GREEN INFRASTRUCTURE MAINTENANCE GUIDE BOOK

San Francisco Water Power Sewer

Services of the San Francisco Public Utilities Commission

SEWER SYSTEM IMPROVEMENT PROGRAM

Grey. Green. Clean.

BEFORE MAINTENANCE

DURING MAINTENANCE

AFTER MAINTENANCE

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SFPUC
WASTEWATER

INTRODUCTION

Purpose

This field guide provides direction on routine preventative maintenance activities for green infrastructure (GI) projects within San Francisco. This guide is intended to be used by anyone conducting routine maintenance on GI systems such as bioretention planters and permeable paving on both public and private property. Users may range from municipal staff and contractors to youth groups and residents.

Glossary

Some terms may be new or unfamiliar and can be found in the Glossary (page 40).

This field guide is divided into four sections.

1. **Preparation:** What you need to know before heading out into the field
2. **Maintenance Tasks:** Guidance on specific maintenance activities
3. **Resources:** Links to additional GI maintenance-related information
4. **Checklists:** Tools to inform and document your maintenance activities

What Does This Guide Cover?

This guide focuses on routine maintenance for the most common types of GI used within San Francisco: bioretention planters and permeable pavement. In addition, this guide will provide information on non-routine maintenance tasks or structural damage that are important to look out for and report. More comprehensive details about remedial, corrective, and replacement maintenance tasks will be covered in later documents.

What Is Green Infrastructure?

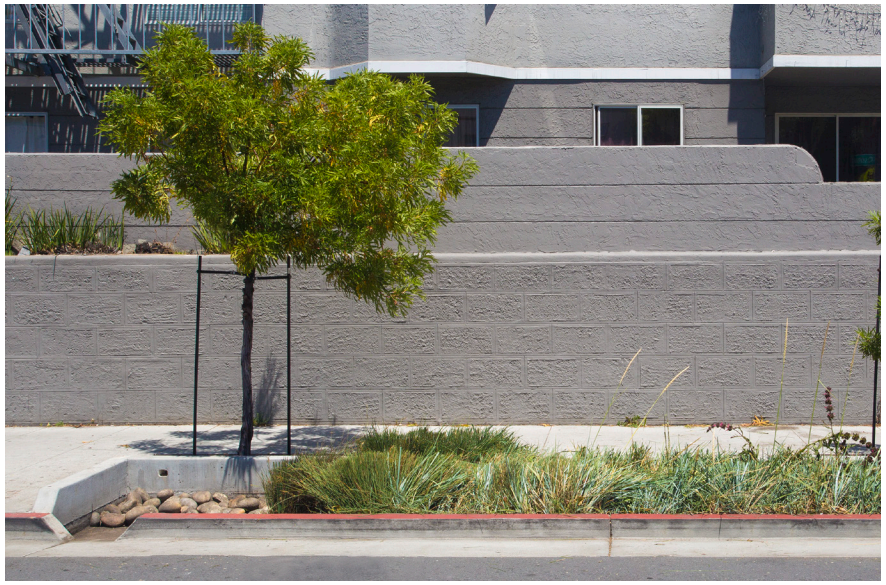
GI is a set of engineered, sustainable stormwater management tools that slow down, clean, and route stormwater to keep it from entering the City's sewer system. Bioretention planters, commonly referred to as rain gardens, are planted depressions designed to capture, infiltrate, and remove pollutants from stormwater runoff. Permeable pavement refers to any paving material that allows water to pass through it into an aggregate base and then to the underlying soil.

Why Is Green Infrastructure Important?

GI plays an important role in how San Francisco's combined sewer and stormwater drainage system functions. GI projects are designed specifically to reduce the amount of stormwater runoff draining into the City's sewer system and treat stormwater while also improving our neighborhoods by increasing biodiversity and greening our streets. GI offers a multi-beneficial alternative to expanding San Francisco's "grey" infrastructure pipes while making our city more livable.

Why Is Maintenance Important?

Proper maintenance is important to the health and function of these engineered GI systems. By maintaining GI projects on a regular basis, they will continue to function properly and provide their many benefits for years to come.



Bioretention Planter

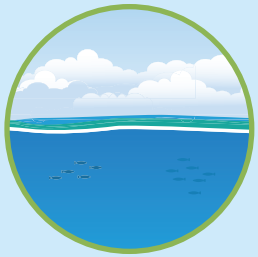
Permable Paving

Green Infrastructure for Stormwater Management

Green infrastructure helps manage stormwater and improve community resilience.

Manages Stormwater

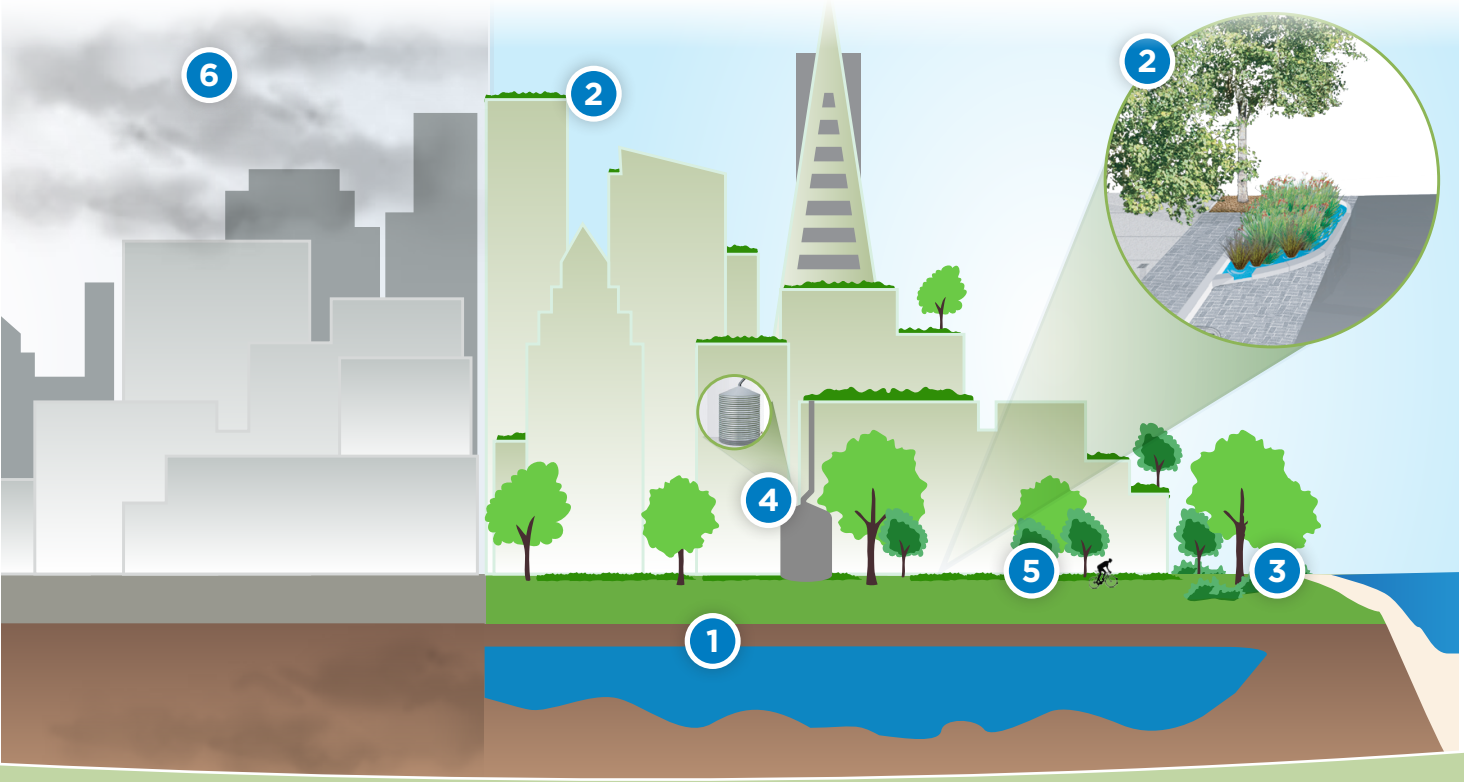
Protects Bay and Ocean



Promotes Natural Processes

Enhances Livable Cities

Increases Urban Habitat



Green Infrastructure Builds Resiliency

1. Promotes natural processes like infiltration and evapotranspiration.
2. Reduces the burden on the existing sewer system by infiltrating stormwater throughout the watershed.
3. In separate sewer areas, filters and cleanses stormwater before it enters the ocean or bay.
4. Captures stormwater for reuse and reduction of potable water demands.
5. Greens the urban landscape to create more livable cities and increase urban habitat.
6. Minimizes carbon footprint through vegetation-based planters.

PREPARATION

Site Visit Preparation

Before you head out to the site, it is important that you consider the background information, tools, and materials that you may need. Some things to think about:

- Know the location and safety considerations for working at the site (e.g., traffic, access).
- Print copies of all applicable checklists (found in Appendix A).
- Make sure that you have all of the safety equipment and maintenance tools that you need.
- Bring a camera along to document your activities or any issues that you identify.

Waste Disposal

Maintenance activities will commonly require disposal of trash, green waste, sediment, and debris. Make sure you are ready to handle waste safely and dispose of it properly.

- Bring gloves to use when handling waste material.
- Collect waste in a safe location that does not block traffic, pedestrian, or cyclist movement.
- Measure the amount of debris removed using a scale or a bucket. Document and report your measurements.
- Dispose of waste in an appropriate manner.

Maintaining Bioretention Planters

Set up safety perimeter, wear a hard hat and safety vest, and use a rake or grabbers to remove trash and debris from the planter.

Place all removed vegetation and weeds outside the planter.

Separate trash and vegetation for disposal in appropriate location.

Safety Considerations and Equipment

General Safety Guidelines

- Set up a safety perimeter and be aware of passing pedestrians, bicycles, and vehicles.
- Do not stand in the street when performing maintenance activities unless traffic control has safely blocked a lane.
- Make yourself visible. Wear bright colored clothing and a safety vest.
- Wear hard hats (as required), protective clothing, thick gloves, and sturdy shoes.
- Be aware when cutting plants and branches overhead or when working on an active construction site.
- Wear eye and ear protection.
- Be aware of broken glass, sharp objects, and other pollutants.
- Be aware of needles and other biohazards that can be found in a GI facility. Use grabbers and gloves to remove needles and dispose of them properly.
- Be aware of loose material, standing water, tripping hazards, uneven ground, and other obstructions.
- Don't leave your tools unattended. Keep them out of the street and off the sidewalk so they don't pose a hazard to others.
- Perform maintenance on your facility during daylight hours and avoid peak traffic times.

For complete safety measures, refer to Cal/OSHA Title 8 regulations in the California Code of Regulations.

Bioretention Planter with Splash Pad at Inlet

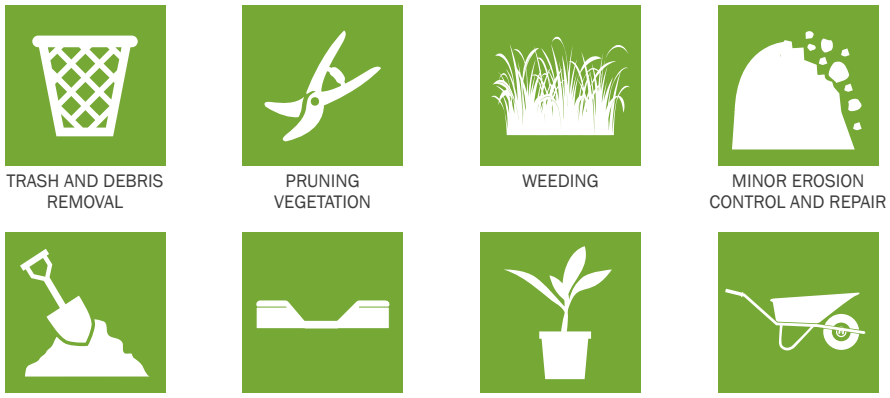
MAINTENANCE TASKS

BIORETENTION PLANTERS

Bioretention planters are a common type of GI application for urban areas like the City of San Francisco. They slow, clean, and infiltrate stormwater, diverting it from the City's sewer system. Bioretention planters have specially engineered soils (bioretention soil mix) and carefully selected plants that help allow stormwater to soak into the ground, trap sediments, and remove pollutants.

This section covers the following field activities:

- Preliminary site inspection
- Trash and debris removal
- Pruning vegetation
- Weeding
- Minor erosion control and repair
- Sediment removal
- Clearing inlets, outlets, and overflow structures
- Plant replacement
- Mulching



Bioretention: Lowered Planting Area That Allows Stormwater to Pond Briefly before Soaking into the Ground

1. **Curb cut inlet** Where stormwater enters the planter.
2. **Capture and treatment area** Sunken area that holds water and allows it to soak in.
3. **Overflow structure** Where uninfiltrated stormwater leaves the planter.

Preliminary Site Inspection

When you first approach a bioretention planter site, conduct a preliminary inspection by reviewing the following seven questions:

1. Is there standing water in the planter more than 48 hours after the most recent rainfall?
2. Is there structural damage to any of the hard infrastructure (concrete/wood/metal) elements?
3. Is there major erosion to the planter bed or side slopes?
4. Are there any inlet or outlet blockages, or has sediment washed onto the planter bed surface?
5. Are there irrigation leaks or any other visible indication that the irrigation system is not working properly?
6. Is there any vandalism or graffiti to any part of the planter?
7. Are there any signs of contamination to any part of the planter?

If you answer "yes" to any of these questions, see the "Things to Look out for and Report" section on page 26.

Tools to Bring for Bioretention Maintenance:

- ☐ Camera
- ☐ Work gloves
- ☐ High-visibility clothes/vest
- ☐ Hand trowel
- ☐ Hoe
- ☐ Hedge shears and loppers
- ☐ Edging spade
- ☐ Plant and weed photo ID sheet
- ☐ Push broom
- ☐ Rake
- ☐ Flat shovel
- ☐ Hand weeding tools
- ☐ Tarp/buckets/trash cans (to remove leaf litter/debris)
- ☐ Trash bags
- ☐ Wheelbarrow
- ☐ Manhole cover hook or lifter (for opening grates)
- ☐ Wrenches and other tools required to unbolt manhole cover and grate locks
- ☐ Hori-hori

Hori-hori

Trash and Debris Removal

BP-2

Urban trash and debris can be carried by stormwater, deposited by people, blown by wind, or pushed by street sweepers into bioretention planters.

Why Is Removing Trash and Debris Important?

Trash and debris removal helps keep the public realm safe and clean and allows the planter to function as designed. Removing trash and debris from the bioretention planter helps to avoid these problems:

- Clogging of the planter's inlets and outlets that can result in standing water and negatively impact plant growth.
- Reduction in the amount of stormwater entering the planter.
- A clogged outflow structure that can lead to overflowing and flooding.

Trash and Debris in a Bioretention Planter

What Is Debris?

- Grass clippings
- Leaves
- Sticks
- Small branches

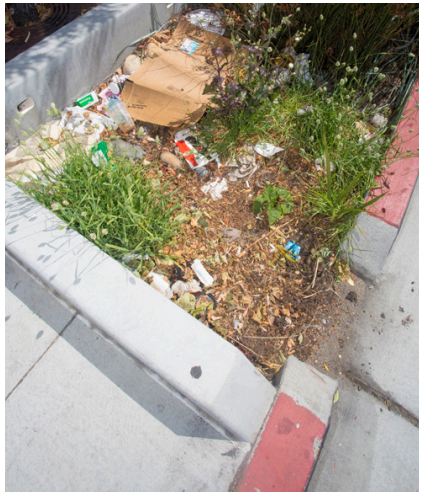
Maintenance Tasks

- Remove trash and debris by gloved hand, with a pick stick or grabber tool, or with a rake and a shovel.
- Be aware of sharp objects like needles and glass.
- Remove all bulky trash and debris and dispose of it appropriately.
- Remove leaves from inside and around the planter, especially in the fall when leaves can quickly clog inlets, outlets, and overflow structures.
- Gather trash and debris outside of the planter.
- Separate trash from debris and dispose of each in the appropriate location.

Collecting trash and debris should be completed every time you visit a bioretention planter. The most important times to remove debris and trash from a bioretention planter are before and after a storm. Heavy rains can cause trash and debris to collect around curb openings and overflow drains and can block stormwater flow.

For oversized trash and debris items that cannot be removed manually, document and report to your supervisor or facility owner.

Trash and Debris Being Removed from Bioretention Planter



Before: *Trash and Debris in a Bioretention Planter*

After: *Trash and Debris Removed*

Pruning Vegetation

BP-3

Overgrown or poorly located vegetation in the bioretention planter can inhibit the proper function of the bioretention planter and possibly interfere with public safety.

Why Is Pruning Important?

A thriving plant community is an important part of a bioretention planter, and regular pruning encourages healthy plant growth.

When plants are overgrown, they can limit the planter's ability to manage stormwater. Overgrown plant material can also block the inlet of a bioretention planter, causing stormwater to bypass the planter entirely.

Plants can also cause hazards by blocking sidewalks or inhibiting the line of sight for drivers. Overgrown plants should be properly pruned to ensure proper function of the planter, improve plant growth and health, and reduce the amount of plant debris that builds up in the planter.

Plants Overhanging the Sidewalk

Maintenance Tasks

- Prune vegetation that clogs inlets and outlets to ensure that stormwater can flow freely into and out of the planter.
- Prune vegetation that obstructs the irrigation system's function.
- Prune overhanging vegetation that inhibits sidewalks or line of sight at intersections.
- Maintain appropriate height for line-of-sight clearance.
- Do not prune vegetation too severly. Maintain plant aesthetic (natural plant form, shape, and habit).
- Remove pruning debris from the planter and dispose of properly.
- Deadhead flowers and remove deadheading debris.
- Prune plants at the appropriate time of year. For information regarding pruning timing, refer to project maintenance documents or Appendix D of the San Francisco Stormwater Management Requirements and Design Guidelines.

Prune Overgrown Vegetation

Prune Overgrown Vegetation

Weeding

BP-4

Plants in bioretention planters were chosen for their ability to thrive in a specialized soil mixture and to absorb and filter stormwater. Weeds and invasive plants can crowd out desirable plants, reducing the planter's ability to perform properly when it rains.

Why Is Weeding Important?

Weeds can limit the proper function of the bioretention planter and damage the visual appeal of the planter. Weeds and invasive plants (shown on pages 16-17) compete with the native plants and must be removed to protect desirable plants and ensure that the planter functions properly.

Weedy Growth in a Bioretention Planter

Manual Removal of Most Weeds:

- Pull weeds upward at the base to remove roots entirely.
- Dig out stubborn root systems with a trowel.
- Remove leaves and stems that break apart from the roots.
- Deposit all weed debris outside of the planter in the appropriate container.
- Smooth the soil and pat down to prevent air pockets and to fill any holes. Loose soils can encourage new weeds.
- Cover any bare soil with mulch.
- Take all weed debris offsite for proper disposal.

Weeding: Pull Plants Upward to Remove Roots Entirely

Weeding: Remove Weeds by Hand

Weeding *continued*

Invasive Weeds

Plants native to San Francisco are best suited for our local climate, and do not need fertilizer or regular irrigation to thrive. Native plants also provide food and habitat for insects and animals that historically live in San Francisco. Our native plants, insects, and animals depend on each other to survive.

Invasive weeds are undesirable plants from other regions that grow and spread very quickly. Invasive weeds are harmful to the environment because they disrupt the balance between native plants, insects, and animals. They also compete with native plants for nutrients, water, and sunlight.

Common Invasive Weeds

Target these 10 weeds for removal. They are common invasive plants in San Francisco and are likely to grow in a bioretention planter.

Veldtgrass – *Ehrharta erecta*

Yellow Sweetclover – *Melilotus officinalis*

English Plantain – *Plantago lanceolata*

Invasive weeds are undesirable plants from other regions that grow and spread very quickly.

Sow Thistle – *Sonchus oleraceus*


Italian Ryegrass – *Lolium multiflorum*


Bristly Ox-Tongue – *Helminthotheca echioides*


Foxtail Barley – *Hordeum jubatum*


Wild Oat – *Avena fatua*


Sourgrass – *Oxalis pes-caprae*


Bromegrass – *Bromus diandrus*


Minor Erosion Control and Repair

BP-5

Erosion may occur in the bioretention planter due to the large volume and speed of stormwater entering the inlet.

Why Are Erosion Control Measures Important?

During a large storm runoff flowing through a bioretention planter may cause erosion and scouring of the soil surface. Erosion can be detrimental to the planter because it may:

- damage plants
- clog outlets and overflow structures
- cause soil and mulch loss
- reduce soil porosity

Erosion tends to occur more frequently in planters that do not have dense plantings or rock cobbles at the forebay area.

Erosion and Scouring of Soil Surface

Erosion at Inlet

What Is Erosion?

The process by which runoff washes away surface soil over a large area.

Maintenance Tasks

- Remove any excess sediment created by the erosion process and dispose of it properly.
- Stabilize damaged areas by filling in ruts and gulleys, smoothing the soil, and adding erosion control measures such as rock cobbles at the inlet. For areas of major erosion, consider using an erosion blanket.
- If plantings are sparse, provide additional plantings to match the originally designed plant density to reduce erosion.
- Replace mulch in repaired areas

Erosion Blanket

If major erosion is observed, then see the "Things to Look out for and Report" Section on page 27.

Rock Cobble

Sediment Removal

BP-6

Sediment can build up on the splash pad in the forebay or at the low point of bioretention planters.

Why Is It Important to Remove Built-up Sediment?

Bioretention planters are designed to allow water to infiltrate through a specially engineered soil. When fine sediment builds up on the planter surface, stormwater cannot drain and could pond for an extended time. During large storms, built-up sediment can also be washed downstream, clogging overflows. Steps must be taken to remove sediment buildup to keep the planter functioning properly.

Sediment Buildup on Planter Surface

Sediment Buildup on Forebay

What Is Sediment?

Very small particles such as silt and clay that can wash off from adjacent landscape areas and road surfaces and accumulate in the planter over time.

Maintenance Tasks

- Locate the splash pad, typically found at the planter inlet, and remove excess sediment and silt by scraping up sediment with a shovel or removing and cleaning cobbles.
- For cobble forebays, remove cobbles from planter, clean the debris from the cobbles, and replace the cobbles as designed.
- If sediment buildup or hard "caking" of silt is found within the planter, remove accumulated sediment and silt while being aware not to damage plants or to remove a significant amount of soil.
- Replant vegetation damaged or destroyed by the sediment accumulation and removal process.
- Dispose of all sediment at an approved facility.

Remove Sediment Build-Up and Debris from Inlet and Forebay

Inlet and Cobble Forebay Cleaned Out

If excessive sedimentation is observed, see the "Things to Look out for and Report" section on page 28.

Clearing Inlets, Outlets, and Overflow Structures

BP-7

Sediment, debris, and trash can block stormwater from entering or exiting a bioretention planter.

Why Is It Important to Clear Blockages?

Bioretention planters are carefully designed for water to enter, flow, and drain in a specific direction. This process is disrupted when sediment, debris, and trash alter the flow of water. Clearing blockages at the inlets, outlets, and overflow structures is one of the most important maintenance tasks for bioretention planters because it restores the intended water flow path.

Maintenance Tasks

- Find areas where water enters or exits the planter — the “inlet” and “outlet.”
- Clear away sediment, debris, overgrown vegetation, and trash so that water can flow freely through the planter.
- If feasible, lift the top of overflow structure lid/grate and manually remove sediment, debris, and trash from within the structure.
- Deposit sediment, debris, and trash outside of the planter in appropriate containers.
- If feasible, separate trash from sediment and debris.
- Dispose of all sediment, debris, and trash at an approved facility.

Debris Blocking Overflow Grate

Overgrown Vegetation and Debris Clogging Outlet

Before: *Trash and Debris Blocking Inlet*

After: *Clear Inlet*

Before: *Trash and Debris Blocking Inlet*

After: *Clear Inlet*

If blockage at overflow structures is too excessive to be removed, document and report to your supervisor or facility owner.

Plant Replacement

BP-8

Why Are Plants Important?

Plants play a critical role in the function of a bioretention planter by aerating the soil through root growth and reducing soil compaction. Plants aid in the removal of pollutants from stormwater and also provide habitat. For a bioretention planter to function properly, it needs a thriving plant community. In addition, bare spots resulting from missing plants give invasive weeds an opportunity to grow.

Maintenance Tasks:

- Record diseased, dying, dead, or missing vegetation in maintenance checklist.
- Remove any trash and debris that have accumulated in or around the planting area.
- Remove dead or unhealthy plants and record possible causes, such as soil compaction, standing water, evidence of disease/fungus, animal burrowing, or contamination in the maintenance checklist.
- Replace dead or unhealthy plants using an appropriate plant from the SFPUC's Stormwater Management Requirements Vegetation Palette or from the original design.
- Immediately water newly planted vegetation.

If major plant die-off or damage is observed, document and report to your supervisor or the facility owner.

Replace Dead or Unhealthy Plants

Healthy Vegetation in a Bioretention Planter

Mulching

BP-9

Why Is Mulching Important?

Mulch helps to minimize weed growth, prevent erosion of the planter surface, promote infiltration, and prevent the soil surface from losing moisture and crusting during dry periods. Mulch can also trap sediments and pollutants from stormwater, which improves the function of the planter.

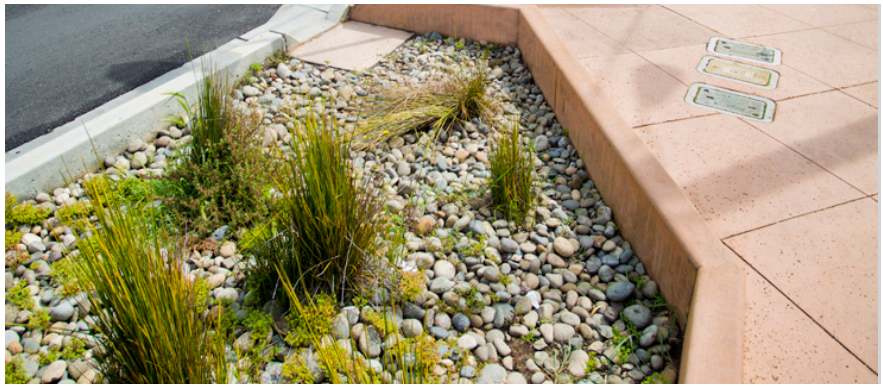
Maintenance Tasks

- Remove sediments, trash, and debris.
- Loosen "plated" or "crusted" mulch with a rake or pitchfork.
- Rake and loosen mulch to distribute evenly when needed.
- Re-mulch any bare spots or eroded areas on the planter surface where the bioretention soil is visible.
- If the planter was installed with rock mulch, select a replacement product of similar or larger size to resist washing out.

What Not to Do

- ⃠ **DO NOT** use a mulch material with high fines content or containing recycled materials or softwoods.
- ⃠ **DO NOT** over-mulch. Mulch should not cover plants' stems or leaves, bury small plants, or rise above the splash pad/inlet elevation.
- ⃠ **DO NOT** add leaves, grass clippings, or other organic debris to the mulch; these items can clog the bioretention soil.
- ⃠ **DO NOT** pile mulch against tree trunks or shrub stems.
- ⃠ **DO NOT** use dyed mulch.
- ⃠ **DO NOT** use wood chips.

Bare Spots or Eroded Mulch in a Planter



Rock Mulch in a Bioretention Planter

What Is Mulch?

A layer of material applied to the surface of soil to help conserve soil moisture, improve fertility and health of the soil, and reduce weed growth.

Things to Look out for and Report

BP-10

Identify, document, and report the following conditions to your supervisor or the facility owner.

- Standing Water
- Structural Damage
- Major Erosion
- Excessive Sedimentation and Debris
- Vandalism/ Graffiti
- Irrigation Leaking or Otherwise Malfunctioning
- Contamination

Standing Water (>48 hours after rainfall)

Extended ponding means that the planter is not functioning properly. Stagnant water can cause problems such as unpleasant odors, plant die-off, and, in extreme cases, the creation of mosquito habitat.

- Inspect the planter for possible cause of ponding water, including blockages, sedimentation, soil compaction, and clogged underdrain.
  - Blockages: Inspect the outlet and downstream catch basin for possible blockages; remove all blockages, if possible.
  - Sedimentation: Visually inspect the ponded area for a layer of fine sediment on top of the planter bed.
  - Soil compaction: “Shovel test” the planter bed to see if soils are tightly packed and hard (i.e., very difficult to dig); aerate soil using a soil aerator or pitchfork, if possible.
  - Clogged underdrain: If an underdrain clean-out is present, open and check for clogging; to clear blockage, snake or jet clean, if possible.
- Photograph the conditions and report to your supervisor or facility owner.

What Is a “Shovel Test”?

Using full weight, step onto pointed-tip shovel; if it does not easily sink into the soil, compaction is likely and the soil should be aerated.

Structural Damage

The integrity of a planter facility can be compromised if the structural elements are damaged by vehicles, tree roots, or severe erosion. Structural collapse or failure can impair function and create a safety hazard.

- Damage to structural components may include:
  - Curbs
  - Perimeter fencing
  - Check dams
  - Walls
  - Trench drains and grates
  - Outlet structures
- Photograph and report the conditions to your supervisor or facility owner.

Damaged Curb

Major Erosion

Significant erosion and scouring of the bioretention soil can damage plants, clog overflow structures, limit infiltration or undermine other critical structures.

- Identify the location and cause of erosion.
- Provide temporary erosion control, if possible, by adding erosion control measures such as rock cobble or an erosion control blanket.
- If temporary erosion control measures are taken, document conditions before and after.
- Photograph and report the conditions to your supervisor or facility owner.

Erosion and Scouring

Excessive Sedimentation/Debris Loading

Sediment and debris can wash into a planter, forming a layer on the surface, killing plants, blocking water from soaking into the ground, and reducing soil porosity.

- Clean out the inlet, outlet, and forebay, if present.
- Working around the plants, remove the top layer of sediment and mulch to expose the original soil. Scrape the surface with a rake to loosen up the soil, then apply a new layer of mulch.
- Follow the sediment trail upstream from the planter to its source; document and report the potential source(s).
- If remedial action is taken, document conditions before and after.
- Photograph and report the conditions to your supervisor or facility owner.

Excessive Sedimentation and Debris within a Bioretention Planter

Vandalism/Graffiti

Infrastructure in our urban areas can be damaged and impacted by vandalism, causing problems to appearance, function, and safety.

Vandalism can range from minor issues, like graffiti, to major issues, like stolen plants or destruction of the entire irrigation system.

- Photograph and report to your supervisor or facility owner.
- Do not use harsh chemicals to remove graffiti within a bioretention planter. Use only plant-safe biodegradeable graffiti removers.

Graffiti within a Bioretention Planter

Irrigation Leaking or Otherwise Malfunctioning

Poorly maintained or leaking irrigation systems are water wasters and can harm GI installations by creating erosion within a planter and can lead to under- or over-watering.

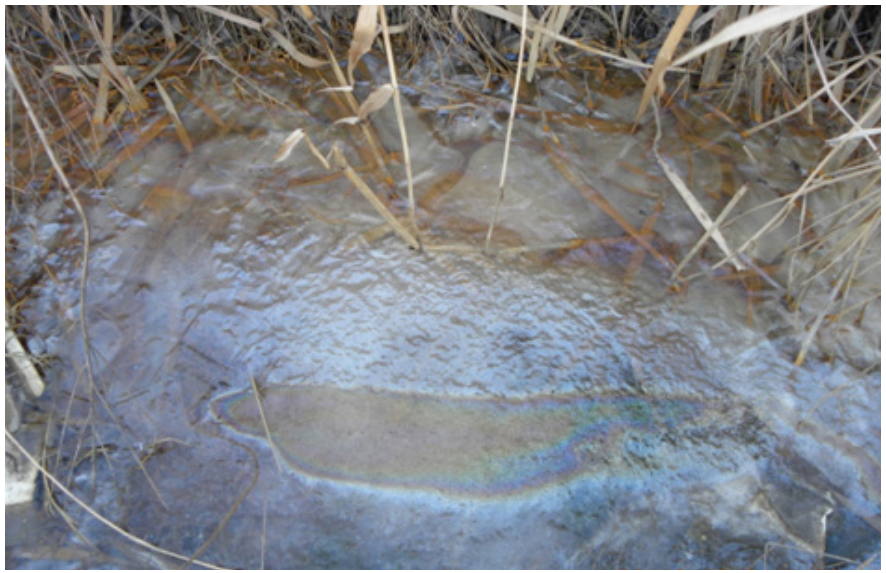
- Malfunctioning irrigation systems can be identified by areas of the planter with browning or wilting plants (underwatered/miswatered) or areas with ponded water (overwatered/leaking).
- If equipped, perform required repairs (e.g., fix leaky valves and couplings, adjust spray patterns).
- If leak cannot be fixed, turn off the main valve to cut off supply and stop active leaking.
- Photograph and report the conditions to your supervisor or facility owner.

Broken and Leaking Irrigation

Contamination

Visible surface contaminants and pollution can clog the bioretention soils, and hazardous substances can impact environmental and human health. Planters can be contaminated with non-hazardous contaminants (e.g. masonry, plaster or concrete "washout," masonry or roadway saw cutting slurry and residue) or with hazardous contaminants (e.g. petroleum-based substances, pesticides, herbicides).

- Clean out the inlet and forebay.
- If non-hazardous contaminants are observed, working around the plants, remove the contaminated layer of mulch and soil to expose clean soil. Roughen the soil surface with a rake, add new soil (if required), and then apply a new layer of mulch.
- If hazardous substances are observed, do not remove or touch. Document and report immediately for proper disposal.
- Follow the contaminant trail upstream from the planter to its source; document and report the potential source(s).
- If remedial action is taken, document conditions before and after.
- Photograph and report the conditions to your supervisor or facility owner.



Example of Visible Surface Contaminants

Bioretention Planter and Permeable Pavement

MAINTENANCE TASKS

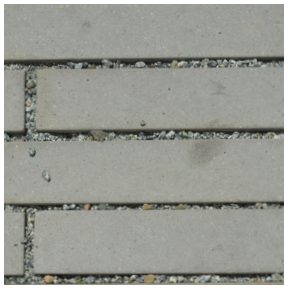
PERMEABLE PAVEMENT

Permeable pavement describes a range of materials and systems used to provide the structural support equal to conventional pavement while allowing the movement of stormwater through the pavement surface and base. Permeable paving is made up of a porous top surface and an underlying clean aggregate (drain rock) layer. The aggregate layer provides temporary storage before stormwater infiltrates into the soil below.

Permeable pavement slows, cleans, and infiltrates stormwater runoff; removing oil and grease, metals, and suspended solids while reducing the amount of stormwater entering the combined sewer system.

This section covers the following field activities:

- Preliminary site inspection
- Trash and debris removal
- Routine vacuuming
- Pressure washing and restorative vacuuming



Unit Pavers

Pervious Concrete

Porous Asphalt

Preliminary Site Inspection

When you first approach a permeable pavement site, conduct a preliminary inspection by asking the following four questions:

1. Is there standing water on the pavement more than 48 hours after the most recent rainfall?
2. Is there structural damage to the pavement, or broken pavers?
3. Is there any weed growth or blockage in the permeable pavement surface?
4. Are there any signs of contamination on the pavement?

If you answer "yes" to any of these questions, see the "Things to Look out for and Report" section on page 36.

Trash and Debris Removal

PP-2

Trash and debris on permeable pavement can clog the pavement surface and prevent stormwater from infiltrating. It can also clog overflow structure grates, which can lead to flooding or ponding on the pavement surface. Large trash and debris should be removed before sweeping or vacuuming the permeable pavement.

Maintenance Tasks

- Smaller trash and debris can be removed by routine vacuuming.
- Rakes and leaf blowers can be used to remove leaves.
- Manually remove all large trash and debris that cannot be removed by routine vacuuming from the permeable paving surface and upstream areas. Dispose of this trash and debris at an appropriate facility.

Tools to Bring for Permeable Pavement Maintenance:

- Flat shovel and broom
- Garbage bags
- Walk-behind vacuum (sidewalks and plazas)
- Pressure washer or power washer with rotating brushes

Trash on Permeable Paving

Routine Vacuuming

PP-3

Sediment and debris accumulated on the permeable pavement can clog the surface and prevent stormwater infiltration. After trash and debris have been removed, permeable pavement should be vacuumed to clear all sediment and debris from the pavement surface. Routine maintenance can help prevent more stubborn clogging by keeping sediment from going deep into the pavement's void spaces where they can be difficult to remove.

Maintenance Tasks

- Prior to vacuuming, remove bulky debris and waste materials from pavement surfaces that are too large to be picked up by vacuum hose (e.g., litter, tree branches, wire, car parts).
- Vacuum sediment and debris from the entire surface area of the permeable pavement installation using a dry vacuum.
- Give extra attention to pavement edges and areas where sediment has accumulated.
- Sweep up sediment and debris from surrounding surface areas, especially those that slope toward the permeable pavement.
- Note and report damage in pavement, including holes, cracks, excessive scuffing, settlement, and areas of standing water.

It is important to vacuum the sediment and debris from upstream, or highest point, to downstream, or lowest point, to prevent any sediment from being carried back onto the vacuumed surface.

Vacuuming Permeable Pavement

Pressure Washing and Restorative Vacuuming

PP-4

Permeable pavement is intended to let water pass through its surface into the aggregate base and soil below. Over time, deep cleaning/unclogging of permeable pavement may become necessary, and is best accomplished by simultaneous pressure washing and restorative vacuuming.

Maintenance Tasks

- Do not use extremely high pressures with a pressure washer because this can dislodge joint aggregate in unit pavers or damage pervious concrete and porous asphalt surfaces.
- Prior to vacuuming or pressure-washing, remove bulky debris and waste materials from pavement surfaces that may be too large to be picked up by vacuum hose (e.g., litter, tree branches, wire, car parts).
- Vacuum and pressure wash impacted areas of the permeable pavement.
- Dispose of the sediments and debris at an appropriate facility.
- Note and report to your supervisor or facility owner any damage in pavement, including holes, cracks, excessive scuffing, settlement, dislodged aggregate, and areas of standing water.
- After vacuuming and pressure washing permeable pavers, re-joint the pavers with the appropriate aggregate based on the original design or the paver manufacturer's recommendation.

Restorative Vacuuming of Permeable Pavement

Things to Look out for and Report

PP-5

Identify, document, and report the following conditions to your supervisor or facility owner.

- Surface Ponding
- Structural Damage
- Weed Growth
- Oil Staining/ Contamination

Surface Ponding (> 48 hours after rainfall)

Extended ponding means that the permeable pavement is not functioning properly. Clogged pavement can prevent stormwater from flowing through the pavement surface.

- Vacuum and pressure wash the permeable pavement. If the ponding persists, it may be a result of clogging in the subsurface storage layer. Report the issue so that further investigation can be conducted to verify the problem.
- Photograph and report to your supervisor or facility owner.

Standing Water on Permeable Pavement

Structural Damage

Damaged permeable pavement can compromise the integrity of the facility and can contribute large amounts of fines, silt, and sediment that can cause clogging and limit infiltration capacity. Collapse or failure can impair function and create a safety hazard.

- Damage to permeable pavement may include:
  - Cracks or chips in permeable pavement
  - Displacement/settlement of permeable pavement
  - Broken or missing pavers
  - Permeable pavement surface spalling or raveling (pervious concrete or porous asphalt)
  - Potholes or sinkholes
  - Significant damage to curbs and pavement edges
- Vacuum loose material to prevent further damage to the deteriorating permeable pavement surface.
- Photograph and report the conditions to your supervisor or facility owner.

Watch out for Potholes and Sinkholes

Report immediately to your supervisor or facility owner if a major pothole has formed on the surface, or a sink hole under the surface. These can be a serious public safety hazard.

Chips in Permeable Pavement

Potholes/Pavement Collapse

Weed Growth in Paver Joints

Noxious and invasive weeds are highly damaging to pavement; they can interfere with the structural stability of the pavement, reduce infiltration, and increase the amount of debris that is deposited on the pavement surface.

- Remove weeds, including the entire root structure, and discard at an appropriate facility to prevent spreading of invasive species.
- Photograph and report the conditions to your supervisor or facility owner.

Vegetation Clogging the Paver Joints

Oil Staining/Contamination

Oil leaks from vehicles can stain the pavement surface. Contaminants can clog the pavement surface and reduce infiltration capacity. Contaminants and pollution can also negatively impact environmental and human health. Permeable pavement can be contaminated with non-hazardous contaminants (masonry, plaster or concrete "washout," masonry or roadway saw cutting slurry and residue) or with hazardous contaminants (petroleum-based substances, pesticides, herbicides).

- Pressure wash oil stains or spills.
- If non-hazardous contaminants are observed, scrape off, vacuum and pressure wash, and discard the contaminated material at an appropriate facility.
- If hazardous substances are observed, do not remove or touch. Document and report immediately for proper disposal.
- Follow the contaminant trail upstream from the facility to its source; document and report the potential source(s).
- Photograph and report the conditions to your supervisor or facility owner.

Oil Staining/Contamination

RESOURCES

San Francisco Bay Area Stormwater Design and Vegetation Information

San Francisco Stormwater Management Requirements
http://www.sfwater.org/index.aspx?page=1000

San Francisco Public Utilities Commission's Vegetation Palette
http://sfwater.org/Modules/ShowDocument.aspx?documentID=2775

Contra Costa County Clean Water Program Stormwater C3 Guidebook
http://www.cccleanwater.org/stormwater-c-3-guidebook/

Weeding and Integrated Pest Management

Plant Health and Pest Prevention Services Pest Prevention Program CDFA Integrated Pest Control
https://www.cdfa.ca.gov/plant/ipc/index.html

The Weed Workers' Handbook: A Guide to Techniques for Removing Bay Area Invasive Plants
http://www.cal-ipc.org/ip/management/wwh/pdf/18601.pdf

SF Plant Finder: A Plant Database for Creating Habitat in San Francisco
http://sfplantfinder.org/index.html

San Francisco Weed Management Area (SFWMA)
http://sfwma.org/

Well-Maintained Planter

GLOSSARY

The following terms and definitions apply in the context of this guidebook:

Bioretention soil mix: A well-blended mixture of sand and compost that has excellent permeability and sufficient moisture retention to support healthy plant growth.

Erosion: The process by which runoff washes away surface soil over a large area.

Evapotranspiration: The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.

Forebay: A level rock area or concrete pad near the inlet designed to catch sediment and debris before it enters the bioretention planter.

Infiltration: The act of water soaking through the surface of the soil.

Mulch: A layer of material applied to the surface of soil to help conserve soil moisture, improve fertility and health of the soil, and reduce weed growth.

Scour: A localized loss of soil caused by the flow of water changing direction and accelerating.

Sediment: Very small particles such as silt and clay that can wash off from adjacent landscape areas and road surfaces and accumulate in the planter over time.

Shovel Test: Using full weight, step onto pointed-tip shovel; if it does not easily sink into the soil, compaction is likely and the soil should be aerated.

Soil porosity: The volume of void spaces witihin the soil that can be filled with water or air. Higher porosity generally allows for more infiltration.

Stormwater: Water originating from precipitation that contacts the ground; often used interchangeably with the term runoff.

Bioretention Planter with Ponded Water Immediately Following a Storm

Bioretention Planter Maintenance Checklist

Maintenance Date:_____Facility Location:_____Number of Planters Serviced at Facility:_____

Supervisor Name:_____ ☐ City Crew ☐ Property Owner ☐ Site Manager ☐ Contractor ☐ Other: _____

No. of staff at the facility:_____ Start Time: _____End Time: _____ Recent Storm (within past 7 days)? ☐ Yes ☐ No

Can you access the facility? ☐ Yes ☐ No If not, why? _____

Preliminary Site Inspection

Document in writing and with photos and report to your supervisor or facility owner if any of the following conditions are present (see "Things to Look out for and Report" section in the Maintenance Guidebook on page 26). Check box if answer is yes.

Is there standing water in the facility more than 48 hours after the most recent rainfall? ☐

Is there structural damage to any of the hard infrastructure (concrete/wood/metal) elements? ☐

Is there erosion to the planter bed or side slopes? ☐

Are there irrigation leaks or any other visible indication that the irrigation system is not working properly? ☐

Is there any vandalism or graffiti to any part of the facility? ☐

Is there any evidence of contamination in the facility? ☐

Trash and Debris Removal

	Y	N	N/A
Clear trash and debris from within and around the planter	☐	☐	☐
Separate trash from debris and dispose of each properly	☐	☐	☐

Comments/Actions Taken:

Pruning Vegetation

	Y	N	N/A
Prune vegetation that clogs inlets and outlets, overhangs sidewalks, or inhibits line of sight for vehicles at intersections.	☐	☐	☐
Maintain plant aesthetic and appropriate height for sight clearance.	☐	☐	☐
Remove pruning debris from grounds and dispose of properly.	☐	☐	☐

Comments/Actions Taken:

Weeding

	Y	N	N/A
Pull plants upward at the base to remove roots entirely and dig out stubborn root systems with a trowel.	☐	☐	☐
Smooth the soil and pat down to prevent air pockets and to fill any holes.	☐	☐	☐
Cover any bare soil with mulch.	☐	☐	☐
Pile all weed debris outside of the planter and dispose of properly.	☐	☐	☐

Comments/Actions Taken:

APPENDIX A

Minor Erosion Control and Sediment Removal	Y	N	N/A
Stabilize damaged areas by adding erosion control measures (e.g., rock cobbles or erosion control blanket).	☐	☐	☐
Remove excess sediments from forebay by scraping up sediment with a shovel or removing and cleaning cobbles.	☐	☐	☐
Plant vegetation as needed where plants are sparse.	☐	☐	☐

Comments/Actions Taken:

Clearing Inlets, Outlets, and Overflow Structures	Y	N	N/A
Clear away sediment, debris, overgrown vegetation, and trash so that water can flow freely through the planter.	☐	☐	☐
Lift top of overflow structure lid/grate and manually remove sediment, debris, and trash from within the structure.	☐	☐	☐
Pile sediment, debris, and trash outside of the planter and dispose of each properly.	☐	☐	☐

Comments/Actions Taken:

Plant Replacement	Y	N	N/A
Does the facility have (please indicate): ☐diseased ☐dying ☐dead ☐missing vegetation ?			
What is the quantity of plants affected? _____			
What are the possible causes? ☐soil compaction ☐standing water ☐evidence of disease/fungus ☐animal ☐trampling ☐other _____			
Remove dead and unhealthy plants and replace with new vegetation. Water new vegetation.	☐	☐	☐

Comments/Actions Taken:

Mulching	Y	N	N/A
Loosen “plated” or “crusted” mulch with a rake or pitchfork.	☐	☐	☐
Re-mulch any bare spots or eroded areas where the bioretention soil is visible. If rock mulch, replace with similar or larger size.	☐	☐	☐

Comments/Actions Taken:

Waste Disposal	Y	N	N/A
Dispose of all materials, including trash, debris, and sediment, at an approved facility.	☐	☐	☐

Comments/Actions Taken:

Field Measurement/Materials Used (optional)

Amount of material (trash, debris, sediment) collected: No. of bags, pounds, or gallons/bag:

Materials/Tools Used:

Other Notes/Observations:

Permeable Pavement Maintenance Checklist

Maintenance Date:_____Facility Location:_____Number of Planters Serviced at Facility:_____

Supervisor Name:_____ ☐ City Crew ☐ Property Owner ☐ Site Manager ☐ Contractor ☐ Other: _____

No. of staff at the facility:_____ Start Time: _____End Time: _____ Recent Storm (within past 7 days)? ☐ Yes ☐ No

Can you access the facility? ☐ Yes ☐ No If not, why? _____

Preliminary Site Inspection

Document in writing and with photos and report to your supervisor or facility owner if any of the following conditions are present (see "Things to Look out for and Report" section in the Maintenance Guidebook on page 36). Check box if answer is yes.

Is there standing water on the facility? ☐

Is there any displacement, settlement, or potholes in the permeable pavement? ☐

Are there any chips, cracks, or broken pavers in the permeable pavement? ☐

Has any part of the permeable pavement surface been patched or replaced with a different material? ☐

Trash and Debris Removal

	Y	N	N/A
Remove all trash and all debris (leaves, sticks, branches) from the permeable paving surface and upstream areas.	☐	☐	☐
Separate trash from debris and dispose of each properly.	☐	☐	☐

Comments/Actions Taken:

☐ Non-routine maintenance needed

Routine Vacuuming

	Y	N	N/A
Vacuum sediment and debris from the entire surface area of the permeable pavement installation, using a dry vacuum.	☐	☐	☐
Vacuum the sediment and debris from upstream, or highest point, end to the downstream, or lowest point, to prevent any sediment from being carried back onto the vacuumed surface.	☐	☐	☐

Comments/Actions Taken:

☐ Non-routine maintenance needed

Pressure Washing/Restorative Vacuuming

	Y	N	N/A
Pressure wash and restorative vacuum impacted areas of the permeable pavement.	☐	☐	☐
Re-joint permeable pavers with the appropriate aggregate based on the original design or the paver manufacturer's recommendation.	☐	☐	☐

Comments/Actions Taken:

☐ Non-routine maintenance needed

APPENDIX A

Field Measurement/Materials Used (optional)	Y	N	N/A
Amount of material (trash, debris, sediment) collected:	☐	☐	☐
No. of bags, pounds, or gallons per bag:			

Materials/Tools Used:

Other Notes/Observations:

ACKNOWLEDGEMENTS

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Additional thanks to our contributors:

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P.18 Erosion and scouring of soil surface
Photo courtesy of Seattle Public Utilities

P.18 Erosion at inlet
© City of Portland, courtesy Bureau of Environmental Services

P.29 Erosion and Scouring
© City of Portland, courtesy Bureau of Environmental Services

Common Invasive Weeds

P.17 *Oxalis pes-caprae*

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P.16 *Melilotus officinalis*

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P.16 *Plantago lanceolata*

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P.17 *Sonchus oleraceus*

William S. Justice, hosted by the USDA-NRCS PLANTS Database. http://plants.usda.gov/java/largeImage?imageID=sool_1h.jpg

Richard A. Howard, hosted by the USDA-NRCS PLANTS Database. http://plants.usda.gov/java/largeImage?imageID=sool_004_ahp.tif

APPENDIX B

P.17 *Helminthotheca echioides*

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P.16 *Ehrharta erecta*

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P.17 *Avena fatua*

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P.17 *Bromus diandrus*

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P.17 *Lolium multiflorum*

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P.17 *Hordeum jubatum*

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SEWER SYSTEM

IMPROVEMENT PROGRAM

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