

Wood River-Barrett Creek-Crex Meadows Targeted Watershed Assessment: A Water Quality Plan to Protect Wisconsin's Watersheds 2020

Wood River Watershed (SC11)
HUC10: 0703000501

Barrett Creek-Saint Croix River Watershed
HUC12: 070300011205



Hay Creek at Benson Road

Photo by Craig Roesler, North DNR Water Quality Biologist
Department of Natural Resources



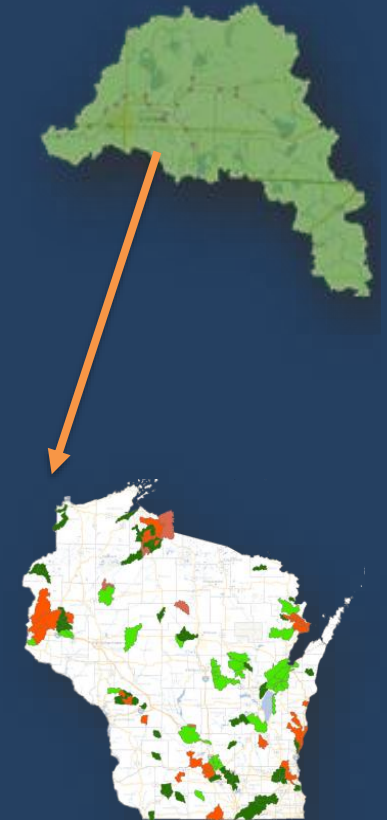
Crex Meadows Wildlife Area

Photo by Aaron Carlson, Google Earth.

To learn more about this area, see Wisconsin TWA Projects Online!
[Wood River, Barrett Creek & Crex Meadows TWA Project](https://dnr.wi.gov/water/TwaPlanSearch.aspx)
<https://dnr.wi.gov/water/TwaPlanSearch.aspx>

Or Search for the Wood River (HUC10) and Barrett Creek-St. Croix Watersheds (HU12) at
[Wisconsin Watershed Search](https://dnr.wi.gov/water/watershedSearch.aspx)
<https://dnr.wi.gov/water/watershedSearch.aspx>

Water Quality
Monitoring conducted
by the Bureau of Water
Quality in support of
the Clean Water Act.



EGAD # 3200-2019-01
Water Quality Bureau
Wisconsin DNR

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Targeted Watershed Assessment Study Summary

In 2014, the Wood River (HUC10) and Barrett Creek-Saint Croix River (HUC12) watersheds were monitored through two Targeted Watershed Assessment (TWA) projects to assess the behavior of iron and its impacts to water quality and stream biology in the vicinity of the Crex Meadows Wildlife Area. A 2016 report entitled *Crex Meadows Wildlife Area Water Quality Assessment (Roesler, et al. 2016)* presented the findings of that project.

The following report presents the data collected in 2014 in a more standardized Targeted Watershed Assessment report format. It focuses on integrating fish, habitat, macroinvertebrate, and chemistry (primarily total phosphorus) water quality data into a series of condition assessments. This baseline condition assessment for specific waters results in management recommendations for DNR and partners such as the Burnett County Land and Water Conservation staff.

About the Watersheds

The Wood River Watershed (HUC 10: 0703000501; green area in Figure 1 below) covers 180 square miles with 195 linear miles of streams and rivers, 5,461 acres of lakes and 34,321 acres of wetlands. The area is dominated by forests (37%), wetlands (24%) and grassland (21%). The Barrett Creek & Saint River watershed (HUC12: 070300011205; blue area in Figure 1 below) lies just north west of the Wood River HUC10 and covers 48 square miles. Forest and wetlands dominate land use, comprising 82% of the watershed area.

Crex Meadows Wildlife Area (CMWA), the primary subject of the study, covers 30,000 acres of brush prairie, wetland, and forest in Burnett County, Wisconsin, northeast of Grantsburg (Figure 2). Since 1945, the Wisconsin DNR has constructed more than 18 miles of dikes to form more than 15,000 acres of wetland wildlife habitat and about 5,000 acres of deep-water marshes. Streams downstream of CMWA have high iron concentrations and are frequently turbid due to an abundance of suspended iron floc (iron hydroxide precipitate) which has generated inquiries and complaints from the public. The monitoring project was conducted in the four HUC12s in and around the CMWA in 2014. Monitoring of soils, streams, flowages, springs, and sediment as well as biological communities (fish and macroinvertebrates) was conducted.

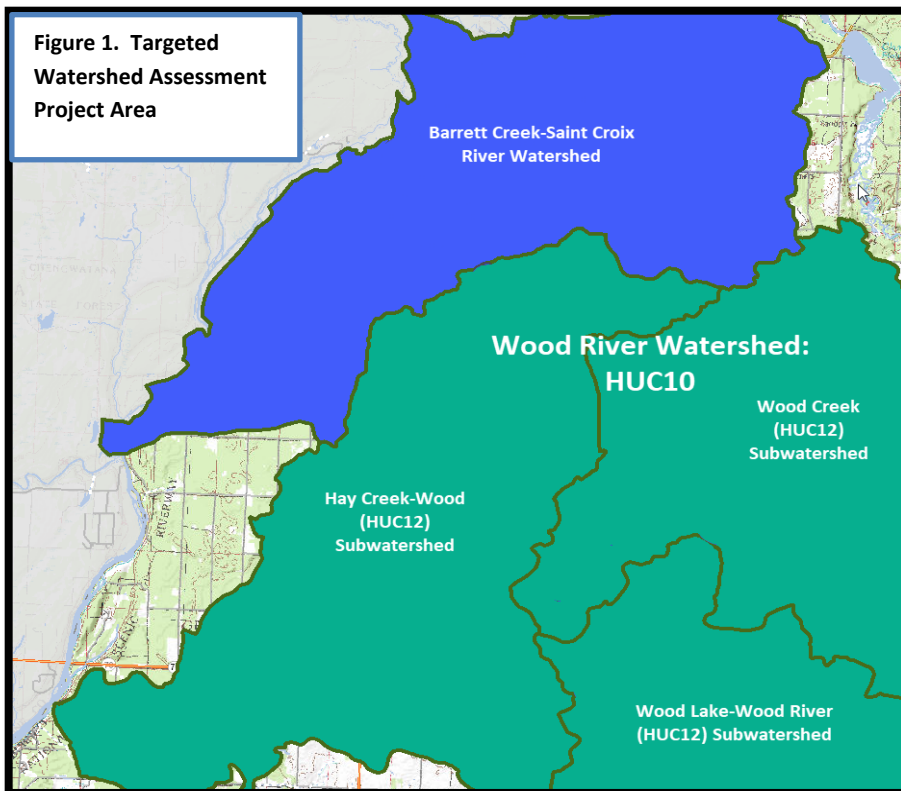
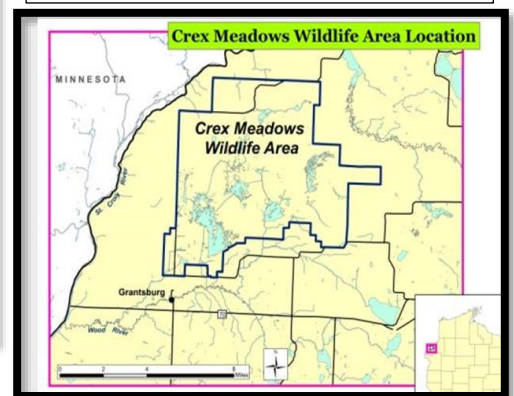


Figure 2. Crex Meadows Wildlife Area



Water Quality and Biological Communities

Stream turbidity due to oxidized iron floc is a notable water quality impairment in the Hay Creek-Wood River-Crex Meadows watershed. Inundation of iron rich soils due to flowage construction at Crex Meadows Wildlife Area (CMWA) is the source of this turbidity. Wisconsin does not have stream water quality standards for turbidity.

Iron floc turbidity causes aesthetic impairment in streams downstream of CMWA. The three streams most directly affected by soil iron releases (Hay, Whiskey, and "North Fork" Creeks) have average summer iron concentrations of 12-25 mg/l, while local background streams have iron concentrations less than 1 mg/l. Average summer water transparencies in these three streams were 19-35 cm (0.6-1.2 feet). These three streams are estimated to discharge 320,000 kg of iron per year to the Wood River. The iron content of CMWA soils can probably maintain this level of iron discharge for at least many decades.

Fish indices of biotic integrity (IBI), number of species, and fish densities in the streams with highest iron concentrations are comparable to those in unaffected streams nearby. Hay Creek, which had the highest stream iron concentrations, had "small stream" fish IBI's of good to excellent.

Fish IBI tools were developed largely to reflect the degree of human disturbance of a stream and its watershed. At CMWA typical human disturbance such as intense land use development is of minor significance, so the value of applying IBIs is uncertain.

To further assess fish populations, non-metric multidimensional scaling was applied to assess how fish assemblages reflect environmental gradients. The fish species occurring in greatest abundance in streams with high iron turbidity are pearl dace, fine scale dace, fathead minnow, and brook stickleback. It appears these species are well adapted to stream conditions resulting from high iron concentrations.

Mussel surveys previously done in the Wood River showed excellent mussel populations were present downstream of Grantsburg (below the Memory Lake dam), where noticeable iron floc turbidity is present.

Some impacts of iron floc turbidity to the biological communities in streams were found. The lower 1.5 miles of Hay Creek is listed as a class II trout water. A reproducing brook trout population was present in 1964. Additional flowages and drainage ditches were constructed in the Hay Creek watershed since that time. Trout are no longer present, very probably due to increased iron turbidity.

Macroinvertebrate communities in streams with high iron concentrations show indications of poorer quality than those in low iron concentration streams. High iron streams have fewer mayflies, stoneflies, and caddisflies (% EPT individuals), more fly larvae (% Dipteran individuals), and more chironomids (a sub-group of fly larvae) (% Chironomid individuals).

Management Recommendations

No feasible means of controlling iron floc turbidity could be identified (other than flowage dewatering). The CMWA flowages provide tremendous wildlife and recreational value. The water quality impairments are an unfortunate environmental trade-off. If the value of specific flowages declines substantially in the future, consideration should be given to flowage dewatering, for downstream water quality restoration.

Wood Lake, which is upstream of, and unaffected by the CMWA, is impaired due to high total phosphorus and chlorophyll concentrations. Efforts to reduce phosphorus loading to the lake should be made. Development of a lake phosphorus budget would be a first step.



Crex Meadows Wildlife Area
Photo by Aaron Carlson

Wisconsin Water Quality Monitoring and Planning

This Water Quality Management Plan was created under the state's Water Resources Planning and Monitoring Programs. The plan reflects water quality program priorities and Water Resources Monitoring Strategy 2015-2020 and fulfills Wisconsin's Areawide Water Quality Management Plan requirements under Section 208 of the Clean Water Act. Condition information and resource management recommendations support and guide program priorities for the planning area.

This WQM Plan is approved by the Wisconsin DNR and is a formal update to St. Croix Basin Areawide Water Quality Management Plan and Wisconsin's statewide Areawide Water Quality Management Plan (AWQM Plan). This plan will be forwarded to USEPA for certification as a formal update to Wisconsin's AWQM Plan.

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Basin/Watershed Partners

- Burnett County Land and Water Conservation Department

Report Acknowledgements

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Abbreviations

AEL: Aquatic Entomology Laboratory at UW – Stevens Point: the primary laboratory for analysis of macroinvertebrate taxonomy in the State of Wisconsin.

BMP: Best Management Practice. A land management practice used to prevent or reduce nonpoint source pollution such as runoff, total suspended solids, or excess nutrients.

DATCP: Wisconsin Department of Agriculture, Trade and Consumer Protection – the state agency in partnership with DNR responsible for a variety of land and water related programs.

DNR: Department of Natural Resources. Wisconsin Department of Natural Resources is an agency of the State of Wisconsin created to preserve, protect, manage, and support natural resources.

END: Endangered Species - Wisconsin species designated as rare or unique due to proximity to the farthest extent of their natural range or due to anthropogenic deleterious impacts on the landscape or both.

ERW: Exceptional Resource Water- Wisconsin's designation under state water quality standards to waters with exceptional quality and which may be provided a higher level of protection through various programs and processes.

FHMD: Fisheries and Habitat Management Database – or Fish Database – the state's repository for fish taxonomy and auto-calculated metrics involving fish assemblage condition and related.

FIBI: Fish Index of biological integrity (Fish IBI). An Index of Biological Integrity (IBI) is a scientific tool used to gauge water condition based on biological data. Results indicate condition and provide insight into potential degradation sources. In Wisconsin, specific fish IBI tools are developed for specific natural communities. Biologists review and confirm the natural community to use the correct fish IBI tool.

HUC: Hydrologic Unit Code. A HUC is a code that represents nested hydrologic watersheds delineated by multiple agencies at the federal and state level including USGS, USFS, and Wisconsin DNR.

MIBI: Macroinvertebrate Index of biological integrity. In Wisconsin, the MIBI, or macroinvertebrate Index of biological integrity, was developed to assess macroinvertebrate community condition.

Monitoring Seq. No. Monitoring sequence number refers to a unique identification code generated by the Surface Water Integrated Monitoring System (SWIMS), which holds much of the state's water quality monitoring data except for fisheries taxonomy and habitat data.

NC: Natural Community. A system of categorizing water based on inherent physical, hydrologic, and biological components. Streams and Lakes have uniquely derived systems that result in specific natural community designations for each lake and river segment in the state. These designations dictate the appropriate assessment tools which improves the condition result, reflecting detailed nuances reflecting the modeling and analysis work foundational to the assessment systems.

MDM: Maximum Daily Averages – maximum daily average is a calculated metric that may be used for temperature, dissolved oxygen and related chemistry parameters to characterize water condition.

mg/L: milligrams per liter - a volumetric measure typically used in chemistry analysis characterizations.

Monitoring Seq. No. Monitoring Sequence Number refers to a unique identification code generated by the Surface Water Integrated Monitoring System (SWIMS), which holds much of the state's water quality monitoring data.

NOAA: National Oceanic and Atmospheric Administration – a federal agency responsible for water / aquatic related activities involve the open waters, seas and Great Lakes.

ND: No detection – a term used typically in analytical settings to identify when a parameter or chemical constituent was not present at levels higher than the limit of detection.

NRCS: USDA Natural Resources Conservation Service - the federal agency providing local support and land management outreach work with landowners and partners such as state agencies.

ORW: Outstanding Resource Water- Wisconsin's designation under state water quality standards to waters with outstanding quality and which may be provided a higher level of protection through various programs and processes.

SC: Species of Special Concern- species designated as special concern due to proximity to the farthest extent of their natural range or due to anthropogenic deleterious impacts on the landscape, or both.

SWIMS ID. Surface Water Integrated Monitoring System (SWIMS) identification number is the unique monitoring station identification number for the location of monitoring data.

TDP: Total Dissolved Phosphorus – an analyzed chemistry parameter collected in aquatic systems positively correlated with excess productivity and eutrophication in Wisconsin waters.

TMDL: Total Maximum Daily Load – a technical report required for impaired waters Clean Water Act. TMDLs identify sources, sinks and impairments associated with the pollutant causing documented impairments.

TP: Total Phosphorus - an analyzed chemical parameter collected in aquatic systems frequently positively correlated with excess productivity and eutrophication in many of Wisconsin's waters.

TWA: Targeted Watershed Assessment. A monitoring study design centered on catchments or watersheds that uses a blend of geometric study design and targeted site selection to gather baseline data and additional collection work for unique and site-specific concerns for complex environmental questions including effectiveness monitoring of management actions, evaluation surveys for site specific criteria or permits, protection projects, and generalized watershed planning studies.

TSS: Total suspended solids – an analyzed physical parameter collected in aquatic systems that is frequently positively correlated with excess productivity, reduced water clarity, reduced dissolved oxygen and degraded biological communities.

WATERS ID. The Waterbody Assessment, Tracking, and Electronic Reporting System Identification Code. The WATERS ID is a unique numerical sequence number assigned by the WATERS system, also known as "Assessment Unit ID code." This code is used to identify unique stream segments or lakes assessed and stored in the WATERS system.

WBIC: Water Body Identification Code. WDNR's unique identification codes assigned to water features in the state. The lines and information allow the user to execute spatial and tabular queries about the data, make maps, and perform flow analysis and network traces.

WISLOH: Wisconsin State Laboratory of Hygiene (aka WSLOH) – the state's certified laboratory that provides a wide range of analytical services including toxicology, chemistry, and data sharing.

WQC: Water quality criteria – a component of Wisconsin's water quality standards that provide numerical endpoints for specific chemical, physical, and biological constituents.



Hay Creek Upstream of CTH F, Photo by Craig Roesler, WDNR.



Whiskey Creek Downstream of CTH D, Photo by Craig Roesler, WDNR.

WQM Plan Goals

In 2014, the Wood River (HUC10) and Barrett Creek-Saint Croix River (HUC12) watersheds (Figure 1) were monitored through two Targeted Watershed Assessment (TWA) projects to assess the behavior of iron and its impacts to water quality and stream biology in the vicinity of the Crex Meadows Wildlife Area. A 2016 report, "Crex Meadows Wildlife Area Water Quality Assessment (Roesler, et al. 2016)", presented the findings of that project.

The following report presents the data collected in 2014 in a more standardized Targeted Watershed Assessment report format. This document presents monitoring results, identifies concerns in the area, and provides recommendations to improve or protect water quality consistent with Clean Water Act guidelines and state water quality standards. It focuses on integrating fish, habitat, macroinvertebrate, and chemistry (primarily total phosphorus) water quality data into a series of condition assessments. This baseline condition assessment for specific waters results in management recommendations for DNR and partners such as the Burnett County Land and Water Conservation staff.

Resources Overview

Location, Size, Land Use

The Wood River Watershed (HUC 10: 0703000501 (mapped red area in Figure 3 below)) covers 180 square miles with 195 linear miles of streams and rivers, 5,461 acres of lakes and 34,321 acres of wetlands. The area is dominated by forests (37%), wetlands (24%) and grassland (21%). Agricultural cropland comprises 11% of the watershed.

The Barrett Creek & Saint Croix River Watershed (HUC12: 070300011205 (mapped red area in Figure 4 below)) lies just northwest of the Wood River HUC10 and covers 48 square miles. Forest and wetlands dominate land use, at over 80%.

Land use distribution for both watersheds is shown in Figure 5.

Figure 3. Wood River HUC10 Watershed Land Use

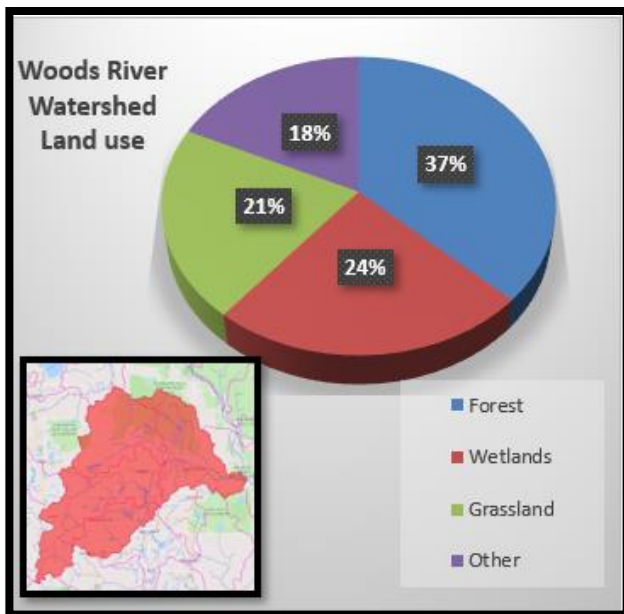


Figure 4. Barrett Creek & Saint Croix River HUC12 Watershed Land Use

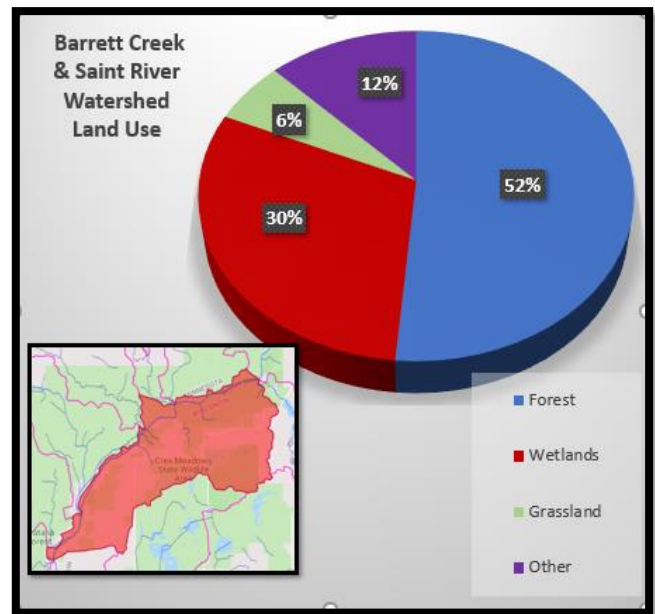
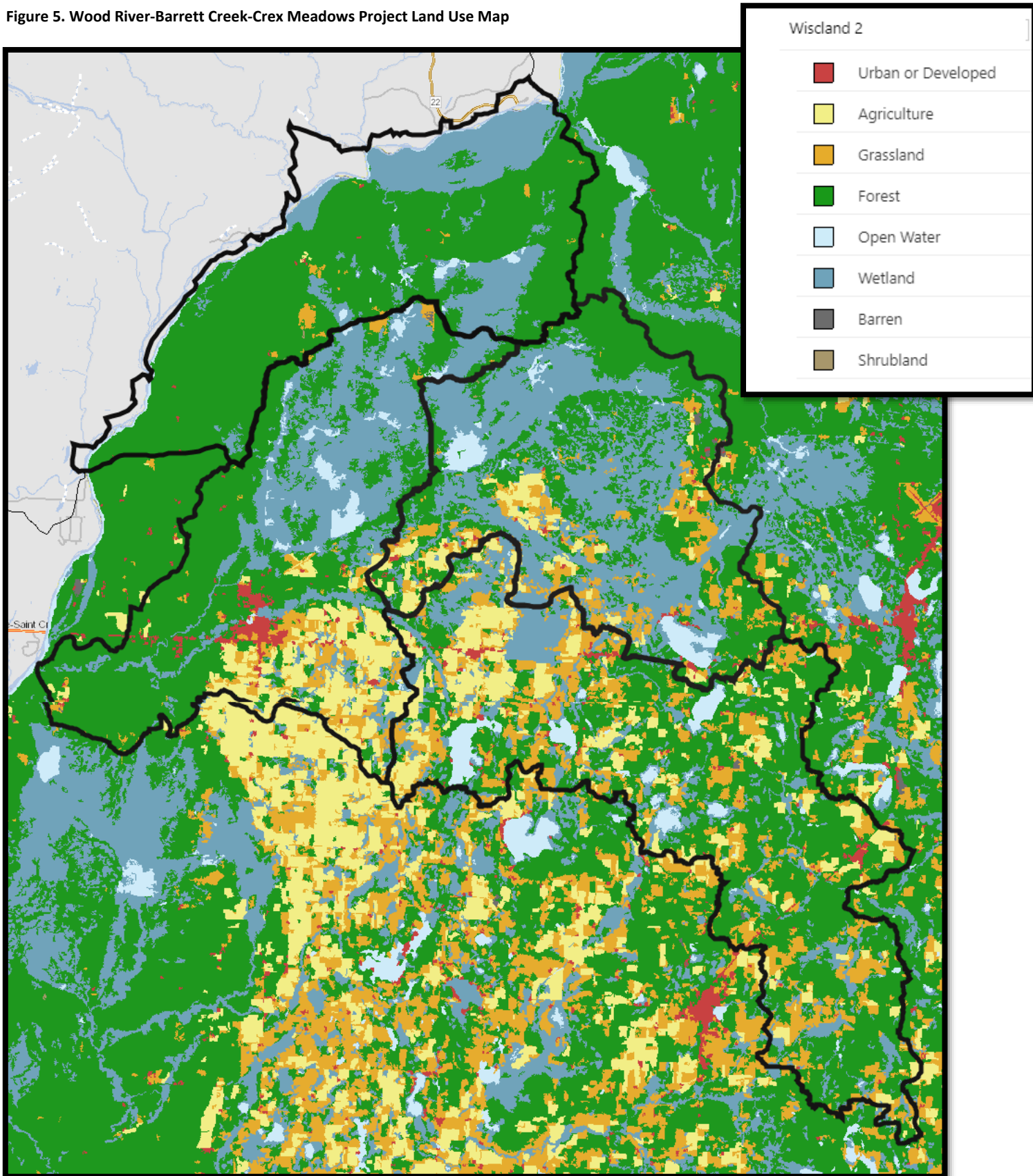


Figure 5. Wood River-Barrett Creek-Crex Meadows Project Land Use Map



Ecological Landscapes

The Wood River Watershed lies primarily in two Ecological Landscapes: Forest Transition and Northwest Sands (Figure 6). The Forest Transition Ecological Landscape contains northern forests and agriculture on glacial till plain soils. Soil textures range from sandy loam to loam.

The Northwest Sands Ecological Landscape is glacial outwash with flat plains or terraces along glacial meltwater channels and pitted or "collapsed" outwash plains with kettle lakes. Soils are deep sands, low in organic material and nutrients. Vegetation is a mix of forest, agriculture, and grassland with some wetlands in the river valleys. All sites monitored in 2014 were in the Northwest Sands Ecological Landscape.

Hydrology

There are several large lakes in the upstream portion of the Wood River watershed. The Wood River drains to the St. Croix River which is designated as a National Wild and Scenic River. The small streams in the Barrett Creek – St. Croix River watershed drain directly to the St. Croix River.

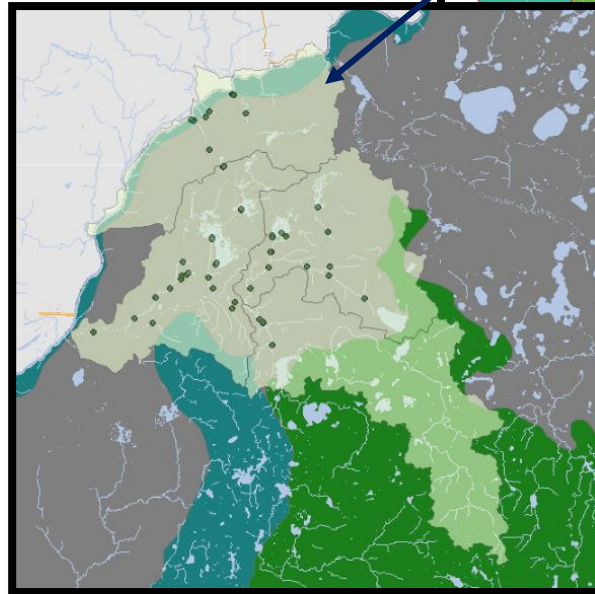
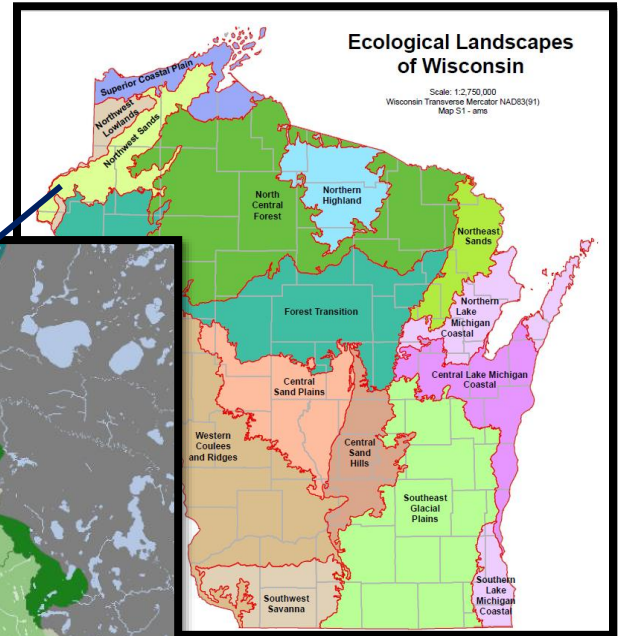


Figure 6. Project Area & Wisconsin Ecological Landscapes



[Read more at Wisconsin DNR](#)

Hydrology in the Crex Meadows Wildlife Area has been extensively modified. Since 1945, the Wisconsin DNR has constructed 18 miles of dikes that form 5,000 acres of deep-water marshes and 15,000 acres of wetland wildlife habitat. Drainage from much of the area flows to the south via several tributaries to the North Fork Wood River and the Wood River.

Soils

The soils in the area monitored in 2014 are sands with high infiltration rates.

Trout Waters

DNR classifies trout streams throughout the state. Class I are naturally reproducing populations; class II are supplemented by stocking, and class III are wholly supported by stocking. New waters are monitored and identified or evaluated every year. There is one small trout water listed in the Wood Creek watershed. Hay Creek is listed as a Class II trout water based on survey data from 1964. However, surveys done in 2014 and 2015 found that trout are no longer present in this stream so the listing is obsolete. There are five small Class I trout waters in the Barrett Creek – St. Croix River watershed:

- Ekdall Brook (WBIC 2653300)
- Bear Brook (WBIC 2653200)
- Kettle Brook (WBIC 2653100)
- Brant Brook (WBIC 2653000)
- East Brook (WBIC 2652900)

Outstanding and Exceptional Resource Waters

Wisconsin designates the highest quality waters as Outstanding Resource Waters (ORW's) or Exceptional Resource Waters (ERW's). These are surface waters that provide outstanding recreational opportunities, support valuable fisheries and wildlife habitat, have good water quality, and are not significantly impacted by human activities. ORW and ERW status identifies waters that the State of Wisconsin has determined warrant additional protection from the effects of pollution. There are no ORW's or ERW's in the Wood River watershed. The

Barrett Creek – St. Croix River watershed has one ORW – the St. Croix River (WBIC 2601400), and five ERW's. The five ERW's are the class I trout streams listed above.

Impaired Waters

Section 303(d) of the Clean Water Act requires states to publish a list of waters that do not meet water quality standards. Wood Lake is the only impaired water in these watersheds. It is on the list due to high total phosphorus and chlorophyll concentrations

Project Methods

Site Selection

In 2014, the Wood River (HUC10) and Barrett Creek-Saint Croix River (HUC12) Watersheds were monitored through two Targeted Watershed Assessment (TWA) projects to assess the behavior of iron and its impacts to water quality and stream biology in the vicinity of Crex Meadows Wildlife Area (Figure 2).

This study involved data collection for soils, stream and flowage (impoundment) water quality, streamflow, stream fish community, qualitative habitat, macroinvertebrate communities, and flowage sediment. Since previous data suggested flowages were the source of elevated iron concentrations in local streams, sites were selected upgradient and downgradient from flowage influence.

Study Design and Methods

Stream, Flowage Outlet, Spring, and Ditch Water Quality and Flow Monitoring

Twenty-four sites with flowing surface water were monitored (Table 1, Figure 7) (Figure 8 includes some additional sites not in Table 1 or Figure 7). Three primary stream monitoring sites (Hay, Whiskey, and "North Fork" Creeks) were the most intensely monitored, since they conduct most of the surface drainage flowing southward out of CMWA. Six secondary sites that included both streams and flowage outlets were monitored on 29-32 dates. An additional 15 sites that included 9 streams, 4 springs, and 2 ditches were infrequently monitored. Water samples were collected and field parameters were measured following standard DNR protocols. Water samples were acidified, as needed, and shipped on ice to the Wisconsin State Lab of Hygiene for analysis.

Field parameters measured were:

- Temperature
- pH
- Dissolved oxygen
- Conductivity
- Transparency (using a transparency tube)
- Continuous temperature (at 3 primary stream sites)

Lab parameters were:

- Iron
- Total phosphorus
- Total suspended solids
- Turbidity
- True color

Flow measurements were made on ten dates at the three primary stream monitoring sites (Hay, Whiskey, and "North Fork" Creeks).

Measurements were made with a Swiffer current meter following standard DNR protocols. Staff gages were used to measure stream stages. Staff gage readings were made once or twice a week or more during April through October. Stage-discharge curves were developed and used to estimate flows on all dates with stage readings. Methods used for water quality and flow monitoring were:

- [Guidelines and Procedures for Surface Water Grab Sampling \(Dec. 2005 Version 3\)](#)
- [2301 open channel flow measurement](#)
- [Guidance for Dissolved Oxygen Meter Sampling](#)

Table 1. Wood River-Barrett Creek-Crex Meadows Monitoring Stations, Site Numbers, and Data Type Collected

WT	Map Site #	Waterbody	WBIC	Station ID	Location	Chemistry	Macro Invertebrate	Habitat	Fish
1	1	Wood River	2642900	073030	West River Rd. (1.8 mi US St Croix R)		x	x	x
1	2	Wood River	2642900	10042968	460m DS STH 70, West Crossing			x	x
1	3	Wood River	2642900	073106	North Williams Rd		x	x	x
4	4	Wood River	2642900	10042994	427m DS STH 70, East Crossing			x	x
4	5	Wood River	2642900	073029	Hwy 70, East Crossing	x	x	x	x
4	7	Wood River	2642900	10029120	US of Crosstown Rd		x	x	x
1	8	Unnamed	5004271	10042428	155m DS North Rd	x	x	x	x
2	9	No. Fork Wood R.	2647000	073032	North Fork Road		x	x	x
2	11	No. Fork Wood R	2647000	073114	CTH D, West Crossing	x	x	x	x
2	12	No. Fork Wood R	2647000	073115	CTH D, East Crossing		x	x	x
2	13	No. Fork Wood R	2647000	10042445	30m US Fossum Rd			x	x
2	14	No. Fork Wood R	2647000	10042430	20m US Shearman Rd		x	x	x
2	15	Unnamed Stream	2649400	10042431	10m US mouth at North Fork River			x	x
1	16	Hay Creek	2643000	10042555	170m DS STH 70			x	x
1	17	Hay Creek	2643000	10042459	177m DS Benson Rd.			x	x
1	18	Hay Creek	2643000	10042528	20m US Borg Rd.	x	x	x	x
1	19	Hay Creek	2643000	10041942	10m West of CTH F	x		x	x
1	20	Unnamed Ditch	no WBIC	10042530	CTH F			x	x
1	21	Whiskey Creek	2646600	10037789	110m DS CTH D	x	x	x	x
1	22	Whiskey Creek	2646600	10042529	192m DS Whiskey Creek Flowage	x		x	x
2	23	Unnamed	2647100	10041943	10m DS Lundquist Rd	x	x	x	x
2	24	Unnamed	5003911	10042157	(Kylingstad) North Fork Dike Rd	x			
2	25	Unnamed	2649300	10042429	3m US Fossum Rd		x	x	x
3	26	Iron Creek	2653700	10042377	124m DS Sadlers Road	x	x	x	x
3	27	Ekdall Creek	2653300	10042427	5m above mouth	x		x	x
3	28	Unnamed Stream	5003640	10042443	Nordstrom Road	x		x	x
3	29	Unnamed Stream	5003630	10042444	near Bang Rd			x	x
3	30	Unnamed Stream	2647100	10042969	160m DS North Fork Flowage			x	x
2	31	Unnamed Stream	(5003922)	10042446	37m DS North Fork Dike Rd	x		x	x

Figure 7. Wood River-Barrett Creek-Crex Meadows Targeted Watershed Assessment Monitoring Sites

Map Site #	Station ID	Location
1	073030	Wood River at West River Rd. (1.8 mi US St Croix R)
2	10042968	Wood River 460m DS STH 70, West Crossing
3	073106	Wood River at North Williams Rd
4	10042994	Wood River 427m DS STH 70, East Crossing
5	073029	Wood River at Hwy 70, East Crossing
7	10029120	Wood River US of Crosstown Rd
8	10042428	Unnamed Stream 155m DS North Rd
9	073032	North Fork Wood River at North Fork Road
11	073114	North Fork Wood River at CTH D, West Crossing
12	073115	North Fork Wood River at CTH D, East Crossing
13	10042445	North Fork Wood River 30m US Fossum Rd
14	10042430	North Fork Wood River 20m US Shearman Rd
15	10042431	Unnamed Stream 10m US mouth at North Fork River
16	10042555	Hay Creek 170m DS STH 70
17	10042459	Hay Creek 177m DS Benson Rd.
18	10042528	Hay Creek 20m US Borg Rd.
19	10041942	Hay Creek 10m West of CTH F
20	10042530	Unnamed Ditch along CTH F
21	10037789	Whiskey Creek 110m DS CTH D
22	10042529	Whiskey Creek 192m DS Whiskey Creek Flowage
23	10041943	Unnamed Stream 10m DS Lundquist Rd
24	10042157	Unnamed (Kylingstad) Creek at North Fork Dike Rd
25	10042429	Unnamed Stream 3m US Fossum Rd
26	10042377	Iron Creek 124m DS Sadlers Road
27	10042427	Ekdall Creek 5m above mouth
28	10042443	Unnamed Stream at Nordstrom Road
29	10042444	Unnamed Stream near Bang Rd
30	10042969	Unnamed Stream 160m DS North Fork Flowage
31	10042446	Unnamed Stream 37m DS North Fork Dike Rd

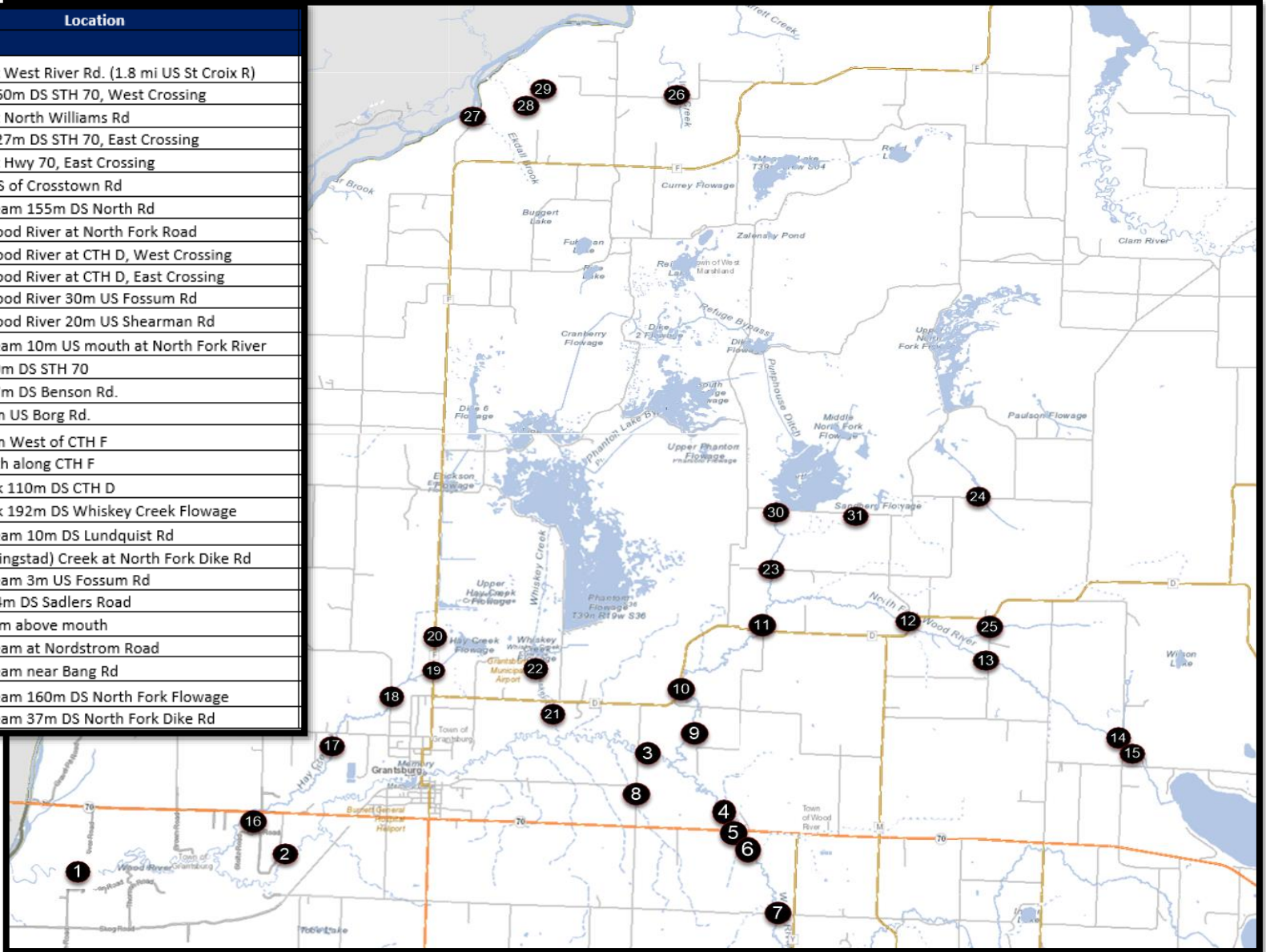
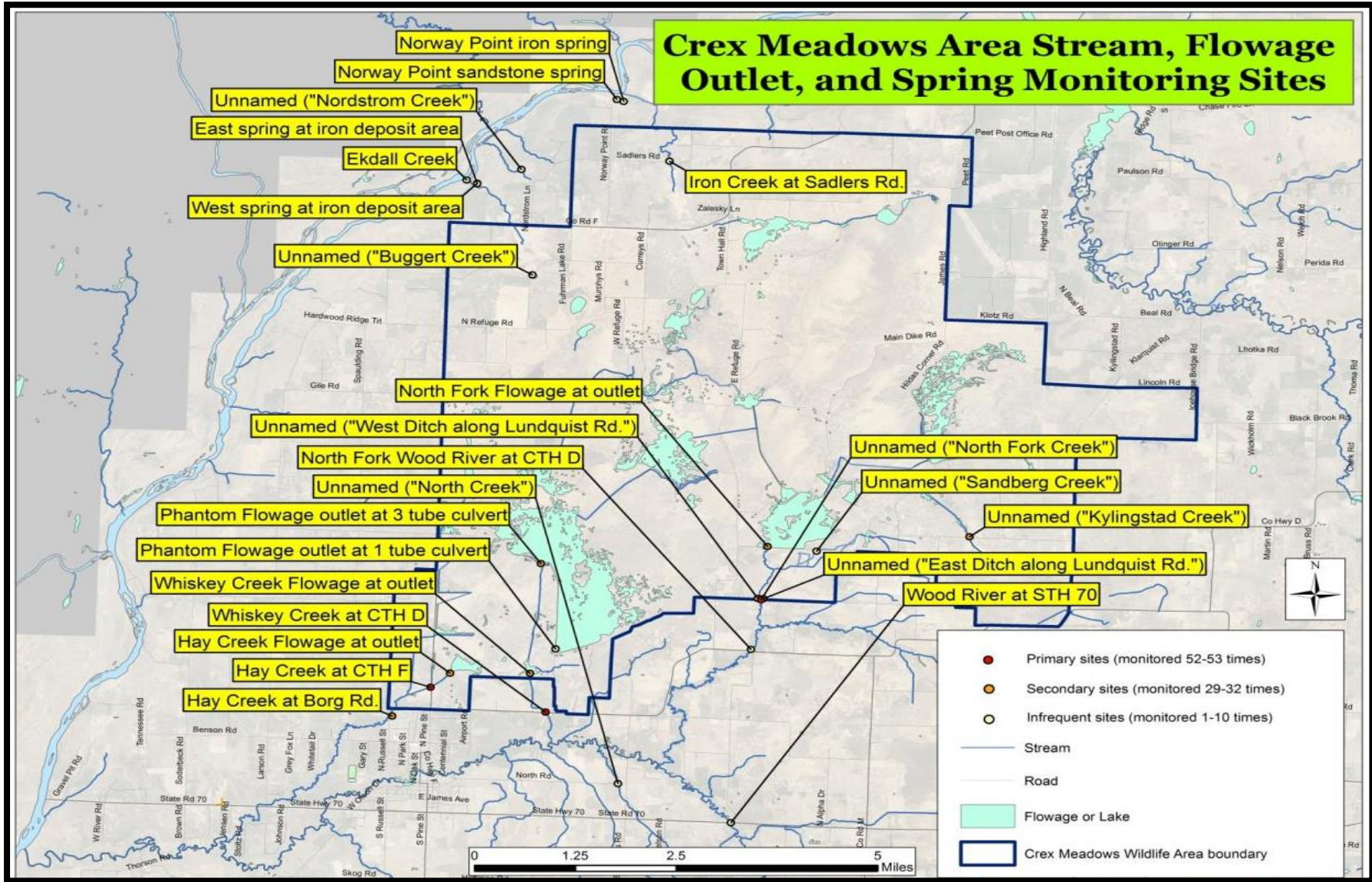


Figure 8. Crex Meadows Area Stream, Flowage Outlet and Spring Water Chemistry Monitoring Sites



Macroinvertebrate Community Assessment

Macroinvertebrate samples were collected from 14 stream sites (Tables 1, 2 & 4 and Figure 9). Macroinvertebrate communities were assessed by collecting kick samples in October using a 500-um mesh rectangular frame net. Most stream sites had sandy substrates and gravel/cobble riffle habitat was not present. To maximize consistency between sites, whenever possible, samples were collected from woody debris which was draped with leaf snags or other vegetative fragments. Samples were preserved in 85% ethanol and were processed by UW – Stevens Point's Aquatic Biomonitoring Lab. Macroinvertebrates were counted and identified to the lowest possible taxa. Biotic indices and other statistics were generated. Field methods used were:

- [Guidelines for Collecting Macroinvertebrate Samples in Wadeable Streams](#)
- [Wadeable Macroinvertebrate Field Data Report Form 3200-081 \(R 08/14\)](#)

Fish Community and Habitat Assessment

Fish communities were surveyed at 28 stream sites (Tables 1 & 2, Figure 10). Fish communities were assessed by electrofishing with one or two single anode backpack shockers on small to medium-sized stream sites, and a double or triple anode tow barge stream shocker on larger stream sites. As many fish as possible were captured with a single upstream pass. Station lengths were 35 times the mean stream width, with a minimum length of 100 meters and a maximum length of 400 meters (Lyons 1992). Fish captured were counted and identified to species. Gamefish lengths were measured. Fish community data was used to determine the natural community of the stream, and to calculate biotic indices. Qualitative habitat assessments were made for all fish survey sites. Methods used were:

- [Wadeable Stream Fish Community Evaluation Form 3600-230 \(R 7/00\)](#)
- [Guidelines for Assessing Fish Communities of Wadeable Streams in Wisconsin](#)
- [Guidelines for Qualitative Physical Habitat Evaluation of Wadeable Streams \(2007\)](#)
- [Qualitative Habitat Rating less than 10m Form \(3600-532A\) \(R 6/07\)](#)

Flowage (Impoundment) Water Quality Monitoring

Flowage water samples were collected and field parameters were measured at eight sites (Appendix D) on two dates (late summer and late winter). Water samples were collected and field parameters were measured following standard DNR protocols. Water samples were acidified, as needed, and shipped on ice to the Wisconsin State Lab of Hygiene for analysis.

Field parameters measured:

- Temperature
- pH
- Dissolved Oxygen
- Conductivity
- Transparency (using a Secchi disk)

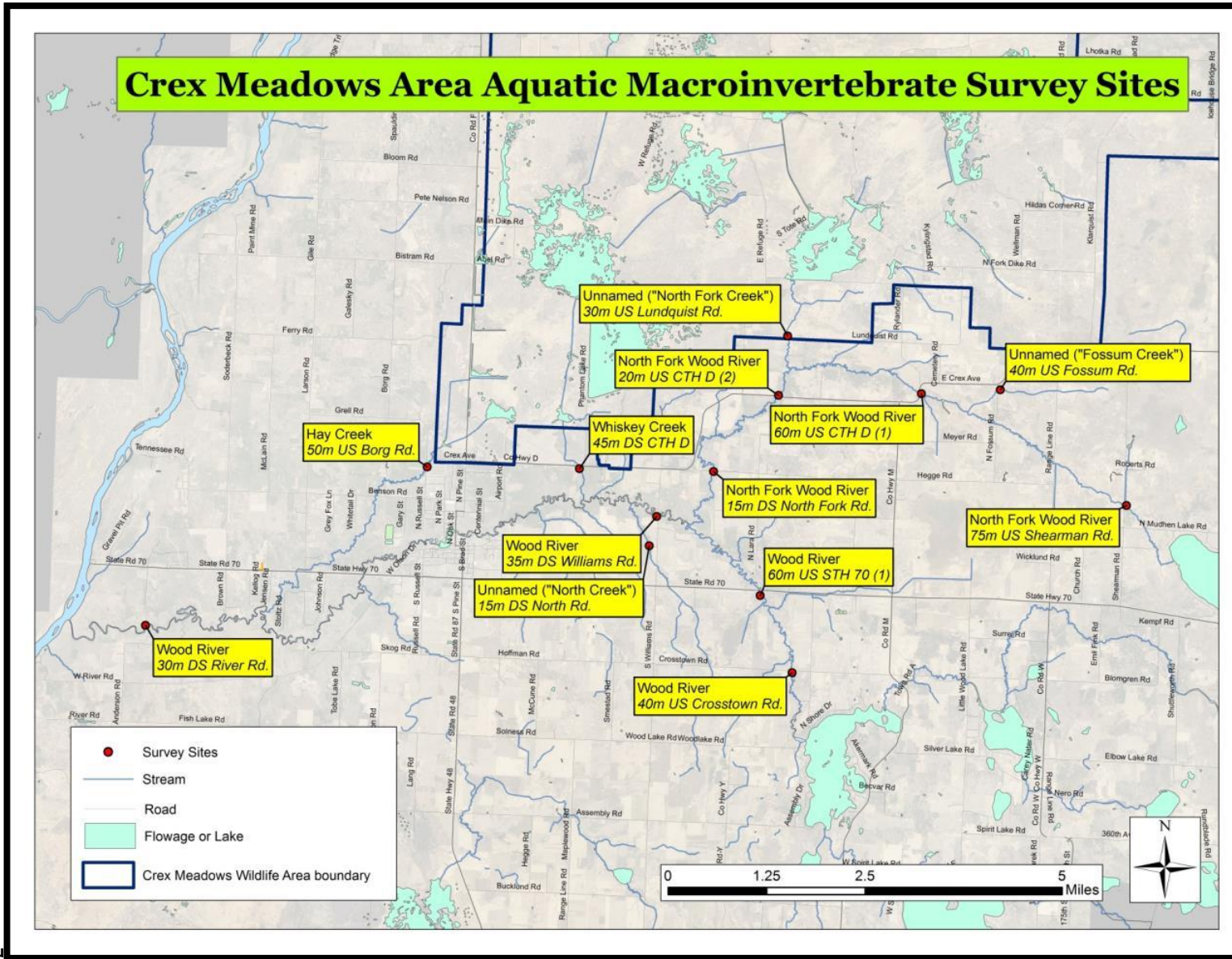
Lab parameters measured:

- Iron
- Total Phosphorus

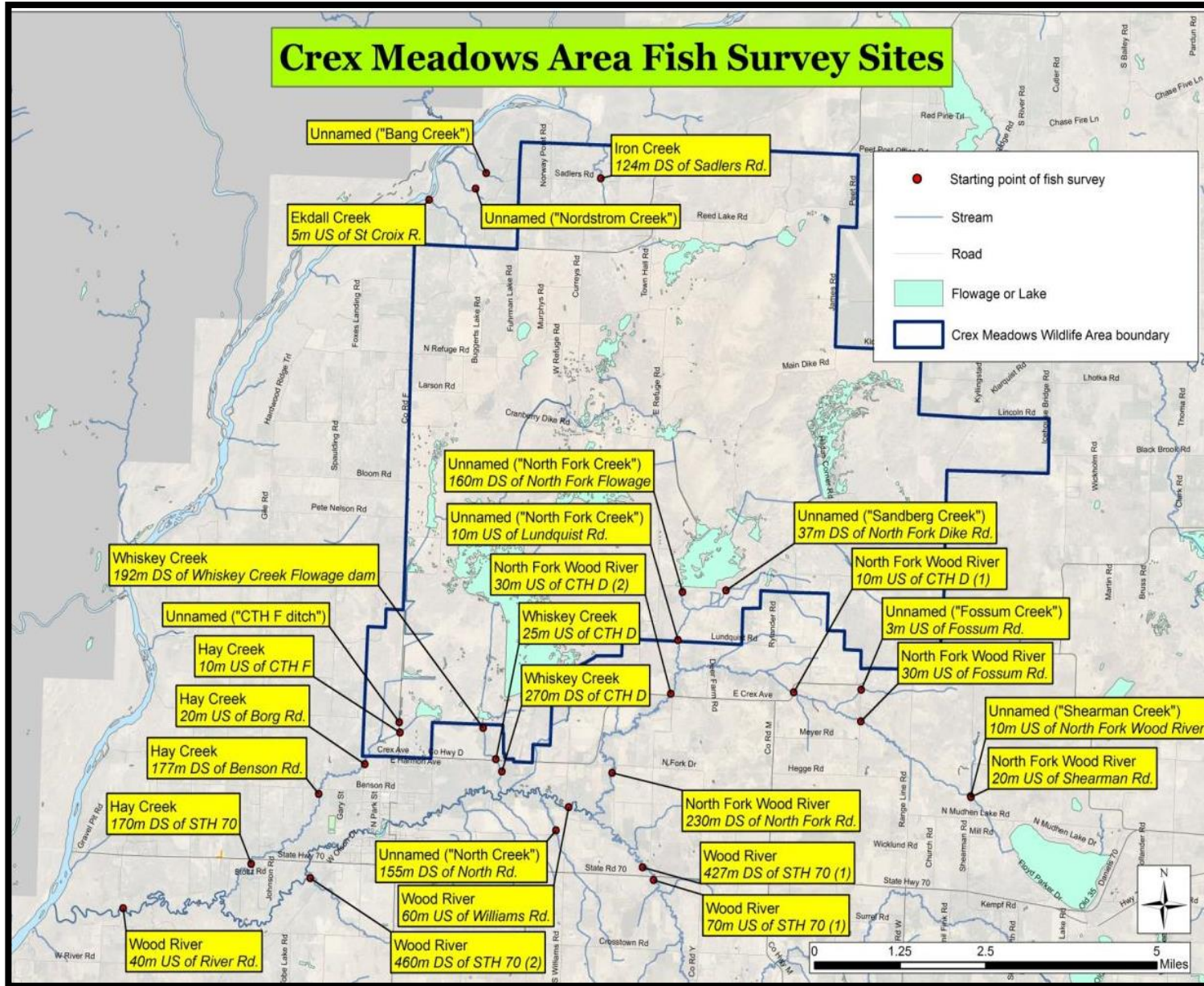
Additionally, field parameters were measured once or twice a week during June through September at four flowage outlets (Lower Hay Creek, Whiskey Creek, Phantom, and North Fork Flowages). Field parameters measured were:

- Temperature
- Conductivity
- Transparency (using a transparency tube)

Figure 9. Crex Meadows Area Macroinvertebrate Sites



Figure



Soil Sampling

Thirty soil samples were collected from 22 sites (Appendix D). A four-inch diameter stainless steel bucket auger with a 5 feet handle was used. Bulk density samples were collected by tapping a four-inch length of a thin-walled stainless steel tube into the side of a shovel-excavated hole. After the tube was fully embedded in the soil, it was gradually excavated with a shovel while the soil at the two ends was trimmed smooth with a flat metal blade. Observations of soil characteristics and changes with depth were recorded. A five feet profile was examined at most sites. Water table depth was recorded when encountered. Most soil samples were collected from a depth of 24–30 inches, and most bulk density samples were collected at a depth of 18 inches. Multiple samples were collected at some sites to assess profile variability. Soil samples were shipped to the UW Soil and Plant Analysis Lab for analyses. Lab parameters tested included: total iron (and total phosphorus, potassium, calcium, magnesium, sulfur, zinc, boron, manganese, copper, aluminum, and sodium), total organic carbon, % sand, silt, clay, and bulk density.

Flowage Sediment sampling

Sediment samples were collected from eight flowage and lake sites (Appendix D). Samples were collected with a stainless-steel Ekman bottom grab. The top 6 inches of sediment was sampled. Soft sediment depth was measured with a ½ inch diameter fiberglass rod. Sediment samples were shipped on ice to the Wisconsin State Lab of Hygiene for analysis. Lab parameters tested were: Iron, Total phosphorus, % Solids, % Volatile solids, % Sand, Silt, clay, Bulk density.



Crex Meadows Wildlife Area, Aaron Carlson

Project Results and Discussion

Stream Fish Communities

The 28 stream sites surveyed for fish are listed in Table 2 and shown in Figure 10. Stream natural community verifications and fish index of biotic integrity (IBI) ratings are also listed in Table 2. Four different IBI's were used depending on stream size and/or thermal regime (Lyons et al. 1996, Lyons et al. 2001, Lyons 2006, Lyons 2012). Figure 11 shows the results for number of species, and number of fish captured per 100 meters.

Most streams surveyed had substrates that are primarily sand or silty sand, so fish species dependent on gravel and/or cobble substrates were not present. Gravel/cobble substrates were present in the Wood River, downstream of Grantsburg, and in "North Creek" (unnamed 10042428). Ekdall Creek and "Nordstom Creek" (unnamed 10042443) had limited areas of small gravel substrate. There is a dam on the Wood River at Memory Lake in Grantsburg. The dam is a barrier to upstream fish movement and may influence the distribution of some fish species.

Two to five sites were surveyed on each of the three main drainage streams on the south side of CMWA (Hay, Whiskey, and "North Fork" (unnamed 10042428) Creeks). These streams have high iron concentrations, high levels of iron floc turbidity, and low transparency. The "small stream" IBI was applied to all sites on these streams. IBI's were similar to, or better than other comparable low iron level streams in the area. Species richness and capture rates were also similar to, or better than other comparable low iron level streams in the area.

Species Diversity & Condition

Hay Creek, with the highest iron concentrations of any area stream, had good to excellent small stream IBI's. However, the lower 1.5 miles of Hay Creek is identified as a class II trout water in "Wisconsin Trout Streams" (WDNR PUB-FH-806-2002). The classification is based on a stream survey from 1964 which found 16 brook trout present in a 1,500 feet segment upstream of STH 70. The trout included 4-year classes and had lengths ranging from 2.8-14.3 inches. No trout were found in the 2014 survey downstream from STH 70. An additional fish survey was done in 2015 for a 430 m segment upstream of STH 70 which also found no trout present. Additional flowages and drainage ditches were constructed in the Hay Creek watershed after 1964. These have probably resulted in increased iron turbidity levels in Hay Creek which probably caused the elimination of the trout population.

Hay Creek sites also had moderate species richness (9-11 species) and moderate to high capture rates (83-512 fish/100 m). Fish communities indicated "cool-warm headwater" was the appropriate natural community. Two of the five sites had no intolerant individuals present, which is atypical for cool-warm headwaters. Occasional low dissolved oxygen (D.O.) concentrations may account for this. Daytime D.O. concentrations as low as 1.7 mg/l were measured in Hay Creek downstream of CTH F. Iron floc turbidity might also contribute to the lack of intolerant species. Fish species that comprised more than 20% of the catch at a site included central mudminnows, pearl dace, and johnny darters.

Whiskey Creek had variable IBI's, ranging from poor to excellent. Whiskey Creek sites had low to moderate species richness (5-7 species) and low to high capture rates (36-357 fish/100 m). Fish communities indicated "cool-warm headwater" was the appropriate natural community. However, all three sites had no intolerant individuals present, which is atypical for cool-warm headwaters. D.O. concentrations are higher in Whiskey Creek than in Hay Creek, with a lowest measured daytime oxygen concentration of 3.4 mg/l. Daytime D.O. concentrations at the outfall of Whiskey Creek Flowage were as low as 0.7 mg/l. Occasionally low D.O. and iron floc turbidity may have influenced the lack of intolerant individuals. Fish species that comprised more than 20% of the catch at a site included central mudminnows, brook stickleback, pearl dace, fathead minnows, and northern pike (juvenile).

The two sites on "North Fork" Creek (unnamed 10041943) had fair IBI's. Species richness was low (5-6 species) and capture rates were moderate (50-125 fish/100 m). Fish communities indicated "cool-warm headwater" was the appropriate natural community. Both sites had no intolerant individuals present. D.O. concentrations are somewhat higher in "North Fork" Creek than in Hay or Whiskey Creek, with a lowest measured daytime oxygen concentration of 3.8 mg/l. Extensive wetland areas drain to the stream. Occasional low D.O. and iron floc turbidity may have influenced the lack of intolerant individuals. Fish species that comprised more than 20% of the catch at a site included central mudminnows, and northern pike (juvenile).

Five sites on the Wood River had good to excellent IBI's. Fish communities at the two furthest upstream sites, with no noticeable iron turbidity, indicated "warmwater mainstem" was the appropriate natural community. Wood Lake is about 2 miles upstream which probably contributes to warmer stream temperatures. Species richness (12 species) and catch rates (53-109 fish/100 m) were moderate at these two sites. Spotfin shiners comprised 60-77% of the catch at these sites, with no other species comprising more than 20% of the catch.

Fish communities at the three Wood River sites downstream of the confluence with the North Fork Wood River, with higher levels of noticeable iron turbidity, indicated "cool-warm mainstem" was the appropriate natural community. Groundwater discharge to the North

Fork Wood River and other streams flowing from the Crex Meadows area probably contributes to cooler temperatures in this segment of the Wood River. Species richness (16-20 species) was high but catch rates (17-28 fish/100 m) were low. High flows and turbidity probably had a large influence on the low catch rates. An August 28, 2008 fish survey at the River Road site found 24 species and had a catch rate of 76 fish/100 m compared to 19 species and a catch rate of 17 fish/100 m in 2014. It is likely that more normal base flows allowed more effective fish capture in 2008. Spotfin shiners and central mudminnows comprised more than 20% of the catch at the William Road site. No species comprised more than 20% of the catch at the two sites downstream of Grantsburg.

Three upstream sites on the North Fork Wood River, with no noticeable iron turbidity, had fair to good IBI's. Species richness (4-11 species) and capture rates (44-101 fish/100 m) were low to moderate. Fish communities indicated "cool-warm headwater" or "cool-warm mainstem" was the appropriate natural community. Two of the sites had no intolerant individuals present. Fairly extensive wetland areas drain to the stream. Occasional low D.O. may have influenced the lack of intolerant individuals.

Three small streams north of CMWA (Ekdall, "Nordstrom" (unnamed 10042443), and "Bang" (unnamed 1042444) Creeks) are coldwater streams with brook trout present. These streams are mostly fed by springs discharging at the top of the clay layer along the slope to the St. Croix River. Deposits of oxidized iron are present at the springs, and stream substrates are coated with a thin layer of oxidized iron. Very low catch rates (7 fish/100 m) resulted in IBI's defaulting to poor for Ekdall and "Bang" Creek. "Nordstrom" Creek had a better catch rate (41 fish/100 m) and a good IBI. Young of year (YOY) brook trout were present in Ekdall and "Nordstrom" Creeks, indicating successful reproduction. Some areas of gravel substrate, necessary for brook trout spawning, were present. No YOY brook trout were found in "Bang" Creek, and no gravel substrate was observed.

Iron Creek on the north edge of CMWA, with high levels of noticeable iron turbidity, had too few fish to apply the small stream IBI. Only 6 fish/100 m were captured. Cool-warm headwater is likely to be the appropriate natural community. Central mudminnows and pearl dace were the two species present. The stream segment surveyed at Sadler Road was observed to be dry in the summer of 2013. There are multiple beaver dams above and below the segment that may restrict fish movement and recolonization. There was also a non-wadeable beaver pond downstream of the stream segment surveyed, and most fish may have preferentially located in the pond.

Fish IBI's were developed largely to reflect the degree of human disturbance of a stream and its watershed. At CMWA typical human disturbances such as intense land use development are of minor significance, so the value of applying IBI's is somewhat uncertain. To further assess fish populations in the CMWA non-metric multidimensional scaling (NMDS ordination) was applied to assess how fish assemblages reflect environmental gradients. This ordination reflects the similarities and differences in species composition and abundance across the stream sites.

An evaluation of environmental associations with fish assemblages found six significant influences along the two axes (Figure 12). Axis 1 represents a gradient of water temperature, total phosphorus and conductivity. Axis 2 represents a gradient of pH, flow, and transparency. The most apparent difference is along NMDS axis 1, where coldwater brook trout streams are separated from the sites containing cool and warm water fish assemblages. NMDS axis 2 separates most of the remaining variation among sites with cool and warmwater species.

In Figure 13 a transparency gradient was added using the ordsurf function in program R. Transparency is a good surrogate for iron concentration and iron turbidity. Transparency vs. iron concentration plots for CMWA streams show good correlations with R² values around 0.85. The fish species occurring in greatest abundance in streams with high iron turbidity are pearl dace, finescale dace, fathead minnow, and brook stickleback.

It appears these species are well adapted to stream conditions resulting from high iron concentrations. Three of these species (pearl dace, finescale dace, brook stickleback) are insectivores. The fourth species (fathead minnow) is an omnivore. Examination of pearl dace stomach contents found that chironomids were commonly present. Perhaps the dominance of chironomid and other fly larvae observed in high iron concentration streams provides a food source that can be well utilized by these species.

Figure 13 also shows that brook trout are restricted to streams with transparencies of about ≥ 100 cm. Reduced transparency due to increased iron floc turbidity, such as occurred in Hay Creek, is likely to be unsuitable for brook trout survival.

Tables below (WMS = warm mainstem, CWMS = cool-warm mainstem, CW = cold water, WHW = warm headwater, CWHW = cool-warm headwater, CCHW = cool-cold headwater)

Condition (Rating) Categories for Cool-Warm Mainstem	
Fish Index of Biotic Integrity (fIBI)	
fIBI	Condition
61-100	excellent
41-60	good
21-40	fair
0-20	poor

Condition (Rating) Categories for Small Stream	
Fish Index of Biotic Integrity (fIBI)	
fIBI	Condition
91-100	excellent
61-90	good
31-60	fair
0-30	poor

Condition (Rating) Categories for Warm Mainstem	
Fish Index of Biotic Integrity (fIBI)	
fIBI	Condition
66-100	excellent
51-65	good
31-50	fair
0-30	poor

Table 2. Wood River-Barrett Creek-Crex Meadows TWA Fish Survey Data

Map Site No.	1	2	3	4	6	8	9	11	12	13	14	15	Fish Tolerance Rating	
Station Number	73030	10042968	73106	10042994	73029	10042428	73032	73114	73115	10042445	10042430	10042431		
Station Name	Wood R at West River Rd	Wood R 460 m DS STH 70 (west crossing)	Wood R at North Williams Rd	Wood R 427 m DS STH 70 (east crossing)	Wood R at STH 70 (east crossing)	Unnamed Stream 155 m DS North Rd	North Fork Wood R at North Fork Rd	North Fork Wood R at CTH D (west crossing)	North Fork Wood R at CTHD (east crossing)	North Fork Wood R 30 m US Fossum Rd	North Fork Wood R 20 m Us Shearman Rd	Unnamed 10 m US North Fork Wood R		
Survey Year	2014	2014	2014	2014	2014	2014	2013	2014	2014	2014	2014	2014		
Bigmouth Shiner		3											intermediate	
Black Bullhead			1		1		6					6	tolerant	
Black Crappie													intermediate	
Blackchin Shiner	1												intolerant	
Blacknose Shiner			2	2	2		1			1			intolerant	
Blackside Darter	5	11	1	1									intermediate	
Bluegill	2	1			4						1		intermediate	
Bluntnose Minnow				4									tolerant	
Bowfin							1						intermediate	
Brassy Minnow	2												intermediate	
Brook Silverside			1										intermediate	
Brook Stickleback												1	tolerant	
Brook Trout													intolerant	
Burbot	9	1											intermediate	
Central Mudminnow	1	8	22	10	4	11	36	29	36	67	30	23	138	tolerant
Channel Catfish			1											intermediate
Common Shiner		8		20	9			12		1	26	9		intermediate
Creek Chub	3	1												tolerant
Fathead Minnow			3									1		tolerant
Finescale Dace														intermediate
Golden Redhorse	1													intermediate
Golden Shiner			4				3	11	3					tolerant
Hornyhead Chub	9	9	2	1							6	7		intermediate
Johnny Darter	4	8	15	18	13		48	62	5	31	13	2		intermediate
Lampreys	9													intolerant
Lampreys Ammoc.		12												intolerant
Largemouth Bass		3	1		2		5				2	1		intermediate
Logperch		4												intermediate
Longnose Dace	7	1												intermediate
Mottled Sculpin	1		1				1	8						intolerant
Northern Hog Sucker	2	2												intolerant
Northern Pike	1	3	12	3	5	50	5	13	7	12	5	1	1	intermediate
Pearl Dace		2												intermediate
Pumpkinseed														intermediate
Pumpkinseed X Bluegill									1			1		intermediate
Redbelly Dace														intermediate
Rock Bass			6	1	5									intolerant
Shorthead Redhorse	3	2												intermediate
Silver Redhorse		1												intermediate
Smallmouth Bass	1	1												intolerant
Spotfin Shiner	5	2	26	205	78									intermediate
Tadpole Madtom				1	4									intermediate
White Sucker	2			1			2	4	1			1		tolerant
Yellow Bullhead			1		2							1		tolerant
Number of Fish	68	83	99	267	129	61	106	141	53	111	83	48	146	
# Species	19	20	16	12	12	2	8	9	6	4	7	11	4	
Modeled NC	WMS	WMS	WMS	CWMS	CWMS	CW	CWMS	CWMS	CWMS	WHW	WHW	WHW	CWHW	
Verified NC	CWMS	CWMS	CWMS	WMS	WMS	CWHW	CWMS	CWHW	CWHW	CWHW	CWMS	CWHW	CWHW	
IBI Tool Used	Cool Warm	Cool Warm	Cool Warm	Warm Water	Warm Water	Small Stream	Cool Warm	Small Stream	Small Stream	Small Stream	Cool Warm	Small Stream	Small Stream	
IBI Value	100	90	100	50	50	30	80	20	40	60	60	60	20	
IBI Condition	Excellent	Excellent	Excellent	Good	Good	Poor	Excellent	Poor	Fair	Good	Fair	Fair	Poor	

Table 2. (Continued) Wood River-Barrett Creek-Crex Meadows TWA Fish Survey Data

Map Site No.	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	30	31	Fish Tolerance Rating
Station Number	10042430	10042431	10042555	10042459	10042528	10041942	10042530	10037789	10042529	10041943	10042429	10042377	10042427	10042443	10042444	10042969	10042446	
Station Name	North Fork Wood R 20 m Us Shearman Rd	Unnamed 10 m US North Fork Wood R	Hay Creek 170 m DS STH 70	Hay Creek 177 m DS Benson Rd	Hay Creek 20 m US Borg Rd	Hay Creek 10 m US CTH F	Unnamed Ditch along CTH F	Whiskey Creek 110 m DS CTH D	Whiskey Creek 192 m DS Whiskey Ck Flowage	Unnamed 10 m US Lundquist Rd	Unnamed 3 m US Fossum Rd	Iron Creek 124 m DS Sadlers Rd	Ekdall Creek 5 m US Mouth	Unnamed Near Nordstrum Rd	Unnamed Near Bang Rd	Unnamed 160 m DS North Fork Flowage	Unnamed 37 m DS North Fork Dike Rd	
Survey Year	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	
Bigmouth Shiner																		intermediate
Black Bullhead		6						3		4						2	2	tolerant
Black Crappie					1													intermediate
Blackchin Shiner																		intolerant
Blacknose Shiner				2		1												intolerant
Blackside Darter																		intermediate
Bluegill	1		2	1		2										3		intermediate
Bluntnose Minnow																		tolerant
Bowfin																		intermediate
Brassy Minnow					13	5	9		20		1						3	intermediate
Brook Silverside																		intermediate
Brook Stickleback		1		14	40	8	49	48	66	2	6		2				26	tolerant
Brook Trout													8	34	7			intolerant
Burbot			2										1					intermediate
Central Mudminnow	23	138	39	45	186	52	261	43	136	47	20	5				72	131	tolerant
Channel Catfish																		intermediate
Common Shiner	9																	intermediate
Creek Chub				4	1	3	3											tolerant
Fathead Minnow	1			2	9	2		23	1								171	tolerant
Finescale Dace				15	44	3	34		35								34	intermediate
Golden Redhorse																		intermediate
Golden Shiner										2								tolerant
Hornyhead Chub	7																	intermediate
Johnny Darter	2		25	2				3		1								intermediate
Lampreys																		intolerant
Lampreys Ammoc.																		intolerant
Largemouth Bass	1																	intermediate
Logperch																		intermediate
Longnose Dace																		intermediate
Mottled Sculpin			5															intolerant
Northern Hog Sucker																		intolerant
Northern Pike	1	1	7				1	12	1	14				7		47		intermediate
Pearl Dace			1	227	264	20	73	1	98			4	1				1	intermediate
Pumpkinseed								1								1		intermediate
Pumpkinseed X Bluegill	1																	intermediate
Redbelly Dace								5										intermediate
Rock Bass																		intolerant
Shorthead Redhorse			1	1														intermediate
Silver Redhorse																		intermediate
Smallmouth Bass																		intolerant
Spotfin Shiner																		intermediate
Tadpole Madtom																		intermediate
White Sucker	1		1	13	4	3	3											tolerant
Yellow Bullhead	1				1	1	1											tolerant
Number of Fish	48	146	83	326	563	100	434	139	357	70	27	9	12	41	7	125	368	
Number of Species	11	4	9	11	10	11	9	9	7	6	3	2	4	2	1	5	7	
Modeled NC	WHW	CWHW	CWMS	CWMS	CWMS	CWHW	NONE	CWMS	CWMS	CWMS	CCHW	CWMS	CWHW	CCHW	CCHW	CWMS	NONE	
Verified NC	CWHW	CWHW	CCHW	CWHW	CWHW	CWHW	CWHW	CWHW	CWHW	CWHW	CWHW	CWHW	CCHW	CW	CW	CWHW	CWHW	
Index of Biotic Index Tool Used	Small Stream	Small Stream	Small Stream	Small Stream	Small Stream	Small Stream	Small Stream	Small Stream	Small Stream	Small Stream	Small Stream	Small Stream	Intermittent	Cold Water	Cold Water	Small Stream	Small Stream	
IBI Value	60	20	80	100	100	100	100	57	57	50	30	10	30	80	(<25 FISH)	40	100	
IBI Condition	Fair	Poor	Good	Excellent	Excellent	Excellent	Excellent	fair	fair	fair	Poor	Poor	Poor	Good	Poor	Fair	Excellent	

Crex Meadows Wildlife Area, Aaron Carlson



Figure 11. Wood River-Barrett Creek-Crex Meadows TWA Fish Surveys – Species Richness and Abundance

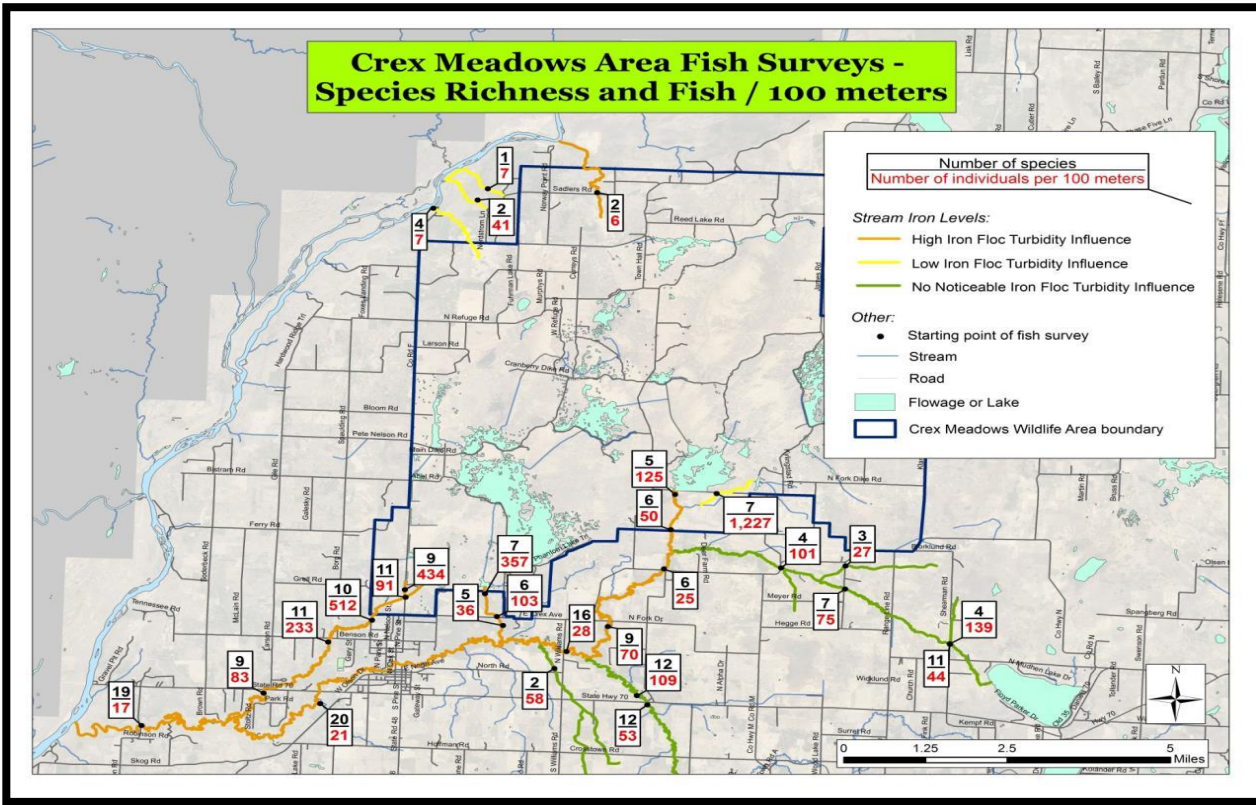


Figure 12. Wood River-Barrett Creek-Crex Meadows Environmental Gradients and Fish Assemblage Variation

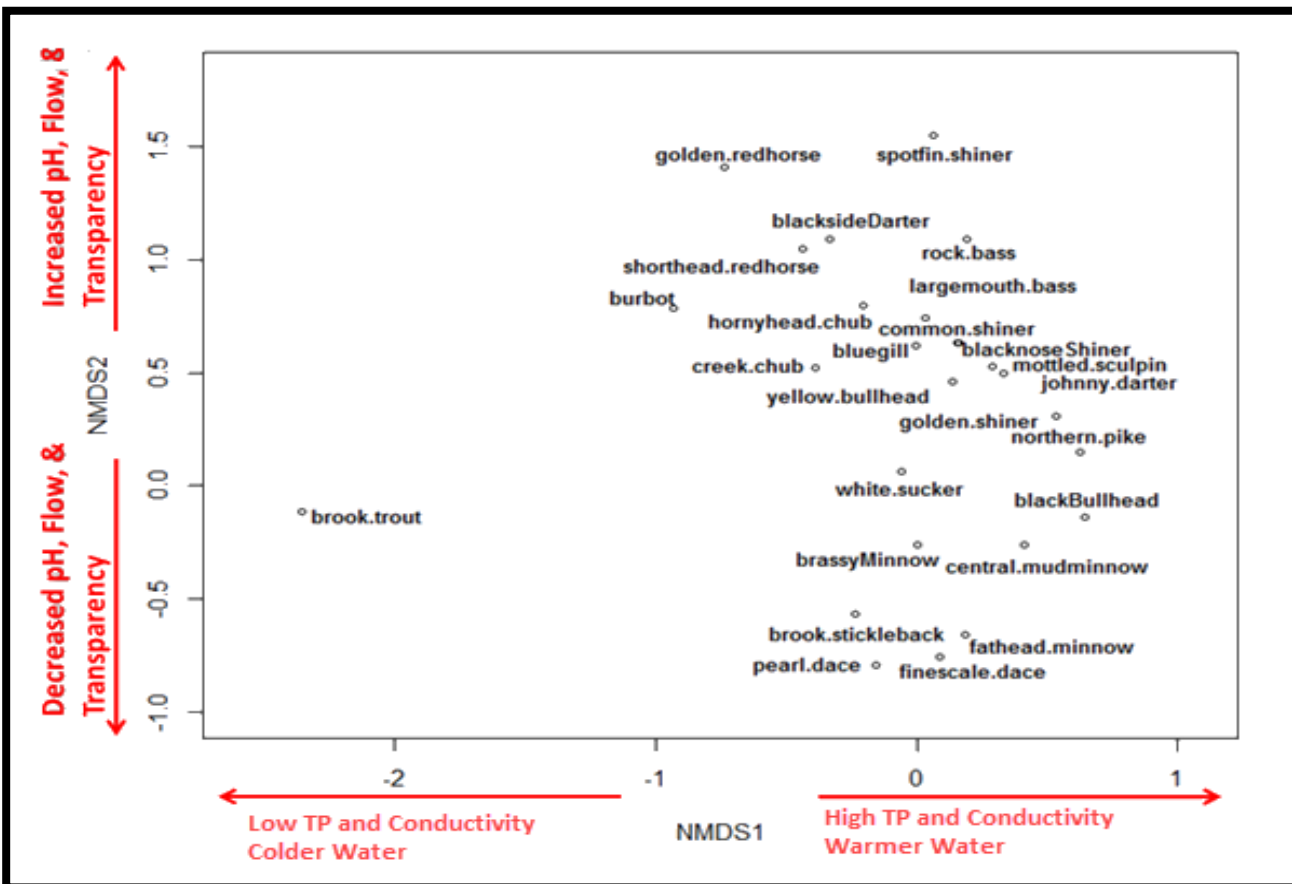
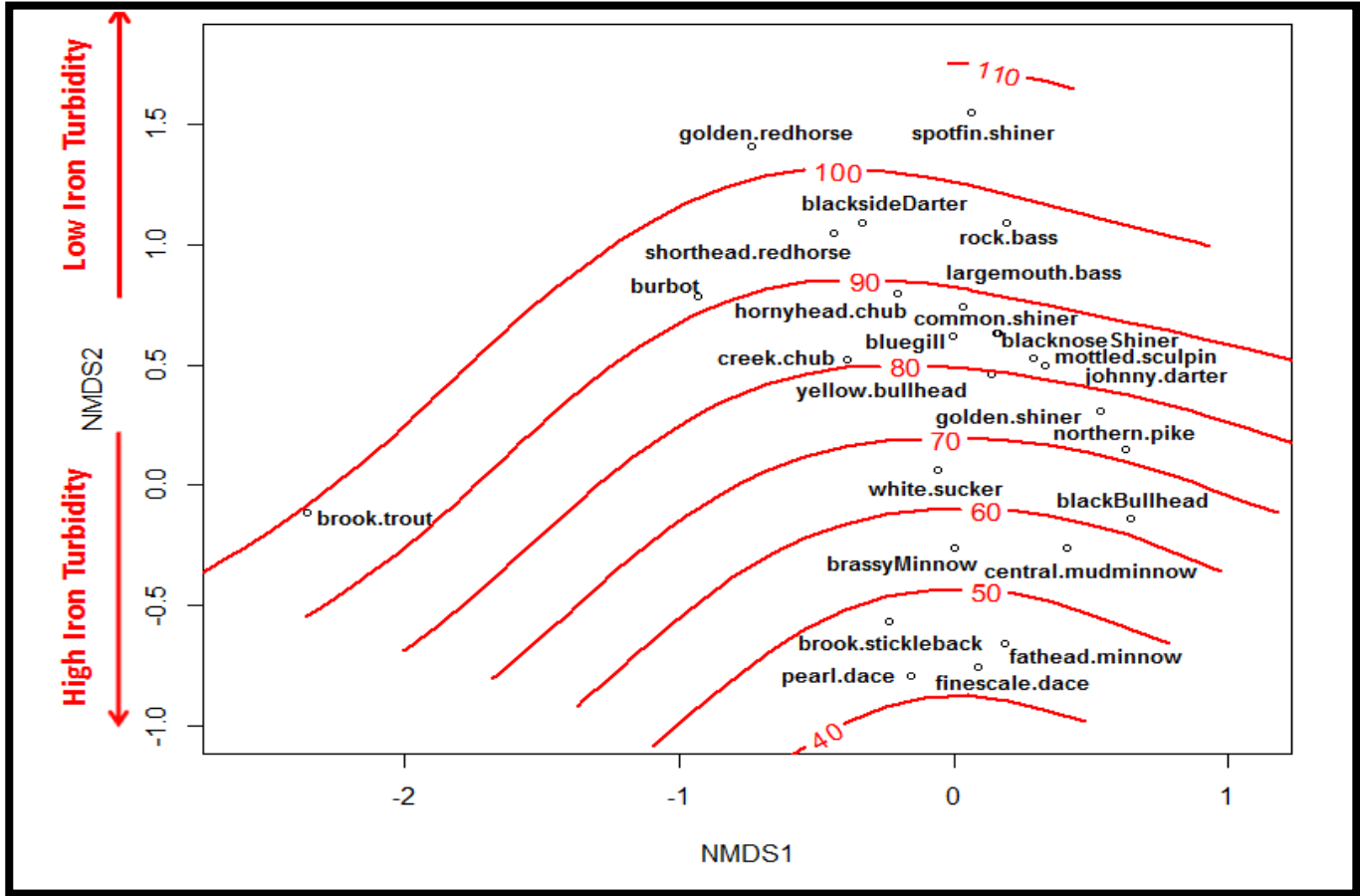


Figure 13. Wood River-Barrett Creek-Crex Meadows Fish Associations with Water Transparency Contours (cm)



South Refuge Flowage Dike Seepage Joining Flowage Surface Outflow

Habitat Conditions

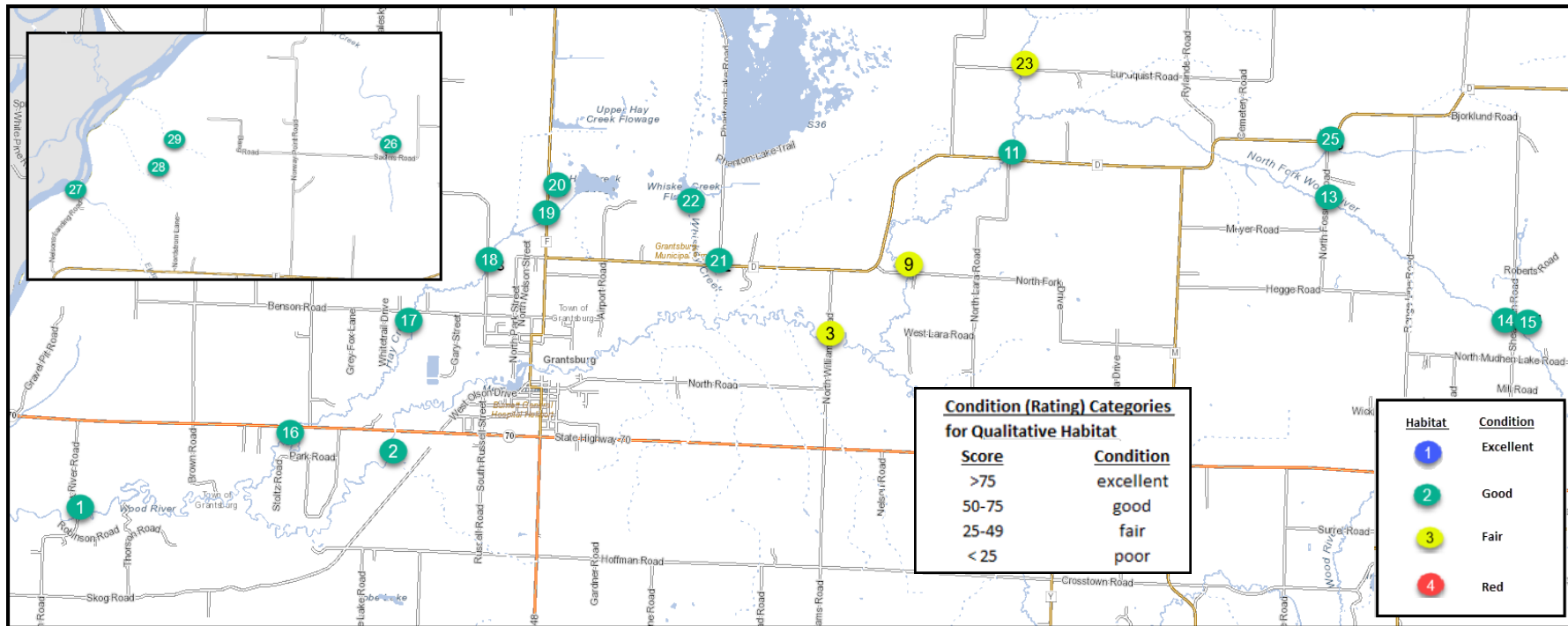
Table 2 lists qualitative habitat conditions and values at fish survey sites in the project area. All habitat conditions values were good or fair. The extensive presence of fine substrates (sand and finer) and the limited presence of pools contributed to lower scores at most sites.

Table 3. Wood River-Barrett Creek-Crex Meadows TWA Qualitative Habitat Survey Sites

Map Site #	SWIMS ID	Stream	Location	Value	Condition
21	10037789	Whiskey Creek	110 m DS CTH D	53	Good
22	10042529	Whiskey Creek	192 m DS Whiskey Creek Flowage	65	Good
23	10041943	Unnamed	10 m US Lundquist Rd	43	Fair
25	10042429	Unnamed	3 m US Fossum Rd	72	Good
26	10042377	Iron Creek	124 m DS Sadlers Rd	55	Good
27	10042427	Ekdall Creek	5 m US mouth	57	Good
28	10042443	Unnamed	Near Nordstrom Rd	72	Good
29	10042444	Unnamed	Near Bang Rd	63	Good

Map Site #	SWIMS ID	Stream	Location	Value	Condition
1	073030	Wood River	West River Rd	73	Good
2	10042968	Wood River	460 m DS STH 70, west crossing	68	Good
3	073106	Wood River	Williams Rd	57	Fair
4	10042994	Wood River	427 m DS STH 70, east crossing	62	Good
5	073029	Wood River	STH 70, east crossing	53	Good
9	073032	North Fork Wood R	North Fork Rd	48	Fair
11	073114	North Fork Wood R	CTH D, west crossing	58	Good
13	10042445	North Fork Wood R	30 m US Fossum Rd	63	Good
14	10042430	North Fork Wood R	20 m US Shearman Rd	72	Good
15	10042431	Unnamed	10 m US North Fork Wood R	50	Good
16	10042555	Hay Creek	170 m DS STH 70	53	Good
17	10042459	Hay Creek	177 m DS Benson Rd	63	Good

Figure 14. Wood River-Barrett Creek-Crex Meadows Habitat Condition Map



Macroinvertebrate Data

Macroinvertebrate index of biotic integrity (mIBI) values range from fair to excellent (Table 5). Hilsenhoff biotic index (HBI) values range from fairly poor, indicating significant organic pollution, to excellent, indicating no apparent organic pollution. "Organic pollution" in this area probably reflects lowered dissolved oxygen concentrations due to wetland influence. Species richness ranges from 13 to 32.

Macroinvertebrate sample results are related to stream iron concentrations in table 6, below. The two sites with non-similar substrates were eliminated from this evaluation. Average mIBI values do not show significant differences related to stream iron concentrations. The mIBI is insensitive to iron concentrations, since it was developed primarily to detect differences due to human influences, such as the intensity of land use development. These influences are fairly low in the streams sampled.

Macroinvertebrate parameters that do show differences related to stream iron concentrations are shown in table 6. Parameters showing significant differences are:

- % Dipteran individuals
- Hilsenhoff Biotic Index (HBI)
- % EPT individuals (ephemeroptera, plecoptera, trichoptera)
- % Chironomid individuals

The differences shown by these parameters in high iron concentration streams are commonly interpreted to indicate declining water quality. Two additional parameters are close to being significantly different - %filterers and % scrapers. Reductions in these parameters are also commonly interpreted to indicate declining water quality. A larger sample size might produce significant differences in these two parameters.

Table 4. Wood River-Barrett Creek-Crex Meadows TWA Macroinvertebrate Survey Data

Map No.	Stream	SWIMS ID	Site Description	mIBI	Condition	HBI	Condition	Species Richness	% EPT* Individuals	%EPT genera	%Chironi- midae
1	Wood River	073030	West R. Rd.1.8 mi US St Croix R	6.77	Good	2.47	Excellent	32	89	48	4
3	Wood River	073106	North Williams Rd	4.56	Fair	6.29	Fair	25	10	25	48
6	Wood River	073029	Hwy 70 US (east crossing)	3.95	Fair	6.94	Excellent	23	12	26	11
7	Wood River	10029120	US of Crosstown Rd	3.03	Fair	5.50	Good	20	56	25	26
8	Unnamed	10042428	155m DS North Rd	2.18	Poor	4.60	Good	13	20	23	16
9	No. Fork Wood River	073108	North Fork Road	6.50	Good	5.39	Good	21	52	57	34
11	No. Fork Wood River	073114	CTH D, West Crossing	6.85	Good	5.56	Fair	27	48	38	13
12	No. Fork Wood River	073115	CTH D, East Crossing	4.13	Fair	5.31	Good	18	57	41	36
14	No. Fork Wood River	10042430	20m US Shearman Rd	10.64	Excellent	4.28	Very Good	21	89	40	5
18	Hay Creek	10042528	20m US Borg Rd.	7.42	Good	6.10	Fair	23	1	9	74
21	Whiskey Creek	10037789	110m DS CTH D	6.13	Good	5.92	Fair	31	17	10	55
23	Unnamed	10041943	10m DS Lundquist Rd	3.82	Fair	6.73	Fairly Poor	17	6	29	38
25	Unnamed	10042429	3m US Fossum Rd	3.08	Fair	6.39	Fair	17	10	18	89
26	Iron Creek	10042377	124m DS Sadlers Road	4.36	Fair	6.17	Fair	29	8	7	43

mIBI -Macroinvertebrate Index of Biological Integrity, HBI – Hilsenhoff Biotic Index, %Chironimidae Individuals

* EPT = ephemeroptera (mayflies), plecoptera (stoneflies), trichoptera (caddisflies)

Complete sample result information is available at [DNR's Surface Water Integrated Monitoring System \(SWIMS\) database](#).

Figure 15. Wood River-Barrett Creek-Crex Meadows TWA mIBI Condition Values



Condition (Rating) Categories for Macroinvertebra Index of Biotic Integrity (MIBI)	
Score	Condition
>75	excellent
50-75	good
25-49	fair
< 25	poor

Table 5. Wood River-Barrett Creek-Crex Meadows Macroinvertebrate Parameter Differences Related to Iron Concentrations

MACROINVERTEBRATE PARAMETER STATISTICS	STREAM IRON CONCENTRATION			NOTABLE DIFFERENCES
	LOW (n = 4)	MED (n = 4)	HIGH (n = 3)	
MIBI average	5.44	6.17	5.79	NO SIGNIFICANT DIFFERENCES
MIBI standard error	1.75	0.54	1.05	
% Dipteran individuals average	38.35	42.75	82.43	HIGH IRON SITES SIGNIFICANTLY HIGHER THAN MEDIUM AND LOW IRON SITES INCREASING AVERAGE % DIPTERA WITH INCREASING IRON CONCENTRATION
% Dipteran individuals standard error	11.30	14.82	8.86	
Species richness average	20.5	26.25	23.67	MEDIUM IRON SITES SIGNIFICANTLY HIGHER THAN LOW IRON SITES
Species richness standard error	1.04	2.29	4.06	
HBI average	5.51	4.92	6.25	HIGH IRON SITES SIGNIFICANTLY HIGHER (POORER) THAN MEDIUM IRON SITES
HBI standard error	0.55	0.84	0.25	
% EPT individuals average	53.50	49.75	8.00	HIGH IRON SITES SIGNIFICANTLY LOWER THAN MEDIUM AND LOW IRON SITES DECREASING AVERAGE % EPT WITH INCREASING IRON
% EPT individuals standard error	15.81	16.15	4.73	
% Chironomid individuals average	19.50	24.75	55.67	HIGH IRON SITES SIGNIFICANTLY HIGHER THAN MEDIUM AND LOW IRON SITES INCREASING AVERAGE % CHIRON WITH INCREASING IRON
% Chironomid individuals standard error	7.05	9.98	4.73	
Shannon diversity index average	2.63	3.15	3.23	NO SIGNIFICANT DIFFERENCES
Shannon diversity index standard error	0.23	0.18	0.43	
% Scrapers average	4.75	3.00	0.67	NO SIGNIFICANT DIFFERENCES
% Scrapers standard error	3.82	2.12	0.33	
% Filterers average	48.25	53.25	20.00	NO SIGNIFICANT DIFFERENCES
% Filterers standard error	24.13	26.63	6.66	
% Shredders average	11.50	15.50	10.00	NO SIGNIFICANT DIFFERENCES
% Shredders standard error	4.73	10.56	8.02	
% Gatherers average	33.50	24.25	43.67	HIGH IRON SITES SIGNIFICANTLY HIGHER THAN MEDIUM IRON SITES
% Gatherers standard error	17.73	4.35	9.70	

Water Quality

Total Phosphorus Concentrations

Six monthly total phosphorus (TP) samples were collected during May to October to evaluate five streams for impairment due to TP concentrations – Wood River, North Fork Wood River, Hay Creek, Whiskey Creek, and an unnamed stream (site 10041493, “North Fork Creek”). A median TP concentration of 75 ug/l is the threshold for stream impairment, but upper and lower 90% confidence limits are taken into consideration (WisCALM; WDNR 2019). The median TP concentration for all five streams is less than 75 ug/l. The North Fork Wood River and Whiskey Creek also have upper 90% confidence limits less than 75 ug/l. These two streams “clearly meet” the stream TP standard and are not impaired for TP. The other three streams have upper 90% confidence limits greater than 75 ug/l. These streams “may meet” the stream TP standard. Additional sampling would be needed to make a definitive determination of their TP impairment status. Table 6 below displays these results.

Table 6. Wood River-Barrett Creek-Crex Meadows Project Total Phosphorus Values

Waterbody Name	WBIC	Station ID	Site Description	TP Result	Units	Date
Wood River	2642900	73030	West River Road	54	ug/l	5/23/2014
Wood River	2642900	73030	West River Road	139	ug/l	6/23/2014
Wood River	2642900	73030	West River Road	53	ug/l	7/29/2014
Wood River	2642900	73030	West River Road	55	ug/l	8/26/2014
Wood River	2642900	73030	West River Road	57	ug/l	9/24/2014
Wood River	2642900	73030	West River Road	53	ug/l	10/21/2014
			median	54.5	ug/l	
			Upper 90% C.L.	80.1	ug/l	
North Fork Wood R	2647000	73108	North Fork Drive	27	ug/l	5/23/2014
North Fork Wood R	2647000	73108	North Fork Drive	116	ug/l	6/23/2014
North Fork Wood R	2647000	73108	North Fork Drive	70	ug/l	7/29/2014
North Fork Wood R	2647000	73108	North Fork Drive	49	ug/l	8/26/2014
North Fork Wood R	2647000	73108	North Fork Drive	49	ug/l	9/24/2014
North Fork Wood R	2647000	73108	North Fork Drive	48	ug/l	10/21/2014
			median	49.0	ug/l	
			Upper 90% C.L.	72.5	ug/l	
Hay Creek	2643000	10041942	CTH F	22	ug/l	5/14/2014
Hay Creek	2643000	10041942	CTH F	103	ug/l	6/16/2014
Hay Creek	2643000	10041942	CTH F	97	ug/l	7/11/2014
Hay Creek	2643000	10041942	CTH F	60	ug/l	8/20/2014
Hay Creek	2643000	10041942	CTH F	76	ug/l	9/15/2014
Hay Creek	2643000	10041942	CTH F	40	ug/l	10/20/2014
			median	41.0	ug/l	
			Upper 90% C.L.	83.5	ug/l	
Whiskey Creek	2646600	10037789	CTH D	30	ug/l	5/14/2014
Whiskey Creek	2646600	10037789	CTH D	62	ug/l	6/16/2014
Whiskey Creek	2646600	10037789	CTH D	73	ug/l	7/11/2014
Whiskey Creek	2646600	10037789	CTH D	57	ug/l	8/20/2014
Whiskey Creek	2646600	10037789	CTH D	51	ug/l	9/15/2014
Whiskey Creek	2646600	10037789	CTH D	36	ug/l	10/20/2014
			median	40.1	ug/l	
			Upper 90% C.L.	73.4	ug/l	
Unnamed	2647100	10041493	Lundquist Rd (“North Fork Creek”)	23	ug/l	5/14/2014
Unnamed	2647100	10041493	Lundquist Rd (“North Fork Creek”)	108	ug/l	6/16/2014
Unnamed	2647100	10041493	Lundquist Rd (“North Fork Creek”)	116	ug/l	7/11/2014
Unnamed	2647100	10041493	Lundquist Rd (“North Fork Creek”)	91	ug/l	8/20/2014
Unnamed	2647100	10041493	Lundquist Rd (“North Fork Creek”)	47	ug/l	9/15/2014
Unnamed	2647100	10041493	Lundquist Rd (“North Fork Creek”)	60	ug/l	10/20/2014
			median	44.7	ug/l	
			Upper 90% C.L.	93.9	ug/l	

Iron Concentrations

Iron concentrations in streams draining CMWA flowage areas averaged 14 times higher than in nearby streams not influenced by flowage drainage. Four monitored streams with high levels of visible iron floc turbidity (Hay, Whiskey, Unnamed (site 1041493, "North Fork Creek"), and Iron Creeks) had mean iron concentrations ranging from 9.3 to 17.5 mg/l, with concentrations as high as 35.2 mg/l found in Hay Creek. There were strong inverse correlations between iron concentration and transparency, with R^2 values ranging from 0.77 to 0.88. Reductions in stream transparency are mostly caused by increasing concentrations of oxidized iron floc.

Iron and total phosphorus concentration correlations had R^2 values ranging from 0.63 to 0.93. Phosphorus is often associated with iron since phosphorus will attach to, or become incorporated in various forms of oxidized iron. When oxidized iron is reduced, both the iron and phosphorus become mobile.

Dissolved Oxygen

Dissolved oxygen concentrations (D.O.'s) were greater than 5 mg/l, the stream standard, in the larger streams monitored – Wood River and North Fork Wood River. D.O.'s less than 5 mg/l were occasionally to frequently found in the smaller streams in the CMWA. These streams are influenced by wetland drainage with high biochemical oxygen demand due to decomposing vegetation. Summer outflow from some of the shallow, wetland-influenced flowages is less than 5 mg/l at times, and so can also contribute to lower D.O.'s in some streams.

The shallow flowages are also subject to severe D.O. depletion under the ice in winter. Three of six flowages monitored on March 2nd, 2015 had D.O.'s less than 0.5 mg/l, and two flowages were frozen to the bottom. Winter fish kills are a common occurrence.

Additional Information

Additional discussion of water quality in the TWA project area can be found in Roesler et al. (2016). Details of water quality monitoring are contained in the water quality appendix of that report.

Dead Fish in Phantom Flowage Following 2014 Winterkill



Management Recommendations

Stream turbidity due to oxidized iron floc is a notable water quality impairment in the Wood River-Barrett Creek-Crex Meadows watersheds. Inundation of iron rich soils due to flowage construction at Crex Meadows Wildlife Area (CMWA) is the source of this turbidity. At least one stream (Hay Creek) has had its trout population eliminated due to iron floc turbidity resulting from flowage construction.

No feasible means of controlling iron floc turbidity could be identified (other than flowage dewatering). The CMWA flowages provide tremendous wildlife and recreational value. The water quality impairments are an unfortunate environmental trade-off. If the value of specific flowages declines substantially in the future, consideration should be given to flowage dewatering, for downstream water quality restoration.

Wood Lake, which is upstream of, and unaffected by the CMWA, is impaired due to high total phosphorus and chlorophyll concentrations. Efforts to reduce phosphorus loading to the lake should be made.

Management Recommendations for DNR

- The DNR should work with the Wood Lake Association and the Burnett County Land and Water Conservation Dept. to identify options for reducing phosphorus inputs to Wood Lake.
- The DNR should encourage the Mud Hen Lake District to continue the pursuit of a long range lake management plan to direct and prioritize lake management efforts.
- The DNR should encourage local communities to apply for grants to continue best management practices designed to reduce runoff of total phosphorus and sediment.

Management Recommendations of External Partners

- The Wood Lake Association should apply for a DNR lake planning grant to determine a phosphorus budget for the lake.
- Burnett County should continue to apply for grants to fund best management practices with landowners to implement practices and continue ongoing work with specific farmers for reduction of sediment and nutrient runoff.

Monitoring and Assessment Recommendations

- After land management practices and restoration practices are conducted to reduce phosphorus loading to Wood Lake, DNR and/or water quality monitoring volunteers should monitor the lake to see if conditions are improving.



Crex Meadows Wildlife Area, Burnett County

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Appendix B: Water Narratives

Waters in the Hay Creek-Wood River-Crex Meadows TWA

Wood Lake

Wood Lake in the Wood River Watershed is a 521.23-acre lake located in Burnett County. This lake is managed for fishing and swimming and is currently considered impaired. This is a drainage lake located on the Wood River with an active lake association and volunteer monitoring since 1986. Wood Lake shows some signs of trophic stress and experiences algae blooms and excessive weed growth. This lake group is encouraged to pursue a lake planning grant to assess the nutrient budget for this lake and establish if there are any protection or restorative measures that could be taken to help Wood Lake. Implementation measures would be dependent upon the results of the feasibility study.

<p>Wood Lake</p> <p>Size: 521.24 Acres Natural Community: Two-Story Year Last Monitored: 2019 General Condition: Poor Impairments: Eutrophication, Excess Algal Growth Pollutants: Total Phosphorus</p>

This water was assessed during the 2014 listing cycle; chlorophyll sample data exceed 2014 WisCALM listing thresholds for the Recreation use, however, total phosphorus data do not exceed REC thresholds.

Additional monitoring was recommended to identify the pollutant causing excess algal growth. This water was assessed during the 2016 listing cycle; chlorophyll sample data exceed 2016 WisCALM listing thresholds for the Recreation use, however, total phosphorus did not exceed REC thresholds. Total phosphorus and chlorophyll data were clearly below Fish and Aquatic Life listing thresholds.

This water was assessed during the 2018 listing cycle; new chlorophyll sample data exceeded 2018 WisCALM listing thresholds for the Recreation use. Assessments during the 2020 listing cycle show both total phosphorus and chlorophyll levels too high for healthy aquatic communities like plants, fish, and bugs. Both the phosphorus and chlorophyll levels exceeded Recreation and Aquatic Life uses. *Eutrophication was added as an impairment in 2020.* Total phosphorus sample data overwhelmingly exceeded 2020 WisCALM listing thresholds for the Recreation use and Aquatic Life use, and chlorophyll data also exceeded REC and FAL thresholds. Based on the most updated information the impairments of Eutrophication were added to the Total Phosphorus listing. The lake was also changed to category 5W (Nine Key Element Planning Supported) in 2020 because it is part of the Implementation Plan for the Lake St. Croix Nutrient Total Maximum Daily Load (2025).

Dunham Lake (2651800)

Dunham Lake, in the Wood River Watershed, is a 230.6-acre lake located in Burnett County. This lake is managed for fishing and swimming and is currently considered impaired. This listing was part of a set removed from the impaired waters list due to a change in fish consumption advisory levels in 2001. In 2001 Wisconsin DNR put into effect a statewide fish consumption advisory for mercury due to atmospheric deposition. Most of the lakes removed from the specific fish consumption advisories list in 2001 were not removed from the impaired waters list even though the thresholds had changed. For the 2020 assessment process WDNR requested delisting of 91 waters with residual mercury listings from prior to 2001. This request was approved by US EPA.

Mud Hen Lake (2649500) 569.3 acres

This lake is proposed for removal from the impaired waters list during the 2018 assessment period. Mud Hen Lake was placed on the 303(d) impaired waters list in 1998 due to mercury from atmospheric deposition and is proposed for removal based on 2001 updated Fish Consumption advisories. Total phosphorus and chlorophyll-a values were assessed in every two years between 2014 and 2020; no impairment was found. This listing was part of a set removed from the impaired waters list due to a change in fish consumption advisory levels in 2001. In 2001 Wisconsin DNR put into effect a statewide fish consumption advisory for mercury due to atmospheric deposition. Most of the lakes removed from the specific fish consumption advisories list in 2001 were not removed from the impaired waters list even though the thresholds had changed. For the 2020 assessment process WDNR requested delisting of 91 waters with residual mercury listings from prior to 2001. This request was approved by US EPA.

Mud Hen Lake, in the Wood River Watershed, is a 569.3-acre lake located in Burnett County. This lake is managed for fishing and swimming and is currently considered impaired. Mud Hen Lake is a 563-acre, hard water, drainage lake located at the headwaters of the North Fork Wood River. The lake community formed a lake district around this lake in 1977. A feasibility study was conducted and the results published in 1981. Mud Hen Lake was documented as a mesotrophic body with good water quality and relatively few trophic problems at present. Management alternatives suggested for this lake concentrated on water quality protection measures but also mentioned aeration, macrophyte harvesting and water level stabilization. This lake should be ranked high for funding implementation measures that follow through on the management recommendations set down in the 1981 report. The lake district should be encouraged to continue the pursuit of a long-range management plan to direct and prioritize their future lake management efforts.

Appendix C: Hay Creek-Barrett Creek-Crex Meadows TWA, Fish and Aquatic Life Use Attainment

WBIC	Local Name	Start Mile	End Mile	Current Use	Attainable Use	Supporting Use	Designated Use	Designated Source	Assessment	Data Source	Category
2841400	Balsam Creek (Big Balsam)	0	3.17	Class III Trout	FAL	Fully Supporting	Default FAL	NR102 Classification	Monitored	B1, B3	Category 2
2841400	Balsam Creek (Big Balsam)	3.17	19.68	Cold (Class II Trout)	Cold (Class II Trout)	Fully Supporting	Cold	1980 Trout Book Classification	Monitored	B1, B3, B2	Category 2
2841400	Balsam Creek (Big Balsam)	19.68	22.29	Cold (Class I Trout)	Cold (Class I Trout)	Not Assessed	Cold	1980 Trout Book Classification	Evaluated	B1	Category 3
2841200	Black Lake	0	82.1	Shallow Lowland	FAL	Supporting	Default FAL	NR102 Classification	Monitored	P1	Category 2
-999991	Black Lake Bog	0	52.38	FAL	FAL	Not Assessed	Default FAL	NR102 Classification	Not Assessed	NA	Category 3
2836900	Black River	0	7.44	Class III Trout	FAL	Fully Supporting	Default FAL	NR102 Classification	Monitored	B1, B3, B2	Category 2
2836900	Black River	7.44	31.11	FAL	Class III Trout	Fully Supporting	Cold	1980 Trout Book Classification	Monitored	P4, B1, B3	Category 2
2836900	Black River	31.11	35.34	FAL	FAL	Not Assessed	Default FAL	NR102 Classification	Not Assessed	NA	Category 3
2756700	Breitzman Lake	0	13.77	Deep Seepage	FAL	Fully Supporting	Default FAL	NR102 Classification	Evaluated	P1	Category 2
2842800	Clear Creek	0	5.6	FAL	FAL	Supporting	Default FAL	NR102 Classification	Monitored	B1	Category 2
2841600	Empire Creek	0	4.66	Cold (Class I Trout)	Cold (Class I Trout)	Not Assessed	Cold	1980 Trout Book Classification	Evaluated	B1	Category 3
2838000	Pattison Beach (State Park)	0	0.07	Impounded Flowing Water	FAL	Not Assessed	Default FAL	NR102 Classification	Monitored	B1	Category 5A
2838000	Interfalls Lake	0	23.29	Impounded Flowing Water	FAL	Supporting	Default FAL	NR102 Classification	Monitored	B1	Category 2
2841700	Little Balsam Creek	0	4.56	Cold (Class I Trout)	Cold (Class I Trout)	Fully Supporting	Cold	1980 Trout Book Classification	Monitored	B1, B3, B2	Category 2
2841700	Little Balsam Creek	4.56	4.97	FAL	FAL	Not Assessed	Default FAL	NR102 Classification	Not Assessed	NA	Category 3
2839900	Little Black River	0	4.63	FAL	WWFF	Fully Supporting	Default FAL	NR102 Classification	Monitored	B1, P3, B3	Category 2
2837000	Miller Creek	0	3.52	FAL	WWFF	Fully Supporting	Default FAL	NR102 Classification	Monitored	B1, B3	Category 2
2837000	Miller Creek	3.52	6.53	Cold (Class II Trout)	Cold (Class II Trout)	Not Assessed	Cold	1980 Trout Book Classification	Not Assessed	B1	Category 3
2843000	Mud Creek	0	4.92	FAL	FAL	Fully Supporting	Default FAL	NR102 Classification	Monitored	B1, B4, T2	Category 2

WBIC	Local Name	Start Mile	End Mile	Current Use	Attainable Use	Supporting Use	Designated Use	Designated Source	Assessment	Data Source	Category
2835300	Lower Nemadji River	0	38.2	WWSF	WWSF	Not Supporting	FAL Warmwater	NR102 Classification	Monitored	B1, B4	Category 5A
2838700	Reichuster Lake	0	13.56	Shallow Seepage	FAL	Supporting	Default FAL	NR102 Classification	Monitored	P1	Category 2
2837300	Rock Creek	0	2.38	Class III Trout	FAL	Fully Supporting	Default FAL	NR102 Classification	Monitored	B1, B3	Category 2
2837300	Rock Creek	2.39	4.79	Cold (Class I Trout)	Cold (Class I Trout)	Not Assessed	Cold	1980 Trout Book Classification	Not Assessed	B1	Category 3
2843400	Nemadji River, South Fork	0	3.65	FAL	FAL	Fully Supporting	Default FAL	NR102 Classification	Monitored	B1, B3, B2	Category 2
2775000	Summit Lake	0	6.38	Small	FAL	Not Assessed	Default FAL	NR102 Classification	Not Assessed	NA	Category 3
5001871	Little Balsam Creek	0	0.46	Cold (Class I Trout)	Cold (Class I Trout)	Not Assessed	Cold	1980 Trout Book Classification	Evaluated	B1	Category 3
2842200	Unnamed Trib To Balsam Creek	0	1.53	FAL	Cold (Class I Trout)	Not Assessed	Default FAL	NR102 Classification	Not Assessed	B1	Category 3
2841500	Unnamed Trib. To Balsam Ck. T47n R15w S23	0.01	4.34	Cold (Class I Trout)	Cold (Class I Trout)	Fully Supporting	Cold	1980 Trout Book Classification	Monitored	B1, B3	Category 2

This table reflects the condition of waters in the study area watershed. This table data is stored in the Water Assessment Tracking and Electronic Reporting System (WATERS) and is updated on an ongoing basis via monitoring data and assessment calculations.

The following definitions apply:

- Current Use – current condition of water based on monitoring data.
- Attainable Use – “ecological potential” of water based on water type, natural community, lack of human-induced disturbances.
- Supporting Use – decision on whether the water’s current condition is supporting its designated use under “water quality standards”.
- Designated Use – the water’s classified use under NR102, Wisconsin Water Quality Standards, for Fish and Aquatic Life.
- Assessment – field indicates what type of data or information supports the decisions in the table (current, attainable, and supporting attainable).
- Data – Specific data areas used for the decision (see below)

P –Physical

B – Biological

C – Chemistry

Range 1-4 (1 – lowest level, 4 most sophisticated data collection)

- DNR Category Is water meeting or not meeting standards

H – Habitat

PA – Pathogens

Category 5A: Water is impaired, TMDL required

Category 5W: Nine Key Element Plan or equivalent in development.

Category 2: Water meets at least 1 WQ standard,

Category 3: Insufficient data,

Category 4A: Water is impaired, TMDL in progress,

Appendix D: Soil & Sediment Sites Hay Creek-Barrett Creek-Crex Meadows TWA

