Spring Lake Stormwater Integrated Assessment Project

"Rein in the Runoff"

Stakeholder Steering Committee
Public Presentation of Final Report
March 3, 2010

Elaine Sterrett Isely
Alan D. Steinman
Annis Water Resources Institute
Grand Valley State University

Agenda

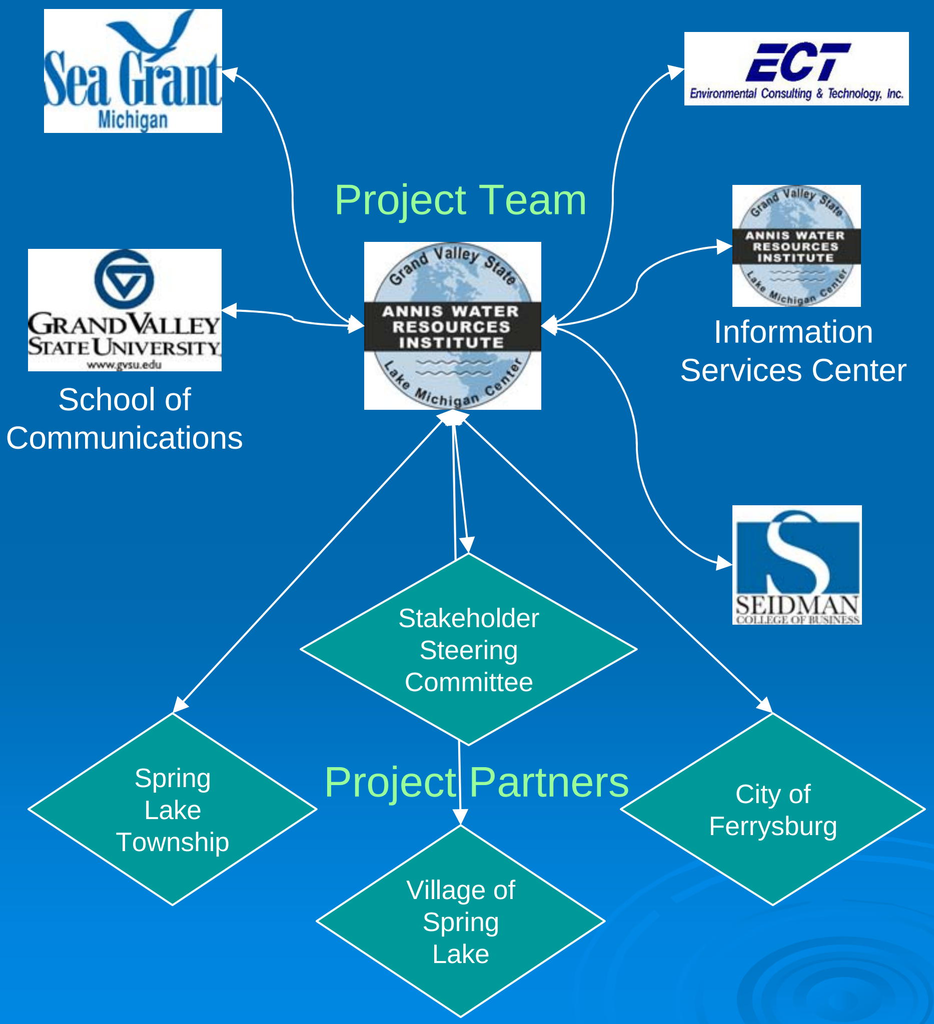
- Final Project Report
  - Project Overview
  - Results
  - Resources
  - Conclusions
  - Guidance
  - Technical Details

Chapter 1:

Introduction & Background

- Project Overview
- Managing Stormwater Runoff
- Integrated Assessment

What is Rein in the Runoff?



- Integrated Assessment
- Stormwater management alternatives
- Spring Lake Watershed

What is Stormwater Runoff?

- Stormwater is rain, sleet or snow

- Stormwater runoff
  - Rain or melting snow that cannot soak into the ground
  - Flows over land and hard surfaces into waterways
  - Collects pollutants and debris which also end up in our lakes, rivers and streams

Why is stormwater runoff a problem?

Photo credit: Spring Lake Lake Board

Photo credit: A. Steinman

- Pollutes waterways
- Too much water, too fast
- Consequences to people and wildlife
- Worsens with global climate change

Photo credit: AWRI

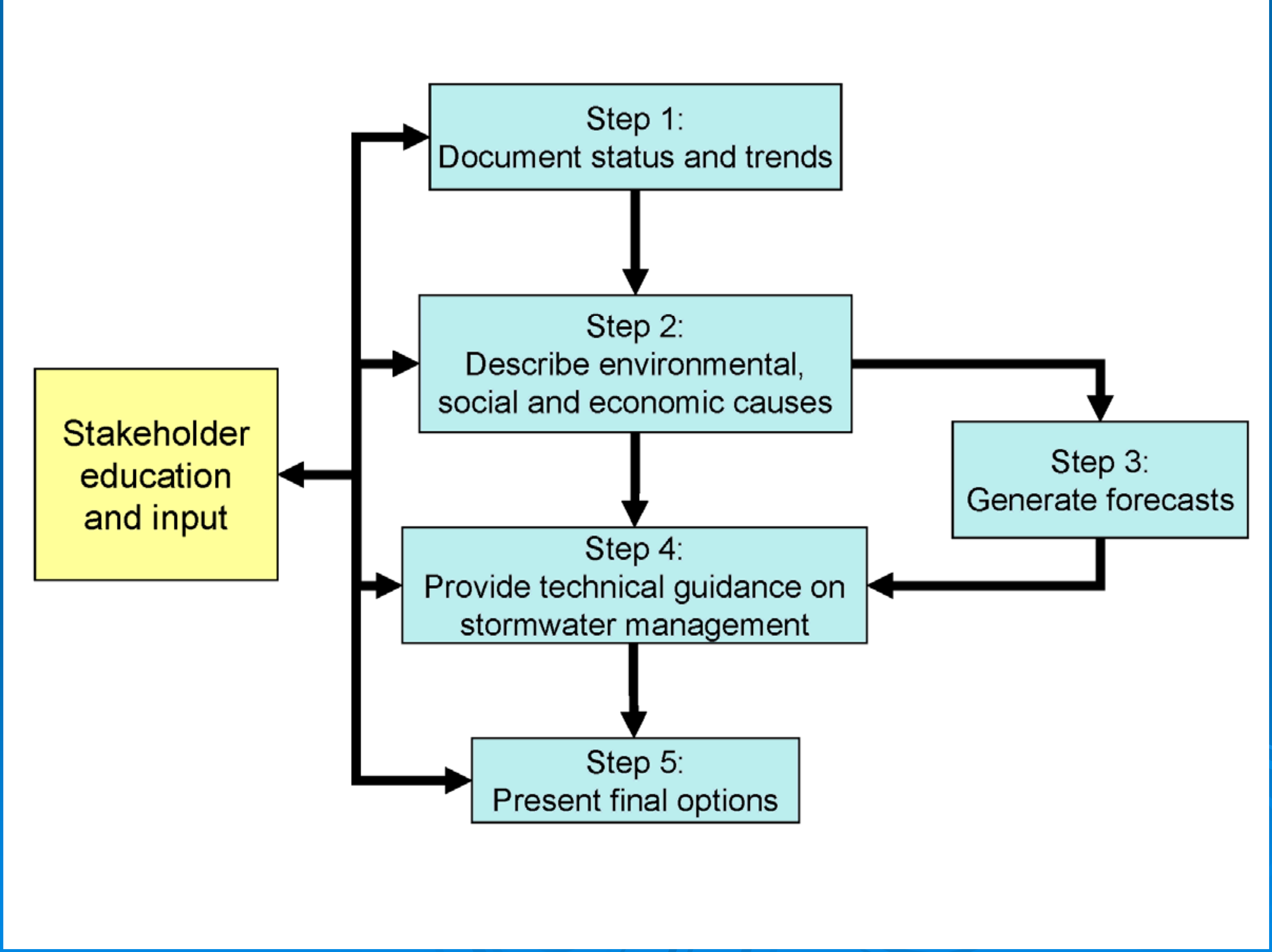
Integrated Assessment

- Application of existing scientific information
- Education and involvement of stakeholders
- To answer policy issue or question

Policy Question

What stormwater management alternatives are available to the communities in the Spring Lake Watershed that allow for future development and also mitigate the effects of stormwater and improve the water quality of Spring Lake, the Grand River, and ultimately, Lake Michigan?

5-Step Approach



Project Objectives

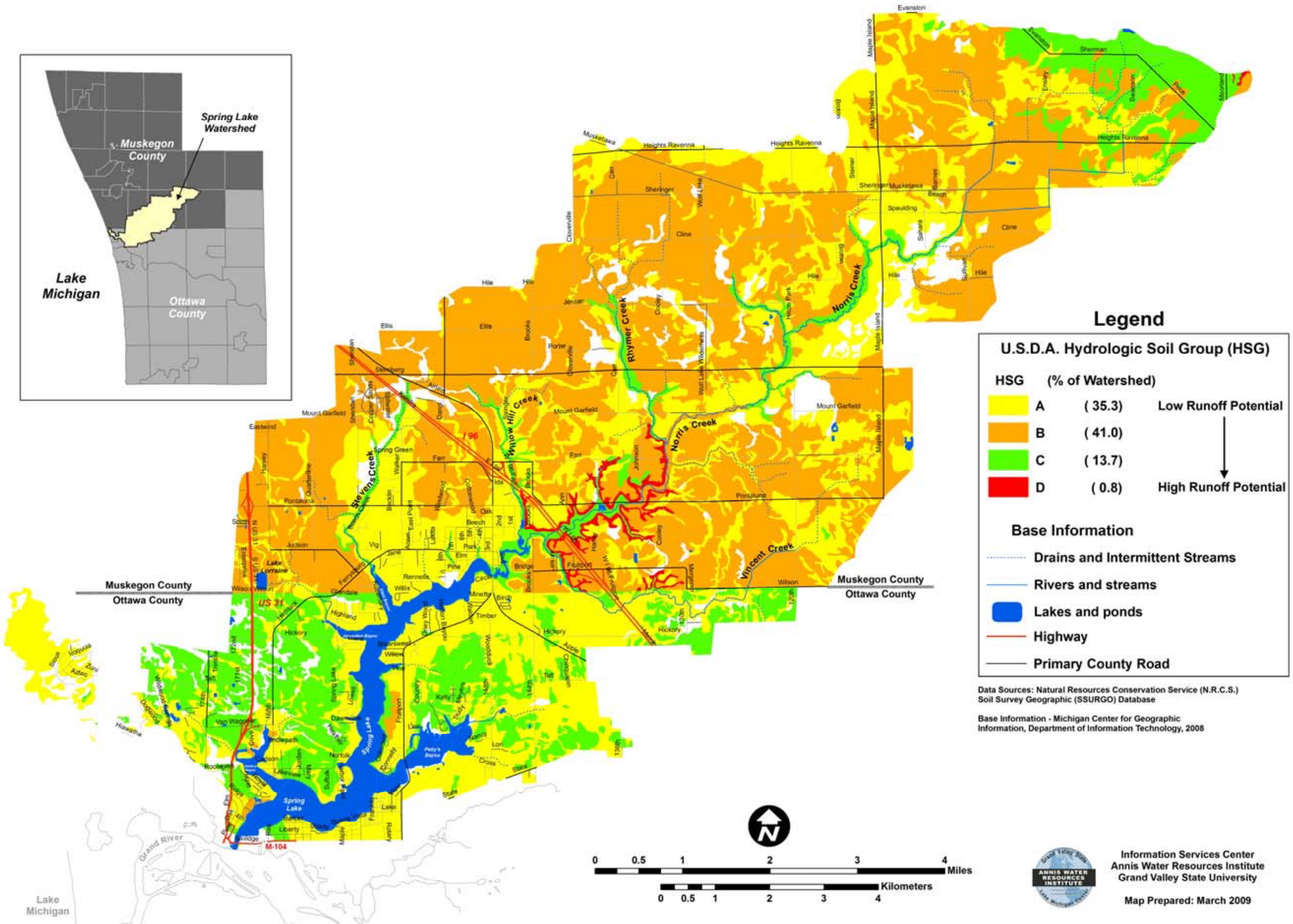
- Increase understanding of the causes and consequences of stormwater runoff
- Increase stakeholder participation in stormwater control and management
- Identify regulatory mechanisms to improve local stormwater management and control
- Recommend alternative BMPs for stormwater management

Chapter 2:

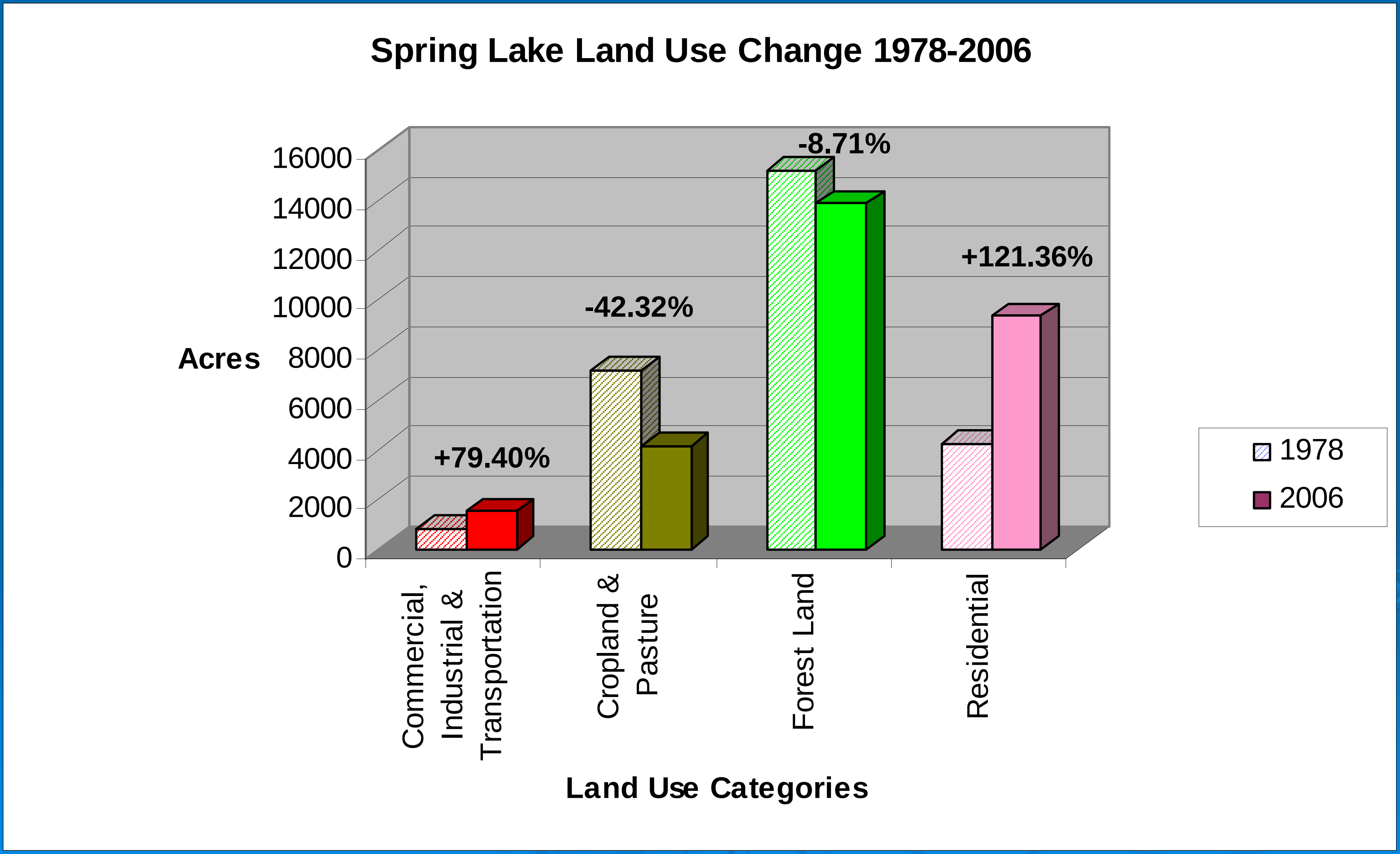
Conditions in the Spring Lake Watershed related to Stormwater Pollution

- Geography and Natural Features
- Population Growth and Land Use Change
- Scope of Stormwater Problem

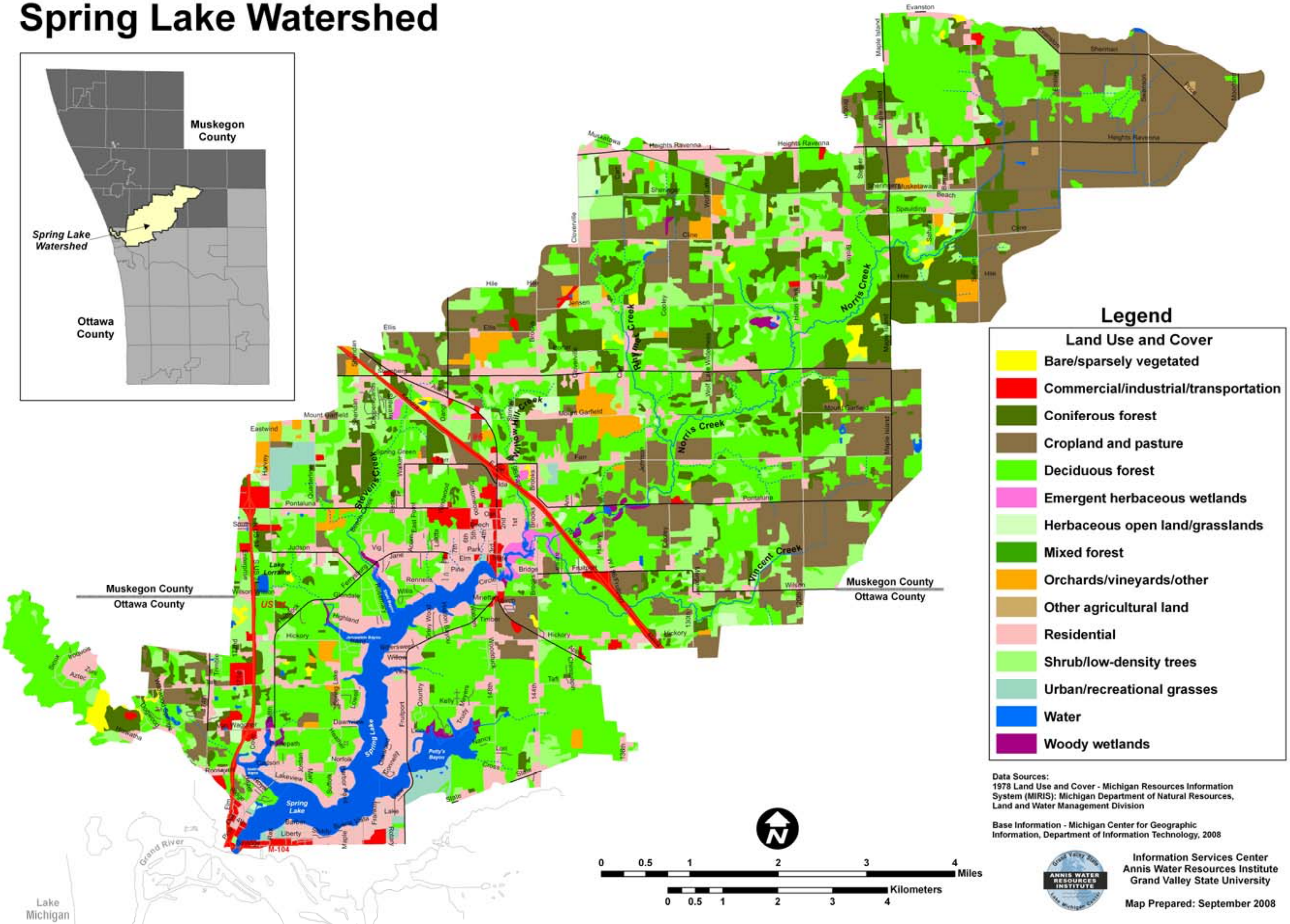
SSURGO Soils - U.S.D.A. Hydrologic Soil Group



Land Use & Cover Change



1978 Land Use and Cover
Spring Lake Watershed



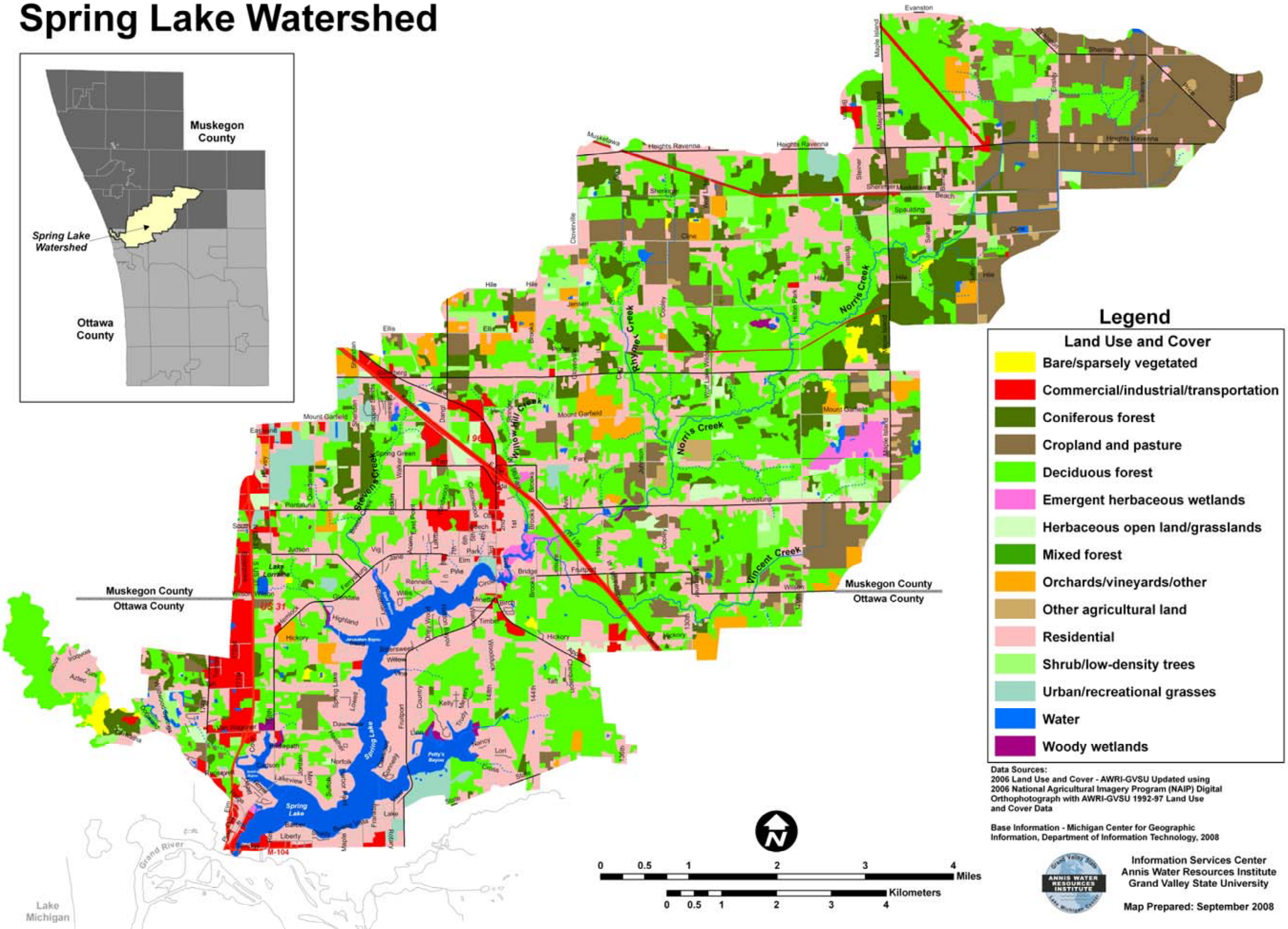
Data Sources:
1978 Land Use and Cover - Michigan Resources Information System (MIRIS): Michigan Department of Natural Resources, Land and Water Management Division

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

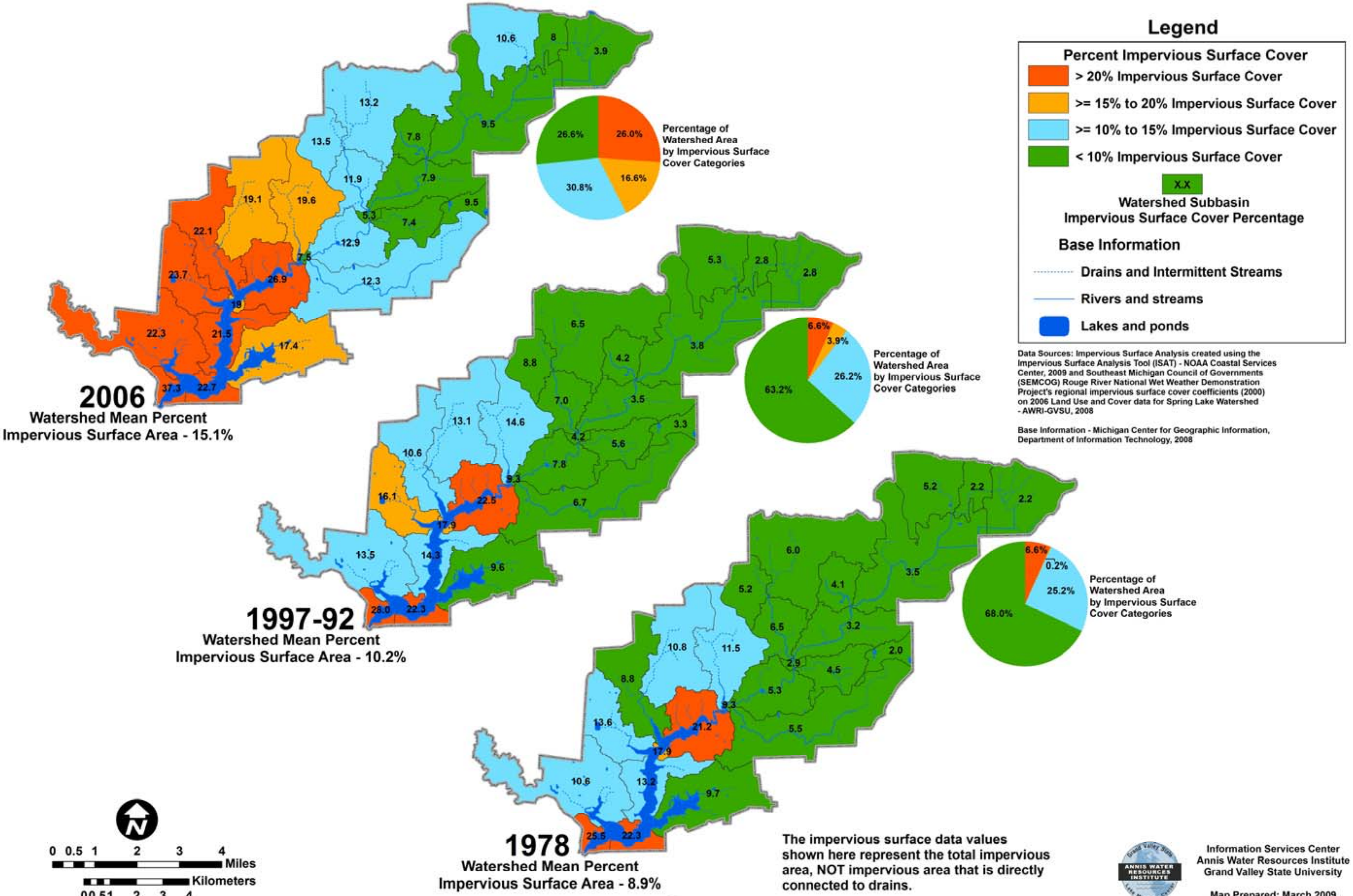
Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: September 2008

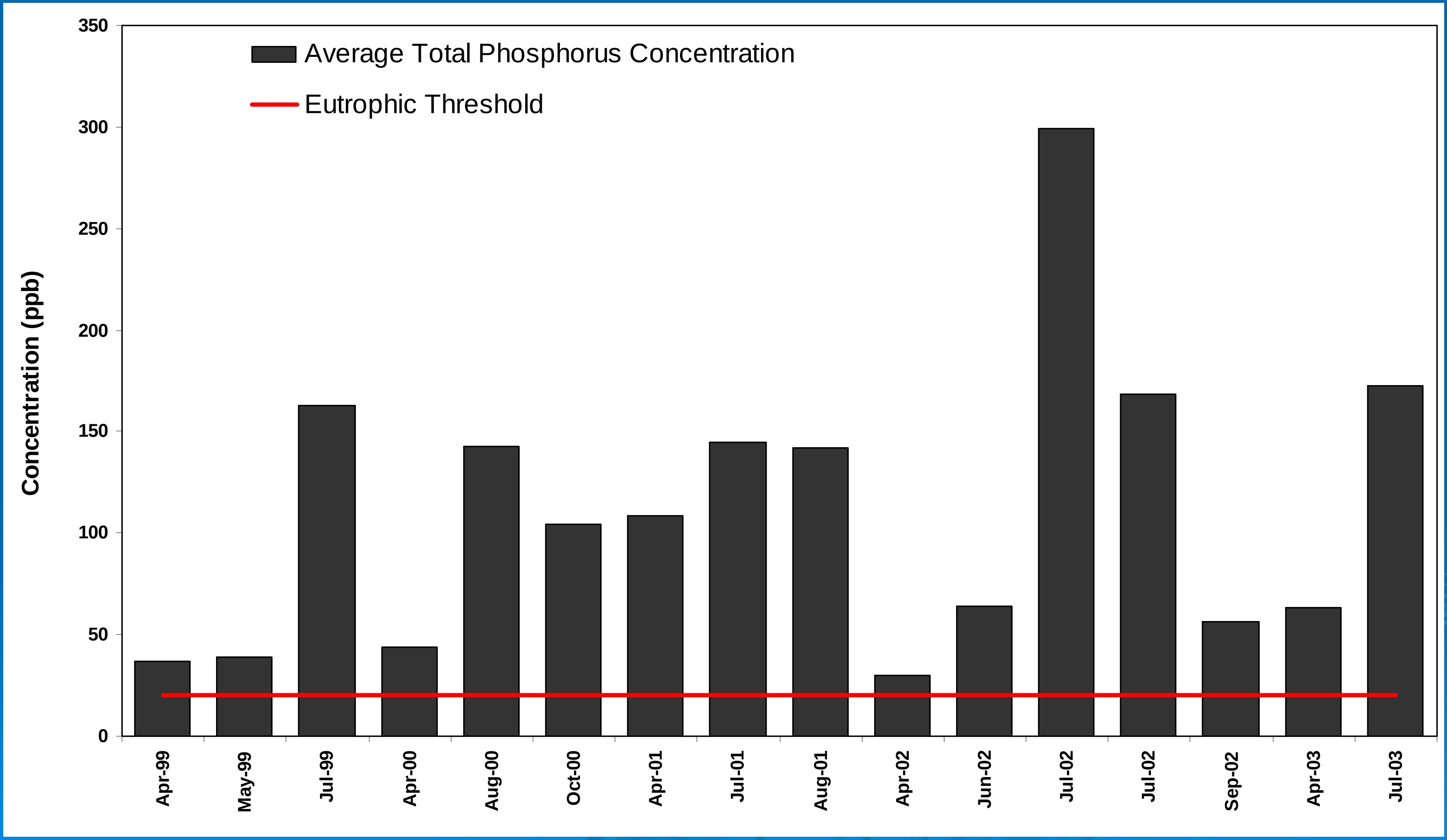
2006 Land Use and Cover
Spring Lake Watershed



Percent Change in Impervious Surface Cover - 2006, 1997-92 and 1978

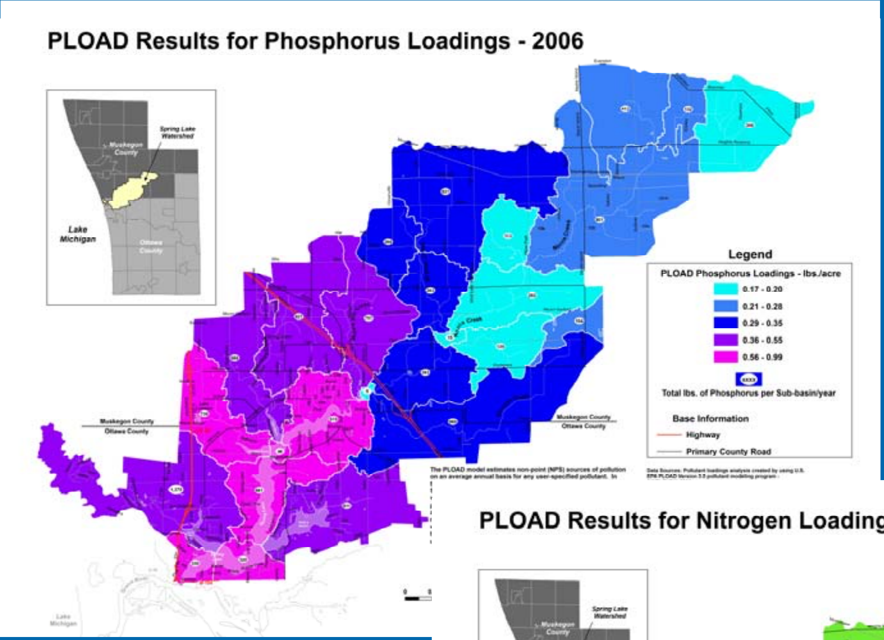


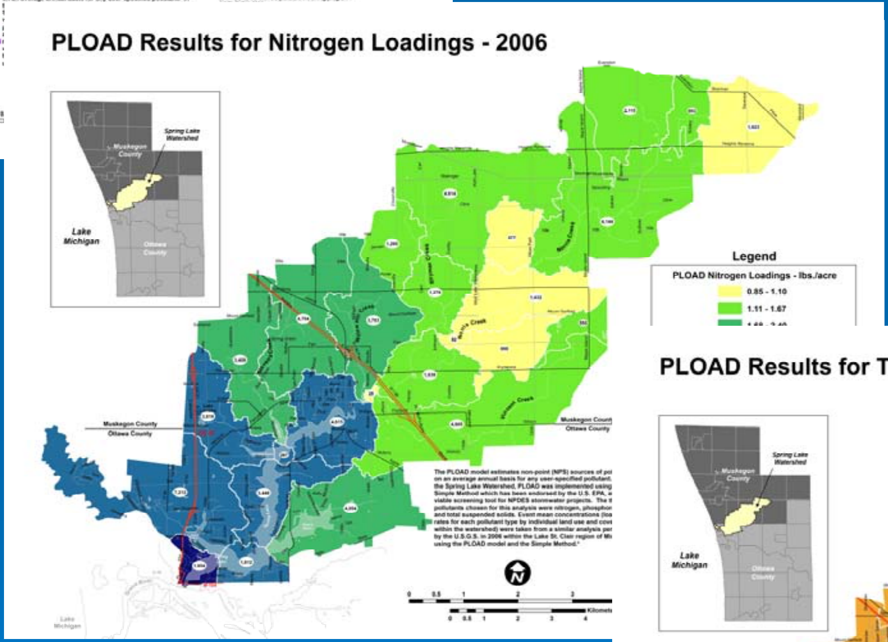
Total Phosphorus: Spring Lake

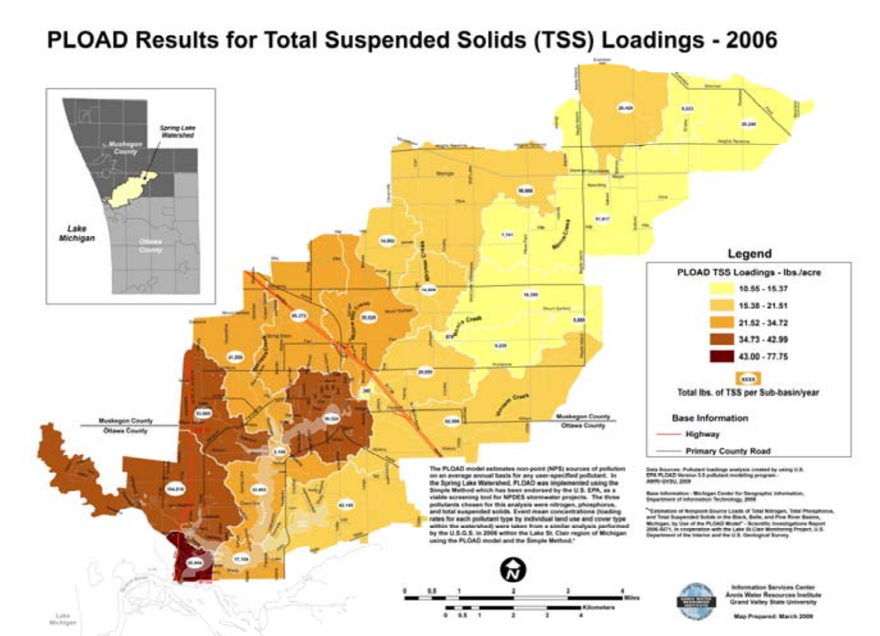


Data courtesy of Progressive AE


Model Results for Subwatershed Pollutant Loads







Chapter 3:

Stakeholder Education and Participation

- Project Website
- Project Branding
- Presentations, Displays, and Demonstrations
- Stakeholder Steering Committee
- Water Quality Survey
- Citizens Guide to Stormwater

http://www.gvsu.edu/wri/reinintherunoff

WHAT CAN YOU DO TO REDUCE STORMWATER POLLUTION?

- Cars and boats
  - Maintain your vehicles so that they do not leak oil or other fluids.
  - Be sure to wash vehicles on the grass or at a designated car or boat wash so that dirt and soap do not flow into our storm drains and waterways; even biodegradable cleaning products can still be toxic to fish and stimulate algae growth.
- Yards and gardens
  - Apply only the recommended amount of fertilizer.
  - Never apply fertilizers or pesticides before a heavy rain.
  - If fertilizer falls onto driveways or sidewalks, sweep it up instead of hosing it away.
  - Mulch leaves and grass clippings and place in the yard at the curb - not in the street. This keeps leaves out of the gutter, where they can wash into the water or storm drain.
  - Turn your gutter downspouts away from hard surfaces.
  - Seed bare spots in your yard to avoid erosion.
  - Consider building a rain garden in low-lying areas of your lawn.
  - Use captured rainwater to water your garden.

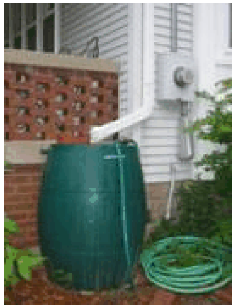


Photo credit: E. Sterrett Isely

- Septic systems
  - Proper maintenance includes having your septic system pumped every three (3) to five (5) years.
  - For older systems, make sure it can still handle current volumes.
  - Never put chemicals down your septic system. This can harm the system and seep into the groundwater.
- Pets
  - Clean up after your pet on walks and in your yard.
  - Dispose of all pet waste in the garbage.
- Chemicals
  - Keep lawn and household chemicals in tightly-sealed containers, where rain cannot reach them.
  - Dispose of old or unwanted chemicals at household hazardous waste collection sites or events.
- Other
  - Never put anything in a storm drain.
  - Don't litter.

Rein in the Runoff

Rein in the Runoff

Improving water quality in Spring Lake

www.gvsu.edu/wri/reinintherunoff

Rein in the Runoff is a collaborative, community-based project that is identifying the causes, consequences, and corrective actions required to minimize the adverse impacts of stormwater discharges to Spring Lake, the Grand River and Lake Michigan.

Algae bloom in Spring Lake at the Fruitport Boat Launch (July 2008).

Contact us

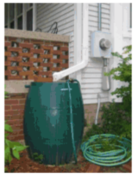
For more information about this project.
Elaine Sterrett Isely (iselyel@gvsu.edu)
Alan Steinman (steinmaa@gvsu.edu)
At GVSU's Annis Water Resources Institute: (616) 331-3749

Learn More

Visit our updated **Stormwater Education** page on our website to learn more about what you can do to minimize your household contribution of pollutants to our waterways.

Take our online water quality survey and tell us what you know about stormwater and stormwater runoff:
http://www.gvsu.edu/wri/waterqualitysurvey

The Village of Spring Lake's rain garden provides rainwater and runoff infiltration, and it beautifies the lot (July 2008)



Rain barrels capture rainwater that can be used to water lawns and gardens.

Join us

At our upcoming Stakeholder Steering Committee Meetings at the Spring Lake Library.

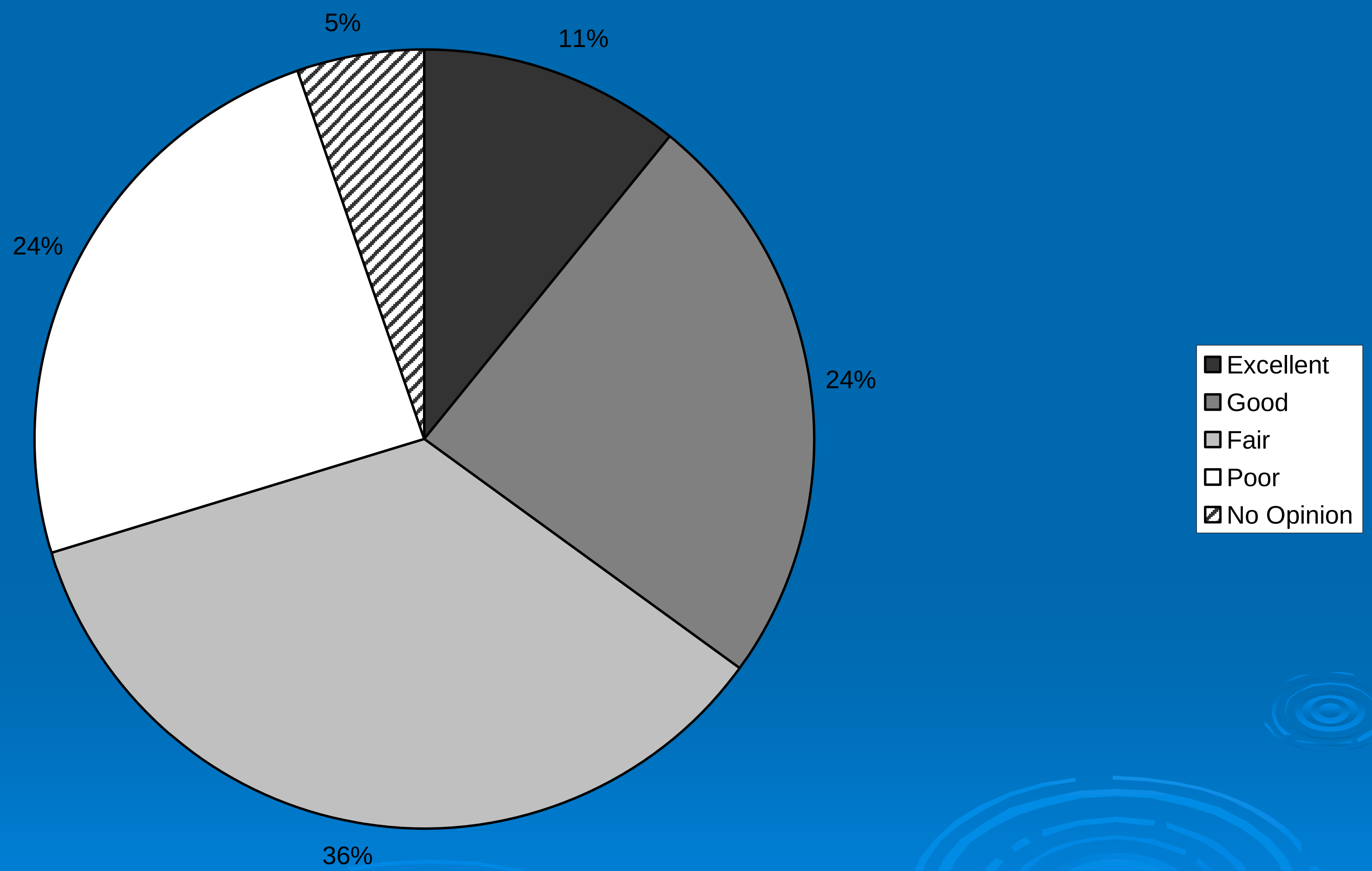
Visit the **Stakeholder** page on our website or contact use for more information.

Rein in the Runoff Logo design compliments of Shane VanOosterhout, Kendall College of Art & Design, Grand Rapids, MI

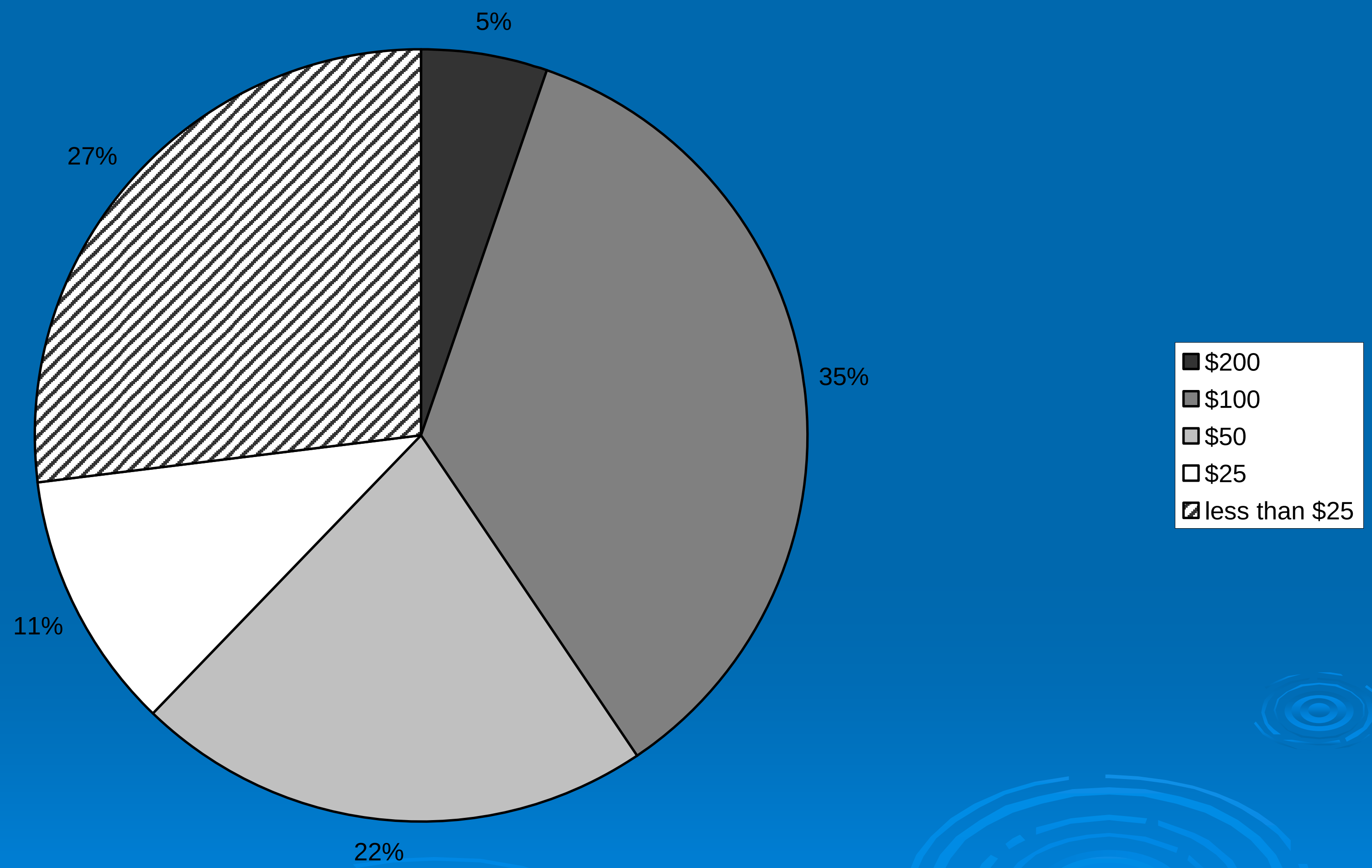

Identify watershed areas
What BMPs are important to Spring Lake?
Where would you like to see these BMPs?
Spring Lake Watershed
Lower Subbasin


Rein in the Runoff

Rate the Overall Water Quality of Spring Lake



Distribution of Willingness to Pay for Phosphorus Reduction Below 20ppb



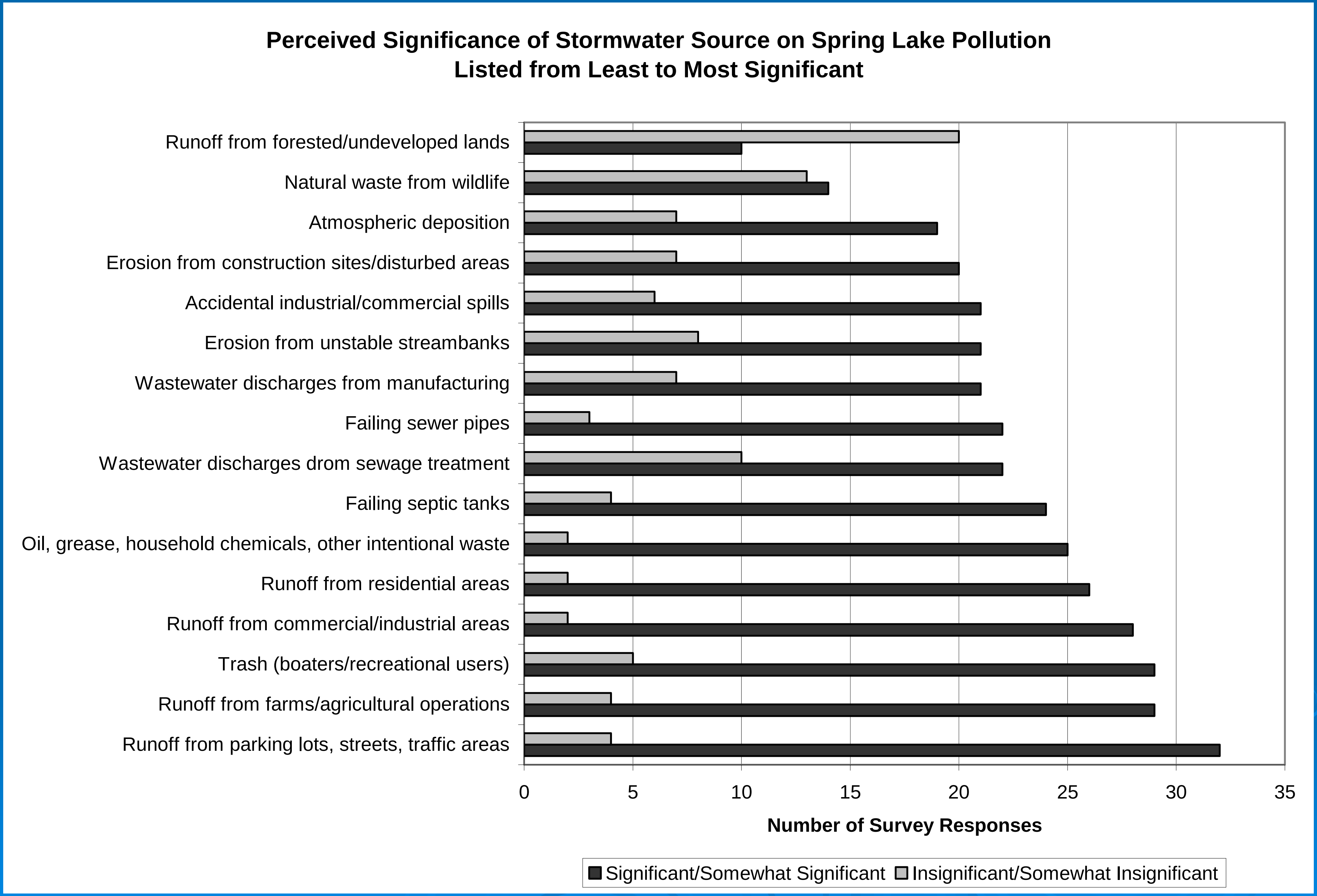

Perceived Significance of Stormwater Source on Spring Lake Pollution
Listed from Least to Most Significant
Runoff from forested/undeveloped lands
Natural waste from wildlife
Atmospheric deposition
Erosion from construction sites/disturbed areas
Accidental industrial/commercial spills
Erosion from unstable streambanks
Wastewater discharges from manufacturing
Failing sewer pipes
Wastewater discharges drom sewage treatment
Failing septic tanks
Oil, grease, household chemicals, other intentional waste
Runoff from residential areas
Runoff from commercial/industrial areas
Trash (boaters/recreational users)
Runoff from farms/agricultural operations
Runoff from parking lots, streets, traffic areas
0
5
10
15
20
25
30
35
Number of Survey Responses
Significant/Somewhat Significant
Insignificant/Somewhat Insignificant

Table 3-2. Water Quality Survey Results Regarding Stakeholder Behaviors.

Survey Questions (Behaviors affecting Stormwater Pollution)	Percent Responses[1]
Respondents that have and mow their own lawn	**98%**
Leave grass clippings in the yard	40%
Throw grass clippings in the garbage	10%
Rake or blow grass clippings into storm drain or ditch	3%
Mulch, compost or otherwise recycle grass clippings	49%
Respondents that fertilize their lawn	**80%**
Have tested soil	28%
Use phosphorus free fertilizer[2]	91%
Respondents wash their personal vehicle at home	**50%**
Soapy water flows into grass, dirt or gravel	53%
Soapy water flows into the street or driveway	37%
Soapy water flows directly into a storm drain	11%
Respondents that change their own (motor) oil	**30%**
Dispose of used oil in garbage	17%
Dispose of used oil at recycling center	83%
Respondents have and walk a pet	**53%**
Always pick up after pet	65%
Often pick up after pet	13%
Rarely pick up after pet	19%
Never pick up after pet	4%
Respondents have a septic tank	**18%**
Pump it out every 3-5 years	86%
Pump it out more than every 5 years	14%

1 Percent responses for some survey questions do not add up to 100% because respondents could give multiple answers.

2 Ottawa and Muskegon counties have ordinances regulating the use of fertilizers containing phosphorus.

Chapter 4:

Best Management Practices (BMPs)

- Structural BMPs
- Nonstructural BMPs

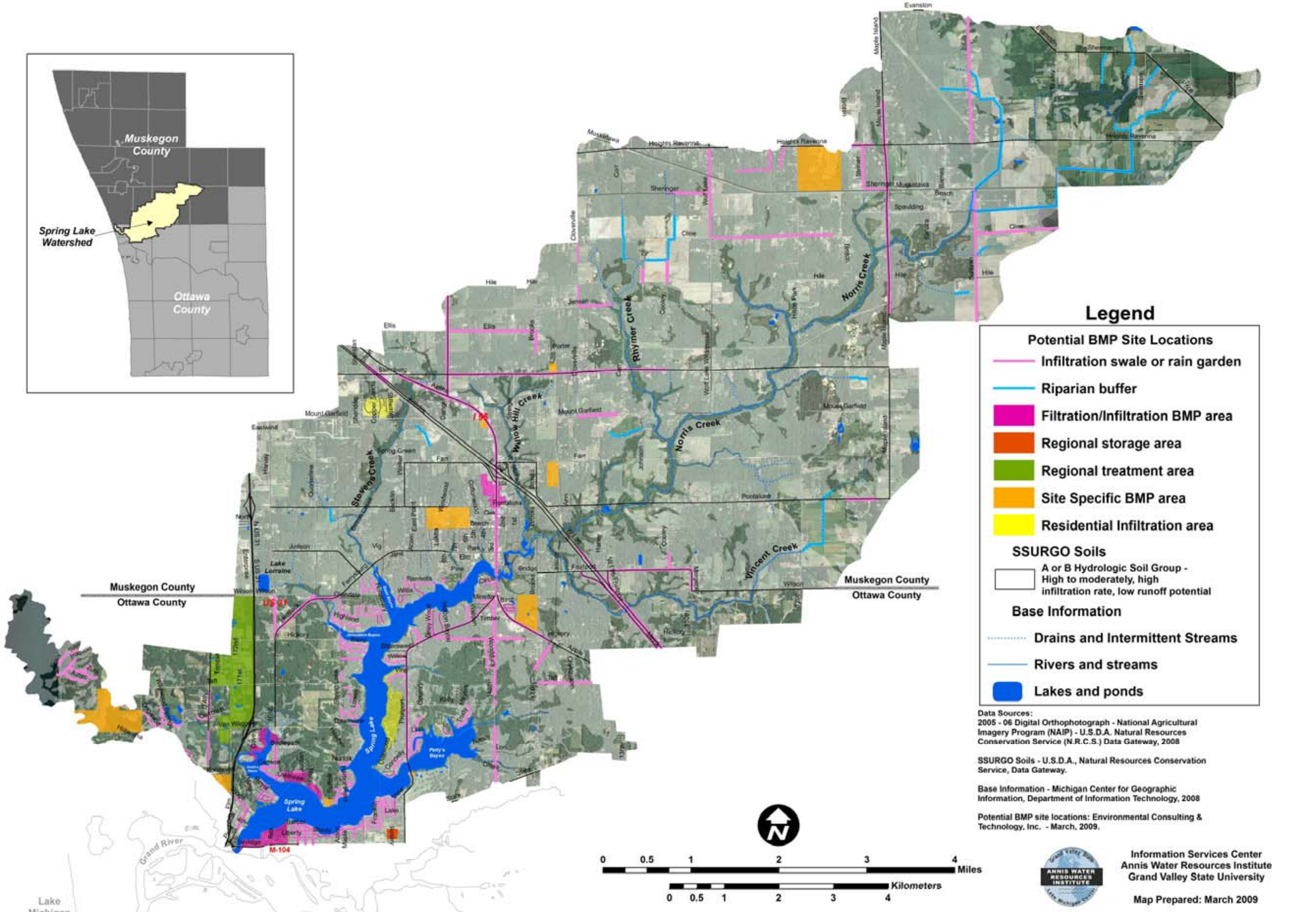
Structural BMPs

- Rain gardens
- Riparian buffers
- Vegetated swales
- Porous pavement
- Rain barrels, cisterns
- Green roofs
- Constructed wetlands

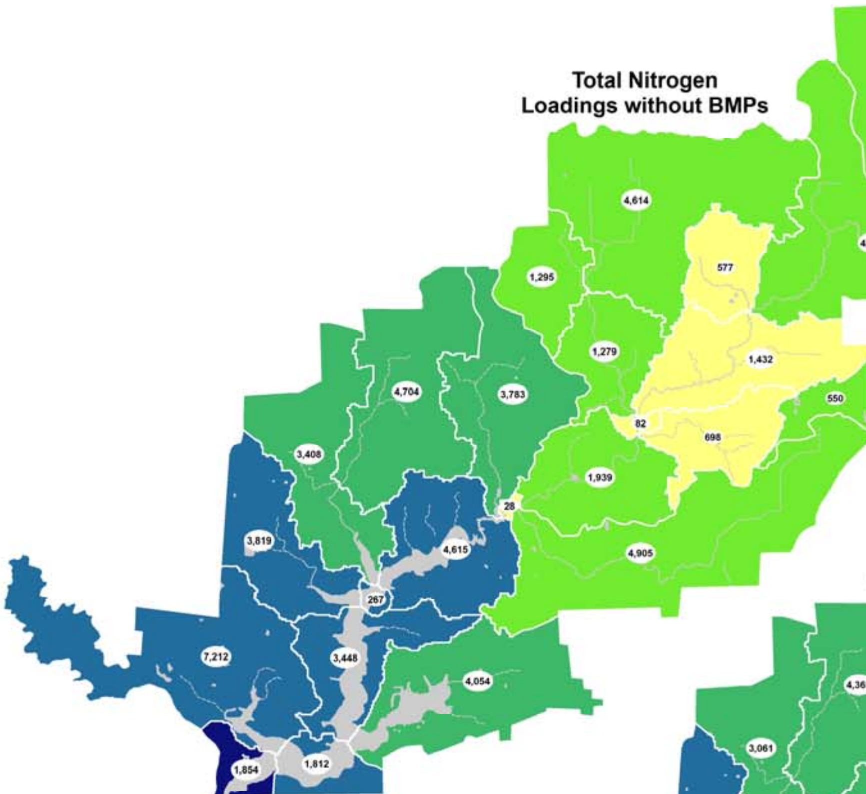
BMP Matrix

	Bioretention/Rain Gardens	Vegetated/Bio Swales	Grow Zones
Description	Shallow landscaped surface depressions designed to infiltrate and/or filter stormwater	Stormwater conveyance channel designed to filtrer and/or infiltrate stormwater	Native planting area
Detail	Shallow landscaped surface depressions; recommended to use deep-rooted native plants; underdrain and mechanism to direct overflow runoff is necessary; should be located at least 10' from any building.	Shallow stormwater channel that is densely planted with a variety of grasses, shrubs, and/or trees. Check dams can be used to improve performance and maximize infiltration, especially in steeper areas.	A grow zone is an upland and/or riparian native planting area.
Where Effective	Roof runoff from residential / commercial areas; parking lots (use curb cuts to direct stormwater runoff to depressed areas and/or consider "inverted" islands rather than landscaped islands.	Vegetated swales typically treat runoff from highly impervious surfaces such as roadways and parking lots.	Parks, riparian corridors and other areas that are currently maintained as mowed lawn but may not be actively used or accessed. Grow zones are excellent opportunities for reducing local maintenance costs by converting turf (or impervious) areas to deep-rooted native vegetation.

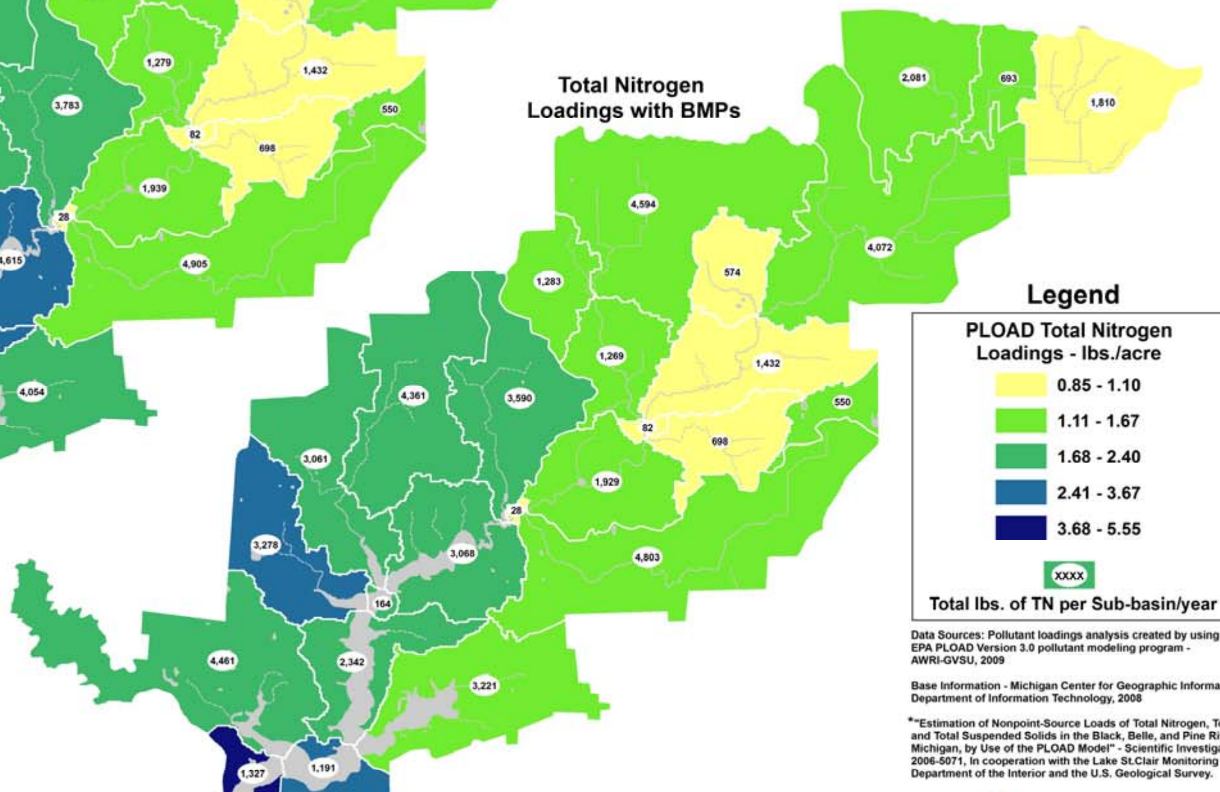
ECT Potential BMP Site Locations



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



Total Nitrogen load reduction in watershed with BMPs present = 9,187 lbs./year



The PLOAD model estimates non-point sources (NPS) of pollution on an average annual basis for user-specified pollutants. In the Spring Lake Watershed, PLOAD was implemented using the Simple Method, which has been endorsed by the U.S. EPA as a viable screening tool for NPDES stormwater projects. The three pollutants chosen for this analysis were total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS). Event mean concentrations and an alternative method for computing an annual rainfall to runoff value for each sub-basin in the watershed were adopted from a similar analysis performed by the U.S.G.S. in 2006 within the Lake St. Clair region of Michigan using the PLOAD model and the Simple Method.*

0 0.5 1 2 3 4 Miles

0 0.5 1 2 3 4 Kilometers

Data Sources: Pollutant loadings analysis created by using U.S. EPA PLOAD Version 3.0 pollutant modeling program - AWRI-GVSU, 2009

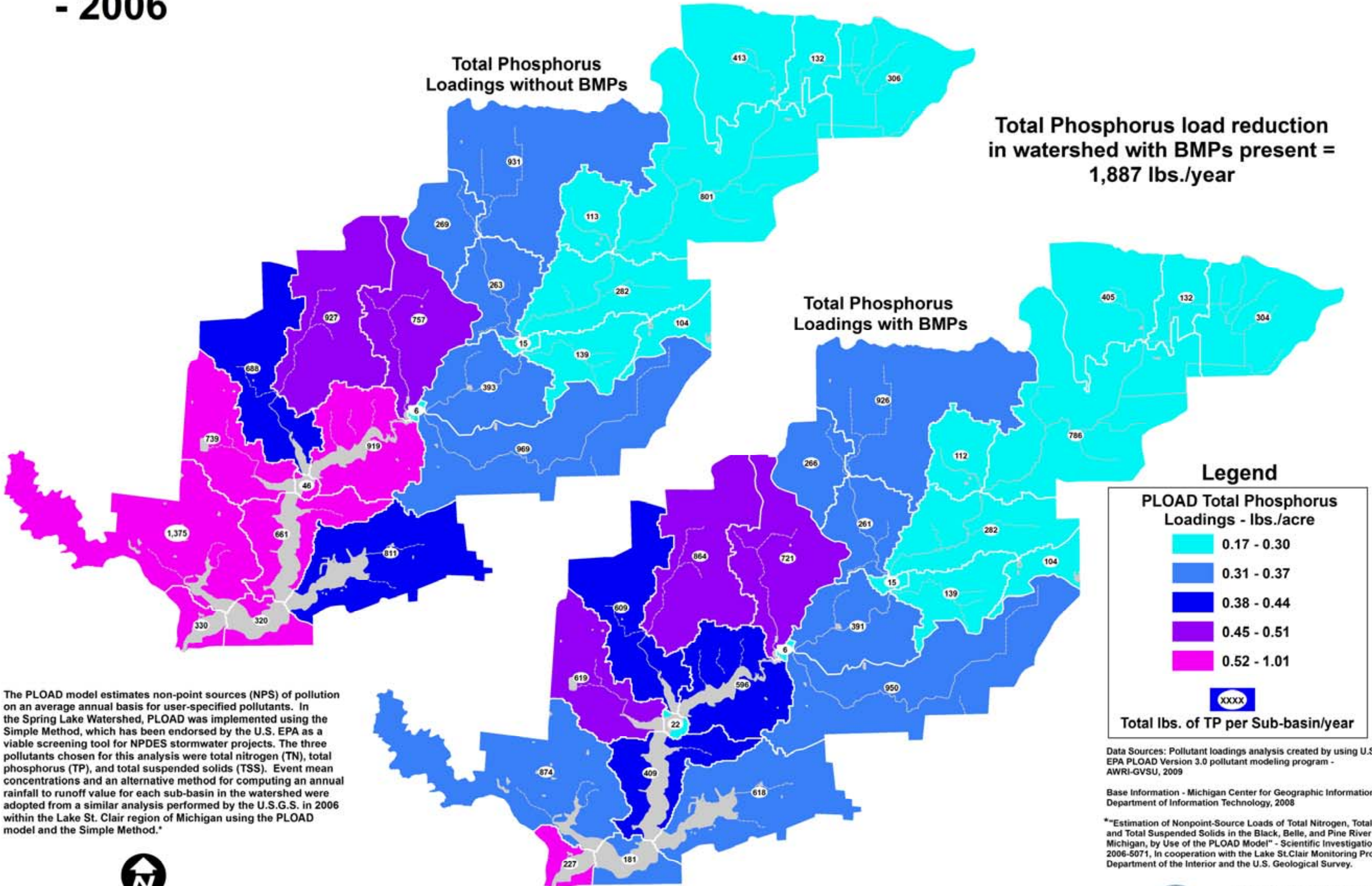
Base Information - Michigan Center for Geographic Information, Department of Information Technology, 2008

*"Estimation of Nonpoint-Source Loads of Total Nitrogen, Total Phosphorus, and Total Suspended Solids in the Black, Belle, and Pine River Basins, Michigan, by Use of the PLOAD Model" - Scientific Investigations Report 2006-5071, In cooperation with the Lake St.Clair Monitoring Project, U.S. Department of the Interior and the U.S. Geological Survey.

Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: August 2009

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



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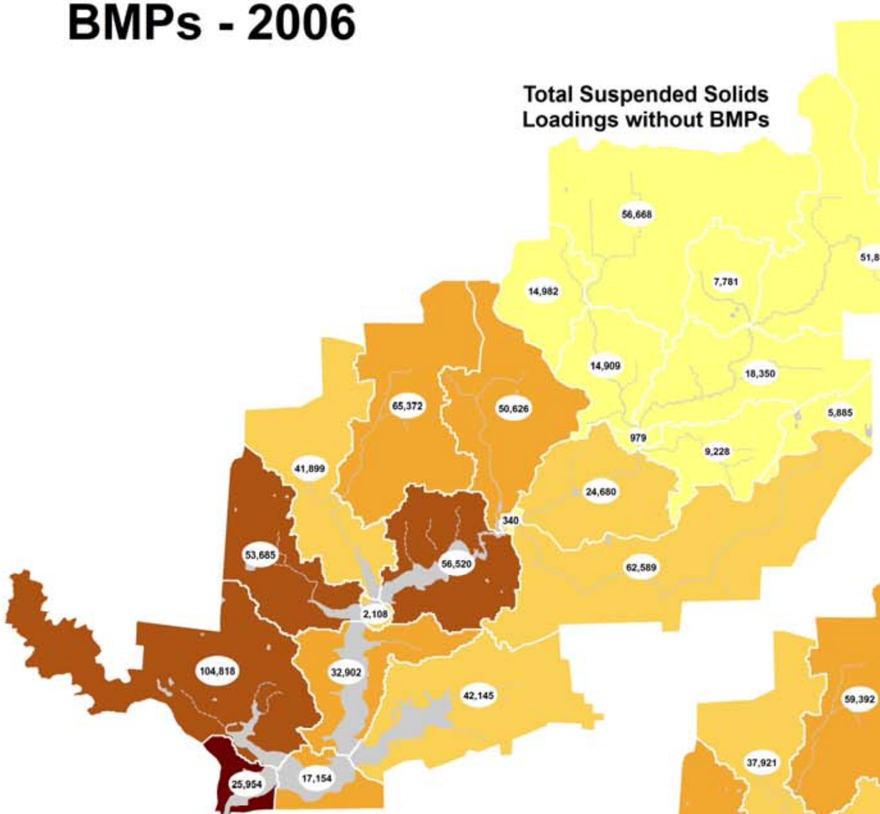
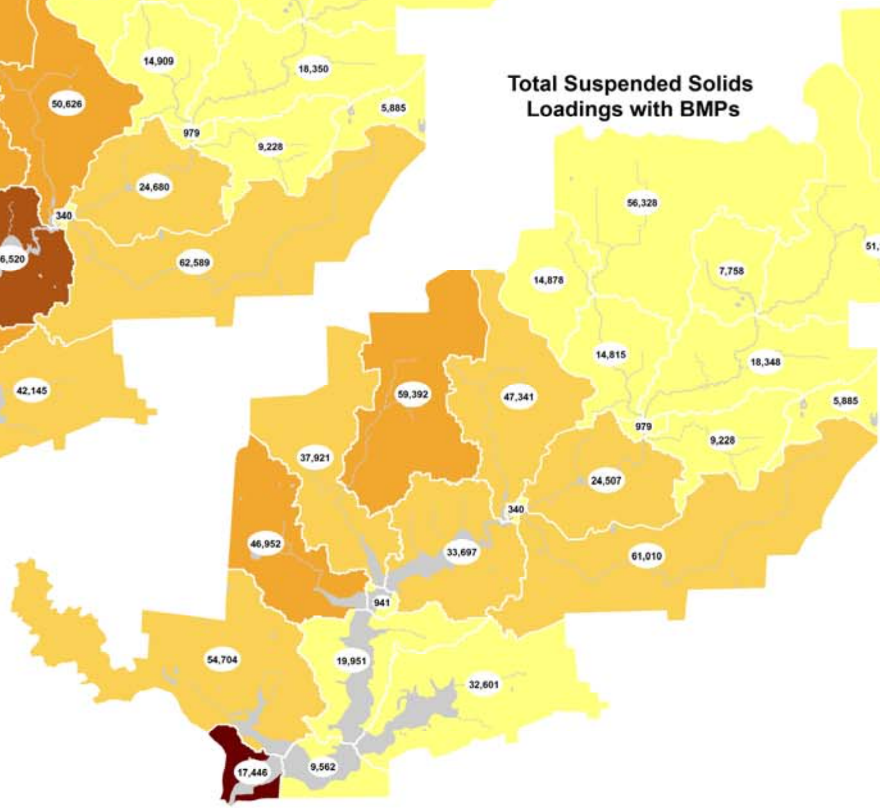
Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: August 2009

PLOAD Results for Total Suspended Solids Loadings with and without BMPs - 2006



Total Suspended Soilids load reduction in watershed with BMPs present = 136,113 lbs./year



Legend

PLOAD Total Suspended Solids Loadings - lbs./acre

- 10.55 - 19.78
- 19.79 - 29.79
- 29.80 - 39.80
- 39.81 - 49.81
- 49.82 - 79.14

XXXX — Total lbs. of TSS per Sub-basin/year

The PLOAD model estimates non-point sources (NPS) of pollution on an average annual basis for user-specified pollutants. In the Spring Lake Watershed, PLOAD was implemented using the Simple Method, which has been endorsed by the U.S. EPA as a viable screening tool for NPDES stormwater projects. The three pollutants chosen for this analysis were total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS). Event mean concentrations and an alternative method for computing an annual rainfall to runoff value for each sub-basin in the watershed were adopted from a similar analysis performed by the U.S.G.S. in 2006 within the Lake St. Clair region of Michigan using the PLOAD model and the Simple Method.*

0 0.5 1 2 3 4 Miles

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Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: August 2009

Non-Structural BMPs

- Ordinances
- Animal Waste Management
- Nonpoint Source and Stormwater Education
- Stormwater Utility Ordinance

Chapter 5:

Economic Analysis of Stormwater Management Alternatives

- Direct Costs
- Opportunity Costs and Benefits
- Cost Effectiveness
- Cost-Benefit Analysis

Table 5-5. Estimated BMP Costs per 1 Acre of Impervious Surface Area

BMP	Direct Initial Costs	Total Opportunity Costs	Annual Maintenance Costs
Bioretention/Rain Gardens	$21,500	$17,100	$250
Vegetated/Bio-Swale	$16,620	$20,500	$32
Green Roofs	$686,070	$442,765	$600
Pervious Pavement	$371,100	$340,400	$0
Constructed Wetlands	$22,500	$25,900	$32
Stormwater Retrofits	Highly variable. Depends on retrofit.		

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.

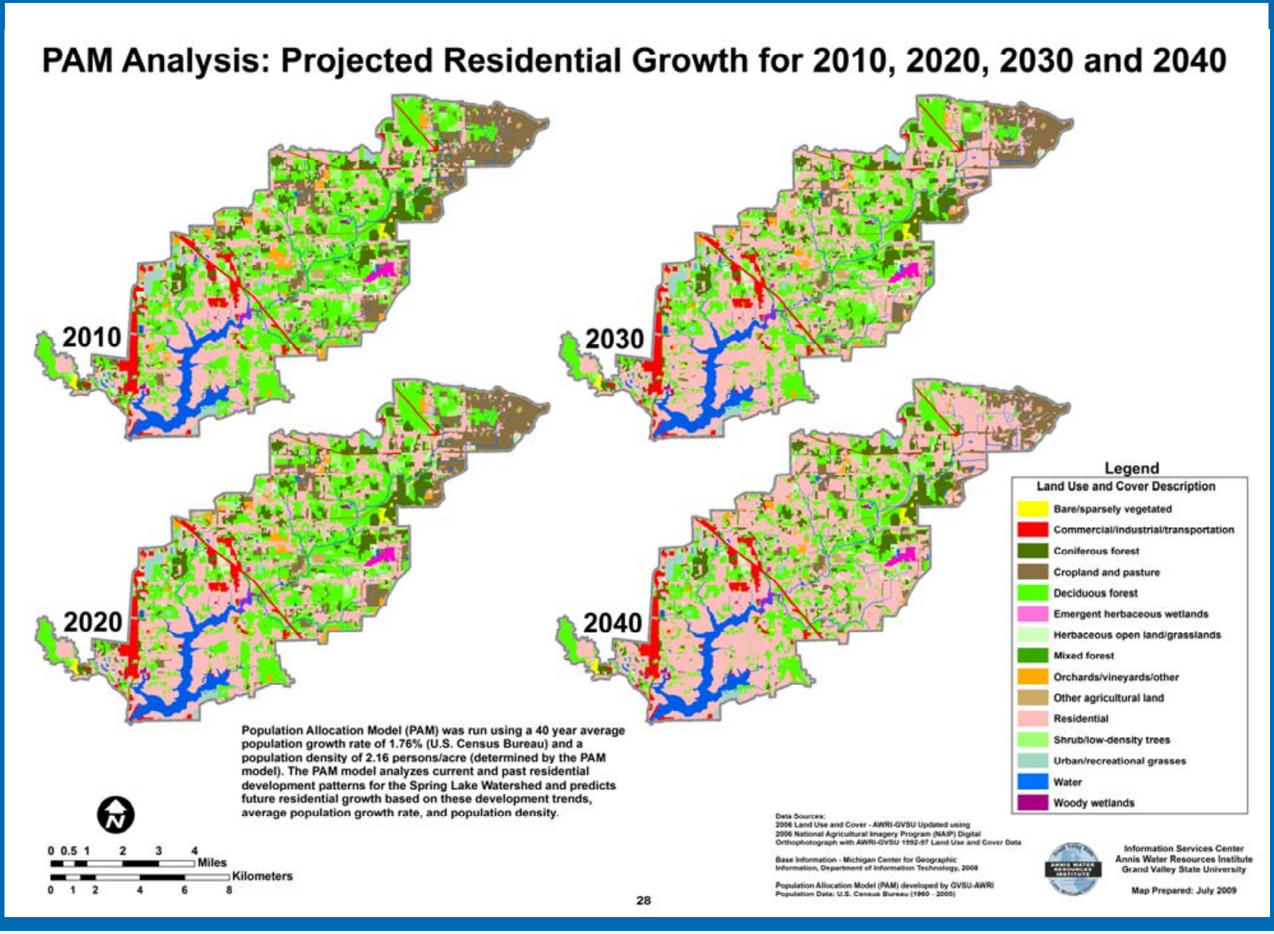
3 These costs were adjusted based upon the BMPs' ability to reduce pollutant loads (Table 5-4).

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.

Chapter 6:

Population Growth and Stormwater Pollution

- Potential Land Use Changes Resulting from Continued Population Growth
- Effects of Future Development on Pollutant Loads to Spring Lake

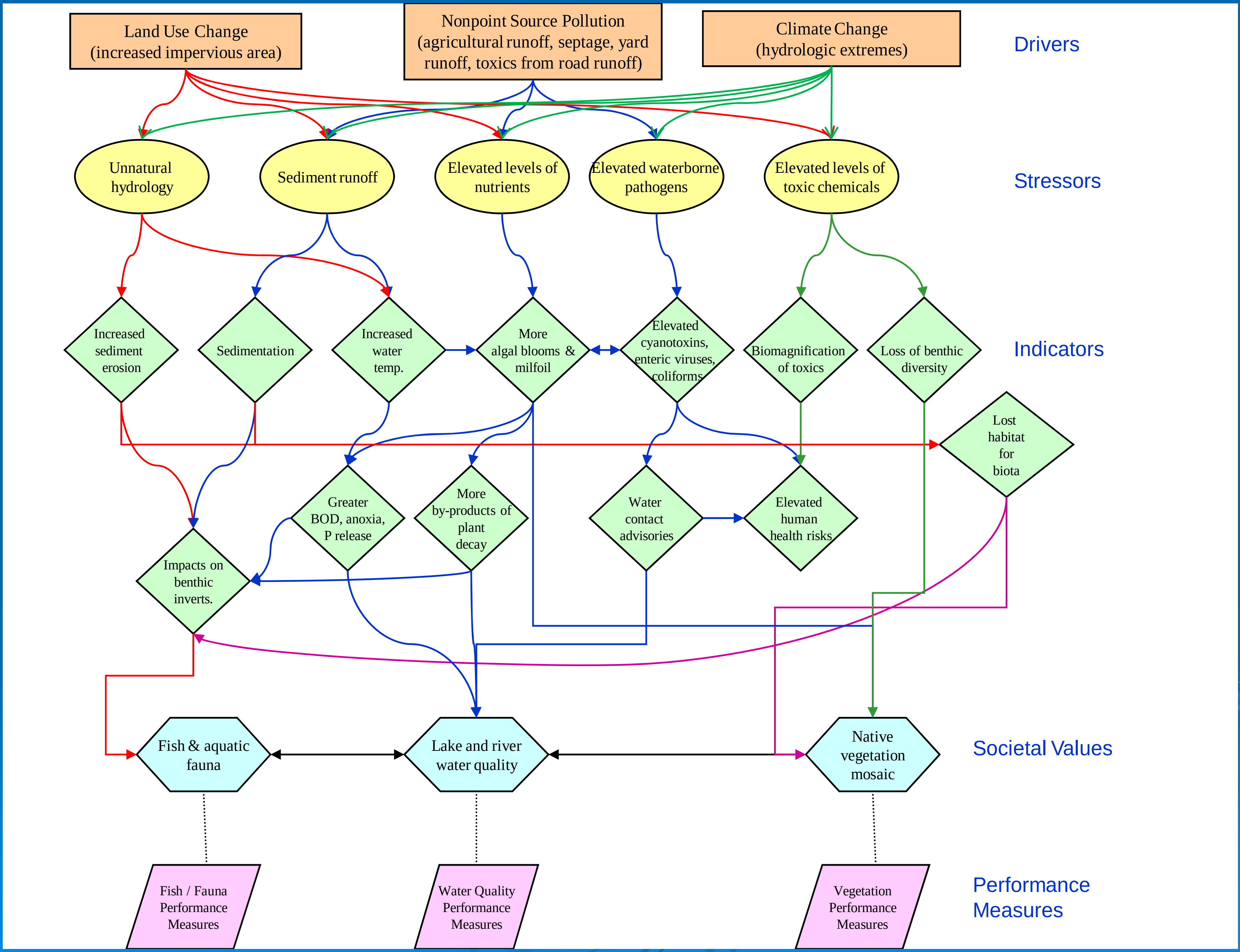


Year	Residential Land Use and Land Cover		Total Nitrogen (lbs/yr)	Total Phosphorus (lbs/yr)	Total Suspended Solids (lbs/yr)
	Acres	% of Watershed			
2010	10,532.06	31.14	68,268	13,456	851,146
2020	12,248.19	36.22	73,239	14,639	904,040
2030	14,415.62	42.62	79,524	16,113	971,524
2040	17,218.64	50.89	87,966	18,090	1,062,751
Change from 2010 - 2040:	**6,586.58**	**19.75**	**19,698**	**4,634**	**211,605**

Chapter 7:

Rein in the Runoff Products and Resultant Projects

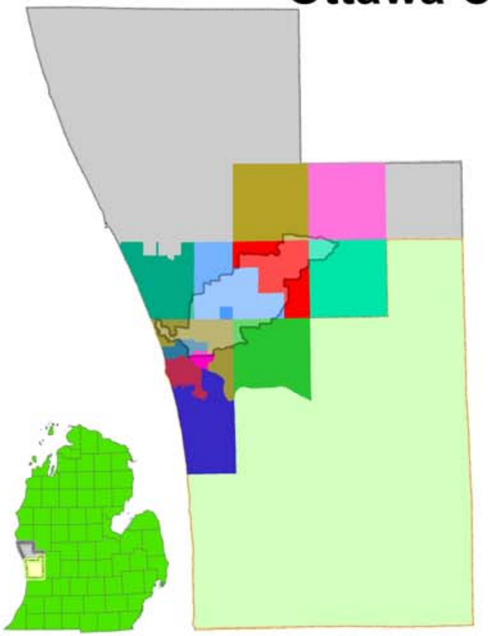
- Conceptual Model
- Spring Lake Watershed Atlas
- Spring Lake Shoreline Assessment
- Functional Wetlands Assessment
- Grant Resources
- Citizens Guide to Stormwater


Land Use Change (increased impervious area)
Nonpoint Source Pollution (agricultural runoff, septage, yard runoff, toxics from road runoff)
Climate Change (hydrologic extremes)
Drivers
Unnatural hydrology
Sediment runoff
Elevated levels of nutrients
Elevated waterborne pathogens
Elevated levels of toxic chemicals
Stressors
Increased sediment erosion
Sedimentation
Increased water temp.
More algal blooms & milfoil
Elevated cyanotoxins, enteric viruses, coliforms
Biomagnification of toxics
Loss of benthic diversity
Indicators
Lost habitat for biota
Greater BOD, anoxia, P release
More by-products of plant decay
Water contact advisories
Elevated human health risks
Impacts on benthic inverts.
Fish & aquatic fauna
Lake and river water quality
Native vegetation mosaic
Societal Values
Fish / Fauna Performance Measures
Water Quality Performance Measures
Vegetation Performance Measures
Performance Measures

Integrated Assessment of Stormwater Management Alternatives

Spring Lake Watershed

Ottawa County and Muskegon County, Project Atlas



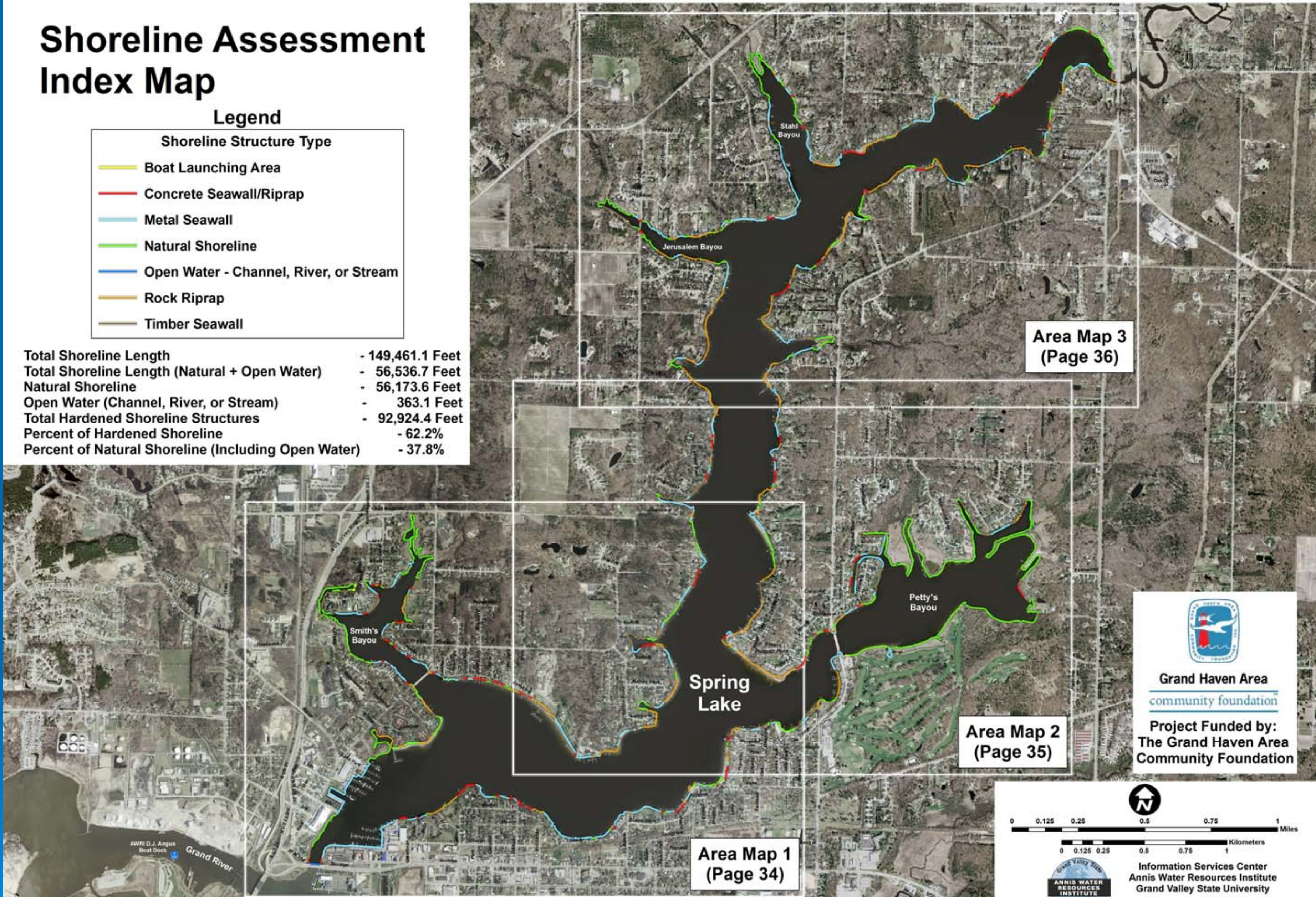
Rein in *the Runoff*

Project funded by: Sea Grant Michigan

Project Leader: GVSU - Annis Water Resources Institute

Project Partners: ECT Environmental Consulting & Technology, Inc.; Sea Grant Michigan; Seidman College of Business; Grand Valley State; Annis Water Resources Institute

Shoreline Assessment Index Map



Total Shoreline Length	- 149,461.1 Feet
Total Shoreline Length (Natural + Open Water)	- 56,536.7 Feet
Natural Shoreline	- 56,173.6 Feet
Open Water (Channel, River, or Stream)	- 363.1 Feet
Total Hardened Shoreline Structures	- 92,924.4 Feet
Percent of Hardened Shoreline	- 62.2%
Percent of Natural Shoreline (Including Open Water)	- 37.8%

Rein in the Runoff

Citizens Guide to Stormwater
January 2010

Rein in the Runoff was a project led by researchers at Grand Valley State University's Annis Water Resources Institute to identify social, economic, and environmental causes and consequences of stormwater runoff in Spring Lake, the Grand River, and ultimately, Lake Michigan.

This Integrated Assessment was funded by Michigan Sea Grant to examine the current conditions in the Spring Lake Watershed, and to apply current scientific standards to answer the policy question posed by local communities:

What stormwater management alternatives are available to the communities in the Spring Lake Watershed that allow for future development and also mitigate the effects of stormwater discharges and improve the water quality in Spring Lake, the Grand River, and ultimately, Lake Michigan?

Chapter 8:

Rein in the Runoff
Conclusions and Next Steps

Conclusions

- Growth and development is resulting in more impervious surfaces
- As rain runs off these surfaces, it carries pollutants to local waterways

Conclusions

- Pollutants cause illnesses, algae blooms, flooding and erosion; they can damage to fish habitat, plants, and wildlife
- There are real costs to your communities to address these problems
- Without intervention, this situation will only worsen

Guidance

- Vegetated/bio-swales and constructed wetlands are most effective
- Rain gardens have relatively low implementation costs; their smaller footprint makes them suitable where land isn't abundant
- Grow zones (e.g., waterfront buffers) are relatively inexpensive to implement and maintain

Guidance

- Green roofs and pervious pavement are more expensive to implement and should be evaluated on a site-by-site basis
- Rain barrels cost $25 – 200 in West Michigan and can reduce use and cost of household water

Guidance

- Tree plantings in new development can help reduce pollution, cool runoff temperatures, provide energy savings, and improve aesthetics
- Regional retention and treatment are worthwhile in densely developed areas

Guidance

- Publicly-owned properties present educational opportunities
- Ordinance changes, animal waste management programs, and stormwater utilities should be implemented throughout the watershed
- Continued stakeholder education is essential to any successful stormwater management program

Report Appendices

- Datasets and Hydrologic Models
- Project Flyers
- Presentation List
- Water Quality Surveys
- Citizens Guide to Stormwater
- BMP Review and Analysis
- Model Stormwater Ordinance and Performance Standards

Report Appendices

- Animal Waste Management Ordinances
- Stormwater Education and Outreach material links
- Stormwater Utility Ordinance Guidance
- Population Allocation Model (PAM)
- Watershed Atlas
- List of academic and technical publications and presentations

Questions??

Elaine Sterrett Isely

iselyel@gvsu.edu

(616) 331-8788

Alan D. Steinman

steinmaa@gvsu.edu

(616) 331-3749