WINNEBAGO COUNTY WATERSHED IMPROVEMENT PLAN:
MADIGAN CREEK WATERSHED

EXECUTIVE SUMMARY
July 2013

The purpose of the Madigan Watershed-Based Plan is to provide stakeholders a better understanding of the watershed and to promote the implementation of plan recommendations aimed at the protection and improvement of water quality , the preservation and restoration of natural areas, and the reduction of flood damages in the watershed.

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This project is funded, in part, by a grant from the Neighborhoods Fund of the Community Foundation of Northern Illinois.

Funding for development of the Madigan Creek Watershed-based Plan was provided in part through the USEPA Section 319(h) of the Clean Water Act distributed through Illinois Environmental Protection Agency. The findings and recommendations herein are not necessarily those of the funding agencies.

ACKNOWLEDGMENTS

Winnebago County (WC), the Rockford Metropolitan Agency for Planning (RMAP), the City of Rockford, the Rockford Park District, the Village of Cherry Valley, Cherry Valley Township, Rockford Township, the Winnebago County Soil and Water Conservation District (SWCD), the Kishwaukee River Ecosystem Partnership (KREP), and the Upper Rock River Ecosystem Partnership (URREP) all contributed personnel to fill leadership roles and carry out the work of the Winnebago County Watershed Improvement Plan Steering Committee and Executive Committee.

Many citizens also contributed numerous hours of time and work filling leadership roles and representing the interests of watershed residents at public meetings as well as meetings of the Steering Committee and Executive Committee.

Executive Committee members include:

Chairperson
Gary McIntyre, RMAP

Vice-Chairpersons
Dennis Anthony, SWCD
Jerry Paulson, KREP

Secretary
Don Krizan, WC Highway Department

Buckbee Creek Watershed Co-Captains
John Ekberg, citizen
Carol Ommodt, citizen

Madigan Creek Watershed Captain
Bonnie Whitmer, citizen

Hey and Associates, Inc., served as consultant for this grant. Deanna Doohaluk provided highly professional and tireless support to the Winnebago County Watershed Improvement Plan Steering Committee and Executive Committee as the principal grant administrator. Other Hey staff members who provided able support include Neal O'Reilly and Jeff Wickenkamp.

The following people generously gave their time serving the Steering Committee or speaking to the Committee and citizens at committee and public meetings:

Brent Denzin, Attorney at Law, Ancel, Glink, Diamond, Bush, DiCianni & Krafthefer, Chicago
Nathan Hill, Natural Areas Maintenance Coordinator, Rockford Park District
Brad Holcomb, Storm Water & Environmental Program Manager, City of Rockford

The contributions of the Kishwaukee River Ecosystem Partnership were funded, in part, through the Natural Land Institute by a grant from the Neighborhoods Fund of the Community Foundation of Northern Illinois.

Winnebago County Watershed Improvement Plan Executive Committee
July 31, 2013

FOREWORD

The Winnebago County Watershed Improvement Plan was developed through a cooperative effort between Winnebago County, local governments and agencies (including the Rockford Metropolitan Agency for Planning, the City of Rockford, the Rockford Park District, the Village of Cherry Valley, Cherry Valley Township, Rockford Township, and the Winnebago County Soil and Water Conservation District), watershed protection and improvement organizations (including the Kishwaukee River and the Upper Rock River Ecosystem Partnerships), and citizens. A Steering Committee was organized which included representatives of each of the stakeholder organizations and groups, and all interested citizens. A Chairperson was elected and an Executive Committee was organized to assist with the planning process.

By means of an invitation, interview, and selection process organized by the Steering Committee, a consultant was hired to prepare and submit grant applications for watershed-based planning for two adjacent but distinct watersheds to the Illinois Environmental Protection Agency through Section 319 of the Clean Water Act. The proposals presented by the Steering Committee and consultant were approved by the IEPA and were combined into a single grant. Work proceeded on implementation of the improvement planning for each watershed.

Plans were developed to provide a blueprint for improving water quality and preserving the natural resources of each watershed. A related goal of the proposed improvements was to reduce flooding which contributes to the transportation of suspended solids and destruction of natural resources within the waterways of each watershed.

The plans are intended to assist individual citizens, citizen groups, local units of government, and governmental agencies with watershed management. The plans contain summaries of data collected for each watershed, quantify resource-related problems, present goals and objectives agreed upon by the stakeholder representatives, and recommend actions for effectively managing watershed resources in a cost-effective and environmentally sound manner. The plans also provide a basis for conducting inter-jurisdictional communication and coordination regarding water resource issues within the watersheds.

While the plans are advisory documents, the stakeholders are encouraged to endorse the plans, utilize them as reference guides, and pursue implementation of the recommended actions. The benefits of making improvements in the watersheds that improve the quality of life of both native species and human habitats can only be realized if the human partners pursue actions such as those recommended by these plans.

Winnebago County Watershed Improvement Plan Executive Committee
July 31, 2013

The Madigan Creek Watershed

The Madigan Creek watershed is located in the south-central Winnebago County in northern Illinois (Figure 1). The watershed drains approximately 6.21 square miles (3,973 acres) of land into the Kishwaukee River (Figure 2). From the confluence with Madigan Creek, the Kishwaukee River flows westward through Rockford before joining the Rock River. The Rock River flows southwesterly before joining the Mississippi River at Rock Island, Illinois.

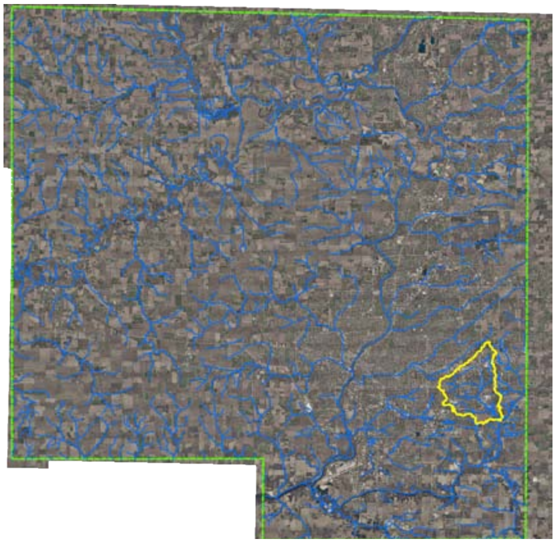


Figure 1: Madigan Creek watershed within the context of Winnebago County

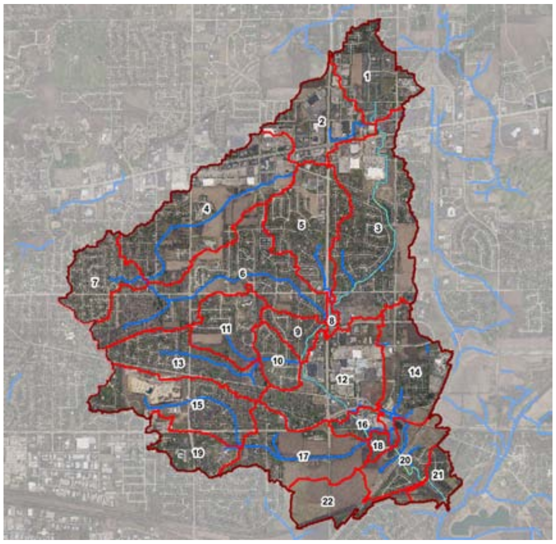
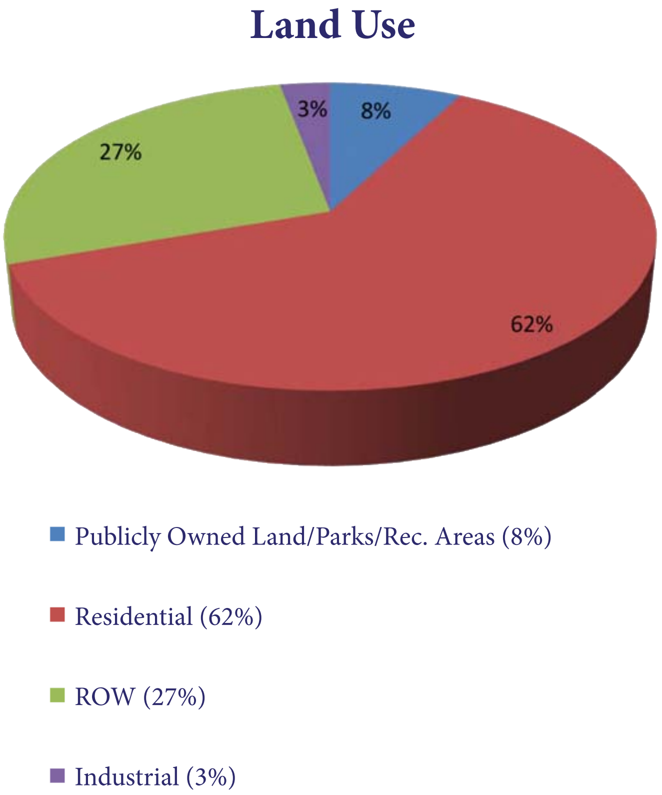


Figure 2: Madigan Creek watershed

In addition to the mainstem of Madigan Creek, three unnamed tributaries make up the Madigan Creek system. Collectively, there are 20.31 stream miles in the Madigan Creek watershed of which 4.42 miles are the mainstem of Madigan Creek. Available data indicates that 25.65 acres of wetlands located within the Madigan Creek watershed. With the exception of the Cherry Valley regional storm water detention facilities near the mouth of Madigan Creek, there are no major impoundments on Madigan Creek or its tributaries.

Approximately 76-percent (4.72 square miles) of the watershed was incorporated as of 2012 in two different municipalities: City of Rockford (50.81%) and Village of Cherry Valley (25.2%). The remaining 24% of the watershed is unincorporated Winnebago County. The Madigan Creek watershed is approximately 88% developed with the majority of the development occurring in the north and central portions of the watershed. Though primarily residential, land use in the watershed also includes commercial/industrial developments, agricultural lands, and a rock quarry.



The Watershed Over Time

Prior to development, in the early 1800s, the landscape of the watershed included prairies, wetlands, and widely scattered oaks and hickories. In the 1800s, due to the fertile soils and openness of the oaks and hickories, farmers began converting the land including the draining of wetlands for agricultural uses. Very quickly by the mid-1800s, the City of Rockford and Village of Cherry Valley were incorporated and urbanization of the watershed began. This development continued with the suburbanization following World War II and the watershed has now been converted to a mix of residential, commercial, and industrial land uses.

The Impact of Watershed Development

Under natural and undisturbed conditions, precipitation that falls onto the land surface is allowed to soak into the soil and become groundwater in a process referred to as infiltration or evaporated into the air by plants or from soil or surface waters in a process known as evapotranspiration. Typically, 75-90% of the rainfall either soaks into the ground or evaporates. Precipitation that is not infiltrated or evapotranspired is called runoff. Urban development in the watershed is reducing the amount of land available for the natural infiltration of rainfall into the ground (Figure 3). Instead of precipitation falling on vegetation where it can be infiltrated, it falls on parking lots, rooftops, and roads. The surfaces that prevent infiltration are known as impervious surfaces. From these impervious surfaces, the runoff is quickly conveyed into streams and creeks via a constructed drainage system comprised of drainage ditches, swales, and storm sewers. As a result, streams receive large pulses of water in shorter periods of time, resulting in erosion and destabilization of the stream channel and streambanks. As physical modification of the stream occurs, adjacent property can be damaged.

Additionally, when the landscape or stormwater system is insufficient to contain these pulses of water, flooding can occur.

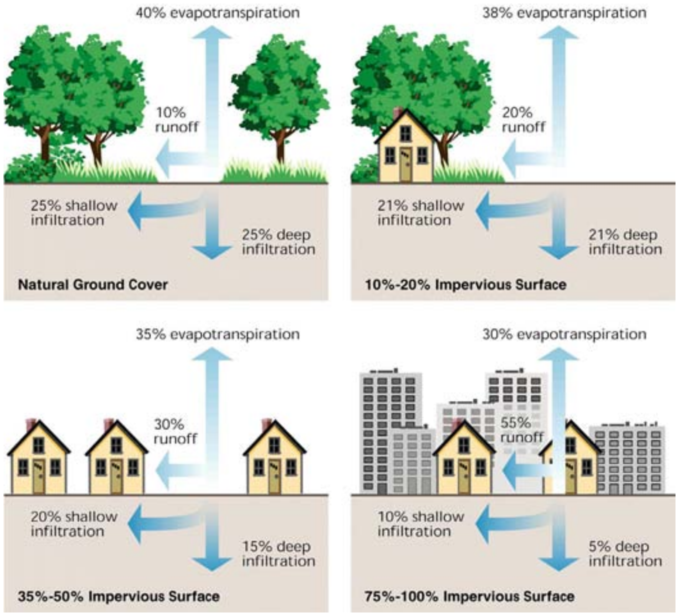


Figure 3: Impacts of increased urbanization on stormwater runoff (FISRWG)

In addition to the change of the volume and rate of runoff, pollutants such as oil and grease, road salt, eroding soil and sediment, metals, bacteria from pet wastes, and excess nutrients (nitrogen and phosphorus) from fertilizers are washed from streets, parking lots, construction sites, lawns, roofs, and golf courses into streams. This type of pollution is called nonpoint source pollution. Additional pollutants include increased water temperature, altered pH, and low dissolved oxygen levels, all of which can make the streams unhealthy for fish and other aquatic species.

Thus, the health of the Madigan Creek watershed is directly related to land use activities throughout the watershed. These activities not only impact the residents of the watershed but those of the communities, both human and natural, living downstream on the Kishwaukee River. Fortunately, there are proven measures and practices for addressing these impacts that watershed stakeholders can utilize to take positive action towards improving the watershed. One of the first steps in the process is to understand watershed problems and make a plan for moving forward – a watershed-based plan.

Watershed Planning

Watershed planning is a collaborative approach to addressing a variety of related water resource issues including water quality protection. This approach allows stakeholders to share information, better target limited financial resources, and address common water-related challenges. These challenges can include improving stream and lake water quality, preserving and protecting groundwater resources, managing stormwater, reducing soil erosion and flood damage, conserving open space, protecting wildlife habitat, providing safe recreational opportunities, supporting opportunities for economic development, and other issues of concern.

The following general steps were used in developing this watershed plan:

- Conduct periodic meetings of the Winnebago County Watershed Improvement Plan Steering Committee (WCWIPSC) with watershed stakeholders.
- Solicit public input on watershed problems and opportunities to develop watershed goals and objectives.
- Review and analyze existing studies, watershed conditions, and available watershed data to identify watershed problems and opportunities.
- Identify best management practices (BMPs) and polices to improve water resources.
- Develop a detailed watershed action plan and implementation plan.

Watershed Issues and Goals

Early in the planning process, WCWIPSC members, using input obtained from stakeholders during a public meeting, developed a list of watershed issues and concerns. Watershed concerns included:

Stakeholder Issues/Concerns

Stormwater
- Too much runoff and not enough infiltration and/or detention leading to flooding.
- Non-point source pollution.
- Hydromodification leading to erosion and sedimentation.

Need for recreational, greenway, and open space.

Lack of education for landowners along the creek, need to encourage riparian best management practices to prevent illicit dumping and bad-housekeeping.

Groundwater contamination/impacts.

Water quality impacts from the Sand and Gravel Quarry.

The ecological condition of the stream channels including lack of fish and wildlife habitat.

Stakeholder Goals

Protect and enhance overall surface and groundwater quality in the Madigan Creek watershed.

Reduce existing flood damage in the watershed and prevent flooding from worsening.

Improve aquatic and wildlife habitat in the Madigan Creek watershed.

Develop open space in the Madigan Creek watershed and provide recreational opportunities.

Increase coordination between decision makers and other stakeholders in the watershed.

Figures 4, 5, and 6 below includes photos of problem areas identified in the watershed. Goals were drafted directly from the concerns expressed by the stakeholders. The final goals were adopted on November 2, 2011 and capture the desired outcomes and vision for the Madigan Creek watershed. Objectives assigned to each goal are intended to be measurable so that the WCWIPSC can assess future progress made towards each goal.

Figure 4: Localized Flooding

Figure 5: Concrete Drainage Channel

Figure 6: Slope Failure

Watershed Inventory and Assessment

Chapter 3 of this watershed-based plan is an assessment of watershed conditions based on available data, studies, and stakeholder input. The assessment includes information on stream corridor conditions, stormwater infrastructure, flooding, water quality, land use, wetlands, and other relevant information. This information not only provides a snapshot of current conditions but also serves as baseline data for comparing future watershed assessments. Four important conclusions based on this watershed assessment are summarized here.

- The Madigan Creek watershed exhibits rapid increases and decreases in water flow and velocity. These frequent changes are causing significant water quality degradation, reductions in the quality of stream habitat, and destabilizing the stream channel leading to erosion and damage to infrastructure.

- Water quality is impacted by low dissolved oxygen levels and high phosphorus concentrations. Large impervious surface areas are significant contributors to water runoff and pollution.

- Hydromodification including streambank erosion and channelization is prevalent through the watershed. These conditions have lead to severely degraded instream and streamside habitat.

- Municipalities, residents, business owners, landowners, and other watershed stakeholders lack the coordination and communication necessary to improve watershed resources.

Watershed Best Management Practices (BMPs) and Solutions Toolbox

Chapter 4 of the watershed-based plan includes a description of BMPs and solutions that when properly applied can reduce stormwater impacts and improve water quality and stream habitat. The toolbox contains BMPs that can be implemented by all levels of watershed stakeholders from residents and landowners to municipalities. BMPs and solutions in the toolbox include:

BMPs and Associated Solutions

Stabilizing and restoring streambanks using bioengineering techniques.

Installing rain gardens and bioinfiltration practices to help slow, infiltrate, cool, and cleanse stormwater runoff before being discharged into stream.

Constructing new and retrofitting existing detention basins to help reduce volume and rate of stormwater released during storm events into streams.

Reducing the area of impervious surfaces and using permeable pavements that allow water to infiltrate into the ground instead of running off as stormwater runoff.

Restoring and maintaining native riparian buffers along stream and detention basins.

Prioritized Action Plan

The effectiveness of the Madigan Creek Watershed-Based Plan will be largely dependent on the successful implementation of the Prioritized Action Plan by watershed stakeholders. The Action Plan serves as a roadmap for watershed improvement and provides the "who, what, where, and when". The Prioritized Action Plan includes programmatic, policy, and site-specific recommendations. Programmatic Actions are focused on watershed-wide action items that are not site specific while the Site Specific Action Plan identifies specific and actual locations where water quality, hydrological modification, and/or flood reduction/prevention projects can be implemented (Figures 7, 8, 9). The eight most important general recommendations include:

- A stormwater management plan feasibility study for the Madigan Creek watershed should be completed to obtain a better understanding of how stormwater runoff can be better managed within the watershed.
- Remediate existing flood problems and protect future flooding by reducing stormwater runoff and preserving and restoring areas for surface water storage such as depressional areas, floodplains, and wetlands. These areas also provide water quality improvement benefits.
- Construct new and retrofit existing stormwater management system including detention basins and storm sewer outfall culverts to reduce runoff volume and rate and improve water quality in streams.
- Reduce impervious areas by incorporating permeable pavements and bioinfiltration practices such depressed islands and rain gardens in parking lots and streets throughout the watershed.
- Stabilize streambanks to reduce erosion, protect property and infrastructure, and improve water quality and habitat.
- Remove the concrete channel and replace with a more naturalized channel using bioengineering techniques in order to improve water quality and habitat.
- Provide public education and outreach to all watershed stakeholders as means of enhancing the understanding of watershed resources and provide opportunities for stakeholders to become involved in plan implementation.
- Monitor and evaluate watershed plan implementation and changes in watershed conditions to gauge progress on reaching watershed goals.

Figure 7: Permeable Paver Parking Lot

Figure 8: Naturalized Detention Basin

Figure 7: Stream Riffles/Slope Stabilization

Monitoring and Evaluation Plan

The final chapter of the watershed plan (Chapter 6) includes the Monitoring and Evaluation Plan. The Monitoring and Evaluation Plan was designed to provide a straightforward means of measuring progress towards watershed goals and plan implementation.

Stakeholders should utilize this plan to monitor watershed resources and track whether meaningful progress is being made towards reaching the watershed-based plan's goals. The monitoring plan includes a series of Report Cards developed for each of the goals. The Report Cards are intended to provide a brief description of current conditions, suggest performance indicators that should be evaluated and monitored, milestones to be met, and remedial actions if milestones are not being met.

Where Do We Go From Here?

Urbanization has played a significant role in the degradation of water resources in the Madigan Creek watershed. Fortunately, there are actions outlined in this plan can be taken to mitigate existing issues and prevent additional future problems. The future health of the watershed is largely dependent on how stormwater is managed. The business-as-usual approach using conventional development practices, stormwater management techniques and landscape management practices will result in a continued decline of the watershed resources and water quality. A new approach that includes proven and environmentally-sensitive practices and approaches to stormwater management can reverse this trend and begin to improve water quality and stream health in the watershed.

There is no single fix for the water quality and flooding problems in the Madigan Creek watershed. These problems are the cumulative result of decisions made since urbanization accelerated in the mid-1900s. It will take the decisions and actions of every stakeholder living in the watershed to work together to improve the health of the watershed. Likewise, actions will need to be taken on every scale from the individual lot to the neighborhood to the municipalities in order to positively impact watershed resources.

This watershed-based plan is the first step in helping watershed residents and stakeholders understand what can be done to restore the valuable resources of the Madigan Creek watershed.

Executive Summary

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Chapter 1.0 Introduction

1.1 The Madigan Creek Watershed

1.1.1 Watershed Setting

A watershed is a land area that contains a common set of streams or rivers that drains to a common body of larger water such as larger rivers, lakes, estuaries, wetlands, or even the ocean (Figure 1-1). Topography is the key element affecting this area of land. The boundary of a watershed is defined by the highest elevations surrounding the stream with water flowing towards the lower elevations within the watershed. Theoretically, a drop of rainwater that falls on the highest elevation within the watershed will eventually make it to the lowest point. Rainfall that falls outside this boundary will enter another watershed and flow to a different stream. Whether you know it or not, you live in a watershed. Watersheds exhibit a complex interaction between land, climate, water, vegetation, humans, and animals. Watersheds are shown to be dynamic, constantly seeking states of equilibrium while being affected by man-made influences and natural daily changes in weather and climate.

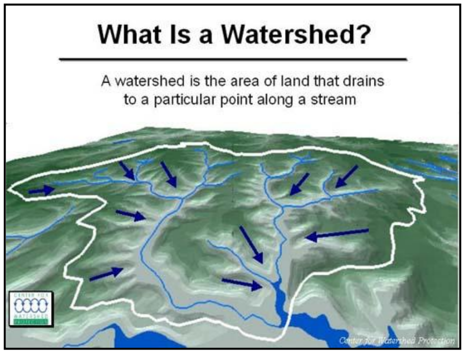

Figure 1-1 What is a watershed? (CWP)

Watersheds come in all shapes and sizes and can cross county, state, and even international borders. Other common names of watershed, depending on size, include basins, sub-basins, and catchments. For example, the United States Geological Survey (USGS) developed a national framework for categorizing watersheds based on geographical scale. This hierarchy of scales utilized a Hydrologic Unit Cataloging (HUC) system. The USGS HUC's divides all of the United State's watersheds into boundaries using four different classifications, and the cataloging unit is the smallest to define the watershed. The 10-digit HUC code (HUC 10) for Madigan Creek is 709000608.

The Madigan Creek watershed is located in the south-central Winnebago County in northern Illinois (Figure 1-2). The watershed drains approximately 6.21 square miles (3,973 acres) of land into the Kishwaukee River. From the confluence with Madigan Creek, the Kishwaukee River flows westward through Rockford before joining the Rock River. The Rock River flows southwesterly before joining the Mississippi River at Rock Island, Illinois.

In addition to the mainstem of Madigan Creek, 3 unnamed tributaries make up the Madigan Creek system. Collectively, there are 20.31 stream miles in the Madigan Creek watershed of which 4.42 miles are the mainstem of Madigan Creek. Available data indicates that 25.65 acres of wetlands are located within the Madigan Creek watershed. With the exception of the Cherry Valley regional storm water detention facilities near the mouth of Madigan Creek, there are no major impoundments on Madigan Creek or its tributaries.

Approximately 76-percent (4.72 square miles) of the watershed was incorporated as of 2012 in two different municipalities: City of Rockford (50.8%) and Village of Cherry Valley (25.2%). The remaining 24% of the watershed is unincorporated Winnebago County. The

Madigan Creek watershed is approximately 88% developed with the majority of the development occurring in the north and central portions of the watershed. Though primarily residential, land use in the watershed also includes commercial/industrial developments, agricultural lands, and a rock quarry.

The Illinois Environmental Protection Agency (Illinois EPA) has identified no impaired waters in the Madigan Creek watershed. However significant water quality concerns including channelization and hydromodification have been identified in the watershed. Erosion and sedimentation is prevalent along the waterways in the watershed. This plan aims at addressing identifying causes and sources of these impacts and developing programmatic and site specific recommendations for restoring the water quality and hydrology of Madigan Creek.

1.1.2 The Watershed Over Time

Prior to development, in the early 1800s, the landscape of the watershed included prairies, wetlands, and widely scattered oaks and hickories. In the 1800s, due to the fertile soils and openness of the oaks and hickories, farmers began converting the land, including the draining of wetlands for agricultural uses. Very quickly by the mid-1800s, both the City of Rockford and the Village of Cherry Valley were incorporated and urbanization of the watershed began. This development continued with the suburbanization following World War II and the watershed has now been converted to a mix of residential, commercial, and industrial land uses.

1.1.3 Impacts of Watershed Development

Under natural and undisturbed conditions, precipitation that falls onto the land surface is allowed to soak into the soil and become groundwater in a process referred to as infiltration or evaporated into the air by plants or from soil or surface waters in a process known as evapotranspiration. Typically, 75-90% of the rainfall either soaks into the ground or evaporates. Precipitation that is not infiltrated or evapotranspired is called runoff. The runoff can be stored in wetlands or depressional areas where it can be infiltrated into the soil or flow across the vegetated land surface and into creeks, stream, rivers, and lakes. As the runoff passes through the vegetation, the flow of the water is slowed allowing for additional infiltration and reducing the potential for high flows to rush into the surface waters. Additionally, the flowing of the runoff through vegetation provides water quality benefits such as the settling out of soil and other solids and nutrient removal by plants. This process is known as the hydrologic cycle (Figure 1-3).

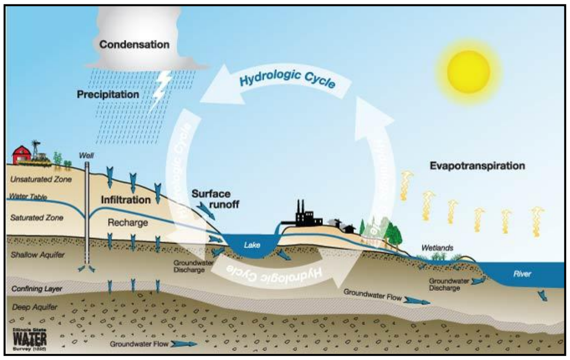

Figure 1-3: Hydrologic Cycle (ISWS)

Urban development in the watershed is reducing the amount of land available for the natural infiltration of rainfall into the ground. Instead of precipitation falling on vegetation where it can be infiltrated, it falls on parking lots, rooftops, and roads. The surfaces that prevent infiltration are known as impervious surfaces. From these impervious surfaces, the runoff is quickly conveyed into stream and creeks via a constructed drainage system comprised of drainage ditches, swales, and storm sewers. The discharge of runoff into the surface waters by the constructed drainage ditches is known as stormwater runoff.

Stormwater runoff tends to enter streams and creeks at a much more rapid rate than runoff from undeveloped areas. This rapid drainage results in what is called "flashy" hydrology. A "flashy" hydrology means that the water level in the stream rises very quickly during a storm and falls quickly afterward. Since less water is infiltrated into the ground to later seep out and create a steady base flow within the stream, low flows are considerably lower or less consistent. Likewise, because less water is absorbed by the ground and more water is flowing into the streams, high flows are considerably higher. These combined effects are referred to as hydromodification.

As a result of hydromodification, stream and creeks received large surges of water in short periods of time. These high flows cause erosion of the streambanks and/or streambeds. As the streambed erodes, the channel deepens and becomes more entrenched (or incised). If the streambed is composed of a stable substrate such as large gravel or stone or when structures provide grade control, the banks will erode and the channel will become wider instead of the channel deepening. As the physical modification of the stream occurs, adjacent property can be damaged.

The flows between these surges can include range from extremely low flows to no flows as there is limited groundwater to maintain baseflow to the creek. Decreased low flows degrade aquatic habitat because low flows have low levels of dissolved oxygen necessary for aquatic animals and because, in extreme cases, the stream can dry up completely for periods of time.

In addition, to problems created by the flashiness of the stream, the duration of high flows can also be a significant problem. High flows that cannot be contained within the stormwater conveyance system or within the stream channels can result in localized flooding of homes, business, and roads. This flooding is caused by over-bank topping, culvert backups, and storm sewer surges and backups. The resulting flooding caused property damage and can make travel difficult and unsafe due to standing water. The heavy flows damage stormwater infrastructure including culverts and discharge pipes by causing dislodgement or erosion around the infrastructure. The high flows also have the ability to carry debris including logs, branches, and trash which can be deposited in debris jams and block the conveyance system.

In addition to the change of the volume and rate of runoff, urbanization can also lead to increased pollutants loadings. This kind of pollution is called nonpoint source pollution. Unlike pollution from industrial and sewage treatment plants, nonpoint source pollution comes from many diffuse sources. Nonpoint pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, and ground waters.

Nonpoint source pollution can include:

- Excess fertilizers, herbicides and insecticides from agricultural lands and residential areas;
- Oil, grease and toxic chemicals from urban runoff and energy production;
- Sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks;
- Salt from roads and irrigation practices and acid drainage from abandoned mines;
- Bacteria and nutrients from livestock, pet wastes and faulty septic systems;
- Atmospheric deposition; and
- Hydromodification.

In addition to chemicals and other substances, nonpoint source pollution also includes other parameters that affect water quality such as temperature, pH, and the amount of oxygen in the water. Each of these parameters plays an important role in the health of aquatic organisms such as fish, macroinvertebrates, and other insects that live in and near streams and waterways. For example, aquatic organisms require oxygen that is dissolved in the water to live and propagate. Low flows and nonpoint sources of pollution can cause the dissolved oxygen levels to become so low that the organisms are killed or need to leave the area in order to find livable conditions.

Temperature is also critical for the health of aquatic organisms. Many fish require cool or cold flowing water in order to successfully breed and survive. Stormwater runoff is typically higher in temperature than the groundwater that feeds streams in an urbanized area. As stormwater runoff flows off of impermeable surfaces and through the stormwater infrastructure it is warmed, leading to elevated water temperatures in the receiving streams. Pollutants picked up along the way can also change the pH of the water making it more acidic or more alkaline. Significant changes towards acidic or alkaline can also have a negative impact on the health of a stream.

Many studies have shown a direct negative impact between the urbanization (or increase in impervious surface area) on water quality and stream health and increase risk of flooding. Thus, the health of the Madigan Creek watershed is directly related to land use activities throughout the watershed. These activities not only impact the residents of the watershed but all of those of the communities, both human and natural, living downstream on the Kishwaukee River.

1.1.4 Where Do We Go From Here

As discussed in Section 1.1.3, urbanization has played a significant role in the degradation of water resources in the Madigan Creek watershed. Fortunately, there are actions that can be taken to mitigate existing issues and prevent additional future problems. This watershed-based plan outlines the recommended actions to restore water quality and stream health, and prevent and reduce flooding. The future health of the watershed is largely dependent on how stormwater is managed. The business-as-usual approach using conventional development practices, stormwater management techniques and landscape management practices will result in a continued decline of the watershed resources and water quality. A new approach that includes proven and environmentally-sensitive practices and approaches to stormwater management can reverse this trend and begin to improve water quality and stream health in the watershed.

There is no single fix for the water quality and flooding problems in the Madigan Creek watershed. These problems are the cumulative result of decisions made since urbanization accelerated in the mid-1900s. It will take the decisions and actions of every stakeholder living in the watershed to work together to improve the health of the watershed. Likewise, actions will need to be taken on every scale from the individual lot to the neighborhood to the municipalities to positively impact watershed resources.

This watershed-based plan is the first step in helping watershed residents and stakeholders understand what can be done to restore the valuable resources of the Madigan Creek watershed.

1.2 About this Watershed-Based Plan

1.2.1 Project Purpose

Watershed planning is a collaborative approach to addressing a variety of related water resource issues including water quality protection. This approach allows stakeholders to share information, better target limited financial resources, and address common water-related challenges. These challenges can include improving stream and lake water quality, preserving and protecting groundwater resources, managing stormwater, reducing soil erosion and flood damage, conserving open space, protecting wildlife habitat, providing safe recreational opportunities, supporting opportunities for economic development, and other issues of concern.

The scope of this project is to develop a watershed-based plan for the Madigan Creek watershed. The purpose of the plan is to address nonpoint-source pollution prevention and water resource protection needs in the Madigan Creek watershed as well as provide a unique forum for public education, involvement, outreach, and community-capacity building opportunities. If no action is taken, our watershed resources will continue to degrade. Water quality will continue to decline, streambank erosion will continue to erode and impact property and infrastructure and the potential for flooding will increase.

This plan provides information and a set of recommendations for municipalities, developers, residents, and others to effectively plan in a way that is appropriate for the protection of the watershed's resources. It provides guidance on water quality improvement, habitat restoration, development standards, and education and outreach programs.

1.2.2 Winnebago County Watershed Improvement Plan Steering Committee

The Winnebago County Watershed Improvement Plan Steering Committee (WCWIPSC) is a consortium of municipalities in the Madigan Creek watershed, resource agency professionals, environmental advocates, and local residents that established itself in April 2010 to guide the development of strategies to protect and restore Madigan Creek and its tributaries. The origin of the WCWIPSC occurred following a meeting on April 27, 2010, of interested parties invited to discuss storm water issues regarding the Madigan Creek watershed. Approximately two dozen people attended the meeting including Winnebago County Board members, the County Engineer and Highway Department staff members, and representatives of the Village of Cherry Valley, Cherry Valley Township, City of Rockford, Rockford Township, Rockford Park District, the Illinois Department of Natural Resources, the Kishwaukee River Ecosystem Partnership (KREP), and the Rockford Metropolitan Agency for Planning (RMAP). After a discussion of water quality and stormwater problems and the need to coordinate the studies and planning required to implement solutions to the problems, the County Board Chairman agreed that the Winnebago County Highway Department would be the lead agency responsible for taking steps to formally organize the WCWIPSC and applied for the CWA Section 319 grant for the preparation of a watershed-based plan on behalf of the WCWIPSC. The Section 319 grant was funded by the Illinois Environmental Protection Agency in Spring 2011 (See Section 1.2.3 for more information).

WCWIPSC met numerous times during the planning process to oversee the development of the watershed-based plan. In addition, a series of public meeting were held to inform the general public of the watershed planning process and solicit input on the plan. A list of meeting is included in Table 1-1. Copies of meeting minutes are included in Appendix A.

Table 1-1 Summary of WCWIPSC Activities

Meeting Number	Date	Meeting Type	Agenda / Topics Covered
1	April 20, 2011	WCWIPSC	Project kickoff; Stakeholder identification; Goal and Objective Setting
2	July 13. 2011	WCWIPSC	Public meeting planning; Water Resource Inventory; Stream walk
3	July 27, 2011	Public Meeting	Watershed planning process; Watershed concerns; Regulatory concerns
4	November 2, 2011	WCWIPSC	Finalize Goals & Objectives; Watershed concerns; Land use issues
5	January 23, 2012	WCWIPSC	Water Resource Inventory; Pollutant load modeling
6	March 16, 2012	WCWIPSC	Water Resource Inventory; Pollutant load modeling
7	July 25. 2012	WCWIPSC	Flood and drainage issue problem area assessment, Technical advisory committee
8	October 10, 2012	WCWIPSC	Flood location identification, Pollutant load modeling
9	November 13, 2012	Public Education Session	Green Infrastructure Best Management Practices, Good Housekeeping Measures
10	March 6, 2013	WCWIPSC	Pollutant load modeling; Programmatic and Site Specific Recommendations
11	March 20, 2013	WCWIPSC	Programmatic and Site Specific Recommendations
12	April 25, 2013	WCWIPSC Executive Committee	Public meeting agenda
13	May 9, 2013	Public Meeting	Programmatic and Site Specific Recommendations

1.2.3 Project Funding

The project was initiated and funded by the Winnebago County Highway Department with a grant from the Illinois Environmental Protection Agency Section 319 grant program. Participating stakeholders contributed staff time to provide information and participate in the watershed planning progress. They include the Village of Cherry Valley, Kishwaukee Ecosystem Partnership (KREP), City of Rockford, Rockford Park District, Winnebago County, Winnebago County Soil and Water Conservation District, and watershed residents.

1.2.4 Watershed-Based Plan Elements

The "Nonpoint Source Program and Grant Guidelines for States and Territories" written by United States Environmental Protection Agency (Illinois EPA) provides guidance for the production of Section 319 funded watershed-based plans. This guidance manual was created to ensure that all Section 319 funded projects including watershed-based plans are aimed at restoring waters impaired by nonpoint source pollution. The guidance manual outlines nine requirements that must be met by the plan in order for the plan to be considered a Watershed-Based Plan. These nine elements are:

1. Identification of causes and sources that will need to be controlled to achieve load reductions estimated within the plan;
2. Estimate of load reductions expected for management measures described in number 3 below;
3. Description of the non-point source pollution management measures that need to be implemented in order to achieve the load reductions estimated in number 2 above and an identification of critical areas
4. Estimate the amounts of technical and financial assistance needed; costs; and the sources and authorities that will be relied upon to implement the plan;
5. Information and public education component;
6. Implementation schedule;
7. Description of interim, measurable milestones for determining whether non-point source pollution measures or other actions are being implemented;
8. Criteria to measure success and re-evaluate the plan; and
9. Monitoring component to evaluate effectiveness of implementation efforts over time.

The Madigan Creek Watershed-Based Plan meets all of the nine minimum criteria outlined by the USEPA. As such, the Madigan Creek stakeholders will be able to apply for Section 319 funding for the implementation of non-point source pollution control projects outlined in the plan.

1.2.5 Prior Watershed Studies and Plans

Formed in 1996 the Kishwaukee River Ecosystem Partnership (KREP) is a coalition of groups and individuals working to protect the high quality natural resources of the Kishwaukee River Watershed. KREP has produced or assisted with the production of numerous reports related to water quality and habitat conditions in the Kishwaukee River:

- Kishwaukee River Subwatershed Reports, KREP, May 2005
- Sustainable Development Guide for Kishwaukee Watershed Municipalities, KREP and Environmental Defenders of McHenry County, 2000
- Kishwaukee River – Strategic Plan for Habitat Conservation and Restoration, January 2006
- Report on the Natural Resources and Habitat in the Kishwaukee River Watershed, KREP April 2004
- Critical Trends Assessment Program (CTAP) Kishwaukee River Area Assessment, Illinois Department of Natural Resources, 1998

While not specifically focused on the Madigan Creek watershed, the information contained in these reports provides general information related to the health and condition of the Kishwaukee River watershed.

1.2.6 Process and Plan Organization

This watershed-based plan was produced via a comprehensive watershed planning approach that involved input from local residents, municipal officials, municipal employees, and representatives from natural resource agencies.

The Winnebago County Watershed Improvement Planning Steering Committee (WCWPSC) held meetings throughout 2010 to 2013 to direct the development of the watershed plan. In the Summer of 2010, WCWIPSC established goals and objectives to focus the watershed planning activities.

Information obtained from watershed stakeholders and numerous natural resource agencies was then used to assess the overall condition of the watershed including water quality, natural resources, and flood risks. Using this information, a series of recommended management practices aimed at improving the water quality and natural resources conditions of the watershed was developed. Potential funding sources and strategies for the implementation and monitoring of the identified recommended projects were also included in the watershed-based plan. Using the guidance provided by the "Guidance for Developing Actions Plans in Illinois" prepared by Chicago Metropolitan Planning Agency (CMAP), the format for the Madigan Creek Watershed-Based Plan includes five main sections.

- Goals and Objectives
- Water Resources Inventory and Assessment
- Stormwater Retrofit Toolbox
- Action Plan
- Monitoring Plan

<u>Goal and Objectives</u>

Watershed stakeholders developed a list of watershed issues, goals, and objectives. The major topics of concern included: hydromodification, water quality, flooding, watershed coordination, watershed hydrology, and instream habitat.

Water Resources Inventory and Assessment

The project planning team assessed watershed conditions and prepared a series of watershed maps based on data, studies, inventories, and stakeholder input. The assessment includes information on stream corridor conditions, stormwater infrastructure, flooding, water quality, land use, wetlands, and other relevant information. This information not only provides a snapshot of current conditions but also serves as baseline data for comparing future watershed assessments.

Stormwater Solutions Toolbox

After the watershed condition was determined, a stormwater solutions toolbox was assembled to identify the range of actions needed to improve watershed resources. This toolbox includes practices in the areas of policy and planning, development standards, stormwater management, erosion control, streambank stabilization, yard and landscape management, habitat restoration, natural area preservation, and flood reduction.

Prioritized Action Plan

The effectiveness of the Madigan Creek watershed plan will be largely dependent on the quality of the action plan. The action plan provides the "who, what, where and when" for watershed improvement and includes programmatic (general) and site-specific recommendations. The site specific action items are tied to a particular location in the watershed or along the stream corridor, and they include details such as area, cost, responsibility, schedule, and priority.

Monitoring Plan

A monitoring and evaluation plan was developed to provide stakeholders and other implementers with a way to monitor watershed conditions and track whether meaningful progress is being made towards plan goals. The monitoring plan includes milestones, parties responsible for monitoring, and the frequency and method for collecting data.

1.3 Using This Plan

For those unfamiliar with watershed-based planning, this plan likely seems overwhelming. There are pages of information to absorb, tables to navigate, and numerous costly recommendations that a single resident could not possibly begin to implement. But there are simple, straightforward actions that each person can take immediately to help improve the watershed.

Remember that every action, no matter how small, can have an impact and improve watershed resources. The Executive Summary of the plan provides a concise overview of what this plan is all about. For additional details, browse the Table of Contents and flip to the relevant section, or refer to Table 1-2 and the suggestions that follow to help find more information.

Table 1-2 Priority Actions by Stakeholder Group

If you are a….	Your top priority action items include:
Resident	1. Join the Kishwaukee Ecosystem Partnership to stay engaged in watershed activities. 2. Restore native riparian buffers, and remove excess debris from stream channels. 3. Capture stormwater runoff using rain gardens, rain barrels or other retrofits and to avoid discharging roof and sump pump runoff directly to the stream. 4. Dispose of yard and municipal waste appropriately, not into stream channels, stormsewers or drainageways. 5. Do not construct structures such as sheds or gazebos in drainage ways or detention facilities.
Business owner	1. Manage your property appropriately by regularly cleaning parking lots and using environmentally-friendly lawn care practices. 2. Incorporate stormwater retrofits to reduce and slow stormwater runoff from your property.
Developer or Homebuilder	1. Incorporate stormwater best management practices into all new development and redevelopment sites aimed at slowing, infiltrating, storing, and cleaning stormwater runoff. 2. Use conservation development or low impact development for a new and redevelopment sites.
Government Official or Staff	1. Incorporate watershed-based plan recommendations into local plans, policies, and regulations. 2. Prepare a detailed stormwater management plan for the watershed. 3. Manage, retrofit, and stabilize the stormwater management system including detention basins, culverts, drainageways, and discharge pipes. 4. Modify and use planning and development standards, policies, and capital improvement plans and budgets to protect and enhance water quality. 5. Require the use of stormwater BMPs and/or stormwater retrofits in all new or redevelopment projects.

To find out….

…what this plan is intended to achieve, read about the watershed goals and objectives in Chapter 2.0.

…detailed information about the watershed, its resources, and problems, read the water resources inventory and assessment included in Chapter 3.0.

…to locate watershed problems close to your home or business, refer to the watershed maps included in Chapter 3.0 to find out what subbasin is closest to the area you are interested in. The maps and text in Chapter 3 will help you locate the watershed resources and problem areas near you.

…what can be done to prevent and mitigate water quality and flooding problems in the watershed, read Chapter 4.0, Stormwater Retrofit Tool Box and Chapter 5, Section 2, the Programmatic Action Plan.

…what types of solutions are available to fix a problem in a specific area, read Chapter 4.0, Stormwater Retrofit Tool Box and Chapter 5, Section 3, the Site Specific Action Plan. The Site Specific Action plan is presented by municipality.

…what king of funding is available for watershed projects, refer to Chapter 6, Section 3, Funding Sources.

Legend

- 🟨 Madigan Creek Watershed
- — Streams & Flowlines
- 🟩 Winnebago County

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Winnebago County Watershed Planning

Madigan Creek - General Location of Watershed

PROJECT NO: 11-0174		SHEET NO:
DESIGNED BY	BRO	1-2
DRAWN BY	BRO	
CHECKED BY	DAD	
APPROVED BY	JAW	
ISSUE DATE	06/30/2013	

FINAL

Chapter 2.0 Goals and Objectives

2.1 WCWIPSC Goals

The Winnebago County Watershed Improvement Plan Steering Committee (WCWIPSC) is a consortium of municipalities in the Madigan Creek watershed, resource agency professionals, environmental advocates, and local residents dedicated to the development of strategies to protect and restore Madigan Creek and its tributaries. WCWIPSC's primary goal is to work effectively to reduce nonpoint source pollution inputs in the Madigan Creek watershed, reduce flooding and improve water quality and stream habitat, while engaging a wide range of audiences in the WCWIPSC's efforts.

2.2 Watershed Goals and Objectives

One of the WCWIPSC's first tasks was the discussion and establishment of goals for the Madigan Creek watershed. Stakeholders included in the goal setting process included the members of the WCWIPSC and watershed residents that attended the watershed public meetings. At the April 2011, July 2011, and November 2011 WCWIPSC members dedicated a significant portion of the committee meeting to the identification of watershed concerns and setting of watershed goals. See Appendix A for the minutes of WCWIPSC meetings. Additionally, at the July 2011 public meeting, attendees that included more than 75 watershed residents, County Board members and representatives from various local and state agencies were asked to express their watershed concerns and vision for the Madigan Creek watershed. As part of the public meeting, attendees were split into four breakout groups and asked to provide input on general and specific water quality and flooding concerns and who they view as responsible for fixing the identified problems. The information provided by the attendees was utilized by WCWIPSC in preparing the goals and objectives for the Madigan Creek Watershed-Based Plan.

As discussed above, prior to setting goals, stakeholders were asked to communicate their concerns and vision for the Madigan Creek watershed. Stakeholder concerns included:

- Stormwater
    - Too much runoff and not enough infiltration and/or detention leading to flooding
    - Non-point source pollution
    - Hydromodification leading to erosion and sedimentation
- Need for recreational, greenway, and open space
- Lack of education for landowners along the creek, need to encourage riparian best management practices to prevent illicit dumping and bad-housekeeping
- Groundwater contamination/impacts
- Water quality impacts from the Sand and Gravel Quarry
- The ecological condition of the stream channels including lack of fish and wildlife habitat

Goals were drafted directly from the concerns expressed by the stakeholders. The final goals were adopted on November 2, 2011 and capture the desired outcomes and vision for the Madigan Creek watershed. Objectives assigned to each goal are intended to be measurable so that the WCWIPSC can assess future progress made towards each goal. The goals are not listed by order of importance.

A. Protect and enhance overall surface and groundwater quality in the Madigan Creek watershed

   Objectives

   1) Reduce sediment loading in streams by stabilizing stream banks.
   2) Implement stormwater best management practices (BMPs) throughout the watershed to improve water quality and reduce runoff.
   3) Retrofit existing stormwater management facilities and design new facilities within urbanized areas to reduce nutrient and sediment loading.
   4) Restore riparian buffers along Madigan Creek and its tributaries.
   5) Restore perennial base flow to Madigan Creek.
   6) Implement infiltration BMPs throughout the watershed to provide groundwater infiltration.
   7) Educate the public about the need for groundwater protection.

B. Reduce existing flood damage in the watershed and prevent flooding from worsening

   Objectives

   1) Encourage decision makers to undergo a detailed hydraulic and hydrology study of the watershed.
   2) Mitigate for existing flood damage by identifying parcels suitable for flood mitigation projects such as compensatory storage basins.
   3) Reconnect channelized stream segments to the floodplain where feasible.
   4) Implement stormwater best management practices (BMPs) throughout the watershed designed to reduce runoff and encourage infiltration.
   5) Protect undeveloped floodplain from development.

C. Improve aquatic and wildlife habitat in the Madigan Creek watershed

   Objectives

   1) Identify opportunities for improving habitat along degraded stream channels using a natural channel design.
   2) Restore riparian buffers along Madigan Creek and its tributaries.
   3) Encourage local residents to utilize native species in their landscapes.
   4) Identify opportunities for habitat improvements at parks and natural areas.

D. Develop open space in the Madigan Creek watershed and provide recreational opportunities

   Objectives

   1) Identify open space along the waterways that would provide access to the waterway.

    2) Identify open space for natural resources and provide passive recreational opportunities.

E. Increase coordination between decision makers and other stakeholders in the watershed.

   Objectives
   1) Ensure communities adopt the Madigan Creek Watershed-Based Plan.
   2) Encourage the adoption and/or revision of comprehensive plans and ordinances that support the watershed plan's goals and objectives.
   3) Encourage communities to continue to be an active member of the WCWIPSC following plan development.

F. Raise stakeholder awareness (residents, public officials, etc) about the importance of best management practices of watershed stewardship

   Objectives
   1) Encourage stakeholder to join the Kishwaukee River Ecosystem Partnership.
   2) Encourage stakeholders to participate in WCWIPSC activities and educational workshops.
   3) Provide watershed stakeholders with an education plan that gives them the skills needed to implement the watershed plan.

Chapter 3: Watershed Resource Inventory and Assessment

3.1 Introduction

An understanding of the unique features and natural processes associated with the Madigan Creek watershed, as well as the current and potential future condition, is critical to developing an effective watershed-based plan. This watershed inventory and assessment organizes, summarizes, and presents available watershed data in a manner that clearly communicates the issues and processes that are occurring in the watershed so that stakeholders living the Madigan Creek watershed can make informed decisions about the watershed's future. The inventory and analysis identifies the causes and sources of watershed degradation and provides the basis for recommending both programmatic and site specific actions intended to improve the watershed, which are found in Chapter 5.

As part of the preparation of the Watershed Resource Inventory and Assessment, WCWIPSC collected and reviewed available watershed data, conducted an investigation of stream reaches in the field, and gathered input from watershed stakeholders. Examples of information investigated includes water quality, streambank erosion, soils, wetlands, flood damage areas, the detention and drainage system, population, and current and future land use.

Geographic Information System (GIS) software was used to compile, analyze, and display this detailed information in graphical and map format so that stakeholders can easily understand the condition and location of watershed resources. The amounts of different pollutants that are expected from various land uses to enter Madigan Creek was also investigated.

This chapter presents the results of the inventory and analysis in a series of maps, tables, graphs, and narrative format. A summary of the watershed assessment is included at the end of the chapter.

3.2 Watershed Setting

The Madigan Creek watershed is located in the south-central Winnebago County in northern Illinois (Figure 3-1). The watershed drains approximately 6.21 square miles (3,973 acres) of land into the Kishwaukee River. From the confluence with Madigan Creek, the Kishwaukee River flows westward through Rockford before joining the Rock River. The Rock River flows southwestly direction before joining the Mississippi River in the Quad Cities area (Moline, Illinois; Rock Island, Illinois, Davenport, Iowa; and Bettendorf, Iowa).

3.3 Water Resources

In addition to the mainstem of Madigan Creek, 3 unnamed major tributaries makeup the Madigan Creek system. Collectively, there are 20.31 stream miles in the Madigan Creek watershed of which 4.42 miles are attributed to the mainstem of Madigan Creek. Available data indicates that 25.65 acres of wetlands are located within the Madigan Creek watershed. With the exception of the Cherry Valley Regional Storm Water Detention Facilities near the confluence of Madigan Creek and the Kishwaukee River, there are no major impoundments on Madigan Creek or its tributaries.

3.4 Geology/Topography

During the Pleistocene Era or "Ice Age" advancing and receding glaciers covered much of North America. The Illinoian glacier extended to southern Illinois between 300,000 and 125,000 years ago. It is the Illinoian glacier that is responsible for the flat, farm-rich areas in the southern half of the state. The northeastern portion of Illinois including the watershed area was also covered by the most recent glacial event known as the Wisconsinan. The Wisconsinan began approximately 70,000 years ago and ended around 14,000 years ago. It was during this time that the temperatures began to rise and the ice retreated to form a landscape similar to the Alaskan tundra. As the temperatures began to rise, the tundra was replaced by cool moist deciduous forests, and eventually oak-hickory forests and prairies. The final retreat of the Lake Michigan lobe of the Wisconsin glacier is responsible for the formation of the Great Lakes and the landscape of the watershed. This landscape contains moraines, flood plains, bogs, outwash plains, lake plains, beaches, stream terraces, kames, ridges, and kettle holes (wetlands, ponds, and lakes).

Topography refers to the elevations of landscape that describes the configuration of its surface. Topography is an essential tool in the watershed planning process because topography defines the boundaries of the Madigan Creek watershed. For this watershed-based plan, the Online Watershed Delineation (HYMAPS-OWL) tool, created by Department of Agriculture and Biological Engineering at Purdue University was use to create the initial subwatershed boundaries. The subwatershed (also referred to as subbasin) boundaries generated by HYMAPS-OWL were then cross referenced with boundaries obtained by inputting 2-foot topography into the GIS-based model, Arc Hydro. This combined data generated a Digital Elevation Model (DEM) that was used to delineate and refine the watershed and subwatershed boundaries for Madigan Creek. Inconsistencies in the two model's delineations were adjusted to reflect field-verified conditions and more accurately depict the hydrologic boundaries. Most of these inconsistencies occurred in areas divided by roadways that were not accounted for the in model. Figure 3-2 depicts the DEM and boundary of Madigan Creek.

The Madigan Creek watershed generally drains from north to south to the Kishwaukee River. The highest point in the watershed (850 feet) is located north of State Street. The lowest point in the watershed (750 feet) is located near the creek's confluence with the Kishwaukee River. The difference in the highest and lowest points reflects a 100-foot change in elevation as you traverse from the northern to the southern section of the watershed.

3.5 Climate and Precipitation

3.5.1 Climate

Illinois is situated midway between the Continental Divide and the Atlantic Ocean and is often times underneath the polar jet-stream. The polar jet-stream is a focal point for movement between cold polar air masses from the north moving southward and warmer, tropical air from the south moving northward. The convergence of polar and tropical air causes Illinois to have a humid continental climate with hot humid summers and cool to cold winters with short frequent fluctuations in wind direction, cloudiness, humidity, and temperature.

Data collected in Rockford, Illinois best represents the overall climate and weather patterns experienced in the watershed. The average annual temperature for Rockford, Illinois is 47.7°F. The winter months (December – February) are cold with an average temperature of 21.7°F with the lowest temperature on record of -27°F recorded on January 10, 1982. There is an average of 144 annual days below freezing. The summer months are hot and humid with an average temperature of 71°F. The highest temperature on record for Rockford, Illinois is 112°F recorded on July 14, 1936.

3.5.2 Precipitation

Average yearly precipitation for Illinois varies from just over 48 inches at the southern tip of the state to just under 32 inches in the northern portion of the state. May and June are the wettest months of the year. Flooding is the most damaging weather hazard within the state. Increased warming within urban heat islands leads to an increase in rainfall downwind of cities. Lake Michigan leads to an increase in winter precipitation along its south shore due to lake effect snow forming over the relatively warm lakes. Normal annual snowfall exceeds 38 inches in Chicago, and the southern portion of the state normally receives less than 14 inches. Storms exceeding the normal winter value are possible within one day. In summer, the relatively cooler lake leads to a more stable atmosphere near the lake shore, reducing rainfall potential. Illinois averages around 50 days of thunderstorm activity a year which puts it somewhat above average for number of thunderstorm days in the United States. Illinois is also vulnerable to tornadoes with an average of 35 occurring annually.

The average annual rainfall for Rockford, Illinois is 36 inches. Average snowfall for the area is 39 inches. The most rainfall received in one year occurred in 2008 when more than 51 inches of rain fell. The snowiest winter in the history of the city was the winter of 1978-1979, when 75 inches of snow fell. The one-day maximum precipitation (3.45 inches) occurred on September 26, 2011.

3.6 Soils

Deposits left during by the Lake Michigan lobe of the Wisconsin glacier are the raw materials of the soils currently found in the Madigan Creek watershed. A combination of biological, physical, and chemical variables such as climate, drainage patterns, vegetation, and topography have all interacted together to form the soils found today. Soils are identified by a name associated with each series or class of soils with similar characteristics. A soil series is commonly derived from a town or landmark in or near the areas where the soil series was first identified, although sometimes naming conventions vary by county. Soil series are differentiated based on the amounts and size of particles making up the soil, water-holding capacity, the slopes where they are located, permeability characteristics, and organic content.

Table 3-1 lists the dominant soil series located within the watershed.

Table 3-1 Soil Series in the Madigan Creek Watershed

Soil Series	Hydric	Highly Erodible	Hydrologic Soil Group	Acres	% of Watershed
Plano	No	Potential	B	568.07	14.30%
Greenbush	No	Potential	B	540.43	13.61%
Olge	No	Potential	B	510.45	12.86%
Atterberry	No	No	B	307.21	7.73%
Argyle	No	Potential	B	211.82	5.33%
Fayette	No	Potential	B	192.20	4.84%
Kidder	No	Yes	B	151.41	3.81%
Flagg	No	Yes	B	133.43	3.36%
Muscatune	No	No	B	125.41	3.16%
Comfrey	Yes	No	B/D	105.51	2.66%
Kane	No	No	B	96.82	2.44%
Grellton	No	No	B	90.37	2.28%
Elco	No	Potential	B	83.14	2.09%
Lahoguess	No	No	B	82.68	2.08%
Virgil	No	No	B	73.73	1.86%
Troxel	No	No	B	57.32	1.44%
Jasper	No	No	B	49.13	1.24%
Stronghurst	No	No	B	48.11	1.21%
Pecatonica	No	Yes	B	46.75	1.18%
Winnebago	No	Yes	B	43.75	1.10%
Waupecan	No	No	B	40.90	1.03%
St Charles	No	Potential	B	39.16	0.99%
Sable	Yes	No	B/D	36.92	0.93%
Martinsville	No	Potential	B	31.03	0.78%
McHenry	No	Yes	B	29.68	0.75%
Hitt	No	Potential	A	27.25	0.69%
Rozetta	No	No	B	25.57	0.64%
Orthents	No	Potential	C	23.73	0.60%
Assumption	No	Potential	B	21.05	0.53%
Pits, Quarry	No	No	N/A	20.86	0.53%
Kendall	No	No	B/D	20.57	0.52%
Non-Dominant Soil Types	N/A	N/A	N/A	137.54	3.46%

There are 37 soil series found in the Madigan Creek watershed. Of these 37, 31 are considerate dominant soil types (greater than 0.5% of the watershed). The remaining 14 soils have been classified as "non-dominant soils". The "non-dominant soils cover 3.46% f the Madigan Creek watershed.

Plano is the predominant soil type in the watershed, covering 568.07 acres or approximately 14.30% of the watershed. Greenbush soils are the next most dominant soil series covering approximately 13.61% or 540.43 acres of the watershed. The majority of the soils located in the watershed are well drained, non-hydric soils. Native plant communities in the watershed were likely comprised of prairie grasses and widely spaced trees including oaks and hickories.

3.6.1 Hydric Soils

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that are formed under conditions of saturation, flooding, or ponding and retain moisture long enough during the growing season to develop anaerobic (oxygen-deprived) conditions in the soil layers closest to the surface. Hydric soils are important because they indicate the presence of existing or historical wetlands and depressional areas. Thus areas of hydric soils may be suitable for wetland restoration. Often, drain tiles are found in areas of hydric soils but because the tiles are draining water away from the area, wetlands that were once present are no longer present. By breaking these tiles and restoring the natural flow of water to these areas, wetland hydrology can potentially be restored and with a properly designed excavation, planting and management plan, a high quality wetland can be established. Table 3-2 identified the percent coverage of hydric soils in the watershed and Figure 3-3 displays the coverage of hydric soils. Hydric soils comprise 142.47 acres or 3.59% of the Madigan Creek watershed and hydric soil inclusions comprise 790.46 acres or 19.89% of the watershed. Hydric inclusion soils are upland soils that have the potential to have pockets of hydric soils contained within them. The remaining 3040.3 acres (76.52%) are non-hydric soils. The hydric soils are primarily located along Madigan Creek. The hydric inclusion soils are located along Madigan Creek and in the southeast corner and northern portion of the watershed.

Table 3-2 Percent Coverage of hydric and non-hydric soils in the Madigan Creek Watershed

Soil	Total area (acres)	Percentage of Watershed
Non-Hydric Soils	3040.3	76.52%
Hydric Soils	142.44	3.59%
Hydric Inclusion Soils	790.46	19.89%
Total	3973.23	100%

3.6.2 Soil Erodibility

Soil erosion and sedimentation are significant causes of degraded water quality in Illinois. Soil erosion is the process in which soil is detached and moved by flowing water, wave action or wind. Through erosion, sediment is transported from its original location and deposited in a new location such as a stream, river, lake, or other ground surface. This deposition process is commonly referred to as sedimentation. The movement of eroded soils into streams, rivers, and lakes affects water quality chemically, biologically, and physically. Damage from sediment can be expensive both environmentally and economically. Over time, sediment deposits can blanket rock, cobble, and sandy substrate needed by fish and macroinvertebrates for habitat, food, and reproduction; reduce useful storage volumes in ponds, reservoirs, and lakes; and increase the need for costly water filtration systems for municipal drinking water supplies. Often times, the impacts of erosion and sedimentation are additive and the effects and costs of the sedimentation can be severe, both for those immediately affected and for those who must mitigate subsequent problems.

A map identifying the highly erodible soils in the watershed was created (Figure 3-4) by selecting soils that have been classified as highly erodible by the Natural Resource Conservation Service (NRCS). It is important to map the highly erodible soils because they represent those areas that have the highest potential to degrade water quality. As identified in Table 3-3, 8.29% (329.3 acres) of the soils within the watershed are highly erodible.

Table 3-3 Highly erodible soils in the Madigan Creek Watershed

Soil Name	Soil Code	Acres	Percent of Watershed
Kidder	361D2	151.41	3.81%
Flagg	419C2	41.63	1.05%
Pecatonica	21C2	37.51	0.94%
Winnebago	728C2, 728D2	27.94	0.70%
McHenry	310D2	17.31	0.44%
Whalen & New Glarus	561C2, 561D2	15.67	0.39%
Ringwood	297D2	10.39	0.26%
Griswold	363D2	8.89	0.22%
Osco	86C2	7.51	0.19%
Westville	22C2	7.29	0.18%
Rockton & Dodgeville	566C2	3.75	0.09%

3.6.3 Hydrologic Soil Groups

The permeability and surface runoff potential of the soils in the United States have been classified by the NRCS into Hydrologic Soil Groups (HSGs). HSGs are based on a soil's infiltration and transmission (or permeability) rates and are used by engineers to estimate runoff curve numbers. Runoff curve numbers are an estimate of runoff potential of different soil types with different land covers. The curve numbers allow engineers to estimate the amount of direct runoff from a rainfall event in a particular area. HSGs are classified into four primary categories: A, B, C, and D, and three dual classes, A/D, B/D, and C/D.

- Group A is comprised of the most permeable soil types and have the lowest runoff potential. These soils consist of mainly deep, well drained to excessively drained sands or gravelly sands. Group A soils have a high rate of water transmission.
- Group B soils have a moderate infiltration rates and are moderately deep, moderately well drained or well drained with fine texture to moderately course texture (silt and sand). Group B soils have a moderate rate of water transmission.
- Group C soils have slow infiltration rates because of a fine texture soil layer comprised of silt and clay that impedes the downward migration of water. Group C soils have a slow rate of water transmission.
- Group D soils have the slowest infiltration rates and a high runoff potential. These soils are typically clay and exhibit very slow rates of water transmission.
- Dual hydrologic groups (A/D, B/D, and C/D) are classified differently. The first letter represents the HSGs for the artificially drained soils in the area. The second letter represents the HSGs for the undrained, natural conditions. Only soils that are rate D in the natural conditions are assigned to dual classes.

The location of Group A and Group B soils within a watershed is imperative to a watershed planning process. Many of the BMPs included in watershed plans rely on infiltration to maximize performance including rain gardens, bioswales, and infiltration basins. Table 3-4 summarizes the HSGs and their corresponding attributes. Figure 3-5 depicts the location of each HSG within the watershed while Table 3-5 summarizes the acreage and percent of the watershed for each HSG. 93.28% of the soils in the Madigan Creek watershed as Group B with 4.37% classified as Group B/D. The remaining 2.35% of soils are comprised of Group A, C, C/D, and unclassified soils. There are no Group A/D or D soils in the Madigan Creek watershed.

Table 3-4 Hydrologic Soil Groups and their corresponding attributes in the Madigan Creek watershed

HSG	Soil Texture	Drainage Description	Runoff Potential	Infiltration Rate	Transmission Rate
A	Sand, loamy sand, or sandy loam	Well to excessively well drained	Low	High	High
A/D	Sand or silt loam to clay	Well drained to poorly drained	High to Low	High to Very Low	High to Very Low
B	Silt loam or loam	Moderately well to well drained	Moderate	Moderate	Moderate
B/D	Silt loam, silty clay loam, clay	Moderately well to poorly drained	Moderate to Low	Moderate to Low	Moderate to Very Low
C	Sandy clay loam	Somewhat poorly drained	High	Low	Low
C/D	Sandy clay loam, silty clay loam, clay	Somewhat poorly drained to poorly drained	High	Low to Very Low	Low to Very Low
D	Clay loam, silty clay loam, sandy clay loam, silty clay, clay	Poorly drained	High	Very Low	Very Low

Table 3-5 Hydrologic Soil Groups including acreage and percent of watershed

HSG	Total Acreage	Percent of Watershed
A	27.25	0.69%
A/D	0	0%
B	3705.23	93.28%
B/D	173.77	4.37%
C	23.73	0.60%
C/D	14.65	0.37%
D	0	0%
Unclassified	28.60	0.69%

As noted above, Madigan Creek is comprised mainly of Type B soils. Type B soils have with moderately low runoff potential when thoroughly wet. Water is typically transmitted through these soils without impediment. Type B soils typically have less than 20 percent clay, and between 50 and 90 percent loamy sand or sandy loam textures. These soils have moderately fine to moderately course textures. The predominance of these Type B soils in the Madigan Creek watershed should facilitate infiltration in pervious areas.

3.7 Watershed Jurisdictions

One county, two municipalities and 2 townships comprise the Madigan Creek watershed (Table 3-6, Figure 3-6). The watershed is located completely in Winnebago County and the

City of Rockford (2018.6 acres/50.81%) is the municipality that occupies the largest portion of the watershed. The Village of Cherry Valley (1001.43 acres/25.2%) is also located within the watershed. All remaining land in the watershed (953.19 acres/23.99%) is Unincorporated and under the jurisdiction of the Rockford and Cherry Valley Townships. Additional entities with jurisdiction in the watershed include:

1. Winnebago County Board Districts (District 8, 11, and 15)
2. Rockford Park District
3. Winnebago County Soil and Water Conservation District
4. Illinois State Representative District (District 67, 68, 69)
5. Illinois State Senatorial District (District 34, 35)
6. US Congressional District (District 16)

Table 3-6 County, municipal, and township jurisdictions in the Madigan Creek Watershed

Jurisdiction	Acres	Percent of Watershed
Winnebago County	3973.23	100%
Municipalities		
Cherry Valley	1001.43	25.2%
Rockford	2018.6	50.81%
Unincorporated Areas	953.19	23.99%
Townships		
Cherry Valley	624	16.2%
Rockford	3332	83.8%
Rockford Park District	120.05	3.02%
Winnebago County Soil and Water Conservation District	3973.23	100%
County Board of Directors		
District 8	1715	43.15%
District 11	1794	45.14%
District 15	465	11.7%
Congressional District		
US House District 16	3973.23	100%
State Senate		
District 34	43	1%
District 35	3930	99%
State Assembly		
District 67	14	0.35%
District 68	3774	95.0%
District 69	185	4.65%

One Watershed: Multiple Decision Makers

As watershed boundaries do not typically follow political boundaries, one of the greatest challenges faced during watershed planning and implementing a watershed plan is that watersheds typically include multiple jurisdictions that have varying interests, resources, and responsibility. Actions by one jurisdiction in the watershed impact others in watershed both negatively and positively. By actively working together, jurisdictions within the watershed can ensure that that goals, objectives, and projects outlined in the watershed plan are considered in each of the jurisdiction's decision making process on policies, projects, and programs.

As part of the watershed planning process, the Winnebago County Watershed Plan Steering Committee (WCWPSC) was formed. WCWPSC has been successful in bringing together representatives from the county, municipalities, townships, the Rockford Park District, and Winnebago County Soil and Water Conservation District. Additionally, the WCWPSC includes watershed residents and members of the Kishwaukee River Ecosystem Partnership (KREP). Ensuing that the WCWPSC or a similar watershed council continues to be active after the watershed planning process is complete is a necessity to provide a venue for communication, coordination, and collaboration between the multiple watershed jurisdictions and ensure the implementation of the watershed plan.

Chapter 5 Section 2 provides details on the role each jurisdiction and other stakeholders play in watershed planning, water quality protection and improvement, and nonpoint source pollution control.

3.8 Watershed Demographics

The Rockford Metropolitan Agency for Planning (RMAP) is the designated Metropolitan Planning Organization (MPO) for the Rockford region. Under Federal law urbanized areas with populations exceeding 50,000 are required to have an organization that plans and coordinates decision regarding the area's transportation systems. RMAP is governed by a Cooperative Agreement that has been adopted by the Cities of Rockford, Belvidere and Loves Park, the Village of Machesney Park, the Counties of Boone and Winnebago and the Illinois Department of Transportation.

Planning for transportation, land use and environmental issues were traditionally undertaken separately by various agencies within an urban area. This separation made it difficult to understand the connection among various subjects and how changes in one area may affect another. Over the past several decades, an integrated approach to transportation planning has evolved to create a system that incorporates environmental, economic development and community goals.

According to RMAP's 2040 forecasts for population, number of households and employment, the Madigan Creek is expected to experience growth (Tables 3-7 to 3-9). Growth within the watershed has the potential to impact watershed conditions through changes in land use.

Table 3-7 RMAP 2000 to 2040 Population Forecast Data for the Madigan Creek Watershed

Population	2000	2040	Change	% Change
Madigan Creek	14,782	19,269	4,487	30.35

Table 3-8 RMAP 2000 to 2040 Household Forecast Data for the Madigan Creek Watershed

Households	2000	2040	Change	% Change
Madigan Creek	6,317	7,826	1509	23.89

Table 3-9 RMAP 2000 to 2040 Employment Forecast Data for the Madigan Creek Watershed

Employment	2000	2040	Change	% Change
Madigan Creek	12,576	18,458	5882	46.77

It should be noted that the population and household data were obtained from the 2010 Decennial Census and are based on block group census geography. As such, the boundaries extend beyond the natural watershed boundaries, potentially leading to inflated estimates for each watershed. The total for each block group that intersected with the watershed was included. Additionally, the employment data came from the U.S. Census Bureau 2010 Longitudinal Employer-Household Dynamics (LEHD). This data follows TAZ (Traffic Analysis Zone) geography, which again extends beyond the natural watershed boundaries, producing inflated estimates for each watershed.

Using 2000 base year data, RMAP was able to use our Travel Demand Model (TDM) to forecast these figures out to 2040. For the TDM, RMAP uses PTV software to project current and future travel volumes for the region's roadways. The model uses demographic and land-use forecasts as a major source of data input for the model. The study area is divided into Transportation Analysis Zones (TAZs) for the purpose of the modeling effort, utilizing trip generation, trip distribution and trip assignment to execute the modeling process. Modeling begins with historic and current data inputs such as current traffic, population, employment and land use, and ties in predictions of future land use to determine how the population, dwelling units (households) and employment will be distributed in the study area. The model runs on the assumption that each land use classification will produce or attract a certain amount of vehicle trips. The model is based on the most recent Census data available for TAZs, Woods and Poole state profile data for regional demographics and economics, as well as employment data from the Illinois Department of Employment Security. The data is projected out to 2040 using employment and dwelling unit data based upon the adopted land use plans of all the local and county jurisdictions.

3.9 Land Use

Land use and cover refer to the type of use assigned to a parcel, such as residential or commercial, and the type of surface coverage found on a parcel, such as forest and grassland, respectively. This information is necessary for understanding the impact of current and future land use on watershed resources and the restoration potential.

3.9.1 Historical Land Use

1972 Land Use data for the Madigan Creek watershed was obtained from the United States Geological Survey (USGS) GIRAS Land Use and Land Cover database. USGS GIRAS

Land Use and Land Cover for the Madigan Creek watershed is summarized in Table 3-10 and depicted in Figure 3-7.

Table 3-10 Geological Survey (USGS) GIRAS Land Use and Land Cover for the Madigan Creek Watershed

USGS GIRAS Land Use and Land Cover Type	Acres	Percent of Watershed
Residential	1,050.29	28.36%
Commercial and Services	143.26	3.87%
Transportation, Communications, and Utilities	65.30	1.76%
Other Urban Built-up	133.51	3.60%
Cropland and Pasture Lands	2,009.06	54.24%
Deciduous Forest Lands	63.01	1.70%
Strip Mines	40.77	1.10%
Transitional Areas	198.71	5.36%

Definitions of each land use/cover types listed in Figure 3-7 and Table 10 are as follows:

Residential: Land cover than contains residential areas ranging from high density to low density.

Commercial and Services: Land cover that contains commercial areas used predominately for the sale of products and services. Includes such land uses are urban business districts, shopping centers, commercial strip developments, junkyards, resorts, etc. Institutional land uses just as educational, religious, health, correctional and military facilities are also included in this land use.

Transportation, Communications and Utilities: Land cover that includes roads, railways, airports, seaports, and major lake ports.

Other Urban or Built-Up Land: Land cover consisting of golf driving ranges, zoos, urban parks, cemeteries, waste sumps, water-control structures and spillways, golf courses, and ski areas.

Cropland and Pasture: Land cover consisting of agricultural land used for harvest and pasture.

Deciduous Forest: Land cover consisting of all forested areas having a predominance of trees that lose their leaves at the beginning of the forest system or at the beginning of a dry season.

Mines: Land cover consisting of extractive mining activities with a significant surface expression.

Transitional Areas: Land cover in areas that are in transition from one land use activity to another.

3.9.2 Existing Land Use

Existing land use data was not readily available for the Madigan Creek watershed. In order generate this data; zoning information provided by the county was overlayed with the 2000 aerial photograph as a means of generating existing land use data. Existing Land Use and Land Cover for the Madigan Creek watershed is summarized in Table 3-11 and depicted in Figure 3-8.

Table 3-11 Existing Land Use and Land Cover for the Madigan Creek Watershed

USGS GIRAS Land Use and Land Cover Type	Acres	Percent of Watershed
Agriculture	270.62	6.81%
Commercial	910.80	22.92%
Other	15.51	0.39%
Publicly Owned Land/Parks/Rec. Areas	212.99	5.36%
Residential	1718.34	43.25%
Right-of-Way	764.14	19.23%
Industrial	80.82	2.03%

Definitions of each land use/cover types listed in Figure 3-8 and Table 3-11 are as follows:

Agriculture: Land cover consisting of agricultural land used for harvest and pasture.

Commercial: Land cover that contains commercial areas used predominately for the sale of products and services. Includes such land uses are urban business districts, shopping centers, commercial strip developments, junkyards, resorts, etc.

Other: Land cover consisting of extractive mining activities with a significant surface expression.

Publically Owned/Land/Parks: Land cover consisting of parks, golf courses, nature preserves, playgrounds and athletic fields when associated with another open space activity. Institutional land uses just as educational, religious, health, correctional and military facilities are also included in this land use.

Residential: Land cover than contains residential areas ranging from high density to low density.

Right of Way (ROW): Land cover that includes roads, railways, airports, seaports, and major lake ports.

Industrial: Land cover consisting of manufacturing and processing, warehousing and distribution centers, wholesale facilities, and industrial parks.

3.9.3 Future Land Use

Through land use decisions and development standards and controls, Cherry Valley, Rockford, and Winnebago County have the majority of the land use discretion to determine the future of the watershed. Without proper attention to development location and design, future impacts to watershed could include increased flooding and streambank erosion and the degradation of water quality, and aquatic habitat.

Much of what is currently agriculture, or other is expected to be converted to urban land uses. As detailed in Table 3-11, approximately 7% of the watershed may be available for additional development in the future. Based on the location of these areas, it is likely that these lands will be converted into residential and commercial uses. Land use conversion from primarily open to a residential and commercial uses will increase the impervious cover of the watershed, which will also have a significant impact on flooding, water quality, and other watershed resources. To help reduce the negative impact of additional impervious surfaces, best management practices should be integrated into development designs wherever possible. Conservation development, practices that attempts to preserve the natural drainage and infiltration capacity of the developed landscape, is another very effective way to reduce the negative effects of land use changes and increased impervious areas.

3.10 Cultural Resources

Cultural resources are sites, structures, buildings, landscapes, districts, and objects that are significant in history, prehistory, archeology, architecture, engineering, and/or culture. Knowing the culture resources of a watershed provides information on changes that occurred in the landscape and help define information related to historical vegetative communities, climate changes, wildlife populations, and historic uses of the land. All of which could be useful during the watershed planning process. Additionally, as cultural resources provide learning opportunities for the public, the preservation and protection of the cultural resources located in the watershed from development and damage is an important objective of watershed planning.

In 1966, the National Historic Preservation Act was passed to manage and protect cultural resources by requiring Federal and State agencies to establish historic preservation programs to identify, evaluate, and protect important sites under their jurisdiction. The National Park Service administers the National Register of Historic Places as part of the requirements of the National Historic Preservation Act. Properties in the Register include districts, sites, buildings, structures, and objects that are significant in American history, archeology, architecture, engineering, and culture. The National Register sites have been nominated by governments, organizations, and individuals according to defined, uniform set of standards. According to the National Register of Historical Places, there are no National Register for Historic Places listed for the Madigan Creek watershed.

In Illinois, the Illinois Historical Preservation Agency (IHPA) preserved and protects public and private historical properties and library collections. The IHPA Historic Architecture and Archeological Resource Geographic Information System (HAAGIS) (http://gis.hpa.state.il.us/hargis/) was utilized to locate and identify the historical properties in the Madigan Creek database. There are no sites within the Madigan Creek watershed identified on the HAAGIS site as historic site.

3.11 Transportation

Approximately 20% of the Madigan Creek watershed is right-of-way for roads, trails, and railroads. The impact of streets and highways on the watershed, particularly water quality, is significant. Table 3-12 lists a number of water quality pollutants and their sources, all of which are associated with the transportation system. Rain water flowing over the surface of our streets can carry these pollutants into our wetlands and stream, where they can accumulate and impair the quality of these resources for aquatic life.

Table 3-12 Transportation Related Pollutants

Pollutant	Primary Sources
Particulates	Pavement wear, atmosphere, vehicles
Nutrients including nitrogen and phosphorus	Atmosphere, fertilizer application
Lead	Tire wear, exhaust
Zinc	Tire wear, motor oil and grease
Iron	Rust, steel highway structures, engine parts
Copper	Metal plating, break lining wear, engine parts, bearing and bushing wear, fungicides and pesticides
Cadmium	Tire wear, insecticides
Chromium	Metal plating, engine parts, break lining wear
Nickel	Diesel fuel, gasoline, oils, metal plating, break lining wear, asphalt paving
Manganese	Engine parts
Cyanide	Anticake compound used in deicing salts
Sodium, Calcium, Chloride	Deicing salts
Sulphate	Fuel, deicing salts
Petroleum	Spills and leaks of motor oils, antifreeze and hydraulic fluids, asphalt surface leachate

3.11.1 Existing Transportation Network

Two interstates are located in or immediately adjacent to the Madigan Creek watershed. Interstate 90 borders the Madigan Creek watershed to the east. Interstate 39 is located in the southeast corner of the watershed near within Cherry Valley. In addition to the interstates, several secondary roads traverse the Madigan Creek watershed: State Street, Newburg Road, Charles Street, Harrison Avenue, Milford Road, and Perryville Road. State Street is located in the north portion of the watershed and generally run from east to west. Many commercial properties are situated along State Street. State Street provides access to Interstate 90 just east of the watershed boundary. Newburg Road also running east to west is located in the central part of the watershed. Residential properties are primarily situated along Newburg Road. Harrison Avenue and Charles Street are located on the southern portion of the Madigan Creek watershed. Charles Street runs on a slight west to east diagonal and eventually terminates at Harrison Avenue just west of the CherryVale Mall. Harrison Avenue also runs east to west and provides access to Interstate 39 via a cloverleaf interchange southeast of the CherryVale Mall. Mulford Road and Perryville Road are the major north to south secondary roads in the watershed. Mulford Road is located in the western portion of the watershed with Perryville located in the eastern part. Figure 3-9 depicts the watershed transportation network.

There is one rail line operated by the Canadian National Railway Company is located in the southeast portion of the Madigan Creek watershed.

3.11.2 Proposed Transportation Projects

There are no significant road constructions or road widening projects proposed in the Madigan Creek watershed. As such, no changes to the existing transportation network are presumed to occur in the watershed.

3.12 Natural Resources

This section of the plan describes the natural areas within the Madigan Creek watershed, including natural areas, parks, recreational trails plant and animal species concerns, wetlands, and groundwater.

3.12.1 Natural Areas

Historically, there was a portion of one Winnebago County Natural Areas Inventory (NAI) site located in the Madigan Creek watershed: Harrison Woods. Approximately 1.9 acres of Harrison Woods were located in the southwest portion of the watershed near the intersection of Harrison Avenue and Stowmarket Avenue. Historically, this area was comprised of undisturbed native upland woods including white oaks, sugar maples, and walnuts. However, this area was developed in 2006 and is now comprised commercial and residential properties. It should be noted that a very small remnant of the native upland forest are located between the commercial and residential properties but are considered be of low ecological significance. Figure 3-10 depicts the historical location of Harrison Woods.

There are no Illinois NAI sites in the Madigan Creek watershed.

3.12.2 Recreational Parks

The Rockford Park District manages seven recreational parks located entirely or partially within the Madigan Creek watershed. Additionally, one privately owned facility, the Midway Village and Museum Center is partially located in the watershed. These facilities and a description of their amenities are included in Table 3-13 and depicted on Figure 3-11.

Table 3-13 Natural Areas and Recreational Parks in the Madigan Creek watershed

Park Name	Address	Total Acreage	Acreage in Watershed	Natural Areas	Playground	Tennis Count	Ball Diamond	Basketball Court	Soccer Field
Gregory School Park	4820 Carol Ct, Rockford, IL	7.13	0.62		✓	✓	✓		
Magic Waters	7820 N Cherryvale Blvd, Cherry Valley, IL	37.3	37.3	Facility is a water park					
Mariposa Park	2175 Arnold Ave., Rockford, IL	6.05	5.62		✓	✓	✓	✓	✓

Park Name	Address	Total Acreage	Acreage in Watershed	Natural Areas	Playground	Tennis Count	Ball Diamond	Basketball Court	Soccer Field
Midway Village and Museum Center	6799 Guilford Road, Rockford, IL	137	6.82	✓					
Southeast Community Park	3151 Perryville Road, Rockford, IL	77.92	58.55	✓					✓
Swanson Park	2780 Swanson Parkway, Rockford, IL	6.15	6.15	✓					
Vandercook School Park	5929 Darlene Drive, Rockford, IL	8.42	4.99		✓	✓	✓	✓	

3.12.3 Pedestrian Trails

There are three pedestrian/recreational trails located in the Madigan Creek watershed: Perryville Path, Charles Street Community Path and the Cherry Valley Pedestrian Path. The Perryville Path is located in the northern portion of the watershed. The Perryville Path runs nearly 7 miles (of which 0.5 miles is located in the watershed) and connects the communities of Loves Park and Rockford. The asphalt paved trails begins in Rock Cut State Park and continues south along Perryville Road through residential, commercial and business areas ending just south of Midway Village and Museum Center in the Madigan Creek watershed near the intersection of Perryville Road and Angus Drive. Future plans for the Perryville Path include extending the path along Perryville Road or Bell School Road to the CherryVale Mall.

The Charles Street Community Path is located in the southern portion of the watershed along Charles Street. This 2.6 mile asphalt-paved path begins at the intersection of Charles Street and Quentin Street near Alpine Park and terminates in the watershed at the intersection of Charles Street and Perryville Road near the CherryVale Mall. The Charles Street Community Path also provides access to AC Thompson Elementary School. Approximately 0.86 miles of the Charles Street Community Path is located within the Madigan Creek watershed. According to the Greenway Plan prepared by RMAP, there are plans to extend the St. Charles Path to connect with the Perryville Path and the Cherry Valley Path.

The Cherry Valley Pedestrian Path is located in the southeast corner of the Madigan Creek watershed. This 1.43-mile long asphalt-path is located in Southeast Community Park and Swanson Park and runs between Swanson Parkway and Valley Woods Drive. The path offers a scenic route through wooded areas and by the three ponds located within Swanson Park. The entire length of the Cherry Valley Pedestrian Path is located within the Madigan Creek watershed. As mentioned above, the Greenway Plan prepared by RMAP proposed to extend the Cherry Valley Pedestrian Path to the Perryville Path and St. Charles Path.

Additional expansions to the Cherry Valley Pedestrian Path also include extending the path to Bauman Park to the southeast and to the Espenscheid Forest Preserve to the south.

Figure 3-12 shows the location of each of the pedestrian trails located in the Madigan Creek watershed.

3.12.4 Threatened and Endangered Species

The Illinois Endangered Species Protection Board was created by the passage of the Endangered Species Protection Act in 1972 and determines which plant and animal species are threatened or endangered (T&E) in the state. The Illinois Endangered Species Protection Board also advises the Illinois Department of Natural Resources (IDNR) on means of conserving those species. State listed T&E species are designated "endangered" if a species is in danger of extinction as a "breeding" species and is considered "threatened" if the species includes any which is likely to become an endangered species within the foreseeable future. The Illinois Endangered Species Protection Board's Natural Heritage Database October 2012 Endangered and Threatened Species List identifies 54 T&E species in Winnebago County. A more refined of the Madigan Creek watershed search using the IDNR's Ecological Compliance Assessment Tool (EcoCat) identified three species located in the vicinity of the watershed (Table 3-12). Additionally, the US Fish and Wildlife Service has identified the three Federally listed T&E species in Winnebago County (Table 3-13)

Table 3-14 State T&E Species Identified in the Vicinity of the Madigan Creek watershed

Common Name	Scientific Name	State Protection	# of occurrences	Last Observed
Blandings Turtle	*Emydoidea blandingii*	Endangered	5	08-07-2012
Gravel Chub	*Erimystax x-punctatus*	Threatened	9	06-06-2012
Black Sandshell	*Ligumia recta*	Threatened	8	06-06-2012

Table 3-15 Federal T&E Species Identified in Winnebago County

Common Name	Scientific Name	Federal Protection
Prairie bush-clover	*Lespedeza leptostachya*	Threatened
Indiana bat	*Myotis sodalis*	Endangered
Eastern prairie fringed orchid	*Platanthera leucophaea*	Threatened

Based on a review of the critical habitat requirements for each of the state and federal T&E species there is very low potential that the species are currently present within the Madigan Creek watershed.

3.12.5 Wetlands

Wetlands, once prevalent within Illinois, have continued to decline in area and quality. Wetlands are of interest to watershed studies of this sort due to the benefits they provide. Wetlands do more for water quality improvement and flood damage reductions than any other natural resource within a watershed. Wetlands provide a multitude of ecological, economic and social benefits. They provide habitat for fish, wildlife and a variety of plants. Wetlands are also important landscape features because they hold and slowly release flood water and snow melt, recharge groundwater, recycle nutrients, and provide recreation and wildlife viewing opportunities for residents.

The National Wetlands Inventory (NWI) was established by the US Fish and Wildlife Service (FWS) to conduct a nationwide inventory of U.S. wetlands to provide biologists and others with information on the distribution and type of wetlands to aid in conservation efforts. The NWI maps are prepared from the analysis of high altitude imagery, vegetation, visible hydrology, and geography. Field inspections and wetland delineations were not utilized in the preparation of the NWI maps. Additionally, certain wetland habitats are not included on their maps due to limitations of aerial reconnaissance to properly identify these habitats as wetlands. According the NWI map, there are 25.64 acres of wetland (0.65% of the watershed). As can be seen from Figure 3-13, the majority of the NWI wetlands in the Madigan Creek watershed have been impacted by development.

In order to protection wetlands, projects and other activity should be designed to avoid and minimize any disturbance to the wetland, stream, or other aquatic area. However, if there is an unavoidable impact or disturbance to a wetland or stream, a Clean Water Act Section 404 permit must be obtained from the US Army Corps of Engineers (USACE). The USACE has jurisdiction over waters of the United States (WOUS) including connected wetlands and navigable streams and rivers. For wetlands and WOUS in the Madigan Creek watershed, the USACE Rock Island District is the responsible entity for permitting any activities that impact jurisdictional wetlands and WOUS. The Rock Island permit program includes a series of regional permits (RP) for various activities such as bank stabilization, flood damage control and road crossings. Activities outside the RP categories are required to obtain an individual permit (IP). The USACE permits must be applied for and issued before any wetland or WOUS disturbance or impacts occur.

3.12.6 Potential Wetland Restoration Sites

Wetland restoration and creation could be beneficial to the Madigan Creek watershed. By restoring the environmental functions of impacted wetlands or creating new wetlands in suitable areas, wetland restoration and wetland creation could potentially reduce flood volumes and rates, increase plant and animal diversity, and improve water quality conditions. Potential restoration sites were identified using a Geographic Information System (GIS) exercise. As part of this exercise, specific criteria essential for the restoration of a functional and beneficial wetland were utilized and included:

- Site contains NWI wetland
- Site contains at least 2.5 acres of hydric soils
- Site is located on an parcel containing no or very few structures

The GIS analysis revealed one location that could potentially be suitable for wetland creation/restoration – a 14.20 acre parcel located east of the Arlington Memorial Park and Cemetery. It should be noted that residential homes are located on portions of this property.

3.12.7 Drinking and Groundwater Wells

Aquifers in the glacial drift (sand and gravel) of the Quaternary age (less than 75,000 year old) and the carbonate deposits (dolomite and limestone) of the Platteville and Galena Group of Ordovician age (about 450 million years old) are the major sources of groundwater in the watershed. These glacial drift and Galena-Platteville aquifers are considered to be extremely susceptible to contamination as the aquifer is near the land surface, typically at a depth of less than 50 feet, and the soils compose and overlie the aquifers have relatively high hydraulic conductivity of at least 1 foot per day. According to the US Geological Survey (USGS), Winnebago County is considered to have the greatest potential for ground-water contamination in Illinois.

Residents in the Madigan Creek watershed utilize groundwater for a variety of purposes including drinking water, irrigation, and industrial process water. Both the City of Rockford and Cherry Valley use groundwater as their source of drinking water. While under natural undisturbed conditions, groundwater in the Madigan Creek watershed is of high quality and meets the drinking and groundwater standards set for different contaminants by the Illinois Pollution Control Board. Due to the nature of the aquifers in the region, impacts associated with urbanization have the potential to negatively impact drinking and groundwater. Potential sources for contamination associated with urbanization include septic system effluent, oil, gasoline, animal wastes, industrial effluent, paint, solvents, road salt, and lawn and household chemicals.

In order to protect groundwater in Illinois in 1987, the General Assembly passed the Illinois Groundwater Protection Act (IGPA). The IGPA emphasizes the comprehensive management of groundwater resources by requiring the implementation of practices and policies to protect groundwater. These include setting groundwater protection policies such as setback zones; assessing the quality and quantity of groundwater resources being utilized; and establishing groundwater standards.

Illinois State Geological Survey Well Database

According to the Illinois State Geological Survey (ISGS) database, there have been 505 wells installed in the Madigan Creek watershed. Table 3-16 depicts the quantity and type of each well and Figure 3-14 illustrated the location of each well in the watershed. The ISGS database contains information on wells that was supplied to the agency and has not been field verified.

Table 3-16 ISGS Wells in the Madigan Creek Watershed

ISGS Well Type	Number of Wells in Watershed
Water Well Monitoring Well	0
Water Well	498
Temporarily Abandoned	0
Engineering Test	6
Dry and Abandoned Well	0
Other Well	1

Illinois Department of Health Well Database

According to the Illinois Department of Health (IDH), there are 18 community and non-community wells in the Madigan Creek watershed. Of the 18 IDH wells, 12 are community wells and 6 are non-community wells. Community wells are public wells that serve residents year round. A public well is defined as well with more than 15 service connections or any well that serves 25 people for at least 60 days per year. A non-community well is public wells that serve nonresidents such as at a restaurant, motel, school, or camp ground. Owners of the community and non-community wells are subject to the requirements of the Safe Drinking Water Act (SWDA) and are responsible for meeting all of the requirements outlined in the Act including conduction drinking water sampling, maintenance of the system and reporting to IDH. Table 3-17 depicts the owner and type of each well and Figure 3-15 illustrated the location of each well in the watershed.

Table 3-17 Community and Non-Community Wells in the Madigan Creek Watershed

Owner	Well Type	Number of Wells Owned
Brian Green Apartments	Community	1
Cherry Valley Easy Apartments	Community	2
Cherry Valley (Village of)	Community	3
Cherry View Apartments	Community	1
Newburgh Landowners Water Association	Community	2
Rockford (City of)	Community	1
Utl Inc/Coventry Hills Uti Inc.	Community	1
Wildwood Utility Company	Community	1
Alvarex Mexican Restaurant	Non-Community	1
Franchesco’s Restaurant	Non-Community	1
Mobil Gas Station	Non-Community	1
Muslim Community Center	Non-Community	1
Oakview Diesel	Non-Community	1
St. Rite’s School	Non-Community	1

3.12.8 Agricultural Best Management Practices

Various programs sponsored by the Natural Resource Conservation Service (NRCS) and Farm Service Agency Wetlands Reserve Program (WRP), Grasslands Reserve Program (GRP), Wildlife Habitat Incentives Program (WHIP), Environmental Quality Incentives Program (EQIP), Conservation Reserve Enhancement Program (CREP), and Conservation Reserve Program (CRP) promote and fund the construction of agricultural BMPs on farmland. Currently there are no agricultural BMPs sponsored by these programs located within the watershed.

3.13 Natural Drainage System

This section describes the conditions and characteristics of the natural drainage system of the Madigan Creek watershed.

3.13.1 Stream Flow

There are no USGS gauging stations on Madigan Creek or within the Madigan Creek watershed. Readily available flow data for the Madigan Creek watershed is limited to calculated flood flows published in the Flood Insurance Survey for Winnebago County and

Incorporated Areas (Table 3-18). It should be noted that these flows were based on analysis performed in 1976 and likely do not reflect current watershed conditions.

Table 3-18 Flood Insurance Study Flows (1976)

Cross Section Location	50-year Flow		100-year Flow	
	Flow (cfs)	Flow cfs/acre)	Flow (cfs)	Flow cfs/acre)
At Charles Street	920	0.369	1139	0.456

3.13.2 Watershed Hydrology and Hydraulics

Hydrology and hydraulics are commonly used terms to describe the effects or precipitation, runoff, and evaporation on the flow of water in streams and rivers and on adjacent land surfaces. The basis for hydrology and hydraulics studies typically start with an understanding of how topography delineates the land into watershed and subwatersheds. As discussed in the Topography section of this report, the Online Watershed Delineation (HYMAPS-OWL) tool, created by Department of Agriculture and Biological Engineering at Purdue University was use to create the initial subwatershed boundaries. The subwatershed boundaries generated by HYMAPS-OWL were then cross referenced with boundaries obtained by inputting 2-foot topography into the GIS-based model, Arc Hydro. This combined data generated a Digital Elevation Model (DEM) that was used to delineate and refine the watershed and subwatershed boundaries for Madigan Creek. Inconsistency in the model's delineations was adjusted to reflect field-verified conditions and more accurately depict the hydrologic boundaries. Most of these inconsistencies occurred in areas divided by roadways that were not accounted for the in elevation model.

The Madigan Creek watershed drains 6.21 square miles. Broad assessment of conditions such as soils, wetlands, and water quality are often evaluated at a watershed levels and provide great information of the overall condition of the watershed. However, a more detailed looks at smaller drainage areas or subwatershed will often be helpful in finding specific problem areas. The Madigan Creek contains 22 subbasins (Table 3-19). Figure 3-16 depicts the location of each of the subwatershed within the Madigan Creek watershed.

Table 3-19 Subbasins in the Madigan Creek Watershed

Subbasins	Total Acres	Percent of Watershed
1	176.17	4.43%
2	188.76	4.75%
3	463.82	11.67%
4	415.16	10.45%
5	243.04	6.12%
6	417.26	10.50%
7	145.77	3.67%
8	10.81	0.27%
9	59.10	1.49%
10	71.78	1.81%
11	139.62	3.51%
12	284.73	7.17%
13	190.17	4.79%
14	216.82	5.46%
15	252.13	6.35%

Subbasins	Total Acres	Percent of Watershed
16	39.07	0.98%
17	229.18	5.77%
18	16.13	0.41%
19	103.17	2.60%
20	131.55	3.31%
21	56.52	1.42%
22	122.47	3.08%

3.13.3 Flow Paths

The Madigan Creek watershed is drained by the mainstem of Madigan Creek and 3 main tributaries. Madigan Creek is 4.42 miles in length. The mainstem of Madigan Creek has its headwaters in the vicinity of State Street and Bell School Road in a heavy developed commercial area. The headwaters have been significantly modified from its historical location by this development including placing the creek into a municipal storm sewer system and relocating the channel around the commercial development. From the commercial area situated along State Street and Bell School Road, Madigan Creek crosses Mill Road and flows southward through a residential area. Through this residential area, Madigan Creek follows along Cerasus Drive and Montmorency Drive before crossing Newburg Road.

Just south of Newburg Road, an unnamed tributary (Tributary #1) joins Madigan Creek. From this point, Madigan Creek runs in a southerly direction through a residential area along Valencia Drive. A series of large on-line wetland bottom detention basins associated with the commercial development along Perryville Road are located on this segment of Madigan Creek. Just north of the on-line detention basins, Tributary #2 joins Madigan Creek.

From its confluence with Tributary #2, Madigan Creek flows to the southeast through a commercial area crossing Perryville and Charles Roads. The segment of Madigan Creek located between Charles Road and Harrison Avenue is lined with concrete revetment mat. From Harrison Avenue, Madigan Creek continues to flow to southeast to Vandiver Road. Just south of Vandiver Road, an on-line regional compensatory storage basin has been constructed on the creek commonly referred to as the upper pond in Southeast Community Park. Tributary #3 is also tributary to the upper pond. From the upper pond, Madigan Creek flows southeasterly into another on-line regional compensatory storage basin known as the lower pond before flowing under Interstate 39 and the Canadian National Railroad before its confluence with the Kishwaukee River. More information on these basins is available in Section 3.16.4.

Tributary #1 has its headwaters in the north central portion of the watershed near the intersection of Trainer Road and Fincham Drive. There have been significant modifications to the hydrology of Tributary #1. The headwaters of Tributary #1 are a stream with an undefined channel flowing southwest towards Mulford Road though an undeveloped parcel. The original flowpath of Tributary #1 floes west/southwest from Mulford Road to near Woodbine Drive and Gordon Avenue where it merged with another small tributary. However, in the 1970s, Tributary #1 from Mulford Road to Woodbine Drive/Gordon Avenue was placed in a culvert and the flows redirected towards the south along Mulford Road. The culvert runs south to Van Matre Heathsouth Rehab Hospital before turning east near Laurel Cherry Drive. From this point, the culvert turns south again and daylights at

Fox Basin Road/Conrad Road. A large concrete energy dissipating structure is located at the outfall of the culvert. It should be noted that flow path of the culvert is approximate as the original construction plans were not available for this review. The energy dissipating structure discharges into Tributary #1 which is concrete lined.

Tributary #1 remains surface water at Woodbine Drive/Gordon Avenue. From this location, Tributary #1 flow south/southeast under Newburg Road. Just south of Newburg Road, a small tributary meets Tributary #1 and continued to flow east. From approximately just east of Greenleaf Way to Mulford Road, the channel of Tributary #1 is concrete lined. At the intersection of Mulford Road and Newburg Road, the creek crosses to the north side of Newburg Road and flows east towards Perryville Road. The segment from Newburg Road to Stoney Creek Way is also concrete lined and the outfall discussed above discharges to this segment of Tributary #1. From this point, Tributary #1 flows in an open channel through a residential area in an easterly direction and meets it confluence with Madigan Creek just south of the intersection of Perryville Road and Newburg Road.

The headwaters of Tributary #2 are located in Arlington Memorial Park Cemetery. From the cemetery, Tributary #2 flows easterly towards Mulford Road. After crossing Milford Road, the tributary continues to flow easterly towards though a forested area and then through a residential subdivision before its confluence with Madigan Creek.

The headwaters of Tributary #3 are located near the intersection of Mulford Road and Columbine Drive. From this point, Tributary #3 flows in an open channel along Columbine Drive to the south/southeast through a residential area before crossing Harrison Avenue. From Harrison, the tributary flows in an easterly direction towards Panorama Drive. After crossing Panorama Drive, the creek becomes concrete lined as the creek flows into Southeast Community Park. However, once inside the park, the creek then begins to flow in an open channel and parallels the Cherry Valley Path until its confluence with Madigan Creek at the upper pond. Just west of Perryville Road, an online compensatory storage basin referred to as the Cherry Valley Phase I detention basin is located on Tributary #3. More information on this basin is available in Section 3.16.4.

3.13.4 Channel Conditions

Urban development in the watershed is reducing the amount of land available for the natural infiltration of rainfall into the ground, where it can be intercepted and absorbed by vegetation or stored in depressional areas and wetlands in the watershed. With increasing amounts of impervious surface and an extensive network of storm sewers that convey the increased volume of runoff to the stream channel faster, a stream channel experiences what is called "flashy" hydrology. "Flashy" hydrology means that the water level in the stream rises very quickly during a storm and falls quickly afterward. Since less water is infiltrating into the ground and constantly seeping out and creating a steady base flow within the stream, low flows are considerably lower. Likewise, because less water is absorbed by the ground and more water is flowing into the streams, high flows are considerably higher. High flows can result in damage to property of watershed residents, erosion, flooding, and pollution. Decreased or low flows degrade aquatic habitat because low flows have low levels of dissolved oxygen necessary for aquatic animals and because, in extreme cases, the stream can dry up completely for periods of time.

A number of factors were inventoried to better describe the condition of the Madigan Creek Watershed. The degree of hydromodification and channelization, are both measures of the health and condition of a river or stream.

Hydromodification

Hydromodification is a term that is used to describe human induced activities that change the dynamics of surface or subsurface flow. Historically, the most prevalent form of hydromodification was the draining of wetlands and channelization of streams to increase agricultural production. Early settlers of the Midwest quickly realized that the soils found under wetlands and wet prairies were ideal for crop production once the water was removed. In order to "dry" the wetlands and the wet prairies, systems of sub-surface drainage tiles were installed in order to re-route the groundwater away from the wetlands and wet prairies and discharged in to surface waters. Given that the drain tiles were drained by gravity flow, the receiving surface water needed to be a lower elevation that the tile. As such, naturalized stream channels were often excavated to a deeper depth and straightened to facilitate quicker drainage of the fields. Once the water was removed, these areas could be put into successful agricultural production. This creation of agricultural land was at the cost of the loss of wetlands, wet prairies, and riparian habitat. Hydromodification attributed to the installation of drain tiles is not prevalent in the Madigan Creek watershed.

In the Madigan Creek watershed, hydromodification attributed to urbanization is prevalent. The process of urbanization affects streams by altering watershed hydrology and sediment-transport patterns. Development increases the amount of impervious surfaces (parking lots, rooftops, highly compacted ground, etc) on formerly undeveloped landscapes. This reduces the capacity of the remaining pervious surfaces to capture, filter rainfall, and allow the rainfall to infiltrate into the ground. As a result, a larger percentage of rainfall becomes runoff during any given storm. Subsequently, runoff reaches stream channels much more quickly, and peak discharge rates are higher than before development for the same size rainfall event.

The short-term impact result of this type of hydromodification is localized, overbank flooding. Over the long term, hydromodification will cause the stream channel to expand as a means of handling the higher flows. As the stream channel expands, the banks will erode and the bottom will become deeper. This deepening of the stream channel is called incision. The process of stream bank erosion and channel incision causes a significant amount of sediment to be generated within the stream and carried through the watershed and into the stream's receiving water. Channel incision also leads to a disconnect between the stream and its floodplain. Once separated, high flows that were once stored in the floodplain and slowly released back into the stream are forced to remain in the channel. These "trapped" flows have high velocities leading to additional streambank erosion and incision of the stream channel. It becomes a vicious pattern where with each rainfall event; the creek continues to erode adding additional sediments to the watershed and further preventing the creek to access the floodplain.

Hydromodification attributed to urbanization is prevalent throughout the Madigan Creek watershed and is the most significant cause of water quality degradation in the watershed. Figure 3-17 depicts significant hydromodification impacts in the Madigan Creek watershed.

Channelization

Channelization is the practice of dredging and straightening stream channels to increase flow rates and carrying capacities. In some cases, the stream channel will be paved with concrete during channelization. Traditionally, channelization was done to move as much water as possible away from an area in a short period of time and prevent flooding. However, there are problems resulting from channelization. Channelization is detrimental for the health of streams and rivers through the elimination of suitable instream habitat for fish and wildlife and the creation of excessive flows in the stream leading to hydromodification both within and downstream of the channelized areas.

Figure 3-18 depicts the location of severe channelization in the Madigan Creek watershed. The figure also denoted which portions of the surface waters are concrete-line and lined with concrete revetment mat.

3.13.5 Hydraulic Structures

Hydraulic structures are categorized as bridges, culverts, levees, weirs, dams, fencing and any other human made structures located in or over the stream channel. The location and condition of hydraulic structures is a valuable piece of information as hydraulic structures may act as possible constrictions in conveying river flow, increase the potential for backwater flooding problems, and impede the movement of fish and other aquatic species up and down the stream.

As part of the watershed planning process, 22 hydraulic structures were surveyed in the Madigan Creek watershed (Table 3-20 and Figure 3-19).

Table 3-20 Hydraulic Structures Surveyed in the Madigan Creek Watershed

Structure No.	Type	Opening	Length	Slope
1	CMP H. Ellipt.	36" Equiv. Diameter	36'	0.20%
2	RCP	24" Dia.	215'	0.25%
3	RC Box	6.5' x 6'	130'	0.40%
4	CMP Arch	106" x 73"	61'	1.21%
5	CMP Arch	106" x 73"	101'	0.92%
6	CMP	2 @ 72" Dia.	61'	0.45%
7	RC Box	1 @ 10' x 4' 1 @ 6' x 4'	97'	0.18%
8	RC Box	1 @ 10' x 4' 1 @ 6' x 4'	102'	0.15%
9	RC Box	1 @ 10' x 4' 1 @ 6' x 4'	88'	0.34%
10	RC Box	10' x 3.5'	38'	0.00%
11	CMP	48" Dia.	75'	0.53%
12	RC Box	13' x 4.5'	119'	0.40%
13	RC Box	11' x 8'	227'	0.59%

Structure No.	Type	Opening	Length	Slope
14	RC Box	2 @ 12' x 5'	72'	0.00%
15 (101-5111)	RC Box	2 @ 12' x 5'	562'	0.42%
16 (101-2017)	RC Box	3 @ 8' x 6'	112'	0.53%
17 (101-2018)	RC Box	3 @ 8' x 6'	200' (W cell) 195' (center) 190' (E cell)	0.34%
18 (101-2026)	RC Box	2 @ 10' x 7.5'	46'	1.00%
19	RC Box	2 @ 12' x 10'	241'	0.59%
20	RC Box	3 @ 8' x 7'	76'	0.51%
21	Railroad Bridge			
22 (101-5146)	RC Box	2 @ 13.5' x 12.5'	62'	0.16%

With the exception of the railroad crossing, all of the hydraulic structures surveyed were in-stream culverts under road crossings. Culverts are metal, plastic, or concrete pipes that transport water, most commonly used under roadways or driveways. Culverts may be round, oval, rectangular, or other shapes, and they can be open or closed on the bottom. A number of these within the watershed are exhibiting clogging, wear and tear, erosion, and near failure in some locations.

Dams can serve as potential barriers to the movement and dispersal of aquatic organisms such as fish and may limit available habitat for breeding and feeding. Two Class III dams are located in the Madigan Creek watershed. These dams are discussed in more detail in Section 3.15.4.

3.13.6 Instream and Riparian Habitat Assessment

Water quality criteria were originally published as guidance under Section 304(a) of the Clean Water Act to allow states to derive site-specific water quality criteria for the protection of stream health. In addition, to these water quality guidance criteria, the US EPA established guidance, *Water Body Survey and Assessment Guidance for Conducting Use Attainability Analysis*, to determine if a surface water is meeting its established criteria. The US EPA has updated this guidance and published the *Rapid Bioassement Protocol (RPB) for Stream and Rivers.* The RPB includes methods for conducting cost effective biological assessments of stream and rivers including sampling methods for periphyton, benthic macroinvertebrates, fish, and habitat. During the Madigan Creek watershed stream walk in July 2011, the RPB methodologies were utilized to evaluate habitat conditions at 19 sites within the watershed (Figure 3-20).

The RBP scoring assessment was used to estimate the habitat quality and conditions at each of the 19 sites on Madigan Creek. The following a list of the physical, water quality, and habitat parameters evaluated at each site:

- **Physical Parameters**
    - Predominate surrounding land use
    - Local watershed nonpoint source pollution
    - Stream depth and width
    - Dams
    - Channelization
    - Canopy Cover
    - Sediment odors
    - Sediment oils
    - Substrate texture
    - Aesthetics
- **Water Quality Parameters**
    - Water odors
    - Surface odors
    - Turbidity
    - Stream type and state class
- **Habitat Parameters**
    - Substrate cover for aquatic organisms
    - Embeddedness
    - Flow
    - Channel alteration
    - Bottom scour/deposition
    - Run/bend ratio
    - Bank stability
    - Bank vegetation
    - Streamside cover
    - Undercut banks
    - Bank slope

The results of the Habitat RBP are presented in Tables 3-21 to 3-28. Field data sheets are included in Appendix B.

Table 3-21 Madigan Creek RBP Physical Characteristic - Instream Features

Station	Instream Features							
	Est. Stream Width	Est. Stream Depth	Canopy Cover	Proportion of Reach Represented by Stream Morphology Types			Channelized?	Dam Present?
				Riffle	Pool	Run		
1	6 ft	0.8 ft	Partly Shaded			100%	Yes	No
2	30 ft	1 ft	Partly Open			100%	Yes	No
3	10 ft	1.33 ft	Partly Open			100%	Moderate	No
4	13 ft	0.8 ft	Partly Open			100%	Yes	No
5	5 ft	0.7 ft	Partly Open			100%	Yes	No
6	10.5 ft	0.3 ft	Partly Open			100%	Moderate	No
7	12.15 ft	0.6 ft	Partly Open			100%	Yes	No
8	6 ft	0.65 ft	Partly Open			100%	Yes	No
9	8 ft	0.2 ft	Partly Shaded			100%	Yes	No
10	20 ft	1 ft	Partly Open	50%	50%		Yes	No
11	5 ft	Dry	Partly Open			100%	Yes	No
12	*	*	Partly Open			100%	Yes	No
13	15 ft	Dry	Partly Open			100%	Yes	No
14	30 ft	2 ft	Partly Shaded	50%	50%		No	No
15	6 ft	Dry	Shaded			100%	Yes	No
16	6 ft	Dry	Shaded			100%	Yes	No
17	**	Dry	Partly Shaded			100%	No	No
18	*	Dry	Partly Open			100%	Yes	No
19	6 ft	Dry	Shaded			100%	Yes	No

*** Online detention**
**** Undefined Channel**

Table 3-22 Madigan Creek RBP Madigan Creek RBP Physical Characteristic -Watershed Features and Riparian Habitat

Station	**Watershed Features**			**Riparian Vegetation**	
	Predominant Surrounding Land Use	**Local Watershed NPS Pollution**	**Local Watershed Erosion**	**Dominant Type**	**Dominant Species**
1	Commercial	Obvious sources	None	Grasses/Herbaceous	Natives
2	Commercial	Obvious sources	None	Grasses/Herbaceous	
3	Commercial/Residential	Obvious sources	None	Shrubs/Grasses/Herbaceous	Natives
4	Residential	Obvious sources	Heavy	Trees/Herbaceous	
5	Residential	Obvious sources	None	Grasses	
6	Residential	Obvious sources	Heavy	Trees/Grasses	
7	Commercial	Some potential sources	Heavy	Trees/Herbaceous	
8	Residential	Some potential sources	Heavy	Grasses	Turf
9	Residential	Obvious sources	Heavy	Trees/Shrubs	
10	Commercial	Obvious sources	Heavy	Trees	
11	Commercial/Residential	Some potential sources	None	Grasses	
12	Commercial/Residential	Some potential sources	None	Grasses	Reed, teasel
13	Commercial	Some potential sources	None	Trees/Grasses	
14	Forest/Residential	Obvious sources	Moderate	Grasses	
15	Forest	Some potential sources	None	Trees	
16	Forest	Some potential sources	None	Trees	
17	Residential	Some potential sources	None	Trees	
18	Residential	Obvious sources	None	Grasses	Turf
19	Forest	Some potential sources	Moderate	Trees	

Table 3-23 Madigan Creek RBP Physical Characteristic – Substrate Components

Station	Inorganic Substrate Components							Organic Substrate Components		
	Bedrock	Boulder	Cobble	Gravel	Sand	Silt	Clay	Detritus	Muck-Mud	Marl
1	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%
2	0%	0%	0%	0%	75%	0%	25%	0%	0%	0%
3	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
4	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
5	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
6	0%	0%	0%	75%	25%	0%	0%	0%	0%	0%
7	0%	0%	0%	25%	75%	0%	0%	0%	0%	0%
8	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
9	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
10	0%	0%	25%	50%	25%	0%	0%	0%	0%	0%
11	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
12	0%	0%	0%	50%	0%	50%	0%	0%	0%	0%
13	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
14	0%	0%	25%	50%	25%	0%	0%	0%	0%	0%
15	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%
16	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%
17	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%
18	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
19	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%

Table 3-24 Madigan Creek Watershed RBP Habitat Assessment Results

Station	Stream Type	Epifaunal Substrate/Available Cover	Pool Substrate Characterization	Pool Variability	Sediment Deposition	Channel Flow Status	Channel Alteration	Channel Sinuosity	Bank Stability		Vegetative Protection		Riparian Vegetative Zone		Total Score
									Left	Right	Left	Right	Left	Right	
1	Perennial	9	4	1	20	2	19	1	9	9	4	4	0	0	82
2	Intermittent	9	7	0	7	1	6	0	10	10	9	9	6	1	75
3	Intermittent	13	1	0	20	1	10	2	10	10	9	9	7	7	99
4	Perennial	9	17	1	20	1	7	0	0	0	0	0	0	0	55
5	Intermittent	7	16	0	20	1	8	0	7	7	6	6	0	0	78
6	Intermittent	7	6	0	19	1	6	0	0	0	1	1	0	0	41
7	Intermittent	10	11	7	7	1	11	4	3	3	2	2	0	0	61
8	Intermittent	9	6	1	20	1	6	1	4	4	2	2	0	0	56
9	Intermittent	3	8	1	20	1	7	1	2	2	1	1	0	0	47
10	Intermittent	5	7	8	15	7	7	3	2	2	2	2	0	0	60
11	Intermittent	1	1	1	20	2	6	1	8	8	6	6	0	0	60
12	Intermittent	6	6	1	1	2	5	1	9	9	8	8	5	5	66
13	Intermittent	1	8	1	19	2	6	1	8	8	7	7	0	0	68
14	Perennial	13	9	13	14	9	14	13	6	6	6	6	1	1	111
15	Intermittent	3	6	0	19	0	16	14	0	0	0	0	4	3	65
16	Intermittent	3	6	0	19	0	16	14	0	0	0	0	4	3	65
17	Intermittent	2	6	0	20	0	16	0	0	0	0	0	2	2	48
18	Intermittent	0	0	0	20	0	0	0	10	10	0	0	0	0	40
19	Intermittent	15	6	0	20	0	6	0	0	0	0	0	4	3	39

Table 3-25 Madigan Creek RBP Physical Characteristic – Water Quality and Soil Conditions

Station	Water Quality			Sediment			
	Water Odors	**Water Surface Oils**	**Turbidity**	**Odors**	**Deposits**	**Oils**	**Black Rock Undersides?**
1	Normal/None	None	Slightly turbid	Normal	None	Absent	No
2	Normal/None	None	Slightly turbid	Normal	None	Absent	No
3	Normal/None	None	Turbid	Normal	None	Absent	No
4	Normal/None	None	Slightly turbid	Normal	None	Absent	No
5	Normal/None	None	Slightly turbid	Normal	None	Absent	No
6	Normal/None	None	Clear	Normal	None	Absent	No
7	Normal/None	None	Slightly turbid	Normal	None	Absent	No
8	Normal/None	None	Turbid	Normal	None	Absent	No
9	Normal/None	None	Turbid	Normal	None	Absent	No
10	Normal/None	None	Slightly turbid	Normal	None	Absent	No
11	Dry	Dry	Dry	Normal	None	Absent	No
12	Normal/None	None	Slightly turbid	Normal	None	Absent	No
13	Fishy	None	Slightly turbid	Normal	None	Absent	No
14	Normal/None	None	Slightly turbid	Normal	Sand	Absent	No
15	Dry	Dry	Dry	Normal	None	Absent	No
16	Dry	Dry	Dry	Normal	None	Absent	No
17	Fishy	None	Slightly turbid	Normal	None	Absent	No
18	Dry	Dry	Dry	Normal	None	Absent	No
19	Dry	Dry	Dry	Normal	None	Absent	No

Each of the habitat parameters listed in Table 3-26 were visually evaluated and assigned a conditions number using the scale in Table 3-27. The habitat parameter evaluation criterion is detailed on the Field Sheets included in Appendix XX. For the purposes of the watershed plan, a Cumulative Habitat Condition Category and Scale was developed in order to assign each sampled site a habitat category from poor to optimal (Table 3-28).

Table 3-26 RBP Madigan Creek Watershed RBP Habitat Condition Category and Scale

Condition Category			
Poor	**Marginal**	**Suboptimal**	**Optimal**
0-5	6-10	11-15	16-20

*Bank Stability, Vegetative Protection, and Riparian Vegetative Zone Width are scored for each bank using a scale of 1-10 and then summed for a score between 1-20.

Table 3-27 RBP Madigan Creek Watershed Cumulative Habitat Condition Category and Scale

Condition Category			
Poor	**Marginal**	**Suboptimal**	**Optimal**
0-50	50-110	100-150	150-200

Based on the cumulative habitat condition scale outline in Table 3-27, 5 sites within the Madigan Creek watershed are categorized as poor, 13 are marginal and 1 is suboptimal. No sites were identified as having optimal habitat conditions (Table 3-28).

Table 3-28 Habitat Condition Scores for Madigan Creek Watershed

Site	Cumulative Score	Condition Category
1	82	Marginal
2	75	Marginal
3	99	Marginal
4	55	Marginal
5	78	Marginal
6	41	Poor
7	61	Marginal
8	56	Marginal
9	47	Poor
10	60	Marginal
11	60	Marginal
12	66	Marginal
13	68	Marginal
14	111	Suboptimal
15	65	Marginal
16	65	Marginal
17	48	Poor
18	40	Poor
19	39	Poor

Benthic Monitoring

RiverWatch volunteers conducted a macroinvertebrate survey on Madigan Creek near its confluence with the Kishwaukee River at the Mill Road Bridge on 06/30/2011. Macroinvertebrates are small animals that do not have a backbone and can be seen with the naked eye. Macroinvertebrates include animals such as insects, crustaceans, mollusks, arachnids, and annelids. As macroinvertebrates live in water for all or part of their lives, their survival is related to water quality. These animals are sensitive to different chemical and physical conditions in the water such as increased water pollution or changes in water flow. As such, the richness of macroinvertebrate community composition in a stream or river can be used to provide an estimate of stream health.

After collecting the macroinvertebrates, the volunteers calculated a Macroinvertebrate Biotic Index (MBI). The MBI is designed to rate water quality using the pollution tolerance of macroinvertebrates and is an estimate of the degree and extent of organic pollution and disturbance in the stream. The MBI is a modification of the Hilsenhoff Biotic Index (HBI) first used in Wisconsin streams. Following data collection, the macroinvertebrates are identified and given a predetermined pollution tolerance rating. The MBI is calculated by taking the average of tolerance ratings weight by the number of individuals in the sample. MBI scores of less than 4.35 represent excellent water quality while scores greater than 6.26 indicate poor water quality.

As the sampling site is just upstream of Madigan Creek's confluence with the Kishwaukee River, the site provides a "snapshot" of water quality for the entire watershed. The results of the macroinvertebrate sampling resulted in a MBI of 6.87 or poor water quality. No macroinvertebrates of special interest such as native mussels were observed. Although the MBI indicated poor water quality, it was noted that numerous frogs, tadpoles, and fish were present in the creek at the time of the sampling.

With the exception of the one RiverWatch sample noted above, no additional biological data is known to exist for the Madigan Creek watershed.

3.14 Water Quality

Water quality is impacted by pollutants from a number of point and non-point sources. Point sources are discharges from a single source such as a pipe conveying wastewater from a wastewater treatment facility into the stream. Nonpoint sources contribute pollutants to the water system from across the landscape including runoff from yards, rooftops, roads, parking lots, and other urban and nonurban surfaces. During storms, pollutants on the landscape are washed from the ground and impervious surfaces into storm sewers and roadside drainage ditches, and ultimately into the Madigan Creek stream system. Physical changes in the watershed, such as hydromodification, channelization and the loss of riparian vegetation and wetlands, also impact water quality and aquatic habitat.

The causes and sources of water quality problems in the Madigan Creek watershed are urban in nature. These problems are the result of many years of modification of the watershed landscape as it changed from natural to agricultural to urban. These changes have included modification of the stream channel, floodplain, and wetlands. Other changes are the result of the increased watershed impervious cover that has led to an increase in the volume and rate of runoff in the watershed. The increased quantity of runoff has caused problems such as excessive stream bank erosion and the deepening of the stream channel due to channel erosion. In addition to increasing surface runoff, impervious surfaces reduce the amount of rainwater that infiltrates into the ground to recharge groundwater sources.

3.14.1 State of Illinois Reporting

Surface water quality monitoring is used by limnologists and scientists to evaluate the ecological health of waterbody. The overall objective for water quality sampling is to assess the existing conditions of a stream, river or lake in an attempt to restore or maintain the chemical, physical, and biological integrity of the monitored surface water. In Illinois, the Illinois EPA utilizes water quality monitoring data as its major source of information for the Illinois EPA Section 305(b) and Section 303(d) List integrated report. Section 303(b) of the Federal Clean Water Act required each state to submit to the USEPA a biannual report of the quality of the state's surface and groundwater resources. The 305(b) report includes a detailed description of the how Illinois assesses water quality and whether the assessed waters meet or do not meet "Designated Uses". When a waterbody is determined to be impaired, IL must list the potential reasons for the impairment in the Section 303(d) impaired waters list.

Section 303(d) of the Clean Water Act requires Illinois to submit to the USEPA a list of waterbodies with impaired uses, the pollutant causing the impairment, and a priority ranking for the development of Total Maximum Daily Loads (TMDLs). The establishment of the TMDL sets the pollution reduction goal to improve the impaired waters. Historically, the 305(b) list and the 303(d) list were submitted to the USEPA as separate documents, however, since 2006, the reports have been integrated into a single report.

The surface water assessments included in the 2012 Illinois Integrated Water Quality Report and Section 303(d) List are based on data obtained through chemical, physical, and biological sampling. These assessments help protect "Designated Uses" by setting water quality standards that will protect the designated uses. In Illinois, the "designated uses" for surface waters include: aquatic life, indigenous aquatic life, fish consumption, primary contact, secondary contact, water supply and aesthetic quality. For each "designated use" it is determined if a waterbody is either "fully supporting" or "not supporting" the use based on the available data. Any waters that are determined to be not supporting a designated use as considered impaired. Additionally, the USEPA required that the assessed waters be placed into categories based on their attainment (Table 3-29). Category 5 waters comprise the Illinois 303 (d) list. The 303(d) listed waters are prioritized by the Illinois EPA and TMDLs are prepared for waters in the order of priority (highest to lowest).

Table 3-29 Categorization of 303(d) Listed Waters

Category	Sub-Category	Description
1		All designated uses are assessed as fully supporting and no use is threatened (Note- Illinois does not assess any waters as threatened).
2		Available data and/or information indicate that some but not all designated uses are supported
3		Insufficient data and/or information to make a use support determine for any use
4		Waterbodies contain at least one impaired use but TMDL is not required. Category 4 is subdivided as listed below based on the reason a TMDL is not required.
	a	TMDL has been approved or established by the USEPA.
	b	Technology based effluent limitations required by the Clean Water Act, more stringent effluent limits required by the state, local, or federal authority, or other pollution control requirements required by state, local or federal authority are stringent enough to implement applicable water quality standards within a reasonable period of time
	c	Failure to meet the applicable water quality standards is not caused but a pollutant but other types of pollution (such as aquatic life impairment due to habitat degradation)
5		Available data and/or information indicate that at least one designated use is impaired and a TMDL is required.

No waters in the Madigan Creek watershed are assessed by the Illinois EPA and therefore, no streams in the Madigan Creek watershed are listed on the 2012 303(d) list as impaired.

3.14.2 Available Chemical and Physical Water Quality Monitoring

Typically, chemical and physical water quality monitoring includes the collection of water quality samples that are analyzed for the following parameters:

- Temperature
- pH
- Dissolved oxygen (DO)
- Conductivity
- Total suspended solids (TSS)
- Total dissolved solids (TDS)
- Metals including cadmium, chromium, copper, iron, lead, manganese, mercury, silver, and zinc
- Nitrogen including nitrite, nitrate, and total nitrogen
- Phosphorus including dissolved phosphorus and total phosphorus
- Bacteria
- Chlorides

There is no known water quality data available for Madigan Creek collected by any local, state, or Federal agency. As such as part of the stream walk conducted in the watershed on July 11, 2011, temperature, conductivity, dissolved oxygen, and pH were collected at 6 sites within the watershed. A visual description of turbidity was also noted. The data collected is summarized in Table 3-30. The monitored sites are shown in Figure 3-19.

Table 3-30 Water Quality Data for the Madigan Creek watershed

Site	Temperature (°C)	Conductivity	Dissolved Oxygen (mg/L)	pH	Turbidity
1	23.3	330	5.06	7.57	Slight
3	24.6	346	5.96	7.55	Turbid
4	24.9	349	6.28	7.62	Slight
5	25.4	345	6.52	7.61	Slight
6	24.5	346	7.06	7.62	Clear
8	27.1	952	6.33	7.71	Turbid

Water quality data was not collected at the other sites visited on the stream walk due to insufficient flows in Madigan Creek at the time of the sampling.

Temperature

Water temperatures fluctuated with daily air temperatures as well as with seasonal changes, i.e., water temperatures are higher in summer and cooler in spring and fall. Maximum water temperatures over 20°C may preclude most numerous fish from using these streams for habitat.

Conductivity

Specific conductivity indirectly measures the concentration of chemical ions or dissolved salts in the water, and may be an indicator of salt as a pollutant. The more chemical ions or dissolved salts a body of water contains, the higher the conductivity will be. Conductivity levels of 200-1,000 are indicative of normal background levels. Conductivity outside of this range may not be suitable for certain species of fish or bugs. High conductivity (1000 to 10,000 μS/cm) is an indicator of saline conditions. High chloride concentrations following salt applications for snow melting in winter can led to high conductivity readings, as can the leaching of effluent from a sanitary sewer line into a stream. Low water levels tend to increase concentrations of ions in the water column, while rain events tended to temporarily flush ions out of the stream system.

Dissolved Oxygen

Algae and aquatic plants in the creek elevate dissolved oxygen (DO) concentrations during the day (due to photosynthesis) and lower DO concentrations at night (due to respiration). Low DO conditions typically exist in mid to late summer when air and water temperatures are high and water levels are low. DO concentrations below the Illinois Environmental Protection Agency standard of 5.0 mg/L can stress many fish species, and concentrations below 1.0 mg/L (hypoxic conditions) can be detrimental to aquatic life.

pH

Normal pH (a measure of hydrogen ions in the water) values in streams should range from 6.5 to 8.5, good conditions for aquatic life.

Turbidity

Turbidity, a measurement of the 'cloudiness' of water, is caused by suspended particles, or TSS (total suspended solids), and may indicate erosion or sedimentation problems. Turbidity tends to increase after rain events when runoff carries particles into the stream, when high flows erode streambanks and/or the streambed, and when the increased volume of water in the channel stirs the sediment in the bottom of the channel.

3.14.3 Illinois EPA Permit Programs

The Illinois Environmental Protection Agency (Illinois EPA) Bureau of Water regulates wastewater discharges through the implementation of the National Pollution Discharge Elimination System (NPDES) program. This program was imitated under the Clean Water Act to reduce pollution to surface waters and required permits be issued for the discharge of: 1) treated municipal effluent; 2) treated industrial effluent; and 3) stormwater from separate storm sewer systems (MS4's) and construction sites.

NPDES Point Source Discharges for Municipal and Industrial Effluent

Point sources of pollution are discharges from a single source such as a pipe conveying wastewater from an industrial process or a wastewater treatment facility into the stream. There are no municipal wastewater treatment plants discharging to the Madigan Creek watershed. There is one NPDES point source industrial permit issued by the Creek watershed: Rockford Sand and Gravel, a crushed and broken limestone quarry, located at 5155 West Charles Street, Loves Park, and Winnebago County, Illinois. The NPDES permit number for this facility is ILG840122 and the facility is permitted to discharge total suspended solids (TSS) into an unnamed tributary of Madigan Creek at one discharge location. The permit also requires Rockford Sand and Gravel to monitor for pH, TSS, flow, and offensive conditions. The quarry also has an air quality permit (ID 201808ACR) for the release of particulates into the air.

NPDES Stormwater Regulations

Stormwater runoff is a major source of pollution to the Madigan Creek watershed. Stormwater runoff includes rainwater and snow melt that flows off the land into storm sewers or directly into lakes, rivers, or streams. Stormwater runoff can carry a wide range of pollutants including sediment, nutrients, metals, chlorides, and petroleum. Additionally, as the runoff flows over land, it can lead to increased erosion of exposed soils, especially on construction sites.

In order to reduce the impacts of stormwater on our rivers, streams and lakes, Illinois has been implementing stormwater regulations since 1990 through the NPDES program. The regulations have been implemented in two phases: Phase I and Phase II. Phase I began in 1990 and required large and medium-size city with populations over 100,000 to obtain an NPDES permit coverage for their municipal separate storm sewer system (MS4). Phase I also required NPDES permits for ten industrial uses and for construction sites disturbing 5 acres or more of land.

The NPDES Phase II program began in 2003 and was an update to the 1990 Phase I program. The Phase II program expanded the program by including additional MS4 categories, providing a "no exposure" exemption to certain industrial facilities if activities are protected by a storm-resistant shelter to prevent the exposure of runoff and material from leaving the facility, and decreasing the threshold for a construction site permit to 1 acre or more of land disturbing activity.

MS4 Permits

The City of Rockford was considered an MS4 under the Phase I regulations (Illinois EPA Permit Number ILS000001). With the implementation of the Phase II regulations in 2003, the following governmental entities with the Madigan Creek watershed were designated as MS4 communities: Cherry Valley; Cherry Valley Township; Rockford Township; and Winnebago County. The Phase II communities all operate under a General Permit for Discharges from Small MS4s (Illinois EPA Permit Number ILR40).

Both the City of Rockford and the Phase II communities are required to complete a series of Best Management Practices (BMPs) including 1) Develop a stormwater management program consisting of BMPs and measurable goals for at least 6 control measures: 1) public education and outreach on stormwater impacts; 2) public involvement; 3) illicit discharge detection and elimination; 4) construction site stormwater runoff control; 5) post-construction stormwater runoff control in new developments; and 6) pollution prevention/good housekeeping for municipal operations. In addition to the six control measures, the MS4s must also submit a Notice of Intent (NOI) and an annual report of activities related to the permit to the Illinois EPA.

Construction Permits

As discussed above, NPDES Phase II Stormwater Regulations were implemented by the Illinois EPA in 2003 to address potential erosion from construction including commercial, residential, road building, and demolition sites in the state that disturb more than one acre of land. Land disturbance is defined as exposing soil during clearing, grading, or excavation.

The regulations specifically require the operator (person with operational control of the day to day construction activities) of the property to ensure compliance with the permit conditions outlined in the Illinois Construction Site General Permit (ILR10). These requirements include submitting a Notice of Intent (NOI) to begin construction, create a Stormwater Pollution Prevent Plan (SWPPP) to control erosion during construction, and submit a Notice of Termination (NOT) when the site is permanently stabilized. The regulations also require that the construction site be inspected every 7 days and after every 0.5-onch or greater rainfall event or equivalent snowfall by a qualified inspector. During the weekly inspection, the sites are existing soil erosion and sediment control (SESC) practices are inspected for needed repairs. Additionally, the inspections are used to identify additional potential sources of erosion and sedimentation and make recommendations for additional SESC control practices. If construction activities result in an off-site discharge of sediment bearing waters, the operator is required to submit a Incident of Non-compliance (ION) to the Illinois EPA and provide a plan to prevent further releases of sediment. As of January 2013, there are two active ILR10s issued for the Madigan Creek watershed and are detailed in Table 3-31.

Table 3-31 ILR10 Permits in the Madigan Creek watershed

Permit Number	Operator	Address	Description of Activity
ILR10Q792	555 Partnership	Anjali Perryville Subdivision, 555 S Perryville Road, Rockford, IL	Office building demolition and construction of new office building (3.9 acres of disturbance)
ILR105804	John Slack	Hampton Crossing, Mulford and Newburg Roads, Rockford, IL	Construction of residential subdivision (40 acres of disturbance)

Winnebago County, the City of Rockford, and the Village of Cherry Valley also have soil erosion and sediment control ordinances that are aimed at reducing the potential for sediment from construction activities for negatively impacting the Madigan Creek watershed.

3.14.4 Nonpoint Source Pollution

When rain flows across the landscape, pollutants such as oil and grease, road salt, eroding soil and sediment, metals, bacteria from pet wastes, and excess nutrients (nitrogen and phosphorus) from fertilizers are washed from streets, buildings, parking lots, construction sites, lawns and golf courses into the streams. This kind of pollution is called nonpoint source pollution, because it comes from the entire watershed rather than a single point, plant, or facility. These pollutants accumulate as the water flows downstream and eventually begin to degrade the quality of Madigan Creek for aquatic life, as well as for human uses such as fishing, wading, and bird watching. In this way, every small bit of pollution adds up to a very large problem.

In addition to chemicals and other substances picked up from the landscape, non point source pollution includes other measures such as temperature, acidity, and the amount of oxygen in the water. Aquatic organism, including fish and benthic macroinvertebrates that are critical links in the food chain, need oxygen that is dissolved in the water to breathe. Low flows and nonpoint source pollution can cause the dissolved oxygen levels in the water to fall below healthy levels. When this happens, some plants and animals will die, in some cases causing fish kills, and others will leave that location to try to find cleaner water.

Water temperature can also cause problems. Many fish and other aquatic animals require cool or cold fl owing water to survive. As rainwater flows across urban surfaces and through the sewer system, these surfaces warm the water causing the overall temperature of the receiving stream to be too warm for many aquatic plants and animals. This water can also be either more acidic (low pH) or more alkaline (high pH) than is healthy for these organisms to survive. Additional potential source of pollution, in addition to the list of potential sources mentioned above are the sanitary sewer system and septic systems.

Sanitary Sewer System

The Rock River Water Reclamation District (RRWRD) wastewater treatment facility discharges treated wastewater the Rock River outside of the Madigan Creek watershed. This discharge is a point source of pollution covered by the NPDES point source permitting process discussed in Section 3.11. However, non-point source pollution also can be traced to issues (cross connections with the storm sewer system, leakage into or out of the sanitary sewer system, overflows of the sanitary sewer system due to stormwater infiltration or combined sewers) within the sanitary or sewer system. The following are known about the RRWRD's system:

- No known cross connections exist between the RRWRD sanitary system and the storm sewer system within the Madigan Creek watershed that could result in sanitary discharge into the storm sewers.
- There are no combined sewers within these watersheds
- There are no RRWRD overflow structures discharging into the waters of the watershed.

Septic Systems

Septic systems have the potential to discharge nutrients (phosphorus and nitrogen) and bacteria and virus in to the surface and groundwater of the Madigan Creek watershed. When properly designed and maintained, the quantity of pollution discharge from the septic systems is limited. However, failing septic systems have the potential to be a significant cause of surface water and groundwater quality degradation. Several areas in the Madigan Creek watershed are serviced by septic systems. These areas include the neighborhood bound to the north by Mill Road, the south by Newburg Road, Perryville to the west, and Bell School Road to the east and the neighborhood located north of Harrison Avenue, south of St Charles Road, east of Mulford Road and west of Perryville Road is also serviced by septic systems. Areas not serviced by sanitary sewer are assumed to be on septic systems.

Nonpoint Point Source Pollutant Load Analysis

As a means of quantifying non-point source pollution loading in the watershed, a Pollutant Loading (PLOAD) application model for the Madigan Creek watershed was developed. PLOAD is an extension of the comprehensive modeling tools in the Environmental Protection Agency's (EPA) Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) model. PLOAD is a GIS-based model that estimates nonpoint-source and point-source loadings on an annual average basis for small urban watersheds.

Hey has selected PLOAD as the nutrient loading modeling application that is the most appropriate for the Madigan Creek watershed for the following reasons:

Transferability

PLOAD was designed to be utilized in a wide range of applications and uses including NPDES stormwater permitting, watershed management, watershed planning, and lake/reservoir protection projects. PLOAD is applicable for both small urban and rural watersheds of any size. The model inputs include GIS coverages of land use, subbasin boundaries, and BMP locations along with look-up tables for pollutant event mean concentrations (EMCs), imperviousness and BMP removal efficiencies.

Additionally, as PLOAD is an extension of the BASINS model, the model can be downloaded for free from the Illinois EPA on the BASINS homepage. As such it is not cost prohibitive for even the smallest watershed planning organizations.

Applicability

PLOAD has the ability to estimate the importance of pollution contributions from multiple land uses and many individual sources in a watershed. Thus, it can be used to target important areas of pollution generation and identify areas best suited for controls within a watershed. Once these "hot spots" are identified, PLOAD can then be utilized to evaluate the effectiveness that various types and locations of BMPs within the "hot spots" would have on pollutant loading.

PLOAD also has the ability to assess seasonal or inter-annual variability of nonpoint-source pollution and to assess long-term water quality trends. It can also be used to address land use patterns and landscape configurations in the watershed. This allows for the user to evaluate changes in pollutant loading that may occur as the result of future, predicted land use conditions.

Ease of Use

PLOAD has a user-friendly interface. Starting a new project within the BASINS platform involves an easy to follow step-by-step process. Once a project is started in BASINS, the gathering of background data necessary to run the PLOAD model can begin. After the initial background data is loaded into the model (land use, elevation and hydrology information, watershed boundaries, etc.) the PLOAD model plug-in can be utilized. The PLOAD model plug-in incorporates another step-by-step process where land use, precipitation, event mean concentration, BMPs, point sources, and bank erosion can either be referenced to BASINS or inserted manually where applicable for the particular project or area being analyzed. Manual insertion of the data is clearly detailed within the software instructions.

After modeling is complete, PLOAD gives its user the ability to generate out-puts as user-defined formats. This enables the user to tailor the output data they need. If so desired, the user can view the data from BASINS and PLOAD in ArcGIS if that software is installed on the computer being utilized.

Customizable

PLOAD's organization and structure facilitates modification and customization. By using look-up tables for EMCs, imperviousness terrain factor, and BMP removal efficiencies, PLOAD gives the user the opportunity to integrate site and region specific data on loading and removal rates into the model. This allows for a more refined calculation of loading and reduction rates.

Pollutants evaluated using PLOAD included
- Total Suspended Solids (TSS)
- Total Dissolved Solids (TDS)
- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Total Phosphorus (TP)
- Total Nitrogen (TN)
- Nitrate-Nitrite (NO3-NO2)
- Total Kjeldahl Nitrogen (TKN)
- Lead
- Copper
- Cadmium
- Chromium
- Nickel
- Zinc

The model estimated pollutant loading of each pollutant from each subbasin. The modeled valued were compared to the Illinois Environmental Protection Agency (Illinois EPA) Water Quality Standards for General Use, Secondary Contact, and Aquatic Life. The Illinois EPA Water Quality Standards used for this assessment are included in Table 3-32.

Table 3-32 Illinois EPA Water Quality Standards

Pollutant	Illinois EPA Standards
TSS	750 ppm
TDS	1,500 mg/L
BOD	5.0 mg/L
COD	30 mg/L
Total Phosphorus*	0.05 mg/L
Total Nitrogen (TN)	15 mg/L
Nitrate – Nitrite (NO3-NO2)	Not applicable
Total Kjeldahl Nitrogen (TKN)	10 mg/L
Lead (Pb)	0.1 mg/L
Copper (Cu)	1.0 mg/L
Cadmium (Cd)	0.15 mg/L
Chromium (Cr)	0.3 mg/L
Nickel (Ni)	1.0 mg/L
Zinc (Zn)	1.0 mg/L

* Applicable only to lakes/reservoirs and streams at its confluence with a lake/reservoir

Four pollutants in particular (TSS, TP, COD, and BOD) are considered as pollution indicators for this watershed. TSS and TP are typical indicators of high urban pollutant loadings. TSS can lead to excessive sedimentation in stream reaches and ultimately cover and impair instream habitat. TP can lead to excessive productivity levels of aquatic plants in slow moving reaches and in wetlands. This can then lead to low DO levels as the plant material decays Low DO levels make the stream uninhabitable for some species of aquatic life. Since COD and BOD represent oxygen demanding substances they were included in the list of indicator pollutants for this watershed.

The pollutant loading results were used to identify and prioritize subbasins by their respective degree of pollutant loading. Table 3-33 details the pollution loading estimates from each subwatershed on a concentration basis (mg/L). Table 3-34 includes pollutant load calculations in pounds per year for each subbasin. Table 3-35 lists pollutant load in pounds per year for each land use.

The loading calculations were used to establish a ranking system for each of the modeled pollutants in order to identify priority watersheds. The rankings included “High” for those pollutants that exceeded the Illinois EPA standard, “Medium” for those pollutants that were under the Illinois EPA standard but at least half their value, and “Low” for those pollutants that were less than half of the Illinois EPA standard. Table 3-36 lists the Illinois EPA standards by pollutant and those subwatersheds exhibiting High, Medium, and Low levels for each pollutant.

Table 3-33 Estimated Pollutant Loading by Subwatershed in the Madigan Creek watershed (mg/L)

Subbasin	Acres	TSS	TDS	BOD	COD	TP	TN	NO3	NO3-NO2	TKN	Pb	Cu	Cd	Cr	Ni	Zn
1	176.17	217.89	92.09	15.87	66.50	0.50	2.38	0.20	0.70	1.79	0.03266	0.03659	0.00495	0.00792	0.00792	0.133
2	188.76	185.83	92.00	16.00	67.00	0.50	2.40	0.20	0.70	1.80	0.03300	0.03700	0.00500	0.00800	0.00800	0.134
3	463.82	207.79	92.03	15.97	66.87	0.50	2.40	0.20	0.70	1.80	0.03291	0.03689	0.00499	0.00798	0.00798	0.134
4	415.16	209.57	92.00	16.00	67.00	0.50	2.40	0.20	0.70	1.80	0.03300	0.03700	0.00500	0.00800	0.00800	0.134
5	243.04	219.60	92.02	15.98	66.91	0.50	2.40	0.20	0.70	1.80	0.03294	0.03693	0.00499	0.00799	0.00799	0.134
6	417.26	246.84	92.01	15.98	66.94	0.50	2.40	0.20	0.70	1.80	0.03296	0.03695	0.00499	0.00799	0.00799	0.134
7	145.77	249.32	92.00	16.00	67.00	0.50	2.40	0.20	0.70	1.80	0.03300	0.03700	0.00500	0.00800	0.00800	0.134
8	10.81	183.82	92.00	16.00	67.00	0.50	2.40	0.20	0.70	1.80	0.03300	0.03700	0.00500	0.00800	0.00800	0.134
9	59.10	231.89	92.00	16.00	67.00	0.50	2.40	0.20	0.70	1.80	0.03300	0.03700	0.00500	0.00800	0.00800	0.134
10	71.78	265.37	92.16	15.78	66.18	0.49	2.37	0.20	0.70	1.78	0.03243	0.03631	0.00492	0.00786	0.00786	0.132
11	139.62	280.45	92.06	15.92	66.70	0.50	2.39	0.20	0.70	1.79	0.03280	0.03675	0.00497	0.00795	0.00795	0.133
12	284.73	187.41	92.01	15.99	66.97	0.50	2.40	0.20	0.70	1.80	0.03298	0.03698	0.00500	0.00800	0.00800	0.134
13	190.17	269.12	92.35	15.52	65.17	0.49	2.34	0.20	0.69	1.75	0.03174	0.03547	0.00483	0.00769	0.00769	0.129
14	216.82	211.90	92.00	16.00	67.00	0.50	2.40	0.20	0.70	1.80	0.03300	0.03700	0.00500	0.00800	0.00800	0.134
15	252.13	217.22	92.01	15.98	66.94	0.50	2.40	0.20	0.70	1.80	0.03296	0.03695	0.00499	0.00799	0.00799	0.134
16	39.07	200.75	92.14	15.81	66.27	0.49	2.38	0.20	0.70	1.78	0.03250	0.03639	0.00493	0.00788	0.00788	0.132
17	229.18	341.43	93.37	14.12	59.81	0.45	2.16	0.18	0.67	1.61	0.02803	0.03100	0.00431	0.00680	0.00680	0.114
18	16.13	430.26	92.65	15.11	63.61	0.48	2.29	0.19	0.68	1.71	0.03066	0.03417	0.00468	0.00743	0.00743	0.125
19	103.17	237.48	92.00	16.00	67.00	0.50	2.40	0.20	0.70	1.80	0.03300	0.03700	0.00500	0.00800	0.00800	0.134
20	131.55	227.51	92.22	15.70	65.86	0.49	2.36	0.20	0.69	1.77	0.03221	0.03605	0.00489	0.00781	0.00781	0.131
21	56.52	309.62	93.27	14.25	60.33	0.45	2.18	0.18	0.67	1.63	0.02839	0.03144	0.00436	0.00689	0.00689	0.116
22	122.47	347.03	93.50	13.94	59.12	0.44	2.14	0.18	0.66	1.59	0.02756	0.03043	0.00425	0.00669	0.00669	0.113

Table 3-34 Estimated Pollutant Loading by Subwatershed in the Madigan Creek subwatershed (lbs/year)

Subbasin	Acres	TSS	TDS	BOD	COD	TP	TN	NO3	NO3-NO2	TKN	Pb	Cu	Cd	Cr	Ni	Zn
1	176	143,090	60,478	10,422	43,672	326	1,565	131	458	1,173	21	24	3	5	5	87
2	189	185,507	91,841	15,972	66,885	499	2,396	200	699	1,797	33	37	5	8	8	134
3	464	396,258	175,491	30,445	127,514	952	4,568	381	1,334	3,426	63	70	10	15	15	255
4	415	351,494	154,304	26,835	112,373	839	4,025	335	1,174	3,019	55	62	8	13	13	225
5	243	196,024	82,136	14,261	59,726	446	2,140	178	624	1,605	29	33	4	7	7	119
6	417	303,567	113,158	19,658	82,326	614	2,949	246	861	2,212	41	45	6	10	10	165
7	146	105,231	38,831	6,753	28,279	211	1,013	84	295	760	14	16	2	3	3	57
8	11	10,794	5,403	940	3,934	29	141	12	41	106	2	2	0	0	0	8
9	59	45,308	17,975	3,126	13,091	98	469	39	137	352	6	7	1	2	2	26
10	72	49,439	17,169	2,941	12,329	92	442	37	130	331	6	7	1	1	1	25
11	140	92,757	30,447	5,266	22,062	165	791	66	231	593	11	12	2	3	3	44
12	285	276,479	135,729	23,592	98,797	737	3,539	295	1,032	2,654	49	55	7	12	12	198
13	190	129,544	44,454	7,471	31,370	234	1,126	94	333	843	15	17	2	4	4	62
14	217	181,407	78,760	13,697	57,358	428	2,055	171	599	1,541	28	32	4	7	7	115
15	252	205,592	87,087	15,129	63,359	473	2,270	189	662	1,702	31	35	5	8	8	127
16	39	34,671	15,913	2,730	11,446	85	410	34	120	308	6	6	1	1	1	23
17	229	135,881	37,159	5,618	23,801	179	860	73	265	641	11	12	2	3	3	46
18	16	8,756	1,885	308	1,294	10	47	4	14	35	1	1	0	0	0	3
19	103	77,485	30,018	5,221	21,861	163	783	65	228	587	11	12	2	3	3	44
20	132	102,399	41,506	7,067	29,642	221	1,063	89	313	797	14	16	2	4	4	59
21	57	35,191	10,601	1,620	6,857	51	248	21	76	185	3	4	0	1	1	13
22	122	72,035	19,408	2,893	12,272	92	444	38	138	331	6	6	1	1	1	23

Table 3-35 Estimated Annual Pollutant Load by Land Use in the Madigan Creek subwatershed (lbs/year)

Source	TSS	TDS	BOD	COD	TP	TN	NO3	NO3-NO2	TKN	Pb	Cu	Cd	Cr	Ni	Zn
Agriculture	4,583,789	1,833,326	313,935	1,316,210	9,828	47,189	3,939	13,846	35,372	645	722	98	156	156	2,621
Commercial	15,426,931	6,170,135	1,056,561	4,429,760	33,076	158,817	13,257	46,599	119,046	2,171	2,431	329	526	526	8,820
Other	262,740	105,085	17,995	75,444	563	2,705	226	794	2,028	37	41	6	9	9	150
Publicly Owned Land/Parks/Rec. Areas	3,607,679	1,442,923	247,083	1,035,925	7,735	37,140	3,100	10,897	27,840	508	568	77	123	123	2,063
Residential	29,105,067	11,640,824	1,993,350	8,357,362	62,402	299,631	25,011	87,916	224,597	4,095	4,586	622	993	993	16,639
Right-of-Way	12,942,952	5,176,646	886,438	3,716,499	27,750	133,245	11,122	39,096	99,878	1,821	2,039	276	442	442	7,399
Industrial	1,368,867	547,490	93,751	393,063	2,935	14,092	1,176	4,135	10,563	193	216	29	47	47	783

Table 3-36 Levels of pollutant compared to Illinois EPA standards in the Madigan Creek watershed

Pollutant	**Illinois EPA Standard (mg/L)**	**High**	**Medium**	**Low**
TSS	750ppm	None	None	All
TDS	1,500 mg/L	None	None	All
BOD	5.0 mg/L	**All**	None	None
COD	30 mg/L	**All**	None	
Total Phosphorus	0.05 mg/L	**All**	None	None
Total Nitrogen (TN)	15 mg/L	None	None	All
Total Kjeldahl Nitrogen (TKN)	10 mg/L	None	None	All
Lead (Pb)	0.1 mg/L	None	None	All
Copper (Cu)	1.0 mg/L	None	None	All
Cadmium (Cd)	0.15 mg/L	None	None	All
Chromium (Cr)	0.3 mg/L	None	None	All
Nickel (Ni)	1.0 mg/L	None	None	All
Zinc (Zn)	1.0 mg/L	None	None	All

3.14.5 Summary of Water Quality Assessment

The conclusions drawn and management strategies recommended in this report are the best possible, given the extremely limited water quality data in this watershed. However, typical urban watershed problems as well as site specific issues have been identified. The primary issues with respect to water quality, including those that relate to instream and riparian habitat, are discussed below.

Total Suspended Solids

Although the nutrient modeling did not identify Total Suspended Solids (TSS) as a major source of impairment, the habitat assessment and stakeholder input has identified TSS as a major issue in the watershed. The primary impact of high suspended solids concentrations in streams occurs when these solids settle in depositional areas of the stream system and cover the more desirable gravel substrates. Excessive levels of particulate material also create difficult conditions for gill breathing fish and some of their food sources, including macroinvertebrate organisms.

The sources of TSS appear to be streambank erosion (due to hydrologic instability) with contributions from urban runoff over impervious surfaces. Suspended solids can be transported to the streams and lakes, even from remote areas of the watershed, via storm sewers and roadside ditches.

Increases in impervious cover combined with introduction of stormwater drainage systems and loss of wetlands has lead to significant changes in watershed hydrology (flow alterations and hydromodification). This has in turn led to increased streambank and streambed erosion and degradation of instream habitat in many reaches.

As the remaining vacant land of the watershed develops, as is projected, construction site runoff will be a potential growing source of sediment if soil erosion and sediment control practices are not properly designed, installed, and maintained.

Habitat

There are very limited high quality habitat features such as instream habitat and relatively natural floodplains in the Madigan Creek watershed. As such, biological communities are of poor quality with limited diversity. The lack of instream features, intermittent hydrologic connection with the Kishwaukee River, the flashy hydrology of the streams due to urban development within the watershed, periods of very low flow, and low dissolved oxygen conditions in the summer months all contribute to the impacts to the biological community of the creek. Additional biological sampling should be conducted in a variety of locations to establish a baseline from which improvement or degradation can be assessed.

Additionally, there has been significant encroachment by urban uses into the stream corridor and loss of riparian habitat. These encroachments can be locations of yard waste dumping as well as sheet drainage of fertilizers and pesticides into the stream. These encroachments can also disrupt wildlife corridors.

Nutrients

Urban runoff is the likely contributor of high nutrient loads, particularly phosphorous, to the stream systems. Stream or streambank dumping of yard waste, grass clippings, and leaves collected in the fall can also contribute significant nutrient loading to the stream. Pet wastes may also contribute to the nutrient loading to the stream.

Total Dissolved Solids

Dissolved solids (TDS) include substances such as salts. One of the most problematic dissolved solids in urban watersheds is sodium chloride, used as road deicing material. Road salt can occur at toxic levels in the water column at intermittent times when the weather conditions demand its use. Sodium chloride is not removed by BMPs and is conservative (does not decompose or readily change form), and can cause spikes in the water column, typically detected as increased conductivity. Salinity and chlorides were measured within the stream by collecting data on the conductivity levels in the stream, which indicated slightly elevated conductivity readings. It should be noted that these conductivity readings were taken in the summer when levels of dissolved solids are most likely at their lowest in the stream. It is expected that high concentrations would be present during the winter months due to the application of road salt.

3.15 Floodplain and Flood Hazard Areas

This section of the plan includes information on the FEMA floodplain as well as areas of known flooding within the Madigan Creek watershed.

3.15.1 Floodplain

Floodplains along stream and river corridors provide a variety of benefits including aesthetic value, flood storage, water quality, and plant and wildlife habitat. However, the most important function is the capacity of the floodplain to hold water during significant rainfall events to minimize flooding. Flood hazard areas are identified on the Flood Insurance Rate Map (FIRMs) and are categorized as a Special Flood Hazard Areas (SFHA). SFHAs are defined as the area that will be inundated by a flood event having a 1-percent chance of being equaled or exceeded in any given year. This 1-percent annual chance flood is commonly referred to as the base flood or 100-year flood. It should be noted that the 100-year flood can and do occur more frequently than every 100 years. SFHAs are labeled as Zone A, Zone AO, Zone AH, Zones A1-A30, Zone AE, Zone A99, Zone AR, Zone AR/AE, Zone AR/AO, Zone AR/A1-A30, Zone AR/A, Zone V, Zone VE, and Zones V1-V30.

There are approximately 44.32 acres of 100-year floodplain with in Madigan Creek watershed (Table 3-37 and Figure 3-21). The Madigan Creek floodplain is classified as Zone A and Zone AE. Zone AE areas are subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations (BFEs) are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply for all structures located in Zone AE. The Zone AE areas in Madigan Creek are located along Madigan Creek from approximately Rolling Hedge Lane to its confluence with the Kishwaukee River.

Zone A Areas are subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown for Zone A areas. Mandatory flood insurance purchase requirements and floodplain management standards apply for all structures located in Zone A. The Zone A areas are located along Madigan Creek near Valencia Drive south of Calimar Drive, along a Madigan Creek tributary #3 in Southeast Community Park, and along a Madigan Creek tributary #2 near Meadowlark Lane and Newburg Road to Woodcreek Bend road.

Table 3-37 Floodplain in the Madigan Creek watershed

SFHA	Acreage	% of Watershed
AE	26.54	0.67%
A	17.78	0.45%

Structures appear to be located in the mapped floodplain near the intersection of Newburg Road and Mulford Road (Figure 3-21).

Records maintained by the Federal Emergency Management Agency (FEMA) indicate that no letters of map revision (LOMRs) have been issued for development projects in the Madigan Creek watershed in the last 30 years.

3.15.2 Flooding and Drainage Problems

Over the past years the Madigan Creek watershed has recorded some of its worst flooding to date. Five inches of rain fell on September 4, 2006 which lead to the damage of hundreds homes. Less than a year later on August 7, 2007, the watershed was again hit by rain when 5 to 7-inches of rain fell. Many streets, including major thoroughfares were flooded. Following the 2007 storm, the Governor of Illinois declared Rockford and Winnebago County a state disaster area. Debris removal, law enforcement, damage assessment, and other duties were offered by the governor.

In addition to these flooding events caused by significant rainfalls, the Madigan Creek watershed experiences flood and drainage problems following much smaller rainfall events. Several different types of flooding that occurs in the watershed include:

- Overbank flooding from a waterway
- Local drainage problems (shallow flooding on roads, yards and sometimes buildings) often due to development in a drainage way, inadequately maintained drainage ditches, undersized storm sewers, and storm sewers.
- Depressional flooding in areas where water ponds in a natural depression in the landscape and there is no natural outlet for runoff. May be caused by failed or sewer or adjacent or surrounding development causing increased runoff into the depressional area.
- Sanitary sewer backups may occur, flooding basements, when stormwater infiltrates into the sanitary sewer pipes, leaky manholes, or inappropriate connections to the sanitary lines.

In 2009, the City of Rockford prepares a Citywide Stormwater Management/Flood Control Assessment of the portions of the Madigan Creek watershed located within its city limits. The Citywide Stormwater Management/Flood Control Assessment identified seven stormwater/flood control issues in the Rockford portion of the watershed. This list was presented to the Winnebago County Watershed Planning Steering Committee and other watershed stakeholders during the watershed planning process and was expanded.

Table 3-38 and Figure 3-22 lists all of the flooding and drainage problems identified during the watershed planning process.

Table 3-38 Flooding and Drainage Problems in the Madigan Creek watershed

Location	**Problem Description**	**Over-bank Flooding**	**Major Surface Flooding**	**Localized Flooding**	**Roadway Overtopping**	**Pipe Surcharge**	**Culvert Scour**	**Water Quality Impacts**	**Streambank Erosion**
Rockford, IL									
Tulip Lane	Area residents west of Tulip Lane report the occurrence of backyard flooding			✓					
Argus Drive and Sundae Drive	Area experiences street flooding with depths of up to 4-feet during small frequent storms			✓					
Stoney Creek Way and Madigan Creek	Occurrence of nuisance flooding due to undersized culverts			✓					
Wood Creek Bend and Madigan Creek	Area residents report flooding along driveways. Storm sewer needs to be upsized.			✓					

Location	**Problem Description**	**Over-bank Flooding**	**Major Surface Flooding**	**Localized Flooding**	**Roadway Overtopping**	**Pipe Surcharge**	**Culvert Scour**	**Water Quality Impacts**	**Streambank Erosion**
Trainer Road and Madigan Creek	The 78-inch culvert is in need of maintenance. Crossing does not have a headwall and side slopes are eroded.						✓		
Trainer Road south of Forest Plaza	Roadside vegetated ditch needs maintenance			✓					
Trainer Road at Grassridge Road	Area residents note the presence of streambank erosion.								✓
Trainer Road at Rolling Hedge Lane	Area residents report that debris clogs roadside swale culvert.			✓					
Near Grassridge Road and tributary to Madigan Creek	Area residents report a bridge has been constructed over the creek. This bridge restricts flow and causes water backup.			✓					
Residences along Grassridge Road	Structures (sheds, gazebos, etc) have been constructed in detention basins.			✓					
Quarry SW of Charles Street and Mulford Road	Current owner would like to deepen quarry and increase discharge to Madigan Creek tributary							✓	✓
Arlington Cemetery and tributary to Madigan Creek	Area residents report that combined flows from Charles St, Mulford St, and the Maplewood Subdivision have caused increased flows in the creek channel.							✓	✓
NE of Brady Lane and Stone Bridge Crossing	Subdivision would like to construct bridge for additional road access			✓					
North of Newberg Road and Madigan Creek	Area residents report loss of storage volume in detention basin			✓				✓	
Newburg Road and Mulford Road	Area residents report increased flows in the tributary to Madigan Creek. Increases flows were noted at about the time the condos at the intersection were constructed				✓				✓
Newburg Road and Woodcreek Bend	Area residents report that debris clogs roadside swale culvert.			✓					
Newburg Road and Avalon Drive	Area residents note the presence of streambank erosion. Culvert may also be undersized. Scour is observed below the culvert.			✓			✓	✓	
Woodcreek Bend and Willowick Lane	A resident has constructed a berm that is redirecting flows			✓					

Location	Problem Description	Over-bank Flooding	Major Surface Flooding	Localized Flooding	Roadway Overtopping	Pipe Surcharge	Culvert Scour	Water Quality Impacts	Streambank Erosion
Woodcreek Bend along tributary Madigan Creek	Residents report that flow is restricted in the channel due to debris accumulation at culverts.			✓				✓	
Newburg Road and Valencia Drive	ComEd electrical box is located on creek bank. Box is submerged during heavy rain events.			✓					
Newburg Road and Perryville Road	Area residents report insufficient detention associated with road widening activities			✓					
Rock Creek Church on Harrison Avenue	Area residents report that debris clogs roadside swale culvert. Erosion is also noted in the drainage swale in the Swanson Park Condos.			✓					
Harrison Avenue and Mulford Road	Area residents report existing detention basin is undersized.			✓	✓				
Cherry Valley, IL									
Valencia Drive and Rolling Hedge Lane	Area residents report that the roadside vegetated ditch needs maintenance			✓					
Valencia Drive and Hedgewood Road	Area residents report insufficient detention.			✓					✓
Mike's Place and Madigan Creek	Area residents report debris and trash in creek.							✓	
Madigan Creek and railroad trestle	Significant streambank erosion observed.								✓
Unincorporated Winnebago County, IL									
Cerasus Drive from Mill Road to Laurel Cherry Drive along Madigan Creek	Significant streambank erosion observed. Also significant amount of trash observed in stream.							✓	✓
Waterford Drive and Cerasus Drive	Area residents report an undersized culvert.			✓	✓				✓
Waterford Drive and Bell School Road	Area residents report undersized detention basin.			✓					
Black Cherry Drive and Madigan Creek	Streambank erosion has exposed electrical lines.								✓
Montmorency Drive from Laurel Cherry Drive to Chokecherry Drive and Temple Circle along Madigan Creek	Significant streambank erosion observed.							✓	✓

Location	Problem Description	Over-bank Flooding	Major Surface Flooding	Localized Flooding	Roadway Overtopping	Pipe Surcharge	Culvert Scour	Water Quality Impacts	Streambank Erosion
North side of Chatsworth Drive	Area residents report high flows in roadside ditches following storm events. In large events, water overflows form the ditches.			✓	✓				
Chatsworth Drive and tributary to Madigan Creek	Area residents report basement flooding and roadway overtopping.			✓	✓				
Swanson Parkway and Harrison	A resident has constructed a berm that is redirecting flows			✓					
Tributary between Kensington Place and Panorama Road	Area residents note debris in creek restricts flows.			✓				✓	

3.15.3 Constructed Drainage System

As development occurred in the Madigan Creek watershed, the natural drainage system in the watershed was altered. Early construction of residential, commercial, industrial and roads were built without detention basins or other stormwater management practices. With the intent of removing stormwater runoff as quick as possible, this early development utilized storm sewer systems and ditches to quickly transport the water into Madigan Creek and its tributaries. Without detention, after each rainfall stormwater was quickly delivered to the surface waters resulting in increased flows in the stream channels. These frequent, intense flows lead to channel hydromodification including streambank erosion and channel incision. See Section 3.14.4 for more information on hydromodification.

More recently city engineers and decision makes have realized the benefits of storing stormwater in detention facilities that are designed to capture runoff from an impervious area and slowly releases the water over a given amount of time. Winnebago County (Article IV Surface Water Management), the City of Rockford (Part II Chapter 109), and the Village of Cherry Valley (Article IV Stormwater Detention) all have stormwater management and detention requirements. Winnebago County and the City of Rockford have also adopted technical regulations/requirements in regards to surface water management.

All three stormwater management ordinances state that the maximum controlled stormwater runoff releases rate from shall not exceed the natural safe stormwater drainage capacity of the downstream system or 0.2 cubic feet per second (cfs) per area. The ordinances allow for the use of the following stormwater storage methods in order to ensure a release rate of 0.2 cfs/acre is met: dry bottom basins, wet bottom basins, paved stormwater storage areas, rooftop storage areas, automobile parking stormwater storage areas, and underground stormwater storage areas.

Detention Basins – dry bottom and wet bottom

Detention basins or detention ponds are stormwater management facilities that are constructed on or adjacent to rivers, streams, or lakes that are designed to storm rainfall in order to protect against flooding and protect downstream channels from hydromodification. Detention facilities that are constructed on a river or stream are commonly referred to as "on-line" basins. On-line basins are not recommended and are commonly prohibited under a variety of stormwater regulations. Detention basins that are not on-line and typically constructed in low areas relative to development and either discharge directly to a surface water or discharge to surface water through a stormwater sewer network. Detention basins are typically designed to be dry bottom or wet bottom.

Dry bottom basins typically hold water for short periods of time following rain events. They are commonly lined with manicured turf grass. While dry detention basins may slow water from reaching creeks and rivers, there short residence time do not promote groundwater infiltration or provide significant water quality benefits. Structures such as gazebos and storage sheds should not be located in dry bottom basins.

Wet bottom basins are designed to permanently retain some volume of water at all times. The amount of water is determined by the elevation of the outlet pipe of the basin. The sideslopes of wet bottom basins can be planted with both turf grass or native grasses. Often wet bottom basins planted with turf grass will experience bank erosion resulting in the placement of riprap near the toe of slope as a measure to slow the erosion.

Wet detention basins planted with native vegetation are commonly referred to as naturalized detention basins. Naturalized detention basins are designed to be wet bottom with side slopes and an emergent zone that is planted with native plants, flowers, and shrubs. In addition to providing stormwater management, naturalized detention basins promote groundwater infiltration and maximize the water quality benefits and wildlife habitat.

The City of Rockford has conducted an overview survey of detention basins within the Rockford portion of the Madigan Creek watershed. According to the survey there are 55 detention basins located within the watershed. The basins, their approximate locations, and any description of the basin's configuration/landscape supplied by the City are included in Table 3-39. Figure 3-23 depicts the location of the detention basins in the watershed.

Table 3-39 Detention Basins in the Madigan Creek Watershed

Basin ID #	Location	Basin Configuration
249	Settlement Way and Old Colony Bend	mowed grass
250	E. State & Perryvile NEX (Lowes)	mowed grass
251	Bell School and E State	
266	Perryville and Argus NW	
57	E State and Puri Pkwy	low grass area
58	E State and Puri Pkwy	low grass area
64	Joyce and Garret	low grass area,
65	Argus and Buckley	cattails
66	Argus and Buckley	
67	Argus and Buckley	
68	Argus and Buckley	low grass area

Basin ID #	Location	Basin Configuration
69	Sundae and State	mowed grass
70	Argus and Bell School	parking lot of Red Roof Inn
71	Bell School and E State	Country Kitchen parking lot
72	Coliseum and Amphitheater	newly seeded grass
73	Colosseum and Tulip	wooded
74	Tulip and Meander	mowed grass
75	Fox Chase and Centennial	mowed grass
76	Meander and Tulip	low grass area with standing water
77	Meander and McKnight	mowed grass
78	McKnight Circle	mowed grass
82	Walton and Doss	low grass basin, with mowed on sideslopes and a small amount of standing water
83	E State around Perryville	cattails
84	Stalter and Deane	unmowed grass
85	Stalter and Mill	cattails
86	Mill and Perryville	mowed grass
87	White Chapel and Highgrove	
88	Fincham and Mid America	unmowed grass
89	Trainer and Fincham	unmowed grass
90	Southfield and Brittania	mowed grass
92	Laurel Cherry Dr and Anee Dr	mowed grass
93	Timberline Ln and Revere Ridge	mowed grass
94	Timberline Ln and Trainer Rd	unmowed grass
95	Newburg Rd and Perryville Rd	low, well kept grass area,
96	End of Creekwood Circle	low, well kept grass area
97	Stony Creek Way and Fox Basin Rd	low, unkept grass area
98	Wood Creek Bend	low, unkept grass area with standing water
99	On Woodcreek	grassy march
100	Highridge Rd and Grassridge Rd	low, well kept area with small creek
101	Old Oaks Ct and Grassridge Rd	well kept low grass area
102	End of Sulkey Ln	low grass area,
103	Carriage Green Way	low grass area with erosion along hillside and standing water
104	Mulford and Phaeton Dr	low, well kept grass area
105	Along Mulford	grass bottom with cement drainageways connecting outfalls
106	Elaine Dr and Mulford	low grass area, well kept
107	Mulford and Elaine Dr	wet pond
203	Wellingham Circle	riprap
212	Ware and Colosseum	
219	Argus and Amphitheater	mowed grass
223	Harrison and Stowmarket	unmowed grass
225	Stoney Creek and Newburg	
226	Argus near Sumberland Furniture	
268	NW Mulford & Harrison	
N/A	west of Best Buy	
N/A	Woodcreek Bend East	small creek channel

While Rockford has compiled a list of detention basins in its jurisdiction, a detailed inventory of all detention basins in the watershed does not exist. A detailed inventory would include the location, size, type (wet bottom, dry, wetland, etc.), description of inlets and outlets, planting plan, and any issues/problems with the basin. The inventory would also include a description of any maintenance needs. While a detailed detention basin inventory was not conducted during the preparation of the watershed-based plan, a field visit to several basins was conducted. The field visits identified several problems with the existing detention basins that limit the storage capacity of the basin and prevent the basin from providing volume control. The identified problems and issues include:

- Structures such as gazebos and sheds constructed in dry basins.
- "Short circuiting" of the basin. Short circuiting occurs when the inlet and outlet are constructed immediately adjacent to each other allowing lows flows to flow directly in and out of the basin and not stored for a gradual release over time.
- Modifications made to the basin such as breeches in side slopes and removal of control structures
- The presence of trash and yard waste within the basins.
- The presence of concrete-lined trenches in the bottom of the basins.

Paved Stormwater Storage Areas

Paved stormwater storage areas are similar to detention basin except that instead of turf grass or native grasses, the basins are paved, typically with concrete. Paved stormwater storage areas prohibit groundwater infiltration and provide no water quality or habitat benefits.

Rooftop Storage Areas

Rooftop storage areas are essentially specialized detention basins used to reduce the peak discharge from rooftops. In a rooftop storage area, all rainfall that falls on a building's roof is stored on the roof and slowly released into the storm sewer system or surface waters. The water is stored on the roof through the use of small weirs located within the roof drains that capture the rainfall and slowly releases it. Rooftop storage areas are traditionally used in high density areas where traditional means of stormwater detention such as ponds are not practical. Rooftop storage areas can be installed at the time of construction or retrofitted onto existing building as long as certain design conditions such as the use of a water proof membrane and ensuring that the roof can handle the additional weight are met.

Automobile Parking Stormwater Storage Areas

Automobile parking stormwater storage areas include the temporary surface storage of stormwater in remote, used areas of parking lots. In this practice, stormwater is temporarily stored on the surface of a parking lot immediately following a storm event prior to be slowly drained into the storm sewer system or other onsite detention facility. Automobile parking stormwater storage areas do not promote groundwater infiltration or provide water quality or habitat benefits. In fact, automobile parking stormwater storage areas may increase pollution loading into a stream or river as parking lots runoff can contain metals, oils, grease, and other water quality contaminants.

Underground Stormwater Storage Areas

Underground stormwater storage areas are a structural practice used to control the flow of stormwater. With underground storage areas, stormwater is stored under the ground in pre-fabricated containers and discharged over time. The systems are typically installed beneath parking lots, streets and parks where there is not enough allowable space for a traditional detention basin. Unless specifically designed, underground stormwater storage areas prevent groundwater infiltration and provide no water quality or habitat benefits.

In addition to the construction of detention facilities, the installation of storm sewer systems has also changed the natural drainage pathways of the Madigan Creek watershed. Storm sewer systems collect water from residential, commercial, and industrial areas and roads and transport the stormwater to directly to surface waters or to detention facilities prior discharging to surface waters. Storm sewer systems are not just underground pipes as constructed drainage swales are also commonly utilized in storm sewer systems. In some cases, surface waters such as creek and rivers are re-routed into storm pipes in order to accommodate development. As discussed in the Flow Path discussion above, numerous areas of the watershed have been impacted by the construction of storm sewer systems. Figure 3-24 depicts locations where Madigan Creek and its tributaries have been redirected into the storm sewer system.

The City of Rockford has conducted a survey of storm sewer outfalls within the Rockford portion of the Madigan Creek watershed. According to the survey there are 34 stormwater sewer outfalls located within the watershed. The outfalls, their approximate locations, and any description supplied by the City are included in Table 3-40. Figure 3-24 depicts the location of the storm sewer outfalls in the watershed.

Table 3-40 Storm sewer Outfalls in the Madigan Creek Watershed

Outfall ID#	Outfall Size (inch)	Material	Description of the End of Pipe
23	24	PCC	elliptical beginning of channel
24	15	PCC	flared end section from detention
25	36	PCC	flat drain from parking lot
26	18	PCC	pipe at box culvert
27	18	PCC	pipe in box culvert
28	15	PCC	flared end section
29	15	PCC	flared end section
30	30	PCC	flared end section
31		Concrete	concrete channel
32	30	PCC	flared end section
33	36	PCC	flat drain
34	12	CPP	flared end section
36	15	PCC	flared end section
35	15	PCC	flared end section
37	12	CPP	pipe
38	15	CMP	2 pipes
39	24	PCC	elliptical pipe at box culvert
40	12	PCC	pipe
41	12	CPP	pipe from UPS store
42	12	CPP	pipe from Quality Inn
43	18	PCC	flared end section
44	8	PVC	pipe from Quality Inn
45	24	PVC	flared end section from detention
46			pipe intake
47	30	CPP	2 pipes in conc. headwall
48	48	PCC	flared end section with grate
50	36	PCC	flared end section

Outfall ID#	Outfall Size (inch)	Material	Description of the End of Pipe
51	48	PCC	pipe
52	78	PCC	culvert
53	36	PCC	3 pipes
N/A	30	PVC	flared end section
N/A		PCC	buried under silt
N/A	5 foot	CMP	4 pipes from under hotel
55	18 & 54	PCC	flared end section

3.15.4 Regional Compensatory Storage Facilities

Three regional compensatory storage facilities are located within the Madigan Creek watershed: the Cherry Valley Detention Pond, the upper pond and the lower pond. All of the facilities are located in the southeast corner of the watershed in Southeast Community Park. The Cherry Valley Detention Pond was constructed in the Summer of 1991 and has a storage volume of 14 acre-feet. The Cherry Valley Detention Pond has not been dredged to date.

The upper and lower ponds were constructed in the Fall of 1992. The storage volume of the upper and lower ponds are included in Table 3-41. The upper pond was dredged in 2001 and approximately 8,200 cubic yards of sediment were dredged from the pond. The lower pond was dredged in 2006 and approximately 12,350 cubic yards of sediment were dredged from the pond. Both the upper and lower pond have a Class III dam. Class III dams are dams for which a failure has a low probability for loss of life or substantial economic loss.

Table 3-41 Storage Volumes of the Upper and Lower Ponds

Pond	Pond Volume (Acre-Feet)		
	No flow	Low Flow	100-Year
Upper	2.98	6.00	14.54
Lower	15.55	20.88	47.52

3.16 Impervious Area Analysis

An Impervious Area Analysis was used to help understand how stream quality relates to the subwatershed area that drains to a particular stream reach (table 3-42). This analysis uses the subbasins described in Section 3.14.2 and illustrated in Figure 3-25. The Impervious Area Analysis utilized based on the well-established belief that as the percentage of watershed imperviousness increases with increasing urbanization, the quality of physical, chemical, and biological conditions of streams within the watershed decreases.

Table 3-42 Impervious Area Analysis Results by Subbasin

Subbasin	Acres	Percent Impervious
1	812.20	50.52%
2	982.74	74.46%
3	854.33	56.56%
4	846.65	55.57%
5	806.56	49.96%
6	727.52	39.01%
7	721.92	38.25%

Subbasin	Acres	Percent Impervious
8	998.25	76.61%
9	766.68	44.47%
10	688.73	33.35%
11	664.35	30.16%
12	971.00	72.81%
13	681.21	32.08%
14	836.68	54.18%
15	815.43	52.02%
16	887.48	60.78%
17	592.90	18.58%
18	542.99	12.81%
19	751.01	42.40%
20	778.40	45.54%
21	622.64	22.58%
22	588.18	17.81%

Of the 22 subwatershed in Madigan Creek, 18 subwatershed have impervious areas greater than 25% (Table 3-42). According to research conducted by the Center for Watershed Protection, impervious coverage of greater than 25% is indicative of severely degraded stream channels, poor water quality, poor channel condition, & poor biological communities. The remaining four watersheds have impervious coverage ranging from 12.81 to 22.58% which is indicative of impacted water quality and habitat conditions in the subwatershed. As all of the subwatersheds appear to have a high percentage of impervious area, the use of impervious cover to determine "hot spots" or critical area may not be an appropriate tool. It may be more useful to select subwatersheds as critical areas where there are willing partners for project implementation and/or where BMP implementation is the most cost effective. These Critical Areas are discussed in the next section, and recommendations for improving conditions within these areas are detailed in Chapter 5.

As part of the watershed planning process eleven cross sections were taken at various locations within Madigan Creek (Figure 3-25). Using the locations of these cross sections, the percent of impervious for the contributing watershed was calculated (Table 3-43). In general, the percent of impervious of the tributary watershed at each cross section is greater than 25%. However, it should be noted that there is a general decrease in impervious area moving downstream in the watershed from the headwaters to the confluence at the Kishwaukee River. Using this information, implementing BMPs that reduce impervious area in the upper reaches of the watershed may be the most effective at improving water quality and habitat in the watershed. Not only would BMPs in the upper reaches reduce impervious areas in the most developed areas but water quality benefits obtained from the BMPs would have a positive impact on downstream reaches as the water flows through the watershed.

Table 3-43 Impervious Area Analysis Results by Cross Section

Cross Section	Tributary Area (acres)	% of Watershed	% Impervious
MCR XS1	364.94	9.18%	68.66%
MCR XS2	415.31	10.45%	70.98%
MCR XS3	555.54	13.98%	68.62%
MCR XS4	1071.80	26.98%	63.45%
MCR XS5	2060.80	51.87%	57.76%

Cross Section	Tributary Area (acres)	% of Watershed	% Impervious
MCR XS6	2526.96	63.60%	54.04%
MCR XS7	2631.76	66.24%	55.30%
MCR XS8	2817.60	70.91%	56.57%
MCR XS9	3433.56	86.42%	53.98%
MCR XS10	3915.71	98.58%	53.39%
MCR XS11	3973.23	100.00%	53.06%

3.17 Critical Areas

The intent of identifying Critical Areas is to focus watershed improvement efforts on areas where impairments are concentrated or relatively worse than in other areas of the watershed. Restoration, prevention, and remediation efforts in these Critical Areas are expected to achieve a greater impact than in less critical parts of the watersheds. The Critical Area analysis identified two different types of Critical Areas: Critical Subbasins and Critical Reaches, as described below. These results, and recommendations for watershed improvement, have been incorporated into the watershed Action Plan.

3.17.1 Critical Subbasins

Critical Subbasins are those that have particularly strong impact on watershed resources and water quality due to the type and extent of current and planned development. These subbasins will require action to reduce the impact of existing impervious surfaces. Critical Subbasins are listed in Table 3-44 and shown on Figure 3-26 and include the following:

- Subbasins 17, 18, 21, and 22 are considered critical as there is potential conversion of undeveloped and agricultural land to higher impervious land uses that would lead to the future degradation of water quality and natural resources.
- Subbasins 1, 3, 6, 10, and 15 are considered critical due to the negative impacts being observed in the watershed including hydromodification, flooding, and streambank erosion. These subwatershed also have willing partners that would be assets during BMP implementation.

Table 3-44 Critical Subbasins

Subbasin	Acres
1	176.17
3	463.82
6	727.52
10	688.73
15	815.43
17	229.18
18	16.13
21	56.52
22	122.47

3.17.2 Critical Reaches

Critical Reaches are those that have been impacted due to significant streambank erosion problems and to low habitat quality. These reaches will require restoration of the channel and riparian areas, which will help improve water quality. Critical Reaches are shown on Figure 3-27 include the following:

- Madigan Creek from Waterford Drive to Newberg Road (streambank erosion)
- Madigan Creek from Camilar Road to Hedgewood Road (streambank erosion and hydromodification)
- Madigan Creek Tributary #1 from Mulford Road to Trainer Road (hydromodification)
- Madigan Creek Tributary #2 from Grassridge Drive to the confluence with Madigan Creek (hydromodification)
- Madigan Creek Tributary #3 from Perryville Road to the confluence with Madigan Creek (undeveloped floodplain)

3.18 Summary and Conclusions

The Madigan Creek watershed resource inventory and assessment provides important insight into the issues and problems in the watershed and the opportunities available for preserving and improving watershed resources. The vast majority of the impacts and impairments to watershed resources identified are the direct result of years of modification of the stream and surrounding lands as land use in the watershed changed from undeveloped to agriculture to urban. The impacts of this changing landscape on watershed resources are summarized here and actions for addressing these impacts are included in the Action Plan in Chapter 5.

It is important to identify potential causes and sources of impairment in the watershed so that preventive and restorative measures can be planned and implemented. The issues, causes and sources identified below and in Table 3-45 are based on the best professional judgment based on the watershed inventory assessment and input from the watershed stakeholders. Thus, they should be considered as potential rather than confirmed until additional sampling and surveying can be done. Table 3-45 includes those impairments, causes, and sources that are most relevant to the Watershed-Based Plan nine element requirements of the US EPA. Nonetheless, although the table does not include all of the issues and problems identified below, they all have been addressed within the Action Plan included in Chapter 5.

Water Quality

The most important water quality issues that need to be addressed include the following:

- low dissolved oxygen concentrations due to low flow and the lack of adequate stream habitat features to help oxygenate the water;
- elevated levels of phosphorus likely resulting from urban runoff;
- sedimentation of stream channels within low gradient reaches, that is the result of streambank erosion and runoff from the urban landscape; and
- elevated chloride levels resulting from application of salt for snow and ice control on roads, as well as other toxic substances in the water column from urban runoff form impervious surfaces including roads and highway

Watershed Hydrology

The most important issues related to watershed hydrology that need to be addressed include the following.

- flashy hydrology (higher high flows and lower low flows), which impact a number of other watershed resources;
- poor performing detention basins;
- unmaintained, undersize and/or damaged culverts and roadside conveyance systems restricting flow in the stream channels; and
- unmaintained, undersize and/or damaged storm sewers restricting flow and causing localized flooding.

Stream Channels

The most important issues related to stream channels that need to be addressed include the following:

- streambank erosion resulting from flashy hydrology, unstable streambanks, and stormwater discharges;
- stormwater discharges from residential and municipal stormwater management systems that cause erosion of the streambanks and stream channel;
- debris buildup and obstruction within the stream channel that is the result of streambank erosion and dislodged trees and vegetation;
- improperly designed, installed or maintained streambank and stream channel armoring (gabions, riprap, etc.) that is intended to control erosion but is contributing to erosion problems; and
- channelized and incised stream channels.

Riparian Corridors

The most important riparian corridor issues that need to be addressed include the following:

- lack of riparian vegetation as the existing turf grass that is present to the water or stream bank edge destabilizes streambanks and provides no water quality or riparian habitat benefits; and
- dumping of yard waste along the stream banks and in stream channels, which smothers ground level vegetation and adds organic matter and nutrients to the water.

Natural Areas and Wetlands

The most important issues related to watershed wetlands include the following:

- lack of management and restoration plans and action to preserve and restore native habitat;
- invasive species infestations that degrade natural habitat;
- lost wetland acreage; and
- impairment of natural hydrologic patterns that support healthy wetlands resulting from stormwater discharge.

Flooding

The most important flooding issues that need to be addressed include the following:

- risk of flood damage to structures located along the waterways;
- hydrologic modification causing high flows; and
- creation of detention and retention areas including wetlands and depressional storage.

Land Use

The most important land use issues that need to be addressed include the following:

- conversion of vacant, agricultural, or open land to urban uses, which increases impervious surface area and impacts water quality and runoff volume; and
- redevelopment of existing developed land to other land uses with greater impervious surface area and/or higher pollutant loading rates;

Table 3-45 Watershed Impairments, Causes and Sources

Impairment	Causes	Sources
Water Quality	Total suspended solids/sedimentation and siltation	In channel erosion caused by streambank modification and destabilization
		Urban runoff/storm sewers
		Construction sites
		Streets, highway and bridge runoff
Water Quality	Nutrients – phosphorus	Urban runoff/storm sewers
		Soil erosion
		Agricultural activities/golf courses
		Improper disposal of wastes (yard waste, pet waste, etc)
		Leaking septic systems
Water Quality	Low dissolved oxygen (elevated biological oxygen demand & chemical oxygen demand)	Flow alteration (low flow)
		Habitat modifications
		Urban runoff/storm sewers
		Improper disposal of wastes (yard waste, pet waste, etc)
Water Quality	Salinity/chlorides/total dissolved solids	Urban runoff/storm sewers
		Road salt storage and use
Habitat degradation	Hydromodification and flow alterations	Urban runoff/storm sewers
		Loss of riparian buffer
		Loss of floodplain, wetlands, and depressional storage
		Modification to stream flow regime
		Development
		Habitat modifications
Habitat degradation	Lack of instream habitat	Unstable streambanks
		Channelization
		Habitat modifications
Habitat degradation	Loss of riparian buffer	Development
		Inappropriate land management
		Unstable streambanks
		Habitat modifications
Increased stream flows	Increased rate and volume or runoff	Development
		Loss of floodplain, wetlands, and depressional storage
		Poorly functioning/undersized detention
Increased stream flows	Loss of floodplain, wetlands, and depressional storage	Draining/filing of floodplain, wetlands, and depressional storage
		Development
Flood damage	Past encroachment on floodplain	Past floodplain development
Flood damage	Undersize/improperly maintained infrastructure (storm sewers, culverts, detention, etc)	Development
		Lack of infrastructure maintenance

0 8,500 17,000
Feet

N W E S

Legend

▭	Madigan Creek Watershed
—	Streams & Flowlines
▭	Winnebago County

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Winnebago County Watershed Planning

Madigan Creek - General Location of Watershed

PROJECT NO: 11-0174		SHEET NO:
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DRAWN BY	BRO	
CHECKED BY	DAD	
APPROVED BY	JAW	
ISSUE DATE	06/30/2013	

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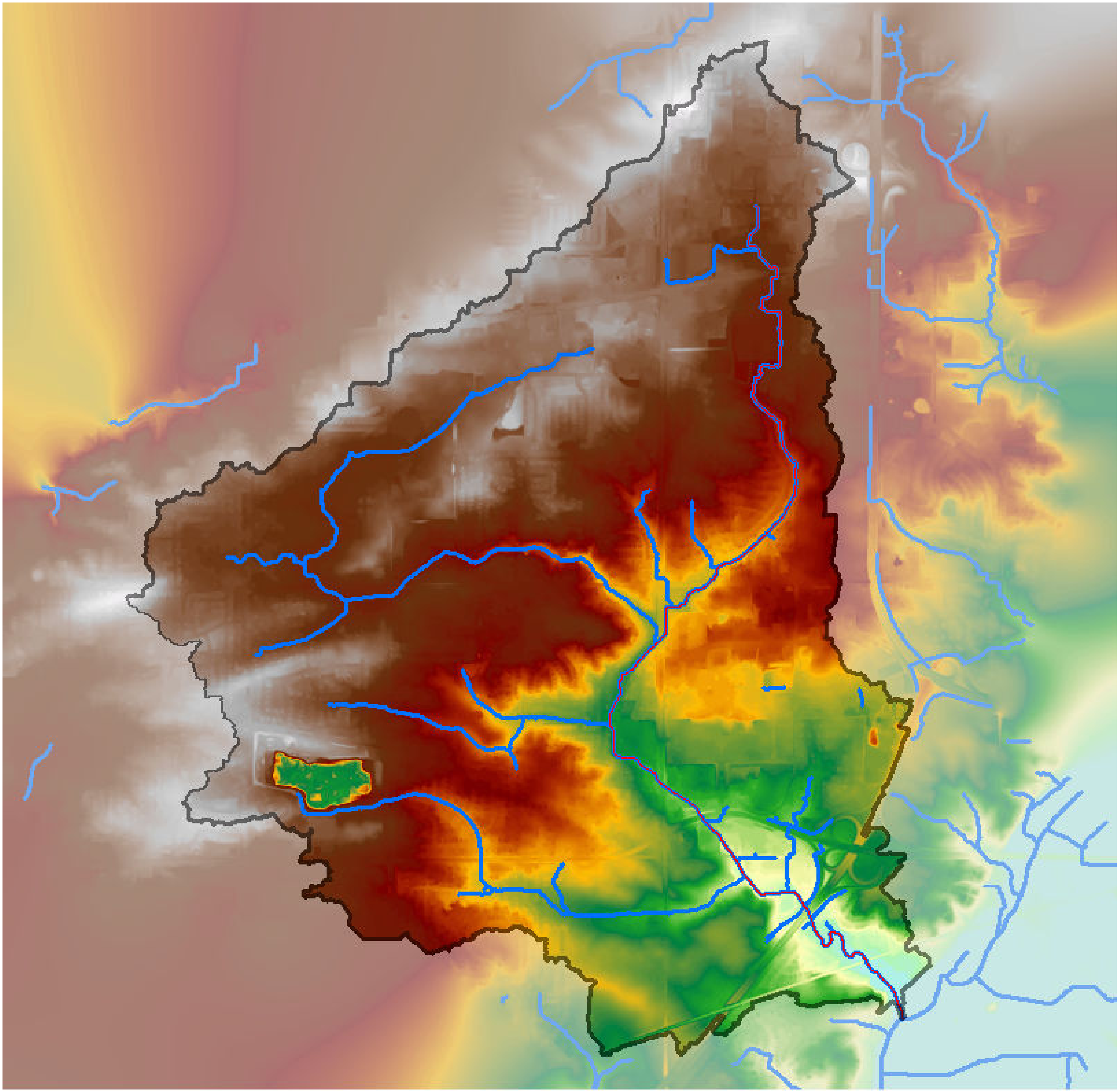

0 1,350 2,700

Feet

Legend

🟥 Madigan Creek Mainstem

🟦 Streams & Flowlines

DEM

High : 917.174

Low : 710.165

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Winnebago County Watershed Planning

Madigan Creek - Digital Elevation Model (DEM)

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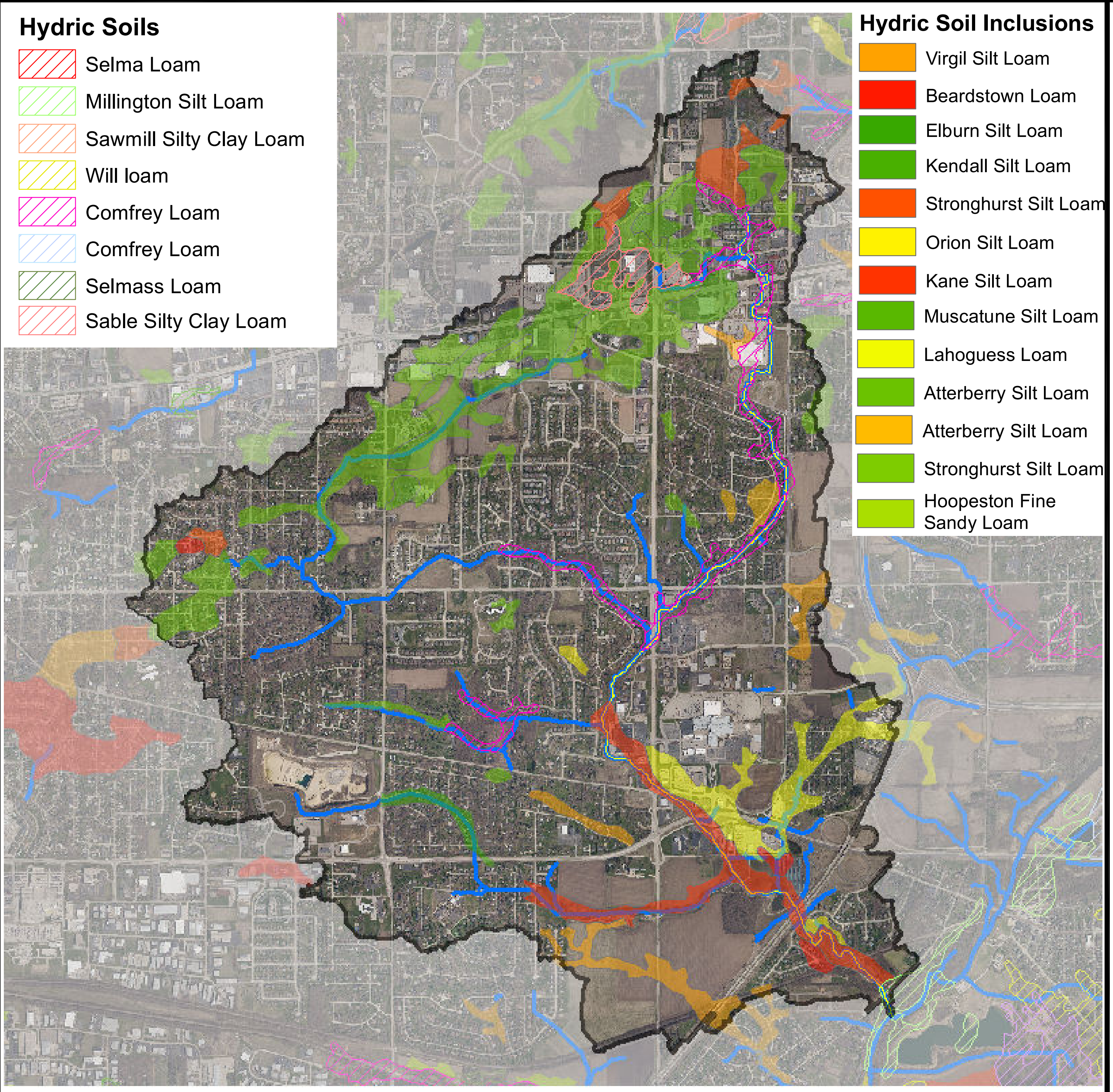

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Legend

Madigan Creek Mainstem

Streams & Flowlines

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Winnebago County Watershed Planning

Madigan Creek - Hydric Soils

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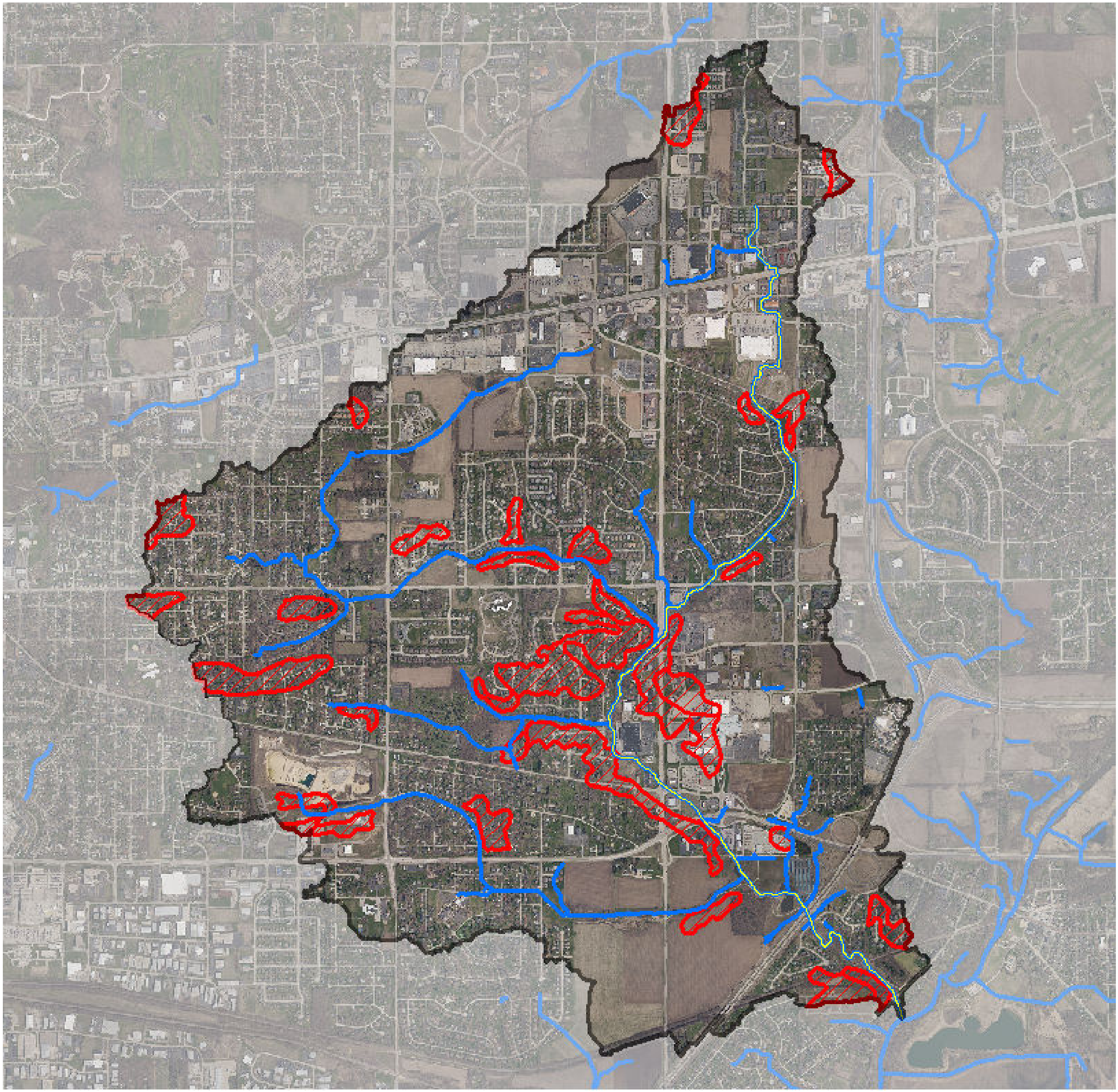

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Legend

— Madigan Creek Mainstem

— Streams & Flowlines

▨ Highly Erodible Soils

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Winnebago County Watershed Planning

Madigan Creek - Highly Erodible Soils

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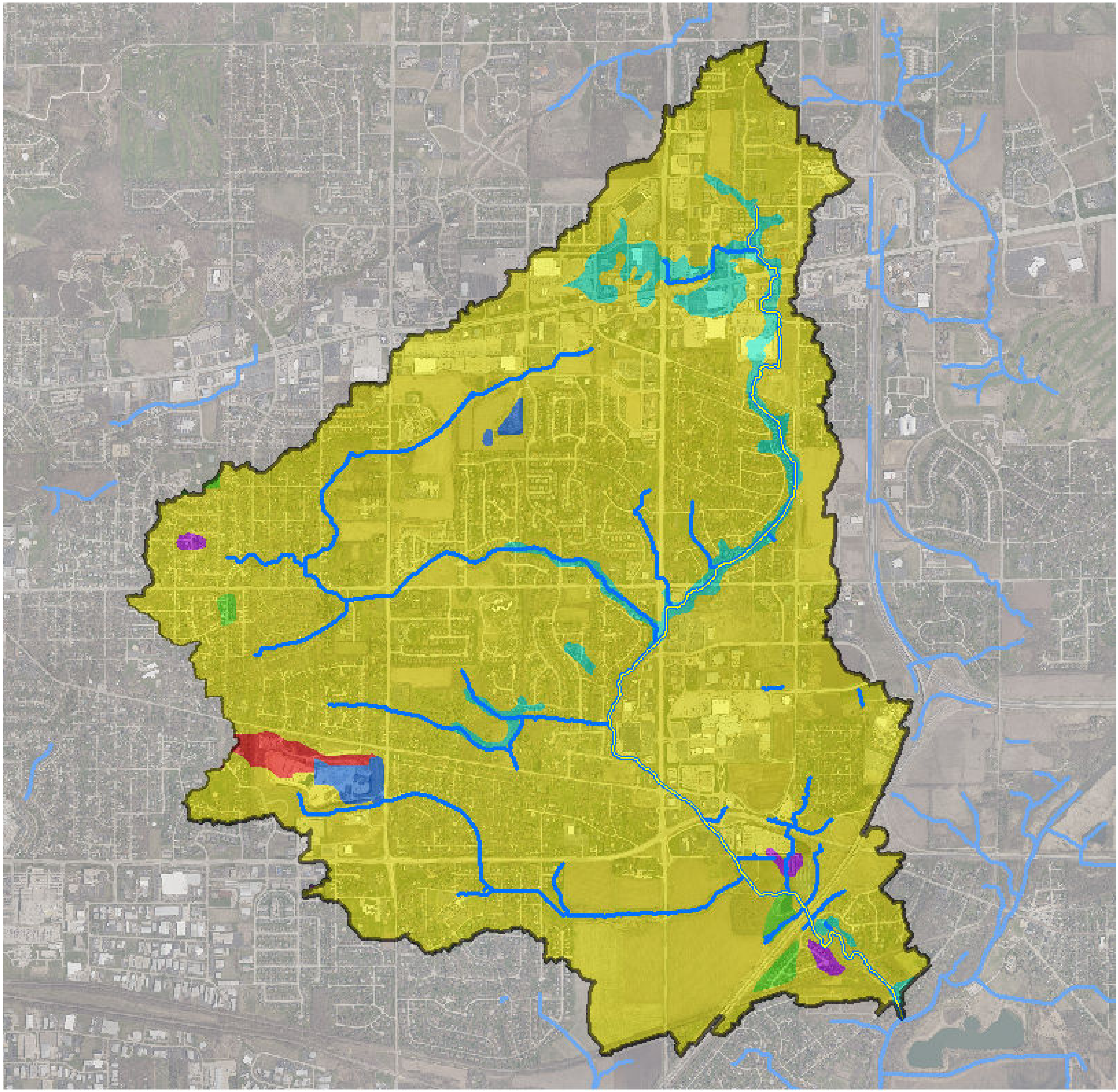

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Legend

―	Madigan Creek Mainstem
―	Streams & Flowlines

Hydrologic Soil Groups

🟥	A	🟪	C/D
🟨	B	🟦	Water/ Gravel/ Quarry/ Urban Land
🟦	B/D		
🟩	C		

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Winnebago County Watershed Planning

Madigan Creek - Hydrologic Soil Groups

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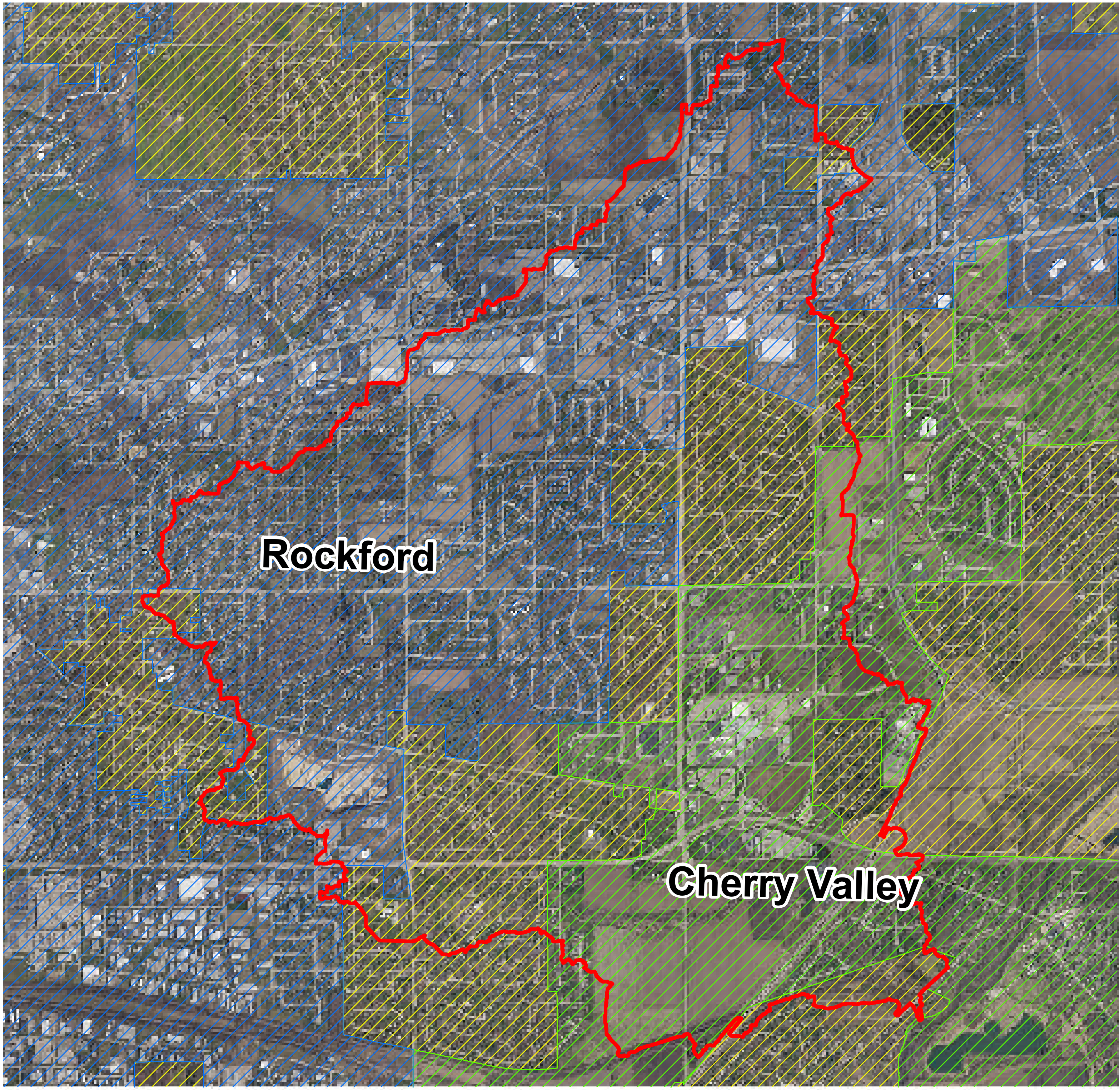

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Feet

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Legend

- ▨ Cherry Valley
- ▨ Rockford
- ▨ Unincorporated Winnebago County
- ☐ Madigan Creek

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Winnebago County Watershed Planning

Madigan Creek - Jurisdictions

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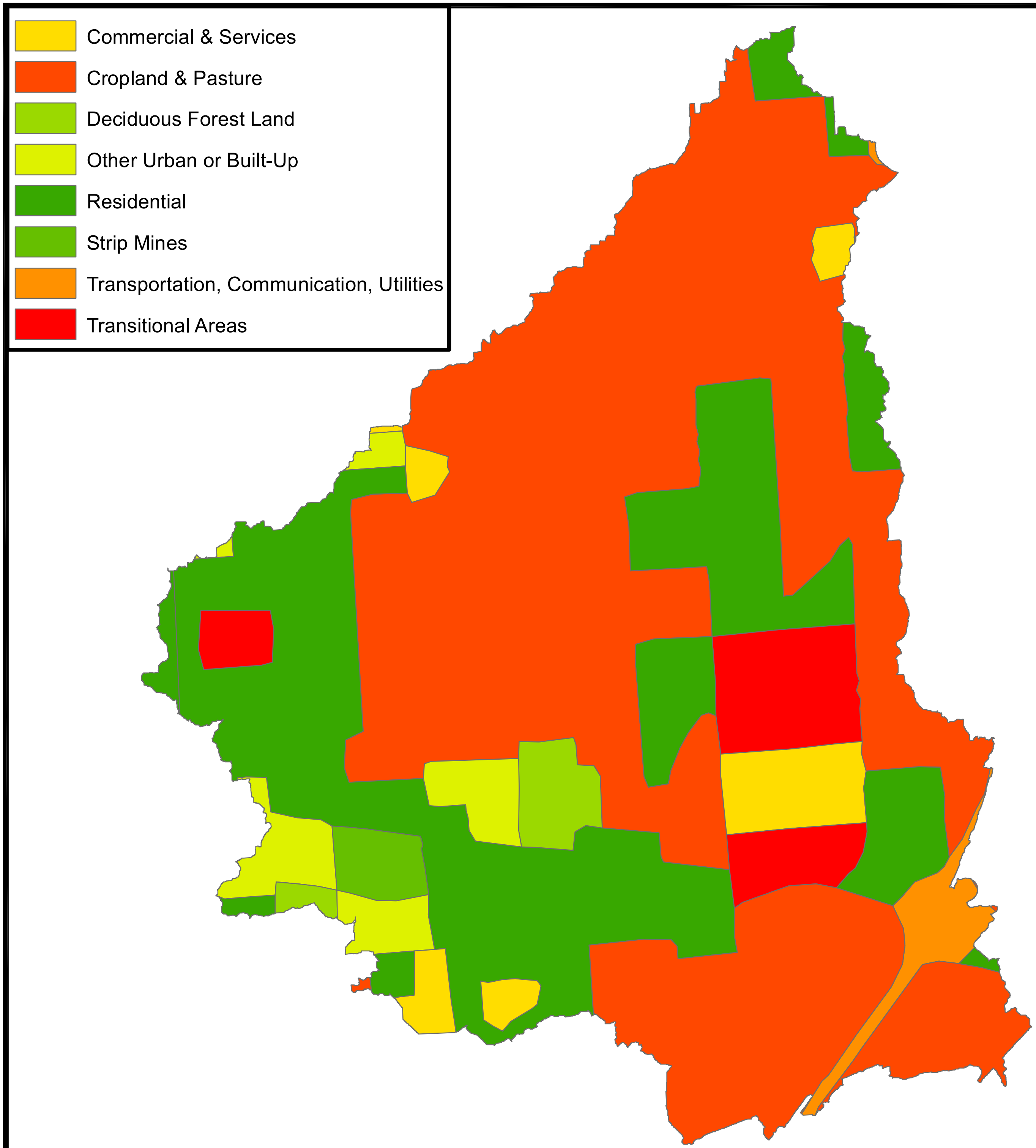

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Winnebago County
Watershed Planning

Madigan Creek -
GIRAS Land Use

PROJECT NO: 11-0174		SHEET NO:
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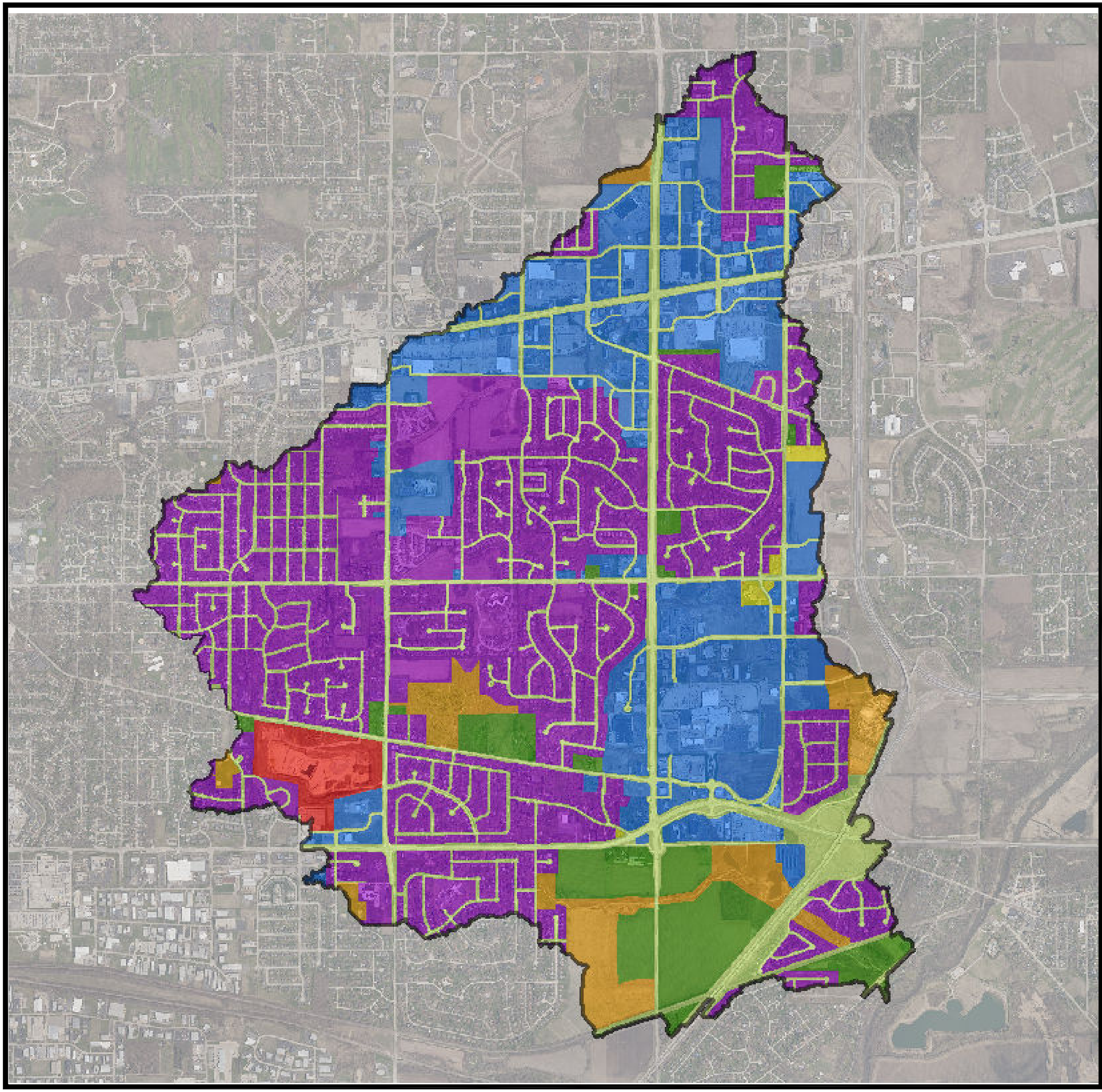

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Feet

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Legend

- 🟩 Agriculture
- 🟦 Commercial
- 🟥 Industrial
- 🟨 Other
- 🟧 Publicy Owned Land/ Parks/Rec. Areas
- 🟩 ROW
- 🟪 Residential

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Madigan Creek - Existing Land Use

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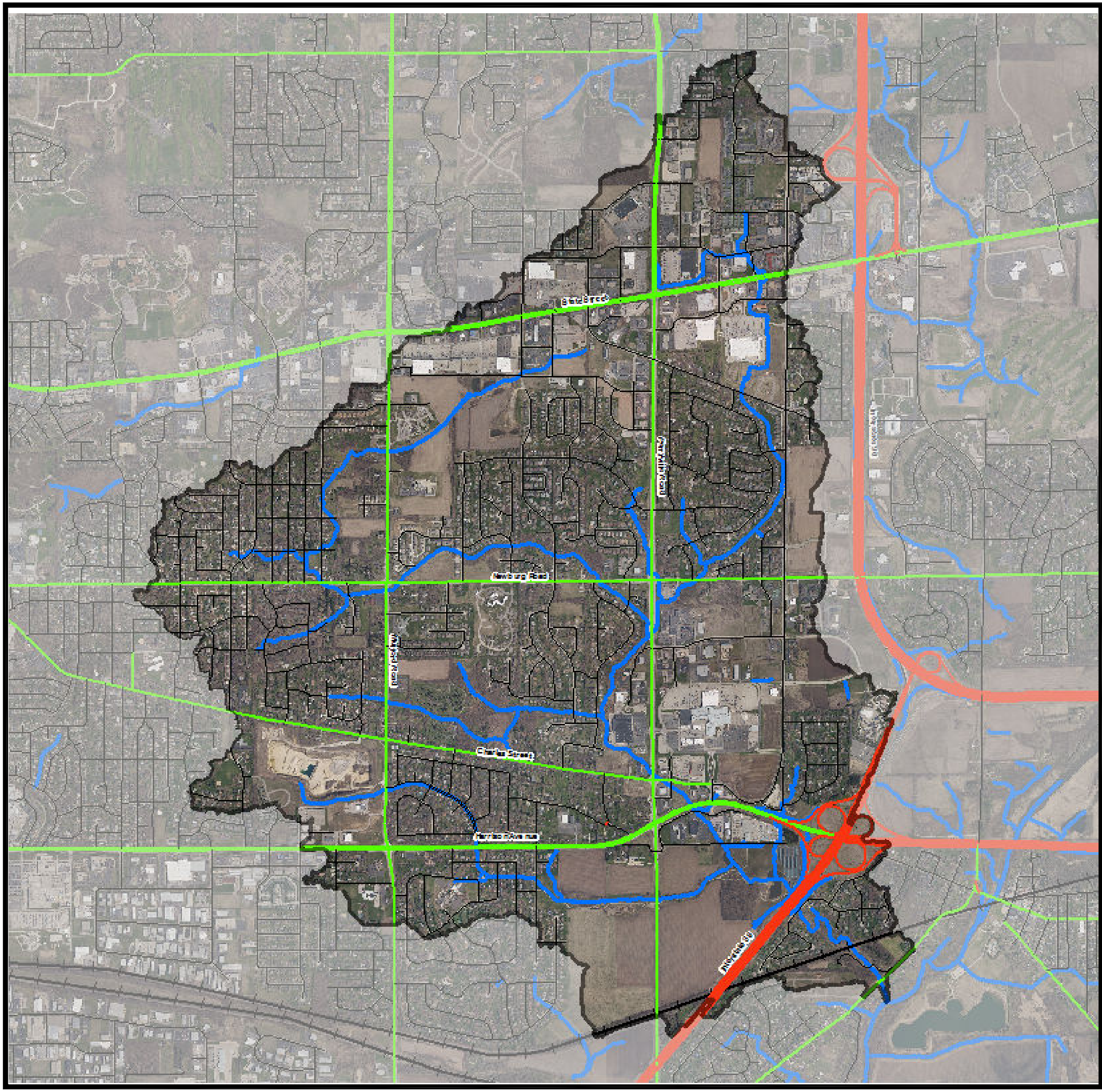

0 1,350 2,700
Feet

Legend

🟦	Streams & Flowlines
—	Local Road
🟩	Secondary or Minor Highway
🟥	Primary or Major Highway
┼─┼	Railroad

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Madigan Creek - Transportation Network

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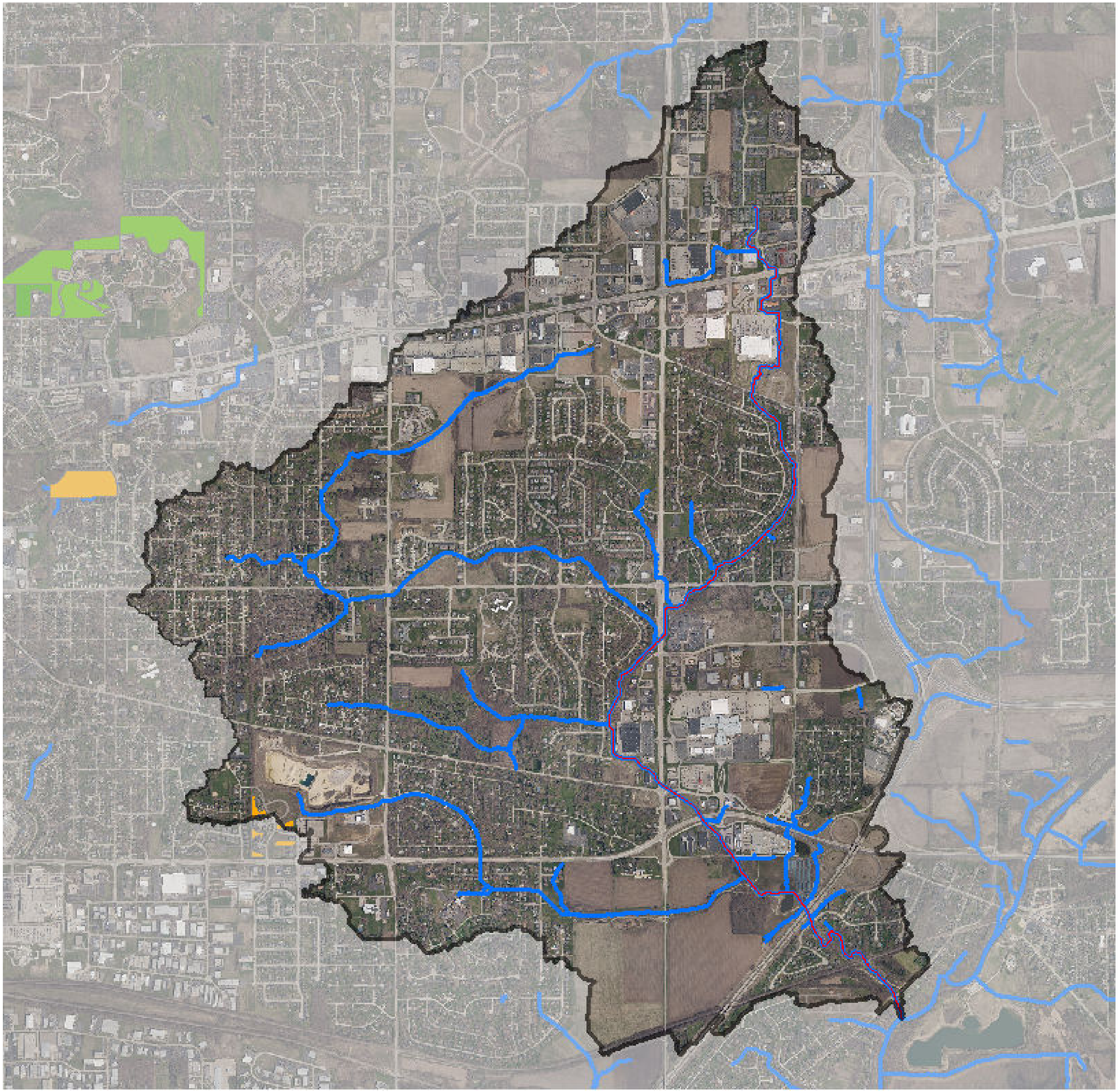

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Feet

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Legend

Natural Areas

🟧 Upland Forest

🟩 Woods & Prairie

Madigan Creek Mainstem

Streams & Flowlines

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Winnebago County Watershed Planning

Madigan Creek - Winnebago County Natural Areas Inventory Sites

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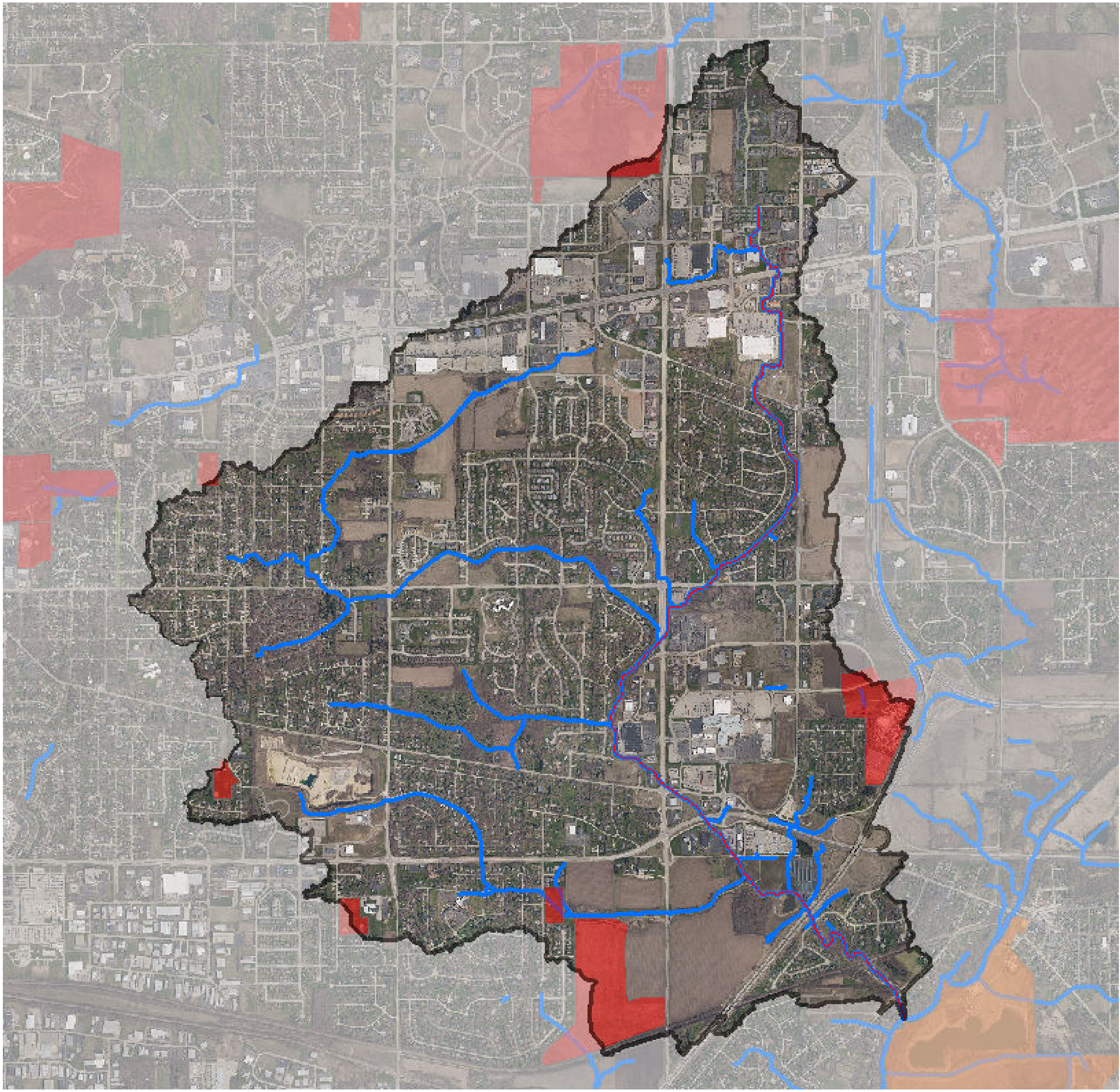

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Legend

Park Areas

🟩 City of Rockford

🟥 Rockford Park District

🟧 Village of Cherry Valley

Madigan Creek Mainstem

Streams & Flowlines

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Winnebago County Watershed Planning

Madigan Creek - Rockford Park District Lands

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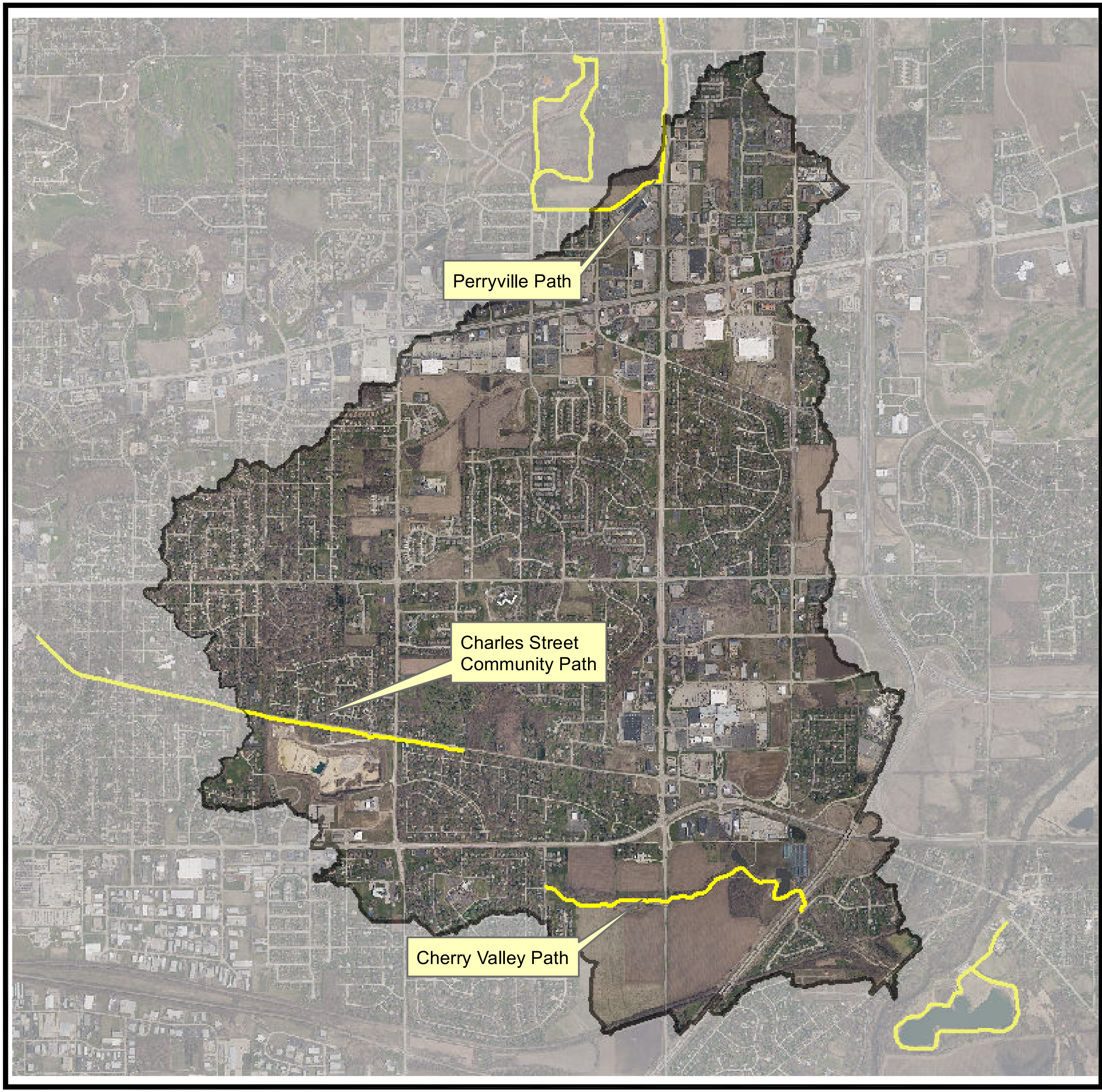

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Winnebago County Watershed Planning

Madigan Creek - Trails

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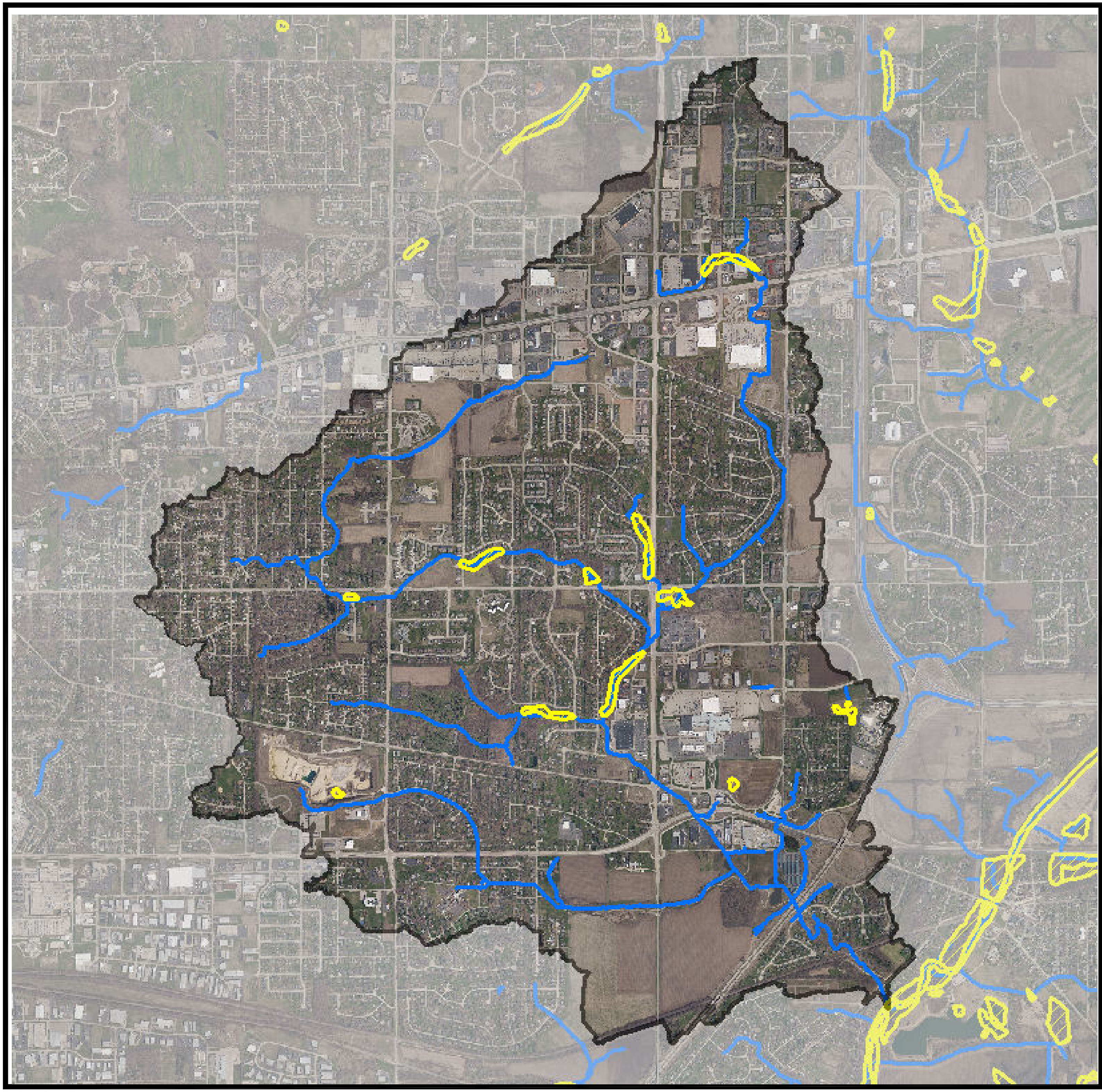

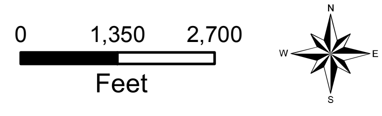

Legend

— Streams & Flowlines

▨ NWI Wetlands

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Winnebago County Watershed Planning

Madigan Creek - NWI Wetlands

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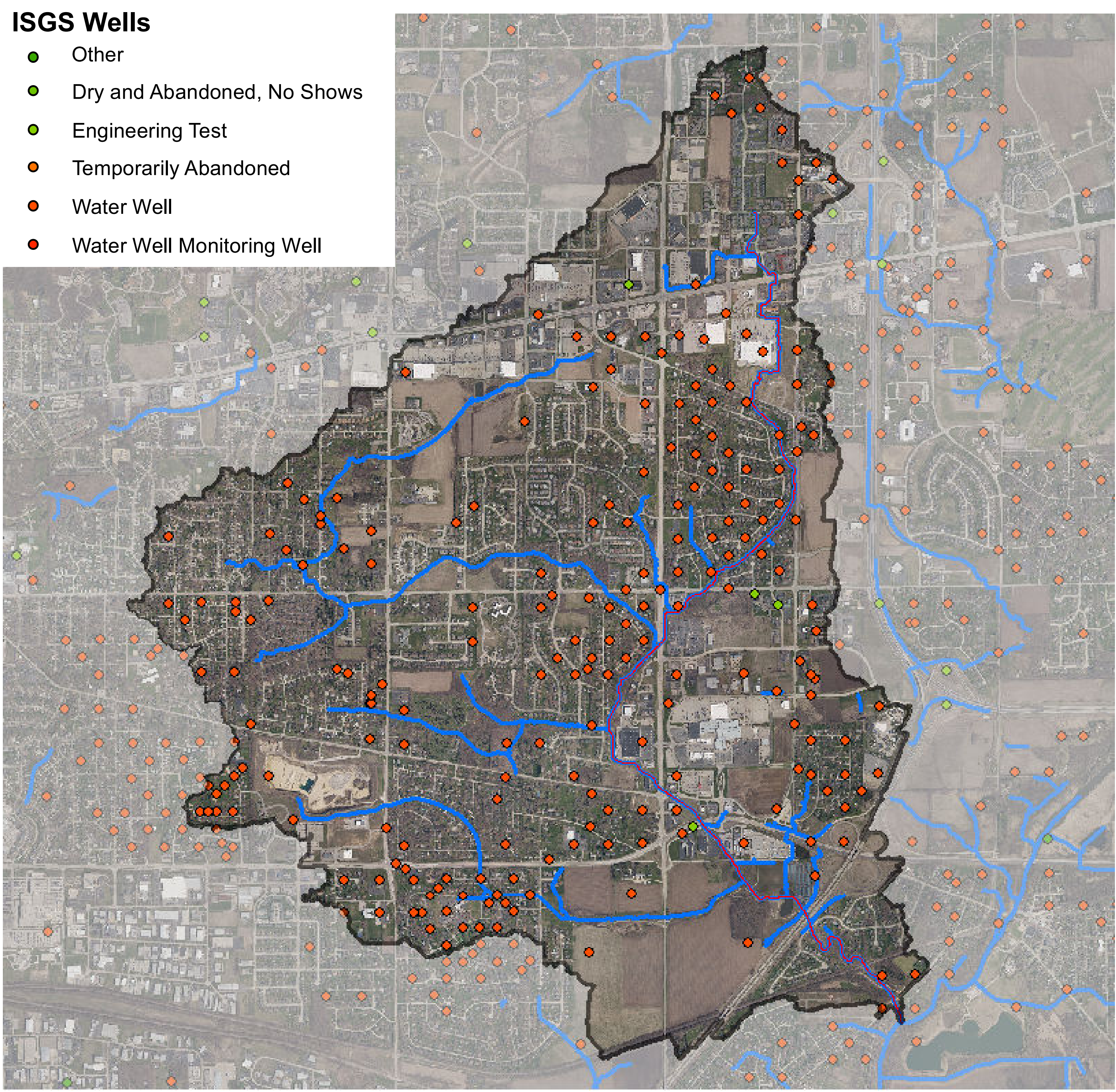

Legend

Madigan Creek Mainstem

Streams & Flowlines

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Winnebago County Watershed Planning

Madigan Creek - Illinois State Geological Survey Wells

PROJECT NO: 11-0174		SHEET NO:
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CHECKED BY	DAD	
APPROVED BY	JAW	
ISSUE DATE	06/30/2013	

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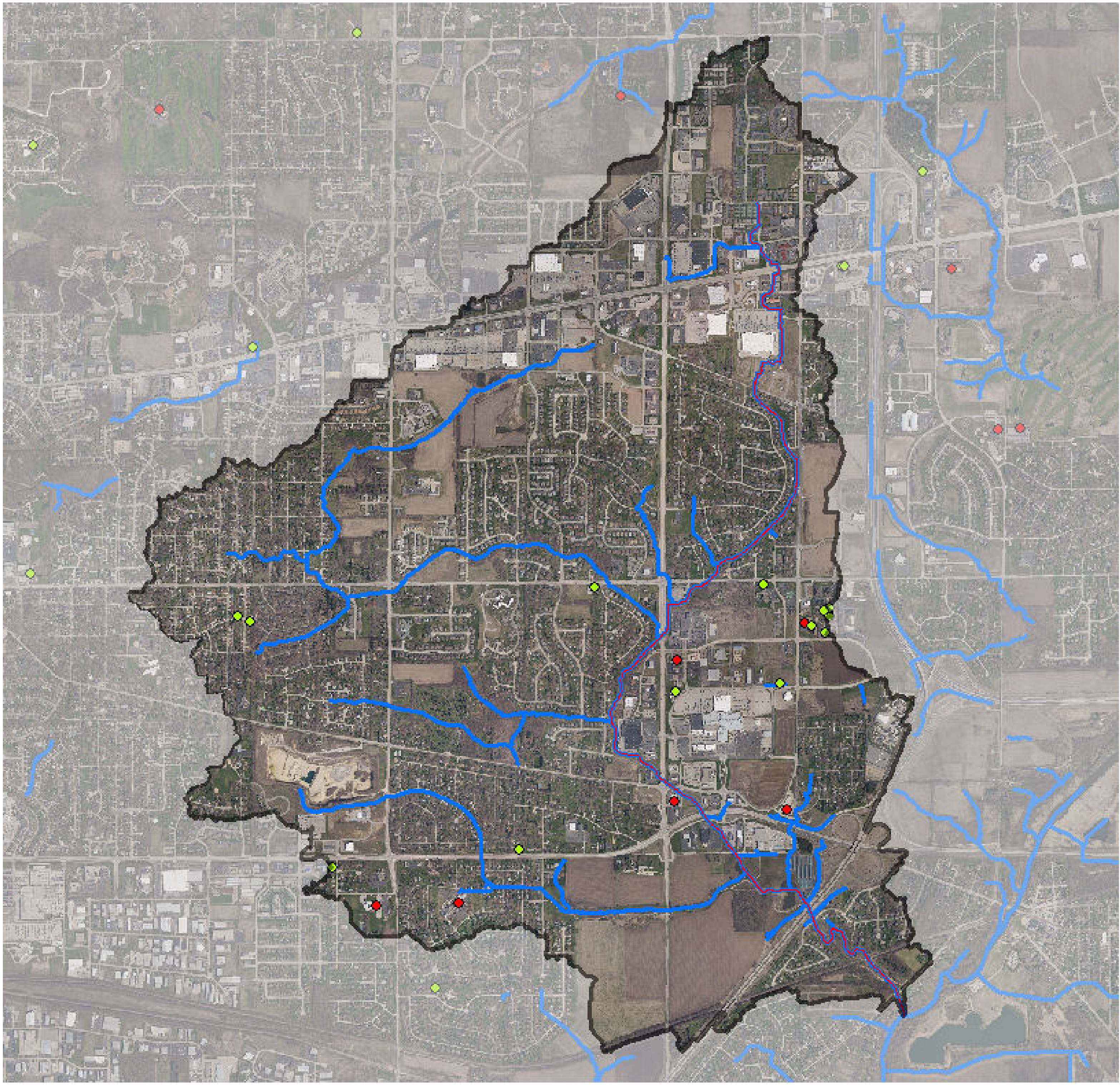

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Legend

- ● Community Water Wells
- ● Non-Community Water Wells
- — Madigan Creek Mainstem
- — Streams & Flowlines

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Winnebago County Watershed Planning

Madigan Creek - IDH Community Wells

PROJECT NO: 11-0174		SHEET NO:
DESIGNED BY	BRO	3-15
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APPROVED BY	JAW	
ISSUE DATE	06/30/2013	

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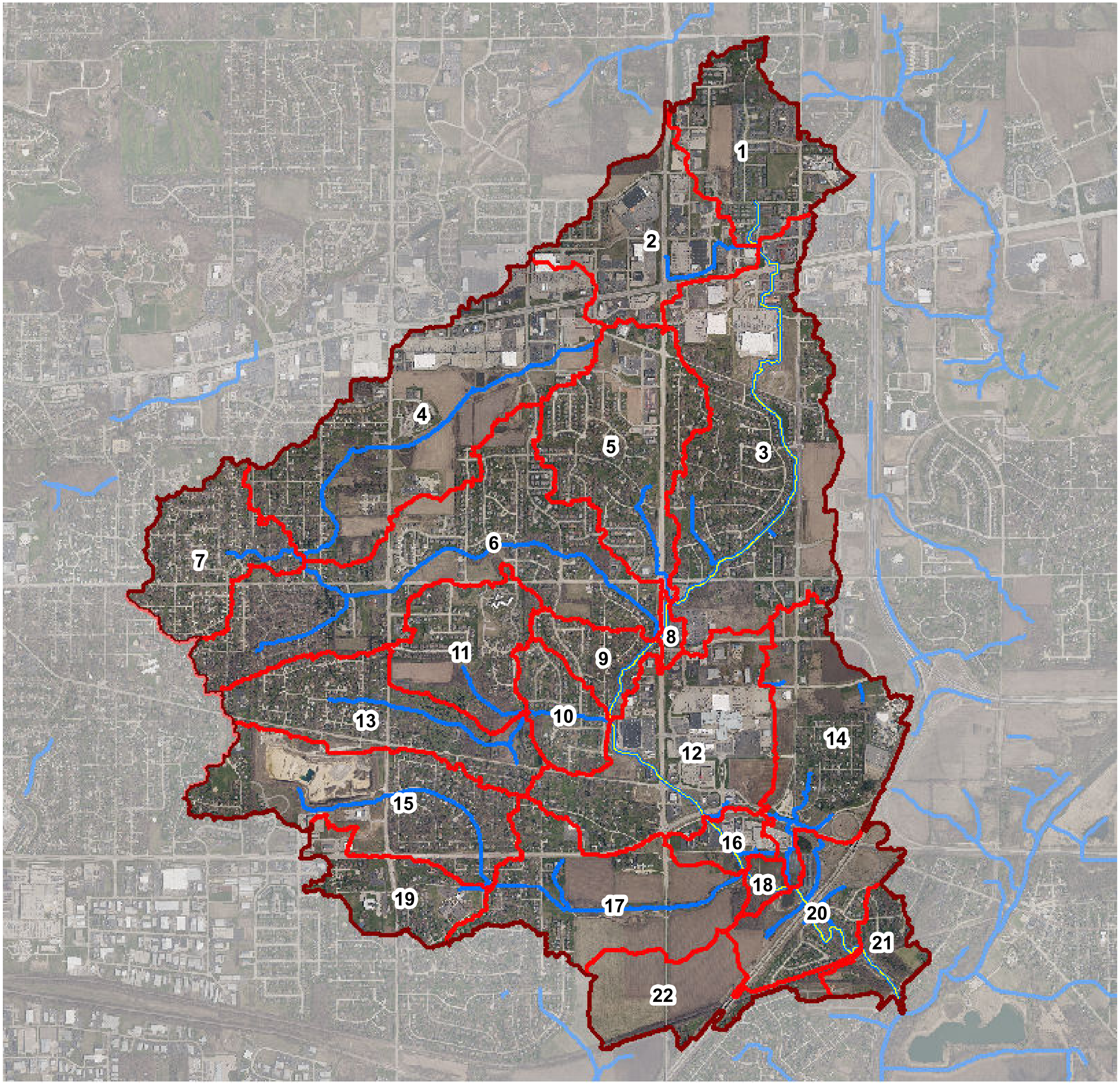

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🟥 Subbasins

— Madigan Creek Mainstem

— Streams & Flowlines

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Winnebago County Watershed Planning

Madigan Creek - Subbasins

PROJECT NO: 11-0174		SHEET NO:
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APPROVED BY	JAW	
ISSUE DATE	06/30/2013	

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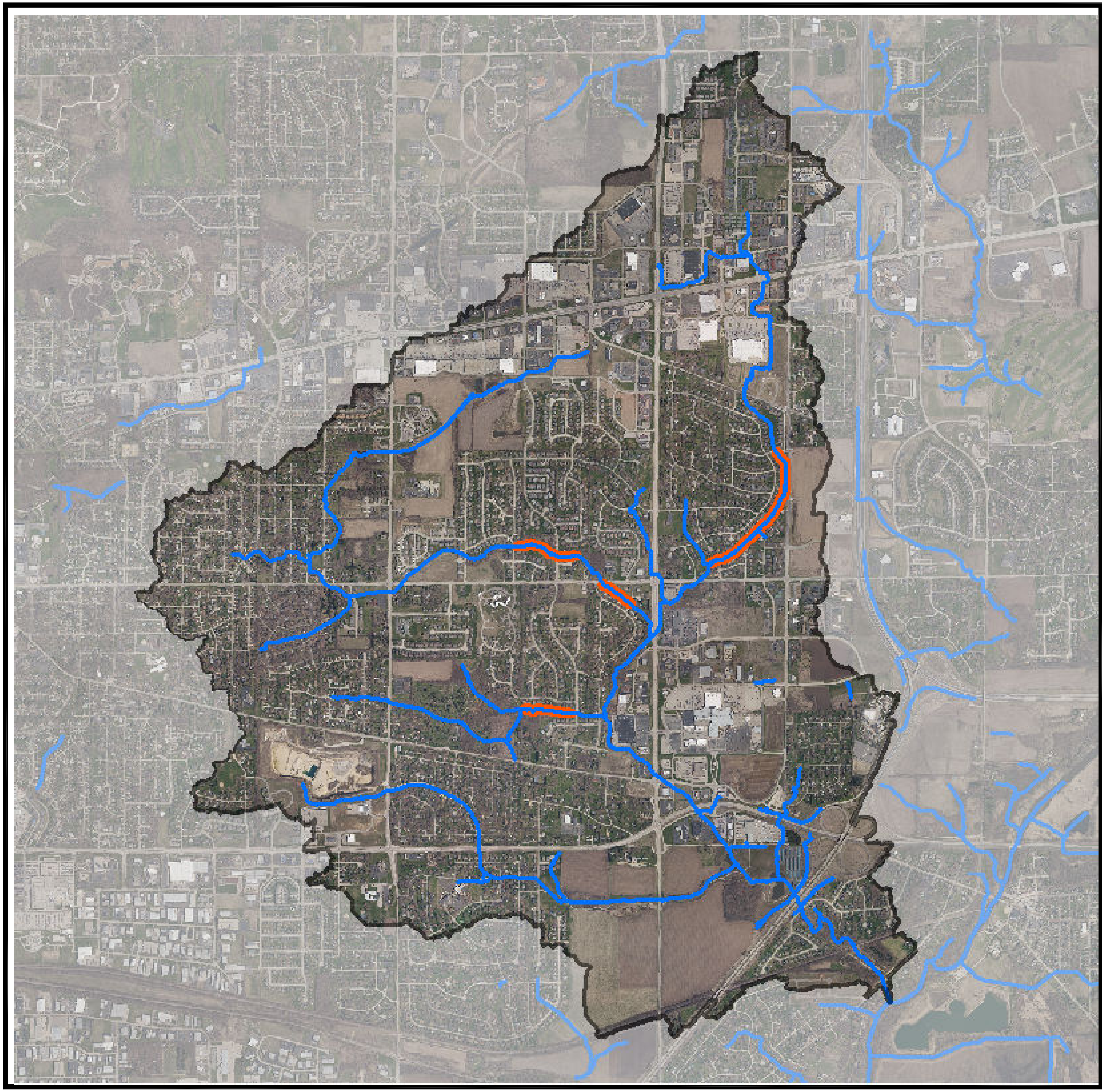

Legend

━	Streams & Flowlines
━	Significant Hydromodification

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Winnebago County Watershed Planning

Madigan Creek - Areas with Significant Hydromodification

PROJECT NO: 11-0174		SHEET NO:
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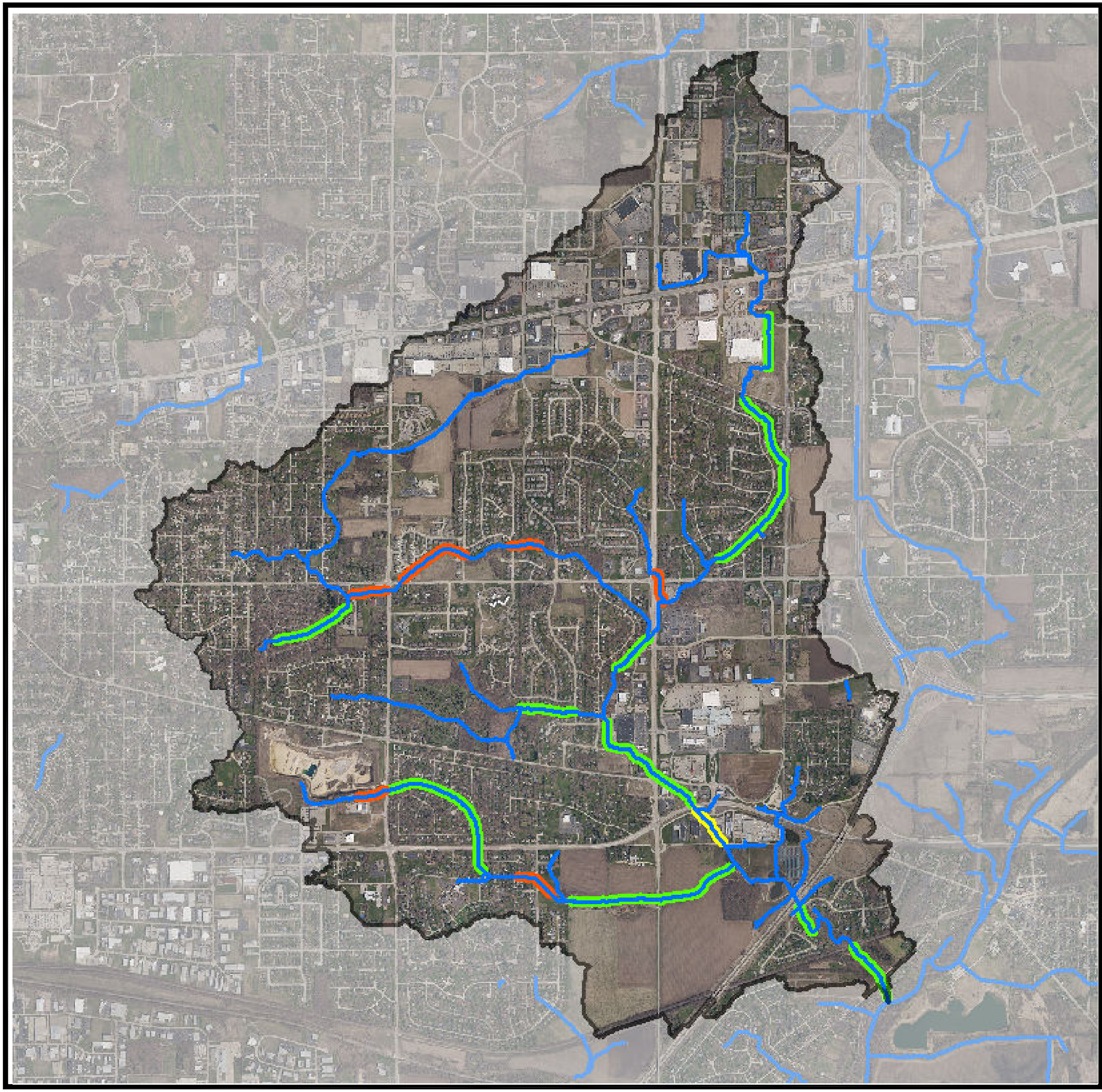

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- 🟦 Streams & Flowlines
- 🟩 Channelization
- 🟧 Channelization with Concrete Lined Channel
- 🟨 Channelization with Concrete Revetment Mat Channel

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Winnebago County Watershed Planning

Madigan Creek - Areas with Significant Channelization

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ISSUE DATE	06/30/2013	

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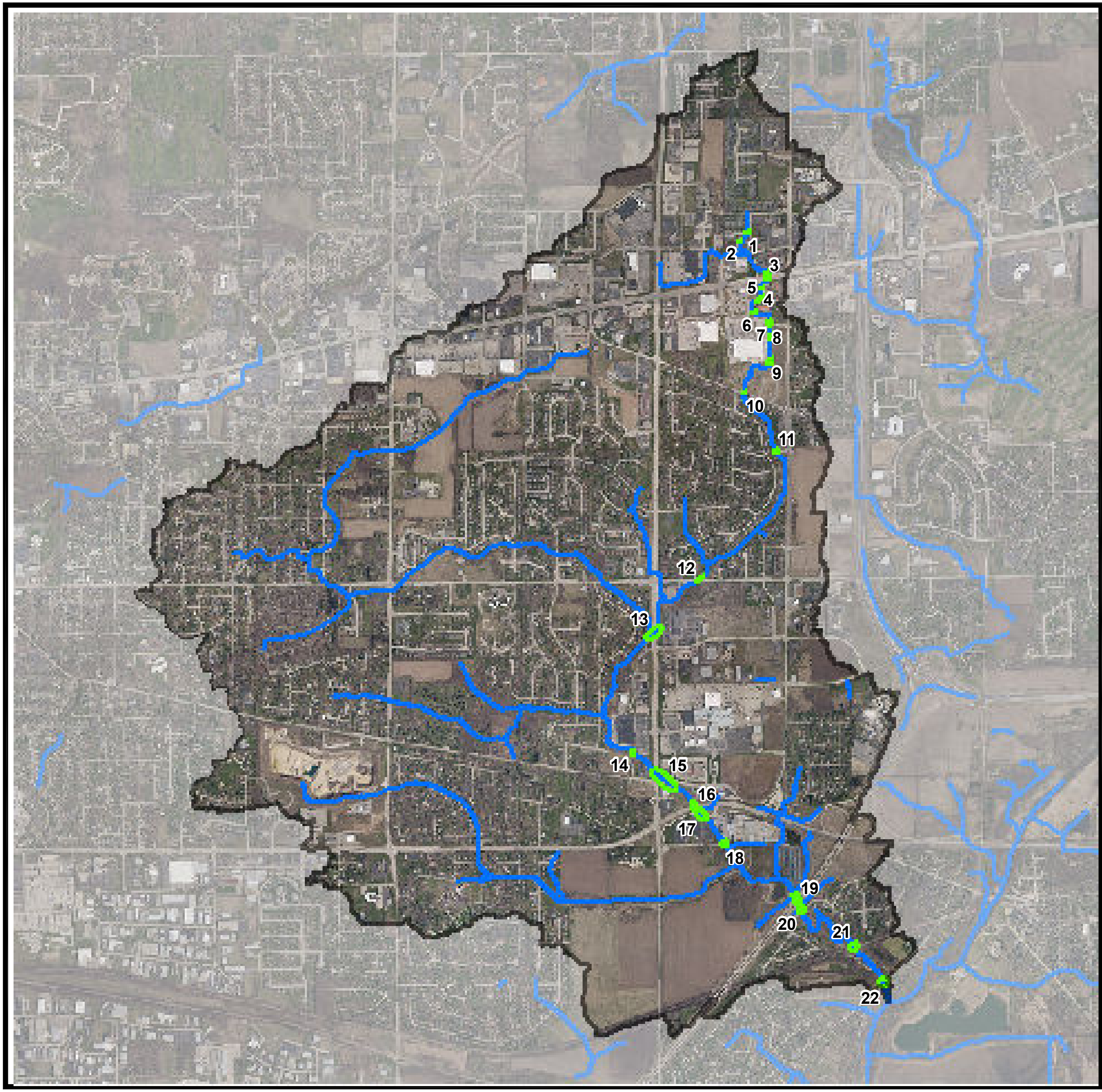

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Legend

Streams & Flowlines

🟩 Surveyed Structures

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Winnebago County Watershed Planning

Madigan Creek - Surveyed Hydraulic Structures

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ISSUE DATE	06/30/2013	

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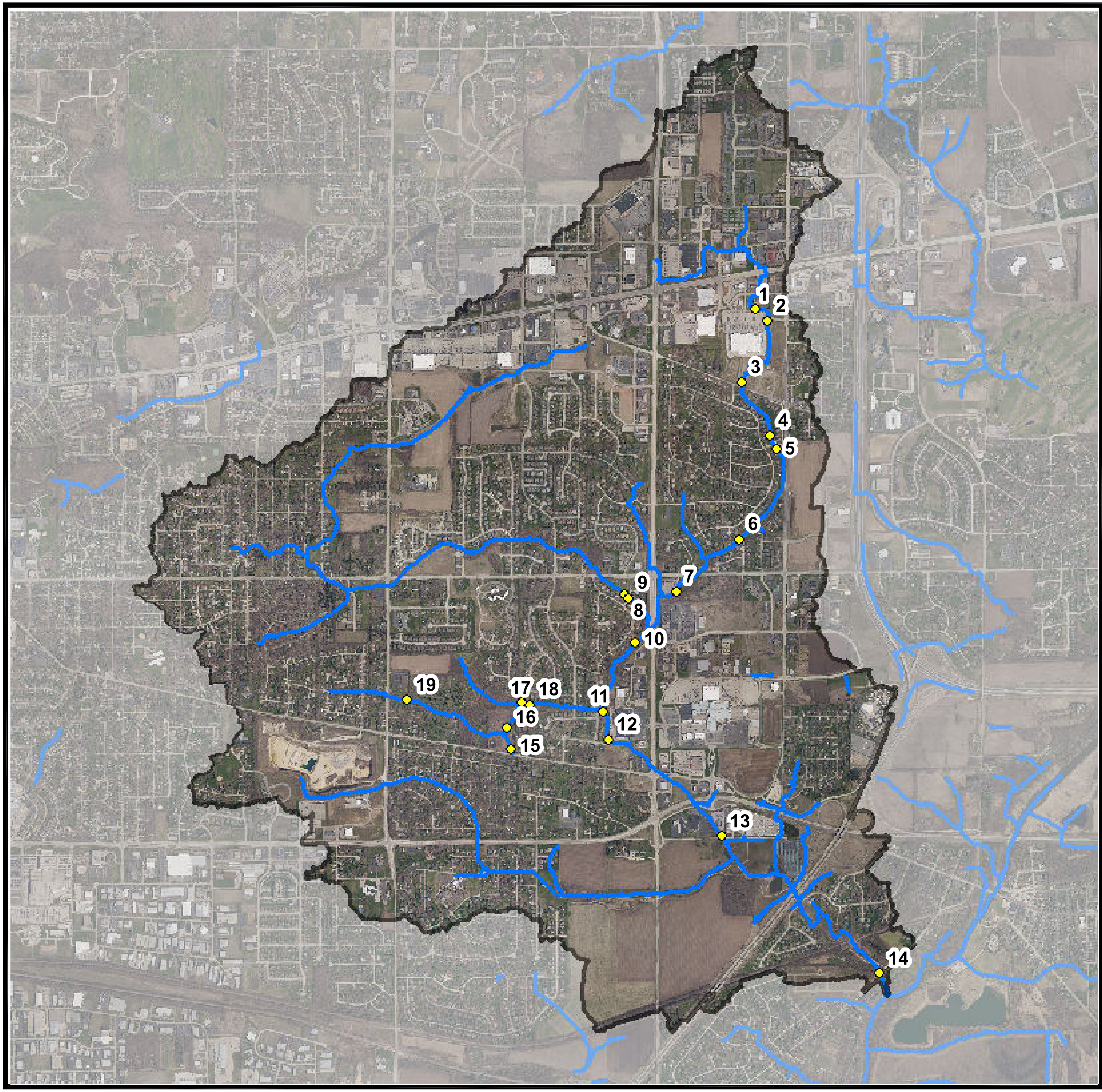

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Streams & Flowlines

● RBP Sites w/
Station Number

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Winnebago County Watershed Planning

Madigan Creek - Instream and Riparian Habitat Assessment Sites

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ISSUE DATE	06/30/2013	

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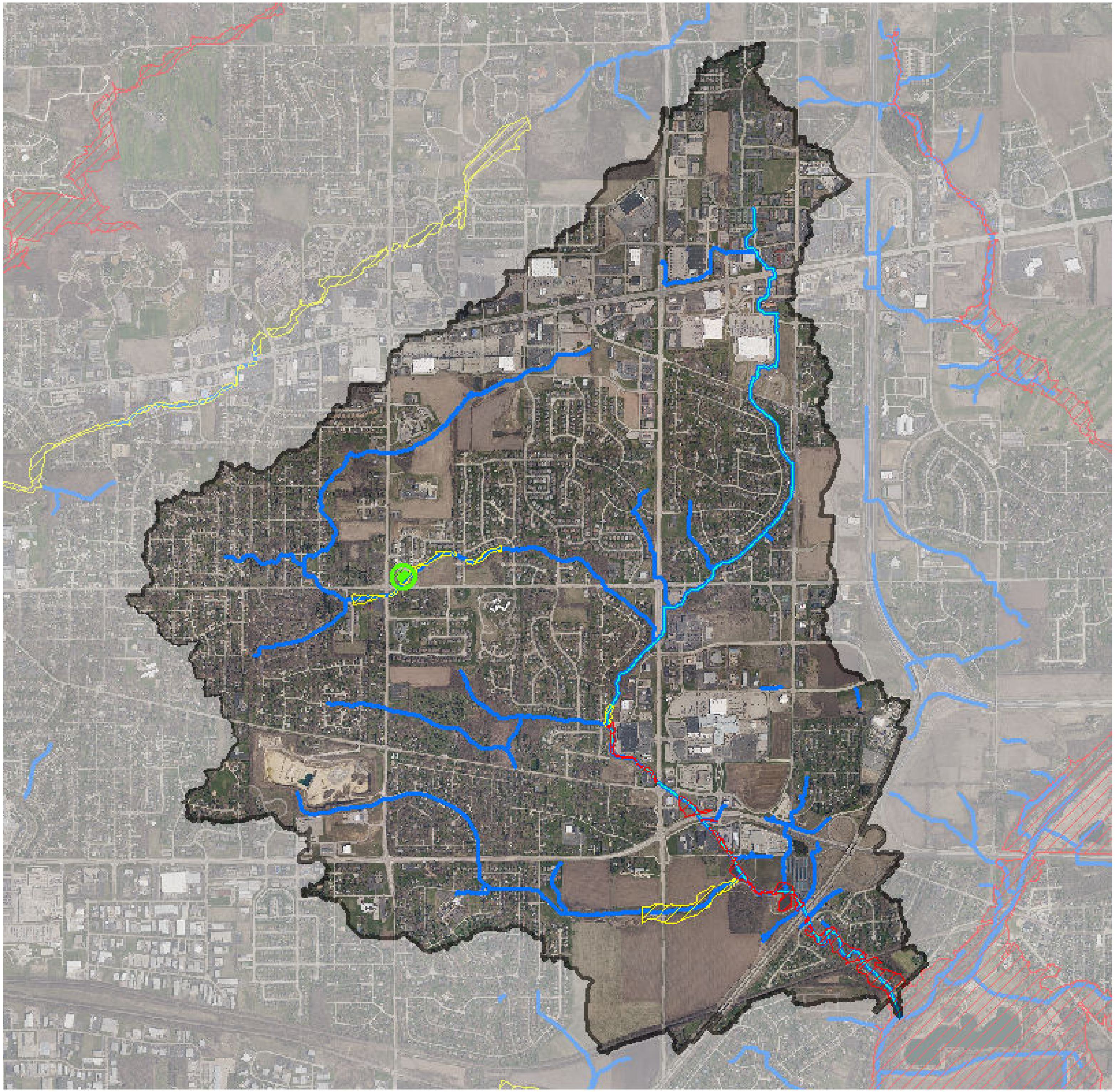

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Legend

- ▨ Zone AE Floodplain
- ▨ Zone A Floodplain
- — Madigan Creek Mainstem
- — Streams & Flowlines
- ▨ Inundated Structures

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Winnebago County Watershed Planning

Madigan Creek - FEMA Floodplain

PROJECT NO: 11-0174		SHEET NO:
DESIGNED BY	BRO	3-21
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ISSUE DATE	06/30/2013	

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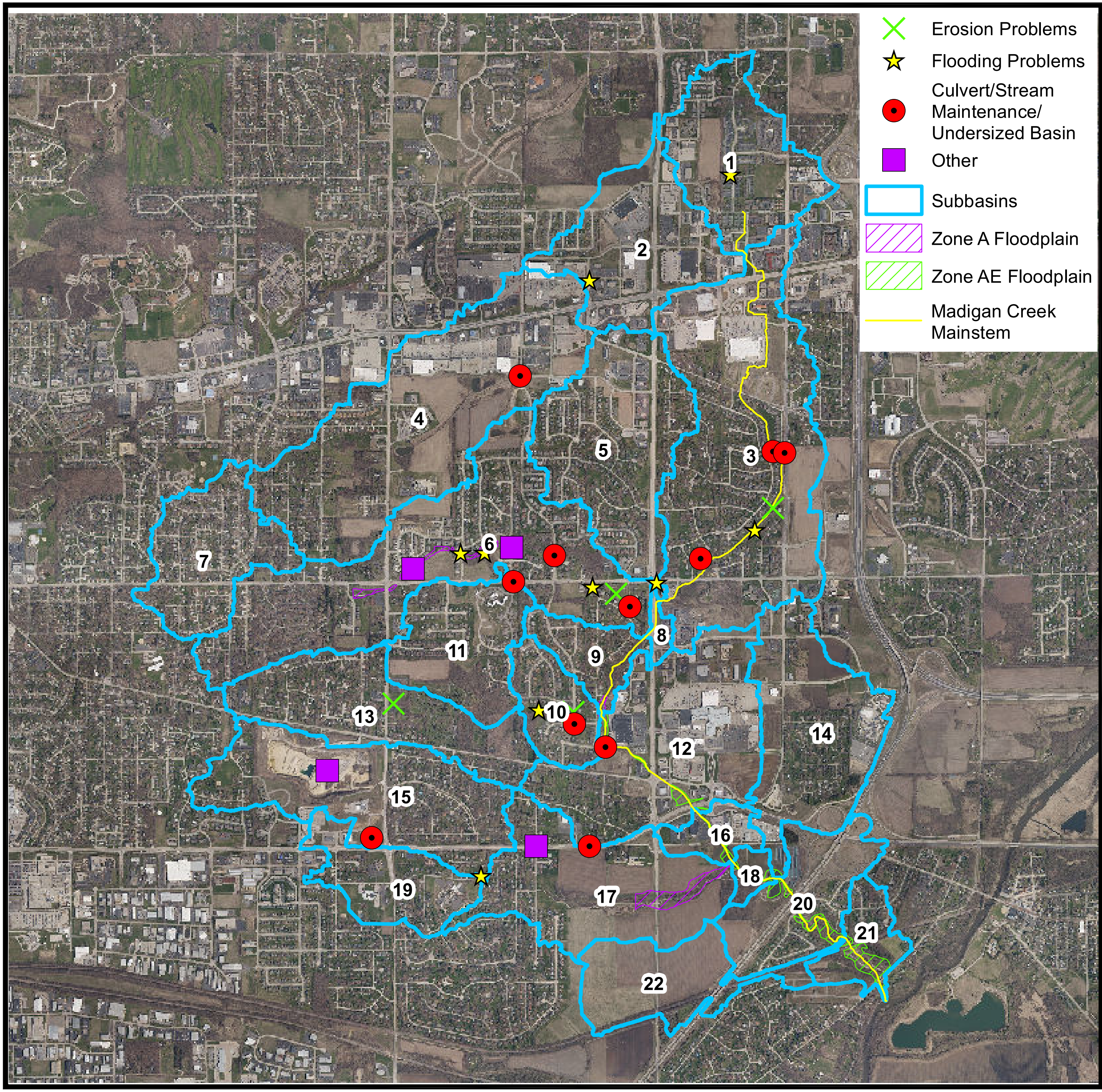

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Winnebago County Watershed Planning

Madigan Creek - Flooding and Drainage Problems

PROJECT NO: 11-0174		SHEET NO:
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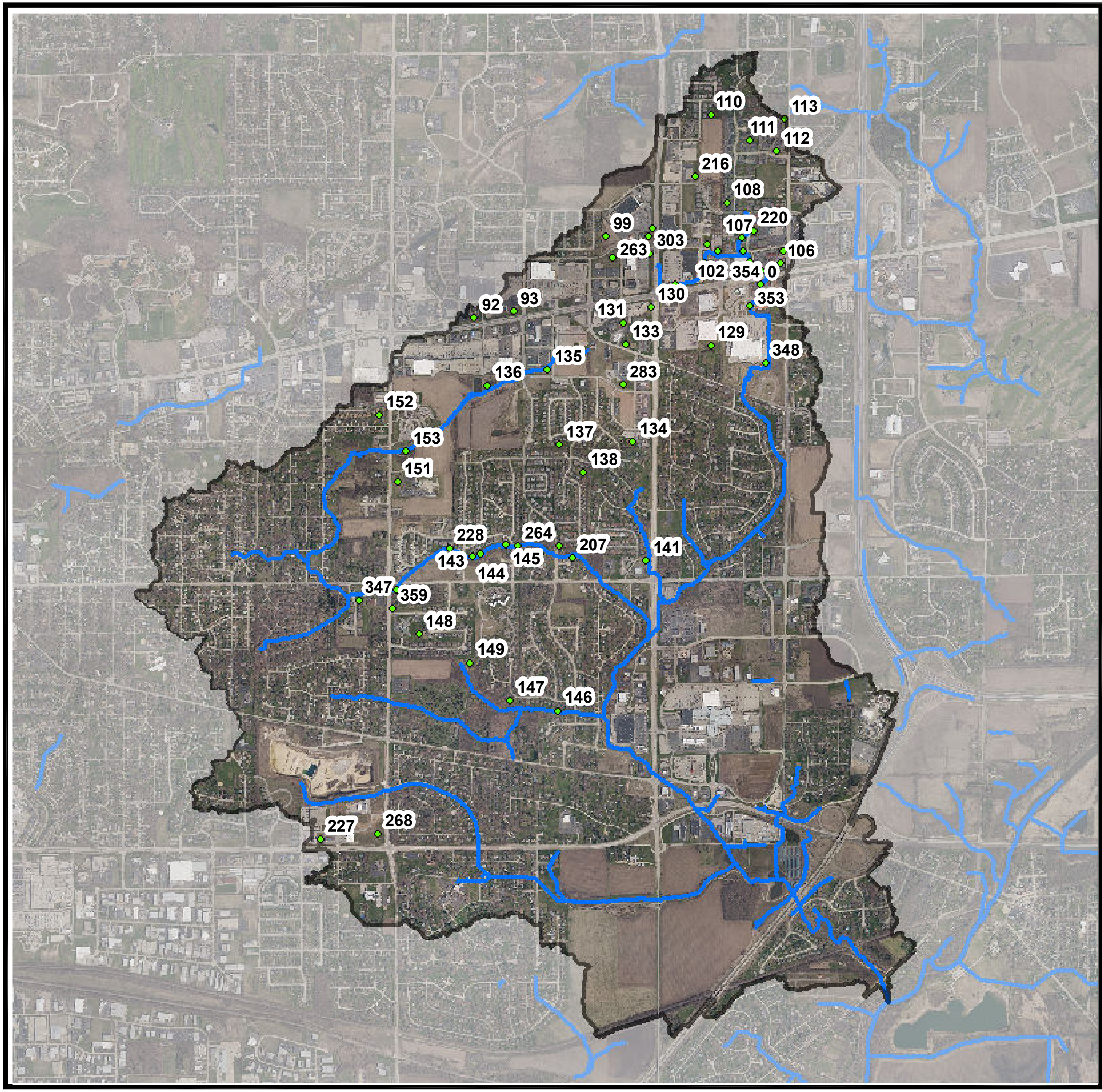

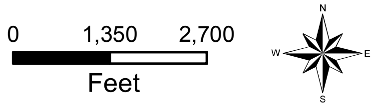

Legend

Streams & Flowlines

● Basins w/ ID Number

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Winnebago County Watershed Planning

Madigan Creek - Existing Detention Facilities (Rockford)

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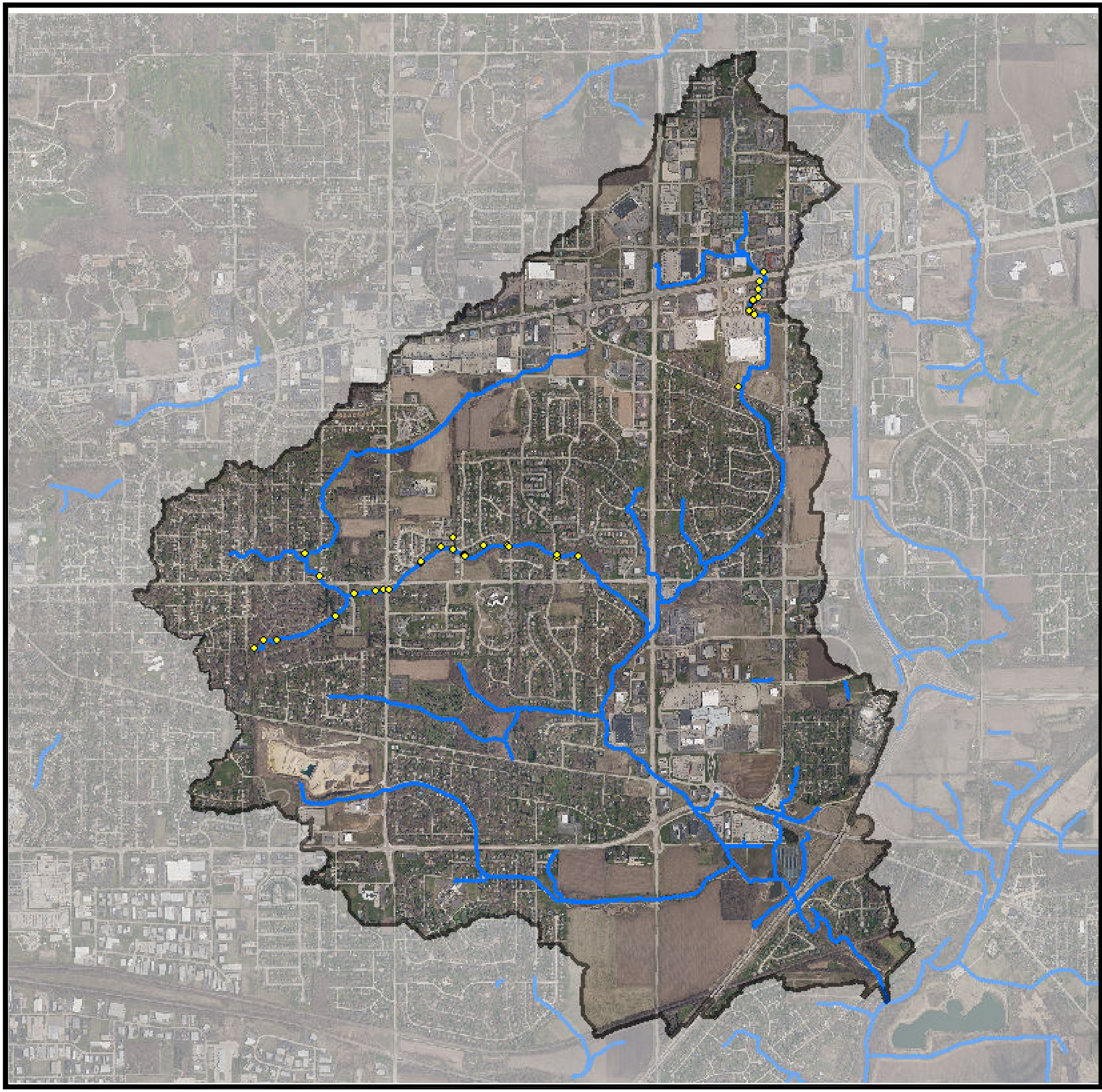

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━ Streams & Flowlines

● Outfalls

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Madigan Creek - Stormsewer Outfalls (Rockford)

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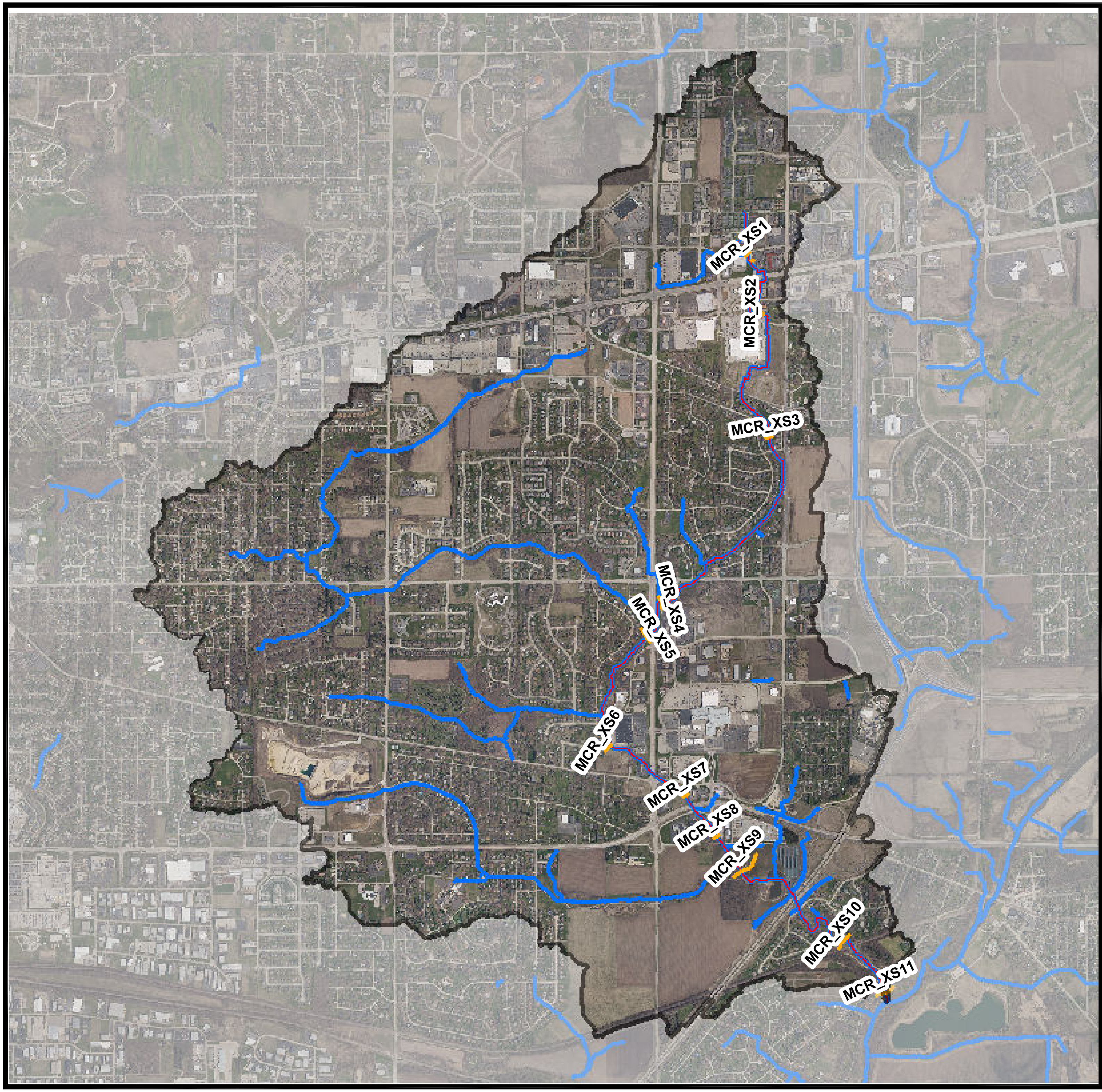

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Legend

- Streams & Flowlines
- Madigan Creek Mainstem
- Cross Section Locations

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Winnebago County Watershed Planning

Madigan Creek - Surveyed Cross Section Locations

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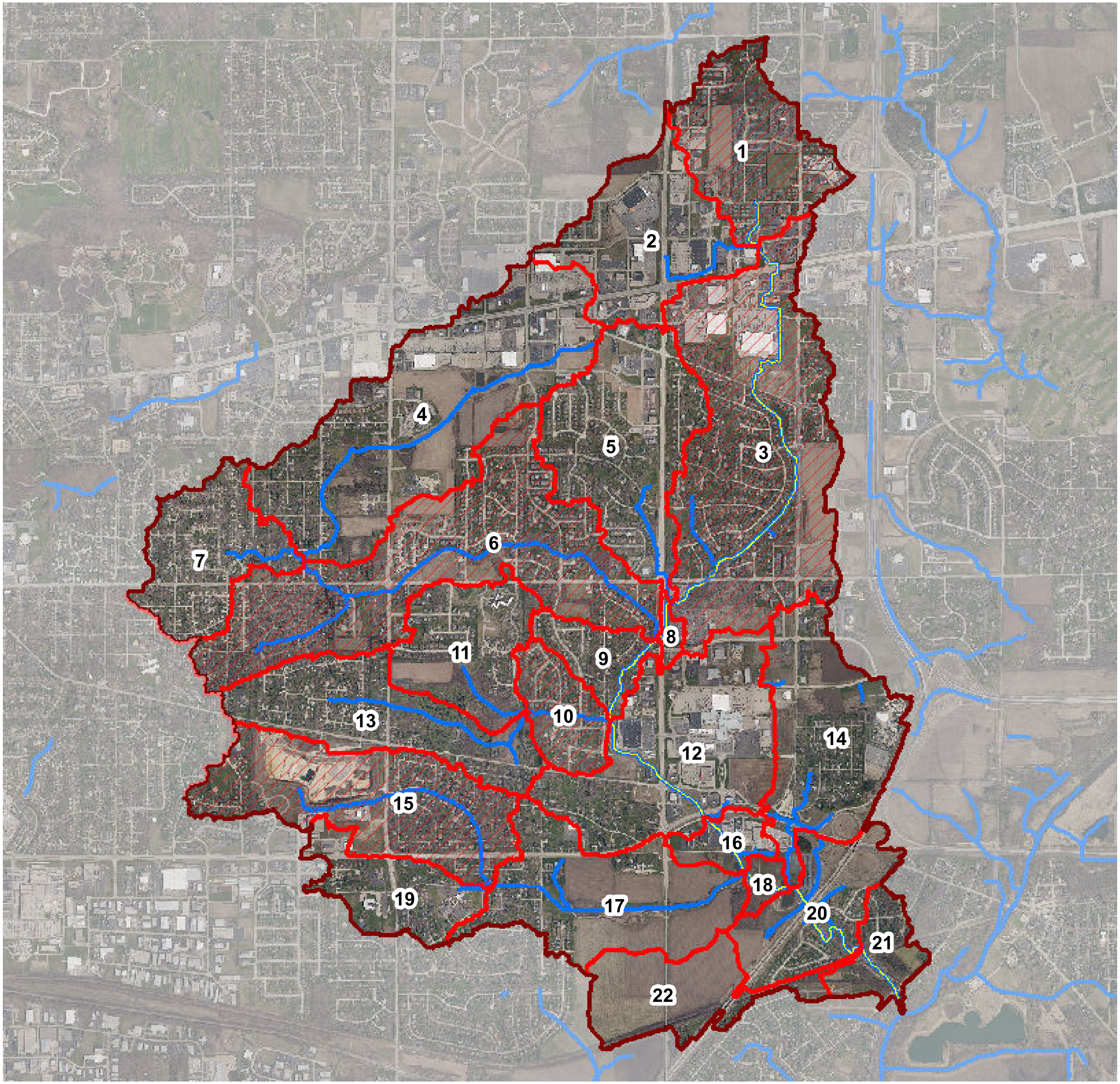

Legend

🟥	Subbasins
—	Madigan Creek Mainstem
—	Streams & Flowlines
▨	Critical Subbasins

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Winnebago County
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Madigan Creek -
Critical Subbasins

PROJECT NO: 11-0174		SHEET NO:
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APPROVED BY	JAW	
ISSUE DATE	06/30/2013	

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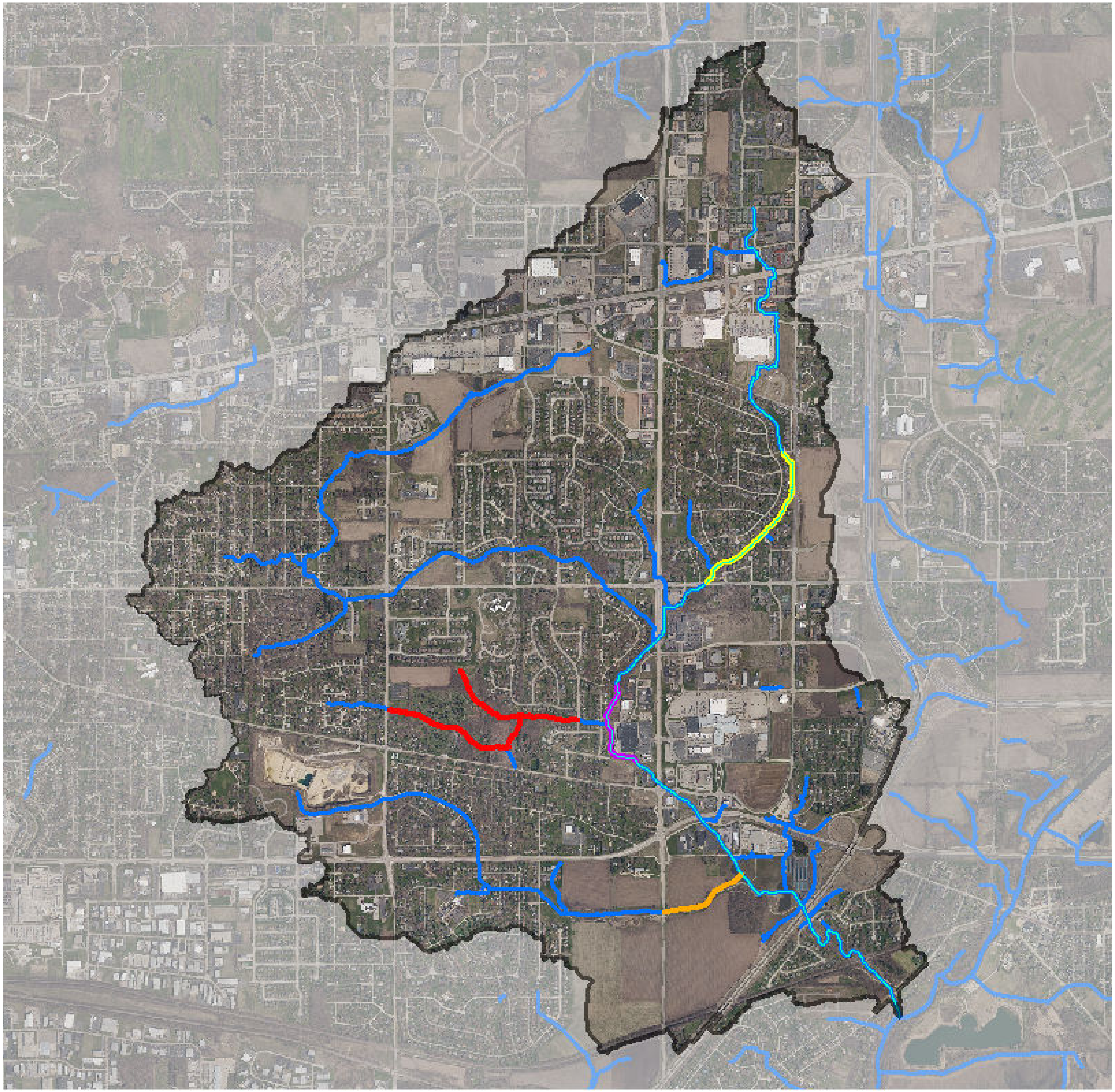

Legend

— Madigan Creek Mainstem

— Streams & Flowlines

Critical Reaches

🟥 Hydromodification

🟨 Streambank Erosion

🟪 Streambank Erosion & Hydromodification

🟧 Undeveloped Floodplain

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Winnebago County Watershed Planning

Madigan Creek - Critical Reaches

PROJECT NO: 11-0174		SHEET NO:
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Chapter 4.0 Watershed Best Management Practice (BMP) and Solutions Toolbox

This section presents a brief illustrated overview of a variety of site planning and stormwater and landscaping best management practices (BMPs). The BMPs are integrated into the Madigan Creek Watershed-Based Plan action items and recommendations presented in Chapter 5. Following the brief descriptions, more detailed information including guidance on applicable scale and land use, benefits and effectiveness, and design considerations are included on BMP Fact Sheets.

4.1 Planning Process BMPs

Planning process BMPs are policy goals used to maintain high environmental quality as a watershed develops and/or restore environmental quality during redevelopment. Significant natural features can be created and/or preserved by open space requirements and other standards. Open space preservation/restoration and riparian buffer standards are tools used to preserve natural resources during development and/or restore natural resources during redevelopment. Impervious area reduction is a critical site-level planning and design strategy use to achieve stormwater management and water quality goals.

Impervious Area Reduction: Impervious area reduction can be achieved in a variety of ways including adding rain garden "bump outs" to neighborhood streets, increasing pervious areas in large parking lots by installing depressed parking lot islands and use of permeable pavement.

Open Space: Protection or re-establishment of open space and/or natural areas as greenways, in order to preserve and connect significant water quality and habitat features and improve aesthetic, recreational and/or alternative transportation uses.

Riparian Buffer: A riparian buffer is a vegetated area next to a stream or wetland that protects water resources from pollution, stabilizes the stream bank, and offers aquatic and wildlife habitat.

4.2 Stormwater BMPs

Stormwater BMPs are site-specific practices are techniques, methods, or structural controls that are designed to manage the quantity and improve the quality of stormwater runoff in a cost-effective manner. Commonly, stormwater BMPs minimize onsite and offsite hydrologic and water quality impacts from stormwater runoff by incorporating and re-establishing natural hydrologic processes into an urbanized area. Stormwater BMPs can be both integrated into new development or retrofitted into existing developments.

Bioswales: Bioswale are filtration and infiltration systems planted with grasses, shrubs, and wetland plants designed to filter, retain, evapotranspirate, and infiltrate stormwater. Typically, bioswales are constructed with an underdrain and infiltration trench comprised of engineered soil and gravel. The infiltration trench provides additional stormwater storage and facilitates infiltration of water into the surrounding soils and groundwater.

Naturalized Detention: Naturalized detention basins are used to temporarily store stormwater runoff and release it at a rate designed to protect stream health and provide water quality treatment. Naturalized detention basins are planted with native wetland and prairie vegetation to provide additional water quality benefits and provide habitat for aquatic and terrestrial species. The naturalized detention basins can be designed both as shallow wetland systems with little to no open water or as open water wetland ponds with a wetland fringe and prairie sideslopes.

Permeable Pavement: Permeable pavement is pavement that is designed to allow for the infiltration of rain and snowfall. Permeable pavement is constructed with an underdrain and infiltration trench bed comprised of gravel underneath the permeable pavement. Rain that falls on the permeable pavement infiltrates into the gravel and then into the soil and/or groundwater below. Runoff that is not infiltrated can is slowly released from the trench into a second BMP as part of a stormwater BMP "treatment train" or into the storm sewer system.

Rain Barrels/Cisterns: Rain barrels and cisterns are storage vessels uses to capture and temporarily store rainfall for landscape irrigation.

Rain Gardens: Rain gardens are landscaped gardens designed to filter, retain, evapotranspirate, and infiltrate stormwater from roofs, driveways, or lots.

Vegetated Swales: Vegetated swales are stormwater features that convey, retain, and infiltrate stormwater. Water quality benefits of vegetated swales are enhances by the planting of native vegetation in the swale.

4.3 Landscaping BMPs

Landscaping has many properties that make it an important BMP to integrate into watershed planning action plans. Landscaping improves biodiversity, aesthetics, and habitat and cools ambient air. Native landscaping can also improve water quality through increasing infiltration and filtration of stormwater runoff.

Native Landscaping: Native vegetation uses the plants that were endemic to a specific geographical region prior to settlement for a variety of purposes including habitat improvement and increasing stormwater infiltration and water quality treatment.

Stream/Wetland Management and Restoration: Landscape restoration practices designed to maintain existing remnant landscapes and/or restore streams and wetlands to their nature state.

Streambank Stabilization: Streambank stabilization includes the use of bioengineering techniques to address streambank erosion and protect private property, roadways, and utilities from damage caused by streambank erosion.

Stormwater Trees: Trees can reduce stormwater runoff from impervious area such as parking lots, roads, and buildings. Trees have an effect on stormwater above the ground surface, at the ground surface, and below the ground surface by slowing, storing, and infiltrating runoff..

4.4 Flood Reduction BMPs

Structural Flood Control: Structural flood control measures include reservoirs, levees, floodwalls, diversions, stream channel conveyance improvements, and stormsewer improvements. These measures are generally designed to reduce the risk of flood damage in urbanized areas. Structural flood control projects are frequently cost prohibitive for munipalities to implement without some type of financial assistance through cost sharing or grants.

Non-Structural Flood Control: Non-structural flood control measures include floodproofing, acquisition and demolition of flood damaged building, and elevating or relocating buildings out of the floodplain.

The following Fact Sheets include guidance on applicable scale and land use, benefits and effectiveness, and design considerations of stormwater BMPs and solutions that are recommended as Action Items in Chapter 5 of this watershed-based plan. The general layout of the Fact Sheets is described below.

BMP Description: Provides a description of the BMP, how it works, and water quality and stormwater management benefits provided by the BMPs.

Applicability: Where and how each BMP is applicable addressed by scale, application, and effectiveness:

Scale

- **Watershed/County:** Applied at a regional scale in the watershed or county-wide.
- **Town/Village:** Applied at a municipal level.
- **Neighborhood:** Applies at development or other sub-municipal level.
- **Lot:** Applied on individual residential, commercial, or industrial lots.

Application

- **Retrofit:** Applied to existing development, infill, and redevelopment.
- **New:** Applied to new development.
- **Roofs:** Applied on roofs or to treat roof runoff.
- **Streets:** Applied on or used to treat runoff from streets and roads.
- **Driveways:** Applied on or used to treat runoff from driveways.
- **Parking Lots:** Applied on or used to treat runoff from parking lots.
- **Lawns:** Applied on or used to treat runoff from lawns that are planted with turf grass.
- **Sensitive Areas:** Applied to ecological important areas such as floodplains, wetlands, and highly erodible soils.

Effectiveness

- **Runoff Rate Control:** BMPs that control or reduce runoff rates.
- **Runoff Volume Control:** BMPs that control or reduce runoff volumes.
- **Physical Habitat Preservation/Creation:** BMPs that preserve, restore, or provide wildlife habitat.
- **Sediment Pollution Control:** BMPs that reduce the amount of suspended sediment in runoff.
- **Nutrient Control:** BMPs that reduce the amount of nutrients in runoff.
- **BOD Control:** BMPs that remove constituents that cause BOD in runoff.
- **Other Pollutant Control:** BMPs that reduce the amount of metals, petroleum-based compounds, and other pollutants in runoff.

Design Consideration: Design recommendation that should be considered when designing and implementing the BMP.

Additional Benefits: Other positive effects that the BMP provides beyond its stormwater and water quality benefits.

Maintenance: Recommendation on maintenance practices necessary to keep the BMP functioning as designed.

Bioinfiltration Basins

How Do Bioinfiltration Basins Help Manage Stormwater?

Bioinfiltration basins are shallow, vegetated depressions designed to capture and hold a volume of stormwater runoff and allow it to infiltrate into the underlying soils over several days. The design of bioinfiltration basins is simple and they are used as an "end of pipe" method to catch stormwater from swales or storm sewer systems. Bioinfiltration basins allow the stormwater to infiltrate into the soil and recharge groundwater rather than discharging directly into sewers and rivers.

Bioinfiltration basins are very effective at removing pollutants and reducing the volume of runoff from impervious surfaces such as parking lots. Based on published pollutant removal efficiencies, bioinfiltration basins can remove approximately 65% of the total phosphorous, 60% of the total nitrogen, 75% of total suspended solids, and 65% of metals.

Where and How can Bioinfiltration Basins be Located?

Scale ☐ Watershed/County ☐ Town/Village ☒ Neighborhood ☒ Lot

Applications

☒ Retrofit
☒ Preventative
☒ Parking lots
☐ Roofs

☒ New
☒ Remedial
☒ Streets
☐ Lawns

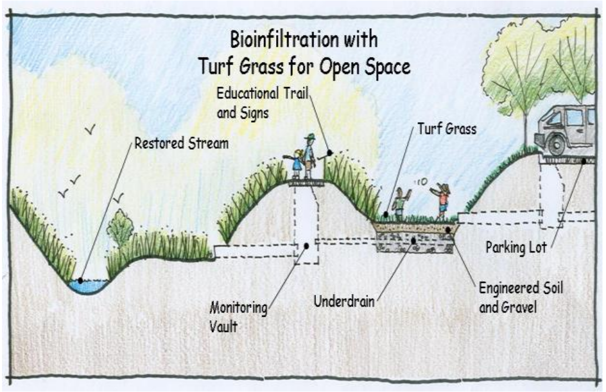
☒ Ongoing/Maintenance
☒ Driveways
☐ Sensitive Areas

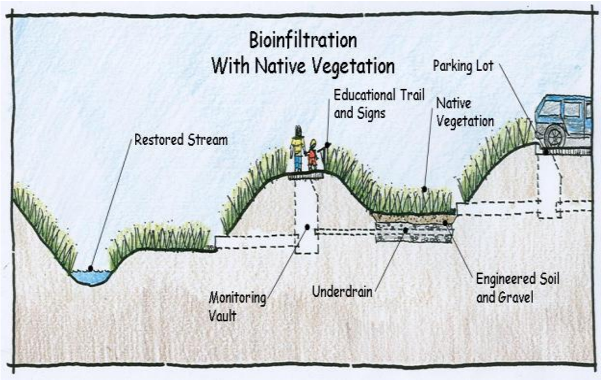
Effectiveness

☒ Runoff Rate Control
☒ Sediment Control
☒ Other Pollutant Control

☒ Runoff Volume Control
☒ Nutrient Control

☐ Habitat Preservation/ Restoration
☒ BOD/COD Control





Design Considerations

- Bioinfiltration basins must be sized and designed to account for drainage area and soils.
- Infiltration storage should be designed to drain in 24-72 hours.
- Filtration benefits can be improved by planting native-deep rooted vegetation.
- Topsoil should be amended with compost and/or sand as a means of improving organic content for filtering and to achieve adequate infiltration.

Additional Benefits of Bioinfiltration Cells

Bioinfiltration cells provide much more than just stormwater management. They also:

- Enhance the aesthetics of the local landscape
- Provide habitat for wildlife
- Provide open space

Maintenance

The maintenance on bioinfiltration cells includes the periodic inspection and cleaning in order to ensure that the system is operating properly. The system should be inspected for clogging of the discharge pipe and sediment accumulation on the basin surface. If a clog is found, rehabilitative maintenance should be conducted immediately to restore its proper operation. In addition, to preventing and repairing clogs, management of the vegetation including mowing, weeding, and replanting sparse areas should also be conducted.

This Fact Sheet was prepared by the Winnebago County Highway Department using funding provided in part through the USEPA Section 319 of the Clean Water Act and administrated through Illinois Environmental Protection Agency.

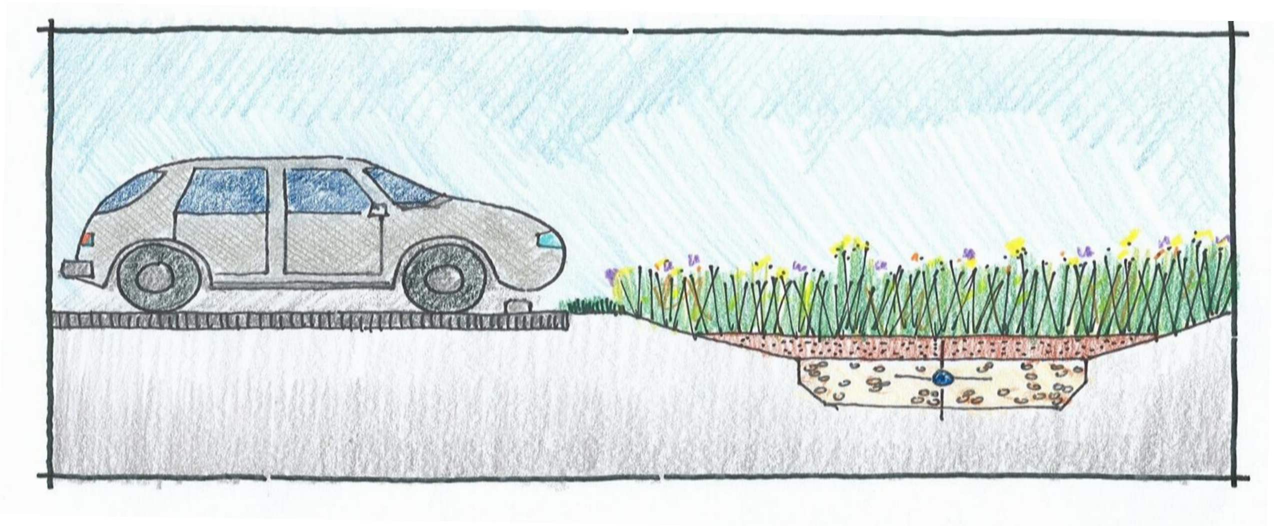
Bioswales

How Do Bioswales Help Manage Stormwater?

Bioswales are stormwater treatment systems that provide an alternative to traditional curb-and-gutter and storm sewers. Bioswales are broad, vegetated channels that reduce the rate and volume of runoff from a site. They are commonly planted with wet-tolerant species and may remain wet for a few days following a storm.

Bioswales differ from traditional vegetated swales in that the bioswales are primarily used for storage of stormwater while vegetated swale is utilized for conveying water. In order to increase the storage capacity of the bioswale, the bioswale can be constructed with an underdrain and infiltration trench comprised of engineered soil and gravel, while a traditional vegetated swale is constructed on native soils. The infiltration trench provides additional stormwater storage and facilitates infiltration of water into the surrounding soils and groundwater. Once the storage capacity of the infiltration trench has been reached, the underdrain will convey the water into the storm sewer system.

Bioswales remove suspended solids through settling and filtration. Dissolved pollutants such as nutrients and metals are removed and/or transformed as runoff infiltrates into the soil. Based on published pollutant removal efficiencies, bioswales can remove approximately 100% of the total phosphorous, 94% of total suspended solids, and 83% of biochemical oxygen demand (the degree of organic pollution in water leading to the depletion of oxygen).



Where and How Can Bioswales Be Located?

Scale ☐ Watershed/County ☐ Town/Village ☒ Neighborhood ☒ Lot

Applications

☒ Retrofit
☒ Preventative
☒ Parking lots
☐ Roofs

☒ New
☒ Remedial
☒ Streets
☐ Lawns

☒ Ongoing/Maintenance
☒ Driveways
☐ Sensitive Areas

Effectiveness

☒ Runoff Rate Control
☒ Runoff Volume Control
☐ Habitat Preservation/ Restoration
☒ Sediment Control
☒ Nutrient Control
☒ BOD/COD Control
☒ Other Pollutant Control

Design Considerations

- Bioswales must be sized and designed to account for drainage area and soils.
- Infiltration storage should be designed to drain in 24-72 hours.
- Filtration benefits can be improved by planting native-deep rooted vegetation.
- Salt tolerant species should be used in the swale is to receive runoff from parking lots and roads.
- Topsoil should be amended with compost and/or sand as a means of improving organic content for filtering and to achieve adequate infiltration.

Additional Benefits of Bioswales

Bioswales provide more than just stormwater management. They also:

- Enhance the aesthetics of the local landscape
- Provide habitat for wildlife
- Can be used for snow storage during winter months

Maintenance

The maintenance requirements for bioswales are minimal. The bioswales should be inspected periodically to remove litter and blockages. Sparse areas may need to be reseeded or replanted.

This Fact Sheet was prepared by the Winnebago County Highway Department using funding provided in part through the USEPA Section 319 of the Clean Water Act and administrated through Illinois Environmental Protection Agency.

Permeable Pavement

How Does Permeable Pavement Help Manage Stormwater?

Permeable pavements refer to paving materials that promote the absorption of rainfall and snowmelt. There are four main types of permeable pavements: porous concrete, porous asphalt, permeable grid pavers, and permeable pavers. See the table below for a detailed description of each paving system.

TYPES OF PERMEABLE PAVING SYSTEMS

Type of Paving System	General Description
Porous concrete	Porous concrete looks very similar to regular concrete. Porous concrete typically consists of specialty formulated mixtures of Portland cement, course aggregate and water that has been manufactured to have gaps through which water can flow into an infiltration bed of uniformly graded gravel below the pavement.
Porous asphalt	Porous asphalt looks very similar to regular asphalt. Porous asphalt consisted of course aggregate bonded together by asphalt cement with sufficient gaps through which water can flow into an infiltration bed of uniformly graded gravel below the pavement.
Permeable grid pavers	Permeable grid pavers are manufactured rigid plastic subsurface reinforcement systems that are backfilled with permeable gravel or soil. The permeable grid pavers are most often installed over an infiltration bed of gravel. This system is most commonly used for fire lanes, overflow parking, or other low-traffic areas.
Permeable pavers	Permeable pavers are modular concrete pavers manufactured with internal void spaces or gaps between pavers to allow stormwater to percolate into an infiltration bed of uniformly graded gravel below the pavers. Course sand is most often used to fill voids, creating a durable smooth surface.

Rain that falls onto the permeable pavement systems described above percolates through the pavement surface and into the gravel bed below. An underdrain is often incorporated into the design to convey excess stormwater to a storm sewer if the infiltration capacity of the underlying soil is exceeded. By infiltrating most of the stormwater that falls onto the permeable pavement, the rate and volume of runoff flowing into storm sewers is reduced, along with pollutants being carried by the stormwater. Thus, permeable pavement helps maintain more stable base flows in streams, reduces flood peaks, and reduces streambank erosion caused by stormwater runoff.

Permeable pavement removes suspended solids through filtration. Dissolved pollutants such as nutrients and metals are removed and/or transformed as runoff infiltrates into the soil. Utilizing the Illinois EPA's Estimating Pollutant Load Reductions for Nonpoint Source Pollution Control BMPs worksheets, the permeable pavement can remove approximately 65% of the total phosphorous, 85% of total nitrogen, and 90% of total suspended solids.

Where And How Can Permeable Pavement Be Located?

Scale ☐ Watershed/County ☐ Town/Village ☒ Neighborhood ☒ Lot

Applications
☒ Retrofit ☒ New
☒ Preventative ☒ Remedial ☐ Ongoing/Maintenance
☒ Parking lots ☒ Streets ☒ Driveways
☐ Roofs ☐ Lawns ☐ Sensitive Areas

Effectiveness
☒ Runoff Rate Control ☒ Runoff Volume Control ☐ Habitat Preservation/ Restoration
☒ Sediment Control ☒ Nutrient Control ☒ BOD/COD Control
☒ Other Pollutant Control

Additional Benefits of Permeable Pavement

Permeable pavers provide much more than just stormwater management. They also:

- Permeable pavements can be engineered to be just as stable as conventional methods and provide the same functionality of traditional concrete and asphalt.
- Snow melts faster on permeable pavements because of the improved drainage
- Permeable pavements are also effective in reducing the "urban heat island" effect.
- The use of pavers improves the aesthetic appeal of paved areas.

Maintenance

Permeable pavements should be inspected annually and after large storms to assure the pavements are still fully functioning. Permeable pavements should also be vacuumed periodically to remove any accumulated sediment and leaves. Vacuum-type street sweeping equipment is the most effect method of vacuuming permeable pavement systems. Snow and ice should be removed via scrapping and shoveling. Avoid the use of de-icing chemicals and sand on permeable pavement. Polymeric jointing sand, commonly used with traditional pavers, should never be used with permeable pavers as it will prevent infiltration.

This Fact Sheet was prepared by the Winnebago County Highway Department using funding provided in part through the USEPA Section 319 of the Clean Water Act and administrated through Illinois Environmental Protection Agency.

Rain Barrels

How Do Rain Barrels Help Manage Stormwater?

In many urban locations roof runoff is routed directly into the sewer system or adjacent areas that are designed to carry the flow away as swiftly as possible. By installing a rain barrel, it is possible to disconnect these downspouts from the sewer system or capture the runoff that would otherwise be lost and save the rain water for other uses. A rain barrel is a temporary storage system for stormwater. The water captured by the barrel can then be used to irrigate your lawn, flower beds and garden or wash your car. By using a rain barrel you will save money and water by having an ample supply of free 'soft water'.

How Do I Install A Rain Barrel For My Home?

Rain barrels are designed to accumulate and store runoff from your rooftop. A rain barrel is composed of a large drum, hose, pipe and hose couplings, a screen grate and other off the shelf items. Rain barrels can be purchased from garden supply stores or they can be easily built with supplies purchased from a hardware store. Information on where to purchase a rain barrel or assembling one yourself can easily be found online.

The first step in installing a rain barrel at your home is to decide where to place the rain barrel. Many people place their rain barrels near an existing downspout as it simplifies installation. But also be sure you consider how far the location of the barrel is from your plants, gardens, and flowerbeds. You want to be sure you can easily utilize the water that is captured in the rain barrel.

Once you have selected the location for your rain barrel, make sure the area is level and free from any rocks, roots, or debris that would cause your barrel to rock from side to side. Also be sure to rake the area in order to remove any leaves that could cause the ground to be soft and unsecure. It is also recommended that prior to placing your rain barrel in its selected location, construct a platform out of cinder blocks, wood, or flat landscape/paver type stones. Raising your rain barrel a few inches off the ground will give you more water pressure when using a hose and make it easier for you to reach the faucet or fill a watering can.

Now that your platform is constructed, place the rain barrel in its location and measure where you need to cut or disassemble your downspout. Often times you can disassemble the downspout at the gutter by removing the bolts. Replace the portion of the metal downspout removed with a flexible downspout extender. Once securely attached to the gutter, place the downspout extender in the barrel.

Where and How Can Rain Gardens Be Located?

Scale ☐ Watershed/County ☐ Town/Village ☐ Neighborhood ☒ Lot

Applications

☒ Retrofit
☒ Preventative
☐ Parking lots
☒ Roofs
☒ New
☐ Remedial
☐ Streets
☐ Lawns
☐ Ongoing/Maintenance
☐ Driveways
☐ Sensitive Areas

Effectiveness

☐ Runoff Rate Control
☐ Sediment Control
☐ Other Pollutant Control
☒ Runoff Volume Control
☐ Nutrient Control
☐ Habitat Preservation/ Restoration
☐ BOD/COD Control

Costs

Rain barrels vary in cost based on size, material and expected lifetime. You can expect to pay between $40 and $150. Purchasing materials and assembling your own rain barrel instead of buying an already assembled rain barrel can reduce this cost.

Maintenance

There are several easy ways to routinely maintain your rain barrel in order to ensure its usefulness for a long period of time. Use a screen on the lid of the rain barrel to prevent insects and debris such as leaves or twigs from getting into the barrel. Rain barrels should also be disconnect over the winter to prevent ice-damming and minimize the potential for damage to gutters, downspout, and house.

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Rain Gardens

How Do Rain Gardens Help Manage Stormwater?

Rain gardens are one of the many BMPs that you can implement at home to reduce the impacts of stormwater in your watershed. Building a rain garden is one of the simplest, easiest and most cost effective ways you can protect water quality at home. The purpose of a rain garden at home is to store and promote the infiltration of rainfall into the groundwater. Without the rain garden, the majority of the rain that falls onto the impervious surfaces around your home such as driveways, sidewalks, and roofs will flow directly into the sewer system or nearby lakes or streams. When properly constructed a rain garden will reduce the amount of runoff from your property. In addition, the plants in the rain garden will also reduce the amount of pollutants in stormwater runoff. Suspended sediments and attached pollutants such as phosphorus and metals are settled out of the stormwater and captured in the basin. Dissolved pollutants such as nitrogen and organic matter are filtered out and/or transformed by the vegetation and as the runoff infiltrates into the underlying soils.

How Do I Design A Rain Garden For My Home?

You should consider location, size/shape, and plant selection when designing a rain garden for home. Each of these critical design elements are discussed in detail below.

Location: When deciding where to place a rain garden it is important to decide where the runoff water will be coming from. Runoff water can collect near a driveway, roof downspout or a low point in your yard. After you pick a location, the first step is to dig a shallow depression of the shape and depth you want your garden to be. Be sure to remember to locate the garden a minimum of 10 feet from your house to keep the water away from the foundation. The overflow should be directed away from the house.

Size and Shape: Typically a rain garden will be 2-6 inches deep and about 70 square feet. The most important factor in determining the depth of your rain garden is to make sure the rain garden will drain in approximately 24 hours after it rains. You can easily determine the proper depth by conducting an infiltration test in the area where you have selected to construction your rain garden. The first step in the infiltration test is to dig a hole approximately 12-inches deep and write down the depth of the hole. Next, fill the hole completely with water and wait approximately 24-hours. The next day, measure the amount of water still remaining in the hole. The amount of water that drained from the hole is a great estimation on how deep your rain garden should be. For example, if 6-inches of water drained, the garden should be about 6-inches deep. Gardens that only hold water for a day will not promote mosquito breeding. The shape of the garden can vary depending on the drainage of the landscape but generally rain gardens are in the shape of a teardrop, oval or a kidney bean. Be sure to consider where the water will enter the garden and where it overflows during large events. You want the overflow to be directed away from your house.

Plant Selection: Your garden can include, but is not limited to native wetland and prairie grasses, wildflowers, shrubs or grasses.

Suggested Species:

Black-eyed Susan
Butterflyweed
Golden Alexander
Obedient Plant
Purple Coneflower
Spiderwort
Wild Columbine
Wild Geranium

Special Considerations:

- Make sure to have utilities marked before digging
- Avoid building your rain garden over or near septic drain fields
- Use of fertilization and exposure to pesticides is typically not necessary
- Make sure to pick plants that you like but also are able to survive with the amount of sunlight/shade in your yard
- Plants should be tolerant to both wet and dry conditions

Costs

Rain gardens are estimated to cost between $3 and $20 per square foot. These costs will very greatly depending on how much of the planning, design, and installation is done by you. Rain gardens can even be free if you use plants that you already own.

Maintenance

Just like any garden, your rain garden needs to be properly maintained in order for it to function properly. After your garden is first built, the plants will need to be watered through the first growing season. After the first season you will only need to water the rain garden during a drought. In addition, your rain garden should be mulched annually in order to keep weeds out. If any weeds to persist they should be pulled. Finally the garden should be inspected periodically for any kind of debris, trash or pet waste, which should be removed

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Stormwater Trees

How Do Trees Help Manage Stormwater?

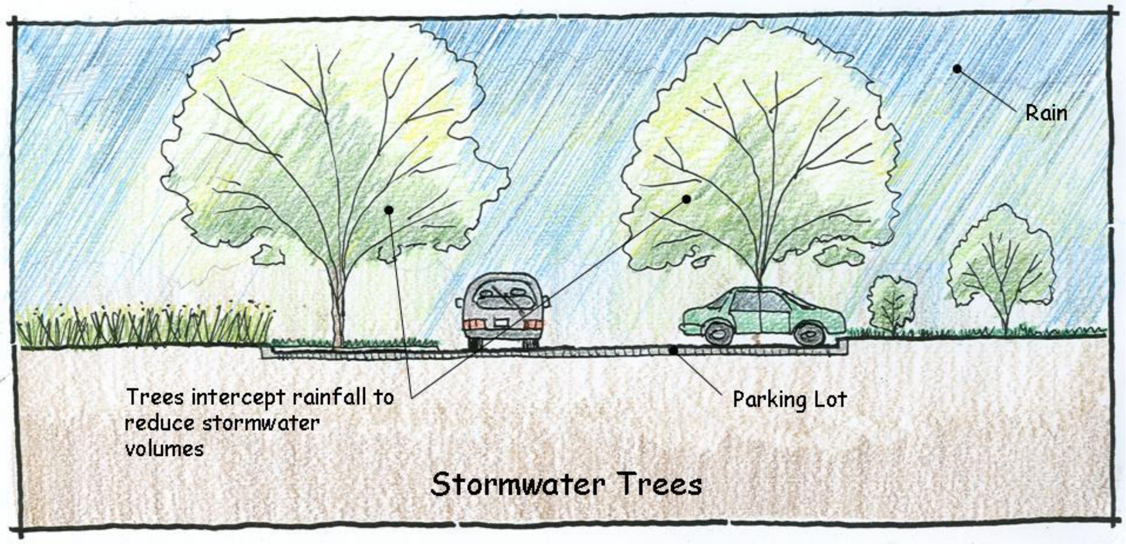
Trees are one of the simplest and most cost effective ways of reducing stormwater runoff from impervious area such as parking lots, roads, and buildings. Trees have an effect on stormwater above the ground surface, at the ground surface, and below the ground surface.

First, rain is caught on the trees' leaves, branches, and trunk slowing the movement of the stormwater. A portion of this rainfall is evaporated from the foliage and released back into the atmosphere as vapor. In addition to being evaporated, some of the rainfall caught by the trees is absorbed into the trees' leaves and stems where it is used for growth.

Not all rainfall that falls on a tree is absorbed or evaporated: some raindrops fall through the trees without landing on leaves or branches and other raindrops drip from the tree before they can be absorbed or evaporated. The rainfall that reaches the ground beneath the trees may still be affected by the tree.

The leaf litter and other organic matter commonly located underneath trees hold the precipitation in temporary surface ponds that reduce the amount and peak rates of stormwater runoff from the area. In addition, roots and the trunks of mature trees create hollows and hummocks on the ground that also provides areas for temporary water storage and ponding.

A small portion of the ponded water is evaporated from the surface while the majority is infiltrated into the soil. The presence of organic matter from leaf litter and other tree detritus and macropores, which are large interconnected pores in the soil created by roots, increases the infiltration rate and the moisture holding capacity of the soils. Once below ground, the stormwater can be taken up by the trees through their roots or percolated into the groundwater. The roots of the trees also act as natural pollution filters removing nitrogen, phosphorus, and potassium from the stormwater before it is able to percolate into the groundwater.



Where and How Can Stormwater Trees Be Located?

Scale ☒ Watershed/County ☒ Town/Village ☒ Neighborhood ☒ Lot

Applications

☒ Retrofit
☒ Preventative
☒ Parking lots
☐ Roofs

☒ New
☒ Remedial
☒ Streets
☒ Lawns

☐ Ongoing/Maintenance
☒ Driveways
☒ Sensitive Areas

Effectiveness

☒ Runoff Rate Control
☒ Sediment Control
☒ Other Pollutant Control

☒ Runoff Volume Control
☒ Nutrient Control

☒ Habitat Preservation/ Restoration
☒ BOD/COD Control

Additional Benefits of Stormwater Trees

Trees provide more than just stormwater management.
They also:

- Reduce air pollution
- Provide shade
- Lower energy costs
- Prevent soil erosion
- Reduce noise level
- Enhance aesthetics and increase property values

Maintenance

Maintenance needs for trees planted for stormwater management is the same for all other trees. Basic tree care should be preformed regularly to ensure healthy trees and minimize the risk of damage to people and property.

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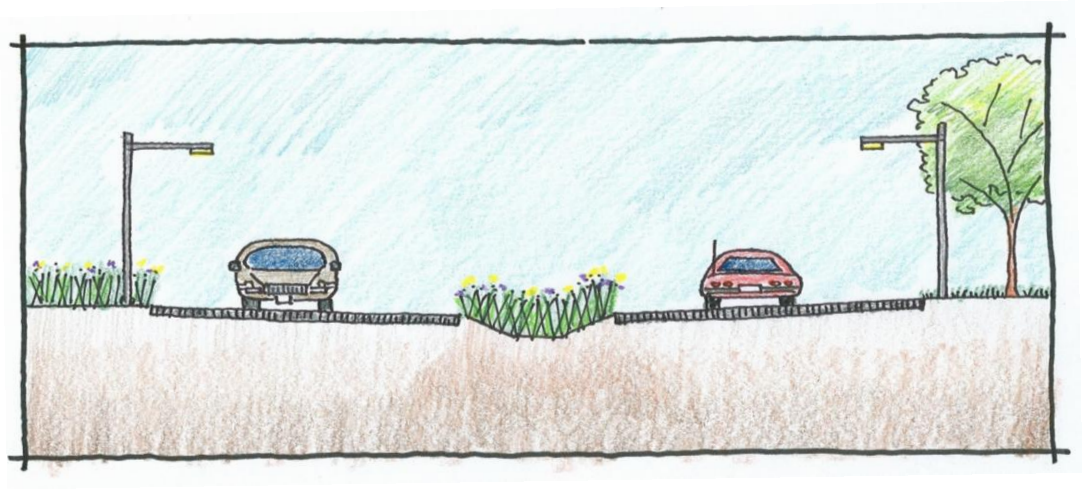
Vegetated Swales

How Do Vegetated Swales Help Manage Stormwater?

The vegetated swale is a common stormwater treatment system. Vegetated swales are vegetated areas used to convey and treat stormwater runoff by acting as a buffer between impervious areas such as roads, parking lots, and driveways and storm sewer systems or streams. While a roadside ditch is technically a vegetated swale, these are typically referred to as "grassed swales". The term vegetated swale most typically refers to swales that are densely vegetated. Vegetated swales function best when constructed with gentle slopes to minimize flow velocities and maximize opportunities for the absorption of runoff and the filtering of pollutants.

Vegetated swales will improve the water quality of stormwater by slowing runoff speed, trapping sediment and other pollutants, and providing some absorption. The swales will also reduce both the rate and volume of stormwater. Choosing to plant swales with native vegetation is more effective in managing runoff than if it was planted with short turf grass.

Vegetated swale removes suspended solids through settling and filtration. Dissolved pollutants such as nutrients and metals are removed and/or transformed as runoff infiltrates into the soil. Utilizing the Illinois Environmental Protection Agency's Estimating Pollutant Load Reductions for Nonpoint Source Pollution Control Best Management Practices (BMPs) worksheets, the vegetated swale will remove approximately 20% of the total phosphorous, 65% of total suspended solids, and 50-71% of metals.



Where And How Can Vegetated Swales Be Located?

Scale ☐ Watershed/County ☐ Town/Village ☒ Neighborhood ☒ Lot

Applications

☒ Retrofit
☒ Preventative
☒ Parking lots
☒ Roofs
☒ New
☒ Remedial
☒ Streets
☒ Lawns
☐ Ongoing/Maintenance
☒ Driveways
☐ Sensitive Areas

Effectiveness

☒ Runoff Rate Control
☒ Sediment Control
☒ Other Pollutant Control
☒ Runoff Volume Control
☒ Nutrient Control
☐ Habitat Preservation/ Restoration
☒ BOD/COD Control

Design Considerations

- Vegetated swales must be sized to convey design runoff rate.
- Filtration benefits can be improved by planting native-deep rooted vegetation.
- Salt tolerant species should be used in the swale is to receive runoff from parking lots and roads.
- Topsoil should be amended with compost and/or sand as a means of improving organic content for filtering and to achieve adequate infiltration.

Additional Benefits of Vegetated Swales

Vegetated Swales provide more than just stormwater management. They also:

- Enhance the aesthetics of the local landscape
- Provide habitat for wildlife
- Can be used for snow storage during winter months

Maintenance

The maintenance requirements for vegetated swales are minimal. The swales just need to be inspected periodically to remove litter and blockages. Sparse areas may need to be reseeded or replanted.

This Fact Sheet was prepared by the Winnebago County Highway Department using funding provided in part through the USEPA Section 319 of the Clean Water Act and administrated through Illinois Environmental Protection Agency.

Chapter 5.0 Prioritized Action Plan

5.1 Introduction

A Prioritized Action Plan has been developed for the Madigan Creek watershed to provide stakeholders guidance on action items for watershed improvement practices. The Prioritized Action Plan serves as a "roadmap" for the implementation of the watershed-based plan and includes recommended watershed-wide and site specific best management practices (BMPs), a prioritized schedule for the implementation of the BMPs, recommendations on agencies and organizations responsible for plan implementation, and estimated BMPs costs.

The Prioritized Action Plan is divided into four subsections:

- Programmatic Action Plan
- Site Specific Action Plan
- Water Quality Monitoring Plan
- Education and Outreach Plan

The Programmatic Action Plan (Section 5.3) is focused on watershed-wide action items that are not site specific while the Site Specific Action Plan (Section 5.4) identifies specific and actual locations where water quality, hydrological modification, and/or flood reduction/prevention projects can be implemented. The Action Items were selected based on their ability to reach the goals and objectives identified by the WCWIPSC for the Madigan Creek watershed (see Chapter 2.0). For each Watershed-wide and Site Specific recommendation a priority ranking was assigned. Additionally, estimated costs and responsible entities for project implementation are also provided.

Section 5.5 includes the Water Quality Monitoring Plan. The Action Items identified in this plan have not been prioritized. However, recommendations on who, what and where the recommendations should be implemented are included.

Section 5.6 includes the Education and Outreach Plan. The Education and Outreach Plan highlights recommended actions that will need additional outreach and educations in order to be implemented.

The eight most important recommendations are summarized as follows:

1. Manage, retrofit, and stabilize the stormwater management system including detention basins and culverts, with focused attention on detention basins, to reduce runoff rate and volume and to improve water quality in the watershed.
2. Stabilize streambanks to reduce erosion, protect property and infrastructure, improve water quality, and improve habitat.
3. Remediate existing flood problems and prevent future flooding by reducing stormwater runoff and restoring areas for surface water storage and absorption such as floodplains, depressional storage areas, and wetlands, which also provide water quality improvement benefits.

4. Restore and manage stream corridors by restoring native riparian buffers, removing excessive debris, and stabilizing the streambed and streambanks with practices that also enhance habitat.
5. Use better stormwater management and low impact development practices for new and existing development that slow, filter, infiltrate, cool, and cleanse stormwater runoff.
6. Modify and use planning and development standards, policies, and capital improvement plans and budgets to protect and enhance water quality.
7. Provide public education and outreach to enhance understanding and appreciation of watershed resources and problems and to provide opportunities for people to get involved in watershed improvement activities.
8. Monitor and evaluate watershed plan implementation and physical watershed conditions to gauge progress towards watershed goals.

5.2 Implementation Partners

Implementation of the Prioritized Action Plan cannot be the responsibility of one watershed stakeholder. Successful plan implementation will require coordination and partnerships between numerous stakeholders in the watershed. Key stakeholders in the Madigan Creek watershed are listed in Table 5-1. A brief description of each stakeholder's role in watershed-plan implementation is also included.

Table 5-1 Key Watershed Stakeholders

Watershed Stakeholders	Abbreviation
Cherry Valley Township	CVT
Cherry Valley, Village of	CV
Corporate and Business Landowners	CBL
Developers and Builders	DB
Federal Emergency Management Agency	FEMA
Golf Courses	GC
Illinois Department of Natural Resources	IDNR
Illinois Department of Transportation	IDOT
Illinois Emergency Management Agency	IEMA
Illinois Environmental Protection Agency	Illinois EPA
Kishwaukee Ecosystem Partnerships	KREP
Residents/Owners	RO
Rock River Water Reclamation District	RRWRD
Rockford, City of	ROCK
Rockford Park District	RPD
Rockford Metropolitan Agency for Planning	RMAP
Rockford Township	RT
Winnebago County Soil Water Conservation District	WCSWCD
Winnebago County	WC
Winnebago County Watershed Improvement Plan Steering Committee	WCWIPSC
US Army Corps of Engineers	USACE

Corporate and Business Landowners (CBL)
The active participation of CBLs including the Cherry Vale Mall and commercial properties located along the State Street corridor in the planning process can lead to positive impacts on the quality of the Madigan Creek watershed. Businesses and commercial properties can become involved by retrofitting existing detention basins and swales, managing their grounds, roof runoff, and parking lots to reduce stormwater runoff volume and pollutant loadings, and sponsoring watershed events. Coordination with the CBL community can also lead to new development being designed to minimize runoff and pollutant loadings.

Developers & Builders (DB)
As discussed previously in the watershed-based plan, the design and construction of properties can significantly impact a watershed. Developers should be encouraged or required to utilize development techniques that protect water quality and stream health. Builders should properly install and maintain BMPs during the construction phase in order to reduce the potential for sediment-bearing water to be discharged to creek and natural areas.

Federal Emergency Management Agency (FEMA)
FEMA is the principal federal agency involved in flood mitigation and flood disaster response. FEMA is responsible for the National Flood Insurance Program, helps municipalities develop and enforce floodplain ordinances, develops floodplain maps, and administers funding for flood mitigation plans and projects.

Golf Courses (GC)
Golf courses can help reduce pollutant loadings, especially nutrients, as well as runoff volume by incorporating BMPs into their golf course management programs.

Illinois Department of Natural Resources (IDNR)
Several offices within IDNR provide services that will be key to the implementation of the Madigan Creek watershed plan for issues related to water resource management, habitat protection and management, wildlife management, invasive species control, and wetland management.

- The Office of Water Resources (OWR) is responsible for the regulation of floodplain development as well as for the implementation and funding of structural flood control and mitigation.
- The Office of Realty and Environmental Planning (OREP) is responsible for natural resource and outdoor recreation planning. It also administers the Conservation 2000 Ecosystems Program, which provides technical and financial assistance through a grant program to natural resource protection.
- The Office of Resource Conservation (ORC) reviews Clean Water Act Section 404 wetland permits for impacts on fish and wildlife resources; it manages threatened and endangered species issues; it also protects fisheries and other aquatic resources through regulation, ecological management and public education.

Illinois Department of Transportation (IDOT)
IDOT Region 2 is responsible for the planning, construction, and maintenance of portions of the transportation network that covers the Madigan Creek watershed. Incorporation of

BMPs into IDOT projects can help lead to improvements in the environmental quality of the watershed.

Illinois Emergency Management Agency (IEMA)
IEMA is responsible for flood and disaster planning, emergency response, and hazard mitigation. IEMA works with local governments on flood mitigation plans and provides operational support during floods. IEMA also administers FEMA-funded programs in the state, including flood mitigation grant programs.

Illinois Environmental Protection Agency (Illinois EPA) Bureau of Water
As discussed in Chapter 3, Under the Illinois EPA is responsible for the protection of the state's water resources and ensuring that Illinois' rivers, streams and lakes will support all uses for which they are designated including protection of aquatic life, recreation and drinking water supplies. The Illinois EPA also provides technical assistance and administers several state and federal grant programs, including Section 319 funding, which helps local governments, not-for-profits, and other stakeholders to complete projects that are aimed at reducing nonpoint source pollution.

Kishwaukee River Ecosystem Partnership (KREP)
The Kishwaukee River Ecosystem Partnership is a group of open space agencies, conservation organizations and local governments in the Kishwaukee River watershed organized under the auspices of the Illinois Department of Natural Resources to protect and restore the high water quality and habitat values of the river and its tributary streams.

Municipalities (all departments) including Cherry Valley (CV) and Rockford (ROCK)
Municipalities (i.e., local elected officials and local agency staff) have the principal responsibility for land use and development planning, establishing legislative and administrative policies, adopting ordinances and resolutions, setting zoning standards, establishing the annual budget, appropriating funds, and setting tax rates. Municipalities are a critical stakeholder in watershed protection efforts because they are responsible for the enforcement of local land use and development ordinances.

Residents and Owners (RO)
The activities of residential landowners, often unknowingly, can have a significant impact of the quality of a watershed. Practices such as excessive lawn fertilization application, disposal of trash and yard waste in waterways or encroachment riparian buffers can be significant sources of nonpoint pollution. Recommendations of the watershed-based plan should include education and outreach programs aimed at informing residents on consequences of their actions and presenting alternative actions. Additionally, political pressure from local residents on municipal or county officials can lead to increased efforts focused on water quality protection and flood remediation.

Rock River Water Reclamation District (RRWRD)
The RRWRD provides wastewater treatment service for watershed communities. The RRWRD maintains the sanitary sewer system in the watershed.

Rockford Parks Districts (RPD)
RPD maintains numerous recreational facilities and parks in the watershed. Partnerships with local park districts can help ensure the preservation of open space while also facilitating recreational and other community opportunities that can help increase support for watershed protection efforts.

Rockford Metropolitan Agency for Planning (RMAP)
The Rockford Metropolitan Agency for Planning (RMAP) is the transportation Metropolitan Planning Organization (MPO) for the Rockford region. Over the past several decades as the MPO process has advanced, the traditional ways that planning for transportation, land use and environmental issues were undertaken by different agencies is now taking a more integrated approach to civic planning. Since the RMAP MPO was reorganized in 2008, the planning horizons have expanded to become more active in other planning issues that alter the overall transportation planning process. RMAP's involvement in broader community collaborative activities that amalgamates overall regional issues with environmental sustainability is one our principal goals. Because of RMAP's involvement with the development of the regional Greenway Plan and its overall purpose of improving environmental quality, RMAP's technical assistance with the Winnebago County Watershed Improvement Plan Steering Committee matches into the strategy of protecting and restoring the region's natural resources.

Townships including Cherry Valley (CVT) and Rockford (RT)
While unincorporated townships generally play a secondary role in watershed protection, they often have responsibility for road upkeep and occasionally sponsor drainage system improvement projects. The use of BMPs by townships, especially for road maintenance, can help improve water quality and stream habitat within the watershed.

Winnebago County Soil and Water Conservation District (WCSWCD)
The Winnebago County Soil & Water Conservation District is a locally operated unit of government functioning under Illinois law. WCSWCD's mission is to promote the protection, restoration, and wise use of the soil, water, and related resources within the district. They provide technical and educational resources in the areas of soils and land use, water quality, soil erosion in both urban and agricultural land uses, conservation program needs, wildlife habitat, and native ecosystem restoration and management.

Winnebago County (WC)
Winnebago County is responsible for land use planning, development, natural resource protection, and drainage system management in the unincorporated areas of the Madigan Creek watershed. Working with the County and its public works, health, and transportation departments, can help ensure responsible, sustainable land use planning, road and sewer maintenance, and public health policies for the watershed.

Winnebago County Watershed Improvement Plan Steering Committee (WCWIPSC)
The Winnebago County Watershed Improvement Plan Steering Committee (WCWIPSC) is a consortium of municipalities in the watershed, resource agency professionals, environmental advocates, and local residents that established itself in April 2010 to guide the development of strategies to protect and restore Madigan Creek and its tributaries. It is likely that WCWIPSC will be the primary lead for the implementation of the watershed-based plan.

U.S. Army Corps of Engineers (USACE)
USACE plays a major role in wetland protection and regulation through Section 404 of the Clean Water Act, which requires USACE to administer permit applications for alterations to wetlands that are considered Waters of the United States.

5.3 Programmatic Action Plan

The Programmatic Action Plan includes recommended BMPs that are applicable watershed-wide and has been divided into two sections. The first section is focused on recommendations that are applicable across the watershed to meet the goals identified by the WCWIPSC. The second section provides a review of the existing stormwater and development ordinances applicable in the watershed and provides recommendations for changes aimed at improving water quality and stream health and the reduction of flooding in the watershed.

Section 5.3.1 Programmatic Action Plan

As discussed in Chapter 2, the watershed-wide goals identified by the WCWIPSC include:

A. Protect and enhance overall surface and groundwater quality in the Madigan Creek watershed
B. Reduce existing flood damage in the watershed and prevent flooding from worsening
C. Improve aquatic and wildlife habitat in the Madigan Creek watershed
D. Develop open space in the Madigan Creek watershed and provide recreational opportunities
E. Increase coordination between decision makers and other stakeholders in the watershed.
F. Raise stakeholder awareness (residents, public officials, etc) about the importance of best management practices of watershed stewardship

The Programmatic Action Plan including measures related to each goal. This Programmatic Action Plan includes remedial, preventative, regulatory, and maintenance action items that are applicable throughout the watershed. This Programmatic Action Plan should be considered as general guidance for all watershed stakeholders and plan implementers.

The Programmatic Action Plan is presented in table format (Tables 5-2 to 5-7). The tables include the recommended action item/BMP, priority, cost, responsible lead agencies or organization with greatest potential to implement the recommendation, and support agencies or agencies who could assist with technical, financial, or regulatory assistance or whose programs may be impacted by the recommendations. Each recommendation is given a unique ID number (ID#). As some recommendations appear in multiple tables, the ID number will link these recommendations.

Cost estimates are only provided for best management practices that involve construction or engineering costs such as streambank stabilization, native plantings, and feasibility studies. Costs are not included for preventative measures such as outreach and educational programs or regulatory actions. The cost estimates are included for advisory purposes only. The cost estimates are concept level costs and are most useful to compare the relative costs of the recommended BMPs. More detailed costs can be developed when site constraints are more fully investigated and preliminary engineering is conducted.

Each of the BMPs was assigned a priority status and classified as high (H), medium (M), or low (L). Priority status was assigned based on need, cost, potential funding opportunities, and technical needs. High priority action items should be considered short-term goals (1-5 years) while medium and low priority action items are considered long-term goals (greater than 5 years).

Goal A: Protect and enhance overall surface and groundwater quality

Objectives

1) Reduce sediment loading in streams by stabilizing stream banks.
2) Implement stormwater best management practices (BMPs) throughout the watershed to improve water quality and reduce runoff.
3) Retrofit existing stormwater management facilities and design new facilities within urbanized areas to reduce nutrient and sediment loading.
4) Restore riparian buffers along Madigan Creek and its tributaries.
5) Restore perennial base flow to Madigan Creek.
6) Implement infiltration BMPs throughout the watershed to encourage groundwater infiltration.
7) Educate the public about the need for groundwater protection.

As discussed in Chapter 3, stormwater runoff is one of the primary sources of water quality impairment in the watershed. The causes and sources of water quality impairment in the Madigan Creek watershed are directly related to the urban nature of the watershed. As the land use in the watershed moved from natural to agriculture to urban, corresponding modifications of the steam channel, floodplain, wetlands, and riparian corridor have occurred. Additionally, construction associated with the urbanization has lead to increase of impervious areas (roads, rooftops, parking lots, etc) that has directly caused an increase in the volume and rate of runoff in the watershed. This increase in runoff volume has lead to problems including streambank erosion and the deepening of the stream channel (channel incision). This increased erosion is leads to increased levels of total suspended solids (TSS) in the waterways. The urbanization has also lead to a flashy stream regime in the creeks where there are long periods of little to no flows during dry times and high velocity flows during and immediately after rain events. This flashiness is caused by efficient storm sewer systems that transport precipitation directly to the creeks during storm events. The impervious areas reduce infiltration to groundwater, which then reduces baseflow to the creeks. These low flows result in low dissolved oxygen levels that can impair aquatic habitat.

As of means of improving water quality, the use of stormwater best management practices (BMPs) and the preservation and restoration of the natural drainage system (overland flow paths, streams, and floodplain) should be required in all new development and encourages in areas that have been previously developed. Drainage and detention in existing areas should be retrofitted or repaired to better control runoff rates and volume as well as to improve water quality. Natural and existing drainageways should also be preserved and/or restored to the extent practicable to reduce the impacts of hydrologic modification within the watershed.

All landowners and stakeholders within the watershed have the ability to improve water quality by managing land and property to prevent or remove pollutants in runoff before they are washed into the stream. The implementation of stormwater BMP is the responsibility of all landowners (for existing development) and developers and builders (for new development). However, municipalities must require or encourage these practices to be installed. Preservation of remaining natural drainage and storage features of the landscape is the responsibility of the private and public land owners. Additionally, the management and maintenance of the stormwater management system (detention basins, storm sewer pipes, drainage swales, etc) is primarily the responsibility of municipalities, unless management of these features has been assumed by a homeowners association or other party.

Programmatic actions aimed at the protection and enhancements of surface and groundwater quality are listed in Table 5-2.

Table 5-2 Water Quality and Groundwater Programmatic Actions

ID#	Location	Recommendation/BMP	Goals + Objective	Priority	Lead Agency	Supporting Agency	Timeframe	Project Cost	Status
1	Watershed-wide	Implement a comprehensive water quality monitoring program aimed at assessing the current condition of the Madigan Creek watershed and to assess changes in water quality associated with the implementation of the watershed-based plan.	A1, C1	H	WCWIPSC; Illinois EPA; IDNR	RRRD	S	n/a	
2	Watershed-wide	Develop a Riparian Landowner Handbook to educate riparian landowners on their responsibilities and easement requirements.	A1, A4, C2	H	CV; ROCK; WC	CVT; RT; KREP	S	n/a	
3	Watershed-wide	Implement a waterside-wide stream maintenance program to remove debris and repair problem hydraulic structures.	A1, A2, A4, B2, C1	H	CV; ROCK; WC; RO	CVT; RT; IDOT	S	$20 per linear foot	
4	Watershed-wide	Conduct a detailed inventory of all detention and retention basins in the watershed to document storage capacity, vegetation, maintenance needs, etc to identify potential retrofit opportunities.	A1, A2, A3, B4	H	CV; ROCK; WC; RO	CVT; RT; IDOT	S	varies	
5	Watershed-wide	Develop a maintenance plan for all detention and retention basins in the watershed to ensure effective operation and provide maximum detention, water quality benefit, and habitat. The plan should identify who is responsible, a maintenance schedule, budget and funding source.	A1, A2, A3, B4	M	CV; ROCK; WC; RO	CVT; RT; IDOT	M	n/a	
6	Watershed-wide	Utilize naturalized detention basins in new development and retrofit existing single function dry bottom detention basins to provide multiple benefits including reducing pollutant loads and proving habitat. Upgrade and maintain existing basins to provide water quality benefits and slower release rates.	A1, A2, A3, A5, B4	M	CV; ROCK; WC; RO; CBL; DB	IDOT	M	varies	
7	Watershed-wide	Stabilize eroding shorelines and replace riprap, concrete and turf pond edges with native vegetation.	A1, A2, A3, C2	L	CV; ROCK; WC; RO; CBL; DB	IDOT	L	$100 per linear foot	

ID#	Location	Recommendation/BMP	Goals + Objective	Priority	Lead Agency	Supporting Agency	Timeframe	Project Cost	Status
8	Watershed-wide	Develop stream restoration guidelines to provide guidance to riparian landowners on methods of streambank stabilization, riparian buffer restoration, and other bioengineering techniques.	A1, A2, A4, C2	M	WCWIPSC	Illinois EPA; IDR; WCSWCD	M	n/a	
9	Watershed-wide	Review and updated local landscaping and stormwater requirements to promote the use of native vegetation in water quality BMPs.	A1, A2, A4, C2, D1	M	CV; ROCK; CVT; RT; WC	WCWIPSC	M	n/a	
10	Watershed-wide	Develop stormwater BMPs for handling residential stormwater including downspouts and sump pumps. Flow should be directed onto a lawn or areas landscaped with native vegetation.	A2, A5, B4	M	RO	WCWIPSC; WCSWCD	M	varies	
11	Watershed-wide	Encourage septic system owners to properly maintain their septic systems. Provide information on routine maintenance evaluations.	A2, A7	L	RO	WCH; CV; ROCK	L	n/a	
12	Watershed-wide	Develop recommendations for outreach regarding the importance of groundwater quality and quantity.	A6, A7	L	WCWIPSC; KREP	WCSWCD	L	n/a	
13	Watershed-wide	When replacing pavement or rebuilding roads, use pervious or porous pavement or permeable pavers where appropriate to increase infiltration and reduce runoff volumes.	A1, A2, A3, A5, B4	L	IDOT; CBL; DH	CV; WC; ROCK	L	$2 to $6 per square foot	
14	Watershed-wide	Retrofit roadways and parking lots to allow stormwater to enter infiltration BMPs (rain gardens, swales, etc)	A1, A2, A3, A5, B4	M	CBL; DH; IDOT	CV; WC; ROCK	M	$1 per linear foot to $650 per acre	
15	Watershed-wide	Where feasible, convert existing swales and open drainageways to infiltration BMPs with native landscaping.	A1, A2, A3, A5, B4	M	CV; ROCK; WC	IDOT	M	$1 per linear foot to $650 per acre	

ID#	Location	Recommendation/BMP	Goals + Objective	Priority	Lead Agency	Supporting Agency	Timeframe	Project Cost	Status
16	Watershed-wide	Encourage the implementation of stormwater BMPs in new developments and in redevelopment projects.	A1, A2, A3, A5, B4	M	CV; ROCK; WC; DB, CBL	Illinois EPA; RO	M	varies	

Goal B: Reduce existing flood damage in the watershed and prevent flooding from worsening

Objectives

1) Encourage decision makers to coordinate the completion of a detailed hydraulic and hydrology study of the watershed.
2) Mitigate for existing flood damage by identifying parcels suitable for flood mitigation projects such as compensatory storage basins.
3) Reconnect channelized stream segments to the floodplain where feasible.
4) Implement stormwater best management practices (BMPs) throughout the watershed designed to reduce runoff and encourage infiltration.
5) Protect undeveloped floodplain from development.

Flooding and risk of flooding is common throughout the Madigan Creek watershed. The flooding and increased flood risk is directly related to the impact of urban development which leads to increased impervious surfaces, increased rate and volume of stormwater runoff, and modifications to the floodplain and wetland areas. While the flooding noted in the watershed is not extensive in terms of area affected, the flooding is extremely destructive and disruptive to those suffering from the flood damage. As such, addressing the current and future flood problem areas is important for those affected for the overall impact of flood damage in the watershed. Current flooding that occurs in the watershed includes:

- Overbank flooding from a waterway
- Local drainage problems (shallow flooding on roads, yards and sometimes buildings) often due to development in a drainage way, inadequately maintained drainage ditches, undersized storm sewers, and storm sewers.
- Depressional flooding in areas where water ponds in a natural depression in the landscape and there is no natural outlet for runoff. May be caused by failed or sewer or adjacent or surrounding development causing increased runoff into the depressional area.
- Sanitary sewer backups may occur, flooding basements, when stormwater infiltrates into the sanitary sewer pipes, leaky manholes, or inappropriate connections to the sanitary lines.

Increasing drainage capacity for the flooded areas will likely require the installation of new or larger sewer pipes, larger culverts, or improving the capacity of drainageways and ditches. Additionally, the flood storage capacity of the areas could be increased through the construction new detention facilities or the retrofitting of existing facilities to increase storage capacity. Floodproofing options, such as raising structures or the low water entry points above the level of flooding are also available but are not typically preferred solutions as they don't address the source or cause of flooding.

Programmatic actions aimed at reducing existing flood damage and preventing the flooding from worsening are listed in Table 5-3.

Table 5-3 Flood Mitigation Programmatic Actions

ID#	Location	Recommendation/BMP	Goals + Objective	Priority	Lead Agency	Supporting Agency	Timeframe	Project Cost	Status
3	Watershed-wide	Implement a waterside-wide stream maintenance program to remove debris and repair problem hydraulic structures.	A1, A2, A4, B2	H	CV; ROCK; WC; RO	CVT; RT; IDOT	S	$20 per linear foot	
4	Watershed-wide	Conduct a detailed inventory of all detention and retention basins in the watershed to document storage capacity, vegetation, maintenance needs, etc to identify potential retrofit opportunities.	A1, A2, A3, B4	H	CV; ROCK; WC; RO	CVT; RT; IDOT	S	varies	
5	Watershed-wide	Develop a maintenance plan for all detention and retention basins in the watershed to ensure effective operation and provide maximum detention, water quality benefit, and habitat. The plan should identify who is responsible, a maintenance schedule, budget and funding source.	A1, A2, A3, B4	M	CV; ROCK; WC; RO	CVT; RT; IDOT	M	n/a	
6	Watershed-wide	Utilize naturalized detention basins in new development and retrofit existing single function dry bottom detention basins to provide multiple benefits including reducing pollutant loads and proving habitat. Upgrade and maintain existing basins to provide water quality benefits and slower release rates.	A1, A2, A3, A5, B4	M	CV; ROCK; WC; RO; CBL; DB	IDOT	M	varies	
13	Watershed-wide	When replacing pavement or rebuilding roads, use pervious or porous pavement or permeable pavers where appropriate to increase infiltration and reduce runoff volumes.	A1, A2, A3, A5, B4	L	IDOT; CBL; DH	CV; WC; ROCK	L	$2 to $6 per square foot	
14	Watershed-wide	Retrofit roadways and parking lots to allow stormwater to enter infiltration BMPs (rain gardens, swales, etc)	A1, A2, A3, A5, B4	M	CBL; DH; IDOT	CV; WC; ROCK	M	$1 per linear foot to $650 per acre	

ID#	Location	Recommendation/BMP	Goals + Objective	Priority	Lead Agency	Supporting Agency	Timeframe	Project Cost	Status
15	Watershed-wide	Where feasible, convert existing swales and open drainageways to infiltration BMPs with native landscaping.	A1, A2, A3, A5, B4	M	CV; ROCK; WC	IDOT	M	$1 per linear foot to $650 per acre	1
16	Watershed-wide	Encourage the implementation of stormwater BMPs in new developments and in redevelopment projects.	A1, A2, A3, A5, B4	M	CV; ROCK; WC; DB, CBL	Illinois EPA; RO	M	varies	
17	Watershed-wide	Conduct a detailed H&H model of the watershed to identify all flood problem areas	B1, B2, B3, B4, B5	H	WC	CV; ROCK	S	varies	
18	Watershed-wide	Identify flood mitigation opportunities in the watershed by additional storage and/or maintaining/improving the local drainage through the installation of new or larger sewer pipes, larger culverts, or improving or increasing the capacity of drainageways.	B2, B3, B4, B5	H	WC; CV; ROCK, RO	FEMA; CVT; RT; IDOT	S	varies	
19	Watershed-wide	Identify locations for and construction regional compensatory storage basins within the watershed	B2, B4	M	WC; CV; ROCK, RO	DH; CBL; USACE	M	varies	
20	Watershed-wide	Create/restore wetlands and depressional areas within the watershed	B2, B3	H	WCWIPSC; RPD	USACE	S	varies	
21	Watershed-wide	Identify locations where the incised stream channel can be reconnected to the floodplain	B1	H	WCWIPSC	CV; ROCK; WC; WCSWCD	S	varies	
22	Watershed-wide	Provide information to residents living within and along the 100-year floodplain on the benefits of a functional floodplain.	B5	L	WCWIPSC	FEMA	L	n/a	
23	Watershed-wide	Develop stormwater BMPs for handling residential stormwater including downspouts and sump pumps. Flow should be directed onto a lawn or in areas landscaped with native vegetation.	A2, A5, B4	M	RO; KREP	WCWIPSC; WCSWCD	M	varies	
24	Watershed-wide	Mitigate flood damages through floodproofing at-risk structures.	B4	L	RO; DB; CBL	FEMA	L	varies	

Goal C: Improve aquatic and wildlife habitat in the Madigan Creek watershed

Objectives

1) Identify opportunities for improving habitat along degraded stream channels using a natural channel design.
2) Restore riparian buffers along Madigan Creek and its tributaries.
3) Encourage local residents to utilize native species in their landscapes.
4) Identify opportunities for habitat improvements at parks and natural areas.

Streambank erosion is threatening property, damaging infrastructure, and degrading water quality and riparian habitat. Stabilization, restoration and management of the stream channel, streambank and riparian corridor are needed throughout the watershed to improve water quality, maintain floodplain functions, and improve aquatic and wildlife habitat both within and near the streams. Practices that are needed include restoring instream habitat such as pools and riffles, removing excessive debris from the stream channel, establishing naturalized streambanks with native plants, establishing natural stream channels by removing concrete, and managing stream corridors by restoring native riparian buffers.

Through easement agreements, most private landowners are responsible for maintaining the stream and riparian zone as it crosses their property or flows along a property line. This includes all aspects of management and maintenance including debris removal, stabilization of streambanks, and management of private stormwater outfall pipes such as sump pumps and downspouts. Exceptions to the private landowner responsibility exist where the stream flows through publically owned lands such as parks and within right-of-way easements. As problems within the stream and riparian corridor are directly related to land use and other activities upstream in the watershed, it is important that all landowners living within the watershed (not just those living adjacent to the creek) work together on implementing the watershed-based plan.

Programmatic actions for the improvement of aquatic and wildlife habitat are detailed in Table 5-4.

Table 5-4 Programmatic actions for the improvement of aquatic and wildlife habitat

ID#	Location	Recommendation/BMP	Goals + Objective	Priority	Lead Agency	Supporting Agency	Timeframe	Project Cost	Status
2	Watershed-wide	Develop a Riparian Landowner Handbook to educate riparian landowners on their responsibilities and easement requirements.	A1, A4, C2	H	CV; ROCK; WC	CVT; RT	S	n/a	
3	Watershed-wide	Implement a waterside-wide stream maintenance program to remove debris and repair problem hydraulic structures.	A1, A2, A4, B2, C1	H	CV; ROCK; WC; RO	CVT; RT; IDOT	S	$20 per linear foot	Watershed-wide
7	Watershed-wide	Stabilize eroding shorelines and replace riprap, concrete and turf pond edges with native vegetation.	A1, A2, A3, C2	L	CV; ROCK; WC; RO; CBL; DB	IDOT	L	$100 per linear foot	
8	Watershed-wide	Develop stream restoration guidelines to provide guidance to riparian landowners on methods of streambank stabilization, riparian buffer restoration, and other bioengineering techniques.	A1, A2, A4, C2	M	WCWIPSC	Illinois EPA; IDR; WCSWCD	M	n/a	
9	Watershed-wide	Review and updated local landscaping and stormwater requirements to promote the use of native vegetation in water quality BMPs.	A1, A2, A4, C2, D1	M	CV; ROCK, CVT; RT; WC	WCWIPSC	M	n/a	
25	Watershed-wide	Use bioengineering techniques in sections of hierologically modified channel to improve instream and streamside habitat.	C1,C 2	H	RO	USACE; IDNR	S	$50-$150 per linear foot	
26	Watershed-wide	Restore instream and riparian habitat in conjunction with road and bridge improvement projects.	C1,C2	M	IDOT; WC; CV; ROCK	USACE	M	Varies	
27	Watershed-wide	Provide information to residents and business owners on the benefits of native landscaping.	C3	L	WCSWCD	IDNR	L	n/a	
28	Watershed-wide	Promote native plant and native seed exchanges and/or sales.	C3	L	WCSWCD	IDNR	L	n/a	
29	Watershed-wide	Where feasible, replace failing or crude armoring and concrete line channels with more naturalized and habitat focused measures.	C1, C2	M	CV; ROCK; WC	RO	M	$250 per linear foot	

ID#	Location	Recommendation/BMP	Goals + Objective	Priority	Lead Agency	Supporting Agency	Timeframe	Project Cost	Status
30	Watershed-wide	Where feasible, daylight and re-meander streams that have been contained in ditches or moved underground into culverts and pipes.	C1, C2	L	RO; CV; ROCK; WC	IDNR	L	$575 per linear foot	
31	Watershed-wide	For moderately and severely eroded stream reaches, develop a stream restoration plan and cost estimate.	C1	M	WCWIPSC	IDNR, Illinois EPA	M	varies	
32	Watershed-wide	Establish native riparian buffers along all unbuffered or inadequately buffered stream reaches.	C2, C3, D1, D2	M	RO	CV, ROCK, WC	M	$25 per linear foot	
33	Watershed-wide	Restore streams and aquatic habitat to a health stream condition by installing habitat features such as natural channel substrates and pools and riffles.	C1	M	RO	CV, ROCK, WC, IDNR	M	$250-$500 per linear foot	
34	Watershed-wide	Prepare a Natural Areas Management Plan for all public lands in the watershed as a means of identifying opportunities for habitat improvement projects.	C4, D1, D2	L	RPD; CV	ROCK, WC	L	varies	
35	Watershed-wide	Prevent the spread and control existing populations of invasive plant species.	C4, D2	M	RPD	IDNR	M	Varies	

D. Develop open space in the Madigan Creek watershed and provide recreational opportunities

Objectives

1. Identify open space along the waterways that would provide access to the waterway.
2. Identify open space that provide natural resources protection and provide passive recreational opportunities.

With the exception of Southeast Community Park, very few areas in natural condition are found in the watershed. Open space and natural areas such as stream and riparian corridors, wetlands, and parks that remain undeveloped provide storm and flood water protection, serve as natural buffers for streams, and serve as passive and active recreational spaces for residents and visitors to the watershed. As such it is important for the watershed-based plan to identify ways of restoring/creating naturalized open space and improving access to creeks for recreational activities.

Programmatic actions for the development of open space and recreational opportunities are presented in Table 5-5.

Table 5-5 Programmatic actions for the development of open space and recreational opportunities

ID#	Location	Recommendation/BMP	Goals + Objective	Priority	Lead Agency	Supporting Agency	Timeframe	Project Cost	Status
35	Watershed-wide	Prevent the spread and control existing populations of invasive plant species.	C4, D2	L	RPD	IDNR	L	varies	
36	Watershed-wide	Form partnerships to develop grant applications for the protection of open space and the expansion of trails and greenways.	D1, D2	H	WCWIPSC	CV; ROCK; RPD; WC	S	n/a	
37	Watershed-wide	Establish native riparian buffers along all unbuffered or inadequately buffered stream reaches.	C2, C3, D1, D2	M	RO	CV; ROCK; WC	M	$25 per linear foot	
38	Watershed-wide	Identify opportunities for municipalities to encourage the use of green infrastructure and open space preservation in new developments.	D1, D2	L	WCWIPSC	CV; ROCK; WC	L	n/a	
39	Watershed-wide	Prepare a Natural Areas Management Plan for all public lands in the watershed as a means of identifying opportunities for habitat improvement projects.	C4, D1, D2	L	RPD; CV	ROCK; WC	L	varies	
40	Watershed-wide	Encourage all municipalities to incorporate the recommendation of the Boone and Winnebago County Greenway Plan into their comprehensive plan.	D2	H	WCWIPSC; KREP	RMAP; RO	S	n/a	

D. Increase coordination between decision makers and other stakeholders in the watershed.

Objectives

1. Ensure communities adopt the Madigan Creek Watershed-Based Plan.
2. Encourage the adoption and/or revision of comprehensive plans and ordinances that support the watershed plan's goals and objectives.
3. Encourage communities to continue to be an active member of the WCWIPSC following plan development.

Due to the nature of watershed, activities in one area of the watershed can impact water resources in another part of the watershed even when those areas seem distant and unconnected. And subsequently, the actions of all those living within the watershed have impacts, whether negative or positive, on the health of Madigan Creek and its tributaries. As such, the participation and coordination of all watershed stakeholders is necessary for water quality and habitat improvements and flood reduction in the watershed. No single person, municipality or entity can effectively implement with the watershed-based plan alone.

Many of the recommendations in the plan require technical expertise and require significant funding to implement. As such, coordination across property and jurisdictional lines is vital for the success implementation in plan. By working together, stakeholders can share expertise and equipment making projects that one entity could not do alone feasible. Additionally, available monies can be combined and leveraged for maximum benefits.

Programmatic actions for the development of coordination between decision makers and watershed stakeholders are presented in Table 5-6.

Table 5-6 Programmatic actions for the development of coordination between decision makers and watershed stakeholders

ID#	Location	Recommendation/BMP	Goals + Objective	Priority	Lead Agency	Supporting Agency	Timeframe	Project Cost	Status
41	Watershed-wide	Encourage the adoption of the Watershed-Based Plan by all jurisdictions located in the watershed.	D1, D2	H	WCWIPSC	CV; ROCK; WC	S	n/a	
42	Watershed-wide	Continue to meet as the WCWIPSC in order to facilitate plan implementation and conduct progress evaluations.	D1, D3	H	WCWIPSC	All stakeholders	S	n/a	
43	Watershed-wide	Members of the WCWIPSC should work together to prepare grant applications and develop funding packages for the implementation of the plan's recommendations.	D3	H	WCWIPSC	CV; RMAP; ROCK: RPD; WC	S	n/a	
44	Watershed-wide	Incorporate the watershed-based plan's goals, objectives, and recommendations in to municipal codes, regulations and comprehensive plans.	D1, D2, D3	M	WCWIPSC	CV; ROCK; WC	M	n/a	
45	Watershed-wide	Hire a watershed coordination to assist the WCWIPSC with plan implementation.	D3	M	WCWIPSC	CV; ROCK; WC	M	n/a	
46	Watershed-wide	Provide training and educational outreach to municipal officials and engineers on the goals, objectives, recommendations, and implementation of the watershed-based plan.	D1, D2	M	WCWIPSC	KREP	M	n/a	

E. Raise stakeholder awareness (residents, public officials, etc) about the importance of best management practices of watershed stewardship

Objectives

1. Encourage stakeholder to join the Kishwaukee River Ecosystem Partnership.
2. Encourage stakeholders to participate in WCWIPSC activities and educational workshops.
3. Provide watershed stakeholders with an education plan that gives them the skills needed to implement the watershed plan.

Even the best plan for managing watersheds and controlling nonpoint source pollution cannot succeed without community participation and cooperation. An aggressive public outreach and education program, therefore, is essential and must be nurtured. Because many water quality problems result from individual actions and the solutions are often voluntary practices, effective public involvement and participation to promote the adoption of management practices is necessary. The needed public buy-in and support is impossible unless stakeholders understand their role in watershed protection and restoration and are willing to make changes in their behavior that will help achieve overall watershed goals. A well designed and implemented education and outreach plan is necessary to facilitate changes in stakeholder's opinions and actions.

Programmatic actions for education and outreach are presented in Table 5-7.

Table 5-7 Programmatic actions for education and outreach

ID#	Location	Recommendation/BMP	Goals + Objective	Priority	Lead Agency	Supporting Agency	Timeframe	Project Cost	Status
46	Watershed-wide	Provide training and educational outreach to municipal officials and engineers on the goals, objectives, recommendations, and implementation of the watershed-based plan.	D1, D2, E3	M	WCWIPSC	KREP	M	n/a	
47	Watershed-wide	Offer workshops to homeowners on native landscaping and other stormwater BMPs.	E2, E3	M	WCWIPSC; KREP	IDNR; WCSWCD	M	n/a	
48	Watershed-wide	Encourage interested watershed residents to join the Kishwaukee Ecosystem Partnership.	E1	H	WCWIPSC		S	n/a	
49	Watershed-wide	Maintain the watershed planning website to keep the public informed on plan implementation activities.	E2, E3	H	KREP	WCWIPSC	S	n/a	
50	Watershed-wide	Hold watershed workshops in parks and other open spaces.	E2, E3	L	WCWIPSC;	WCSWCD; KREP; RPD	L	n/a	
51	Watershed-wide	Educate riparian property owners on ways to improve riparian conditions for water quality and habitat.	E3	L	KREP	WCSWCD	L	n/a	
52	Watershed-wide	Educate homeowners associations, developers, and municipalities about the importance of protecting open space, incorporating stormwater BMPs, and maintenance strategies for existing BMPs.	E2, E3	M	WCWIPSC	KREP	M	n/a	

Section 5.3.2 Regulatory Ordinance Review and Recommendations

A review of the existing regulations related to stormwater management was conducted. The stormwater management regulations govern strategies and stormwater management controls to improve water quality of runoff. They also play a primary role in addressing hydromodification, which has been identified as a primary cause of impairments in the waterway.

Regulations in the Madigan Creek watershed fall under three jurisdictions, Rockford, Cherry Valley and Winnebago County. All jurisdictions have very similar regulations regarding stormwater management. There are additional regulations and codes governing the prevention of water pollution through non-stormwater discharges, but the most applicable regulations related to active management of stormwater are listed below:

- Rockford, Illinois Code of Ordinances; Part II – Land Development Regulations; Chapter 109 – Flood Hazard Reduction; Article I. Surface Water Management; and Technical Requirements.
- Cherry Valley, Illinois Code of Ordinances; Chapter 50 – Planning; Article IV. Stormwater Detention
- Winnebago County Code, Article IV. Surface Water Management; and Technical Regulations.

The comments that follow apply to all jurisdictions (except as noted).

Regulated Development – The definition of developments subject to detention requirements is quite broad with only several reasonable exclusions (notably agriculture and existing single family dwellings). However the trigger of "developments which increase the amount of impermeable area" limits the ability to require detention as part of redevelopment activities. This language could be modified to require detention under a broader range of proposed development scenarios. One such modification would be to require detention for developments that propose "redeveloped impervious area," which can be defined as follows:

> ***Redeveloped Impervious Area.*** Redeveloped impervious area includes all of the impervious areas associated with a proposed development on a previously developed parcel. This includes new buildings, building additions, new parking lots, and reconfigured parking lots that will have revised drainage patterns and or new drainage structures. It does not include work such as seal coating, restriping, patch repairs or resurfacing of existing pavement with no change in the drainage patterns or drainage structures serving that pavement.

Release Rate – The required release rate is 0.2 cfs per acre for the 100-year event, which is identified as the natural safe stormwater drainage capacity of the downstream system. The basis for this release should be revisited if a detailed stormwater management plan is conducted for the watershed. In addition, many communities have developed a dual release rate requirement to provide additional stream protection due to higher peak flows and volumes in smaller storm events. A release rate of 0.04 cfs per acre in the 2-year event has been shown to offer enhance protection from the damaging effects of hydromodification.

Design Storm – While detention is required for the 100-year event, the technical source for rainfall depth (i.e. – Illinois Bulletin 70), and a rainfall duration are not specified in the regulations. These should be clarified.

Low flow conduits – Low flow conduits are required in dry detention basins. These conduits reduce any potential benefits that can be derived from a dry detention in small storm events. With proper inlet and outlet protection, dry detention basins do not require these conduits to maintain an acceptable appearance. The low flow conduits convey water across the basin bottom and limit any chance for infiltration or water quality benefits. The requirement for these low flow conduits should be removed from the regulations.

Automobile parking stormwater storage areas – By allowing storage of stormwater on parking lots, there is no opportunity to require other more beneficial types of storage that would allow for some infiltration and water quality improvements. In addition, most vehicles will sustain damage if flooded to the allowable depth of 1.5 feet. Consider removing this allowance altogether; allowing it for only a portion of the required detention, and/or lowering the depth of allowable storage.

Off-site tributary areas – It is encouraged that detention be provided to limit the release rate to 0.2 cfs per acre for the total acreage of the tributary watershed. However, a larger outlet may be permitted where large tributary areas are developed without detention. Then the regulations state that if the orderly management of stormwate runoff cannot be achieved by passing the entire tributary area through the stormwater storage area, the storage area shall be constructed to exclude the runoff from the tributary area outside of the area to be developed.

This sequence of rules starts with the requirement to provide storage for the entire tributary area. While this would be good for the watershed, it is doubtful that any developer would willingly construct detention for upstream non-detained areas if they are not required to do so. The second rule suggests that a release rate to account for bypass flow may be granted. This typically creates a de facto on-line detention basin. Depending on the ratio of upstream area and the allowable bypass release rate, online detention basins typically underperform and do not provide the anticipated hydrologic benefits. The final requirement to bypass upstream flow, which seems to be presented as a last resort, is the hydrologically preferred solution. Consider eliminating the possibility of flow-through detention basins and require upstream drainage to be routed around new detention basins.

Detention basins less than 0.3 acre feet – Requirements for detention basins less than 0.3 acre-feet may be waived. This is a missed opportunity to implement detention. If the communities feel strongly that detention basins of this size are undesirable, then consider converting this allowance to a fee-in-lieu of detention. Monies could then be collected and used for other watershed improvements to offset the impacts of new development.

Post construction runoff controls - The technical reference documents for Rockford and Winnebago County discuss both post construction runoff quantity and quality controls. For post construction runoff quantity control, detention volume reduction credit is offered to facilities that can be shown to infiltrate stormwater runoff. This may be a good way to incentivize best management practices and green infrastructure to reduce the volume of stormwater runoff discharged to surface waterways. Future revisions to regulations may wish to consider requiring these measures outright with no detention credit. The section on post construction runoff quality controls are quite brief and acknowledge that at this time these measures are simply encouraged. The local jurisdictions are aware that this section will require modification to maintain compliance with their community MS4 permits.

Section 5.4 Site Specific Action Plan

In addition to the programmatic recommendations, which generally apply watershed wide, site specific action items and recommendations are tied to a particular location in the watershed. As with the programmatic actions, these site specific recommendations were developed to address watershed problems, to improve watershed resources, and to achieve the watershed goals and objectives.

The process of identifying specific sites that are in need of, or suited to, watershed improvement projects has been ongoing during the planning process and will continue throughout plan implementation. Watershed improvement projects in the site specific plan range from small maintenance and repair tasks, to mid-size projects such as detention basin retrofits to the construction of large regional storage facilities.

During development of the watershed-based plan, several methods were used to identify project sites.

1) Members of the WCWIPSC provided site and project recommendations during meetings.
2) Watershed stakeholders provided site and project recommendations during public meetings.
3) Sites were identified based on results of previous watershed studies.
4) New data was collected during the field assessments conducted as part of the watershed planning process.
5) Extensive map analysis using existing data including land use, wetlands, soil, floodplain, etc.

The Site Specific Plan is presented in table format (Tables 5-7). The tables include the recommended BMP, priority, cost, responsible lead agencies or organization with greatest potential to implement the recommendation, and support agencies or agencies who could assist with technical, financial, or regulatory assistance or whose programs may be impacted by the recommendations. Each recommendation is given a BMP ID number (ID#).

The provide cost estimates are included for advisory purposes only. The cost estimates should not be interpreted as concept costs and are best used to compare the relative costs of the recommended BMPs. More detailed costs can be developed once site constraints and some preliminary engineering activities are conducted.

Each of the BMPs was assigned a priority status and classified as high (H), medium (M), or low (L). Priority status was assigned based on need, cost, potential funding opportunities, and technical needs. High priority action items should be considered short-term goals (1-5 years) while medium and low priority action items are considered long-term goals (greater than 5 years).

Table 5-8 Madigan Creek Watershed Site Specific Action Plan

BMP ID#	Location	Approximate Size	Recommendation/BMP	Priority	Lead Agency	Supporting Agency	Timeframe	Approximate Cost	Status
1	See Exhibit 5-4	4.3 acres	Retrofit detention basins with native vegetation.	H	CBL	ROCK	S	$14,000/acre	
2	See Exhibit 5-4	7 acres	Remove and replace turf grass with native vegetation. Also, conduct a detailed hydrologic/hydraulic study to investigate the feasibility of a detention basin.	L	WC		L	$5,000/acre	
3	See Exhibit 5-3	1,400 feet	Streambank stabilization with rock riffle features. Cost also includes approximate floodplain excavation for storage. A feasibility study should be undertaken to determine exact size of any potential storage area.	M	WC; WCWIPSC	RO	M	$350/foot	
4	See Exhibit 5-3	3,430 feet	Implement a combination of soft- and hard-stabilization practices. Also, conduct a detailed hydrologic/hydraulic study to determine storage feasibility within the reach.	H	WC; WCWIPSC	RO	S	$350/foot	
5	See Exhibit 5-4	1.05 acres	Repair berm adjacent to the Creek, along with re-grade and plant native vegetation in the detention basin.	H	RO; WCWIPSC	WC	S	$20/sq-yd	
5a	See Exhibit 5-1	1,300 feet	Convert to grass swale/bioswale.	L	CV; WCWIPSC	RO	L	$50/foot	
6	See Exhibit 5-3	1,980 feet	Implement soft-stabilization practices in the reach. Also, conduct a detailed hydrologic/hydraulic study to determine storage feasibility within the reach.	H	WC; WCWIPSC	RO	S	$150/foot	

BMP ID#	Location	Approximate Size	Recommendation/BMP	Priority	Lead Agency	Supporting Agency	Timeframe	Approximate Cost	Status
7	See Exhibit 5-3	4,670 feet	Concrete channel removal with stream restoration and stabilization. Also, conduct a detailed hydrologic/hydraulic study to determine storage feasibility within the reach.	M	WC; ROCK		M	$100/foot	
8	See Exhibit 5-4	4.24 acres, 14 Ac-ft	Construct detention basin with up to 14 Ac-ft of storage. A detailed hydrologic/hydraulic study should be completed support the preparation of a conceptual design for a detention basin at this location. Final cost would be contingent on the size of the basin and overall complexity.	H	WC		S	$210,000/Ac-ft of storage	
9	See Exhibit 5-1	2,250 feet	Install a grass swale/bioswale along the boulevard.	H	CV	WC	S	$50/foot	
10	See Exhibit 5-4	5.1 acres	Remove the concrete channel in two detention basins and perform associated grading and planting of native vegetation. Conduct a detailed hydrologic/hydraulic study to determine the feasibility for storage increase.	L	ROCK; CBL	WCWIPSC	L	$60,000/acre	
11	See Exhibit 5-4	3.4 acres	Armoring of the swale north of the floodplain/storage area. Additional items include excavation of floodplain/storage area along with native vegetation planting. Conduct a detailed hydrologic/hydraulic study to determine exact storage feasibility.	M	CV		M	$40/sq-yd	

BMP ID#	Location	Approximate Size	Recommendation/BMP	Priority	Lead Agency	Supporting Agency	Timeframe	Approximate Cost	Status
12	See Exhibit 5-4	2.07 acres	From an initial review, accommodating additional storage at this location would be difficult because of limited space and the lack of impact additional storage would have. It is recommended that resources be utilized elsewhere.	L	WC		L	-	
13a1	See Exhibit 5-4	0.60 acres	Remove and replace turf grass with native vegetation. A detailed hydrologic/hydraulic study should be completed to see if additional storage can be implemented at this location.	L	ROCK; CBL		L	$15/sq-yd	
13a2	See Exhibit 5-4	0.85 acres	Remove concrete channel in the basin bottom along with re-grading and planting native vegetation. Conduct a detailed hydrologic/hydraulic study to determine if an increase in storage is feasible.	M	ROCK; CBL		M	$20/sq-yd	
13a3	See Exhibit 5-4	0.42 acres	Remove concrete channel in the basin bottom along with re-grading and planting native vegetation. Conduct a detailed hydrologic/hydraulic study to determine if an increase in storage is feasible.	M	ROCK; CBL		M	$25/sq-yd	
13a4	See Exhibit 5-4	0.56 acres	Remove concrete channel in the basin bottom along with re-grading and planting native vegetation. Conduct a detailed hydrologic/hydraulic study to determine if an increase in storage is feasible.	M	ROCK; CBL		M	$25/sq-yd	
13a5	See Exhibit 5-4	0.94 acres	Remove concrete channel in the basin bottom along with re-grading and planting native vegetation. Conduct a detailed hydrologic/hydraulic study to determine if an increase in storage is feasible.	L	ROCK; CBL		L	$20/sq-yd	

BMP ID#	Location	Approximate Size	Recommendation/BMP	Priority	Lead Agency	Supporting Agency	Timeframe	Approximate Cost	Status
13a6	See Exhibit 5-2	1.4 acres	Remove pavement in select parking stall areas and install permeable pavers. Underdrains are not accounted for in the cost estimate.	L	CBL	ROCK	L	$15/sq-ft	
13a7	See Exhibit 5-4	2.8 acres	Remove concrete channel in the basin bottom along with re-grading and planting native vegetation. Conduct a detailed hydrologic/hydraulic study to determine if an increase in storage is feasible.	M	ROCK; CBL		M	$20/sq-yd	
13a8	See Exhibit 5-4	1.4 acres	Remove concrete channel in the basin bottom along with re-grading and planting native vegetation. Conduct a detailed hydrologic/hydraulic study to determine if an increase in storage is feasible.	L	ROCK; CBL		L	$25/sq-yd	
13a9	See Exhibit 5-2	1.08 acres	Remove pavement in select parking stall areas and install permeable pavers. Underdrains are not accounted for in the cost estimate.	M	CBL	ROCK	M	$15/sq-ft	
13a10	See Exhibit 5-2	0.75 acres	Remove pavement in select parking stall areas and install permeable pavers. Underdrains are not accounted for in the cost estimate.	L	CBL	ROCK	L	$15/sq-ft	
13a11	See Exhibit 5-2	1.25 acres	Remove pavement in select parking stall areas and install permeable pavers. Underdrains are not accounted for in the cost estimate.	M	CBL	ROCK	M	$15/sq-ft	
13a12	See Exhibit 5-2	1.14 acres	Remove pavement in select parking stall areas and install permeable pavers. Underdrains are not accounted for in the cost estimate.	L	CBL	ROCK	L	$15/sq-ft	

BMP ID#	Location	Approximate Size	Recommendation/BMP	Priority	Lead Agency	Supporting Agency	Timeframe	Approximate Cost	Status
13a13	See Exhibit 5-4	1.37 acres	Remove concrete channel in the basin bottom along with re-grading and planting native vegetation. Conduct a detailed hydrologic/hydraulic study to determine if an increase in storage is feasible.	L	ROCK; CBL		L	$20/sq-yd	
13a14	See Exhibit 5-4	0.73 acres	Remove concrete channel in the basin bottom along with re-grading and planting native vegetation. Conduct a detailed hydrologic/hydraulic study to determine if an increase in storage is feasible.	M	ROCK; RO		M	$20/sq-yd	
13a15	See Exhibit 5-4	0.68 acres	Remove concrete channel in the basin bottom along with re-grading and planting native vegetation. Conduct a detailed hydrologic/hydraulic study to determine if an increase in storage is feasible.	M	ROCK; RO		M	$20/sq-yd	
13a16	See Exhibit 5-4	4.47 acres	Remove pavement in select parking stall areas and install permeable pavers. Underdrains are not accounted for in the cost estimate.	M	CBL	ROCK	M	$15/sq-ft	
13b	See Exhibit 5-1	740 feet	Re-grade and plant a grass swale/bioswale with native vegetation. If a storage increase is desired then a detailed hydrologic/hydraulic study should be completed.	L	ROCK		L	$150/foot	
13c	See Exhibit 5-4	16 acres	Create floodplain/detention storage next to the Creek with possible channel relocation. A detailed hydrologic/hydraulic study should be completed to support the preparation of a conceptual design for the project. Final cost would be contingent on the size of the basin and overall complexity.	H	ROCK		H	$180,000/acre	

BMP ID#	Location	Approximate Size	Recommendation/BMP	Priority	Lead Agency	Supporting Agency	Timeframe	Approximate Cost	Status
14	See Exhibit 5-3	8.54 acres	Implement a combination of hard- and soft-stabilization practices in this reach. Cost includes re-grading of the floodplain area and rock riffles. Conduct a detailed hydrologic/hydraulic study and associated floodplain map revision applications as work is contained within a FEMA Zone AE floodplain.	H	CV		H	$350/foot	

5.5 Water Quality Monitoring Plan

As detailed in Section 3.14, limited water quality monitoring data is available for the Madigan Creek watershed. A comprehensive water quality monitoring program should be implemented in the Madigan Creek watershed aimed at assessing the current condition of the Madigan Creek watershed and to assess changes in water quality associated with the implementation of the watershed-based plan. A quality assurance project plan (QAPP) should be developed for the comprehensive monitoring program.

Chemical and Physical Water Quality Monitoring

Baseline Sampling

Baseline sampling is regularly scheduled water quality sampling designed to obtain a long term record of water quality in the watershed. Sampling is typically conducted on a weekly, monthly, or yearly basis. Baseline chemical and physical water quality monitoring typically includes monitoring for nutrients, suspended solids, water clarity, dissolved oxygen, temperatures, conductivity, and pH. Due to the frequency of sampling, a baseline program can be expensive so budget is a significant consideration in determining the number of sampling sites and the frequency of the sampling.

It is recommended that two types of baseline stream sampling be conducted in the Madigan Creek watershed: 1) sampling of the main stem of Madigan Creek near its confluence with the Kishwaukee River (1 site) and 2) sampling of the three major tributaries near their confluence with Madigan Creek (3 sites). Baseline sampling of the main stem of Madigan Creek will give an overall picture of stream health of the entire watershed. Sampling of the tributaries will provide data on the pollutant loading from the each of major tributaries. The sites along the main stem should be sampled on an annual basis with sampling conducted every 3-5 years on the tributaries. See Table 5-9 and Figure 5-5 for details and the locations of the recommended baseline sampling sites. The table also includes recommendation of potential responsible parties for the sampling.

At each sampling site, it is recommended the following parameters being analyzed as part of the baseline sampling program:

- Temperature
- Conductivity
- pH
- Dissolved Oxygen
- Total Suspended Solids (TSS)
- Total Nitrogen (TN)
- Total Phosphorus (TP)

It is recommended that the water quality samples for TSS, TN, and TP be collected using grab sampling methods. Samples should be collected using careful collection and handling procedures to ensure that the samples are representative and uncontaminated. The collected samples should be submitted for analysis at an Illinois Environmental Protection Agency (Illinois EPA) accredited lab. Temperature, conductivity, pH, and dissolved oxygen measurements should be collected in the field using portable instruments. To ensure the proper collection and handling, a Quality Assurance Project Plan (QAPP) should be developed for the baseline sampling program.

Table 5-9 Recommended Water Quality Monitoring Sites in the Madigan Creek Watershed

Sampling Program	**Site Location (see Figure XX)**	**Sampling Frequency**	**Indicators Tested**	**Recommended or Existing Sampling Parties**
Baseline Sampling	Madigan Creek at confluence with Kishwaukee River	Annually	Physical and Chemical	
Baseline Sampling	3 tributaries at confluence of Madigan Creek	Every 3-5 years	Physical and Chemical	
Stormwater Sampling	Baseline Sampling sites	Every 3-5 years	Physical and Chemical	
Macroinvertebrates	Madigan Creek at confluence with Kishwaukee River	Every year	Biological	RiverWatch
Fish	Madigan Creek at confluence with Kishwaukee River	Every 5 years	Biological	IDNR and Illinois EPA
Hydrologic Sampling	Throughout watershed	Every 3-5 years	Flow, water, level, erosion and deposition	
Project Implementation	Varies	Pre and post project construction	Physical, Chemical, Biological, and Habitat	Varies

Stormwater Sampling

Stormwater sampling is water quality sampling immediately following storm events designed to quantify pollutant loading to the creek from runoff events. This information is useful in refining the pollutant loading calculations generated by the PLOAD model to better reflect watershed conditions. It is recommended that stormwater sampling be conducted at each of the four baseline sampling sites at a frequency of every 3-5 years, depending on budget constraints. Stormwater samples should be collected within 12 hours of a significant rainfall event (>1.0 inches) and all 4 stormwater samples should be collected on the same day. The stormwater sampling program should mirror the baseline sampling program in regards to analyzed parameters, sampling methods, and quality assurance/quality control.

Table 5-9 and Figure 5-5 includes the details and the locations of the recommended stormwater sampling sites. The table also includes recommendations of potential responsible parties for the sampling.

Biological Monitoring

Monitoring the biological communities including macroinverterbrates and fish are extremely useful for assessing the health of a stream system. As both fish and macroinvertebrates live in water for all or part of their lives, their survival is related to water quality. These animals are sensitive to different chemical and physical conditions in the water such as increased water pollution or changes in water flow. As such, the richness of fish and macroinvertebrate community composition in a stream or river can be used to provide an estimate of stream health.

Macroinvertebrate Sampling

It is recommended that RiverWatch continue to conduct benthic macroinvertebrate sampling on Madigan Creek near its confluence with the Kishwaukee River. As discussed in Section 3.11, a RiverWatch sampling site was established at this location during the development of the watershed plan. This site should be sampled on a yearly basis to provide a baseline on the overall health of the Madigan Creek stream system. Baseline sampling at this location will also provide information on water quality changes resulting from the implementation of the watershed plan.

Macroinvertebrate sampling should also be conducted in stream segments immediately preceding and following the completion of stream restoration and stream habitat enhancement project completed during the implementation phase of the watershed plan. Macroinvertebrate sampling should be conducted prior to the construction of the project and 1-3 years following the completion of the project in order to quantify the success of the project on improving water quality and instream habitat conditions.

Fish Sampling

It is also recommended that watershed stakeholders work with the Illinois Department of Natural Resources (IDNR) and the Illinois Environmental Protection Agency (Illinois EPA) to establish a fish sampling site along Madigan Creek near its confluence with the Kishwaukee River.

Table 5-9 and Figure 5-5 includes the details and the locations of the recommended biological sampling sites. The table also includes recommendation of potential responsible parties for the sampling.

Habitat Assessment

The *Rapid Bioassement Protocol (RPB) for Stream and Rivers* provides a cost effective, straightforward and accurate means for evaluating and assessing instream and riparian habitat condition. It is recommended that the RBP for habitat be conducted in stream segments immediately preceding and following the completion of stream restoration and stream habitat enhancement project completed during the implementation phase of the watershed plan. The RBP evaluation should be conducted prior to the construction of the project and 1-3 years following the completion of the project in order to quantify the success of the project on improving instream and riparian habitat conditions. Details on the RBP for Habitat are included in Section 3.11.

Hydraulic and Hydrological Sampling

To supplement the water quality and habitat monitoring conducted in the Madigan Creek watershed, it is important to also assess hydraulic and hydrological conditions of the watershed. As described in the previous sections of the watershed plan, a significant portion of the watershed has been developed with no or inadequate stormwater control. This has lead to increases in the total volume and rate of stormwater entering the stream system causing high fluctuations in the water levels and flows in the watershed. These rapidly changing fluctuations are the predominate cause of the hydromodification that is prevalent throughout the watershed. In order to understand and define these hydrological impacts, it is recommended that stream flow and stage monitoring be conducted in the Madigan Creek watershed. When combined with the water quality data, the collected stream flow and stage monitoring data will also be useful in refining pollutant load calculations in the watershed.

Flow and water level monitoring

Four sites in the Madigan Creek watershed have been identified for stream flow and stage monitoring. It is recommended that stream flow and water level measurements be based on the methodology outlined in *Discharge measurements at Gaging Stations, U.S. Geological Survey, Techniques of Water-Resources Investigations, Book 3, Chapter A8* by T.J. Buchanan and W.P. Somers. It is recommended that the stream flow and water level be integrated into the baseline and stormwater sampling monitoring program of the sites located on Madigan Creek and its 3 major tributaries. All four sites should be monitored on the same day.

Additional sites for stream flow and stage monitoring may be identified during future Hydraulic and Hydrologic efforts and should be added as necessary.

Stream Bank and Bed Erosion and Deposition Measurements

Stream bank and bed erosion and deposition measurements should be collected at three locations in the Madigan Creek River watershed at locations that represent typical conditions for the stream network. It is recommended that stream bank and bed erosion and deposition be quantified using the following methods:

- Erosion pins
- Erosion chains
- Stream cross-sections

An erosion pin is a marker, a steel rod 48-inch long, should be driven into the stream bank. Approximately 4-inches of the pins are exposure at the soil surface. The head of the erosion pin is considered as a fixed reference and changes in its height are interpreted as changes in the elevation of the surrounding ground surface. Measured over time the erosion pins provide a measurement of recession or deposition rates. The stream banks on Madigan Creek are relatively high due to hydromodification and channelization of much of the stream; therefore, it is recommended that the pins be placed at the following locations on the bank:

- Upper Level
- Mid Level
- Water Level
- Lower bank underwater

Measuring at the various locations on the bank provide the investigators an understanding of which portions of the banks are providing different amounts of soil. Erosion rates for each study reaches are based on an average of the pin erosion rates and measurements of the lineal and vertical extent of exposed bank representative of the reach.

To measure streambed scour, scour chains should be used. Scour chains are steel chains implanted vertically in streambeds to measure scour and fill of sediments over a period of time. The technique is based on the concept that bed load movements in streams occurs as discrete scour and fill events along the stream channel. During high flows, the streambed is scoured and the exposed portion of the scour chain lies over to the depth of scour. The portion of the chain now parallel to the streambed records the depth of the scour. As peak flows recede, deposition occurs, and the scour chain is buried. The depth of burial indicates the depth of deposition.

To confirm the rates of erosion and deposition at each study reach, stream-cross-sections should also be surveyed.

Table 5-9 and Figure 5-5 includes the details and the locations of the recommended hydraulic and hydrology sampling sites. The table also includes recommendation of potential responsible parties for the sampling.

5.6 Education and Outreach Plan

The cumulative actions of thousands of individuals can either improve water quality, flooding, and natural resources or further degrade them. As such a watershed-based plan must include a strategy to educate and inform watershed stakeholders about watershed issues and encourage them to take an active role in implementing the watershed-based plan. Because many watershed problems are caused by individual actions and their solutions are often voluntary practices, effective public involvement and participated are necessary for the successful implementation of the plan. Furthermore, the general public is often unaware of the environmental impact their day to day activities have on the watershed's resources. With an understanding of watershed issues, watershed stakeholders can play a critical role in protecting and restoring water quality.

This section of the Action Plan includes:

- Primary goals addressed by each action;
- Targeted audiences and partner organizations;
- Best package (vehicle) for the action message for delivery to the targeted audience;
- Lead and supporting organizations; and
- Potential outcomes

The WCWIPSC Education Committee will lead the efforts to build and implement the education and outreach campaign.

5.6.1 Education and Outreach Strategy for the Madigan Creek watershed

Development of an effective Education and Outreach Plan begins by defining E&O goals and objectives. WCWIPSC specifically addressed watershed information and education issues by developing an education goal. The education goal for the plan reads:

F. Raise stakeholder awareness (residents, public officials, etc) about the importance of best management practices of watershed stewardship

The E&O Plan includes program needs related to each of the watershed goals outlined in Chapter 2. Table 5-10 includes the E&O Plan for the Madigan Creek watershed.

5.6.2 Target Audience

The primary target audiences for the Education and Outreach (E&O Plan are 1) residents and other landowners, 2) Land and resource managers and organizations, 3) Government officials and agencies, and 4) Developers and contractors. Each of these targeted audiences can be broken down into more specific sub-groups as detailed below:

1. Residents, other landowners, and visitors
    a. Riparian landowners and residents (RR)
    b. Non-riparian landowners and residents (NR)
    c. Homeowner Associations (HOA)
    d. General public and visitors (GP)
    e. Businesses and industrial properties (BI)
2. Land and resource managers and organizations
    a. Land and resource managers including golf courses and farmers (LM)
    b. Organizations, committees, and special interest groups involved in water resource management (OG)
3. Government officials and agencies
    a. Local governments including municipalities, townships, park districts, health departments, transportation departments, and other departments that manage land within the watershed (LG)
    b. Schools (S)
4. Developers and contractors
    a. Developers and home builders (DH)
    b. Consultants and contractors including civil engineers, planners, and landscapers (CC)

The abbreviations are keyed to the Education and Outreach Plan in Table 5-10.

To determine programming needs for each audience, WCWIPSC Education Committee should reach out and speak with representatives from each group to determine their level of understanding of watershed issues. The intent of this plan is to include both existing partners, as well as stakeholders that have previously not been participants in the watershed planning process. It is critical that the E&O Plan address the needs of both groups.

5.4.3 Partner Organizations

Organizations that can assist with the implementation of the Education and Outreach Plan are the same as those charged with implementing the Programmatic and Site Specific Action Plans. These same organizations may also serve as targeted audiences for programs. These organizations are listed in Section 2 of this chapter.

5.4.4 Evaluating the Education and Outreach Plan

Actual reduction in water quality and habitat degradation in the watershed is perhaps the best indication that the Education and Outreach Plan is successful. Although it is extremely difficult to attribute water quality and habitat improvement to a specific action item in the Education and Outreach Plan, there is little doubt that increased knowledge and understanding of watershed issues and solutions is essential to improving water quality and stream health and reducing flooding in the watershed. As such, it is extremely important to regularly evaluate the E&O plan to ensure the programs are being effective. Evaluation conducted early in the process will help determine which programs are meeting their goals and which are not. This will allow for timely refinements to the E&O program to maximize efforts and facilitate plan implementation. Chapter 6, Section 6.5.1 contains "Report Cards" with milestone related to watershed education that can be used to access the E&O efforts.

Table 5-10 Education and Outreach Action Plan

Education Action	Primary Goal	Target Audience	Package (vehicle)	Lead and Supporting Organizations	Outcomes/Behavior Changes
Educate the public about general watershed issues.	All Goals	GP	• Signs at stream crossings and watershed boundaries. • Messages in community newsletters. • Post watershed maps in public buildings.	WC; ROCK; CV; WCWIPSC; KREP	• General public participate in watershed events and activities. • General public requests additional information on watershed activities.
Educate the public that a watershed-based plan has been developed for the watershed to gain interest for implementing Action Items.	All Goals	GP	• Website. • Public interest message on radio. • Articles in newspaper.	WCWIPSC; KREP	• General public requests additional information on watershed-based plan. • Majority of watershed residents have a working knowledge of watershed conditions and know how to get involved in plan implementation. • Public begins to make small changes in day to day behaviors aimed at improving water quality and habitat in the watershed.
Maintain the watershed planning website	All goals	All stakeholders	• Maintain the website to keep the public informed on plan implementation activities.	WCWIPSC; KREP	• Increase in the number of visitors to the website. • Website users have information related to the watershed including potential and ongoing projects, watershed problems, and a calendar of upcoming events.
Provide training and educational outreach to municipal officials and engineers on the goals, objectives, recommendations, and implementation of the watershed-based plan.	All goals	CC; WC; ROCK; CV	• Meet with elected boards to promote the Watershed-Based Plan. • Meet with consulting engineers to promote the Watershed-Based Plan.	WCWIPSC	• All elected officials are familiar with the Watershed-Based Plan. • Local governments adopt the Watershed-Based Plan.

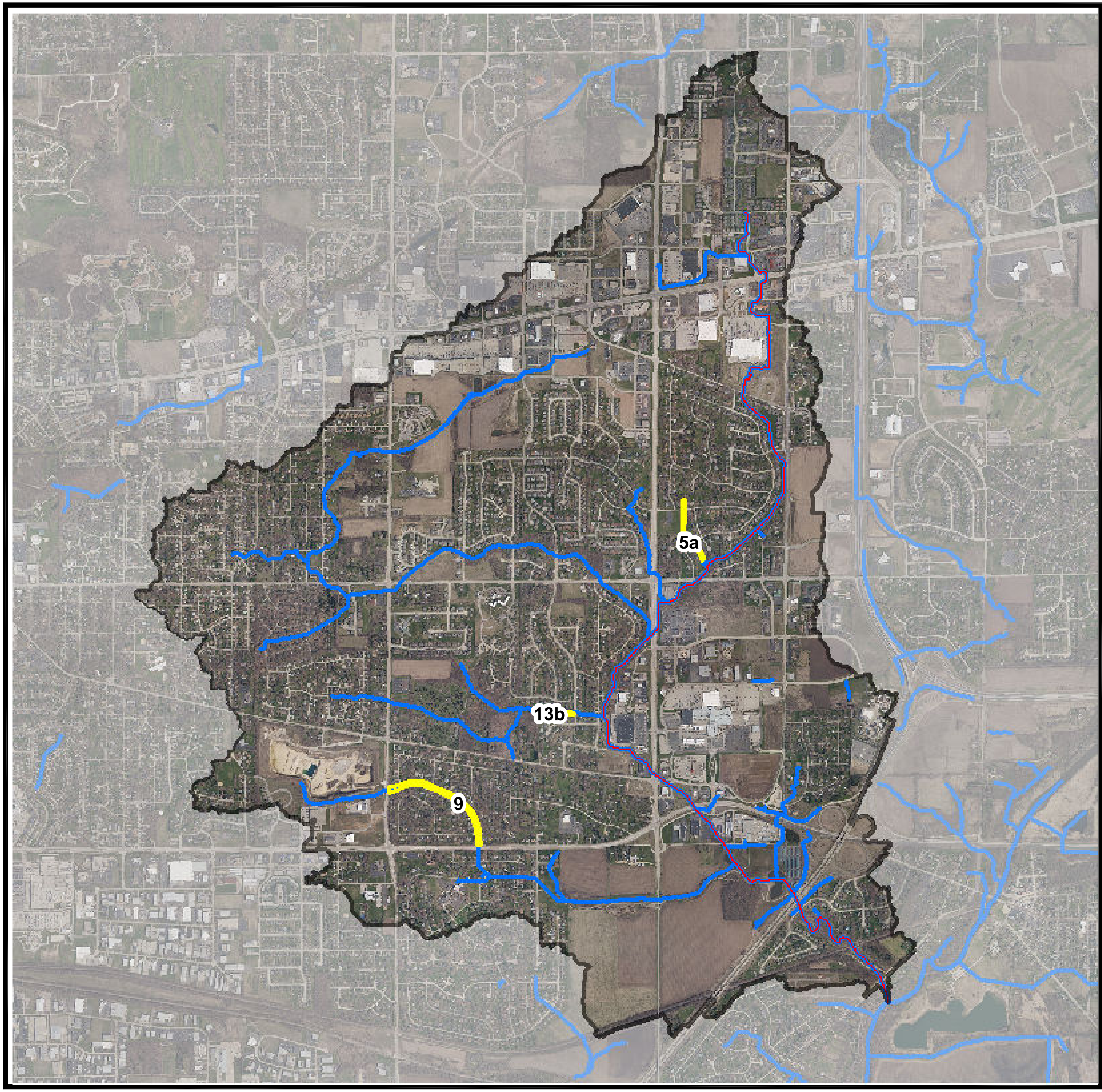
Education Action	Primary Goal	Target Audience	Package (vehicle)	Lead and Supporting Organizations	Outcomes/Behavior Changes
Educate riparian landowners on their responsibilities and easement requirements.	A & C	RL	• Hold riparian owner training workshops. • Develop and distribute an information booklet/pamphlet.	WC; ROCK; CV; WCWIPSC; KREP	• Number of reported debris blocks decrease. • Problems are reported to the proper authorities.
Educate homeowners on how to best maintain septic systems	A	RR, NR	• Distribute educational letters to all residents with septic systems.	WC	• Owners act quickly to mitigate and repair problems with their septic system. • Owners understand the impact poorly maintained and broken septic systems have on water quality.
Educate the general public on the importance of groundwater quality and quantity.	A	GP	• Hold education workshops to educate the general public on groundwater related issues. • Hold field trips to educate the general public on the importance of groundwater recharge.	WC; WCWIPSC	• Attendees gain a better understanding of groundwater related issues. • Attendees inform their neighbors of information they learned at the workshops and field trips.
Educate owners/developers of existing and new developments on ways to reduce volume and rate of stormwater runoff.	A & B	HOA, BI, DH, CC, WC, ROCK, CV	• Meet on a case-by-case basis to develop strategies and incentives for reducing impervious areas. • Distribute fliers to existing HOAs and businesses that highlight the benefits and funding sources for retrofitting existing stormwater management facilities. • Hold training seminars on stormwater BMPs. • Install stormwater BMP demonstration projects.	WCWIPSC; KREP	• Municipalities, businesses, and HOAs realize the potential that naturalized detention basins have to improve water quality and reduce flooding. • Municipalities, businesses, and HOAs implement maintenance programs for all existing stormwater management facilities.

Education Action	Primary Goal	Target Audience	Package (vehicle)	Lead and Supporting Organizations	Outcomes/Behavior Changes
Educate municipalities, HOAs, and businesses on importance of and how to maintain naturalized detention basins.	A, B, C, & D	RR, HOA, BI, WC, ROCK, CV	• Meet with landowners, municipalities, and others who manage these facilities. • Develop and distribute an information booklet/pamphlet. • Hold technical workshops that provide information on detention basin retrofits and stress maintenance needs for existing facilities.	WCWIPSC	• Number of retrofit projects increase. • Detention basins are monitored, maintained, and repaired on a regular basis.
Educate HOA, developers, and municipalities about the importance of protecting open space.	A, C & D	DH, CC, HOA, WC, ROCK, CV	• Meet on a case-by-case basis to develop strategies and incentives for developing and preserving open space. • Municipalities use zoning to protect open space and natural areas. • HOAs and developers allocate funding to the protection and restoration of open space. • Distribute copies of the Winnebago and Boone County Green Infrastructure Plan. • Presentations on open space at community and board meetings.	WCWIPSC; WCSWCD	• Voluntary preservation and restoration of open space. • Linear feet of trail in the watershed increases. • Number of municipalities adopting the Winnebago and Boone County Green Infrastructure Plan increase. • Number of government officials and board members reached at community meetings.
Educate municipalities and landowners on stream maintenance strategies aimed at removing debris and repairing problem hydraulic structures.	A & B	RR, HOA, WC, ROCK, CV	• Meet with landowners, municipalities, and others who manage these facilities. • Hold training seminars on stormwater infrastructure management.	WCWIPSC; KREP; Illinois EPA	• Number of reported debris blocks decrease. • Number of reported culvert issues decrease. • Infrastructure problems are reported to the proper authorities.

Education Action	Primary Goal	Target Audience	Package (vehicle)	Lead and Supporting Organizations	Outcomes/Behavior Changes
Provide information to residents living within and along the 100-year floodplain on the benefits of a functional floodplain.	A & B	RR	• Develop and distribute an information booklet/pamphlet. • Provide contacts for flood assistance on the website. • Hold workshops for landowners on flood proofing and flood awareness.	FEMA; IEMA; WC; ROCK; CV	• Number of flood prone properties owners reached increase. • Number of structures insured, flood proofed, or removed from the flood prone areas increase.
Educate landowners and municipal Public Works about the use of environmentally-friendly (phosphorus-free) fertilizer.	A	GP, WC, ROCK, CV	• Develop and distribute an information booklet/pamphlet. • Use media (radio, newspapers, website, etc) to communicate the negative impacts of using a phosphorus-based fertilizer.	WCWIPSC; KREP	• Decrease in the number of Public Works and homeowners utilizing phosphorus-based fertilizers
Provide information to residents and business owners on the benefits of native landscaping.	A & C	RR, NR, HOA, BI, CC	• Offer free workshops that help individuals choose the appropriate native plants and trees for their yards, planting beds, etc. • Host native plant and seed sales and exchanges.	WCSWCD; WCWIPSC; KREP	• Stakeholders can identify native plants. • Number of native plantings in residential yards and near businesses increase. • Stakeholders recognize the benefits of native plants on water quality and habitat.

Education Action	Primary Goal	Target Audience	Package (vehicle)	Lead and Supporting Organizations	Outcomes/Behavior Changes
Educate riparian property owners on ways on streambank stabilization methods that promote water quality and stream habitat.	A, B & C	RR, HOA, BI, CC	• Conduct technical workshops for riparian property owners that recommend bioengineering options, funding sources, and certified contractors for stabilizing eroded streambanks. • Install streambank stabilization demonstration projects. • Provide stream stabilization and restoration stewardship volunteer opportunities. • Develop and distribute an information booklet/pamphlet • Provide a list of funding and technical assistance sources.	WCWIPSC; WCSWCD; IDNR; Illinois EPA	• Riparian landowners recognize the benefits of bioengineering techniques for streambank stabilization. • Bioengineering techniques are utilized to stabilize streambanks over hardscape armoring. • Participation in volunteer opportunities. • Requests for technical assistance with projects. • Number of stakeholders attending technical workshops. • Number of stream restoration and stabilization projects increase.
Educate riparian property owners on ways to improve riparian buffer conditions for water quality and habitat.	A, B & C	RR, HOA, BI, CC	• Hold riparian landowner training workshops on riparian zone management. • Publish articles in newsletters and newspapers. • Provide stream management volunteer opportunities.	WCWIPSC; WCSWCD; IDNR; Illinois EPA	• Participation in volunteer opportunities. • Number of stakeholders attending workshops. • Requests for assistance for riparian buffer restoration projects. • Riparian landowners plant native buffers. • Riparian landowners stop dumping yard waste and other trash in the stream.

Education Action	Primary Goal	Target Audience	Package (vehicle)	Lead and Supporting Organizations	Outcomes/Behavior Changes
Educate landowners on lot level BMPs aimed at improving water quality and reducing stormwater	A & B	RR, HOA, BI, CC	• Hold technical sessions on the use and construction of rain gardens, rain barrels, and other lot level BMPs. • Provide detailed instructions on the construction of rain gardens and the use of rain barrels on the website. • Distribute stormwater management how-to materials for rain gardens and rain barrels.	WCWIPSC; WCSWCD; IDNR; Illinois EPA	• Landowners voluntarily act to reduce the rate and volume of stormwater runoff from their lot. • Number of rain gardens constructed increases. • Number of rain barrels in the watershed increase.
Educate school children, adults, corporate and political entities on how to provide stewardship in the watershed.	F	All stakeholders	• Provide stewardship volunteer opportunities. • Host activities such as stream cleanups, storm drain painting, and natural area maintenance.	KREP; WCSWCD	• Number of people in the watershed aware of how their daily activities affect water quality and stream health increases. • Individuals make behavior changes to protect and improve water quality and stream health.



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Legend

- Streams & Flowlines
- ▭ BMP w/ Number
- Madigan Creek Mainstem

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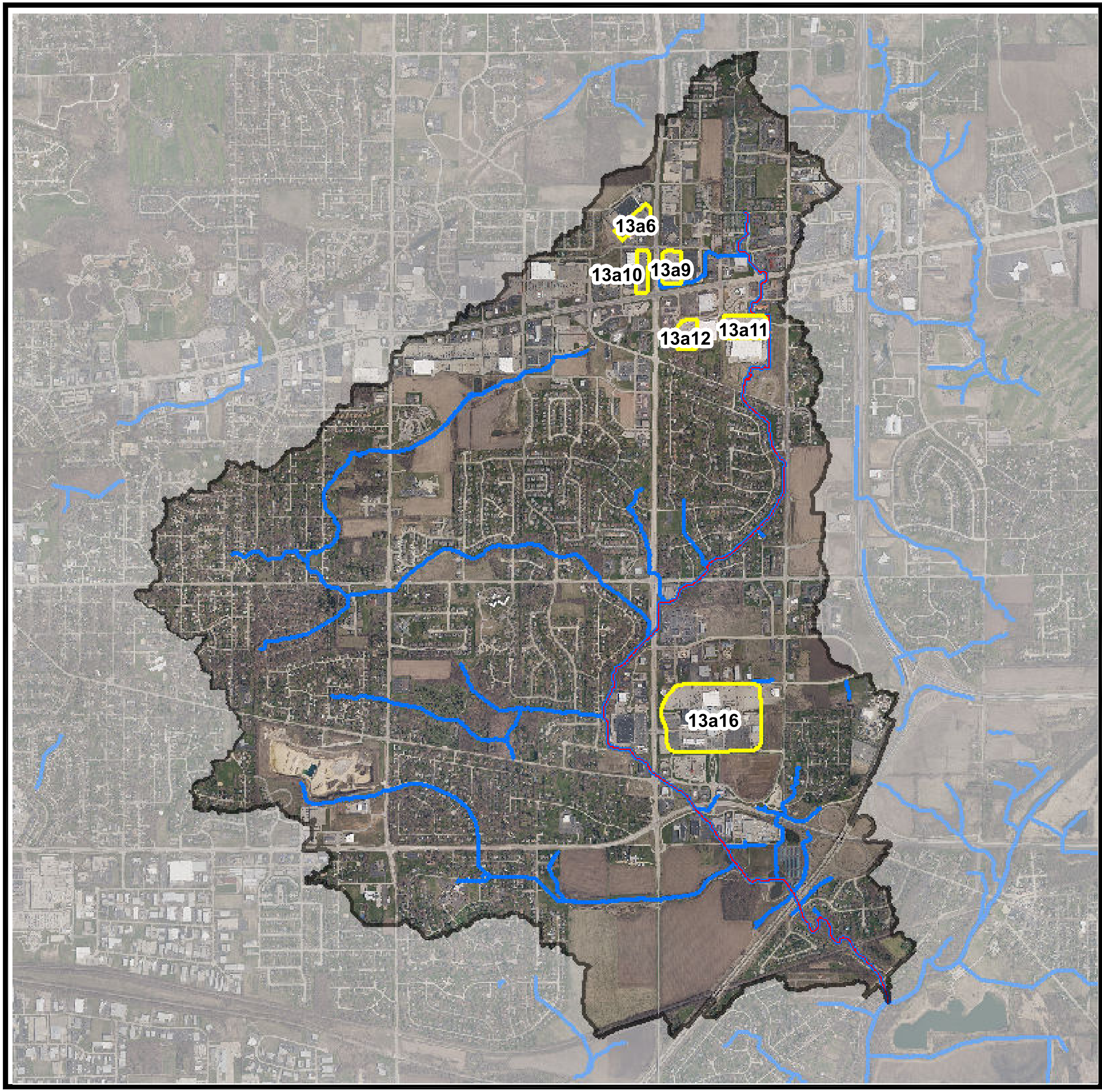
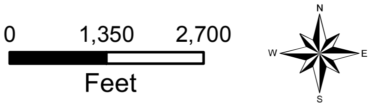
Winnebago County Watershed Planning

Madigan Creek - Bioswale BMP Locations

PROJECT NO: 11-0174		SHEET NO:
DESIGNED BY	BRO	5-1
DRAWN BY	BRO	
CHECKED BY	DAD	
APPROVED BY	JAW	
ISSUE DATE	06/30/2013	

FINAL





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- Streams & Flowlines
- ▭ BMP w/ Number
- Madigan Creek Mainstem

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Winnebago County Watershed Planning

Madigan Creek - Permeable Pavement BMP Locations

PROJECT NO: 11-0174		SHEET NO:
DESIGNED BY	BRO	5-2
DRAWN BY	BRO	
CHECKED BY	DAD	
APPROVED BY	JAW	
ISSUE DATE	06/30/2013	

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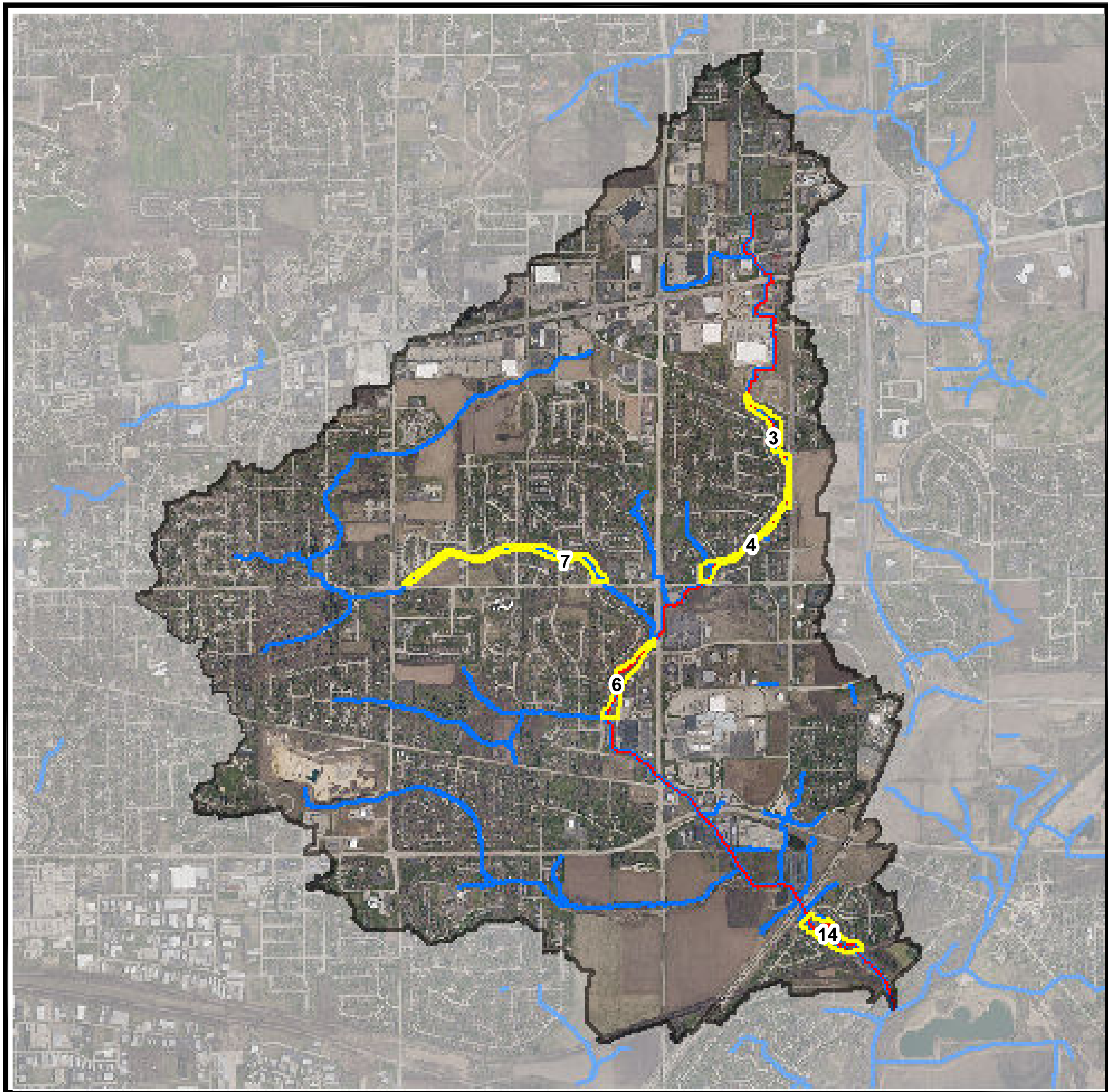

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- Streams & Flowlines
- BMP w/ Number
- Madigan Creek Mainstem

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Winnebago County Watershed Planning

Madigan Creek - Streambank Stabilization BMP Locations

PROJECT NO: 11-0174		SHEET NO:
DESIGNED BY	BRO	5-3
DRAWN BY	BRO	
CHECKED BY	DAD	
APPROVED BY	JAW	
ISSUE DATE	06/30/2013	

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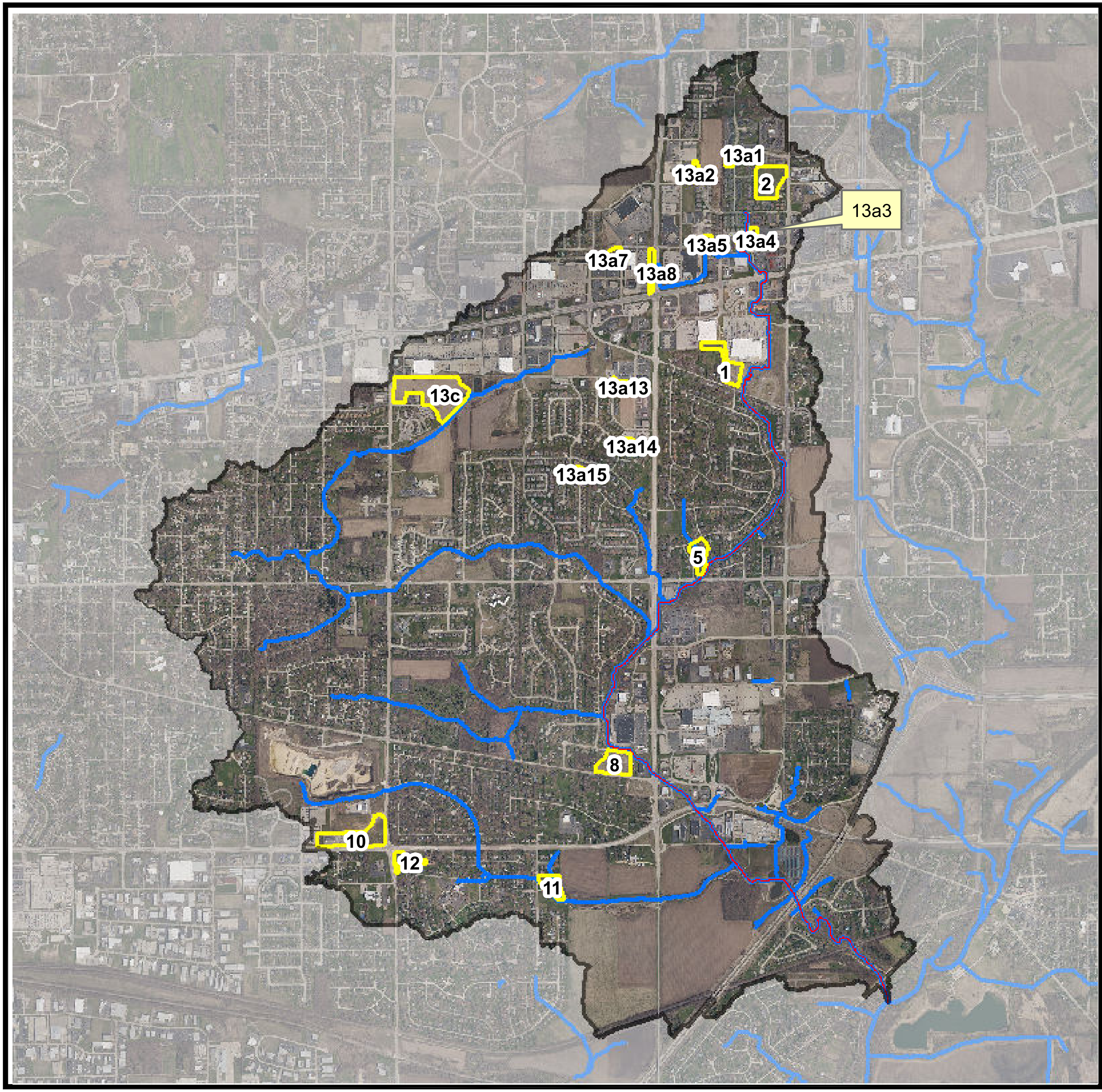

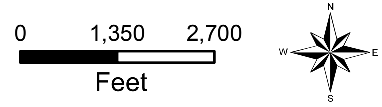

Legend

- Streams & Flowlines
- BMP w/ Number
- Madigan Creek Mainstem

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Winnebago County Watershed Planning

Madigan Creek - Naturalized Detention BMP Locations

PROJECT NO: 11-0174		SHEET NO:
DESIGNED BY	BRO	5-4
DRAWN BY	BRO	
CHECKED BY	DAD	
APPROVED BY	JAW	
ISSUE DATE	06/30/2013	

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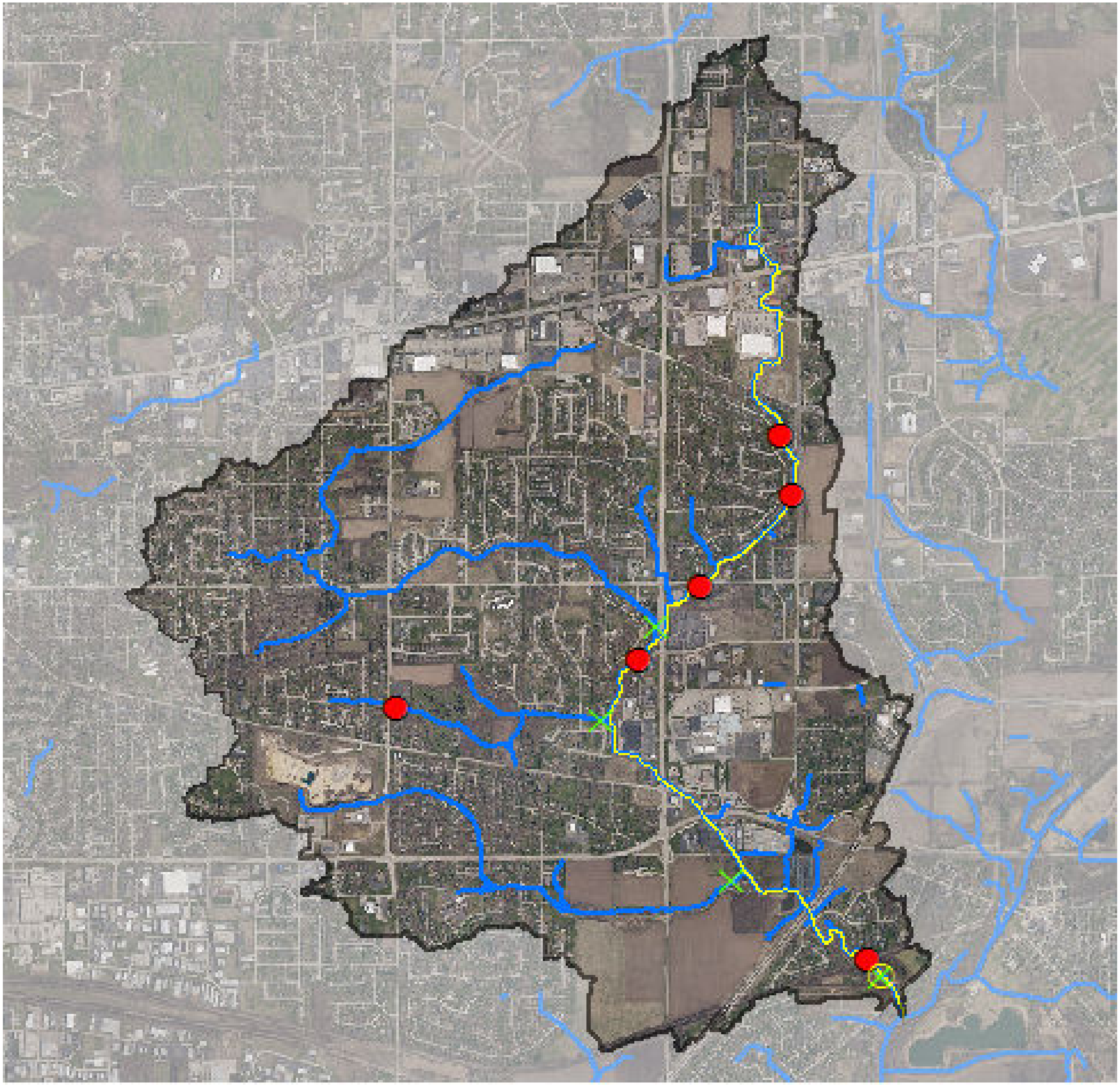

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Legend

- Madigan Creek Mainstem
- Streams & Flowlines
- ○ Macroinvertebrate Sampling/Fish Sampling
- ● Streambank, Bed Erosion, and Deposition Measurements
- ✕ Baseline Sampling

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Winnebago County Watershed Planning

Madigan Creek - Monitoring Plan

PROJECT NO: 11-0174		SHEET NO:
DESIGNED BY	BRO	5-5
DRAWN BY	BRO	
CHECKED BY	DAD	
APPROVED BY	JAW	
ISSUE DATE	06/30/2013	

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Section 6.0 Plan Implementation and Evaluation

This chapter identifies a strategy for moving from planning to implementation of the action plan recommendations. How frequently this plan is used and implemented by watershed stakeholders is one indicator of its success. Improvement in water quality and watershed resources, the reduction of nonpoint source pollution, and the reduction of flooding is also important indicator. Successful plan implementation will require significant cooperation and coordination among watershed stakeholders to secure project funding and to efficiently and effectively move the action plan from paper to the watershed.

This chapter also relates some more technical details about the expected results of putting action recommendations in place. It also presents a plan for monitoring and evaluating plan implementation as a way to determine progress towards meeting the watershed goals and objectives.

6.1 Plan Implementation Roles Strategy

Successful plan implementation is dependent on watershed stakeholders forming partnerships as a means of maximizing efforts to complete watershed projects. Key stakeholders that have potential to form watershed partnerships for the implementation of the watershed plan are listed in Chapter 5 Section 2. These and other stakeholders are encouraged to:

- Acquire funding through grants and other means;
- Implement educational programs;
- Sponsor and participate in water quality sampling;
- Provide technical and regulatory guidance;
- Maintain and monitor water quality improvement projects; and
- Update and amend the watershed plan as changes occur.

Throughout the planning process the Winnebago County Watershed Improvement Plan Steering Committee (WCWIPSC) functioned as the stakeholder forum for the watershed. The implementation of the Madigan Creek Watershed-Based Action Plan will ultimately depend on the WCWIPSC continuing to serve as the lead organization focused on the implementation of the plan.

6.2 Pollutant Load Reductions and Targets

In order to meet the requirements for a watershed-based plan, the plan must pay particular attention to water quality pollutants and impairments and measures for reducing the impairment. The high priority water quality pollutants for the Madigan Creek Watershed include low dissolved oxygen indicated by high BOD and COD and nutrients (phosphorous). Additional impairments addressed by the plan include degraded watershed aquatic habitat, impacted or lack of stream buffers and riparian zones, and flood flows and damages. See Chapter 3 for additional details on the causes and sources of water quality impairments.

For each of these impairments, the intent of the action plan recommendations is to reduce the impairment to an acceptable level. The ‘acceptable level’ for some pollutants is set by the Illinois Pollution Control Board and Illinois Environmental Protection Agency.

Setting impairment reduction targets and estimating the improvement expected by implementing plan recommendations are important for assessing the effectiveness of watershed plan recommendations for determining whether watershed impairments are being addressed. Targets and reduction estimates also satisfy one of the nine required watershed-based plan elements established by the US Environmental Protection Agency.

Targets and reduction estimates can be based on water quality criteria, data analysis, reference conditions, literature values, and/or expert examination of water quality conditions that support "Designated Uses" and biological integrity. Progress towards meeting the targets and reduction estimates indicated whether implemented BMPs are effective at achieving the watershed plan's goals. If the implemented BMPs are determined to not be making progress towards obtaining the goals, the Action Plan should be altered. Table 6-1 includes specific target values and indicators for meeting the water quality objectives developed for this watershed-based plan. Section 6.5 conatins Report Cards that can be used to evaluate the effectiveness of the implemented Action Plan projects.

Table 6-1 Targets and Indicators to meet water quality objectives

Water Quality Objective	**Target Value and Indicator**
1) Stream shall meet state water quality standards to fully support designated uses.	• *Dissolved Oxygen:* No less than 5 mg/L (Illinois EPA standard) • *Temperature:* Less than 90 degree F (Illinois EPA standard) • *pH: Between 6.5 and 9* (Illinois EPA standard) • *Chemical water quality standards:* See Illinois EPA standards in Table 3-32 • *Macroinvertebrate Biotic Index (MBI):* Less than 5.7 • *Public Opinion:* 50% of surveyed citizens feel water quality is improving.
2) Reduce sediment and nutrient loading by restoring eroded streambanks using bioengineering techniques.	• *Linear feet of restored stream:* Implement stream channel restoration improvement projects: one project in years 1-5 and two projects in years 5-10 and 10+ • *Linear feet of stabilized streambanks:* Implement stream stabilization improvement projects: one project in years 1-5 and two projects in years 5-10 and 10+ • *Linear feet of restored buffer:* Riparian buffers restored on three parcels within each timeframe: 1-5 years, 5-10 years, and 10+ years. • *Macroinvertebrate Biotic Index (MBI):* Less than 5.7 • *Chemical water quality standards:* See Illinois EPA standards in Table 3-32
3) Retrofit existing stormwater management facilities and install new facilities within developed areas to reduce nutrient and sediment loading.	• *Retrofits:* Implement detention basin retrofits: one project in years 1-5 and two projects in years 5-10 and 10+ • *New Facilities:* Construct new stormwater management facilities in developed areas: one project in years 1-5 and two projects in years 5-10 and 10+ • *Chemical water quality standards:* Discharges from stormwater management facilities meet Illinois EPA standards

Water Quality Objective	Target Value and Indicator
4) Identify open space parcels for implementation of BMPs designed for water quality improvement	• *Acres of wetland/depressional area restoration/creation:* Implement at least one wetland/depressional area creation/restoration during years 5-10 and 10+ • *Linear feet of restored stream:* Implement stream channel restoration improvement projects: one project in years 1-5 and two projects in years 5-10 and 10+ • *Linear feet of restored buffer:* Riparian buffers restored on three parcels within each timeframe: 1-5 years, 5-10 years, and 10+ years • *Retrofits:* Implement detention basin retrofits: one project in years 1-5 and two projects in years 5-10 and 10+
5) Implement stormwater management practices to stabilize stream flows and reduce stormwater runoff entering streams.	• *Flood problem areas:* Implement at least two flood mitigation projects within each timeframe: 1-5 years, 5-10 years, and 10+ years • *Linear feet of restored stream:* Implement stream channel restoration improvement projects: one project in years 1-5 and two projects in years 5-10 and 10+ • *Linear feet of stabilized streambanks:* Implement stream stabilization improvement projects: one project in years 1-5 and two projects in years 5-10 and 10+ • *Acres of wetland/depressional area restoration/creation:* Implement at least one wetland/depressional area creation/restoration during years 5-10 and 10+ • *Retrofits:* Implement detention basin retrofits: one project in years 1-5 and two projects in years 5-10 and 10+ • *New Facilities:* Construct new stormwater management facilities in developed areas: one project in years 1-5 and two projects in years 5-10 and 10+
5) Educate the public about protecting and improving water quality	• *Public Opinion:* 50% of surveyed citizens feel water quality is improving.

6.2.1 Estimating Pollutant Load Reductions

PLOAD was used for estimating pollutant load reductions associated with action plan implementation at the subbasin level. PLOAD allows a planner to rapidly evaluate the pollutant loading reductions at a site for several BMP types. It should be noted that calculated load reductions by the model are estimates and not absolute values to be expected in the field.

PLOAD facilitates watershed BMP evaluation, but still requires the results to be reviewed for accuracy and feasibility. For example, the tributary area to each BMP must be calculated and inputted into the model so that the model properly estimates the load reductions that can be attributed to the BMP. Also, the modeler is responsible for choosing a BMP that will have a sufficient volume or area to properly treat the drainage area as PLOAD does not have this ability.

Reducing pollutant loading in the watershed can be accomplished by reducing the percent of impervious surfaces within the watershed, construction of new BMPs, improvements to existing pollutant control practices, and or a combination of the methods. Typically improvements to existing practices can be implemented more quickly and at a lesser cost the construction of new BMPs. However, retrofitting existing practices alone is not efficient to reduce pollutant loads to meet the goals of the watershed-based plan. As such, new BMPs and the reduction of impervious area need to be integrated into plans to reduce pollutant water in the watershed.

PLOAD was used to calculate pollutant load reductions for four BMP types identified in the site specific action plan (Chapter 5 Section 5.4): permeable pavements, streambank stabilization, infiltration basins, and wetland/naturalized detention basins. Pollutant load reductions in the PLOAD model are based on predicted pollutant load removal efficiencies developed by the Indiana Department Environmental Management (IDEM), Michigan Department of Environmental Quality (MDEQ), Illinois State Water Survey (ISWS), and Illinois Environmental Protection Agency (Illinois EPA). Table 6-2 includes a list of BMPs and predicted removal efficiencies.

BMP Recommendations for Water Quality Improvement (Pollutant Load Reductions)

PLOAD was used to calculate pollutant load reductions for four BMP types: bioswales, permeable pavements, streambank stabilization, and wetland/naturalized detention basins. While other BMP types such as flood mitigation projects and streambank restoration (removal of concrete channels) were identified in the Site Specific Action Plan (Section 5.4), PLOAD was only applicable to calculate loading reductions for the four above-listed BMPs.

Bioswales

Proposed bioswale (or grass swale) projects exist in the Madigan Creek watershed. Common uses of bioswales are in parking lots, roadside ditches, and in detention areas. The main focus of this practice is to reduce the velocity of storm water flow and runoff, and to provide a water quality filtration device along with an aesthetically pleasing green space for nearby residents and recreational users. Implementation consists of removing existing vegetation along with grading the ditch to the proper size and slope. An appropriate native seed mix is then spread on the area. If desired, wetland vegetation can be used on the bottom of the swale if standing water is expected. Directing water to the bioswale can be done by grading the surrounding area so that it slopes to the bioswale, or incorporating curb cuts into the adjacent street so water flows into the swale rather than into curb inlets. If installed correctly and maintained over time, bioswales can be an effective best management practice to manage stormwater. Pollutant load reduction impact areas are accounted from the channel itself to the top-of-bank/limits of construction work and the immediate vicinity of the channel. In total, there are approximately 4,290-feet (0.81-miles) of proposed bioswale installation within the watershed.

Permeable Pavements

Utilized as a detention method for stormwater runoff on impervious surfaces, permeable pavement/pavers provide a practical means toward reducing runoff while not having to use traditional detention storage methods. The aggregate beneath the pavers provides storage while also providing a pathway for water to infiltrate into an underdrain or the ground. Permeable pavement systems are utilized in many applications such as parking lots, alleys, and access roads. The main application in the Madigan Creek watershed will be in commercial parking lots. Used in combination with traditional storm sewer systems, stormwater runoff can be reduced by allowing water to infiltrate into the porous pavement. Installation consists of pavement removal and excavation, followed by the placement of stone aggregate and pavers/pavement. Permeable pavement is a practical best management practice as it enables the full use of a facility for driving

Table 6-2 BMP percent pollutant removal efficiencies

BMP	TSS	TDS	BOD	COD	TN	TKN	DP	TP	Cadmium	Lead	Copper	Zinc
Vegetated Filter Strips	73%	*	50.5%	40%	40%	*	*	45%	*	45%	*	60%
Grass Swales	65%	*	30%	25%	10%	*	*	25%	50%	70%	50%	60%
Infiltration Devices	94%	*	83%	*	*	*	*	83%	*	*	*	*
Extended Wet Detention	86%	*	72%	*	55%	*	*	68.5%	*	40%	*	20%
Wetland Detention	77.5%	*	63%	50%	20%	*	*	44%	*	65%	*	35%
Dry Detention	57.5%	*	27%	20%	30%	*	*	26%	*	50%	*	20%
Settling Basin	81.5%	*	56%	*	*	*	*	51.5%	*	*	*	*
Sand Filters	82.5%	*	40%	*	*	*	*	37.5%	*	*	*	*
Water Quality Inlets	37%	*	13%	5%	20%	*	*	9%	*	15%	*	5%
Weekly Street Sweeping	16%	*	6%	*	*	*	*	6%	*	*	*	*
Infiltration Basin	75%	*	*	65%	60%	*	*	65%	*	65%	*	65%
Infiltration Trench	75%	*	*	65%	55%	*	*	60%	*	65%	*	65%
Porous Pavement	90%	*	*	80%	85%	*	*	65%	*	1%	*	1%
Concrete Grid Pavement	90%	*	*	90%	90%	*	*	90%	*	90%	*	90%
Sand Filter/Infiltration Basin	80%	*	*	55%	35%	*	*	50%	*	60%	*	65%
WQ Inlet with Sand Filter	80%	*	*	55%	35%	*	*	*	*	80%	*	65%
Oil/Grit Separator	15%	*	*	5%	5%	*	*	5%	*	15%	*	5%
Wet Pond	60%	*	*	40%	35%	*	*	45%	*	75%	*	60%
Agricultural Filter Strip	*	*	*	*	53%	*	*	61%	*	*	*	*
Streambank Stabilization	Streambank stabilization pollutant efficiencies vary depending on bank height and lateral recession rates. The USEPA only estimates the removal of sediment, phosphorus and nitrogen from streambank stabilization.											

while at the same time providing a means to infiltrate stormwater runoff. Pollutant load reduction impact area for permeable pavement is calculated to be two-times the area of actual permeable pavement installation at each location. In total, there are six proposed installation locations for porous pavement within the watershed.

Streambank Stabilization
The Madigan Creek watershed has a large amount of impervious area, subsequently causing higher amounts of flow greater than pre-development rates. This in turn causes the erosion and degradation of channels throughout the watershed. Implementing measures to reduce these impacts can be done in several ways. Soft-stabilization measures such as grading to eliminate steep slopes and scour areas, with the subsequent planting of native vegetation, and bioengineering practices can be utilized to achieve a more aesthetically pleasing channel. The planting of native vegetation provides stabilization by embedded root growth that helps hold soil together. However, soft-stabilization measures should be used in channels with lower velocities. In channels with higher velocities and sheer stress, more hard-scape or armoring measures are used such as articulating concrete pads, gabions, and rip rap. These practices are more adept at handling larger amounts of water than just planting native vegetation. Ideally, a combination of soft-stabilization and hard-scape measures is used when stabilizing a streambank. This offers protection against high velocities of flow while also giving a water quality and fish habitat benefit. Riffles, cross-vanes, chevrons, stone toes, and bendway weirs are additional methods that can be used with both soft-stabilization and hard-scape methods to improve the dissolved oxygen content of water along with fish habitat. Pollutant load reduction impact areas are accounted from the channel itself to the top-of-bank/limits of construction work and the immediate vicinity of the channel. In total, there are approximately 11,480-feet (2.17-miles) of proposed streambank stabilization within the watershed.

Wetland/Naturalized Detention Basins
The implementation or retrofitting of wetland detention in a watershed can provide numerous benefits. By eliminating low-flow concrete channels in the bottom of a detention basin (as seen in many locations) and subsequently re-grading and planting native wetland vegetation, the residence time of stormwater runoff can be increased. With a low-flow concrete channel in place, stormwater runoff is not given the chance to attenuate, infiltrate, or evaporate in the basin. It is immediately conveyed to the outlet of the detention basin causing increased flow and velocities in the downstream channel. A water quality benefit also results by helping to reduce pollutant loads by filtering through wetland vegetation. Even in basins with no low-flow concrete channels, multiple locations exist in both watersheds that will be able to utilize the implementation and retrofitting of wetland detention basins from re-grading to increase residence time further and from the planting of native wetland vegetation. To ensure these basins are designed correctly, detailed hydrologic and hydraulic studies should be completed. Additional volume may need to be added to a basin because of increased development in its watershed from the time it was initially designed. This can be implemented when retrofitting the wetland detention basin with the appropriate measures. Wetland detention areas provide the most effective water quality benefits when they are at least 3-5 percent as large as the watershed they serve.. Within the watershed, there are eighteen wetland detention basin installations or retrofits.

Pollutant Load Reductions Following the Implementation of Recommended BMPs

If all of the modeled BMPs (bioswales, permeable pavements, streambank stabilization, and wetland/naturalized detention basins) are implemented, the estimated percentage of pollutant load reductions for each pollutant of concern (BOD, COD, and total phosphorus) for each subbasin is detailed in Table 6-3. Table 6-4 summarizes the overall watershed load reductions associated with the implementation of the four BMPs types modeled in PLOAD. Appendix C includes expanded load reductions results for each pollutant of concern.

Table 6-3 Pollutant Load Reductions for Pollutants of Concerns Modeled by PLOAD

Subbasin	Acres	Percent Reduction following BMP implementation		
		BOD	COD	Total Phosphorus
1	176.17	31.9%	25.3%	22.3%
2	188.76	15.3%	15.2%	13.1%
3	463.82	11.6%	10.4%	10.8%
4	415.16	36.8%	29.2%	25.7%
5	243.04	17.1%	13.6%	11.9%
6	417.26	0%	0%	1.7%
7	145.77	0%	0%	0%
8	10.81	0%	0%	0.4%
9	59.10	100%	100%	100%
10	71.78	100%	100%	88.6%
11	139.62	0%	0%	0%
12	284.73	4.1%	6.1%	5.2%
13	190.17	0%	0%	0%
14	216.82	0%	0%	0%
15	252.13	3.9%	3.1%	2.8%
16	39.07	0%	0%	0%
17	229.18	4.5%	3.5%	3.1%
18	16.13	0%	0%	0%
19	103.17	10.2%	8.1%	7.1%
20	131.55	0%	0%	0%
21	56.52	0%	0%	0%
22	122.47	0%	0%	0%

Ideally, the water quality goal of the watershed-based plan would be to decrease pollutant levels to meet water quality standards. With the exception of BOD and COD in Subbasins 9 and 10 and total phosphorus in Subbasin 9, implementing the four BMPs types modeled by PLOAD will not solely be able to bring the watershed in compliance with water quality standards. However, implementation of these four types of BMPs discussed in this analysis is a big step in meeting this goal. The PLOAD model will allow stakeholders to quickly estimate the reductions in pollutant loadings if BMPs are installed.

As discussed above, simply constructing all of the BMPs modeled in PLOAD will not solve all of the problems in the Madigan Creek watershed. Additional water quality BMPs should be installed in the watershed as recommended in Chapter 5. These BMPs could include native vegetation, downspout disconnection on residential lots, and the construction of rain gardens on individual lots. Table 6-4 lists and compares additional BMPs that are designed to achieve water quality goals and standards. The table also includes a rating for each BMP that represents their effectiveness when applied to a particular land use. The ratings include High (H), Medium (M), and Low (L). Chapter 4 also includes additional information on BMPs that can be implemented in the watershed.

Table 6-4 Watershed-wide Summary of BMPs

BMP Type	Unit of Measurement	Cumulative Size	Cumulative Cost	Pollutant Load Reductions (lbs)								
				TSS	BOD	COD	TN	TP	Cd	Pb	Cu	Zn
All BMPs	-	-	$ 23,946,050.00	287986.6	31598.5	111435.5	1925.8	766.2	0	0	0	0
Infiltration Basin	feet	4,290	$ 227,600.00	1966.1	133.1	464.4	6.7	3.5	0	0	0	0
Wetland/ Naturalized Detention	acre	56.03	$ 16,208,500.00	266266.5	31465.5	104607.1	1499.2	687.1	-	0	-	0
Permeable Pavement	acre	10.05	$ 5,380,150.00	11647.7	-	6364.1	242.2	38.6	-	0	-	0
Streambank Stabilization	feet	11,480	$ 2,129,800.00	8106.4	-	-	177.8	37.0	-	-	-	-
Existing Load	-	-	-	3138540.8	221940.3	930142.1	33338.3	6943.9	69.3	456.56	511.43	1854.62

Table 6-5 List of urban/transitional BMPs for reducing pollutant loading

Land Use	**Contaminant Reduction**							**Runoff Reduction**	
	TSS	**BOD**	**Oil/ Grease**	**Total N**	**Sediment**	**Total P**	**Metals**	**Rate**	**Volume**
Developed Areas									
Native Landscaping	M	M	M	H	M	H	L		
Paved Area Sweeping	M	L	L	L	H	H	M		
Downspout Disconnection								L	L
Rain Gardens		L		L	L	L		M	M
Construction Sites									
Maintenance of Erosion Control	L				M		L		
Expedited Stabilization	L				H		L		
Use of Polymers	L				M	L	L		
Retrofits and New Development									
Sediment Basins	M	L	M	L	H	M	M	H	L
Swales	M	L	M	L	M	M	M	M	M
Wetland Treatment	M	M	H	H	H	M	M	H	M
Stormwater Treatment Train	H	H	H	H	H	H	H	H	M
Permeable Pavement	H	M	M	M	H	M	M	H	H
Infiltration Basins	H	H	H	H	H	H	H	H	H
Naturalized Detention	M	L	M	L	H	M	M	H	L

Two recommendations included in the Action Plan for the watershed that were not modeled by PLOAD should be discussed in more detail as they are priority recommendations: Stormwater Management Plan Feasibility Study and Streambank Restoration.

Stormwater Management Plan Feasibility Study

It is recommended that a stormwater management plan feasibility study for the Madigan Creek watershed be completed to obtain a detailed understanding of stormwater runoff management issues in the watershed. It was identified early in this planning process that hydromodification was a significant cause of impairments in the watershed. A detailed stormwater management plan will identify and further quantify specific areas where stormwater management projects would be most beneficial. Also, the detailed hydrologic and hydraulic modeling prepared to support a stormwater management plan can also be used to identify flood risks. Throughout the planning process, watershed residents and stakeholders expressed concern about increased flooding and property damage. By quantifying flood risk problems, the value and benefits of stormwater management projects to reduce flood risk may be identified. As a result of recent flood events in Illinois, there have grant opportunities for flood risk reduction projects, but information on existing flood risk and project benefits is needed to build support or secure grant monies. If implemented, many flood risk reduction projects would also benefit the health of the watershed.

Streambank Restoration

In addition to streambank stabilization, multiple locations exist in which restoration activities can take place within the watershed. These mainly occur in existing areas of concrete channel. With already higher amounts of flow and greater velocities due to increased impervious area upstream, the concrete channel magnifies these factors even more causing impacts downstream. By removing the concrete and employing soft-stabilization or hard-scape methods like those previously mentioned in the Streambank Stabilization section, channel velocities can be reduced along with providing habitat for fish and native vegetation. In addition to improving the channel itself, it also provides an aesthetically pleasing area for nearby residents and recreational users to enjoy. Removal of concrete channel and restoration of a more naturalized streambank condition does not directly result in pollutant constituent reduction. However, it reduces the impacts of hydromodification by reducing channel velocity and improving in-stream habitat. Streambank restoration will provide significant habitat benefits and is necessary to achieve the watershed goals.

6.3 Plan Implementation Schedule

Watershed planning is an ongoing process that does not end with the completion of this plan. The implementation schedule acts as a guide for these future efforts by directing the priority given to the various Action Plan recommendations selected for the watershed. Higher priority or less expensive BMPs are often scheduled for implementation prior to very expensive or highly technical projects. The schedule also provides a framework for implementation by spreading out project implementation over time and allowing for reasonable timeframe for securing funding.

The Implementation Schedule for the Madigan Creek Watershed-Based Plan is included in the Action Plan tables (Chapter 5). The Site Specific Action Plan tables include a column with a recommended implementation schedule based on short term (1-5 years), medium term (5-10 years) and long term (greater than 10 years) objectives. The tables also include a column denoting priority (low, medium, or high) of the implementation of the Action Item. In many cases implementation schedule and priority reflect higher priority items being implemented on a short term schedule and lower priority items being implemented on a long term scheduled. However, it should be noted that some high priority goals have been included as a long term goal due to the cost and technical resources required for the implementation of the project. Table 6-6 presents a summary of the plan implementation schedule. The number of short, medium, and long term actions is shown to give watershed plan implementers an idea of how many actions are recommended to be implemented in each of these time frames.

6-6 Plan Implementation Summary Schedule

Implementation Term	**Number of Action Items**
Short (1-5 years)	24
Medium (5-10 years)	35
Long (greater than 10 years)	26

6.4 Funding Sources

Plan implementation is largely based on the availability of funding and technical assistance available in the watershed for the implementation of watershed wide and site specific action items. It is no secret that securing funding is one of the biggest challenges that watershed stakeholders will face during plan implementation.

A list of potential funding sources that may be used to move forward with plan implementation is included in Table 6-7.

6.5 Plan Monitoring and Evaluation

6.5.1 Monitoring Plan Implementation

Continued monitoring is essential for providing feedback on the progress of the implementation of this watershed-based plan. The implementation and effectiveness of the plan and its recommendations, and an assessment of whether the plan goals are being achieved its measured through this monitoring. Simply, monitoring is observing and tracking watershed conditions for both positive and negative changes that are a result of the implementation of the plan. These conditions can then be compared to water quality monitoring data to determine whether there is a correlation between them. If no correlation between water quality improvement and recommendation implementation can be determined and/or is progress is not being made towards reaching the goals of the plan, WCWIPSC, as the implementation team, should consider whether the recommended strategies are having the desired effect or if the plan should be updated and modified.

Recommendations that are physical or structural in nature such as streambank stabilization, the construction of infiltration BMPs, and restoring riparian buffers, can be assessed in terms of the reduction of pollutant loads discharged into the watershed, improved biological and habitat health, and the degree of change in stormwater runoff volume and flow. The effectiveness of non-structural recommendations such as the implementation of education/outreach programs, stream maintenance programs, and changes to policies and regulations are much more difficult to monitor. Changes in behavior following the implementation of non-structural recommendations, can be assessed by gathering feedback through meetings with watershed stakeholders and tools such as surveys and focus groups.

Evaluation is a critical part of watershed planning. It will tell you whether or not your efforts are successful and provide a feedback loop for improving project implementation. A well-planned milestone and evaluation process will provide a way to measure the effectiveness of the watershed-based plan. As projects are implementation and results are demonstrated, additional support from the community will be gained and the likelihood of project sustainability will be greatly increased

The goal of the Madigan Creek Watershed-Based Plan's evaluation process is to not turn evaluation and monitoring into an academic process. This monitoring strategy is intended to help track and measure the implementation of recommendations made in this plan using a variety of indicators that are monitored regularly, typically on an annual basis or every three years. Progress on overall plan implementation should be reviewed using the milestones and indicators every 5 years and the plan should be updated as needed. As a means of facilitating plan evaluation, "Report Cards" were developed for each watershed goals (Chapter 2). The report cards are intended to provide a brief description of current conditions, suggest performance indicators that should be evaluated and monitored, milestone to be met, and remedial actions if milestones are not being met.

As water quality is one of the primary goals of this plan, stream and lake water quality impairments should be monitored by regularly collecting and testing water samples, either manually or using constant monitoring equipment. A recommended sampling program for the watershed was included in Chapter 5, Section 5.4.

Watershed issues, opportunities, and conditions will change over time. This watershed-based plan should be evaluated and updated every five years to account for these changes. At each evaluation and update, completed projects can be removed from the plan and new projects should be added. In addition to this 5-year update, plan implementation should be monitored annually by the Winnebago County Watershed Improvement Plan Steering Committee (WCWIPSC). At the time of the annual evaluation, the committee should assess the list of priorities and identify the top priority actions for the following year.

As projects are implemented, they should be recorded using the Report Cards and the tables in Chapter 5 which track the implementation of actions against the watershed plan goals and objectives as a means of monitoring watershed plan implementation.

Goal A: Protect and enhance overall surface and groundwater quality in the Madigan Creek watershed

Current Conditions and Problems:

- Water quality modeling indicates that predicted levels of phosphorus, COD, and BOD are above state standards. Low dissolved oxygen levels and high levels of total suspended solids/sedimentation and total dissolved solids/salinity may also be potential water quality impairments.
- Streambank erosion, hydromodification and channelization are prevalent throughout the watershed.
- Very limited water quality and habitat data is available for the watershed.

Indicators to Meet Objectives:

- Chemical water quality parameters (nutrients, metals, etc) meet Illinois EPA standards for designate use of the waterbody.
- All physical water quality parameters (DO, pH, TSS, etc) meet Illinois EPA standards.
- Linear feet of streambank stabilization and restoration.
- Number of detention basin retrofits to improve water quality.
- Number of wetland/depressional area creation projects.
- Percentage of surveyed citizens who feel water quality is improving, are able to identify where water pollution originates, and are able to identify methods of protecting and restoring water quality.

Milestones: 1-5 Years: 1. Establish and fund a water quality monitoring program (Chapter 5, Section 5). 2. Develop stream restoration concept plans for at least two stream reaches. 3. Construct at least two detention basin retrofits. 4. Identify at least three locations for BMP implementation (rain gardens, bioinfiltration basins, etc). 5. Develop concept plans for two wetland/depressional area restoration projects. 6. Homeowners and business be required to use phosphorus-free fertilizers. 7. Promote alternatives to salt on roads and driveways to reduce salt usage.	Grade
5-10 Years 1. Implement the water quality monitoring program. 2. Implement at least two stream restoration projects in the watershed. 3. Construct at least two detention basin retrofits. 4. Construct at least one wetland/depressional area restoration project. 5. Install at least three BMPs designed for water quality improvement. 6. Develop stream restoration concept plans for at least two stream reaches. 7. Develop concept plans for two wetland/depressional area restoration projects. 8. Reduce salt concentrations used on roads to levels that are not harmful to aquatic species.	

10+ Years

1. Implement at least two stream restoration projects in the watershed.
2. Construct at least two detention basin retrofits.
3. Construct at least one wetland/depressional area restoration project.
4. Install at least three BMPs designed for water quality improvement.
5. A survey posted to the WCWIPSC or KREP website indicated that at least 50% of the watershed stakeholders feel that water quality is improving and is able to identify sources of pollution and methods to protect water quality.

Monitoring Needs/Efforts:

- Regular monitoring of physical, chemical, and biological water quality parameters. See Chapter 5, Section 5 for more information.
- Periodically visit stream restoration and stabilization project locations to access successes and failures.
- Periodically visit all installed retrofits and BMPs to access successes and failures.

Remedial Actions:

- Assess the number of projects that have been implemented versus water quality changes to determine if projects are improving water and habitat quality. If not, conduct an assessment to find causes of pollution and address.
- If stream restoration and stabilization projects do not improve instrem and streamside habitat, determine if hydraulic problems upstream or downstream are damaging the project and/or conduct remedial work such as re-seeding or habitat installation.

Notes:

Grade Evaluation: A = Met or exceeded milestone(s) B = Milestone(s) 75% achieved
C = Milestone(s) 50% achieved D = Milestone(s) 25% achieved
F = Milestone(s) not achieved

Goal B: Reduce existing flood damage in the watershed and prevent flooding from worsening

Current Conditions and Problems:

- Urbanization has drastically altered the historic hydrology in the watershed.
- The changes in hydrology have lead to changes in stream function and decreased in infiltration.
- Storm sewers collect a greater volume of runoff and transport it to streams more quickly. Additionally, runoff from many impervious surfaces is not detained.
- Current flooding in the watershed includes: overbank flooding, local drainage problems, sanitary sewer backups, and depressional flooding.

Indicators to Meet Objectives:

- Number of flood problem areas that are mitigated or reduced by BMP implementation.
- Number of stream restoration projects that reconnect the stream channel to the floodplain.
- Number of new and existing developments that implement flood reduction BMPs.
- Number of stream reaches with problematic debris jams or culverts that are repaired and/or removed.
- Number of detention basins that are retrofitted or repaired to increase flood storage capacity.

Milestones:

Grade

1-5 Years

1. Secure funding for and complete a Stormwater Management Plan including a detailed H&H study of the watershed.
2. Identify and develop concept plans to mitigate for at least two flood problems areas by construction projects recommended in the Site Specific Action Plan.
3. Develop stream stabilization concept plans for at least two stream reaches.
4. Conduct a detention basin inventory.
5. Construct at least two detention basin retrofits designed to reduce flooding.
6. All new or re-development incorporate infiltration BMPs.
7. Implement a watershed-wide stream maintenance program to clear streams channels of problematic debris jams.

5-10 Years

1. Mitigate for at least two flood problems areas constructing projects recommended in the Site Specific Action Plan.
2. Identify and protect at least two parcels located in the 100-year floodplain.
3. Implement at least two streambank stabilization projects.
4. Implement at least one streambank restoration project where the stream is reconnected to the floodplain.
5. Construct at least two detention basin retrofits designed to reduce flooding.
6. Retrofit at least two older developments with flood reduction BMPs.
7. Identify and develop concept plans to mitigate for at least two flood problems areas by construction projects recommended in the Site Specific Action Plan.

10+ Years

1. Identify and protect at least 2 parcels located in the 100-year floodplain.
2. Mitigate for at least two flood problems areas constructing projects recommended in the Site Specific Action Plan.
3. Implement at least one streambank stabilization projects.
4. Implement at least one streambank restoration project where the stream is reconnected to the floodplain.
5. Construct at least two detention basin retrofits designed to reduce flooding.
6. Retrofit at least two older developments with flood reduction BMPs.

Monitoring Needs/Efforts:

- Track the number of mitigated/reduced flood problem areas.
- Track the linear feet of stream restoration projects that reconnect the stream channel to the floodplain.
- Track the number of stream reaches where problematic debris jams or culverts are repaired.
- Track the number of retrofitted or repaired detention basins.
- Track the number of older developments that construct flood reduction BMPs.

Remedial Actions:

- Conduct follow-up visits to flood problem areas during flood events to determine if additional work is needed.
- Conduct an inventory of detention basins to determine if retrofits are possible.

Notes:

Grade Evaluation:	A = Met or exceeded milestone(s)	B = Milestone(s) 75% achieved
	C = Milestone(s) 50% achieved	D = Milestone(s) 25% achieved
	F = Milestone(s) not achieved	

Goal C: Improve aquatic and wildlife habitat in the Madigan Creek watershed

Current Conditions and Problems:

- Vegetation along the creek channels is not diverse and is dominated by turf grass.
- There are very few natural stream features (pools, riffles, etc) present in the watershed's creeks.
- Significant hydromodification including channelization and streambank erosion is present in the watershed.
- Portions of the creek channel have been placed in a concrete-lined channel and in storm sewer.

Indicators to Meet Objectives:

- Linear feet of stream habitat restoration (including in-stream habitat and native buffers).
- Number of riparian buffers restored with native vegetation.
- Number of detention basins retrofitted with native vegetation.
- Number of stakeholder landscapes that incorporate native vegetation.
- Number of wetland and/or depressional area projects that incorporate native vegetation.

Milestones:	Grade
1-5 Years 1. Implement at least one stream restoration projects (projects that create instream habitat) in the watershed. 2. Develop concept plans for at least two additional stream restoration projects in the watershed. 3. Conduct at least two detention basin retrofits where turf grass basins are converted into native vegetation. 4. Develop concept plans for two wetland/depressional area restoration projects. 5. At least ten watershed stakeholders (private residents, business owners, etc) incorporate native vegetation into existing landscapes. 6. Riparian buffers restored on at least three parcels.	
5-10 Years 1. Implement at least two stream restoration projects in the watershed. 2. Conduct at least two detention basin retrofits where turf grass basins are converted into native vegetation. 3. Construct at least one wetland/depressional area restoration project. 4. At least twenty watershed stakeholders (private residents, business owners, etc) incorporate native vegetation into existing landscapes. 5. Riparian buffers restored on at least three parcels.	
10+ Years 1. Implement at least two stream restoration projects in the watershed. 2. Conduct at least two detention basin retrofits where turf grass basins are converted into native vegetation. 3. Construct at least one wetland/depressional area restoration project. 4. At least 25% of watershed stakeholders (private residents, business owners, etc) incorporate native vegetation into existing landscapes. 5. Riparian buffers restored on at least three parcels.	

Monitoring Needs/Efforts:

- Periodically visit stream and wetland restoration projects to assess function and success.
- Track the number (linear feet) of stream restoration projects in the watershed.
- Track the number of detention basin retrofits.
- Track the number of parcels where riparian buffers are established.
- Track the number of stakeholders that incorporate native plants into landscapes each year.

Remedial Actions:

- If stream and wetland restoration projects are failing, conduct remedial work such as re-seeding and habitat installation.
- If the buffer and native grass installation milestones cannot be met, reduce the number to more feasible goals.

Notes:

Grade Evaluation:
A = Met or exceeded milestone(s)
B = Milestone(s) 75% achieved
C = Milestone(s) 50% achieved
D = Milestone(s) 25% achieved
F = Milestone(s) not achieved

Goal D: Develop open space in the Madigan Creek watershed and provide recreational opportunities

Current Conditions and Problems:

- The pre-settlement landscape consisting mostly of savanna, marsh, and prairie communities has been significantly altered by urbanization.
- Very few parcels of open space are preserved in the watershed.

Indicators to Meet Objectives:

- Number of riparian buffers restored with native vegetation.
- Number of new development that is designed to include and protect open space.
- Number of linear feet of new trail constructed in the watershed as part of the Boone and Winnebago County Greenway Plan.

Milestones:	Grade
1-5 Years 1. Riparian buffers restored on at least three parcels. 2. Conduct at least one seminar for developments on methods to integrate open space into residential and commercial development. 3. All municipalities incorporate the recommendations of the Boone and Winnebago County Greenway Plan into their comprehensive plans. 4. Construction of at least one segment of trail included on the Boone and Winnebago County Greenway Plan.	
5-10 Years 1. Riparian buffers restored on at least three parcels. 2. Conduct at least one seminar for developments on methods to integrate open space into residential and commercial development. 3. Construction of at least one segment of trail included on the Boone and Winnebago County Greenway Plan.	
10+ Years 1. Riparian buffers restored on at least three parcels. 2. At least one new development constructed designed to include and protect open space. 3. Complete a Natural Areas Management Plan for all park and open space in the watershed. 5. Completion of the trails included on the Boone and Winnebago County Greenway Plan.	

Monitoring Needs/Efforts:

- Track the linear feet of new trails constructed.
- Track the number of parcels where riparian buffers are established.
- Track the number of developments that are designed to include and protect open space.

Remedial Actions:

- Reassess municipal budgets for open space protection efforts.
- Apply for grant monies for the acquisition of additional open space.
- Apply for grant monies for the preparation of a Natural Areas Management Plan.

Notes:	

Grade Evaluation:

A = Met or exceeded milestone(s)
B = Milestone(s) 75% achieved
C = Milestone(s) 50% achieved
D = Milestone(s) 25% achieved
F = Milestone(s) not achieved

Goal E: Increase coordination between decision makers and other stakeholders in the watershed.

Current Conditions and Problems:

- A limited number of stakeholders are currently working together to pursue grant funds to implement watershed improvement projects.
- Municipal decisions-makers need to work together to develop beneficial multi-jurisdictional partnerships related to funding, technical assistance, grant proposals, and open space/greenway protection.

Indicators to Meet Objectives:

- Number of municipalities in the watershed that adopt the watershed-based plan.
- Number of municipalities and stakeholders that participate in WCWIPSC activities.
- Number of municipalities that implement Action Items.
- Number of municipalities that adopt comprehensive plan, codes, and ordinances that support the recommendations of the watershed-based plan.

Milestones:

Grade

1-5 Years

1. WCWIPSC to hold a minimum of two meetings per year to discuss plan recommendations and track plan implementation.
2. All municipalities adopt the watershed-based plan and implement changes to plans, codes, and ordinances that support plan recommendations.
3. Representatives from all municipalities and other stakeholders attend the WCWIPSC meetings.
4. At least two multi-jurisdictional and/or public-private stream channel maintenance projects (streambank stabilization, streambank restoration, culvert maintenance, etc) are implemented.

5-10 Years

1. WCWIPSC to hold a minimum of two meetings per year to discuss plan recommendations and track plan implementation.
2. Representatives from all municipalities and other stakeholders attend the WCWIPSC meetings.
3. At least two multi-jurisdictional and/or public-private stream channel maintenance projects (streambank stabilization, streambank restoration, culvert maintenance, etc) are implemented.

10+ Years

1. WCWIPSC to hold a minimum of two meetings per year to discuss plan recommendations and track plan implementation.
2. Representatives from all municipalities and other stakeholders attend the WCWIPSC meetings.
3. At least two multi-jurisdictional and/or public-private stream channel maintenance projects (streambank stabilization, streambank restoration, culvert maintenance, etc) be implemented

Monitoring Needs/Efforts:

- Track number of WCWIPSC meetings and what was discussed.
- Track the number of municipalities in the watershed that adopt the watershed-based plan.
- Track the number of Action Items implemented by municipalities.

Remedial Actions:

- WCWIPSC encourage government officials to adopt the watershed-based plan if not adopted in years 1-5.
- WCWIPSC to meet with government officials to discuss Action Items that have not been implemented.

Notes:

Grade Evaluation: A = Met or exceeded milestone(s) B = Milestone(s) 75% achieved
C = Milestone(s) 50% achieved D = Milestone(s) 25% achieved
F = Milestone(s) not achieved

Goal F: Raise stakeholder awareness (residents, public officials, etc) about the importance of best management practices of watershed stewardship

Current Conditions and Problems:

- KREP has done a wonderful job of leading the education process through plan development, however, education is an ongoing process.
- Education on stream maintenance and water quality and habitat improvements is needed for residents living in the watershed.

Indicators to Meet Objectives:

- Number of members of KREP.
- Number of seminars or workshops related to educating the public on the benefits of native plants and natural area restoration.
- Number of seminars or workshops related to general water quality.
- Attendance at seminars and workshops.
- Number of publicized watershed improvement projects in the new media, newsletters, websites, etc.
- Number of homeowners associations (HOA) programs related to water quality and stream maintenance.

Milestones: 1-5 Years 1. Maintain watershed website. 2. Conduct at least 2 seminars related to benefits of native plants and natural area restoration and track attendance. 3. Conduct at least 2 seminars related to water quality and stream habitat improvement and track attendance. 4. Publicize all watershed improvement projects in the news media, newsletters, websites, etc. 5. Identify at least 1 HOA interesting in hosting an educational program.	Grade
5-10 Years 1. Maintain watershed website. 2. Conduct at least 2 seminars related to benefits of native plants and natural area restoration and track attendance. 3. Conduct at least 2 seminars related to water quality and stream habitat improvement and track attendance. 4. Publicize all watershed improvement projects in the news media, newsletters, websites, etc. 5. Conduct at least 1 HOA interesting in hosting an educational program.	
10+ Years 1. Maintain watershed website. 2. Conduct at least 2 seminars related to benefits of native plants and natural area restoration and track attendance. Hold at least 1 of these workshops in a park or open space. 3. Conduct at least 2 seminars related to water quality and stream habitat improvement and track attendance. 4. Publicize all watershed improvement projects in the news media, newsletters, websites, etc. 5. Conduct at least 1 HOA interesting in hosting an educational program.	

Monitoring Needs/Efforts:

- Track all watershed projects being implemented each year.
- Track number and topic of workshops each year.
- Track changes in attendance at workshops and seminars.
- Track number of workshops hosted by HOAs.

Remedial Actions:

- Ask local, state, and federal agencies to host workshops.
- If attendance at workshops is low, experiment with different types of events to see which draw larger participation.
- Identify a volunteer or hire staff to lead the educational efforts.

Notes:

Grade Evaluation:
A = Met or exceeded milestone(s) B = Milestone(s) 75% achieved
C = Milestone(s) 50% achieved D = Milestone(s) 25% achieved
F = Milestone(s) not achieved

Appendix A

Winnebago County Watershed Improvement Plan Steering Committee Meeting Minutes

MEETING OF THE WINNEBAGO COUNTY WATERSHED IMPROVEMENT PLAN STEERING COMMITTEE

Thursday, June 03, 2010
4:30 p.m.
424 N. Springfield Avenue

1. Welcome – Mr. Vanderwerff introduced himself as the County Engineer for Winnebago County

2. Roll Call – Dennis Anthony, Judy Barnard, Joe Cavney, Jim Claeyssen, Steve Ernst, Carol Dmmondt, Don Krizan, Marcy Leach, Pat Michelsen, Wendy Owano, Jerry Paulson, Kelly Spera, Jessica Vanderbaum, Joe Vanderwerff, Wayne Vlk, Stuart R. Wahlin.

3. Temporary Chairperson / Committee Organization – Mr. Krizan asked the steering committee if there would be any committee member willing to come forward and become a temporary chairperson. Motion made to nominate Ms. Owano. Seconded by other members. Ms. Owano declined position. Motion made to nominate Mr. Krizan. Seconded by all members. Motion carried.

   Mr. Krizan made a motion to the Steering Committee that as far as the steering committee we invited many agencies and other groups. What the Highway Department is suggesting for some initial guidelines is that we need representatives from each group and agency. In addition, how the committee wanted to organize themselves. Seconded by all members. Motion carried.

4. Grant Application Schedule –

   a. June 3 - WCHD Distributes List of Applicants – Mr. Krizan informed the Committee of the 21 consultants to whom we sent the qualifications. Only six responded with the qualifications, so we will have that group of six to whittle down. Further discussion by the Steering Committee.

   b. June 4-11 - Committee Members Review Qualifications / Rate Consultants – Mr. Krizan informed the Committee that we would like the members to come to the Highway Department to review and rate the 6 qualified consultants during the week of June 4-11. Mr. Krizan further discussed how the rating sheets were set up and how Committee Members were to use them. Please have your ratings back to our office by June 11. Further discussion by the Steering Committee.

5. June 14-15 - Rating Sheets Evaluated / Consultant Selected – Mr. Krizan made a motion that the Highway Department totals the votes and selects the consultants. Further Discussion by the Steering Committee. Seconded by all Committee Members. Motion carried.

    a. June 15 - Committee Members Notified

    b. June 16 - Selected Consultant Notified

    c. June 16-21 - Meeting Scheduled with Consultant to Review Application Process

    d. June 16-July 23 - Application Data Provided as Needed

    e. July 26-28 - Meeting Scheduled with Consultant to Review Grant Applications

    f. July 30 - Grant Applications Submitted to Illinois EPA

6. Questions / Comments - The statement was made that we need a lot of backyard space. Mr. Vanderwerff informed the Steering Committee that we need a wide girth for the watershed, and that is why we need the residents to be involved in this watershed improvement plan.
   The comment was also noted that the EPA is trying to impose further restrictions on quality of storm water discharge. The question was whether or not we are opening ourselves up by applying for these grants? Mr. Vanderwerff informed the Steering Committee that this project will unfold as we go forward, and we will have to make decisions as we move forward. Right now, it is only one group for both watersheds. We will determine the best way to handle the funding of both watersheds as a group. Further discussion by the Steering Committee.

7. Next Meeting - Tentative meeting on Monday June 14, at 12:00 p.m., possibly to interview some candidates.

8. Adjourn / Recess - Mr. Krizan made a motion to adjourn the meeting. Unanimous by all present. Motion Carried.

MEETING OF THE WINNEBAGO COUNTY WATERSHED IMPROVEMENT PLAN STEERING COMMITTEE

Wednesday, April 20, 2011
10:00 a.m.
Winnebago County Highway Department
424 N. Springfield Avenue
Rockford, IL

I. Welcome by Don Krizan (WCHD), Temporary Chairman.

II. Presentation by Deanna Doohaluk, Hey and Associates, Inc. (see Slide 1 on the attached Kickoff Presentation).

A. Overview of Watershed Planning (Slides 2-12)

1. The Section 319 standard of performance for watershed planning consists of the Nine Minimum Criteria for Watershed-Based Plans (Slide 2).

2. A general approach to comprehensive watershed planning has been developed and is presented in IEPA's "Guidance for Developing Watershed Action Plans in Illinois" as the seven Illinois Model Watershed Planning Stages (Slide 3).

B. Planning Schedule (Slide 13)

1. Deanna believes that the critical project dates can be met without difficulty.

2. The final watershed plans are due to IEPA by **March 1, 2013**.

C. WCWIPSC Roles and Committees (Slides 14-15)

1. The WCWIPSC was created by a group of stakeholders (Slide 14) that includes citizens and several governmental and independent agencies. Deanna asked if there are other entities that might have a stake in this planning process. Committee members suggested the following:

a. CherryVale Mall, Menards, Lowes, Walmart (Madigan)
b. CBro Development (Madigan)
c. United Technologies/Hamilton Sundstrand (Welworth/Wentworth)
d. UPRR (both); CNRR (Welworth/Wentworth)
e. RRWRD (both)
f. Rolling Green HOA (Welworth/Wentworth)
g. Kishwaukee Corridor Improvement Committee (Madigan)
h. J.L. Clark (?? May be north of Welworth/Wentworth.)
i. Winnebago County Health Department (both)
j. Farmers (both)

2. The structure of the WCWIPSC (Slides 14-15) needs to be further developed to handle comprehensive watershed planning. Deanna suggested an organizational leadership chart which Committee members discussed and endorsed (see the attached Organization Chart).

D. The Watershed Concerns / Preliminary Goals (Slides 16-17)

1. Deanna asked for, and received from Committee members, the following list of the problems associated with the two watersheds from which planning goals and objectives can be developed:

    a. Hydromodification (erosion/sedimentation) – (both)
    b. Need for stream restoration (Madigan)
    c. Flooding (both)
    d. Nonpoint source pollution (both)
    e. Need for greenway/open space development (both)
    f. Degraded groundwater quality (both)
    g. Quarry impacts (Madigan)
    h. Habitat degradation (both)
    i. Illicit dumping / landowner “bad-housekeeping” (both)
    j. Impacts from Superfund / CERCLA sites (Welworth/Wentworth)
    k. Lack of collaboration between government / business / private interests (Welworth/Wentworth)

2. Deanna asked for, and received from Committee members, the following list of the desired outcomes for the two watersheds from which planning goals and objectives can be developed:

    a. Restore hydrology / perennial flow (Madigan)
    b. Increase open space / public access (both)
    c. Mitigate flooding (both)
    d. Increase green infrastructure BMPs (both)
    e. Restore habitat (both)
    f. Increase educational outreach (both)
    g. Improve water quality (both)
    h. Restore infiltration / groundwater (both)
    i. Revise / amend local ordinances to address watershed improvements (Madigan)
    j. Address Superfund / CERCLA impacts (Welworth/Wentworth)

E. Watershed Resource and Condition Inventory (Slides 18-21)

   1. Deanna described the various data requirements for performing the watershed inventories (Slide 19). Committee members cited existing data sources including WinGIS – perhaps 80% to 85% of required data are currently available.

   2. Deanna recommended that stream walks (Slide 21) be undertaken within the period from late June (after June 15) to early July. The new Committee leadership group will work with her to schedule one-day, weekday stream walks for each watershed.

F. Public Workshops (Slides 22-23)

   1. Deanna suggested a seven-module format for public workshops (three per watershed) that will be held to obtain input for each watershed (Slide 22). Modules 1-3 consist of presentations by Committee members – modules 4-6 consist of work by breakout groups.

   2. Deanna recommended scheduling the first workshops on weeknights in July after the stream walks. The new Committee leadership group will work with her to schedule the first workshop for each watershed.

III. Committee Appointments (confirmed by voice votes of the Committee members):

A. Chairperson – Michael Maddox (RMAP)
B. Co-Vice Chairpersons – Jerry Paulson (KREP), Dennis Anthony (URREP)
C. Secretary – Don Krizan (WCHD)
D. Madigan Co-Captains – Bonnie Whitmer (citizen), Pat Michelsen (citizen)
E. Welworth/Wentworth Co-Captains – Carol Ommodt (citizen), John Ekberg (County Board Member)

IV. Next meeting – July 13, 2011. The time and location are to be announced. **This will be the first Quarterly Meeting.**

V. Closing Comments / Adjournment

Respectfully submitted,

Don Krizan, Secretary

MEETING OF THE WINNEBAGO COUNTY WATERSHED IMPROVEMENT PLAN EXECUTIVE COMMITTEE

Thursday, May 12, 2011
9:00 a.m.
Rockford Metropolitan Agency for Planning
313 N. Main Street
Rockford, IL

1. Attendance

Present:	Chairperson Michael Maddox Co-Vice Chairpersons Dennis Anthony and Jerry Paulson Secretary Don Krizan

2. Stakeholder contacts

Committee members will contact and/or compile more information regarding the following potential stakeholders:

CherryVale Mall; vacant land owners – by Maddox

Rock River Water Reclamation District (RRWRD); Jonah Katz (planner/developer); IEPA regional office (Chuck Corley, Nancy Sisson); Home Builders Association of the Greater Rockford Area (HBAGRA); Rockford Home Builders Association (RHBA); farmers – by Anthony

Larry Swacina (Director, Winnebago County Health Department); CBro (developer); Rubloff (developer) – by Paulson

Railroads – by Krizan

Contact information will be forwarded to Krizan who will send letters inviting participation in the Steering Committee's watershed planning activities.

3. Stream Walks, Quarterly Meeting, and Workshops scheduling

Committee members discussed the following tentative general schedules:

Stream Walks – two 1-day walks during the period June 20 to June 30
Quarterly Meeting – July 13 (set by Steering Committee at April 20 meeting)
Workshops – after Quarterly Meeting, later July

Krizan will contact Deanna Doohaluk to discuss her preferences for meeting dates and inform Committee members by Friday, May 13.

4. Respectfully submitted,
Don Krizan, Secretary

MEETING OF THE WINNEBAGO COUNTY WATERSHED IMPROVEMENT PLAN STEERING COMMITTEE

Friday, July 13, 2011
9:00 a.m.
Rockford Metropolitan Agency for Planning
313 N. Main Street
Rockford, IL

I. Welcome by Michael Maddox (RMAP), Chairman

II. Deanna Doohaluk, Hey and Associates, Inc., provided comments and led discussions on several topics:

A. Review of stream walks & data collection, in general

1. Charles Street portion of the Madigan basin walk will be completed today

2. Hey needs any available information regarding the following:

a. WinGIS (raw ArcView) including land use & cover

b. Gap data (2007)

c. 2-foot topo

d. Soils

e. Census data

f. Wetlands / floodplains

g. Storm sewers

h. Roads / streets

i. Greenways, parks, trails, green infrastructure, including anecdotal information regarding rain gardens, rain barrels, etc.

j. Point source discharges (e.g., quarries)

k. Agricultural drainage tiles

l. Weather data / storm events (rainfall amounts, high water marks, flood damage reports)

        m. Detention ponds
        n. Water supply, ground water, well & septic data
        o. Fish & benthic surveys
    3. All available information will be considered for its usefulness in the process of model selection

B. Workshop planning

    1. Madigan
        a. July 27th at the Rock Church
        b. 500 fliers have been mailed notifying the public
        c. Organizers are obtaining addresses & providing notices via reverse 911 calls
        d. Other invitees include stakeholders, board members & other political representatives, media
        e. Deanna reminded all that the agenda at the meetings must be water-quality driven
        f. Presenters will include Mike M., Jerry P., Nathan H., Deanna D.
        g. Breakout groups will be asked to consider: What are the problems?; Who is responsible?; What projects/activities are you aware of that help/harm conditions?
        h. Preparations underway for handouts, display boards, maps
    2. Welworth/Wentworth
        a. Mid to late August
        b. Possibly at the Heartland Church in Colonial Village

C. Other items:

1. Deanna will provide information for soliciting technical assistance
2. Hey will provide a draft of the watershed inventory
3. Discussed having a future meeting of the Technical (Executive) Committee
4. Discussed scheduling for the **next Quarterly Meeting**
    a. Tentatively, October 12th at RMAP
    b. Decision will have to be made regarding the modeling approach based on recommendations of Hey and the Technical Committee

III. Closing Comments / Adjournment

Respectfully submitted,

Don Krizan, Secretary

MEETING OF THE WINNEBAGO COUNTY WATERSHED IMPROVEMENT PLAN STEERING COMMITTEE

Wednesday, November 2, 2011
2:00 p.m.
Rockford Metropolitan Agency for Planning
313 N. Main Street
Rockford, IL

I. Welcome by Michael Maddox, Chairman

II. The Quarterly Meeting Minutes from July 13, 2011, were reviewed and approved.

III. Deanna Doohaluk, Hey and Associates, Inc., reviewed procedures for completion and submittal of the Inkind Match Logs (timesheets).

IV. Deanna provided a Watershed Resource Inventory update and reviewed the list of required data and the sources of the data (i.e., agencies that are compiling and submitting data to her).

V. The Committee reviewed the Public Meeting #1 Minutes for each watershed and discussed the conduct and accomplishments of the meetings.

VI. The Committee reviewed watershed problems and concerns that were raised at the public meetings and discussed goals and objectives to be achieved by the study of each watershed (see Attachment 1).

VII. To put into perspective the approximate quantity of effective detention that would have to be provided by environmentally-sound and sustainable watershed management practices in order to improve conditions that negatively affect water quality, Deanna provided information regarding theoretical detention volumes provided by traditional means that would be required for each watershed (see Attachment 2).

VIII. The next steps to be taken by the Committee include continuation of data input to Deanna and organization of a Technical Committee.

IX. The next Quarterly Meeting of the Steering Committee will be held late winter-early spring.

X. Closing comments / adjournment.

Respectfully submitted,

Don Krizan, Secretary

Watershed Problems and Goals/Objectives
Madigan and Welworth/Wentworth Watersheds
November 2, 2011

Watershed Problems

a. Hydromodification (erosion/sedimentation) – (both)
b. Need for stream restoration (Madigan)
c. Flooding (both)
d. Nonpoint source pollution (both)
e. Need for greenway/open space development (both)
f. Degraded groundwater quality (both)
g. Quarry impacts (Madigan)
h. Habitat degradation (both)
i. Illicit dumping / landowner "bad-housekeeping" (both)
j. impacts from Superfund / CERCLA sites (Welworth/Wentworth)
k. Lack of collaboration between government / business / private interests (Welworth/Wentworth)
l. Storm sewers back up (Welworth/Wentworth)

Watershed Goals

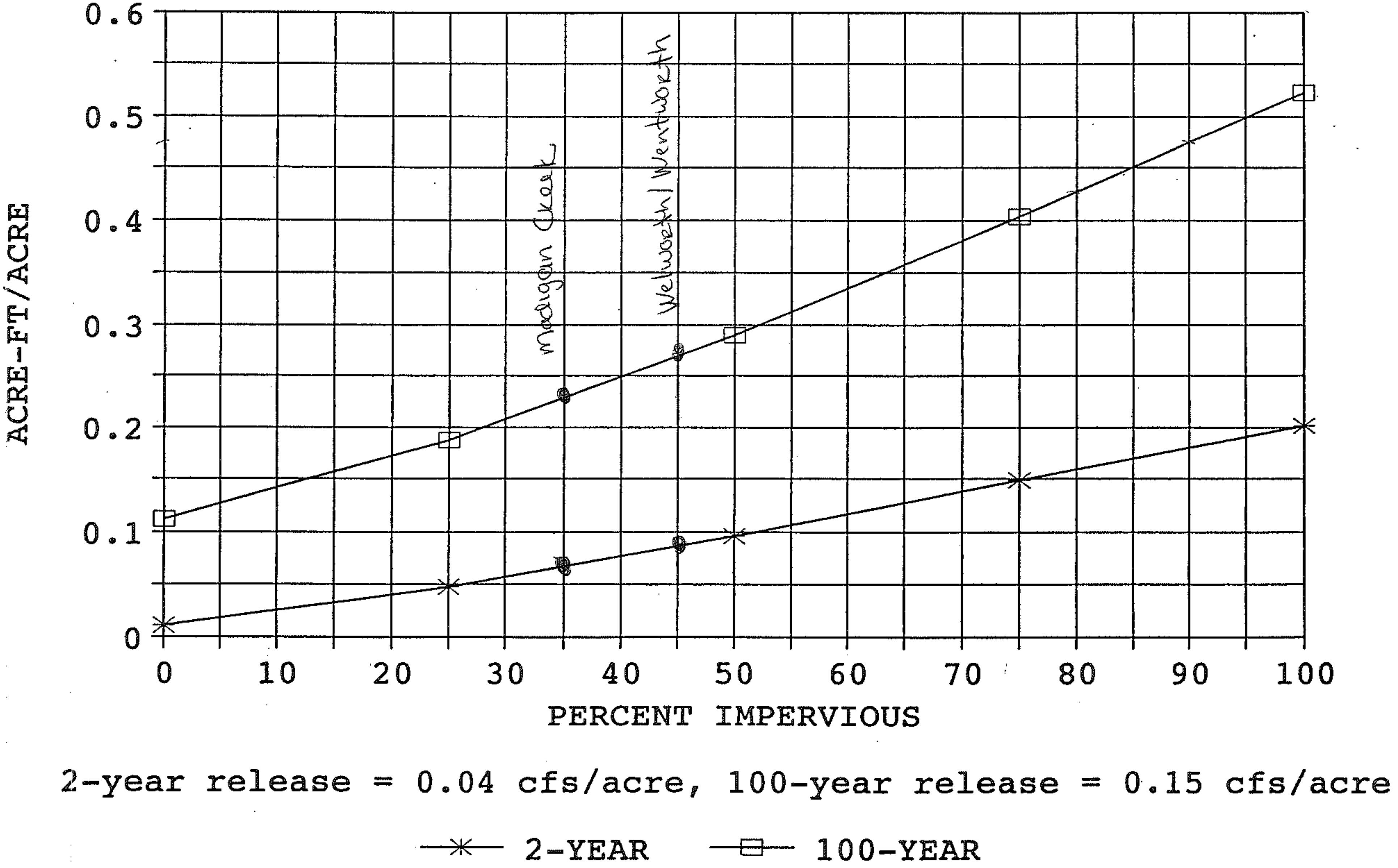
a. Restore hydrology / perennial flow (Madigan)
b. Increase open space / public access (both)
c. Mitigate flooding (both)
d. Increase green infrastructure BMPs (both)
e. Restore habitat (both)
f. Increase educational outreach (both)
g. Improve water quality (both)
h. Restore infiltration / groundwater (both)
i. Revise / amend local ordinances to address watershed improvements (Madigan)
j. Address Superfund / CERCLA impacts (Welworth/Wentworth)
k. Monitoring results (both)
l. Sustainable funding (both)

Attachment 1

FIGUI 3-10

DETENTION VOLUME VS PERCENT IMPERVIOUS

2-YEAR AND 100-YEAR UNIT AREA DETENTION



2-year release = 0.04 cfs/acre, 100-year release = 0.15 cfs/acre

Reference: Northeastern Illinois Planning Commission, Investigation of Hydrologic Methods for Urban Development in Northeastern Illinois

Attachment 2

Watershed Problems and Goals/Objectives
Madigan and Welworth/Wentworth Watersheds
November 2, 2011

Watershed Problems

a. Hydromodification (erosion/sedimentation) – (both)
b. Need for stream restoration (Madigan)
c. Flooding (both)
d. Nonpoint source pollution (both)
e. Need for greenway/open space development (both)
f. Degraded groundwater quality (both)
g. Quarry impacts (Madigan)
h. Habitat degradation (both)
i. Illicit dumping / landowner "bad-housekeeping" (both)
j. impacts from Superfund / CERCLA sites (Welworth/Wentworth)
k. Lack of collaboration between government / business / private interests (Welworth/Wentworth)
l. Storm sewers back up (Welworth/Wentworth)

Watershed Goals

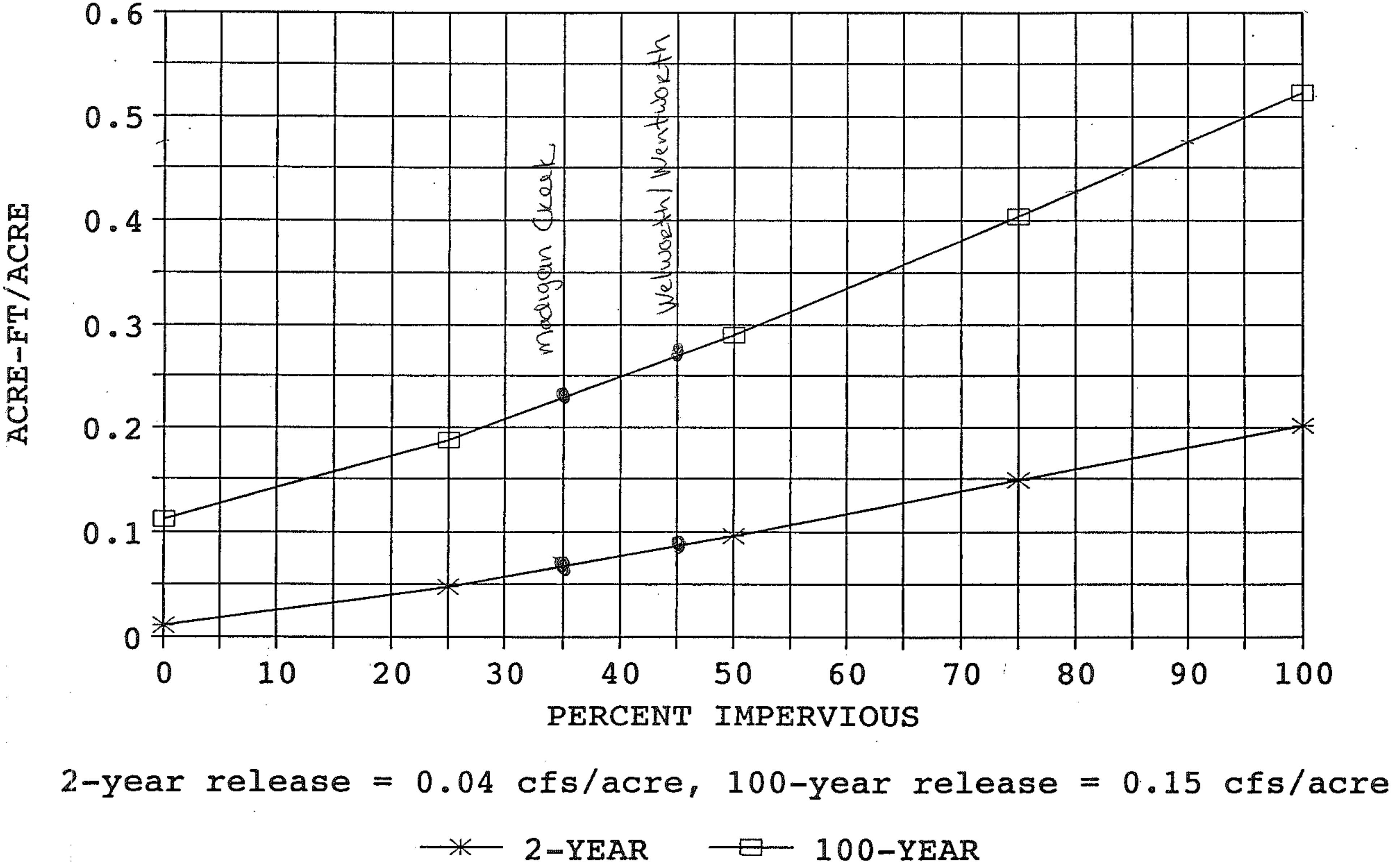
a. Restore hydrology / perennial flow (Madigan)
b. Increase open space / public access (both)
c. Mitigate flooding (both)
d. Increase green infrastructure BMPs (both)
e. Restore habitat (both)
f. Increase educational outreach (both)
g. Improve water quality (both)
h. Restore infiltration / groundwater (both)
i. Revise / amend local ordinances to address watershed improvements (Madigan)
j. Address Superfund / CERCLA impacts (Welworth/Wentworth)
k. Monitoring results (both)
l. Sustainable funding (both)

Attachment 1

FIGUI 3-10

DETENTION VOLUME VS PERCENT IMPERVIOUS

2-YEAR AND 100-YEAR UNIT AREA DETENTION



2-year release = 0.04 cfs/acre, 100-year release = 0.15 cfs/acre

Reference: Northeastern Illinois Planning Commission, Investigation of Hydrologic Methods for Urban Development in Northeastern Illinois

Attachment 2

MEETING OF THE WINNEBAGO COUNTY WATERSHED IMPROVEMENT PLAN EXECUTIVE COMMITTEE

Monday, January 23, 2012
10:00 a.m.
Rockford Metropolitan Agency for Planning
313 N. Main Street
Rockford, IL

1. Attendance

Present: Co-Vice Chairpersons Dennis Anthony and Jerry Paulson
Secretary Don Krizan
Consultant Deanna Doohaluk
Madigan Co-Captain Bonnie Whitmer
RMAP Representative Gary McIntyre

2. Chairperson Election

Members discussed the resignation of Chairperson Mike Maddox from his position with RMAP effective January 6th, and his subsequent move to a new job in North Dakota. By a unanimous vote of the Committee and gracious acceptance by Mr. McIntyre, Gary was selected as the new Chairperson.

3. Re-naming the Welworth/Wentworth Basin

Based on community and Committee member suggestions, the Committee agreed to re-designate the Welworth/Wentworth waterway and basin as Buckbee Creek and Buckbee basin, in commemoration of Congressman John T. Buckbee, founder of the Buckbee Seed Company and person after whom a new public school was named in 1928. Built at the intersection of Alpine Road and Harrison Avenue (at the center of the upper reach of the future Buckbee basin), the new school replaced the original local school which was built in 1866.

4. General Discussion Regarding Past, Current and Future Issues / Event and Task Scheduling

a. Data providers (e.g., City of Rockford, Village of Cherry Valley, Winnebago County) will be reminded that input regarding watershed features should be provided to Deanna **a.s.a.p.**
b. Organization of the Technical Committee will proceed with invitations to other agencies and consultants, possibly by the **first week in February**.
c. The next quarterly meeting of the Steering Committee will be planned for **Mid-March, possibly March 14th**. Topics will include a review of data gathered to date, a discussion of the water resources inventory, and a discussion of the up-coming meeting of the Technical Committee.
d. The first meeting of the Technical Committee will be held **mid-to-late March**.
e. Public workshops will be planned for the **April-May** time period covering topics such as good housekeeping (e.g., use of rain barrels, use and disposal of pesticides/herbicides, and yard waste disposal) and understanding drainage easements.
f. The next round of public meetings will be planned for the **July-August** time period during which the preliminary Water Resource Inventory will be presented and discussed and opinions will be solicited regarding potential solutions to water quality/quantity problems.

g. The Water Resource Inventory will be submitted to IEPA in **November**.
h. The first invoice and quarterly report were discussed.
i. The Illinois State Water Survey (ISWS)/FEMA floodplain study of the Rock River watershed in Winnebago County was discussed.
j. Creation of a website for the Buckbee basin was discussed.
k. The need for the documentation of follow-ups with citizens who registered complaints at public meetings regarding drainage issues was discussed. The listing of complaints and resolutions on the Madigan and Buckbee websites was suggested.

5. Respectfully submitted,
Don Krizan, Secretary

MEETING OF THE WINNEBAGO COUNTY WATERSHED IMPROVEMENT PLAN EXECUTIVE COMMITTEE

Friday, March 16, 2012
9:00 a.m.
Rockford Metropolitan Agency for Planning
313 N. Main Street
Rockford, IL

1. Attendance

Present:
Chairperson, Gary McIntyre
Co-Vice Chairperson, Dennis Anthony (by telephone)
Co-Vice Chairperson, Jerry Paulson
Secretary, Don Krizan
Consultant, Deanna Doohaluk (by telephone)
IEPA Grant Manager, Scott Tomkins (by telephone)

2. General Discussion of Topics Regarding Project Goals, Objectives, and Progress

a. MBE/WBE utilization (DOC Standard Form 334)
b. Quarterly progress reports, Nos. 1 & 2
c. Format for future quarterly reports (**New!**)
d. Submittal of project progress schedule (**New!**)
e. Documentation summary sheet (**New!**)
f. Watershed resource inventories / base plans
g. Success of initial public meetings
h. Possible informal public workshops
i. Submittal of invoices / receipt of reimbursements

Respectfully submitted,
Don Krizan, Secretary

MEETING OF THE WINNEBAGO COUNTY WATERSHED IMPROVEMENT PLAN STEERING COMMITTEE

Wednesday, July 25, 2012
10:00 a.m.
Rockford Metropolitan Agency for Planning
313 N. Main Street
Rockford, IL

I. Welcome by Gary McIntyre, Chairman, & introductions by participants.

II. Jerry Paulson reported that Pat Michelsen will be moving from the area and will no longer be able to serve as Co-Captain for the Madigan Watershed. Recommendations for a replacement will be welcomed.

III. Deanna Doohaluk, Hey and Associates, Inc. (Hey), reminded the Steering Committee of the need to establish a Technical Advisory Committee (TAC) to review and provide comments regarding the model selection for the watersheds. Members of the Executive Committee will contact people who have been recommended for participation on the TAC.

IV. After the review and comments by the TAC, Hey will complete preliminary work on the watershed modeling including defining basins, creating map layers, and preparing exhibits.

V. Future Steering Committee activities will include a review of the Watershed Resource Inventory, a review and endorsement of the model selection, a review of flood inventory data from questionnaires submitted by citizens, and planning of public workshops.

VI. The flood inventory questionnaires will serve to identify candidate areas for specific watershed improvements and to provide data for inclusion in the spatial database. City of Rockford and Madigan Watershed representatives on the Steering Committee will work together to create a questionnaire.

VII. Suggested topics for public workshops include watershed good housekeeping and Best Management Practices (BMPs), and a presentation and discussion regarding Illinois drainage law and ownership issues.

VIII. After the Watershed Improvement Plan (WIP) is completed, final public workshops for each of the two watersheds will be held to present the final plan. The presentation will include educational topics to encourage the participation of citizens in making improvements on an individual basis.

IX. The tentative date of the next Quarterly Meeting of the Steering Committee is October 10, 2012.

X. Closing comments / adjournment.

Respectfully submitted,

Don Krizan, Secretary

MEETING OF THE WINNEBAGO COUNTY WATERSHED IMPROVEMENT PLAN EXECUTIVE COMMITTEE

Tuesday, October 30, 2012
1:00 p.m.
Rockford Metropolitan Agency for Planning
313 N. Main Street
Rockford, IL

1. Attendance

Present:
Chairperson, Gary McIntyre
Co-Vice Chairperson (Buckbee), Dennis Anthony
Co-Vice Chairperson (Madigan), Jerry Paulson
Co-Captain (Madigan), Bonnie Whitmer
RMAP Representatives, Colin Belle & Colleen Hoesly
Secretary, Don Krizan

2. Madigan Co-Captain Replacement

Bonnie is still seeking a replacement for Pat Michelsen.

3. General discussion regarding a homeowners workshop dealing with legal aspects of the ownership of property located within drainageway easements

a. Tentative date/time:	Tuesday, November 13th, 6:00-8:00 p.m.
b. Tentative location:	Shepherd of the Valley Lutheran Church 2715 S. Mulford Road, Rockford (southwest corner at Mulford & Harrison)
c. Principal presenter/topics:	Brent O. Denzin, Attorney at Law - Stormwater law - Local ordinances - Easements/setbacks
d. Other presenters/topics:	Brad Holcomb - Best Management Practices for homeowners Deanna Doohaluk - Improvement Plan impacts Gary McIntyre & Don Krizan - Improvement Plan Update
e. Planning/arrangements:	Continuing under the capable guidance of Jerry Paulson

4. Meeting follow-up

Gary and Don called Deanna – she supports this event and will plan to attend. She confirmed that Scott Tomkins, the IEPA Grant Manager for our study, has concurred with extending the deadline for submittal of the draft watershed plans and executive summary beyond the original date, November 1, 2012. All remaining activities (including two more watershed planning workshops, the final watershed plans, and the final executive summary) will be completed by the final deadline, March 1, 2013.

Respectfully submitted,
Don Krizan, Secretary

Attachment: IEPA Agreement / Scope of Work and Project Schedule

MEETING OF THE WINNEBAGO COUNTY WATERSHED IMPROVEMENT PLAN STEERING COMMITTEE

Wednesday, March 6, 2013
2:30 p.m.
Cherry Valley Village Hall
806 E. State Street
Cherry Valley, IL

I. Welcome by Deanna Doohaluk, Hey and Associates, Inc., & introductions by participants.

II. In-kind Match Logs (time logs) should be updated and sent to Deanna before April 1st.

III. An amendment to our grant agreement is being routed through IEPA channels for final approval. The amendment will extend the end date of the agreement period to July 31, 2013.

IV. The Watershed Resource Inventory for each watershed was discussed. Final review comments should be submitted to Deanna prior to April 1st.

V. Deanna presented preliminary modeling results for each watershed. While the percentage of impervious areas was high for each basin (46.5% for Buckbee and 40.5% for Madigan), the preliminary analyses raised no significant “red flags” regarding either stream quality or quantity measures. Discussion followed.

VI. Deanna asked that Committee members help to identify watershed-wide and site-specific action items (projects) that can be included in the improvement plan recommendations. Discussion followed.

VII. Deanna reminded the local agencies that an EPA Water Quality Scorecard she had earlier distributed is to be prepared for each jurisdiction. After a discussion, a conference call was tentatively arranged for 10:30 a.m., Monday, March 18th, to discuss results and reach a consensus on scoring for each watershed.

VIII. A date/time for the next Steering Committee meeting was discussed – the next meeting will be held at 9:30 a.m. on Wednesday, March 20th, at the Cherry Valley Village Hall.

IX. The next round of public meetings for each watershed to discuss BMP identification and prioritization was discussed – meetings will be scheduled in April.

X. Closing comments / adjournment.

Respectfully submitted,

Don Krizan, Secretary

Appendix B

Rapid Bioassement Protocol (RPB) for Stream and Rivers
Field Data Sheets

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madison Creek
LOCATION Walmart
STATION # 1 RIVERMILE
STREAM CLASS
LAT 42 16.075 LONG 88 58.357
RIVER BASIN
STORET #
AGENCY
INVESTIGATORS
FORM COMPLETED BY DAD, KO
DATE 7/11/11
TIME 10:40 [✓ AM] PM
REASON FOR SURVEY planning

WEATHER CONDITIONS

Windy

Now		Past 24 hours
☐	storm (heavy rain)	☒
☐	rain (steady rain)	☐
☒	showers (intermittent)	☐
___% ☐	%cloud cover	☐ ___%
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☒ Yes ☐ No

Air Temperature_____ ⁰ C

Other

SITE LOCATION/MAP

*request asbuilts
for Walmart/Sams

Draw a map of the site and indicate the areas sampled (or attach a photograph)

online basin upstream → drains
via 2 4' culverts
basin is sparsely vegetated w/natives

upstream of basin has been lined
w/gabion mattress to protect
Quality Suites parking
- mattress are failing

STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other

Catchment Area__________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☒ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☒ Obvious sources

Local Watershed Erosion
☒ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☐ Shrubs ☒ Grasses ☒ Herbaceous

dominant species present natives (mitigation)

INSTREAM FEATURES

Estimated Reach Length to bend behind Hotel

Estimated Stream Width 6 ft

Sampling Reach Area ______ m²

Area in km² (m²x1000) ______ km²

Estimated Stream Depth ______ m

Surface Velocity (at thalweg) ______ m/sec

Canopy Cover
☐ Partly open ☒ Partly shaded ☐ Shaded

High Water Mark ______ m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle ______% ☐ Run ______%
☐ Pool ______%

Channelized ☒ Yes ☐ No

Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD ______ m²

Density of LWD ______ m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae

dominant species present ______

Portion of the reach with aquatic vegetation ______%

WATER QUALITY

Temperature 23.3 °C

Specific Conductance 330

Dissolved Oxygen 5.06/23.0

pH 7.57

~~**Turbidity**~~ ______

WQ Instrument Used ______

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other ______

Turbidity (if not measured)
☐ Clear ☒ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other ______

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other ______

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")	100			
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")				
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)				

Riprap on sides & Bottom

Distance from Rt looking ↑ stream	1.5	3	4.5
depth -	.7	.9	.8
flow -	1.1	1.2	.81

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madison	LOCATION Walmat
STATION # 1 RIVERMILE ________	STREAM CLASS
LAT ________ LONG ________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS MR, DAD	
FORM COMPLETED BY DAD	DATE 7/11/11 TIME 10.40 [✓ AM] PM
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 [✓ 4] 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 [✓ 2] 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 [✓ 19] 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 [✓ 4] 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 [✓ 4] 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]

Total Score __________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madison	LOCATION walmart 2	
STATION # 2 RIVERMILE ______	STREAM CLASS	
LAT 4216.048 LONG 8858.304	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS NL		
FORM COMPLETED BY dad	DATE 11/11 TIME 11:05 [✓ AM] PM	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☒
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
100 % ☒	%cloud cover	☐ ____ %
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☒ Yes ☐ No

Air Temperature _____ ⁰ C

Other ______________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

downstream of bend behind Hotel

-creek silted in

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☒ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other ________

Catchment Area ________ km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☑ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______________
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☑ Obvious sources

Local Watershed Erosion
☑ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☐ Shrubs ☑ Grasses ☑ Herbaceous

dominant species present ______________________________

INSTREAM FEATURES

Estimated Reach Length ______m
Estimated Stream Width 30 ft
Sampling Reach Area ______m^2
Area in km^2 (m^{2}x1000) ______km^2
Estimated Stream Depth 1 ft ~~m~~
Surface Velocity (at thalweg) ______m/sec

Canopy Cover
☑ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark ______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle______% ☐ Run 100 % all Run
☐ Pool______%

Channelized ☑ Yes ☐ No

Dam Present ☐ Yes ☑ No

LARGE WOODY DEBRIS

LWD ______m^2
Density of LWD ______m^2/km^2 **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present None

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature________ °C
Specific Conductance________
Dissolved Oxygen ________
pH ________
Turbidity ________
WQ Instrument Used ______________

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other________________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other________________________

Turbidity (if not measured)
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other________

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other________________________________

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other________________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")				
Sand	0.06-2mm (gritty)	75	Marl	grey, shell fragments	
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)	25			

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madison	LOCATION Walmart 2
STATION # 2 RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE ________ TIME ________ AM PM REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 [✓ 6]	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 [✓ 1] 0

Total Score ________

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madisan	LOCATION	
STATION # 3 RIVERMILE ______	STREAM CLASS	
LAT ______ LONG ______	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS NR, DAD		
FORM COMPLETED BY DAD	DATE ______ TIME ______ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 [✓ 2] 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 [✓ 7] 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 [✓ 7] 6	5 4 3	2 1 0

Total Score _________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madison	LOCATION
STATION # 3 RIVERMILE	STREAM CLASS
LAT 42 15.925 LONG 88 58.415	RIVER BASIN
STORET # 839	AGENCY
INVESTIGATORS NR, DAD	
FORM COMPLETED BY DAD	DATE 7/11/11 TIME 11:40 [✓ AM] PM — REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☒
☐	rain (steady rain)	☒
☐	showers (intermittent)	☐
100% ☒	%cloud cover	☐ ____%
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☒ Yes ☐ No

Air Temperature_____ ° C

Other________________________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

-Section was recently terraced & planted beginning of summer ~~2010~~ 2009 → pond & Walmart construction ENCAP

-sampled downstream of outlet from pond
↳ outlet of pond is brown in color

-checkdams present in channel
But covered in H_2O

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☒ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other_________

Catchment Area_________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☑ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ____________
☑ Residential

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☑ Obvious sources → pond
Local Watershed Erosion
☑ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☐ Shrubs ☐ Grasses ☑ Herbaceous
dominant species present native

INSTREAM FEATURES

Estimated Reach Length _______m
Estimated Stream Width 10 ft m
Sampling Reach Area _______m²
Area in km² (m²x1000) _______km²
Estimated Stream Depth _______m
Surface Velocity (at thalweg) _______m/sec

Canopy Cover
☑ Partly open ☐ Partly shaded ☐ Shaded
High Water Mark _______m
Proportion of Reach Represented by Stream Morphology Types
☐ Riffle_____% ☐ Run 100 %
☐ Pool_____%
Channelized ☐ Yes ☐ No moderate
Dam Present ☐ Yes ☑ No

LARGE WOODY DEBRIS

LWD _______m²
Density of LWD _______m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae
dominant species present cant tell due to turbidity
Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature 24.6 °C
Specific Conductance 346
Dissolved Oxygen 5.96/23.7
pH 7.55
Turbidity visual
WQ Instrument Used ____________

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other____________
Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other____________
Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☑ Turbid
☐ Opaque ☐ Stained ☐ Other______

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other____________
Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other____________
Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	
Gravel	2-64 mm (0.1"-2.5")	
Sand	0.06-2mm (gritty)	
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	100

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

distance Ldownstm	3	5	7	9
dept	1.1	1.75	1.75	.7
flow	.05	.15	.6	.25

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madison	LOCATION
STATION # 4 RIVERMILE	STREAM CLASS
LAT LONG	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE TIME AM PM
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 [✓ 17] 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 [✓ 1] 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 [✓ 1] 0

Total Score __________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Madigan	LOCATION
STATION # 4 RIVERMILE	STREAM CLASS
LAT 42 15.774 LONG 88.58.578	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS NR, DAD	
FORM COMPLETED BY DAD	DATE 7/11/11 TIME 11:54 [✓ AM] PM
	REASON FOR SURVEY

WEATHER CONDITIONS	**Now**		**Past 24 hours**	**Has there been a heavy rain in the last 7 days?** ☑ Yes ☐ No
	☐	storm (heavy rain)	☑	**Air Temperature**_____ ⁰ C
	☐	rain (steady rain)	☐	**Other**_____
	☐	showers (intermittent)	☐	
	80 % ☑	%cloud cover	☐ ___ %	
	☐	clear/sunny	☐	

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

STREAM CHARACTERIZATION

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☑ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other_________

Catchment Area_________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ____________
☑ Residential

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☑ Obvious sources

Local Watershed Erosion
☐ None ☐ Moderate ☑ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☐ Shrubs ☐ Grasses ☑ Herbaceous

dominant species present ____________

INSTREAM FEATURES

Estimated Reach Length ______m
Estimated Stream Width 13 ft
Sampling Reach Area ______m²
Area in km² (m²x1000) ______km²
Estimated Stream Depth ______m
Surface Velocity (at thalweg) ______m/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark ______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle ______% ☐ Run ______%
☐ Pool ______%

Channelized ☑ Yes ☐ No

Dam Present ☐ Yes ☐ No

LARGE WOODY DEBRIS

LWD ______m²
Density of LWD ______m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present ____________

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature 24.9 °C
Specific Conductance 349
Dissolved Oxygen 6.28 / 24.0 77%
pH 7.62
Turbidity ______
WQ Instrument Used ____________

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ____________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other ____________

Turbidity (if not measured)
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ______

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other ____________

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other ____________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			**ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)**		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")	100			
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)				

distance from L↑stream -	3ft	6ft	9ft	12ft
depth -	.7	.8	.8	Q .1146
flow -	.45	.86	.32	NF

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madigan	LOCATION
STATION # 5 RIVERMILE	STREAM CLASS
LAT 42 15.615 LONG 88 58.264	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS DAD, MB	
FORM COMPLETED BY DAD	DATE 7/11/11 TIME 12:26 AM PM
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0

16x20

200

150

100

50

0

X

① ⑬ ⑤

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 [✓ 7] 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 [✓ 7] 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 [✓ 6]	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 [✓ 6]	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]

Total Score __________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madison	LOCATION
STATION # 5 RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS NO, DAD	
FORM COMPLETED BY DAD	DATE 7/11/11 TIME 12:26 AM [✓ PM]
	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☒
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
100%☐	%cloud cover	☐ ____%
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature _____ °C

Other ______________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

less tree cover than 4

↳ so more vegetation on banks

-House on corner of waterford SE

-flooded basement

-H2O commonly reaches steps of brown house

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☒ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☐ Mixture of origins
☐ Swamp and bog ☐ Other__________

Catchment Area_________ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☐ Forest ☐ Commercial ☐ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other ______________ ☑ Residential **Local Watershed NPS Pollution** ☐ No evidence ☐ Some potential sources ☑ Obvious sources dad **Local Watershed Erosion** ☑ None ☑ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☐ Trees ☐ Shrubs ☑ Grasses ☐ Herbaceous **dominant species present** ______________________
INSTREAM FEATURES	**Estimated Reach Length** _______m **Estimated Stream Width** 5ft m **Sampling Reach Area** _______m² **Area in km² (m²x1000)** _______km² **Estimated Stream Depth** _______m **Surface Velocity (at thalweg)** _______m/sec **Canopy Cover** ☑ Partly open ☐ Partly shaded ☐ Shaded **High Water Mark** _______m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle_______% ☐ Run_______% ☐ Pool_______% **Channelized** ☑ Yes ☐ No **Dam Present** ☐ Yes ☑ No
LARGE WOODY DEBRIS	**LWD** _______m² **Density of LWD** _______m²/km² (LWD/ reach area)
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating ☐ Floating Algae ☐ Attached Algae **dominant species present** None **Portion of the reach with aquatic vegetation** _____%
WATER QUALITY	**Temperature** 25.4 °C **Specific Conductance** 345 **Dissolved Oxygen** 6.52 / 79.5% **pH** 7.61 239 **Turbidity** ________ **WQ Instrument Used** ______________ **Water Odors** ☑ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other______________ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☑ None ☐ Other______________ **Turbidity (if not measured)** ☐ Clear ☑ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other________
SEDIMENT/ SUBSTRATE	**Odors** ☑ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other______________ **Oils** ☑ Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other______________ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")	100			
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)				

L ↑ stream	1 ft	2 ft	3 ft	4 ft
depth	.5	.6	.7	.8
flow	.03	.99	1.86	1.62

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madigan	LOCATION
STATION # 6 RIVERMILE	STREAM CLASS
LAT 42 15.348 LONG 88 58.418	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS NR, DAD	
FORM COMPLETED BY DAD	DATE 7/11/11 TIME ________ AM PM
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 [✓ 19] 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 [✓ 1] 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 [✓ 1] 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]

Total Score __________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madison	LOCATION
STATION # 6 RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS NR, DAD	
FORM COMPLETED BY DAD	DATE 7/11/11 TIME ______ AM PM
	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☒
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
100% ☐	%cloud cover	☐ ___%
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☒ Yes ☐ No

Air Temperature_____ ⁰ C

Other______________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☒ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other__________

Catchment Area__________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest
☐ Field/Pasture
☐ Agricultural
☒ Residential
☐ Commercial
☐ Industrial
☐ Other ____________

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☒ Obvious sources

Local Watershed Erosion
☐ None ☐ Moderate ☒ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☒ Grasses ☐ Herbaceous

dominant species present ____________

INSTREAM FEATURES

Estimated Reach Length ______m

Estimated Stream Width 10.5 m

Sampling Reach Area ______m²

Area in km² (m²x1000) ______km²

Estimated Stream Depth ______m

Surface Velocity (at thalweg) ______m/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark ______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle______% ☐ Run______%
☐ Pool______%

Channelized ☐ Yes ☐ No

Dam Present ☐ Yes ☐ No

LARGE WOODY DEBRIS

LWD ______m²

Density of LWD ______m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

None

dominant species present ____________

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature 24.5 °C

Specific Conductance 346

Dissolved Oxygen 7.06/86.7

pH 7.62

24.1

Turbidity ______

WQ Instrument Used ____________

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other____________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other____________

Turbidity (if not measured)
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other______

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other____________

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other____________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	
Gravel	2-64 mm (0.1"-2.5")	75
Sand	0.06-2mm (gritty)	25
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Characteristic**	**% Composition in Sampling Area**
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

distance from R	2ft	4	6ft	8ft	~~10ft~~
depth	.3	.45	.4	.1	
flow	1.5	.75	1.12	NF	

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madison	LOCATION
STATION # 7 RIVERMILE	STREAM CLASS
LAT 42 16.149 LONG 88 58.709	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS NR, DAD	
FORM COMPLETED BY DAD	DATE 7/11/11 TIME 2:07 AM [✓ PM]
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 [✓ 4] 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 [✓ 3]	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 [✓ 3]	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]

Total Score __________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Madigan	LOCATION
STATION # 1 RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE ______ TIME ______ AM PM
	REASON FOR SURVEY

WEATHER CONDITIONS	**Now** / **Past 24 hours** ☐ storm (heavy rain) ☑ ☐ rain (steady rain) ☐ ☐ showers (intermittent) ☐ 100% ☑ %cloud cover ☐ ___% ☐ clear/sunny ☐ **Has there been a heavy rain in the last 7 days?** ☑ Yes ☐ No **Air Temperature**_____ ⁰ C **Other**______
SITE LOCATION/MAP	**Draw a map of the site and indicate the areas sampled (or attach a photograph)** Behind Ingrassia
STREAM CHARACTERIZATION	**Stream Subsystem** ☐ Perennial ☑ Intermittent ☐ Tidal **Stream Type** ☑ Coldwater ☐ Warmwater **Stream Origin** ☐ Glacial ☐ Spring-fed ☐ Non-glacial montane ☐ Mixture of origins ☐ Swamp and bog ☐ Other______ **Catchment Area**______km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest
☐ Field/Pasture
☐ Agricultural
☐ Residential
☑ Commercial
☐ Industrial
☐ Other ____________

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☐ Moderate ☑ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☐ Shrubs ☐ Grasses ☑ Herbaceous

dominant species present ____________

INSTREAM FEATURES

Estimated Reach Length _______m
Estimated Stream Width 12-15ft m
Sampling Reach Area _______m^2
Area in km² (m^2x1000) _______km^2
Estimated Stream Depth _______m
Surface Velocity (at thalweg) _______m/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark _______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle_______% ☐ Run_______%
☐ Pool_______%

Channelized ☐ Yes ☐ No

Dam Present ☐ Yes ☐ No

LARGE WOODY DEBRIS

LWD _______m^2 [illegible]
Density of LWD _______m^2/km^2 **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present None

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature________° C
Specific Conductance________
Dissolved Oxygen ________
pH ________
Turbidity ________
WQ Instrument Used ______________

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other______________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☐ None ☐ Other______________

Turbidity (if not measured)
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other_______

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other______________

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other______________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	
Gravel	2-64 mm (0.1"-2.5")	25
Sand	0.06-2mm (gritty)	75
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madigan Creek	LOCATION Avalon
STATION # 8 RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS DAD, NO	
FORM COMPLETED BY DAD	DATE 7/14/11 TIME 2:49 AM PM
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1 0]

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 [✓ 4] 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 [✓ 4] 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]

Total Score __________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Madison	LOCATION W side of Avalon
STATION # 8 RIVERMILE	STREAM CLASS
LAT 42 15.133 LONG 88.58.907	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS DAD, NO	

FORM COMPLETED BY dad	DATE TIME AM PM	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☑
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
100%☐	%cloud cover	☐ ___%
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☑ Yes ☐ No

Air Temperature_____ ⁰ C

Other____________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

Wside of Avalon

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☑ Intermittent ☐ Tidal

Stream Type
☑ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other_________

Catchment Area_________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ____________
☒ Residential

Local Watershed NPS Pollution
☐ No evidence ☒ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☐ Moderate ☒ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☐ Shrubs ☒ Grasses ☐ Herbaceous

dominant species present turf

INSTREAM FEATURES

Estimated Reach Length _______m
Estimated Stream Width 6 ft
Sampling Reach Area _______m^2
Area in km² (m^2x1000) _______km^2
Estimated Stream Depth _______m
Surface Velocity (at thalweg) _______m/sec

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark _______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle______% ☒ Run 100 %
☐ Pool______%

Channelized ☒ Yes ☐ No

Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD _______m^2
Density of LWD _______m^2/km^2 **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present None observed

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature 27.1 °C
Specific Conductance 952
Dissolved Oxygen 6.33
pH 7.71 26.8
Turbidity _______ 80.8%
WQ Instrument Used ____________

Water Odors
☐ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other____________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other____________

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☒ Turbid
☐ Opaque ☐ Stained ☐ Other______

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other____________

Oils
☐ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other____________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")	100			
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)				

L ↑ stre	2ft	4ft
depth	.7	.6
flow	1.76	.76

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madison	LOCATION E of Avalon
STATION #_____ RIVERMILE_____	STREAM CLASS
LAT _____ LONG _____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS NO, DAD	
FORM COMPLETED BY DAD	DATE 7/11/11 TIME 3:00 AM [✓ PM]
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 [✓ 3] 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 [✓ 1] 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 [✓ 1] 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]

Total Score ________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Madsen	LOCATION
STATION # 9 RIVERMILE ______	STREAM CLASS
LAT 42 15.126 LONG 88. 58.910	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS DA D, NO	
FORM COMPLETED BY drd	DATE 7/11/11 TIME ______ AM PM
	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☑
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
80% ☑	%cloud cover	☐ ___%
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☑ Yes ☐ No

Air Temperature _____ ⁰ C

Other ____________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

E of bridge

1ft drop on E side of culvert

debris (concrete) in stream

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☑ Intermittent ☐ Tidal

Stream Type
☑ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other ________

Catchment Area ________ km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest
☐ Field/Pasture
☐ Agricultural
☑ Residential
☐ Commercial
☐ Industrial
☐ Other ______________

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☑ Obvious sources

Local Watershed Erosion
☐ None ☐ Moderate ☑ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☑ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present ______________________________

INSTREAM FEATURES

Estimated Reach Length _______m

Estimated Stream Width 8 ft

Sampling Reach Area _______m²

Area in km² (m²x1000) _______km²

Estimated Stream Depth _______m

Surface Velocity (at thalweg) _______m/sec

Canopy Cover
☐ Partly open ☑ Partly shaded ☐ Shaded

High Water Mark _______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle_______% ☐ Run 100 %
☐ Pool_______%

Channelized ☑ Yes ☐ No

Dam Present ☐ Yes ☑ No

LARGE WOODY DEBRIS

LWD _______m²

Density of LWD _______m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present None

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature________ °C

Specific Conductance________

Dissolved Oxygen ________

pH ________

Turbidity ________

WQ Instrument Used ______________

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other______________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other______________

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☑ Turbid
☐ Opaque ☐ Stained ☐ Other________

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other______________

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other______________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	
Gravel	2-64 mm (0.1"-2.5")	100
Sand	0.06-2mm (gritty)	
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madison	LOCATION
STATION # 10 RIVERMILE	STREAM CLASS
LAT 42 14.969 LONG 88 58.860	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS dad, NL	
FORM COMPLETED BY dad	DATE 7/11/11 TIME 3:18 AM PM
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	[✓ 5] 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 [✓ 7] 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 [✓ 3] 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score __________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Madigen	LOCATION
STATION # 10 RIVERMILE ________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	

FORM COMPLETED BY	DATE ________ TIME ________ AM PM	REASON FOR SURVEY

WEATHER CONDITIONS

Now		**Past 24 hours**
☐	storm (heavy rain)	☒
☐	rain (steady rain)	☐
☑	showers (intermittent)	☐
80 % ☐	%cloud cover	☐ ____ %
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☐ Yes ☐ No

Air Temperature _____ ⁰ C

Other ________________________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☑ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☑ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other _________

Catchment Area _________ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☑ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______________
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☑ Obvious sources

Local Watershed Erosion
☐ None ☐ Moderate ☑ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present ______________________________

INSTREAM FEATURES

Estimated Reach Length _______m

Estimated Stream Width 20 ~~m~~ ft

Sampling Reach Area _______m²

Area in km² (m²x1000) _______km²

Estimated Stream Depth 1 ~~m~~ ft

Surface Velocity (at thalweg) _______m/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark _______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 50 % ☐ Run_______%
☐ Pool 50 %

Channelized ☑ Yes ☐ No

Dam Present ☐ Yes ☐ No

LARGE WOODY DEBRIS

LWD _______m²

Density of LWD _______m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present ______________________________

Portion of the reach with aquatic vegetation 0 %

WATER QUALITY

Temperature________ °C

Specific Conductance________

Dissolved Oxygen ________

pH ________

Turbidity ________

WQ Instrument Used ______________

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other______________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other______________

Turbidity (if not measured)
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other________

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other______________

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other______________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	25
Gravel	2-64 mm (0.1"-2.5")	50
Sand	0.06-2mm (gritty)	25
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madigan	LOCATION	
STATION # 11 RIVERMILE ______	STREAM CLASS	
LAT ______ LONG ______	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE ______ TIME ______ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 [✓ 2] 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 [✓ 6]	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 [✓ 6]	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]

Total Score __________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madigan	LOCATION
STATION # 11 RIVERMILE	STREAM CLASS
LAT 42 14.748 LONG 88 59.022	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE 7/11/17 TIME 3:36 AM [✓ PM]
	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☑
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
80% ☑	%cloud cover	☐ ___%
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☑ Yes ☐ No

Air Temperature_____ ⁰ C

Other____________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

creek from 10 to 11 looks like 10
then 60 ft of concrete
other channel comin
in is an active detention basin

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☑ Intermittent ☐ Tidal

Stream Type
☑ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other_________

Catchment Area_________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☑ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______
☑ Residential

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☑ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☐ Shrubs ☑ Grasses ☐ Herbaceous

dominant species present Reed canary

INSTREAM FEATURES

Estimated Reach Length ______m
Estimated Stream Width 5 ft ~~m~~
Sampling Reach Area ______m^2
Area in km^2 (m^2x1000) ______km^2
Estimated Stream Depth ______m
Surface Velocity (at thalweg) ______m/sec

Canopy Cover
☑ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark ______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle ______% ☐ Run 100%
☐ Pool ______%

Channelized ☑ Yes ☐ No

Dam Present ☐ Yes ☑ No

LARGE WOODY DEBRIS

LWD ______m^2
Density of LWD ______m^2/km^2 **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present None

Portion of the reach with aquatic vegetation ____%

WATER QUALITY

Temperature ______° C
Specific Conductance ______
Dissolved Oxygen ______
pH ______
Turbidity ______
WQ Instrument Used ______

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other______

Turbidity (if not measured)
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other______

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other______

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other______

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	
Gravel	2-64 mm (0.1"-2.5")	100
Sand	0.06-2mm (gritty)	
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

w/ blocks of concrete

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madison	LOCATION
STATION # 12 RIVERMILE	STREAM CLASS
LAT LONG	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE TIME AM PM
REASON FOR SURVEY	

Parameters to be evaluated in sampling reach

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 [✓ 2] 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	[✓ 5] 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 [✓ 9]	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	[✓ 5] 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	[✓ 5] 4 3	2 1 0

Total Score _________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madison

LOCATION

STATION # 12 RIVERMILE_____

STREAM CLASS

LAT 42 14.642 LONG 88 59.009

RIVER BASIN

STORET #

AGENCY

INVESTIGATORS NL, dad

FORM COMPLETED BY dad

DATE 7/11/11

TIME 3:52 AM [✓ PM]

REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☒
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
___% ☐	%cloud cover	☐ ___%
☒	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☒ Yes ☐ No

Air Temperature_____ °C

Other____________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

-online detention for Menards

↳ dredged in 2009/2010

-lots of deposition of upstream riprap

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☒ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other______

Catchment Area______ km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☑ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______________
☑ Residential

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☑ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☐ Shrubs ☑ Grasses ☐ Herbaceous

dominant species present Reed, teasel

INSTREAM FEATURES

Estimated Reach Length _______m

Estimated Stream Width _______m

Sampling Reach Area _______m²

Area in km² (m²x1000) _______km²

Estimated Stream Depth _______m

Surface Velocity (at thalweg) _______m/sec

Canopy Cover
☑ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark _______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle_______% ☑ Run 100 %
☐ Pool_______%

Channelized ☑ Yes ☐ No

Dam Present ☐ Yes ☑ No

LARGE WOODY DEBRIS

LWD _______m²

Density of LWD _______m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present None

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature________ ⁰C

Specific Conductance________

Dissolved Oxygen ________

pH ________

Turbidity ________

WQ Instrument Used ______________

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other______________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☐ None ☐ Other______________

Turbidity (if not measured)
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other________

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other______________________________

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other______________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	
Gravel	2-64 mm (0.1"-2.5")	50
Sand	0.06-2mm (gritty)	
Silt	0.004-0.06 mm	50
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madkar	LOCATION Vandiver	
STATION # 13 RIVERMILE	STREAM CLASS	
LAT 42 14.338 LONG 88 54.480	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS Jad, ND		
FORM COMPLETED BY Jad	DATE 7/11/11 TIME 4:10 AM [✓ PM]	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 [✓ 19] 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 [✓ 2] 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 [✓ 1] 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	[✓ 8] 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 [✓ 7] 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 [✓ 7] 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]

Total Score __________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Madison	LOCATION
STATION # 13 RIVERMILE ________	STREAM CLASS
LAT ____________ LONG __________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE ________ TIME ________ AM PM
	REASON FOR SURVEY

WEATHER CONDITIONS	**Now**		**Past 24 hours**	**Has there been a heavy rain in the last 7 days?** ☒ Yes ☐ No
	☐	storm (heavy rain)	☒	**Air Temperature**_____ ⁰ C
	☐	rain (steady rain)	☐	
	☐	showers (intermittent)	☐	**Other**______________________
	____% ☐	%cloud cover	☐ ____%	
	☒	clear/sunny	☐	

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

N of Vandiver → Sector extends to Hamner

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☒ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other_________

Catchment Area_________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest
☐ Field/Pasture
☐ Agricultural
☐ Residential
☑ Commercial
☐ Industrial
☐ Other ____________

Local Watershed NPS Pollution
☐ No evidence
☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☑ None
☐ Moderate
☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees
☐ Shrubs
☑ Grasses
☐ Herbaceous

dominant species present ____________

INSTREAM FEATURES

Estimated Reach Length ______m
Estimated Stream Width 15ft m
Sampling Reach Area ______m²
Area in km² (m²x1000) ______km²
Estimated Stream Depth ______m
Surface Velocity (at thalweg) ______m/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark ______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle______% ☐ Run______%
☐ Pool______%

Channelized ☐ Yes ☐ No
Dam Present ☐ Yes ☐ No

LARGE WOODY DEBRIS

LWD ______m²
Density of LWD ______m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent
☐ Rooted submergent
☐ Rooted floating
☐ Free floating
☐ Floating Algae
☒ Attached Algae

dominant species present ____________

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature________ °C
Specific Conductance________
Dissolved Oxygen ________
pH ________
Turbidity ________
WQ Instrument Used ____________

Water Odors
☐ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☑ Fishy ☐ Other____________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☐ None ☐ Other____________

Turbidity (if not measured)
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other________

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other____________

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other____________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")	100	Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")				
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)				

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Mcdugan	LOCATION CKisH
STATION # 14 RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY dod	DATE ______ TIME ______ AM PM
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 [✓ 6]	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 [✓ 6]	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 [✓ 6]	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 [✓ 6]	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 [✓ 1] 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 [✓ 1] 0

Total Score __________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madison

LOCATION @ KISH

STATION # 14 RIVERMILE

STREAM CLASS

LAT 42 13.5560 LONG 88 57.70

RIVER BASIN

STORET #

AGENCY

INVESTIGATORS NO, dad

FORM COMPLETED BY dad, NO

DATE 7/11/11

TIME 4:40 AM [✓ PM]

REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☑
☐	rain (steady rain)	☐
☑	showers (intermittent)	☐
____%☐	%cloud cover	☐____%
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☑ Yes ☐ No

Air Temperature_____ °C

Other______________________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

6 sq miles

200 ft drop in elevation

from top to bottom

STREAM CHARACTERIZATION

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other__________

Catchment Area__________ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _______
☑ Residential

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☑ Obvious sources

Local Watershed Erosion
☐ None ☑ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present _______

INSTREAM FEATURES

Estimated Reach Length _______m

Estimated Stream Width 30 ft

Sampling Reach Area _______m^2

Area in km^2 (m^2x1000) _______km^2

Estimated Stream Depth 2 ft

Surface Velocity (at thalweg) _______m/sec

Canopy Cover
☐ Partly open ☑ Partly shaded ☐ Shaded

High Water Mark _______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 50 % ☐ Run 0 %
☐ Pool 50 %

Channelized ☐ Yes ☑ No

Dam Present ☐ Yes ☑ No

LARGE WOODY DEBRIS

LWD _______m^2

Density of LWD 10% m^2/km^2 (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present _______

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature_______ ° C

Specific Conductance_______

Dissolved Oxygen _______

pH _______

Turbidity _______

WQ Instrument Used _______

Water Odors
☐ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other_______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☐ None ☐ Other_______

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other_______

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other_______

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☑ Sand
☐ Relict shells ☐ Other_______

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☑ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	25
Gravel	2-64 mm (0.1"-2.5")	50
Sand	0.06-2mm (gritty)	25
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madison	LOCATION
STATION # 15 /16 RIVERMILE	STREAM CLASS
LAT LONG	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS dad	
FORM COMPLETED BY dad	DATE 7/13/11 TIME 125 AM [✓ PM]
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 [✓ 3] 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats	All mud or clay or sand bottom; little or no root mat; no submerged	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE			8 7 [✓ 6]	5 4 3 2 1 0
3. Pool Variability			s much more n deep pools.	Majority of pools small-shallow or pools absent.
SCORE			8 7 6	5 4 3 2 1 [✓ 0]
4. Sediment Deposition			position of sand or fine old and new of the ted; sediment bstructions, , and bends; position of ent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE			8 7 6	5 4 3 2 1 0
5. Channel Flow Status	channel substrate is exposed.	is exposed.	5-75% of the annel, and/or tes are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]

15: 42° 14' 37.51" N

88° 59' 25.96" W

16: 42° 14' 41.50" N

88° 59' 28.37" W

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 ~~[✓ 6]~~	5 [✓ 4] 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 ~~[✓ 7]~~ 6	5 4 [✓ 3]	2 1 0

dla

Total Score ________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madigan	LOCATION	
STATION # 15/16 RIVERMILE ________	STREAM CLASS	
LAT ____________ LONG ____________	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE ________ TIME ________ AM PM	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☒
___%☐	%cloud cover	☐___%
☒	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☒ Yes ☐ No

Air Temperature_____ °C

Other________________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

(15) receives drainage from Charles -
roadside ditch runs ~~from~~ on
S side of Charles from the W

(16) W branch from ~~cemetery~~ yard
same habitat but
10 ft wide

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☒ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☐ Mixture of origins
☐ Swamp and bog ☐ Other__________

Catchment Area__________km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ____________
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☑ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present ____________________________

INSTREAM FEATURES

Estimated Reach Length _______m
Estimated Stream Width 6 ft ~~m~~ (15)
Sampling Reach Area _______m^2
Area in km^2 (m^2x1000) _______km^2
Estimated Stream Depth _______m
Surface Velocity (at thalweg) _______m/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark _______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle_______% ☐ Run_______%
☐ Pool_______%

Channelized ☐ Yes ☐ No

Dam Present ☐ Yes ☐ No

LARGE WOODY DEBRIS

LWD _______m^2
Density of LWD _______m^2/km^2 **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present None

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature________ °C
Specific Conductance________
Dissolved Oxygen________
pH ________
Turbidity ________
WQ Instrument Used ______________

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other____________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other____________

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other________

No H_2O

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other____________________

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other____________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")				
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm	100			
Clay	< 0.004 mm (slick)				

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madig	LOCATION
STATION # 17 RIVERMILE	STREAM CLASS
LAT 42 14'45.21 LONG 88 59 22.25	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY daq	DATE 7/3/11 TIME 2:04 AM [✓ PM] REASON FOR SURVEY

Parameters to be evaluated in sampling reach	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 [✓ 2] 1 0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
	3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 [✓ 16]	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	[✓ 2] 1 0

Total Score _________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madison	LOCATION
STATION # 17 RIVERMILE	STREAM CLASS
LAT LONG	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY dad	DATE 7/13/11 TIME 2:04 AM [✓ PM]
	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☑
____% ☐	%cloud cover	☐ ____%
☑	clear/sunny	☐

Has there been a heavy rain in the last 7 days?
☑ Yes ☐ No

Air Temperature_____ ° C

Other__________________________________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

No distinct channel →
H2O meander through
a non defined channel
↳ ~~[illegible]~~ feed by
Springs

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☑ Intermittent ☐ Tidal

Stream Type
☑ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other_________

Catchment Area_________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______________
☑ Residential

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☑ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present ______________________________

INSTREAM FEATURES

Estimated Reach Length _______m

Estimated Stream Width _______m

Sampling Reach Area _______m^2

Area in km^2 (m^2x1000) _______km^2

Estimated Stream Depth _______m

Surface Velocity (at thalweg) _______m/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark _______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle_______% ☐ Run_______%
☐ Pool_______%

Channelized ☐ Yes ☐ No

Dam Present ☐ Yes ☐ No

LARGE WOODY DEBRIS

LWD _______m^2

Density of LWD _______m^2/km^2 **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present ______________________________

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature________ °C

Specific Conductance________

Dissolved Oxygen ________

pH ________

Turbidity ________

WQ Instrument Used ______________

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other______________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other______________

Turbidity (if not measured)
☑ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other________

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other______________

Oils
☑ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other______________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	
Gravel	2-64 mm (0.1"-2.5")	
Sand	0.06-2mm (gritty)	
Silt	0.004-0.06 mm	100
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madigan	LOCATION
STATION # 18 RIVERMILE	STREAM CLASS
LAT LONG	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY dad	DATE 7/13/11 TIME 1:25 AM [✓ PM]
	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank [✓ 10] 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]

Total Score __________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madison	LOCATION
STATION # 18 RIVERMILE _____	STREAM CLASS
LAT _____ LONG _____	RIVER BASIN
STOREET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY dael	DATE 7/13/11 TIME 1:45 AM PM REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☒
____%☐	%cloud cover	☐____%
☒	clear/sunny	☐

Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature _____ ⁰ C

Other ____________

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

upstream of this spot is wooded & similar to 15/16

downstream residential - South Vale / North Vale

come out of woods & is in small "basin" rock lined w/riprap. then 10yds of pipe (inlet is filled in w/ silt)

then a series of 3 dry basins w/ ~~storm~~ low flows in pipe → there are also other basin (paved ditchs E of ~~[illegible]~~ Trainer - could be seen from Menands area

b/w woods & Trainer

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other______

Catchment Area________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ______________
☑ Residential

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☐ Shrubs ☑ Grasses ☐ Herbaceous

dominant species present turf

INSTREAM FEATURES

Estimated Reach Length _______m

Estimated Stream Width _______m

Sampling Reach Area _______m^2

Area in km^2 (m^2x1000) _______km^2

Estimated Stream Depth _______m

Surface Velocity (at thalweg) _______m/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark _______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle_______% ☐ Run_______%
☐ Pool_______%

Channelized ☐ Yes ☐ No

Dam Present ☐ Yes ☐ No

LARGE WOODY DEBRIS

LWD _______m^2

Density of LWD _______m^2/km^2 **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present None

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature________ °C

Specific Conductance________

Dissolved Oxygen ________

pH ________

Turbidity ________

WQ Instrument Used ______________

Water Odors
☐ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other________________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☐ None ☐ Other________________

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other__________

SEDIMENT/ SUBSTRATE

Odors
☐ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other______________________________

Oils
☐ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other________________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	
Gravel	2-64 mm (0.1"-2.5")	
Sand	0.06-2mm (gritty)	
Silt	0.004-0.06 mm	~~100~~
Clay	< 0.004 mm (slick)	~~100~~ 100

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	

pipe → basins are dry turf

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME Madigan	LOCATION	
STATION # 19 RIVERMILE	STREAM CLASS	
LAT LONG	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE 7/13/11 TIME 2:30 AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	[✓ 20] 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 [✓ 6]	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 [✓ 0]
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 [✓ 0]
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 [✓ 4] 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 [✓ 3]	2 1 0

Total Score ________

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME Madison	LOCATION	
STATION # 19 RIVERMILE ______	STREAM CLASS	
LAT ______ LONG ______	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE 7/13/16 TIME 2:36 AM [✓ PM]	REASON FOR SURVEY

WEATHER CONDITIONS	**Now**		**Past 24 hours**	**Has there been a heavy rain in the last 7 days?** ☒ Yes ☐ No
	☐	storm (heavy rain)	☐	**Air Temperature**_____ ° C
	☐	rain (steady rain)	☐	**Other**______________
	☐	showers (intermittent)	☒	
	____% ☐	%cloud cover	☐ ____%	
	☒	clear/sunny	☐	

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

W of cemetery in woods -
very entrenched

immediately ↑stream of pipe
~~farm~~ tile is present in channel

channel has rock but
was man added

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☑ Intermittent ☐ Tidal

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☐ Mixture of origins
☐ Swamp and bog ☐ Other________

Stream Type
☐ Coldwater ☐ Warmwater

Catchment Area________km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest
☐ Field/Pasture
☐ Agricultural
☐ Residential
☐ Commercial
☐ Industrial
☐ Other ______________

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present ______________________________

INSTREAM FEATURES

Estimated Reach Length _______m
Estimated Stream Width 6 ft ~~m~~
Sampling Reach Area _______m^2
Area in km^2 (m^{2}x1000) _______km^2
Estimated Stream Depth _______m
Surface Velocity (at thalweg) _______m/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☑ Shaded

High Water Mark _______m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle_______% ☐ Run_______%
☐ Pool_______%

Channelized ☑ Yes ☐ No

Dam Present ☐ Yes ☑ No

LARGE WOODY DEBRIS

LWD _______m^2
Density of LWD _______m^2/km^2 **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

None

dominant species present ______________________________

Portion of the reach with aquatic vegetation _____%

WATER QUALITY

Temperature________ °C
Specific Conductance________
Dissolved Oxygen ________
pH ________
Turbidity ________
WQ Instrument Used ______________

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other______________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☑ None ☐ Other______________

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other_______

SEDIMENT/ SUBSTRATE

Odors
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other______________

Oils
☐ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other______________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)

Substrate Type	Diameter	% Composition in Sampling Reach
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	
Gravel	2-64 mm (0.1"-2.5")	
Sand	0.06-2mm (gritty)	
Silt	0.004-0.06 mm	100
Clay	< 0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)

Substrate Type	Characteristic	% Composition in Sampling Area
Detritus	sticks, wood, coarse plant materials (CPOM)	
Muck-Mud	black, very fine organic (FPOM)	
Marl	grey, shell fragments	