THE KINNICKINNIC RIVER WATERSHED UPDATED IMPLEMENTATION PLAN

A Comprehensive Watershed Restoration Plan

Southeastern Wisconsin Watersheds Trust, Inc.

Will Kort and Kaitlyn Taylor

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PART 1. BACKGROUND

INTRODUCTION

The Kinnickinnic River Watershed is the smallest of three watersheds that discharge into Lake Michigan via the Milwaukee River and Milwaukee Harbor Estuary. At approximately 25 square miles, it is the also most urbanized watershed in the state of Wisconsin. Historically, the Kinnickinnic River Watershed was predominately forested, however, massive urbanization of the watershed beginning in the 1960s quickly turned the wooded watershed into a paved landscape and the Kinnickinnic River into a channelized stream. This transformation, paired with a growing population rate, resulted in dangerous flood events, water pollution from industry and development, and elimination of almost all of the natural habitat. Today, two thirds of the waterways are either lined with concrete or underground, all but six miles of streams are not meeting water quality standards, and flood events frequently damage property and cause dangerously fast stream flows. Further degrading the watershed is a general disinvestment in development that this area of the city has experienced in the last few decades, which deters improvement that would otherwise provide more opportunity and funds for restoration projects.

Despite this, headway has been made in the past decade by committed stakeholders in the watershed and a general momentum towards watershed restoration has begun. For example, the recently released Milwaukee River Basin Total Maximum Daily Load (TMDL) allocates stricter than ever pollutant reductions to the region's point sources and requires a watershed mind-set to successfully implement. Green infrastructure (GI) funding opportunities and GI popularity with project implementers are both increasing, large-scale flood management and removal of concrete channelization plans for the watershed are under development, and preexisting collaborations between diverse partners in the Kinnickinnic River Watershed are strengthening. Overall, however, watershed restoration efforts are falling behind established timelines of prior watershed plans, and the watershed is in need of major improvements.

It is clear the Kinnickinnic River Watershed is at a critical juncture. Now, more than ever, stakeholders understand that true watershed restoration requires a plan that moves the needle on multiple fronts including improvements in water quality, managing water quantity, addressing aquatic and terrestrial habitat, and creating new opportunities for recreation and access to this incredible urban asset. Without such a plan, effective, coordinated and visible watershed improvements may be unobtainable. The Kinnickinnic River Watershed Updated Implementation Plan (the Plan) does just that. The Plan is an effort to localize and strengthen watershed improvement projects in the watershed by focusing on strategic implementation, consolidation and accountability. It is the product of a multi-year effort to collect and analyze data, establish diverse stakeholder collaborations, and implement best management practices in the Kinnickinnic River Watershed, and it provides an update to the Implementation Plan developed in 2010 by the Southeastern Wisconsin Watersheds Trust, Inc. (SWWT) and the watershed plans that informed it. In addition, the Plan is structured to comply with the United States Environmental Protection Agency's (US EPA) "Nine Minimum Elements" of a watershed plan (Appendix K).

SWWT is a non-profit organization dedicated to restoring the Greater Milwaukee watersheds to conditions that are healthy for swimming and fishing. The organization brings diverse partners together and provides the leadership and innovation necessary to protect and restore our shared water resources. SWWT achieves this by taking a watershed approach to restoration that bridges jurisdictional and social boundaries and recognizes that how we manage the land affects our water resources. SWWT uses its unique understanding of conditions in the watershed to play key roles in the dissemination, implementation, and tracking of the Plan in the Kinnickinnic River Watershed. This will be achieved by housing and updating the Plan on an as-needed basis, facilitating collaboration between key stakeholders, serving as an advisor for implementers, tracking metrics associated with implementation and assisting with funding opportunity identification.

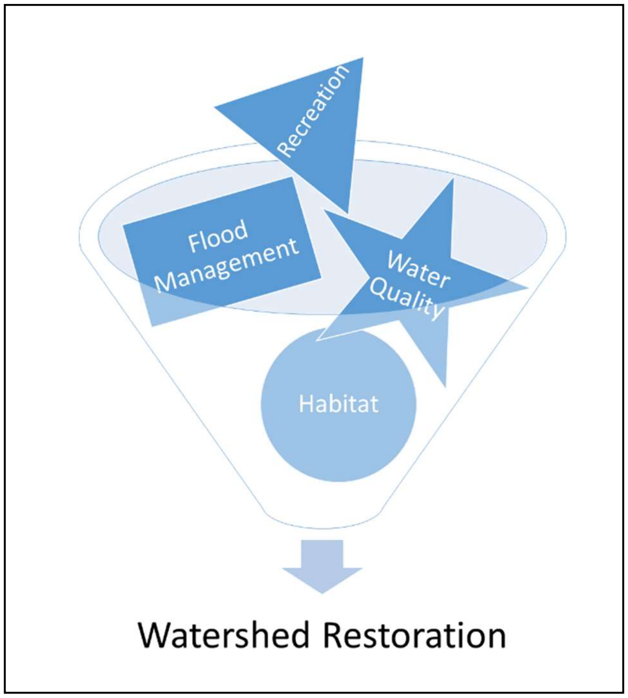


Figure 1 Components of Successful Watershed Restoration

The most successful watershed restoration plans recognize the unique features of the watershed and shape their approach around those existing conditions. With this philosophy in mind, SWWT has worked diligently to solicit input from numerous stakeholders directly working in the Kinnickinnic River Watershed, and thoroughly researched the characteristics of the area in the development of the Plan. It is crucial that watershed-wide plans are driven by the specific topography, land use, politics, environmental factors, and culture of the area. The Kinnickinnic River Watershed is no exception. The Plan for the Kinnickinnic River Watershed is a ten-year plan created to make improvements in four main categories: water quality, flood management and water quantity, habitat, and recreational use, through a comprehensive and collaborative implementation of priority projects and practices (Figure 1).

Plan Objectives

The Kinnickinnic River Watershed Updated Implementation Plan lays out a comprehensive and strategic approach to watershed restoration in three parts. Part 1 of the Plan provides the background and history of the watershed. Part 2 describes the current conditions and goals of the Plan, and Part 3 provides the actual implementation and evaluation process needed to achieve the goals.

The objectives of the Plan for the Kinnickinnic River Watershed are to:

1. Provide guidance for a watershed-wide collaborative, adaptive, and cost-effective approach by combining water quality, water quantity, habitat and recreational improvements to restore the Kinnickinnic River Watershed to the greatest possible extent.
2. Ensure Eligibility for Section 319 funding by gaining US EPA approval for the Nine (Minimum) Key Elements of a watershed plan.
3. Make recommendations for Total Maximum Daily Load implementation in the Milwaukee River Watershed for Total Suspended Solids, Phosphorus, and Fecal Coliform.
4. Make recommendations for water quality improvement actions for emerging pollutants such as chlorides and serve as a template for other watersheds in the Milwaukee River Basin looking to gain US EPA Nine Key Element approval in the future.
5. Create a roadmap for the eventual protection, restoration and delisting of Kinnickinnic waterways from section 303(d) of the Clean Water Act impaired waters list.
6. Incorporate restoration projects and opportunities into planned flood management investments, where possible.
7. Improve the livability of the Kinnickinnic watershed neighborhoods through terrestrial and aquatic habitat improvements, increased recreational opportunities and increased green space.
8. Consolidate, connect and expand efforts to implement existing watershed plans and projects, and provide coordination to prevent duplicity of efforts.

How to Use this Plan

Who: As a whole, the Plan will be useful to any entity seeking to improve water quality in the Milwaukee River Basin: water resource managers, county conservationists, municipalities, non-profit organizations, environmental consultants, and other public and private sector actors. In addition, this plan should serve as a starting point for permitted point sources looking to comply with new TMDL-driven load and waste load reductions

When: Watershed restoration efforts, especially those that focus on nonpoint source pollution reduction, are part of a long-term adaptive process that typically spans decades. As such, this iteration of The Plan will influence watershed restoration in the Kinnickinnic River Watershed over the next ten years but should be considered a living document that will be adapted and amended over decades as conditions in the watershed change.

How: First and foremost, the Plan should be used as a guide for project implementers in the Kinnickinnic watershed and facilitate their decision making process. For example, the priorities and practices presented in the Plan structure a comprehensive implementation framework for the Milwaukee River Basin Total Maximum Daily Load (TMDL) in the Kinnickinnic River Watershed that addresses numerous negative impacts to habitat, flooding and recreation, to better and fully restore the watershed.

Secondly, as the Plan is updated, it can be used as a reference and management tool for watershed restoration projects and SWWT will also provide a process for feedback and evaluation from project implementers. Lastly, as a US EPA approved Nine Key Element plan, it should be used as a mechanism to leverage more funding in the watershed.

Since the focus of a Nine Key Elements plan is largely on non-point source pollution, the approach can facilitate holistic watershed planning and implementation that goes beyond just point-source permitting. This focus implicitly and explicitly encourages collaboration among a broad range of watershed stakeholders, including property owners, farmers, permitted point sources, and NGOs, among others. This not only raises awareness of all of the sources of pollutants in a watershed, but can also result in new strategies for reducing pollutants among different stakeholders. For example, water quality trading can bring point sources and non-point sources together in mutually beneficial partnerships that may achieve pollutant reductions at lower costs than alternative methods. Water quality trading explicitly recognizes and credits watershed habitat improvements, so its benefits can extend beyond a sole focus on reduction of specific pollutants and create multiple community benefits. Another benefit of nine key element planning is the recognition that watershed improvement, especially in regard to reductions of pollutants from non-point sources, is a long-term adaptive process that typically spans decades. Where investments in point source “end-of-pipe” technology may achieve relatively rapid progress, this progress often comes at a high economic cost. By utilizing a nine key element framework, pollution in the Kinnickinnic River Watershed can be reduced throughout the geographical expanse of the watershed before entering a stormwater system, and at a much lower cost. In addition, once point source reductions have reached their limits, overall progress in improving watershed health is ultimately determined by non-point reductions. Finally, the nine key element framework establishes a set of standards to evaluate and conduct watershed planning, providing planners and project implementers with some assurance that good plans and implementation of projects and policies can ultimately meet watershed goals.

The Plan will:

- Provide an in-depth description of the Kinnickinnic River Watershed
- Explain the history leading up to The Plan and the need for a Nine Key Element Approach

- Establish the Water Quality, Flood Management, Habitat and Recreational goals of the watershed and the metrics used to evaluate them
- List the priority projects identified to achieve the aforementioned goals
- Recommend the implementation process for watershed restoration in the Kinnickinnic River Watershed
- Provide a detailed tracking and data housing process for determining the success of watershed restoration

OVERVIEW OF THE WATERSHED

The Kinnickinnic River Watershed is part of the Milwaukee River Basin, a 900-square mile basin comprised of six watersheds that drain directly to Lake Michigan (Figure 2). Of these, the Kinnickinnic is the most densely populated watershed in the region, at 5,800 residents per square mile. The watershed drains approximately 25 square miles of urban landscape in the heart of metropolitan Milwaukee and it falls within the borders of six local municipalities (Table 1). The multiplicity of civil boundaries may make project implementation and credit allocation more challenging. The watershed's 25 miles of streams are comprised of the Kinnickinnic River and its four major tributaries: Cherokee Creek, Holmes Avenue Creek, Wilson Park Creek and South 43rd Street Ditch, all of which drain into the mainstem of the Kinnickinnic River (Table 2).

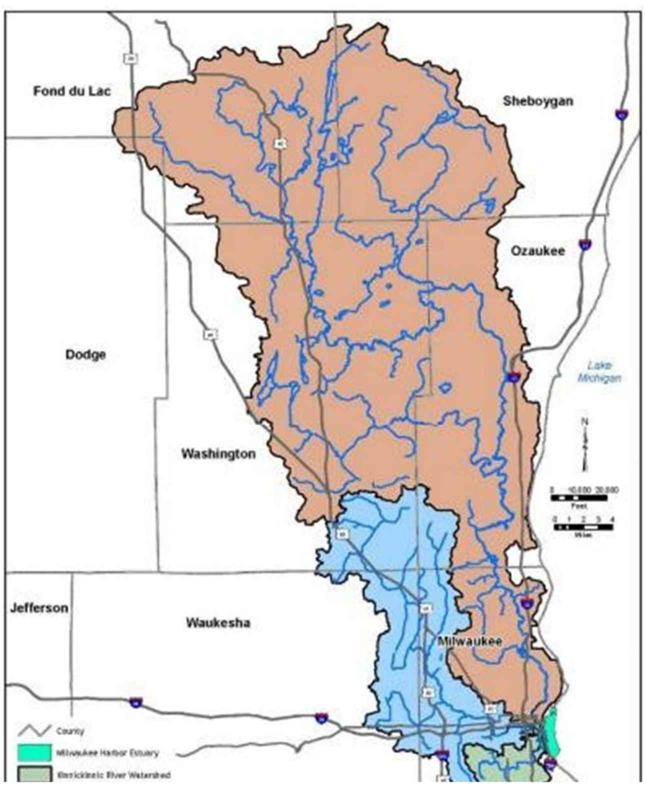


Figure 2 Milwaukee River Basin and Three Sub-watersheds

The watershed is heavily urbanized, with 90% of its land mass fully developed for nearly 40 years: 46% for transportation and utilities, 34% for residential use, 10% for commercial or other uses, and only 10% of its land mass left undeveloped as parks or open space. General Mitchell Airport, the largest airport in Wisconsin, covers the majority of the southeastern portion of the watershed. The majority of the Kinnickinnic River Watershed lies within the boundaries of the City of Milwaukee. Approximately 17% of the watershed is connected to the combined sewer system, where stormwater and waste water run through the same sewer lines to be treated by the Milwaukee Metropolitan Sewerage District. This distinction will be crucial for determining projects and strategies to reach water quality improvements in the Plan. The remaining 83% of the watershed discharges stormwater directly into the Kinnickinnic River and its tributaries, untreated (Milwaukee River Basin TMDL).

TABLE 1 CIVIL DIVISIONS IN THE KINNICKINNIC RIVER WATERSHED. STAKEHOLDER COLLABORATION IS CRUCIAL IN IDENTIFYING AND IMPLEMENTING SUCCESSFUL PROJECTS. SOURCE: WNDR SURFACE WATER DATA VIEWER

Civil Division	Square Miles
City of Milwaukee	21.4
City of Greenfield	2.2
City of West Allis	1.7
City of Cudahy	4.5
City of St. Francis	2.6
Village of West Milwaukee	0.47

TABLE 2 THE KINNICKINNIC RIVER AND ITS TRIBUTARIES. SOURCE: WNDR SURFACE WATER DATA VIEWER

Name	Length in Miles
Kinnickinnic River	11.6
Wilson Park Creek	5.8
Holmes Avenue Creek	1.8
Lyons Park Creek	1.7
Cherokee Creek	1.6
Edgerton Ditch	1.3
43rd Street Ditch	1.2

Approximately 30% of the streams within the Kinnickinnic River system are concrete lined, 30% are in an enclosed channel, and the majority of remaining miles exhibit dangerous levels of erosion. Some portions of open stream channels have experienced up to four to five feet of downcutting, or loss of streambank, within the last 40 years.

Long range planning conducted jointly by the Milwaukee Metropolitan Sewerage District (MMSD) and the Southeastern Wisconsin Regional Planning Commission (SEWRPC) determined that nonpoint source pollution loading represents the most significant threat posed to Southeastern Wisconsin's regional water resources. For example, the Regional Water Quality Management Plan (PR-50, see below) estimates that 78% of phosphorus (TP), 98% of Total Suspended Solids (TSS), and 69% of bacteria (FC) in the greater Milwaukee watersheds come from non-point sources (year 2000 land use simulation). Just recently, this was confirmed in the development in the Milwaukee Basin Total Daily Maximum Load. Specifically, stormwater runoff and the suspended solids, bacteria, phosphorus and other pollutants that it carries to area waterways need to be addressed in a comprehensive manner and in a way that results in the widespread application of practices along the full continuum of land uses. Additionally, while the frequency of combined sewer overflows has been drastically reduced over the past twenty years, increased attention is being placed on the role that stormwater plays in triggering dramatic inflow and infiltration (I&I) issues into combined and separate sewer systems, which often results in sewer overflows, basement backups, and property damage.

Finally, and perhaps more so in the Kinnickinnic River Watershed than in any other watershed of Southeastern Wisconsin, flood risks and the deteriorating condition of extensive concrete-lined channels represent major threats to property and public safety.

Previous and Ongoing Planning Efforts in the Kinnickinnic River Watershed

Many years of research and planning efforts were conducted for the Kinnickinnic River Watershed prior to the creation of this plan. Most recently, the draft Total Maximum Daily Load Report for the Milwaukee River Basin, including the Kinnickinnic watershed, was released in July 2016 and will be finalized in 2017. The present Plan builds on previous efforts, provides an update to include the TMDLs, green infrastructure, and flood management plans, and provides a roadmap moving forward to identify and implement cohesive and effective solutions to watershed degradation. The efforts listed below have all been incorporated into the development of this updated effort. A full list of referenced plans is available in Appendix A.

Regional Water Quality Management Plan (2007) and Update (2013)

The Regional Water Quality Management Plan (RWQMPU), or Planning Report 50, was developed by Southeastern Wisconsin Regional Planning Commission in cooperation with the Wisconsin Department of Natural Resources (WDNR) and US Geological Survey (USGS) in 2007 and updated in 2013. There is a companion Technical Report (TR-39), which includes in-depth data analysis and modelling of decades of water quality data. The RWQMPU covers the geographic area of the Greater Milwaukee Watersheds, which includes the Milwaukee, Menomonee, Oak Creek, Root, and Kinnickinnic Rivers and spans the years 2007-2020. It was developed in conjunction with the MMSD's 2020 Facilities Planning Report to represent a larger scale integrated water quality management plan. Together, the plans are called the Water Quality Initiative (WQI). The purpose of the WQI was to develop a framework for the management of surface water for the greater Milwaukee watersheds incorporating measures to abate existing pollution problems (bacteria, total suspended solids, and nutrients) and elements intended to prevent future pollution problems in the most cost effective manner.

Part 1-Chapters 1-12 Part 2-Appendices

Supplement to Part 2-Appendices C-F and 2013 Update https://www.mmsd.com/government-business/2020-water-quality-initiative/2020-facilities-plan-reports

Kinnickinnic River Watershed Restoration Plan (2010)

The Watershed Restoration Plan (WRP) for the Kinnickinnic River Watershed was developed by MMSD in collaboration with SWWT with the goal of implementing the restoration based recommendations of the WQI in the watershed in an adaptive and phased approach. It is a second-level planning effort that builds upon the sound science, data and alternatives analysis presented in the WQI. After several public reviews and comments, the WRP established primary goals of reducing pollutants such as bacteria, and phosphorus/, total suspended solids, and chloride, which were goals that were set out the RWQMPU and 2020 Facilities plans.

Part 1 Part 2 Part 3 Part 4

Stream Habitat Conditions and Biological Assessment (SCHBA) of the Kinnickinnic River Watershed: 2000-2009 (2010)

The Stream Habitat Conditions and Biological Assessment of the Kinnickinnic and Menomonee Rivers (MR-194) was published by SEWRPC in 2010. It addresses and expands on the habitat-related content in the RWQMPU/PR-50 and includes fishery, invertebrate and habitat data gathered since completion of that plan up to 2009. The report also provides recommendations for the integration of wildlife and habitat-related projects into the more water quality focused WRPs and corresponding Implementation Plans.

MR-194

Kinnickinnic River Implementation Plan (2010)

Both the Watershed Restoration Plan and Stream Habitat Conditions plans identified SWWT as the organizational vehicle for plan implementation. As such, SWWT's Watershed Action Team began developing and implementing on-the-ground projects to meet the water quality and habitat goals of the RWQMPU, WRP, and SHCBA by creating the Kinnickinnic River Implementation Plan. This plan identified foundational and priority actions to implement in the Kinnickinnic watershed in the years 2011-2016 based on the modeling conducted in the WRP and RWQMP. The 2010 Implementation Plan, however, has run its course and the Plan will serve as its update.

Implementation Plan

MMSD Kinnickinnic River Watershed Flood Management Plan (2017)

The Kinnickinnic River has experienced amplified flood events as a result of increased rainfall and the urban conditions of the watershed. SEWRPC has developed draft updated floodplain maps for the watershed which reflect a 10-25% increase in flood flows throughout the watershed. The increased flood flows result in the addition of 600 commercial and residential structures to the 1% annual probability (100-year) floodplain. As a result, MMSD has developed and begun to implement flood management projects that will reduce the risk of flooding to properties adjacent to the river and improve safety. In order to ensure that flood management projects work in tandem to manage flows and are designed to be resilient to increased rainfall predicted from climate change modeling, MMSD has undertaken the development of an update to the Kinnickinnic River Watercourse Management Plan. This Flood Management Plan evaluates the watershed and provides recommendations to be implemented over the course of the coming decades. Recommendations include removal of concrete lined channels, creation of stormwater storage, and improvements to culverts and bridges. Full implementation will result in over 600 properties being removed from the regulatory flood plain and an improved, more natural Kinnickinnic River corridor.

https://www.mmsd.com/what-we-do/flood-management/kinnickinnic-river

MMSD Regional Green Infrastructure Plan (2013) and Kinnickinnic River Green Infrastructure Plan (2018)

The Regional Green Infrastructure Plan (2013) presents information by watershed necessary to achieve the goal of capturing 740 million gallons of stormwater runoff in the MMSD service area (see detailed discussion in the GI section below). Building on the Regional Green Infrastructure Plan, and relevant existing and ongoing community plans, MMSD completed a Kinnickinnic River Watershed Green Infrastructure Plan (KKGIP) in 2018 to refine and update recommendations for strategic investment in green infrastructure. The KKGIP is primarily a GI prioritization tool and feasibility study for the KK watershed; it does not present specific projects, timelines, or resource allocations. It includes various analyses of the watershed, including, 100-year flood risk reduction support, drainage problem areas, site constraints, available land, redevelopment opportunities, capital projects, high pollutant loading areas, stream corridor rehabilitation locations, and others. These factors have been analyzed to recommend priority areas and catalytic projects that add resiliency to the watershed and meet triple bottom line objectives (equity, economy, and ecology). The KKGIP is a centralized plan to assist with coordinated fund development and increasing the potential impact of green infrastructure implementation by watershed stakeholders of all types and sizes.

https://www.freshcoast740.com/resources/our-plans

Milwaukee Basin Total Maximum Daily Load (2018)

The Milwaukee Basin Total Maximum Daily Load (MRB TMDL) is a calculation of the allowable pollutant loadings for the Basin to maintain water quality standards set by the state; it is required by the Clean Water Act when these standards are not being met. The MRB TMDL covers four watersheds: the Kinnickinnic, Menomonee, Milwaukee, and the Lake Michigan Estuary. It sets pollutant allocations for phosphorus, sediment, and bacteria. The purpose of the TMDL is to allocate loads of total phosphorus (TP), total suspended solids (TSS), and bacteria in a manner that will result in attainment of applicable designated uses and water quality standards throughout the Basin.

Milwaukee River Basin TMDL DNR webpage

Plan Consolidation

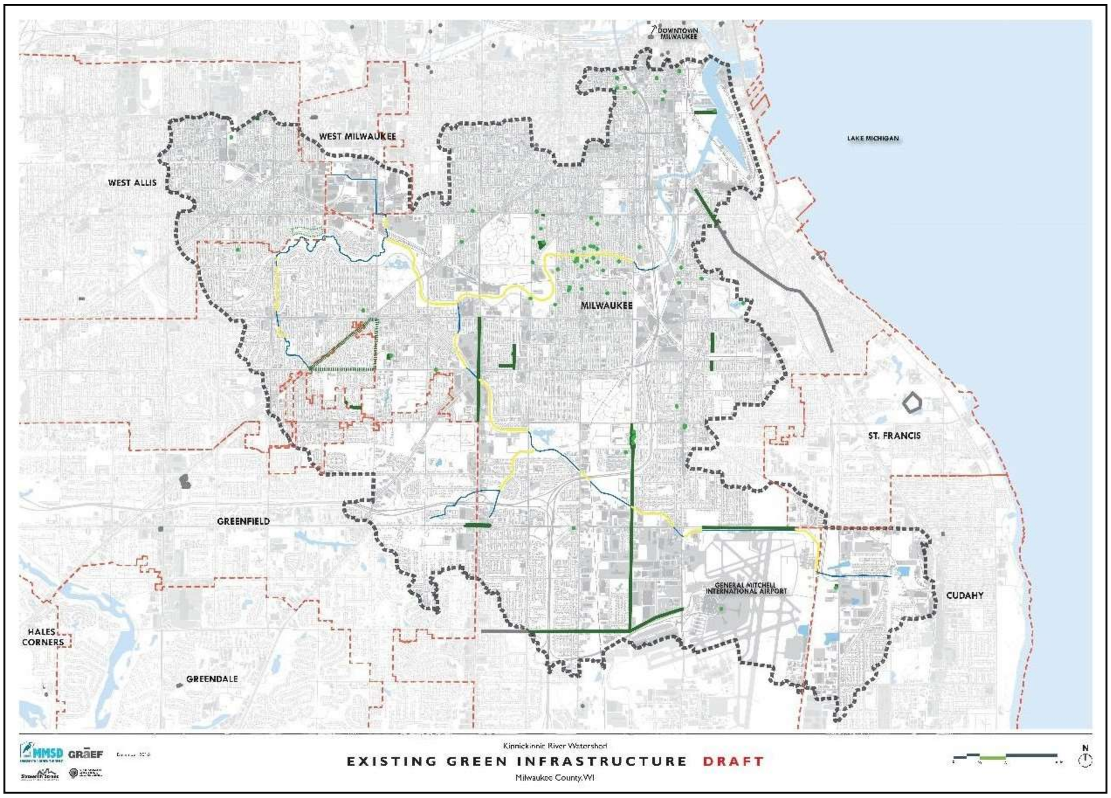
As with most complex problems and planning efforts, variations of nomenclature and planning boundaries have occurred over the decades of work. To provide a consistent nomenclature that also aligns with regulatory permits throughout the watershed and Greater Milwaukee region, the nomenclature presented in the Milwaukee River Basin TMDL will be used in the Plan for the Kinnickinnic River Watershed and future planning efforts. If the region hopes to collaboratively address watershed improvements as a whole, agreed upon boundaries are essential.

The efforts put forth prior to the TMDL, however, must be addressed and incorporated into future efforts to best achieve watershed goals. The Kinnickinnic River Updated Implementation Plan is, in part, a summary of past efforts and the varied nomenclatures are referenced throughout. Each variation in the body of the Plan is called out and crossed referenced in Appendix B.

Where is the Watershed Today?

Since the creation of the Watershed Restoration Plan for the Kinnickinnic River Watershed in 2010, several of the priority actions have been achieved and additional goals identified. Despite these successes, the watershed is not adequately meeting the goals and timelines set in the Watershed Restoration Plan and a reexamination of watershed restoration planning is needed.

Major restoration successes in the Kinnickinnic River Watershed in the last six years include: citizen monitoring at 14 sites, the identification of numerous illicit discharges of bacteria (including *E. coli*, Enterococcus, and human strains of *Bacteroides* and*Lachnospiracea* at dozens of locations), the removal of 1,000 linear feet of concrete stream bank lining downstream of 6th Street, numerous green infrastructure projects (Figure 3), several neighborhood scale green infrastructure projects (Appendix C) including the 6,778 square feet of rain gardens and 50 rain barrels put in the ground between 14th and 16th Street that in total captured 33, 000 gallons of stormwater and 173 pounds of TSS, and the development of the site specific Pulaski Park Neighborhood Stormwater Plan that is estimated to reduce 50% total suspended solids, capture 45% of the volume associated with the first half inch of rain, and 42% of phosphorus (see project highlight on p.36 and Appendix D for full plan).



MAP LEGEND

Municipal Boundary
Kinnickinnic Watershed Boundary
GI - Rain Barrel, Cistern, Green Roof, Rain Garden, Native Landscaping
GI - Bioswale
GI - Porous Pavement

Figure 3 Map of Current GI Practices in the Kinnickinnic River Watershed

Source: Stormwater Solutions Engineering and Graef USA

Some of the results have been encouraging: the residential rain gardens and barrels from 14th-16th Street were modeled to capture 33,000 gallons of rain water and remove 173 pounds of total suspended solids per year; a popular community-run fishing class is held on the naturalized portion of the Kinnickinnic; salmon have been seen running in the lower portions of the river; and in-stream phosphorus levels have been steadily improving.

Kinnickinnic River Legacy Act

In 2009, a $22 million Great Lakes Legacy Act project dredged a section of the Kinnickinnic River between Becher St. and Kinnickinnic Ave. Dredging removed 167,000 cubic yards of sediment contaminated with approximately 1,200 pounds of PCBs and 13,000 pounds of PAHs, and restored the functionality of the navigation channel. Project partners included EPA, the U.S. Army Corps of Engineers, Wisconsin DNR, the City and Port of Milwaukee, and local stakeholders.

EPA funded 65 percent, or $14.3 million of the project cost. A special state bond, part of the Governor's Growing Milwaukee Initiative, funded the mandatory nonfederal share of 35 percent, or $7.7 million.

https://www.epa.gov/milwaukee-estuary-aoc/kinnickinnic-river-legacy-act-dredging-project

http://dnr.wi.gov/topic/greatlakes/KKRiver.html

The Milwaukee Estuary Area of Concern

In 1987, the Milwaukee Estuary was designated an Area of Concern (AOC) by the International Joint Commission because of historical modifications and pollutant loads that contributed toxic contaminants to the AOC and Lake Michigan. Sediments contaminated with PCBs, PAHs and heavy metals contribute to nearly all of the eleven beneficial use impairments within the original boundaries of the AOC. The original boundaries of the AOC included the lower 4 km of the Kinnickinnic River downstream of Chase Avenue; sections of the Milwaukee River and Menomonee River; the inner and outer harbors; and nearshore waters of Lake Michigan.

In 2008, the boundaries of the AOC were expanded for the purposes of addressing sites that contributed significant loads of contaminated sediments to the estuary. These expanded portions of the AOC are associated with the beneficial use impairments that are directly connected to contaminated sediment.

The DNR worked with community stakeholders to develop a Remedial Action Plan in 1991, with updates in 1994 and 1999. Since that time, much work has been completed and significant progress made towards improving conditions in the AOC.

http://dnr.wi.gov/topic/greatlakes/milwaukee.html

However, there is considerable work remaining to overcome the remaining impairments and restore designated uses in the watershed. The majority of river miles in the Kinnickinnic are not meeting water quality standards, pathogen levels are too high, and flooding events continue to cause property damage and endanger the community. In addition, limited recreation opportunities exist, and two-thirds of the river miles remain channelized or underground. Even worse, the concrete lined streams of the Kinnickinnic pose a major safety risk; several children have drowned over the past few decades after being swept into swiftly moving water in concrete channels.

Major barriers to watershed restoration in the Kinnickinnic River Watershed:

1. Capacity:
   There is significant planning and implementation capacity in the region, exemplified by the efforts of MMSD, SEWRPC, SSCHC, SWWT, and others. However, current and prior watershed restoration efforts have been either too broad or too narrowly focused, and have not leveraged the full benefits of a Nine Key Element approach (see below). Given

adequate resources, a lead organization such as SWWT can develop watershed plans at appropriate scales, coordinate implementation and monitoring, and adapt plans as needed to ensure effectiveness in the face of climate change and other challenges.

2. Funding:
   Budget cuts and new budgetary controls at the state and local levels have drastically affected available funding for municipalities to implement watershed restoration projects. Funding for Nine Key Element plans in turn can increase eligibility for a broader range of funding, including funding for TMDL implementation.
3. Cohesive Approach:
   A cohesive approach is needed for project implementation that includes all sources of water quality impairments, multiple facets of watershed restoration, and community benefits including public access, recreation, and education and outreach.
4. Timing:
   Future flood management efforts that alter the flow of the streams could affect current best management practices, streambank stabilization projects, access projects, etc. in the watershed. An updated Plan can anticipate and incorporate multiple planning initiatives and timelines to help achieve maximum long term effectiveness.
5. Flashiness of streams:
   Flashiness of the system and frequency of big storms or “channel forming” flows impede the designing and implementation of projects that are often affected by upstream concrete channelized streams and/or stormwater inputs. As noted above, the Plan is a comprehensive tool that both anticipates and adapts, and helps to mitigate uncertainty.

SWWT and other stakeholders in the watershed recognize that restoration efforts that occur in relative isolation may waste valuable resources and are not as successful as collaborative, thoughtful planning efforts. Therefore, this Plan identifies a comprehensive approach to move past these barriers and create a more comprehensive and cohesive approach to all major facets of watershed restoration: water quality, quantity, habitat, policy, and recreational opportunities.

Overview of Nine Key Elements

The 1987 amendments to the Clean Water Act (CWA) established the US EPA's Section 319 Nonpoint Source Management Program. Under Section 319, states, territories and tribes receive grant money that supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects. Eligibility for Section 319 funding, and increasingly, other sources of funding, depends on providing "reasonable assurance" that management measures will achieve plan goals. Generally, this assurance is demonstrated through achieving EPA approval for a nine key element watershed plan.

The Nine Key Element designation comes from EPA guidance that has identified nine key elements that are critical for achieving improvements in water quality. Nine Key Element plans are designed to address documented nonpoint source-related water quality problems and to help prevent future nonpoint source water quality-related problems.

Additionally, EPA guidelines outline that existing plans can be amended by incorporating new or adjusted information and other key elements not contained in the original plan. If separate documents support the plan and the nine elements but are too lengthy to be included in the watershed plan, they can be summarized or referenced in the appropriate sections of the plan. The EPA supports this overall approach—building on prior efforts and incorporating related information—as an efficient, effective response to the need for comprehensive watershed plans that address impaired and threatened waters. Due to the large amount of prior watershed planning and implementation efforts already in progress in the watershed, SWWT and their associated Kinnickinnic River Watershed partners have opted for this recommendation.

US EPA Nine Minimum Elements of Successful Watershed Plans

1. Identify causes and sources of impairments
2. Estimate of reductions expected by management practice
3. Management measures
4. Technical and financial assistance, costs, and leadership team
5. Information and education
6. Schedule for implementation
7. Measurable milestones
8. Criteria to determine if desired reductions are being achieved
9. Monitoring

PART 2. WATERSHED RESTORATION GOALS

WATER QUALITY IN THE KINNICKINNIC RIVER WATERSHED

The Kinnickinnic River Watershed has a long history of watershed restoration efforts, and water quality monitoring and modeling work. The water quality section of the Plan will utilize these efforts to establish a water quality baseline, identify causes and sources of impairments, and finally to determine water quality goals and measures of progress in the Kinnickinnic River Watershed over the next ten years.

CURRENT CONDITIONS AND CRITICAL SOURCE AREAS

Currently, of the 25 stream miles in the Kinnickinnic River system, only 5 miles are meeting their designated uses, and the remaining sections are listed as impaired. Major impairments include: recreational use restrictions, habitat degradation, low dissolved oxygen, and chronic aquatic toxicity (Table 3 and Figure 7).

Recently a Total Maximum Daily Load (TMDL) was developed specifically for TP, bacteria and TSS in the watershed. The TMDL specifies pollutant allocations for each section, or reach, of the watershed that are needed to obtain water quality standards set by the US EPA (Table 4 and Table 5).

Although investments made at the municipal and regional level have reduced combined sewer system overflows and other causes of poor water quality, stressors continue to degrade water quality in the Kinnickinnic River Watershed. In the recent Milwaukee River Basin TMDL, urban and stormwater runoff were identified as the leading cause of TP, TSS, and FC pollutants. In addition, several related indicators of poor water quality in the Kinnickinnic River include: lack of riparian habitat, increasing frequency of flood events, lack of widespread policy supporting water quality improvement efforts, and a growing disconnect between community members and their water resources. These indirect causes are discussed in the following sections.

Impervious pavement in the Kinnickinnic River Watershed is a large contributor to runoff and resulting pollutant loading of TSS and TP. In 2012, MMSD estimated that 10.8 square miles, or approximately 44% of the almost 25 square mile watershed are covered with impervious surfaces such as roofs and pavement. In 2013, SWWT conducted an additional analysis of the watershed and identified

> **Green Infrastructure**
>
> Green infrastructure is an approach to urban runoff management that uses natural systems — or engineered systems that mimic natural processes — to enhance overall environmental quality and provide utility services. Generally, green infrastructure techniques use soils and vegetation and decentralized techniques to store, infiltrate, evapotranspire, slow down, and/or recycle stormwater runoff.
>
> Adapted from Odefey et al. 2014 and USEPA.

critical "priority hot spots" on impervious and commercial lots to target for Green Infrastructure (GI) implementation (Figure 4). These GI priority hotspots were determined by the areas with high densities of impervious pavement and the commercial lots within those areas with the goal of targeting clusters instead of individual sources. The full study which identified parcels, property owners, and cost estimates of green infrastructure projects is provided in Appendix E. Stormwater and urban runoff is closely tied with the infiltration rates of a watershed's landscape. In a highly urban area such as the Kinnickinnic River Watershed, large expanses of impervious surfaces force high volumes of untreated and pollutant heavy stormwater to runoff into waterways through the area's storm sewers.

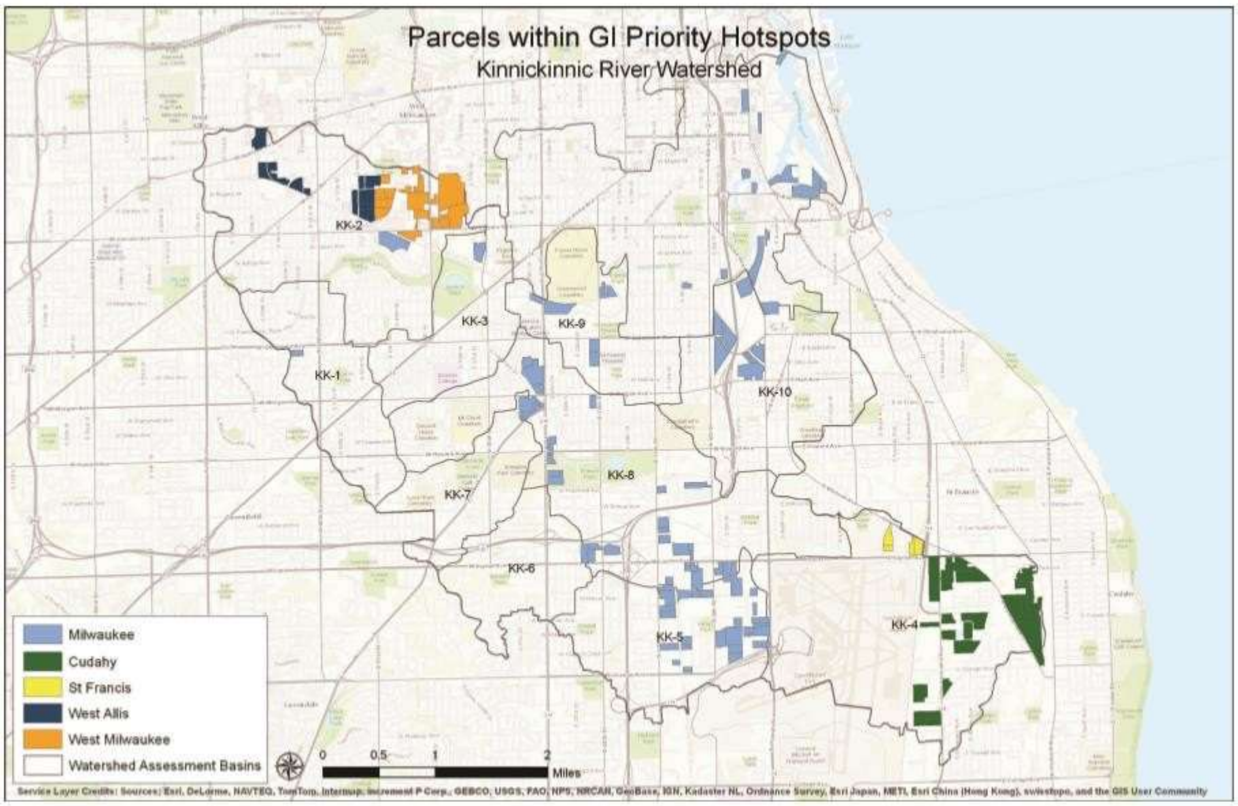


Figure 4 Green Infrastructure Hotspots in the Kinnickinnic River Watershed.

See Appendix B for cross-reference of reach nomenclature. Source: SWWT analysis 2013

According to Technical Planning Report-39 (TR-39) and the Milwaukee River Basin TMDL, the annual average load of TP to streams of the Kinnickinnic River Watershed is estimated to be 12,750 pounds per year. Combined sewer overflows and sanitary sewer overflows contribute about 3.8 percent and 7.0 percent, respectively, of this load. Industrial discharges contribute about 11.3 percent of this load. The rest of TP loadings to streams in the watershed, about 77.9 percent, are contributed by urban runoff sources. Phosphorus concentrations have decreased in the Kinnickinnic, however, several stream segments remain impaired for TP (Figure 5)

Figure 5 Phosphorus Concentrations in the Kinnickinnic River Watershed 2015.

Source: Milwaukee Riverkeeper

The TR-39 and the MRB TMDL estimate that average load of bacteria to streams of the watershed is 4,900 trillion cells per year. Combined sewer overflows and separate sewer overflows contribute about 11.3 percent and 20.0 percent, respectively, of this load. The rest of bacteria loading to streams in the watershed, about 68.7 percent, is contributed by runoff, including runoff from the land as well as illicit discharges from storm sewers. Heavy bacteria loadings to streams has resulted in large portions of the Kinnickinnic River Watershed listed as impaired for recreational use. Typically, fecal coliform or *E. coli* concentration is used as an indicator of bacteria or fecal loading in area waterways-fecal coliform is the standard for recreational use of streams and *E. coli* is the standard for recreational use of Great Lakes beaches. The MRB draft TMDL is based on load reductions required to meet the fecal coliform standard for streams, but reductions were also modeled to help achieve the *E. coli* standard for downstream beaches. However*,* fecal coliform and *E. coli* are imperfect indicators because these bacteria can be found in excrement of many warm bodied animals, in addition to humans, so presence of bacteria may not always indicate a risk to human health.

In order to better target the human health risk of bacteria in the Kinnickinnic that is causing the recreational use impairment, there is a need to better identify and localize bacteria sources from specifically human waste, which poses a significantly higher risk to human health than other forms of bacteria. Milwaukee Riverkeeper in conjunction with Dr. Sandra McLellan's lab at the University of Wisconsin-Milwaukee School of Freshwater Sciences conducted stormwater outfall testing in the Kinnickinnic River watershed from 2008-2016 to locate human sources of bacteria in the waterways (Figure 5 shows data from 2008-2014). This research has included bacteria plating for *E. coli* and Enterococcus as well as qPCR for human strains of Bacteroides and Lachnospiraceae. Roughly half of stormwater outfalls tested to date have been positive for human bacteria, which indicates failing and aging infrastructure. Further research and development of better and cheaper tools for detecting human-sources of fecal contamination, including new bacteria markers as well as development of a human sewage sensor, are underway at University of Wisconsin-Milwaukee School of Freshwater Sciences as well as USGS. The Implementation Plan for the TMDL is expected to focus on reducing bacteria loading from urban runoff, including illicit discharges from storm sewers.

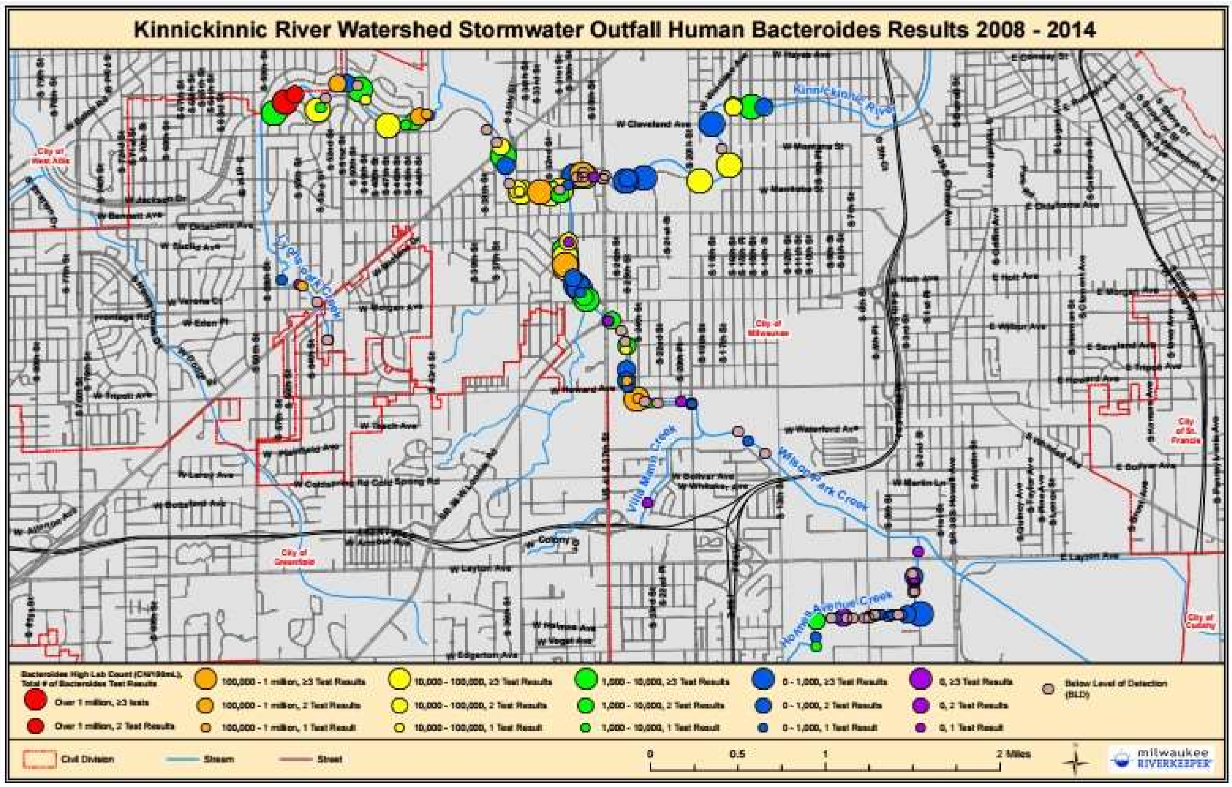


Figure 6 Human Bacteroides From Stormwater Outfalls.

Source: Milwaukee Riverkeeper

SWWT convened multi-stakeholder groups in 2017 to develop and implement a framework to identify and prioritize the mitigation of bacteria loading sources. The final report of the Bacteria Working Group will be released in early 2018. Report findings and recommendations are expected to inform the permitting process for MS4s in the KK watershed. Permit renewals are expected to contain additional requirements for MS4s to show progress in meeting the TMDL for bacteria.

SEWRPC's TR-39 also estimates that the annual average load of TSS to streams of the watershed is 5,300,000 pounds (2,650 tons) per year. Combined sewer overflows and separate sewer overflows contribute about 0.8 percent and 1.0 percent, respectively, of this load. Industrial discharges contribute about 0.2 percent of this load. The rest of TSS loading to streams in the watershed, about 98.0 percent, is contributed by urban runoff.

The mean chloride concentration for the Kinnickinnic River Watershed was 99.0 mg/L and has steadily increased from 1993 (TR-39). However, large differences between maximum and minimum levels were observed, as well as large differences across seasons. This chloride concentration was also strongly negatively correlated to ambient temperature, reflecting the use of de-icing salts on streets and highways during cold weather, and levels often rose more quickly than the rate of urbanization (Corsi et. al., 2015). Surface water monitoring conducted by Milwaukee Riverkeeper and MMSD in recent years has shown significant exceedances of acute criteria for chloride recommended by EPA (instantly toxic to fish and aquatic life) of 860 mg/L, as well as exceedances of chronic criteria (toxic to fish at lower levels over longer time periods) of 230 mg/L. In 2015, 68% of all surface water samples in the watershed met chronic toxicity criteria (or 32% of samples exceeded standards), and there were 12 samples that exceeded acute criteria—5 in January and 7 in March. Looking at data from 2002-2015, approximately 22% of water samples exceeded chronic toxicity criteria in the Kinnickinnic River Watershed, and only 2% exceeded acute toxicity criteria. Given the large impacts to area streams during winter runoff events, looking only at an annual compliance rate or mean chloride levels minimizes the real risk of road salt to fish and aquatic life in streams. Even a handful of very high chloride loading events, leading to chloride levels that exceed acute toxicity criteria, can be catastrophic to stream aquatic life. A future chloride TMDL is likely for large portions of the Kinnickinnic Watershed. Water quality improvement projects identified in the Plan for the Kinnickinnic River Watershed will both target the TMDL identified pollutants (TP, TSS, and FC), and also help prepare for addressing the anticipated chloride-caused impairments in the watershed.

SEWRPC has developed a prospectus to study current levels of chloride contamination of surface waters and groundwater in the region, as well as types and locations of practices that contribute to excessive chloride levels. The study will also identify priority project areas to reduce chloride loadings, as well as best practices and monitoring regimes. The study is projected to cost $1.7 million, and the Commission is currently seeking funding. Results and recommendations from the study are expected to inform permit requirements for MS4s and CSSAs, and areas outside of these boundaries. In addition, the design, inspection, and ongoing operation and maintenance of GI in regions where road salt is used require special consideration. These considerations, with recommended BMPs, are detailed in a 2016 EPA publication, Operation and Maintenance of Green Infrastructure Receiving Runoff from Roads and Parking Lots.

https://www.epa.gov/sites/production/files/2015-09/documents/319-guidelines-fy14.pdf

SPECIFIC IMPAIRMENTS BY RIVER MILE

The specific impairments that result in 303(d) listing for each section of the Kinnickinnic River and its tributaries are listed in Table 4. Table 3 provides information to aid in understanding water quality metrics as they relate to current and designated uses.

TABLE 3 WATER QUALITY IMPAIRMENT TERMS AND DEFINITIONS

Term	Definition
Impairment	The assigned condition for a water body not meeting water quality standards set by the Clean Water Act section 303(d) list. This condition is correlated to a specific pollutant.
Impaired water	A waterway that is not meeting water quality standards set by the Clean Water Act section 303(d) list.

Natural Community Classification for Streams and Rivers	Distinct "natural communities" into which different types of streams, rivers and lakes can be grouped. These groupings help us manage the resources more effectively.
Fish and Aquatic Life (FAL)	Use Designation Category
Limited Aquatic Life (LAL)	DO ≥ 3 mg/L; capable of supporting forage fish and macroinvertebrates tolerant of organic pollution
Limited Forage Fishery (LFF)	DO ≥ 1 mg/L; capable of supporting limited organics-tolerant fish and macroinvertebrate populations
Designated Use	Goals and expectations for how a water body is to be used set by the state and required by the Clean Water Act. Water quality standards are then developed for each designated use.
Current Use	The use for which a water body is currently meeting the water quality standards.

TABLE 4. SECTION 303(D) IMPAIRED WATERWAYS IN THE KINNICKINNIC RIVER WATERSHED. SOURCE: WDNR IMPAIRED WATERS SEARCH.

Impaired Waters in the Kinnickinnic River Watershed

Map Code	Name	Miles	Pollutant	Impairment	Natural Community	Current Use	Designated Use
	Kinnickinnic River	0-2.83	Metals, PCBs, Fecal Coliform, E. Coli, TP	Chronic Aquatic Toxicity, Contaminated Fish Tissue, Recreational Restrictions-Pathogens	Warm Headwater, COOL-Warm Mainstem	Full Body Contact-Swimming	FAL
	Kinnickinnic River	2.84-5.50	Fecal Coliform, TP	Low DO, Degraded Biological Community, Recreational Restrictions-Pathogens, Chronic Aquatic Toxicity, Acute Aquatic Toxicity	Warm Headwater, COOL-Warm Mainstem, COOL-Warm Headwater	LAL	Default LAL
	Kinnickinnic River	5.50-9.94	Fecal Coliform, TP	Recreational Restrictions-Pathogens, Degraded Biological Community	Cool-Warm Headwater	LAL	Default LAL
	Lyons Park Creek	0-1.50	Fecal Coliform	Recreational Restrictions – Pathogens			
	South 43rd Street Ditch	0-1.16	Fecal Coliform, TP	Recreational Restrictions-Pathogens, Degraded Biological Community	Cool-Warm Headwater	LAL	Default LAL
	Cherokee Creek	0-1.6	Fecal Coliform, TP	Recreational Restriction-Pathogens	Cool-Warm Headwater	LAL	Default FAL
	Holmes Ave Creek	0-1.8	Fecal Coliform, TP	Recreational Restrictions-Pathogens	Cool-Warm Headwater	LAL	Default FAL
	Wilson Park Creek	0-3.5	Fecal Coliform	Recreational Restrictions-Pathogens	Cool-Warm Headwater	LAL	Default FAL
	Wilson Park Creek	3.5-5.5	Fecal Coliform	Recreational Restrictions-Pathogens	Cool-Warm Headwater	FAL	LFF

TP: Total Phosphorus, TSS: Total Suspended Slodis, PCB: Polychlorinated biphenyl, DO: Dissolved Oxygen
FAL: Fish and Aquatic Life, LAL: Limited Aquatic Life Community, LFF: Limited Forage Fish Community

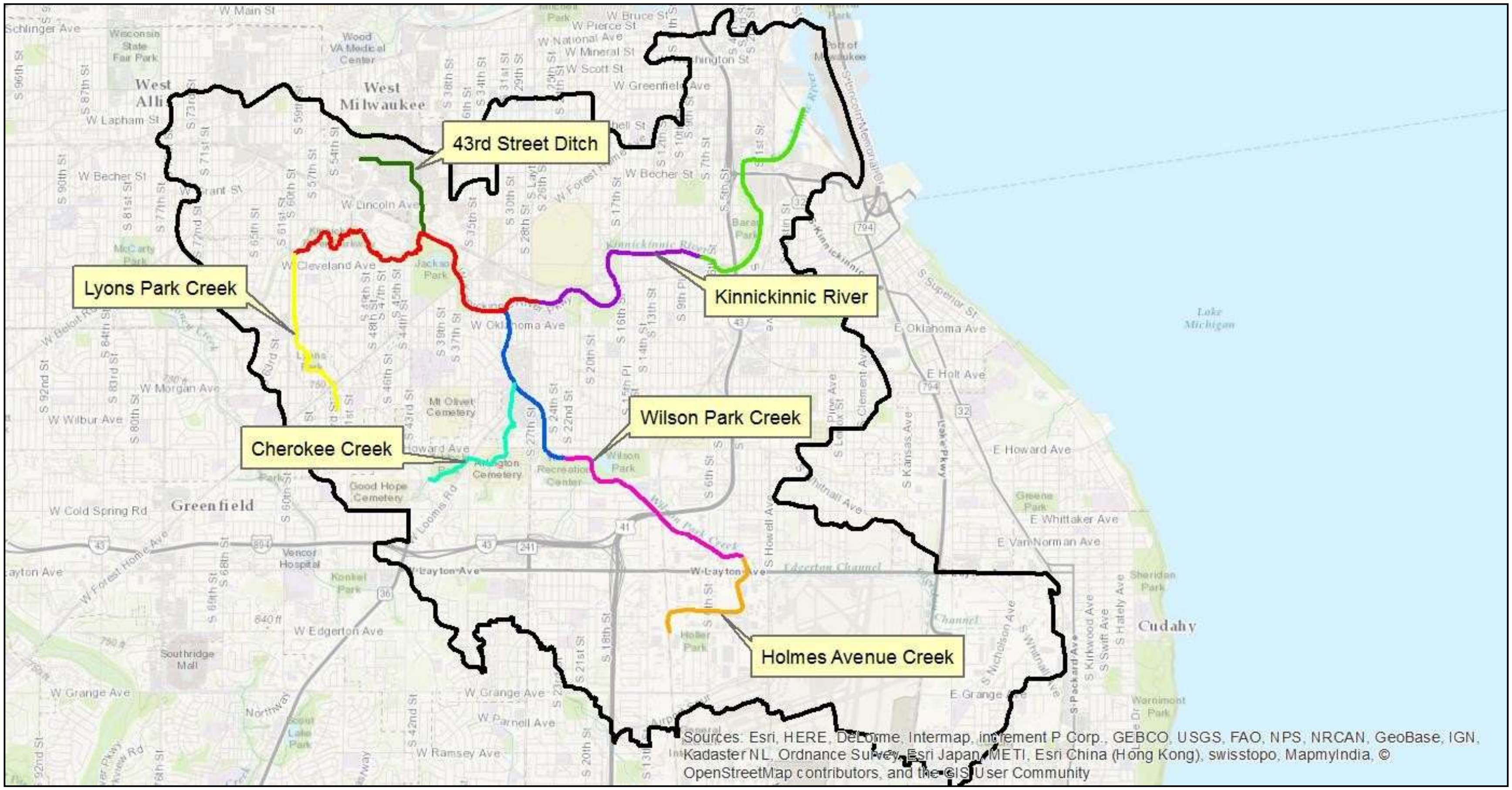


FIGURE 7 MAP OF IMPAIRED WATERWAYS IN THE KINNICKINNIC RIVER WATERSHED.

WATER QUALITY GOALS AND METRICS

The following goals and metrics were formulated by combining water quality goals of the Milwaukee Basin TMDL and multiple organizations in the watershed, numerous conversations with environmental non-profit groups, and government agencies responsible for regulation, and vetted against key stakeholders in the watershed.

Goals	Metrics
1. Make substantial progress towards meeting and maintaining water quality standards set in Milwaukee River TMDL for Phosphorus, Total Suspended Sediment and Fecal Coliform in the Kinnickinnic reaches (Table 4 and 5) 2. Delist 303(d) impaired water ways in the Kinnickinnic Watershed 3. Reduce chloride concentrations in waterways 4. Increase infiltration 5. Prioritize projects from the Commercial/Industrial Hot Spot Analysis and other critical sources areas identified in the Kinnickinnic River Watershed Green Infrastructure Plan	1. Instream monitoring results 2. Number of point sources in compliance with TMDL based permits 3. Load reductions from model analysis 4. Number, type and area of GI practices installed 5. Linear feet of stabilization projects 6. Number of streams delisted 7. Number, type and area of water quality improvement projects in the watershed

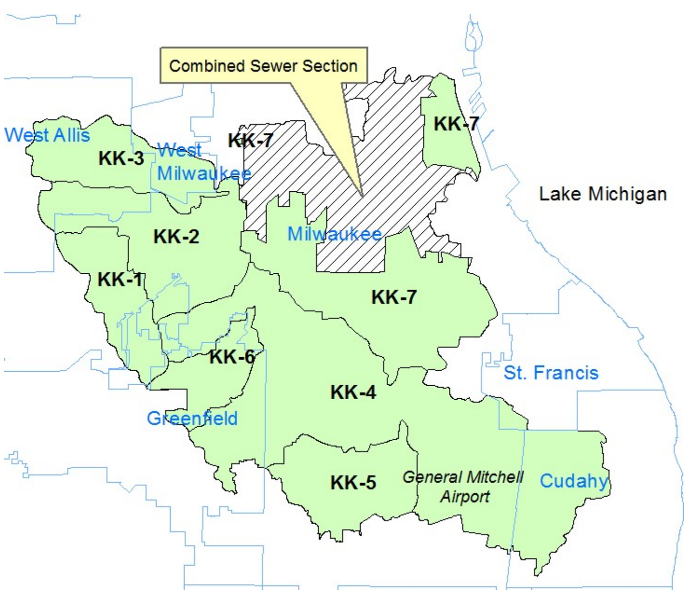


Figure 8 Milwaukee River Basin TMDL Reach Sub-watersheds Within Municipal Boundaries.

Water quality goals for the Plan for each reach, or sub-watershed, were determined by pollutant load reductions calculated in the Milwaukee River Basin TMDL (Figure 8). Table 4 provides a summary of these reductions by municipal separate storm sewer systems (MS4) and reach for TSS and TP. Pollutant loading reductions for Fecal Coliform are summarized in Table 5. A full list of TMDL allocations by source can be found in Appendix A of the Milwaukee River Basin TMDL.

Pollutant limits are calculated by reach in the TMDL. See Appendix B for reach definitions.

A section of the KK-7 sub-basin comprises 17% of the watershed area and is a combined sewer area in the City of Milwaukee. No direct discharges of stormwater to surface waters are permitted from this area; combined sewage is conveyed to MMSD for processing under its point source permit. The remaining 83% of the watershed area is in the following municipalities: City of Milwaukee, Greenfield, West Allis, West Milwaukee, Cudahy, and St. Francis. Each of these has a Municipal Separate Storm Sewer System (MS4) Permit.

Table 5 - Kinnickinnic River Watershed MS4 or Combined Sewer permits

Permittee Name	***Permit Type & Number***	***Permit Expire Date***	***Permit area (acres) ****	***Non-Permit area (acres) ****	***TMDL Reach***
City of Milwaukee	*MS4 - S050156*	*Dec 2017*	*6852*	*0*	*KK-1-6*
City of Greenfield	*MS4 - S050156*	*Dec 2017*	*1424*	*0*	*KK-1,2,4,6*
City of West Allis	*MS4 - S050156*	*Dec 2017*	*1074*	*0*	*KK-2,3*
City of Cudahy	*MS4 - S049875*	*Jun 2018*	*953*	*0*	*KK-4*
City of St. Francis	*MS4 - S049893*	*Jun 2018*	*66*	*0*	*KK-4*
Village of West Milwaukee	*MS4 - S050156*	*Dec 2017*	*304*	*0*	*KK- 3*
City of Milwaukee	*Municipal Combined Sewer 0036820-03*	*Jan 2018*	*2536*	*0*	*KK-7*
** = Estimated using known MS4 or Municipal Combined Sewer Service Areas within TMDL Reach boundaries*					

Current MS4 and Combined Sewer maps for each municipality are provided in Appendix A. As shown in table 5, no non-permitted urban areas were identified using the MS4 maps provided by municipalities. Some practices that do not directly implement the terms of the permits may be eligible for §319 funding There may be some non-permitted areas within county parks, areas which fall outside of Milwaukee County's MS4 permit.

The Milwaukee River TMDL has identified the areas in the KK River Watershed as being impaired almost entirely due to point sources. Of these point sources, MS4 areas are the main contributor/cause of pollutant loading. The specific loadings (TMDL tables) are included in the appendix. Table A.30 of the MR TMDL indicates that there are no baseline reductions for TP and TSS necessary for non-permitted urban areas. (MRW TMDL Appendix A KK TMDL Tables pg.

37). Due to the highly urbanized setting of the Kinnickinnic watershed, watershed areas which discharge stormwater to a MS4 or Combined Sewer system will be the primary focus for practices to reduce pollutants identified in the Plan. The combined sewer and MS4 permitting process will thus be the primary implementation and monitoring mechanism. MS4 permits, for example, are renewed every five years by DNR, so progress toward meeting reductions will be assessed as part of the permit renewal process at least every five years. Table 6 lists annual MS4 load allocations for TSS and P, along with average percent reductions from baseline loads for each of the TMDL reaches in the Kinnickinnic watershed.

Table 5. TMDL Summary Table for Kinnickinnic Reaches

TMDL Reach	TP Target (mg/L)	Annual Allowable TP Load for Reach (lbs./year)	TSS Target (mg/L)	Annual Allowable TSS Load for Reach (lbs./year)	Municipalities	MS4 Area (acres)	Average TP Percent Reduction for MS4	Average TSS Percent Reduction for MS4
KK-1	**0.075**	**143**	**12**	**22,807**		**853**	**64%**	**73%**
					City of Greenfield	108	64%	73%
					City of Milwaukee	745	64%	73%
KK-2	**0.075**	**282**	**12**	**45,172**		**1,669**	**64%**	**72%**
					City of Greenfield	111	64%	72%
					City of Milwaukee	1,218	64%	72%
					City of West Allis	340	64%	72%
KK-3	**0.075**	**253**	**12**	**40,500**		**1,097**	**76%**	**71%**
					City of Milwaukee	60	76%	71%
					City of West Allis	734	76%	71%
					Village of West Milwaukee	304	76%	71%
KK-4	**0.075**	**1,050**	**12**	**167,948**		**5,339**	**88%**	**80%**
					City of Cudahy	953	88%	80%
					City of Greenfield	649	88%	80%
					City of Milwaukee	3,671	88%	80%
					City of St. Francis	66	88%	80%
KK-5	**0.075**	**244**	**12**	**39,091**		**1,099**	**76%**	**75%**
					City of Milwaukee	1,099	76%	75%
KK-6	**0.075**	**99**	**12**	**15,871**		**615**	**65%**	**72%**
					City of Greenfield	556	65%	72%
					City of Milwaukee	59	65%	72%
KK-7	**0.1**	**1,366**	**12**	**81,102**		**2,536**	**38%**	**69%**
					City of Milwaukee	2,536	38%	69%

TSS and TP Pollutant Loading Goals for the Plan in Blue. Reach source: Milwaukee River Basin TMDL. See Appendix B for reach definitions.

The TMDL addresses bacterial contaminants using fecal coliform levels as the load indicator, and establishes allocations as billions of cells per month, as listed in Table 7.

Table 6 Fecal Coliform Allocations under various conditions.

Reach Waterbody Name-Extents	Allocation Component			Monthly Fecal Coliform Load (billion cells/month)				
				Low	Dry	Mid	Moist	Wet
KK-1 Lyons Park Creek- Entire Length	Total Loading Capacity			117.71	257.83	361.43	540.85	993.03
		Reserve Capacity		-	-	-	-	-
		Load Allocation		0.05	0.15	0.24	0.43	1.02
			Background	0.05	0.15	0.24	0.43	1.02
			Agricultural	-	-	-	-	-
			Non-Permitted Urban	-	-	-	-	-
		Wasteload Allocation		117.66	257.69	361.19	540.43	992.01
			General Permits - NCCW	-	-	-	-	-
			General Permits - Other	-	-	-	-	-
			MS4	117.66	257.69	361.19	540.43	992.01
			Individual Permits	-	-	-	-	-
KK-2 Kinnickinnic River- From Wilson Park Creek to Lyons Park Creek	Total Loading Capacity			232.91	499.18	702.48	1,051.79	1,951.82
		Reserve Capacity		-	-	-	-	-
		Load Allocation		0.29	0.94	1.60	3.00	7.86
			Background	0.29	0.94	1.60	3.00	7.86
			Agricultural	-	-	-	-	-
			Non-Permitted Urban	-	-	-	-	-
		Wasteload Allocation		232.62	498.24	700.87	1,048.79	1,943.96
			General Permits - NCCW	-	-	-	-	-
			General Permits - Other	-	-	-	-	-
			MS4	232.62	498.24	700.87	1,048.79	1,943.96
			Individual Permits	-	-	-	-	-

Reach Waterbody Name-Extents	Allocation Component			Monthly Fecal Coliform Load (billion cells/month)				
KK-3	Total Loading Capacity			**Low**	**Dry**	**Mid**	**Moist**	**Wet**
South 43rd St Ditch- Entire Length		Reserve Capacity		-	-	-	-	-
		Load Allocation		0.04	0.13	0.24	0.49	1.11
			Background	0.04	0.13	0.24	0.49	1.11
			Agricultural	-	-	-	-	-
			Non-Permitted Urban	-	-	-	-	-
		Wasteload Allocation		253.05	480.72	660.11	952.02	1,460.28
			General Permits - NCCW	-	-	-	-	-
			General Permits - Other	-	-	-	-	-
			MS4	253.05	480.72	660.11	952.02	1,460.28
			Individual Permits	-	-	-	-	-
KK-4	Total Loading Capacity			1,035.07	2,030.57	2,726.80	3,972.37	5,808.45
Edgerton Channel, Wilson Park Creek, Villa Mann Creek- Entire Length		Reserve Capacity		-	-	-	-	-
		Load Allocation		0.73	2.48	4.24	8.39	16.73
			Background	0.73	2.48	4.24	8.39	16.73
			Agricultural	-	-	-	-	-
			Non-Permitted Urban	-	-	-	-	-
		Wasteload Allocation		1,034.34	2,028.09	2,722.56	3,963.97	5,791.72
			General Permits - NCCW	-	-	-	-	-
			General Permits - Other	-	-	-	-	-
			MS4	1,034.34	2,028.09	2,722.56	3,963.97	5,791.72
			Individual Permits	-	-	-	-	-

Reach Waterbody Name-Extents	Allocation Component			Monthly Fecal Coliform Load (billion cells/month)				
KK-5	Total Loading Capacity			**Low**	**Dry**	**Mid**	**Moist**	**Wet**
Holmes Avenue Creek- Entire Length		Reserve Capacity		-	-	-	-	-
		Load Allocation		0.15	0.30	0.57	0.91	1.61
			Background	0.15	0.30	0.57	0.91	1.61
			Agricultural	-	-	-	-	-
			Non-Permitted Urban	-	-	-	-	-
		Wasteload Allocation		258.03	422.94	657.34	914.21	1,360.25
			General Permits - NCCW	-	-	-	-	-
			General Permits - Other	-	-	-	-	-
			MS4	258.03	422.94	657.34	914.21	1,360.25
			Individual Permits	-	-	-	-	-
KK-6	Total Loading Capacity			84.57	177.24	251.58	366.48	703.94
Cherokee Park Creek- Entire Length		Reserve Capacity		-	-	-	-	-
		Load Allocation		0.12	0.34	0.56	0.98	2.52
			Background	0.12	0.34	0.56	0.98	2.52
			Agricultural	-	-	-	-	-
			Non-Permitted Urban	-	-	-	-	-
		Wasteload Allocation		84.45	176.90	251.02	365.50	701.42
			General Permits - NCCW	-	-	-	-	-
			General Permits - Other	-	-	-	-	-
			MS4	84.45	176.90	251.02	365.50	701.42
			Individual Permits	-	-	-	-	-

Reach Waterbody Name-Extents	Allocation Component			Monthly Fecal Coliform Load (billion cells/month)				
KK-7	Total Loading Capacity			**Low**	**Dry**	**Mid**	**Moist**	**Wet**
Kinnickinnic River- From Estuary to Wilson Park Creek		Reserve Capacity		-	-	-	-	-
		Load Allocation		0.32	0.82	1.35	2.62	7.27
			Background	0.32	0.82	1.35	2.62	7.27
			Agricultural	-	-	-	-	-
			Non-Permitted Urban	-	-	-	-	-
		Wasteload Allocation		560.85	909.14	1,167.78	1,638.05	2,744.88
			General Permits - NCCW	-	-	-	-	-
			General Permits - Other	-	-	-	-	-
			MS4	560.85	909.14	1,167.78	1,638.05	2,744.88
			Individual Permits	-	-	-	-	-

See Appendix B for reach definitions. Source: Milwaukee River Basin TMDL Final Report

MS4 permits, green infrastructure projects, riparian habitat and streambank restoration will be the primary means to reduce the pollutant loads identified in this plan. Table A.30 of the MR TMDL indicates that there are no baseline reductions for TP and TSS necessary for non-permitted urban areas (MRW TMDL Appendix A KK TMDL Tables pg. 37). Implementation and monitoring of progress toward meeting TP, TSS, and bacteria reductions will largely occur through MS4 permit revisions. As MS4 permits expire and are reissued within the watershed during the Plan's ten year schedule, each MS4 permit will be revised to reflect TMDL based waste load allocations per the steps 1, 2 and 3 described within DNR's 2014 TMDL Guidance for MS4 Permits: http://dnr.wi.gov/topic/stormwater/documents/MS4TMDLImpGuidance.pdf

and

Addendums A and B to the 2014 TMDL guidance for MS4 permits:
http://dnr.wi.gov/topic/stormwater/standards/ms4_modeling.html

Below is a summary of the steps from DNR's TMDL MS4 guidance that describes how MS4 permits will, over one or more permit terms, be used to achieve the Plan's pollutant load reductions:

- Inclusion of TMDL reach specific waste load allocations for phosphorus, sediment and bacteria in the MS4 permit

- Provisions for revising or creating a Storm Water Management Plan (SWMP) with a TMDL implementation analysis that demonstrates that the discharge of pollutants to the MS4 system, over time, is progressing toward the percent reductions needed to meet the TMDL waste load allocations (see below)
- Establishing benchmarks within the SWMP to reflect what pollutant reduction practices will be employed and over what time frame the practices will be implemented to meet reductions consistent with TMDL waste load allocations
- Tracking implementation of stormwater management practices by TMDL reach
- Estimating pollutant load reductions from implemented practices on a percentage basis using WINSLAMM or equivalent models/methods
- Comparing load reductions achieved on a percentage basis, to TMDL pollutant reduction goals
- Reporting on TMDL implementation in the MS4 annual reports to DNR and including a description of practices and pollutant load reductions achieved

Municipal Storm Water Management Programs

The MS4 permits require municipalities to reduce polluted storm water runoff by implementing storm water management programs with best management practices. Municipal storm water management programs cover a wide array of activities that occur within a municipality. The permits contain requirements for the following.

- **Public Education and Outreach [exit DNR]** - The MS4 permit specifies that public education and outreach programs be developed to encourage the public and businesses to modify their behaviors and procedures to reduce storm water pollution.
- **Public Involvement and Participation [exit DNR]** - In addition to public education and outreach, the MS4 permit requires municipalities to encourage participation from individuals to prevent storm water pollution. Some examples of public involvement are volunteer stream monitoring, storm drain stenciling, presenting information to established community groups, or planting a community rain garden.
- **Illicit Discharge Detection and Elimination [exit DNR]** - Storm sewers that carry rain water runoff are not intended for other fluids and waste material. These pollutants are illicit discharges and may have the potential to harm people, animals and aquatic life in the downstream rivers, lakes and wetlands. Municipalities are required to develop programs to identify, prevent, and eliminate illicit discharges to their storm sewer systems. The DNR has developed additional illicit discharge detection and elimination guidance [PDF] to assist municipalities with this requirement.
- **Construction Site Pollutant Control** - Municipalities are required to develop a soil erosion control ordinance and enforce it on construction sites. Municipalities may use state-recommended technical standards for methods and products used to control erosion and prevent sediment-laden water from discharging into a lake, stream or wetland.
- **Post-Construction Storm Water Management** - Municipalities are required to develop a post-construction ordinance and enforce it to ensure that areas of new and redevelopment will include structural measures to control pollutants, control peak flow, maintain infiltration, and establish vegetated protective areas adjacent to waterways and

wetlands. Municipalities may use state-recommended technical standards for post-construction storm water management practices.

- **Pollution Prevention Practices for the Municipality [exit DNR]** - MS4 storm water programs are to include practices to prevent pollutants from municipally-owned transportation infrastructure, maintenance areas, storage yards, sand and salt storage areas, and waste transfer stations entering the storm sewer system.
- **Developed Urbanized Area Standard** - Municipalities are required to control the Total Suspended Solids (TSS) carried in storm water from existing urban areas as compared to no controls. Many municipalities have already achieved the state standard of 20 percent TSS. Compliance with the standard is achieved by implementing a system of practices and activities, which has been verified by a storm water computer model.
- **Storm Sewer System Maps** - Municipalities covered by a MS4 permit area are required to maintain a map of the storm sewer system. These maps identify storm sewer conveyances such as pipes and ditches, and identify roads, streams and lakes.
- **Impaired Waters** - Many streams and lakes in Wisconsin are polluted or impaired to a point that the receiving water's animal and plant communities, the fish in a local lake for example are significantly impacted. If the storm sewer system discharges a pollutant of concern to an impaired water, a municipality covered by a MS4 permit is required to develop a plan to reduce those pollutants.

MS4 permits will require permittees to identify critical areas for practices within the KK watershed. Examples of stormwater best management practices used by municipalities to meet permit requirements above include, but are not limited to: detention basins, street sweeping, filter strips, porous pavement, rain barrels, water quality inlets, grassed swales/ditches, green roofs and rain gardens. Several of these practices have already been adopted within the watershed to meet NR 151 requirements. Rerouting storm water generated by MS4 areas into non-MS4 areas for infiltration and treatment is another recommended practice.

Combined Sewer Overflows

MMSD's WPDES permit allows up to 6 Combined Sewer Overflows (CSOs) annually; in recent years, the average number of annual CSOs has been 2.3. The permit also requires MMSD to capture and treat at least 85% of combined sewage in the CSSA; since 1993, the actual amount has exceeded 98%. Appendix 10A of MMSD's 2020 Facilities Plan (FP) details the District's CSO Long Term Compliance Plan (LTCP), consistent with EPA's 1994 policy guidance for CSO compliance. In addition to implementing the nine minimum technology-based controls detailed in an MMSD 2003 document, specific measures include upgraded capacity for the Inline Storage System (ISS) pump station at the Jones Island treatment plant and operational strategies to curtail CSS discharges at an outfall north of South Shore Park. Overall, the 2020 FP adopts a watershed-based approach to reducing CSOs, in accordance with the companion RWQMPU (see also 2050 FP below).

The implementation schedule for the elements of the 2020 Facilities Plan is included in Appendix 11A, and includes both "adaptive" and "full" versions which track actual and maximum population projections, respectively. Implementation progress is reported annually to WDNR. The implementation schedule beyond 2020 will be included in the 2050 Facilities Plan, due out in late 2018. This plan will include milestones at 6 year intervals that correspond with budget timelines. It will also include 2035 and 2050 milestones, which correspond with the timeframes to achieve the goal of zero CSOs and the anticipated full buildout of the MMSD service area, respectively. The 2050 FP will include preliminary modeling of the potential contributions of various levels of GI implementation to reduce future occurrences of CSOs.

Flooding and Water Quantity Control

Water quantity and flood management are highly correlated to the water quality of a stream or river. This is perhaps especially the case in the highly urbanized Kinnickinnic River Watershed where extreme flooding events have plagued the area throughout the last several decades. Flood events collect pollutants from streets and paved surfaces, rushing them to nearby waterways, causing sewer overflows, and discouraging recreational and stewardship opportunities. Polluted runoff also poses safety and property damage concerns. The following section will establish the flood management and water quantity baselines and determine the goals and measures of progress in the Kinnickinnic River Watershed over the next ten years to achieve watershed restoration as well as to support water quality improvements.

Current Conditions

As with many U.S. cities, the increased variability and intensity in rainfall has led to a more focused approached for how to manage flooding in urban communities. The Kinnickinnic River has experienced amplified flood events as a result of increased rainfall in the highly urbanized context of the watershed. Additionally, there are over 8.8 miles of concrete lined channel and enclosed culverts within the watershed, which amplify the speed and volume of runoff (i.e., increase “flashiness”) compared to natural stream conditions.

After a recent review and update of models, MMSD found that there was a 10-25% increase in flow in some parts of the watershed. MMSD has undertaken the development of the Kinnickinnic River Watershed Flood Management Plan. This Flood Management Plan evaluates the watershed and provides baseline recommendations to be implemented over the course of the coming decades to reduce the risk of flooding. Recommendations include removal of concrete lined channels, creation of storage spaces, and improvements to culverts and bridges. Full implementation will result in over 600 properties being removed from the regulatory flood plain and an improved, more natural Kinnickinnic River corridor.

Flood Management and Water Quantity Goals and Metrics

The following goals and metrics were formulated by combining the flood management goals of multiple organizations in the watershed, numerous conversations with environmental non-profit groups, government agencies responsible for regulation, and goals were vetted with key stakeholders in the watershed.

Goals	Metrics
1. Reduce flooding occurrences in the Kinnickinnic River Watershed to maintain a safe and dry community to the 1% probability 2. Reduce flashiness of streams 3. Return streams to a stable state	1. Linear feet of concrete removed 2. Number of properties flood-proofed 3. Acre feet of flood storage added 4. Modeling results 5. Number of bridges and culverts improved or replaced 6. Number of properties acquired and removed from the floodplain

The Kinnickinnic River Watershed Flood Management Plan

MMSD commissioned a flood management plan for the KK watershed that was completed in May, 2017. The plan includes each of the metrics listed above, and quantifies the practices planned for specific locations in each reach of the watershed. Concrete lining removal, daylighting of stream sections, and addition of detention ponds and other storage will reduce stream flashiness and peak flows during storm events. The plan models peak flow reductions for a one percent annual probability storm event at full BMP implementation for critical points by reach. While modeling indicates that some locations may experience an increase in peak flows, there is an overall flow reduction in sensitive areas. At the mouth of the Kinnickinnic, where the river empties into the harbor, peak flows are expected to decrease by more than 1,500 cfs during peak events compared to current conditions. Implementation will occur over a 15-20 year timespan, with an implementation schedule to be developed in 2018. The estimated cost of full implementation of the recommended alternative is $248,700,000. Project components are listed in Appendix G. Green infrastructure will be incorporated into flood management components in accordance with the regional and KK GI plans.

In addition to flood control, the plan's design includes the following criteria to enhance and provide co-benefits for recreational access and habitat metrics (The Kinnickinnic River Watershed Flood Management Plan p. 23-24).

Where flow velocities allow, open channel improvements shall be constructed with vegetated linings rather than hard surfaces such as concrete or riprap.

Surface slopes in storage facilities and channel sides shall be no steeper than 3:1 and should be 4:1 or flatter whenever possible.

The environmental impact of the proposed flood management measures must be taken into account during the planning process. This includes consideration of their effect on water quality and the ecological integrity of the watershed.

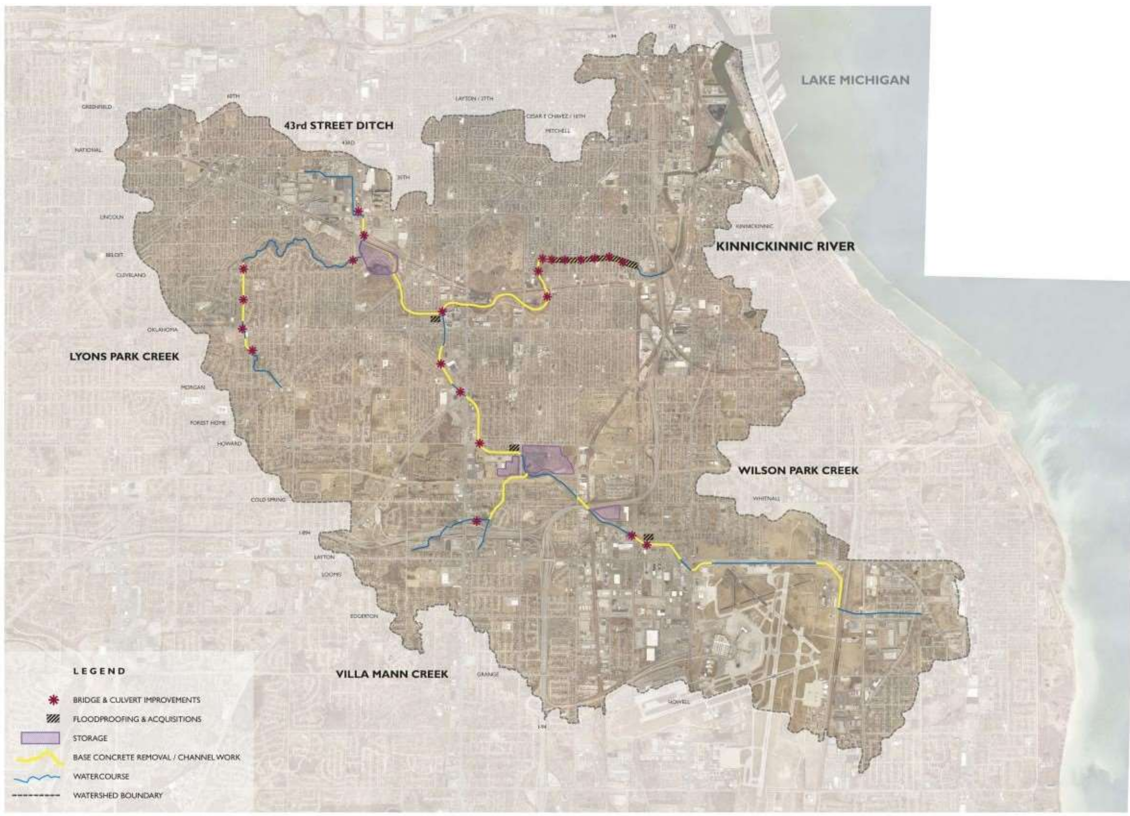


Figure 9 - Locations of Kinnickinnic River Flood Management Recommended BMPs

Implementation of the flooding mitigation BMPs is also expected to result in improved aquatic and terrestrial habitat, as well as enhancing public access and recreational opportunities The associated metrics below give an idea of the relationships between flood mitigation BMPs and habitat and access benefits.

Aquatic and Terrestrial Habitat

Stable and diverse habitat is a key component of watershed restoration and highly correlates with the water quality of a system. As water quality improves, better quality habitat can result, and vice versa, creating a positive feedback loop. Without strong habitat, water quality improvements are either unobtainable or unsustainable.

CURRENT CONDITIONS

The Kinnickinnic River Watershed lies almost entirely in the Southern Lake Michigan Coastal Ecological Landscape, a landscape influenced by glacial lake features. Near the shores of Lake Michigan, the landscape is composed of ridge and swale topography, clay bluffs, and lake plain. Further inland the land is dominated by ground moraines.

Historically, the northern portions of the watershed were dominated by forests of sugar-maple, basswood-beech and some oak. The southern portions contained oak forest, oak savanna, and prairies and numerous black ash and relict cedar and tamarack swamps were found on the landscape.

Today, however, very little of the watershed is forested (approximately 8 percent in 2011) and evidence of glacial influence has been covered by massive urbanization. Urban development dominates the landscape with 10.8 of the total 25 square miles impervious. Very little natural bordering habitat, or riparian habitat, remains (Figure 9). In addition, extensive channelization of the Kinnickinnic River began in the 1960s, and the majority of the channels remain today. In the rare locations where channels are not present, stream bank stability is very poor and erosion poses a large threat to aquatic and terrestrial habitat (Figure 10).

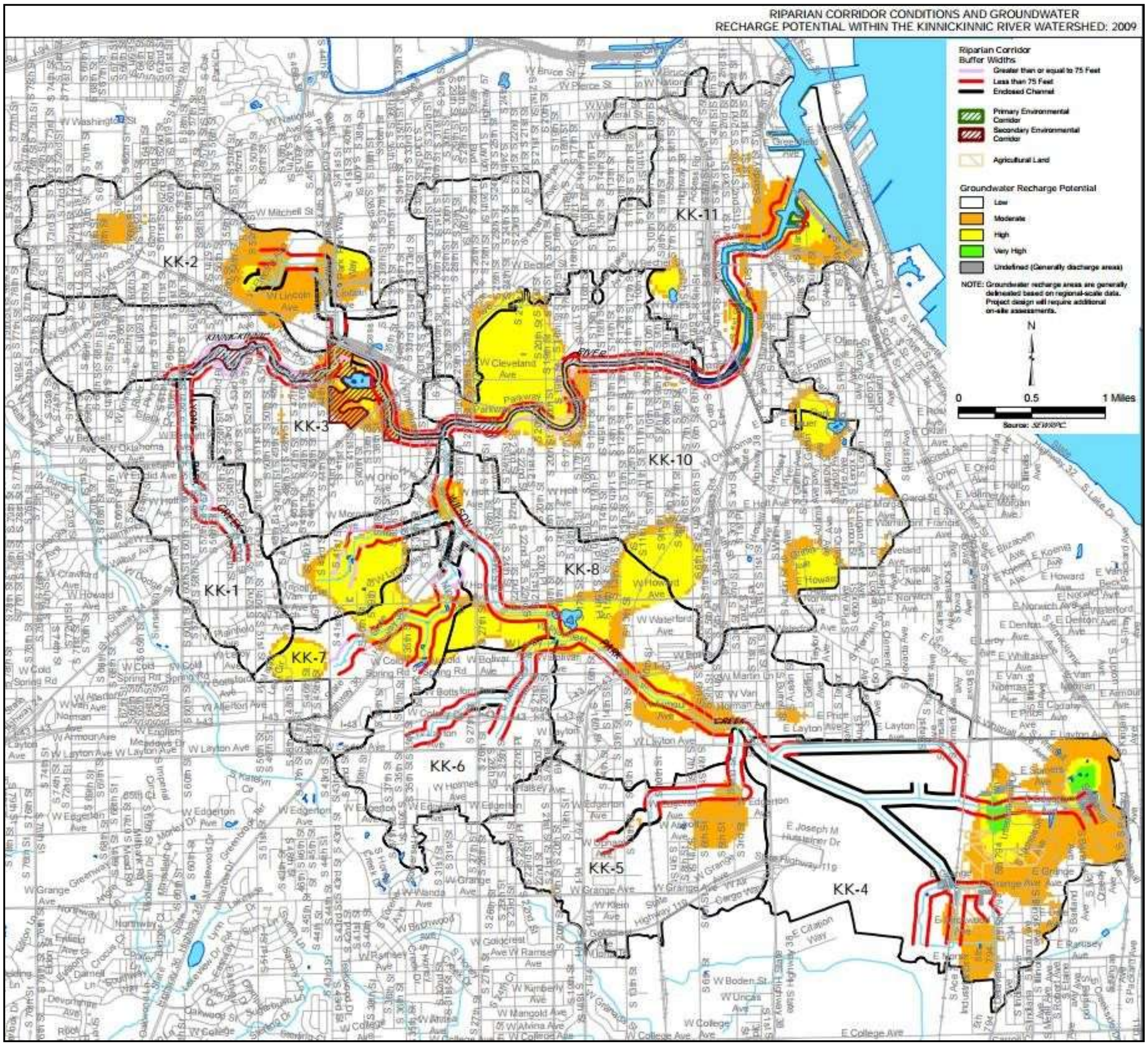


Figure 10 Riparian Corridor Conditions and Groundwater Recharge Potential within the Kinnickinnic River Watershed.

Source: Sewrpc 2009. See **APPENDIX B** For Reach Definitions.

Land use in the Kinnickinnic River Watershed is predominantly residential with a large portion of transportation land use dedicated to General Mitchell Airport. The area is highly urbanized with the majority of housing identified as multifamily low-rise buildings. Industrial and commercial uses are evident throughout, with pockets of high intensity use as identified by SEWRPC.

Milwaukee County is classified as a humid continental climate, in which large seasonal temperature differences between summer and winter months are seen. Precipitation is typically well distributed throughout the year, with rainy and humid summers and snowy winters. An upward trend in average annual temperatures has occurred in the last 150 years, however, which may have great influence on habitat restoration goals and plans. As temperatures continue to rise, the Milwaukee area should expect to see a shift towards warmer climate species, will be at greater risk for invasive and exotic species to colonize, and will experience an increase in large, drastic storm events.

Very few naturalized stream miles are present in the Kinnickinnic River and its tributaries. Thirty percent of the stream miles are concrete channelized, 30% underground or culverted, and the remaining 40% of stream miles have often times dangerously unstable banks with high levels of erosion (Figure 10). The Kinnickinnic River Watershed contains a very poor fishery and benthic macroinvertebrate community. In recent assessments conducted by the Wisconsin Department of Natural Resources, the fish community contained relatively few species of fishes, few or no top carnivores, and was dominated by pollutant-tolerant species. The macroinvertebrate community was similar with relatively little diversity and tolerant species dominant. Since the Kinnickinnic River has seen some improvement in water quality in the last few years, poor habitat may potentially be the factor that limits biodiversity in streams.

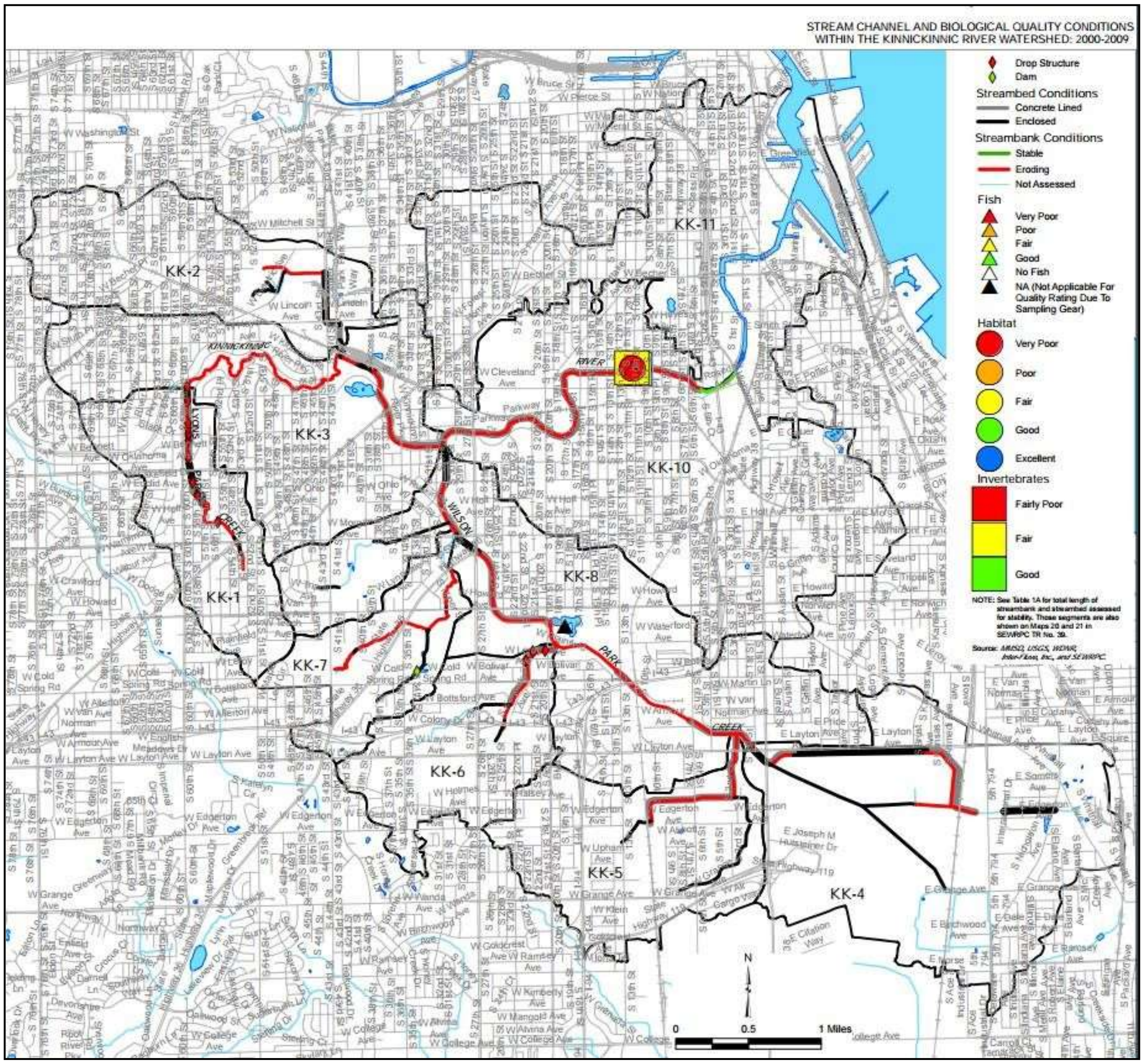


Figure 11 Streambank, Fish and Invertebrate Conditions in the Kinnickinnic River Watershed.

See Appendix B for Reach Definitions. Source: SEWRPC

HABITAT IMPROVEMENT GOALS AND METRICS

The following goals and metrics were formulated by combining habitat goals and metrics of multiple organizations in the region, numerous conversations with environmental non-profit groups, government agencies responsible for regulation, and were vetted with key stakeholders in the watershed. MMSD's Flood Management Plan addresses habitat goals and metrics, either directly or as a co-benefit if flood management measures. Specific implementation timelines are still under development and are expected to be completed by late 2018.

Goals	Metrics
1. Meet and maintain the natural community classifications of the Kinnickinnic River waterways 2. Remove concrete lining 3. Expand riparian buffers to 75 feet wherever possible 4. Improve connectivity of riparian zones for wildlife habitat 5. Protect high quality areas and sensitive lands 6. Restore fish and aquatic organism passage 7. Remove trash and debris from aquatic habitat	1. Biological Index 2. Acres of riparian habitat and/or river buffers 3. Acres of connected riparian habitat and or/river buffers 4. Linear feet of stream bank restoration 5. Linear feet of connected stream bank restoration 6. Acres of exotic invasive species removed 7. Linear feet of concrete removed 8. Number of barriers to organism passage removed

Policy Implications

Policies and regulations often lag behind innovative solutions to watershed problems and it is often the case that they unknowingly hinder progress. Without updated policies in the watershed that accurately reflect and support the goals and objectives of the Plan, watershed restoration will occur at a slower and more costly pace.

Current Conditions

Despite the growing popularity of green infrastructure practices for watershed restoration, many local policies and regulations make implementation difficult and costly, both for municipalities and the private sector working within those municipalities. In a recent effort conducted by SWWT and the non-profit Clean Wisconsin, polling approximately 70 local professionals in a series of roundtable meetings throughout 2016 identified barriers to green infrastructure. The major barriers identified included: cost, operation and maintenance, and lack of regulation *requiring* green infrastructure.

These findings were supported by a study conducted by the non-profit organization 1,000 Friends of Wisconsin that examined the codes and ordinances of all seven Kinnickinnic River Watershed municipalities (along with the remaining 21 municipalities making up the Milwaukee Metropolitan Sewerage District's service territory). It found that despite the fact that all of the municipalities in the Kinnickinnic River Watershed have either group or specific stormwater permits that would open up the possibility of green infrastructure, several policy barriers remain that either impede implementation of green infrastructure or are not strong enough to encourage green infrastructure.

Goals and Metrics

The following list is a summary of the strategic outcomes of the green infrastructure roundtables for the Greater Milwaukee (see current Information and Education section of the Plan) area but will have significant influence on the Kinnickinnic River Watershed. Due to the multiplicity of civil divisions in the Kinnickinnic River Watershed, GI policies adopted by the various municipalities in the watershed will have consequences that reach beyond individual municipal borders. Collaborative efforts will be critical to achieve maximum benefits at the lowest cost.

Goals	Metrics
1. Strengthen regulations requiring green infrastructure 2. Incentivize and help fund green infrastructure implementation 3. Accurately reflect recommendations of the Plan in local regulations	1. Number and extent of stormwater management plans that include green infrastructure practices 2. Number of codes and ordinances updates adopted 3. Number of individualized (non-general) stormwater permits issued by the DNR

Recreation and Public Access in the Kinnickinnic River Watershed

Recreational opportunity and access are crucial to the ideals of watershed restoration. Bringing the community to the riverside and on the river can help to develop a sense of stewardship for the watershed. This stewardship is crucial to citizen safety around water, proper maintenance of watershed restoration projects, citizen monitoring efforts, and establishing the political support needed for restoration projects.

Current Conditions

Limited to no recreational opportunities exist in the Kinnickinnic River Watershed due to the variability in flow and water depths of the river. Access points are additionally limited because of steep concrete lining. For example, there is only one public dock where the KK River enters the harbor. Of the 11.6 miles of stream, the Kinnickinnic River Trail only follows 2.5 miles of it. Little to no integration of the river into park spaces occurs in the watershed. Fishing opportunities are limited by multiple barriers to fish and other aquatic passage down the river.

Additionally, the community has many more negative associations to the river than positive ones. The flashiness of the river creates unsafe swimming conditions and threatens the safety of the community, and flood events cause major property damage.

Recreation and Public Access Goals and Metrics

The following list was formulated by combining goals various recreational goals identified in watershed and vetted with stakeholders in the Kinnickinnic River Watershed

Goals	Metrics
1. Improve the livability of the Kinnickinnic River Watershed through increased green space and outdoor recreational opportunities	*1.* Acres of green space added *2.* Miles of trail added *3.* Number of recreational programs added

2. Establish a connection between the Kinnickinnic River waterways and local community 3. Improve aesthetics of riverside locations	4. Number of safe access points in watershed 5. Number of visits to water side 6. Aesthetic classification 7. Miles of re-naturalized streambed

PART 3. IMPLEMENTATION AND EVALUATION

The following sections will provide the implementation tools to make the water quality, quantity, habitat and recreational goals of the Kinnickinnic River Watershed a reality. The implementation portion of the Plan is an adaptive process. It builds from prior successes in the watershed, provides solutions to identified problems in the watershed, and incorporates the decades of restoration work and planning that was conducted in the Kinnickinnic into a cohesive watershed restoration plan.

PRIORITY PROJECTS IDENTIFIED FOR THE PLAN

The priority projects identified in the Plan comprise numerous watershed initiatives to provide cost effective solutions to holistic watershed restoration. Watersheds are complex systems in which one action can have multiple reactions. For example, water quality improvements can be both a result and cause of improvements to flood management, habitat restoration, and recreational opportunities. Truly comprehensive planning identifies and supports projects that will result in achieving multiple and synergistic objectives in a cost effective manner.

Table 7 serves as a starting point for priority projects in the watershed. Note that several projects reference or support the development of plans in the watershed. Upon completion of these plans, priority projects that align with the objectives of the Plan will be incorporated in an updated version. Priority will be given to projects that address multiple components of watershed restoration and practices that provide co-benefits across multiple components.

Table 7. Priority Projects for the Plan

Project	**Water Quality**	**Flood Management**	**Habitat**	**Recreation & Public Access**	**Responsible Organizations (Lead orgs. in bold)**
Increase access in conjunction with City of Milwaukee's Kinnickinnic River Trail, the Milwaukee Urban Water Trail, the Harbor District Water and Land Use Plan, and other riparian corridor improvement activities			X	X	**City of Milwaukee, Milwaukee Riverkeeper, Harbor District, Inc. (HDI),** National Park Service

Continue to build on flood management projects	X	X	X	X	**MMSD**
Establish/Continue recreational and educational programming	X			X	**SWWT**
Leverage MMSD 2050 Urban Biodiversity Plan to identify wildlife habitat restoration opportunities	X	X	X	X	**SWWT**, MMSD
Survey, inventory, maintain and preserve environmentally significant lands	X	X	X	X	MMSD
Continue water quality monitoring activities to support policy adjustments and management actions including bacteria testing for fecal coliform.	X				**Milwaukee Riverkeeper**, USGS, MMSD
Specify and prioritize water quality monitoring locations (see monitoring section)	X				**Milwaukee Riverkeeper, MMSD**
Evaluate MS4 performance across the watershed and identify ways to support continual environmental improvement by permit holders	X		X		**DNR**
Implement comprehensive and collaborative projects with stakeholders to advance TMDL goals	X	X	X	X	**Permitted point sources, SWWT**
Implement coordinated Green Infrastructure reporting and metrics to address quantity and quality objectives of Updated Implementation Plan	X	X	X		**SWWT**

Project	**Water Quality**	**Flood Management**	**Habitat**	**Recreation & Public Access**	**Responsible Organizations (Lead orgs. in bold)**
Conduct stormwater public education and outreach (see education and outreach section)	X	X	X	X	**SWWT**
Identify sources of trash and debris. Continue and expand collection activities-trash wheel	X		X	X	Milwaukee Riverkeeper, Harbor District, Inc.

Develop Model Ordinances for targeted MS4s in the KK for stormwater management	X	X	X		**SWWT**, Clean Wisconsin
Finalize and Widely Circulate the "Tackling Barriers to Green Infrastructure" Guidebook	X	X	X		**SWWT, Clean Wisconsin , Sea Grant**
Complete watershed wide flood management planning to inform and update MMSD's KK Watercourse Management Plan		X			MMSD
Implement projects identified in MMSD's Watercourse plan that remove concrete lined channels, improve aquatic habitat and fish passage, reduce flood risk and risk of drowning	X	X	X	X	**MMSD,** SWWT, Sixteenth Street Community Health Centers
Identify unknown sources of bacteria, and correct/remove/disconnect unknown sources of bacteria	X			X	Municipalities, Milwaukee Riverkeeper
Include interpretative signage for projects and recreational locations					SWWT, project implementers
Create a resource center for green infrastructure for the Greater Milwaukee Area	X	X	X	X	**MMSD**
Implement the Water and Land Use Plan (WaLUP) in the Harbor Estuary	X		X	X	**HDI**

EXPECTED REDUCTIONS FOR GREEN INFRASTRUCTURE PLANS

Since the Kinnickinnic River Watershed is highly urbanized, virtually all of the non-point source runoff is from impervious surfaces and not from agricultural sources. Green infrastructure (GI) will therefore be a major component of non-point source control outside of MS4 boundaries or as an indirect component in permitted areas. A number of current GI plans for the watershed and larger plans that encompass the watershed detail some of the scope of GI implementation and the expected resulting pollutant reductions. Several of the GI practices are listed as priority projects in the Plan and the reductions estimates will inform implementation and evaluation of the Plan. Below is a summary of the calculated reductions for each plan: MMSD's Regional Green Infrastructure Plan, the Pulaski Park Neighborhood Stormwater Plan (which covers 108 acres of the watershed), and the City of Milwaukee's Green Infrastructure Baseline Inventory.

1. The MMSD Regional Green Infrastructure Plan of 2013 and the Kinnickinnic GI Plan of 2018 cover the period through 2035. The 2018 plan refines feasibility assumptions and adds prioritization metrics. Full implementation encompasses the following GI practices (2013 plan/2018 plan).

    - Porous Pavement: 1,210/403 average city block equivalent with porous pavement
    - Bioretention / Rain Gardens: 22,000/10,000 gardens covering 3.3 million/60,000 square feet
    - Stormwater Trees: 10/20 new trees per average city block
    - Green Roofs: 1,000/333 buildings with green roofs
    - Cisterns: 200/200 cisterns
    - Native Landscaping: 200/200 average city blocks converted to native landscaping
    - Rain Barrels: 17,100/2,635 homes with one rain barrel
    - Soil Amendments: 200/200 average city blocks with soil amendments

    The MMSD 2013 plan determined baseline loading for TSS and TP using the Source Loading and Management Model (SLAMM) and combined sewer overflow data. Pollutant reduction estimates are conservative and consistent with Chesapeake Stormwater Network (2012) values modeled for New York State. As confirmed by basic WINSLAMM modeling in the KK 2018 GI plan, expected reductions of TMDL constituents are in the 15-20% range (p. 26).

2. The Pulaski Park Neighborhood Stormwater Plan area is entirely within the 2,536 acre KK-7 reach identified in the Milwaukee River Basin TMDL approved in 2018. The TMDL calls for a 38% reduction in TP and a 69% reduction in TSS. Load reduction estimates from the Pulaski Park Plan using analysis indicate that TP reductions can meet or exceed the TMDL TP goals, while meeting TSS reduction goals will require greater interventions than detailed in the plan.

    The plan considers eight types of GI strategies for advancing these goals:
    - Rainwater Harvesting (rain barrels or cisterns)
    - Rain Gardens
    - Stormwater Trees
    - Permeable Pavements
    - Bioswales
    - Deep Sump Catch Basins
    - Biofiltration Basins
    - Synthetic Turf Field with Sub-grade Drainage System

Project Highlight: Pulaski Park Neighborhood Stormwater Plan (2015)

The Pulaski Park neighborhood stormwater plan is an excellent example of collaborative and holistic planning on a small scale. The plan identifies projects that improve flood management, water quality, aquatic and terrestrial habitat and recreational opportunities through the following recommendations:

- 212,117 square feet of permeable pavement
- 44,591 square feet of bioswales and biofiltration basins
- 30 stormwater trees
- 16,000 square feet of rain gardens
- 12,655 gallons of rainwater harvesting

Through WinSLAMM modeling analysis, these recommendations will result in a 50% reduction in total suspended solids, capture 45% of the volume associated with the first half inch of rain, and 42% reduction in phosphorus.

Similar projects are planned in areas throughout the watershed, including Jackson and Wilson Parks. Future critical areas identified within KK watershed need to mimic the Pulaski Park plan critical area analysis, description of practices and modeling. Specific timelines and recommendations, along with expected pollutant reductions from WINSLAMM modeling, may be included in those plans. MMSD's 2018 Kinnickinnic Watershed Green Infrastructure Plan identifies potential implementation priority areas based on combined criteria. Additionally, MMSD recently completed a spreadsheet tool for calculating the pollution reduction, volume of rainwater capture, and cost of various green infrastructure. The City of Milwaukee's ECO, DPW, and IT departments coordinate an online GIS map of green infrastructure in the city, including city-installed and private GI projects. The map includes watershed boundary layers, as well as size and volume capacity for each GI feature (but not pollution reduction estimates). As of November 2016, the map includes GI installed through 2014; the city expects to update the map and keep it up-to-date as soon as practicable.

GI and other practices are not expected to achieve the targets set by the TMDL. Additional reductions to achieve these are expected to be addressed through MS4 requirements over several permit cycles.

MS4s

Because virtually all of the KK watershed is covered by MS4 permits, these permits will be the primary method for meeting the plan's pollutant load reductions over time. MS4 permits, when reissued in 2018, will require each permittee to use WINSLAM to model the amounts, types and locations of practices that need to be implemented within MS4 permitted areas to achieve MS4 TMDL waste load allocations for TP, TSS and bacteria over time. Road salt usage and reductions from prior levels will also be tracked via MS4 permit annual reports. MS4 pollutant load reduction estimates will be generated and reported to WDNR within a MS4 five-year permit term. Each MS4 permittee's load reduction estimates and other annual report information will be included in this plan and compared to TMDL reduction goals for specific pollutants. Pages 45-46 (Table 7) of the Plan contain milestones for annual tracking efforts and practices implemented in watershed by MS4 permittees. With respect to other pollutants (e.g., chlorides), the metrics in plan (gallons infiltrated, reduction in salt use from previous use levels) will be used for pollutant reduction estimates.

IMPLEMENTATION FRAMEWORK

The framework for the Plan in the Kinnickinnic River Watershed follows a cycle of four main steps: Plan, Do, Check, Act (Figure 11). This framework was first suggested in the Kinnickinnic Watershed Restoration Plan of 2010 and is intended to facilitate an adaptive approach to watershed management as well as to provide strategy for SWWT to further develop implementation.

Since the development of the Kinnickinnic WRP, watershed management has consistently followed this structure implicitly or explicitly. For example, the framework is clearly utilized in the Pulaski Park Project and again in the creation of this Updated Implementation Plan. Pulaski Park improvements was an identified goal in the Kinnickinnic WRP in 2010.

The "Plan, Do, Check, Act" framework will be continued in the Plan as a mechanism for adapting previous projects and strategies to better achieve watershed restoration goals in the

Kinnickinnic River Watershed over the next ten years and beyond.

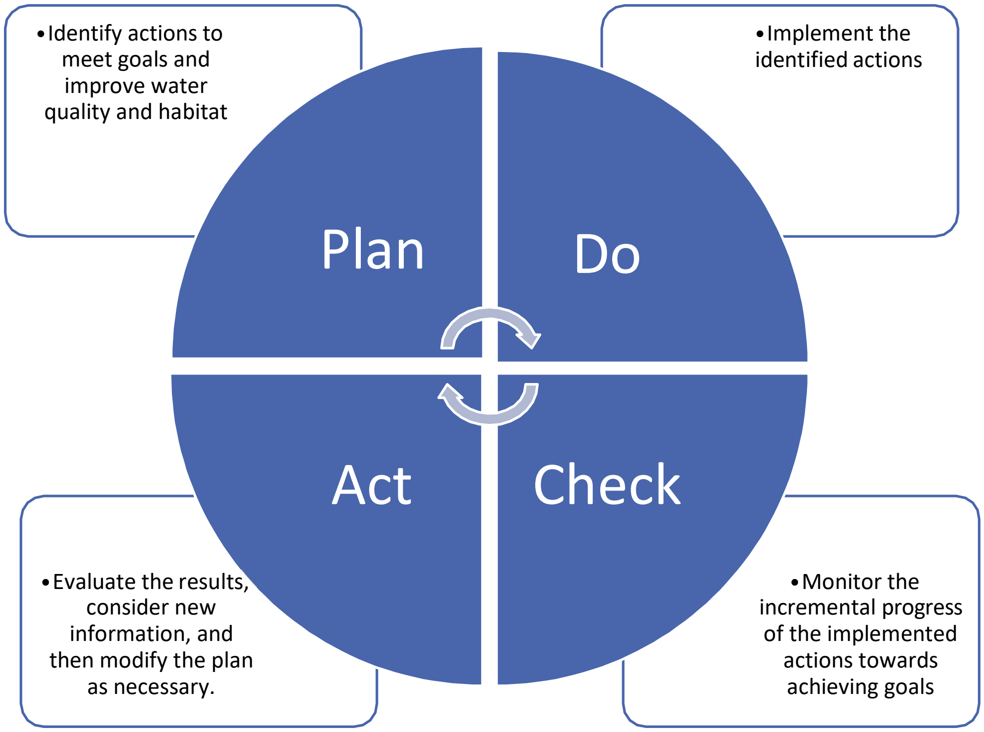


Figure 12 Plan, Do, Check, Act" Implementation Process

Actual implementation of suggested projects in the Plan will be based on several factors, including available funding, commitment of key participants, organizational capacity. The adaptive management theory used in the development of this plan and its implementation framework is specifically designed to allow for changes and additions that may occur in the watershed. In order to strategically adapt and evaluate the success of the Plan, strong reporting, communication, and feedback systems are required and will be incorporated into each project.

Measurable Milestones

In order to truly create an adaptive and comprehensive watershed restoration plan, data on practices implemented needs to be collected. For the Kinnickinnic River Watershed Updated Implementation Plan, the effort will be led by SWWT through the creation of a system for annually compiling, analyzing and disseminating information on the watershed through an annual meeting. Metrics and information from this system will regularly be incorporated back into the Plan. In addition to the aforementioned metrics, a general timeline (Table 8) and several key milestones will be used by SWWT as indicators of the Plan's implementation progress.

Table 8 General Timeline for the Plan

Task	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Update the UIP priority projects based on activity in the watershed and SWWT's Annual Meeting with key stakeholders		X		X		X		X		
Conduct project planning, site surveys, project design and budget development		X	X	X	X	X	X	X	X	X
Prioritize and incorporate the recommendations of the Plan into existing programs, activities and Budgets	X	X	X	X	X	X	X	X	X	X
Implement and construct projects	X	X	X	X	X	X	X	X	X	X
Evaluate criteria for re-evaluating the schedule and effectiveness of projects and practices due to lack of progress.					X					
Monitor, report and evaluate success	X	X	X	X	X	X	X	X	X	X

SWWT will take the lead in collecting, summarizing and distributing data and efforts in the watershed through an annual meeting. Information will be collected with a uniform, fillable template that contains metrics from pre-existing reports in addition to new, useful tracking information so as to limit additional work for stakeholders. Data collected will be used to update the watershed restoration plans. In addition, the annual meeting will provide stakeholders the opportunity to provide feedback and report on successes from the prior year, and formally request the help of SWWT in the upcoming year to overcome any barriers to successful watershed restoration. The completion of plans prioritized in the Plan will serve as milestones for implementation.

Supporting Plans

Many of the plans and supporting studies that form the basis for this Watershed Based Plan (WBP) are still in-process, with many schedules, implementation timelines, and funding needs to be determined in 2018 and thereafter. Table 9 lists these plans and studies, along with their associated time frames. As these are completed and made available, specific goals, practices recommendations, milestones, and costs from the underlying plans will be added to the WBP matrix and updated regularly (at least annually). As shown in the table, of the plans that have already established implementation deadlines, all will be completed by 2050, or within 3-4 iterations of the Plan. This is consistent with the requirement that implementation schedules be reasonably expeditious. The Plan will serve as a consolidated and comprehensive source of information gathering and sharing to facilitate true watershed-based planning that addresses the nine key elements, especially those regarding implementation schedules, measurable milestones, and criteria for success.

Table 9 Supporting Plans

Plan/Study	Organization(s)	ETA/ Effective Date	Timespan	Notes	Practices	Costs
MS4 Permits	WDNR, municipalities, county	2018	20+ years	Permits renew every 5 years	TBD	TBD
KK WRB & Implementation Plans	SWWT	2010	2010-2015	superseded by the present WBP	N/A	N/A
Chloride Impact Study	SEWRPC	2021	2021 -		TBD	TBD
2020 Facilities Plan	MMSD	2010	2010-2020	2050 FP will supersede	N/A	N/A
2050 Facilities Plan	MMSD	09/2018	2018-2050		TBD	TBD
RWQMPU	SEWRPC	2007/2013	-2020	companion to 2020 FP	N/A	N/A
MRB TMDL	MMSD/ DNR	03/2018	-2050+		N/A	N/A
Kinnickinnic River Watershed Flood Management Plan	MMSD	2017	*	*implementation plan by 09/2018	Concrete/ culvert removal, streambank stabilization, bridge work	$249 million
Bacteria Working Group Report	SWWT	03/2018	N/A	baseline/informational report	N/A	N/A
Stream Habitat Conditions and Biological Assessment of the Kinnickinnic and Menomonee River Watersheds: 2000-2009	SEWRPC	2010	N/A	baseline/informational report	N/A	N/A

Regional Kinnickinnic River Watershed: Green Infrastructure Plans	MMSD	2013, 2018	2013-2035	Examples of GI practices, implementation levels & costs, prioritization maps	Various GI practices	$142 million
Pulaski Park Green Infrastructure Plan	SSCHC, GRAEF, MMSD, MKE DPW, Milwaukee County Parks, UEC	2015	2015-	template for GI and park plans, including WINSLAMM analysis	Various GI practices	See Appendix G

The following items will be tracked on an annual basis:

- Metrics for Water Quality, Flood Management and Quantity, Habitat, and Recreational Use goals identified in the Plan
- Staff hours and resource and/or funding levels that were needed to implement projects identified in the Plan
- Land use changes or weather events that may impact plan implementation
- Participation by other groups, organizations and citizens to implement the Plan
- Status of other programs that reduce pollutant loadings i.e. Adaptive Management, WQ Trading etc.
- Successes and lessons learned in the prior year
- Barriers to watershed restoration
- Additional data as needed

Through this reporting process, implementation will stay true to the adaptive nature of a comprehensive watershed restoration plan. If the below indicators are not met by year five (5) of implementation, key stakeholders led by SWWT, will initiate a new cycle of the implementation framework: “Plan, Do, Check, Act”.

- At least 20% of planned projects have been implemented.
- At least 20% of the watershed goals have been met for water quality, flood management, habitat, policy and recreation.
- At least 20% of required financial resources are available for practice implementation

Leadership Structure

Extensive collaboration exists in the Kinnickinnic River Watershed and includes the following lead organizations (Table 8). With the extensive network already in place, implementation of the

Plan will continue to function through these lead organizations. A full list of partnering organizations can be seen in Appendix F.

TABLE 10. LEAD ORGANIZATIONS FOR THE PLAN

Organization	Leadership Roles
Southeastern Wisconsin Watersheds Trust, Inc. (SWWT)	• Develop and House Updated Implementation Plan • Annual Meeting • Secure Funding for Watershed Work • Key Initiative Coordinators • Policy Committee • Science Committee
Sixteenth Street Community Health Centers	• Develop Updated Implementation Plan • Leverage Existing Relationships With Residents of KK Watershed • Project Implementation • SWWT Key Initiative Coordinator for Kinnickinnic River Watershed
Harbor District Initiative	• Develop and Implement Water and Land Use Plan for the Harbor Estuary • Project Implementation • Public Access to rivers/water • SWWT Key Initiative Coordinator for Harbor/Estuary
Milwaukee Riverkeeper	• Annual River Clean Ups • Citizen Monitoring • SWWT Key Initiative Coordinator for Menomonee River Watershed
Milwaukee Metropolitan Sewerage District (MMSD)	• Funding • Kinnickinnic River Watershed Green Infrastructure Plan • Flood Management Project • Green Infrastructure Plan • 2020 Facilities Planning Program • Project Implementation • Monitoring
Southeastern Wisconsin Regional Planning Commission (SEWRPC)	• Watershed Modeling and TMDL Development
Municipalities	• Project Implementation
WI Department of Natural Resources (WDNR)	• Regulator for TMDL Implementation • Monitoring

Another recommended task for all of these lead organizations is to review all maps included in the Plan. This review should be conducted in order to identify:

- The source organization for each map.
- Any outdated or inaccurate information included in the maps that needs to be replaced.
- If there is a need for completely revised maps.

Southeastern Wisconsin Watersheds Trust, Inc.

Sweet Water is the lead organization on the Kinnickinnic River watershed Updated Implementation Plan. Sweet Water was formed in 2008 as a collaborative organization intended to, in part, implement the recommendations made in the WRP and RWQMP for in the Greater Milwaukee watersheds. The organization operates with a Board of Directors, Executive Director, staff and several partnering non-profits and consultants that form the Key Initiative Coordinators. Additionally, Sweet Water collaborates with regional policy makers and scientists through its Policy and Science Committees, with participation open to the public.

1. Key Initiative Coordinators

   Key Initiative Coordinators (KICs) exist for all of the Greater Milwaukee watersheds: The Milwaukee, Kinnickinnic, and Menomonee Rivers, the Estuary, and one for Emerging Issues identified by the Board. The KIC for the Kinnickinnic River Watershed is local non-profit Sixteenth Street Community Health Centers. The KICs operate in three main categories: advancing policy, implementing projects, and educating and outreach. The purpose of the KICs is to advise Sweet Water's Executive Director, Board of Directors, other KICs, and its Science and Policy Committees on important issues pertaining to Sweet Water's work in the Greater Milwaukee watersheds. Each Coordinator is primarily responsible for managing and reporting on the work relating to their Key Initiative. The KICs meet approximately two times a month.

2. Science Advisory Committee

   The Science Advisory Committee is a group of regional professionals that volunteer their expertise for a membership period of at least two years to advance Sweet Water's work. The purpose of the committee is to advise Sweet Water's executive director, its Policy Advisory Committee and its Key Initiative Coordinators, on important science and technical issues pertaining to Sweet Water's activities, watershed restoration goals, and other endeavors. This committee meets approximately four to six times a year.

3. Policy Advisory Committee

   The Policy Advisory Committee is a group of regional professionals that volunteer their expertise for a membership period of at least two years to advance Sweet Water's work. The purpose of the Policy Advisory Committee is to advise Sweet Water's executive director, its Science Advisory Committee and its Key Initiative Coordinators, on important policy issues pertaining to Sweet Water's activities, watershed restoration goals, and other endeavors. This committee meets approximately four to six times a year.

Funding Sources

One major pool of funding that is accessible with a US-EPA approved nine key element watershed plan is federal Section 319 funding outlined in the 1987 amendments to the Clean Water Act. In addition, there has been a notable shift in funding opportunities in Wisconsin towards watersheds plans that are approved nine key element plans, most notably the funding available through the Great Lakes Restoration Initiative, which prior to 2016 did not require an approved watershed plan. Other examples of traditionally 319 funding projects include citizen monitoring, targeted runoff management (TRM) grants, and other Wisconsin Department of Natural Resources administered grants for lake planning, river planning, and urban stormwater projects. Table 9 provides a list of several of these programs. Section 319 funding cannot be used for practices that directly implement MS4 permits. Practices that support, but do not directly implement activities required by the permit, and practices that go above and beyond permit requirements may be eligible for 319 funding. Examples of such practices include GI, where not required as a condition of the permit.

In addition to Section 319 funding, extensive funding sources were compiled for the Kinnickinnic WRP and are available for use in the Plan (KK WRP Chapter 8.3 and Appendix 8A). Among a host of others, the Joyce Foundation, the Fund for Lake Michigan, Wisconsin Coastal Management, and MMSD have previously funded efforts in the Kinnickinnic watershed. For development of riverside trails and walkways, Department of Transpiration Transportation Infrastructure Finance and Innovation Act (TIFIA) funding may be available. Projects using these funds have been developed with the co-benefits of improved transportation, recreation, and environmental quality. Signage that explains the benefits of implemented water quality projects can be especially effective along trails and at other public access points. Funding for signage can play an important role in the Plan's ongoing education and outreach.

TABLE 11. EXISTING 319 GRANT OPPORTUNITIES HYPERLINKED.

Notice of Discharge Grant Program
Lake Protection and Management Grant Program
River Protection Grant Program
Urban Nonpoint Source & Storm Water Management Grant Program
DATCP Soil Water Resource Management Grant Program
Wisconsin Coastal Management Program
Great Lakes Restoration Initiative
NRCS financial assistance grants and programs
EPA nonpoint source related funds
Water Quality Trading
Adaptive Management
Trails and Walkways
EPA Urban Stormwater Runoff

Cost Estimates and Annual Funding Needs from Green Infrastructure Plans

Several cost estimates for green infrastructure practices have been estimated for the Kinnickinnic River Watershed. Below is a summary of the costs associated with MMSD's Regional Green Infrastructure Plan, the Pulaski Park Neighborhood Stormwater Plan (which covers 108 acres of the watershed), and the City of Milwaukee's Green Infrastructure Plan. These cost estimates will help determine funding needs for implementation of the Kinnickinnic River Watershed Updated Implementation Plan.

The MMSD Regional Green Infrastructure Plan of 2013 estimates that an investment of $142 million for capital costs through 2035 is required in the Kinnickinnic River Watershed to meet its portion of the overall goal of the Regional GI Plan. The cost breakdown is roughly $50-55 million each for GI strategies to address runoff from buildings and streets, $31 million for parking lots, and $6 million for turfgrass areas. Capital costs for porous pavement and bioretention/raingardens are $43-45 million each, and green roofs account for an additional $36 million. Planting stormwater trees would cost an estimated $10 million, with an additional $8 million spread among soil amendments, rain barrels, native landscaping, and cisterns. Through 2025, which covers much of the time period of the present plan, approximately half of these capital funds would be expended, with the remaining 50% of expenditures occurring 2026-2035.

Capital costs are broken out for each GI strategy (but not individually by watershed), including both stand-alone and incremental costs, where the latter represent the cost differences of incorporating GI strategies over conventional rebuilding methods that do not contain GI features. For example, porous pavement and green roofs cost more than conventional paving and roofing, and these costs represent the incremental costs of GI. Cost estimates here are not true life cycle costs, in that they do not incorporate potential cost savings from GI strategies, such as lower building heating and cooling costs after green roof installation.

Incremental capital costs of full implementation amount to $1.3 billion, compared to $2.15 billion stand-alone costs. Annual operation and maintenance costs are estimated to be $10.4 million. The $142 million incremental cost of GI strategies in the Kinnickinnic River Watershed amounts to 11% of the total GI capital cost for the region. (p. 62-65)

Potential Funding Sources (MMSD 2013 p. 79):

- Property tax assessments (though these may be subject to state-imposed caps)
- Municipal stormwater utilities
- A regional or watershed-permit-based stormwater/green infrastructure utility
- Smart growth and smart community grants for pilot projects
- State and private grants for pilot projects
- State revolving loan funding
- Cost-sharing models that leverage local funding to obtain regional funding
- Private funding of green infrastructure following energy service company

(ESCO) models
- Incentives for private property implementation that may be phased out over time
- Issuing bonds to fund sub-basin scale demonstration projects or to establish local funds for a revolving fund program

The Pulaski Park Neighborhood Stormwater Plan estimates capital costs from a variety of sources for each technique (p. 16):

- Rain Barrel (55-gallon) - $80 to $120 per barrel
- Rain Cistern - $1,000 to $10,000 depending on size and material
- Rain Garden - $5 to $10 per square foot
- Stormwater Tree - $200 to $340 per tree
- Permeable Pavement - $9 to $12 per square foot
- Bioswale - $5 to $15 per square foot
- Deep Sump Catch Basin - $2,000 to $3,000 per precast basin
- Biofiltration Basin - $5 to $15 per square foot
- Turf with Sub-Grade Drainage System - $3 to $4 per square foot (base); $4 to $6 per square foot (turf)

The 2015 City of Milwaukee Green Infrastructure Baseline Inventory provides capital cost estimates for various types of GI from a range of sources (p. 32).

Annual capital funding required to meet the city's 173 million gallon goal (based on watersheds area alone), assuming incremental progress from 2015-2035, would be $62 million. To reach the 380 million gallon goal (based on watersheds share of impervious surfaces) would require an investment of approximately $130 million annually. (p. 35). The portion of funding needed to meet goals in the KK watershed would vary similarly, with a higher proportion due to the watershed's relatively high level of imperviousness.

Appendix G provides a master table with selected current and planned green infrastructure practices and cost estimates.

MONITORING

Monitoring is an essential component to any long term, adaptive management plan. Results from monitoring data in the Kinnickinnic River Watershed will create the necessary database for ultimately delisting impaired waterways and for meeting and maintaining their natural community classifications, two goals of the Plan.

WATER QUALITY-CURRENT MONITORING:

Several agencies having existing water quality monitoring programs in place in the Kinnickinnic River Watershed (Table 10). These agencies will therefore serve as the main sources of monitoring in the Plan, and mentoring will be expanded and improved according to TMDL implementation requirements. Current monitoring sites in the Kinnickinnic River Watershed are seen in Figure 13.

TABLE 12. CURRENT WATER QUALITY MONITORING PROGRAMS IN THE KINNICKINNIC RIVER WATERSHED

Local Non-Profit	
Milwaukee Riverkeeper	
Government and Quasi-Government	
SEWRPC MMSD	WDNR
State	
DOA Coastal Management Program	UW Sea Grant
Federal	
US Fish and Wildlife US EPA	USGS NOAA

Figure 13 Monitoring Locations by Monitoring Entity in the Kinnickinnic River Watershed.

Parameters currently being monitored in the Kinnickinnic River Watershed by Milwaukee Riverkeeper include:

- Total Phosphorus
- Turbidity
- Dissolved Oxygen
- pH
- Conductivity (proxy for chlorides)
- Temperature
- Bacteria
- Flow

Water Quality-Updated Implementation Plan Monitoring

For the purposes of the Plan, Wisconsin DNR approved protocol and methodology will be followed and, to the maximum extent possible, current monitoring efforts will be updated to these standards. The Wisconsin 2016 Consolidated Assessment and Listing Methodology (WisCALM) for Clean Water Act Section 305(b), 314, and 303(d), and Integrated Reporting was used to determine appropriate sampling criteria. Sample methodology for monitoring Total Phosphorus, Total Suspended Solids, and Fecal Coliform is shown in Appendix H.

As seen in Figure 13, a majority of the watershed has and will continue to be monitored to evaluate pollutant concentrations/levels. However, it is recommended an additional monitoring site be included at the confluence of Wilson Park Creek and Holmes Avenue Creek to help evaluate pollutant loading from the sub-basins located upstream (Appendix M). The Plan will rely on prior and expert monitoring agencies in the determination of any other monitoring locations.

Information and Education

Significant sharing of information and education already occurs in the Kinnickinnic River Watershed and the Milwaukee River Basin through agencies like SWWT, Sixteenth Street Community Health Centers, and MMSD, among others. The Plan will leverage these established communication channels over the next ten years as well as create two new outlets to overcome identified barriers of communication. The following efforts will target five key audiences: Municipal, Residential/Homeowners, Private Businesses, Voters, and Implementation Partners.

Current Communication Channels in the Kinnickinnic River Watershed:

1. Respect Our Waters Campaign: *Residential/Homeowners/Voters*

   Respect Our Waters (ROW) is an information and education campaign to raise awareness about the problem of stormwater runoff and encourage residents to help prevent it through behavioral changes. ROW's goal is to educate homeowners and residents on the many small steps they can take to keep our waterways clear of pollutants. The campaign is a collaboration between SWWT and the Root-Pike Watershed Initiative Network. ROW regularly hosts booths at community events throughout Southeastern Wisconsin and includes television and mobile advertisements that run in summer months where water use increases. Results from the most recent ROW survey in 2016 are seen in Appendix I.

2. SWWT Annual Clean Rivers, Clean Lake Conference: *Implementation Partners, Municipalities*

   Every spring, SWWT hosts its annual Clean Rivers, Clean Lake Conference. The conference is an opportunity for water professionals, government representatives, nonprofit organizations, and private businesses to learn about improving the health of our watersheds through policy innovation, technical expertise and engineering, watershed restoration planning and practices, and collaboration and stakeholder involvement. It is an all-day event that includes presentations, workshops, exhibits, and an awards presentation for SWWT Mini-Grant recipients.

3. SWWT Mini-Grant Program: *Implementation Partners*

   SWWT's Mini-Grant Program distributes grants every year of $1,000 - $5,000 each to established non-profit organizations, community, and civic groups for projects or activities that advance the objectives of SWWT. Funding is available for eligible projects located the Kinnickinnic, Menomonee, Milwaukee, Root, and Oak Creek watersheds. The aim of the Water Quality Mini-Grant Program is to support local, grassroots efforts that employ green infrastructure practices and other water quality-related activities that will improve water quality, enhance conservation, restore habitat, or educate people about these issues.

4. Milwaukee Riverkeeper Report Card: *Implementation Partners, Residential/Homeowners, the Public*

   Each year Milwaukee Riverkeeper compiles a report card for the watersheds in the Milwaukee Basin, including the Kinnickinnic. The report card assigns a letter grade to each watershed based on the analysis of Milwaukee Riverkeeper of its own monitoring, as well as DNR, MMSD, and USGS monitoring. The report is distributed to Riverkeeper's members and partners to help inform the public on the water quality conditions in the watershed.

5. Green Infrastructure Roundtables: *Municipalities, Implementation Partners*

   Over the course of 2016, SWWT in conjunction with Clean Wisconsin hosted a series of meetings with local green infrastructure stakeholders to address the current barriers to green infrastructure in the Greater Milwaukee area. The series of gatherings was intended to create a set of prioritized strategies and collaborative steps to effectively promote and implement green infrastructure in the region. Goals of the roundtable included: identifying areas where more support is needed and brainstorming a range of options to overcome social, financial, and political barriers.

Planned Communication Channels in the Kinnickinnic River Watershed

In addition to the aforementioned current communication channels the following programs will be implemented as part of the Watershed Restoration Plan in the Kinnickinnic River Watershed:

1. SWWT Annual Meeting: *Municipalities, Project Implementers*

   The Annual Meeting will provide the communication structure needed to make effective watershed restoration plan implementation a reality and achieve effective improvements. The Annual Meeting will serve as an official exchange of information in the watersheds by first requiring project implementers in the Kinnickinnic watershed to submit metrics (described in Measurable Milestones). And second, by providing stakeholders in the watershed with the opportunity to provide feedback, lessons learned, and suggest priority projects, research or policy changes that would facilitate effective TMDL implementation.

   Information shared at the Annual Meeting will be compiled by SWWT to be shared to and by all stakeholders in the watershed. This process will inform project implementers on other efforts in the watershed that they may not otherwise know of, encourage collaboration, and over all, improve the effectiveness of watershed restoration in the Kinnickinnic. Information will additionally be used to feedback into future adaptions of the Plan.

Conclusion

Successful and cost-effective watershed restoration requires comprehensive, thoughtful efforts in water quality, flood and water quantity, habitat, recreation, and policy improvements. The Plan for the Kinnickinnic River Watershed outlines each of these facets individually and then prioritizes projects that incorporate numerous facets in order to most succinctly address the issues in the watershed. By identifying and evaluating past barriers to successful implementation of the multitude of prior plans in the area, the Plan uses the adaptive process of “Plan, Do, Check, Act” presented in the Kinnickinnic River Watershed Restoration Plan of 2010. The Plan layers the goals and priorities from prior and upcoming plans, and establishes specific evaluation criteria to guide the next 10 years of project implementation in the Kinnickinnic River Watershed and beyond.

By incorporating the US EPA’s Nine Minimum Elements of a Watershed Plan, the Plan additionally ensures that the Kinnickinnic will be eligible for Section 319 and Great Lakes Restoration Initiative funding, upon its approval.

The Kinnickinnic River Watershed is at a critical juncture. Although significant headway has been made towards restoring the watershed, several barriers have impeded desired progress. The Kinnickinnic Updated Implementation Plan addresses these barriers and will guide the comprehensive restoration of the Kinnickinnic River Watershed for the next 10 years.

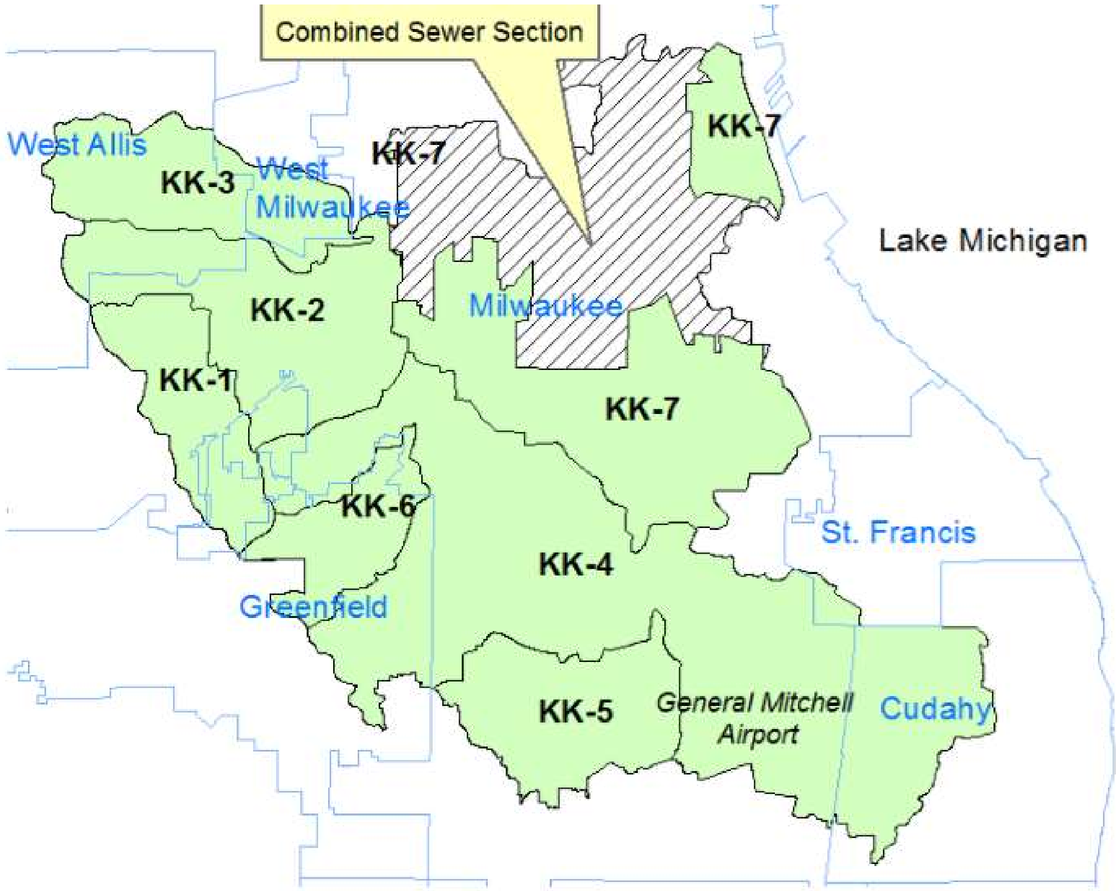
REFERENCES

1. Milwaukee River TMDL, 2016, CDM Smith/MMSD
2. Kinnickinnic Watershed Restoration Plan, 2010, Milwaukee Metropolitan Sewerage District (part 1, part 2, part 3, part 4)
3. Kinnickinnic Implementation Plan, 2010, Southeastern Wisconsin Watershed Trust Inc. Kinnickinnic Watershed Action Team
4. Milwaukee River Basin Report Card, 2014, Milwaukee River Keeper
5. 2011 Water Quality Management Plan Update, 2011, WDNR (part 1, part 2, part 3)
6. Pulaski Park Plan, SSCHC, MMSD, Graef, 2015
7. MMSD Regional GI Plan, 2013
8. City of Milwaukee ReFresh Sustainability Plan, 2013
9. MMSD Water Quality Report for 2013 http://www.mmsd.com/-/media/MMSD/Documents/Water%20Quality/WQ%20Monitoring%20Data/WQSummaryStatistics2013.pdf
10. Odefey, et al., 2012. Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide
11. EPA - about green infrastructure, https://www.epa.gov/green-infrastructure/what-green-infrastructure
12. City of Milwaukee 2015. Green Infrastructure Baseline Inventory
13. Corsi et. al.,2015,"River Chloride Trends in Snow Affected Urban Watersheds: Increasing Concentrations Outpace Urban Growth Rate and Are Common Among All Seasons,"
14. Planning Report-39 Water Quality Conditions and Sources of Pollution in the Greater Milwaukee Watersheds, 2007, SEWRPC part 1 and part 2
15. Wisconsin Consolidation Assessment and Listing Methodology (WISCALM) for CWA Section 303(d) and 305(b_ Integrated Reporting. Guidance #3200-2015-01

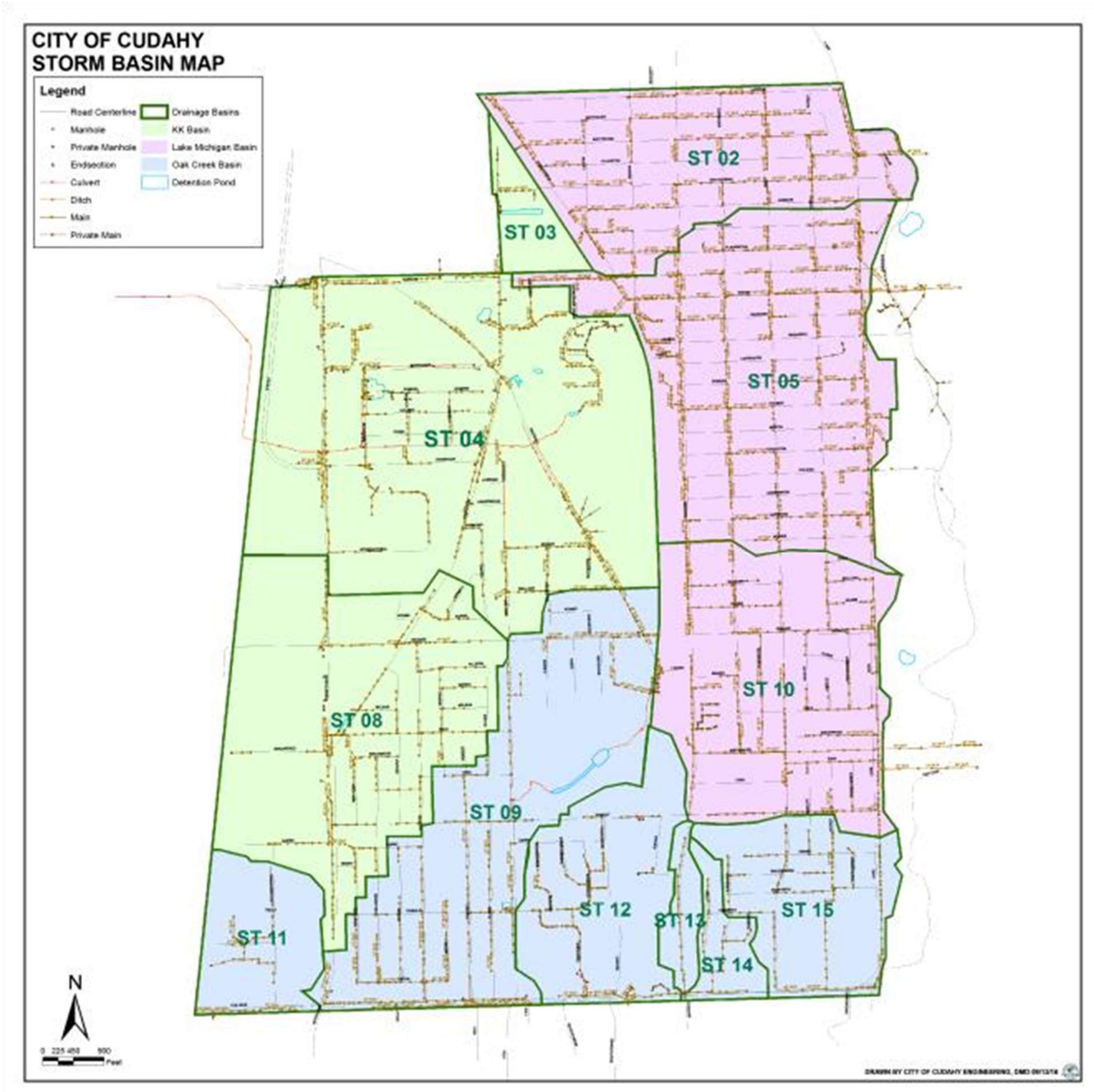
APPENDICES

Appendix A. Permitted Municipal Separated Storm Sewer System (MS4) and Combined Sewer Service Area (CSSA) Maps

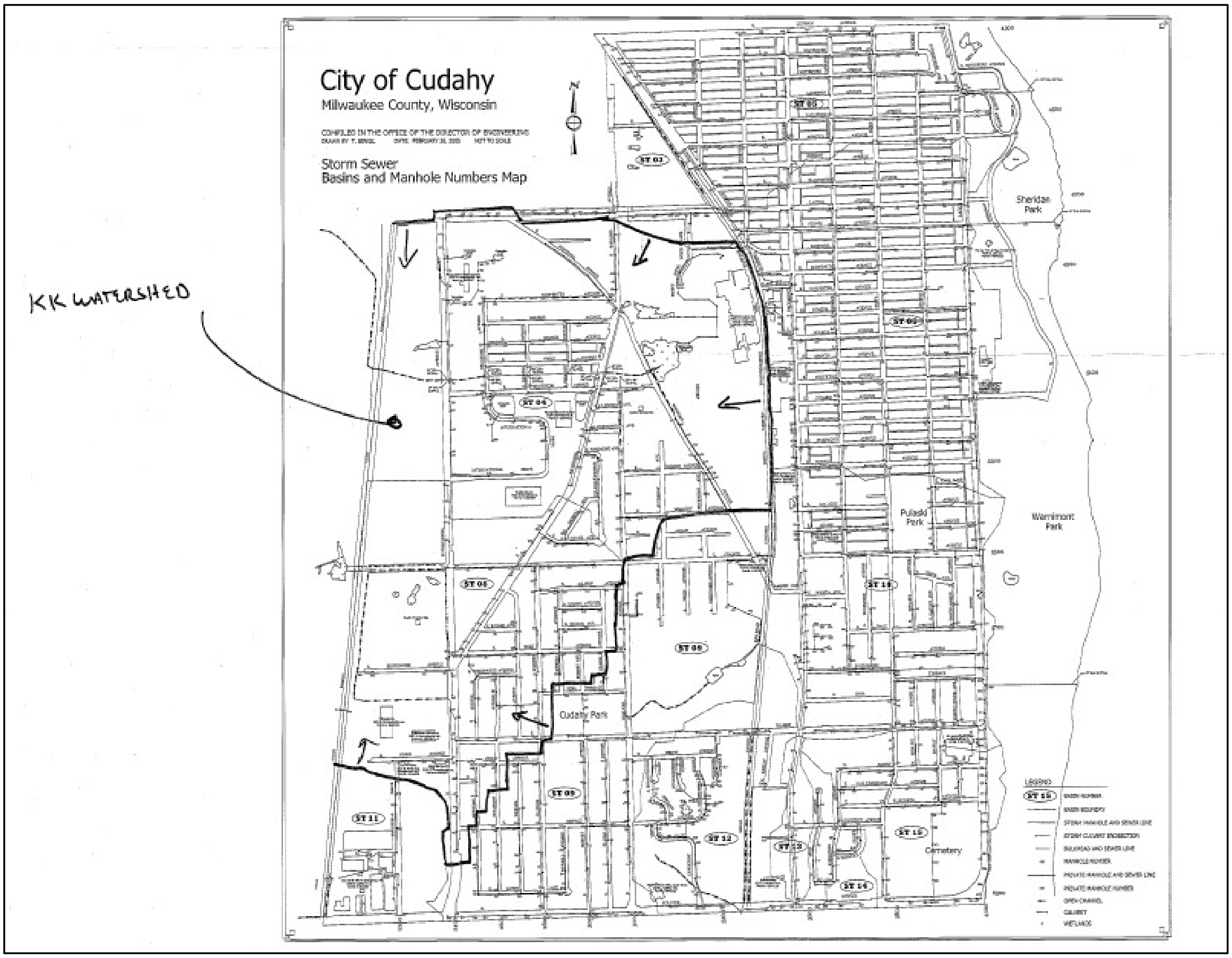
Milwaukee River Basin TMDL Reach Sub-Watersheds within Municipal Boundaries



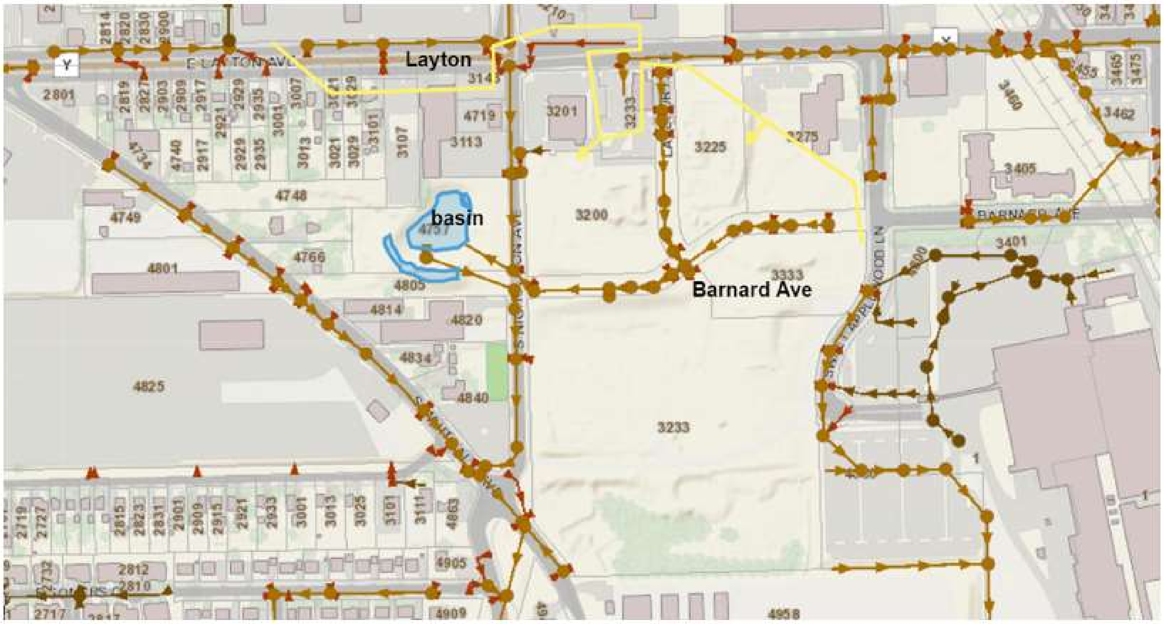
CITY OF CUDAHY MS4 MAP



City of Cudahy MS4 Map: Storm Sewer Basins and Manhole Numbers

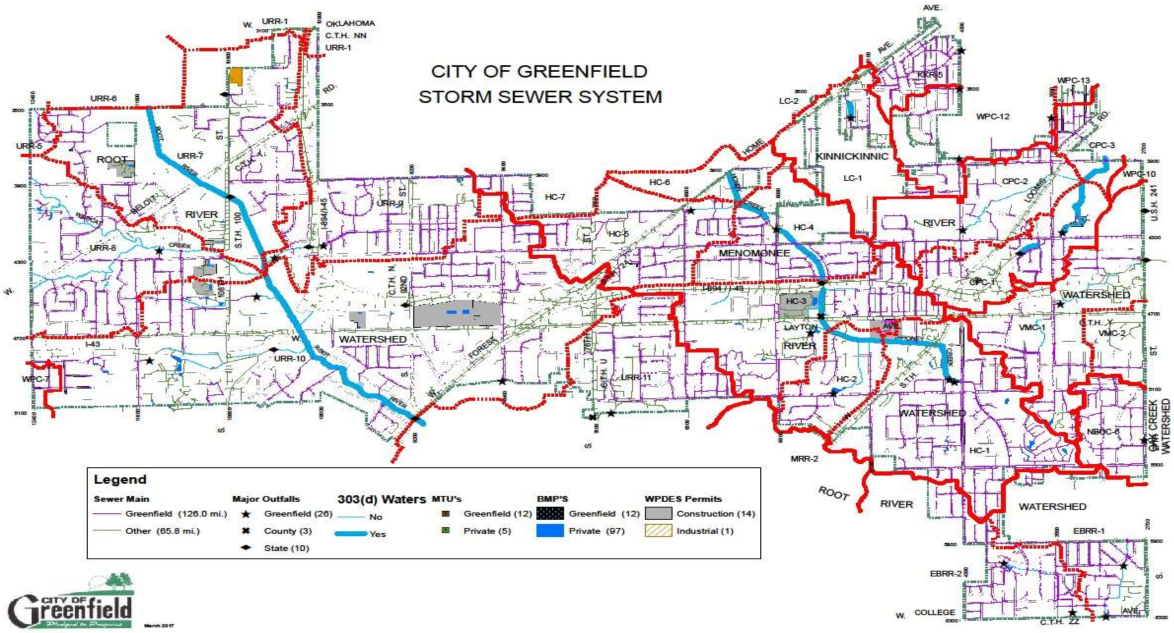


City of Cudahy MS4 Map: Additional Stormwater Basin Layton/Barnard/Sweet Applewood

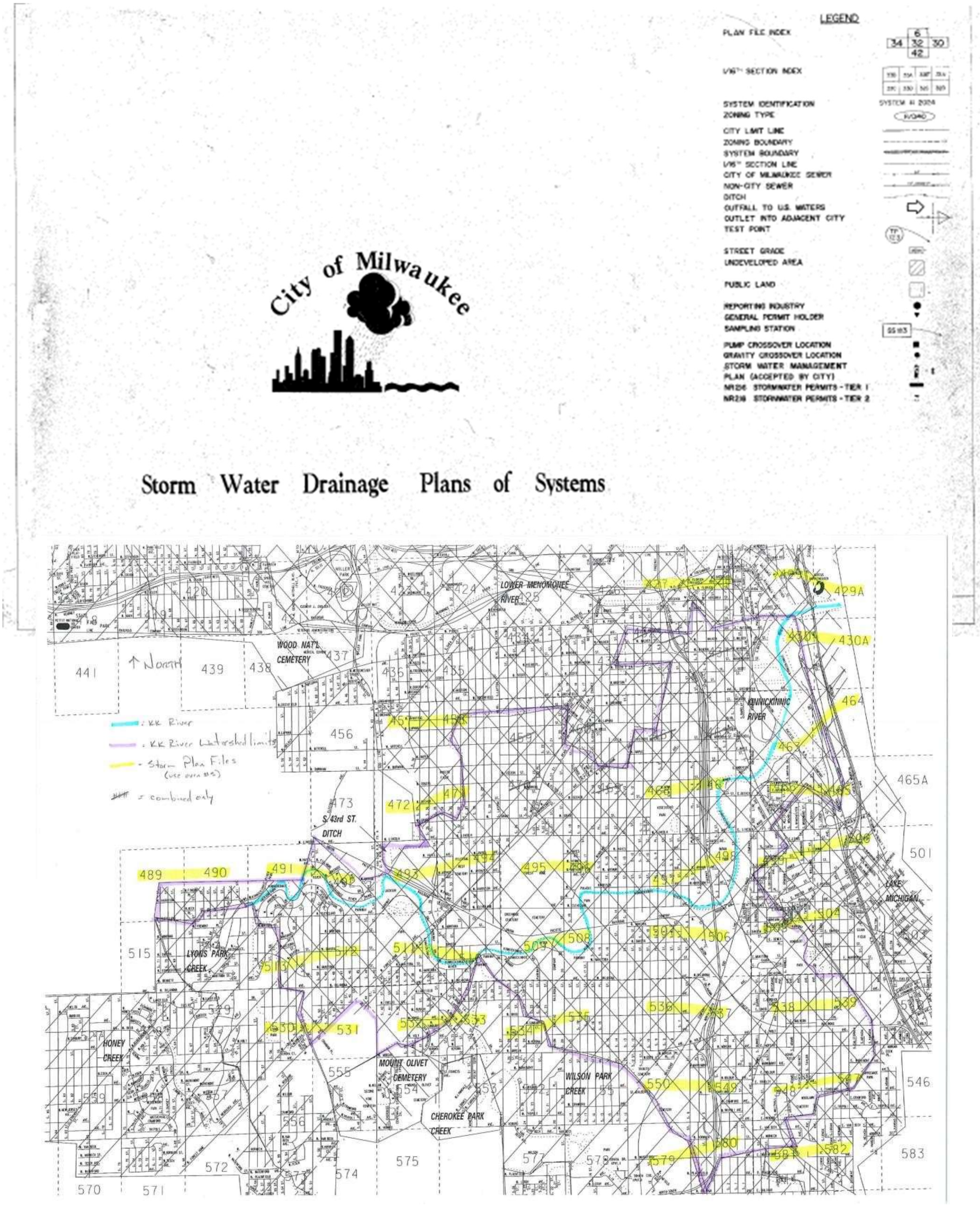


City of Cudahy Additional Storm Water basin Layton/Barnard/Sweet Applewood.

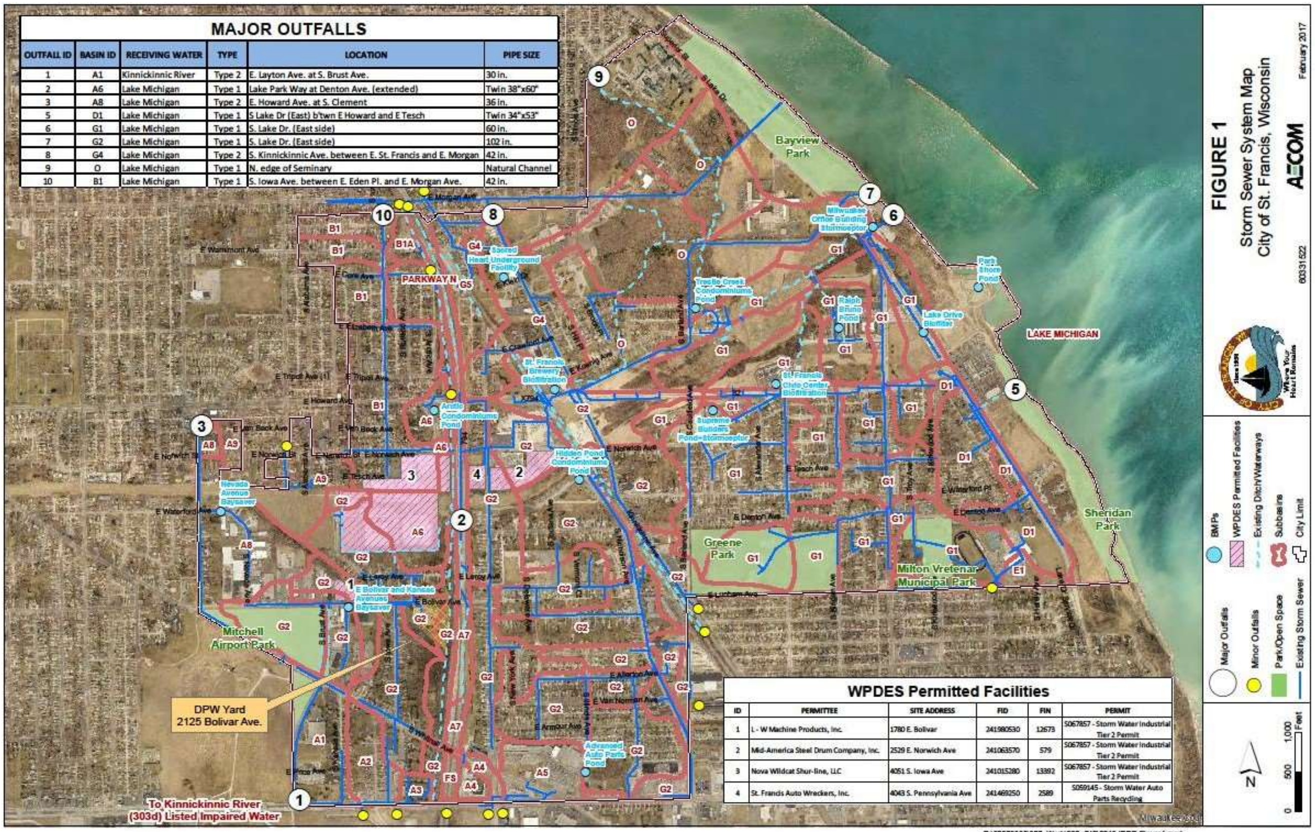
CITY OF GREENFIELD MS4 MAP



CITY OF MILWAUKEE MS4 MAP - KK WATERSHED



CITY OF ST. FRANCIS MS4 MAP



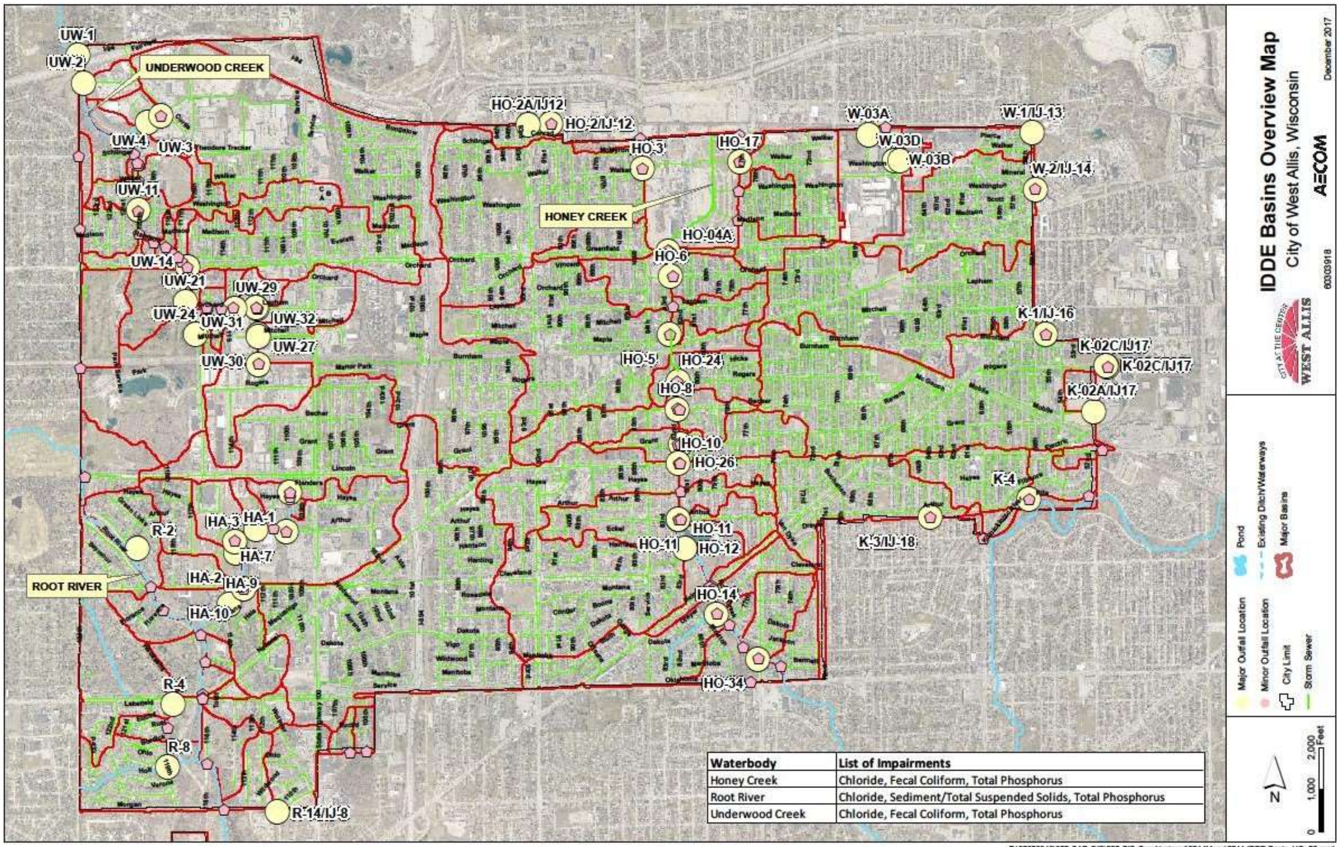
MAJOR OUTFALLS

OUTFALL ID	BASIN ID	RECEIVING WATER	TYPE	LOCATION	PIPE SIZE
1	A1	Kinnickinnic River	Type 2	E. Layton Ave. at S. Brust Ave.	30 in.
2	A6	Lake Michigan	Type 1	Lake Park Way at Denton Ave. (extended)	Twin 38"x60"
3	A8	Lake Michigan	Type 2	E. Howard Ave. at S. Clement	36 in.
5	D1	Lake Michigan	Type 1	S Lake Dr (East) b'twn E Howard and E Tesch	Twin 34"x53"
6	G1	Lake Michigan	Type 1	S. Lake Dr. (East side)	60 in.
7	G2	Lake Michigan	Type 1	S. Lake Dr. (East side)	102 in.
8	G4	Lake Michigan	Type 2	S. Kinnickinnic Ave. between E. St. Francis and E. Morgan	42 in.
9	O	Lake Michigan	Type 1	N. edge of Seminary	Natural Channel
10	B1	Lake Michigan	Type 1	S. Iowa Ave. between E. Eden Pl. and E. Morgan Ave.	42 in.

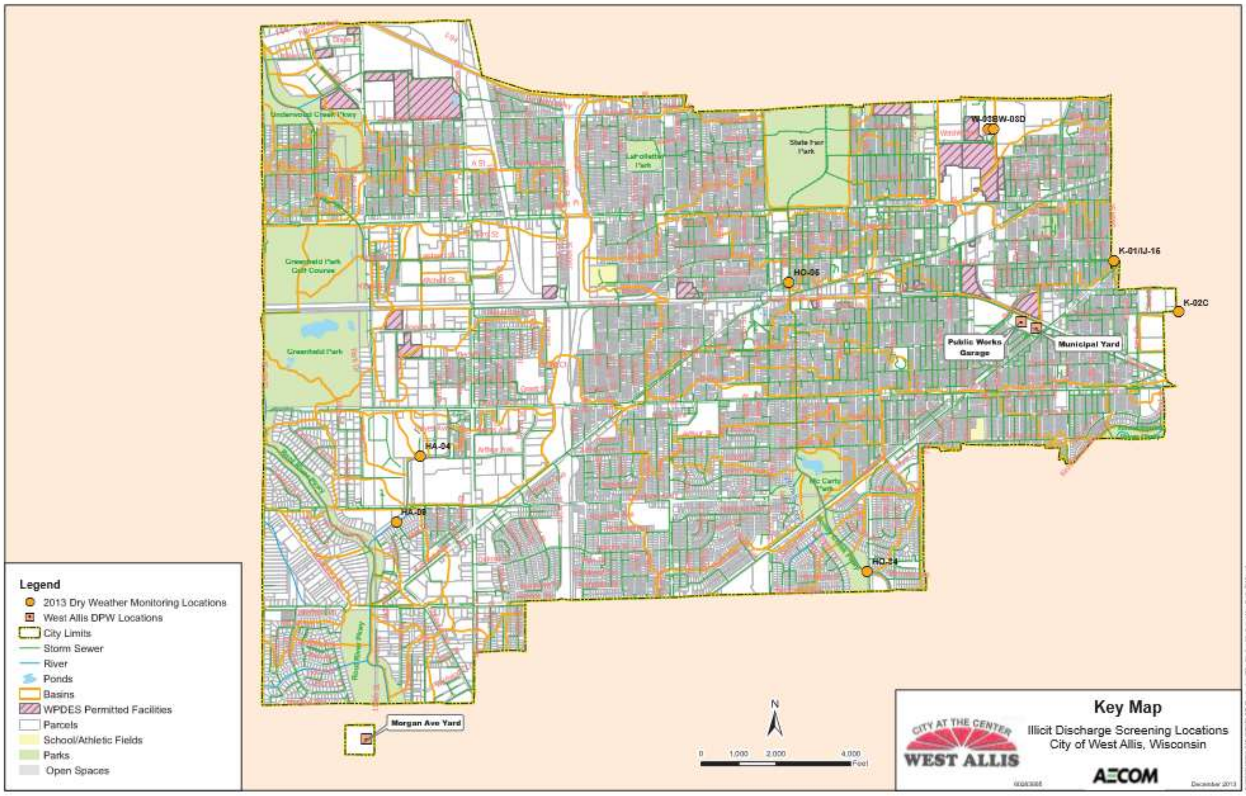
WPDES Permitted Facilities

ID	PERMITTEE	SITE ADDRESS	FID	FIN	PERMIT
1	L - W Machine Products, Inc.	1780 E. Bolivar	241980530	12673	S067857 - Storm Water Industrial Tier 2 Permit
2	Mid-America Steel Drum Company, Inc.	2529 E. Norwich Ave	241063570	579	S067857 - Storm Water Industrial Tier 2 Permit
3	Nova Wildcat Shur-line, LLC	4051 S. Iowa Ave	241015280	13392	S067857 - Storm Water Industrial Tier 2 Permit
4	St. Francis Auto Wreckers, Inc.	4043 S. Pennsylvania Ave	241469250	2589	S059145 - Storm Water Auto Parts Recycling

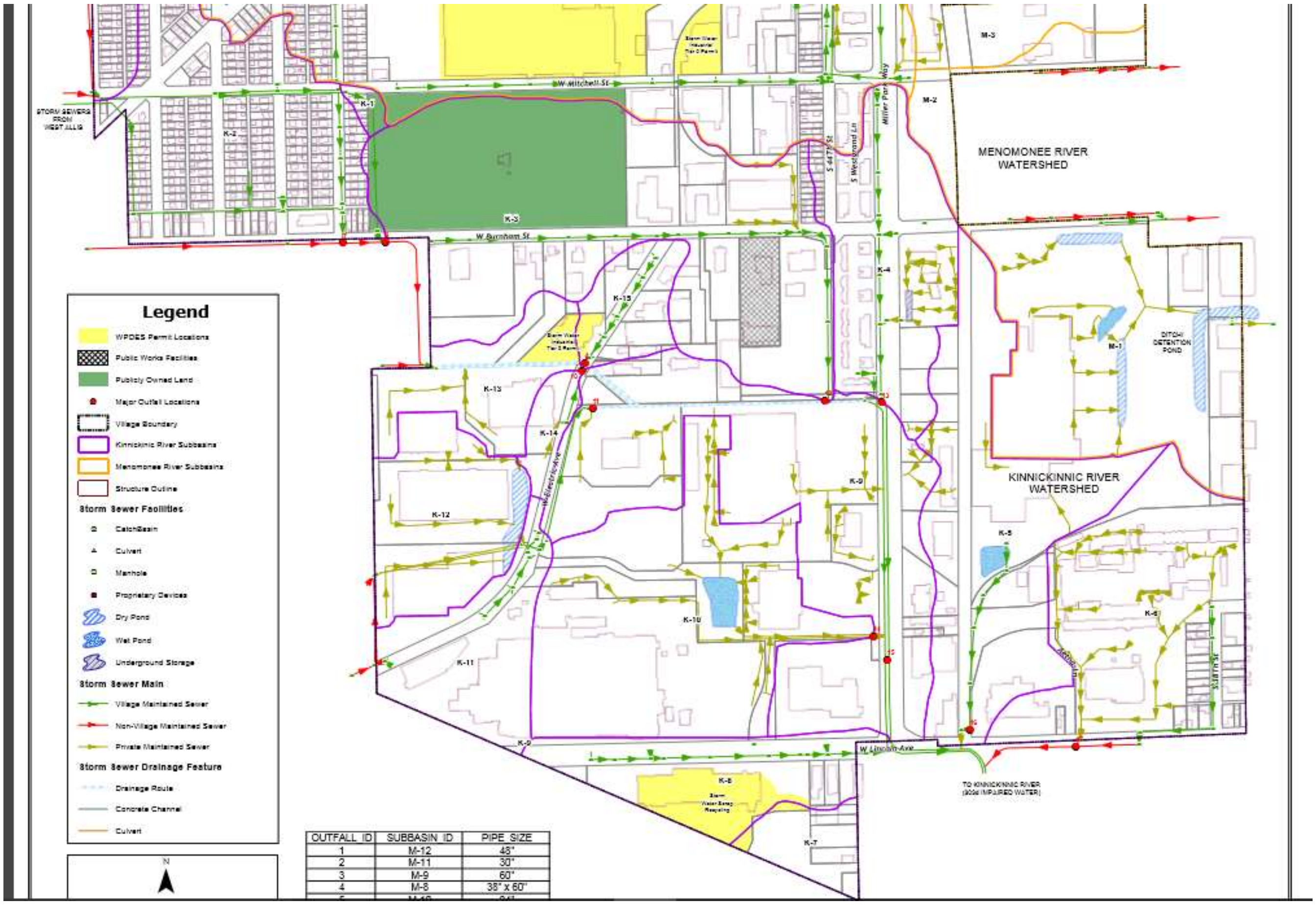
CITY OF WEST ALLIS MS4 MAP



CITY OF WEST ALLIS MS4 MAP II



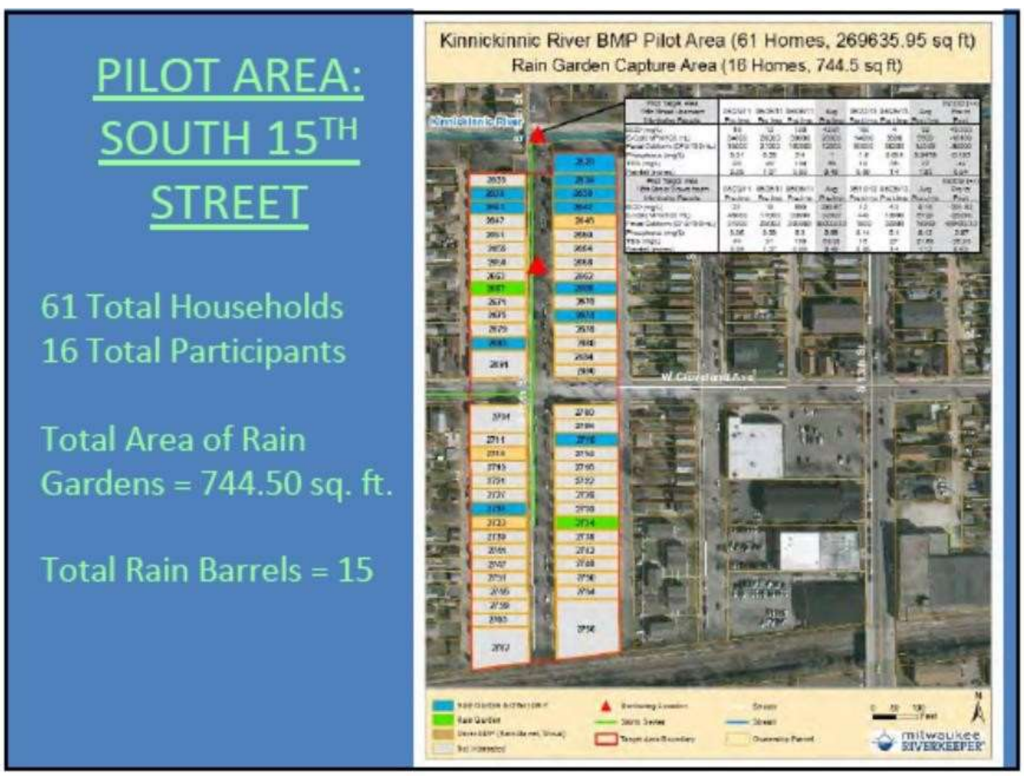
City of West Milwaukee MS4 Map



APPENDIX B. REACH DEFINITIONS CROSS REFERENCE MATRIX

TMDL Reference Reach	**Kinnickinnic Watershed Implementation Plan, SWWT**	**Kinnickinnic Watershed Restoration Plan and SWWT Green Infrastructure Hot Spot Analysis**	**SEWRPC Habitat Condition and Biological Assessment of Kinnickinnic and Menomonee River Watersheds**
KK1	KK-1	KK-1	KK-1
KK-2	KK-3	KK-3 and southern portion of KK-2	KK-3
KK-3	KK-2	Northern portion of KK-2	KK-2
KK-4	KK-4, KK-6 and KK-8	KK-4, KK-6 and KK-8	KK-4, KK-6, and KK-8
KK-5	KK-5	KK-5	KK-5
KK-6	KK-7	KK-7	KK-7
KK-7	KK-9 and KK-10	KK-9, KK-10 and KK-11	KK-10 and KK-11

Appendix C. Neighborhood GI Projects 14th - 16th Streets



Pilot Target Area – S 15th St

Pilot Target Area 15th Street Upstream Monitoring Results	05/23/11 Pre-Imp	05/25/11 Pre-Imp	06/06/11 Pre-Imp	Avg Pre-Imp	05/22/13 Post-Imp	06/25/13 Post-Imp	Avg Post-Imp	Inc/Dcr (+/-) Pre to Post
BOD (mg/L)	16	12	100	42.67	180	4	92	49.333
E-Coli (MPN/100 mL)	34000	20000	30000	28000	14000	5800	9900	-18100
Fecal Coliform (CFU/100 mL)	35000	21000	160000	72000	30000	38000	34000	-38000
Phosphorus (mg/L)	0.31	0.29	2.4	1	1.6	0.095	0.8475	-0.153
TSS (mg/L)	28	49	130	69	18	36	27	-42
Rainfall (inches)	0.05	1.37	0.05	0.49	0.66	1.4	1.03	0.54
Pilot Target Area 15th Street Downstream Monitoring Results	**05/23/11 Pre-Imp**	**05/25/11 Pre-Imp**	**06/06/11 Pre-Imp**	**Avg Pre-Imp**	**05/10/13 Post-Imp**	**06/25/13 Post-Imp**	**Avg Post-Imp**	**Inc/Dcr (+/-) Pre to Post**
BOD (mg/L)	21	18	590	209.67	12	4.3	8.15	-201.52
E-Coli (MPN/100 mL)	46000	17000	33000	32000	440	13000	6720	-25280
Fecal Coliform (CFU/100 mL)	31000	25000	200000	85333.33	1800	32000	16900	-68433.33
Phosphorus (mg/L)	0.35	0.33	8.3	2.99	0.14	0.1	0.12	-2.87
TSS (mg/L)	44	31	100	58.33	16	27	21.50	-36.83
Rainfall (inches)	0.05	1.37	0.05	0.49	0.83	1.4	1.12	0.63

Parameter	Site	Date	Result (CN/mL)
Human Bacteroides	FMRKK01	5/25/2013	2354
Human Bacteroides	FMRKK01	6/6/2011	2348

Water Quality Impact in Pilot Area

- Analysis:
  - Water quality improvements at both monitoring sites over the 2 year project period
  - Large reductions in bacteria and BOD
- Challenges or Special Considerations:
  - Plants' roots the most established since planting took place in 2011
  - Significantly increased rainfall during post-imp sampling did not influence improvements

Unique Characteristics

- First neighbors to participate; set a precedent
- BMP installation work involved community members and was "fun"
- Signage helps reinforce the message in the neighborhood

Neighborhood kids on S. 15th St. help the Green Team plant a rain garden

TARGET AREA #1: SOUTH 14TH STREET

38 Total Households
13 Total Participants

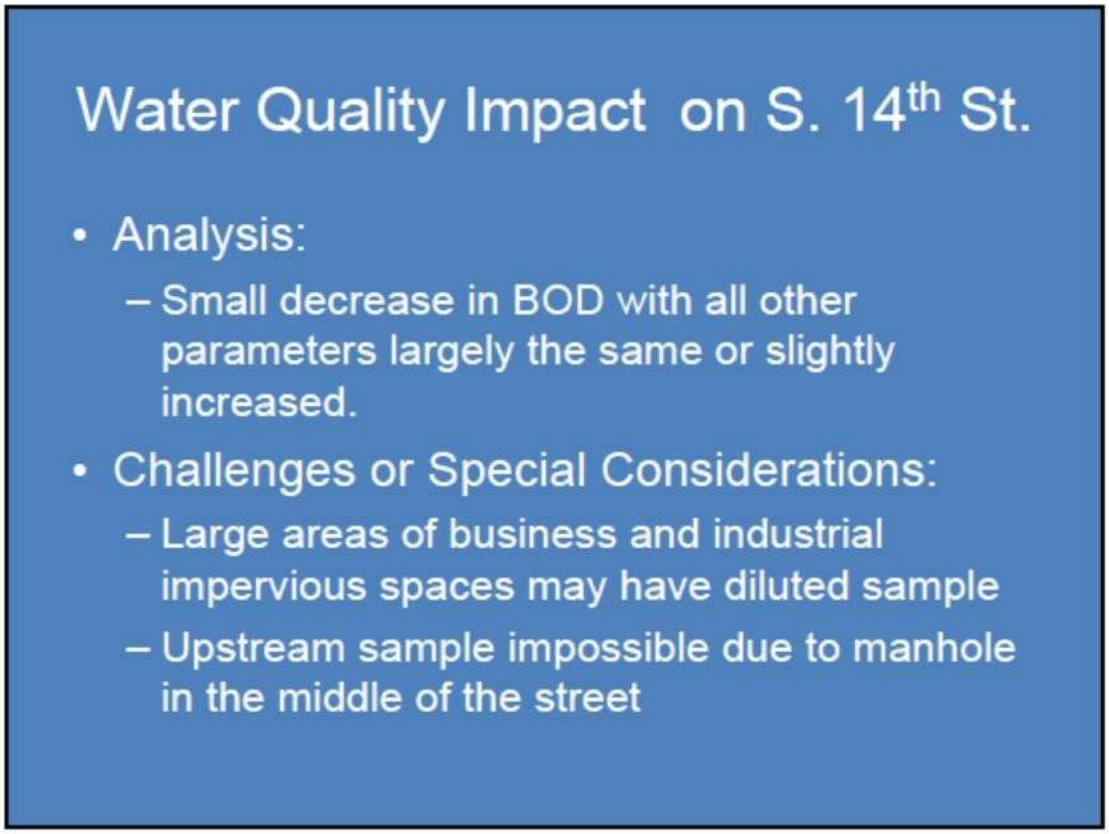
Total Area of Rain Gardens = 1,410 sq. ft.

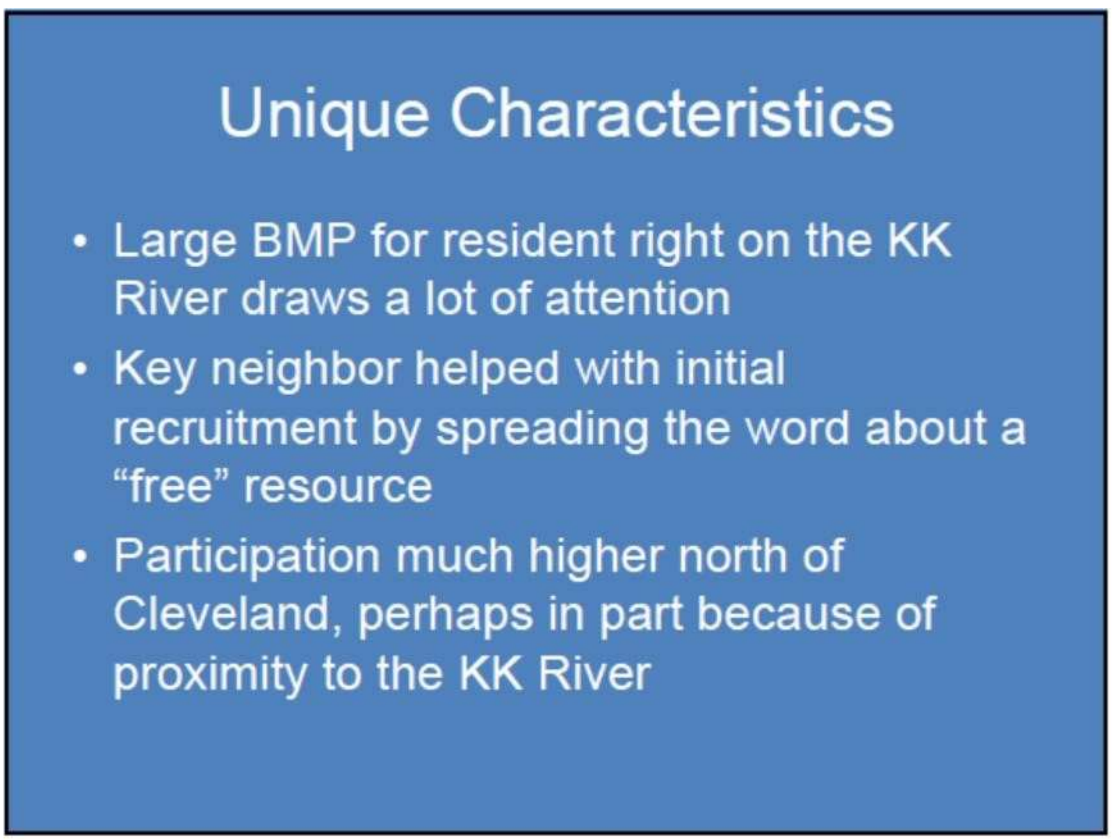
Total Rain Barrels = 12

Target Area 1 – S. 14th St

Target Area 1 14th Street Monitoring Results	9/26/11 Pre-Imp	9/27/11 Pre-Imp	Avg Pre-Imp	5/22/13 Post-Imp	6/26/13 Post-Imp	Avg Post-Imp	Inc/Dcr (+/-) Pre to Post
BOD (mg/L)	11	10	10.5	13	2	7.5	-3
E-Coli (MPN/100 mL)	3300	3600	3450	12000	1200	6600	3150
Fecal Coliform (CFU/100 mL)	12000	4300	8150	16000	2600	9300	1150
Phosphorus (mg/L)	0.085	0.042	0.0635	0.18	0.082	0.131	0.0675
TSS (mg/L)	5.2	1.7	3.45	14	5.6	9.8	6.35
Rainfall (inches)	0.57	0.12	0.345	0.66	0.31	0.485	0.14

Parameter	Site	Date	Result (CN/mL)
Human Bacteroides	FMRKK57	5/25/2013	Below Level of Detection


Water Quality Impact on S. 14th St.
• Analysis:
– Small decrease in BOD with all other parameters largely the same or slightly increased.
• Challenges or Special Considerations:
– Large areas of business and industrial impervious spaces may have diluted sample
– Upstream sample impossible due to manhole in the middle of the street


Unique Characteristics
• Large BMP for resident right on the KK River draws a lot of attention
• Key neighbor helped with initial recruitment by spreading the word about a "free" resource
• Participation much higher north of Cleveland, perhaps in part because of proximity to the KK River

The largest BMP on S. 14th St. is at the end of the block, where pedestrians walk along the River. A retaining wall was constructed due to the heavy slope of the property.

TARGET AREA #2: SOUTH 16TH STREET

26 Total Households
6 Total Participants

Total Area of Rain Gardens = 1,213 sq. ft.

Total Rain Barrels = 3

Target Area 2 – S. 16th St

Target Area 2 16th Street Downstream Monitoring Results	09/27/11 Pre-Imp	09/29/11 Pre-Imp	Avg Pre-Imp	05/10/13 Post-Imp	06/25/13 Post-Imp	Avg Post-Imp	Inc/Dcr (+/-) Pre to Post
BOD (mg/L)	10	24	17	94	4	49	32
E-Coli (MPN/100 mL)	5600	19000	12300	340	550	445	-11855
Fecal Coliform (CFU/100 mL)	7600	22000	14800	530	5600	3065	-11735
Phosphorus (mg/L)	0.089	0.41	0.2495	0.083	0.048	0.0655	-0.184
TSS (mg/L)	29	30	29.5	18	21	19.5	-10
Rainfall (inches)	0.12	0.19	0.155	0.83	1.4	1.115	0.96

Target Area 2 16th Street Upstream Monitoring Results	09/29/11 Pre-Imp	06/25/13 Post-Imp	Inc/Dcr (+/-) Pre to Post
BOD (mg/L)	24	4	-20
E-Coli (MPN/100 mL)	10000	1000	-9000
Fecal Coliform (CFU/100 mL)	22000	15000	-7000
Phosphorus (mg/L)	0.16	0.033	-0.127
TSS (mg/L)	18	4.5	-13.5
Rainfall (inches)	0.19	1.4	1.21

Parameter	Site	Date	Result (CN/mL)
Human Bacteroides	FMRKK59	5/25/2011	2639
Human Bacteroides	FMRKK59	6/6/2011	24229

Water Quality Impact on S. 16th

- Analysis:
  - Significant improvements in all parameters, with reduction of bacteria most significant and improvements in phosphorus and TSS.
  - Positive human bacteroides samples may be a sign of failing sewer pipes
- Challenges or Special Considerations:
  - Upstream sample was difficult to monitor due to very low flows during wet weather
  - Larger yards in a small drainage area

Unique Characteristics

- S. 16th St. a busy thoroughfare facing Pulaski Park
- Garbage, traffic and visibility factors
- Corner business participated hoping to attract attention
- Gardens serve to connect neighbors

This S. 16th St. property owner also agreed to host a weeding workshop as a way to meet his neighbors.

One enthusiastic participant wanted his entire yard to be a rain garden to avoid mowing and help protect the KK River.

TARGET AREA #3: LYONS PARK

41 Total Households
15 Total Participants

Total Capture of Rain Gardens = 2,910 sq. ft.

Total Rain Barrels = 20

Target Area 3 – Lyons Park Neighborhood

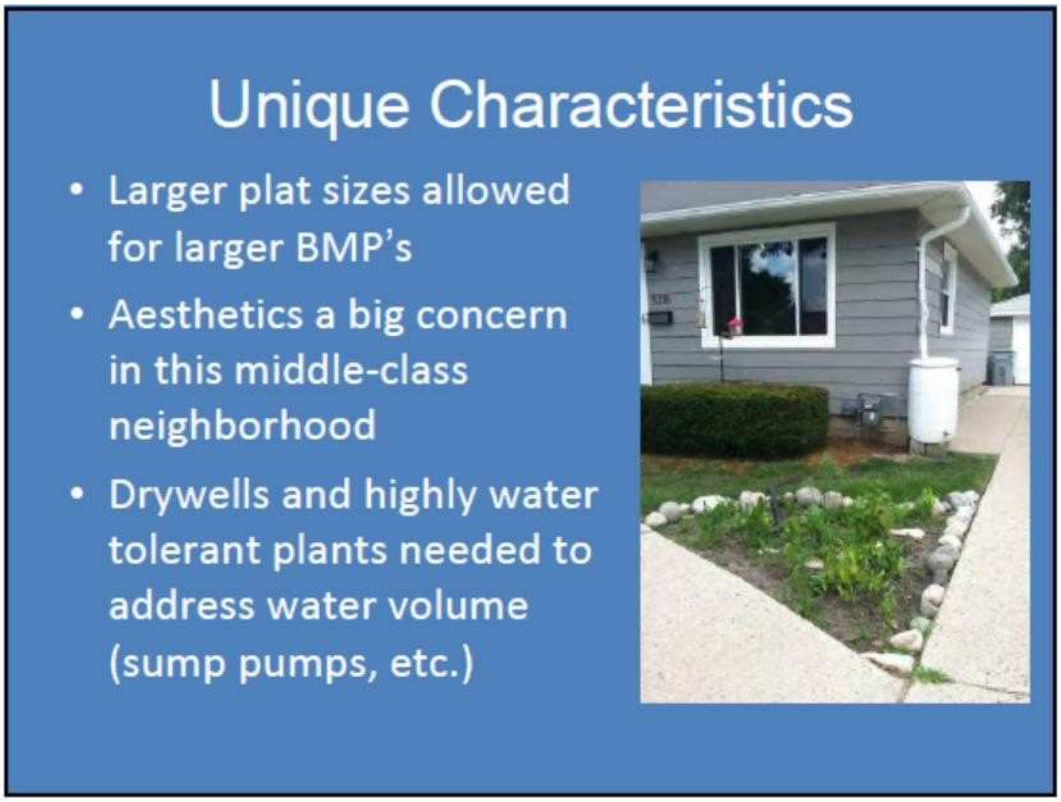
Target Area 3 Lyons Park Neighborhood Monitoring Results	05/31/12 Pre-Imp	07/03/12 Pre-Imp	Avg Pre-Imp	10/23/12 Post-Imp	05/10/13 Post-Imp	Avg Post-Imp	Inc/Dcr (+/-) Pre to Post
BOD (mg/L)	10	30	20	20	8.2	14.1	-5.9
E-Coli (MPN/100 mL)	1300	13	656.5	49000	2900	25950	25293.5
Fecal Coliform (CFU/100 mL)	12000	100	6050	54000	2200	28100	22050
Phosphorus (mg/L)	0.15	0.35	0.25	0.2	0.21	0.205	-0.045
TSS (mg/L)	3.2	1.3	2.25	5.7	26	15.85	13.6
Rainfall (inches)	0.23	0.07	0.15	0.06	0.83	0.445	0.295

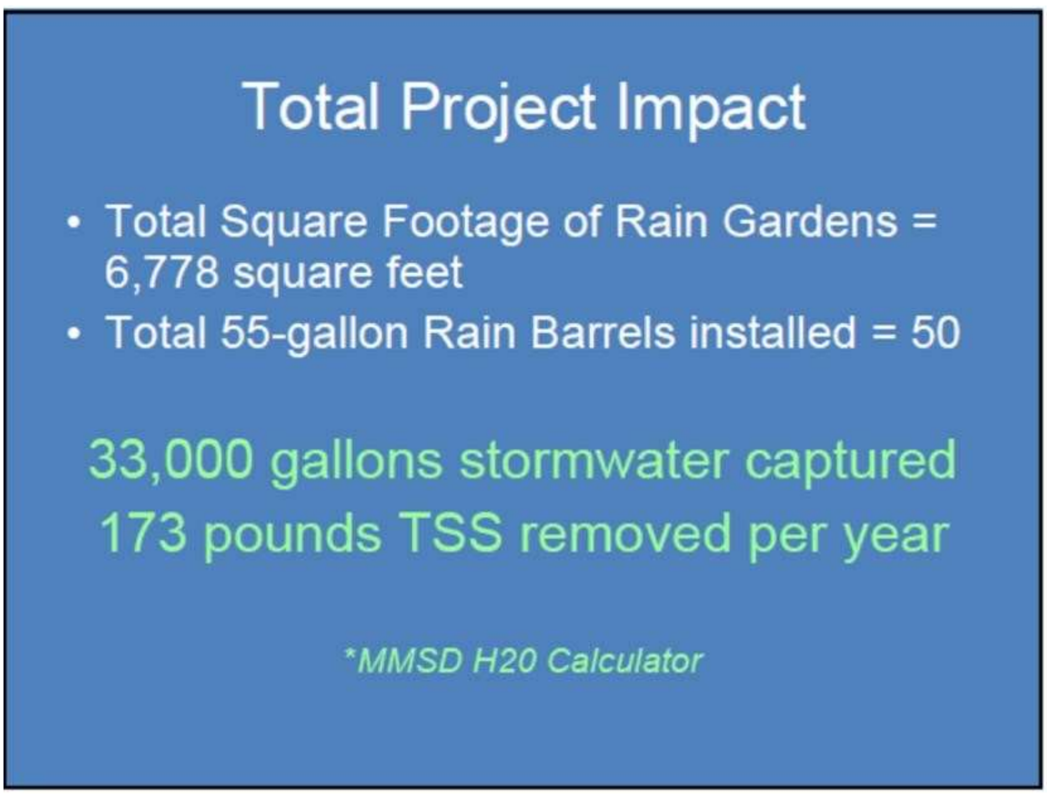
Parameter	Site	Date	Result (CN/mL)
Human Bacteroides	FMRKK60	6/21/2012	BLD

Water Quality Impact for Lyons Park

- Analysis:
  - Minor improvements in phosphorus and BOD, with fairly big increases for bacteria indicators.
- Challenges or Special Considerations:
  - Largest drainage area of project & about 3.5 miles upstream of the other 2 target areas
  - BMPs installed in late summer 2012 with sampling in fall 2012 and spring 2013
  - All samples taken during small storm events due to drought of 2012

Ownership change at this property led to an aesthetic concern with the new owner. After attending a weeding workshop where she learned more and met other neighbors who participated, the new owner requested more flowers and decided to keep the BMP.


Unique Characteristics
• Larger plat sizes allowed for larger BMP's
• Aesthetics a big concern in this middle-class neighborhood
• Drywells and highly water tolerant plants needed to address water volume (sump pumps, etc.)


Total Project Impact
• Total Square Footage of Rain Gardens = 6,778 square feet
• Total 55-gallon Rain Barrels installed = 50
33,000 gallons stormwater captured
173 pounds TSS removed per year
*MMSD H20 Calculator

APPENDIX D. PULASKI PARK NEIGHBORHOOD STORMWATER PLAN (EXCERPTS)

EXECUTIVE SUMMARY

The Pulaski Park Neighborhood is located on Milwaukee's South Side and is home to over 18,000 residents living in just under two square miles. The Kinnickinnic River runs through this community and is beginning to be seen as an asset in part due to large scale channel restoration being undertaken by the Milwaukee Metropolitan Sewerage District. The channel restoration has opened the doors for partners to develop the Pulaski Park Neighborhood Stormwater Plan that identifies complementary projects that will:

- Help reduce the risk of flooding
- Improve water quality
- Improve aquatic and terrestrial habitat
- Assist municipalities in meeting regulatory requirements

What makes this project unique is the collaboration of community, public, and private sector partners who have been working together since 2012. The plan identifies opportunities to revitalize Pulaski Park and address other community needs related to health, housing, and environmental education. This plan was developed with public, private, non-profit, and resident partners in order to identify:

- The most cost effective types and locations of green infrastructure
- How green infrastructure implementation can be leveraged to achieve additional triple bottom line goals
- A comprehensive plan that meets multiple stakeholder goals and can be implemented in a phased approach
- How partners can work together to meet stormwater management and community goals in a more financially effective and impactful way.

Recommendations listed in this plan include:

212,117 square feet of permeable pavement
44,591 square feet of bioswales and biofiltration basins
30 stormwater trees
16,000 square feet of rain gardens
12,655 gallons of rainwater harvesting

The implementation of the above recommendations would result in a 50% reduction of total suspended solids, a capture of 45% of the volume associated with the first half inch of rain, and 42% reduction in phosphorus.

Recommendations listed in this plan have already begun to move forward and full implementation will result in substantial improvements in water quality, reductions in stormwater quantity entering the sewer system and river, a community that understands the challenges and opportunities in their neighborhood, and government agencies better positioned to meet regulatory goals. This plan is intended to be replicated to the degree possible in other parts of the watershed and throughout southeastern Wisconsin in order to support collaborative approaches to stormwater management and creative approaches to neighborhood revitalization.

Thank you to all of the people who have provided input into the development and implementation of this plan!

NEIGHBORHOOD BACKGROUND

The Kinnickinnic River neighborhood is a diverse and vibrant community on Milwaukee's south side. The boundaries of the neighborhood extend from S. 27th Street to Interstate 43/94 and W. Oklahoma Avenue to W. Lincoln Avenue. The neighborhood has a population of 18,280 residents in 5,378 households living in under two square miles. Of these households, 71 percent are Latino and 38 percent of residents are under the age of 19. Homeownership is approximately 67 percent and the average household income is $32,030 per year.[1]

The neighborhood is named after the Kinnickinnic River, or "KK River," one of three rivers that flow into the Milwaukee River Estuary and Lake Michigan harbor. The KK River drains a watershed that covers 25 square miles, and is the smallest within the Milwaukee River Basin. The area surrounding the river is the most urbanized and densely populated of all of the Milwaukee rivers and has experienced significant flooding events over the years. Since the 1960s, the river has been lined with concrete starting near Interstate 43/94 as a solution to minimize flooding in the surrounding neighborhoods. Flooding persists however, and safety has become a significant concern given the high velocity water that results during storms in the concrete-lined riverbed.

Through substantial community engagement efforts, residents are in a position to scale up commitments to environmental education, stewardship, and community ownership of green infrastructure projects in the neighborhood. Currently there are 65 property owners in the KK River neighborhood that contribute to these stormwater efforts many of which are along S. 16th Street, facing Pulaski Park. These efforts include a total of 3,868 square feet of rain gardens, 140 rain barrels and 13 stormwater shrubs. This is significant as these efforts work in tandem with the Milwaukee Metropolitan Sewerage District's (MMSD) Kinnickinnic River Flood Management Project; supports City of Milwaukee, Milwaukee County and regional plans; helps address regulatory relief; trains residents on how and why to manage stormwater; and illustrates the need and impact of cross jurisdictional collaboration. SSCHC has been working to support these initiatives to ensure that improvements in quality of life and health outcomes are also achieved in addition to flood management goals.

1 Information from 2010 census

Figure 1. City of Milwaukee and project area context.

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EXISTING ENVIRONMENTAL CONDITIONS

As part of this plan, the City of Milwaukee performed WinSLAMM analysis for the proposed green infrastructure elements listed on page 14. This analysis not only gives information on the existing water quality and quantity issues, but also shows the predicted environmental outcomes of implementing specific green infrastructure within the three zones. The modeling output for each subarea includes the following:

- TSS Reduction
- Phosphorus Reduction
- Volume Reduction (based on the average annual rainfall)
- Volume Reduction (based on the first 1/2" of rainfall)

Existing conditions show a total of over 35,000 pounds of TSS enters the sewer system or KK River untreated. The long term vision of the Pulaski Park Neighborhood Stormwater Plan, which includes the total buildout of multiple green infrastructure elements, results in a 50% reduction in TSS, 42% phosphorus reduction, capturing of 45% of the volume associated with the of the first half inch of rainfall, and 20% reduction of average annual rainfall directly entering the storm sewer or KK River. Pages 22-27 show greater detail for the three subareas.

What's WinSLAMM?

WinSLAMM (Source Loading and Management Model for Windows) is the only Urban Stormwater Quality Model that evaluates runoff volume and pollution loading for each source area within each land use for each rainfall event. It does not lump impervious areas together nor does it lump all the areas in a single land use together. Evaluation at the source area level allows stormwater quality professionals to target the highest loading areas and recommend improvements to reduce runoff volume and pollution loading from those areas.

WinSLAMM can be used to answer questions such as:

- How effective are stormwater control measures in reducing runoff and pollutant loadings?
- What are the most cost-effective solutions for meeting urban stormwater quality objectives?
- What type of, and how big should, stormwater control measures be and where should they be located?

www.winslamm.com

	Land Use Totals	Building	Parking	Driveway	Sidewalk	Street	Alley	Landscape	
Total Acres	90.09	26.51	6.66	0.8	4.08	14.18	2.6	34.93	Land Use Area
Percent Area	100%	29%	7%	1%	5%	16%	3%	39%	
TSS - total lbs:	35,300	5,800	6,500	654	1,500	14,900	2,246	3,700	TSS
Percent TSS:	100%	17%	18%	2%	4%	6%	42%	11%	
Phos. - total lbs:	84	18	7	2	4	31	6	16	Phosphorus
Percent Phos.	100%	21%	8%	2%	5%	37%	7%	20%	
Total volume cf:	5,181,000	2,550,200	470,200	62,874	322,200	1,283,500	231,426	260,600	Volume (avg. annual)
Percent volume	100%	49%	9%	1%	6%	25%	5%	5%	
Total volume cf:	100,112	47,623	12,081	1,448	7,409	25,732	5,324		Volume (1st 1/2")
Percent volume	100%	48%	12%	2%	7%	26%	5%		

Figure 14. Table showing the existing output data according to land use.

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INTERVENTION SUMMARY

	Land Use Totals	Building	Parking	Driveway	Sidewalk	Street	Alley	Landscape	
Total Acres	90.09	26.51	6.66	0.8	4.08	14.18	2.6	34.93	Land Use Area
Percent Area	100%	29%	7%	1%	5%	16%	3%	39%	
TSS - total lbs:	35,300	5,800	6,500	654	1,500	14,900	2,246	3,700	TSS
Percent TSS:	100%	17%	18%	2%	4%	6%	42%	11%	
Total lbs out:	17,600								
% reduction:	50%								
Phos. - total lbs:	84	18	7	2	4	31	6	16	Phosphorus
Percent Phos.	100%	21%	8%	2%	5%	37%	7%	20%	
Total lbs out:	48								
% reduction:	42%								
Total volume cf:	5,181,000	2,550,200	470,200	62,874	322,200	1,283,500	231,426	260,600	Volume (avg. annual)
Percent volume	100%	49%	9%	1%	6%	25%	5%	5%	
Total volume cf out:	4,220,000								
% reduction:	20%								
Total volume cf:	100,112	47,623	12,081	1,448	7,409	25,732	5,324		Volume (1st 1/2")
Percent volume	100%	48%	12%	2%	7%	26%	5%		
total volume cf out:	55,035								
% reduction:	45%								

Figure 16. December 2014 WinSLAMM table showing the overall TSS, phosphorus, and volume reduction numbers for the entire project area.

TSS Reduction
50%

Phosphorus Reduction
42%

Volume Reduction (avg. annual)
20%

Volume Reduction (1st 1/2")
45%

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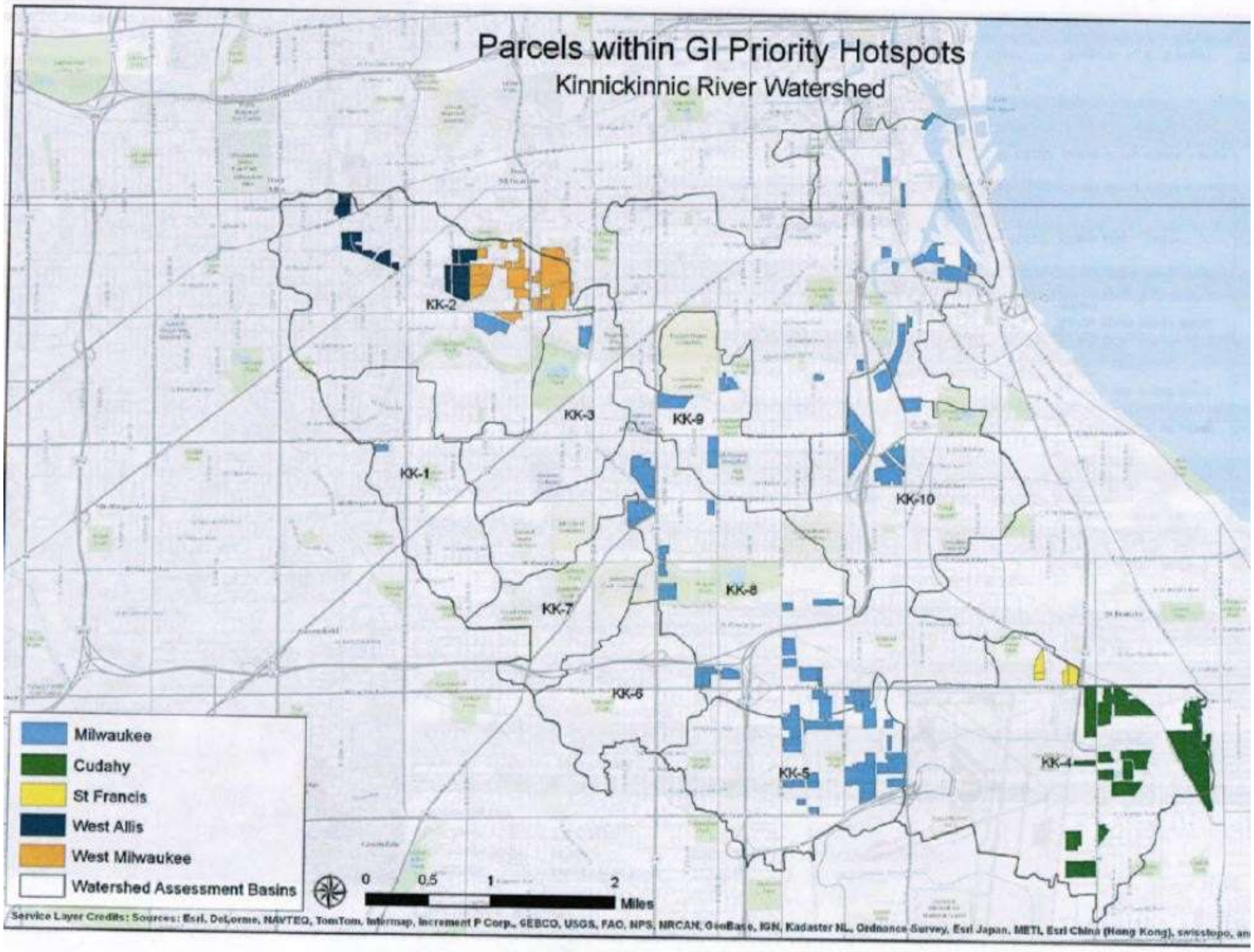
Appendix E. GI Priority Hotspot Analysis – SWWT 2013



Priority Hotspots by Municipality

Equivalent Runoff Unit (ERU) - area varies by municipality, as listed

Cudahy KK-4

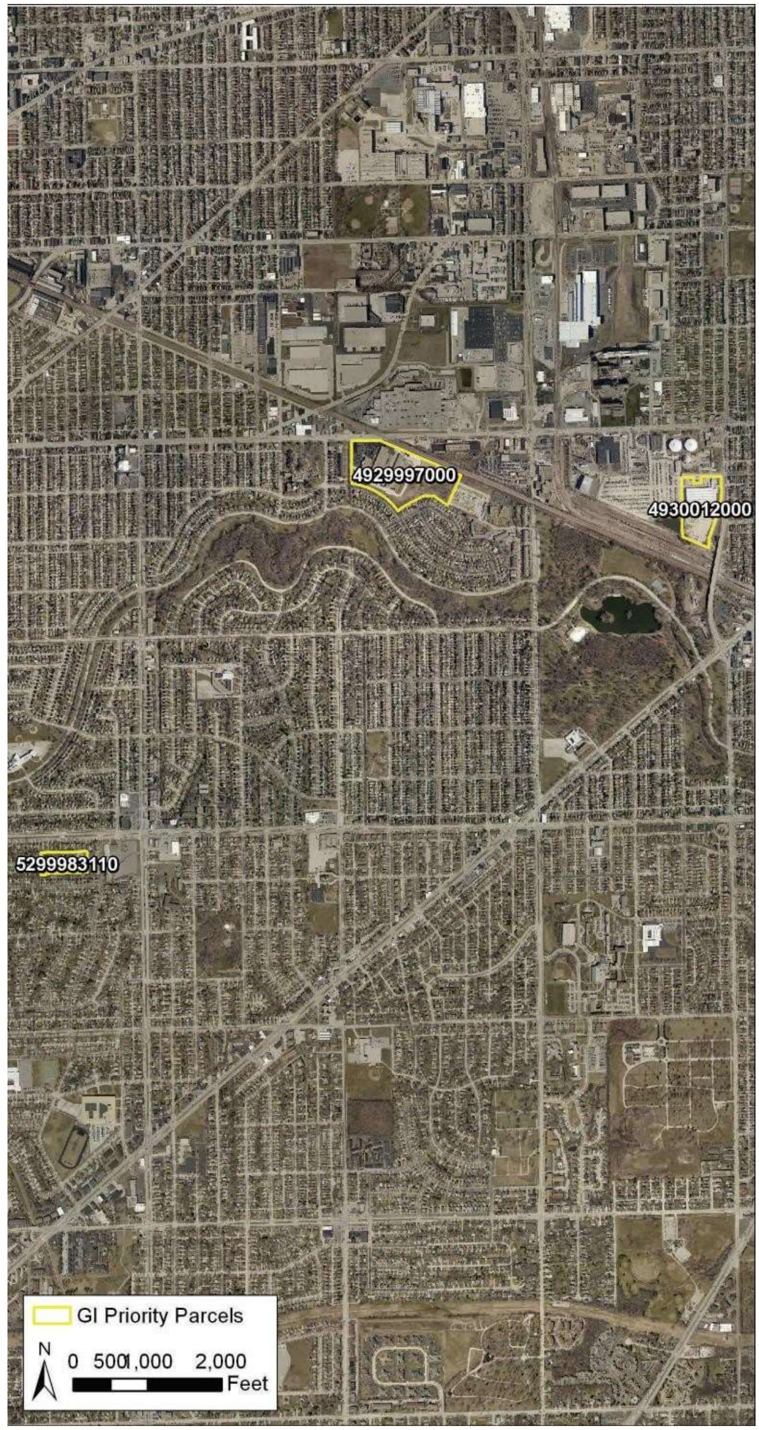
1 ERU = 2700 Square Feet

Taxkey	Comments	Parcel Address	ERU
6299995000	Vacant lot as of 2013 photo	4701 S PENNSYLVANIA AVE	648
6309929006	Vegetation along N and E	4850 S PENNSYLVANIA AVE	199
6309929017	Grass near parking, pond	4900 S PENNSYLVANIA AVE	105
6309954000	Grass in SE	4825 S WHITNALL AVE	458
6309957007	Grass in SE	4801 S WHITNALL AVE	52
6309963001	Grass bordering parking	2727 E LAYTON AVE	175
6309963003	Grass bordering parking	2525 E LAYTON AVE	108
6310114009	Parking for 6319977003	4860 SWEET APPLEWOOD LN	116
6319976000	Rail yard, gravel, no vegetation	5000 S WHITNALL AVE	197
6319977003	Grass and pond in SE	ONE SWEET APPLEWOOD LN	700
6369998001	Large complex, all paved	5481 S PACKARD AVE	892
6379992002	Grass along edges, berms	5300 INTERNATIONAL DR	282
6379995013	Large grass areas along edges	5255 INTERNATIONAL DR	116
6379995016	Grass along edges	5235 INTERNATIONAL DR	167
6379999001	Large grass areas along edges	2401 E EDGERTON AVE	123
6379999002	Grass strips along edges	5120 INTERNATIONAL DR	104
6379999005	Grass strips, bushes, pond	5140 INTERNATIONAL DR	237

Milwaukee KK-1/2/3

ERU = 1610 Square Feet

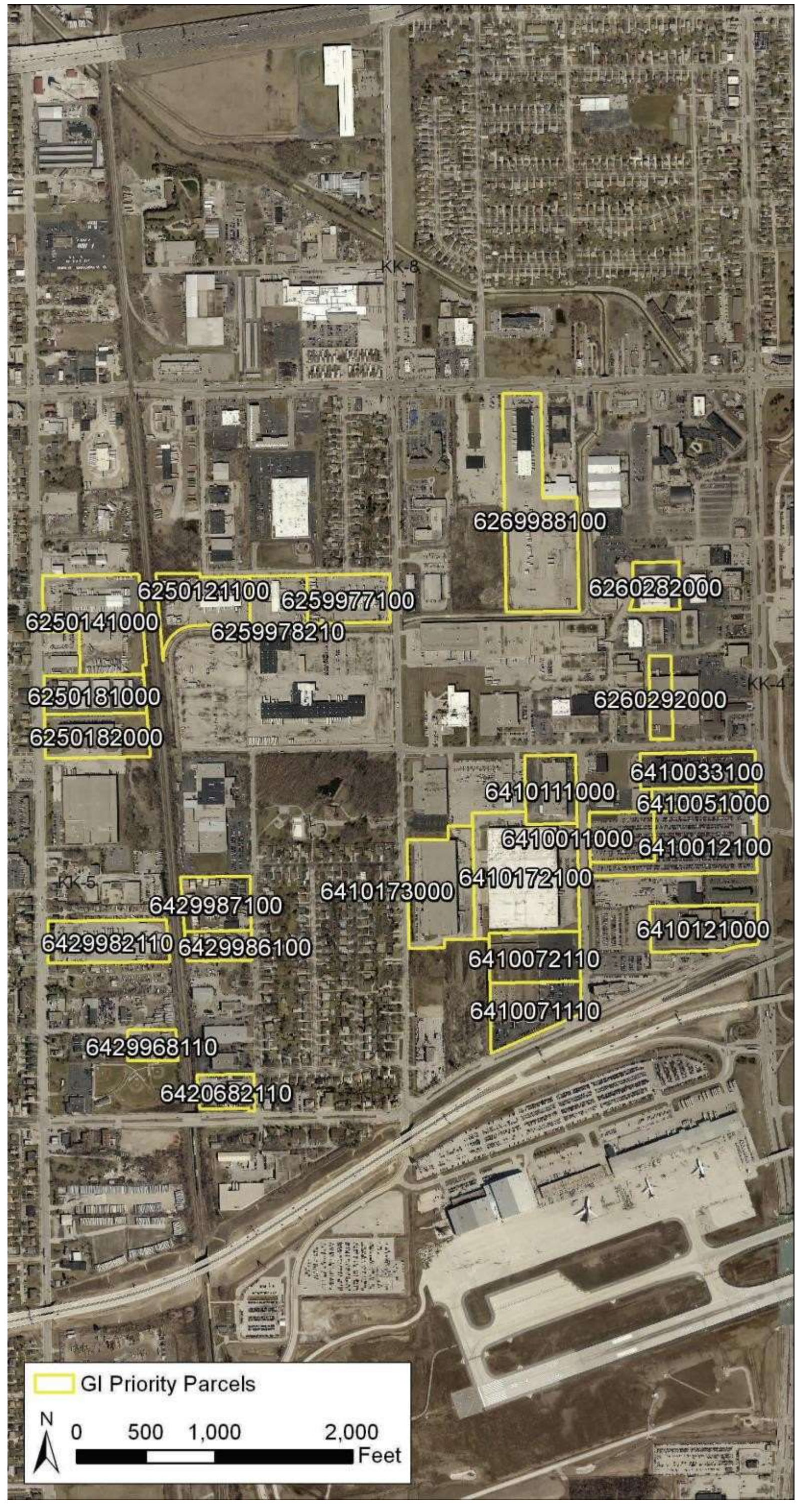
Taxkey	Parcel Address	ERU
4929997000	2300 S 51ST ST	269
4930012000	2425 S 35TH ST	222
5299983110	6333 W LAKEFIELD DR	50



Milwaukee KK-5

ERU = 1610 Square Feet

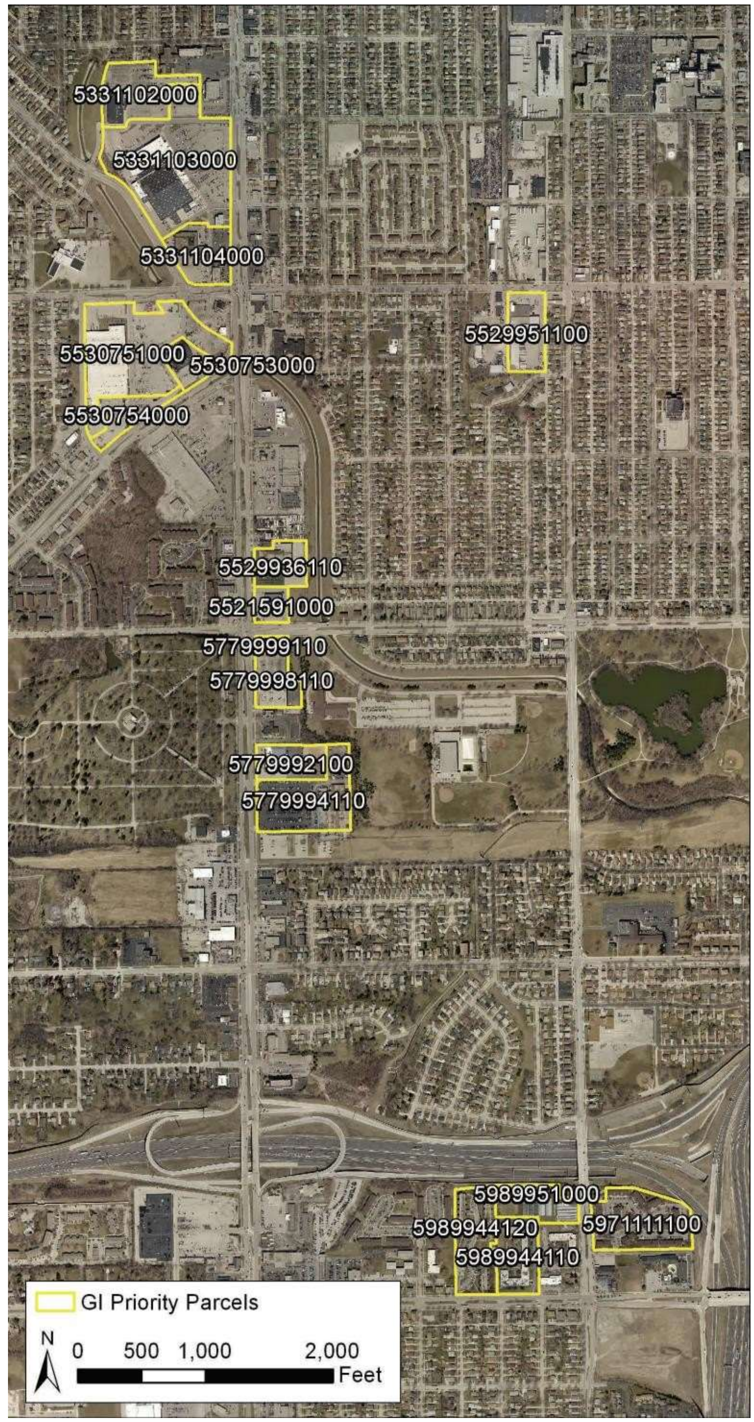
Taxkey	Parcel Address	ERU
6250121100	909 W CARPENTER AVE	131
6250141000	4924 S 13TH ST	222
6250181000	5000 S 13TH ST	109
6250182000	5050 S 13TH ST	78
6259977100	4939 S 6TH ST	124
6259978210	819 W CARPENTER AVE	89
6260282000	4930 S 2ND ST	71
6260292000	150 W EDGERTON AVE	60
6269988100	401 W LAYTON AVE	370
6410011000	5220 S 3RD ST	72
6410012100	5201 S HOWELL AVE	238
6410033100	5105 S HOWELL AVE	127
6410051000	5151 S HOWELL AVE	75
6410071110	5319 S 3RD ST	142
6410072110	5315 S 3RD ST	135
6410111000	5131 S 3RD ST	101
6410121000	5311 S HOWELL AVE	121
6410172100	5211 S 3RD ST	338
6410173000	5170 S 6TH ST	201
6420682110	5467 S 9TH ST	51
6429968110	1101 W MALLORY AVE	50
6429982110	5282 S 13TH ST	118
6429986100	5311 S 9TH ST	60
6429987100	5223 S 9TH ST	99



Milwaukee KK-8 (1 of 2)

ERU = 1610 Square Feet

Taxkey	Parcel Address	ERU
5331102000	3300 S 30TH ST	133
5331103000	3355 S 27TH ST	406
5331104000	3473 S 27TH ST	116
5521591000	3860 S 27TH ST	72
5529936110	3804 S 27TH ST	84
5529951100	2101 W MORGAN AVE	107
5530751000	3545 S 27TH ST	368
5530753000	3555 S 27TH ST	67
5530754000	3565 S 27TH ST	421
5779992100	4040 S 27TH ST	88
5779994110	4100 S 27TH ST	202
5779998110	3920 S 27TH ST	86
5779999110	3904 S 27TH ST	74
5971111100	4568 S 20TH ST	151
5989944110	2126 W LAYTON AVE	62
5989944120	2220 W LAYTON AVE	81
5989951000	4569 S 20TH ST	50



Milwaukee KK-8 (2 of 2)

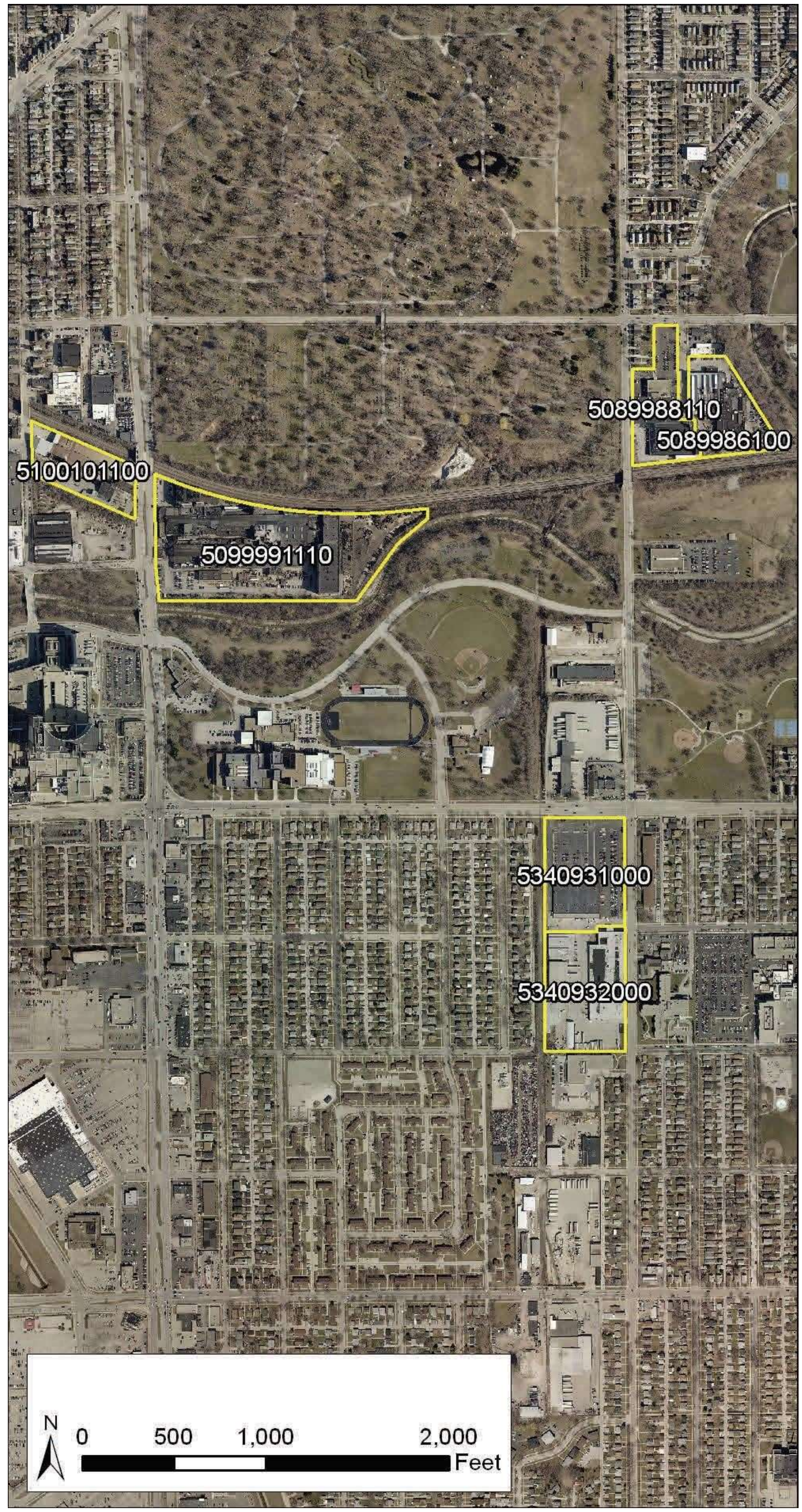
ERU = 1610 Square Feet

Taxkey	Parcel Address	ERU
5790011110	4157 S 6TH ST	115
5799951000	4160 S 13TH ST	74
5960041100	900 W LAYTON AVE	73
5960091000	999 W ARMOUR AVE	264
5969960100	4524 S 13TH ST	116
5969964100	4446 S 13TH ST	66
5969994100	4400 S 13TH ST	91
6250151000	801 W LAYTON AVE	225
6250171000	909 W LAYTON AVE	54
6250202000	841 W LAYTON AVE	57
6259981100	4866 S 13TH ST	83
6259982100	4828 S 13TH ST	70
6260341000	545 W LAYTON AVE	93
6269986000	517 W LAYTON AVE	162

Milwaukee KK-9

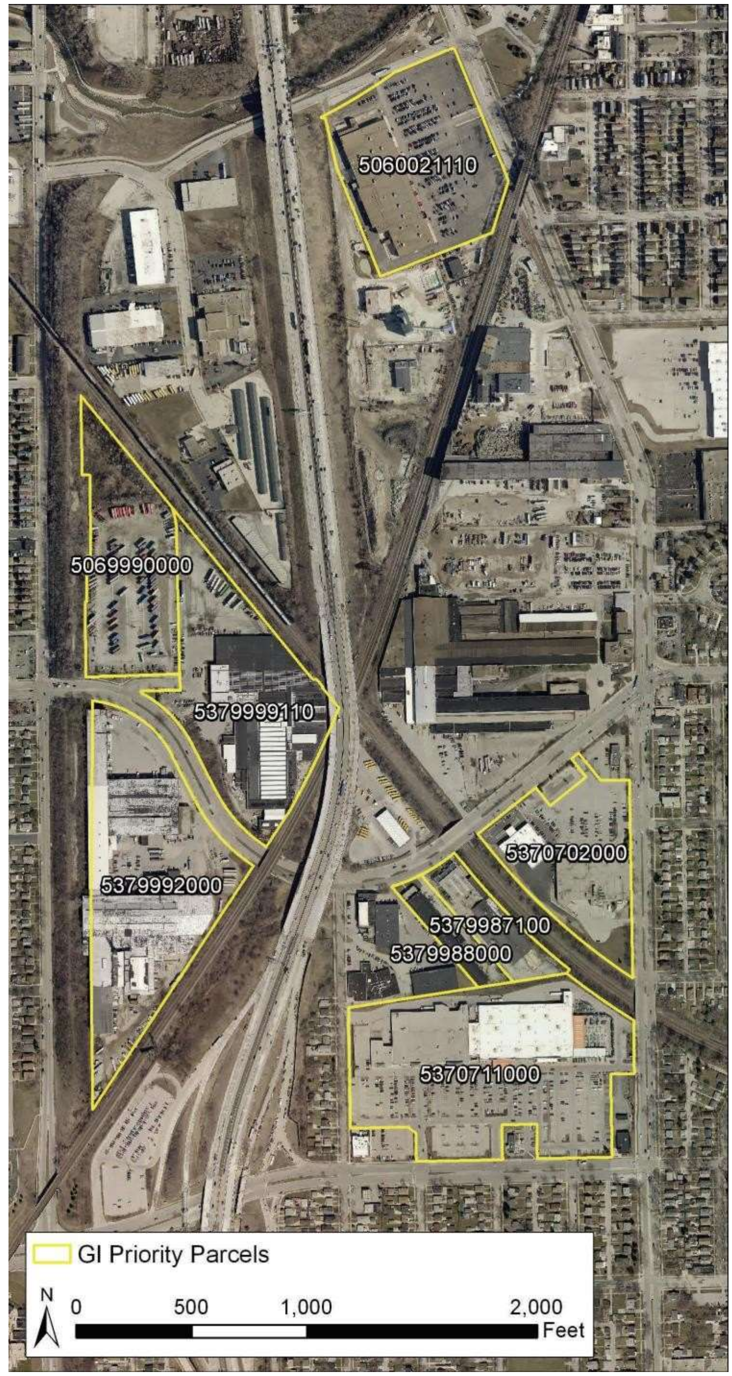
ERU = 1610 Square Feet

Taxkey	Parcel Address	ERU
5089986100	2730 S 19TH ST	110
5089988110	2740 S 20TH ST	107
5099991110	2856 S 27TH ST	377
5340931000	2005 W OKLAHOMA AVE	142
5340932000	3137 S 20TH ST	154
5100101100	2776 S 29TH ST	99



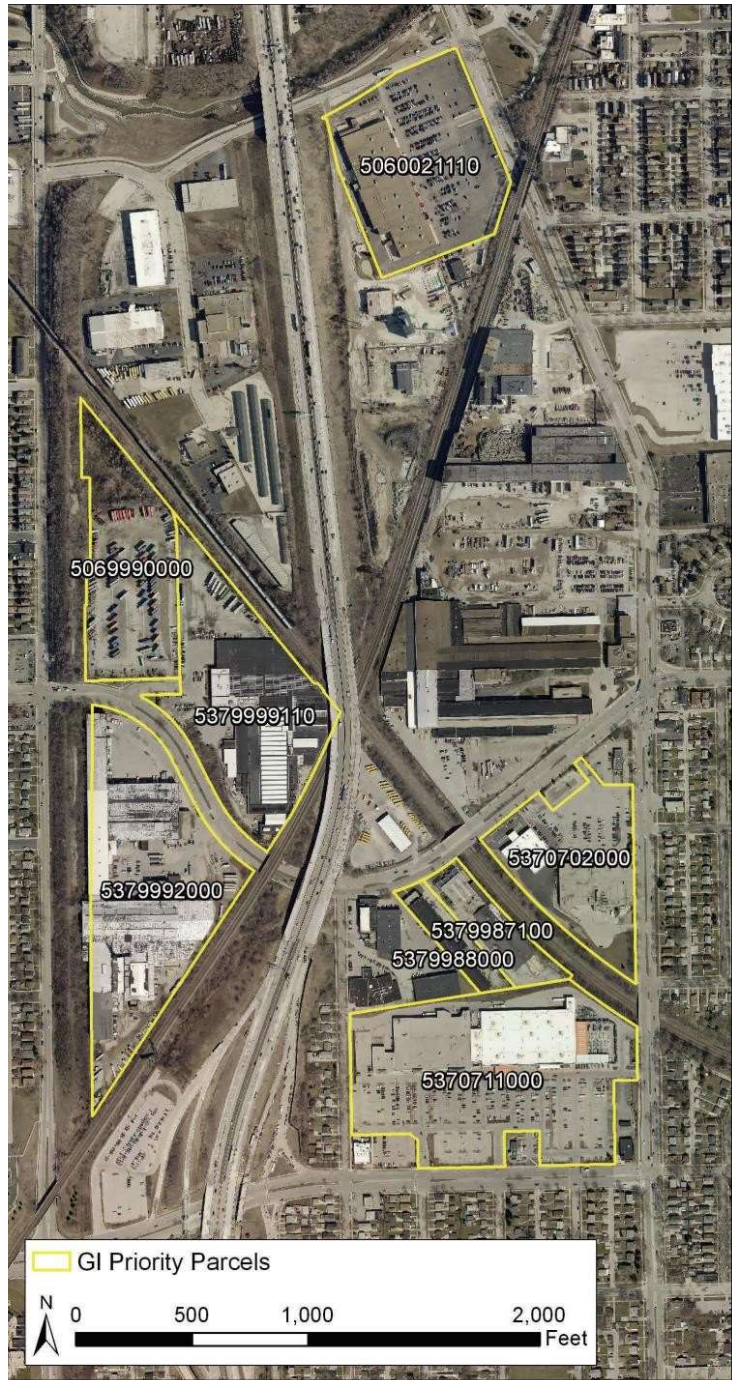
Milwaukee KK-10

ERU = 1610 Square Feet



Milwaukee KK Outside Assessment Area

ERU = 1610 Square Feet



Taxkey	Parcel Address	ERU
4290040100	700 S WATER ST	104
4310429100	136 W GREENFIELD AVE	192
4620348100	1500 S BARCLAY ST	90
4659999110	2021 S LENOX ST	83
4660201100	427 E STEWART ST	370
4661106100	2008 S KINNICKINNIC AVE	58
4661601000	1982 S HILBERT ST	249
4670101110	2018 S 1ST ST	60
4679992230	1933 S 1ST ST	101
4980323210	2636 S 5TH ST	75
4981721000	2650 S CHASE AVE	177
4990252110	2375 S BURRELL ST	56
5051127100	2950 S CHASE AVE	188
5071312100	2742 S 9TH PL	56

St. Francis KK-4

ERU = 2500 Square Feet

Taxkey	Comments	Parcel Address	ERU
5920005002	Grass & trees in E and W sides	4630 S BRUST AVE	59
5929928002	Large grass areas in N and S	4550 S BRUST AVE	68
5920051003	Large parking lot with grass strips	2000 E LAYTON AVE	88
5929876001	Grass between buildings & parking	4561 S WHITNALL AVE	121

West Allis KK-2

ERU = XX

Taxkey	Comments	Parcel Address	ERU
4530001005	Grass strips along edges	6767 W GREENFIELD AVE	62
4530001008	Berms, trees in parking lot	6760 W NATIONAL AVE	256
4530776003	Buildings cover almost all of parcel	1706 S 68TH ST	203
4540255001	Small plantings near parking in NE	1745 S 66TH ST	176
4740001000	Small grass area in NE	5317 W BURNHAM ST	93
4740002001	Vacant lot as of 2013 photo	5017 W BURNHAM ST	242
4740002002	Narrow grass strips in E and W	2005 S 54TH ST	180
4740004001	Grass along edges and in center	5121 W ROGERS ST	252
4740542000	Grass surrounding parking lots	2160 S 54TH ST	190
4740542000	Grass in E and W	2100 S 54TH ST	97
4740542000	Grass along edges	6525 W BURNHAM ST	81
4740542000	Grass & gravel in SE	1903 S 62ND ST	181
4740542000	Grass & gravel in NE	6048 W BELOIT RD	50

West Milwaukee KK-2

ERU = XX

Taxkey	Comments	Parcel Address	ERU
4361122004	Grass in S near parking	4600 W BURNHAM ST	54
4361127001	Grass bordering parking	4500 W BURNHAM ST	73
4571006005	Berms in parking lot	2086 MILLER PARK WAY	58
4571008009	Large grass areas	4101 W BURNHAM ST	584
4571009002	Small grass area in SE	4100 W LINCOLN AVE	151
4571020001	Large grass area in S	3830 W GRANT ST	448
4571043003	Gravel, no vegetation	4777 W LINCOLN AVE	192
4731007001	Grass along northern edge	4415 W BURNHAM ST	156
4731020000	Grass along northern edge	4915 W BURNHAM ST	103
4731022002	Grass along N, E, & W	4800 W ELECTRIC AVE	109
4731022003	Grass in N and E	4740 W ELECTRIC AVE	107
4731022004	Large grass area in E	4900 W ELECTRIC AVE	174
4731022005	Grass along SE	5000 W ELECTRIC AVE	142
4731028001	Grass in SE, berms w/ trees	2230 MILLER PARK WAY	76
4731035009	Grass in SE, stream adjacent	4701 W ELECTRIC AVE	58
4731039000	Grass bordering parcel, berms	2101 MILLER PARK WAY	397
4731041000	Grass bordering parcel, berms	2201 MILLER PARK WAY	167

West Milwaukee

Appendix F. Partnering Organizations

Partnering Organizations
1000 Friends of Wisconsin
City of Cudahy
City of Greenfield
City of Milwaukee
City of South Milwaukee
City of St. Francis
City of West Allis
Clean Wisconsin
Environmental Collaboration Office - City of MKE
FEMA
Gateway to Milwaukee
Graef USA
Groundwork Milwaukee
Harbor District, Inc.
Milwaukee County
Milwaukee County Parks
Milwaukee Metropolitan Sewerage District
Milwaukee Riverkeeper
RA Smith International
River Revitalization Foundation
Sixteenth Street Community Health Centers
Southeast Wisconsin Watersheds Trust
Southeastern Wisconsin Regional Planning Commission
Stormwater Solutions Engineering
Urban Ecology Center
US Army Corps of Engineers
US Department of Agriculture
US Geological Survey
US National Park Service
UW-Milwaukee
Village of West Milwaukee
Wisconsin Department of Natural Resources

APPENDIX G. KINNICKINNIC WATERSHED FLOOD MANAGEMENT PLAN PROJECT COMPONENTS (EXCERPTS FROM PLAN)

WATERWAY	COMPONENT	DESCRIPTION*
Kinnickinnic River Mainstem	Channel and Floodplain Improvements	Stabilize and enhance 500 feet of channel upstream of South 43rd Street
		Relocate and reconstruct 2,800 feet of channel through Jackson Park with relocated drop structure
		Remove 4,350 feet of concrete lining and expand overbank storage between Jackson Park and South 27th Street
		Remove 10,900 feet of concrete lining, naturalize channel and expand overbank storage from South 27th Street to South 6th Street
		South 43rd Street - Increase capacity to 58' bridge span or equivalent flow area (existing: 22' bridge span)
		Remove 700 feet of culverts that enclose waterway in Jackson Park
		Kinnickinnic Parkway bridge – increase capacity with expanded channel capacity and raised bridge deck (by 29th Street)
		Remove abandoned railroad abutments (by 16th Street)
		West Cleveland Avenue - increase channel capacity below existing bridge deck to provide an additional 230 sq. ft. of hydraulic opening area
		Pulaski Park pedestrian bridge span increase from 56' to 130'
		South 16th Street – increase bridge span to 135' for 90% increase in hydraulic opening or equivalent capacity (existing 62' bridge span')
		South 15th Street pedestrian bridge span increase from 62' to 140' to accommodate the wider channel.
		South 13th Street - increase bridge span to 122' for 140% increase in hydraulic opening or equivalent capacity (existing span 62')
		South 11th Street pedestrian bridge span increase from 62' to 145' to accommodate the wider channel.
		South 9th Place - increase bridge span to 132' for 219% increase in hydraulic opening or equivalent capacity (existing span 62')
		South 8th Street pedestrian bridge removal or increase span from 68' to 195' to accommodate the wider channel.
	Storage Facility	Jackson Park storage improvements including lowered lagoon
	Voluntary Floodproofing or Acquisitions	3 structures on West Kinnickinnic Pkwy between West Sumac Place and West Montrose Avenue
		3 structures between South 31st Street and South 33rd Street
		7 structures between South 6th Street and South 13th Street

WATERWAY	COMPONENT	DESCRIPTION*
		South 5th Street – increase capacity to three 14' x 10'culverts or equivalent flow area (existing two 12.6' x 10' culverts)
		South 6th Street – increase capacity by adding three 12.5' x 10' bypass culverts or equivalent flow area (existing two 12.5' x 10'
Lyons Park Creek	Channel and Floodplain Improvements	Concrete lining removal and overbank storage expansion for 650 feet between South 57th Street and West Lakefield Drive
		Concrete lining removal and channel reconstruction for 2,200 feet from West Bennett Avenue to West Cleveland Avenue
		Concrete lining for 280 feet and install grade control structures downstream of West Cleveland Avenue
	Bridge/Culvert Improvements	South 57th Street – increase capacity to 19' x 6' culvert or equivalent flow area (existing 9' x 5' culvert)
		West Oklahoma Avenue – add bypass culverts comprised of 560 feet of twin 8-foot by 5-foot culverts and 150 feet of 12' x 6' culvert or equivalent flow area (existing 11' x 7' culvert)
		West Stack Drive – increase capacity to bridge span of 40 feet (existing culvert 12.5-foot by 7.9-foot pipe arch)
		West Cleveland Avenue – increase capacity to two 10' x 8' culverts or equivalent flow area (existing 10' x 6' culvert)
Villa Mann Creek	Channel and Floodplain Improvements	Concrete lining removal and channel reconstruction for 2,640 feet upstream of West Bolivar Avenue to confluence with Wilson Park Creek**
	Bridge/Culvert Improvements	Install 1,340 feet of 8' x 5' concrete bypass culvert next to the existing 9.7'x5' S. 27th St culvert on the Villa Mann Creek Tributary
Wilson Park Creek	Channel and Floodplain Improvements	Concrete lining removal and channel reconstruction for 4,050 feet from railroad east of GMIA to West Howell Avenue
		Concrete lining removal and channel reconstruction for 4,700 feet from West Layton Avenue to Canadian Pacific Railroad (CPRR) at I-94
		Concrete lining removal and channel reconstruction for 700 feet from CPRR to Wilson Park
		Concrete lining removal and channel reconstruction for 4,320 feet from South 20th Street to South 27th Street
		Concrete lining removal and channel reconstruction for 1,930 feet from West Morgan Avenue to West Euclid Avenue

APPENDIX H. GREEN INFRASTRUCTURE STRATEGIES AND COSTS AT CITY, NEIGHBORHOOD AND WATERSHED SCALES

Green Infrastructure Strategies and Costs at City, Neighborhood, and Watershed Scales

Source	Green Infrastructure Strategy	Stand-Alone Cost (per Square Foot unless indicated)	Sources for Stand-Alone Cost Estimates	Non-Green Infrastructure Cost (per Square Foot)	Incremental Cost (per Square Foot)	Capacity/Units at Full Implementation	Stand-alone Cost at Full Implementation	Annual O&M Cost
2015 Milwaukee Green Infrastructure Baseline Study (GIBI)	BIORETENTION/BIOSWALE	$24.00	Average of Philadelphia Water Dept. (PWD) and SUSTAIN model (Determining the Potential of Green Infrastructure to Reduce Overflows in Milwaukee, MMSD, 2011)	$7.20	$16.80	6.6 million sf[1] (*includes rain gardens)	$111.2 million[1]	$16.5 million[1]
GIBI	CISTERN (1000 gallon)	$5000 each unit	$5/gallon: middle of Fresh Coast Green Solutions (FCGS, City of Milwaukee, 2009) range for 1000-gallon cistern	$500.00	$4,500.00	473 units[1]	$2.4 million[1]	–
GIBI	GREEN ROOF	$11.50	Median PWD cost	$6.55	$4.95	15.2 million sf[1]	$174.8 million[1]	–
GIBI	NATIVE LANDSCAPING	$0.11	Middle of FCGS Range rounded up to nearest $1000	$0.04	$0.07	87.6 million sf[1]	$9.6 million[1]	–
GIBI	POROUS PAVEMENT	$10.00	$10 per square foot, approximately 90% of median PWD costs.	$3.00	$7.00	12.1 million sf[1]	$121.1 million[1]	–
GIBI	RAIN BARREL (55 gallon)	$120 each unit	Middle of FCGS range rounded up to nearest $10	$12.00	$108.00	35,568 units[1]	$4.3 million[1]	–
GIBI	RAIN GARDEN	$10.00	Middle of FCGS range rounded up to $10 per square foot	$3.00	$7.00	(*included in bioretention above)[1]	(*included in bioretention above)[1]	–
GIBI	SOIL AMENDMENTS	$0.11	Middle of FCGS range rounded up to nearest $1000	$0.04	$0.07	154.9 million sf[1]	$17 million[1]	–
GIBI	STORMWATER TREE	$250 each tree	FCGS	$125.00	$125.00	172,692 units[1]	$43.2million[1]	–
2015 Pulaski Park Green Infrastructure Plan (PPGIP)	RAIN BARREL	$80 - $120 each unit	MMSD, USEPA, WDNR, GRAEF	–	–	6,328 gallons[2]	$11,505[2]	–
PPGIP	CISTERN	$1,000 - $10,000 each unit	MMSD, USEPA, WDNR, GRAEF	–	–	6,328 gallons[2]	$31,640[2]	–
PPGIP	RAIN GARDEN	$5 - $10	MMSD, USEPA, WDNR, GRAEF	–	–	16,000 sf[2]	$80,000-$160,000[2]	–
PPGIP	STORMWATER TREE	$200 - $340	MMSD, USEPA, WDNR, GRAEF	–	–	30 units[2]	$6,000-$10,200[2]	–
PPGIP	POROUS PAVEMENT	$9-$12	MMSD, USEPA, WDNR, GRAEF	–	–	212,117 sf[2]	$1.9-$2.5 million[2]	–
PPGIP	BIOSWALE	$5-$15	MMSD, USEPA, WDNR, GRAEF	–	–	22,296 sf[2]	$111,480-$334,440[2]	–
PPGIP	DEEP SUMP BASIN	$2,000-$3,000 each unit	MMSD, USEPA, WDNR, GRAEF	–	–	Included in Biofiltration below	Included in Biofiltration below	–
PPGIP	BIOFILTRATION BASIN	$5 - $15	MMSD, USEPA, WDNR, GRAEF	–	–	22,296 sf[2]	$111,480-$334,440[2]	–
PPGIP	TURF W/DRAINAGE SYSTEM	$7-$10	MMSD, USEPA, WDNR, GRAEF	–	–	Included in Biofiltration above	Included in Biofiltration above	–
2013 MMSD Green Infrastructure Plan (GIP)	BIORETENTION/RAIN GARDEN	$10-$24	FCGS, MMSD (2011)	–	–	3.3 million sf[3]	$43-$45 million total[3] (2016-2035)	–
MMSD GIP	STORMWATER TREE	$250 each tree	FCGS	–	–	10 new trees/city block[3]	$10 million total[3] (2016-2035)	–
MMSD GIP	POROUS PAVEMENT	$10.00	PWD	–	–	1,210 city blocks[3]	$43-$45 million total[3] (2016-2035)	–
MMSD GIP	SOIL AMENDMENT/RAIN BARREL/CISTERN/NATIVE LANDSCAPING	–	FCGS	–	–	200 city blocks soil amendment/17,100 rain barrels/200 cisterns/200 city blocks native landscaping[3]	$8 million total[3] (2016-2035)	–
MMSD GIP	GREEN ROOF	$11.50	PWD	–	–	1,000[3]	$36 million total[3] (2016-2035)	–

1 City of Milwaukee (all watersheds)
2 Pulaski Park (in TMDL reach KK-7)
3 Kinnickinnic River Watershed

APPENDIX I. MONITORING METHODOLOGY

Per WisCALM recommendation, data collected will be representative of current water quality conditions and from a wide range of weather and flow conditions. Monitoring for the Plan will include:

1. annual sampling dates spread over representative seasonal periods and,
2. samples collected under a wide range of weather conditions.

TOTAL PHOSPHORUS

Water quality sampling follows WDNR's protocols that address seasonality, timing and frequency of sample collection. Protocols are based on USGS development of the TP criteria [s. NR 102.06(3) Wis.Adm. Code]. Waters are sampled monthly over a 6-month period from May through October, approximately 30 days apart. If samples are missed, samples collected in different months over multiple years may be combined to create a complete annual data set. Where multiple years of data are available, the three most recent years of data are used. Study-specific or targeted sampling are not appropriate for assessment of attainment of the applicable TP water quality criterion. Appropriate statistical approaches are employed as outlined in WDNR 2015 to achieve a 95% confidence interval around the mean for water quality assessment.

TOTAL SUSPENDED SOLIDS

No sampling standards or Water Quality criteria are found for streams in WISCALM guidance. As such, total suspended solids will be monitored indirectly through turbidity testing conducted by Milwaukee Riverkeeper.

FECAL COLIFORM

Fecal Coliform monitoring is a time intensive and costly endeavor. For the purposes of The Plan, the following sample design for fecal coliform monitoring and analysis is presented:

Sample Design
Select surface water and stormwater outfall grab samples are collected from the Menomonee River (N:5) and Kinnickinnic River (N:4) and Milwaukee River (N:1). A total of 10 samples will be collected during dry weather and wet weather conditions (weather permitting) at the locations specified in the maps below. Samples sites were selected based on previous work conducted by the Milwaukee River Keepers (MRK), Milwaukee Metropolitan Sewerage District (MMSD) and the McLellan Lab (Great Lakes Water Institute). Samples will be collected five (5) times each month over the period of three (3) select months (April, July, October) to monitor seasonal fluctuations. Select samples will be collected from upgradient surface water samples, source area "hot-spot" samples from select outfalls identified in the 2009 McLellan Report and downgradient samples at the confluence of the two rivers.

Sample Collection
Samples will be collected using a surface water sample collection chamber, a 20 foot metal pole with an adjustable arm and a 500mL Nalgene sample bottle attached to the end, and transported in a clean 1L Nalgene bottle. Bottle will be rinsed 2-3 times at each station prior to final sample collection. Sample collection chamber will be rinsed between each sample collection with DI/MQ water. Free flowing surface water samples will be collected from the area adjacent to the suspected source area (i.e. stormwater outfall, point-source discharge location). Samples will be place in a cooler on ice or held at 4º C until laboratory analysis is performed. Samples will be labeled with sample location (i.e. watershed denomination Menomonee (MN-), Kinnickinnic (KK-), Milwaukee (MKE-)), location number, flow condition (i.e. wet weather (W), dry weather (D) and sample collection date. For example: MN1-W 04-10-14.

Methodology

All water samples will be analyzed within 12 hours using the USEPA 9222.b membrane filter method for Fecal Coliform enumeration (USEPA 2008). Due to the unknown concentration of fecal coliforms, E.coli, and enteroccoci contamination present in the samples, graduated volume(s) of sample to be filtered will vary from 100ml, 10ml and 1ml. If contaminant concentrations appear to be high, filtration volumes may be adjusted. Following filtration procedures, plates will be incubated for 18 hours at 44.5°C and colony forming units (CFUs) will be counted and recorded. Plate counts exceeding 200 CFUs/100 ml sample will be documented as positive results.
Results will be characterized according to the water quality criteria for fecal coliforms identified in s. NR 102.04(5), Wis. Adm. Code: (a) Bacteriological guidelines: the membrane filter fecal coliform count may not exceed 200 CFUs/100 ml as a geometric mean based on not less than 5 samples per month, nor exceed 400 CFUs/100 ml in more than 10% of all samples during any month ("Water Quality Standards", 2010).
Results will also be characterized according to the water quality standards for E. coli set by the EPA. Levels may not exceed 235 CFU/100mL for a single sample. Also the membrane filter E. coli count may not exceed 126 CFU/100mL for the monthly geometric mean based on not less than 5 samples per month.

Quantitative Polymerase Chain Reaction (qPCR)

All water samples were filtered within 12 hours for DNA extraction. A volume of 200ml of sample was filtered onto a 0.22 µm pore size 47 mm nitrocellulose filter and stored at -80°C. The frozen filters were broken into small fragments using a metal spatula. DNA was extracted using the MPBIO FastDNA® SPIN Kit for Soil (MP Biomedicals, Santa Anna, CA) and DNA was eluted using 150 ul of DES.
Quantitative PCR was carried out using an Applied Biosystems StepOne Plus ™ Real-Time PCR System Thermal Cycling Block (Applied Biosystems; Foster City, CA) with Taqman hydrolysis probe chemistry. We used previously published primers and probe for human Bacteroides (Kildare et al. 2007) with the exception that the HF183F was used as the forward primer (Bernard and Fields 2000).

Data Analysis

Fecal coliforms, E. coli, and entercocci concentrations per 100 ml will be recorded for each sample, along with weather conditions, site location, and any significant site parameters, such as proximity to a sewer outfall, etc. Data analysis will be completed using Excel or a statistics software package such as Stata or SPSS. The geometric mean will be determined for each 30 day sampling period, and ANOVA will be used to calculate statistically significant variances among sampling sites and conditions, in order to better isolate potential sources of fecal contamination. The WDNR standard dictates a 95% data confidence level (WDNR, 2015). Depending on the preliminary results of the analysis, including number of initial samples and standard deviations, further sampling may be needed to ensure at least 95% confidence in the results. Wider variations in fecal coliform readings will necessitate a greater number of samples, for example. Further sampling and analysis may also be needed for suspected hot spots, unexpected results, and outliers.

APPENDIX J. RESULTS FROM ROW SURVEY 2016

Views on Root-Pike Water Resources: Responses from Urban/Suburban Residents

Summary Report

Prepared by the University of Wisconsin Whitewater's Fiscal and Economic Research Center

Executive Summary

This report is intended to shed new light on water quality outreach and education efforts in the Root Pike watershed. Towards that end, a survey of 2,400 homeowners living in the watershed was administered and analyzed. The watershed is located in parts of Racine and Kenosha counties in Wisconsin, and includes the Upper Pike River, Pikes Creek, and Pike River, which drains into Lake Michigan.

Survey respondents were more highly educated than the average individuals living in the two counties, and may have higher household incomes. To the extent this is true, it is possible that knowledge regarding water quality issues may be found more often among survey respondents compared to the general population. Indeed, even if there were no education or income differences, respondents to any water quality survey may tend to be those who know and care about the issues, imparting some bias to the results.

The results find that 42% of respondents believe the quality of water used for recreational purposes (e.g., rivers) is ‘good’ or ‘excellent’, with 81% placing the quality of drinking water at those levels. When asked about specific problems in their area with water for recreational purposes, the issues attracting at least a ‘moderate’ level of severity included *Algae blooms* (56%); *Polluted/closed beaches and swimming areas* (46%); and *Contaminated fish* (44%).

In terms of the importance of water quality, 81% of respondents ‘agree’ or ‘strongly agree’ that it affects *community quality of life* and 73% that it affects *economic stability*. In terms of personal responsibility, only 41% ‘agree’ or ‘strongly agree’ that *I would be willing to pay more to improve lakes, rivers, or streams,* but 95% ‘agree’ or ‘strongly agree’ that it is their *personal responsibility to help protect water quality*, with 75% agreeing that I *would be willing to change the way I care for my yard to improve water quality.*

When asked about the severity of nine specific pollutants, the only item attracting a majority viewing one of these as a ‘moderate’ or ‘severe’ problem was 62% for *Nutrients from fertilizers in local streams.* Not surprisingly, when asked about 15 specific sources for these types of pollutants, the only item attracting a majority agreeing it was a ‘moderate’ or ‘severe’ problem was 54% for *Lawn fertilizers and pesticides*.

When asked about nine water quality improvement practices around the home, at least half of respondents reported engaging in *Proper disposal of yard debris* (78%), *Recycling motor oil* (75%), *Directing downspouts away from paved surfaces* (69%), *Properly disposing of pet waste* (54%), and *Applying pesticides and herbicides at manufacturer’s guidelines for your lawn* (49%). Still, the most common response regarding three practices was that they were aware of but not using *rain barrels* (62%), *Soil testing* (55%), or *a rain garden* (52%). Out of a list of seven possible reasons why the respondents could not further improve water quality practices around the home, only *Cost* (56%) attracted a majority, with at least ‘some’ or ‘a lot’ responses. The survey delved more deeply into five issues, finding that only 10% had ever used a *Rain garden*, but 76% reported ‘maybe’ or ‘would’ consider using; 87% reported currently managing *Yard waste*, with an overlapping 36% willing to improve their use of fertilizer; 18% had ever used a *Rain barrel*, with 63% ‘maybe’ or ‘would’ consider using; 66% of dog owners currently clean up *Pet waste* immediately, with 63% of the remainder at least ‘maybe’ willing to consider doing so; and 80% of respondents had their automobile or truck inspected regularly for leaks, with 84% fixing any leaks found immediately.

Finally, the survey asked which public service announcement efforts had ‘definitely’ reached them, and the main provider of such information. Relatively commonly held knowledge included *stories addressing stormwater runoff* (41%), *water pollution caused by stormwater runoff* (36%), *ways homeowners potentially contributed to water pollution* (34%), and *ways homeowners can help improve water quality* (34%). Main providers of information included the Wisconsin Department of Natural Resources (42%), and their local city government (32%).

One interpretation of these results is that most respondents are concerned with water quality, and are willing to undertake some actions to improve water quality, so long as these are not financially costly. Not surprisingly, respondents seem most aware of issues that are both visible and close to home, including disposal of yard waste, recycling of motor oil, downspout positioning, fertilizer use, and pet waste. Perhaps the lowest cost initiative which would be utilized by many respondents involves reducing the incidence of over-fertilized gardens and lawns, since over-fertilization involves an unnecessary cost. Rain barrel utilization is currently low, but interest in this water quality improvement device is reasonably high, such that a small public subsidies to homeowners installing the devices might generate substantial increases in utilization. Finally, regardless of specific initiatives considered to improve water quality, respondents hold very different levels of information at present, so concentrated efforts may be required to yield success moving forward.

Introduction

This report presents results of a survey of urban and suburban residents in the Wisconsin portion of the Root-Pike Watershed in the southeastern part of the state. The study was conducted by the University of Wisconsin Whitewater’s (UWW) Fiscal and Economic Research Center (FERC). The information is intended to help focus water quality outreach and education efforts and provide a baseline for future research. 2,400 surveys were mailed to homeowners, with the mailing list provided by Mailers Haven. 176 households responded.

Results

The survey included eleven sections, measuring demographics, yard and household practices as well as knowledge, attitudes and beliefs regarding water resource issues for the Root Pike watershed.

1. Rating Water Quality

This section asked respondents to rate local water quality for two separate purposes, the quality of local waters in rivers, streams, and lakes for the purposes of swimming, fishing, and other recreational activities (kayaking, etc.) and the quality of drinking water. Respondents generally perceived the water quality in their local rivers, streams, and lakes to be 'okay' to 'good.' The vast majority of respondents believed their quality of drinking water was 'good' or 'excellent.'

3. Consequences of Poor Water quality

Respondents were asked to rate the severity of the consequences of poor water quality in their area. Available choices ranged from 'not a problem' to 'severe problem,' with 'don't know' and 'no opinion' as additional options for each.

Several of the consequences listed in the survey were perceived as a 'moderate' to 'severe' problems by respondents. These were: *Algae blooms* (56%); *Polluted/closed beaches and swimming areas* (46%); and *Contaminated fish* (44%). The three sources with the highest percentage in the 'not a problem' and 'slight problem' categories were: *odor* (55%); *Reduced beauty of rivers and streams* (50%); *Reduced opportunities for water activities such as boating, canoeing, and fishing* (50%).

4. General Water Quality Attitudes

Section three of the questionnaire measured respondents' agreement with a battery of statements regarding water quality and local and personal actions. In general, respondents expressed strongly positive attitudes toward water resource protection. Several highlights are:

- Most respondents 'agree' or 'strongly agree' that *community quality of life (*81%) and *economic stability (*73%) depend on good water quality. When personalized to *I would be willing to pay more to improve lakes, rivers, or streams,* the percent of 'agree' and 'strongly agree' drops significantly (41%).

- A strong majority 'agree' to 'strongly agree' that it is their *personal responsibility to help protect water quality (95%).*

While there is a significant majority in agreement that they have a role in maintaining water quality, a smaller number would be willing to pay to improve water quality. This does not necessarily call into question commitment, as many respondents feel that there are yard care actions they can implement that do not cost anything. This is supported by a large percentage of respondents (75%) stating they 'agree' or 'strongly agree' that they *would be willing to change the way I care for my yard to improve water quality.*

5. Types of Water pollutants

Respondents were asked to identify which pollutants were problematic in their area. Available choices on the questionnaire for each ranged from 'not a problem' to 'severe problem,' and 'don't know' and 'no opinion' as additional options for each. Respondents showed a high degree of uncertainty regarding problems in their area, with nearly half of the types of water pollutants having *don't know* as their most common response. Over thirty percent of respondents indicated that they did not know how much of a problem salt, bacteria and viruses, and phosphorus were in their area. This was the highest percentage of response for all of these categories. For those respondents that did not answer 'don't know,' the following pollutants were most frequently identified as a 'severe problem': *Invasive aquatic plants and animals, nutrients, trash and debris, and phosphorus.* Of least concern was *organic matter* and *dirt and soil* in local streams.

6. Sources of Water Pollution

This section queried the perceived severity of eighteen potential sources of water pollution. Again, available choices on the questionnaire for each ranged from 'not a problem to 'severe problem' and 'don't know' as an additional option for each. For each of the following categories, respondents most commonly indicated that they 'don't know' how much of a problem it is for their area: *Discharges from industry (22%); Improper disposal of household waste (21%); Soil erosion from farm fields (20%); Construction sites (20%) and Manure from farm animals (19%).*

Only two pollutants, *Discharge from sewage treatment plants (24%);* and *Agricultural fertilizers and pesticides (24%),* were most commonly identified as 'severe problem'. Respondents most commonly identified the following six sources as a 'moderate problem': *Street salts (36%);*

Stormwater runoff from streets, highways, and/or parking lots (37%); Lawn fertilizers and pesticides (34%); Droppings from geese, ducks, and other waterfowl (31%); Discharges from storm sewers (28%); and Discharges from industry into streams and lakes (24%).

Combining 'moderate problem' and 'severe problems' categories, the following were rated the highest by respondents: *Lawn fertilizers and pesticides (53%); Stormwater runoff from streets, highways, and/ or parking lots (53%); Street salt and sand (53%); Discharges from sewage treatment plants (45%).* The three sources with the highest percentages in the 'not a problem' and 'slight problem' categories combined were: *Pet Waste (59%); Grass clippings and leaves (57%);* and *Soil erosion from construction sites (51%).*

7. Practices to Improve Water Quality

Section seven asked respondents to provide their level of familiarity with nine practices designed to improve water quality. Choices ranged from 'never heard of it' to 'currently use it.'

Respondents most commonly chose 'currently use it' for the following practices:

- Proper disposal of yard debris (78%)
- Recycling motor oil (75%)
- Directing downspouts away from paved surfaces (69%)
- Properly disposing of pet waste (54%)
- Applying pesticides and herbicides at manufacturer's guidelines for your lawn (49%)

The most common response for the following practices was 'Know how to use; not using it':

- Using rain barrels (62%)
- Soil testing (55%)
- Using a rain garden (52%)

8. Making Management Decisions

This section was designed to determine which factors (constraints) most strongly limit respondents' general ability to change runoff management and lawn care practices. Options ranged from 'not at all' to 'a lot', and included a 'don't know' choice.

Grouping the 'some' to 'a lot' responses together, respondents most commonly identified *Cost* (57%). These constraints were the least influential in changing practices (responses of 'not at all' and 'a little'): *My own physical abilities (60%); Legal restriction on my property (53%); Not having access to the necessary equipment that I need (53%);* and *Lack of available information about the practice (46%).*

9. Constraints for Specific Practices

The section asked for detailed information regarding awareness, use, and constraints related to five specific practices: rain gardens, yard waste management, downspouts, pet waste and auto and truck care.

Rain Garden: A rain garden was defined as 'a garden that is designed to absorb and filter stormwater.' Most people (86%) responded 'no' or 'never used' when asked if they have or had a rain garden, though only 33% of the respondents have 'never heard of it,' with 47% indicating they were 'somewhat familiar with it.' Over 75% of the respondents indicated 'Maybe' or 'Yes' they were willing to use a rain garden. Roughly one third of respondents indicated they 'Don't know' whether their property could support a rain garden, and one third indicated that lack of information skills limited their ability to build a rain garden 'A lot.' Physical limitations were the least important constraint, with 45% responding it was 'not at all' a limitation.

Yard Waste: The definition provided for this practice was 'keeping grass clippings and leaves out of the roads, ditches, and gutters.' Although 86% of the respondents state that they are currently managing yard waste, 30% of them are either 'Somewhat familiar with it' or 'Never heard of it.' 36% of the respondents indicated 'Maybe' or 'Yes' they were willing to manage their yard waste.

Downspouts and rain barrels: This practice involved the usage of rain barrels. When asked how familiar they were with rain barrels over 47% of respondents indicated they were 'somewhat familiar with them.' 7% of respondents claimed they had 'never heard of them,' while 18% claim to 'have installed a rain barrel.' 65% of respondents indicated they would be willing to try utilizing a rain barrel.

Pet Waste: Respondents were asked if they owned a dog, with 41% indicating they did. When asked how often they clean up their pet's waste, 66% claim to 'always' clean up their pet's waste, with 10% indicating they never clean up their pet's waste.

Auto & Truck Care: Survey respondents were asked about aspects of their vehicle care, with 91% of respondents indicating 'yes' or 'somewhat regularly' when asked how often they had their vehicles inspected for leaks. 84% of respondents indicated 'I get it fixed as soon as possible' when asked how long does it usually take to get their vehicle fixed when a leak is found.

10. About You and Your Property

A series of questions were asked regarding the respondent and his or her property.

Information about respondents and their property:

- Less than one percent have an education below high school graduate level, with 14% having a HS diploma. Respondents to the survey were well educated, with 29% having a four-year degree or higher and a large number of graduate degrees (22%). Those figures are above U.S. Census estimates of education for Racine County, where 12.1% of adults do not have a HS diploma, and only 23.4% have a Bachelor's degree or above.[1] Similarly, in Kenosha County, 10.3% of adults do not have a HS diploma, and 24.3% hold a Bachelor's degree or above.[2]
- Roughly 30% of respondents have a household income of over $100,000, while 19% have a household income below $49,999. The median category for income was '$55,000 to $74,999, which fits or is higher than U.S. Census figures. Those estimates place median household income in Racine in 2014 of $55,000, with a similar figure of $54,700 for Kenosha.

[1] Education and household income figures for Racine from U.S. Census: census.gov/quickfacts/table/PST045215/55101 December 4, 2016.
[2] Education and household income figures for Kenosha from U.S. Census: census.gov/quickfacts/table/PST045215/55059 December 4, 2016.

These differences suggest that respondents tended to be more highly educated than the average adult living in the area, and may have higher incomes.

11. Information Acquisition

Respondents were asked if they recalled seeing information regarding water quality regarding 6 different areas.

Most respondents responded with the majority ‘I Think so’ or ‘Definitely Have’ to the following five areas:

1. *Recall seeing or hearing related advertising about water pollution caused by stormwater runoff (52%)*
2. *Aware of any advertising that carries the message “Respect our Water?” (52%)*
3. *Recall watching, reading, or hearing any news stories that address stormwater runoff (71%)*
4. *Advertising or news stories, have you learned of ways homeowners potentially contributed to water pollution (67%)*
5. *Have you learned of ways homeowners can help improve water quality (66%).*

Respondents were also asked to what extent did the information about water quality come from 22 different sources.

Respondents indicated that these sources did not assist in the education and awareness regarding the issue: *Root Pike Watershed Initiative Network (72%); your local school or college (64%); Political organizations (61%); Wisconsin Department of Agriculture, Trade and Consumer Protection (53%); UW Extension (50%;* and *your local home and garden center (50%).*

Part 1: Water Quality

Overall, how would you rate the quality of the water in your area?

	Poor -0	Okay-1	Good-2	Excellent-3	Don't Know-4	No Opinion - 5
Overall, how would you rate the quality of the water in your local rivers, streams, and lakes for purposes of swimming, fishing, and other recreational activities (kayaking, etc.)?	13%	37%	40%	2%	7%	>1%
Overall, how would you rate the quality of your drinking water?	3%	15%	48%	33%	1%	0%

Part 3: Consequences of Poor Water Quality

Poor water quality can lead to a variety of consequences for communities. In you opinion, how much of a problem are the following issues in your area?

	Not a Problem -0	Slight Problem -1	Moderate Problem -2	Severe Problem -3	Don't know -4	No Opinion -5
Contaminated drinking water	51%	22%	13%	5%	9%	>1%
Polluted / closed beaches & swimming areas	20%	30%	37%	9%	3%	2%
Contaminated fish	18%	20%	32%	12%	18%	2%
Increase in water / sewage bill	27%	18%	28%	11%	7%	9%
Loss of desirable fish and wildlife species	15%	20%	26%	19%	18%	3%
Reduced beauty of rivers and streams	19%	31%	31%	11%	7%	2%
Reduced opportunities for water activities such as boating, canoeing, and fishing	25%	25%	30%	7%	10%	3%
Algae blooms	8%	22%	33%	23%	15%	>1%
Odor	26%	29%	25%	8%	11%	2%
Lower property values	34%	22%	12%	5%	21%	8%

Part 4: General Water Quality Attitudes

What is your level of agreement with the following statements?

	Strongly Disagree -0	Disagree -1	Neither Agree or Disagree -2	Agree -3	Strongly Agree -4	No Opinion -5
The economic stability of my community depends upon clean lakes, rivers, and streams	3%	7%	14%	43%	30%	3%
The way that I care for my yard can influence water quality in lakes, rivers and streams	>1%	2%	7%	51%	39%	1%
It is my personal responsibility to help protect water quality	1%	>1%	2%	57%	38%	1%
What I do on my property doesn't have much impact on overall water quality	32%	42%	11%	10%	5%	>1%
Yard-care practices (on individual lots) do not have an impact on local water quality	37%	48%	6%	7%	1%	1%
My actions can have an impact on lakes, rivers, and streams	2%	2%	5%	60%	29%	2%

I would be willing to pay more to improve lakes, rivers, and streams	5%	16%	35%	32%	9%	4%
I would be willing to change the way I care for my yard to improve water quality	>1%	5%	17%	61%	14%	2%
The quality of life in my community depends on good water quality in local streams, rivers and lakes	1%	6%	9%	46%	35%	2%

Part 5: Types of Water Pollutants

Below is a list of water pollutants that are generally present in water bodies to some extent. In your opinion, how much of a problem are the following pollutants in your area?

	Not a Problem -0	Slight Problem -1	Moderate Problems -2	Severe Problem -3	Don't Know -4	No Opinion -5
Dirt and Soil in local streams	16%	26%	29%	10%	17%	1%
Nutrients from fertilizers in local streams	4%	19%	33%	29%	15%	0%
Phosphorus in local streams	5%	18%	23%	21%	32%	>1%
Bacteria and viruses in local streams	9%	14%	23%	18%	34%	1%

(such as E. coli)						
Salt in local streams	15%	16%	16%	11%	40%	2%
Invasive aquatic plants and animals	6%	17%	24%	33%	18%	>1%
Oil or antifreeze from cars and trucks	15%	22%	16%	17%	29%	>1%
Trash and debris	10%	24%	34%	22%	10%	0%
Organic matter, such as fallen trees, branches, grass clippings, leaves	17%	31%	27%	8%	15%	1%

Part 6: Sources of Water Pollution

The items listed below are sources of water quality pollution across the country. In your opinion, how much of a problem are the following sources in your area?

	Not a Problem -0	Slight Problem -1	Moderate Problem -2	Severe Problem -3	Don't Know -4	No Opinion -5
Discharges from industry into streams and lakes	14%	19%	25%	18%	22%	>1%
Discharges from sewage treatment plants	14%	20%	22%	24%	19%	1%
Soil erosion from construction sites	15%	36%	18%	9%	20%	1%

Soil erosion from stream farm fields	12%	29%	20%	17%	20%	2%
Lawn fertilizers and pesticides	5%	24%	34%	20%	15%	1%
Grass clippings and leaves	21%	36%	18%	3%	18%	3%
Discharges from storm sewers	13%	24%	28%	15%	18%	2%
Improper disposal household waste (such as batteries, medications, chemicals, fluorescent light bulbs, etc.)	13%	23%	22%	19%	21%	2%
Improper disposal of used motor oil and antifreeze	14%	25%	21%	14%	24%	2%
Manure from animal farms	15%	24%	23%	16%	19%	2%
Stormwater runoff from streets, highways, and/or parking lots	8%	29%	37%	15%	9%	1%
Street salt and sand	5%	29%	36%	16%	12%	2%
Droppings from geese, ducks, and other waterfowl	13%	31%	31%	9%	13%	2%
Pet waste (such as dogs or cats)	18%	39%	16%	4%	19%	2%
Agricultural fertilizers and pesticides	7%	23%	24%	24%	19%	2%

Part 7: Practices to Improve Water Quality

Please indicate which statement most accurately describes your level of experience with each practice listed below.

	Never Heard of it	Somewhat Familiar	Aware How to Use it; Not Using it	Currently Using it

	-0	-1	-2	-3
Applying pesticides and herbicides at manufacturer's guidelines for your lawn	4%	17%	29%	49%
Using phosphate free fertilizer	20%	23%	36%	20%
Properly disposing of pet waste	10%	13%	23%	54%
Using rain barrels	4%	15%	62%	19%
Recycling motor oil	4%	8%	12%	75%
Directing downspouts away from paved surfaces	5%	11%	15%	69%
Using a rain garden	23%	15%	52%	10%
Proper disposal of yard debris	5%	8%	9%	78%
Soil testing	14%	25%	55%	7%

Part 8: Making Management Decisions

In general, how much does each issue limit your ability to change your household & lawn care practices (such as those in Question 7)?

	Not at all -0	A little -1	Some -2	A lot -3	Don't Know -4	No Opinion -5
Cost	17%	21%	39%	17%	3%	3%
My own physical abilities	41%	17%	26%	12%	2%	2%
The need to learn new skills or techniques	32%	16%	31%	5%	7%	2%
Legal restriction on my property	49%	5%	18%	5%	21%	3%
Not having access to the necessary equipment that I need	39%	14%	26%	6%	11%	4%
Lack of available information about the practice	29%	17%	29%	7%	15%	4%
Concerns about resale value	42%	15%	21%	10%	8%	5%

Part 9: Constraints for Specific Practices

Rain Garden: A rain garden is a garden that is designed to absorb and filter stormwater. It is usually designed to collect stormwater from a house or structure.

Do you have or have you had a rain garden?

Yes:	8%
Currently use:	2%
Do not currently use:	2%
No:	70%
Never Used:	16%

How familiar are you with rain gardens?

Never heard of it:	33%
Somewhat familiar with it:	47%
Know how to install, not doing it:	12%
Have installed a rain garden:	8%

Are you willing to try utilizing a rain garden?

Yes:	24%
Maybe:	52%
No:	17%

Already have one: 6%

How much do the following factors limit your ability to build a rain garden (or limited, if you already have one)?

	Not at all -0	A little -1	Some -2	A lot -3	Don't Know-4	No Opinion-5
Lack of information skills	21%	15%	26%	29%	5%	4%
Time required	16%	18%	30%	18%	12%	4%
Cost	18%	14%	29%	19%	16%	4%
The features of my property do not support it	17%	8%	15%	22%	34%	3%
Physical or health limitations	45%	12%	20%	13%	8%	2%

Yard Waste Management: Yard waste management means keeping grass clippings and leaves out of roads, ditches, and gutters.

Do you manage your yard waste by keeping grass clippings out of street, etc.?

Yes: 79%

Maybe: 3%

Currently do: 8%

No: 6%

Never have: 2%

Currently do not: 3%

How familiar are you with yard waste management?

Never heard of it: 4%

Somewhat familiar with it: 26%

Know how to manage, not doing it: 4%

Currently managing yard waste: 66%

Are you willing to manage your use of fertilizer?

Yes: 29%

Already managing it: 40%

No: 4%

Maybe: 7%

Downspouts and rain barrels: Downspouts should be aimed at pervious areas like gardens, lawns, and pervious paved areas and not down driveways or onto sidewalks. A rain barrel installed on a downspout can hold back stormwater.

How familiar are you with rain barrels?

Never heard of them: 7%

Somewhat familiar with them: 47%

Know how to install, not doing it: 29%

Have installed a rain barrel: 18%

Are you willing to try utilizing a rain barrel?

Yes: 25%

Maybe: 40%

No: 21%

Already have one: 13%

Pet Waste: Dog poop is a major pollutant in runoff. When it reaches our rivers and lakes, poop uses oxygen as it decays and sometimes releases ammonia, both of which can kill fish. Pet poop also contains nutrients that encourage weed and algae growth. Most importantly, pet waste carries diseases, which make water unsafe for swimming or drinking.

Do you own a dog?

Yes: 41%

No: 59%

How often do you clean up your pet's waste?

Always:	66%
In nice weather:	0%
Rarely:	4%
Most of the time:	16%
When people will be in my yard:	3%
Never:	10%

Are you willing to clean up your pet's waste every time?

Yes:	55%
Maybe:	8%
No:	15%
I already do:	23%

Auto & Truck Care: How we care for our vehicles has an impact on water quality. Leaking oil and other fluids along with runoff from washing cars in the driveway lead to an increase in pollutant in our waterways.

Do you have your car inspected for leaks regularly?

Yes: 80%

Somewhat regularly: 11%

I don't own a car: 1% No:

7%

I'm not sure: >1%

When a leak is discovered, how long does it usually take you to get it fixed?

I get it fixed as soon as possible: 84%

I get it fixed if it causes problems with how my car runs: 6% I

don't own a car: >1%

I get it fixed when I can afford it: 9%

I don't worry about it or get it fixed: >1%

Part 10: About You and Your Property:

What is your gender?

Male: 50%

Female: 50%

What year were you born?

≥1930's: 8%

1940's: 19%

1950's: 34%

1960's: 23%

1970's: 12%

1980's: 5%

What is the highest level of education you have completed?

Less than High School:	>1%
High School diploma or equivalent:	14%
Some college:	17%
2 year Associate's Degree:	16%
4 year Bachelor's Degree:	29%
Graduate Degree:	22%

What is your annual household income level?

Less than $24,999: 6%

$25,000 to 49,999: 19%

$50,000 to 74,999: 23%

$75,000 to 99,999: 19%

$100,000 or more: 33%

Part 11: Information Acquisition

1. Please look at the loose leaf image provided, Sparkles the Water Spaniel, which represents a to public awareness campaign that has run over the past four years. Then answer the questions below:

	Definitely Not -0	Don't Think So -2	Don't Know -3	I Think So -4	Definitely Have -5
Do you recall seeing or hearing related advertising about water pollutions caused by stormwater runoff (storms that ultimately carry yard or street pollutant into lakes, rivers, & streams)?	17%	26%	5%	17%	35%
Are you aware of any advertising that carries the message, "Respect Our Waters?" (as seen above)	12%	27%	9%	25%	27%
Do you recall watching, reading, or hearing any news stories that address stormwater runoff?	6%	14%	9%	30%	41%
Do you recall seeing, reading or hearing the Respect Our Water message at any community events (fairs, festivals, farmer's markets, etc.)?	19%	37%	14%	18%	12%
Through advertising or news stories, have you learned of ways homeowners potentially contributed to water pollution?	8%	17%	8%	33%	34%
Through advertising or news stories, have you learned of ways homeowners can help improve	7%	18%	9%	32%	34%

water quality?					

2. People receive information about water quality though many different sources. From which of these sources have you received information about water quality, and to what extent did the source assist you in education and awareness regarding the issue?

	Not at All -0	A Little -1	Some -2	A Lot -3	Don't Know -4
Respect Our Waters	46%	17%	19%	7%	11%
Southeast Wisconsin Watersheds Trust Inc. (aka Sweet Water)	66%	8%	6%	1%	19%
Root Pike Watershed Initiative Network	72%	7%	5%	1%	15%
Your Local School or College	64%	10%	10%	4%	12%
Your Local Home & Garden Center	51%	21%	15%	2%	11%
Your Local City Government	39%	21%	27%	5%	9%
Your County Government	50%	15%	21%	3%	12%
UW Extension	50%	18%	17%	4%	14%
Wisconsin Department of Agriculture, Trade and Consumer Protection	53%	16%	11%	2%	17%
Wisconsin Department of Natural Resources	29%	21%	30%	12%	8%

The United States Environmental Protection Agency	49%	14%	19%	3%	15%
Political Organizations, such as League of Conservation Voters	61%	9%	8%	5%	17%

Appendix K. SWWT Mini Grant Statistics

SWWT Mini-grant Program Summary (2010-2016)				
Mini-grant Year	**Total Requests**	**Number of Requests**	**Total Funded**	**Number Funded**
2010	$55,625	33	$15,000	10
2011-2012 Round 1	$41,171	12	$29,010	8
2011-2012 Round 2	$69,108	21	$25,190	9
2012	$91,840	24	$55,000	16
2013	$143,353	31	$48,464	12
2014	$171,512	38	$47,269	13
2016*		28	$49,895	14
Totals	**$572,609**	**187**	**$269,828**	**82**

*The gap in years represents a change in grant cycle, not a skipped year. Prior to 2015, mini grant projects were funded by the previous year's grant ex. 2015 completed projects received 2014 mini grant funding. To alleviate this confusion, in 2015 the grant cycle was changed so that projects implemented in 2016 were referred to as 2016 projects.

Appendix L. Nine Key Element Reference Table

US EPA Minimum Element	Source
1. Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan.	KK UIP: Water Quality, Current Conditions p. 18 Watershed Restoration Plan: Chapter 4 RWQMPU: p. 262-278 MRB TMDL: 2.1.2.3
2. An estimate of the load reductions expected from management measures.	KK UIP: Expected Reductions from Green Infrastructure Practices: p. 41 PR-50: Chapter V Milwaukee River TMDL: 4.2.1
3. A description of the nonpoint source management measures that will need to be implemented to achieve load reductions in paragraph 2, and a description of the critical areas in which those measures will be needed to implement this plan.	Watershed Restoration Plan: Chapter 6 City of Milwaukee GI plan MMSD Green Infrastructure plan
4. Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.	KK UIP: Priority Projects p. 38-40, Leadership Structure p. 45, and Appendix G KK WRP Chapter 8.3 and Appendix 8A
5. An information and education component used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.	KK UIP: Information and Education section p. 51-53
6. Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious	KK UIP: p. 43-44
7. A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.	KK UIP: p. 44
8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.	KK UIP: p.44-45
9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under element 8.	KK UIP: Monitoring p. 49-51 and Appendix H TMDL monitoring implementation plan: To Be Released

APPENDIX M. Additional Monitoring Site Map