

Muskegon Lake Watershed Green Infrastructure

Community Partnership Projects

Creatively leveraging resources and funding
for green infrastructure stormwater control
and shoreline habitat restoration projects



Kathy Evans, Environmental Program Manager

A Lumber Town

Muskegon 1889



Muskegon Lake Shoreline during the Lumber Era

A Foundry Town

Muskegon 1940s



Post World War II Industrial Era

A Sand Mining Town



During the early-mid 1900s, one of the largest sand dunes on the Lake Michigan coastline was mined on Muskegon Lake to support the region's booming foundry industry

A Port City



Manufacturing , Foundries and Shipping
Downtown Muskegon Waterfront in the Mid 1900s

A Thriving Downtown



Historic Downtown Muskegon

That Happened

Occidental Hotel Demolition for Muskegon Mall Parking in 1975



Muskegon's Downtown was Inside a Mall from 1976-2003

Rebirth of Downtown Muskegon



Muskegon Mall is Demolished in 2003 and Western Avenue Re-Opens
Shoreline Brownfields are Prepared for Redevelopment.
Large-Scale Lake Cleanups are Planned

A Coastal Wetland

West Michigan's Lake Michigan shoreline is world-class, containing the largest collection of freshwater dunes in the world. These coastal resources support a globally unique ecosystem. Muskegon Lake is a 4,232-acre drowned river mouth lake, connected to Lake Michigan by a navigational channel



At the east end of Muskegon Lake, the Muskegon River transports sediment into and throughout the Lake, creating natural wetland habitats.

Muskegon Lake is a Great Lakes Coastal Marsh. It provides habitat, flood control and filtering of water that drains into Lake Michigan.





City of Muskegon Lakeshore Trail
Bike Path along Restored Muskegon Lake Shoreline
From Muskegon River to Lake Michigan

Muskegon Lake Watershed Partnership Monthly Meetings from 1993 - Present



MLWP Established a Credible Group and Good Working Relationships



Why is Muskegon Lake being dredged?

Muskegon Lake is getting cleaned up. Dredging will remove 41,000 cubic yards of sediment that is contaminated with mercury and polycyclic aromatic hydrocarbons (PAHs). The \$12 million cleanup is a Great Lakes Legacy Act project by the U.S. Environmental Protection Agency and Michigan Department of Environmental Quality. The current dredging project, along with past cleanup activities in the lake, are part of a larger strategy to keep the contaminants out of not only Muskegon Lake, but also the Lake Michigan food chain.



Boater Tips



Questions?

Muskegon Lake Watershed Partnership
 Kathy Evans
 West Michigan Shoreline Regional
 Development Commission
 231-722-7878 x17
 kevans@wmsrdc.org
 www.muskegonlake.org

Illinois-Indiana Sea Grant
 Caïse McCoy
 312-886-1430
 cmccoy2@iincis.edu

The Dredge
 "JASON" via channel 16



Cleanup of Contaminated Lake Bottom Sediments

EPA Great Lakes Legacy Act/Great Lakes Restoration Initiative & Michigan DEQ CMI (65/35)

You may wonder what's in the water when you consider whether the fish you catch are clean enough to eat, but sediment at the bottom of a lake is just as important to consider. Sediment cleanups help remove contaminants like mercury (Hg) from the food chain, making the water a safer, cleaner place for fish to live and grow.

To learn more about which fish are safe to eat, check your local fish advisories at www.michigan.gov/eatsafe/fish.



Contaminated sediment can lead to contaminated fish

Hg indicates mercury



WMSRDC
 WEST MICHIGAN SHORELINE
 REGIONAL DEVELOPMENT COMMISSION

MLWP
 Muskegon Lake
 Watershed Partnership

Removal of Historic Lake Fill and Hardened Shoreline Materials

Broken Concrete, Failing Metal Seawall and Wooden Sawmill Remnants Needed to be Removed to Restore Aquatic Habitat and the Shoreline's Appearance and Accessibility



Contiguous Shoreline Habitat Greenscape YMCA and Heritage Landing / Rotary Park



Muskegon YMCA, Muskegon County, WMSRDC, Muskegon Lake
Watershed Partnership, United Way, Great Lakes Legacy Act, NOAA +

Heritage Landing

NOAA
Habitat Restoration



Hands on Experiential Education



Lakeshore Trail Bike Path Restored Natural Shoreline



Partners: Muskegon Lake Watershed Partnership, West Michigan Shoreline Regional Development Commission, National Oceanic and Atmospheric Administration (NOAA), City of Muskegon +



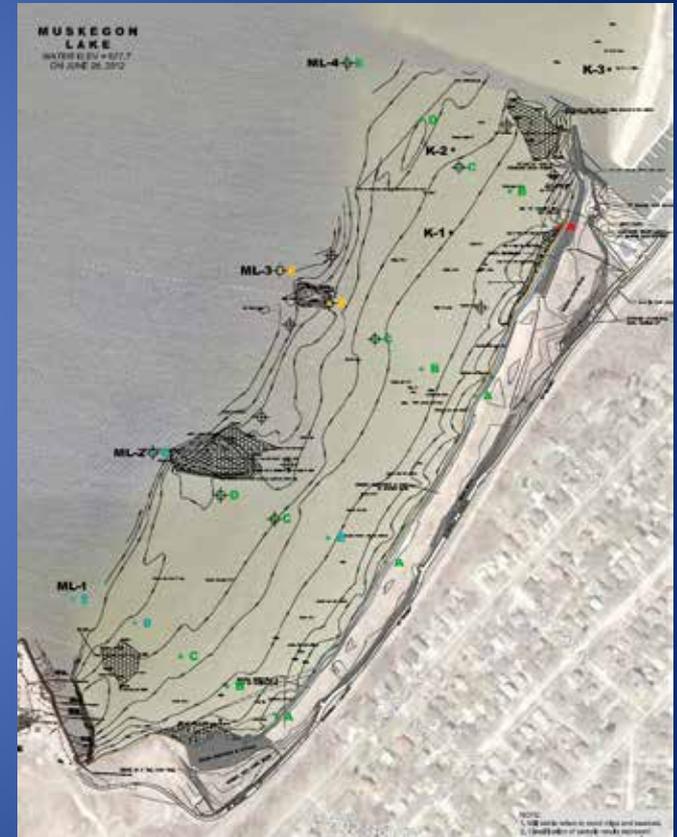
Port Operators Soften Shorelines



Partners: Great Lakes Dock & Materials, Verplank Trucking, Muskegon Lake Watershed Partnership, West Michigan Shoreline Regional Development Commission, Great Lakes Commission, NOAA and the Great Lakes Restoration Initiative

Lakeshore Trail and Mill Debris

- WMSRDC NOAA Great Lakes Habitat Restoration Program / GLRI Grant for Engineering & Design at a Mill Debris Site w/ GVSU-AWRI & Cardno JFNew



Historic Saw Mill Debris



Local Artists Repurpose Sawmill Slabwood



City of Muskegon Hartshorn Municipal Marina West Peninsula

A natural, restored spur off Lakeshore Trail Bike Path



Partners: City of Muskegon, Michigan DNR, Muskegon Lake Watershed Partnership, WMSRDC, NOAA +

Muskegon Lake Shoreline Restoration at the Former Pigeon Hill location near the Historic Site of the Buster Keaton Actors Colony



Sand mining on Muskegon Lake during the early-mid 1900s removed one of the largest sand dunes on the Lake Michigan coastline. Remnants of the former sand docks, wood pilings and a heavily rip rapped shoreline still exist. Shoreline softening restored a portion of shoreline in 2011.



Wetland and Water Quality Restoration Muskegon Lake Watershed Former Celery Flats on Bear Creek along Bear Lake



Partners: Muskegon County, Several Private Landowners, West Michigan Shoreline Regional Development Commission, NOAA, Great Lakes Commission, MLWP, Drain Commissioner +

Ryerson Creek - Daylighting & Wetland Restoration



Ryerson Creek was pumped and routed around the work area back into the creek. A sewer stop and bypass for a Muskegon County Wastewater Management System force main was used during re-construction of the stream channel. Additional lengths of pilings were installed under the Yuba and Northbound Muskegon Avenue road crossings to ensure that the new fish-friendly culverts would maintain their elevation and not sink and submerge.

Alleviated Parking Lot Flooding with Habitat Restoration/Wetland Swale



Roadside Stormwater Swale Integrated with Habitat Restoration



Education Integrated with Green Infrastructure/Habitat Projects



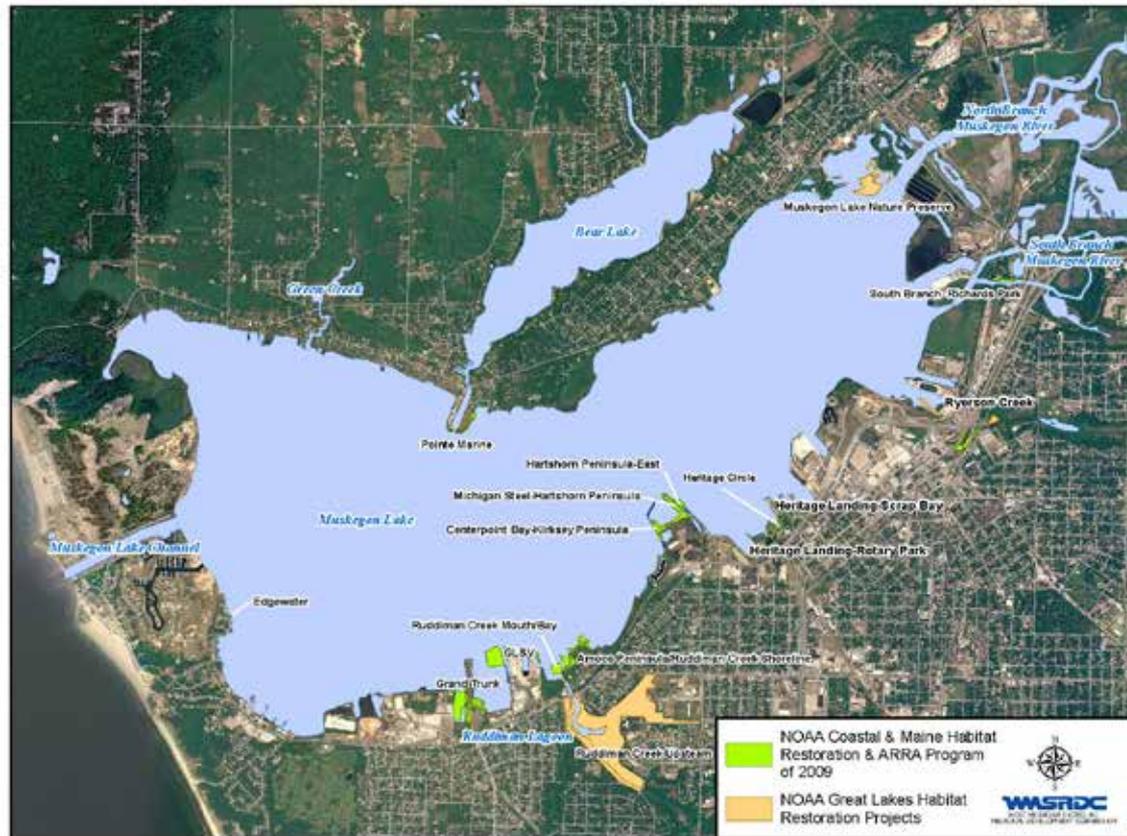
Phytoremediation is Green Infrastructure Too



Partners: Muskegon Lake Watershed Partnership, Delta Institute, West Michigan Shoreline Regional Development Commission, State of Michigan, US EPA, US Forest Service +

A Green, Contiguous Shoreline

From 2010-2015, 17,000 feet of hardened shoreline was restored and softened with native plantings. 70 acres of unnatural shoreline fill was removed and improved. Nearly 40 acres of shoreline wetlands were restored.



Green Roof



This green roof can be observed from the Lakeshore Trail Bike Path along Muskegon Lake in the City of Muskegon

GVSU AWRI Rain Garden and Native Landscape on Muskegon Lake at Lafarge Terminal



Neighbors along the Muskegon Lake Shoreline and Lakeshore Trail Bike Path
Blend Landscaping Styles and Harmonize Green Infrastructure

Contiguous Shoreline Green Infrastructure

Heritage Landing Parking Lot Stormwater Filter/Shoreline Habitat
Lafarge Terminal Native Landscape/Shoreline Habitat



Rain Garden Downtown Muskegon



Muskegon Lakeshore Chamber of Commerce Stormwater Rain Garden



Muskegon County Hall of Justice



Parking Lot Sand Infiltration Beds for Stormwater Treatment and Water Quality

Muskegon Public School Students Involved Planting the Stormwater Control Rain Garden at Grand Trunk Launch Ramp



Muskegon Lake Public Boat Ramp Parking Lot Stormwater Control Rain Garden



Community Partners



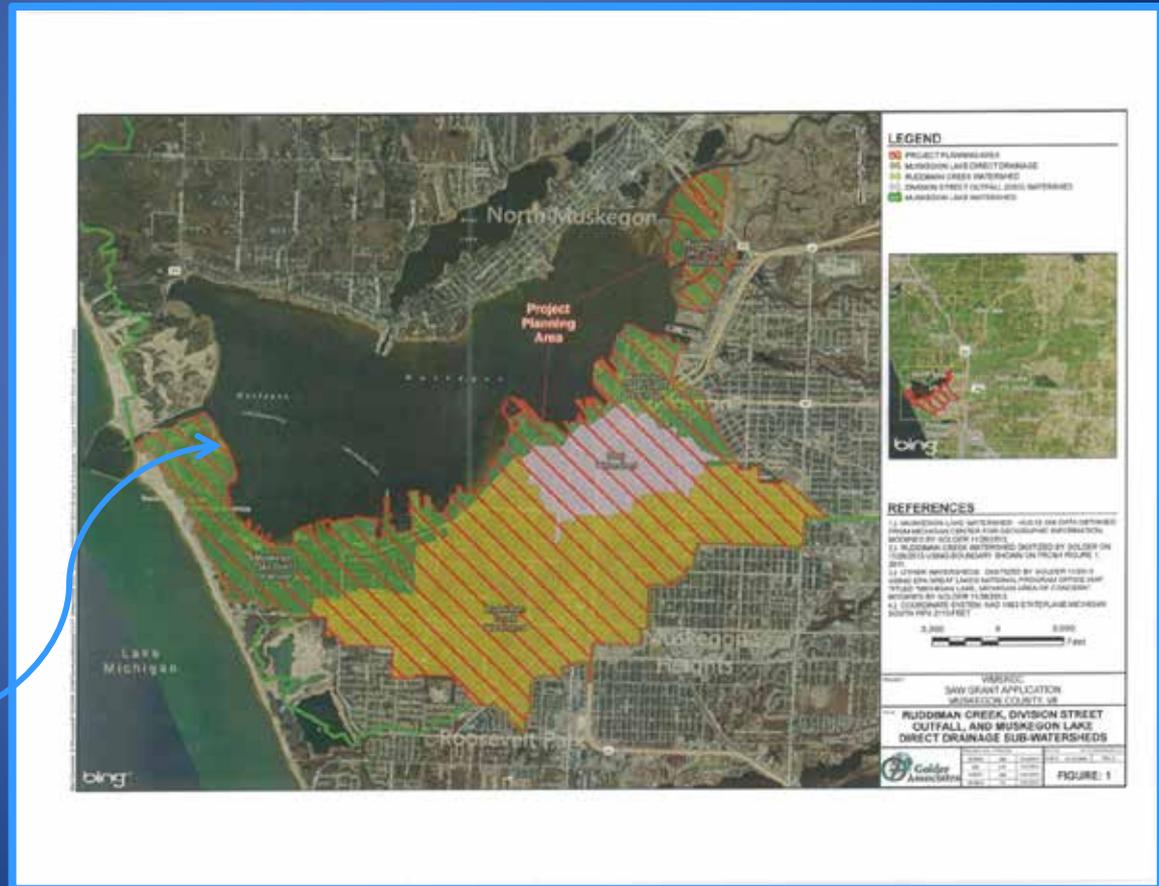
Heritage Landing Stormwater Filter and Shoreline Habitat. Partners: Muskegon County, WMSRDC, MLWP, DEQ, EPA, NOAA +



Grand Trunk Public Launch Ramp and Community Park. Partners: Michigan DNR, MLWP, Neighborhood Association, Schools, NOAA, EPA, Great Lakes Commission +

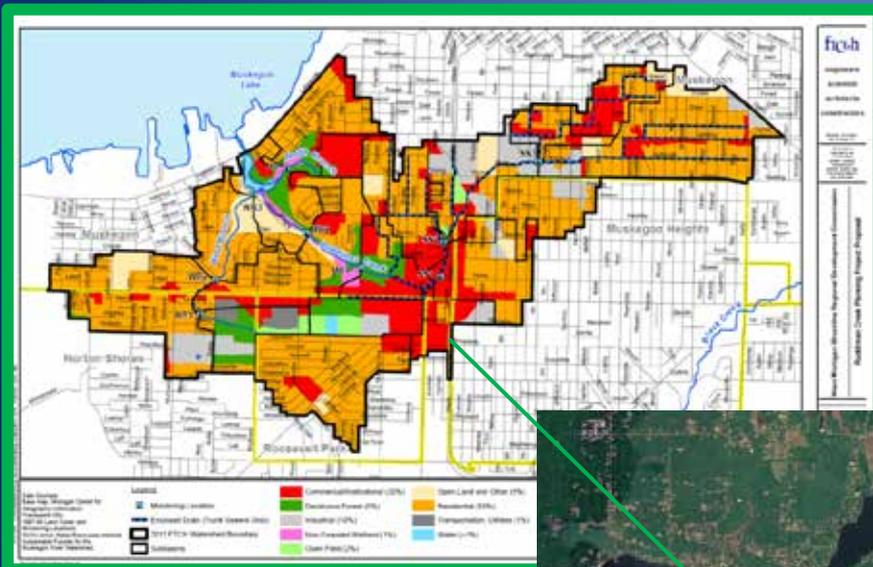
US EPA Shoreline Cities and MDEQ SAW

Green Infrastructure/Stormwater Project Area

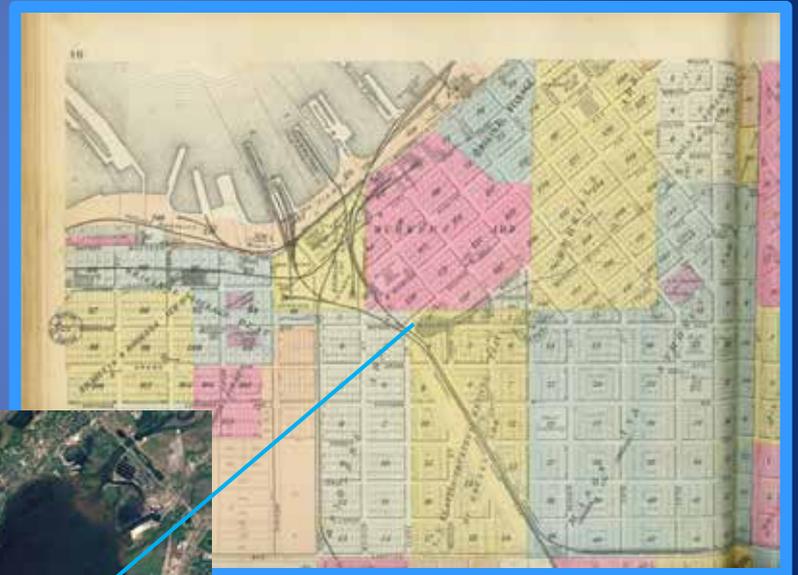


Muskegon Lake Watershed

Highly Urbanized Subwatershed Communities and Direct Drainage Areas along South Shoreline



Ruddiman Creek Subwatershed



Former Beidler Creek Subwatershed

Why Beidler Creek?

Stormwater Discharge to Muskegon Lake



Hartshorn Marina, Lakeshore Trail, Heritage Landing and Rotary Park



Fricano's Parking Lot, Hartshorn Marina and Lakeshore Trail Bike Path



Beidler Creek Watershed or Division Street Stormsewer?

Muskegon Public Schools / Nelson School
Former Shaw Walker / Watermark Center



Community Partnership in Place

Strong Interest in Public Access Recreation & Clean Water
for Muskegon Lake / Beidler Creek Subwatershed



Community Support



Partners: Nelson School, Muskegon County, City of Muskegon, West Michigan Shoreline Regional Development Commission, Muskegon Lake Watershed Partnership, Rotary, Private Landowners, Great Lakes Dock & Materials, Verplank Trucking, Consumers Energy, DEQ, EPA+

Why Ruddiman Creek?

- 2006 Sediment Cleanup Completed

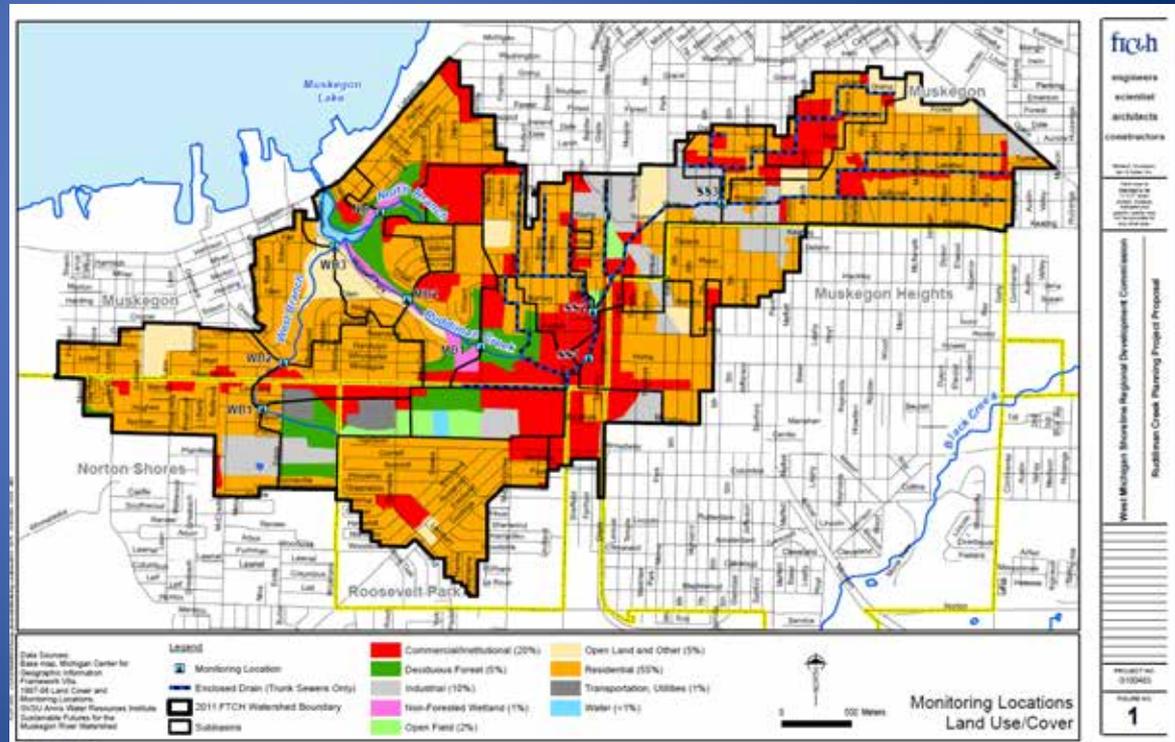
Great Lakes Legacy Act/DEQ, 90,000 cy

- E.Coli TMDL

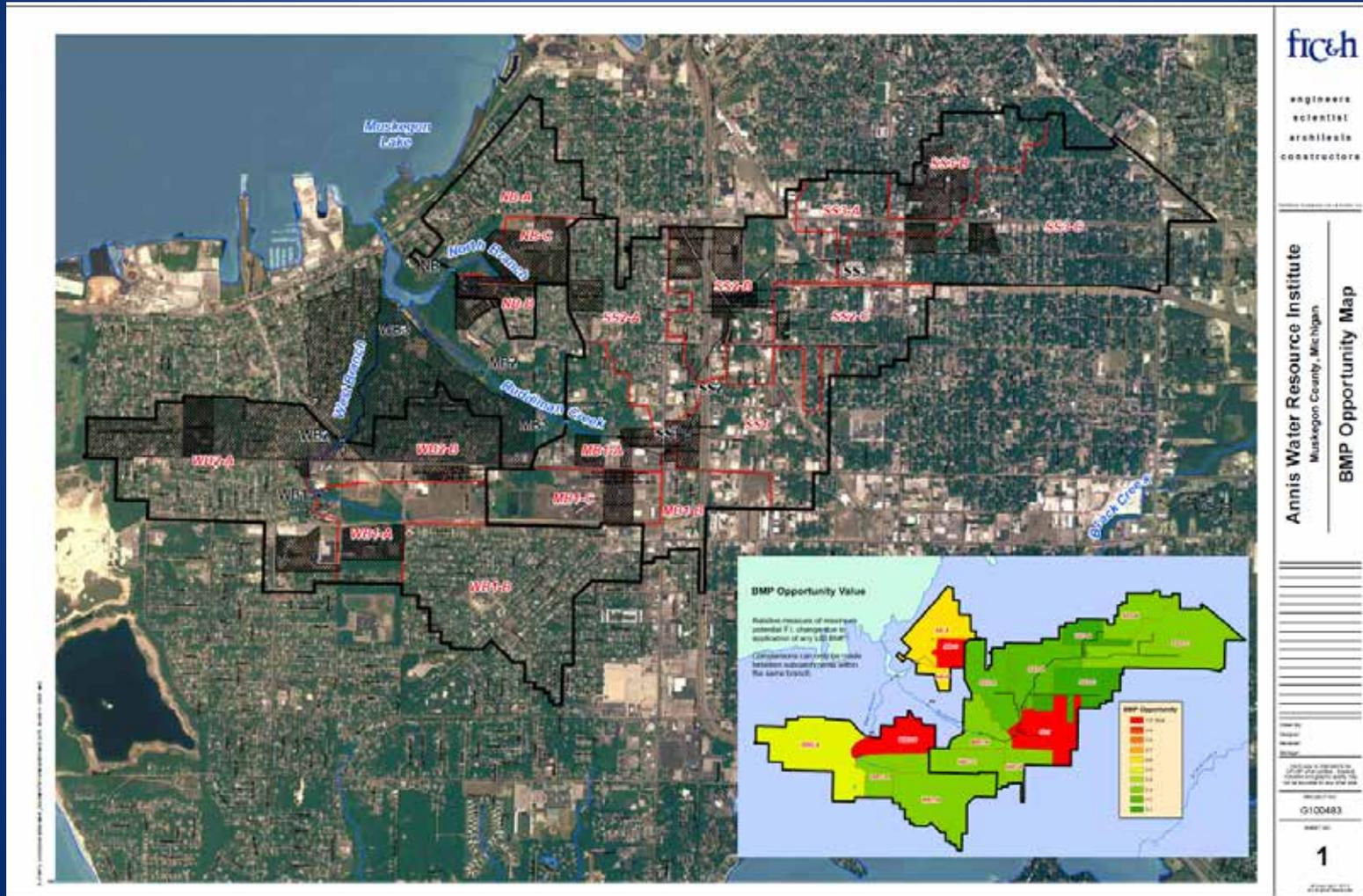
Sanitary/storm drain cross connections corrected in 2014

- Biota TMDL

Degraded benthos from flashy storm flows and sedimentation



Potential BMP Locations Identified



Community Partnership in Place

Strong Interest in Public Access Recreation & Clean Water
for McGraft Park and Ruddiman Creek Subwatershed



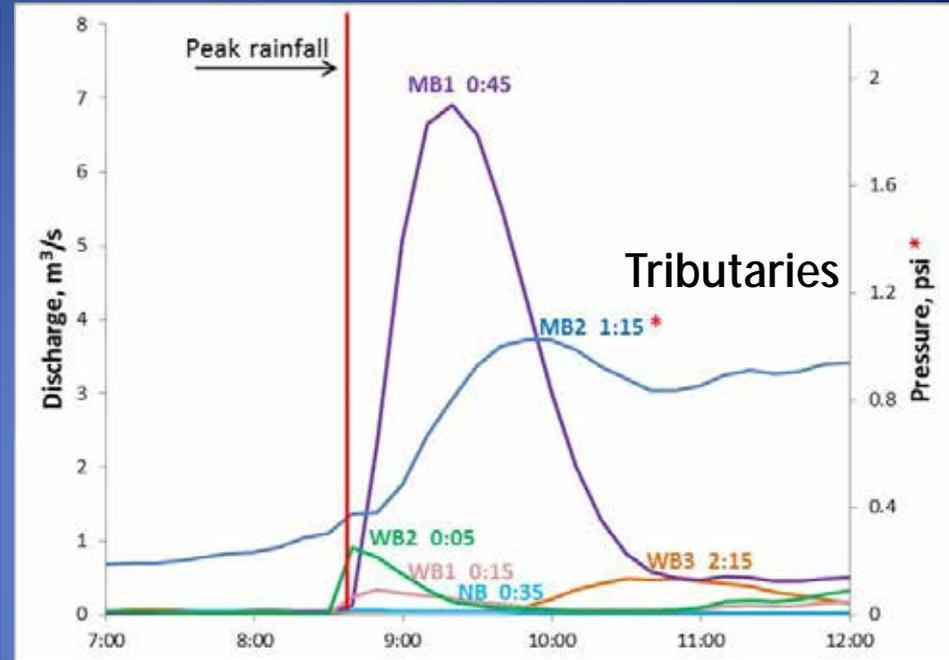
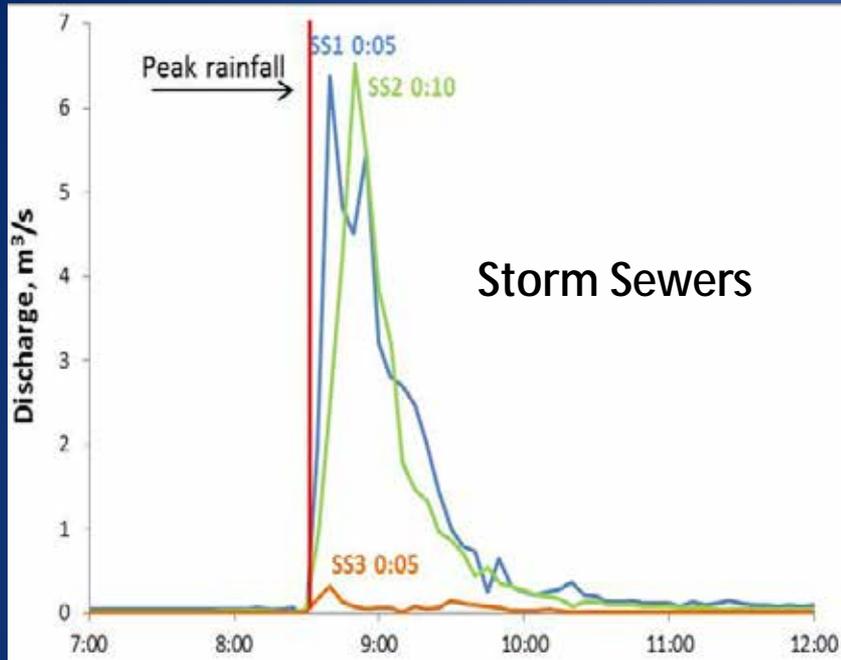
Ruddiman Creek Base Flow vs. Storm Flow



Ruddiman Creek Summary

- Storm water moves very quickly through sewers and into Ruddiman Creek
- Storm water carries a considerable amount of suspended sediment into Ruddiman Creek
- Bedload sediment is also significant during storms, but 62-98% of total sediment load is suspended sediment
- The MDEQ SAW and U.S. EPA Shoreline Cities Green Infrastructure grants are addressing these issues

Very flashy hydrology

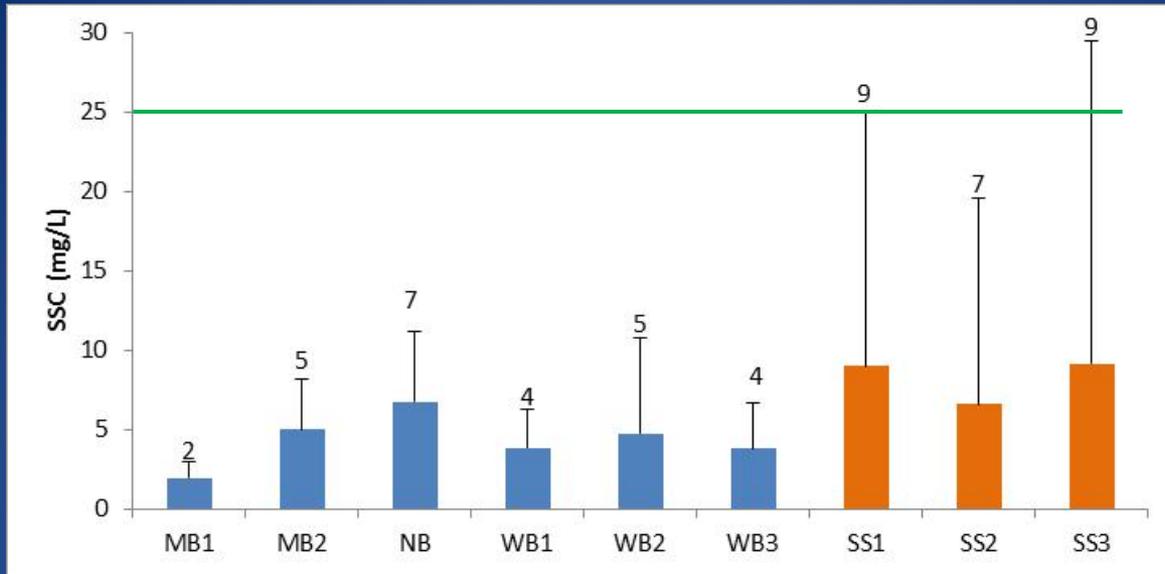


| | |
|-----------------------------------|------|
| Total Rainfall, in | 0.29 |
| Duration, hr | 0.5 |
| Peak flow: MB1, m ³ /s | 6.9 |
| Peak flow: SS1, m ³ /s | 6.4 |



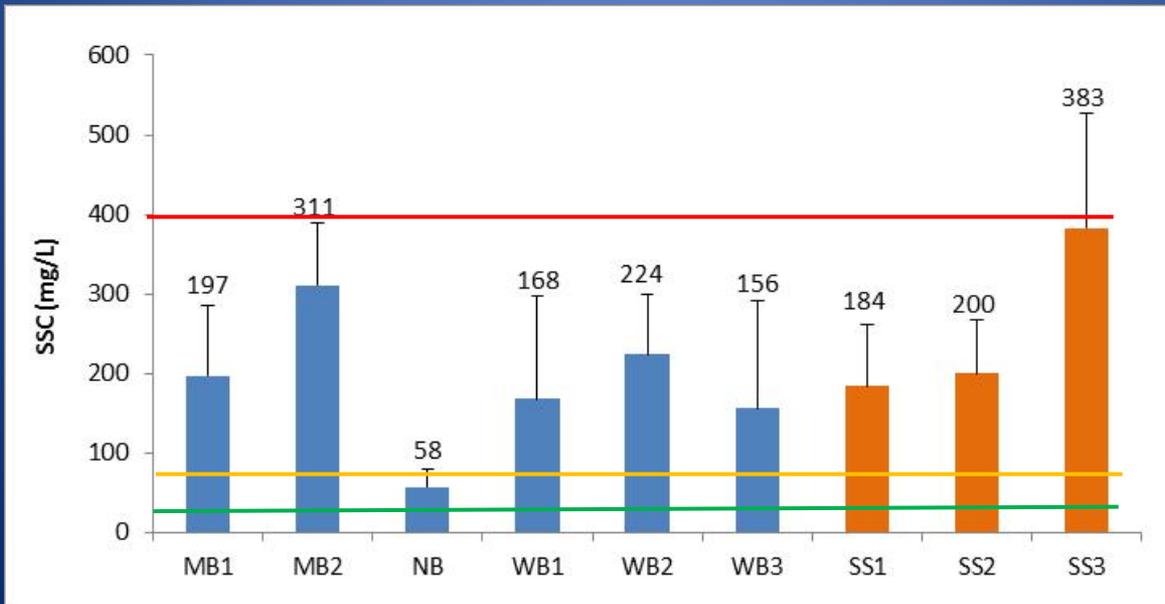
Suspended Sediment Concentration (mg/L)

Average
Base
Flow



Optimum

Average
Storm
Flow



Poor

Less than Moderate

Good to Moderate
Optimum



North Branch: **Poor**

- 0 fish found



West Branch: **Poor**

- 34 fish found
- Brook stickleback (56%), creek chub (21%), largemouth bass (18%)



Main Branch: **Acceptable tending toward poor**

- 104 fish found
- Brook stickleback (64%), largemouth bass (17%), central mudminnow (8%)

Green Infrastructure Conceptual Plan City of Muskegon Harbortowne Beach on Muskegon Lake



Green Infrastructure Design

WMSRDC DEQ SAW Grant

1. Stormwater Plan
2. Field Visits
3. Eight Conceptual Plans (Topo Surveys, Research & Preliminary Engineering)
4. Landowner Meetings
5. Operation & Maintenance Plans
6. One Public Education Tour

Green Infrastructure Construction

City of Muskegon EPA Grant

1. Final Engineering/Design (25% of grant funds)
2. Construction Bid Package
3. Construction and Construction Oversight
4. Signage Installation
5. Runoff Calculations
6. Final Report

Green Infrastructure Stormwater Control Project

Project Design:

\$90,068 DEQ SAW w/

\$9,602.29 EPA (E&D)

Total = \$99,671.15

Project Construction:

\$83,767.04 EPA

Additional Community

Support (Final \$ Amount TBD)

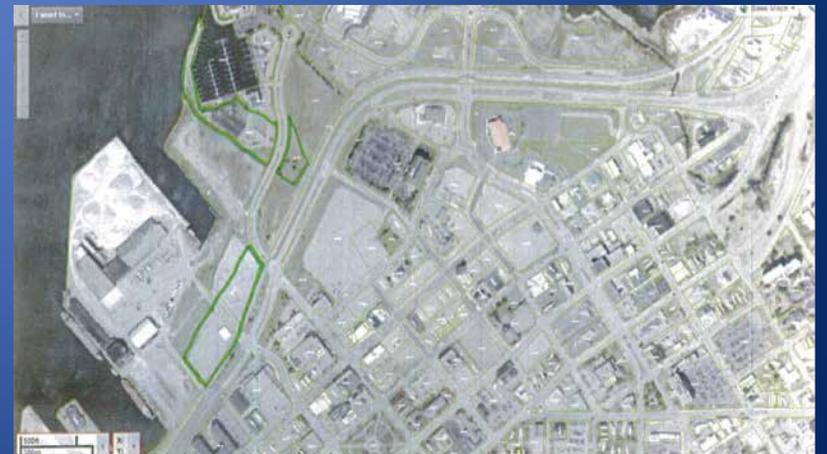
Estimated Reduction in Stormwater Runoff of the Green Infrastructure Project/s:

- Infiltrate 5,059,457 gallons of rainwater w/ additional 67,635 by evaporation
Total = 5,127,092 gallons.

Based on 31.85 annual inches of rainfall and a 6.5 –acre project area

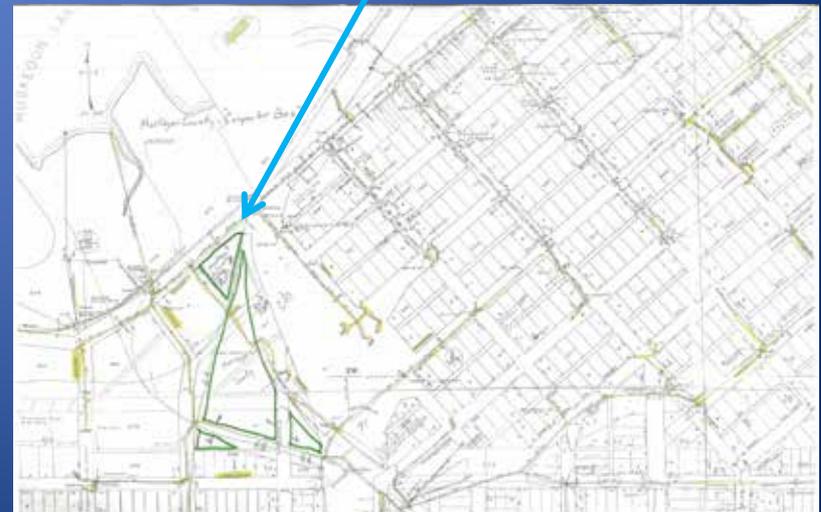
Adding Value, Leveraging Resources

- City of Muskegon will TV priority stormwater/green infrastructure BMP locations during Asset Management mapping
- Muskegon Area Municipal Stormwater Committee is collaborating on Phase II MS4 goals



Adding Value, Leveraging Resources

- Integrating Green Infrastructure Stormwater Control with Downtown Dog Park
- Located in Beidler Creek Subwatershed across from Muskegon Lake Hartshorn Municipal Marina and Rotary Park at Heritage Landing



Adding Value, Leveraging Resources

- West Michigan Environmental Action Council will Partner
- Watershed Stormwater Management Plan will be provided to WMEAC
- WMEAC will apply the Ecosystem Services Calculator to identify cost benefits of green infrastructure for stormwater control
- Ecosystem services calculator will build support for implementation of green infrastructure
- WMSRDC and Golder & Associates are in the process of developing eight conceptual designs with public landowners
- Private landowners are providing matching support

Adding Value, Leveraging Resources



Muskegon Watch Us Go Image Campaign has Beautification & Natural Resources Components. The Entrance to Muskegon at Seaway Drive / Shoreline Drive is a Green Infrastructure/Stormwater Control Project Planning Area

Community Resources and Involvement



Partners: Muskegon Lake Watershed Partnership, City of Muskegon, Muskegon County, West Michigan Shoreline Regional Development Commission, West Michigan United Labor, United Way +

Watershed Cleanups and General Public Involvement



Volunteers Monitor Habitat

Bird Studies Canada's Volunteer Marsh Monitoring Program (MMP)
Great Lakes Stewardship Initiative Student Monitoring Programs



Partner with Big Events for Outreach Bass Masters Tournament



Make the Great Lakes Connection



Have Fun and Celebrate Successes



WATCH MUSKEGON

We're just getting started.

Revitalization



Questions? Kathy Evans, WMSRDC, kevans@wmsrdc.org