found in the map on the following page.

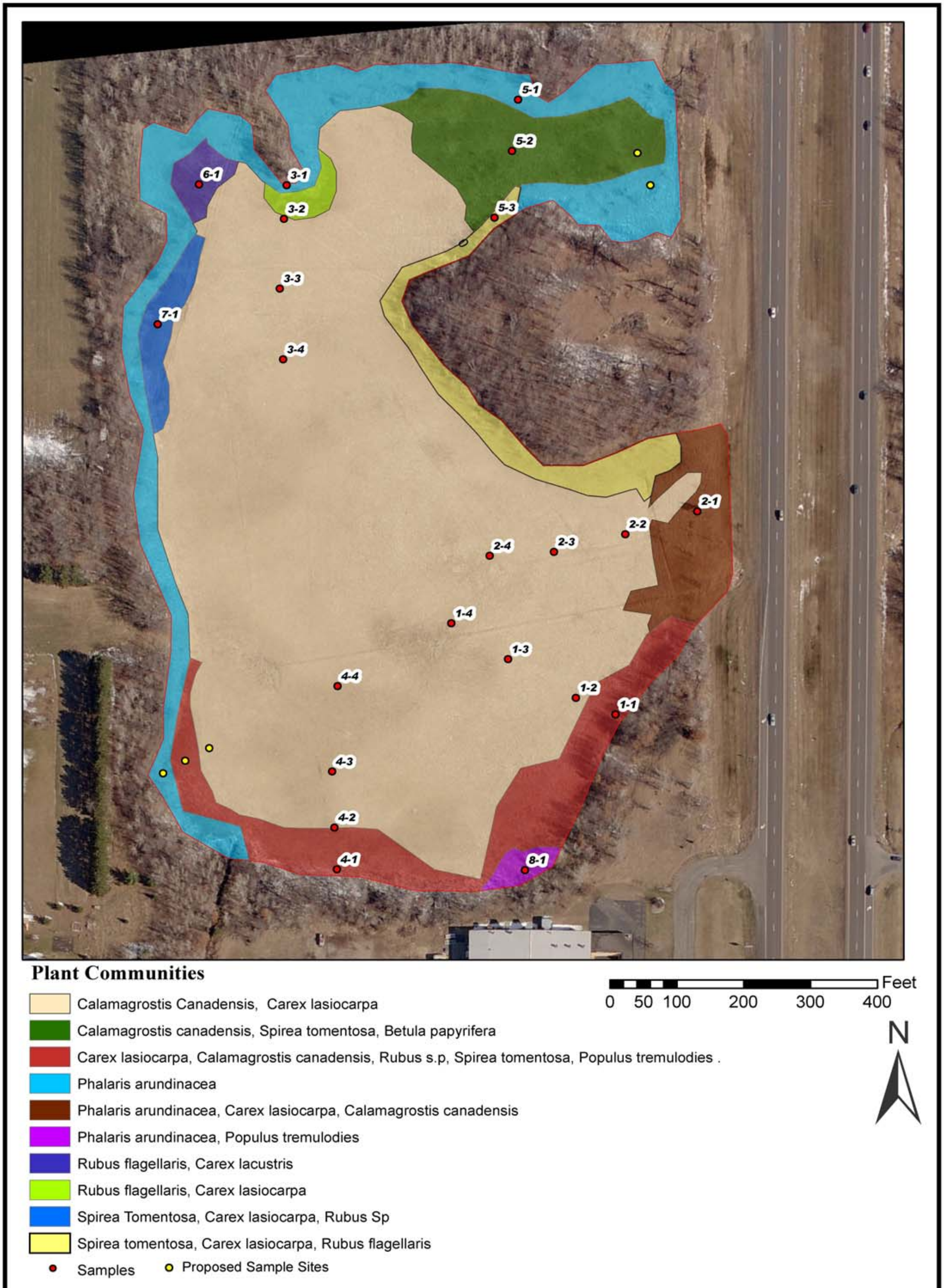
1. Native
   - Calamagrostis Canadensis, Carex lasiocarpa
   - Calamagrostis canadensis, Spirea tomentosa, Betula papyrifera
   - Rubus flagellaris, Carex lasiocarpa
   - Spirea tomentosa, Carex lasiocarpa, Rubus flagellari

2. Dominate Native/Invasive mix,
   - Carex lasiocarpa, Calamagrrostis canadensis, Phalaris arundinacea, Rubus flagellaris, Spirea tomentosa, Populus tremulodies
   - Rubus flagellaris, Carex lacustris, Phalaris arundinacea
   - Spirea Tomentosa, Carex lasiocarpa, Phalaris arundinacea Rubus flagellaris

3. Dominate Invasive/Native mix
   - Phalaris arundinacea
   - Phalaris arundinacea, Carex lasiocarpa, Calamagrostis Canadensis
   - Phalaris arundinacea, Populus tremulodies

No change in the vegetation communities has been observed in the three years since the plant surveys began for Sannerud Wetland. To improve our ability to detect small changes we plan to add study quadrats in 2011 where native plant communities border infestations of invasive plants. These proposed quadrats are shown in the map on the following page.

PLANT COMMUNITIES MAP WITH TRANSECT DATA POINT LOCATIONS



Native Plant Communities

This plant community encompasses 73% (13.8 acres) of the total wetland area, and is located mostly in the interior of the basin where the organic deposits are the thickest and the hydrology is the most stable. By far the most dominant plant species are *Carex lasiocarpa* and *Calamagrostis Canadensis.* These communities are comprised of the following species data.

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 2-2

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

Sample 2-3

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

Sample 2-4

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

Sample 3-2

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

Sample 3-3

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

Sample 3-4

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

Sample 4-2

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

Sample 4-3

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

Sample 5-2

Scientific Name	Common Name	% Coverage	Native/Invasive
Rubus flagellaris	Raspberry	60	Native
Calamagrostis canadensis	Canada Blue Joint	40	Native
Carex lasiocarpa	Wooly-fruit sedge	20	Native
Spirea tementosa	Steeple Bush	20	Native

Dominant Native/Non-native invasive mix

This plant community encompassed 11%, (2.1 acres) of the wetland and is located either along the perimeter or between the perimeter and the interior basin. The dominate species in these plant communities are the Dew Berry and Canada Blue-joint Grass, with various trees and shrubs. This is where the organic soils were the thinnest, (4-16 inches) and the hydrology has the most bounce. Listed below are the sample data taken within these plant communities.

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 trembeloidies	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 4-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	40	Native
Rubus flagellaris	Dew Berry	30	Native
Salix exigia	Sandbar Willow	20	Native
Phalaris arundinacea	Reed Canary Grass	20	Invasive
Acer rubrum	Red Maple	10	Native
Fraxinus pennsylvanicum	Green Ash	10	Native
Cornus stolonifera	Red-osier Dogwood (s)	10	Native
Acer rubrum	Red Maple (T)	10	Native
Ilex verticillata	Winterberry (S)	5	Native
Spirea tementosa	Steeple Bush	5	Native

Sample 6-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Rubus flagellaris	Dew Berry	80	Native
Carex lasiocarpa	Wooly-fruit sedge	30	Native
Phalaris arundinacea	Reed Canary Grass	15	Invasive

Sample 7-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Calamagrostis canadensis	Canada Blue Joint	80	Native
Carex lasiocarpa	Wooly-fruit sedge	30	Native
Phalaris arundinacea	Reed Canary Grass	10	Invasive

Dominant Non-native invasive/native mix

This plant community encompassed 16%, (2.0 acres) of the wetland and is located along the perimeter of the wetland. The dominate species in these plant communities is Reed Canary Grass. This is also where the organic soils were the thinnest, (4-16 inches) and the hydrology has the most bounce.

Sample 2-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Phalaris arundinacea	Reed Canary Grass	60	Invasive
Carex lasiocarpa	Wooly-fruit sedge	40	Native
Calamagrostis canadensis	Canada Blue Joint	30	Native
Typha angustifolia	Narrow-leaf Cattail	10	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 trembeloidies	Quaking Aspen (S)	30	Native
Betula papyrifera	Paper Birch (s)	30	Native
Solidago gigantia	Giant Goldenrod	10	Native

Sample 5-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Phalaris arundinacea	Reed Canary Grass	80	Invasive
Calamagrostis canadensis	Canada Blue Joint	10	Native
Carex lasiocarpa	Wooly-fruit sedge	10	Native

Sample 8-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Phalaris arundinacea	Reed Canary Grass	80	Invasive
Populas trembeloidies	Quaking Aspen (S)	50	Native
Calamagrostis canadensis	Canada Blue Joint	20	Native

Stormwater Retrofit Assessment – Woodcrest Creek

Description: This stormwater retrofit assessment takes a systematic approach to identifying and prioritizing water quality improvement projects that provide the greatest amount of stormwater treatment per dollar spent. Woodcrest Creek was chosen because it is a high priority to the Coon Creek Watershed District and drains to a segment of Coon Creek where water quality is known to deteriorate. Woodcrest Creek's watershed is located in the Cities of Blaine and Coon Rapids.

Purpose: To improve stormwater quality and reduce the volume of runoff entering the stormwater system from neighborhoods that most greatly contribute to the degradation of Woodcrest Creek and Coon Creek.

Results: This stormwater assessment divided Woodcrest Creek's subwatershed into nine separate catchments which were individually analyzed. Pollutant and volume loading from each catchment was modeled with WinSlamm under three scenarios – (a) base conditions with no water quality practices, (b) existing conditions with existing water quality practices, and (c) proposed conditions with each possible water quality project installed. A cost estimate was generated for each project. Based on these costs and estimated pollutant reductions, the cost effectiveness of each possible project was calculated. Projects are listed in the table below in order of cost effectiveness. Concept designs were created for many favorable projects. Some projects were installed while the assessment was ongoing, others are planned for future installation.

Due to the extensive nature of this work, a separate report has been prepared. That report is available at www.metrocd.org or from the Anoka Conservation District.

Summary of stormwater retrofit opportunities ranked by cost-effectiveness

Tier 1 Retrofit Recommendations ($0-$500/lb TP/yr)

Catchment ID	Retrofit Type	Projects Identified	TP Reduction (lb/yr)	TSS Reduction (lb/yr)	Volume Reduction (ac-ft/yr)	Estimated Cost	Estimated cost/1,000lb-TSS/year (30-year)	Estimated cost/lb-TP/year (30-year)
In-Stream	New Pond	1	39.0 - 64.0	12,345 - 19,478	0.0	$105,000 - $136,500	$275 - $348	$84 - $110
WC-9*	Infiltration/Retention	1	7.9	3,594	6.7	$4,620	$240	$109
WC-1	Residential Rain Gardens	10 - 18	18.4 - 24.5	8,548 - 11,341	14.5 - 19.1	$43,720 - $77,240	$258 - $346	$120 - $160
WC-4	Residential Rain Gardens	10 - 18	16.2 - 24.1	7,503 - 11,137	12.6 - 18.8	$43,720 - $77,240	$294 - $352	$136 - $163
WC-8	Residential Rain Gardens	6 - 12	8.3 - 13.0	3,833 - 5,963	6.6 - 10.4	$26,960 - $52,100	$352 - $442	$162 - $203
WC-5	Pond Modification	1	9.4	3,821	0.0	$24,320 - $35,490	$423 - $619	$172 - $252
WC-7	Residential Rain Gardens	4 - 6	4.9 - 6.1	2,278 - 2,808	4.0 - 5.0	$18,580 - $26,960	$396 - $480	$188 - $221
WC-5	Stormwater Disconnects	4	1.3	982	2.3	$1,900	$278	$204
WC-9*	Residential Rain Gardens	3 - 5	4.4 - 5.8	2,048 - 2,701	3.5 - 4.6	$26,540 - $38,970	$542 - $620	$252 - $289
In-Stream	Pond Modification	2 - 3	11.0 - 31.0	1,972 - 7,272	0.0	$71,400 - $210,000	$1,393 - $2,746	$327 - $450

Tier 2 Retrofit Recommendations ($501-$1,500/lb TP/yr)

Catchment ID	Retrofit Type	Projects Identified	TP Reduction (lb/yr)	TSS Reduction (lb/yr)	Volume Reduction (ac-ft/yr)	Estimated Cost	Estimated cost/1,000lb-TSS/year (30-year)	Estimated cost/lb-TP/year (30-year)
WC-1	Apt. Rain Garden	1 - 2	2.1 - 2.9	1,462 - 1,974	2.1 - 5.2	$15,230 - $29,130	$758 - $1,100	$527 - $759
WC-3	Apt./Office Rain Gardens	2	2.3	1,078	2.3	$22,180	$1,521	$701
WC-6*	Bioretention	2 - 14	2.4 - 3.6	1,903 - 2,769	4.0 - 5.8	$33,635 - $329,690	$1,196 - $6,887	$948 - $5,297
WC-6*	Biofiltration	2 - 14	2.0 - 3.0	1,522 - 2,215	0.0	$40,758 - $404,430	$1,277 - $7,304	$1,277 - $7,304
In-Stream	Channel Stabilization	1	5.7	538,650	0.0	$210,000	$14	$1,368

Tier 3 Retrofit Recommendations (>$1,500/lb TP/yr)

Catchment ID	Retrofit Type	Projects Identified	TP Reduction (lb/yr)	TSS Reduction (lb/yr)	Volume Reduction (ac-ft/yr)	Estimated Cost	Estimated cost/1,000lb-TSS/year (30-year)	Estimated cost/lb-TP/year (30-year)
WC-7	Pond Modification	1	2.0	730	0.0	$45,030 - $67,930	$4,112 - $6,204	$1,501 - $2,264
WC-5	Sand Filter	1	0.4	252	0.0	$15,800	$4,947	$2,899
WC-6*	Sand Filter	1	2.4	1,607	0.0	$97,680	$5,013	$3,315
WC-3	Sand Filter	1	0.5 - 1.5	350 - 1,054	0.0	$22,280 - $65,680	$5,105 - $5,060	$3,463 - $3,503
WC-6*	Permeable Asphalt	1	3.8	2,769	5.8	$611,520	$7,723	$5,628

*Pollution reduction benefits and costs cannot be summed with other projects in the same catchment because they are alternative options for treating the

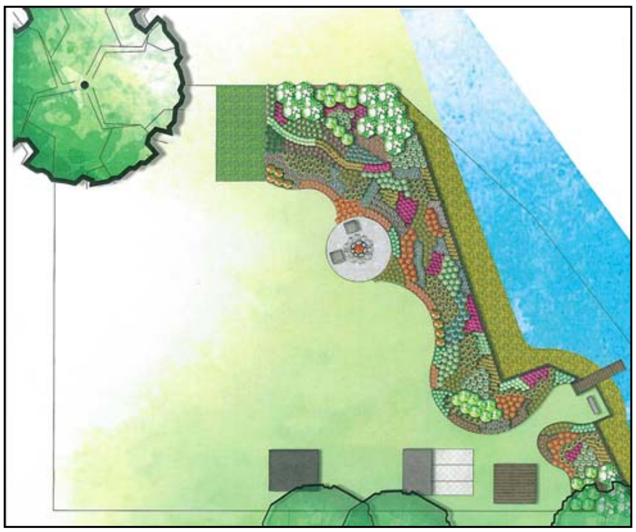
(yellow highlight) Project concept that can be applied to commercial properties in other catchments.

Water Quality Improvement Projects

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

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

Results: Projects are described in a separate report produced by the Anoka Conservation District.



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.

Note in the table below that all precipitation related work, including monitoring and analysis, is grouped as CCWD rain. Likewise, all reference wetland work, including monitoring, analysis, and vegetation mapping, are grouped as Ref Wet.

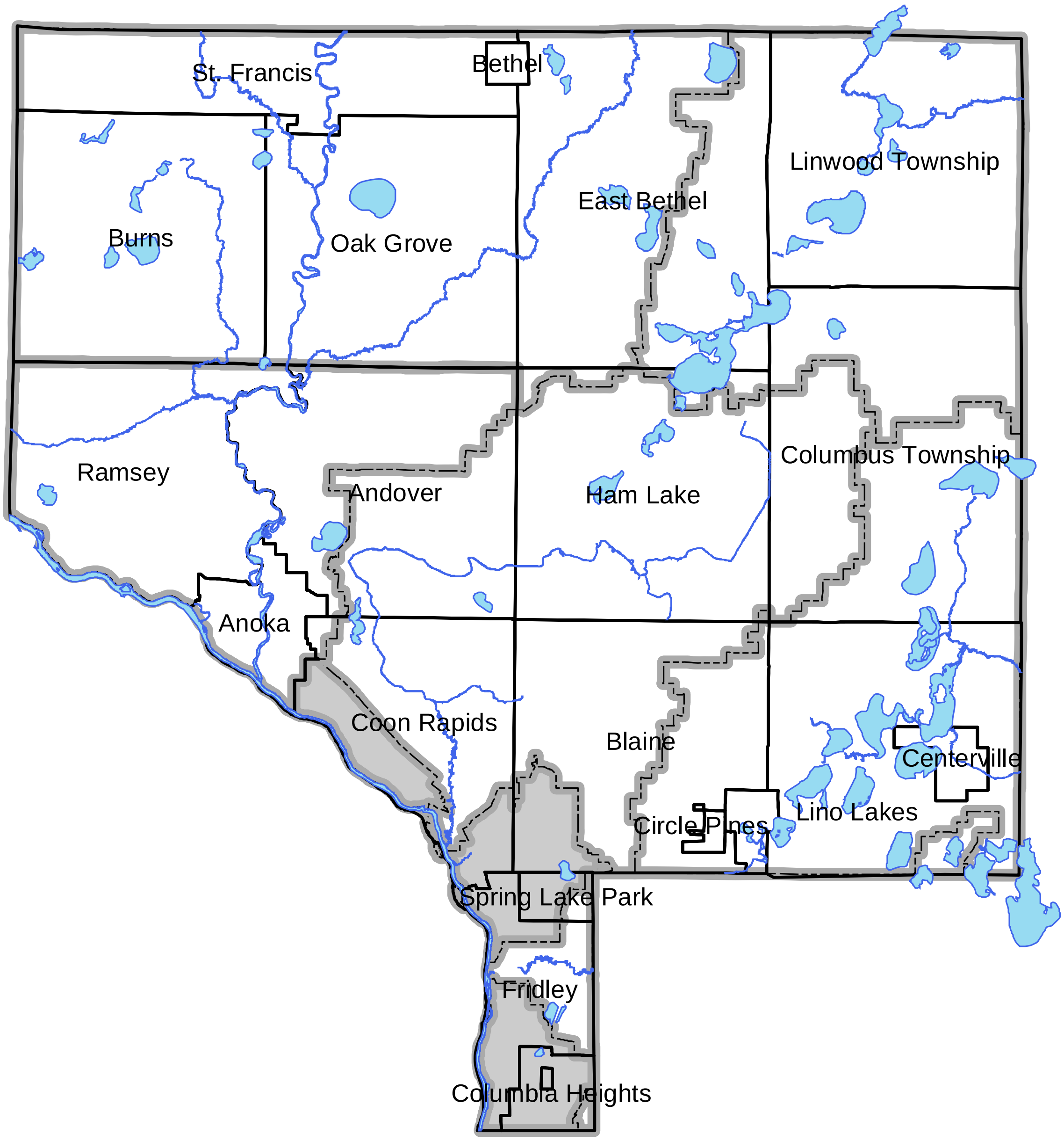
Coon Creek Watershed Financial Summary

Coon Creek Watershed	Volunteer Precip	CCWD Rain	Ref Wet	Lake Lvl	Obwell	Stream Lvl	Lake WQ	Stream WQ	Student Bio	Pro Biomon	Rate Curve	Geologic Atlas	Woodcrests Retrofit	Total
Revenues														
CCWD	0	4300	4265	750	0	2675	2050	7920	780	3825	1000	0	11830	39395
State	0	0	0	0	220	0	0	0	0	0	0	0	0	220
Anoka Conservation District	173	1881	305	579	363	521	68	116	1182	4896	637	1929	1745	14394
County Ag Preserves	0	0	0	0	0	0	980	0	855	0	0	0	5000	6834
Regional/Local	0	0	0	0	0	0	0	0	0	0	0	0	0	(0)
Other Service Fees	0	0	0	0	0	0	0	0	0	0	0	0	5972	5972
Local Water Planning	0	0	0	0	0	1696	2612	795	0	0	0	0	0	5103
TOTAL	173	6181	4570	1329	583	4892	5709	8830	2817	8721	1637	1929	24547	71917
Expenses-														
Capital Outlay/Equip	21	681	354	70	69	483	793	628	101	930	353	201	970	5652
Personnel Salaries/Benefits	120	4242	3356	1028	406	3453	3190	4544	2182	6037	1015	1280	18894	49749
Overhead	23	800	541	149	77	596	1281	2032	281	1183	220	345	3064	10592
Employee Training	1	33	26	9	3	25	20	24	22	57	5	6	254	485
Vehicle/Mileage	2	66	51	15	6	53	51	72	32	93	17	20	270	748
Rent	6	227	186	55	21	184	132	313	103	318	25	74	950	2594
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	0	131	54	1	0	95	195	1114	94	104	2	1	144	1934
Equipment Maintenance	0	2	2	1	0	2	48	103	2	0	1	1	1	164
TOTAL	173	6181	4570	1329	583	4892	5709	8830	2817	8721	1637	1929	24547	71917
NET	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Recommendations

- **Install water quality improvement projects identified in the Sand and Woodcrest Creek stormwater assessments.** Potential projects have been ranked by cost effectiveness; most cost effective projects should be done first.
- **Conduct subwatershed assessments for lower Coon Creek that locate and prioritize water quality improvement opportunities.** The Anoka Conservation District and Coon Creek Watershed District are planning an assessment for lower Coon Creek in 2011. Based on monitoring data, areas of focus should be total phosphorus, total suspended solids, and storms >1-inch.
- **Install continuous water quality monitoring of Coon Creek at Vale Street** during storms to better understand variability in nutrients and suspended solids throughout the storm. This should also aid in understanding pollutant sources so they can be addressed.
- **Ensure that future stream monitoring is done in such a way that it can be incorporated into future total maximum daily load (TMDL) studies.** Coon Creek is presently listed as impaired for biota, but may also be failing to meet turbidity standards.
- **Increase the usage of reference wetland data** among wetland regulatory personnel as a means for efficient, accurate wetland determinations. It is also use for analyzing long term trends in shallow water table hydrology.
- **Secure funding for Blaine High School biomonitoring** of Coon Creek at Egret Street.
- **Integrate stream hydrology, precipitation, and water quality data into watershed-wide computer models.**
- **Expand the number of quadrats in the Sannerud wetland vegetation studies** to improve our ability to detect small changes.
- **Scrutinize monitoring and water quality improvement needs for Pleasure and Springbrook Creeks**, which will likely become part of the Coon Creek Watershed District. Past work on these waterbodies has been limited, but substantial problems are known to occur.
- **Reduce road salt use.** Elevated chlorides are pervasive throughout shallow aquifers and the streams that feed them.

Six Cities Watershed



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

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

CHAPTER 7: SIX CITIES WATERSHED

Task	Partners	Page
Lake Levels	SCWMO, ACD, MNDNR, volunteers	7-216
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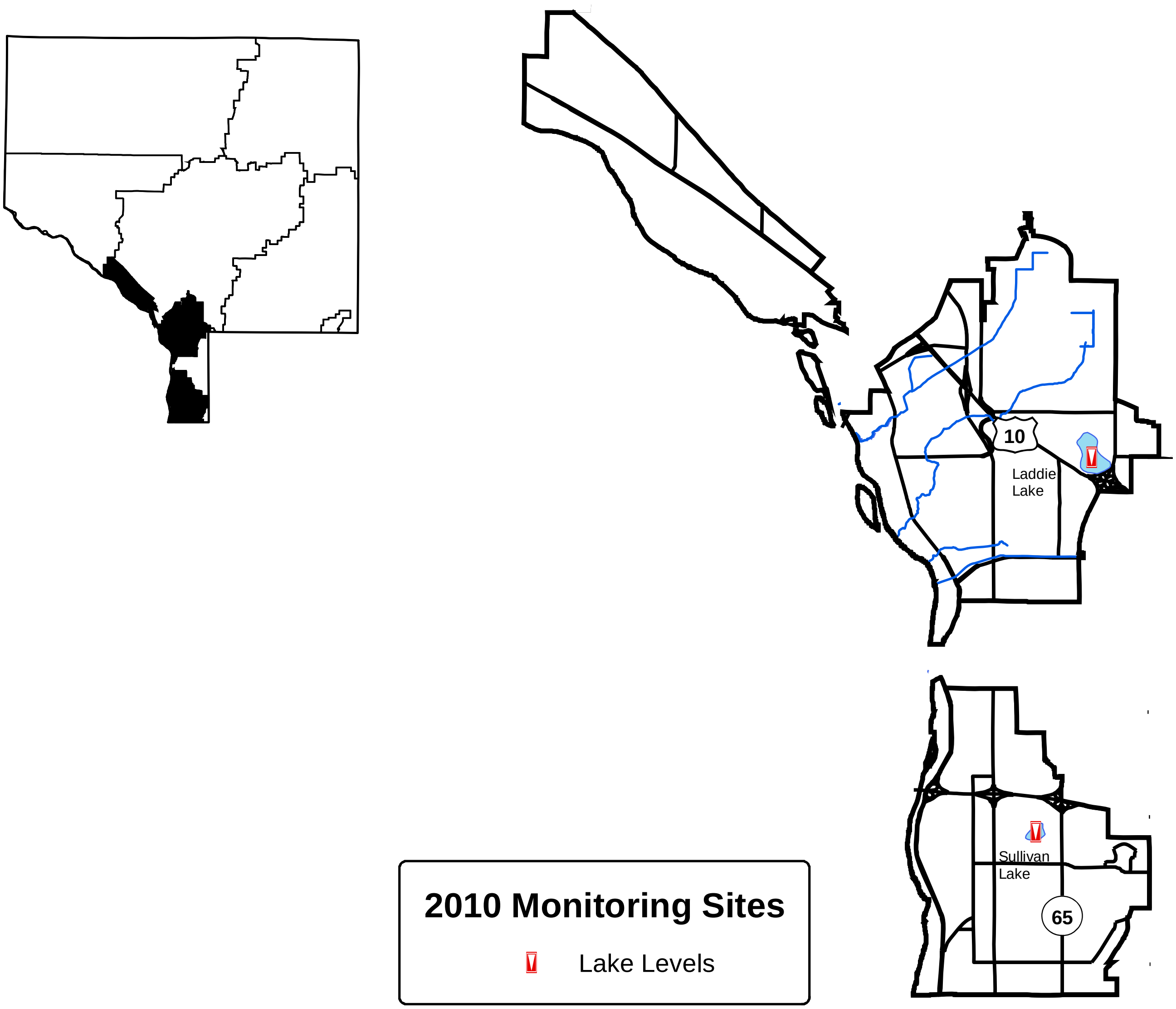
Precipitation	ACD, volunteers	Chapter 1
Ground Water Hydrology (obwells)	ACD, MNDNR	Chapter 1

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



Lake Level Monitoring

Description: Weekly water level monitoring in lakes. The past five years are shown below, and all historic data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

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

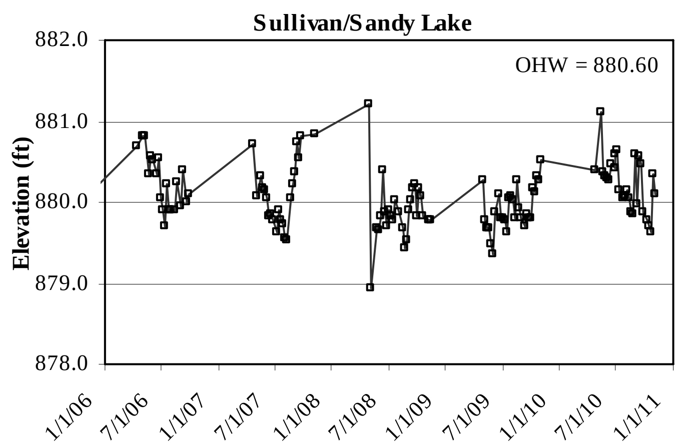
Locations: Laddie Lake

Sullivan/Sandy Lake

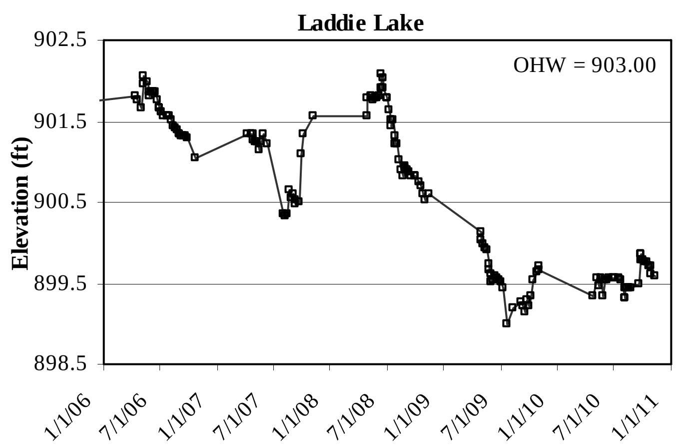
Results: Water levels were recorded 27 times at Sullivan Lake and 29 times at Laddie Lake. Sullivan Lake levels were variable and fluctuated approximately one foot. Rapid variation, which is different from most other lakes, occurs because Sullivan serves as a storm water retention basin for urbanized areas. The outlet prevents large sustained declines or increases in water level. Laddie Lake also receives storm water inputs, but to a lesser degree. Laddie Lake levels did not rebound in 2010 despite a return to normal precipitation following several years of drought. Instead, Laddie Lake levels held relatively constant and about two feet lower than 2007-2008.

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

Sullivan/Sandy Lake Levels 2006-2010



Laddie Lake Levels 2006-2010



Six Cities Watershed Lake Levels Summary 2006-2010

Lake	Year	Average	Min	Max
Laddie	2006	901.60	901.04	902.05
	2007	900.96	900.33	901.55
	2008	901.28	900.53	902.09
	2009	899.55	898.99	900.14
	2010	899.56	899.31	899.87
Sullivan	2006	880.32	879.52	881.92
	2007	880.12	879.54	880.83
	2008	880.22	879.42	881.24
	2009	879.92	879.36	880.52
	2010	880.23	879.62	881.10

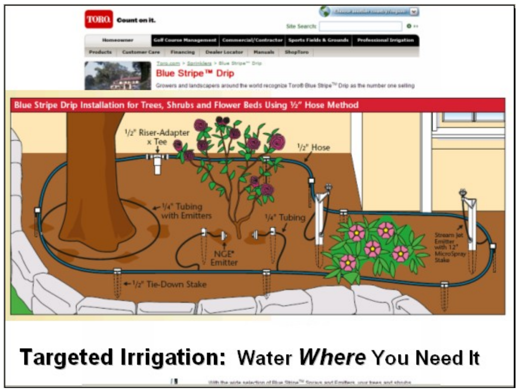
Water Quality Workshop – WaterSmart

Description: The Anoka Conservation District, watershed organizations, and participating cities cooperate to host conservation workshops for the public. The workshops are taught by Anoka Conservation District staff. Cities handle registration and provide facilities. Other costs are shared among the partners.

Purpose: To assist and encourage landowners to install water quality improvement projects.
To encourage water conservation.

Results: A workshop titled "WaterSmart: Creating a Low Maintenance Landscape" was held April 21, 2010. The workshop was two hours in length and taught by Anoka Conservation District staff. It was promoted by Six Cities WMO cities, as well as the City of Lino Lakes. Promotion occurred in city newsletters, on city websites, on city hall fliers, and elsewhere. The City of Blaine provided facilities for the workshop as well as handled all registrations. Nine residents participated. This workshop covered a variety of topics related to landscaping and water conservation, including turf management, native plants, soil compaction, irrigation techniques, stormwater pollution, rain barrels, and rain gardens. Participants will be provided with take-home materials and one-on-one question and answer opportunities with experts.

Some teaching materials from the WaterSmart workshop.



Educational Newsletter Articles

Description: As part of the SCWMO's public education efforts, an annual newsletter article will be produced to be published in city newsletters. Cities may choose to use this work to meet their NPDES Phase II requirements, if desired.

Purpose: To educate the public about how to help improve water quality and about the SCWMO.

Results: In June 2010 the Anoka Conservation District drafted a newsletter article on behalf of the SCWMO. The article, entitled "We all have waterfront property," emphasized:

- water quality problems of stormwater runoff,
- the connection between streets, gutters, and lakes and streams through the stormwater conveyance system,
- that stormwater treatment, where it exists, does not remove 100% of pollutants,
- things homeowners can do to protect lakes and stream, and
- basic information about the SCWMO.

The SCWMO Board reviewed and edited the article before publication. A final draft was produced in late June. The final draft was sent to SCWMO cities with a request to include it in their newsletters.

Article submitted to the SCWMO cities for inclusion in their newsletters.

We All Have Waterfront Property

Many do not consider their homes as waterfront property, yet we are all directly connected to nearby lakes, streams, and ponds. Curb and gutter drainage systems in urban areas efficiently carry water to man-made and natural waterbodies. Therefore, how we manage our own properties has the potential to affect these waterbodies just as if we lived on their shores.

Runoff traveling via storm sewers is not processed by the wastewater treatment plant. Rather, it flows directly to nearby ponds, wetlands, lakes, and streams.

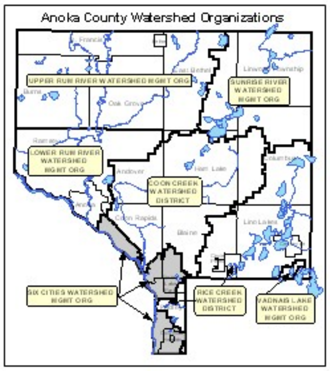
Runoff traveling through storm sewers is not processed by the wastewater treatment plant. In many locations, the water does go through stormwater ponds or other pollution removal devices. However, the effectiveness of these is far from 100%. For example, on average stormwater ponds remove 50-60% of phosphorus, an important pollutant that fuels algal blooms (source: MN Stormwater Manual). Other practices, such as street sweeping, sumps, infiltration basins, and rain gardens provide additional treatment, but a significant amount of pollution still makes its way into creeks, lakes, or the Mississippi River.

Several lakes and streams in southern Anoka County have declining or poor water quality. Known water quality problems exist in Pleasure Creek (Blaine and Fridley) and Springbrook (Blaine, Coon Rapids, Spring Lake Park [SLP]). Water quality in Laddie Lake (Blaine, SLP) is declining and Sullivan Lake (Columbia Heights) is on the state impaired waters list. Glen Creek (Fridley) has serious erosion driven by high flows during storms. Others are suspected to have problems, but have not yet been monitored.

Because all of our homes are connected to these waterbodies through the storm sewer system, each homeowner can have a positive or negative impact. To do your part:

- Dispose of grass clippings, leaves, and other yard waste properly; do not sweep them into the street.
- Eliminate pesticides and fertilizers as much as possible. When necessary to use them, follow label instructions. Keep them off of hard surfaces like driveways and streets.
- Redirect gutter downspouts from hard surfaces into grassy areas.
- Wash your vehicle on the lawn or treat yourself by taking it to the car wash.
- Never use the gutter to dispose of wastes or chemicals.
- If sealing your driveway, make sure your contractor uses an asphalt-based sealers. Avoid use of coal-tar sealers, which release toxic chemicals that reach water bodies.

This information is provided by the Six Cities Watershed Management Organization (SCWMO). The SCWMO is a special purpose unit of government aimed at managing water resources. It is formed jointly by the Cities of Coon Rapids, Columbia Heights, Fridley, Hilltop, Blaine, and Spring Lake Park and covers a portion of each of these communities. Representatives from each member city comprise the SCWMO Board. The organization's boundaries are determined by watershed boundaries. As a result, they focus on water issues which affect multiple communities, such as streams that flow from one community into the next. More information about the SCWMO can be found on their website at www.AnokaNaturalResources.com/scwmo.



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.

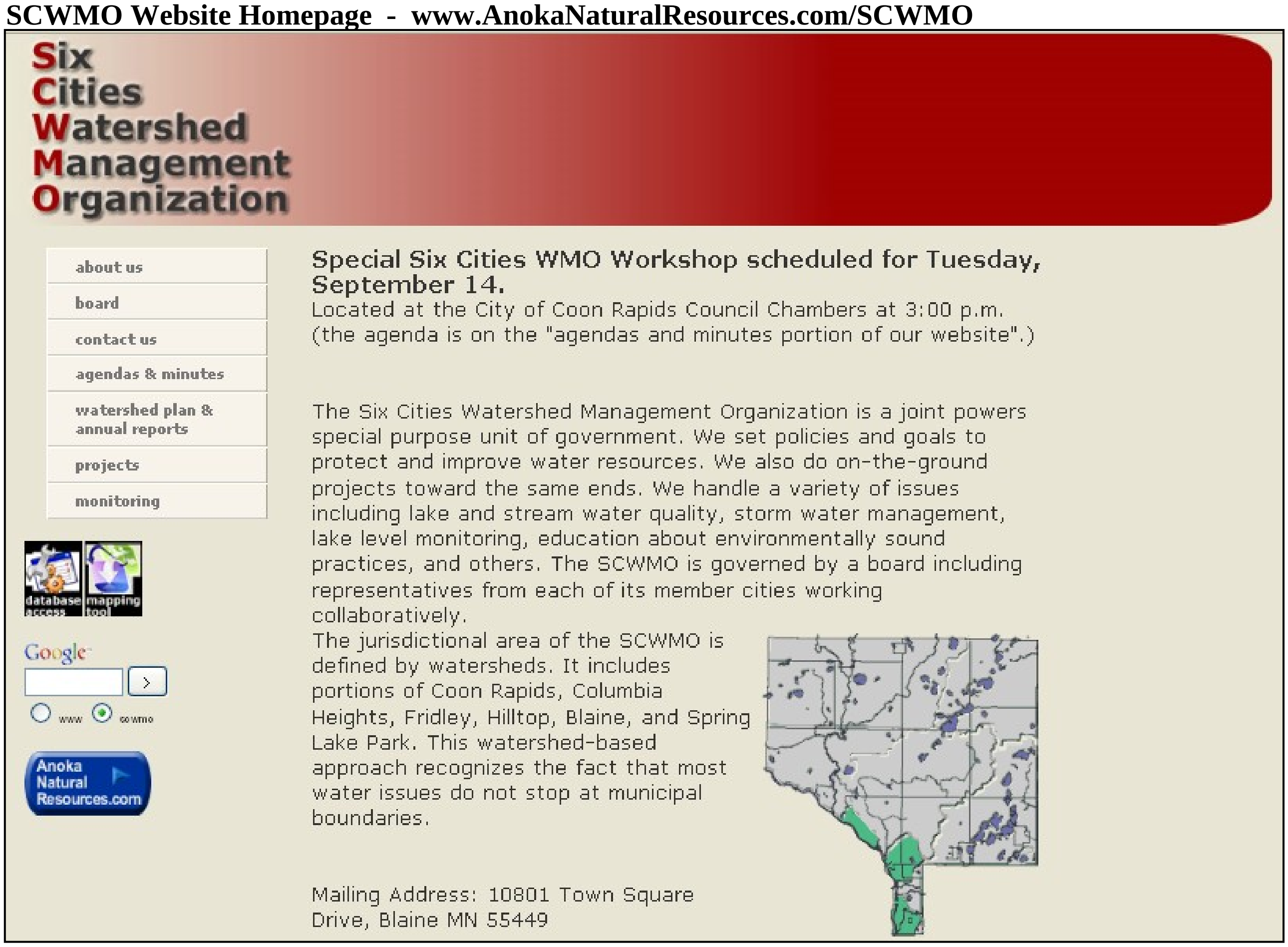
Information about the SCWMO includes:

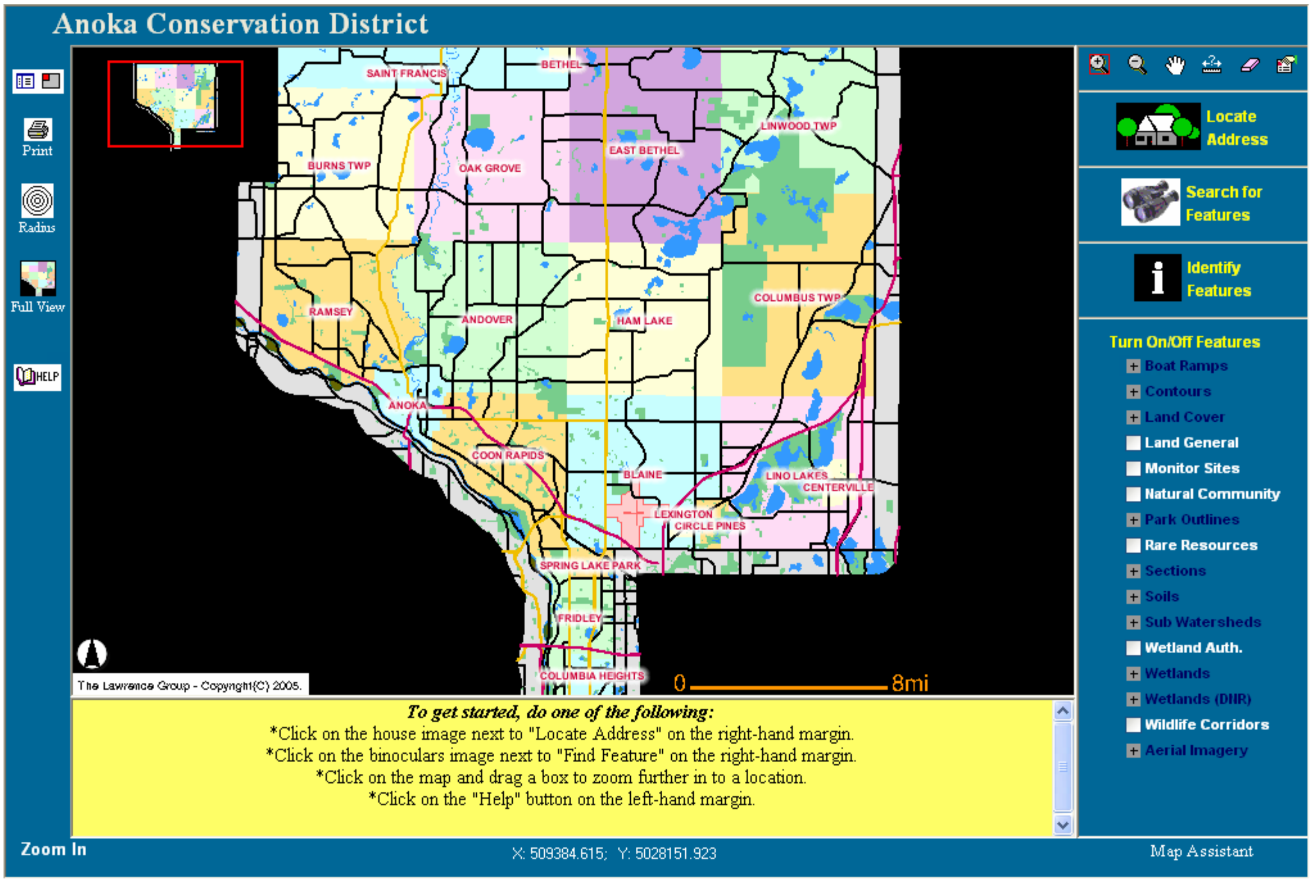
- a directory of board members,
- meeting minutes and agendas,
- watershed plan and annual reports,
- descriptions of work that the organization is directing,
- highlighted projects.

Other tools on the website include:

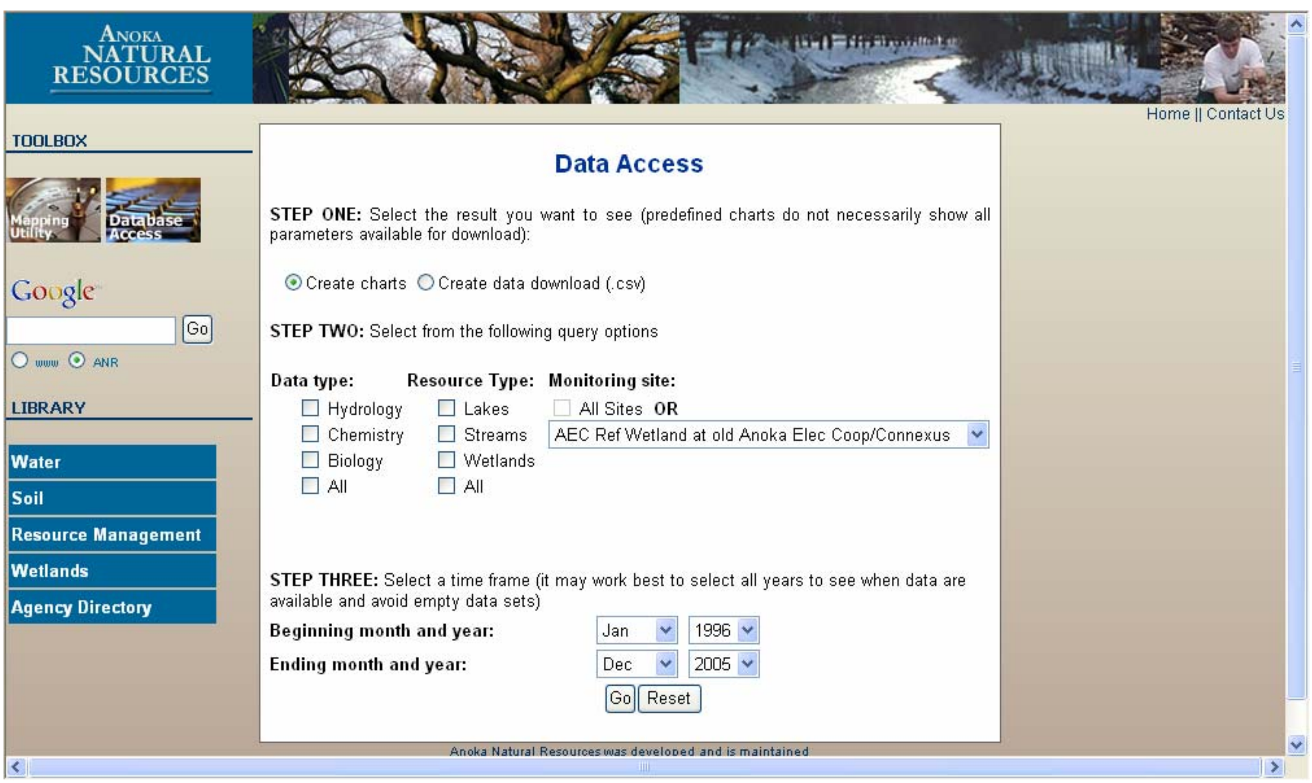
- an interactive mapping tool that shows natural features and aerial photos
- an interactive data download tool that allows users to access all water monitoring data that has been collected
- narrative discussions of what the monitoring data mean

SCWMO Website Homepage - www.AnokaNaturalResources.com/SCWMO





Interactive Data Access Tool

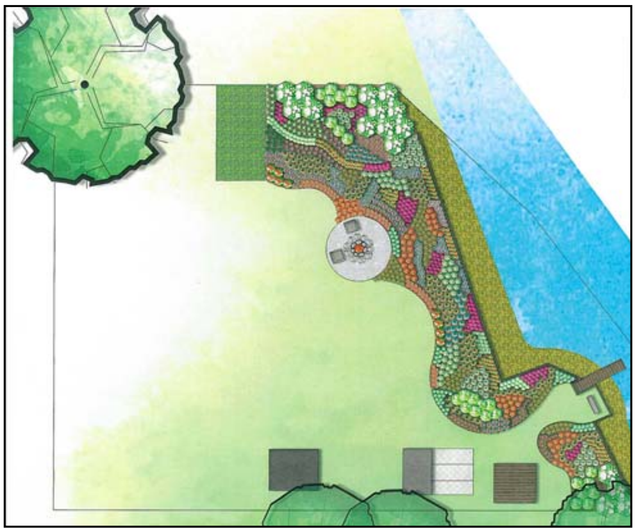


Water Quality Improvement Projects

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

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

Results: Projects are described in a separate report produced by the Anoka Conservation District.



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		Website	Workshops, ed articles	Lake Lvl	Geologic Atlas	Total
Revenues						
SCWMO		440	770	300	0	1510
State		0	0	0	0	(0)
Anoka Conservation District		1992	4647	232	437	7307
County Ag Preserves		0	0	0	0	(0)
Regional/Local		0	0	0	0	(0)
Other Service Fees		143	0	0	0	143
Local Water Planning		0	0	0	0	(0)
	TOTAL	2575	5417	532	437	8960
Expenses-						
Capital Outlay/Equip		182	747	28	46	1003
Personnel Salaries/Benefits		1325	3490	411	290	5516
Overhead		972	582	60	78	1692
Employee Training		11	19	4	1	34
Vehicle/Mileage		20	55	6	5	86
Rent		62	127	22	17	228
Program Participants		0	0	0	0	0
Program Supplies		1	394	0	0	395
Equipment Maintenance		1	4	0	0	6
	TOTAL	2575	5417	532	437	8960
	NET	0	0	0	0	0

Recommendations

- **As of March 2011 the SCWMO is dissolving.** Implementation of recommendations for natural resource management will be carried out by the watershed organizations that have jurisdiction over former SCWMO areas.
- **Perform E. coli reduction strategies in Pleasure Creek**, including cleaning stormwater facilities more frequently, targeted public education, and an assessment of the entire watershed to determine opportunities to improve water quality by retrofitting the stormwater system. Install these practices.
- **Increase monitoring of Springbrook and Pleasure Creeks to improve understanding of existing water quality problems and to guide management.**
- **Conduct an assessment of the Oak Glen Creek watershed** to identify opportunities to reduce stormwater rates and volumes, as well as water quality. Install these practices.
- **Structure all investigative work to fit into future TMDL studies.**
- **Reduce the frequency of lake and stream water quality monitoring**. An adequate baseline of data currently exists, so future monitoring should be focused upon detecting changes, especially changes resulting from land use and management change