



SHOREWOOD GUIDEBOOK FOR

GREEN INFRASTRUCTURE



Clark Dietz, Inc.
759 North Milwaukee Street, Suite 624
Milwaukee, WI 53202



INTRODUCTION

Shorewood is surrounded by fresh water: the Milwaukee River is the village's western boundary, while Lake Michigan is its eastern boundary. Despite being a completely developed and urbanized community, Shorewood is intensely focused on protecting the region's natural resources and creating a sustainable environment for its residents.

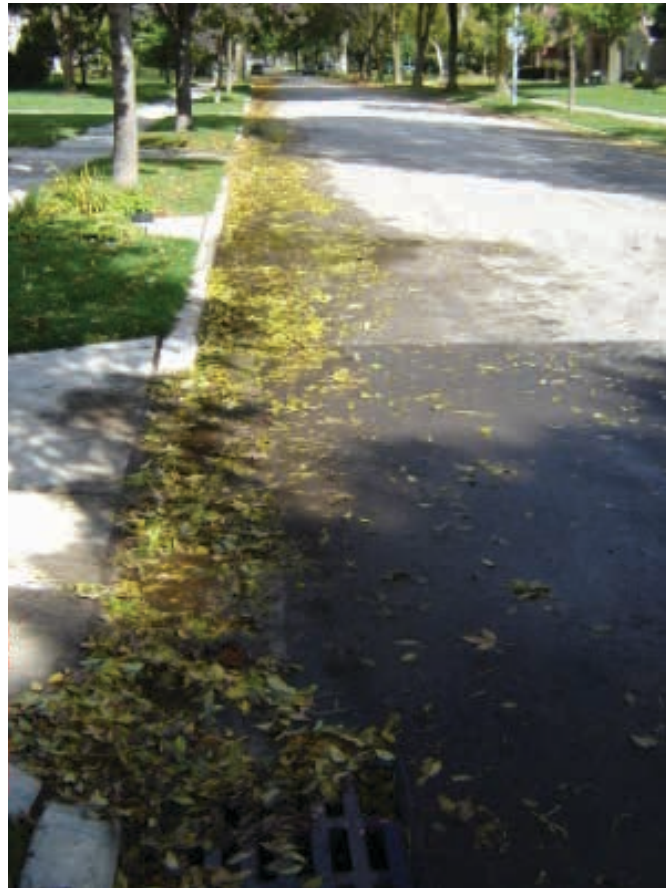
For communities, sustainability is often defined as the satisfaction of basic economic, social, and security needs now and in the future without undermining the natural resource base and environmental quality on which life depends. Sustainability in Shorewood therefore encompasses smart growth, a green community, and green buildings. Shorewood's efforts are concentrated on both policies and practices that promote its philosophy of sustainability.

Green Policies

Conservation Committee

In 2007, the Village re-activated the Conservation Committee whose charge is to inform and educate the public as to matters related to conserving energy and recycling materials. The Committee was originally created in 1990 when a village recycling program was implemented with goals of attaining a healthier and safer environment in which to live, and of protecting and conserving our valuable natural resources. The Shorewood Conservation Committee is charged with:

- Researching relevant data and work with local environmental experts and organizations to get current reliable data on those environmental issues which affect the community of Shorewood.
- Educating village government, businesses and residents of Shorewood on pertinent environmental issues and collaborate with them to implement new sustainable, healthy practices.
- Advocating for new and updated policy/guidelines/codes to support best practices and solutions.



The vision of the Shorewood Conservation Committee is to establish Shorewood as a showcase for organizing a green community working with a diverse group of stakeholders to increase awareness of how our everyday living patterns affect the environment and to suggest ways to minimize the impact.

The Village Board of Trustees appoints new members to the Conservation Committee when there is a vacancy. Any residents who are interested in joining the committee must complete and submit a Volunteer Application. The application will be kept on file and considered when there is a committee vacancy.

Green Leaf Award Program

The Green Leaf Award was developed by the Village of Shorewood Conservation Committee to encourage local businesses to take concrete steps toward a more sustainable way of operating their business. Greening your business helps attract new customers, develop a loyal customer base and create a healthier work environment for employees. Businesses can also improve their bottom line and consumers receive more environmentally responsible product and service options.

Volunteers collaborate with business owners and managers to conduct green business assessments. Topics covered in the assessment include energy, transportation, waste reduction, water and air quality, responsible purchasing, building and remodeling, food, and education. When a Shorewood business meets specified criteria it receives a Green Leaf Award. A Green Leaf decal is available for posting on a storefront window, and notice of the award can be posted online on a business website.

Wisconsin 25 x 25 Program

In 2009, the Village of Shorewood joined the State of Wisconsin's 25 x 25 Program. Initiated in 2007, the 25 x 25 program aims to obtain 25 percent of the state's energy and fuel needs by 2025 from renewable resources. By passing the resolution, Shorewood became one of over 125 communities in the state to join the program. The Village's first task was completing energy audits of its facilities.

The adoption of the 25x25 resolution reflects the community's belief that meaningful steps can be taken at the local level to deal with the effects of poor sustainability. In addition, the village will be eligible for energy efficiency grants and technical assistance from the state.

Village Sustainability Plan

Shorewood continues to identify funding opportunities for sustaining facilities and infrastructure. Village staff formed an internal Sustainability Committee to coordinate and focus the Village's priority for developing and implementing sustainable practices. Village staff began developing a Sustainability Plan in 2010 to help focus energies and align them with the Village's Vision Plan.

In 2009, a task force was assembled through the Village's Conservation Committee to research sustainability. The task force found the "Natural Step" book to be a commonly used framework for local government sustainability planning in Wisconsin. Resolutions to endorse sustainability principles ("eco-municipality") were recommended to the Village Board and adopted in November 2009.

Sustainable Shorewood

On November 2, 2009, the Village of Shorewood Board of Trustees adopted an eco-municipality resolution that supported sustainability principles and identified The Natural Step as the preferred model for achieving greater sustainability in local government and the larger community. The Natural Step (or "TNS") is a scientifically based, socially just model with a proven track record. Many other Wisconsin communities are implementing the principles and methods of The Natural Step, affording us the opportunity to share strategies and successes with nearby, similar communities.

The Natural Step

The Natural Step model of sustainability was developed in Sweden in 1983 by a group of scientists led by Dr. Karl-Henrik Robèrt. His work led to the development of a framework of four system conditions and a four step planning process to systematically effect positive change. The successful efforts of city planner Torbjörn Lahti to apply these methods in Övertorneå, Sweden marked the beginning of what became known as the "eco-municipality" movement.

The Natural Step's system conditions define the framework through which Village programs and practices can be reviewed and modified in order to become a more sustainable organization. The four system conditions are expressed here as defined by the American Planning Association's Planning for Sustainability Policy Guide:

1. Eliminate our community's contribution to fossil fuel dependence and to wasteful use of scarce metals and minerals;
2. Eliminate our community's contribution to dependence upon persistent chemicals & wasteful use of synthetic substances
3. Eliminate our community's contribution to encroachment upon nature (e.g., land, water, forests, soil, ecosystems)
4. Eliminate conditions that undermine the capacity for people to meet basic needs.

Eco-Municipality

An eco-municipality is defined as a city, village, town, county, or region that aspires to develop an ecologically, economically, and socially healthy community for the long term, using The Natural Step framework for sustainability as a guide, and a democratic, highly participative development and decision-making process as the method (from *Toward a Sustainable Community: A Toolkit for Local Government*). This systems approach is critical to the Village's long-term success because the approach helps to raise awareness of sustainability, works to integrate the goals and actions across departments within the organization, and helps to develop a common language and shared understanding. This systems approach should reduce the likelihood of conflict and competition among individual actions and avoid duplication of efforts.

Sustainable Shorewood Action Plan

The Village of Shorewood's Staff Sustainability Committee, along with the efforts of a task force of community volunteers, is in the process of developing a Sustainability Action Plan. The purpose of the action plan is to document the vision, goals, and actions for the Village of Shorewood in their efforts to adopt and implement sustainability in long-range planning, policy efforts, and daily operations.

Over the years, the Village has implemented programs and completed projects that could be considered sustainable. Some of these are listed below.

- Shorewood was one of the first Wisconsin communities to completely switch over to LED traffic signals.
- Shorewood was one of the first Wisconsin communities to implement a curbside recycling program.
- Christmas tree recycling program and electronics recycling program.
- Actively manages a pesticide-free lawn maintenance program on all of the green space maintained by the Village.
- The distribution of reusable shopping bags.
- Active program to incorporate more native plants into the Village landscaping.
- Preparation and adoption of a new parks plan – the Comprehensive Outdoor Recreational Plan (2007). The establishment of an active Parks Commission; Shorewood is one of the few municipalities in the Milwaukee area with an active Parks Commission.
- Shorewood funded and approved a detailed plan for the management of the Milwaukee bluff from Capitol Drive to the Village's south border. The plan includes a proposed sustainable trail system along the river.
- Shorewood adopted an extremely strong Shoreland zoning ordinance to protect and preserve the Milwaukee River bluff.
- A bike study was funded and completed in 2008 which lays out plans for safe bike routes throughout the Village.
- Completed an ecological study and management plan for Atwater Beach.
- Bike racks and recycling bins were installed throughout Capitol Dr. and Oakland Ave. as part of the streetscaping project. Bike lanes and stormwater filtration basins were also installed along Capitol Dr.
- The Village has an active Pedestrian and Bicycle Safety Committee. The Village funded a pedestrian safety study and is implementing many recommendations as opportunities arise.
- Developing the Compost Mentoring Program to show residents how to take certain kitchen wastes, yard waste and leaves and make them into a valuable resource for their lawn and garden.
- Biofilters to treat urban runoff were included in the Village's 2012 street and sanitary sewer construction designs.

As the Shorewood Village Board considers new policy initiatives, and Village staff search for new ways to make day-to-day operations more efficient, the need for a coordinating document which would identify new projects and programs, and help prioritize where the Village should focus their efforts became obvious.

This action plan describes the results of recent planning activities by the Staff Sustainability Committee, Sustainability Task Force, Village staff, Village Board, and interested residents. The resulting document aims at raising awareness about sustainability in local government, establishing a baseline for various efforts and activities, developing the compelling vision for the organization, and laying out the action steps and priorities necessary for achieving this broad vision in the future.

The action plan is organized into the following five elements of municipal operations:

1. Buildings and Energy
2. Purchasing and Materials
3. Development
4. Infrastructure / Green Infrastructure
5. Resource Management

Shorewood's Green Infrastructure Initiative

As an on-going effort to support the Sustainable Shorewood Action Plan, the Department of Public Works promotes the use of green infrastructure technologies for public and private construction and development activities within the Village. The Green infrastructure initiative has the following two goals:

- Reduction of runoff volume and/or flow rates
- Reduction of urban non-point pollution to receiving waters

The intended protocol for the use of Green Infrastructure Initiative Guidance is as follows:

1. The use of the Guidance Document is required for all public infrastructure renewal projects in the Village of Shorewood.
2. If Green Infrastructure practices are not found to be feasible, the designer of public infrastructure renewal projects must support this finding by using the criteria provided herein.
3. If Green Infrastructure practices are feasible (as determined by the criteria provided herein), the designer of the public infrastructure improvements will design specific BMPs based on guidance and performance standards provided herein as well as other sources as may be applicable.
4. The Department of Public Works, from time to time, may amend or modify implementation criteria, Green Infrastructure design or performance standards provided herein.

The intent of Shorewood's Green Infrastructure Initiative is to provide an implementation roadmap for residents, development planners, engineering designers, and construction site contractors involved in private and public infrastructure renewal projects in Shorewood.

Benefits of Green Infrastructure

In Shorewood's separate sewer service area (west of Oakland Avenue), green infrastructure will help to improve water quality in Milwaukee River. When water from rainfall or melting snow flows across the landscape, it washes soil particles, bacteria, pesticides, fertilizer, pet waste, oil and other toxic materials into our lakes, streams, and groundwater. This is called "nonpoint source pollution" or "polluted runoff."

Runoff from municipal areas contains a mixture of pollutants from parking lots, streets, rooftops, lawns, and other areas. These areas contribute heavy metals, pesticides, sediment, nutrients, bacteria, and oxygen-demanding organic waste. Although municipal storm sewer systems are efficient at controlling water volume to avoid flooding, they also transport polluted runoff directly into the Milwaukee River.

However, with green infrastructure components, significant amounts of pollution can be removed. Nitrogen and phosphorus removal can be 50 percent or more of the total pollutant load from runoff; copper, lead, zinc, ammonium, and calcium have high removal rates as well.

Green infrastructure will reduce the amount of wastewater needing to be treated at the Jones Island facility. In Shorewood, our sanitary sewer systems carry between two to 16 times the amount of water when it rains compared to when it doesn't rain. There is a clear benefit to keeping rainwater from getting into the sanitary sewers because doing so can help to minimize treatment costs at the water reclamation facilities. Green infrastructure can help by storing stormwater and keeping it from leaking into the sanitary sewer pipes.

In Shorewood's combined sewer service area (east of Oakland Avenue), green infrastructure will help capture enough rainwater that might have otherwise contributed to a combined sewer overflow. Reducing the amount of water needing to be treated is a benefit to everyone.

GREEN INFRASTRUCTURE FOR RESIDENTS

When it rains, every property generates runoff. To handle rain water, we choose to install gutters and downspouts that collect water running from your rooftop, and sump pumps that pumps infiltrating water some distance away from your foundation. Even though this system helps to ensure our homes do not flood, it results in a massive strain in the amount of stormwater volume entering our natural streams and rivers. The runoff volume leads to stream or river bank overtopping and high flow velocities cause stream bank erosion.

There are many things we can all do to reduce the amount of runoff that leaves our property. This helps the receiving streams cope with our runoff, especially during heavy downpours. Shorewood has an established record in implementing and funding on-lot runoff management measures.

In the last decade, Shorewood successfully implemented an on-lot runoff management program that consisted of downspout disconnections from combined sewers, rain garden construction, and rain barrel installation. This comprehensive project resulted in increased awareness on runoff issues, the disconnection of nearly 1,000 downspouts, the elimination of 240 roofs from the watershed drainage area, the construction of 61 public and private rain gardens, and the installation of 268 rain barrels.

Disconnect Your Downspouts

Direct roof downspouts away from foundations and driveways to planting beds and lawns where the water can safely soak into the ground. Downspout disconnection removes water from Shorewood's underground pipes and puts runoff on lawns where it has a chance to percolate into the ground. Downspout disconnection supports Shorewood's goal of runoff reduction. What's more, the runoff that does not percolate into the ground has to travel through lawns and vegetation and undergoes filtration, which means that Shorewood's water quality improvement goals are supported as well.

Here's how to disconnect downspouts:

1. Cut existing downspout 2 to 3 feet above ground; remove the lower portion of existing downspout.
2. Cap drain in accordance with Village codes (contact the Building Inspector for details)
3. Install 1 or 2 elbow connection.

4. Install down strap.
5. Install approximately 5 ft. downspout extension.
6. Cleanup and haul away debris.

Between 2005 and 2008, thousands of downspouts were disconnected from combined sewers, with hundreds of roofs no longer draining into the Village pipes. The runoff was directed onto lawns and rain gardens and stored in many rain barrels throughout the Village. This effort showed the value of downspout disconnections and the resulting benefits have:

- Reduced Shorewood's basement backups,
- Reduced Shorewood's need and demand for reconstruction operations,
- Reduced the need and demand for more extensive property modifications,

Build a Rain Garden

Rain gardens are shallow depressions that are planted with native flowering plants and grasses, which not only look great, but also help soak up rain water and melted snow. The runoff soaks into the ground rather than causing erosion or carrying pollution to the nearest lake or stream. Rain gardens strongly support Shorewood's water quality improvement goals. The steps needed to construct a rain garden are as follows:

1. Site Assessment/Soil Testing: Determine optimal placement of the Rain Garden and current soil conditions.
2. Rain Garden Design: Prepare and present proposed layout and design for homeowner and Village approval.
3. Digger's Hotline Location: Submit request for location of utilities prior to commencement of work.
4. Rain Garden Installation – ASSUME 100 SQUARE FEET:
 - a. Define Rain Garden location.
 - b. Plywood lawn areas, as needed, to minimize compaction and lawn disturbance from equipment.
 - c. Excavate soil 2 to 3 feet, based on site assessment.
 - d. Use portion of excavated soil to create berm, as dictated by site topography; remove remaining excavated soil from site and dispose of off-site.
 - e. Furnish and install approximately 6.5 CY of custom soil mix (50% sand/25% topsoil/25% compost). Final grade to be 3" below existing lawn grade to allow for future settling.
 - f. Furnish and install 75 plants – (25) plugs and (50) 4½" pots.
 - g. Furnish and install approximately 1" of shredded hardwood bark mulch.
 - h. Water in plant material (one time).
 - i. Remove debris and dispose of off-site.

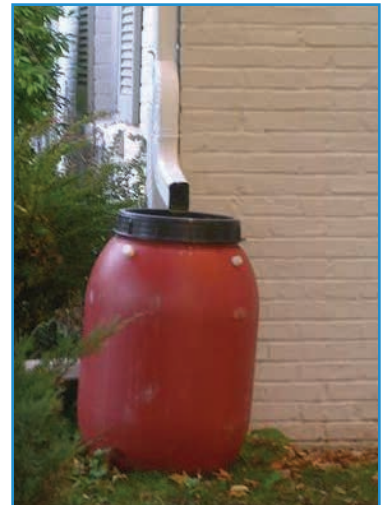


5. Drainage: Furnish and install flagstone steppers (or approved equivalent) to direct water from downspout extension to Rain Garden. Flagstone to extend 5feet from extension, and installed at grade to allow for ease of mowing. If distance of Rain Garden is greater than 10feet from house, additional grading/swales shall be provided.
6. Post-Construction Lawn Repair: Top-dress disturbed lawn with topsoil, seed and mulch, and water (once).

Install a Rain Barrel

A rain barrel collects rainfall running off a roof and stores it for future use, such as watering flowers and garden plants when the weather turns dry. Rain water can be better for plants than water pumped from the ground or piped through a city water main. It's not chlorinated, fluoridated or loaded with dissolved salts. Rainwater is mildly acidic, which helps plants take up important minerals from the soil. Properly maintained rain barrels do not provide breeding sites for mosquitoes or other pests. Rain barrels are usually about 40-60 gallons. You can purchase commercially made ones, but many watershed groups sell them.

1. Rain Barrels can be obtained from many sources. In Milwaukee, MMSD, Beans and Barley, and the Urban Education Center are some locations where barrels can be purchased.
2. Installation requires downspout disconnection as described above, except that the cut will be 5 to 6 feet above ground.
3. An inverted "Y" connection will be installed at the cut, with one side of the inverted "Y" routed to the barrel by a length of downspout and two elbows. The other leg of the inverted "Y" will be extended to the ground with a 5 or 6 ft downspout, and elbow and another 5 ft extension for discharge onto the ground. This or other hardware is generally sold with the barrels.



Consider a Green Roof

Green roofs, thought originally only to provide garden roof top living space extensions to urban apartments and condominiums, are now also thought to provide benefits such as saving energy, adding vegetation in an urban setting, and conserving and filtering water resources.

Green roofs have shown to demonstrate insulating capabilities that result in savings in heating and cooling costs. Chicago's City Hall green roof demonstrated that its black tar portion of the roof at a temperature of 169 degrees on a summer day with outdoor air temperature in the 90's, while the half-acre size planted green roof portion recorded temperatures between 90 and 120 degrees.

Recent studies and applications of green roof projects have demonstrated that in the summer, green roofs can retain 70 to 90 percent of the precipitation that falls on them. In winter months, the green roofs can retain 25 to 40 percent of the precipitation that falls on them. This demonstrates a potential to reduce the amount of runoff that is sent to our sewer systems. This retained water, can also be considered for re-use, such as irrigation of plantings, or filtered to use to cool equipment.

Two types of green roofs are recognized in the industry, the extensive roof and the intensive roof. Both roof systems require the input of structural engineers from the beginning of design, to assure compliance with loading requirements, building codes and material compatibility and performance. The extensive roof 3 to 6 inch depth of planting medium in containers, with finished weights in the 50 pounds per square foot. The intensive roof consists of an 8 inch to 4 foot depth planting medium,



and can approach finished weights of 150 pounds per square foot. Both systems include attention to waterproofing, proper drainage and in some cases irrigation to promote healthy plant growth.

Roof composition can be engineered concrete roof systems, and waterproofed using EPDM liners, spray applied liquid rubber, or coat-tar applications. Once the roof top is waterproofed and tested for leaks, the lining system is applied, which consists of heavy geotextile fabric, a drainage/water retention layer, insulation layer, woven weed barrier fabric, and then planting medium.

Green roofs, when visible from living spaces or work places, offer aesthetic appeal, reduce the heat-island effect, and can improve quality of life and productivity. Innovation in green roof design is indeed exciting, but needs to be tempered with a strategy to measure the cost benefits, and develop sound strategies and training for correctly maintaining and managing these spaces.

Simple extensive green roof systems can be in the \$5.00 to \$10.00 per square foot, up to \$25.00 to \$75.00 per square foot for more complex intensive systems. Longevity of the systems can be 15 to 30 years, depending on the quality of materials used initially, and the care and management of the system on a regular basis. For more information visit www.greenroofs.org or www.agreenroof.com.

GREEN INFRASTRUCTURE FOR ENGINEERS AND DEVELOPERS

Structural controls are engineered and constructed systems that are designed to achieve runoff quantity reduction and pollution reduction benefits by detaining, filtering, or otherwise removing the pollutants that are transported by runoff.

Shorewood has evaluated and identified a number of green infrastructure practices that are suitable for public and private construction projects. Pollutant removal capabilities for a given structural stormwater control practice are based on a number of factors including the physical, chemical and/or biological processes that take place in the structural control and the design and sizing of the facility. In addition, pollutant removal efficiencies for the same structural control type and facility design can vary widely depending on the tributary land use and area, incoming pollutant concentration, rainfall pattern, time of year, maintenance frequency and numerous other factors.

Shorewood supports the consideration, design, and construction of the following three categories of structural controls:

1. **Stormwater Filtering Systems** that increase the quality of the runoff discharged into Lake Michigan and Milwaukee River. Filtering removes particulate pollutants like sediment from the runoff either through biological processes or mechanical means. Since other pollutants are transported by attaching themselves onto sediment particles, sediment removal also reduces chemicals washed off of roadways and lawns.

Stormwater filtration systems are selected because of their applicability to smaller drainage areas and their reliable pollutant removal rates, provided that appropriate maintenance is performed.

Stormwater Filtering is appropriate for:

RESIDENTS: Landscaping projects that can include runoff reduction efforts

PUBLIC WORKS: Introducing green infrastructure in Village projects

DEVELOPERS: Meeting Village ordinance requirements and improving pollutant removal

Stormwater filter systems proposed for consideration are:

- a. Bio-Filters
- b. Sand Filters

- c. Infiltration Trenches
- d. Filter Strips

2. **Pervious Pavement Systems** that reduce the total amount of surface runoff available to wash off sediment and chemicals from roadways. Perviousness also reduces the need for larger pipes draining Shorewood's streets. In the combined area, perviousness reduces flows in the combined sewers and directly result in reduced basement backup risks.

Pervious pavement systems refer to a number of applications that seek to reduce the imperviousness of traditional pavement systems by introducing means to transfer surface runoff into the subgrade. This is generally achieved through two main ways:

- a. Use of porous materials: the increased porousness of traditional paving materials like concrete and asphalt: this means that the properties of the pavement are modified to let more water through instead of shedding it as runoff.
- b. Use of reduced coverage with traditional paving materials: The reduction of the coverage area of traditional paving materials by building in pervious inserts: this means the actual surface of the paved area is reduced by not paving certain areas to reduce total paved surfaces as well as encourage runoff to reach the soils under the pavement.

Pervious Pavement Systems are appropriate for:

PUBLIC WORKS: Introducing green infrastructure in Village projects

DEVELOPERS: Meeting Village ordinance requirements and improving pollutant removal

Pervious pavement systems proposed for consideration are:

- a. Gutters constructed with pervious concrete or proprietary materials such as Filterpave
- b. Use of pavers or conventional catch basins feeding runoff into an engineered storage and infiltration trench below pavement surface

3. **Separators** are designed to remove oil, grease, debris and sediment from runoff using sedimentation of solids, skimming of floatables, and phase separation of oils and greases. Soluble pollutants such as metals and nutrients are not removed. Separators require an aggressive cleaning program to remove the collected pollutants. There are both proprietary and non-proprietary systems available, ranging from simple sump catch basins to multi-chambered designs, some with drop in filtration devices.

Separators are appropriate for:

PUBLIC WORKS: Introducing green infrastructure in Village projects

DEVELOPERS: Meeting Village ordinance requirements and improving pollutant removal

Examples of proprietary separators proposed for consideration are:

- a. Stormceptor
- b. Vortechs
- c. Downstream Defender

STORMWATER FILTERING SYSTEMS

Bio-Filters

Bioretention areas are shallow depressions that are landscaped with engineered soils and deep rooted vegetation to capture and filter runoff. Runoff is directed into these depressions to be treated and subsequently discharged into Shorewood's conventional storm sewer system.

Bioretention is ideally suited for placement along the curb, where it can receive runoff from conventional gutters along Shorewood's streets. Several examples of bioretention areas exist along Capitol Drive and Kensington Boulevard.

Design Criteria:

1. Maximum contributing drainage area of 5 acres
2. Often located in "landscaping islands"
3. Treatment area consists of grass filter, sand bed, ponding area, organic/mulch layer, planting soil, and vegetation
4. Typically requires 5 feet of head

Advantages & Benefits:

1. Applicable to small drainage areas
2. Good for highly impervious areas, particularly parking lots
3. Good retrofit capability
4. Relatively low maintenance requirements
5. Can be planned as an aesthetic feature

Disadvantages & Limitations:

1. Requires extensive landscaping
2. Not recommended for areas with steep slopes

Maintenance Requirements:

- Inspect and repair/replace treatment area components, including soils and vegetation

Sand Filters

This is a filtration basin designed to treat stormwater runoff through filtration through a sand bed as its primary filter media and, typically, an under-drain collection system. Instead of the engineered organic soils and the deep rooted vegetation, sand filters are typically not vegetated. Also, a sediment fore-bay is sometimes incorporated to capture coarse particles and trash before runoff flows into the sand bed.

Sand filters can be of different shapes depending on size requirements, and the depth is generally limited by the depth of the storm sewers that are necessary to drain the filter. It is possible to infiltrate some of the filtered runoff, provided the native soils are suitable for infiltration.

Design Criteria:

1. Typically requires 2 to 6 feet of head
2. Maximum contributing drainage area of 10 acres for surface sand filter; 2 acres for perimeter sand filter
3. Sand filter media with under-drain system

Advantages & Benefits:

1. Applicable to small drainage areas
2. Good for highly impervious areas
3. Good retrofit capability

Disadvantages & Limitations:

1. High maintenance burden
2. Not recommended for areas with high sediment content in stormwater or clay/silt runoff areas
3. Relatively costly
4. Possible odor problems

Maintenance Requirements:

1. Inspect for clogging – rake first inch of sand
2. Remove sediment from fore-bay/chamber
3. Replace sand filter media as needed

STORMWATER FILTERING SYSTEMS

Infiltration Trenches

An infiltration trench is an excavated trench filled with stone aggregate used to capture and allow infiltration of stormwater runoff into the surrounding soils from the bottom and sides of the trench.

This is similar to the sand filter, except that the infiltration trench relies on runoff loss through infiltration into the surrounding native soils. In this sense, the practice is limited by soil conditions at the site.

Design Criteria:

1. Soil infiltration rate of 0.5 in/hr or greater required
2. Excavated trench (3 to 8 foot depth) filled with stone media (1.5- to 2.5-inch diameter); pea gravel and sand filter layers
3. A sediment fore-bay and grass channel, or equivalent upstream pretreatment, must be provided
4. Observation well to monitor percolation

Advantages & Benefits:

1. Provides for groundwater recharge
2. Good for small sites with porous soils

Disadvantages & Limitations:

1. Potential for groundwater contamination
2. High clogging potential; should not be used on sites with fine-particle soils (clays or silts) in drainage area
3. Significant setback requirements
4. Restrictions in Karst, dolomite bedrock, areas
5. Geotechnical testing required, two borings per facility

Maintenance Requirements:

1. Inspect for clogging
2. Remove sediment from fore-bay
3. Replace pea gravel layer as needed

Filter Strips

Ideal for placement at the edge of paved areas, filter strips are engineered to offer high permeability to reduce runoff shedding off of paved surfaces. Filter strips are generally found on the downstream edge of parking lots and other large paved surfaces. If storm sewers exist in the area, an underdrain system can be used to drain the filter. Otherwise, the permeability of the surrounding soil must be high enough to drain the filter after a rainfall. Filter strips are uniformly graded and densely vegetated sections of land engineered and designed to treat runoff from and remove pollutants through vegetative filtering and infiltration.

1. Runoff from an adjacent impervious area must be evenly distributed across the filter strip as sheet flow
2. Can be used as part of the runoff conveyance system to provide pretreatment
3. Can provide groundwater recharge
4. Reasonably low construction cost
5. Large land requirement
6. Requires periodic repair, regrading, and sediment removal to prevent channelization

PERVIOUS PAVEMENT SYSTEMS

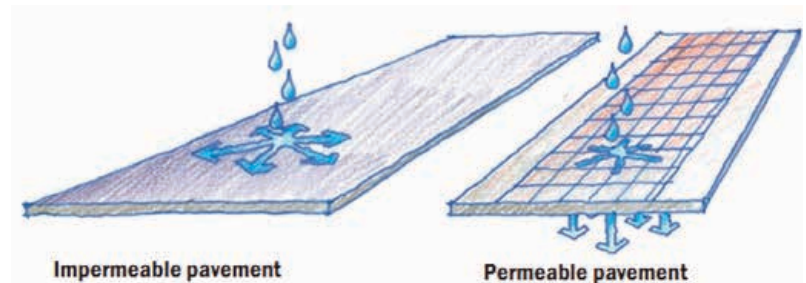
Shorewood targets the reduction of runoff rates and volumes through opportunistic reduction of urban imperviousness in the Village. This means that public and private hard surfaces like roadways, parking lots, alleys, and other paved surfaces are all potential candidates for imperviousness reduction whenever repairs or construction is undertaken.

As previously described, imperviousness reduction can be achieved either through the use of more pervious paving materials (compared to conventional paving materials) or using less of the conventional paving materials (compared to conventional construction methods).

Shorewood acknowledges that conventional paving materials can also be used in creative ways to reduce runoff rates and volumes that drain to storm (or combined) sewers. The guiding principle for this approach is designing a paved surface with a mechanism that takes the surface water underground, a mechanism to store, infiltrate, and filter this water, and a mechanism to safely and effectively convey the remainder into Shorewood's storm (or combined) sewers.

PERVIOUS EDGE STRIPS

The installation of pervious materials in the Village has limited applicability at a large scale due to the inherent maintenance requirements for such surfaces. Therefore, Shorewood encourages the evaluation of the use of porous or pervious pavement systems in specific locations and circumstances such as street gutters, parking lot gutters, or as edge strips around large paved surfaces like parking lots or loading docks.



The concept of a pervious edge strip is to intercept and percolate some of the surface runoff before the flow reaches a conventionally located and constructed stormwater catch basin. The design goal for the pervious strip is a 50 percent reduction in runoff measured at the receiving catch basin. Depending on soil permeability in the project area, some of the flow may be collected below the surface and transmitted to the catch basin by a system of underdrains.

PERVIOUS EDGE STRIPS

Pervious Concrete

Pervious concrete is the term for a mixture of coarse aggregate, portland cement and water that allow for rapid infiltration of water.

Pervious concrete can achieve a voids ratio of up to 25 percent and allows the water to flow through it at about 450 inches per hour.

FILTERPAVE®

According to the manufacturer's data, FILTERPAVE™ system is a high-strength, durable, and attractive type of hard-surfaced porous pavement said to perform with the best qualities of both concrete and asphalt.

The system mix is made of recycled glass materials that can achieve a voids ratio of 38 percent.

REDUCTION OF PAVED SURFACES

As one of the most densely populated communities in Wisconsin, Shorewood has an overall imperviousness of about 40 percent, which results in relatively high runoff potential, especially during short and intense rainfall events.

As a fully developed community, the way to reduce the existing imperviousness in the Village is to convert paved areas to green space. One important opportunity lies in the annual street reconstruction program where specific segments of roadways are targeted for narrowing to reduce total paved surfaces. The Village generally prefers a 28 foot wide residential street width, and where wider streets are found, the Village is committed to evaluate the narrowing of these areas to the standard 28 foot width. Safety, emergency access, and convenience to residents are also considered in this decision.

Another way to reduce overall imperviousness is to encourage re-development activity to reduce private paved surfaces to the greatest extent practicable. Examples of re-development activity that fulfill this philosophy are narrower driveways and access roads, smaller parking areas, green roofs, and smaller overall footprint for buildings.

SHOREWOOD GREEN ALLEY PROGRAM

Shorewood features about 31,000 feet of alleyways representing 10 acres of hard paved surface in the Village. Continuing with its efforts to reduce imperviousness, Shorewood has focused on exploring ways to modify its alleys and make them “green alleys.”

The Shorewood Green Alley Program was started as a pilot project in 2008 to evaluate the feasibility of the adopted Green Alley components in the Village. The pilot design features underground storage, underground filtration, conventional storm sewer and catch basin drainage, and a conventional concrete travelling surface.

While a formal rehabilitation and reconstruction program has been adopted as a Village-wide Alley Management Plan, the Green Alley Program offers a new twist to Shorewood’s Alley Management Plan, modeled after Chicago’s pioneering Green Alley Program.

Following the Chicago approach, Shorewood is seeking to install green alleys wherever it can and reduce runoff by reducing imperviousness and filtering stormwater through underground filters. When executed properly, a green alley has a potential of reducing peak flows by as much as 80 percent and provide filtration benefits that help with high water quality.

Shorewood’s Green Alley Program emulates the Chicago Plan by supporting the consideration of several techniques identified as follows:

Alley Drainage Improvement through Proper Alley Pitching and Grading:

All alleys, whether they are permeable or not, should be properly graded and pitched to allow water to run to the center of the alley and then flow to the street. This prevents the need for additional sewer infrastructure and prevents adjacent properties from flooding.

Permeable Pavement:

Permeable pavement has pores or openings that allow water to pass through the surface and percolate through the existing subsoil. Permeable pavement comes in the form of permeable asphalt, permeable concrete, and permeable pavers. In areas where soils do not drain freely, permeable pavement can be used in combination with subsurface drainage systems, like pipe underdrains or stormwater infiltration trenches to slow runoff and reduce stress on the combined sewer system.

High Albedo Pavement:

High albedo pavement material is light in color and reflects sunlight away from the surface. With less sunlight absorbed by pavement, less heat is radiated by the pavement. High albedo pavement therefore reduces the urban heat island effect. This reduces cooling costs, helps the survival of urban vegetation, and improves air quality, which can help reduce the symptoms of some respiratory diseases.

Recycled Construction Materials:

Recycled construction materials can be incorporated in a variety of ways in green alleys. Recycled concrete aggregate can be used in the concrete mix and as a base beneath surface paving. Also, slag, a by-product of steel production, can be used as a component of the concrete mix, reducing industrial waste. Ground tire rubber can be used in porous asphalt and reclaimed asphalt pavement in non-porous asphalt.

Dark Sky Compliant Light Fixtures:

Energy efficient, dark sky compliant light fixtures are specially designed to direct light downward, focusing light where it's needed. These fixtures can also incorporate the latest technologies in energy efficiency while maintaining adequate light levels. New alley fixtures will also use metal halide lamps, which produce white light, instead of the yellow light produced by the existing high-pressure sodium fixtures. This will help people to be able to distinguish color at night.



SEPARATOR SYSTEMS

Separators are designed to remove oil, grease, debris and sediment from runoff using sedimentation of solids, skimming of floatables, and phase separation of oils and greases. Soluble pollutants such as metals and nutrients are not removed. Separators require an aggressive cleaning program to actually remove the collected pollutants.

Non-Proprietary Systems

The Village of Shorewood already requires that new storm sewer inlets use 24 inch deep sump catch basin boxes. However, since grit chambers or deep sumps have limited storage capacity, they cannot provide significant water treatment. In terms of sediments, only coarse sediment is trapped, with high likelihood of re-suspension during high flow periods. Deep sump catch basin is the default inlet structure in use in Shorewood.

As a matter of BMP evaluation, the designer must maximize the size of the sump to capture larger amounts of sediment than currently achieved. The evaluation must be presented with the following information:

- Computed inlet flow
- Estimate of sediment load
- Volume of sump required to achieve one year cleanout schedule

Grit chambers consist of an extended catch basin inlet box that allows runoff to travel through two or three chambers which allow sedimentation. Outflow occurs through an inverted pipe to a final chamber connected to the outflow pipe. Grit chambers take more room than traditional sump catch basins, but they have the capacity to contain more pollution as well.

As a matter of BMP evaluation, the designer must consider the installation of grit chambers at storm sewer inlets. The evaluation must be presented with the following information:

- Computed inlet flow
- Inverted pipe sizing
- Estimate of sediment load
- Chamber design and configuration
- Volume of chamber required to achieve one year cleanout schedule

Proprietary Systems

Proprietary systems incorporate physical filtration, hydrodynamic settlement, oil/grease removal, and screening media to remove pollutants from the runoff. We note that some liquids such as coolants, soluble lubricants, glycols, and alcohols cannot be captured.

Examples of proprietary separators are:

- Stormceptor
- Vortechs
- Downstream Defender

These are only some of the commercially available products in use in southeast Wisconsin. Their inclusion in this document does not reflect an endorsement.

Recent studies indicate that separators are best used as pretreatment devices for other BMPs. Accordingly, their application in Shorewood must consider combinations with other methods that increase overall pollutant removal potential.

GLOSSARY

10 Year Storm Event – A storm that has a 10% probability of occurrence in *any* given year.

100 Year Storm Event – A storm that has a 1% probability of occurrence in *any* given year.

2 Year Storm Event – A storm that has a 50% probability of occurrence in *any* given year.

303(d) waterbody – A list of lakes, rivers, and streams that have been designated as impaired or threatened by a pollutant(s) for which one or more TMDLs are needed. Impaired means that the water is not meeting state water quality standards.

319 – The section of the Clean Water Act that deals with nonpoint pollution

Algal bloom – Rapidly occurring growth and accumulation of algae within a body of water, which usually results from excessive nutrients or sluggish circulation within a waterbody. Persistent and frequent blooms can result in low oxygen conditions which is hazardous to aquatic life.

Aquifer – A geologic stratum containing groundwater that can be withdrawn and used for human purposes.

Average Particle Size – Average size of suspended solids expected to be exported from the site by stormwater runoff.

Backwater – Water upstream from an obstruction which is deeper than it would normally be without the obstruction.

Baffle – A device to deflect, check or regulate flow. Any deflector device used to change the direction or flow of water.

Base flow – The flow in a stream between storm events. The flow is supplied by groundwater.

Benthic – Relating to or occurring at the bottom of an aquatic ecosystem.

Berm – A constructed barrier of compacted earth.

Best Management Practice (BMP) – Actions, behaviors or on-the-ground landscaping practices that reduce pollution and/or the amount of storm water runoff flowing into local waterways. BMPs are used to control the generation and delivery of pollutants from the built environment to water ways, thereby reducing the amount of pollutants entering surface and ground waters. BMPs can be structural like stormwater ponds, rain barrels, shoreline buffers or can be non-structural, like street sweeping, picking up after your pet or washing your car on the grass.

Biochemical Oxygen Demand (BOD) – A measure of the quantity of oxygen used by microorganisms in the oxidation of organic matter.

Biofiltration swale – A long, gently sloped, vegetated ditch designed to filter pollutants from stormwater. Grass is the most common vegetation, but wetland vegetation can be used if the soil is saturated.

Bioretention – A water quality practice that utilizes landscaping and soils to treat stormwater by collecting it in shallow depressions and then filtering it through a planting soil media.

Buffer – (1) A designated area adjacent to and a part of a steep slope or landslide hazard area which protects slope stability, attenuation of surface water flows, and landslide hazards reasonably necessary to minimize risk; or a designated area adjacent to or a part of a stream or wetland that is an integral part of the stream or wetland ecosystem. (2) A vegetated strip immediately adjacent to a water body. The primary function of the buffer is to protect the receiving waterbody from sediment and pollutants derived from upstream areas. (3) An area of trees, shrubs and plants next to a waterbody designed to protect the receiving waterbody from sediment and pollutants contained in storm water runoff. Buffers also function as habitat for migratory birds and aquatic and terrestrial wildlife. (4) An area of predominantly deeply rooted native vegetated land adjacent to channels, wetlands, lakes or ponds for the purpose of stabilizing banks, reducing contaminants, including sediments, in stormwater that flows to such areas.

Catch basin – Curbside opening that collects rainwater from streets and serves as an entry point to the storm drain system.

Channel – A long, narrow excavation or surface feature that conveys surface water and is open to the air.

Channel, constructed – A channel or ditch constructed to convey surface water; also includes reconstructed natural channels.

Channel, natural – A channel which has occurred naturally due to the flow of surface waters; or a channel that, although originally constructed by human activity, has taken on the appearance of a natural channel including a stable route and biological community.

Clean Water Act – (Formerly the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972). Public law 92-500; 33 U.S.C. 1251 et seq.; legislation which provides statutory authority for the NPDES program. Also known as the Federal Water Pollution Control Act. The Clean Water Act prohibits the discharge of any pollutant to waters of the United States from a point source unless the discharge is authorized by a National Pollutant Discharge Elimination System (NPDES) permit.

Check dam – A small barrier built across the direction of water flow in a swale to retain excess water during heavy rains and to slow the speed of runoff traveling through the swale.

Combined sewer system – A system for conveying both sanitary sewage and stormwater runoff.

Constructed conveyance system facilities – Gutters, ditches, pipes, channels, and most flow control and water quality treatment facilities.

Conveyance – The process of water moving from one place to another.

Culvert – Pipe or concrete box structure which drains open channels, swales, or ditches under a roadway or embankment typically with no catch basins or manholes along its length.

Curve Number (CN) – A procedure developed to estimate runoff volume from rainfall volume. CN for particular combinations of soil and cover characteristics (soil-cover complex) have been developed by plotting largest annual storm runoff and associated rainfall for a watershed having one soil and one cover. Laid over this plot was a graph of CN array constructed at the same scale. The median CN was selected, dividing the plotting into two equal numbers of points. Curve Numbers have been developed for many soil-cover complexes and are published in the NRCS National Engineering Handbook Section 4 Hydrology (NEH-4). (1986)

Dead storage – The volume available in a depression in the ground below any conveyance system, or surface drainage pathway, or outlet invert elevation that could allow the discharge of surface and storm water runoff.

Depression storage – The amount of precipitation that is trapped in depressions on the surface of the ground.

Detention pond – A facility that collects water from developed areas and releases it at a slower rate than it enters the collection system. The excess of inflow over outflow is temporarily stored in a pond or a vault and is typically released over a few hours or a few days. A structure designed to temporarily store stormwater runoff for later release in order to delay and reduce peak flow rates. It does not have a permanent pool of water at non storm event times. The most common detention facilities include *dry basins*.

Discharge – The volume of water (and suspended sediment if surface water) that passes a given location within a given period of time.

Dissolved oxygen (DO) – The amount of oxygen that is dissolved in water. It also refers to a measure of the amount of oxygen available for biochemical activity in a waterbody and as indicator of the quality of that water.

Diversion – A change in the natural discharge location or runoff flows onto or away from an adjacent downstream property.

Domestic wastewater – Wastewater discharged from residences and from commercial, institutional and similar facilities; also known as wastewater or sanitary wastewater.

Drainage – The collection, conveyance, containment, and/or discharge of surface and storm water runoff.

Drainage area or Drainage basin – A watershed. An area draining to a point of interest. An area of catchment contributing runoff to the treatment system.

Drainage facility – A constructed or engineered feature that collects, conveys, stores or treats surface and storm water runoff. Drainage facilities shall include but not be limited to all constructed or engineered streams, pipelines, channels, ditches, gutters, lakes, wetlands, closed depressions, flow control or water quality treatment facilities, erosion and sedimentation control facilities, and other drainage structures and appurtenances that provide for drainage.

Easement – A right, such as a right-of-way, afforded a person to make limited use of another's real property.

Ecosystem – An interactive system that includes the organisms of a natural community together with their biological, physical, and chemical environment.

Erosion – The process by which the land's surface is worn away by the action of wind, water, ice or gravity. When land is diminished or worn away due to wind, water, or glacial ice. Often the eroded debris (silt or sediment) becomes a pollutant via stormwater runoff. Erosion occurs naturally but can be intensified by land clearing activities such as farming, development, road-building, and timber harvesting.

ESC – Erosion and Sediment Control

Estuary – Brackish-water area influenced by the tides where the mouth of the river meets the sea.

Eutrophic – A condition of a water body in which excess nutrients, particularly phosphorous, stimulates the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen. Thus, less dissolved oxygen is available to other aquatic life.

Eutrophication – Having waters rich in mineral and organic nutrients that promote a proliferation of plant life, especially algae, which reduces the dissolved oxygen content and often causes the extinction of other organisms. Used for a lake or pond.

Evapotranspiration – A term used to describe the sum of evaporation and plant transpiration from the Earth's land surface to atmosphere. Evaporation accounts for the movement of water to the air from sources such as the soil, canopy interception, and waterbodies. Transpiration accounts for the movement of water within a plant and the subsequent loss of water as vapor through stomata in its leaves. Evapotranspiration is an important part of the water cycle.

Fecal coliform bacteria – Bacteria that are present in the intestines or feces of warm-blooded animals. Often used as indicators of water quality.

First Flush – The first big rain after an extended dry period (usually summer) which flushes out the accumulated pollutants in the storm drain system and carries them straight to the ocean.

Floodplain – Land typically adjacent to a body of water with ground surface elevations at or below the base flood or the 100-year frequency flood elevation and includes detached special flood hazard areas, ponding areas and the like.

Forebay – Stormwater design feature that uses a small basin to settle out incoming sediment delivered in runoff to a stormwater BMP.

Geographic information systems (GIS) – A computer system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data related to positions on the Earth's surface. Typically, GIS is used for handling maps of one kind or another. These might be represented as several different layers where each layer holds data about a particular kind of feature (i.e., roads, waterbodies, etc). Each feature is linked to a position on the graphical image of a map.

Grading – The cutting and/or filling of the land surface to a desired slope or elevation.

Green Roof – Green roofs are either partially or completely vegetated in growing soil to hold rainwater instead of shedding rain into downspouts. They can be planted in waterproof containers and can be intensive like a rooftop park or extensive, covering the entire roof area. They function for stormwater management purposes when they are lush and green or when they are dormant.

Greenways – Greenways include riparian and non-riparian buffer zones and strips that store and drain stormwater runoff into the ground naturally. As vegetated strips that help infiltrate and evapotranspire both rainwater and snow melt, they can be placed along bike paths, sidewalks, riverbanks, and streets. They can be planted with native vegetation, in mowed grass, as gardens.

Groundwater – Water below the earth's surface, often between saturated soil and rock, that feeds drinking wells and springs. Runoff can seep into the soil and recharge groundwater supplies.

Gutter – The edge of a street (below the curb) designed to drain water runoff from streets, driveways, parking lots, etc. into catch basins.

Habitat – The specific area or environment where a plant or animal lives. A habitat must provide all of the basic requirements for life (food, water, shelter) and should be free of harmful contaminants and pollution.

Harmful pollutant – A substance that has adverse effects to an organism including death, chronic poisoning, impaired reproduction, cancer, or other effects.

Household hazardous waste – Common everyday products that people use in and around their homes—including paint, paint thinner, herbicides, and pesticides—that, due to their chemical nature, can be hazardous if not properly disposed

Hydraulics – The science and study of the mechanical behavior of water in physical systems and processes

Hydrologic cycle – The circuit of water movement from the atmosphere to the earth and return to the atmosphere through various stages or processes such as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.

Hydrologic Soil Classification – A classification of soils depending on their infiltration rate. It groups all soils into four basic groups depending on the minimum infiltration capacity, and based on laboratory tests and soil texture. The four groups were A, B, C, and D, with sands in group A, and clays in group D. Presently, about 14,000 soils have been so classified in the United States. This hydrologic classification system is a major component of the runoff Curve Number system for classification of hydrologic sites.

Hydrology – The science of the behavior of water, including its dynamics, composition and distribution in the atmosphere, on the surface of the earth and underground

Illegal Discharge – Any discharge to a MS4 that is not composed entirely of storm water except discharges authorized by a WPDES permit or other discharge not requiring a WPDES permit such as landscape irrigation, individual residential car washing, firefighting and similar discharges.

Impervious surface – A hard surface area which either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development; and/or a hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Rooftops, sidewalks, parking lots, and street surfaces are examples of impervious surfaces

Infiltration – The process by which rainfall or surface runoff percolates or penetrates into the underlying soil.

Invert – Elevation of the inside bottom of the pipe.

Maximum Extent Practicable (MEP) – A standard for water quality that applies to all MS4 operators regulated under the NPDES Stormwater Program. Since no precise definition of MEP exists, it allows for maximum flexibility on the part of MS4 operators as they develop and implement their programs.

MS4 or Municipal Separate Storm Sewer System – A conveyance or system of conveyances including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, constructed channels or storm drains, that discharges to waters of the U.S. and is designed or used for collecting or conveying stormwater, is not a combined sewer, and is not part of a publicly-owned treatment works (POTW).

Natural conveyance system elements – Swales and small drainage courses, streams, rivers, lakes, and wetlands.

Natural onsite drainage feature – A natural swale, channel, stream, closed depression, wetland, or lake.

Net Annual TSS Load Reduction – Suspended solids removal efficiency target.

Non-point Source (NPS) pollutants – Pollutants from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water.

Nonpoint source (NPS) pollution – (1) NPS pollution occurs when rainfall, snowmelt, or irrigation runs over land or through the ground, picks up pollutants, and deposits them into rivers, lakes, and coastal waters or introduces them into ground water. (2) broad term referring to the type of pollution that is caused by non-specific sources, including human-made and natural pollutants. By contrast, the direct dumping of chemicals into a water body by a factory would be a specific source for pollution. (3) Pollution that comes from many different sources in a watershed and is carried by storm water runoff into local waterways. Sources of NPS pollution are difficult to identify and control. Typical NPS pollutants are pet waste, lawn fertilizer, pesticides, car washing detergents, litter and sediment.

Nonstructural BMP – A preventative action to protect receiving water quality that does not require construction. Nonstructural BMPs rely predominantly on behavioral changes in order to be effective. Major categories of non-structural BMPs include education, recycling, maintenance practices and source controls.

NPDES (National Pollutant Discharge Elimination System) – (1) The name of the surface water quality program authorized by Congress as part of the 1987 Clean Water Act. This is EPA's program to control the discharge of pollutants to waters of the United States (see 40 CFR 122.2). (2) A permit issued by the US EPA or a state regulatory agency that sets specific limits on the type and amount of pollutants that a municipality or industry can discharge to a receiving water; it also includes a compliance schedule for achieving those

limits. The permit process was established under provisions of the federal Clean Water Act.

NR 151 – Created by the WDNR and enacted under NR 216 includes non-agricultural performance standards, agricultural performance standards, transportation performance standards, implementation and enforcement provisions, and a process to develop and distribute non-agricultural technical standards. The non-agricultural performance standards encompass the construction and post-construction phases of new development and redevelopment areas, as well as certain requirements for developed urban areas. The standards targeting a percent removal of the total suspended solids, a reduction of the peak discharge rate, and an increase in the infiltration rate, are intended to protect water quality by minimizing the amount of sediment and other non-point source pollutants that enter waterways.

NR 216 – Wisconsin Administrative Code Chapter created by the WDNR and enacted under the WPDES permit establishes criteria defining those storm water discharges needing WPDES storm water discharge permits, as required by s. 283.33, Stats. The goal of NR 216 is to eliminate to the maximum extent practicable the discharge of pollutants carried by storm water runoff into waters of the state from certain industrial facilities, construction sites and municipal storm water runoff.

NRCS – United States Department of Agriculture Natural Resources Conservation Service (formerly Soil Conservation Service (SCS)).

Nutrient – A primary element necessary for the growth of living organisms. For example, nitrogen and phosphorous, are nutrients required for phytoplankton (algae) growth.

Outfall – The point at which storm water is discharged to waters of the state or leaves one municipality and enters another.

Oxygen depletion – Deficit of dissolved oxygen in a water system due to oxidation of organic matter.

Peak Flow – The maximum flow that the collection system is designed to handle, typically associated with a recurrence interval (e.g., 10-yr, 25-yr, 50-y or 100-yr).

Percent Impervious – The specific portion of the contributing drainage area that does not allow stormwater to infiltrate, usually expressed as a percent 0-100%. Examples include asphalt or bituminous surface and other non-porous or compacted surfaces.

Pervious Surface – A surface that infiltrates rainfall during a large portion of the design rainfall event. Well-managed lawns, fields, and woodlands are examples of pervious surfaces. Pervious materials allow water to soak into the surface by virtue of their porous nature or by “void” spaces in the material.

Phase 1 Stormwater Permit Program – The Phase I program addressed sources of storm water runoff that had the greatest potential to negatively impact water quality. Under Phase I, EPA required NPDES permit coverage for storm water discharges from “medium” and “large” municipal separate storm sewer systems (MS4s) located in incorporated places or counties with populations of 100,000 or more; and eleven categories of industrial activity, one of which is construction activity that disturbs five or more acres of land.

Phase 2 Stormwater Permit Program – The Phase II Program requires NPDES permit coverage for storm water discharges from certain regulated small municipal separate storm sewer systems (MS4s); and construction activity disturbing between 1 and 5 acres of land.

Physically interconnected MS4 – This means that one MS4 is connected to a second MS4 in such a way that it allows for direct discharges into the second system.

Point discharge – The release of collected and/or concentrated surface and storm water runoff from a pipe, culvert, or channel.

Point Source Pollution – Pollution from a single identifiable source such as an industrial factory or a sewage-treatment plant. Most of this pollution is highly regulated at the state and local levels.

Pollutant loading – The total quantity of pollutants in stormwater runoff.

Pollution – Any substance that exists in the environment that is undesirable or harmful for that environment.

Pollution-generating pervious surface – A non-impervious surface with vegetative ground cover subject to use of pesticides and fertilizers. Such surfaces include, but are not limited to, the lawn and landscaped areas of residential or commercial sites, golf courses, parks, and sports fields.

Porous Pavement – Porous pavement can reduce the surface runoff through its permeable surface. Runoff would percolate into the ground or conveyed offsite as

part of a stormwater system. Porous pavements can be of asphalt or concrete.

Rain Barrels are often 50 to 80 gallon containers placed underneath downspouts that collect rainwater to reduce runoff volumes discharging offsite. The barrel is often configured with a hose to provide water for gardens and lawns.

Rain Garden – Landscaped areas designed to capture and contain localized runoff. The garden is often planted with plants that can handle wet conditions and have the ability to remove pollutants. A rain garden helps to prevent erosion and reduce stormwater runoff discharging off site.

Rainwater Harvesting – The capture and storage of rainwater. It also includes the ability to reuse the stored rainwater for appropriate uses, primarily gardening and lawn watering. Harvesting is accomplished through collection and storage systems.

Reach – A length of channel with uniform characteristics.

Receiving waters – (1) Bodies of water or surface water systems receiving water from upstream man-made or natural systems. (2) Creeks, streams, rivers, lakes, estuaries and other bodies of water into which stormwater flows into.

Recharge – The flow to groundwater from the infiltration of surface and stormwater runoff.

Regulated MS4 – Any MS4 covered by the NPDES Stormwater Program (regulated, small, medium, or large MS4s).

Retention – The process of collecting and holding surface and storm water runoff with no surface outflow.

Retention Pond – A storage structure designed to reduce or eliminate the surface discharge of stormwater through *evaporation* and *infiltration* reduce pollutant concentrations. Wet ponds are the most common type of retention storage.

Riparian – Pertaining to the banks of rivers and streams, and sometimes also wetlands, lakes, or tidewater.

Riprap – A facing layer or protective mound of stones placed to prevent erosion or sloughing of a structure or embankment due to the flow of surface and storm water runoff.

Runoff – Water originating from rainfall and other precipitation that ultimately flows into drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands as well as shallow groundwater.

Runoff Coefficient – The percentage of rainfall volume that will become runoff.

Runoff means stormwater or precipitation including rain, snow or ice melt or similar water that moves on the land surface via sheet or channelized flow.

Sanitary sewer system – The system that collects and transports sanitary wastewater from building plumbing systems to a wastewater treatment plant for treatment (i.e. wastewater from toilets, showers, sinks, water fountains).

SCS – Soil Conservation Service. Former name of the US Department of Agriculture's Natural Resources Conservation Service

Sediment – Soil or dirt that washes into a body of water and contributes additional nutrients to the water. Sediment often comes from construction sites or bare lawns. Sediment can destroy fish-nesting areas, clog animal habitats, and cloud waters so that sunlight does not reach aquatic plants.

Separate storm sewer – A conveyance or system of conveyances including roads with drainage systems, streets, catch basins, curbs, gutters, ditches, constructed channels or storm drains, which meets all of the following criteria:

Sheet flow – The portion of precipitation that moves initially as overland flow in very shallow depths before eventually reaching a stream channel.

Source control – Action to prevent pollution where it originates.

Storm drainage system – The system built to collect and transport runoff to prevent flooding. This system consists of storm drains, drainage ditches, pipes and culverts. Anything that flows into the storm drainage system flows directly into local creeks and waterways. (Storm water runoff is not treated.) Storm drainage systems are completely separate from those that carry domestic and commercial wastewater (sanitary sewer system).

Storm Sewer – A sewer carrying only runoff from storm events.

Stormwater – Runoff water resulting from precipitation.

Stormwater Facility – All ditches, channels, conduits, bridges, culverts, levees, ponds, natural and manmade impoundments, wetlands, riparian environment, tile, swales, sewers or other natural or artificial structures or measures which serve as a means of draining surface water and groundwater from land. Stormwater facilities included storage facilities (ponds, vaults, underground tanks, and infiltration systems); water quality facilities (wet ponds, biofiltration swales, constructed wetlands, sand filters, and oil/water separators); and conveyance systems (ditches, pipes, and catch basins). These systems are most often built in conjunction with new development. Once constructed, stormwater facilities require on-going maintenance to ensure they continue to perform as intended. Maintenance of storage facilities typically includes the removal of accumulated sediment and debris, routine mowing, and minor repairs to mechanical appurtenances. Management of water quality facilities is more complex, requiring intensive vegetation management, inspection and maintenance of flow control features, and restoration or replacement of filter media.

Stormwater Management Plan – A document that identifies what actions will be taken to reduce stormwater quantity and pollutant loads from land development activity to levels meeting the purpose and intent of this Section.

Stormwater Pollution – Water from rain, irrigation, garden hoses or other activities that picks up pollutants (cigarette butts, trash, automotive fluids, used oil, paint, fertilizers and pesticides, lawn and garden clippings and pet waste) from streets, parking lots, driveways and yards and carries them through the storm drain system to a local water body.

Stormwater Pollution Prevention Plan (SWPPP) – A plan to describe a process whereby a facility thoroughly evaluates potential pollutant sources at a site and selects and implements appropriate measures designed to prevent or control the discharge of pollutants in stormwater runoff.

Stormwater Runoff – Water from rain, melted snow or landscaping irrigation that flows over land and into local creeks, streams and waterways. Runoff carries pollutants in it.

Stormwater Trees – Stormwater trees can hold rainwater on their leaves and branches, infiltrate it to the ground, absorb it through root systems and evapotranspire it to the atmosphere. They can be used in conjunction with engineered soils and other types of green infrastructure and work best when they are mature.

Structural BMP – Constructed facilities or measures to help protect receiving water quality and control stormwater quantity. Examples include storage, vegetation, infiltration, and filtration.

Structural Storm Water Management Facilities are engineered and constructed systems that are designed to provide storm water quality control such as wet detention ponds, constructed wetlands, infiltration basins and grassed swales.

Surface water – The water that rests on top of the earth in streams, lakes, rivers, oceans and reservoirs and is open to the atmosphere.

Swale – A shallow drainage conveyance with relatively gentle side slopes, generally with flow depths less than one foot.

Time of Concentration – The amount of time it takes a drop of water falling in the hydraulically most distant point in the watershed to reach the watershed outfall.

Total Kjeldahl Nitrogen – The sum of organic nitrogen and ammonia in a water body.

Total Maximum Daily Load (TMDL) – The maximum amount of pollutants which can be released into a water body without adversely affecting the water quality.

Toxic – Poisonous, carcinogenic, or otherwise directly harmful to life.

Toxic substances – Those chemical substances, such as pesticides, plastics, heavy metals, detergents, solvents, or any other harmful materials, which are or have constituents that are poisonous, carcinogenic, or otherwise directly harmful to human health and the environment.

Tributary – A stream that flows into a larger stream or other body of water.

Turbidity – Having sediment or foreign particles stirred up or suspended in water; muddy.

Urbanized Area (UA) – A Bureau of the Census determination of a central place (or places) and the adjacent densely settled surrounding territory that together have a minimum residential population of 50,000 people and a minimum average density of 1,000 people/square mile. This is a simplified definition of a UA, the full definition is very complex.

Wastewater – Usually refers to sanitary sewage and other waste water destined for treatment at a sewage treatment plant.

Water quality – The biological, chemical and physical conditions of a waterbody; a measure of the ability of a waterbody to support beneficial uses.

Water Quality Criteria – Specific levels of water quality that, if achieved, are expected to render a body of water suitable for its designated use. The criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

Water Quality Standards – State-adopted and EPA-approved ambient standards for waterbodies. The standards cover the use of the waterbody and the water quality criteria that must be met to protect the designated use or uses.

Water quality treatment facility – A drainage facility designed to reduce pollutants once they are already contained in surface and storm water runoff. Water quality treatment facilities are the structural component of best management practices (BMPs); when used singly or in combination, WQ facilities reduce the potential for contamination of surface and/or ground waters.

Water Table – The upper limit of a free water surface in a saturated soil or underlying material.

Waters of the State – Surface waters, groundwater and wetlands.

Watershed – (1) A geographic area in which water, sediments, and dissolved materials drain to a common outlet, typically a point on a larger stream, a lake, an underlying aquifer, an estuary, or an ocean. A watershed is also sometimes referred to as the “drainage basin” of the receiving waterbody. (2) All land drained by, or contributing water to the same stream, lake, stormwater facility, or draining to a point.

Watershed plan – A plan and all implementing regulations and procedures including but not limited to capital projects, public education activities, land use management regulations adopted by ordinance for managing surface and storm water management facilities, and features within individual subbasins.

Wet Retention Pond – A permanent pool of water with designed dimensions, outlets and storage capacity, constructed to collect, *detain*, *treat* and release stormwater runoff.

Wet Volume – The volume available in a depression in the ground below any conveyance system, or surface drainage pathway, or outlet invert elevation that could allow the discharge of surface and storm water runoff.

Wetland – An area inundated or saturated by ground or surface water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (U.S. Army Corps of Engineers Regulation 33 CFR 328.3 (1988)).

WPDES, Wisconsin Pollution Discharge Elimination System requires municipalities, industrial sites, and animal waste operations discharging water to surface or groundwater to obtain WPDES permits for wastewater discharge, storm water runoff, runoff from large animal operations (CAFOs). Each permit contains monitoring, reporting, and operational requirements needed to ensure protection of Wisconsin’s water resources.





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