WEST MICHIGAN ENVIRONMENTAL ACTION COUNCIL

Rainwater Rewards Stormwater Calculator

Valuing Ecosystem Services for Green Infrastructure

Who is WMEAC?

Informing, engaging and nurturing an inclusive community, acting together to protect natural resources, mitigate climate change and build a resilient West Michigan

Protecting Water Resources

Non-Profit 501C3

West Michigan's voice for environmental protection since 1968

Lead on development of current economic valuation project

Integrated Valuation of Ecosystem Services Tool (INVEST)

Generation 1: Valuing Ecosystem Services

Valuing Ecosystem Services

- Benefits people obtain directly or indirectly from ecological systems

West Michigan's Green Infrastructure

- Forests, grasslands and prairies
- Urban and rural parks and trails
- Wetlands, lakes, rivers and streams
- Shoreline, beaches, and dunes
- Cropland and orchards
- Fish and wildlife

Green Infrastructure Valuation

❖ Valuation of ecosystem services

- Region/County-Level: development of online tool (INVEST)
- Parcel Level: development of ecosystem services calculator (Owasippe)

West Michigan Ecosystem Services Calculator Output Page

	Grass,Shrub & Prairie	Forest Low Value	Forest High Value	Water	Wetlands Low Value	Wetlands High Value
Food Production	n/a	n/a	n/a	n/a	n/a	n/a
Raw Materials	n/a	$9	$63	INS	INS	INS
Aesthetic/Amenity	$10	$0	$6	$18	$13	$13
Recreation	$69	$69	$69	$250	$125	$250
Fish/Wildlife Habitat	$21	$24	$24			
Pollination	INS	NEI	NEI	n/a	NEI	NEI
Nutrient Cycling	NEI	NEI	NEI	NEI	$4	$8
Waste Assimilation	NEI	NEI	NEI	NEI	NEI	NEI
Erosion Control	NEI	$0	$4	n/a	NEI	NEI
Water Regulation	NEI	NEI	NEI	NEI	NEI	NEI
Water Supply	n/a	n/a	n/a	$64	$32	$64
Value Per Acre/Per Year	$100	$116		$332	$286	
Annual Value for All Acres	$25,755	$475,863		$61,746	$34,686	
					TOTAL YEARLY VALUE	$598,049
PV of Future Yearly Values						
Value Per Acre/Per Year	$1,426	$1,654		$4,745	$4,088	
Annual Value for All Acres	$367,931	$6,798,039		$882,081	$495,511	
					TOTAL PRESENT VALUE	$8,543,562

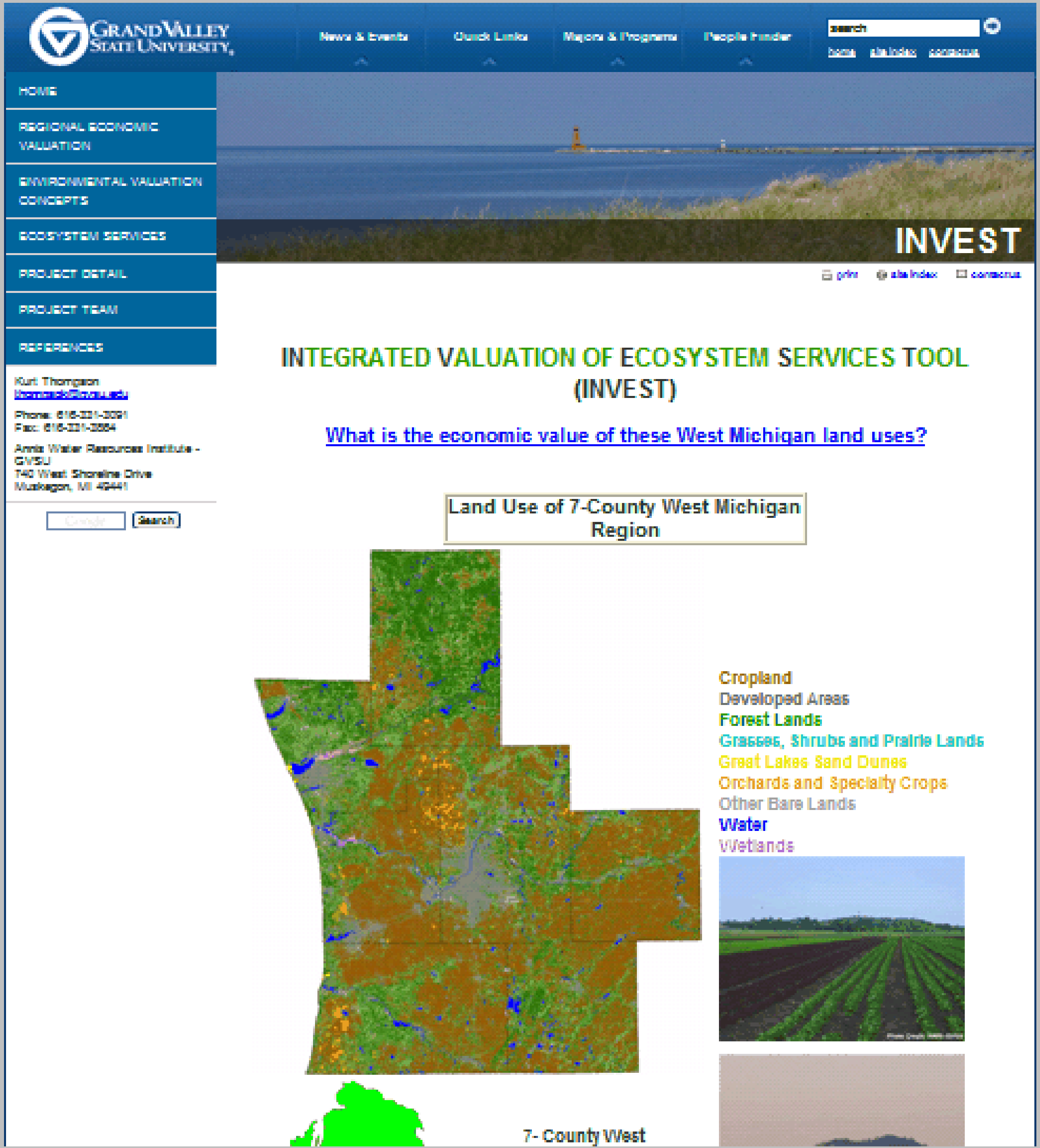
INVEST

- ❖Online educational tool

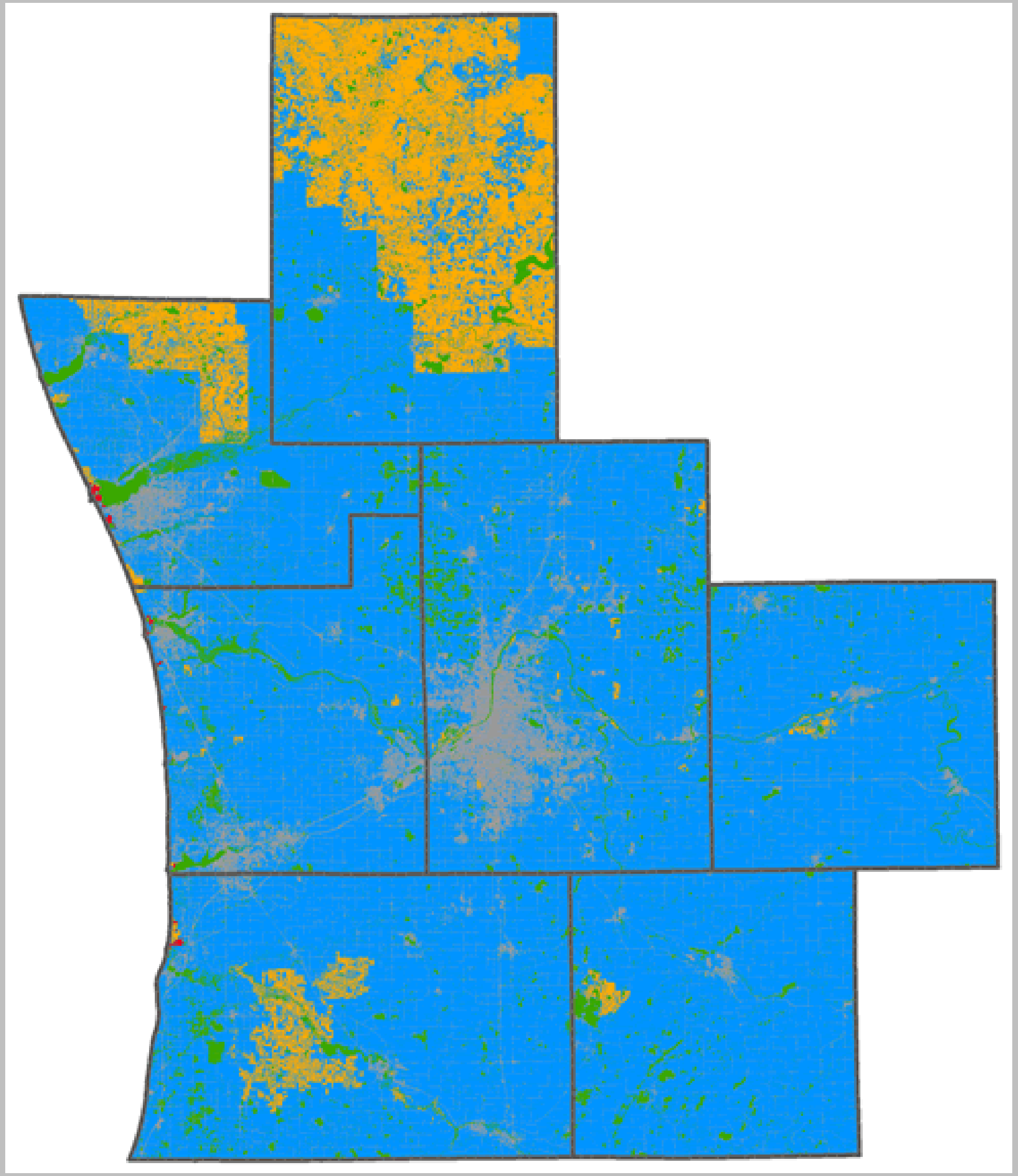
http://INVEST.wri.gvsu.edu

- ❖Places monetary value on ecosystem services associated with West Michigan land uses

- ❖$ per acre/mile per year



Regional Value Estimate for Ecosystem Services



$1.8 billion per year

Legend

- Red: > $10,000*
- Orange: $2,001 - $10,000*
- Green: $201 - $2,000*
- Blue: $0 - $200*
- Grey: Developed Area/Not Valued

Rein in the Runoff

Generation 2: Valuing Stormwater Green Infrastructure

PLOAD Results for Total Phosphorus Loadings with and without BMPs - 2006

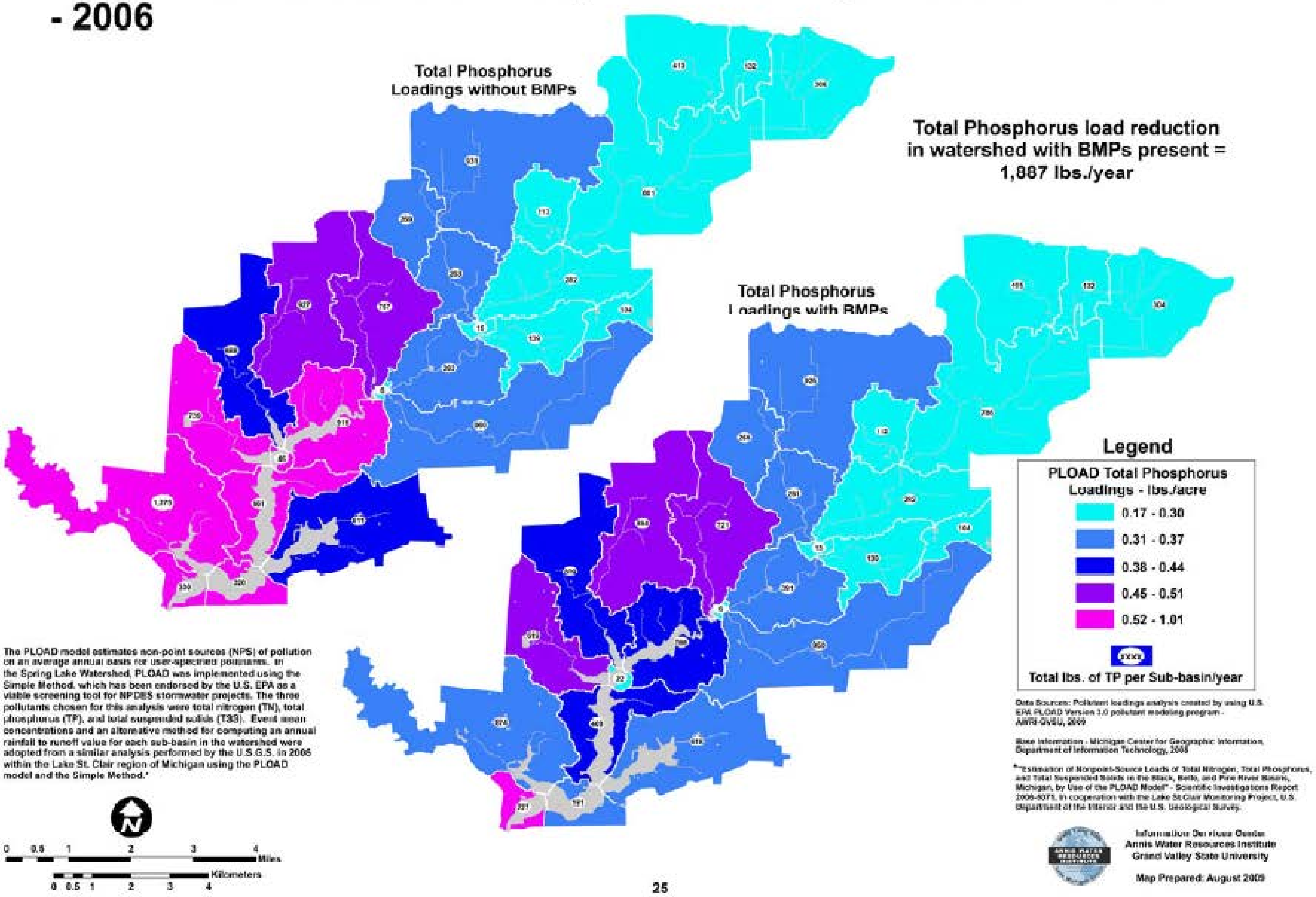
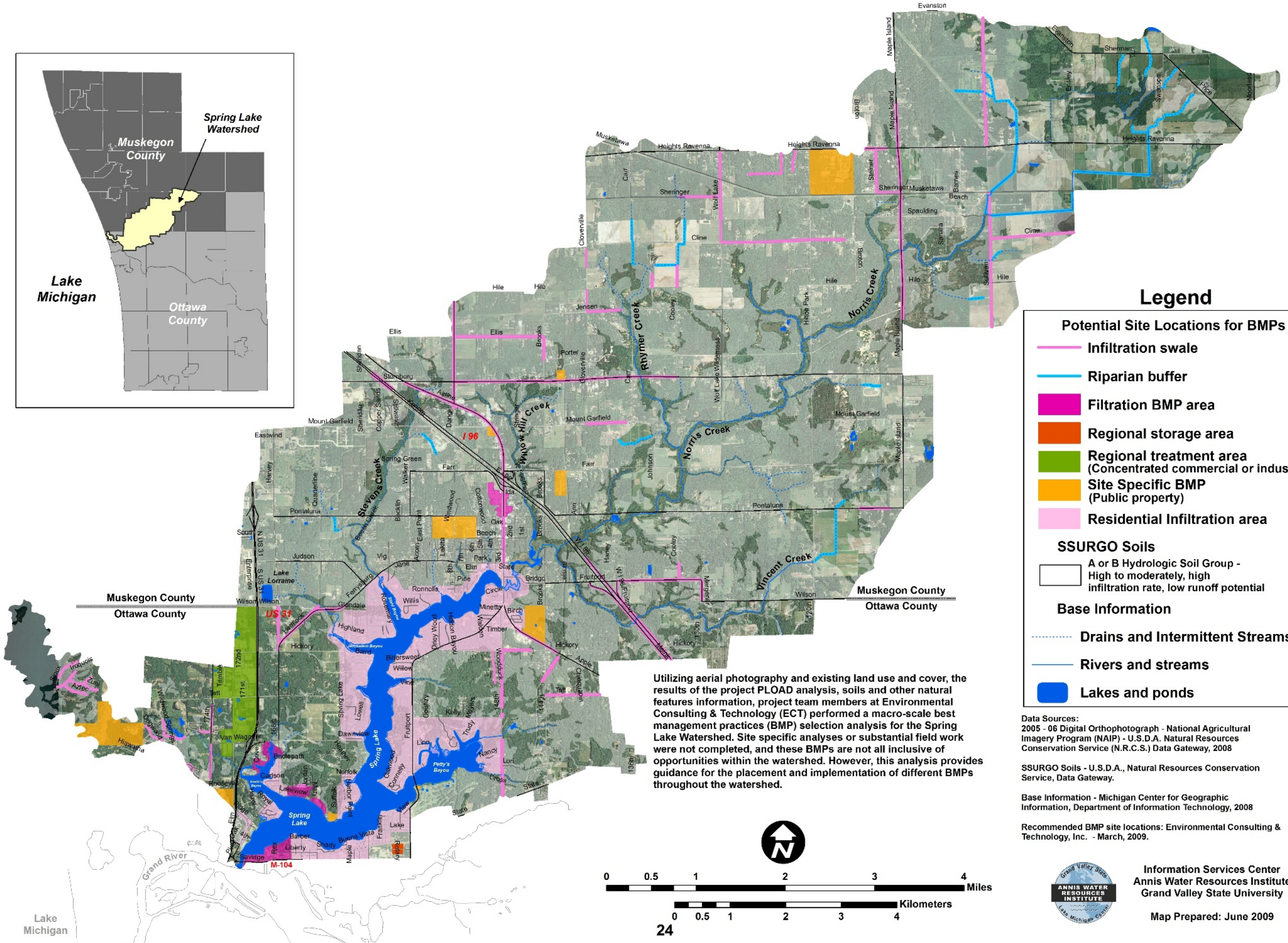


Figure 4-4. PLOAD results with and without BMPs for Total Phosphorus mapped to the ArcSWAT sub-basins for the Spring Lake Watershed's 2006 land use and land cover.

Potential Site Locations for BMPs



Legend

Potential Site Locations for BMPs

- Infiltration swale
- Riparian buffer
- Filtration BMP area
- Regional storage area
- Regional treatment area (Concentrated commercial or industrial)
- Site Specific BMP (Public property)
- Residential Infiltration area

SSURGO Soils

- A or B Hydrologic Soil Group - High to moderately, high infiltration rate, low runoff potential

Base Information

- Drains and Intermittent Streams
- Rivers and streams
- Lakes and ponds

Utilizing aerial photography and existing land use and cover, the results of the project PLOAD analysis, soils and other natural features information, project team members at Environmental Consulting & Technology (ECT) performed a macro-scale best management practices (BMP) selection analysis for the Spring Lake Watershed. Site specific analyses or substantial field work were not completed, and these BMPs are not all inclusive of opportunities within the watershed. However, this analysis provides guidance for the placement and implementation of different BMPs throughout the watershed.

Data Sources:
2005 - 06 Digital Orthophotograph - National Agricultural Imagery Program (NAIP) - U.S.D.A. Natural Resources Conservation Service (N.R.C.S.) Data Gateway, 2008

SSURGO Soils - U.S.D.A., Natural Resources Conservation Service, Data Gateway.

Base Information - Michigan Center for Geographic Information, Department of Information Technology, 2008

Recommended BMP site locations: Environmental Consulting & Technology, Inc. - March, 2009.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: June 2009

Table 5-6. Cost Effectiveness Associated with Pollutant Load Reductions Per Treated Acre.

BMP	Total Installation Cost	Total Opportunity Cost[1]	25 Year Maintenance Costs[2]	Total Cost	Net Costs Associated with Pollutant Load Reductions[3]		
					TP	TN	TSS
Bioretention/ Rain Gardens	$21,500	($17,100)	$3,773	$8,173	$13,622	$24,038	$8,603
Vegetated/ Bio-Swales	$16,620	($20,500)	$483	($3,396)	($7,718)	($8,490)	($5,660)
Green Roofs	$686,070	($442,765)	$9,056	$252,361	$315,451	$315,451	$315,451
Pervious Pavement	$371,100	($340,400)	$0[4]	$30,700	$56,330	Not Calculated	$33,736
Constructed Wetlands	$22,500	($25,900)	$483	($2,917)	($6,077)	($3,740)	($3,241)

1 These represent added costs associated with traditional stormwater management practices and/or replacement costs.

2 Maintenance costs were the net present value of annual maintenance costs from Table 5-5 over 25 years, given a 5% discount rate.

3 These costs were adjusted based upon the BMPs' ability to reduce pollutant loads (Table 5-4).

4 Zero maintenance costs for pervious pavement are based on the assumption that current pervious pavement technologies were used and that high efficiency street sweeping is already in place.

Owasippe Scout Camp Demonstration Project

Generation 3: Developing a Calculator Spreadsheet

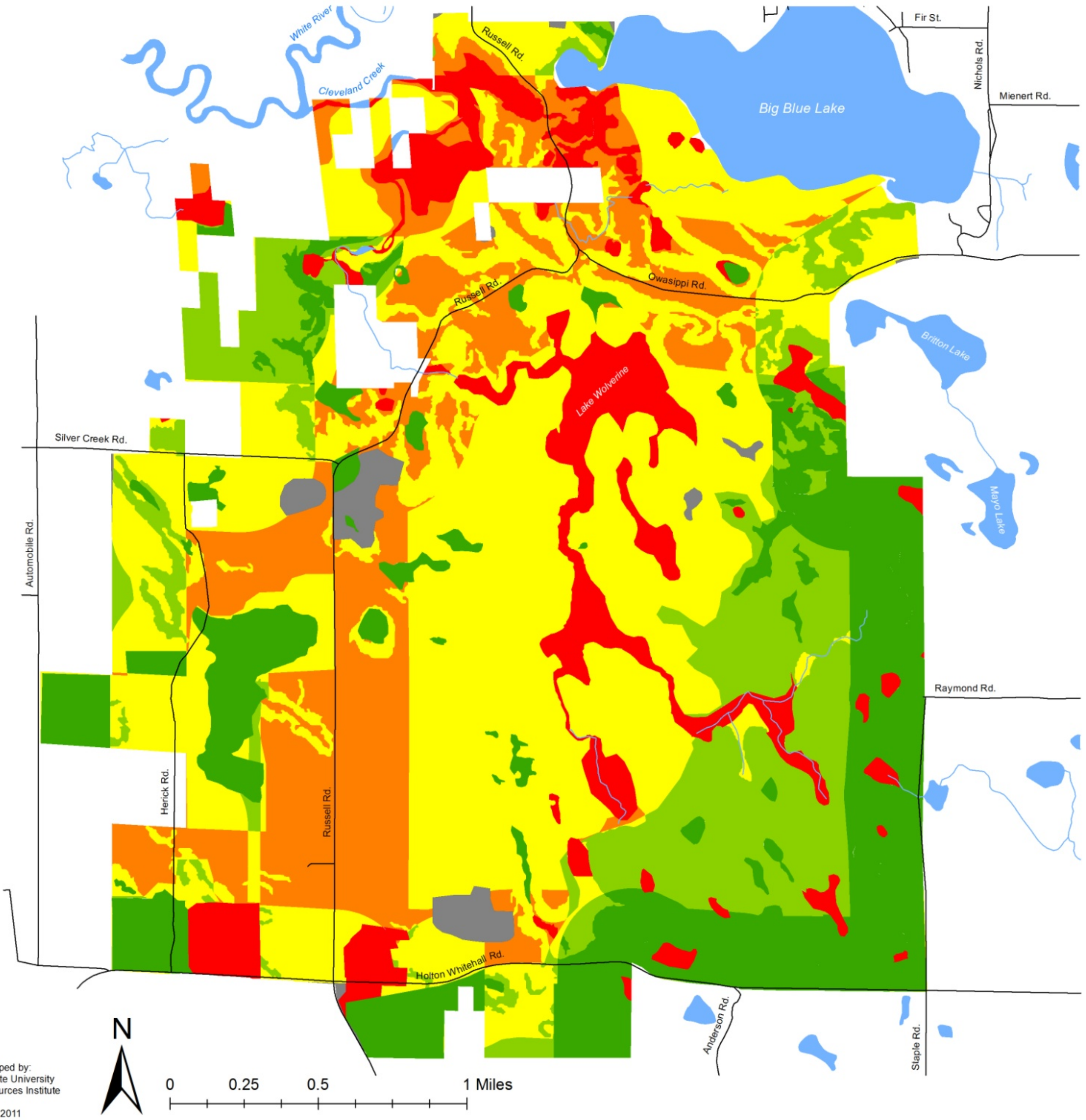
Valuations

Owasippe Scout Reservation

Legend

Dollars Per Acre Per Year

- 64.00 - 109.13
- 109.14 - 112.76
- 112.77 - 117.38
- 117.39 - 122.45
- 122.46 - 284.35
- Developed lands not valued

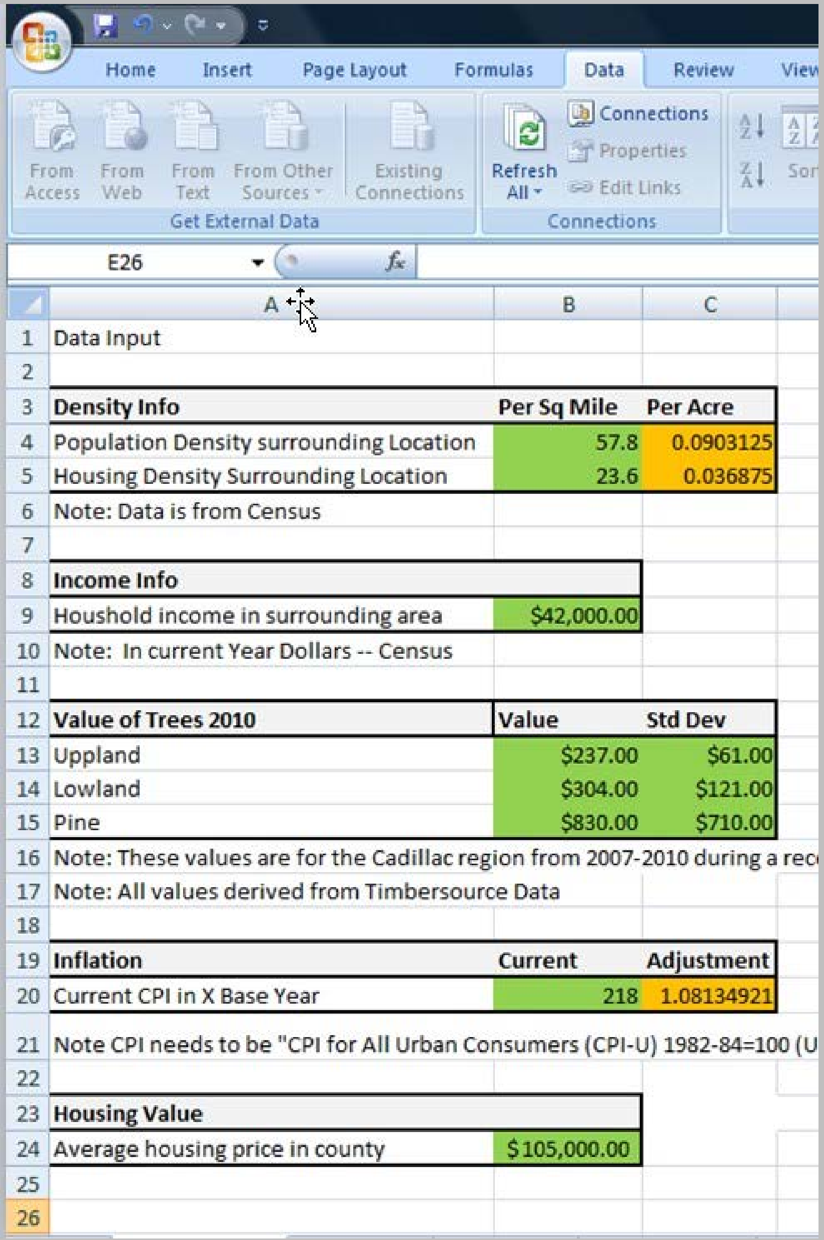


Map Developed by:
Grand Valley State University
Annis Water Resources Institute

February 2011

Data Sources: Valuations modeled by Dr. Paul Isely, GVSU,
Roads and hydrology based on Michigan Geographic Data Framework, 2010.

Ecosystem Services Calculator Tool

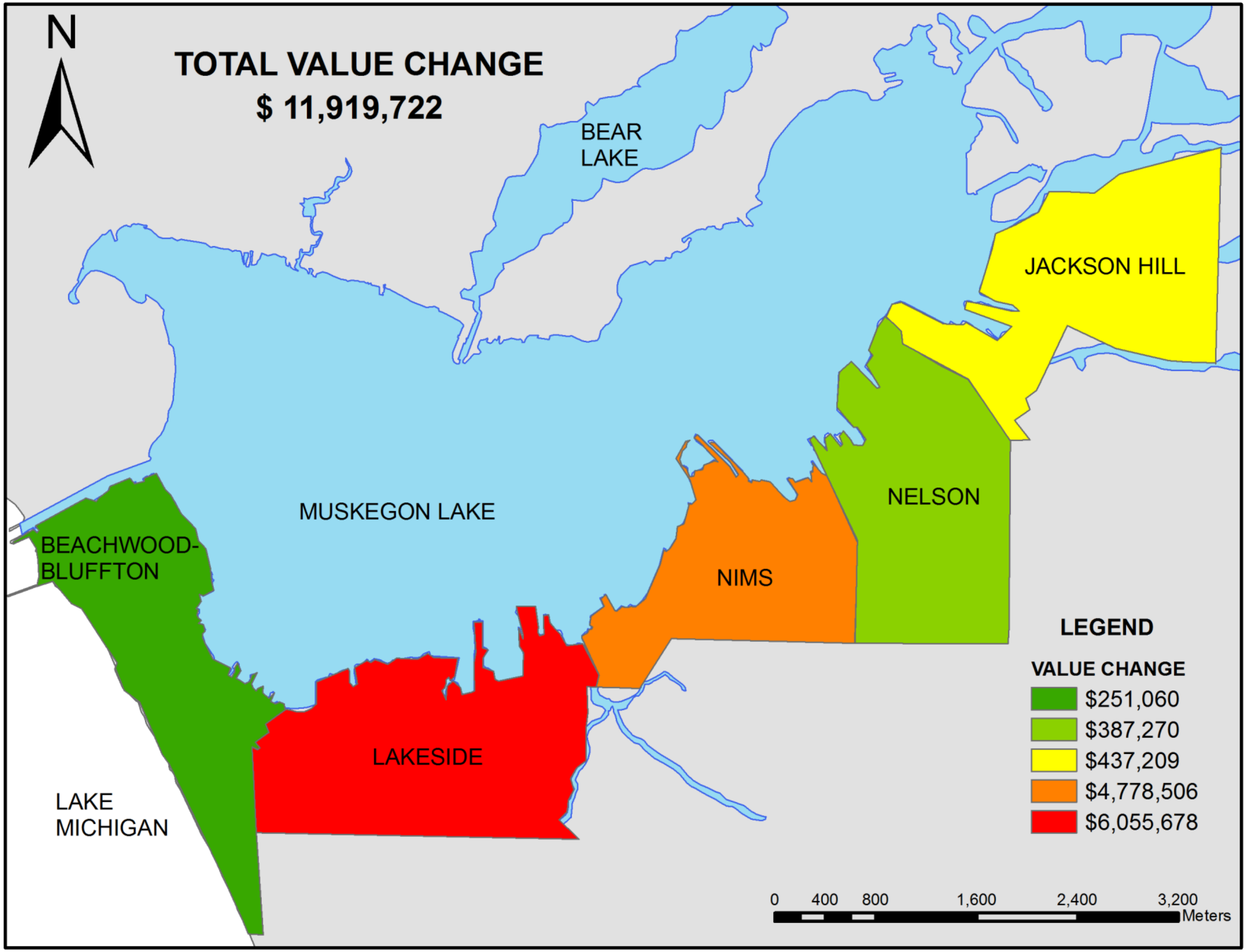


	A	B	C
1	Data Input		
2			
3	**Density Info**	**Per Sq Mile**	**Per Acre**
4	Population Density surrounding Location	57.8	0.0903125
5	Housing Density Surrounding Location	23.6	0.036875
6	Note: Data is from Census		
7			
8	**Income Info**		
9	Houshold income in surrounding area	$42,000.00	
10	Note: In current Year Dollars -- Census		
11			
12	**Value of Trees 2010**	**Value**	**Std Dev**
13	Uppland	$237.00	$61.00
14	Lowland	$304.00	$121.00
15	Pine	$830.00	$710.00
16	Note: These values are for the Cadillac region from 2007-2010 during a rec		
17	Note: All values derived from Timbersource Data		
18			
19	**Inflation**	**Current**	**Adjustment**
20	Current CPI in X Base Year	218	1.08134921
21	Note CPI needs to be "CPI for All Urban Consumers (CPI-U) 1982-84=100 (U		
22			
23	**Housing Value**		
24	Average housing price in county	$105,000.00	
25			
26			

- ❖Current Value: $582,526 per year
- ❖Developed Value: $183,196 per year
- ❖Public Land/Access Value: $1,450,383 per year

Muskegon Lake Habitat Restoration

Generation 4: Valuing Great Lakes Area of Concern (AOC) Restoration


N
TOTAL VALUE CHANGE
$ 11,919,722
BEAR LAKE
JACKSON HILL
MUSKEGON LAKE
NELSON
BEACHWOOD-BLUFFTON
NIMS
LAKESIDE
LAKE MICHIGAN
LEGEND
VALUE CHANGE
$251,060
$387,270
$437,209
$4,778,506
$6,055,678
0 400 800 1,600 2,400 3,200
Meters

Rainwater Rewards

Generation 5: Building an Online Stormwater Calculator for Small and Medium Cities in the Great Lakes Basin

Great Lakes Restoration Initiative Funding

FOREST SERVICE
U S
DEPARTMENT AGRICULTURE

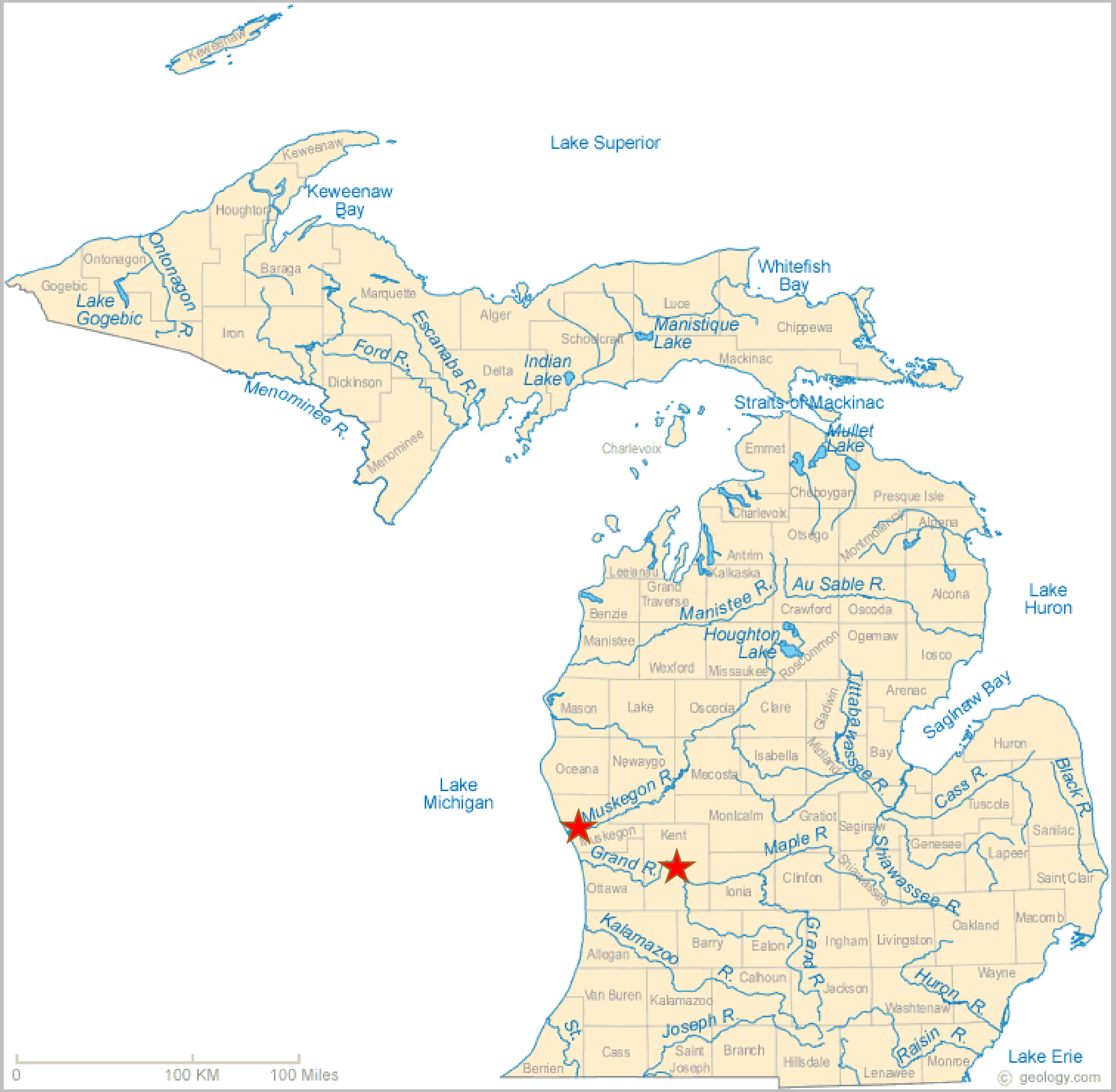
GRAND VALLEY STATE UNIVERSITY

GRAND VALLEY STATE UNIVERSITY
ROBERT B. ANNIS WATER RESOURCES INSTITUTE

SEIDMAN COLLEGE OF BUSINESS

Michigan Tech

Project Pilot Cities

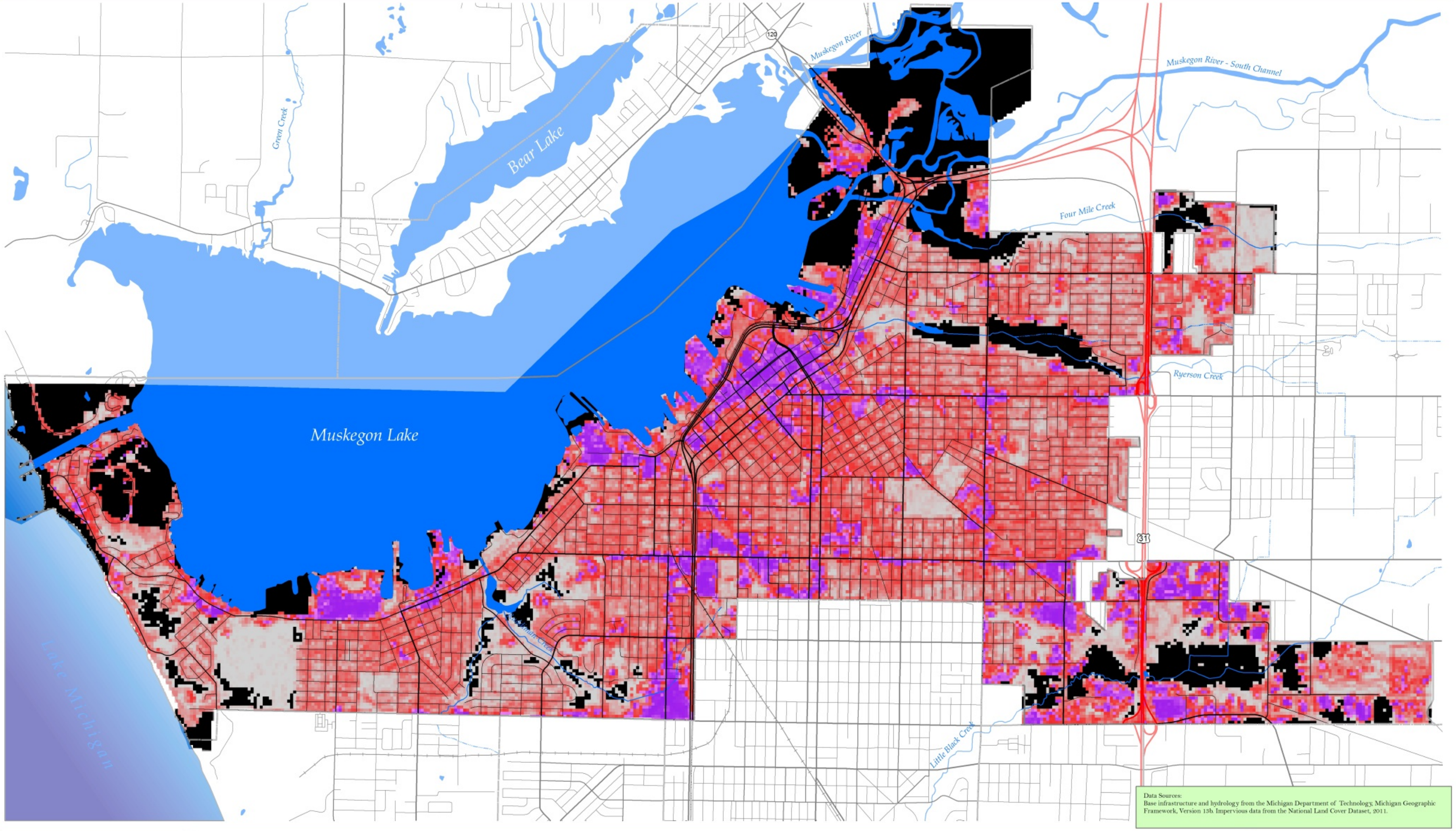


Collaborative Water Quality Projects and Programming

- ❖ 13th Annual Mayors' Grand River Cleanup
- ❖ Rain Barrel Stormwater Education Program
- ❖ 15 to River Public Service Announcement
- ❖ Grand Rapids Stormwater Planning
  - Community-Based Stormwater Initiative
  - Sustainably Managing Stormwater
  - Sustaining Stormwater Investments
  - 2013 Flood Sandbag Volunteers
  - Stormwater Oversight Commission
  - Vital Streets Oversight Commission
- ❖ Rainwater Rewards Stormwater Calculator

Impervious Surfaces

City of Muskegon, Michigan



Data Sources:
Base infrastructure and hydrology from the Michigan Department of Technology, Michigan Geographic Framework, Version 13b. Impervious data from the National Land Cover Dataset, 2011.

Project Partners:

U.S. Environmental Protection Agency Great Lakes Restoration

WMEAC

Grand Valley State University Robert B. Annis Water Resources Institute

Legend

- Interstate
- Arterial Road
- Collector Road
- Local Road
- Political Limits
- Railroad
- Creek
- Intermittent Stream/Drain
- Water
- Lake Michigan

0% 50% 100%

Percent Imperviousness

Map Created: April 2015

N S W E

1:24,000

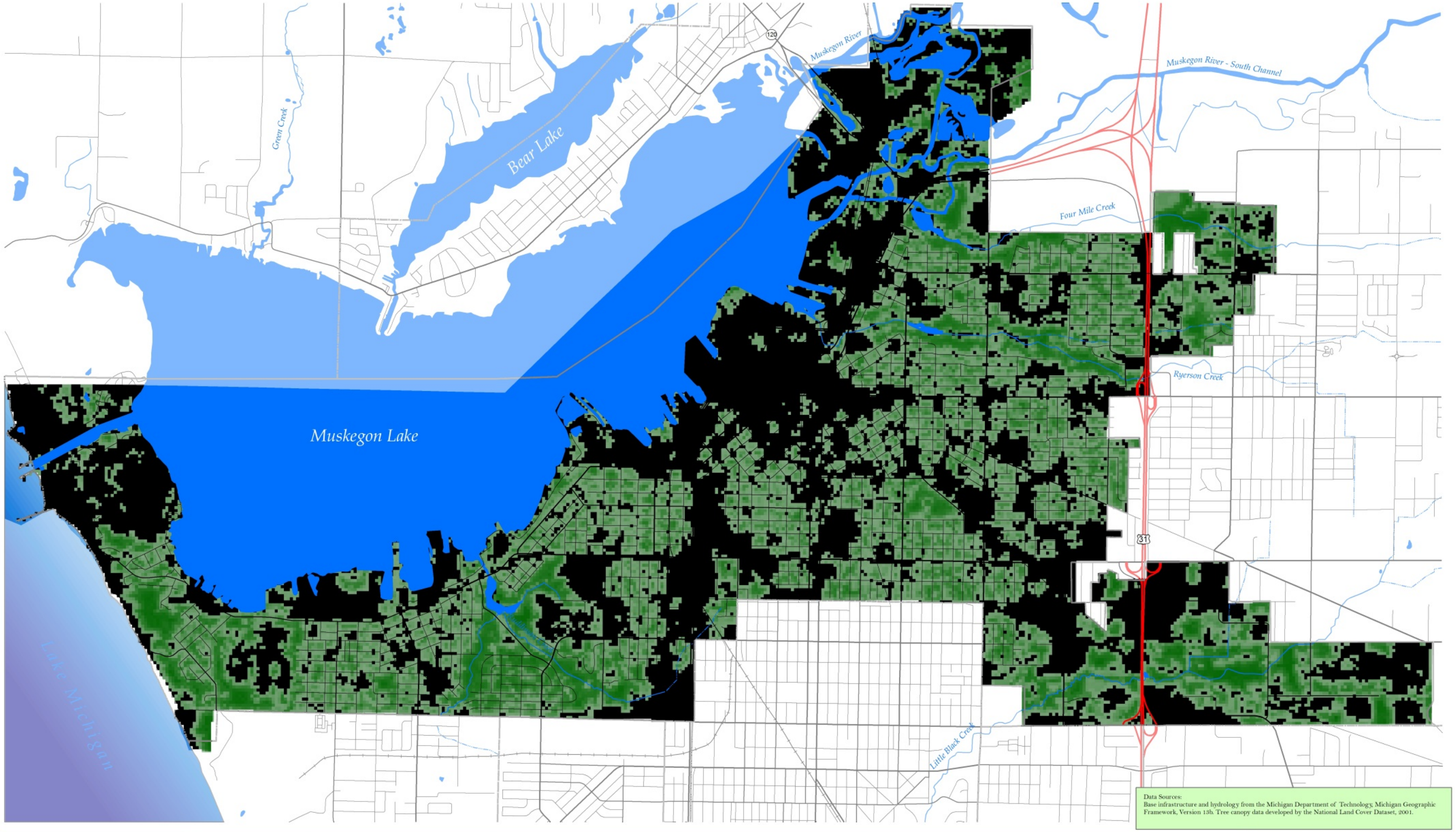
0 0.25 0.5 1

Miles

Projected Coordinate System: Michigan Georeference - NAD 1983, Meters

Urban Tree Canopy - NLCD

City of Muskegon, Michigan



Data Sources:
Base infrastructure and hydrology from the Michigan Department of Technology, Michigan Geographic Framework, Version 13b. Tree canopy data developed by the National Land Cover Dataset, 2001.

Project Partners:
U.S. Environmental Protection Agency
Great Lakes RESTORATION
WMEAC
Grand Valley State University Robert B. Annis Water Resources Institute

Legend

- Interstate
- Arterial Road
- Collector Road
- Local Road
- Political Limits
- Railroad
- Creek
- Intermittent Stream/Drain
- Water
- Lake Michigan

0% 50% 100%

Percent Tree Canopy

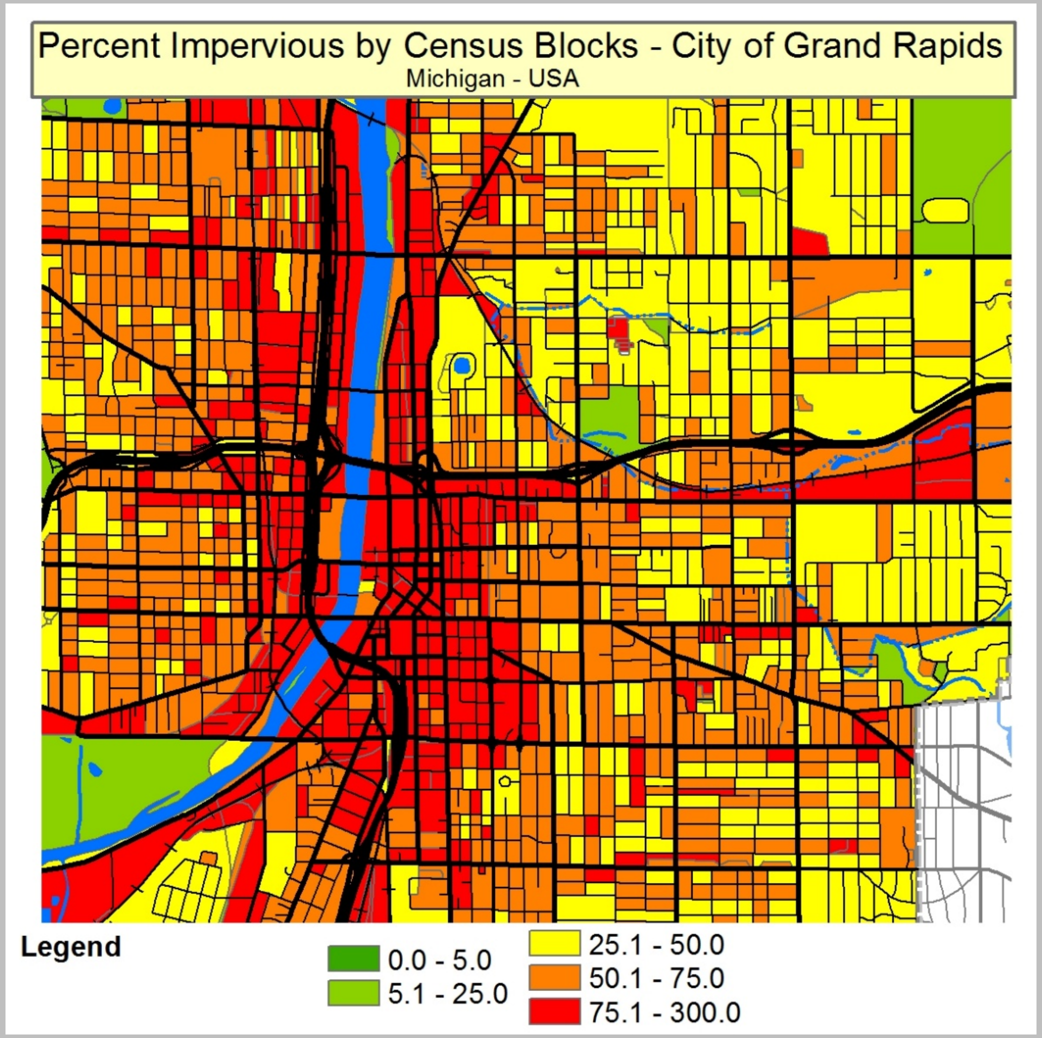
Map Created: April 2015

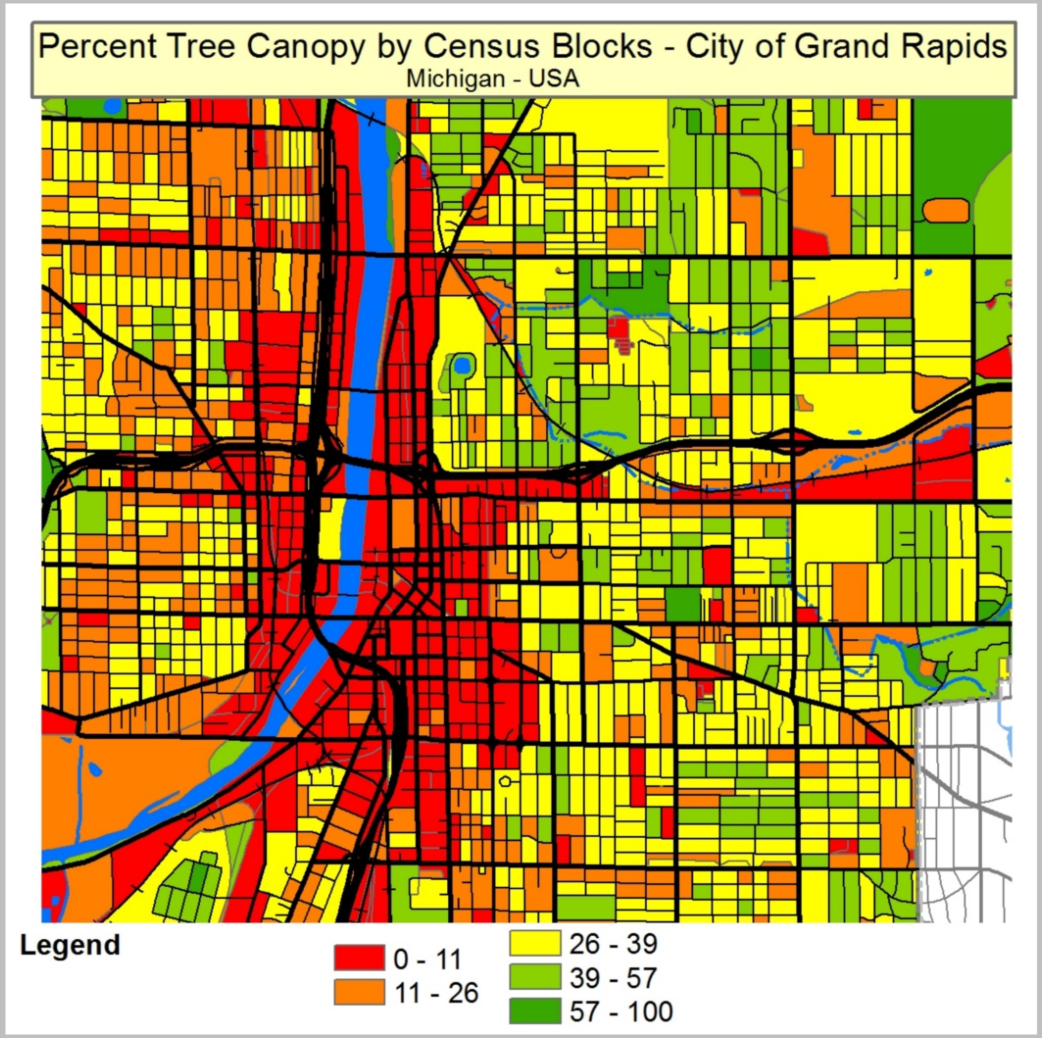
1:24,000

0 0.25 0.5 1 Miles

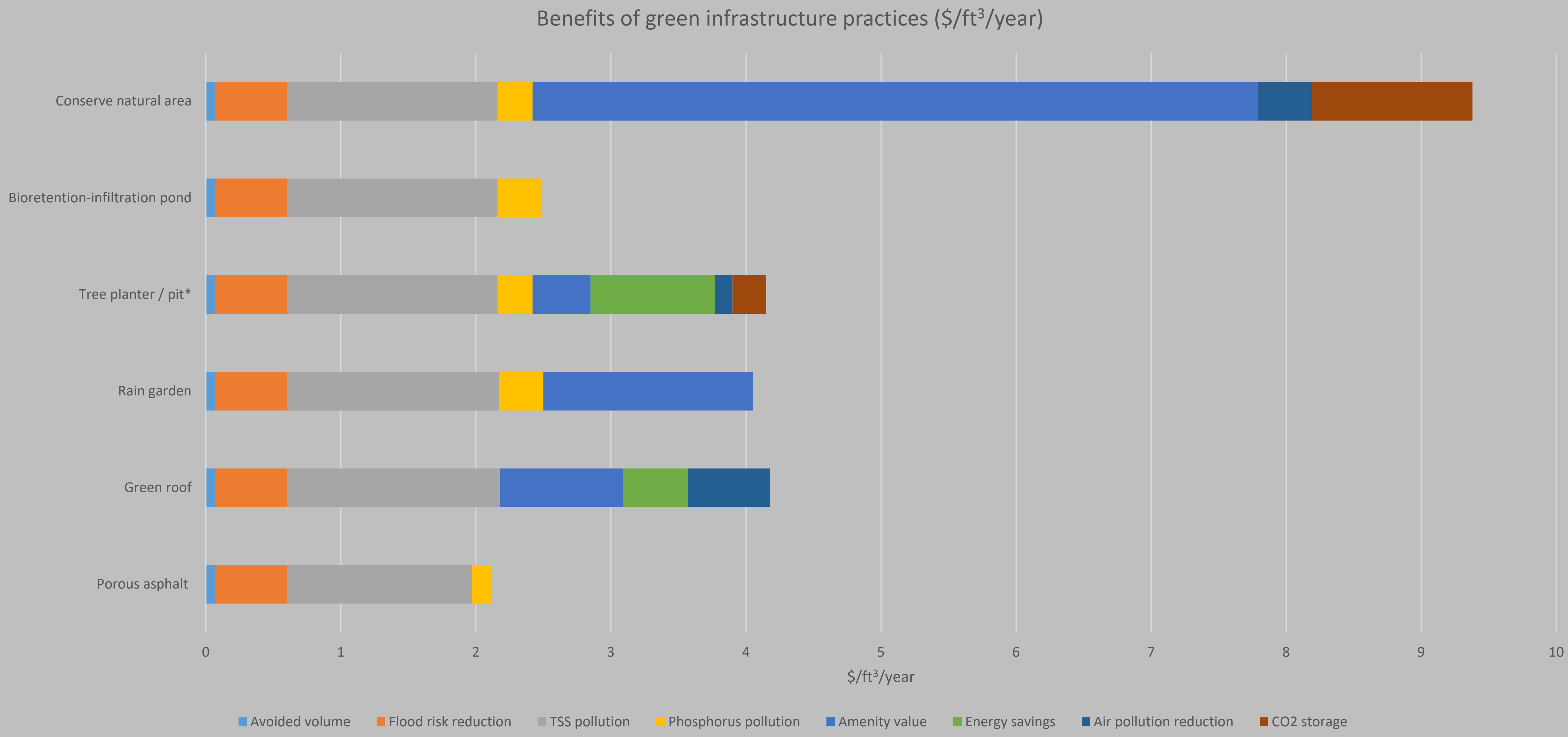
Projected Coordinate System: Michigan Georeference - NAD 1983, Meters

The unit of analysis was the census block.





Values were estimated using benefit transfer.



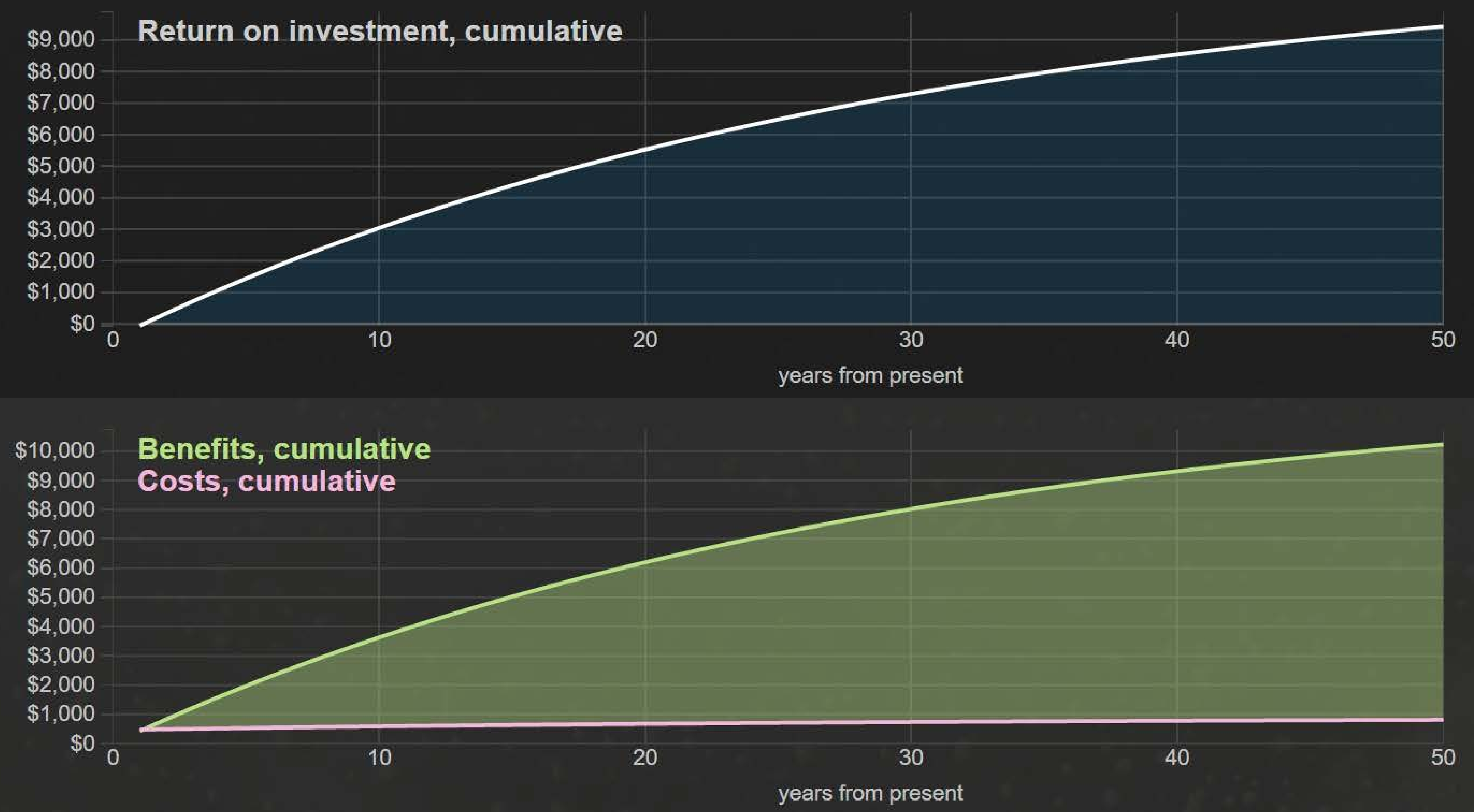
Infrastructure / SMP type	SMP size (for 3,000 ft^3 WQv per 1” event)	PV benefits ($/$ft^3$ WQv)	PV cost of green ($/$ft^3$ WQv)	PV cost of gray ($/$ft^3$ WQv)	Net Present Value ($/$ft^3$ WQv)
Porous asphalt	37,897 ft^2	$1.13	$5.38	$4.99	$0.74
Green roof	37,200 ft^2	$2.93	$12.47	$8.01	$-1.54
Rain garden	2,145 ft^2	$2.43	$0.90	-	$1.53
Bioretention infiltration	3,049 ft^2	$1.37	$1.81	-	$-0.44
Conserve natural area	37,897 ft^2	$6.35	$2.62		$3.72
Street tree planter / tree pit	342 trees	$5.79	$4.29	-	$1.50
Rain barrel	2 barrels*	$1.07	$0.10		$0.97

Basic information you'll need…

- Location of proposed project
- Type(s) of green infrastructure being considered
- Size (ft^2) or number of green infrastructure practice

What the calculator tells you…

- Stormwater runoff at that location (ft^3)
- Runoff reduced by installing green infrastructure
- Return on investment over 50 years
- Pollutants reduced by installing green infrastructure



0.1 of 0.3 lbs annually

54.8 of 74.1 lbs annually

v Advanced settings

Will roof be installed on a LEED-certified building?	No ▼
Installation cost ($/ft^2)	15

Pollution reduction

TSS reduction %	0.85
Phosphorus reduction %	0

Runoff reduction

Drainage area that is impervious (%)	1
Depth of soil media (ft)	0.5
Porosity of soil media (%)	0.2
Volume provided in soil media (ft^3)	
Depth of drainage layer (ft)	0.04
Porosity of drainage layer (%)	0.25
Volume provided in drainage layer (ft^3)	
Depth of ponding above surface (ft)	0
Volume provided in ponding layer (ft^3)	
Total volume provided (ft^3)	

Infrastructure capacity (ft^3):	--
Runoff reduced per rainfall event (ft^3):	-- of --
Runoff reduced (%):	--
Runoff reduced per year (ft^3) :	--

Rainwater Rewards

Calculator Demonstration

Plainfield Avenue Bioretention Islands

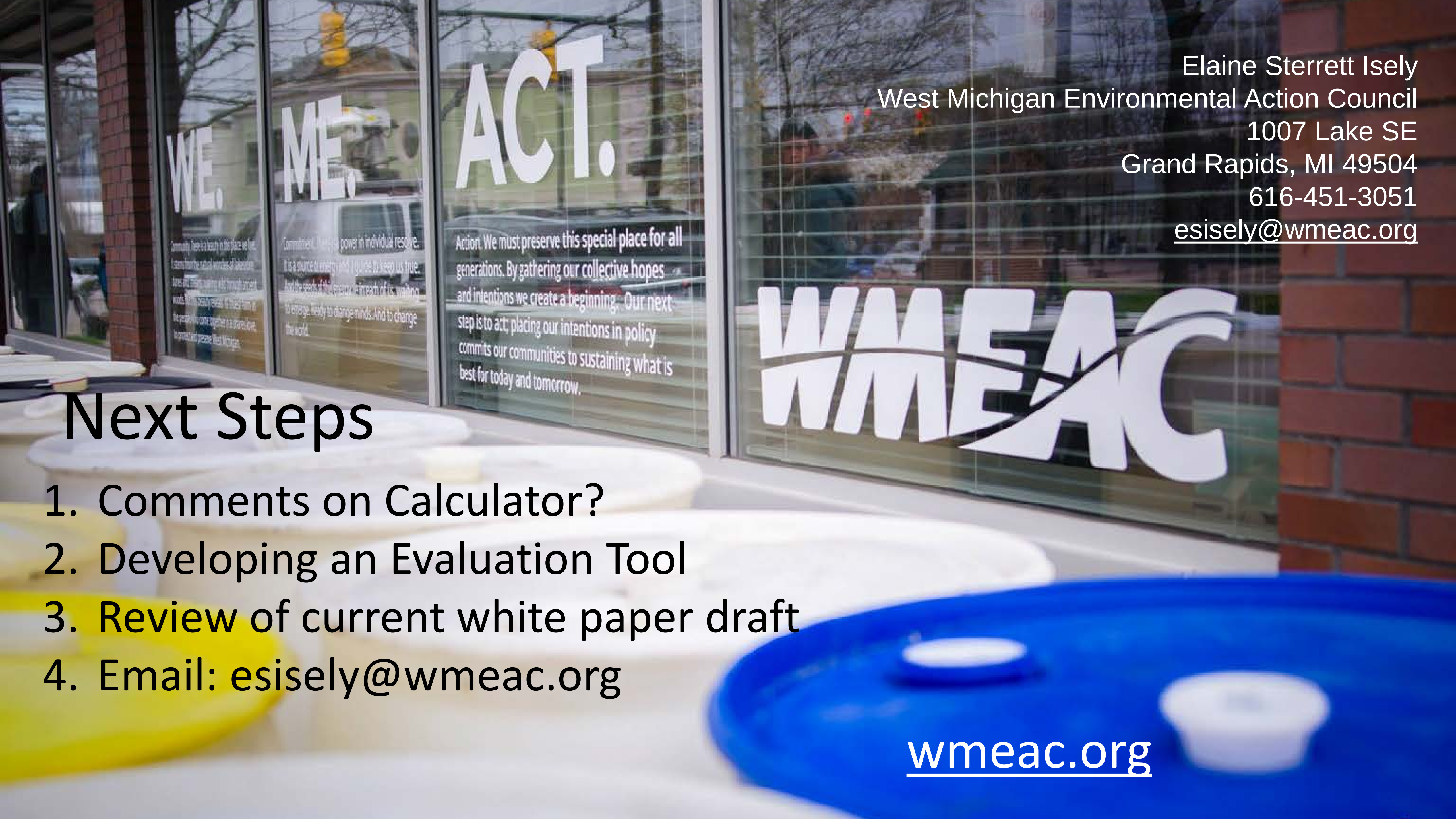
- 5,950 ft^2 bioretention/rain garden
- 96,700 ft^2 drainage area
- Advanced
  - \$50 per ft^2 installed
  - Soil media 2ft
  - Drainage layer 1.5ft
  - Ponding .8ft

Center of the Universe
Rain Garden

- 300 ft^2 bioretention/rain garden
- 4,200 ft^2 drainage area
- Advanced
  - $5 per ft^2 installed

Center of the Universe
Green Roof

- 2,000 ft^2 bioretention/rain garden
- 2,000 ft^2 drainage area
- Advanced
  - LEED Certified Building



Elaine Sterrett Isely
West Michigan Environmental Action Council
1007 Lake SE
Grand Rapids, MI 49504
616-451-3051
esisely@wmeac.org

Next Steps

1. Comments on Calculator?
2. Developing an Evaluation Tool
3. Review of current white paper draft
4. Email: esisely@wmeac.org

wmeac.org