Appendix F: BMP Review and Analysis

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The Rein in the Runoff project team evaluated a broad suite of stormwater best management practices (BMPs) that have been implemented in other parts of Michigan, and in communities similar to those in the Spring Lake Watershed around the United States and worldwide. Team members incorporated broad BMP types into a macro-scale BMP selection analysis for different locations throughout the Spring Lake Watershed. These locations were mapped onto the watershed to provide spatial data associated with the selected BMPs. These spatial data provided the basis for additional hydrologic modeling scenarios using PLOAD (see Appendix A) that examined changes in different pollutant loads after implementation of this suite of structural BMPs. For nonstructural BMPs, team members developed a menu of different alternatives that have been utilized in other, similarly-situated communities, with guidance for implementation by the communities within the Spring Lake Watershed.

MODEL STORMWATER MANAGEMENT PROJECTS

Team members visited several communities throughout the United States that have implemented successful stormwater management projects, including Grayling (MI), Portland (OR), Seattle (WA), Madison (WI), and Milwaukee (WI). Team members toured project sites and met with personnel to talk about “lessons learned” regarding specific BMP implementation and maintenance. Additional resources were obtained through participation in several technical conferences, such as the Center for Watershed Protection’s Stormwater Institute (2007), the International Low Impact Development Conference (2008), the Michigan Water Environment Association’s Innovative Stormwater Management Seminar (2008), and the Water Environment Federation’s Sustainability – Green Practices for the Water Environment Conference (2008).

MACRO-SCALE BMP ANALYSIS

The Rein in the Runoff project team conducted a macro-scale BMP selection analysis for the Spring Lake Watershed. This approach was based upon the methodology proposed by Schueler et al. (2007), although it was adapted to fit the project needs and the Spring Lake Watershed geographic region.

The timeline and resources allotted to this project did not allow for site-specific BMP analyses or substantial field evaluation. Because Rein in the Runoff was an Integrated Assessment, project team members had to principally rely on data and information that were previously collected by other researchers or community groups and readily accessible during the course of this project. The simplified BMP selection approach adopted by the project team identified only large-scale areas within the Spring Lake Watershed that would be suitable for the implementation of different types of BMPs: infiltration BMPs, filtration BMPs, regional storage areas, regional treatment areas, and site-specific BMPs on publicly-held lands. The project team did not develop site-specific target treatment volumes or costs, and the BMPs selected were not ranked in any way. The results of the following six-step analysis help identify opportunities for the implementation of different structural and nonstructural stormwater BMPs throughout the Spring Lake Watershed (see Figure 4-1 in Chapter 4).

Step 1: Identification of Priority Areas

The PLOAD model results, aerial photographs, and existing land uses and land covers were compared to identify priority implementation areas for stormwater BMPs. Proposed BMP types (i.e., infiltration BMPs, filtration BMPs, regional storage areas, regional treatment areas, and site-specific BMPs on publicly held lands) were focused in areas with higher phosphorus loadings (based on PLOAD results) and land use and land cover types generally associated with higher nutrient loadings. Specifically, impervious surfaces and agricultural lands will have the highest loadings.

Also of consideration was proximity to water bodies, including Spring Lake and its tributary streams. The closer the source of stormwater pollution is to these water bodies the less opportunity there is for natural processes to reduce nutrient levels, based on estimates for sediment reduction associated with increasing the flow path of runoff through vegetated swales or other filtering media. It was assumed that stormwater runoff from properties located at the upstream ends of each sub-watershed would have more opportunity for sediments to settle out, adsorb to particles, or be taken up by plants than runoff from properties located closer to a waterbody.

Step 2: Evaluation of Existing Riparian Buffers

Riparian buffers provide significant benefits to the watershed and to the water quality of surface waterbodies, such as Spring Lake. Forested, native meadow, or grass buffers improve the quality of stormwater runoff and provide a reduction in stormwater runoff volume compared to maintained turf grass. Because of widespread use and successful past performance, riparian buffers do not generally require detailed engineering or in-depth analysis of hydraulics and hydrology, so are easy BMPs to implement on a watershed-wide basis. Aerial photography was used to identify which streams or portions of streams currently have a forested riparian buffer. Areas without forested riparian buffers along tributaries were identified as BMP opportunities.

Another priority would be to install native vegetative buffers along the lakeshore. A native grass buffer would provide filtering of stormwater runoff from adjacent lawns and impervious surfaces prior to discharge to the lake. Compared with traditionally maintained lawns, native vegetation generates reduced stormwater runoff volumes, peak flow rates, and improved water quality. Mowed turf grass does not provide significant benefits to stormwater quality and can be a nutrient source when improperly fertilized or disposed of (Nielson and Smith 2005; Lehman et al. 2009).

Step 3: Identification of Public Properties for BMPs

One easy place to start with when installing BMPs is publicly-owned properties. In particular, public maintenance yards and areas where soils and minerals area stored above-ground are of higher priority based on the level of nutrients discharged within runoff from these types of sites. Depending on soil types, filtrative or infiltrative BMPs should be installed on these public sites. This type of installation does not rely on public participation and does not have easement requirements. Additionally, if public entities want to promote BMPs to private property owners, it is important to set a good example.

Step: 4: Identification of Opportunities for Infiltration BMPs

Hydrologic soil groups A and B (see Table 2-1 in Chapter 2), generally considered good for infiltration, were identified as an attribute of the maps used in BMP selection. Infiltration is the movement of water into the soil. Where subsoil and geologic conditions are appropriate, water that infiltrates from the surface can potentially percolate to recharge shallow water tables or groundwater. Infiltrative BMPs include infiltration swales and basins, rain gardens, porous pavement, dry wells, and others. A specific type of site or land use does not necessarily merit one type of BMP over another. Each site will vary when identifying the most effective or inexpensive solution. However, in very general terms, commonly suitable BMPs can be identified for land uses such as transportation corridors, residential neighborhoods, and urbanized areas.

Step 5: Identification of Opportunities for Filtration BMPs

Where existing soils do not have high rates of permeability, filtrative BMPs can be used. Filtrative BMPs generally include vegetation or subsurface layers of soil, sand, or aggregate which filter stormwater prior to discharge to a waterbody or outlet through a subsurface engineered underdrain system. While infiltrative BMPs will often provide a higher benefit to cost ratio than filtrative BMPs, filtrative BMPs are still appropriate in certain areas. Specifically, properties in very close proximity or immediately adjacent to a waterbody are critical to the nutrient levels within that waterbody. Where soil and other site conditions are not favorable for infiltration, such as for contaminated sites or sites with proposed future uses that are incompatible with infiltration, filtrative BMPs should be applied.

Step 6: Identification of Universal BMPs

Some BMPs are appropriate “retrofits” to existing development. These universal BMPs can be effective in any situation, independent of location within the watershed, soil type, or land use. Examples include structural BMPs such as the installation and maintenance of riparian buffers or the planting of native vegetation; and nonstructural BMPs such as the use and encouragement of rain barrels/cisterns, the disconnection of roof leads, or the enactment of fertilizer ordinances.

MODELING POLLUTANT LOADS AFTER APPLICATION OF STRUCTURAL BMPS

As noted in Chapter 4, following the macro-scale BMP analysis, the Rein in the Runoff project team applied the structural BMPs for the high priority-areas identified in Figure 4-2 to the 2006 land use and land cover data layer. These BMPs were burned into the GIS layer as land use and land cover changes: residential infiltration, regional treatment, and site-specific BMP areas in the Spring Lake Watershed were reclassified as urban/recreational grasses; regional storage areas were reclassified as emergent herbaceous wetlands; and filtration BMP areas were reclassified as woody wetlands (Table F-1). The project team then ran PLOAD (see Chapter 2) on the 2006 land use and land cover GIS layer to show the changes in nutrient loadings to Spring Lake after the application of these various BMPs throughout the watershed. The results of this analysis are discussed in Chapter 4.

Table F-1. Spring Lake Watershed BMPs Conversions to Rein in the Runoff Project Land Use and Land Cover Classifications.

Structural BMPs[1]	Size	Land Use and Land Cover Classification	Size
Infiltration Swales	60.8 miles	Grasslands	60.8 miles
Riparian Buffers	19.0 miles	Mixed Forest	19.0 miles
Filtration BMP Areas	140.9 acres	Woody Wetlands	140.9 acres
Regional Storage Areas	7.9 acres	Emergent Herbaceous Wetlands	7.9 acres
Regional Treatment Areas	321.0 acres	Urban/Recreational Grasses	2,620.4 acres
Site Specific BMPs	459.9 acres		
Residential Infiltration Areas	1,839.5 acres		

1 See, Figure 4-2, Chapter 4.