Maintaining Stormwater Systems

A Guidebook for MS4s and Private Owners in Iowa

Iowa Storm Water Education Program

2008

The Iowa Stormwater Education Program...

Providing educational and technical resources to communities, agencies and others to promote positive action on the part of the public to protect water quality.

PROGRAM SUPPORTED BY:

Altoona, Ames, Ankeny, Asbury, Bettendorf, Bondurant, Cedar Falls, Cedar Rapids, Clinton, Clive, Conservation Districts of Iowa, Coralville, Council Bluffs, Davenport, Des Moines, Grimes, Hiawatha, Iowa City, Johnston, Marion, Marshalltown, Muscatine, North Liberty, Norwalk, Ottumwa, Pleasant Hill, Sergeant Bluff, Sioux City, Storm Lake, University of Iowa, Urbandale, Waterloo, Waukee, Windsor Heights

MSA PROFESSIONAL SERVICES

Acknowledgments: This manual was adapted from the Northern Virginia Planning District Commission Manual *Maintaining Your Stormwater System* and the *Iowa Stormwater Managment Manual*.

THIS GUIDEBOOK IS a resource on maintaining stormwater management facilities. However, it is not a set of rules and regulations or a manual that provides guidance on how to design or build a stormwater management facility.

For specific information regarding regulations, contact your local government agency.

Contents

The Stormwater Story

While Webster's New Millennium Dictionary describes stormwater as "an abnormal amount of surface water due to a heavy rain or snowstorm," stormwater can be a valuable resource if properly managed.

Rainfall and snow melt keep gardens green, streams and rivers full, and wells from running dry. However, stormwater problems can occur when there is too much of a good thing, or when excessive pollution and changes in land use prevent natural infiltration and filtering processes from taking place.

Stormwater Challenges

Once rain reaches the ground, what happens next depends largely on land cover type. Rain falling in a prairie is slowed, filtered, and absorbed as it makes its way into the ground or to the nearest stream, river, or reservoir. In contrast, hard, impervious surfaces such as roof tops and roads send stormwater rushing to the nearest ditch, culvert, storm drain, and stream.

This stormwater picks up pollutants, such as heavy metals, gas, oil, nutrients, and sediment, along the way. Uncontrolled stormwater erodes stream banks, causes flooding, and carries nutrients and sediment downstream. An excess of nutrients contributes to the expansion of oxygen-depleted "dead zones" in local and regional waterways.

Stormwater Solutions

To improve the quality and reduce the quantity of stormwater runoff, before it enters natural waterways, stormwater **Best Management Practices**, or **BMPs**, are promoted throughout Iowa's residential and commercial areas.

BMPs range from structural facilities, such as ponds, bioretention areas, to non-structural practices, such as street-sweeping and educational efforts.

Simple Things Residents Can Do

There are several simple things residents can do to ensure stormwater facilities function properly and the downstream aquatic environment is protected.

- Pick up after pets, always. Place their waste in the trash or flush it down the toilet.
- Place motor oil, paint and antifreeze in separate sturdy containers and recycle them at a local disposal facility.
  Never pour them down the storm drain.
- Compost yard waste or bag it for municipal collection.
- Recycle or put litter in the trash.
- Fertilize in the fall, if at all, to reduce algal blooms.
- Call your City or County government, local Fire Department, or Iowa Department of Natural Resources if there is a visible oil spill or other liquid spill into a waterway.

Short History of Stormwater Management

Over time, the approaches to managing stormwater have adapted to a variety of different challenges. The techniques used to control stormwater evolved from ditches and pipes that remove water quickly and reduce flooding to an intricate system of practices that retain water and improve its quality.

Short History of Stormwater Solutions

Pre-1900s - *Run It All in Ditches*
Everything (stormwater, kitchen waste, wastewater) drained to the nearest stream.

Early-1900s - *Run It All in Pipes*
All waste efficiently got to the stream through the same pipe. But, downstream neighbors became ill due to upstream-generated waste. It was then recognized that sewage and stormwater require different levels of water quality treatment.

From 1940s - *Run It in Separate Stormwater Pipes*
A system of catch basins and pipes was developed to get stormwater to the nearest stream.

Early-1970s - *Keep It From Stormwater Pipes*
Stormwater was detained in ponds. This approach worked in theory but not in practice, as too many detention ponds releasing water at a controlled rate at the same time caused downstream flooding and an increase in the frequency and duration of runoff events.

1970-80s - *Well, Just Don't Cause Flooding*
Stormwater Master Plans were developed. However, very few plans were actually completed as designed, and stormwater runoff was identified as a major pollution source.

Late-1980s - *Oh, and Don't Pollute Either*
Best Management Practices or ways to improve the quality of stormwater runoff were implemented. However, the lack of good data on **BMP** efficiency or comprehensive monitoring programs were problematic.

Early-1990s - *It's the Ecology*
Use of biological criteria and bioassessment protocols became a common parameter for determining the type of stormwater management practice. But there were still questions about which parameters actually contribute to solutions to runoff problems.

Late-1990s - *Water is Water is Watershed*
Planning was conducted according to where the water flows, a watershed approach. However, people didn't relate to watersheds, and the watershed approach may be too large in scale to have an impact at the site level or to be meaningful to residents, which is where political change begins.

Present - *Green and Bear It*
A range of approaches is considered to address basic issues and institutional practices associated with the way in which land is used or developed: green infrastructure, conservation development, low impact development (LID), better site design, etc. This paradigm returns to small-scale distributed approaches that will succeed if supported and enforced by local governments.

Adapted from Land and Water, May-June 2004, Andy Reese of Amec Earth and Environmental

Future - A Vision of Comprehensive Stormwater Management
Mimicking pre-development runoff characteristics will become increasingly important as regulations continue to encourage using watershed planning for expanded nutrient control and streambank preservation. Monitoring the effectiveness of green technologies at improving the quality and decreasing the quantity of stormwater runoff leads to improved designs and performance criteria. Stormwater is viewed as a resource as opposed to a waste product.

Key Points to Remember When Reading This Guide

A thorough inspection and maintenance program for any stormwater management facility will save time and money in the long term.

Identify Facility Characteristics and Maintenance Needs	Understand how the facility works and its specific maintenance needs. While this Guidebook includes general information on the maintenance needs of common stormwater management facilities,
Check the Maintenance Agreement	If there is a stormwater management facility maintenance agreement, consult it often to ensure that specific obligations are met.
Perform Routine Inspections	The frequency of required inspections may be found in the maintenance agreement, the technical guide provided by the manufacturer, or on the facility's design specifications. In some local jurisdictions, all inspections are conducted by staff, while maintenance is typically the responsibility of the owner.
Define Maintenance Tasks, Personnel, and Equipment	Defining maintenance tasks and who will undertake these tasks - along with establishing a regular inspection program - is the core of a successful stormwater management facility maintenance program.
Identify Costs and Allocate Resources	While routine maintenance costs can typically be predicted for an annual budget, some maintenance tasks will require infrequent but considerable expense. Non-routine expenses need to be identified, and a long-term fund allocation plan needs to be developed.
Involve the Community, if possible	Pollution treated by the stormwater management facility may be generated from surrounding yards, streets, and businesses. Implementing a pollution prevention program and educating neighbors on the purpose of the stormwater management facility is a cost-effective way to prolong its life and to protect water quality.
Establish a Record Keeping Procedure	Establishing a record keeping procedure will help to define chronic maintenance problems and aid in future budget preparation. A periodic examination of maintenance practices will assist in identifying persistent problems early.

Identify Facilities and Maintenance Needs

There are many types of stormwater management facilities, which are introduced in this manual. Taking a moment to understand what kind of stormwater management facility you have and how it works, will help you to better plan for its maintenance needs.


Infiltration Trench


Infiltration Basin


Bioretention


Rain Garden


Sand Filter

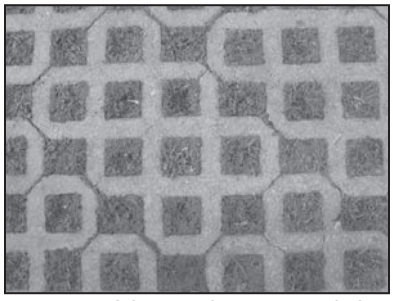

Native Landscaping


Dry Detention Pond

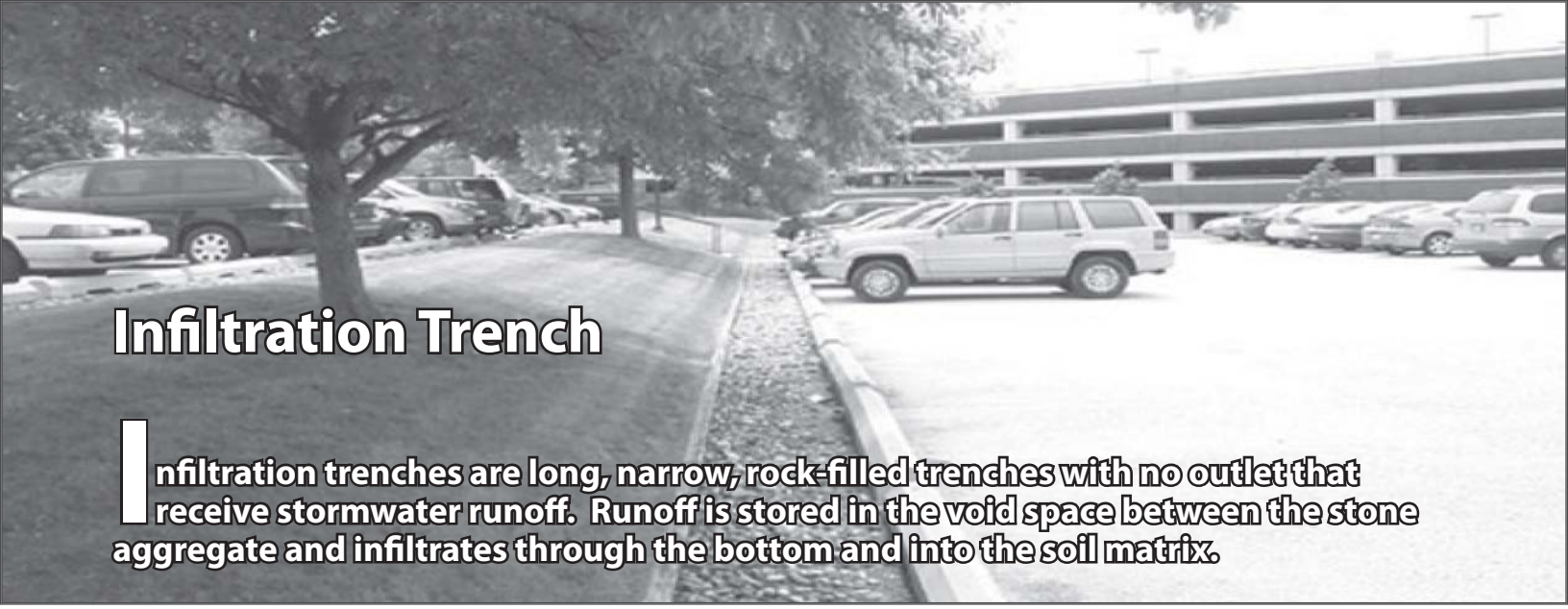

Wet Detention Pond


Stormwater Wetland


Vegetated Swale

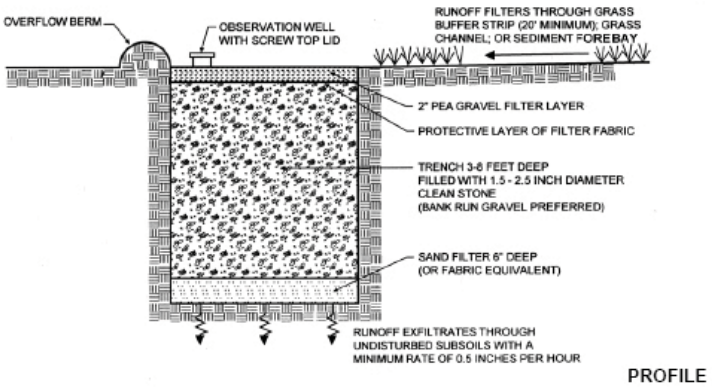

Perneable Paving Materials


Vegetated Rooftop



Infiltration Trench

Infiltration trenches are long, narrow, rock-filled trenches with no outlet that receive stormwater runoff. Runoff is stored in the void space between the stone aggregate and infiltrates through the bottom and into the soil matrix.



PROFILE

Infiltration trenches are classified in two ways:

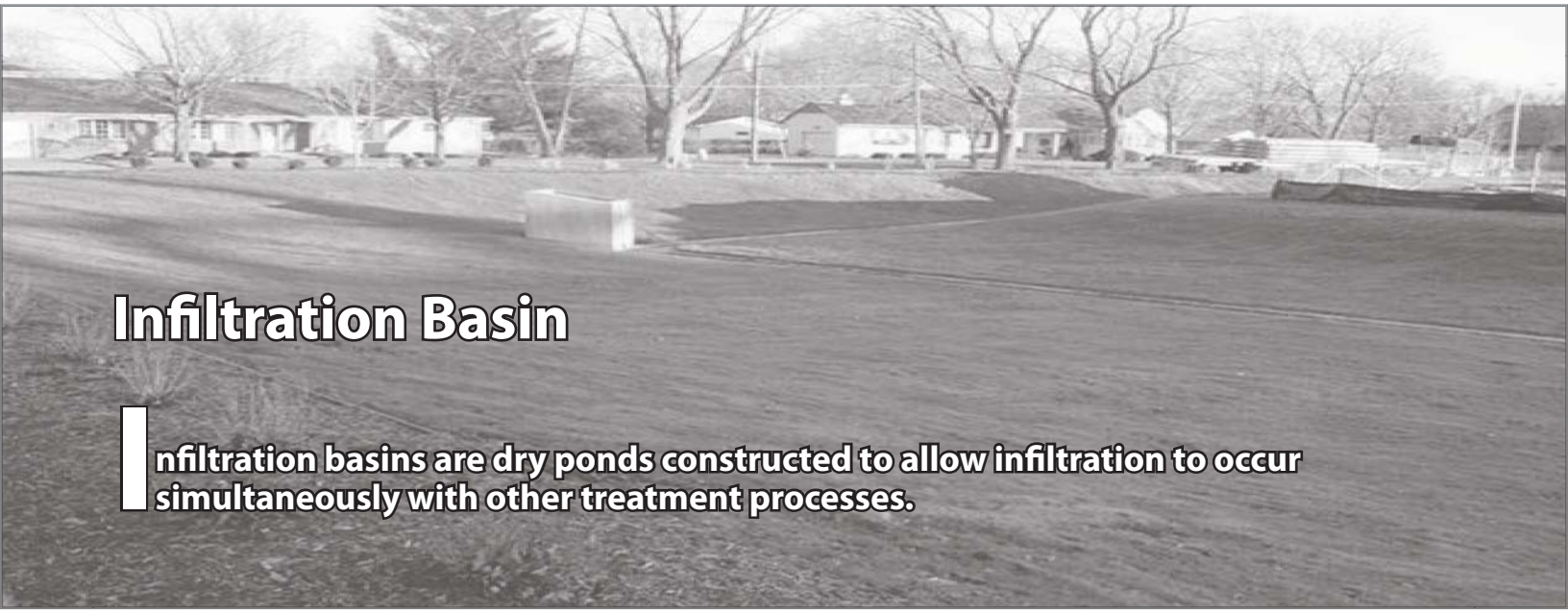
In dispersed input facilities, runoff from impervious surfaces is directed over a gently sloping grass area before it reaches the facility, to remove large particles that otherwise might cause clogging.

In concentrated input facilities, runoff is transferred to the trench directly from curb inlets, gutters, and pipes.

MAINTENANCE IS REQUIRED WHEN:

- Standing water is visible in the observation well 48 hours after a rain even
- Insects and/or odor become problems.
- Wetland vegetation emerges.
- There is visible damage to the embankment (such as sinkholes) or to the mechanical components.
- Trash, leaves, and other debris are visible on the gravel surface.
- Runoff flows across, rather than into, the facility.

The purpose of an infiltration trench is to infiltrate stormwater.



Infiltration Basin

Infiltration basins are dry ponds constructed to allow infiltration to occur simultaneously with other treatment processes.

Infiltration basins are often designed as off-line or end-of-pipe BMPs to capture a defined volume of stormwater runoff volume and transform the water into groundwater flow through infiltration.

Pollutants are also removed through filtration and adsorption as the water percolates through the underlying soils.

MAINTENANCE IS REQUIRED WHEN:

- Sediment accumulation is observed in forebay, if present.
- Sediment accumulation is observed in the basin.
- There is settling, cracking, erosion, leakage, or tree growth on the embankments.
- There is accumulation of trash or debris.

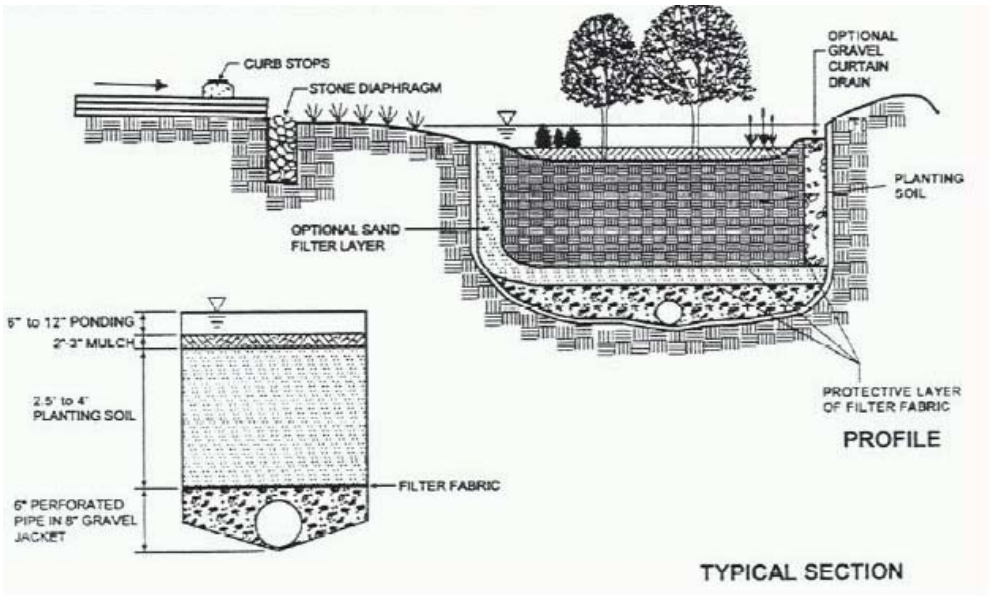
A key feature of an infiltration basin is vegetation, which increases the infiltration capacity of the basin.

Bioretention

Bioretention areas are structural stormwater controls that capture and temporarily store the water quality volume using soils and vegetation in shallow basins or landscaped areas to remove pollutants from stormwater runoff.

The facility is planted with specific types of vegetation that can withstand both wet and dry weather extremes. Reference information for plants recommended for Bioretention Basins can be found in the Iowa Rain Garden Design and Installation Manual.

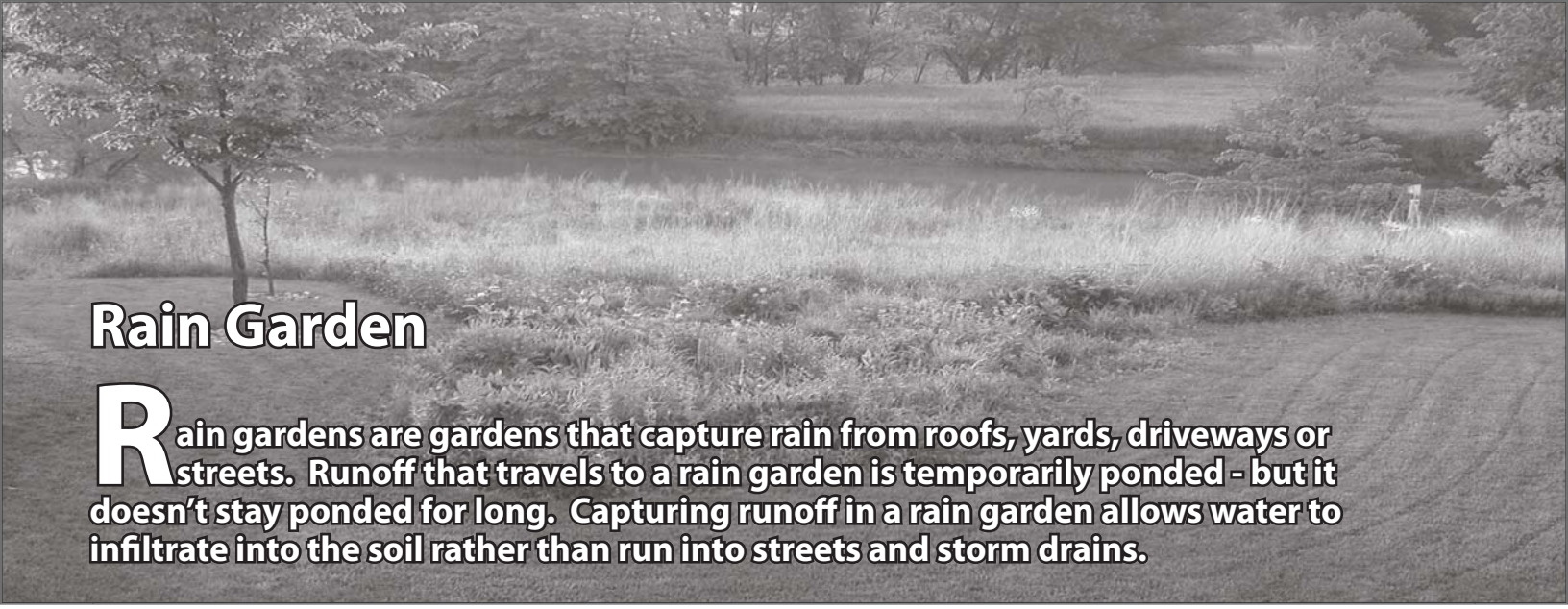
In areas where the local soils do not support infiltration, a bioretention facility may be underlain with layers of sand or gravel and an underdrain that carries treated water to the storm drain network.



MAINTENANCE IS REQUIRED WHEN:

- Standing water is visible in the basin 72 hours after a rain event.
- Insects and/or odor become problems.
- Vegetation is wilting, discolored, or dying.
- Erosion is visible within the basin, on the berms, or on the slopes.
- Settling has occurred along the berm, if present.
- The overflow riser or grate is covered by debris.

Bioretention facilities intercept stormwater runoff and use plants and soil layers to remove pollutants.



Rain Garden

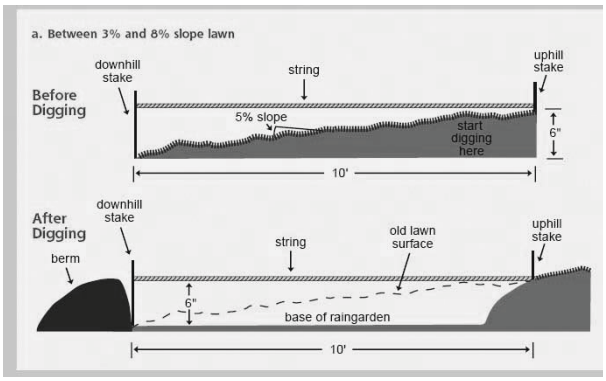
Rain gardens are gardens that capture rain from roofs, yards, driveways or streets. Runoff that travels to a rain garden is temporarily ponded - but it doesn't stay ponded for long. Capturing runoff in a rain garden allows water to infiltrate into the soil rather than run into streets and storm drains.

Rain gardens are an infiltration-based storm water management practice that relies on soils with good percolation rates to help manage rainfall to protect water quality. By installing rain gardens, homeowners can create landscapes that add beauty, wildlife habitat and interest to a yard while helping manage storm water more sustainably.

Rain gardens are a key practice for creating landscapes that are both beautiful and hydrologically functional - that is - landscapes that hold and infiltrate rainfall rather than generating runoff that causes water quality problems and contributes to flooding.

MAINTENANCE IS REQUIRED WHEN:

- Water ponds for more than 24 hours.
- Vegetation has died and needs replacing.
- Erosion is visible on the berm, the cut slope, the floor of the rain garden, or where the rain garden outlet(s) overflows.
- A low spot has developed on the berm due to settling.



It is important that the rain garden be level from side to side and end to end so that water infiltrates uniformly across the bottom of the rain garden.

Perhaps the most important maintenance item is to keep the rain garden weeded, especially the first couple of years when natives are establishing their deep root systems.

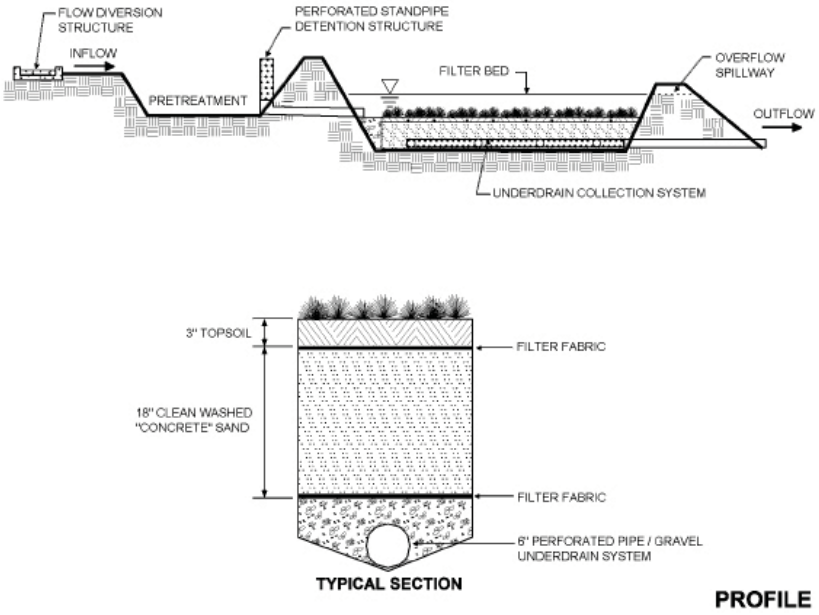
Sand Filtration System - "Sand Filter"

Sand filtration systems are used to treat runoff from highly impervious settings (commercial/office complexes and high density residential areas). To save space, sand filters are usually constructed inside a concrete shell and placed underground.

Sand filters consist of a series of chambers that remove heavy sediment, floatable debris, and oil, before slowly filtering stormwater through a layer of sand (and sometimes a sand/peat mix) where additional pollutants are removed when they become trapped between sand particles and other filter media. In some filters, microbes help remove metal and nutrient pollutants through biochemical conversion.

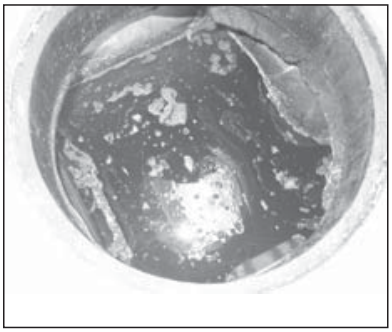
The perimeter sand filter is an enclosed filter system typically constructed just below grade in a vault along the edge of an impervious area such as a parking lot.

From the surface, some sand filters look like a series of manholes.



MAINTENANCE IS REQUIRED WHEN:

- The facility has reached its capacity for sediment accumulation, see the device's owners manual for specific amounts.
- Standing water is noticeable in the sediment and/or filter chambers.
- Excessive amounts of oil and trash are visible in the sediment chamber.
- Regular maintenance time interval has passed.



Sand filters are commonly used in areas where stormwater runoff has a high concentration of oil and grease.

Native Landscaping

Native plants are those that grew naturally in Iowa before European settlement and are well adapted to this environment. The deep root systems of native plants let to the development of Iowa's fertile soils, and still can contribute significantly to soil quality enhancement.

Landscaping with native plants is a simple way to obtain multiple benefits while mimicking the native ecosystems of the tallgrass prairie, oak savannas, woodlands, and wetlands. Native species are low maintenance once established because they are adapted to Iowa temperatures, wind, and rainfall patterns. Properly-designed native landscaping can improve the value of the site, improve aesthetics, support wildlife, increase soil and water quality, and absorb noise.

Through plant uptake, plants can bind nutrients and other pollutants, and remove water through evapotranspiration. Pathways for rainfall infiltration will be created through root development, which also contributes to a healthy soil structure. An additional benefit of the deep root system is seen when native plants also resist local pests and disease.

Native species bloom at a variety of times throughout the growing season and attract butterflies and birds often not seen in non-native landscapes. Native plants attract this variety of beneficial birds, butterflies, insects, and other wildlife by providing diverse habitats and food sources.

Carefully chosen native plants can be used in a wide variety of infiltration and filtration practices to increase water quality.

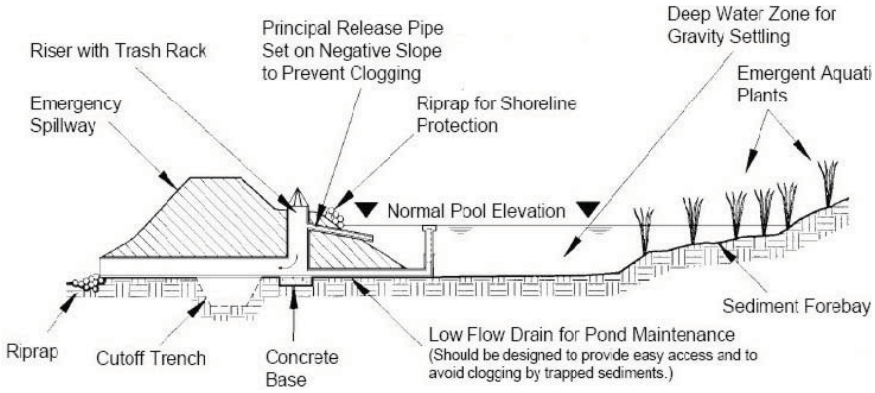
MAINTENANCE IS REQUIRED WHEN:

- Establishing the deep root systems of native plants, especially in the first year.
- There is excessive weed growth or pressure.
- Bare patches appear.
- Dead vegetation requires removal, usually in the spring or fall.

Dry Detention Pond and Dry Extended Detention (ED) Pond

Dry ponds retain water for a specified period of time (usually 48 hours) after a storm. Water is impounded temporarily to allow many of the pollutants time to settle to the bottom. The impounded water is discharged through an outlet that provides for prolonged release.

Dry ponds are commonly found in residential and commercial areas throughout Iowa.



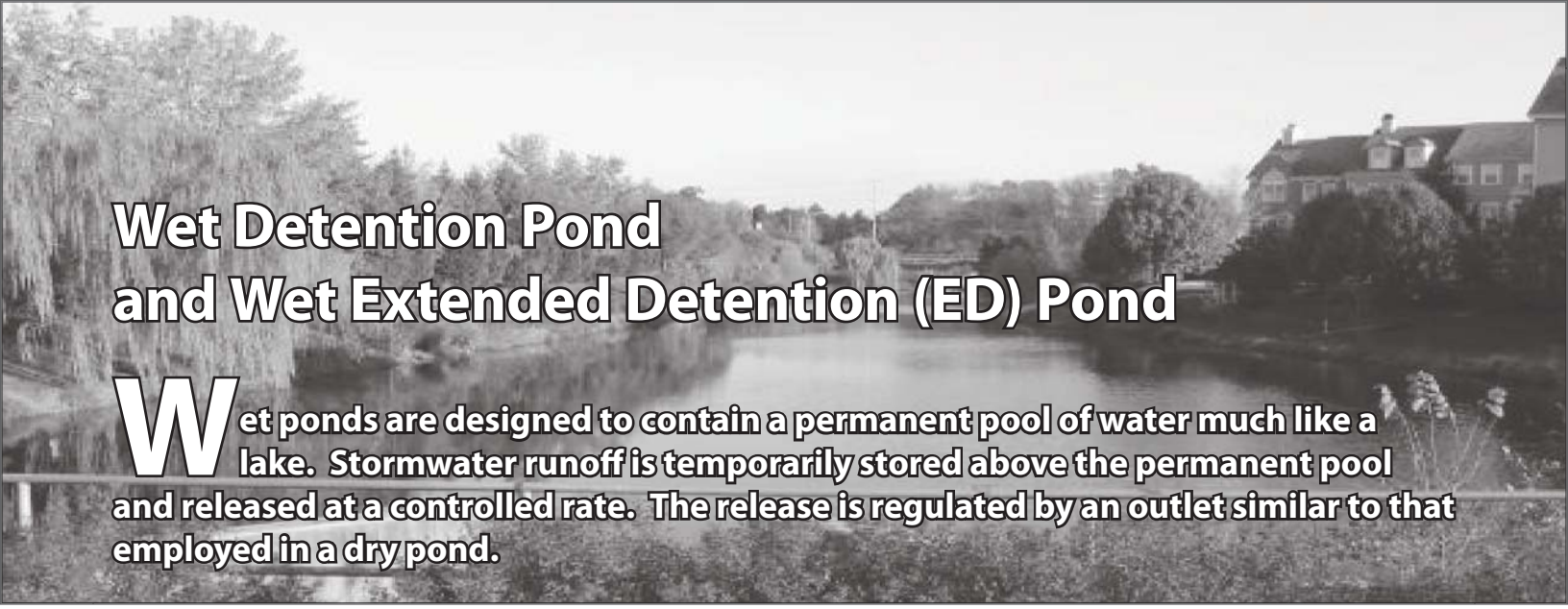
Dry ponds are the most common stormwater management facilities in Iowa. Most do not contain a permanent pool of water and no water should remain if it is functioning properly.

Dry ED basins provide downstream channel protection through extended detention of the channel protection volume, and can be designed to control the extreme flood (100-year storm event).

MAINTENANCE IS REQUIRED WHEN:

- Standing water is visible in inappropriate areas 72 hours after a rain event.
- Insects and/or odor become problems.
- Wetland vegetation emerges (unless the facility is specifically designed with a marsh or wetland area).
- There is visible damage to the embankment or to the mechanical components.
- Animal burrows or trees present on embankment or near riser.
- Low flow orifice, forebay, or concrete trickle ditches blocked by trash, debris, or sediment.

Extended detention wetland basins, or two-stage detention ponds, incorporate a shallow marsh or wetland to increase pollutant removal.

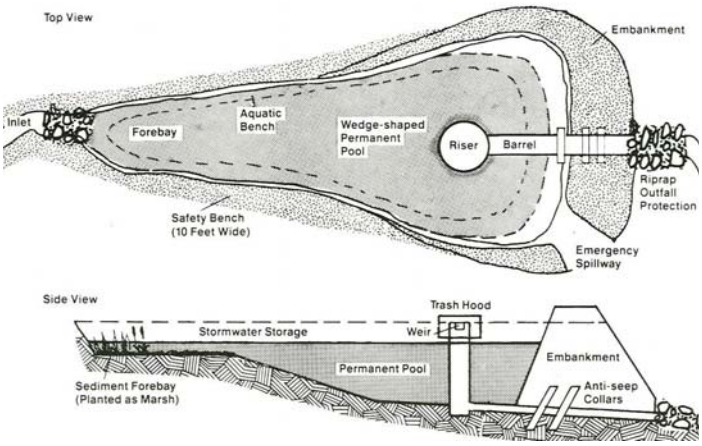


Wet Detention Pond and Wet Extended Detention (ED) Pond

Wet ponds are designed to contain a permanent pool of water much like a lake. Stormwater runoff is temporarily stored above the permanent pool and released at a controlled rate. The release is regulated by an outlet similar to that employed in a dry pond.

The advantages of a wet pond over a dry pond are higher pollutant removal and less chance that pollutants will be resuspended during a storm. However, wet ponds also pose a higher safety liability than other stormwater management facilities, since they are permanently filled with water.

A wet extended detention pond is a wet pond where the water quality volume is split evenly between the permanent pool and extended detention (ED) storage provided above the permanent pool. During storm events, water is detained above the permanent pool and released over 24 hours. This design has similar pollutant removal to a traditional wet pond, but consumes less space.



Wet ponds and their surrounding vegetated buffers may also serve as an aesthetic or recreational amenity, as well as habitat for some wildlife.

MAINTENANCE IS REQUIRED WHEN:

- There are visible signs of sediment accumulation.
- Insects and/or odor become problems.
- Algae blooms occur in the summer months or the ponded areas become dominated by a single aquatic plant.
- There is visible damage to the embankment or to the mechanical components.
- There are visible seeps on the downstream dam face.
- Woody vegetation is growing on the dam.
- Beavers are present in the plunge pool.

NOTE: If your wet pond is protected by perimeter fencing, periodic inspections of its integrity should be conducted.

Stormwater Wetlands

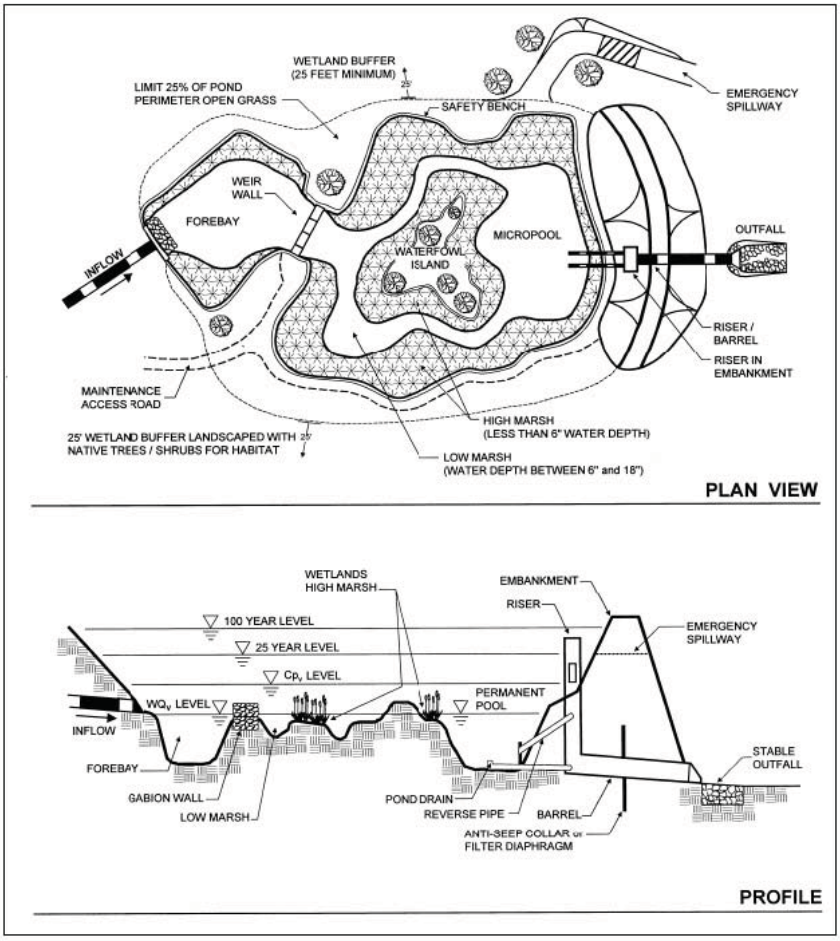
Stormwater wetlands are constructed wetland systems explicitly designed to incorporate the functions of natural wetlands to aid in pollutant removal from stormwater. Constructed wetlands can also provide for quantity control of stormwater by providing a significant volume of temporary water storage above the permanent pool elevation.

A sediment forebay is provided for removal of coarse sediments that could degrade performance.

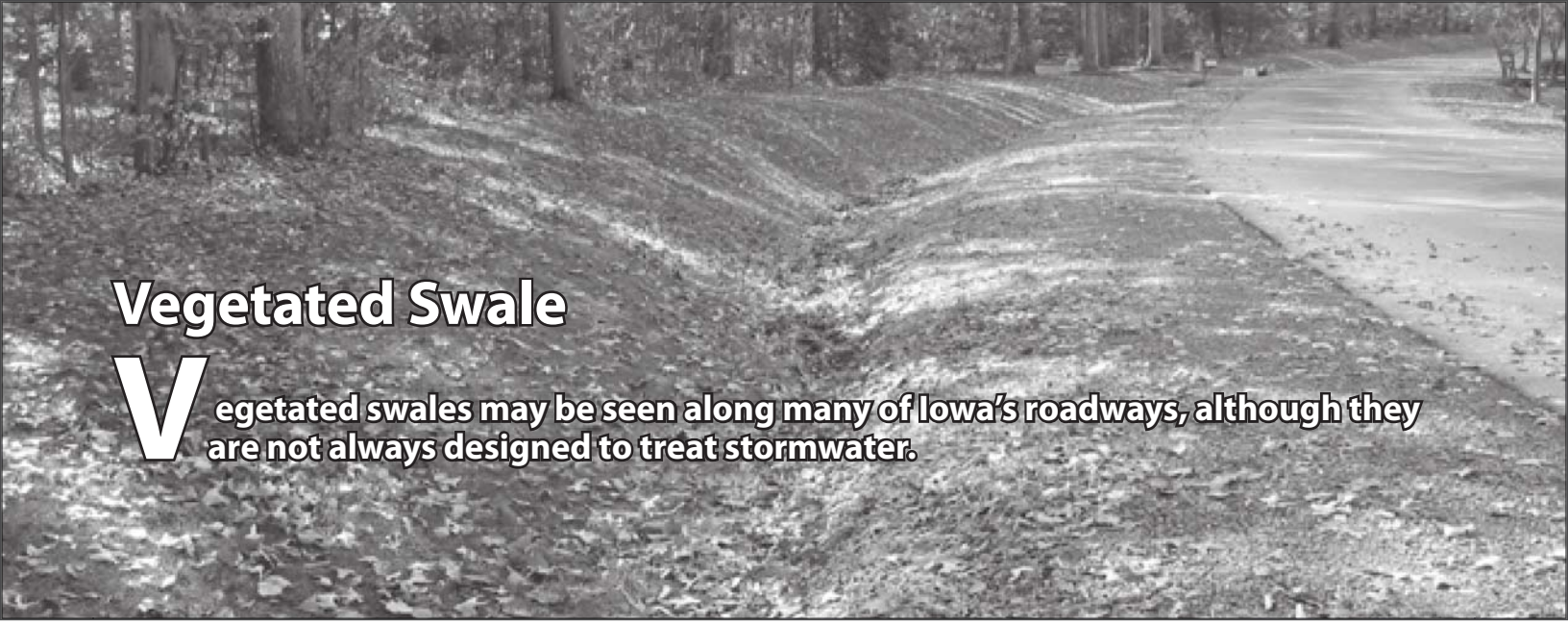
Stormwater wetlands are designed specifically for the purpose of treating stormwater runoff, and typically have less bio-diversity than natural wetlands both in terms of plant and animal life. However, as with natural wetlands, stormwater wetlands require a continuous base flow or a high water table to support aquatic vegetation.

MAINTENANCE IS REQUIRED WHEN:

- The facility has reached its capacity for sediment accumulation.
- Wetland vegetation decreases to less than 50% surface area coverage.
- Invasive vegetation appears.



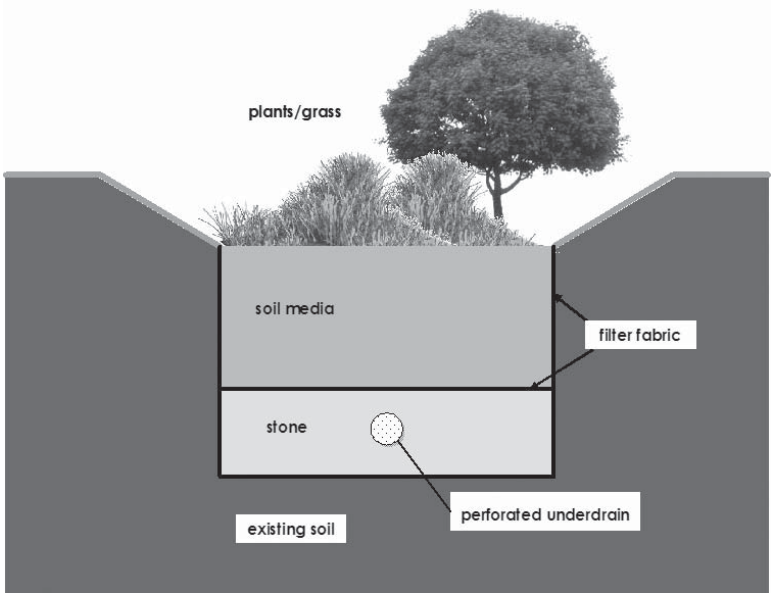
There are several design variations of the stormwater wetland, each design differing in the relative amounts of shallow and deep water, and dry storage above the wetland. These include the shallow wetland, the extended detention shallow wetland, pond/wetland system and pocket wetland.



Vegetated Swale

Vegetated swales may be seen along many of Iowa's roadways, although they are not always designed to treat stormwater.

Typically, vegetated swales are concave, earthen conveyance systems designed to simply transfer runoff. Today they are constructed to serve a water quality purpose, trapping particulate matter in the vegetative groundcover and allowing stormwater to soak into the soil.



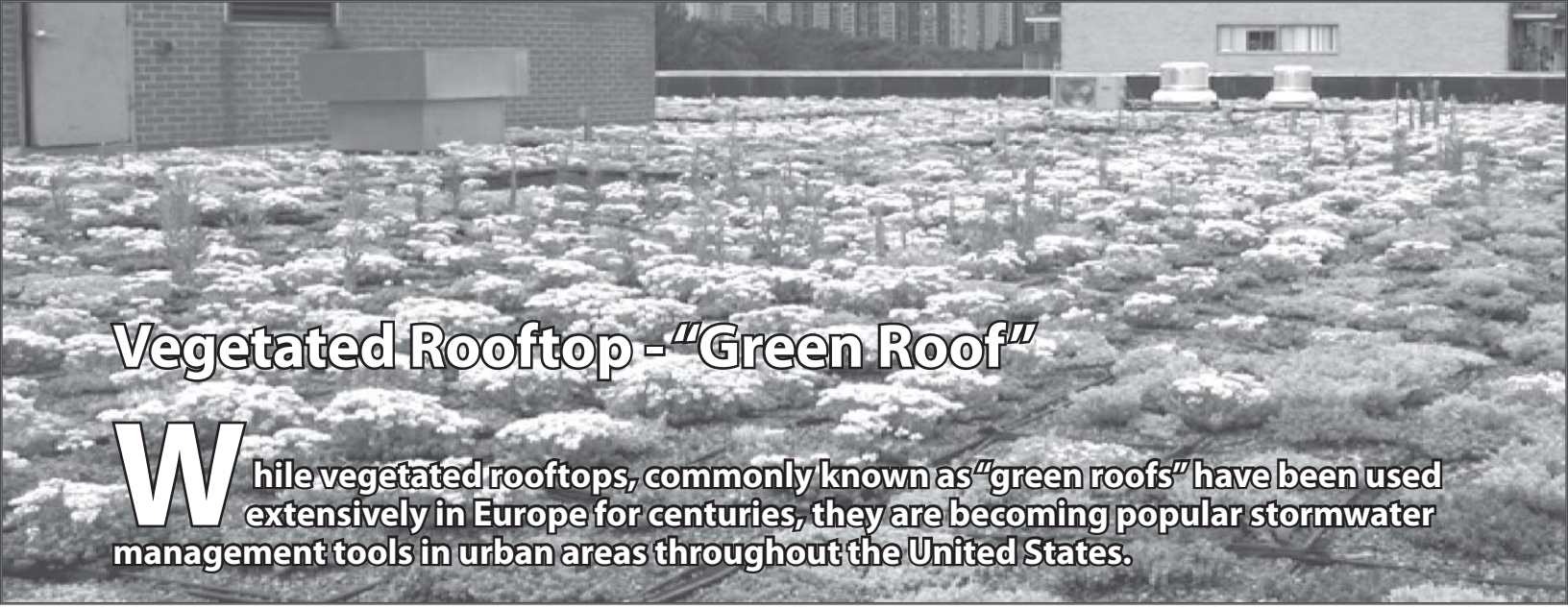
Vegetated swales serve a water quality purpose by trapping particulate matter in the vegetative groundcover.

Vegetated swales are often located along roadways, parking lots, and other impervious areas.

MAINTENANCE IS REQUIRED WHEN:

- Vegetation is bare in spots or appears unstable.
- Significant sediment has accumulated behind check dams*, if present.
- Erosion is visible in the bottom of the swale.
- Trash, grass clippings, leafy, and/or woody debris have accumulated.
- Standing water is visible after 48 hours.

check dams are small* ***berms* *built across a facility to slow water and create small areas of ponding.*

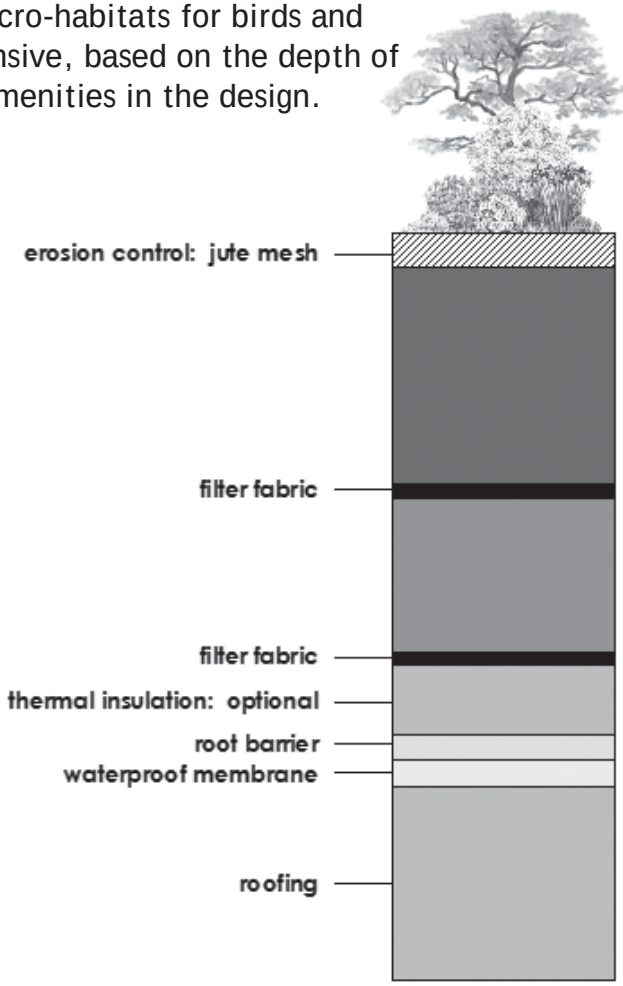


Vegetated Rooftop - "Green Roof"

While vegetated rooftops, commonly known as "green roofs" have been used extensively in Europe for centuries, they are becoming popular stormwater management tools in urban areas throughout the United States.

Green roofs intercept stormwater and slow its flow off of rooftops. In addition to reducing the amount of stormwater runoff and improving its quality, green roofs also reduce the effect of city "heat islands" and provide micro-habitats for birds and insects. Green roofs are classified as extensive or intensive, based on the depth of the growing medium and the types of vegetation and amenities in the design.

Extensive green roofs employ succulent low-growing plant species, such as sedums.



MAINTENANCE IS REQUIRED WHEN:

- Leaks occur.
- Unwanted vegetation appears.
- Vegetation shows signs of stress.

Intensive green roofs, applied on sturdier roofing systems, can accommodate paths, perennial plants, and other amenities.

NOTE: A detailed structural analysis of the existing building is required to ensure it can adequately support the weight of a vegetated rooftop, before one can be constructed.

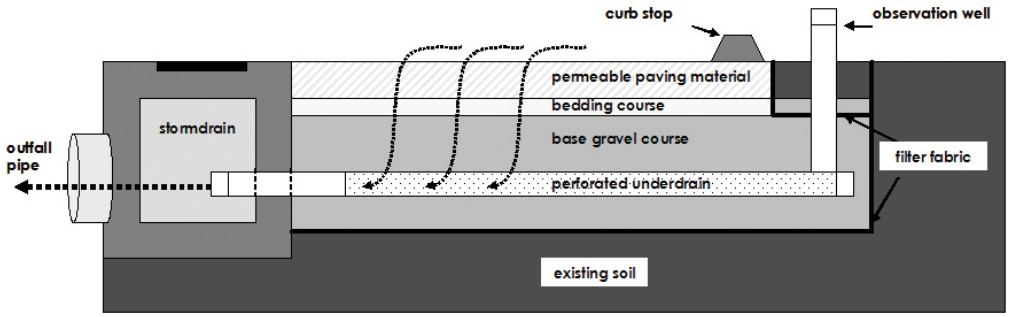
Permeable Paving Material

Permeable paving materials consist of bricks, gravel, or other permeable materials that provide structure and stability yet allow water to infiltrate through to the ground's surface. They can be used in place of traditional asphalt in parking areas, sidewalks, and low traffic vehicular corridors.

Permeable paving materials appear in a variety of different forms. Brick pavers are commonly used in parking lots and other areas that may receive frequent use. Permeable pavers can be used as a retrofit to treat runoff from parking lots or adjacent rooftops. Good opportunities can be found in spillover parking lots, municipal facilities, and urban hardscapes.

Porous asphalt pavement is a paved surface and subbase comprised of asphalt, gravel, and stone, formed in a manner resulting in a permeable surface. The various layers, called "courses," have the potential for stormwater detention. Stormwater which passes through the pavement may completely or partially infiltrate the underlying soil, the excess being collected and routed to an overflow facility through perforated underdrain pipes.

Pervious concrete is a mixture of coarse aggregate, Portland cement, water and little to no sand. A typical pervious concrete pavement has a 15-25% void structure and allows 3-8 gallons of water per minute to pass through each square foot.



MAINTENANCE IS REQUIRED WHEN:

- Puddling or ponding water is visible on the surface 48 hours after a rain event.
- Significant amounts of sediment have accumulated between the pavers.

Permeable paving materials are often used along streets, driveways, parking lots, sidewalks, paths, and other low traffic volume areas.

Inspecting Stormwater Structures

We are all responsible for protecting water quality. Routinely inspecting the stormwater management facility and detecting issues early are the first line of defense to ensure the facility is operating optimally and avoid long term problems.

Who is Responsible for Inspections and Maintenance?

Many Iowa local governments will maintain stormwater management facilities in residential areas under specific conditions. However, if a community or business is subject to a BMP maintenance agreement, that community or business is responsible for the maintenance of their BMP.

It is important to check the maintenance agreement to identify specific legal obligations. In the event that the maintenance agreement is unable to be located, consult a local government contact to determine who is responsible for conducting inspections and/or maintenance. Ask local government staff about the conditions of this agreement.

Developing an Inspection Strategy

Depending on the specific stormwater facility, inspection requirements vary from jurisdiction to jurisdiction.

Some sand filtration systems require monthly or seasonal inspections while other BMPs can be inspected on an annual basis. Some localities conduct inspections of all facilities, while others require that the responsible party arrange for an inspection and send the results to the jurisdiction inspection manager for confirmation.

The local government should be contacted to determine specific requirements and for assistance in selecting a qualified inspector.

It is unlikely that a lawn care or landscaping company has the knowledge or experience to perform a proper, comprehensive BMP inspection. A professional (engineer, landscape architect, surveyor, etc.), or someone who has had appropriate training, should be hired to perform inspections. Since there is no "BMP inspection" listing in the telephone book, call a local government for advice on hiring a skilled professional.

Planning for BMP Maintenance Costs

Routine maintenance costs can usually be predicted for an annual budget and may range from four percent of original capital construction costs per year for a dry pond to nine percent of original capital costs per year for an infiltration trench.

A general rule of thumb is that annual maintenance costs may run from $100 per acre for minor maintenance, such as mowing, to $500 per acre for more intensive maintenance including weed control, debris removal, etc.

Non-routine maintenance costs, however, can be substantial over the long run, especially when considering the possibility of eventual BMP replacement. To lessen the immediate financial impact of non-routine costs, it is advised that a BMP maintenance fund, with annual contributions, be established.

As an example, for dry ponds, which need to have sediment removed once every two to ten years, ten to 50 percent of anticipated dredging costs should be collected annually. In addition, the average dry pond has a life expectancy of 20 to 50 years. A separate fund that collects two to five percent a year should be established for replacement. Anticipated interest may be used to offset the effects of inflation.

Estimating and Planning for Non-routine Costs for BMPs

Costs for non-routine maintenance of BMPs are highly specific and will vary depending upon:

- the type, size, and depth of the facility;
- the volume of the sediment trapped in the BMP;
- the accessibility of the BMP; and
- whether or not on-site disposal of the sediment is possible.

Type of BMP	Sediment Removal Frequency	Facility Life Span*
Infiltration Trench	Monthly or as needed	10 years
Infiltration Basin	Annually or as needed	20 to 50 years
Bioretention	5 to 10 years	10 to 25 years
Sand Filter	Every 6 months or as required	20 to 50 years
Dry Detention	2 to 10 years	20 to 50 years
Wet Detention	10 to 20 years	20 to 50 years
Stormwater Wetlands	10 to 20 years	20 to 50 years
Vegetated Swale	As needed	10 to 25 years
Permeable Paving	3 to 4 times per year	25 years
Vegetated Rooftop	5 times per year	25 years

*Assumes the facility is maintained on a regular basis.

Planning for BMP Maintenance Costs

Wet and Dry Detention Pond Sediment Removal

The technique used to remove sediment from a wet or dry pond is very site-specific. The information below provides an estimate of costs associated with the dredging process.

- Mobilization and Demobilization of Machinery

Associated Costs: $1,000 to $10,000
Large wet ponds or regional facilities will often require a waterborne operation during which an excavator or a crane must be mounted to a floating barge and moved into position. For smaller ponds, larger ponds that can be drained or dredged from the shore, and extended detention basins, a perimeter or dry operation will usually suffice. In this case, a backhoe, truck equipment, or crane may be used to scoop out the sediment. Additional costs for the construction and restoration of access roads for trucks and heavy equipment may be accrued.

- Dredging

Associated Costs: $10 per cubic yard to $20 per cubic yard
The cost of dredging a BMP depends on the volume of sediment removed. The cost (expressed by cubic yard) is largely influenced by the depth of the water and the distance between the excavation area and the "staging area" where sediment is transferred to trucks for removal. Another consideration is whether equipment can easily access the BMP bottom. The following equation can be used to estimate the volume of sediment in cubic yards.

Equation to Estimate the Volume of Sediment in a BMP (in cubic yards)

surface area _____ (acres) **x** depth of sediment _____ (feet) **x** 43,560 **=** _____ cubic feet

cubic feet _____ **/** 27 **=** _____ **cubic yards**

- Disposal

Associated Costs: $5 per cubic yard - on-site to $47 per cubic yard - off-site
The primary determinant of disposal costs is whether on-site disposal is an option. If on-site disposal is not available, then locating a landfill or large area to apply the spoils, such as a farm may prove challenging and transportation costs may increase considerably. Dredged materials will require special disposal if found to contain hazardous materials.

Additional costs that vary per jurisdiction, should be considered for permitting fees, grading plans, and erosion and sediment controls.

Adding the likely costs of the sediment removal components establishes a range in which an owner can expect to pay for sediment/pollutant removal. For a facility with a small surface area (0.25 acres) overall costs can range from $4,000 to $10,000+. For a large facility (10 acres) overall costs can range from $170,000 to $550,000+.

Planning for BMP Maintenance Costs

	Maintenance	Annual Associated Cost
Vegetated Facilities		
Bioretention	Removal of sediments and replacement of some level of soil is required periodically. Mulch should be replaced annually, or as needed.	Between $1,500 and $2,000, depending upon the size and complexity of the facility.
Vegetated Rooftop	Repair leaks, as necessary. Replenish soil and plants, annually. If drought is a concern, installing an irrigation system or supplemental watering will be necessary.	Between $500 and $7000, depending upon the size of the facility and the amount of soil/planting area that needs to be replenished.
Vegetated Swale	Remove sediments, replace check dams (usually made of earth, riprap, or wood), reseed or sod (if grassed) or replace dead plants, every two years.	If located on a highway right-of-way, maintenance may be covered through state maintenance. Call the Iowa Department of Transportation at 515-239-1101 to find out if the swale is on state property.
Infiltration Facilities		
Infiltration Trench	Remove the top six to 12 inches of gravel and to replace the filter cloth sediment barrier.	Between $1,500 and $2,000, depending on the size of the facility.
Permeable Paving Material	Vacuum sediments from surface, twice a year.	Between $500 and $1,000, depending on the size of the facility.
Underground Facilities		
Sand Filter	Remove the top filter cloth and remove/replace the filter gravel, when a semi-annual inspection reveals that it is necessary. Pump and refill the carbon trap every six months. Remove and replace the filter cloth and gravel every three to five years.	Between $3,000 to $10,000, depending on the type and size of the sand filter and the amount of impervious surface draining to it.

If an oil sheen is present in the facility, it should be removed by a qualified oil recycler, which increases costs. Other expenses, such as removal of trash and hydrocarbons from water traps may also be required. The owner should consult a local government representative to determine an appropriate funding level.

Removing sediment from stormwater facilities can be a considerable expense. Look for opportunities to reduce the amount of sediment entering the pond from the surrounding drainage area.

Maintaining Stormwater Structures

A consistent maintenance program is the best way to ensure that a stormwater structure will continue to perform its water quality functions. Actual maintenance needs will obviously vary according to the specific facility and site conditions.

Factors Affecting the Type and Frequency of Maintenance Required

Visibility of the Facility/Aesthetics

The needs and preferences of the surrounding community will determine to a large extent the amount of maintenance required for aesthetic purposes.

Landscaping

Maintenance needs will vary considerably depending upon the types of vegetation used in landscaping. Rain gardens, dry ponds, and vegetated rooftops in particular will require special attention to vegetation management.

Upstream Conditions

The condition of the surrounding watershed will significantly impact the amount of sediment and other pollutants the facility must manage. For example, erosion problems and high traffic areas upstream can dramatically increase the amount of sediment accumulation.

Safety

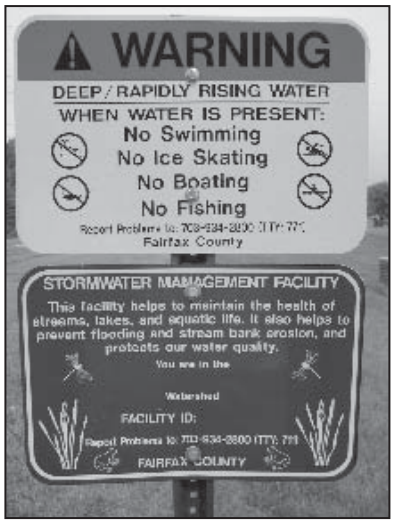
Since BMPs often involve the storage or impoundment of water, the safety of nearby residents or customers must be considered. This includes maintaining appropriate fencing and signs. Confined space training is required before entering underground facilities.

Need for Professional Judgement

BMPs are water treatment facilities. While some maintenance can be conducted by a non-professional, the advice of a professional should be consulted regularly.

Financing

The costs associated with non-routine BMP maintenance tasks can be considerable. A fund should be established to provide for the costs of long-term maintenance needs such as sediment removal.



Signs increase awareness of stormwater and explain the benefits of the BMP.

Maintaining Stormwater Structures

Routine maintenance will keep a BMP functioning properly and will pay off in the long run by preventing unneccesary repairs. Preventing pollutants from reaching the BMP will result in lower maintenance costs and cleaner water.

Common Routine Maintenance Needs for Most BMPs

Regular Inspections	**Vegetation Management**	**Embankment & Outlet Stabilization**	**Debris & Litter Control**	**Mechanical Components Maintenance**
Insect Control	**Access Maintenance**	**Overall Pond Maintenance**	**Sediment/ Pollutant Removal**	**Components Replacement**

Regular Inspections

Local governments require a specific schedule of inspections for a BMP. In many instances, an annual or semi-annual inspection, depending on the facility, is required. It will also be necessary to conduct an inspection after a large storm event during which the BMP's capacity was surpassed.

Some BMPs, such as sand filters, may require more frequent inspections. Additional information on who needs to carry out inspections is provided under Inspecting Stormwater Structures.

Vegetation Management

Most BMPs rely on vegetation to filter sediment from stormwater before it reaches the BMP. Vegetation also serves to prevent erosion of the banks and stabilize the bottom of the facility. While turf grass is the most common groundcover, many BMPs are being retrofitted or designed with woody vegetation and wetland plants to increase pollutant removal.

- Mowing. Most grass is hardiest if it is maintained as an upland meadow, therefore mow no shorter than six to eight inches. Grass on embankments should be cut at least twice during the growing seasons and once during the summer.
- Pest and Weed Control. To reduce the amount of pollutants reaching the BMP, avoid overfertilization and excessive pesticide use.
- Removing Sediment Build-Up. Since the vegetation surrounding the BMP is designed to trap sediment, it is likely to become laden with sediment.
- Stabilize Eroded Areas or Bare Spots. Bare spots should be vigorously raked, backfilled if needed, covered with top soil, and seeded.
- Unwanted Vegetation. Some vegetation is destructive to a BMP. Keeping dams and bottom areas free of deep-rooted vegetation is critical as roots may destabilize the structure. Consistent mowing and monitoring will control any unwanted vegetation.
- No Mow Zones. For wet ponds, a ten foot vegetated buffer, around the perimeter of the facility (exclusive of the dam embankment) may be established to filter pollutants from adjacent properties and to help prevent shoreline erosion.

Embankment and Outlet Stabilization

A stable embankment is important to ensure that erosion does not contribute to water quality problems and that embankments are not breached - resulting in downstream flooding. Maintaining a healthy vegetative cover and preventing the growth of deep-rooted (woody) vegetation on embankment areas is an important component to stabilization.

Animal burrows will also deteriorate the structural integrity of an embankment. Muskrats and groundhogs in particular will burrow tunnels up to six inches in diameter. Efforts should be made to control excessive animal burrowing and existing burrows should be filled as soon as possible.

Outlet structures are particularly prone to undercutting and erosion. Unchecked, a small problem can easily result in the need to replace the entire structure. A professional engineer should be consulted if sink holes, cracking, wet areas around the outlet pipe, displacement, or rusting of the pipe are observed.

Maintaining Stormwater Structures

Debris and Litter Control

Regular removal of debris and litter can be expected to help in the following areas:

- reduce the chance of clogging outlet structures and trash racks;
- prevent damage to vegetated structures;
- reduce mosquito breeding habitats;
- maintain facility appearance; and,
- reduce conditions for excessive algal growth.

Special attention should be given to the removal of floating debris which can clog inlets, outlets, and low-flow orifices. If trash or dumping is particularly problematic, outreach to the local community can help.

Mechanical Components Maintenance

Some BMPs have mechanical components that need periodic attention - valves, sluice gates, pumps, anti-vortex devices, fence gates, locks, and access hatches should be functional at all times. This type of routine maintenance is best left to a professional.

Insect Control

A healthy ecosystem actually promotes biological control of mosquitoes. However, mosquito and other insect breeding grounds can be created by standing water. Though perceived as a significant nuisance, mosquitoes are not as big a problem as is often thought, and there are ways to address the issue.

The best technique is to ensure that stagnant pools of water do not develop. For BMPs that have a permanent pool of water, this means the prompt removal of floatable debris. It may also be possible in larger wet ponds to stock fish that feed on mosquito larvae.

The development of a mosquito problem, particularly in dry ponds, infiltration trenches, and rain gardens, is usually an early indication that there is a maintenance problem, such as clogging. In such cases, the infiltration capacity of the BMP needs to be increased or sediment needs to be removed.

Access Maintenance

Most BMPs are designed so that heavy equipment can safely and easily reach the facility for non-routine maintenance. Routine maintenance of access areas is particularly important since one never knows when emergency access will be needed. Maintenance includes removal of woody vegetation, upkeep of gravel areas, fences, and locks.

Overall Pond Maintenance

An often overlooked aspect of maintenance, especially for wet ponds, is the need to ensure a healthy aquatic ecosystem. A healthy ecosystem should require little maintenance. An indicator of an unhealthy system is excessive algal growth or the proliferation of a single species of plant in the permanent pool of a wet pond. This may be caused by excess nutrients from fertilization practices (of a landscape company or surrounding neighbors), or by excess sediment.

Steps should be taken to reduce excess nutrients at their source and to encourage the growth of native aquatic and semi-aquatic vegetation in and around the permanent pool.

Maintaining Stormwater Structures

The non-routine maintenance of a BMP, while infrequent, can be a major undertaking and should always be performed by a professional. While tasks will vary by facility, they typically include sediment/pollutant removal and replacement of the facility's structural components.

Sediment/Pollutant Removal

Since the primary purpose of a BMP is to remove sediment and other pollutants (which are usually attached to sediment) from stormwater, sediment will accumulate in a BMP and need to be removed. Facilities vary dramatically so there are no universal "rules of thumb" to guide responsible parties in sediment removal requirements.

For instance, dry detention ponds should be cleared of sediment once a significant portion of the BMP volume (25-50 percent) has been filled. For wet detention ponds, a minimum water depth of approximately three feet is desirable.

Sediment and pollutants will need to be discarded. The best solution is to have an onsite area or a site adjacent to the facility (outside a floodplain) set aside for sediment. If on-site disposal is not an option, transportation and landfill tipping fees can greatly increase sediment removal costs. Once the sediment is removed, the facility should be quickly restabilized, either through revegetation or, in the case of a sand filter, replacement of sand and other filter media.

Finally, wet sediment is more difficult and expensive to remove than dry sediment. In some cases, the entire facility can be drained and allowed to dry so that heavy equipment can remove sediment from the bottom. In other cases, it may be necessary to remove sediment from the shoreline or by hydraulic dredging from the surface. A permit may be required for removal and proper disposal of sediment. Contact your local government for assistance.

Stormwater Management Facility Component Replacement

Eventually, like most infrastructure, actual facility components will need to be replaced. Components may include:

- inflow and outflow pipes;
- trash racks and anti-vortex devices;
- valves, orifices, and aerators;
- concrete structures (such as the casing for a sand filter, or riser structures in ponds);
- pumps and switches;
- manhole covers and access hatches*;
- earthworks (such as embankments and side slopes); and,
- mulch and vegetation.

While most stormwater management facilities may last up to 100 years with proper maintenance, a community or business should plan long in advance for replacing these facilities.

*Many BMPs are located in parking lots. When the parking lot is repaved, ensure that the access areas are not covered.

Who Should Carry Out Maintenance

In determining who should carry out maintenance activities, safety, cost, and effectiveness need to be balanced. Some activities can be undertaken effectively by a facility owner. Some examples of tasks that are appropriate for a facility owner may include landscaping and revegetating bare areas, education, and litter removal.

While engaging a community or business in routine maintenance is a great way to educate people about the facility's purpose, it is strongly recommended that a professional landscaping company be hired for more difficult work. Trained personnel may be able to identify problems in their early stages of development when it is most cost-effective to make repairs. Additionally, mowing and handling a wheelbarrow can be dangerous on sloping embankments. Filling eroded areas, and soil disturbing activities, such as resodding and replanting vegetation, are also tasks that a professional landscaping firm can manage.

Working with Lawn Care Companies

Communicate to a lawn care company that the stormwater management facility is a water treatment system that requires special attention. While most companies have the ability to perform special maintenance, many will not unless specifically asked.

Contact a company manager to discuss how their services can be tailored to help meet the stormwater management facility's maintenance objectives.

Tips for Working with Lawn Care Companies

COMMUNICATE that the facility is a water quality protection facility.

PROVIDE specific instructions on mowing and fertilization practices. For example, mowing at a higher level and perhaps not as frequently is preferred. Ask that heavy equipment be avoided where possible and particularly in vegetated areas.

INFORM land owners and landscape companies of the need to keep sediment from accumulating and the need to keep the facility clear of grass clippings.

REQUIRE that the company follows an integrated pest management (IPM) plan to minimize the application of pesticides and fertilizers.

An IPM plan can include the:

- use of pesticides only as needed and only on trouble spots;
- use of alternatives to pest controls or no pesticides; and/or,
- policy of not applying chemicals when rainfall is in the forecast.

If the company cannot oblige, consider switching to a lawn care company that will.

Who Should Carry Out Maintenance

Involving the Community

It is a common misconception that curbside storm drains go to a water treatment plant. In actuality, they lead to a stormwater facility or directly to a stream!

Educating and involving the community is a cost-effective way to prolong the life of the facility, prevent pollution, and make a difference in improving the local environment. Activities can range from organizing a clean-up day to developing a community-wide education program.

Numerous local organizations provide supplies, resources, and technical support to businesses and communities interested in developing a public education program or hosting an event.

A community activity, such as a cleanup or tree planting, will help increase appreciation for a facility and maintenance.

Questions to Ask When Developing a Public Education Program for a Community

What pollution problem(s) need to be addressed?
Determining the type of pollution that is causing an issue with a stormwater management facility can help with planning community activities to remediate the problem.

What activity or activities are responsible for pollution?
Locating possible sources of pollution are helpful in targeting educational messages, planning activities, and determining solutions.

Who can help implement a community education program?
Rallying the community together can make an activity much more successful. One suggestion is to involve an existing active group that is looking for opportunities to complete community service or volunteer hours.

A storm drain marking project will increase awareness that storm drains lead to streams.

How will the message reach the targeted community?
Publicizing the event or educational message using existing or new outlets, including websites, list serves, and newsletters, should be explored.

What alternatives to pollution generating activities should be encouraged?
Implementing solutions and providing alternatives for pollution prevention will greatly assist in reducing the amount of pollution entering a stormwater management facility and local streams.

Tips to Lessen Maintenance Costs

If properly cared for, a stormwater management facility can work effectively for years without major maintenance costs. Neglected, it can potentially be a continual financial drain.

Businesses and homeowner associations can minimize costs and the potential liability of those responsible for the facility's maintenance by promoting and following these simple rules:

DO!!

- DO keep properties, streets, and gutters free of trash, debris, and lawn clippings.
- DO provide information to those who maintain their own automobiles on where to recycle oil and antifreeze.
- DO encourage residents to take dirty vehicles to a commercial carwash or select a location where soapy water will infiltrate into the ground and not enter a storm drain.
- DO put a pan underneath your car if it is leaking to catch the fluids until it is repaired. Spread an absorbent material, such as kitty litter, to soak up drippings and dispose of it properly.
- DO educate residents on where to properly dispose of hazardous wastes, including oil and latex paint.
- DO plan lawn care to minimize the use of chemicals and pesticides. Sweep paved surfaces of fertilizers and put the clippings back on the lawn.
- DO limit the amount of impervious surfaces. For patios, walkways, and landscaping, consider porous pavements such as bricks, interlocking blocks, or gravel.
- DO plant native trees, shrubs, and groundcovers to help the water soak into the ground. Replace turf with native plants. Select species that need little or no fertilizer or pest control and are adapted to specific site conditions.
- DO sweep up and dispose of sand and ice melting chemical residues in the winter. This will protect grass and other plants, as well as reduce the amount entering the storm drain network.

DO NOT!!

- DO NOT dump used motor oil, antifreeze or other oil and grease into storm inlets. This is a criminal offense and will greatly increase BMP maintenance costs.
- DO NOT dump grass clippings, leaves, soil, or trash of any kind into the stormwater facility or a storm inlet. Leaves and grass clippings release bacteria, oxygen consuming materials and nutrients. They will also clog the facility's components.
- DO NOT dispose of pet wastes in the storm system, including grassy areas near a facility. Animal wastes contain disease-causing bacteria and release oxygen consuming materials.
- DO NOT wash dirty vehicles on streets or driveways. Whatever comes off the car ends up in the stormwater facility or directly in streams.
- DO NOT overfertilize the lawn. Whatever washes off the lawn or impervious areas (such as driveways or sidewalks) drains into the stormwater facility and shortens its life-span.
- DO NOT leave bare areas unstabilized. Erosion from bare soil results in sediments that can quickly clog a stormwater facility.
- DO NOT dispose of left over paint or hazardous materials into the storm drain. These materials can kill vegetation and aquatic life.

Troubleshooting Guide

SEDIMENT REMOVAL AND DISPOSAL
Impact on Facility Performance

The purpose of a stormwater treatment facility is to remove pollutants, including suspended solids, by capturing sediment. Sediment can include dirt, leaves, and litter. These materials can restrict or clog a facility. Timely removal of sediment will improve infiltration rates, water quality, and help prevent clogging and flooding.

Type of Facility This Applies To	Remove Sediment When
Vegetated Vegetated Rooftops, Bioretention Facilities, Ponds, Constructed Wetland Forebays, Swales, and Vegetated Filters	• Sediment depth is damaging or killing vegetation; or, • Sediment is preventing the facility from draining in the time designed (usually 48 - 72 hours).
Underground Manufactured Facilities, Sand Filters, Underground Detention	• At least once a year, or when • The basin is half-full of sediment, whichever comes first.
Infiltration Permeable Paving Materials (Grasscrete, permeable pavers, gravel), Infiltration Trenches	• Sediment is preventing the facility from draining in the time required (usually 48 hours).

What to Do

For small facilities, sediment can be removed by hand. Large facilities and underground facilities will need to be cleaned with heavy equipment by trained professionals. For example, a vacuum truck may need to be used for confined spaces.

- Remove sediment during dry months when it is easiest to remove because it weighs less and creates fewer secondary environmental impacts, such as wet sediment running off the site.

A vacuum truck may be required to remove sediment from stormwater facilities located underground.

Vegetated Facilities:

- Use rakes and shovels to dig out accumulated sediment.
- Avoid damage to existing vegetation. If sediment is deep, some plants may need to be removed to excavate sediment.
- Reseed, replant, and mulch disturbed area to prevent erosion.
- Excavate sand and gravel and clean or replace.

Underground Facilities:

- Use a vacuum truck to remove sediment from the vaults or chambers.

Infiltration Facilities:

- Infiltration Trenches: Excavate sand or gravel and clean or replace.
- Permeable Paving Materials: Remove accumulated sediment from the surface with a dry broom, vacuum system, or other hand tools. A vacuum truck or street sweeping equipment may also be used, with professional assistance.

How To Reduce Sediment Accumulation in the Facility

- Minimize external sources of sediment, such as eroding soil upstream of the facility.
- Sweep surrounding paved areas on the property regularly.

Troubleshooting Guide

VEGETATION MANAGEMENT

Importance to Facility Performance:

Plants play an important role in stormwater facilities. They absorb water, improve infiltration rates of soil, prevent erosion by stabilizing soil, cool water, and capture pollutants. Plants create habitat for birds and other wildlife and provide aesthetic value to a property. Proper maintenance of vegetation improves the appearance and performance of the facility.

Type of Facility	Facility Needs Maintenance When
Vegetated Vegetated Rooftops, Bioretention Facilities, Ponds, Swales, and Vegetated Filters	• Areas of exposed, bare soil. • Vegetation is buried by sediment. • Vegetation appears unhealthy or has died. • Nuisance and invasive plants are present. • Vegetation is compromising the facility's structure by blocking inlets or outlets, or roots are intruding into the component of the facility. • Dropped leaves and other debris are contributing to sediment accumulation or are blocking inlets or outlets.

What to Do

Maintenance activities can easily be incorporated into existing site landscape maintenance contracts. Vegetation can be maintained with a formal or more natural appearance depending on your preference.

General maintenance:

- Remove dropped leaves, dead plants, grass and other plant clippings. Plant debris adds nutrient pollution as it breaks down and can clog facility piping and reduce infiltration.
- Avoid using fertilizers, herbicides, or pesticides in the facility. These products add to the pollution problems the facilities are designed to remedy.
- Use mulch to inhibit weed growth, retain moisture, and add nutrients. Replenish when needed. Ensure mulch does not inhibit water flow.
- Irrigate all new plantings as needed for the first two years.

Caring for desired vegetation:

- Plant in late-fall or early-spring so plant roots can establish during the cool, rainy seasons, before summer.
- Amend and aerate compacted soils before replanting by adding compost to increase nutrients and enhance soil texture.
- Protect young plantings from herbivory from deer and waterfowl.

Mowing:

- Grass facilities are designed for routine mowing. Mow at least twice a year.
- Grass should be mowed to keep it 4 - 9 inches tall. Grass that is at least 4 inches tall captures more pollutants and is hardier.

Nuisance and unwanted vegetation:

- Remove nuisance and invasive vegetation before it goes to seed in the spring. Conduct additional weeding in the fall.
- Immediately remove vegetation that is clogging or impeding flow into the facility.
- Remove potentially large and deep-rooted trees or bushes when they might impede the flow path or compromise facility structures. Provide erosion control on any soil exposed by vegetation removal.

Troubleshooting Guide

EROSION, BANK FAILURE, AND CHANNEL FORMATION
Importance to Facility Performance

Stormwater flowing through a facility can cause erosion. Erosion can increase sediment build up, clog outlets, reduce water quality benefits, add to pollution, and cause facility components to fail. Eroded channels create an easy path for water to travel down reducing the ability of the facility to filter pollutants and infiltrate water.

Type of Facility	Facility Needs Maintenance When
Vegetated Vegetated Rooftops, Bioretention Facilities, Ponds, Swales, and Vegetated Filters	• The formation of flow restricting channels occurs in the bottom of the facility, around inlet pipes and curb cuts, or at overflows. • Undercutting, scouring, and slumping occur along banks and **berms**. • Channels and undercutting occur through check dams*. **check dams are small* **berms** *built across a swale or channel to slow water and create small areas of ponding.*

What to Do

Any area with erosion more than two inches deep needs maintenance.

- Fill the eroded area with soil, compact it lightly, and cover with mulch, compost, seed, sod, or other erosion prevention materials.
- Plant banks with deep or heavily rooted plants to permanently stabilize soil.
- Plant the bottom of the facility with grass or grass-like plants to slow water and stabilize soil.
- Install or repair structures designed to dissipate energy and spread flow, such as splash blocks on downspouts, or riprap around inlet pipes and curb cuts.
- If erosion continues to be a problem, consult a professional to determine the cause and the solution.

POLLUTION YOU CAN SEE OR SMELL
Importance to Facility Performance

Stormwater facilities often collect a variety of trash and debris. Trash and debris, especially floating debris, can clog pipes or treatment media. It can also cause odors through decay or by collecting spilled or dumped materials. Stormwater facilities are designed to help prevent pollutants from entering rivers and streams. Any visible water quality pollutants may wash out of the facility spreading the pollution problem.

Type of Facility	Facility Needs Maintenance When
All Types of Facilities	Any unusual or unpleasant smells from sources such as: • Natural plant decay. • Dying plants trapped under sediment. • A spill or a leak (e.g., gasoline or sewage). Visible pollution such as: • Sheens and discoloration. • Turbid (cloudy) water. • Other pollution on the surface of the water.

What to Do

Check monthly for trash and debris and look for opportunities to minimize the pollutant source.

- Regularly remove trash and plant debris.
- Remove accumulated sediment (see “Sediment Removal” in this guidebook).
- Make sure inlets and outlets are not clogged.
- Identify the source of trash, debris, or pollutant, such as a spill, leak, or illicit discharge.

Troubleshooting Guide

PONDING WATER

Importance to Facility Performance

Most facilities are designed to drain in a certain amount of time. This varies from two to 48 hours depending on the type of facility. Ponding water is usually a sign that the facility's filter or outlet is clogged or it is not infiltrating properly.

Type of Facility	Facility Needs Maintenance When
Vegetated Vegetated Rooftops, Bioretention Facilities, Ponds, Swales, and Vegetated Filters **Underground** Manufactured Facilities and Sand Filters **Infiltration** Permeable Paving Materials	• Clogging of overflows or outlets with debris, trash, or other obstructions. • Fine sediments filtering into the soil or other filtration media (like sand or gravel) that can prevent proper infiltration. • Water that has remained ponded for more than 72 hours. • Evidence of seepage at toe of slope on embankment (wet and dry ponds).

What to Do

Any area with erosion more than two inches deep needs maintenance.

- For surface facilities, first try raking the top few inches of soil to break up clogged sections and restore water flow.
- Clean out overflows and outlets with hand tools, if possible. Difficult or hard to access blockages may require professional contractors.
- Identify sources of sediment and debris and prevent them from entering the facility.
- Make sure the facility has adequate vegetation. Vegetation absorbs water and roots help keep soil loose so it can infiltrate water.
- Make sure there is a sufficient amount of mulch in vegetated facilities. This will also help to absorb excess water.

IOWA STORM WATER EDUCATION PROGRAM

Stormwater Lingo - A Glossary of Commonly Used Terms

A

Access Systems
Measures and devices that provide access to facility components by maintenance personnel and equipment.

Aeration
The process of introducing air space into soil.

Anti-Vortex Device
A device that promotes the settling of pollutants by preventing a whirlpool from occurring at the outlet device.

B

Berm
An elongated elevated ridge of material that is used to hold or direct stormwater.

Best Management Practice - BMP
A facility designed to reduce the impacts on local streams from pollutants and increased stormwater caused by development.

Bypass System
A system which allows maintenance by temporarily diverting stormwater or allowing it to flow through a facility during heavy rain events.

D

Dam/Embankment
The wall or structural fill that impounds runoff in the facility.

Dredge
The process of physically removing sediment from the bottom of a pond.

E

Emergency Outlet/Spillway
The structure that safely conveys overflows from the facility.

Emergent Plants
An aquatic plant that is rooted in sediment but whose leaves are at or above the water surface.

F

Filter Fabric/Geomembrane
A webbed fabric which serves to filter pollutants or to hold a filter medium such as gravel or sand in place.

I

Impervious Cover
Any hard surface that prevents water from infiltrating into the soil.

Integrate Pest Management Plan - IPM
A plan that minimizes the application of pesticides and fertilizers on vegetated or grassed areas.

L

Low Impact Development - LID
An integrated stormwater management design strategy to replicate pre-development hydrology. LID techniques promote storage, infiltration, and groundwater recharge.

P

Perimeter
The outward boundary of the BMP.

Principal Outlet
The structure that controls and conveys the facility's outflow.

Pump System
Electrical/mechanical components, including pipework, used to convey discharge under pressure.

R

Riprap
A layer or mound of large stones placed to prevent erosion.

Riparian
Habitat occurring along the banks of a water body.

Riser/Outlet
A vertical pipe extending from the bottom of a BMP that is used to control the rate of stormwater discharge.

S

Side Slopes
Slopes at dams, embankments, spillways, and the facility perimeter.

Swale
An elongated depression in the land used to channel runoff.

Stormwater Management - SWM
A system of structural and non-structural practices used to control the water quantity and water quality of stormwater runoff.

T

Trash Rack
Device placed upstream of the principle outlet or drain to intercept debris.

Trickle Ditch/Low Flow System
Measures that convey low and dry weather inflows to the principle outlet without detention.

V

Vegetative Cover
Vegetation used to stabilize surfaces and/or provide stormwater treatment.