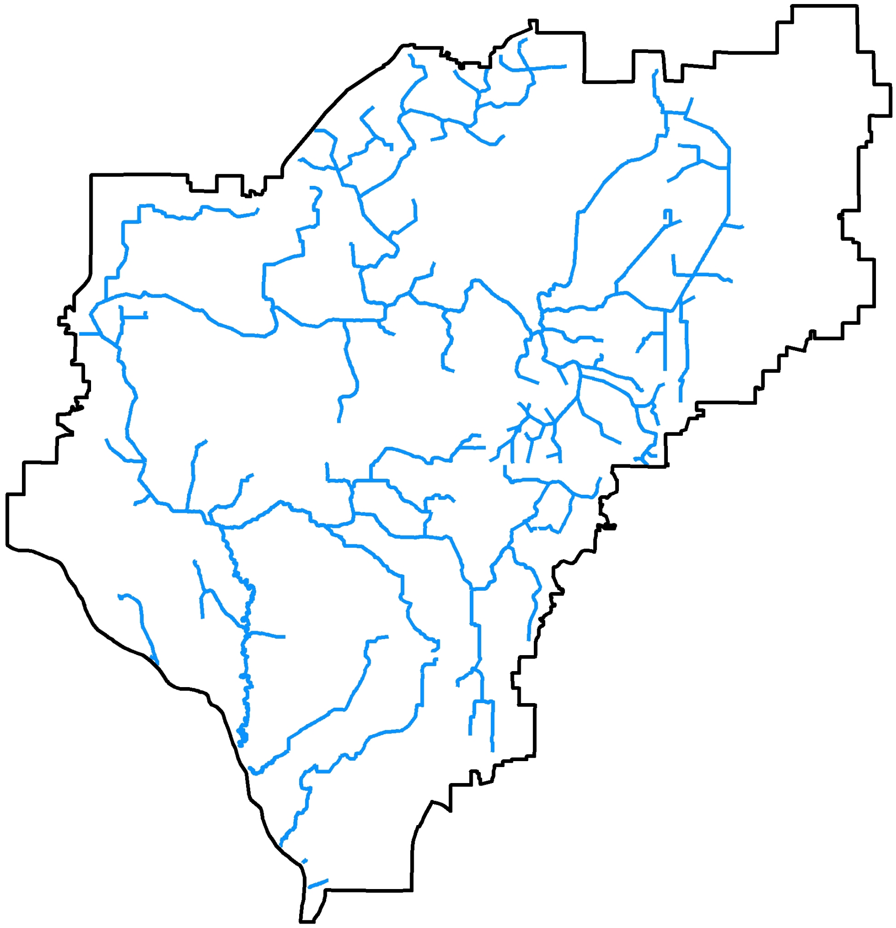
Coon Creek Watershed District

PHASE I SUMMARY REPORT



Prepared by:

Coon Creek Watershed District
12301 Central Ave NE, Blaine, MN 55434

April 2013

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ACD	Anoka Conservation District
BMP	Best Management Practice
CAC	Citizen Advisory Committee
CADDIS	Causal Analysis/Diagnosis Decision Information System
CCWD	Coon Creek Watershed District
CFU	Colony Forming Units
DELT	Deformities, Eroded fins, Lesions or Tumors
DNR	Department of Natural Resources
DO	Dissolved Oxygen
ECS	Ecological Classification System
EPT	Ephemeroptera, Plecoptera, Trichoptera
FBI	Family Biotic Index
F-IBI	Fish Index of Biological Integrity
FASL	Feet above Sea Level
GIS	Geographic Information Systems
IBI	Index of Biological Integrity
M-IBI	Macroinvertebrate Index of Biological Integrity
MPCA	Minnesota Pollution Control Agency
MPN	Most Probable Number
MSHA	Minnesota Stream Habitat Assessment
PLS	Public Land Surveys
SI	Stressor Identification
STORET	STOrage and RETrieval Systems
TAC	Technical Advisory Committee
TALU	Tiered Aquatic Life Uses
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USEPA	United States Environmental Protections Agency
USGS	United States Geological Survey
WRAP	Watershed Restoration and Protection Strategy

Executive Summary

This Phase I Summary report evaluates the potential stressors and factors that are the likely cause or causes of biological impairment in Coon Creek and its tributaries, Sand Creek, Pleasure Creek, and Springbrook Creek in Anoka County, Minnesota. This report is a summary of steps taken through Phase I of the Coon Creek Watershed WRAP strategy. The final form of this report will be in the form of the Stressor Identification (SI) report as mandated by the MPCA. Stressor identification reports are formulated using the United States Environmental Protection Agency's and Minnesota Pollution Control Agency's Stressor Identification guidance and the US EPA's Causal Analysis/Diagnosis Decision Information System (CADDIS). CADDIS is a methodology for conducting a stepwise analysis of candidate causes of impairment. CADDIS characterizes the potential relationships between candidate causes and stressors and identifies the probable stressors based on the strength of evidence from available data.

In 2006, Coon Creek (reach 07010206-530) was added to Minnesota's 303(d) List of Impaired Waters for biological impairment. Sand Creek (reach 07010206-58) was also added in 2006 along with Pleasure Creek (reach 07010206-594), and Springbrook Creek (reach 07010206-557) for biological impairment. The MPCA has developed an Index of Biotic Integrity (IBI) to evaluate the biological health of streams in the State. Currently, an IBI has been developed for two biological communities: fish (F-IBI) and macroinvertebrates (M-IBI). Coon Creek, Sand Creek, Pleasure Creek, and Springbrook Creek, are all listed as impaired based on M-IBI standards. Coon Creek and Sand Creek are also in violation of F-IBI standards, but, since both of these streams are more than 50% channelized, the fisheries impairment has been deferred until the state's Tiered Aquatic Life Uses (TALU) program is in place. Coon Creek, Pleasure Creek, and Springbrook Creek, are also in violation of the state's water quality standard for Escherichia Coli (E. coli) making them likely candidates for the 2014 303(d) List of Impaired Waters.

Portions of CCWD have been monitored for biota since 2000 (see Anoka Conservation District annual Water Almanacs). In addition to biomonitoring data provided by ACD, data collected by the MPCA was also compiled. All data available was analyzed to determine the validity, and severity, of listed impaired reaches. Existing biomonitoring data suggests Coon Creek's health is average compared to nearby streams, but also highly variable throughout the system. Some portions of the system indicate a good biotic standing while other portions show a clear violation of standards.

It is important to note, CCWD's primary service role is to provide flood protection to its residents. In upper reaches of the watershed, stream habitat is relatively sparse, due mostly to routine excavations performed to maintain the flood control responsibilities of CCWD. In

contrast, lower portions of our system with steeper channel grades are highly meandered, creating more suitable habitat for macroinvertebrates. These variations in habitat are just one example of varying conditions throughout CCWD

In order to begin the CADDIS methodology, a list of preliminary candidate stressors needed to be created. This list included all physical, biological, and chemical stressors which may be contributing to the current impairment listings for CCWD. The formation of this preliminary list resulted in a comprehensive set of stressors, which was then refined using professional judgment, in an effort to simplify the CADDIS methodology.

Five stressors that are potential candidate causes and will be examined in more detail are: TSS; turbidity; nutrients; altered habitat; and altered hydrology. These five stressors will be evaluated according to CADDIS' structured, weight-of-evidence approach, to determine which stressor or stressors are the likely candidate cause(s) of the impairments to Coon Creek and its tributaries.

1.0 Introduction

1.1 PURPOSE

This Phase I Summary report presents the work completed to begin identifying stressors which are likely contributing to the biological impairment in Coon Creek and its tributaries Sand Creek, Pleasure Creek, and Springbrook Creek, in Anoka County, Minnesota. The primary candidate stressor(s) leading to the biological impairment have not been identified at this point (that task is delegated to Phase II of the Watershed Restoration and Protection Strategy) but preliminary stressors have been identified for their potential roles. This report summarizes steps taken to formulate a preliminary candidate stressors list, which will be analyzed using the United States Environmental Protection Agency's (US EPA) and Minnesota Pollution Control Agency's (MPCA) Stressor Identification guidance and the US EPA's Causal Analysis/Diagnosis Decision Information System (CADDIS). CADDIS is a methodology for conducting a stepwise analysis of candidate causes of impairment. CADDIS characterizes the potential relationships between candidate causes and stressors, and identifies the probable stressors based on the strength of evidence from available data (Figure 1.0).

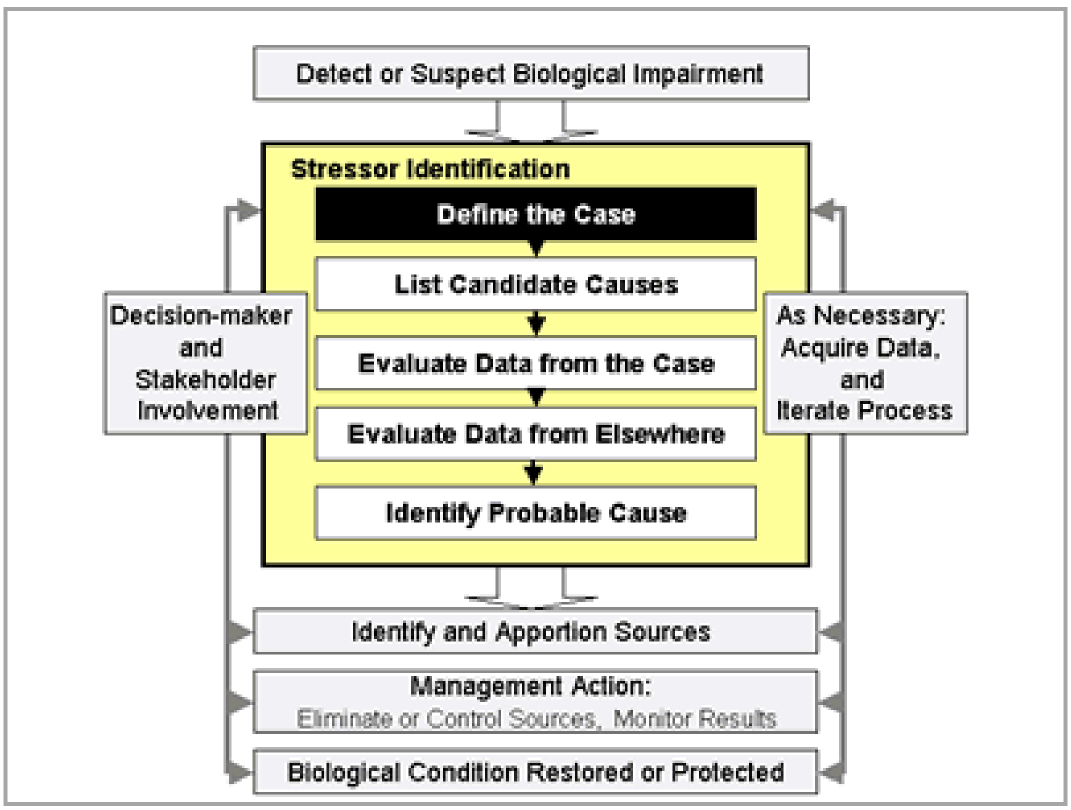


Figure 1. Stressor Identification Process

1.2 PROBLEM IDENTIFICATION

In 2006, Coon Creek (Reach 07010206-530) was placed on the State of Minnesota's 303(d) list of impaired waters for impairment of "aquatic life" as measured by macroinvertebrate index of biological integrity (M-IBI) (Table 1). Sand Creek (reach 07010206-58), Pleasure Creek (reach 07010206-594), and Springbrook Creek (reach 07010206-557) were also added in 2006 for impairment as measured by the same M-IBI assessment. In 2011, the MPCA also monitored Coon Creek for bacteria as part of the Upper Mississippi River Bacteria TMDL study. The assessment process in 2012 for the draft 2014 303(d) list determined that Coon Creek, Pleasure Creek, and Springbrook Creek are all exceeding the state's Escherichia coli (E. coli) water quality standard. Fish monitoring on Sand Creek and Coon Creek indicate that the Fishes bioassessment (F-IBI) standard is in violation, however since both of these streams are more than 50% channelized, the listing will be deferred until the State's Tier Aquatic Life Uses (TALU) is in place.

Water body name	Reach Description	AUID#	Year Listed	Affected use	Impairment
Coon Creek	Unnamed Cr. to Mississippi R.	07070206-530	2006	Aquatic life	Macroinvertebrate bioassessments
Unnamed Ditch *Pleasure Creek*	Headwaters to Mississippi R.	07010206-594	2006	Aquatic life	Macroinvertebrate bioassessments
Sand Creek	Unnamed Cr. to Coon Cr.	07010206-558	2006	Aquatic life	Macroinvertebrate bioassessments
County Ditch 17 *Springbrook Creek*	Headwaters to Mississippi R.	07010206-557	2006	Aquatic life	Macroinvertebrate bioassessments
Coon Creek	Unnamed Cr. to Mississippi R.	07070206-530	Draft 2014	Aquatic recreation	Escherichia coli
Unnamed Ditch *Pleasure Creek*	Headwaters to Mississippi R.	07010206-594	Draft 2014	Aquatic recreation	Escherichia coli
County Ditch 17 *Springbrook Creek*	Headwaters to Mississippi R.	07010206-557	Draft 2014	Aquatic recreation	Escherichia coli
Coon Creek	Unnamed Cr. to Mississippi R.	07070206-530	Deferred	Aquatic Life	Fish bioassessment
Sand Creek	Unnamed Cr. to Coon Cr.	07010206-558	Deferred	Aquatic Life	Fish bioassessment

Table 1 303(d) listings for CCWD

2.0 Watershed Description

2.1 ECOLOGICAL SETTING

The EPA defines ecoregions for Minnesota based on areas of relative homogeneity for land use, soils, landforms, and potential natural vegetation (MPCA). The Coon Creek watershed is located within the North Central Hardwood Forest ecoregion as classified by the U.S. EPA. This ecoregion is defined as an area of transition between forested areas to the north and east and the agricultural areas to the south and west. The terrain varies from rolling hills to smaller plains. Upland areas are forested by hardwoods and conifers while the plains include livestock pastures, hay fields and row crops such as potatoes, beans, peas, and corn.

The Minnesota Department of Natural Resources and the U.S. Forest Service have also developed an Ecological Classification System (ECS) to aid in ecological mapping and landscape classification. The ECS follows the National Hierarchical Framework of Ecological Units (ECOMAP 1993). The ECS is a method to identify, describe, and map progressively smaller units of land with varying capabilities to support natural resources. The system integrates climate, geology, topography, soils, hydrology, and vegetation data. The benefits of this classification system are it allows resource managers the ability to consider ecological patterns at various scales and to identify areas with similar management issues and opportunities (Table 2).

Province	Eastern Broadleaf Forest
Section	Minnesota and NE Iowa Morainal
Subsection	Anoka Sand Plain
Land Type Association	Anoka Lake Plain
Land Types	Glacial Lake Hugo Lake Plain
	Glacial Lake Fridley Lake Plain
	Mississippi Sand Plain
Land Type Phase	N/A

Table 2 Ecological Classification System

2.2 LAND USE

The Coon Creek watershed is comprised of varying land uses but is generally described as having an almost entirely developed watershed in the southern portions while having an open and agricultural northern portion. The lower watershed is defined by much more impervious area than the upper watershed. Table 3 details 2010 land use, which is also illustrated in Figure 2.

LAND USE	Area (acres)	Percent
Single Family Residential	21,413	31.5%
Open/Vacant	19,054	28.0%
Parks/Recreation	10,909	16.1%
Agricultural	4,965	7.3%
Multi-family Residential	2,337	3.4%
Commercial	2,249	3.3%
Water	1,686	2.5%
Industrial	1,623	2.4%
Public/Semi-Public	1,535	2.3%
Major Highways	1,426	2.1%
Airport	627	0.9%
Railway	92	0.2%
Total	67,916	100%

Table 3 2010 CCWD Land use

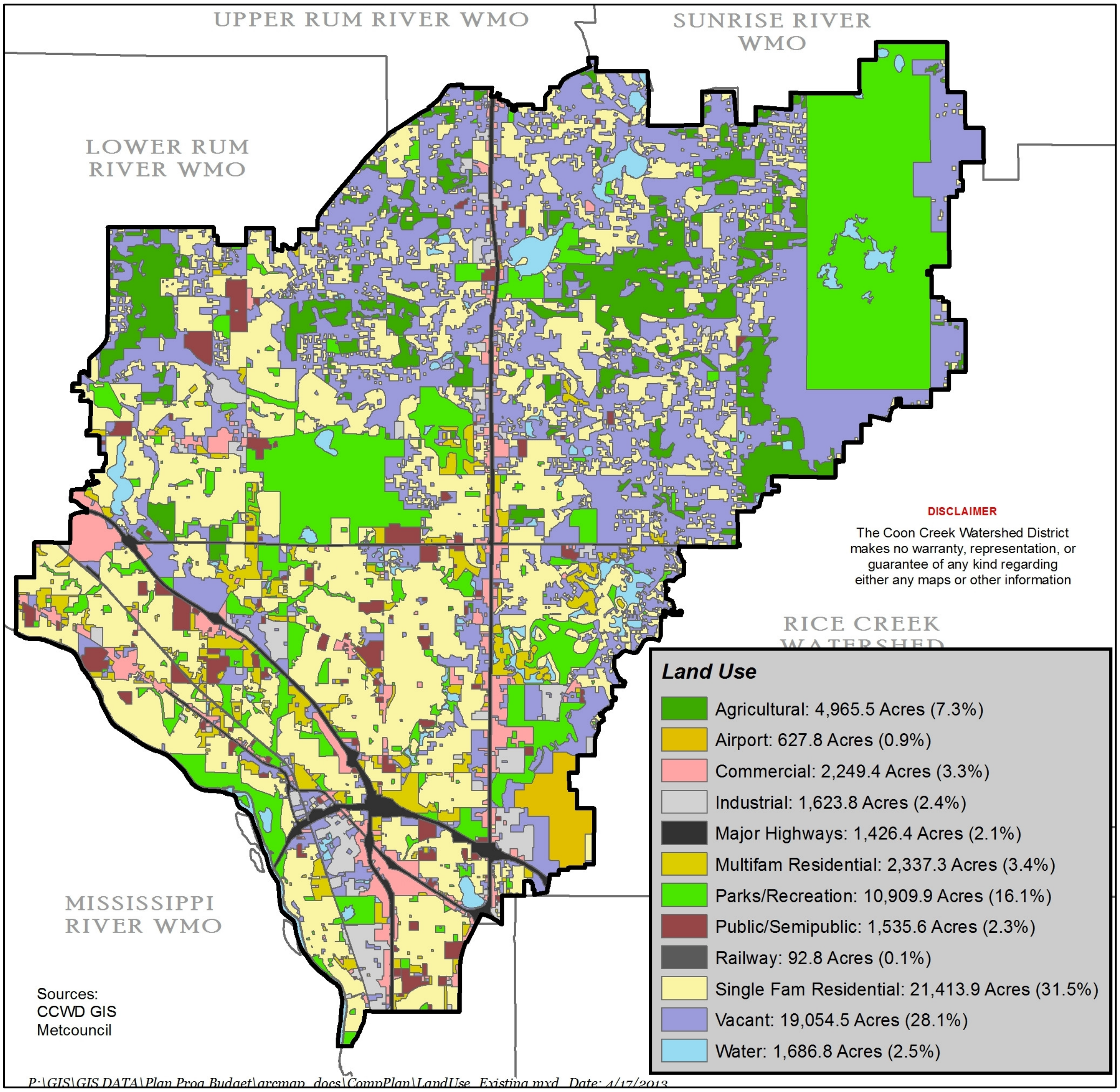


Figure 2. 2010 Land use within CCWD

2.3 SOILS

The soils of the Coon Creek watershed developed from glacial outwash and organic deposits (USDA 1977). The differences in glacial deposits account for many of the differences in soils. CCWD is located on the Anoka Sand Plain, which is approximately 1,960 square miles in size (CCWD is 107 square miles). It is a sand outwash plain formed by the retreat of the Superior Lobe, of the Grantsburg Sub-Lobe, of the late Wisconsin glaciers. Soils are derived primarily from fine sands and are mostly droughty, upland soils (Psamments). However, there are organic soils (Hemists) in depressions and valleys along with poorly drained prairie soils (Aquolls) along the Mississippi River (Cummins and Grigal 1981).

On a finer scale, CCWD's landscape occurs in three geomorphic land types that contain distinctive landforms and patterns. These land types are Glacial Lake Hugo, Glacial Lake Fridley, and the Mississippi River Terrace (Figure 3).

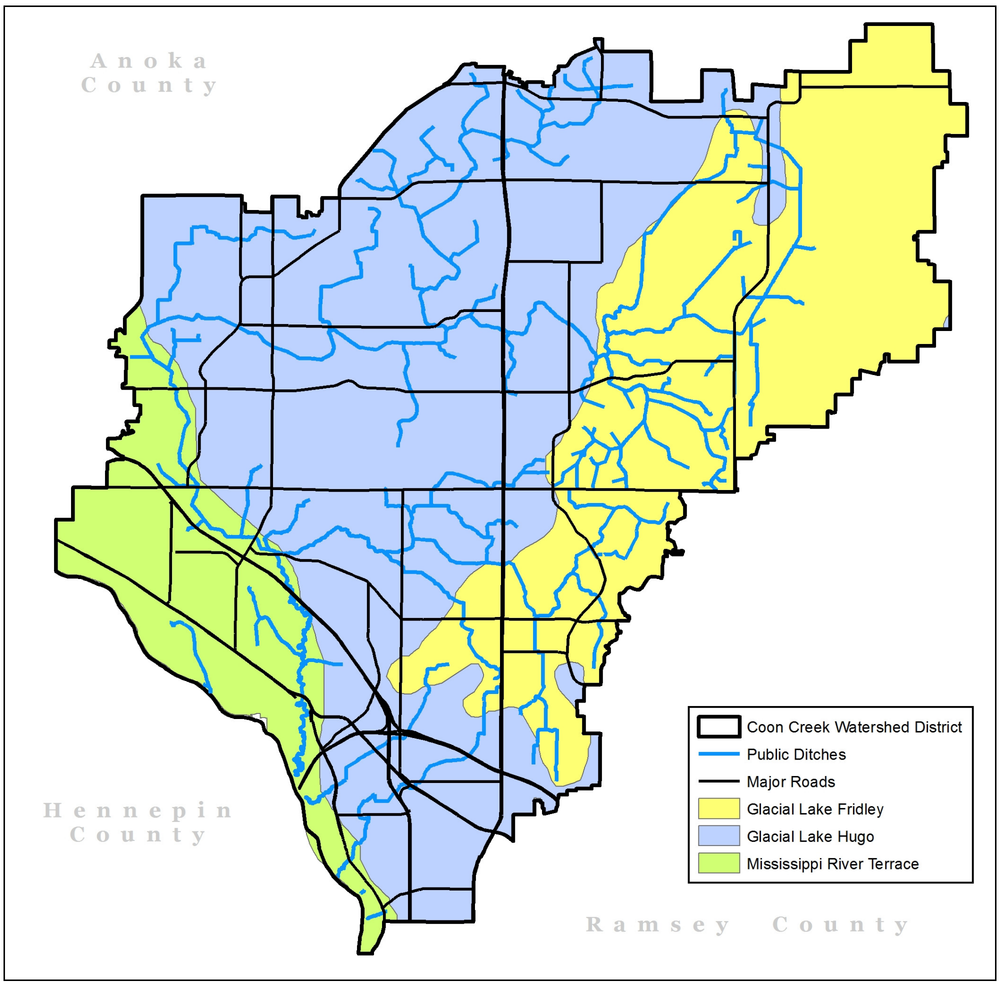


Figure 3. Major land types within CCWD

Glacial Lake Hugo

This is the largest land type in the watershed, covering approximately 37,000 acres (57 sq. mi.) This equates to about 54% of the total watershed area. The Glacial Lake Hugo Plain is an undulating sand plain comprised of rolling dunes and small flats in the upland, and low-lying depressions and flats. The elevation ranges from 930 feet above sea level (FASL) to 840 with an average slope of roughly 0.95%. Soils on this plain are excessively drained, somewhat poorly drained, or very poorly drained and dominated by Zimmerman fine sands (45%) followed by Isanti fine sand and Lino fine sand (15% and 10% respectively).

Glacial Lake Fridley Plain

Approximately 22,042 acres (34 sq. mi.) are classified as Glacial Lake Fridley Plain. This plain covers roughly 32% of the total watershed area and is characterized by large, level areas that were, or still are, bogs with small island-like features rising roughly 0-15 feet above the general surrounding land level. Elevations for this land type range from 920 to 890 FASL with an average slope of 0.7%. This is the flattest portion of the watershed. Soils in this plain are very poorly drained and formed in organic material and fine sands which are also poorly drained. Rifle peat and muck account for 60% of the soils in this land type followed by 20% of Isanti fine sand.

Mississippi River Terrace

The Mississippi River Terrace defines most of the western boundary of the watershed. The Coon Creek portion of the Mississippi River Terrace is approximately 8,736 acres (13.7 sq. mi.), which comprises roughly 13% of the total watershed area. This land type is described as nearly level, to a gently sloping outwash plain, which is dissected by drainage ways that historically led to the Mississippi River. This plain has an average slope of 1.4% but greater variability is seen due to the large depressions that have steeper slopes adjacent to them. Elevation ranges from 890 to 810 FASL occur in the Mississippi River Terrace. Soils in this portion of the plain tend to be excessively drained and sandy throughout.

2.4 STREAM DESCRIPTIONS

In total, the Coon Creek watershed covers 107 square miles in Central Anoka County. Of those 107 square miles, approximately 78.3 square miles are drained by the Coon Creek subwatershed (Figure 4). This subwatershed includes portions of Andover, Blaine, Columbus, Coon Rapids, and Ham Lake. The main stem of Coon Creek begins in Ham Lake and flows generally south - southwest to its confluence with the Mississippi River in Coon Rapids, just south of the Coon Rapids Dam. The main channel of Coon Creek is approximately 26.7 miles long and drops roughly 90 feet from its headwaters to mouth. Nearly half of the total drop occurs within 5 miles of the creeks outlet into the Mississippi River. A general description of land use would be a shift moving from predominately agricultural, open space, and wetland, in the headwaters to dense, urban residential use near the outlet. A breakdown of land use in this watershed shows vacant space (31.8%) accounting for the most acreage. Below vacant space came single family residential housing (29.8%), parks/recreation (17.6%), and agriculture use, which near 10%. All other land use types are minimal.

A total of 15.8 square miles are drained by the Sand Creek subwatershed unit. This subwatershed is covered mostly by the rapidly developing city of Blaine along with the eastern edge of Coon Rapids. Land use in this drainage area is dominated by three main classifications, single family residential (37.9%), vacant space (20.1%), and parks/recreation (10.7%). No other land use type accounts for more than 10% of the total subwatershed area. The Sand Creek subwatershed drains to Sand Creek itself. This subwatershed includes Public Ditch 41, 39, and 60. Sand Creek is a tributary of Coon Creek and begins northeast of the Central Avenue (Hwy 65) and Highway 10 junction in Blaine. Sand Creek itself has an approximately 8.3 mile main channel, that flows northerly before turning west to its outlet into Coon Creek near Northdale Boulevard in Coon Rapids. Sand Creek has a total elevation change of roughly 50 feet over the entire main channel.

Both Pleasure Creek and Springbrook Creek have much smaller subwatersheds than those mentioned above. Pleasure Creek drains only 2.7 square miles accounting for roughly 2.5% of the total area for the Coon Creek Watershed District. Springbrook Creek is slightly larger at 4.13 square miles (3.8% of total watershed area) but is still small when compared to the Coon Creek and Sand Creek subwatersheds. Land use in both of these systems in densely urbanized and almost completely developed. In Pleasure Creek, 62.8% of the subwatershed is broken down between single family residential (35%), multifamily residential (14.3%), and major highways (13.5%). Springbrook Creek subwatershed is similar with 40% single family residential, 13.9% commercial, and 9% vacant.

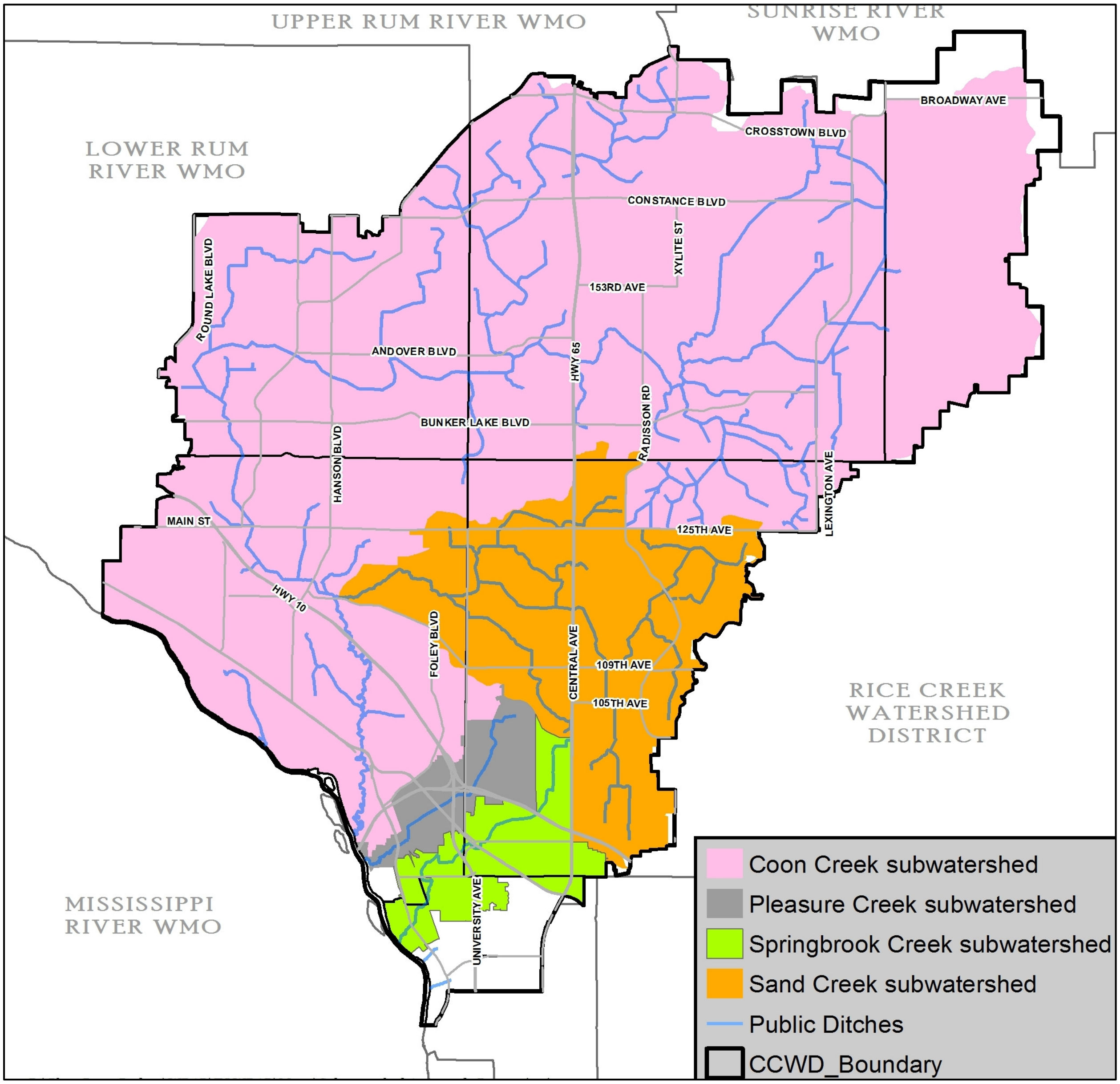


Figure 4. Subwatershed breakdown of major creek systems within CCWD

2.5 HISTORIC CONDITIONS

Three historic "periods" can be distinguished based upon land cover change within Coon Creek watershed. These periods were identified through use of Public Land Surveys (PLS), oral history accounts, and examination of aerial photos. The first of these periods is defined as the pre-European Settlement era, prior to the 1850's. Land cover in the pre-European era was mostly dominated by oak savannah intermixed with tamarack bogs and sedge meadows. Deciduous forest and wet prairie are the only other land cover types utilizing more than 5% of the total watershed area (Figure 5).

While there are no detailed maps of CCWD showing pre-European settlement morphology, generalizations can be made from PLS sketches. Public land surveys from 1847-1855 suggest Coon Creek was a highly meandering stream along most of its reaches. The suggestion that Coon Creek was a highly meandering stream is further substantiated when soils and topography are examined. Soils in this area are mostly comprised of highly erodible fine sands which favor sinuous channels. Topography in the area has minimal change evidenced by an average stream slope of less that 1.0% through most of the district. Lower portions of the system do have a slightly larger variation but still exhibit a modest average stream slope of 1.4%. Erodible soils, in combination with low stream gradient, provide conditions favorable for a meandering system.

The second period of land cover change was dominated by the introduction and intensification of agricultural practices, beginning in the late 1800's and continuing into the early to mid-20th century. This period is defined by the intensification of agriculture and progressive drainage of the land. To facilitate agriculture on poorly drained land and sub-par soils, the state passed Chapter 108 in 1883 allowing county commissioners to authorize the construction of ditches or water courses within the county, including the drainage of shallow, grassy, meandered lakes under four feet in depth. Drainage law set forth a process allowing landowners the right to petition for drainage projects; those who benefitted from the drainage were assessed to pay for it. In central Anoka County, a total of 13 ditches were dug from 1891-1918 in the drainage area of Coon Creek. Ditches dug for agricultural drainage were often laterals stemming off the main channel of Coon Creek.

The third and final period of historic change within CCWD occurred during the mid to late 1900's. By the late 1940-50's, flooding became an issue affecting agriculture upstream and Coon Rapids downstream where rapid housing growth occurred post-World War II. With continued suburban growth, the drainage system that mainly served as an agricultural tool began to function as a storm sewer system in the 1960-80's. Agriculture has remained prominent into the early 2000's while housing has expanded northward and public demand for water quality and aesthetics have become dominant issues.

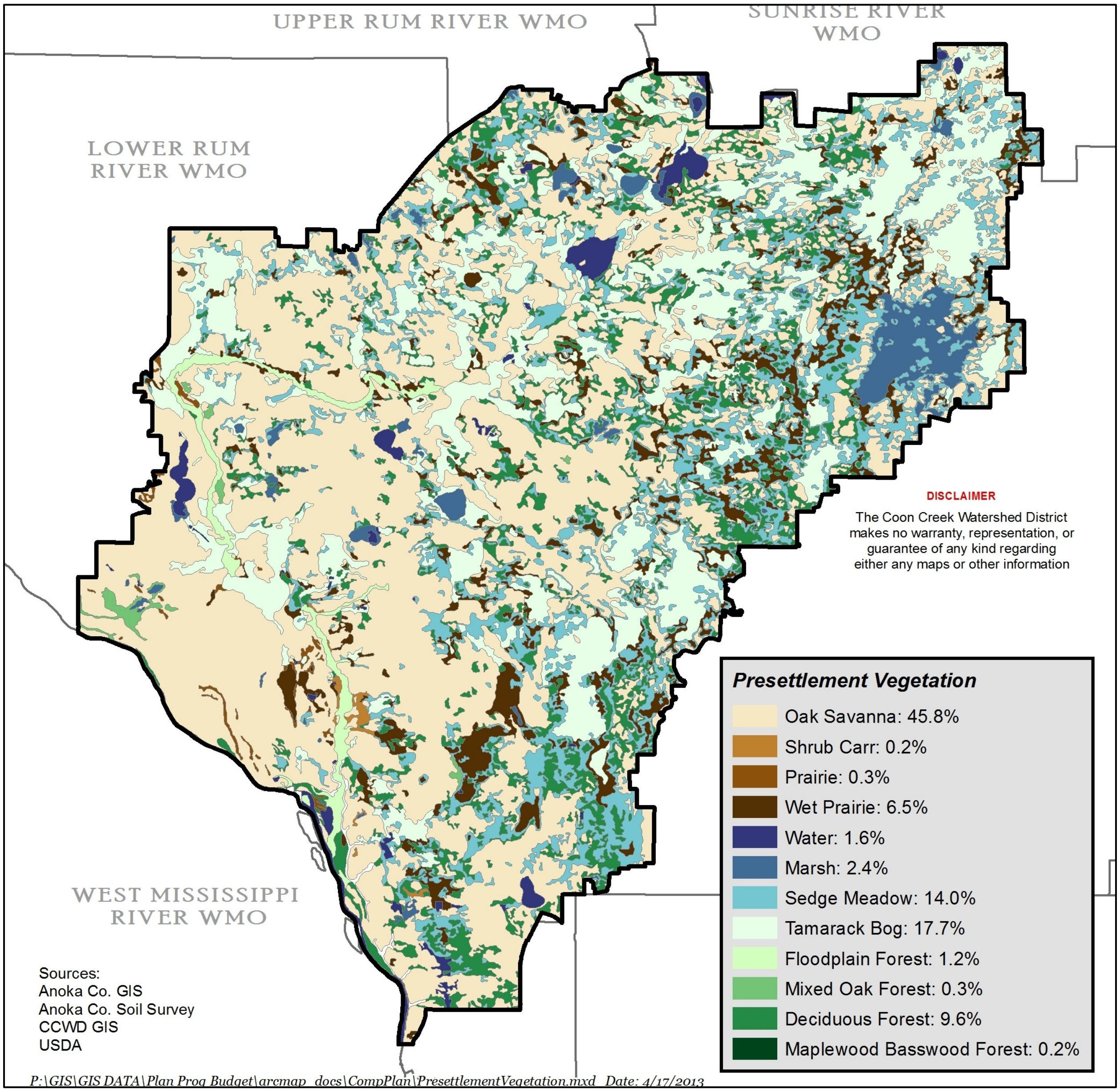


Figure 5. Pre-settlement land cover type

2.6 CURRENT STREAM CONDITIONS

Coon Creek, Sand Creek, Pleasure Creek, and Springbrook Creek all serve as an important component of the storm water drainage system for portions of the seven cities within the watershed. The Coon Creek Watershed District is required to annually inspect 20% of the system. This leads to assessment of the entire system on a 5 year basis. These inspections consist of recording elevations of inlets and outfalls, culvert condition/elevations, channel elevations and condition, cross sections, and general assessment of bank condition/stability. These inspections serve to assess the capacity and efficiency of the system to serve as a flood control measure.

Assessment of CCWD shows much of the system has been straightened, channelized, and dredged over its existence to maintain its functionality for storm water conveyance. Riparian buffers vary greatly throughout the district. Most stretches of Coon Creek and Sand Creek maintain a buffer of 25 feet or more, while Pleasure Creek and Springbrook Creek are more residential resulting in little to no buffer at all. Where riparian buffer does exist in residential areas, it is most often invasive, cultivated, or opportunistic species. In stream habitat for fish, macroinvertebrates, and other aquatic life, varies throughout the system. Generally speaking, in-stream habitat and pool-riffle sequences increase towards lower portions of the system, especially below Highway 10. Coon Creek above Highway 10 has had extensive channel maintenance to maintain its flood control capacity, which is assumed to be a limiting practice to habitat. Coon Creek below Highway 10 has never been dredged, so it's more natural condition suggests a likelihood of more favorable habitat.

The hydrologic regime also shows great variation throughout the district but shows the same general trend as habitat. Storm hydrographs for upper portions of Coon Creek show a much less "flashy" response when compared to lower portions such as Pleasure Creek, and Springbrook Creek. Water levels in the lower portions rise quickly in response to precipitation, but return to base flow conditions much more slowly. The quick response to rainfall is most likely due to the increased imperviousness of lower portions and then the slower return to base flow is due mostly to the release of water from upper portions of the watershed. This increased "flashiness" is typical of urban streams. Unfortunately, most of these lower portions, such as Springbrook Creek and Pleasure Creek, were developed prior to watershed regulation so there is little pretreatment and rate control in place. Retrofit projects have been installed in efficient locations and will continue in the future in an effort to remedy the lack of regulation during time of development.

3.0 Define the Impairment

The MPCA's Biological Monitoring Program has developed biological criteria for rivers and streams in Minnesota. The MPCA utilizes two aquatic communities (fish and aquatic macroinvertebrates) for assessment of aquatic life use since these two indicators can respond differently to near stream and watershed wide pollution and stressors. Biological impairments are based on two Indices of Biological Integrity (IBI): one for fish (FIBI) and one for macroinvertebrates (MIBI). Since these IBI's are separate, it is possible to be listed as impaired for one biological community but not the other. The MPCA currently employs a watershed-wide monitoring strategy where sites are established at the outlets of main rivers, tributaries, and headwater streams. Biological communities are collected following standard procedures.

In 2006, Coon Creek (reach 07010206-530) was added to Minnesota's 303(d) List of Impaired Waters as having impaired aquatic life based on macroinvertebrate data collected in 2000. Sand Creek (reach 07010206-558), Pleasure Creek (reach 07010206-594) and Springbrook Creek (reach 07010206-557), were also added for the same aquatic life impairment. Those same reaches, with exception of Sand Creek, were determined to be in violation of state Escherichia coli standards. They were assessed in 2012 for the inclusion on the Draft 2014 303(d) List of Impaired waters for bacteria (Figure 6). Fish monitoring on Sand Creek and Coon Creek have shown that the Fish Bioassessment standard is in violation but that listing has been deferred until the state's TALU is in place.

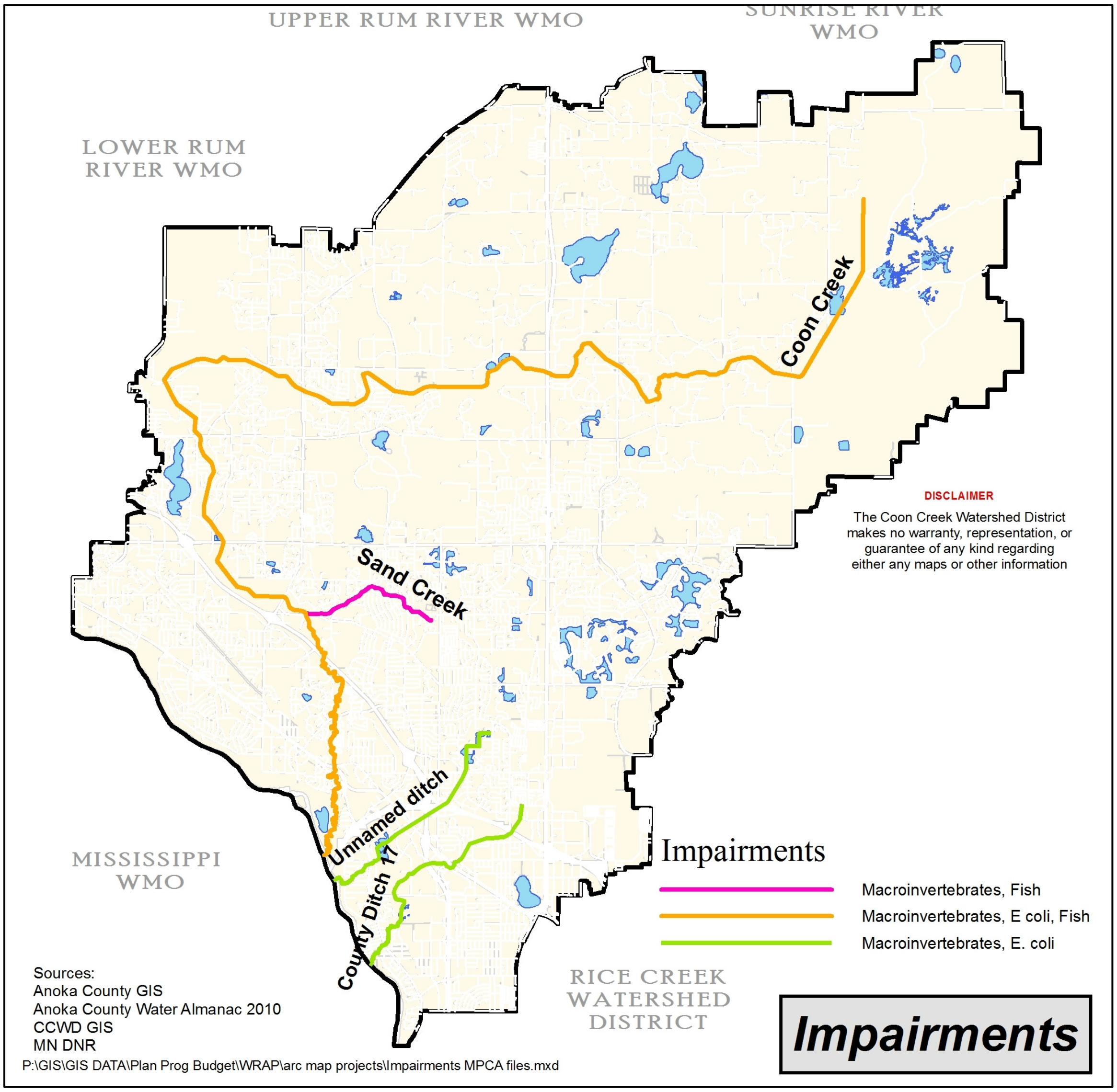


Figure 6. Impaired reaches within CCWD

3.1 WATER QUALITY STANDARDS

The Clean Water Act requires states to adopt water quality standards to protect waters from pollution. These standards define how much of a certain pollutant can be in the water and still allow it to meet its designated use(s). Those waters that do not meet water quality standards are listed as "impaired" meaning they do not support there designated use(s) (MPCA).

"Designated uses" are the uses that water resources and their associated aquatic communities provide. Seven designated uses as defined in Minn. R. 7050.0140 but only two designations are currently not supported within the Coon Creek Watershed. These designated uses are listed below.

"Domestic Consumption" – includes all waters of the state that are or may be used as a source of supply for drinking, culinary or food processing use, or other domestic purposes and for which quality control is or may be necessary to protect the public health, safety, or welfare.

"Aquatic life and recreation" - includes all waters of the state that support or may support fish, other aquatic life, bathing, boating, or other recreational purposes and for which quality control is or may be necessary to protect aquatic or terrestrial life or their habitats or the public health, safety, or welfare.

4.0 Project Overview

The Coon Creek Watershed Restoration and Protection strategy is currently scheduled to be completed in three phases. This report is a summary of work completed in phase one and the resulting products. The objective of phase one was to identify potential sources of stress to the Coon Creek watershed. To best accomplish this objective, Phase one was divided into 10 detailed tasks (Table 5), resulting in deliverables such as technical reports, database submittals, GIS maps, preliminary stressors, conceptual models, and a supplementary monitoring strategy.

Task Identification	Description
Task A	Compile and manage existing data
Task B	Review existing data and models (P8 and XP-SWMM)
Task C	Data submittal to EQuIS
Task D	Identify data gaps
Task E	Determine supplementary monitoring sites
Task F	Meet with TAC/CAC
Task G	Develop preliminary list of candidate stressors
Task H	Develop conceptual models
Task I	Solicit technical review of candidate causes, conceptual models and monitoring strategy
Task J	Project meeting

Table 4 Tasks of CCWD WRAP Phase I

Upon completion and approval of phase one outcomes, phase two will follow. Phase two consists of four main goals: 1) collect and analyze supplementary data, 2) watershed modeling, 3) determine extent of impairments and exceedances, and 4) Stressor Identification Report compilation. Phase two is also separated into more detailed tasks which are listed below (Table 6). The main product of phase two will be the Stressor Identification Report that will include summation of all available data, strength of evidence tables, causal analysis, and stressor identification documentation. Phase two is scheduled to begin in June 2013 and to be completed by May 2014.

Task Identification	Description
Task A	Collect supplementary data
Task B	Format and submit to MPCA
Task C	Analyze supplementary data
Task D	Develop model input parameters
Task E	Meet with TAC/CAC
Task F	Field inspection of select reaches
Task G	Conduct groundwater and surface water review
Task H	Determine extent of impairment and exceedances
Task I	Develop strength of evidence tables
Task J	Draft primary stressor identification report
Task K	Review conclusions with technical stakeholders

Table 5 Tasks of CCWD WRAP Phase II

Phase three will begin upon completion of previous phase. Phase three consists of three main objectives: 1) determine loadings and allocations, 2) retrofit analysis, 3) implementation planning. Biotic TMDL development is not as straightforward as those TMDL's developed for a single pollutant. The reason for this is biotic impairment itself is not the cause, rather it is the result. Therefore, it is difficult to determine a TMDL until the root cause of impairment is actually identified. The previously mentioned first and second phases are dedicated to determination of actual stressors that can limit biota, and then computed into load allocations and an eventual TMDL. It is possible that stressors are identified resulting from natural conditions which would make TMDL determinations difficult to obtain. Assuming TMDL's can be developed from the project, an implementation plan will be developed to address identified stressors and their sources. This phase is scheduled to begin June 2014 and terminate at the end of the project in June 2015. Similar to phases one and two, phase three is distributed over 16 more detailed tasks (Table 7).

Task Identification	Description
Task A	Refine primary stressor identification report
Task B	Determine loadings and allocations
Task C	Estimate TMDL's
Task D	Meet with TAC/CAC
Task E	Evaluate BMP and retrofit potential
Task F	Model evaluation of watershed response

Task G	Estimate potential costs of implementation strategies
Task H	Develop integrated capital improvement program for adoption by stakeholders
Task I	Develop monitoring plan based on load allocations and restrictions
Task J	Project meetings with stakeholders
Task K	Prepare submittal draft of WRAP report and TMDL's
Task L	Prepare comprehensive plan amendment
Task M	Submit draft report/amendment to Board of Managers
Task N	Revise draft report and comprehensive plan amendment
Task O	Review CCWD capital improvement plan
Task P	Submit final TMDL's and WRAP report.

Table 6 Tasks of CCWD WRAP Phase III

5.0 Existing Data

5.1 FISH DATA

During Phase I of this project, all available biological data, pertaining to the Coon Creek watershed was collected. Data was requested from various sources including the Anoka Conservation District, MPCA STORET database, DNR Waters, DNR Fisheries, and USGS. Monitoring stations along with corresponding identification number are shown below (Figure 7).

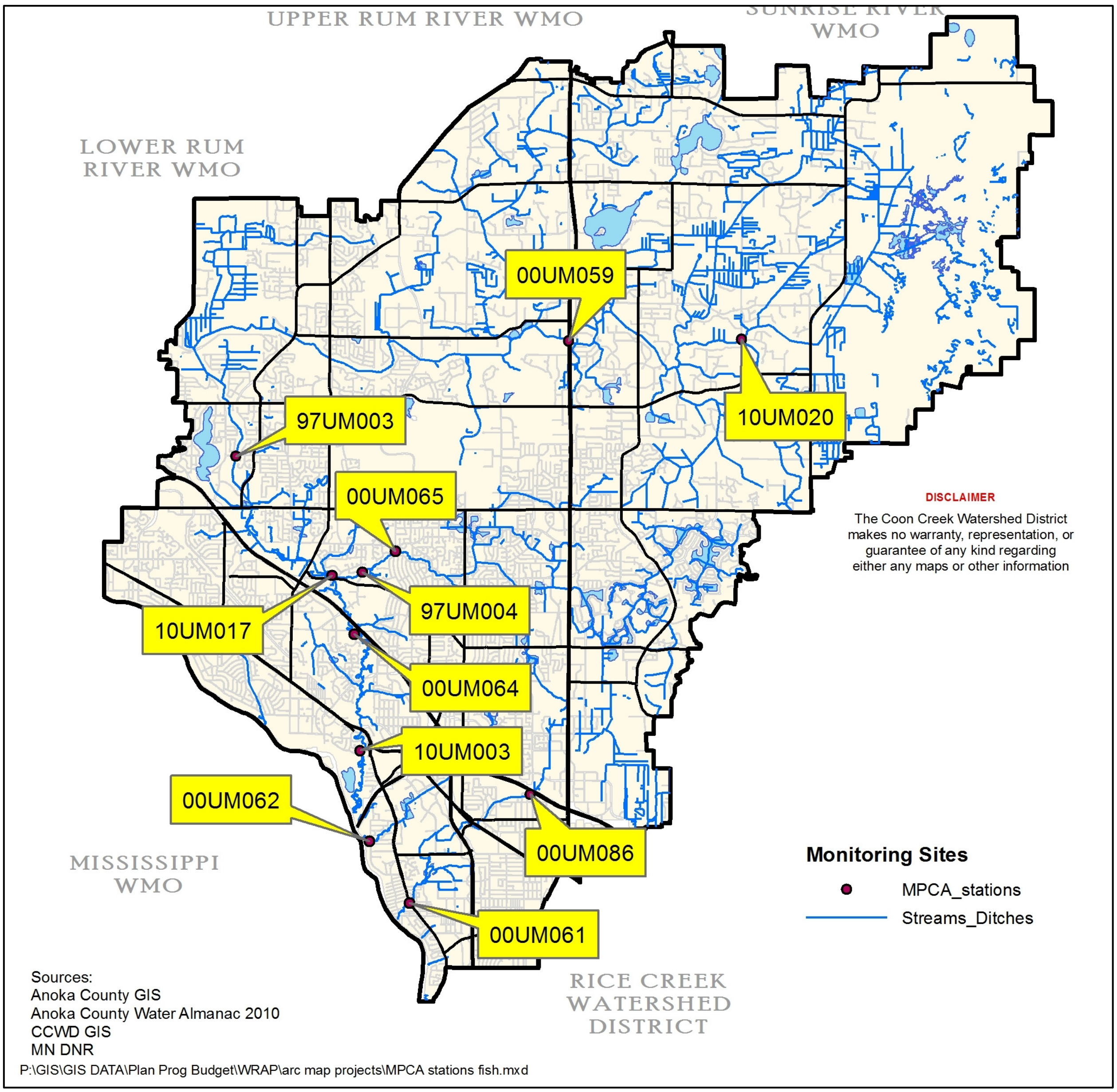


Figure 7. Monitoring station identification numbers and locations for fish sampling.

Available fisheries data is quite limited for the Coon Creek watershed and a portion of it is quite dated. Data is available from the MPCA and USGS for 1997-2000, 2005 and 2010. Protocols for data collection have changed over the lifespan of this data so caution should be used when comparing older data to data collected more recently. As fisheries data is collected in the future, it would be practical to phase out older data for more accurate comparisons between survey sites.

Biological health is determined through the use of a multi-metric approach commonly called the Index of Biological Integrity (IBI). These indices make use of numerous attributes found in biological communities. Typically, IBI's will use 8-12 attributes (also known as metrics) to draw conclusions about the biological assemblage present and ultimately, the "health" of the stream they are in. Each of the metrics recorded has a predictable change in the face of human disturbance. For example, species which are tolerant of some form of human disturbance, such as sedimentation, could form a "tolerant" metric. Stream reaches degraded with sediment would tend to show more of these "tolerant" species. IBI's have been developed separately for fisheries (F-IBI) and macroinvertebrates (M-IBI), each using different metrics.

F-IBI scores are calculated from various metrics and used to determine whether or not a stream reach is impaired. To determine impairment, F-IBI scores, calculated from actual survey data, are compared to an F-IBI standard (or threshold) of a reference or "least disturbed" stream. In theory, a "least disturbed" stream has minimal human disturbance and is considered to be non-degraded, therefore sustaining a well-balanced fish assemblage comprised of some pollution sensitive species and habitat specialists.

After comparison, IBI scores falling below the IBI standard (threshold), are considered "impaired" and are likely candidates for listing on Minnesota's 303(d) list of impaired waters. Fish IBI scores meeting or exceeding the threshold, are considered to have a healthy fisheries assemblages.

Retrieval of data from the Minnesota Pollution Control Agency's online database (Environmental Data Access) lists the following fish metrics for monitoring stations along with a corresponding F-IBI score:

- DELT (abnormalities)
- Number of darter, sculpin, and madtom species
- Number of exotic species
- Number of fish per 100 meters *(tolerant species not included)*
- Game fish species
- Number of Lithophils
- Number of piscivore species

- Number of pollution intolerant species
- Special concern species
- Total number of species

Tables 8-11 (below) provide data collected for these metrics for fish surveys conducted on Coon Creek, Sand Creek, Pleasure Creek, and Springbrook Creek through 2010.

Coon Creek was surveyed for fish assemblages in 2000 and 2010. A total of 4 sites were visited in 2010 and the other 6 sites were from 2000 and earlier (Table 8). Overall, the F-IBI scores show an increasing trend when moving from downstream to upstream (Figure 8). Stations 10UM003, 00UM064, 10UM017, and 97UM003 were scored based on the Northern Streams IBI while stations 00UM059 and 10UM020 were scored under the Low Gradient IBI. This is important to note since these classifications have different IBI thresholds.

Coon Creek	Year	2010	2000	2010	1997	1997	1998	2000	2000	2010	2010
Metric	Station	10UM 003	00UM 064	10UM 017	97UM 003	97UM 003	97UM 003	00UM 059	00UM 059	00UM 059	10UM 020
DELT (anomalies)		2	3	2	0	0	1	2	3	3	0
Darter species		3	3	2	3	3	3	2	2	1	1
Exotic species		1	1	0	0	1	1	1	1	0	0
Fish per 100m		67.4	165.5	287.9	1780.7	484.7	562.7	181.2	90.4	58.9	74.7
Game fish species		5	5	3	1	4	6	3	2	0	0
Lithophils		7	5	4	6	5	7	3	2	2	2
Piscivores		3	2	2	1	2	4	1	1	0	0
Pollution Int. species		1	2	2	0	1	1	0	0	0	0
Special Concern species		0	0	0	0	0	0	0	0	0	0
Total species		27	19	19	16	18	24	16	15	8	12
Fish IBI		33	32	27	38	34	21	44	37	36	52
IBI Threshold		50	50	50	50	50	50	40	40	40	40

Table 7 Summary of known fish surveys on Coon Creek. Stations are listed downstream to upstream. Fish IBIs in red are below impairment threshold.

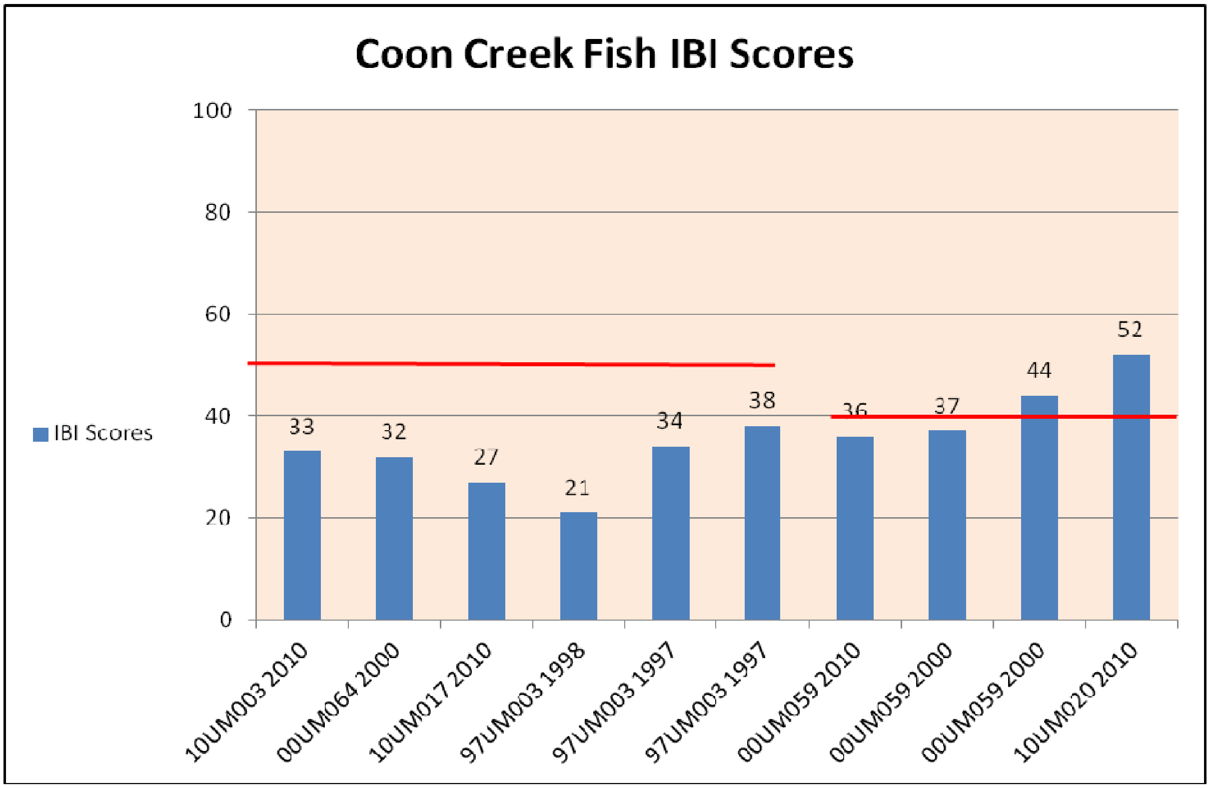


Figure 8. F-IBI scores for known fish surveys. Stations had different classifications for IBI scoring resulting in different thresholds ("Northern Streams" has IBI of 50; "Low Gradient" has IBI of 40). Stations listed downstream to upstream.

Sand Creek fish surveys were conducted on 2 sites and over 5 years. All samples from all years are indicative of non-support for fisheries (Table 9, Figure 9). Clear impairment is evident and the listing is justified in this reach. Both stations were scored using the “Northern Headwaters” classification which has an IBI threshold of 40.

Sand Creek	Year	1997	1998	2000	2005	2010	2010
Metric	Station	97UM004	97UM004	00UM065	00UM065	00UM065	00UM065
DELT (anomalies)		0	0	0	0	0	1
Darter species		1	1	1	1	0	0
Exotic species		0	0	0	0	0	0
Fish per 100m		106.1	145.2	152.6	45.4	5.1	27.2
Game fish species		1	2	3	4	0	1
Lithophils		2	2	2	2	1	1
Piscivores		0	0	1	1	0	1
Pollution Int. species		0	0	0	0	0	0
Special Concern species		0	0	0	0	0	0
Total species		8	8	12	9	2	6
Fish IBI		16	21	32	30	0	11
IBI Threshold		40	40	40	40	40	40

Table 8 Summary of known fish surveys for Sand Creek. Stations are listed downstream to upstream. Impairment threshold is F-IBI score below 40 for “Northern Headwater” classification.

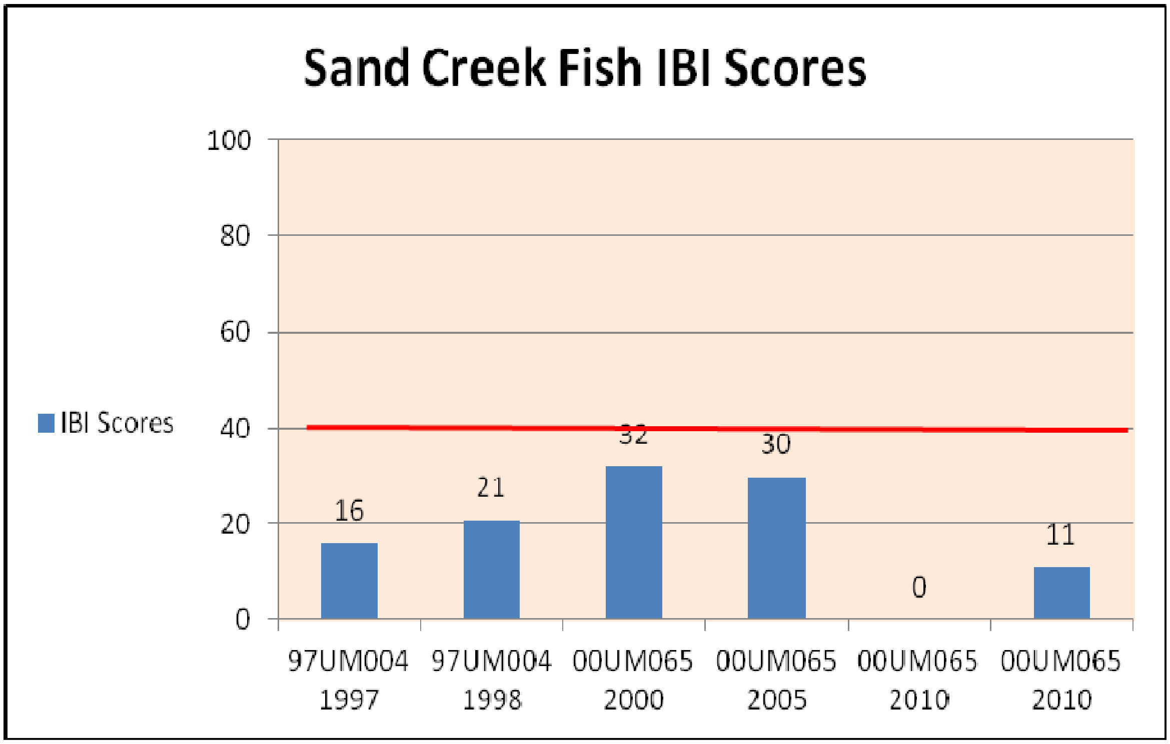


Figure 9. F-IBI scores for known fish surveys. Red line indicates IBI threshold (40) for "Northern Headwaters" classification. Stations are listed downstream to upstream.

At time of sampling in 2000, it was below the threshold and within the confidence interval; as to its current condition (Table 10, Figure 10). Additional data would be beneficial in understanding the current biological conditions. Pleasure Creek was assessed under the "Northern Headwaters" classification with an IBI threshold of 40.

Pleasure Creek	Year	2000
Metric	Station	00UM062
DELT (anomalies)		0
Darter species		1
Exotic species		1
Fish per 100m		296.8
Game fish species		4
Lithophils		4
Piscivores		3
Pollution Int. species		1
Special Concern species		0
Total species		15
Fish IBI		34
IBI Threshold		40

Table 9 Summary of fish surveys for Pleasure Creek. Impairment threshold for "Northern Headwaters" is an IBI score below 40.

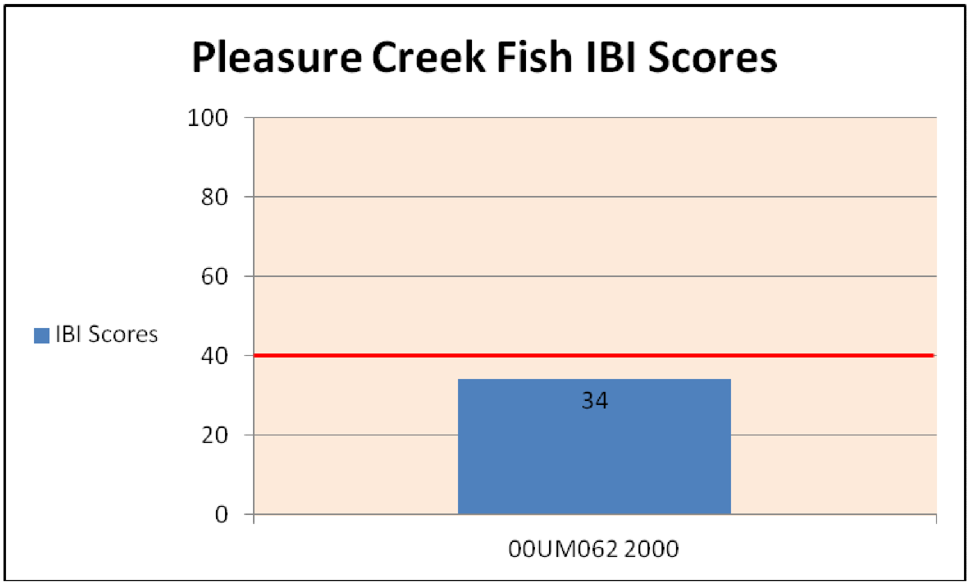


Figure 10. F-IBI score for known fish surveys on Pleasure Creek. Red line indicates "Northern Headwaters" IBI threshold (40).

Springbrook Creek has a limited number of surveys much like Pleasure Creek. Two fish surveys were conducted in 2000 and both validated impaired status. The survey conducted at site 00UM086 had an IBI score of 2 (Table 11, Figure 11). Additional data collection would be helpful at this site to determine its current biological condition. Springbrook Creek was also scored under the "Northern Headwaters" classification.

Springbrook Creek	Year	2000	2000
Metric	Station	00UM061	00UM086
DELT (anomalies)		3	2
Darter species		2	0
Exotic species		0	0
Fish per 100m		306.8	24.7
Game fish species		2	1
Lithophils		3	0
Piscivores		1	0
Pollution Int. species		0	0
Special Concern species		0	0
Total species		12	4
Fish IBI		35	2

Table 10 Summary of known fish surveys for Springbrook Creek. Stations are listed downstream to upstream. Impairment threshold for "Northern Headwaters" is a F- IBI score below 40.

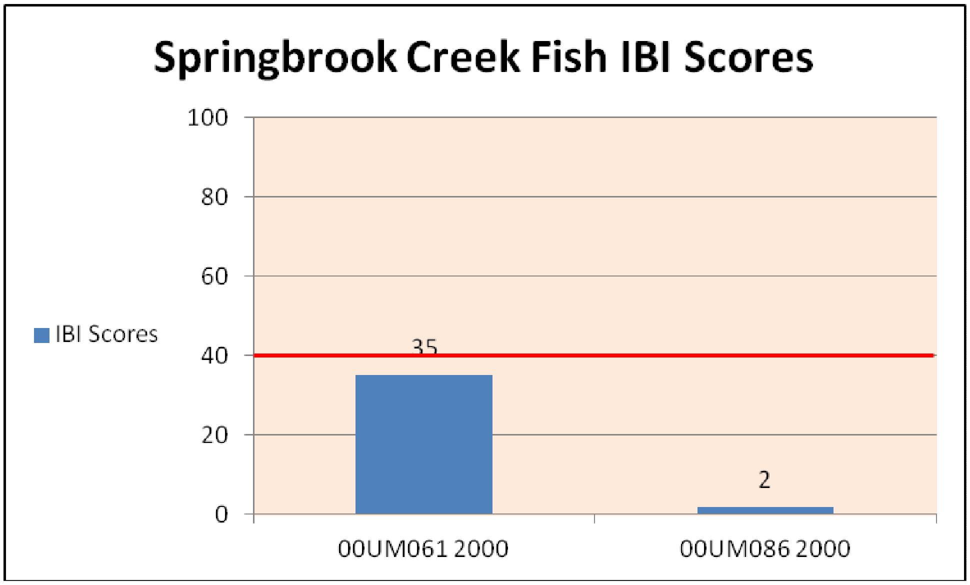


Figure 11. F-IBI scored for fish surveys on Springbrook Creek. Red line indicates IBI threshold (40).

5.2 MACROINVERTEBRATE DATA

Macroinvertebrate assemblages have been monitored in the Coon Creek watershed from 2008 to 2012. Data was collected by ACD and MPCA. Data was collected by the MPCA in the year 2000. A summary table (Table 12) is provided below indicating collecting agency and collection year.

	Monitored by					
Site	2000	2008	2009	2010	2011	2012
Ditch 58 at 165th Ave.		ACD	ACD			
Ditch 58 at Andover Blvd.			ACD	MPCA	ACD	ACD
Sand Creek at Olive St.	MPCA		ACD	MPCA	ACD	ACD
Coon Creek at Egret St.	MPCA	ACD	ACD	ACD	ACD	ACD
Ditch 59-4 at Bunker Lake Blvd.		ACD				
Ditch 41 at Highway 65		ACD	ACD	ACD	ACD	ACD
Coon Creek at Highway 65	MPCA	ACD	ACD	MPCA	ACD	ACD
Coon Creek at 131st Ave.		ACD	ACD	ACD	ACD	ACD
Coon Creek at Vale St.				MPCA		
Coon Creek at Hanson Blvd.				MPCA		
Coon Creek at Naples St.				MPCA		
Ditch 11 at 149th Ave.				MPCA		
MPCA=MN Pollution Control Agency. ACD=Anoka Conservation District						

Table 11 Displays years when invertebrate data was collected, agency responsible, and survey location.

Invertebrate sampling in the Coon Creek Watershed District consists of 13 samples conducted at 8 sites by MPCA (Figure 12). Five samples were collected in 2000, while the other eight were in 2010. The breakdown by sampling by stream is nine samples taken from Coon Creek, two samples from Sand Creek, and one sample each for Pleasure Creek and Springbrook Creek.

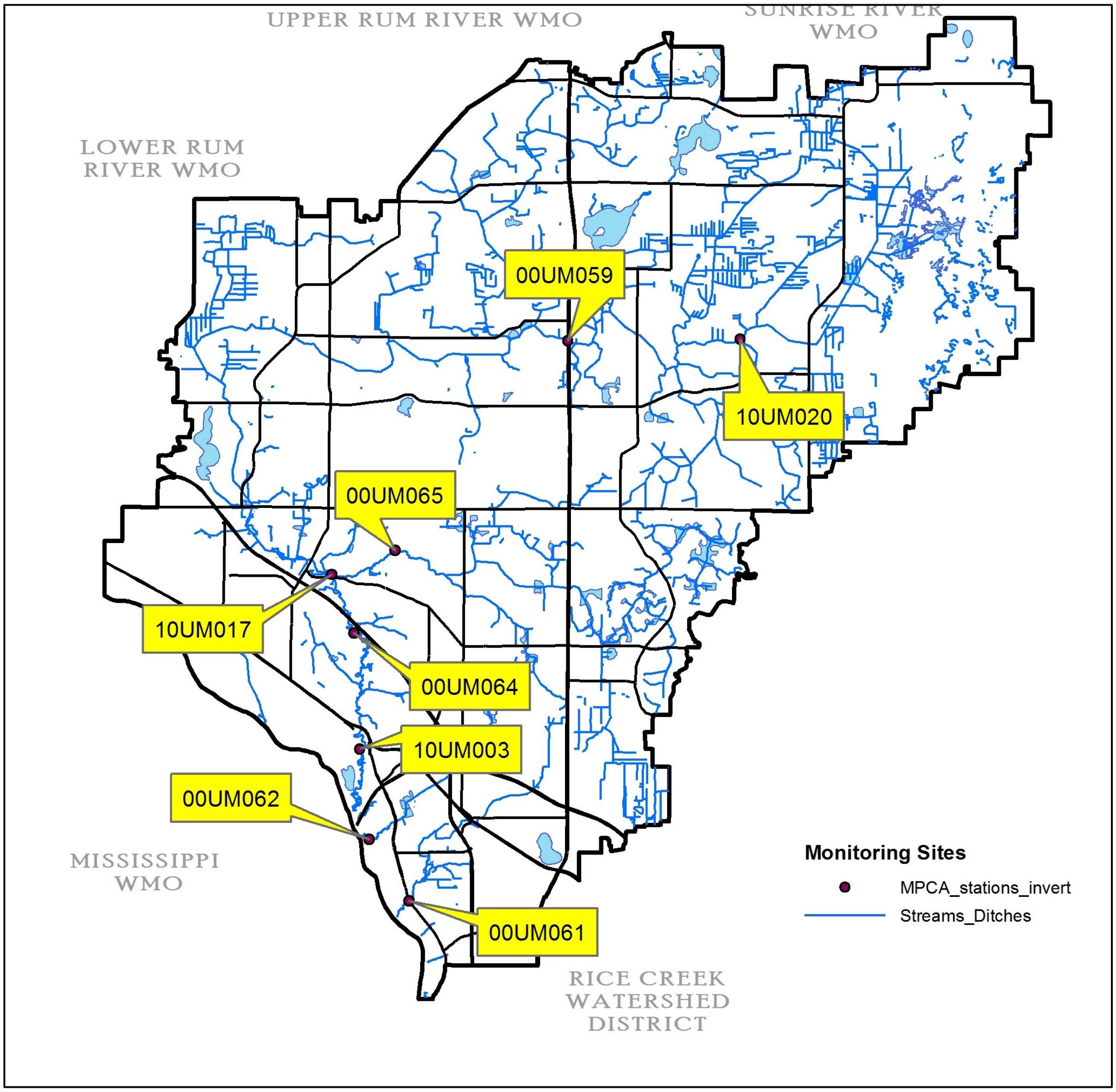


Figure 12. Monitoring station identification numbers and location for macroinvertebrate sampling.

Sampling on Coon Creek in 2000 did not contain any "assessable" sites using the current assessment status used by MPCA. However, these sites were considered "assessable" when data was collected in 2000. Two of three samples indicate support of aquatic life with IBI scores of 53 and 57. The third sample had an IBI score of 46, which is less than 1 point below the threshold (Figure 13).

In 2010, sampling was done at five sites. Two of these sites (10UM017, 00UM059) met the threshold while two other sites (10UM020, 00UM065) fell below the threshold. Station 10UM003 is difficult to define since it has one sample above the threshold and one sample below (Figure 13). Based on the fact that macroinvertebrate IBI scores aren't clearly in support of aquatic life and fish IBI scores indicate clear impairment, MPCA determined there was not sufficient evidence to de-list Coon Creek.

Sand Creek was sampled 2 times and all at station 00UM065 (Olive St). One sample was recorded in 2000 and the other was done in 2010. All samples provide IBI scores below the impairment threshold indicating Sand Creek is non-supporting of aquatic life. It is worth noting that the IBI score calculated in 2010 is well below those calculated in 2000. This may indicate deteriorating conditions over the past 10 years (Figures 13 and 14).

Pleasure Creek and Springbrook Creek are both listed as impaired for macroinvertebrates based on data collected in 2000 (Figure 13). This determination was based on results from one sample. This impairment should be either substantiated or refuted with further data collection.

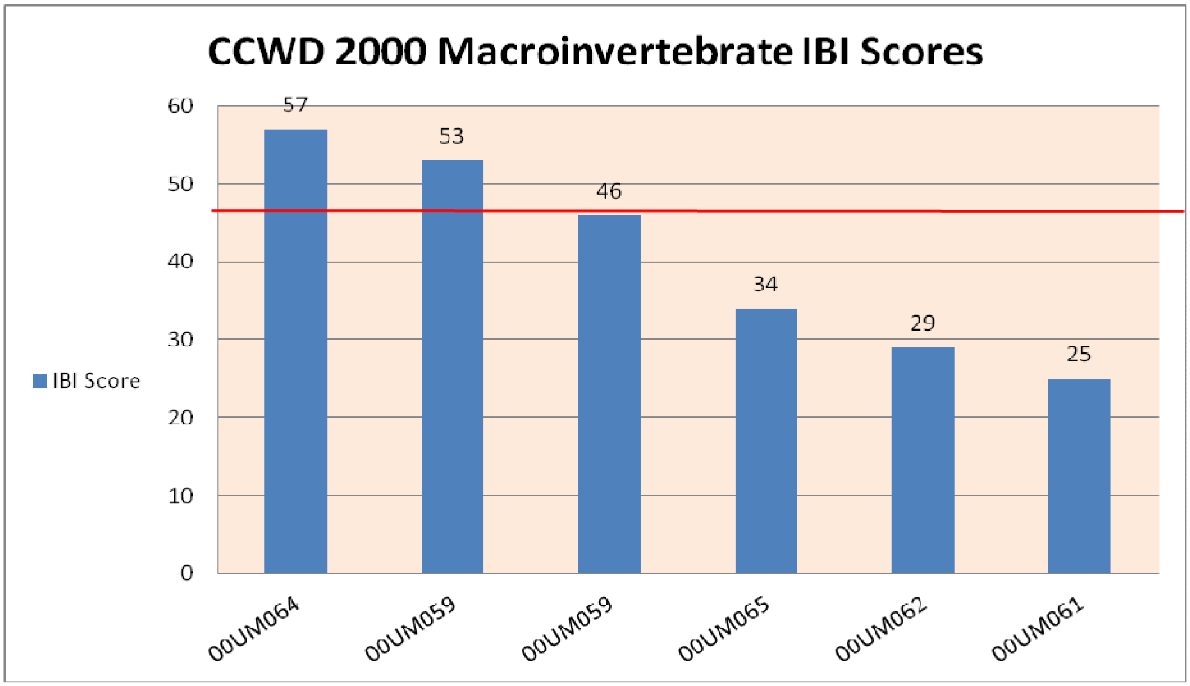


Figure 13. M-IBI scores for all streams sampled in 2000. Coon Creek was sampled 3 times. Red line indicates IBI threshold for "Southern Forest Streams" classification (46.8).

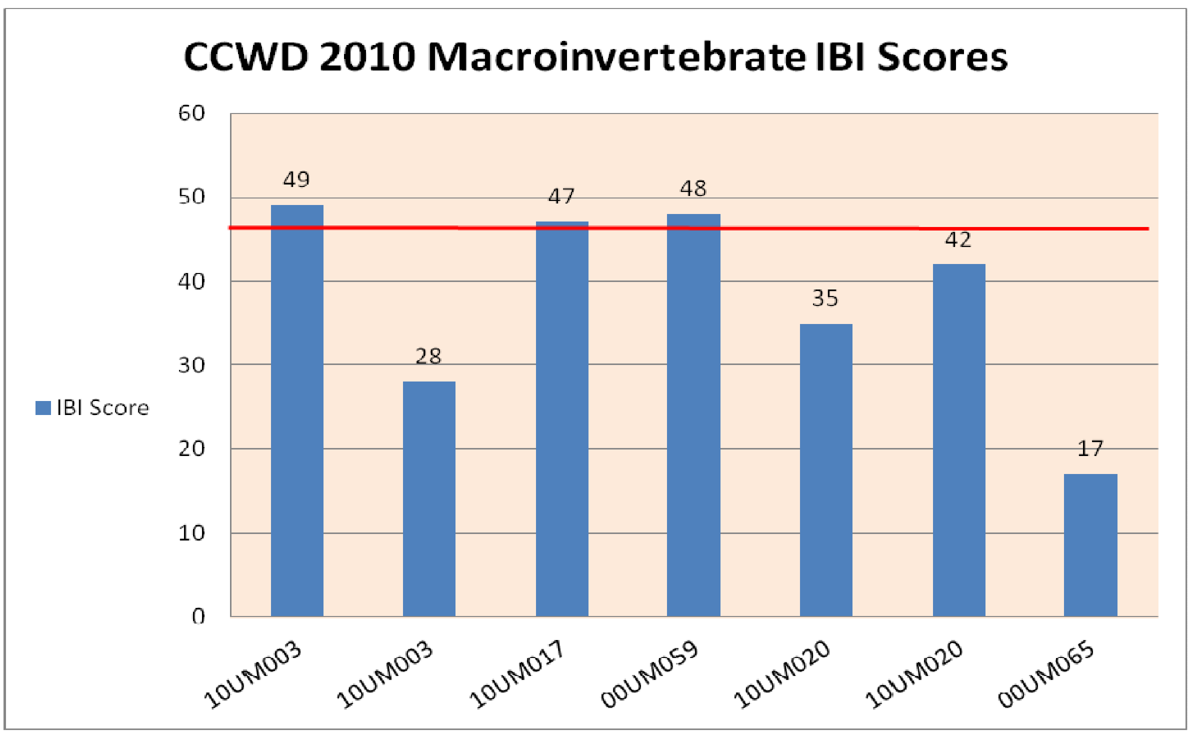


Figure 14. M-IBI scores for all streams sampled in 2010. Coon Creek was sampled 6 times. Red line indicates IBI threshold for "Southern Forest Streams" classification (46.8).

To supplement the work done by MPCA, CCWD has partnered with ACD since 2008 to conduct further macroinvertebrate monitoring. ACD has been conducting water quality monitoring within CCWD dating back to 1998, so their knowledge of the Coon Creek system is quite extensive. ACD has partnered with Blaine High School and Andover High School to undertake a student monitoring program where students are given the opportunity to collect biological data under the direct supervision of ACD staff.

All ACD monitoring sites within each year were sampled twice per year. The first was 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. The sampling methods used were the same as those used by the MPCA, the US EPA's multi-habitat method. In addition, the MCPA's Stream Habitat Assessment (MSHA) worksheet was completed for each site.

Several measures of stream biological health were calculated. Invertebrates were identified 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. EPT is a count of families belonging to the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddis flies). With a few exceptions, macroinvertebrates in these three orders are sensitive to pollution. Therefore, more EPT families present in a stream indicate a healthier biologic system. FBI, the Family Biotic Index, incorporates pollution tolerance scores for each family present.

The MPCA calculates similar invertebrate indices, but does so at the genus level. This allows accounting for the differing pollution tolerances that sometimes occur among genus in the same family. Because genus level identifications were not available for sites studied by ACD, all MPCA data was analyzed at the family level. Using the less precise family level indices for many sites was chosen over using more precise genus level indices at fewer locations.

5.3 COMPARISON TO NEARBY STREAMS

Comparison of the biotic indices of stream health between Coon Creek watershed sites, with other sites across Anoka County, provides perspective for the overall health of the Coon Creek system. The ranking of sites within the Coon Creek system from best to worst stream health (based on invertebrate data) is useful for prioritizing stream restoration efforts by the Coon Creek Watershed District. Overall, invertebrate indices for Coon Creek sites are distributed widely over the range seen in other streams locally, and the sites designated by the MPCA as “impaired” are at or better than the county average.

This analysis includes a total of 15 Coon Creek sites and 13 sites outside of the Coon Creek watershed but within Anoka County. The data from all of these sites was collected by a variety of groups, including professional staff at the MPCA and ACD, along with the student biomonitoring program.

When comparing all sites county-wide, it is important to consider the number of times each has been sampled. Substantial variability can be observed between sampling occasions due to weather, flows, time of year, and other factors. Figure 15 provides the number of sampling occasions at each site.

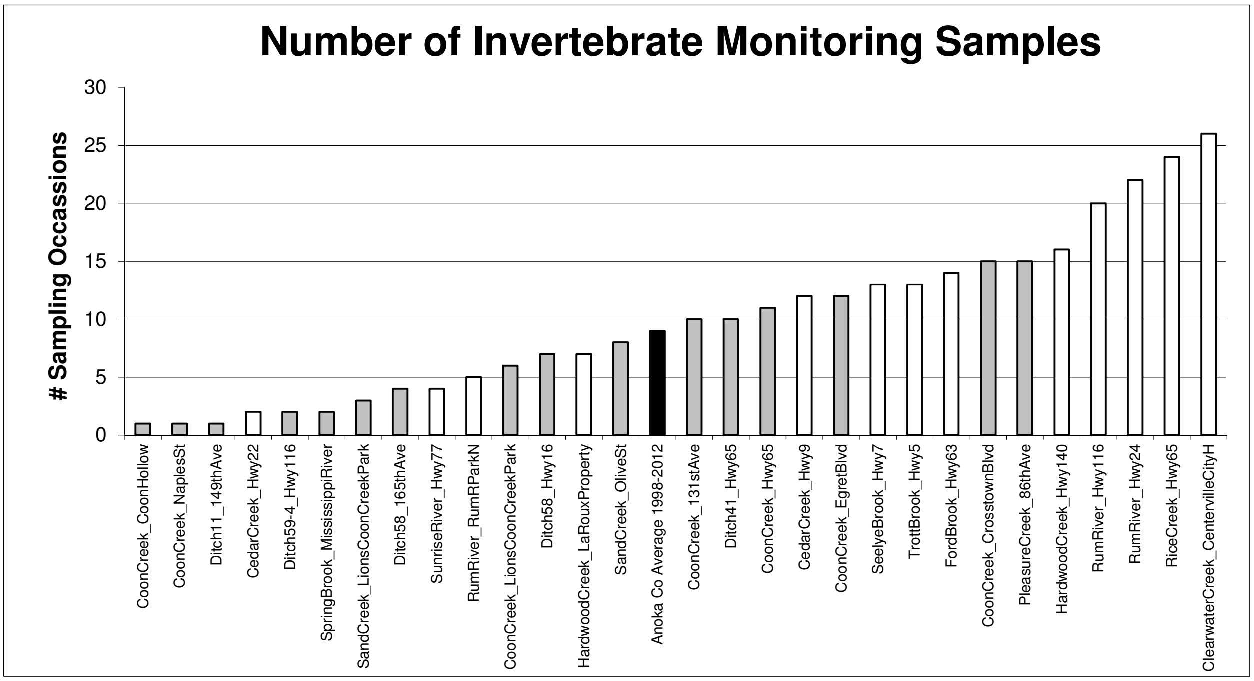


Figure 15. Number of invertebrate monitoring samples taken at all ACD monitored sites in Anoka County. Sites with grey bars are within the Coon Creek watershed.

The average number of families is a basic measurement of diversity, regardless of each invertebrate family's pollution sensitivity (Figure 16). Nine of the 15 CCCWD sites have an above average number of families. While there may be more families at these sites, many were generalists.

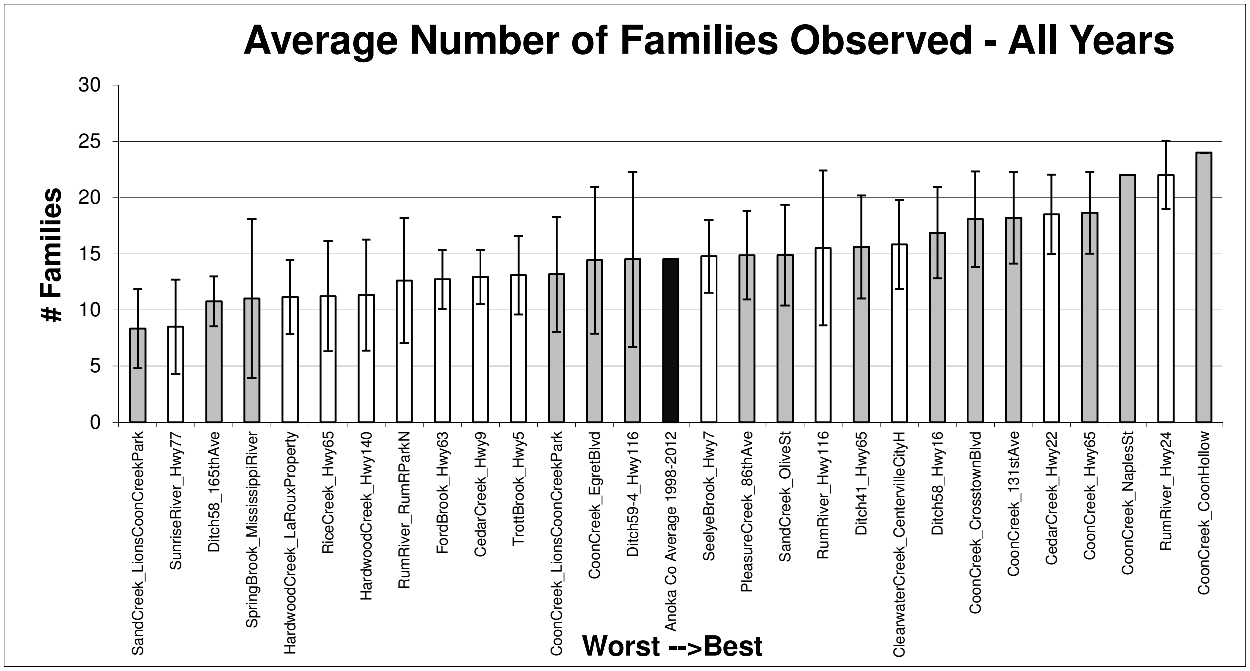


Figure 16. Average number of invertebrate families (± 1 standard deviation) observed at each monitored site in Anoka County. Higher numbers of families (i.e. higher diversity) is generally reflective of better stream health. Sites with grey bars are wit

The number of EPT families is the sum of families from three generally pollution sensitive orders (mayflies, stoneflies, and caddis flies; Figure 17). The EPT orders are generally pollution sensitive and higher numbers are generally reflective of better stream health. Just five of the Coon Creek watershed sites have more EPT families than the county average.

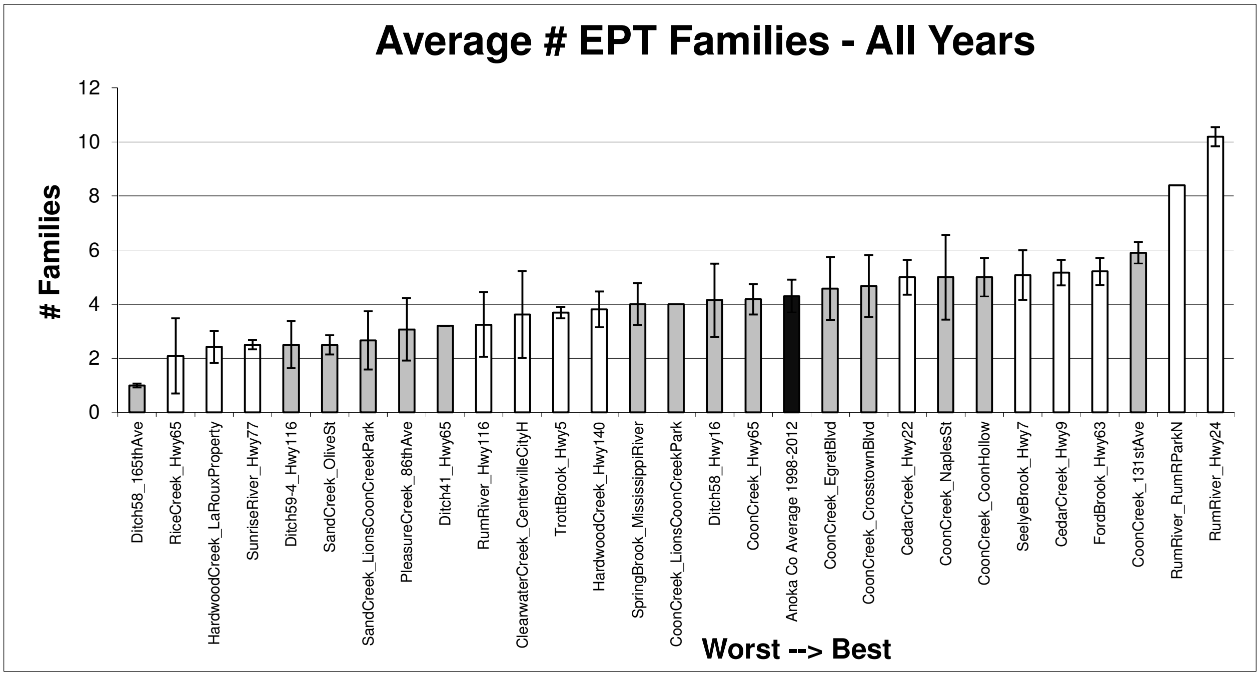


Figure 17 Ave number of invert families (± 1 standard deviation) in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddis flies) observed at each monitored site in Anoka County. The EPT orders are generally pollution sensitive

Family Biotic Index (FBI) is calculated from both the number of families and the pollution tolerance of each family (Figure 18). While the Coon Creek watershed sites again span the spectrum observed in the county, the extremes are noteworthy. The 2nd, 3rd, and 4th best average FBI scores are from Coon Creek watershed sites. These are sites in the downstream reaches of the watershed. The site that ranked 2nd best county-wide was Coon Creek at Coon Hollow (Vale St), where only one sampling has occurred so there is lower certainty in the accuracy. On the other hand, the site that ranked 3rd best county-wide was Coon Creek at Egret Street which the 2000 MPCA sampling found had an “impaired” invertebrate community.

The qualitative guidelines for interpreting the FBI scores are as follows 0-3.75 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. 20 of 28 sites monitored county-wide have average, multi-year FBI scores above five, indicating fair to poor stream health. Based on this invertebrate index, most streams in the county have substandard health.

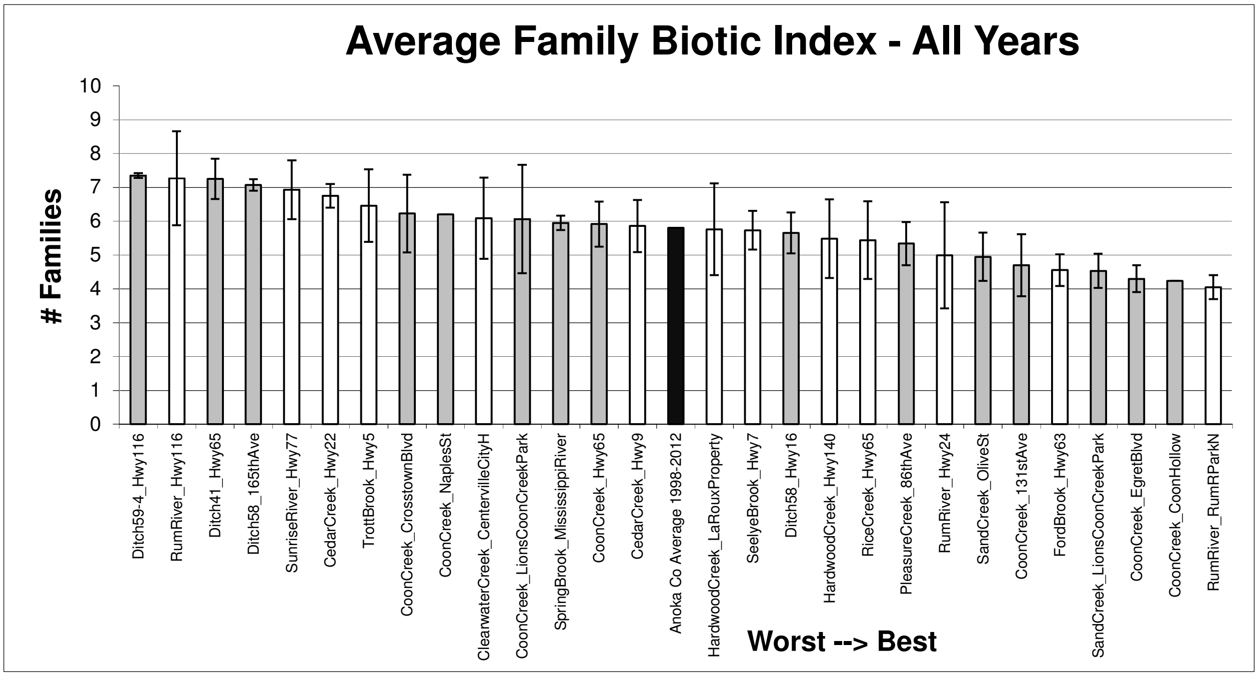


Figure 18 Average family biotic index (FBI) score (± 1 standard deviation) observed at each monitored site in Anoka County. Lower FBI scores are reflective of better stream health. Sites with grey bars are within the Coon Creek watershed.

5.4 ESCHERICHIA COLI DATA

Escherichia coli (E. coli), a bacterium found in the feces of warm blooded animals, is a pathogen of concern to humans as it may pose health risks to those who come in contact with it. E. coli is an easily testable indicator of all pathogens that are associated with fecal contamination. The Minnesota Pollution Control Agency sets E. coli standards for contact recreation (swimming, etc.). A stream is designated as “impaired” if 10% of measurements in a calendar month are >1260 colony forming units per 100 milliliters of water (cfu/100mL) or if the geometric mean of five samples taken within 30 days is greater than 126 cfu/100mL. These standards are often referred to the “acute” and “chronic” standard respectively.

E. coli bacteria in Pleasure Creek have been monitored since 2006, with the exception of 2012 (Figure 18). Pleasure Creek exceeds both acute and chronic criteria (Figure 19). The creek has not yet been listed as “impaired” by the State, but a water quality problem exists regardless.

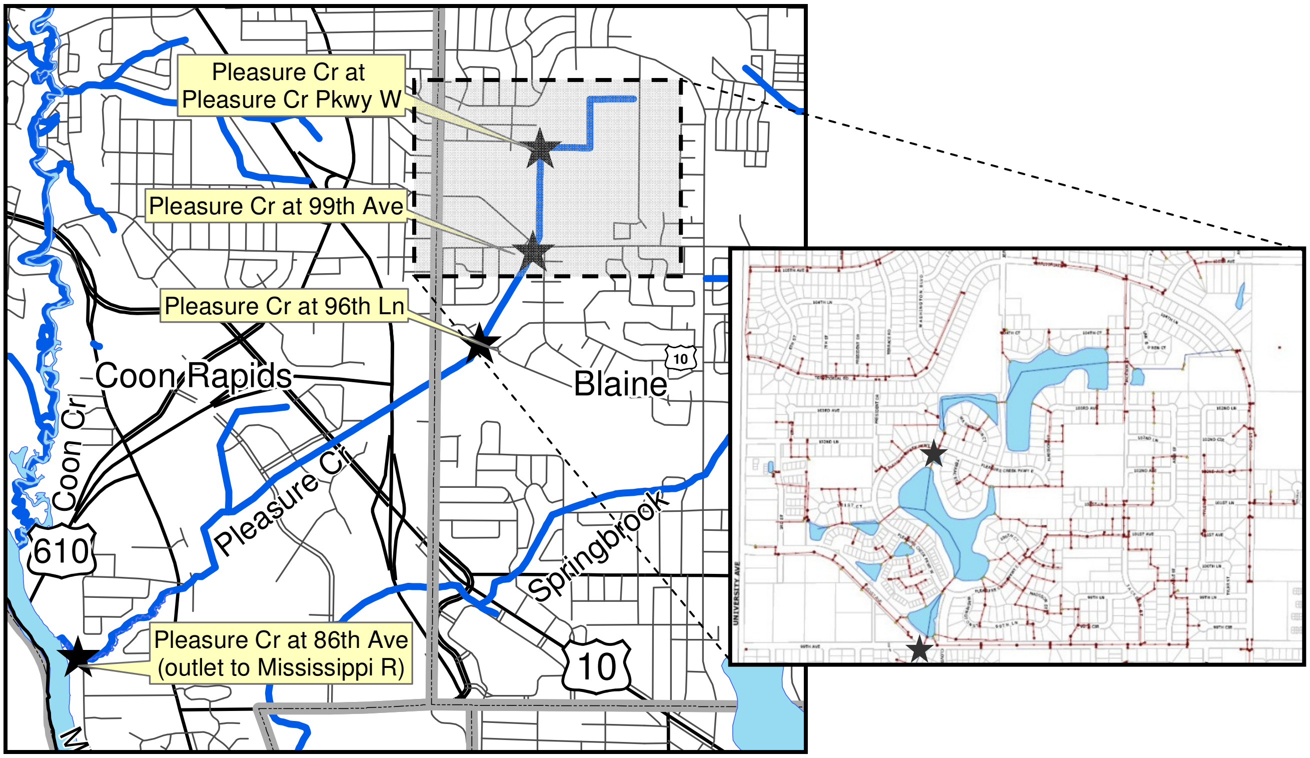


Figure 19 Pleasure Creek monitoring sites. Callout box details network of stormwater ponds in Blaine, MN.

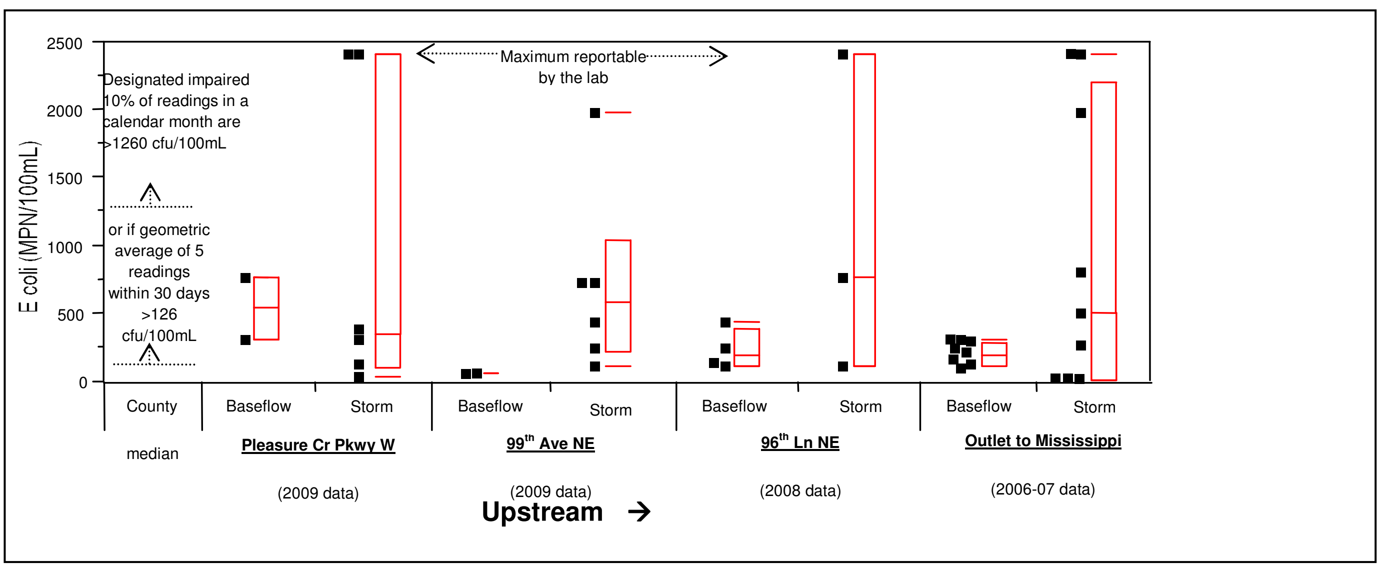


Figure 20 Pleasure Creek E. coli bacteria results during base and storm conditions. Dots are individual readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

Enough data is available for the downstream monitoring site (outlet to Mississippi River) to clearly document exceedances of the "impaired" criteria. At the upstream sites not enough data has been gathered, but the E. coli values observed are similar to the downstream site. At the farthest-downstream monitoring site three of four samples in May 2007 exceeded 1260 cfu/100mL (261, 1986, and two samples exceeded the test limits of 2420 cfu/100mL). In 2006, five samples taken between 5/24 and 6/21 had a geometric mean of 318 cfu/100mL. In 2007 five samples were taken between 5/24 and 6/20, but calculating their geometric mean is impossible because two of the samples exceed the test's capacity of 2420 cfu/100mL. If we conservatively replace those readings with 2420 cfu/100mL, then geometric mean is 934 cfu/100mL. On all accounts, Pleasure Creek at the outlet to the Mississippi River exceeds the State of Minnesota E. coli standard for contact with the water.

E. coli levels were highest and most variable at the outlet to the Mississippi River during storms (Figure 20 above). Average baseflow E. coli was 257 MPN/100mL (n=8; units MPN/100mL are comparable to cfu/100mL and differ in analytical method) and varied little (standard deviation 179). During storms average E. coli jumped to 935 MPN/100mL (n=9) and varied widely (standard deviation 1046). A large part of this variability might be explained by the intensity of the storm, phenology of the storm, and when during the storm the sampling was done. E. coli during storms is higher because storms flush bacteria from impermeable surfaces throughout the watershed, and because higher flows suspend and transport E. coli that were already present in the creek.

In 2008 monitoring occurred at the Blaine-Coon Rapids Boundary (96th Lane) to determine if the problem originated up or downstream of that point. Average baseflow E. coli was 235 MPN/100mL (n=4) and varied little (standard deviation 135). Average storm E. coli was 1102 MPN/100mL (n=3) and varied widely (standard deviation 1187). This is similar to the outlet to the Mississippi River, so it appears that an important bacteria source is within the City of Blaine. It is likely that urban runoff within Coon Rapids is also contributing E. coli to the stream.

In 2009 monitoring moved further upstream to diagnose the bacteria source. The portions of the watershed above the 2008 monitoring site are a network of stormwater ponds in the City of Blaine. 2009 monitoring was designed to determine which drainage areas to these ponds are bacteria sources or if the ponds themselves might be the source. One monitoring site was split mid-way through the pond network (Pleasure Cr Parkway W), while the other was at the outlet of the last pond (99th Avenue). Most monitoring (6 of 8 occasions) was during storms because the highest bacteria levels were found during storms in previous years. The results suggest that the ponds themselves are a source of E. coli, while additional bacteria may come from the neighborhoods around the ponds.

The monitoring site mid-way through the pond network (Pleasure Cr Parkway W) did have elevated E. coli during baseflow and storms, which suggests that the small drainage area upstream of this site contributes E. coli to the creek. Only two baseflow samples were taken and little flow was moving; E. coli levels were 307 and 770 MPN/100mL, which is moderately high. This would seem to suggest that bacteria levels may have a regular, non-storm related presence in the ponds (i.e. the ponds are a bacteria source). During storms, six samples had widely different E. coli levels. On the low end, one storm had only 34 MPN/100mL and another had only 122 MPN/100mL. These readings are below the state water quality standard. Two other storms had moderate E. coli levels of 307 and 387 MPN/100mL. But during the other two storms E. coli levels were so high they exceeded the laboratory's maximum test result of 2420 MPN/100mL. E. coli levels were not correlated with precipitation totals or stream water level.

The monitoring site at the bottom of the pond network (99th Avenue) had low E. coli during baseflow. Only two samples were taken during baseflow, and the E. coli levels were low (55 and 58 MPN/100mL). While two samples are too few for a confident assessment, it suggests that few bacteria exit the last stormwater pond during baseflow. The last ponds are the largest and deepest, and therefore least likely to harbor bacteria and most likely to remove them during baseflow. While the smaller, shallower upper ponds may harbor E. coli, the larger, deeper lower ponds remove them during baseflow. However, higher flows during storms can allow bacteria to pass through all of the ponds.

E. coli levels during storms at 99th Avenue were much more variable, similar to what was found in the ponds. While one storm sample had desirably low E. coli (104 MPN/100mL), others were high (248, 435, 727, 727, and 1986 MPN/100mL). This indicates some bacteria pass through the ponds, or are flushed from them, during storms. E. coli levels were not correlated with precipitation totals or stream water level.

Fecal coliform and fecal streptococcus bacteria testing were done at 99th Avenue to determine if the bacteria source came from human sewage. The feces of different animals have different ratios of these two bacteria types (Table 13). Admittedly, this is an imperfect test for several reasons. First, pollution from multiple sources can alter the ratio. Second, bacterial ratios will change over time because of different die-off rates; fecal streptococci die-off faster thereby increasing the ratio and possibly resulting in incorrect determinations that the bacterial source is human. Research has found that these bacteria types can survive and reproduce outside of the digestive tracts of warm-blooded animals. The population dynamics of these "free-living" bacteria could affect the ratio. These limitations are important to recognize when interpreting the data.

Source	Ratio	Source	Ratio
Human	4.4	Pig	0.4
Duck	0.6	Cow	0.2
Sheep	0.4	Turkey	0.1
Chicken	0.4		

Table 12 Fecal coliform to fecal streptococcus bacteria ratios in the feces of various animals (Csuros and Csuros, 1999).

Fecal coliform to fecal streptococcus ratios consistently indicated that the bacteria source is not human feces (i.e. ratio <4.4). On average, the ratio was 0.30 (n=8, standard deviation 0.31). The highest observed ratio was 1.03 and lowest was 0.03. There was no apparent difference between storms (n=6, average 0.30, standard deviation 0.36) and baseflow (n=2, average 0.28, standard deviation 0.07).

Likely bacterial sources include:

Urban stormwater. It is well documented that urban stormwater runoff has elevated E. coli. There is no reason to believe that this is not true across Pleasure Creek's watershed. The absence of a step-wise increase in bacteria downstream suggests that bacterial concentrations of stormwater entering the stream are not greater than those already in the stream.

It should be noted that no animal concentrations for feedlots are known to exist in the watershed that would contribute significant fecal or coliform bacteria.

Stormwater ponds. Although stormwater ponds generally remove pollutants by allowing settling there are many documented instances throughout the U.S. where the ponds accumulate fecal bacteria that are then flushed out during larger storms. Research has shown that these bacteria can survive and reproduce outside of the intestines of warm-blooded animals. Survival is longest when the water temperature is lower, sun exposure is less, and bacterivorous predators (nematodes, ciliates, rotifers, etc.) are fewer. Some bacteria are attached to particles that settle within stormwater ponds but are still vulnerable to re-suspension during storms, while others are “free” and less likely to settle.

Of particular interest are the 11 stormwater ponds that the creek flows through in its headwaters in the City of Blaine. These ponds and the developments around them were built post-1995. Some are small and shallow and serve as forebays to the larger, deeper ponds. The stormwater pond network in Blaine is likely a source of bacteria, collecting them from polluted runoff, harboring them, and releasing them (especially during storm flushing). Smaller, shallower upper ponds are the most suitable for bacterial survival. The larger, deeper lower ponds are less suitable for bacteria and seem to remove them from the system during baseflow but not during storms. While these ponds do a good job removing suspended solids in all conditions, they do not regulate water rate and volume during storms well. These storm flushes can provide a means for transporting bacteria. The fact that suspended solids seem to be captured by the ponds during storms but not bacteria seems inconsistent and deserves more research.

Waterfowl. Waterfowl congregations on Pleasure Creek primarily occur in winter. During this time several hundred ducks have been observed in Coon Rapids near Evergreen Boulevard.

In the summer small waterfowl congregations do occur in places around the watershed, but none are large. Waterfowl usage of the network of stormwater ponds that the creek flows through in Blaine would be of greatest concern, but few birds congregate there. The ponds are encircled with a >25 foot wide buffer of unmowed vegetation designed to filter runoff, but which also discourages waterfowl. Some birds do use the ponds for resting or feeding on the water, but no concentrations of more than 10 birds were seen by staff during monitoring. The stormwater ponds in Coon Rapids near the railroad tracks have not been checked for summer waterfowl congregations.

Possible, but likely minor, bacterial sources include:

Stormwater sumps/catch basins. The catch basins below many curbside gutters are designed to capture solids. The dark, moist environment with consistently moderate temperatures might be favorable for bacteria, although this is not well documented or researched to our knowledge. Any bacteria in these basins would be flushed out by larger storms. Catch basin sumps have been found to capture solids during small storms but some is flushed out during intense storms.

Sanitary sewer. Sanitary sewers could contribute bacteria either through leaking pipes or if a wastewater pipe improperly intersects with a storm water pipe. The extent of this occurring is unknown. Dry-weather screening of stormwater outfalls for illicit discharges could be used to detect any such problems. The lower bacterial concentrations during baseflow suggest this may not be an issue, as does the fecal coliform to streptococcus ratio.

E. coli bacteria monitoring has also been conducted on Coon Creek at Vale St. located in Coon Rapids, MN. This monitoring was conducted as part of the Upper Mississippi River Bacteria TMDL project by the MPCA. Monitoring was only conducted for this location in years 2010 and 2011 so the data set is small when compared to monitoring on Pleasure Creek. Data indicates an E. coli violation exists, and would likely be substantiated if further data was collected.

Table 14 indicates E. coli impairment at the Vale St. monitoring location does exist. The chronic standard defines impaired if as a geometric mean of at least five samples is greater than 126 cfu/100mL in a calendar month. Only four sampling months met the five sample requirement for valid determination of impairment (numbers in red). Of these four months with five samples or more, three of them exceeded 126 cfu/100mL in a calendar month. These measurements (in shaded blue boxes) are the basis for the likely E. coli impairment. All geometric means in the table below were calculated from at least 3 samples with the exception of July 2011. If the 5 sample minimum was eliminated, the E coli impairment would occur during most summer months (May through October).

Site	Year	Month						
		April	May	June	July	August	September	October
Vale St.	2010	76	151	330	220	448	1466	119
Vale St.	2011	18	193	136	130	253	No data	209

Table 13 Geometric mean of E. coli data for Coon Creek at Vale St. Values in red are months that meet the minimum requirement of 5 samples. Shaded boxes are months that exceed state "chronic" standards for Escherichia coli.

Acute standard impairment is defined as more than 10% of all samples exceeding 1260 cfu/100mL in any month. Table 15 (below) highlights months when exceedances did occur but doesn't represent the magnitude of the exceedance. It is worth noting that in both September 2010 and May 2011 (months in violation) had recorded lab values <2400 cfu/100mL. This is two times the standard and also the maximum limit of laboratory values. It is unknown exactly how high these observations were. Regardless, it is apparent that obvious exceedances exist at the Vale St. location. Further bacteria monitoring at this location and other locations throughout the district would be helpful to determine both the magnitude and possible causes of the impairment.

Month	Coon Creek at Vale St.			
	Year	N (total)	N (above standard)	Percent
April	2010	3	0	0%
May	2010	3	0	0%
June	2010	3	0	0%
July	2010	5	0	0%
August	2010	5	0	0%
September	2010	3	2	66%
October	2010	3	0	0%
April	2011	4	0	0%
May	2011	6	1	16%
June	2011	3	0	0%
July	2011	1	0	0%
August	2011	4	0	0%
September	2011	0	0	0%
October	2011	4	0	0%

Table 14 Samples collected (N total) and % exceeding acute standard of 126 cfu/100mL. Shaded boxes indicate months when acute standard was exceeded.

6.0 Supplementary Monitoring

The Coon Creek Watershed District is again partnering with the Anoka Conservation Disrict in 2013 to supplement prior years data collections as part of Phase II of this project. Monitoring will include a variety of collections including water chemistry data, stream hydrology, and bacteria monitoring. Water chemistry data may include conductivity, turbidity, temperature, dissolved oxygen (DO), salinity, and total suspended solids (TSS). Stream hydrology monitoring involves deployment of Hydro lab equipment which offers continuous 24 hour monitoring of storm events in combination with aforementioned water quality parameters. Lastly, bacteria monitoring will be done through the use of grab samples at designated locations. Figure 21 illustrates the spatial distribution of proposed monitoring locations. It is believed the current proposed monitoring locations will provide a representative picture of the water quality throughout CCWD. Monitoring will cover portions of the district with varying degrees of urbanization as well as varying degrees of stream channelization.

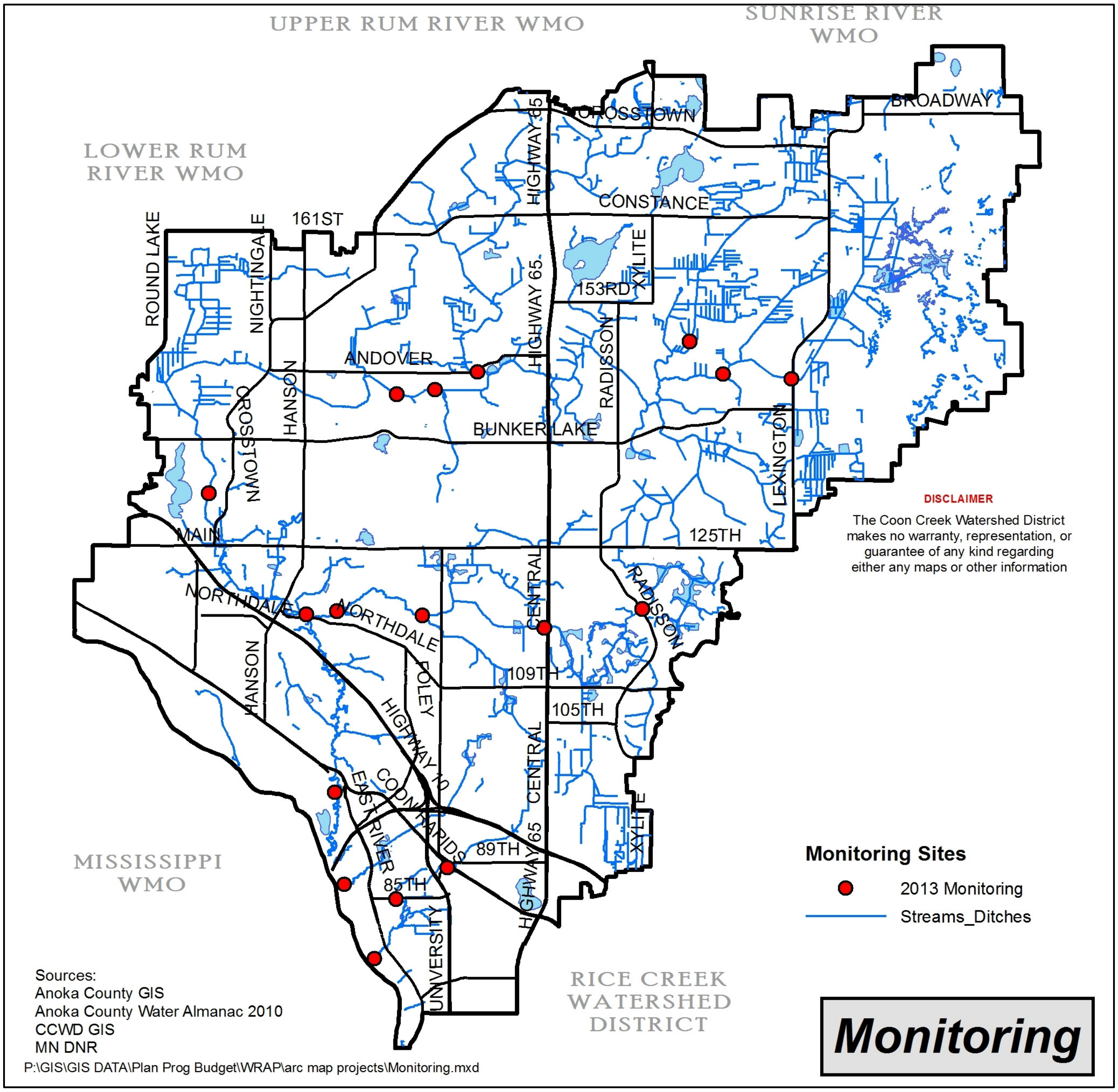


Figure 21 Spatial distribution of proposed supplementary 2013 water quality monitoring. A total of 17 sites are proposed for Phase II.

7.0 Preliminary Stressors

A main objective in Phase I of this project was the development of a preliminary list of stressors. This preliminary brainstorming of potential stressors is a key step to the beginning stages of the CADDIS process. As mentioned earlier in this report, CADDIS is a methodology for conducting a stepwise analysis of candidate causes of impairment. CADDIS characterizes the potential relationships between candidate causes and stressors, and identifies the probable stressors based on the strength of evidence from available data.

A preliminary stressor list is meant to be a comprehensive compilation of any potential stressors which are leading to the current impairments, in this case - biotic impairment. A preliminary list of candidate stressors is even more critical to the development of TMDL's for biotic impairment. The reason for this is that biotic impairments are often a result of something outside the typical idea of a "pollutant". These could be items things such as altered hydrology or habitat. TMDL's for an actual pollutant, such as chlorides, are a bit more straightforward as to their cause.

Developing a list of candidate cause requires balancing a tradeoff. The tradeoff being too many candidate causes leads to a time consuming, expensive, and burdensome CADDIS process. However, a list of candidate causes too narrow risks of overlooking the true cause of impairment.

In this project, a multitude of stressors were identified individually and then compiled back into 6 main conceptual models to convey likely modes of transport, delivery, and availability. We felt these models summarized the preliminary list of candidate causes while also allowing stakeholders a visual representation of potential pathways. Preliminary stressors identified were biological, chemical, and physical in nature.

The preliminary list was developed based on existing monitoring data, input from stakeholders, input from citizen advisory committees, professional knowledge of the Coon Creek system, and understanding of various biological processes.

Table 16 is the list of preliminary stressors and was developed by CCWD and brainstorming sessions involving both the Technical Advisory (TAC) and Citizen Advisory Committee (CAC). The preliminary stressors are listed in the far left hand column while the effect is listed along the top. For example, the first stressor on the list is "urban runoff". The effects of urban runoff play some role in biota, E. coli levels, TSS, turbidity, phosphorus, volume, flow, temperature. The far right hand column represents the total number of "effects" each stressor creates. It is an extremely simplified way to begin prioritizing stressors, a process which will be further refined as the project moves through the CADDIS process.

Stressor	Biota	E. Coli	TSS	Turb	Phos	Vol	Flow	Hab	DO	Channelize	Tox	Temp	Total
Urban Runoff	1	1	1	1	1	1	1					1	8
Flow Regime	1	1	1	1				1	1	1			7
Stream bank erosion	1		1	1		1	1	1		1			7
Channelization	1		1	1		1	1	1					6
Ditch Maintenance	1					1	1	1		1			5
Impervious Cover			1	1		1	1					1	5
TSS	1			1				1	1			1	5
Turbidity	1		1					1	1			1	5
Bed load	1		1	1				1					4
Lack of Riparian Buffer	1		1	1				1					4
Storm Intensity			1	1		1	1						4
Temperature	1	1						1	1				4
Vegetation	1						1	1	1				4
Flood Control						1	1			1			3
Geology of Sand Plain			1	1	1								3
Illicit Discharges	1				1						1		3
Precipitation	1					1	1						3
Road de-icing	1		1	1									3
Stormwater Ponds		1							1			1	3
Water Control Strt.	1						1	1					3
Algal growth				1					1				2
Connectivity	1							1					2
Exposed Soils			1	1									2
Invasive Species	1							1					2
Lawn Clippings					1				1				2
Leaves					1				1				2
Wastewater		1			1								2
Chlorides	1												1
Dis. Oxygen	1												1
Habitat	1												1
Landscaping runoff					1								1
Nat Strain E. coli		1											1
Nitrogen				1									1
Pet Waste		1											1
Phosphorus									1				1

Predation	1												1
Salinity	1												1
Self-reproduction		1											1
Toxics	1												1
Volume										1			1
WDE Landfill											1		1
Wildlife Waste		1											1
Metals											1		1
Pesticides											1		1

Table 15 Comprehensive list of preliminary candidate stressors.

The stressor identification (SI) process calls for the elimination of very unlikely stressors to prevent the SI process from becoming too unwieldy. Upon completion of Phase II data collection and analyses, this list will be refined through elimination of those stressors we find not to be an issue in the Coon Creek watershed.

8.0 Conceptual Models

Once the preliminary list of candidate causes was completed, conceptual model diagrams were developed to help establish connections between potential causes and their effects. Conceptual models are simple graphic illustrations aiming to show connections between potential “pollutant” sources and their biological effects. It is helpful to think of conceptual models as a vehicle to show how a stressor moves from point A (origin) to point B (destination). Conceptual models are especially useful in TMDL’s dealing with biotic impairment because they can help to show how different candidate causes may interact or compound one another to contribute to biotic impairment. After initial discussion with the TAC and CAC regarding developing a list of preliminary stressors, it was decided the formation of conceptual models would be a prudent strategy to help communicate how and why stressors are leading to impairments.

The development of six conceptual models was necessary to summarize most of the preliminary stressors list. These six models were TSS/Turbidity (Figure 22), Nutrients (Figure 23), DO (Figure 24), Bacteria (Figure 25), Altered Flow (Figure 26), and Altered Habitat (Figure 27).

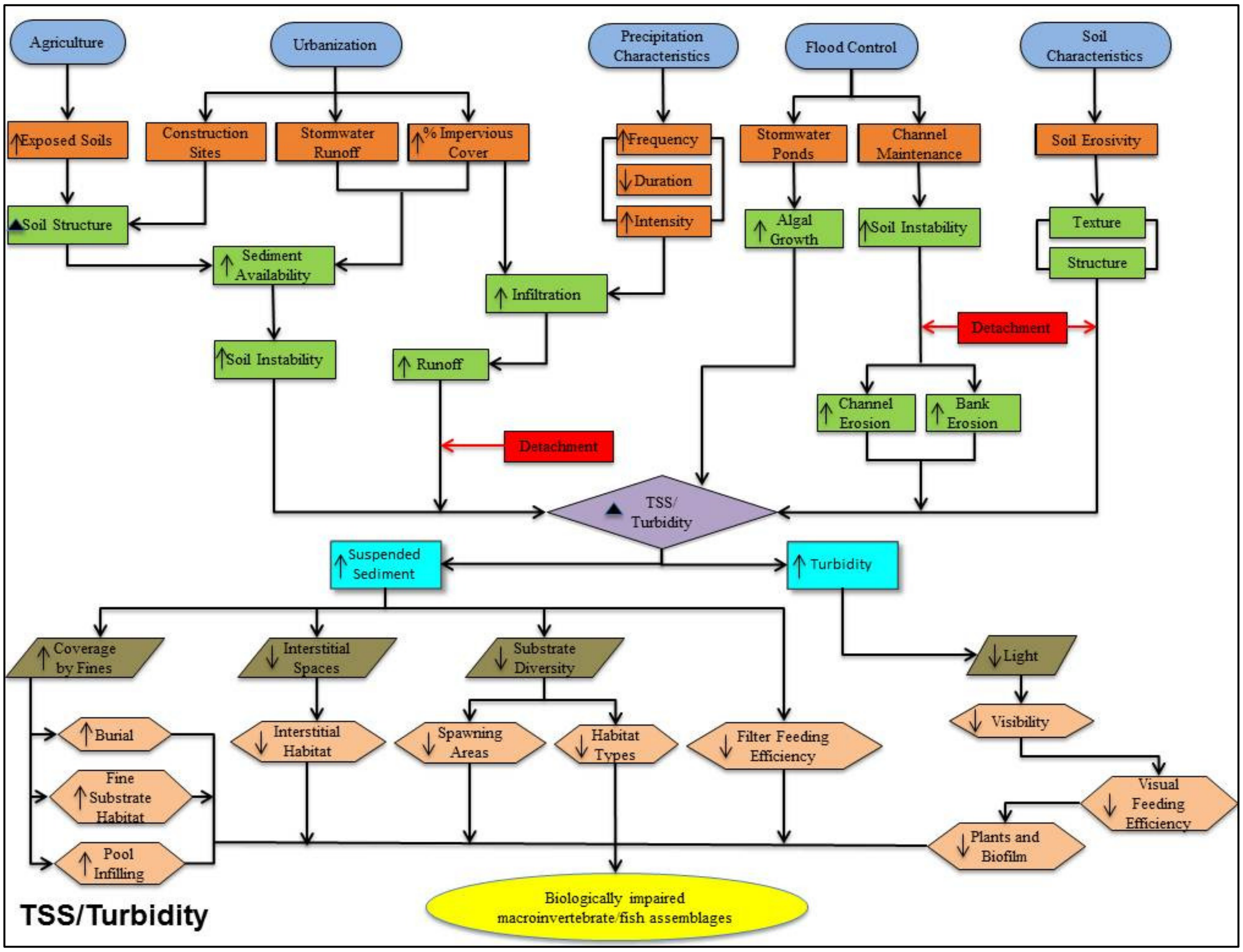


Figure 22 TSS/Turbidity conceptual model diagram.

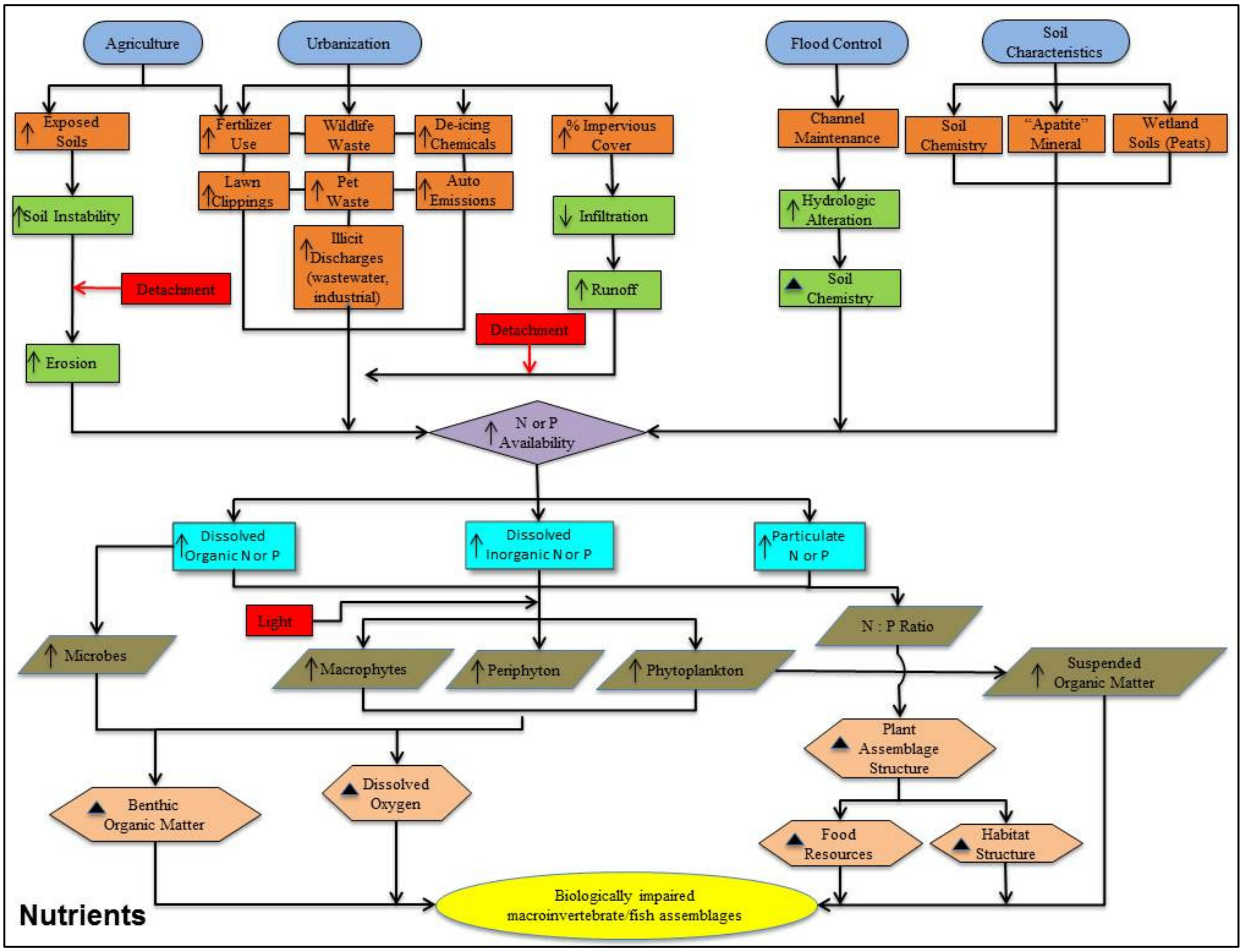


Figure 23. Nutrients conceptual model diagram

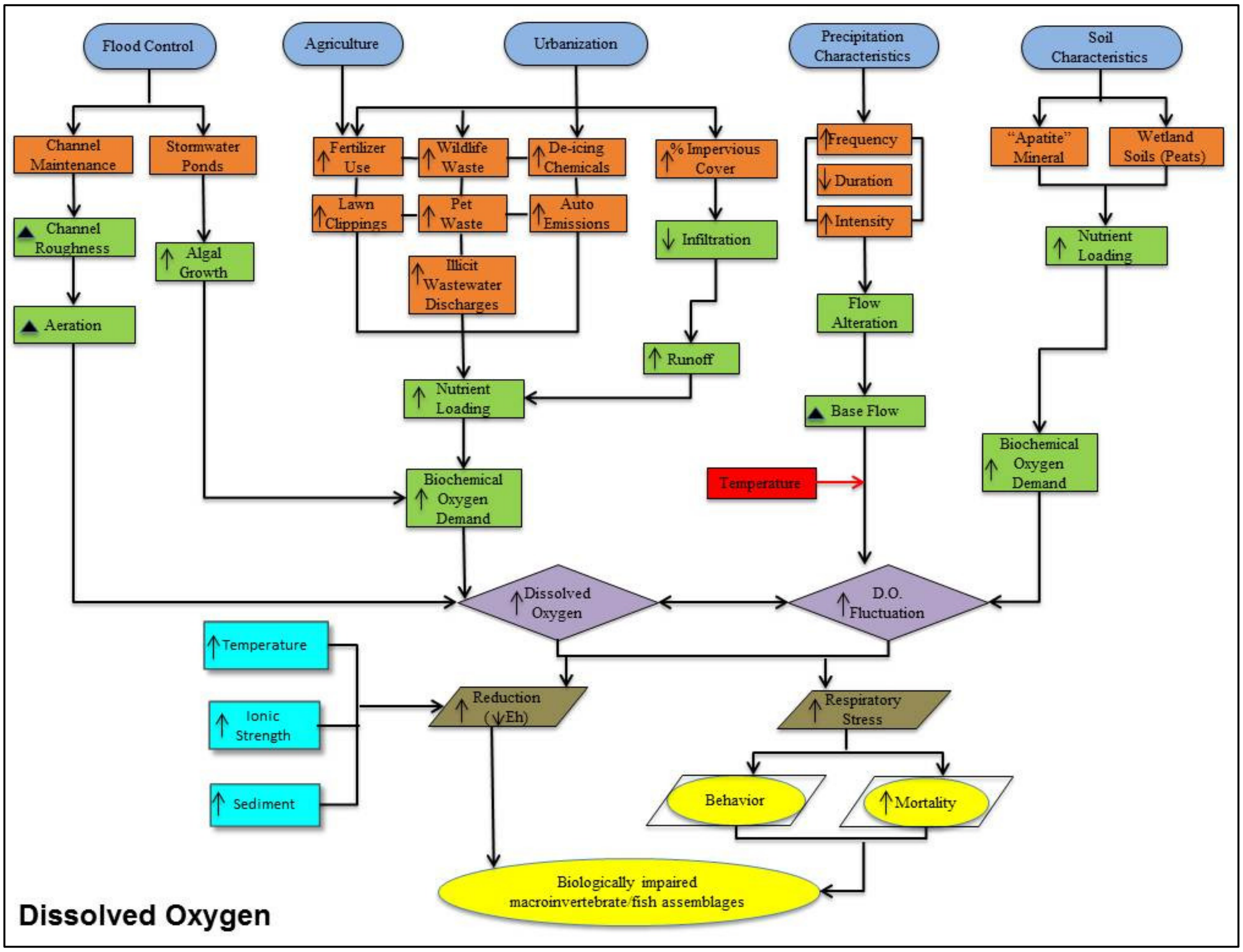


Figure 24. Dissolved oxygen conceptual model diagram.

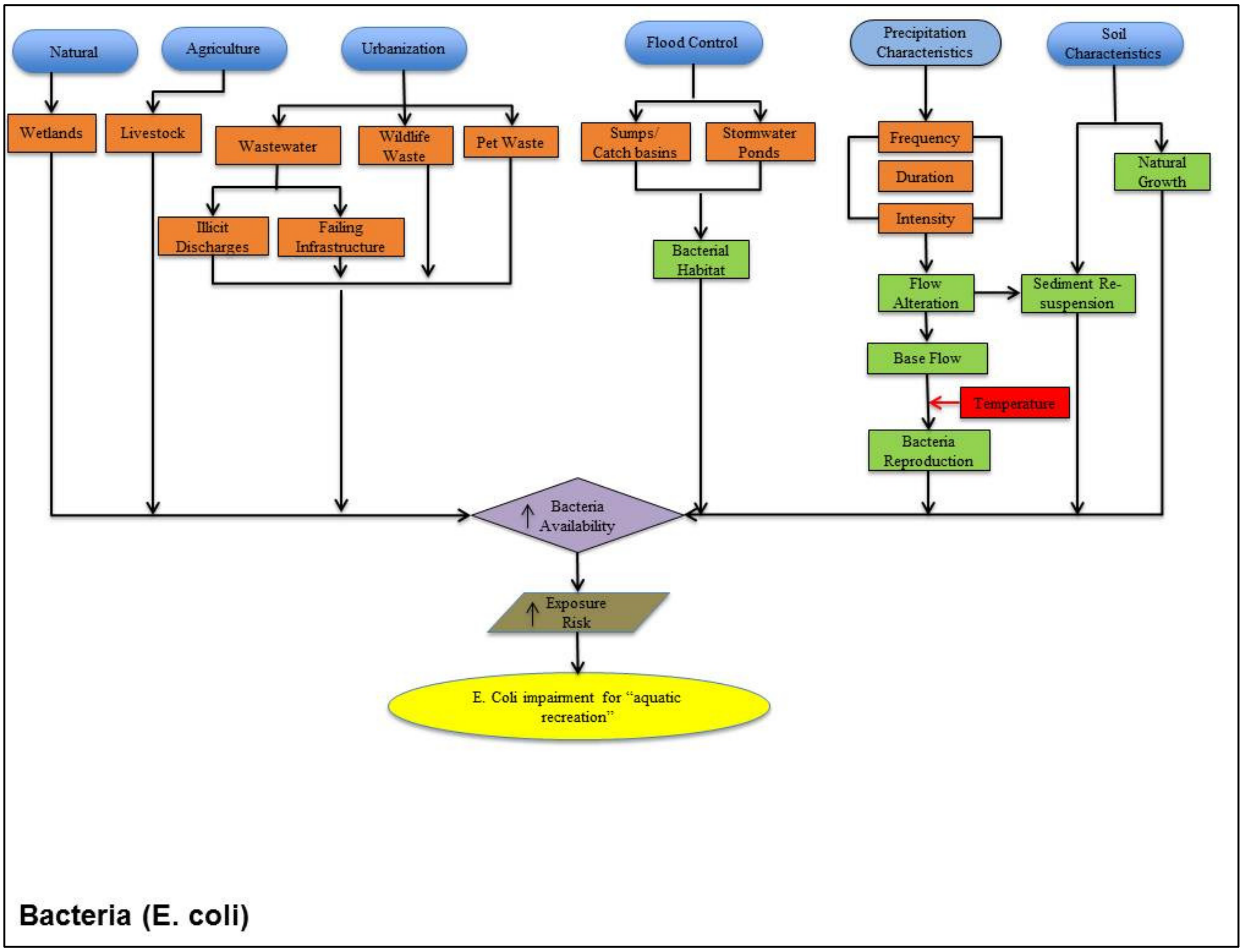


Figure 25. Bacteria (E. coli) conceptual model diagram.

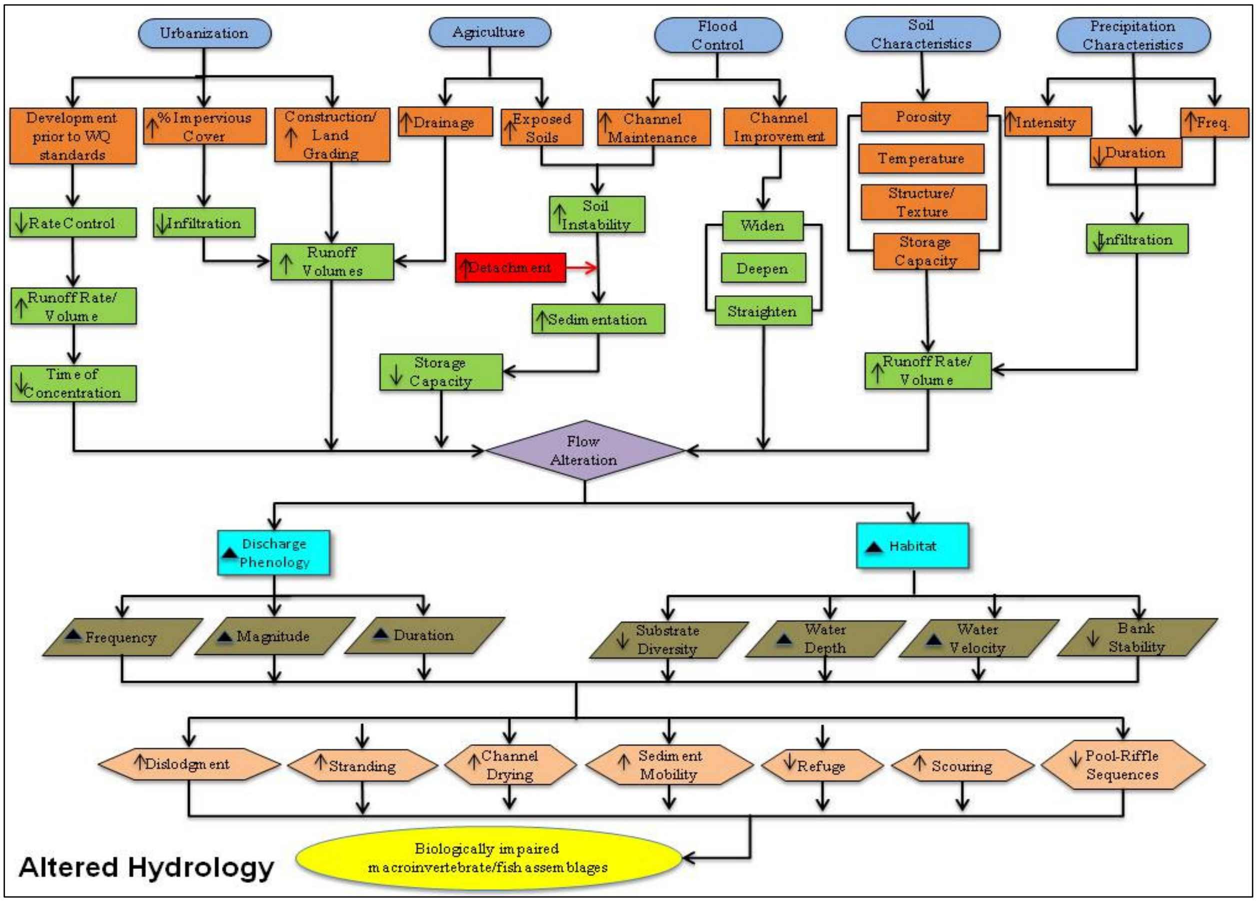


Figure 26. Altered hydrology conceptual model diagram.

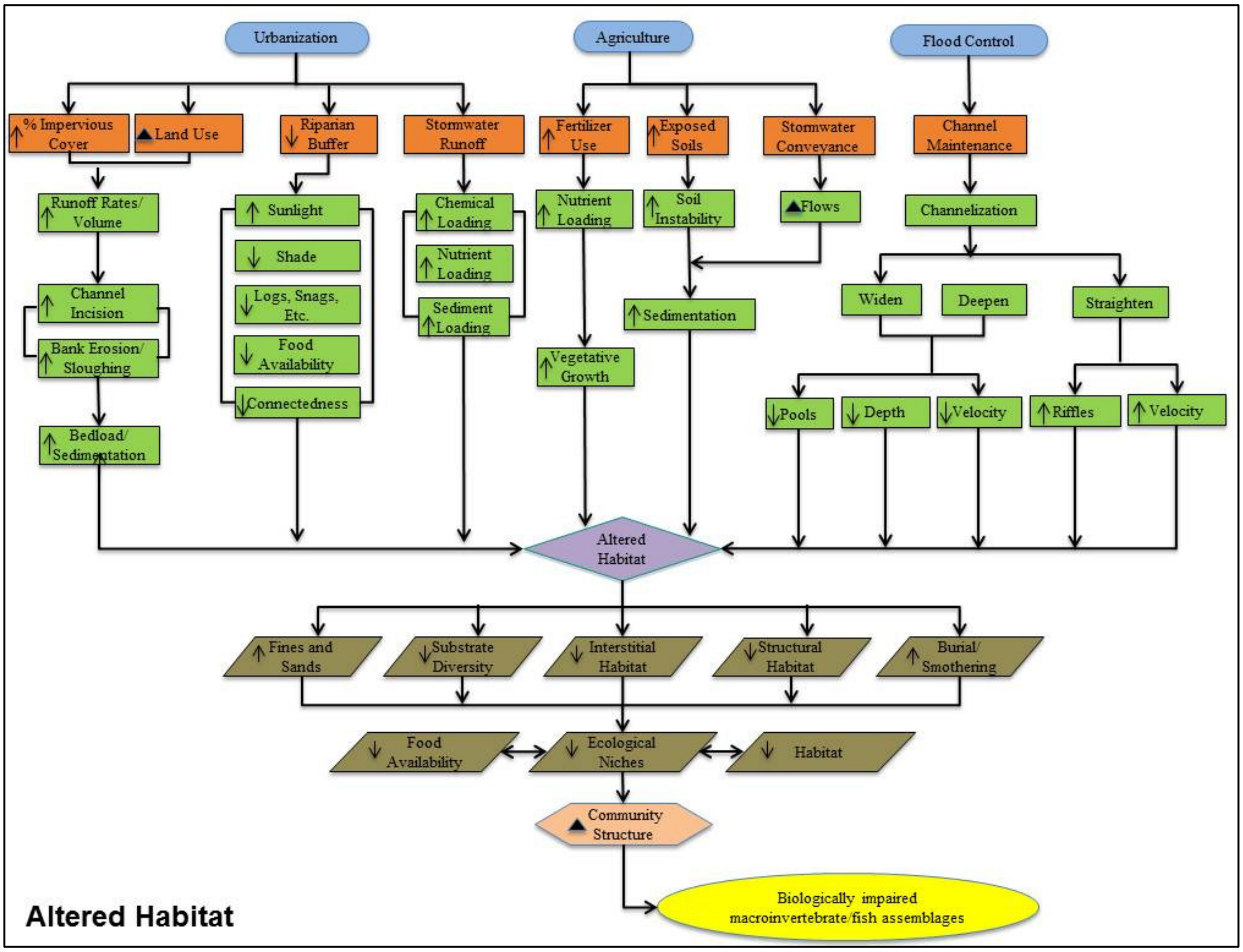


Figure 27. Altered habitat conceptual model diagram.

9.0 Phase I Conclusions

Overall, impairment of the fish and invertebrate community appears variable throughout the Coon Creek system. IBI scores for fisheries indicate the deferred fish impairment is more severe than macroinvertebrates. The macroinvertebrate impairment appears varied throughout CCWD. Data suggests impairment designations for portions of Coon Creek are appropriate, but possibly not for the entire reach. Impairments on Sand Creek, Pleasure Creek, and Springbrook Creek appear more accurate. Regardless of this issue, a district wide opportunity for overall water quality improvement does exist.

New information and procedures at the MPCA should help refine biotic impairment designations for the Coon Creek watershed. First, the agency monitored seven sites in 2010, which is better than the two that were monitored in 2000 and used to designate the system as impaired. Additionally, the MPCA is developing tiered biological expectations for different types of streams. Portions of CCWD that are actively maintained for stormwater conveyance will be evaluated with TALU for their ability to support a general use or modified use aquatic life assemblages. Objectives found in Phase II of this project, will hopefully further the understanding of CCWD's biotic impairment and its root cause(s).

10.0 Phase II Agenda

Upon review and completion of Phase I, work of Phase II will begin. Work objectives for Phase II are scheduled to begin in June 2013 and conclude in May 2014. A total of 11 work tasks are planned for successful completion of Phase II (Table 17).

Task A	Collect supplementary data
Task B	Format and submit data to MPCA
Task C	Analyze supplementary data
Task D	Develop model input parameters
Task E	Meet with TAC/CAC
Task F	Field inspection of select reaches
Task G	Conduct groundwater and surface water review
Task H	Determine extent of impairments and exceedances
Task I	Develop strength of evidence tables
Task J	Draft primary stressor identification memoranda
Task K	Review conclusion with technical stakeholders

Table 16 Scheduled work tasks for Phase II of approved work plan.

Phase II is the portion of the work plan where significant understanding of CCWD's water quality concerns will be gained. Supplementary data collection will be conducted and submitted to EQuIS. This supplementary monitoring will help to fill data gaps and help to gain knowledge about areas of the district that haven't had routine monitoring conducted. Once these gaps are filled, modeling efforts will be undertaken to help determine the extent of listed impairments and exceedances. Supplementary data analysis will aid in the creation of an accurate and meaningful model performance. Models will predict loadings and help to determine proper allocations necessary to remedy CCWD's impairments. Both P8 and XP-SWMM models will be used to make loading and allocation determinations. A highly important outcome of Phase II will be the SI document which will hopefully lead to conclusive results on what can be done regarding biotic impairment within CCWD. The SI report will document all steps taken to determine candidate causes of all impairments.

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