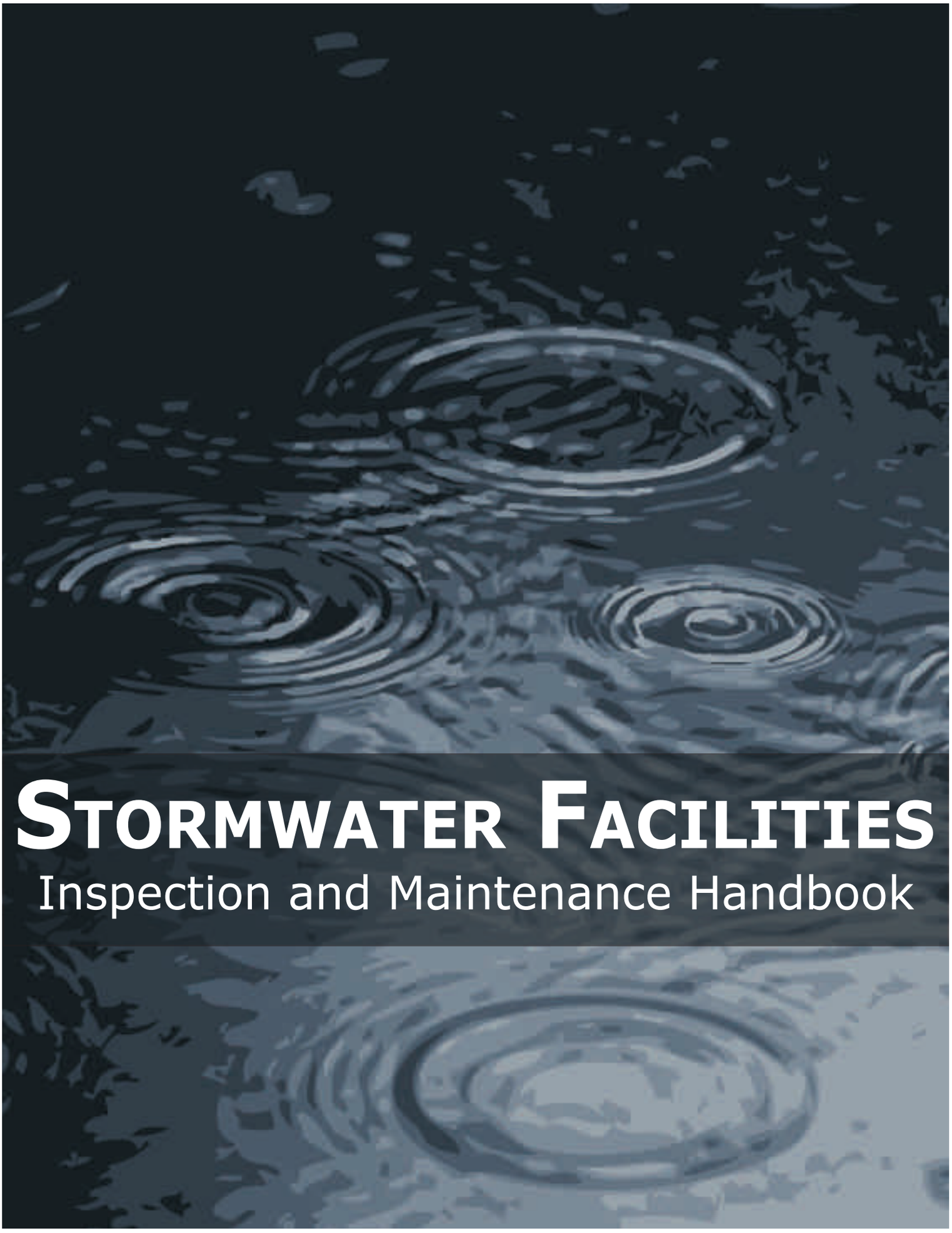


Stormwater Facilities

Inspection and Maintenance Handbook

Table of Contents

About

Whatcom County has numerous valuable aquatic natural resources that supply drinking water, and economic and recreational opportunities for the citizens of Whatcom County. Protecting the County's drinking water supplies, preserving and restoring aquatic habitat for threatened and endangered aquatic life, and protecting public infrastructure and private property are the primary factors behind the creation and implementation of this National Pollution Discharge Elimination System (NPDES) Phase II Stormwater Management Program.

The purpose of this handbook, part of the NPDES stormwater program, is to provide home owners' associations and other owners of private community stormwater systems with information on how to **inspect** and **maintain** their stormwater facilities. Included are an introduction to stormwater management concerns, descriptions of typical stormwater facilities, and general guidelines for inspecting and maintaining a community stormwater system.

This handbook is a resource to help determine what maintenance actions are needed to ensure stormwater systems are functioning properly and when to seek professional help for maintenance or repairs. If your stormwater system has an engineer's operation and maintenance plan (O&M plan), this handbook can provide general information to help you understand your O&M plan, but it is not intended to replace any specific recommendations made by your plan.

Properly maintained stormwater systems **save money**, help **protect water quality**, **minimize potential liability**, and **reduce the risk of flooding.**

Introduction

What is stormwater?

Stormwater systems are designed to help keep pollutants like sediment out of receiving waters

Stormwater is precipitation that runs off of any surface it can't seep into. Most stormwater runs off surfaces such as roads, sidewalks, highways, parking lots, and rooftops.

As we expand our cities, roads, parking lots, and industries, we create more impervious surfaces (surfaces that water cannot penetrate) thereby changing the way water moves through the landscape.

Before large areas of Whatcom County were developed, forests and open spaces absorbed rainwater. In a natural landscape, water is captured by vegetation or able to pool in wetlands, where it can slowly seep into the ground. Wetlands include swamps, marshes, bogs, and similar areas that are saturated with water for most of the year.

In many developed areas of Whatcom County, the wetlands and native soils have been filled or drained for previous development so that very little stormwater can be absorbed.

Stormwater treatment in an undeveloped landscape (left) and in a developed landscape

A natural wetland

A constructed detention pond

Introduction

Why is stormwater a concern?

Stormwater is a concern for two reasons: faster runoff leads to flooding and pollution. In western Washington, stormwater is a special concern due to our wet climate and rapid rate of urbanization.

Faster runoff: Water runs off impervious surfaces much faster than in natural areas. This means that when it rains or snow melts, there are larger volumes of water flowing faster in creeks and rivers. These increased volumes and faster flows often lead to erosion that can damage stream banks, cause local flooding, undercut roads or buildings, and reduce property values.

Pollution transport: Stormwater does not originate from a single source like a discharge pipe, so it can pick up pollution as it flows across impervious surfaces in residential or industrial areas. Activities such as home construction, outdoor machinery maintenance, driving, lawn fertilizing and car washing contribute pollutants to stormwater. These pollutants include oil, heavy metals, pesticides and excess nutrients (like nitrogen or phosphorus in fertilizer), all of which can degrade water quality and harm or kill fish and aquatic wildlife. Stormwater is the largest source of pollution in Puget Sound.

With the rapid increase in impervious surfaces and development in Whatcom County, the potential for more stormwater and stormwater pollution increases every day. To reduce the negative impacts that development has on stormwater, the County requires most new developments to create stormwater treatment systems.

One solution? LID on **your** site.

How do stormwater ponds and wetlands compare?	Stormwater Pond	Wetland
Help prevent flooding and downstream property damage	✓	✓
Protect water quality via physical and chemical processes	✓	✓
Provide water storage	✓	✓
Maintenance free		✓
Have a stable water level		✓
Provide high-quality wildlife habitat		✓
Have diverse plant community and species diversity		✓

Low-impact Development

Water infiltration on your property

Seattle's SEA Street, an example of an urban area with multi-layered trees and shrubs

Low-impact development (LID) is a way to manage stormwater right on your property by encouraging water to infiltrate, rather than diverting it. By decreasing the amount of compacted soil and impervious surfaces on your lot, you can encourage water to stay on your property instead of adding to stormwater run off.

> Stormwater is not wastewater, it is a resource – as potential ground water, as unpolluted water, as habitat, as amenity.
>
> - The Integrated Pond

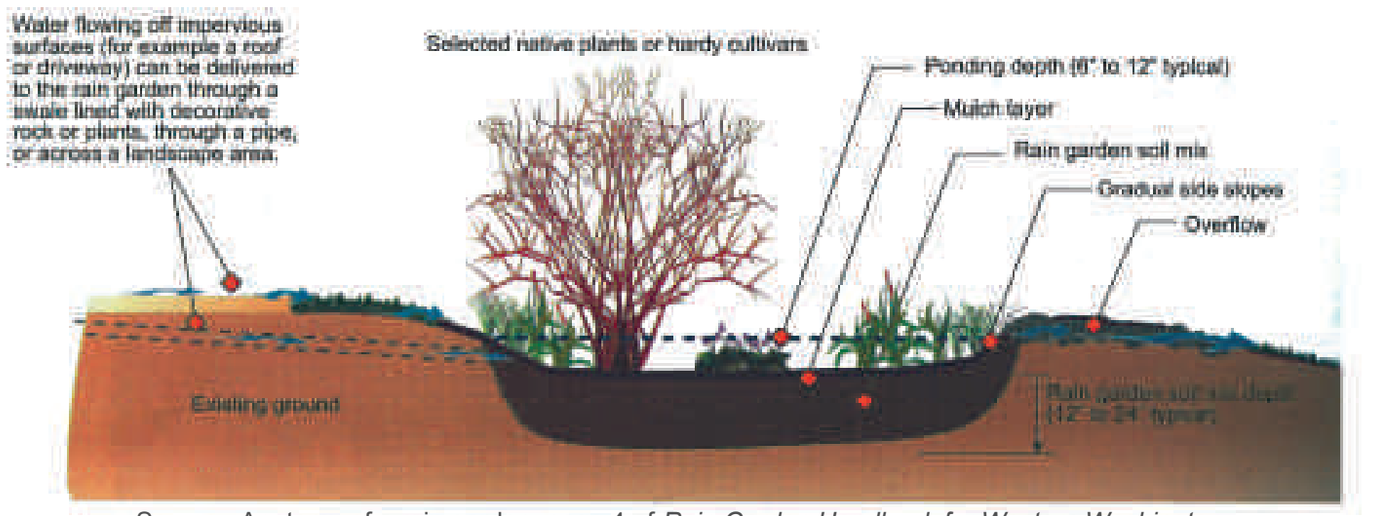
The easiest way to promote infiltration is by adding a variety of shrubs and trees on your property. Grassy lawns are generally considered to be impermeable. Why? Because the soil in most lawns is compacted, and because grass roots are short. Short rooted plants in compacted soil do not promote water infiltration, so a lot of water runs off lawns.

The roots of shrubs and trees can go deep into the soil, breaking up compacted layers, allowing more water to infiltrate deep into the ground. Water collects on the surfaces of leaves and branches, allowing evaporation. The rain that makes it to the ground through large plants is mostly absorbed by the plant roots.

Increasing the variety of deep rooted plants is one of the best things people can do to reduce stormwater flows, and using native plants is a great choice. Native trees and shrubs are adapted to our climate, require low maintenance, capture lots of water, and help build soil structure better than lawns. Native plants often have berries and seeds, attracting birds and other wildlife.

When properly designed and constructed, rain gardens drain rapidly with surface water present for only 1-2 days. Mosquitoes take a minimum of about 4 days (many types of mosquitoes take several days longer) to become adults after eggs are deposited in water.

A typical rain garden (below)



Source: Anatomy of a rain garden, page 4 of *Rain Garden Handbook for Western Washington*

Low-impact Development

Slow it down, spread it out, soak it in

Bioretention is an integrated stormwater management practice that uses plants, microbes, and soils to remove and retain pollutants from stormwater. All you have to do is slow it down, spread it out, and let it soak in. Here are some great ways to do it:


Photo: RE Sources

Remove lawn, then install native plants, pervious walkways and pervious pavers: By replacing your lawn with deep rooted plants, you will be promoting infiltration. Consider a green roof for your garage or other structures. By removing paved walkways, patios, and driveways, and replacing them with permeable surfaces, you will allow for even more water infiltration. Photo left: a permeable driveway, removed lawn, pervious walkways and pavement.


Photo: Cypress Designs

Install a rain barrel: A rain barrel collects and stores rainwater from your roof to use for things like watering your garden. Water is diverted from your roof's downspout, where it would normally flow to the ground or a stormwater collection system, into the rain barrel for later use.

Install a French drain: A French drain is a trench in the ground that collects water from your roof, and allows infiltration. French drains can take somewhat different forms but generally consist of a trench with a perforated drain pipe surrounded by drain rock and filter fabric or sand.


Photo: Drainage Masters

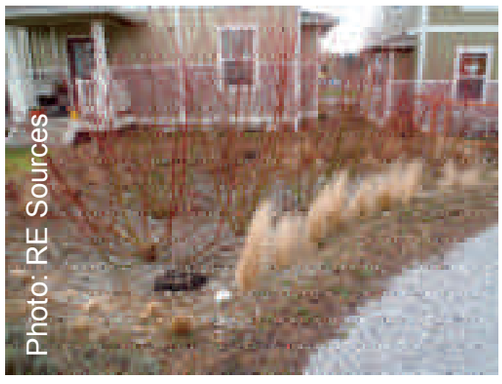


Photo: RE Sources

Install a rain garden: A rain garden is a planted depression that allows rainwater runoff from impervious urban areas like roofs, driveways, walkways, parking lots, and compacted lawn areas the opportunity to be absorbed.

Stormwater Systems

Why inspect and maintain stormwater systems?

There are many reasons to regularly inspect and maintain your stormwater system. If you maintain your stormwater system, you will help protect downstream water quality and habitat for wildlife and people to enjoy. In addition to keeping water clean, a well-maintained stormwater facility will help protect downstream properties from potential flood or erosion damage. A little bit of maintenance goes a long way—if you keep up with some simple tasks, you may avoid having to pay for expensive repairs in the future.

By maintaining every facility in your stormwater system you will:

As a property owner, you are required to follow the maintenance tasks and schedule specified in the operations and maintenance (O & M) plan for your facility. Whatcom County Code contains requirements for maintenance of private stormwater facilities, and the federal Clean Water Act, Safe Drinking Water Act, and Endangered Species Act all require states to manage stormwater runoff to protect water quality in rivers and streams.

Save money—Identifying and correcting potential problems early will save you money by reducing long-term maintenance costs. It's much easier to prevent maintenance problems than it is to fix them once the damage is done.

Protect water quality—Properly inspecting and maintaining your stormwater system is an important action you can take to keep water clean and safe in your watershed. Making sure pollutants such as sediment, litter, oil, or animal waste stay out of your stormwater system will ensure the water leaving your system is as clean as possible. Remember, stormwater does not go to the sewage treatment plant. It flows to the nearest stream or beach.

Minimize potential liability—Local, State and Federal regulations require privately owned stormwater systems be properly maintained and polluted water and sediments removed during cleaning be disposed of properly. Property owners could be liable for polluted discharge from stormwater systems.

Reduce flooding and erosion—A properly functioning stormwater system is also less likely to fail and cause erosion or flooding during a big storm.

The wastewater from our homes—sinks, toilets, dishwashers and the like—goes to a sanitary sewer treatment facility or septic system before it's released into our waterways. Stormwater, however, travels through our local catch basins, into our storm drain system and into Puget Sound itself. If our streets, rooftops and private stormwater facilities are dirty, then our local waters will be too.

If we all work to decrease litter, animal waste, oil waste and other pollutants, and keep our stormwater facilities properly maintained, then we can help protect marine water quality as well as the freshwater tributaries and wetlands that private stormwater facilities often discharge to.

Stormwater Systems

Understanding stormwater systems

Stormwater systems include a variety of **stormwater facilities** that convey, slow, filter, or infiltrate (absorb) stormwater runoff. Stormwater systems can be simple or complex. A small residential development may have one or two ditches and a single stormwater pond. A large development may have a network of ditches, buried pipes, catch basins and ponds.

Regardless of its complexity, most stormwater systems will include conveyances like pipes and ditches that move stormwater from one place to the next; catch basins that regulate the speed that stormwater moves through the system and help settle out trash and sediment; and ponds that help filter and reduce the rate of flow of stormwater.

Photo of a Whatcom County subdivision. Stormwater flows into catch basins and is transported in the direction of the flow arrows to the two ponds located in the middle of the development. *(Source: Whatcom County Public Works)*

A **stormwater system** is a series of connected **stormwater facilities** that convey, slow, filter, or infiltrate (absorb) stormwater runoff from your property, then release that stormwater to surface waters or other stormwater systems.

How does water move through a typical development's stormwater facilities?

As an example (at left), this stormwater system captures stormwater at street level in Type 1 catch basins and pipes it to the two detention ponds at center of the photograph. The detention ponds slow and control the flow of stormwater into natural water bodies. This system includes catch basins, pipes, detention ponds, and a biofiltration swale.

Stormwater Systems

Guidelines for maintaining stormwater systems

Properly maintained stormwater systems **save money**, help **protect water quality**, and **reduce the risk of flooding.**

Know where the water flows—Develop a good understanding of your stormwater system by following stormwater runoff as it enters and flows through your community during a rainstorm. Be sure to note where the stormwater goes once it leaves your system.

Stop pollution at its source—The easiest way to protect water quality and save on cleaning costs is to keep pollutants from entering your stormwater system.

Sweep—Sweeping driveways clean instead of using a hose or covering loose soil with a tarp keep sediment and other pollutants out of your stormwater system.

Keep yard debris out of ditches—Grass clippings or branches from pruning should be kept away from your stormwater system. Yard debris can cause problems by adding pollutants like fertilizer or animal waste to stormwater or causing flooding by blocking culverts, ditches, or pipes.

Look for blockages—Watch for debris or litter blocking the flow of stormwater through your system and remove it as soon as possible before it becomes a problem.

Determine your level of responsibility—The ownership of stormwater systems varies between different housing developments in Whatcom County. The best way to determine what you are responsible for maintaining is to read the plat conditions for your development. Some homeowners' associations may have these records available. If you need assistance finding your plat conditions, contact Whatcom County Public Works Stormwater Division.

Regularly inspect and maintain your stormwater system—Follow the guidelines presented in this handbook to ensure your stormwater system is functioning properly.

More about your stormwater system

Depending on when your stormwater system was built, you may have access to engineering documents that should be used to help you properly inspect and maintain your stormwater system.

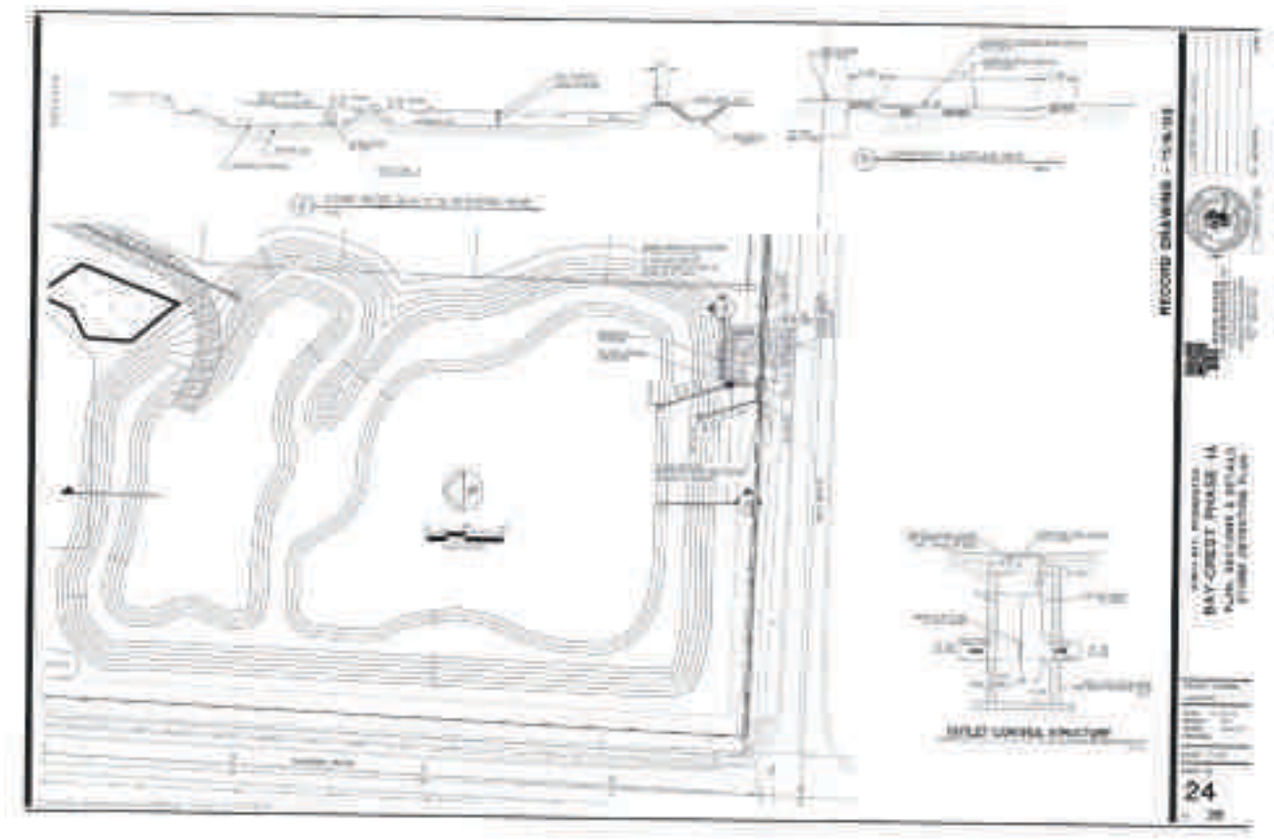
As-built (record) drawings

An as-built drawing, or record drawing, is a technical drawing that shows how your stormwater system was built and documents any changes made to the original system design during the construction process. These drawings are usually signed and stamped by a professional engineer and are a great reference that will help you determine the size and location of the components of your stormwater system. If you are part of a large housing development, you might have a series of as-built drawings in different sizes or scales.

Operation and Maintenance (O&M) Plans

An operation and maintenance plan (O&M plan) is a technical manual written by an engineer containing specific directions on how to best maintain your stormwater system. Only newer developments will have a complete stormwater system O&M plan. However, when one is available, it should be used as your primary reference on how to best inspect and maintain your stormwater system. This handbook may provide additional details and information about conducting inspections, schedules, and maintenance tasks not found in your O&M plans or it may help you better understand the recommendations made in your plan.

Contact the Whatcom County Public Works Stormwater Division if you need help locating copies of the documents for your stormwater system.



Your as-built drawing from county files will have many important details.

Maintaining Your System

Best Management Practices (BMPs)

Proper maintenance of your stormwater facility begins with the understanding of the term “best management practices,” or BMPs, for short. For stormwater systems, BMPs are ways to prevent or reduce the amount of pollution travelling through or leaving the system. BMPs can also reduce stormwater facility maintenance costs.

BMPs are separated into two categories: source control and treatment BMPs. Source control BMPs prevent pollution by controlling pollutants at their source. Treatment BMPs are used to treat stormwater that is already polluted. Source control BMPs are always more effective than treatment BMPs because they prevent pollution from entering the water, whereas treatment BMPs rely on cleaning up the water after it has been polluted.

If you can promote source control BMPs that keep debris and sediment out of the stormwater facility, you will reduce maintenance costs. To keep debris and sediment out of your stormwater facility, practice good housekeeping **(see box below)**.

Throughout the rest of this section, you will be able to read about each type of stormwater facility, see what it looks like, and understand the BMPs that will ensure it functions properly and lasts as long as possible. See pages 35 and 36 for a checklist to use when inspecting and maintaining your stormwater system.

Keeping records of inspections is very important. It allows a homeowners association or community to keep up with an inspection schedule, review data collected during past inspections, and estimate when routine maintenance is needed. Inspection checklists and all records should be kept with the O & M plan and as-built drawings for your stormwater system.

Ongoing, regular maintenance activities are different from inspection. Regular, ongoing maintenance should include activities like vegetation management and/or mowing side slopes and pond shorelines; inspections will find problems that need to be fixed.

Good Housekeeping BMPs

- ⇒ Sweep and remove trash and sediments from the streets.
- ⇒ Sweep and remove sand from winter sanding operations when no longer needed.
- ⇒ Ensure that roofers sweep and remove grit from roads after completing a roofing job.
- ⇒ Rake and pick up leaves from lawns.
- ⇒ Cover soil piles from construction or landscaping efforts.
- ⇒ Place yard waste and compost out of the path of drainage ways.

Maintaining Your System

Type 1 catch basins


Photo: RE Sources

Inspection Frequency: Exterior: Monthly (weekly when leaves are falling) & after storms, **Interior**: Annually

Stormwater from streets drains into small underground vaults called **Type 1 catch basins**. These are installed in the center of a street or along the street curb or gutter. Type 1 catch basins are sometimes called “storm drains.”

A catch basin consists of a grate on the road surface with an underground vault beneath it. Stormwater collects in the vault, allowing sediment to settle on the bottom. Water from the catch basin flows through pipes to a variety of destinations: into a swale, a stormwater pond, or directly into a river or stream.

Check catch basin grates regularly as they can become clogged with litter or leaves. Remove trash, debris, and sediment from the vicinity so it won’t enter the basins. Remove the grate to check the accumulation of sediment in the vault. When sediment exceeds 60% of the vault depth or comes within 6” of the lowest pipe, the catch basin needs to be cleaned (Dept. of Ecology: Volume V, February 2005). Contact a professional to clean the catch basin with a vactor truck. During the dry season, sediment can be removed by hand with a bucket and shovel. Follow recommendations in Appendix IV-G of the Dept. of Ecology’s *Stormwater Management Manual for Western Washington* for disposal of the sediment.

You will often see fabric filters placed in these catch basins near construction sites. These filters are designed to keep out large debris but do not capture silt or other fine material. They should be changed whenever they are torn and monitored in case they become clogged. Filters should be removed after construction is complete.

Reminder: Catch basins in private roads are the owners’ responsibility; catch basins in county roads are county responsibility.

Type 1 and **2 catch basins** are designed to catch debris and regulate flow. They both can protect receiving waters such as bays, streams, and wetlands.

Type 1 catch basins are usually found before a stormwater pond, protecting the inlet and pond from debris.

Type 2 catch basins are usually found at the outlet of a stormwater pond, protecting downstream waters by trapping excess sediment before it leaves a pond.

BMPs for Type 1 Catch Basins

Grate	Remove trash and sediment from around grate	Replace if broken
Filter	Change if torn; monitor for blockages and remove or clean if restricting flow into the basin	
Inside	Remove trash and debris if present	Remove sediment if it fills >60% of the vault or is full to within 6” of the lowest pipe

Maintaining Your System

Type 2 catch basins

Inspection Frequency: Exterior: Monthly & after storms, **Interior**: Annually

DO NOT ENTER Type 2 CATCH BASINS! They are confined spaces and can be dangerous! Contact a trained professional for needed maintenance or repairs.

A Type 2 catch basin is a large concrete manhole structure that varies from 4' to 8' in diameter and up to 20' deep. A Type 2 catch basin functions both to control flow from a detention pond and as a final depository for sediments and pollutants before stormwater exits the pond.

Determine the location of these catch basins from your O & M plan or by getting out there and finding them. Gather a flashlight and the tools needed to remove catch basin covers. For Type 2 catch basins, remove the cover using a manhole cover lifter. Use a long iron bar or rebar to check the depth of sediment.

If trash, debris, or sediment exceeds one-third the depth from the bottom of the basin to the bottom of the lowest pipe into or out of the basin, it should be removed by a vactor truck (Thurston County: Maintaining Catch Basins and Dept. of Ecology, Volume V, February 2005). As with sediment removed from Type 1 catch basins, special disposal requirements may apply. Follow the recommendations for disposal of street wastes in Appendix IV-G of the Dept. of Ecology's *Stormwater Management Manual for Western Washington.*

Control structure inside a Type 2 catch basin

Once cleaned, look for cracks in basin walls or bottoms. If catch basin covers are missing or only partially in place, repair. If the basin contains a ladder, check ladder rungs for strong attachments and integrity. Look for presence of any pollutants (including trash, paint, auto fluids, grease and food waste). If any vegetation is growing inside the catch basin, remove it.

Inside many Type 2 catch basins is a pipe called an orifice or flow restrictor. It controls the flow and discharge of water from the catch basin and detention pond.

When inspecting inside the Type 2 catch basins, check the integrity of the orifice plate and overflow pipes. If any of these components are missing, bent, or out of place, they should be replaced. If any trash, debris, sediment, or vegetation is blocking the plate, remove it.

BMPs for Type 2 Catch Basins

Grates or inlets	Remove trash and vegetation that may be obstructing	Replace if broken
Inside	Remove trash, vegetation, and debris if present	If sediment exceeds one third of the depth from the floor to the outlet pipe, remove
Structure	Check ladder rungs, orifice, and cleanout grates. Have repaired as necessary	Look for cracks in wall or bottom Have repaired as necessary

Maintaining Your System

Conveyances & bioswales

Inspection Frequency: Quarterly and after storms

All stormwater systems contain conveyance facilities that move stormwater from one location to another. Conveyance facilities include bioswales, ditches, check dams, and buried pipes and culverts.

A **bioswale**, or vegetated swale, is a grass lined swale that is designed to improve water quality. It filters surface water through the grass or selected vegetation. A bioswale is a form of bioretention, and is similar to a rain garden. The difference between a bioswale and a rain garden is that bioswales have a slight slope, allowing them to convey stormwater run-off to another destination, such as a ditch, culvert, or rain garden. They are often used as an alternative to, or an enhancement of, traditional stormwater piping. Most bioswales look like a wide, vegetated ditch. Most of the time, they are vegetated with a variety of grasses or other perennial plants.

*A **bioswale** under construction*

In some settings, bioswales are planted with wetland plants and shrubs. The bioswale in this photo is about 100 feet long. The water that doesn't get absorbed in this bioswale gets discharged into a roadside ditch, and into a stream. Bioswales can be incorporated into lots of settings, such as homeowner developments, roadsides, and parking lots.

A bioswale planted with wetland plants

A bioswale with perpendicular weirs

Bioswales vary in size and shape, but most of the time, they are linear. In locations that have well drained soils, bioswales can be built with ditch blocks, or perpendicular weirs, such as in this photo. Weirs and blocks help slow down water flow, promoting infiltration. Bioswales are usually seeded with a special seed mix that is capable of tolerating wet and dry conditions.

Maintaining Your System

Conveyances & bioswales (continued)

Undercutting: When the top edge of a stream bank or ditch side extends further out than the underlying bank

Scouring: Stream bank or ditch side erosion caused by high-velocity water

Slumping: Where a landform settles or slides, usually due to saturated soil

Inspection Frequency: Quarterly and after storms

Maintaining your bioswale

The single most important task is to maintain the plants - these protect the facility, and do all the work! Regular inspection of bioswales should be conducted to identify signs of erosion, accumulation of trash and debris near pipes, and signs of excessive sedimentation. Some bioswales are designed with a mix of plants, including small shrubs. Most bioswales are lined with grass or non-woody plants. If there are bare spots or erosion, repair these by applying an appropriate seed mix. It is important to know what type of plants your bioswale was designed for so that you can maintain the plants appropriately. Keep trees and deep rooted plants out of your bioswale. Remember, grass likes sun – if your grass is shaded, your bioswale may not function correctly.

Ditches

Properly functioning ditches and pipes are critical to your facility, because without them, water would stay in place.

Ditches let water move between parts of the storm-water system or out to receiving waters. They may be U-shaped, or trapezoidal with a flat bottom.

*A well-maintained **ditch** with new vegetation layered on the bottom*

Ditches are commonly lined with grass or rock. Grass helps trap sediment, improving water quality, and should be maintained in the ditch. However, if grass or other vegetation start to restrict water flow in the ditch or cause drainage problems, it should be mowed or trimmed back. Grass taller than 9", trees, or shrubs may impede the flow of water.

Never dump yard waste in ditches. Look for and remove trash, debris, yard waste, and accumulated sediment. Maintain the ditch so that the ditch profile matches the original design.

Too many trees as above will slow down and block water flow

At places where ditches or streams drop in elevation, there will usually be one or a series of small rock berms called **check dams** installed across the ditch to help slow down the velocity of the water, preventing erosion.

Locate ditches by walking your stormwater system and/or reading your O & M plan. As you walk along your ditch, look for **undercutting**, **scouring**, and **slumping**. At the places where ditches lose eleva-

Maintaining Your System

Conveyances & bioswales (continued)

*A **check dam** should stretch across the whole ditch*

tion, check for integrity of check dams, if they are present.

Pipes and culverts

Most stormwater systems use **pipes** to convey water underground, and **culverts** to route water under roads and driveways. Pipes are also used to connect catch basins turn corners and route stormwater into other conveyance systems.

*A **pipe** entering a catch basin*

Even though many pipes are underground, it is important to know approximately where they're located, and to regularly check that they're not getting filled with sediment, rocks, or other material. Find pipe locations, ditches, check dams, and culverts by reading your O & M plan or by walking your stormwater system, preferably during a rain event. At the places where pipes and conveyance systems are exposed, note accumulation of sediment or other blockages.

If sediment or blockages are found, contact a stormwater professional who can flush the pipes with water during the dry season. It's important to hire a professional to do this, as flushing the system incorrectly could overload a stormwater pond or transport pollution to the receiving waters.

Stormwater **culverts** can be plastic, concrete or metal. Look for dented, rusted, or broken edges of culverts, and for rocks that have been moved by strong flows of water. If found, replace rocks in original location.

Time to remove sediment

If there is evident sediment build-up on the bottom of the culvert, it is probably time to remove sediment. Keep trees, and tree roots, away from culverts and pipes. Willow roots are especially bad because they can completely block the flow of water. If roots are evident, remove them using a mechanical auger with a rotating head that can cut roots inside a pipe; professionals are available for these services.

Reminder: Conveyances along private roads are the owners' responsibility; conveyances along county roads are county responsibility.

Maintaining Your System

Conveyances & bioswales (continued)

BMPs for Conveyances (bioswales, ditches, pipes and culverts)		
All conveyances	Remove trash, yard debris, and excess vegetation	Remove sediment if it impedes water flow
Bioswales	Vegetation: bare patches should not exceed 10% of swale bottom. Don't allow excessive shading. Re-seed bare areas, and increase amount of sunlight reaching swale, if necessary	If vegetation growth is sparse, determine why, and replant
	Check inlets and outlets for debris	Remove debris that causes clogging or blockage
	Check for accumulation of sediment.	If sediment exceeds 2" beyond design depth, remove. Swale bottom should be level from side to side, and should drain freely towards outlet
	Check for standing water	If standing water remains in between storms, remove sediment or blockages, or other drainage problems
Ditches	Repair undercutting, scouring, and slumping	See definition in sidebar
	Inspect vegetation, don't allow vegetation to impede water flow	Check for integrity of grass, check dams, inlets, and outlets. Remove shrubs and trees.
	Inspect for accumulation of sediment	
Pipes and culverts	Inspect for accumulation of sediment	If sediment exceeds 20% of diameter, clean pipes and culverts
	Inspect for vegetation overgrowth	Remove vegetation if it reduces the free movement of water
	Inspect for damaged joints, dents, or rust	Repair accordingly. Any dent that decreases the pipe's cross section by more than 20% should be repaired.
Check dams	Check formation of dams and replace rocks if necessary	

Maintaining Your System

Stormwater ponds

Stormwater ponds are engineered systems that mimic the natural process in wetland systems. Stormwater ponds create a place for water to collect and for sediments and other contaminants to settle before flowing to a natural watercourse.

Like in a wetland, some stormwater pollutants can also be "treated" in stormwater ponds. Pollutants such as sediment and debris settle to the bottom of the pond and can be removed at a later time. Other pollution such as excess nutrients are taken up by a variety of plants and microorganisms. Other contaminants bind with soil particles through a process called sorption.

There are two types of stormwater ponds. **Wet ponds** are designed to have a permanent pool of water, or at least a pool throughout the wet season. **Dry ponds** are designed to hold water temporarily after a storm, releasing the water slowly then drying out between storm events (EPA Stormwater Menu of BMPs).

Water storage capacity is the amount of water your stormwater pond is designed to contain, and it's the most important design aspect of your stormwater system. An engineer designed your pond to have a specific storage capacity based on the area of your development, the amount of impervious surfaces, the soil type, the average rainfall rate, the topography, and other considerations.

The primary reason to maintain your stormwater pond is to make sure that its storage capacity is maintained and it's not getting filled in with sediment. We will talk more about sediment in the following sections.

A one stage constructed stormwater pond

A two stage constructed stormwater pond with berm

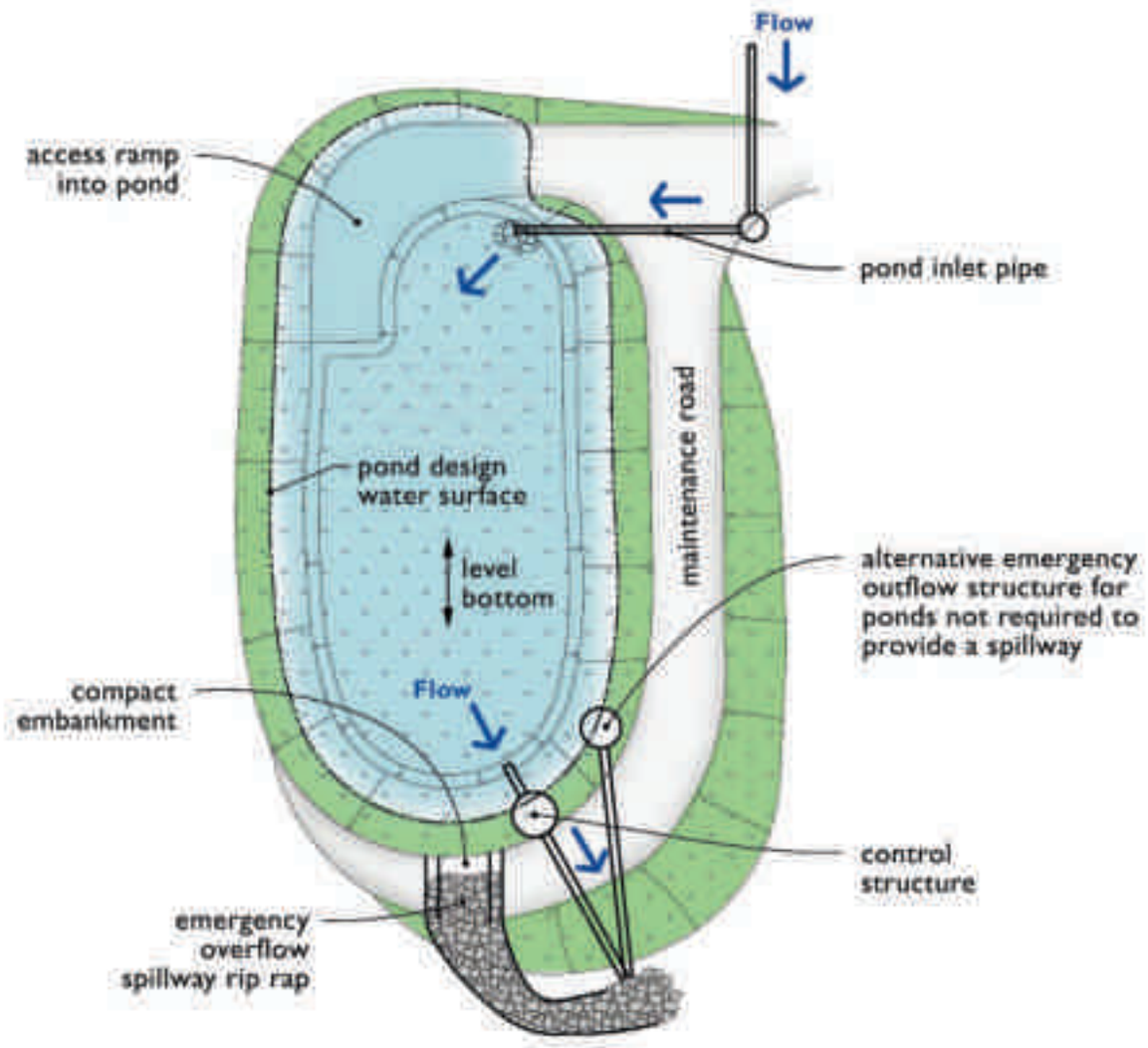
Maintaining Your System

Stormwater pond components

Most older stormwater ponds contain a single basin, often called a **cell**. Newer ponds may contain two cells separated by a low berm. In most cases, the berm forces water to slow down, causing particles of sediment to settle out in the first cell. In two-celled (two-stage) ponds, sediment in the stormwater runoff will usually settle in the first cell.

Stormwater ponds always have an **inlet**, **outlet**, and **spillway**. The inlet is the point where stormwater enters the pond. Inlets are often covered with a **debris barrier (trash rack)**. The outlet is the structure through which water exits the pond, allowing for controlled release of water from the pond into another water course, usually a ditch or a stream. A Type 2 catch basin is often present as part of the outlet structure.

The spillway is a low area, constructed with rock or concrete, in a low area of the pond wall that allows for "spillover" if the water level gets too high in the pond. Without this safety feature, the pond walls could be damaged if the water level gets too high.



Example of a constructed stormwater pond *(Source: Pierce County Stormwater Manual)*

Maintaining Your System

Stormwater pond components (continued)

Inlets and outlets

Inspection Frequency: Quarterly and after storms

Maintaining inlets and outlets

Find your inlets and outlets by walking around the pond. Remove all trash and vegetation that is blocking the inlet or outlet. If there is evidence of erosion or scour around either the inlet or outlet, determine and remedy its cause. If rip-rap is present below the outlets, check to see that all rocks are in place.

Check that there is no evidence of sediment reaching the receiving waters. If there is, determine its cause by a thorough inspection and correct the problem.

Debris barrier (trash rack)

Inspection Frequency: Annually

A **debris barrier** (or **trash rack**) is a metal rack located at the entrance to a pipe or culvert or on an outlet control structure. These prevent trash, wood, and other debris from entering pipes, stormwater ponds, or outlet structures. If your facility does not have a trash rack located on its inlet or outlet pipe, you should consider installing one to prevent plugging.

If trash or debris is blocking more than 20% of the openings in the barrier, remove (Dept. of Ecology: Volume V, February 2005, and Pierce County Stormwater Maintenance Manual). If bars are missing, bent, or excessively rusty, replace them. If the barrier is not firmly attached, repair it.

Vegetation and obstructions should be removed from clogged inlets

*Beneath the **outlet pipe** is a pad of large rock, an **energy dissipater**, that slows fast-moving water. There may also be a dissipater below the inlet to your pond.*

*A **trash rack** or **debris barrier** should be cleared of vegetation, trash, and other debris*

Maintaining Your System

Stormwater pond components (continued)

Spillway

Inspection Frequency: Annually

While walking around the perimeter of the pond, look for the lowest area – this is the spillway. Carefully check this area and all berms over 4' in height. If any trees or shrubs are growing here, remove them. If only one layer of rock exists above native soil in any portion of the spillway, or if any native soil is exposed, add more rocks and restore the area to design standards (Dept. of Ecology: Volume V, February 2005).

Check for **piping** and erosion. If there is any discernable water flow through the pond berm, consult a civil or geotechnical engineer (Dept. of Ecology: Volume V, February 2005).

Water only passes over the spillway when the pond fills up.

Below the spillway, there is often an **energy dissipater** consisting of layers of rock that the exiting water falls on. If only one layer of rock exists above native soil, or if any native soil is exposed, add more rocks to the area. If there is evidence of erosion near the rock pad, repair it.

Piping is an engineering term used for water that moves through a channel or narrow hole.

BMPs for Components of a Stormwater Pond

Inlets and outlets	Remove vegetation and debris that impede water flow Look for sediment below outlet; if found, note and correct	Fix the cause of any erosion or scouring
Debris barrier	Remove vegetation and debris that impede water flow	
Energy dissipater	Add rock to energy dissipater if only one layer or holes	
Spillway	Check integrity of rock blankets Replace rock as necessary If piping or erosion visible in berm, consult a civil or geotechnical engineer	Remove trees, shrubs, and vegetation over 4"

Maintaining Your System

Pond cell

Inspection Frequency: Monthly

The pond cell is the one- or two-part basin that retains water while trapping sediment. In the pond itself, you can inspect the water in the wet season for trash and debris, oil sheen, excess vegetation (see pages 24-26) and algae.

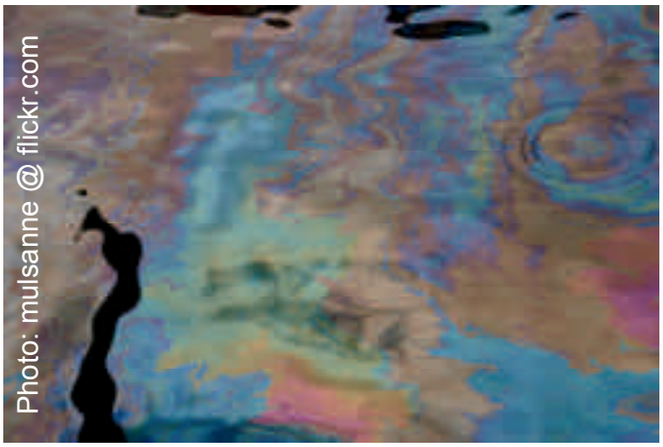
General pond maintenance

Any time you see **trash and debris**, it should be removed because it can clog pipes in the outlet control structure, but at a minimum check and remove trash monthly and after storm events.

If you observe an **oil sheen**, it should be removed by use of oil-absorbent pads or a professional with a vactor truck. Locate the source of the oil and correct it. Special disposal requirements may apply.

Well-trimmed vegetation makes a detention pond's outlet and fencing clearly visible.

Many ponds become stagnant during the summer months, allowing a layer of algae to grow. **Algal mats** interfere with dissolved oxygen content in the water and pose a threat to downstream water resources. If algal mats develop over 10% of the water surface, they should be removed (King County Drainage Maintenance Standards). A rake can be used to remove the algae, which can be left to dry on the pond slope in the summer season.



*If there is an **oil sheen,** the oil should be removed immediately.*

*Use a rake to remove an **algal mat** from a stagnant pond.*

Maintaining Your System

Pond structure

Inspection Frequency: Walls & side slopes: Quarterly, **Bottom**: Annually, **Sediment removal:** Annually in a two-stage system, or as needed

Pond walls & side slopes

Walk the perimeter of your pond quarterly. Look for anything out-of-the-ordinary including erosion, animal burrows and settling. If you see animal burrows, take immediate action—hire a professional who can remove rodents without impacting water quality. If any part of the pond has settled more than 4 inches it can be an indication of more severe problems with the berm or outlet (Dept. of Ecology: Volume V, February 2005). A licensed geotechnical engineer should be consulted to determine the cause of the settlement.

Bottom of the pond

During the dry season, inspect the bottom of the pond for sediment buildup and liner integrity, if applicable. If you have a **liner** (check your O&M manual) it should not be visible or have holes in it. If it is visible you may want to ask a stormwater professional if there is an operational reason for this. If the liner has holes, it will need to be repaired or replaced.

Although some ponds may never need to have **sediment** removed, most will. To determine whether it's time to remove sediment, check to see how deep the sediment is and the condition of the bottom of the pond. Has sediment built up near the inlet? Is the bottom of the pond flat? Is the entire bottom of the pond vegetated? Some ponds will have grass on the bottom, and some won't.

Sediment accumulation in the pond bottom that exceeds the depth of the designed sediment zone (usually 1' or 10% of pond's capacity) should be removed (City of Portland: Operation and Maintenance for Private Property Owners and Dept of Ecology: Volume V, February 2005). Sediment markers placed in the facility can help you identify sediment depths.

Settlement and sloughing of a pond side slope

Additionally, if accumulated sediment is higher than the bottom of the outlet pipe, sediment must be removed to ensure that it does not contaminate downstream water bodies.

Some newer ponds may have a two-stage pond system. In these types of ponds, sediment should be removed from the first cell (basin) on a regular basis. This will prolong the life of the main pond, and if this is done with regularity, the rest of the pond may never need to be excavated.

When your stormwater pond requires cleaning, contact a professional cleaning service. Make sure the professional follows the recommendations for management of street wastes from Appendix IV-G of the Washington State Department of Ecology's 2005 *Stormwater Management Manual for Western Washington*. You should request that the cleaning professional you hire state that sediments removed from your pond will be properly handled in your contract.

Maintaining Your System

BMPs for the Pond Structure		
Pond walls	Check for slumping or sloughing; if over 4” of slump, consult with an engineer	Check for and fix the cause of any erosion or scouring
Pond bottom (during dry season)	If liner is visible, check for holes; repair or replace Check sediment depth, especially near inlet; have removed if necessary	
Pond surface	Clean any oil sheen from water with oil absorbent pads or vactor truck	

Settling, sloughing, and erosion can be signs of serious problems that lead to failure of the pond wall

Dry pond bottom, with fencing, walls, inlet and control structure visible

Maintaining Your System

Vegetation in and around the pond

Inspection Frequency: Annually

Plants are an important water quality part of stormwater facilities—they do all of the actual work! Plants absorb water and nutrients, and their roots improve the infiltration rates of soil while stabilizing slopes and preventing erosion. Plants capture pollution, provide habitat for birds and wildlife, and add aesthetic appeal to property. Proper maintenance of plants at your stormwater facility is the single most important action that will improve performance and appearance of your facility.

In order to identify vegetation maintenance needs, it is helpful to have a copy of your as-built drawing or a landscape plan (which is often part of the O & M plan). When your pond was installed, specific kinds of plants were planted to function in certain areas. The plants in most stormwater facilities are a mixture of native and non-native plants. Some of these plants are adapted to live in saturated soils, and some are adapted to live in upland soils.

Vegetation on the sides of your pond

Native and non-native grasses are the most common vegetation used in stormwater pond construction. The root system of grasses holds the surface soil in place and protects slopes from wind and erosion. The right kind of vegetation on the pond sidewalls will protect the integrity of the pond.

Grass should be mowed during the dry season to keep it 4” to 9” tall (City of Portland: Operation and Maintenance for Private Property Owners). Grass that is at least 4” tall captures more pollutants and is hardier. Grass that is over 10” tall is considered a nuisance because it hides potential problems such as volunteer tree seedlings and rodents. Grass clippings should always be removed from the pond area. If areas of the pond walls are bare, re-seed in the spring or summer (as soon as is possible).

Trees are often planted for aesthetic, stabilization, and temperature control reasons. They have to be managed to prevent clogging of pipes and other infrastructure. Trees and shrubs with extensive root systems can destabilize side slopes and cause seepage through pond walls. If tree shade causes bare areas and erosion, consider removing the tree. A couple of carefully placed native trees or shrubs are okay if they are in the right places (away from the flow paths, and inlet/outlet structures).

Good vegetation management makes potential problems visible, and other maintenance easier

Vegetation on the bottom of your pond

In the fall, winter, and spring, your pond will probably contain lots of water. You may or may not be able to see the bottom of the pond to determine what kind of plants are growing there. Check vegetation on the bottom of the pond during the dry season. Bare areas on the pond bottom are okay; bare areas on the sidewalls of the pond are not okay unless the pond has just been built.

In the wet season, if your pond has no vegetation sticking up above the water (emergent vegetation), the pond bottom does not require any vegetation management.

If your pond has 25 to 50% emergent vegetation during the wet season, it may need to have sedi-

Maintaining Your System

ment removed. This is especially true if the emergent vegetation is in the middle (deepest part) of the pond. If no more sediment is being added to the pond through the conveyance systems (like from nearby development projects), vegetation management may not be needed.

When the pond is 50 to 100% covered with emergent vegetation during the wet season, it probably requires vegetation management.

Not entirely grown in, but in need of vegetation management

A pond that is 100% cattails will need management

A proliferation of cattails usually indicates that the pond has too much sediment, since cattails cannot grow in deep water. When your pond is filled with cattails, it is time to remove sediment.

Cattails are also a problem because they can dominate shallow stormwater ponds, wetlands, and swales. Cattails out-compete other native emergent plants that otherwise establish more varied, mature plant ecology.

If your pond is near a wooded area that contains alders or cottonwood trees, it may receive thousands of tree seeds in the spring. Sometimes these seeds will sprout. Depending on the species of tree and the amount of time the pond bottom is inundated with water, the seeds will thrive. If seedlings cover your stormwater pond, you will need to remove them by mowing the pond bottom several times during the dry season. If you can't mow them, the seedlings will need to be removed using another method (brush cutting or hand-pulling).

A pond entirely grown in with trees and other vegetation

Maintaining Your System

Vegetation in and around the pond (continued)

Inspection Frequency: Annually; Semi-annually during growing season for nuisance vegetation

Vegetation near the inlet, outlet, control structures, fences, and access ramps

It is very important to regularly check the vegetation around inlets, outlets, controls structures, fences, and ramps. Trees and shrubs should be cleared from these structures because they can block your view of the facility, making inspections difficult, and their roots may damage pond structures. Maintained grass is the only vegetation that should be allowed around these features. You don't want to have vegetation blocking the access ramp in the event that you need to remove sediment or an outlet blockage during winter months!

Vegetation should be cleared from around this inlet

Nuisance vegetation

In the dry season, inspect the pond, sidewalls, and access areas for any poisonous plants or invasive weeds such as purple loosestrife, knotweed, tansy ragwort, Himalayan blackberry, English ivy, Canada thistle, bull thistle, yellow flag iris, and reed canary grass, before it goes to seed. Invasive weeds are a problem because they have the ability to out-compete the more desirable vegetation (grass). They spread quickly and often grow taller than grass, making maintenance difficult.

Whatcom County has an excellent web site to help you identify invasive species on your property:

http://www.co.whatcom.wa.us/publicworks/weeds/weedlist.jsp

Trim invasives like English Ivy off of fences and structures

Proper maintenance of plants at your stormwater facility is the **single most important action** that will improve performance and appearance of your facility.

Maintaining Your System

BMPs for Vegetation Management		
Pond walls	Mow grass 4-9” and remove clippings	Reseed any bare areas
Pond surface and bottom	Check for emergent vegetation over more than half the area; if present, sediment removal will be necessary	Remove tree seedlings Remove algae if over 10% of surface
Around pond	Remove trees and shrubs that may shade and kill grass on sidewalls or that might have problem roots near pipes and structures	Remove invasive and poisonous plants

High or low water levels

A common maintenance issue for stormwater ponds is abnormally high or low water levels. Most stormwater ponds are designed to hold water at a stable level, which will rise during and after a storm event. If the pond is draining correctly, the water level will fluctuate, but should not stay high or low for long time periods.

If the water level remains higher than average after a storm event, it is likely that the low orifice in the outlet control structure is clogged or trash has blocked a weir, trash rack, or other entrance to the control structure. This is an undesirable situation, as the water storage volume in the pond is less, reducing the ability of the pond to attenuate flood flows. High water levels can lead to dike, berm, or pond wall failures, resulting in downstream property and habitat damage.

Low water levels can be caused by leaks in the pond walls or berms, in the spillway, or in the pond bottom. Leaks can be serious because they can lead to erosion and major failures during storm events. To assess whether there are leaks and/or to correct them, you should contact a stormwater professional.

Maintaining Your System

Access and safety

Inspection Frequency: Quarterly

Stormwater ponds can be safety hazards to small children, especially if they play in or around the ponds. Some ponds have very steep walls, increasing the likelihood of falls. In most cases, it is wise to restrict access to ponds by installing and maintaining fences and gates. Check the integrity of all fences, gates, and locks. Repair any fence sections that are damaged. Make sure that gates open and close freely. Lubricate locks when needed.

A well maintained rock access ramp with gate and fence ensuring neighborhood safety

Access road/ramps

Access ramps are rock-lined access routes (roads) that allow access for heavy machinery. These are constructed of asphalt, concrete, rock, or other approved material.

Look for the rock access ramp near the fence gate. It should have a covering of rock, allowing access for heavy equipment in case sediment needs to be removed from the pond. No trees, shrubs, or perennial vegetation should be allowed to grow on the ramp. If any of the rocks have been displaced, replace them.

Wildlife and insects

Rodents usually damage ponds by burrowing or dam building. Burrowing may jeopardize embankment stability for dams and berms. If you have a lot of tall vegetation at your facility, you may be attracting wildlife.

Moles, muskrats, pocket gophers, nutria, rats, and beavers routinely cause destruction to embankments and berms. Beaver dams reduce water storage in the pond and can lead to severe drainage problems. The food source of many of these rodents is aquatic plants—so they may be attracted to your stormwater facility if it has a healthy plant community. Management of rodents and beavers include maintaining a fence, removing trees, trapping, dam and lodge removal, and other techniques.

Beavers and other rodents can be trapped using a live trap, but the cost is often prohibitive. Lethal control may become necessary to control beaver damage. If you need to have a beaver trapped, call your local Washington Department of Fish and Wildlife Office at (425) 775-1311 for information.

Large numbers of ducks and geese are undesirable in a stormwater pond because of increased fecal coliform bacteria counts and nutrient loading. Large numbers of waterfowl can also eat desirable grasses and plants. Small numbers of waterfowl are typically not a concern. Do not feed birds attracted to stormwater ponds.

Mosquito populations sometime use stormwater ponds as breeding habitat. Sometimes the public becomes very concerned that the source of local mosquitoes is a nearby pond or wetland. Often, the problem may come from a combination of breeding habitats. The proliferation of mosquitoes is typically an indication of a maintenance problem, as mosquitoes usually lay eggs in still pools of water or on mud or fallen leaves. Proper maintenance of your pond should reduce mosquito presence. If insects such as wasps and hornets are found, they should be destroyed or removed from the site. These will interfere with regular maintenance activities.

Costs

The expenses associated with stormwater facility maintenance depend on the size, design, and type of facility. Most of the short-term maintenance (mowing, removing invasive plants, checking for trash, small erosion repairs, re-seeding, removing trees in unwanted areas) can be performed by neighborhood residents or a landscaping company.

Costs for mowing and weed control are usually calculated on a per-acre basis. You should expect these costs to increase between three to five percent each year. When you have a grasp on the costs associated with upkeep, you can establish a monthly or yearly dues payment to assess to each homeowner.

Long-term maintenance costs typically involve replacing structural components and removing sediment from the facility. It is best to hire a team of professionals to perform these tasks. Tasks that will likely require the services of a professional include replacement of outlets, embankments, and removal of sediment. If a severe flood damages your facility, get assistance.

If you don't already collect funds for maintaining your facility, you will need to figure out how to finance your maintenance needs. A maintenance fund is recommended for both capital maintenance procedures (e.g., sediment removal and major replanting costs) and routine activities such as facility inspections, debris removal, and vegetation management. For homeowner associations, this could be a portion of homeowner fees, or a specific assessment.

Beavers create their own detention ponds

It is a good idea to save an average of 5 to 10% per year of the facility's capital cost for annual routine maintenance. A percentage of this amount should be saved for sediment removal. For example, if it is estimated that the facility will need sediment removal every five years, 20% of the cost should be put aside each year. An additional 3 to 5% of the facility's capital cost per year should be put aside for eventual facility replacement. Most of these facilities have a life expectancy of 25 to 50 years, although they could last much longer (City of Portland: Operation and Maintenance for Private Property Owners).

Most routine maintenance is estimated to have an annual cost of $200 to $600 dollars per acre of facility (Pierce County Stormwater Maintenance Manual). These costs will vary depending on the types and level of maintenance practices desired. If you have a brand new facility, cost and intensity of maintenance activities may be higher during the first several years, as vegetation becomes established.

Most important, educate the people who live in your community about the benefits and purpose of your stormwater facility.

References and Resources

Whatcom County Government

Whatcom County Public Works Stormwater Division
http://www.whatcomcounty.us/publicworks/water/index.jsp

Noxious and Invasive Weeds of Whatcom County
http://www.co.whatcom.wa.us/publicworks/weeds/weedlist.jsp

Whatcom County Development Standards Chapter 2 – Stormwater Management (2002)
http://www.co.whatcom.wa.us/publicworks/engineering/documents/ch2stormwater.pdf

Whatcom County Department of Health
http://www.co.whatcom.wa.us/health/index.jsp

Finding Stormwater System Contractors

Find stormwater systems maintenance contractors by searching local business listings or the internet. Search under: Erosion Control, Sewer Contractors, Storm Drain Cleaning, and Stormwater Management.

References & Resources Outside Whatcom County

Citizen's Guide to Maintaining Stormwater
http://www.co.pitt.nc.us/depts/planning/enviro/documents/citizenguide.pdf

Maintaining Catch Basins in Thurston County, WA
http://www.co.thurston.wa.us/wwm/Publications/Water/Catchbasins_Drywells2.pdf

Pierce County Stormwater Maintenance Manual for Private Facilities: http://www.co.pierce.wa.us/pc/services/home/environ/water/wq/prifacmanual.htm

Puget Sound Partnership Resource Center
http://www.psparchives.com/our_work/stormwater/stormwater_resources.htm

Stormwater Management Facilities – Operation and Maintenance for Private Property Owners, City of Portland, Oregon: http://www.portlandonline.com/bes/index.cfm?c=45464

Washington State Department of Ecology website
http://www.ecy.wa.gov/programs/wq/stormwater/index.html

2005 Washington State Department of Ecology Stormwater Management Manual for Western Washington – Volume V – Runoff Treatment BMPs
http://www.ecy.wa.gov/biblio/0510033.html

US EPA National Pollutant Discharge Elimination System (NPDES) National Menu of Stormwater BMPs
http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

US EPA Stormwater Wet Pond and Wetland Management Guidebook
http://www.epa.gov/npdes/pubs/pondmgmtguide.pdf

Puget Sound Partnership LID manual: http://www.psp.wa.gov/downloads/LID/LID_manual2005.pdf

Puget Sound Partnership LID website: http://www.psparchives.com/our_work/stormwater/lid.htm

Protecting waterways starts in your own yard:
http://www.metrocouncil.org/directions/water/water2007/yardcare.htm

Bioswale brochure: http://buildgreen.ufl.edu/Fact_sheet_Bioswales_Vegetated_Swales.pdf

Biofilters: A manual by Oregon Dept of Environmental Quality: http://www.deq.state.or.us/wq/stormwater/docs/nwr/biofilters.pdf

The Integrated Pond: Enhancing the design and value of stormwater ponds:
http://your.kingcounty.gov/dnrp/library/1998/kcr745/intro.pdf

Glossary

Beaver deceiver: A constructed flow control device that reduces beaver damming activities. It is a non-lethal beaver management technique.

Berm: A constructed barrier of compacted earth, rock, or gravel. In a stormwater facility, a berm may serve as a vertical divider typically built up from the bottom.

Bioretention: An integrated stormwater management practice that uses plants, microbes, and soils to remove and retain pollutants from stormwater.

Bioswale: 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.

BMP: Best Management Practice. Activities or practices that prevent or reduce the release of pollutants into receiving waters.

Buffer: 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.

Catch Basin, Type 1: An underground concrete water receiving inlet, rectangular in shape (approximately 3' x 2' x 4' deep) with a slotted iron grate on top to inlet water or a solid rectangular cover. Water may also enter/exit through culverts visible in the side walls of basin. Also referred to as Inlet.

Catch Basin, Type 2: A round concrete underground basin (4'-8' diameter; 6' or greater deep); may contain Flow Restrictor/Oil Pollution control device. These basins are also required when larger diameter culverts are used. Also referred to as a Manhole or Control Manhole.

Catch basin insert: A device installed underneath a catch basin inlet to treat stormwater through filtration, settling, absorption, adsorption, or a combination of these mechanisms. There are a number of shapes, sizes, and configurations of inserts available.

Channel: A long, narrow excavation or surface feature that conveys surface water and is open to the air. Same as a ditch.

Check dams: Small rock dams built across a ditch to slow water and allow for settling.

Conveyance system: Drainage facilities and features that collect, contain, and provide for the flow of surface and storm water from the highest points on the land down to a receiving water.

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.

CWA: Clean Water Act. The federal environmental law that includes the management of stormwater.

Debris barrier: A metal trash rack.

Detention: Release of surface and storm water runoff from the site at a slower rate than it is collected by the stormwater facility, the difference being held in temporary storage.

Detention facility: 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.

Detention pond: A type of stormwater detention facility.

Discharge: Runoff, excluding offsite flows, leaving the proposed development through overland flow, built conveyance systems, or infiltration facilities.

Ditch: A constructed channel with its top width less than 10 feet at design flow.

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

Drainage area or drainage basin: An area draining to a point of interest.

Drainage facility: A constructed or engineered fea-

Glossary (continued)

ture that collects, conveys, stores or treats surface and storm water runoff. Drainage facilities include but are not 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.

Dry season: May 1 to September 30.

Embankment: A structure of earth, gravel, or similar material raised to form a pond bank or foundation for a road.

Emergent vegetation: Vegetation in a stormwater pond or wetland that emerges above the water level.

EPA: Environmental Protection Agency.

Energy dissipater: A rock pad constructed at inlets/outlets to prevent erosion, or a constructed percolation trench to disperse discharge flows over a large area, or a catch basin used to slow fast flowing runoff. Catch basins may be a part of the dispersion trench.

Erosion: The detachment and transport of soil or rock fragments by water, wind, ice, etc.

Flow control facility: A drainage facility designed to mitigate the impacts of increased surface and storm water runoff generated by site development.

Flow restrictor: A control device or a T section with one or more orifices to control release rates.

French drain: A trench in the ground that collects water, and promotes infiltration into the ground.

Groundwater: Underground water usually found in aquifers. Groundwater usually originates from infiltration. Wells tap the groundwater for water supply uses.

Ground truthing: Ground truth refers to information that is collected "on location."

Habitat: The specific area or environment in which a particular type of plant or animal lives and grows.

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. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam, or other surfaces.

Impoundment: A natural or man-made containment for surface water.

Low-impact Development (LID): Stormwater management methods that encourage water to infiltrate into the ground, rather than being conveyed away.

Nonpoint source (**NPS**) **pollution**: 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.

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

Nutrients: Nitrogen and phosphorus are considered nutrients in stormwater runoff and can accumulate in stormwater ponds, leading to degraded conditions such as low dissolved oxygen levels, algae blooms, unsightly conditions, and odors.

Outfall: A point where collected and concentrated surface and storm water runoff is discharged from a pipe system or culvert.

Piping: An engineering term used for water that moves through a channel or narrow hole.

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

Point source pollutant: Pollution issuing from a single point (e.g., a pipe) discharge.

Rain barrel: A barrel installed to capture water from a roof.

Glossary (continued)

Rain garden: A planted depression that allows rainwater from impervious surfaces to be absorbed.

Receiving waters: Bodies of water or surface water systems receiving water from upstream man-made or natural systems.

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

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

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.

Scour: Stream bank or ditch side erosion caused by high-velocity water.

Sewer system: The system of pipes and pump stations that collect and transport wastewater from homes and businesses to a wastewater treatment plant.

Slumping: Where a landform settles or slides, usually due to saturated soil.

Stormwater: Water that runs off surfaces such as rooftops, paved streets, highways, and parking lots. It can also come from hard grassy surfaces like lawns, play fields, and from graveled roads and parking lots.

Stormwater facilities: Facilities that control the discharge of stormwater and/or remove pollutants. These are most often built in conjunction with new development but include regional systems.

Stormwater system, **residential**: Residential stormwater systems typically serve all or part of a single development and are built on a tract dedicated to this purpose.

Stormwater management: The application of site design principles and construction techniques to prevent sediments and other pollutants from entering surface or ground water; source controls; and treatment of runoff to reduce pollution.

Storm drain system: The system of gutters, pipes, streams, or ditches used to carry surface and storm water from surrounding lands to streams, lakes, or Puget Sound.

Submerged vegetation: Vegetation that grows underwater, and does not emerge above the water level.

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

Type 1 catch basin: A rectangular underground inlet to the stormwater piping system, with a slotted iron grate on top. See catch basin, type 1.

Type 2 catch basin: A round concrete underground basin, 4'-8' in diameter, 6' deep or deeper. See catch basin, type 2.

Undercutting: When the top edge of a stream bank or ditch side extends further out than the underlying bank.

Vactor truck: A truck with a special tank and vacuum attachment designed to remove sediment from stormwater facilities like catch basins or pipes.

Weir: A small dam in a river, stream or drainage channel.

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.

Wet season: October 1 to April 30.

Wetland: An area inundated or saturated by ground or surface water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Inspection Schedule & Checklist

Typical Inspection / Maintenance Schedule for Stormwater Pond Facilities

Activity	Schedule/Frequency
Inspect pond area for oil sheens or trash	Monthly
Inspect exterior of catch basins	Monthly and after storm
Inspect pond area, sidewalls, and shoreline for erosion, settlement, rodent damage, and insects	Quarterly
Inspect fences, gates and locks	Quarterly
Inspect bioswales for vegetation cover and bare areas	Quarterly
Inspect ditches, check dams, and all visible pipes and culverts for trash, obstructions and other problems	Quarterly and after storm events
Inspect inlets and outlets for trash, obstructions, and vegetation	Quarterly and after storm events
Inspect trash racks, debris barriers, and energy dissipaters	Quarterly and after storm events
Inspect water levels in the pond	After storm events
Inspect pond area for undesirable or poisonous vegetation and noxious weeds	Semi-annually, during growing season
Pond area sediment accumulation (pond bottom)	Annually
Inspect interior of catch basins for debris and sediment	Annually
Inspect spillway for vegetation overgrowth and ease of heavy equipment access	Annually
Inspect inside type 2 catch basins, including flow restrictor/orifice plate	Annually
Inspect access ramps for ease of heavy equipment access	Annually

Stormwater System Inspection Checklist

INSPECTOR'S NAME & DATE:

NAME & ADDRESS OF FACILITY:

GENERAL OBSERVATIONS (IS WATER FLOWING?):

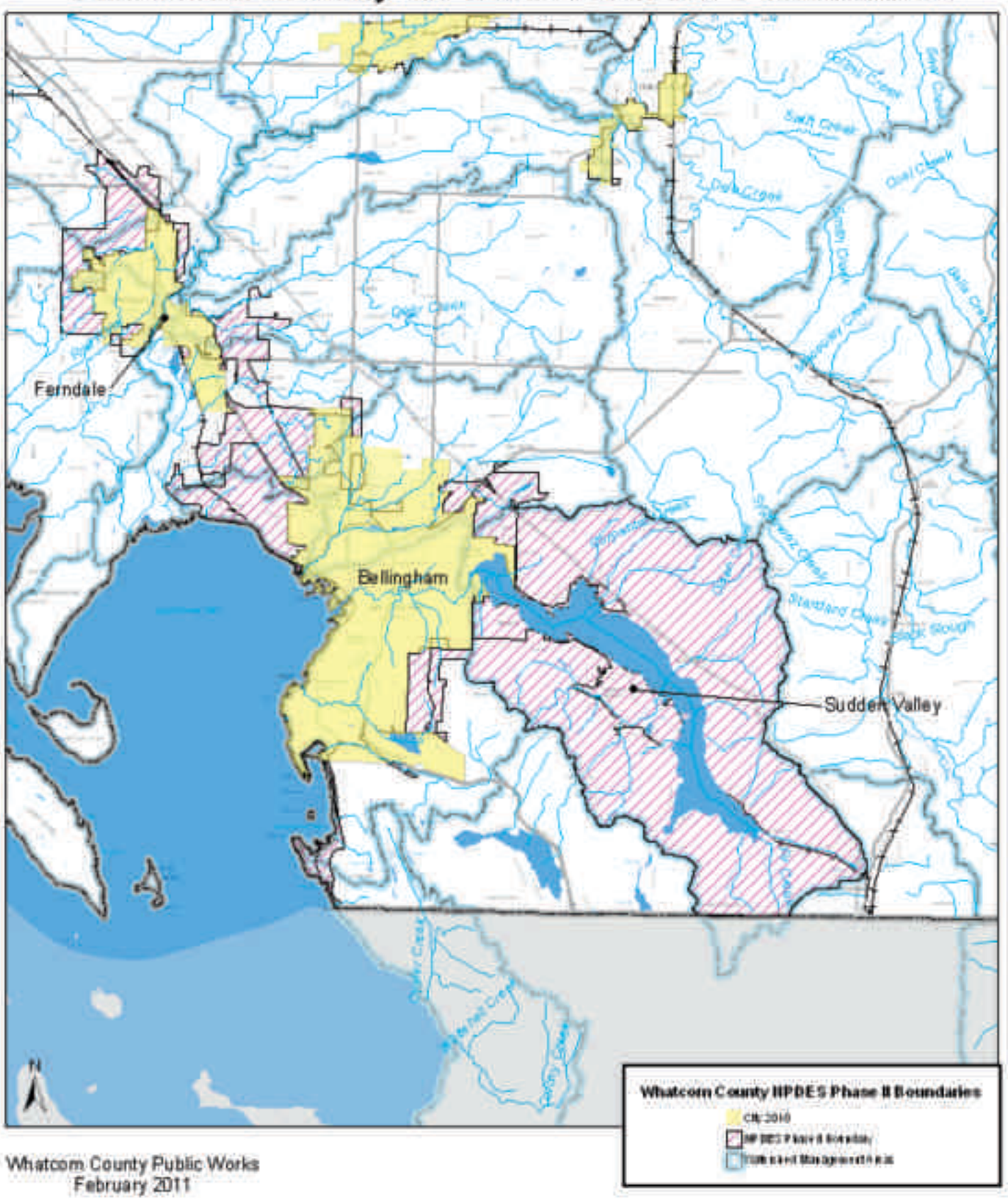
WEATHER:

	Checked? (Y/N)	Maintenance Needed? (Y/N)	Maintenance Completed/ Observations & Remarks
Type 1 catch basins			
Look for debris and sediment blocking catch basin grate. If found, remove.			
Inspect filter. Change if torn; clean if clogged; monitor for blockages.			
Look for sediment and trash in catch basin sump. Clean out if sediment fills 60% of the sump or comes within 6" of a pipe.			
Look for damage or cracks to frame, grate, basin walls or bottom. If found, repair or replace.			
Type 2 catch basins			
Remove trash blocking grates or inlets; replace if broken.			
Remove lid and check for sediment accumulation. Remove trash. Remove sediment if more than 1/3 full.			
Check integrity of ladder rungs, cleanout gate, and orifice plate. If bent or obstructed, take appropriate action.			
Have cracks in wall or bottom repaired as necessary.			
Conveyances (ditches, bioswales, culverts, and pipes)			
Check for undercutting, scouring, and slumping. If found, repair or maintain.			
Remove all trash and loose sediment. Remove sediment if it will impede water flow or clog downstream structures.			
Maintain vegetation; mow or cut back if impedes water movement or grass health.			
Repair check dams as necessary.			
Remove any dumped yard waste.			
In ditches and swales, check for integrity of grass, check dams, inlets, and outlets. Remove shrubs and trees.			

	Checked? (Y/N)	Maintenance Needed? (Y/N)	Maintenance Completed/ Observations & Remarks
Components of the pond			
Inlets and **outlets:** remove vegetation and debris. Fix erosion and scouring. Fix cause of sediment found below outlet.			
Remove vegetation and debris from **trash rack.**			
Add rock to **energy dissipater** if missing.			
If necessary, repair rock on **spillway**. Remove trees, shrubs, and vegetation over 4". If piping or erosion is visible, consult engineer.			
Pond			
Check for slumping or sloughing of **walls**. If over 4" of slumping, consult with an engineer. Fix any erosion or scouring. If **leaks**, **piping**, or **soft spots** are found, consult with an engineer.			
If **liner** visible on bottom, check for holes or replace.			
Clean any oil sheen from water with oil-absorbent pads or vactor truck.			
Check **sediment depth** near inlet. If more than one foot exists, or there is build up near inlet, the pond needs to be cleaned.			
Vegetation			
On the **pond walls/side slopes,** mow grass to 4 – 9". Remove clippings. Reseed bare areas.			
On **pond surface**, emergent vegetation over 50% of the area indicates sediment removal needed.			
On **pond bottom**, remove tree seedlings.			
Around the pond, remove trees and shrubs that shade sidewall grass or that might have problem roots near pipes and structures.			
Remove invasive and poisonous plants.			
Remove algae if over 10% of surface.			
Access and Safety			
Check integrity of **access ramp**; ensure stable and clear for heavy equipment.			
Check integrity and operation of all **fences**, **gates**, and **locks**. Repair as needed for ease of access.			
Remove rodents and insects if evidence found.			
Remove vegetation on fences.			

Attach pictures, summary, sketches, and notes as appropriate.

Whatcom County NPDES Phase II Permit Area



Whatcom County Public Works
February 2011

For questions about stormwater systems, contact:

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Bellingham, Washington, 98225

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