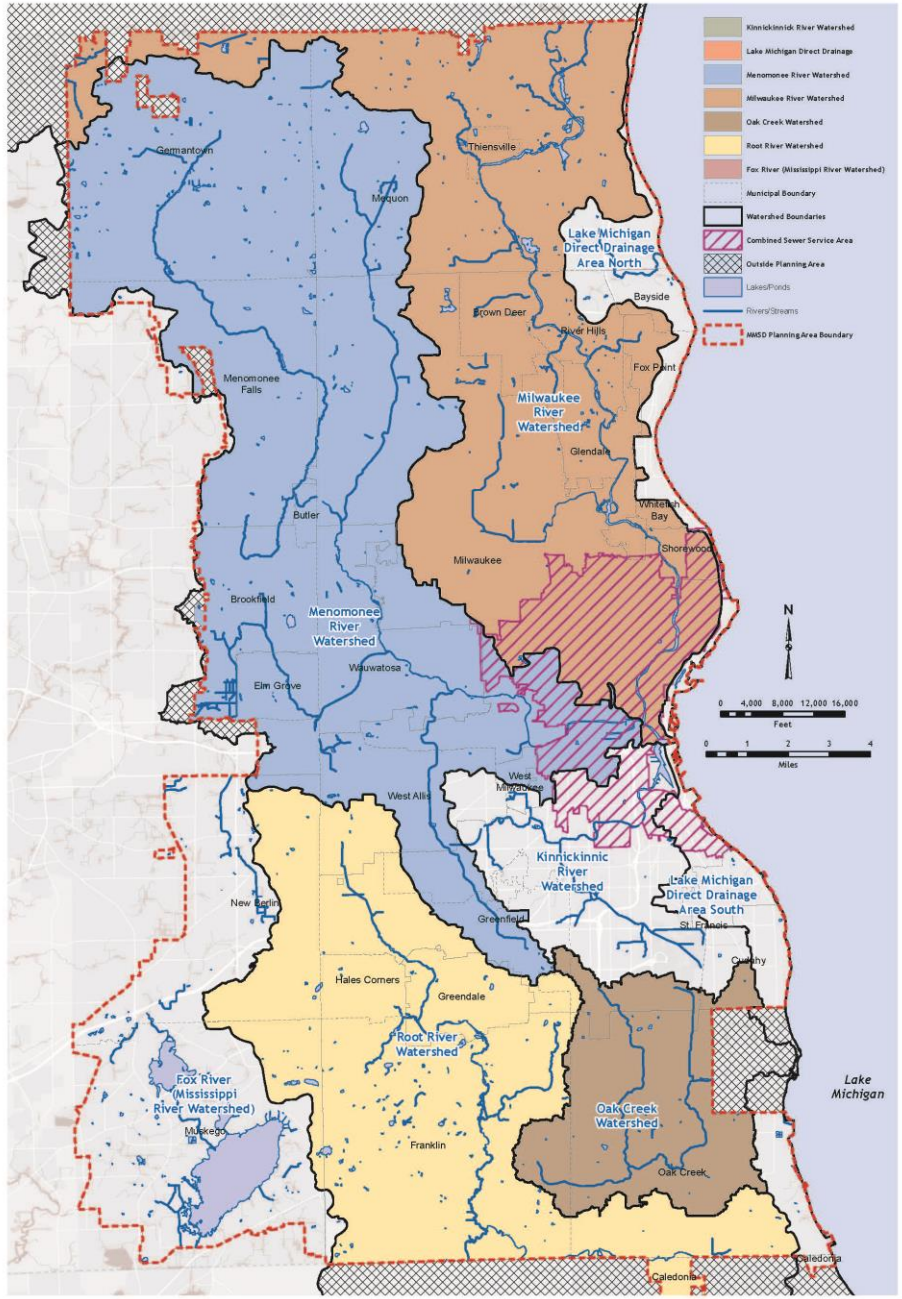
KINNICKINNIC RIVER GREEN INFRASTRUCTURE PLAN

Carrie Bristoll-Groll, PE, CFM

Principal Civil Engineer/CEO

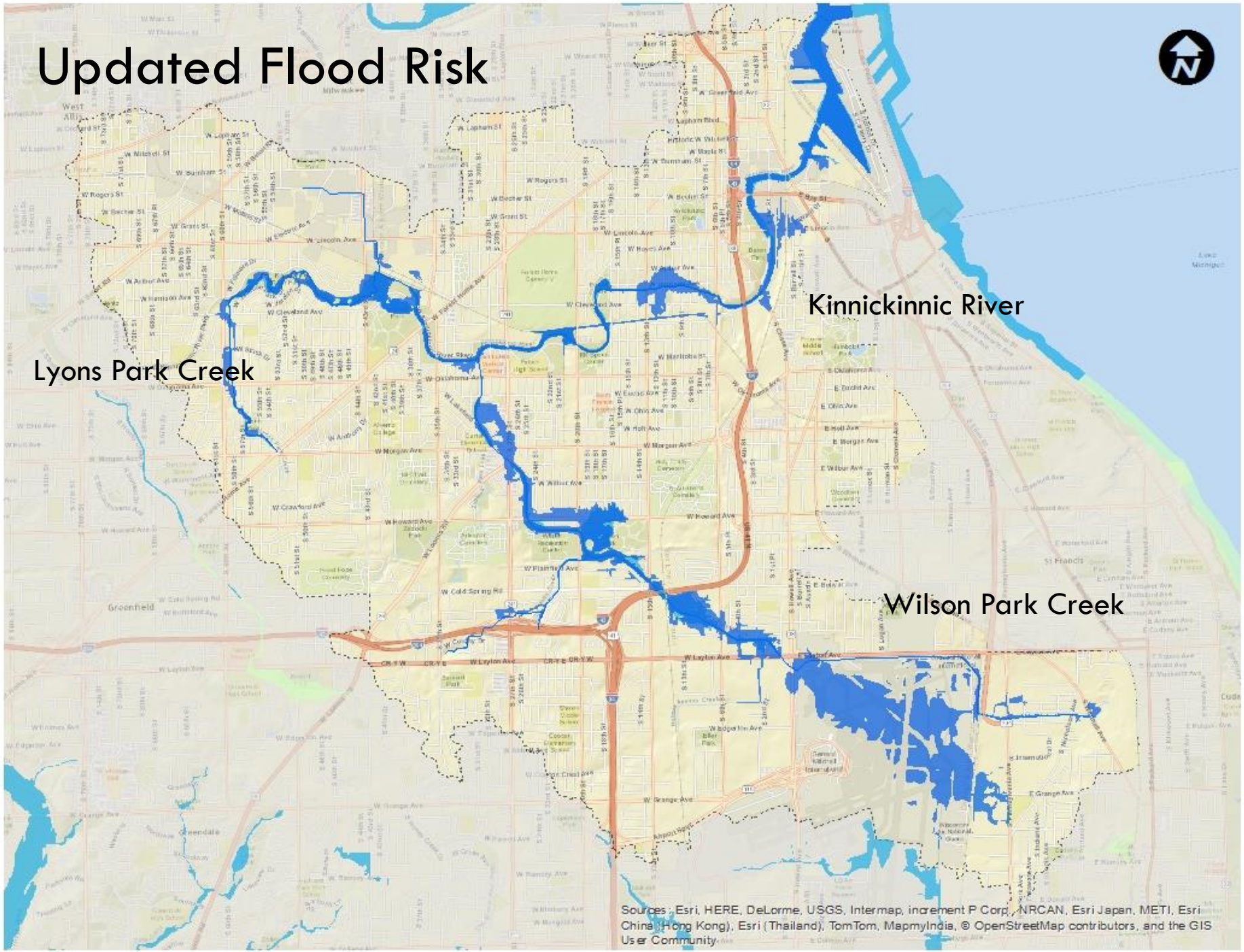
FIGURE 2. MMSD'S PLANNING AREA



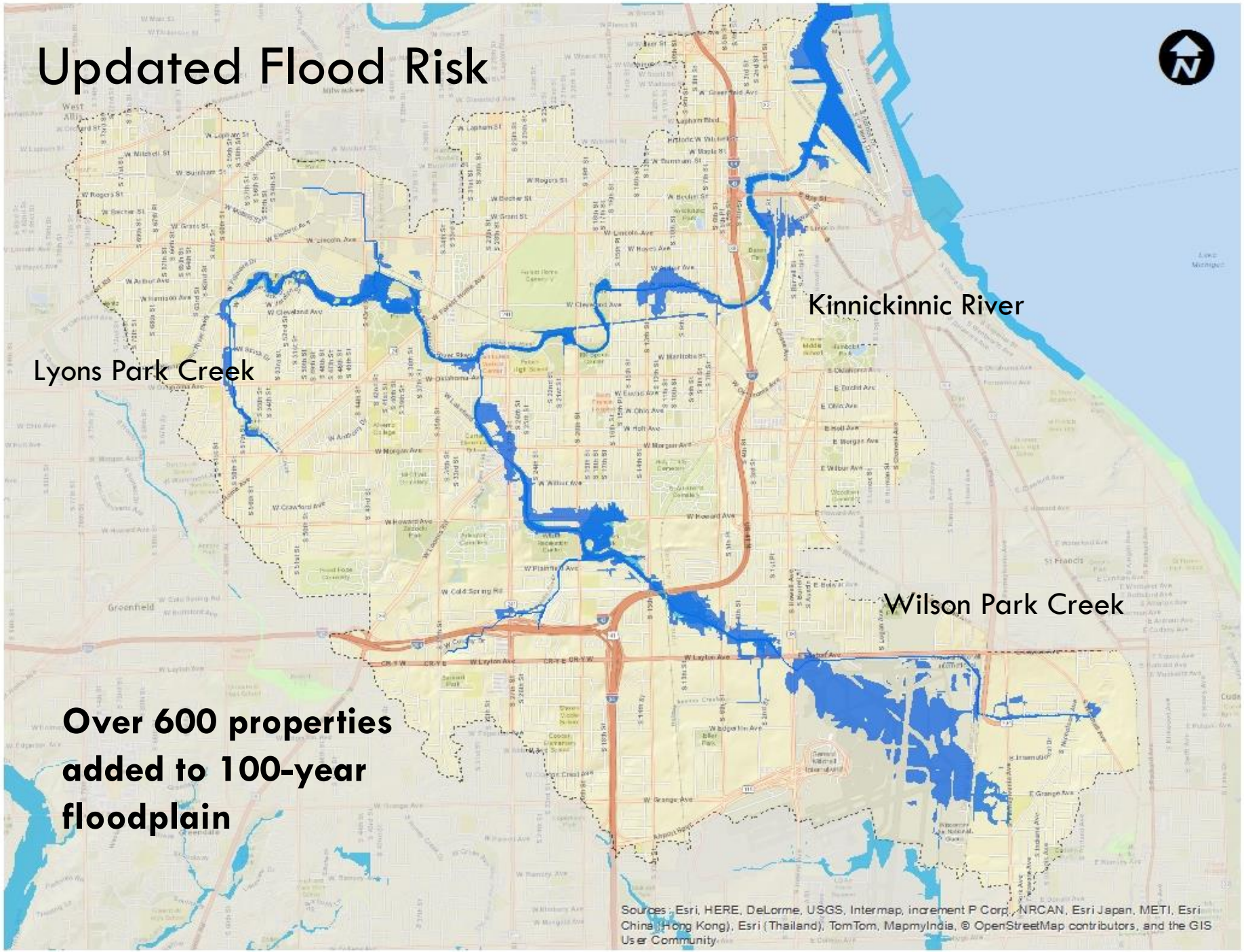
Source: MMSD Regional Green Infrastructure Plan, 2013

Previous Flood Risk

Updated Flood Risk

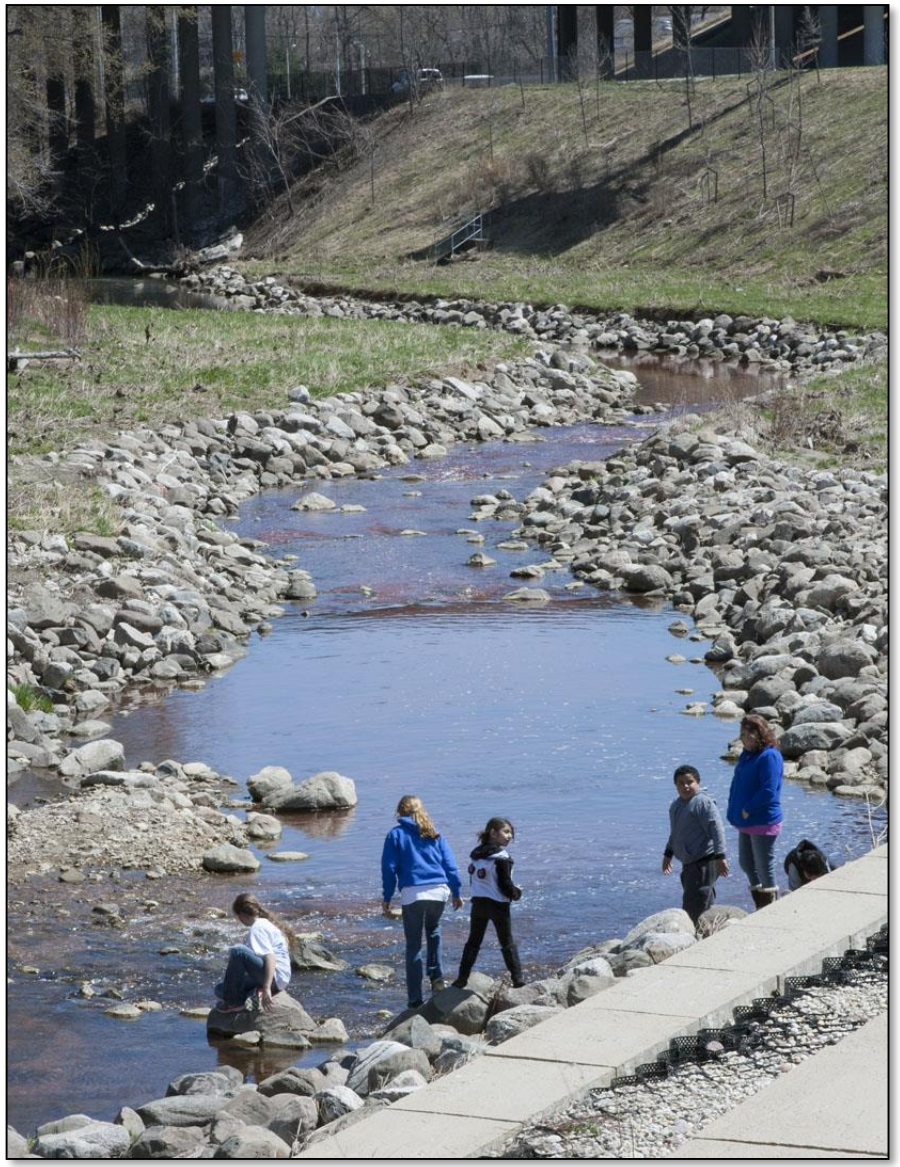


Updated Flood Risk

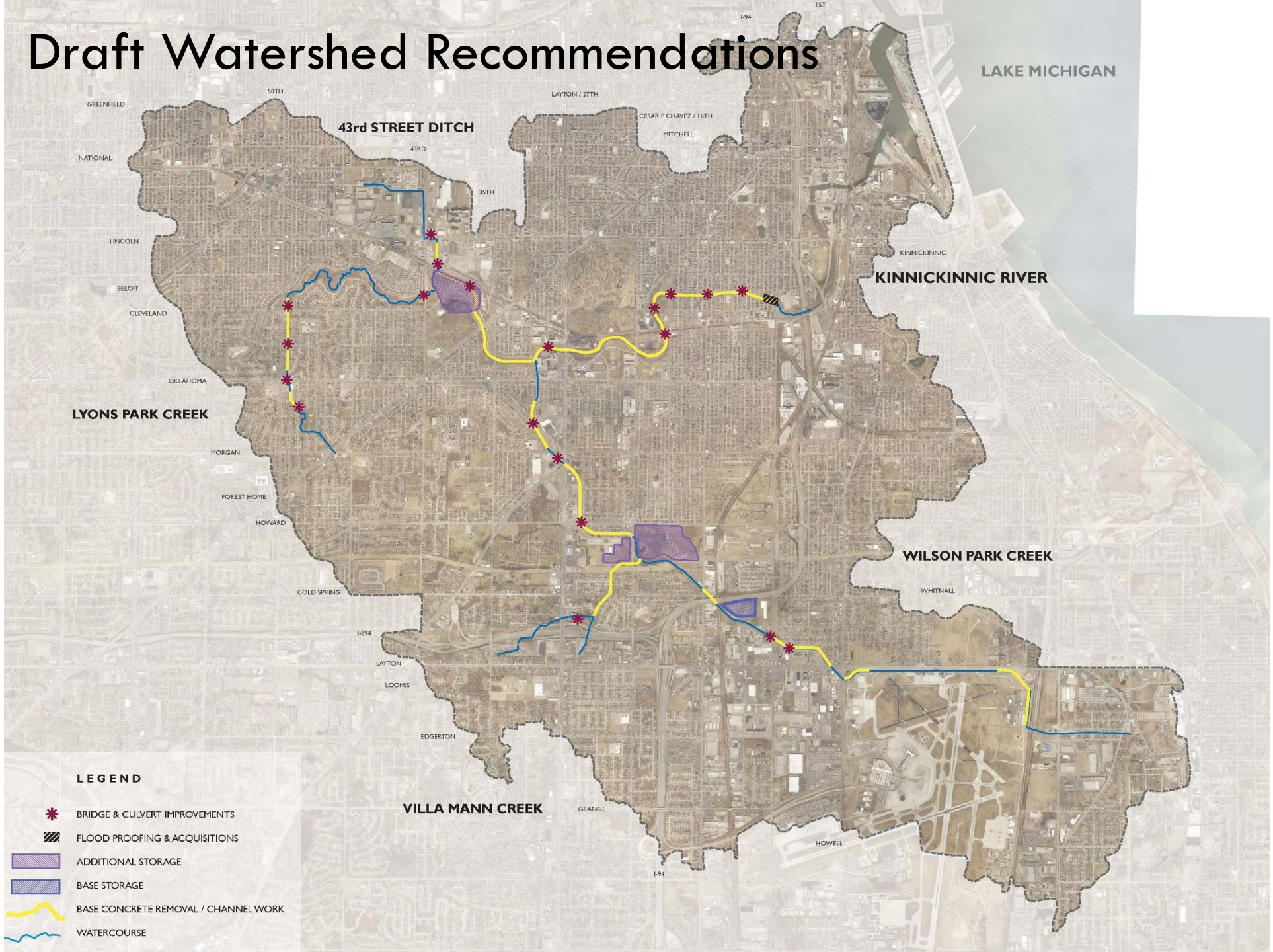


KK River Watershed Plan Objectives

- Reduce Flood Risk
- Improve Public Safety
- Improve Riparian & Aquatic Habitat
- Leverage Additional Community Objectives

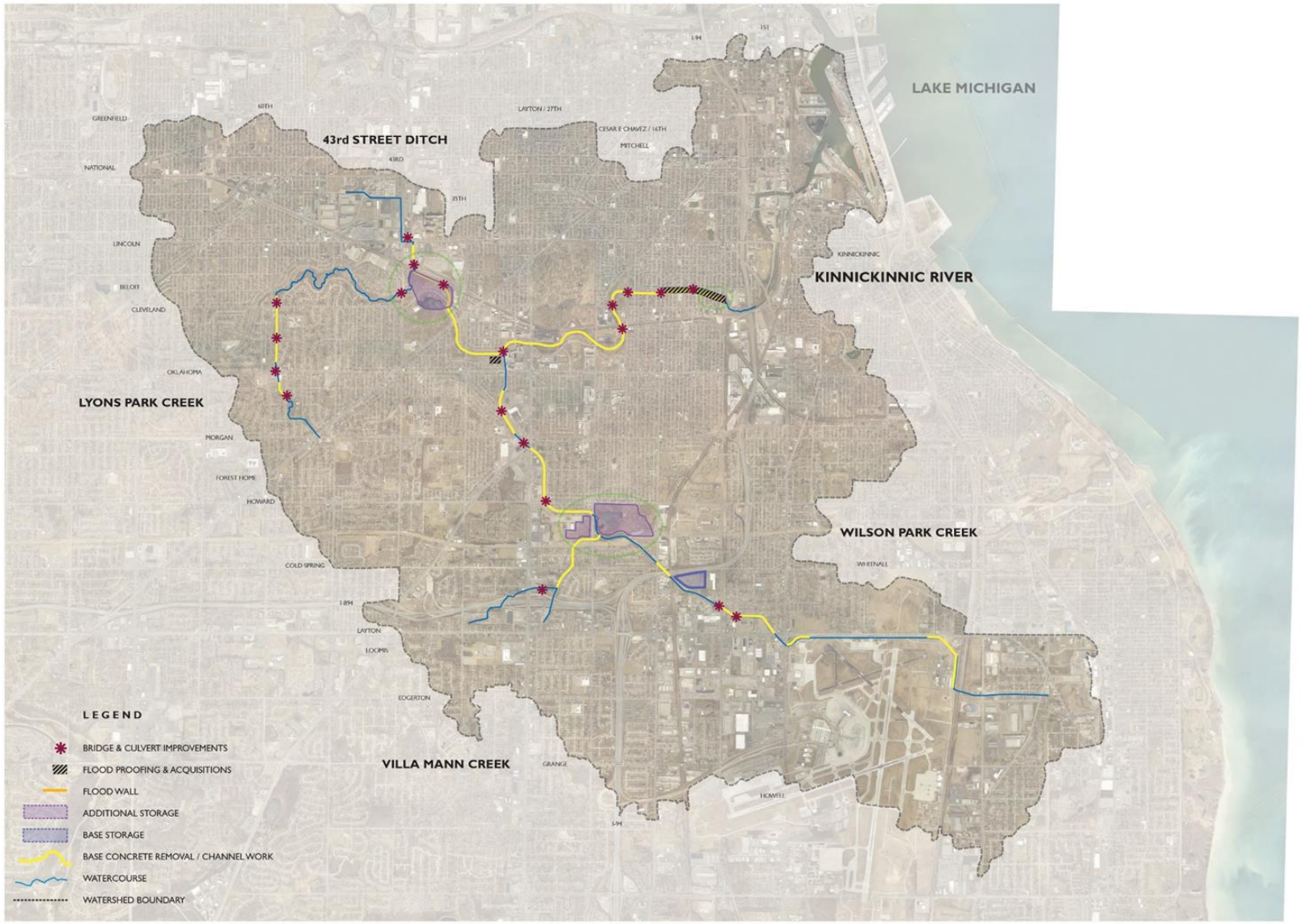


Draft Watershed Recommendations



KK WATERSHED WATERSHED PLAN COMPONENTS

- Concrete Channel Lining Removal
- Flood Storage
- Culvert / Bridge Improvements
- Floodproofing
- Green Infrastructure



GREEN INFRASTRUCTURE ALTERNATIVE

2-600’ long x 2’ deep x 6’ wide bioswale on both sides of each city block

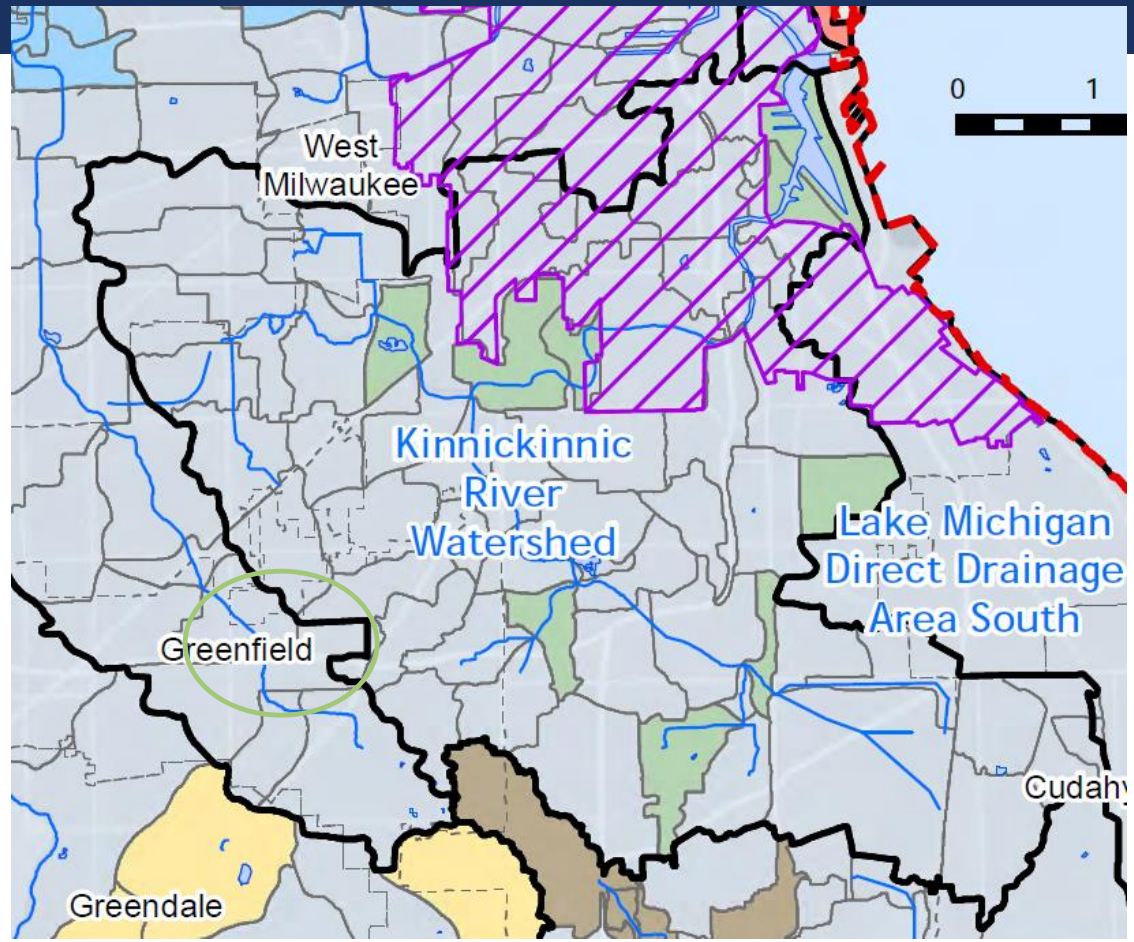
Or

4’ wide porous pavement parking lanes, with stone storage layer 4.5’ below

STORMWATER SOLUTIONS ENGINEERING LLC

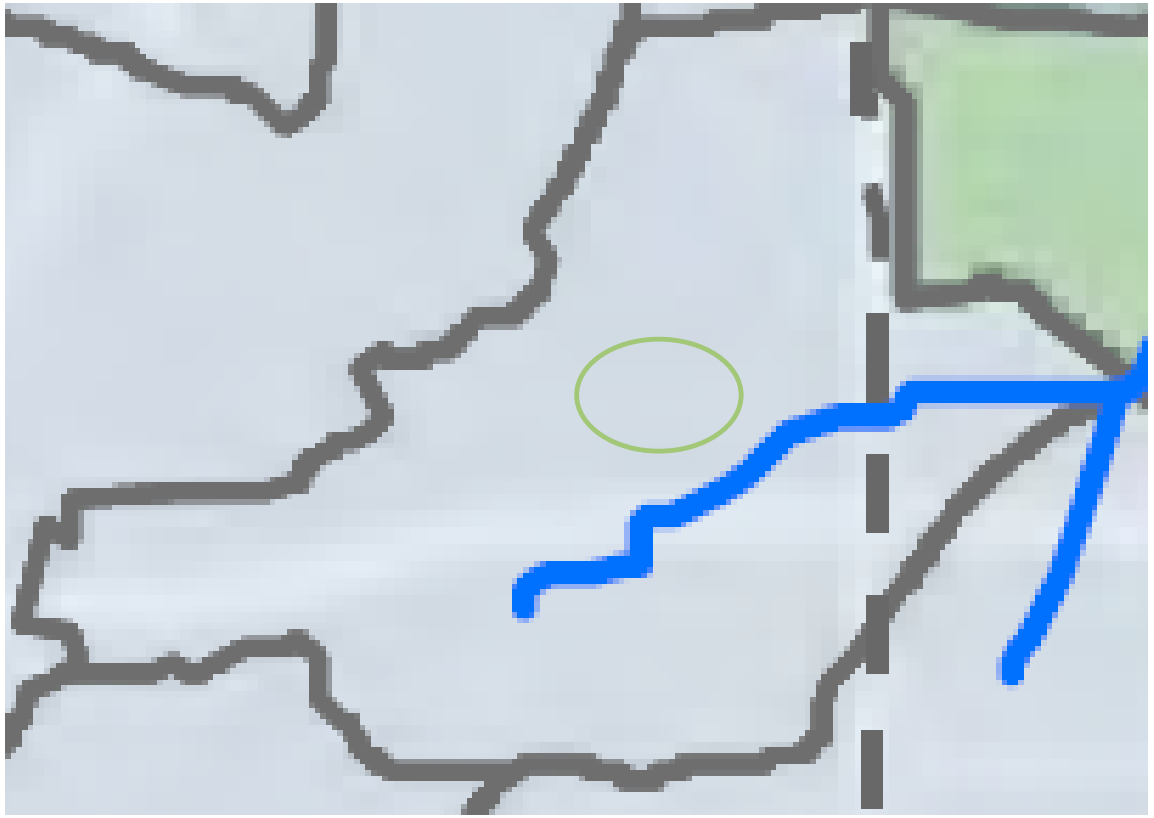
OVERVIEW OF RUNOFF MODEL

WATERSHED



OVERVIEW OF RUNOFF MODEL

SUBWATERSHED



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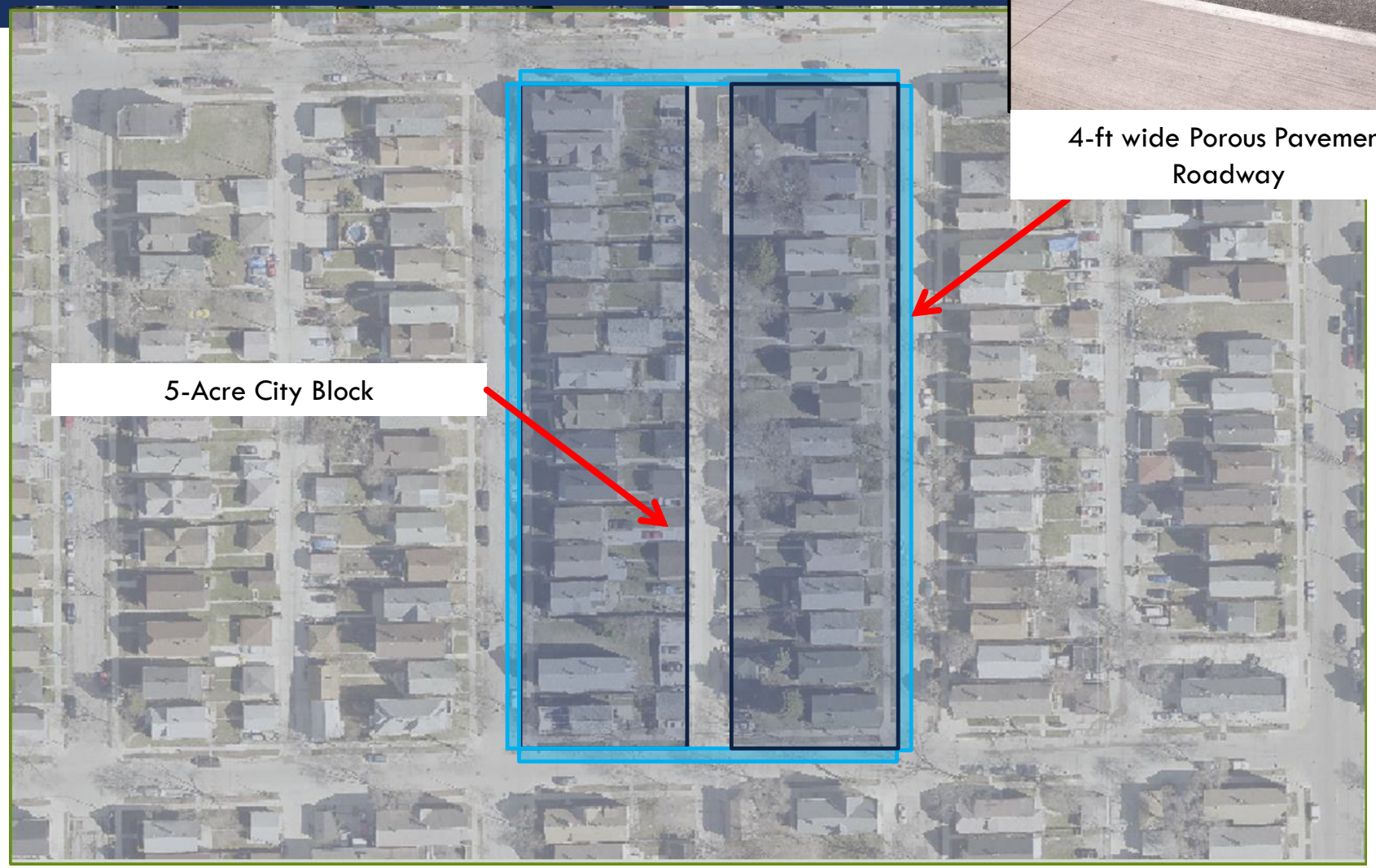
GREEN INFRASTRUCTURE ALTERNATIVE
OVERVIEW OF RUNOFF MODEL

4-ft wide Porous Pavement Roadway



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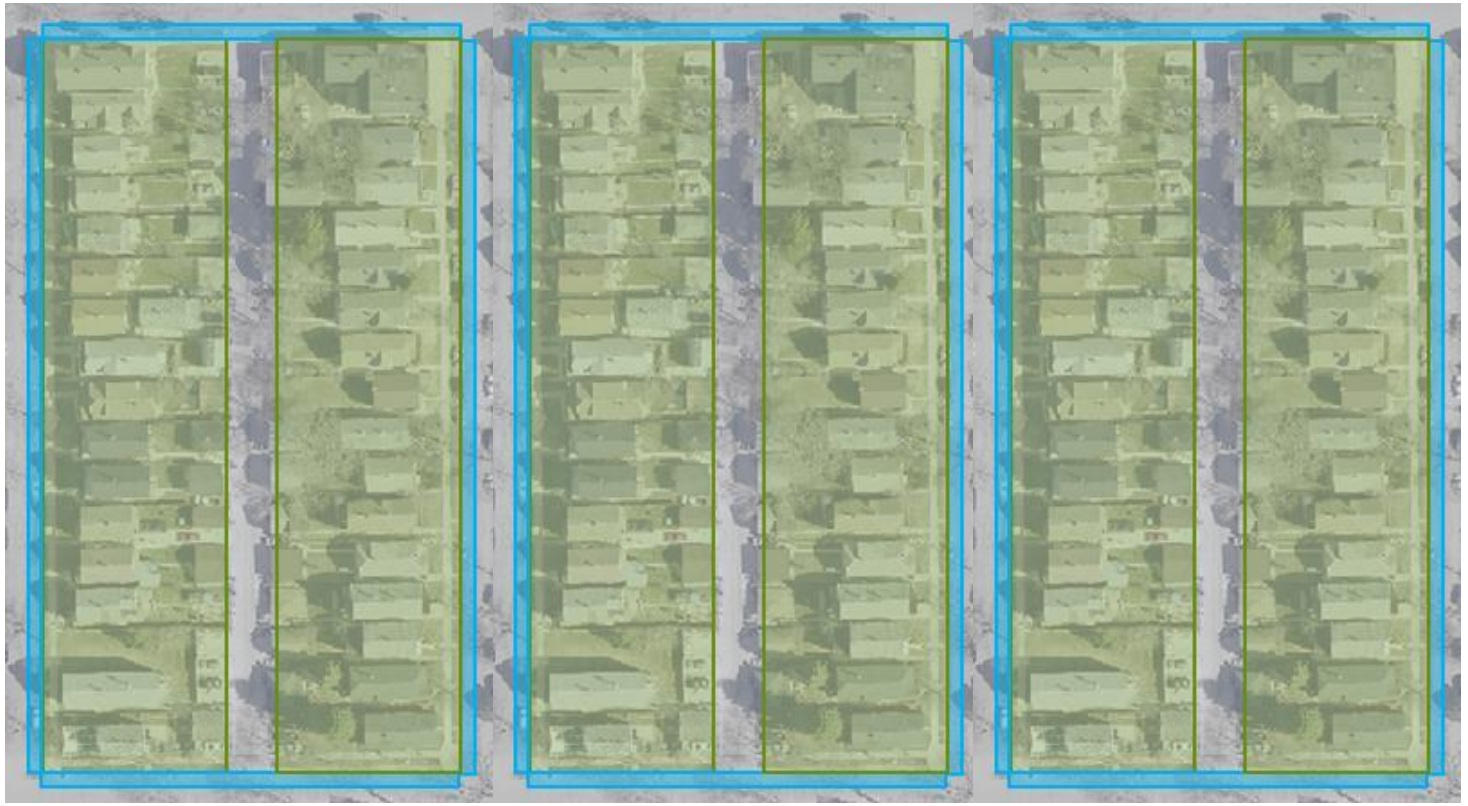
A CLEANER ENVIRONMENT

STORMWATER SOLUTIONS ENGINEERING LLC

BLOCK BY BLOCK



STORMWATER SOLUTIONS ENGINEERING LLC

OVERVIEW OF RUNOFF MODEL

NEIGHBORHOOD BY NEIGHBORHOOD

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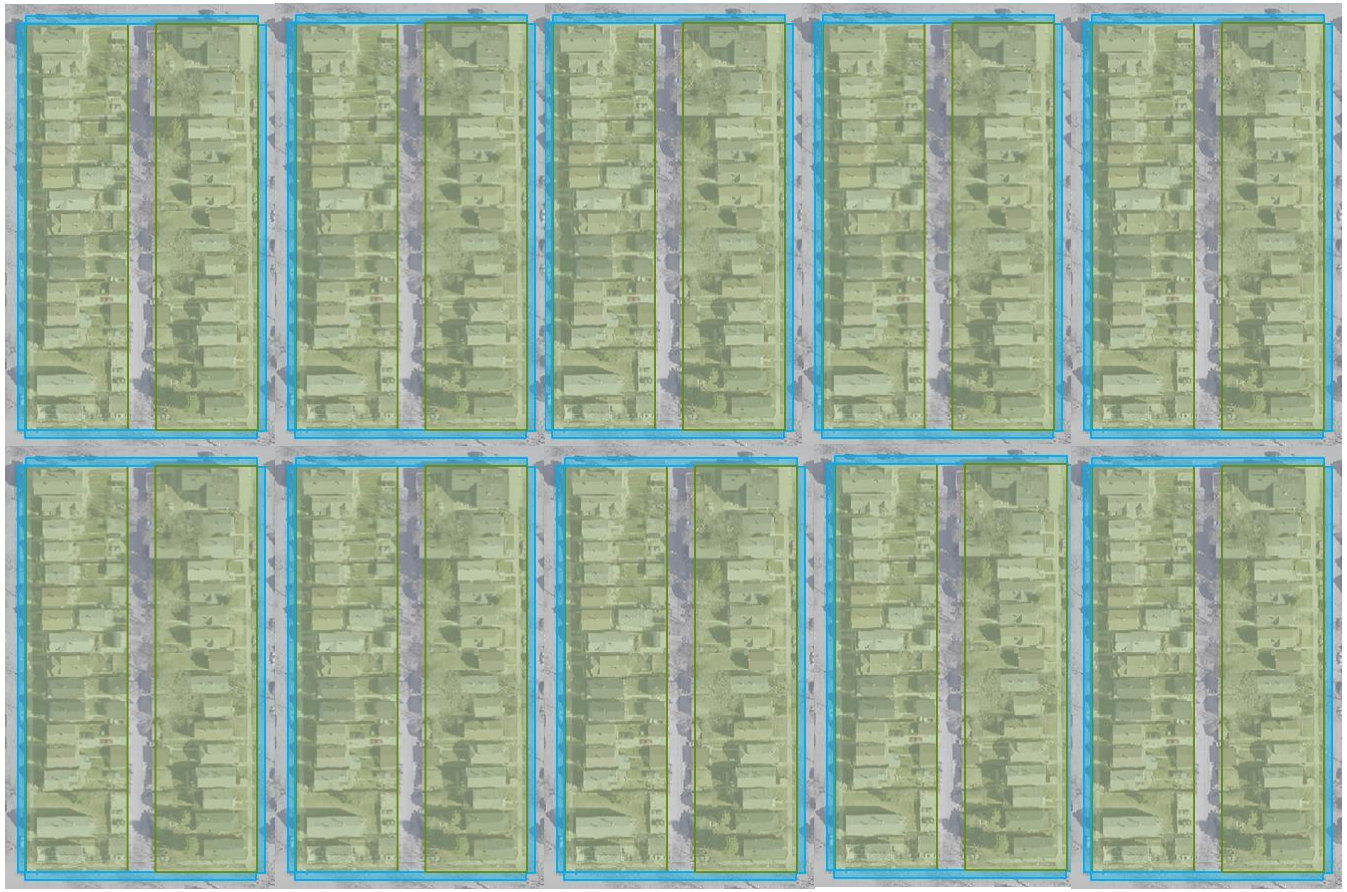
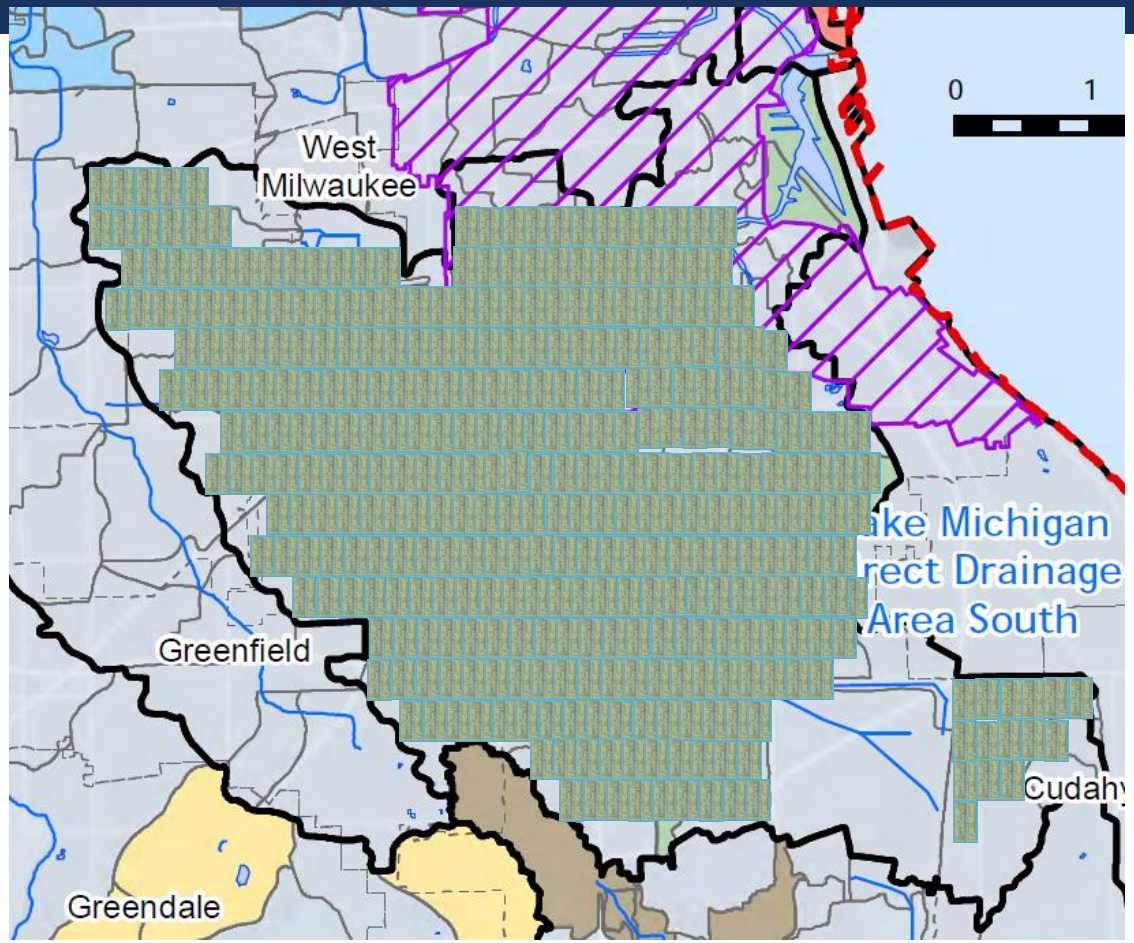


STORMWATER SOLUTIONS ENGINEERING LLC

OVERVIEW OF RUNOFF MODEL

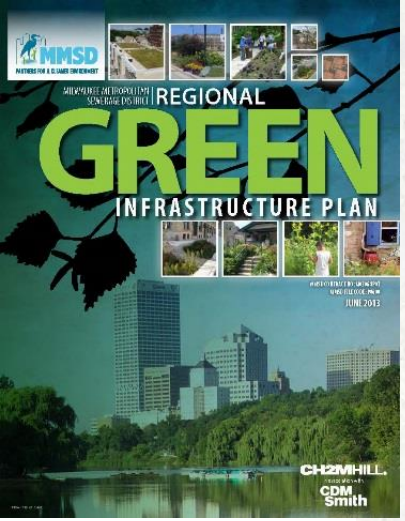
THROUGH THE ENTIRE WATERSHED



GREEN INFRASTRUCTURE ALTERNATIVE RESULTS (JUNE 2015)

- 18% decrease in flows as a stand-alone alternative (doesn't entirely meet the objectives)

- May be used to supplement other alternatives or in conjunction with a "blended" alternative



SUMMARY ANALYSIS AND RESULTS

Through this Plan, MMSD undertook a detailed data analysis of the opportunities and constraints for implementing green infrastructure strategies (Figure 1) in the seven watersheds in the MMSD planning area. Through extensive data collection and mapping, the analysis quantified the number of roads, buildings, and parking lots that can be treated with green infrastructure in order to meet the 2035 Vision of capturing 0.5 inch of rainfall per storm from impervious surfaces, which is equivalent to 740 million gallons of storage.

The Plan analysis involved collecting, creating, and analyzing extensive data—including impervious area, soils, land use, property ownership, groundwater, topography, separate/combined sewer areas, tree canopy, and other data.

The planning area has 91 square miles of impervious area made up of streets, buildings, parking lots, airports, and other imperviousness (Figures 2 and 3). The analysis considered different land uses that can be targeted with a combination of green infrastructure strategies. This approach will help the region make green infrastructure implementation decisions based upon localized conditions.

FIGURE 3
Impervious Area by Type and Ownership in the MMSD Planning Area

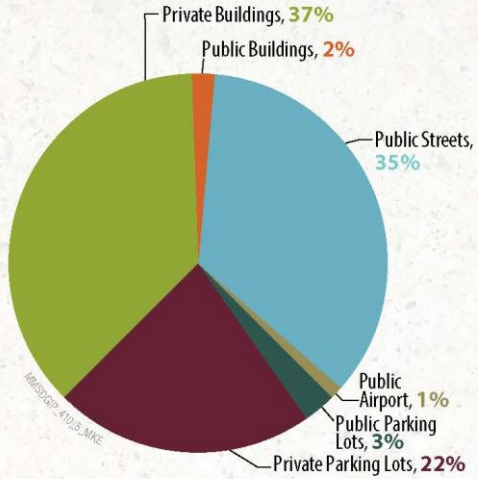
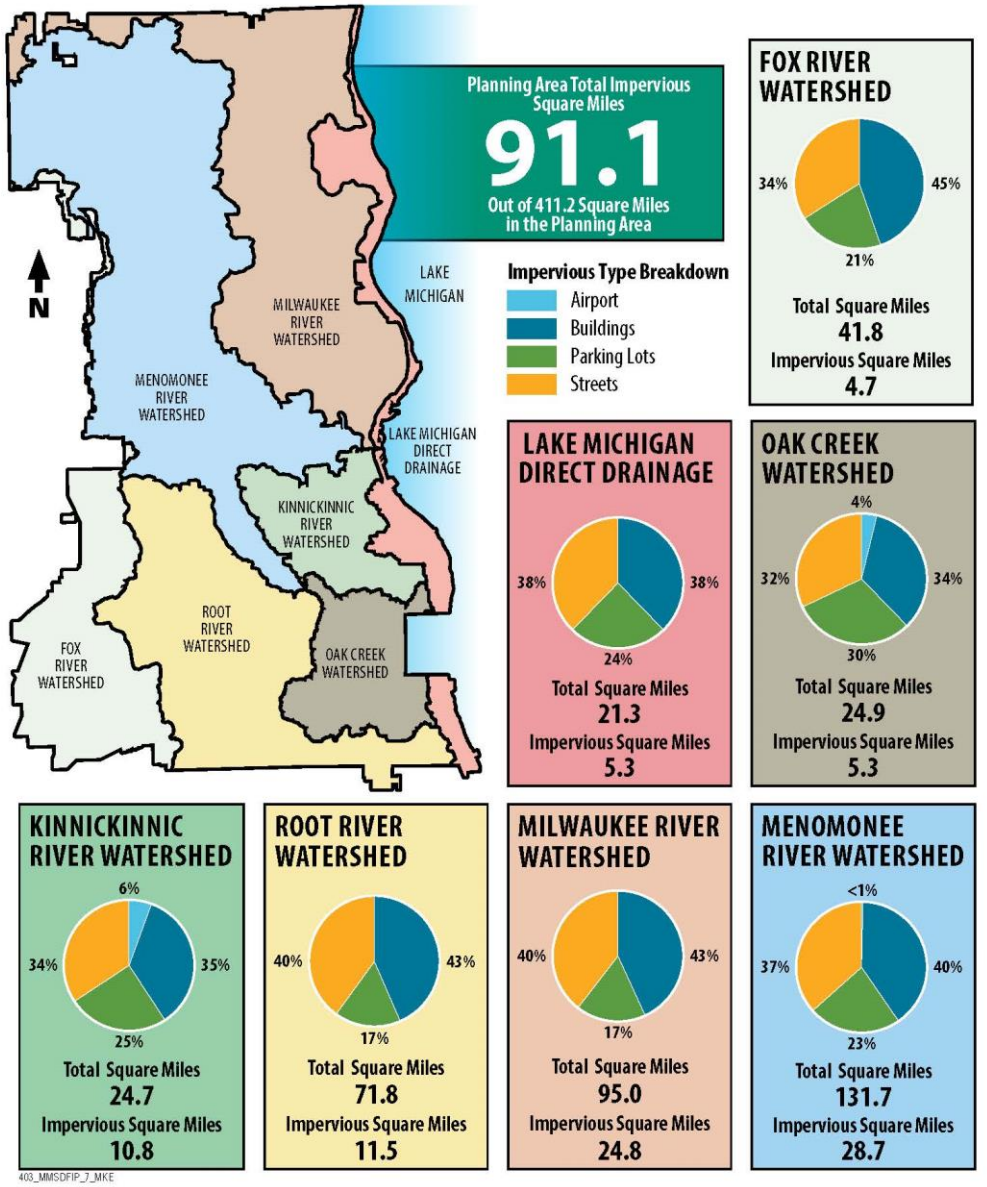


FIGURE 2

FIGURE 16
Impervious Area Type by Watershed

The total amount of green infrastructure needed in each watershed to meet the goal is closely related to the total amount of imperviousness. As different runoff surfaces require different green infrastructure strategies to achieve the capture goal, the percentage of buildings, parking lots, and streets influences the green infrastructure strategy recommendations.



KK RIVER WATERSHED GREEN INFRASTRUCTURE PLAN

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Objectives

- Develop goals and recommendations that are specific to the KK River Watershed
- Short-term and long-term implementation actions through partnerships
- Increased resiliency for water quality and quantity in the KK River Watershed

Outcomes

- Coordinated plan for green infrastructure investments in KK River Watershed
- Coordinated fund development for green infrastructure in the KK River Watershed

STORMWATER SOLUTIONS ENGINEERING LLC

TYPES OF GREEN INFRASTRUCTURE

There are many different types of green infrastructure and strategies for implementation. These strategies vary in terms of cost, target locations, effectiveness, as well as maintenance considerations. It is critical to implement strategies based on the ability to maintain and monitor the feature. Some types of green infrastructure can be implemented and maintained fairly easily, while some require professional assistance. Due diligence is needed to ensure that the particular type of green infrastructure will achieve the desired goal of stormwater management.

BIOSWALES

Landscape features that capture and infiltrate runoff and can remove pollutants.

BLUE ROOFS

Roofs that are designed for temporary water storage with either passive or active control devices.

GREEN ROOFS

Partially or completely planted roofs with vegetation growing in soil or other growing media to hold rainwater.

GREENWAYS

Riparian and non-riparian buffer zones and strips that store and drain stormwater runoff into the ground naturally.

NATIVE LANDSCAPING

Native plants that can tolerate drought and flooding cycles because of deep roots and climate-specific adaptations.

POROUS PAVEMENT

Pavement that can reduce and infiltrate surface runoff through its permeable surface into a stone or filter media below.

RAIN GARDENS

Gardens that are watered by pooled stormwater runoff, slowly infiltrating it into the ground along root pathways.

RAINWATER CATCHMENT

The capture and storage of water, potentially for reuse later.

REMOVAL OF PAVEMENT & STRUCTURES

Removal of structures or paving in order to allow infiltration.

SOIL AMENDMENTS

Organic materials spread on existing lawn to enhance its ability to infiltrate or absorb water.

STORMWATER TREES

Trees that hold rainwater on their leaves/branches, infiltrate it into the ground, absorb it through root systems and release it into the atmosphere (also known as evapotranspiration).

WETLANDS

Areas that have soils that are inundated or saturated for part of the year or the entire year.

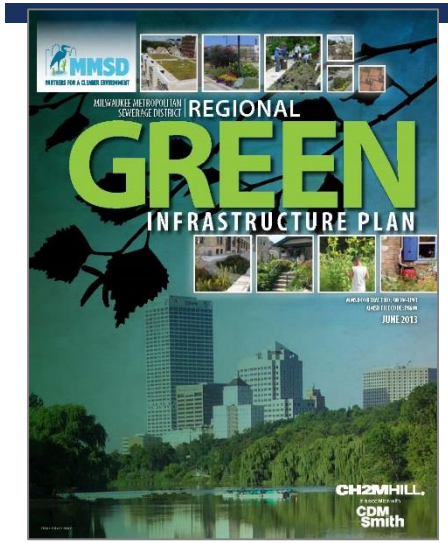
STAKEHOLDER ENGAGEMENT

- Quarterly or semi-annually meetings with KK Watershed Advisory Committee
- Meetings with GI Subcommittee
- 3-4 meetings with each of the communities: Milwaukee, West Milwaukee, Greenfield, St. Francis, Cudahy
- Outreach meetings to neighborhoods with help of SSCHC

TABLE 7
Prioritization Analysis Factors

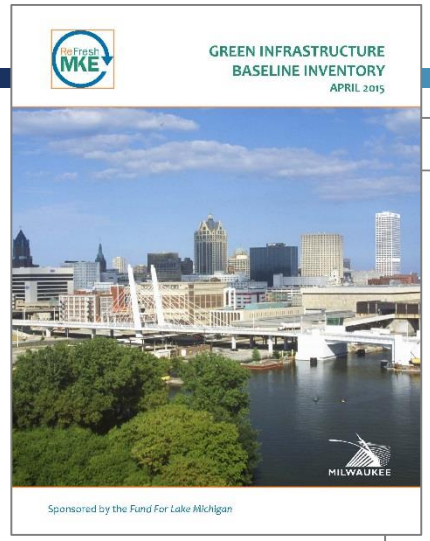
	Factor	Reason for Consideration
Opportunities for Green Infrastructure Implementation		
1	Vacant Land	Opportunity for easy implementation on vacant parcels
2	Redevelopment Areas	Opportunity for easy implementation within redevelopment areas
3	Areas with Existing Green Infrastructure Strategies	Builds on momentum and success of other green infrastructure projects
4	Parks	Creates new park amenities where there are large open spaces
5	Selective Sewer Separation Opportunities	Opportunity to route storm sewer flow through green infrastructure
6	Potential Stream Corridor Rehabilitation Locations	Opportunity for planned implementation and complements projects by reducing pollutants
Areas with Multiple Potential Green Infrastructure Benefits		
7	High Inflow Areas to the Deep Tunnel	Green infrastructure could reduce inflow to the Deep Tunnel by managing a portion of wet-weather flow
8	Known Basement Backup Areas	Green infrastructure could reduce basement backup risk by managing a portion of wet-weather flow
9	Potential Drainage Problem Areas	Historical stream locations can be correlated with increased surface flooding potential; green infrastructure could help by managing a portion of wet-weather flow
10	Potential High Sewer Inflow and Infiltration Areas	High levels of stormwater in sanitary sewer pipe indicate higher sewer inflow and infiltration rates. Green infrastructure could help these areas by managing a portion of wet weather flow
11	High Pollutant Loading Areas[1]	Green infrastructure could reduce pollutant loads by managing a portion of stormwater and associated pollution

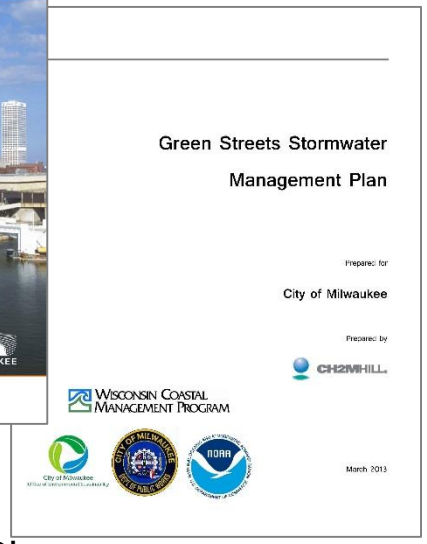
[1] *From SEWRPC's* ***A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds****, 2007.*



KK River Watershed

- Watercourse Management Plan
- Reach 2 Preliminary Engineering
- Resiliency Plan
- Park Plans

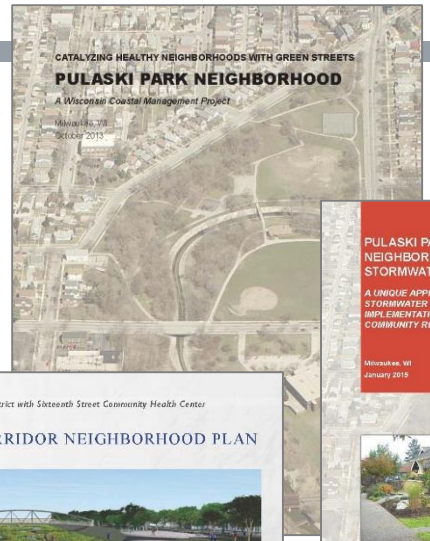


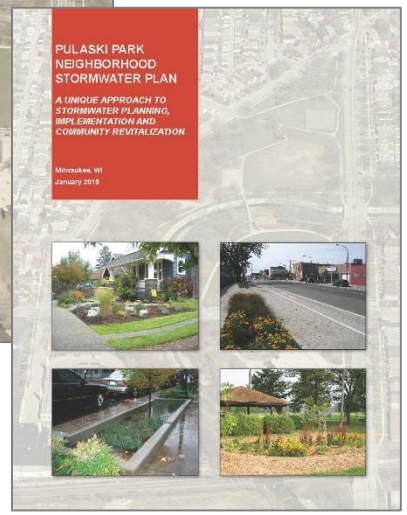


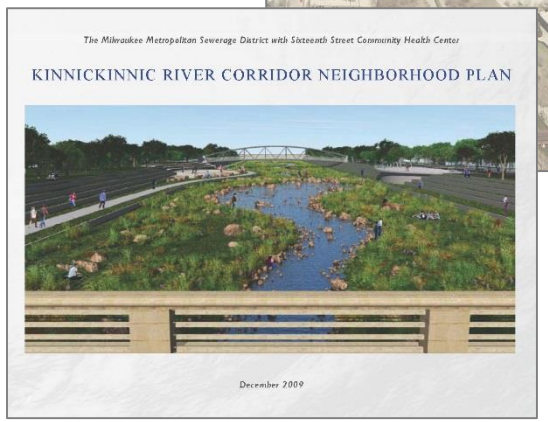
S. 27th Street
Strategic Action Plan

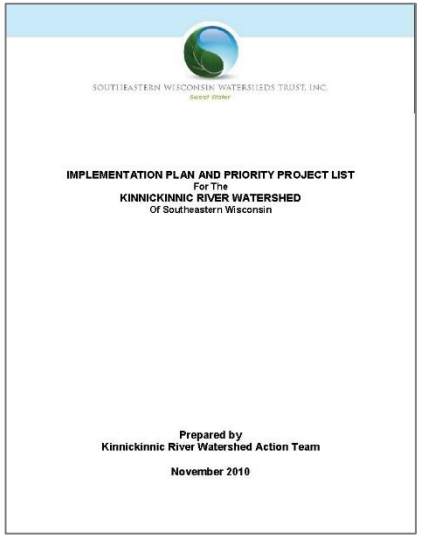
Harbor District
Water & Land Use Plan

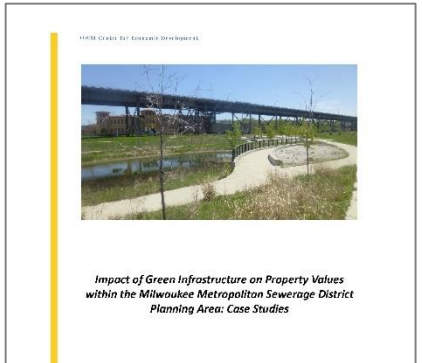
TMDLs

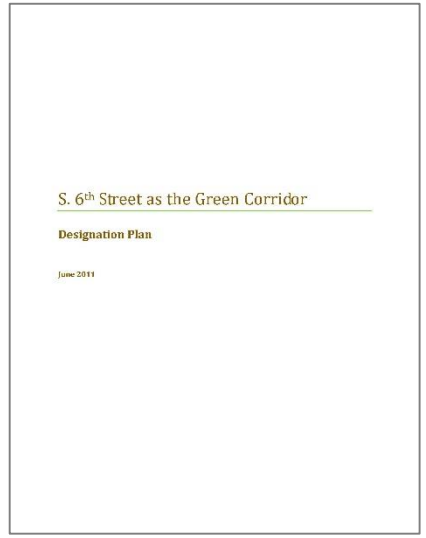












FACTORS	REASON FOR CONSIDERATION	ORIGINAL RGIP WEIGHTS	REVISED KKGIP WEIGHTS
Vacant Land	Opportunities for easy implementation, focusing on vacant land solely dedicated to green infrastructure implementation	1	4.50
Opportunities Areas	Opportunities for easy implementation within redevelopment areas	1	4.54
Areas With Existing Green Infrastructure Strategies	Builds on momentum and success of other green infrastructure projects	1	2.67
Parks	Creates new park amenities where there are large open spaces - includes 500' buffer	1	3.29
Selective Sewer Separation Opportunities	Removing stormwater from the combined sewer to storm sewers provides opportunities to route stormwater through green infrastructure	0.5	1.79
Potential Stream Corridor Rehabilitation Locations	Opportunities for planned implementation and complements projects by reducing pollutants - includes 500' buffer	1	4.33
High Inflow Areas To The Deep Tunnel	Green infrastructure could reduce inflow to the Deep Tunnel by managing a portion of wet-weather flow	1	2.75
Report Wet Basement Areas	Green infrastructure could reduce basement backup risk by managing a portion of wet-weather flow	1	3.42
Potential Drainage Problem Areas	Historical stream locations can be correlated with increased surface flooding potential — green infrastructure could help by managing a portion of wet-weather flow	0.5	3.04
Potential High Sewer Inflow & Infiltration Areas	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	1	1.75
High Pollutant Loading Areas	Improves poor water quality by reducing pollutant concentrations (pathogens, nutrients, heavy metals), erosion, sedimentation, pollution, etc.	1	4.75
1% Flood Risk Support	Strategic placement of green infrastructure to assist with flood risk reduction by adding resiliency	Factors not evaluated &/or weighted in RGIP analyses	4.00
Environmentally Impaired	Improves habitat and air quality needs for groundwater recharge, road salt reduction, noise pollution reduction, atmospheric CO_2, energy use, urban heat island effect, and health concerns (asthmas)		3.86
Capital Improvements	Opportunities to incorporate green infrastructure into future capital improvement projects and plans		4.00
Strong Established Partnerships	Builds on the momentum of neighborhood leadership, partnerships and organizations (non-profits, neighborhood associations, block clubs, etc.) to concentrate green infrastructure investment and co-benefits; leveraging volunteers		3.36
Improvement Districts (BIDs, NIDs, & TINs)	Business Improvement Districts (BIDs), Neighborhood Improvement Districts (NIDs), & Targeted Investment Neighborhoods (TINs): Builds on momentum of organized property owners, grows understanding and demand for green infrastructure, leverages opportunities for coordinated maintenance		3.22
Schools	Cultivates public education opportunities (about the environment and understanding/acceptance/demand/ support for green infrastructure) - with 500' buffer		4.25
Physical Site Constraints	High water table, high slopes, site geology, topography, brownfields		4.00

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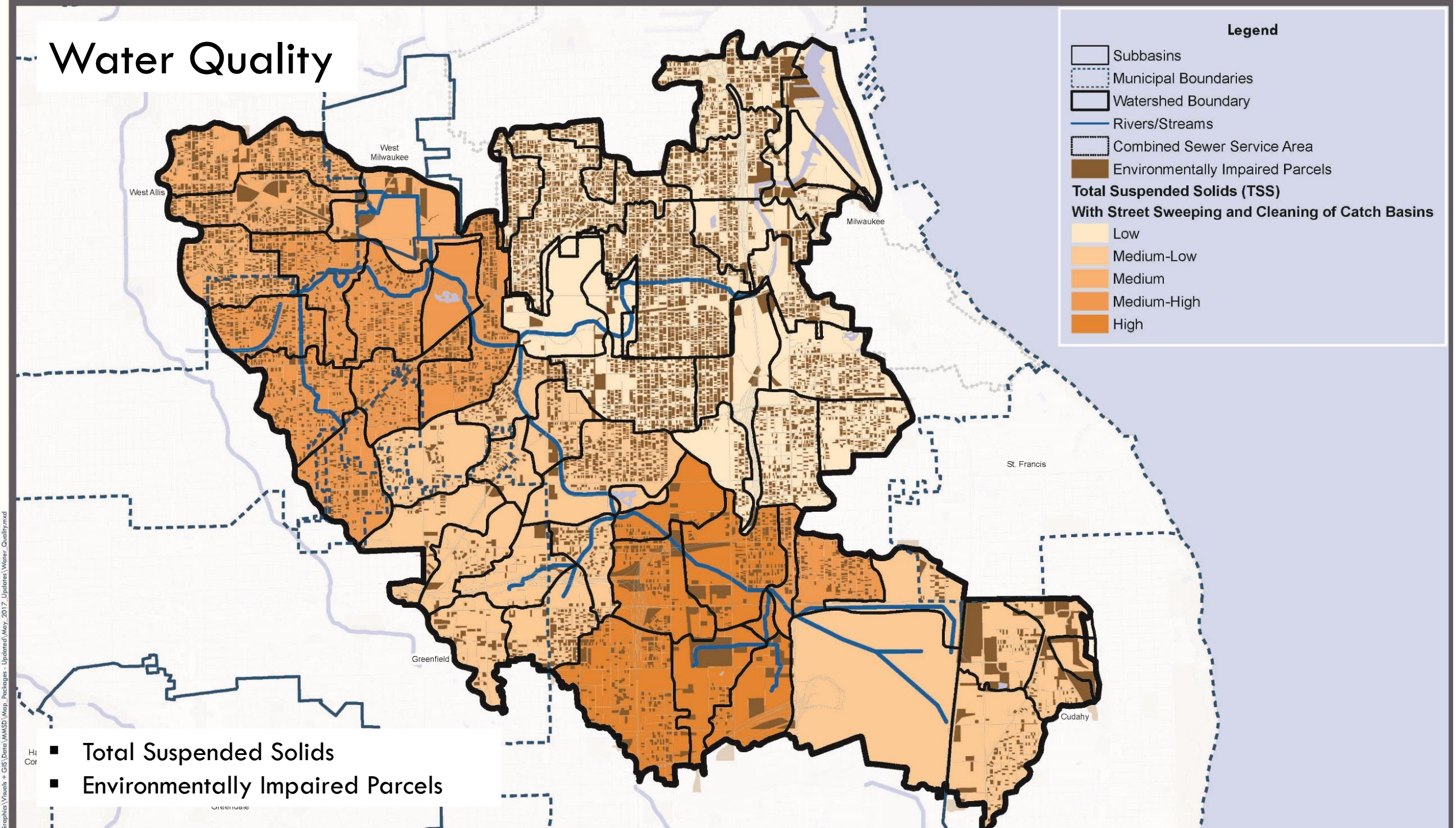
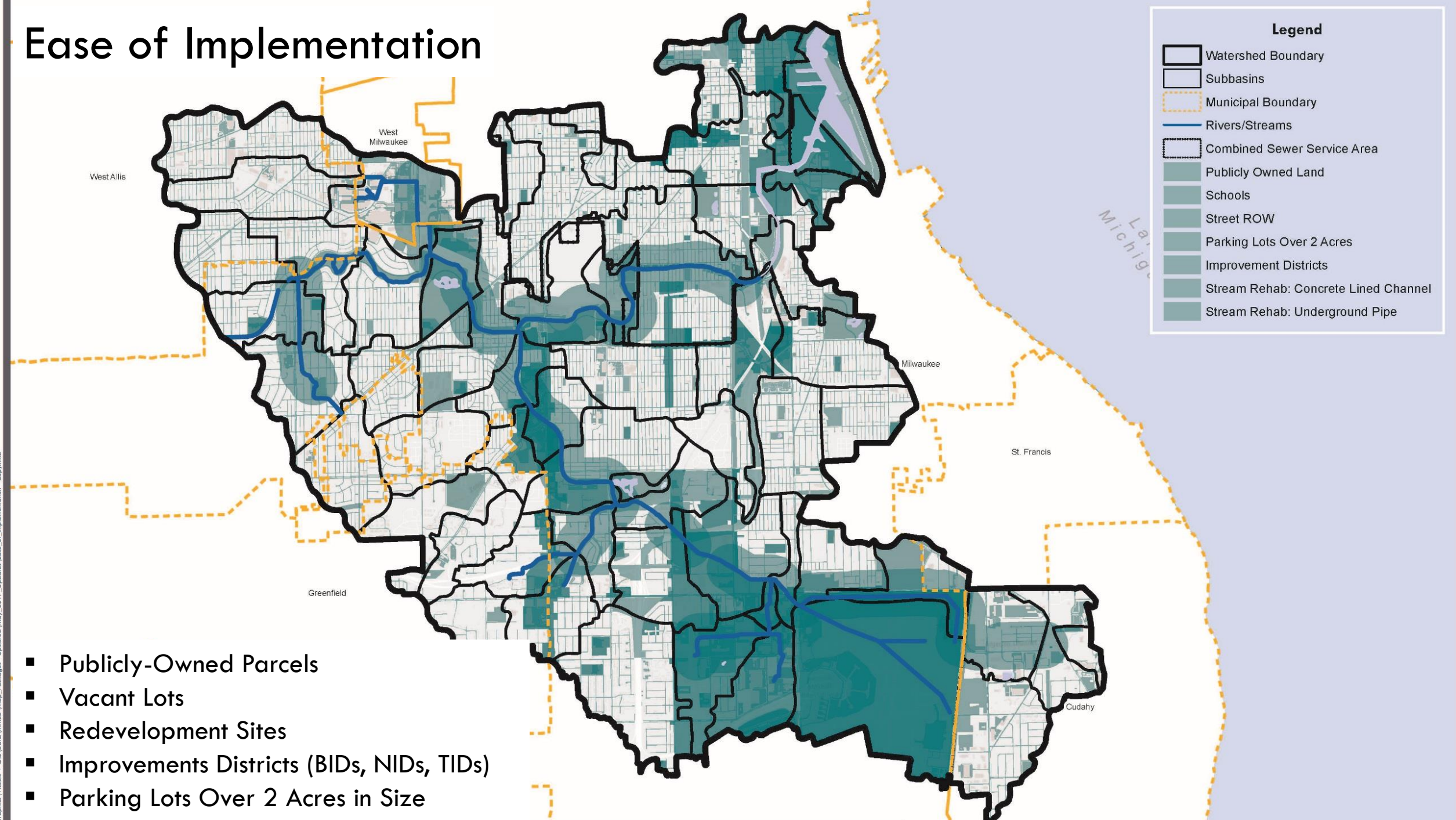
Water Quality



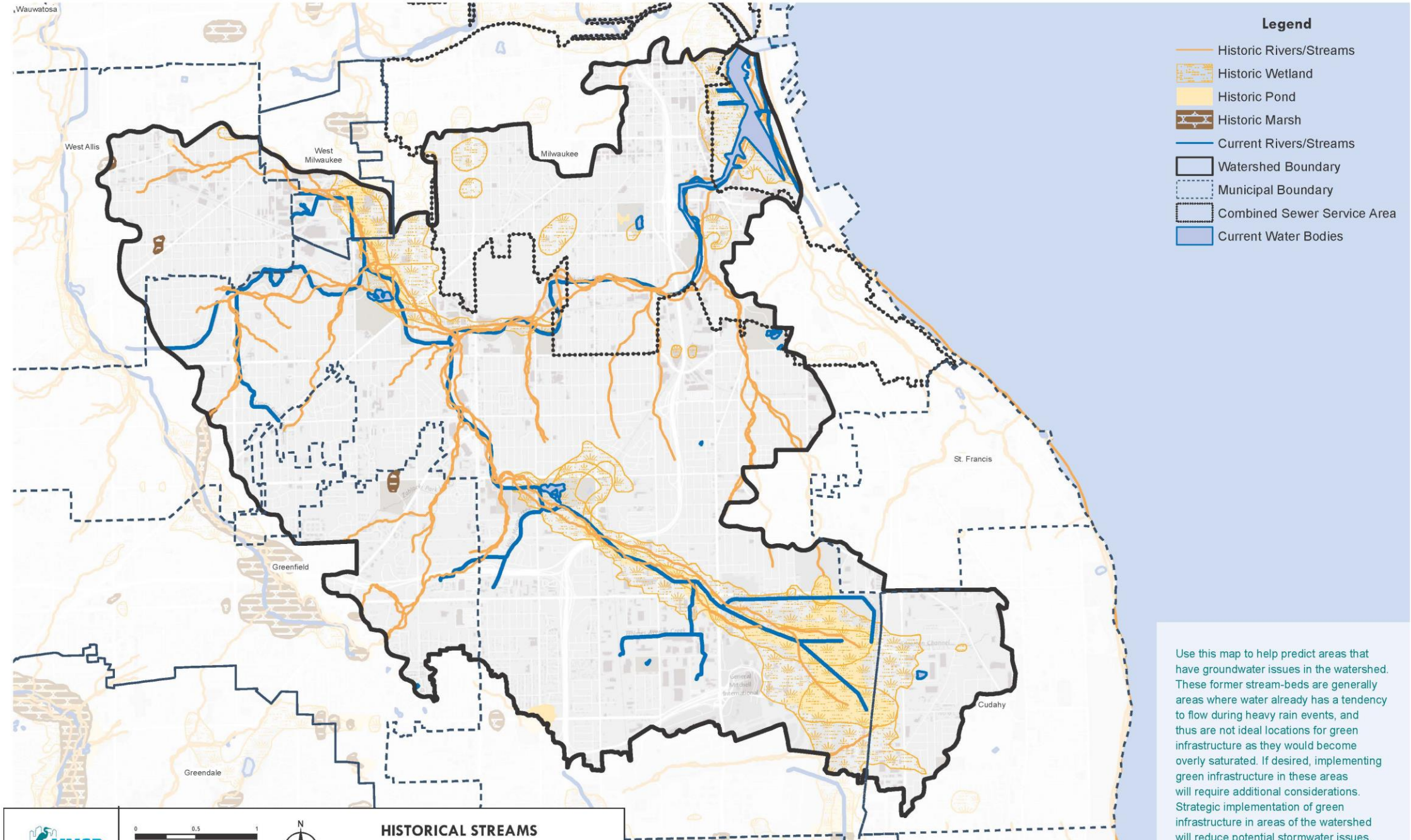
- Total Suspended Solids
- Environmentally Impaired Parcels

Ease of Implementation

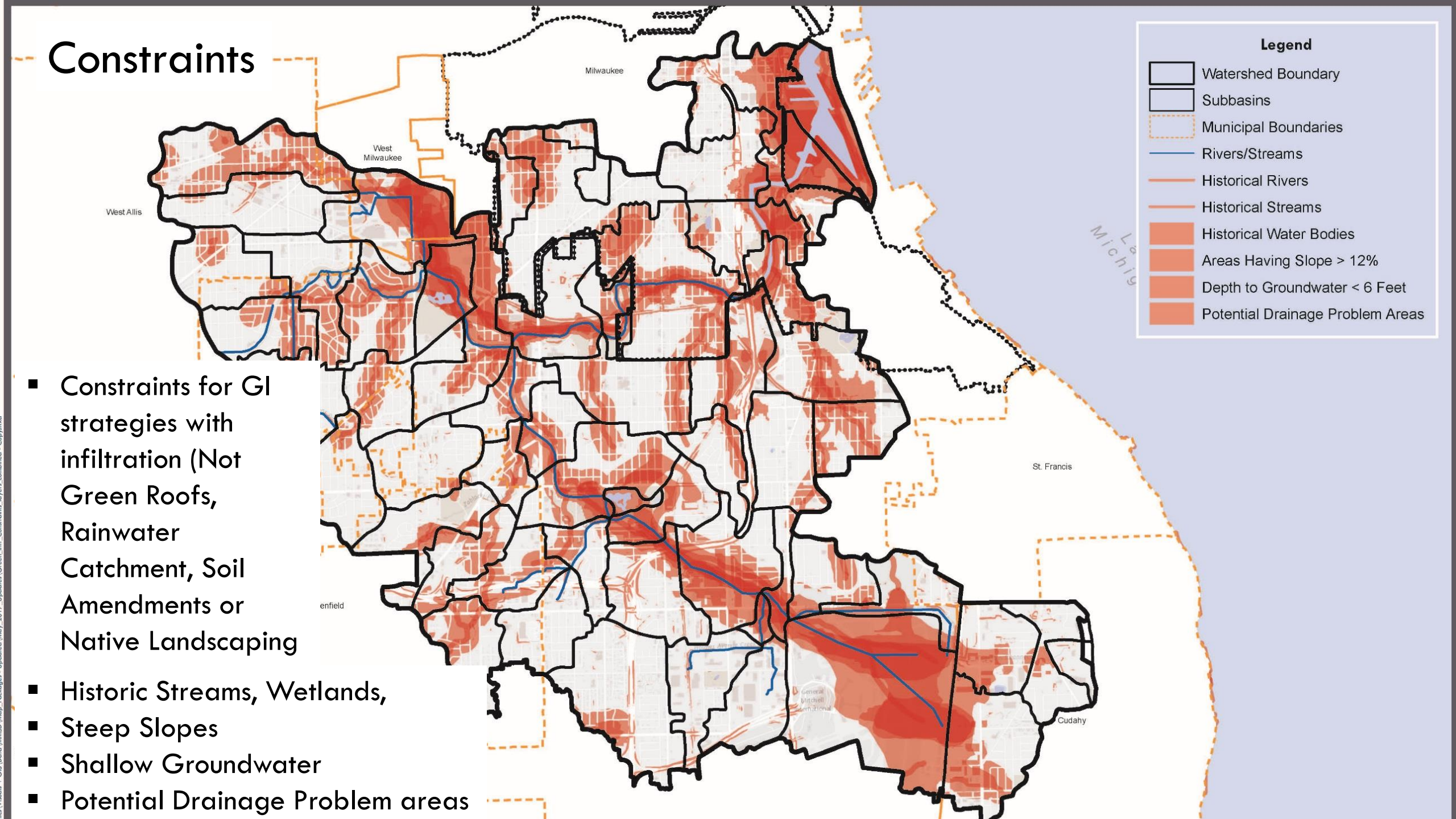


- Publicly-Owned Parcels
- Vacant Lots
- Redevelopment Sites
- Improvements Districts (BIDs, NIDs, TIDs)
- Parking Lots Over 2 Acres in Size

FIGURE A-15. HISTORIC STREAMS

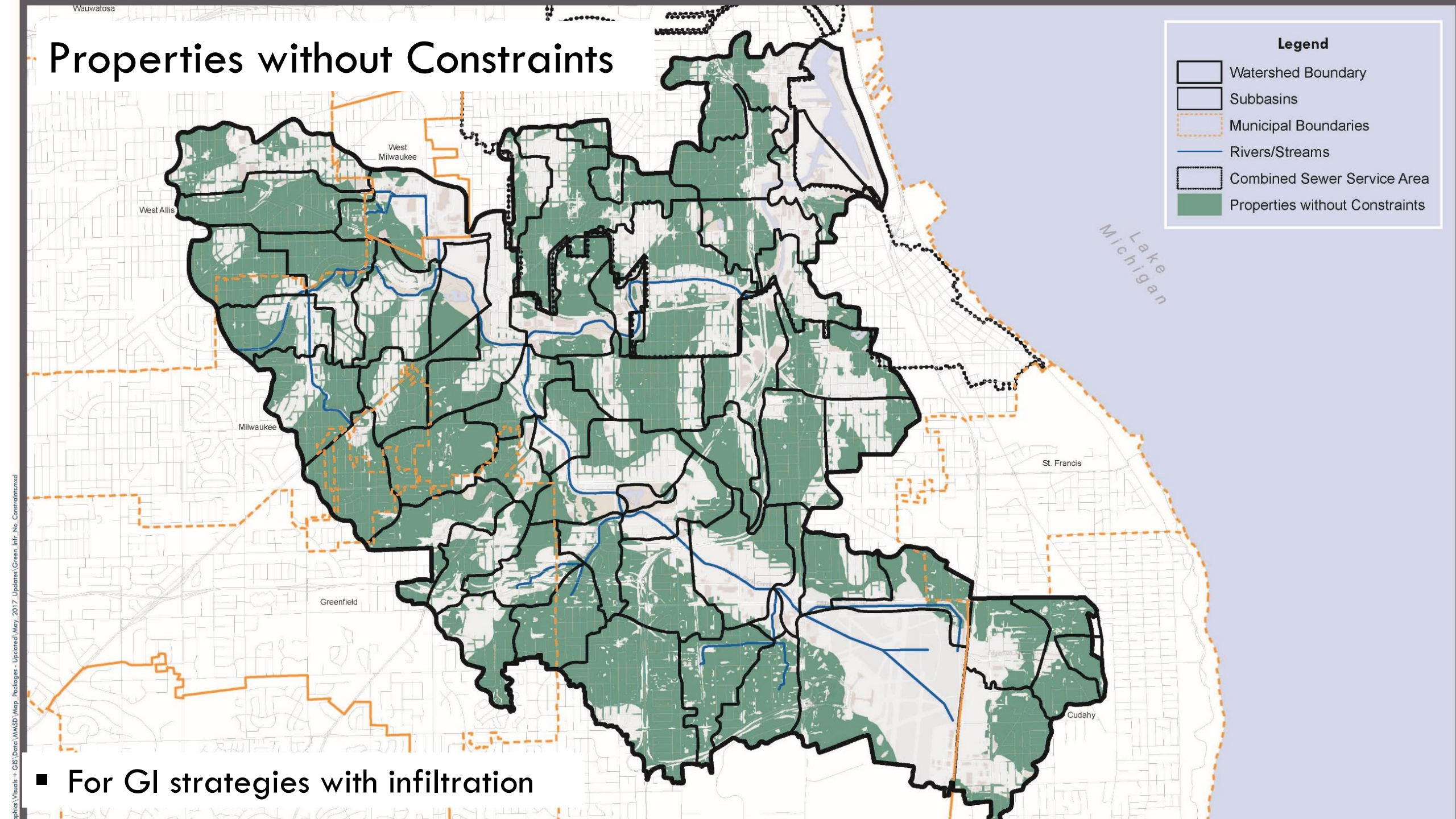


Constraints



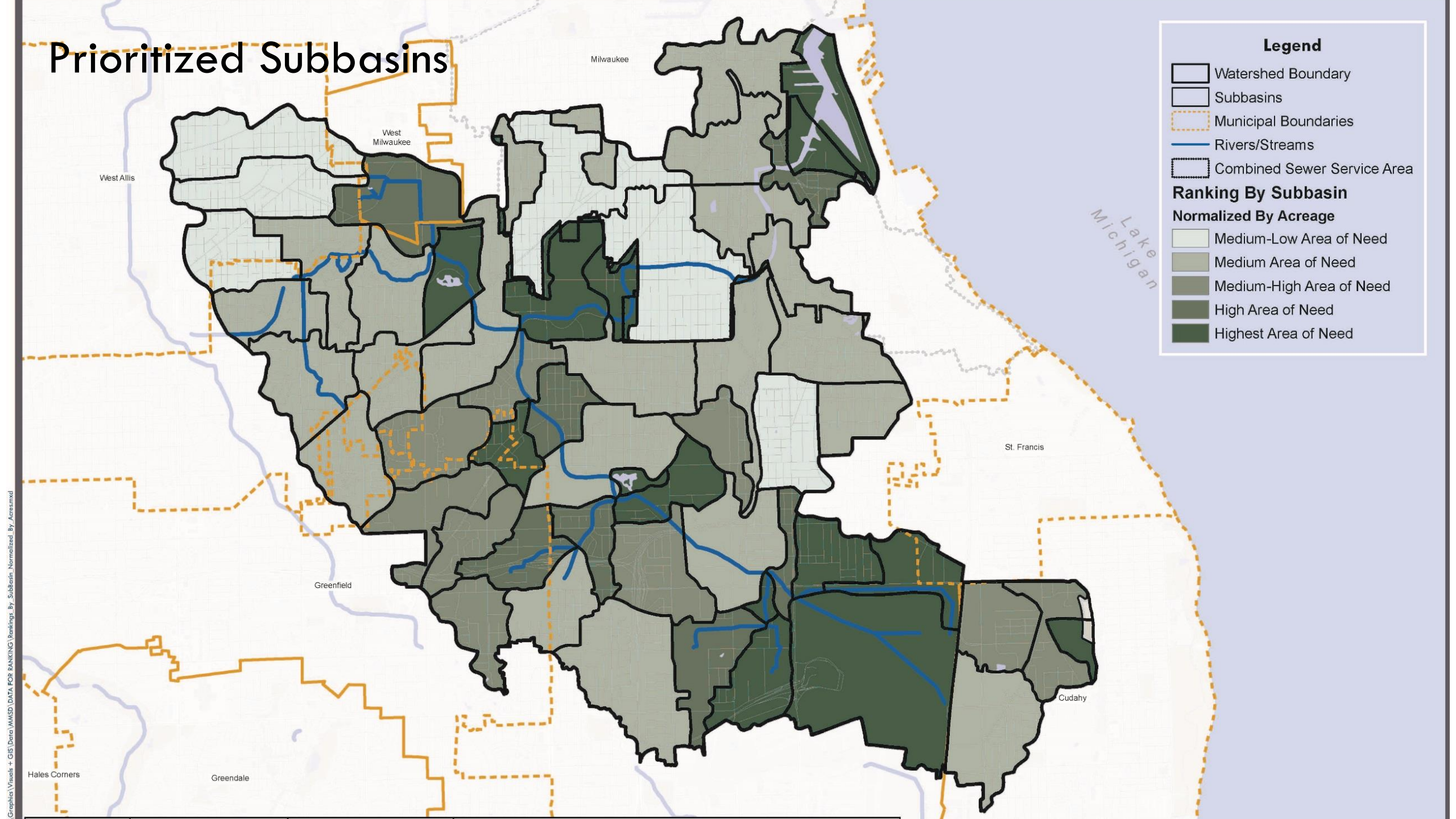
- Constraints for GI strategies with infiltration (Not Green Roofs, Rainwater Catchment, Soil Amendments or Native Landscaping
- Historic Streams, Wetlands,
- Steep Slopes
- Shallow Groundwater
- Potential Drainage Problem areas

Properties without Constraints

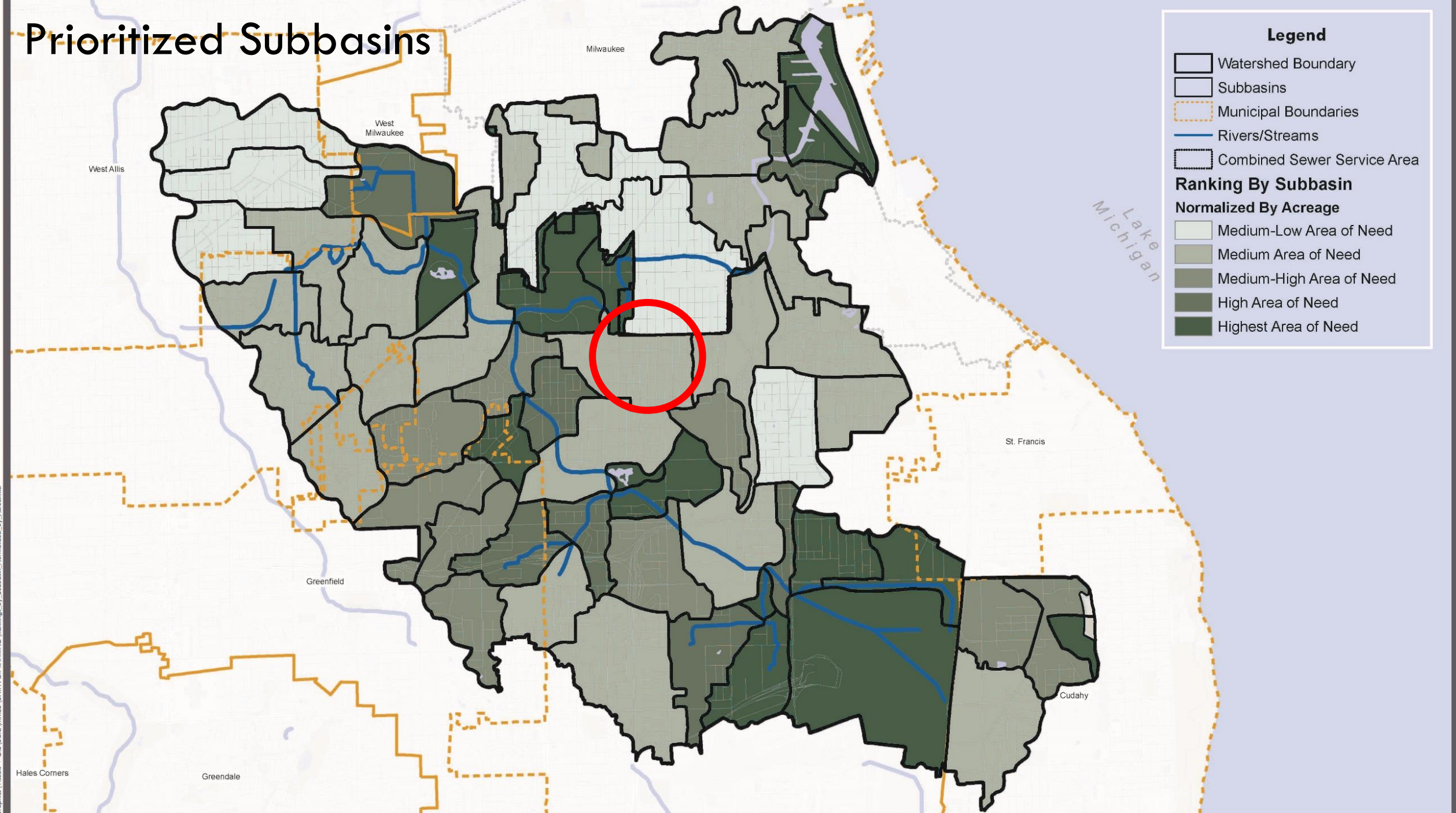


- For GI strategies with infiltration

Prioritized Subbasins



Prioritized Subbasins



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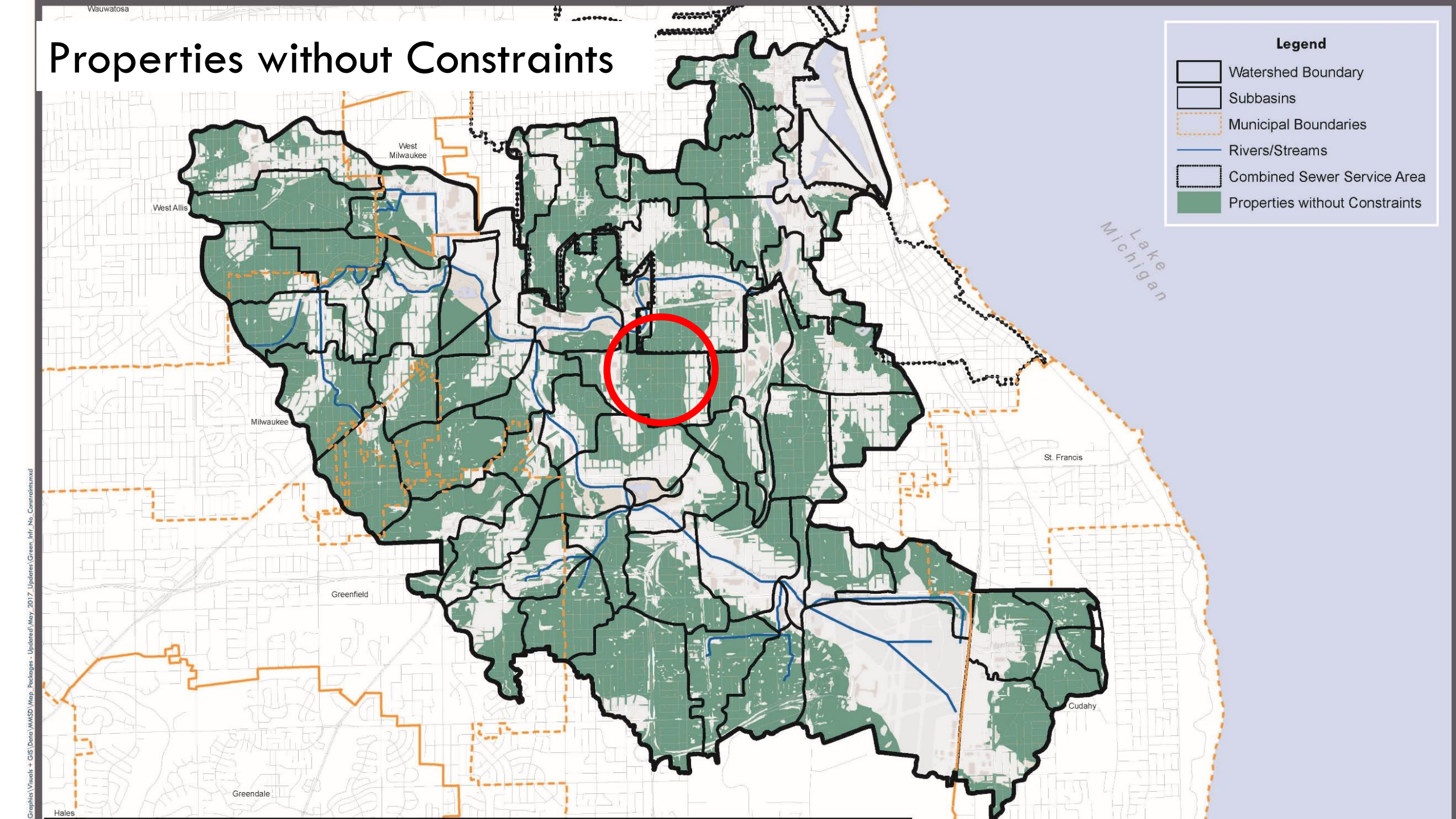
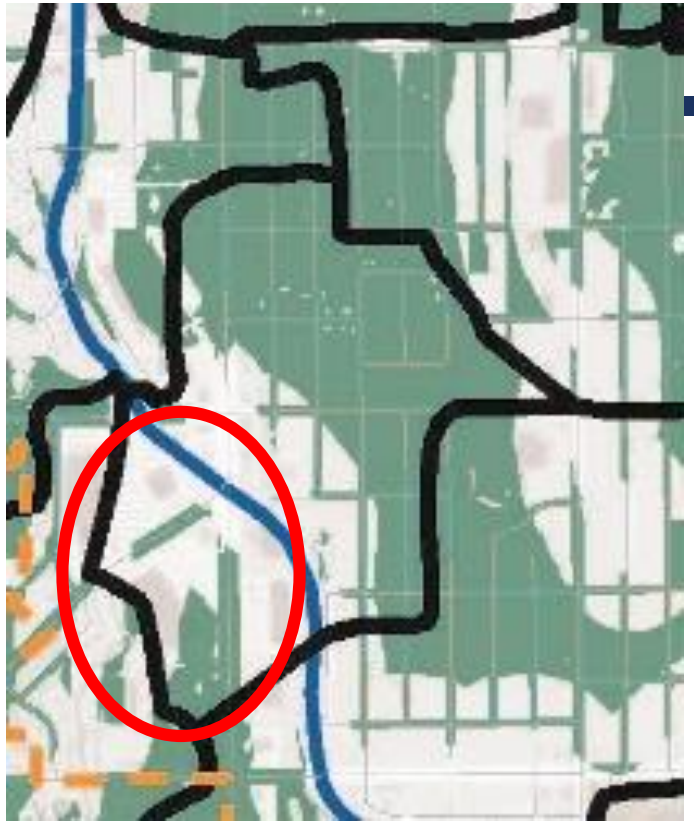
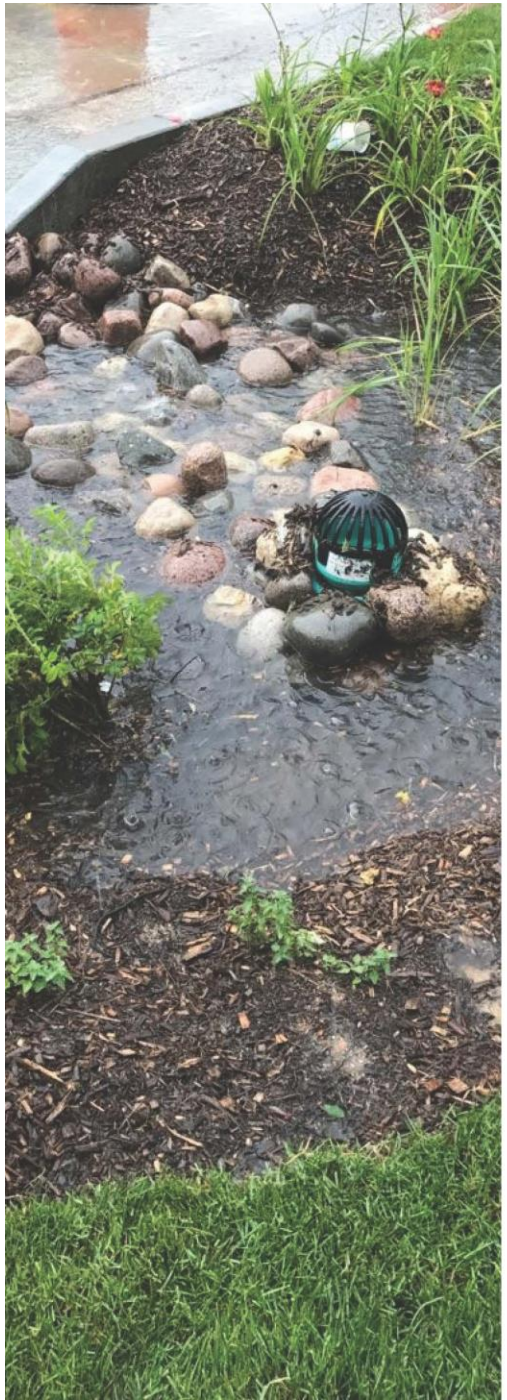
Properties without Constraints






Marcus Southgate Cinema
W Lakefield Dr
Walmart Supercenter
W Morgan Ave
Michaels
SOUTHPOINT
Pick'n Save



KINNIC
WATERS
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GRĀEF

Prepared for
MILWAUKEE METI
SEWERAGE DISTF
2018

FIGURE 5. TRIPLE BOTTOM LINE OF SUST

FIGURE 6. TRIPLE BOTTOM LINE CO-BENEFITS FOR GREEN INFRASTRUCTURE STRATEGIES

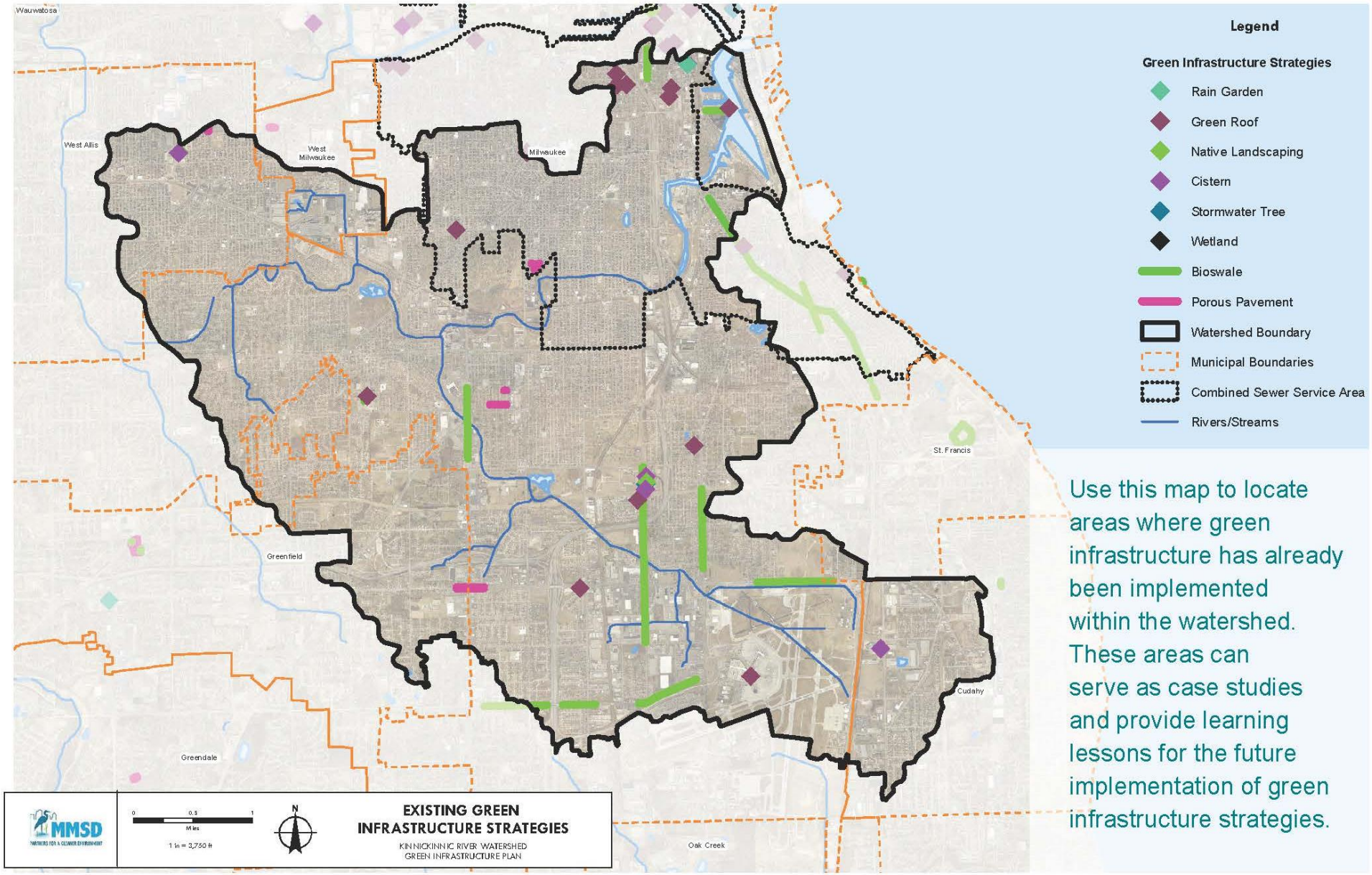
High
Medium
Low
None

TRIPLE BOTTOM LINE OF SUSTAINABILITY	CO-BENEFITS	BIOSWALES	GREEN ROOFS / BLUE ROOFS
Economic	Initial Cost Of Investment		
	Cost Of Operations & Maintenance		
	Job Growth		
	Property Value Increase		
	Existing Grey Infrastructure Relief		
Social	Potential To Reduce Crime Through Design		
	Recreation / Education Opportunities		
	Community Connectedness		
Environmental	Water Quality Improvement		
	Energy Savings		
	Urban Heat Island Reduction		
	Habitat Improvement		
	Air Quality Improvement		

FIGURE 4. LAND USE MATRIX FOR POTENTIAL IMPLEMENTATION

LAND USE	LOCATION	BIOSWALES	GREEN ROOFS / BLUE ROOFS	GREENWAYS	NATIVE LANDSCAPING	POROUS PAVEMENT	RAIN GARDENS	RAINWATER CATCHMENT	REMOVAL OF PAVEMENT & STRUCTURES	SOIL AMENDMENTS	STORMWATER TREES	WETLANDS (CONSTRUCTION OR RESTORATION)
Commercial	Parking / Driveway	o				o			o			
	Buildings		o					o				
	Walkways				o				o	o	o	
	Green Space				o					o	o	
Industrial	Parking / Driveway	o				o			o			
	Buildings		o					o				
	Green Space				o					o	o	
Residential	Roof (capture runoff)						o	o				
	Yard				o		o			o	o	
	Driveway					o						
	Alley					o						
Transportation & Utilities	Streets / Alley					o						
	Parking / Driveway					o			o			
	Medians	o			o	o			o	o	o	
	Buildings		o			o		o				
	Green Space				o		o			o	o	o
Government & Institutional	Parking / Driveway	o				o			o	o		
	Buildings		o					o				
	Green Space	o			o			o		o	o	o
Parks & Recreational Space	Parking / Driveway	o		o		o			o			
	Buildings		o					o				
	Green Space	o		o	o		o			o	o	o

FIGURE 9. GREEN INFRASTRUCTURE PROJECTS IN THE WATERSHED TO-DATE



Use this map to locate areas where green infrastructure has already been implemented within the watershed. These areas can serve as case studies and provide learning lessons for the future implementation of green infrastructure strategies.

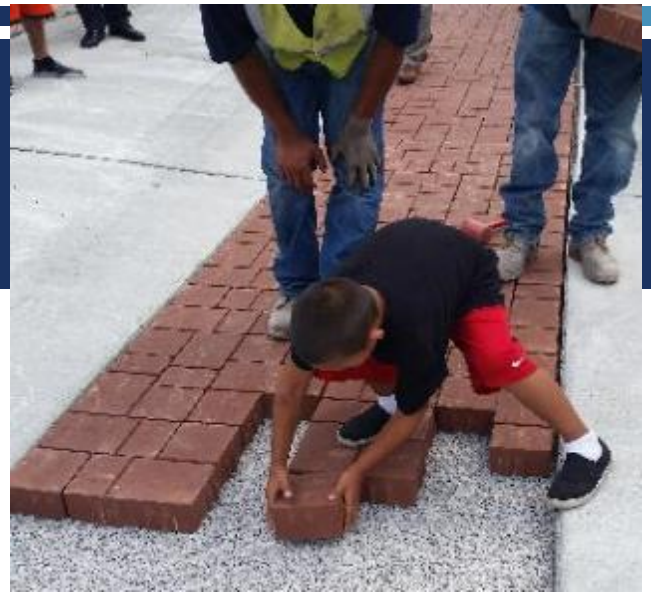


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FIGURE 1. KK RIVER WATERSHED GREEN INFRASTRUCTURE GOALS

GREEN INFRASTRUCTURE FEATURE	ORIGINAL RGIP QUANTITY	RECOMMENDED CHANGES	UPDATED QUANTITY	REFERENCE MAPS	TYPICAL AREAS OF IMPLEMENTATION
Bioswales	RGIP combined bioswales with rain gardens	In public rights of way or on Commercial Developments. Design subgrade with 3' stone storage for 10 gallons/ square feet capacity.	1,200,000 Square Feet (2,400 10' x 50' Bioswales)	1 Reduce Impacts to Structures 2 Prioritized Subbasins 3 Water Quality 4 Ease Of Implementation	Street Rights Of Way, Parking Lots, Improvement Districts, Residential Lots & Commercial Developments
Cisterns	200 Cisterns	Promote where urban agriculture or other outdoor uses need water.	200 Cisterns	All Areas	Publicly-Owned Lands / Buildings, Schools
Green Roofs / Blue Roofs	1,000 Buildings	Monolithic / contiguous / built-in-place green roof systems hold 1.5" depth & are more durable.	333 Buildings	All areas where appropriate roofs exist or are planned.	Public Buildings, Schools, Commercial Developments, Improvement Districts
Native Landscaping	200 City Blocks	Use native turf grasses (i.e. buffalo grass or low-mow deep rooting fescue) in publicly-owned lands.	200 City Blocks	All Areas 4 Ease Of Implementation	Publicly-Owned Lands, Schools, Commercial Developments, Improvement Districts, Residential Lots

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Porous Pavement	1,210 City Blocks	storage (3' storage depth suggested). Promote green alleys & use in parking lots where deicing salt usage is less.	403 City Block-Equivalent In Alleys & Parking Lots	2 Prioritized Subbasins 3 Water Quality 4 Ease Of Implementation	Alley Rights Of Way, Parking Lots, Schools, Commercial Developments, Improvement Districts
Rain Barrels	17,100 Homes	Consider using StormGUARDen (eq. to 6.5 rain barrels) or other similar alternatives.	2,635 Homes	All Areas	Residential Lots, Publicly-Owned Buildings, Commercial Developments, Improvement Districts
Rain Gardens	3.3 Million Square Feet (22,000 10' x 15' Gardens)	Incorporate additional storage (gravel layer), amend soil beneath rain garden (up to 5 gallons/square foot).	60,000 Square Feet (10,000 10' x 6' Gardens)	1 Reduce Impacts to Structures 2 Prioritized Subbasins	Street Rights Of Way, Parking Lots, Improvement Districts, Residential Lots & Commercial Developments
Soil Amendments	200 City Blocks			All Areas	Publicly-Owned Lands, Schools, Improvement Districts, Commercial Developments, Residential Lots
Stormwater Trees	10 Trees / Block		20 New Trees / Block	All Areas	Publicly-Owned Lands, Schools, Street Rights Of Way, Commercial Developments

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Questions?

Thank you!

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