CITY OF MILWAUKEE
Green Infrastructure Plan

City of Milwaukee

WATER CENTRIC CITY | ecoCITY of MILWAUKEE

JUNE 2019

Cover photo credit to Eddee Daniel and Menomonee Valley Partners.

ACKNOWLEDGMENTS

The City of Milwaukee Environmental Collaboration Office (ECO) would like to acknowledge those who supported and helped create the City's Green Infrastructure Plan:

Milwaukee Metropolitan Sewerage District
City of Milwaukee – Department of Public Works
City of Milwaukee – Department of Neighborhood Services
City of Milwaukee – Department of City Development
Fund for Lake Michigan
The Brico Fund
Stormwater Solutions Engineering, LLC
GRAEF
University of Milwaukee – School of Freshwater Sciences
Marquette University Water Law and Policy Initiative

The Honorable Tom Barrett, Mayor of Milwaukee

Alderman Ashanti Hamilton, 1st District
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Alderman Russell W. Stamper II, 15th District

Former Alderman Jim Bohl, 5th District

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MMSD PARTNERS FOR A CLEANER ENVIRONMENT

Fondy Park Bioswale
Photo credit: Timothy McCollow

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Milwaukee Mayor Tom Barrett outlines his green infrastructure vision.
Also pictured: Kevin Shafer, MMSD; Travis Luzney, MPS; Erick Shambarger, ECO
Photo credit: Lee Matz

EXECUTIVE SUMMARY

The Vision

By 2030, Milwaukee will add approximately 36 million gallons of stormwater storage by implementing green infrastructure. This is the equivalent of adding 143 acres of green space throughout the City. Green infrastructure will be designed, installed, and maintained by an inclusive workforce that is representative of the City's diversity. The Green Infrastructure Plan will help Milwaukee adapt to climate change while creating a healthier and more resilient city.

Mission

The City of Milwaukee Green Infrastructure Plan is a roadmap to achieve this vision, providing leaders with strategic and comprehensive strategies for implementing green infrastructure and prioritizing projects. It identifies various green infrastructure practices and potential financing mechanisms, prioritizes subbasins and locations, formalizes policy changes within the City, and recognizes stakeholders within City, County, private, and non-profit communities that can partner to accomplish these goals. The Green Infrastructure Plan satisfies the targets outlined in the **Refresh Milwaukee Sustainability Plan.**

Green Infrastructure Plan Framework

In October 2017, the Milwaukee Common Council passed a resolution (**CCFN 171053**) directing the City of Milwaukee's Environmental Collaboration Office (ECO) to develop a comprehensive green infrastructure plan for Milwaukee's Combined Sewer Area. After extensive consultation with the Milwaukee Metropolitan Sewerage District, Departments of Public Works and City Development, and community stakeholders, ECO proposed a Green Infrastructure Plan Framework. The Framework was unanimously approved by the Common Council (**CCFN 180527**) in September 2018 and its policy recommendations guided development of this document. A companion Common Council resolution (**CCFN 180803**) revised City ordinances to require green infrastructure on all large developments and redevelopments and explicitly outlines green infrastructure as a climate adaptation strategy in **Chapter 120** of the City of Milwaukee Code of Ordinances.

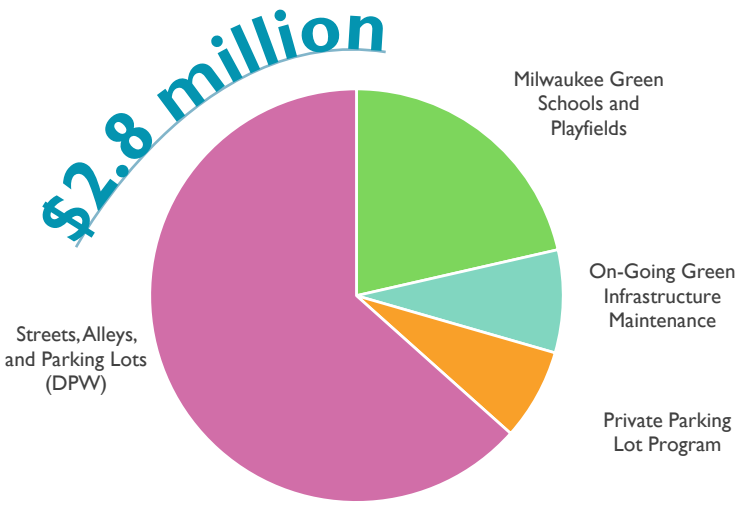
Green Infrastructure Plan Policies and Priorities

- Focus on green infrastructure projects in **high-priority subbasins** that will reduce stormwater impacts to vulnerable structures.
- Prioritize green infrastructure on **schoolyards** as they present an opportunity to achieve multiple ReFresh Milwaukee goals simultaneously. Allocate at least $600,000 annually to Milwaukee Public Schools (from MMSD's Green Solutions funding) to support green schoolyard projects and a Sustainability Specialist position, with an emphasis on project collaboration with the Green Schools Consortium of Milwaukee
- Support 2019 revisions to MMSD's Chapter 13 rules to require green infrastructure on a **regional** basis, and update City codes accordingly.
- Prioritize opportunities to **"de-pave"** and add green infrastructure to properties with excess pavement or parking capacity, and provide **one-time financial incentives** for installing green infrastructure.
- Add green infrastructure to **City owned parking lots,** especially Milwaukee Public Library parking lots.
- Continue to partner with MMSD and non-profit organizations to support training and job opportunities for Milwaukee residents, creating a **diverse and equitable green workforce**.
- Pursue site-specific combinations of both **gray and green infrastructure** to maximize stormwater management and the co-benefits associated with increased green space.
- Require green infrastructure on all **large developments** through ordinance.
- Support Department of City Development as they implement recent changes to **parking lot landscape standards**, intended to strengthen and clarify City Zoning Code.
- Incorporate locally produced **compost** from food waste into local green infrastructure and landscaping projects when feasible.

Funding for Green Infrastructure

The 2019 City Budget includes $2.8 million for green infrastructure in the Department of Public Works, including $2 million from MMSD's Green Solutions Program.

The pie chart at left shows how this money will be spent. The amount of money spent on green infrastructure maintenance is predicted to increase yearly.



THE VISION

By 2030, Milwaukee will add approximately 36 million gallons of stormwater storage by implementing green infrastructure. This is the equivalent of adding 143 acres of green space throughout the City. Green infrastructure will be designed, installed, and maintained by an inclusive workforce that is representative of the City's diversity. The Green Infrastructure Plan will help Milwaukee adapt to climate change while creating a healthier and more resilient city.

Fondy Park
Photo credit: Lisa Misky

BACKGROUND

In July 2010, Milwaukee County declared a state of emergency. Heavy rainfall and flash flooding throughout the City led to roughly 2,000 reports of basement water back-up and over 144 incidents of street and surface flooding. Similar historic flooding occurred in August of 2018.

The **National Climate Assessment** predicts climate change will increase the frequency and severity of heavy rainfall in the Midwest resulting in greater flood risk. This threat is especially pertinent in urban areas like Milwaukee where hardscape (buildings, parking lots, roads, driveways, and other impervious surfaces) prevents water from penetrating the ground, which can accelerate water runoff into storm sewers and local waterways, increasing pollutant load and flood risk. To reduce these threats, the City needs to add green infrastructure along with replacing and upgrading traditional sewer infrastructure.

The City of Milwaukee Green Infrastructure Plan will help us prepare and adapt to future climate change. It's a crucial step in Milwaukee's transition to a cleaner, healthier, and more economically resilient future. According the **2015 Green Infrastructure Baseline Inventory**, the City of Milwaukee is approximately 45.5% hardscape. Replacing these impervious areas with widespread green infrastructure can reduce pressure on storm sewers and wastewater treatment facilities. It can make our neighborhoods more beautiful and welcoming, and even reduce the temperature of the City in the hot summer months. Green infrastructure provides stormwater management while also offering a variety of co-benefits, from improving air quality to providing children with outdoor space to play and learn.

As we add green infrastructure in Milwaukee, we must prioritize projects based on both their feasibility and their potential impact. This Plan is intended to recognize the green infrastructure work already being done and identify priority projects for the future, helping City leaders, community groups, and businesses work together to make a more resilient and sustainable Milwaukee.

A Water Centric City

Milwaukee is re-inventing itself as a world class eco-city built on a sustainable relationship with fresh water. In 2013, Mayor Tom Barrett released ReFresh Milwaukee, the City's first sustainability plan. It was formally adopted by the Milwaukee Common Council and signed by Mayor Barrett in December of that year. ReFresh Milwaukee serves as a strategic vision and framework for transforming Milwaukee into a more sustainable community. It provides a citywide road map and sets goals and targets for individuals and organizations to achieve for improving environmental, economic, and social conditions in Milwaukee's neighborhoods over a ten-year period.

ReFresh Milwaukee addresses eight major issue areas including Buildings, Energy, Food Systems, Human Capital, Mobility, Resource Recovery, Catalytic Projects, and Water. The Water Chapter

set the goal to establish Milwaukee as "America's Water Centric City," and directs the City to reduce stormwater runoff and clear water from entering the sewer system.

In light of these goals, the City's Environmental Collaboration Office (ECO) partnered with the UWM School of Freshwater Sciences to develop a Water Centric Cities program that defines seven key principles: Water Leadership; Arts, Talent, Culture, and Education; Water Technology; Applied Water Research and Policy; Fishable Swimmable Rivers and Water Bodies; Sustainable and Healthy Water Supply; and Green Infrastructure.

The Milwaukee Common Council passed a resolution in October 2017 (CCFN 171053) directing ECO to develop a comprehensive Green Infrastructure Plan for Milwaukee's Combined Sewer Area. After extensive consultation with the Milwaukee Metropolitan Sewerage District (MMSD), the City, and community stakeholders, ECO proposed a Green Infrastructure Plan Framework. The Framework and this Plan extend beyond the Combined Sewer Area to address the entire City of Milwaukee, including the separated sewer area. The Framework was unanimously approved by the Common Council in September 2018 (CCFN 180527), and its policy recommendations guided the development of this Plan.

Pollution Control through TMDL Requirements

Wisconsin has numerous lakes, streams, and rivers that consistently do not meet water quality standards and are categorized as "impaired," primarily due to the impacts of nonpoint source pollution. As required by the federal Clean Water Act, the Department of Natural Resources (DNR) is addressing many of these impaired waterways by establishing a "Total Maximum Daily Load" (TMDL). The goal of a TMDL analysis is to determine how much of a pollutant a water body can tolerate while still meeting water quality standards. Through the TMDL development process, sources of pollutants are identified and assigned reduction requirements in order to meet water quality standards.

The US EPA approved the Milwaukee River TMDL report in March, 2018. The report identifies load requirements for discharge and runoff into the Milwaukee, Kinnickinnic, and Menomonee Rivers, and the Milwaukee Harbor Estuary. The City of Milwaukee and local businesses are required to comply with restrictive discharge limits on the targeted pollutants.

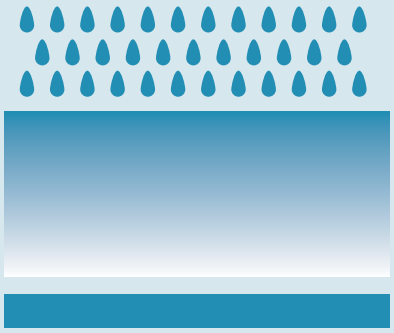
Implementing plans to achieve TMDL targets for polluted runoff from cities, construction sites, farms and roads is a challenging process that requires the collaboration of diverse stakeholders and a substantial commitment of public and private dollars. But strategic implementation of green infrastructure can reduce pollutant loads in stormwater runoff and, therefore, assist Milwaukee in complying with these TMDL requirements.

MMSD 2035 Vision

The Milwaukee Metropolitan Sewerage District (MMSD) released its Regional Green Infrastructure Plan in 2013 with a goal to capture the first half-inch of rainfall on impervious surfaces using green infrastructure, the equivalent of 740 million gallons of stormwater runoff, as set forth in the 2035 Vision.

The goal of capturing 740 million gallons of stormwater runoff covers the entirety of MMSD's service area encompassing 411 square miles, portions of six watersheds, and 28 municipalities, of which the City of Milwaukee comprises 96 square miles of land area. The proposed stormwater capture goals include 20 million gallons in the combined sewer area, and 30 million gallons in the separated sewer area. The City's goal of 36 million gallons is based on the targeted volumes outlined in ReFresh Milwaukee and available funding.

MILWAUKEE'S STORMWATER CAPTURE GOAL



1/2 inch rain

captured by green infrastrucuture per rain event

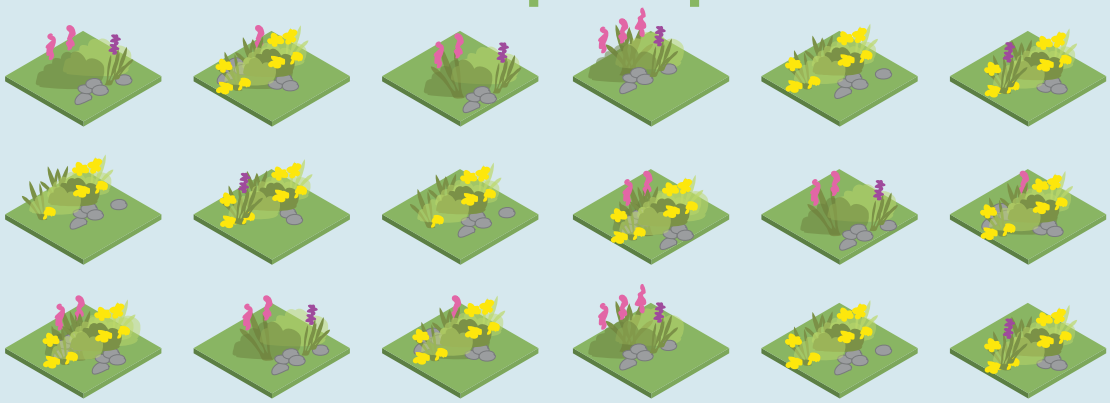
=

36 million gallons of water

per rain event

=

Approximately 143 acres of new open space



Milwaukee & Its Watersheds

Three primary watersheds fall within the City of Milwaukee's municipal boundaries: the Milwaukee River, the Menomonee River, and the Kinnickinnic River. These watersheds vary in size, development, and environmental health, but they all flow to the Milwaukee Harbor Estuary, which is currently listed as an Area of Concern by the Wisconsin State Department of Natural Resources (DNR). The land immediately adjacent to Lake Michigan is within the Direct Drainage Area Tributary to Lake Michigan and drains directly to Lake Michigan.

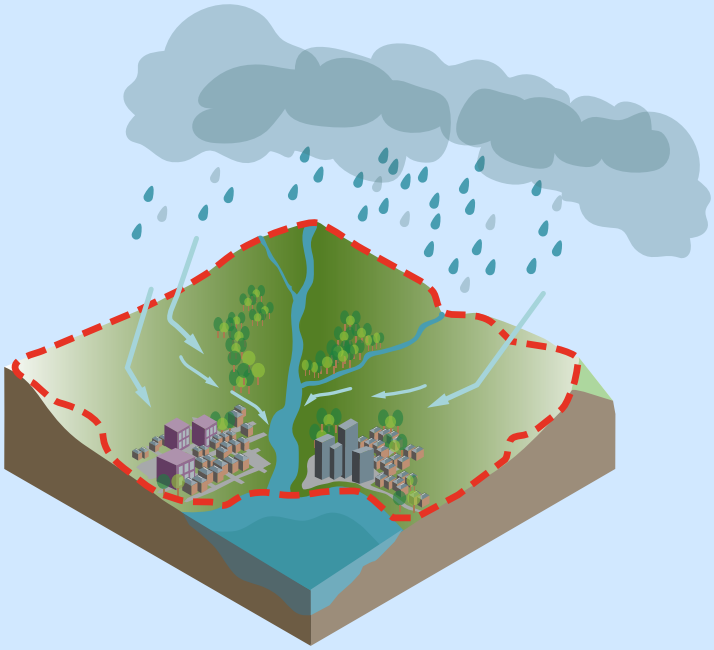
Combined Sewer Area

The City of Milwaukee is served by two types of sewer systems – separated and combined. In a separated sewer system, stormwater travels through a dedicated sewer directly to local waterways and Lake Michigan, while sewage travels separately to a wastewater treatment plant. In a combined sewer system, however, stormwater and sewage flow to a water treatment plant using the same sewer pipes.

The combined sewer systems are vulnerable to high-volume rain events, as the system can overflow directly into waterways – meaning high-volume events may cause untreated sewage to enter Milwaukee's watershed. This is referred to as a combined sewer overflow. MMSD has worked diligently to reduce these combined sewer overflows from approximately 60 per year to an average of 2-3 per year, primarily as a result of the Deep Tunnel project.

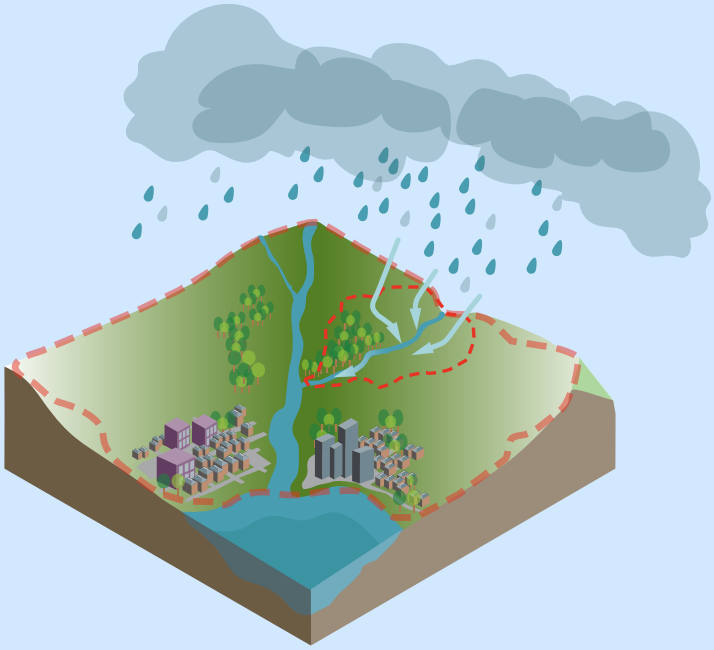
Combined sewer areas make up about 6% of MMSD's total service area and includes Milwaukee's central business district and surrounding neighborhoods. Although combined sewer systems may overflow, they also have significant water quality benefits. In combined sewer systems, stormwater is filtered through the water treatment plant along with sewage which can help remove surface pollution before it's carried into Lake Michigan.

What is a watershed?

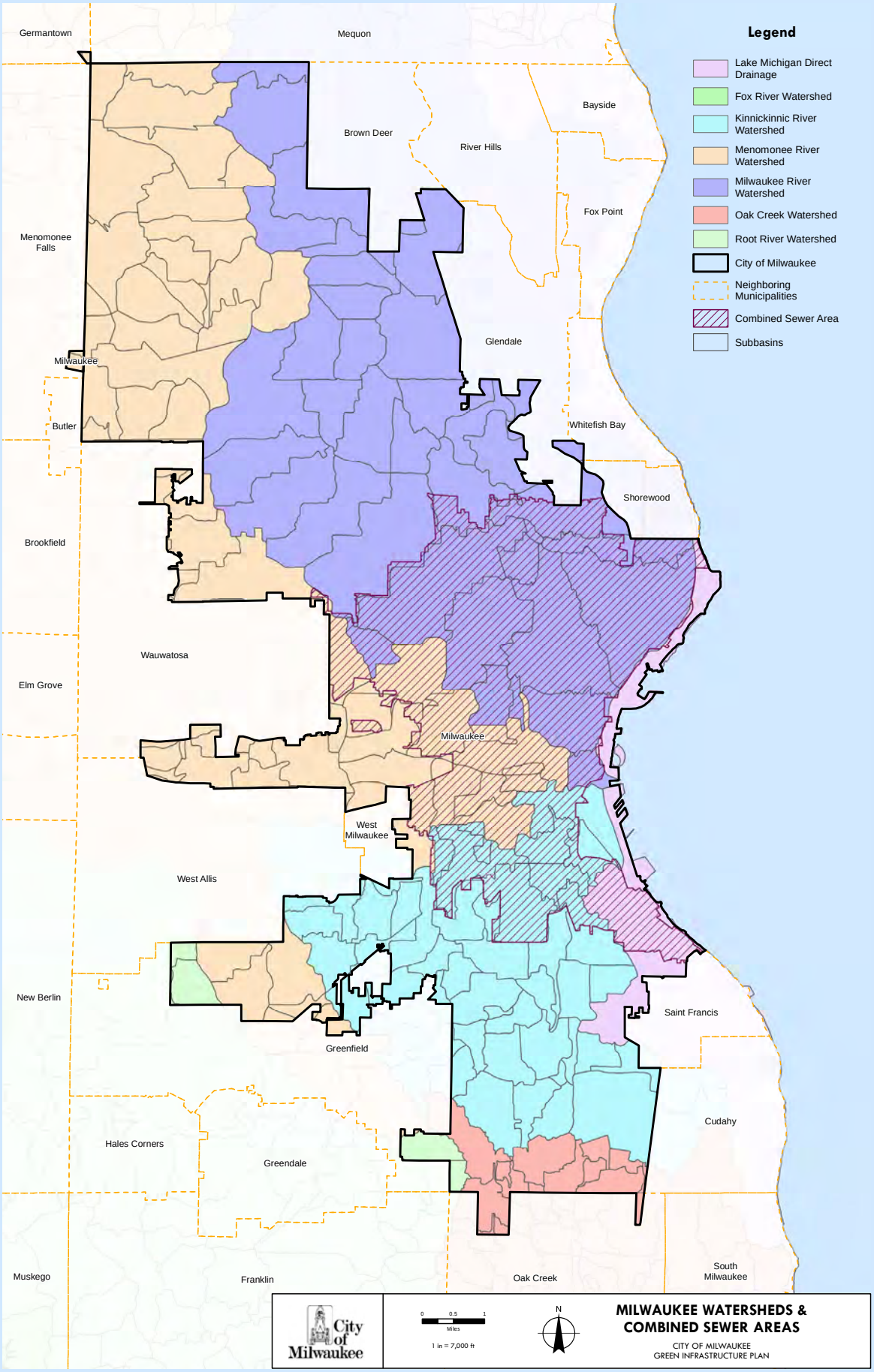


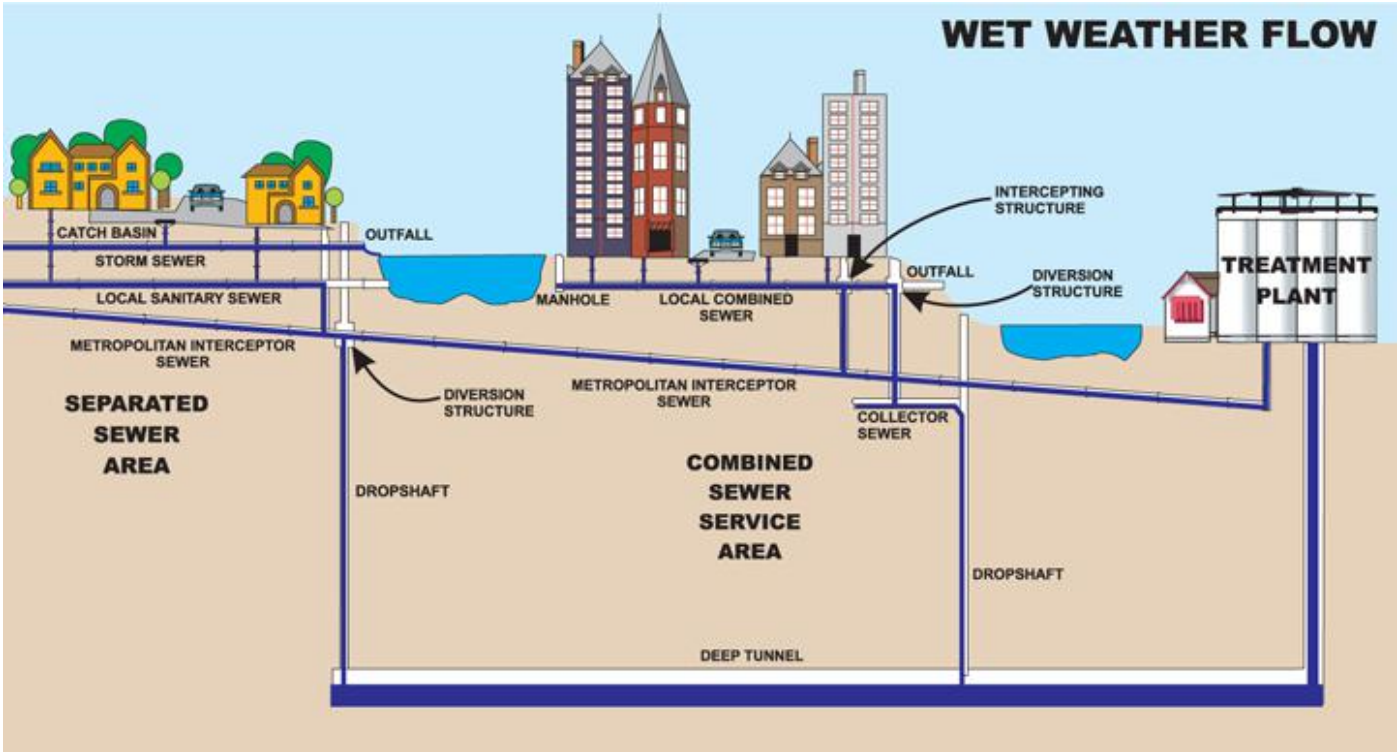
The word watershed refers to an area of land in which water or other precipitation drains to a common outlet. A watershed is like a funnel, carrying all the water that falls within its boundaries downhill to one larger water body.

What is a sub-basin?



A sub-basin is a smaller area within a larger watershed in which precipitation drains to a common point before flowing into a larger water body.


Legend
Lake Michigan Direct Drainage
Fox River Watershed
Kinnickinnic River Watershed
Menomonee River Watershed
Milwaukee River Watershed
Oak Creek Watershed
Root River Watershed
City of Milwaukee
Neighboring Municipalities
Combined Sewer Area
Subbasins
Germantown
Mequon
Bayside
Brown Deer
River Hills
Fox Point
Menomonee Falls
Glendale
Milwaukee
Butler
Whitefish Bay
Shorewood
Brookfield
Wauwatosa
Elm Grove
Milwaukee
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
Muskego
Franklin
Oak Creek
South Milwaukee
City of Milwaukee
0 0.5 1
Miles
1 in = 7,000 ft
N
MILWAUKEE WATERSHEDS & COMBINED SEWER AREAS
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN



Wet Weather – stormwater and wastewater flows through separated and combined sewer systems // Image source: Milwaukee Metropolitan Sewerage District

Support Green Jobs in the Neighborhood

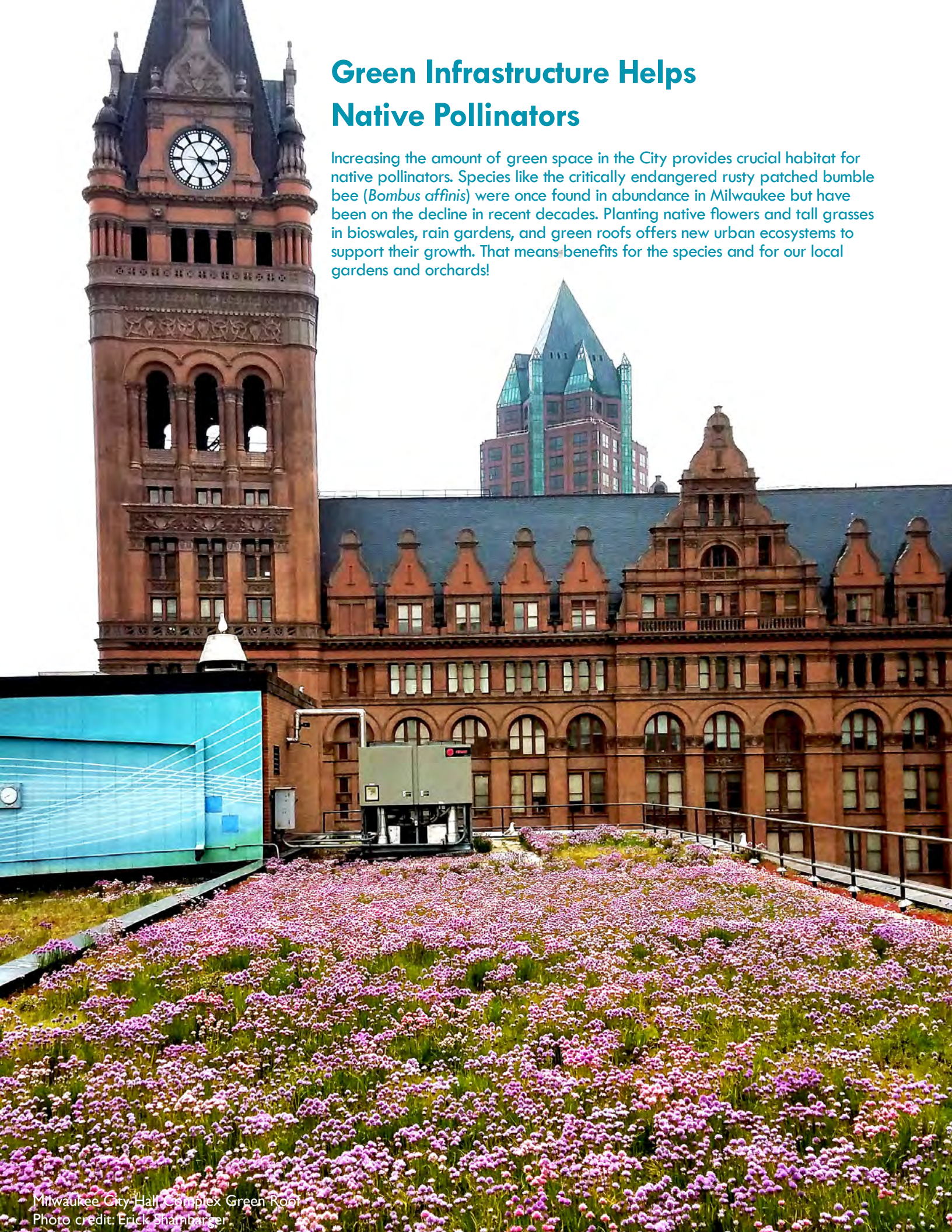
As the City of Milwaukee creates more green infrastructure opportunities, we are taking active steps to support an inclusive workforce that is reflective of the City's diversity. The City's Department of Public Works and Environmental Collaboration (ECO) have contracted with Walnut Way's Blue Skies landscaping and Groundwork Milwaukee to install and maintain green infrastructure.

In February 2018, ECO and Blue Skies Landscaping began a year-long project to increase the climate resilience and sustainability of Milwaukee's Lindsay Heights neighborhood, with funding from the Institute for Sustainable Communities. These projects were significant for Blue Skies Landscaping in that they were among the first green infrastructure projects where Blue Skies served as general contractor, significantly expanding their training and capacity to take on larger projects in the future.

Photo credit:Erick Shambarger

Green Infrastructure Helps Native Pollinators

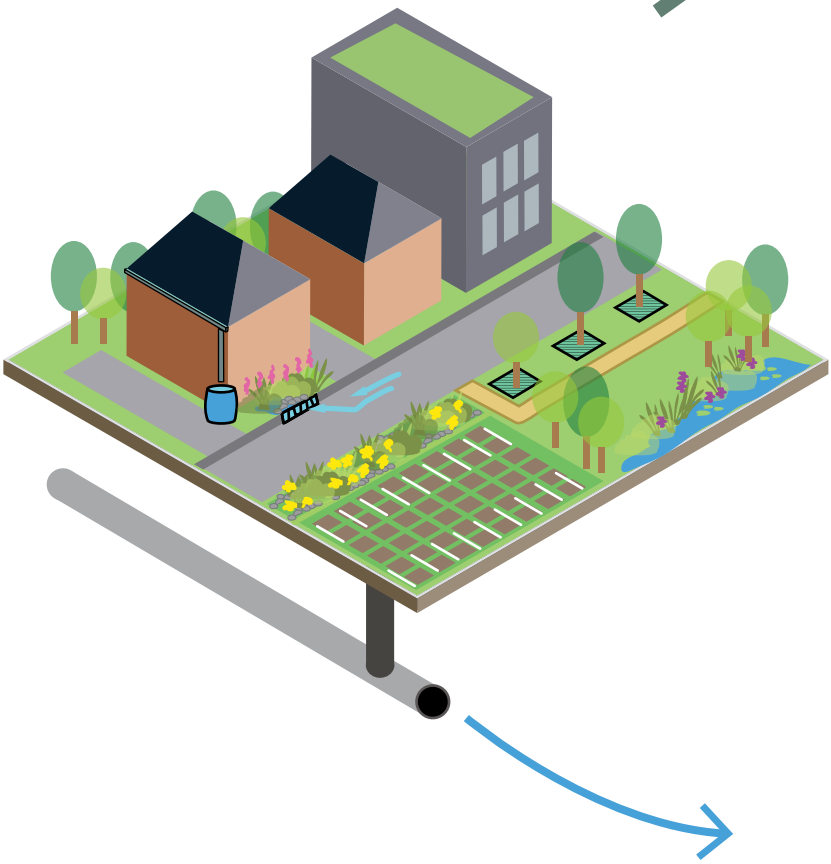
Increasing the amount of green space in the City provides crucial habitat for native pollinators. Species like the critically endangered rusty patched bumble bee (*Bombus affinis*) were once found in abundance in Milwaukee but have been on the decline in recent decades. Planting native flowers and tall grasses in bioswales, rain gardens, and green roofs offers new urban ecosystems to support their growth. That means benefits for the species and for our local gardens and orchards!



Milwaukee City Hall Complex Green Roof
Photo credit: Erick Shamberger

GRAY INFRASTRUCTURE

- $$$ EXPENSIVE
- LESS ECOLOGICAL CO-BENEFIT
- LESS SOCIAL CO-BENEFIT
- EFFICIENTLY TRANSPORTS WATER



GREEN INFRASTRUCTURE

- $$ EXPENSIVE
- PROVIDES URBAN HABITAT
- PROMOTES BIODIVERSITY
- PROTECTS WATER BODIES
- ADDS GREEN SPACE AMENITIES
- BEAUTIFIES NEIGHBORHOODS
- RETAINS STORMWATER
- WATER INFILTRATES INTO SOIL
- LESS WATER ENTERS SEWERS

GRAY

Gray infrastructure consists of all of the pipes, sewers, storage tanks and tunnels, and other human-made water conveyance and storage strategies that move and store stormwater in the City of Milwaukee. Gray infrastructure plays an essential role in the way our city functions – we need gray infrastructure systems to help us efficiently collect and clean our water and prevent flooding events. However, gray infrastructure has its limits, and is very expensive to build, maintain, and replace over time.

Gray infrastructure transports water efficiently, but it does so in a way that is largely out of site and out of mind (if it's working well). It does not have as many significant social co-benefit beyond its essential role of storing and conveying water. Beyond the essential role that our gray infrastructure plays in filtering water before it enters Lake Michigan, it also does not contribute to the ecological health of Milwaukee in the same way that green infrastructure does.

WE NEED BOTH

&

GREEN

According to the United States Environmental Protection Agency, green infrastructure is a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits. While single-purpose gray stormwater infrastructure – conventional piped drainage and water treatment systems – is designed to move urban stormwater from the built environment, green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits.

Green infrastructure manages water where if falls by slowing it down, retaining it, filtering it, and allowing it to infiltrate into the ground instead of entering the sewer system. Though green infrastructure strategies can be expensive to implement and require ongoing maintenance, they can be a cost effective alternative to building ever larger sewers while also providing critical ecological and social co-benefits.

IMPACTS OF GREEN INFRASTRUCTURE

Green Infrastructure offers triple bottom line benefits of sustainability: environmental, economic, and social.

Environmental

Not only does green infrastructure make Milwaukee more resilient to future climate change-related weather events, it can help reduce urban heat. Concrete and asphalt retain heat and can make urban areas significantly hotter than their rural or suburban neighbors. Removing impervious surfaces to implement green infrastructure can reduce this "heat island" effect. Replacing hardscape with green space increases the amount of plants available to sequester atmospheric carbon, reducing the greenhouse effect and improving air quality.

These new green spaces also provide habitat for native plant and animal species. For example, green infrastructure along Lake Michigan can improve coastal habitat for the threatened rufa red knot bird. Bioswales and rain gardens with native flower species can help save the highly endangered rusty patched bumble bee that once called Milwaukee home.

Economic

Depending on the particular stormwater needs, green infrastructure can be more cost-effective than adding traditional gray infrastructure. It can reduce the burden on existing sewer infrastructure, leading to lower maintenance costs for the City. Those with properties along Milwaukee's tributaries and rivers can experience significant economic loss from flooding. Green infrastructure can help reduce this risk and prevent damage, leading to increased property values and improved community aesthetics. Finally, widespread green infrastructure creates jobs, helping the hardworking people of Milwaukee grow and thrive in green career paths.

Photo credit: Clean Wisconsin and MMSD

Installing aquablocks at UW-Milwaukee Sandburg Hall
Photo credit: Milam Smith

Social

Implementing green infrastructure makes Milwaukee a better place to live, work, and visit. Green infrastructure can prevent pollutants from entering our waterways and filter carbon dioxide from the air we breath, making us less vulnerable to related illnesses. Added green space also allows for increased outdoor physical activity which can reduce incidences of obesity, diabetes, and heart disease. The **EPA EnviroAtlas Eco-Health Relationship Browser** demonstrates the various ways environmental services like stormwater management affect human health. Exposure to nature makes people feel calmer and less stressed. It increases likelihood of positive social engagement in our communities, and improves people's moods. Even the sounds of nature have been shown to have a calming effect, dampening the noise pollution of urban life.

Triple Bottom Line Co-benefits for Green Infrastructure Strategies

High
Medium
Low
None

Triple Bottom Line of Sustainability	Co-benefits	Bioswales & Regenerative Stormwater Conveyance (RSC)	Green Roofs / Blue Roofs	Greenways & Land Conservation	Native Landscaping	Permeable Pavement	Rain Gardens	Rain Barrels, Cisterns & BaseTerns (Rainwater Catchment)	Depaving (Removal of Pavement & Structures)	Soil Amendments	Stormwater Trees	Downspout Disconnect
Economic	Initial Cost Of Investment	Medium	High	Medium	Low	Medium	Low	Medium	Medium	Medium	Low	Low
	Cost Of Operations & Maintenance	Medium	Medium	Medium	Low	Medium	Low	Low	None	Low	Low	Low
	Job Growth	High	High	Medium	Low	Medium	Low	Low	Low	Low	Low	None
	Property Value Increase	High	Low	High	High	Low	High	Low	Low	Low	High	None
	Existing Gray Infrastructure Relief	Medium	Low	Low	Low	Low	Low	Low	Low	Low	Low	Medium
Social	Potential To Reduce Crime Through Design	High	Medium	High	Medium	Low	High	Low	Low	None	High	None
	Recreation / Education Opportunities	High	Low	High	Medium	Medium	High	Medium	Low	Low	Medium	None
	Community Connectedness	Medium	Low	High	Low	Low	Low	Low	Low	Low	Medium	None
Environmental	Water Quality Improvement	High	None	Low	None	Medium	Medium	None	Low	None	None	Medium
	Energy Savings	Medium	High	None	Low	None	Low	None	None	None	Medium	Medium
	Urban Heat Island Reduction	Medium	Medium	Medium	Low	None	Low	None	Medium	None	High	None
	Habitat Improvement	High	High	High	High	Low	High	Low	High	High	High	Medium
	Air Quality Improvement	High	Low	Low	Medium	None	Medium	None	Low	None	High	None

TYPES OF GREEN INFRASTRUCTURE

Several green infrastructure technologies can be employed for stormwater management, each with their own advantages and limitations. But the effectiveness of their application depends on project-specific factors like stormwater management needs, design conditions, surrounding landscape, and built environments. These green infrastructure practices can be implemented in conjunction with each other to maximize their environmental, economic, and social benefits. Therefore, each project must be considered independently to determine which combination of green and gray infrastructure elements would be most efficient.

Rain Barrels & Cisterns

Rainwater harvesting systems like rain barrels or cisterns collect and store rainfall for later use. A typical rain barrel will store 50 gallons of water, often used by homeowners to water their gardens during a period when no rain is falling. When they are full, most systems will need to be drained to allow space for more rainfall. MMSD's recent Rain Barrel Program distributed more than 20,000 barrels – enough to capture and store one million gallons of water. A cistern, on the other hand, can range in size from tens to thousands of gallons. Many rely on pumps to reuse the harvested water.

Rain Gardens

Rain gardens (also known as bioretention or biofiltration cells) are shallow basins with native vegetation that collect and absorb runoff from rooftops, sidewalks, and streets. Rain gardens mimic natural hydrology by infiltrating and evapotranspiring runoff. Rain gardens are versatile features that can be installed in almost any unpaved space.

Native Landscaping

Native plants are adapted to the local climate and can tolerate drought and flooding cycles. Incorporating native landscaping into Milwaukee's urban area, especially in conjunction with other green infrastructure strategies, provides a way to enhance water infiltration and absorption into the landscape while also improving urban habitat for wildlife and beautifying neighborhood spaces. Many plants traditionally used in landscaping (like privet, English ivy, Japanese honeysuckle, or Chinese wisteria), can become invasive if spread to other green spaces. Choosing native landscaping can help maintain healthy ecosystems in the City's existing parks and gardens.

Permeable Pavement

Permeable pavement is any paved surfaces that infiltrates, treats, and/or stores rainwater where it falls, such as pervious concrete, porous asphalt, permeable interlocking pavers, and several other materials. These pavements are particularly cost-effective where land is highly developed with little or no space for stormwater detention and where flooding or icing is a problem. While permeable pavement is an allowable green infrastructure strategy, this plan prioritizes vegetated green infrastructure strategies where possible.

Bioswales

Bioswales are vegetated or mulched channels that provide water treatment and retention as they move stormwater from one place to another. Vegetated swales slow, infiltrate, and filter stormwater. They are particularly suitable along streets and parking lots due to their linear shape, but will require maintenance to remove weeds and litter that accumulate there to ensure proper drainage.

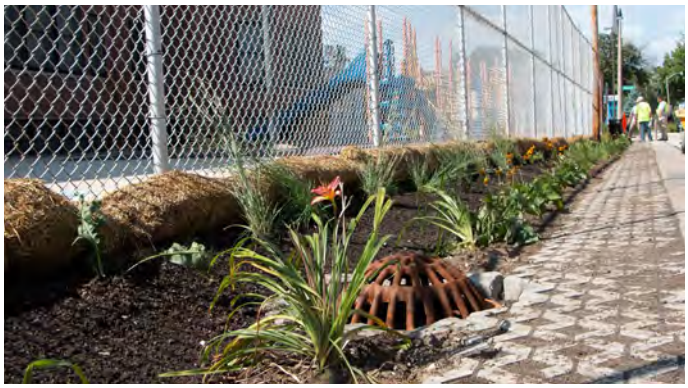
Stormwater Trees

Trees manage stormwater in a variety of ways. They soak up stormwater through their roots and provide surface area for water to evaporate directly from leaves and branches. The ReFresh Milwaukee calls to double the City's tree canopy. Home and business owners can help reach this goal and manage stormwater by planting and maintaining trees throughout Milwaukee.

Regenerative Stormwater Conveyance

Regenerative stormwater conveyance (RSC) involves a series of pools and riffles designed to convey and treat stormwater runoff. RSC is a low impact development alternative to bioswales, pipes, and retention/detention structures. RSC uses native plants to slow stormwater and control erosion as water travels down sloped land, reducing or eliminating the need for downstream detention.

Photo credit: Stormwater Solutions Engineering

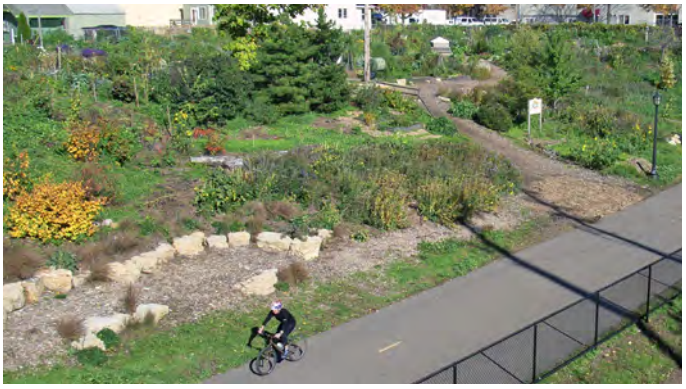


Depaving

Depaving is the practice of removing excess impervious surfaces and replacing it with absorbent landscaping. Depaving is often done preceding the installation of permeable pavement, native landscaping, or absorbent turf. This practice can mitigate stormwater runoff, allow for natural infiltration, and increase aesthetic appeal. Property owners can decrease their annual Stormwater Management Fees by depaving parts of their land.

Green Streets & Alleys

Green streets and alleys integrate multiple green infrastructure elements, such as permeable pavement, bioswales, planter boxes, and trees. Streets represent over 20% of the total area in Milwaukee. Implementing a combination of green infrastructure practices when upgrading, replacing, or maintaining the City's right-of-way has potential to sustainably manage stormwater while also beautifying our communities.



Greenways & Land Conservation

Greenways are strips of land that store and drain stormwater runoff into the ground naturally. Greenways are often implemented along rivers and tributaries as a buffer to prevent bank erosion and filter pollutants before they enter our waterways. Protecting open spaces and sensitive natural areas within and adjacent to cities can mitigate flooding impacts of urban stormwater and improve water quality while providing recreational opportunities for city residents. Natural areas that are particularly important in addressing water quality and flooding include riparian areas, wetlands, and steep hillsides.

Green Roofs

Green roofs are partially or completely planted with vegetation, thus enabling rainfall infiltration and evapotranspiration of stored rainwater. Green roofs are particularly cost-effective on large industrial or office buildings where stormwater management costs may be high or land availability for other methods is low. They provide additional benefits such as natural habitat, and aesthetic appeal.

Soil Amendments

Soil amendments are materials added to improve overall soil quality, enhance re-vegetation, and bolster the soil's ability to infiltrate and absorb water. Milwaukee has been using soil amendments in vacant City lots to repurpose them into healthy, usable green spaces. Strategic plant choice can also be used to amend soil composition in a process called phytoremediation.

Blue Roofs

Blue roofs are non-vegetated systems that are designed to passively or actively collect stormwater through control devices. A blue roof system detains rainwater directly on a rooftop and slowly releases that water to the sewer system, allowing for some evaporation. The collected water can be used for irrigation or rain gardens, or it can be slowly discharged into the sewer system. Blue roofs are most effective when installed on relatively flat surfaces, such as industrial buildings. While allowed, this plan prioritizes vegetated green infrastructure strategies.

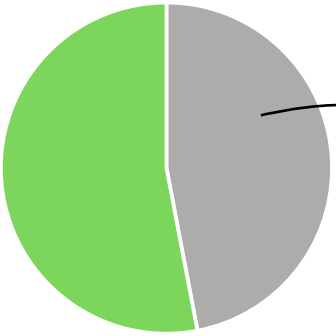
MILWAUKEE'S GREEN INFRASTRUCTURE

MMSD and the City of Milwaukee have made significant investments in green infrastructure on both public and private property throughout the City. These projects help address stormwater on these properties specifically, but also contribute to the overall health of our shared watersheds.

The **Green Infrastructure Baseline Inventory (GIBI)** was developed to achieve ReFresh Milwaukee's Water Chapter goal of measuring impervious surface and green infrastructure in the City. The GIBI does not establish green infrastructure targets but rather provides an overview of known citywide green infrastructure installations as of 2015.

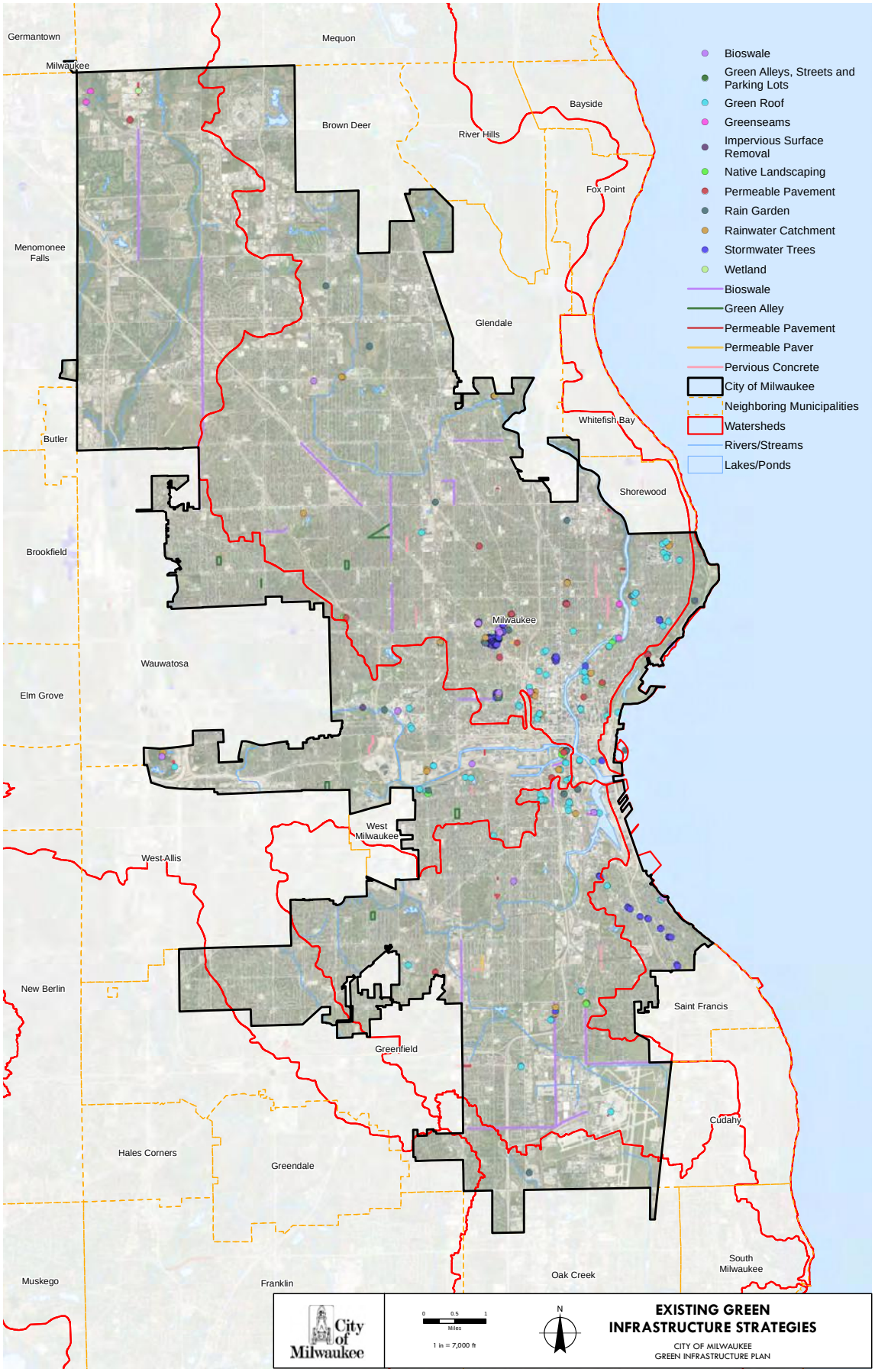
The GIBI report also provided valuable information regarding the amount of impervious surface throughout the City, categorized by what the space is used for and whether the space is public or private. The report revealed three major impervious surface types – streets, parking lots, and vacant lots--each with ample opportunity to implement green infrastructure and each requiring their own unique strategies for doing so.

Milwaukee is
96.6
square miles
in total



47%
of Milwaukee's total land area is impervious surface

Radio Milwaukee Green Roof
Photo credit: MMSD


Germantown
Mequon
Milwaukee
Brown Deer
River Hills
Bayside
Fox Point
Menomonee Falls
Glendale
Whitefish Bay
Butler
Shorewood
Brookfield
Milwaukee
Wauwatosa
Elm Grove
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
South Milwaukee
Muskego
Franklin
Oak Creek
Bioswale
Green Alleys, Streets and Parking Lots
Green Roof
Greenseams
Impervious Surface Removal
Native Landscaping
Permeable Pavement
Rain Garden
Rainwater Catchment
Stormwater Trees
Wetland
Bioswale
Green Alley
Permeable Pavement
Permeable Paver
Pervious Concrete
City of Milwaukee
Neighboring Municipalities
Watersheds
Rivers/Streams
Lakes/Ponds
City of Milwaukee
0 0.5 1
Miles
1 in = 7,000 ft
N
EXISTING GREEN INFRASTRUCTURE STRATEGIES
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN

Pabst Brewery
Photo credit: MMSD

POLICIES & INITIATIVES

As the City of Milwaukee grows, it's important that our policies evolve to reflect the work of the City and its partners. Green infrastructure is a key piece in Milwaukee's sustainable future; revising the City's policies and creating new initiatives is a clear commitment to making that future a reality.

Stormwater Management Plans

The Common Council passed revisions to City Ordinance Chapter 120 (CCFM 180803), consistent with the Green Infrastructure Plan Framework. The existing Chapter 120 rules established stormwater management regulations and required developers to submit a stormwater management plan on any development or redevelopment that...

- Disturbs one acre (43,560 ft^2) or more;
- Disturbs one acre (43,560 ft^2) or more over a three year period; or
- Increases impervious surfaces by 0.5 acres (21,780 ft^2).

The Purpose of the Chapter was expanded to promote the co-benefits of visible green infrastructure, including reduction of urban heat island effects, improvements to human health, city beautification, and protection of coastal areas; and help the city adapt to climate change and become more resilient to climate threats.

The Common Council's revisions to Chapter 120 now prioritize green infrastructure when developing a stormwater management plan. Green infrastructure is now required whenever developers submit a mandated stormwater management plan. The development must include a detention volume

equal to at least one half inch multiplied by the total area of new or redeveloped impervious surface. While permeable pavements and porous asphalt are allowed under the code, the City would like to emphasize green infrastructure strategies that add plants and vegetation.

City Support for MMSD Action on Green Infrastructure at Regional Level

Water connects us all. Local action benefits not just Milwaukee, but also all the cities that depend on Lake Michigan to survive. The health of our watershed rides on the shared successes of many communities working towards a singular goal. MMSD has worked diligently to protect public health and drinking water for 1.1 million people throughout the Greater Milwaukee Area, capturing and cleaning wastewater from 28 communities. Their dedication to innovative green infrastructure and thoughtful collaboration is integral to the success of Milwaukee, the region, and all of Lake Michigan. The City of Milwaukee fully supports MMSD's continued work to protect the health of our watershed through green infrastructure.

The City's Chapter 120 is subordinate to the MMSD Chapter 13 rules for managing stormwater quantity for development projects. MMSD Chapter 13 has additional requirements for reducing rates of runoff on redevelopment sites 2 acres or larger, regardless of added impervious surface. In 2019, MMSD has updated Chapter 13 to lower the threshold for applicability from ½ acre to 5,000 square feet of new impervious area. The City of Milwaukee will update its Chapter 120 accordingly to accomodate this change.

PROJECT HIGHLIGHT:

Fondy Park

Fondy Park used to be a vacant lot next to a farmers' market pavilion in the Lindsay Heights neighborhood of Milwaukee. HOME GR/OWN worked with UWM's Community Design Solutions to create a preliminary design for a community eco-park and town commons – Phase 1 construction began in 2017. With local partners, including Walnut Way Conservation Corps and their Blue Skies Landscaping program, the park has become a model for community-driven climate change resilience and beautiful green infrastructure. The park includes bioswales, stormwater trees, and a stormwater cistern, all of which collect water from the roof of the farmer's market as well as from the street. Find out more about Fondy Park here:

milwaukee.gov/homegrownmilwaukee/FondyPark

Photo credit: Timothy McCollow

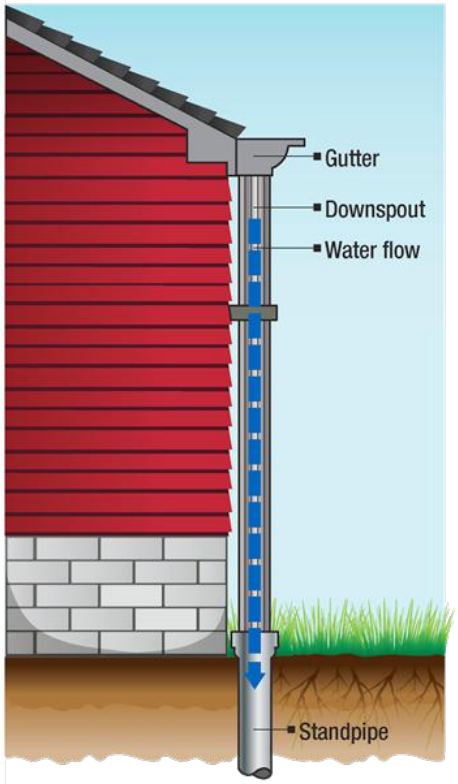
Updates to Plumbing & Drainage Code

In 2017, ECO in collaboration with the Department of Neighborhood Services and Stormwater Solutions Engineering, LLC completed a review and analysis of City Code in Chapter 225, which covers City regulation on plumbing and drainage. Based on their recommendations, updated language was integrated into the existing code to make the permeable pavement design and approval process more seamless, and to allow permeable pavement in lieu of catch basins every 300 feet. The Common Council adopted these changes in 2017 (**CCFN #170818**).

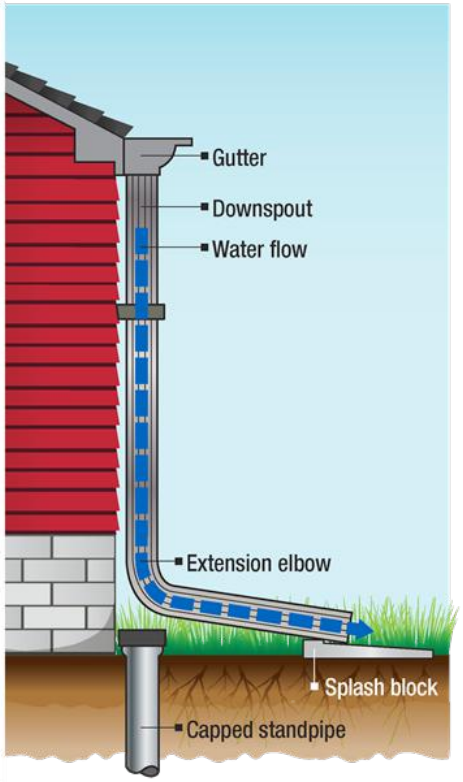
Downspout Disconnections

Many homes in Milwaukee have gutters and downspouts that drain directly into the sewer system through a standpipe. This can result in a significant amount of rainwater entering the sewer system during a large rain event. When these homes are in an area served by the combined sewer system, a large amount of rainwater entering the system can quickly cause issues with street flooding, basement sewage backups, and sewage overflows into neighboring waterways and Lake Michigan.

MMSD has created a policy to combat this issue and reduce the amount of rainwater entering the combined sewer system during a large rain event. Homes that fall within the combined sewer system boundary are required to disconnect their downspouts from the standpipe that leads directly to the sewer and instead direct the rainwater away from the house to an adjacent grassy area, when such a green space is available. The City will disconnect when practicable; downspout disconnection depends on the ability of a property owner to do so safely and without causing a stormwater nuisance. The City of Milwaukee Department of Public Works and the Department of Neighborhood Services began work on this program early in 2019 and properties within the Combined Sewer Area have been notified about the new legislation. Information on the City's Downspout Disconnection program is available at **milwaukee.gov/DDP**



Downspout connected to the sewer system



Downspout disconnected from the sewer system

Image source: City of Milwaukee

Landscaping on Commerical Property

Milwaukee zoning code in Chapter 295 provides landscaping and screening requirements for parking lots, outdoor storage areas, contractors' yards, and loading docks. In 2019, the Department of City Development (DCD) revised Chapter 295, simplifying the code and allowing for a broader range of landscaping and green infrastructure options on parking lots. These changes will help reduce the amount of impervious pavement in the city, increase the amount of trees and green space, and encourage the use of green infrastructure. ECO is working with DCD to align ECO's neighborhood beautification programs with these new standards. The Common Council adopted these changes in March of 2019 (**CCFN #181520**).

Green Streets Stormwater Management Plan

The City of Milwaukee's Department of Public Works has been installing green infrastructure since 2008 as a matter of practice. In 2010 the Milwaukee Flooding Task Force recommended the City develop policies to incorporate green technologies into street development projects. In March of 2013, the City published the **Green Streets Stormwater Management Plan.** This document provides an extensive overview of locally-specific stormwater strategies to improve water quality and reduce polluted stormwater runoff in the City's streets and alleys. This creates a system whereby every street and alley reconstruction project is systematically evaluated for green infrastructure opportunities, and allows the City to utilize the public right-of-way for multiple benefits including climate change resilience, improved air and water quality, reduced heat island effect, neighborhood beautification, and improved drainage.

Stormwater Management Credits

The City uses the Stormwater Management Charge (Milwaukee Code of Ordinances 309-54.5) to offset the cost of managing polluted stormwater runoff that enters Milwaukee's storm sewers and waterways. The Stormwater Management Charge is based on an "Equivalent Residential Unit" in which all residential properties are charged a uniform fee per residential unit and commercial properties pay a fee based on their actual amount of impervious surface on their property. Commercial property owners can reduce their fee by removing unnecessary impervious surfaces or using the City's **stormwater credit worksheet**. During the development of the Green Infrastructure Plan Framework, multiple stakeholders indicated that one-time grants to defray the upfront costs of installing green infrastructure were more impactful and financially sustainable than enhancing the stormwater credit structure.

Green Infrastructure Mapping

In an effort to track progress, the City of Milwaukee has included Green Infrastructure investments and other stormwater management planning features into **Map Milwaukee**, an ESRI based mapping application. In addition to existing green infrastructure, users are also able to map government owned property, foreclosed properties in the city, the FEMA floodplain, basement backups, watersheds and rivers, past DPW paving projects, parks, and the combined sewer area. Milwaukee partners have also come together to offer the **Milwaukee Community Map**, a Google Earth based map that features community water stories.

Miranda from Reflo's Water Story MKE

Green Schools

Green infrastructure can directly improve the lives of children, especially on schoolyards that include large areas of impervious surfaces. The City of Milwaukee has formalized a partnership with Milwaukee Public Schools (MPS) to advance green infrastructure in school and schoolyard capital improvement projects. Working with MPS and the Green Schools Consortium of Milwaukee, MMSD, and the Fund for Lake Michigan (FFLM), the City has pledged $600,000 annually to support 4-5 green schoolyard projects per year. Participating schools will remove excess asphalt and pavement and replace it with functional green space. The Green Schools Consortium of Milwaukee has created a model program that designs and implements green schoolyards and outdoor classrooms while integrating these features with environmental education. The City of Milwaukee and FFLM are also funding a new Sustainability Projects Specialist position to lead sustainability efforts for schoolyards and playfields at MPS, thus insuring similar projects continue into the future. In 2019, partners secured funding from the Funders' Network for Smart Growth and Livable Communities as part of their Partners for Places program to accelerate adoption of green schoolyards and outdoor classrooms at Milwaukee Public Schools.

In 2019, the following Milwaukee Public School will begin implementing green infrastructure on the schoolyards at Burdick, Hawley, Longfellow, and Starms Early Childhood Center as well as on some MPS-owned playfields.

Photo credit: Reflo

Photo credit: MMSD

Commercial Property Grant Program

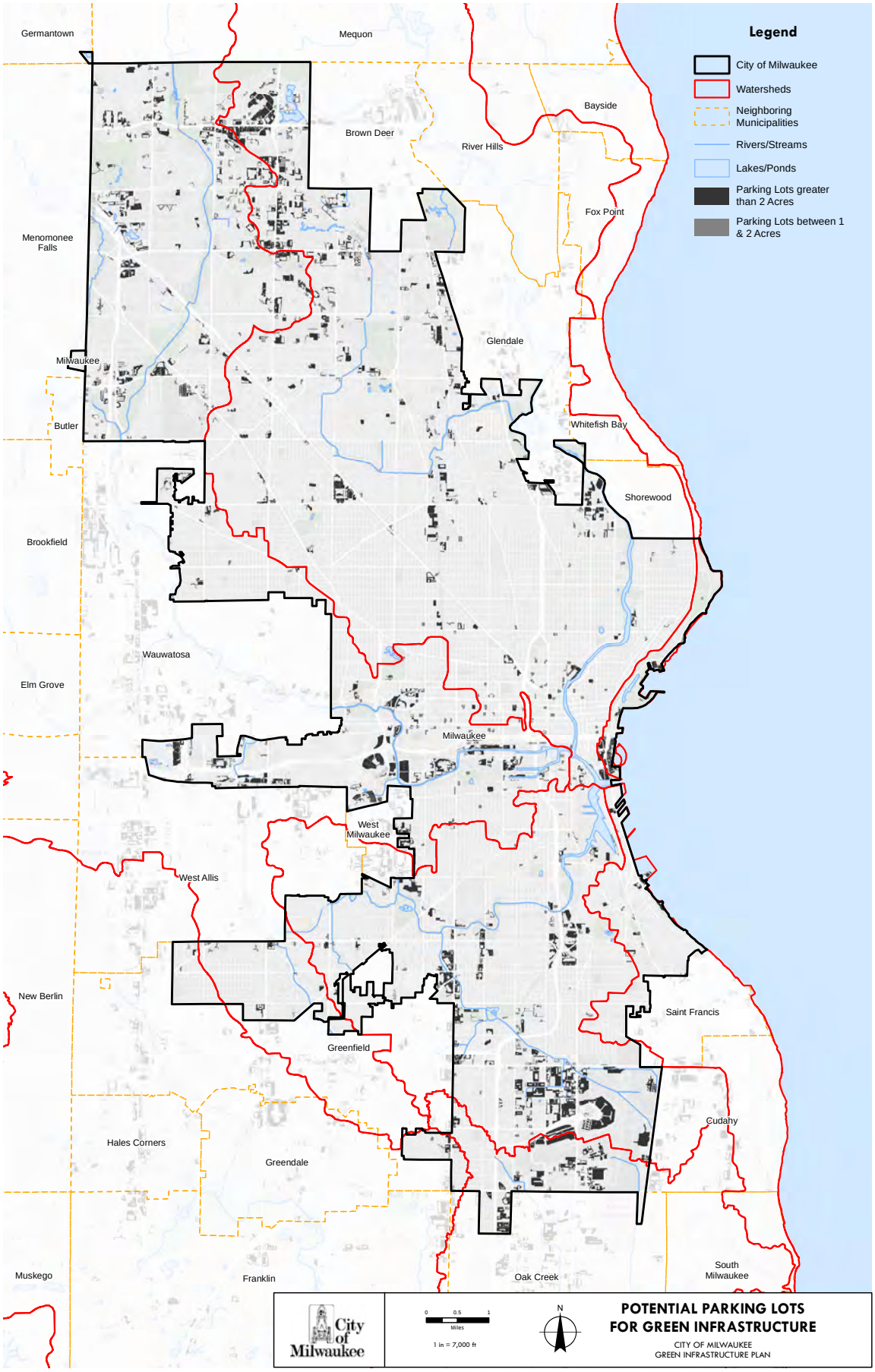
Parking lots represent a considerable percentage of the total impervious surface in the City of Milwaukee. While providing adequate customer parking is necessary for businesses to compete and grow, this vast quantity of concrete and asphalt presents an environmental challenge in managing stormwater.

Starting in the summer of 2019, the City of Milwaukee will offer grants to implement green infrastructure in commercial property. Applicable properties must be non-residential and currently paved with non-porous asphalt or cement. Examples of qualifying green infrastructure include rain gardens, bioswales or bioretention areas, native plants and landscaping, storm water trees, de-paving parking lots, green roofs, and engineered wetlands.

This program can provide funds for projects exceeding $25,000. Funds are provided as a reimbursement following successful completion of the project within 2 years of project approval and a signed ten year conservation easement with MMSD.

Additional program details and application requirements can be found at:

milwaukee.gov/GreenLots


Legend
City of Milwaukee
Watersheds
Neighboring Municipalities
Rivers/Streams
Lakes/Ponds
Parking Lots greater than 2 Acres
Parking Lots between 1 & 2 Acres
Germantown
Mequon
Bayside
Brown Deer
River Hills
Fox Point
Menomonee Falls
Glendale
Milwaukee
Butler
Whitefish Bay
Shorewood
Brookfield
Wauwatosa
Elm Grove
Milwaukee
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
Muskego
Franklin
Oak Creek
South Milwaukee
City of Milwaukee
0 0.5 1
Miles
1 in = 7,000 ft
N
POTENTIAL PARKING LOTS FOR GREEN INFRASTRUCTURE
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN

ECO INNOVATIONS

Eco Design Guidelines

The **Eco Design Guidelines** were created to guide commercial building developers and owners with guidance on incorporating sustainability practices into their buildings. The guidelines promote and encourage environmentally responsible building practices by recognizing ecological context, promoting access to waterways, and improving existing infrastructure (sidewalks, streets, storm drainage). Sustainable site designs include the use of green infrastructure and natural landscaping to address water quality, quantity and floodplain issues, soil erosion, open space that provides recreation, wildlife habitat, and cultural and neighborhood connections.

Vacant Lot Solutions: HOME GR/OWN Initiative

The City of Milwaukee currently owns approximately 2,900 vacant lots. These spaces, if underutilized, can be an economic drain on taxpayers and diminish the aesthetic of our neighborhoods and commercial corridors. Recognizing the potential of these vacant lots, the City created the **HOME GR/OWN** initiative to transform them into green space and promote economic development in support of Mayor Barrett's Strong Neighborhoods Plan.

HOME GR/OWN has incorporated green infrastructure on a number of sites, including **Fondy Park**, which won a "Green Luminary" award from the Milwaukee Metropolitan Sewerage District. HOME GR/OWN is intentional about working with local groups such as Walnut Way's Blue Skies landscaping and Groundworks Milwaukee to employ workers from these neighborhoods.

BaseTern Stormwater Catchment Pilot Program

The City of Milwaukee is developing cost-effective and innovative approaches for managing stormwater to help neighborhoods be more resilient to extreme storm events. One approach is the **BaseTern**, an underground stormwater management or rainwater harvesting structure created from the former basement of an abandoned home that has been slated for demolition. By using this existing basement cavity, the City saves on demolition costs of the old structure and the construction of the new one. The structures would be underground and covered with turf to fit safely within the neighborhood. The preliminary prototypes can hold as much water as 600 hundred rain barrels.

Northwestern Mutual Green Roof
Photo credi: MMSD

PRIORITY LOCATION ANALYSIS

Priority Subbasins For Strategic Implementation

The map analysis on page 31 can be used to identify priority subbasins for strategic green infrastructure investment – for private and public infrastructure as well as redevelopment projects.

Each watershed is made of a number of subbasins, or smaller drainage areas that drain into streams or tributaries, and ultimately into the watershed's primary waterway. Each subbasin in a watershed has its own unique physical features which may cause different green infrastructure technologies to vary in impact. This spatial analysis was performed in a geographic information system using a range of data sources and is intended to help clarify these distinctions.

The analysis focuses on twenty-four factors as part of the larger analysis. The factors and associated weights for analysis are detailed on page 30. All the subbasins within the City's municipal boundary were ranked by level of impact (opportunities and benefits) as part of the analyses for this effort – from "Medium-Low Area of Impact" to "Highest Area of Impact." Maps in the appendix highlight some of this critical data and can be used as tools when evaluating areas or specific projects for green infrastructure. The rankings are critical for City staff, policy makers, and private investors to consider when integrating green infrastructure investments into re/development sites or retrofitting existing sites in the city.

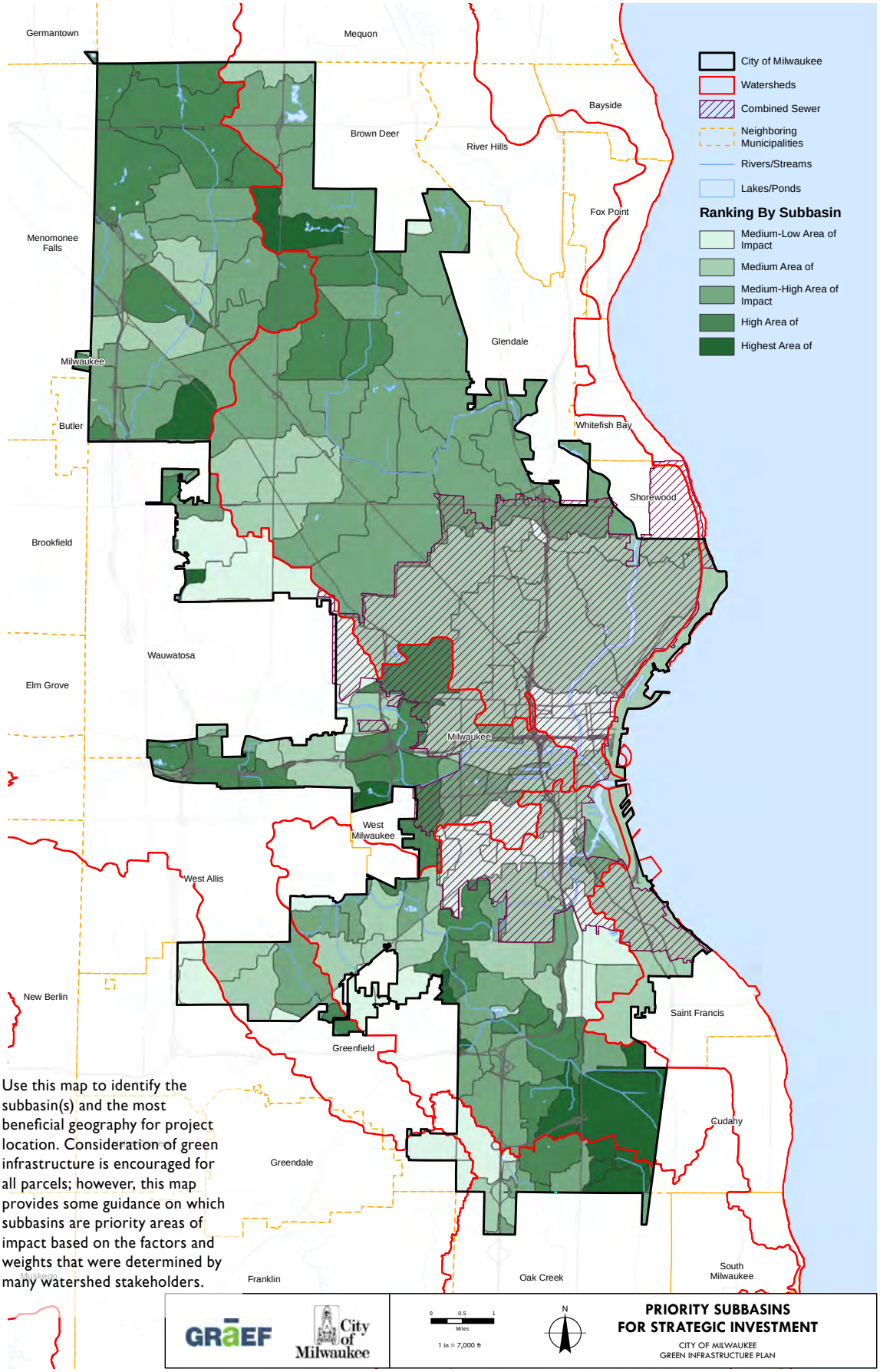
This study has some limitations in that it does not include the water quality measure of total suspended solids (TSS). This is a measure of sediment loads which contain contaminants such as phosphorus and bacteria in stormwater discharge, making it a highly relevant measure to consider for water quality in highly urbanized areas like Milwaukee. This measure has not been included, as its level of effort for inclusion was beyond the scope of this study. These measures are considered at the next level of implementation planning for stormwater management. TSS may also be considered as part of additional high-level green infrastructure planning efforts in the future.

Additionally, average parcel size of a subbasin may have an effect on calculated priority. Based on the nature of the model, larger areas are statistically more likely to contain the various environmental and community elements weighted as high-priority. This average of rankings is a common limitation when conducting spatial data analysis of non-uniform parcels.

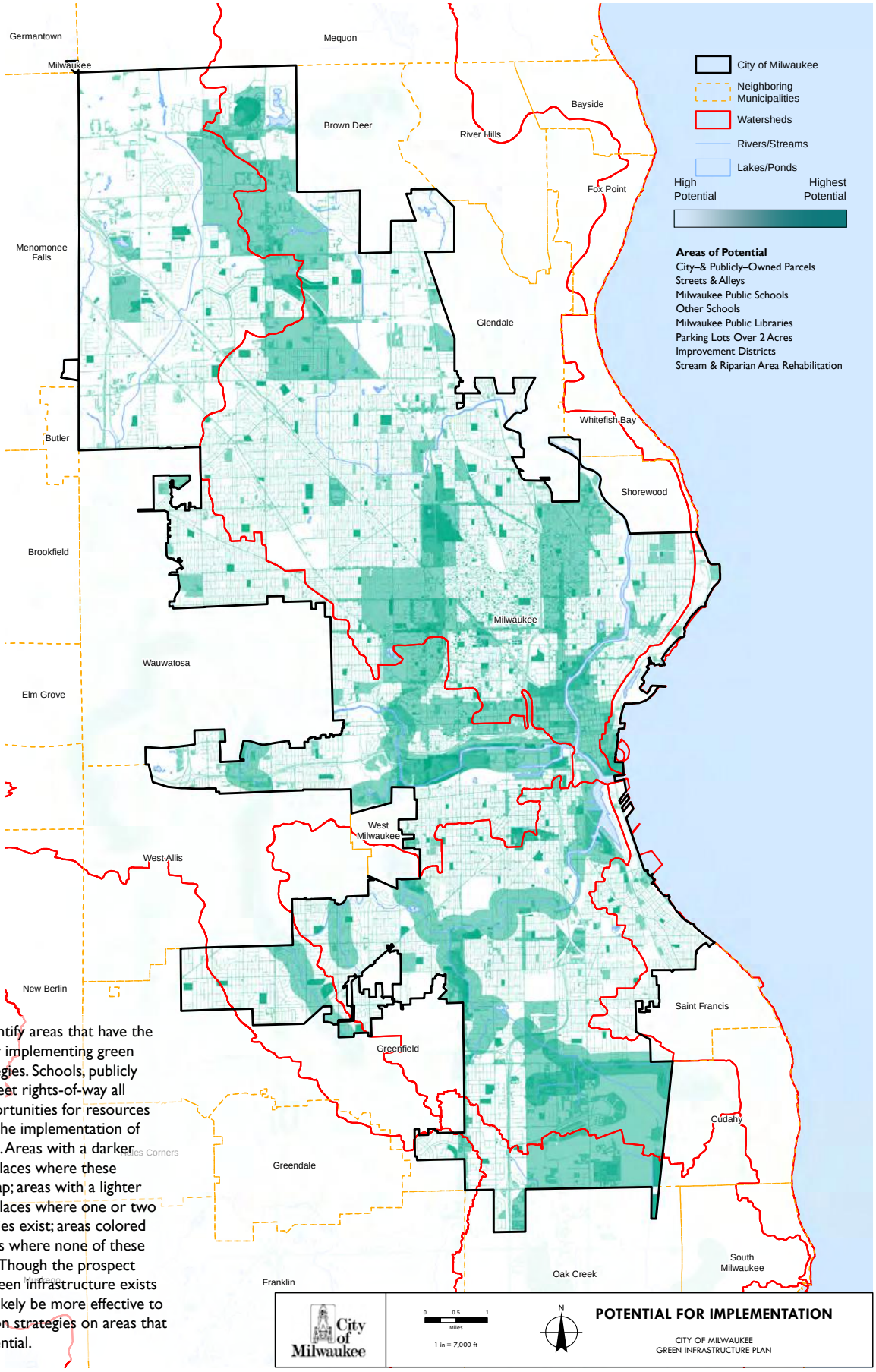
While some subbasins rank as lower priority, this does not indicate that green infrastructure should not be pursued. There are many critical co-benefits of green infrastructure to be considered, that were not factored into this analysis for a variety of reasons (typically the unavailability of data) but they should be considered when making decisions on redevelopment, capital improvement, or other physical projects.

Subbasin Prioritization Analysis Factors & Weights

FACTORS	REASON FOR CONSIDERATION	WEIGHT
Areas without Tree Canopy (environmentally impaired)	Improves habitat and air quality needs for groundwater recharge, road salt reduction, noise pollution reduction, atmospheric CO2, energy use, and urban heat island effect, health concerns (asthmas)	4
Improvement Districts (Business & Neighborhood – BIDs & NIDs)	Builds on momentum of organized property owners, grows understanding and demand for GI, leverages opportunities for coordinated maintenance	3
City of Milwaukee Parks	Creates new park amenities where there are large open spaces	5
City-Owned properties	Opportunities for public implementation and on-going maintenance	5
City-Owned vacant lots	Opportunities for public implementation and on-going maintenance	5
Community Development Block Grant Areas (CDBGs)	Builds on momentum of organized property owners, grows understanding and demand for GI, leverages opportunities for coordinated maintenance	3
Depth to Bedrock Over 25 Feet	Areas without high bedrock are more ideal for infiltrating green infrastructure	5
Depth to Groundwater Over 6 Feet	Areas without high groundwater are more ideal for infiltrating green infrastructure	5
Impervious Surface	Parcels that are more heavily impervious surface could be prime opportunity sites for green infrastructure on-site	>75% = rank 4 50% to 75% = rank 3 <50% = rank 2
Known Stormwater Issue Areas	GI could reduce ponding and basement backup risk by managing a portion of wet-weather flow	3
Milwaukee Public Libraries	Opportunities for public implementation and on-going maintenance	5
Milwaukee Public Schools	Cultivates public education opportunities (about the environment and understanding/acceptance/ demand/support for GI)	5
Non-Brownfields	Brownfield areas are generally less ideal for ground infiltrating green infrastructure (liners are needed in these instances) – non-infiltrating strategies are preferred on brownfield sites	1
Outside of High Infiltration and Inflow Area	High levels of stormwater in sanitary sewer pipes indicate higher sewer inflow and infiltration rates – green infrastructure could help these areas by disconnecting downspouts and directing to green infrastructure	2
Outside of High Inflow Areas to the Deep Tunnel	Green infrastructure could reduce inflow to the Deep Tunnel by managing a portion of wet-weather flow	2
Parking Lots (2 acres and larger)	Large areas of parking lots can be targeted to be retrofitting with green infrastructure to address surface flows	5
Potential Drainage Problem Areas	Historic stream locations can be correlated with increased surface flooding potential — GI could help by managing a portion of wet-weather flow	3
Potential Stream Corridor Rehabilitation Areas	Opportunities for planned implementation to improve waterways and improve adjacent riparian and habitat areas	3
Schools	Cultivates public education opportunities (about the environment and understanding/acceptance/ demand/support for GI)	4
Selective Sewer Separation Opportunities	Opportunities for planned implementation and complements projects by reducing pollutants	2
TMDL Areas	Areas identified by the Wisconsin DNR as TMDL (or, Total Maximum Daily Load) Priority Areas.	5
Slopes Less Than 5%	Positive conditions for green infrastructure (higher slopes are less ideal for GI)	3
Vacant Land	Opportunities for easy implementation, focusing on vacant land solely dedicated to GI implementation	3



Use this map to identify the subbasin(s) and the most beneficial geography for project location. Consideration of green infrastructure is encouraged for all parcels; however, this map provides some guidance on which subbasins are priority areas of impact based on the factors and weights that were determined by many watershed stakeholders.



Use this map to identify areas that have the highest potential for implementing green infrastructure strategies. Schools, publicly owned land, and street rights-of-way all present strong opportunities for resources to be allocated for the implementation of green infrastructure. Areas with a darker teal color indicate places where these opportunities overlap; areas with a lighter teal color indicate places where one or two of these opportunities exist; areas colored white indicate places where none of these opportunities exist. Though the prospect for implementing green infrastructure exists everywhere, it will likely be more effective to focus implementation strategies on areas that have significant potential.

Potential for Implementation

There are many layered opportunities to collaboratively implement green infrastructure with partner organizations, private property owners, and developers to garner shared impacts. This map demonstrates these opportunities, by considering public capital improvement potential, quantity of impervious area, and local stakeholder involvement. The following sections describe these factors in greater detail.

City & Other Publicly–Owned Land

The City holds dedicated funding for green infrastructure on public property like City facilities, Department of Public Works facilities, schools, and City-owned parks. Implementing green infrastructure on public lands has a high likelihood of long-term investment and successful maintenance. Targeting public land is a great way to make green infrastructure accessible and visible to the community and, therefore, should be considered when making decisions.

Streets & Alleys

Although some streets are owned and managed by other public entities, the City has jurisdiction over streets and public alleys of a variety of sizes. As these spaces are upgraded and maintained, the City's Department of Public Works is committed to incorporating green infrastructure into these capital improvement projects when it is technically feasible to do so. Space constraints, utilities, and ground slope all must be taken into account when evaluating these areas for green infrastructure.

Schools & Libraries

Every chapter of ReFresh Milwaukee calls on the City to create better connections to our educational institutions. Schoolyard green infrastructure is an essential step towards that and several other Water Centric City goals. Milwaukee Public Schools own more impervious land within Milwaukee's combined sewer service area than any other building owner. These gray spaces do not provide students and teachers with the natural resources they need to play, learn, and grow. There is often little green space available for teachers to take class outside and help students explore their environment. Large rain events can cause stormwater to puddle and freeze, making it dangerous for children to play. This is the case with many urban schools around the country but green infrastructure can help transform these spaces into inviting and vibrant nature-inspired landscapes. In doing so, we can efficiently manage large amounts of stormwater while also providing countless co-benefits to the students, their families, and the surrounding community.

Research shows exposure to nature promotes social and emotional skills like cooperative play and positive relationship building. It can reduce aggression and discipline problems, improve their attention and behavior, increase students' engagement and enthusiasm for learning, and even provide mental and physical health benefits. This can support better academic performance.

Reflo's Green Schools Consortium of Milwaukee (**gscm.refloh2o.com**) leads a program that works with five MPS schools each year to plan, design, and implement green schoolyards. Participating schools form Green Teams with the goal of creating a space by the community, for the community. The designs include environmental educational components like outdoor classrooms, offer more options for students with diverse needs and abilities to be physically active, and offer ample opportunity for students to explore and learn about our local environment.

MMSD's Green Infrastructure Guidebook for Schools **freshcoastguardians.com/resources** is an additional resource that can guide local schools in integrating green infrastructure into their schoolyard and building improvements. Milwaukee's twelve Public Libraries are also

prime locations for green infrastructure. The City is in the midst of capital improvements to make library facilities universally accessible. As parking lots are updated to meet the standards of the Americans with Disabilities Act (ADA), we have the opportunity to also make these spaces more environmentally sustainable with green infrastructure and porous pavement.

Large Parking Lots

Currently, there are 1,036 parking lots in Milwaukee 2 acres or larger in size. These spaces have ample opportunity for large amounts of infiltration-based green infrastructure but many may also be decreased in size. Although parking is a necessary resource in urban areas, some parking lots in Milwaukee are oversized based on shifting property uses or over-assumptions on parking needs. Removing pavement in spaces with little to no utilization would allow us to implement more green space in our commercial corridors.

Infiltration-based green infrastructure practices to be considered for large parking lots are pavement removal, strategically placed permeable pavements, bioswales, rain gardens, stormwater trees, native plantings, and soil amendments. Automotive use is predicted to decline in the future. This Green Infrastructure Plan prioritizes depaving excess parking lots where possible to add green infrastructure, trees, and vegetated buffers between parking lots and sidewalks.

Business & Neighborhood Improvement Districts

Improvement districts throughout the city are key locations for consideration of green infrastructure, given their focus on economic vitality and quality of life through physical improvements and capacity building. Improvement districts have boundaries and are self-funded (through taxation) and operated by property owners located within the district's designated area. Business Improvement Districts (BIDs) are made of primary commercial and/or manufacturing/industrial properties. Neighborhood Improvement Districts (NIDs) typically consist of residential properties, but depending on the area, can also contain commercial properties. These districts foster collaboration among numerous property owners and additional stakeholders to leverage investment and maintenance, and create a larger positive impact on the wider public.

Stream & Riparian Area Rehabilitation

When Milwaukee first began to urbanize, many smaller tributaries and streams were enclosed within storm sewers in an attempt to control waterways and protect nearby development. Removing these storm sewers and attempting to restore a more natural hydrology is a form of green infrastructure. Not only does this practice begin to rehabilitate these streams, but it also offers habitat for native riparian vegetation and endangered or threatened species and provides the public with more opportunity to enjoy Milwaukee's natural environment. The City is supportive of MMSD's efforts to re-naturalize streams and tributaries.

Non-Profit & Community Organization Partners

Collaboration is critical to increase green infrastructure adoption. Local nonprofits and community organizations are already working on a variety of projects from economic to education, recreation, and beyond. Partnering with these groups opens new doors to community engagement, helping implement more equitable and successful green infrastructure projects. However, many of these organizations do not have defined geographies and, therefore, could not be mapped and included in our analysis of green infrastructure priority areas. Therefore, it is all the more crucial to pair the tools we've developed with community outreach and collaboration when making decisions about green infrastructure. While it is not possible to list all the engaged nonprofits and community organizations here, the City is grateful for the ongoing interest and commitment to growing the green infrastructure movement in Milwaukee.

Land Use Matrix for Potential Implementation

Land Use	Location	Bioswales & Regenerative Stormwater Conveyance	Green Roofs / Blue Roofs	Greenways & Land Conservation	Native Landscaping	Permeable Pavement	Rain Gardens	Rain Barrels & Cisterns (Rainwater Catchment)	Depaving (Removal of Pavement & Structures)	Soil Amendments	Stormwater Trees	Downspout Disconnect
Commercial	Parking / Driveway	●				●			●			
	Buildings		●					●				●
	Walkways				●				●	●	●	
	Green Space				●					●	●	
Industrial	Parking / Driveway	●				●			●			
	Buildings		●					●				●
	Green Space				●					●	●	
Residential	Roof (capture runoff)						●	●				●
	Yard				●		●			●	●	
	Driveway					●						
	Alley					●						
Transportation & Utilities	Streets / Alley					●						
	Parking / Driveway					●			●			
	Medians	●			●	●			●	●	●	
	Buildings		●			●		●				●
	Green Space				●		●			●	●	
Government & Institutional	Parking / Driveway	●				●			●	●		
	Buildings		●					●				●
	Green Space	●			●			●		●	●	
Parks & Recreational Space	Parking / Driveway	●		●		●			●			
	Buildings		●					●				●
	Green Space	●		●	●		●			●	●	

Key Project Areas

In addition to the areas of high-impact identified in the analysis, the following places have been and will continue to be valuable opportunities for green infrastructure. For some of these locations, this is due to investment that has already been established there. For others, this distinction is justified by elevated ecological needs within a particular section of the watershed, or by a pronounced, vested community interest in environmental action and green infrastructure. However, this is by no means an exhaustive list. These key project areas are intended to showcase some of the green infrastructure and sustainability work currently taking place by the City and various community partners.

Century City & the 30th Street Industrial Corridor

The 30th Street Industrial Corridor is a major industrial and commercial district consisting of 880 acres of land that transects multiple distinct neighborhoods. The district is bordered by West Hampton Avenue to the north, North 27th Street to the east, West Highland Boulevard to the south, and North 35th Street to the west. The City and partners are engaged in an ongoing ambitious effort to transform the 30th Street Industrial Corridor into a major modern employment center and economic hub. This effort includes large catalytic development projects such as the conversion of the former Tower Automotive Site into the Century City Business Park and smaller community-focused projects like Cream City Farms. The effort also includes facilitating private sector development in affordable housing such as at Washington Park Townhomes and Century City Lofts. Green infrastructure and storm water management are central pieces of these projects as they provide ways to improve water quality and help manage flooding, while also enhancing green space and building community. Finally, the revitalization

PROJECT HIGHLIGHT:

Green Tech Station

The City of Milaukee and the Northwest Side Community Development Corporation (NWSCDC) are partnering to create a green technology demonstration area within the new Century City Business Park called "Green Tech Station." The project will use a 2.9 acre brownfield to showcase a variety of green infrastructure strategies including a 40,000 gallon cistern, bioswales, permeable pavement, native landscaping, and stormwater trees.

Green tech station will serve as a water cycle demonstration, filtering out Total Suspended Solids and other pollutants before storing the filtered stormwater in the cistern with pumps for reuse on the hundreds of on-site poplar and cottonwood trees. Green infrastructure installation has already begun and is expected to be completed later in 2019. Phase two of the installation will create a mobile classroom for local schools and neighborhood groups to learn about green technologies and water conservation. The classroom will include solar panels and batteries for energy storage and will feature interactive energy controls.

nwscdc.org/tag/green-tech-station/

Photo credit: Tory Kress

effort relies on strong partnerships with local neighborhood organizations, business improvement districts, and other stakeholders in order to advance planning, implementation and maintenance of projects. The most recent planning effort being undertaken in the Corridor is the "Connecting the Corridor" Strategic Action Plan update which will prioritize actionable projects within the themes of parks and public space, mobility and streets, off-street trails, and stormwater management.

The Green Corridor: Milwaukee's 13th District

Milwaukee's Green Corridor is located on South Sixth Street between Howard Avenue and College Avenue in the 13th Aldermanic District. The Green Corridor showcases the continuing commitment to achieve common sustainability goals that improve environmental performance, attract business development, raise public awareness, and support regional growth. The Green Corridor functions as a showcase for green technology and innovation, currently including community gardens, solar flowers, permeable pavement, greenhouses for food production, mushroom & indoor microgreen production, bioswales, vermiculture, and orchards.

milwaukee.gov/Green-Corridor

Photo credit: Elizabeth Hittman

Harbor District, Milwaukee's Inner Harbor Redevelopment

South of the Third Ward, east of Walker's Point and north of Bay View; the heart of our port city is over 1,000 acres, includes 500 acres of property adjacent to water, 44,000 linear feet of shoreline, and the Milwaukee Harbor Estuary. Throughout Milwaukee's industrial years, the estuary experienced severe environmental degradation and is now categorized as an Area of Concern. Recognizing the inextricable tie of the Inner Harbor to the estuary, ReFresh Milwaukee targeted this district as a catalytic project. The City and the Harbor District, Inc.'s **Water and Land Use Plan** for the Harbor District provides the framework for the integration of green infrastructure into the ongoing public and private redevelopment projects throughout the District. As shown in the map of Priority Subbasins for Strategic Implementation, the area along Lake Michigan is critical for ecological health, thus justifying the City and the Harbor District's past and continued investment in coastal stormwater management and green infrastructure.

School of Freshwater Studies
Photo credit: City of Milwaukee Dept. of Public Works

North Avenue Redevelopment

The Lindsay Heights neighborhood and the North Avenue commercial corridor have seen a surge in catalytic investment in the last two years. To build on this momentum of neighborhood reinvestment, HOME GR/OWN and its partners have launched a "Greenscaping" Project, a multi-year program to enhance the appearance of the North Avenue commercial corridor west of I-43, specifically targeting North Avenue between 8th Street and 27th Street. This has been critical in increasing green space in a highly urbanized area.

Reed Street Yards, Global Water Technology Park

The Reed Street Yards is an evolving eco-industrial district, focused on Milwaukee's growing water industry. Reed Street Yards is a 17-acre property in the Walker's Point neighborhood, just south of downtown Milwaukee and adjacent to the Global Water Center. Once complete, the Reed Street Yards will be a showcase of water technologies and practices, including a purple pipe for development-wide water recycling and bioswales and permeable pavement to capture stormwater runoff. Site amenities will include an extension of the Hank Aaron State Trail as part of the Riverwalk along the Menomonee Canal and an interactive public plaza.

North Avenue

BEFORE

Photo credit: Timothy McCollow

AFTER

Kinnickinnic Watershed

The smallest and most densely populated watershed within the Milwaukee River Basin has long suffered decline in its natural and built environment. The Kinnickinnic Watershed drains 25 square miles of urban hardscape into the heart of Milwaukee. Great efforts, like the $75 million Kinnickinnic River Flood Management Project by MMSD, have already begun to help control the high frequency of flooding and urban stormwater runoff by replacing the river's concrete banks with a wider, more natural river channel. Sixteenth Street Community Health Center (SSCHC), a Kinnickinnic-local independent non-profit agency, is partnering with MMSD, Southeastern Wisconsin Watersheds Trust (SWWT), and other key agencies to restore the watershed.

Restoration of the Kinnickinnic Watershed and surrounding neighborhoods fosters a sense of place and social equity, improves residents' quality of life, encourages resident participation in building a healthier and more sustainable community, and assists municipalities in meeting regulatory requirements.

To view the KK River Watershed Green Infrastructure Plan, please visit:

freshcoastguardians.com/resources

Photo credit: 16th Street Community Health Center

Ezekiel Gillespie Park
Photo credit: Timothy McCollow

IMPLEMENTATION RESOURCES

In an effort to increase green infrastructure in the city and the wider region, MMSD, the City of Milwaukee, and their partners offer technical support, design, training, and funding resources available.

Fresh Coast Resource Center

In March 2017, MMSD opened the Fresh Coast Resource Center (FCRC) in the Global Water Center, located at 247 W. Freshwater Way. Milwaukee's Fresh Coast Guardians Program empowers individuals, homeowners, businesses, and government institutions to take an active role in protecting our most precious natural resource: water. MMSD does this by providing the inspiration, education and tools needed to manage water where it falls. The FCRC offers the following services: GI Design Services through tools and preliminary plans and specifications, workshops, grant writing support and funding opportunities, and training, workforce development, and GI Certification. Visit FCRC's website to learn more:

freshcoastguardians.com

Green Infrastructure Job Training

In order for MMSD to meet their 2035 Vision of capturing 740 million gallons of stormwater, we need a skilled workforce to ensure the GI is properly installed and maintained. MMSD partners with the Water Environment Federation's National Green Infrastructure Certification Program (NGICP) to provide the base-level skill set needed for entry-level workers to properly construct, inspect and maintain green infrastructure. Designed to meet international best practice standards, NGICP is a tool that can be used to meet a wide range of needs, including professional development for existing green infrastructure professionals. MMSD is participating in the program to help Milwaukee grow its green workforce by providing community members with the skills to design, install, and maintain green infrastructure while earning a livable wage. Learn more at **ngicp.org**

Green Schools Consortium of Milwaukee

The Green Schools Consortium of Milwaukee (GSCM) organized to improve the environmental, social, and economic health of Milwaukee-area schools and to increase eco-literacy among students, families, educators, and community members. By developing a local network of green school practitioners, agencies, and funders, the GSCM can share resources and support meaningful schoolyard redevelopment projects that improve the quality of our watersheds while providing students with access to healthy green space and exciting educational opportunities. Find out more about the Green Schools Consortium of Milwaukee here:

gscm.refloh2o.com

Students at Burdick School
Photo credit: Reflo

FUNDING RESOURCES

Beginning in 2019, the City of Milwaukee will have a budget of $2.8 million annually for green infrastructure implementation and ongoing maintenance. Primary funding for green infrastructure is sourced from the City's annual budget ($800,000) and from MMSD's Green Solutions funds ($2 million) for municipalities to use for green infrastructure. The City's $2.8 million annual budget includes funds for Milwaukee Public Schools and playfields, streets, alleys, and parking lots, on-going green infrastructure maintenance, and the newly proposed Commercial Property Program.

This funding does not include additional grant funds garnered by the City and its partners on projects throughout the city as they arise. The City is committed to researching and pursuing new funding sources and mechanisms to continue implementing green infrastructure projects.

MMSD's Green Infrastructure Partnership Program

Funding Eligibility: Government, 4+ Multi-family Residential, Commercial, Industrial, Public, Private or Non-Profits.
MMSD provides partnership funding for the implementation of green infrastructure practices within participating municipalities in its service area. These projects support the District's 2035 Vision by reducing water entering the sewer system. Typically, projects chosen also include benefits such as improving water quality benefit to waterways, and incorporating an overall triple bottom line sustainable approach. Projects may receive incentive funding up to 50% of total eligible project costs from the District. For more information, please visit
freshcoastguardians.com

Sweet Water Mini Grants

Funding Eligibility: Projects located in Southeastern Wisconsin watersheds (the Kinnickinnic, Menomonee, Milwaukee, Root, and Oak Creek) at an individual site, as a neighborhood project, or as a community-wide initiative.
Sweet Water's signature Water Quality Mini-Grant Program distributes grants of $1,000 – $5,000 to established non-profit organizations, community, and civic groups for projects or activities that protect and restore the five watersheds located in Southeastern Wisconsin.

Fund for Lake Michigan

Funding Eligibility: 501(c)3 non-profit organizations, local units of government, government agencies, tribes, universities and other educational institutions
The Fund for Lake Michigan seeks projects that improve the water quality of Lake Michigan through habitat restoration, pollutant reduction, stream restoration, or improvements to coastal areas in Wisconsin. The proposals must be submitted through the Fund's online grants management system. For more information, visit
fundforlakemichigan.org

Sustain Our Great Lakes

Funding Eligibility: 501(c) organizations, state and local governments, Native American tribes, and educational institutions
The National Fish and Wildlife Foundation's Sustain Our Great Lakes (SOGL) program awards grants to projects that improve and enhance stream and riparian habitat, coastal wetland habitat, and water quality in the Great Lakes and its tributaries, as well as projects that maintain and enhance habitat restoration projects through invasive species control. For more information, visit
nfwf.org/greatlakes

Photo credit: Clean Wisconsin and MMSD

Wisconsin Department of Natural Resources Municipal Flood Control Grants

Funding Eligibility: Cities, villages, towns, WI Tribes, and metropolitan sewerage districts
Eligible organizations may apply for grant funding to acquire land, remove structures, flood-proof structures, administrative support, and other related activities. For more information, visit:
dnr.wi.gov/aid

Targeted Runoff Management Grants

Funding Eligibility: Cities, villages, towns, counties, regional planning commissions, tribal governments, and special purpose lake, sewerage and sanitary districts. Eligible organizations may apply for grants to reimburse costs for agriculture or urban nonpoint source pollution control in targeted, critical geographic areas with surface water or groundwater quality concerns. For more information, visit:
dnr.wi.gov/aid

Urban Nonpoint Source & Stormwater Management Grant (UNPS&SW)

Funding Eligibility: Cities, villages, towns, counties, regional planning commissions, tribal governments and special purpose lake, sewage, or sanitary districts. The local government must have either jurisdiction over the project area or be required to control stormwater discharge with an inter-governmental agreement between the municipality and the Department of Natural Resources. For more information, visit:
dnr.wi.gov/aid

Wisconsin Wetland Conservation Trust in Lieu Fee Mitigation Program (WWCT)

Funding Eligibility: Land trusts, conservation groups, government organizations, or Wisconsin landowners
Eligible organizations may apply for a WWCT grant to preserve, enhance, and restore wetland resources in Wisconsin. The WWCT is an in-lieu fee wetland mitigation program that utilizes revenue generated from the sale of wetland mitigation credits to fund wetland restoration projects. For more information, visit: **dnr.wi.gov/aid**

Great Lakes Restoration Initiative (GLRI)

Funding Eligibility: States, cities, non-governmental groups
GLRI is a federal program that provides unprecedented funding for protection and restoration efforts on the five Great Lakes. The GLRI is guided by an action plan with detailed performance goals and clear accountability standards. An interagency task force, led by the U.S. Environmental Protection Agency (EPA), coordinates federal efforts and directs funding to states, cities and nongovernmental groups that are best able to address local restoration priorities. For more information, visit:
glri.us/funding

Pabst Brewery
Photo Credit: MMSD

REQUIRED PLANS & PERMITS

Stormwater Management Plan

A stormwater management plan (SWMP) may be needed for a new or redevelopment site that includes green infrastructure. Check here to see if your project requires a SWMP before construction: **milwaukee.gov/stormwatermanagement**

Permits

In general, City permits are important to obtain because they help protect property value and improve safety to you, your family, your friends, and future owners. Insuring projects follow City code reduces the potential hazards of unsafe construction.

Plumbing permits are required when any gray infrastructure, such as an underdrain, is combined with green infrastructure. Chapter 225 of the City of Milwaukee Code of Ordinances governs Plumbing and Drainage and says:

PLUMBING WITHOUT PERMIT. No person may install, alter, extend, move or remove any plumbing, plumbing system, lay any drain pipe, make any attachment to any drain, sewer or manhole, or do any work whatsoever in connection with any sewer service lateral, or public or private sewer leading into any city sewers, or to any river, lake or stream, without first obtaining a permit from the commissioner of city development. Any person violating this regulation shall be subject to penalty pursuant to s. 200-19-2.

When applying for plumbing permits, please be aware of the following:

- Any gray infrastructure that is part of your green infrastructure project will require a permit.
- You must work with a licensed plumber for all plumbing projects that require a permit.
- When meeting with the Plumbing Plan Examiner, it is helpful if you come prepared with a design so the examiner can give you feedback.
- Please submit a City of Milwaukee Plumbing Plan Examination Application to the Development Center.

The Milwaukee Plan Examination Application can be found at the following link:
milwaukee.gov/DNSinfo

Consult City, State, and MMSD requirements and thresholds before starting any green infrastructure practice. If you have questions at any time, please contact the City of Milwaukee Development Center and ask to speak with a Plumbing Plan Examiner.

Plan Exam and Permits
809 N. Broadway, First Floor
Milwaukee, WI 53202
(414) 286-8210

Green Infrastructure Practice	Potential Permit Needed
Bioswales	Erosion, Grading, Plumbing (underdrain)
Green Roofs	Building Structural Permit
Native Landscaping	Noxious Weeds
Rain Gardens	Erosion, Grading
Rainwater Catchment	N/A*
Removal or Structure/Depaving	Erosion, Grading
Permeable Pavement	Erosion, Plumbing (underdrain)
Soil Amendments	Erosion, Grading
Trees	Call/Visit Diggers Hotline **
* use of captured rain water does not require a permit unless the collected water is pressurized or applied to an indoor use	
**gas, electric, cable TV, water, and sewer lines may be underground	

OPERATIONS & MAINTENANCE

Like all stormwater management, green infrastructure is a long term commitment with ongoing inspection and maintenance needs that must be budgeted for in order to assure successful functioning. It is critical to design with maintenance in mind, anticipating the cost, time, and personnel required for your project's continued care before implementation begins.

The United States Environmental Protection Agency provides a list of decisions that must be made in order to sufficiently plan for the maintenance of your green infrastructure project. Learn more:
epa.gov/green-infrastructure

Required maintenance activities and costs are dependent on the given green infrastructure project. For instance, bioswales must be cleared of the trash and debris that accumulate there. Stormwater trees must be inspected and pruned for the safety of the people and structures that surround them. Rain gardens must be weeded and native plants must be replaced as needed in order to maintain their infiltration capacity. Even abiotic green infrastructure like porous pavement should be maintained with regular power-washing. American Rivers and Green for All have created a guide with strategies to improve operations and maintenance of green infrastructure.
Staying Green: Strategies to Improve Operations and Maintenance of Green Infrastructure

Regardless of funding source, green infrastructure implemented on private land must be maintained by the property owner and the above resources may provide assistance in developing such a maintenance plan. Existing City-owned green infrastructure projects have been maintained through private contractors. The City will continue to seek partnerships with green infrastructure experts in order to insure the proper care on all future developments.

Collaboration

This Plan recognizes the importance of cooperation among residents and business owners within the City, private, and non-profit communities to accomplish these goals. The continued collaboration and open communication with a multitude of stakeholders has positioned Milwaukee to become a world class eco-city built on a sustainable relationship with freshwater.

Photo Credit: clean Wisconsin and MMSD

Downtown Green Roof

DEFINITIONS & MAPS

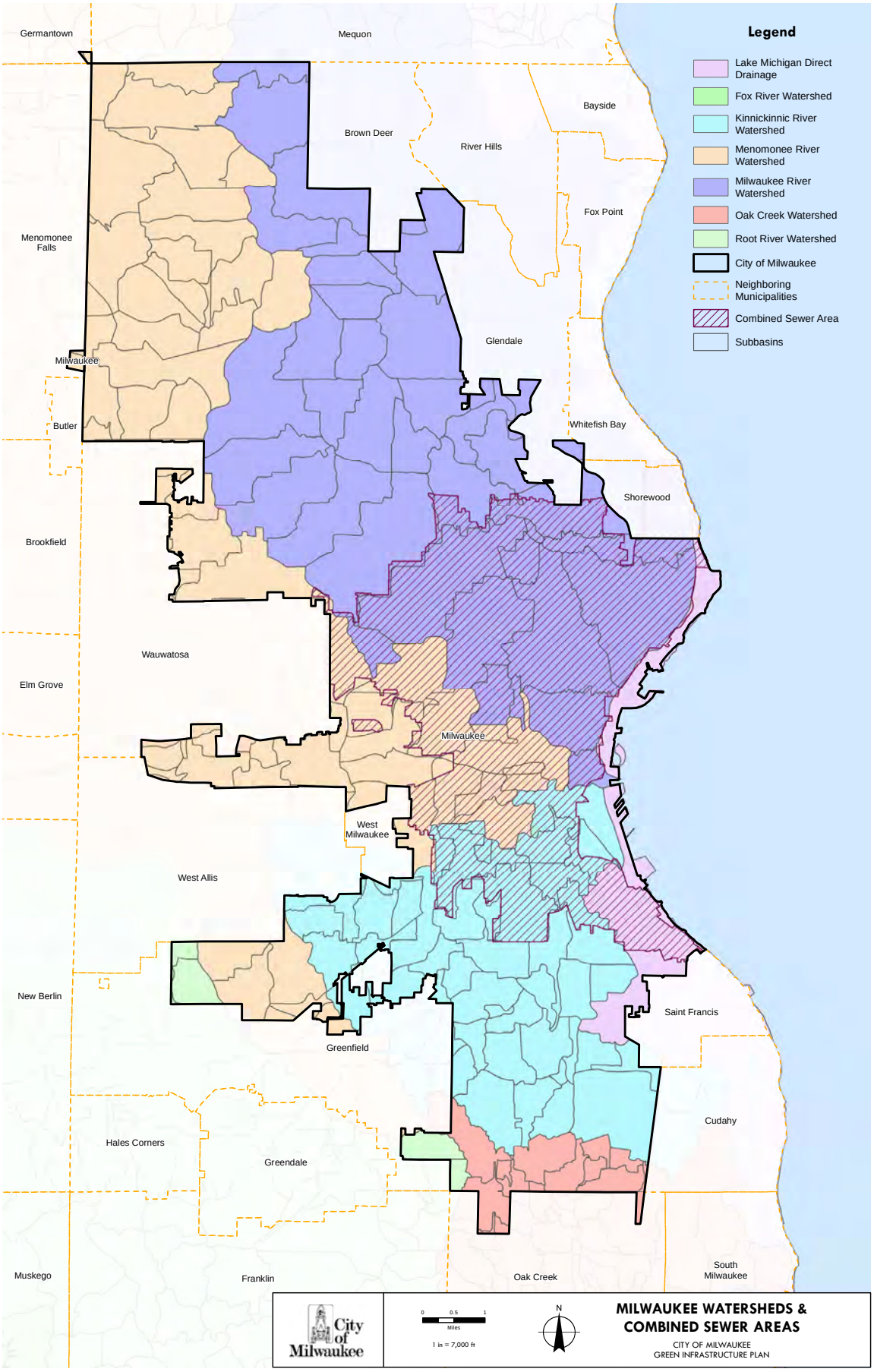
ABBREVIATIONS & DEFINITIONS

DCD – Department of City Development
DNR – Department of Natural Resources
ECO – Environmental Collaboration Office
EPA– Environmental Protection Agency
ERU – Equivalent Residential Unit
GI – Green infrastructure
GIBI – The Green Infrastructure Baseline Inventory
MMSD – Milwaukee Metropolitan Sewer District
MS4 – Municipal Separate Storm Sewer System
SWMP – Stormwater Management Plan
RSC – Regenerative Stormwater Conveyance
TMDL – Total Maximum Daily Load

Area of Concern (AOC) a geographic area where significant impairment of beneficial uses has occurred as a result of human activities at the local level.

Total Maximum Daily Load (TMDL) specify the amount of pollutant a waterbody can receive and still meet water quality standards.

Urban heat island effect is the term used to describe built-up urban areas, such as the City of Milwaukee, that are hotter than nearby rural areas. This effect is due to roof and pavement surface temperatures being hotter than the air temperature, whereas shaded or moist surfaces–often in more rural surroundings–remain closer to the air temperature.


Legend
Lake Michigan Direct Drainage
Fox River Watershed
Kinnickinnic River Watershed
Menomonee River Watershed
Milwaukee River Watershed
Oak Creek Watershed
Root River Watershed
City of Milwaukee
Neighboring Municipalities
Combined Sewer Area
Subbasins
Germantown
Mequon
Bayside
Brown Deer
River Hills
Fox Point
Menomonee Falls
Glendale
Milwaukee
Butler
Whitefish Bay
Shorewood
Brookfield
Wauwatosa
Elm Grove
Milwaukee
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
Muskego
Franklin
Oak Creek
South Milwaukee
City of Milwaukee
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Miles
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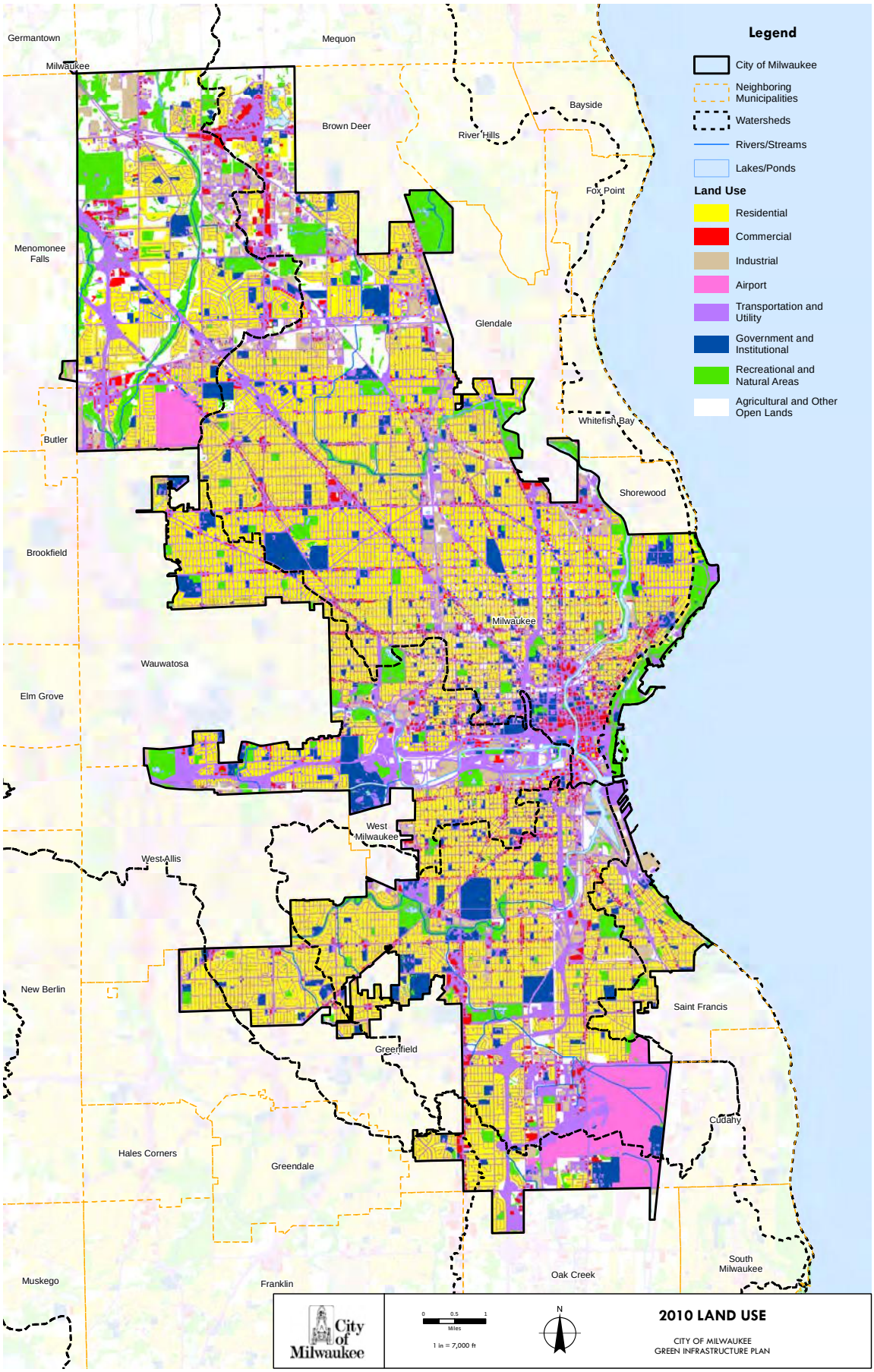
MILWAUKEE WATERSHEDS & COMBINED SEWER AREAS
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN


Legend
City of Milwaukee
Neighboring Municipalities
Watersheds
Rivers/Streams
Lakes/Ponds
Land Use
Residential
Commercial
Industrial
Airport
Transportation and Utility
Government and Institutional
Recreational and Natural Areas
Agricultural and Other Open Lands
Germantown
Mequon
Milwaukee
Brown Deer
River Hills
Bayside
Fox Point
Menomonee Falls
Glendale
Whitefish Bay
Butler
Shorewood
Brookfield
Milwaukee
Wauwatosa
Elm Grove
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
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Hales Corners
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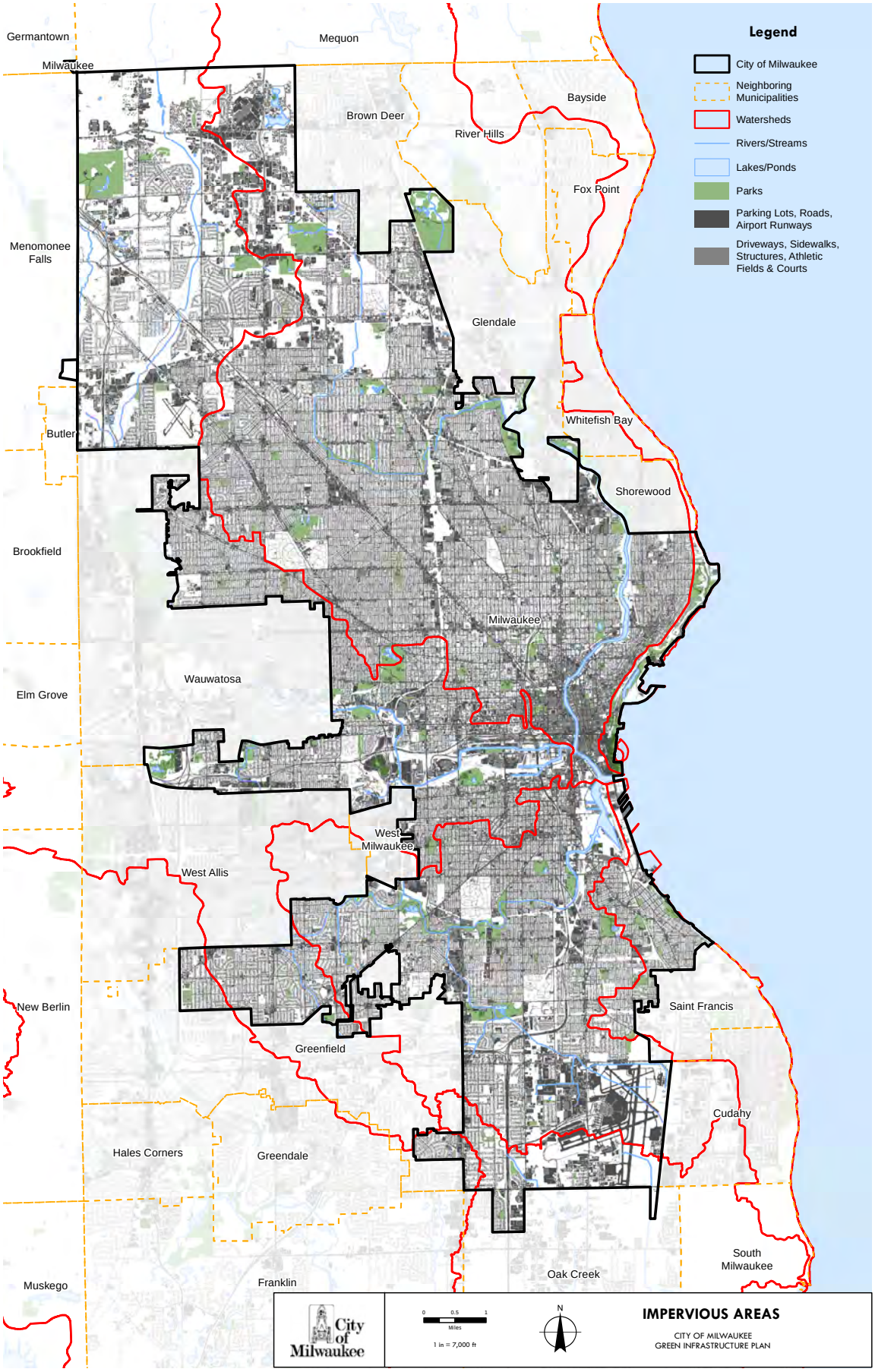
2010 LAND USE
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN


Legend
City of Milwaukee
Neighboring Municipalities
Watersheds
Rivers/Streams
Lakes/Ponds
Parks
Parking Lots, Roads, Airport Runways
Driveways, Sidewalks, Structures, Athletic Fields & Courts
Germantown
Milwaukee
Mequon
Brown Deer
River Hills
Bayside
Fox Point
Menomonee Falls
Glendale
Whitefish Bay
Butler
Shorewood
Brookfield
Milwaukee
Wauwatosa
Elm Grove
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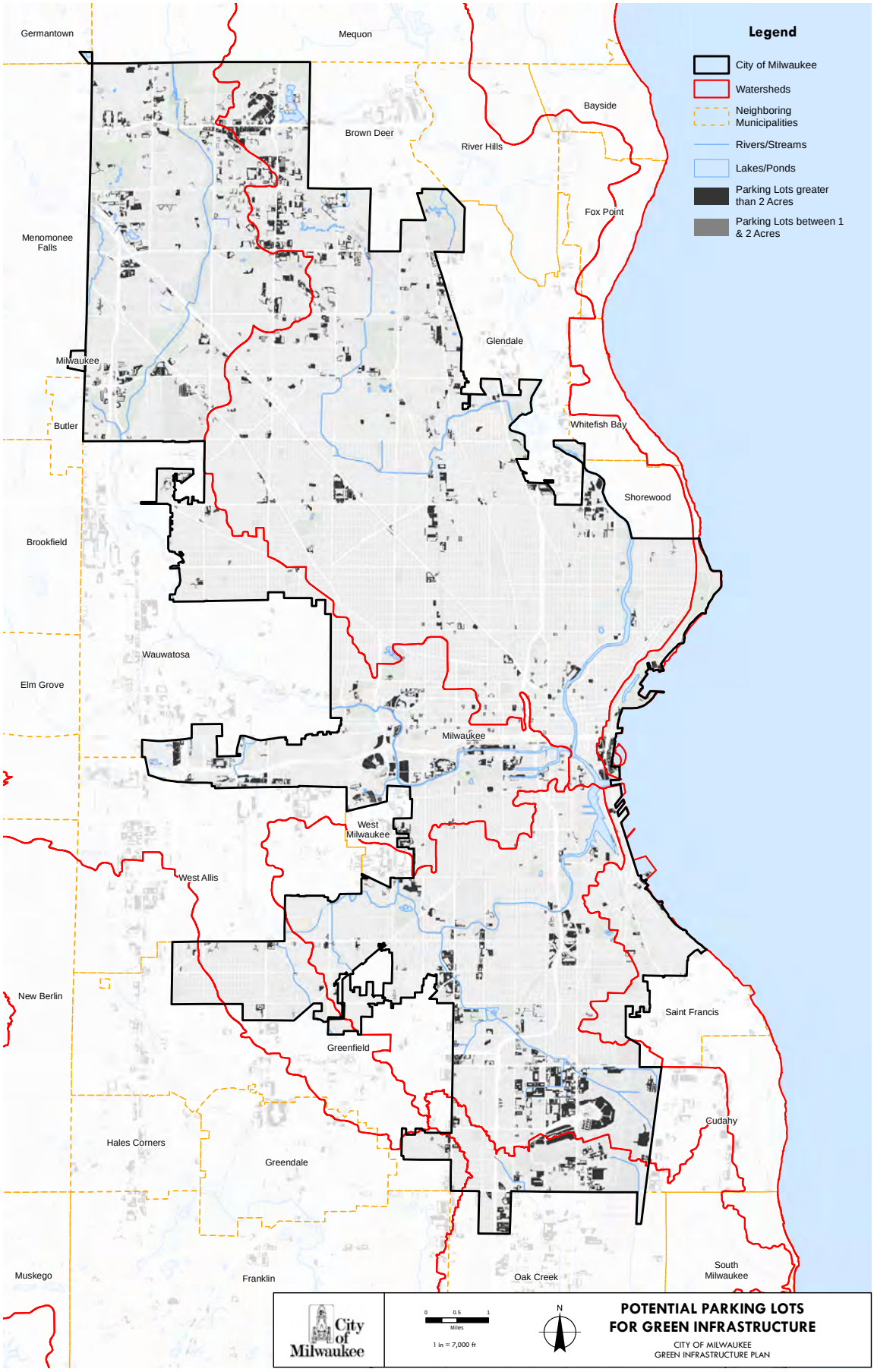
IMPERVIOUS AREAS
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN


Legend
City of Milwaukee
Watersheds
Neighboring Municipalities
Rivers/Streams
Lakes/Ponds
Parking Lots greater than 2 Acres
Parking Lots between 1 & 2 Acres
Germantown
Mequon
Bayside
Brown Deer
River Hills
Fox Point
Menomonee Falls
Glendale
Milwaukee
Butler
Whitefish Bay
Shorewood
Brookfield
Wauwatosa
Elm Grove
Milwaukee
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
Muskego
Franklin
Oak Creek
South Milwaukee
City of Milwaukee
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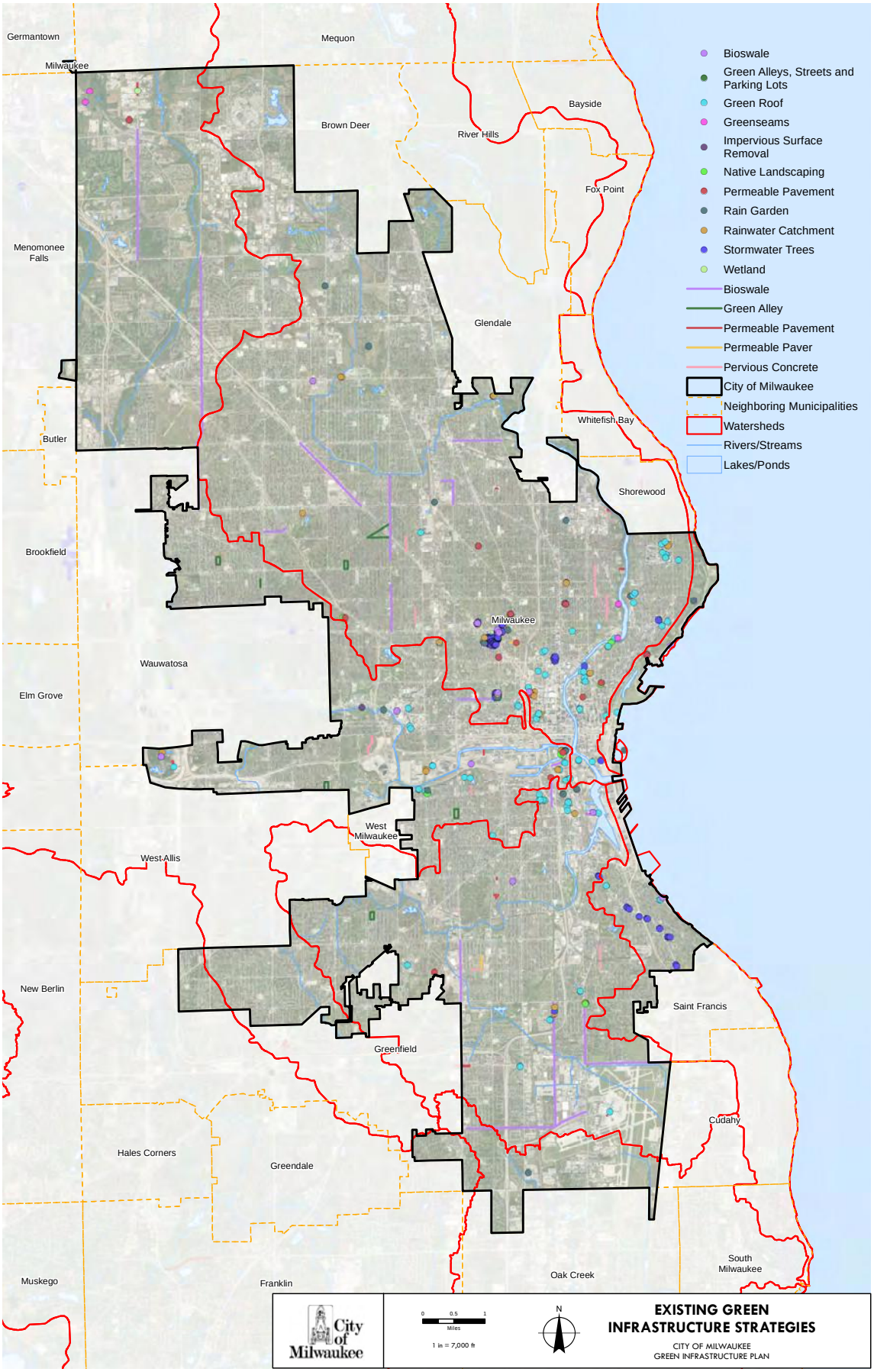
POTENTIAL PARKING LOTS FOR GREEN INFRASTRUCTURE
CITY OF MILWAUKEE GREEN INFRASTRUCTURE PLAN


Germantown
Milwaukee
Mequon
Brown Deer
River Hills
Bayside
Fox Point
Menomonee Falls
Glendale
Whitefish Bay
Butler
Shorewood
Brookfield
Milwaukee
Wauwatosa
Elm Grove
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
South Milwaukee
Muskego
Franklin
Oak Creek
Bioswale
Green Alleys, Streets and Parking Lots
Green Roof
Greenseams
Impervious Surface Removal
Native Landscaping
Permeable Pavement
Rain Garden
Rainwater Catchment
Stormwater Trees
Wetland
Bioswale
Green Alley
Permeable Pavement
Permeable Paver
Pervious Concrete
City of Milwaukee
Neighboring Municipalities
Watersheds
Rivers/Streams
Lakes/Ponds
City of Milwaukee
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Miles
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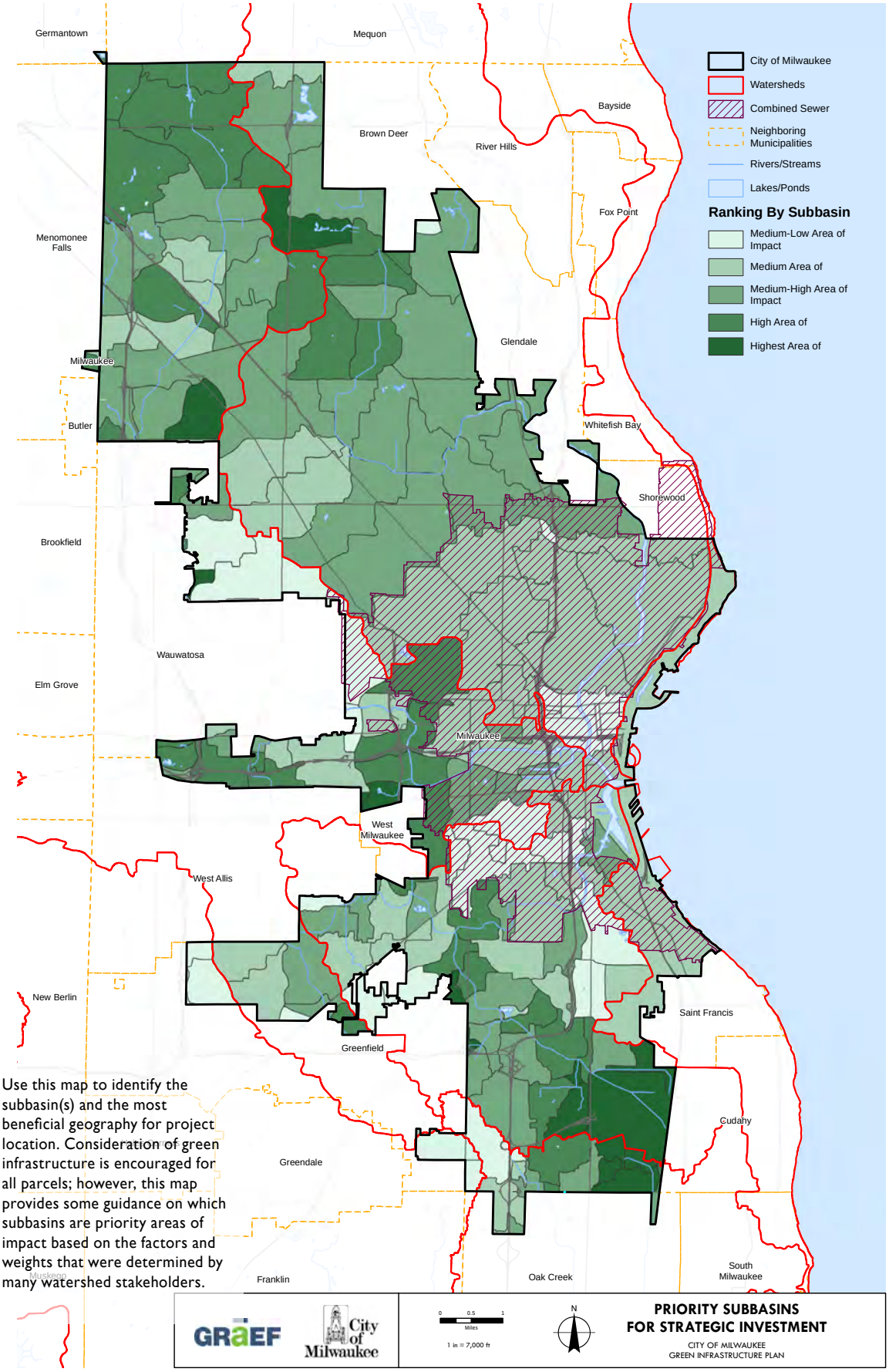
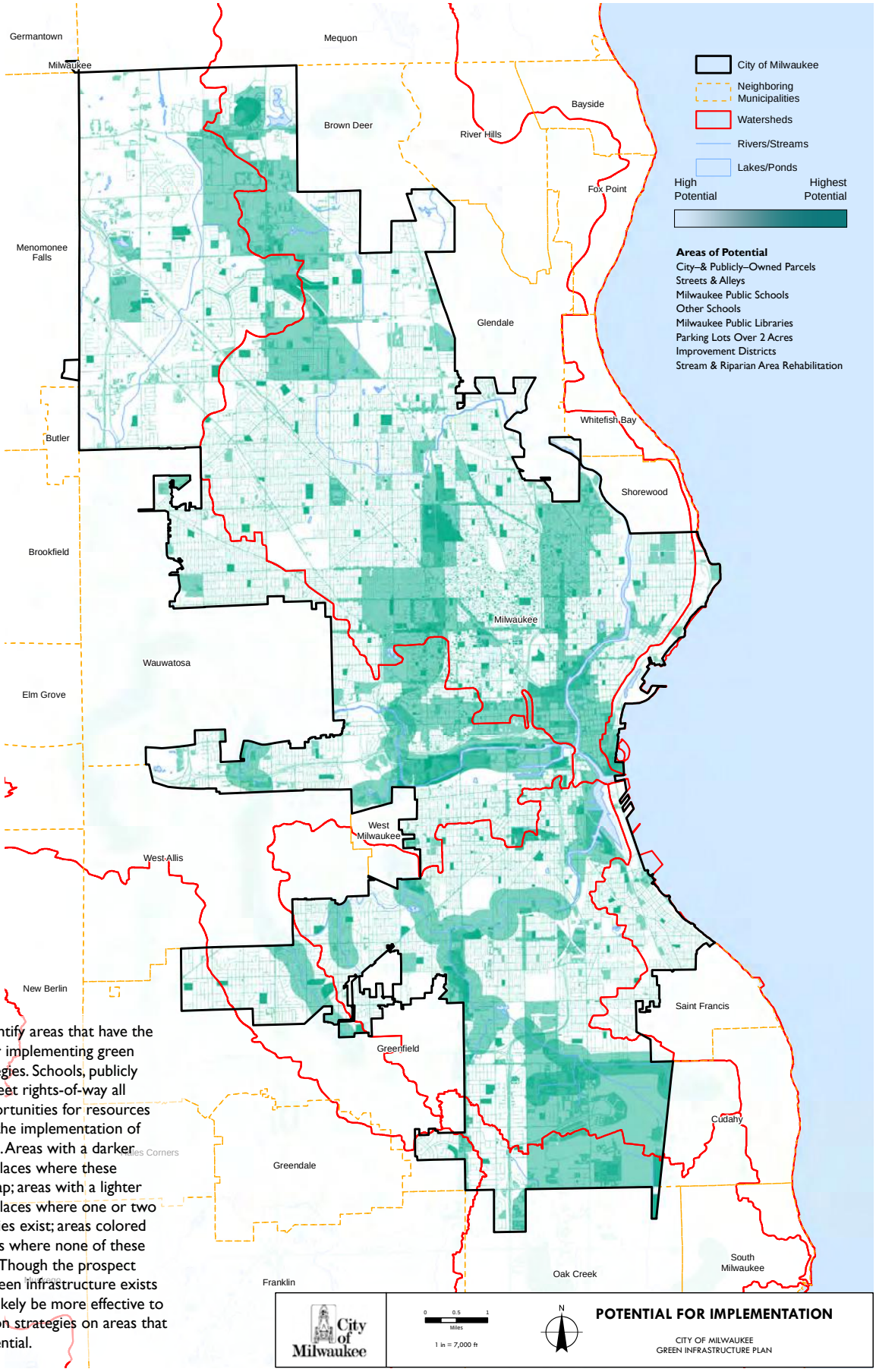
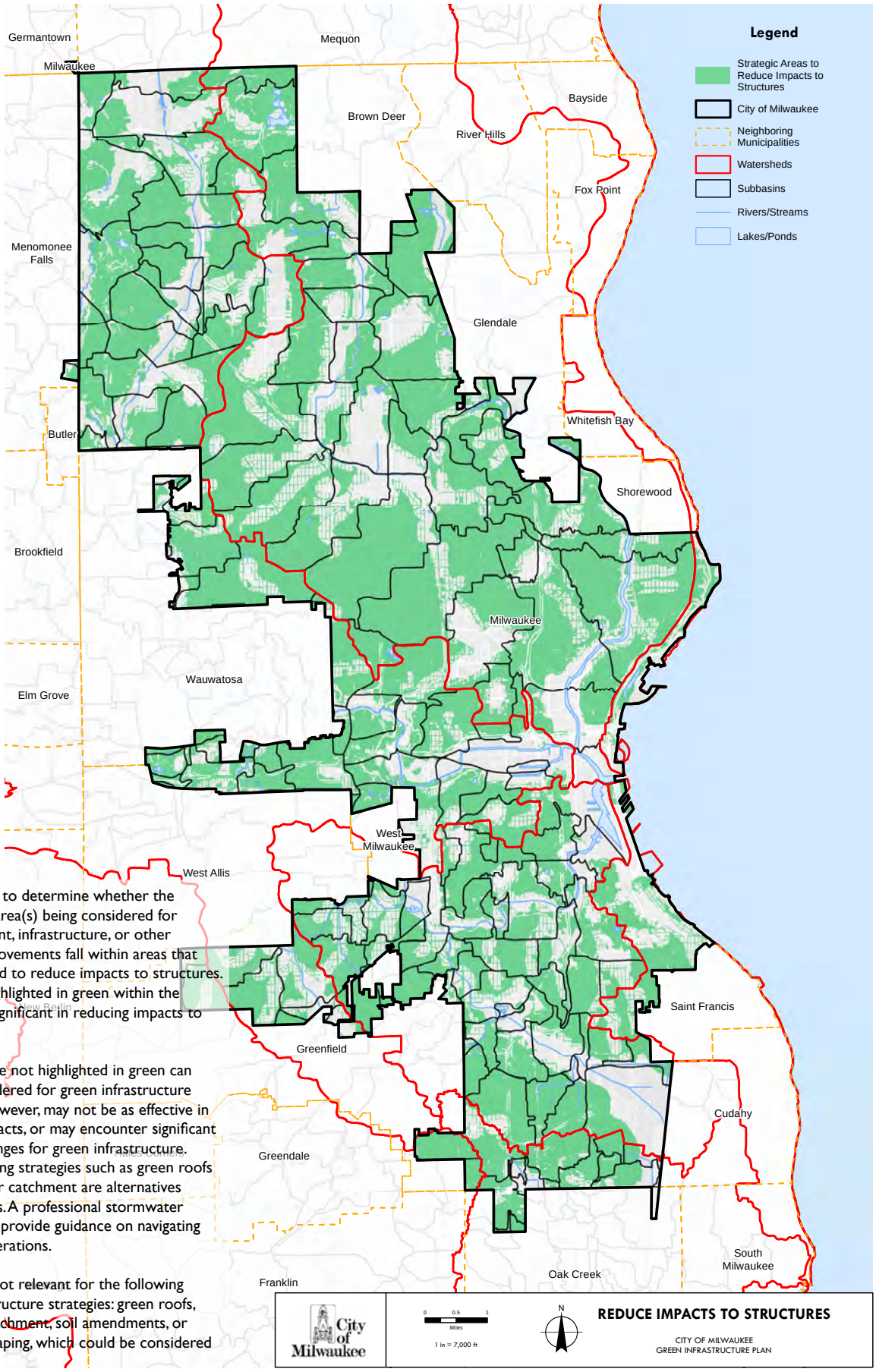
EXISTING GREEN INFRASTRUCTURE STRATEGIES
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN



Use this map to identify the subbasin(s) and the most beneficial geography for project location. Consideration of green infrastructure is encouraged for all parcels; however, this map provides some guidance on which subbasins are priority areas of impact based on the factors and weights that were determined by many watershed stakeholders.



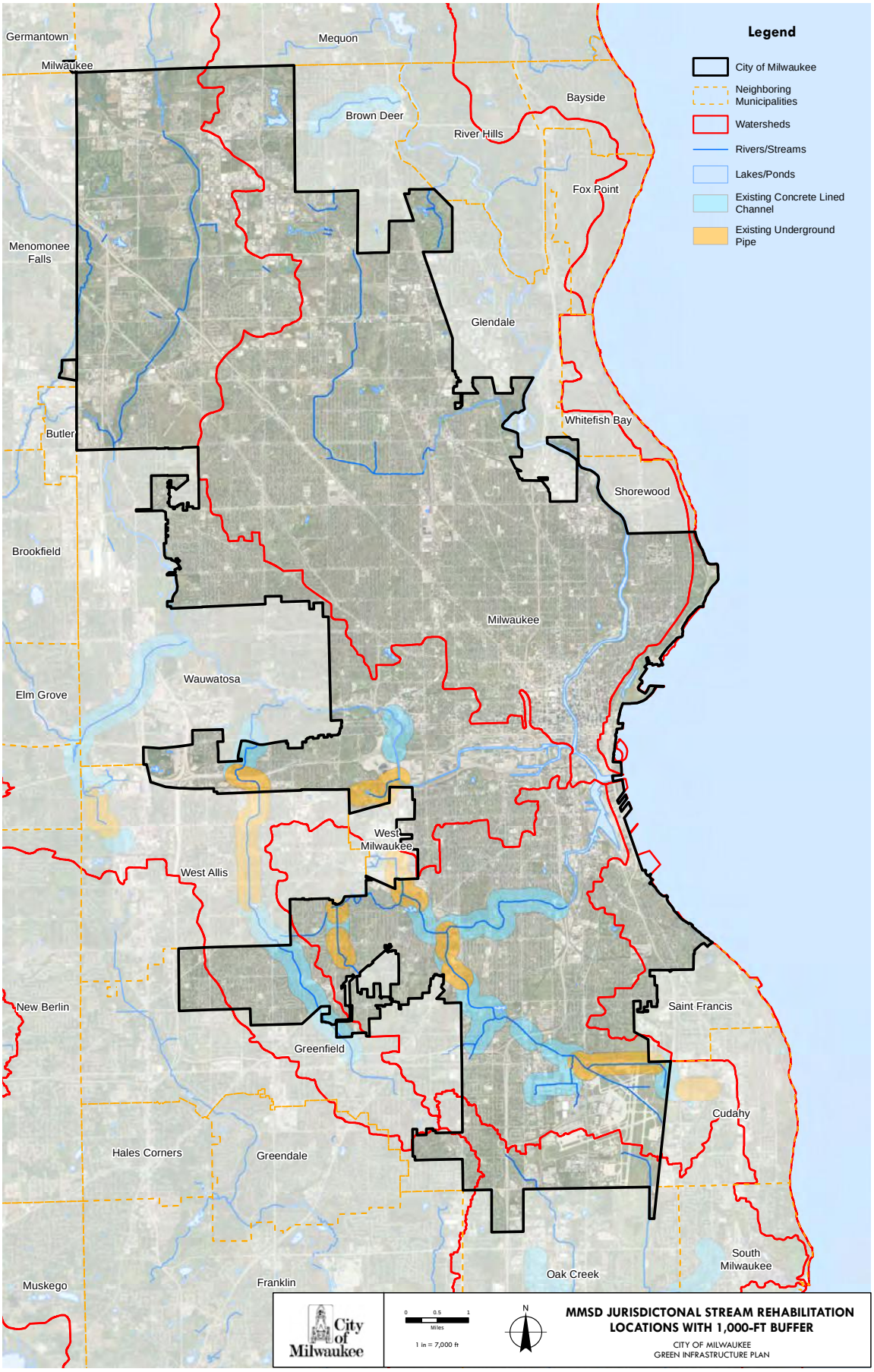
Use this map to identify areas that have the highest potential for implementing green infrastructure strategies. Schools, publicly owned land, and street rights-of-way all present strong opportunities for resources to be allocated for the implementation of green infrastructure. Areas with a darker teal color indicate places where these opportunities overlap; areas with a lighter teal color indicate places where one or two of these opportunities exist; areas colored white indicate places where none of these opportunities exist. Though the prospect for implementing green infrastructure exists everywhere, it will likely be more effective to focus implementation strategies on areas that have significant potential.



Use this map to determine whether the parcel(s) or area(s) being considered for redevelopment, infrastructure, or other physical improvements fall within areas that are prioritized to reduce impacts to structures. The areas highlighted in green within the parcels are significant in reducing impacts to structures.

Areas that are not highlighted in green can still be considered for green infrastructure strategies, however, may not be as effective in reducing impacts, or may encounter significant design challenges for green infrastructure. Non-infiltrating strategies such as green roofs and rainwater catchment are alternatives in these areas. A professional stormwater engineer will provide guidance on navigating these considerations.

This map is not relevant for the following green infrastructure strategies: green roofs, rainwater catchment, soil amendments, or native landscaping, which could be considered in any areas.


Legend
City of Milwaukee
Neighboring Municipalities
Watersheds
Rivers/Streams
Lakes/Ponds
Existing Concrete Lined Channel
Existing Underground Pipe
Germantown
Milwaukee
Mequon
Brown Deer
River Hills
Bayside
Fox Point
Menomonee Falls
Glendale
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Oak Creek
Muskego
Franklin
City of Milwaukee
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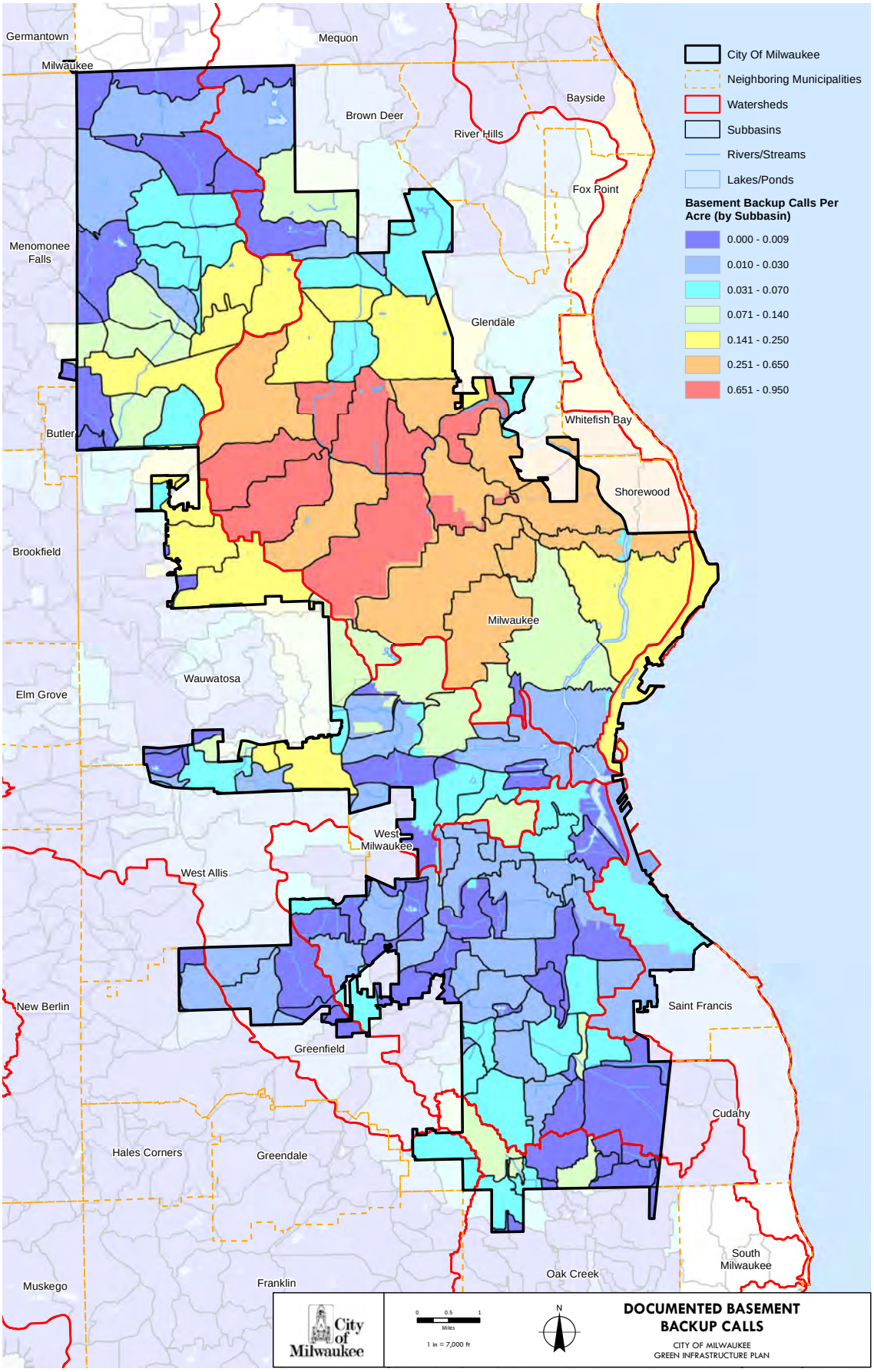
MMSD JURISDICTONAL STREAM REHABILITATION LOCATIONS WITH 1,000-FT BUFFER
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN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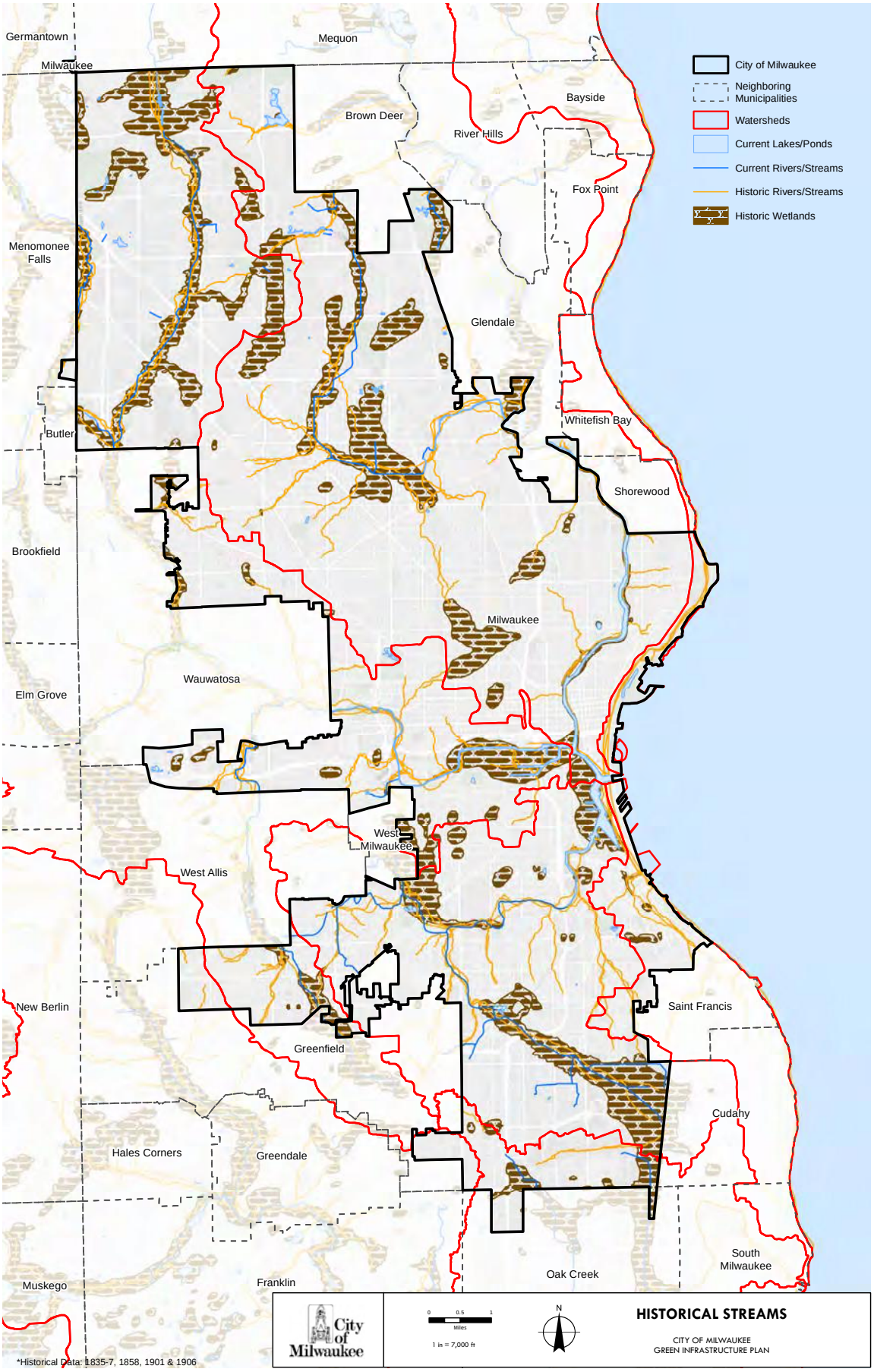
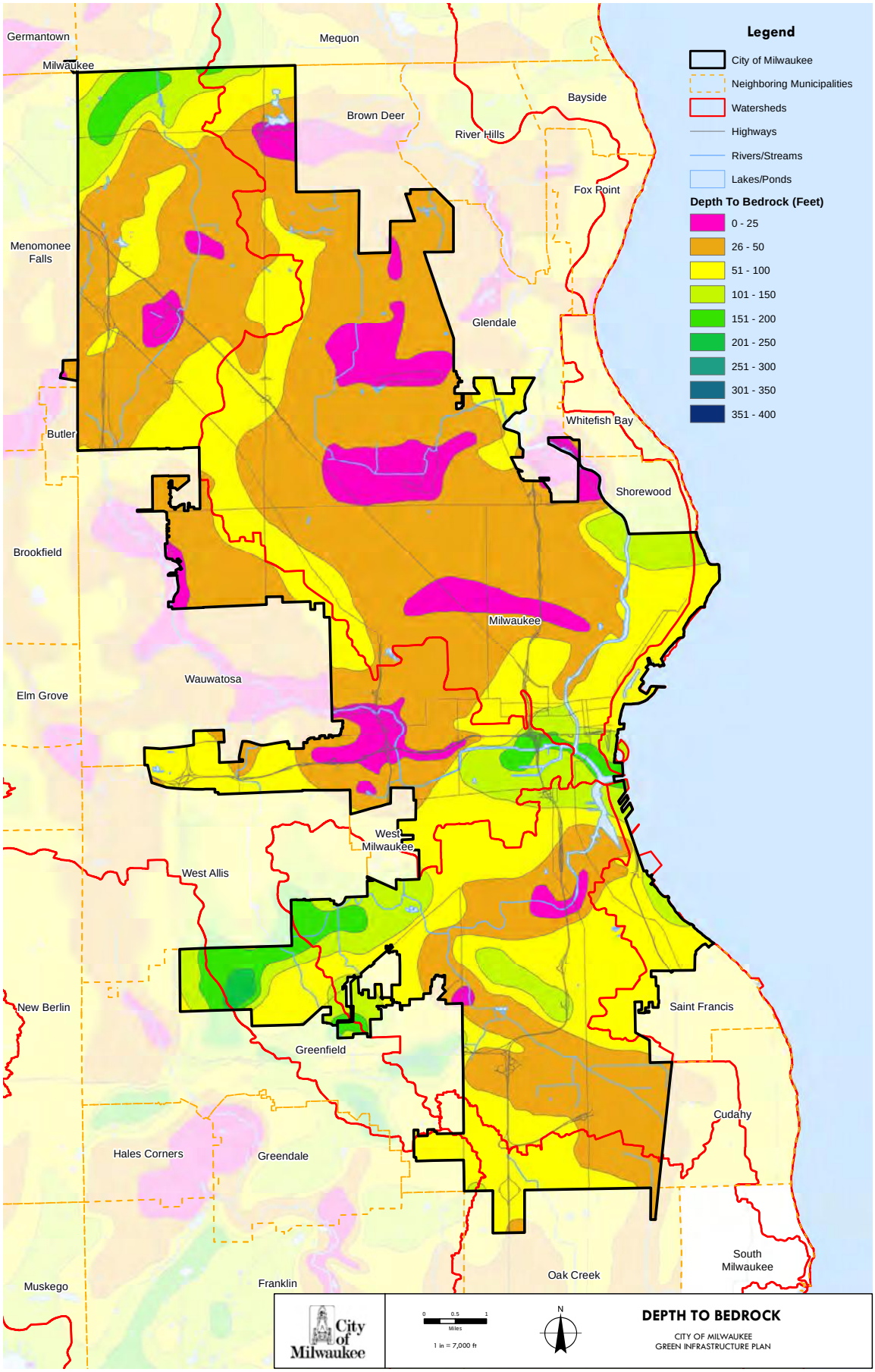
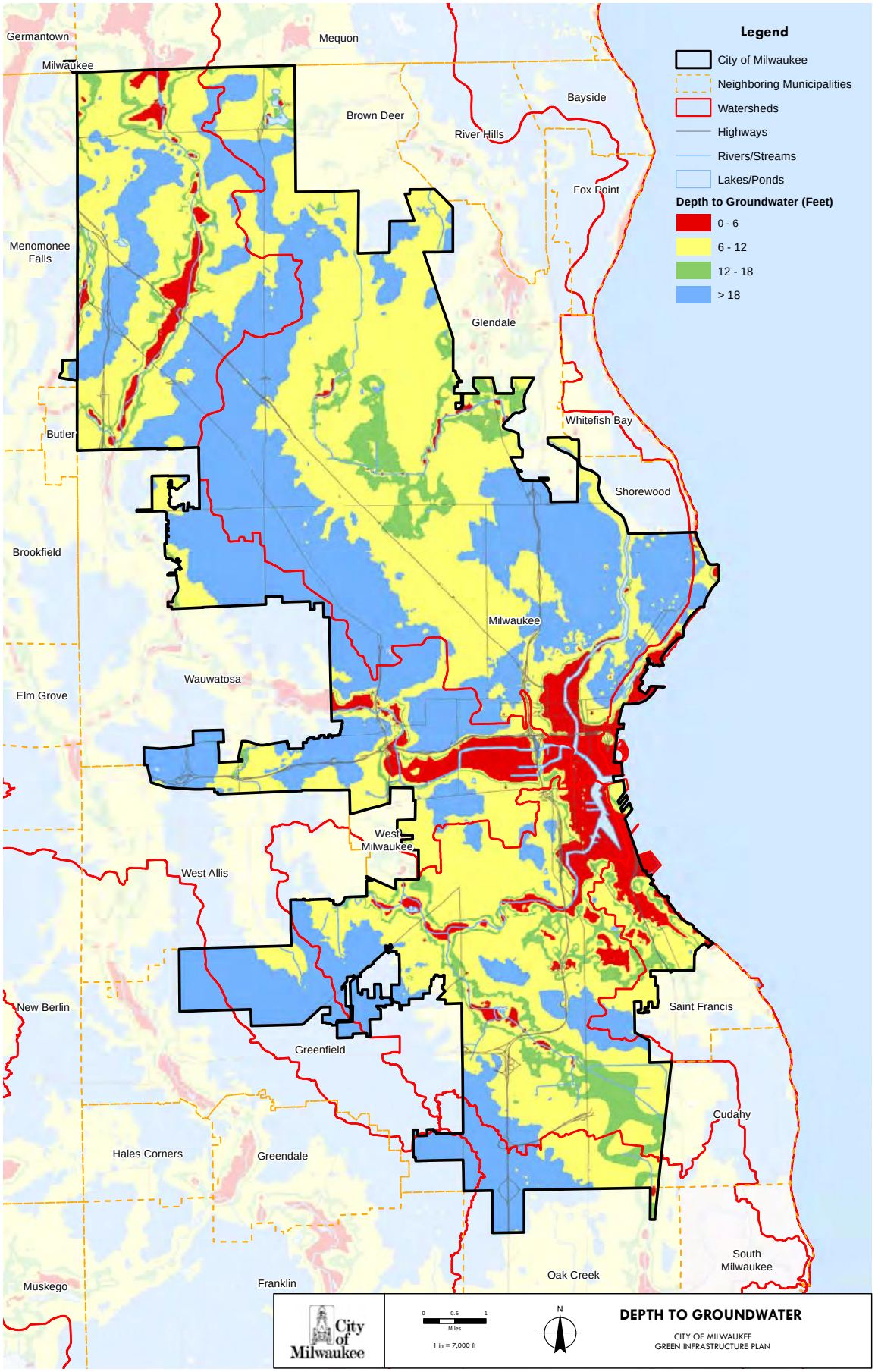
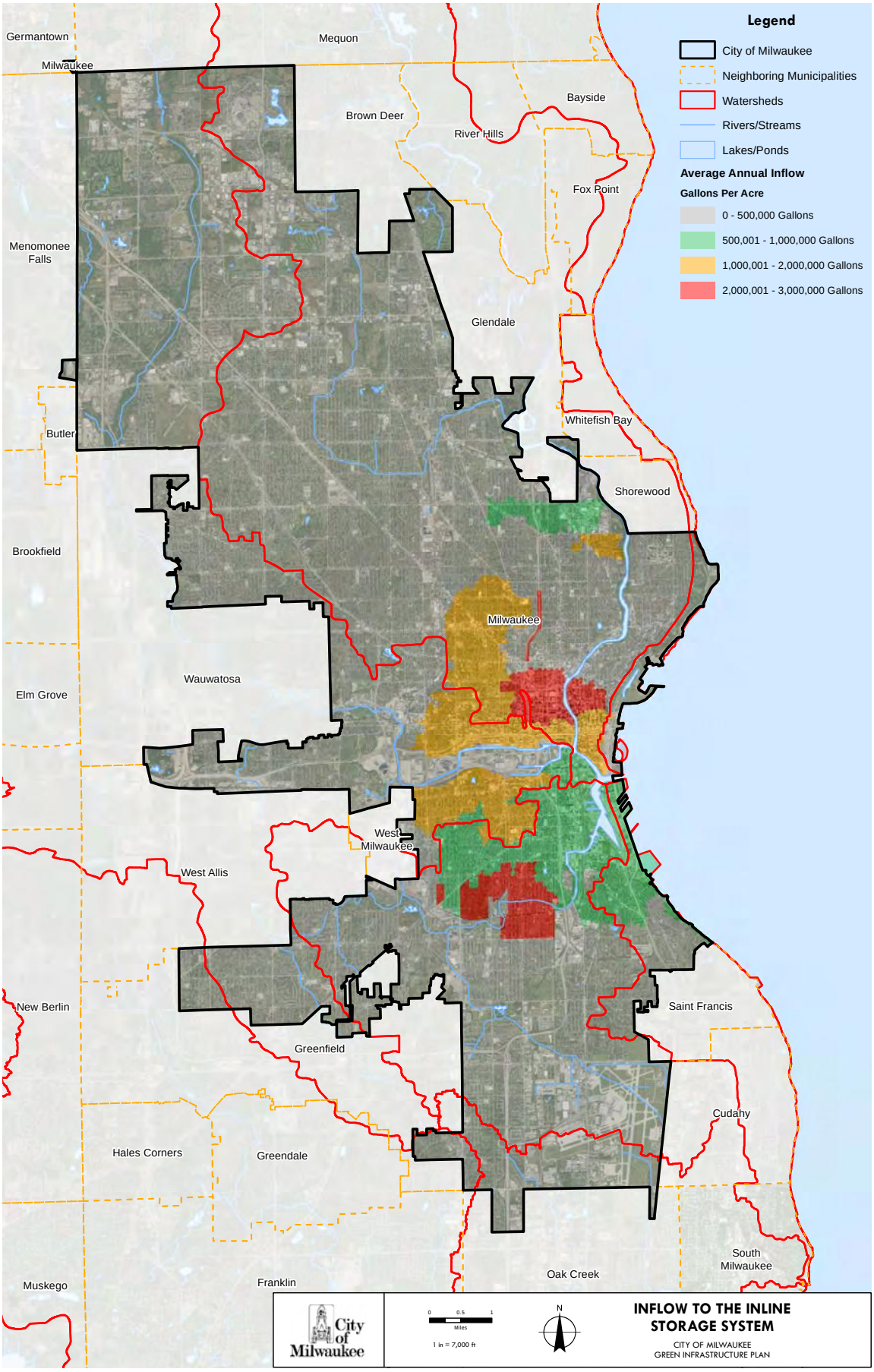
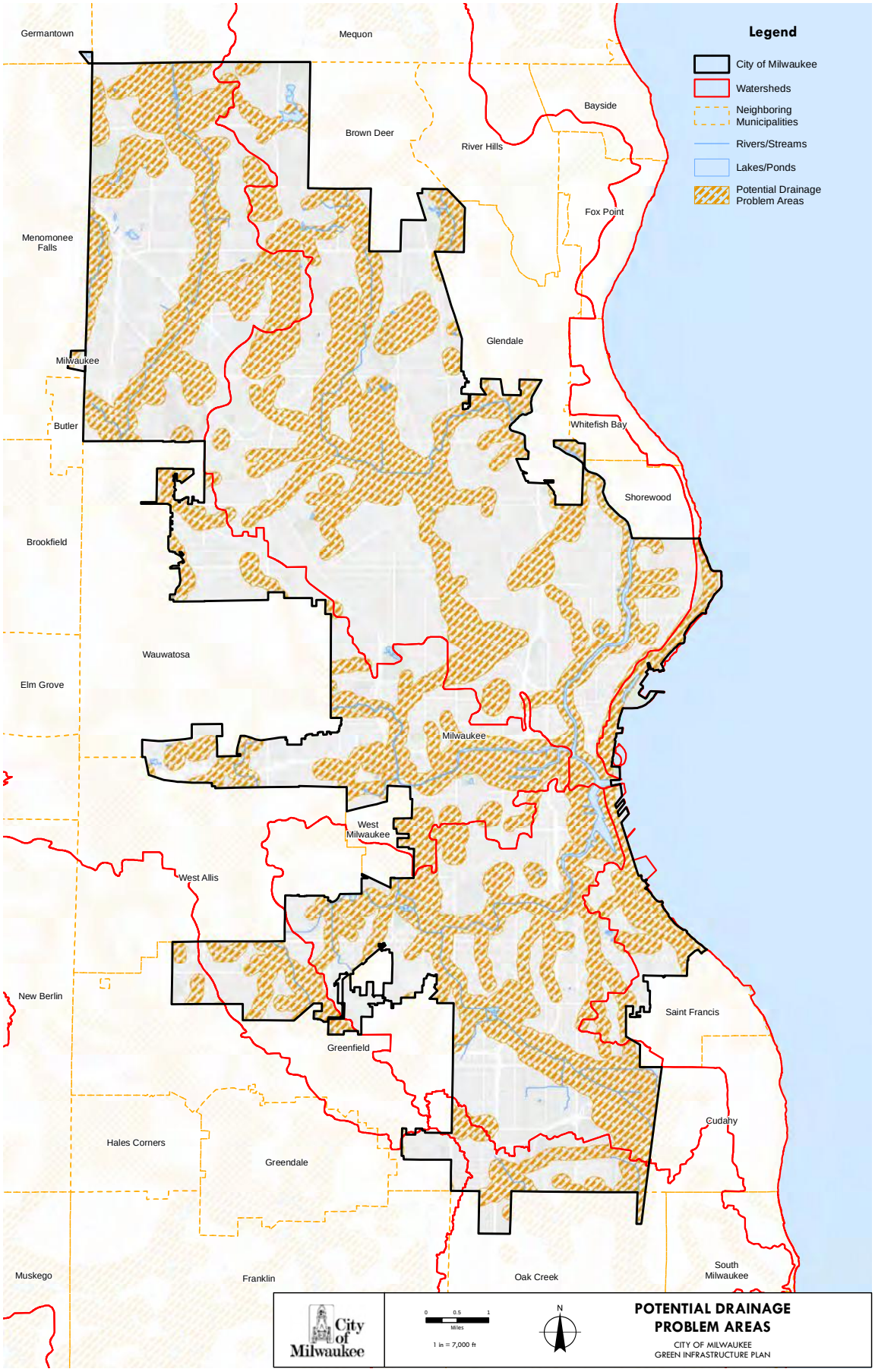
Glendale
Butler
Whitefish Bay
Shorewood
Brookfield
Milwaukee
Wauwatosa
Elm Grove
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
South Milwaukee
Oak Creek
Muskego
Franklin
City Of Milwaukee
Neighboring Municipalities
Watersheds
Subbasins
Rivers/Streams
Lakes/Ponds
Basement Backup Calls Per Acre (by Subbasin)
0.000 - 0.009
0.010 - 0.030
0.031 - 0.070
0.071 - 0.140
0.141 - 0.250
0.251 - 0.650
0.651 - 0.950
City of Milwaukee
0 0.5 1
Miles
1 in = 7,000 ft
N
DOCUMENTED BASEMENT BACKUP CALLS
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN

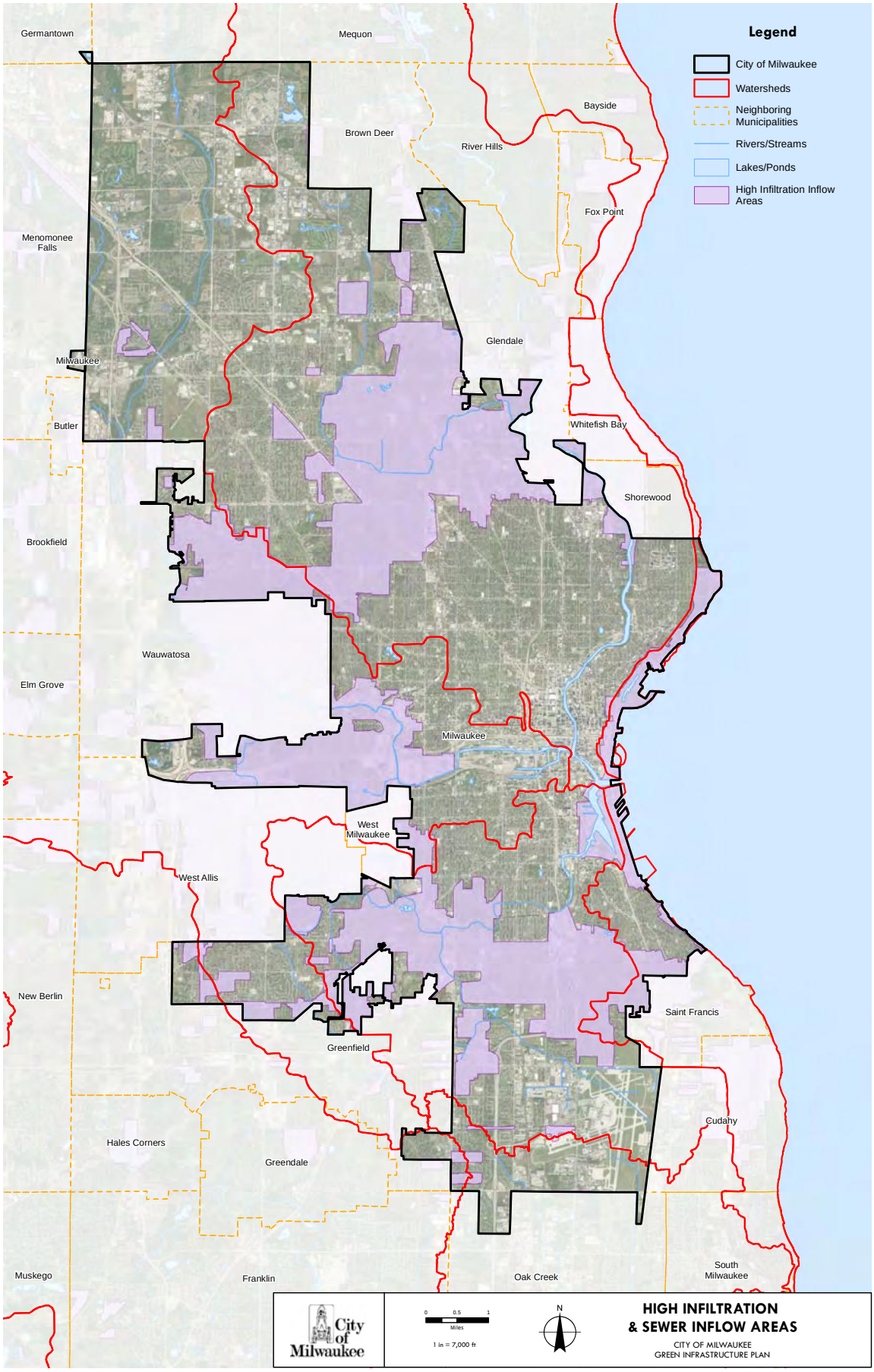

Germantown
Milwaukee
Mequon
Brown Deer
River Hills
Bayside
Fox Point
Menomonee Falls
Glendale
Whitefish Bay
Butler
Shorewood
Brookfield
Milwaukee
Wauwatosa
Elm Grove
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
South Milwaukee
Oak Creek
Muskego
Franklin
City of Milwaukee
Neighboring Municipalities
Watersheds
Current Lakes/Ponds
Current Rivers/Streams
Historic Rivers/Streams
Historic Wetlands
City of Milwaukee
0 0.5 1
Miles
1 in = 7,000 ft
N
HISTORICAL STREAMS
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN
*Historical Data: 1835-7, 1858, 1901 & 1906

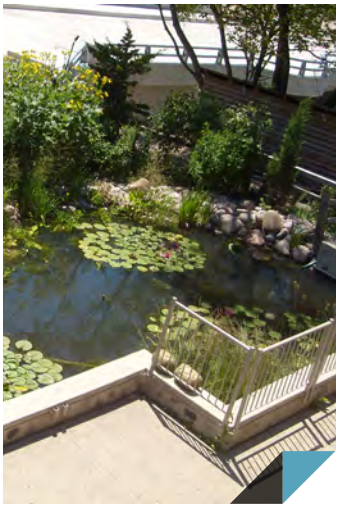

Legend
City of Milwaukee
Neighboring Municipalities
Watersheds
Highways
Rivers/Streams
Lakes/Ponds
Depth To Bedrock (Feet)
0 - 25
26 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 400
Germantown
Milwaukee
Mequon
Brown Deer
River Hills
Bayside
Fox Point
Menomonee Falls
Glendale
Butler
Whitefish Bay
Shorewood
Brookfield
Milwaukee
Wauwatosa
Elm Grove
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
South Milwaukee
Oak Creek
Muskego
Franklin
City of Milwaukee
0 0.5 1
Miles
1 in = 7,000 ft
N
DEPTH TO BEDROCK
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN


Legend
City of Milwaukee
Neighboring Municipalities
Watersheds
Highways
Rivers/Streams
Lakes/Ponds
Depth to Groundwater (Feet)
0 - 6
6 - 12
12 - 18
> 18
Germantown
Milwaukee
Mequon
Brown Deer
River Hills
Bayside
Fox Point
Menomonee Falls
Glendale
Whitefish Bay
Butler
Shorewood
Brookfield
Milwaukee
Wauwatosa
Elm Grove
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
South Milwaukee
Oak Creek
Muskego
Franklin
City of Milwaukee
0 0.5 1
Miles
1 in = 7,000 ft
N
DEPTH TO GROUNDWATER
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN


Legend
City of Milwaukee
Neighboring Municipalities
Watersheds
Rivers/Streams
Lakes/Ponds
Average Annual Inflow
Gallons Per Acre
0 - 500,000 Gallons
500,001 - 1,000,000 Gallons
1,000,001 - 2,000,000 Gallons
2,000,001 - 3,000,000 Gallons
Germantown
Mequon
Milwaukee
Brown Deer
Bayside
River Hills
Fox Point
Menomonee Falls
Glendale
Whitefish Bay
Butler
Shorewood
Brookfield
Milwaukee
Wauwatosa
Elm Grove
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
South Milwaukee
Oak Creek
Muskego
Franklin
City of Milwaukee
0 0.5 1
Miles
1 in = 7,000 ft
N
INFLOW TO THE INLINE STORAGE SYSTEM
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN


Legend
City of Milwaukee
Watersheds
Neighboring Municipalities
Rivers/Streams
Lakes/Ponds
Potential Drainage Problem Areas
Germantown
Mequon
Bayside
Brown Deer
River Hills
Fox Point
Menomonee Falls
Glendale
Milwaukee
Butler
Whitefish Bay
Shorewood
Brookfield
Wauwatosa
Elm Grove
Milwaukee
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
Muskego
Franklin
Oak Creek
South Milwaukee
City of Milwaukee
0 0.5 1
Miles
1 in = 7,000 ft
N
POTENTIAL DRAINAGE PROBLEM AREAS
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN


Legend
City of Milwaukee
Watersheds
Neighboring Municipalities
Rivers/Streams
Lakes/Ponds
High Infiltration Inflow Areas
Germantown
Mequon
Bayside
Brown Deer
River Hills
Fox Point
Menomonee Falls
Glendale
Milwaukee
Butler
Whitefish Bay
Shorewood
Brookfield
Wauwatosa
Elm Grove
Milwaukee
West Milwaukee
West Allis
New Berlin
Saint Francis
Greenfield
Cudahy
Hales Corners
Greendale
Muskego
Franklin
Oak Creek
South Milwaukee
City of Milwaukee
0 0.5 1
Miles
1 in = 7,000 ft
N
HIGH INFILTRATION & SEWER INFLOW AREAS
CITY OF MILWAUKEE
GREEN INFRASTRUCTURE PLAN



Location/Photo credit, Left to Right: Radio Milwaukee/MMSD; Convent Hill/HACM; Bioswale Maintenance/Reflo; Regenerative Stormwater Conveyance/ Stormwater Solutions Engineering; Urban Ecology Center; Pabst Brewery/MMSD; Porous Pavement/SSCHC; Radio Milwaukee Green Roof/MMSD; Olga Village/ HACM; Maryland Ave Montessori School/MMSD