Chapter 4: Stormwater Best Management Practices (BMPs)

Stormwater runoff is generally controlled through the implementation of various best management practices, or BMPs (Wu et al. 2006). BMPs are stormwater control measures that slow, retain, or absorb nonpoint source pollutants associated with runoff (Tsihrintzis and Hamid 1997; Chang et al. 2007). However, in the United States, the term “BMP” has come to mean any stormwater control measure, and not just the “best” ones (Roy et al. 2008). Better stormwater management practices include low impact development (LID), which incorporates the basic principle of managing stormwater where it lands by implementing design techniques that mimic presettlement hydrology (i.e., infiltration, filtration, storage, evaporation, and detention) (SEMCOG 2008). Particularly when LID strategies are widely applied at the watershed level, these practices can help achieve water quality improvement goals (Wu et al. 2006).

To help the Spring Lake Watershed stakeholders with the selection of appropriate BMPs to implement within their local communities and on individual properties, the Rein in the Runoff project team conducted a broad-scale analytical review of structural and non-structural BMPs that have been successfully implemented in other communities in Michigan and throughout the country. A summary of these BMP alternatives, and where they might be most successfully applied throughout the Spring Lake Watershed, is provided in this chapter. The technical details of the team’s methodology in selecting the BMPs described here are provided in Appendix F.

STRUCTURAL BMPS

Structural BMPs are constructed devices or structures such as detention ponds, created wetlands, or bioswales, that help manage stormwater by collecting and treating runoff (Jacob and Lopez 2009; Chang et al. 2007; Tsihrintzis and Hamid 1997). The Rein in the Runoff project team developed a table of common structural Low Impact Development (LID) BMPs that would be appropriate for implementation in the Spring Lake Watershed, based on the current land use and land cover, soils, general site conditions, and current and expected patterns of development. Table 4-1 provides summary descriptive information about 10 structural BMPs, including the best locations, benefits in addition to stormwater control, and local resources. This information is meant to assist the Spring Lake Watershed stakeholders in the selection of BMPs to help achieve water quality and stormwater management goals.

Table 4-1. Structural Best Management Practices (BMPs) Alternatives Appropriate for Implementation in the Spring Lake Watershed.

	Bioretention/Rain Gardens	Vegetated/Bio Swales	Grow Zones	Capture and Reuse (Rain Barrels/Cisterns)	Tree Planting	Green Roofs	Pervious Pavement	Infiltration Facilities	Constructed Wetlands	Stormwater Retrofits
Description	Shallow landscaped surface depressions designed to infiltrate or filter stormwater	Stormwater conveyance channel designed to filter or infiltrate stormwater	Native planting area	Storing and reusing stormwater	Increased tree cover	Rooftops partially or completely covered with vegetation	Pavements that allow for infiltration or stormwater	Facilities (above- or underground) that allow for infiltration of stormwater	Wetland constructed for the purpose of treating stormwater	Enhancements to an existing stormwater management system or site that provides improved stormwater treatment
Detail	• Shallow landscaped surface depressions • Recommend using deep-rooted native plants • Underdrain and mechanism to direct overflow runoff is necessary • Should be located at least 10 feet from any building	• Shallow stormwater channel that is densely planted with a variety of grasses, shrubs, or trees • Check dams can be used to improve performance and maximize infiltration, especially in steeper areas	• Upland or riparian native planting area	• Structures that capture stormwater for the purpose of reuse	• Tree canopy and forest cover has been shown to reduce stormwater runoff through interception and reduced surface runoff rates compared to un-wooded areas	• Rooftops that are partially or completely covered with vegetation and soil or a growing media planted over a waterproof membrane • Allows the roof to function more like a vegetated surface	• Pervious pavements, including concrete, asphalt, and pavers promote stormwater infiltration and groundwater recharge	• Dry wells, which generally consist of an open bottom chamber installed over a bed of coarse aggregate • Infiltration basins and trenches generally include a layer of coarse stone aggregate installed at or just below the surface • Subsurface infiltration beds consist of a stone storage bed installed below the ground surface	• Man-made wetland with over 50% of its surface area covered by wetland vegetation	• Structural practices such as updating detention basin to promote infiltration, filtration and habitat enhancement; installing catch basin inserts; proprietary stormwater quality enhancement structures; oil-water separators; and general updating of existing stormwater practices
Where Effective	• Residential and commercial areas • Parking lots (use curb cuts to direct stormwater runoff to depressed areas 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 • Other areas currently maintained as mowed lawn, but which are not 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	• Rain barrels are well-suited for residential lots • Cisterns and other large storages tanks are more appropriate for commercial or industrial sites • Captured water can be re-used for a variety of applications, including irrigation and grey water uses in buildings	• Areas where cooling impervious surfaces is a priority • Adjacent to water bodies and BMPs	• Green roofs are not common for residential homes • Schools, libraries, and commercial or industrial buildings are perfect candidates for installation • Flat roofs are preferred, but green roofs can be installed on pitched roofs when designed accordingly	• Parking lots • Walking paths • Sidewalks • Playgrounds • Plazas • Tennis courts • Parking lanes	• Must be located in areas of permeable soils • Dry wells may work well for residential applications and retrofits for existing catch basins • Infiltration trenches would be appropriate along roadways without curb and gutter • Consider large infiltration beds for regional stormwater management	• Ideal for large, regional tributary areas where volume control is needed	• Basins that directly discharge to waterbodies and do not have any form of pretreatment
Mechanisms of Pollutant Reduction	• Infiltration • Vegetative transpiration	• Filtration • Infiltration • Vegetative transpiration	• Infiltration • Vegetative transpiration	• Capture and reuse of stormwater greatly improves water quality through reduction in the amount of volume and pollution entering the waterway	• Interception (keeping rain water from becoming stormwater runoff) • Infiltration	• Vegetative transpiration	• Stormwater drains through the permeable surface where it is temporarily held in the voids of a stone bed or other storage reservoir and then slowly infiltrates into the underlying substrate (soil)	• Stormwater is temporarily stored within the voids of the stone bed and then slowly infiltrates into the underlying soil	• Infiltration • Vegetative transpiration	• Depends on retrofit
Other Benefits	• Provides enhancements to landscapes • Could fulfill landscaping requirements for site plan approval	• For new construction, swales are more cost effective than storm sewers for conveyance	• Reduced maintenance costs compared to turf grass	• Reduced use of potable water • Energy savings • Money savings	• Stormwater volume reduction • Improved air and water quality • Wildlife habitat • Enhanced aesthetics • Reduction to the heat island effect if trees shade paved surfaces	• Stormwater volume control • Reduced heating and cooling costs • Increased roof lifespan • Heat island reduction • Habitat enhancement • Green roofs can also be used as an educational tool and site-seeing attraction	• Reduced storm sewer costs for new construction	• Increases groundwater recharge	• Hydrological restoration benefits • Creation or restoration of valuable wetland habitat for wildlife and environmental enhancement	• Remove or treat stormwater pollutants • Minimize channel erosion • Help restore stream hydrology • May be more cost effective than new BMPs
Local Resources	Rain Gardens of West Michigan (Grand Rapids) (616) 451-3051 http://www.raingardens.org		Ottawa Conservation District (Grand Haven) (616) 846-8770 http://ottawacd.org	Rain Gardens of West Michigan (Grand Rapids) (616) 451-3051 http://www.raingardens.org	Ottawa Conservation District (Grand Haven) (616) 846-8770 http://ottawacd.org	LiveRoof, L.L.C., Subsidiary of Hortech, Inc. (Spring Lake) (616) 842-1392 http://www.liveroof.com Center for Sustainability at Aquinas College (Grand Rapids) (616) 632-1994 http://www.centerforsustainability.org	Permaloc Corporation (Holland) (800) 356-9660 http://www.permaloc.com Green Built Michigan (Lansing) (517) 646-2560 http://greenbuiltmichigan.org			

In addition to the identification of these specific BMPs for stakeholders to consider, the project team conducted a macro-scale BMP selection analysis (Figure 4-1; for more details see Appendix F), and identified several opportunities for the implementation of structural BMPs in the Spring Lake Watershed. BMP opportunities were classified into five categories, which are described in more detail below: infiltration BMPs, filtration BMPs, regional storage area, regional treatment area, and site specific BMPs. The team then honed in on two priority areas for reducing phosphorus loadings to Spring Lake: restoring riparian buffers and providing BMPs in areas of high pollutant loading, based on the PLOAD modeling results described in Chapter 2. These locations were identified and delineated on an orthophotographic map of the Spring Lake Watershed (Figure 4-2). Infiltrative BMPs are generally preferred because they provide a reduction in stormwater runoff volume and often provide improvements to water quality that are more significant than comparable filtrative BMPs (SEMCOG 2008).

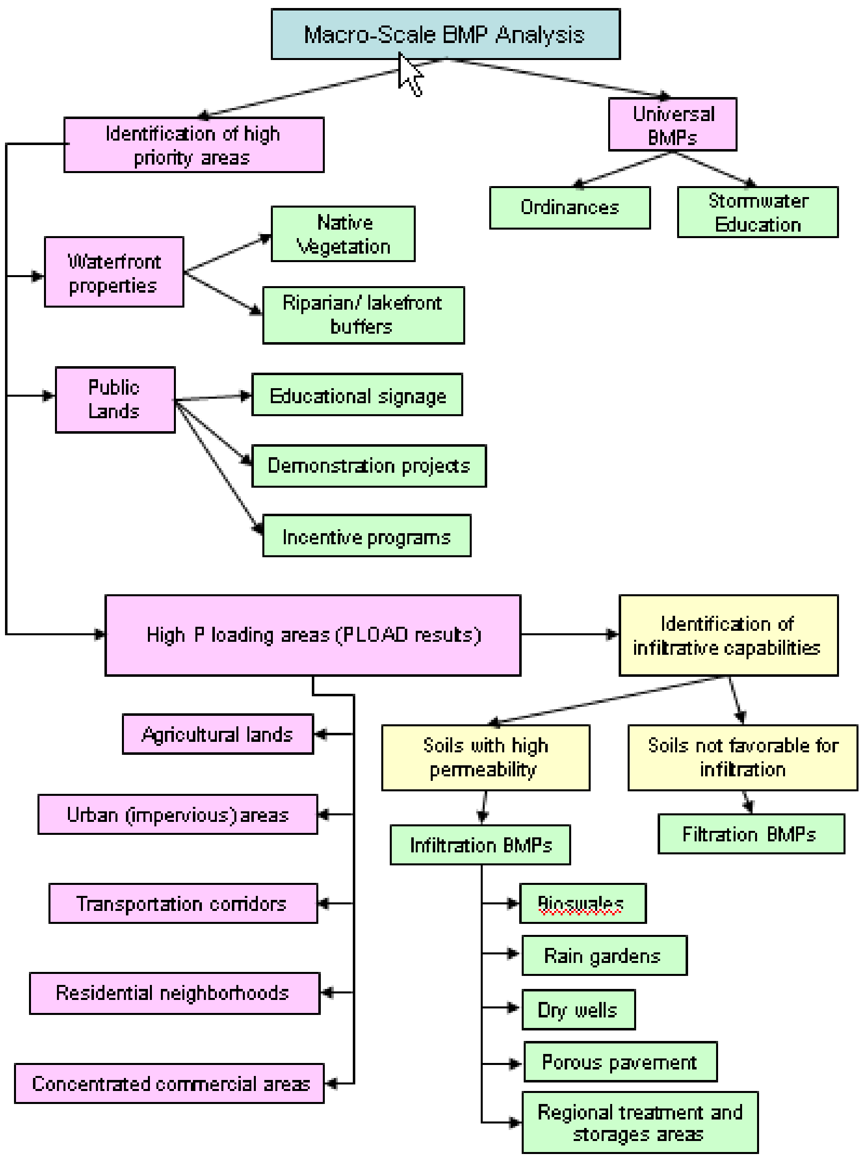

Figure 4-1. Rein in the Runoff macro-scale BMP selection analysis for the Spring Lake Watershed.

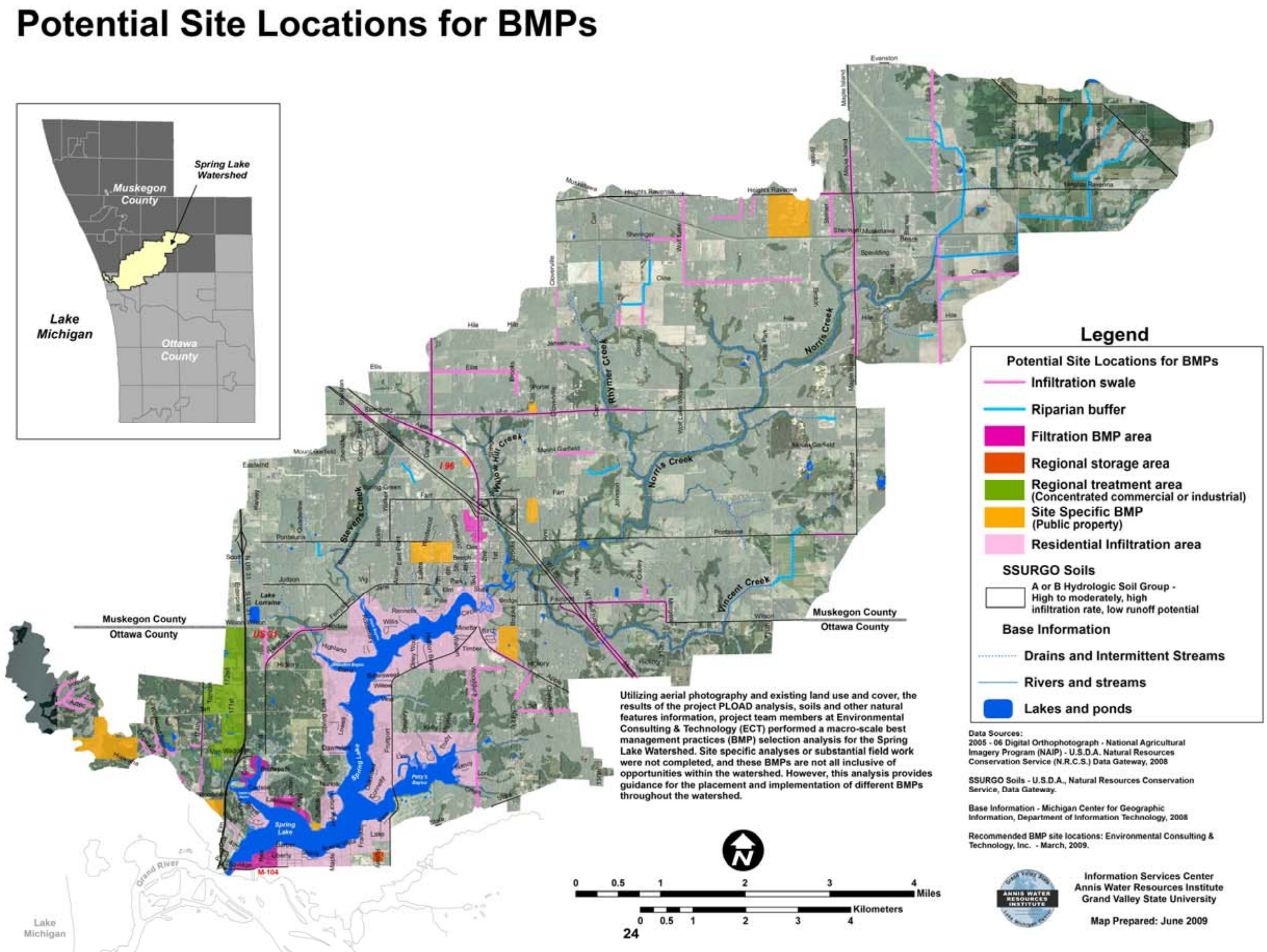

Figure 4-2. High priority areas for implementation of Low Impact Development (LID) BMPs in the Spring Lake Watershed.

Infiltration BMPs

Located in areas of high-permeability soil, infiltration BMPs reduce stormwater runoff volume and improve water quality by promoting infiltration of stormwater. Shallow vegetated swales or steeper swales with check dams are suitable for installation along roadways, while rain gardens are suitable for installation in residential neighborhoods, parks, schools, and other small sites.

Infiltration swales are ideally used along transportation corridors and in road rights-of-way. Where existing open channels or swales (rather than storm sewers) convey runoff, the existing swales are very easily modified to provide infiltration with installation of check dams. Where sufficient road rights-of-way exist, infiltrative swales can be installed along roads with existing curb and gutter. Curb cuts can be used to direct low flows into newly constructed infiltrative swales. High flows can be directed to the swales or allowed to overflow into the existing storm sewer. For smaller roads with existing curb and gutter, catch basins can be replaced with dry wells to promote infiltration for some of the runoff. For residential areas with well-draining soils, infiltration BMPs, including infiltration swales and rain gardens, can be installed in a development-wide fashion.

Rain gardens are one type of infiltration BMP that are ideally installed in residential neighborhoods, parks, and schools, because these BMPs can be designed to accept drainage from multiple properties. Costs will vary based on the plants and subsurface material used. In areas of well-draining soils, engineered underdrain systems are not required, thus reducing costs. However, sites with existing soil contamination, or sites with very high infiltration rates, may need additional treatment or other design provisions before implementation of these types of infiltration BMPs. This would increase costs and may make this option infeasible or inadvisable.

Filtration BMPs

Located in areas of low-permeability soil, filtration BMPs utilize vegetation or soil media to remove sediment and nutrients from stormwater. These BMPs can include planting media and sand layers and an underdrain to improve filtration, or may simply rely on the filtration capabilities of native plants. Vegetated swales and bioswales are suitable for installation along roadways and smaller bioretention basins, and they are suitable for installation in residential neighborhoods, parks, schools, or other small sites.

One critical priority area for implementation of filtrative BMPs in the Spring Lake Watershed includes the streets that terminate at, or very near to, the shoreline. During the limited site visits to the watershed, the project team noticed many dead-end streets which convey untreated stormwater runoff into Spring Lake or the Grand River. Specifically, properties in very close proximity or immediately adjacent to Spring Lake are critical to the nutrient levels within Spring Lake. Where soil conditions are not favorable for infiltration, filtrative BMPs should be applied. Some examples of filtrative BMPs include: bioretention/rain gardens, porous pavement with underdrains, vegetated/bio-swales, and detention/sediment basins.

Regional Storage Areas

In densely developed areas, it may not be feasible to install BMPs for each site. Because these areas often generate high pollutant loads and nutrients to local waterbodies, it might be worthwhile to provide one or more BMP(s) to store stormwater on a regional basis. Regional storage BMPs are generally constructed for the retention of water and stormwater runoff (e.g., retention basins).

Regional Treatment Areas

In urbanized areas, existing concentrated commercial and industrial areas contribute high amounts of nutrients to local waterbodies. Installation of BMPs on existing, developed sites often requires removal of pavement, extensive re-grading, removal or replacement of stormwater conveyance facilities, or other site changes, which can make such retrofits cost prohibitive. Similar to regional storage areas, provisions for more BMPs to treat stormwater on a regional basis would be appropriate. Depending on soil conditions, the regional treatment BMPs can be infiltration basins or sedimentation/filtration basins. Mechanical treatment structures can also provide treatment in areas where available land is limited.

Site-Specific BMPs

Publicly-owned properties present opportunities for BMP installation without complicated land ownership concerns. Of particular concern for improving water quality are sites with high pollutant loadings, including departments of public works or public safety storage facilities and material storage yards. Communities may want to focus on providing treatment for runoff from their own properties, which can also provide opportunities for educational demonstrations and signage.

Effects of Implementing Wide-Spread Structural BMPs

To help demonstrate to stakeholders that there are potential environmental benefits to the implementation of widespread, structural BMPs throughout the Spring Lake Watershed, the Rein in the Runoff project team converted the 2006 land use and cover associated with these BMPs to comparable classifications (see Appendix F), and, using PLOAD (see Appendix A), modeled the effects of this “land use and cover change” on nutrient loads to Spring Lake. These results (Table 4-2) showed that the introduction of these proposed widespread structural LID BMPs throughout the Spring Lake Watershed resulted in a reduction of the overall pollutant loads for Total Nitrogen (TN), Total Phosphorus (TP), and Total Suspended Solids (TSS), particularly from the areas proximate to Spring Lake (Figures 4-3, 4-4, and 4-5).

Table 4-2. PLOAD Results With and Without BMPs for TN, TP, and TSS in the Spring Lake Watershed for 2006 Land Use and Land Cover.

ArcSWAT Sub-Basin	Sub-Basin Acreage	Total Nitrogen (TN) (lbs/yr)		Total Phosphorus (TP) (lbs/yr)		Total Suspended Solids (TSS) (lbs/yr)	
		Without BMPs	With BMPs	Without BMPs	With BMPs	Without BMPs	With BMPs
1-1	642.4	577	574	113	112	7,782	7,758
1-2	78.4	82	82	15	15	979	979
1-3	824.0	698	698	139	139	9,228	9,228
1-4	537.5	693	693	132	132	8,223	8,223
1-5	1,499.1	2,115	2,081	413	405	28,429	28,084
1-6	2,957.9	4,614	4,594	931	926	56,668	56,328
1-7	1,653.3	1,823	1,810	306	304	20,240	20,169
1-8	1,446.4	1,432	1,432	282	282	18,350	18,348
2-1	1,416.9	4,615	3,068	919	596	56,520	33,697
2-2	74.8	267	164	46	22	2,108	941
2-3	1,104.3	3,448	2,342	661	409	32,902	19,951
2-4	494.1	1,812	1,191	320	181	17,154	9,562
2-5	334.2	1,854	1,327	330	227	25,954	17,446
2-6	1,252.1	3,819	3,278	739	619	53,684	46,952
2-7	2,579.9	7,212	4,461	1,375	874	104,818	54,704
1-9	3,399.8	4,144	4,072	801	786	51,817	51,111
2-8	1,958.9	4,054	3,221	811	618	42,145	32,601
2-9	1,961.5	4,704	4,361	927	927	65,372	59,392
2-10	1,615.2	3,408	3,061	688	609	41,899	37,921
1-10	397.0	550	550	104	104	5,885	5,885
2-11	32.2	28	28	6	6	340	340
1-11	779.6	1,295	1,283	269	226	14,982	14,878
1-12	856.8	1,279	1,269	263	261	14,909	14,815
2-12	1,610.4	3,783	3,590	757	721	50,626	47,341
2-13	3,081.8	4,905	4,803	969	950	62,589	61,010
1-13	1,230.6	1,939	1,929	393	391	24,680	24,507
Watershed Totals:	**33,818.8**	**65,150**	**55,963**	**12,706**	**10,819**	**818,284**	**682,171**

The application of these BMPs to the 2006 land use and land cover data layer, targeting the highest priority areas identified by the project team for the Spring Lake Watershed, decreased Total Nitrogen (TN) by 14%, Total Phosphorus (TP) by 15%, and Total Suspended Solids (TSS) by 17%. These results are watershed-wide; not all sub-basins saw reductions in these pollutant loads. The implementation of additional BMPs, or alternatively, a cooperative, regional approach to improving the water quality in Spring Lake, its tributary streams, the Grand River, and Lake Michigan would provide the best results.

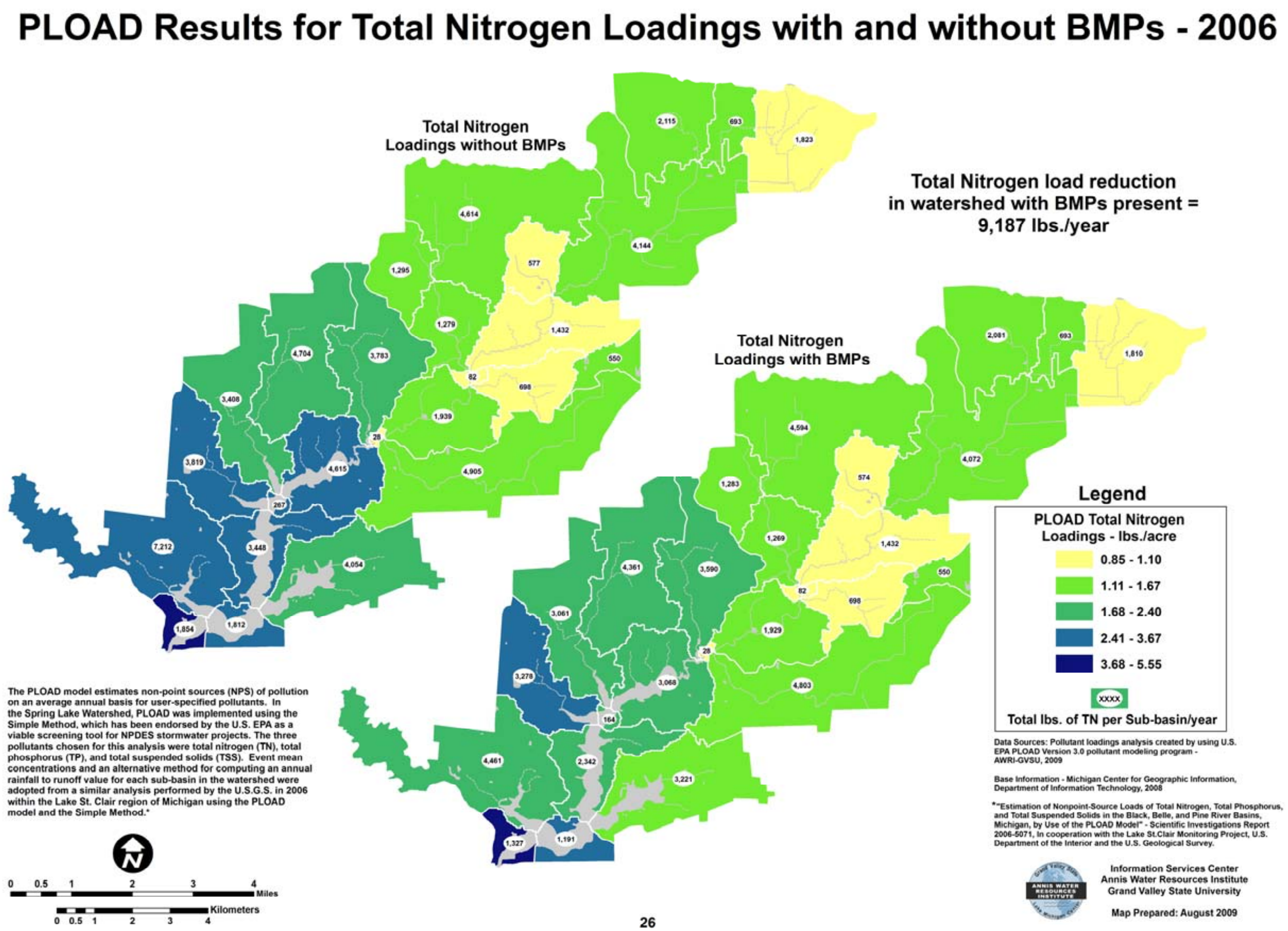

Figure 4-3. PLOAD Results with and without BMPs for Total Nitrogen mapped to the ArcSWAT sub-basins for the Spring Lake Watershed's 2006 land use and land cover.

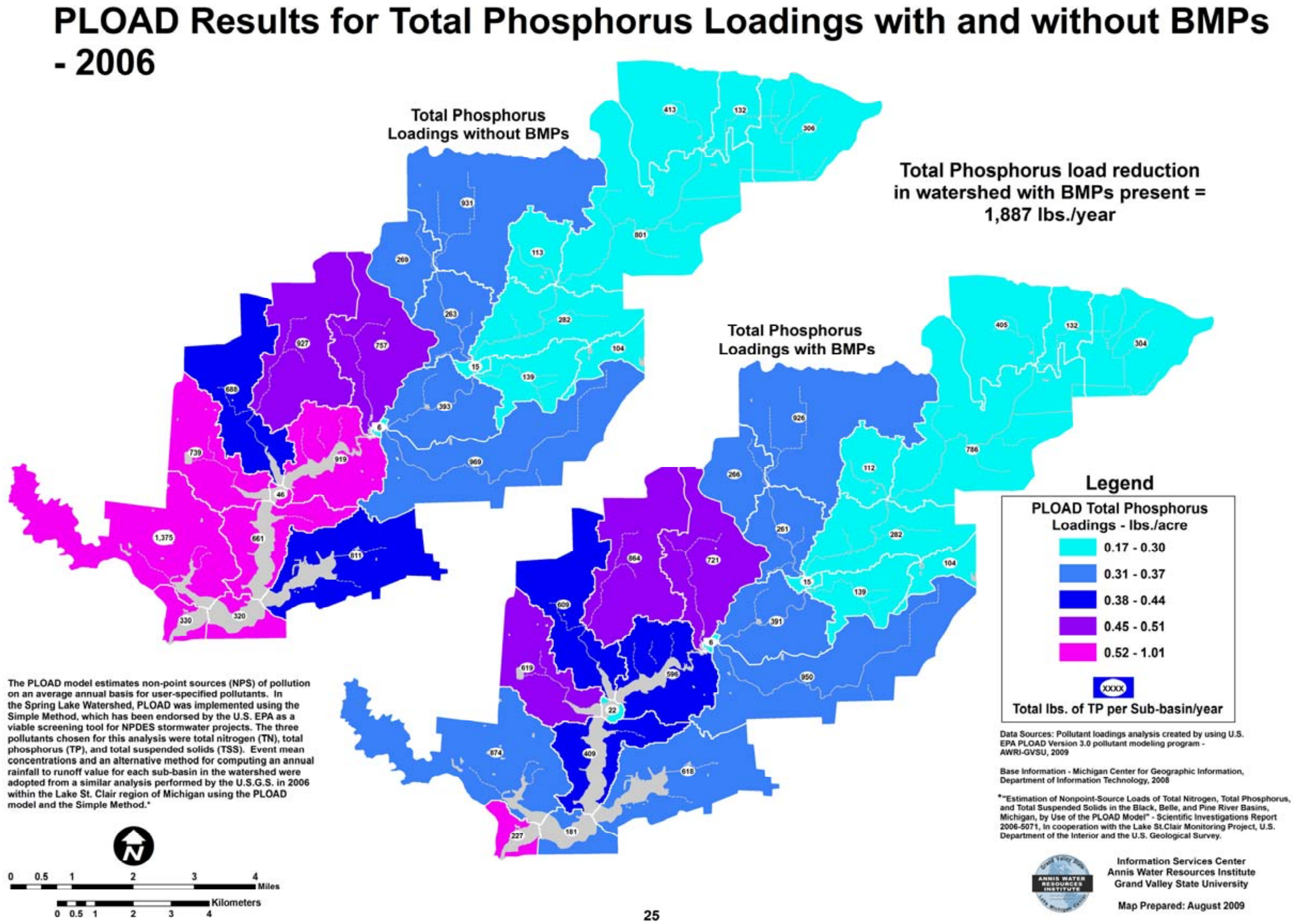

Figure 4-4. PLOAD results with and without BMPs for Total Phosphorus mapped to the ArcSWAT sub-basins for the Spring Lake Watershed's 2006 land use and land cover.

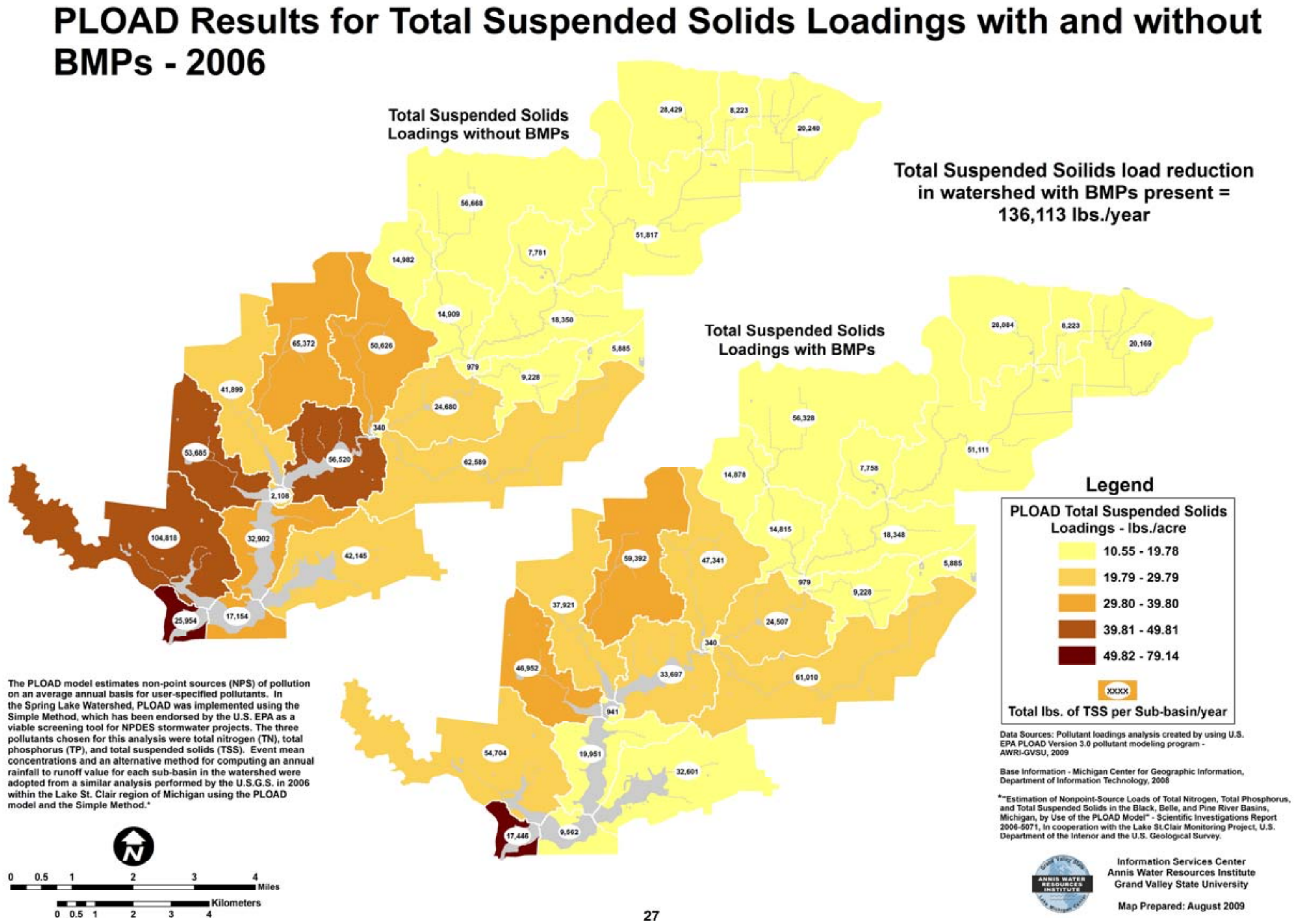

Figure 4-5. PLOAD Results with and without BMPs for Total Suspended Solids mapped to the ArcSWAT sub-basins for the Spring Lake Watershed's 2006 land use and land cover.

NONSTRUCTURAL BMPs

Nonstructural BMPs are regulatory, educational, or on-site "good housekeeping" practices that help manage stormwater runoff (Jacob and Lopez 2009; Chang et al. 2007; Tsihrintzis and Hamid 1997). Nonstructural BMPs can be appropriate independent of a geographic location within a watershed, soil type, or land use and land cover type. Table 4-3 provides summary descriptive information for four types of nonstructural BMPs, including examples of each and where these BMPs would be most effective. Where not already in place, these types of BMPs should be encouraged for implementation throughout the Spring Lake Watershed. Additional, more-detailed guidance regarding the implementation of these types of nonstructural BMPs concludes this chapter.

Ordinances

The Rein in the Runoff project team reviewed general, zoning, and special ordinances for the 15 municipalities in and downstream of the Spring Lake Watershed[1] to determine the extent that these local communities were trying to address stormwater control or management. Particular ordinances or ordinance provisions were extracted for more detailed review, including those pertaining to stormwater, LID, illicit discharges and connections, fertilizer, animal waste, flood prevention, wetlands, watercourses and natural resources, trees and woodlands, native vegetation, and stormwater utilities. These local ordinances were then compared with the general state and federal statutory requirements pertaining to stormwater management, including the Michigan Natural Resources and Environmental Protection Act (Michigan Compiled Laws, Section 324.101 et seq.), the Michigan Right to Farm Act (Michigan Compiled Laws, Section 286.471 et seq.), and the federal Clean Water Act.

In Michigan, local municipalities have general legislative authority to regulate stormwater runoff and nonpoint source pollution under the Michigan Natural Resources Environmental Protection Act (Public Act 451 of 1994, Michigan Compiled Laws 324.101 et seq.) and the Michigan Drain Code (Public Act 40 of 1956, Michigan Compiled Laws 280.1 et seq.). In the Spring Lake Watershed, the majority of the local jurisdictions have ordinances or ordinance provisions that somehow address stormwater management, or at least the control of polluted stormwater runoff (Table 4-4). Some municipalities have detailed, stand-alone ordinances that address stormwater management, fertilizer application, wetland protection, riparian or littoral buffers, or flood prevention. Others have only general requirements for the implementation of management practices that help protect against such stormwater-related problems as flooding, or the accidental discharge of prohibited materials or wastes into local

[1] Some of the local ordinances reviewed by the project team may have been incomplete or not fully up-to-date. A few of the online ordinance resources were missing code sections or the text differed slightly from the printed versions, which is not uncommon for state and local level regulations (Stevens and Edwards 2009). In one case, the official printed ordinance book had not been properly maintained over the years, and the project team had to review that municipality's historical legal files at its attorney's office.

drainage systems or waterbodies. Depending on the local municipalities' goals and overall ordinance structure, both of these approaches can be appropriate, although implementation and enforcement will be easier and more defensible with consistent and clear rules and standards.

Table 4-3. Nonstructural Best Management Practices (BMPs) Alternatives for Potential Implementation in the Spring Lake Watershed.

	Ordinances	Animal Waste Management	Nonpoint Source and Stormwater Education	Stormwater Utility Fee
Description	Local ordinances can be updated to control stormwater discharges directly, to increase or maintain green space or natural features, or to limit impervious surfaces.	Animal waste in urbanized watersheds can come from wildlife (e.g., raccoons, geese, and deer); domestic cats and dogs; and agricultural animals. Geese and dogs contribute a large portion of bacterial contamination to urban watersheds, especially from areas near lakes and detention ponds.	Nonpoint source education is a broad BMP that can help control pollution sources from homeowners, municipalities, riparian landowners, land and home associations, commercial lawn care businesses, and local businesses and institutions.	Property owners pay a stormwater utility fee based on the amount of stormwater runoff generated from their property, based on the total impervious surface area. Property owners must be given an opportunity to reduce the utility fee they pay, generally through the implementation of structural BMPs that reduce stormwater runoff volumes.
Examples	• Stormwater ordinances can be implemented or updated to require pretreatment and implementation of low impact development (LID) practices • Wetland, woodland, riparian buffers, or other natural features ordinances can be implemented or updated to provide protection for these local resources • Landscaping ordinances can be updated to encourage plantings with native vegetation or to regulate the use of phosphorus-based fertilizers • Zoning ordinances can be updated to allow for cluster developments, reduced setbacks, reduced parking and road widths, and other LID techniques	• Pet waste ordinances can be implemented or updated to require dog owners to pick up after their pets in all public and private property • Providing dog waste stations on public property • Requiring vegetative barriers around stormwater BMPs, lakefront areas and tributary streams • Ordinances prohibiting feeding of geese can be implemented • Making available educational signs or pamphlets	• The Rein in the Runoff project report, stakeholders guide, and watershed matrix will be available at the Spring Lake Library • The Rein in the Runoff project website will be maintained and will have links to other websites and resources • Municipalities can continue to host educational sessions, publish newsletter articles, and promote LID-BMPs through examples on public property	• Stormwater utility ordinances in Michigan must be based on user fees, and cannot be in the form of a local tax (Bolt v Lansing, 459 Mich. 152; 587 N.W. 2d 264 (1998)).
Where Effective	These non-structural BMPs are most effective in local communities with adequate enforcement mechanisms.		These BMPs are most effective in communities that make resources available for ongoing, long-term educational programs.	Communities with publicly-owned and maintained storm sewer infrastructure

Table 4-4. Current Spring Lake Watershed Local Ordinances that Address Stormwater Management.

Ordinance Provision	Ottawa County	Muskegon County[1]	Village of Spring Lake	Village of Fruitport	City of Ferrysburg	City of Grand Haven	City of Norton Shores	Egelston Township	Fruitport Township[2]	Moorland Township	Ravenna Township	Sullivan Township	Crockery Township	Grand Haven Township	Spring Lake Township
Stormwater	✓		✓	✓	✓	✓		✓		✓	✓	✓		✓	✓
Low Impact Development (BMPs)	✓							✓				✓		✓	✓
Illicit Discharge/Illicit Connections			✓	✓		✓	✓	✓							✓
Fertilizer	✓	✓	✓		✓										✓
Animal Waste			✓		✓	✓	✓							✓	✓
Flood Prevention	✓		✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
Wetlands			✓			✓									✓
Watercourse/Natural Resource Setback			✓			✓	✓	✓		✓	✓		✓		✓
Tree/Woodland Protection															✓
Native Vegetation					✓										✓
Stormwater Utility															

1 The Muskegon County Drain Commissioner is currently developing written standards for stormwater retention and detention.

2 One of the goals in Fruitport Township's Master Plan (2002 – 2022) is to increase shoreline setbacks to retain natural features and to provide for vegetative filtration instead of manicured lawns that can contribute fertilizer runoff directly into local waterbodies.

In addition to this local ordinance review, the project team collected model ordinances, including the Michigan Low Impact Development model stormwater ordinance (SEMCOG 2008) and stormwater and stormwater utility ordinances from around the state, and from other communities in the United States and Canada. Utilizing a combination of these resources and stakeholder input, the team developed model ordinances, sample ordinance provisions, and stormwater performance standards targeting the local conditions in the Spring Lake Watershed. An initial draft stormwater ordinance was presented to representatives for Spring Lake Township, the City of Ferrysburg, the Village of Spring Lake, and Ottawa County for review and comment in the Spring of 2009. This model ordinance was modified based on the input and feedback from these representatives, and draft performance standards were proposed as a stand-alone document (Appendix G). Because of the different ordinance structures that existed throughout the watershed, any ordinance or ordinance provision considered for implementation should be reviewed by that municipality's attorney.

Despite the existence of ordinances geared toward stormwater management or environmental protection, many traditional zoning ordinance provisions – low density development; large lot, frontage, or front yard setbacks; curb and gutter requirements; street, sidewalk, and driveway width and composition specifications; and requirements for subdivision-wide detention basins – are still in place throughout the Spring Lake Watershed that not only inhibit the implementation of Low Impact Development (LID) and other stormwater BMPs, but also exacerbate other stormwater runoff problems. For example, subdivision-wide detention basins and traditional curb and gutter requirements are designed to convey and detain stormwater to prevent localized and downstream flooding with limited consideration for controlling the total volume of, and pollutants within, stormwater runoff. LID source-control techniques such as rain gardens or bioinfiltration swales are generally inconsistent with these types of design standards and present challenges to builders asked to incorporate LID design techniques (Roy et al. 2008). In addition, residential driveways and sidewalks constitute one third of an average parcel’s impervious area, which is a significant source of stormwater runoff from a region. Allowances need to be made for alterative (i.e., LID) design components for these types of features, including installation of curb cuts or driveway runners (two strips of pavement instead of an entirely paved driveway surface), reduced road and sidewalk widths, BMPs that allow temporary ponding of water, and the use of permeable paving materials for driveways and sidewalks (Stone and Bullen 2006).

Additionally, many of the local zoning ordinances throughout the Spring Lake Watershed focus on low density residential development for much of the watershed land area. As an alternative, high density development – generally characterized by smaller lot sizes – should be considered. This type of development has been shown to reduce pollutant loads and runoff volume, although higher density development over an entire watershed area will result in greater total pollutant loads than lower density development over the same region (Stone and Bullen 2006; Jacob and Lopez 2009). In Madison (WI), it has been shown that a 25% reduction in standard residential lot size – particularly reduced frontage, front yard setbacks, and street widths – when combined with the use of porous pavement materials, minimizes the overall impervious surfaces which can reduce development-induced stormwater volumes by over 30% for the average residential parcel – and potentially more for larger, low density parcels (Stone and Bullen 2006).

Higher density development could fit into the existing regulatory stormwater framework under the rubric of “alternative site design” (Jacob and Lopez 2009). For example, the City of Grand Rapids (MI) is one of the first communities in the country to grant stormwater management waivers for higher density development (Lemoine 2007). If a high density development project can demonstrate a reduction of at least 80% in the “equivalent impervious area” for the same development at low density, then a waiver is granted for stormwater management features (detention). Currently the waiver is granted only for infill and not for greenfield development, and it does not take into consideration improvements to water quality (Jacob and Lopez 2009).

Animal Waste Management

Urban animal waste ordinances currently in effect in the Spring Lake Watershed come in many different forms. Some simply require that an animal custodian or caretaker immediately remove animal excrement deposited on any public or private property. Others identify specific domesticated animals (cats, dogs, or horses), and others specify removal only from public sidewalks or paths. Some ordinances make it illegal to appear on public or private land with an animal without the proper means of removing its waste. More complete ordinances require both immediate removal and having the appropriate means to do so; additionally, these ordinances make violation of the ordinance a civil infraction and specify the municipal officials who have enforcement authority.

None of the municipalities in the Spring Lake Watershed have an ordinance or management plan that addresses geese or waterfowl pollution. Geese and other migratory waterfowl are attracted to manicured and fertilized lawns, landscaped ponds and reservoirs, and food handouts from people (U.S. Department of Agriculture 2003). These waterfowl will congregate near lakes, ponds, detention basins, and other bodies of water, and they can contribute a large portion of bacterial and nutrient contamination to these waterbodies. In the Spring Lake Watershed, waterfowl contributions of phosphorus are low (16 kg/year) (Lauber 1999), but that does not diminish the importance of controlling local populations. One regulatory solution to this problem is the local enactment and enforcement of a municipal ordinance that prohibits the feeding of wild and domestic ducks and geese. Alternatively, ordinances encouraging the planting or maintenance of native shoreline vegetation, instead of manicured lawns or park-areas, would also inhibit the numbers of geese and waterfowl from congregating in such an area. In communities with waterfowl problems, this is a necessary first step to controlling and reducing environmental damage (U.S. Department of Agriculture 2003).

Sample animal excrement and waterfowl ordinances are included in Appendix H.

Nonpoint Source and Stormwater Education

The issues related to stormwater runoff, control, and management are complex, and despite even the more visible effects of stormwater pollution, many local officials and members of the general public do not fully understand the impacts of, or the need to manage, stormwater runoff. During the Rein in the Runoff project, even repeated educational sessions and participation in community events led to only a limited understanding regarding these issues for most stakeholders. Accordingly, local understanding and behavior change will require ongoing, long-term educational efforts to stakeholders of all ages throughout the Spring Lake Watershed.

Educational efforts can be targeted at three broad groups of stakeholders: municipal regulators and decision-makers; landowners and residents; and youth educators and students. At the municipal level, it should be recognized that water resources are often managed across local departments; e.g., municipal water, stormwater, surface water (Niemczynowicz 1999). Stormwater and nonpoint source pollution, in particular, are also managed across different jurisdictional levels: local, county, state, and federal (Roy et al. 2008). Each manager may understand only his or her role in these complex environmental and regulatory processes. Ongoing educational workshops and appropriate guidance documents regarding all issues related to stormwater management and control, including changes and advancements in Low Impact Development and stormwater BMPs, would help integrate overall management of water resources, generate increased support from managers to push legal mandates (Roy et al. 2008), and contribute to better stewardship and management at the local government level.

Watershed landowners and residents need to understand how their own, daily activities impact the water quality of their local water resources. While these stakeholders might support water quality goals, there still seems to be a reluctance to both acknowledge individual or household responsibility for water resource degradation, and to accept additional individual or household financial obligations to try and correct the problem (see, Table 3-2 and Figure 3-2 in Chapter 3). A study in Portland (OR) examining stakeholder attitudes toward various issues related to water resource management found similar results (Larson 2009). To address these shortcomings, locally-based stormwater education programs that address the environmental, social, and economic issues associated with stormwater management and control – including education sessions, demonstrations emphasizing interactions among the solutions, informational packets, and local partnerships – that connect residents to resources are crucial to the successful implementation and maintenance of LID practices (Larson 2009; Bedan and Clausen 2009; Roy et al. 2008).

Finally, it is important to target stormwater education efforts at education professionals (Roy et al. 2008), particularly those that teach schoolchildren. It is important to engage young people in the discussion regarding stormwater management and water resources stewardship so that they can bring that knowledge into their homes and into their personal and professional futures. Helping educators present these complex issues – particularly through active and experiential learning targeted at skill development and connections to local interests and concerns (Lane et al. 2005) – will help instill a culture of support and participation in environmental management.

In addition to the information provided in the Rein in the Runoff Final Project Report and the Rein in the Runoff Stormwater Education webpage (http://www.gvsu.edu/wri/reinintherunoff), sample stormwater education and outreach resources are listed in Appendix I.

Stormwater Utility Ordinance

Another means of encouraging the use of alternative LID BMPs is through the creation of a regional stormwater utility. Generally based on the amount of impervious surface per parcel, stormwater utility fees create a monetary incentive for developers and property owners to reduce the surface impervious area (Stone and Bullen 2006). This type of fee and rebate approach uses stormwater fees in combination with rebates on stormwater runoff abatement strategies, such as LID strategies, to encourage homeowners to better manage stormwater runoff on their properties (Fullerton and Wolverton 1999).

Stormwater utilities are generally acknowledged to be the most equitable means for funding stormwater management (Cowles 2009). It incorporates a "polluter pays" approach, which is generally accepted by the general public – even if it is not perfectly understood that it is applicable to individual residents and homeowners (Larson 2009). These utilities are already in place in many municipalities throughout the United States (Doll et al. 1998; Doll and Lindsey 1999); however, the fee is usually a flat rate – not tied to differing quantities of stormwater runoff – and too low to encourage implementation of LID-BMPs (Roy et al. 2008).

Stormwater utilities have been established in several Michigan municipalities, including Marquette, Lansing, and Ann Arbor. However, the Michigan Supreme Court struck down the Lansing statute in Bolt v. City of Lansing (459 Mich. 152; 587 N.W.2d 264 (1998)) and articulated a three-prong test that a stormwater utility must meet in order for the stormwater utility fee to not be considered an unauthorized tax: (1) the stormwater utility fee must serve a regulatory purpose other than to merely raise revenue; (2) the fee must be proportionate to the necessary costs of the service provided; and finally, (3) the stormwater utility fee must have a voluntariness component, where property owners can refuse or limit their use of the service. As a result of this decision, changes were made to existing stormwater utility statutes (see, Appendix J for a copy of Marquette's (MI) amended statute). In addition, it has prompted the introduction of legislation to help guide municipalities in the establishment of a local stormwater utility (see, Michigan Senate Bill 256, accessible online: http://www.legislature.mi.gov/(S(fgade055fi4jn5ahvlgmxruy))/mileg.aspx?page=getObject&objectName=2009-SB-0256.

Introductory information regarding stormwater utility ordinances, a summary of the ordinance currently in effect in Ann Arbor (MI), and information about the Bolt decision and Michigan S.B. 256 was presented to the Joint Council Session of representatives from Spring Lake Township, the City of Ferrysburg, the Village of Spring Lake, and Ottawa County in the Spring of 2009. Although there was general reluctance on the part of these local stakeholders to consider implementation of a stormwater utility at this time, the project team has provided guidance on how to calculate and set stormwater utility fees (Appendix J).